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July 7, 2022

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RE: Revised Draft Final Butte Treatment Lagoons (BTL) Groundwater Treatment System Routine Operations, Maintenance, and Monitoring (OM&M) Plan

Agency Representatives:

I am writing to you on behalf of Atlantic Richfield Company to submit the Revised Draft Final Butte Treatment Lagoons (BTL) Groundwater Treatment System Routine Operations, Maintenance, and Monitoring (OM&M) Plan. The report and appendices may be downloaded at the following link:

https://pioneertechnicalservices.sharepoint.com/:f:/s/submitted/EpVlJ_A9ltNPqsHlN0MKLZwBNuNBI-YWmTl1Jsdy2tTXBQ.

General Comments:

1. *The current name change from MSD to BPSOU subdrain is required by a court ruling but may cause confusion when comparing this document to previous BTL documents. Please add a description of the name change from MSD subdrain to BPSOU subdrain in Section 1 to bridge this document with previous documents to avoid confusion.*

Atlantic Richfield Response: The following text has been added as a footnote in Section 1. "A State of Montana District Court decision known as *Silver Bow Creek Headwaters Coalition v. State of Montana, DV-10-431 (*August 17, 2015) declared that the surface area between Texas Avenue in Butte to the confluence of Blacktail Creek with Silver Bow Creek was named "Silver Bow Creek." This area is now known and referred to here, geographically, as upper Silver Bow Creek. EPA called the surface area from Texas Avenue to the confluence with Blacktail Creek the "Metro Storm Drain"

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in prior Superfund removal and remedial documents and publications, including the 2006 BPSOU ROD and 2011 BPSOU Explanation of Significant Differences (ESD). Due to the Montana Department of Environmental Quality (DEQ) involvement in this document's issuance, and where reference to this specific section of Silver Bow Creek is necessary, further geographic descriptions, such as Silver Bow Creek "east" or "above" its confluence with Blacktail Creek are used in order for DEQ to comply with the Court's order. Reference to the area as "Silver Bow Creek" or "Silver Bow Creek east of its confluence with Blacktail Creek" is not and should not be construed as an admission or determination by any party on any procedural or substantive issue involving the area named Silver Bow Creek."

> 2. *There are many references to sections and SOPs in the response to comments that refer to old numbering from previous drafts that have changed in the current document. Please update references to the current draft.*

Atlantic Richfield Response: Standard Operating Procedure (SOP) references have been updated to current revisions.

> 3. *It is unclear if the updates to the SCADA system that was incorporated in the spring are reflected in the work plan. Please confirm that the additional set point alarms build into the logic for early detection of off spec occurrence have been incorporated within these plans, and if not please incorporate them.*

Atlantic Richfield Response: Updates to the SCADA system have been incorporated into the system programming logic.

> 4. *There are multiple inconsistencies with SOP renumbering throughout the document. Please check all references to SOPs throughout the document, including within each SOP for updated numbering and version updates.*

Atlantic Richfield Response: SOP updates are ongoing and will be incorporated into the Plan as completed.

> 5. *Considering that modified analysis EPA method 245.1 is a unique analysis that one Pace laboratory is able to provide, there is a risk that data loss will occur if there are any issues with the facility that offers the analysis, as demonstrated in the data loss observed in November 2020. To avoid this, an alternative method 1631 should be listed as a contingency, as it is the commonly used trace mercury analysis that other laboratories could perform. Please add a note that method 1631 will be used as a contingency to the Appendix A (QAPP) with all references to the modified 245.1.*

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Atlantic Richfield Response: Method 1631 will be listed as a contingency method for mercury analysis in Table 2 of the QAPP (Appendix A).

Specific Comments:

1. *Page 2 of Response to Comments, Atlantic Richfield Response to Agency Response on General Comment 6: Noted that renaming of IDs of wells, control valves, etc do not directly mention the "Metro Storm Drain", but the use of the acronym "MSD" is used for labels directly referring to an association to the Metro Storm Drain, such as manholes and outfalls. These occurrences of the acronym MSD should be changed to "BPSOU Sub Drain" and to avoid confusion or use of the term Metro Storm Drain in the future. The Table below summarizes locations where revisions are needed:*

PDF PG	Location	Item
188	Acronym Defined Table	MSD
226	Figure 2	MSD Discharge Location MSD Wet/Dry Vault MSD Subdrain Metro Strom Drain Wet / Vault
233	Attachment 1 Table Description	MSD Wet Vault Pump
238	System Description	MSD
252	Redistribution of Retained Flow	Return MSD flow to the HCC
306	BTL-SOP-08	Purpose
417	BTL-SOP-25 - Chemicals	MSD Vault
574	Item 6 - Definition	MSD: Metro Storm Drain Under b, last bullet "MSD Sampling"
1062 1063 1064 1065	Operator Training Logs	6 Locations
1083	Figure Plot Plan Overview	4 labels and Title Box
1084	Figure Plot Plan BL/Western Portion LAO	Legend and Title Box
1085	Figure Plot Plan BRW/Eastern Portion LAO	Legend and Title Box Label MSD Pump Station
1086	Plot Plan METRO STORM DRAIN Pumping Station	4 labels, Legend, Figure Title and Title Box
1087	Plot Plan WCP-1/Lower Missoula Gulch	Legend and Title Box
1088	Electrical Code Audit Figure	MSD Pump Station Label
1103	Routine Valve Alignment Table	Columns: Reference (1); Function (1); and footnote
1106	BTL Valve Cause and Effect, Routing Options	P&ID7AB Columns - Description (1); Function (1); Effect (12)
1107	BTL Valve Cause and Effect, Routing Options	P&ID7AB Columns - Description (1); Effect (12)
1113	Appendix G	Functional Description Column

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Atlantic Richfield Response: Edits were completed according to the above table of comments except for page 188 where the acronym will remain to remain consistency with previously submitted reports, sample locations, and associated data and page; page 1,088 which is not updated because it's a historical document; and 1,113 which will not be changed because all MSD references are location IDs.

2. *Section 2.3.8: The text lists three stations that are monitored, INF-04, MSD-HCC, and EFS-07. Rational is provided for the INF-04 and EFS-07 sampling locations, however, no rational or detail is provided for the MSD-HCC. Please include a description of the data uses and sampling detail for MSD-HCC to match the information presented for INF-04 and EFS-07.*

Atlantic Richfield Response: Section 2.3.8 has been revised to include the following clarification. Samples from MSD-HCC will be obtained monthly during routine sample collection events. Samples are also obtained from MSD-HCC during the semiannual sampling events. Sample results from MSD-HCC provide information to determine treatment system effectiveness. Data from this location are not used to determine compliance.

3. *Section 4.1, Bullet List: These bullets are presented as a summary of the routine normal tasks, and then the text states that the following subsections provide an overview of specific activities of each bulleted task. Section 4.1.1 matches the first bullet, however, the subsequent sections 4.1.2-4.1.5 do not follow the bullet list. Section 4.1.2 discusses task involving Lime feed data flows and pH, but does not include SOPs for calibration. Section 4.1.3 details O&M of the Missoula Gulch groundwater system and associated catch basins which is not included in the initial bulleted list. Section 4.1.4 discusses West Camp pump station that will be checked weekly, while the task bullet states it will be checked Monday and Thursday. Please align the bulleted tasks with the activity descriptions in the subsections that follow.*

Atlantic Richfield Response: Section 4.1 has been revised.

4. *Sections 4.1.1-5.1.5: Each section has a list of SOPs or additional documents that provide detail of general tasks, however the specific tasks are only partially listed or not listed at all. Please list out specific tasks with their appropriate SOP references for clarity.*

Atlantic Richfield Response: SOP number, title, and text edits have been incorporated for clarity in the revised Plan.

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5. <u>*Section 4.2.1:*</u>

oThe first paragraph mentions the Ops Building for the first time. This abbreviated term for operations is not called out in earlier reference to the operations building and is used inconsistently in subsequent sections which is confusing for the reader. Please change text in all references to "operations building."

Atlantic Richfield Response: The reference has been changed.

o *The last sentence lists SOPs that are supposed to be detailed instructions for routine processes of the CAS system, however, most appear to be maintenance related SOPs and it is difficult to determine how they specifically relate to the listed routine tasks. For clarity, please include the relevant SOPs with the each listed routine tasks.*

Atlantic Richfield Response: SOP number and title have been included in the revised Plan.

6. <u>*Section 4.2.2:*</u> *The text describes the lime addition control mechanisms but does not clearly state the associated task. Instead, SOP numbers are listed with no explanation. Please list the specific tasks associated with the process with their corresponding SOP for reference.*

Atlantic Richfield Response: SOP number and title have been included in the revised Plan.

7. <u>*Section 4.2.3:*</u> *The first and last paragraph directs the reader to the QAPP (Appendix A) for additional detail on the autosampler operation, sample prep, sample shipment, and additional field parameter measurements but does not specify QAPP sections. Please reference the specific sections within the QAPP that provides this detail.*

Atlantic Richfield Response: The referenced QAPP includes a detailed table of contents to readily locate appropriate sections. To limit issues with future updates and references, these will be omitted in the text.

8. <u>*Section 4.2.4:*</u> *Criteria listed in the bullets detail the range and optimal pH targets but does not give detail on range of design flows. Please include the design flow ranges in the second bullet, or at a minimum reference where the ranges are listed.*

Atlantic Richfield Response: Reference to flow range is provided.

9. <u>*Section 4.2.4.1:*</u> *Calculations presented provide conversion factors for everything except for the conversion from tons to pounds. Please show the conversion factor of 1 ton per 2,000 pounds in the second equation.*

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Atlantic Richfield Response: The equation included in the text has been updated as requested.

10. *Section 4.2.4.2: The SOP list at the end of the section is for gravimetric lime additions system startup, cleaning the screw conveyor, and volumetric lime addition which do not appear to be related to tasks of reordering lime or for managing lime delivery. Please provide an explanation how these SOPs relate to these tasks, or if they do not relate, please remove them from this section.*

Atlantic Richfield Response: Unrelated SOP references were removed from the revised Plan.

11. *Section 4.2.5: There are no specific SOPs referenced for operating the compressed air system, instead a general reference to Appendix C is given. Please reference the specific SOP(s) that pertain to this task.*

Atlantic Richfield Response: Reference to specific SOPs has been added to the revised document.

12. *Section 4.3.1: Table 4 shows alarms will activate if the screw conveyor is turned off. However, based on the 2/14-2/15 event where the screw conveyer/mixing motor was accidentally turned to volumetric (manual) from gravimetric (auto), the motors stopped but were not in an off position. As part of the action plan to address this issue, an alarm was proposed to be set up so that the system will call out for notification if the setting is turned to volumetric. This change does not appear to be represented in the Table 4 list of alarms. Please include a detail for an alarm that will call out for notification if the lime screw conveyors and slurry motors are set to volumetric.*

Atlantic Richfield Response: The WIN 911 dialer was reconfigured to call out based on alarm priority 1&2, tested, and called out using existing alarms. No additional alarm was warranted or added to the system.

13. *Section 4.3.2: Specifies five topics to be covered within this section but does not detail 'Conditions required for equipment to start remotely' or 'settings for routine mode of control.' Please include a subsection for each of these two topics with similar detail provided with the other three.*

Atlantic Richfield Response: Text has been revised.

14. *Section 4.4: First paragraph refers to system valve alignment reference tables and associated P&IDs. While the P&IDs are presented in Appendix E, there is no information given as to where the reference tables can be found. Please include a reference to where these tables can be looked up.*

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Atlantic Richfield Response: Reference provided to Routine Valve Alignment Table in Appendix F.

15. *Section 4.4.2: First paragraph mentions multiple procedures that need to be followed in SOPBTL-03, 06, 07, and 28. Some description of the specific elements of SOP-BTL-03 and 07 are given in the numbered list at the end of the subsection, but not for the others. Please list out the multiple procedures with their corresponding SOPs.*

Atlantic Richfield Response: Edits have been made for clarity.

16. *Section 4.7.2.3: Last paragraph, last sentence. Please change the text to read "a summary of the video inspection will be included at a minimum in the Annual O&M report, and in the quarterly report(s) if noteworthy video inspection observations or non-routine maintenance recommendation are identified".*

Atlantic Richfield Response: Text revised as requested.

Appendix A - Revised Draft Final Butte Treatment Lagoons Groundwater Treatment System and BPSOU Subdrain Sampling and Monitoring QAPP:

17. *Section 2.1, Project Management, Analytical Services, Page 3: The laboratory should also be NELAC/NELAP certified for methods when applicable.*

Atlantic Richfield Response: The certification has been added to the Plan as recommended.

18. *Section 2.4.2, Data Quality Objectives, Step 3, Page 6: The BTL System field data bullet states parameters will be collected from the locations shown on Figure 2 and in Table 3. Figure 2 shows many more locations that are listed in Table 3. Please write the sentence to read "collected daily and/or monthly from locations listed in Table 3, which are identified in Figure 2."*

Atlantic Richfield Response: Data Quality Objectives are provided in Section 2.4.2. Step 3 has been updated as requested.

19. *Section 2.4.2.2, Accuracy/Bias, Page 10: ICP serial dilution %D results can also be evaluated as a precision parameter. Please include.*

Atlantic Richfield Response: As stated in the 2020 National Functional Guidelines, the intent of the serial dilution is to "*determine if significant physical or chemical interferences exist due to sample matrix*", which would be an indication of accuracy/bias. As such, the serial sample will be used to assess accuracy and not precision.

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20. *<u>Section 2.4.2.2, Accuracy/Bias, Flow Measurement, Page 11:</u> Please include the calculation where the 12% instrument error was developed from. Additionally, is there an estimate as to the percentage of environmental error that is incurred within the subdrain? If so, please include an estimate or range of estimates.*

Atlantic Richfield Response: Instrument error (12%) referenced in the text was obtained from *2013 Metro Storm Drain (MSD) Sub-Drain Loading Study Interim Technical Memorandum*, Appendix F - Data Summary Report submitted to Agencies on June 30, 2014. Accuracy measurements will be re-evaluated based on recent data and updated accordingly.

A reasonable effort to account for environmental error has not been undertaken as a component of this document. In October 2014, flumes were removed from some of the subdrain manholes and replaced with doppler area velocity (AV) meters (per RFC-MSDLS-02; 2014) to provide a more reliable method of flow measurement and eliminate variability in measurements observed during large precipitation events. Flow rates were also evaluated in the Draft Final *Revised Metro Storm Drain (MSD) Groundwater Management Report*; 2015. After comparing flow rates along the Subdrain, effects from precipitate accumulation were nominal.

Because the degree of uncertainty and variability associated with environmental error makes estimating extremely difficult, and most of the previously known environmental factors have been accounted for, there are currently no other estimates other than the instruments' accuracy. Atlantic Richfield may reconsider this effort upon completion and implementation of the final remedy.

21. *<u>Section 2.4.2.4, Comparability, Page 11:</u> It is recommended that a summary sentence or two stating that "newly" collected data will be comparable to previously collected data because field collection practices and analytical laboratory procedures, are following all applicable standard requirements, etc.*

Atlantic Richfield Response: Section 2.4.2.4 has been revised to include the following:

"Because these procedures have been in place all newly collected data will be comparable to previously collected data. All field collection practices and analytical laboratory procedures are following applicable SOPs."

22. *<u>Section 2.6.1.2, Quarterly Reporting, Page 14:</u> Please clarify that the laboratory data packages will be included with the Data Summary Reports.*

Atlantic Richfield Response: The text has been revised for clarification as requested.

23. *<u>Section 2.6.4, Laboratory Analytical Data, Page 17:</u> A bullet should be added that laboratory raw data will also be provided in the data packages.*

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Atlantic Richfield Response: A bullet was added to Section 2.6.4 listing supplemental electronic files which includes laboratory data.

24. *<u>Section 3.1.2 and Section 3.3.1: Section 3.1.2:</u> These sections states "Samples will be collected at locations identified as EFS-07, MSD-HCC, and INF-04, shown on Figure 2." Figure 2 does show EFS-07, MSD-HCC, and INF-04. Section 3.3.1 deviates from this nomenclature by introducing SS numbers which are not described or located on a figure. Please change Section 3.3.1 to use EFS-07, MSD-HCC, and INF-04 as the sample location identifiers for the LAO samples. This is a correction that has been previously made in the quarterly and annual reports and needs to be reflected here.*

Atlantic Richfield Response: Section 3.1.2 was revised to be consistent with approved text applied to quarterly and annual reports.

25. *<u>Section 3.1.2.3, BTL Sample Handling and Preservation, Page 23:</u> Information is provided that the laboratory will dispose of any sample portion not used for analysis according to their sample disposal policy." Consideration should be given that samples not disposed of until validation is complete in case samples have to be re-analyzed. This comment is applicable in other sections of the QAPP referring to sample disposal.*

Atlantic Richfield Response: As described in the laboratory Quality Assurance Manual included in Appendix C, samples may be stored when all analyses are complete, the hold time is expired, the report has been delivered, and/or when allowed by the customer or program. Samples are held until final validation is complete.

26. *<u>Section 3.6.5, Method Validation, Page 29:</u> It should be noted that the information provided by the laboratory for "method validation" of non-standard methods will be retained in the project files and available to EPA and DEQ for review.*

Atlantic Richfield Response: Noted, all project related information is retained in the project files and available to the Agencies upon request.

27. *<u>Section 3.7.1, Field-Generated Quality Control Samples, Page 30:</u> Understanding the collection minimums have been provided in the text, please also include the frequency (e.g., 1/20) of the collection of the field duplicates, field blanks, and equipment blanks.*

Atlantic Richfield Response: The text has been revised for clarification as requested.

28. <u>Section 3.7.3, Quality Control Statistics, Page 31:</u> In the first paragraph there is discussion of PARCCS evaluation. Please also include sensitivity in that evaluation.

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Atlantic Richfield Response: The text has been revised as requested.

29. Section 5.1.4.1, Field Data Verification, Page 40: The term "Sample Preservation Technique" should be added to the Level A criteria list.

Atlantic Richfield Response: The text has been revised as requested.

30. *<u>Section 5.2, Verification and Validation Methods, Page 42:</u> Review of the data package case narrative, tune analysis, and internal standards should be added to the bulleted list as applicable.*

Atlantic Richfield Response: The text has been revised as requested.

31. *<u>Section 5.3, Reconciliation with User Requirements:</u> A footnote should be added to the table that results qualified as estimated by the laboratory because they are between the MDL and RL, and are not qualified for any other reason, are considered enforcement quality data.*

Atlantic Richfield Response: The text has been revised as requested.

32. *<u>Crosswalk Comments/Responses (included within the crosswalk):</u>*

o Comment A9-b: The comment response refers to the Enviro Data program and Level 2 validation. The revised QAPP only discusses Level 4 validation and does not reference the Enviro Data program. Is that program being used and is there any data that will be validated as Level 2? There are other comments where this is applicable as well.

Atlantic Richfield Response: Enviro Data is no longer used to perform data validation. The revised SOP is included with the revised QAPP.

o Comment B10-e: Please confirm that only validated data will be input into the database. There are other comments where this is applicable as well.

Atlantic Richfield Response: Laboratory analytical data is uploaded to the project database prior to data validation to assist the data validation process. Upon completion of validation, the project database is updated to include the data validation qualifiers, the data validation reason codes, and the data quality designations for each data point. All tables used for reporting the laboratory analytical data are generated from the project database after data validation is completed.

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o Comment D2-a: There are new EPA National Functional Guidelines that were updated in 2020. As QAPPs are updated the new guidelines should be referenced and followed going forward.

Atlantic Richfield Response: National Functional Guidelines references were updated to 2020. Future updates will be performed as a part of the annual review process.

Appendix C - BTL Standard Operating Procedures

33. BTL SOP List 2021:

o BTL-SOP 27, "last dated copy" cell states "in progress." Please confirm that this SOP will be completed for the final draft of this work plan.

o List of SOPs does not include the DE, DV, SA, and WFM series SOPs, nor the Pace Environmental SOPs. Please update the list to contain all SOPs.

Atlantic Richfield Response: Updated SOPs are provided in the revised Plan.

34. *There are multiple references to BTL-SOP-OG-# naming conventions within the SOPs that do not match any SOP nomenclature in Appendix C. Please go through the document and adjust all SOP naming conventions to match those presented in Appendix C.*

Atlantic Richfield Response: Updated SOPs are provided in the revised Plan.

35. *There are multiple SOPs that have changed numbers, however many have only had the page 1 title changed, while the subsequent pages have the old number. Many of the SOP references listed in subsequent SOPs also need updating with the new numbering. Please go through all SOPs and make sure naming is consistent on all pages and that they are updated with the current revision numbering scheme. The following are several examples:*

o BTL-SOP-41: Subsequent pages of SOP are named BTL-SOP-OG-24. Also, this SOP is dated March 2016 as Revision 0, whereas the Appendix C table of Contents indicates a 2021 revision. Please insert current revision of BTL-STL-41 and adjust naming on subsequent SOP pages to BTL-SOP-41. o BTL-SOP-15: Subsequent pages of SOP are named BTL-SOP-OG-22. Please adjust naming
on subsequent SOP pages to BTL-SOP-15. Also, all pages are dated 2014 which is not the current revision as per the List of SOPs. Confirm Title and replace with current revision.

o BTL-SOP-04: Drawing, Documents, and Tools/Equipment, Related SOP's/Procedures/Work Plans: References SOP-16 H2S Alarm Response West Camp Check, which is blank in the list and not included in Appendix C. Please change reference to BTL-SOP-44.

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Atlantic Richfield Response: Updated SOPs are provided in the revised Plan.

End of Comment Responses.

If you have any questions or comments, please call me at (406) 723-1820.

Sincerely,

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Katherine Hausrath / NRDP - email
Meranda Flugge / NRDP - email
Ted Duaime / MBMG - email
Gary Icopini / MBMG - email
Becky Summerville / MR - email
Kristen Stevens / UP - email
Robert Bylsma / UP - email
John Gilmour / Kelley Drye - email
Leo Berry / BNSF - email
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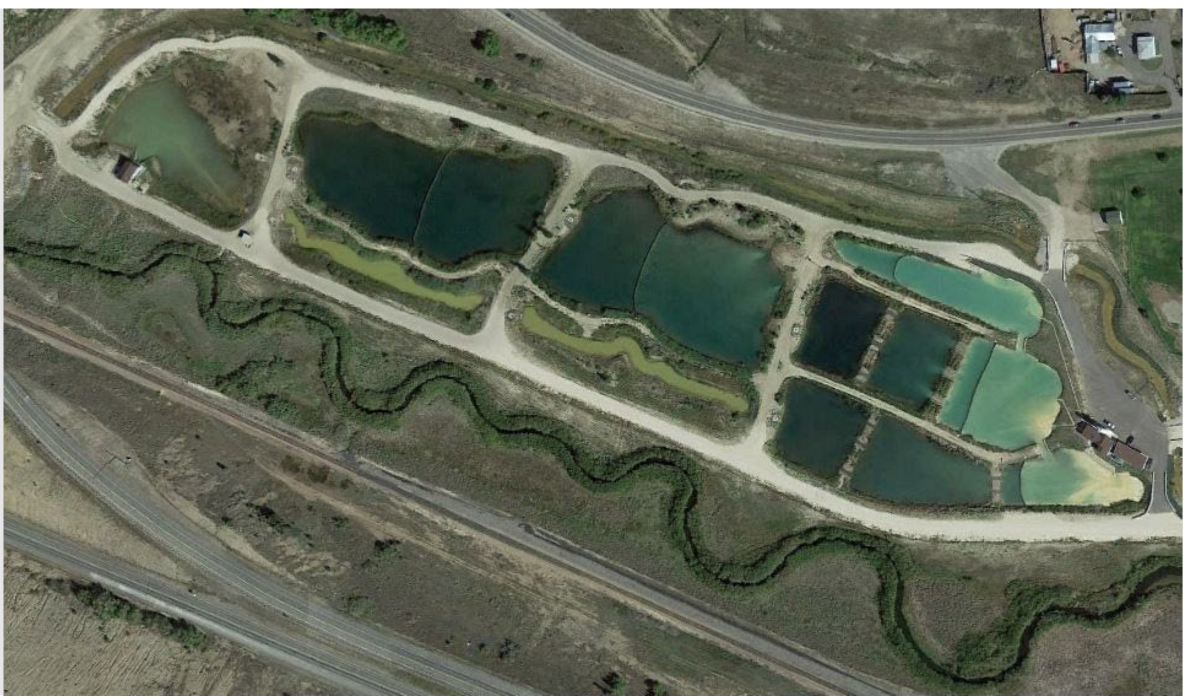
SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT

Revised Draft Final

Butte Treatment Lagoons (BTL) Groundwater Treatment System Routine Operations, Maintenance, and Monitoring (OM&M) Plan



Atlantic Richfield Company

July 2022

SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT

Revised Draft Final

Butte Treatment Lagoons (BTL) Groundwater Treatment System Routine Operations, Maintenance, and Monitoring (OM&M) Plan

Prepared for:

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Prepared by:

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July 2022

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LIST OF ACRONYMS

Acronym	Definition	Acronym	Definition
amsl	above mean sea level	**MCC**	Motor Control Center
ARAR	Applicable or Relevant and Appropriate Requirements	**mg/L**	milligrams per Liter
ASB	Automatic Sampling Building	**min/hr**	minutes per hour
BPSOU	Butte Priority Soils Operable Unit	**NAVD**	North American Vertical Datum
BRW	Butte Reduction Works	**NGVD**	National Geodetic Vertical Datum
BSB	Butte-Silver Bow	**NPL**	National Priority Listed
BTL	Butte Treatment Lagoons	**O&M**	Operations and Maintenance
CAS	Chemical Addition System	**OM&M**	Operations, Maintenance, and Monitoring
CD	Consent Decree	**OS**	Outlet Structure
CFWEP	Clark Fork Watershed Education Program	**OSHA**	Occupational Safety and Health Administration
COC	Contaminants of Concern	**P.A.S.S.**	Pull, Aim, Squeeze, and Sweep
DEQ	Department of Environmental Quality	**P&ID**	Piping and Instrumentation Diagrams
DSB	Dredge Storage Building	**pH**	Potential Hydrogen
EL	Effluent Line	**PLC**	Programmable Logic Controller
EPA	Environmental Protection Agency	**ppm**	parts per million
ESS	Emergency Shutdown Switch	**psig**	pounds per square inch gauge
FCD	Flood Containment Dike	**PVB**	Pressure Vacuum Breaker
FTE	Full-Time Equivalent	**PVC**	Polyvinyl Chloride
g	grams	**QAPP**	Quality Assurance Project Plan
gal	gallon	**ROD**	Record of Decision
gpm	gallons per minute	**rpm**	revolutions per minute
HAZWOPER	Hazardous Waste Operations and Emergency Response	**SAP**	Sampling and Analysis Plan
HCC	Hydraulic Control Channel	**SCADA**	Supervisory Control and Data Acquisition
HMI	Human-Machine Interface	**SOP**	Standard Operating Procedures
HOA	HAND-OFF-AUTO (Switch)	**su**	standard unit
hp	Horsepower	**TW**	Treatment Wall
hr/day	hours/day	**µg/L**	Micrograms per Liter
HSSE	Health, Safety, Security, and Environment	**UPS**	Universal Power Supply
IPS	Influent Pump Station	**VFD**	Variable Frequency Drives
LAO	Lower Area One	**WCP-1**	West Camp Pump station
lb	Pound		

1.0 INTRODUCTION

This Butte Treatment Lagoons (BTL) Groundwater Treatment System Routine Operations, Maintenance, and Monitoring, (OM&M) Plan details the routine, day-to-day OM&M requirements to keep the treatment system and peripheral pumping systems running efficiently. The document is designed to be a reference for operators and operations personnel (collectively referred to as operators) and describes proper system operation and routine maintenance activities. As such, this document assumes the reader has a working knowledge of the BTL system and does not contain detailed background information and characterization for BTL and the associated systems. The appendices referenced in this document also provide additional information related to routine operations:

- Appendix A. BTL Groundwater Treatment System and BPSOU Subdrain Sampling and Monitoring Quality Assurance Project Plan (QAPP).
- Appendix B. BTL Water Management Contingency Operations Plan.
- Appendix C. BTL Standard Operating Procedures (SOPs).
- Appendix D. Operating Tables, Checklists, and Logs.
- Appendix E. System Drawings.
- Appendix F. BTL Systems Operation Decision Trees.
- Appendix G. Device Register and Supplier Contact Information.
- Appendix H. Revision Summary

Equipment product information and additional detailed site information is maintained with site records in the Operations Building.

1.1 Purpose and Scope

The BTL Treatment System consists of multiple interrelated systems including the West Camp Pump station (WCP-1), BPSOU subdrain[1] (referred to as BPSOU subdrain or subdrain) and pump station, and related systems within Lower Area One (LAO). This document contains key information for routine operation of the BTL Treatment System. Performing the routine operation and maintenance tasks described within this document is critical to daily system

---

[1] A State of Montana District Court decision known as *Silver Bow Creek Headwaters Coalition v. State of Montana, DV-10-431 (*August 17, 2015) declared that the surface area between Texas Avenue in Butte to the confluence of Blacktail Creek with Silver Bow Creek was named "Silver Bow Creek." This area is now known and referred to here, geographically, as upper Silver Bow Creek. EPA called the surface area from Texas Avenue to the confluence with Blacktail Creek the "Metro Storm Drain" in prior Superfund removal and remedial documents and publications, including the 2006 BPSOU ROD and 2011 BPSOU ESD. Due to the Montana Department of Environmental Quality (DEQ) involvement in this document's issuance, and where reference to this specific section of Silver Bow Creek is necessary, further geographic descriptions, such as Silver Bow Creek "east" or "above" its confluence with Blacktail Creek is used in order for DEQ to comply with the Court's order. Reference to the area as "Silver Bow Creek" or "Silver Bow Creek east of its confluence with Blacktail Creek" is not and should not be construed as an admission or determination by any party on any procedural or substantive issue involving the area named Silver Bow Creek.

operation and achieving discharge quality requirements. Major equipment, components, and features within the LAO site, and remote pumping stations, are shown on Figure 1.

The following sections describe the treatment system, performance goals, routine operations, record keeping and reporting requirements, routine inspection and maintenance activities, and typical emergency response procedures associated with the BTL system.

LEGEND:

- WATER SURFACE ELEVATION
- COMPOSITE CHEMISTRY SAMPLES
- FLOW RATES
- OUTLET STRUCTURE
- LAO BOUNDARY

N

DISPLAYED AS:
COORD SYS/ZONE: MONTANA STATE PLANE
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER/2015 NAIP

SCALE IN FEET
0 250 500

FIGURE 1

PIONEER
TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

BUTTE TREATMENT LAGOONS (BTL) AND PERIPHERAL SITE SYSTEMS OVERVIEW

DATE: 12/2020

12/8/2020 4:20:44 PM P:\ARCO\BPSOU\2020\BTL-LAO\SITE FIGURES\BTL-PLN-001-20.DWG

1.2 Performance Standards

Performance standards for the BTL system are identified in Attachment A to the BPSOU Statement of Work (SOW) to the Final Consent Decree (CD) (EPA, 2020). The overall remedial goal is to achieve and maintain the in-stream concentrations of site-specific contaminants of concern (COCs) below the numeric surface water quality standards identified in the Applicable or Relevant and Appropriate Requirements (ARARs) for all flow conditions throughout the length and directly downstream of the Butte Priority Soils Operable Unit (BPSOU). During the interim monitoring period, the system will be operated to meet Montana Department of Environmental Quality (DEQ) Circular DEQ-7 Numeric Water Quality Standards for site-specific COCs (listed in Table 1 below), and effluent potential hydrogen (pH) greater than 6.5 but less than or equal to 9.5 standard units (su). Final performance standards will be re-calculated by the U.S. Environmental Protection Agency (EPA), in consultation with DEQ, for hardness dependent COCs listed in Table 8-1 of Appendix D, Attachment A of the BPSOU CD, after conclusion of any shakedown period.

Table 1. Montana DEQ-7, Montana Numeric Water Quality Standards.

Site-Specific COC*	Hardness Corrected Concentration ($CaCO_3$ greater than 400 mg/L)
Aluminum	87 µg/L Chronic Aquatic
Arsenic	10 µg/L Human Health
Cadmium*	0.756 µg/L Chronic Aquatic
Copper*	30.5 µg/L Chronic Aquatic
Iron	1,000 µg/L Chronic Aquatic
Lead*	18.6 µg/L Chronic Aquatic
Mercury	0.05 µg/L Human Health
Silver*	44 µg/L Acute Aquatic
Zinc*	388 µg/L Chronic Aquatic

*Hardness corrected.
µg/L: micrograms per Liter. $CaCO_3$: calcium carbonate. COC: contaminant of concern. mg/L: milligrams per Liter.

1.2.1 Additional Monitoring

Other analytes to be monitored include the following:

- Total recoverable calcium and magnesium (required for COC hardness corrected calculations).
- Total alkalinity, sulfate, total dissolved solids, and total suspended solids.

Operators monitor temperature and pH daily as described under routine operational tasks (Section 3.1.1).

1.3 System Background

The BTL system was originally designed as a pilot-scale treatment system in 1997 to demonstrate the treatment lagoon technology. The system was initial designed to accommodate approximately 100 gallons per minute (gpm) of untreated influent flow. As a result of favorable treatment performance, the system has been modified several times to increase treatment capacity and accommodate groundwater from within LAO, West Camp, and subdrain sources. The current influent treatment capacity is 1,880 gpm.

The following briefly summarizes the progression of the BTL and influent capacity components from 1996 to 2014 and available storage capacity to mitigate influent flow from exceeding the critical water level in Cell D4 and the Hydraulic Control Channel (HCC).

The BTL started in 1996-97 as a field-scale demonstration project to test the efficacy of the proposed groundwater treatment remedy. As part of the BPSOU remedial investigation / feasibility study (PRP Group, 1996), two treatment lagoon demonstration projects were constructed in 1996 within LAO: one located in Colorado Tailings, the other in Butte Reduction Works (BRW). The demonstration project in the Colorado Tailings area was the original treatment lagoon and now makes up the B Cells. Water quality and flow data were being collected over several years to evaluate the performance of the proposed lagoon technology. The HCC was constructed during Phase II construction of the permanent pump system building at LAO in 1997-1998 to intercept groundwater entering from the north. The function of the HCC was to prevent untreated groundwater from impacting the reconstructed and realigned Silver Bow Creek channel and floodplain in its final configuration south of the lagoons system. The HCC remained in the alignment of the original Silver Bow Creek channel along the northern boundary of LAO to provide hydraulic control of groundwater within LAO. Groundwater collected within the HCC was diverted west to Open Area 4, now referred to as Cell D4.

In 2001, C Cell lagoons were installed to increase treatment capacity and Cell B1 was expanded. Construction of diversion components at the west end of the HCC was completed during November and December 2001. The west end diversion consists of a sheet pile cutoff wall placed in the HCC immediately downstream of a 36-inch corrugated metal pipe (CMP) that was installed in the dike separating the HCC from Cell D4. The crest of the sheet pile wall was constructed at an even elevation of 5,421.40 feet North American Vertical Datum 1988 (NAVD 88) (5,417.04 feet National Geodetic Vertical Datum 1929 [NGVD 29]) above mean sea level (amsl) across its entire length to provide sufficient structural elevation to capture and divert runoff water from frequent, small storm events contributing to the BTL total influent stream.

In the fall of 2001, the WCP-1 system and pipeline were modified to allow discharge of groundwater from the West Camp Complex to be discharged to the demonstration treatment system at LAO. The influent pump system capacity was increased to 510 gpm to accommodate increased flow from West Camp and intermittent stormwater.

In 2004, the Colorado Tailings Treatment Lagoon was constructed, which introduced A Cell lagoons (A1, A1, and A3) and the D2 cell. Flow from the BPSOU subdrain pump system was also directed to the HCC for treatment within the BTL system. Additional upgrades were also completed to the influent pump system to include redundant vertical turbine pumps. The capacity of the Influent Pump Station (IPS) was increased to include two 1,000-gpm pumps.

The IPS was upgraded in 2012, as a component of the BTL and WCP-1 upgrades. The IPS was designed to support influent flows ranging from 800 to 2,200 gpm. The system was upgraded to include parallel/redundant pumps capable of delivering up to 2,400 gpm, influent intake vaults, a permanent pump system building, and associated controls and utilities to operate the system. Modifications to the HCC included minor re-routing along the east entrance crossing.

Minor grading modifications were also completed at this time to accommodate construction of the IPS building including the intake vaults and improved hydraulic connectivity to the D2 and D3 Cells.

The BTL system is operated to treat groundwater impacted by mine waste associated with the BPSOU National Priority Listed (NPL) site. The governing purpose of the BTL is to protect adjacent surface water bodies (Blacktail Creek and Silver Bow Creek) through capture and treatment of impacted groundwater under a variety of anticipated conditions.

1.4 System Operating Principle

The BTL system receives groundwater impacted by historic mining activity within the BPSOU. Groundwater from the Missoula Gulch drainage, West Camp Complex, subdrain, and within LAO is collected and directed to the D4 cell via the HCC. These influent sources, shown on Figure 2, are combined and pumped from the IPS at Cell D4 to the Chemical Addition System (CAS) Building where lime is introduced. The IPS is set to maintain the D4 cell below the adjacent surface water elevation in Silver Bow Creek. Operational parameters are monitored by the supervisory control and data acquisition (SCADA) system and displayed within the operations Building. The SCADA system provides automated alarm callout to system operators when parameters are outside normal limits.

Hydrated lime is added to adjust the treatment water pH to precipitate dissolved heavy metals and separate them from the groundwater. Within the CAS Building, hydrated lime is mixed with a slipstream of influent to create a slurry, which is then added to the main influent flow received from the IPS. The lime slurry is used to increase pH of the treatment water to approximately 10.2, where dissolved heavy metals are precipitated and separated from the treated water. The formation of solids further promotes the formation and agglomeration of additional solids. These solids, containing primarily precipitated calcium carbonate ($CaCO_3$) and metal hydroxides, settle out of the water and accumulate on the primary cell floors (A1, B1, and C1).

The lagoon system consists of multiple cells operating in parallel. Each system consists of three, unlined, open water cells. The primary purpose of the first cell is to allow the chemical reaction to occur, introduce additional carbon dioxide to the system, and to capture sediment and chemical precipitates. The second and third cells of each parallel series provide additional residence time, polishing, and pH adjustment of the treated effluent. Earthen walls separate the cells. Floating silt curtains deployed in A1, A2, A3, B1, and C1 optimize flow conditions in the sedimentation ponds and mitigate solids carry over from the primary cells to downstream cells.

Vertical elevations listed in this document at A, B, C, and D cells are provided in the NAVD 88 datum and recorded as feet amsl. Vertical elevations listed at the WCP-1 and BPSOU subdrain pump station are provided in the NGVD 29 datum and recorded as feet amsl.

Point Table

Description	Northing	Easting
MH-MSD106	651209.02	1197905.47
MH-MSD108	651265.29	1198781.03
MH-MSD110	651503.81	1199850.85
MH-MSD113	652414.06	1200906.31
MH-MSD116	653236.82	1201858.01
MSD-HCC	651600.21	1194949.19
MSD-OUT	651324.20	1197083.50
A1	651838.45	1192164.94
A2	651931.22	1191690.21
A3	652055.47	1191180.80
B1	651484.14	1192551.84
B2	651657.02	1192233.20
B3	651702.08	1192096.79
C1	651464.96	1192558.36
C3	651541.57	1192046.18
INDC	651511.64	1192604.67
INF04	651457.40	1192637.70
EFS-07	651925.98	1191093.47
WCP-1	652590.76	1194821.36

LEGEND:
- BTL ANALYTICAL SAMPLE COLLECTION
- SUBDRAIN LOADING - FLOW WATER LEVEL, FIELD PARAMETERS. ANALYTICAL SAMPLES
- BTL FIELD DATA - LEVEL
- BTL FIELD DATA- pH, TEMP, CONDUCTIVITY
- INDC

N

DISPLAYED AS:
COORD SYS/ZONE: MSP
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER

SCALE IN FEET
0 100 200

FIGURE 2

PIONEER TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

BTL AND BPSOU SUBDRAIN ROUTINE SAMPLE AND MONITORING LOCATIONS

DATE: 7/2022

1.4.1 System Routine Capacity

Routine flow of approximately 1,270 gpm is distributed to the lagoons based on the following percentage of total flow: A-system cells receive approximately 50% of the total flow, and the remaining flow is split between the B and C cells. Residence time is listed below:

- Theoretical hydraulic residence time of the A system, based on an average flow rate of 635 gpm, is approximately 10.5 days.
- The hydraulic residence time of the B system, based on an average flow rate of 315 gpm, is approximately 5 days.
- The hydraulic residence time of the C system, based on an average flow rate of 315 gpm, is also approximately 5 days.

The CAS and treatment lagoon system is designed to accommodate a maximum steady-state flow of 1,880 gpm and meet discharge performance standards discussed in Section 2.3.8.

The lime storage silo capacity is 44,000 pounds of hydrated lime ($CaOH_2$). The average lime feed rate is approximately 130 milligrams (mg) of lime per liter (mg/L) of influent, but the rate is determined by the chemistry of the influent flow, seasonal conditions, and target pH level measured immediately prior to entering the first lagoon cells. Silo storage capacity, routine design flow, and feed rate allow up to 23 days of continuous runtime without a lime delivery.

1.4.2 Control and Monitoring System

The BTL control system monitors each remote site for data and controls the lime addition process. Several remote locations, including the BPSOU subdrain and WCP-1, use independent systems that control basic operating parameters at their respective location. Data transmitted back to the BTL control system are archived and also displayed on the human-machine interface (HMI) screen in the Operations Building control room.

The HMI terminal in the Operations Building also allows operators to remotely start or stop pump motors, open/close actuated valves, or adjust alarm set points. An HMI screen, Figure 3, in the CAS Building allows operators to monitor all system parameters (levels, flows, set points, and alarms). As described in Appendix D, Attachment B.1 to the BPSOU CD (EPA, 2020), operational data will be saved to a long-term database further detailed in the BPSOU Sitewide Data Management Plan when the database is finalized and operational. An auto-dialer, installed in the master control panel inside the CAS, also automatically notifies operators of alarm conditions.

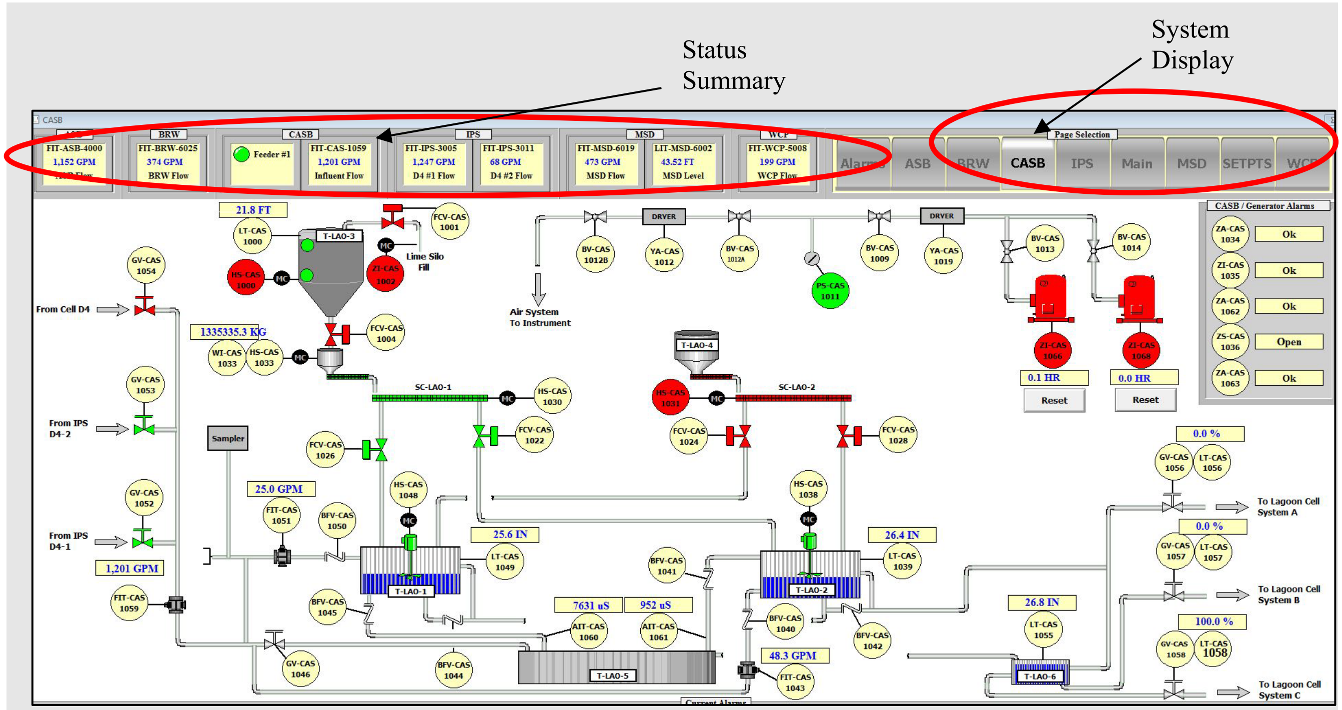

Figure 3. CAS Building HMI Screen.

1.5 System Conditions

System operating conditions can normally be classified as described in this section.

1.5.1 Routine Conditions

Routine operating conditions provide a range of water levels (elevation), treatment, and flow conditions that ensure the system operates to meet performance objectives and additional interaction from system operators is not necessary. Routine conditions provided in this OM&M Plan include routine non-freezing/summer conditions or routine freezing/winter conditions. A routine valve alignment table is provided in Appendix F for routine non-freezing/summer and routine freezing/winter conditions.

Non-freezing/summer conditions are typically prevalent from April through October, or when ambient temperature consistently remains above 32-degrees Fahrenheit. Routine freezing/winter conditions are typically prevalent from November through March, or when ambient temperature consistently remains below 32-degrees Fahrenheit resulting in the formation of ice along the lagoons cells.

System operation is consistent for the given conditions as described in Section 3.1.

1.5.2 Non-Routine Conditions

Non-routine operating conditions describe the state of system operation outside of the range of routine conditions. The system is operational, but one or more routine parameters require site operators to perform additional monitoring, maintenance, or adjustments to ensure treatment meets performance objectives. Alternative routing valve alignments, and consequences of altering valve alignment, are provided in the BTL Valve Cause and Effect, Routing Options table in Appendix D.

The system may also be operated in a non-routine condition through Agency consultation and approval to support additional pilot studies or investigations within BPSOU. Specific objectives and parameters will be included in a project-specific QAPP and associated work plan. A summary of system performance during this period will be included in the annual OM&M report.

1.5.3 Upset Conditions

"Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with effluent limitations because of factors beyond the reasonable control of site operations personnel. Upset conditions describe scenarios that may include one or more of the following: the system is not operating; alarm notification has been activated; system performance objectives are not being achieved; significant natural phenomena (earthquake, lighting strike, etc.) are occurring; or an unforeseeable scenario that is unprecedented resulted in major adjustments to treatment protocol. Upset conditions require action by site operators to reset system components (single or multiple) to re-establish routine operating conditions and require site operator(s) to perform more frequent monitoring of system status until the system is returned to conditions described in Sections 3.1.1.

During upset conditions site operators may increase monitoring of lagoon pH, perform additional sampling at EFS-07, and provide consistent communication to the Agencies.

NOTE: Site operators will notify the Lead Operator immediately upon notification of upset conditions and begin initial investigation of the cause. The Lead Operator is responsible for notifying the Project Managers (contractor project manager and Atlantic Richfield Company [Atlantic Richfield] liability manager). Appropriate further notifications will be made at the discretion of the Atlantic Richfield liability manager. The Atlantic Richfield liability manager is responsible for coordination of appropriate Agency notifications.

1.6 Butte Treatment Lagoons-Lower Area One Contact Information

Atlantic Richfield is the system owner and is responsible for system operation and discharge as described in the BPSOU CD (EPA, 2020) and Record of Decision Amendment (RODA) (Appendix A to the CD) in coordination with the Agencies. Pioneer Technical Services, Inc. (Pioneer) operates the BTL Treatment System as a representative of Atlantic Richfield and reports all data to applicable agencies as directed.

1.6.1 Owner Contacts

Name	Title	Office	Mobile
Chris Greco	Portfolio Manager	630-299-9743	312-809-4024
Garrick Milkeris	HSSE Advisor	630-803-7808	331-239-9521
Josh Bryson	Liability Manager – BPSOU Sitewide	406-723-1834	406-565-7164
Dave Griffis	Liability Manager – Water Treatment	406-723-1820	406-490-4210

HSSE: Health, Safety, Security, and Environment

1.6.2 Regulatory Agency Contacts

Name	Title	Office
Nikia Greene	EPA, Project Manager	406-497-3264
Daryl Reed	Montana DEQ, Project Officer	406-444-6442

DEQ: Montana Department of Environmental Quality. EPA: U.S. Environmental Protection Agency.

1.6.3 System Operation, Maintenance and Monitoring, Pioneer

Name	Title	Office	Mobile
Shawn Bisch	Contract Project Manager	406-497-8230	
Tara Schleeman	HSSE Manager	406-497-8026	406-490-8272
Brad Hollamon	Lead Operator		406-490-7678

HSSE: Health, Safety, Security, and Environment

1.6.4 Additional Emergency Contact Agencies

Emergency Response	911
Disaster-Emergency	(406) 497-6295
NorthWestern Energy Emergency	1-888-467-2427
Electrical Emergency	1-888-467-2353

1.6.5 Non-Emergency Services

Police	(406) 497-1120
Mt. Highway Patrol	(406) 494-3233
Fire Department	(406) 497-6481
NorthWestern Energy Connect and Repair	1-888-467-2669
Qwest Communications	1-800-954-1211
Underground Utilities	1-800-424-5555
BSB Department of Reclamation and Environmental Services	(406) 497-5042

1.6.6 Supplier Contact Information

Appendix G contains a list of suppliers and their contact information.

1.7 Staffing and Personnel Requirements

Collection and treatment operations are designed to require minimal direct operator interaction. Collection, transfer, and treatment operations are designed to operate continuously with callout alarms to notify personnel of upset conditions or loss of normal status. The majority of tasks are associated with minor equipment maintenance, system monitoring, and compliance reporting. Staffing levels require full time coverage Monday through Friday from approximately 8 am to 5 pm; 24-hour callout availability 365 days of the year to address system-upset conditions; and operational monitoring including a brief site visit completed each Saturday and Sunday. Multiple employees are required to account for operations, maintenance, and rotating/callout work schedules. Additional staffing requirements may be established by the project manager or system owner.

The system operator is responsible for day-to-day operations and reporting as described in this Plan and in the QAPP (included in Appendix A). Reports will be submitted to the project manager. The system operator may distribute the reports to other recipients at the OM&M project manager's discretion. Other report recipients will include Montana DEQ and EPA.

The system operator is also responsible for identifying and resolving problems, complying with the maintenance schedule, and repairing or replacing faulty system components. With authorization from the project manager, the system operator will contract services for system component repairs, replacement, or upgrades.

1.8 Training

All system operators must be qualified and competent to perform the tasks and duties associated with the treatment system. The Lead Operator must be a certified and licensed wastewater treatment system operator. The Lead Operator will be responsible for providing appropriate task training to all operations personnel. Safety personnel may provide additional specific safety and hazard recognition training as needed. Operations personnel will receive appropriate training before assuming the various roles and responsibilities within the system. Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training and on-going annual re-certification is required for all operations personnel. Required site-specific training will be recorded and maintained in Appendix D. Refer to the site-specific health and safety plan, policies, and procedures for complete safety related guidance. Site personnel must also demonstrate competency in their area of responsibility through practical application and appropriate certifications.

The system operator and project manager will assure that all personnel entering the site areas comply with the appropriate health and safety requirements. Completing specific tasks may require site personnel to be trained in specific safety elements such as the following:

- Confined Space Entry
- Working at Heights
- 40-hour OSHA HAZWOPER/current refreshers
- Energy Isolation (Lockout/Tagout)
- Hydrogen Sulfide Gas Safety
- Hazard Recognition

2.0 SYSTEM OVERVIEW

Various systems associated with the BTL Treatment System are shown on Figure 1. This section provides area designations and a brief overview of each system location.

2.1 Area Designations

2.1.1 Lower Area One

The LAO site is located at the lowest topographic elevation within the BPSOU and contains the treatment lagoons, CAS Building, Operations Building, HCC, Automatic Sampling Building (ASB), BRW, and open areas. The LAO extends from Montana Street, along Centennial Avenue to the western boundary near Interstate-90 as shown on Figure 1.

Groundwater flow from the entire drainage is captured and converges in the west-central portion of BPSOU in LAO. Contaminated alluvial groundwater at LAO and base flow from Missoula Gulch are intercepted by the HCC and routed to the Cell D4 for treatment through the system. All groundwater and surface flow are naturally directed to the D4 cell located at the west end of the LAO site as shown on Figure 2.

2.1.2 Butte Treatment Lagoons

The treatment lagoon system is located in the northwest portion of the LAO site and consists of pump/pipe systems, lime addition equipment, monitoring and control systems, and multiple unlined, open water cells.

2.1.3 Chemical Addition System Building

The CAS consists of lime storage, feed, slurry equipment, and associated automated controls. The CAS Building (photograph to the right), located immediately west of the lime silo, houses all lime feed, slurry tanks, associated equipment, monitoring and control equipment, and the Distribution Tank. A site emergency generator is installed southwest of the CAS Building.

Photograph 1. Operations and CAS Buildings.

2.1.4 Operations Building

The Operations Building is located on the east side of the CAS Building. The Operations Building includes an operations room with a desk, HMI, computer, compressed air system, sample preparation room with heaters and fans, and restroom amenities.

2.1.5 Automatic Sampling Building

The ASB (photograph to the right) houses sampling equipment, effluent piping and associated valves, interior heaters, and an exhaust fan. The building contains the ISCO® 3700 automatic sampler; effluent flow is monitored and automatically sampled through the ISCO® 3700 automatic sampler.

Photograph 2. Automatic Sampling Building.

2.1.6 Butte Reduction Works Open Areas

The BRW open areas are located in the northeastern portion of LAO. Previous remediation and waste removal efforts resulted in open spaces and depressions in the BRW area landscape.

2.1.7 West Camp

The West Camp is located directly north of Centennial Avenue adjacent to the BRW area. It includes a submersed pumping system, system piping and valves, associated controls and monitoring equipment, and emergency generator.

Note: There is potential for exposure to hydrogen sulfide gas at the West Camp area. Refer to Section 2.2.5 for additional information and precautions.

2.1.8 BPSOU Subdrain Pump Station

The BPSOU subdrain pumping station is located to the north of the Butte-Silver Bow (BSB) Visitor's Center at 1000 George Street. The station consists of a wet vault water collection source, dry vault pumping system and discharge piping, pig-launching station, associated controls and monitoring equipment, and emergency generator.

2.1.9 Influent Pump Station

The IPS is located in the southwest corner of Cell D4, adjacent to the flood containment dike (FCD). The ISP contains a redundant pumping system, associated controls and monitoring equipment, and emergency generator.

2.2 Groundwater Capture System

The capture system captures groundwater through groundwater interception areas and remote pumping stations, which make up the influent flows to BTL (Figure 2). Groundwater interception areas include the HCC, D cells (D2, D3, and D4), and the BRW open areas (Section 2.2.2). Remote groundwater pumping stations are installed at WCP-1 and subdrain areas. Additional details are provided below.

2.2.1 Hydraulic Control Channel

The HCC was constructed during the Phase I LAO Expedited Response Action to intercept impacted alluvial groundwater in LAO. The HCC functions as an interception trench to collect impacted alluvial groundwater from the Butte Hill and Missoula Gulch base flow, WCP-1, subdrain pumping station, and BRW open areas, and prevents groundwater from impacting the reconstructed Silver Bow Creek channel and floodplain.

As shown on Figure 2, the HCC directs groundwater to the IPS located within Cell D4. The HCC begins on the eastern boundary of LAO, west of Montana Street, and continues to the western boundary of LAO, paralleling the northern site boundary along the western half of its alignment. The HCC terminates along the western boundary of LAO just beyond the IPS and at a sheet pile termination wall (photograph to the right), which prevents the flow from entering Silver Bow Creek as surface water. Elevation of the sheet pile is 5,421.4 feet amsl (NAVD 88). Critical water level of the HCC and D4 is 5,421 feet amsl (NAVD 88).

Photograph 3. HCC Sheet Pile Termination Wall.

2.2.2 Butte Reduction Works Open Areas

The BRW open areas are located in the northeastern portion of LAO. Previous remediation and waste removal efforts resulted in open spaces and depressions in the BRW area landscape. These areas are used for groundwater collection. Outlet structures allow operators to raise or lower water levels as required to control gradient and provide surge capacity for the BTL systems during non-routine operating conditions.

The BRW open areas, labeled BRW-01 and BRW-00, are the result of the tailings removal performed as part of a remedial action in the late 1990s. The BRW area is used primarily to capture contaminated groundwater to help control groundwater levels and ensure that the eastern third of the reconstructed Silver Bow Creek channel does not gain impacted groundwater from this aquifer. BRW-01 was formerly divided into BRW-01 West and BRW-01 East. However, the two open areas essentially function as one unit as they are hydraulically connected without any infrastructure available to isolate the east and west portions independently. Therefore, BRW-01 West and BRW-01 East are referred to as BRW-01, and BRW-01 transports groundwater from BRW to the HCC.

2.2.3 D Cells

The D2 and D3 cells are located along the south side of the A2 and A3 cells. The D2 and D3 cells create a groundwater capture gradient that ensures flow away from Silver Bow Creek and provides a way to re-circulate treated water back to the D4 Cell and IPS during upset conditions. Without these cells, percolation of water from the unlined A2 and A3 cells could reach adjacent water systems without confirmation that effective metals were removed. During routine operations, the system is set as follows:

- Effluent flow from the treatment lagoons (treated water) **is not** discharged into D2; however, intercepted groundwater is directed downgradient to Cell D3.
- Effluent flow from the treatment lagoons **is not** discharged into Cell D3; however, intercepted groundwater is directed into Cell D4.

2.2.4 Missoula Gulch Discharge

The base flow (discharging groundwater) from the upper portion of the Missoula Gulch drainage exits the storm sewer system just south of Iron Street into the Missoula Gulch base flow diversion basin pipe. This flow combines with WCP-1 discharge flow at manhole MBG-MH-07 and discharges near BRW-01 east and eventually discharges to the HCC (see Site Plot Plan Sheets 3 and 5 in Appendix E), along with other BTL groundwater.

A concrete forebay sediment vault located at the upper end of the diversion pipe collects sediment and debris from Missoula Gulch surface and stormwater flow. This requires periodic maintenance to remove collected solids from the vault as described in the *Final Missoula Gulch Catch Basins Operation and Maintenance (O&M) Plan* (Atlantic Richfield, 2018) as a component of the O&M Plan for BSB Superfund Storm Water System (BSB, 2018). BSB performs routine maintenance of this structure. Any disturbances or issues should be reported to the BSB Department of Reclamation and Environmental Services, Environmental / O&M Division Manager.

2.2.5 West Camp Pump Station

The primary function of WCP-1 (photograph to the right) is to maintain water levels in the West Camp system below the established critical water level of 5,435 feet amsl (NGVD 29). The pump station transfers groundwater from the West Camp Complex to the BTL at an average flow of approximately 185 gpm.

Photograph 4. West Camp Pump Station.

Routine flow rates from the WCP-1 range from a minimum of approximately 160 gpm to 200 gpm while operating to maintain West Camp Complex water level below the critical water level.

The pump's maximum flow is approximately 420 gpm. A level control **maintains the water level at approximately 5,420 feet amsl** under routine conditions. The automated high water level alarm is set at 5,430 feet amsl to minimize the potential of the water level rising above the critical water level of 5,435 feet amsl).

Due to the geology of the area, hydrogen sulfide (H_2S) gas has been detected in the groundwater conveyed from West Camp. Although the presence of hydrogen sulfide gas is not common, there is potential for the gas to re-occur. A hydrogen sulfide gas sensor is installed in the WCP-1 pump building to monitor for the presence of hydrogen sulfide gas and provide notification if the gas is detected in amounts greater than 20 parts per million (ppm).

If the audible and/or visual alarm is activated, vacate the area immediately and contact local emergency services personnel. Do not approach the area if the audible and/or visual alarm is activated, or if a sulfur (rotten egg) odor is detectable in the area. Activation of the hydrogen sulfide gas detection system will also display an alarm on the HMI located in the Operations Building control room along with the appropriate callout notifications required.

2.2.6 BPSOU Subdrain Groundwater Collection System

The subdrain consists of a groundwater collection system and a pumping system, with the controls housed in one building (photograph to the right). The groundwater collection system uses gravity to collect and transfer impacted groundwater to a wet vault collection sump located at the west end of the subdrain. This groundwater containment system prevents discharge of contaminated groundwater to Blacktail and Silver Bow creeks that could lead to violations of surface water ARARs (EPA, 2020).

Photograph 5. BPSOU Subdrain Pump Station Control Building

Pumps located in the dry vault at the bottom end of the subdrain act as a lift station to transfer impacted groundwater from the wet vault, via underground forced main, to LAO at a routine average flow of 450 gpm. The system can provide a maximum flow of approximately 680 gpm with both pumps operating in parallel at full capacity. The outlet of the BPSOU subdrain discharge piping is located at the east end of the HCC where the discharged flow mixes with other influent sources discussed in Section 1.4.

Two independent sub-surface pipes are installed from the subdrain pump station to the BRW area. Valves and piping crossovers are available to allow flow to be discharged from any pump configuration through either or both pipe system. The system can discharge flow to the HCC, BRW-00, or both from either pipe system.

During maintenance activities including jetting and pigging of the subdrain and piping components, flow is diverted to the north drying bed cell to capture accumulated solids.

2.2.7 Cell D4

Cell D4 is the main water collection area of the influent system, located at the west end of the site. This collection area is fed by the HCC and serves as the main influent water source. Cell D4 is designed to operate at a routine elevation of approximately 5,418.3 feet amsl (NAVD 88), to ensure capture of groundwater before it can migrate further down the alluvium and eventually to Silver Bow Creek. Cell D4 is operated with a minimum and maximum routine pool elevation of approximately 5,418 feet amsl, and 5,419 feet amsl, respectively, to ensure the critical water level in the HCC is not exceeded.

2.2.8 Silver Bow Creek Floodplain

The Silver Bow Creek floodplain is located on the southern half of the LAO site. The original Silver Bow Creek was diverted around the tailings impoundment from the Colorado Smelter. During the initial cleanup of LAO in 1996-1997, the Silver Bow Creek floodplain was reconstructed to its original state using historical data for the design. Following completion of material removal and reconstruction efforts, flows were then directed back into the reconstructed Silver Bow Creek channel, which was constructed at an elevated grade within the floodplain. The elevated channel results in a net loss of surface water to groundwater over this reach and minimizes the potential of Silver Bow Creek to collect impacted groundwater within LAO.

2.3 Groundwater Treatment System Components

Groundwater treatment systems include the, IPS, CAS Building, lagoons (A, B, and C), and Effluent System.

2.3.1 Influent Pump Station

The IPS houses monitoring equipment and influent pumps driven by variable frequency drives (VFD) (photograph to the right). Two centrifugal pumps provide redundant pumping capabilities. A primary pump operates at approximately 1,270 gpm to 1,880 gpm while a second pump provides redundant pumping capability. Level transducers provide a signal to each pump speed controller to maintain an established operating level at Cell D4 while operating in AUTO mode.

Photograph 6. D4 Cell and IPS

2.3.1.1 Influent Piping

Piping from the discharge flange of the influent pumps to the CAS system makes up the CAS system influent piping. Each pump has an independent, 14-inch discharge pipe with isolation valves and a tee pipe fitting that allows access to each pipe system from both pumps. A 10-inch polyvinyl chloride (PVC) pipe is also in place, parallel to the 14-inch influent lines from D4 to the piping manifold located near the CAS Building, to provide system redundancy for emergency use with a submersible pumping system. Each influent line from the IPS is routed along the FCD road alignment to the CAS Building.

All influent piping transitions to a single, consolidated, 14-inch ductile iron pipe immediately following the gate valves installed to provide pipe isolation capabilities. Valve position indicator posts located near the southeastern corner of the Operations Building show the status (photograph to the right). Locally, the valve status (OPEN/CLOSED) displays on the post at the valve in the field. A proximity switch on each valve also provides a signal to the programmable logic controller (PLC) to display the OPEN/CLOSED status on the HMI.

Photograph 7. Influent Valve Indicators

2.3.2 Chemical Addition System

Influent water is pumped to the CAS Building for hydrated lime addition. A slipstream of influent flow is used for lime slurry make-up water. A continuous throttled flow of raw influent water is directed to each tank. The primary tank receives approximately 200 gpm of raw influent water, while the secondary tank receives approximately 50 to 100 gpm. Dry lime feed is continuously fed to the primary tank at the dosage described in Table 2. The table also lists the influent flow and corresponding lime usage operating ranges. Influent flow is discharged from the 14-inch influent line directly to the sluice box inside the CAS Building. Slurry is discharged from the active slurry tank to the sluice box and mixed with raw influent water and discharged to the Distribution Tank. From the Distribution Tank, the flow is then distributed to the first cell of each series of lagoons (A, B, and C).

Table 2. Daily Lime Usage Estimates

	Influent Flow	Lime Usage @ 130 mg/L lime feed rate
Minimum	700 gpm	1,095 lb/day
Routine	1,270 gpm	1,986 lb/day
Maximum	1,880 gpm	2,940 lb/day

mg/L: milligrams per Liter. gpm: gallons per minute. lb: pound.

2.3.2.1 Chemical Addition System Components

General descriptions of the CAS components are outlined in the following paragraphs.

Lime Silo – the lime silo consists of a 22-ton capacity silo with equipment and controls to transfer dry, hydrated lime to the lime transfer auger. A skirt support structure allows access to the bottom of the silo, and houses lime feed components such as the lime hopper, AccuRate feeder, knife gate valve, and screw conveyor (these components are described below).

AccuRate Feeder and Screw Conveyor – the AccuRate feeder controls the amount of dry lime from the bottom of the lime silo that passes directly to the screw conveyor. The screw conveyor then transfers lime to the slurry tanks. Lime is delivered at a dosage (mg/L) set by the operator on the HMI screen; however, mass delivery of lime is based on influent flow rate. The incorporated control system provides variable lime feed to accommodate the influent flow rate fluctuations.

Supply Water Feed Lines – these feed lines provide makeup water for the continuous dry lime addition operations.

Slurry Tanks – the slurry tanks are 730-gallon tanks that allow continuous addition of lime slurry into the main influent supply flow stream.

Slurry Mixers – each slurry tank contains an APPCOR model CYB-100, elastomer-coated mixer with on-off controls, a 1.5 horsepower (hp) electric motor, and a gear reducer. These mixers provide constant agitation to maintain thoroughly mixed lime slurry in each tank.

Sluice Box – the 21-foot sluice box provides initial mixing of raw influent flow and lime slurry. Lime slurry is introduced directly into the sluice box prior to being discharged into the Distribution Tank.

Distribution Tank – the concrete Distribution Tank has an internal volume of approximately 2,300 gallons and provides final mixing of influent water with lime slurry. Three weir gates are installed on interior surfaces of the Distribution Tank, and they function as downward opening rectangular weirs. Weir gates provide flow control to direct the mixed influent water and lime slurry to each of the distribution channels.

Distribution Channels – three, independent concrete distribution channels extend from each weir gate of the concrete Distribution Tank. The channels are sloped to each of the primary treatment lagoons (A1, B1, and C1).

Compressed Air System – two Ingersoll Rand Model 2475N7.5FP electric driven (230-volt, 60-amp, single phase), two-stage compressors provide compressed air up to 175-pounds per square inch gauge (psig) to various components such as the knife gate valve actuators and the silo baghouse.

Bin Discharge – the bin discharge vibrates at a specified interval and prevents any lime from agglomerating within the cone and assists in keeping the AccuRate feeder supplied with lime. The time on and time off for vibration of the bin discharge can be controlled either through the PLC while operating in AUTO mode or adjusted by the operator depending on density and volume of the lime stored in the silo while operating in HAND mode. While in AUTO mode, programmable logic allows vibration while the knife gate valve is open.

2.3.3 Lagoon System A

Lagoon System A consists of 3 cells: A1, A2, and A3 (see Figure 1). Cell A1 allows primary settling of solids for the treated influent flows that enter Lagoon System A. Treated influent water flows to the west end of the cell through a silt curtain. The silt curtain filters the water and distributes it as uniformly as possible across the cell to achieve optimum flow and residence time. Treated water is then discharged into Cell A2 through Outlet Structure 1 (OS-1). The outlet structures act as level control devices for each cell as stop logs can be added or removed to raise or lower cell level. Once water from Cell A1 reaches Cell A2, it flows to OS-5 located on the west bank of Cell A2.

Cell A3 is the final cell in Lagoon System A. Water from Cell A2 is discharged on the east end of Cell A3 from OS-5 and flows west to OS-7. Water meeting discharge criteria is discharged from A3 through Effluent Line D (EL-D) to the main Effluent System, described below, then to Silver Bow Creek. Effluent not meeting discharge criteria provided in Table 3 (on page 32) can be diverted to Cell D4 if retreatment is necessary (refer to Section 6.1.6).

2.3.4 Lagoon System B

Lagoon System B is located within the central portion of the treatment lagoon area. Treated water from the Distribution Tank flows through Distribution Channel B to Cell B1 and first enters Cell B1 on the east bank. Then it travels west through a 120-foot silt curtain for approximately 200 feet until it reaches Treatment Wall B1 (TW-B1). TW-B1 separates Cells B1 and B2 and is constructed of 3- to 6-inch rock. The treatment walls act as secondary filters for the suspended solids.

Water flows through and over the treatment wall. Once the water enters Cell B2, it travels west approximately 150 feet until it reaches TW-B2, where further filtration of any solids that may have migrated through TW-B1 occurs. After water travels through TW-B2 it then enters Cell B3, which acts as the final polishing cell in Lagoon System B. Water travels west to OS-2 where it can be diverted to either Cell A2, located directly to the west, or into EL-A. The outlet structures act as level control devices for each cell as stop logs can be added or removed to raise or lower cell level.

2.3.5 Lagoon System C

Lagoon System C is constructed much like Lagoon System B and consists of three treatment lagoons operated directly south of Lagoon System B. Treated influent water enters Cell C1 on the east bank and travels west, through a silt curtain to TW-C1. As in Lagoon System B, these treatment walls aid in filtration of suspended solids, but they are constructed of 6- to 9-inch rock.

After water filters through and over TW-C1 it enters Cell C2 and continues to TW-C2, which was constructed the same as TW-C1. Once water enters Cell C3, it flows to OS-3. The design for OS-3 diverts flows to either EL-B, Cell A2, or Cell D2 depending on lagoon elevation, volume of flow, and water quality leaving Cell C3. Effluent flow from Cell C3 in EL-B is combined with

EL-A flow and directed to the main Effluent System. The outlet structures act as level control devices for each cell as stop logs can be added or removed to raise or lower cell level.

2.3.6 Effluent System

The Effluent System and outlet structures discharge the maximum flows through each series of treatment lagoons. Effluent flow is discharged to Silver Bow Creek downgradient of sampling location EFS-07, shown on Figure 2.

The ASB contains the effluent ISCO® automatic sampler, peristaltic pump, inline flow meter, automatic continuous effluent pH meter, heater, and main electric box for the ASB (photograph to the right). Water samples are collected prior to discharge from this location to determine water quality and to assess compliance with discharge criteria.

Photograph 8. ASB Sample Station

2.3.7 Lime Addition Rate and Influent Pump Station Automation

The lime addition rate and IPS controls are automated to accommodate functional changes in the system without the need for constant manual adjustments. As previously described, IPS pumps are configured to maintain the Cell D4 water level. Therefore, flow rates may vary during high precipitation events. Lime feed rates are based on influent flow to deliver the prescribed dosage of lime.

Programming is also in place to ensure untreated influent flow is not discharged through the lagoon system. The IPS and lime feed components are interlocked, through PLC programming, to ensure both systems are functional and operating in conjunction with each other to maintain treatment objectives.

2.3.8 Water Quality Sampling and Monitoring Overview

Monitoring is performed at INF-04, MSD-HCC, WCP-1 and EFS-07 (shown on Figure 1 and Figure 4). This section describes the established stations, facilities, and parameters measured. Complete information regarding monitoring and sampling, including related SOPs, is provided in Appendix C. Additional details regarding routine field measurements and routine calibration tasks are discussed in Section 4.0.

Influent water quality is monitored to provide baseline information based on field parameters described in the QAPP in Appendix A of influent flows that enter the treatment facilities. The influent water is sampled at INF-04 within the CAS Building. An ISCO® automatic composite water sampler is programmed to collect a set volume of water once per hour over 24 hours into a separate composite container; operators composite and collect the sample. Operators prepare and ship the samples to a laboratory and also collect manual field measurements. Field measurements are recorded in the Field Parameter Form/Logbook maintained in the Operations Building sample preparation area.

Samples from MSD-HCC and WCP-1 will be obtained monthly during routine sample collection events. Samples are also obtained from MSD-HCC during the semiannual sampling events. Sample results from MDS-HCC and WCP-1 provide information to determine treatment system effectiveness. Data from these locations are not used to determine compliance. Sample location WCP-1 will be sampled beginning in June 2022 through the end of May 2023. At the end of this period the WCP-1 sample location will be evaluated for continued sampling.

Effluent water quality is monitored at EFS-07 shown on Figure 4 to ensure effluent meets ARARs listed in the RODA (EPA, 2020). An ISCO® automatic composite water sampler located in the ASB collects effluent samples from the effluent line. The automatic sampler collects a separate composite container once per hour over 24 hours. Operators prepare and ship the samples to a laboratory for analysis.

The QAPP (Appendix A) provides detailed information regarding sampling procedures (SOPs), laboratory analytical methods, and sampling activities.

Point Table			Point Table		
Description	Northing	Easting	Description	Northing	Easting
MH-MSD106	651209.02	1197905.47	HCC-01	651325.00	1193749.26
MH-MSD108	651265.29	1198781.03	HCC-01A	651326.53	1193021.75
MH-MSD110	651503.81	1199850.85	HCC-01B	651331.65	1192933.79
MH-MSD113	652414.06	1200906.31	HCC-02A	651364.64	1192780.84
MH-MSD116	653236.82	1201858.01	HCC-03	651895.05	1192245.96
MSD-HCC	651600.21	1194949.19	HCC-03A	651940.66	1192156.74
MSD-OUT	651324.20	1197083.50	HCC-04	652072.94	1191792.43
A1	651838.45	1192164.94	HCC-04A	652097.11	1191743.43
A2	651931.22	1191690.21	HCC-05	652280.66	1191254.87
A3	652055.47	1191180.80	HCC-05A	652303.23	1191210.43
B1	651484.14	1192551.84	HCC-06	652343.18	1191051.80
B2	651657.02	1192233.20	HCC-06A	652355.78	1191012.56
B3	651702.08	1192096.79	HCC-07	652188.07	1190724.00
C1	651464.96	1192558.36	INDC	651511.64	1192604.67
C3	651541.57	1192046.18	INF04	651457.40	1192637.70
			EFS-07	651925.98	1191093.47

LEGEND:
- BTL ANALYTICAL SAMPLE COLLECTION
- SUBDRAIN LOADING - FLOW WATER LEVEL, FIELD PARAMETERS. ANALYTICAL SAMPLES
- BTL FIELD DATA - LEVEL
- HCC STAFF GAUGE LOCATIONS
- BTL FIELD DATA- pH, TEMP, CONDUCTIVITY
- INDC

N

DISPLAYED AS:
COORD SYS/ZONE: MSP
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER

SCALE IN FEET
0 100 200

FIGURE 4

PIONEER TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

BTL AND BPSOU SUBDRAIN ROUTINE SAMPLE AND MONITORING LOCATIONS

DATE: 12/2020

2.4 Sludge Management Components

2.4.1 Dredge Storage Building

The Dredge Storage Building (DSB), located directly east of the Operations Building, is used to store the Crisafulli dredge, SuperSax temporary lime feed system, outlet structure stop logs, system spare parts, and back-up components. The building is not heated. It provides cold storage capabilities only. The dredge piping components must be drained prior to long-term storage. A list of on-hand equipment stored in the DSB is provided in Appendix G.

2.4.2 Sludge Drying Beds

The sludge drying beds are located within the BRW area (Section 2.1.6). Gross water decanting from sludge is directed to the HCC via BRW-01. Natural processes, including evaporation, infiltration, and freeze/thaw, also serve to dewater dredged material prior to retained solids being transported to the mine waste repository for disposal.

Solids from jetting and pigging operations of the subdrain piping are also directed to the north drying bed. Refer to Section 4.7.2.3 for addition information related to jetting and pigging.

2.4.3 Sludge Removal and Dewatering

Using the remotely operated Crisafulli dredge and shore-mounted anchor posts, operators remove sludge from the primary lagoons. Sludge material is pumped from the dredge through a dedicated pipe to the drying beds area. Subsurface valves and valve indicator posts installed at the east end of the drying beds allow operators to select which drying bed receives material from the dredge. A stop log structure at the west end of each drying bed allows free water to be decanted from the drying bed and flow to BRW-01 West. Each stop log allows the operating level of the cell a plus or minus (±) 6-inch adjustment. Level sensors installed near the stop log structures transmit level indications to the HMI. Routine operating elevation of each drying bed cell is provided in Table 3 (on page 32).

2.5 Treatment Processes and Controls

The BTL water treatment system is an active lime treatment system. It uses a series of lagoons to precipitate dissolved metals from groundwater sources, described in Section 1.4, as well as groundwater collected within the LAO site. The addition of hydrated lime ($CaOH_2$) to the influent at the CAS Building is the primary treatment.

The lagoon systems are made up of three parallel retention systems (A, B, C), each containing three lagoons (A1, A2, A3, etc.) located in series. The result is a 3-by-3 array of cells. The treatment lagoons are unlined, allowing a small volume of treated water to infiltrate into native groundwater while the majority of the water discharges to Silver Bow Creek as surface water. Water that does infiltrate through the floors of the lagoon cells is re-captured in the HCC and routed to Cell D4 to be recycled through the treatment system. Treated effluent water from the system is routinely sampled for quality as described in the QAPP (Appendix A) and is discharged directly to Silver Bow Creek.

2.5.1 Chemical/Physical Treatment Processes

The target pH used for hydroxide precipitation depends on the specific COCs in the influent and the effluent discharge requirements. Metals have a different ideal insolubility pH level. To remove dissolved metals from water, the precipitation process begins with adjusting pH to the maximum insolubility point. To precipitate multiple metals, a pH range that initiates precipitation of the most important, or strictest standard, metal is typically targeted. This represents the best possible metal precipitation performance in a one-step precipitation process. Co-precipitation of specific metals can also enhance precipitation of additional metals in the influent or increase removal of specific metals. The range of the pH provides a target range that provides COC removal to meet effluent performance standards (Section 1.2) and allows for minor fluctuations in system performance as is standard in system operations. System optimization is out of the scope of routine operations. Through operational experience, the BTL treatment and lime usage have been set at optimum levels to treat current influent to meet discharge requirements provided in Table 1. Should influent conditions change considerably, the system may be reconsidered for optimization.

The hydrated lime addition rate, which ranges from 110 mg/L to 140 mg/L, is varied to achieve pH targets, which lowers metal solubility in the water to form a low volume solid. The low volume solid is chemically and physically stable and will eventually settle out of the water. Lime is added to the influent stream to adjust the pH level to the range provided in Table 3. Hydrated lime is combined with a side stream of water in the slurry tanks. Lime slurry (from the slurry tanks) is added to the main influent water in the sluice box. Combined flows from the sluice box enter the Distribution Tank and are distributed to A, B, and C channels. The pH level is measured immediately downstream of the Distribution Tank, typically obtained from the channel with the greatest flow. The pH adjustment promotes removal of dissolved metals through the following chemical and physical processes:

- Formation of metal hydroxide and carbonate particles, which then settle from suspension through the water column adhering with other solids and removing them from the treated water.
- Time spent in settling ponds provides for additional holding time that allows settling of treated solids, sorption of carbon dioxide (CO_2) from the atmosphere, precipitation of unreacted lime as calcium carbonate ($CaCO_3$), and a decrease of treated water pH to values below 9.5 prior to discharge into Silver Bow Creek.

2.6 Site Ecology, Access, and Maintenance

At some time, the area adjacent to the treatment system may include additional amenities and interpretive areas that have potential to intersect with operating personnel's daily routine. Community involvement and positive interactions are important to the long-term success of the remedy. Site tours may be provided to educate the public on how the system operates and provide assurances that the remedy does not impact remediation efforts. Tours may include regulatory personnel, education groups such as the Clark Fork Watershed Education Program (CFWEP), and area schools, etc. Public access will be restricted in operating areas throughout LAO and limited to access along the floodplain south of the FCD.

Silver Bow Creek and floodplain management may be the responsibility of multiple internal or external entities to ensure the reclaimed areas are sustainable. Management activities may include eradication of invasive plant species, routine weed spraying, etc. Any action that adversely impacts the Silver Bow Creek floodplain will be identified for consultation with EPA and appropriate agencies. Ecological components are vital to the performance of the site remedy and must be appropriately maintained.

Remote stations and LAO are inhabited by various forms of wildlife (birds, waterfowl, deer, rabbits, etc.). Care must be taken to ensure normal OM&M activities do not endanger wildlife in the area. Operators will use caution while navigating the roadways, properly store and dispose of wastes, etc., and will not approach or feed the wildlife.

3.0 LAGOON OPERATIONS

The BTL systems are normally operated at constant levels to maintain efficiency. However, there is flexibility built into the system to anticipate various flow conditions depending on water levels, flow conditions, and influent water chemistry. Routine operations are discussed below, while Section 3.1.4 provides guidance on system adjustments.

3.1 Description of Lagoon Operations

Lagoon operating levels can be adjusted through stop log elevation adjustments within each outlet structure. Typically, the lagoons operate at a constant stop log elevation with little variance required during routine conditions. Optimum treatment results are obtained when the system operates at consistent elevations and flow rates. Adjustments are not immediately detectable as the overall treatment process takes several days to stabilize. Approximate retention times are provided in Section 1.4.

Lagoon elevations are obtained by calculating the elevation of the water surface relative to a surveyed elevation. Transducers deployed in the lagoon cells measure the height of liquid above the position in the lagoon referenced to atmospheric pressure. Elevations displayed on the HMI provide the water level of the respective cell as elevation amsl relative to a known vertical datum (NAVD 88). Conversion of height of water to the elevation displayed on the HMI is performed within the PLC relative to a known surveyed elevation measuring point.

Transducer verification is performed quarterly (at a minimum) to ensure water elevations displayed on the HMI are indicative of actual elevation. Standard procedure (BTL-SOP-039) provides instructions to perform this verification. The operator enters manual field measurement values into the Lagoon Elevations spreadsheet located on the LAO computer in the Operations Building. This spreadsheet calculates the actual elevation of the water in feet and is used to compare to the displayed water elevation on the HMI for each outlet structure.

3.1.1 Routine Operations

The text below describes the routine operations of each component of the BTL system and the required settings. Table 3 (on page 32) lists the routine operating range and target operating levels of each cell in the treatment system. Every week, a designated operator completes the Daily Cell Data electronic file listing the data collected and recorded during that week (refer to Section 7.2).

Distribution Tank. Combined flows from the sluice box enter the Distribution Tank and are distributed to A, B, and C channels. Weir gates (A, B, and C) direct the flow through the tank (the gates are open a specific percentage based on summer or winter operations settings in Table 3 on page 32). Operators manually adjust the system to maintain a minimum freeboard of 4 inches inside the Distribution Tank, while allowing flow to be distributed as necessary to each of the Lagoon Systems (A, B, and C). Operators manage flow by setting the operating height of the weir gates. Height is determined by the percentage of how far the gate is open. The percentage appears on the HMI. Table 3 lists the percentages (based on non-freezing/summer and freezing/winter conditions) to establish flow into the cells.

Cell A1. Under routine conditions, the majority of flow from the Distribution Tank is regulated through Weir Gate A into Cell A1. ***Initial target water level for this cell is 5,426.3 feet amsl (NAVD 88) (5,421.94 feet amsl [NGVD 29]) and the stop logs in OS-1 can be adjusted accordingly to achieve this water level.*** From OS-1 there are two, 15-inch discharge pipes that extend to the northeast corner of Cell A2 that allow flow to be dispersed into Cell A2.

Cell A2. Water level in Cell A2 is regulated with OS-5 stop logs. The initial ***target operating elevation of this cell is 5,425.85 feet amsl (NAVD 88) (5,421.49 feet amsl [NGVD 29]).*** Water can be discharged to either Cell A3, through a 24-inch discharge pipe that extends from the bottom of OS-5 to the east edge of Cell A3, or to the effluent pipe through EL-C.

Cell A3. Water level in Cell A3 is regulated with OS-7. ***The initial target operating level of this cell is 5,425.2 feet amsl (NAVD 88) (5420.84 feet amsl [NGVD 29]).*** Water can be discharged to either Cell D4, through an 18-inch discharge pipe that extends from the bottom of OS-7 to the east edge of Cell D4, or to the effluent pipe through EL-D.

Lagoon System B. Flow into Lagoon System B is regulated with Weir Gate B located in the Distribution Tank. Manual settings of the stop logs in OS-2, located in Cell B3, determine the water levels of Lagoon System B. ***The initial target operating level of this system is 5,426.3 feet amsl (NAVD 88) (5,421.94 feet amsl [NGVD 29]).*** Water can be discharged to either Cell A2, through a 12-inch discharge pipe that extends from the bottom of OS-2 to the east edge of Cell A2, or to the effluent pipe through EL-B.

Lagoon System C. Flow into Lagoon System C is regulated with Weir Gate C located in the Distribution Tank. Manual settings of the stop logs in OS-3, located in Cell C3, determine the water levels of Lagoon System C. ***The initial target operating level of this system is***

5,426.3 feet amsl (NAVD 88) (5,421.94 feet amsl [NGVD 29]). Water can be discharged to either Cell A2 (through a 12-inch discharge pipe that extends from the bottom of OS-3 to the southeast corner of Cell A2), Cell D2 (through a 16-inch discharge pipe), or to the effluent pipe through EL-A.

Cell D2. During routine operations, ***the initial target-operating water level of Cell D2 is 5,421 feet amsl (NAVD 88) (5,416.94 feet amsl [NGVD 29]).*** The level is controlled with stop logs located in OS-6.

Cell D3. During routine operations, ***the initial target-operating water level of Cell D3 is 5,420 feet amsl (NAVD 88) (5,415.94 feet amsl [NGVD 29])***. The level is controlled with stop logs located in OS-8.

Table 3. Routine Operating Ranges

	Routine Operating Elevation	
Lagoons	**amsl**	**Datum**
A1; LT-2000	5426.30 +/- 0.5 ft	NAVD 88
A2; LT-2003	5425.85 +/- 0.5 ft	NAVD 88
A3; LT-2006	5425.20 +/- 0.5 ft	NAVD 88
B Cells; LT-2013	5426.30 +/- 0.5 ft	NAVD 88
C Cells; LT-2025	5426.30 +/- 0.5 ft	NAVD 88
D2; LT-2009	5421.30 +/- 0.5 ft	NAVD 88
D3; LT-2011	5420.30 +/- 0.5 ft	NAVD 88
D4; LT-2013	5418.30 +/- 0.5 ft	NAVD 88
Remote Pump Stations	**amsl**	
WCP Well; LT-5001	5420.00 +/- 5.0 ft	NGVD 29
	inches	
Subdrain Wet Vault; LT-6002	5,435.83 +/- 0.6 ft	NGVD 29
Distribution Tank		
Non-Freezing/Summer Operations	**% Open**	
GV-1056 to A1	75-80 %	
GV-1057 to B1	65-70%	
GV-1058 to C1	55-60 %	
Freezing/Winter Operations		
GV-1056 to A1	55-60 %	
GV-1057 to B1	65-70%	
GV-1058 to C1	75-80 %	
Slurry Tank Levels	**inches**	
Tank #1; LT-1049	25 +/- 5	
Tank #2; LT-1039	25 +/- 5	
Influent Flows	**gpm**	
IPS; FT-1059	1,000 - 1,300	
WCP; FT-5006	130 - 280	
Subdrain pump station; FT-6019	430 - 500	
Subdrain Pump Station; FT-6021	430 - 500	
Missoula Gulch Baseflow	50 - 100	
Slurry Make Up; FT-1085	50 - 150	
Effluent Flow	**gpm**	
Effluent; FT-4000	850 - 1,100	
Flow Routing		
Non-freezing/Summer	A3, B3 and C3 to EL-D.	
Freezing/Winter	A1,B3, C3 to A2, A2 to A3, A3 to EL-D.	
Lime Feed Rate	115 - 160 mg/L	
Channel pH	10.10 - 10.60 S.U.	
Effluent Discharge pH	8.90 - 9.50 S.U.	

Drying Beds	**Normal Operating Elevation**	
	amsl	**Datum**
Cell 1	5,443.00 - 5,438.00	NAVD 88
Cell 2	5,443.75 - 5,438.75	NAVD 88
Cell 3	5,443.75 - 5,438.75	NAVD 88

Cell D4. Under routine conditions, the ***water level at Cell D4 will be maintained at approximately 5,418 feet amsl (NAVD 88) (5,413.94 feet amsl [NGVD 29]),*** with only *one influent pump in operation.*

The outlet structures must be routinely checked and cleaned of debris, as needed.

3.1.2 Routine Flow Path – Non-Freezing/Summer Conditions

The following scenarios describe routine effluent flow paths during months of seasonal non-freezing/summer conditions. Non-freezing/summer conditions are typically prevalent from April through October, or when ambient temperature consistently remains above 32 degrees Fahrenheit and lagoons cells remain ice free. Routine flow for the system indicates effluent flow meets established parameters for pH and other field or analytical criteria monitored at the ASB.

The routine flow path of water within the BTL does not require recirculation, retreatment, or series operation of the lagoon systems. Normal, average daily flow can range from 1,000 gpm to 1,300 gpm. For this scenario, to obtain similar residence times in each lagoon system (i.e., A, B, and C cells), operators set the flows to be distributed according to summer operations settings. Operators open the weir gates a certain percentage in the Distribution Tank (see Table 3 on page 32 for the settings) to distribute the flow.

During routine conditions, parallel flow paths are maintained for each lagoon system, and effluent flow from A3, B3, and C3 is discharged to the effluent line and directed towards sampling station EFS-07 for discharge to Silver Bow Creek. During routine conditions (i.e., water quality meets discharge standards and target water levels are achieved in the treatment cells):

- Flows entering Cell A3 discharge into EL-D;
- Flows entering Cell B3 discharge into EL-A;
- Flows entering Cell C3 discharge into EL-B;
- Flows in EL-A and EL-B combine with flow in EL-D; and
- Combined flow in EL-D is sampled at EFS-07 and discharged to Silver Bow Creek.

3.1.3 Routine Flow Path – Freezing/Winter Conditions

The following scenarios describe routine effluent flow paths during months of routine seasonal freezing/winter conditions. Freezing/winter conditions are typically prevalent from November through March, or when ambient temperature is below 32 degrees Fahrenheit for extended periods resulting in ice forming over the lagoon surfaces. Ice cover effects oxygenation and carbon dioxide gas exchange, which is a by-product of the treatment. The icing ultimately effects lagoon pH. To counteract this effect, adjustments to the effluent flow may be made to minimize icing conditions at Cell A2 as determined by site operations personnel. In addition, gaseous carbon dioxide may be added to the effluent, within EL-D and upstream of EFS-07, to provide final pH adjustment before discharge to Silver Bow Creek.

Operators set the weir gates in the Distribution Tank to distribute flows according to winter operations settings. The weir gates are open a certain percentage (see Table 3 on page 32 for the settings) to distribute the flow.

General flow routing adjustments that may be implemented during freezing/winter conditions is as follows.

- Cell A1 flow is discharged to Cell A2;
- Flows from Cell B3 and/or C3 are diverted into Cell A2;
- Flows entering Cell C3 discharge into EL-B and then enter EL-D;
- Flow entering Cell A2 is discharged to Cell A3;
- Flow entering Cell A3 is discharged into EL-D; and
- Flow in EL-D is sampled at EFS-07 and discharged to Silver Bow Creek.

3.1.4 System Flexibility and Adjustment

The BTL system design contains provisions to allow the system to respond to varying conditions and optimize overall treatment performance. The following paragraphs summarize the possible adjustments and describe the purpose and effect of each adjustment. Possible reasons to operate cells at their *minimum* operating level include anticipated increased flows into the system or planned maintenance activities within the associated lagoon cell or outlet structure. One possible reason to run the system at the *maximum* operating level would be to retain treated water to facilitate maintenance of downstream components.

Cell A1. Cell A1 *water level can be changed by manually adjusting the stop log height in OS-1*. The **minimum and maximum allowable operating levels of Cell A1 are 5,423 and 5,426.50 feet amsl *(NAVD 88) (5,418.64 and 5,422.14 feet amsl [NGVD 29])***, respectively. An auxiliary pump can be used to lower the water level to approximately 5,416 feet amsl (NAVD 88) to perform maintenance-related activities.

Cell A2. Cell A2 *water level can be changed by manually adjusting the stop log height in OS-5*. The **minimum and maximum allowable operating levels of Cell A2 are 5,423 and 5,426.50 feet amsl *(NAVD 88) (5,418.64 and 5,422.14 feet amsl [NGVD 29])***, respectively. An auxiliary pump can be used to lower the water level to approximately 5,416 feet amsl (NAVD 88) to perform maintenance-related activities.

Cell A3. Cell A3 *water level can be changed by manually adjusting the stop log height in OS-7*. The **minimum and maximum allowable operating levels of Cell A3 are 5,423 and 5,426.50 feet amsl *(NAVD 88) (5,418.64 and 5,422.14 feet amsl [NGVD 29])*,** respectively. An auxiliary pump can be used to lower the water level to approximately 5,420 feet amsl (NAVD 88) to perform maintenance-related activities.

Treatment System B. Treatment System B *water levels can be changed by manually stop log height in OS-2*. The **minimum and maximum allowable operating levels of Cell B3 are**

5,423.7 and 5,426.5 feet amsl *(NAVD 88) (5,421.64 and 5,422.14 feet amsl [NGVD 29])*, respectively. An auxiliary pump can be used to lower the water level to approximately 5,420 feet amsl (NAVD 88) to perform maintenance-related activities.

Treatment System C. Treatment System C *water levels can be changed by manually adjusting the stop log height in OS-3*. The **minimum and maximum allowable operating levels of Cell C3 are 5,423.7 and 5,426.5 feet amsl *(NAVD 88) (5,421.64 and 5,422.14 feet amsl [NGVD 29])***, respectively. An auxiliary pump can be used to lower the water level to approximately 5,420 feet amsl (NAVD 88) to perform maintenance-related activities.

South Hydraulic Control. Cell D2 *water level can be changed by manually removing or adding stop logs in OS-6*. The **minimum and maximum allowable operating levels of Cell D2 are 5,416.1 and 5,425.1 feet amsl *(NAVD 88) (5,411.74 and 5,420.74 feet amsl [NGVD 29])***, respectively. Cell *D3 water level can be changed by manually removing or adding stop logs in OS-8*. The minimum and maximum operating levels of **Cell D3 are 5,414.8 and 5,423.2 feet amsl *(NAVD 88) (5,411.74 and 5,420.74 feet amsl [NGVD 29])***, respectively.

4.0 ROUTINE OPERATION AND MAINTENANCE TASKS

The purpose of this section is to define the routine system conditions and operator activities for the BTL systems. The definitions given are a starting point based on available experience gained during operation of previous treatability study systems and the full-scale treatment system. Routine operating tasks are described as readily identifiable, planned tasks that must be performed on a known interval to ensure the system operates as designed. The referenced standard operating procedures (SOPs) are a set of written instructions that provide detailed information to perform a specific task. The SOPs enable operators to follow a consistent, specified method to complete the task. Along with SOPs, system checklists identify routine tasks that operators must perform at weekly, monthly, bi-monthly, and quarterly intervals. Routine tasks regularly incorporate one or more SOPs. Appendix D contains a list of routine activities, including frequency, and multiple system checklists. Appendix C contains the SOPs for the BTL-LAO systems and remote pumping stations. Appendix F contains several troubleshooting and decision trees to return systems back to routine status.

4.1 Routine Operational Tasks

The operator's normal routine tasks are summarized in the subsections below.

These sections provide a general overview of the specific activities in each task; activities completed automatically by the system and those that must be completed manually by the operator. Again, Appendix C contains the detailed SOPs for each task.

4.1.1 Initial Arrival and System Operational Status Check

Upon arrival at the site each routine workday, the operator will check the HMI screen in the Operations Building for alarms and current monitoring status. This provides the operator with a quick overview of the facility and operating conditions and allows immediate attention to be given to major problems. The operator will complete the initial site and system check according to the checklists in Appendix D. Detailed instructions are in BTL-SOP-01 (Appendix C).

- Initial arrival and system operational status check; (BTL-SOP-1)
- pH meter daily field calibrations; (BTL-SOP-36)
- Daily site visit and check of subdrain pump station and discharge; (BTL-SOP-31)
- Manual pH channel verification sampling; (BTL-SOP-1), (BTL-SOP-13)
- Daily monitoring of cell levels, pH, and flows; (BTL-SOP-1), (BTL-SOP-13)

After completing the site arrival tasks and confirming that the system is operational, the operator will continue with routine monitoring tasks. During daily routine monitoring, the operator will complete a site overview tour of the facilities to identify potential problem areas that require attention. The operator should observe and document the following during routine daily tasks (BTL-SOP-1)

- Alarms – review alarm logs (Figure 5) and address critical alarms that require attention.
- Influent Water Flow – confirm IPS pumps are operating and that flows from the IPS are comparable with flows into the CAS Building as indicated by the influent flow meter.
- Lime Addition – confirm lime feed delivery to the influent stream (i.e., the feeder is working correctly, screw conveyor operating, mixers operating, discharge lines open and flowing freely). Daily observations, used to verify lime feed rates and influent flow rates, recorded, and used to generate a daily operations report as described in Section 7.0.
- Monitoring Systems – confirm data points are being updated locally at specific devices and match values displayed on the HMI.
- Lagoon System Cells– confirm water is freely flowing from the Distribution Tank through the lagoon cells and continuing to the effluent area.

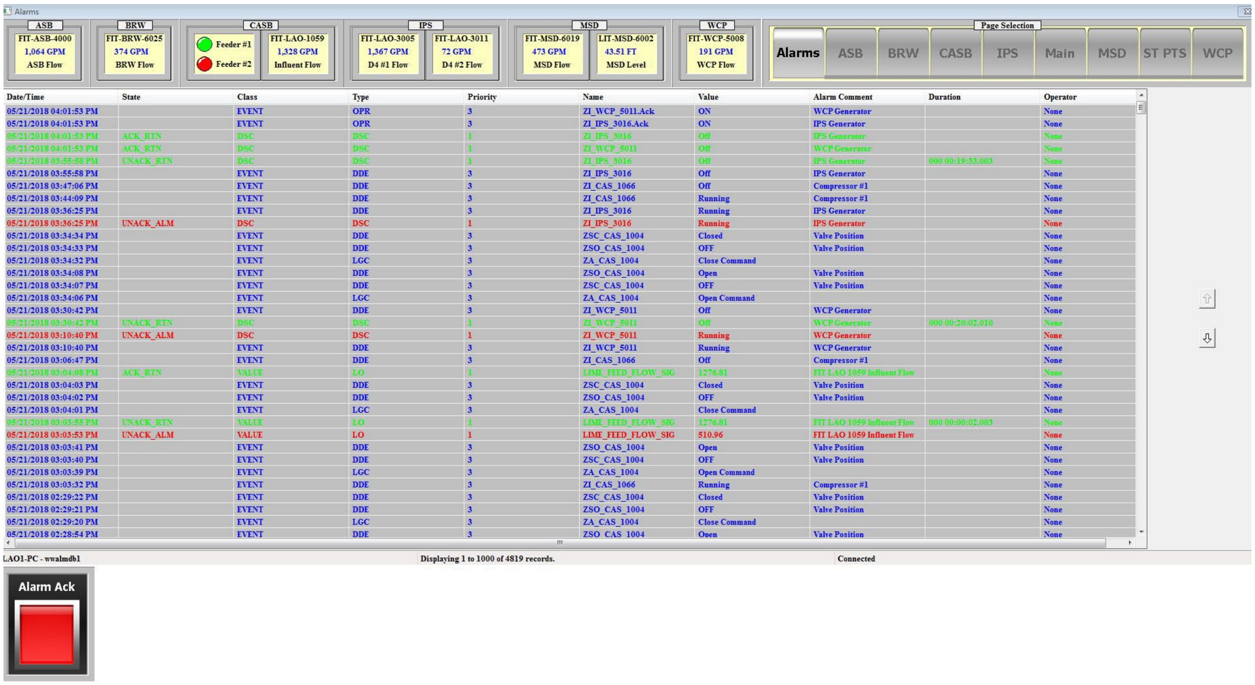

Figure 5. HMI Alarm Log Screen.

4.1.2 Lime Feed Data Flows, and pH

The operator should review the previous day's monitoring data to verify daily summary/indicator data for the following information categories to detect operational trends:

- Lime Operations (daily use, average mg/L).
- Hydraulics (daily flow rates of influent and effluent and water levels).
- pH (daily readings of influent and effluent lagoons).

Detailed instructions are in BTL-SOP -01 Initial Arrival at the Chemical Additions Building and BTL-SOP-13 Outlet Structure Grab Sampling. (Appendix C).

4.1.3 Missoula Gulch Groundwater System

BSB is primarily responsible for operations and maintenance (O&M) of the Missoula Gulch groundwater system and associated catch basins. Specific tasks are detailed in the *Missoula Gulch Catch Basins (CB-1, CB-8, and CB-9) O&M Plan* (Atlantic Richfield, 2018.)

4.1.4 West Camp Pump Station

The operator will visit and check WCP-1 on Monday each week and record the system status (as displayed from the HMI) electronically in the Daily Cell Data file (refer to Section 7.2) and perform a weekly check of the WCP-1 site to verify HMI data and field device readings. These tasks include verifying the following:

- The West Camp pump flows are within normal operating range of 160-280 gpm;
- Water level within the adjacent monitoring well is below the critical water level of 5,435.5 feet amsl (NGVD 29), and within routine operating limits (refer to Table 3 on page 32); and
- Site security and integrity is maintained.

Pump operating status and flow data appear on the HMI screen (Figure 6) in the Operations Building. This provides operators a continuous view of the system operation status. Operators will record verification data obtained during the site visits electronically in the Daily Cell Data file (refer to Section 7.2). Detailed instructions are in BTL-SOP-04 West Camp Arrival, BTL-SOP-09 Generator Inspection, BTL-SOP-42 West Camp Pump Stop/Restart, and BTL-SOP-44 West Camp H2S Alarm Response (Appendix C).

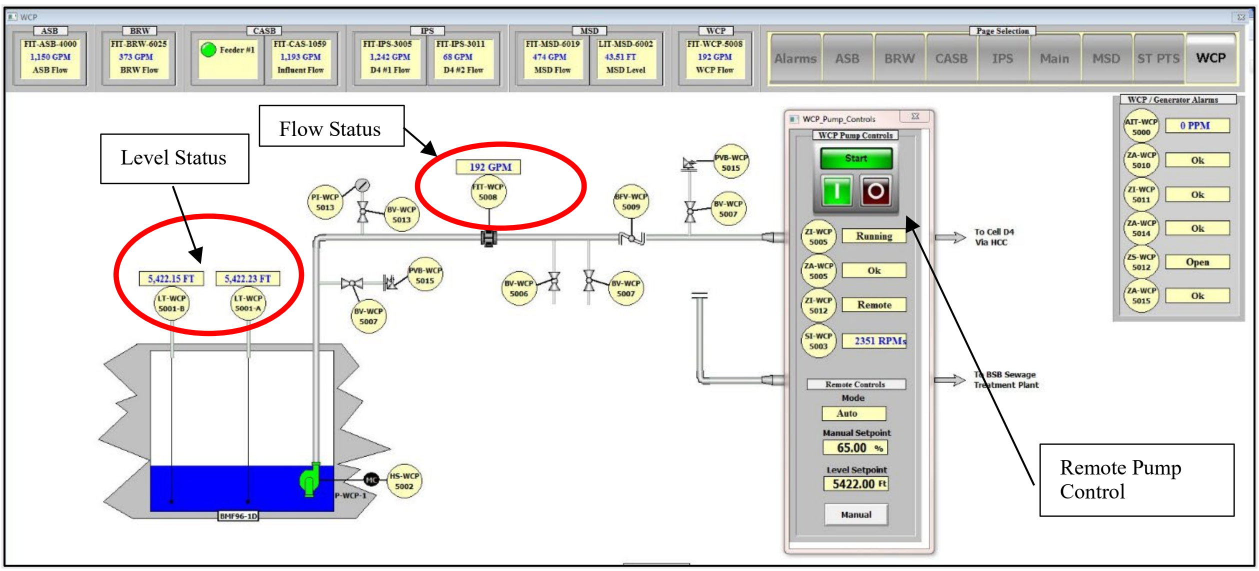

Figure 6. WCP HMI Screen.

4.1.5 Subdrain Pump Station

The operator will perform a **daily status check** of the subdrain pump station. Pump operating status and flow data appear on the HMI screen (Figure 7) in the Operations Building. This provides the operator with real-time system status information that shows the following:

- If the subdrain pumps are operational and within normal flow range 430 – 650 gpm; and
- If the water level in the wet vault is within the operating range (35.8 – 51.8 inches; total water depth).

Detailed instructions are in BTL-SOP-05A LAO BPSOU Subdrain Operations Check Procedures, BTL-SOP-09 Generator Inspection. (Appendix C).

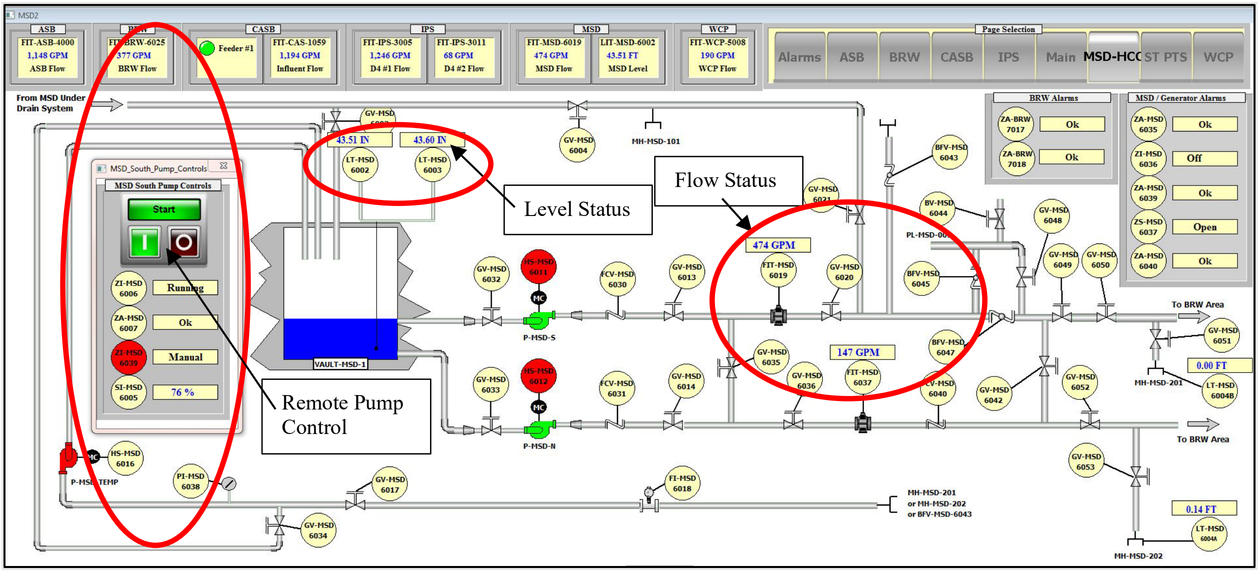

Figure 7. BPSOU Subdrain Pumping System HMI Screen.

4.2 Chemical Addition System Building Operation

The sections below provide operational details related to the lime feed system and influent flow. The sections describe the regular tasks performed by the system and those tasks an operator must complete.

4.2.1 Chemical Addition System Overview

The following description outlines the routine process associated with equipment within the CAS Building and IPS. Section 4.3.2 describes the control settings. The SCADA system is programmed to ensure the following routine tasks are performed and status displayed on the HMI (Figure 8) located in the Operations Building.

1. Pump untreated influent water from the IPS (at Cell D4) to the CAS Building.
2. Monitor the influent flow rate via the 14-inch flow meter in the CAS Building.
3. Divert a side stream (50 to 250 gpm) of the influent flow into a slurry tank. This flow is mixed with lime from the screw conveyor and discharged as lime slurry to the Sluice Box where it mixes with the main influent flow.
4. Feed lime into the influent. Lime is fed from the silo via the Schenk AccuRate feeder helix and the screw conveyor to either slurry tank. The operator sets the lime feed rate (mg of dry lime per liter of influent water) at the HMI. The system automatically adjusts the rate according to influent flow rate. In the slurry tank, lime is mixed with the slipstream influent water and then discharged (refer to Section 2.3.2).

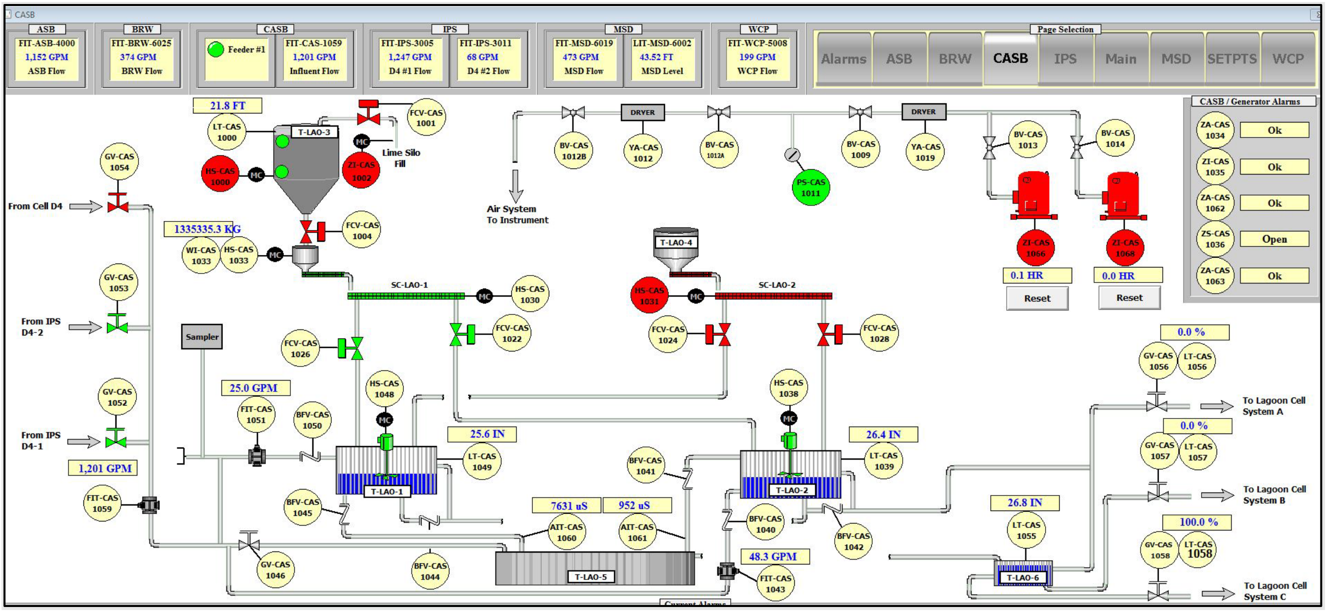

Figure 8. CAS HMI Screen.

Detailed instructions are in BTL-SOP-01 CAS Initial Arrival Status Check, BTL-SOP-03 Gravimetric Lime Addition System Startup, BTL-SOP-07 Slurry Tank Feed Water Re-Establishment, BTL-SOP-10 Screw Conveyor Cleaning and BTL-SOP-19 Slurry Tank and Discharge Pipe Cleaning. (Appendix C).

4.2.2 Lime Addition Control Mechanism

As described in Section 2.4, the lime feed facility is designed to allow easy adjustment to the lime addition rate to meet treatment objectives. The primary control system is configured to transmit the operational status to the HMI screen located in the Operations Building, which allows operators to view status at a glance. The Feeder helix rpm corresponds directly to lime feed rate. Lime dosage is applied as milligrams (mg) of lime per liters (L) of influent. Through integrated programming, the helix revolutions per minute (rpm) coincides with the influent flow rate to maintain consistent lime dosage at the desired setpoint to achieve pH levels within operating limits provided in Table 3. An increase or decrease in influent flow rate will automatically result in an increase or decrease in helix rpm to ensure the proper mass of lime is added to the volume of influent. Similarly, a change in lime dosage results in an automatic change in helix speed (rpm) to meet dosage requirements.

Detailed instructions to adjust lime feed system components to meet treatment objectives are described in the following SOPs BTL-SOP-03 Gravimetric Lime Addition System Startup, BTL-SOP-28 Volumetric Lime Addition Startup, and BTL-SOP-35 Calibrating Accurate Feeder (Appendix C).

4.2.3 Sampling and Monitoring

As stated previously in Section 2.3.8, an ISCO® automatic composite water sampler collects a set volume of water once per hour over a 24-hour period and places the water into one 2.5-gallon container. (BTL-SOP-17 ISCO Automatic Composite Water Sampling Procedures and BTL-SOP-24 Effluent Grab Sample) Operators prepare and ship the samples to a laboratory. Additional detailed information is provided in the QAPP (Appendix A).

Operators routinely monitor the pH of influent water and effluent water throughout the treatment process. Effluent pH is monitored manually at station INDC after lime addition. Post-lime addition pH measurements obtained from station INDC (Figure 4) are used to make changes required to lime addition and are compared to the routine ranges provided in Table 3. A pH measurement outside of the routine ranges for a prolonged period would indicate to the operator that an adjustment to the lime addition is necessary. For example, a pH measurement above the routine range indicates a reduction in lime addition rate is necessary, while a pH below the routine range indicates an increase in lime addition is necessary to meet effluent discharge parameters.

Additional pH measurements are obtained throughout the lagoons system to ensure the system meets water quality discharge parameters. Additional readings may be required following significant changes in flow rate and/or lime addition rate adjustments. The readings help operators maintain a general understanding of how pH is changing as water flows through the lagoon systems A, B, and C, and provide diagnostic information regarding the BTL system performance. Detailed instructions are in BTL-SOP-13 Outlet Structure Grab Sampling (Appendix C). Hourly average effluent pH measurements are reported on the daily report generated each day.

Additional field parameter measurements obtained during sample collection are described in the QAPP (Appendix A).

4.2.4 Chemical Addition System Criteria

The lime treatment facilities located in and around the CAS Building are the primary components to manage the water treatment process. The design criteria of the building and lime treatment facilities were based on two major factors:

- Lime addition can maintain pH levels to a minimum of 9.5 su, but not exceed 11.0 su; the target inflow pH is 10.2 when measured at station INDC.
- Lime addition must be effective at routine flows (800 -1,400 gpm) listed in Table 3.

4.2.4.1 Lime Dosage

The lime dosage for the system ranges from 110 mg/L to 140 mg/L. At the routine dosage of 130 mg/L, lime is delivered at approximately 1.5 pounds of dry lime per day per gpm influent flow (lb/day/gpm). Using this typical rate and the assumptions below result in the usage calculation below.

Assumptions:

Assume Lime Rate = 130 mg/L

Assume Routine Flow = 1,200 gpm

Known Silo Capacity = 22 tons * 2,000lb/1 Ton = 44,000lb

Theoretical lime usage calculation is as follows:
(Note: g: grams, gal: gallon, min/hr: minutes per hour, hr/day: hours/day, lb: pounds.)

130 mg/L * 0.001 g/mg * 1/(454 lb/g) * 1,200 gpm * 3.785 L/gal * 60 min/hr * 24 hr/day = 1,877 lb/day

44,000 lb * 1 day/1,877 lb = 23.4 days

Lime feed and actual usage is verified through a computer spreadsheet-based calculation that uses field data and the difference in lime storage over a given period of time. Calculations provide operators with a reliable projection of lime storage at current operating levels. Detailed instructions are in BTL-SOP-03 Gravimetric Lime Addition System Startup and BTL-SOP-28 Volumetric Lime Addition Startup (Appendix C).

4.2.4.2 Lime Delivery

Lime is normally delivered 5 to 7 days after an order is placed. Deliveries are made in 24- to 30-ton trucks with pneumatic unloading capabilities. Operators must be aware of the two items paramount to maintaining a supply of lime for the system: 1) when to reorder the lime and 2) how the lime is stored.

Reordering lime: **Operators must reorder lime from the lime provider before the lime level reaches 5 feet on the Bindicator Yo-Yo level indicator.** The Yo-Yo meter level appears on the HMI and there is also a local readout within the “skirt” below the silo. Appendix G contains the lime order contact information.

Storing the lime: When lime is delivered to the site, operators must make sure that the delivery personnel do not unload more than the required amount of lime to fill the silo. **Overfilling the silo will create operational difficulties.** Operators can view a high level alarm for the silo that appears on the HMI and also watch for visible lime discharge from the pressure vacuum breaker (PVB) on the silo (this breaker allows air to enter or escape from the silo to prevent rupture or collapse; it is set at very low internal pressure and vacuum pressures).

4.2.5 Compressed Air System

The compressed air system cannot be started remotely through the HMI. Compressors and the air dryer must be energized and started manually by placing the local switch into the ON position. Operators must check the air system periodically for air leaks, excessive runtime, overheating of the compressor interconnecting piping, and condensate bled from filters and water traps. *Note:* A pressure switch on the compressor will cycle the compressor ON/OFF to maintain pressure within the system.

4.3 Control System

Automated control and monitoring of the BTL-LAO systems and remote pumping stations is achieved primarily through local PLC programming and data transmission to a master PLC located in the CAS Building. The HMI operator console located in the Operations Building displays the system data. While the system is operating in AUTO mode, operators can perform the following actions from this HMI and control equipment remotely:

- Open/close knife gate valves installed in the lime delivery system.
- Start/stop slurry tank mixer motors.
- Start/stop pumping at remote stations WCP-1, IPS, and subdrain (Figure 9).

Operational information is continuously updated and transmitted to the CAS PLC, displayed on the HMI, and logged on the data historian computer. Refer to the *BTL-LAO Systems Control Theory Document* (Atlantic Richfield, 2013) for a complete description of instrumentation and controls system.

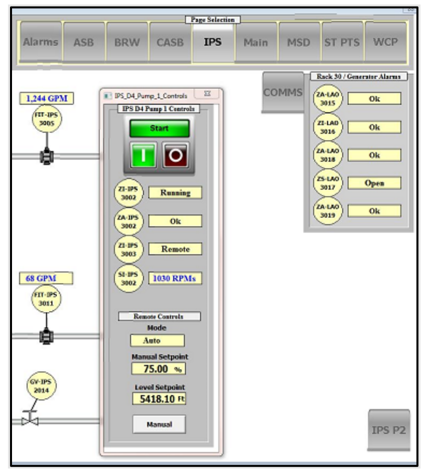

Figure 9. Remote Pump Start Screen.

A motor control center (MCC) located in the CAS Building provides primary power to each lime slurry mixer motor, screw conveyor motors, silo vibratory shaker, AccuRate feeder helix motor, AccuRate feeder massager paddle motor, lime silo baghouse system, and redundant lime feed system. The MCC contains a HAND-OFF-AUTO (HOA) selector switch, start, and stop push buttons, and master circuit breaker (ON/OFF/TRIP) capabilities.

4.3.1 Control System Glossary

HAND. Hand or manual position of a HOA control or selector switch. When in this position (HAND), primary power is delivered and the device is under manual control.

OFF. Off position of a control or selector switch. When in this position, the device is turned off. No primary power is delivered.

AUTO. Auto position of a HOA control or selector switch. When in this position, primary power is delivered and the device is automatically controlled by the control system.

ON. On position of a control or selector switch. When in this position, primary power is delivered and the device turned on.

OPERATOR INTERFACE. The operator interface is a personal computer running an industrial control software package that acts as the HMI. It allows the operator to view the process, status, and alarms of the entire system. It displays a graphical view of the system and provides access to all required set points and operator-adjustable values and alarms. Table 4 (on the next page) provides a list of instruments, alarms, and set points for LAO systems.

Table 4. BTL Treatment System Alarm Conditions

ALARM LIST

Alarm acknowledgement must be performed locally at the site of the instrument. Alarms are PLC based, and callouts are performed through the RACO Catalyst alarm dialer located in the Operations Building.

Remote station data are transmitted to the Master Polling PLC located at the Operations Building.

X =Action is performed

S = System shutdown directly

C = Cascading Event

DEVICE ID	NAME	SET POINT	*TIME DELAY*	*TYPE*	***Cause Type = Direct Acting, PLC Based, Or Electro-Mechanical Based, And Description*** ***DESCRIPTION***	Display Status on HMI Panel **DISPLAY**	Visual Control Panel Alarm **ACTIVATE**	Auto Dialer Notification **ACTIVATE**	Local Alarm **DISPLAY**	Starts PLC Timer Interlock **ACTIVATE**	Influent Pumps (D4-1 & 2) Shutdown **ACTIVATE**	Lime Feed System Shutdown **ACTIVATE**
LT-CAS-1000	T-LAO-3 Lime Silo Level; Alarm on low level	4 FT	*10-min*	*PLC*	*Measurement < FT-starts 600 second PLC-based timer; < 4-FT*	X	X	X				
PS-CAS-1011	Pressure Switch; Alarm on low pressure	80 PSI	*3-min*	*PLC*	*Measurement < 80PSI*	X	X	X	X			
ZA-CAS-1030	SC-LAO-1 Primary Screw Conveyor Run Status; Alarm at OFF status	OFF	*3-min*	*PLC*	*OFF Status = 0*	X	X	X		X	X	X
ZA-CAS-1031	SC-LAO-2 Secondary Screw Conveyor Run Status; Alarm at OFF status	OFF	*3-min*	*PLC*	*OFF Status = 0*	X	X	X		X	X	X
ZA-CAS-1033	Accurate Feeder Run Status; Alarm at OFF status	OFF	*3-min*	*PLC*	*OFF Status = 0*	X	X	X	X	X	X	X
ZA-CAS-1034	Detects CAS Building Generator Alarm Status; Alarm on Generator Fault	FAULT	*3-min*	*DA*	*FAULT Status = 0*	X	X	X	X			
ZS-CAS-1036	Detects CAS Building Transfer Switch Status; Alarm on Transfer	CLOSED	*3-min*	*DA*	*CLOSED Status = 0*	X	X	X	X			
LT-CAS-1039	T-LAO-2 Slurry Tank 2 Level; Alarms at LOW/HIGH	12, 45 IN	*10-min*	*PLC*	*Measurement >45-IN or < 12-IN starts 600 second PLC based timer*	X	X	X				
FIT-CAS-1043	Measures Flow to T-LAO-2 Slurry Tank 2; Alarm on LOW flow	50 GPM	*10-min*	*PLC*	*Measurement < 50GPM starts 600 second PLC based timer; <50GPM*	X	X	X				
LA-CAS-1049	T-LAO-1 Slurry Tank 1 Level; Alarms at LOW/HIGH	12 IN, 45 IN	*10-min*	*PLC*	*Measurement >45-IN or < 12-IN starts 600 second PLC based timer*	X	X	X				
FIT-CAS-1051	Measures Flow to T-LAO-1 Slurry Tank 1; Alarm on LOW flow	50 GPM	*10-min*	*PLC*	*Measurement < 50GPM starts 600 second PLC based timer; <50GPM*	X	X	X				
ZSO-CAS-1052	GV-LAO-1052 State; Alarms when CLOSED	CLOSED	~	*PLC*	*CLOSED Status = 0*	X	X					
ZSO-CAS-1053	GV-LAO-1053 State; Alarms when CLOSED	CLOSED	~	*PLC*	*CLOSED Status = 0*	X	X					
ZSO-CAS-1054	GV-LAO-1054 State; Alarms when CLOSED	CLOSED	~	*PLC*	*CLOSED Status = 0*	X	X					
LT-CAS-1055	T-LAO-6 Distribution Tank Level; Alarms at LOW/HIGH	4 IN, 30 IN	*10-min*	*PLC*	*Measurement > 30-IN or < 4-IN starts 600 second PLC based timer*	X	X	X				
ZSO-CAS-1056	GV-LAO-1056 State; Alarms when CLOSED	CLOSED	~	*PLC*	*CLOSED Status = 0*	X	X					
ZSO-CAS-1057	GV-LAO-1057 State; Alarms when CLOSED	CLOSED	~	*PLC*	*CLOSED Status = 0*	X	X					
ZSO-CAS-1058	GV-LAO-1058 State; Alarms when CLOSED	CLOSED	~	*PLC*	*CLOSED Status = 0*	X	X					
FIT-CAS-1059	Measure Influent Flow to CAS; Interlock with lime feed system, Alarm on LOW Flow	700 GPM	*3-min*	*PLC*	*Measurement < 700GPM starts 180 second PLC based timer; <700GPM >180-sec, IPS & CAS shutdown.*	X	X	X		X	X	X
AIT-CAS-1060	T-LAO-1 Slurry Tank 1 Conductivity; Alarms when out of range	2500 uS	*10-min*	*PLC*	*Measurement < 2500 uS starts 600 second PLC based timer; <700GPM >180-sec, IPS & CAS shutdown.*	X	X					
AIT-CAS-1061	T-LAO-2 Slurry Tank 2 Conductivity; Alarms when out of range	2500 uS	*10-min*	*PLC*	*Measurement < 2500 uS starts 600 second PLC based timer; <700GPM >180-sec, IPS & CAS shutdown.*	X	X					
ZA-CAS-1062	Detects power surge at CAS Building; Alarms on surge	FAULT	~	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X					
ZA-CAS-1063	Monitors power at CAS Building; Alarms on loss of power	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				
ZA-CAS-1064	Emergency Stop Button, mounted directly to the master control PLC panel	STOP	~	*E-MECH*	*Local hardwired emergency shutdown button*	X	X	X	X		X	X
ZA-CAS-1065	Detects communication failure at CAS Building; Alarms on loss of communication	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				
LT-LAO-2000	Lagoon A1 Level (shown on screen as elevation); Alarms at LOW/HIGH	5422, 5429.85 FT	~	*PLC*	*Measurement > 5429.85-FT or < 5422-FT starts 600 second PLC based timer*	X	X					
LT-LAO-2003	Lagoon A2 Level (shown on screen as elevation); Alarms at LOW/HIGH	5420, 5428 FT	~	*PLC*	*Measurement > 5428-FT or < 5420-FT starts 600 second PLC based timer*	X	X					

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Remote station data are transmitted to the Master Polling PLC located at the Operations Building.

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C = Cascading Event

DEVICE ID	NAME	SET POINT	*TIME DELAY*	*TYPE*	*Cause Type = Direct Acting, PLC Based, Or Electro-Mechanical Based, And Description* *DESCRIPTION*	Display Status on HMI Panel DISPLAY	Visual Control Panel Alarm ACTIVATE	Auto Dialer Notification ACTIVATE	Local Alarm DISPLAY	Starts PLC Timer Interlock ACTIVATE	Influent Pumps (D4-1 & 2) Shutdown ACTIVATE	Lime Feed System Shutdown ACTIVATE
LT-LAO-2006	Lagoon A3 Level (shown on screen as elevation); Alarms at LOW/HIGH	5420, 5428.83 FT	~	*PLC*	*Measurement > 5428.83-FT or < 5420-FT starts 600 second PLC based timer*	X	X					
LT-LAO-2017	Lagoon B3 Level (shown on screen as elevation); Alarms at LOW/HIGH	5422, 5429.11 FT	~	*PLC*	*Measurement > 5429.11-FT or < 5422-FT starts 600 second PLC based timer*	X	X					
LT-LAO-2025	Lagoon C3 Level (shown on screen as elevation); Alarms at LOW/HIGH	5420, 5428.29 FT	~	*PLC*	*Measurement > 5428.29-FT or < 5422-FT starts 600 second PLC based timer*	X	X					
LT-LAO-2009	Lagoon D2 Level (shown on screen as elevation); Alarms at LOW/HIGH	5418, 5424 FT	*10-min*	*PLC*	*Measurement > 5424-FT or < 5418-FT starts 600 second PLC based timer*	X	X	X				
LT-LAO-2011	Lagoon D3 Level (shown on screen as elevation); Alarms at LOW/HIGH	5418, 5424 FT	*10-min*	*PLC*	*Measurement > 5424-FT or < 5418-FT starts 600 second PLC based timer*	X	X	X				
LT-LAO-2013	Lagoon D4 Level (shown on screen as elevation); Alarms at LOW/HIGH	5418.35, 5419 FT	*10-min*	*PLC*	*Measurement > 5419-FT or < 5418.35-FT starts 600 second PLC based timer*	X	X	X				
ZA-LAO-2030	Detects power surge at OA1; Alarms on surge	FAULT	~	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X					
ZA-LAO-2031	Monitors power at OA1, Alarms on loss of power	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				
ZA-LAO-2032	Detects communication failure at OA1; Alarms on loss of communication	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				
ZA-LAO-2060	Detects power surge at OA2; Alarms on surge	FAULT	~	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X					
ZA-LAO-2061	Monitors power at OA2, Alarms on loss of power	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				
ZA-LAO-2062	Detects communication failure at OA2; Alarms on loss of communication	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				
LT-IPS-3001	Detects T-IPS-D4-1 Vault Level; Alarms at LOW/HIGH	5418.35, 5418.8, 5419 FT	*10-min*	*PLC*	*Measurement >5418.8-FT or < 5418.35-FT starts 600 second PLC based timer; >600-sec ALARM*	X	X	X				
ZA-IPS-3002	Detects P-IPS-D4-1 Pump Run Status; Alarms on State - OFF	OFF	*3-min*	*PLC*	*OFF Status = 0, NORMAL RUN Status = 1*	X	X	X		X	X	X
FIT-IPS-3005	Detects P-IPS-D4-1 Pump Flow; Alarms on LOW Flow	700 GPM	*3-min*	*PLC*	*Measurement < 700GPM starts 180 second PLC based timer; <700GPM >180-sec*	X	X	X				
LT-IPS-3007	Detects T-IPS-D4-2 Vault Level; Alarms at LOW/HIGH	5418.35, 5418.8, 5419 FT	*10-min*	*PLC*	*Measurement >5418.8-FT or < 5418.35-FT starts 600 second PLC based timer; >600-sec ALARM*	X	X	X				
ZA-IPS-3008	Detects P-IPS-D4-2 Pump Run Status; Alarms on State - OFF	OFF	*3-min*	*PLC*	*OFF Status = 0, NORMAL RUN Status = 1*	X	X	X		X	X	X
FIT-IPS-3011	Detects P-IPS-D4-2 Pump Flow; Alarms on LOW Flow	700	*3-min*	*PLC*	*Measurement < 700GPM starts 180 second PLC based timer; <700GPM*	X	X	X				
PA-IPS-3013	Pressure Switch for P-IPS-D4-1; Alarm on high pressure	60 PSI	*3-min*	*PLC*	*Measurement > 60-PSI*	X	X	X				
PA-IPS-3014	Pressure Switch for P-IPS-D4-2; Alarm on high pressure	60 PSI	*3-min*	*PLC*	*Measurement > 60-PSI*	X	X	X				
ZA-IPS-3015	Detects IPS Building Generator Alarm Status; Alarm on Generator Fault	ON	*3-min*	*DA*	*OFF Status = 0, NORMAL RUN Status = 1*	X	X	X	X			
ZS-IPS-3017	Detects IPS Building Transfer Switch Status; Alarm on Transfer	CLOSED	*3-min*	*DA*	*OFF Status = 0, NORMAL RUN Status = 1*	X	X	X	X			
ZA-IPS-3018	Detects power surge at IPS; Alarms on surge	FAULT	~	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X					
ZA-IPS-3019	Monitors power at IPS; Alarms on loss of power	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				
ZA-IPS-3020	Detects communication failure at IPS; Alarms on loss of communication	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				
FIT-ASB-4000	Measures Effluent Discharge Flow to Silver Bow Creek; Alarm on LOW flow	400 GPM	*3-min*	*PLC*	*Measurement < 400GPM starts 180 second PLC based timer; <400GPM >180-sec*	X	X	X				
ZA-ASB-4002	Detects P-ASB Pump Run Status; Alarms on State - OFF	OFF	*10-min*	*PLC*	*OFF Status = 0, NORMAL RUN Status = 1*	X	X					
AIT-ASB-4005	Measures Effluent Discharge pH; Alarms when out of range	8.9, 9.4 pH	*3-min*	*PLC*	*Measurement > 9.4 or < 8.9 starts 180 second PLC timer*							
ZA-ASB-4007	Detects power surge at ASB; Alarms on surge	FAULT	~	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X					

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Remote station data are transmitted to the Master Polling PLC located at the Operations Building.

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S = System shutdown directly
C = Cascading Event

DEVICE ID	NAME	SET POINT	*TIME DELAY*	*TYPE*	*DESCRIPTION* (*Cause Type = Direct Acting, PLC Based, Or Electro-Mechanical Based, And Description*)	Display Status on HMI Panel (DISPLAY)	Visual Control Panel Alarm (ACTIVATE)	Auto Dialer Notification (ACTIVATE)	Local Alarm (DISPLAY)	Starts PLC Timer Interlock (ACTIVATE)	Influent Pumps (D4-1 & 2) Shutdown (ACTIVATE)	Lime Feed System Shutdown (ACTIVATE)
ZA-ASB-4008	Monitors power at ASB; Alarms on loss of power	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				
ZA-ASB-4009	Detects communication failure at ASB; Alarms on loss of communication	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				
AIT-WCP-5000	H2S Sensor Measures H2S level at WCP-1 Building; Alarms on High level	10 ppm	*3-min*	*PLC*	*Measurement >10ppm, field instrument audible and visual alarm*	X	X	X	X			
LT-WCP-5001A	WCP-1 Well (BMF96-1D) Level; Alarms on HI Level	5,430 FT	*10-min*	*PLC*	*Measurement > 5430 FT*	X	X	X				
LT-WCP-5001B	WCP-1 Well (BMF96-1D) Level; Alarms on HI Level	5,430 FT	*10-min*	*PLC*	*Measurement > 5430 FT*	X	X	X				
ZA-WCP-5005	Detects P-WCP-1 Pump Fault; Alarm on Fault	ON	*3-min*	*PLC*	*ON Status = 0, NORMAL OFF Status = 1*	X	X	X				
FIT-WCP-5008	Measures WCP-1 Flow; Alarms on LOW Flow	70 GPM	*10-min*	*PLC*	*Measurement < 70GPM starts 180 second PLC based timer; <70GPM*	X	X	X				
ZA-WCP-5010	Detects WCP-1 Building Generator Alarm Status; Alarm on Generator Fault	ON	*3-min*	*DA*	*ON Status = 0, NORMAL OFF Status = 1*	X	X	X	X			
ZS-WCP-5012	Detects WCP-1 Building Transfer Switch Status; Alarm on Transfer	CLOSED	*3-min*	*DA*	*ON Status = 0, NORMAL OFF Status = 1*	X	X	X	X			
ZA-WCP-5014	Detects power surge at WCP-1; Alarms on surge	FAULT	~	*PLC*	*FAULT Status = 0, Normal Status = 1*	X	X					
ZA-WCP-5015	Monitors power at WCP-1; Alarms on loss of power	FAULT	*3-min*	*PLC*	*FAULT Status = 0, Normal Status = 1*	X	X	X	X			
ZA-WCP-5016	Detects communication failure at WCP-1; Alarms on loss of communication	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				
LT-MSD-6002A	Wet Vault; VAULT--1 Level; Alarms on HIGH Level	48, 38 IN	*3-min*	*PLC*	*Measurement < 38 IN or > 48 IN = Alarm callout*	X	X	X				
LT-MSD-6002B	Wet Vault; VAULT- 1 Level; Alarms on HIGH Level	48, 38 IN	*3-min*	*PLC*	*Measurement < 38 IN or > 48 IN =Alarm callout*	X	X	X				
ZA-MSD-6006	Detects P-MSD-S Pump Run Status; Alarms on State - OFF	OFF	*3-min*	*PLC*	*OFF Status = 0, NORMAL RUN Status = 1*	X	X	X		X	X	X
ZA-MSD-6007	Detects P-MSD-S Pump Fault; Alarm on Fault	ON	*3-min*	*PLC*	*ON Status = 0, NORMAL OFF Status = 1*	X	X	X	X			
ZA-MSD-6009	Detects P-MSD-N Pump Run Status; Alarms on State - OFF	OFF	*3-min*	*PLC*	*OFF Status = 0, NORMAL RUN Status = 1*	X	X	X		X	X	X
ZA-MSD-6010	Detects P-MSD-N Pump Fault; Alarm on Fault	ON	*3-min*	*PLC*	*ON Status = 0, NORMAL OFF Status = 1*	X	X	X	X			
ZA-MSD-6015	Detects P-MSD-TEMP Pump Status change; Alarms on OFF status	OFF	*3-min*	*PLC*	*OFF Status = 0, NORMAL ON Status = 1*	X	X	X	X			
FIT-MSD-6019	Measures Effluent Flow; Alarms on LOW / HIGH flow	100, 900 GPM	*3-min*	*PLC*	*Measurement < 100-GPM or > 900-GPM*	X	X	X	X			
FIT-BRW-6025	Measures Effluent Flow; Alarms on LOW / HIGH flow	100, 900 GPM	*3-min*	*PLC*	*Measurement < 100-GPM or > 900-GPM*	X	X	X				
ZA-MSD-6035	Detects Building Generator Alarm Status; Alarm on Generator Fault	FAULT	*3-min*	*DA*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X	X			
FIT-BRW-6061	Measures Effluent Flow; Alarms on LOW/HIGH flow	100, 900 GPM	*3-min*	*PLC*	*Measurement < 100-GPM or > 900-GPM*	X	X	X				
FIT-BRW-6064	Measures Effluent Flow; Alarms on LOW / HIGH flow	100, 900 GPM	*3-min*	*DA*	*Measurement < 100-GPM or > 900-GPM*	X	X	X				
ZS-MSD-6037	Detects Building Transfer Switch Status; Alarm on Transfer	100, 900 GPM	*3-min*	*DA*	*Measurement < 100-GPM or > 900-GPM*	X	X	X				
ZA-MSD-6039	Detects power surge; Alarms on surge	FAULT	~	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X					
ZA-MSD-6040	Monitors power; Alarms on loss of power	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				
ZA-MSD-6041	Detects communication failure; Alarms on loss of communication	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				
ZSO-BRW-7007	GV-BRW-7007 State displayed on HMI	CLOSED	~	*PLC*	*CLOSED Status = 0*	X	X					
ZSO-BRW-7008	GV-BRW-7008 State displayed on HMI	CLOSED	~	*PLC*	*CLOSED Status = 0*	X	X					

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					Cause Type = Direct Acting, PLC Based, Or Electro-Mechanical Based, And Description	Display Status on HMI Panel	Visual Control Panel Alarm	Auto Dialer Notification	Local Alarm	Starts PLC Timer Interlock	Influent Pumps (D4-1 & 2) Shutdown	Lime Feed System Shutdown
DEVICE ID	**NAME**	**SET POINT**	***TIME DELAY***	***TYPE***	***DESCRIPTION***	**DISPLAY**	**ACTIVATE**	**ACTIVATE**	**DISPLAY**	**ACTIVATE**	**ACTIVATE**	**ACTIVATE**
LT-BRW-7009	DB-BRW-1 Drying Bed Level (shown on screen as elevation); Alarms on HIGH	5,445 FT	*10-min*	*PLC*	*Measurement < 3-FT or < 4.5-FT*	X	X					
ZSO-BRW-7011	GV-BRW-7011 State displayed on HMI	CLOSED	~	*PLC*	*CLOSED Status = 0*	X	X					
ZSO-BRW-7012	GV-BRW-7012 State displayed on HMI	CLOSED	~	*PLC*	*CLOSED Status = 0*	X	X					
LT-BRW-7013	DB-BRW-2 Drying Bed Level (shown on screen as elevation); Alarms on HIGH	5445 FT	*10-min*	*PLC*	*Measurement < 3-FT or < 4.5-FT*	X	X					
LT-BRW-7015	DB-BRW-3 Drying Bed Level (shown on screen as elevation); Alarms on HIGH	5445 FT	*10-min*	*PLC*	*Measurement < 3-FT or < 4.5-FT*	X	X					
ZA-BRW-7017	Detects power surge at BRW; Alarms on surge	FAULT	~	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X					
ZA-BRW-7018	Monitors power at BRW; Alarms on loss of power	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				
ZA-BRW-7019	Detects communication failure at BRW; Alarms on loss of communication	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				
ZSO-LAO-7019	GV-LAO-7019 State; Alarms when OPEN	OPEN	~	*PLC*	*OPEN Status = 0*	X	X					
ZA-BRW-7030	Detects power surge at Drying Beds; Alarms on surge	FAULT	~	*PLC*	*FAULT Status = 0, NORMAL Status = 1*							
ZA-BRW-7031	Monitors power at Drying Beds; Alarms on loss of power	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*							
ZA-BRW-7032	Detects communication failure at Drying Beds; Alarms on loss of communication	FAULT	*3-min*	*PLC*	*FAULT Status = 0, NORMAL Status = 1*	X	X	X				

4.3.2 Control Settings Description

The sections below outline the electrical and control requirements to operate the lime treatment equipment, and list the variables required to operate the equipment under certain conditions:

- Conditions required for the equipment item to operate automatically.
- Conditions required for the equipment item to start locally.
- Conditions under which the equipment item will automatically stop operation.

4.3.2.1 Auto Operation

AUTO operation is the routine mode of control and allows PLC control of monitoring devices, interlocks, and automatic shutdown capabilities. Auto operation also allows equipment to be started remotely from the HMI in the Operations Building when the conditions listed below are satisfied.
Motors must still be started by depressing the Start or On function of the respective device or via the HMI controller.

1. Influent Sample Pump Sampling:

   a. The influent automatic sampler located in the CAS Building will sample the flow automatically when all the conditions listed below are satisfied; however, the operator must also locally configure the sampler:

      – Breaker is not tripped.
      – The ON/OFF key is in ON position.
      – The programmed sampling start time is set appropriately (initially set at 08:00 a.m.).
      – The START button is depressed.
      – The sampling pump is operating properly.

2. Effluent Sample Pump Sampling:

   a. The effluent automatic sampler will sample the flow automatically when all the following conditions are satisfied; however, the operator must also locally configure the sampler:

      – Breaker is not tripped.
      – The ON/OFF key is in ON position.
      – The programmed sampling start time is set appropriately (initially set at 08:00 a.m.).
      – The START button is depressed.
      – The sampling pump is operating properly.

3. Lime Feeder:

   a. Lime addition is provided automatically when the feeder switch is in Gravimetric mode and when all associated components are configured appropriately as described below:

      – The lime feeder switch on the OP1 feeder control is in Gravimetric position.
      – The dosage (mg/L) is set as provided in Table 3 (on page 32) and indicated on the screen display.

   b. The MCC in the CAS Building must be configured as described below:

      – The AccuRate feeder motor control switch is set to ON.
      – The AccuRate paddle motor control switch is set to ON.
      – The Mixer motor control switch is set to AUTO.
      – The screw conveyor motor control switch is set to AUTO, and the screw conveyor is operating.
      – The Silo Vibrator motor control switch is set to AUTO.

   c. Refer to BTL-SOP-03 Gravimetric Lime Addition System Startup in Appendix C for complete lime addition operating instructions and control HMI configuration.

4.3.2.2 Local Start Control

The following describes settings to start devices locally, without remote start functionality at the HMI.

1. Lime Feeder:

   a. The lime feed system will operate manually (without PLC control) when **all** the following conditions exist.

      – The OP1 feeder control switch is in Volumetric (Manual) position.
      – The Silo Vibrator motor control switch on the MCC is in Auto.
      – The AccuRate feeder motor control switch is set to ON.
      – The AccuRate paddle motor control switch is set to ON.

   b. While the lime feed system is operating in Volumetric mode, the Bin Discharge cycle is set to run for 30 seconds and then stop for 20 minutes before starting again.

2. Screw Conveyor:

   a. The screw conveyor will start manually when **all** the following conditions exist:

      – Local panel control switch is in HAND position.
      – Breaker switch is not tripped.

   b. The screw conveyor will start remotely when **all** the following conditions exist:

      – Local panel control switch is in AUTO position.
      – Auto Start button on the Local panel is depressed.
      – Breaker switch is not tripped.
      – Main silo control panel and interlocked/associated equipment is in correct state (running or stopped, dependent on piece of equipment).
      – IPS delivers influent flow is operable.

   C. The routine setting for the screw conveyor is when the local panel control switch is in AUTO position. The screw conveyor will run continuously.

3. Slurry Tank Mixers:

   a. Each of the slurry mixers will run when **all** the following conditions exist:

      – MCC switch is in HAND or AUTO if operating in "Gravimetric" mode.
      – Breaker switch is not tripped.

Or

MCC switch is in AUTO if operating in "Gravimetric" mode.

– Slurry level is detected within the specified range (12-inch minimum, 45-inch maximum).
– Breaker switch is not tripped

   b. The slurry mixers will not run when **any** of the following conditions exist:

      – MCC switch is in OFF position.
      – Breaker switch is tripped.
      – Slurry level is outside the specified range (below 12 inches or above 45 inches).
      – Lime feed system interlocks are operable and have cascaded system shutdown.
      – CAS Emergency Stop Switch is activated.

   c. The routine setting for each slurry mixer is to run continuously.

4.3.2.3 Automatic Shutdown

Programmed logic ensures untreated influent is not discharged from the CAS into the Lagoon system for prolonged periods of time. Lime feed equipment **must be operational** while water is pumped from the IPS to the CAS Building. The following scenarios provide a summary of the PLC logic in place and resulting equipment shutdown at the CAS and IPS.

1. The AccuRate feeder will **stop** under **any** of the following conditions:

   - MCC HOA switch is in OFF position.
   - Breaker switch is tripped.
   - Loss of flow from IPS, influent flow transmitter records "no flow" for a period longer than 10 minutes.
   - Loss of screw conveyor delivery system.
   - Lime slurry tank(s) low level.
   - CAS Emergency Stop Switch is activated.

2. The Influent Pumps will **stop** under **any** of the following **conditions**:

   - Variable frequency drives (VFD) HOA switch is in the OFF position.
   - Loss of screw conveyor delivery system.
   - Lime slurry tank(s) low level; tank level less than 12 inches.
   - CAS Emergency Stop Switch is activated.
   - IPS Vault level low.
   - High pressure at the pump discharge.
     a. Pump #1 pressure switch HIGH will shut down Pump #1.
     b. Pump #2 pressure switch HIGH will shut down Pump #2.
   - Pump #1 or Pump #2 Emergency Shutdown Switch (ESS) is activated.

Any condition described above initiates a PLC-based, 10-minute timer, and an alarm of the associated device condition. If the condition status remains unchanged after 10 minutes, program logic stops operation of the remaining systems listed above and associated devices. Alarm callout provides notification of the shutdown status.

3. The screw conveyor will stop when **any** of the following conditions exist:

   - MCC HOA switch is in OFF position.
   - Breaker switch is tripped.
   - Interlocked/associated lime feed system equipment is shutdown.
   - Influent pump stops operating.
   - CAS Emergency Stop Switch is activated.

4.4 Routine System Start-Up of Interlocked Systems

Whether the IPS starts up depends on the CAS system status. If the CAS slurry equipment is off-line for longer than 10 minutes, the IPS enters auto-shutdown status. Under routine start-up, operators should verify valve alignments are completed according to the system valve alignment reference tables provided in Appendix F and verified according to associated P&IDs (Appendix E.1) to ensure the desired flow routing. On verification of valve alignments, an operator can start the system in the following order:

1. Compressed air system;
2. IPS; then
3. Lime feed system.

Operators complete routine start-up tasks at the HMI in the Operations Building with system components operating in AUTO mode when possible. Then, operators visually verify that the system is operating correctly.

4.4.1 Influent Pump Station Start-Up

Each pump control panel contains a HOA switch that controls the operational mode of each pump. The IPS pumps can be operated in two different configurations (Manual or Automatic). Refer to BTL-SOP-03 Gravimetric Lime Addition System Startup in Appendix C for the procedures to start pumps in either configuration. The pumps do not operate when the switch is in the OFF position. (The photograph to the right shows a VFD panel.)

Operators can remotely start the pump from the HMI located in the Operations Building. While operating in AUTO mode, pump speed is automatically controlled to maintain vault level set point. Low level and high pressure PLC interlocks provide automatic shutdown capabilities to protect pumps from operational damage. Automatic system alarm callouts notify operators of upset conditions. Detailed instructions are in BTL-SOP-06 Influent Pump Station Startup/Shutdown (Appendix C).

Photograph 9. IPS VFD Panel

4.4.2 Chemical Addition System Start-Up

Prior to starting the CAS and lime feed systems, the IPS must be operational and influent water must be flowing through the CAS Building. Proper CAS start-up requires multiple procedures, the specific start-up procedures are provided in the following SOPs SOP-BTL-03 Gravimetric Lime Addition System Startup, SOP-BTL-06 Influent Pump Station Startup/Shutdown, SOP-

BTL-07 Slurry Tank Feed Water Re-Establishment, and BTL-SOP-28 Volumetric Lime Addition Startup located in Appendix C.

Prior to initiating any start-up procedures, place motor controls on the MCC as described in Section 4.3.2.1 previously. The following motors must be placed in AUTO mode:

- Slurry tank mixers 1&2.
- Silo shaker.
- Silo screw conveyor.

The AccuRate feeder and paddle must be placed in the ON position on the MCC. Speed control of these devices is achieved within the proprietary programming of the AccuRate feeder control system. Refer to the following SOPs (provided in Appendix C) for detailed instructions to start-up the system.

1. Re-establish lime slurry feed water as described in BTL-SOP-07.
2. Ensure lime addition is added to the lime slurry tanks as described in BTL-SOP-03.
3. Energize the lime slurry tank mixers when the tank liquid level is above the low-level shutdown set point in the slurry tank by depressing the start button of the associated tank/mixer on the MCC.

Note: Operating the mixer below the minimum level will result in damage to the mixer impeller or shaft. A low-level shutdown set point is included in the system programming. Mixers automatically shut down if liquid level in the tank is less than 12 inches.

After approximately 20 minutes following initial start-up of the influent and lime addition systems, manually verify that channel pH is within normal operating limits provided in Table 3 (on page 32). Adjustments to lime feed must be made if pH is not within normal operating limits. Troubleshooting decision tree guides (BTL-DT-1, -5, and -6) are provided in Appendix F.

4.5 Normal Shutdown

Under normal operating conditions, the CAS system will remain operating. From the HMI, operators can manually shutdown the lime feed system and/or CAS components. Programmed logic will automatically complete the shutdown of associated components.

4.6 Routine Maintenance of On-Site Systems

Periodic routine maintenance is required to maintain system operations. Operators should complete routine maintenance activities as needed and as part of normal work functions. The following sections describe routine maintenance tasks.

4.6.1 Routine Maintenance of Sampling Equipment

Sampling equipment must be routinely maintained to provide accurate measurements. The pH meters must be calibrated daily according to manufacturer instructions and as described in BTL-SOP-36 (Appendix C). Automatic samplers (influent and effluent) located in the CAS and ASB must be cleaned monthly as described in BTL-SOP-17 ISCO Automatic Composite Water Sampling Procedure (Appendix C).

4.6.2 Routine Maintenance of CAS Building

Routine maintenance of the CAS Building and associated components is required to ensure the building is kept clean, lime dust accumulations are minimized, and ancillary components are functional. Daily tasks include visual inspection of lime feed components and confirmation of lime level in the lime silo. Lime slurry components require daily inspection and frequent periodic cleaning, depending on accumulations. The SOPs in Appendix C, specifically BTL-SOP-10 "Cleaning Screw Conveyor" and BTL-SOP-19 "Slurry Tank & Discharge Pipe Cleaning", provide additional information. The compressed air lines should be blown down daily at low points in the system to ensure moisture entrained in the airstream cannot accumulate in the line. Monthly maintenance activities include cleaning ISCO auto-samplers, replacing pH buffer solution, inspecting/replacing air dryer desiccant, inspecting/replacing lime silo baghouse filter cartridges, and inspecting/replacing/surface cleaning building heaters and motor enclosures. Additional duties include periodically washing the CAS Building floor to remove lime dust accumulations.

Annual maintenance tasks include removing sludge precipitate materials from the bottom of the Distribution Tank and channels. Removing the sludge from the Distribution Tank can be completed after treatment operation is suspended temporarily and the Distribution Tank is drained. Material can be removed from the floor of the tank using a vacuum truck. Material accumulations within the channels should be flushed downstream to the primary lagoon cells using either pressure washing equipment or manually with a square–type shovel.

4.6.3 Routine Maintenance of Influent Pump Station

Operational maintenance of the IPS inlet screens (BTL-SOP-22 IPS Intake Screen Cleaning) is necessary to prevent large diameter solids from passing through or to prevent the inlet screens clogging from debris accumulation. Either condition could lead to decreased pump performance or impeller damage. Operators must periodically clean the screens using a plastic toothed rake. The rake must be manually lowered to the screen and raked vertically against the screens, across the entire width of the screen to remove accumulations of solids. The IPS inlet screens must be kept clean to ensure flow is not impeded to the pump inlet vault. Operators can use the wall-mounted, articulated jib crane to remove the screens to clean more thoroughly as necessary (BTL-SOP-22 IPS Intake Screen Cleaning) (Appendix C).

4.6.4 Sludge Management

The lime addition and metals precipitation processes produce sludge in cells A1, B1, and C1, and the sludge must be periodically removed. To remove the sludge, operators use a remotely operated dredge to remove the sediment from the floor of each primary cell and pump it to a drying bed area located within the BRW area as described in Section 2.4.2. Operators complete dredging operations up to three times per calendar year, usually in **early spring** (immediately after ice cover recedes from lagoons), approximately late March to early April, and **late fall** (prior to ice cover on the lagoons), approximately mid-October to early November, or as system performance requires. An additional, optional dredging event may be needed near **mid-summer** (at the discretion of operators), approximately mid-July if an early spring event was previously completed. Each complete dredging event takes approximately 30 - 40 days to complete. Dredged material is discharged into one of the drying bed cells to reduce water content, decrease volume, and allow the material to be removed using conventional earth-moving equipment. Free water is decanted over stop logs at the discharge end of each drying bed. Table 5 lists the drying bed cell operating elevations.

In addition, precipitate must be periodically removed from the HCC and D4 Cell. Precipitate removal from the HCC is performed as described in the 2016 internal HCC Sediment Removal and Maintenance Plan document. Sediment and precipitate removal from the D4 Cell will be performed using the sludge removal dredge similar to the process described above.

Table 5. Drying Bed Cell Operating Elevations.

Drying Beds	Normal Operating Elevation (amsl)	Datum
Cell 1	5,443.00 - 5,438.00	NAVD 88
Cell 2	5,443.75 - 5,438.75	NAVD 88
Cell 3	5,443.75 - 5,438.75	NAVD 88

amsl: above mean sea level. NAVD: North American Vertical Datum.

Additional dewatering is achieved via drainage through the porous, unlined drying bed floor and evaporation. Sufficiently dewatered solids must be removed from drying beds and hauled to the Mine Waste Repository after drying sufficiently to be handled by mechanical earthmoving equipment.

4.6.4.1 Drying Bed Floor Survey and Grading

The drying bed floor elevation should be surveyed annually to ensure excessive material was not removed from the drying bed floor during sludge removal operations. Cell floor elevations should not be lowered more than 6 inches below original construction elevation listed in Table 6. Additional floor bedding material must be placed and compacted to original design elevation and compaction specifications if the survey indicates the elevation is below recommended minimum elevation.

Table 6. Drying Bed Cell Floor Elevations.

Floor Elevation	5,442.25 - 5,438.25	NAVD 88
Minimum Floor Elevation	5,441.75 - 5,437.75	NAVD 88

Note: Each drying bed cell is sloped at 1% from the east end down to the west end at the outlet structure wall. Backfill floor to original construction elevation.
NAVD: North American Vertical Datum.

4.6.5 Site Vegetation Maintenance

All vegetation within LAO and associated remote sites must be routinely maintained throughout the year. Site weed inspections and surveys will be conducted to evaluate the need for removal and spraying to eradicate undesirable and noxious weeds. Trained, competent personnel (from a subcontractor) complete all weed spraying activities.

4.6.6 Site Access Maintenance

Periodic site access maintenance is required to ensure efficient and unobstructed access to the equipment associated with the BTL. Operators will complete the following site access maintenance tasks:

1. Spring, summer, and fall maintenance will consist of periodic road grading along the main entrance road to the CAS Building, the ASB, and the IPS at the southwest corner of Cell D4. General grading of the access routes will occur following large storm events or snowmelt events.

2. Winter maintenance will consist mainly of plowing and removing snow to provide access to site locations and buildings. Access must be maintained to the Operations and CAS Building, LAO parking area, lime silo, IPS, FCD, cross dikes, West Camp entrance, and BPSOU subdrain control building. Access to the BRW area may be required periodically.

4.7 Routine Maintenance of Off-Site Stations

Off-site pumping stations require periodic maintenance activities specific to each system. These activities are briefly discussed below.

4.7.1 West Camp Pump Station

Operators must check the WCP-1 pump routinely twice per week as described in BTL-SOP-04 West Camp Arrival (Appendix C). In addition to site verification tasks described in Section 4.1.4, operators must complete additional weekly, monthly, quarterly, and semi-annual maintenance tasks described below.

4.7.1.1 Weekly Maintenance

In addition to verifying that the system is functioning, operators must inspect the site generator weekly. This can be completed during routine site visits. Operators must inspect the generator systems; check and record fluid levels, hoses, and cables; and record hour meter readings. Hour meter readings should be compared to previous readings to verify that auto-start events occur weekly as described in BTL-SOP-09 Generator Inspections (Appendix C).

4.7.1.2 Quarterly Maintenance

Quarterly maintenance tasks include manual water level measurements. Operators compare actual measurements to water level indications displayed on the HMI. Operators measure, record, and complete the report form (Appendix D) to provide proof of verification tasks. The hydrogen sulfide (H_2S) meter located within the WCP-1 building must be calibrated quarterly according to the instructions listed in BTL-SOP-41 West Camp H2S Meter Calibration (Appendix C).

4.7.1.3 Semi-Annual Maintenance

To perform preventative maintenance on the building exhaust fan and heater, remove dust and debris accumulations from the fan and heater.

4.7.2 BPSOU Subdrain

Operators must check the subdrain pump system daily to verify that systems are operating normally and conditions of the equipment and water level in the wet vault are within normal ranges as described in BTL-SOP-05A LAO BPSOU Subdrain Operations Check Procedures (Appendix C). Operators must also complete weekly, monthly, and semi-annual maintenance tasks. Periodic routine maintenance activities of the BPSOU subdrain system include the following (SOPs are in Appendix C):

- Subdrain jetting (semi-annually) tasks are described in BTL-SOP-20 Subdrain Jetting.
- Discharge line pigging (semi-annually) tasks are described in BTL-SOP-21 Subdrain Pigging.
- Routine site and building maintenance (weekly) tasks are described in BTL-SOP-05A LAO SBPSOU Subdrain Operations Check Procedures.

The subdrain pumps are scheduled to cycle automatically from primary to secondary pump. Routine maintenance tasks should be completed as needed. A spare, replacement-in-kind pump is located in the dredge storage building, and it should be installed when major failure or maintenance is required on an in-service pump.

4.7.2.1 Weekly Maintenance

In addition to verifying system operation, operators must inspect the site generator weekly, usually during the routine site visits. Operators will inspect the generator systems, check, and record fluid levels, check the hoses and cables, and record hour meter readings. Hour meter readings should be compared to previous readings to verify that auto-start events occur weekly as described in BTL-SOP-09 Generator Inspection (Appendix C).

4.7.2.2 Semi-Annual Maintenance - Subdrain Jetting

As previously described, the BPSOU subdrain system allows groundwater to be conveyed by the subdrain to the wet vault. Jetting the BPSOU subdrain system (BTL-SOP-20) removes precipitate build-up from the subdrain piping and perforations along the pipe (Appendix C). Routine removal of the precipitates from the subdrain features ensures the subdrain can operate efficiently and reliably. Subdrain jetting effectiveness is verified through a Loading Study Data Summary Report included in the annual OM&M report.

The subdrain jetting is typically performed twice per calendar year. One jetting event is conducted in March/April to prepare the subdrain for ground thaw and runoff flow conditions. Another event is conducted prior to freezing and ground frost, typically around October /

November. A local contractor with high pressure jetting capabilities is typically used to complete this work.

Note: The wet vault level should be monitored during jetting operations to ensure that the subdrain pump systems maintain water levels and vault capacity is not exceeded. Jetting operations may be suspended as needed to lower wet vault levels as necessary to maintain operations.

4.7.2.3 Semi-Annual Maintenance - BPSOU Subdrain Discharge Pipe Pigging

The subdrain discharge pipe, which extends from the dry vault to the HCC discharge at BRW, must be swabbed/pigged to remove precipitates from the interior surface of the pipe. Cleaning frequencies generally coincide with the subdrain jetting described above, but they can be increased based on pressure and flow characteristics of the subdrain pumps. If pumping pressure increases, while flow decreases, the discharge pipe requires cleaning. Routine pigging events are completed in March/April and October/November as required to meet operating requirements.

To clean the pipe, operators launch either a cleaning swab, or a more aggressive pipe pig, from the subdrain pumping station. Pump pressure moves the swab through the pipe and discharges the accumulations into the HCC. The swab removes precipitate accumulations from the interior surface of the pipe. Refer to BTL-SOP-21 (Appendix C) for specific instructions to perform line pigging and required valve alignments. Flows from jetting and pigging activities are directed to the north drying bed as described in Section 2.1.8.

Periodically, video inspections may be conducted to confirm integrity of the subdrain. Video inspections will be performed by a third-party and recorded for evaluation. The video inspection will be coordinated and completed following jetting activities. A summary of the video inspection will be included at a minimum in the Annual O&M report, and in the quarterly report(s) if noteworthy video inspection observations or non-routine maintenance recommendation are identified.

4.7.2.4 BPSOU Subdrain Pump System Building Maintenance

Each quarter, preventative maintenance must be performed on the building exhaust fan and heater to remove dust and debris accumulations from the fan and heater.

4.7.2.5 BPSOU Subdrain Monitoring and Maintenance

Information from the flow meter dataloggers installed in the subdrain manholes (MH-MSD106, -108, -110, 113, and -116) must be downloaded monthly and minor maintenance tasks such as replacement of batteries and desiccant completed as needed. Flow meters must be removed prior to subdrain jetting, discussed in section 4.7.2.2, and re-installed after jetting is complete. Specific task requirements are provided in BTL-SOP-08 BPSOU Subdrain Flowmeter Download (Appendix C).

The subdrain is sampled semi-annually and the activities coordinated with low flow and high flow groundwater periods and subdrain jetting events. The low-flow monitoring event is performed in October / November each year, and the high flow event is performed in March / April. These monitoring and sampling events are coordinated with the jetting and pigging events, described previously, by the BTL Lead Operator.

4.8 Emergency Generators

Emergency generators are installed at the CAS Building, IPS, West Camp, and subdrain pump station. In addition to the weekly routine general maintenance checks, operators must annually inspect the emergency generators. Annual maintenance is typically performed by an authorized service representative. Annual maintenance includes comprehensive checking of all components and systems not limited to the following: battery test, all fluid levels and quality, and all hoses, cables, and connections. Detailed instructions are in BTL-SOP-09 Generator Inspection (Appendix C).

5.0 NON-ROUTINE OPERATION

As previously discussed, systems can be operated in Manual mode. Manual (HAND) mode is a non-routine operating condition. Manual mode disables all PLC-based interlock controls. Devices operate in a non-controlled status. Pumps are not controlled based on level transmitter input signal. Pump VFD speed must be set by the operator to maintain a constant speed, and therefore constant flowrate. Remote start/stop capabilities are disabled in Manual mode. All operating adjustments must be made locally by operators. Condition-based interlocks and cascaded shutdowns are not functional in Manual mode. System status is displayed locally and at the HMI stations.

5.1 Influent Pump Station

Influent pumps operated in Manual mode require the operator to set the pump speed on the VFD panel and verify flow at the local flow meter readout on the IPS wall. Pump speed is set to supply a constant rate to the CAS Building. Level control and high pressure shutdown features are disabled. Local activation of the ESS deactivates pumping capabilities, but a cascaded shutdown of the lime addition equipment is disabled.

5.2 Chemical Addition System

While operating in Manual mode, lime addition is completed in Volumetric mode, which delivers lime based on the rpm of the feeder. The rpm must be set by the operator based on influent flow rate. Volumetric lime addition does not vary with changes in influent flow. A manual timer controls the shaker ON/OFF function. The knife gate located at the bottom of the lime silo is manually placed in the OPEN position and remains OPEN while operating in Volumetric mode.

Automatic shutdown interlocks are disabled when the lime feed system is operated in Volumetric mode; therefore, upset conditions to the lime feed system do not result in an automatic shutdown of the IPS. Operators must respond to alarm callout notifications at the site and perform manual shutdown of systems as required. Operators should perform additional visual monitoring and pH measurements when Volumetric mode is used. Local activation of the ESS deactivates lime addition equipment, but cascaded shutdown of the influent pumping components is not activated.

A post-lime addition pH reading, at station INDC, outside of these routine ranges would indicate to the operator that an adjustment to the lime addition is necessary. If Channel pH is out of routine operating limits for a period exceeding 6 hours, adjustments to lime addition should be implemented (refer to Section 6.1). At routine influent flow rates, lime addition adjustments can be made in increments of 5 mg/L in the appropriate direction (addition or reduction), and Channel, Lagoon Cell, and effluent pH monitored over a 24-hour period. Additional adjustments may be made until Channel pH is within routine operating limits. Additionally, the carbon dioxide addition system, described in 6.6, can be activated to reduce elevated pH prior to discharge.

6.0 OPERATION DURING DISTURBANCES

This section addresses operational responses to upset conditions that might develop during operation of the BTL systems. Automatic alarm callouts notify operators when conditions are out of specified operating parameters. Timely response and corrective action to critical alarms should prevent long-term disturbances.

Appendix F contains decision trees (BTL-DT-1, -3, -5, and -6) that list suggested actions for various upset conditions. Typical conditions that must be investigated during operation upsets include the following:

- High or low pH.
- Impacts of WCP-1 and BPSOU subdrain influent water quality and quantity.
- Lack of lime treatment.
- Lack of influent flow.
- High or low lagoon water levels.

The rest of this section describes other common disturbances and remedy aids.

6.1 Lime Feed System Disturbances

Lime feed system disturbances stop the addition of lime to the influent flow. Disturbances can be attributed to CAS Building electrical service loss, AccuRate feeder failure, screw conveyor failure, lime blockage, running out of lime in the silo, slurry tank feed water flow failure, and loss of flow from the IPS.

System disturbances that result in water being discharged without adequate treatment must be addressed and corrected relative to the length of time treatment has been disrupted. The following stages provide response guidance based the duration of treatment disturbances. Refer to the decision tree BTL-DT-5 in Appendix F to help make process-based decisions to ensure effluent meets discharge standards during non-routine conditions.

The three stages and the corresponding operator responses are listed below from minimal to significant. These stages provide response guidance based on the length of time treatment has been affected. System redundancy along with auto alarm callout and operator response and acknowledgement should alleviate disturbances greater than 6 hours in most cases.

- **Stage 1** (0 to 6 hours): A disturbance of 0 to 6 hours will require no changes to the lime feed system. After the cause of the lime feed disturbance is determined and routine conditions are re-established, treatment system and sample results must be monitored.
- **Stage 2** (6 to 12 hours): A disturbance of 6 to 12 hours will require an increase in monitoring in the lagoon pH and possible recirculation of potentially undertreated water through the system if a decrease in lagoon pH is detected. After the cause of the lime feed disturbance is determined and routine conditions are re-established, lime feed rate (dosage) should be increased relative to the total volume of untreated water passed through the system.
- **Stage 3** (greater than 12 hours): A disturbance greater than 12 hours resulting from a catastrophic failure event will require an increase in monitoring similar to a Stage 2 disturbance, and the treatment system flows will be changed according to operator parameters. Recirculation of potentially undertreated water may also be required as described in Section 6.1.6. Standard operating procedures provided in Appendix C summarize recovery of inadequate or zero lime addition. System alarm callouts are in place to prevent this type of scenario. Additional guidance for contingency operations is provided in Appendix B and Appendix F. A disturbance should be considered an upset condition and notifications provided as described in Section 1.5.3.

6.1.1 Lime Feed System Disturbance Remedy

The back-up lime feed system is intended to address lime feed disturbances if the operator anticipates that the primary lime feed systems (silo, bin discharge, feeder, conveyor, slurry tanks, sluice box) will be out of service for an extended period. This system is modular and must be relocated from the DSB to the concrete apron east of the CAS Building prior to operation as described in BTL-SOP-15 Super Sax Redundant Lime Feed System Start-up/Shutdown (Appendix C). Bulk lime is stored in supersacks and must be hoisted into position to fill the feeder with lime.

6.1.2 Lime Feed Mechanical Failure

Disruptions to the lime feeder system could include malfunctions with the AccuRate feeder, screw conveyor, massage paddles, or bin discharge. Refer to standard procedures detailed in BTL-SOP-03 (Appendix C) to determine and correct the disturbance. Decision tree BTL-DT-5 and BTL-DT-6 are available in Appendix F to assist in system troubleshooting efforts.

6.1.3 Slurry Tank Feed Water Interruption

A portion of the influent flow is discharged into both slurry tanks where the lime addition occurs. If interruption of the slurry tank feed water occurs, lime addition interruption to the treatment system will also occur and the flow must be re-established as described in BTL-SOP-07 (Appendix C).

6.1.4 No Lime Discharged from the Silo

Disruption of lime from the silo to the AccuRate feeder hopper can result from several issues. Decision trees BTL-DT-5 and BTL-DT-6, located in Appendix F, provide troubleshooting guidance to correct no lime discharged from the silo. Lime bridging in the cone section of the silo is also common. A bin discharge motor was installed to run automatically to prevent lime bridging. It can also be run manually to dislodge the lime bridge. If the Yo-Yo meter indicates lime level is sufficient but no lime is discharged investigate the silo vibrator function.

6.1.5 Troubleshooting Lime Feed

To troubleshoot the lime feed system, evaluate the lime feed trend line on the OP1 screen. An erratic trend line (jumps up and down sharply) indicates that the feeder has lost its calibration point and it must be re-calibrated. Refer to BTL-SOP-35 to recalibrate the lime feeder (Appendix C). Refer to decision tree BTL-DT-5 (in Appendix F) to assist in identifying problems with the lime feed system.

****When the lime feed is re-calibrated, the operators must monitor several loading cycles to verify load rates are accurate.****

6.1.6 Recirculation of Under-Treated Water

A pH measurement 8.9 su or below obtained from A2, B3, or C3 is indicative of inadequate lime addition, and re-circulation is appropriate to meet surface water discharge requirements listed in Table 1. If it is necessary to re-circulate treated water in the BTL lagoons due to inadequate lime addition (Stage 2 or Stage 3 disturbance described in 6.1), recirculation through the system is possible for retreatment. The decision tree BTL-DT-8 (in Appendix F) provides recirculation guidance. The B lagoons can be discharged from Cell B3 to Cell A2. The combined flows of the A and B lagoons can be diverted from Cell A3 to Cell D4 for recirculation through the IPS. The C lagoons can be discharged from Cell C3 to D2 for recirculation. Flow diverted to Cell D2 continues to Cell D3, and then into Cell D4 for recirculation through the IPS.

6.1.7 Increased Retention Time of Treated Water

If it is necessary to increase retention time of treated water in the BTL lagoons to allow additional pH buffering, flow can be routed through the lagoon system as described below.

The B lagoons can be discharged from Cell B3 to Cell A2. To increase overall retention time of the lagoons, the combined flows of A lagoons and B lagoons can discharge from Cell A3 to the effluent discharge. The C lagoons can also be discharged from Cell C3 to A2 for increased retention time. Because the D lagoon cells are used primarily as groundwater interception areas, these cells are not used for pH buffering or increased retention times. As described above, Cell D3 is used as a recirculation bypass to Cell D4 for water discharged from Cell D2.

6.2 Influent Flow Disturbance

An influent flow disturbance prevents the water from flowing through the treatment process and into the treatment cells. Disturbances in the influent flow can be attributed to IPS electrical service loss, pump failure, pipeline malfunction, valve malfunction, and pump intake screen failure. Cell D4 can store water for a flow disturbance **until water crests the sheet pile termination wall at an elevation of 5,421.4 (NAVD 88) feet amsl**.

6.2.1 Influent Pump Station Pump Failure

Pump failure can include, but is not limited to, pump shaft seal failure, impeller failure, and pump control failure. If one pump fails, the redundant pump will operate. If both pumps shutdown (or are shut down), Cell D4 can store water for a short period of time but must resume operation as soon as possible. Refer to Appendix B for additional information and guidance on contingency operations.

6.2.2 Influent Flow Disturbance Remedy

Influent flow can be reduced temporarily to alleviate pumping requirements at the IPS. In this case, the WCP-1 should be shutdown to reduce the influent flow until the IPS is restored and functioning normally, and BRW stop logs should be installed to mitigate influent from BRW to the HCC. The subdrain has a very short retention capacity; therefore, it should remain operating. More in-depth guidance and retention time is available in the BTL Water Management Contingency Operations Plan (Appendix B).

6.3 Monitoring Equipment Disturbance

Common disturbances to non-treatment systems are discussed below. Back-up systems are in place to alleviate short-term disturbances.

6.3.1 Electrical Service Loss to Chemical Addition System Building

A Universal Power Supply (UPS) provides uninterrupted electrical services for approximately 15 minutes to the PLC and associated equipment. The alarm callout system will begin notifying the operator of the electrical service loss. The CAS Building generator is also equipped with an on-site generator and auto-transfer switch to supply generator power as required. The auto-transfer switch ensures back-up power is supplied immediately without disruption to the treatment system.

6.3.2 Remote Monitoring Station Failure

A signal loss from one of the remote stations may be caused by a radio failure or an electrical service loss at one or more of the stations. A malfunction with the radios will cause a disruption with the transfer of data from the monitoring equipment to the monitoring system and initiate the alarm callout; however, treatment will not be affected. The system will continue to operate on the last value received. Operators should investigate the cause of the disturbance and may need to increase visual field monitoring intervals until the disruption is corrected.

6.4 Off-Site Disturbances

The following sections provide common disturbances to remote stations not located within the BTL-LAO area.

6.4.1 West Camp and BPSOU Subdrain Pump Station Electrical Service Loss

In the event of an electrical service loss to the WCP-1 or subdrain pump system, electrical supply will resume with the automatic transfer of power provided by the on-site emergency back-up generator. Automated alarm callouts notify operators of the disturbance. The operator must visually verify that WCP-1 or subdrain pumping system returns to routine operating conditions.

6.5 Seasonal Water Management

Seasonal high flows may require contingency water management and water routing similar to addressing influent flow disturbance as discussed in Section 6.2. Detailed guidance and retention time are listed in the BTL Water Management Contingency Operations Plan (Appendix B). During periods of high surface flows or extended precipitation events, implement one or more of the following to reduce influent source flow to D4.

1. Cease WCP-1 pumping operations. Pumping operation at WCP-1 can remain off until water level at BMF-96 1D reaches 5,430 amsl. The time to reach this elevation depends on the water level when pumping was stopped and the re-charge rate. However, time to reach the specified elevation is typically approximately 10 days under routine conditions.
2. Add stop logs to cease discharge from BRW-01 West to the HCC and retain BRW flows within BRW open areas.
3. Temporarily route subdrain discharge to BRW-00 (add stop logs as needed), or north drying bed.
4. Increase storage capacity by increasing the operational level of D4 **until water approaches the sheet pile at an elevation of 5,421.4 feet amsl (NAVD 88). Cell D4 elevation cannot be allowed to exceed 5,421.4 feet amsl (NAVD 88).**

The above mitigations allow influent flows to be reduced from approximately 1,200 gpm to approximately 300 gpm under routine conditions.

6.6 Carbon Dioxide Addition

Carbon dioxide (CO_2) addition is used to maintain effluent pH below 9.5 su prior to effluent discharge to Silver Bow Creek. Carbon dioxide is routinely used during freezing conditions but may be used at any time to reduce effluent pH. Implementing the carbon dioxide addition system allows effluent pH to be reduced in the range from .10 su to .25 su. The carbon dioxide addition system is located along the north wall of the ASB and consists of one carbon dioxide storage vessel complete with regulator and distribution system, supply hosing, and gas diffusor.

Site operators routinely monitor pH discharge from Cell A2 and note any increase in pH as this may lead to elevated pH levels in Cell A3 and potential effluent discharge pH above 9.5 su at EFS-07. In addition to pH monitoring, site operators reference historic trend data to identify performance indicators (i.e., ambient temperature, lime rates, flow, seasonal similarities, etc.) as predictors for carbon dioxide addition. Site operators initiate carbon dioxide addition, immediately downstream of OS-7 at EL-D upstream of EFS-07 (Figure 1), as pH measurements begin to rise to 9.5 su to ensure effluent to Silver Bow Creek does not exceed 9.5 su. This configuration allows maximum contact and mixing time upstream of the EFS-07 while minimizing gas dispersion to atmosphere since the system is within a closed pipe until discharge to Silver Bow Creek. Refer to BTL-SOP-45 CO2 Addition System Monitoring/Inspection (Appendix C) for additional details regarding initial set-up, carbon dioxide delivery, monitoring, and reporting.

7.0 OPERATIONS REPORTING AND RECORD KEEPING

Operators will complete reports as described in this section. Daily, weekly, monthly, quarterly, and annual reporting activities are summarized below. Additional information related to data collection and reporting requirements is available in the QAPP (Appendix A).

7.1 Daily Operations Report

Daily reporting is used to inform project personnel of routine operations.

7.2 Weekly Operations Report

Weekly reporting is not a requirement but has historically been provided to regulatory agencies. As a courtesy, weekly reporting is provided as informational to effectively communicate system performance during the interim shakedown period and will be provided throughout the implementation of remedial action detailed in the BPSOU CD (EPA, 2020) and RODA (Appendix A to the BPSOU CD), after which time further distribution of the weekly report will be re-evaluated.

Weekly reporting includes completing the electronic Daily Cell Data worksheet (a Microsoft Excel format [.xls] file) and a summary report. The *BTL Weekly Operations Summary Report* provides a narrative summary of routine operations; minimum, maximum, and average flows and water level elevation at WCP-1, subdrain, influent, and effluent stations; lime usage; effluent pH; and BRW Pond elevations. The Daily Cell Data worksheet file contains daily cell data from the week being reported. Weekly reporting is typically submitted to the Liability Manager, Water Treatment, by 4:00 pm each Friday.

7.3 Monthly Operations Report

Monthly reporting will be included in the external document *BPSOU Monthly Report of Activities*. Information provided may include a summary of volumetric estimates for each pump system, lime treatment, routine operations and maintenance activities, description non-routine and/or construction activities, and upcoming relevant events.

7.4 Quarterly Operations Report

Quarterly reports will provide a summary of BTL system OM&M tasks performed over each three-month period. This summary will include monitoring, performance, operations, and training information. The quarterly report will include the following:

- Monitoring summary that describes sample collection frequency, locations, and analytes.
- System performance summary that discusses sample results that have exceeded discharge standards and/or data that were tagged with a data qualifier.
- Operation summary that provides system flows (average flow rate and totalized), water elevations, lime addition, and pH measurement.
- Inspection, maintenance, and operator training activities summary that highlights the high-level component inspections completed during the reporting period to confirm that the system operation obligations are being met.
- Conclusion section that provides a summary of system performance.
- Attachment section for additional information.

Attachments to quarterly reports will include data summary reports of final validated data packages that have undergone Stage 4 validation (described in Appendix A), discharge monitoring reports, graphical representations of analytical results for each COC listed in Table 1, graphical representations of system flows and levels, and operator training logs.

Quarterly reports are submitted for Agency review and approval according to the schedule below:

Report Submittal	Performance Period	Submittal Due Date
First Quarter	January 1 - March 31	June 30
Second Quarter	April 1 - June 30	September 30
Third Quarter	July 1 - September 30	December 30
Fourth Quarter	October 1 - December 31	March 30

7.5 Generator Runtime Reporting

Emergency generator logs are maintained and reported to comply with 40 CFR 4211. These generators may operate up to 50 hours per year in non-emergency situations, and they may be operated for maintenance and readiness testing (limited to 100 hours per year).
Runtime (hour meter) reporting and maintenance logs are submitted quarterly to verify total operating hours of each generator, and maintenance tasks are completed per manufacturer's recommendations. Generator runtime reports are typically not included in quarterly operations reports described previously.

7.6 Annual Operations Report

Annual Operations Reports will include specific operation and maintenance activities that have occurred over the previous calendar year at BTL and related systems. This report may describe activities such as a dredging and sludge removal summary, pipeline pigging, subdrain jetting, or subdrain Loading Study summary, compliance comparison summary, etc. Annual reports are described in the QAPP (Appendix A) and will be provided for Agency review by May 30 of the following year.

As necessary, supplementary data may be collected for process control and system evaluation to assist the operator to improve the treatment effectiveness or optimize the BTL systems. This data may be included in the annual operations and maintenance report as needed.

7.7 Reporting Excursions

The Lead Operator is responsible for providing notifications, as described in Section 1.5.3, of any upset conditions and excursions from discharge standards at EFS-07 (listed in Table 1) or pH greater than 9.5 su. A brief description of excursion parameters will be communicated to the Atlantic Richfield Liability Manager and Agencies. A summary of excursion details, conditions, communications, and potential findings will be reported in the weekly operations report. An excursions investigation form (Appendix D) will be initiated upon discovery of the excursion and maintained until final communication and closeout is warranted. Additional reporting and discussion will be provided in the appropriate quarterly OM&M report and summarized in the annual OM&M report.

The Lead Operator will initiate additional investigative measures and corrective actions, as appropriate, in consultation with the Atlantic Richfield Liability Manager, Water Treatment, and Agencies. Additional investigative measures may include the following.

- Review and verify sample laboratory results and associated quality assurance and quality control parameters.
- Discuss results with laboratory project manager/quality assurance manager.
- Discuss results with field personnel.
- Discuss results with Atlantic Richfield project manager.
- Request confirmation analysis from the laboratory, if necessary.

- Inspect materials and review procedures used to obtain the sample(s).
- Review historic data/parameters (previous sample results, lime addition, flow rate, etc.).

Initial findings will be communicated with the project team and Agencies. Additional follow-up investigations may be performed in consultation with the Atlantic Richfield Liability Manager, Water Treatment, and Agencies.

8.0 ROUTINE INSPECTION AND MAINTENANCE GUIDELINES

Operators complete routine inspection and maintenance activities as a component of daily system operation and maintenance. Inspection and maintenance, as described in the sections below, may be coordinated through the appropriate personnel or external resources as appropriate. Routine inspection involves an operator's use of sight, sound, and touch to identify maintenance items and implement routine remedies. System-specific maintenance tasks for the CAS, IPS, ASB, WCP-1, subdrain, and overall site are listed in the checklists provided in Appendix D. At a minimum, operators must maintain systems as provided in these checklists.

8.1 Scheduled Inspections

Routine weekly and quarterly inspections are discussed below. These inspections are visual and functional to ensure system operability is maintained.

8.1.1 Weekly Inspections

Operators should complete routine **visual inspections weekly** to ensure the equipment is operating and meets process requirements. Operators must document these inspections in the site logbook retained in the Operations Building. All routine maintenance activities must be included on the site overall checklist and site-specific checklists provided in Appendix D.

8.1.2 Quarterly Inspections

During each quarter (minimally), operators will conduct a visual inspection to check the general component integrity on each system. The intent of the inspection is to deliberately look for signs and indicators of damage, malfunction, degradation, serious corrosion, etc. that could threaten the integrity of the equipment, system housing, and system appurtenances. Detailed notes of these inspections must be recorded for each piece of equipment. Notes will include detailed descriptions of visual appearances, normal and abnormal sounds of equipment, operating parameters, and usage. Inspections will reference the appropriate site, equipment field ID number, date, and inspection personnel. Operators will record the inspection findings on the Quarterly Overview Inspection Log. Field verification of alarm set points, and monitoring equipment function should also be performed quarterly.

8.2 Equipment Maintenance

Appendix G contains a device register that lists all equipment, instruments, and valves installed in the system. Specific periodic maintenance requirements are provided by the equipment manufacturer. Manufacturer's operating manuals are maintained and stored within the CAS Building for operator reference/use. Equipment maintenance should be performed per manufacturer's recommendations, as a minimum, and if visual inspections reveal issues. Most major equipment requires very little maintenance. The screw conveyors, weir gate valves, and IPS pumps all require monthly lubrication.

8.2.1 Manual Transducer Verification

Transducer measurements must be manually verified at least quarterly by completing depth to water measurements as described in Section 3.1. Manual measurements are required to ensure transducer readings have not drifted. Adjustments or correction to transducers should be made to match depth to water measurements.

8.2.2 Instrument Calibrations

Instruments that provide functional control or monitor specific system operation must be calibrated annually to maintain device accuracy. The calibration process generally involves testing the instrument against known values and ranging the instrument to known low and high levels. The following instruments are calibrated annually at a minimum.

- Level monitoring and control devices.
- Lime feeder system.
- Hydrogen sulfide (H_2S) monitor device.

8.3 Site Maintenance

Overall site maintenance is centered on maintaining integrity of the FCD, floodplain, lagoon cells, site vegetation, and fencing/security features. This periodically includes the following:

- Vegetation inspection/weed spraying.
- Fence and gate inspection and adjustment/repair.
- Silver Bow Creek channel inspection and debris/trash removal.
- Snow removal and grading.

Treatment lagoons should be periodically inspected for dike stability, signs of erosion, and vegetation sustainability. Formal inspections should be completed in early spring when snow and ice cover is off the lagoon surface. Periodic inspections should also be performed during routine site tasks after periods of heavy precipitation events. Appendix D contains a lagoon cell inspection checklist to document formal inspections and capture follow-up action item requirements. Informal inspections can be captured on the Daily Log tab of the Daily Cell Data worksheet.

9.0 EMERGENCY PROCEDURES

This section discusses alarm conditions and response actions for each alarm.

To contact ambulance, fire, rescue, or police call 911. Provide the address as needed (below):

BTL-LAO: Provide the address 1146 Centennial Avenue, LAO, adjacent to Metro Treatment Plant. Meet response units at the front gate area and provide additional direction to direct response units to the specific location within LAO.

WCP-1: Provide the address West Camp Pumping Station 526 Centennial Avenue. Meet response units at the road entrance and provide additional direction to direct response units as needed.

BPSOU Subdrain: Provide the address of the subdrain pumping station located north of the Butte Chamber of Commerce Visitor Center, 1000 George Street. Meet response units at the road entrance and provide additional direction to direct response units as needed.

9.1 Operational Alarm Response and Notification

Alarms associated with most of the inputs monitored at the BTL were installed to notify operators immediately after an upset, malfunction, or maintenance issue occurs. The control system auto dialer provides alarm callout notification to operators when the alarm activates. The callout includes pre-programmed distinct messages to operators describing the alarm callout and location. The alarm list, shown in Table 4 (on page 45), provides description, set point, and callout priority for each system alarm. Depending on the severity of the alarm, the operator is expected to respond to an alarm situation as soon as practical. Alarms are also logged and archived on the system HMI.

9.2 Emergency Devices – Fire Extinguishers

Multiple, 5-pound ABC fire extinguishers are located near exits within the buildings at LAO in the IPS, CAS, Ops, DSB, and ASB buildings. The remote pumping stations (WCP-1 and subdrain) also have extinguishers mounted in the site buildings. The extinguishers are effective on wood, electrical, and chemical fires.

If a fire occurs, **if the main power switch can be reached safely, immediately shut off power to the site.** ***Attempt to extinguish the fire only if it is of manageable size.*** Position yourself with an exit at your back before attempting to extinguish the fire to allow a means of escape. Using the ABC fire Extinguisher located in the area, maintain a safe distance from the fire and use the P.A.S.S. (pull, aim, squeeze, and sweep) technique to extinguish the fire:

- *Pull* the pin located at the handle of the extinguisher.
- *Aim* at the base of the fire, not merely the flames.

- *Squeeze* the top handle.
- *Sweep* side to side until the fire is completely extinguished.

Remain at the site until it is certain that the fire has been completely extinguished. Secure the site as necessary and notify proper personnel.

If the fire is not of manageable size, vacate the fenced perimeter and contact the local fire department by dialing 911. If the main power switch can be reached safely, shut off power to the site prior to evacuating the site. Leave the area and wait for emergency response personnel to arrive. To evacuate the area, walk quickly, and take the most direct route to the open gate. Once outside the perimeter fence and at a safe distance from the fire, dial 911 to notify the local fire department of the fire.

9.2.1 Fire Extinguisher Inspection and Maintenance

All extinguishers must be visually inspected monthly for pressure and integrity as described in BTL-SOP-50 (Appendix C). Annual inspections and recertification must be completed once per 12-month interval by a certified fire extinguisher inspector.

9.3 System Vulnerabilities

The system may be vulnerable to unauthorized access and minor vandalism. Pumping and treatment components are located in locked and secure locations. Open lagoon cells and associated outlet structures are vulnerable to nuisance wildlife (beavers, muskrats, etc.) whose activities can impede the flow of treated water throughout the system. Operators should monitor outlet structures and associated areas to ensure treated water flows freely.

10.0 REVISIONS AND UPDATES

This document should be reviewed annually and revised as necessary when any of the following occur:

- Changes to system operating requirements.
- Updates of manufacturers' recommended practices for the system or equipment.
- Changes in operating conditions.
- New knowledge and experience of deterioration mechanisms, or other parameters that could affect the equipment integrity or reliability.
- Alterations or modification of the system or system equipment.

11.0 REFERENCES

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Atlantic Richfield Company, 2013. Final Operation, Maintenance, and Monitoring Plan for Butte Priority Soils Operable Unit Systems Control Theory Document. January 23, 2013.

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Appendix A
Butte Treatment Lagoons Groundwater Treatment System and BPSOU Subdrain Sampling and Monitoring Quality Assurance Project Plan

SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT

2022

Revised Draft Final

Butte Treatment Lagoons Groundwater Treatment System and BPSOU Subdrain Sampling and Monitoring Quality Assurance Project Plan (QAPP)

July 2022

SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT

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Revised Draft Final

Butte Treatment Lagoons Groundwater Treatment System and BPSOU Subdrain Sampling and Monitoring Quality Assurance Project Plan (QAPP)

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July 2022

APPROVAL PAGE

Butte Treatment Lagoons Groundwater Treatment System and BPSOU Subdrain Sampling and Monitoring Quality Assurance Project Plan

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Plan is effective on date of most recent signature above.

Revision:

DISTRIBUTION LIST

Silver Bow Creek/Butte Area NPL Site
Butte Treatment Lagoons Groundwater Treatment System
and BPSOU Subdrain Sampling and Monitoring
Quality Assurance Project Plan (QAPP)
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ACRONYMS

Acronym	Definition	Acronym	Definition
%R	Percent Recovery	**LCS**	Laboratory Control Sample
%D	Percent Difference	**LMS**	Laboratory Matrix Spike (sample)
ARAR	Applicable or Relevant and Appropriate Requirements	**LOD**	Limit of Detection
Atlantic Richfield	Atlantic Richfield Company	**MB**	Method Blank
AV	area velocity	**MDL**	Method Detection Limit
BPSOU	Butte Priority Soils Operable Unit	**mg/L**	milligrams per Liter
BRW	Butte Reduction Works	**MH**	manholes
BTL	Butte Treatment Lagoons	**NFG**	National Functional Guidelines
CAR	Corrective Action Report	**OM&M**	Operations, Maintenance, and Monitoring
CD	Consent Decree	**ORP**	Oxidation-Reduction Potential
$CaCO_3$	Calcium carbonate	**PARCCS**	Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity
CFRSSI	Clark Fork River Superfund Site Investigation	**PDF**	Portable Document Format (Adobe)
COC	Contaminant of Concern	**Pioneer**	Pioneer Technical Services, Inc.
CPM	Contractor Project Manager	**PVC**	Polyvinyl Chloride
DEQ	Department of Environmental Quality	**QA**	Quality Assurance
DM/DV	Data Management/Data Validation	**QAM**	Quality Assurance Manager
DO	Dissolved Oxygen	**QAO**	Quality Assurance Officer
DQA	Data Quality Assessment	**QAPP**	Quality Assurance Project Plan
DQO	Data Quality Objectives	**QC**	Quality Control
EDD	Electronic Data Deliverable	**RAO**	Remedial Action Objective
EM	Electromagnetic (EM sensor)	**RL**	Reporting Limit
EPA	U.S. Environmental Protection Agency	**RRL**	Required Reporting Limit
ESD	Explanation of Significant Differences	**RODA**	Record of Decision Amendment
HAZWOPER	Hazardous Waste Operations and Emergency Response	**RPD**	Relative Percent Difference
HCC	Hydraulic Control Channel	**SC**	Specific Conductance
HMI	Human-Machine Interface	**SCADA**	Supervisory Control and Data Acquisition
HSSE	Health Safety Security and Environment	**SOP**	Standard Operating Procedures
ICV	Initial Calibration Verification	**SSHASP**	Site-Specific Health and Safety Plan
ID	Identification	**WCP-1**	West Camp Pump Station
LAO	Lower Area One		

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) contains the sampling procedures, laboratory analytical methods, and Quality Assurance/Quality Control (QA/QC) procedures applicable to the sampling activities at the Butte Treatment Lagoons (BTL) Groundwater Treatment System and the Butte Priority Soils Operable Unit (BPSOU) subdrain (referred to as subdrain or BPSOU subdrain) monitoring activities. This QAPP follows the U.S. Environmental Protection Agency (EPA) *Requirements for Quality Assurance Project Plans,* EPA QA/R-5 (EPA, 2001); EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4 (EPA, 2006); EPA *Guidance for Quality Assurance Project Plans*, EPA QA/G-5 (EPA, 2002); EPA Region 8 Quality Assurance Document Review Crosswalk checklist (EPA, 2016a); and the *Butte Area National Priorities List Site BPSOU Quality Management Plan* (Atlantic Richfield Company, 2020).

This QAPP is organized in accordance with the basic groups and subgroup elements discussed in the EPA guidance documents listed above (EPA, 2001 and EPA, 2002). There are four basic groups:

- Group A - Project Management (Section 2.0).
- Group B - Data Generation and Acquisition (Section 3.0).
- Group C - Assessment and Oversight (Section 4.0).
- Group D - Data Validation and Usability (Section 5.0).

The procedures identified in this QAPP are intended to meet the regulatory requirements outlined in the water quality Applicable or Relevant and Appropriate Requirements (ARARs) described in Table 1, reflective of the ARARs established in the EPA Record of Decision Amendment (RODA) for the BPSOU, which is Appendix A to the BPSOU Consent Decree (CD) (EPA, 2020a). Examples of the forms, checklists, and logs mentioned throughout this report are in Appendix D of the BTL Groundwater Treatment System Routine Operations, Maintenance, and Monitoring (OM&M) Plan to which this QAPP is an appendix; the OM&M Plan is referred to herein as the main OM&M Plan. The main OM&M Plan also includes the Standard Operating Procedures (SOPs) mentioned in this QAPP (in Appendix C) and the annual revision summary information (Appendix H).

1.1 Purpose and Objectives

The surface water discharge monitoring activity objective of the BTL groundwater treatment system is to define the frequency, location, and analysis of discharge water quality.

The groundwater monitoring activity objectives of the subdrain monitoring are as follows:

1. Support evaluation of achievement of remedial action objectives (RAOs) provided in the BPSOU CD (EPA, 2020a).
2. Perform load monitoring along the subdrain twice yearly to determine whether adequate groundwater capture is maintained along the subdrain.

The objective applicable to both surface water and groundwater systems is below:

- Document approved methods to sample and analyze water to provide data that are complete, precise, accurate, and defensible.

2.0 PROJECT MANAGEMENT

This section addresses administrative functions and concerns, goals, and approaches to be followed during sampling and monitoring activities on the site. Roles and responsibilities of key individuals involved in the project and their respective organizations are identified below, and graphically shown on Figure 1.

2.1 Project Organization and Responsibilities

Figure 1 shows the overall organization of the project team. The text below describes the responsibilities of the key individuals.

Atlantic Richfield Company BPSOU Liability Manager

The Atlantic Richfield Company (Atlantic Richfield) Liability Manager monitors reclamation obligations within BPSOU beyond collection and treatment of contaminated groundwater and is responsible for interaction and correspondence with Agency representatives concerning BPSOU.

Atlantic Richfield Company Liability Manager - Water Treatment Project Manager

The Atlantic Richfield Water Treatment Project Manager monitors the performance of the contractor(s), consults with the Contractor Project Manager (CPM) and Quality Assurance Officer (QAO) on deficiencies, helps finalize resolution actions, and is responsible for interaction and correspondence with Agency representatives.

Atlantic Richfield Company Quality Assurance Manager (QAM)

The Atlantic Richfield QAM interfaces with the Atlantic Richfield Water Treatment Project Manager on company policies regarding quality and has the authority and responsibility to approve specific QA documents including this QAPP.

Contractor

Pioneer Technical Services Inc. (Pioneer) is the Contractor responsible for operating, maintaining, and sampling the site under the direction of Atlantic Richfield.

Contractor Project Manager

The CPM schedules all sampling work to be completed and ensures that the work is performed according to this QAPP. The CPM, or designated alternate, will also consult with the specific project QA personnel regarding any deficiencies and finalize resolution actions, maintain the QAPP, and verify effective implementation of the QAPP requirements and procedures. This includes reviewing field and laboratory data and evaluating data quality.

Lead Operator

The Lead Operator ensures that the QAPP for each project area has been reviewed by all members of the field team and that the QAPP is properly followed during field activities. The Lead Operator will conduct daily safety meetings, assist in field activities, and document activities in the logbook.

The Lead Operator is also responsible for equipment, problem solving, and decision making in the field, and for addressing technical aspects of the project. The Lead Operator (or designated alternative) will provide "on-the-ground" overviews of project implementation by observing site activities to ensure compliance with technical project requirements, Health Safety Security and Environment (HSSE) requirements, and the Site-Specific Health and Safety Plan (SSHASP).

Field Team Leader

The Field Team Leader will confirm that each member of the operations and sampling team is familiar with the QAPP, will maintain signatures of each team member who has read the QAPP (including reviews and addenda, as necessary), and verify each team member has been trained in the appropriate sample collection methods.

Safety and Health Manager

The Safety and Health Manager will develop the SSHASP and review it with all members of the field team. The Safety and Health Manager will lead applicable Task Risk Assessments and conduct the initial safety meeting prior to starting fieldwork. The Safety and Health Manager will ensure that work crews comply with all site safety and health requirements and will revise the SSHASP, if necessary.

Quality Assurance Officer

The QAO verifies effective implementation of QAPP requirements and procedures, including reviewing field and laboratory data and evaluating data quality. The QAO may conduct on-site reviews and prepare site review reports for the QAM. The QAO will have a direct line of communication to the QAM to ensure issues related to project quality assurance are resolved.

The QAO is authorized to stop work if, in the judgment of that individual, the work is performed contrary to or in the absence of prescribed quality controls or approved methods, and further work would make it difficult or impossible to obtain acceptable results.

Analytical Services

The contracted laboratory will be an Atlantic Richfield-approved laboratory and will ensure that the laboratory QA personnel are familiar with the QAPP and are available to perform the work as specified. Contracted laboratory personnel are responsible for reviewing final analytical reports produced by the laboratory, scheduling laboratory analyses, and supervising in-house chain of custody procedures.

The contracted laboratory is required to generate and report high quality data that identify and define the physical and chemical characteristics of surface water and groundwater for environmental investigations, remediation activities, long-term monitoring programs, discharge compliance monitoring, and waste characterization under the purview of Resource Conservation and Recovery Act, and Comprehensive Environmental Response, Compensation & Liability Act referred to as *Superfund*. As such, analytical data must be accurately and precisely generated and reported in conformance with the applicable method and "best industry standards." The selected laboratory will have QA personnel familiar with the approved QAPP, and be responsible for reviewing final analytical reports, scheduling analyses, and supervising in-house custody procedures. The laboratory is NELAC/NELAP certified for methods when applicable.

2.2 Problem Definition and Background

Groundwater contaminated from historic mining operations within BPSOU is captured and diverted to BTL and treated to meet surface water quality standards. The purpose of the BTL system is to capture and treat contaminated groundwater to meet surface water standards prior to discharge to Silver Bow Creek. Configuration of the groundwater capture features such as the lagoon system and BPSOU subdrain creates a hydraulic gradient to ensure contaminated groundwater cannot migrate to adjacent surface water bodies (i.e., Blacktail Creek and Silver Bow Creek).

2.2.1 Location

The Lower Area One (LAO) is located within the BPSOU immediately west of the Butte-Silver Bow municipal water treatment facility on the western edge of the city of Butte in Silver Bow County, Montana. The entire LAO site is approximately 80 acres and 1 mile long. Currently, the full-scale water treatment system (BTL system) is operating within the northwest one-quarter of the LAO site as a portion of the final BPSOU remedy. Figure 2 shows the area and sample locations.

2.2.2 Site History

Remedial action activities completed in the LAO area in the late 1990s included removing approximately 1.2 million cubic yards of tailings and impacted soils and reconstructing the stream and floodplain. During remedial action activities in 1996, 2 demonstration wetlands projects were constructed within LAO. One demonstration was discontinued in 2005. The remaining demonstration system has undergone a series of improvements and modifications from 1999 through 2010. The Agency-approved, full-scale, permanent BTL system was constructed between 2011 and 2014. The BTL system can effectively treat Missoula Gulch base flow and West Camp Pump Station (WCP-1) groundwater entering the Hydraulic Control Channel (HCC), groundwater collected from the subdrain, groundwater collected from the Butte Reduction Works (BRW) western areas (BRW-00 and BRW-01W), and groundwater collected within the BTL system at LAO. Figure 2 shows the general site location.

2.3 Project/Task Description

This QAPP details the water monitoring programs that occur in BTL and along the subdrain. Categories of monitoring data are delineated as follows:

1. Effluent compliance monitoring related to specific discharge compliance requirements.
2. Routine operational monitoring related to monitoring that provides details for operation and maintenance.
3. Subdrain monitoring to determine if the subdrain is operating as expected, and if maintenance benchmarks or triggers have been reached to indicate maintenance is required.

2.4 Quality Objectives and Criteria

This section provides the outputs of the systematic planning process used for sampling events associated with BTL and the subdrain. The Data Quality Objective (DQO) process is described in Section 2.4.1. The principal indicators of data quality—precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS)—are discussed in Section 2.4.2.

2.4.1 Data Quality Objectives

The DQOs and criteria identify the performance/measurement criteria for all data to be collected and acceptance criteria for information obtained, project discharge limits, and laboratory detection and reporting limits.

The DQOs were developed according to EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (QA/G-4) (EPA, 2006). The DQOs are statements that define the type, quality, quantity, purpose, and use of data to be collected. EPA developed a seven-step process for establishing DQOs to help ensure that data collected during a field sampling program will be adequate to support reliable site-specific decision making or estimation, whichever is appropriate. The following DQOs were developed for this QAPP for the three categories of data collection described in Section 2.3:

Step 1. State the Problem.

The purpose of this step is to describe the problem so that the focus of the data collection will not be ambiguous.

Contaminants from historic mining operations have been detected in groundwater throughout BPSOU that need to be captured and removed to achieve acceptable water quality standards prior to being discharged to downstream Silver Bow Creek.

The following parameter are used to verify groundwater is effectively captured treated by the BTL System.

- Effluent compliance monitoring: analytical data from the treatment system are necessary to determine compliance with water quality standards in the 2020 RODA (EPA, 2020a).

- Routine operational data: to evaluate operating assumptions, implement any needed modifications and/or refinements to the system operations, and support activities.

- Subdrain monitoring: data collected from the BPSOU subdrain groundwater collection system are necessary to determine effective capture and identify maintenance triggers of the subdrain.

Step 2. Identify the Goals of the Program.

This step identifies what questions the monitoring program will attempt to resolve and what actions may result.

Principle questions specific to the treatment system include:

- Does the treated groundwater water quality meet end of pipe discharge standards established for the BTL treatment system?

Principle questions specific to the subdrain monitoring include:

- Is the subdrain operating as expected (i.e., within the flow and loading variability identified in the Loading Study Technical Memorandum (Atlantic Richfield Company, 2016)?
- Has a flow benchmark (BPSOU pump discharge) been reached that triggers subdrain maintenance?

Step 3. Identify Information Inputs.

The purpose of this step is to identify the informational variables that will be required to resolve the decision statements and determine which variables require environmental measurements. The following data and information are required to satisfy or resolve the decision statements:

1. Effluent water quality data.
    a. Two 24-hour composite samples are collected twice per week at station EFS-07 and analyzed for parameters listed in Table 2 and compared to Table 8-1 of Appendix D of the BPSOU CD (EPA, 2020a).
2. BTL system field data.
    a. Field data parameters include pH, temperature, and conductivity collected daily and/or monthly from locations listed in Table 3, which are identified on Figure 2.
3. Subdrain flow measurements and samples.

    Flow measurements and water quality samples are collected twice yearly from subdrain locations shown on Figure 2, and samples analyzed for the parameters listed in Table 4. Subdrain monitoring includes additional constituents (i.e., fluoride, boron, lithium) to assist with diagnostics of potential upset conditions associated with the subdrain. In the event of an unforeseen condition, these additional constituents are useful in determining what type of water may be contributing to the issue or characterizing the potential source of water.

These constituents are not associated with compliance at the effluent discharge from the BTL Treatment System.

Step 4. Define the Study Boundaries.

The purpose of this step is to define the spatial and temporal boundaries of the problem.

Spatial boundaries of the system extend from manhole locations of the groundwater capture system from near Texas Avenue to the effluent discharge point at EFS-07. All sampling and monitoring locations are depicted on Figure 2, which includes specific georeferenced locations in the point table.

Surface water analytical samples will be collected from locations according to the frequency listed in Table 3.

Monitoring activities will continue until groundwater meets all federal, state, and local regulations as determined by appropriate Agencies and groundwater treatment is no longer deemed necessary.

Step 5. Develop the Analytical Approach.

The purpose of this step is to define the parameters of interest and specify action levels.

The decision rule for the BTL effluent is defined in Table 8-1 in Appendix D of the BPSOU CD (EPA, 2020a). The Montana Department of Environmental Quality (DEQ) Circular DEQ-7 aquatic life standards for cadmium, copper, lead, silver, and zinc (DEQ, 2006) are dependent on effluent hardness with an upper limit of 400 milligrams per Liter (mg/L) calcium carbonate ($CaCO_3$). Hardness of BTL effluent is most commonly greater than 400 mg/L $CaCO_3$, resulting in a consistent maximum standard from sample to sample.

The effluent water quality data collected weekly will be used to determine the effectiveness of the BTL Treatment System. The effluent water quality data, collected at EFS-07, will also be compared to the values in Table 1 for compliance. Operational and field data are reviewed for increasing and decreasing trends to assist with operational decision making.

The analytical approach for subdrain monitoring is addressed by reviewing monitoring results and groundwater chemistry listed in Table 4, comparing the results to operating data and baseline test results, and identifying conditions that could affect long-term remedy effectiveness (i.e., scaling, attenuation and release, and changes in the groundwater potentiometric surface). Data will be evaluated to confirm groundwater RAOs specified in the BPSOU CD (EPA, 2020a) are met to prevent groundwater discharge that would lead to violations of surface water ARARs and/or to detect new contaminant of concern (COC) releases that could impact remedy effectiveness.

Step 6. Specify Performance or Acceptance Criteria.

The purpose of this step is to specify the decision maker's tolerable limits on decision errors, which are used to establish performance goals for the data collection design.

There are limitations in evaluating data over a given area and the inherent variability of the matrix being sampled. Measurement error occurs from the inherent variability in the collection, preparation, and analysis of an environmental sample. Sampling design and measurement errors will be minimized by following the procedures outlined in this QAPP and the SOPs in Appendix C of the main OM&M Plan.

All the data gathered under this QAPP will be verified and validated to ensure they are usable for their intended purpose. Specific data validation processes that will be followed to ensure analytical results are within acceptable limits are detailed in Section 2.4.2 and Section 5.0. The data validation process will include an evaluation of analytical control limits and of the PARCCS parameters. Acceptance criteria for analytical data are detailed in Section 2.4.2 and Table 5. If significant issues with the data are found, results will be discussed with EPA.

The closer the reported COC concentration is to the action level, the higher the probability that an incorrect decision will be made; therefore, there is a “gray region” surrounding the performance standard. Results near action level limits should be thoroughly reviewed with QC qualifier criteria and compared with previously collected data. The review must provide assurance that the data reported are within tolerable limits to support final decisions. Refer to Section 2.4.2 for additional detail regarding data acceptance criteria.

Step 7. Develop the Plan for Obtaining the Data.

The purpose of this step is to identify a resource-effective data collection design for generating data that are expected to satisfy the DQOs.

The data collection described in Section 3.0 is expected to adequately meet the qualitative aspect of the DQOs. The data collection scheme is designed to ensure data are of sufficient quality to support decisions regarding system performance.

This QAPP is designed to ensure that the data will be of sufficient quality and quantity to answer the principal study questions outlined in Step 2. This QAPP provides the detailed descriptions of the field work to be completed.

2.4.2 Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity

The principal indicators of data quality are PARCCS. Each is summarized below.

2.4.2.1 Precision

Precision is the amount of scatter or variance that occurs in repeated measurements of a particular analyte. Acceptance or rejection of precision measurements is based on the relative percent difference (RPD) or absolute difference between the laboratory and field duplicate pairs.

When both duplicate pair results are greater than 5 times the laboratory reporting limit (RL), acceptable precision is an RPD of less than or equal to 20% in water samples. For duplicate pair samples with 1 or both results less than 5 times the RL (including non-detect), acceptable precision is an absolute difference between the duplicate pair results less than or equal to the RL. These precision goals are derived from the Clark Fork River Superfund Site Investigation (CFRSSI) QAPP (ARCO, 1992a) and the *National Functional Guidelines* (NFG) *for Inorganic Superfund Methods Data Review* (EPA, 2020b).

For example, perfect precision would be a 0% RPD between duplicate samples (both samples have the same analytical result) for results that are greater than 5 times the RL or an absolute difference of 0 if 1 or both results are less than 5 times the RL.

The equation for RPD is:

$$RPD = \frac{|x-y|}{\frac{(x+y)}{2}} \times 100$$

The equation for absolute difference is:

$$absolute\ difference = |x-y|$$

Where:

x = investigative sample result
y = duplicate sample result

For analytical data, precision will be assessed based on laboratory-prepared and field duplicate sample analysis.

2.4.2.2 Accuracy/Bias

Analytical Data

Accuracy of sample analysis is controlled primarily by the laboratory and is reported as bias. Accuracy is the degree of difference between the measured or calculated value and the true value. It is a measure of the bias or systematic error of the entire data collection process. Potential sources of systematic errors include the following:

- Sample collection methods.
- Physical or chemical instability of the samples.
- Interference effects during sample analysis.

- Calibration of the measurement system.
- Contamination.

The percent recovery (%R) and/or the percent difference (%D) of QC samples may be used to evaluate accuracy. For example, perfect accuracy would be a %R of 100% or a %D of 0% between the found value and the true value of the analyte concentrations.

The equation for %R is:

$$\%R = \frac{Found\ (value)}{True\ (value)} \times 100$$

The equation for %D is:

$$\%D = \frac{|True\ (value) - Found\ (value)|}{True\ (value)} \times 100$$

The QC samples used to access accuracy will depend on the analytical method. The accuracy goal will be the QC criteria used during the data validation process, listed in Table 5. The following QC samples are used to assess accuracy as applicable per method:

- Calibration.
- Initial calibration verification (ICV) samples.
- Initial calibration blank samples.
- Continuing calibration verification samples.
- Continuing calibration blank samples.
- Low-level ICV samples.
- Laboratory control samples (LCS).
- Laboratory method blank (MB) samples.
- Laboratory matrix spike samples (LMS).
- Interference check samples.
- Serial dilution samples.
- Field blank samples (including rinsate and trip blank samples when applicable).
- Internal standards.

Flow Measurement

Flow meter accuracy: Teledyne ISCO 2150 Area Velocity Flow Meters (AV flow meters) deployed at stations MH-MSD106, MH-MSD108, MH-MSD110, and MH-MSD113 have listed measurement accuracies of plus or minus 0.01 feet for the water level measurement, and plus or minus 0.1 feet/second for the water velocity measurement. Water level and velocity are used in conjunction with the measured subdrain inner pipe diameter to calculate the flow rate. As a result, errors in the accuracy of these 2 parameters could potentially compound errors in the flow rate. This flow meter has listed measurement accuracies of plus or minus 0.01 feet for water level measurements, plus or minus 2% for water velocity measurements. Within the range of water levels and velocities measured in the subdrain, improper instrument installation and error in flow measurements could account for as much as plus or minus 12% of the total uncertainty in the flow rate. .

To measure the very low flows at MH-MSD116, the manhole contains a Marsh-McBirney Flo-Tote® Electromagnetic Sensor (EM sensor). This flow meter has listed measurement accuracies of plus or minus 1% for water level measurements, plus or minus 2% for water velocity measurements, and plus or minus 5% for flow measurement conversion accuracy. The minimum resolution of the velocity sensor is plus or minus 0.01 feet/second, and the 0 stability (i.e., the amount of fluctuation at the zero point) is plus or minus 0.05 feet/second.

2.4.2.3 Representativeness

Data representativeness is defined as the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or environmental conditions. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program. Representativeness will be achieved through judicious selection of sampling locations and methods. This QAPP has been designed to ensure that the samples are representative and meet the project DQOs. Sample representativeness may also be evaluated using the precision criteria for field duplicate results.

The sampling program developed for the BTL system was designed to comprehensively assess levels of COCs listed in Table 2 and compare the results to Table 8-1 in Appendix D of the BPSOU CD (EPA, 2020a), while the subdrain sampling activity was designed to comprehensively assess the flow and loading, within the subdrain, of the COCs listed in Table 4.

2.4.2.4 Comparability

Comparability is assessed to determine if one set of data can be compared to another set of data. Comparisons are made by examining and comparing the laboratory and field methods used to acquire sample data for different, distinct data sets. The data sets will include samples collected by field personnel and analyzed by the analytical laboratory.

The samples will be collected according to standard sampling methods and SOPs (Appendix C of the main OM&M Plan). The sampling design, SOPs, and laboratory analytical methods are based on EPA and other industry standard practices. Sample collection will be completed by professionals properly trained in the applicable SOPs and equipment use. Collection procedures will be documented in a field book and/or on field data sheets. Proper chain of custody and sample handling protocol will be completed according to SOPs. Because these procedures have been in place all newly collected data will be comparable to previously collected data. All field collection practices and analytical laboratory procedures, are following applicable SOPs.

2.4.2.5 Completeness

Completeness refers to the amount of usable data produced during a sampling and analysis program. The procedures established in this QAPP are designed to ensure, to the extent possible, that data will be valid and usable. To achieve this objective, every effort will be made to collect each required sample and to avoid sample loss.

Completeness is assessed to determine if enough valid data have been collected to meet the project needs. Valid data collected under this QAPP may include both enforcement and screening quality data. Rejected data are not considered valid data in the completeness determination. Information on enforcement, screening, and rejected quality data is in Section 5.3.

This QAPP has been developed to ensure the resulting data will be usable for the intended purpose of each data set. There are two completeness goals:

1. Comparing the number of samples collected to the number of samples planned for the investigation, as listed below. The completeness target is 95% or greater.

$$C = (n/N) * 100$$

Where: n: number samples collected
N: total number of samples planned

2. Comparing the number of valid sample results (not rejected data) to the number of sample results planned for the investigation, as listed below. The completeness target is 95% or greater.

$$C = (n/N) * 100$$

Where: n: number of valid data points produced
N: total number of data points produced

2.4.2.6 Sensitivity

Sensitivity is a quantitative measure and is evaluated by comparing the laboratory RL or the laboratory method detection limit (MDL) to the project-required detection limit. The decision rule for the BTL effluent is defined in Table 8-1 in Appendix D of the BPSOU CD (EPA, 2020a). To evaluate sensitivity, the required reporting limits (RRL) listed in the Circular DEQ-7 (DEQ, 2006) is compared to the RRL. Table 2 and Table 4 list the anticipated laboratory MDLs and RLs and relevant RRLs.

Method Sensitivity

Method sensitivity is related to the MDL. The method sensitivity or lower limit of detection depends on several factors including the analyte of interest, the method used, the type of detector used, matrix effects, etc. Appropriate methods must be selected with sufficient method sensitivity to accomplish the project's goals.

Laboratory Analysis

The method sensitivity for laboratory analyses is determined as part of the laboratory's SOPs. A review of these detection limits will be conducted as part of the data validation process.

2.5 Specialized Training and Certifications

Operations personnel will receive Occupational Safety and Health Administration 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training, hazard recognition training, and site-specific SOP task training including site sampling and monitoring tasks. All personnel will be trained for the specific task to be completed and will review the requirements of this QAPP and the associated SOPs (Appendix C of the main OM&M Plan).

All training will be reviewed annually. Site personnel must demonstrate competency of SOPs through classroom review and practical application. The Lead Operator must approve the training and record the information on the training log prior to personnel completing any unsupervised tasks in the field. A training log is provided in Appendix D of the main OM&M Plan). All training records will be maintained by the site Safety and Health Manager and will be available for review on request.

Annual HAZWOPER re-certification will be provided by the site Safety and Health Manager (or qualified alternate) and appropriate HSSE professionals. Site personnel will review the site-specific SOPs annually with the Lead Operator and demonstrate their proficiency.

One hard copy of the current, approved version of this QAPP will be maintained for reference purposes at the BTL Operations Building office. All field personnel will have access to the hard copy and the electronic version (in an Adobe Portable Document Format [.PDF] format).

2.6 Documentation and Records

This section summarizes the data collection documentation requirements related to the BTL system and subdrain monitoring data. Analytical results for surface water effluent samples at EFS-07 and subdrain manhole locations (MH-MSD106, 108, 110, 112, and 116) will be considered *critical* information. Analytical results from samples at INF-04, WCP-1 and MSD-HCC and all field parameters will be considered *informational*.

2.6.1 Butte Treatment Lagoons Reporting Format

Required routine BTL reporting includes quarterly reports and an annual OM&M summary report. All reports will be produced in a Microsoft Word format and converted to a PDF format for distribution. Supplemental daily logged data will also be kept in a Microsoft Excel format.

Operations monitoring data will be provided to a third-party database administrator. This will include field data (influent and effluent flow, pH, temperature, and specific conductance [SC], and lagoon cell levels) and preliminary analytical data (total recoverable metals concentrations).

2.6.1.1 Weekly Reporting

Weekly reporting is provided as informational to effectively communicate system performance during the interim shakedown period. The weekly report typically includes compiling information into the *BTL Weekly Operations Summary Report* and the Daily Cell Data worksheet file (in Microsoft Excel format). The BTL Weekly Operations Summary Report provides a narrative summary of routine operations; minimum, maximum, and average flows and water level elevation at WCP-1, subdrain vault, influent, and effluent stations; lime usage amounts; effluent pH readings; and BRW Pond elevations. The Daily Cell Data worksheet contains daily cell data from the week being reported. The Lead Operator submits the BTL Weekly Operations Summary Report by 4:00 pm each following Monday.

2.6.1.2 Quarterly Reporting

Quarterly reports will provide a summary of BTL system OM&M tasks performed over each three-month period. This summary will include monitoring, performance, operations, and training information. The quarterly report will include the following:

- Monitoring summary that describes sample collection frequency, locations, and analytes.
- System performance summary that discusses sample results that have exceeded discharge standards and/or data that were tagged with a data qualifier.
- Operation summary that provides system flows (average flow rate and totalized), water elevations, lime addition, and pH measurement.
- Inspection, maintenance, and operator training activities summary that highlights the high-level component inspections completed during the reporting period to confirm that the system operation obligations are being met.
- Conclusion section that provides a final summary of system performance.
- Attachment section for additional information.
- Supplemental electronic files.

Attachments to quarterly reports will include a data summary report of final validated analytical data packages that have undergone Stage 4 validation as described in Section 5.0, laboratory data packages, discharge monitoring reports, graphical representations of analytical results for each COC listed in Table 2, graphical representations of system flows and levels, and operator training logs.

Submittals and submittal dates follow the schedule below:

Report Submittal	Performance Period	Submittal Due Date
First Quarter	January 1 - March 31	June 30
Second Quarter	April 1 - June 30	September 30
Third Quarter	July 1 - September 30	December 30
Fourth Quarter	October 1 - December 31	March 30

2.6.1.3 Annual Reporting

The annual reports will provide similar content as quarterly reports but will elaborate on major seasonal maintenance tasks such as subdrain jetting and forced main pigging, lagoon cell dredging, and vegetative maintenance activities. The annual report will contain a summary of the BTL system quarterly data summary reports.

Annual reports will discuss the following:

- Major seasonal operations and maintenance tasks.
- Presentation of data and discussion if project objectives (Section 1.1) are met including the following:
    - Summary of the data quality.
    - Summary of quarterly data summary reports.
    - Summary of the fulfillment of the project objectives.
    - Compliance comparison of sampled effluent to discharge standards.

The annual report will be submitted to the Agencies by May 30 of the following year.

2.6.2 Subdrain Reporting Format

The semi-annual subdrain monitoring data will be documented in an annual data summary report. The annual subdrain monitoring data summary report will be prepared as described in the CFRSSI Addendum (AERL, 2000) and discuss the following:

- Abstract.
- Statement of authenticity.
- Executive summary.
- Summary of the data collection.
- Summary of equipment maintenance.
- Data quality assessment.
- Conclusions on data quality.

The annual subdrain monitoring report will be submitted to the Agencies by April 30.

2.6.3 Field Data Collection Documentation

The BTL performance monitoring process includes both automated and manual (field measurements) data collection. The BTL system operators and field engineers collect field measurements daily from various locations throughout BTL and the remote stations (Figure 2). The different collection methods are detailed in this section.

2.6.3.1 Butte Treatment Lagoons Performance Monitoring Field Data

Performance monitoring data consist of pre-treatment, in-process, and post-treatment data monitored to ensure final effluent meets discharge performance standards criteria. The data collection is both automated and manual at stations throughout the BTL and ancillary systems and stored on the system historian and field data sheets as appropriate.

The manual performance monitoring field data will come from operators manually collecting daily pH and temperature measurements from the following locations at LAO (shown on Figure 2):

- Distribution Channel at INDC.
- Treatment Lagoons levels.
    - A2
    - B2
    - C2
    - A3
    - B3
    - C3
- Effluent Discharge - EFS-07.

Operators will record manual field data on field data sheets and input the data into an Excel spreadsheet for retention, trending, and reporting needs. Along with pH and temperature measurements, operators will record general description, location, and day of collection.

2.6.3.2 Subdrain Field Data

During sample collection, field personnel measure field parameters (pH, oxidation-reduction potential [ORP], SC, temperature, and dissolved oxygen [DO]) and record the information in a bound, field logbook dedicated to subdrain monitoring and sampling activities. The Lead Operator, or designated alternate, will be responsible for recording sampling information prior to proceeding to the next sampling site. The data will be compiled using the applicable field parameters form and chain of custody form (Appendix D of the main OM&M Plan) according to the corresponding SOPs (Appendix C of the main OM&M Plan).

The following minimum field data will be recorded at each site:

- Site identification (ID).
- Date and time of sample collection.
- Weather conditions.
- Names of field crew members.

- Samples collected (including appropriate sample identifier).
- Procedures used.
- Field data collected.

The following is a list of various field documents that may be completed during routine sampling activities for the subdrain.

- Chain of custody records.
- Field data collection forms.
- Sampling notes in logbooks.
- Field instrument calibration logs.
- Electronic flow meter data downloads.

2.6.4 Laboratory Analytical Data

The laboratory will provide analytical data in a Full 4 data package including a laboratory report in PDF format and an electronic data deliverable (EDD) in Microsoft Excel-compatible format. Complete data packages from the laboratory will contain the following minimum information:

- A narrative addressing any anomalies encountered during sample analysis and a discussion of any exceedances in the laboratory QC sample results.
- Analytical method references.
- Definition of any data flags or qualifiers used.
- Chain of custody documentation signed and dated by the laboratory to indicate sample receipt.
- MDLs and RLs.
- Analytical results for each field sample.
- Blank and QC sample results.

2.6.5 Data Records

Program quality records are documents that furnish objective evidence of the quality of items or services, activities affecting quality, or the completeness of data. These records will be organized and managed by the Water Treatment Project Manager, or designated alternate, and will include the following, at a minimum:

- This QAPP and any approved revisions or addenda.
- Site-specific figures and supporting documentation.
- SSHASP and any addenda.
- Copies of SOPs for field data collection, with any updates or revisions or addenda to those SOPs.

- Incoming and outgoing project correspondence related to system performance data.
- Field documentation forms.
- Copies of all bound field logbooks.
- Copies of all field data sheets.
- Electronic field forms.
- Electronic copies of completed chain of custody forms for samples.
- Copies of all laboratory agreements and amendments.
- As-received laboratory data packages (hard copy and electronic).
- Documentation of field and/or laboratory audit findings and any corrective actions.
- Draft and final delivered versions of all reports and supporting documents.

Any addendums or revisions to this QAPP will be electronically distributed to all parties identified on the distribution list by the Water Treatment Project Manager. All records will be maintained and archived electronically for future reference.

2.6.6 Data Storage

All system sampling and performance records (electronic and manual field data and as-received laboratory electronic data packages and EDDs) will be stored and maintained on a dedicated computer at the BTL Operations Building in Butte, Montana. Electronic versions of these records will be maintained on a local server system with backup scheduled daily. In addition to the on-site storage system, an off-site backup will be completed daily on a disaster recovery site. Final validated analytical data will be uploaded to a master cloud-based database maintained by BP Remediation Management for long-term data retention.

A regular backup of the component databases will be performed to provide security against damage or loss of data. Each day, data will be backed up electronically to a hard-disk for storage. Daily backups will be retained for a 30-day period and replicated to a third-party cloud-based system. Additionally, backup copies, copied monthly, will be maintained at off-site, co-location. These off-site copies will only contain the latest backup and will only be used if the core system is damaged and requires replacement.

2.6.6.1 Butte Treatment Lagoons Data

All process data monitored and logged by the BTL Supervisory Control and Data Acquisition (SCADA) system is stored on a dedicated computer hard drive located in the Operations Building and archived daily to an off-site server located at the Pioneer Butte office, and a cloud-based server.

Analytical water quality data results received from the laboratory (in EDD format) will be reviewed by the Lead Operator, validated as described in Section 5.0, and then archived in the project database. Field data will be reviewed, corrected (as needed), and imported into a project database.

2.6.6.2 Subdrain Monitoring Data

The Lead Operator will ensure all data collected and recorded for the subdrain monitoring is verified, qualified, or corrected if needed, and imported into a project database for long-term retention and accessibility. Analytical water quality data results received from the laboratory (in EDD format) will be reviewed by the Lead Operator, validated as described in Section 5.0, and then archived in the project database. Likewise, field and flow meter data will be reviewed and screened for atypical data and then imported into a project database. If atypical flow or levels are observed (e.g., spikes, drops, inconsistencies, fluctuations, etc.), they will be plotted and compared to other flow meter, precipitation, and/or transducer data to identify a root cause (i.e., precipitation event, operations in or near the subdrain, etc.). Final data will be used in the subdrain monitoring reports (refer to Section 2.6.2).

2.6.7 QAPP Distribution

This approved QAPP and subsequent annual revisions will be provided electronically to personnel identified on the project distribution list. Hard copies may be provided to Agency personnel and key project personnel upon request. One hard copy of the current version will be maintained in the BTL Treatment System Operations Building.

The Water Treatment Project Manager, or designated alternate, will be responsible for distributing revisions of this document on an annual basis, or as necessary, to communicate associated changes.

3.0 DATA GENERATION AND ACQUISITION

Sampling provides confirmation that the treatment system is performing as designed to prevent groundwater discharge that would lead to violations of surface water ARARs for the BPSOU. This section contains an overview of sampling and monitoring activities and lists the sampling locations.

Treatment system operators and field scientists/engineers will conduct all sampling activities (collectively referred to as field personnel in this report). Sampling events will be scheduled to ensure the laboratory receives the samples and completes the analyses within the sample hold times provided in Table 2 and Table 4. Subdrain sampling events will be scheduled to align with timeframes provided in the BPSOU RODA and the Explanation of Significant Differences (ESD) to the BPSOU Record of Decision (both in Appendix A of the BPSOU CD; EPA, 2020a). Adverse weather conditions or inaccessibility of sample locations may necessitate rescheduling sampling events to assure collection of representative samples.

Impacted groundwater is collected and treated to meet surface water discharge standards listed in Table 8-1 in Appendix D of the BPSOU CD (EPA, 2020a) via the subdrain and BTL system prior to being released to Silver Bow Creek. The sampling efforts described in this document help verify compliance with the previously referenced discharge standards.

Routine sampling regimens described in this QAPP are designed to reduce analytical variability.

Field personnel will follow the appropriate SOP (listed below and provided in Appendix C of the main OM&M Plan) for all field sampling and monitoring activities.

SOP Number	Title	Organization
SOP-DE-02	Equipment Decontamination	Pioneer
SOP-GW-03	Depth to Water Level Measurements	Pioneer
SOP-GW-10C	Purging and Sampling with Peristaltic Pump	Pioneer
SOP-SA-01	Soil and Water Sampling Packaging and Shipping	Pioneer
SOP-SA-03A	Field Quality Control Samples for Water Sampling	Pioneer
SOP-SA-04	Chain of Custody Forms for Environmental Samples	Pioneer
SOP-SA-05	Project Documentation	Pioneer
SOP-WFM-01	Field Measurement of pH in Water	Pioneer
SOP-WMF-02	Field Measurement of Oxidation Reduction Potential in Water	Pioneer
SOP-WMF-03	Field Measurement of Specific Conductance	Pioneer
SOP-WMF-04	Field Measurement of Water Temperature	Pioneer
SOP-WMF-07	Field Measurement of Dissolved Oxygen	Pioneer
BTL-SOP–13	Outlet Structure Grab Sampling	Pioneer
BTL-SOP-02	BPSOU Subdrain Sampling and Monitoring Operations	Pioneer
BTL-SOP-08	BPSOU Subdrain Flow Meter Download	Pioneer
BTL-SOP-17	ISCO Automatic Composite Water Sampling Procedures	Pioneer
BTL-SOP-24	Effluent Water Grab Sampling	Pioneer
BTL-SOP–36	Recalibrate the pH Meter	Pioneer

3.1 Butte Treatment Lagoons Sampling and Monitoring

Water sampling will be limited to four locations within the treatment system: EFS-07, MSD-HCC, WCP-1 and INF-04. Surface water elevations are monitored at the D Cells, BRW area, and HCC (Figure 2).

3.1.1 Discharge Compliance Monitoring

To monitor compliance, field personnel will monitor EFS-07 twice a week and collect two 24-hour composite paired, total recoverable, and dissolved samples and submit them to the laboratory to be analyzed for parameters listed in Table 2. For each sample collected, field personnel will immediately take and record the following field parameters: pH, SC, and temperature. Field personnel will record the sample location, sample ID, date/time, and analysis information on the field form and record the final stabilized field parameters in a project-specific field logbook.

As described in the BPSOU CD (EPA, 2020a), dissolved samples are collected at the BTL effluent station (EFS-07) to determine end-of-pipe compliance. At some point during the pilot project progression, the decision was made between the Agencies and Potentially Responsible Parties (now referred to as Settling Defendants) to continue to collect dissolved samples, but analysis was not necessary because discharge criteria is based on total recoverable results. Dissolved samples are archived by the laboratory for six months, then disposed. Analysis can be performed at the request of the Agencies or site operations personnel.

Aluminum is the sole analyte in routine BTL monitoring with an ARAR associated with the dissolved fraction. Dissolved results are not required to complete the hardness calculation since the SM 2340B test method uses calcium and magnesium values generated from the total metals to complete the hardness calculation. Discussion with Agency representatives indicate reporting total recoverable aluminum in quarterly and annual monitoring data is acceptable. The total recoverable aluminum result is compared to the dissolved aluminum ARAR. Routine collection and archival of the dissolved samples will continue. These dissolved samples will be archived for a period of up to six months, then be disposed by the laboratory. In the event a total recoverable aluminum sample exceeds the chronic standard of dissolved aluminum in two consecutive sampling events, then the dissolved sample submitted and archived by the laboratory will be analyzed as well. The BTL Lead Operator will be responsible for contacting the laboratory and requesting the dissolved sample be analyzed consistent with the total recoverable sample identified by sample ID number and date.

Once every month, additional samples will be collected at all sites listed in Table 3 and submitted to the laboratory to be analyzed for the parameters listed in Table 2. The analytes that will be monitored monthly include total recoverable calcium and magnesium (for hardness calculations), total alkalinity, total dissolved solids, total suspended solids, nitrate/nitrite, and sulfate. Standard procedures to complete sampling and monitoring tasks are available in Appendix C of the main OM&M Plan. Specific procedures are listed below.

- SOP-WFM-01 Field Measurement of pH in Water.
- SOP-WFM-04 Field Measurement of Water Temperature.
- BTL-SOP-13 Outlet Structure Grab Sampling.

Field personnel will collect samples according to the schedule in Table 3. Typically, the weekly effluent samples will be collected each Monday and Thursday and shipped to the laboratory to ensure samples are received at the laboratory within holding time and temperature ranges. Samples from MSD-HCC and WCP-1 will be obtained monthly during routine sample collection events. The WCP-1 station will be included as an additional sample location and will be sampled from July 2022 through June of 2023. The WCP-1 sample location will be evaluated after one year for continued monthly, quarterly, or semi-annually sampling in following revisions.

3.1.2 Butte Treatment Lagoons Sampling and Monitoring

Sample station locations are shown on Figure 2 and identified below by location name, station field ID, and sample ID:

Sample Station Name	Station Field Identification	Sample Identification
Effluent sample station	EFS-07	SS-1
Influent sample station	INF-04	SS-2
MSD-HCC station	MSD-HCC	SS-3
WCP-1 Station	WCP-1	SS-5

Two 24-hour composite samples will be collected using an automated sample collection device (ISCO 3700 automatic sample collection) twice each week at EFS-07 (SS-1) and once each week at INF-04 (SS-2) and sent to the laboratory to be analyzed for COCs listed in Table 2. Field grab samples are collected at station MSD-HCC (SS-3) and WCP-1 (SS-5) monthly. Temperature and pH will be monitored daily from locations shown on Figure 2. Additional required field parameters will be determined based on facility operational needs.

In addition to weekly samples, monthly samples will be collected at EFS-07 (SS-1) and INF-04 (SS-2) and sent for laboratory analysis, as listed in Table 2.

3.1.2.1 Butte Treatment Lagoons Sample Collection Method

Samples will be collected following established surface water sampling SOPs and the ISCO sampling equipment SOP BTL-SOP-17 ISCO Automatic Composite Water Sampling Procedures (SOPs are in Appendix C of the main OM&M Plan). The list below shows the general analyses that will be performed, and Table 2 provides detailed information:

- Total recoverable metals.
- Dissolved metals (archived sample).
- Total alkalinity.
- Sulfate.
- Nitrate/nitrite.
- Total dissolved solids.
- Total suspended solids.
- Hardness.
- pH.
- Temperature.
- SC.

All samples will be preserved with the appropriate preservative and kept cool until delivery to the analytical laboratory, and chain of custody procedures will be followed as described in Section 3.1.2.3.

Field parameters (SC, pH, and temperature) will be collected (BTL-SOP-17 and BTL-SOP-13) during sample collection and recorded in the *Field Parameter Form* located in the laboratory area of the Operation Building.

Sample ID, location, date/time, and analyses will be recorded on the *Field Sample Data Sheet* also located in the Operations Building. Both forms are provided in Appendix D of the main OM&M Plan.

3.1.2.2 Butte Treatment Lagoons Sampling Equipment and Supplies

The analytical laboratory performing analysis will provide the required sampling supplies (bottles, labels, coolers, chain of custody forms, etc.) and equipment (pump, filters, gloves, etc.) necessary to complete the monitoring procedures will be provided and maintained on the site by the operating Contractor. Additional equipment requirements are described below.

3.1.2.2.1 Automatic Samplers

The BTL system includes an ISCO model 3700 portable full-sized sampler that is used to collect 24-hour composite influent samples at station INF-04, and EFS-07.

3.1.2.2.2 pH Meter

Continuous pH monitoring of effluent is performed at station EFS-07 using pH meter AIT-ASB-4005. The pH meter is standardized daily by operations personnel to ensure accurate readings are maintained.

Field personnel also use a field-use, multi-meter to measure pH throughout the treatment process. Refer to BTL-SOP-36 for specific information related to the pH meter.

3.1.2.3 Butte Treatment Lagoons Sample Handling and Preservation

Field personnel will fill sample containers directly from one 2.5 gallon, 24-hour composite container located in the ISCO automatic sampler. If a 24-hour composite sample is not automatically collected by the ISCO sampler, field personnel will obtain a grab sample by directly filling the sample containers from the open end of the discharge pipe. Sample handling and preservation instructions are detailed in SOP-SA-02 provided in Appendix C of the main OM&M Plan.

Table 2 lists sample location, volume, frequency, handling and preservation, and analytical methods for specified parameters. Samples for dissolved metals analyses are filtered using a peristaltic pump with a new, disposable, high-volume filter capsule (0.45 micrometer) attached to the pump tubing (effluent): water is pumped through the filter directly into the sample container, and the sample container is preserved using the appropriate preservative. All samples will be preserved immediately following collection.

The samples will be preserved with the appropriate preservative for the analysis requested and stored in coolers (on ice) or refrigerated from the time of collection until delivery to the analytical laboratory. All samples will be handled and transferred following established chain of custody procedures using the chain of custody form (Appendix D of the main OM&M Plan). Samples will be prepared for shipment to the laboratory each Monday. If a national holiday falls on a Monday, samples will be shipped on the following Tuesday. Custody seals must be placed on shipped coolers to protect the integrity of the samples while in transit to the laboratory. The laboratory will dispose of any sample portion not used for analysis according to their sample disposal policy.

3.1.3 Butte Treatment Lagoons Surface Water Flow Monitoring

The system includes an in-line McCrometer model UM06-14 electromagnetic flow meter at station INF-04, and EFS-07 to collect instantaneous and continuous flow measurements.

3.2 Subdrain Sampling and Monitoring

Sampling and monitoring activities associated with the subdrain include semiannual sampling events at 5 manholes (MH) along the subdrain (MH-MSD106, 108, 110, 113, and 116), MSD-OUT, and the MSD-HCC discharge point in the BRW area, and continual flow meter measurements at each manhole (MH-MSD106, 108, 110, 113, and 116), which are recorded at 15-minute intervals and downloaded monthly.

3.2.1 Subdrain Sampling

Field personnel will collect samples for the subdrain at the 5 manholes along the subdrain alignment (MH-MSD106, 108, 110, 113, and 116), MSD-OUT, and at MSD-HCC (refer to Figure 2 for sampling locations) and submit them to the laboratory. Samples will be analyzed as listed in Table 4. Sampling will occur semiannually, and the events will be coordinated with BTL operations and will coincide with historic low flow and high flow groundwater periods, as described in the BPSOU CD (EPA, 2020a) and ESD (Appendix A to the BPSOU CD), based on historic trends. Low flow periods occur from approximately late October to early November of each year, and the high flow periods occur from late June to early July each year. Samples obtained from MSD-HCC during the semiannual sampling events are independent of monthly samples described in Section 3.1.2, thus generating 12 samples annually and additional field QC samples.

For each sample collected, field personnel will immediately take and record the following field parameters: pH, ORP, SC, temperature, and DO, as described in BTL-SOP-02 BPSOU Subdrain Sampling and Monitoring and BTL-SOP-08 BPSOU Subdrain Flow Meter Download in Appendix C of the main OM&M Plan. Field personnel will record the sample location, sample ID, date/time, and analysis information on the field form and record the final stabilized field parameters in a project-specific field logbook. All samples will be submitted to the laboratory (according to SOP-SA-01 Soil and Water Sampling Packaging and Shipping and SOP-SA-04 Chain of Custody Forms for Environmental Samples) to be analyzed for the parameters listed in Table 4.

3.2.1.1 Subdrain Sample Collection Methods

Field personnel will collect subdrain samples using a peristaltic pump, beginning at MH-MSD106 and ending at MH-MSD116 (refer to Figure 2). The tubing used to collect the sample must be set up differently than conventional monitoring well sampling protocol. In the process, hard tubing is taped to a polyvinyl chloride (PVC) pipe and placed in the inlet to the manhole to keep it in place at the center of flow laterally and vertically during sampling. Sample collection is described in detail in SOP-GW-10C and BTL-SOP-02 (Appendix C of the main OM&M Plan).

The following parameters will be obtained at each manhole location and be recorded in the field logbook. The associated SOP is included for reference after the parameter below and the SOPs are in Appendix C of the main OM&M Plan).

- pH (SOP-WFM-01).
- ORP (SOP-WFM-02).
- SC (SOP-WFM-03).
- Temperature (degrees Celsius) (SOP-WFM-04).
- DO (SOP-WFM-07).

3.2.1.2 Subdrain Sampling Equipment and Supplies

Field personnel will use a field-use, multi-meter to collect field parameter measurements (temperature, SC, pH and DO) during sample collection at each manhole.

The analytical laboratory performing the analysis will provide the required sampling supplies (bottles, labels, coolers, chain of custody forms, etc.). Equipment (pump, filters, gloves, etc.) necessary to complete the monitoring procedures will be provided and maintained on the site by the operating Contractor.

3.2.1.3 Subdrain Sample Handling and Preservation

Upon sample collection and preservation, water samples will either be placed in a cooler with ice or stored in the sample refrigerator located in the Operations Building at LAO and shipped the following day (according to SOP-SA-01). Samples will be recorded on a chain of custody form per SOP-SA-04, prior to being shipped to the laboratory. The laboratory will dispose of any sample portion not used for analysis according to their sample disposal policy. Appendix C of the main OM&M Plan contains the SOPs.

3.2.2 Subdrain Flow Monitoring

On a monthly basis, field personnel will download dataloggers from the flow meters within the manholes (according to BTL-SOP-08 BPSOU Subdrain Flow Meter Download in Appendix C of the main OM&M Plan) (Figure 2), verify that all the equipment is working properly, and measure and record human health air quality parameters within the manhole, depth to water in the manholes and piezometers, and manual flow velocities. All information (manual data and real-time flow readings) will be recorded on the field logbook (according to SOP-SA-05 Project Documentation). Downloaded flow data are saved to a dedicated server location and then uploaded to the project database.

3.2.2.1 Subdrain Flow Measurement

The AV flow meters are located at the inlet of each manhole (MH-MSD106, 108, 110, 113, and 116) shown on Figure 2. Manhole MH-MSD116 also contains an EM sensor installed in the outlet. The meter sensors are programmed to record the instantaneous measurements listed below at 15-minute intervals. Parameters and units are provided below for AV and EM sensors. Flow measurements will be logged to a continuous data logger and downloaded monthly.

AV flow meters

- Level – feet.
- Velocity – feet per second.
- Flow Rate – gallons per minute.
- Utilization – percent.
- Temperature – degrees Celsius.
- Input Voltage – volts.
- Velocity Signal – percent.
- Velocity Spectrum – percent.

EM sensor

- Level – feet.
- Velocity – feet per second.
- Flow Rate – gallons per minute.
- Utilization – percent.
- Temperature – degrees Celsius.
- Input Voltage – volts.

3.2.2.2 Subdrain Flow Meters

The AV flow meters are Teledyne ISCO 2150 AV flow meters. The EM flow meter installed in MH-MSD116 is a Marsh-McBirney Flo-Tote® EM sensor.

3.2.2.3 Subdrain Flow Meter Data Download

Field personnel will download subdrain groundwater flow monitoring data from each data logger monthly as described in BTL-SOP-08 (Appendix C of the main OM&M Plan).

3.3 Sample Handling and Chain of Custody

Samples will be obtained by treatment system operations personnel as described in BTL-SOP-17 (for the ISCO sampling) and BTL-SOP-24 (for effluent water grab sampling). Field personnel will collect the subdrain samples according to BTL-SOP-02 (SOPs are in Appendix C of the main OM&M Plan).

Upon sample collection and preservation, field sampling personnel will ensure samples are properly packaged and maintained for transport. Water samples will either be placed in a cooler with ice or stored in the sample refrigerator located in the Operations Building at LAO until they are shipped to the laboratory in a cooler with ice. Field personnel will record all samples on a chain of custody (Appendix D of the main OM&M Plan) form per SOP-SA-04 and handle and transfer the samples per SOP-SA-01 (Appendix C of the main OM&M Plan).

Upon receipt of samples at the analytical laboratory, the chain of custody form will be completed by the individual accepting the sample container, and temperature of the samples will be obtained and recorded on the Sample Condition Upon Receipt form.

3.3.1 Sample Identification and Labeling

Sample ID and labelling information are described below. Sampling ID includes alphanumeric coding that incorporates specific sample location and date of sample collection. This ID will include the project, site ID, and collection date. The site ID will be consistent with the point of sample collection shown on Figure 2. Sample collection date will follow a double-digit convention of month, day, and year format (mmddyy). Single digit months and days will contain "0" as a placeholder in the collection date. The sample ID will be recorded in the field logbook and will match the sample ID on the collection bottle and chain of custody form.

An example of an alpha numeric sample ID code would be LAO-SS-1-092215.

- LAO – Site code designating the site (LAO).
- SS – Sample site ID.
- Specific location code – field/tag ID (Table 2 indicates which location code is associated with each site).
- Date – Indicates the date the sample was collected in month, day, and year format (mmddyy).

An example of a sample ID for a sample collected from a subdrain manhole MH-MSD106 on November 13, 2020, would be LS-MH-MSD106-111320.

- LS – Site code designating the project (Loading Study).
- SS – Sample site ID.
- MH – manhole.
- Specific location code – field/tag ID (Table 2 indicates which location code is associated with each site).
- Date – Indicates the date the sample was collected in month, day, and year format (mmddyy).

Field quality samples will be assigned ID that includes alphanumeric coding and incorporates a unique specific sample location and date of sample collection. Field blank and field duplicate sample ID numbers will be recorded in the field logbook.

3.3.2 BTL Field Quality Assurance/Quality Control

Field QA/QC samples are assigned specific sample ID codes to represent field duplicates and blanks. The QA/QC ID codes for BTL are described below.

- SS-1T – field duplicate.
- SS-4 –field blank.
- SS-10 – equipment blank.

3.3.3 Subdrain Field QA/QC

Field QA/QC samples for subdrain samples are described below.

- 990 – field duplicate.
- 991 – equipment blank.

3.4 Instrument Calibration

All portable meters used in both surface water and subdrain monitoring and sampling will be calibrated daily according to the manufacturers' instructions issued with the equipment and the applicable SOPs: SOP-WFM-01 for pH, SOP-WFM-03 for SC, BTL-SOP-36 for pH meter recalibration, SOP-WMF-07 for DO, and SOP-WMF-02 for ORP (Appendix C of the main OM&M Plan). Field personnel will complete calibration requirements per the referenced SOPs daily, prior to use. Calibration results will be recorded in the field logbook.

3.5 Decontamination Procedures

All reusable equipment will be decontaminated after each use in accordance with SOP-DE-02 (for inorganic contaminants) (Appendix C of the main OM&M Plan). Decontamination procedures apply to all electronic probes used to collect field parameters (i.e., pH, SC, DO, etc.).

Field personnel will wipe off visible gross contamination with a paper towel, thoroughly spray the probes with deionized water, and shake excess liquid from the probe.

3.6 Analytical Methods

Analytical methods for metals and wet chemistry analyses will be completed using the methods listed in Table 2 and Table 4. Standard laboratory procedures (Appendix C of the main OM&M Plan) will be developed and maintained by the laboratory performing the analysis. Additional details related to the following sections are available in the laboratory Quality Assurance Manuals provided in Appendix C of the main OM&M.

3.6.1 Laboratory Equipment

The laboratory completing the analysis will complete metals analysis using the Inductively Coupled Plasma – Mass Spectrometer method, which uses an acid digestion of the samples followed by analysis on an Inductively Coupled Plasma – Mass Spectrometer instrument. To analyze mercury in water, the laboratory will use acid and oxidizing agent digestion of the samples followed by reduction to the metal and analysis of the vapor on an atomic absorption instrument.

3.6.2 Method Performance Criteria

In the laboratory, the limit of detection (LOD) is initially established for each analyte's method in a clean matrix with no target analytes present and no interferences at a concentration that would impact the results. The LOD is determined every time there is a change in the test method that affects how the test is performed or when there has been a change in the instrument that affects the sensitivity. The LOD is represented as the MDL in Table 2 and Table 4 for each compound analyzed.

The limit of quantitation is based on the lowest calibration standard concentration that is used in each initial calibration for every analyte of concern. The quantitation limits are provided in Table 2 and Table 4 and are referred to as the RL. The RL must be greater than the LOD (refer to Section 3.7.3). The laboratory should flag data that are between the MDL and RL as recommended.

3.6.3 Sample Disposal

The laboratory will dispose of any sample portion not used for analysis according to their sample disposal policy.

3.6.4 Laboratory Turnaround Schedule

Preliminary analytical results will be reported based on the standard turnaround time of two weeks. Finalized data will be in the full data package within four additional weeks of preliminary results.

3.6.5 Method Validation

Sample analysis for metals in water will be performed using EPA standard methods (EPA 200.8). Mercury analysis will be performed using a modified analysis method (EPA 245.1) to provide lower quantitation limits.

When non-standard methods are required, the laboratory will validate the method prior to applying to samples submitted under this QAPP. Method validation will be established by meeting criteria for precision and accuracy as specified in this QAPP (Section 3.7.3). Method validation will include an evaluation of sensitivity, quantitation, precision, bias, and selectivity of each analyte. The laboratory will record the validation procedure, results obtained, and provide a statement regarding usability of the method.

3.6.6 Quality Control Results Outside of Performance Criteria

If laboratory QC results fall outside of the performance criteria during analyses of the samples, corrective actions should be implemented immediately by the laboratory. The laboratory project manager should contact the CPM or Lead Operator to inform personnel of the issue. Following consultation, the Laboratory Quality Manager will approve implementation of a corrective action. Corrective actions may include re-running the analysis, diluting samples, completing additional sample extraction cleanup, etc. If the laboratory cannot correct the situation that caused the nonconformance, then the laboratory will immediately contact the QAO and request instructions regarding how to proceed with sample analyses. Corrective action implemented will be included with project summary reporting for Agency review.

3.7 Quality Control

Quality control samples will be generated in the field and laboratory.

3.7.1 Field-Generated Quality Control Samples

Field QC protocols will be consistent with the SOP-SA-03A (Appendix C of the main OM&M Plan). The QC samples will include at a minimum one field duplicate and one field blank collected each month or at a frequency of one in twenty samples (whichever is more frequent) for BTL sampling and one field duplicate, one field blank, and one equipment blank collected each sampling event for subdrain sampling:

Field duplicate: for the field duplicate, field personnel will concurrently collect two samples from one water sample location (in the field). The field duplicate will be analyzed for the same parameters as for the original sample (Table 2 or Table 4, depending on the type of sample). The field duplicate will be used to verify the reproducibility of the monitoring data.

Field blank: for the field blank, field personnel will pour deionized water directly into appropriate sample containers (in the field). The field blank will be analyzed for the parameters listed in Table 2 or Table 4, depending on the type of sample. The field blank will be used to verify the quality of the laboratory data and the cleanliness of the sample containers.

Equipment blank: for the equipment blank, field personnel will run deionized water through decontaminated re-usable equipment. The equipment blank will be analyzed for the same parameters as for the original sample (Table 2 or Table 4, depending on the type of sample). The equipment blank will be used to verify the effectiveness of decontamination procedures.

3.7.2 Laboratory-Generated Quality Control Samples

Laboratory QA/QC samples will be generated at a rate of 5% (1 per 20 analytical samples) or 1 per submitted batch, whichever is more frequent. Laboratory QA/QC samples will include the preparation blank, used to assess laboratory contamination and analytical bias near the limit of detection, and the LCS, used to determine accuracy of the preparatory steps and analyses. Additionally, laboratory duplicates, including LCS duplicates and/or LMS duplicates, will be used to determine precision of the preparatory steps and analyses. To obtain the LMS sample, the laboratory spikes the sample matrix with a known amount of analyte. The recovery of the analyte from the spiked sample matrix helps to assess the interferences present in the sample. These are the minimum number of QC samples used by the laboratory to monitor preparation and analyses. Other QC samples will be analyzed during instrumental analyses to monitor the accuracy and ongoing precision (drift) during the analytical run. Not all QC samples will be appropriate for every determinative method; however, the laboratory must apply as many QC sample types to each method as possible.

At a rate of 1 in 20 natural samples, a sample will be designated for use as a matrix spike sample on the chain of custody form in the notes/comments section for that sample. Additional volume for a matrix spike sample may be required depending on method.

3.7.3 Quality Control Statistics

Specific data validation processes ensure that analytical results are within acceptable limits. All the information gathered according to this QAPP will be checked to ensure the data are usable for their intended purposes. The data will be classified as enforcement or screening quality data with definitive confirmation and should meet data quality requirements for the sampling process. An evaluation of analytical control limits and of the PARCCS parameters will be performed. If significant issues with the data are found, data results will be discussed with the Agency project managers. Then, a decision can be made if the total study error could factor into or cause an incorrect decision. Using this approach, the probability of making an incorrect decision (i.e., either a false negative or positive) based on the information collected is considered small.

The definition of the PARCCS parameters along with calculations and the acceptance criteria for data collected is provided in Section 2.4.2.

3.8 Instrument/Equipment Testing, Inspection, and Maintenance

To ensure continual quality performance of any instruments or equipment, the testing, inspection, and maintenance activities listed in this section will be performed and documented.

3.8.1 Laboratory Equipment

Instruments used by the laboratories will be maintained in accordance with each laboratory's QA plan and analytical method requirements. All analytical measurement instruments and equipment used by the laboratory will be controlled by a formal calibration and preventive maintenance program.

The laboratories will keep maintenance records and make them available for review, if requested, during laboratory audits. Laboratory preventive maintenance will include routine equipment inspections and calibrations at the beginning of each day or each analytical batch, per the laboratory internal SOPs (Appendix C of the main OM&M Plan) and method requirements.

3.8.2 Field Equipment

Field equipment used for sampling is limited to the devices listed below.

- Rosemount model 1056-02-22-38-AN-UL pH analyzer with pH probe (Rosemount Analytical model 389VB-10-54) to provide continuous pH monitoring of effluent at station EFS-07.
- A field-use, multi-meter (temperature, SC, pH and DO), or equivalent, to measure pH throughout the treatment process.
- For subdrain data: A Marsh-McBirney Flo-Tote® EM sensor to provide flow rate, velocity, and temperature of subdrain flow.

Field personnel will examine field equipment to be used for sampling and analysis in the sample preparation area in the BTL Operations Building to certify that it is in proper operating order prior to its first use and at intermittent intervals during the day. Equipment, instruments, tools, and other items requiring preventative maintenance will be serviced in accordance with the manufacturers' specified recommendations. Any routine maintenance recommended by the manufacturer will also be performed and documented in field logbooks or appropriate data sheets.

3.8.3 Equipment Calibrations

Calibration of pH and field-use multi-meters will be performed daily per applicable SOPs (Appendix C of the main OM&M Plan) and manufacturers' instructions provided in user manuals. Measurements will be compared to standard units. For example, pH meters will be calibrated according to the manufacturer instructions and standard pH solution used to verify instrument readings.

3.8.4 Equipment Deficiencies

If equipment deficiencies are found, including calibration failures, the instrument will be immediately removed from service and repaired. Once failures have been resolved and testing/calibration demonstrates proper function, it will be returned to service. The Lead Operator, or designated alternative, will be responsible for conducting field checks and maintaining the equipment calibration logs.

3.8.5 Field Equipment Maintenance

Field equipment used for remediation and maintenance activities will be maintained as described in the manufacturers' recommendations. Equipment will be inspected and replaced, if needed, before it is transported to a field setting. Spare parts, including pH probes, transducers, and sample pumps, will be maintained in the BTL Operations Building.

The Lead Operator will be responsible for ensuring spare parts are readily available, and re-ordering sampling supplies. Sample bottles, coolers, etc. will be obtained from the analytical laboratory performing the sample analysis. Sample bottles will be visually inspected for damage and preservative prior to being deployed in the field. Bottles will not be opened prior to sampling.

3.9 Use of Existing Data (Non-direct Measurements)

Non-direct measurement and data include types of data not obtained through the project monitoring activities. Non-direct measurements referenced for the BTL include surface water monitoring performed along Silver Bow Creek and the HCC. Results from measurements performed by a third party will be provided to the Lead Operator. These data will be used to confirm groundwater capture along the BRW area to the east, along the D Cells to the west, and along the HCC to the north.

3.9.1 Data Sources

Some data are obtained from transducers installed within stilling wells in the HCC and monitoring wells along Silver Bow Creek. Staff gauges installed directly downgradient of the transducer locations are used to verify measurements.

3.10 Data Management

This section describes how the BTL system and individuals manage data, including field and laboratory data. Atlantic Richfield will maintain the QAPP quality records. These records, in either electronic or hard copy form, may include the following:

- Project work plans with any approved modifications, updates, and addenda.
- Project QAPP with any approved modifications, updates, or addenda and any approved corrective or preventative actions.

- Field documentation (including logbooks, data sheets, and photographs) in accordance with SOP-SA-05 (Appendix C of the main OM&M Plan).
- Chain of custody records (see Section 3.3 and SOP-SA-04 [Appendix C of the main OM&M Plan]).
- Laboratory documentation (results received from the laboratory will be documented in hard copy and in an electronic format).
- Associated reports.

Hard copy field and laboratory records will be maintained in the project's central data file where original field and laboratory documents are filed chronologically for future reference. These records are also scanned to produce electronic copies. The Water Treatment Project Manager is responsible for management of project data.

Preliminary sample results will be reported from the analytical laboratory based on the standard turnaround time of two weeks. Preliminary laboratory results will also be sent to the Lead Operator to review and interpret the treatment system operational performance.

Field data that have been reviewed and approved in a hard copy format will be entered into an electronic system to be uploaded to the project database. Laboratory EDDs provided in Microsoft Excel format and correlating PDF data packages will be reviewed as part of the internal data review process. Following these review steps, field and laboratory electronic data files will be imported to the project database. Standardized data import formats and procedures will be used to upload both field and laboratory data into the electronic database. Standardized parameter names, numerical formats, and units of measure will be applied to the original information to facilitate comparability across all data sets and within the database. Final validated results will be sent electronically to Atlantic Richfield or their representatives for review and inclusion into the BPSOU database.

Annual reports will be maintained in the project database as described in the BPSOU Quality Management Plan (Atlantic Richfield Company, 2020).

3.10.1 Data Collection and Recording

The BTL performance monitoring data collection is both automated and manual (field measurements).

3.10.1.1 BTL Data Collection

The operators collect field measurements daily from various locations throughout BTL and remote stations (Figure 2) according to the tasks described in the main OM&M Plan. Field data used for system performance monitoring consist of pre-treatment, in-process, and post-treatment data monitored to ensure final effluent meets discharge performance standards criteria. The data collection is both automated and manual at stations throughout the BTL and ancillary systems.

System performance monitoring data collected automatically is recorded by the SCADA system, displayed on the Human-Machine Interface screens located at the operator's centralized control center, and stored on a dedicated redundant computer hard drive. Data are stored within the historian database. This system provides real-time performance monitoring data and allows operators to monitor system operation and performance.

Performance monitoring field data collected manually consist of daily pH and temperature measurements obtained from sampling locations at LAO, shown on Figure 2. Field personnel collect analytical water samples from three influent source locations (INF-04 WCP-1 and MSD-HCC) and one effluent location (EFS-07) at BTL and send the samples to the laboratory. These samples provide information to determine treatment system effectiveness and compliance.

Field pH measurements obtained at sample locations (EFS-07, INF-04, WCP-1 and MSD-HCC) and lagoons cells (A2, A3, B2, B3, C2, and C3) are recorded manually each day in a field logbook, then transferred to a computer database.

Data recorded during routine sampling activities includes the following.

- Chain of custody records.
- Field data collection forms.
- Sampling notes in logbooks.
- Field instrument calibration logs.
- Photographs.

Data recorded automatically by the SCADA system include the following routine operating parameters monitored continuously by SCADA:

- Cell level.
- Flow rates.
- Lime feed rate.
- Pump run status.
- Effluent pH, and SC.

The automatic data are logged to the data historian database and used to monitor and confirm system performance. Performance monitoring data will be reported in weekly and monthly reporting (refer to Section 2.6).

3.10.1.1.1 Subdrain Data Collection

Subdrain monitoring data are recorded from locations identified on Figure 2. The subdrain monitoring data include flow measurements, groundwater level measurements, and analytical laboratory data. Field personnel download information from the dataloggers monthly per BTL-SOP-08 (Appendix C of the main OM&M Plan) and upload the information to the project database.

3.10.2 Analytical Data

Laboratory EDDs and related data packages will be reviewed as part of the internal data review process before the information is incorporated into the project database. Analytical data results are received in electronic Microsoft Excel format and imported into the project database for long-term data retention. Preliminary data are used for performance monitoring reporting. Validation information is in Section 5.1.5.

3.10.3 Data Archival and Retrieval

All raw data will be saved in a specific file format within the project file location to ensure associated figures or tables can be re-created if necessary. Standardized parameter names and formats will be applied to the original information to facilitate extraction and comparability across the database. Standardized data import formats and procedures will be used to upload both field and laboratory data into the electronic database, as well as to extract data from the database. All electronic files saved to the project directory will be backed up daily. The Lead Operator is responsible for archiving data.

4.0 ASSESSMENT AND OVERSIGHT

Assessment and oversight of data collection and reporting activities are designed to verify that sampling and analyses are performed in accordance with the procedures established in this QAPP. The audits of field and laboratory activities include two independent parts: internal and external audits. Internal audits will be performed by Atlantic Richfield, their contractor, or a contracted laboratory consultant, as necessary. External audits will be performed by EPA, as necessary. Performance and system audits of field and laboratory data collection and reporting procedures are described in this section.

All personnel will have the authority, obligation, and responsibility to stop work for situations involving imminent danger to health and safety of personnel and/or environment. Atlantic Richfield personnel, the QAM, the CPM, and the QAO have stop-work authority if they determine continued work will not support project objectives, meet quality management standards, or if completion of corrective actions is not acceptable.

Upon notice of stop work, the initiator will immediately notify the affected workforce and the immediate supervisor. Communication from the immediate supervisor to additional affected parties will follow the line of communication on Figure 1. Any problems and associated corrective actions identified, if applicable, will be documented on a Corrective Action Report (CAR) (Appendix D of the main OM&M Plan) as appropriate.

4.1 Field Data

Assessment of sampling data will be performed during fieldwork each day sampling is performed. Any equipment malfunctions and field data outliers will be reviewed by field technicians and reported verbally to the CPM as appropriate. All activities will be documented within the project field log and reported weekly. Equipment malfunctions will be remedied by following manufacturers' recommendations. Corrective actions during fieldwork will include replacing/repairing defective equipment and resampling to verify or negate original results. All field personnel will have the authority to stop work until any issues are remedied.

4.2 Laboratory Data

Laboratory assessments and corrective actions will follow established procedures and published performance criteria common to accredited facilities and will be documented and reported by the laboratory to the CPM. If a performance criteria issue is unresolved by established laboratory procedures, the CPM, in consultation with the Agencies, will resolve the issue by reanalyzing or resampling. Any actions outside the scope of this QAPP will be reviewed and approved by the Agencies prior to work being completed.

4.3 Audits and Reviews

Internal audits performed by Atlantic Richfield, their contractor, or a contracted laboratory consultant as necessary, may use Table D-16 of EPA QA/G-5 to document assessments (EPA, 2002).

4.4 Corrective Action Procedures

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out-of-QC performance, which can affect data quality. Corrective action can occur during field activities, laboratory analyses, and data assessment.

Non-conforming equipment, items, activities, conditions, and unusual incidents that could affect data quality and attainment of the project's quality objectives will be identified, controlled, and reported in a timely manner. For this QAPP, a non-conformance is defined as a malfunction, failure, deficiency, or deviation that renders the quality of an item unacceptable or indeterminate in meeting the project's quality objectives. Corrective actions implemented by field personnel will follow appropriate field SOPs (Appendix C of the main OM&M Plan) as necessary.

Corrective action in the laboratory may occur prior to, during, and after initial analyses. A number of conditions such as broken sample containers, preservation or holding-time issues, and potentially high-concentration samples may be identified during sample log in or just prior to analyses. Corrective actions to address these conditions will be taken in consultation with the CPM and reported on a CAR form (included in Appendix D of the main OM&M Plan). If corrective action requests are not in complete accordance with approved project planning documents, EPA will be consulted, and concurrence will be obtained before the change is implemented.

If, during sample analyses, the associated laboratory QC results fall outside of the project's performance criteria, the laboratory should initiate corrective actions immediately. If laboratory QC results are outside of the project specifications, the laboratory should take the appropriate corrective actions for the specific analytical method. Following consultation with laboratory analysts and section leaders, it may be necessary for the laboratory manager, or designated alternate, to approve implementing a corrective action. These conditions may include dilution of samples, additional sample extract cleanup, or automatic re-analysis when certain QC criteria are not met. If the laboratory cannot correct the situation that caused the non-conformance and an out-of-control situation continues to occur or is expected to occur, then the laboratory will immediately contact the CPM and request instructions regarding how to proceed with sample analyses.

Completion of any corrective action should be evidenced by data once again falling within the project's performance criteria. If this is not the case, and an error in laboratory procedures or sample collection and handling procedures cannot be found, the results will be reviewed by the CPM and Lead Operator to assess whether re-analysis or resampling is required.

All corrective actions taken by the laboratory will be documented in writing by the laboratory project manager and reported to the Lead Operator and CPM. If corrective action requests are not in complete accordance with approved project planning documents, EPA will be consulted, and concurrence will be obtained before the change is implemented. All corrective action records will be included with the QAPP records.

4.5 Corrective Action During Data Assessment

During data assessment, the QAO could identify the need for corrective action. Potential types of corrective action include resampling by the field team, re-analyzing samples by the laboratory, or re-submitting data packages with corrected clerical errors. The appropriate and feasible corrective actions are dependent on the ability to mobilize the field team and whether the data to be collected are necessary to meet the required QA objectives (e.g., the holding time for samples is not exceeded, etc.). If corrective action requests are not in complete accordance with approved project planning documents, EPA will be consulted, and concurrence will be obtained before the change is implemented. Corrective actions of this type will be documented by the QAO on a CAR and will be included in any subsequent reports.

4.5.1 Analytical Results Exceeding Standard

If laboratory analytical results exceed standard parameters, the Lead Operator will review associated analytical QA/QC and field data and may contact the laboratory project manager for additional review and request confirmation analysis to be performed as needed. Following any consultation and confirmation, if additional analysis is warranted the Laboratory Quality Manager may approve implementation of a corrective action. Corrective actions may include revised reporting or re-running the analysis or as described in Section 4.5.2 below. Any corrective action implemented will be included with project summary reporting for Agency review.

4.5.2 Correcting Errors

The Lead Operator is responsible for reviewing data and records to verify accuracy of data. Measurements are compared to historic values or standard calibration units. Errors identified in field data will be corrected by repeating the data collection process. Suspected errors in laboratory data will be reported to the CPM, who will coordinate with the laboratory to correct the error (refer to Section 3.6.6).

4.6 Reports to Management

A summary of assessments performed, and any corrective actions implemented will be provided in the annual report. Field quality assessments will be performed as determined by the QAO. A summary of the assessment will be completed by the QAO and provided to the CPM within 30 days of assessment.

5.0 DATA VALIDATION AND USABILITY

Data validation and usability elements are addressed in this section to determine if the data meet project DQOs described in Section 2.4 and to evaluate the data against the method, procedure, or contractual requirements. Assessments related to data verification, validation, and usability will be completed as summarized:

- Review field data and compare within seasonal range(s).
- Secondary review of field data entered into electronic device(s) to identify obvious anomalies.
- Screening level review of preliminary data results from the laboratory.
- Data validation by an objective, independent third-party.
- Assessment of data by the project team for usability as described below.

The final analytical data collected under this QAPP will undergo Stage 4 verification and validation as defined in EPA *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA, 2009).

5.1 Data Review, Verification, and Validation

This section describes the review, verification, and validation process for field data and laboratory data. The section also details laboratory data reporting requirements, which describe how results are conveyed to data users.

5.1.1 Data Review Requirements

Data review is performed by the data producer to ensure that the data have been recorded, transmitted, and processed correctly.

5.1.2 Internal Field Data Review

Field data review will include verification that any QC checks and calibrations, if necessary, were performed and were recorded properly in the field logbook and that any necessary actions were implemented and recorded. The QC and calibration data must be recorded in the field logbook at the time calibrations were completed. Any errors recorded in the logbook must be legibly crossed out with a single line strikeout and contain the initials of the field member, the date, and the correction in a space adjacent to the original (erroneous) entry. The Lead Operator will review the field logs to determine whether any transcription errors have been made. In the event of errors, the Lead Operator and field crew will address the errors to provide resolution.

The Lead Operator will review all field data for accuracy and completeness before the information is entered into the electronic database. Data entries will be made from the reviewed field data sheets or logbooks. The electronic data will be maintained as part of the project's quality records.

5.1.3 Internal Laboratory Data Review

The laboratory will perform initial internal data reduction as described in the individual laboratory's quality management plan. At a minimum, records will be maintained by the analysts to document sample ID number and the sample tag number with sample results and other details, such as the analytical method used (e.g., method SOP #), name of analyst, the date of analysis, matrix sampled, raw data, and flag unacceptable data. These records will be signed and dated by the analyst. A secondary review will be completed by the Laboratory Supervisor, laboratory project manager, or designated alternate. Hard copy records, or PDF files will be maintained to document completion of data reduction.

Records will also be maintained internally by laboratory personnel to include records of instrument calibrations and results and maintenance activities, as described within the laboratory's internal QA manual.

5.1.4 Data Verification Requirements

Data verification is the process for evaluating the completeness, correctness, and conformance / compliance of a specific data set against the method, procedural, or contractual specifications.

5.1.4.1 Field Data Verification

The Level A/B review, as described in the CFRSSI Data Management/Data Validation (DM/DV) Plan (ARCO, 1992b) and the CFRSSI DM/DV Plan Addendum (AERL, 2000), will be used in the verification process for field documentation related to samples collected for laboratory analysis.

The Level A criteria are:

- Sampling date.

- Sample team and/or leader.
- Physical description of sample location.
- Sample depth (soils).
- Sample collection technique.
- Field preservation technique.
- Sample preservation technique.
- Sample shipping records.

The Level B criteria are:

- Field instrumentation methods and standardization complete.
- Sample containers preparations.
- Collection of field duplicates.
- Proper and decontaminated sampling equipment.
- Field custody documentation.
- Shipping custody documentation.
- Traceable sample designation number.
- Field notebook(s), custody records in secure repository.
- Complete field forms.

5.1.4.2 Laboratory Data Verification

The laboratory will prepare full data packages for transmittal of results and associated QC information to Atlantic Richfield or its designee within a standard turnaround time, unless otherwise required.

The laboratory will prepare full data packages in general accordance with EPA Contract Laboratory Program Statement of Work (Multi-Media, Multi-Concentration) (EPA, 2016b). Deviations from these specifications should be acceptable provided the report presents all the requested types of information in an organized, consistent, and readily reviewable format.

Each data package, as described above, will be accompanied by an EDD prepared by the laboratory. Additional laboratory QC data can be included in the EDD. The EDDs will be cross checked against corresponding data reports to confirm consistency in results reported in these two separate formats. This cross check will take place as part of the data verification process.

The data packages from the laboratory will contain the following minimum information:

- A narrative addressing any anomalies encountered during sample analysis, and a discussion of any exceedances in the laboratory QC sample results.
- Analytical method references.

- Definition of any data flags or qualifiers used.
- Chain of custody documentation signed and dated by the laboratory to indicate sample receipt.
- MDLs and RLs.
- Analytical results for each field sample.
- QC sample results (as applicable).

Full data packages will also include raw data as well as results for all QC samples and calibration data.

5.1.4.3 Resolution of Deficiencies

Any deficiencies found during the verification process will be discussed with the data producer and may be resolved with a revised data package.

5.1.5 Data Validation Requirements

Data validation is the process of ensuring data are correct and useful. Data validation will be performed by qualified, independent data validation personnel who are not associated with data collection or sampling responsibilities and who have applicable training. The QC criteria used during the data validation process will follow the NFG for Inorganic Superfund Methods Data Review (EPA, 2020b), except when superseded by the CFRSSI QAPP (ARCO, 1992a), the CFRSSI DM/DV Plan (ARCO, 1992b), the CFRSSI Pilot Data Report Addendum (ARCO, 2000), laboratory-specific QC criteria, and/or method-specific criteria where applicable. All data collected under this QAPP will be validated to Stage 4 requirements using the QC criteria outlined in Table 5, and data quality will be classified as enforcement, screening, or rejected as discussed in Section 5.3.

5.2 Verification and Validation Methods

The Level A/B Assessment and data validation checklists included in Appendix D of the main OM&M Plan are based on the CFRSSI DM/DV Plan Addendum (AERL, 2000) guidance.

Stage 4 verification and validation checks include an evaluation of the following, as applicable for each analytical method:

- Completeness of laboratory data package.
- Requested analytical methods performed.
- Raw data included.
- Case narrative.
- Holding times.
- Reported detection limits.
- Dilution factors.

- Instrument calibration.
- Internal Standards.
- Tuning.
- Initial and Continuing Calibration Verification Standards.
- Initial and Continuing Calibration Blank Standards.
- Method blanks.
- Low Level Initial Calibration Verification Standards (also referred to as the Contract Required Detection Limit standards).
- Matrix spike samples/matrix spike duplicates/post digestion spike samples.
- LCS and LCS duplicates.
- Laboratory duplicate samples.
- Interference check samples.
- Serial Dilution.
- Field blanks.
- Field duplicates.

Data qualifiers will follow those used in EPA NFG (EPA, 2020b). Data validation for each laboratory data package will be documented on the data validation checklists in Appendix D of the main OM&M Plan.

The data validator will be responsible for reviewing field documentation associated with sample collection, conducting the verification and validation of laboratory-produced data, and completing a data validation report, which will be reviewed by the CPM. A detailed validation standard procedure is in Appendix C of the Routine OM&M Plan (SOP-DV-01).

5.3 Reconciliation with User Requirements

The Data Quality Assessment (DQA) process described in the CFRSSI DM/DV Plan Addendum (AERL, 2000) and the Guidance for DQA EPA QA/G-9 (EPA, 2000) will be performed to determine whether project-specific DQOs have been satisfied. The DQA process consists of five steps that relate the quality of the results to the intended use of the data:

Step 1: Review DQOs and sampling design.
Step 2: Conduct preliminary data review.
Step 3: Select statistical test(s), as appropriate, to evaluate data quality.
Step 4: Verify assumptions.
Step 5: Draw conclusions about the quality of the data (data report will not include interpretation of results but will state conclusions regarding the quality of the results).

If, as a result of the DQA process, it is determined that data do not satisfy all DQOs, then corrective action(s) should be recommended. Corrective actions include, but are not limited to, revision of the DQOs based on the results of the investigation or collection of more information or data. It may be determined that corrective actions are not required, or the decision process may continue with the existing data, with recognition of the limitations of the data.

The PARCCS data quality indicators (Section 2.4.2) will be used when conducting the DQA. If the PARCCS assessment satisfies the project DQOs, then usability of the data will follow the enforcement/screening/unusable data categories as described in the CFRSSI DM/DV (ARCO, 1992b):

1. Enforcement Quality (Unrestricted Use) Data

   Enforcement quality data may be used for all purposes under the Superfund program including the following: site characterization, health and safety, Environmental Evaluation/Cost Analysis, remedial investigation/feasibility study, alternatives evaluation, confirmational purposes, risk assessment, and engineering design.

2. Screening Quality (Restricted Use) Data

   Potential uses of screening quality data, depending upon their quality, include site characterization, determining the presence or absence of contaminants, developing or refining sampling and analysis techniques, determining relative concentrations, scoping and planning for future studies, engineering studies and engineering design, and monitoring during implementation of the response action.

3. Unusable Data

   These data are not useable for Superfund-related activities.

Data that meet the Level A and Level B criteria and are not qualified as estimated or rejected during the data validation process are assessed as enforcement quality data and can be used for all Superfund purposes and activities. Data that meet only the Level A criteria and are not rejected during the data validation process can be assessed as screening quality data. Screening quality data can be used only for certain activities, which include engineering studies and design. Data that do not meet the Level A and/or B criteria and/or are rejected during the data validation process are designated as unusable. The data are assigned one of the following qualifiers:

E = Enforcement quality. No qualifiers or U qualifier and meets Level A and B criteria.
S = Screening quality. J or UJ qualifier and/or meets only Level A criteria.
R = Unusable. R qualifier and/or does not meet Level A or B requirements.

Enforcement/Screening Designation

Data Validation Qualifier	Meets Level A and B	Meets Level A	Does not meet Level A or B
No qualifier, A, or U	E	S	R
J, J+, J-, or UJ	S	S	R
R	R	R	R

Note: Results qualified as estimated by the laboratory because they are between the MDL and RL, and are not qualified for any other reason, are considered enforcement quality data.

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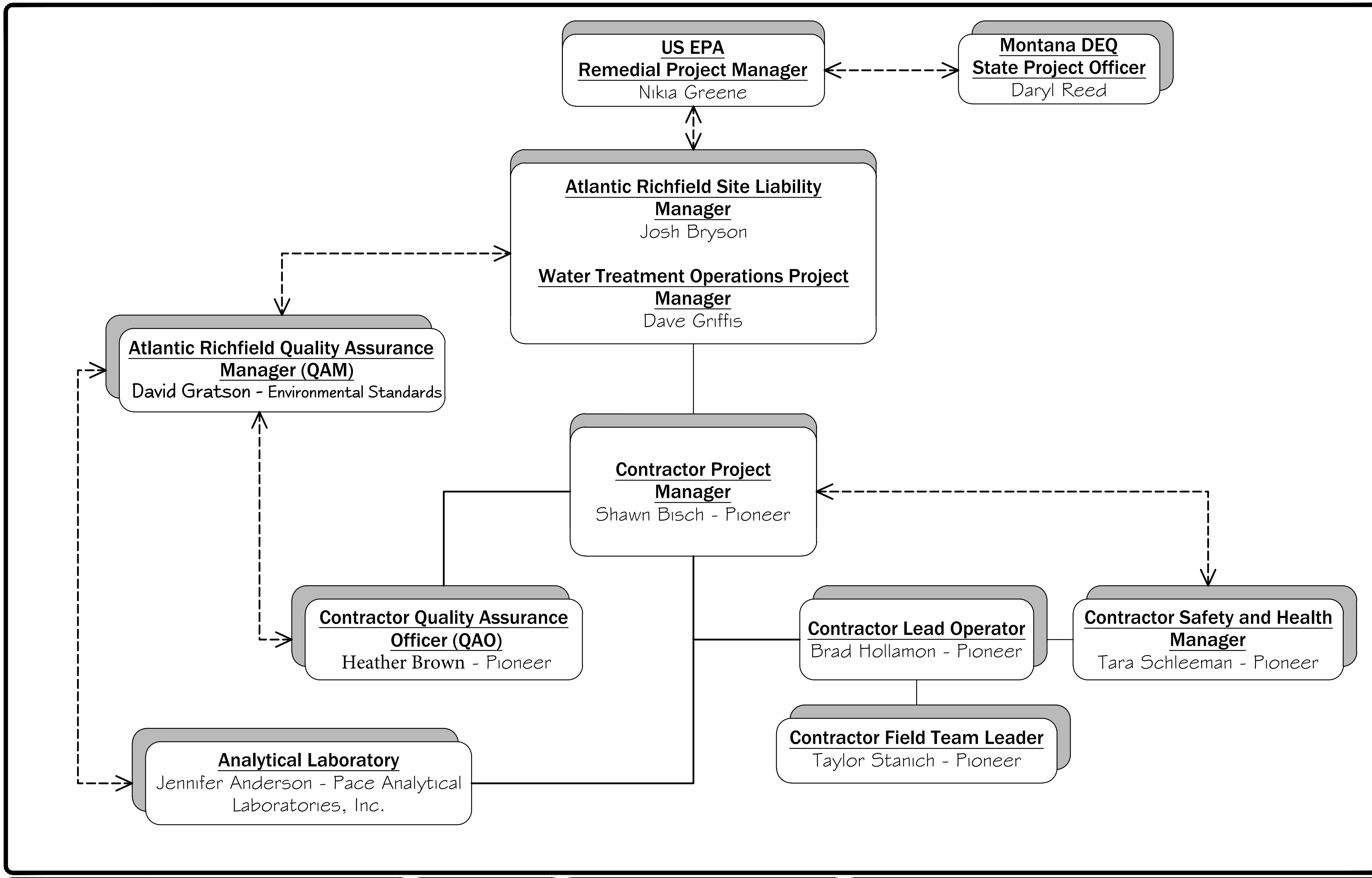
FIGURES

Figure 1. Project Organization and Communication
Figure 2. BTL and BPSOU Subdrain Routine Sample and Monitoring Locations



- - -> COMMUNICATION

DISPLAYED AS:
COORD SYS/ZONE: NA
DATUM: NA
UNITS: NA
SOURCE: PIONEER

SCALE IN FEET
0 N.T.S.

FIGURE 1

PIONEER TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406)-782-5177

PROJECT ORGANIZATION AND COMMUNICATION

DATE: 6/2022

11/3/2020 1:25:40 PM Z:\SHARED\ACTIVE PROJECTS\ARCO\BPSOU\BTL\ORGCHART.DWG

Point Table		
Description	Northing	Easting
MH-MSD106	651209.02	1197905.47
MH-MSD108	651265.29	1198781.03
MH-MSD110	651503.81	1199850.85
MH-MSD113	652414.06	1200906.31
MH-MSD116	653236.82	1201858.01
MSD-HCC	651600.21	1194949.19
MSD-OUT	651324.20	1197083.50
A1	651838.45	1192164.94
A2	651931.22	1191690.21
A3	652055.47	1191180.80
B1	651484.14	1192551.84
B2	651657.02	1192233.20
B3	651702.08	1192096.79
C1	651464.96	1192558.36
C3	651541.57	1192046.18
INDC	651511.64	1192604.67
INF04	651457.40	1192637.70
EFS-07	651925.98	1191093.47
WCP-1	652590.76	1194821.36

LEGEND:
- BTL ANALYTICAL SAMPLE COLLECTION
- SUBDRAIN LOADING - FLOW WATER LEVEL, FIELD PARAMETERS. ANALYTICAL SAMPLES
- BTL FIELD DATA - LEVEL
- BTL FIELD DATA- pH, TEMP, CONDUCTIVITY
- INDC

N

DISPLAYED AS:
COORD SYS/ZONE: MSP
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER

SCALE IN FEET
0 100 200

FIGURE 2

PIONEER TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

BTL AND BPSOU SUBDRAIN ROUTINE SAMPLE AND MONITORING LOCATIONS

DATE: 7/2022

TABLES

Table 1. Applicable or Relevant and Appropriate Requirements
Table 2. BTL Analytical Parameters and Methods
Table 3. BTL Sample Location and Frequency
Table 4. Subdrain Monitoring Analytical Parameters and Methods
Table 5. Stage 4 Data Validation Guidelines for Butte Treatment Lagoon Weekly and Monthly Monitoring Samples and the Semi-Annual Subdrain Loading Sampling.

Table 1. Applicable or Relevant and Appropriate Requirements (ARARs)

CONSTITUENT	Fraction	BTL EFFLUENT Standard	Notes
Aluminum	Dissolved	87 µg/L	Chronic aquatic standard
Arsenic	Total Recoverable	10 µg/L	Human health standard
Cadmium	Total Recoverable	0.097 µg/L @ 25 mg/L hardness	Chronic aquatic standard
Copper	Total Recoverable	2.85 µg/L @ 25 mg/L hardness	Chronic aquatic standard
Iron	Total Recoverable	1,000 µg/L	Chronic aquatic standard
Lead	Total Recoverable	0.545 µg/L @ 25 mg/L hardness	Chronic aquatic standard
Mercury	Total Recoverable	0.05 µg/L	Human health standard
Silver	Total Recoverable	0.374 µg/L @ 25 mg/L hardness	No chronic standard listed for silver, thus, acute standard applies
Zinc	Total Recoverable	37 µg/L @ 25 mg/L hardness	Chronic aquatic standard
pH	NA	Between 6.5 and 9.5 S.U.	

µg/L = microgram per liter; mg/L= milligram per liter

Table 2. BTL Analytical Parameters and Methods

Sample Location / Frequency

Parameters	INF-04 (SS-2)	EFS-07 (SS-1)	MSD-HCC (SS-3)	WCP-1 (SS-5)	Sample Handling & Preservation	Anticipated Method Detection Limit (MDL)[1] (mg/L)	2021 MDL	Anticipated Reporting Limit (RL)[1] (mg/L)	2021 RL	MT DEQ-7 Required Reporting Limit[2] (mg/L)	Holding Time	Method Name	Source	Laboratory
Nitrate/Nitrite	1,000 ml, 250 ml sample from 24-hr composites once per month.	1,000 ml, 250 ml sample from 24-hr composites once per month.	1,000 ml, 250 ml grab sample taken once per month.	1,000 ml, 250 ml grab sample taken once per month.	Pre-preserved with sulfuric acid.	0.1	0.095	0.2	0.2	0.02	28 days	SM4500NO3-H	APHA 1995	PACE
						0.031		0.1			28 days	353.2	EPA	PACE
Total Alkalinity					Raw-cool to < 6 C. Unpreserved bottle.	1.8	2	5	5	N/A	14 days	SM 2320B	APHA 1995	PACE
Total Dissolved Solids (TDS)						5	5	10	10	N/A	7 days	SM 2540C	APHA 1995	PACE
Total Suspended Solids (TSS)						5	5	10	10	N/A		SM 2540D	APHA 1995	PACE
Sulfate						1.2	1.2	2.5	2.5	N/A	28 days	D516	ASTM	PACE
						0.43		1.2			28 days	300.0	EPA	PACE
Total Recoverable and Dissolved Metals[3]														
Aluminum (Al)	250 ml sample from 24-hr composite; once per month.	250 ml sample from 24-hr composite twice per week.	250 ml grab sample taken once per month	250 ml grab sample taken once per month	Pre-preserved with nitric acid. Dissolved (EFS-07 only) is filtered thru a 0.45 µm filter prior to preservation.	0.008	0.0071	0.02	0.02	0.009	6 months	200.8	EPA	PACE
Calcium (Ca)						0.018	0.015	0.04	0.04	N/A		200.8	EPA	PACE
Magnesium (Mg)						0.0034	0.0039	0.01	0.01	N/A		200.8	EPA	PACE
Arsenic (As)						0.000083	0.00014	0.0005	0.0005	0.001		200.8	EPA	PACE
Cadmium (Cd)						0.000016	0.00003	0.00008	0.00008	0.00003		200.8	EPA	PACE
Copper (Cu)						0.0005	0.00043	0.001	0.001	0.002		200.8	EPA	PACE
Iron (Fe)						0.012	0.012	0.05	0.05	0.02		200.8	EPA	PACE
Lead (Pb)						0.000028	0.000043	0.0001	0.0001	0.0003		200.8	EPA	PACE
Silver (Ag)						0.00016	0.000077	0.0005	0.0005	0.0002		200.8	EPA	PACE
Uranium (U)						0.000022	0.000028	0.0005	0.0005	N/A		200.8	EPA	PACE
Zinc (Zn)						0.002	0.0023	0.005	0.005	0.008		200.8	EPA	PACE
Total Hardness by 2340B (calculated)[4]						0.06	0.054	0.14	0.14	N/A		200.8	EPA	PACE
Mercury (Hg)7						#N/A	0.0000045	#N/A	0.00001	#N/A	28 days	245.1 (low level)	EPA	PACE
Sample Frequency[5,6]	Table 3	Table 3	Table 3	Table 3	Table 3									

Notes:

1. The laboratory updates MDLs and RLs periodically. The listed values are from January 2022.
2. For the analytes with a Required Reporting Limit listed in the most recent publication of the MT DEQ-7 (2019), this value is used for sensitivty assessment. Because Pace reports results between the MDL and RL, if the MDL is less than the Required Reporting Limit, the requirement is met. Note the Required Reporting Limit for nitrate/nitrite is less than Pace's MDL for this analyte. The MT DEQ-7 human health standard for nitrate/nitrite is 10 mg/L; therefore, this MDL is considered low enough to meet project needs.
3. Dissolved samples are collected at EFS-07 by field personnel, submitted to the laboratory, and archived by the laboratory for six months, then disposed. Analysis can be performed at the request of the Agencies or site operations personnel.
4. Total Hardness is calculated by method SM 2340B from the results of total recoverable Mg and Ca by method EPA 200.8.
5. One field duplicate sample set will be collected once per month at the effluent EFS-07) sample stations to include Raw and TR metals Parameters.
6. One Field Blank/Equipment Blank sample will be collected once per month and delivered to the analytical laboratory for the same analysis as requested for the actual sample stations to include Raw and TR metals Parameters.
7. Mercury method 245.1 will be used as an alternate method if the reporting limit is below the Human Health Standard, Method 1631 will be used if either method 245.1 or 245.1 low level is unavailable.

Table 3. BTL Sample Location and Frequency

Weekly				
	TR Metals	**DISS Metals**	**Days Collected**	
EFS-07	X	X	Mon, Thurs	
INF-04	X		Mon	
Diss. sample is archived.				
Monthly				
	TR Metals	**DISS Metals**	**RAW Parameters**	**Days Collected**
EFS-07	X	X	X	Middle of month
INF-04	X		X	Middle of month
Duplicate[1]	X		X	Middle of month
Blank[2]	X		X	Middle of month
WCP-1	X		X	Middle of month
MSD-HCC	X		X	Middle of month
Diss. sample is archived.				

1. One field duplicate sample set will be collected once per month at the effluent EFS-07) sample stations to include Raw and TR metals Parameters.
2. One Field Blank/Equipment Blank sample will be collected once per month and delivered to the analytical laboratory for the same analysis as requested for the actual sample stations to include Raw and TR metals Parameters.

Table 4. Subdrain Monitoring
Analytical Parameters and Methods

Sample Location / Frequency

Parameters	MH-MSD106	MH-MSD108	MH-MSD110	MH-MSD113	MH-MSD116	MSD-HCC (LAO-SS-3)	MSD-OUT	Sample Handling & Preservation	Holding Time	Anticipated Method Detection Limit (MDL)[1] (mg/L)	Anticipated Reporting Limit (RL)[1] (mg/L)	MT DEQ-7 Required Reporting Limit[2] (mg/L)	Method Name	Source	Laboratory
Nitrate/Nitrite	250 mL sample; twice per year; one high flow conditions one at low flow conditions	250 mL sample; twice per year; one high flow conditions one at low flow conditions	250 mL sample; twice per year; one high flow conditions one at low flow conditions	250 mL sample; twice per year; one high flow conditions one at low flow conditions	250 mL sample; twice per year; one high flow conditions one at low flow conditions	250 mL sample; twice per year; one high flow conditions one at low flow conditions	250 mL sample; twice per year; one high flow conditions one at low flow conditions	Pre-preserved with sulfuric acid.	28 days	0.095	0.2	0.02	SM4500NO3-H	APHA 1995	PACE
										0.031	0.1		353.2	EPA	PACE
Sulfate								Raw- cool to < 6 C. Unpreserved bottle.		1.2	2.5	N/A	D516	ASTM	PACE
										0.43	1.2		300.0	EPA	PACE
Fluoride[3]										0.044	0.1	0.2	SM4500DF/C	APHA 1995	PACE
										0.015	0.05		300.0	EPA	PACE
Total Recoverable and Dissolved Metals															
Aluminum (Al)	250 mL sample; twice per year; one high flow conditions one at low flow conditions	250 mL sample; twice per year; one high flow conditions one at low flow conditions	250 mL sample; twice per year; one high flow conditions one at low flow conditions	250 mL sample; twice per year; one high flow conditions one at low flow conditions	250 mL sample; twice per year; one high flow conditions one at low flow conditions	250 mL sample; twice per year; one high flow conditions one at low flow conditions	250 mL sample; twice per year; one high flow conditions one at low flow conditions	Pre-preserved with nitric acid. Dissolved is filtered thru a 0.45 µm filter prior to preservation.	6 months	0.0071	0.02	0.009	200.8	EPA	PACE
Calcium (Ca)										0.015	0.04	N/A	200.8	EPA	PACE
Magnesium (Mg)										0.0039	0.01	N/A	200.8	EPA	PACE
Arsenic (As)										0.00014	0.0005	0.001	200.8	EPA	PACE
Cadmium (Cd)										0.00003	0.00008	0.00003	200.8	EPA	PACE
Copper (Cu)										0.00043	0.001	0.002	200.8	EPA	PACE
Iron (Fe)										0.012	0.05	0.02	200.8	EPA	PACE
Lead (Pb)										0.000043	0.0001	0.0003	200.8	EPA	PACE
Silver (Ag)										0.000077	0.0005	0.0002	200.8	EPA	PACE
Uranium (U)										0.000028	0.0005	N/A	200.8	EPA	PACE
Zinc (Zn)										0.0023	0.005	0.008	200.8	EPA	PACE
Boron (B)[3]										0.0046	0.01	N/A	200.8	EPA	PACE
Lithium (Li)[3]										0.00014	0.0005	N/A	200.8	EPA	PACE
Total Hardness by 2340B (calculated)[4]										0.054	0.14	N/A	200.8	EPA	PACE
Mercury (Hg)									28 days	0.0000045	0.00001	0.000005	245.1 (low level)	EPA	PACE
Sampling Frequency[5]	2/year	2/year	2/year	2/year	2/year	2/year	2/year	2/year							

Notes:

1. The laboratory updates MDLs and RLs periodically. The listed values are from December 2020.
2. For the analytes with a Required Reporting Limit listed in the most recent publication of the MT DEQ-7 (2019), this value is used for sensitivty assessment. Because Pace reports results between the MDL and RL, if the MDL is less than the Required Reporting Limit, the requirement is met. Note the Required Reporting Limit for nitrate/nitrite is less than Pace's MDL for this analyte. The MT DEQ-7 human health standard for nitrate/nitrite is 10 mg/L; therefore, this MDL is considered low enough to meet project needs.
3. These analytes have been identified as unique indicators of specific sources within the upper Silver Bow Creek drainage basin.
4. Total Hardness is calculated by method SM 2340B from the results of total recoverable Mg and Ca by method EPA 200.8.
5. One Field Blank sample and one field duplicate will be collected during each sampling event.

Table 5. Level 4 Data Validation Guidelines for Butte Treatment Lagoon Weekly and Monthly Monitoring Samples and the Semi-Annual Subdrain Loading Sampling.

Quality Control	Frequency	Acceptance Criteria		Criteria Exceedance	Action: Associated Sample Result[1] - Detected	Action: Associated Sample Result[1] - Non-Detected	DV Reason Code	Reference
Field Quality Control Samples								
Field Blank	One per month	≤ 2x MDL		> 2x MDL	U for result < 5x blank	No Qualification	FB	CFRSSI QAPP
Field Duplicate Sample	One per month	1. If both original sample and duplicate sample results are ≥ 5x RL, then RPD ≤ 20%; 2. If original sample or duplicate sample result < 5x RL (including non-detects[2]), then absolute difference between sample and duplicate ≤ RL		Both original and duplicate sample results are ≥ 5x RL and RPD is > 20%	J	UJ	FD	CFRSSI QAPP, NFG
				RPD > 100%	professional judgement	professional judgement		
				Original sample or duplicate sample result is < 5x RL and absolute difference between the sample and duplicate > RL	J	UJ		
Laboratory Quality Control Samples								
Preservation	Every sample	EPA 200.8	pH < 2 (HNO_3)	samples received with pH > 2 and pH not adjusted	J-	professional judgment, UJ or R	Pres	Pace SOP
		EPA 245.1	pH < 2 (HNO_3)					
		SM 4500-NO3-H	pH<2 (H_2SO_4), < 6°C	samples received with pH > 2 and pH not adjusted (for samples with acid preservation); Receiving temperature at lab >6°C	J-	professional judgment, UJ or R		
		EPA 353.2	pH<2 (H2SO4), < 6°C					
		SM 4500DF/C	N/A					
		SM 2320B	< 6°C					
		SM 2540C/D	< 6°C					
		ASTM D516	< 6°C					
		EPA 300.0	< 6°C					
Holding Time	Every analysis	EPA 200.8	180 days	Samples analyzed outside of technical hold times	J- or R for gross exceedance >2x hold time	UJ or R for gross exceedance >2x hold time	H	Pace SOP
		EPA 245.1	28 days					
		SM 4500-NO3-H	28 days					
		EPA 353.2	28 days					
		SM 4500DF/C	28 days					
		SM 2320B	14 days					
		SM 2540C/D	7 days					
		ASTM D516	28 days					
		EPA 300.0	28 days					
Tune Analysis	EPA 200.8 only Prior to every calibration	Resolution of the mass calibration to within 0.1 u over the range of 6-		Resolution of mass calibration not within 0.1 u.	J	UJ	Tune	NFG
		%RSD ≤5% for each isotope of the analyte.		%RSD > 5%	J	UJ		
		Appropriate number of analytes and tuning solution analyzed or scanned at least 5 times consecutively.		If tune not performed or not performed properly	Not performed - R incomplete - J or R	Not performed - R incomplete - UJ or R		
Initial Instrument Calibration	Daily	EPA 200.8	a blank and at least 3 non-zero standards	Calibration not performed or incomplete. Calibration performance criteria not met.	Not performed - R incomplete - J or R criteria not met - J	Not performed - R incomplete - UJ or R criteria not met - UJ	Cal	Pace SOP
			r≥0.998					
	Daily	EPA 245.1	a blank and at least 5 non-zero standards					
			r≥0.995					
	Daily	SM 4500-NO3-H	a blank and 7 non-zero standards					
			r≥0.995					
	Daily	EPA 353.2	a blank and 6 non-zero standards					
			r≥0.995					
	Daily	SM 4500DF/C	three calibration standards					
			Slope > 47.3 mV					
	Prior to analysis	SM 2320B	three point pH calibration					
			slope 96-106%					
			pH calibration check ± 0.1 su					
	At instrument set up	ASTM D516	a blank and at least 3 non-zero standards					
			r≥0.990					
	Every 90 Days	EPA 300.0	a blank and at least 5 non-zero standards					
			r≥0.995					

Table 5. Level 4 Data Validation Guidelines for Butte Treatment Lagoon Weekly and Monthly Monitoring Samples and the Semi-Annual Subdrain Loading Sampling.

Quality Control	Frequency	Acceptance Criteria	Criteria Exceedance	Action		DV Reason Code	Reference
				Associated Sample Result[1] - Detected	Associated Sample Result[1] - Non-Detected		
	N/A	SM 2540C/D	N/A				

Table 5. Level 4 Data Validation Guidelines for Butte Treatment Lagoon Weekly and Monthly Monitoring Samples and the Semi-Annual Subdrain Loading Sampling.

Quality Control	Frequency	Acceptance Criteria	Criteria Exceedance	Action: Associated Sample Result[1] - Detected	Action: Associated Sample Result[1] - Non-Detected	DV Reason Code	Reference
Initial Calibration Verification (ICV), Continuing Calibration Verification (CCV)	ICV - Immediately after system is calibrated CCV- every 10 sample	%R 90-110% %R 95-115% for EPA 245.1 N/A for SM 240C/D	ICV/CCV %R < 75%	professional judgement, J or R	professional judgement, UJ or R	ICV CCV	Pace SOP
			ICV/CCV %R 75-LCL%	J	UJ		
			ICV/CCV %R UCL-125%	J+	No Qualification		
			ICV/CCV %R > 125%	professional judgement, J+ or R	No Qualification		
Initial Calibration Blank (ICB), Continuing Calibration Blank (CCB)	ICB - Following ICV after initial calibration CCB - Following each CCV	Absolute value of blank result < 2x the IDL	Positive blank result- > 2x IDL	U for result < 5x blank detection	No Qualification	ICB CCB	CFRSSI QAPP
			Negative blank results - absolute value > 2x IDL	J- for result <5x absolute value of blank detection	UJ		
Method Blank (MB)	Each analytical batch of samples for every 20 (or fewer) samples received	Absolute value of blank result < 2x the MDL	Positive blank result- > 2x MDL	U for result < 5x blank detection	No Qualification	MB	CFRSSI QAPP
			Negative blank results - absolute value > 2x MDL	J- for result <5x absolute value of blank detection	UJ		
Interference Check Sample (ICS)	EPA 200.8 only At the beginning of each analytical sequence.	80 - 120% recovery -OR- within ± 2x the RL (whichever is greater for analytes and interferents present in Solution A and AB).	ICS not analyzed or not analyzed in proper sequence	professional judgement (R if not analyzed)	professional judgement (R if not analyzed)	ICS	NFG
			ICS Solution AB %R<50%	J-	R		
			ICS Solution A and AB %R 50-79% OR ICS found value is < (true value - 2x RL), whichever is greater.	J-	UJ		
			ICS Solution A and AB %R >120% -OR- the ICS found value is > (true value + 2x RL) whichever is greater.	J+	No Qualification		
			ISC Solution A and AB >150%.	professional judgement	professional judgement		
		< MDL for analytes not present in Solution A.	Sample results for analytes not present in the ICS ≥MDL, and interferents are present in associated samples at similar or higher concentrations as in the ICS solutions.	J+ for results < 10x the ICS detection	No Qualification		
			Negative sample results for analytes not present in the ICS with an absolute value ≥MDL, and interferents are present in associated samples at similar or higher concentrations as in the ICS solutions.	J- for results <10x the absolute value of the ICS detection	UJ		
Low Level Initial Calibration Verification (LLICV)[3]	EPA 200.8 and 245.1 only At the beginning of the analytical run	%R 60-140% for EPA 200.8 %R 70-130% for EPA 245.1	%R < LCL	J- for results < true value of ICV	UJ	CS	Pace SOP
			%R > UCL	J+ for results < true value of ICV	No Qualification		
Laboratory Control Sample (LCS)	Each analytical batch of samples for every 20 (or fewer) samples received	%R 80-120%	%R < 40%	J-	R	L%	CFRSSI QAPP, NFG
			%R 40-79%	J-	UJ		
			%R > 120%	J+	No Qualification		
			%R > 150%	R	No Qualification		
Laboratory Duplicate Sample (LDS)[4]	Each analytical batch of samples for every 20 (or fewer) samples received	1. If both original sample and duplicate sample results are ≥ 5x RL, then RPD ≤ 20%; 2. If original sample or duplicate sample result < 5x RL (including non-detects[2]), then absolute difference between sample and duplicate ≤ RL	Both original and duplicate sample results are ≥ 5x RL and RPD is > 20%	J	UJ	D%	CFRSSI QAPP, NFG
			RPD > 100%	professional judgement	professional judgement		
			Original sample or duplicate sample result is < 5x RL and absolute difference between the sample and duplicate > RL	J	UJ		

Table 5. Level 4 Data Validation Guidelines for Butte Treatment Lagoon Weekly and Monthly Monitoring Samples and the Semi-Annual Subdrain Loading Sampling.

Quality Control	Frequency	Acceptance Criteria	Criteria Exceedance	Action: Associated Sample Result[1] - Detected	Action: Associated Sample Result[1] - Non-Detected	DV Reason Code	Reference
Laboratory Matrix Spike (LMS) and Post-Digestion Spike (PDS)	Each analytical batch of samples for every 20 (or fewer) samples received PDS for EPA 200.8 only	%R 80-120% (general chemistry) %R 75-125% (metals) If the original sample result is ≥ 4x the spike amount added, the data shall not be flagged even if the %R exceeds the acceptance criteria	LMS %R < 30% and PDS %R < 75% (EPA 200.8)	J-	R	S%	CFRSSI QAPP, NFG
			LMS %R < 30% and PDS %R ≥ 75% (EPA 200.8)	J	UJ		
			LMS %R 30-74% and PDS %R < 75% (EPA 200.8)	J-	UJ		
			LMS %R 30-74% and PDS %R ≥ 75% (EPA 200.8)	J	UJ		
			LMS %R > 125% and PDS %R > 125% (EPA 200.8)	J+	No Qualification		
			LMS %R > 125% and PDS %R ≤ 125% (EPA 200.8)	J	No Qualification		
			LMS %R < 30% No PDS performed	J-	R		
			LMS %R 30-79% (general chemistry) LMS %R 30-74% (metals) No PDS performed	J-	UJ		
			LMS %R >120% (general chemistry) LMS %R > 125% (metals) No PDS performed	J+	No Qualification		
			Sample analyte concentration ≥ 4x spike concentration	No Qualification	No Qualification		
Serial Dilution (SD)	EPA 200.8 only Each analytical batch of samples	%D≤ 10% if sample concentrations are sufficiently high	%D > 10% and Original concentration >50x MDL and serial dilution concentration ≥ RL	J	UJ	SD	NFG
			%D > 100% and Original concentration >50x MDL and serial dilution concentration ≥ RL	professional judgement J or R	professional judgement UJ or R		
			Original concentration is > 5x RL and serial dilution result is < RL	No Qualification	No Qualification		
Internal Standards	EPA 200.8 only All samples analyzed during an analytical sequence except the tune must contain internal standards.	For each analyte reported for each sample the Percent Relative Intensity (%RI) should fall between 60-125% of the response of the internal standard in the calibration blank. (Calibration blank usually reported as 100%).	No internal standards reported	R	R	IS	NFG
			<5 of the required internal standards as defined in Laboratory SOP	R	R		
			Target analyte not associated with internal standard	R	R		
			%RI < 60% or > 125% and original sample reanalyzed at 2-fold dilution	J	UJ		
			%RI < 60% or > 125% and original sample not reanalyzed at 2-fold dilution	professional judgement J or R	professional judgement UJ or R		

Notes:
1. Associated sample results:
   For Field Blank results that do not meet technical criteria, apply action to all samples in the SDG.
   For Field Duplicate results that do not meet technical criteria, apply action to field duplicate pair and any samples from the same sample location in the SDG.
   For Tuning, initial calibrations, ICV, LLICV, and ICB results that do not meet technical criteria apply the action to all samples reported in the analytical sequence.
   For CCV and CCB standards that do not meet technical criteria, apply action to all samples analyzed between a previous acceptable standard and the next acceptable standard.
   For MB and LCS results that do not meet technical criteria, apply action to all samples in the analytical batch.
   For LDS, LMS/MSD, and SD results that do not meet technical criteria, apply action to the parent sample and, per the NFG, "apply the action to all samples of the same matrix if the samples are considered sufficiently similar."
   For holding time, preservation, and internal standard results that do not meet technical criteria, apply action to sample.
2. For consistency in validations between validators, if a sample result is reported as non-detect, the MDL is used for the duplciate absolute difference calculations.
3. The LLICV is also called the CRDL Check Standard.
4. An LCS, an LMS, or an original sample may all be used to perform a laboratory duplicate. If a LCS Duplicate or LMS Duplicate is used, the QC sample must also meet the applicable %R technical criteria.

Qualifications:
U - Non-detect
UJ - Estimated non-detect
J - Estimated
J+ - Estimated high
J- - Estimated low
R - Rejected

Abbreviations:
MDL - method detection limit
RL - reporting limit
IDL - instrument detection limit
mV - millivolts
su - standard units
LCL - lower control limit
UCL - upper control limit
%D - percent difference
%R - percent recovery
RPD - relative percent difference
RSD - relative standard deviation
%RI - percent relative intensity

References:
CFRSSI QAPP - ARCO, 1992. Clark Fork River Superfund Site Investigations (CFRSSI) Quality Assurance Project Plan (QAPP). Prepared for ARCO by PTI Environmental Services, Bellevue, Washington. May 1992.
NFG - EPA, 2017. National Functional Guidelines for Inorganic Superfund Methods Data Review. January 2017.
-- Available at EPA's Superfund Analytical Services and Contract Laboratory Program website: https://www.epa.gov/clp/contract-laboratory-program-national-functional-guidelines-data-review
Pace SOP -
EPA 200.8 - ENV-SOP-MIN4-0043: Metals Analysis by ICP/MS - Method 6020 and 200.8
EPA 245.1 - ENV-SOP-MIN4-0054: Mercury in Liquid and Solid/Semi-Solid Waste by 7470A, 7471, 7471B, and 245.1
SM 4500-NO3-H - ENV-SOP-MIN4-0113: Nitrate/Nitrite in Aqueous Samples by SM 4500-NO3-H
SM 4500DF/C - ENV-SOP-MIN4-0104: Fluoride in Aqueous Samples by SM 4500-F-C
SM 2320B - ENV-SOP-MIN4-0103: Alkalinity, Titrimetric by SM 2320B
SM 2540C/D - ENV-SOP-MIN4-0122: Solids in Aqueous Samples by SM 2540B/C/D, EPA 160.4, TSS
ASTM D516 - ENV-SOP-MIN4-0115: Sulfate by ASTM D516
EPA 353.2 - ENV-SOP-MIN4-0130: Determination of Nitrate/Nitrite by 353.2

Table 5. Level 4 Data Validation Guidelines for Butte Treatment Lagoon Weekly and Monthly Monitoring Samples and the Semi-Annual Subdrain Loading Sampling.

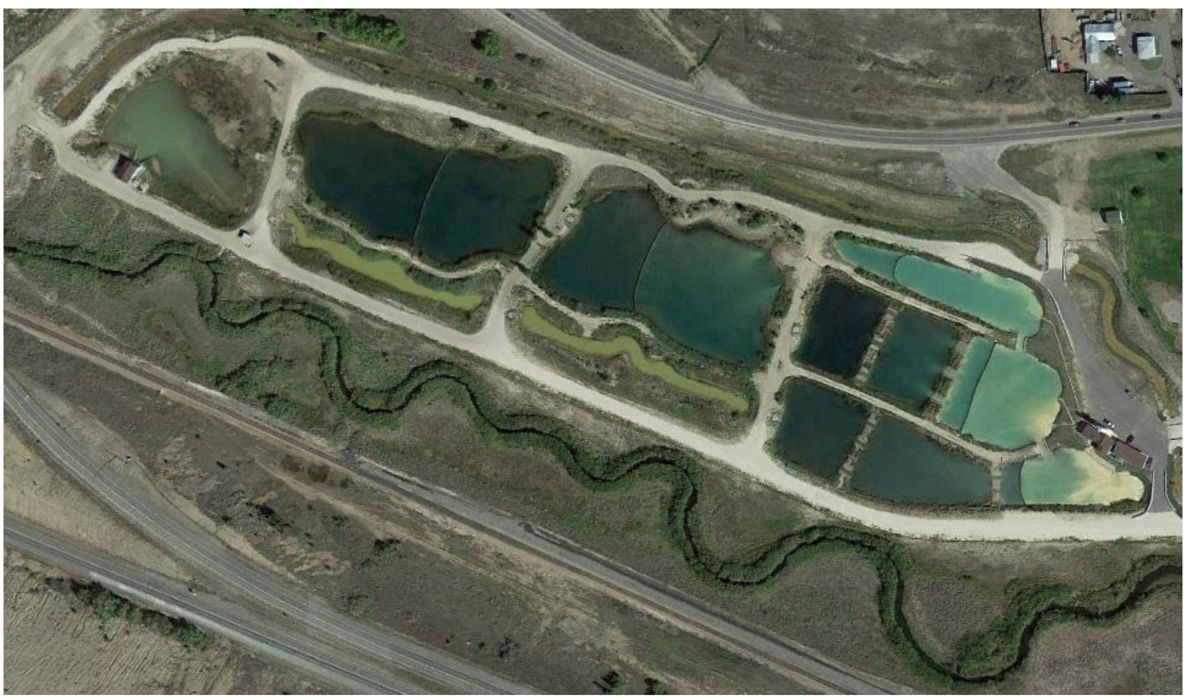
Quality Control	Frequency	Acceptance Criteria	Criteria Exceedance	Action		DV Reason Code	Reference
				Associated Sample Result[1] - Detected	Associated Sample Result[1] - Non-Detected		
EPA 300.0 -	ENV-SOP-MIN4-0129: Sulfate by ASTM D516						

Appendix B
Butte Treatment Lagoons Water Management Contingency Operations Plan

SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT

Revised Draft Final

Butte Treatment Lagoons Water Management Contingency Operations Plan



Atlantic Richfield Company

July 2022

SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT

Revised Draft Final

Butte Treatment Lagoons Water Management Contingency Operations Plan

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July 2022

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Attachment 2 BTL Discharge Pipe Capacities at Routine Operating Elevations Calculation Brief
Attachment 3 West Camp Drawdown Estimate

ACRONYM DEFINITIONS

Acronym	Definition	Acronym	Definition
ASB:	Automatic Sampling Building	**LAO:**	Lower Area One
BPSOU:	Butte Priority Soils Operable Unit	**MBMG:**	Montana Bureau of Mines and Geology
BRW:	Butte Reduction Works	**mg/L:**	milligrams per Liter
BTL:	Butte Treatment Lagoons	**NAVD:**	North American Vertical Datum
CAS:	Chemical Addition System	**NGVD:**	National Geodetic Vertical Datum
CB:	Catch Basin		National Priorities List
CMP:	Corrugated Metal Pipe	**OM&M:**	Operation, Maintenance, and Monitoring
CPVC:	Chlorinated Polyvinyl Chloride	**OS:**	Outlet Structure
CWL:	Critical Water Level	**PLC:**	Programmable Logic Controller
EPA:	U.S. Environmental Protection Agency	**PVC:**	Polyvinyl Chloride
FCD:	Flood Containment Dike	**RFC**	Request for Change
gpm:	gallons per minute	**rpm:**	Revolutions per minute
HCC:	Hydraulic Control Channel	**SS:**	sampling station
HDPE:	High-Density Polyethylene	**TEFC:**	Totally Enclosed Fan Cooled
HMI:	Human Machine Interface	**VFD:**	Variable Frequency Drive
HP:	horsepower	**WCP-1:**	West Camp Pump Station
IPS:	Influent Pump Station		

DOCUMENT MODIFICATION SUMMARY

Number	Author	Version	Description	Date
0	J. Bryson	Draft Final	Issued for Agency Review	8/23/2011
1	J. Bryson	Draft Final	Re-issued for Atlantic Richfield Review	2/27/2013
2	J. Bryson	Draft Final	Issued to Agencies	9/12/2013
3	S. Sampson	Revised Draft Final	Re-issued for Atlantic Richfield Review	4/29/2016
4	S. Sampson	Revised Draft Final	Document re-named and re-issued to Agencies*	5/29/2016
5	S. Sampson	Revised Draft Final	Re-issued for Agency Review	8/13/2018
6	S. Sampson	Revised Draft Final	Issued internally	7/18/2019
7	S. Sampson	Revised Draft Final	Issued for Agency Review	5/4/2021
8	S. Sampson	Revised Draft Final	Issued for Agency Review	7/5/2022

* Original name – BTL Water Management Contingency Operations Technical Report.

1.0 INTRODUCTION

Contingency operations for the Butte Treatment Lagoons (BTL) system include strategies to manage groundwater capture during periods of non-routine operating conditions including unscheduled maintenance, abnormal flow conditions, or any event not described in the operating and maintenance documents. This BTL Water Management Contingency Operations Plan (Plan) is a supplemental document to routine operation and maintenance procedures. It summarizes existing treatment system capacity and control mechanisms, and it lists contingent operation strategies available in the event of specific systemic failures of associated entities related to the BTL Groundwater Treatment System.

1.1 Purpose

This Plan evaluates the existing treatment system and operational capacity as prescribed in the U.S. Environmental Protection Agency (EPA) Record of Decision "*to prevent the discharge of untreated water into Silver Bow Creek, the design will be required to include contingencies for how to manage and store collected groundwater during extended periods of upset (e.g., flooding, equipment malfunction or failure, extended periods of freezing, etc.)*" (EPA, 2020). Specific treatment and peripheral site systems are described in the BTL Groundwater Treatment System Routine Operation, Maintenance, and Monitoring (OM&M) Plan (to which this document is an appendix and referred to herein as main BTL Routine OM&M Plan) and shown on Figure 1 and Figure 2.

This Plan provides current routine operational data, capacity, and description of existing control mechanisms and infrastructure for each site system. Information presented includes itemized, routine, and maximum flow rates from each site system; treatment system capacities and available storage volumes above routine operating levels; and calculations of expected available retention time for each specific portion of the treatment system. Routine conditions and maximum limits listed in the main BTL Routine OM&M Plan are used to determine available capacity throughout this document.

For each listed site system, the document proposes scenarios focusing on operational disruption and outlines mitigation strategies for each disruption, focusing primarily on available water storage capacities above routine operating levels, diversion routing using existing site infrastructure, and alternative treatment options, if any. Each analysis includes approximate probabilistic replacement estimates to aid in assessing critical operational disruptions. Additional information concerning detailed design and thorough operations, monitoring, and maintenance of site treatment systems can be found in the following documents.

- Main BTL Routine OM&M Plan.
- *BTL and WCP-1 Upgrades Design Construction Detailed Scope of Work – Phase II* (Atlantic Richfield, 2012).
- *BTL and WCP-1 Upgrades Design Construction Detailed Scope of Work – Phase I* (Atlantic Richfield, 2011a).
- *BTL and WCP-1 Upgrades Design Report/Work Plan* (Atlantic Richfield, 2011b).

- *Final Metro Storm Drain (MSD) Pump Station Upgrades Construction Completion Report (CCR)* (Atlantic Richfield, 2016).
- BTL-OMM-RFI-01-2020 BPSOU Subdrain Iron Precipitation Capture Work Plan (Atlantic Richfield, 2020).

The main BTL Routine OM&M Plan describes routine operation, maintenance, and monitoring activities. The system and components are designed to accommodate up to maximum flows from typical groundwater sources associated with the BTL groundwater treatment system. Extended periods of precipitation, unplanned equipment failures, or extended periods of freezing may require implementation of contingency measures described in this document.

1.2 Site Background

Historically, site elevations were reported in National Geodetic Vertical Datum (NGVD) 29. Portions of site operations have transitioned to reporting in North American Vertical Datum (NAVD) 88. The simplified conversion from NGVD 29 to NAVD 88 for the BTL and related systems is completed by adding 4.36 vertical feet to any elevation reported in NGVD 29. Note, the conversion is relative to the datum being reported and the physical water level remains unaffected by the conversion. All elevations in this Plan are reported in NAVD 88 as feet above mean sea level with NGVD 29 elevations included for reference.

1.3 System Infrastructure

The treatment system includes several redundant systems and spare components to allow groundwater treatment to continue through most foreseeable upset conditions. Spare parts are stored centrally in the Dredge Storage Building at Lower Area One (LAO), near the Operations Building. This storage area ensures components can be readily accessed and deployed as needed. A list of spare parts applicable to this Plan, included in Attachment 1, is updated annually and routinely maintained to ensure components are in operating condition and required quantities are available.

Commercial off the shelf components are readily available through local commercial suppliers. The commercial off the shelf components are not included in the system inventory since the availability from local suppliers is not considered detrimental to system storage capacity.

1.4 Component Replacement Scenario Estimates

Several foreseeable replacement scenarios are provided in this Plan. Scenarios are based on engineered estimates, observations of related activities, and discussions with experienced construction specialists familiar with site conditions and replacement tasks. Replacement times are provided based on probabilistic time estimates that consider optimistic, most likely, and pessimistic time estimates. An optimistic time estimate is the length of time required to complete a task under ideal conditions, while a pessimistic time estimate is the length of time required to complete a task under the worst foreseeable conditions. A most likely time estimate is the most probable estimated time. Expected replacement times are calculated as a weighted average of the time estimates provided as a method to consider the inherent variability of time estimates.

2.0 ITEMIZED GROUNDWATER CAPTURE

The current groundwater reaching the treatment system at BTL consists of water from West Camp Pump Station (WCP-1), the Butte Priority Soils Operable Unit (BPSOU) subdrain (referred to as subdrain) groundwater collection system, the Missoula Gulch base flow and groundwater captured from the Butte Reduction Works (BRW), groundwater captured by the Hydraulic Control Channel (HCC), and "recycled" flow that exfiltrates from the BTL lagoon cells into the HCC and the BTL capture cells (D2, D3, and D4).

Pump systems operate to maintain a constant level via a control system that uses programmable logic controllers (PLCs), level measurements, and variable frequency drives. Pumping rates may vary slightly to maintain the set point level of each pump system (Influent Pump Station [IPS], WCP-1, and subdrain); however, routine system operation is generally consistent in level and flow. Routine operating ranges are provided in the main BTL Routine OM&M Plan, Table 2. Routine conditions are consistent with data recorded prior to system upgrades and after upgrades were completed (2014-2015). The routine conditions were calculated using historical data from January 1, 2014, through December 1, 2020. These flows are referred to throughout the document as *routine average flow*.

2.1 Routine Average Flow

Routine average flow is provided as the consistent average flow observed. As noted previously, flow rates fluctuate within routine limits under routine conditions. The routine average is provided as a consistent data point throughout this report. Table 1 lists the individual flows from each site system contributing to the treatment system during routine flow conditions.

Table 1. BTL Treatment System Groundwater Capture (Routine Average)

Source	Routine Flow Range	Routine Annual Average Flow Conditions
West Camp[1]	150 to 250 gpm	185 gpm
Subdrain[2]	430 to 500 gpm	480 gpm
Missoula Gulch Base Flow[3]	20 to 100 gpm	60 gpm
BRW[3]	150 to 200 gpm	200 gpm
LAO & HCC Capture[3]	250 to 450 gpm	375 gpm
BTL Influent [4]	1,010 to 1,500 gpm	1,270 gpm

Source: Technical memorandum from Pioneer Technical Services, Inc. to Atlantic Richfield Company titled *Butte Treatment Lagoons (BTL) Influent Pump Station Configuration – Revised Draft (August 10, 2009).*

1. *West Camp routine average flow based on observed pump rate for selected Goulds 320L15 submersible pump.*
2. *Subdrain routine average flow based on observed flow rates using a single existing or combination of Ampco E Series Model 4X3C 10 HP (horsepower) pump(s).*
3. *Influent flows were estimated from historic operations as the balance of known influent sources and flow recorded at the IPS.*
4. *The routine BTL influent is based on the sum of possible influent flows from peripheral site systems that reach Cell D4.*

BRW: Butte Reduction Works. BTL: Butte Treatment Lagoons gpm: gallons per minute. BRW: Butte Reduction Works.
HCC: Hydraulic Control Channel. LAO: Lower Area One.

Therefore, based on the data provided in Table 1, the anticipated total system groundwater capture flow reaching Cell D4 under routine operating conditions is 1,270 gallons per minute (gpm) based on historic averaged data for the Chemical Addition System (CAS) influent flows. Under these routine conditions, the operating elevation for Cell D4 is approximately 5,418.30 feet (NAVD 88) [5,413.94 feet (NGVD 29)].

2.2 Maximum Design Flow

Maximum design flows are the maximum achievable flows from each groundwater capture system contributing to the treatment system influent during high flow conditions based on operational data and design values. Maximum flow conditions were used in the engineering design process and the maximum BTL treatment capacity is limited by the component with the lowest maximum design flow, the sluice box. The maximum flows from each system are listed in Table 2.

Table 2. BTL Treatment System Groundwater Capture (Maximum Design Flow)

Source	Routine Flow Range	Maximum Design Flow
West Camp[1]	150 to 250 gpm	315 gpm
Subdrain[2]	430 to 500 gpm	750 gpm
Missoula Gulch Base Flow[3]	20 to 100 gpm	270 gpm
BRW[3]	150 to 200 gpm	325 gpm
LAO & HCC Capture[3]	250 to 450 gpm	540 gpm
BTL Groundwater Capture[4]	1,010 to 1,500 gpm	2,200 gpm

Source: Technical memorandum from Pioneer Technical Services, Inc. to Atlantic Richfield Company titled *Butte Treatment Lagoons (BTL) Influent Pump Station Configuration – Revised Draft (August 10, 2009).*

1. *West Camp maximum flow and system capacity based upon selected Goulds3 20L15 submersible pump rate at 3,450 rpm (revolutions per minute).*
2. *Subdrain system maximum flow estimated based on historical conditions and based upon parallel operation of existing Ampco E Series Model 4X3C 10 HP (horsepower) pumps and temporary pumping system. The maximum operational limit only applies during non-routine conditions.*
3. *Groundwater capture flows were estimated from historic operations as the balance of known groundwater capture sources and flow recorded at the IPS.*
4. *The maximum BTL groundwater capture is based upon the sum of possible groundwater flows from peripheral site systems that reaches Cell D4 and is limited by the maximum BTL treatment capacity.*

BRW: Butte Reduction Works. BTL: Butte Treatment Lagoons. gpm: gallons per minute. HCC: Hydraulic Control Channel. LAO: Lower Area One.

Based on the data provided in Table 2, the maximum potential BTL groundwater capture of 2,200 gpm exceeds the maximum BTL treatment capacity of 1,880 gpm. The operations strategy for periods when the groundwater capture exceeds the maximum BTL treatment capacity is described in Section 6.0.

3.0 GROUNDWATER CAPTURE SOURCES

Groundwater capture sources contributing flow to the system are described in the sections below. Routine operating conditions, storage capacity, system components, and estimated replacement times are described for each source.

3.1 West Camp Pump Station

The function of the WCP-1 groundwater extraction system is to maintain water levels in the West Camp system below the established critical water level (CWL) of 5,439.86 feet (NAVD 88) [5,435.50 feet (NGVD 29)]. The extraction well, WCP-1, is installed directly into the 800-foot sill of the Travona Mine, as are monitoring well BMF96-1D and the former well AMC-21.

3.1.1 Routine Operating Conditions

Water level within monitoring well BMF96-1D is maintained at approximately 5,429.36 feet (NAVD 88) [5,425.00 feet (NGVD 29)], approximately 10 feet below the CWL. Operation of the WCP-1 system below the CWL ensures available capacity in the event of non-routine or upset conditions. To maintain this approximate 10-foot buffer, the WCP-1 extraction well is generally operated at 130 gpm to 280 gpm, with the routine average flow rate at approximately 215 gpm.

3.1.2 Available Retention Time and Storage Capacity

Data from a previous recharge test conducted from May 13, 2005, through May 25, 2005, along with additional recharge projection calculations, indicate that WCP-1 pumping can cease for an approximate period of 26 days before the water level reaches the CWL of 5,439.86 feet (NAVD 88) (5,435.50 feet [NGVD 29]). This projection assumes that the initial water level is at the routine operation elevation of 5,429.36 feet (NAVD 88) (5,425.00 feet [NGVD 29]) and recharge within WCP-1 occurs at a constant rate of 215 gpm.

The Montana Bureau of Mines and Geology (MBMG) completed a study to determine additional water storage capacity within the void areas in the West Camp underground mine workings as described in the *West Camp Critical Water Level Review Draft Final Data Summary Report (DSR)* (MBMG, 2014). Pump operations at WCP-1 were suspended and water levels monitored. Levels rose from 5,430.36 feet (NAVD 88) (5,426.00 feet [NGVD 29]) initial elevation to 5,439.36 feet (NAVD 88) (5,435 feet [NGVD 29]) within approximately 22 days.

On July 6, 2017, at approximately 12:30 A.M. a 5.8 magnitude seismic event occurred near Lincoln, Montana. Immediately following the event, the pump flow rate increased from approximately 180 gpm to nearly 280 gpm to maintain static water level in the Butte Mine Flooding Operable Unit groundwater aquifer level.

To accommodate the increase in pumping rate, the pump wet end was replaced with a Goulds Model 320L pump wet end and mounted to the existing 15 horsepower motor according to manufacturer's drawings. The Goulds 320L15 pump has an operating range from 100 gpm to 420 gpm. Existing discharge piping and associated components were then reassembled and re-used. Changes to the pump wet end were approved through the Request for Change (RFC) process, documented as BTL-OMM RFC-04, and approved on July 24, 2017. Additional capacity estimates were not completed to account for the effects of the seismic event.

As described in the 2020 Record of Decision Amendment (Appendix A to the BPSOU Consent Decree; EPA, 2020), water levels in West Camp will be allowed to exceed the critical water level for brief periods to provide additional treatment capacity for operational flexibility in the BTL Treatment System.

3.1.3 Infrastructure and Control Mechanisms

Additional system control and isolation comes from a valve installed on the discharge pipe. An air release valve protects the piping system from residual air buildup resulting from system start-up and possible vacuum effects caused during system shutdown or failure. The WCP-1 extraction well ultimately connects and discharges to the Missoula Gulch bypass line.

3.1.4 System Components and Probabilistic Replacement Estimates

Primary WCP-1 operational disruptions and mitigation strategies will focus on the WCP-1 extraction and piping system from its inception to its merging with the bypass line before final discharge within BRW. Non-routine events of concern include pump failure, failure of monitoring devices, damage to buried pipeline, and failure or error of instrumentation and control devices. Table 3 summarizes the WCP-1 system components and estimated replacement times for each item. Refer to Attachment 1 for additional information.

Table 3. WCP-1 Components and Probabilistic Replacement

System Component	Task	Optimistic	Likely	Pessimistic	Expected	Units
Goulds Submersible Pump	Replace	8	16	24	16.0	hours
McCrometer UM06-04	Replace	2	3	4	3.0	hours
Esterline KPSI	Replace	1.5	3	6	3.3	hours
Above Ground Pipe	Repair	1.5	3	5	3.1	hours
Subgrade Pipe	Repair	2	3	5	3.2	days
Input/Output Card	Replace	1.5	3	4	2.9	hours
Power Supply	Repair	1.5	3	4	2.9	hours
PLC Processor	Replace	1.5	4	6	3.9	hours
Communication Failure	Repair	0.5	2	4	2.1	hours

Calculation of probabilistic replacement times derived from *Production/Operations Management*, 4th Edition (Stevenson, 1993).
PLC: programmable logic controller.

3.1.5 Contingent Operations and Mitigation Strategies

Contingent operations or mitigation strategy for the West Camp pumping system consists of ceasing pump operations, retaining water within the Travona Shaft/West Camp System, and monitoring water level. Redistribution of detained flow is described in Section 5.3.

Because of the large aquifer storage capacity that is maintained in the West Camp area, and the calculated probabilistic replacement times for system components, it is not necessary to propose any specific water management strategies (alternative routing or storage) to complete necessary repairs or replace identified components.

Provisions are available to route water to Butte-Silver Bow Water Treatment Plant; however, the viability of this option has not been determined since completion of Butte-Silver Bow Metro Treatment Plant upgrades[1].

3.2 Missoula Gulch Base Flow Diversion

The function of the Missoula Gulch system is to capture, store, and regulate the discharge of storm water within the Missoula Gulch watershed. The Missoula Gulch system consists of Catch Basin 8 (CB-8), the CB-8 bypass structure, the Missoula Gulch bypass line, and the downstream storm water reservoir CB-9. Immediately south of the Iron Street/Excelsior Avenue intersection, CB-8 intercepts excess storm water flow. Immediately west of WCP-1 and north of Centennial Avenue, and downstream of CB-8 is CB-9.

The majority of water intercepted by the Missoula Gulch system is retained in the catch basin system (CB-8 and CB-9). Missoula Gulch base flow is captured and routed to the BTL system because it is historically higher in constituent of concern concentrations. Storm water flows exceeding base flow naturally by-pass to the catch basin system as described in the *Missoula Gulch Catch Basin (CB-1, CB-8, and CB-9) Operation and Maintenance Plan* (Atlantic Richfield, 2018).

3.2.1 Routine Operating Conditions

The Missoula Gulch base flow diversion structure intercepts routine storm water base flows of approximately 20 to 100 gpm, which can vary seasonally. Under typical conditions, 60 gpm of base flow is diverted to the BTL for treatment through the BRW system. Storm water flows exceeding the capacity of the base flow diversion are routed to CB-8 and CB-9. Storm water flows are typically retained in the catch basins and the storm water is either naturally infiltrated to the groundwater aquifer or lost to evaporation.

3.2.2 Available Retention Time and Storage Capacity

The Missoula Gulch base flow diversion structure does not contain any available retention capacity or storage capacity that impacts the BTL systems; however, the Missoula Gulch base flow can be diverted to reduce the BTL groundwater capture. Flow entering the Missoula Gulch base flow system bypass line can be routed to the BRW-01 Pond for temporary storage, if required.

3.2.3 Infrastructure, Control Mechanisms, and System Capacity

The Missoula Gulch system consists of an in-channel structure to divert base flow to the BTL system and flow exceeding the diversion pipe capacity to CB-8 and CB-9. Discharge of the base flow is diverted to BRW-01.

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[1] Treatment of West Camp water at the Butte Metro Sewage Plant Waste Treatment Plan terminated in 2002 in favor of treatment at the BTL (EPA, 2011).

3.2.4 System Components and Probabilistic Replacement Estimates

Missoula Gulch operational disruptions and system components do not have a direct effect on the operation of the BTL system or the treatment of impacted groundwater. Operation and maintenance of the Missoula Gulch system is the responsibility of Butte-Silver Bow. Table 4 summarizes the CB-8 bypass structure components and estimated replacement times for each item. Refer to Attachment 1 for additional information.

Table 4. CB-8 Bypass Structure Components and Probabilistic Replacement

System Component	Task	Optimistic	Likely	Pessimistic	Expected	Units
Intake Grating	Repair	4	12	24	12.7	hours
Sediment Vault	Clean	8	16	24	16.0	hours
Subgrade Pipe	Repair	2	3	5	3.2	days

Calculation of probabilistic replacement times derived from *Production and Operations Management* (Stevenson, 1993).

3.2.5 Contingent Operations and Mitigation Strategies

There is no method available to reduce Missoula Gulch base flow upgradient of the existing concrete diversion pre-basin. In the event of an upset, or to reduce groundwater capture discharged to Cell D4, the Missoula Gulch flows can be retained within the BRW open areas.

3.3 BPSOU Subdrain

Groundwater intercepted by the BPSOU subdrain is captured and pumped to the head of the HCC where it mixes with other groundwater capture sources and flows to the BTL for treatment. The pump system includes two centrifugal pumps, a temporary back-up pumping system, and parallel discharge lines to the BRW open areas. The second discharge line and temporary back-up pumping system are available for redundancy. Both centrifugal pumps are operated in parallel during periods of increased flow as described in Section 6.0.

3.3.1 Routine Operating Conditions

The subgrade pumping station maintains a nearly constant water level in the wet vault of 5,440.36 feet (NAVD 88) (5,436.00 feet [NGVD 29]). The wet-vault water level is maintained below the maximum operational water elevation of 5,440.76 feet (NAVD 88) (5,436.40 feet [NGVD 29]). The pump system was designed to operate at a routine capacity up to 680 gpm[2]. Actual flow rate typically ranges from 430 to 500 gpm but depends on the seasonal conditions and varies to maintain the constant operating elevation in the wet vault below the maximum operational water elevation.

[2] The pump system was designed to operate with the pumps operating in parallel to deliver up to 680 gpm during routine conditions. The maximum operational capacity of flows up to 750 gpm during non-routine conditions is achieved with the temporary back-up pumping system.

3.3.2 Available Retention Time and Storage Capacity

There is no appreciable storage capacity within the subdrain system; however, previous studies suggest that pumping may be suspended for up to four hours without observing impacts to surface water. This time is used as response time to correct the system upset conditions or deploy a back-up pump system. Allowing groundwater to routinely pool within the subdrain is detrimental to the overall capture effectiveness. The pump system flow can be diverted to the BRW-00 Pond and/or the north drying bed to be stored temporarily and to reduce groundwater capture discharged to Cell D4. Redistribution of detained flow is described in Section 5.3.

3.3.3 Infrastructure, Control Mechanisms, and System Capacity

The subdrain is a perforated polyvinyl chloride (PVC) pipe, bedded in gravel, that collects potentially impacted groundwater and directs the flow to the wet vault. Multiple manholes are installed throughout the length of the subdrain to promote effective maintenance of the groundwater collection system.

The subdrain pumping system consists of a wet-vault water collection source and dry-vault pumping system. The wet vault serves to collect influent water, settle large particulates out of the system to protect pumping components, and provide a consistent supply to the pump inlet. The subdrain discharge piping protrudes into the east side of the wet vault at approximately 5,440.76 feet (NAVD 88) (5,436.40 feet [NGVD 29]). Variable frequency drives (VFDs) control 2 identical centrifugal pumps that provide pumping capacity from the dry vault. The dry vault houses the twin centrifugal pumps, discharge flow meters, exhaust fan, and a sump pump. The centrifugal pumps are sized to discharge a flow from the wet vault of 680 gpm when operated in parallel. The pumps operate using a level controller and VFD to maintain the established water level within the wet vault. Flow meters measure the flow produced by the subdrain system as the water exits the dry vault.

Two independent subsurface pipes and various valves and piping crossovers are available to allow flow to be discharged from any pump configuration through either or both pipe systems to the HCC, BRW-00, or both. Due to the variability of discharging to multiple locations, the mitigation strategies provided only consider total flow from any discharge source. Flow routing options and associated valve alignments are provided in BTL-SOP-48 (main BTL Routine OM&M Plan, Standard Operating Procedures appendix).

3.3.4 Back-up Pump System Capacity

For short-term, back-up pumping, a skid-mounted diesel-powered (Godwin CD 150M) self-primed centrifugal pump will be deployed. Temporary flexible piping components are used for pump suction and discharge lines. When the system is deployed, the suction line is placed directly into the wet vault at manhole MH-MSD-102 and the discharge line re-introduces flow into the subdrain pipe system at MH-MSD-105. The temporary pumping system also provides additional capacity during non-routine periods of increased flow from wet-weather events as described in Section 6.0. The maximum operational capacity of the pump system is 750 gpm with the temporary back-up pumping system.

For long-term back-up pumping, an electric, submersible pump (Godwin GSP300HH) can be installed in the wet vault to create additional suction head within the bypass line. When the submersible pump is installed in the wet vault, water from the wet vault will be discharged into the subdrain piping system at MH-MSD-201, downstream of the dry vault. The maximum operational capacity of the pump system remains 750 gpm with the long-term back-up pumping system in place.

Following the dry vault flow meter, the discharge pipeline extends westward from a location directly north of the Butte-Silver Bow Visitor Center approximately 3,200 feet (under Blacktail Creek, the Butte-Silver Bow asphalt plant, and Silver Bow Creek) to the discharge point within BRW at the head of the HCC.

3.3.5 System Components and Probabilistic Replacement Estimates

The operational disruptions and mitigation strategies focus on the pumps, flow meters, pressure relief valve, level sensor, subdrain, and discharge line. Non-routine events of concern include pump and flow meter failure, level sensor malfunction, pressure relief valve failure, and damage to the subdrain or discharge pipelines. Table 5 summarizes the system components and estimated replacement times for each item. Also, refer to Attachment 1 for additional information.

Table 5. Subdrain System Components and Probabilistic Replacement

System Component	Task	Optimistic	Likely	Pessimistic	Expected	Units
Ampco Model E 4x3C	Replace	2	4	8	4.3	hours
McCrometer UM06-04	Replace	1.5	3	6	3.3	hours
Dwyer Pressure Transducer	Replace	1.5	2	6	2.6	hours
Rosemount 8750WA	Replace	1.5	2	6	2.6	hours
Cla-Val 50-01	Replace	1	2	4	2.2	hours
Subgrade Pipe*	Repair	8	10	28	12.7	hours
Input/Output Card	Replace	1.5	3	4	2.9	hours
Power Supply	Replace	1.5	3	4	2.9	hours
PLC Processor	Replace	1.5	4	6	3.9	hours
Communication Failure	Replace	1.5	2	4	2.3	hours

*Subgrade pipe repair considered for portions of pipe between discharge vault and Montana Street only.
Calculation of probabilistic replacement times derived from *Production and Operations Management* (Stevenson, 1993).
PLC: programmable logic controller.

Repairs to the subdrain are not considered due to the extremely unlikely nature of damage to this feature. The complete subdrain system, including discharge lines, is included in the MT811 underground utility registry to provide notification of any excavation in the area and allow the location of the excavation area to be confirmed and a determination made regarding proximity to subdrain features.

Damage to the subdrain would require isolation of the damaged area, temporary pumping of systems upgradient of the damage, and surface pipe re-routing to a downgradient manhole location. Similar configurations were implemented under the subdrain *Isolation Test Phase III Pilot Study Work Plan* (Atlantic Richfield, 2010).

3.3.6 Contingent Operations and Mitigation Strategies

Limited options are available for contingent operation because of the lack of storage in the subdrain system and upgradient of the subdrain pump system, and because there is no way to interrupt the subdrain flow. The bypass system is designed to pass all flow collected by the subdrain. Available infrastructure allows operation of both dry vault pumps (operated in parallel), the temporary pump system, a combination of dry vault pumps and the temporary pump, or temporary bypass of the subdrain vault system. If it is observed that the water elevation within the wet vault is increasing during bypass operations, the temporary pump can be installed and operated as needed to maintain a level below the subdrain maximum operational water elevation.

If the vault pumping system and temporary bypass system require simultaneous maintenance, pumping operations must be ceased. Because the subdrain does not have storage capacity, parallel pipe systems, multiple levels of pump redundancy, and routine inspection and maintenance procedures are in place to reduce the likelihood of system failure.

3.4 Butte Reduction Works

The BRW Ponds (BRW-00 and BRW-01) function as groundwater collection areas. The BRW open areas include the drying beds, which are used for treatment system sludge dewatering but are not included in the mitigation strategies.

3.4.1 Routine Operating Conditions

The BRW Ponds serve as groundwater capture cells to maintain the groundwater gradient away from Silver Bow Creek. The open areas also provide temporary storage capacity during non-routine conditions for peripheral systems. The routine operating elevations of BRW-00 and BRW-01 vary seasonally depending on the elevation of adjacent reaches of Silver Bow Creek and the rate of alluvial recharge. Routine operating elevation at the outlet structure of BRW-00 is 5,433.64 feet (NAVD 88) (5,429.28 feet [NGVD 29]) and 5,431.79 feet (NAVD 88) (5,427.43 feet [NGVD 29]) at the outlet structure of BRW-01. The Missoula Gulch base flow is routinely diverted to the BTL for treatment through the BRW system as described in Section 3.2.1.

3.4.2 Available Retention Time and Storage Capacity

The maximum elevations for the BRW system are determined by the outlet structure operating limits and the elevation of Silver Bow Creek. The maximum elevation of BRW-00 is 5,437.05 feet (NAVD 88) (5,432.69 feet [NGVD 29]), which is equal to the average elevation of Silver Bow Creek measured at sampling station SS-05A. Because the HCC is between BRW-01 and Silver Bow Creek, the BRW-01 pond can be operated to the maximum elevation of its outlet structure, which is 5,435.74 feet (NAVD 88) (5,431.38 feet [NGVD 29]). BRW-00 has a storage capacity of approximately 0.85 million gallons and BRW-01 has a storage capacity of approximately 4.35 million gallons, for a total storage capacity of approximately 5.2 million gallons within the BRW system. The BRW open areas effectively operate as a single area for the purposes of this report.

Groundwater capture within the BRW area ranges from 200 to 325 gpm. The BRW open areas can store the routine average and maximum groundwater capture for approximately 13.9 days to 6.1 days, respectively, with the BRW groundwater capture and Missoula Gulch base flow (260 to 595 gpm).

As previously stated, subdrain discharge can be diverted to BRW-00 or the north drying bed for additional short-term retention of influent sources to the HCC and Cell D4.

Diversion of subdrain discharge to the north drying beds can provide approximately 1.9 million gallons of additional storage volume or 3 days to 2.6 days of storage. Redistribution of detained flow is described in Section 5.3.

3.4.3 Infrastructure and Control Mechanisms

The elevation of BRW-00 can be adjusted from 5,431.50 feet (NAVD 88) (5,427.14 feet [NGVD 29]) to 5,439.03 feet (NAVD 88) (5,434.67 feet [NGVD 29]) by inserting or removing stop logs at the outlet structure, but its maximum elevation is limited by the average elevation of Silver Bow Creek measured at SS-05A. BRW-00 and BRW-01 plan and profile elevations are provided on Figure 3 through Figure 5.

Discharge flow from BRW-00 is passed to the east end of BRW-01 before discharging to the HCC. The elevation of BRW-01 can be adjusted from 5,429.80 feet (NAVD 88) (5,425.44 feet [NGVD 29]) to the maximum structure elevation of 5,435.74 feet (NAVD 88) (5,431.38 feet [NGVD 29]) by inserting or removing stop logs at the outlet structure. The stop logs for the BRW system are maintained near the outlet structures and can be quickly deployed by the operators. Additional stop logs are stored on the site at the Dredge Storage Building.

3.4.4 System Components and Probabilistic Replacement Estimates

The BRW operational disruptions and mitigation strategies focus on the outlet structures' elastomeric seals and discharge piping interconnecting the open areas and ultimately discharging to the HCC. Table 6 summarizes the BRW system components and estimated replacement times for each component. Also, refer to Attachment 1 for additional information.

Table 6. BRW System Components and Probabilistic Replacement

System Component	Task	Optimistic	Likely	Pessimistic	Expected	Units
Elastomeric Seals	Replace	8	16	24	16.0	hours
HDPE Discharge Pipe	Repair	32	40	60	42.0	hours
CMP Discharge Pipe	Repair	44	56	80	58.0	hours

Calculation of probabilistic replacement times derived from *Production and Operations Management* (Stevenson, 1993).
CMP: corrugated metal pipe. HDPE: high-density polyethylene.

3.4.5 Contingent Operations and Mitigation Strategies

Because the BRW Ponds primarily serve as groundwater capture areas, contingent operations and mitigation strategies are limited. The groundwater capture rate is limited to the level and rate of the alluvial aquifer as previously stated. Captured groundwater can be retained within BRW-00 and BRW-01, but not eliminated or reduced.

Contingent storage of water within BRW-00 and BRW-01 would only result if downstream system components (IPS, CAS, or other entity included within the BTL system) needed repair or if the groundwater capture of the peripheral components exceeded the maximum BTL system capacity.

Contingent storage of water within the north drying bed cell allows for up to 1.9 million gallons water storage.

3.5 Hydraulic Control Channel

The HCC begins at the east side of LAO directly south of BRW and flows west to LAO where it discharges to Cell D4.

3.5.1 Routine Operating Conditions and Available Storage Capacity

Flow within the HCC is a summation of flows from sources previously identified, and groundwater capture along the HCC (typically 375 gpm when including BTL groundwater capture). The routine average observed flow in the HCC is approximately 1,270 gpm.

3.5.2 Available Retention Time and Storage Capacity

The HCC is not intended to retain water, but rather act as a conduit for transfer of captured groundwater to Cell D4 as previously described.

3.5.3 Infrastructure, Control Mechanisms, and System Capacity

A sheet pile cut-off wall protected by riprap terminates the HCC immediately west of Cell D4, preventing untreated flow from reaching Silver Bow Creek. The crest of the sheet pile is 5,421.40 feet (NAVD 88) (5,417.04 feet [NGVD 29]). A staff gauge located in the HCC near the sheet pile provides direct visual indication of the HCC water level. Flow from the end of the HCC is diverted to Cell D4 via a transfer pipe. The transfer pipe is controlled by a control gate, which is left in the full open position and locked during routine operating conditions.

3.5.4 System Components and Probabilistic Replacement Estimates

Identified system components of the HCC include the sheet pile cut-off wall, screw gate, and transfer pipe connecting to Cell D4. Table 7 summarizes the system components of the HCC and estimated replacement times for each component. Also, refer to Attachment 1 for additional information.

Table 7. HCC System Components and Probabilistic Replacement

System Component	Task	Optimistic	Likely	Pessimistic	Expected	Units
Sheet Pile Cut-off Wall	Repair	16	24	32	24.0	hours
30 inch Screw Gate	Replace	12	24	40	24.7	hours
30 inch CMP Pipe	Replace	24	40	80	44.0	hours

Calculation of probabilistic replacement times derived from *Production and Operations Management* (Stevenson, 1993).
CMP: corrugated metal pipe.

3.5.5 Contingent Operations and Mitigation Strategies

Under most foreseeable operational circumstances, the HCC will continue to function as intended. Because the HCC primarily serves as a groundwater capture and conveyance feature, contingent operations and mitigation strategies are limited. Groundwater capture rate is limited to the level and rate of the alluvial aquifer. Mitigation strategies include suspension of the WCP-1 system and diversion of sources previously described.

If maintenance to the HCC is necessary, temporary dewatering could be required. Maintenance or replacement of the sheet pile cut-off wall, screw gate, or transfer pipe would require a similar dewatering effort, with flow produced due to work activities transferred directly to Cell D4.

3.6 Cell D4

Cell D4 is the primary collection area for captured groundwater and is located on the west end of the BTL within the site. Cell D4 collects flow from the HCC, site groundwater, and recycled flow from lagoon cells A3 and D3. Captured groundwater flows can be stored in Cell D4 as a last resort during upset conditions or emergency situations.

3.6.1 Routine Operating Conditions

Historic operational data suggest an average influent flow of captured groundwater to Cell D4 of approximately 1,270 gpm. Cell D4 is operated at a routine elevation of 5,418.30 feet (NAVD 88) (5,413.94 feet [NGVD 29]) to remain protective of Silver Bow Creek and to ensure effective groundwater capture within Cell D4.

3.6.2 Available Retention Time and Storage Capacity

Cell D4 has a storage capacity above its routine operating elevation of approximately 1,740,000 gallons before the maximum operational water elevation of 5,421.40 feet (NAVD 88) (5,417.04 feet [NGVD 29]) is reached. Accounting for available storage capacity in the HCC to the critical water level provides an additional 419,600 gallons. Total available storage capacity in the combined Cell D4 and HCC is approximately 1,740,000 gallons above the routine operating elevation before the maximum operational water elevation of 5,421.40 feet (NAVD 88) (5,417.04 feet [NGVD 29)] is reached. Table 8 summarizes available storage capacity (in hours) of Cell D4 if no pumping is performed from the IPS based on available volume above routine operating elevations. Available storage volume only includes the volume of water that could be added above the routine volume of water previously stored, but that does not exceed the maximum operational water elevation.

Table 8. Cell D4 Available Storage Capacity without IPS Operating

Influent Flow Condition	Influent Rate (gpm)	Storage Capacity (gallons)	Time Estimated Until Cell D4 Reaches Maximum Elevation (hours)
Routine Average	1,270	1,740,000	22.8
Maximum	2,200	1,740,000	13.2

gpm: gallons per minute

3.6.3 Infrastructure, Control Mechanisms, and System Capacity

Infrastructure affecting the control and performance of Cell D4 is directly associated with adjacent components of the treatment system including the HCC, IPS, Automatic Sampling Building (ASB), and lagoon cells A3 and D3.

3.6.4 System Components and Probabilistic Replacement Estimates

System components and probabilistic replacement estimates were not identified for this component of the treatment system because of the lack of mechanical infrastructure associated with Cell D4.

3.6.5 Contingent Operations and Mitigation Strategies

Contingent operations described in Section 5.0 dictate actual influent flow rates observed at Cell D4. Remaining available storage capacity in addition to fluctuations in flow produced by the subdrain, WCP-1, and Missoula Gulch and flow captured by BRW-00, BRW-01, and the HCC will determine operational flexibility during non-routine conditions. Redistribution of detained flow is described in Section 5.3.

4.0 GROUNDWATER TREATMENT SYSTEM COMPONENTS

The BTL system includes local groundwater capture and treatment of the sources described previously in Section 3.0. The BTL system was not designed as a storage facility or for treatment of surface water. Routine operating conditions, storage capacity, system components, and estimated replacement times for the BTL system are described in the sections below.

4.1 Influent Pump Station

The IPS includes a pump and control building that houses a parallel pumping and control system with independent suction piping from a below-grade concrete influent sump located in Cell D4. The pump system includes redundant centrifugal pumps and parallel discharge lines to the CAS Building. The system operates with a single pump, with the offline pump available for complete redundancy. Flows provided below are for a single pump operation.

4.1.1 Routine Operating Conditions

Each pump system can deliver flows ranging from 800 gpm up to maximum rated pump capacity of 2,200 gpm[3]. Pumping rates are automatically adjusted by associated VFDs as needed to maintain the Cell D4 routine operating elevation of 5,418.30 feet (NAVD 88) (5,413.94 [NGVD 29]).

4.1.2 Infrastructure, Control Mechanisms, and System Capacity

The redundant pump system consists of two pumps controlled by VFDs. The pumps operate in alternating duty cycles. Level transmitters are mounted within respective chambers of the influent wet well and within Cell D4. Two flow meters (one on each run of discharge piping) monitor flow rates leaving the IPS.

Parallel 14-inch high-density polyethylene (HDPE) influent lines convey captured groundwater from the IPS to the CAS. The original 10-inch PVC line also runs adjacent to the influent lines as a tertiary influent line. Each independent influent line can be operated to convey the IPS flow to a single line at the CAS Building.

4.1.3 System Components and Probabilistic Replacement Estimates

As previously described, the IPS provides complete redundancy. Consequently, repairs to the individual pump system components can be made with no effect on overall treatment system operation. Identified components of the IPS include the intake screens, influent pumps, VFDs, level sensors, flow meters, and buried influent lines. Table 9 summarizes the IPS components and estimated replacement times for each component. Also, refer to Attachment 1 for additional information.

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[3] The IPS discharge rate cannot exceed the maximum BTL treatment capacity of 1,880 gpm.

Table 9. IPS Components and Probabilistic Replacement

Component	Task	Optimistic	Likely	Pessimistic	Expected	Units
Intake Grates	Clean	0.5	2	4	2.1	hours
Godwin CD225M Pump Motor	Replace	4	6	10	6.3	hours
Godwin CD225M Pump Compressor	Replace	3	4	5	4.0	hours
Godwin CD225M Pump End	Replace	3	4	5	4.0	hours
Temporary Pump	Install	2	4	8	4.3	hours
WEG CFW-09 VFD	Replace	4	6	10	6.3	hours
Rosemount 3105 Sensor	Replace	0.5	1.5	4	1.8	hours
14” McCrometer UltraMag	Replace	1.5	2	4	2.3	hours
14” SDR 17 HDPE	Repair	3	6	12	6.5	hours
Input/Output Card	Replace	1.5	3	4	2.9	hours
Power Supply	Replace	1.5	3	4	2.9	hours
PLC Processor	Replace	1.5	4	6	3.9	hours
Communication Failure	Repair	1.5	2	4	2.3	hours

Calculation of probabilistic replacement times derived from *Production and Operations Management* (Stevenson, 1993).
HDPE: high-density polyethylene. PLC: programmable logic controller. VFD: variable frequency drive.

4.1.4 Contingent Operations and Mitigation Strategies

Redundant IPS infrastructure mitigates concerns regarding replacement or repair of identified system components. The parallel orientation of redundant pumping systems accommodates operator transition of treatment activities during non-routine events. A site-dedicated diesel generator provides alternative power supply to the IPS.

Failures or inaccurate readings of any of the flow meters result in improper lime dosage at the CAS. The interlock between IPS flow meters and the VFDs provides an alarm to the operator if a discrepancy exists between the measured flow rate and the displayed pumping rate. A secondary check can be made by observing the recorded flow rate at the IPS versus the influent flow rate recorded at the CAS.

Loss of electrical service will result in nearly instantaneous, automated actuation of the site-dedicated diesel generator. The site-dedicated generator provides sufficient capacity to operate the IPS pumping system, all associated monitoring and control devices, and incidental lighting and heating fixtures contained within the IPS control building. Following loss of electrical service, the operator will contact NorthWestern Energy to have electrical service restored. Table 10 provides estimated generator runtime available at various loads before re-fueling is required.

Table 10. IPS Generator Run Time Estimate.

IPS Fuel Generator				
Load Rating	230 kW (kVA)			
Fuel Capacity	366 gallons			
Fuel Usage and Estimated Run Time at Percent Load				
Percent Load	25%	50%	75%	100%
Fuel Usage US (gph)	6.2	10.8	14.7	18.2
Est. Run Time (hours)	59.03	33.89	24.90	20.11

kW: kilowatts. kVA: kilo-volt-ampere. gph: gallons per hour.

Damage to individual influent lines buried within the flood containment dike (FCD) will require transition to the unaffected redundant pump and influent piping system, followed by excavation and repair. If all three lines happen to be simultaneously damaged during construction activities, then the IPS would be temporarily shut down to perform needed repairs. The risk of damaging the influent lines is mitigated by site standard practices and use of site plot plans. In this unlikely event, distribution of captured groundwater to Cell D4 would be minimized according to the actions described in Section 5.0.

4.2 Chemical Addition System

The CAS consists of lime storage, feed and slurry equipment, consolidated influent flow, distribution tank, and associated automated monitoring and control elements. The lime addition equipment adds dry lime to the consolidated raw captured groundwater coming from the IPS as the primary treatment method.

The human-machine interface (HMI) displays all system monitoring device signals for the operators and is located in the Operations Building. The monitoring equipment provides information on all processes occurring in the water treatment system including flow rates from the peripheral water sources, lagoon cell elevations, and lime addition rates.

4.2.1 Routine Operating Conditions

During routine operating conditions approximately 1,270 gpm of flow reach the CAS. A portion of the influent flow is directed to each of the slurry tanks by the feed water supply line. Approximately 250 gpm of flow are diverted to the lime slurry make-up system comprised of redundant slurry tanks and associated components. Dry lime is added to the primary slurry tank at the dosage rates described in Table 11.

Table 11. Lime Dosage Rates and Available Storage Capacity

Influent Flow Condition	Rate (gpm)	Lime Dosage (mg/L)	Lime Usage (lb/day)	Silo Storage Capacity (days)
Routine Average	1,270	120	1,827	22
Maximum BTL System Capacity	1,880	120	2,705	175

Lime Dosage Rate of 130 milligrams per Liter (mg/L) was selected as a representative value based on routine operations. Variance of influent water chemistry and effluent chemistry can result in modification of actual dosage rate. Typical dosage rates vary from 110 mg/L to 130 mg/L. The exiting lime silo has a capacity of 22 tons of hydrated lime.
gpm: gallons per minute. lb: pounds.

The continuously mixed slurry is constantly discharged from the primary slurry tank to the sluice box for initial mixing with the consolidated raw captured groundwater prior to reaching the distribution tank located in the west addition of the CAS Building. Additional turbulent mixing is induced in the distribution tank by the stationary baffle prior to discharge to the lagoon distribution channels.

4.2.2 Available Retention Time and Storage Capacity

The CAS does not have storage capacity or retention time.

4.2.3 Infrastructure, Control Mechanisms, and System Capacity

Primary infrastructure of the CAS includes a consolidated influent line, feed water supply line, slurry tanks, sluice box, distribution tank, lime silo, vibratory bin discharger, mechanical feeder, screw conveyor, and numerous miscellaneous control devices. The influent lines are consolidated at a manifold near the southeast corner of the Operations Building then continue subgrade to the CAS Building south, where the lines enter through the floor.

The slurry feed water supply line originates from a lateral wye located on the horizontal segment of the main influent line. The feed water supply line wyes follow the initial control valve, allowing distribution of feed water to either slurry tank. Flow to each parallel leg of the feed water supply line is valve controlled and measured by flow meters. The slurry system consists of redundant slurry tanks and supply lines. Maintenance to one tank can be completed without disrupting operation of the treatment system.

The sluice box transfers lime slurry and raw captured groundwater mixture directly to the center baffle of the distribution tank. The sluice box has a flow capacity of 1,880 gpm. The sluice box is divided into 4 modular segments, which supplement ease of installation, maintenance, and removal as required. The distribution tank, located in the CAS Building west addition, is a cast-in-place concrete chamber. Each of the 3 weir gates installed in the distribution tank can pass the maximum influent design flow of 1,880 gpm.

Hydrated lime storage is provided at the site. The lime silo is a 22-ton capacity silo with equipment and controls to transfer dry, hydrated lime to the lime screw conveyor and onto either of the slurry tanks. Lime is typically delivered every three weeks and can be received within 3 days of order placement.

4.2.4 System Components and Probabilistic Replacement Estimates

Components of the CAS include the influent line, feed water supply lines, rectangular weir gates, slurry tank level sensors, conductivity sensors, vibratory bin discharger motor, lime feeder, screw conveyor motor, knife gates, butterfly valves, and flow meters. These components and their estimated replacement times are summarized in Table 12. Refer to Attachment 1 for additional details.

Table 12. CAS Components and Probabilistic Replacement

System Component	Task	Optimistic	Likely	Pessimistic	Expected	Units
14” Influent Line (Buried)	Repair	6	8	12	8.3	hours
14” Influent Line (Exposed)	Repair	2	3	6	3.3	hours
14” McCrometer Flow Meter	Replace	2.5	4	8	4.4	hours
2” Danfoss Comboair Valve	Replace	0.5	2	4	2.1	hours
4” Feed Water Supply Line	Repair	1.5	4	6	3.9	hours
4” McCrometer Flow Meter	Replace	1	2	4	2.2	hours
4” Hayward CPVC Valve	Replace	0.5	2	4	2.1	hours
Fontaine Weir Gates	Replace	1.5	2	4	2.3	hours
Rosemount 3105 Level Sensor	Replace	0.5	2	4	2.1	hours
Rosemount 400 Conductivity	Replace	0.5	2	4	2.1	hours
Carman CD Motor	Replace	2	4	8	4.3	hours
Schenck Accurate Mechatron	Replace	4	8	16	8.7	hours
Continental TEFC Motor	Replace	2	4	8	4.3	hours
8” Salina Vortex Knife Gate	Replace	2.5	6	10	6.1	hours
4” Salina Vortex Knife Gate	Replace	2	4	8	4.3	hours
Input/Output Card	Replace	1.5	3	4	2.9	hours
Power Supply	Replace	1.5	3	4	2.9	hours
PLC Processor	Replace	1.5	4	6	3.9	hours
Communication Failure	Repair	1.5	2	4	2.3	hours

Calculation of probabilistic replacement times derived from *Production and Operations Management* (Stevenson, 1993).
CPVC: chlorinated polyvinyl chloride. PLC: programmable logic controller. TEFC: totally enclosed fan cooled.

4.2.5 Contingent Operations and Mitigation Strategies

Non-routine events that could warrant contingent operation of the CAS include damage to influent or feed water supply lines or main influent flow meter malfunction, damage to or failure of distribution tank weir gates, lime delivery system damage or failure, and disruption of electrical service. Redundant infrastructure mitigates concerns regarding replacement or repair of several identified system components.

Damage to the consolidated influent line will trigger immediate termination of pumping activities at the IPS and treatment at the CAS. Total captured groundwater distributed to Cell D4 will be minimized according to the mitigation strategies listed in Section 5.0.

Damage to the feed water supply line will trigger isolation of the line. In turn, termination of flow within the combined feed water supply line will stop the lime feed system from operating. Multiple valves allow the operator to isolate either branch of the feed water supply line during repairs and maintain continued operation of the lime feed system. As described in the main BTL Routine OM&M Plan, lime feed can be suspended for up to 12 hours with no effect on effluent water quality. Longer repair time will require implementation of the redundant lime feed system.

System control and measurement devices within the CAS include the level sensors and the flow meters. Redundant units of the level and conductivity sensors allow the operator to transition to the redundant treatment system during upset or non-routine conditions.

Flow meters are installed throughout the CAS system. Three flow meters are installed on the feed water supply line, one on the main branch, and one on each branch leading to the slurry tanks. Multiple manual control valves allow the operator to isolate either branch of the feed water supply line when flow meters need repair. The primary influent flow meter is located on the vertical segment of the primary influent line. Malfunction or failure of the influent flow meter results in interlock controls switching to the influent flow meter in use at the IPS. This allows monitoring and control features to function without loss of treatment while the primary flow meter is evaluated. If the primary flow meter in the CAS requires replacement, IPS will be suspended and total captured groundwater distributed to Cell D4 will be reduced as described in Section 5.0 until the unit can be replaced.

The weir gates located in the distribution tank may require replacement following inadvertent damage or because of deterioration. Replacement of a weir gate or displacement transducer located within the distribution tank requires termination of treatment system activities at the CAS and IPS. The operator can suspend influent flow as described in Section 5.0 while making necessary replacements or repairs. Deployment time to convert to the redundant lime feed system is summarized in the following table.

Table 13. Redundant Lime Feed System Probabilistic Deployment

System Component	Task	Optimistic	Likely	Pessimistic	Expected	Units
Supersacker	Deploy	1.5	6	12	6.3	hours
Lime	Refill	0.5	1	3	1.3	hours
Electrical[1]	Installation	1	2	4	2.2	hours

1. Assumes off-site contractor.

Loss of electrical service will result in automated actuation of the site-dedicated diesel generator. The generator provides sufficient capacity to operate the entire CAS and the adjacent Operations Building including all associated lime delivery systems, monitoring and control devices, and incidental lighting and heating fixtures contained within the buildings. Loss of power will not result in changes to existing water management strategies due to the brief duration of transition time between the interrupted utility-provided service and startup of the backup diesel generator. Following loss of electrical service, the operator will contact NorthWestern Energy to have electrical service restored. Table 14 provides estimated generator runtime available at various loads before re-fueling is required.

Table 14. CAS/OPS Generator Runtime Estimate.

CAS/ OPS Generator				
Load Rating (kVA)	275 kVA			
Fuel Capacity	631 gallons			
Fuel Usage and Estimated Run Time at Percent Load				
Percent Load	25%	50%	75%	100%
Fuel Usage US (gph)	6.65	11.08	16.28	21.81
Est. Run Time (Hours)	94.89	56.95	38.76	28.93

kVA: kilo-volt-ampere. gph: gallons per hour.

4.3 Butte Treatment Lagoons

The BTL system consists of 12 lagoons divided into 4 series indicated as “A,” “B,” “C,” and “D” lagoons. The purpose of the A, B, and C series is to allow dissolved metals to agglomerate as suspended solids and fall out of the water column and stabilize pH levels to meet discharge standards.

The D series lagoons serve to collect captured groundwater from peripheral sources (Cell D4) and maintain a gradient away from Silver Bow Creek (lagoon cells D2 and D3). Figure 2 shows the water treatment and collection system components and Figure 6 shows the water surface elevations.

The BTL system design was not intended to store water during non-routine conditions. For this reason, lagoon cells A, B, and C are not included in the mitigation strategies.

4.3.1 Routine Operating Conditions and Available Storage Capacity

Typically, one-half of the total treated flow is routed to the A series, while the remaining half is equally divided between the B and C series. Table 15 summarizes typical distribution of flow during routine average and maximum flow conditions. The lagoon cells are not used for storage capacity of captured groundwater.

Table 15. Lagoon Cell Typical Influent Flow Distribution

Influent Flow Condition	Total Rate (gpm)	Cell A1 (gpm)	B Series (gpm)	C Series (gpm)
Routine Average	1,270	635	318	318
Maximum BTL System Capacity	1,880	940	470	470

gpm: gallons per minute

The BTL contains seven outlet structures that allow operators to establish the routine operating elevation of the lagoon cells, to respond to varying conditions and optimize overall treatment performance, and to provide flexibility to account for anticipated changes in flow conditions or any needed maintenance. The elevation of the B series and C series is consistent through each cell of the respective series because of the porosity of the cross dikes separating the individual lagoons. Figure 6 provides plan and profile elevations for the lagoon cells. Table 16 summarizes the routine operating elevations and additional retention time available to meet effluent performance standards; the lagoon cells are not used for storage capacity. The retention time provided in Table 16 indicates the time, in hours, estimated to raise the lagoon cells from routine elevation to maximum elevation at the two flow regimes provided. The B Cells and C Cells are analyzed as a single unit because there is no elevation control between the cells.

Table 16. BTL Routine Operating Elevations and Additional Retention Time

Lagoon Cell Elevation	Elevation [Feet (NAVD 88)]	Elevation [Feet (NGVD 29)]	Additional Retention Time (hours)	
A1 Lagoon Cell				
Maximum	5,426.50	5,422.14	**Routine Average**	**Maximum**
Routine	5,426.30	5,421.94	1.1 hours	0.8 hours
A2 Lagoon Cell				
Maximum	5,426.50	5,422.14	**Routine Average**	**Maximum**
Routine	5,425.85	5,421.49	11.8 hours	8.0 hours
A3 Lagoon Cell				
Maximum	5,426.50	5,422.14	**Routine Average**	**Maximum**
Routine	5,425.20	5,420.84	23.7 hours	16.0 hours
B Lagoon Cells				
Maximum	5,426.50	5,422.14	**Routine Average**	**Maximum**
Routine	5,426.30	5,421.94	6.1 hours	4.1 hours
C Lagoon Cells				
Maximum	5,426.50	5,422.14	**Routine Average**	**Maximum**
Routine	5,426.30	5,421.94	5.6 hours	3.8 hours

4.3.2 Infrastructure and Control Mechanisms

Five particulate control curtains are installed in lagoon cells A1, A2, A3, B1, and C1 at the approximate midpoint of each cell. Multiple anchor piles provide operational flexibility, if needed, to optimize sludge management operations. Submersible pressure transducers, installed within stilling wells located in each outlet structure, relay water elevations to the HMI at the Operations Building.

Effluent piping allows flexibility in routing treated discharge water between cells and to the effluent discharge point in Silver Bow Creek. Each of the tertiary treatment cells—Cell A3, Cell B3, and Cell C3—can discharge to Silver Bow Creek. However, valves and piping between cells and on the discharge system allow for flexibility so that discharge from each of the lagoon cell series can be routed to Cell D4 and ultimately re-circulated throughout the entire treatment system. Additional information regarding flow routing options is available in the main BTL Routine OM&M Plan. Table 17 summarizes the maximum flow capacity of each effluent line. Flow capacity calculations for the effluent lines are available in Attachment 2.

Table 17. BTL Effluent Line Capacities

Effluent Line	Outlet Structure	Nominal Diameter (inches)	Estimated Discharge Capacity[1] (gpm)
EL-A (12 inch Effluent Line)	OS-2	12	1,400
EL-A (15 inch Effluent Line)[2]	--	15	3,300
EL-B	OS-3	12	1,500
EL-C	OS-5	15	3,300
EL-D	OS-7	15	4,700

1. Calculations assume free discharge flow at the effluent station and submersion of the effluent line inlet inverts based on maximum operating elevations of associated lagoon cells.
2. EL-A transitions from 12 inch to a 15 inch just prior to its intersection with EL-C.

gpm: gallons per minute.

4.3.3 System Components and Probabilistic Replacement Estimates

Effluent lines may become clogged. Periodic maintenance and repairs include removal of debris and vegetation accumulations in these lines. Elastomeric seals, canal gates, and related components may become damaged or deteriorate over time and must be replaced to function properly. Estimates provided below (Table 18) reflect these foreseeable repairs. Catastrophic failure of effluent lines requires implementation of mitigation strategies described throughout this document. Routing options available for effluent flow, described above, will not affect treatment.

Identified system components of the lagoons cells include outlet structure elastomeric seals, canal gates, and effluent lines. Table 18 summarizes the system components of the lagoon cells and estimated component replacement times. Also, refer to Attachment 1 for additional information.

Table 18. BTL System Components and Probabilistic Repair

System Component	Task	Optimistic	Likely	Pessimistic	Expected	Units
Elastomeric Seals	Repair	8	16	24	16.0	hours
Waterman C-20 Gates	Replace	4	6	8	6	hours
Effluent Lines	Repair	2	4	8	4.3	hours

Calculation of probabilistic replacement times derived from *Production and Operations Management* (Stevenson, 1993).

4.3.4 Contingent Operations and Mitigation Strategies

Multiple operation and mitigation strategies are available within BTL because of the numerous outlet structures, discharge pipes, and effluent lines. Distribution rate to each lagoon cell series controls initial downstream flexibility of potential operator adjustment to account for non-routine conditions. If a BTL system component is damaged or otherwise in need of maintenance, operators can implement the following response sequence.

1. Raise the weir gate of the affected lagoon or BTL component to isolate it from influent flow.
2. Deploy the AquaBarrier within the appropriate dredge passageway.
3. If necessary, reduce captured groundwater flow distributed to Cell D4 (Section 5.0).

4. Commence peripheral site pumping and groundwater capture efforts.
5. Perform necessary repairs or maintenance.

If necessary, treated water can be detained within BTL prior to discharge to Silver Bow Creek (Table 16). Conditions prompting temporary detention within BTL can include noncompliance with effluent discharge standards or damage to the effluent station. If temporary noncompliance events are encountered, the operator can recycle treated flow through Cell D4 in lieu of discharging to Silver Bow Creek. If it is necessary to recycle previously treated flows, the operator will minimize captured groundwater flows distributed to Cell D4 to accommodate treatment capacity. Flows can be detained in lagoon cells A2 and A3 to promote additional treatment interaction and settling prior to discharge. If damage occurs to the effluent station or effluent piping adjacent to Silver Bow Creek, treated flow can be detained in lagoon cells A2 and A3, to the extent practical, to complete necessary repairs.

Non-routine, high-flow conditions reaching the IPS, dosed at the CAS, and eventually distributed to the BTL could warrant implementation of wet-weather contingent operations as described in Section 6.0.

4.4 Automatic Sampling Building

The ASB is located adjacent to the FCD near the southeast corner of Cell D4. The primary function of the ASB is to collect regular water quality samples from the effluent stream to ensure effluent water meets pH discharge requirements, evaluate treatment effectiveness, and assess necessary modifications to treatment operations.

4.4.1 Routine Operating Conditions

Effluent water quality is monitored at sampling station EFS-07 to evaluate the effectiveness of the treatment system. Sample water is routinely drawn from the effluent discharge line and cycled through the automatic composite water sampler.

4.4.2 Available Retention Time and Storage Capacity

The ASB does not have any available retention time or storage capacity.

4.4.3 Infrastructure, Control Mechanisms, and System Capacity

Within the ASB, effluent flow and pH are continually monitored, and water quality samples collected by an automatic sampler. The BTL effluent discharge rates are monitored by a submersible flow meter.

Effluent flow is drawn from the effluent line by a pump and routed to the ASB where pH is monitored. All wastewater produced by sampling events is disposed of in Cell D4 via the building drainage system.

4.4.4 System Components and Probabilistic Replacement Estimates

Identified system components of the ASB include the flow meter and pH sensor, automatic sampler, and self-priming pump. Table 19 summarizes the ASB system components and lists estimated component replacement times. Also, refer to Attachment 1 for additional information.

Table 19. ASB System Components and Probabilistic Replacement

System Component	Task	Optimistic	Likely	Pessimistic	Expected	Units
Rosemount 8750WA	Replace	1.5	2	6	2.6	hours
Grundfos MQ3-45	Replace	2	4	6	4.0	hours
Rosemount 399 pH	Replace	1	2	4	2.2	hours
ISCO 3700	Replace	4	6	8	6.0	hours

Calculation of probabilistic replacement times derived from *Production and Operations Management* (Stevenson, 1993).

4.4.5 Contingent Operations and Mitigation Strategies

Replacing the submersible flow meter will require a temporary delay of effluent discharge to Silver Bow Creek. In this event, each effluent discharge line will be closed using gate valves located adjacent to outlet structures OS-2, OS-3, OS-5, and OS-7. Closure of the effluent line gate valves will result in accumulation of influent flows in lagoon cells A2, A3, B3, and C3. Because of the brief probabilistic replacement time for the flow meter, reduction of captured groundwater distributed to Cell D4 is not anticipated. If required, refer to Section 5.0 for mitigation strategies.

Replacing the self-priming pump, automatic sampler, or pH sensor will not result in direct interference with effluent discharge or operation of the BTL cells. Each aforementioned piece of equipment can be taken offline in the ASB and replaced with shelf-spare units maintained within the Operations Building storage room and Dredge Storage Building. Sample collection and pH monitoring can be manually completed as needed during equipment replacement.

5.0 BUTTE TREATMENT LAGOONS SYSTEM CONTINGENCY OPERATIONS

Interruptions affecting the treatment process can be mitigated through a variety of response sequences. The connectivity of peripheral sites allows operators to reduce captured groundwater distributed to Cell D4, reducing the possibility of discharging untreated groundwater to Silver Bow Creek.

5.1 Contingency Operations Strategy

Operators can implement the following response actions during non-routine scenarios to reduce the captured groundwater distributed to Cell D4 and mitigate discharge of untreated water to Silver Bow Creek.

1. Retain WCP-1 flows within the Travona Mine/West Camp System aquifer.
2. Detain BRW groundwater capture and Missoula Gulch flow in the BRW open areas.

3. Divert subdrain flows to BRW-00 and/or the north drying bed and detain the flow within the BRW open areas.

The contingency operations strategy uses the available storage capacity to store untreated water temporarily until the BTL system can return to routine operations. A decision guide is provided as Attachment 3. The time required to reach the maximum elevation of Cell D4 is included in Table 20 for each response action. The available storage capacity within each component is described in Section 5.2 and the redistribution of the detained water is described in Section 5.3.

Table 20. Response Action Summary and Resulting Cell D4 Storage Time

Response Action ID	Response Action	Routine Average Flow Conditions		Maximum Flow Conditions	
		Resulting Flow to Cell D4 (gpm)	Cell D4 Storage Time[1] (hours)	Resulting Flow to Cell D4 (gpm)	Cell D4 Storage Time[1] (hours)
No Action	a. Routine operation	1,270	17.3	2,200	10.0
1	a. Suspend WCP-1 Pumping Activities	1,115	19.7	1,885	11.7
2	a. Suspend WCP-1 Pumping Activities b. Detain BRW Capture and Missoula Gulch Flow within the Open Areas	855	25.7	1,290	17.1
3	a. Suspend WCP-1 Pumping Activities b. Detain BRW Capture and Missoula Gulch Flow within Open Areas c. Divert Subdrain Flow to BRW	375	58.7	540	40.8

[1] The Cell D4 storage time is defined as the time to reach the maximum Cell D4 elevation without the IPS component operating for the respective response action reduced flow rate.
ID: Identification. gpm: gallons per minute

5.2 Contingency Operations Storage Capacity

As discussed in Section 5.1, the contingency operations strategy can use the available storage capacity of the Travona Mine/West Camp System aquifer, the BRW open areas, and Cell D4. In general, the contingency operations strategy is limited by the storage time within Cell D4 as described in Table 20. The storage time in the other system components, as a result of the response actions, is described in Table 21 below.

Table 21. Storage Time Summary Resulting from Contingency Response Actions

Storage Component	Response Action ID	Response Action	Routine Average Flow Conditions		Maximum Flow Conditions	
			Flow to Storage Component (gpm)	Available Storage Time (days)	Flow to Storage Component (gpm)	Available Storage Time (days)
WCP	1	a. Suspend WCP-1 Pumping Activities	200	22	200[1]	22
BRW	2	a. Suspend WCP-1 Pumping Activities b. Detain BRW Capture and Missoula Gulch Flow within the Open Areas	260	13.9	595	6.1
BRW	3	a. Suspend WCP-1 Pumping Activities b. Detain BRW Capture and Missoula Gulch Flow within Open Areas c. Divert Subdrain Flow to BRW and north drying bed	740	7.9	1,345	5.3

[1] WCP-1 recharge is assumed as a constant 200 gpm based on the previous investigations. The maximum flow for WCP-1 is based on the maximum pumping rate, not the aquifer recharge rate.

ID: Identification. gpm: gallons per minute

5.3 Redistribution of Detained Water

As previously discussed, the BTL system components were designed as a groundwater capture system, not as surface water storage facilities. Captured groundwater will only be stored temporarily during non-routine conditions. The detained water will be redistributed to the BTL system following non-routine operating conditions as soon as practicable, and it will not be retained for extended periods. The rate of redistribution depends on cumulative flow rate reaching the BTL treatment system, and the ability of the system to accommodate increased flows. A Decision Guide for redistribution of retained water is also provided in the main BTL Routine OM&M Plan, Decision Trees appendix. Operators can take the following approach to minimize overall impact on the BTL system.

1. Return subdrain routing to the HCC.
2. Meter untreated water stored in the BRW open areas to the HCC by gradually removing individual stop logs.
3. Resume WCP-1 pumping activities, routing directly to the former Silver Bow Creek Diversion Channel.

Water stored within the West Camp and Travona mine workings aquifer can be gradually metered back to the treatment system by increasing the pumping rate of the WCP-1 extraction well. Redistributed flows can be discharged directly to the former Silver Bow Creek Diversion Channel or to BRW-01, both of which merge with the HCC. Discharge routing is controlled by existing valves installed within BRW. Rate of redistribution of water detained in the WCP-1 system depends on available downstream storage and current flow rates from other groundwater capture components. West Camp drawdown estimates are provided in Attachment 3.

Flow detained within the BRW open areas and north drying bed will be re-directed to the HCC as soon as practical and levels within BRW-00 and BRW-01 will be returned to routine operating conditions as soon as feasible. The detained volume is metered from BRW-01 to the HCC by gradually removing individual stop logs. Flow rates for various stop log heights and the estimated time to discharge water detained in the BRW open areas and return to routine elevations is described in Table 22. The estimated periods provided in Table 22 provide a range of time to discharge detained groundwater, actual times are also subject to site conditions and capture rates (see Table 22 notes below). The IPS rate will be increased as the BTL system capacity is allowed to return Cell D4 to its routine operating elevation.

Table 22. BRW Open Areas Estimated Discharge Rate and Period of Detained Groundwater

Stop Log Height	BRW-01 Maximum Discharge Rate[1] (gpm)	BRW Open Areas Storage Volume[2] (gal)	Estimated Period to Discharge Detained Groundwater[3] (days)
1-inch	68	5,200,000	53.2
3-inch	374	5,200,000	9.6
6-inch	1,057	5,200,000	3.4

[1] The discharge rate of the BRW open areas is controlled by a 24-inch weir at the BRW-01 outlet structure. The discharge rate was estimated assuming the discharge head is equivalent to the stop log height. The actual discharge rate will depend on the stop log removal rate.
[2] The BRW open areas storage volume is defined as the storage volume from the routine average elevation to the maximum elevation.
[3] The estimated period to discharge detained groundwater is defined as the period to discharge the maximum storage volume of the BRW open areas at the maximum discharge rate.
BRW: Butte Reduction Works. gpm: gallons per minute. gal: gallons.

5.4 Contingency Operations Mitigation Measures

The BTL system components whose expected replacement times exceed the anticipated 40.8 hours of available storage time within Cell D4 during maximum conditions (Table 20) are identified as critical components. The critical components are included in Table 23. Although the critical component replacement times exceed the anticipated storage time, normal operation of the BTL system can be maintained as described by their risk mitigation strategy identified in the table.

Table 23. Critical Component Probabilistic Replacement Times

Component Location	Critical Component	Task	Expected Replacement Time (hours)	Risk Mitigation Strategy
BRW	***CMP Discharge Pipe***	Repair	58.0	A pump and temporary piping can be installed to bypass the component and maintain discharge from the BRW open areas to the HCC.
HCC	***30-inch CMP Pipe***	Replace	44.0	A pump(s) and temporary piping can be installed to bypass the component and maintain discharge from the HCC to Cell D4.

BRW: Butte Reduction Works. CMP: corrugated metal pipe. HCC: Hydraulic Control Channel.

Additionally, operation of the BTL system includes shelf-spare replacements for some components, routine inspections, and scheduled preventative maintenance to reduce the failure risk of system components. These measures not only reduce the likelihood of a failed system component, but also expedite the repair or replacement process in the event of a failure.

6.0 WET-WEATHER CONTINGENCY OPERATIONS

Although the BTL system was designed as a groundwater treatment system, the operation of the system and peripheral site systems can be influenced by surface water conditions and periods of extended precipitation. Extended periods of precipitation may require modification of the routine operating procedures to maintain the target-discharge water quality. The following sections describe the general modifications to the routine operations that implement the Contingency Operations due to extended periods of precipitation or wet-weather Contingency Operations. A Decision Guide for contingency operations is also provided in the main BTL Routine OM&M Plan Decision Trees appendix. The main BTL Routine OM&M Plan also contains standard operating procedures and relevant system descriptions to operate the system effectively.

6.1 Trigger for Contingency Operations Due to Precipitation

The precise time to implement wet-weather Contingency Operations can be difficult to define. Operational parameters and observations used to manage increased flows proactively as a result of extended precipitation include the following, listed in order of increasing urgency:

1. A forecast with two to three sequential days of significant precipitation.
2. Increased subdrain flow above 600 gpm and/or increased IPS flow greater than 1,500 gpm.
3. A high alarm value from the IPS wet vault.

Wet-weather Contingency Operations are likely to be encountered during the wet-weather periods in the spring and occasionally during the fall. Initiation of wet-weather Contingency Operations is partially dependent on the judgment of the operator and cannot be defined by a specific event. The wet-weather Contingency Operations will be coordinated with the BTL operations manager.

6.2 Anticipated Wet-Weather Operating Conditions

The increase in flow to the BTL system as a result of wet-weather conditions varies and is difficult to quantify accurately. The increase in flow is dependent on multiple factors including the duration of the wet-weather period, the groundwater conditions, and the BTL operational parameters. The groundwater captured during wet-weather Contingency Operations does not routinely exceed the maximum design capacity of 2,200 gpm; however, precipitation and surface water runoff at the BTL and peripheral systems can cause capture to exceed the maximum design capacity for short periods.

During wet-weather periods, some surface water runoff from the LAO site is treated by the BTL system. The storm water runoff north of Centennial Avenue is conveyed beneath Centennial Avenue to the HCC in three locations and treated by the BTL system. The introduction of additional surface water would routinely increase the flow to the BTL system above the maximum design capacity during the surface water runoff event. Implementation of mitigation measures described in this document are crucial to ensuring critical water level is not exceeded at the HCC termination wall.

A sustained precipitation event is plausible to exceed the critical water level at the HCC termination wall with the currently available mitigation measures implemented.

6.3 Response Action Summary

Wet-weather Contingency Operations procedures are very similar to the procedures to mitigate non-routine operating conditions that have been discussed throughout this Plan. The BTL system is automated to adjust the operating parameters to increases in flow; however, the operators may need to implement one or more of the following response actions to manage flows greater than the BTL system design capacity. Operators can implement the following response sequence to implement the wet-weather Contingency Operations.

1. ***Increase monitoring of the local weather forecast and BTL peripheral systems***. Forecasted extended precipitation or increases in the peripheral site system parameters are useful in proactively managing increased system flow.
2. ***Suspend WCP-1 pumping activities***. Suspension of WCP-1 pumping activities can be maintained for a period of 22 days, assuming a routine flow rate of 200 gpm.
3. ***Modify the subdrain flow alignment to allow operation of both discharge lines in parallel***. Operating the discharge lines in parallel can increase the capacity of the system to approximately 680 gpm to maintain a constant level in the wet vault.
4. ***If required, activate the subdrain auxiliary diesel pump***. The auxiliary diesel pump can increase the system pumping capacity to approximately 750 gpm if subdrain inflow exceeds the capacity of the discharge lines operated in parallel. To increase the capacity of the system to its maximum operational limit, additional flow from other areas must be reduced so the BTL system maximum operational limit of 1,880 gpm is not exceeded.
5. ***Divert all or a portion of the subdrain discharge to the BRW open areas and north drying bed***. The BRW open areas and north drying bed can retain Missoula Gulch base flow, on-

site groundwater capture, and the subdrain flows for 7.9 days at routine flow rates and 5.3 days at maximum flow rates as described in Section 5.2.

Effective implementing the wet-weather Contingency Operations requires operators to monitor extended weather patterns proactively rather than retroactively responding to excess flow issues. The sum of the individual components has the potential to exceed the BTL maximum design capacity during periods of wet weather; however, the BTL system maximum operational limit of 1,880 gpm cannot be exceeded. For this reason, the wet-weather Contingency Operations manage the increased flow of components by diverting flows to available storage areas described throughout this document.

7.0 REFERENCES

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Stevenson, William J., 1993. Production/Operations Management, 4th Ed. Richard D. Irwin, 1993.

Figures

Figure 1. BTL and Peripheral Site Systems

Figure 2. BTL Water Collection & Treatment System Flow Diagram

Figure 3. Butte Reduction Works (BRW) Overview

Figure 4. BRW-01 Plan & Profile A – A’

Figure 5. BRW-00 Plan & Profile B – B’

Figure 6. LAO Water Survey West End Plan and Profile

LEGEND:

- WATER SURFACE ELEVATION
- COMPOSITE CHEMISTRY SAMPLES
- FLOW RATES
- OUTLET STRUCTURE
- LAO BOUNDARY

N

DISPLAYED AS:

COORD SYS/ZONE: MONTANA STATE PLANE
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER/2015 NAIP

SCALE IN FEET
0 250 500

FIGURE 1

PIONEER TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

BUTTE TREATMENT LAGOONS (BTL) AND PERIPHERAL SITE SYSTEMS OVERVIEW

DATE: 12/2020

12/8/2020 4:20:44 PM P:\ARCO\BPSOU\2020\BTL-LAO\SITE FIGURES\BTL-PLN-001-20.DWG

LEGEND:

- ROUTINE LAGOON CELL FLOW PATH
- EFFLUENT PIPING AND DISCHARGE FLOW PATH
- HYDRAULIC CONTROL CHANNEL FLOW PATH
- INFLUENT PIPELINE(S) FLOW PATH
- WEST CAMP DISCHARGE LINE
- MISSOULA GULCH DIVERSION PIPE
- BUTTE REDUCTION WORKS FLOW PATH
- SILVER BOW CREEK DIVERSION CHANNEL
- METRO STORM DRAIN DISCHARGE LINE

N

DISPLAYED AS:

COORD SYS/ZONE: MSP
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER

SCALE IN FEET
0 250 500

FIGURE 2

PIONEER TECHNICAL SERVICES, INC.
307 E. PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

BTL WATER COLLECTION & TREATMENT SYSTEM FLOW DIAGRAM

DATE: 5/4/2022

4/21/2016 12:21:04 PM \\192.168.254.15\PROJECTS\ARCO\BUTTE\BPSOU\2016\REVISED DRAFT FINAL BTL CONTINGENCY OPERATIONS REPORT\DWG\BRW-FG-PLN-003-16.DWG

LEGEND:

MAXIMUM ELEVATION

N

DISPLAYED AS:
COORD SYS/ZONE: MSP
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER

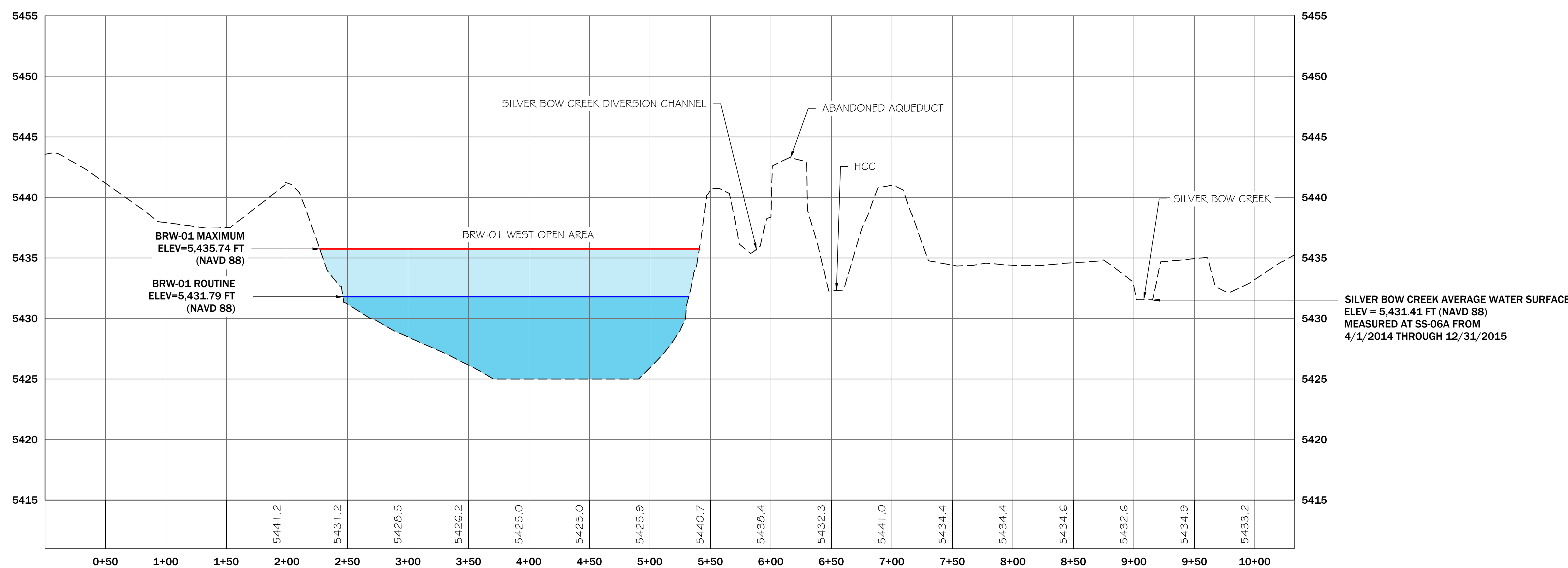
SCALE IN FEET
0 100 200

FIGURE 3

PIONEER TECHNICAL SERVICES, INC.
307 E. PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

BUTTE REDUCTION WORKS (BRW) OVERVIEW

DATE: 3/23/2016



LEGEND:

- ROUTINE STORAGE CAPACITY
- AVAILABLE STORAGE CAPACITY FOR CONTINGENCY OPERATIONS
- ROUTINE OPERATING ELEVATION
- MAXIMUM OPERATING ELEVATION

NOTE:

BRW-01 MAXIMUM ELEVATION CORRESPONDS TO THE SURVEYED TOP OF OUTLET STRUCTURE ELEVATION. THE MAXIMUM ELEVATION IS GREATER THAN THE AVERAGE SS-06A ELEVATION IN SILVER BOW CREEK, BUT THE HCC REMAINS PROTECTIVE OF SILVER BOW CREEK.

DISPLAYED AS:	
COORD SYS/ZONE:	MSP
DATUM:	NAD 83
UNITS:	FEET
SOURCE:	PIONEER

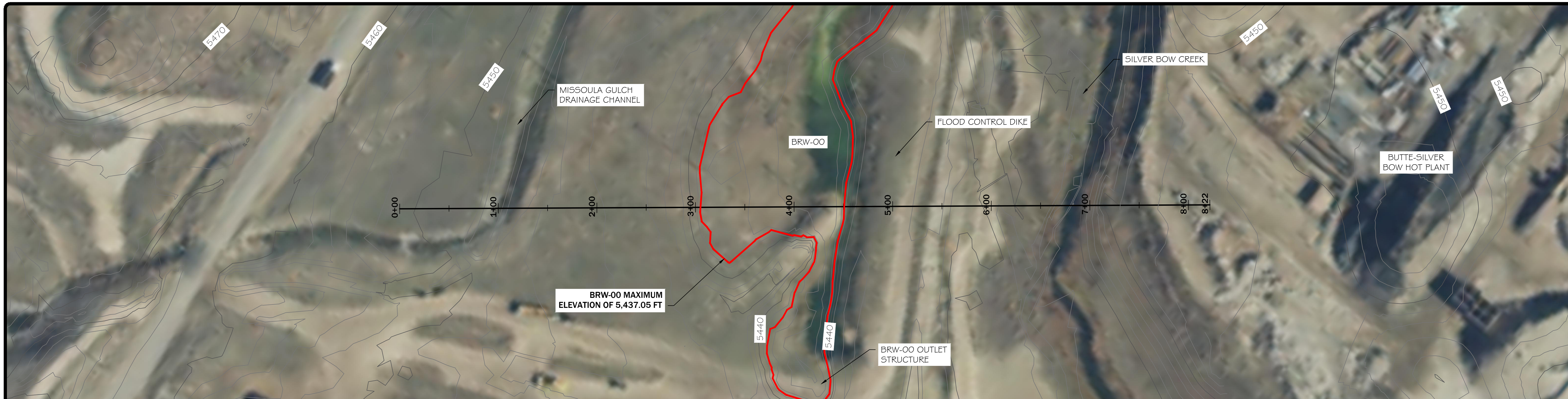
SCALE IN FEET
0 50 100

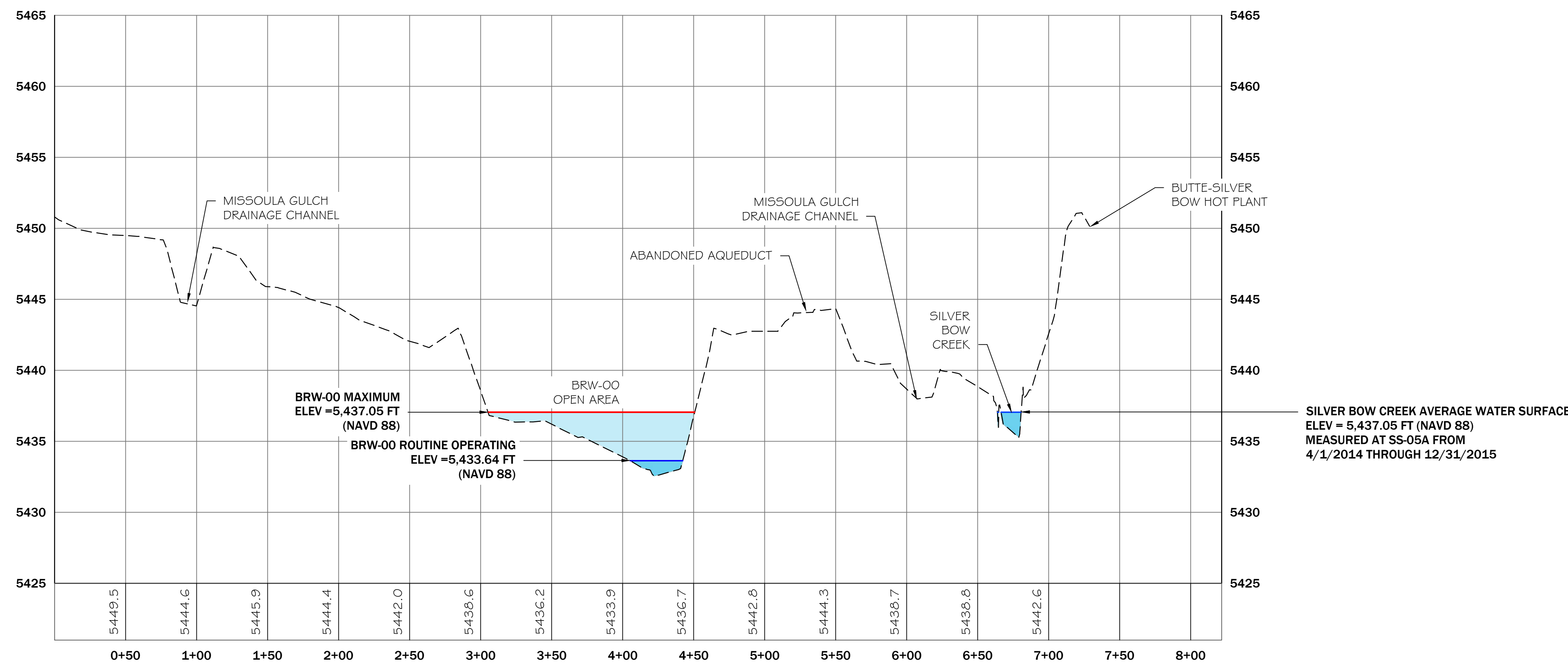
FIGURE 4

PIONEER TECHNICAL SERVICES, INC.
307 E. PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

BRW-01 PLAN & PROFILE A - A'

DATE: 3/23/2016





LEGEND:

- ROUTINE STORAGE CAPACITY
- AVAILABLE STORAGE CAPACITY FOR CONTINGENCY OPERATIONS
- ROUTINE OPERATING ELEVATION
- MAXIMUM OPERATING ELEVATION

NOTE:

BRW-00 MAXIMUM ELEVATION CORRESPONDS TO THE AVERAGE SILVER BOW CREEK ELEVATION MEASURED AT SS-05A FROM 4/1/2014 THROUGH 12/31/2015.

DISPLAYED AS:	
COORD SYS/ZONE:	MSP
DATUM:	NAD 83
UNITS:	FEET
SOURCE:	PIONEER

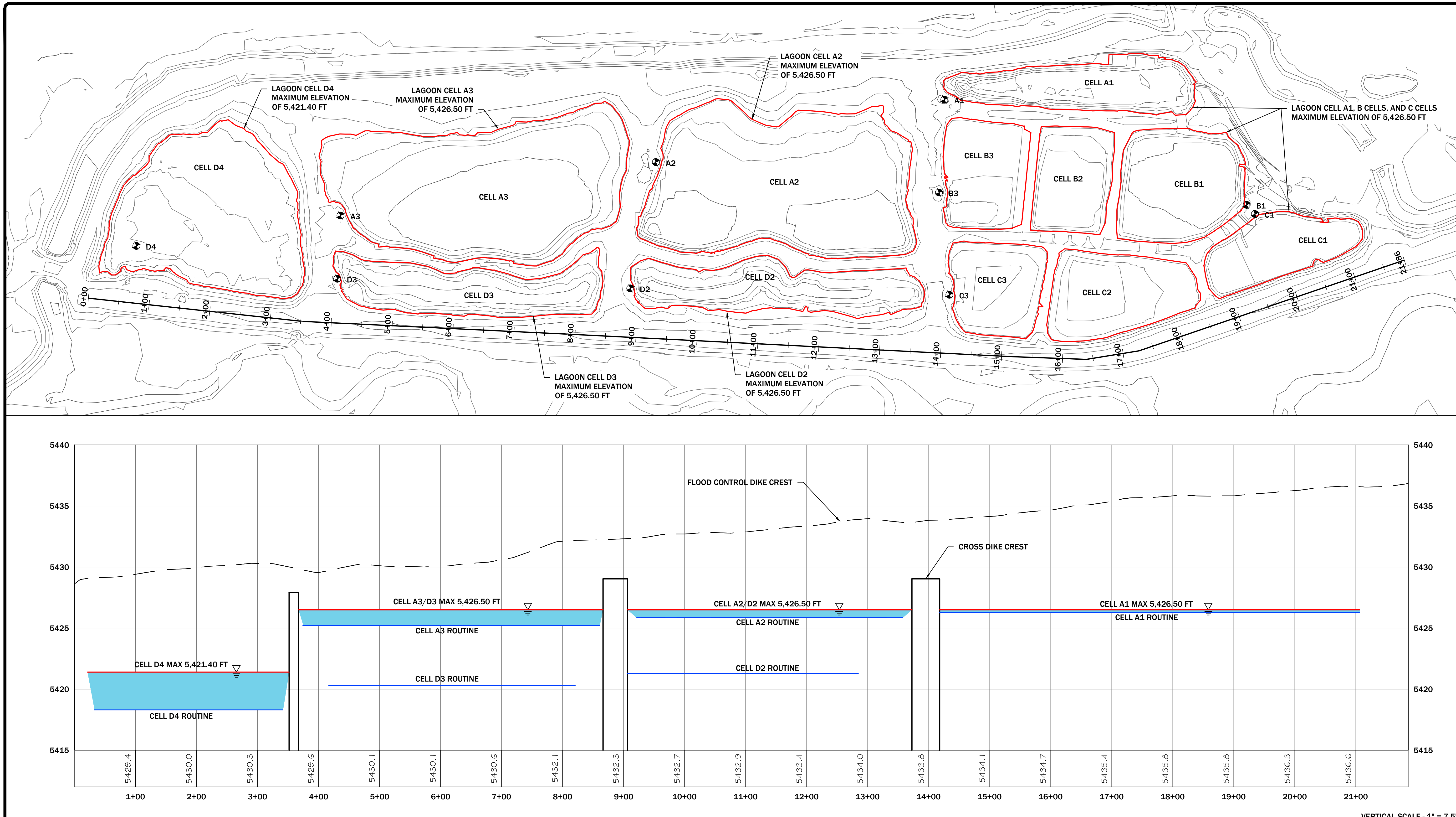
SCALE IN FEET
0 50 100

FIGURE 5

PIONEER TECHNICAL SERVICES, INC.
307 E. PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

BRW-00 PLAN & PROFILE B - B'

DATE: 3/23/2016



LEGEND:

- LAGOON CELL OPERATING RANGE
- MAXIMUM OPERATING ELEVATION
- ROUTINE OPERATING ELEVATION MEASURED FROM 4/1/2014 THROUGH 12/31/2015

NOTE:

1. THE BTL SYSTEM WAS NOT DESIGNED TO STORE WATER DURING NON-ROUTINE INFLUENT CONDITIONS.
2. THE BTL SYSTEM CAN TEMPORARILY BE OPERATED AT THE MAXIMUM ELEVATIONS DURING NON-ROUTINE CONDITIONS.
3. THE LAGOON CELLS ARE CONNECTED AND CONTROLLED BY THE LOWEST MAXIMUM ELEVATION WHICH IS THE MAXIMUM ELEVATION OF THE B CELLS.

N

DISPLAYED AS:

COORD SYS/ZONE:	MSP83
DATUM:	NAVD88
UNITS:	IF
SOURCE:	PIONEER

SCALE IN FEET
0 75 150

FIGURE 6

LAO WATER SURVEY WEST END PLAN AND PROFILE

PIONEER TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

DATE: 3/22/16

Attachment 1

Contingency Inventory List, System Components and Probabilistic Replacement Time Calculation Brief

Quantity in Stock	Name	Description	Part #	Model #	Serial #	Pin #	Condition
Pumps							
1	Berkeley Pump			B37PM	M5120, 7"		Used
1	A.O. Smith Century Pump Motor	5.0 HP Dewatering Pump Motor	7-360327-02-03	SCE	093086M		Used
2	Godwin 230 Volt 1 Phase 2.5 HP	2.5 HP Dewatering Pump					New
2	Pump Controller	Pump Controller for Godwin 2.5 HP					New
2	Well Pump level Switch	Temporary pump level control					Used
1	SRS Crisafulli Dredge/Pump Power control	Electrical Pump Power Control Box					Used
2	Submersible Pumps	Godwin 3"					Used
1	Leeson 6HP Pump w/ spare pumpend	HCC-02A Spare Pump					new
4	Dewatering Pumps	Rebuilt Pumps Used for HCC-02A&B					Rebuilt
1	Goulds Pump, ITT 15 HP Submersible pump	15 HP Submersible Pump					New
1	Centripro 15 HP Submersible Pump	15 HP Submersible Pump		6M154			New
2	Godwin GSP 600 .035 8" Submersible Pumps	HCC Temporary Pumps					Used
1	Ampco 4x3 Centrifugal Pump and Motor	BPSOU Subdrain Wet Vault Pump Assembly		Ampco 4x3			Re-built
1	Godwin Pumpend	IPS Spare Pumpend					New
1 box	Extra Parts for IPS pumps	Hoses, Valves Rubber Drive Adapter, 125PSI Poppet Style Valve					New
Instruments							
5	Ametek Digital Display	LCD Level Indicator Display					Used
1	Rosemont Analytical Inc. Conductivity Sensor	Discharge Conductivity Sensor			L12-4270637-003		New
3	Level Transducers	Pond Pressure Level transducers	See EDS				New
1	Waycon Linear Displacement Transducer			5X5Q500-420A-DA-0	12524085		New
1	Rosemont 3100 series	Ultrasonic Level transducer					New
Lagoon Cell Components							
31	Gunderboom Buoys	Buoys					New
3	Large Aqua Barriers	Outlet Structure Isolation					Used
3	8' X 20' Repair Aqua Barriers	A1, B1, C1 Crossing Aqua Barriers					Used/New
1 Crate	6" X 48" Stop Logs	Outlet Structure Stop Logs					New
7	3" X 48" Stop Logs	Outlet Structure Stop Logs					New
3	4" X 48" Stop Logs	Outlet Structure Stop Logs					New
10	6" X 48" Stop Logs	Outlet Structure Stop Logs					New
14	4" X 36" Stop Logs	Outlet Structure Stop Logs					New
12	3" X 36" Stop Logs	Outlet Structure Stop Logs					New
1/2 Pallet	6"X 36" Stop Logs	Outlet Structure Stop Logs					New
2	Outlet Structure Valve handles						New

Quantity in Stock	Name	Description	Part #	Model #	Serial #	Pin #	Condition
Electrical Misc.							
1	WEG Vectrue Inverter	IPS Spare VFD		CFW09			New
1	WEG Vectrue Inverter	WCP Spare VFD		CFW11			New
1	Rosemont Analytical Inc.- Intelligent Dual Input Analyzer	24VDC Input Analyzer		1056-02-21-32-AN-UL			New
1	Electrical Panel Housing	2' X 3.5" Housing					New
2	Ashcroft A series Switch	Range 100 PSI 1/4" NPT male 10219437-1		APAN41P012CS02100#NSR			New
2	Godwin Pump Power Controllers	Temporary HCC pump controller					Used
2	Eaton Cutler Hammer Starter	10HP at 200V, 15@230V, 25@460V	AN16GNOAB	Series B1			New
1	Eaton Cutler Hammer Starter	10HP at 200V, 15@230V, 25@460V	AN16GNOAB	Series B1			Used
1	Eaton Cutler Hammer Overload Relay	75 amp	C306GN3B				New
1	Franklin Electric Pump Electrical Pannel	Pump Pannel					Used
2	WEG Vectrue Inverter panels w/ Stands			CFW-11			Used
Electric Motors							
1	Leeson Washgaurd Motor			C6T17VC2G			Used
1	Ironhorse General Purpose Industrial Motor	1 HP Electric Motor		MTC-1-3BD18			Used
1	US Electric motor	1 HP Electric Motor		AF41A			Used
1	US Electric motor	Electric Motor		C637A			Used
1	APCOR Mixer Motor	Slurry tank mixer motors	SEE EDS				New
1	WEG Severe Duty Inverter Motor	IPS Spare Electrical Motor		365T	07518EP3E365T		New
2	Leeson Washgaurd Motor	Accufeeder Screw Feeder Motor 1 HP		C6T17VC2H			Used
1	Emerson Motor Co.	Electric Auger Motor 1HP		AF41			New
1	Nord gear Corporation	Agitator Motor For Accufeeder					New
1	Franklin Electric Submersible Motor	1.5HP 3-Phase, 4-inch, High thrust		2345249403			Used
Miscellaneous Equipment							
1	Quincy Air Pump	IPS Spare Air Compressor for Pumps		216		114560-1	New
1	Ingersol Air Compressor	Spare Air Compressor for inside Silo		2475			New
1	Influent Line Air Relief Valve	CASB 14" Influent Line Air Relief					New
1	Mini Dredge	Mini Dredge on Pontoons					Used
Lime Addition Equipment							
3	Schenk Accurate Feeder Augers	Various Helix Splines					Used
10 Bags	Lime for Supersacker	Interim Operation Emergency Lime Addition					New
1	SuperSacker	Interim Operation Emergency Lime Addition					Used
1	Mixer Paddle	Slurry tank mixer Paddle					New
1	Mixer Shaft	Slurry tank mixer paddle shaft					New
1	Mecha Tron Accufeeder	Accufeeder					Used

Date:	2/25/2013	Project:	BTL Contingency Management	Prepared By:	SDS
Rev. No.	1	Project No.		Checked By:	ADL
Rev. Date:	5/25/2022	Calc. No.	1	Approved By:	
Subject:	BTL-LAO Critical Path Replacement Tasks				

Purpose/Objective

Several components have been identified as critical to system operation and treatment within the BTL-LAO Treatment System. Depending upon several scenarios, repair/replacement of these components may require contingency operations, or deviations to be considered in regard to treatment. Critical replacement times have been calculated for various components and are provided within Attachment A-1. The following provides information regarding expected repair/replacement time calculation methods.

Background/Data

Historic repair/replacement durations were used for items that have been replaced previously. Personal conversations with field foremen and supervisors were used to estimate repair/replacement durations for items which have not previously been replaced.

Method

Due to the variability associated with repair/replacement times of equipment within the BTL treatment system, a probabilistic approach was used to estimate the length of time required to repair/replace identifiable critical components. This approach utilizes three time estimates for each component (optimistic, pessimistic, and likely) to yield a likely time. These times require an estimate for the following times:

Optimistic time (T_o): length of time required under optimal conditions (i.e. everything goes perfectly).

Pessimistic time (T_p): length of time required under the worst working conditions, but still able to safely complete the task.

Most likely time (T_m): most probable length of time required to complete the task. A standard time estimate would likely use this time estimate.

The expected time (T_e) is then determined as the weighted average of the three estimated times according to the following equation:

$$T_e = \frac{1}{6}\left[T_0 + (4 * T_m) + T_p\right] \quad \text{Equation 16-4, pp. 792}$$

The weighted average approach provided above was utilized for this task since it closely resembles the beta distribution, which is used to describe the inherent variability in time estimates in probability calculations.

Date:	2/25/2013	Project:	BTL Contingency Management	Prepared By:	SDS
Rev. No.	1	Project No.		Checked By:	ADL
Rev. Date:	5/25/2022	Calc. No.	1	Approved By:	
Subject:	BTL-LAO Critical Path Replacement Tasks				

These time estimates were made with input from personnel with intimate knowledge of the system, replacement requirements, equipment configurations and working conditions. Many time estimates were made based on previous replacement tasks within the system.

Most time estimates describe the task duration in hours, however, some tasks require long-term durations and are provided in overall working days.

A reliable method for determining an expected time given variability in the task conditions allowed a realistic approach to determining critical replacement components.

Results/Discussion

See the attached spreadsheet.

References

Stevenson, William J. (1993). *Production/Operations Management*, 4th Edition.

ATTACHMENT A-1

Probalistic time estimates constist of three time estimates for a specific activity. (Production/Operations Mangement, 4th ed)	
Optimistic	Length of time under optimum conditions; everything goes perfectly
Most likely	Most probable legth of time required, typical installation
Pessimistic	Length of time under worst conditions; Murphy's Law…

Expected time (Te) = (o + (4*m) + p)/6

System Component	***Task***	***Optimistic***	***Likely***	***Pessimistic***	***Expected***	***Units***
West Camp						
Goulds Model 250L15	Replace	8	16	24	16.0	hours
McCrometer UM06-04	Replace	2	3	4	3.0	hours
Esterline KPSI	Replace	1.5	3	6	3.3	hours
Above Ground Pipe	Repair	1.5	3	5	3.1	hours
Subgrade Pipe	Repair	2	3	5	3.2	days
Input/Output Card	Replace	1.5	3	4	2.9	hours
Power Supply	Repair	1.5	3	4	2.9	hours
PLC Processor	Replace	1.5	4	6	3.9	hours
Communication Failure	Repair	0.5	2	4	2.1	hours
Missoula Gulch						
Intake Grating	Repair	4	12	24	12.7	hours
Sediment Vault	Clean	8	16	24	16.0	hours
Subgrade Pipe	Repair	2	3	5	3.2	days
Subdrain						
Ampco Model E 4x3C	Replace	2	4	8	4.3	hours
McCrometer UM06-04	Replace	1.5	3	6	3.3	hours
Pulsar Level Sensor	Replace	1.5	2	6	2.6	hours
Rosemount 8750WA	Replace	1.5	2	6	2.6	hours
Cla-Val 50-01	Replace	1	2	4	2.2	hours
Subgrade Pipe	Repair	8	10	28	12.7	hours
Input/Output Card	Replace	1.5	3	4	2.9	hours
Power Supply	Replace	1.5	3	4	2.9	hours
PLC Processor	Replace	1.5	4	6	3.9	hours
Communication Failure	Replace	1.5	2	4	2.3	hours
BRW						
Elastomeric Seals	Replace	8	16	24	16.0	hours
HDPE Discharge Pipe	Repair	32	40	60	42.0	hours
CMP Discharge Pipe	Repair	44	56	80	58.0	hours
HCC						
Sheet Pile Cut-off Wall	Repair	16	24	32	24.0	hours
30” Screw Gate	Replace	12	24	40	24.7	hours
30” CMP Pipe	Replace	24	40	80	44.0	hours
IPS						
Intake Grates	Clean	0.5	2	4	2.1	hours
Godwin CD225M Pump Motor	Replace	4	6	10	6.3	hours
Godwin CD225M Pump Compressor	Replace	3	4	5	4.0	hours
Godwin CD225M Pump End	Replace	3	4	5	4.0	hours
Temporary Pump	Install	2	4	8	4.3	hours
WEG CFW-09 VFD	Replace	4	6	10	6.3	hours
Rosemount 3105 Sensor	Replace	0.5	1.5	4	1.8	hours
14” McCrometer UltraMag	Replace	1.5	2	4	2.3	hours
14” SDR 17 HDPE	Repair	3	6	12	6.5	hours
Input/Output Card	Replace	1.5	3	4	2.9	hours
Power Supply	Replace	1.5	3	4	2.9	hours
PLC Processor	Replace	1.5	4	6	3.9	hours
Communication Failure	Repair	1.5	2	4	2.3	hours

CAS						
14” Influent Line (Buried)	Repair	6	8	12	8.3	hours
14” Influent Line (Exposed)	Repair	2	3	6	3.3	hours
14” McCrometer Flow Meter	Replace	2.5	4	8	4.4	hours
2” Danfoss Comboair Valve	Replace	0.5	2	4	2.1	hours
4” Feed Water Supply Line	Repair	1.5	4	6	3.9	hours
4” McCrometer Flow Meter	Replace	1	2	4	2.2	hours
4” Hayward CPVC Valve	Replace	0.5	2	4	2.1	hours
Fontaine Weir Gates	Replace	1.5	2	4	2.3	hours
Rosemount 3105 Level Sensor	Replace	0.5	2	4	2.1	hours
Rosemount 400 Conductivity	Replace	0.5	2	4	2.1	hours
Carman CD Motor	Replace	2	4	8	4.3	hours
Schenck Accurate Mechatron	Replace	4	8	16	8.7	hours
Continental TEFC Motor	Replace	2	4	8	4.3	hours
8” Salina Vortex Knife Gate	Replace	2.5	6	10	6.1	hours
4” Salina Vortex Knife Gate	Replace	2	4	8	4.3	hours
Input/Output Card	Replace	1.5	3	4	2.9	hours
Power Supply	Replace	1.5	3	4	2.9	hours
PLC Processor	Replace	1.5	4	6	3.9	hours
Communication Failure	Repair	1.5	2	4	2.3	hours
Lime System						
Supersacker	Deploy	1.5	6	12	6.3	hours
Lime	Refill	0.5	1	3	1.3	hours
Electrical1	Installation	1	2	4	2.2	hours
BTL System						
Elastomeric Seals	Repair	8	16	24	16.0	hours
Waterman C-20 Gates	Replace	4	6	8	6.0	hours
Effluent Lines	Repair	2	4	8	4.3	hours
ASB						
Rosemount 8750WA	Replace	1.5	2	6	2.6	hours
Grundfos MQ3-45	Replace	2	4	6	4.0	hours
Rosemount 399 pH	Replace	1	2	4	2.2	hours
ISCO 3700	Replace	4	6	8	6.0	hours

Attachment 2

BTL Discharge Pipe Capacities at Routine Operating Elevations Calculation Brief

Date:	2/25/2013	**Project:**	Contingency Management Ops	**Prepared By:**	ADL
Rev. No.	1	**Project No.**		**Checked By:**	AMD
Rev. Date:	NA	**Calc. No.**	1	**Approved By:**	JTB
Subject:	BTL Discharge Pipe Flows				

Purpose/Objective

Determine the discharge capacity of each effluent line during maximum operating conditions at the Butte Treatment Lagoons (BTL).

Background/Data

Influent water to BTL is treated with hydrated lime for metals removal. Each lagoon cell is connected to the subsequent cells through a high-density polyethylene (HDPE) discharge pipe and discharge to Silver Bow Creek through effluent lines. Operating conditions for the lagoon treatment cells were identified in the *Draft Final Butte Treatment Lagoons Water Management Contingency Operations Technical Report* (Atlantic Richfield Company, 2016). BTL infrastructure data was obtained from the *Final Butte Treatment Lagoons (BTL) and West Camp Pump Station (WCP-1) Upgrades Construction Completion Report (CCR)* (Atlantic Richfield Company, 2014) and *2004 Butte Treatment Lagoon System Modifications Lagoon Earthwork Plan* as-built drawings. Effluent Line A (EL-A) was evaluated as two separate sections: 1) a 12 inch diameter section from Lagoon Cell C3 to it junction with EL-C and 2) a 15 inch diameter section from the junction with EL-C to Silver Bow Creek.

Method

Effluent line flow rates were calculated assuming a submerged inlet and outlet for each of the discharge lines under maximum operating conditions. The discharge pipe routine flow rates were calculated utilizing the following equation provided in the *Civil Engineer Reference Manual for the PE Exam* (Lindeburg, 2006).

$$Q = C_d A_0 \sqrt{2g \frac{H_1 - H_2}{1 + \frac{29 C_d^2 n^2 L}{R^{4/3}}}}$$

Equation 19.104 p. 19-28

Under the maximum BTL operating conditions, the entrance velocity head, the entrance friction loss, and the exit friction loss can be neglected. The coefficient of discharge (C_d) value of 0.82 was obtained from *Civil Engineer Reference Manual for the PE Exam* Table 17.5 (Lindeburg, 2006) for a sharp tube orifice with no separation. A Manning's n value of 0.012 was used as per the manufacturer's recommendation. The remaining input values are based on the site conditions which were obtained from the outlet structure design and the operating conditions.

Results/Discussion

The results of the flow rate analysis are included in Attachment 2-1.

Date:	2/25/2013	Project:	Contingency Management Ops	Prepared By:	ADL
Rev. No.	1	Project No.		Checked By:	AMD
Rev. Date:	NA	Calc. No.	1	Approved By:	JTB
Subject:	BTL Discharge Pipe Flows				

References

Lindeburg, Michael R. (2006). Civil Engineer Reference Manual for the PE Exam, 10th Edition.

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Atlantic Richfield Company, 2016. Draft Final Butte Treatment Lagoons Water Management Contingency Operations Technical Report. April 29, 2016.

ATTACHMENT 2-1

Effluent Line:		EL-A (12 inch Diameter)			
Input:	Inlet Elev (H_1) =	5,426.50	ft		Maximum operating elevation of Lagoon Cell C3
	Outlet Elev (H_2) =	5,422.73	ft		2004 BTL Modifications as-built drawings.
	Length (L) =	567	ft		2004 BTL Modifications as-built drawings.
	Diameter (d) =	1.0	ft		2004 BTL Modifications as-built drawings.
	Manning's Roughness (n) =	0.012	unitless		
	Coefficient of discharge (C_d) =	0.82	unitless		
	Gravitational Constant (g) =	32.2	ft/s^2		
Output:	Area (A_0)=	0.79	ft^2	$pi*d^2/4$	
	Wetted Perimeter (WP) =	3.14	ft	pi*d	
	Hydraulic Radius (R) =	0.25	ft	A_0/WP	
	Elevation Head =	3.77	ft	H_1-H_2	
	Flow Rate (Q) =	3.01	ft^3/s	$C_d*A_0*((2g*(H_1-H_2)/(1+((29*(C_d^2)*(n^2)*L/(R^{4/3}))))^{0.5})$	*Civil Engineer Reference Manual for the PE Exam* (Lindeburg, 2006)
	Flow Rate (Q) =	1,351	gal/min		

Effluent Line:		EL-A (15 inch Diameter)			
Input:	Inlet Elev (H_1) =	5,426.50	ft		Maximum operating elevation of Lagoon Cell C3
	Outlet Elev (H_2) =	5,419.71	ft		Phase II as-built elevation of the effluent discharge line.
	Length (L) =	545	ft		2004 BTL Modifications as-built drawings.
	Diameter (d) =	1.3	ft		2004 BTL Modifications as-built drawings.
	Manning's Roughness (n) =	0.012	unitless		
	Coefficient of discharge (C_d) =	0.82	unitless		
	Gravitational Constant (g) =	32.2	ft/s^2		
Output:	Area (A_0)=	1.23	ft^2	$pi*d^2/4$	
	Wetted Perimeter (WP) =	3.93	ft	pi*d	
	Hydraulic Radius (R) =	0.31	ft	A_0/WP	
	Elevation Head =	6.79	ft	H_1-H_2	
	Flow Rate (Q) =	7.34	ft^3/s	$C_d*A_0*((2g*(H_1-H_2)/(1+((29*(C_d^2)*(n^2)*L/(R^{4/3}))))^{0.5})$	*Civil Engineer Reference Manual for the PE Exam* (Lindeburg, 2006)
	Flow Rate (Q) =	3,293	gal/min		

Effluent Line:		EL-B			
Input:	Inlet Elev (H_1) =	5,426.50	ft		Maximum operating elevation of Lagoon Cell B3
	Outlet Elev (H_2) =	5,424.26	ft		2004 BTL Modifications as-built drawings.
	Length (L) =	243	ft		2004 BTL Modifications as-built drawings.
	Diameter (d) =	1.0	ft		2004 BTL Modifications as-built drawings.
	Manning's Roughness (n) =	0.012	unitless		
	Coefficient of discharge (C_d) =	0.82	unitless		
	Gravitational Constant (g) =	32.2	ft/s^2		
Output:	Area (A_0)=	0.79	ft^2	$pi*d^2/4$	
	Wetted Perimeter (WP) =	3.14	ft	pi*d	
	Hydraulic Radius (R) =	0.25	ft	A_0/WP	
	Elevation Head =	2.24	ft	H_1-H_2	
	Flow Rate (Q) =	3.35	ft^3/s	$C_d*A_0*((2g*(H_1-H_2)/(1+((29*(C_d^2)*(n^2)*L/(R^{4/3}))))^{0.5})$	*Civil Engineer Reference Manual for the PE Exam* (Lindeburg, 2006)
	Flow Rate (Q) =	1,503	gal/min		

Effluent Line:		EL-C			
Input:	Inlet Elev (H_1) =	5,426.50	ft		Maximum operating elevation of Lagoon Cell A2
	Outlet Elev (H_2) =	5,422.70	ft		2004 BTL Modifications as-built drawings.
	Length (L) =	273	ft		2004 BTL Modifications as-built drawings.
	Diameter (d) =	1.3	ft		2004 BTL Modifications as-built drawings.
	Manning's Roughness (n) =	0.012	unitless		
	Coefficient of discharge (C_d) =	0.82	unitless		
	Gravitational Constant (g) =	32.2	ft/s^2		
Output:	Area (A_0)=	1.23	ft^2	$pi*d^2/4$	
	Wetted Perimeter (WP) =	3.93	ft	pi*d	
	Hydraulic Radius (R) =	0.31	ft	A_0/WP	
	Elevation Head =	3.8	ft	H_1-H_2	
	Flow Rate (Q) =	7.32	ft^3/s	$C_d*A_0*((2g*(H_1-H_2)/(1+((29*(C_d^2)*(n^2)*L/(R^{4/3}))))^{0.5})$	*Civil Engineer Reference Manual for the PE Exam* (Lindeburg, 2006)
	Flow Rate (Q) =	3,287	gal/min		

Effluent Line:	EL-D			
Input:	Inlet Elev (H_1) =	5,426.50	ft		Maximum operating elevation of Lagoon Cell A3
	Outlet Elev (H_2) =	5,421.44	ft		2004 BTL Modifications as-built drawings.
	Length (L) =	150	ft		2004 BTL Modifications as-built drawings.
	Diameter (d) =	1.3	ft		2004 BTL Modifications as-built drawings.
	Manning's Roughness (n) =	0.012	unitless		
	Coefficient of discharge (C_d) =	0.82	unitless		
	Gravitational Constant (g) =	32.2	ft/s^2		
Output:	Area (A_0)=	1.23	ft^2	$pi*d^2/4$	
	Wetted Perimeter (WP) =	3.93	ft	pi*d	
	Hydraulic Radius (R) =	0.31	ft	A_0/WP	
	Elevation Head =	5.06	ft	H_1-H_2	
	Flow Rate (Q) =	10.51	ft^3/s	$C_d*A_0*((2g*(H_1-H_2)/(1+((29*(C_d^2)*(n^2)*L/(R^{4/3}))))^{0.5})$	*Civil Engineer Reference Manual for the PE Exam* (Lindeburg, 2006)
	Flow Rate (Q) =	4,716	gal/min		

Attachment 3

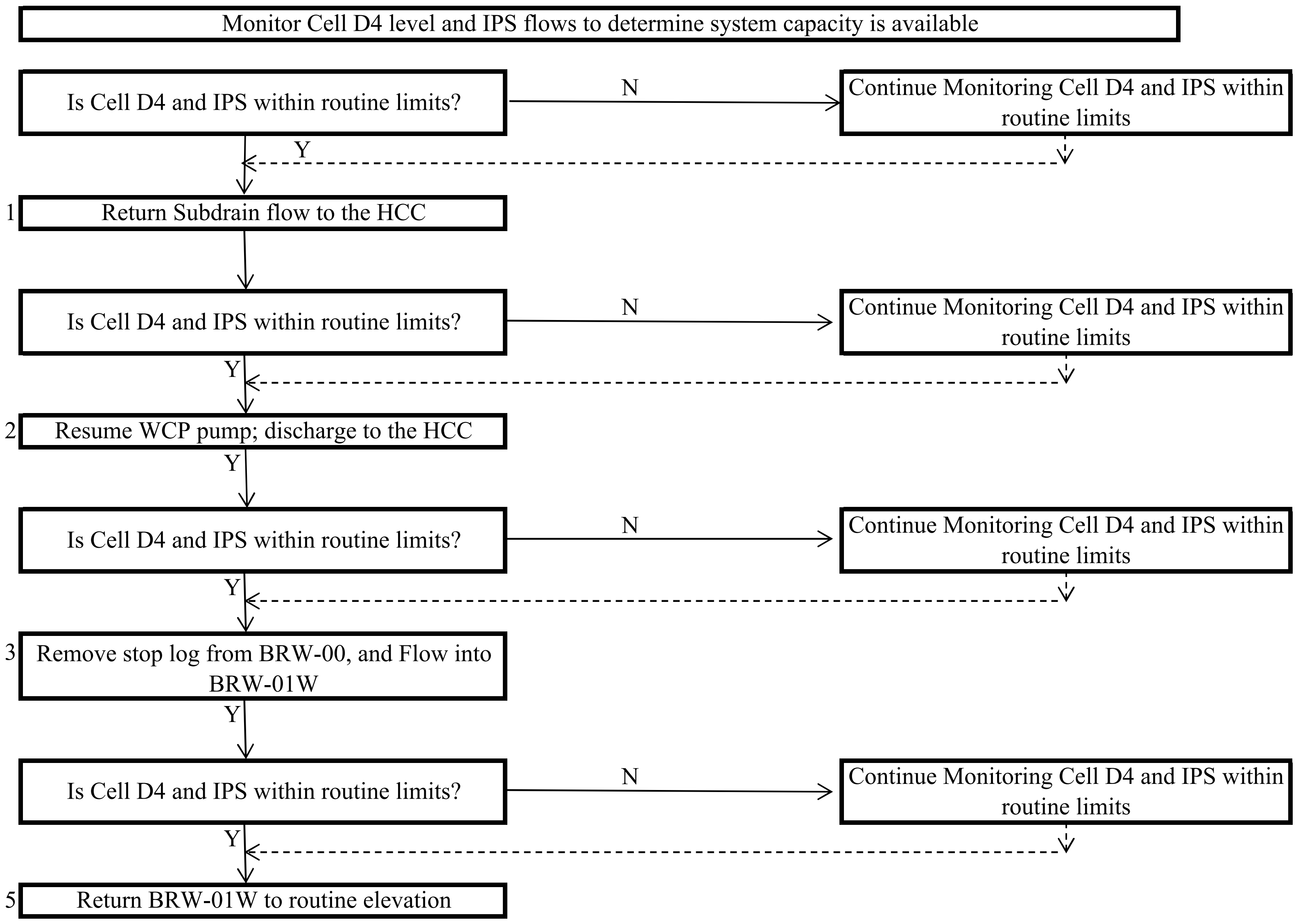
West Camp Drawdown Estimate

Estimated time required to return to pre-shutdown level.
***Assume pre-shutdown pumping rate held the West Camp level static for that re-charge period. Resume pumping rate must be > than pre-shutdown pumping rate**
Reacharge rate and associated pumping rate is seasonal based upon groundwater flow

Resume Pumping rate	Pre-shutdown pumping rate					Pre-shutdown pumping rate					Pre-shutdown pumping rate					Pre-shutdown pumping rate					Pre-shutdown pumping rate				
	166					177					205					255					324				
	Days without pumping operations					Days without pumping operations					Days without pumping operations					Days without pumping operations					Days without pumping operations				
	3	5	10	15	20	3	5	10	15	20	3	5	10	15	20	3	5	10	15	20	3	5	10	15	20
gpm	Estimated days to return to normal operating level					Estimated days to return to normal operating level					Estimated days to return to normal operating level					Estimated days to return to normal operating level					Estimated days to return to normal operating level				
160	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
170	124.5	207.5	415.0	622.5	830.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
180	35.6	59.3	118.6	177.9	237.1	177.0	295.0	590.0	885.0	1180.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
190	20.8	34.6	69.2	103.8	138.3	40.8	68.1	136.2	204.2	272.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
200	14.6	24.4	48.8	73.2	97.6	23.1	38.5	77.0	115.4	153.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
210	11.3	18.9	37.7	56.6	75.5	16.1	26.8	53.6	80.5	107.3	123.0	205.0	410.0	615.0	820.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
220	9.2	15.4	30.7	46.1	61.5	12.3	20.6	41.2	61.7	82.3	41.0	68.3	136.7	205.0	273.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
230	7.8	13.0	25.9	38.9	51.9	10.0	16.7	33.4	50.1	66.8	24.6	41.0	82.0	123.0	164.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
240	6.7	11.2	22.4	33.6	44.9	8.4	14.0	28.1	42.1	56.2	17.6	29.3	58.6	87.9	117.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
250	5.9	9.9	19.8	29.6	39.5	7.3	12.1	24.2	36.4	48.5	13.7	22.8	45.6	68.3	91.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
260	5.3	8.8	17.7	26.5	35.3	6.4	10.7	21.3	32.0	42.7	11.2	18.6	37.3	55.9	74.5	153.0	255.0	510.0	765.0	1020.0	NA	NA	NA	NA	NA
270	4.8	8.0	16.0	23.9	31.9	5.7	9.5	19.0	28.5	38.1	9.5	15.8	31.5	47.3	63.1	51.0	85.0	170.0	255.0	340.0	NA	NA	NA	NA	NA
280	4.4	7.3	14.6	21.8	29.1	5.2	8.6	17.2	25.8	34.4	8.2	13.7	27.3	41.0	54.7	30.6	51.0	102.0	153.0	204.0	NA	NA	NA	NA	NA
290	4.0	6.7	13.4	20.1	26.8	4.7	7.8	15.7	23.5	31.3	7.2	12.1	24.1	36.2	48.2	21.9	36.4	72.9	109.3	145.7	NA	NA	NA	NA	NA
300	3.7	6.2	12.4	18.6	24.8	4.3	7.2	14.4	21.6	28.8	6.5	10.8	21.6	32.4	43.2	17.0	28.3	56.7	85.0	113.3	NA	NA	NA	NA	NA
310	3.5	5.8	11.5	17.3	23.1	4.0	6.7	13.3	20.0	26.6	5.9	9.8	19.5	29.3	39.0	13.9	23.2	46.4	69.5	92.7	NA	NA	NA	NA	NA
315	3.3	5.6	11.1	16.7	22.3	3.8	6.4	12.8	19.2	25.7	5.6	9.3	18.6	28.0	37.3	12.8	21.3	42.5	63.8	85.0	NA	NA	NA	NA	NA
320	3.2	5.4	10.8	16.2	21.6	3.7	6.2	12.4	18.6	24.8	5.3	8.9	17.8	26.7	35.7	11.8	19.6	39.2	58.8	78.5	NA	NA	NA	NA	NA
325	3.1	5.2	10.4	15.7	20.9	3.6	6.0	12.0	17.9	23.9	5.1	8.5	17.1	25.6	34.2	10.9	18.2	36.4	54.6	72.9	972.0	1620.0	3240.0	4860.0	6480.0
330	3.0	5.1	10.1	15.2	20.2	3.5	5.8	11.6	17.4	23.1	4.9	8.2	16.4	24.6	32.8	10.2	17.0	34.0	51.0	68.0	162.0	270.0	540.0	810.0	1080.0
335	2.9	4.9	9.8	14.7	19.6	3.4	5.6	11.2	16.8	22.4	4.7	7.9	15.8	23.7	31.5	9.6	15.9	31.9	47.8	63.8	88.4	147.3	294.5	441.8	589.1
340	2.9	4.8	9.5	14.3	19.1	3.3	5.4	10.9	16.3	21.7	4.6	7.6	15.2	22.8	30.4	9.0	15.0	30.0	45.0	60.0	60.8	101.3	202.5	303.8	405.0
345	2.8	4.6	9.3	13.9	18.5	3.2	5.3	10.5	15.8	21.1	4.4	7.3	14.6	22.0	29.3	8.5	14.2	28.3	42.5	56.7	46.3	77.1	154.3	231.4	308.6
350	2.7	4.5	9.0	13.5	18.0	3.1	5.1	10.2	15.3	20.5	4.2	7.1	14.1	21.2	28.3	8.1	13.4	26.8	40.3	53.7	37.4	62.3	124.6	186.9	249.2
355	2.6	4.4	8.8	13.2	17.6	3.0	5.0	9.9	14.9	19.9	4.1	6.8	13.7	20.5	27.3	7.7	12.8	25.5	38.3	51.0	31.4	52.3	104.5	156.8	209.0
360	2.6	4.3	8.6	12.8	17.1	2.9	4.8	9.7	14.5	19.3	4.0	6.6	13.2	19.8	26.5	7.3	12.1	24.3	36.4	48.6	27.0	45.0	90.0	135.0	180.0
365	2.5	4.2	8.3	12.5	16.7	2.8	4.7	9.4	14.1	18.8	3.8	6.4	12.8	19.2	25.6	7.0	11.6	23.2	34.8	46.4	23.7	39.5	79.0	118.5	158.0
370	2.4	4.1	8.1	12.2	16.3	2.8	4.6	9.2	13.8	18.3	3.7	6.2	12.4	18.6	24.8	6.7	11.1	22.2	33.3	44.3	21.1	35.2	70.4	105.7	140.9
375	2.4	4.0	7.9	11.9	15.9	2.7	4.5	8.9	13.4	17.9	3.6	6.0	12.1	18.1	24.1	6.4	10.6	21.3	31.9	42.5	19.1	31.8	63.5	95.3	127.1
380	2.3	3.9	7.8	11.6	15.5	2.6	4.4	8.7	13.1	17.4	3.5	5.9	11.7	17.6	23.4	6.1	10.2	20.4	30.6	40.8	17.4	28.9	57.9	86.8	115.7
385	2.3	3.8	7.6	11.4	15.2	2.6	4.3	8.5	12.8	17.0	3.4	5.7	11.4	17.1	22.8	5.9	9.8	19.6	29.4	39.2	15.9	26.6	53.1	79.7	106.2
390	2.2	3.7	7.4	11.1	14.8	2.5	4.2	8.3	12.5	16.6	3.3	5.5	11.1	16.6	22.2	5.7	9.4	18.9	28.3	37.8	14.7	24.5	49.1	73.6	98.2
395	2.2	3.6	7.2	10.9	14.5	2.4	4.1	8.1	12.2	16.2	3.2	5.4	10.8	16.2	21.6	5.5	9.1	18.2	27.3	36.4	13.7	22.8	45.6	68.5	91.3
400	2.1	3.5	7.1	10.6	14.2	2.4	4.0	7.9	11.9	15.9	3.2	5.3	10.5	15.8	21.0	5.3	8.8	17.6	26.4	35.2	12.8	21.3	42.6	63.9	85.3
405	2.1	3.5	6.9	10.4	13.9	2.3	3.9	7.8	11.6	15.5	3.1	5.1	10.3	15.4	20.5	5.1	8.5	17.0	25.5	34.0	12.0	20.0	40.0	60.0	80.0
410	2.0	3.4	6.8	10.2	13.6	2.3	3.8	7.6	11.4	15.2	3.0	5.0	10.0	15.0	20.0	4.9	8.2	16.5	24.7	32.9	11.3	18.8	37.7	56.5	75.3
415	2.0	3.3	6.7	10.0	13.3	2.2	3.7	7.4	11.2	14.9	2.9	4.9	9.8	14.6	19.5	4.8	8.0	15.9	23.9	31.9	10.7	17.8	35.6	53.4	71.2
420	2.0	3.3	6.5	9.8	13.1	2.2	3.6	7.3	10.9	14.6	2.9	4.8	9.5	14.3	19.1	4.6	7.7	15.5	23.2	30.9	10.1	16.9	33.8	50.6	67.5

Redistribution of Detained Flow

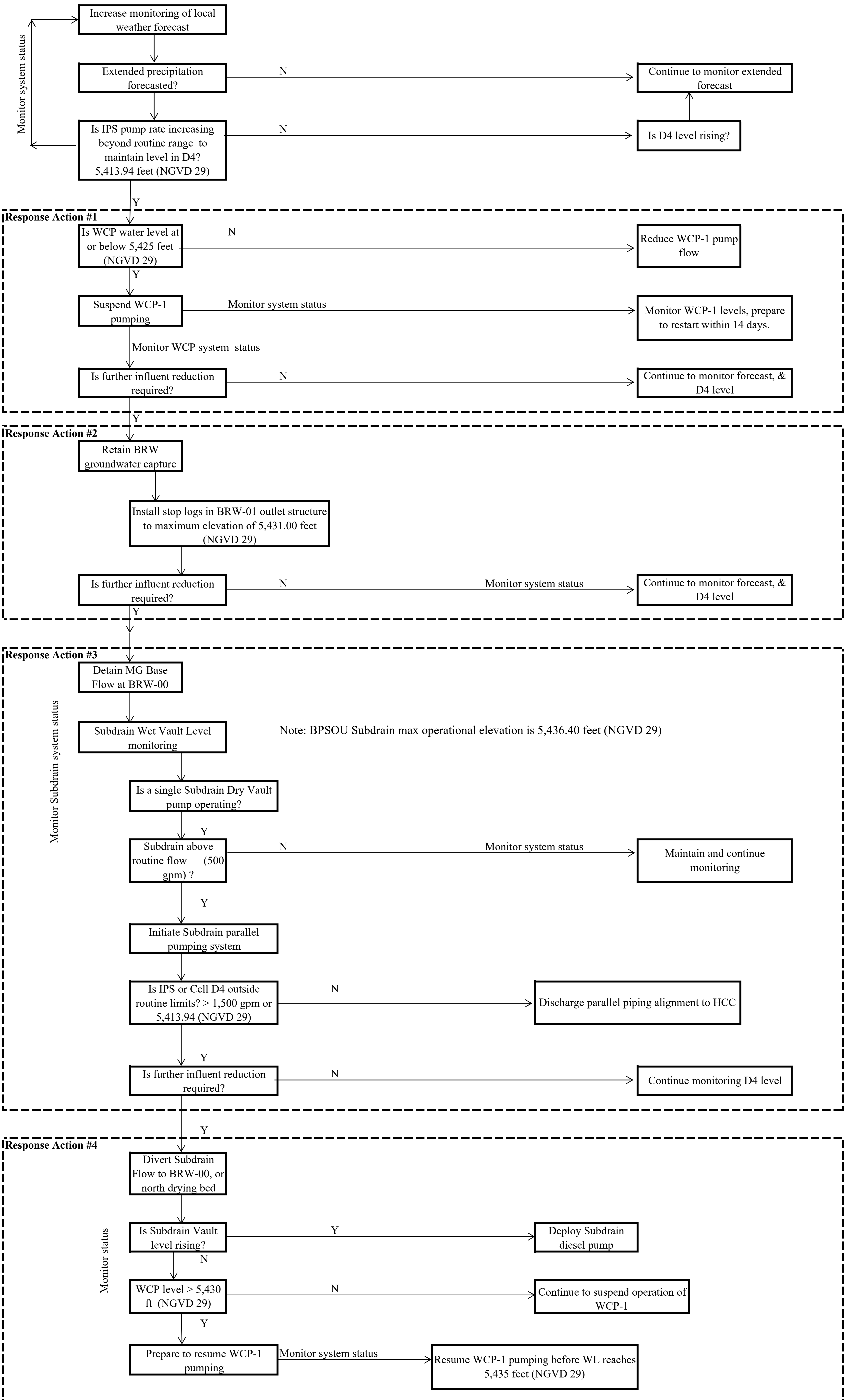
After IPS flows and levels have stabilized to routine limits, retained flow should be redistributed to the HCC, treatment, and effluent release to Silver Bow Creek.



Wet-Weather Contingency Decision Guide

During period of extended wet weather, or unseasonably warm winter weather periods the following decision guide can be implemented to assist operations with mitigation strategies.

Typical wet weather season: April - June; September - October



Appendix C
BTL Standard Operating Procedures

List of BTL Standard Operation Procedures (SOP)

BTL-SOP	#	Procedure Title	Last Dated Copy	Updated 2020	Field Verified
BTL-SOP	1	Chemical Addition System (CAS) Building Initial Arrival Operation Status Check	2020	12/4/2020	Yes
BTL-SOP	2	BPSOU Subdrain Sampling and Monitoring Operations	2021	1/13/2020	Yes
BTL-SOP	3	Gravimetric Lime Addition System Startup.	2020	12/4/2020	Yes
BTL-SOP	4	West Camp Arrival	2020	12/4/2020	Yes
BTL-SOP	5A	LAO BPSOU Subdrain Operations Check Procedures	2020	12/4/2020	Yes
BTL-SOP	5B	LAO BPSOU Subdrain Valve Cycling	2020	12/4/2020	Yes
BTL-SOP	6	Influent Pump Station Startup/Shutdown	2020	12/4/2020	Yes
BTL-SOP	7	Slurry Tank Feed Water Re-establishment.	2020	12/4/2020	Yes
BTL-SOP	8	BPSOU Subdrain Flowmeter Download	2021	1/13/2021	Yes
BTL-SOP	9	Generator Inspection.	2020	12/4/2020	Yes
BTL-SOP	10	Screw Conveyor Cleaning.	2020	12/7/2020	Yes
BTL-SOP	11	Stop Log Removal/Installation.	2020	12/7/2020	Yes
BTL-SOP	12	LAO Accurate Feeder Helix Modification	2020	12/9/2020	Yes
BTL-SOP	13	Outlet Structure Grab Sampling.	2020	12/9/2020	Yes
BTL-SOP	14	IPS Pump Maintenance	2020	12/14/2020	Yes
BTL-SOP	15	Super Sax Redundant Lime Feed System Start-Up/Shutdown	2021	1/13/2021	Yes
BTL-SOP	16				
BTL-SOP	17	ISCO® Automatic Composite Water Sampling Procedures.	2020	12/14/2020	Yes
BTL-SOP	18	CAS Building Cleaning	2020	12/14/2020	Yes
BTL-SOP	19	Slurry Tank and Discharge Pipe Cleaning.	2020	12/14/2020	Yes
BTL-SOP	20	Subdrain Jetting	2020	12/7/2020	Yes
BTL-SOP	21	Subdrain Pigging	2020	12/7/2020	Yes
BTL-SOP	22	IPS Intake Screen Cleaning	2020	12/16/2020	Yes
BTL-SOP	23	Maintenance of the Freeway Wetlands	2020	12/16/2020	Yes
BTL-SOP	24	Effluent Grab Sample.	2020	12/16/2020	Yes
BTL-SOP	25	Subdrain Generator Start-Up/Shutdown/ Emergency Shutdown	2020	1/4/2021	Yes
BTL-SOP	26	ASB Sample Pump Replacement/Filter Cleaning	2020	12/16/2020	Yes
BTL-SOP	27	Quarterly Valve Exercise	In progress		
BTL-SOP	28	Volumetric Lime Addition Startup.	2020	12/21/2020	Yes
BTL-SOP	29	Ultramag Flowmeter Maintenance	2020	12/21/2020	Yes
BTL-SOP	30	BRW Staff Gauge Monitoring	2020	12/21/2020	Yes
BTL-SOP	31	Subdrain Dry Vault Monitoring and Dewatering	2020	12/22/2020	Yes
BTL-SOP	32	LAO Relay Switch Replacement	2020	1/4/2021	Yes
BTL-SOP	33	LAO Dialer Alarm Callout Update.	2020	12/22/2020	Yes
BTL-SOP	34	LAO Security Procedures	2020	12/22/2020	Yes
BTL-SOP	35	Calibrating Accurate Feeder.	2020	12/22/2020	Yes
BTL-SOP	36	LAO Recalibrate pH meter	2020	12/22/2020	Yes
BTL-SOP	37	Lime Silo Cleaning.	2020	12/22/2020	Yes
BTL-SOP	38	Air Compressor Start-Up/Shutdown Maintenance.	2020	12/22/2020	Yes
BTL-SOP	39	Tranducer Maintenance and Verification	2020	12/22/2020	Yes
BTL-SOP	40	Screw Conveyor Oil Chnage.	2020	12/23/2020	Yes
BTL-SOP	41	West Camp H2S Meter Calibration	2021	1/13/2021	Yes
BTL-SOP	42	West Camp Pump Stop/Restart.	2020	12/23/2020	Yes
BTL-SOP	43	Soleniod Air Cylinder Replacement	2020	12/23/2020	Yes
BTL-SOP	44	WCP H2S Alarm Response.	2020	12/23/2020	Yes
BTL-SOP	45	CO2 Addition System Monitoring /Inspection	2020	12/23/2020	Yes
BTL-SOP	46	HMI Re-Start	2020	12/23/2020	Yes
BTL-SOP	47	Site Overview Inspections	2020	12/23/2020	Yes
BTL-SOP	48	Subdrain Pump Station Start Up/Shut Down.	2020	12/23/2020	Yes
BTL-SOP	49	IPS Pressure Switch Testing	2020	12/24/2020	Yes
BTL-SOP	50	Fire Extinguisher/Eye Wash Inspections	2020	12/24/2020	Yes
BTL-SOP	51	Piranha Dredge Operation	2020	12/24/2020	Yes
BTL-SOP	52	Silt Curtain Cleaning	2020	12/24/2020	Yes

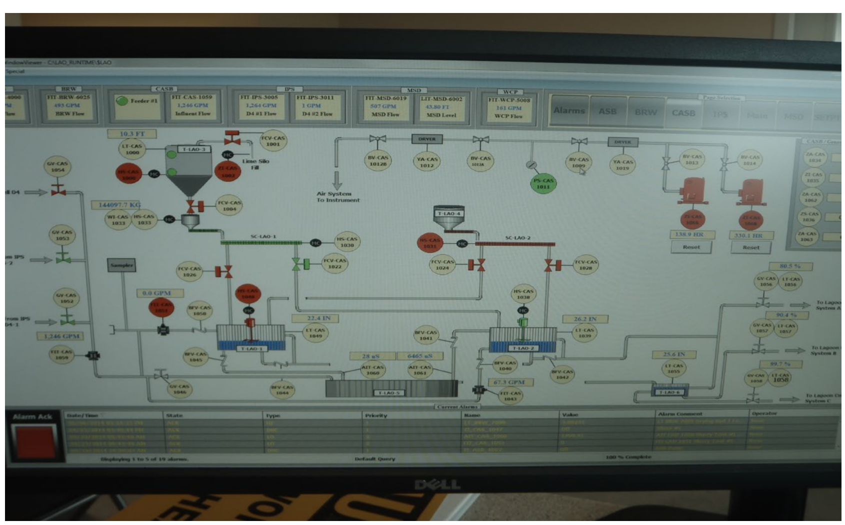
List of Pioneer Standard Operation Procedures (SOP)

Pioneer-SOP	#	Procedure Title	Last Dated Copy	Updated	Field Verified
SOP-DE	2	Equipment Decontamination	2020	9/8/2020	Yes
SOP-DV	1	Data Validation	2018	9/30/2018	Yes
SOP-SA	1	Soil and Water Sample Packaging and Shipping	2014	12/11/2014	Yes
SOP-SA	2	Sample Preservation and Containerization for Aqueous Samples	2015	5/28/2015	Yes
SOP-SA	4	Chain Of Custody Forms for Environmental Samples	2020	11/12/2020	Yes
SOP-SA	5	Project Documentation	2014	12/17/2014	Yes
SOP-WFM	1	Field Measurement of pH in Water	2020	9/29/2020	Yes
SOP-WFM	2	Field Measurement of Oxidation Reduction Potential in Water	2020	10/15/2020	Yes
SOP-WFM	3	Field Mesurement of Specific Conductance	2014	12/17/2014	Yes
SOP-WFM	4	Field Mesurement of Water Temperature	2020	9/30/2020	Yes
SOP-WFM	7	Field Measurement of Dissolved Oxygen	2014	12/17/2014	Yes

PURPOSE	To provide standard instructions for operators performing initial arrival operation status check and adjustment for the Chemical Addition System (CAS) Building.
SCOPE	This practice has been prepared for the Pioneer Technical Services (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach used to perform a weekly operations check to ensure every component is working properly and information is accurately being gathered.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Check the HMI	Check the BTL HMI screen and alarm log screen located in the Operations Building for normal operating O&M conditions and any alarm conditions. Values in red indicate alarm conditions; values in blue or green indicate routine conditions.
Check associated system statuses on the HMI	Check the BTL HMI screen for any alarm conditions from all monitored associated BTL equipment inputs. Select the appropriate tab at the top of the screen display to view other remote systems such as West Camp Pump station, Subdrain vault, IPS. Values in red on the HMI alarm screen indicate alarm conditions, values in blue or green on the HMI screen indicate routine conditions. 

Check the Schenk OP1 Gravimetric Controller	Check the Schenk OP1 Gravimetric Controller located in the CAS building for any alarm conditions and system operating status. Alarms will appear at the lower half of the screen. Press the flashing alarm notification to view all alarms and acknowledge alarm to clear alarm status. If there are any active alarms, attend to them appropriately using the standard troubleshooting procedures described in the BTL O&M Manual. Once completed, continue with OP1 system startup discussed in BTL-BTL-SOP-003 *Gravimetric Lime Addition System Startup*. If none exist, proceed with the daily routine operating procedures. 
Measure and record parameters	Measure and record all required daily parameters associated with LAO operations from the HMI screen and collect necessary field parameters. These parameters include: o Operator, date and time, o Lime rate, o Influent flow and totalized flows, o Effluent flow and totalized flows, o WCP flow and totalized flows, o Subdrain flow and totalized flows, o Lagoon and channel pH, o Total lime usage indicated on OP1 controller screen.
Inspect the Lime Screw Conveyor Lime Entry Port	Inspect the Lime Screw Conveyor Lime Entry Port into the slurry tanks to check for a build-up of lime in the screw conveyor. Loosen any lime build-up by hitting the outside of the screw conveyor with a rubber head mallet.

Manually measure Lime Silo	Measure the Lime Silo level with the YOYO meter (LT-CAS-1000) by manually pressing "Measure" on the Yo-Yo control panel located in lower section of the Lime Silo to the left of the man door.
Adjust lime rate	After measuring all required daily parameters as described in *BTL-SOP-13 Outlet Structure Grab Sampling*, monitor and adjust the lime rate (mg/L) if necessary. Post CAS building pH and lime rate will be determined by Atlantic Richfield Company.
Adjust flow to Lagoon Systems	Adjust flows to Lagoon Systems A, B, and C by using the weir gates located in the Distribution Tank (T-LAO-103). A flow rating curve table for each weir gate is located inside the CAS building and in Table B-5 of the O&M manual.
Bleed Compressed Air Line.	Bleed Compressed Air Line(s) at WT-OPS-2001 and WT-OPS-2002 located downstream of the compressors in the Operations Building and Chemical Addition Building. This is performed on a daily basis.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

SOURCE	*HAZARD*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
BIOLOGICAL	Wildlife and Insects	Site	Exposure to wildlife, insects, spiders, etc. could result in in bites and/or allergic reactions.	First aid kits are available on site, wear gloves when moving parts and opening lids.
BODY MECHANICS	Not applicable			
CHEMICAL	Hydrated Lime	CASB and Lime Silo	Inadvertent contact with residual lime dust on equipment/surfaces in the CASB and lime silo, and/or contact with treated water in the CASB could result in adverse skin reaction such as burns, mucous membrane, eye and respiratory tract irritation.	Wear required PPE as listed in this SOP, wash hands before eating or drinking. Avoid unnecessary contact with surfaces where lime can accumulate. Clean or wet areas to be accessed that have lime accumulation if necessary.
ELECTRICAL	Not applicable			
GRAVITY	Falls from slips or trips	Walking surfaces	Fall could result from tripping and/or slipping while walking on site	Keep walking/working areas free from clutter and/or debris. Keep floors dry, use ice melt or sand during winter

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
			resulting in injury.	months.
MECHANICAL	Pinch Points, slips, and trips	Equipment covers, doors, walking/ working surfaces	Fingers could be pinched in doors and/or equipment covers resulting in cuts, scrapes, wet/muddy and/or cluttered walking surfaces could cause employees to slip and/or trips.	Wear gloves when opening closing covers/lids, keep walking/working area free from clutter/debris. Keep floors dry, use ice melt or sand during winter months. Screw conveyor is equipped with a guard. Keep guard in place at all times while in operation. Follow lock out/tag out procedures when conducting any maintenance.
NOISE	Not applicable			
PRESSURE	Air Compressor Line	Lime Silo	Unexpected pressure build-up in the compressor line could cause the line to rupture/burst. Employees could be struck by hoses/lines and/or exposed to lime resulting in injury and/or adverse health effects.	Air compressor is equipped with pressure relief valves and block/bleed on shut off valves. Wear required PPE and follow lock out/tag out procedures.
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained worker	Site	Inexperienced workers and improper training could cause incidents resulting in personal injuries and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement stop work procedures, if necessary.
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt, gloves
APPLICABLE SDSs	Lime

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PERMITS/FORMS	Field Authorization Form
ADDITIONAL TRAINING	Control of Work, 40-hour Hazwoper, 8-hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-1-AB and P&ID-2-AB.
DRAWINGS	Site wide as-built drawings are contained in the Draft O&M Manual.
RELATED SOP's/PROCEDURES/ WORK PLANS	*BTL-SOP-03 Gravimetric Lime Addition System Startup* *BTL-SOP-13 Outlet Structure Grab Sampling*
TOOLS	
FORMS/CHECKLIST	Butte Treatment Lagoons (BTL) at Lower Area One (LAO) Groundwater Treatment System, CAS Checklist.

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
	11/24/14
SAFETY OFFICER	**DATE**
	11/24/14
LEAD OPERATOR	**DATE**
	11/24/14
OPERATOR	**DATE**

OTHER	**DATE**
OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval
3	Annual Review	4/2/20	Brad Hollamon
4	Update Risk Table for consistency	12/4/20	Hailey Thompson

PURPOSE	To establish a uniform procedure for operations at the BPSOU Subdrain.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this Standard Operating Procedure (SOP) will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (OM&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
The following tasks summarize work to be completed under operations at the Butte Priority Soils Operable Unit (BPSOU) Subdrain.	
Flow Meter Installation and Assessment	
The BPSOU Subdrain consists of five manholes (see attached map); MH-MSD106, MH-MSD108, MH-MSD110, MH-MSD113, and MH-MSD116. Teledyne ISCO 2150 Area-velocity (AV) flow meters are located at the inlet to each manhole. MH-MSD116 also has a Marsh-McBirney Flo-Tote® Electromagnetic (EM) sensor installed in the outlet to measure the very low flows. The flow meters are downloaded monthly.	
1. Obtain tools and equipment.	Review equipment list for monthly download to ensure all necessary equipment and tools are available.
2. Delineate work area.	Using safety cones delineate the vehicle area on the walking path.
3. Access manhole.	Set up manhole guard around the manhole and turn on the calibrated 4-gas meter. Remove screws/bolts from the manhole when required (MH-MSD116). Once the 4 gas meter is ready, remove the manhole cover by using the manhole pick. Immediately check the air for oxygen content, lower explosive limit (LEL), hydrogen sulfide (H_2S) levels, and carbon monoxide (CO) levels and record in logbook (SOP-SA-05) at both the bottom and the top of the manhole. Levels are recorded from the bottom of the manhole to detect seasonal variations related to geochemistry parameters within the Subdrain. When recording the air quality levels at the bottom of the manhole take extreme precaution not to submerge the tubing but get as near to the water surface as possible. Levels are recorded from the top of the manhole to ensure a hazardous atmosphere does not exist. There is no need to enter the manhole during site visits. Because the plane is being broke when retrieving the flow module, air quality at the surface needs to be taken.
4. Flow meter installation.	The AV Flow Meter and EM sensor are both attached to metal spring rings that fit into the PVC at each inlet and outlet respectively. The sensor must be located at the bottom and perpendicular to flow (Figure 1). The spring rings are installed completely into the pipe using a Marsh-McBirney Q-stick. For the most accurate reading the flow meter needs to be inserted as far as possible into the inlet pipe. The spring ring still needs to be visible to make the removal process feasible. The

flow modules are secured at the top of each manhole with safety harnesses and hooks. The sensors will be set to record the following data at fifteen minute intervals.

AV flow meter:
- Level – Feet
- Velocity – Feet per second
- Flow Rate – Gallons per minute
- Utilization – Percent
- Temperature – Degrees Celsius
- Input Voltage – Volts
- Velocity Signal – Percent
- Velocity Spectrum – Percent

EM sensor:
- Level – Feet
- Velocity – Feet per second
- Flow Rate – Gallons per minute
- Utilization – Percent
- Temperature – Degrees Celsius
- Input Voltage – Volts

To verify the flow meter is working properly a manual velocity measurement will be taken using a Marsh-McBirney Flow Meter (SOP-WFM-05).

Figure 1. Spring ring ready for installation.

5. Assess water quality.	Visually assess the manhole from the surface for conditions that may compromise the data logging unit and record in logbook during installation and any other site visit. Also record water color, water level, foam or discoloration on the water's surface, and any other observations at each site.
6. Assess the flow module.	Remove the flow module device to check the following: • Battery compartments – Water can seep into battery compartments and should be checked. If water has leaked inside, the desiccant pack in the compartment covers should be replaced. • Desiccant – The desiccant tube soaks up any other water that enters the device and should be inspected. The material is orange in color when first installed and slowly changes colors as moisture is taken in. Once the desiccant has turned a blue/green it should be replaced.
7. Download data.	Once the flow meter has been in place and recording, the data can be downloaded. After the flow module has been removed and assessed, as described above (Task 6), connect to the field laptop; follow BTL-SOP-08 for specific instructions. While connected to the module, record real-time readings (listed above) in the logbook. Attention should be given to the following real-time readings: • Utilization – Describes the amount of memory used on the device. If it reaches the max limit (100%) and isn't deleted the device will stop recording. As a rule of thumb, once the memory has reached 80% during a monthly visit the data should be archived and deleted (refer to manual). • Voltage – Once the batteries reach 9 volts they should be replaced with new ones.
8. Additional measurements.	A manual velocity measurement will be taken using a Marsh-McBirney Flow Meter. A manual depth to water (DTW) in the manhole and surrounding piezometers will also be taken and recorded (SOP-GW-03).
Sampling Event	
Sampling is performed once during both the high and low flow sampling periods. Scheduling is primarily dependent on weather; base flow conditions need to be sampled and because of storms and run off the sampling event may need to be rescheduled.	
1. Obtain tools and equipment.	Review equipment list for sampling to ensure all necessary equipment and tools are available.
2. Download flow meters.	Tasks 2, 3, 5, 6, and 7 from above are completed.
3. Sample preparation.	Sampling will be performed with the use of a peristaltic pump (SOP-GW-10C) starting at MH-MSD106 and ending at MH-MSD116. The tubing used to collect the sample must be set up differently than conventional monitoring well sampling protocol. Hard tubing is taped to a PVC pipe and placed in the inlet to the manhole to keep it in place at the center of flow laterally and vertically during sampling. The sampling activities are completed along the walking trail, at the crest of the channel, to reduce hauling a large amount of equipment down the steep slope (Figure 2). Set up the table on an even surface with a secondary containment

	(overflow tub) beneath to prevent impacted water from spilling onto the ground surface.  **Figure 2. Sampling layout**
4. Parameter stabilization.	The following parameters are recorded at each location: • pH, SOP-WFM-01 • Oxidation reduction potential (ORP), SOP-WFM-02 • Specific conductivity (SC), SOP-WFM-03 • Temperature (degrees Celsius), SOP-WFM-04 • Dissolved oxygen (DO), SOP-WFM-07
5. Sample collection.	Samples for the analytes listed in the *Lower Area One (LAO)/Butte Treatment Lagoons (BTL) and BPSOU Subdrain Monitoring Quality Assurance Project Plan (QAPP)* will be collected at each site along with QA/QC samples.
6. Decontamination.	Proper equipment decontamination will be completed between sites and after the sampling event (SOP-DE-02).
7. Storing and shipping samples.	The water samples will be stored in the sample refrigerator located in the Operations Building at LAO until they are shipped the following day (SOP-SA-01), and proper chain of custody forms will be filled out (SOP-SA-04).

Jetting and Pigging

Jetting (BTL-SOP-20) and pigging (BTL-SOP-21) will take place in accordance with the high (June/July) and low (October/November) flow sampling and monitoring events. Based upon findings from previous investigations the ideal times to jet and pig the Subdrain are before the high flow event (March/April) and after the low flow event (October/November). Data will be reviewed annually to verify system is operated as intended and jetting/pigging events are optimal. All data will be summarized in the BTL Annual O&M report.

Flow Meter Removal

1. Flow meter removal.	Flow meters will be removed prior to the jetting and pigging and replaced after the event. The meters are removed with the Marsh-McBirney Q-stick. Take caution when removing the spring ring, the rope on the Q-stick needs to be kept taught to prevent the device from falling into the manhole.

2. Flow meter storage.	The meters will be brought to LAO after removal to have excess precipitate sprayed off the spring rings and flow meters in the distribution tank. Carefully clean the equipment because the flow meters sensor is sensitive. No additional cleaner should be used on the device other than water. The flow modules connections and surface will also be wiped down during this time. Do not submerge the device in water.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Potential contact with contaminated water.	Testing sites, during field measurements.	Inadvertent exposure to contaminated water could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Employees will wear nitrile gloves and safety glasses during monitoring and sampling activities.
	Preservatives (sulfuric and nitric acid).	In bottles or added to bottles through sampling process.	Inadvertent exposure to preservatives could lead to adverse health effects.	Safety Data Sheets for each preservative chemical are available to all employees on the Pioneer company web site. Personnel will wear nitrile gloves and safety glasses when adding preservatives to samples bottles and when handling the bottles. Refer to the Chemical Flushing Guidelines available inside vehicle's first aid kit for first-aid procedures in case of contact with preservatives.
	Dielectric grease.	Connections for the flow modules.	Prolonged or repeated direct exposure to the skin and/or eyes could result in irritation and redness.	Personnel will avoid direct contact with the dielectric grease. Personnel will wear nitrile gloves and safety glasses when applying grease to the equipment connections. If contact occurs, flush eye with water for at least 15 minutes and wash skin with mild soap and water.
NOISE	Not applicable.			
ELECTRICAL	Improper use of 12-volt battery.	Sites, when using battery to power equipment.	Personal injuries could result from improper use and maintenance of a 12-volt battery. Example are:	Personnel will remove all jewelry before working with a 12-volt battery. Personnel will disconnect the negative cable first and re-connect it last to prevent getting a shock from

			shocks, acid burns on skin or eyes, skin burns from electrical charge transfer through a tool and into a metal ring or watch, and battery explosions.	current overflow. Personnel will use batteries in well-ventilated areas. Personnel will inspect battery before and after each use. Personnel will wear leather gloves and safety glasses, when handling battery.
BODY MECHANICS	Improper lifting and carrying of equipment.	Testing sites.	Back injuries and muscle/back strains could result when using improper techniques to lift and carry equipment, and when moving manhole covers.	Personnel will use proper lifting techniques – get a good grip, keep the load close to the body, lift with legs and not with back, and avoid lifting loads above shoulder's height. Two people will lift, if necessary. Personnel will use a manhole pick and use proper lifting techniques when moving manhole covers.
	Bending, squatting, and kneeling.	During monitoring and sampling activities.	Bending, squatting, and kneeling during monitoring activities could result in muscle/back strains or other injuries.	Personnel should stretch prior to starting work and they will take breaks when necessary.
	Body positioning.	Accessing equipment inside the manholes.	Reaching equipment inside the manhole could involve awkward body positioning, which could lead to muscle strains/sprains/ cramp.	Prior to starting work, personnel will inspect the area to find the safest place to access equipment to prevent awkward body positions. Personnel should stretch prior to starting work and they will take breaks when necessary.
GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet surfaces and steep slopes.	Walking/working on slick/muddy/wet, uneven, and steep	Workers will wear work boots with good traction and ankle support. Personnel will be aware of working/walking

			terrain could cause slips and trips resulting in falls and injuries.	surfaces and choose a path to avoid hazards. Keep work areas as dry as possible. Wear muck boots, as necessary. Personnel will use a rope and grab onto it, while descending/ascending slopes to access the location of the manholes. Personnel will wear work gloves when using the rope. Personnel will avoid carrying heavy/awkward objects while walking on steep slopes.
	Falls into manholes.	Working near manholes.	Personnel could fall into manholes resulting in serious bodily injuries.	Personnel will set up a manhole guard around the manhole to prevent falls.
WEATHER	Cold/heat stress.	Sites.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors. Employees will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Employees will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during summer months causing sun burns, skin	Employees will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Employees should wear sunscreen, if necessary.

			damage, and eye damage.	
BIOLOGICAL	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Employees with allergies will notify their supervisor.
MECHANICAL	Pinch points.	Manhole covers.	Personal injury could result from fingers getting pinched when opening/closing manhole covers.	Personnel will wear work gloves when opening/closing manhole covers. Personnel will watch for hand placement and will use a manhole pick to remove manhole covers.
PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained worker.	Sites.	Inexperienced workers and improper training could cause incidents resulting in adverse health effects and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement stop work procedures, if necessary.
	Public entering the work area.	Sites.	The manholes are located next to a walking trail and public could enter the work area interfering with work activities.	Personnel will stop work, if public enters the work area. Work will resume once public has left the area. Personnel will use safety cones to delineate the work area on the walking trail.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

REQUIRED PPE	Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, nitrile gloves, and work gloves.
APPLICABLE SDS	Safety Data Sheets (SDSs) will be maintained based on site characterization and contaminants. Sulfuric acid, nitric acid, and dielectric grease.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	Map with site and sample locations.
RELATED SOPs/PROCEDURES/ WORK PLANS	BTL-SOP-20 Jetting, BTL-SOP-21 Pigging, SOP-DE-02 Equipment Decontamination, SOP-GW-03 Depth to Water Level Measurements, SOP-GW-10C Purging and Sampling with a Peristaltic Pump, SOP-SA-01 Soil and Water Sample Packaging and Shipping, SOP-SA-04 Chain of Custody Forms for Environmental Samples, SOP-SA-05 Project Documentation, SOP-WFM-01 Field Measurement of pH in Water, SOP-WFM-02 Field Measurement of Oxygen Reduction Potential in Water, SOP-WFM-03 Field Measurement of Specific Conductance, SOP-WFM-04 Field Measurement of Water Temperature, SOP-WFM-05 Streamflow Measurement with Marsh McBirney Flow Meter, and SOP-WFM-07 Field Measurement of Dissolved Oxygen.
TOOLS	See attached equipment lists.
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Heather Brown	**07/15/2015**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman	**07/15/2015**

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

Revisions:

Revision	Description	Date
1	Ferrous Iron readings no longer required during sampling events, removed.	1/24/19
2	Name changed to BTL-SOP -2, updated SOP reference from OG	1/13/20

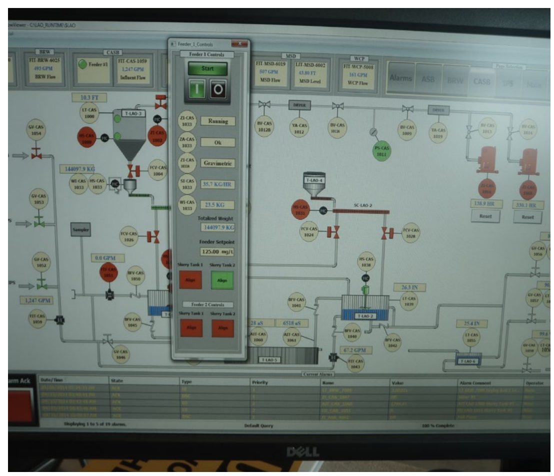
PIONEER TECHNICAL SERVICES, INC.	BTL-SOP-03 GRAVIMETRIC LIME ADDITION SYSTEM STARTUP	STATUS: Draft Final DATE ISSUED: 3/27/18 REVISION: 3 REVISION DATE: 12/4/2020 PAGE 1 of 6

PURPOSE	To provide standard instructions for operators performing gravimetric lime addition startup.
SCOPE	This practice has been prepared for the Pioneer Technical Services Pioneer workforce and applies to work carried out by and on behalf of Pioneer. All members of the PTS Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach used to ensure proper startup of the AccuRate Feeder gravimetric lime addition system should the system fail due to a power loss, a clog in the screw conveyor, or if the system was disengaged for maintenance

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Position MCC selector switches	Locate the H-O-A selector switch on the MCC inside the CAS Building. Manually place the Shaker, Slurry Tank 1, Slurry Tank 2, and Silo Screw Conveyor to AUTO position. Energize the screw conveyor and mixer motors by pressing the START button on the MCC. Place the AccuFeed Paddle and AccuFeed Feeder switches to the ON position. This energizes the paddle and feeder, operation of the feeder is controlled through OP1 control logic. Visually inspect operation of the screw conveyor and mixer by checking the status on The HMI control panel located in the CAS building. 
Close knife valve in lime silo	Ensure the 10” Salina Vortex pneumatic knife valve is in the closed position. This valve is located inside the silo above the AccuRate Feeder. If in the open position, the valve must be closed by pushing “Close Valve” (FCV-CAS-1004) on the HMI screen in the CAS. By pressing this button, the valve automatically closes, thus ensuring a “loss-in-weight” position, by separating the weight of lime in the silo from the weight of lime inside the AccuRate Feeder.

Restart Influent Pump Station (IPS) pumps	Restart the desired IPS pump located at the Influent Pump Station (IPS) by using steps described in BTL-SOP 6- *Influent Pump Station Start Up*.
Align slurry tank	Once the influent water has reached the CAS building, verify slurry tank liquid level is above the mixer blades. Press "Align Tank 1" or Align Tank 2" on the HMI screen in the Ops Building depending on which Slurry Tank is in operation. This will open the desired tank's 4" drop tube pneumatic valve and designate which mixer will be in operation. This will ensure that any lime distributed through the screw conveyor will be discharged into the desired tank.
Start AccuRate Feeder	Select gravimetric operation by turning the selector toggle to gravimetric on the OP1 controller in the CAS building. Using the HMI screen in the operations building, press the green "Start" button located in the Lime Feeder Control Box screen on the HMI. This step turns on the AccuRate Feeder helix and paddle motors. Enter the desired lime rate into the lime set point box.  

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

SOURCE	***HAZARD***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
BIOLOGICAL	Wildlife and Insects	Site	Exposure to wildlife, insects, or spiders, could result in bites and/or allergic reactions.	First aid kits are available on site, wear gloves when moving parts and opening lids.
BODY MECHANICS	Not applicable			
CHEMICAL	Hydrated lime	CASB and Lime Silo	Inadvertent contact with residual lime dust on equipment/surfaces in the	Wear required PPE as outlined in this SOP, wash hands before eating or

			CASB and lime silo, and/or contact with treated water in the CASB could result in adverse skin reaction such as burns, mucous membrane, eye and respiratory tract irritation. Inadvertent ingestion via hand to mouth contact (i.e. eating outside of designated areas, poor hygiene) could result in Gastrointestinal tract irritation.	drinking. Avoid unnecessary contact with surfaces where lime can accumulate. Clean or wet areas to be accessed that have lime accumulation if necessary.
ELECTRICAL	Electric shock	MCC panel in CAS	Possible electric shock when placing H-O-A toggle in correct positions, starting equipment.	Inspect equipment prior to starting, make sure it is in good repair and functions as designed. Check that breakers are in correct positions and function as required.
GRAVITY	Falling tools and/or equipment Falls	CASB – Below elevated work platforms Walking working surfaces	Injury could occur from tool or equipment falling off of elevated work surfaces and striking a worker who is working below an elevated work platform. Wet/icy walking/working surfaces, debris or clutter could create tripping/slipping hazards which could result in falls and injuries.	Elevated work platforms have been designed with kick plate to prevent tools from falling off of the edge. There are designated safety zones in the area and only personnel performing work is allowed in the area. Personnel will wear Level D PPE as outlined in this SOP. Keep floors free from clutter/debris. Use ice melt or sand when ice is present in the work area. Keep tools and equipment out of walking areas.

MECHANICAL	Unguarded conveyer	Screw conveyer assembly	Injury could occur from inadvertent contact with a moving conveyer.	Lime screw conveyor is equipped with a guard. The guard will remain in place at all times. If guard must be removed, the appropriate lock out/tag out procedures will be followed.
	Pinch Points	Lime screw conveyor, doors and valves	Injury could occur from fingers getting pinched in doors, valves or the cover plate or clamps on the lime screw conveyer.	Leather gloves will be throughout this process. Do not place fingers between objects.
	Slips, trips	Walking/working surfaces	Wet/icy surfaces could cause personnel to slip, debris and poor housekeeping could cause personnel to slip/trip resulting in injury.	Keep floors free from clutter/debris. Use ice melt or sand when ice is present in the work area. Keep tools and equipment out of walking areas.
NOISE	Not applicable			
PRESSURE	Air pressure release	Air Compressor line in the lime silo	Injury to personnel or property damage could occur from pressure buildup and/or release in the air compressor line from a faulty hose or valve.	Open relief valve on the air compressor prior to performing any maintenance activities. Perform daily inspection and maintenance as described in owners manual. Wear required PPE as described in this SOP.
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained worker	Site	Inexperienced workers and improper training could cause incidents resulting in personal	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement

			injuries and/or property damage.	stop work procedures, if necessary.
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt. Work gloves
APPLICABLE SDSs	Lime
REQUIRED PERMITS/FORMS	Field Authorization Form, TRA (if applicable)
ADDITIONAL TRAINING	Control of Work, 40-hour Hazwoper, 8-hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-1-AB and P&ID-2-AB.
DRAWINGS	Site-wide as-built drawings are contained in the Draft O&M Manual.
RELATED SOP's/ PROCEDURES/ WORK PLANS	BTL-SOP-06 *Influent Pump Station Start Up*
TOOLS	
FORMS/ CHECKLIST	
APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
	11/24/14
SAFETY OFFICER	**DATE**
	11/24/14

LEAD OPERATOR	DATE
Brad Hallamon	11/24/14
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

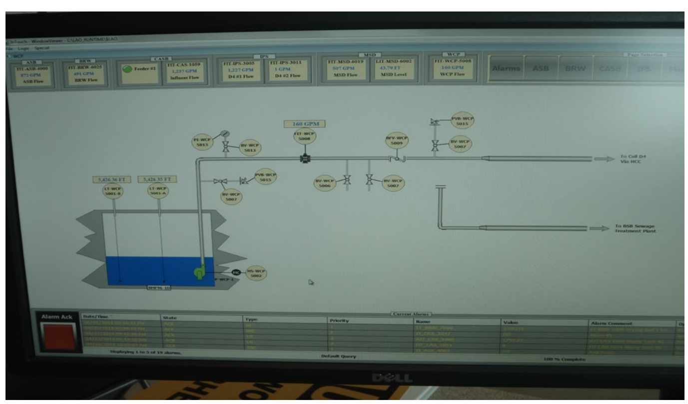
Revisions:

Rev.	Description	Date	Approval
2	Annual Review	4/6/20	Brad Hollamon
3	Update Risk Table for consistency	12/4/20	Hailey Thompson

PURPOSE	The purpose of this document is to provide standard instructions for operators performing routine monitoring and inspection of the West Camp Pumping system.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work. SOP defines the procedural approach used to site arrival and check at the West Camp Pump Station.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Alarm indication	**Check system HMI screen for any alarm conditions prior to WCP arrival.** Alarms for the West Camp Pumping Station (WCP-1) are displayed on the HMI screen in the Operations building. If an alarm exists a site visit at the WCP-1 is required to verify and correct alarm. 
Site Entry	**Before entering site**, visually inspect the condition of the security fence, gate and exterior of WCP-1 building. If conditions appear normal, operator may enter site. If visual inspection shows signs of damage or security gate is open, operator will contact the Pioneer Project Manager. If determined necessary by the Project Manager, contact 911.
WCP-1 Entry	**Before entering WCP-1**, follow procedures outlined in BTL-SOP-44 WCP H2S Alarm Response. If there is no visual or audible indication of an alarm and the H_2S meter reads zero upon entry, then it is safe to occupy the building.

Electrical Disruption	If **electrical service** has been **disrupted** the operator will verify the back-up generator is operating. If generator did not start automatically, manually start generator. If breaker is tripped, reset breaker once. If previous steps do not restore power, contact NorthWestern Energy **(888) 467-2669.**
Generator verification	**Verify** that the backup generator is operating, and the automatic transfer switch has transferred power to the WCP building. Verify that the West Camp pump P-WCP-1 is in operation. If pump is not operating refer to BTL-SOP-42 West Camp Pump Start-Up/Shut Down.
Restore Pump	Once electrical service is restored the pump must be restored to routine operation. Follow the steps outlined in BTL-SOP-42 West Camp Pump Start-Up/Shut Down.
Routine Flow check	Check the flow meter (FIT-WCP-5008) for flow indication, the level reading, and pump rpm are located on the VFD display. 
Record parameters	Measure and record required daily parameters associated with the WCP-1. Record measurements on BTL-LAO Weekly Ops Log on the date of inspection.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARDS***	***WHERE***	***RESULT***	***CONTROLS***
BIOLOGICAL	Wildlife and Insects	Site	Exposure to wildlife, insects, spiders, etc. could result in bites and/or allergic reactions.	First aid kits are available on site, wear gloves when moving parts and opening lids.
BODY MECHANICS	Not applicable			
CHEMICAL	H_2S Gas	Accumulated in building.	Inadvertent exposure to H_2S gas from pipe	Building is equipped with an alarm that will trigger when levels reach half the permissible

HSSE CONSIDERATIONS
This section to be completed with concurrence from the Safety Officer.

			failure could result in adverse health effects and in extreme cases death.	exposure limit. The alarm also signals a call out and flashes on outside of building to prevent entry.
ELECTRICAL	Shock	When resetting breaker	Breaker malfunction could expose personnel to electrical hazards resulting in injury.	Stand to the side and behind the panel door when resetting breaker, Level D PPE and gloves.
GRAVITY	Not applicable			
MECHANICAL	Slips and trips Pinch Points	Walking and working surfaces Doors	Wet/mud and/or cluttered walking surfaces could cause employees to slip and/or trip. Fingers could be pinched when opening and closing doors resulting in cuts, scrapes.	Keep floors dry, use ice melt or sand during winter months. Keep tools and equipment out of walking/working area. Use door handle when opening and closing the door. Do not place fingers between door and jam.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced	Site	Inexperienced	Employees will be properly

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
	and improperly trained worker		workers and improper training could cause incidents resulting in personal injuries and/or property damage.	trained in this procedure and other applicable procedures. Employees will implement stop work procedures, if necessary.
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt gloves as needed
APPLICABLE SDSs	H_2S
REQUIRED PERMITS/FORMS	Field Authorization Form
REQUIRED ADDITIONAL TRAINING	Control of Work, OSHA 40-Hour Hazwoper/ 8-Hour refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-6-AB and P&ID-1-AB.
DRAWINGS	Site-wide as-built drawings are contained in the draft O&M manual.
RELATED SOP's/PROCEDURES/ WORK PLANS	BTL-SOP-44 *H2S Alarm Response West Camp Check* BTL-SOP-42 *West Camp Pump Start-Stop*
TOOLS	None
FORMS/CHECKLIST	WCP Checklist.

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
Dave Aniffi	**11/24/14**
SAFETY OFFICER	**DATE**
Sara Schleeman	**11/24/14**
LEAD OPERATOR	**DATE**
Brad Hallam	**11/24/14**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

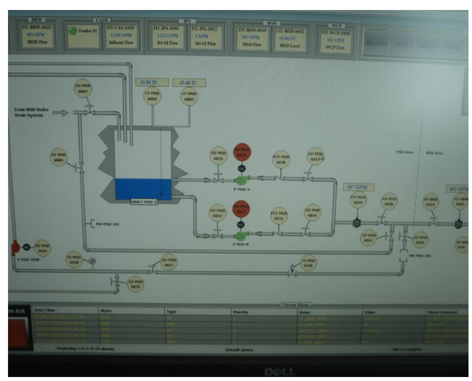
Revisions:

Rev.	Description	Date	Approval
3	Annual Review	4/7/20	Brad Hollamon
4	Update Risk Table for consistency	12/4/20	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing routine monitoring and inspection of the BPSOU Subdrain.
SCOPE	This practice has been prepared for the Pioneer Technical Services (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach to routine operational inspections of Subdrain.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Check the BTL Operations HMI	On the HMI screen located in the Operations Building, check the control system for BPSOU Subdrain Pumping Station alarms. If there is indication of an alarm, inspection of the Subdrain pumping station is required to verify and correct the alarm condition. 
Site Entry	**Before entering site**, visually inspect the condition of the security fence and gate and exterior of the Subdrain Pump Control building. If conditions appear normal, operator may enter site. If visual inspection shows signs of damage or security gate is open, operator will contact the Pioneer Project Manager. If determined necessary by the Project Manager, contact 911.
Verify and determine alarm conditions at the Subdrain pump station	Upon arrival at the Subdrain pump station check the ABB Variable Frequency Drives or temporary 30 hp pump for any abnormal operating conditions or error codes on the VFD read out. If there are any abnormal conditions, attend to them as outlined in steps 4 and 5 below. If no abnormal conditions exist check the electrical system.

Generator verification	**Verify** that the backup generator is operating, and the automatic transfer switch has transferred power to the WCP building.
Check for electrical service disruption	If electrical service has been disrupted, the operator will verify the back-up generator is operating. If generator did not start automatically, manually start generator. If breaker is tripped, reset breaker once. • Determine if it is within operator control to restore power, if within operator control (i.e., restart or reset breaker), operator will resume power. • If not within operator controls, the operator will contact Northwestern Energy to have electrical service restored.
Restore pump to routine operation	Once electrical service is restored; pumps 1 and 2 will be restored to routine operation. (refer to BTL-SOP-48 Subdrain Pumps Station Start-Up/Shutdown). Hand switches located below the Pulsar Level Controller are used to control pumps 1 and 2. Switches for the pumps may be placed in ON or OFF positions. ON position turns pump on. OFF position turns pump off. Switch positions will be determined according to current BTL operator parameters. 

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARD*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
BIOLOGICAL	Spiders and insects	Subdrain pumping station	Exposure to insects and spiders could result in bites and/or allergic reactions.	Training on the signs and symptoms of exposure to insects and spiders is required. Avoid contact with insects and spiders, and wear gloves when moving parts and opening lids. First aid kits are available on site.
BODY MECHANICS	Slips and trips	Walking and working surfaces	Wet, muddy, and/or cluttered walking and working surfaces could cause personnel to slip and/or trip resulting in injury.	Personnel will keep walking and working areas free from clutter/debris, avoid walking on steep slopes, wear boots with good traction, avoid wet/slippery terrain.
CHEMICAL	Untreated ground water (metals)	Subdrain pumping station	Inadvertent contact with untreated water in the Subdrain pumping station could result in adverse health effects.	Personnel will wear required PPE as outlined in this SOP, wash hands before eating or drinking, and wear nitrile gloves if contact with untreated water is possible.
ELECTRICAL	Shock	Throughout the vault and control building	Injury could occur from inadvertent contact with electrical current, if there is equipment malfunction, deterioration, or damage.	Equipment inspections will be performed as outlined in the O&M manual. Only qualified personnel (i.e., electrician) will perform replacement/repair. All equipment and wiring are equipped with GFCI. Damaged equipment will be tagged out and replaced.
GRAVITY	Falling tools and/or equipment	Subdrain site	Injury or could occur from tool or equipment falling off of elevated work surfaces and striking a worker who is working below.	Designate safety zones with caution tape or spotter. Keep vault lid closed when not in vault. Wear PPE as outlined in this SOP.
	Falls	Uneven walking and working surfaces	Personnel could slip and trip when working and walking on uneven terrain resulting in falls	Personnel will avoid walking on uneven and steep slopes, wear boots with good traction, avoid wet/slippery terrain, and use sand

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
			and serious injuries.	or have area cleared and maintained in winter.
MECHANICAL	Pinch points	Equipment covers, doors	Fingers could be pinched in doors and/or equipment covers/lids resulting in cuts, scrapes.	Personnel will wear gloves when opening closing covers/lids, do not place fingers/hands between covers/doors/lids.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Ultraviolet (UV) radiation.	Working outdoors	Exposure to UV radiation when working outdoors may result adverse health effects and/or injury.	Personnel will wear PPE as outlined in this SOP and personnel should wear sunscreen when applicable.
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained personnel	Subdrain pumping station	Inexperienced personnel and improper training could cause incidents resulting in injury and/or property damage.	Personnel will be trained in this procedure/equipment and will understand the scope of work prior to starting work activities. Personnel will implement STOP work policy/procedures, if there are any issues.
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D Personal Protective Equipment (PPE): Hard hat, safety glasses, safety-toed boots, high-

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
	visibility outerwear, long-sleeved shirt, long pants, and gloves (nitrile and leather) when necessary.
APPLICABLE SDS	Heavy metals. Safety Data Sheets (SDSs) are located in the Operations Building Control Room.
REQUIRED PERMITS/ FORMS	Field Authorization Form.
ADDITIONAL TRAINING	Control of Work (CoW), 40-hour Hazwoper, 8-hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-7-AB
DRAWINGS	Site-wide
RELATED SOPs/ PROCEDURES/ WORK PLANS	
TOOLS	Wrench and screwdriver.
FORMS/ CHECKLIST	BPSOU Subdrain Checklist.

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	DATE
Dave Griffis	11/24/14
SAFETY AND HEALTH MANAGER	DATE
Sara Scheeman	11/24/14
LEAD OPERATOR	DATE

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

Brad Hollamon	**11/24/14**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

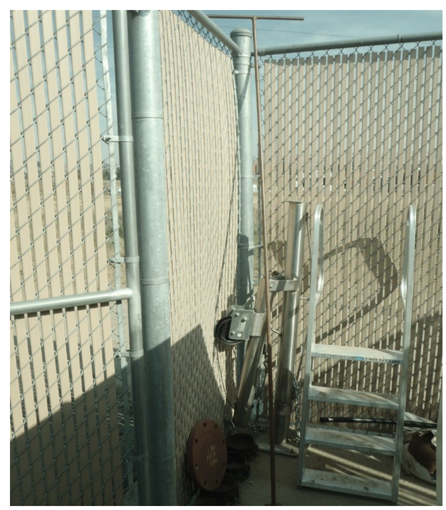
Revisions:

Revision	Description	Date	Approval
1	Updated to reflect I&C upgrades	2/20/2014	
2	Annual Review	4/7/2020	Brad Hollamon
3	Update Risk Table for consistency	12/4/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing valve cycling at the BPSOU Subdrain.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This Standard Operating Procedure (SOP) defines the procedural approach for valve cycling at the Subdrain.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is outdated, inaccurate, or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons (BTL) Water collection and Treatment System, the Site-Specific Health and Safety Plan (SSHASP)for BTL, Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Valve cycling of buried gate valves (P&ID-7-AB)	Retrieve the long T-handle valve key from the fenced area located north of the Subdrain Vault. Remove the locking valve covers using the t-handle lock key, which is located inside of the Subdrain Vault control building.   Place the T handle valve key on the valve to be exercised. Depending on position of the valve, rotate valve until fully opened (counterclockwise) or closed (clockwise) and then return the valve to its original position. On the inspection form, verify valve “as found” and “as left” position. When leaving valve in closed position, tighten the valve per manufacturer’s recommendations to prevent leakage.

Valve cycling of dry vault gate valves (P&ID-7-AB)	Open the Dry Vault access lids, allow blower to run for 10-15 minutes to ensure air exchange in vault. Climb into dry vault using the fixed access ladder to access valves. Depending on position of the valve, turn valves fully clockwise to close or fully counterclockwise to open. Valve position indicators are mounted on valves showing open and closed position. Prior to exiting the vault, verify "as found" and "as left" position on inspection form.  
Valve cycling of pigging vault gate/butterfly valves (P&ID-7-AB)	Open pigging vault access lids. Using the removable ladder, access the vault on the west end. Use the T handles located inside of the pigging vault to access the valve(s) below the walking grate. Turn valves fully clockwise to close or fully counterclockwise to open. Valve position indicators are mounted on valves showing open and closed position. Prior to exiting vault, verify "as found" and "as left" position on inspection form. 
Emergency by-pass manhole injection port check	Remove manhole covers from the north and south by-pass manholes using a manhole lid puller. Inspect the injection port cap, fittings and manhole space for signs of water leakage such as corrosion, rust, discoloration, and impacts to transducers.  
Monitor system for leaks.	Check valves, risers, and transducers for any leakage. Monitor system for 10-20 minutes.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARD*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
BIOLOGICAL	Spiders and insects	Subdrain sites	Exposure to insects and spiders could result in bites and/or allergic reactions.	Training on the signs and symptoms of exposure to insects and spiders is required. Avoid contact with insects and spiders, and wear gloves when moving parts and opening lids. First aid kits are available on site.
BODY MECHANICS	Repetitive motion/over-exertion	Exercising valves	Repetitive motion when turning valves could result in muscle strain. Over-exertion when closing valves could result in muscle strain or injury.	Personnel will take breaks as needed, switch job positions, and tighten valves per manufacturer's recommendations.
	Slips and Trips	Walking and working surfaces	Wet, muddy, and/or cluttered walking and working surfaces could cause employees to slip and/or trip resulting in injury.	Personnel will keep walking and working areas free from clutter/debris, avoid walking on steep slopes, wear boots with good traction, and avoid wet/slippery terrain.
CHEMICAL	Untreated ground water (metals)	Subdrain Vault	Inadvertent contact with untreated water in the Subdrain Vault could result in adverse health effects.	Personnel will wear required PPE as outlined in this SOP, wash hands before eating or drinking, and wear nitrile gloves if contact with untreated water is possible.
ELECTRICAL	Shock	Throughout the vault and control building	Injury could occur from inadvertent contact with electrical current if there is equipment malfunction, deterioration, or damage.	Equipment inspections will be performed as outlined in the O&M manual. Only qualified personnel (i.e., electrician) will perform replacement/repair. All equipment and wiring are equipped with GFCI. Damaged equipment will be tagged out and replaced.
GRAVITY	Falling tools and/or	Subdrain site	Injury could occur	Personnel will designate safety

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

	equipment		from tools or equipment falling off elevated work surfaces and striking a worker who is working below.	zones with caution tape or spotter (as needed), not place tools on the edge of the vault, and keep vault lid closed when not in vault. Personnel will also wear PPE as outlined in this SOP.
	Falls	Uneven walking and working surfaces, and the dry vault's access ladder	Personnel could slip and trip when working and walking on uneven terrain resulting in falls and serious injuries. Personnel using the fixed ladder to access the dry vault could also fall.	Personnel will avoid walking on uneven and steep slopes, wear boots with good traction, avoid wet/slippery terrain, and use sand or have area cleared and maintained in winter. Personnel will also use designated fixed/removable ladder when accessing the dry vault and maintain three points of contact.
MECHANICAL	Pinch points	Equipment and manhole covers, doors, and hand tools	Fingers could be pinched in equipment and manhole covers, doors, and when using hand tools resulting in cuts, scrapes, and hand injuries.	Personnel will wear gloves when opening/closing covers/lids and when using hand tools, do not place fingers/hands between objects/doors/lids, and inspect hand tools before each use. Personnel will also use the manhole lid puller when opening/closing manhole covers.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Ultraviolet (UV) radiation	Working outdoors	Sunburn or heat-related illness could result from extended exposure to sunlight while working outside.	Personnel will wear Level D PPE as outlined in this SOP. Sunscreen should be used when applicable.
THERMAL	Not applicable			
SIMOPS	Public	Adjacent walking trail	Interaction with members of the public could result in property damage and/or injury.	Follow stop work procedures, if members of the public enter the work area.
HUMAN FACTORS	Inexperienced and	Subdrain site	Lack of understanding	Workers will be properly trained

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
	improperly trained workforce		of scope of work, inexperienced workers, and lack of training could cause incidents, resulting in injury and/or property damage.	in this procedure and applicable procedures. STOP work policy will be followed, if there are any issues.
WEATHER	Heat or cold related injuries and illnesses	Working outdoors	Personnel could experience adverse health effects while working outdoors in the winter or summer months.	Follow procedures outlined in the Corporate HASP and SSHASP. Dress for weather conditions and check the forecast/plan ahead.
	Adverse weather conditions/lightning	Working outdoors	Personnel could be exposed to adverse weather conditions and/or lightning resulting in injury and/ or property damage.	Follow procedures outlined in Corporate HASP and SSHASP and stop work if necessary.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D Personal Protective Equipment (PPE): Hard hat, safety glasses, safety-toed boots, high-visibility outerwear, long-sleeved shirt, long pants, and gloves (nitrile and leather) when necessary.
APPLICABLE SDS	Heavy metals. Safety Data Sheets (SDSs) are located in the Operations Building Control Room.
REQUIRED PERMITS/ FORMS	Field Authorization Form.
ADDITIONAL TRAINING	Control of Work (CoW). 40-hour Hazwoper, 8-hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-7-AB
DRAWINGS	Vault area plot plan, as-built drawings.
RELATED SOPs/ PROCEDURES/	BTL-SOP-5A *LAO BPSOU Subdrain Operations Check Procedures*

WORK PLANS	
TOOLS	Wrench, screwdriver, and manhole lid puller.
FORMS/ CHECKLIST	BPSOU Subdrain Checklist and Inspection Form.

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
SAFETY AND HEALTH MANAGER	**DATE**
LEAD OPERATOR	**DATE**
OPERATOR	**DATE**
OTHER	**DATE**

Revisions:

Revision	Description	Date	Approval
1	Updated to reflect I&C upgrades	2/20/2014	
2	Annual review	4/7/2020	Brad Hollamon
3	Update Risk Table for consistency	12/4/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing Influent Pump Station start up.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. Pioneer workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach used to start the Influent Pump Station pumps to avoid system problems.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Local-Manual Start/Stop	**Local-Manual Startup Position** Ensure the switch for the two 225 Dri-Prime pumps is in the LOCAL position. Verify the following valves are in the “OPEN” position: • GV-IPS-3003, • GV-IPS-3004, • GV-IPS-3009, • GV-IPS-3010, • GV-CAS-1052, • GV-CAS-1053 Verify the following valves are in the “CLOSED” position: • GV-IPS-3012, • GV-CAS-1054 The valves listed above are located inside the IPS building or outside of the CAS building as indicated. Select “LOCAL” from the LOCAL-OFF-REMOTE switch on the front of the VFD. Start the pumps by depressing the green button located on the touchpad on front of the VFD panel. Adjust pump speed by depressing the up arrow key to increase speed and the down arrow key to decrease the speed. After starting the pumps, inspect piping for any signs of leakage. To stop the pump depress the red stop button located on the keypad or if there is an

<table>
<tr><td></td><td>emergency depress the E-Stop button located on the front of the VFD panel.
NOTE: Do NOT start both 225M Dri-Prime pumps simultaneously.
</td></tr>
<tr><td>Remote-HMI Operation</td><td>Prior to start the pumps, verify the following valves are in the "OPEN" position:
• GV-IPS-3003,
• GV-IPS-3004,
• GV-IPS-3009,
• GV-IPS-3010,
• GV-CAS-1052,
• GV-CAS-1053

Verify the following valves are in the "CLOSED" position:
• GV-IPS-3012,
• GV-CAS-1054.

The valves listed above are located inside the IPS building or outside of the CAS building as indicated.</td></tr>
<tr><td></td><td>Automatic Startup from HMI

Select "REMOTE" from the LOCAL-OFF-REMOTE switch on the front of the VFD. Access the IPS screen on the HMI. Select the Pump Control Box on the IPS screen by left clicking the MC symbol and select "AUTO". Once in the auto mode, select start and the desired pump will start. In this configuration, the VFD is controlled by the "Level Setpoint". The Level Setpoint is entered in the IPS pump control box. Enter the desired D4 pond level to be maintained.

Manual Startup from HMI

Select "REMOTE" from the LOCAL-OFF-REMOTE switch on the front of the VFD. Access the IPS screen on the HMI. Select the Pump Control Box on the IPS screen by left clicking the MC symbol and select "MANUAL". Once in the manual mode, select start and the desired pump will start. In this configuration, the VFD is controlled by the "Manual Setpoint". The Manual Setpoint is entered in the IPS pump control box. Enter the desired percentage of pump speed to achieve the desired</td></tr>
</table>

pumping rate.
Stop the operating pump in either "auto" or "manual" mode by clicking stop in the IPS Pump Control box.

In the event of an emergency, depresses the E-Stop button located on front of the VFD panel in the IPS building.

To avoid pumping system problems, the two 225M Dri-Prime pumps must not be started simultaneously.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	**HAZARDS**	**WHERE**	**RESULT**	**CONTROLS**
BIOLOGICAL	Spiders and insects	IPS building	Exposure to insects and spiders could result in bites and/or allergic reactions.	Training on the signs and symptoms of exposure to insects and spiders is required. Avoid contact with insects and spiders, and wear gloves when moving parts and opening lids. First aid kits are available on site.
BODY MECHANICS	Not applicable			
CHEMICAL	Not applicable			
ELECTRICAL	Shock	Panel	Injury could occur from inadvertent contact with electrical current if there is equipment malfunction, deterioration, or	Equipment inspections will be performed as outlined in the O&M manual. Only qualified personnel (i.e., electrician) will perform replacement/repair. All equipment and wiring are

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

			damage.	equipped with GFCI. Damaged equipment will be tagged out and replaced.
GRAVITY	Slips, trips, falls	Slippery walking or working surface	Injury could occur from personnel slipping, tripping or falling while working onsite due to wet floors or poor housekeeping.	Good housekeeping – tools and equipment will be picked up to prevent tripping hazards in the work area. Personnel will wear work boots with good traction and support. Pay attention to surroundings. Inspect work area prior to performing work.
MECHANICAL	Pinch Points	Opening/closing 14” gate valves	Injury could occur from fingers getting pinched in the valve handles while turning valve.	Gloves will be worn to protect hands and fingers throughout this process. Keep hands to outside of valve handle.
NOISE	Not applicable			
PRESSURE	Unexpected pressure build-up or release	In piping during initial startup	Unexpected/sudden release of pressure in the piping from a worn/defective fitting could result in injury from being splashed with impacted water.	Open by-pass pressure relief valve on pump piping. Inspect system prior to start and as outlined in the O&M manual.
RADIATION	Not applicable			
THERMAL	Not applicable			

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained workforce	Subdrain site	Lack of understanding of scope of work, inexperienced workers, and lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures. STOP work policy will be followed, if there are any issues.
WEATEHR	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, Steel toe boots, Long pants, Long sleeve shirt, Gloves (on person).
APPLICABLE MSDS	Heavy metals
REQUIRED PERMITS/FORMS	Field Authorization Form
ADDITIONAL TRAINING	Control of Work, 40-hour Hazwoper, 8-hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-4-AB.
DRAWINGS	Site-wide as-built drawings are contained in the Draft O&M Manual.
RELATED SOP's/PROCEDURES/ WORK PLANS	
TOOLS	
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
Dave Sniffi	**11/24/14**
SAFETY OFFICER	**DATE**
Sara Scheeman	**11/24/14**
LEAD OPERATOR	**DATE**
Brad Hallam	**11/24/14**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

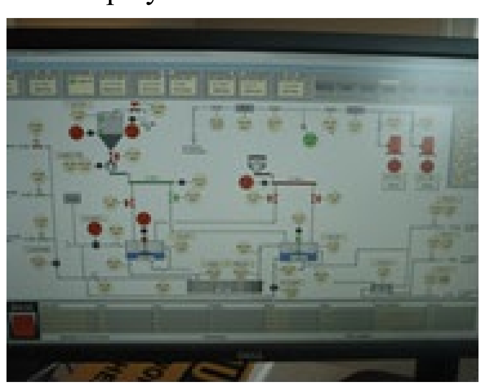
Revisions:

Rev.	Description	Date	Approval
2	Annual review	4/7/2020	Brad Hollamon
3	Update Risk Table for consistency	12/4/2020	Hailey Thompson

PURPOSE	To provide standard instructions for slurry tank feed water re-establishment.
SCOPE	This practice has been prepared for the Pioneer Technical Services (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach used to re-establish flow if an interruption of influent water to the slurry tank occurs. A portion of the influent flow is diverted to discharge into the slurry tank and mixed with the dry lime from the silo to form a slurry which is added to the untreated influent. If the flow into the slurry tank occurs, lime slurry does not reach the untreated influent and disruption of treatment will occur.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Slurry tank feed water re-establishment	Re-establish slurry tank feed water by completing the following steps: • Ensure the 4” butterfly valve (BFV-CAS-1084) immediately upstream of the 4” wye from the main 14” influent line is fully open. • Adjust the 4” butterfly valves (BFV-CAS-1040, BFV-CAS-1082, BFV-CAS-1083 and BFV-CAS-1050) open/closed to balance the flow of the feed water to Slurry Tanks 1 and 2. • Ensure feed water flow is within the range of 50-150 GPM as read from the slurry tank feed water flow display located on the CAS HMI or on the local slurry tank flow display screens located on the south CAS wall. 

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

SOURCE	*HAZARD*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
BIOLOGICAL	Spiders and insects	Slurry Tank	Exposure to insects and spiders could result in bites and/or allergic reactions.	Training on the signs and symptoms of exposure to insects and spiders is required. Avoid contact with insects and spiders, and wear gloves when moving parts and opening lids. First aid kits are available on site.
BODY MECHANICS	Not applicable			
CHEMICAL	Hydrated lime	Lime Slurry tank discharge	Inadvertent contact with residual lime dust on equipment/surfaces in the CASB, and/or contact with treated water in the CASB could result in adverse skin reaction such as burns, mucous membrane, eye and respiratory tract irritation Inadvertent ingestion via hand to mouth contact (i.e. eating outside of designated areas, poor hygiene) could result in Gastrointestinal tract irritation	Wear required PPE as outlined in this SOP, wash hands before eating or drinking. Avoid unnecessary contact with surfaces where lime can accumulate. Clean or wet areas to be accessed that have lime accumulation if necessary
ELECTRICAL	Not applicable			
GRAVITY	Falls	Slippery walking or working surface	Fall could result from tripping and/or slipping while walking on site resulting in injury	Keep walking/working areas free from clutter and/or debris. Keep floors dry, use ice melt or sand during winter months.
MECHANICAL	Pinch Points	Slurry tank water supply piping and	Injury could occur from fingers getting pinched between the slurry tank	Gloves will be worn to protect hands and fingers throughout this process. A crescent wrench will

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
		valves	water supply valves and pipes when opening and closing valves.	be used.
	Slips and trips	Walking, working surfaces	Injury could occur from personnel slipping, tripping while walking on slick/icy surfaces or trip over debris/clutter	Good housekeeping – tools and equipment will be picked up to prevent tripping hazards in the work area. Personnel will wear work boots with good traction and support.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained workforce	Subdrain site	Lack of understanding of scope of work, inexperienced workers, and lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures. STOP work policy will be followed, if there are any issues.
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt, gloves
APPLICABLE MSDS	Lime, Heavy Metals.
REQUIRED PERMITS/FORMS	Field Authorization Form
ADDITIONAL TRAINING	Control of Work, 40-hour Hazwoper, 8-hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-2-AB.
DRAWINGS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
RELATED SOP's/ PROCEDURES/ WORK PLANS	BTL-SOP-06 *Influent Pump Station Start Up.*
TOOLS	Pipe wrench
FORMS/ CHECKLIST	Operations Guide for Butte Priority Soils Operable Unit. Butte Treatment Lagoons (BTL) at Lower Area One (LAO) Groundwater Treatment System.

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
Dave Griffis	**12/4/14**
SAFETY OFFICER	**DATE**
Sara Scheeman	**12/4/14**
LEAD OPERATOR	**DATE**
Brad Hallo	**12/4/14**
OPERATOR	**DATE**
OTHER	**DATE**

OTHER	DATE

Revisions:

Rev.	Description	Date	Approval
2	Annual Review	5/6/20	Brad Hollamon
3	Update Risk Table for Consistency	12/4/2020	Hailey Thompson

PURPOSE	To establish a uniform procedure for downloading flow meters at the BPSOU Subdrain.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this Standard Operating Procedure (SOP) will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (OM&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS

Teledyne Isco 2150 Area-Velocity Flow Meter (AV Flow Meter) Download

AV flow meters are located at MH-MSD106, MH-MSD108, MH-MSD110, MH-MSD113, and MH-MSD116. The following describes how to download data from the devices during monthly site visits and sampling events (BTL-SOP-OG-25). Figure 1 below shows the key parts when downloading the instrument.

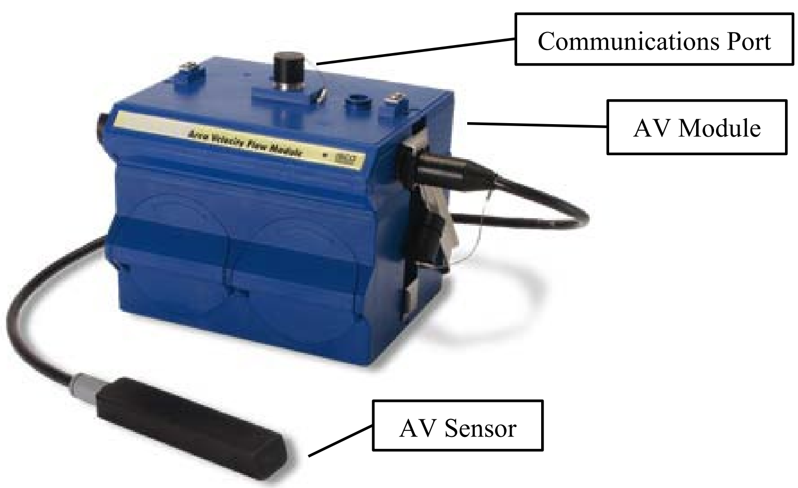


Figure 1

TASK	INSTRUCTIONS
1. Connect to flow module.	Open up the computer program, Flowlink 5.1. Using the communication cable connect the AV module to the computer. The window in Figure 2 will automatically open. Choose the “2100 Instruments” icon to connect.

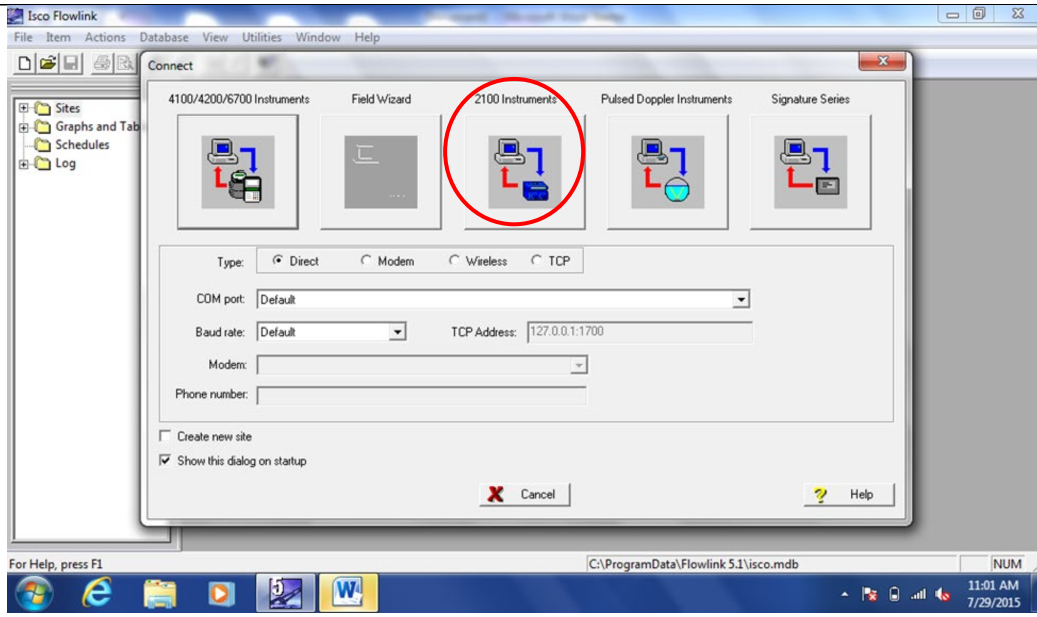


Figure 2.

If the window in Figure 2 is not up choose the "quick connect icon" in Figure 3 to open the connect window. The computer can take longer than ten minutes to connect at the first location of the day.

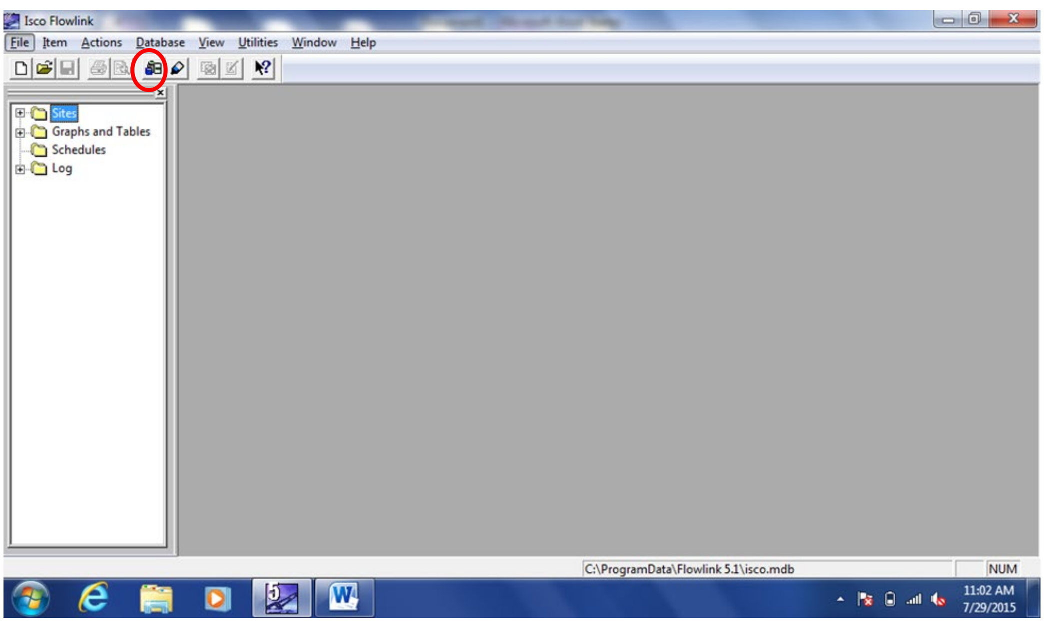


Figure 3.

2. Retrieve data.

Once the connection is complete the window in Figure 4 will appear and the upper right hand corner will show that it is connected. Click on "Retrieve Data" to begin the download.

The screen shot below also shows the instruments time in red text and that it does not match the computers time. This is because the computer automatically swithces to

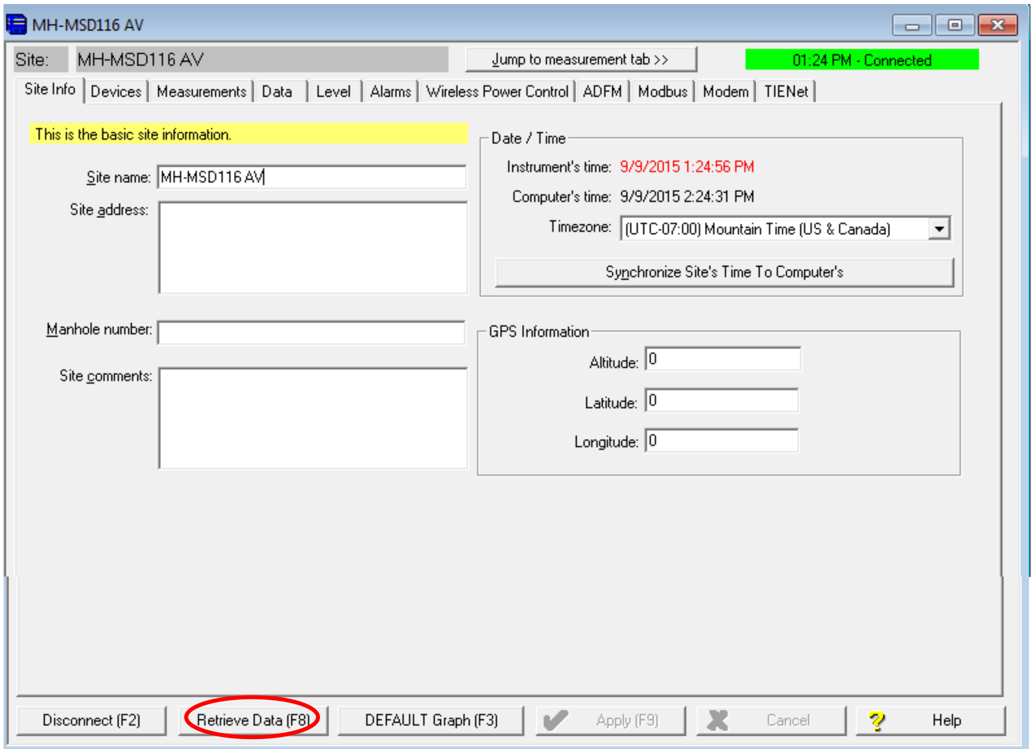
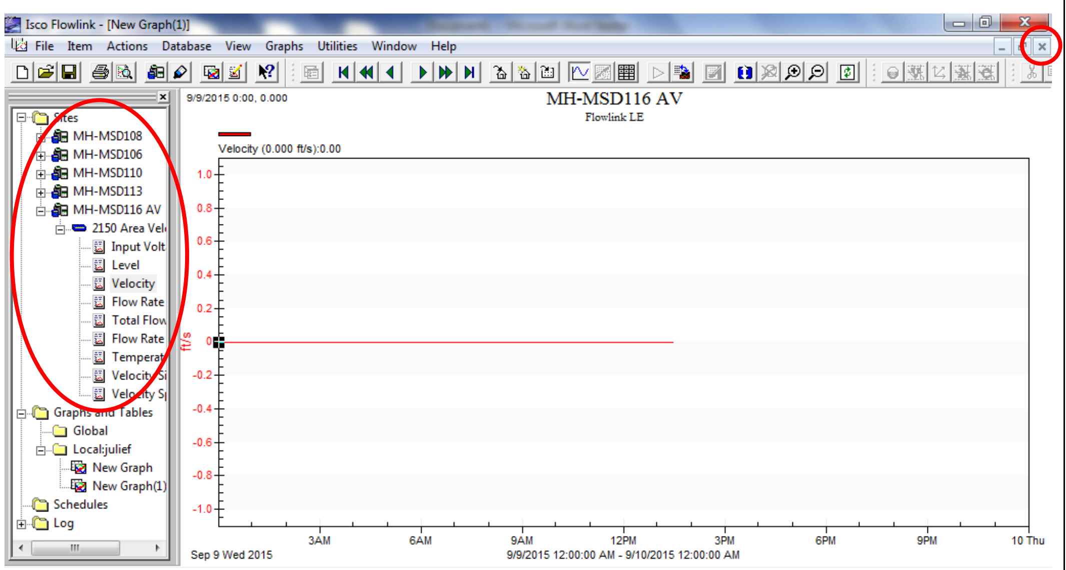
	daylight savings time and the devices need to be kept in standard time. Make sure to NOT “Synchronize Site’s Time to Computer’s” during daylight savings.  **Figure 4**
3. Verify real-time readings.	After the data has been retrieved, verify that the device has been recording since the last download. On the drop down menu in the left pane select the correct site and then 2150 Area Velocity Meter. Double click on one of the graphs (preferably level, velocity, or flow rate) to check that there are readings up until the current day. Close the graph and do not save changes. 

Figure 5

After the data has been verified record the real-time readings. Select the "Measurements" tab for level, velocity, flow rate, input voltage, temperature, velocity signal, and velicty spectrum real-time values.

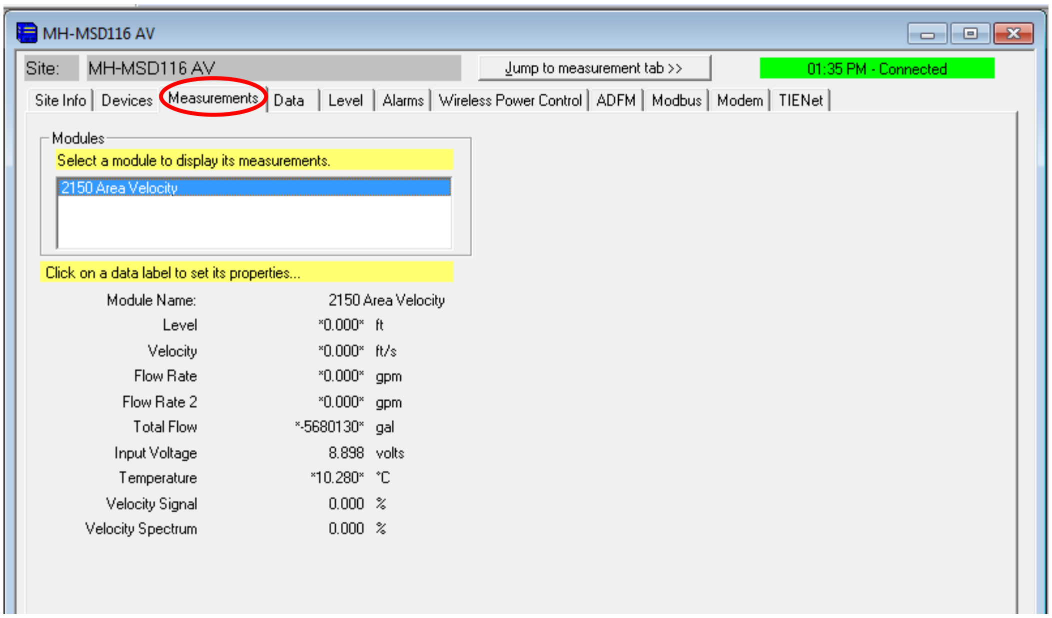


Figure 6

Select the "Data" tab for the utilization. Once the utilization reaches 80% the data should be archived (Task 4). If everything looks correct, select the "Disconnect" icon and physically disconnect the cable from the device.

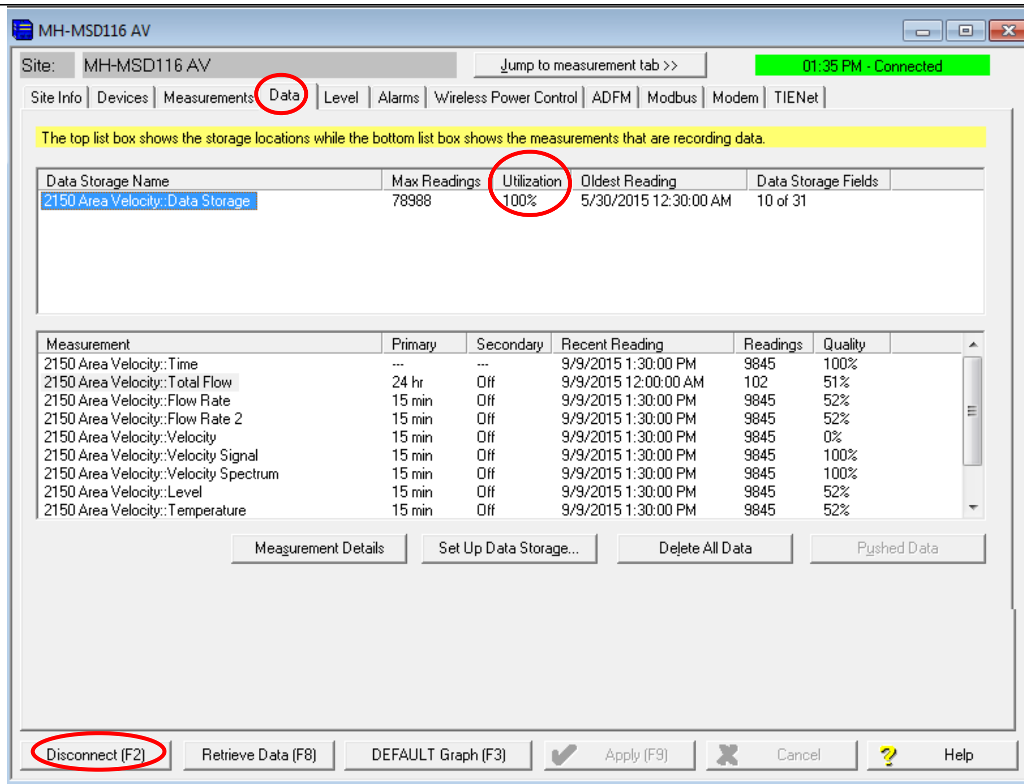


Figure 7

4. Archive data.

To archive data, right click on the site name in the left pane and select "Archive". The window in Figure 9 should open.

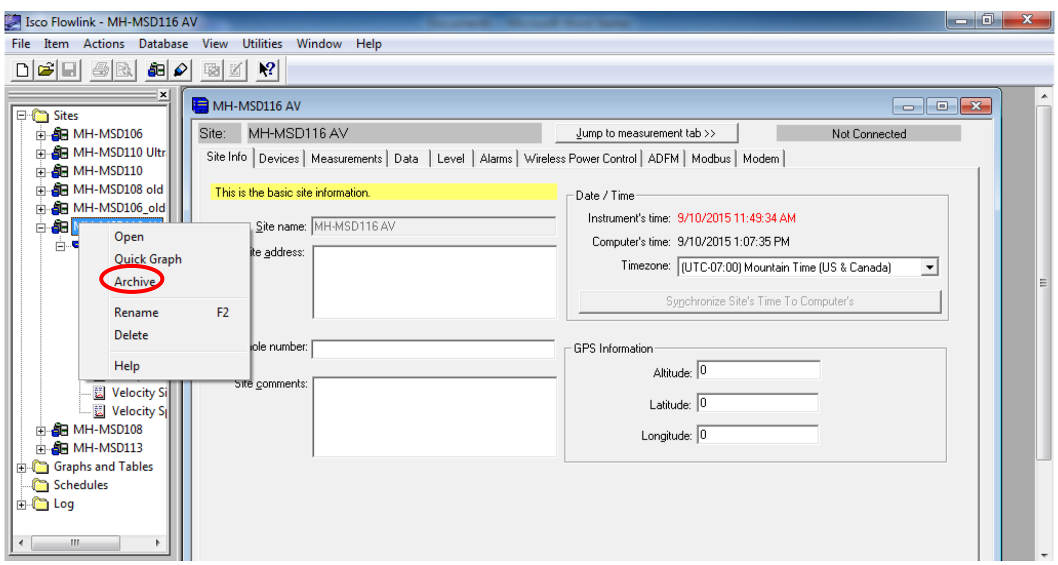


Figure 8

Make sure the box by "Archive to csv" is checked and "All data" is selected. Select where the csv file will be saved and click the "Archive" icon. The process can take up to 10 minutes.

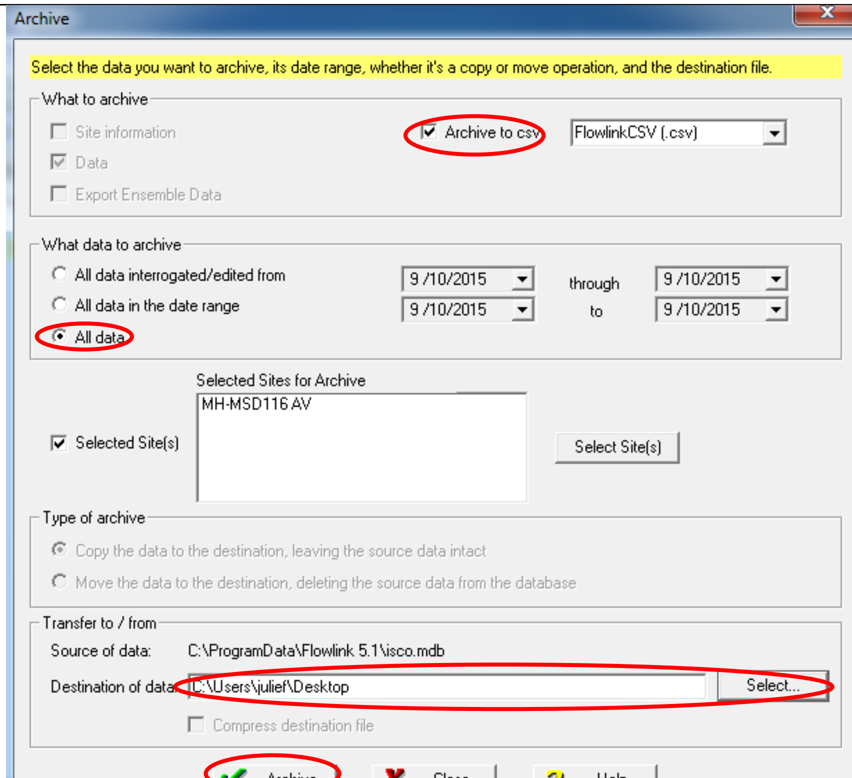


Figure 9

Once archiving is done exit the windows and verify all the data saved in your selected location. Go back to the “Data” tab and “Delete All Data”.

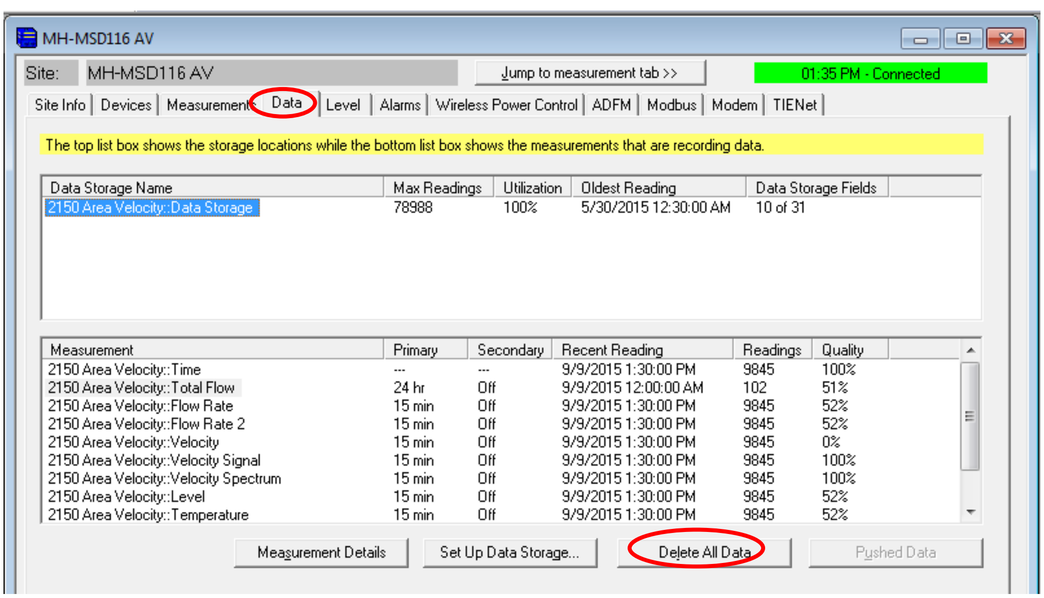


Figure 10

Marsh-McBirney Flo-Tote® Electromagnetic Sensor (EM Flow Meter) Download

An EM flow meter is located at MH-MSD116. The following describes how to download data from the devices during monthly site visits and sampling events (BTL-SOP-02). Figure 11 below shows the key parts when downloading the instrument.

Figure 11

1. Connect to flow module.

Open up the computer program, Flo-Ware. Using the communication cable connect the Flow Logger to the computer. Select the following file path from the tasks listed: Communicate with an istrument > FL900 Series > Communications.

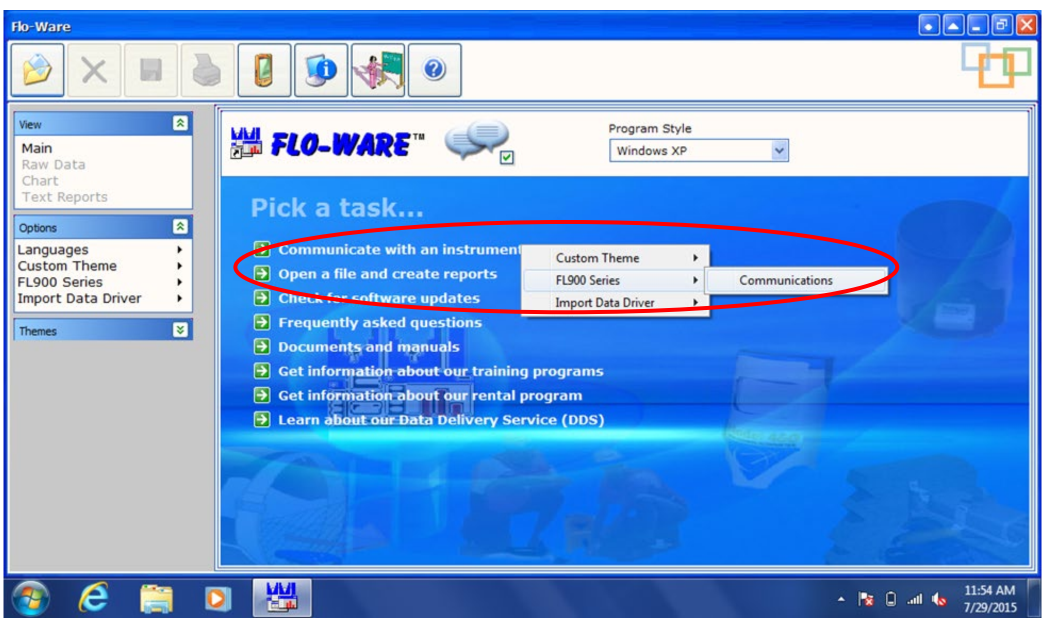


Figure 12

The window in Figure 13 will open next, select the icon (connect to logger) to connect with the instrument.

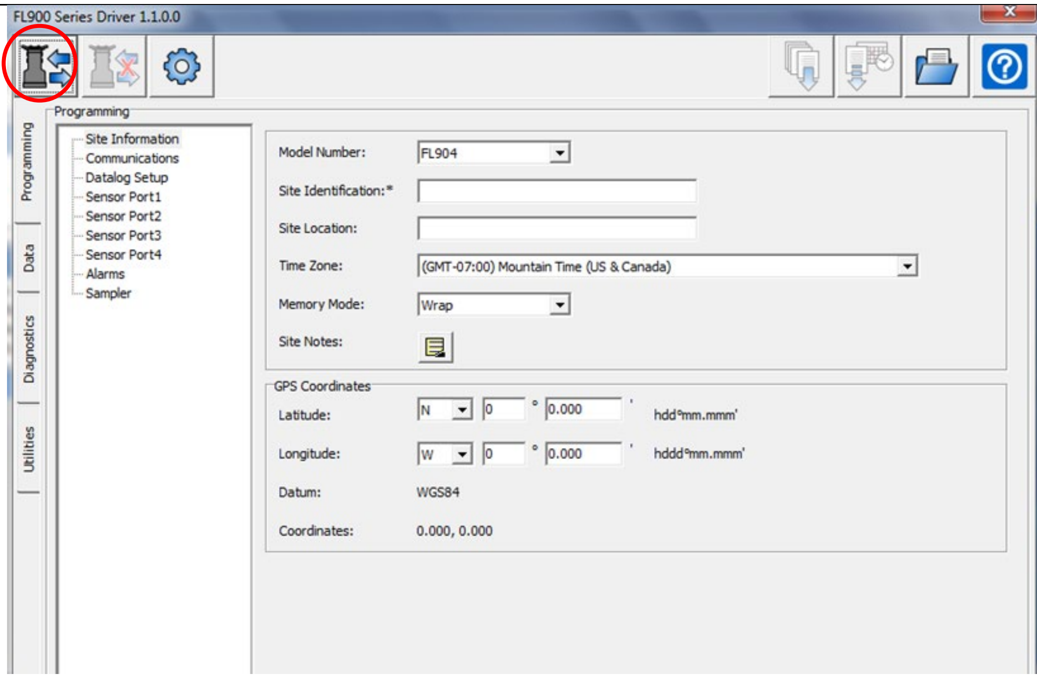
<table>
<tr>
<td></td>
<td>


Figure 13
</td>
</tr>
<tr>
<td>2. Download data.</td>
<td>
After connected the site identification should update to the intstruments name. The data can now be downloaded, click on the icon shown below (download complete site data, events, alarms, and sample history). This can take upwards of fifteen minutes. When the download is complete the window in Figure 15 will appear, make sure to record the file location in the logbook.

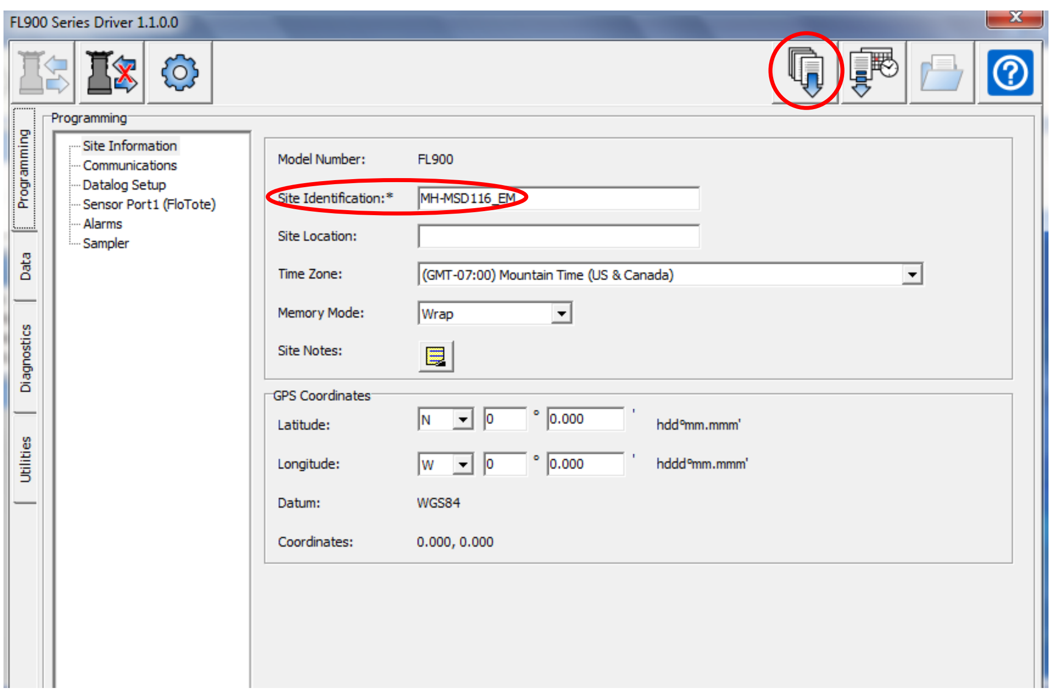


Figure 14
</td>
</tr>
</table>

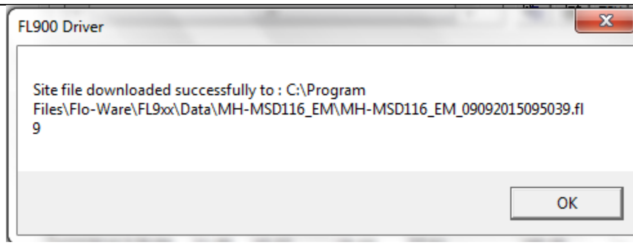
<table>
<tr>
<td></td>
<td>

Figure 15</td>
</tr>
<tr>
<td>3. Verify real-time readings.</td>
<td>Once the data has been downloaded record the real-time readings. Select the “Diagnostics” tab then “Current Status” for level, velocity, flow rate, power supply, temperature, and data log used. The “Last Logged Readings” pane did not update in the screen shot below because the device is not recording currently. The parameters listed will be shown here when downloading in the field.

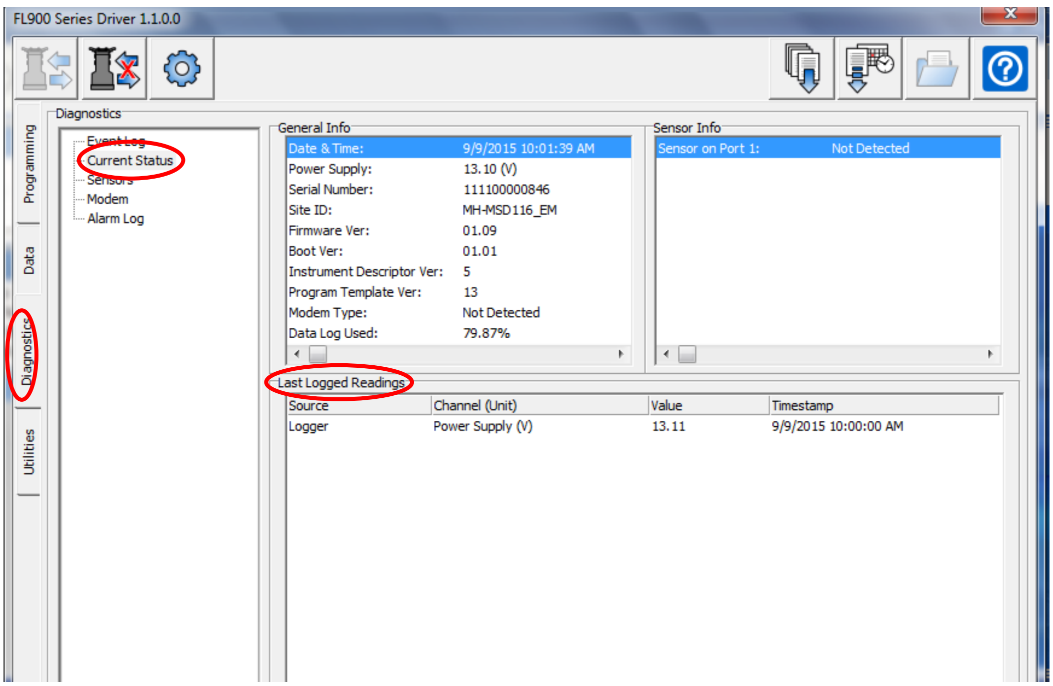


Figure 16

Lastly, verify the device has been recording since the last download by selcting the “Data” tab and “View Graph”. Once verified select “Disconnect from Logger” and physically disconnect the cable from the device.</td>
</tr>
</table>

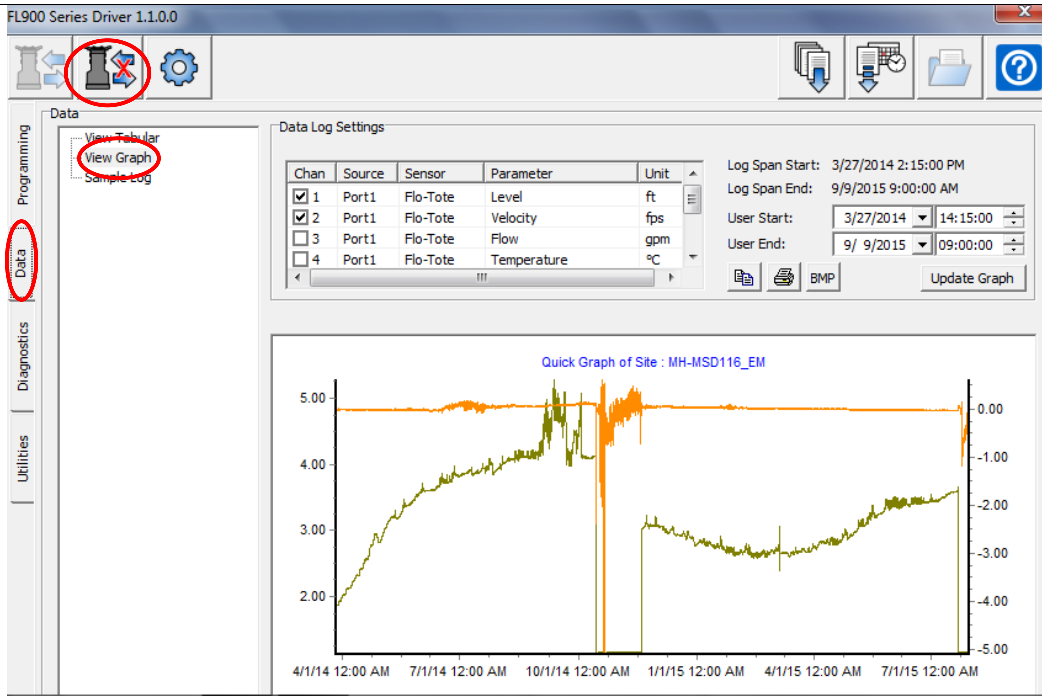


Figure 17

This SOP is meant to be a basic instruction manual for downloads in the field. For any additional information refer to device manuals.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Potential contact with contaminated water.	Testing sites, during field measurements.	Inadvertent exposure to contaminated water could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Employees will wear nitrile gloves and safety glasses during monitoring and sampling activities.
	Dielectric grease.	Connections for the flow modules.	Prolonged or repeated direct exposure to the skin and/or eyes could result in irritation and redness.	Personnel will avoid direct contact with the dielectric grease. Personnel will wear nitrile gloves and safety glasses when applying grease to the equipment connections. If contact occurs, flush eye with water for at least 15 minutes and wash skin with mild soap and water.
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			
BODY MECHANICS	Bending, squatting, and kneeling.	During monitoring and sampling activities.	Bending, squatting, and kneeling during monitoring activities could result in muscle/back strains or other injuries.	Personnel should stretch prior to starting work and they will take breaks when necessary.
GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet surfaces and steep slopes.	Walking/working on slick/muddy/wet, uneven, and steep terrain could cause slips and trips resulting in falls and injuries.	Workers will wear work boots with good traction and ankle support. Personnel will be aware of working/walking surfaces and choose a path to avoid hazards. Keep work areas as dry as possible. Wear muck boots, as necessary. Personnel will use a rope and

				grab onto it, while descending/ascending slopes to access the location of the manholes. Personnel will wear work gloves when using the rope. Personnel will avoid carrying heavy/awkward objects while walking on steep slopes.
	Falls into manholes.	Working near manholes.	Personnel could fall into manholes resulting in serious bodily injuries.	Personnel will set up a manhole guard around the manhole to prevent falls.
WEATHER	Cold/heat stress.	Sites.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors. Employees will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Employees will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Employees will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Employees should wear sunscreen, if necessary.

BIOLOGICAL	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Employees with allergies will notify their supervisor.
MECHANICAL	Not applicable.			
PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained worker.	Sites.	Inexperienced workers and improper training could cause incidents resulting in adverse health effects and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement stop work procedures, if necessary.
	Public entering the work area.	Sites.	The manholes are located next to a walking trail and public could enter the work area interfering with work activities.	Personnel will stop work, if public enters the work area. Work will resume once public has left the area. Personnel will use safety cones to delineate the work area on the walking trail.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, nitrile gloves, and work gloves.
APPLICABLE SDS	Safety Data Sheets (SDSs) will be maintained based on site characterization and contaminants. Dielectric grease.

REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	BTL-SOP-02 BPSOU Sampling and Monitoring Operations
TOOLS	
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Heather Brown	**09/11/2015**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman	**09/11/2015**

Revisions:

Revision	Description	Date
1	Rename and update SOP references to BTL SOP	1/13/2021

PURPOSE	To provide standard instructions for operators inspecting the backup generators at WCP, BPSOU Subdrain, IPS building, and the CAS building.
SCOPE	This practice has been prepared for the Pioneer Technical Services (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach uses to inspect backup generators at WCP, BPSOU Subdrain, IPS building, and the CAS building.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical services Corporate health and Safety Plan.

TASK	INSTRUCTIONS
Retrieve generator keys	The keys for the generators are located inside the appropriate control building (WCP, BPSOU Subdrain, IPS and CAS).
Access doors on the generator	Open generator doors to allow access for inspection.
Isolate energy	Locate the generator key and turn it to the "OFF" position and remove the key to prevent the generator from starting automatically while completing inspection.
Inspect generator	Inspect the generators belts and hoses, fluids and generator housing for excessive wear and correct level. Once visual inspection is complete, replace and return the generator key to the "AUTO" position. Obtain the battery voltage, water temperature and generator hour history from the control panel and record on the generator checklist.  

Close the access doors on the generator	Once all inspections are completed and recorded on the generator inspection sheet close and secure all generator access doors opened during inspection.
Place keys back in appropriate building	Once the generator access doors are locked and secured place the keys to the generator back into the appropriate building.
Post service documentation	Enter as left information on job form. Report any deficiencies or concerns to the project manager immediately.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARD***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
BIOLOGY	Spiders and insects	Subdrain sites	Exposure to insects and spiders could result in bites and/or allergic reactions.	Training on the signs and symptoms of exposure to insects and spiders is required. Avoid contact with insects and spiders, and wear gloves when moving parts and opening lids. First aid kits are available on site.
BODY MECHANICS	Not applicable			
CHEMICAL	Diesel fuel , coolant	Generator	Inadvertent contact with fuel, coolant during inspection could result in skin irritation.	Wear required PPE as outlined in this SOP and nitrile gloves to prevent contact, wash hands before eating or drinking.
ELECTRICAL	Electric shock, unexpected start-up of machinery	Generator	During inspection, inadvertent contact with electrical system.	Follow energy isolation, make sure generator is in “off” position prior to inspection.
GRAVITY	Slips, trips, falls	Uneven or slippery walking or working surface	Injury could occur from personnel slipping, tripping on terrain/rocks and falling while working onsite.	Use established access points to access generator locations. Use ice melt if necessary during winter months.
MECHANICAL	Slips, trips, falls	Walking working	Workers could slip, trip when	Use established access points to access generator locations. Use ice melt if

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

		surfaces, uneven terrain	walking on uneven terrain resulting in injury.	necessary during winter months.
	Wind	Generator Enclosure	Wind could cause injury from open doors blowing into workers.	If windy conditions are present stay clear of open panel doors or hold door open with free hand while inspections are completed.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Sunlight	Working outside	While working outdoors, workers could be exposed to UV radiation resulting in sunburns and could contribute to heat relate illnesses.	Personnel will wear Level D PPE as outlined in this SOP. Sunscreen should be used when applicable.
THERMAL	Heat/Cold Stress	Working outside	Adverse health effects could result from exposure to hot or cold temperatures.	Training on signs and symptoms of heat stress, emergency response plan. Follow procedures outlined in the SSHASP and Corporate HASP.
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained workforce	Subdrain site	Lack of understanding of scope of work, inexperienced workers, and lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures. STOP work policy will be followed, if there are any issues.
	Public		Interaction with	Stop work and leave area if interaction with public becomes

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
	Interaction	Site	the public could result in confrontations.	confrontational/hostile.
WEATHER	Heat or cold related injuries and illnesses Adverse weather conditions/lightning	Working outdoors Working outdoors	Personnel could experience adverse health effects while working outdoors in the winter or summer months. Personnel could be exposed to adverse weather conditions and/or lightning resulting in injury and/ or property damage.	Follow procedures outlined in the Corporate HASP and SSHASP. Dress for weather conditions and check the forecast/plan ahead. Follow procedures outlined in Corporate HASP and SSHASP and stop work if necessary.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt, gloves
APPLICABLE SDSs	Diesel Fuels, coolant, oils.
REQUIRED PERMITS/FORMS	Field Authorization Form
ADDITIONAL TRAINING	Control of Work, 40-hour Hazwoper, 8-hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-1-AB, P&ID-4-AB, P&ID-6-AB and P&ID-7-AB
DRAWINGS	Draft drawings are contained in the Draft O&M Manual.
RELATED SOP's/ PROCEDURES/ WORK PLANS	

TOOLS	Generator keys.
FORMS/ CHECKLIST	Operations Guide for Butte Priority Soils Operable Unit. Butte Treatment Lagoons (BTL) at Lower Area One (LAO) Groundwater Treatment System

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
	12/5/14
SAFETY OFFICER	**DATE**
	12/5/14
LEAD OPERATOR	**DATE**
	12/5/14
OPERATOR	**DATE**
OTHER	**DATE**

Revisions:

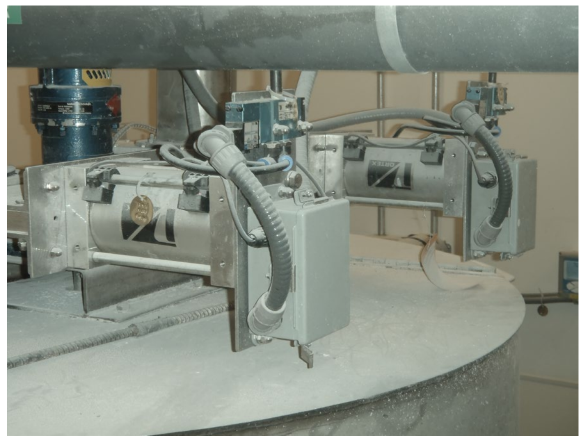
Rev.	Description	Date	Approval
2	Annual review	5/6/2020	Brad Hollamon
3	Update Risk Table for consistency	12/4/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing Screw Conveyer Cleaning.
SCOPE	This practice has been prepared for the Pioneer Technical Services (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP covers the procedural approach used to clean the Screw Conveyer.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Shut down screw conveyer control	Shut down the Screw Conveyor Control System by turning the screw conveyor control toggle located on the front of the MCC control panel to the off position. Disconnect the main power to the Screw Conveyor by placing the main disconnect switch to off position and placing lockout/tagout device on the switch. 

Bleed off the compressed air supply	Prior to cleaning the screw conveyor, place both knife gates in the open position by pressing the gate open/closed button on the CAS HMI. CLOSE the block/bleed type ball valves (BV-CAS-1015, BV-CAS-1020 and BV-CAS 1021) to isolate/release any stored pressure from the system. Complete the Isolation Control register for LO/TO of the Screw conveyor and air systems. 
Remove conveyor cover	Remove the top cover plate of the screw conveyor by removing the cover plate bolts and then lifting the cover plate off. 
Remove lime buildup	Using hand tools, breakup and remove any accumulated lime that is clogging the screw conveyor and drop ports with a scoop or shop vac. Discard any lime product removed from the screw conveyor into the slurry tanks via the hatch located on top of the tanks.
Replace conveyor cover	Replace the top cover plate and cover plate bolts.
Start the lime feeder system	Once the built-up lime has been removed, restart the Screw Conveyor Control System by removing the lockout/tagout device on the main breaker disconnect switch and placing the main disconnect switch in the "ON" position.

	Turn the screw conveyor control toggle located on the front of the MCC control panel to the "AUTO" position. Restart the lime feeder system. Refer to BTL-SOP-03 *Gravimetric Lime Addition System Start up*.
Restart influent pumps if necessary	Once the lime feeder system is in normal operations the influent pump station will be reset and influent pumps will be turned on if needed. Refer to BTL-SOP-06 – *Influent Pump Station Start Up* for influent pump station start up.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

SOURCE	***HAZARD***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
BIOLOGICAL	Spiders and Insects	Site	Exposure to insects, spiders, etc. could result in in bites and/or allergic reactions.	First aid kits are available on site, wear gloves when moving parts and opening lids.
BODY MECHANICS	Not applicable			
CHEMICAL	Hydrated lime	CASB – Screw Conveyer assembly	Inadvertent contact with residual lime dust on equipment/surfaces in the CASB and/or contact with treated water in the CASB could result in adverse skin reaction such as burns, mucous membrane, eye and respiratory tract irritation Inadvertent ingestion via hand to mouth contact (i.e. eating outside of designated areas, poor hygiene) could result in Gastrointestinal tract irritation	Wear required PPE as outlined in this SOP, wash hands before eating or drinking. Avoid unnecessary contact with surfaces where lime can accumulate. Clean or wet areas to be accessed that have lime accumulation if necessary
ELECTRICAL	Not applicable			
GRAVITY	Slips and trips	Walking/working surfaces	Wet/mud and/or cluttered walking surfaces could cause employees to slip	Keep walking/working area free from clutter/debris. Keep floors dry, use ice melt or sand during

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

			and/or trip	winter months.
	Falling tools and/or equipment	CASB – Below elevated work platforms	Injury could occur from tool or equipment falling off of elevated work surfaces and striking a worker who is working below an elevated work platform	Elevated work platforms have been designed with kick plate to prevent tools from falling off of the edge. Personnel will wear Level D PPE as outlined in this SOP. Personnel will not work under elevated work platforms when work is taking place on the screw conveyor.
	Falling down stairs	Elevated work platforms	Injury could occur from personnel falling off of an elevated work platform.	Elevated work platforms are engineered and built with railings and proper access stairs to prevent personnel from falling off of the platform.
MECHANICAL	Unguarded conveyer	Screw conveyer assembly	Injury could occur from inadvertent contact with a moving conveyer while the cover is off for cleaning.	LO/TO screw conveyer system to prevent it from moving prior to removing the cover.
	Pinch Points	Cover plate and cover clamps/hand tools	Injury could occur from fingers getting pinched in the cover plate or clamps while removing or replacing them.	Leather gloves will be worm when removing cover plate and using hand tools. Do not place hands or fingers between conveyor housing and cover plate.
NOISE	Not applicable			
PRESSURE	Air pressure release	Knife gate control	Injury or property damage could occur from unintentional air release at the knife gate control.	Lockout/tagout of the air system prior to starting work. Open relief valve in lime silo to release stored air.
RADIATION	Not applicable			

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained workforce	Site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage. Exposure to insects, spiders, could result in bites and/or allergic reactions.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed, First aid kits are available on site, wear gloves when moving parts and opening lids.
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt and gloves (nitrile when handling lime and work gloves when using hand tools)
APPLICABLE SDSs	Hydrated lime
REQUIRED PERMITS/FORMS	Isolation control register, Field Authorization Form
ADDITIONAL TRAINING	Control of Work, 40-hour Hazwoper, 8-hour Refresher, Lockout/ tagout /Energy Isolation

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-1-AB and P&ID-2-AB
DRAWINGS	Draft drawings are contained in the Draft O&M Manual.
RELATED SOP's/ PROCEDURES/ WORK PLANS	*BTL-SOP-06 – Influent Pump Station Start Up,*

	BTL-SOP-03 Gravimetric Lime Addition System Start-Up.
TOOLS	Flat blade screw driver, wrench
FORMS/ CHECKLIST	Operations Guide for Butte Priority Soils Operable Unit. Butte Treatment Lagoons (BTL) at Lower Area One (LAO) Groundwater Treatment System.

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
Dave Giuffia	**12/4/14**
SAFETY OFFICER	**DATE**
Sara Scheeeman	**12/4/14**
LEAD OPERATOR	**DATE**
Brad Hallam	**12/4/14**
OPERATOR	**DATE**

Revisions:

Rev.	Description	Date	Approval
1	Annual Review	5/6/2020	Brad Hollamon
2	Update Risk Table for Consistency	12/7/2020	Hailey Thompson

PURPOSE	To establish a uniform procedure for removing and installing stop logs at the Butte Treatment Lagoons/Lower Area One (BTL/LAO).
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach used to remove and add stop logs in the outlet structures at Butte Treatment Lagoons/Lower Area One. This task is done on an as needed basis depending on pond levels in relation to dike safety and secondary to treatment. Stop logs are similar throughout the site except for the BRW Drying Beds where they are a considerably larger stop log. This SOP will cover both types of stop logs. This procedure requires two people to remove or add any stop logs.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is outdated, inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, BTL Water collection and Treatment System, the Site-Specific Health and Safety Plan (SSHASP) for BTL, Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS

Stop logs at OS-1, OS-2, OS-3, OS-4, OS-5, OS-6 and OS-7

Removing Stop Logs	Two operators are required to remove stoplogs.
Gather tools and equipment	Collect proper tools – Guard railing and hoist, gloves and stop logs. Both people will have proper PPE (see required PPE below) including leather gloves.
Place guard railing	Once at the location, open the access hatches and place the guard railing around the opening to prevent a fall into the outlet structure opening.
Secure stop log retrieval/installation tool	Once the guard railing is secure, lower the stop log retrieval/installation tool down into the structure using the hoist or long handle retrieval/installation tool until secured around the pins on the stop log.
Raise the stop log	Using the hand crank located on the hoist slowly lift the stoplog until the stoplog clears the platform or raise using the long handle tool and set onto the platform.
Adding Stop Logs	Two operators are required to replace stoplogs.
Gather tools and equipment	Collect proper tools –Guard railing and hoist, gloves. Both people will have proper PPE (see required PPE below) including leather gloves.
Place guard railing	Once at the location, place the desired stop log onto the platform adjacent to stop log slot. Open the access hatches and place the guard railing around the opening to prevent a fall into the outlet structure opening.
Secure stop log retrieval/installation tool and lower stoplog	Once the guard railing is secure, place the stop log retrieval/installation tool down onto the stop log structure until secure around the pins on the stop log. Using the hand crank located on the hoist slowly lower the stop log into the guide channel and lower into place. Alternately use the long handle retrieval/installation tool to lower the stoplog into place.

Stop logs at BRW Drying Beds

Removing Stop Logs	Two operators are required to remove stoplogs.
Gather tools and equipment	Collected proper tools – Mobile crane, stop logs and stop log removal/Installation tool. Each operator will have proper PPE (see required PPE below) including leather gloves.
Secure crane to pins on stop logs	Once at the location, attach the stop log removal/Installation tool to the crane. Lower the stop log removal tool by using the hand crank located on the crane until it secures the pins on the sides of the stop log to be removed.
Raise stop log	Once the removal tool firmly hooks the log, hoist the log up using the hand crank/winch.
Lower stop log to ground	Once the log is clear of the structure, the operators will move it towards the solid ground on either side of the discharge structure and set onto the ground.
Adding Stop Logs	Two operators are required to replace stoplogs.
Gather tools and equipment	Collected proper tools – Mobile crane and stop log removal/Installation tool. Each operator will have proper PPE (see required PPE below) including leather gloves.
Place stop log	Carry the stop log over to the location to be installed.
Secure crane to pins on stop logs	Once at the location, attach the stop log removal/Installation tool to the crane. Lower the stop log removal tool by using the hand crank located on the crane until it secures the pins on the sides of the stop log to be added.
Lower stop log into channel	Lower the stop log down into the channels uniformly so that it does not bind and set into place. Remove the stop log removal tool by using the hand crank located on the crane

Stop logs at BRW-00 and BRW-01W

Removing Stop Logs	Two operators are required to remove stop logs.
Gather tools and	Collected proper tools –Gloves, stop logs and stop log removal/Installation tool. Each

equipment	operator will have proper PPE (see required PPE below) including leather gloves.
Secure stop log removal/installation tool	Once at the location, lower the stop log removal tool until it secures the pins on the sides of the stop log to be removed.
Lift the stoplog	Once the removal tool firmly hooks the log, lift the log up using the handle on the removal tool.
Place stoplog on ground	Once the log is clear of the structure, the operators will move it towards the solid ground on either side of the discharge structure and set onto the ground.
Adding Stop Logs	Two operators are required to replace stop logs.
Gather tools and equipment	Collected proper tools – Gloves, stop logs and stop log removal/Installation tool. Each operator will have proper PPE (see required PPE below) including leather gloves.
Place stoplog	Carry the stop log over to the location to be installed.
Secure stop log removal/installation tool	Once at the location, lower the stop log removal/Installation tool over the stop log until it secures the pins on the sides of the stop log. Lower the stop log by using the handle on the stop log removal tool
Lower stoplog into channel	Lower the stop log down into the channel guides uniformly so that it does not bind and set into place. Remove the stop log removal tool.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARDS***	***WHERE***	***RESULT***	***CONTROLS***
BIOLOGICAL	Wildlife and Insects	Site	Exposure to wildlife, insects, spiders, etc. could result in in bites and/or allergic reactions.	First aid kits are available on site, wear gloves when moving parts and opening lids.
BODY MECHANICS	Repetitive motion/over-exertion	Exercising valves	Repetitive motion when turning valves could result in muscle strain. Over-exertion when closing valves could result	Personnel will take breaks as needed, switch job positions, and tighten valves per manufacturer's recommendations.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

			in muscle strain or injury.	
CHEMICAL	Untreated/treated Groundwater	At the outlet structures	Eye/skin irritation or spill	Wear proper type of gloves-nitrile or leather. Wash hands prior to eating or drinking.
ELECTRICAL	Not applicable			
GRAVITY	Uncontrolled stop logs Uneven surfaces	Stop log locations Entering/exiting vehicles & structures	Struck by-injury Slips, trips, falls-sprains/strains and injury	Wear hard hat and be aware of surroundings. Use good communication with buddy when moving stop logs. Use three points of contact when entering/exiting vehicles, use handrails when available on structures, be aware of uneven terrain, rough surfaces.
MECHANICAL	Pinch points Manual lifting, bending	Site and Stop log locations Stop logs	When opening/closing doors, gates, handling stop logs, employees are exposed to pinch points/hand injuries resulting in cuts/abrasions. Sprains/Strains	Wear gloves and use caution when opening/closing doors, gates, and use the buddy system when handling stop logs. Use good body mechanics when lifting, pushing, and pulling stop logs. Use buddy system when removing/adding stop logs. Keep body/arms/wrists in neutral position when lifting, pushing, and pulling.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
NOISE	Not applicable			
PRESSURE	Wind	Site	Wind could cause vehicle doors to shut quickly creating pinch points resulting in hand injuries. Wind could cause stop logs to create struck by hazard resulting in personal injury.	Do not place hand between vehicle door and body of vehicle. Keep one hand on vehicle when opening and closing to control movement of the door. Do not leave doors open and do not stand/work between vehicle door and body of the vehicle. Use the buddy system when handling stop logs. Wear PPE including safety glasses and STOP work in severe winds.
RADIATION	UV	Sun	Sunburn/Eye damage	Use sunscreen with SPF>15 and wear PPE (tinted safety glasses).
THERMAL	Cold stress and heat stress	Site	Hypothermia/frost bite, heat exhaustion/stroke	Know the signs and symptoms of stresses, dress appropriately (layers in winter, long sleeve light-weight shirt in summer) keep hydrated, rest if necessary and use vehicle for shelter.
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained worker	Site	Inexperienced workers and improper training could cause incidents resulting in personal injuries and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement stop work procedures, if necessary.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
WEATHER	Heat or cold related injuries and illnesses	Working outdoors	Personnel could experience adverse health effects while working outdoors in the winter or summer months.	Follow procedures outlined in the Corporate HASP and SSHASP. Dress for weather conditions and check the forecast/plan ahead.
	Adverse weather conditions/lightnin g	Working outdoors	Personnel could be exposed to adverse weather conditions and/or lightning resulting in injury and/ or property damage.	Follow procedures outlined in Corporate HASP and SSHASP and stop work if necessary. Follow 30/30 rule when applicable.

Additional HSSE CONSIDERATIOSN This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety Glasses, lace-up safety-toed shoes, long-sleeved shirt, high visibility outerwear, and leather gloves. SS-5 required full body harness and lanyard.
APPLICABLE SDS	Heavy Metals
REQUIRED PERMITS/FORMS	
ADDITIONAL TRAINING	Control of Work, 40-hour Hazwoper, 8-hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOP's/PROCEDURES/ WORK PLANS	
TOOLS	Work Vehicle, Stop logs, tools
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
SAFETY OFFICER	**DATE**
LEAD OPERATOR	**DATE**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval
1	Annual review	5/6/2020	Brad Hollamon
2	Update Risk Table for Consistency	12/7/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing Accurate Feeder Helix Modification.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. The volume of treatable water entering the Butte Treatment Lagoons (BTL) can very greatly depending on factors in the Butte area including precipitation and contamination levels of specific areas that water is collected from. Occasionally, the Accurate Feeder Helix needs to be changed to better accommodate the amount of lime that needs to be added to the influent water. This Standard Operating Procedure (SOP) covers the procedural approach used to modify the Accurate Feeder Helix.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is outdated, inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, BTL Water collection and Treatment System, the Site-Specific Health and Safety Plan (SSHASP) for BTL, Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Stop Lime Supply	Prior to performing work on the Accurate Feeder, lime supply to the feeder will be stopped by manually closing the 10” Salina Vortex pneumatic knife valve between the cone of the silo and the feeder. Once all the lime has been emptied from the hopper within the accurate feeder, all equipment and pumps will be shut down and locked out.
Shut down all associated operating equipment	All operating equipment associated with the silo and lime addition will be powered down, any hazardous energy will be relieved, and the switches will be locked out by placing the main power control handle located on the Silo Control Panel to the “off” position and placing a lock and tag on this handle. This equipment includes: • Accurate Feeder; • Screw Conveyor; • Silo Air Compressor; and • Silo bin discharger.
Remove rear face panel	Refer to manufacturer’s manual and remove the rear face panel of the accurate feeder for access to internal components.
Replace Helix	Rotate the motor and drive assembly until it is clear of the feeder hopper. Remove top bolt in plastic housing and loosen 2 nuts securing the “U” clamp. Loosen hose clamp on hopper. The currently installed helix is then accessible and will be removed by hand and replaced with the alternate helix per manufacturer’s procedures.
Inspect hopper	Inspect the feeder hopper for wear or damage and dislodge and remove any lime build-up on inside of hopper if necessary.
Reassemble feeder	Rotate the motor and drive assembly back into place, reinstall the rear face panel, and fastened system to the feeder per manufacturer’s procedures.
Restart each component of the chemical addition system	Clean the work area and reenergize and start each component of the chemical addition system per LAO SOP-003 *Gravimetric Lime Addition System Startup*, LAO SOP-007 *Slurry Tank Feed Water Re-establishment*. To ensure proper installation and operating

	speed of the helix, calibrate the Accurate Feeder per LAO SOP-35 *Calibrate Accurate Feeder* and record the amount of lime delivered.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARD*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
BIOLOGICAL	Insects and spiders	CASB	Exposure to insects and spiders may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to insects and spiders is required. Avoid contact with insects and spiders. First-aid kits are available on site. Personnel with allergies will notify their supervisor.
BODY MECHANICS	Not applicable			
CHEMICAL	Hydrated lime	CASB and lime silo	Inadvertent contact with residual lime dust on equipment/surfaces in the CASB and lime silo, and/or contact with treated water in the CASB could result in adverse skin reaction such as burns, mucous membrane, eye and respiratory tract irritation. Inadvertent ingestion via hand-to-mouth contact (i.e., eating outside of designated areas and poor hygiene) could result in gastrointestinal tract irritation.	Wear required PPE as outlined in this SOP, wash hands before eating or drinking, and eat in designated areas only. Avoid unnecessary contact with surfaces where lime can accumulate. Clean or wet areas to be accessed that have lime accumulation if necessary.
ELECTRICAL	Not applicable			
GRAVITY	Falling tools and/or lime	Silo – below elevated work platforms	Injury could occur from tools or equipment falling off elevated work surfaces and striking a worker who is working below an elevated work platform.	Elevated work platforms have been designed with a kick plate to prevent tools from falling off the edge. There are designated safety zones in the area and only personnel performing work is allowed in the area. Remove lime build-up (if applicable) prior

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

				to performing modification. Personnel will wear Level D PPE as listed in this SOP. Hoist tools with bucket and rope to maintain 3-points of contact and minimize frequency of climbing ladder.
	Falls	Elevated work platforms	Injury or death could occur from personnel falling off an elevated work platform.	Elevated work platforms are equipped with top and mid-rail. Platform is equipped with a fixed ladder and a chain is installed at top of platform to prevent personnel from falling.
MECHANICAL	Pinch points	Baghouse access door, silo man door, locks, and hand tools	Injury could occur from pinching hands/fingers or getting caught in access door or man door, closing/opening locks, and using hand tools.	Engineering controls are in place to prevent doors from slamming shut. Personnel will wear Level D PPE as outlined in this SOP while performing work. Avoid placing fingers/hands between objects. Inspect hand tools prior to each use.
	Caught between/struck by hazards	Accidental startup of equipment	Personnel could be caught between or struck by equipment if motor in equipment is inadvertently energized.	De-energize and lockout equipment as described in this SOP.
NOISE	Elevated noise levels	CASB	Prolonged exposure to elevated noise levels from operating equipment could result in temporary or permanent hearing damage.	Personnel will wear earplugs if prolonged exposure is expected or limit the amount of time spent in the working area.
PRESSURE	Air pressure release	Lime silo	Injury and/or property damage could occur from unintentional air release at the lime silo.	Open relief valve in lime silo to release stored air. Lockout/tagout of the air system prior to starting work is required. Personnel will wear Level D PPE while performing this task.
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
HUMAN FACTORS	Inexperienced and improperly trained personnel	Sites	Lack of understanding of the scope of work, inexperienced personnel, and improper training could cause incidents resulting in injury and/or property damage.	Personnel will be properly trained in this procedure and applicable procedures. Personnel will implement STOP work policy/procedures, if there are any issues.
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Heath Manager.	
REQUIRED PPE	Level D Personal Protective Equipment (PPE): Hard hat, safety glasses, long-sleeved work shirt, high-visibility outerwear, long pants, safety-toed boots, and nitrile/work gloves (as needed).
APPLICABLE SDS	Hydrated lime. Safety Data Sheets (SDSs) are located in the Operations Building Control Room.
REQUIRED PERMITS/FORMS	Isolation control register and Field Authorization Form.
ADDITIONAL TRAINING	Energy isolation, Hazardous Waste Operations and Emergency Response (HAZWOPER), and Control of Work (CoW).

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
DRAWINGS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
RELATED SOPs/ PROCEDURES/ WORK PLANS	SOP-3 *Gravimetric Lime Addition System Startup* SOP-7 *Slurry Tank Feed Water Re-establishment* SOP-35 *Calibrate Accurate Feeder*.
TOOLS	Screwdriver, wrench, and locks and tags.
FORMS/ CHECKLIST	..\..\BPSOU OM Manual\Op_Report_Blank - Controlled.xlsx

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the

procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
	1/9/13
SAFETY AND HEALTH MANAGER	**DATE**
	1/9/13
LEAD OPERATOR	**DATE**
	1/9/13
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Revision	Description	Date	Approval
1	Annual updates and update Risk table for consistency	12/9/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing water "grab" sampling for pH analysis.
SCOPE	This practice has been prepared for the Pioneer Technical Services (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. Daily, water is sampled from the Outlet Structures (OS-2, OS-3, OS-5, and OS-7) for pH. These parameters must be collected and reported on a daily basis to ensure the system is operating as designed. This SOP defines the procedural approach for operators performing outlet structure "grab" sampling.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Collect pH "grab" Sample.	Retrieve the appropriately labeled sample bottles for each outlet structure to be sampled from the Operations Building. Drive to the outlet structure to be sampled. Open the sample access lid, place the sample container into the sample thief and carefully lower thru the sampling hatch in the lid of the outlet structure into the upstream side of the stoplog structure. While lowering the sample thief into the structure, ensure that any sediment in the sample location is undisturbed. While sampling at each of the outlet structures, the operator must use caution to avoid collecting an unrepresentative sample of the water being tested. This is done following the above process. Avoiding cross contamination of the sample is achieved by using the designated sample containers for each outlet structure and by rinsing the sample bottle three times before collecting a sample. To prevent inconsistent data, it is important each "grab" sample is collected from the same point. This location is immediately upstream of the stoplogs located inside the structure. Once the sample has been collected, close the sampling port on the outlet structure and proceed to the next sampling location and repeat the above steps to collect the remaining samples.

Record Field Parameters	Using the field multi-meter pH meter in the Operations Lab area, record the following parameters for each sample: • pH, • Conductivity, • Temperature. These pH readings are recorded into the field book and transferred to both the daily cell data spreadsheet and weekly Operations Report.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARD***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
BIOLOGICAL	Insect bites, stings, domestic animals, public access, exposure to water borne bacteria	Working outdoors/site Outlet structures	Exposure to insects, spiders, could result in bites and/or allergic reactions. Interaction with the public could result in confrontations. Dogs in area could become aggressive resulting in bites and injury.	First aid kits are available on site, wear gloves and PPE as outlined in this SOP. Stop work and leave area if interaction with public becomes confrontational/hostile. Stop work and wait in vehicle if necessary for dogs to leave area. Call animal control if necessary.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
BODY MECHANICS	Not applicable			
CHEMICAL	Treated ground water	Inside the outlet structures	Inadvertent contact with the treated ground water during sampling collection could result in exposure to water borne bacteria.	Wear required PPE as outlined in this SOP and nitrile gloves to prevent contact with treated ground water, wash hands before eating or drinking.
ELECTRICAL	Lightning	Worksite	Serious injury or death could occur from lightning strike/storm	Follow established 30-30 procedure for working in lightning storms as outlined in the SSHASP.
GRAVITY	Falls	Uneven or slippery walking or working surface	Injury could occur from personnel slipping, tripping on terrain/rocks and falling while working onsite.	Use established access points to access sample locations. Use ice melt if necessary during winter months.
MECHANICAL	Wind Slips, trips Pinch points	Work Site Walking working surfaces, uneven terrain Sample port access lid	Wind could cause injury from blowing debris. Workers could slip, trip when walking on uneven terrain resulting in injury When opening/closing sample port access lid	If windy conditions result in blowing debris or reduced visibility, workers will stop work and get in vehicle until conditions improve. Use established access points to access sample locations. Use ice melt if necessary during winter months. Wear leather gloves when opening/closing lid. Use handle, keep fingers away from edges.
NOISE	Not applicable			

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
PRESSURE	Not applicable			
RADIATION	Sunlight	Working outside	While working outdoors, workers could be exposed to UV radiation resulting in sunburns and could contribute to heat relate illnesses.	Wear PPE as outlined in this SOP.
THERMAL	Heat/Cold Stress	Working outside	Adverse health effects could result from exposure to hot or cold temperatures.	Training on signs and symptoms of heat stress, emergency response plan. Follow procedures outlined in the SSHASP and Corporate HASP.
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained workforce	Site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed,
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
	sleeved shirt. Nitrile when collecting samples.
APPLICABLE SDS	Nitric Acid
REQUIRED PERMITS/FORMS	
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-3-AB.
DRAWINGS	Drawings will be provided in Draft O&M Plan
RELATED SOP's/ PROCEDURES/ WORK PLANS	*BTL-SOP-24 Effluent Water Grab Sampling*
TOOLS	Sample bottles, peristaltic pump, filter, sampling tubing.
FORMS/ CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
Dave Siuffi	**12/8/14**
SAFETY OFFICER	**DATE**
Sara Schleeman	**12/8/14**
LEAD OPERATOR	**DATE**

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
Brad Hallam	12/8/14
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

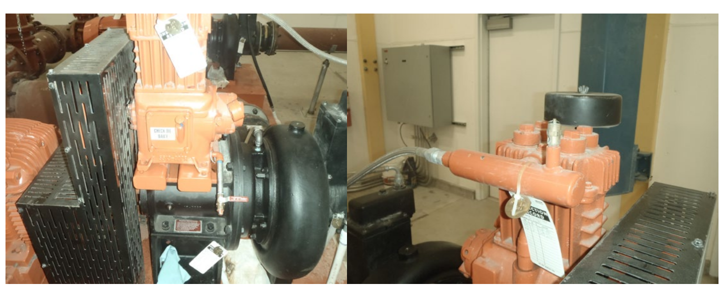
Revisions:

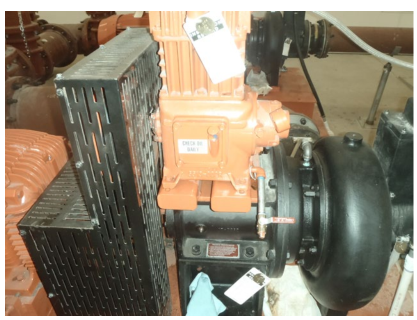
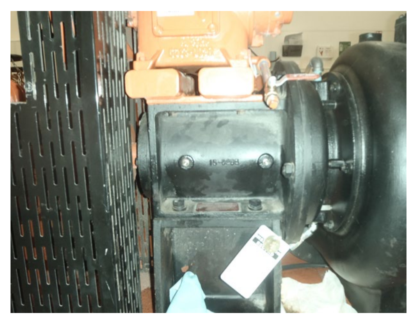
Rev.	Description	Date	Approval
3	Annual updates and update Risk table for consistency	12/9/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing routine maintenance of the Godwin CD225M Dri-Prime Pump.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer at Pioneer work sites. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach used to perform routine maintenance of the Godwin CD225M Dri-Prime Pump to maintain proper working order. Prior to performing any maintenance work refer to *BTL-SOP-6 IPS Pump Start Up/Shutdown*.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Daily Preventative Maintenance	1. Check oil level in compressor oil reservoir by removing dip stick and reading oil level, add 10w-40 motor oil if needed. 2. Check water recirculation/cooling line to make sure water is discharging at the outlet. 3. Check grease fitting of bearing bracket. Grease should be present at fitting. Add grease if necessary. 4. Check for proper actuation of the pressure relief valve of compressor. Valve should easily spring back into position when released. 5. Check position of volute drain and discharge non return valves. Valves should be closed prior to operation. 

Monthly Filter Inspection & Cleaning	1. Unscrew and remove the wing nut securing the compressor air filter housing to its base. 2. Remove the filter housing and withdraw the old filter element. Clean the element with a jet of air or vacuum. 3. Replace the filter element and housing, securing it in place with the wing nut previously removed. Replace filter annually or after 2000 hours.
Compressor and mechanical seal oil change	1. Initially inspect pump and remove any accumulated dirt and debris. Open volute and discharge non return valves to drain any water from pump. Visually inspect volute from suction flange for any obstructions and remove accordingly. 2. Check motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Remove with vacuum as needed to ensure proper ventilation of the motor. 3. Check all electrical connections and ensure they are tight. 4. Inspect all hoses, belts, wiring, and connections. Correct as required. 5. Drain oil from the compressor by opening the drain valve on the bottom of the compressor. Once oil has drained, close the drain valve and fill with 10w-40 motor oil until full. 6. Check and replenish grease at bearing bracket. 7. Inspect compressor oil and air lines and connections for leaks, damage, ect. 8. Disconnect ejector assembly and inspect for wear and condition of O-rings and nozzle. Remove housing and check condition of ejector ball, seat, and screen. Clean screen of any dirt or debris and replace.  
Annual Motor Maintenance	Re-grease the motor shaft bearing using a high-grade ball or roller bearing grease. A procedure to re-grease the motor bearings is provided in the "Service" section of Godwin CD225M Dri-Prime Electric Drive Pump Operating and Maintenance Manual located in the operations building.
Documentation Updates	Complete work order documentation, and maintenance task in the eMMS records.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

SOURCE	*HAZARDS*	*WHERE*	*RESULT*	*CONTROLS*
BIOLOGICAL	Insects and spiders	Compressor area	Exposure to insects, spiders, etc. could result in in bites and/or allergic reactions.	First aid kits are available on site, wear gloves when reaching into dark areas, etc.
BODY MECHANICS	Not applicable			
CHEMICAL	Compressor Oil and mechanical seal oil, Bearing grease	Air compressor, pump head assembly	Adverse health effects, skin irritation.	Level D PPE-gloves, clothing Wash hands before eating or drinking
ELECTRICAL	Expose to electrical circuits	Compressor motor/controls	Electrocution Electric shock	Grounding GFCI Lock out tag out procedures
GRAVITY	Falls from slips or trips	Walking surfaces	Fall could result from tripping and/or slipping while walking on site resulting in injury.	Keep walking/working areas free from clutter and/or debris. Keep floors dry, use ice melt or sand during winter months.
MECHANICAL	Pinch points	Air compressor motor and pulleys, motor and pump shafts	Hand injuries.	LO/TO procedures Proper tools and gloves
NOISE	Not applicable			
PRESSURE	Release of compressed air	Air Compressor Line	Eye injuries, injection.	Pressure relief valve on air compressor, shut off valves PPE-safety glasses, gloves Lock out tag out procedures
RADIATION	Not applicable			
THERMAL	Hot surfaces on compressor motor, air line	Compressor and pump motor	Burns, hand injuries.	Guarding let equipment cool prior to work.
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained worker	Site	Inexperienced workers and improper training could cause incidents resulting in	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement stop work procedures, if necessary.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
			personal injuries and/or property damage.	
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D PPE (Hard hat, high visibility outerwear, long sleeve shirt, long pants, safety glasses, gloves)
APPLICABLE SDS	10w-40 motor oil, Bearing Grease.
REQUIRED PERMITS/FORMS	Isolation Register
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	Not applicable
DRAWINGS	Not applicable
RELATED SOP's/PROCEDURES/ WORK PLANS	Energy Isolation (LO/TO), Waste Management
TOOLS	Hand Tools- Pipe Wrench, Screw driver, Channel lock pliers, Crescent wrench.
FORMS/CHECKLIST	eMMS Work Order; eMMS maintenance task completion

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SAFETY OFFICER	**DATE**
LEAD OPERATOR	**DATE**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

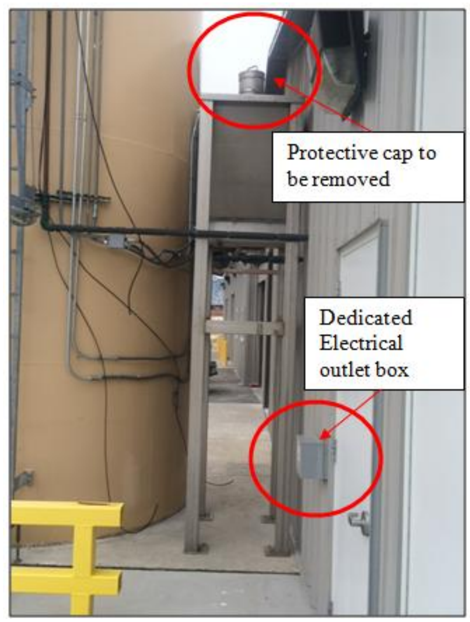
Revisions:

Rev.	Description	Date	Approval
2	Annual updates and Updates to Risk table for consistency	12/14/2020	Hailey Thompson

PURPOSE	To provide standard instructions for the external inspection of a portable fire extinguisher, and emergency eye wash station.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach used to perform an external inspection of a portable fire extinguisher, and emergency eye wash station.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Operations Guide for Butte Treatment Lagoons (BTL) at Lower Area One (LAO) Groundwater Treatment System.

TASK	INSTRUCTIONS
1. Relocate the DSS Supersacker unit.	1. Relocate the DSS Supersacker from the Dredge Storage Building (DSB) to the east side of the CAS Building. Orient the discharge of the Supersacker to match the lime hopper located between the Lime Silo and CAS Building. 2. Align the Superpacker footpads with site guides painted on the concrete apron. **Note: Remove the cap from the auxiliary hopper inlet port.** 
2. Provide electrical power to the Supersacker unit	1. Connect electrical power from the Supersacker unit to the receptable located on the east side of the CAS Building. 2. Remove LO/TO lock from MCC motor starter in CAS Building.
3. Verify motor rotation.	1. Turn the unit of and visually verify motor and auger rotation.

<table>
<tr><td>4. Add Lime to Hopper</td><td>
1. Relocate the bulk lime storage sacks from the Dredge Storage Building (DSB) to the Supersacker.

2. Fill the Supersacker hopper.

a. Hoist the supersack of lime above open lid of Supersacker unit.

b. Lower bottom portion (~ lower ¼) of supersack into hopper and discharge lime into hopper.
</td></tr>
<tr><td>5. Set manual lime feed rate.</td><td>
1. Use the Supersacker controls to adjust motor RPM to set lime feed rate.
<table>
<tr><th></th><th colspan="6">Target Dosage (mg/L) (from HMI)</th></tr>
<tr><th></th><th>100</th><th>110</th><th>120</th><th>130</th><th>140</th><th>150</th></tr>
<tr><th>IPS (GPM)</th><th colspan="6">Calculated dosage (lb/min)</th></tr>
<tr><td>700</td><td>0.585</td><td>0.643</td><td>0.702</td><td>0.760</td><td>0.819</td><td>0.877</td></tr>
<tr><td>850</td><td>0.710</td><td>0.781</td><td>0.852</td><td>0.923</td><td>0.994</td><td>1.065</td></tr>
<tr><td>900</td><td>0.752</td><td>0.827</td><td>0.902</td><td>0.978</td><td>1.053</td><td>1.128</td></tr>
<tr><td>950</td><td>0.794</td><td>0.873</td><td>0.953</td><td>1.032</td><td>1.111</td><td>1.191</td></tr>
<tr><td>1,000</td><td>0.836</td><td>0.919</td><td>1.003</td><td>1.086</td><td>1.170</td><td>1.253</td></tr>
<tr><td>1,050</td><td>0.877</td><td>0.965</td><td>1.053</td><td>1.141</td><td>1.228</td><td>1.316</td></tr>
<tr><td>1,100</td><td>0.919</td><td>1.011</td><td>1.103</td><td>1.195</td><td>1.287</td><td>1.379</td></tr>
<tr><td>1,150</td><td>0.961</td><td>1.057</td><td>1.153</td><td>1.249</td><td>1.345</td><td>1.441</td></tr>
<tr><td>1,200</td><td>1.003</td><td>1.103</td><td>1.203</td><td>1.303</td><td>1.404</td><td>1.504</td></tr>
<tr><td>1,270</td><td>1.061</td><td>1.167</td><td>1.273</td><td>1.379</td><td>1.486</td><td>1.592</td></tr>
<tr><td>1,300</td><td>1.086</td><td>1.195</td><td>1.303</td><td>1.412</td><td>1.521</td><td>1.629</td></tr>
<tr><td>1,350</td><td>1.128</td><td>1.241</td><td>1.354</td><td>1.466</td><td>1.579</td><td>1.692</td></tr>
<tr><td>1,400</td><td>1.170</td><td>1.287</td><td>1.404</td><td>1.521</td><td>1.638</td><td>1.755</td></tr>
<tr><td>1,450</td><td>1.212</td><td>1.333</td><td>1.454</td><td>1.575</td><td>1.696</td><td>1.817</td></tr>
<tr><td>1,500</td><td>1.253</td><td>1.379</td><td>1.504</td><td>1.629</td><td>1.755</td><td>1.880</td></tr>
<tr><td>1,550</td><td>1.295</td><td>1.425</td><td>1.554</td><td>1.684</td><td>1.813</td><td>1.943</td></tr>
<tr><td>1,600</td><td>1.337</td><td>1.471</td><td>1.604</td><td>1.738</td><td>1.872</td><td>2.005</td></tr>
<tr><td>1,650</td><td>1.379</td><td>1.517</td><td>1.654</td><td>1.792</td><td>1.930</td><td>2.068</td></tr>
<tr><td>1,700</td><td>1.420</td><td>1.562</td><td>1.705</td><td>1.847</td><td>1.989</td><td>2.131</td></tr>
<tr><td>1,750</td><td>1.462</td><td>1.608</td><td>1.755</td><td>1.901</td><td>2.047</td><td>2.193</td></tr>
<tr><td>1,880</td><td>1.571</td><td>1.728</td><td>1.885</td><td>2.042</td><td>2.199</td><td>2.356</td></tr>
</table>
2. Verify lime feed rate by manually timing and weighing lime discharged from the DSS.
a. Place a 5-gallon bucket below the manual knife gate valve located on the angled discharge tube.
</td></tr>
</table>

	b. Open the knife gate and allow lime to discharge into the bucket for 1-minute. c. Weigh the lime to determine mass flow rate in (lbs/minute).
6. Modify control system	Switch control system to Volumetric – Reference BTL-SOP-OG-13. **Note:** Volumetric lime addition disables automated interlocks associated with the lime feed system and IPS. Operators must respond to alarm callout notifications at the site and perform manual shut down of systems as required. Operators should perform additional visual monitoring and pH measurements when Volumetric mode is used.
7. Restart IPS	Refer to BTL-SOP-OG-6.
8.System monitoring	Manually monitor lime feed system and pH measurements in the Distribution Channel, until the system stabilizes. Reference BTL-SOP-OG-11.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARDS***	***WHERE***	***RESULT***	***CONTROLS***
CHEMICAL	Hydrated Lime	Lime Silo	Inadvertent contact with residual lime dust on equipment/surfaces in lime silo and/or contact with treated water could result in adverse skin reaction such as burns, mucous membrane, eye and respiratory tract irritation Inadvertent ingestion via hand to mouth contact (i.e. eating outside of designated areas, poor hygiene) could result in Gastrointestinal tract irritation	Wear required PPE as listed in this SOP, wash hands before eating or drinking. Avoid unnecessary contact with surfaces where lime can accumulate. Clean or wet areas to be accessed that have lime accumulation if necessary.
PRESSURE	NA			
ELECTRICAL	Shock	Motor Control Center	Inadvertent contact with electrical components could result in shock/injury.	Lockout tagout procedures will be followed.
MOTION	Pinch Points, slips, and trips,	Setup at flexible discharge connection, hopper, and loading hatch	Fingers could be pinched when equipment covers resulting in cuts, scrapes, wet/mud and/or cluttered walking surfaces could cause employees to slip and/or trip, Inadvertent contact with the screw conveyor could result in injury.	Wear gloves when connecting components of the DSS system. Keep walking/working area free from clutter/debris. Keep aprons/floors dry, use ice melt or sand during winter months. .

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
GRAVITY	Falls from slips, trips	Walking surfaces Loading lime into unit.	Fall could result from tripping and/or slipping while walking on site resulting in injury. Overhead loads could slip or fall severely injuring/crushing personnel below a load.	Keep walking/working areas free from clutter and/or debris. Keep floors dry, use ice melt or sand during winter months. Do not stand/work under suspended or lifted loads. Work zone will be limited to essential personnel training in lifting operations.
THERMAL	NA			
RADIATION	UV exposure	Sunlight/ working outdoors	Working outdoors and prolonged exposure to sunlight may lead sunburn and/or related illness	Wear appropriate PPE, long sleeved shirt, hard hat, UV protective safety glasses. Personnel should use sunscreen when exposed to UV light.
BIOLOGICAL	Inexperienced, improperly trained workforce	Site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed,

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt. Leather gloves when removing/replacing extinguisher
APPLICABLE MSDS	Hydrated Lime
REQUIRED PERMITS/FORMS	
REQUIRED TRAINING	Task training,

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT

The following documents should be referenced to assist in completing the associated task.	
P&IDS	None
DRAWINGS	None
RELATED SOP's/PROCEDURES/ WORK PLANS	BTL-SOP-OG-6 BTL-SOP-OG-11 BTL-SOP-OG-13
TOOLS	None
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

PROJECT MANAGER	**DATE**
SAFETY OFFICER	**DATE**
LEAD OPERATOR	**DATE**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval

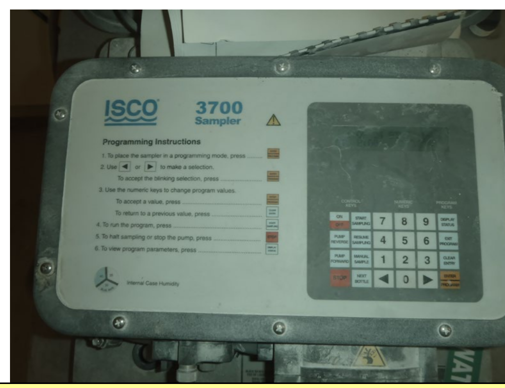
44PURPOSE	To provide standard instructions for operators collecting samples via the ISCO® Automatic Composite Water Sampler.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the ISCO® Automatic Composite Water Sampling Procedure.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Verify Sample collection	Verify that the ISCO® sampler has sampled through the complete sampling program by checking the sample bottles for appropriate sampled water volumes. If ISCO sampler did not sample, collect a grab sample as outlined in *BTL-SOP-13.* 
Remove containers	Remove composite sample containers from the automatic sampler.
Fill sample bottles with ISCO composite samples	Fill the appropriate sample bottles from the ISCO® sampler composite as follows: **EFS-07 Samples (twice weekly)** One 250 ml total recoverable sample pre-preserved with nitric acid, and one 250 ml filtered portion of the composite sample for dissolved metals sample pre-preserved with nitric. The filtered portion will be filtered through a 0.45 µm hi flow

	filter using a peristaltic pump and silicon tubing. Once monthly one 1 Liter Raw (non-metals) sample for TSS, TDS and Alkalinity, one 250 ml Nitrate/Nitrite sample pre-preserved with sulfuric acid. **INF-01 Samples (once per week)** One 250 ml total recoverable sample pre-preserved with nitric acid. Once monthly one 1 Liter Raw (non-metals) sample for TSS, TDS and Alkalinity, one 250 ml Nitrate/Nitrite sample pre-preserved with sulfuric acid. See Table 1 of Appendix G of the BTL O&M manual for specific sampling requirements.
Discard excess water	Discard excess water from composite sample containers to the floor drain leading to Cell D4 in the Automatic Sampler Building (ASB) or to the wall drain leading to Cell D4 in the Automatic Sample Building (ASB). Clean and replace container in automatic sampler.
Program sampler for next event	Program the date and time for the next scheduled sampling event. Refer to the ISCO® Refrigerated Sampler (3700R/3740) Programming Guidelines manual maintained in the Component Owner's Manual Volume I and II for programming the ISCO® sampler. If Automatic composite sampler needs reconfigured for sample configurations other than date and time refer to the ISCO® Refrigerated Sampler (3700R/3740) Programming Guidelines manual.



HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARDS***	***WHERE***	***RESULT***	***CONTROLS***
BIOLOGICAL	Insects & spiders	Site	Insects, and/or spiders may cause rashes, blisters, redness, swelling, and serious injuries.	Training on the signs and symptoms of exposure to insects and spiders is required. Avoid contact with insects, spiders. First-aid kits are available on site. Personnel with allergies will notify their supervisor.

BODY MECHANICS	Not applicable			
CHEMICAL	Heavy Metals	Composite sample	Inadvertent contact with impacted water via ingestion could result in adverse health effects.	Wear required PPE as outlined in this SOP, wash hands before eating or drinking. Avoid contact with treated or impacted water.
	Acids	Sample preservative	Inadvertent contact with sample preservative could result in skin burns.	Wear nitrile gloves when filling the pre-preserved sample containers.
ELECTRICAL	Not applicable			
GRAVITY	Falls from slips, trips	Walking surfaces	Fall could result from tripping and/or slipping while walking on site resulting in injury.	Keep walking/working areas free from clutter and/or debris. Keep floors dry, use ice melt or sand during winter months.
MECHANICAL	Pinch points	Doors and sampler	Hands/fingers could be pinched when opening building doors and/or removing samples resulting in cuts and scrapes.	Wear gloves when exposed to pinch points.
	Slips and trips	Walking/ working surfaces	wet/muddy and/or cluttered walking surfaces could cause employees to slip and/or trip.	Keep walking/working areas free from clutter and/or debris. Keep floors dry, use ice melt or sand during winter months.
PRESSURE	Filter pump tubing	Filter pump	Filter tubing could detach from filter and spray workers with impacted water	Adjust flow to prevent overloading of filter. Wear PPE as outlined in this SOP.

			resulting in potential adverse health effects.	
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained workforce	Site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage. Exposure to insects, spiders, could result in bites and/or allergic reactions.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed, First aid kits are available on site, wear gloves when moving parts and opening lids.
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt. Nitrile gloves
APPLICABLE SDSs	Nitric and sulfuric Acid

REQUIRED PERMITS/FORMS	Daily toolbox, TSEA (if applicable)
ADDITIONAL TRAINING	Control of Work, 40-hour Hazwoper, 8-hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-1-AB and P&ID-5-AB.
DRAWINGS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
RELATED SOP's/PROCEDURES/ WORK PLANS	
TOOLS	
FORMS/CHECKLIST	Operations Guide for Butte Priority Soils Operable Unit. Butte Treatment Lagoons (BTL) at Lower Area One (LAO) Groundwater Treatment System

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
SAFETY OFFICER	**DATE**
LEAD OPERATOR	**DATE**

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval
2	Annual updates and update risk table for consistency	12/14/2020	Hailey Thompson

PURPOSE	To provide standard instructions for cleaning the CAS Building.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This Standard Operating Procedure (SOP) defines the procedural approach to cleaning the CAS Building.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is outdated, inaccurate, or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons (BTL) Water collection and Treatment System, the Site-Specific Health and Safety Plan for BTL, Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Remove contents of the CAS building	Remove all objects from the CAS Building that could be damaged by water.
Remove excess lime on non-washable areas	Remove any lime from the floor by scraping and sweeping. Remove any excess lime that has accumulated on non-wash down areas by brushing or wiping with damp cloth.
Gather supplies	Retrieve the garden hose from the storage shed and install it onto the hose bib near the eye wash station.
Wash down CAS Building	Carefully rinse the floor, slurry tanks, stairs and any equipment that is wash down rated inside the CAS Building. Make sure all walls; electrical equipment, including but not limited to the MC3000; and outlets remain as dry as possible. Do not spray walls with water. Scrub as necessary.
Remove residual water	Squeegee all standing water into the drain under the steel monitoring structure.
Allow Building to dry	Allow the CAS Building to dry and return all removed objects to their proper places.
Remove trash	Remove any accumulated trash to the garbage located outside the CASB and remove any unused items or equipment and return to their proper storage locations.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARD***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
BIOLOGICAL	Insects and spiders	CAS Building	Exposure to insects, spiders, could result in bites and/or allergic reactions.	Training on the signs and symptoms of exposure to insects and spiders is required. Avoid contact with insects and spiders. First-aid kits are available on site. Personnel will wear gloves when moving parts and opening lids. Personnel with allergies will notify their supervisor.
BODY MECHANICS	Improper lifting	CAS Building	Improper lifting when moving objects to/from the CAS Building could result in back injuries and muscle strains.	Personnel will practice proper lifting techniques – get a good grip, keep load close to body, lift with legs and not with back, and avoid lifting items above shoulder height.
CHEMICAL	Hydrated lime	CAS Building	Inadvertent contact with residual lime dust on equipment/surfaces in the CASB, and/or contact with residual water used for cleaning in the CASB could result in adverse skin reaction such as burns, mucous membrane, eye and respiratory tract irritation. Inadvertent ingestion via hand-to-mouth contact (i.e., eating outside of designated areas and poor hygiene) could result in gastrointestinal tract irritation. Respiratory irritation from inhalation.	Wear required PPE as outlined in this SOP, wash hands before eating or drinking, and eat in designated areas only. Avoid unnecessary contact with surfaces where lime can accumulate. Open bay door, wash down floor, mats and other areas away from electrical sources.
ELECTRICAL	Electrocution or burns. Property damage	Electrical outlets or panels	Personnel could be electrocuted or burned while washing out the	Outlets in the CAS Building are equipped with GFCI outlets that are safe for wash down

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

			building, if water comes in contact with electrical outlets or panel. Also, panels could short out resulting in disruption to the system.	procedures. Personnel will not spray electrical panels or equipment. Water is not pressurized; therefore, there is not potential for over spraying.
GRAVITY	Falls	Slippery/wet walking or working surface	Injury could occur from personnel slipping, tripping or falling when working/walking on slippery/wet surfaces in the CAS Building.	Personnel will wear, at minimum, Level D PPE as outlined in this SOP. Personnel will practice good housekeeping – tools and equipment will be picked up to prevent additional tripping hazards in the work area. Personnel will wear work boots with good traction and support. Personnel will wait until the building is mostly dry before re-entering to prevent slipping on wet floors. Any water that is left will be squeegeed to the drain.
	Falling tools	Working platforms, performing overhead work	Objects could fall from overhead locations and injure personnel working below.	Working overhead will not be performed while building is being cleaned.
	Wet walking/working surfaces	CAS Building	Walking on wet surfaces during cleaning could result in slips, trips, and body injuries.	Personnel will wear, at minimum, Level D PPE as outlined in this SOP. Personnel will practice good housekeeping – tools and equipment will be picked up to prevent additional tripping hazards in the work area. Personnel will wear work boots with good traction and support. Personnel will wait until the building is mostly dry before re-entering to prevent slipping on wet floors. Any water that is left will be squeegeed to the drain.
MECHANICAL	Flying pieces of lime	CAS Building	Residual lime could strike personnel during scraping/cleaning process resulting in eye injuries and/or unwanted	Personnel will wear, at minimum, Level D PPE as outlined in this SOP. Personnel will not stand under walking/working surfaces during

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
			skin contact with lime.	scraping/cleaning process.
NOISE	Elevated noise levels	CAS Building	Prolonged exposure to elevated noise levels from operating equipment could result in temporary or permanent hearing damage.	Personnel will wear earplugs if prolonged exposure is expected or limit the amount of time spent in the working area.
PRESSURE	Not applicable			
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained personnel	Site/CAS Building	Lack of understanding of the scope of work, inexperienced personnel, and improper training could cause incidents resulting in injury and/or property damage.	Personnel will be properly trained in this procedure and applicable procedures. Personnel will implement STOP work policy/procedures, if there are any issues.
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D Personal Protective Equipment (PPE): Hard hat, safety glasses, safety-toed boots, high-visibility outerwear, long-sleeved work shirt, long pants, and nitrile/work gloves (as needed).
APPLICABLE SDSs	Hydrated lime. Safety Data Sheets (SDSs) are located in the Operations Building Control Room.
REQUIRED PERMITS/FORMS	Field Authorization Form.
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.

DRAWINGS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
RELATED SOPs/ PROCEDURES/ WORK PLANS	
TOOLS	Hose, squeegee, and rags.
FORMS/ CHECKLIST	..\..\BPSOU OM Manual\Op_Report_Blank - Controlled.xlsx

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
Dave Griffis	**12/12/11**
SAFETY AND HEALTH MANAGER	**DATE**
Sara Scheeman	**12/12/11**
LEAD OPERATOR	**DATE**
Brad Hall	**12/12/11**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

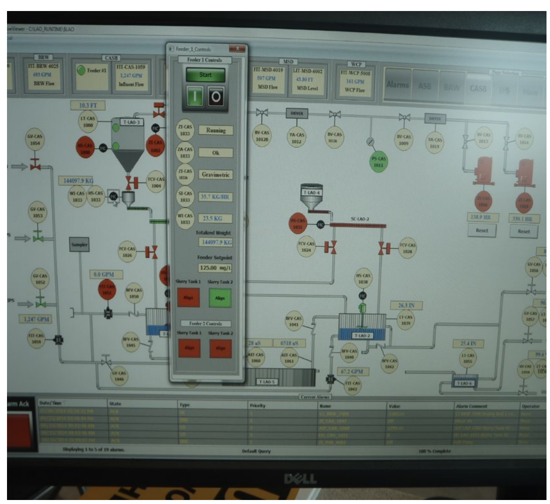
Revisions:

Revision	Description	Date	Approval
1	Annual updates and update Risk table for consistency	12/14/2020	Hailey Thompson

PURPOSE	To provide standard instructions for cleaning slurry tank pipe discharge
SCOPE	This practice has been prepared for the Pioneer Technical Services (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work is described below. This SOP defines the procedural approach to cleaning slurry tank discharge pipe.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Switch lime feeder system to alternate tank	Switch the lime feeder system to the secondary or primary tank (whichever is not currently requiring discharge pipe cleaning) by pressing "Align Tank 1" or "Align Tank 2" on the HMI screen in the Ops Building depending on which Slurry Tank is in operation. This will open the desired tank's 4" drop tube pneumatic valve and designate which mixer will be in operation. This will ensure that any lime distributed through the screw conveyor will be discharged into the desired tank. 
Configure slurry tank feed water flow	Configure the slurry tank feed water flow as outlined in *BTL-SOP-07 Slurry Tank Feed Water Re-establishment*) into the secondary or primary tank (whichever is not currently requiring discharge pipe cleaning) and lockout/tagout the valve that provides the flow to the slurry tank that requires the discharge pipe cleaning.

Remove/Clean the Emerson Conductivity Probe	Remove and clean the Emerson Conductivity Probe sensor located on the top of the discharge pipe by removing any excess lime build up from the sensor for the discharge pipe that requires cleaning.
Remove PVC Pipe	Once the tank's water level is below the inlet of the discharge pipe, remove the section of PVC pipe from the slurry tank discharge pipe valve to the sluice box that requires cleaning. 
Clean discharge pipe	Clean the removed discharge pipe by removing excess lime and rinsing pipe.
Reinstall System Components	Reinstall the spare or cleaned discharge pipe and components.
Clean Slurry Tank	To clean the slurry tank, follow the above steps. Prior to returning the slurry tank back on-line, retrieve the hose from the distribution tank room and hose out the inside of the desired slurry tank.
Reset System	Once all the components are properly reinstalled, the system can be reset to discharge slurry from the primary slurry tank. Operator will then re-fill the operating tank to approximately 30" and adjust the slurry tank feed water flow as described in *BTL-SOP-07 - Slurry Tank Feed Water Re-establishment.*

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

SOURCE	*HAZARD*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
BIOLOGICAL	Spiders and insects	Site/CAS Building	Exposure to insects, or spiders may cause rashes, blisters, redness, swelling, and serious injuries.	Training on the signs and symptoms of exposure to spiders, or insects is required. Avoid contact with spiders, insects. First-aid kits are available on site. Personnel with allergies will notify their supervisor.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
BODY MECHANICS	Not applicable			
CHEMICAL	Hydrated lime	Lime Slurry tank and tank discharge	Inadvertent contact with residual lime dust on equipment/surfaces in the CASB, and/or contact with treated water in the CASB could result in minor skin and respiratory tract irritation	Wear required PPE as outlined in this SOP, wash hands before eating or drinking. Avoid unnecessary contact with surfaces where lime has accumulated. Clean or wet areas to be accessed that have lime accumulation if necessary
	Heavy Metals	Water in slurry tank and tank discharge	Inadvertent contact with metals in the water could result in skin irritation or adverse health effects.	Wear required PPE as outlined in this SOP, wash hands before eating or drinking.
ELECTRICAL	Not applicable			
GRAVITY	Falls	Slippery walking or working surface	Injury could occur from personnel slipping, tripping and falling while working onsite due to wet floors or poor housekeeping.	Good housekeeping – tools and equipment will be picked up to prevent tripping hazards in the work area. Personnel will wear work boots with good traction and support.
	Slips and trips	Walking and working surfaces	Workers could slip, trip on slick walking surfaces and/or trip on debris.	Good housekeeping – tools and equipment will be picked up to prevent tripping hazards in the work area. Personnel will wear work boots with good traction and support.
MECHANICAL	Pinch Points	Slurry tank water supply valves, hand tools.	Injury could occur from fingers getting pinched in the slurry tank water supply valves while turning and using hand tools.	Gloves will be worn to protect hands and fingers throughout this process. A crescent wrench will be used.
NOISE	Not applicable			

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
PRESSURE	Struck by, contact with lime slurry and untreated water.	Lime slurry tank discharge	Pressure buildup in the lime slurry discharge tank could be unintentionally released causing personnel to be sprayed with lime slurry or untreated water. This could result in minor irritation of the skin, respiratory tract.	The slurry tank water supply will be locked out/tagged out. Water will be drained from the tank prior to removing the discharge valve and pipe. Level D PPE as outlined in this SOP will be worn when performing this work.
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained workforce.	Site/CAS Building	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed.
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt, gloves
APPLICABLE SDSs	Hydrated lime, Heavy Metals
REQUIRED PERMITS/FORMS	Isolation control register, Field Authorization Form
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher, Lockout/ tagout, and Energy Isolation

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-1-AB and P&ID-2-AB
DRAWINGS	Draft drawings are contained in the Draft O&M Manual.
RELATED SOP's/ PROCEDURES/ WORK PLANS	*BTL-SOP-07 - Slurry Tank Feed Water Re-establishment.*
TOOLS	Screw driver, spare PVC Pipe, wrench, scrapers, brush
FORMS/ CHECKLIST	Operations Guide for Butte Priority Soils Operable Unit. Butte Treatment Lagoons (BTL) at Lower Area One (LAO) Groundwater Treatment System

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
Dave Griffis	**12/5/14**
SAFETY OFFICER	**DATE**
Sara Scheeleman	**12/5/14**
LEAD OPERATOR	**DATE**
Brad Hallam	**12/5/14**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval
2	Annual updates and updates to Risk Table for consistency	12/14/2020	Hailey Thompson

PURPOSE	The purpose of this document is to provide standard instructions for the BPSOU Subdrain jetting operations.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer at Pioneer work sites. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This Standard Operating Procedure (SOP) defines the procedural approach used to perform the Subdrain jetting that is conducted two to three times per year to keep the Subdrain line free of debris and allow more efficient flow through the 10-inch perforated pipe.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is outdated, inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and policies described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons (BTL) Water Collection and Treatment System, the Site-Specific Health and Safety Plan (SSHASP) for BTL, Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
BPSOU Subdrain Monitoring	During the Subdrain jetting process, the flow rate and water level in the BPSOU Subdrain Vault will be monitored from the HMI located at the BTL operations building by the vault operator. In addition, solids monitoring will be conducted at manhole locations by the jetting project superintendent and noted in the jetting log. <u>BPSOU Subdrain Vault Monitoring:</u> The following Subdrain Vault monitoring consists of water surface elevation and flow rate monitoring at 15-minute intervals. The following tasks shall be conducted: a. Measure and record Subdrain Vault water surface elevations and flow rates at 15-minute frequency intervals. i. Total flow recorded every 15 minutes (gallons); ii. Instantaneous flow recorded every 15 minutes (gallons per minute); and iii. Water level elevation recorded every 15 minutes (inches). b. Measurements shall be recorded in Table 1 provided in the work plan. c. The Subdrain Vault operator shall operate the Subdrain Vault pump to maintain water surface elevations a minimum of 3 inches below the Subdrain influent pipe invert. d. If the Subdrain Vault water surface elevations are higher than 3 inches below influent pipe invert then: i. The Subdrain Vault Operator shall inform the Project Superintendent to cease jetting operations; and ii. When the Subdrain Vault water surface elevation returns to equal to or lower than the influent pipe invert, the Subdrain Vault Operator shall inform Project Superintendent that cleanout operations can resume.

	Manhole Solids Monitoring: Downgradient manholes shall be monitored for solids accumulation during the jetting activities to maintain system flow and minimize blockage. Downgradient manholes will be checked a minimum of once every four hours during the course of the jetting work. Monitoring frequency shall be increased if once every four hours is not adequate to manage solids deposition. If solids deposition appears to be reducing flow through the system, the Contractor shall remove solids using a Vac truck or other approved method.
BPSOU Subdrain Jetting and Monitoring Procedure	Figure 1 illustrates the work area and cleanout locations and is included in original work plan. Contractor shall conform to the following jetting procedures and schedule (all jetting is expected to be completed during the course of one or two 10-hour working days): Task 1: Mobilize to MSD-MH-116 (manhole immediately east of the Civic Center and north of Harrison Avenue). The downstream pipe from this manhole includes a solid pipe that passes under Harrison Avenue that needs to be jet-cleaned. 1. Turn pump on. Deploy jet and launch up the pipe for a distance of 500 feet with water on (or to the Civic Center Cell Tower location whichever comes first) to pull any debris down the pipe. 2. Leave water on and return jet to the initial insertion point. 3. Turn off water. (this process will be repeated at a minimum of 2X). 4. Reposition the jet into the downstream pipe section, turn on pump, and deploy jet down the pipe to Station MSD-MH-113. 5. Leave water on and return jet to the initial insertion point. 6. Turn off water (this process will be repeated at a minimum of 2X).and remove jet from the cleanout. 7. Clean out the Civic Center Manhole sump with Vac Truck if necessary. Task 2: Mobilize to the next down-gradient clean out (Station MSD-MH-113) Additional length of hose will be added prior to jetting to ensure overlap between MSD-MH-116 and MSD-MH-113 and MSD-MH-110. 1. Turn pump on. Deploy jet and launch up the pipe to the Harrison Avenue Bridge to pull any debris down the pipe (jetting operator will know when the Harrison Avenue Bridge has been reached as the jet will not move upstream any further). 2. Leave water on and return jet to the Station MSD-MH-113. 3. Turn off water. (this process will be repeated at a minimum of 2X). 4. Reposition the jet into the downstream pipe section, turn on pump, and deploy jet down the pipe to Station MSD-MH-110. 5. Leave water on and return jet to the Station MSD-MH-113. 6. Turn off water (this process will be repeated at a minimum of 2X).and remove jet from the cleanout.

	Task 3: Mobilize to the next down-gradient Station MSD-MH-110. Precipitation buildup was noted from 475 feet (STA 22+25) to approximately 625 feet (STA 23+75) during past video inspections. Additional passes will be made in this section. 1. Turn pump on. Deploy jet and launch up the pipe to Station MSD-MH-113 to pull any debris down the pipe. 2. Leave water on and return jet to the Station MSD-MH-110. 3. Turn off water. (this process will be repeated at a minimum of 2X). 4. Reposition the jet into the downstream pipe section, turn on pump, and deploy jet down the pipe to Station MSD-MH-108. 5. Leave water on and return jet to the Station MSD-MH-110. 6. Turn off water (this process will be repeated at a minimum of 2X).and remove jet from the cleanout. Task 4: Continue jetting operations downstream in this manner at each sequential manhole until the jetting crew has finished work activities at the manhole located at the Subdrain Vault (MSD-MH-106) making sure to jet the pipe into the Subdrain vault from MH-106. Monitoring of water levels in the Subdrain Vault shall continue and a Vac-truck shall be kept on standby at the Subdrain Vault manhole as directed by the technical staff.
Secondary Pump Transition	1. If needed after jetting MSD-MH-113, transition Subdrain Vault pump control from the primary VFD controlled pumps to the Godwin GSP-300 pump. Follow the existing Start-Up Procedure Manual for pump operation instructions.
BPSOU Subdrain Line Jetting and Monitoring Procedure (continued)	2. Coordinate with Project Superintendent and Contractor to begin jetting process at MSD-MH-110. Before jetting begins, confirm that vacuum truck is available and ready to remove water from MSD-MH-106. Begin jetting at MSD-MH-110 and monitor water level status at the Subdrain Vault. Stop jetting if Subdrain Vault level reaches 30 inches or less and resume jetting when water level becomes stable again. 3. Coordinate with Project Superintendent and Contractor to begin jetting process at MSD-MH-108. Before jetting begins, confirm that vacuum truck is available and ready to remove water from MSD-MH-106. Begin jetting at MSD-MH-108 and monitor water level status at the Subdrain Vault. Stop jetting if Subdrain Vault level reaches 30 inches or less and resume jetting when water level becomes stable again. Coordinate with Project Superintendent and Contractor to begin jetting process at MSD-MH-106. Before jetting begins, confirm that vacuum truck is available and ready to remove water from MSD-MH-106. Begin jetting at MSD-MH-106 and monitor water level status at the Subdrain Vault. Stop jetting if Subdrain Vault level reaches 30 inches or less and resume jetting when water level becomes stable again.

Final Vault Monitoring	4. Upon completion of BPSOU Subdrain line jetting, continue to monitor the Subdrain Vault level for 1 hour and adjust pump as needed. 5. Transition from Godwin GSP-300 pump to the primary VFD controlled pumps and monitor periodically until Subdrain water level becomes stable.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*RESULT*	*CONTROLS*
BIOLOGICAL	Plants, insects, and domestic animals	Subdrain jetting locations and Subdrain Vault	Exposure to plants, insects, and/or domestic animals may cause rashes, blisters, redness, swelling, and serious injuries.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and domestic animals. If necessary, leave work area until animals leave and/or contact animal control. First-aid kits are available on site. Personnel with allergies will notify their supervisor.
BODY MECHANICS	Slips and trips	Walking and working surfaces	Wet, muddy, and/or cluttered surfaces may cause slips and trips resulting in injury. Jetting equipment (i.e., hose, rakes, and ropes) could also cause tripping hazard/injury.	Personnel will plan their path, walk cautiously, and keep walking/working surfaces clear of equipment and tools. Personnel will also wear required PPE as outlined in this SOP.
CHEMICAL	Heavy metals Diesel and gasoline	Impacted water in Subdrain Vault and at discharge location Equipment and vehicles	Inadvertent contact with impacted water could result in adverse health effects.	Personnel will wear gloves when there is potential for skin contact with impacted water. Personnel will also practice proper personal hygiene - wash hands prior to eating and/or drinking and when leaving the site, eating/drinking is only allowed in designated areas.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
ELECTRICAL	Shock/ electrocution	Overhead electrical utilities	Inadvertent contact with live electrical components with Vac truck boom could result in injury, property damage, and/or death.	An overhead permit will be issued at MSD-MH-116 and/or equipment will be positioned away from electrical lines when possible. Use a spotter if necessary.
GRAVITY	Falls from slips and trips Falls into manholes	Slopes, and jetting locations Manholes and Subdrain Vault	Falls from slips and/or trips when walking on the site could result in injury. Falling into man-holes/Subdrain Vault could result in serious injury or death.	Personnel will keep walking/working surfaces clear of equipment and tools, avoid uneven surfaces when possible, and wear PPE as outlined in this SOP. Personnel will use a manhole guard, restraints, and lanyard tag lines around manhole openings.
MECHANICAL	Struck by moving vehicles/ equipment	Manhole cleanouts, Subdrain Vault, walking trail, and slopes	Moving vehicles and jetting equipment placed on slopes could move/shift and strike personnel resulting in serious injuries.	Personnel will place jetting equipment away from moving vehicles, on a firm level surface, and away from slopes or muddy terrain. Non-essential personnel will stay clear of area being jetted. Delineate work area with traffic cones as needed. If moving vehicles enter the work area, stop work activities.
NOISE	Elevated noise levels	Jetting and vacuum truck	Exposure to elevated noise levels could occur when working around equipment resulting in hearing damage.	Personnel will wear earplugs if prolonged exposure is expected or limit the amount of time spent in the working area.
PRESSURE	Pressurized	Jetting and	Broken/damaged	All equipment used for jetting

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

	water and hydraulic lines	vacuum truck lines	lines may cause sudden release of high-pressure fluids resulting in injury.	operations will be inspected prior to use and will be in working condition prior to starting work. Personnel will wear required PPE as outlined in this SOP. Non-essential personnel will stay clear of area being jetted.
RADIATION	Ultraviolet (UV) radiation	Working outdoors	Exposure to UV radiation when working outdoors may result adverse health effects and/or injury.	Personnel will wear PPE as outlined in this SOP and personnel should wear sunscreen when applicable.
THERMAL	Radiant heat, hot surface, and hot water	Radiant heat from equipment and hot surfaces and water from Vac truck	Direct contact with radiant heat from equipment and with hot surfaces and water from the Vac truck can result in burns and skin injuries.	Personnel will stay clear of hot surfaces located on Vac truck and wear gloves if using hot water to jet.
SIMOPS	Other work activities	Subdrain jetting locations and Subdrain Vault	Interaction with other contractors and their corresponding activities at the site could result in injuries and/or property damage.	Personnel will follow SIMOPS plan and procedures outlined in applicable SSHASP.
HUMAN FACTORS	Inexperienced and improperly trained personnel	Subdrain jetting locations and Subdrain Vault Subdrain	Inexperienced personnel and improper training could cause incidents resulting in injury and/or property damage.	Personnel will be trained in this procedure/equipment and will understand the scope of work prior to starting work activities. Personnel will implement STOP work policy/procedures, if there are any issues.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
	Interaction with public	jetting locations and Subdrain Vault	Interaction with public could interfere with work activities and create a hazardous work environment.	Personnel will avoid interaction with the public by stopping work if members of the public enter work area.
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D Personal Protective Equipment (PPE): Hard hat, safety glasses, safety-toed boots, high-visibility outerwear, long-sleeved work shirt, long pants, and gloves.
APPLICABLE SDS	Heavy metals. Safety Data Sheets (SDSs) are located in the Operations Building Control Room.
REQUIRED PERMITS/ FORMS	Field Authorization Form.
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Hazwoper

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	I&C-C-18
DRAWINGS	

RELATED SOPs/ PROCEDURES/ WORK PLANS	
TOOLS	Manhole lid puller, manhole guard, harness and lanyard, vac truck(s), wrenches, rakes, and shovel.
FORMS/ CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
SAFETY AND HEALTH MANAGER	**DATE**
LEAD OPERATOR	**DATE**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Revision	Description	Date	Approval
3	Update Risk Table for Consistency	12/7/2020	Hailey Thompson

PURPOSE	The purpose of this document is to provide a standard, safe, and appropriate level of response instructions for the BPSOU Subdrain scale removal (pigging) operations.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work. This Standard Operating Procedure (SOP) defines the procedural approach used to perform the BPSOU Subdrain scale removal that is conducted two to three times per year to keep the Subdrain line free of debris and allow more efficient flow through the 8-inch HDPE pipe.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is outdated, inaccurate, or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and policies described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons (BTL) Water Collection and Treatment System, the Site-Specific Health and Safety Plan (SSHASP) for BTL, Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
BPSOU Subdrain Pigging Team Organization	Prior to BPSOU Subdrain pigging procedures, a knowledgeable and trained crew will be organized to perform Subdrain scale removal. The project team will consist of the Project Superintendent, Subdrain Vault/Pump Operator, Contractor, and operations personnel. Below are project member roles and responsibilities. <u>Project Superintendent:</u> The Project Superintendent is in charge of the pigging crew and coordinating pigging activities. <u>BPSOU Subdrain Vault/Pump Operator:</u> The Subdrain Vault/Pump Operator will be a Pioneer employee responsible for monitoring the Subdrain Vault activities which include the following tasks: a. Monitoring Subdrain Vault water levels, flow rates, and pump performance; b. Operating the temporary pump required during the pigging activities; c. Adjusting back pressure on the Subdrain Vault pump to control pumping rates and Subdrain Vault water surface elevation; and d. Communicating changes in flow rates and Subdrain Vault water surface elevations to the Project Superintendent and pigging crew members. <u>Contractor</u>: The Contractor will provide a safety professional and all labor and equipment necessary to install items associated with the pipeline pigging.
Subdrain Pigging and Monitoring	1. To begin the scale removal process, check that all in-line valves are fully opened. The pressure in the 8-inch line must be between 30 and 60 pounds per square inch (psi) and have a minimum flow rate of 450 gallons per minute (gpm). 2. The Subdrain Vault pumps shall be turned off and gate valves GV-MSD 103, GV-MSD 6050, GV-ESL 1, and ball valves BV-L1 and BV-L2 will be closed.

	3. Open gate valve GV-MSD 6022 and start either the Godwin GSP300HH temporary pump or the Godwin CD 150M diesel pump for scale removal process. 4. Insert two full sized soft foam swabs into launcher. 5. Open gate valve GV-MSD 6050 and slowly open BV-L1 and BV-L2 to pressurize the launcher and seat the swabs. 6. Gate valve GV-MSD 6022 will be partially closed to force the water through the launcher and send the pig down the line. After the swabs have passed the 8-inch by 6-inch wye, GV-MSD 6022 will be reopened. 7. Close GV-MSD 6050, BV-L1 and BV-L2. 8. Open the pressure relief valves on the launcher. 9. Retrieve the swabs from the HCC discharge location and inspect for damage. Measure the swab diameter to observe the estimated internal diameter of the pipe (scale and obstructions will wear away the soft foam). 10. Select a crisscross pig with a diameter that is approximately 3/4 inch smaller than the pipeline's true internal diameter. 11. Open the launcher and insert the foam swab/crisscross pig. 12. Repeat steps 6 through 9 to send the swab/pig through pipeline. 13. Retrieve the swab/pig at HCC location and inspect for damage. If the pig is damaged, run a similar sized pig(s) through the pipeline until and undamaged pig exists. A foam swab may be passed through the line following the crisscross swab/pig to sweep out loose material and gauge the pipeline cleaning process. 14. Once a reusable undamaged swab/pig is discharged from the pipeline, increase the diameter of the pig by ¼ inch to ½ inch. 15. Repeat steps 12 through 16 until the pipeline's internal diameter is restored. 16. Launch a foam swab to remove any remaining loose material and verify internal diameter of the pipeline.
Lodged Pig Removal Procedure	1. Increase the pressure in the line (maximum of 60 psi) to force the pig past the obstruction if possible. 2. If pig remains lodged, shut down the pumps and remove all line pressure by opening GV-MSDTEMP101. This may help the pig return to its normal shape and back out of obstruction area. 3. After the pressure has been removed for several minutes, close GV-

	MSDTEMP101, restart pump, and re-pressurize the line to attempt to force the pig through the obstruction. Repeat steps 1 and 2 as necessary. 4. If the pig remains lodged, release the line pressure by opening GV-MSDTEMP101. Attach a hose to gate valve GV-6027 and to a water truck. Close gate valves GV-BRW6028 and GV-BRW6029A on the 4-inch pressure relief line and open gate valve GV-BRW6027. P&ID-7-AB illustrates the back-flush gate valve locations. Back flush the line in an effort to drive the pig up the pipeline and free it from the obstruction. 5. If a bypass situation is expected, a swab may be sent down the line to the lodged pig to increase the seal and stop fluid bypass. Increase line pressure to a maximum of 60 psi. If the pigs remain lodged, repeat Step 4.
Permanent Lodged Pig Removal Procedure	1. Use alternate discharge line to maintain Subdrain flow until the lodged pig is free and Subdrain discharge pipeline is operational. 2. Locate lodged pig using handheld receivers. 3. Excavate Subdrain discharge pipeline to expose location of lodged pig. 4. Install a replacement section of HDPE pipe. 5. Backfill the excavation to original contours.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***RESULT***	***CONTROLS***
BIOLOGICAL	Plants, insects, and domestic animals	Subdrain Vault and discharge location	Exposure to plants, insects, and/or domestic animals may cause rashes, blisters, redness, swelling, and serious injuries.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and domestic animals. If necessary, leave work area until animals leave and/or contact animal control. First-aid kits are available on site. Personnel with allergies will notify their supervisor.
BODY MECHANICS	Slips and trips	Walking and working surfaces, bypass line, and valves	Wet, muddy, and/or cluttered surfaces may cause slips and trips resulting in injury. Pigging equipment could	Personnel will plan their path, walk cautiously, and keep walking/working surfaces clear of equipment and tools. Personnel will also wear required PPE as outlined in this SOP. Avoid steep, muddy

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

			also cause tripping hazards and injury.	terrain when placing equipment and materials on the ground.
CHEMICAL	Heavy metals from water and soil	Subdrain Vault and discharge location	Inadvertent contact with impacted water could result in adverse health effects.	Personnel will wear required PPE as listed in this SOP. Personnel will also wear gloves when there is potential for skin contact with impacted water and soil. Personnel will practice proper personal hygiene – wash hands prior to eating and/or drinking and when leaving the site. Use designated areas when eating/drinking.
	Diesel and Gasoline	Equipment and vehicles	Skin/eye contact with diesel and gasoline could result in adverse health effects. Spills could also occur when refueling equipment and vehicles.	Personnel will prevent splash hazards and spills when refueling equipment/vehicles and wear required PPE as outlined in this SOP. Spill control kits will be available at the site.
ELECTRICAL	Shock/ electrocution	Electrical components located in dry vault and control building	Inadvertent contact with live electrical component, could result in injury, property damage, or death.	Personnel will inspect equipment before each use. All utilities will be properly shutdown and will be locked/tagged out when not in use. Isolation Control Register will be completed.
GRAVITY	Falls from slips and trips	Subdrain Vault, tracking locations, and discharge location	Falls from slips and trips when walking on the site could result in injury.	Personnel will keep walking/working surfaces clear of equipment and tools, avoid uneven surfaces when possible, and wear PPE as outlined in this SOP.
	Falling tools and materials	Subdrain Vault, tracking locations, and discharge location	Falling tools and materials could strike personnel resulting in serious injuries.	Personnel will not stand/work below pigging operations. Personnel will wear required PPE as outlined in this SOP. Non-essential personnel will stay clear of the active work

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
				area(s).
MECHANICAL	Struck by moving vehicles	Subdrain Vault and discharge location	Moving vehicles could enter the work area and strike personnel resulting in serious injuries.	Delineate work area with traffic cones as needed. If moving vehicles enter the work area, stop work activities.
NOISE	Not applicable			
PRESSURE	Pigging hoses, bypass line, and crisscross pig	Near Subdrain Vault and HCC inlet during pigging operations	Broken lines/hoses may cause high water pressure exposure resulting in injury. Pig may exit Subdrain line quickly and strike personnel resulting in injury.	All equipment used for pigging operations will be inspected and kept in safe and approved working condition. Personnel will stay clear of area where pig exits Subdrain line.
RADIATION	Ultraviolet (UV) radiation	Working outdoors	Exposure to UV radiation when working outdoors may result adverse health effects and/or injury.	Personnel will wear PPE as outlined in this SOP and personnel should wear sunscreen when applicable.
THERMAL	Radiant heat and hot surfaces	Diesel pump exhaust and motor	Direct contact with radiant heat and hot surfaces from equipment can result in burns and skin injuries.	Personnel will stay clear of areas emitting radiant heat and hot surfaces from equipment. Personnel will wear required PPE as outlined in this SOP.
SIMOPS	Other work activities	Subdrain Vault and discharge location	Interaction with other contractors and their corresponding activities at the site could result in injuries	Personnel will follow SIMOPS plan and procedures outlined in applicable SSHASP.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
			and/or property damage.	
HUMAN FACTORS	Inexperienced and improperly trained personnel	Subdrain Vault and discharge location	Inexperienced personnel and improper training could cause incidents resulting in injury and/or property damage.	Personnel will be trained in this procedure/equipment and will understand the scope of work prior to starting work activities. Personnel will implement STOP work policy/procedures, if there are any issues.
	Interaction with public	Subdrain Vault and discharge location	Interaction with the public could interfere with work activities and create a hazardous work environment.	Personnel will avoid interaction with the public by stopping work if members of the public enter work area.
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D Personal Protective Equipment (PPE): Hard hat, safety glasses, safety-toed boots, high-visibility outerwear, long-sleeved shirt, long pants, and gloves.
APPLICABLE SDS	Heavy metal, diesel, and gasoline. Safety Data Sheets (SDSs) are located in the Operations Building Control Room.
REQUIRED PERMITS/	Field Authorization Form

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
FORMS	
ADDITIONAL TRAINING	Control of Work, 40-hour Hazwoper, 8-hour Refresher, Site-specific training, OTJ Task training, competency verification

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	I&C-C-18, P&ID-7-AB
DRAWINGS	Figures 1-6, 2012 BPSOU Subdrain Jetting and Discharge Line Scale Removal Work Plan
RELATED SOPs/ PROCEDURES/ WORK PLANS	*BTL-SOP-05A LAO BPSOU Subdrain Operations Check Procedures, BTL-SOP-5B LAO BPSOU Subdrain Valve Cycling, BTL-SOP-031 Subdrain Dry Vault Monitoring and Dewatering*
TOOLS	Wrench, pigs and swabs.
FORMS/ CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
SAFETY AND HEALTH MANAGER	**DATE**
LEAD OPERATOR	**DATE**
OPERATOR	**DATE**

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OTHER	**DATE**
OTHER	**DATE**

Revisions:

Revision	Description	Date	Approval
3	Update Risk Table for Consistency	12/9/2020	Hailey Thompson

Scenario 1 - Both Subdrain Pumps dishcarge into south line

Valve Tag Number	Function	As-Left Position:	Flow (gpm)
GV-MSD-6013	6-Inch Dry Vault isolation	OPEN	FIT-BRW-6025
GV-MSD-6014	6-Inch Dry Vault isolation	OPEN	364
GV-MSD-6020	Discharge line control	OPEN	
GV-MSD-6027	Discharge line bypass control	CLOSE	
GV-MSD-6035	6-Inch Dry Vault isolation	OPEN	
GV-MSD-6036	6-Inch Dry Vault isolation	CLOSE	
GV-MSD-6042	Discharge line control	CLOSE	
GV-MSD-6049	Discharge line control	OPEN	
GV-MSD-6050	Discharge line bypass control	OPEN	
GV-MSD-6051	Discharge line bypass control	CLOSE	
GV-MSD-6052	Discharge line bypass control	CLOSE	
GV-MSD-6053	Discharge line bypass control	CLOSE	
GV-MSD-6048	Pig Launcher control	CLOSE	
BFV-MSD-6043	Manifold connection control	CLOSE	
BFV-MSD-6045	4-Inch Pig Launcher control	CLOSE	
BFV-MSD-6047	8-Inch Pig Launcher control	OPEN	
BV-MSD-6044	Pig Launcher drain	CLOSE	
BV-MSD-6046	Pig Launcher vent	CLOSE	
FCV-MSD-6040	Discharge line backflow	NA	
GV-BRW-6024	Discharge line route control	OPEN	
GV-BRW-6028	Discharge line route control	OPEN	
GV-BRW-6060	Discharge line route control	NA	
GV-BRW-6062	Discharge line route control	NA	
GV-BRW-6063	Discharge line route control	NA	
GV-BRW-6066	Discharge line route control	OPEN	
GV-BRW-6067	Discharge line bypass control	CLOSE	
GV-BRW-6068	Discharge line bypass control	NA	
GV-BRW-6085	Discharge line route control	CLOSE	
FCV-BRW-6029C	4-Inch PRV line backflow	NA	
FCV-BRW-6029D	4-Inch PRV line backflow	NA	

Scenario 2 - Both Subdrain Pumps discharge into south line, divert into BRW-00

Valve Tag Number	Function	As-Left Position:	Flow (gpm)
GV-MSD-6013	6-Inch Dry Vault isolation	OPEN	FIT-BRW-6064
GV-MSD-6014	6-Inch Dry Vault isolation	OPEN	369
GV-MSD-6020	Discharge line control	OPEN	
GV-MSD-6027	Discharge line bypass control	CLOSE	
GV-MSD-6035	6-Inch Dry Vault isolation	OPEN	
GV-MSD-6036	6-Inch Dry Vault isolation	CLOSE	
GV-MSD-6042	Discharge line control	CLOSE	
GV-MSD-6049	Discharge line control	OPEN	
GV-MSD-6050	Discharge line bypass control	OPEN	
GV-MSD-6051	Discharge line bypass control	CLOSE	
GV-MSD-6052	Discharge line bypass control	CLOSE	
GV-MSD-6053	Discharge line bypass control	CLOSE	
GV-MSD-6048	Pig Launcher control	CLOSE	
BFV-MSD-6043	Manifold connection control	CLOSE	
BFV-MSD-6045	4-Inch Pig Launcher control	CLOSE	
BFV-MSD-6047	8-Inch Pig Launcher control	OPEN	
BV-MSD-6044	Pig Launcher drain	CLOSE	
BV-MSD-6046	Pig Launcher vent	CLOSE	
FCV-MSD-6040	Discharge line backflow	NA	
GV-BRW-6024	Discharge line route control	OPEN	
GV-BRW-6028	Discharge line route control	OPEN	
GV-BRW-6060	Discharge line route control	NA	
GV-BRW-6062	Discharge line route control	NA	
GV-BRW-6063	Discharge line route control	CLOSE	
GV-BRW-6066	Discharge line route control	CLOSE	

GV-BRW-6067	Discharge line bypass control	CLOSE
GV-BRW-6068	Discharge line bypass control	NA
GV-BRW-6085	Discharge line route control	OPEN
FCV-BRW-6029C	4-Inch PRV line backflow	NA
FCV-BRW-6029D	4-Inch PRV line backflow	NA

Scenario 3 - Both Subdrain Pumps discharge into north line

Valve Tag Number	Function	As-Left Position:	Flow (gpm)
GV-MSD-6013	6-Inch Dry Vault isolation	OPEN	FIT-BRW-6061
GV-MSD-6014	6-Inch Dry Vault isolation	OPEN	375
GV-MSD-6020	Discharge line control	CLOSE	
GV-MSD-6027	Discharge line bypass control	CLOSED	
GV-MSD-6035	6-Inch Dry Vault isolation	OPEN	
GV-MSD-6036	6-Inch Dry Vault isolation	OPEN	
GV-MSD-6042	Discharge line control	CLOSED	
GV-MSD-6049	Discharge line control	CLOSED	
GV-MSD-6050	Discharge line bypass control	CLOSED	
GV-MSD-6051	Discharge line bypass control	CLOSED	
GV-MSD-6052	Discharge line bypass control	OPEN	
GV-MSD-6053	Discharge line bypass control	CLOSED	
GV-MSD-6048	Pig Launcher control	CLOSED	
BFV-MSD-6043	Manifold connection control	CLOSED	
BFV-MSD-6045	4-Inch Pig Launcher control	CLOSED	
BFV-MSD-6047	8-Inch Pig Launcher control	CLOSED	
BV-MSD-6044	Pig Launcher drain	CLOSED	
BV-MSD-6046	Pig Launcher vent	CLOSED	
FCV-MSD-6040	Discharge line backflow	NA	
GV-BRW-6024	Discharge line route control	CLOSED	
GV-BRW-6028	Discharge line route control	CLOSED	
GV-BRW-6060	Discharge line route control	OPEN	
GV-BRW-6062	Discharge line route control	OPEN	
GV-BRW-6063	Discharge line route control	CLOSED	
GV-BRW-6066	Discharge line route control	CLOSED	
GV-BRW-6067	Discharge line bypass control	CLOSED	
GV-BRW-6068	Discharge line bypass control	CLOSED	
GV-BRW-6085	Discharge line route control	CLOSED	
FCV-BRW-6029C	4-Inch PRV line backflow	NA	
FCV-BRW-6029D	4-Inch PRV line backflow	NA	

Scenario 4 - North pump discharge into north line. South pump discharge into south line.

Valve Tag Number	Function	As-Left Position:	Flow (gpm)
GV-MSD-6013	6-Inch Dry Vault isolation	OPEN	FIT-BRW-6064
GV-MSD-6014	6-Inch Dry Vault isolation	OPEN	256
GV-MSD-6020	Discharge line control	OPEN	
GV-MSD-6027	Discharge line bypass control	CLOSED	FIT-BRW-6025
GV-MSD-6035	6-Inch Dry Vault isolation	CLOSED	185
GV-MSD-6036	6-Inch Dry Vault isolation	OPEN	
GV-MSD-6042	Discharge line control	CLOSED	Combined flow
GV-MSD-6049	Discharge line control	OPEN	441
GV-MSD-6050	Discharge line bypass control	OPEN	
GV-MSD-6051	Discharge line bypass control	CLOSED	
GV-MSD-6052	Discharge line bypass control	OPEN	
GV-MSD-6053	Discharge line bypass control	CLOSED	
GV-MSD-6048	Pig Launcher control	CLOSED	
BFV-MSD-6043	Manifold connection control	CLOSED	
BFV-MSD-6045	4-Inch Pig Launcher control	CLOSE	
BFV-MSD-6047	8-Inch Pig Launcher control	OPEN	
BV-MSD-6044	Pig Launcher drain	CLOSED	
BV-MSD-6046	Pig Launcher vent	CLOSED	
FCV-MSD-6040	Discharge line backflow	NA	

GV-BRW-6024	Discharge line route control	OPEN
GV-BRW-6028	Discharge line route control	OPEN
GV-BRW-6060	Discharge line route control	OPEN
GV-BRW-6062	Discharge line route control	OPN
GV-BRW-6063	Discharge line route control	CLOSED
GV-BRW-6066	Discharge line route control	OPEN
GV-BRW-6067	Discharge line bypass control	CLOSED
GV-BRW-6068	Discharge line bypass control	OPEN
GV-BRW-6085	Discharge line route control	CLOSE
FCV-BRW-6029C	4-Inch PRV line backflow	NA
FCV-BRW-6029D	4-Inch PRV line backflow	NA

Scenario 5. North pump discharge into north line, divert to BRW-00. South pump discharge into south line, divert to BRW-00.

Valve Tag Number	Function	As-Left Position:	Flow (gpm)
GV-MSD-6013	6-Inch Dry Vault isolation	OPEN	FIT-BRW-6064
GV-MSD-6014	6-Inch Dry Vault isolation	OPEN	358
GV-MSD-6020	Discharge line control	OPEN	
GV-MSD-6027	Discharge line bypass control	CLOSED	
GV-MSD-6035	6-Inch Dry Vault isolation	CLOSED	
GV-MSD-6036	6-Inch Dry Vault isolation	OPEN	
GV-MSD-6042	Discharge line control	CLOSED	
GV-MSD-6049	Discharge line control	OPEN	
GV-MSD-6050	Discharge line bypass control	OPEN	
GV-MSD-6051	Discharge line bypass control	CLOSED	
GV-MSD-6052	Discharge line bypass control	OPEN	
GV-MSD-6053	Discharge line bypass control	CLOSED	
GV-MSD-6048	Pig Launcher control	CLOSED	
BFV-MSD-6043	Manifold connection control	CLOSED	
BFV-MSD-6045	4-Inch Pig Launcher control	CLOSE	
BFV-MSD-6047	8-Inch Pig Launcher control	OPEN	
BV-MSD-6044	Pig Launcher drain	NA	
BV-MSD-6046	Pig Launcher vent	NA	
FCV-MSD-6040	Discharge line backflow	NA	
GV-BRW-6024	Discharge line route control	OPEN	
GV-BRW-6028	Discharge line route control	CLOSED - NA	
GV-BRW-6060	Discharge line route control	OPEN	
GV-BRW-6062	Discharge line route control	CLOSED	
GV-BRW-6063	Discharge line route control	OPEN	
GV-BRW-6066	Discharge line route control	CLOSED	
GV-BRW-6067	Discharge line bypass control	CLOSED	
GV-BRW-6068	Discharge line bypass control	CLOSED - NA	
GV-BRW-6085	Discharge line route control	OPEN	
FCV-BRW-6029C	4-Inch PRV line backflow	NA	
FCV-BRW-6029D	4-Inch PRV line backflow	NA	

PURPOSE	To provide standard instructions for operators performing routine maintenance and cleaning of the Influent Pump Station (IPS) pump intake screens.
SCOPE	This practice is prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the approach used to perform routine maintenance and cleaning of the Influent Pump Station (IPS) pump intake screens.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is outdated, inaccurate, or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and policies described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons (BTL) Water Collection and Treatment System, the Site-Specific Health and Safety Plan (SSHASP) for BTL, Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Cleaning IPS pump intake screens	Remove small debris and vegetation from the D4 pond side of the intake screens. The operator will retrieve the long-handled rake from the IPS building and carefully lower the rake below the water level of the D4 pond with the tines facing toward the intake screen and slowly raise the rake upward removing the debris from the intake screen. Repeat the above process until the screens have been completely cleaned. The debris will be deposited to the west or east bank and collected for disposal. The operator will remain behind the safety railing while performing this operation. 
IPS Pumps Station Shutdown	Shutdown the IPS system. Prior to intake screen assembly removal, the operator must first shut down the IPS pumps per BTL-SOP– 6 Influent Pump Station Start Up/Shutdown and LO/TO the pumps.
Energy Isolation	Perform LO/TO of the IPS Pumps. Complete energy isolation Lock Out/Tag Out, and isolation register.

	Then, the operator must verify all forms of energy are isolated.
Sling and hoist	Retrieve the sling and chain hoist from the IPS Pump Building.
Fall Protection	Provide personnel fall protection measures. The operator must don a safety harness and lanyard and tie off to the IPS Building prior to removing the safety railing and lifting the screens from the screen guides for cleaning.
Lift Screen to the Road	The Godwin davit crane located near the roadside can be utilized to lift the screen to the road. Rotate and extend the davit crane to reach the screen removed in Step 6 above. Secure the screen to the crane. Lift the screen by rotating the hand crank on the crank until the screen can be place at the road. Use a tagline to guide the screen. *CAUTION: DO NOT STAND BELOW ANY COMPONENTS LIFTED OVERHEAD.*
Replace items	Replace all components by reversing the sequences listed above.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARDS***	***WHERE***	***RESULT***	***CONTROLS***
BIOLOGICAL	Plants, insects, and animals	Sites	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Employees with allergies will notify their supervisor.
BODY MECHANICS	Bending, squatting, and kneeling	During rigging activities	Bending, squatting, and kneeling during monitoring activities could result in muscle/back strains or other injuries.	Personnel should stretch prior to starting work and they will take breaks when necessary.
CHEMICAL	Heavy Metals	D4 Cell, Solid material on screen	Exposure to heavy metals in the untreated	Wear level D PPE and nitrile gloves. Wash hands prior to eating

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

			groundwater	drinking.
ELECTRICAL	NA			
GRAVITY	Falls from slips and trips	Uneven terrain, slick/muddy/wet surfaces and steep slopes	Walking/working on slick/muddy/wet, uneven, and steep terrain could cause slips and trips resulting in falls and injuries.	Workers wear work boots with good traction and ankle support. Personnel are aware of working/walking surfaces and choose a path to avoid hazards.
MECHANICAL	Rotating equipment	Cranes and hoist		
NOISE	NA			
PRESSURE	NA			
RADIATION	Ultraviolet (UV) radiation	Outdoors	Employees could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Employees will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Employees should wear sunscreen, if necessary.
THERMAL	NA			
SIMOPS	NA			
HUMAN FACTORS	Inexperienced and improperly trained worker	Sites	Inexperienced workers and improper training could cause incidents resulting in adverse health effects and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement stop work procedures, if necessary.
WEATHER	Cold/heat stress	Sites	Exposure to cold climates may result in cold burns,	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
			frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	outdoors. Employees will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Lightning	Site	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Employees will follow the 30/30 rule during lighting storms.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, nitrile gloves, and work gloves.
APPLICABLE SDS	Safety Data Sheets (SDSs) are located in the Operations Building Control Room.
REQUIRED PERMITS/FORMS	Field Authorization Form
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	BTL OM&M Plan, Volume IV Appendix A
RELATED SOP's/PROCEDURES/ WORK PLANS	*BTL-SOP– 6 Influent Pump Station Start Up/Shutdown*

TOOLS	Chain hoist, rigging, sling
FORMS/CHECKLIST	LO/TO energy Isolation register

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

SOP TECHNICAL AUTHOR	**DATE**
Scott Sampson	
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman	
SYSTEM LEAD OPERATOR	**DATE**
Brad Hollamon	
SYSTEM OPERATORS	**DATE**

Revisions:

Rev.	Description	Date	Approval
1	Annual review and update Risk Table for consistency	12/16/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing maintenance of the freeway wetlands.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This Standard Operating Procedure (SOP) defines the procedural approach to the maintenance of the Freeway Wetlands (Kaw Ave. Ponds).

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is outdated, inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons (BTL) Water collection and Treatment System, the Site-Specific Health and Safety Plan (SSHASP) for BTL, Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Remove build up from East Pond	Remove any sediment build-up and vegetation growth from the East pond discharge channel using rakes and hand shovels.
Remove build up from West Pond	Remove any sediment build-up and vegetation growth from the West pond discharge channel using rakes and hand shovels.
Place buildup on banks	Place all removed sediment and vegetation on the banks of the channel away from the flowing water.
Replace damaged equipment	Replace any damaged staff gauges, and read and record the gauges within both the East and West ponds.
Clean-up	Hand tools will be stored and visual inspection of the site will be performed after the Kaw Wetlands has been inspected to ensure the channels have been properly cleaned.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARD***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
BIOLOGICAL	Plants, insects, and domestic animals.	Working outdoors	Exposure to plants, insects, and spiders could result in bites and/or allergic reactions. Dogs in area could become aggressive resulting in bites and injury.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and domestic animals. If necessary, leave work area until animals leave and/or contact animal control. First-aid kits are available on site. Personnel with allergies will notify their supervisor.
BODY MECHANICS	Ergonomic injuries	Repetitive motion when using rake or other hand tools	Muscle strains could result from bending, squatting, shoveling, raking, etc.	Workers will take breaks to prevent injury from bending and lifting, workers will lift with their legs.
CHEMICAL	Potentially contaminated water/soil	Wetlands area	Inadvertent contact with contaminated water/soil onsite could result in adverse skin reaction such as burns, mucous membrane, eye and respiratory tract irritation. Inadvertent ingestion via hand-to-mouth contact (i.e., eating outside of designated areas and poor hygiene) could result in gastrointestinal tract irritation.	Personnel will wear required PPE as outlined in this SOP. Personnel will practice proper personal hygiene – wash hands prior to eating and/or drinking and when leaving the site. Use designated areas when eating/drinking.
ELECTRICAL	Not applicable			
GRAVITY	Falls from slips and trips	Uneven or slippery walking and working surfaces	Injury could occur from personnel slipping, tripping or falling while working onsite.	Personnel will practice good housekeeping – tools and equipment will be picked up to prevent tripping hazards in the work area. Personnel will wear work boots with good traction

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
				and support. Use alternate access routes if necessary.
	Falls into water	Wetlands area	Injury or death could occur from personnel falling into water in the wetlands area.	Personnel will follow practices for working around water as outlined in applicable SSHASP and/or Pioneer Corporate HASP. Personnel will not access water that is flowing swiftly or is deeper than three feet.
MECHANICAL	Infection, blisters, scrapes, and cuts	Shoveling and racking activities	Hand injuries (e.g., blisters, scrapes, and cuts) can result from shoveling and raking activities.	Personnel will wear leather gloves to prevent blisters and other hand injuries while shoveling and raking. If personnel get blisters or cuts, they will apply first aid measures immediately to prevent infection. Personnel will also inspect tools prior to use to ensure handles are secure and free from splinters/burs.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Ultraviolet (UV) radiation	Working outdoors	While working outdoors, personnel could be exposed to UV radiation resulting in sunburns and could also contribute to heat-related illnesses.	Personnel will wear PPE as outlined in this SOP and personnel should wear sunscreen when applicable.
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained personnel	Working outdoors	Inexperienced personnel and improper training could cause incidents resulting in injury and/or property damage.	Personnel will be trained in this procedure and will understand the scope of work prior to starting work activities. Personnel will implement STOP work policy/procedures, if there are any issues.
	Interaction with the public	Working	Interaction with the	Personnel will avoid interaction

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

		outdoors and public accesses	public could interfere with work activities and create a hazardous work environment	with the public by stopping work if members of the public enter work area. Personnel will leave the area if interaction with public becomes confrontational/hostile.
WEATHER	Lightning	Working outdoors	Equipment and/or personnel could be struck by lightning while working outdoors resulting in serious injury or death and/or property damage.	Personnel will follow established 30-30 procedure for working in lightning storms as outlined in applicable SSHASP.
	Wind	Working outdoors	Blowing dirt/debris could strike workers and/or impact visibility resulting in injury.	If windy conditions result in blowing debris or reduced visibility, personnel will stop work and get in vehicle until conditions improve.
	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

REQUIRED PPE	Level D Personal Protective Equipment (PPE): Hard hat, safety glasses, safety-toed boots, high-visibility outerwear, long-sleeved shirt, and long pants. Leather gloves when using hand tools.
APPLICABLE SDS	Arsenic, Cadmium, Copper, Lead, and Zinc. Safety Data Sheets (SDSs) are located in the Operations Building Control Room.
REQUIRED PERMITS/ FORMS	Field Authorization Form, Task Risk Assessment (TRA) (if applicable).

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
DRAWINGS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
RELATED SOPs/ PROCEDURES/ WORK PLANS	
TOOLS	Rake and shovel
FORMS/ CHECKLIST	..\..\BPSOU OM Manual\Op_Report_Blank - Controlled.xlsx

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	DATE
Dave Griffis	12/12/11
SAFETY AND HEALTH MANAGER	DATE
Sara Scheeman	12/12/11
LEAD OPERATOR	DATE
Brad Hallan	12/12/11
OPERATOR	DATE

OTHER	**DATE**
OTHER	**DATE**

Revisions:

Revision	Description	Date	Approval
1	Annual updates and Updates to Risk Table for consistency	12/16/2020	Hailey Thompson

PIONEER TECHNICAL SERVICES, INC.	**BTL-SOP-24** **EFFLUENT WATER “GRAB” SAMPLING**	**STATUS: Final** **DATE ISSUED: 3/27/18** **REVISION: 2** **REVISION DATE: 12/16/2020** **PAGE 1 of 5**

PURPOSE	To provide standard instructions for operators performing effluent water “grab” sampling.
SCOPE	This practice has been prepared for the Pioneer Technical Services (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. Twice a week, water is sampled from the EFS-07 station as discussed in *BTL SOP 17- ISCO® Automatic Composite Water Sampling Procedure*. During cold weather, the sample line connecting the EFS-07 ISCO sampler and effluent water can become obstructed, thus preventing sampling operations from being performed. Automatic composite sampling is also prevented after a power outage or operator error during the ISCO® Automatic Sampler setup. These parameters must be collected and reported on a twice-weekly basis to ensure the system is operating as well as possible, so operators must manually collect a Total Recoverable “grab” water sample during these occurrences. This SOP defines the procedural approach for operators performing effluent water “grab” sampling.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate health and Safety Plan.

TASK	INSTRUCTIONS
Sample Collection	Wearing a new pair of nitrile gloves, retrieve the sample bottles marked “EFF Grab” from the Operations Building Lab area. Access the 14” (EFS-07) effluent pipeline discharge. Rinse the sample cup before sample collection to avoid cross contamination. Collect a representative sample by carefully inserting the sample thief and the sample cup into effluent discharge water to avoid disturbing the sediment. *NOTE:* To prevent inconsistent data, ensure each “grab” sample is collected in the same area located immediately downstream from the effluent pipeline. 

Sample Filtration	Using the portable peristaltic pump and a new high flow 0.45 micron filter, filter the sample into the preserved certified container provided by PACE Analytical. Perform the following steps once the sample has been filtered: Complete the sampling label provided by PACE Analytical and attach it to the sample bottle. Ensure to include the date, time, sampler's initials and correct sample I.D. Discard both the sample filter and nitrile gloves into the trash located inside the Operations building. Store the filtered dissolved "grab" sample inside the ISCO® refrigerator sampler until day of shipment. The Total Recoverable "grab" sample is collected following the same procedures as the filtered or dissolved "grab" sample excluding the filtering of the EFS-07 water that is collected. The water collected is poured directly into the labeled and preserved container.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARD***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
BIOLOGICAL	Insects, domestic animals	Site	Exposure to insects, spiders, could result in bites and/or allergic reactions. Dogs in area could become aggressive resulting in bites and injury.	First aid kits are available on site, wear gloves and PPE as outlined in this SOP. Stop work and wait in vehicle if necessary for dogs to leave area. Call animal control if necessary.
BODY MECHANICS	Not applicable			
CHEMICAL	Nitric Acid	Pace Analytical sample container	Inadvertent contact with nitric acid during sampling collection could result in skin burns/irritation.	Wear required PPE as outlined in this SOP and nitrile gloves to prevent contact with sample preservative, wash hands before eating or drinking.
ELECTRICAL	Lightning	Worksite	Serious injury or death could occur from lightning strike/storm	Follow established 30-30 procedure for working in lightning storms as outlined in the SSHASP.
GRAVITY	Uneven or slippery walking or working	Site/Sample location	Injury could occur from personnel slipping, tripping on terrain/rocks	Use established access points to access sample location. Use ice melt if necessary during winter

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
	surface		and falling while working onsite.	months.
MECHANICAL	Slips, trips Wind	Walking working surfaces, uneven terrain Work Site	Workers could slip, trip when walking on uneven terrain resulting in injury Wind could cause injury from blowing debris.	Use established access points to access sample locations. Use ice melt if necessary during winter months. If windy conditions result in blowing debris or reduced visibility, workers will stop work and get in vehicle until conditions improve.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	UV Radiation	Working outside	While working outdoors, workers could be exposed to UV radiation resulting in sunburns and could contribute to heat related illnesses.	Wear PPE as outlined in this SOP.
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained workforce Public Access	Working outdoors/site Site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage. Interaction with the public could result in confrontation.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed, Stop work and leave area if interaction with public becomes confrontational/hostile.
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in	Training on signs and symptoms of cold/heat stress is required.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
			cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt. Nitrile when collecting samples.
APPLICABLE SDS	Nitric Acid
REQUIRED PERMITS/FORMS	Field Authorization Form
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-3-AB and P&ID-5-AB
DRAWINGS	Draft drawings are contained in the Draft O&M Manual.
RELATED SOP's/ PROCEDURES/ WORK PLANS	*BTL-SOP-17 ISCO Automatic Composite Water Sampling.*
TOOLS	Sample bottles, peristaltic pump, filter, sampling tubing.
FORMS/ CHECKLIST	Operations Guide for Butte Priority Soils Operable Unit. Butte Treatment Lagoons (BTL) at Lower Area One (LAO) Groundwater Treatment System

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
	12/5/14
SAFETY OFFICER	**DATE**
	12/5/14
LEAD OPERATOR	**DATE**
	12/5/14
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval
2	Annual updates and Updates to Risk table for consistency	12/16/2020	Hailey Thompson

PIONEER TECHNICAL SERVICES, INC.	**BTL-SOP-25;** **SUBDRAIN GENERATOR STARTUP\ SHUT DOWN\ EMERGENCY SHUT DOWN**	**STATUS: Final** **DATE ISSUED: 12/29/11** **REVISION: 1** **REVISION DATE: 1/4/2021** **PAGE 1 of 6**

PURPOSE	To provide standard instructions for operators performing Subdrain Generator Startup\Shutdown\Emergency Shutdown Procedure.
SCOPE	This practice has been prepared for the Pioneer Technical Services (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP covers the procedural approach used to performing Subdrain Generator Startup\Shutdown\Emergency Shutdown Procedure.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Start Up	1. The operator will throw the toggle switch on the main electrical service disconnect panel (EL-MSD101) to the “OFF” position and Lock Out/tagout the main disconnect service. 2. The operator will then ensure all pump controls, light and heater switches, pump vault electrical switches within the building are in the “OFF” position and the main breaker switch in the 120/240 breaker panel (EL-MSD111) is in the “off” position. 3. The operator will throw the switch on the Manual Double Throw Transfer Switch Panel (EL-MSD103) to the ”ON” position and install the appropriate. 4. Set the generator’s main line circuit breaker to the “OFF” position. 5. Start the generator. Do not crank the generator for more than 30 seconds or damage to the starter may occur. 6. When the generator has run normally for a short time (2-3 minutes) and all instruments and gauges are checked move the transfer switch manual handle to the “STANDBY” position. 7. Set the generator’s main line circuit breaker to the “ON” position. 8. The generator now powers load circuits. 9. The operator will remove LO/TO devices to start site electrical and monitoring equipment. The operator will ensure that the generators control panel access doors are locked prior to leaving the site to assure the generator cannot be shutdown or damaged by unauthorized individuals.

Manual Shut Down	1. Set the generator's main line circuit breaker to its "OFF" position. 2. Throw the toggle switch on the main electrical service disconnect panel (EL-MSD101) to the "ON" position and Lock Out the switch. The other site equipment may then be restarted. 3. Allow the generator to run at no-load for a minimum of 5 minutes to allow internal temperatures to stabilize. 4. Toggle the main generator-operating switch to the "OFF" position and allow the generator to shut down and ensure that the engine had completely stopped. Install a lock and tag.
Emergency Shut Down	1. Upon identifying an emergency situation, the operator will toggle the main generator-operating switch to the "OFF" position and allow the generator to shut down and ensure that the engine has completely stopped. The operator will then install a lock\tag. 2. The operator will proceed to inform any emergency services personnel if necessary, and the Pioneer Project Manager of the situation. The operator will then address the emergency situation if he is qualified or continue to provide notification in accordance with the BTL HASP and BTL O&M Manual.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

SOURCE	*HAZARD*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
BIOLOGICAL	Inexperienced, improperly trained workforce bites, stings, domestic animals, public access	Working outdoors/site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage. Exposure to insects, spiders, could result in bites and/or allergic reactions. Interaction with the public could result in confrontations. Dogs in area could become aggressive resulting in bites and	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed, First aid kits are available on site, wear gloves and PPE as outlined in this SOP. Stop work and leave area if interaction with public becomes confrontational/hostile. Stop work and wait in vehicle if necessary for dogs to leave area. Call animal control if necessary.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
			injury.	
BODY MECHANICS	Not applicable			
CHEMICAL	Gasoline/Diesel Untreated Ground Water	Generator	Inadvertent contact with gasoline/diesel via inhalation and/or ingestion could result in adverse health effects Unintentional spill while refueling the generator could result in environmental damage. Inadvertent contact with untreated water in the BPSOU Subdrain Vault could result in adverse health effects Inadvertent ingestion via hand to mouth contact (i.e. eating outside of designated areas, poor hygiene) could result in adverse health effects	Wear required PPE, wash hands before eating or drinking. Avoid unnecessary contact with gasoline/diesel. Minimize time spent around idling generator. Stay up wind. Spill containment kits are available and will be used if a spill occurs. Wear required PPE, wash hands before eating or drinking. Avoid unnecessary contact with gasoline/diesel
ELECTRICAL	Electrical shock	Electrical panel and generator	Injury or death could occur from inadvertent contact with electrical current at the electrical panel or generator.	LO/TO procedures will be followed for this process as outlined in the above job steps. Workers will be trained in the appropriate LOTO methods.
GRAVITY	Falls	Walking working surfaces	Workers could fall if they slip or trip when walking on uneven or wet/icy terrain	Avoid walking on steep slopes. Establish access points and keep them maintained. Use ice melt or sand when necessary.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
MECHANICAL	Slips and trips	Walking working surfaces	Workers could slip trip when walking on uneven or wet/icy terrain.	Avoid walking on steep slopes. Establish access points and keep them maintained. Use ice melt or sand when necessary.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Ultraviolet (UV) radiation	Working outdoors	Exposure to UV radiation when working outdoors may result adverse health effects and/or injury.	Personnel will wear PPE as outlined in this SOP and personnel should wear sunscreen when applicable.
THERMAL	Hot Surface	Generator	Burns could occur from inadvertent contact with a hot surface on the generator.	Leather gloves will be worn when working with the generator to prevent burn injuries.
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained worker	Site	Inexperienced workers and improper training could cause incidents resulting in personal injuries and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement stop work procedures, if necessary.
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D PPE: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt. Leather gloves when working with the generator.
APPLICABLE SDS	Gasoline, Heavy Metals
REQUIRED PERMITS/FORMS	Isolation control register, Daily toolbox, TSEA (if applicable)
ADDITIONAL TRAINING	Energy isolation, Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
DRAWINGS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
RELATED SOP's/ PROCEDURES/ WORK PLANS	
TOOLS	Locks, keys and tags located on the south wall of the pump control station.
FORMS/ CHECKLIST	..\..\BPSOU OM Manual\Op_Report_Blank - Controlled.xlsx

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
SAFETY OFFICER	**DATE**

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

LEAD OPERATOR	**DATE**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval
1	Annual updates and updates to Risk table for consistency	1/4/2021	Hailey Thompson

PURPOSE	To provide standard instructions for operators replacing the effluent sample recirculation pump (P-ASB-1) at the ASB building.
SCOPE	This practice has been prepared for the Pioneer Technical Services (PTS) workforce and applies to work carried out by and on behalf of PTS. All members of the PTS workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach used to replace the effluent sample recirculation pump (P-ASB-1).

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical services Corporate health and Safety Plan.

TASK	INSTRUCTIONS
Field Verification	Compare the device field ID number to the device ID requiring replacement. Ensure appropriate device.
Energy Isolation	Prior to performing the removal of the existing pump (P-ASB-1), all necessary systems will be shut down. Isolate and release all stored energy (pressure, electrical, etc.) from the system. Release excess water from the effluent sample line by opening the all of 1inch PVC ball valves on the effluent sample line. (BV-ASB-4003,4004,4005) Energy isolation can be obtained by unplugging the power cord running from the Grundfos pump (P-ASB-1) to the standard GFCI 3 prong plug receptacle.
Remove existing sample recirculation pump	Note the orientation of the existing pump, inlet and outlet port locations. Unthread the inlet brass coupling on the intake side of the sample recirculation pump (P-ASB-1) by rotating the coupling in a counter clockwise direction using a pipe wrench or crescent wrench. Next remove the plastic coupling from the outlet port on the top of the Grundfos pump (P-ASB-1), by rotating the plastic coupling in a counter clockwise direction. Once both coupling are undone use a socket wrench with the appropriate size socket to unbolt the mounting plate attaching the sample recirculation pump (P-ASB-1) to the concrete slab in the ASB building. Remove existing pump and dispose of pump properly. 

Install new Pump	Once existing pump has been removed, install the new sample recirculation pump (P-ASB-1) in the same manner as the existing pump previously removed. Verify the new pump is orientated in the correct direction, this being; the intake of the pump should face the plastic effluent sample line coming from the ASB manhole. With the new pump (P-ASB-1) in the proper location slide the female threaded union connections tight against the male threaded connection of the new Grundfos pump. Tighten the union connection on the intake side of the pump in a clockwise direction using a pipe wrench or channel lock pliers. Repeat same procedure for the outlet union connection on the top of the new pump. Once intake and outlet connections are made, reattach the pump (P-ASB-1) to the concrete slab of the ASB building, by threading the bolt nut back onto the concrete anchor bolts.
Put system back into service	Once the new pump is in place, in the proper position, prime the new pump according to manufactures recommendation by removing the priming port plug on the top of the pump. Next fill the pump with 1.2 gallons of water or until no more water can be placed into the pump. Plug in the pump (P-ASB-1) power supply cord back into the GFCI standard 3 prong plug receptacle. Once the pump has started, allow pump to prime, watch for water to discharge out of the end of the PVC effluent sample line.
Post service verification	Verify that all appropriate valves, pumps and associated devices return to their original state. Check for any leaks and verify that the new sample recirculation pump is functioning properly.
Post service documentation	Enter as left information on job form. Complete a new equipment data sheet for the replacement device. Provide all replacement documentation to the project manager for implementation into the equipment records (device register, drawings (as applicable) etc.)

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARD***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
BIOLOGICAL	Insects, spiders, domestic animals	Site	Exposure to insects, spiders, could result in bites and/or allergic reactions. Dogs in area could become aggressive resulting in bites and injury.	First aid kits are available on site, wear gloves and PPE as outlined in this SOP. Stop work and wait in vehicle if necessary for dogs to leave area. Call animal control if necessary.
BODY MECHANICS	Not applicable			
CHEMCIAL	Not applicable			
ELECTRICAL	Shock	Electrical components	Inadvertent contact with live electrical component, could	Personnel will inspect equipment before each use. All utilities will be properly locked/tagged out when not in use. Avoid

HSSE CONSIDERATIONS
This section to be completed with concurrence from the Safety Officer.

			result in injury, property damage, or death.	contact between electrical equipment and water. Unplug pump prior to replacement.
GRAVITY	Falls	Uneven or slippery walking or working surface	Injury could occur from personnel slipping, tripping on terrain/rocks and falling while working onsite.	Use established access points to access sample locations. Use ice melt if necessary during winter months.
MECHANICAL	Pinch Points Slips and trips	ABS Sample Pump Walking, working surfaces	Injury could occur from fingers getting pinched between the pump and pipes when opening and closing valves. Injury could occur from personnel slipping, tripping while walking on slick/icy surfaces or trip over debris/clutter	Gloves will be worn to protect hands and fingers throughout this process. A crescent wrench will be used. Good housekeeping – tools and equipment will be picked up to prevent tripping hazards in the work area. Personnel will wear work boots with good traction and support.
NOISE	Not applicable			
PRESSURE	Release of excess water in sample line	Sample line	Injury could occur from water pressure	Make sure LOTO procedures are in place, wear proper PPE
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly	Site	Lack of understanding of	Workers will be properly trained in this procedure and applicable procedures,

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
	trained workforce Public access		scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage. Interaction with the public could result in confrontations.	STOP work policy will be followed, Stop work and leave area if interaction with public becomes confrontational/hostile.
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt. Nitrile when collecting samples.
APPLICABLE SDSs	
REQUIRED PERMITS/FORMS	Daily toolbox, TSEA (if applicable)
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	I&C-C-5 AB
DRAWINGS	
RELATED SOP's/ PROCEDURES/ WORK PLANS	
TOOLS	Pipe Wrench, Screw driver, Channel lock pliers, Crescent wrench.
FORMS/ CHECKLIST	..\..\BPSOU OM Manual\Op_Report_Blank - Controlled.xlsx

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
SAFETY OFFICER	**DATE**
LEAD OPERATOR	**DATE**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval
2	Annual Updates and Updates to Risk Table for Consistency	12/16/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing Volumetric Lime Addition Startup
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach used in the Volumetric Lime Addition Startup.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Volumetric Lime Addition Startup	Locate the H-O-A selector switch on the MCC inside the CAS Building and place the indicator switch for Mixer 1, Mixer 2, and Silo Screw Conveyor motor controls in the HAND position. Push the screw conveyor start button on the MCC to start the screw conveyor operation. Ensure screw conveyor is operating properly by visual inspection of the motor end of the screw conveyor for correct rotation or checking the visual indication located on the HMI panel. Verify slurry tank liquid level is above the mixer blades, then push the slurry tank start button on the MCC to start the start the slurry tank mixer for the desired slurry tank to be operated. Ensure the 10” Salina Vortex pneumatic knife valve is in the open position. This valve is located inside the silo above the AccuRate Feeder. If in the closed position, the valve must be opened by pushing “Open Valve” (FCV-CAS-1004) on the HMI screen in the Ops Building or HMI in the CAS. Restart IPS pumps (if pumps are not running) by using steps described in SOP- 6 *Influent Pump Station Start Up.* Once the influent water has reached the CAS building, select the appropriate slurry tank to provide lime slurry and press “Open Valve” FCV-CAS-1026 to Tank #1 or FCV-CAS-1022 to Tank 2” on the HMI in the Operations Building or CAS building. This allows lime distributed through the screw conveyor to be discharged into the desired tank.

Using the OP1 Gravimetric Controller, press the green “Start” button located on the OP1 Controller hand controls to turn on the AccuRate Feeder helix and paddle motors. The agitation paddle motor speed can be manually adjusted using the “Agitation” variable control knob located on the right side of the OP1 Controller. The helix speed can be controlled using the “Manual” variable control knob located on the left side of the OP1 Controller

Operate the “Silo Bin Discharge” (Silo Vibrator) on a timer to ensure the hopper within the AccuRate feeder receives proper lime flow. The timer is located on the top right corner of the MCC and can be adjust by using the hand control knob. The knobs control:

- Time the vibrator is “OFF” between cycles; and
- Time the vibrator is “ON” during cycles.

Refer to the PLC for guidance on controlling the shaker.

After enough time has been allowed for thorough lime addition throughout the mixing tank, test the channel for the current pH. Depending on the “Channel” pH, adjust the “Manual” variable control knob until a desirable “Channel” pH is achieved. (10.00-10.50 S.U)

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARDS***	***WHERE***	***RESULT***	***CONTROLS***
BIOLOGICAL	Insects and spiders	CASB/ Lime Silo	Exposure to insects, spiders, could result in bites and/or allergic reactions.	Training on the signs and symptoms of exposure to insects and spiders is required. Avoid contact with insects and spiders. First-aid kits are available on site. Personnel will wear gloves when moving parts and opening lids. Personnel with allergies will notify their supervisor.
BODY MECHANICS	Not applicable			
CHEMICAL	Lime	CASB/ Lime Silo	Inadvertent contact with residual lime dust on equipment/surfaces in the CASB and lime silo, and/or contact with treated water in the CASB could result in adverse skin reaction such as burns, mucous membrane, eye and respiratory tract irritation. Inadvertent ingestion via hand to mouth contact (i.e. eating outside of designated areas, poor hygiene) could result in Gastrointestinal tract irritation.	Wear required PPE as listed in this SOP, wash hands before eating or drinking. Avoid unnecessary contact with surfaces where lime can accumulate. Clean or wet areas to be accessed that have lime accumulation if necessary.
ELECTRICAL	Not applicable			
GRAVITY	Walking surfaces	CAS and Silo	Fall could result from tripping and/or slipping while walking on site resulting in injury.	Keep walking/working areas free from clutter and/or debris. Keep floors dry, use ice melt or sand during winter months.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
MECHANICAL	Pinch points	Equipment and/or building doors	Fingers/hands could be pinched in doors and equipment covers resulting in cuts/scrapes.	Wear gloves when opening closing covers/lids.
	Caught by	Screw conveyor	Inadvertent contact with the screw conveyor could result in employee being pinched or caught in the conveyor.	Screw conveyor is equipped with a guard. Keep guard in place at all times. Do not reach into screw conveyor while power is on.
	Slips, trip	Walking and working surfaces	Wet/muddy and/or cluttered walking surfaces could cause employees to slip and/or trip.	Keep walking/working area free from clutter/debris. Keep floors dry, use ice melt or sand during winter months.
NOISE	Not applicable			
PRESSURE	Air compressor	Lime Silo and CASB	Unexpected build up in the compressor line could cause to rupture/burst Employees could be struck by hoses/lines and/or exposed to lime resulting in injury and/or adverse health effects.	Air compressor is equipped with pressure relief valves and shut off valves. Wear required PPE, ensure valves are working properly by following maintenance and inspection procedures as outlined in the O&M manual.
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained workforce	Site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt, gloves
APPLICABLE SDS	Lime
REQUIRED PERMITS/FORMS	Field Authorization Form (FAF)
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-1-AB and P&ID-2-AB
DRAWINGS	Draft drawings are contained in the Draft O&M Manual.
RELATED SOP's/PROCEDURES/ WORK PLANS	BTL-SOP-06 *Influent Pump Station Start Up.*
TOOLS	
FORMS/CHECKLIST	Operations Guide for Butte Priority Soils Operable Unit.

	Butte Treatment Lagoons (BTL) at Lower Area One (LAO) Groundwater Treatment System

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
Dave Aiuffo	**12/8/14**
SAFETY OFFICER	**DATE**
Sara Scheeeman	**12/8/14**
LEAD OPERATOR	**DATE**
Brad Hallo	**12/8/14**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval
1	Annual updates and updates to Risk table for Consistency	12/21/2020	Hailey Thompson

Figure 1. OPI Schenck Control

PURPOSE	To provide standard instructions for operators performing Maintenance of the Ultramag Flowmeter.
SCOPE	This practice has been prepared for the Pioneer Technical Services (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer at Pioneer sites. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. When the flow rate of a pipeline does not seem to be accurate, the flowmeter on that line needs to be maintained. When maintenance is being conducted on a flowmeter, the following steps should be followed. This Standard Operating Procedure (SOP) defines the procedural approach used in Ultramag Flowmeter Maintenance.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is outdated, inaccurate, or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons (BTL)Water collection and Treatment System, the Site-Specific Health and Safety Plan (SSHASP) for BTL, Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Maintenance of the Ultramag Flowmeter	1. Stop all water flow to the flow meter by shutting the associated pump off. 2. Disconnect the main power to the associated pump(s) by using on-off switch for the pump. Lockout/tagout (LO/TO) main switch. Verify that residual water is fully drained from the line by observing discharge. 3. Remove the nuts and/or bolts from the flange connections between the flowmeter and piping. Remove the flowmeter from piping. 4. Replace with inkind flowmeter in reverse of step #4, verify model and serial numbers. 5. Ensure all removed equipment is properly restored and remove the lockout/tagout from the main power switch. 6. Re-establish flow to the flow meter and check for accuracy. If still inaccurate, refer to Step 1. 7. If the flow meter has a 4-20mA output, inspect the electronics for water damage or electrical damage.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARD***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
BIOLOGICAL	Insects and spiders	Site	Exposure to insects and spiders could result in bites and/or allergic reactions.	Training on the signs and symptoms of exposure to insects and spiders is required. Avoid contact with insects and spiders, and wear required PPE as listed in this SOP. First-aid kits are available on site. Personnel with allergies will notify their supervisor.
BODY MECHANICS	Slips and trips	Walking/ working surfaces	Wet and cluttered walking/working surfaces could cause employees to slip and/or trip resulting in injury.	Keep walking/working area free from clutter/debris. Keep floors dry, use ice melt or sand during winter months. Practice good housekeeping – tools and equipment will be picked up to prevent tripping hazards in the work area. Personnel will wear work boots with good traction and support. Pay attention to surroundings.
CHEMICAL	Exposure to heavy metals	Untreated/ impacted water	Inadvertent contact with impacted water via ingestion and skin/eye contact could result in adverse health effects.	Personnel will wear required PPE as listed in this SOP. Personnel will also wear gloves when there is potential for skin contact with impacted water. Personnel will practice proper personal hygiene - wash hands before eating or drinking and when leaving the site. Use designated areas when eating/drinking.
ELECTRICAL	Electrical current	Flow meter	Injury or death could occur from inadvertent contact with electrical current flowing through the flow meter.	Personnel will follow LO/TO procedures for this process, and they will be task trained.
GRAVITY	Falls from slips and trips	Walking/working surfaces	Falls from slips and trips when walking/working	Personnel will practice good housekeeping – tools and

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
			on the site could result in injury.	equipment will be picked up to prevent tripping hazards in the work area. Personnel will wear work boots with good traction and support. Pay attention to surroundings.
MECHANICAL	Pinch points	Flowmeter, piping, and propeller assembly	Injury could occur from fingers getting pinched in the flowmeter, piping or propeller assembly, and when using hand tools.	Personnel will wear gloves to protect hands and fingers throughout this process. A crescent wrench will be used remove bolts. Personnel will inspect hand tools before each use.
NOISE	Not applicable			
PRESSURE	Unintentional release of residual water	Pipeline	Pressure buildup in the pipeline could be unintentionally released causing personnel to be hit with untreated water. This could result in eye/facial injuries or ingestion of untreated water.	The water supply will be locked out/tagged out as described in the job steps above and allowed to drain. Personnel will be trained on the LO/TO procedures as outlined in the Pioneer HASP. Personnel will wear required PPE as listed in this SOP.
RADIATION	Ultraviolet (UV) radiation	Working outdoors	Exposure to UV radiation when working outdoors may result adverse health effects and/or injury.	Personnel will wear PPE as outlined in this SOP and personnel should wear sunscreen when applicable.
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained personnel	Site	Inexperienced personnel and improper training could cause incidents resulting in injury and/or property damage.	Personnel will be trained in this procedure and will understand the scope of work prior to starting work activities. Personnel will implement STOP work policy/procedures, if there are any issues.
WEATHER	Cold/heat stress	Working	Exposure to cold	Training on signs and symptoms

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
		outdoors	climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D Personal Protective Equipment (PPE): Hard hat, safety glasses, safety-toed boots, high-visibility outerwear, long-sleeved shirt, and long pants. Gloves when using hand tools and removing flowmeter.
APPLICABLE SDS	Heavy metals. Safety Data Sheets (SDSs) are located in the Operations Building Control Room.
REQUIRED PERMITS/ FORMS	Isolation control register, Field Authorization Form (FAF), Task Risk Assessment (if applicable).
ADDITIONAL TRAINING	Energy isolation, Control of Work (CoW), and 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
DRAWINGS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
RELATED SOPs/ PROCEDURES/ WORK PLANS	
TOOLS	Crescent wrench.
FORMS/ CHECKLIST	..\..\BPSOU OM Manual\Op_Report_Blank - Controlled.xlsx

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
	1/9/13
SAFETY AND HEALTH MANAGER	**DATE**
	1/9/13
LEAD OPERATOR	**DATE**
	1/9/13
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Revision	Description	Date	Approval
1	Annual updates and update Risk Table for Consistency	12/21/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing BRW Staff Gauge Monitoring
SCOPE	This practice has been prepared for the Pioneer Technical Services (PTS) workforce and applies to work carried out by and on behalf of PTS. All members of the PTS workforce who conduct the work shall be trained and competent in the risk-assessed work described below. THIS SOP covers the procedural approach used to performing a weekly check to insure the BRW ponds are monitored for consistent water levels. This SOP is applicable to the following locations at BRW-00, BRW-01 West, and BRW Sludge Drying Cells as needed.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Access monitoring area	Access the BRW area via the BRW/East gate entrance. Drive along the access road to the BRW-00 and BRW-01W outlet structures.
Walk to edge of pond	Proceed on foot to the outlet structures at BRW-00 and BRW-01W at the outlet of each pond where each of the staff gauges are located.
Record data	While staying inside of the engineered structures, record the staff gauge readings to the nearest 100th inch in the BTL/LAO site logbook with date and time recorded.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

SOURCE	*HAZARD*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
BIOLOGICAL	Insects, spiders, small animals	Site	Exposure to insects, spiders, or small animals could result in bites and/or allergic reactions.	Training on the signs and symptoms of exposure to insects, spiders, or small animals is required. Avoid contact with insects and spiders. First-aid kits are available on site.. Personnel with allergies will notify their supervisor.
BODY MECHANICS	Not applicable			
CHEMICAL	Potentially Impacted	Staff gauge site	Inadvertent contact via ingestion with impacted	Wear required PPE as listed in this SOP, wash hands before

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
	water/soil		water/soil onsite could result in adverse health effects	eating or drinking.
ELECTRICAL	Lightning	Worksite	Serious injury or death could occur from lightning strike/storm.	Follow established 30-30 procedure as outlined in the SSHASP.
GRAVITY	Falls from slips, trips, Falls into water	Walking surfaces Staff gauge location	Fall could result from tripping and/or slipping while walking on site resulting in injury. Personnel could fall into water when reading staff gauge resulting in injury	Personnel will wear work boots with good traction and support. Pay attention to surroundings. Personnel will follow PTS practice for working around water. Staff gauge locations are equipped with platforms with top and mid-rail and toe board to prevent falls.
MECHANICAL	Wind Slips, trips	Work Site Uneven or slippery walking surface	Wind could cause injury from blowing debris. Slips and trips could occur when walking on uneven/slippery terrain resulting in injury	If windy conditions result in blowing debris or reduced visibility, workers will stop work and get in vehicle until conditions improve. Personnel will wear work boots with good traction and support. Used established access points and stay within engineered structures.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Employees will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Employees should wear sunscreen, if necessary.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained personnel	Site/CAS Building	Lack of understanding of the scope of work, inexperienced personnel, and improper training could cause incidents resulting in injury and/or property damage.	Personnel will be properly trained in this procedure and applicable procedures. Personnel will implement STOP work policy/procedures, if there are any issues.
WEATHER	Heat/Cold Stress	Work Site	Adverse health effects or injury could result from working outdoors in hot and/or cold temperatures.	Workers will be training on signs and symptoms of heat and cold stress and emergency response plan. Follow procedures outlined in the

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt.
APPLICABLE SDS	Heavy Metals
REQUIRED PERMITS/FORMS	Daily toolbox, TSEA (if applicable)
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	NA
DRAWINGS	BTL-LAO Site Plot Plan, Sheet 3 of 5 – Eastern Portion of LAO.
RELATED SOP's/ PROCEDURES/ WORK PLANS	*Pioneer SOP-SA-05 – Project Documentation* *Working Around Water*

TOOLS	NA
FORMS/ CHECKLIST	Field documentation

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
SAFETY OFFICER	**DATE**
LEAD OPERATOR	**DATE**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval
1	Annual Updates and Updates to Risk Table for Consistency	12/21/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing BPSOU Subdrain Dry Vault monitoring and dewatering.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work. This Standard Operating Procedure (SOP) defines the procedural approach used to monitor and dewater BPSOU Subdrain Dry Vault.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is outdated, inaccurate, or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons (BTL) Water collection and Treatment System, the Site-Specific Health and Safety Plan for BTL, Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Regularly check the BPSOU Subdrain Dry Vault for the presence of water.	1. Once a week, manually open the hatch to the dry vault to check for water. 2. Visually inspect the vault to see if any water has accumulated in the vault. 3. If the presence of water is detected and is estimated to be more than 2" deep, manually turn on the sump pump with the switch located on the south east edge of the vault walls. 4. Once the water has been pumped out, manually shut of the switch and return the vault hatch to the original locked position.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Officer.

SOURCE	*HAZARDS*	*WHERE*	*RESULT*	*CONTROLS*
BIOLOGICAL	Insects and spiders	Site	Exposure to insects and spiders could result in bites and/or allergic reactions.	Training on the signs and symptoms of exposure to insects and spiders is required. Avoid contact with insects and spiders, and wear gloves when opening doors/lids. First-aid kits are available on site. Personnel with allergies will notify their supervisor.
BODY MECHANICS	Slips and trips	Walking surfaces	Slips and trips could occur when walking	Personnel will wear work boots with good traction and

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Officer.

			on uneven/slippery terrain resulting in injury.	support, plan their path, and avoid walking on steep slopes.
CHEMICAL	Not applicable			
ELECTRICAL	Not applicable			
GRAVITY	Not applicable			
MECHANICAL	Pinch points	Doors/lids	Hand/fingers could become pinched in doors and/or lids when opening the Subdrain Dry Vault resulting in cuts/scrapes.	Personnel will wear gloves in addition to the PPE listed in this SOP when opening doors/lids.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Ultraviolet (UV) radiation	Working outdoors	Exposure to UV radiation when working outdoors may result adverse health effects and/or injury.	Personnel will wear PPE as outlined in this SOP and personnel should wear sunscreen when applicable.
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained personnel	Site	Inexperienced personnel and improper training could cause incidents resulting in injury and/or property damage.	Personnel will be trained in this procedure and will understand the scope of work prior to starting work activities. Personnel will implement STOP work policy/procedures, if there are any issues.
	Interaction with the public	Site	Interaction with the public could interfere with work activities and create a hazardous work environment.	Personnel will avoid interaction with the public by stopping work if members of the public enter work area.
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g.,

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Officer.				
			temperatures may result in heat cramps, heat exhaustion, or heat stroke.	layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D Personal Protective Equipment (PPE): Hard hat, safety glasses, safety-toed boots, high-visibility outerwear, long-sleeved shirt, and long pants. Gloves when opening doors/lids.
APPLICABLE SDS	
REQUIRED PERMITS/ FORMS	Field Authorization Form (FAF) and Task Risk Assessment (TRA) (if applicable).
ADDITIONAL TRAINING	Control of Work (CoW), 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
DRAWINGS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
RELATED SOPs/ PROCEDURES/ WORK PLANS	
TOOLS	
FORMS/ CHECKLIST	..\..\BPSOU OM Manual\Op Report Blank - Controlled.xlsx

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
	1/10/13
SAFETY AND HEALTH MANAGER	**DATE**
	1/10/13
LEAD OPERATOR	**DATE**
	1/10/13
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Revision	Description	Date	Approval
1	Annual Updates and Updates to Risk Table for consistency	12/22/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators Relay Switch Replacement.
SCOPE	This practice has been prepared for the Pioneer Technical Services (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach required to replace relay switches in the control panel.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
De-energize the power and lockout/tagout	The operator must de-energize the power to the lime silo control panel by turning the main power switch located on the upper right hand side of the control panel to the off position and lock/tagout power switch.
Access panel	With the power off, the panels are now accessible. The operator will open the left panel to gain access to the relay switches.
Identify inoperable relays	The inoperable relays will then be identified and replaced with a new/operable relay switch.
Restore power	The panels can now be closed and the main power switch can be turned to the **ON** position to restore power to the lime silo control panel.
Restart accurate feeder	Now that power has been restored, the accurate feeder must be restarted by following *BTL-SOP-3 Gravimetric Lime Addition System Start Up.*

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

SOURCE	***HAZARD***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
BIOLOGICAL	Inexperienced, improperly trained workforce bites, stings,	Site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed, First aid kits are available on site, wear gloves when moving parts and opening

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
			damage. Exposure to insects, spiders, could result in bites and/or allergic reactions.	lids.
BODY MECHANICS	Not applicable			
CHEMICAL	Lime	CASB Lime Silo	Inadvertent contact with residual lime dust on equipment/surfaces in the CASB and lime silo, and/or contact with treated water in the CASB could result in adverse skin reaction such as burns, mucous membrane, eye and respiratory tract irritation Inadvertent ingestion via hand to mouth contact (i.e. eating outside of designated areas, poor hygiene) could result in Gastrointestinal tract irritation	Wear required PPE as listed in this SOP, wash hands before eating or drinking. Avoid unnecessary contact with surfaces where lime can accumulate. Clean or wet areas to be accessed that have lime accumulation if necessary.
ELECTRICAL	Electrical current	Lime silo control panel	Injury or death could occur from inadvertent contact with electrical current at the electrical panel.	De-energize and LO/TO as outlined in above job steps. Workers will be trained in applicable energy isolation methods.
GRAVITY	Falls from slips, trips,	Walking surfaces	Fall could result from tripping and/or slipping while walking on site resulting in injury	Keep walking/working areas free from clutter and/or debris. Keep floors dry, use ice melt or sand during winter months.
MECHANICAL	Pinch Points	Equipment covers, doors,	Fingers could be pinched in doors and/or equipment covers resulting in cuts,	Wear gloves when opening closing covers/lids,

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

	slips, and trips	walking/ working surfaces	scrapes, wet/mud and/or cluttered walking surfaces could cause employees to slip and/or trip,	keep walking/working area free from clutter/debris. Keep floors dry, use ice melt or sand during winter months.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained worker	Site	Inexperienced workers and improper training could cause incidents resulting in personal injuries and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement stop work procedures, if necessary.
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

REQUIRED PPE	Level D PPE: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt and gloves.
APPLICABLE SDS	Lime
REQUIRED PERMITS/FORMS	Isolation control register, Daily toolbox, TSEA (if applicable)
ADDITIONAL TRAINING	Energy Isolation, Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT

The following documents should be referenced to assist in completing the associated task.

P&IDS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
DRAWINGS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
RELATED SOP's/ PROCEDURES/ WORK PLANS	*BTL-SOP-3 Gravimetric Lime Addition System Start Up*
TOOLS	
FORMS/ CHECKLIST	..\..\BPSOU OM Manual\Op_Report_Blank - Controlled.xlsx

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

PROJECT MANAGER	**DATE**
	1/10/13
SAFETY OFFICER	**DATE**
	1/10/13
LEAD OPERATOR	**DATE**
	1/10/13
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

1	Annual updates and Updates to Risk Table for Consistency	1/4/2021	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing BTL Dialer Alarm Callout List Update.
SCOPE	This practice has been prepared for the Pioneer Technical Services (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described. This SOP defines the procedural approach required in to complete BTL Dialer alarm callout list update.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Update the BTL alarm call out list via Dialer	1. The following steps must be taken to update the BTL alarm callout list. 2. Access the dialer by opening the door on the right side of the control panel. 3. A list of current operator phone numbers is posted in the operations building. 4. Press the (**Program Button**). 5. Press code **<u>(70) enter</u>** (Runs through the current order of the Callout List). 6. Press code (**<u>701*</u>** then the **<u>phone number</u>** of the person to be called first - then press **<u>enter</u>**). 7. Press code (**<u>702*</u>** then the **<u>phone number</u>** of the person to be called second - then press **<u>enter</u>**). 8. Press code (**<u>703*</u>** then the **<u>phone number</u>** of the person to be called third - then press **<u>enter</u>**). 9. Press code (**<u>704*</u>** then the **<u>phone number</u>** of the person to be called forth - then press **<u>enter</u>**). 10. Once all of the numbers have been changed press the (**Normal Button**) to activate.

Update the BTL alarm call out list via Phone	The following steps must be taken to update the BTL alarm callout list by phone. 1. Access the dialer by dialing 723-1889. 2. A list of current operator phone numbers is posted in the operations building. 3. To access the Program RTU function, enter 5 "to hear report", press 1 "to program RTU" enter PIN 7678. (**NOTE-Enter = ###).** 4. Press code **(70) enter (###)** (Runs through the current order of the Callout List). 5. Press code **701*** then the **phone number** of the person to be called first - then press **enter (###**). 6. Press code **702*** then the **phone number** of the person to be called second - then press **enter (###**). 7. Press code **703*** then the **phone number** of the person to be called third - then press **enter (###**). 8. Press code **704*** then the **phone number** of the person to be called forth - then press **enter (###**). 9. Once all of the numbers have been changed press ###. Press 0 to hang up and end the RTU programming session.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

SOURCE	***HAZARD***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
BIOLOGICAL	Not applicable			
BODY MECHANICS	Not applicable			
CHEMICAL	Not applicable			
ELECTRICAL	Not applicable			
GRAVITY	Not applicable			
MECHANICAL	Pinch Points	Control panel	Fingers could be pinched in doors and/or	Wear gloves when opening

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
		cover	equipment covers resulting in cuts, scrapes.	closing covers/lids.
	Slips and trips	Walking surfaces	Wet/mud and/or cluttered walking surfaces could cause employees to slip and/or trip	Keep walking/working area free from clutter/debris. Keep floors dry.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained workforce	Site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed,
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt. gloves
APPLICABLE SDS	
REQUIRED PERMITS/FORMS	Field Authorization Form (FAF)
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-1-AB and P&ID-2-AB.
DRAWINGS	Draft drawings are contained in the Draft O&M Manual.
RELATED SOP's/ PROCEDURES/ WORK PLANS	
TOOLS	
FORMS/ CHECKLIST	Operations Guide for Butte Priority Soils Operable Unit. Butte Treatment Lagoons (BTL) at Lower Area One (LAO) Groundwater Treatment System

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
Dave Aiuffi	**12/8/14**
SAFETY OFFICER	**DATE**
Sara Scheeeman	**12/8/14**
LEAD OPERATOR	**DATE**
Brad Hallam	**12/814**
OPERATOR	**DATE**
OTHER	**DATE**

OTHER	DATE

Revisions:

Rev.	Description	Date	Approval
1	Annual updates and Updates to Risk Table for consistency	12/22/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing LAO Security Procedures.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This Standard Operating Procedure (SOP) defines the procedural approach for LAO security.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is outdated, inaccurate, or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons (BTL) Water collection and Treatment System, the Site-Specific Health and Safety Plan (SSHASP) for BTL, Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Maintaining LAO Security	1. Upon arrival to the LAO Site in the morning, check to see if the security gates located at the BRW area, LAO West and Main LAO/BTL are locked. 2. If the security gates are locked, safely park, exit your vehicle and open the gate by opening the combination lock. 3. Open the gates and secure it open by hooking the gate to the metal wire hook connected to the appropriate gate restraint next to the access road. 4. The security gates will remain open during normal working hours of 8:00 am to 5:00 pm, Monday thru Friday. 5. At the close of the work day, the gates shall be locked by the last remaining operator at the site.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*RESULT*	*CONTROLS*
BIOLOGICAL	Insects, domestic animals	Site	Exposure to insects, spiders, or domestic animals could result in bites and/or allergic reactions. Dogs in area could become aggressive resulting in bites and injury.	First aid kits are available on site, wear gloves and PPE as outlined in this SOP. Stop work and wait in vehicle if necessary for dogs to leave area. Call animal control if necessary.
BODY	Slips and trips	Walking/	Slips and trips could	Personnel will wear work

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
MECHANICS		working surfaces	occur when walking/working on uneven/slippery/ muddy terrain resulting in injury.	boots with good traction and support. Keep access gates maintained by removing snow and/or grading the area.
CHEMICAL	Not applicable			
ELECTRICAL	Not applicable			
GRAVITY	Falls from slips and trips	Walking/ working surfaces	Falls could result from tripping and/or slipping while walking on the site or accessing the vehicle resulting in injury.	Personnel will wear work boots with good traction and support, maintain three points of contact when accessing their vehicles, and keep access gates maintained by removing snow and/or grading the area.
MECHANICAL	Pinch points	Fences, locks, and gates	Fingers could be pinched in fences, locks, and gates resulting in cuts, scrapes, and hand injuries.	Personnel will wear gloves when opening/closing fences, locks, and gates. Avoid placing hand/fingers between objects.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Ultraviolet (UV) radiation	Working outdoors	Exposure to UV radiation when working outdoors may result adverse health effects and/or injury.	Personnel will wear PPE as outlined in this SOP and personnel should wear sunscreen when applicable.
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained personnel	Site	Inexperienced personnel, improper training, and lack of understanding of scope of work could cause incidents, resulting in injury and/or property damage.	Personnel will be trained in this procedure and will understand the scope of work prior to starting work activities. Personnel will implement STOP work policy/procedures, if there are any issues.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
	Unauthorized persons	Site	Members of the public could access site resulting in injury to public and/or personnel and/or property damage.	Personnel will follow stop work policy/procedures and unauthorized persons will be asked to leave the site. If necessary, call local authorities.
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D Personal Protective Equipment (PPE): Hard hat, safety glasses, safety-toed boots, high-visibility outerwear, long-sleeved shirt, and long pants. Gloves when opening/closing gates.
APPLICABLE SDS	
REQUIRED PERMITS/ FORMS	Field Authorization Form and Task Risk Assessment (TRA) (if applicable)
ADDITIONAL TRAINING	Control of Work (CoW), 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	Final drawings will be issued upon completion of construction as as-built drawings.

	Draft drawings are contained in the Draft O&M Manual.
DRAWINGS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
RELATED SOPs/ PROCEDURES/ WORK PLANS	
TOOLS	
FORMS/ CHECKLIST	[..\..\BPSOU OM Manual\Op Report Blank - Controlled.xlsx]

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

PROJECT MANAGER	**DATE**
	1/10/13
SAFETY AND HEALTH MANAGER	**DATE**
	1/10/13
LEAD OPERATOR	**DATE**
	1/10/13
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

Revision	Description	Date	Approval
1	Annual updates and Updates to Risk Table for Consistency	12/22/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing Calibration of the Accurate Feeder.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach required to calibrate the Accurate Feeder.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Recalibrate AccuRate Feeder	1. Verify the 10" Salina Vortex pneumatic knife valve is in the closed position. If necessary close the valve by pushing "Close Valve" (FCV-CAS-1004) on the HMI screen in the Operations Building or HMI in the CAS. 2. The hopper must then be emptied by placing the lime delivery system into volumetric mode (refer to BTL-SOP-28 Volumetric Lime Addition Start-up) and increasing the helix speed to expedite the empting process. 3. Once the hopper is emptied, press the calibrate button on the AccuRate Feeder OP1 display and follow the step by step process provided. (Note: objects of a known weight for the calibration process are located next to the accurate feeder in the lime silo). 4. Once the calibration process is complete the system can then be returned to Gravimetric mode. BTL-SOP-03 *Gravimetric Lime Addition System Start up*. **The operator shall to monitor a few loading cycles to insure proper load rates.** 

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARDS***	***WHERE***	***RESULT***	***CONTROLS***
BIOLOGICAL	Insects, spiders	Site	Exposure to insects, spiders, could result in bites and/or allergic reactions.	First aid kits are available on site, wear gloves and PPE as outlined in this SOP.
BODY MECHANICS	Not applicable			
CHEMICAL	Hydrated Lime	CASB Lime Silo	Inadvertent contact with residual lime dust on equipment/surfaces in the CASB and lime silo, and/or contact with treated water in the CASB could result in adverse skin reaction such as burns, mucous membrane, eye and respiratory tract irritation. Inadvertent ingestion via hand to mouth contact (i.e. eating outside of designated areas, poor hygiene) could result in Gastrointestinal tract irritation.	Wear required PPE as listed in this SOP, wash hands before eating or drinking. Avoid unnecessary contact with surfaces where lime can accumulate. Clean or wet areas to be accessed that have lime accumulation if necessary.
ELECTRICAL	Not applicable			
GRAVITY	Falls from slips, trips Struck by debris and/or tools	Walking surfaces Below working platform	Fall could result from tripping and/or slipping while walking on site resulting in injury. Operator helper could be struck with hand tools and/or with lime while operator is working on platform.	Keep walking/working areas free from clutter and/or debris. Keep floors dry. Do not allow workers to stand under platform when overhead work is being performed. Wear PPE as outlined in this SOP.

MECHANICAL	Pinch Points Slips, and trips	Doors walking/ working surfaces	Fingers could be pinched in doors and/or resulting in cuts, scrapes. wet/mud and/or cluttered walking surfaces could cause employees to slip and/or trip.	Wear gloves when opening closing doors. keep walking/working area free from clutter/debris. Keep floors dry.
NOISE	Not applicable			
PRESSURE	Air Compressor Line	Lime Silo	Unexpected build up in the compressor line could cause to rupture/burst Employees could be struck by hoses/lines and/or exposed to lime resulting in injury and/or adverse health effects.	Air compressor is equipped with pressure relief valves on shut off valves. Wear required PPE, and follow lock out/tag out procedures.
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced improperly trained workforce	Site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed.
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing

			in heat cramps, heat exhaustion, or heat stroke.	in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt.
APPLICABLE MSDS	Lime
REQUIRED PERMITS/FORMS	Field Authorization Form
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-1-AB and P&ID-2-AB
DRAWINGS	
RELATED SOP's/PROCEDURES/ WORK PLANS	BTL-SOP-03 *Gravimetric Lime Addition System Startup*, BTL-SOP-28 *Volumetric Lime Addition.*
TOOLS	
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
	12/8/14

SAFETY OFFICER	**DATE**
Sara Schleeman	**12/8/14**
LEAD OPERATOR	**DATE**
Brad Hallam	**12/8/14**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval
1	Annual updates and Updates to Risk Table for consistency	12/22/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing recalibration of the Aqua Troll 400 pH meter.
SCOPE	This practice has been prepared for the Pioneer Technical Services (PTS) workforce and applies to work carried out by and on behalf of PTS. All members of the PTS workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach used to perform recalibration of the Aqua Troll 400 pH meter which is required to achieve accurate readings of pH levels at several locations throughout the LAO site.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
The recalibration of the field multi-meter (pH, SC, Temp)	1. Turn on the Aqua multi-meter by pressing the on/off button. 2. Follow the manufacturers calibration steps for pH calibration in the manual located in the operations building. 3. Rinse the probe and calibration cup. 4. Fill calibration cup with 7.00 pH known buffer solution. 5. Place the pH probe in the calibration cup. 6. Once the probe reading has stabilized, indicated by the green Stabilized check mark, press accept. 7. Rinse the probe and calibration cup. 8. Fill calibration cup with 10.01 pH known buffer solution. 9. Place the pH probe in the calibration cup. 10. Once the probe reading has stabilized, indicated by the green Stabilized check mark, press accept. 11. Record in the logbook the date which the calibration has taken place, readings for 7.00 and 10.01 buffers and slope (located in the calibration report). Slope must be greater than 50 mV/pH, less than 55 mV/pH. Clean probe and recalibrate if slope fails. If slope fails again, replace buffer solution.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARD***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
BIOLOGICAL	Not applicable			
BODY MECHANICS	Not applicable			
CHEMICAL	pH Buffer Solution	ASB, CASB	Inadvertent contact with pH buffer chemicals during calibration could result in adverse skin reaction	Nitrile gloves, wash hands if contacted
ELECTRICAL	Not applicable			
GRAVITY	Not applicable			
MECHANICAL	Not applicable			
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained workforce	Site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed,
WEATHER	Not applicable			
ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt. Nitrile gloves
APPLICABLE SDS	pH meter solutions
REQUIRED PERMITS/FORMS	Field Authorization Form (FAF), Daily calibration log.
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	Not applicable
DRAWINGS	Not applicable
RELATED SOP's/ PROCEDURES/ WORK PLANS	
TOOLS	
FORMS/ CHECKLIST	..\..\BPSOU OM Manual\Op_Report_Blank - Controlled.xlsx

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	DATE
SAFETY OFFICER	DATE
LEAD OPERATOR	DATE

OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval
2	Annual update and Update to Risk Table for consistency	12/22/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing routine maintenance/cleaning of the lime silo.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (PTS) workforce and applies to work carried out by and on behalf of PTS at PTS work sites. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach used for cleaning the lime silo.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate health and Safety Plan.

TASK	INSTRUCTIONS
Cleaning of the lime silo	1. Operators may don a Tyvek suit, respirator, if conditions merit. Safety glasses and gloves must be worn and are available in the Operations Building. 2. Access the lime silo via the man door. 3. With the use of the shop vac and/or broom and dust pan located in the Operations Building, vacuum/sweep up the lime dust that is deposited on the floor, AccuRate Feeder, and other components located within the lime silo. 4. After the majority of lime has been removed, use a damp cloth/sponge to wipe off the feeder and other components. 5. After cleaning is complete, discard any tyvek, gloves and wash hands and any other exposed areas with soap and water using the sink inside the Operation Building.  

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARDS***	***WHERE***	***RESULT***	***CONTROLS***
BIOLOGICAL	Insects, domestic animals	Site	Exposure to insects, spiders, could result in bites and/or allergic reactions. Dogs in area could become aggressive resulting in bites and injury.	First aid kits are available on site, wear gloves and PPE as outlined in this SOP. Stop work and wait in vehicle if necessary for dogs to leave area. Call animal control if necessary.
BODY MECHANICS	Not applicable			
CHEMICAL	Hydrated Lime	Lime silo	Skin/respiratory irritation	Proper PPE-gloves, ventilation, Tyvek, respirator if needed, nitrile gloves and safety glasses.
ELECTRICAL	Exposure to electricity	Silo motors, shop vac	Electrocution Electric shock	Grounding, GFCI Lock out tag out procedures, inspect equipment/cords.
GRAVITY	Falling object Slips/Falls	Silo Below silo platform	Fall injury, head injury.	PPE –hard hat, engineer controls. Restricted area. Use an attendant/signage to keep area clear. 3-points of contact when accessing fixed ladder.
MECHANICAL	Pinch points Caught in/struck by	Rotating motors-silo Silo man-door	Lock out/tag out procedures Engineered controls	Lock out/tag out procedures Engineered controls, prop door.
NOISE	Not applicable			
PRESSURE	Air Compressor Line/Knife gate	Lime Silo	Unexpected release of compressed air	PPE-safety glasses, gloves Lock out tag out procedures.
RADIATION	UV Radiation	Working outside	While working outdoors, workers could be exposed to	Wear PPE as outlined in this SOP.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
			UV radiation resulting in sunburns and could contribute to heat related illnesses.	
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained workforce	Working outdoors/site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed,
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt.
APPLICABLE SDS	Hydrated Lime

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PERMITS/FORMS	
ADDITIONAL TRAINING	Task training is required to perform this task. Operator must receive training on this procedure and associated competency testing.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-1-AB
DRAWINGS	
RELATED SOP's / PROCEDURES/ WORK PLANS	
TOOLS	Shop Vac, broom, dust pan.
FORMS/CHECKLIST	Field Authorization Form (FAF), Task Risk Assessment (TRA).

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
SAFETY OFFICER	**DATE**
LEAD OPERATOR	**DATE**
OPERATOR	**DATE**

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval
1	Annual update and Update to Risk Table for Consistency	12/22/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing routine maintenance of the air compressors.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (PTS) workforce and applies to work carried out by and on behalf of PTS at PTS work sites. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach used to perform routine maintenance of the air compressors to maintain proper working order.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate health and Safety Plan.

TASK	INSTRUCTIONS
Compressor Start-Up/Shutdown	1. In order to start the compressors, ensure the compressor Main Disconnect EL-OPS-5004 is in the "ON" position prior to starting compressor #1 or Main Disconnect EL-OPS-5005 is in the "ON" position prior to starting compressor #2. 2. Place the switch located on the front of the compressor in the "AUTO" position to start the desired compressor. 3. If operating compressor #1, open ball valves BV-OPS-1013, BV-CAS-1009 to supply compressed air to the manifold located in the Chemical Additions Systems Building (CASB). If operating compressor #2 ball valve BV-OPS-1014 will need to be opened and ball valve BV-OPS-1013 will need to be closed. 4. In order to shutdown the compressors, place the switch located on the front of the compressor in the "OFF" position to stop the desired compressor. 5. Place the Main Disconnect in the "OFF" position and LO/TO if maintenance is required. 

Filter Inspection & Cleaning. Oil Level Check (Weekly)	1. Unscrew and remove the wing nut securing the filter housing to its base. 2. Remove the filter housing and withdraw the old filter element. Clean the element with a jet of air or vacuum. 3. Replace the filter element and housing, securing it in place with the wing nut previously removed. **Replace filter annually or after 2000 hours.** 4. Check oil level and leaks. 5. Ensure belt guards and covers are secure. 
Leak and Belt Tension Check (Monthly)	1. Inspect for air leaks. Squirt soapy water around joints during operation and watch for bubbles. Tighten as needed. 2. Check tightness of screws and bolts. Tighten as needed. 3. Inspect drive belts. Adjust as necessary.
Belt Adjustment	Follow manufacturer's instructions contained in Ingersoll Rand Owner's Manual Installation, operation and Maintenance Instruction for Model #2475. Pages 9 and 10.
Oil Change (3 months or 500 hours)	1. Remove the oil drain plug and allow the lubricant to drain into a suitable container. 2. Replace the oil drain plug. 3. Unscrew and remove the oil fill plug. **Do not remove the oil fill plug while the compressor is running.** 4. Fill the crankcase with lubricant. (XL-300 or comparable petroleum based lubricant). 5. Replace the oil fill plug HAND TIGHT ONLY. 
Electric Drain Maintenance (monthly). Cleaning the filter screen	1. Close the strainer ball valve completely to isolate it from the air receiver tank. 2. Press the TEST button on the timer to vent the pressure remaining in the valve. Repeat until all pressure is removed. 3. Remove the plug from the strainer with a suitable wrench. If you hear air escaping from the cleaning port, STOP IMMEDIATELY and repeat steps 1 and 2. 4. Remove the stainless steel filter screen and clean it. Remove any debris that

	may be in the strainer body before replacing the filter screen. 5. Replace plug and tighten with wrench. 6. When putting the EDV-2000 back into service, press the TEST button to confirm proper function.
Tank Inspection (once every 5 years)	Schedule a certified tank inspection within the first five years with Ingersoll-Rand.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

SOURCE	*HAZARDS*	*WHERE*	*RESULT*	*CONTROLS*
BIOLOGICAL	Insects, domestic animals	Site	Exposure to insects, spiders, could result in bites and/or allergic reactions. Dogs in area could become aggressive resulting in bites and injury.	First aid kits are available on site, wear gloves and PPE as outlined in this SOP. Stop work and wait in vehicle if necessary for dogs to leave area. Call animal control if necessary.
BODY MECHANICS	Not applicable			
CHEMICAL	Compressor Oil	air compressors		Level D PPE-gloves, clothing Wash hands before eating or drinking
ELECTRICAL	Expose to electrical circuits	Compressor motor/controls	Electrocution Electric shock	Grounding GFCI Lock out tag out procedures
GRAVITY	Uneven or slippery walking or working surface	Site/Sample location	Injury could occur from personnel slipping, tripping on terrain/rocks and falling while working onsite.	Use established access points to access sample location. Use ice melt if necessary during winter months.
MECHANICAL	Pinch points	Air compressor motor and pulleys	Hand injuries.	Ensure lock out tag out procedures are in place. Use proper level D PPE including gloves. Make sure to use proper tools when handling air compressor motor and pulleys.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
NOISE	Not applicable			
PRESSURE	Release of compressed air	Air Compressor Line	Eye injuries, injection.	Ensure lock out tag out procedures are in place. Use proper level D PPE including safety glasses and gloves. Pressure relief valve on air compressor, make sure to shut off valves prior to work.
RADIATION	Not applicable			
THERMAL	Hot surfaces on compressor motor, air line	Compressor Motor	Touching hot surfaces on the compressor motor could lead to burns, or hand injuries.	Use proper guarding on machinery, make sure to let equipment cool prior to work being performed.
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained workforce	Working outdoors/site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed,
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt.
APPLICABLE SDS	XL-300 air compressor oil
REQUIRED PERMITS/FORMS	Isolation Register
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOP's/ PROCEDURES/ WORK PLANS	
TOOLS	Hand Tools
FORMS/ CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	DATE
SAFETY OFFICER	DATE
LEAD OPERATOR	DATE
OPERATOR	DATE
OTHER	DATE
OTHER	DATE

Revisions:

Rev.	Description	Date	Approval

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

1	Annual updates and Updates to Risk Table for Consistency	12/22/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators performing routine maintenance and verification of elevation readings of the Dwyer pressure transducers installed throughout the BTL Treatment System.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer at Pioneer work sites. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach used to maintain and verify proper operation of the Dwyer pressure transducers. Tasks described in this SOP include depth to water measurement, verification, adjustments, removal, and replacement.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate health and Safety Plan.

TASK	INSTRUCTIONS
Gather Equipment	Operators will need to have a water level tape, grade rod, well keys, wrenches, leather gloves and notepad and pen prior to beginning any maintenance or verification tasks.
Confined Space Entry	A **Confined Space permit is required** before maintenance or adjustment of the Dwyer pressure transducers in the following locations; A1, A2, A3, B3, C3, D2 or D3 outlet structures. The operator is required to break the plane of the space with his/her hand and arm to access the pressure nut for removal or adjustment of the transducer.
Depth to Water measurement	Using the water level tape or grade rod measure from the north edge of the sample port in the outlet structure lid to the static water level in the outlet structure. Record this measurement on the field sheet. 

Measurement Verification	Once all of the manual measurements have been recorded for all of the outlet structures, the operator will enter the recorded values into the *Lagoon Elevations* spreadsheet located on the LAO computer in the operations building. This spreadsheet calculates the actual elevation of the water in feet and is used to compare to the displayed water elevation on the HMI for each outlet structure.
Transducer Adjustments	The transducer will require adjustment if the manually measured value differs +/- 0.10 from the displayed value. Refer to *Task Confined Space Entry* above for confined space entry requirements as needed. Adjustments are made by loosening the pressure nut on the top of the stilling well located inside of the outlet structure and raising or lowering the pressure transducer until the correct value is displayed on the HMI screen**.** Once the correct value is displayed retighten the pressure nut. 
Transducer Removal	**Caution:** The device is 4-20 mA devise, failure to remove power could result in electric shock or damage to the device. Prior to replacement of the transducer the operator must complete LO/TO of the device by removing the power supply to the device. The operator will locate the SCADA panel wiring diagram in the OM&M manual for the panel that the transducer receives power from and open the fuse for the device and lock the panel. Refer to *Task Confined Space Entry* above for confined space entry requirements as needed. Once LO/TO has been completed, remove the transducer wiring nuts at the junction box to disconnect the transducer from service. Then, securely attach a string or small diameter rope to the end of the transducer cable in the junction box. Note: the string is required to pull new transducer cable back to the junction box. Ensure sufficient length of string is prevent from pulling free end into the conduit. Locate the cable end of the transducer in the stilling well, and pull the old cable back (and string) through the conduit to the stilling well. The operator can then remove the old transducer from the stilling well located in the outlet structure by lifting the housing from the top of the stilling well. Once the transducer has been removed from the stilling well loosen the nut on top of the housing and pull the transducer wire thru the nut.

	
Transducer Replacement	To replace the transducer, loosen the nut on top of the housing and thread the transducer wire thru the nut. Once the wire has been pulled through the nut, securely attach the string or small diameter rope, from Task 6 above, to the end of the transducer cable and pull the new cable back through the conduit to the junction box. Reattach the wire nuts, complete and remove the LO/TO, and close the fuse to the devise. Verify the transducer is working properly and adjust if necessary following steps 4 and 5, above.
Documentation Updates	Complete work order documentation, eMMS records, update equipment data sheet as applicable for equipment replacements.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
BIOLOGICAL	Plants, insects, and animals	Sites	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Employees with allergies will notify their supervisor.
BODY MECHANICS	Bending, squatting, and kneeling	During monitoring and sampling activities	Bending, squatting, and kneeling during monitoring activities could result in muscle/back strains or	Personnel should stretch prior to starting work and they will take breaks when necessary.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

			other injuries.	
CHEMICAL	Potential contact with contaminated water	Testing sites, during field measurements	Inadvertent exposure to contaminated water could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site.
ELECTRICAL	Electric shock	Transducer connection in the junction box	Failure to LO/TO the devise when unhooking the wires, could result in electric shock or damage to the devise.	LO/TO of the devise prior to removal, do not handle electrical equipment with wet hands. Keep work areas as dry as possible.
GRAVITY	Falls from slips and trips	Uneven terrain, slick/muddy/wet surfaces and steep slopes	Walking/working on slick/muddy/wet, uneven, and steep terrain could cause slips and trips resulting in falls and injuries.	Workers will wear work boots with good traction and ankle support. Personnel will be aware of working/walking surfaces and choose a path to avoid hazards. Keep work areas as dry as possible.
MECHANICAL	Pinch points	Doors, gates	Personal injury could result from fingers getting pinched when opening/closing manhole covers.	Personnel will wear work gloves when opening/closing doors and gates.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Ultraviolet (UV) radiation	Outdoors	Employees could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Employees will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Employees should wear sunscreen, if necessary.
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained worker	Sites	Inexperienced workers and improper training could cause	Employees will be properly trained in this procedure and other applicable procedures.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

			incidents resulting in adverse health effects and/or property damage.	Employees will implement stop work procedures, if necessary.
WEATHER	Cold/heat stress Lightning	Sites Outdoor sites	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke. Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors. Employees will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP. Employees will follow the 30/30 rule during lightning storms.

ADDITIONAL HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

REQUIRED PPE	Level D PPE: Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, nitrile gloves, and work gloves.
APPLICABLE SDS	Safety Data Sheets (SDSs) are located in the Operations Building Control Room.
REQUIRED PERMITS/FORMS	Field Authorization Form (FAF)
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Hazwoper

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT

The following documents should be referenced to assist in completing the associated task.

P&IDS	
DRAWINGS	
RELATED SOP's/PROCEDURES/ WORK PLANS	*SOP-GW-03 Depth to Water Level Measurement*
TOOLS	Hand tools
FORMS/CHECKLIST	*Equipment Data Sheet.xls*

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

SOP TECHNICAL AUTHOR	**DATE**
Scott Sampson	
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman	
SYSTEM LEAD OPERATOR	**DATE**
Brad Hollamon	
SYSTEM OPERATORS	**DATE**

Revisions:

Rev.	Description	Date	Approval
1	Annual update and Update to Risk Table for Consistency	12/22/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators changing the screw conveyor oil.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work. This Standard Operating Procedure (SOP) defines the procedural approach required for seasonal changing of the Screw Conveyor Oil.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is outdated, inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons (BTL) Water collection and Treatment System, the Site-Specific Health and Safety Plan (SSHASP) for BTL, Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Screw conveyor oil change	1. De-energize screw conveyor assembly by shutting off main power to conveyor at silo control panel located in the Chemical Addition System Building (CASB) and lockout/tagout (LO/TO) the handle. 2. Use wrench to remove the drain plug from the reservoir housing of the screw conveyor drive casing. 3. Allow the old oil to gravity drain into a plastic drip pan until housing is empty. 4. Replace the drain plug that was removed in step 1. 5. Use wrench to remove the one casing bolt directly over the cap for the oil filler. 6. This will provide access to the filler cap which now can be removed. 7. With a flexible rubber hose fill the reservoir to the proper level with SAE 80W gear lube. 8. Replace the filler cap and the one casing bolt. 9. Dispose of oil in accordance with any federal, state and/or local regulations.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*RESULT*	*CONTROLS*
BIOLOGICAL	Insects and spiders	Site	Exposure to insects and spiders could result in bites and/or allergic reactions.	Training on the signs and symptoms of exposure to insects and spiders is required. Avoid contact with insects and spiders, and wear gloves when moving parts and opening lids. First-aid kits are available on site. Personnel with allergies will notify their supervisor.
BODY MECHANICS	Slips and trips	Walking and working surfaces	Wet, muddy, and/or cluttered walking/working surfaces could cause personnel to slip and/or trip resulting in injury.	Personnel will keep floors dry, keep the work areas organized and clear of equipment and tools, and use ice melt or sand during winter months as needed.
CHEMICAL	Lime	CASB	Inadvertent contact with residual lime dust on equipment/surfaces in the CASB and lime silo, and/or contact with treated water in the CASB could result in adverse skin reaction, such as burns, mucous membrane, eye and respiratory tract irritation.	Personnel will wear required PPE as listed in this SOP and nitrile gloves if contact with lime is possible. Personnel will also practice proper personal hygiene - wash hands before eating or drinking and after completing the task, and eating/drinking in designated areas. Avoid unnecessary contact with surfaces where lime can accumulate. Clean or wet areas to be accessed that have lime accumulation, if necessary.
	Gear Oil	Screw conveyor assembly	Inadvertent ingestion of gear oil via hand-to-mouth contact (i.e., eating outside of designated areas and poor hygiene) could result in gastrointestinal tract irritation. Accidental contact with	In addition to the PPE listed in this SOP, personnel will wear nitrile gloves when changing oil. Personnel will also practice proper personal hygiene - wash hands before eating

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
			gear oil may also cause eye, skin and/or respiratory tract irritation.	or drinking and after completing the task, nd eating/drinking in designated areas.
ELECTRICAL	Not applicable			
GRAVITY	Falls	CASB-elevated access platform	Personnel could fall when accessing and working on elevated platform resulting in injury.	The elevated access and working platforms are engineered with kick plates, railing, and access stairs to prevent falls.
MECHANICAL	Screw conveyor	Screw conveyor assembly	Personnel could be caught by screw conveyor when changing oil resulting in injury.	Personnel will LO/TO the screw conveyor drive motor circuit as outlined in Step 1 of this procedure. Personnel will practice LO/TO procedures as outlined in the Pioneer HASP.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained personnel	Site	Inexperienced personnel and improper training could cause incidents resulting in injury and/or property damage.	Personnel will be trained in this procedure/equipment and will understand the scope of work prior to starting work activities. Personnel will implement STOP work policy/procedures if there are any issues.
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D PPE: Hard hat, safety glasses, safety-toed boots, high-visibility outerwear, long-sleeved shirt, long pants, and nitrile and work gloves.
APPLICABLE SDS	Lime and gear oil. Safety Data Sheets (SDSs) are located in the Operations Building Control Room.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PERMITS/ FORMS	Isolation control register, Field Authorization Form (FAF), Task Risk Assessment (TRA) (if applicable).
ADDITIONAL TRAINING	Energy Isolation, Control of Work (CoW), 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
DRAWINGS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
RELATED SOPs/ PROCEDURES/ WORK PLANS	
TOOLS	Wrenches, drip pan, and flexible rubber hose.
FORMS/ CHECKLIST	..\..\BPSOU OM Manual\Op_Report_Blank - Controlled.xlsx

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
	1/11/13
SAFETY AND HEALTH MANAGER	**DATE**
	1/11/13
LEAD OPERATOR	**DATE**
	1/11/13
OPERATOR	**DATE**

OTHER	**DATE**
OTHER	**DATE**

Revisions:

Revision	Description	Date	Approval
1	Annual update and Update to Risk Table for Consistency	12/23/2020	Hailey Thompson

PURPOSE	Provide a uniform procedure for quarterly calibration of the Detcon Model TP-624D hydrogen sulfide monitor located at the West Camp pump station.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedure and approach for quarterly calibration of the Detcon Model TP-624D hydrogen sulfide monitor.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Operations Guide for Butte Treatment Lagoons (BTL) at Lower Area One (LAO) Groundwater Treatment System.

TASK	INSTRUCTIONS
1. Gather necessary equipment for calibration	The following items are needed to perform calibration of the Detcon Model TP-624D hydrogen sulfide monitor. Detcon Span gas kit- Span gas, regulator and tubing. (Located in the operations building of the BTL/LAO site). West Camp Site keys. Detcon Model TP-624D hydrogen sulfide monitor instruction manual. (located in the WCP building).
2. Calibration (Auto Span)	1. Refer to Section 3.4 of the instruction manual and follow steps a) thru e) to complete calibration of the Detcon Model TP-624D hydrogen sulfide monitor. 

SSE CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	H2S gas	WCP pump station	Exposure to H2S gas during calibration of the H2S meter	Use the minimum concentration and quantity of H2S gas necessary for calibration. Keep door open and operate exhaust fan while calibrating meter.
NOISE	Not applicable			
ELECTRICAL	Not applicable.			
BODY MECHANICS	Bending, squatting, and kneeling.	H2S meter inside WCP building.	Bending, squatting, and kneeling during monitoring activities could result in muscle/back strains or other injuries.	Personnel should stretch prior to starting work.
GRAVITY	Falls from slips and trips.	Slick/muddy/ wet surfaces.	Walking/working on slick/muddy/wet, surfaces could cause slips and trips resulting in falls and injuries.	Workers will wear work boots with good traction and ankle support. Personnel will be aware of working/walking surfaces. Personnel will utilize good housekeeping protocol within the Operations Building to remove wet areas.
WEATHER	Not applicable.			
RADIATION	Not applicable.			
BIOLOGICAL	Not applicable.			
MECHANICAL	Not applicable.			

PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained worker.	Sites.	Inexperienced workers and improper training could cause incidents resulting in adverse health effects and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement stop work procedures, if necessary.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, nitrile gloves, and work gloves.
APPLICABLE SDS	H2S calibration gas.
REQUIRED PERMITS/FORMS	
ADDITIONAL TRAINING	

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	BTL-SOP-04 West Camp Initial Arrival, BTL-SOP-44 WCP H2S Alarm Response
TOOLS	Span Gas Kit
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
SAFETY AND HEALTH MANAGER	**DATE**
LEAD OPERATOR	**DATE**
OPERATOR	**DATE**

Revisions:

Revision	Description	Date

PURPOSE	To provide standard instructions for operators performing routine shutdown and start-up of the West Camp Pump (P-WCP-1).
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP covers routine instructions followed to stop and re-start P-WCP-1

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Local-Manual Start/Stop of P-WCP-1 Pump	Access WCP-1 building as outlined in *BTL-SOP-04 Site Arrival/Check West Camp Pumping Station* and *BTL-SOP-44 H2S Alarm Response West Camp Pumping Station.* Evaluate system status on the VFD control panel located inside the WCP building • Record current pump flow rate and totalized flow from FIT-WCP-5008. Ensure the "LOCAL-OFF-REMOTE" switch on the pump is in the "LOCAL" position and the BFV-WCP-5009 valve is in the "OPEN" position. The valve is located inside the WCP building downstream of the flowmeter in the discharge piping. Select "LOCAL" on the VFD control panel. Press the green button on the VFD control panel touch pad to start the pumps. Adjust the pump speed by pressing the up arrow to increase speed or the down arrow to decrease speed. After pumps have been started, inspect piping for any signs of leakage. Stop the pump by pressing the red stop button located on the front of the VFD control panel touch pad. In the event of an emergency, press the E-stop button located on the front of the VFD control panel. **Verify** pump operation has been stopped by 0 rpm indication on the VFD HMI screen and 0-gpm flow indication at FIT-WCP-5008, and inspections of the pump

discharge pipe. There should be no vibration or noise coming from the pipe. If long term shut down of the pump is required, place the main power disconnect located in the upper right hand corner of the VFD from On to the Off position.

If power to the VFD needs to be disconnected, place the electrical disconnect switch (EL-WC-105) to the "OFF" position. The switch is located on the South interior wall of the WCP building. Lock and tagout the switch.

Remote-HMI Operation

Automatic Pump Startup from HMI

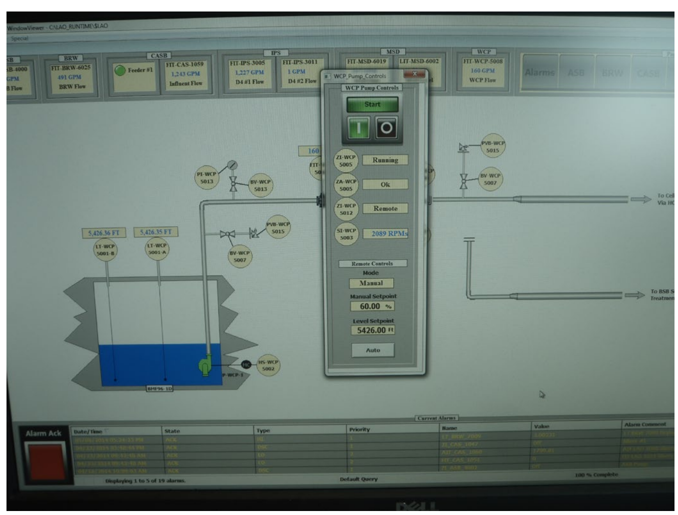
Ensure the VFD "LOCAL-OFF-REMOTE" switch is in the "REMOTE" position. Using the HMI screen in the operations building, left click the MC symbol on the WCP screen to access the WCP Pump Control box. Select "AUTO" mode and "START". In "AUTO" mode, the VFD is controlled by the "Level Setpoint". Set the desired WCP pumping well elevation to be maintained in the WCP Pump Control Box.

Manual Pump Startup from HMI

Ensure the VFD "LOCAL-OFF-REMOTE" switch is in the "REMOTE" position. Using the HMI screen in the operations building, left click the MC symbol on the WCP screen to access the WCP Pump Control box. Select "MANUAL" mode and "START". In "MANUAL" mode, the VFD is controlled by the "Manual Setpoint". Set the desired percentage of pumping speed in the WCP Pump Control Box to achieve desired pumping rate.

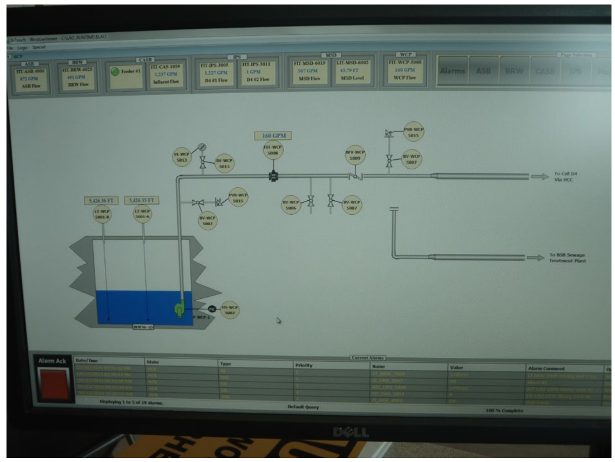
To stop the operating pump in either "auto" or "manual" in the WCP Pump Control box on the HMI click on stop.

In the event of an emergency, press the E-Stop button located on front of the VFD panel in the WCP building.



Water Level Monitoring and

When target water level elevation is reached, resume pumping. **DO NOT EXCEED CWL 5435'.** Water-level data will be forwarded to the agencies on a schedule that compares to monitoring activities, i.e. weekly, bi-weekly, and monthly.

Coordination	Continue to monitor water level readings from LT_WCP-5001A & B, monitored at well BMF96-1D, until target water level elevation is reached. 
Pumping and Monitoring	Continue pumping at a rate determined to be acceptable with LAO system capabilities. Continue to pump at a rate above normal operating flows to drop the water level in the underground mine workings. Reduce pumping rate to normal flow (~180 to 220GPM) when the water level approaches 5422'. Record the date, time, and totalized flow on FIT-WCP-5008 when normal level is achieved.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

SOURCE	*HAZARDS*	*WHERE*	*RESULT*	*CONTROLS*
BIOLOGICAL	Insects, domestic animals	Site	Exposure to insects, spiders, could result in bites and/or allergic reactions. Dogs in area could become aggressive resulting in bites and injury.	First aid kits are available on site, wear gloves and PPE as outlined in this SOP. Stop work and wait in vehicle if necessary for dogs to leave area. Call animal control if necessary.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
BODY MECHANICS	Not applicable			
CHEMICAL	H_2S Gas	Accumulate in building	Inadvertent exposure to H_2S gas from pipe failure could result in adverse health effects.	Building is equipped with an alarm that will trigger when levels reach half the permissible exposure limit. The alarm also signals a call out and flashes on outside of building to prevent entry.
ELECTRICAL	Not applicable			
GRAVITY	Not applicable			
MECHANICAL	Slips and trips Pinch Points	Walking and working surfaces Doors	Wet/mud and/or cluttered walking surfaces could cause employees to slip and/or trip, Fingers could be pinched when opening and closing doors and resulting in cuts, scrapes.	Keep floors dry, use ice melt or sand during winter months Use door handle when opening and closing the door. Do not place fingers between door and jam.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained	Site	Lack of understanding of	Workers will be properly trained in this procedure and applicable

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
	workforce		scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage.	procedures, STOP work policy will be followed,
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt.
APPLICABLE SDS	H_2S
REQUIRED PERMITS/FORMS	Field Authorization Form (FAF)
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-6-AB

DRAWINGS	P&ID-6-AB **MSE Drawings**: D46-15IN-023 Thru -029
RELATED SOP's/PROCEDURES/ WORK PLANS	*BTL-SOP-04 Site Arrival/Check West Camp Pumping Station* *BTL-SOP-44 H2S Alarm Response West Camp Pumping Station.*
TOOLS	None
FORMS/CHECKLIST	Operations Guide for Butte Priority Soils Operable Unit. Butte Treatment Lagoons (BTL) at Lower Area One (LAO) Groundwater Treatment System

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
	12/8/14
SAFETY OFFICER	**DATE**
	12/8/14
LEAD OPERATOR	**DATE**
	12/8/14
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	

Revisions:

Rev.	Description	Date	Approval
1	Annual updates and Updates to Risk Table for consistency	12/23/2020	Hailey Thompson

PURPOSE	To provide standard instructions for operators replacing the actuating Solenoid and pneumatic knife gate valve.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This Standard Operating Procedure (SOP) defines the procedural approach used to replace the actuating solenoid and 10" Salina Vortex pneumatic knife valve on the AccuRate Feeder.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is outdated, inaccurate, or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons (BTL) Water collection and Treatment System, the Site-Specific Health and Safety Plan for BTL, Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Replacing the actuating solenoid and 10" Salina Vortex pneumatic knife valve on the AccuRate Feeder	1. Place the lime feed system in Volumetric mode by following *SOP-28 Volumetric Lime Addition Startup* making sure the Salina Vortex knife gate is in the open position. 2. Shut off air supply from the compressor by closing the ball valve on the air supply line located inside the lime silo and lock out/tag out (LO/TO). 3. Disconnect the three air supply hoses from the actuating solenoid by removing them from the fittings. 4. Unbolt the actuating solenoid assembly from the stabilizing bracket. 5. Remove the 10 bolts to the cover of the pneumatic knife gate. 6. Disconnect the cylinder piston from the pneumatic knife gate by removing the 2 connector bolts. 7. Replace with the new actuating solenoid assembly using the reverse procedure. 8. Remove excess lime buildup from the knife gate by scrapping with a putty knife (scraper). 9. Disconnect the pneumatic knife gate from the cylinder piston rod by removing the 2 connecting bolts. 10. Disconnect the old pneumatic knife gate cylinder housing by removing the 4 large diameter bolts. 11. Reconnect the new pneumatic knife gate cylinder housing by replacing the 4 large diameter bolts.

	12. Reconnect the cylinder piston rod to the pneumatic knife gate using the 2 connecting bolts. 13. Replace all 10 bolts from the pneumatic knife gate cover. 14. Reconnect the air supply hoses. 15. Return the air supply to the cylinder by opening the ball valve on the air supply line and check for air leaks. 16. Return the lime feed system to Gravimetric mode by switching the controls on the control panel in the Chemical Addition System Building (CASB) and following the *SOP-3 Gravimetric Lime Addition Startup*.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	***HAZARDS***	***WHERE***	***RESULT***	***CONTROLS***
BIOLOGICAL	Insects and spiders	Site	Exposure to insects and spiders could result in bites and/or allergic reactions.	Training on the signs and symptoms of exposure to insects and spiders is required. Avoid contact with insects and spiders, and wear gloves when moving parts and opening lids. First-aid kits are available on site. Personnel with allergies will notify their supervisor.
BODY MECHANICS	Slips and trips	Walking and working surfaces	Wet, muddy, and/or cluttered walking/working surfaces could cause personnel to slip and/or trip resulting in injury.	Personnel will keep floors dry and keep walking/working areas free from clutter/debris.
CHEMICAL	Hydrated lime	CASB and lime silo	Inadvertent contact with residual lime dust on equipment/surfaces in the CASB and lime silo, and/or contact with treated water in the CASB could result in adverse skin reaction, such as burns, mucous membrane, eye and respiratory tract irritation. Inadvertent ingestion of lime via hand-to-mouth	Personnel will wear required PPE as listed in this SOP and nitrile gloves if contact with lime is possible. Personnel will practice proper personal hygiene - wash hands before eating or drinking and after completing the task, eating/drinking in designated areas. Avoid unnecessary contact with surfaces where lime can accumulate. Clean or wet

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

			contact (i.e., eating outside of designated areas and poor hygiene) could result in gastrointestinal tract irritation.	areas to be accessed that have lime accumulation if necessary.
ELECTRICAL	Not applicable			
GRAVITY	Falls	Elevated work platforms inside the silo	Personnel could fall when accessing and working on elevated platform resulting in injury.	The working platforms are engineered with kick plates, railing, and access stairs to prevent falls.
	Falling objects	Inside the silo	Objects could fall from elevated work platforms inside the silo and strike personnel working under the platforms.	The working platforms are engineered with kick plates, railing, and access stairs to prevent objects from falling.
MECHANICAL	Unwanted operation of knife gate	Knife gate actuator	Exposure to energized knife gate while completing the steps listed above can result hand/finger injuries, laceration, and amputation.	Personnel will follow the LO/TO procedures for the air supply as described in Step 2 of this SOP and in the Pioneer HASP.
	Pinch points	Hand tools	Fingers could be pinched when using hand tools to manipulate and removed bolts resulting in cuts and scrapes.	Personnel will wear required PPE as listed in this SOP and work gloves when using hand tools. Personnel will also inspect hand tools before each use.
NOISE	Not applicable			
PRESSURE	Air compressor line	Solenoid/ actuator assembly	Unexpected build up in the compressor line could cause the line to rupture/burst. Personnel could be struck by hoses/lines and/or exposed to lime resulting in injury and/or adverse health effects.	Air compressor is equipped with pressure relief valves on shut off valves. Personnel will wear required PPE as listed in this SOP. Personnel will follow LO/TO procedures as outlined in this SOP and in the Pioneer HASP.
RADIATION	Not applicable			
THERMAL	Not applicable			

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained personnel	Site	Inexperienced personnel and improper training could cause incidents resulting in injury and/or property damage.	Personnel will be trained in this procedure/equipment and will understand the scope of work prior to starting work activities. Personnel will implement STOP work policy/procedures, if there are any issues.
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D PPE: Hard hat, safety glasses, safety-toed boots, high-visibility outerwear, long-sleeved shirt, long pants, work gloves, and nitrile gloves.
APPLICABLE SDS	Lime. Safety Data Sheets (SDSs) are located in the Operations Building Control Room.
REQUIRED PERMITS/ FORMS	Isolation control register, Field Authorization Form (FAF), Task Risk Assessment (TRA) (if applicable).
ADDITIONAL TRAINING	Energy Isolation, Control of Work (CoW), 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
DRAWINGS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
RELATED SOPs/ PROCEDURES/ WORK PLANS	*SOP-3 Gravimetric Lime Addition System Startup* *SOP-28 Volumetric Lime Addition Startup*
TOOLS	Wrenches, screwdriver, and scraper/putty knife.
FORMS/ CHECKLIST	..\..\BPSOU OM Manual\Op_Report_Blank - Controlled.xlsx

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
Dave Giuffrida	**1/11/13**
SAFETY AND HEALTH MANAGER	**DATE**
Sara Scheeleman	**1/11/13**
LEAD OPERATOR	**DATE**
Brad Hallam	**1/11/13**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

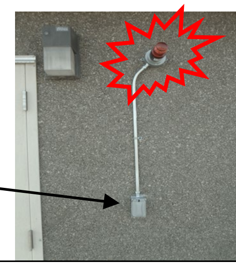
Revision	Description	Date	Approval
1	Annual updates and Updates to Risk Table for Consistency	12/23/2020	Hailey Thompson

PURPOSE	The purpose of this document is to provide standard, safe and appropriate level of response instructions for operators responding to the H_2S alarm (AIT-WCP-5000) at West Camp.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work. This SOP defines the procedural approach used to responding to H_2S alarm at the West Camp Pumping Station.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Alarm Indication while in WCP Control Building	H_2S levels >10ppm in the building will cause alarm activation. Alarm activation includes both audible and visual alarm activation to notify personnel of H_2S. If the H_2S alarm is activated while inside the West Camp control building the personnel shall follow the steps provided below:
Alarm response	Immediately evacuate the building by exiting the man door and using the north gate, verify the exhaust fan is ON, If exhaust fan is not running, manually turn the fan ON using the ON/OFF switch located on the exterior wall on the north side of the man door below the H_2S alarm light. 
Verify H_2S Concentration	Return to the Operations Building and verify H2S concentration at the WCP building from the WCP HMI screen
If the readout is below 20 ppm	If the readout is below 20 ppm: a. The area is safe, 911 emergency response personnel is not warranted. b. Continue to monitor the H2S concentration from the Operations Building and allow ventilation to circulate/exhaust the gas to the outside of the WCP building. The alarm will automatically reset once the H2S concentration is below 10 ppm. Alarm reset will silence the audible and

	visual alarms.
If the readout is above 20 ppm:	c. If the readout on the H_2S meter is above 20 ppm **Dial 911** to notify proper emergency **response personnel to 526 Centennial Avenue**, Butte. d. Inform officials of the alarm and of the high H_2S condition (>20ppm).
Wait for emergency response	Do not enter the building until **emergency response personnel** has designated the site safe for re-entry.
H_2S alarm is activated upon arrival (*exterior light is ON*).	**Do NOT enter the building.** Use the externally mounted switch to turn the exhaust fan ON in the event that the exhaust fan did not activate with the alarm automatically. Evacuate the site immediately by moving upwind. 
Notify emergency response personnel.	**Dial 911** to notify emergency response personnel if H_2S levels are above 20ppm at the West Camp pumping station, 526 Centennial Avenue, Butte as indicated on the WCP HMI screen located at the Operations Building.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARDS***	***WHERE***	***RESULT***	***CONTROLS***
BIOLOGICAL	Insects, domestic animals	Site	Exposure to insects, spiders, could result in bites and/or allergic reactions. Dogs in area could become aggressive resulting in bites and injury.	First aid kits are available on site, wear gloves and PPE as outlined in this SOP. Stop work and wait in vehicle if necessary for dogs to leave area. Call animal control if necessary.
BODY MECHANICS	Not applicable			
CHEMICAL	H_2S Gas	Accumulate in	Inadvertent exposure to H_2S	Building is equipped with an alarm that will trigger when

HSSE CONSIDERATIONS
This section to be completed with concurrence from the Safety Officer.

		building	gas from pipe failure could result in adverse health effects and in extreme cases death. Inadvertent opening of sampling valves.	levels reach half the permissible exposure limit. The alarm also signals a call out and flashes on outside of building to prevent entry. BV-WCP-5006 & BV-WCP-5007 car seal closed (C.S.C.) to prevent inadvertent opening.
ELECTRICAL	Not applicable			
GRAVITY	Uneven or slippery walking or working surface	Site	Injury could occur from personnel slipping, tripping on terrain/rocks and falling while working onsite.	Use established access points to access sample location. Use ice melt if necessary during winter months.
MECHANICAL	Slips and trips Pinch Points	Walking and working surfaces Man doors	Wet/mud and/or cluttered walking surfaces could cause employees to slip and/or trip, Fingers could be pinched when opening and closing doors resulting in cuts, scrapes.	Keep floors dry, use ice melt or sand during winter months Use door handle when opening and closing the door. Do not place fingers between door and jam.
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Not applicable			

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained workforce	Site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed.
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt, gloves
APPLICABLE SDS	H2S
REQUIRED PERMITS	Field Authorization Form (FAF)
REQUIRED TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-6-AB.
DRAWINGS	**PTS Drawings**: WCP-C-1 Thru C-4
RELATED SOP's/PROCEDURES/ WORK PLANS	*BTL-SOP-04 Site Arrival/Check West Camp Pumping Station*
TOOLS	NA
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
Dave Griffis	**12/8/14**
SAFETY OFFICER	**DATE**
Sara Scheeleman	**12/8/14**
LEAD OPERATOR	**DATE**
Brad Hall	**12/8/14**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

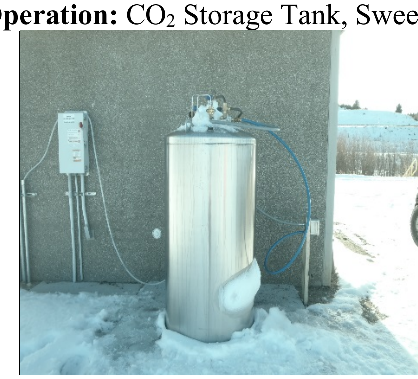
Revisions:

Rev.	Description	Date	Approval
1	Annual updates and Update to Risk table for consistency	12/23/2020	Hailey Thompson

PURPOSE	To establish a uniform procedure for adding carbon dioxide (CO_2) to treated effluent flow stream to assist operations in maintaining pH at target levels during winter months/freezing conditions when ice cover over the lagoon cells adversely affects treatment.
SCOPE	This practice is prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate health and Safety Plan.

TASK	INSTRUCTIONS
	Environmental Considerations
Preparation	Prior to freezing conditions at the BTL site, inspect the CO_2 addition equipment. Check the CO_2 storage tank for any signs of failure, cracks, deformation, corrosion, etc. Make sure that the tank is full and the flow meter, pressure gauges are in good working order.
Continued Monitoring	Although the equipment has been inspected and made ready for use, operators should continue to monitor effluent pH. Do not add CO_2 until pH trends indicate addition is required. Refer to Table 1 below.
	Equipment Operation: CO_2 Storage Tank, Sweetwater® Diffuser 
CO_2 Tank Delivery	Contact General Distributing (406) 723-5491 to arrange CO_2 tank delivery. CO_2 will be delivered once per month on the first Tuesday of the month once CO_2 addition begins. If additional CO_2 is required contact General Distributing for extra delivery.

Daily Tank Inspection

Operators will inspect the CO_2 tank daily for pressure and CO_2 remaining in the tank.
Clear any accumulated snow/ice from the top of the tank.
Additional CO_2 will be ordered once the tank level goes below ¼ full.



Determine CO_2 Flow Rate

CO_2 addtion is based on pH and flowrate at Cell A2.

Locate the nearest pH reading of the effluent in the pH column (vertically).
Locate nearest effluent flow measurement in the effluent flow rate column (horizontally).

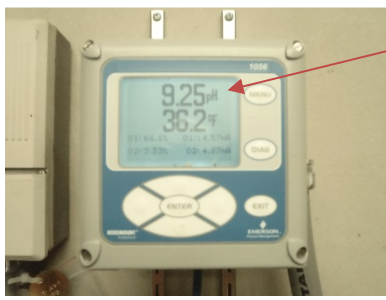
Set the CO_2 addition rate (cfh) where these values intersect in the table below.

Table 1. CO_2 Addition Flow Rate (cfh).

	Effluent Flow Rate (GPM)							
pH	**800**	**900**	**1,000**	**1,100**	**1,200**	**1,300**	**1,400**	**1,500**
9.8	14.3	16.1	17.9	19.7	21.5	21.5	25	26.8
9.7	11.4	12.8	14.3	15.7	17.2	18.6	20	21.4
9.6	8.6	9.6	10.7	11.8	12.9	14	15	16.1
9.5	5.7	6.4	7.2	7.9	8.6	9.3	10	10.7

CO_2 Adjustment

Once operators confirm the correct CO_2 flow required from the table above, the CO_2 flow can be adjusted by turning the flow control knob located on the left-hand side of the flow meter to achieve the desired flow rate at the rotometer shown below.

Monthly inspection	Perform visual inspection of the diffuser, regulator, pressure gauge and piping/tubing distribution system for apparent signs of degradation or damage. Temporarily suspend CO_2 addition and replace components as needed.
Monitoring	
Calibration	Calibrate the pH probe with 7.00 and 10.01 buffer solutions prior to performing pH measurements. Refer to BTL-SOP-36.
Daily Sampling	Record pH and temperature measurements at OS-5, OS-7, and EFS-07 each day.
Additional Sampling	Measure alkalinity at EFS-07 **monthly** while the CO_2 addition system is operating.
Verify Real Time Readings	**Effluent pH must be maintained** below a maximum pH of 9.5 S.U. 
CO_2 Flow Adjustments	Adjustment CO_2 flow rate from these data evaluations to optimize the system and keep the pH of the effluent below a maximum pH of 9.5 S.U.
Reporting	
Daily	Record field parameters described in the Monitoring Section above on the Daily Cell Data spreadsheet.
Weekly	Compile CO_2 data with the effluent flow, pH, and temperature data obtained while collecting daily and weekly parameters at LAO.
Annual	A detailed description of CO_2 addition will be included in the BTL Operations Annual Report. This will include the duration of CO_2 addition, a range of pH measurements, average CO_2 addition, and any additional details relevant to CO_2 addition.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
BIOLOGICAL	Plants, insects, and animals	Sites	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits are available on site. Personnel with allergies will notify their supervisor.
BODY MECHANICS	Bending, squatting, and kneeling	During monitoring activities	Bending, squatting, and kneeling during monitoring activities could result in muscle/back strains or other injuries.	Personnel should stretch prior to starting work and they will take breaks when necessary.
CHEMICAL	Potential contact with calibration buffer solutions	During calibration of pH probe	Inadvertent exposure to calibration buffer solutions could result in skin/eye irritation.	Personnel will wear safety glasses and nitrile gloves when using the calibration buffer solutions.
ELECTRICAL	Not applicable			
GRAVITY	Falls from slips and trips	Uneven terrain, slick/muddy/wet surfaces and steep slopes	Walking/working on slick/muddy/wet, uneven, and steep terrain could cause slips and trips resulting in falls and injuries.	Personnel wear work boots with good traction and ankle support. Personnel are aware of working/walking surfaces and choose a path to avoid hazards.
MECHANICAL	Not applicable			
NOISE	Not applicable			
PRESSURE	Compressed gas	Tank	The CO_2 tank contains gas under pressure. If heated, the tank could burst or explode causing serious	Protect the tank from sunlight when the ambient temperature exceeds 125°F.

			personal injuries and property damage.	
RADIATION	Ultraviolet (UV) radiation	Outdoor sites	Personnel could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Personnel will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Personnel should wear sunscreen, if necessary.
THERMAL	Frostbite	Cryogenic Tank	Compressed gases may create low temperatures when they expand rapidly. Leaks and uses that allow rapid expansion may cause a frostbite hazard if direct contact with skin and/or eyes occurs.	Inspect tank for leaks prior to starting work. Close valve after each use and when empty. Avoid contact with eyes, skin, and clothing. Personnel will wear work gloves, if contact with CO_2 is possible. If frostbite occurs, immediately move indoors and slowly warm up the frozen tissues. Seek medical attention. **Caution** – Do not vigorously rub frostbite areas. Place in room temperature water.
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained personnel	Sites	Inexperienced personnel and improper training could cause incidents resulting in adverse health effects and/or property damage.	Personnel will be properly trained in this procedure and other applicable procedures. Personnel will implement stop work procedures, if there are any issues.
WEATHER	Cold/heat stress	Outdoor sites	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow

	Lightning	Outdoor sites	Electrocution injury, death, or equipment damage could result from lightning strike.	procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP. Personnel will follow the 30/30 rule during lightning storms.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D PPE: Hard hat, safety glasses, long-sleeved work shirt, high-visibility outwear, long pants, safety-toed boots, nitrile gloves, and work gloves.
APPLICABLE SDS	Heavy metals, carbon dioxide, and buffer solutions. Safety Data Sheets (SDSs) are located in the Operations Building Control Room.
REQUIRED PERMITS/FORMS	Field Authorization Form (FAF)
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	BTL P&ID3AB
DRAWINGS	NA
RELATED SOPs/ PROCEDURES/ WORK PLANS	*Final Butte Treatment Lagoons (BTL) CO_2 Influent Addition and Effluent/Silver Bow Creek Monitoring Work Plan.*
TOOLS	Hand tools
FORMS/ CHECKLIST	Field parameter form

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Scott Sampson	
SAFETY AND HEALTH MANAGER	**DATE**

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
Tara Schleeman	
SYSTEM LEAD OPERATOR	**DATE**
Brad Hollamon	
SYSTEM OPERATOR	**DATE**

Revisions:

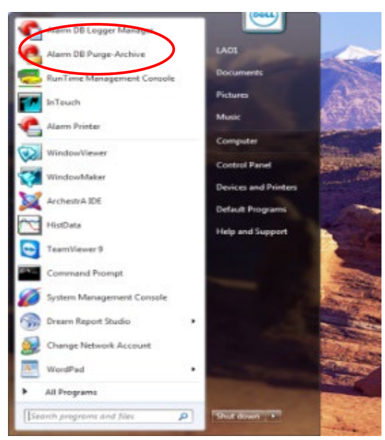
Revision	Description	Date
2	Annual update and update risk table for consistency	12/23/2020

PURPOSE	Provide a uniform procedure for restarting the alarm logging programs related to the Wonderware HMI system located inside the Operations Building. The Wonderware HMI restarts automatically upon computer reboot.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

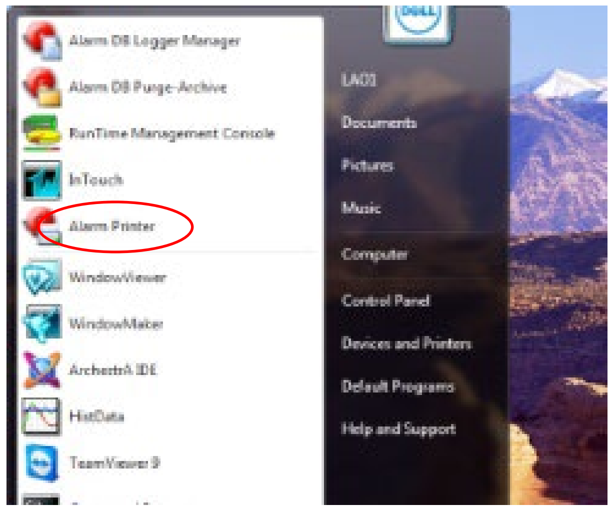
The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate health and Safety Plan.

TASK	INSTRUCTIONS
Butte Treatment Lagoon HMI System Re-Starts automatically upon LAO1-PC reboot.	
Program Re-Start	The following programs must be re-started and minimized when the HMI is restarted to activate system alarm logging. Lime feed setpoint – Step 2 below Alarm DB Purge – Step 3 below Alarm DB Printer – Step 4 below
Lime feed setpoint	1. Refer to *BTL-SOP-1 Chemical Addition System (CAS) Building Initial Arrival.*
Alarm DB Purge	Open alarm DB Purge on the HMI start menu. 1. Select - **Purge/Archive Tab** 2. Then **activate the purge utility** 3. Minimize the application by clicking on the minimize button located in the upper right corner of the window.



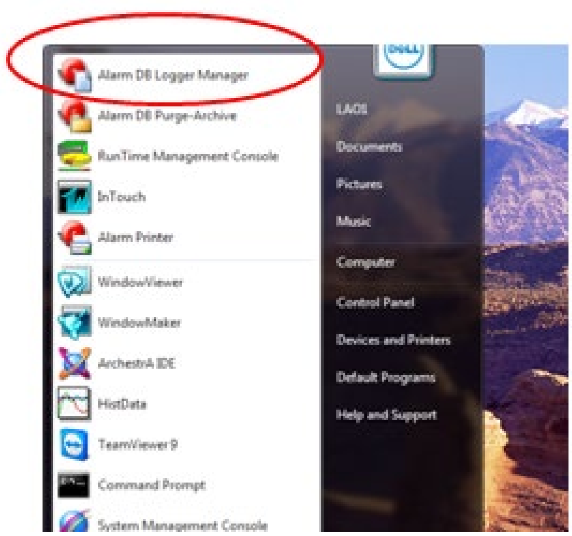
<table>
<tr>
<td>Alarm DB Printer</td>
<td>
Open the Alarm DB Printer on the HMI start menu

1. Open LAO Alarm Printer Config
2. Click on File, select LAO ALARM PRINTER CONFIG
3. Query
    1. Select - **Start/Stop**
    2. Minimize the application



</td>
</tr>
<tr>
<td>Alarm DB Manager</td>
<td>
Start the Alarm DB Manager.

1. Open **“Alarm DB Manager”** located HMI computer start menu.
2. Select “Start” and minimize the application.



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</table>

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
BIOLOGICAL	Not applicable			
BODY MECHANICS	Bending, squatting, and kneeling.	HMI console area.	Bending, squatting, and kneeling during monitoring activities could result in muscle/back strains or other injuries.	Personnel should stretch prior to starting work.
CHEMICAL	Not applicable			
ELECTRICAL	Not applicable			
GRAVITY	Falls from slips and trips.	Slick/muddy/ wet surfaces.	Walking/working on slick/muddy/wet, surfaces could cause slips and trips resulting in falls and injuries.	Workers will wear work boots with good traction and ankle support. Personnel will be aware of working/walking surfaces. Personnel will utilize good housekeeping protocol within the Operations Building to remove wet areas.
MECHANICAL	Not applicable			
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained worker.	Sites.	Inexperienced workers and improper training could cause incidents resulting in adverse health effects and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement stop work procedures, if necessary.
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, nitrile gloves, and work gloves.
APPLICABLE SDS	Safety Data Sheets (SDSs) will be maintained based on site characterization and contaminants.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	*BTL-SOP-1 Chemical Addition System (CAS) Building Initial Arrival*
TOOLS	
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Scott Sampson	**01/11/2016**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman	

Revisions:

Revision	Description	Date
1	Annual updates and updates to risk table for consistency	12/23/2020

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.		

PURPOSE	To establish a uniform procedure to safely and effectively perform system overview inspections at any site within the Butte Priority Soils Operable Unit (BPSOU).
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is outdated, inaccurate, or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this Standard Operating Procedure (SOP) will be consistent with procedures and policies described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons (BTL) Water Collection and Treatment System, the Site-Specific Health and Safety Plan for BTL, Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
A system overview assessment is a high-level visual inspection or walk around of the system, equipment, and immediate surroundings performed to identify general signs and indicators of damage, malfunction, degradation, and other anomalies that provide early warning of needed repairs, replacements, or alterations.	
Obtain tools and equipment	Specialty tools are not required for overview inspections.
Perform visual inspection of system components	Inspect exterior surfaces. Identify general signs and indicators of damage, malfunction, degradation, and other anomalies listed below. Electrical panels or enclosures do not need to be accessed. Internal assessment of panels is not required. ☐ Discoloration of equipment, piping, and housings. ☐ Unexpected accelerated deterioration or degradation. ☐ Changes in the noise generated by rotating equipment. ☐ Evidence of rust and corrosion. ☐ Settlement or surface cracking of trenches, well heads, and vaults. ☐ Damaged insulation or coverings. ☐ Significant peeling paint. ☐ Distortion or warping of equipment. ☐ Loose or broken electrical and signal wires. ☐ Deterioration, damage, or vandalism to system buildings, trailers, housings, and protective barriers.

	Condition of, or missing hazard/warning signs and field labels.
Complete Inspection Forms	Record and save the data on the appropriate inspection form.
Reporting	Include inspection log with quarterly inspection logs.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
BIOLOGICAL	Plants, insects, and animals	Outdoor sites	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, swelling, and serious injuries.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. If necessary, leave work area until animals leave and/or contact animal control. First-aid kits are available on site. Personnel with allergies will notify their supervisor.
BODY MECHANICS	Bending, squatting, and kneeling	BPSOU sites	Bending, squatting, and kneeling during inspection activities could result in muscle/back strains or other injuries.	Personnel should stretch prior to starting work and they will take breaks when necessary.
CHEMICAL	Potential contact with impacted water	BPSOU sites	Inadvertent exposure to impacted water could lead to adverse health effects.	Personnel will wear required PPE as listed in this SOP and nitrile gloves if contact with impacted water is possible. Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site.
ELECTRICAL	Not applicable			
GRAVITY	Falls from slips and trips	Uneven terrain, slick/muddy/wet surfaces and steep slopes	Walking/working on slick/muddy/wet, uneven, and steep terrain could cause slips and trips resulting in falls and injuries.	Personnel will wear work boots with good traction and ankle support. Personnel will be aware of working/walking surfaces and choose a path to avoid hazards. Keep work areas as dry as possible.

MECHANICAL	Pinch points	Manhole covers, doors, gates, and hand tools	Personal injury could result from fingers getting pinched when opening/closing manhole covers, doors and gates, and when using hand tools.	Personnel will wear work gloves, watch for hand/finger placement, and inspect hand tools before each use..
NOISE	Elevated noise levels from operating equipment	IPS, WCP-1, CAS, and BPSOU Subdrain	Exposure to elevated noise levels could result in temporary changes in hearing, reduced concentration and productivity, and hearing damage.	Personnel will carry hearing protection and wear when necessary. Personnel will also limit the amount of time spent in areas with elevated noise levels.
PRESSURE	Not applicable			
RADIATION	Ultraviolet (UV) radiation	Outdoor sites	Personnel could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Personnel will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Personnel should wear sunscreen, if necessary.
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained personnel	BPSOU sites	Inexperienced personnel and improper training could cause incidents resulting in injuries and/or property damage.	Personnel will be trained in this procedure/equipment and will understand the scope of work prior to starting work activities. Personnel will implement STOP work policy/procedures, if there are any issues.
	Lightning	Outdoor sites	Electrocution, injury, death, or equipment damage could be	Personnel will avoid interaction with the public by stopping work if members of the public enter work area.

			caused by lightning strike.	
WEATHER	Cold/heat stress	Outdoor sites	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.
	Lightning	Outdoor sites		Personnel will follow the 30/30 rule during lightning storms as outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D PPE: Hard hat, safety glasses, high-visibility work shirt or vest, long pants, safety-toed boots, nitrile gloves, and work gloves.
APPLICABLE SDS	Safety Data Sheets (SDSs) will be maintained based on site characterization and contaminants. SDSs are located in the Operations Building Control Room.
REQUIRED PERMITS/ FORMS	Overview inspection log
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	BTL/LAO Site Plot Plan.
RELATED SOPs/ PROCEDURES/ WORK PLANS	BTL-SOP- 01 CASB Initial Site Arrival

TOOLS	N/A
FORMS/ CHECKLIST	Overview Inspection Log

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman	**08/15/2015**

Revisions:

Revision	Description	Date
1	Annual updates and updates to Risk table for consistency	12/23/2020

PURPOSE	To provide standard instructions for operators performing BPSOU Subdrain Pump Station start up.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (PTS) workforce and applies to work carried out by and on behalf of PTS at PTS work sites. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This SOP defines the procedural approach used to start the Subdrain Pump Station pumps to avoid system problems.

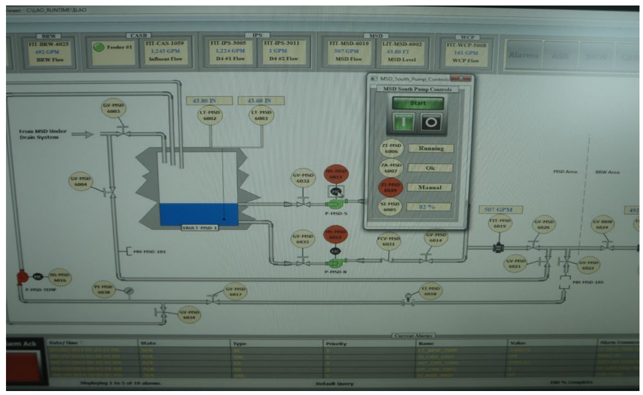
WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate health and Safety Plan.

TASK	INSTRUCTIONS
Subdrain Pump configuration	The two BPSOU Subdrain pump station VFD pump control panels are located inside the Subdrain building north of George St. near the Chamber of Commerce. These provide electrical service control for the two Ampco Model E 4X3C centrifugal pumps. For each pump control a LOCAL-OFF-REMOTE switch controls the status of each pump. The two Ampco Model E 4X3C pumps will not operate in the OFF position. The two Ampco Model E 4X3C pumps can be operated in two different configurations (Local or Remote). If in the remote position the pumps can be operated from the HMI located in the Operations building at the BTL/LAO site. In the Local or "Manual" configuration the pumps are operated from the VFD keypad located in the Subdrain control building. The procedures described below outline the process for start the Subdrain pumps in both configurations. 

Local-Manual Start/Stop	For operation of the two Ampco Model E 4X3C pumps in Local "Manual" mode the operator must have the VFD LOCAL-OFF-REMOTE switch on the VFD keypad in the LOCAL position. To avoid pumping system problems, the two Ampco Model E 4X3C pumps must not be started simultaneously. Prior to start up the operator must verify that valves GV-MSD-6003, GV-MSD-6013, GV-MSD-6014, GV-MSD-6032, GV-MSD-6033, GV-MSD-6051, GV-BRW-6024 and GV-BRW-6028 are in the "open" position and valves GV-MSD-6004, GV-MSD-6021, GV-MSD-6022, GV-MSD-6050 and GV-BRW-6027 are in the "closed" position. These valves are located inside the Subdrain Dry Vault, outside of the Dry Vault and at the discharge as designated on P&ID-7-AB. Select Local from the Local-off-Remote switch on the front of the VFD. The pumps are started by depressing the green button located on the touchpad on front of the VFD panel. The pump speed is controlled from the vault elevation and programming in the VFD, the higher the water level in the vault the faster the pumps will operate to maintain the vault level set point. After the pumps have been started, inspect piping for any signs of leakage. To stop the pump depress the red stop button located on the keypad or if an emergency depress the E-Stop button located in the Subdrain Dry Vault.
Automatic Startup from HMI	To operate the two Ampco Model E 4X3C influent pumps in the automatic mode the operator must have the VFD LOCAL-OFF-REMOTE switch in the REMOTE position and use the Subdrain Pump Control box located on the HMI screen in the Operations building for pump startup. To avoid pumping system problems, the two Ampco Model E 4X3C pumps must not be started simultaneously. Prior to start up the operator must verify that valves GV-MSD-6003, GV-MSD-6013, GV-MSD-6014, GV-MSD-6032, GV-MSD-6033, GV-MSD-6051, GV-BRW-6024 and GV-BRW-6028 are in the "open" position and valves GV-MSD-6004, GV-MSD-6021, GV-MSD-6022, GV-MSD-6050 and GV-BRW-6027 are in the "closed" position. These valves are located inside the Subdrain Dry Vault, outside of the of the dry vault and at the discharge as designated on P&ID-7-AB. The Subdrain Pump Control box is accessed by left clicking on the MC symbol on the BPSOU Subdrain screen on the HMI, the operator then clicks on the start button and the desired pump will start. In this configuration the VFD is controlled by the "Level Setpoint", the higher the water level in the vault the faster the pumps will operate to maintain the vault level set point.

If an emergency is encountered the operator depresses the E-Stop button located inside of the Subdrain Dry Vault or depressing the stop button on the Subdrain Pump Control box on the HMI screen inside of the Operations building.



HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	**HAZARDS**	**WHERE**	**RESULT**	**CONTROLS**
BIOLOGICAL	Insects, domestic animals	Site	Exposure to insects, spiders, could result in bites and/or allergic reactions. Dogs in area could become aggressive resulting in bites and injury.	First aid kits are available on site, wear gloves and PPE as outlined in this SOP. Stop work and wait in vehicle if necessary for dogs to leave area. Call animal control if necessary.
BODY MECHANICS	Not applicable			
CHEMICAL	Untreated Ground Water and heavy metals	BPSOU Subdrain Pump Station	Inadvertent ingestion via hand to mouth contact (i.e. eating outside of designated areas, poor hygiene) could result in adverse health effects.	Wear required PPE, wash hands before eating or drinking
ELECTRICAL	Electrocution	Power supply panel and pump	Injury or death could occur from	Lockout/tag out panel prior to troubleshooting work.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
		control panel	expose to high voltage.	Inspect equipment for loose connections damaged wiring prior to start up. Equipment will be grounded.
GRAVITY	Slips, trips, falls	Slippery walking or working surface	Injury could occur from personnel slipping, tripping or falling while working onsite due to wet floors or poor housekeeping.	Good housekeeping – tools and equipment will be picked up to prevent tripping hazards in the work area. Personnel will wear work boots with good traction and support. Pay attention to surroundings. Inspect work area prior to performing work.
MECHANICAL	Pinch Points	Opening/closing gate valves.	Injury could occur from fingers getting pinched in the valve handles while turning valve.	Gloves will be worn to protect hands and fingers throughout this process. Keep hands to outside of valve handle.
NOISE	Not applicable			
PRESSURE	Unexpected pressure build-up or release.	In piping during initial startup	Injury could occur from being splashed with impacted water, release of unexpected pressure in piping.	Open by-pass pressure relief valve on pump piping.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
RADIATION	Not applicable			
THERMAL	Minor burns	Hot surfaces on pump motors, electrical.	Contact with hot surfaces could cause minor burns or skin irritation.	Wear leather gloves, shut down pumps and allow to cool prior to maintenance activities.
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained workforce	Working outdoors/site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed,
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D PPE: Hard Hat, Safety glasses, Steel toe boots, Long pants, Long sleeve shirt, high visibility outer wear, and Gloves (on person).

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
APPLICABLE MSDS	Heavy metals
REQUIRED PERMITS/FORMS	Field Authorization Form (FAF). Level 1 and 2 HITRA (if applicable)
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher, Task Training

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	P&ID-7-AB.
DRAWINGS	Final drawings will be issued upon completion of construction as as-built drawings. Draft drawings are contained in the Draft O&M Manual.
RELATED SOP's/PROCEDURES/ WORK PLANS	SSHASP, Final Operation, Maintenance and Monitoring (OM&M) Plan for Priority Soils Operable Unit Volume II Metro Storm Drain Collection Systems
TOOLS	
FORMS/CHECKLIST	Isolation Control Register (if Appliacable).

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
SAFETY OFFICER	**DATE**
LEAD OPERATOR	**DATE**

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

OPERATOR	DATE
OTHER	DATE
OTHER	DATE

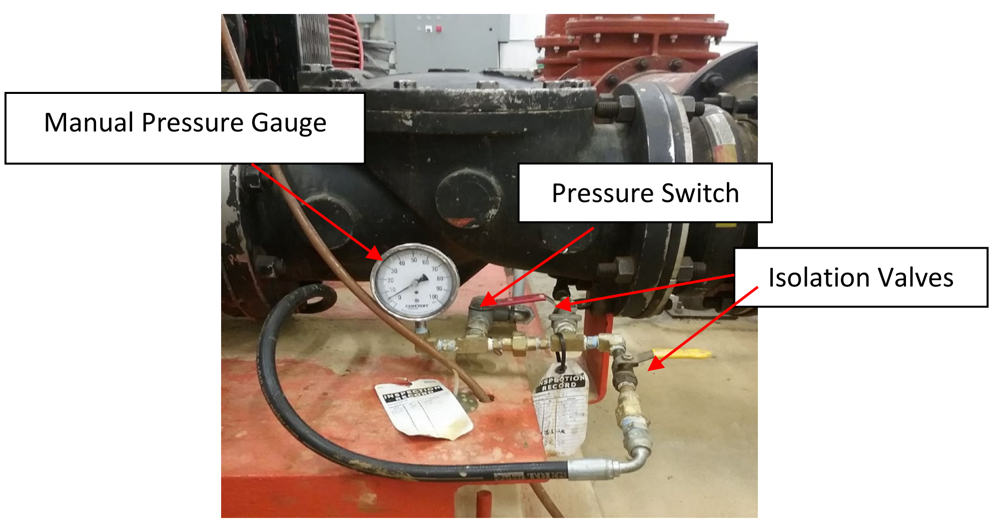
Revisions:

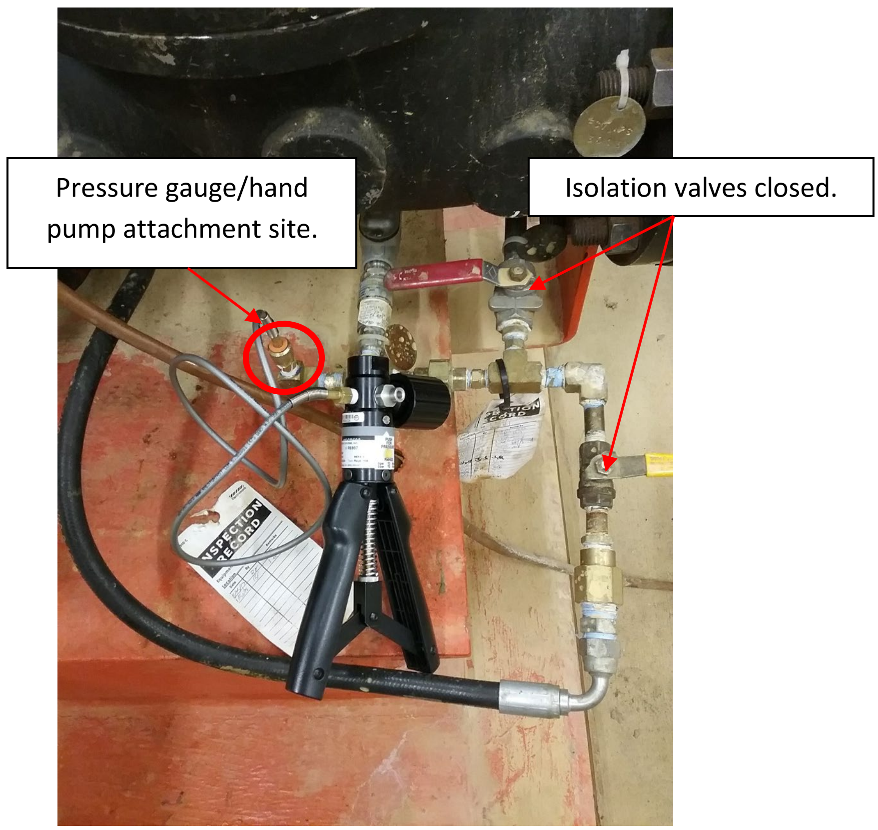
Rev.	Description	Date	Approval
2	Annual updates and updates to Risk table for Consistency	12/24/2020	Hailey Thompson

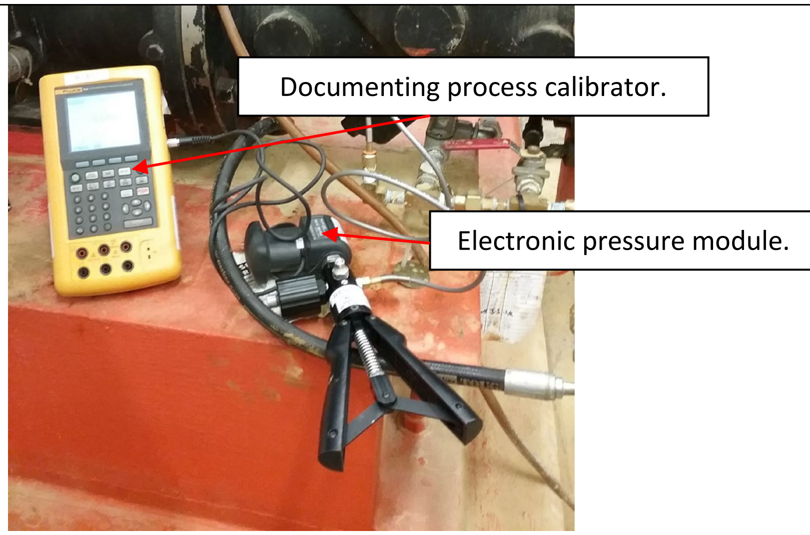
PURPOSE	To provide standard instructions for operators performing quarterly integrity management inspections and functional testing of pressure monitoring and safety equipment at the Internal Pumping Station (IPS).
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below. This Standard Operating Procedure (SOP) defines the procedural approach to quarterly integrity management of the IPS.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is outdated, inaccurate, or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons (BTL) Water collection and Treatment System, the Site-Specific Health and Safety Plan (SSHASP) for BTL, Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Check the BTL Operations HMI	Check the control system HMI screen for alarms for the IPS, and check for normal pump operation, and make note of which pump is running.
Initial work area inspection and check	Upon arrival at the IPS, inspect the area near water jacket circulation system valves and the pressure switch. Observe and report any visible leakage from the valves, tubing, or any other areas. Check the manual gauge for pressure. Check water flow through the water jacket circulation system. Any leaking valves, tubing or pressure gauges observed at this stage must be repaired prior to moving forward with testing. 

Isolation of pressure switch from water jacket circulation system	Isolate the pressure switch from the water jacket circulation system by first closing the isolation valve that is closest to the pump discharge, then followed by the second isolation valve. Water flow to the pressure switch has now been isolated from the system, this can be verified by reading the manual pressure gauge which should show an observable drop in pressure.
Removal of manual pressure gauge and attachment of hand pump	Using a crescent wrench, remove the manual pressure gauge. Attach the hand pump in place of the manual pressure gauge and ensure there is no air leakage from the connections. The hand pump will be used to pressurize the system to the alarm level of 80psig, to test the function of the pressure switch. It is important at this step to ensure that both isolation valves are fully closed and should remain so throughout the remainder of the testing procedure. 
Attachment of all other necessary testing equipment	Attach the electronic pressure module and documenting process calibrator to the hand pump. Both pieces of equipment are listed with specifics in the 'drawings, documents, and tools/equipment' table listed in this SOP. The function is to give the operator a real time read out of pressure that has been applied to the system, specifically when the 80psig alarm level has been reached.

	
Functional test of the pressure switch	Slowly pressurize the system by depressing the hand pump. The screen on the documenting process calibrator will give the operator a real time read of pressure applied to the system. Continue to depress the pump until 80psig is read from the screen on the documenting process calibrator. Hold 80psiq on the system for a minimum of 2 minutes to allow for the pressure switch alarm to appear on the HMI and operator callout to occur. IF PUMP IS RUNNING: allow for pump shut down to occur after pressurization of the system.
HMI alarm and operator callout verification	Check the LAO HMI computer alarm log to verify that the IPS pressure switch alarm occurred. Check with the operator on call to verify that an alarm callout was received. If the pump was running, verify that pump shutdown has occurred. Once all have been verified, the functional test of the pressure switch has been successful.
Depressurization of system	Using the bleeder valve located on the hand pump, slowly relieve the pressure on the system until the screen on the documenting process calibrator reads zero pressure. Slow release of pressure is important to prevent damage to the pressure switch or testing equipment.
Removal of equipment and replacement of manual pressure gauge	Using the crescent wrench, remove the hand pump from the water jacket circulation system. Replace the manual pressure gauge. Ensure that all fittings have been properly tightened, and that no leakage will occur when water is returned through the system.
Return water flow through the water jacket circulation system	Return water flow through the system by slowly opening the isolation valves. Open the valve closest to the pump discharge first, followed by a slow opening of the second valve. Slow opening is highly important, as to prevent a surge of pressure from occurring and damaging the pressure switch or the manual pressure gauge.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	HAZARD	WHERE	HOW, WHEN, RESULT	CONTROLS
BIOLOGICAL	Insects and spiders	Inside the IPS building	Exposure to insects and spiders may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to insects and spiders is required. Avoid contact with insects and spiders. First-aid kits are available on site. Personnel with allergies will notify their supervisor.
BODY MECHANICS	Bending, squatting, and kneeling	During inspection activities	Bending, squatting, and kneeling during monitoring activities could result in muscle/back strains or other injuries.	Personnel should stretch prior to starting work and they will take breaks when necessary.
CHEMICAL	Potential contact with untreated ground water (metals)	Water jacket circulation system	Inadvertent, prolonged contact with untreated water from the water jacket circulation system could result in adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site, and eating/drinking in designated areas. If contact with contaminated water is possible, personnel will wear nitrile gloves.
ELECTRICAL	Not applicable			
GRAVITY	Falls	Stairs to access IPS pumping station	Falls could occur as a result of slips and trips when walking up/down the stairs to access the IPS building.	Identify and avoid slippery surfaces and use the hand rail located within the stairway when accessing the IPS building.
MECHANICAL	Pinch points	Equipment covers, doors, and hand tools	Fingers could be pinched in equipment covers, doors, and/or hand tools resulting in cuts, scrapes, and other hand injuries.	Wear gloves when opening closing covers/lids and using hand tools, do not place fingers/hands between objects/doors/lids, and inspect hand tools before use.
	Moving/rotating equipment	IPS pumps and motors	Loose clothing/equipment could become caught in rotating pumps and motors, causing severe	Work area is located away from rotating equipment. Avoid walking/standing near pumps or motors while pumps are in

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
			physical injury.	operation.
NOISE	Elevated noise levels	Inside the IPS building	Prolonged exposure to elevated noise levels from operating equipment could result in temporary or permanent hearing damage.	Personnel will wear earplugs if prolonged exposure is expected or limit the amount of time spent in the working area.
PRESSURE	80psig of air pressure	Pressurization of pressure switch	Failure to tighten all fittings or use of faulty equipment could result in a rapid release of pressure causing physical injury.	Wear required PPE as outlined in this SOP, inspect all equipment before using, and inspect fittings for air leaks before testing.
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced and improperly trained personnel	Sites	Lack of understanding of the scope of work, inexperienced personnel, and improper training could cause incidents resulting in injury and/or property damage.	Personnel will be properly trained in this procedure and applicable procedures. Personnel will implement stop work procedures, if there are any issues.
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D Personal Protective Equipment (PPE): Hard hat, safety glasses, long-sleeved work shirt, high-visibility outwear, long pants, safety-toed boots, and nitrile/work gloves (as needed).

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
APPLICABLE SDS	Heavy metals. Safety Data Sheets (SDSs) are located in the Operations Building Control Room.
REQUIRED PERMITS/FORMS	Field Authorization Form (FAF)
ADDITIONAL TRAINING	Control of Work (CoW), 40-Hour Hazwoper, 8-Hour Refresher.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	NA
DRAWINGS	Site-wide drawings.
RELATED SOPs/ PROCEDURES/ WORK PLANS	Starting of IPS pumps.
TOOLS	Wrench, hand pump capable of 80psig, electronic pressure module (Fluke 700P07, 500psig range), documenting process calibrator (Fluke 744), and extra pipe fittings to attach hand pump to pressure switch.
FORMS/ CHECKLIST	IPS checklist.

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
	11/24/14
SAFETY AND HEALTH MANAGER	**DATE**
	11/24/14

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
LEAD OPERATOR	**DATE**
Brad Hallam	**11/24/14**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Revision	Description	Date	Approval
1	Annual updates and Updates to Risk Table for Consistency	12/24/2020	Hailey Thompson

PURPOSE	To provide standard instructions for the external inspection of a portable fire extinguisher, and emergency eye wash station.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (PTS) workforce and applies to work carried out by and on behalf of PTS. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work. This SOP defines the procedural approach used to perform an external inspection of a portable fire extinguisher, and emergency eye wash station.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate health and Safety Plan.

TASK	INSTRUCTIONS
Visually inspect extinguisher	Locate portable fire extinguisher to be inspected. Inspect for external damage, cracking, deformation, discoloration, and corrosion. Inspect for adequate cylinder/cartridge pressure. Pressure should be in the green area of the gauge on the extinguisher. Cartridge will be taken out of service if defects, damage, or inadequate pressure is observed. Inspection evaluation should compare as-found conditions to new condition. Initial the inspection tag on fire extinguisher.
Invert extinguisher	Invert extinguisher a few times to ensure powder does not become compacted on the bottom of the extinguisher
Visually inspect eye wash station	Locate eye wash station to be inspected. (Operations Building, CASB). Inspect for external damage, cracking, deformation, discoloration, and corrosion. Ensure nothing obstructs function of the eye wash and shower.
Manually test eye wash station	Activate the eye wash and allow to run water for approximately 10 -15 seconds. Activate the emergency shower and allow to run water for approximately 10 -15 seconds. Confirm water is clear and runs freely. Initial the inspection tag on eye wash.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARDS***	***WHERE***	***RESULT***	***CONTROLS***
BIOLOGICAL	Insects, domestic animals	Site	Exposure to insects, spiders, could result in bites and/or allergic reactions. Dogs in area could become aggressive resulting in bites and injury.	First aid kits are available on site, wear gloves and PPE as outlined in this SOP. Stop work and wait in vehicle if necessary for dogs to leave area. Call animal control if necessary.
BODY MECHANICS	Not applicable			
CHEMICAL	Hydrated Lime	Lime Silo#1 Lime	Inadvertent contact with residual lime dust on equipment/surfaces in lime silo# 1 or Lime silo # 2 , and/or contact with treated water could result in adverse skin reaction such as burns, mucous membrane, eye and respiratory tract irritation Inadvertent ingestion via hand to mouth contact (i.e. eating outside of designated areas, poor hygiene) could result in Gastrointestinal tract irritation	Wear required PPE as listed in this SOP, wash hands before eating or drinking. Avoid unnecessary contact with surfaces where lime can accumulate. Clean or wet areas to be accessed that have lime accumulation if necessary.
ELECTRICAL	Not applicable			
GRAVITY	Falls from slips, trips	Walking surfaces	Fall could result from tripping and/or slipping while walking on site resulting in injury	Keep walking/working areas free from clutter and/or debris. Keep floors dry, use ice melt or sand during winter months.
MECHANICAL	Pinch Points,	Extinguisher bracket, and	Fingers could be pinched when equipment covers	Wear gloves when removing extinguishers, keep

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
	slips, and trips	walking/ working surfaces	resulting in cuts, scrapes, wet/mud and/or cluttered walking surfaces could cause employees to slip and/or trip, Inadvertent contact with the screw conveyor could result in injury.	walking/working area free from clutter/debris. Keep floors dry, use ice melt or sand during winter months. .
NOISE	Not applicable			
PRESSURE	Not applicable			
RADIATION	Not applicable			
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained workforce	Site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed,
WEATHER	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt. Leather gloves when removing/replacing extinguisher
APPLICABLE SDS	Lime
REQUIRED PERMITS/FORMS	
REQUIRED TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher, Site Specific Training, OTJ Task Training

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOP's/PROCEDURES/ WORK PLANS	
TOOLS	
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
PROJECT MANAGER	**DATE**
SAFETY OFFICER	**DATE**
LEAD OPERATOR	**DATE**
OPERATOR	**DATE**
OTHER	**DATE**
OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval
1	Annual updates and updates to Risk Table for Consistency	12/24/2020	Hailey Thompson

PURPOSE	To provide standard instructions for the operation and routine maintenance of the Piranha dredge.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work. This SOP defines the procedural approach used to operate and maintain the Piranha Dredge.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and polices described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water collection and Treatment System, The Site Specific Safety and Health plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate health and Safety Plan.

TASK	INSTRUCTIONS
Visually inspect dredge	Check both engine crankcases for proper oil level, fill if necessary. Check fuel level in both engines, these require regular unleaded gasoline, fill if necessary. Inspect dredge intake and discharge hoses and connections, making sure gaskets are in place on hose connectors and hoses are not damaged. Inspect pontoon floats for damage, cracks, ect. Inspect dredge suction/agitator head, make sure debris screen is in place, and in good repair.
Connect suction and discharge hose to pump	Attach the pump discharge and intake hoses using the quick connect couplers, making sure coupler gaskets are in place. Attach the pole to the suction/agitator head. Add hose floats as needed along the intake and discharge hoses to prevent hoses from dragging along the bottom.
Prime pumps	Priming of both pumps is required prior to starting pumps. Damage may occur if pumps are started dry. Prime both pumps by removing the priming plug on top of each pump. Fill both pump casings with water until overflowing.
Starting pumps/dredging	Prior to starting pump, submerge the suction/agitator into the water. Start and operate the engines according to instruction in the owners manuals.

	It may take several minutes for the suction lines to fully fill with water. Once water begins to flow from the discharge hose, use the pole to position the suction/agitator into the material to be removed. If the engine begins to lug down, raise the suction head so that it is not picking up as much material and pump clean water to clear the line.
Dredge shutdown	Prior to shutting down the pumps on the dredge, pump clean water to flush the material from the hoses. Turn off both pump motors and drain hoses. If dredge is not to be used again in a short amount of time, drain both pumps heads also prior to storage.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARDS***	***WHERE***	***RESULT***	***CONTROLS***
BIOLOGICAL	Insects, domestic animals	Site	Exposure to insects, spiders, could result in bites and/or allergic reactions. Dogs in area could become aggressive resulting in bites and injury.	First aid kits are available on site, wear gloves and PPE as outlined in this SOP. Stop work and wait in vehicle if necessary for dogs to leave area. Call animal control if necessary.
BODY MECHANICS	Not applicable			
CHEMICAL	Exposure to gasoline, oils, and contaminated water	Dredge storage	Inadvertent contact with gasoline, oils, or contaminated water could result in skin irritations or injury.	Wear required PPE as outlined in this SOP and nitrile gloves to prevent contact with gasoline, oils, and contaminated water. Wash hands before eating or drinking.
ELECTRICAL	Not applicable			
GRAVITY	Falls from slips, trips	Walking surfaces	Fall could result from tripping and/or slipping while walking on site resulting in injury.	Keep walking/working areas free from clutter and/or debris. Keep floors dry, use ice melt or sand during winter months.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
MECHANICAL	Pinch Points	Doors and hand tools	Personal injury could result from fingers getting pinched when opening/closing manhole covers, doors and gates, and when using hand tools.	Personnel will wear work gloves, watch for hand/finger placement, and inspect hand tools before each use..
NOISE	Not applicable			
PRESSURE	Pressure around the suction/agitator head and in the hoses	Dredge	Pressure using the suction/agitator head and hoses could result in injury to personnel.	Personnel will wear proper PPE during inspection, ensure coupling gaskets are in place.
RADIATION	UV Radiation	Working outside	While working outdoors, workers could be exposed to UV radiation resulting in sunburns and could contribute to heat related illnesses.	Wear PPE as outlined in this SOP.
THERMAL	Hot surfaces on pump motors	Pump motors	While performing dredge inspection, contact with pump motors could result in injury.	Do not touch hot surfaces, let pump motors cool before inspection, wear proper PPE, including gloves, during inspection.
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained workforce	Site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed,

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D PPE: Hard Hat, Safety glasses, lace-up safety-toed shoes, high visibility outerwear, long-sleeved shirt. Leather gloves when removing/replacing extinguisher
APPLICABLE SDS	Lime
REQUIRED PERMITS/FORMS	
REQUIRED TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher, Site Specific Training, OTJ Task Training

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOP's/PROCEDURES/ WORK PLANS	
TOOLS	
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
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Revisions:

Rev.	Description	Date	Approval
1	Annual updates and updates to Risk Table for Consistency	12/24/2020	Hailey Thompson

PURPOSE	The purpose of this document is to provide a standard, safe, and appropriate level of instruction for deploying a floating work platform and cleaning the silt curtains located at the Butte Treatment Lagoons (BTL).
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer at Pioneer work sites. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work. This SOP defines the procedural approach used to perform the cleaning of the silt curtains located at the BTL facility. Removal of accumulated sludge is conducted once every two to three years to keep the silt curtains free of debris and allow more efficient flow through the A, B and C lagoon systems.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried out under this SOP will be consistent with procedures and policies described in the Draft Operation, Maintenance and Monitoring (O&M) Plan, Volume IV, Butte Treatment Lagoons Water Collection and Treatment System, The Site Specific Safety and Health Plan for the Butte Treatment Lagoons (BTL), Lower Area One (LAO), West Camp, Butte Reduction Works (BRW), and BPSOU Subdrain Operation and Maintenance (O&M) Activities, and Pioneer Technical Services Corporate Health and Safety Plan.

TASK	INSTRUCTIONS
Mobilize floating work platform(s) and Piranha dredge from the Dredge Storage Building (DSB) to A1 boat ramp.	Locate the floating work platforms, dredge, suction hoses and cables/rope in the DSB. Load the above equipment and secure onto the trailer for transport to the A1 boat ramp.
Assembly	Back trailer down the boat ramp and unload the equipment near the end of the ramp allowing access to complete assembly of the platform. Assemble the platform as shown on the manufacturer's assembly drawings, and install three sides of the removable safety rail system prior to deployment. Allow one small (end) section of the safety rail system to remain unattached. This section will allow personnel to access the platform and will be installed after accessing the platform. Note: Apply anti-seize lubricant to the bolts during assembly.

Deploy work platforms and dredge using boat ramp located in lagoon cell A1.	Fill Piranha dredge with fuel, attach suction and discharge hoses, test to make sure dredge is in proper working order. Using two people, position the platform and place into lagoon cell A1. Attach buoys to the dredge discharge hose sections as needed.
Connect guide cable/rope to working platform	Attach the platform guide ropes and Piranha dredge to working platform at the anchor points, with a granny knot, float the platform into A1 lagoon. Connect guide cable to the north and south side of the A1 lagoon utilizing the dredge anchor posts.
Position working platform in desired cell and begin dredging process.	Using the guide ropes attached to the platform, position the platform adjacent to the first section of silt curtain to be cleaned/dredged. This WILL be a section adjacent to the shoreline and at one end of silt curtain. Once the platform has been positioned, access the platform from shore and use the guide rope to make slight adjustments north/south along the silt curtain. Once the platform is positioned and stable, begin dredging following the steps outlined in the Piranha dredge operations manual and BTL-SOP-51.
Dredging Operation	Refer to manufacturers operations manual and BTL-SOP-51. Position the outlet end of the discharge hose in a location adjacent to the east back of treatment Cell B1. The discharge location should be chosen to be compatible with subsequent removal utilizing the Crisafulli dredge.
Re-position work platform/dredge to next cell to be cleaned.	Once a section of the curtain has been cleaned, use the guide cable to move along the silt curtain to the next portion/section that requires cleaning. When completed in lagoon cell A1, the operator will come back to shore and the platform will be manually moved to the next cell that requires cleaning by use of the guide ropes and passageways between lagoon cells. Cleaning of the additional silt curtains will be completed using the above steps.
De-Mobilization/ Equipment Decon	Once silt cleaning is complete in all cells, the platform and Piranha dredge will be manually pulled back to the boat ramp in the A1 cell using the attached lines. The equipment will be loaded onto the trailer and taken to the BRW area for general cleaning, and decontamination if needed. Once the equipment has been checked and cleaned it will be returned to the DSB for

	storage.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
SOURCE	***HAZARDS***	***WHERE***	***RESULT***	***CONTROLS***
BIOLOGICAL	Insects, domestic animals	Site	Exposure to insects, spiders, could result in bites and/or allergic reactions. Dogs in area could become aggressive resulting in bites and injury.	First aid kits are available on site, wear gloves and PPE as outlined in this SOP. Stop work and wait in vehicle if necessary for dogs to leave area. Call animal control if necessary.
BODY MECHANICS	Muscle or back strains	Moving intake and platform	Moving intake platform could cause muscle strains or back injuries.	Rest intake on railing system if possible. Take breaks, use 2 people to move platform.
CHEMICAL	Lime sludge Metals	Ponds	Inadvertent contact with lime sludge or heavy metals could cause skin irritation.	Level D PPE, decon equipment wash hands
ELECTRICAL	Not applicable			
GRAVITY	Fall into the water	Ponds	Falls into the ponds could result in injury.	Guardrail will be in place and secure at all times.
MECHANICAL	Pinch points Hand tools.	Moving intake and platform Connecting hose, or assembling	Moving intake and platform, connecting hose or assembling platform could	Level D PPE including gloves, watch hand placement, use correct tool for the job.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety Officer.

		platform	cause injury or scrapes.	
NOISE	Not applicable			
PRESSURE	Agitation head of intake hose, discharge hose	Hoses	Sprayed sludge, water	Inspection, Pin cam locks so they can't open, screen on intake so rocks can plug intake and cause back pressure.
RADIATION	UV Radiation	Working outside	While working outdoors, workers could be exposed to UV radiation resulting in sunburns and could contribute to heat related illnesses.	Wear PPE as outlined in this SOP.
THERMAL	Not applicable			
SIMOPS	Not applicable			
HUMAN FACTORS	Inexperienced, improperly trained workforce	Working outdoors/site	Lack of understanding of scope of work, inexperienced workers, lack of training could cause incidents, resulting in injury and/or property damage.	Workers will be properly trained in this procedure and applicable procedures, STOP work policy will be followed,
WEATHER	Cold/heat stress	Working outdoors	Exposure to cold climates may result in cold burns, frostbites, and hypothermia.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers in cold weather, and breathable light weight clothing

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.				
			Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	in hot weather). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety Officer.	
REQUIRED PPE	Level D PPE: Hard hat, safety glasses, lace-up safety-toed shoes, high visibility outerwear, and long-sleeved shirt.
APPLICABLE SDS	
REQUIRED PERMITS/FORMS	Field Authorization Form (FAF)
ADDITIONAL TRAINING	Control of Work, 40-Hour Hazwoper, 8-Hour Refresher, Site Specific Training, OTJ Task Training

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	General Float Connector Instructions
RELATED SOP's/PROCEDURES/ WORK PLANS	
TOOLS	$^{5}/_{16}$″ wrench, ½″ wrench, cordless drill with $^{5}/_{16}$″ drill bit, anti-seize lubricant
FORMS/CHECKLIST	Piranha Dredge Inspection Form

APPROVALS/CONCURRENCE

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OTHER	**DATE**

Revisions:

Rev.	Description	Date	Approval
1	Annual updates and updates to Risk Table for consistency	12/24/2020	Hailey Thompson

PURPOSE	To provide standard instructions for equipment decontamination.
SCOPE	Pioneer Technical Services, Inc. (Pioneer) prepared this practice for the workforce and this Standard Operating Procedure (SOP) applies to all work performed by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent (as defined by OSHA) in the risk-assessed procedure described below before performing the work.
NOTES	All equipment leaving the contaminated area of a site must be decontaminated. Decontamination methods include removal of contaminants through physical, chemical, or a combination of both methods. Decontamination procedures are to be performed at the same level of protection used in the contaminated area of a site. In some cases, decontamination personnel may be sufficiently protected by wearing one level lower protection. The information for site-specific equipment decontamination and personnel protection levels, as detailed in the Sampling and Analysis Plan (SAP), work plan (WP), and Site-Specific Health and Safety Plan (SSHASP), should be followed. The following decontamination procedures are for typical uncontrolled hazardous waste sites. For a specific or unusual contaminant, such as dioxins, see the SSHASP and consult with the Safety and Health Manager. Decontamination procedures should be used in conjunction with methods to prevent contamination of sampling and monitoring equipment. If practical, particularly with organic contaminants, one-time-use equipment should be used and disposed of in accordance with the SAP, WP, and SSHASP. This SOP covers all equipment decontamination EXCEPT for submersible pumps. Decontamination of pumps is detailed in SOP-DE-02A – Equipment Decontamination - Pumps for Well Sampling.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is inaccurate or unsafe, personnel must notify the Project Manager, Safety Manager, and the SOP Technical Author to initiate appropriate revisions. Personnel will perform all work under this SOP in a manner that is consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plans (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
1. Set up decontamination station.	a. Review the SAP or WP and determine if decontamination fluids need to be contained and the need for special decontamination requirements (i.e., chemical rinse). b. If the fluids require containment, set up the decontamination station so that it is located within a small plastic swimming pool or on plastic sheeting with turned up edges to contain water that may slop over during the decontamination process.

	c. If pressurized or gravity flow water is available, attach a hose or piping to reach the decontamination area. If no water is available, bring 5-gallon containers of tap and deionized water (DI) to the decontamination area to clean the equipment. d. Label empty 5-gallon buckets: *gross wash, soap wash, DI rinse, final rinse, and chemical rinse* (if required). e. Lay out clean plastic or foil to place cleaned equipment on to allow for air drying. f. If a chemical rinse is required, fill a spray bottle with the appropriate chemical and label the spray bottle with the chemical's name. g. Pour approximately 2.5 to 3 gallons of tap water into the buckets labeled: *gross wash* and *soap wash*. h. Add a **few drops** (1-3 drops) of Liquinox© soap to the bucket marked *soap wash*. i. Pour 2.5-3 gallons of DI water into the buckets labeled: *DI rinse* and *final rinse.* If a chemical rinse is required, pour DI water into the bucket labeled: *chemical rinse.*
2. Remove gross contamination.	Remove gross contamination using pressurized or gravity flow tap water, if available. If not, manually scrub the equipment using the 5-gallon bucket of water marked *gross wash* and a stiff brush (dedicated to the gross wash step).
3. Wash equipment.	Move the equipment to the 5-gallon bucket marked *soap wash*. Wash equipment with a stiff brush (dedicated to the soap wash step).
4. Triple rinse equipment.	In the bucket marked *DI rinse*, triple rinse the equipment with DI water to remove any soap residue.
5. Second rinse with deionized water.	Using DI water, triple rinse the equipment again in the bucket marked *final rinse* if a chemical rinse is not required.
6. Rinse equipment with chemicals.	In many cases, the tap water and DI water rinses will be sufficient. However, if specified in the SAP, WP, or SSHASP, chemical rinses of the equipment may be required. For inorganic contaminants, a mixture of 10:1 nitric acid in distilled water (10 parts water to 1 part nitric acid) may be specified. A methanol rinse may be required for some organic contaminants, such as hydrocarbons. Spray bottles, clearly marked with the appropriate chemical name, are an acceptable means of rinsing most equipment. **To perform the chemical rinse:** a. Hold the equipment over a collection container (5-gallon bucket or bowl). b. Make sure that all personnel and vehicles are upwind of the spray. c. Spray the piece of equipment inside and out starting at the top and working down to the bottom. d. Dispose of the contained chemicals as described in the SAP, WP or SSHASP. The Safety and Health Manager and/or Project Manager must approve the disposal method used.

7. Rinse equipment with deionized water.	After a required chemical rinse, rinse the equipment again with the DI water in the bucket marked *chemical rinse*. This DI water will need to be retained (i.e., do not dispose of this water on the site), tested, and disposed of according to federal and state requirements for the chemical used. The Safety and Health Manager and/or Project Manager must approve the disposal method used. After the rinse in the *chemical rinse* bucket, triple rinse the equipment again in the bucket marked *final rinse.*
8. Air dry equipment.	Place equipment on plastic sheeting or foil to air dry.
9. Transport/ store equipment.	Wrap equipment in foil or plastic wrap to transport or store.
10. Clean decontamination equipment.	a. Triple rinse equipment from the *gross wash* and *soap wash* (brushes and buckets) with clean tap water, preferably with pressurized water. Soap can be used on particularly dirty equipment. b. Triple rinse all decontamination equipment with DI water, including *DI rinse* and *final rinse* buckets. c. Store decontamination equipment, labeled and in a clean location so they are used only for decontamination purposes.
11. Dispose of decontamination solutions.	Storage of contained decontamination fluids as required by the SAP, QAPP, or WP or of residue from a chemical rinse should have been arranged on site prior to sampling. Once the sampling and associated decontamination is complete, sampling of the stored fluids for hazardous waste criteria will be required. If the fluids are determined to be hazardous (e.g., meet the characteristics of a hazardous waste [ignitability, corrosivity, reactivity, or toxicity] or contain listed wastes from title 40 of the Code of Federal Regulations [CFR] in part 261.4), dispose of them according to federal and state requirements. The Safety and Health Manager and/or Project Manager must approve the disposal method used. Note: when using other than the above-mentioned solutions, check with the Safety and Health Manager and the Project Manager.
12. Measure effectiveness of procedures.	Measure the effectiveness of the decontamination procedures using field equipment rinsate blanks as discussed in the SAP, QAPP, or WP.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Potential contact with contaminated items and resulting water from decontamination procedures.	Sites.	Inadvertent exposure to contaminated items and water resulting from decontamination procedures could lead to adverse health effects.	Personnel will practice proper personal hygiene (wash hands prior to eating/drinking and when leaving the site); follow decontamination procedures as described above; and wear nitrile gloves and safety glasses when handling contaminated items.
	Chemical rinse (e.g., dilute nitric acid, methanol, and hexane).	Sites.	Personnel could be exposed to chemicals via ingestion and skin/eye contact when decontaminating equipment. Exposure could cause irritation of skin/eye and adverse health effects.	Personnel will check and follow safety procedures as outlined in the chemical-specific Safety Data Sheets. Personnel will prevent skin/eye contact with chemicals and they will wear nitrile gloves and eye protection when handling chemicals. Personnel will practice proper personal hygiene (wash hands prior to eating/drinking, after decontaminating equipment, and when leaving the site). All personnel and vehicles will stand upwind when spraying equipment with chemicals. Refer to the Chemical Flushing Guidelines available inside any Pioneer vehicle's first aid kit for first-aid procedures in case of contact with chemicals.
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
BODY MECHANICS	Improper lifting.	Sites.	Back injuries and muscle/back strains could result when using improper techniques to lift and carry 5-gallon containers.	Personnel will use proper lifting techniques: get a good grip, keep the load close to the body, lift with legs and not with back, and avoid lifting loads above shoulder's height. Two people will lift awkward/heavy tools and equipment.
GRAVITY	Falls from slips and trips.	Areas designated for decontamin-ation procedures.	Slips and falls could occur while performing decontamination procedures due to slippery surfaces resulting in bruises, scrapes, or broken bones.	Personnel will wear work boots with good traction and ankle support. Personnel will also be aware of working/ walking surfaces and choose a path to avoid hazards, keep work areas as dry as possible, and wear muck boots as necessary.
WEATHER	Cold/heat stress.	Sites.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors, remain hydrated, and have sufficient caloric intakes during the day. Personnel will also follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Hypothermia/ frostbite.	Sites where air temperature is 35.6 °F (2 °C) or less.	Personnel whose clothing becomes wet during decontamination procedures may be exposed to hypothermia and/or frostbite.	Personnel will change clothing if it becomes wet.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Personnel will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Personnel could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Personnel will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Personnel should wear sunscreen, if necessary.
BIOLOGICAL	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Personnel will avoid contact with plants, insects, and animals. First-aid kits will be available on the site. Personnel with allergies will notify their supervisor.
MECHANICAL	Not applicable.			
PRESSURE	Not applicable.			
THERMAL	Contact with hot surfaces.	Foil and decontamination equipment.	If foil and decontamination equipment are placed directly in the sun, they could get hot. Contact with hot surfaces could result in personal injury.	Personnel will not set decontamination stations directly in the sun.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
HUMAN FACTORS	Inexperienced and improperly trained personnel.	Sites.	Inexperienced personnel and improper training could cause incidents resulting in injuries and/or property damage.	Personnel will be properly trained in this procedure and other applicable procedures. Personnel will implement stop work procedures, if necessary.
SIMOPS (Simultaneous Operations)	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	**Personnel Protection Equipment** (PPE)**:** Safety glasses, high-visibility work shirt or vest, long pants, work boots, and nitrile gloves.
APPLICABLE SDSs	**Safety Data Sheets** (SDSs) for corresponding chemicals used during chemical rinse will be maintained based on the site characterization and contaminants. Safety Data Sheets are available to Pioneer personnel at the link below: https://pioneertechnicalservices.sharepoint.com/Safety/SafetyDataSheets
REQUIRED PERMITS/ FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
DRAWINGS	
RELATED SOPs/ PROCEDURES/ WORK PLANS	

TOOLS/ EQUIPMENT	Five empty 5-gallon buckets, tap water, stiff brushes, Liquinox soap, four 5-gallon containers of DI (or distilled water if DI water is not available), chemicals for chemical rinse (if required), small plastic swimming pool/plastic sheeting or foil, tarps, and sprayers (if available). If additional items for decontamination are needed, they will be listed on the SAP.
FORMS/ CHECKLIST	

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

SOP TECHNICAL AUTHOR	**DATE**
Julie Flammang **Julie Flammang**	**09/08/2020**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**09/08/2020**

PURPOSE	To describe Pioneer Technical Services, Inc. (Pioneer) data validation (DV) process for projects within the Silver Bow Creek/Butte Area National Priorities List (NPL) Site. This process provides instruction for the validation of laboratory generated analytical data. The procedure was developed to ensure a reliable and consistent approach to analytical DV and to describe the specific DV requirements for the Silver Bow Creek/Butte Area NPL Site.
SCOPE	Pioneer prepared this practice for the workforce and this Standard Operating Procedure (SOP) applies to all work performed by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent (as defined by OSHA) in the risk-assessed procedure described below before performing the work.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is inaccurate or unsafe, personnel must notify the Project Manager, Safety Manager, and the SOP Technical Author to initiate appropriate revisions. Personnel will perform all work under this SOP in a manner that is consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
1. Review Relevant Documents **QAPP:** Quality Assurance Project Plan **CFRSSI**: Clark Fork River Superfund Site Investigation	The hierarchy of documents when determining relevant DV requirements follows: 1. Project QAPP 2. CFRSSI documents: • CFRSSI QAPP (ARCO, 1992a) (referred to herein as CFRSSI QAPP). • CFRSSI Data Management (DM)/DV Plan (ARCO, 1992b) and Addendum (AERL, 2000) (referred to herein as CFRSSI DM/DV Plan and Addendum). 3. National Functional Guidelines (Inorganic [EPA, 2020a], Organic [EPA, 2020b], High Resolution [EPA, 2020c]). 4. Analytical Methods. 5. Laboratory SOPs. Environmental Protection Agency (EPA) Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA, 2009) defines “stages” to describe the extent and processes used to validate laboratory analytical data packages. This terminology is used to describe the data verification and DV performed. **References:** AERL, 2000. Clark Fork River Superfund Site Investigations Data Management/Data Validation Plan Addendum.

	ARCO, 1992a. Clark Fork River Superfund Site Investigation Quality Assurance Project Plan. Prepared by PTI Environmental Services May 1992. ARCO, 1992b. Clark Fork River Superfund Site Investigation Data Management/Data Validation Plan, Prepared by PTI Environmental Services, Contract C 117-06-64, April 1992. EPA, 2009. U.S. Environmental Protection Agency Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use, January 2009. EPA, 2020a. National Functional Guidelines for Inorganic Superfund Methods Data Review EPA 542-R-20-006. U.S. Environmental Protection Agency, November 2020. EPA, 2020b. National Functional Guidelines for Organic Superfund Methods Data Review, EPA 540-R-20-005. U.S. Environmental Protection Agency, November 2020. EPA, 2020c. National Functional Guidelines for High Resolution Superfund Methods Data Review, EPA 542-R-20-007. U.S. Environmental Protection Agency, November 2020.
2. Review DV Quality Control (QC) Criteria	Each project should have a DV QC Criteria summarizing the required frequency, acceptance criteria, and DV qualification specifications for each method. The DV QC Criteria should be created prior to beginning DV using the reference documents in Task 1. The same DV QC Criteria should be used throughout the project.
3. Gather Documentation Associated with each SDG **SDG:** Sample Delivery Group **PDF:** portable document file **EDD:** Electronic Data Deliverable	The DV is performed for each SDG produced by the laboratory, as required by the Project QAPP. The following documents will be reviewed during the DV process: a. Field Sample Collection Documentation – Field logbook and/or field data sheets, calibration notebooks, sample logs, etc. b. Laboratory Deliverables – Laboratory Analytical Reports are provided in a PDF format. A standard report will include at a minimum, the analytical results, a QC summary of batch-related QC sample results, the chain of custody form, and any other correspondence associated with the laboratory submittal. A full report will include instrument-related QC sample results and the raw data. – EDD in Microsoft Excel format.

<table>
<tr><td>4. Upload data to Pioneer database

TfR: Table for Record

ID: Identification</td><td>Pioneer uses Enviro Data®, an environmental DM system, to internally manage analytical data. Enviro Data® works with Microsoft Access and Microsoft Excel. Data are uploaded electronically (from Excel files) or entered manually into the database.

The following Microsoft Excel workbooks are generated from the database to assist the data validator:

a. Sample ID Tracking
– The details of the Level A/B assessment are recorded.
b. Laboratory Calculation Workbook
– Validators use this workbook to review laboratory QC sample results and perform recalculations if required.
c. TfR
– The initials of the data validator and reviewer, the DV qualifier, the DV reason code(s), and the data quality designation applied are recorded for each result.
– DV information is uploaded to the project database after DV is completed.</td></tr>
<tr><td>5. Complete Level A/B Assessment Checklist</td><td>Complete the Level A/B review, as described in the CFRSSI DM/DV Plan and Addendum.

a. Use a Sample ID Tracking worksheet to record sample documentation review.
b. Review field documentation for the criteria on the Level A/B Assessment checklist (attached). Resolve deficiencies with Field Team Leader or Project Manager as appropriate.
c. Review Laboratory Analytical Report for chain of custody completeness and sample name, sample collection time, and analytical method(s) accuracy.
d. Fill out the Level A/B Assessment.</td></tr>
<tr><td>6. Complete Data Verification and Validation

LCS: laboratory control sample.

LCSD: laboratory control sample duplicate.

MS: matrix spike.

MSD: matrix spike duplicate.</td><td>Complete data verification and DV to the Stage specified in the project QAPP. Each Stage is completed until the required Stage is reached. For example, a Stage 2B validation includes the items in Stage 1, Stage 2A, and Stage 2B. The Stages are summarized below, and additional details are in EPA Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA, 2009).

<table>
<tr><th>Verification and Validation</th><th>Stage 1</th><th>Stage 2A</th><th>Stage 2B</th><th>Stage 3</th><th>Stage 4</th></tr>
<tr><td>Sample Receipt Condition</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>Sample-Related QC Results</td><td></td><td>x</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>Instrument-Related QC Results</td><td></td><td></td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>Recalculation Checks</td><td></td><td></td><td></td><td>x</td><td>x</td></tr>
<tr><td>Review of Instrument Outputs</td><td></td><td></td><td></td><td></td><td>x</td></tr>
</table></td></tr>
</table>

ICP: Inductively Coupled Plasma **LMS:** laboratory matrix spike **LMSD:** laboratory matrix duplicate	a. Sample Receipt Condition – Completeness of laboratory data package. – Requested analytical methods performed. Deficiencies found may require communication with the laboratory to resolve. If a requested method was not performed and the laboratory is unable to perform the analysis due to insufficient sample volume, gross holding times exceedance, etc., the resolution will be determined by the Pioneer Project Manager. b. Sample-Related QC (as applicable for each method) – Holding times. – Preservation. – Method blanks. – LCS and LCSD. – MS samples and MSD samples. – Laboratory duplicate samples. – Field blanks. – Field duplicates. – Trip Blanks. – Surrogates. – Serial dilutions*. Any sample-related QC results outside the control limit specified on the project-specific DV QC Criteria will be documented on the DV Checklist. If qualifications are made to sample results, the qualification and the reason for qualifying the data will be documented on the DV Checklist and the qualification and reason code will be recorded on the TfR. If no qualifications are made, a comment will be made in the DV Checklist documenting why no qualification was warranted. *Serial dilutions are not always provided in the standard laboratory reports. Evaluation of serial dilution results will only be completed for Stage 2A validation if they are provided. c. Instrument-Related QC (as applicable for each method) – Tuning. – Instrument Calibration. – Initial and Continuing Calibration Verification Standards. – Initial and Continuing Calibration Blank Standards.

– Low-Level Calibration Verification Standards.
– Interference Check Samples.
– Internal Standards.

Any instrument-related QC results outside the control limit specified on the project-specific DV QC Criteria will be documented on the DV Checklist. If qualifications are made to sample results, the qualification and the reason for qualifying the data will be documented on the DV Checklist and the qualification and reason code will be recorded in the TfR. If no qualifications are made, a comment will be made in the DV Checklist documenting why no qualification was warranted.

d. Recalculation Checks

Using the "Laboratory Calculation Workbook" (Pioneer customized Excel file) and the provided laboratory PDF report, complete the recalculation checks by filling out all the tabs. For example, the Workbook for ICP-MS contains the following tabs:

– Tune Analysis.
– Initial Calibration Verification.
– Continuing Calibration Verification.
– Low-level Initial Calibration Verification.
– Initial Calibration Blanks.
– Continuing Calibration Blanks.
– Method blanks.
– LCS and LCSD.
– LMS and LMSD.
– Serial Dilution.
– Interference Check Samples.
– Internal Standards.
– Dilution Calculation Check.

The laboratory may use more significant figures for the calculation than are presented in the laboratory report; therefore, some small discrepancies are expected. Gross discrepancies require communication with the laboratory to resolve. When performing validation, the laboratory calculated values should be used. For example, if the laboratory presents the percent recovery as 81% and the recalculation was 79%, the 81% would be used to determine that 80%-120% criteria was met.

e. Review of Instrument Outputs

Ensure raw data are included in the full data report.

Deficiencies found require communication with the laboratory to resolve.

7. Documentation of Validation **SAP:** Sampling and Analysis Plan **FSP:** Field Sampling Plan	The following documentation will be produced during the DV process for each project: a. DV QC Criteria table – If this table is not provided in the project QAPP/SAP/FSP, it must be generated prior to DV being performed and then included in the reporting of validation. b. Level A/B Assessment – At least one Level A/B Assessment per project will be completed. More than one per project may be completed to group samples into sampling events. c. DV Checklists – At least one DV Checklist per SDG will be completed. More than one per SDG may be completed to group similar analyses. For example, one checklist may be completed for metals (EPA 200.8, 200.7, etc.) and other for general chemistry (EPA 300.0, Standard Methods, etc.). d. Electronic database – The project database will be updated to include the DV qualifier, the DV reason code, and the data quality designation. Any tables required for reporting will be generated from the project database after DV is completed.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
DRAWINGS	Not applicable.
RELATED SOPs/ PROCEDURES/ WORK PLANS	Related project-specific plans. QC documents.
TOOLS/EQUIPMENT	N/A
FORMS/CHECKLIST	Level A/B Assessment Checklist. DV Checklist.

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Laura Moon	**4/4/2022**
SAFETY AND HEALTH MANAGER	**DATE**

PURPOSE	To provide standard instructions for soil and water sample packaging and shipping.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
1. Preserve the samples.	Water samples will be preserved, if required, according to SOP-SA-02 Sample Preservation and Containerization for Aqueous Samples, and SOP-SA-02B Sample Preservation and Containerization for Aqueous Samples for VOAs.
2. Place the sample containers in Ziploc bags.	Based on the analytes requested (e.g., low level mercury, low level chromium, etc.), it may be necessary to place each filled sample container in separate Ziploc bags to prevent cross contamination, keep the container clean, dry, and isolated, and protect the sample label. In most cases, all sample containers collected from a specific sample location are placed in a large Ziploc bag and shipped together.
3. Package the samples.	Place samples in a cooler, which has been previously lined with a plastic bag. Surround the samples with non-contaminating packaging materials to reduce movement and absorb any leakage. Double bag the ice and place it in the cooler. Seal the plastic bag in the cooler to contain the samples, packing material, and ice.
4. Review and sign COC forms.	The Field Team Leader or their designated representative will double check the chain-of-custody (COC) forms to assure those samples recorded on the COC forms are in the cooler. The Field Team Leader or the designated representative will then sign the chain-of-custody form to relinquish custody. One copy of the signed COC form will remain with the Field Team Leader. Make a photocopy of the completed forms, if there are no carbon copies available.
5. Tape paper work to cooler.	Place paper work in a sealed Ziploc bag and tape it to the inside of the cooler lid.
6. Bag samples for separate analytical batches.	If the shipping cooler contains more samples than can be analyzed in one analytical batch, the laboratory may request that the samples in the cooler be bagged for separate analytical batches. This may be necessary so that the appropriate Quality Control/Quality Assurance samples are included in each analytical batch. In this case, fill out separate COC forms for each batch and include the forms in the

	appropriate plastic bags. Place the COC forms for each batch in a sealed Ziploc bag. The COC forms for each batch should be placed at the top of the plastic bag so that they are clearly visible to laboratory personnel when they open the plastic bags.
7. Label the cooler.	Label the cooler with the appropriate labels to describe the content of the cooler (e.g., NOS, flammable liquids, flammable solids, this side up, fragile, etc.). Close the cooler and place the appropriate shipping labels (e.g., overnight shipping from Federal Express, UPS, or the United States Postal Service or equivalent) on the lid of the cooler.
8. Sign COC seals.	The Field Team Leader or the designated representative will sign COC seals and place the signed seals over the opening edge of the cooler.
9. Tape the cooler.	Place tape over the custody seals and around the cooler.
10. Transport the cooler.	Transport the cooler(s) to a secure storage, to the shipping agent, or directly to the laboratory. If shipping the cooler, follow established federal and state regulations depending on cooler content.
Notes	Bagging of samples and lining of coolers is not necessary, if samplers transport the samples directly to the laboratory.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Potential contact with contaminated soil and water samples.	Sites.	Inadvertent exposure to contaminated soil and water samples could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Employees will wear nitrile gloves and safety glasses when handling sample containers.
	Preservatives (HCL, HNO3, H2SO4, Zinc, Acetate, NaOH).	In bottles or added to bottles through sampling process.	Inadvertent exposure to preservatives could lead to adverse health effects.	Safety Data Sheets for each preservative chemical are available to all employees on the Pioneer company web site. Personnel will wear nitrile gloves and safety glasses when adding preservatives to samples bottles and when handling the bottles. Refer to the Chemical Flushing Guidelines available inside vehicle's first aid kit for first-aid procedures in case of contact with preservatives.
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			
BODY MECHANICS	Bending, squatting, and kneeling.	During sample packaging.	Bending, squatting, and could result in muscle/back strains or other injuries.	Employees should stretch prior to starting work and they will take breaks when necessary.
	Improper lifting.	Sites.	Back injuries and muscle/back strains could result when using improper techniques to lift and carry coolers with samples.	Personnel will use proper lifting techniques – get a good grip, keep the load close to the body, lift with legs and not with back, and avoid lifting loads above shoulder's height. Two workers will lift/carry the coolers, if needed.

GRAVITY	Not applicable.			
WEATHER	Not applicable.			
RADIATION	Not applicable.			
BIOLOGICAL	Not applicable.			
MECHANICAL	Not applicable.			
PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained worker.	Sites.	Inexperienced workers and improper training could cause incidents resulting in adverse health effects and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement stop work procedures, if necessary.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Sampling site: hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, and nitrile gloves. Off site: nitrile gloves.
APPLICABLE SDS	HCL, HNO3, H2SO4, Zinc, Acetate, and NaOH. Additional Safety Data Sheets (SDSs) will be maintained based on site characterization and contaminants.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	SOP-SA-02 Sample Preservation and Containerization for Aqueous Samples and SOP-SA-02B Sample Preservation and Containerization for Aqueous Samples for VOAs.
TOOLS	Plastic bags, Ziploc bags, non-contaminating packaging materials, tape, COC seals, ice, and cooler.
FORMS/CHECKLIST	Chain-of-custody (COC) forms.

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Julie Flammang **Julie Flammang**	**12/11/2014**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**12/11/2014**

Revisions:

Revision	Description	Date

PURPOSE	The SOP covers aqueous samples being analyzed for commonly requested organic, inorganic and RADCHEM parameters. Guidance is provided on industry standard containers, preservatives, analytical methods and holding times associated with sample collection.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Notes	Most bottles come certified and preserved from the laboratory. If bottles do not contain preservatives, field personnel will add it at the time of water sample collection. If bottles are not certified, a triple rinse with the water to be sampled will be done before collecting the sample. Preservative will be added to the sample container after triple rinse and before sample collection. The following information was supplied to Pioneer from Pace Analytical Services. If another laboratory is contracted for analyzing samples, verify with the laboratory the appropriate containers, preservatives and holding time limits for the required analyses. If a different analytical method is specified in the Sampling and Analysis Plan (SAP) from those listed below verify with the contracted laboratory for sampling method, container requirements, preservative and holding time limits.
Label samples	Label samples as per SOP-SA-01 Soil and Water Sample Packaging and Shipping.

Organic Parameters in Aqueous Samples

Parameter	Method: EPA Drinking Water	EPA Water	EPA Waste SW-846	Container	Preservative	Max Hold Time
Aromatic and Halogenated Volatiles		601/602	8021	3 - 40mL vials	pH<2 HCl, ≤6°C, $Na_2S_2O_3$ if Cl present	14 Days (7 days for aromatics if unpreserved)
Base/Neutrals and Acids		625	8270	1L Amber Glass	≤6°C, $Na_2S_2O_3$ if Cl present	7/40 Days
Base/Neutrals, Acids & Pesticides	525.2			1L Amber Glass	pH <HCl, sodium sulfite if Cl present	14/30 Days
Diesel Range Organics			8015	1L Amber Glass	≤6°C, $Na_2S_2O_3$ if Cl present	7/40 Days
Dioxins and Furans	1613B			1L Amber Glass	≤6°C, $Na_2S_2O_3$ if Cl present	1 Year
Dioxins and Furans			8290	1L Amber Glass	≤6°C, $Na_2S_2O_3$ if Cl present	30/45 Days
Dissolved Organic Carbon			Method 5310	250 ml Amber Glass	Field Filter from an Unpreserved Sample into an pH<2 H2SO4, ≤6°C	28 days
EDB & DBCP	504.1		8011	40mL vials	≤6°C, $Na_2S_2O_3$ if Cl present	14 Days
Explosives			8330/8332	1L Amber Glass	≤6°C	7/40 Days
Gasoline Range Organics			8015	40mL vials	pH<2 HCl	14 Days
Haloacetic Acids	552.1/552.2			40mL Amber vials	NH_4Cl, ≤6°C	14/7 Days if extracts stored at ≤6°C or 14/14 Days if extracts stored at ≤-10°C
Herbicides, Chlorinated	515.1/515.3		8151	1L Amber Glass	≤6°C, $Na_2S_2O_3$ if Cl present	7/40 Days for 8151; 14/28 Days for 515.1/515.3
PCBs, Organochlorine			8082	1L Amber Glass	≤6°C; $Na_2S_2O_3$ if Cl present	1 Year/1Year
PCBs & Pesticides, Organochlorine		608		1L Amber Glass	≤6°C; $Na_2S_2O_3$ if Cl present	7/40 Days
Pesticides, Organochlorine			8081	1L Amber Glass	≤6°C, $Na_2S_2O_3$ if Cl present	7/40 Days
Pesticides, Organophosphorus			8141	1L Amber Glass	pH 5-8 with NaOH or H_2SO_4; ≤6°C, $Na_2S_2O_3$ if Cl Present	7/40 Days
Polynuclear Aromatic Hydrocarbons			8270 SIM	1L Amber Glass	≤6°C, $Na_2S_2O_3$ if Cl present	7/40 Days
Volatiles		624	8260	3 - 40mL vials	pH<2 HCl; ≤6°C	14 Days (7 Days for aromatics if unpreserved)
Volatiles (see note 1)	524.2			40mL vials (in duplicate)	pH<2 HCl, ≤6°C, $Na_2S_2O_3$ if Cl present	14 Days

[1] Method 524.2 lists ascorbic acid as the preservative when residual chlorine is suspected, unless gases or Table 7 compounds are NOT compounds of interest and then sodium thiosulfate is the preservative recommended.

Inorganic Parameters in Aqueous Samples

Parameter	Method: EPA Water	Method: Standard Methods	Method: EPA Waste SW-846	Container	Preservative	Max Hold Time
Acidity		SM2310B		Plastic/Glass	≤6°C	14 Days
Alkalinity	310.2	SM2320B		Plastic/Glass	≤6°C	14 Days
Anions by IC, including Br, Cl, F, NO2, NO3,o-Phos, SO4, bromate, chlorite, chlorate)	300.0			Plastic/Glass	≤6°C	All analytes 28 days except NO2, NO3, o-Phos (48 hours); chlorite (immediate); NO2/NO3 combo 28 days
Bacteria, Total Plate Count		SM9221D		Plastic/WK	≤6°C, $Na_2S_2O_3$	24 Hours
BOD/cBOD		SM5210B/Hach 10360		Plastic/Glass	≤6°C	48 hours
Chloride		SM4500Cl-C,E		Plastic/Glass	None	28 Days
Chlorine, Residual	330.5	SM4500Cl-D, E, G / Hach 8167		Plastic/Glass	None	15 minutes
COD	410.4	SM5220C, D / Hach 8000		Plastic/Glass	pH<2 H_2SO_4, ≤6°C	28 Days
Color		SM2120B,E		Covered Plastic, Acid Washed Amber Glass	≤6°C	24 Hours
Cyanide, Reactive			Chapter 7	Plastic/Glass	None	28 Days
Cyanide, Total and Amenable	335.4	SM4500CN-A,B,C,D,E,G,I,N	9010/9012	Plastic/Glass	pH>12 NaOH; ≤6°C ascorbic acid if Cl present	14 Days (24 hrs if sulfide present - applies to SM4500CN only)
Ferrous Iron		SM3500Fe-D		Glass	None	Immediate
Flashpoint/Ignitability			1010	Plastic/Glass	None	28 Days
Fluoride		SM4500Fl-C,D		Plastic	None	28 Days
Hardness, Total (CaCO3)	130.1	SM2340B,C		Plastic/Glass	pH<2 HNO_3	6 Months
Hexavalent Chromium	218.6	SM3500Cr-C,D	7196	Plastic/Glass	≤6°C	24 Hours, unless preserved per method, then 28 Days
Mercury	245.1/245.2		7470	Plastic/Glass	pH<2 HNO_3	28 Days
Mercury, Low Level	1631E			Fluoropolymer (Glass if Hg is only analyte being tested)	12N HCl or BrCl	48 hours for preservation or analysis; 28 days to preservation if sample oxidized in bottle; 90 days for analysis if preserved
Metals (ICP/ICPMS)	200.7/200.8		6010/6020	Plastic/Glass	pH<2 HNO_3	6 Months
Nitrogen, Ammonia	350.1	SM4500NH3		Plastic/Glass	pH<2 H_2SO_4, ≤6°C	28 Days
Nitrogen, Kjeldahl	351.2	SM4500-Norg		Plastic/Glass	pH<2 H_2SO_4, ≤6°C	28 Days
Nitrogen, Nitrate	352.1	SM4500-NO3		Plastic/Glass	≤6°C	48 Hours
Nitrogen, Nitrate & Nitrite, combined	353.2	SM4500-NO3		Plastic/Glass	pH<2 H_2SO_4, ≤6°C	28 Days
Nitrogen, Organic	351.2 / 350.1	SM4500-Norg		Calculation	pH<2 H_2SO_4, ≤6°C	28 Days
Odor		SM2150B		Glass	≤6°C	24 Hours
Oil and Grease/HEM	1664A	SM5520B	9070	Glass	pH<2 H_2SO_4 or HCl, ≤6°C	28 Days
Oxygen, Dissolved (Probe)		SM4500-O		Glass	None	15 minutes
Paint Filter Liquid Test.			9095	Plastic/Glass	None	N/A

Inorganic Parameters in Aqueous Samples (Cont.)

Parameter	Method			Container	Preservative	Max Hold Time
	EPA Water	Standard Methods	EPA Waste SW-846			
Phenol, Total	420.1/420.4		9065/9066	Glass	pH<2 H_2SO_4, ≤6°C	28 Days
Phosphorus, Orthophosphate	365.1/365.3	SM4500P		Plastic	Filter, ≤6°C	Filter within 15 minutes, Analyze within 48 hours
Phosphorus, Total	365.1 / 365.3 / 365.4	SM4500P		Plastic/Glass	pH<2 H_2SO_4, ≤6°C	28 Days
Silica, Dissolved		SM4500Si-D		Plastic	≤6°C	28 Days
Solids, Settleable		SM2540F		Glass	≤6°C	48 Hours
Solids, Total		SM2540B		Plastic/Glass	≤6°C	7 Days
Solids, Total Dissolved		SM2540C		Plastic/Glass	≤6°C	7 Days
Solids, Total Suspended	USGS I-3765-85	SM2540D		Plastic/Glass	≤6°C	7 Days
Specific Conductance	120.1	SM2510B	9050	Plastic/Glass	≤6°C	28 Days
Sulfate	375.2	SM4500S04 / ASTM D516	9036/9038	Plastic/Glass	≤6°C	28 Days
Sulfide, Reactive			Chapter 7	Plastic/Glass	None	28 Days
Sulfide, Total		SM4500S	9030	Plastic/Glass	pH>9 NaOH and ZnOAc; ≤6°C	7 Days
Sulfite		SM4500SO3		Plastic/Glass	None	15 minutes
Surfactants (MBAS)		SM5540C		Plastic/Glass	≤6°C	48 Hours
Total Organic Carbon (TOC)		SM5310B,C,D	9060	Glass	pH<2 H_2SO_4 or HCl, ≤6°C	28 Days
Total Organic Halogen (TOX)		SM5320	9020/9021	Glass (No headspace)	pH<2 H_2SO_4, ≤6°C	14 Days
Turbidity	180.1	SM2130B		Plastic/Glass	≤6°C	48 Hours

[2] Methods 9315 and 9320 both state that if samples are unpreserved, the samples should be brought to the lab within 5 days of collection, preserved in the lab, and then allowed to sit for a minimum of 16 hours before sample preparation/analysis.

RADCHEM PARAMETERS

Parameter	Method			Container	Preservative	Max Hold Time
	EPA Water	Standard Methods	EPA SW-846			
Gamma Emitting Radionuclides (see note 2)	901.1			Plastic/Glass	pH<2 HNO_3	180 days
Gross Alpha (NJ 48Hr Method)	NJAC 7:18-6			Plastic/Glass	pH<2 HNO_3	48 hours
Gross Alpha and Gross Beta (see note 2)	900.0		9310	Plastic/Glass	pH<2 HNO_3	180 days
Radium-226 (see note 2)	903.0/903.1			Plastic/Glass	pH<2 HNO_3	180 days
Radium-228 (see note 2)	904.0		9320	Plastic/Glass	pH<2 HNO_3	180 days
Radioactive Strontium (see note 2)	905.0			Plastic/Glass	pH<2 HNO_3	180 days
Total Alpha Radium (see note 2)	903.0		9315	Plastic/Glass	pH<2 HNO_3	180 days
Total Uranium (see note 2)	908.0	D5174-97		Plastic/Glass	pH<2 HNO3	180 days
Tritium	906.0			Glass	None	180 Days

[2] Methods 9315 and 9320 both state that if samples are unpreserved, the samples should be brought to the lab within 5 days of collection, preserved in the lab, and then allowed to sit for a minimum of 16 hours before sample preparation/analysis.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
CHEMICAL	Potential contact with contaminated water samples.	Sites.	Inadvertent exposure to contaminated water samples could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Employees will wear nitrile gloves and safety glasses when handling sample containers.
	Preservatives (HCL, HNO_3, H_2SO_4, NaOH and $Na_2S_2O_3$).	In bottles or added to bottles through sampling process.	Inadvertent exposure to preservatives could lead to adverse health effects.	Safety Data Sheets for each preservative chemical are available to all employees on the Pioneer company web site. Personnel will wear nitrile gloves and safety glasses when using preservatives and when handling the bottles. Refer to the Chemical Flushing Guidelines available inside vehicle's first aid kit for first-aid procedures in case of contact with preservatives.
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			
BODY MECHANICS	Improper lifting.	Sites.	Back injuries and muscle/back strains could result when using improper techniques to lift and carry coolers with samples.	Personnel will use proper lifting techniques – get a good grip, keep the load close to the body, lift with legs and not with back, and avoid lifting loads above shoulder's height. Two workers will lift/carry the coolers, if needed.
GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet surfaces and steep slopes.	Walking/working on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Personnel will wear work boots with good traction and ankle support. Personnel will be aware of working/walking surfaces and choose a path to avoid hazards. Keep work areas as dry as possible. Wear muck boots, as necessary.

WEATHER	Cold/heat stress.	Sites.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors. Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Employees will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Employees will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Employees should wear sunscreen, if necessary.
BIOLOGICAL	Plants, insects, and animals.	Outdoors.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Employees with allergies will notify their supervisor.
MECHANICAL	Not applicable.			
PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained worker.	Sites.	Inexperienced workers and improper training could	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement

			cause incidents resulting in adverse health effects and/or property damage.	stop work procedures, if necessary.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, and nitrile gloves.
APPLICABLE SDS	HCL, HNO_3, H_2SO_4, NaOH and $Na_2S_2O_3$. Additional Safety Data Sheets (SDSs) will be maintained based on site characterization and contaminants.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	SOP-SA-01 Soil and Water Sample Packaging and Shipping.
TOOLS	Preservatives, sample container, ice, and cooler.
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Julie Flammang **Julie Flammang**	**05/28/2015**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**05/28/2015**

Revisions:

Revision	Description	Date

PURPOSE	This Standard Operating Procedure (SOP) establishes the requirements for documenting and maintaining environmental sample chain of custody from point of origin to receipt of sample at the analytical laboratory. This procedure will apply to all types of air, soil, water, sediment, biological, and/or core samples collected in environmental investigations by Pioneer Technical Services, Inc. (Pioneer). It is applicable from the time of sample acquisition until custody of the sample is transferred to an analytical laboratory.
SCOPE	Pioneer prepared this practice for the workforce and this SOP applies to all work performed by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent (as defined by OSHA) in the risk-assessed procedure described below before performing the work.
DEFINITIONS	**Chain of custody** is an unbroken trail of accountability that ensures the physical security of samples, data, and records. Custody refers to the physical responsibility for sample integrity, handling, and/or transportation. Custody responsibilities are effectively met, if the samples are: • In the responsible individual's physical possession; • In the responsible individual's visual range after having taken possession; • Secured by the responsible individual so that no tampering can occur (usually for shipping); or • Secured or locked by the responsible individual in an area in which access is restricted to authorized personnel only.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is inaccurate or unsafe, personnel must notify the Project Manager, Safety Manager, and the SOP Technical Author to initiate appropriate revisions. Personnel will perform all work under this SOP in a manner that is consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plans (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Project Manager's Responsibilities	The Project Manager is responsible for overall management of environmental sampling activities, designating sampling responsibilities to qualified personnel, and reviewing any changes to the sampling plan.
Field Team Leader's Responsibilities	The Project Manager may act as the Field Team Leader or may choose to appoint a Field Team Leader. The Field Team Leader is responsible for general supervision of field sampling activities and ensuring proper storage/transportation of samples from the field to the analytical laboratory. The Field Team Leader is also responsible for maintaining sample custody as defined above until the sample has been properly relinquished as documented on the chain of custody form.

	The Field Team Leader will review chain of custody forms for accuracy and completeness to preserve sample integrity from collection to receipt by an analytical laboratory. The review of chain of custody forms may be delegated to qualified personnel.
Field Sampler's Responsibilities	The Field Sampler is responsible for sample acquisition in compliance with technical procedures, initiating the chain of custody, and checking sample integrity and documentation prior to transfer. Field samplers are also responsible for initial transfer of samples consisting of physical transfer of samples directly to the internal laboratory or transferred to a shipping carrier, (e.g., United Parcel Service or Federal Express) for delivery.
Laboratory Technician's Responsibilities	The receiving Laboratory Technician is responsible for inspecting transferred samples to ensure proper labeling and satisfactory sample condition. Unacceptable samples will be identified and segregated. The Laboratory Project Manager will be notified. The Laboratory Technician will review the chain of custody for completeness and file as part of the project's permanent record.

Fill out Chain of Custody Forms	The Field Team Leader or designated Field Sampler will initiate the chain of custody form for the initial transfer of samples.
	
	A chain of custody form will be completed and accompany every sample set. Only those samples included in the shipping container (cooler or box) should be listed on the chain of custody form included in the container. All chain of custody forms must be completed and include the following information:
	
	• Project code.
	• Project name.
	• Sampler's signature.
	• Sample identification.
	• Date sampled.
	• Time sampled.
	• Analysis requested.
	• Remarks column should contain information about a sample that the laboratory might need. Examples of remarks that should be included:
	
	  ▪ If samples could have very high or low expected concentrations (outside of normal instrument calibration range).
	  ▪ DO NOT USE FOR QA/QC (quality assurance/quality control) should be indicated for field blanks, bottle blanks, or equipment rinsate blanks.
	  ▪ If a sample should be held for later analysis (i.e., if sample being analyzed requires results from another sample to determine analysis status).

	▪ The sample should be archived after initial analysis by the laboratory for potential additional analysis in the future. ▪ Requires filtering (if not completed in the field). ▪ Requires preservation (if not completed in the field). ▪ Any other sample specific information that will aid the laboratory in completing the appropriate analysis. • Relinquishing signature, data, and time. • Receiving signature, date, and time. Laboratory-provided chain of custody forms should be used if provided, and all required fields should be filled out. Pioneer also has generic chain of custody forms that can be used if no laboratory forms are available. Make sure that the above required information is on the form and include the laboratory name and address to which the samples are being shipped. The Field Sampler relinquishing custody and the responsible individual accepting custody will sign, date, and note the time of transfer on the chain of custody form. Note: if the transporter is not an employee of Pioneer, the Field Sampler may identify the carrier and reference the bill of lading number in lieu of the transporter's signature. One copy of the chain of custody form will be filed as a temporary record of sample transfer by the Field Sampler. The original form will accompany the sample set and will be returned to Pioneer as part of the contracted laboratory QA/QC requirements. The original form and the transporter’s receipt will be filed as part of the project’s permanent records. The Project Manager (or designee) will track the chain of custody to ensure timely receipt of samples by an analytical laboratory. Shipping information, including date shipped, laboratory shipped to, transporter’s identity (i.e., Federal Express), and tracking number should be recorded in the field logbook. If more than one sample shipment occurs during a project, the associated samples per shipment should be referenced (sample numbers or samples collected on these dates).
Sample Handling.	All samples will be collected and handled in accordance with SOP-SA-01 Soil and Water Sample Packaging and Shipping and SOP-SA-02 Sample Preservation and Containerization for Aqueous Samples, or methods described in the Sampling and Analysis Plan (SAP) or Work Plan (WP). Samples will be transported in insulated coolers with ice as necessary to maintain a temperature of 4 degrees Celsius (°C) plus or minus 2 °C until receipt by the analytical laboratory. Alternate shipping containers can be used if the analytical method, SAP, or WP does not have temperature requirements for the samples.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
CHEMICAL	Potential contact with contaminated water/soil samples.	Outside of bottles.	Inadvertent exposure to contaminated water/soil samples could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Personnel will wear nitrile gloves and safety glasses when handling sample containers.
	Preservatives (HCL, HNO_3, H_2SO_4, Zinc, Acetate, and NaOH).	Outside of bottles.	Inadvertent exposure to preservatives could lead to adverse health effects.	Safety Data Sheets for each preservative chemical are available to all Personnel on the Pioneer company web site. Personnel will wear nitrile gloves and safety glasses when handling the bottles. Refer to the Chemical Flushing Guidelines available inside vehicle's first aid kit for first-aid procedures in case of contact with preservatives.
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			
BODY MECHANICS	Improper lifting.	Sites.	Back injuries and muscle/back strains could result when using improper techniques to lift and carry packaged samples and coolers.	Personnel will use proper lifting techniques – get a good grip, keep the load close to the body, lift with legs and not with back, and avoid lifting loads above shoulder's height. Two workers will lift/carry packaged samples and coolers, if needed.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet surfaces and steep slopes.	Walking/working on slick/muddy/ wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Personnel will wear work boots with good traction and ankle support. Personnel will be aware of working/walking surfaces and choose a path to avoid hazards. Keep work areas as dry as possible.
WEATHER	Not applicable.			
RADIATION	Not applicable.			
BIOLOGICAL	Not applicable.			
MECHANICAL	Not applicable.			
PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained personnel.	Sites.	Inexperienced personnel and improper training could cause incidents resulting in adverse health effects and/or property damage.	Personnel will be properly trained in this procedure and other applicable procedures. Personnel will implement stop work procedures, if necessary.
SIMOPS (Simultaneous Operations)	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	**Personal Protection Equipment** (PPE): Safety glasses, high-visibility work shirt or vest, long pants, work boots, and nitrile gloves.
APPLICABLE SDSs	**Safety Data Sheets** (SDSs): HCL, HNO_3, H_2SO_4, Zinc, Acetate, and NaOH. Safety Data Sheets are available to Pioneer employees at the link below: https://pioneertechnicalservices.sharepoint.com/Safety/SafetyDataSheets
REQUIRED PERMITS/ FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
DRAWINGS	
RELATED SOPs/ PROCEDURES/ WORK PLANS	SOP-SA-01 Soil and Water Sample Packaging and Shipping and SOP-SA-02 Sample Preservation and Containerization for Aqueous Samples.
TOOLS/ EQUIPMENT	Seals and labels, chain of custody forms, chain of custody seals (provided by contracted laboratory), packing and shipping materials, cooler, and ice.
FORMS/ CHECKLIST	Chain of custody forms.

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Julie Flammang **Julie Flammang**	**11/12/2020**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**11/12/2020**

PURPOSE	This SOP establishes the requirements for documenting and maintaining field logbooks and photographs. These procedures shall apply to all types of air, soil, water, sediment, biological, and/or core samples collected in environmental investigation by Pioneer Technical Services, Inc. (Pioneer). These procedures apply from the time field work begins until site activities are completed.
SCOPE	This practice has been prepared for the Pioneer workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
1. Logbooks.	A designated field logbook will be used for each field project. If requested by the Project Manager, use a separate field logbook for each field task within a larger project. Label each logbook with the project name, dates that it covers, and logbook number. Use a waterproof marker, such as a Sharpie©, to write down the information. The logbooks will be bound and have consecutively numbered pages. The information recorded in these logbooks shall be written in ink. Begin a new page for each days notes. Write on every line of the logbook. If a blank space is necessary for clarity, such as a change of subject, skip one line before beginning the new subject. Do not skip any pages or parts of pages unless a day's activity ends in the middle of a page. Draw a diagonal line on any blank spaces of four lines or more to prevent unauthorized entries. The author will initial and date entries at the end of each day. All corrections will consist of a single line-out deletion in ink, followed by the author's initials and the date. Information not related to the project should not be entered in the logbook. The language used in the logbook should be factual and objective. These bound logbooks shall include the following entries: 1. A description of the field task. 2. Time and date fieldwork started. 3. Location and/or a description of the work areas including sketches, if needed, any maps or references needed to identify locations, and sketches of construction activities. If the location has been documented in the logbook during/prior visits, only changes in conditions should be noted. 4. Names and company affiliations of field personnel.

	5. Name, company affiliation or address, and phone number of any field contacts or official site visitors. 6. Meteorological conditions at the beginning of fieldwork and any ensuing changes in these conditions. 7. Details of the fieldwork performed and reference to field data sheets, if used. 8. Deviation from the task-specific Sampling and Analysis Plan (SAP), Work Plan (WP), or Standard Operating Procedures (SOP). 9. All field measurements made. 10. Any field laboratory analytical results. 11. Personnel and equipment decontamination procedures, if appropriate. For any field sampling work, the following entries should be made: 1. Sample location and number. 2. Sample type and amount collected. 3. Date and time of sample collection. 4. Type of sample preservation. 5. Split samples taken by other parties. Note the type of sample, sample location, time/date, name of person for whom the split was collected, that person's company, and any other pertinent information. 6. Sampling method, particularly any deviations from the SOP. 7. Documentation or reference of preparation procedures for reagents or supplies that will become an integral part of the sample, if available. This information may not be available for water or soil sampling bottles that come preserved from the laboratory or for preservatives provided by the laboratory. Bottle blanks will need to be used to evaluate the provided reagents. 8. The laboratory where the samples will be sent. No bound field logbooks will be destroyed or thrown away even if they are illegible or contain inaccuracies that require a replacement document.
2. Photographs.	Take photographs of field activities using a digital camera. Photographs should include a scale in the picture when practical. Telephoto or wide-angle shots will not be used, since they cannot be used in enforcement meetings. The following items shall be recorded in the bound field logbook or on a field data sheet for each

	photograph taken: 1. The photographer's name, the date, the time of the photograph, and the general direction faced. 2. A brief description of the subject and the fieldwork portrayed in the picture. 3. Sequential number of the photograph. An electronic copy and/or a hard copy of the photographs shall be placed in task files in the field office after each day of field activities. Supporting documentation from the bound field logbooks or field data sheets shall be photocopied and placed in the task files to accompany the photographs once the field activities are complete.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Not applicable.			
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			
BODY MECHANICS	Not applicable.			
GRAVITY	Not applicable.			
WEATHER	Not applicable.			
RADIATION	Not applicable.			
BIOLOGICAL	Not applicable.			
MECHANICAL	Not applicable.			
PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Not applicable.			
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	
APPLICABLE SDS	Safety Data Sheets (SDSs) will be maintained based on site characterization and contaminants.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	
TOOLS	Field logbook, Sharpie©, black pen, digital camera, and field data sheets.
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Julie Flammang **Julie Flammang**	**12/17/2014**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**12/17/2014**

Revisions:

Revision	Description	Date

PURPOSE	To provide standard instructions for field measurement of pH in water.
SCOPE	Pioneer Technical Services, Inc. (Pioneer) prepared this practice for the workforce and this Standard Operating Procedure (SOP) applies to all work performed by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent (as defined by OSHA) in the risk-assessed procedure described below before performing the work.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is inaccurate or unsafe, personnel must notify the Project Manager, Safety Manager, and the SOP Technical Author to initiate appropriate revisions. Personnel will perform all work under this SOP in a manner that is consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plans (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
1. Prepare the pH meter.	Pioneer owns and operates different brands and models of pH field measurement meters. All units, in general, have automatic temperature correction (ATC) capabilities. Prior to using a pH meter, verify that it has the ATC function. User manuals for each meter are available and the specific directions for calibrating and measuring pH with that meter should be followed. Calibrate pH meter in the field at the beginning of each day and if a standard check is out of calibration. Record the calibration information in the field logbook. 1. For a new probe, prepare the pH probe according to the directions in the electrode user guide. 2. Connect the probe to the appropriate connection on the meter. 3. Turn the meter on and make sure it is in the pH measurement mode. Calibrate instrument as described in the meter-specific operating manual.
2. Calibrate the meter.	The following is a general summary for instrument calibration: 1. Rinse the ATC pH probe in deionized water. 2. Turn on meter and immerse the ATC pH probe in a pH 7 buffer solution. Calibrate meter to pH 7 allowing enough time for meter to stabilize. 3. Rinse ATC pH probe with deionized water. 4. Immerse ATC pH probe in a pH 4 buffer solution. Calibrate meter to pH 4 allowing enough time for meter to stabilize.

	5. Rinse pH and temperature probe with deionized water. 6. Immerse ATC pH probe in a pH 10 buffer solution. Calibrate meter to pH 10 allowing enough time for meter to stabilize. 7. Record the slope reading in the field logbook. 8. Recheck meter calibrations with the pH 4, pH 7, and pH 10 calibration solutions. Repeat the calibration process (steps 2-6) if a value for any final pH check is outside the manufacturer's stated accuracy as stated in the user's manual
3. Take field measurements.	The following is a general summary for field measurement of pH: 1. Rinse beaker with sample water 3 times. 2. Rinse ATC pH probe with deionized water. 3. Fill beaker with sample water. 4. Turn on meter and immerse ATC pH probe in sample water. Stir sample for thorough mixing. Read and record pH to the nearest 0.01 unit once pH reading has stabilized. 5. Rinse electrodes with deionized water and store in carrying case. Note: pH may also be measured by placing the probe directly into the water body being tested. The probe must be moved slowly in a circular motion when measuring stagnant water.
Important information about meter.	1. Store meter in case during transport. 2. Check batteries before taking meter into the field. Carry spare batteries and deionized water for rinsing probe. 3. Inspect probe for damage or dirt. 4. Dust and wipe the meter with a damp cloth. If necessary, warm water or mild water-based detergent can be used to clean the case. Immediately remove any spilled substance from the meter using the proper cleaning procedure for the type of spill. 5. If meter readings are erratic, replace the probe. If readings continue to be erratic, return the meter to factory for repair.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Potential contact with contaminated water.	Testing sites, during pH measurements.	Inadvertent exposure to contaminated water could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Personnel will wear nitrile gloves and safety glasses when taking measurements.
	Potential contact with pH buffer solutions.	Equipment calibration.	Inadvertent exposure to pH buffer solutions could lead to adverse health effects (e.g., irritation of eye, skin, and/or respiratory tract).	Personnel will practice proper personal hygiene – wash hands prior to eating and after calibrating equipment. Personnel will wear nitrile gloves and safety glasses when handling pH buffer solutions.
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			
BODY MECHANICS	Bending, squatting, and kneeling.	During pH measurements.	Bending, squatting, and kneeling during pH measurements could result in muscle/back strains or other injuries.	Personnel should stretch prior to starting work and they will take breaks when necessary.
	Drowning and/or entrapment hazards.	Bodies of water, during pH measurements.	If personnel need to stand in bodies of water to take measurements, they could be exposed to drowning and/or entrapment hazards from soft soils and/or sudden changes in depth of water.	If necessary, personnel will use rods to test soil stability and/or depth of water as they walk to sample locations. Additionally, personnel may be required to wear life vests when crossing deeper bodies of water. When possible, personnel will not enter the water body and take measurements from the bank.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
GRAVITY	Falls from slips and trips.	Uneven terrain, slick/ muddy/wet surfaces and steep slopes.	Walking/working on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Personnel will wear work boots with good traction and ankle support. Personnel will be aware of working/walking surfaces and choose a path to avoid hazards. Keep work areas as dry as possible. Wear muck boots, as necessary.
WEATHER	Cold/heat stress.	Sites.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors. Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Hypothermia/ frostbite.	Sites where air temperature is 35.6 °F (2 °C) or less.	Personnel who become immersed in water or whose clothing becomes wet may be exposed to hypothermia and/or frostbite.	Personnel will change clothing if it becomes wet. When applicable, Personnel will wear waders to prevent clothing from getting wet.
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Personnel will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Personnel could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Personnel will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Personnel should wear sunscreen, if necessary.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
BIOLOGICAL	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Personnel with allergies will notify their supervisor.
MECHANICAL	Not applicable.			
PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained personnel.	Sites.	Inexperienced personnel and improper training could cause incidents resulting in adverse health effects and/or property damage.	Personnel will be properly trained in this procedure and other applicable procedures. Personnel will implement stop work procedures, if necessary.
SIMOPS (Simultaneous Operations)	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	**Personal Protection Equipment** (PPE): Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, and nitrile gloves.
APPLICABLE SDSs	**Safety Data Sheets** (SDSs): pH 4, pH7, and pH10 buffer solutions. Safety Data Sheets are available to Pioneer personnel at the link below: https://pioneertechnicalservices.sharepoint.com/Safety/SafetyDataSheets
REQUIRED PERMITS/ FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
DRAWINGS	Map with site location and sample locations.
RELATED SOPs/ PROCEDURES/ WORK PLANS	
TOOLS/ EQUIPMENT	pH field measurement meters, spare batteries for the pH field measurement meters, deionized water, pH 7 buffer solution, pH 4 buffer solution, pH 10 buffer solution, beaker, and field logbook.
FORMS/ CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Julie Flammang **Julie Flammang**	**09/29/2020**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**09/29/2020**

PURPOSE	To provide standard instructions for field measurements of oxidation reduction potential (ORP) in water.
SCOPE	Pioneer Technical Services, Inc. (Pioneer) prepared this practice for the workforce and this Standard Operating Procedure (SOP) applies to all work performed by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent (as defined by OSHA) in the risk-assessed procedure described below before performing the work.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is inaccurate or unsafe, personnel must notify the Project Manager, Safety Manager, and the SOP Technical Author to initiate appropriate revisions. Personnel will perform all work under this SOP in a manner that is consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plans (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Important information about meter's calibration.	Pioneer owns and operates different brands and models of ORP field measurement meters. At this time, Pioneer uses YSI, In-Situ, Thermo Scientific ORION (Orion 3 Star or Orion 5 Star) Portable Meters for ORP measurements. An Orion 9179BNMD epoxy low maintenance ORP/ATC Triode is attached to the ORION meters. The Orion Star meters can perform an automatic ORP calibration adjusted for temperature. User manuals for each meter are available and the specific directions for calibrating and measuring ORP with that meter should be followed. If there is a choice between measuring ORP in the millivolt (mV) or relative millivolt (RmV), measure in **mV mode**. The Orion meters are calibrated using RmV mode and then changed to mV for measuring. The YSI and In-Situ multi probes, units will be in mV for both calibration and measurements. The mV values can be compared among multiple meters and electrode systems. Listed below is the general calibration procedure. Refer to the meter specific operating manual for detailed calibration instructions.
1. Prepare electrode.	1. Remove the protective shipping cap from the sensing element and save the cap for storage. 2. Clean any salt deposits from the exterior of the electrode by rinsing with distilled water. 3. Shake the electrode downward (similar to a clinical thermometer) to remove air bubbles from the Orion and YSI probes. 4. Connect the electrode to the meter.

2. Connect the electrode to the meter.	1. For the Orion meters, insert the ORP connector (large diameter) in the pH or BNC electrode input jack on the meter and the reference electrode connector (small diameter) into the reference electrode input jack. 2. For the YSI and In-Situ meters, slide probe into correct slot and turn counterclockwise to tighten. Make sure threads are not cross threaded and tighten. **Hand tighten only!**
3. Calibrate the meter.	All field meters must be calibrated prior to use. Calibration shall be performed at a minimum of once per day when the instrument is in use. Calibration shall be performed prior to the first measurements of the day. All calibration results **will** be recorded in the field logbook, or if stored on the meter, downloaded and saved in the project file. Downloaded calibration files will be included as part of the field logbook record. 1. For the Orion meters, set the meter to the RmV mode referring to the specific meter's user guide for instructions. If using YSI or In-Situ meters skip to step 2. 2. Rinse the electrode with deionized or distilled water and place the ORP electrode in an appropriate ORP standard. Pioneer uses a 400 mV standard (Orion 967901 or similar) for most calibrations. If project-specific measurements of ORP are expected to be much higher or lower than 400 mV, use an ORP calibration standard with an appropriate concentration. **Always** use fresh ORP standard for calibrations. Empty the ORP calibration container in the Pioneer Calibration Kit, rinse the bottle with fresh ORP solution, empty it, and then pour enough of the calibration fluid into the bottle to cover the bottom of the electrode. 3. For Orion meters, wait for the RmV icon to quit flashing. If using YSI or In-Situ meters, wait for mV to stabilize and accept calibration. 4. The Orion Star meters will automatically calculate the mV. Small adjustments may be required to the reading to achieve the mV value of the ORP standard at the measured temperature. Information provided in the Thermo Orion User Guide for Redox/ORP Electrodes or Table 1, on page 4, can be used as a reference for the appropriate reading. Adjust the meter referring to the meter user's guide for detailed instructions on adjusting the reading. 5. For Orion meters, press the measure symbol to end the calibration. The mV offset will be displayed and the meter will proceed to the measurement mode. The In-situ meter will display the mV offset and temperature immediately after accepting the calibration. This information can be stored for downloading. 6. If using the YSI meter, calibration is stored on the meter and can be downloaded. To access the calibration information immediately to record in the logbook, return to the main display screen. Press "File," scroll down to the "GLP" file, and press enter to view. The information from the latest calibration will be displayed at the top. Scroll down to view previous calibrations.

	7. Record the calibration information in the logbook or save for later download.
4. Conduct field measurements.	Field ORP measurements for surface water may be made by direct submersion of the instrument probe into the sample stream. If flow is turbulent or shallow, or if direct immersion could damage the probe, a grab sample can be collected in a beaker or bottle and the probe should be placed immediately into the beaker for measurement. Field ORP measurements of groundwater may be made by inserting the probe into a flow-through device or by collection of a grab sample and immediate analysis of that sample in the field. Specific requirements may be listed in the project-specific documents (sampling and analysis plan, quality assurance project plan, work plan, etc.). The ORP measurements are considered stable during groundwater sampling when 3 consecutive readings vary by no more than 10 mV units. Oxidation Reduction Potential is always measured and reported in mV. Refer to the meter specific user manual for measurement instructions. Listed below are general measurement instructions: 1. Rinse the electrode with distilled or deionized water. Shake off any excess water and blot the electrode dry with lint-free tissue. 2. Check and make sure that the meter is measuring in mVs. 3. Place the electrode directly into the water to be measured. If the probe cannot be placed directly into the water being measured, rinse a decontaminated beaker with sample water 3 times and fill the beaker with the water to be measured. 4. Continuously stir or move the probe through the sample at a rate of about 1 foot per second. 5. If the meter is in the continuous measurement mode, it will start reading immediately and continuously update the display. The mV icon will flash until the reading is stable. 6. Read and record the result in the field logbook or on a field data sheet. 7. Remove the electrode from the sample, rinse it with distilled or deionized water, and blot it dry before inserting the probe into the storage sleeve.
Important information about the meter.	1. Store meter in its case during transport. 2. Check batteries before taking meter into the field. Carry spare batteries and deionized water for rinsing probe. 3. Inspect probe for damage or dirt.

4. Dust and wipe the meter with a damp cloth. If necessary, warm water or mild water-based detergent can be used to clean the case. Immediately remove any spilled substance from the meter using the proper cleaning procedure for the type of spill.

5. If meter readings are erratic, replace the probe. If measurement readings continue to be erratic, return the meter to factory for repair.

Table 1. ORP Standard Values – Page 1

Table 1– ORP Standard Values
Absolute mV values may vary by ± 60 mV

Temperature (°C)	E_H Value (mV)	Absolute Value with Cat. No. 900011 Filling Solution (mV)	Absolute Value with Cat. No. 900001 Filling Solution (mV)
0	438	218	176
1	437	218	176
2	437	218	176
3	436	218	176
4	435	218	176
5	435	218	176
6	434	218	176
7	433	218	176
8	433	218	175
9	432	219	175

Table 1. ORP Standard Values – Page 2

Temperature (°C)	E_H Value (mV)	Absolute Value with Cat. No. 900011 Filling Solution (mV)	Absolute Value with Cat. No. 900001 Filling Solution (mV)
10	431	219	175
11	430	219	175
12	430	219	175
13	429	219	175
14	428	219	175
15	428	219	175
16	427	219	174
17	426	219	174
18	425	219	174
19	424	219	174
20	424	219	174
21	423	219	174
22	422	219	174
23	421	219	173
24	420	220	173
25	420	220	173
26	419	220	173
27	418	220	173
28	417	220	172
29	416	220	172
30	415	220	172
31	414	220	172
32	413	220	172
33	412	220	171
34	412	220	171
35	411	220	171
36	410	220	171
37	409	220	171
38	408	220	170
39	407	220	170
40	406	220	170
41	405	220	170
42	404	220	169
43	403	220	169
44	402	220	169
45	401	220	169
46	400	220	168
47	399	220	168
48	398	220	168
49	397	220	168
50	396	220	167

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Potential contact with contaminated water.	Testing sites, during field measure-ments.	Inadvertent exposure to contaminated water could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Personnel will wear nitrile gloves and safety glasses when taking measurements.
	Potential exposure to ORP standard solution.	Equipment calibration.	ORP standard solution is moderately toxic if ingested. It may also irritate eyes and skin.	Personnel will practice proper personal hygiene – wash hands prior to eating and after calibrating equipment. Personnel will wear nitrile gloves and safety glasses when handling the ORP standard solution.
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			
BODY MECHANICS	Bending, squatting, and kneeling.	During field measure-ments.	Bending, squatting, and kneeling during field measurements could result in muscle/back strains or other injuries.	Personnel should stretch prior to starting work and they will take breaks when necessary.
	Drowning and/or entrapment hazards.	Bodies of water, during field measure-ments.	If personnel need to stand in bodies of water to take measurements, they could be exposed to drowning and/or entrapment hazards from soft soils and/or sudden changes in depth of water.	If necessary, personnel will use rods to test soil stability and/ or depth of water as they walk to sample locations. Also, personnel may be required to wear life vests when crossing deeper bodies of water. When possible, personnel will not enter the water body and take measurements from the bank.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/ wet surfaces and steep slopes.	Walking/working on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Personnel will wear work boots with good traction and ankle support. Personnel will be aware of working/walking surfaces and choose a path to avoid hazards. Keep work areas as dry as possible. Wear muck boots, as necessary.
WEATHER	Cold/heat stress.	Sites.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors. Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Hypothermia/ frostbite.	Sites where air temperature is 35.6 °F (2 °C) or less.	Personnel who become immersed in water or whose clothing becomes wet may be exposed to hypothermia and/or frostbite.	Personnel will change clothing if it becomes wet. When applicable, Personnel will wear waders to prevent clothing from getting wet.
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Personnel will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Personnel could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Personnel will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Personnel should wear sunscreen, if necessary.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
BIOLOGICAL	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Personnel with allergies will notify their supervisor.
MECHANICAL	Not applicable.			
PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained personnel.	Sites.	Inexperienced personnel and improper training could cause incidents resulting in adverse health effects and/or property damage.	Personnel will be properly trained in this procedure and other applicable procedures. Personnel will implement stop work procedures, if necessary.
SIMOPS (Simultaneous Operations)	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

REQUIRED PPE	**Personal Protection Equipment** (PPE): Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, and nitrile gloves.
APPLICABLE SDSs	**Safety Data Sheets** (SDSs): ORP Standard Solution Safety Data Sheets are available to Pioneer personnel at the link below: https://pioneertechnicalservices.sharepoint.com/Safety/SafetyDataSheets

REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
DRAWINGS	Map with site location and sample locations.
RELATED SOPs/ PROCEDURES/ WORK PLANS	
TOOLS/ EQUIPMENT	ORP field measurement meters, ORP standard solution, spare batteries for the meters, distilled water or deionized water, lint-free tissue, beaker, and field logbook or field data sheet.
FORMS/ CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Julie Flammang **Julie Flammang**	**10/15/2020**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**10/15/2020**

PURPOSE	To provide standard instructions for field measurements of specific conductance.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Important information about the meter.	Pioneer owns and operates different brands and models of specific conductance (SC) field measurement meters. All the units, in general, have automatic temperature correction (ATC) capabilities. Prior to using a SC meter check that it does have the ATC function. User manuals for each meter are available and the specific directions for calibrating and measuring SC with that meter should be followed. The following is a general summary for field measurement of SC.
1. Calibrate the meter.	All field meters must be calibrated prior to use. Calibration shall be performed at a minimum of once per day for each day of instrument use. Calibration shall be performed prior to the first measurements of the day. Refer to the meter specific operating manual for calibration instructions. Listed below are general calibration requirements: 1. For a new probe, prepare the SC probe according to the directions in the electrode user guide. 2. Connect the probe to the appropriate connection on the meter. 3. Turn the meter on and make sure it is in the conductivity measurement mode. Calibrate instrument as described in the meter specific operating manual. Unless specified in the Sampling and Analysis Plan (SAP) or work plan, one conductivity standard is used for calibration. Unless directed otherwise, use the 1413 micromhos/centimeter (µs/cm) calibration standard present in all of Pioneers calibration cases. Make sure that the calibration standard in the case is fresh. The container of calibration standard should be emptied, rinsed with new calibration standard and filled prior to a field sampling event. Replace batteries and try fresh calibration solutions if meter does not calibrate properly. 4. Record the calibration results in the field logbook. If the meter displays an average calculated cell constant, record this in the field logbook. 5. Once the SC meter is in measure mode, measure the calibration standard and

	record this result and the measurement temperature in the field logbook. 6. Re-measure the calibration fluid at the end of the day and note any drift. Record the information in the field logbook.
2. Conduct field measurements.	Field conductivity measurements for surface water may be made by direct submersion of the instrument probe into the sample stream. When flow is turbulent or shallow, or when direct immersion of the probe would risk damaging the probe, measurements may be made by collection of a grab sample and immediate analysis of the grab sample in the field. Field SC measurements of groundwater may be made by inserting the probe into a flow through device or by collection of a grab sample and immediate analysis of the grab sample in the field. Specific requirements may be listed in the SAP or work plan. Field SC is measured in units of µS/cm (micromhos/centimeter) or mS/cm (millihos/centimeters) on all Pioneer meters. Refer to the meter specific operating manual for measurement instructions. Listed below are general measurement instructions: 1. If the probe cannot be placed directly into the water being measured, rinse the decontaminated beaker with sample water three times. 2. Fill the beaker with the water to be measured. 3. With the meter in measurement mode, rinse the conductivity cell with distilled water, blot dry with a lint-free tissue and place the cell into the water being measured. 4. Submerge conductivity probe in sample so that flow cell holes are immersed and wait for the readings to stabilize. 5. Read and record the SC result in the field logbook or on a field data sheet making sure that the correct units are recorded, either µS/cm or mS/cm. Record the sample temperature to the nearest 0.1 degree Celsius (°C) from the conductivity meter after temperature has equilibrated. 6. Repeat the above steps for all samples. 7. When all samples have been measured, store the electrode according to their specific user guides.
Important information about the meter.	1. Store meter in case during transport. 2. Check batteries before taking meter into the field. Carry spare batteries and de-ionized water for rinsing probe. 3. Inspect probe for damage or dirt.

	4. Dust and wipe the meter with a damp cloth. If necessary, warm water or mild water based detergent can be used to clean the case. Immediately remove any spilled substance from the meter using the proper cleaning procedure for the type of spill. 5. If meter readings are erratic, replace the probe. If readings continue to be erratic, return the meter to factory for repair.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Potential contact with contaminated water.	Testing sites, during field measurements.	Inadvertent exposure to contaminated water could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Personnel will wear nitrile gloves and safety glasses when taking measurements.
	Exposure to 1413 µs/cm calibration standard solution.	Equipment calibration.	The calibration standard solution may cause irritation of eyes and skin.	Personnel will practice proper personal hygiene – wash hands prior to eating and after calibrating equipment. Personnel will wear nitrile gloves and safety glasses when handling the calibration standard solution.
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			
BODY MECHANICS	Bending, squatting, and kneeling.	During field measurements.	Bending, squatting, and kneeling during field measurements could result in muscle/back strains or other injuries.	Employees should stretch prior to starting work and they will take breaks when necessary.
	Drowning and/or entrapment hazards.	Bodies of water, during field measurements.	If employees need to stand in bodies of water to take measurements, they could be exposed to drowning and/or entrapment hazards from soft soils and/or sudden changes in depth of water.	If necessary, personnel will use rods to test soil stability and/or depth of water as they walk to sample locations. In addition, personnel may be required to wear life vests when crossing deeper bodies of water. When possible, workers will not enter the water body and take measurements from the bank.

GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet surfaces and steep slopes.	Walking/working on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Personnel will wear work boots with good traction and ankle support. Personnel will be aware of working/walking surfaces and choose a path to avoid hazards. Keep work areas as dry as possible. Wear muck boots, as necessary.
WEATHER	Cold/heat stress.	Sites.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors. Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Hypothermia/ frostbite.	Sites where air temperature is 35.6°F (2°C) or less.	Workers who become immersed in water or whose clothing becomes wet may be exposed to hypothermia and/or frostbite.	Employees will change clothing if it becomes wet. When applicable, employees will wear waders to prevent clothing from getting wet.
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Employees will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Employees will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Employees should wear sunscreen, if necessary.

BIOLOGICAL	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Employees with allergies will notify their supervisor.
MECHANICAL	Not applicable.			
PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained worker.	Sites.	Inexperienced workers and improper training could cause incidents resulting in adverse health effects and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement stop work procedures, if necessary.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, and nitrile gloves.
APPLICABLE SDS	1413 µs/cm calibration standard solution. Additional Safety Data Sheets (SDSs) will be maintained based on site characterization and contaminants.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	Map with site location and sample locations.
RELATED SOPs/PROCEDURES/ WORK PLANS	
TOOLS	Specific conductance field measurement meter, calibration standard solution, calibration kit, spare batteries for the meter, distilled water or de-ionized water, lint-free tissue, beaker, and field logbook or field data sheet.
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Julie Flammang **Julie Flammang**	**12/17/2014**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**12/17/2014**

Revisions:

Revision	Description	Date

PURPOSE	To provide standard instructions for field measurement of water temperature.
SCOPE	Pioneer Technical Services, Inc. (Pioneer) prepared this practice for the workforce and this Standard Operating Procedure (SOP) applies to all work performed by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent (as defined by OSHA) in the risk-assessed procedure described below before performing the work.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is inaccurate or unsafe, personnel must notify the Project Manager, Safety Manager, and the SOP Technical Author to initiate appropriate revisions. Personnel will perform all work under this SOP in a manner that is consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plans (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Note	Pioneer uses a pH field measurement meter or multi-meter for measuring temperature.
1. Prepare the pH meter for measuring water temperature.	Pioneer owns and operates different brands and models of pH and multi-meters. All units, in general, have automatic temperature correction (ATC) capabilities. Prior to using a pH meter or multi-meter, verify that it has the ATC function. User manuals for each meter are available and the specific directions for calibrating and measuring pH with that meter should be followed. Calibrate pH in the field at the beginning of each day. Record the calibration information in the field logbook. 1. For a new probe, prepare the pH probe according to the directions in the electrode user guide. 2. Connect the probe to the appropriate connection on the meter. 3. Turn the meter on and make sure it is in the pH measurement mode. Calibrate the instrument as described in the meter-specific operating manual.
2. Calibrate the meter.	The following is a general summary for instrument calibration: 1. Rinse the ATC pH probe in deionized water. 2. Turn on meter and immerse the ATC pH probe in a pH 7 buffer solution. Calibrate meter to pH 7 allowing enough time for meter to stabilize. 3. Rinse ATC pH probe with deionized water. 4. Immerse ATC pH probe in a pH 4 buffer solution. Calibrate meter to pH 4

	allowing enough time for meter to stabilize. 5. Rinse pH and temperature probe with deionized water. 6. Immerse ATC pH probe in a pH 10 buffer solution. Calibrate meter to pH 10 allowing enough time for meter to stabilize. 7. Record the slope reading in the field logbook. 8. Recheck meter calibrations with the pH 4, pH 7, and pH 10 calibration solutions. Repeat the calibration process (steps 2-6), if a value for any final pH check is more than the manufacture's listed accuracy in the associated user's manual. Record pH and temperature calibration recheck values in logbook.
3. Take field measurements.	The following is a general summary for field measurement of pH and temperature: 1. Rinse beaker with sample water 3 times. 2. Rinse ATC pH probe with deionized water. 3. Fill beaker with sample water. 4. Turn on meter and immerse ATC pH probe in sample water. Stir sample for thorough mixing. Read and record temperature to the nearest 0.01 unit once pH and temperature readings have stabilized. 5. Rinse electrodes with deionized water and store in carrying case. Note: Temperature may also be measured by placing the probe directly into the water body being tested. The probe must be moved slowly in a circular motion when measuring stagnant water.
Important information about meter.	1. Store meter in case during transport. 2. Check batteries before taking meter into the field. Carry spare batteries and deionized water for rinsing probe. 3. Inspect probe for damage or dirt. 4. Dust and wipe the meter with a damp cloth. If necessary, warm water or a mild water-based detergent can be used to clean the case. Immediately remove any spilled substance from the meter using the proper cleaning procedure for the type of spill. 5. If meter readings are erratic, replace the probe. If readings continue to be erratic, return the meter to factory for repair.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
CHEMICAL	Potential contact with contaminated water.	Testing sites, during temperature measurements.	Inadvertent exposure to contaminated water could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Personnel will wear nitrile gloves and safety glasses when taking measurements.
	Potential contact with pH buffer solutions.	Equipment calibration.	Inadvertent exposure to pH buffer solutions could lead to adverse health effects (e.g., irritation of eye, skin, and/or respiratory tract).	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and after calibrating equipment. Personnel will wear nitrile gloves and safety glasses when handling pH buffer solutions.
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			
BODY MECHANICS	Bending, squatting, and kneeling.	During temperature measurements.	Bending, squatting, and kneeling during temperature measurements could result in muscle/back strains or other injuries.	Personnel should stretch prior to starting work and take breaks when necessary.
	Drowning and/or entrapment hazards.	Bodies of water, during temperature measurements.	If personnel need to stand in bodies of water to take measurements, they could be exposed to drowning and/or entrapment hazards from soft soils and / or sudden changes in depth of water.	If necessary, personnel will use rods to test soil stability and/or depth of water as they walk to sample locations. Additionally, personnel may be required to wear life vests when crossing deeper bodies of water. When possible, personnel will not enter the water body and take measurements from the bank.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
GRAVITY	Falls from slips and trips.	Uneven terrain, slick/ muddy/wet surfaces and steep slopes.	Walking/working on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Personnel will wear work boots with good traction and ankle support. Personnel will be aware of working/walking surfaces and choose a path to avoid hazards. Keep work areas as dry as possible. Wear muck boots, as necessary.
WEATHER	Cold/heat stress.	Sites.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors. Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Hypothermia/ frostbite.	Sites where air temperature is 35.6 °F (2 °C) or less.	Personnel who become immersed in water or whose clothing becomes wet may be exposed to hypothermia and/or frostbite.	Personnel will change clothing if it becomes wet. When applicable, personnel will wear waders to prevent clothing from getting wet.
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Personnel will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Personnel could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Personnel will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Personnel should wear sunscreen, if necessary.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	HAZARDS	WHERE	HOW, WHEN, RESULT	CONTROLS
BIOLOGICAL	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Personnel with allergies will notify their supervisor.
MECHANICAL	Not applicable.			
PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained personnel.	Sites.	Inexperienced personnel and improper training could cause incidents resulting in adverse health effects and/or property damage.	Personnel will be properly trained in this procedure and other applicable procedures. Personnel will implement stop work procedures, if necessary.
SIMOPS (Simultaneous Operations)	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

REQUIRED PPE	**Personal Protection Equipment** (PPE): Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, and nitrile gloves.
APPLICABLE SDSs	**Safety Data Sheets** (SDSs): pH 4, pH 7, and pH 10 buffer solutions. Safety Data Sheets are available to Pioneer personnel at the link below: https://pioneertechnicalservices.sharepoint.com/Safety/SafetyDataSheets

REQUIRED PERMITS/ FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
DRAWINGS	Map with site location and sample locations.
RELATED SOPs/ PROCEDURES/ WORK PLANS	
TOOLS/ EQUIPMENT	pH field measurement meters, spare batteries for the pH field measurement meters, deionized water, pH 7 buffer solution, pH 4 buffer solution, pH 10 buffer solution, beaker, and field logbook.
FORMS/ CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Julie Flammang **Julie Flammang**	**09/30/2020**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**09/30/2020**

PURPOSE	To provide standard instructions for field measurements of dissolved oxygen.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Note	Pioneer owns and operates several brands and models of dissolved oxygen (DO) field measurement meters. All the units have automatic barometric pressure and salinity content compensation. User manuals for each meter are available and the specific directions for calibrating and measuring DO with that meter should be followed. The following is a general summary for field measurement of DO.
1. Calibrate the meter.	All field meters must be calibrated prior to use. Calibration shall be performed at a minimum of once per day for each day of instrument use. Calibration shall be performed prior to the first measurements of the day. Refer to the meter specific operating manual for calibration instructions. Listed below are general calibration requirements: 1. Inspect DO meter and probe for damage. If one of the YSI DO meters is to be used, inspect the probe for sufficient electrolyte and to determine if the oxygen sensor membrane is in good condition. Replace membrane, if torn or wrinkled. Inspect for air bubbles beneath the membrane. If bubbles are present, remove membrane and add electrolyte solution. Replace membrane so that air bubbles are absent. If the Thermo Scientific DO meters are used, check to make sure the RDO Optical Dissolved Oxygen probe has not exceeded its lifespan. 2. Turn the meter on and if needed place the meter in the DO measurement mode. Calibrate instrument as described in the meter specific operating manual. Unless specified in the Sampling and Analysis Plan (SAP) or work plan, calibration should be conducted in the % saturation mode. Replace batteries and clean probe, if meter does not calibrate properly. 3. With all of Pioneers DO meters, an air calibration is performed in water saturated air using the calibration/storage sleeve. To begin, check the sponge in the calibration sleeve and moisten the sponge with distilled water, if needed. Place 3-6 drops of water on the sponge and then allow any excess water to drain out of the chamber. The wet sponge creates a 100% water saturated air environment for the probe. This environment is ideal for DO calibration and for

	storage of the probe during transport and non-use. 4. Allow the probe and calibration standard (water saturated air) to reach equilibrium. 5. Calibrate the meter according to manufacturer's instructions. To accurately calibrate the YSI DO meters you will need to know the following information: • The approximate salinity of the water you will be analyzing. Fresh water has a salinity of approximately zero. Seawater has a salinity of approximately 35 parts per thousand (ppt). • For calibration in % saturation mode, the approximate altitude (in feet) of the region where you are located is required. This information can be obtained over the internet or from a topographic map. 6. Record the % saturation number displayed at the end of the automatic calibration.
2. Take measurements.	Field DO measurements for surface water may be made by direct submersion of the instrument probe into the sample stream. If flow is turbulent or shallow, or if direct immersion of the probe would risk damaging the probe, a grab sample can be collected and immediate measurement of the grab sample conducted. Field DO measurements of groundwater may be made by inserting the probe into a flow through device or by collection of a grab sample and immediate analysis of the grab sample in the field. Specific requirements may be listed in the SAP or work plan. The site-specific document may list the units that DO should be measured in (e.g., % saturation or mg/L). Refer to the meter-specific operating manual for measurement instructions. Listed below are general measurement instructions: 1. If the probe cannot be placed directly into the water being measured, rinse the decontaminated beaker with sample water three times. 2. Fill the beaker with the water to be measured. 3. Continuously stir or move the probe through the sample at a rate of about one foot per second. 4. Allow temperature and dissolved oxygen readings to stabilize. 5. Read and record the DO result in the field logbook or on a field data sheet making sure that the correct units are recorded (either % Sat or mg/L). Record the sample temperature to the nearest 0.1ºC from a pH meter, if available, after the temperature has equilibrated. 6. Spray the probe with de-ionized water and wipe clean before reinserting to calibration/storage sleeve. 7. Repeat the above steps for all samples.

	8. When all samples have been measured, store the electrode according to their specific user guides.
3. Maintenance of equipment.	1. Store meter in case during transport. 2. Check batteries before taking meter into the field. Carry spare batteries and de-ionized water for rinsing probe. 3. Inspect probe for damage or dirt. 4. Dust and wipe the meter with a damp cloth. If necessary, use warm water or mild water based detergent to clean the case. Immediately remove any spilled substance from the meter using the proper cleaning procedure for the type of spill. 5. If meter readings are erratic, replace the probe. If measurement readings continue to be erratic, return the meter to factory for repair.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Potential contact with contaminated water.	Testing sites, during field measurements.	Inadvertent exposure to contaminated water could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Personnel will wear nitrile gloves and safety glasses when taking measurements.
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			
BODY MECHANICS	Bending, squatting, and kneeling.	During field measurements.	Bending, squatting, and kneeling during field measurements could result in muscle/back strains or other injuries.	Employees should stretch prior to starting work and they will take breaks when necessary.
	Drowning and/or entrapment hazards.	Bodies of water, during field measurements.	If employees need to stand in bodies of water to take measurements, they could be exposed to drowning and/or entrapment hazards from soft soils and/or sudden changes in depth of water.	If necessary, workers will use rods to test soil stability and/or depth of water as they walk to sample locations. In addition, personnel may be required to wear life vests when crossing deeper bodies of water. When possible, workers will not enter the water body and take measurements from the bank.
GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet surfaces and steep slopes.	Walking/working on slick/muddy/wet and uneven terrain could cause slips and trips resulting in	Personnel will wear work boots with good traction and ankle support. Personnel will be aware of working/walking surfaces and choose a path to avoid hazards. Keep work areas as dry as possible. Wear

			falls and injuries.	muck boots, as necessary.
WEATHER	Cold/heat stress.	Sites.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors. Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Hypothermia/ frostbite.	Sites where air temperature is 35.6°F (2°C) or less.	Workers who become immersed in water or whose clothing becomes wet may be exposed to hypothermia and/or frostbite.	Employees will change clothing if it becomes wet. When applicable, employees will wear waders to prevent clothing from getting wet.
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Employees will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Employees will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Employees should wear sunscreen, if necessary.
BIOLOGICAL	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Employees with allergies will notify their supervisor.

MECHANICAL	Not applicable.			
PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained worker.	Sites.	Inexperienced workers and improper training could cause incidents resulting in adverse health effects and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement stop work procedures, if necessary.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, and nitrile gloves.
APPLICABLE SDS	Safety Data Sheets (SDSs) will be maintained based on site characterization and contaminants.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	Map with site location and sample locations.
RELATED SOPs/PROCEDURES/ WORK PLANS	
TOOLS	Dissolved oxygen field measurement meter, de-ionized water, distilled water, decontaminated beaker, field logbook or field data sheet, and spare batteries for meter.
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Julie Flammang **Julie Flammang**	**12/17/2014**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**12/17/2014**

Revisions:

Revision	Description	Date

Pace Analytical®
ENVIRONMENTAL SCIENCES

Document Information

Document Number: ENV-SOP-MIN4-0103	**Revision:** 02
Document Title: Alkalinity, Titrimetric by SM 2320B	
Department(s): Wet Chemistry	

Date Information

Effective Date: 18 Mar 2020

Notes

Document Notes:

All Dates and Times are listed in: Central Time Zone

Signature Manifest

Document Number: ENV-SOP-MIN4-0103 **Revision:** 02

Title: Alkalinity, Titrimetric by SM 2320B

All dates and times are in Central Time Zone.

ENV-SOP-MIN4-0103 - alkalinity

QM Approval

Name/Signature	Title	Date	Meaning/Reason
Janielle Ward (007319)	Manager - Quality	14 Feb 2020, 01:54:42 PM	Approved

Management Approval

Name/Signature	Title	Date	Meaning/Reason
Christina Schmitt (005842)	Administrative Assistant	04 Feb 2020, 11:35:53 AM	Approved
Adam Haugerud (005828)	General Manager 1	17 Feb 2020, 01:17:53 PM	Approved
Andrew Mickelson (009792)	Manager	18 Mar 2020, 04:10:40 PM	Approved

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TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: Alkalinity, Titrimetric by SM 2320B
TEST METHOD SM 2320B
ISSUER: Pace ENV – Minneapolis – MIN4

1.0 Scope And Application

The purpose of this Standard Operating Procedure (SOP) is to determine the alkalinity, i.e. the acid-neutralizing capacity of potable and surface waters, domestic and industrial wastewaters, and saline waters as delineated in Standard Methods 2320B. Alkalinity may be reported as total alkalinity or individually as bicarbonate, carbonate, or hydroxide.

1.1 **Target Analyte**

Analyte	Matrix (units)	LOQ
Alkalinity	Water (mg/L)	5

The reporting limit (LOQ) for all analytes is 5 mg/L for this method. All current MDLs are listed in the LIMS and are available by request from the Quality Manager.

LOQ are established in accordance with Pace policy and SOPs for method validation and for the determination of detection limits (DL) and quantitation limits (LOQ). DL and LOQ are routinely verified and updated when needed.

1.2 **Applicable Matrices:** This SOP is applicable to water and wastewater samples.

1.3 **Personnel:** The policies and procedures contained in this SOP are applicable to all personnel involved in the analytical and preparation methods.

1.4 **Parameters:** This method is applicable to waters or wastes with alkalinity in ranges from 5 mg/L to approximately 1,000 mg/L.

2.0 Summary of Method

The sample is titrated to an electrometrically determined endpoint of pH 8.3 then to pH 4.5 in succession with an acid reagent.

3.0 Interferences

Soaps, oily matter, suspended solids, or precipitates may coat the glass electrode and cause a sluggish response. Allow additional time between titrant additions to let the electrode come to equilibrium or clean the electrodes occasionally. Do not filter, dilute, concentrate, or alter the sample.

4.0 Definitions

Refer to the Laboratory Quality Manual for a glossary of common lab terms and definitions.

5.0 Health and Safety

The toxicity or carcinogenicity of each chemical material used in the laboratory has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable.

The laboratory maintains documentation of hazard assessments and OSHA regulations regarding the safe handling of the chemicals specified in each method. Safety data sheets for all hazardous chemicals are available to all personnel. Employees must abide by the health, safety and environmental (HSE) policies and procedures specified in this SOP and in the Pace Chemical Hygiene / Safety Manual.

Personal protective equipment (PPE) such as safety glasses, gloves, and a laboratory coat must be worn in designated areas and while handling samples and chemical materials to protect against physical contact with samples that contain potentially hazardous chemicals and exposure to chemical materials used in the procedure.

Concentrated corrosives present additional hazards and are damaging to skin and mucus membranes. Use these acids in a fume hood whenever possible with additional PPE designed for handing these materials. If eye or skin contact occurs, flush with large volumes of water. When working with acids, always add acid to water to prevent violent reactions. Any processes that emit large volumes of solvents (evaporation/concentration processes) must be in a hood or apparatus that prevents employee exposure.

Contact your supervisor or local HSE coordinator with questions or concerns regarding safety protocol or safe handling procedures for this procedure.

6.0 SAMPLE COLLECTION, PRESERVATION, HOLDING TIME, AND STORAGE

Samples should be collected in accordance with a sampling plan and procedures appropriate to achieve the regulatory, scientific, and data quality objectives for the project.

The laboratory does not perform sample collection or field measurements for this test method. To assure sample collection and field checks and treatment are performed in accordance with applicable regulations Pace project managers will inform the client of these requirements at the time of request for analytical services when the request for testing is received prior to sample collection. If samples were already collected, the laboratory will record any nonconformance to these requirements in the laboratory's sample receipt record when sufficient information about sample collection is provided with the samples.

The laboratory will provide containers for the collection of samples upon client request for analytical services. Bottle kits are prepared in accordance with laboratory ENV-SOP-MIN4-0009 *Bottle Preparation* (most recent revision or replacement).

Requirements for container type, preservation, and field quality control (QC) for the common list of test methods offered by Pace are included in the laboratory's quality manual.

General Requirements

Matrix	Routine Container	Minimum Sample Amount[1]	Preservation	Holding Time
Aqueous	Glass or polyethylene bottles	25 mL	Thermal: ≤6° Celsius Chemical: N/A	14 days

[1]*Minimum amount needed for each discrete analysis.*

Thermal preservation is checked and recorded on receipt in the laboratory in accordance with laboratory SOP ENV-SOP-MIN4-0008 *Sample Management* (current revision or replacement).

After receipt, samples are stored at ≤6°C until sample preparation.

7.0 Equipment And Supplies

7.1 Equipment

Equipment	Description	Vendor/Item #
Analytical Balance	Capable of reading to 0.0001 g	Sartorius RC 210P or equivalent
Hot plate	General laboratory equipment	Fisher Scientific or equivalent
Miscellaneous Glassware	Class A 25 mL graduated cylinder; Watch glass	Fisher Scientific or equivalent
10 L Nalgene Bottle with Dispenser	For storing and delivering titer	Fisher part # 02-963-2A or equivalent
778 Autotitrator system w/ 888 Titrando Dosing unit (10WET6)	Includes mechanical burette, pH electrode, 1 L amber glass container for titer, Tiamo software	Metrohm
814 Autotitrator system w/ 905 Titrando Dosing unit (10WT63)	Includes mechanical burette, pH electrode, 1 L amber glass container for titer, Tiamo software	Metrohm

7.2 Supplies

Supply	Description	Vendor/Item #
Magnetic Stir Bars		Fisher part # 16-800-508 or equivalent
75 mL sample vessel	Sample vessels for autotitrator	Metrohm part # 6.1432.210

8.0 Reagents And Standards

8.1 Reagents

Reagent	Concentration/ Description	Requirements/ Vendor/ Item #
De-ionized (DI) Water	N/A	See ENV-SOP-MIN4-0090 Reagent Water Quality, or equivalent
Hydrochloric Acid (HCl)	6N HCl. Store at room temperature. Expires per manufacturer's specifications.	Fisher part # 3750-1 or equivalent
Sodium Carbonate (Na_2CO_3), Anhydrous	Powder. Store at room temperature. Expires per manufacturer's specifications.	Fisher part # S263-500 or equivalent
Sodium Carbonate (Na_2CO_3) Solution	0.05N. For use in standardizing titer. Purchase premade. Store at room temperature. Expires per manufacturer's specifications.	Fisher part # 7185-16 or equivalent

8.1.1 **1.0N HCl Stock Solution:** Add 167 mL of 6 N HCl to a 1000 mL volumetric flask containing 800 mL DI water. Dilute to mark, mix thoroughly, cool in fume hood and transfer to 1 L amber glass container. Expires in 12 months.

8.1.1.1 **0.02N HCl Solution (Titer):** Add 40 mL of 1.0N stock to 2000 mL volumetric flask containing approximately 1500 mL DI water. Dilute to mark, mix thoroughly, cool in fume hood and transfer to a 10 L Nalgene plastic dispenser. Expires in three months. Standardize this solution per section 9.2.

8.2 Standards

Reagent/Standard	Concentration/ Description	Requirements/ Vendor/ Item #

Pace Analytical®

TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: Alkalinity, Titrimetric by SM 2320B
TEST METHOD SM 2320B
ISSUER: Pace ENV – Minneapolis – MIN4

Alkalinity Spiking Solution	10,000 mg $CaCO_3$/L; Expires in six months.	
pH 4.00 ± 0.01 Buffer	Used for calibration of the pH electrode. Store at room temperature. Expires as specified by manufacturer.	SCP Science part # 250-204-503 or equivalent
pH 7.00 ± 0.01 Buffer	Used for calibration of the pH electrode. Store at room temperature. Expires as specified by manufacturer.	SCP Science part # 250-207-503 or equivalent
pH 10.00 ± 0.01 Buffer	Used for calibration of the pH electrode. Store at room temperature. Expires as specified by manufacturer.	SCP Science part # 250-210-503 or equivalent
pH 5.00 ± 0.01 Buffer	Used to verify calibration of the pH electrode before sample analysis. Store at room temperature. Expires as specified by manufacturer.	Fisher part # SB102-1 or equivalent

8.2.1 **Alkalinity Spiking Solution:** 10,000 mg $CaCO_3$/L as Na_2CO_3. Dry ~200 g of anhydrous Na_2CO_3 at 180ºC for at least four hours. Dissolve 10.6 g of Na_2CO_3 in a 1000 mL volumetric flask containing about 900 mL of DI water. Dilute to the mark and mix thoroughly. Transfer to a plastic bottle, cap tightly and store at room temperature. Expires in six months.

9.0 PROCEDURE

9.1 Equipment Preparation

9.1.1 Support Equipment

9.1.1.1 All balances must be certified by an outside agency on an annual basis with documentation of the calibration maintained in the QA office.

9.1.1.2 Daily calibration of the balance is required following SOP ENV-SOP-NW-0016 *Support Equipment* (or equivalent replacement). Record in associated balance calibration logbook. Calibration limits are found in the balance calibration logbook; if values exceed these limits, recalibrate the balance.

9.1.2 pH Probe Calibration

9.1.2.1 Before beginning analysis, the pH probe used with the autotitrator must be calibrated daily to three points: 4.00, 7.00 and 10.00. The acceptance criteria for the slope is 96-106% per manufacturer guidelines. Print this information from the database and include with the respective batch paperwork.

9.1.2.2 Immediately after calibration a pH calibration check must be performed using the pH 5.00 buffer. The acceptance criteria for this check is ± 0.10 pH units. If outside the acceptance criteria, the pH probe must be recalibrated and the pH 5.00 buffer check must be reanalyzed. Print this information from the database and include with the respective batch paperwork.

9.1.2.3 Additional calibration procedures (where applicable) can be found in ENV-SOP-NW-0027 Calibration Procedures, or equivalent replacement.

9.2 Titer Standardization

9.2.1 The 0.02N HCl solution must be standardized prior to any sample analysis.

9.2.1.1 In a beaker, add 15 mL 0.05 N $NaCO_3$ solution and approximately 22 mL DI water.

9.2.1.2 Fill 1 L amber glass container with 0.02 N HCl titer to be standardized.

9.2.1.3 Load sample table "Titer Standardization" within the Metrohm Tiamo software. Run the template to titrate potentiometrically to a pH of about 5.0.

9.2.1.4 Lift out the electrode and rinse into the beaker.

9.2.1.5 Boil contents of the beaker for 3-5 minutes under a watch glass, cool to room temperature. Rinse watch glass into the beaker.

9.2.1.6 Continue the "Titer Standardization" template to finish titrating to a pH of 4.5, and calculate the normality using the formula in section 10.1.1.

9.2.1.7 Update the Normality of Titer in the Tiamo software.

9.2.1.7.1 Open the configuration tab and right click the HCl in Titrants/Solutions. Select Properties and update the concentration in both the Solution and Titer tabs to the new true value of the titrant.

9.2.1.8 Scan the completed Titer Standardization worksheet and transfer to J:\Share\LAB\Wet Chem\Alkalinity Titer Standardization

9.3 **Sample Analysis**

9.3.1 Measure the sample with a 25 mL class A graduated cylinder and transfer it to a 75-mL sample vessel. The recommended sample volume is 25 mL, less may be used when required.

9.3.2 Add a magnetic stir bar to each sample vessel. Mixing of the sample is controlled by the automated process.

9.3.3 Fill the 1L titer container with the standardized 0.02 N HCl.

9.3.4 The pH of the sample is measured. The values are recorded into the instrument's database. The instrument software will titrate the sample based on the initial pH.

9.3.4.1 If the initial pH is greater than 8.3, titrate the sample to pH 8.3 and record the volume of the titrant, then continue titration to pH 4.5 and record the volume of the titrant.

9.3.4.2 If the initial pH is less than 8.3 but greater than 4.5, titrate the sample to pH 4.5 and record the volume of the titrant.

9.3.4.3 If the pH is less than or equal to 4.5, alkalinity is not present.

9.3.4.3.1 If the sample's initial pH is < 4.5, rerun the sample to confirm the initial pH.

9.3.5 If the total alkalinity of the sample is less than 20 mg/L, it must be re-analyzed using the instrument's low level method. The low level method uses the titrant to reduce the sample to a pH of 4.5 without measuring the volume. It then titrates to a pH of 4.2, records the volume and uses it for the total alkalinity concentration.

9.3.5.1 Titrate all method blanks, initial calibration blanks and continuing calibration blanks using the low level method.

9.4 **Exporting Data**

9.4.1 LimsLink

9.4.1.1 Select samples from the database to be exported. Send the results to the folder “Alkalinity Data”, found on the desktop or J:\Share\LAB\Wet Chem\Alkalinity Data Files

9.4.1.2 After the files are sent to the desktop folder, rename file: AlkBatch#20010 MM.DD.YY.xls

9.4.1.3 Upload to LIMSLINK. Send to 10WET6 or 10WT63 data file.

9.4.2 Paperless Export

9.4.2.1 Select the results to export and print to the paperless server using the Multiple Result Overview template.

10.0 DATA ANALYSIS AND CALCULATIONS

10.1 **Calculations**

See the Laboratory Quality Assurance Manual for equations for common calculations.

10.1.1 Normality of 0.02N HCl:

$$N = \frac{A \times B}{C}$$

Where, A = Normality of NaCO3
B = mL of NaCO3 solution used for titration
C = mL HCl used

10.1.2 Phenolphthalein alkalinity (pH 8.3):

$$\text{mg } CaCO_3\text{/L} = (A \times N \times 50000) \div V$$

Where, A = mL standard acid titrant to pH 8.3
N = Normality of standard acid titrant
V = Volume of sample analyzed

10.1.3 Total alkalinity (pH 4.5):

$$\text{mg CaCO3/L} = (A \times N \times 50000) \div V$$

Where, A = mL standard acid titrant to pH 4.5
N = Normality of standard acid titrant
V = Volume of sample analyzed

10.1.4 Low level total alkalinity:

$$\text{mg CaCO3/L} = [(2B - C) \times N \times 50000] \div V$$

Where, B = mL standard acid titrant to pH 4.5

C = total mL standard acid titrant to pH 4.2
N = Normality of standard acid titrant
V = Volume of sample analyzed

10.1.5 Bicarbonate, carbonate, and hydroxide alkalinity values may also be calculated using the data obtained from the titration and the following table.

	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Concentration as CaCO3
P = 0	0	0	T
P < ½T	0	2P	T - 2P
P = ½T	0	2P	0
P > ½T	2P - T	2(T - P)	0
P = T	T	0	0

Where, P = Phenolphthalein alkalinity
T = Total alkalinity

10.1.6 LCS and MS/MSD % Recovery:

$$\%\,Recovery = \frac{SS - PS}{SA} \times 100$$

Where, SS = Spiked Sample result, mg/L
PS = Parent Sample result, mg/L (only applicable to MS/MSD, LCS = 0)
SA = Spike Added from spiking standard, mg/L

10.1.7 Relative Percent Difference (RPD):

$$RPD = \frac{|PS - Dup|}{(PS + Dup)/2} \times 100$$

Where, PS = Parent Sample result
Dup = Duplicate sample result

10.1.8 Calculating non-$CaCO_3$ fractions:

10.1.8.1 Converting bicarbonate as $CaCO_3$ to bicarbonate as HCO_3:

$$CaCO_3 + H_2O + CO_2 \rightarrow Ca(HCO_3)_2$$

10.1.8.1.1 The molecular weight of $CaCO_3$ is 100 g/mol and that of HCO_3^- is 61 g/mol. One mole of $Ca(HCO_3)_2$ corresponds to one mole of $CaCO_3$ and contains 122 g of HCO_3^-. Therefore, bicarbonate alkalinity as:

HCO_3^- (mg/L) = 1.22 x Bicarbonate alkalinity as $CaCO_3$ (mg/L)

10.1.8.2 Converting carbonate as $CaCO_3$ to carbonate as CO_3^{2-}:

10.1.8.2.1 The molecular weight of $CaCO_3$ is 100 g/mol and that of CO_3^{2-} is 60 g/mol, therefore carbonate alkalinity as:

CO_3^{2-} = (60/100) or 0.60 x Carbonate alkalinity as $CaCO_3$ (mg/L)

10.1.8.3 Converting hydroxide as $CaCO_3$ to hydroxide as OH^-:

$$CaCO_3 + 2\,H^+ \rightarrow Ca^{2+} + H_2CO_3$$
$$2\,OH^- + 2\,H^+ \rightarrow 2\,H_2O$$

10.1.8.3.1 Two moles of OH^- (17 g/mol) consume as many protons as one mole of $CaCO_3$ (100 g/mol). Therefore, hydroxide alkalinity as:

OH^- (mg/L) = (2 x 17/100) or 0.34 x Carbonate alkalinity as $CaCO_3$ (mg/L)

11.0 QUALITY CONTROL AND METHOD PERFORMANCE

11.1 Instrument QC

QC Sample	Components	Frequency	Acceptance Criteria	Corrective Action
pH Calibration Check	pH 5.0 Buffer	Immediately after calibration of the pH probe.	±0.10 pH units	If the acceptance criterion is not met, terminate analysis, correct the problem, recalibrate and attempt a new pH calibration check.
Initial & Continuing Calibration Verification (ICV/CCV)	Prepare by pipetting 0.1 mL of the 10,000mg/L stock standard into 25 mL of DI water. The true value is 40 mg/L.	An ICV must be conducted immediately after pH calibration check (pH 5.0 Buffer). Analyze a CCV prior to the analysis of any samples and after every 10 samples thereafter. Samples must be bracketed with a closing CCV standard.	90-110% of the true value	If the requirements for the ICV are not met, verify standard preparation, remake standards, and reanalyze one additional time. If still not met, the system must be recalibrated. If the requirements for the CCV are not met, reanalyze the CCV one additional time. If still not met, stop the analysis and recalibrate the system. All bracketed samples must be reanalyzed. ***<u>Exception:</u>*** If the CCV recovery is greater than the acceptance criteria and the bracketed sample results are non-detect, the sample data may be reported.
Initial & Continuing Calibration Blank (ICB/CCB)	DI water	A calibration blank must be analyzed immediately after every ICV and CCV.	The ICB and CCB's must be less than ½ the reporting limit unless otherwise specified by the client or QAPP.	If the absolute value exceeds the criteria, reanalyze one additional time. If the second analysis is also above the acceptance limit, the cause of the blank failure must be investigated, the system must be

				recalibrated, and all bracketed samples must be reanalyzed. ***Exception:*** If all the bracketed samples are non-detect or at least 10x the concentration of the failing result, the sample data may be accepted.

11.2 **Batch QC**

QC Sample	Components	Frequency	Acceptance Criteria	Corrective Action
Method Blank (MB)	DI water	A method blank must be analyzed once per batch.	Must be less than the absolute value of the reporting limit. Per QAPP or client specific criteria, alternate criteria such as ½ RL evaluation may apply.	Re-analyze. If the re-analysis fails, reject all associated sample data, recalibrate the instrument and re-analyze the batch. ***Exceptions:*** If associated samples are non-detect or >10x MB detect, the sample data may be accepted; If sample result <10x MB detect and sample cannot be reanalyzed, report sample with appropriate qualifier to indicate an estimated value. Client must be alerted and authorize this condition.
Laboratory Control Spike (LCS) / Laboratory Control Spike Duplicate (LCSD)	Prepare by pipetting 0.1 mL of the 10,000mg/L stock standard into 25 mL of DI water. The true value is 40 mg/L.	An LCS and LCSD must each be analyzed once per batch.	90-110% of the true value 20% RPD for LCS/LCSD	Re-analyze. If the re-analysis fails, reject all associated sample data, recalibrate the instrument and re-analyze the batch. ***Exceptions:*** If LCS recovery fails high and the associated samples are non-detect, the sample data may be reported with appropriate data qualifiers.
Matrix Spike (MS) and Matrix Spike Duplicate (MSD)	Prepare by pipetting 0.1 mL of the 10,000mg/L stock standard into 25 mL of sample. The true value is 40 mg/L.	The spikes are performed at a minimum frequency of 10%. Samples identified as field blanks cannot be used for spike sample analysis.	The recovery must be within 80-120% of the true value. 20% RPD for the MS/MSD	If the MS recovery is not within the criteria, and the LCS/LCSD are shown to be in control, the recovery problem is judged to be matrix related and the results may be qualified and accepted.

11.3 **Method Performance**

11.3.1 Method Validation

11.3.1.1 Detection Limits

Detection limits (DL) and limits of quantitation (LOQ) are established at initial method setup and verified on an on-going basis thereafter. Refer to Pace ENV corporate SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification* and to the laboratory's SOP ENV-SOP-NW-0018 *Determination of LOD and LOQ* (or equivalent replacements) for these procedures.

11.3.1.2 Periodic performance evaluation (PE) samples

Periodic performance evaluation (PE) samples are analyzed per ENV-SOP-NW-0011, *Proficiency Testing (PT) Program* (current version or replacement), to demonstrate continuing competence. All results are stored in the QA office.

11.4 **Analyst Qualifications and Training**

Employees that perform any step of this procedure must have a completed Read and Acknowledgment Statement for this version of the SOP in their training record. In addition, prior to unsupervised (independent) work on any client sample, analysts that prepare or analyze samples must have successful initial demonstration of capability (IDOC) and must successfully demonstrate on-going proficiency on an annual basis. Successful means the initial and on-going DOC met criteria, documentation of the DOC is complete, and the DOC record is in the employee's training file. Refer to laboratory SOP ENV-SOP-NW-0025 *Orientation and Training Procedures* (current version or replacement) for more information.

12.0 DATA REVIEW AND CORRECTIVE ACTION

12.1 **Data Review**

Pace's data review process includes a series of checks performed at different stages of the analytical process by different people to ensure that SOPs were followed, the analytical record is complete and properly documented, proper corrective actions were taken for QC failure and other nonconformance(s), and that test results are reported with proper qualification.

The review steps and checks that occur as employee's complete tasks and review their own work is called primary review.

All data and results are also reviewed by an experienced peer or supervisor. Secondary review is performed to verify SOPs were followed, that calibration, instrument performance, and QC criteria were met and/or proper corrective actions were taken, qualitative ID and quantitative measurement is accurate, all manual integrations are justified and documented in accordance with the Pace ENV's SOP for manual integration, calculations are correct, the analytical record is complete and traceable, and that results are properly qualified.

A third-level review, called a completeness check, is performed by reporting or project management staff to verify the data report is not missing information and project specifications were met.

Refer to laboratory SOP ENV-SOP-MIN4-0092 *Data Review Process* (current version or replacement) for specific instructions and requirements for each step of the data review process.

12.2 **Corrective Action**

Corrective action is expected any time QC or sample results are not within acceptance criteria. If corrective action is not taken or was not successful, the decision/outcome must be documented in the analytical record. The primary analyst has primary responsibility for taking corrective action when QA/QC criteria are not met. Secondary data reviewers must verify that appropriate action was taken and/or that results reported with QC failure are properly qualified.

Corrective action is also required when carryover is suspected and when results are over range.

Samples analyzed after a high concentration sample must be checked for carryover and reanalyzed if carryover is suspected. Carryover is usually indicated by low concentration detects of the analyte in successive samples analyzed after the high concentration sample.

Sample results at concentrations above the upper limit of quantitation must be diluted and reanalyzed. The result in the diluted samples should be within the upper half of the calibration range. Results less than the mid-range of the calibration indicate the sample was over diluted and analysis should be repeated with a lower level of dilution. If dilution is not performed, any result reported above the upper range is considered a qualitative measurement and must be qualified as an estimated value.

13.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

Pace proactively seeks ways to minimize waste generated during our work processes. Some examples of pollution prevention include but are not limited to: reduced solvent extraction, solvent capture, use of reusable cycletainers for solvent management, and real-time purchasing.

The EPA requires that laboratory waste management practice to be conducted consistent with all applicable federal and state laws and regulations. Excess reagents, samples and method process wastes must be characterized and disposed of in an acceptable manner in accordance with Pace's Chemical Hygiene Plan / Safety Manual.

14.0 MODIFICATIONS

A modification is a change to a reference test method made by the laboratory. For example, changes in stoichiometry, technology, quantitation ions, reagent or solvent volumes, reducing digestion or extraction times, instrument runtimes, etc. are all examples of modifications. Refer to Pace ENV corporate SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification* for the conditions under which the procedures in test method SOPs may be modified and for the procedure and document requirements.

14.1 The lab utilizes a sample volume of 25 mL instead of 100 to 200 mL as described in the method for the potentiometric titration of low alkalinity (SM 2320B section 4d).

15.0 RESPONSIBILITIES

Pace ENV employees that perform any part this procedure in their work activities must have a signed Read and Acknowledgement Statement in their training file for this version of the SOP. The employee is responsible for following the procedures in this SOP and handling temporary departures from this SOP in accordance with Pace's policy for temporary departure.

Pace supervisors/managers are responsible for training employees on the procedures in this SOP and monitoring the implementation of this SOP in their work area.

16.0 ATTACHMENTS

Not applicable to this SOP.

17.0 REFERENCES

Standard Methods for the Examination of Water and Wastewater, 2320 B (1997, 2011).

Pace Quality Manual- most current version.

TNI Standard, Management and Technical Requirements for Laboratories Performing Environmental Analyses, EL-V1-2009.

TNI Standard, Management and Technical Requirements for Laboratories Performing Environmental Analyses, EL-VI-2016-Rev.2.1.

18.0 REVISION HISTORY

This Version:

Section	Description of Change
All	Converted to new template.
9.1.2.3	Calibration SOP reference added.
9.2.1	Updated titer standardization to new semi-automated process.
9.3.4.3.1	Added instructions to confirm initial sample pH if < 4.5.
9.4.2	Added paperless export instructions.

This document supersedes the following document(s):

Document Number	Title	Version
ENV-SOP-MIN4-0103	Alkalinity, Titrimetric by SM 2320B	01

Document Information

Document Number: ENV-SOP-MIN4-0115	**Revision:** 02
Document Title: Sulfate by ASTM D516	
Department(s): Wet Chemistry	

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Notes

Document Notes:

All Dates and Times are listed in: Central Time Zone

Signature Manifest

Document Number: ENV-SOP-MIN4-0115 **Revision:** 02
Title: Sulfate by ASTM D516

All dates and times are in Central Time Zone.

ENV-SOP-MIN4-0115 - Sulfate

QM Approval

Name/Signature	Title	Date	Meaning/Reason
Janielle Ward (007319)	Manager - Quality	11 Aug 2020, 01:19:33 PM	Approved

Management Approval

Name/Signature	Title	Date	Meaning/Reason
Andrew Mickelson (009792)	Manager	06 Aug 2020, 03:11:34 PM	Approved
Krista Carlson (004514)	Project Coordinator 1	07 Aug 2020, 02:51:44 PM	Approved
Adam Haugerud (005828)	General Manager 2	14 Aug 2020, 02:49:15 PM	Approved

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TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: Sulfate Determination by Turbidimetric Analysis
TEST METHOD ASTM D516
ISSUER: Pace ENV – Minneapolis – MIN4

1.0 SCOPE AND APPLICATION

1.1. This standard operating procedure (SOP) describes the laboratory procedure for the determination of sulfate in potable, surface waters, wastewater and industrial wastes, as delineated in reference methods ASTM D516-1990, ASTM D516-2002, ASTM D516-2007 and ASTM D516-2011.

1.1 Target Analyte List and Limits of Quantitation (LOQ)

Analyte	Matrix	LOQ
Sulfate	Aqueous	2.5 mg/L

LOQ are established in accordance with Pace policy and SOPs for method validation and for the determination of detection limits (DL) and quantitation limits (LOQ). DL and LOQ are routinely verified and updated when needed. The current LOQ for each target analyte that can be determined by this SOP as of the effective date of this SOP is provided in the table above.

The reporting limit (RL) is the value to which analytes are reported as detected or not detected in the final report. When the RL is less than the lower limit of quantitation (LLOQ), all detects and non-detects at the RL are qualitative. The LLOQ is the lowest point of the calibration curve used for each target analyte.

DL, LOQ, and RL are always adjusted to account for actual amounts used and for dilution.

1.2 Applicable Matrices

This SOP is applicable to potable, surface waters, wastewater and industrial wastes.

2.0 SUMMARY OF METHOD

Sulfate ion is converted to a barium suspension under controlled conditions. The resulting turbidity is determined using a filter photometer at 405 nm.

3.0 INTERFERENCES

3.1 As much as 50 mg Fe^{3+}/L, 10 mg Cu^{2+}/L, and 10 mg SiO_2/L can be tolerated. High silica concentrations cause positive interference. High iron concentrations can cause precipitation of, and subsequent loss of, phosphorus.

3.2 Insoluble suspended matter in the sample must be removed. Dark colors that cannot be compensated for in the procedure interfere with the measurement of suspended barium sulfate ($BaSO_4$).

3.3 Polyphosphates as low as 1.0 mg/L will inhibit barium sulfate precipitation causing a negative interference. Phosphonates present in low concentrations, depending on the type of phosphonate, will also cause a negative interference.

3.4 Silica in excess of 500 mg/L may precipitate along with a barium sulfate causing a positive interference.

3.5 Chloride in excess of 5000 mg/L will cause a negative interference. Aluminum, polymers, and large quantities of organic material present in the test sample may cause the barium sulfate to precipitate nonuniformly.

3.6 In the presence of organic matter certain bacteria may reduce sulfate to sulfide. To minimize the action of sulfate reducing bacteria, samples should be refrigerated at 4°C when the presence of such bacteria is suspected.

4.0 DEFINITIONS

Refer to the Laboratory Quality Manual for a glossary of common lab terms and definitions.

5.0 HEALTH AND SAFETY

The toxicity or carcinogenicity of each chemical material used in the laboratory has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable.

The laboratory maintains documentation of hazard assessments and OSHA regulations regarding the safe handling of the chemicals specified in each method. Safety data sheets for all hazardous chemicals are available to all personnel. Employees must abide by the health, safety and environmental (HSE) policies and procedures specified in this SOP and in the Pace Chemical Hygiene / Safety Manual.

Personal protective equipment (PPE) such as safety glasses, gloves, and a laboratory coat must be worn in designated areas and while handling samples and chemical materials to protect against physical contact with samples that contain potentially hazardous chemicals and exposure to chemical materials used in the procedure.

Concentrated corrosives present additional hazards and are damaging to skin and mucus membranes. Use these acids in a fume hood whenever possible with additional PPE designed for handing these materials. If eye or skin contact occurs, flush with large volumes of water. When working with acids, always add acid to water to prevent violent reactions. Any processes that emit large volumes of solvents (evaporation/concentration processes) must be in a hood or apparatus that prevents employee exposure.

Contact your supervisor or local HSE coordinator with questions or concerns regarding safety protocol or safe handling procedures for this procedure.

6.0 SAMPLE COLLECTION, PRESERVATION, HOLDING TIME, AND STORAGE

Samples should be collected in accordance with a sampling plan and procedures appropriate to achieve the regulatory, scientific, and data quality objectives for the project.

The laboratory does not perform sample collection or field measurements for this test method. To assure sample collection and field checks and treatment are performed in accordance with applicable regulations Pace project managers will inform the client of these requirements at the time of request for analytical services when the request for testing is received prior to sample collection. If samples were already collected, the laboratory will record any nonconformance to these requirements in the

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laboratory's sample receipt record when sufficient information about sample collection is provided with the samples.

General Requirements

Matrix	Routine Container	Minimum Sample Amount[1]	Preservation	Holding Time
Aqueous	Plastic or glass container	25 mL	Above freezing but below 6°C	Must be analyzed within 28 days of collection.

[1]*Minimum amount needed for each discrete analysis.*

Thermal preservation is checked and recorded on receipt in the laboratory in accordance with laboratory ENV-SOP-MIN4-0008 *Sample Management*, or equivalent replacement.

After analysis, unless otherwise specified in the analytical services contract, samples are retained for 21 days from date of final report and then disposed of in accordance with Federal, State, and Local regulations.

7.0 Equipment And Supplies

7.1 Equipment

Supply	Description
Discrete Analyzer	SEAL AQ400
Analytical balance	Capable of reading to 0.0001g

8.0 Reagents And Standards

8.1 Reagents

Reagent	Description
De-Ionized (DI) Water	ASTM Type II water See ENV-SOP-MIN4-0090 *Reagent Water Quality*, or equivalent replacement
Hydrochloric Acid (HCl)	6 N. Store at room temperature. Expires per manufacturer's recommendations. Fisher part # SA56-4, or equivalent
Barium Chloride ($BaCl_2{\cdot}2H_2O$)	Crystalline. Store at room temperature. Expires per manufacturer's recommendations. Fisher part # B34-100, or equivalent
Sodium Chloride (NaCl)	Granular. Store at room temperature. Expires per manufacturer's recommendations. Fisher part # S640-500, or equivalent
Gelatin, Type A	Granular. Store at room temperature. Expires per manufacturer's recommendations. Fisher part # G8-500, or equivalent

8.1.1 Working Reagents

Solution	Reagent(s) Used	Reagent(s) Amount	Solvent	Final Solution Volume	Final Concentration
Turbidimetric Reagent	$BaCl_2{\cdot}2H_2O$	2.0 g	DI Water	200 mL	N/A
	NaCl	2.0 g			
	Gelatin	0.05 g			

	HCl	1 mL			

8.1.1.1 Turbidimetric Reagent – Dissolve 2.0 g barium chloride, 2.0 g sodium chloride and 0.05 g gelatin in 100 mL DI water. This requires prolonged stirring and heat to dissolve. Carefully add 1 mL 6 N hydrochloric acid and dilute to 200 mL with DI water. Store in an amber glass bottle at less than 6° C but above freezing. Expires in one week.

8.2 Standards

Standard	Concentration/Description
Sulfate QC Stock Standard	1000 mg SO_4/L. Purchase premade. Store at room temperature. Expires as specified by the manufacturer. Inorganic Ventures part # ICS041-1, or equivalent
Sulfate Curve Stock Standard	1000 mg SO_4/L. Purchase premade. Store at room temperature. Expires as specified by the manufacturer. ERA part # 995, or equivalent

8.2.1 **Working Standard Dilutions and Concentrations**

Standard	Standard Used	Standard Amount	Solvent	Solvent Volume	Final Total Volume	Final Concentration
SO_4 Calibration Solution	Curve Stock Standard	0.4 mL	DI Water	9.6 mL	10 mL	40 mg SO_4/L
ICV/CCV Solution	QC Stock Standard	2.0 mL	DI Water	98 mL	100 mL	20 mg SO_4/L

8.2.1.1 SO_4 Calibration Solution - Add 5 mL of DI water to a 10 mL Class A volumetric flask, or equivalent. Add 0.4 mL of Sulfate Curve Stock Solution. Dilute to the mark and mix. Prepare fresh daily. The calibration curve solution is loaded onto the instrument and all calibration standards are prepared by the automated instrument at the following concentrations using a matrix matched diluent:

CAL0	0 mg/L
CAL1	2.5 mg/L
CAL2	5.0 mg/L
CAL3	10.0 mg/L
CAL4	20.0 mg/L
CAL5	40.0 mg/L

8.2.1.2 SO_4 ICV/CCV Solution - Add 25 mL of DI water to a 100 mL Class A volumetric flask, or equivalent. Add 2.0 mL of SO_4 QC Stock Solution. Dilute to the mark and mix. Prepare fresh daily.

9.0 PROCEDURE

9.1 Equipment Preparation

9.1.1 Instrument

This instrument used for Sulfate determination is a Seal AQ400 with a 405 nm filter.

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9.1.1.1 **Routine Instrument Operating Conditions**

Parameter	AQ400 Setting
Decimals	3
Test Type	Endpoint
Sample Volume (uL)	400
Water volume (uL)	0
Number of mixes	2
Cuvette primes	2
Cuvette washes	2
Baseline on wash	Ticked
Reaction time (seconds)	270
Wavelength	405
Polynomial order	2
Number of reagents	1
Turbidimetric reagent (uL)	200

9.1.2 **Start-Up**

9.1.2.1 Turn on instrument, open software and allow lamp to warm up for approximately 30 minutes.

9.1.2.2 Follow AQ400 Daily (Morning) Tasks checklist (Appendix B).

9.1.3 **Shut Down**

9.1.3.1 Follow AQ400 Daily (Evening) Tasks checklist (Appendix C).

9.2 Initial Calibration

9.2.1 **Calibration Design**

The calibration curve must consist of a minimum of a calibration blank and three non-zero standards for each mode of analysis. Using the instrumentation software, prepare a standard curve for each element by plotting absorbance versus concentration. The calibration is a quadratic regression using equation; $y = cx^2 + bx + a$. The analyst may employ a regression equation that does not pass through the origin, however forcing through zero is not allowed. Additional calibration specifications may be referenced in ENV-SOP-NW-0027 *Calibration Procedures*, or equivalent replacement.

9.2.2 **Calibration Sequence**

Calibration Blank (CAL0)
CAL1
CAL2
CAL3
CAL4
CAL5
ICV
ICB
Client samples
CCV
CCB

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9.2.3 **ICAL Evaluation**

9.2.3.1 Curve Fit

With a multi-point calibration, the regression calculation will generate a correlation coefficient (r) that is the measure of the “goodness of fit” of the regression line to the data. In order to be used for quantitative purposes, the correlation coefficient must be > 0.990.

9.2.3.2 Relative Standard Error (RSE)

%RE is measured at the lowest calibration level and at a point near the mid-level of the calibration (the continuing calibration verification level is recommended). In order for a standard curve to be acceptable, the correlation coefficient/coefficient of determination criterion specified in the method must be met **and** both the low-level and mid-level %RE measures must meet the acceptance criteria. The low-level %RE acceptance criteria is 60%-140% and the mid-level is 90-110%.

9.2.3.3 Initial Calibration Verification

In addition to meeting the linearity requirement, any new calibration curve must be assessed for accuracy in the values generated. To assess the accuracy, a single standard from a secondary source must be analyzed and the results obtained must be compared to the known value of the standard. This step is referred to as Initial Calibration Verification. The ICV is analyzed immediately following an initial calibration curve.

9.2.4 **Continuing Calibration Verification**

A CCV followed immediately by a CCB must be analyzed after every 10 samples and at the end of the analytical batch to verify the system is still calibrated.

9.3 Sample Preparation

9.3.1 Homogenize sample prior to loading onto instrument. Filter any samples displaying a high amount of suspended matter with a 0.45 µm syringe filter. Record the lot number of the filters on the batch traceability sheet. If any samples are filtered, the corresponding method blank and LCS must also be filtered.

9.3.2 Batch QC Preparation – Prepared in Class A volumetric flask, or equivalent.

Parameter	Components
Method Blank (MB)	DI Water
Laboratory Control Sample / Laboratory Control Sample Duplicate (LCS/LCSD)	9.8 mL DI water spiked with 0.2 mL QC stock standard True Value = 20.0 mg/L
Matrix Spike / Matrix Spike Duplicate (MS/MSD)	9.8 mL client sample spiked with 0.2 mL QC stock standard True Value = 20.0 mg/L

9.4 Analysis

9.4.1 Insert standards, samples and reagents into the instrument. The instrument will automatically prepare each standard in the calibration curve from the 40 mg/L curve standard. Allow samples to warm to room temperature prior to analysis.

9.4.2 Enter sample IDs into the instrument using the barcode scanner and the batch worklist.

9.4.3 Highlight samples and select Sulfate test 'SO4' and save.

9.4.4 Before running, check the analyzer for sufficient reagent water, fresh reaction segments and correct location of reagent vessels.

9.4.5 Double click the Run icon and select the saved run.

9.5 Reporting Data

9.5.1 All samples with a concentration greater than the highest calibration standard must be diluted within range.

9.5.2 If a sample is more negative than the equivalent of the reporting limit, the sample should be diluted to remove interferences. If the sample has an MS/MSD associated with it, and the spike did not recover, then the MS/MSD should be diluted and post spiked.

9.5.3 Record the necessary traceability information in ENV-FRM-MIN4-0022 *WET Chemistry Batch Traceability Sheet*. Information includes batch, analyst, analysis date, and lot numbers of solutions and consumables used.

10.0 Data Analysis And Calculations

See the laboratory SOP ENV-SOP-MIN4-0171 *Laboratory Calculations*, or equivalent replacement, for equations for common calculations.

10.1 LCS Recovery

$$LCS\ Recovery = \frac{SSR \times 100\%}{SA}$$

Where: SSR = Spike Sample Results
SA = Spike Added from spiking mix

10.2 Relative Percent Differences (RPD)

$$RPD = \frac{|A - B|}{(A + B)/2} x100$$

Where: RPD = Relative Percent Difference
A = First Sample Value
B = Second Sample Value (duplicate)

10.3 Matrix Spike Recovery

$$\%Recovery = \frac{SSR - SR}{SA} x100$$

Where: SSR = Spike Sample Results
SR = Sample Result
SA = Spike Added from spiking mix

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When the sample concentration is negative, use SR = 0 for the purpose of calculating spike recovery.

11.0 Quality Control and Method Performance

11.1 Quality Control

The following QC samples are prepared and analyzed with each batch of samples. Refer to Appendix B for acceptance criteria and required corrective action.

QC Item	Frequency
Method Blank (MB)	1 per batch of 20 or fewer samples.
Laboratory Control Sample / Laboratory Control Sample Duplicate (LCS/LCSD)	1 per batch of 20 or fewer samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD)[1]	A pair of MS/MSD must be analyzed once every ten samples or once per batch, whichever is more frequent.

[1]Samples identified as field blanks cannot be used for spike sample analysis.

11.2 Instrument QC

The following Instrument QC checks are performed. Refer to Appendix A for acceptance criteria and required corrective action.

QC Item	Frequency
Initial Calibration	Daily
Initial Calibration Verification	Immediately after each initial calibration
Initial Calibration Blank	Immediately after each initial calibration
Continuing Calibration Verification	Prior to the analysis of any samples and after every 10 injections thereafter. Samples must be bracketed with a closing CCV standard.
Continuing Calibration Blank	Following every CCV injection

11.3 Method Performance

11.3.1 Method Validation

11.3.1.1 Detection Limits

Detection limits (DL) and limits of quantitation (LOQ) are established at initial method setup and verified on an on-going basis thereafter. Refer to Pace ENV corporate SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification* and to the laboratory's SOP ENV-SOP-NW-0018 *Determination of LOD and LOQ* for these procedures.

11.4 Analyst Qualifications and Training

Employees that perform any step of this procedure must have a completed Read and Acknowledgment Statement for this version of the SOP in their training record. In addition, prior to unsupervised (independent) work on any client sample, analysts that prepare or analyze samples must have successful initial demonstration of capability (IDOC) and must successfully demonstrate on-going proficiency on an annual basis. Successful means the initial and on-going DOC met criteria, documentation of the DOC is complete, and the DOC record is in the employee's training file. Refer to laboratory SOP ENV-SOP-NW-0025 *Training and Orientation Procedures* for more information.

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12.0 Data Review And Corrective Action

12.1 Data Review

Pace's data review process includes a series of checks performed at different stages of the analytical process by different people to ensure that SOPs were followed, the analytical record is complete and properly documented, proper corrective actions were taken for QC failure and other nonconformance(s), and that test results are reported with proper qualification.

The review steps and checks that occur as employee's complete tasks and review their own work is called primary review.

All data and results are also reviewed by an experienced peer or supervisor. Secondary review is performed to verify SOPs were followed, that calibration, instrument performance, and QC criteria were met and/or proper corrective actions were taken, qualitative ID and quantitative measurement is accurate, all manual integrations are justified and documented in accordance with the Pace ENV's SOP for manual integration, calculations are correct, the analytical record is complete and traceable, and that results are properly qualified.

A third-level review, called a completeness check, is performed by reporting or project management staff to verify the data report is not missing information and project specifications were met.

Refer to laboratory SOP ENV-SOP-MIN4-0092 *Data Review Process* for specific instructions and requirements for each step of the data review process.

12.2 Corrective Action

Corrective action is expected any time QC or sample results are not within acceptance criteria. If corrective action is not taken or was not successful, the decision/outcome must be documented in the analytical record. The primary analyst has primary responsibility for taking corrective action when QA/QC criteria are not met. Secondary data reviewers must verify that appropriate action was taken and/or that results reported with QC failure are properly qualified.

Corrective action is also required when carryover is suspected and when results are over range.

Samples analyzed after a high concentration sample must be checked for carryover and reanalyzed if carryover is suspected. Carryover is usually indicated by low concentration detects of the analyte in successive samples analyzed after the high concentration sample.

Sample results at concentrations above the upper limit of quantitation must be diluted and reanalyzed. The result in the diluted samples should be within the upper half of the calibration range. Results less than the mid-range of the calibration indicate the sample was over diluted and analysis should be repeated with a lower level of dilution. If dilution is not performed, any result reported above the upper range is considered a qualitative measurement and must be qualified as an estimated value.

Refer to Appendix A for a complete summary of QC, acceptance criteria, and recommended corrective actions for QC associated with this test method.

13.0 Pollution Prevention And Waste Management

Pace proactively seeks ways to minimize waste generated during our work processes. Some examples of pollution prevention include but are not limited to: reduced solvent extraction, solvent capture, use of reusable cycletainers for solvent management, and real-time purchasing.

The EPA requires that laboratory waste management practice to be conducted consistent with all applicable federal and state laws and regulations. Excess reagents, samples and method process wastes must be characterized and disposed of in an acceptable manner in accordance with Pace's Chemical Hygiene Plan / Safety Manual.

14.0 Modifications

A modification is a change to a reference test method made by the laboratory. For example, changes in stoichiometry, technology, quantitation ions, reagent or solvent volumes, reducing digestion or extraction times, instrument runtimes, etc. are all examples of modifications. Refer to Pace ENV corporate SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification* for the conditions under which the procedures in test method SOPs may be modified and for the procedure and document requirements.

This procedure has no modifications included.

15.0 Responsibilities

Pace ENV employees that perform any part this procedure in their work activities must have a signed Read and Acknowledgement Statement in their training file for this version of the SOP. The employee is responsible for following the procedures in this SOP and handling temporary departures from this SOP in accordance with Pace's policy for temporary departure.

Pace supervisors/managers are responsible for training employees on the procedures in this SOP and monitoring the implementation of this SOP in their work area.

16.0 Attachments

Appendix A: QC Summary

Appendix B: AQ400 Daily (Morning) Tasks

Appendix C: AQ400 Daily (Evening) Tasks

17.0 References

Pace Quality Assurance Manual- most current version.

TNI Standard, *Management and Technical Requirements for Laboratories Performing Environmental Analyses*, EL-V1-2009.

TNI Standard, *Management and Technical Requirements for Laboratories Performing Environmental Analyses*, EL-VI-2016-Rev.2.1.

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ASTM International, Standard Test Method for Sulfate Ion in Water, (Method ASTM D516-1990, ASTM D516-2002, ASTM D516-2007, ASTM D516-2011).

SEAL Analytical AQ400 Method EPA-165-C, Sulfate in Drinking, Saline and Surface Waters, and Domestic and Industrial Wastes, Rev.A October 2018.

Standard Methods for the Examination of Wastewater, SM4500-SO_4^{2-}E.

EPA, SW-846, Method 9038, current revision.

40 CFR Appendix B to Part 136, *Definition and Procedure for the Determination of the Method Detection Limit - Rev 2*, August 28, 2017.

18.0 REVISION HISTORY

This Version:

Section	Description of Change
All	Update to new SOP template
9.0	Added Calibration SOP reference, start-up/shut-down procedure.

This document supersedes the following document(s):

Document Number	Title	Version
ENV-SOP-MIN4-0115	Sulfate by ASTM D516	01

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Appendix A: QC Summary

QC Item	Frequency	Acceptance Criteria	Corrective Action	Qualification
ICAL	At instrument set up, after CCV failure	r ≥ 0.990 Standard at or below the reporting limit must recover at 60-140% of the true value. Low-Level %RE 60-140% Mid-Level %RE 90-110%	Identify and correct source of problem, repeat	None. Do not proceed with analysis
ICV	After Each ICAL	80-120% of the true value	Identify source of problem, re-analyze. If repeat failure, repeat ICAL. Analysis may proceed if it can be demonstrated that the ICV exceedance has no impact on analytical measurements. For example, the ICV %R is high, CCV is within criteria, and the analyte is not detected in sample(s).	Qualify analytes with ICV out of criteria.
ICB	Immediately after the initial calibration verification	Result must be less than the absolute value of the Reporting Limit (LOQ).	Identify source of problem, re-analyze. If repeat failure, repeat ICAL.	None. Do not proceed with analysis.
CCV	Daily, before sample analysis, after every 10, and at end of analytical window.	80-120% of the true value	Identify source of problem, re-analyze. Analysis may proceed if it can be demonstrated that the CCV exceedance has no impact on analytical measurements. For example, the CCV %R is high, and the analyte is not detected in sample(s).	Qualify analytes with CCV out of of criteria.
CCB	Immediately following every and CCV.	The absolute value of the CCB must be less than the reporting limit. Some client QAPPs may require the absolute value of the CCB to be less than ½ the reporting limit.	If the absolute value exceeds the criteria, reanalyze one additional time. If the second analysis is also above the acceptance limit, the cause of the blank failure must be investigated, the system must be recalibrated, and all bracketed samples must be reanalyzed. ***<u>Exception:</u>*** If all the bracketed samples are non-detect or at least 10x the	Qualify outages and explain in case narrative.

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			concentration of the failing result, the sample data may be accepted.	
Method Blank	Once per batch of up to 20 samples	The absolute value of the MB must be less than the reporting limit. Some client QAPPs may require the absolute value of the MB to be less than ½ the reporting limit.	Re-analyze. If the re-analysis fails, reject all associated sample data, recalibrate the instrument and re-analyze the batch. ***Exceptions:*** If associated samples are non-detect or >10x MB detect, the sample data may be accepted; If sample result <10x MB detect and sample cannot be reanalyzed, report sample with appropriate qualifier to indicate an estimated value. Client must be alerted and authorize this condition.	Qualify outages and explain in case narrative.
LCS/LCSD	One LCS/LCSD pair per batch of up to 20 samples	80-120% of the true value RPD $\leq$ 20%	Re-analyze. If the re-analysis fails, reject all associated sample data, recalibrate the instrument and re-analyze the batch. ***Exceptions:*** If LCS recovery fails high and the associated samples are non-detect, the sample data may be reported with appropriate data qualifiers	Qualify outages and explain in case narrative.
MS/MSD	One MS/MSD pair per 10 samples with a minimum of one pair per batch	80-120% of the true value RPD $\leq$ 30%	If the MS recovery is not within the criteria, and the LCS is shown to be in control, the recovery problem is judged to be matrix related and the results may be qualified and accepted.	Qualify outages and explain in case narrative.

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Appendix B: AQ400 Daily (Morning) Tasks

AQ400 Daily (Morning) Tasks

		Daily (Morning) Tasks
☐		Empty and Refill Wash Water Reservoir
☐		Empty the Waste Container
☐		Replace Reaction Segments as Required
Maintenance Menu		
	☐	Observe movements during initialization • Movements should be smooth and they should be the same each initialization
	☐	**DILUTER:** Prime Syringe (5-10 times) • Verify no air remains in syringe and operating smoothly.
	☐	**DILUTER:** Check operation of Probe Washer • Turn on Waste Pump and Wash Valve • Verify water movement through chamber
	☐	**CUVETTE:** Perform 1-5 Auto Washes • Observe Wash Bath is Filling and Clean
	☐	**CUVETTE**: Check/Adjust Aspiration for both Inner and Outer Wells • Verify that there is 1-2" of water (no bubbles) in the outlet tubing of cuvette
☐		Run "Daily Startup" Procedure. Water baseline voltages for filters 1 through 9 should range from 0.7 to 4.85 V. Filter 10/Dark should be near 0.027 V.
☐		Inspect reagents for particulates or excessive color. Filter or replace reagents as needed. Check the method documents for information on reagent stability and symptoms of reagent degradation.
☐		Cadmium Coil checks as required. See Cadmium Coil Care section of "Technical Tips" in the Customer Support Manual

**See Customer Support Manual or Operator Manual for more information of above items.

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Appendix C: AQ400 Daily (Evening) Tasks

AQ400 Daily (Evening) Tasks

	Daily (Evening) Tasks
☐	Place Cuvette Cleaning Solution in Reagent Position 1. From Settings—Maintenance, perform Wash the Cuvette—Extra Wash
☐	Zero Segments – From Settings—Maintenance, zero segments and discard the used reaction segments
☐	Discard used Sample Cups
☐	Empty the Waste Container
☐	Empty the Wash Water Reservoir
☐	Put Reagent Tray into the refrigerator for overnight storage
☐	If any spills on the reagents tray, clean the tray by removing the reagent wedges, wiping up spills and condensate in the tray and wiping the bottom of the wedges.
☐	If any spills on the carousel, clean the reaction carousel by removing reaction segments and wiping spills in and around the carousel

ENVIRONMENTAL SCIENCES

Document Information

Document Number: ENV-SOP-MIN4-0044 **Revision:** 05

Document Title: Preparation of Aqueous Samples for ICPMS Analysis by 200.8 and 3020A

Department(s): Metals

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All Dates and Times are listed in: Central Time Zone

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Document Number: ENV-SOP-MIN4-0044 **Revision:** 05
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All dates and times are in Central Time Zone.

ENV-SOP-MIN4-0044 - ICPMS Aqueous Prep

QM Approval

Name/Signature	Title	Date	Meaning/Reason
Janielle Ward (007319)	Manager - Quality	27 Oct 2020, 01:41:18 PM	Approved

Management Approval

Name/Signature	Title	Date	Meaning/Reason
Andrew Mickelson (009792)	Manager	26 Oct 2020, 02:25:42 PM	Approved
Krista Carlson (004514)	Project Manager 1	27 Oct 2020, 03:22:41 PM	Approved
Adam Haugerud (005828)	General Manager 2	10 Dec 2020, 02:47:23 PM	Approved

TEST METHOD STANDARD OPERATING PROCEDURE

TITLE:	Preparation of Aqueous Samples for ICP-MS Analysis
TEST METHOD	EPA 200.8 and 3020A
ISSUER:	Pace ENV – Minneapolis– MIN4

1.0 Scope And Application

This standard operating procedure (SOP) describes the laboratory procedure for the preparation of aqueous samples using hot block digestion as described in EPA Method 3020A and EPA 200.8.

1.1 Target Analyte List and Limits of Quantitation (LOQ)

LOQ are established in accordance with Pace policy and SOPs for method validation and for the determination of detection limits (DL) and quantitation limits (LOQ). DL and LOQ are routinely verified and updated when needed. The current LOQ for each target analyte that can be determined by this SOP as of the effective date of this SOP is provided in the associated analytical ENV-SOP-MIN4-0043 *Metals Analysis by ICP/MS – Method 6020 and 200.8* (or equivalent replacement).

The reporting limit (RL) is the value to which analytes are reported as detected or not detected in the final report. When the RL is less than the lower limit of quantitation (LLOQ), all detects and non-detects at the RL are qualitative. The LLOQ is the lowest point of the calibration curve used for each target analyte.

DL, LOQ, and RL are always adjusted to account for actual amounts used and for dilution.

1.2 Applicable Matrices

This SOP is applicable to ground, surface, drinking, and storm runoff water samples; industrial, and domestic waste waters.

Dissolved elements are determined after suitable filtration and acid preservation. In order to reduce potential interferences, dissolved solids should not exceed 0.2 % (w/v).

2.0 Summary of Method

A 25mL aliquot sample is digested in concentrated nitric and hydrochloric acids. After digestion, samples are brought to a final volume of 25mL. Determinative analyses include using Inductively Coupled Plasma (ICP-MS) technologies for trace metals in solution.

Samples requiring dissolved metals analysis must be filtered through a 0.45 micron (µm) filter prior to preservation.

3.0 Interferences

Refer to laboratory SOP ENV-SOP-MIN4-0043 for discussion of potential interferences.

4.0 Definitions

Refer to the Laboratory Quality Manual for a glossary of common lab terms and definitions.

5.0 Health and Safety

The toxicity or carcinogenicity of each chemical material used in the laboratory has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable.

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The laboratory maintains documentation of hazard assessments and OSHA regulations regarding the safe handling of the chemicals specified in each method. Safety data sheets for all hazardous chemicals are available to all personnel. Employees must abide by the health, safety and environmental (HSE) policies and procedures specified in this SOP and in the Pace Chemical Hygiene / Safety Manual.

Personal protective equipment (PPE) such as safety glasses, gloves, and a laboratory coat must be worn in designated areas and while handling samples and chemical materials to protect against physical contact with samples that contain potentially hazardous chemicals and exposure to chemical materials used in the procedure.

Concentrated corrosives present additional hazards and are damaging to skin and mucus membranes. Use these acids in a fume hood whenever possible with additional PPE designed for handing these materials. If eye or skin contact occurs, flush with large volumes of water. When working with acids, always add acid to water to prevent violent reactions. Any processes that emit large volumes of solvents (evaporation/concentration processes) must be in a hood or apparatus that prevents employee exposure.

Contact your supervisor or local HSE coordinator with questions or concerns regarding safety protocol or safe handling procedures for this procedure.

6.0 SAMPLE COLLECTION, PRESERVATION, HOLDING TIME, AND STORAGE

Samples should be collected in accordance with a sampling plan and procedures appropriate to achieve the regulatory, scientific, and data quality objectives for the project.

The laboratory does not perform sample collection or field measurements for this test method. To assure sample collection and field checks and treatment are performed in accordance with applicable regulations Pace project managers will inform the client of these requirements at the time of request for analytical services when the request for testing is received prior to sample collection. If samples were already collected, the laboratory will record any nonconformance to these requirements in the laboratory's sample receipt record when sufficient information about sample collection is provided with the samples.

General Requirements

Matrix	Routine Container	Minimum Sample Amount[1]	Preservation	Holding Time
Aqueous	250 mL Plastic	25 mL	Acidified[2] with nitric acid to pH<2, stored ambient	Must be analyzed within 180 days of collection.

[1]*Minimum amount needed for each discrete analysis.*
[2] *Samples must equilibrate for a minimum of 24 hours following acidification. Lead and Copper Rule Monitoring and Reporting Guidance for Public Water Systems, EPA 816-R-10-004, March 2010, Exhibit II-9, Samples must stand in the original container used for sampling for at least 28 hours after acidification.*

Thermal preservation is checked and recorded on receipt in the laboratory in accordance with laboratory ENV-SOP-MIN4-0008 *Sample Management*, or equivalent replacement. Chemical preservation is checked and recorded at time of receipt or prior to sample preparation.

After receipt, samples are stored either at ambient or 6°C until sample preparation. Prepared samples digestates are stored at ambient temperatures until sample analysis.

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After analysis, unless otherwise specified in the analytical services contract, samples are retained for 21 days from date of final report and then disposed of in accordance with Federal, State, and Local regulations.

7.0 Equipment And Supplies

7.1 Equipment

Equipment	Description	Vendor/Item #/Description
Mechanical pipettes	Various sizes	Fisher Scientific or equivalent
Hot Block TM	54 Place Hot Block	Environmental Express
Analytical Balance	Ability to weigh to the nearest 0.01g	Fisher Scientific or equivalent

7.2 Supplies

Supply	Description	Vendor/Item #/Description
Digestion Cups	50 mL verified to class A specification	Environmental Express or equivalent
Vapor Recovery Device	Reflux cap or Watch glass	Environmental Express or equivalent
Resin beads	For solid matrix QC	Environmental Express or equivalent
Filters	0.45 um	Celltreat or equivalent
Filters	filter mates	Environmental Express, # SC0401

8.0 Reagents And Standards

8.1 Reagents

Reagent/Standard	Concentration/Description	Requirements/Vendor/Item #
De-ionized (DI) water	ASTM Type II	Verify that background levels of volatile compounds are acceptable by analysis
Concentrated nitric acid (HNO_3)	Trace Metal grade	Fisher brand
Concentrated hydrochloric acid (HCl)	Trace Metal grade	Fisher brand

8.2 Standards

Reagent/Standard	Concentration/Description	Requirements/Vendor/Item #
Metals Spike - Stock solution standards for LCS and MS/MSD	The solution identifications are PACE-67AW and Pace-67BW. See Appendix A for composition	Purchased from Inorganic Ventures (or equivalent). Store at room temperature. Expires as specified by manufacturer.

9.0 Procedure

9.1 Equipment Preparation

9.1.1 Support Equipment

Calibrate variable and fixed volume pipettes as specified in SOP ENV-SOP-MIN4-0161 *Support Equipment* (or equivalent replacement). Calibration records are kept in the QA Office.

Calibrate the thermometer as specified in in SOP ENV-SOP-MIN4-0161 *Support Equipment* (or equivalent replacement). Calibration records are kept in the QA Office.

Calibrate the turbidimeter as specified in SOP ENV-SOP-MIN4-0110 *Turbidity.* Calibration is performed every 30 days or as needed.

9.1.2 Equipment

The hot block digestors are set to maintain a digestion temperature of 95 +/- 2°C. Use a NIST-traceable thermometer inserted into a digestion cup filled with 50mL of DI to measure the temperature of the hot block. The temperature should be checked in different wells of the hot blocks such that all wells are evaluated over a period of time. Record the temperature of each hot block daily in the temperature logbook.

9.1.3 Turbidity Screen

Samples submitted under SDWA may be analyzed directly without digestion if the turbidity is <1 NTU with the exception of samples requiring the determination of silver. All other samples will be digested following procedures outlined in section 9.2.

9.1.3.1 Verify the expiration date for the current calibration.

9.1.3.2 Using the barcode scanner and barcode sheet (Appendix B) scan the CRDL barcode to enter the sample ID into the instrument. Place the CRDL vial into the vial compartment and close the lid. Repeat with the CCV and CCB.

9.1.3.3 All quality control check samples must meet acceptance criteria prior to analyzing samples. If criteria are not met, the instrument may need to be recalibrated.

QC Sample	True Value	Acceptance	Frequency
CCRDL	0.5 NTU	60-140%	Daily, prior to each analytical batch
CCV	10 NTU	90-110%	Daily, before sample analysis, and after every 10 samples.
CCB	N/A	< 1 NTU	Daily, before sample analysis, and after every 10 samples.

9.1.3.4 Allow the samples to come to room temperature before analysis.

9.1.3.5 Mix the samples gently but thoroughly to disperse the solids throughout the container, allowing for air bubbles to disappear prior to taking an aliquot of sample. Carefully dab off any water or moisture on the outside of the sample cell and remove any smudges using a Kimwipe.

9.1.3.6 Scan the sample IDs into the instrument from the barcodes on the batch worklist.

9.1.3.7 Ensure the sample has remained homogenous and place vial containing sample into the vial compartment and close the lid. Record results using preplog template F-VM-M-023 *ICP/ICPMS DW Turbidity* (or equivalent replacement). Detections exceeding 1 NTU will be scheduled for digestion and analysis, results less than 1 NTU will be scheduled for direct analysis.

9.2 Sample Preparation

9.2.1 Obtain and label digestion tubes in the order for which samples will be poured out.

9.2.2 Transfer a well-mixed 25 mL acid preserved aliquot of the sample to a labeled digest cup. Document the initial volume used.

9.2.2.1 Create a method blank (MB) and laboratory control sample (LCS) using DI water.

9.2.2.2 If the samples are filtered in the lab for dissolved metals, an associated filter blank must be performed and be digested with the batch of samples filtered. The filter blank is not in substitution of the MB, but in addition to.

9.2.3 Spike the LCS (if applicable, LCSD) and matrix spike/matrix spike duplicate (MS/MSD) samples with 0.025 mL of the appropriate spiking standards.

9.2.4 Add 0.5 mL concentrated HNO_3 and 0.25 mL concentrated HCl to each sample.

9.2.5 Cover each digest cup with a ribbed plastic watch glass.

9.2.6 Place samples in a hot block at 95°C +/- 2°C in the hot block. Document temperature of the hot block.

9.2.7 Gently reflux samples down to approximately 5 mL volume. Do not allow the samples to boil or to go to dryness.

9.2.8 Remove from hot block. Document the temperature of the hot block.

9.2.9 Allow the digest to cool. Bring up to a final volume of 25 mL with DI water, cap and mix.

Note: Filter the samples if needed – filtration is to be done only if there is concern that insoluble materials may clog the nebulizer. If any sample is filtered, the MB and LCS must also be filtered. Use the filter mates to plunge-filter the sample in the existing cup.

9.3 Documentation

9.3.1 Digestion Records

Record the necessary information in the electronic prep log using template version F-MN-I-328. Information includes batch and sample ID, initial and final volumes, initial and final time, prep date, prep analyst, supporting equipment, and lot numbers of solutions used. Also include any additional comments if needed.

10.0 Data Analysis And Calculations

10.1 Calculations

Refer to associated analytical SOP for equations and common calculations.

11.0 Quality Control and Method Performance

11.1 Quality Control

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The following QC samples are prepared and analyzed with each batch of samples. Refer to associated analytical SOP for acceptance criteria and required corrective action.

QC Item	Frequency
Method Blank (MB)	1 per batch of 20 or fewer samples.
Laboratory Control Sample (LCS)	1 per batch of 20 or fewer samples.
Laboratory Control Sample Duplicate (LCSD)[1,2]	As needed when insufficient native sample volume exists
Matrix Spike (MS)	Prepared with each batch of samples. Client specific requirements may result in a greater number of MS or MS/MSD sets in a batch
Matrix Spike Duplicate (MSD)	1 per batch of 20 or fewer samples.
Sample Duplicate	Performed at client request.
Filter Blank (FB)	If applicable

[1]WIDNR requires the use of a lab created matrix solution from unused samples.
[2]In the event that only samples identified as Equipment Blanks and/or Field Blanks are available, and LCS/LCSD will be prepared in place of MS/MSD.

11.2 Method Performance

11.2.1 Method Validation

11.2.1.1 Detection Limits

Detection limits (DL) and limits of quantitation (LOQ) are established at initial method setup and verified on an on-going basis thereafter. Refer to Pace ENV corporate SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification* and to the laboratory's SOP ENV-SOP-MIN4-0163 *Determination of LOD and LOQ* for these procedures.

11.3 Analyst Qualifications and Training

Employees that perform any step of this procedure must have a completed Read and Acknowledgment Statement for this version of the SOP in their training record. In addition, prior to unsupervised (independent) work on any client sample, analysts that prepare or analyze samples must have successful initial demonstration of capability (IDOC) and must successfully demonstrate on-going proficiency on an annual basis. Successful means the initial and on-going DOC met criteria, documentation of the DOC is complete, and the DOC record is in the employee's training file. Refer to laboratory SOP ENV-SOP-NW-0025 *Orientation and Training Procedures* (or equivalent replacement) for more information.

12.0 DATA REVIEW AND CORRECTIVE ACTION

12.1 Data Review

Pace's data review process includes a series of checks performed at different stages of the analytical process by different people to ensure that SOPs were followed, the analytical record is complete and properly documented, proper corrective actions were taken for QC failure and other nonconformance(s), and that test results are reported with proper qualification.

The review steps and checks that occur as employee's complete tasks and review their own work is called primary review.

All data and results are also reviewed by an experienced peer or supervisor. Secondary review is performed to verify SOPs were followed, that calibration, instrument performance, and QC criteria were met and/or proper corrective actions were taken, qualitative ID and quantitative measurement is accurate, all manual integrations are justified and documented in accordance with the Pace ENV's SOP for manual integration, calculations are correct, the analytical record is complete and traceable, and that results are properly qualified.

A third-level review, called a completeness check, is performed by reporting or project management staff to verify the data report is not missing information and project specifications were met.

Refer to laboratory SOP ENV-SOP-MIN4-0092 *Data Review Process* for specific instructions and requirements for each step of the data review process.

12.2 Corrective Action

Corrective action is expected any time QC or sample results are not within acceptance criteria. If corrective action is not taken or was not successful, the decision/outcome must be documented in the analytical record. The primary analyst has primary responsibility for taking corrective action when QA/QC criteria are not met. Secondary data reviewers must verify that appropriate action was taken and/or that results reported with QC failure are properly qualified.

Corrective action is also required when carryover is suspected and when results are over range.

Samples analyzed after a high concentration sample must be checked for carryover and reanalyzed if carryover is suspected. Carryover is usually indicated by low concentration detects of the analyte in successive samples analyzed after the high concentration sample.

Sample results at concentrations above the upper limit of quantitation must be diluted and reanalyzed. The result in the diluted samples should be within the upper half of the calibration range. Results less than the mid-range of the calibration indicate the sample was over diluted and analysis should be repeated with a lower level of dilution. If dilution is not performed, any result reported above the upper range is considered a qualitative measurement and must be qualified as an estimated value.

Refer to the associated analytical SOP for a complete summary of QC, acceptance criteria, and recommended corrective actions for QC associated with this test method.

13.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

Pace proactively seeks ways to minimize waste generated during our work processes. Some examples of pollution prevention include but are not limited to: reduced solvent extraction, solvent capture, use of reusable containers for solvent management, and real-time purchasing.

The EPA requires that laboratory waste management practice to be conducted consistent with all applicable federal and state laws and regulations. Excess reagents, samples and method process wastes must be characterized and disposed of in an acceptable manner in accordance with Pace's Chemical Hygiene Plan / Safety Manual.

14.0 MODIFICATIONS

A modification is a change to a reference test method made by the laboratory. For example, changes in stoichiometry, technology, quantitation ions, reagent or solvent volumes, reducing digestion or extraction times, instrument runtimes, etc. are all examples of modifications. Refer to Pace ENV corporate SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification* for the conditions under which the procedures in test method SOPs may be modified and for the procedure and document requirements.

14.1. The scope of the method for 3020A has been expanded to include additional metals that require HCl for best solubility and stability at the levels of analysis required by ICPMS. Due to this requirement method 3020A has been modified to include the addition of HCl to the digestion.

14.2. Our procedure uses a final concentration of HNO_3 at 2% and a final HCl concentration of 1%. This is consistent with the digestion prescribed in EPA Method 200.8, however the final HNO_3 concentration differs from that prescribed in method 3020A.

14.3. Method 3020A has been modified to follow EPA 200.8 given the scope of metals in 200.8 are similar to the scope of metals in 6020A.

14.4. Our procedure uses 25 mL initial and final volumes using the hot block digestion system rather than glassware and 100 mL sample volume.

15.0 Responsibilities

Pace ENV employees that perform any part this procedure in their work activities must have a signed Read and Acknowledgement Statement in their training file for this version of the SOP. The employee is responsible for following the procedures in this SOP and handling temporary departures from this SOP in accordance with Pace's policy for temporary departure.

Pace supervisors/managers are responsible for training employees on the procedures in this SOP and monitoring the implementation of this SOP in their work area.

16.0 Attachments

Appendix A – Stock Standard Summary

Appendix B – Turbidity Barcodes

17.0 References

Pace Quality Assurance Manual- most current version.

TNI Standard, *Management and Technical Requirements for Laboratories Performing Environmental Analyses*, EL-V1-2009.

TNI Standard, *Management and Technical Requirements for Laboratories Performing Environmental Analyses*, EL-VI-2016-Rev.2.1.

Test Methods for Evaluating Solid Waste Physical/Chemical Methods, SW-846, Third Edition. Method 3020A, 1992.

TEST METHOD STANDARD OPERATING PROCEDURE	
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Test Methods for Evaluating Solid Waste Physical/Chemical Methods, SW-846, Third Edition. Method 3005A.

U.S. Environmental Protection Agency. Method 200.8, Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma – Mass Spectrometer, Revision 5.4, EMMC Version, May 1994.

40 CFR Appendix B to Part 136, *Definition and Procedure for the Determination of the Method Detection Limit - Rev 2*, August 28, 2017.

18.0 REVISION HISTORY

This Version:

Section	Description of Change
ALL	New SOP format
9.1.1 / .3	Include turbidity procedure
9.2	Update spike amounts for LCSD

This document supersedes the following document(s):

Document Number	Title	Version
ENV-SOP-MIN4-0044	Preparation of Aqueous Samples for ICP-MS by 200.8 and 3020A	04

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TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: Preparation of Aqueous Samples for ICP-MS Analysis
TEST METHOD EPA 200.8 and 3020A
ISSUER: Pace ENV – Minneapolis– MIN4

Appendix A: Metals Standard Reference

Stock standards used for aqueous sample preparation

PACE-67BW		PACE-67AW	
Element	(mg/L)	Element	(µg/L)
Ca	2000	Si	500
Fe	2000	Sb	100
Mg	2000	Mo	100
K	2000	Sn	100
Na	2000	Ti	100
Se	100		
Al	2000		
Ba	100		
Be	100		
Bi	100		
B	100		
Cd	100		
S	2000		
Cs	100		
Cr	100		
Co	100		
Cu	100		
As	100		
Li	100		
P	100		
Mn	100		
Pb	100		
Ni	100		
Ag	50		
Sr	100		
Tl	100		
V	100		
Zn	100		
U	100		
Pd	20		
Pt	20		

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TITLE:	Preparation of Aqueous Samples for ICP-MS Analysis
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Appendix B: Turbidity Barcodes

Turbidity

CRDL	
CCVA	CCVB
CCV	CCB
CAL1	CAL2
ICV	ICB

ENVIRONMENTAL SCIENCES

Document Information

Document Number: ENV-SOP-MIN4-0043 **Revision:** 03

Document Title: Metals Analysis by ICP/MS - Method 6020 and 200.8

Department(s): Metals

Date Information

Effective Date: 30 Jul 2020

Notes

Document Notes:

All Dates and Times are listed in: Central Time Zone

Signature Manifest

Document Number: ENV-SOP-MIN4-0043 **Revision:** 03

Title: Metals Analysis by ICP/MS - Method 6020 and 200.8

All dates and times are in Central Time Zone.

ENV-SOP-MIN4-0043

QM Approval

Name/Signature	Title	Date	Meaning/Reason
Janielle Ward (007319)	Manager - Quality	30 Jul 2020, 04:58:00 PM	Approved

Management Approval

Name/Signature	Title	Date	Meaning/Reason
Andrew Mickelson (009792)	Manager	20 Jul 2020, 11:59:33 AM	Approved
Krista Carlson (004514)	Project Coordinator 1	20 Jul 2020, 12:11:36 PM	Approved
Adam Haugerud (005828)	General Manager 2	30 Jul 2020, 04:58:52 PM	Approved

TEST METHOD STANDARD OPERATING PROCEDURE

TITLE:	Metals Analysis by ICP/MS
TEST METHOD	6020, 6020A, 6020B, and 200.8
ISSUER:	Pace ENV – Minneapolis – MIN4

1.0 Scope And Application

This standard operating procedure (SOP) describes the laboratory procedure for the determination of dissolved and total recoverable metals by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS).

1.1 Target Analyte List and Limits of Quantitation (LOQ)

The target analytes and the normal LOQ that can be achieved with this procedure are provided in Table 1, Appendix A.

LOQ are established in accordance with Pace policy and SOPs for method validation and for the determination of detection limits (DL) and quantitation limits (LOQ). DL and LOQ are routinely verified and updated when needed. The current LOQ for each target analyte that can be determined by this SOP as of the effective date of this SOP is provided in Table 1, Appendix A.

The reporting limit (RL) is the value to which analytes are reported as detected or not detected in the final report. When the RL is less than the lower limit of quantitation (LLOQ), all detects and non-detects at the RL are qualitative. The LLOQ is the lowest point of the calibration curve used for each target analyte.

1.2 Applicable Matrices

This SOP is applicable to ground, surface, drinking, and storm runoff water samples; industrial, domestic waste waters and solids.

Dissolved elements are determined after suitable filtration and acid preservation. In order to reduce potential interferences, dissolved solids should not exceed 0.2 % (w/v).

For the determination of total recoverable analytes in aqueous samples containing particulate and suspended solids a digestion step is required prior to analysis.

2.0 Summary of Method

Prior to analysis, samples must be solubilized or digested using appropriate sample preparation methods. For the total recoverable determination of analytes in drinking water by 200.8 where sample turbidity is < 1 NTU, the sample is made ready for analysis by the appropriate addition of nitric acid, mixed, and allowed to equilibrate for the required time prior to analysis.

Sample solutions are introduced by pneumatic nebulization into a plasma, in which desolvation, atomization and ionization occurs. Ions are extracted from the plasma through a differentially pumped vacuum interface and sorted on the basis of their mass-to-charge ratio. The ions transmitted through the quadrupole are detected by an electron multiplier. Ion intensities at each mass are recorded and compared to those obtained from external calibration standards to generate concentration values for the samples. Results are corrected for instrument drift and matrix effects using internal standards.

3.0 Interferences

Isobaric Elemental Interferences – Isobaric elemental interferences result when isotopes of different elements have the same nominal mass-to-charge ratio and cannot be resolved with the instruments spectrometer. One way to solve this problem is to measure a different isotope for which there is no interference. Alternatively, one can monitor another isotope of the element and subtract an appropriate amount from the element being analyzed, using known isotope ratio information. Corrections for most of the common elemental interferences are programmed into the software.

Isobaric Polyatomic Interferences – Isobaric polyatomic interferences result when ions containing more than one atom have the same nominal mass-to-charge ratio as an analyte of interest and cannot be resolved by the instrument's spectrometer. An example includes ClO+ (mass 51), which interferes with V, and must be corrected by measuring ClO+ at mass 53. When possible an interference free isotope should be chosen for measurement.

Physical interferences are associated with the sample nebulization and transport processes as well as with ion-transmission efficiencies. Nebulization and transport processes can be affected if a matrix component causes a change in surface tension or viscosity. Changes in matrix composition can cause significant signal suppression or enhancement. Dissolved solids can deposit on the nebulizer tip of a pneumatic nebulizer and on the interface skimmers (reducing the orifice size and the instrument performance). Total solid levels below 0.2% (2,000 mg/L) have been currently recommended to minimize solid deposition. An internal standard can be used to correct for physical interferences, if it is carefully matched to the analyte so that the two elements are similarly affected by matrix changes.

Memory interferences can occur when there are large concentration differences between samples or standards, which are analyzed sequentially. Sample deposition on the sampler and skimmer cones, spray chamber design, and the type of nebulizer affects the extent of the memory interferences, which are observed. The rinse period between samples must be long enough to eliminate significant memory interference.

4.0 DEFINITIONS

Refer to the Laboratory Quality Manual for a glossary of common lab terms and definitions.

5.0 HEALTH AND SAFETY

The toxicity or carcinogenicity of each chemical material used in the laboratory has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable.

The laboratory maintains documentation of hazard assessments and OSHA regulations regarding the safe handling of the chemicals specified in each method. Safety data sheets for all hazardous chemicals are available to all personnel. Employees must abide by the health, safety and environmental (HSE) policies and procedures specified in this SOP and in the Pace Chemical Hygiene / Safety Manual.

Personal protective equipment (PPE) such as safety glasses, gloves, and a laboratory coat must be worn in designated areas and while handling samples and chemical materials to protect against physical contact with samples that contain potentially hazardous chemicals and exposure to chemical materials used in the procedure.

Concentrated corrosives present additional hazards and are damaging to skin and mucus membranes. Use these acids in a fume hood whenever possible with additional PPE designed for handing these materials. If eye or skin contact occurs, flush with large volumes of water. When working with acids, always add acid to water to prevent violent reactions. Any processes that emit large volumes of solvents (evaporation/concentration processes) must be in a hood or apparatus that prevents employee exposure.

Contact your supervisor or local HSE coordinator with questions or concerns regarding safety protocol or safe handling procedures for this procedure.

6.0 Sample Collection, Preservation, Holding Time, And Storage

Samples should be collected in accordance with a sampling plan and procedures appropriate to achieve the regulatory, scientific, and data quality objectives for the project.

The laboratory does not perform sample collection or field measurements for this test method. To assure sample collection and field checks and treatment are performed in accordance with applicable regulations Pace project managers will inform the client of these requirements at the time of request for analytical services when the request for testing is received prior to sample collection. If samples were already collected, the laboratory will record any nonconformance to these requirements in the laboratory's sample receipt record when sufficient information about sample collection is provided with the samples.

General Requirements

Matrix	Routine Container	Minimum Sample Amount[1]	Preservation	Holding Time
Aqueous	250 mL Plastic	25 mL	Acidified[2] with nitric acid to pH<2, stored ambient	Must be analyzed within 180 days of collection. If mercury is requested, analysis must occur within 28 days of sample collection.
Solid	8 oz glass jar	1 gram	<6°C, but above freezing	

[1] *Minimum amount needed for each discrete analysis.*
[2] *Samples must equilibrate for a minimum of 24 hours following acidification. Lead and Copper Rule Monitoring and Reporting Guidance for Public Water Systems, EPA 816-R-10-004, March 2010, Exhibit II-9, Samples must stand in the original container used for sampling for at least 28 hours after acidification.*

Thermal preservation is checked and recorded on receipt in the laboratory in accordance with laboratory ENV-SOP-MIN4-0008 *Sample Management*, or equivalent replacement. Chemical preservation is checked and recorded at time of receipt or prior to sample preparation.

After receipt, samples are stored either stored at ambient or 6°C until sample preparation. Prepared samples digestates are stored at ambient temperatures until sample analysis.

After analysis, unless otherwise specified in the analytical services contract, samples are retained for 45 days from date of final report and then disposed of in accordance with Federal, State, and Local regulations.

7.0 Equipment And Supplies

7.1 Equipment

Equipment	Description
ICPMS (Inductively Coupled Plasma Mass Spectrometer)	Agilent 7700, 7800 7900 ICPMS instrumentation equipped with interference reduction technology. Each instrument has an associated auto-sampler, rough pump and recirculating chiller.

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Centrifuge	Thermo Sorvall Legend XT
Analytical Balance	Sartoriius or equivalent, capable of weighing to 0.01g
Mechanical pipettors	Eppendorf, Fisher brand or equivalent replacement, various sizes
Glassware	Class A volumetric flasks and graduated cylinders of various sizes

7.2 Supplies

Supply	Description
Argon gas	Praxair or equivalent, High purity grade, 99.99%
Collision Gas	Praxair or equivalent, Ultra high purity He, Ultra high purity H_2,
Analytical Balance	Sartoriius or equivalent, capable of weighing to 0.01g
Auto-sampler tubes	Moldpro or equivalent, 15 mL metals free auto-sampler tubes
Digestion cups	Moldpro or equivalent, 50 mL disposable digestion cups
Data-Uploading Software	Pace internal software used to transfer data from the instrument to the LIMS

8.0 Reagents And Standards

8.1 Reagents

Reagent	Description
Reagent water	ASTM Type II
Nitric Acid (HNO_3)	Fisher Scientific, A-509-P212 or equivalent replacement
Hydrochloric acid (HCl)	Fisher Scientific, A-508-P212 or equivalent replacement
2% (v/v) Nitric Acid/1% (v/v) Hydrochloric Acid Solution	Used for instrument blanks, standards and dilutions. Prepared in 1 L increments utilizing a volumetric flask and transferring into a C&G narrow mouth storage bottle. This is measured by mixing 20 mL of HNO_3 trace metals grade acid and 10 mL of HCl trace metals grade acid and DI H2O, and bringing to volume of 1 L.
Rinse Blank	2-5% (v/v) Nitric Acid solution for rinsing between runs. Combine76 mL of HNO_3 trace metals grade acid and 38 mL of HCl trace metals grade and DI H2O, and bringing to volume of 1 G.

8.2 Standards

Reagent	Description
Calibration Stock Standards	Custom blend of elements. See Appendix D for the standard information
Agilent Tune Solution	Purchased multi-element standard from a qualified vendor, 10ug/mL.
EPA Tune solution	Purchased multi-element standard from a qualified vendor, 10ug/mL.
Internal Standard Stock Solution	Various suppliers; single element standards to be mixed prior to use with concentrations of 10,000 ug/mL.
Working Standards	See Appendix C

9.0 Procedure

9.1 Equipment Preparation

Pre-Start Checks: Turn on the computer and load the software. Initiate appropriate operating configuration of the instrument's computer according to the instrument manufacturer's instructions. Check the following:

9.1.1 Support Equipment

- Vacuum pump oil - Examine the sight glasses of the vacuum pump. Oil should be no darker than a light brown color. If it is, change the oil in the pump according to the directions in the manufacturer's guide.
- Chiller temperature, pressure and water level - The temperature should be regulated at 17 ± 1ºC. Check the current temperature on the chiller to ensure it is within this range. Check the inlet cooling water pressure that must be between 55 and 60psi. Check to ensure that chiller water level is full. If it is not, fill with Polyclear 30.
- Verify the level of nebulizer waste and rinse waste, if more than half full, empty it into the acid waste stream.
- Ar/O pressure - The argon supply pressure should be set at about 80psi. If the supply argon pressure falls below about 45psi, a safety interlock automatically shuts off the torch.
- Helium / Hydrogen pressure - The helium and hydrogen supply pressure should be set at about 15 and 9 psi respectively.
- Wash solution level - The wash solution supply is maintained in a 4-liter carboy. Ensure that there is sufficient volume present for the analytical sequence.
- Peristaltic pump tubing - Change the sample and internal standard tubing, spray chamber drain tubing and the rinse station tubing as needed. Signs of degradation include flattened sections and hazy appearance. Allow at least 30 minute for break-in period.
- Interface cones - Remove and inspect the outside of the sampling and skimmer cones around the orifice. Install a new set of cones if needed or clean the existing cones using the following procedure: Carefully polish each cone with silver polish and cotton swabs dampened with deionized water. Rinse cones with deionized water and blow-dry with house air supply, being careful not to damage the cones. After the cones are fully dry, replace them in the instrument. Allow for conditioning of the cones with a solution containing sufficient concentrations of major cations. The orifice should be circular and about 1mm in diameter. Examine the orifice periodically with a magnifier to determine if there are irregularities that may impair instrument performance. DO NOT use a cone with a significantly degraded tip.

9.1.2 Instrument

Lighting Torch and Warm-Up: After all pre-start checks pass inspection, perform the following steps:

- Torch Ignition - Click on the Plasma icon to open the Instrument window, and then click on the plasma on button to light the plasma. This takes a little over a minute to complete. (See instrument software guide.)
- Warm-up- Instrument is allowed to warm-up 30 minutes. Instrument has a timer to let you know when it is ready to move on to the next step.
- Check peristaltic pump flow by monitoring bubble movement in the pump tubing. Adjust tension as needed to achieve a smooth flow.

- Start-up Configuration - Once the analysis tubing is placed in the Agilent tune solution and stable signal is achieved, the start-up configuration can be initiated. See section 9.1.2.1 for Agilent tune performance monitoring and criteria.
- Create New Experiment File – Open template from the drive. Apply the proper run name for the day (MMDDYYICPMS#). Introduce EPA tune solution and allow signal to stabilize. Initiate performance verification for each mode of analysis. Save each performance report to the network drive. See section 9.1.2.1 for EPA tune acceptance criteria.

9.1.2.1 Routine Instrument Operating Conditions

The instrument is configured to go through the manufacturer recommended startup tune procedure which includes; Torch Alignment, Axis/Resolution, EM settings, Plasma Correction, Standard Lenses tune, and standard mode performance verification. The measured ratios of oxides 156/140 and doubly charged 70/140 should be <3%. The measured masses of ^{7}Li, ^{89}Y, ^{205}Tl are monitored for initial resolution/axis tuning. EPA Performance verification is later performed for each cell condition used for sample analysis.

EPA Tune Verification - The EPA tuning standard must be analyzed in each mode of analysis to verify resolution and mass calibration are within the required specifications. The tuning standard is analyzed in each mode of analysis at least five times and the relative standard deviation (RSD) must be <5% for all analytes contained in the tuning standard. Conduct mass calibration and resolution checks in the mass regions of interest. If the mass calibration differs more than 0.1 amu from the true value, then the mass calibration must be adjusted to the correct value. The resolution must also be verified to be <0.9 amu full width at 5% peak height.

Pace Minneapolis maintains approval for the analysis of up to 35 elements by the EPA Methods 200.8, 6020, 6020A, 6020B for water and soil matrices. All target analytes are analyzed either in a Helium mode (Collision Cell), hydrogen (Collision Cell), or No gas mode on the Agilent instruments depending on the sample matrix type. The use of interference reduction technologies (Collision Cell) is not allowed for drinking water analysis. Separate calibrations are performed for samples reporting by regulation of the SDWA.

9.2 Initial Calibration

9.2.1 Calibration Design

The calibration curve must consist of a minimum of a calibration blank and three non-zero standards for each mode of analysis. Use the average of at least three integrations for both calibration and sample analyses. Using the instrumentation software, prepare a standard curve for each element by plotting absorbance versus concentration. The calibration is a linear regression using equation; $y = mx + b$ The analyst may employ a regression equation that does not pass through the origin, however forcing through zero is not allowed. Additional calibration specifications may be referenced in ENV-SOP-NW-0027 *Calibration Procedures*, or equivalent replacement.

9.2.2 Calibration Sequence

Calibration Blank (CAL0)
CAL1

CAL2
CAL3
CAL4
CAL5
CAL6
ICV
ICB
CRDL
ICSA
ICSAB
CCV
CCB
Client samples
CCV
CCB
CRDL (Optional)

9.2.3 ICAL Evaluation

9.2.3.1 Curve Fit

With a multi-point calibration, the regression calculation will generate a correlation coefficient (r) that is the measure of the "goodness of fit" of the regression line to the data. In order to be used for quantitative purposes, the correlation coefficient must be > 0.998.

9.2.3.2 Relative Standard Error (RSE)

%RE is measured at the lowest calibration level and at a point near the mid-level of the calibration (the continuing calibration verification level is recommended). In order for a standard curve to be acceptable, the correlation coefficient/coefficient of determination criterion specified in the method must be met **and** both the low-level and mid-level %RE measures must meet the acceptance criteria. The low-level %RE acceptance criteria is 60%-140% and the mid-level is 90-110%.

9.2.3.3 Initial Calibration Verification

In addition to meeting the linearity requirement, any new calibration curve must be assessed for accuracy in the values generated. To assess the accuracy, a single standard from a secondary source must be analyzed and the results obtained must be compared to the known value of the standard. This step is referred to as Initial Calibration Verification. The ICV is analyzed immediately following an initial calibration curve.

9.2.4 Continuing Calibration Verification

A CCV followed immediately by a CCB must be analyzed after every 10 samples and at the end of the analytical batch to verify the system is still calibrated.

9.3 Digestate Preparation

9.3.1 Homogenization and Subsampling

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All solid matrices are subject to centrifuge at a rate of 1000 rpm for 15 minutes or allowed to settle overnight prior to analysis. Once samples have been centrifuged or allowed to settle, an initial dilution of 20 fold is performed on each sample. This is completed by taking 4.75mL of 2% HNO3 / 1% HCL diluent and mixing with a 0.25mL aliquot of sample by means of vortex.

Aqueous samples are inverted multiple times and poured without initial dilution unless historical data demonstrates otherwise.

9.4 Analysis

The instrument performs sample analysis by executing 100 mass sweeps per replicate. Three replicates are utilized for an average result which must fall within a 20% RSD for the replicate values. If any sample or QC is found to have a concentration of >5x the RL and >20% RSD it must be evaluated for interference. If a matrix interferent is determined to be the cause, dilute the sample by 5x and re-analyze. Perform further dilutions if necessary.

The instrument(s) have been setup and configured in conjunction with manufacturer specifications. Masses were carefully selected to avoid and/or minimize interferences. Internal standard selection was based on performance for the appropriate mass range. Internal standard association must remain within 50 amu of targeted analyte.

The total recoverable sample digestion procedure is suitable for the determination of silver in aqueous samples containing concentrations up to 0.1 mg/L. For the analysis of wastewater samples containing higher concentrations of silver, succeeding smaller volumes of well mixed sample aliquots must be prepared until the analysis solution contains < 0.1 mg/L silver.

10.0 Data Analysis And Calculations

See the laboratory SOP ENV-SOP-MIN4-0171 *Laboratory Calculations*, or equivalent replacement, for equations for common calculations.

10.1 Hardness as CaCO3 in mg/L = 2.497 * [Ca in mg/L] + 4.118 * [Mg in mg/L]

10.2 Concentration of lead = summation of signals at 206, 207, and 208 m/z.

10.3 Silica (SiO2) (µg/L) = Silicon (Si) (µg/L) * DF * 60.09 amu (SiO2 molecular weight) / 28.09 amu (Si atomic weight)

Where: DF is the sample Dilution Factor

11.0 Quality Control And Method Performance

11.1 Quality Control

The following QC samples are prepared and analyzed with each batch of samples. Refer to Appendix B for acceptance criteria and required corrective action.

QC Item	Frequency

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Method Blank (MB)	1 per batch of 20 or fewer samples.
Laboratory Control Sample (LCS)	1 per batch of 20 or fewer samples.
Laboratory Control Sample Duplicate (LCSD)	As needed
Matrix Spike (MS)	1 per batch of 20 or fewer samples for 6020 (A)(B). 1 per batch of 10 or fewer samples for 200.8
Matrix Spike Duplicate (MSD)	1 per batch of 20 or fewer samples.
Sample Duplicate	Performed at client request.
Serial Dilution	1 per batch of 20 or fewer samples.
Post Digestion Spike	1 per batch of 20 or fewer samples for method 6020(A)(B).
Internal Standard	An appropriate internal standard is required for each analyte and sample determined by ICP-MS.

Internal Standard	Associated element
Scandium 45	Li, Be, B, Na, Mg, Al, Si, K, Ca, Ti, V, Cr, Mn, Fe, Se
Germanium 72	Co, Ni, Cu, Zn, As, Sr
Indium 115	Mo, Pd, Ag, Cd, Sn, Sb
Terbium 159	Ba, Pt, Hg, Tl, Pb, Bi
Thorium 232	U

11.2 Instrument QC

The following Instrument QC checks are performed. Refer to Appendix B for acceptance criteria and required corrective action.

QC Item	Frequency
Tune	Daily prior to any calibration
Initial Calibration	Daily
Initial Calibration Verification	Immediately after each initial calibration
Initial Calibration Blank	Immediately after each initial calibration
Continuing Calibration Verification	Prior to the analysis of any samples and after every 10 injections thereafter. Samples must be bracketed with a closing CCV standard.
Continuing Calibration Blank	Following every CCV injection
CRDL / LLCCV verification	At the beginning of each run for 6020/6020B/200.8 and must be analyzed at the beginning of each run, and once at the end of each analytical batch for 6020A.
ICSA verification	At the beginning of each sample run sequence after the CRDL. 6020A and 6020B requires the ICSA/AB be analyzed every 12 hours thereafter.
ICSAB verification	At the beginning of each sample run sequence after the ICSA. 6020A and 6020B requires the ICSA/AB be analyzed every 12 hours thereafter.

11.3 Method Performance

11.3.1 Method Validation

11.3.1.1 Detection Limits

Detection limits (DL) and limits of quantitation (LOQ) are established at initial method setup and verified on an on-going basis thereafter. Refer to Pace ENV corporate SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument*

Verification and to the laboratory's SOP ENV-SOP-NW-0018 *Determination of LOD and LOQ* for these procedures.

11.4 Analyst Qualifications and Training

Employees that perform any step of this procedure must have a completed Read and Acknowledgment Statement for this version of the SOP in their training record. In addition, prior to unsupervised (independent) work on any client sample, analysts that prepare or analyze samples must have successful initial demonstration of capability (IDOC) and must successfully demonstrate on-going proficiency on an annual basis. Successful means the initial and on-going DOC met criteria, documentation of the DOC is complete, and the DOC record is in the employee's training file. Refer to laboratory SOP ENV-SOP-NW-0025 *Training and Orientation Procedures* for more information.

12.0 Data Review And Corrective Action

12.1 Data Review

Pace's data review process includes a series of checks performed at different stages of the analytical process by different people to ensure that SOPs were followed, the analytical record is complete and properly documented, proper corrective actions were taken for QC failure and other nonconformance(s), and that test results are reported with proper qualification.

The review steps and checks that occur as employee's complete tasks and review their own work is called primary review.

All data and results are also reviewed by an experienced peer or supervisor. Secondary review is performed to verify SOPs were followed, that calibration, instrument performance, and QC criteria were met and/or proper corrective actions were taken, qualitative ID and quantitative measurement is accurate, all manual integrations are justified and documented in accordance with the Pace ENV's SOP for manual integration, calculations are correct, the analytical record is complete and traceable, and that results are properly qualified.

A third-level review, called a completeness check, is performed by reporting or project management staff to verify the data report is not missing information and project specifications were met.

Refer to laboratory SOP ENV-SOP-MIN4-0092 *Data Review Process* for specific instructions and requirements for each step of the data review process.

12.2 Corrective Action

Corrective action is expected any time QC or sample results are not within acceptance criteria. If corrective action is not taken or was not successful, the decision/outcome must be documented in the analytical record. The primary analyst has primary responsibility for taking corrective action when QA/QC criteria are not met. Secondary data reviewers must verify that appropriate action was taken and/or that results reported with QC failure are properly qualified.

Corrective action is also required when carryover is suspected and when results are over range.

Samples analyzed after a high concentration sample must be checked for carryover and reanalyzed if carryover is suspected. Carryover is usually indicated by low concentration detects of the analyte in successive samples analyzed after the high concentration sample.

Sample results at concentrations above the upper limit of quantitation must be diluted and reanalyzed. The result in the diluted samples should be near the midpoint of the calibration range. If dilution is not performed, any result reported above the upper range is considered a qualitative measurement and must be qualified as an estimated value.

Refer to Appendix B for a complete summary of QC, acceptance criteria, and recommended corrective actions for QC associated with this test method.

13.0 Pollution Prevention And Waste Management

Pace proactively seeks ways to minimize waste generated during our work processes. Some examples of pollution prevention include but are not limited to: reduced solvent extraction, solvent capture, use of reusable containers for solvent management, and real-time purchasing.

The EPA requires that laboratory waste management practice to be conducted consistent with all applicable federal and state laws and regulations. Excess reagents, samples and method process wastes must be characterized and disposed of in an acceptable manner in accordance with Pace's Chemical Hygiene Plan / Safety Manual.

14.0 Modifications

A modification is a change to a reference test method made by the laboratory. For example, changes in stoichiometry, technology, quantitation ions, reagent or solvent volumes, reducing digestion or extraction times, instrument runtimes, etc. are all examples of modifications. Refer to Pace ENV corporate SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification* for the conditions under which the procedures in test method SOPs may be modified and for the procedure and document requirements.

14.1 Tuning criteria observed is more stringent than required by the SW846 methods so that the same criteria can be used for both methods 6020 and 200.8.

14.2 The following elements are not listed in the method 6020A recommended analyte list; bismuth, boron, lithium, molybdenum, palladium, platinum, silica, silicon, strontium, tin, titanium, and uranium-238. The accuracy and precision for the analysis of these analytes have been demonstrated in the matrices of interest, at the concentration of interest, and in the same manner as the elements recommended in the method.

14.3 The following elements are not listed in the method 200.8 recommended analyte list: bismuth, boron, calcium, iron, lithium, magnesium, palladium, platinum, potassium, silica, silicon, sodium, strontium, tin, and titanium. The accuracy and precision for the analysis of these analytes have been demonstrated in the matrices of interest, at the concentration of interest, and in the same manner as the elements recommended in the method.

14.4 The following elements are not listed in the method 6020B recommended analyte list: bismuth, boron, lithium, molybdenum, palladium, platinum, silica, silicon, strontium, tin, titanium and uranium-238. The accuracy and precision for the analysis of these analytes have been demonstrated in the matrices of interest, at the concentration of interest, and in the same manner as the elements recommended in the method.

15.0 RESPONSIBILITIES

Pace ENV employees that perform any part this procedure in their work activities must have a signed Read and Acknowledgement Statement in their training file for this version of the SOP. The employee is responsible for following the procedures in this SOP and handling temporary departures from this SOP in accordance with Pace's policy for temporary departure.

Pace supervisors/managers are responsible for training employees on the procedures in this SOP and monitoring the implementation of this SOP in their work area.

16.0 ATTACHMENTS

Appendix A – Target Analyte List and Routine LOQ

Appendix B – QC Summary

Appendix C – Working Standard Summary

Appendix D – Stock Standard Summary

17.0 REFERENCES

Pace Quality Assurance Manual- most current version.

TNI Standard, *Management and Technical Requirements for Laboratories Performing Environmental Analyses*, EL-V1-2009.

TNI Standard, *Management and Technical Requirements for Laboratories Performing Environmental Analyses*, EL-VI-2016-Rev.2.1.

U.S. Environmental Protection Agency. Method 200.8, Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma – Mass Spectrometer, Revision 5.4, EMMC Version, May 1994.

Fisons –VG Genesis Users Manual.

Region 9 Laboratory Standard Operating Procedure 130, Glassware Cleaning Procedures.

Region 9 Laboratory Standard Operating Procedure 462, Analysis of Total Suspended Solids By EPA Method 160.2.

U.S. Environmental Protection Agency. SW846 Method 6020, Inductively Coupled Plasma – Mass Spectrometry, Revision 0, 9/94.

U.S. Environmental Protection Agency. SW846 Method 6020A, Inductively Coupled Plasma – Mass Spectrometry, Revision 1, 02/2007.

U.S. Environmental Protection Agency. SW846 Method 6020B, Inductively Coupled Plasma – Mass Spectrometry, Revision 2, 7/2014.

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Test Methods for Evaluating Solid Waste Physical/Chemical Methods, SW-846, Third Edition. Method 3020A.

Test Methods for Evaluating Solid Waste Physical/Chemical Methods, SW-846, Third Edition. Method 3050B.

40 CFR Appendix B to Part 136, Definition and Procedure for the Determination of the Method Detection Limit - Rev 2, August 28, 2017.

18.0 REVISION HISTORY

This Version:

Section	Description of Change
1.0	Corrected section numbering, Applicable Matrices as 1.2 instead of 2.0 per template.
17.0	Added TNI references back in, removed last revision in error when converted.
Appendix B	Updated MB Acceptance Criteria and Corrective Action.
Appendix C	Added footnote to Table, added row for Cal 6.

This document supersedes the following document(s):

Document Number	Title	Version
ENV-SOP-MIN4-0043	Metals Analysis by ICP/MS – Method 6020 and 200.8	02

TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: Metals Analysis by ICP/MS
TEST METHOD 6020, 6020A, 6020B, and 200.8
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Appendix A: Target Analyte List and Routine LOQ[1]

Analyte	Non-Potable Water (ug/L)	Potable Water (ug/L)	Soil (mg/kg)
Aluminum	20.00	20.0	20.00
Antimony	0.50	0.50	0.50
Arsenic	0.50	0.50	0.50
Barium	0.30	0.30	0.30
Beryllium	0.20	0.20	0.20
Bismuth	0.50	-	0.50
Boron	10.00	-	10.00
Cadmium	0.08	0.08	0.08
Calcium	40.00	-	40.00
Chromium	0.50	0.50	0.50
Cobalt	0.50	-	0.50
Copper	1.00	1.00	1.00
Iron	50.00	-	50.00
Lead	0.10	0.10	0.20
Lithium	0.50	-	0.50
Magnesium	10.00	-	10.00
Manganese	0.50	0.50	0.50
Mercury	0.20	0.20	0.20
Molybdenum	0.50	-	0.50
Nickel	0.50	0.50	0.50
Palladium	0.50	-	-
Platinum	0.50	-	-
Potassium	100.00	-	100.00
Selenium	0.50	0.50	0.50
Silica	107.00	-	107.00
Silicon	50.00	-	50.00
Silver	0.50	0.50	0.50
Sodium	50.00	-	50.00
Strontium	0.50	-	0.50
Thallium	0.10	0.10	0.10
Tin	0.50	-	2.000
Titanium	1.00	-	1.00
Vanadium	1.00	1.00	1.00
Uranium-238	0.50	0.50	0.50
Zinc	5.00	5.00	5.00

[1] *Values in place as of effective date of this SOP. LOQ are subject to change. For the most up to date LOQ, refer to the LIMS or contact the laboratory.*

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Appendix B: QC Summary

QC Item	Frequency	Acceptance Criteria	Corrective Action	Qualification
Tune	Daily prior to any calibration	Adjust spectrometer resolution to produce a peak width of approximately 0.75 amu at 5% peak height. This must be completed using 5 replicates with a resulting RSD of <5%.	Adjust mass calibration if it has shifted by more than 0.1 amu from unit mass. Identify and correct source of problem, repeat performance verification(s).	None. Do not proceed with analysis.
ICAL	Daily	r ≥ 0.998 Mid Level (Cal4) %RE 90-110% Low-Level (Cal1) %RE 60-140%	Identify and correct source of problem, repeat.	None. Do not proceed with analysis.
ICV	After Each ICAL	All analytes must be within ± 10% of the true value. (%R)	Identify source of problem, re-analyze. If repeat failure, repeat ICAL. Analysis may proceed if it can be demonstrated that the ICV exceedance has no impact on analytical measurements. For example, the ICV %R is high, CCV is within criteria, and the analyte is not detected in sample(s).	Qualify analytes with ICV out of criteria.
ICB	Immediately after the initial calibration verification	All elements of interest must be evaluated to a criterion of +/- ½ of the RL for method 6020 (A)(B) and samples originating from NC. All elements of interest must be evaluated to +/- the RL for method 200.8, and 6020. WIDNR and West Virginia require samples to be reported to the MDL. The blanks must be clean to the data quality objectives.	Identify source of problem, re-analyze. Analysis may proceed if it can be demonstrated that the ICB exceedance has no impact on analytical measurements. For example, the ICB has detections and the analyte is not detected in sample(s).	Qualify analytes with ICB out of criteria.
CRDL / LLCCV	At the beginning of each run for 6020/6020B/200.8 and must be analyzed at the beginning of each run, and once at the end of each analytical batch for 6020A.	For 6020/200.8: The acceptance criteria are ± 40% (or specified by the client). For 6020A: The acceptance criteria are ± 30% (or specified by the client). 6020B: The acceptance criteria is ± 20% (or specified by the client).	Identify source of problem, re-analyze. Analysis may proceed if it can be demonstrated that the CRDL exceedance has no impact on analytical measurements. For example, the CRDL %R is high and the analyte is not detected in sample(s). For example, the CRDL %R is high and the analyte detections exceed the continuing calibrations verification level (midpoint of the curve).	Qualify outages and explain in case narrative.

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			If the CRDL is biased low, no data can be reported for the target elements failing criteria.	
CCV	Daily, before sample analysis, after every 10, and at end of analytical window.	All analytes must be within ± 10% of the true value. (%R): %RSD between multiple integrations must be ≤ 5%	Identify source of problem, re-analyze. Analysis may proceed if it can be demonstrated that the CCV exceedance has no impact on analytical measurements. For example, the CCV %R is high, and the analyte is not detected in sample(s).	Qualify analytes with CCV out of criteria.
CCB	Daily, before sample analysis, after every 10, and at end of analytical window	All elements of interest must be evaluated to a criterion of +/- ½ of the RL for method 6020 (A) and samples originating from NC. All elements of interest must be evaluated to +/- the RL for method 200.8, and 6020 (B). WIDNR and West Virginia require samples to be reported to the MDL. The blanks must be clean to the data quality objectives.	Identify source of problem, re-analyze. Analysis may proceed if it can be demonstrated that the CCB exceedance has no impact on analytical measurements. For example, the CCB has detections and the analyte is not detected in sample(s).	Qualify analytes with CCB out of criteria.
Internal Standards	Every field sample, standard and QC sample	For method 6020, the intensity of internal standard in the ICB/CCB and ICS (ICSA/AB) standards must not deviate more than 80-120% from its original intensity in the associated calibration blank. The intensity of internal standard in the samples and remaining QC must not deviate more than 30-120%. For method 6020A/B, the intensity of the internal standard must not fall below 70% and not exceed 130% from its original intensity in the associated calibration blank. For Method 200.8 the intensity of internal standard in the samples and QC must not deviate more than 60-125% from its original intensity in the associated calibration blank.	Troubleshoot instrument performance. Reanalyze samples and dilute if needed.	Qualify outages and explain in case narrative.
Interference check solutions	ICSA containing high concentrations of C, Cl, Al, Ca, Fe, K, Mg, Mo, Na, P, S and Ti is analyzed at the beginning of each sample run sequence after the CRDL. ICSAB containing high concentrations of	ICSA all spiked elements are to be within 20% of the expected true value. The non-spiked elements are to be below the RL. ICSAB all spiked elements are to be within 20% of the expected true value.	Identify and correct source of problem, repeat performance verification(s).	None. Do not proceed with analysis for elements that cannot be verified.

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	C, Cl, Al, Ca, Fe, K, Mg, Mo, Na, P, S and Ti and mid-range concentrations of the remaining elements is analyzed at the beginning of each sample run sequence following the ICSA. 6020A and 6020B requires the ICSA/AB be analyzed every 12 hours thereafter.			
Method Blank	One per 20 samples	Method 200.7: The method blank is considered to be acceptable if it does not contain the target analytes that exceed 1/2 LLOQ or project-specific DQOs. Method 6010B, 6010C and 6010D: The method blank is considered to be acceptable if it does not contain the target analytes that exceed the LLOQ or project-specific DQOs.	Identify source of problem, re-analyze. If reanalysis of the MB fails, all samples affected by the failing MB elements need to be re-digested and re-analyzed. If the method blank exceeds the criteria, but the associated samples are either below the reporting level or other DQOs, or detections in the sample are >10x MB detections then the sample data may be reported. J-flag qualification will be applied for blank detections between the LOQ and LOD when DQOs require evaluation to the MDL.	Qualify outages and explain in case narrative.
LCS	One per 20 samples	6020/6020A/6020B: 80-120% 200.8: 85-115%	Identify source of problem, re-analyze. If reanalysis of the LCS fails, all samples affected by the failing LCS elements need to be re-digested and re-analyzed. If LCS recovery is > QC limits and these compounds are non-detect in the associated samples	Qualify analytes with LCS out of criteria.
LCSD	An LCSD must be substituted in the event of insufficient sample volume for a matrix spike duplicate sample.	6020/6020A/6020B: 80-120% 200.8: 85-115% %Diff ≤ 20%	Identify source of problem, re-analyze. If reanalysis of the LCS fails, all samples affected by the failing LCS elements need to be re-digested and re-analyzed. If LCS recovery is > QC limits and these compounds are non-detect in the associated samples	Qualify analytes with LCS out of criteria.
MS/MSD	One per 20 samples for 6020 / 6020A / 6020B One per 10 samples for 200.8	6020/6020A/6020B: 75-125% 200.8: 70-130%	Perform a SD and PDS on any elements that fail to meet criteria for method 6020(A)(B).	Qualify analytes with MS out of criteria.
Sample Duplicate	Per client request	%Diff ≤ 20%	Qualify outages	Qualify outages.

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Serial Dilution[1]	One per batch of 20 samples or less	6020/6020A fivefold dilution must agree within ± 10% of the original determination if analyte concentration is >50x MDL. 6020B 1:5 dilution of sample 25x > LLOQ or 1:5 dilution of MS since reasonable concentrations are present, results to agree to ± 20%.	If criteria is not met, original sample and dilution shall be reanalyzed. If reanalysis fails, it is determined to be matrix interference.	Qualify outages.
Post Digestion Spike[2]	One per batch if there is a MS failure.	6020/ 6020A 80-120% 6020B applicable to elements failing MS, results to agree to +/- 25%. Recommended if high concentration sample not available for dilution test.	If the element fails to meet the recovery criteria, reanalyze. If reanalysis fails, it is determined to be matrix interference.	Qualify outages.
Laboratory Filter Blank (FB)	Analyzed only with batches of lab filtered dissolved metals, one per batch of 20 or less.	Target analytes must be less than reporting limit. NC samples are required to be < ½ RL for target analytes. WIDNR and West Virginia require samples to be reported to the MDL. The blanks must be clean to the data quality objectives.	Identify source of problem, re-analyze. If reanalysis of the MB fails, all samples affected by the failing MB elements need to be re-digested and re-analyzed. If sample(s) non-detect, report the data. If sample result >10x MB detections, report the data.	Qualify outages and explain in case narrative.
Linear Dynamic Range	For method 6020B: Following calibration, the laboratory may choose to analyze a standard at a higher concentration than the high standard in the calibration. If a linear range standard is not analyzed for any specific element, the highest standard in the calibration becomes the linear range.	The standard must recover within 10% of the true value, and if successful, establishes the linear range. In each scenario, the linear range is established using 90% of the highest calibration level or LDR sample.	The linear range of the instrument must be adjusted until 90% recovery of the reference standard can be achieved as well as maintaining the minimum number of calibration standard requirements.	N/A

[1]To prepare a 5-fold dilution: take a 1 mL aliquot from the sample and add to 4 mL of diluent. Note: this is a typical process for 200.8 and 6020W. It can be replicated for the preparation of highly concentrated samples by starting with a diluted "parent" sample and then performing the stepwise dilution process.
[2]To Prepare a Post Digestion Spike: An aliquot of the parent sample used for the MS, prepared at the same dilution as the parent sample. The spike addition should produce a minimum level of 10 times the lower limit of quantitation; routine spike volume is 0.020 mL of 20/250 mg/L and 1mg/L mercury stock concentration(s).

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Appendix C: Working Standard Summary

Standard	Standard(s) Used	Standard(s) Amount (mL)	Diluent	Diluent Volume (mL)	Final Total Volume[1] (mL)	Final Concentration (ug/L)
Internal Standard	6020-Ge	1	See table 8.1	495	500	2000
	6020-Sc	1				
	6020-Tb	1				
	6020-In	1				
	6020-Th	1				
Hg 10ppb intermediate solution	HG-LL Stock	0.05		49.95	50	10
Cal 0	N/A	N/A		50	50	0
Cal 1	PACE-28	0.1		9.8	10	Varied
	Hg 10ppb intermediate solution	0.1				0.1
Cal 2	Cal 4	0.500		9.5	10	0.5/10/125
Cal 3	Cal 4	1.000		9	10	1.0/20/250
Cal 4	Hg 10ppb intermediate solution	0.1		9.6	10	10/200/2500
	XFSPA-221-250	0.1				
	XFSPA-656-250	0.1				
	XFSPA-220-250	0.1				
Cal 5	XFSMN-26-250A	0.05		9.45	10	20/250/500/25000
	XFSMN-27-250A	0.05				
	XFSMN-28-250A	0.25				
	Hg 10ppb intermediate solution	0.2				
Cal 6	XFSMN-28-250A	0.5		9.5	10	50000
CRDL	PACE-28	0.1		9.7	10	varied
	Hg 10 ppb intermediate solution	0.2				0.2
ICS-A	6020 ISC-OA	0.25		9.75	10	25000
ICS-AB	6020 ISC-OA	0.25		9.56	10	4/100/1250/26250
	XFSPA-221-250	0.05				
	XFSPA-656-250	0.05				
	XFSPA-220-250	0.05				
	Hg 10 ppm intermediate	0.04				
ICV / CCV	PACE-5	0.2		49.4	50	4/80/1000
	PACE-4B	0.2				
	CGHG1	0.2				

[1]Alternate final volumes may be prepared at the discretion of the scientist, so long as the concentrations specified above are maintained.

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Appendix D: Stock Standard Summary

	Stock Standard Concentrations											
	XFSPA-221-250	XFSPA-656-250	XFSPA-220-250	XFSMN-26-250A	XFSMN-27-250A,	XFSMN-28-250A	PACE-5	PACE-4B	PACE-28	6020 ISC-OA	Agilent Tune	EPA Tune
Analyte	(ug/mL)	(ug/mL)	(ug/mL)	(ug/mL)	(ug/mL)	(ug/mL)	(ug/mL)	(ug/mL)	(ug/L)	(ug/mL)	(ug/mL)	(ug/mL)
Aluminum		20		1000				20	1,000	1,000		
Antimony	20				100		20		50			
Arsenic	20					100		20	50			
Barium		20				100		20	30			10
Beryllium		20				100		20	20			10
Bismuth		20						20	50			
Boron		20			100			20	500			
Cadmium		20				100		20	8			
Calcium		250		1000				250	4000	1,000		
Chromium		20				100		20	50			
Cobalt		20				100		20	50		10	10
Copper		20				100		20	100			
Iron		250		1000				250	5000	1,000		
Lead		20				100		20	10			
Lithium		20				100		20	50		10	10
Magnesium		250		1000				250	1,000	1,000		10
Manganese		20				100		20	50			
Molybdenum		20			100		20		50	20		
Nickel		20				100		20	50			
Palladium			20				20		50			
Platinum			20				20		50			
Potassium		250		1000				250	5000	1,000		
Selenium		20				100		20	50			
Silicon	250				500		250		5000			
Silver		20			50			20	50			
Sodium		250		1000				250	5000	1,000		
Strontium		20				100		20	50			
Thallium	20					100		20	10		10	10
Tin	20				100		20		50			
Titanium		20			100		20		100	20		
Vanadium		20				100		20	100			
Zinc		20				100		20	500			
Uranium		20						20	50			10
Indium												10
Cesium												10
Cerium											10	
Yttrium											10	10
Rhodium												10

Document Information

Document Number: ENV-SOP-MIN4-0054 **Revision:** 04

Document Title: Mercury in Liquid and Solid/Semi-Solid Waste by 7470A, 7471, 7471B, and 245.1

Department(s): Metals

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All Dates and Times are listed in: Central Time Zone

Signature Manifest

Document Number: ENV-SOP-MIN4-0054 **Revision:** 04

Title: Mercury in Liquid and Solid/Semi-Solid Waste by 7470A, 7471, 7471B, and 245.1

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ENV-SOP-MIN4-0054 - Mercury

QM Approval

Name/Signature	Title	Date	Meaning/Reason
Janielle Ward (007319)	Manager - Quality	30 Jul 2020, 05:04:19 PM	Approved

Management Approval

Name/Signature	Title	Date	Meaning/Reason
Krista Carlson (004514)	Project Coordinator 1	20 Jul 2020, 11:18:09 AM	Approved
Andrew Mickelson (009792)	Manager	20 Jul 2020, 11:31:19 AM	Approved
Adam Haugerud (005828)	General Manager 2	31 Jul 2020, 10:38:58 AM	Approved

TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: Mercury Analysis by CVAA
TEST METHOD 7470A, 7471A, 7471B, and 245.1
ISSUER: Pace ENV – Minneapolis – MIN4

1.0 Scope And Application

This standard operating procedure (SOP) describes the laboratory procedure for the determination of mercury in mobility procedure extracts, aqueous wastes, ground waters, soils, sediments, bottom deposits, and sludge-type materials using cold vapor atomic absorption (CVAA).

1.1 Target Analyte List and Limits of Quantitation (LOQ)

The default reporting limit (RL) or Limit of Quantitation (LOQ) for mercury in liquid is 0.2 µg/L. The default reporting limit for mercury in soil is 0.02 mg/kg. Reporting limits may vary based on the nature of the individual sample matrix. For certain applications, a lower level method optimized for sensitivity in which the reporting limit is 0.010 µg/L is available. This is for aqueous samples only.

LOQ are established in accordance with Pace policy and SOPs for method validation and for the determination of detection limits (DL) and quantitation limits (LOQ). DL and LOQ are routinely verified and updated when needed. The current LOQ for each target analyte that can be determined by this SOP as of the effective date of this SOP is provided in Table 1, Appendix A.

The reporting limit (RL) is the value to which analytes are reported as detected or not detected in the final report. When the RL is less than the lower limit of quantitation (LLOQ), all detects and non-detects at the RL are qualitative. The LLOQ is the lowest point of the calibration curve used for each target analyte.

DL, LOQ, and RL are always adjusted to account for actual amounts used and for dilution.

1.2 Applicable Matrices

This SOP is applicable to ground, surface, drinking, and storm runoff water samples; industrial, domestic waste waters and solids.

2.0 Summary of Method

2.1 The method, a CVAA technique, is based on the absorption of radiation at the characteristic wavelength of 253.7 nm by mercury vapor. The mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrophotometer. Absorbance is measured as a function of mercury concentration.

2.2 Chemical Reactions - Organic mercury compounds are decomposed by digestion with potassium permanganate in acid solution. The mercuric ions are then reduced to the elemental state with stannous chloride and mercury vapor is produced.

3.0 Interferences

3.1 Potassium permanganate is added during digestion of samples to break down organo-mercury compounds which would otherwise not respond to the cold vapor technique. A heating step is required for methyl mercuric chloride when present in or spiked to a natural system. Possible sulfide interferences are also eliminated by the addition of potassium permanganate. EPA studies indicate concentrations as high as 20 mg/L of sodium sulfide do not interfere with the recovery of added inorganic mercury from distilled water.

3.2 Copper has also been reported to interfere; however, EPA studies indicate copper concentrations as high as 10 mg/L had no effect on recovery of mercury from reagent water.

3.3 Sea waters, brines and industrial effluents high in chlorides require additional permanganate. During the oxidation step, chlorides are converted to free chlorine which will also absorb radiation of 253 nm. Care must be taken to assure that free chlorine is absent before the mercury is reduced and swept into the cell. The design of the dedicated mercury analyzer assures that this does not occur.

4.0 DEFINITIONS

Refer to the Laboratory Quality Manual for a glossary of common lab terms and definitions.

5.0 HEALTH AND SAFETY

The toxicity or carcinogenicity of each chemical material used in the laboratory has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable.

The laboratory maintains documentation of hazard assessments and OSHA regulations regarding the safe handling of the chemicals specified in each method. Safety data sheets for all hazardous chemicals are available to all personnel. Employees must abide by the health, safety and environmental (HSE) policies and procedures specified in this SOP and in the Pace Chemical Hygiene / Safety Manual.

Personal protective equipment (PPE) such as safety glasses, gloves, and a laboratory coat must be worn in designated areas and while handling samples and chemical materials to protect against physical contact with samples that contain potentially hazardous chemicals and exposure to chemical materials used in the procedure.

Concentrated corrosives present additional hazards and are damaging to skin and mucus membranes. Use these acids in a fume hood whenever possible with additional PPE designed for handing these materials. If eye or skin contact occurs, flush with large volumes of water. When working with acids, always add acid to water to prevent violent reactions. Any processes that emit large volumes of solvents (evaporation/concentration processes) must be in a hood or apparatus that prevents employee exposure.

Contact your supervisor or local HSE coordinator with questions or concerns regarding safety protocol or safe handling procedures for this procedure.

6.0 SAMPLE COLLECTION, PRESERVATION, HOLDING TIME, AND STORAGE

Samples should be collected in accordance with a sampling plan and procedures appropriate to achieve the regulatory, scientific, and data quality objectives for the project.

The laboratory does not perform sample collection or field measurements for this test method. To assure sample collection and field checks and treatment are performed in accordance with applicable regulations Pace project managers will inform the client of these requirements at the time of request for analytical services when the request for testing is received prior to sample collection. If samples were already collected, the laboratory will record any nonconformance to these requirements in the laboratory's sample receipt record when sufficient information about sample collection is provided with the samples.

General Requirements

Matrix	Routine Container	Minimum Sample Amount[1]	Preservation	Holding Time
Aqueous	250 mL Plastic	30 mL	Acidified with nitric acid to pH<2, stored ambient	Must be analyzed within 28 days of collection.
Solid	8 oz glass jar	0.3 gram	<6°C, but above freezing	

[1]*Minimum amount needed for each discrete analysis.*

Thermal preservation is checked and recorded on receipt in the laboratory in accordance with laboratory ENV-SOP-MIN4-0008 *Sample Management*, or equivalent replacement. Chemical preservation is checked and recorded at time of receipt or prior to sample preparation.

After receipt, samples are stored either stored at ambient or 6°C until sample preparation. Prepared samples digestates are stored at ambient temperatures until sample analysis.

After analysis, unless otherwise specified in the analytical services contract, samples are retained for 45 days from date of final report and then disposed of in accordance with Federal, State, and Local regulations.

7.0 Equipment And Supplies

7.1 Equipment

Equipment	Description
Mercury analyzer, computer controlled	Cold Vapor Atomic Adsorption (CVAA), Cetac M-7600 or equivalent. Each instrument has an associated auto-sampler, Cetac ASX 520 or equivalent
Hot Block™ digester	54 place block or equivalent, Environmental Express SC154 or equivalent
Analytical Balance	Sartoriius or equivalent, capable of weighing to 0.01g
Mechanical pipettors	Eppendorf, Fisher brand or equivalent replacement, various sizes
Glassware	Class A volumetric flasks and graduated cylinders of various sizes

7.2 Supplies

Supply	Description
Argon gas	Praxair or equivalent, High purity grade, 99.99%
Peristaltic pump tubing	Fisher Scientific or equivalent
Digestion cups	Moldpro or equivalent, 50 mL disposable digestion cups
Resin Pellets	Environmental Express SC400 or equivalent
Auto-sampler tubes	Moldpro or equivalent, 15 mL metals free auto-sampler tubes
Digestion cups	Moldpro or equivalent, 50 mL disposable digestion cups

8.0 Reagents And Standards

8.1 Reagents

Reagent	Description
Reagent water	ASTM Type II
Nitric Acid (HNO_3)	Fisher Scientific, A-509-P212 or equivalent
Hydrochloric acid (HCl)	Fisher Scientific, A-508-P212 or equivalent
Sulfuric acid	Fisher Scientific P/N A510-P212 or equivalent
Potassium permanganate solution	Dissolve 100 g potassium permanganate in a minimum volume of reagent water and dilute to 2000 mL with reagent water. Store the reagent at room temperature in either a plastic or glass container. This solution expires 3 months from preparation date. Fisher Scientific brand reagents or equivalent.
Sodium chloride - Hydroxylamine hydrochloride solution	Dissolve 240 g sodium chloride and 240 g hydroxylamine hydrochloride in reagent water and dilute to 2000 mL with reagent water. Store the standard at room temperature in either a plastic or glass container. Solution expires 1 month from preparation date. Fisher Scientific brand reagents or equivalent.
Potassium persulfate solution (5%)	Dissolve 100 g of potassium persulfate in reagent grade water and dilute to 2000 mL. This solution expires 3 months from the preparation date. Fisher Scientific brand reagents or equivalent.
Rinse solution	Add 48 mL concentrated hydrochloric acid to 800 mL water, add 24 mL concentrated nitric acid and dilute to 1 L with reagent water. Store in 5L Nalgene container at room temperature. The solution expires 1 week from preparation date.
Stannous Chloride	Add 140 mL concentrated hydrochloric acid and 200 grams SNCl2-2H20 to 2000 mL reagent water. Different amounts may be made based on need. Store in bottle marked "Stannous Chloride" at the instrument. Fisher Scientific brand reagents or equivalent.
Aqua Regia	Mix 3 parts concentrated hydrochloric acid with 1 part concentrated nitric acid. Use fresh daily, expires within 24 hours.

8.2 Standards

Standard	Description
Mercury Calibration Stock Solution	1000 mg/mL, NIST traceable standard. Store at room temperature. Expires as specified by manufacturer. Inorganic Ventures or equivalent.
Intermediate Working Calibration Solution[1]	50 ug/L intermediate final concentration. Mercury Calibration Intermediate Standard to be prepared every 6 months or as needed. The calibration standards are prepared using the same type of acid and reagents, at the same concentration range as the samples to be analyzed. See appendix B for composition.
ICV/CCV Mercury Stock Solution	1 ug/mL, NIST traceable standard. Must be from a separate source than the mercury calibration stock source. Spex-Certiprep or equivalent.
Low Level Mercury Calibration Stock Solution	10 mg/L, NIST traceable standard. Store at room temperature. Expires as specified by manufacturer. Inorganic Ventures or equivalent.
Low Level ICV/CCV Mercury Stock Solution	10 mg/L, NIST traceable standard. Must be from a separate source than the mercury calibration stock source. Inorganic Ventures or equivalent.
Low Level Mercury Calibration Intermediate Standard[1]	1 ug/L final concentration. Mercury Calibration Intermediate Standard to be prepared every 6 months or as needed. The calibration standards are prepared using the same type of acid and reagents, at the same concentration range as the samples to be analyzed.

	See appendix B for composition.

8.2.1 Mercury Calibration Intermediate Standard to be prepared every 6 months or as needed. The calibration standards are prepared using the same type of acid and reagents, at the same concentration range as the samples to be analyzed.

8.2.2 SW-846 series methods for mercury require that calibration standards are processed like samples including heating while EPA 245.1 specifically prohibits the calibration standards from being heated. Daily calibration records are documented in the electronic Prep Log.

9.0 PROCEDURE

9.1 Water

9.1.1 Sample Preparation

9.1.1.1 Prepare a method blank (MB) by transferring 30 mL of reagent grade water to a new 50 mL digestion cup. Label with the LIMS batch number and sample number.

9.1.1.2 Prepare a laboratory control sample (LCS) by transferring a 0.15 mL aliquot of the stock mercury standard to a 50 mL cup. For low level mercury samples, transfer 0.15 mL aliquot of the low level mercury intermediate standard. Bring the total volume to 30 mL with reagent water. Label with the LIMS batch number and sample number.

9.1.1.3 Shake sample to achieve homogeneity. Maximum sample volume is 30 mL. Use this or a smaller volume diluted to 30 mL. Place the sample into the 50 mL cup labeled with the corresponding LIMS sample number. Record sample volume in the Hg CVAA Sample Preparation Log.

9.1.1.4 Prepare an MS/MSD by transferring 0.15 mL aliquot of the stock mercury standard to 50 mL cups. For low level mercury samples, transfer 0.15 mL aliquot of the low level mercury intermediate standard. Bring the total volume of each to 30 mL with sample.

9.1.1.5 To all samples (including QC) add 1.5 mL concentrated sulfuric acid and 0.75 mL concentrated nitric acid, mixing well after each addition.

9.1.1.6 To all samples (including QC) add 5 mL potassium permanganate. If the purple color disappears, the sample is re-batched and re-prepped at a lower volume.

9.1.1.7 To all samples (including QC) add 2.5 mL of potassium persulfate solution and swirl to mix.

9.1.1.8 Loosely cap each cup and place into the digestion block, maintained at a temperature of 95°C ± 2°C and heat for two hours. Observe the initial temperature and time in the block.

9.1.1.9 After the two hour digestion, remove the samples from the block and cool. Observe the time the samples were removed from the block, as well as the final temperature of the block.

9.1.1.10 To all samples (including QC) add 1.8 mL of hydroxylamine hydrochloride to reduce the excess permanganate. The permanganate is reduced when the purple color dissipates. If the purple color does not dissipate, add additional hydroxylamine hydrochloride until the color dissipates. Note this on the preparation log and adjust in LIMS. For example: if an additional mL is needed, then add 1 mL to the final volume.

9.1.2 Documentation – Digestion Records

Record the observations and necessary information in the electronic preplog using template version F-MN-I-342-Rev.02. Information includes batch and sample ID, initial and final times, temperatures, volumes, prep date, prep analyst, supporting equipment, and lot numbers of solutions used. Also include any additional comments if needed. The initial and final times and temperatures will be representative of the elapsed time for the batch.

9.2 Solid/Semi-Solid

9.2.1 Sample Preparation

9.2.1.1 Prepare a MB by weighing 0.3 g of resin pellets in a 50 mL cup.

9.2.1.2 Prepare a LCS by weighing 0.3 g of resin pellets in a 50 mL cup and spiking with a 0.15 mL aliquot of the ICV/CCV working mercury standard.

9.2.1.3 Weigh a representative 0.3-0.36 g portion of sample in a 50 mL cup.

9.2.1.4 Weigh two additional samples for matrix spike/matrix spike duplicate (MS/MSD) and spike carefully to get these samples as close to the weight of the unspiked sample used for QC, as possible. Spike both the MS and MSD with 0.15 mL of the mercury ICV/CCV working standard.

9.2.1.5 To all samples (including QC) add 3 mL DI water.

9.2.1.6 To all samples (including QC) add 3 mL aqua regia (see 10.1 above).

9.2.1.7 Place in hot block, maintained at 95°C ± 2°C and heat for 2 minutes. Record this time and temperature as the initial start time.

9.2.1.8 Remove from hot block and allow to cool.

9.2.1.9 Bring all samples (including QC) up to a volume of 30 mL with DI water.

9.2.1.10 To all samples (including QC) add 9 mL potassium permanganate. If the purple color disappears, re-prepare the sample, MB, and LCS with less DI and the corresponding amount of potassium permanganate added so that final volume does not exceed 30 mL. Additional permanganate is noted as a comment on the prep form.

9.2.1.11 Loosely cap each cup and return samples to hot block digester, maintained at a temperature of 95°C ± 2°C and heat for 30 minutes.

9.2.1.12 Remove the samples from the block and record the final time and the temperature. Allow the samples to cool.

9.2.1.13 To all samples (including QC) add 3.6 mL of hydroxylamine hydrochloride to reduce the excess permanganate. The permanganate is reduced when the purple color dissipates. If the purple color does not dissipate, add additional hydroxylamine hydrochloride until the color dissipates. Note this on the preparation log and adjust in LIMS. For example: if an additional mL is needed, then add 1 mL to the final volume.

9.2.2 Documentation – Digestion Records

Record the necessary information in the electronic preplog using template version F-MN-I-343-Rev.03. Information includes batch and sample ID, initial and final times, temperatures, volumes, prep date, prep analyst, supporting equipment, and lot numbers of solutions used. Also include any additional comments if needed. The initial and final times and temperatures will be representative of the elapsed time for the batch.

9.3 Equipment Preparation & Analysis

9.3.1 Turn on the computer and load the software. Turn on, or 'wake up' the instrument and allow the lamp to warm up for about 90 minutes from a cold shut down (lamp off, main power off and gas off) and 5 minutes from standby (lamp off, main power on and gas off). Check the following:

9.3.2 Prepare any necessary reagents and record the appropriate information (volumes, manufacturer, lot numbers, etc.) in the standard solution log.

9.3.3 Check instrument waste and empty as needed.

9.3.4 Perform any routine maintenance as needed and record in maintenance log.

9.3.5 Check the $KMnO_4$ trap at the back of the instrument to make sure it is filled with crystalline $KMnO_4$ and not wet or spent (the brown MnO_2 color approaches the open end of the trap).

9.3.6 Fill the rinse solution container with rinse solution, if needed, and move the probe down into the rinse well.

9.3.7 Check peristaltic pump tubing installation, make sure tension is adjusted if needed, and turn pump on.

9.3.8 Place the $SnCl_2$ line in DI water.

9.3.9 Initialize the wetting of the GLS by selecting 'wet the gas liquid separator post' option in the software. This increases the gas flow to 300-350 mL/min and ramps the pump speed to 100%. Pinch the waste line tubing shut with your fingers. Watch the bubbles and ensure that 1-2 bubbles completely propels to the top of the chamber, wetting the entire post and the top. As soon as this happens, open the waste line tubing so the GLS can drain.

9.3.10 Inspect the GLS to make sure it is draining completely and liquid is not pooling.

9.3.11 Attach the sample gas line to the nafion dryer cartridge.

9.3.12 Fill the stannous chloride bottle with stannous chloride.

9.3.13 Place the $SnCl_2$ line into the $SnCl_2$ solution bottle.

9.3.14 Create a worksheet for analysis by selecting 'new from' in the file menu. Enter the name, ie 20Aug15 (DDMMMYY), a, b, c etc. (if more than one run is performed that day) soil or water to indicate sample matrix, and instrument ID number. The program will then go to the Method Editor page.

9.3.14.1 In the conditions page in the Method Editor, check the instrument settings including the time profile (baseline correction and read time delays). To do this, read a standard and move the baseline correction window and read time window accordingly if needed.

9.3.14.2 Check the Standards page to ensure the correct calibration parameters and standards are entered.

9.3.14.3 Check the QC tests page to make sure the correct test solutions and parameters are entered if the software is to calculate recoveries during analysis.

9.3.15 Create a sequence in the sequence editor tab and enter sample IDs or import them from LimsLink.

9.3.16 Start analysis, monitor all initial QC checks. If initial QC fails, make adjustments if needed and re-calibrate. If checks pass criteria, continue with sample analysis.

9.3.17 After analysis, print out a report and transfer valid data into LIMS system via LimsLink.

9.3.18 After completing sample analysis for the day, shut down the instrument.

9.3.18.1 Place the $SnCl_2$ line in 10% HNO_3 and run for ~10 minutes. After this move the probe up out of the rinse well and place the $SnCl_2$ line in DI water and run for 2-5 minutes. Remove from DI and allow the line to run dry. Turn off pump, disconnect the clamps, and loosen pump tubing.

9.3.18.2 Disconnect the sample gas line from the nafion dryer cartridge.

9.3.18.3 Turn off the gas and the lamp.

9.3.18.4 If the instrument will be used in the next day or two, leave it in the stand-by mode. If not, do a cold shut down and turn off the software, instrument, auto sampler and auto diluter.

9.4 Routine Instrument Operating Conditions

Parameter	Setting
Sample Probe Depth (mm)	145
ASX Rinse Pump Speed (%)	50
Sample Uptake Time (s)	45
Rinse Time (s)	95
Gas Flow (mL/min)	100
Pump speed (%)	50
Read Delay time (s)	55.50
Replicate read time (s)	1.50
Replicates	4

9.5 Initial Calibration

9.5.1 Calibration Design

9.5.1.1 The calibration curve must consist of a minimum of a calibration blank and five non-zero standards for each mode of analysis. Use the average of four integrations for both calibration and sample analyses. Using the instrumentation software, prepare a standard curve for each element by plotting absorbance versus concentration. The calibration is a linear regression using equation; $y = mx + b$ The analyst may employ a regression equation that does not pass through the origin, however forcing through zero is not allowed. Instruments must be calibrated at a minimum of once every 24 hours or prior to use. The instrument standardization date and time must be included in the raw data.

9.5.1.2 Additional calibration specifications may be referenced in ENV-SOP-NW-0027 *Calibration Procedures*, or equivalent replacement.

9.5.2 Calibration Sequence

Calibration Blank (CAL0)
CAL1
CAL2
CAL3
CAL4
CAL5
ICV
ICB
CRDL
CCV
CCB
Client samples
CRDL
CCV
CCB

9.5.3 ICAL Evaluation

9.5.3.1 Curve Fit

With a multi-point calibration, the regression calculation will generate a correlation coefficient (r) that is the measure of the "goodness of fit" of the regression line to the data. In order to be used for quantitative purposes, the correlation coefficient must be > 0.995.

9.5.3.2 Relative Standard Error (RSE)

%RSE is evaluated after all calibration points have been measured. In order for a standard curve to be acceptable, the %RSE acceptance criteria is 80%-120% must be observed.

Note: %RSE is analogous to %RSD. 40CFR Part 136 allow %RSE to be used in place of correlation coefficient (R) or coefficient of determination (r^2) for the acceptability determination of the curve.

9.5.3.3 Initial Calibration Verification

In addition to meeting the linearity requirement, any new calibration curve must be assessed for accuracy in the values generated. To assess the accuracy, a single standard from a secondary source must be analyzed and the results obtained must be compared to the known value of the standard. This step is referred to as Initial Calibration Verification. The ICV is analyzed immediately following an initial calibration curve.

9.5.4 Continuing Calibration Verification

A CCV followed immediately by a CCB must be analyzed after every 10 samples and at the end of the analytical batch to verify the system is still calibrated.

10.0 Data Analysis And Calculations

10.1 The percent recovery in the LCS is calculated using Equation 1:

Equation 1

$$\%\,Recovery = \frac{SR}{SA}\,\mathrm{x}100$$

Where, SR = LCS result (ug/L or mg/kg)
SA = spike added, ug/L or mg/kg

10.2 The percent recovery of mercury in the matrix spike and matrix spike duplicate is calculated using Equation 2:

Equation 2

$$\%\,Recovery = \frac{(SSR - SR)}{SA}\,\mathrm{x}100$$

Where, SSR = Spiked sample result, mg/L or mg/kg
SR = Sample result, mg/L or mg/kg
SA = Spike added, mg/L or mg/kg

10.3 Calculate the Relative Percent Difference (RPD) between the matrix spike and matrix spike duplicate using Equation 3:

Equation 3

$$\%RPD = \frac{|S - D|}{(S + D)/2}\,x100$$

Where, S = Sample result, mg/L or mg/kg
D = Duplicate sample result, mg/L or mg/kg

10.4 The corrected dry weight concentration can be calculated using the following:

$$corrected\ dry\ wt\ conc = \frac{\left(c \times \frac{v_f}{wt_i}\right)}{\%\,dry\ wt}$$

Where, c = concentration on instrument, µg/L
v_f = final volume, L
wt_i = initial weight, g

$$\%Dry\ weight = \frac{Sample\ Dry\ Weight}{Sample\ Wet\ Weight}\,\mathrm{x}100$$

11.0 Quality Control and Method Performance

11.1 Quality Control

The following QC samples are prepared and analyzed with each batch of samples. Refer to Appendix B for acceptance criteria and required corrective action.

QC Item	Frequency
Method Blank (MB)	1 per batch of 20 or fewer samples.
Laboratory Control Sample (LCS)	1 per batch of 20 or fewer samples.
Laboratory Control Sample Duplicate (LCSD)	As needed
Matrix Spike (MS)	1 per batch of 20 or fewer samples for 7470/7471. 1 per batch of 10 or fewer samples for 245.1
Matrix Spike Duplicate (MSD)	1 per batch of 20 or fewer samples.
Sample Duplicate	Performed at client request.
Serial Dilution	Performed at client request.
Post Digestion Spike	Performed at client request.
Filter Blank (FB)	1 per batch of 20 or fewer samples when applicable.

11.2 Instrument QC

The following Instrument QC checks are performed. Refer to Appendix B for acceptance criteria and required corrective action.

QC Item	Frequency
Initial Calibration	Daily
Initial Calibration Verification	Immediately after each initial calibration
Initial Calibration Blank	Immediately after each initial calibration
Continuing Calibration Verification	Prior to the analysis of any samples and after every 10 injections thereafter. Samples must be bracketed with a closing CCV standard.
Continuing Calibration Blank	Following every CCV injection
CRDL / LLCCV verification	At the beginning of each run. May be run more frequently per state or client requirement.

11.3 Method Performance

11.3.1 Method Validation

11.3.1.1 Detection Limits

Detection limits (DL) and limits of quantitation (LOQ) are established at initial method setup and verified on an on-going basis thereafter. Refer to Pace ENV corporate SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification* and to the laboratory's SOP ENV-SOP-NW-0018 *Determination of LOD and LOQ* for these procedures.

11.4 Analyst Qualifications and Training

Employees that perform any step of this procedure must have a completed Read and Acknowledgment Statement for this version of the SOP in their training record. In addition, prior to unsupervised (independent) work on any client sample, analysts that prepare or analyze samples must have successful initial demonstration of capability (IDOC) and must successfully demonstrate on-going proficiency on an annual basis. Successful means the initial and on-going DOC met criteria, documentation of the DOC is complete, and the DOC record is in the employee's training file. Refer to laboratory SOP ENV-SOP-NW-0025 *Training and Orientation Procedures* for more information.

12.0 DATA REVIEW AND CORRECTIVE ACTION

Pace Analytical®

TEST METHOD STANDARD OPERATING PROCEDURE

TITLE:	Mercury Analysis by CVAA
TEST METHOD	7470A, 7471A, 7471B, and 245.1
ISSUER:	Pace ENV – Minneapolis – MIN4

12.1 Data Review

Pace's data review process includes a series of checks performed at different stages of the analytical process by different people to ensure that SOPs were followed, the analytical record is complete and properly documented, proper corrective actions were taken for QC failure and other nonconformance(s), and that test results are reported with proper qualification.

The review steps and checks that occur as employee's complete tasks and review their own work is called primary review.

All data and results are also reviewed by an experienced peer or supervisor. Secondary review is performed to verify SOPs were followed, that calibration, instrument performance, and QC criteria were met and/or proper corrective actions were taken, qualitative ID and quantitative measurement is accurate, all manual integrations are justified and documented in accordance with the Pace ENV's SOP for manual integration, calculations are correct, the analytical record is complete and traceable, and that results are properly qualified.

A third-level review, called a completeness check, is performed by reporting or project management staff to verify the data report is not missing information and project specifications were met.

Refer to laboratory SOP ENV-SOP-MIN4-0092 *Data Review Process* for specific instructions and requirements for each step of the data review process.

12.2 Corrective Action

Corrective action is expected any time QC or sample results are not within acceptance criteria. If corrective action is not taken or was not successful, the decision/outcome must be documented in the analytical record. The primary analyst has primary responsibility for taking corrective action when QA/QC criteria are not met. Secondary data reviewers must verify that appropriate action was taken and/or that results reported with QC failure are properly qualified.

Corrective action is also required when carryover is suspected and when results are over range.

Samples analyzed after a high concentration sample must be checked for carryover and reanalyzed if carryover is suspected. Carryover is usually indicated by low concentration detects of the analyte in successive samples analyzed after the high concentration sample.

Sample results at concentrations above the upper limit of quantitation must be diluted and reanalyzed. The result in the diluted samples should be within the upper half of the calibration range. Results less than the mid-range of the calibration indicate the sample was over diluted and analysis should be repeated with a lower level of dilution. If dilution is not performed, any result reported above the upper range is considered a qualitative measurement and must be qualified as an estimated value.

Refer to Appendix B for a complete summary of QC, acceptance criteria, and recommended corrective actions for QC associated with this test method.

13.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

Pace proactively seeks ways to minimize waste generated during our work processes. Some examples of pollution prevention include but are not limited to: reduced solvent extraction, solvent capture, use of reusable cycletainers for solvent management, and real-time purchasing.

The EPA requires that laboratory waste management practice to be conducted consistent with all applicable federal and state laws and regulations. Excess reagents, samples and method process wastes must be characterized and disposed of in an acceptable manner in accordance with Pace's Chemical Hygiene Plan / Safety Manual.

14.0 Modifications

A modification is a change to a reference test method made by the laboratory. For example, changes in stoichiometry, technology, quantitation ions, reagent or solvent volumes, reducing digestion or extraction times, instrument runtimes, etc. are all examples of modifications. Refer to Pace ENV corporate SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification* for the conditions under which the procedures in test method SOPs may be modified and for the procedure and document requirements.

14.1 Use of Block Digestor- Heating is conducted with hot block digestion as the heating equivalent mentioned in SW 846 7471B (section 6.10) and SW 846 7470. This is also compliant with method 245.1 under the Clean Water Act method flexibility in 40CFR section 136.6 (b) (4) (iii).

14.2 The lab utilizes a 30 mL final volume, all solid weights and reagent ratios are conducted based on the 0.3 g versus the 0.5 g initial weight accordingly.

14.3 Mercury calibration standards are prepared and digested weekly for SW-846 analysis of soils and waters. The stability and performance of standards prepared weekly has been evaluated and documented.

15.0 Responsibilities

Pace ENV employees that perform any part this procedure in their work activities must have a signed Read and Acknowledgement Statement in their training file for this version of the SOP. The employee is responsible for following the procedures in this SOP and handling temporary departures from this SOP in accordance with Pace's policy for temporary departure.

Pace supervisors/managers are responsible for training employees on the procedures in this SOP and monitoring the implementation of this SOP in their work area.

16.0 Attachments

Appendix A – QC Summary

Appendix B – Working Standard Summary

17.0 References

Pace Quality Assurance Manual- most current version.

TEST METHOD STANDARD OPERATING PROCEDURE

TITLE:	Mercury Analysis by CVAA
TEST METHOD	7470A, 7471A, 7471B, and 245.1
ISSUER:	Pace ENV – Minneapolis – MIN4

TNI Standard, *Management and Technical Requirements for Laboratories Performing Environmental Analyses*, EL-V1-2009.

TNI Standard, *Management and Technical Requirements for Laboratories Performing Environmental Analyses*, EL-VI-2016-Rev.2.1.

Test Methods for Evaluating Water and Solid Waste, Physical/Chemical Methods, SW-846, Method 7470A, 1994.

Test Methods for Evaluating Water and Solid Waste, Physical/Chemical Methods, SW-846, Method 7471A, 1994.

Test Methods for Evaluating Water and Solid Waste, Physical/Chemical Methods, SW-846, Method 7000a, Revision 1, July 1992.

Test Methods for Evaluating Water and Solid Waste, Physical/Chemical Methods, SW-846, Method 7471B, Revision 2, Feb 2011.

Methods for Chemical Analysis of Water and Wastes, Method 245.1. Rev.3.0, 1994.

40 CFR Appendix B to Part 136, *Definition and Procedure for the Determination of the Method Detection Limit - Rev 2,* August 28, 2017.

Minnesota Pollution Control Agency, Laboratory Quality Control and Data Policies, July 2011.

18.0 REVISION HISTORY

This Version:

Section	Description of Change
Appendix A	Updated MB Acceptance Criteria and Corrective Action.

This document supersedes the following document(s):

Document Number	Title	Version
ENV-SOP-MIN4-0054	Mercury in Liquid and Solid/Semi-Solid Waste by 7470A, 7471, 7471B, and 245.1	03

Pace Analytical®

TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: Mercury Analysis by CVAA
TEST METHOD 7470A, 7471A, 7471B, and 245.1
ISSUER: Pace ENV – Minneapolis – MIN4

Appendix A: QC Summary

QC Item	Frequency	Acceptance Criteria	Corrective Action	Qualification
ICAL	Daily	r ≥ 0.995 RSE < 20%	Identify and correct source of problem, repeat.	None. Do not proceed with analysis.
ICV	After Each ICAL	± 10% for SW-846 7000 series methods and ± 5% for 245.1	Identify source of problem, re-analyze. If repeat failure, repeat ICAL. Analysis may proceed if it can be demonstrated that the ICV exceedance has no impact on analytical measurements. For example, the ICV %R is high, CCV is within criteria, and the analyte is not detected in sample(s).	Qualify analytes with ICV out of criteria.
ICB	Immediately after the initial calibration verification	Result must be less than the absolute value of the Reporting Limit (LOQ). NC requires blanks to be clean to ½ RL. WIDNR and West Virginia require samples to be reported to the MDL.	Identify source of problem, re-analyze. Analysis may proceed if it can be demonstrated that the ICB exceedance has no impact on analytical measurements. For example, the ICB has detections and the analyte is not detected in sample(s).	Qualify analytes with ICB out of criteria.
CRDL / LLCCV[4]	At the beginning of each run. Depending on data quality objectives it may be required that a CRDL bracket samples.	± 30% (or specified by the client)	Identify source of problem, re-analyze. Analysis may proceed if it can be demonstrated that the CRDL exceedance has no impact on analytical measurements. For example, the CRDL %R is high and the analyte is not detected in sample(s). For example, the CRDL %R is high and the analyte detections exceed the continuing calibrations verification level (midpoint of the curve). If the CRDL is biased low, no data can be reported for the target elements failing criteria.	Qualify outages and explain in case narrative.
CCV[5]	Daily, before sample analysis, after every 10, and at end of analytical window.	All analytes must be within ± 10% of the true value. (%R):	Identify source of problem, re-analyze. Analysis may proceed if it can be demonstrated that the CCV exceedance has no impact on analytical measurements. For example, the CCV %R is high, and the analyte is not detected in sample(s).	Qualify analytes with CCV out of criteria.

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CCB	Daily, before sample analysis, after every 10, and at end of analytical window	Result must be less than the absolute value of the Reporting Limit (LOQ). NC requires blanks to be clean to ½ RL. WIDNR and West Virginia require samples to be reported to the MDL.	Identify source of problem, re-analyze. Analysis may proceed if it can be demonstrated that the CCB exceedance has no impact on analytical measurements. For example, the CCB has detections and the analyte is not detected in sample(s).	Qualify analytes with CCB out of criteria.
Method Blank	One per 20 samples	Method 7470/7471: The method blank is considered to be acceptable if it does not contain the target analytes that exceed the LLOQ or project-specific DQOs. Method 245.1: The method blank is considered to be acceptable if it does not contain the target analytes that exceed 1/2 LLOQ or project-specific DQOs.	Identify source of problem, re-analyze. If reanalysis of the MB fails, all samples affected by the failing MB elements need to be re-digested and re-analyzed. If the method blank exceeds the criteria, but the associated samples are either below the reporting level or other DQOs, or detections in the sample are >10x MB detections then the sample data may be reported. J-flag qualification will be applied for blank detections between the LOQ and LOD when DQOs require evaluation to the MDL.	Qualify outages and explain in case narrative.
LCS	One per 20 samples	80-120% for 7470/7470A and 7471/7471B. 85-115% for 245.1.	Identify source of problem, re-analyze. If reanalysis of the LCS fails, all samples affected by the failing LCS elements need to be re-digested and re-analyzed. If LCS recovery is > QC limits and these compounds are non-detect in the associated samples	Qualify analytes with LCS out of criteria.
LCSD[1]	An LCSD must be substituted in the event of insufficient sample volume for a matrix spike duplicate sample.	80-120% for 7470/7470A and 7471/7471B. 85-115% for 245.1 % RPD ≤ 20%	Identify source of problem, re-analyze. If reanalysis of the LCS fails, all samples affected by the failing LCS elements need to be re-digested and re-analyzed. If LCS recovery is > QC limits and these compounds are non-detect in the associated samples	Qualify analytes with LCS out of criteria.
MS/MSD[2,3]	One per 20 samples for 7470/7470A and 7471/7471B. One per 10 samples for 200.8	80-120% for 7470/7470A[3] and 7471/74/1B. 245.1: 70-130% %RPD: 20%	If the percent recovery for the MS and MSD fall outside the control limits, the results are flagged that they are outside acceptance criteria along with the parent sample. If the RPD exceeds the acceptance criteria,	Qualify analytes with MS out of criteria.

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			the MSD sample and associated parent sample need to be flagged. If MS or MSD fails and spike amount is less than 4 times the native concentration in the sample, remove M1 flag and replace with P6 flag. If the RPD is outside the limit, report the data and footnote the samples with precision outliers. The footnote only applies to samples within the same batch containing the sample used for the MS and MSD analyses.	
Sample Duplicate	Per client request	%Diff ≤ 20%	Qualify outages	Qualify outages.
Serial Dilution	Per client request	Refer to project specific technical specifications.	Qualify outages	Qualify outages.
Post Digestion Spike	Per client request	Refer to project specific technical specifications.	Qualify outages	Qualify outages.
Laboratory Filter Blank (FB)	Analyzed only with batches of lab filtered dissolved metals, one per batch of 20 or less.	Result must be less than the absolute value of the Reporting Limit (LOQ). NC requires blanks to be clean to ½ RL.	Identify source of problem, re-analyze. If reanalysis of the MB fails, all samples affected by the failing MB elements need to be re-digested and re-analyzed. If sample(s) non-detect, report the data. If sample result >10x FB detections, report the data.	Qualify outages and explain in case narrative.

[1]WIDNR requires the use of a lab created matrix solution from unused samples.

[2]In the event that only samples identified as Equipment Blanks and/or Field Blanks are available, and LCS/LCSD will be prepared in place of MS/MSD.

[3]In the absence of method specified recovery limits, results will be evaluated based on specifications outlined by the MPCA guidelines for Inorganic Analysis.

[4]A reporting limit verification is performed by analyzing a CRDL at ± 30% while the method has no low end criteria.

[5] ICV/CCV criteria is ± 10% while the 7000 series indicates ± 20%, the tighter criteria is applied to allow for instrumentation to be utilized for any mercury method throughout an analytical shift.

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Appendix B: Working Standard Summary

Standard	Standard(s) Used	Standard(s) Amount (mL)	Solvent	Solvent Volume (mL)	Final Total Volume (mL)	Final Concentration (µg/L)
Mercury Calibration Intermediate.	Mercury Stock (10 ug/mL)	5	Reagent water	985	1000	50
	Concentrated nitric acid	10				
Standard 0	Intermediate Standard (50 µg/L)	0	Reagent water	30	30	0
Standard 1		0.12		29.88		0.2
Standard 2		0.6		29.4		1.0
Standard 3		1.8		28.2		3.0
Standard 4		3.0		27		5.0
Standard 5		6.0		24		10
CRDL		0.12		29.88		0.2
ICV/CCV	Mercury Stock 1000 mg/mL	0.15	Reagent water	29.85	30	5.0
ICB/CCB	N/A	N/A	Reagent water	30	30	0
Low Level Mercury Calibration Intermediate Standard; Prepare every 6 months.	Calibration Mercury Stock (10 mg/L)	0.100	Reagent water	984.9	1000	1.0
	Concentrated nitric acid	5.0				
	Concentrated hydrochloric acid	10				
Standard 0	Intermediate Standard (1.0 µg/L)	0	Reagent Water	30	30	0
Standard 1		0.30		29.7		0.010
Standard 2		0.75		29.25		0.025
Standard 3		1.5		28.5		0.050
Standard 4		3.0		27		0.100
Standard 5		6.0		24		0.200
CRDL		0.30		29.7		0.01
Low Level Mercury ICV/CCV **Intermediate** Standard. Prepare every 6 months	ICV/CCV Mercury Stock (10 mg/L)	0.4	Reagent water	184.6	200	20
	Concentrated nitric acid	5.0				
	Concentrated hydrochloric acid	10				
Low Level Mercury ICV/CCV	Low Level Mercury ICV/CCV Intermediate (75 µg/L)	0.15	Reagent water	29.85	30	0.10
Lower Level Mercury ICB/CCB	N/A	N/A	Reagent water	30	30	0

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ENVIRONMENTAL SCIENCES

Document Information

Document Number: ENV-SOP-MIN4-0104 **Revision:** 02

Document Title: Fluoride in Aqueous Samples by SM 4500-F-C

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All Dates and Times are listed in: Central Time Zone

Signature Manifest

Document Number: ENV-SOP-MIN4-0104 **Revision:** 02

Title: Fluoride in Aqueous Samples by SM 4500-F-C

All dates and times are in Central Time Zone.

ENV-SOP-MIN4-0104 - Fluoride

QM Approval

Name/Signature	Title	Date	Meaning/Reason
Janielle Ward (007319)	Manager - Quality	08 Jun 2020, 01:32:22 PM	Approved

Management Approval

Name/Signature	Title	Date	Meaning/Reason
Krista Carlson (004514)	Project Coordinator 1	02 Jun 2020, 12:21:52 PM	Approved
Andrew Mickelson (009792)	Manager	09 Jun 2020, 10:33:30 AM	Approved
Adam Haugerud (005828)	General Manager 2	29 Jun 2020, 09:03:18 AM	Approved

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TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: Fluoride in Aqueous Samples by SM 4500 F-C
TEST METHOD SM 4500 F-C
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1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure is to determine the concentration of of fluoride in water and wastewaters as delineated in Standard Method 4500 F-C.

1.1 **Target Analyte**

Analyte	Matrix (units)	LOQ
Fluoride	Water (mg/L)	0.1

All current MDLs are listed in the LIMS and are available by request from the Quality Manager.

LOQ are established in accordance with Pace policy and SOPs for method validation and for the determination of detection limits (DL) and quantitation limits (LOQ). DL and LOQ are routinely verified and updated when needed.

1.2 **Applicable Matrices:** This SOP is applicable to water and wastewater.

1.3 **Personnel:** The policies and procedures contained in this SOP are applicable to all personnel involved in the analytical method.

1.4 **Parameters:** This SOP determines fluoride in the range of 0.1 to 10 mg/L. The fluoride electrode is nonlinear below 0.1 mg/L. Samples at a concentration greater than 10.0 mg/L are diluted.

2.0 SUMMARY OF METHOD

Fluoride is determined potentiometrically using a fluoride ion-selective electrode and a meter.

3.0 INTERFERENCES

Extremes of pH interfere. Sample pH should be between 5.0 and 9.0. Polyvalent cations of Si+4, Fe+3 and Al+3 interfere by forming complexes with fluoride. The degree of interference depends upon the concentration of the complexing cations, the concentration of fluoride and the pH of the sample. The addition of TISAB II containing a strong chelating agent complexes the interfering cations and eliminates the pH problem.

4.0 DEFINITIONS

Refer to the Laboratory Quality Manual for a glossary of common lab terms and definitions.

5.0 HEALTH AND SAFETY

The toxicity or carcinogenicity of each chemical material used in the laboratory has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable.

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The laboratory maintains documentation of hazard assessments and OSHA regulations regarding the safe handling of the chemicals specified in each method. Safety data sheets for all hazardous chemicals are available to all personnel. Employees must abide by the health, safety and environmental (HSE) policies and procedures specified in this SOP and in the Pace Chemical Hygiene / Safety Manual.

Personal protective equipment (PPE) such as safety glasses, gloves, and a laboratory coat must be worn in designated areas and while handling samples and chemical materials to protect against physical contact with samples that contain potentially hazardous chemicals and exposure to chemical materials used in the procedure.

Concentrated corrosives present additional hazards and are damaging to skin and mucus membranes. Use these acids in a fume hood whenever possible with additional PPE designed for handing these materials. If eye or skin contact occurs, flush with large volumes of water. When working with acids, always add acid to water to prevent violent reactions. Any processes that emit large volumes of solvents (evaporation/concentration processes) must be in a hood or apparatus that prevents employee exposure.

Contact your supervisor or local HSE coordinator with questions or concerns regarding safety protocol or safe handling procedures for this procedure.

6.0 SAMPLE COLLECTION, PRESERVATION, HOLDING TIME, AND STORAGE

Samples should be collected in accordance with a sampling plan and procedures appropriate to achieve the regulatory, scientific, and data quality objectives for the project.

The laboratory does not perform sample collection or field measurements for this test method. To assure sample collection and field checks and treatment are performed in accordance with applicable regulations Pace project managers will inform the client of these requirements at the time of request for analytical services when the request for testing is received prior to sample collection. If samples were already collected, the laboratory will record any nonconformance to these requirements in the laboratory's sample receipt record when sufficient information about sample collection is provided with the samples.

The laboratory will provide containers for the collection of samples upon client request for analytical services. Bottle kits are prepared in accordance with laboratory ENV-SOP-MIN4-0009 *Bottle Preparation* (most recent revision or replacement).

Requirements for container type, preservation, and field quality control (QC) for the common list of test methods offered by Pace are included in the laboratory's quality manual.

General Requirements

Matrix	Routine Container	Minimum Sample Amount[1]	Preservation	Holding Time
Aqueous	Glass or polyethylene bottles	25 mL	Thermal: ≤6° Celsius Chemical: N/A	28 days

[1]*Minimum amount needed for each discrete analysis.*

Thermal preservation is checked and recorded on receipt in the laboratory in accordance with laboratory SOP ENV-SOP-MIN4-0008 *Sample Management* (most recent revision or replacement).

After receipt, samples are stored at ≤6°C until sample preparation.

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7.0 Equipment And Supplies

7.1 Equipment

Equipment	Description
778 Autotitrator system with 888 Titrando Dosing unit	Metrohm Autotitrator System
814 Autotitrator system with 905 Titrando Dosing unit	Metrohm Autotitrator System
Fluoride Ion-Selective Electrode (ISE)	Metrohm part #6.0502.150
ISE Reference Electrode	Metrohm part #6.0750.100

7.2 Supplies

Supply	Description
Transfer Pipettes	Disposable, polyethylene; Fisher part #13-711-9AM or equivalent
pH Strips	pH range 0-14; Fisher part #13-640-520 or equivalent
75 mL sample vessel	Metrohm part #6.1432.210
Magnetic Stir Bars	Fisher part #16-800-508, or equivalent
Volumetric Glassware	Class A; Fisher Scientific or equivalent

8.0 Reagents And Standards

8.1 Reagents

Reagent	Description
E-pure DI water	ASTM Type II - See ENV-SOP-MIN4-0090 Reagent Water Quality, or equivalent replacement
TISAB II Buffer	Purchase pre-made. Store at room temperature. Expires per manufacturer's specifications. Fisher part #13-642-578, or equivalent

8.2 Standards

Standard	Concentration/ Description
Fluoride Calibration Stock Standard	1000 mg F^-/L Purchase premade. Store at room temperature. Expires per manufacturer's specifications. ERA part #989
Fluoride QC Stock Standard	1000 mg F^-/L Purchase premade. Store at room temperature. Expires per manufacturer's specifications. Inorganic Ventures part #ICF1-1

8.2.1 Working Standard Dilutions and Concentrations

Solution	Standard(s) Used	Standard(s) Amount	Solvent	Final Solution Volume	Final Concentration
CAL0	N/A	N/A	DI Water	100 mL	0 mg F^-/L
CAL1	CAL3	1.0 mL	DI Water	100 mL	0.1 mg F^-/L
CAL2	Calibration Stock	0.5 mL	DI Water	100 mL	5.0 mg F^-/L
CAL3	Calibration Stock	1.0 mL	DI Water	100 mL	10.0 mg F^-/L
ICV/CCV Solution	QC Stock	0.5 mL	DI Water	100 mL	5.0 mg F^-/L

8.2.1.1 Prepare each working standard by spiking the respective standard amount in approximately 50 mL of DI water in a 100 mL volumetric flask and bringing up to volume. All standards must be stored at room temperature in a glass container. All standards expire in 28 days or at the manufacturer's specified expiration date for the stock standard, whichever is sooner.

9.0 PROCEDURE

9.1 Equipment Preparation

9.1.1 Prior to analysis, the fluoride ISE electrode should be preconditioned in DI water for approximately 30 minutes.

9.2 Calibration Design

9.2.1 The calibration curve must consist of three calibration standards. Using the instrumentation software, prepare a standard curve for each element by electrode potential versus fluoride concentration. The calibration is logarithmic. Instruments must be calibrated daily prior to analysis of any samples.

9.2.2 Additional calibration specifications may be referenced in ENV-SOP-NW-0027 *Calibration Procedures*, or equivalent replacement.

9.3 Calibration Procedure

9.3.1 Standard Locations

Standard	Location (Vessel Number)
0.1 mg/L Fluoride (CAL 1)	3
5.0 mg/L Fluoride (CAL 2)	4
10.0 mg/L Fluoride (CAL 3)	5
ICV/CCV	21
ICB/CCB	2
DI Water Rinse	22, 23, 24

9.3.1.1 Calibration standards, rinses and verification standards should be loaded as detailed in table 9.3.1. All standards should be prepared as detailed in section 9.4. Rinse sample vessels should be full enough to fully submerge both probes.

9.4 Sample Prep

9.4.1 Allow samples to warm to room temperature.

9.4.2 Use a clean volumetric pipette to transfer 10 mL of sample or working standard to a 75 mL sample vessel with a stir bar.

9.4.3 Use a clean volumetric pipette to transfer 10 mL of TISAB II to each vessel containing sample or standard.

9.4.4 pH Check: After analysis is complete, dip a pH strip in the sample beaker containing the mixture of sample and TISAB II. Shake excess sample off the strip, measure the result using the pH strip box and record in the electronic prep log. The pH should be within 5 to 9.

9.4.5 If the pH is outside 5 to 9, qualify the reported data as being outside the pH range.

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9.5 **Sample Analysis**

9.5.1 In the Tiamo software, in the workspace page, click the button that says “Sample Table”

9.5.1.1 In the prompt that opens, select the “Fluoride” template and click “Load”.

9.5.2 In the column labeled ID1, scan sample IDs from batch worklist, making sure to start after the ICV and ICB pair. Also be sure to include a CCV and CCB pair after every 10 samples.

9.5.3 Click the “Start” button in the upper left hand corner. Once samples have been analyzed, the sample cup may be rinsed and the next sample to occupy that container may be loaded.

9.6 **Reporting Data**

9.6.1 All samples with a concentration greater than the highest calibration standard must be diluted within range.

9.6.2 If a sample is more negative than the equivalent of the reporting limit, the sample should be diluted to remove interferences. If the sample has an MS/MSD associated with it, and the spike did not recover, then the MS/MSD should be diluted and post spiked.

9.6.3 Record the necessary traceability information in form L-124 WET Chemistry Batch Traceability Sheet. Information includes batch, analyst, analysis date, and lot numbers of solutions and consumables used.

10.0 DATA ANALYSIS AND CALCULATIONS

10.1 **Calculations**

See the laboratory SOP ENV-SOP-MIN4-0171 *Laboratory Calculations*, or equivalent replacement, for equations for common calculations.

10.1.1 **LCS and MS/MSD % Recovery:**

$$\%\,\mathrm{Recovery} = \frac{SS - PS}{SA} \times 100$$

Where, SS = Spiked Sample result, mg/L
PS = Parent Sample result, mg/L (only applicable to MS/MSD, LCS = 0)
SA = Spike Added from spiking standard, mg/L

10.1.2 **Relative Percent Difference (RPD):**

$$RPD = \frac{|PS - Dup|}{(PS + Dup)/2} \times 100$$

Where, PS = Parent Sample result
Dup = Duplicate sample result

11.0 QUALITY CONTROL AND METHOD PERFORMANCE

11.1 Quality Control

The following QC samples are prepared and analyzed with each batch of samples. Refer to Appendix A for acceptance criteria and required corrective action.

QC Item	Frequency
Method Blank (MB)	1 per batch of 20 or fewer samples.
Laboratory Control Sample (LCS)	1 per batch of 20 or fewer samples.
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	A pair of MS/MSD must be analyzed once every ten samples or once per batch, whichever is more frequent.

11.2 Instrument QC

The following Instrument QC checks are performed. Refer to Appendix A for acceptance criteria and required corrective action.

QC Item	Frequency
Initial Calibration	Daily
Initial Calibration Verification	Immediately after each initial calibration
Initial Calibration Blank	Immediately after each initial calibration
Continuing Calibration Verification	Prior to the analysis of any samples and after every 10 injections thereafter. Samples must be bracketed with a closing CCV standard.
Continuing Calibration Blank	Following every CCV injection

11.3 Method Performance

11.3.1 Method Validation

11.3.1.1 Detection Limits

Detection limits (DL) and limits of quantitation (LOQ) are established at initial method setup and verified on an on-going basis thereafter. Refer to Pace ENV corporate SOP ENV-SOP-CORQ-0011 Method Validation and Instrument Verification and to the laboratory's SOP ENV-SOP-NW-0018 *Determination of LOD and LOQ* for these procedures.

11.4 Analyst Qualifications and Training

Employees that perform any step of this procedure must have a completed Read and Acknowledgment Statement for this version of the SOP in their training record. In addition, prior to unsupervised (independent) work on any client sample, analysts that prepare or analyze samples must have successful initial demonstration of capability (IDOC) and must successfully demonstrate on-going proficiency on an annual basis. Successful means the initial and on-going DOC met criteria, documentation of the DOC is complete, and the DOC record is in the employee's training file. Refer to laboratory SOP ENV-SOP-NW-0025 *Training and Orientation Procedures* for more information.

12.0 DATA REVIEW AND CORRECTIVE ACTION

12.1 Data Review

Pace's data review process includes a series of checks performed at different stages of the analytical process by different people to ensure that SOPs were followed, the analytical record is complete and properly documented, proper corrective actions were taken for QC failure and other nonconformance(s), and that test results are reported with proper qualification.

The review steps and checks that occur as employee's complete tasks and review their own work is called primary review.

All data and results are also reviewed by an experienced peer or supervisor. Secondary review is performed to verify SOPs were followed, that calibration, instrument performance, and QC criteria were met and/or proper corrective actions were taken, qualitative ID and quantitative measurement is accurate, all manual integrations are justified and documented in accordance with the Pace ENV's SOP for manual integration, calculations are correct, the analytical record is complete and traceable, and that results are properly qualified.

A third-level review, called a completeness check, is performed by reporting or project management staff to verify the data report is not missing information and project specifications were met.

Refer to laboratory SOP ENV-SOP-MIN4-0092 *Data Review Process* for specific instructions and requirements for each step of the data review process.

12.2 **Corrective Action**

Corrective action is expected any time QC or sample results are not within acceptance criteria. If corrective action is not taken or was not successful, the decision/outcome must be documented in the analytical record. The primary analyst has primary responsibility for taking corrective action when QA/QC criteria are not met. Secondary data reviewers must verify that appropriate action was taken and/or that results reported with QC failure are properly qualified.

Corrective action is also required when carryover is suspected and when results are over range.

Samples analyzed after a high concentration sample must be checked for carryover and reanalyzed if carryover is suspected. Carryover is usually indicated by low concentration detects of the analyte in successive samples analyzed after the high concentration sample.

Sample results at concentrations above the upper limit of quantitation must be diluted and reanalyzed. The result in the diluted samples should be within the upper half of the calibration range. Results less than the mid-range of the calibration indicate the sample was over diluted and analysis should be repeated with a lower level of dilution. If dilution is not performed, any result reported above the upper range is considered a qualitative measurement and must be qualified as an estimated value.

13.0 Pollution Prevention And Waste Management

Pace proactively seeks ways to minimize waste generated during our work processes. Some examples of pollution prevention include but are not limited to: reduced solvent extraction, solvent capture, use of reusable cycletainers for solvent management, and real-time purchasing.

The EPA requires that laboratory waste management practice to be conducted consistent with all applicable federal and state laws and regulations. Excess reagents, samples and method process

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wastes must be characterized and disposed of in an acceptable manner in accordance with Pace's Chemical Hygiene Plan / Safety Manual.

14.0 Modifications

Not applicable to this SOP

15.0 Responsibilities

Pace ENV employees that perform any part this procedure in their work activities must have a signed Read and Acknowledgement Statement in their training file for this version of the SOP. The employee is responsible for following the procedures in this SOP and handling temporary departures from this SOP in accordance with Pace's policy for temporary departure.

Pace supervisors/managers are responsible for training employees on the procedures in this SOP and monitoring the implementation of this SOP in their work area.

16.0 Attachments

Appendix A – QC Summary

17.0 References

Pace Quality Assurance Manual- most current version.

TNI Standard, Management and Technical Requirements for Laboratories Performing Environmental Analyses, EL-V1-2009.

TNI Standard, *Management and Technical Requirements for Laboratories Performing Environmental Analyses*, EL-VI-2016-Rev.2.1.

Standard Methods for the Examination of Water and Wastewater, 4500-F C (1997, 2011).

40 CFR Appendix B to Part 136, Definition and Procedure for the Determination of the Method Detection Limit - Rev 2, August 28, 2017.

18.0 Revision History

This Version:

Section	Description of Change
All	Updated to new template, updated equations.
9.2.2	Added section for Calibration SOP reference.
9.2, 9.4	Updated to auto-titrator procedure

This document supersedes the following document(s):

Document Number	Title	Version
ENV-SOP-MIN4-0104	Fluoride in Aqueous Samples by SM 4500 F-C	01

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Appendix A: QC Summary

QC Item	Frequency	Acceptance Criteria	Corrective Action	Qualification
ICAL	Daily	Slope > 47.3 mV Low Level %RE 60-140% Each Additional Calibration Level %RE 90-110%	Identify and correct source of problem, repeat.	None. Do not proceed with analysis.
ICV	After Each ICAL	90-110% of the true value	Identify source of problem, re-analyze. If repeat failure, repeat ICAL.	None. Do not proceed with analysis.
ICB	Immediately after the initial calibration verification	Result must be less than the absolute value of the Reporting Limit (LOQ).	Identify source of problem, re-analyze. If repeat failure, repeat ICAL.	None. Do not proceed with analysis.
CCV	Daily, before sample analysis, after every 10, and at end of analytical window.	All analytes must be within ± 10% of the true value.	Identify source of problem, re-analyze. Analysis may proceed if it can be demonstrated that the CCV exceedance has no impact on analytical measurements. For example, the CCV %R is high, and the analyte is not detected in sample(s).	Qualify analytes with CCV out of criteria.
CCB	Daily, before sample analysis, after every 10, and at end of analytical window	Result must be less than the absolute value of the Reporting Limit (LOQ). Per QAPP or client specifications, alternate criteria such as evaluating to ½ RL may apply.	Identify source of problem, re-analyze. Analysis may proceed if it can be demonstrated that the CCB exceedance has no impact on analytical measurements. For example, the CCB has detections and the analyte is not detected in sample(s).	Qualify analytes with CCB out of criteria.
Method Blank	One per 20 samples	Result must be less than the absolute value of the Reporting Limit (LOQ). Per QAPP or client specifications, alternate criteria such as evaluating to ½ RL may apply.	Identify source of problem, re-analyze. If reanalysis of the MB fails, all samples affected by the failing MB elements need to be re-analyzed. If sample(s) non-detect, report the data. If sample result >10x MB detections, report the data	Qualify outages and explain in case narrative.
LCS	One per 20 samples	90-110% of the true value	Identify source of problem, re-analyze. If reanalysis of the LCS fails, all samples affected by the failing LCS elements need to be re-analyzed. If LCS recovery is > QC limits and these compounds are non-detect in the associated samples, report the data.	Qualify analytes with LCS out of criteria.
MS/MSD	A pair of MS/MSD must be analyzed once every ten samples or once per batch, whichever is more frequent.	80-120% of the true value RPD ≤ 20%	If the MS recovery is not within the criteria, and the LCS is shown to be in control, the recovery problem is judged to be matrix related and the results may be accepted. If the concentration of matrix spike is less than 25% of the background concentration of the matrix, the matrix spike recovery should not be calculated.	Qualify analytes with MS/MSD out of criteria.

Document Information

Document Number: ENV-SOP-MIN4-0113 **Revision:** 01

Document Title: Nitrate/Nitrite in Aqueous Samples by SM 4500-NO3-H

Department(s): Wet Chemistry

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Notes

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ENV-SOP-MIN4-0113 - nitrate/nitrite

QM Approval

Name/Signature	Title	Date	Meaning/Reason
Janielle Ward (007319)	Manager - Quality	28 Apr 2020, 12:36:57 PM	Approved

Management Approval

Name/Signature	Title	Date	Meaning/Reason
Krista Carlson (004514)	Project Coordinator 1	27 Apr 2020, 04:05:26 PM	Approved
Adam Haugerud (005828)	General Manager 2	19 May 2020, 03:52:36 PM	Approved
Andrew Mickelson (009792)	Manager	16 Jun 2020, 11:22:04 AM	Approved

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TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: Nitrate/Nitrite in Aqueous Samples
TEST METHOD SM 4500-NO3-H
ISSUER: Pace ENV – Minneapolis – MIN4

1.0 Scope And Application

The purpose of this standard operating procedure is to determine the concentration of nitrate (NO_3^{-1}) alone, nitrite (NO_2^{-1}) alone, or nitrate plus nitrite (this sum is known as total oxidized nitrogen) in potable and surface waters, domestic and industrial wastewater and saline waters as delineated in SM4500-NO3 H.

1.1 **Target Analyte**

Analyte	Matrix (units)	LOQ
NO_3+NO_2	Water (mg/L)	0.2

All current MDLs are listed in the LIMS and are available by request from the Quality Manager.

LOQ are established in accordance with Pace policy and SOPs for method validation and for the determination of detection limits (DL) and quantitation limits (LOQ). DL and LOQ are routinely verified and updated when needed.

1.2 **Applicable Matrices:** This SOP is applicable to potable and surface waters, domestic and industrial wastewater, and saline waters.

1.3 **Personnel:** The policies and procedures contained in this SOP are applicable to all personnel involved in the analytical method or non-analytical process.

1.4 **Parameters:** This SOP applies to nitrate (NO_3) alone or nitrate plus nitrite (this sum is known as total oxidized nitrogen).

2.0 Summary of Method

Nitrate is reduced to nitrite with hydrazine sulfate. Nitrite ions produced and those originally present are determined by diazotization with sulfanilamide and coupling with N-(naphthyl)-ethylenediamine dihydrochloride to form a highly colored azo dye, which is measured colorimetrically at 550 nm. If nitrate (NO_3) results are needed an unpreserved aliquot should be analyzed for nitrite (NO_2) by SM4500NO2-B. Nitrate concentrations are determined by subtracting the nitrite concentration from the combined NO3 + NO2 ions present.

3.0 Interferences

3.1 Sample color that absorbs in the photometric range used for analysis will interfere. The presence of sulfide ions in solution can interfere.

3.2 Turbid samples should be filtered prior to analysis. Suspended particles should also be removed by filtration. Note: If this is done, you must also filter the MB and LCS.

3.3 Concentrations of sulfide ion <10 mg/L can cause variations up to ±10%.

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TEST METHOD STANDARD OPERATING PROCEDURE

TITLE:	Nitrate/Nitrite in Aqueous Samples
TEST METHOD	SM 4500-NO3-H
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4.0 DEFINITIONS

Refer to the Laboratory Quality Manual for a glossary of common lab terms and definitions.

5.0 HEALTH AND SAFETY

The toxicity or carcinogenicity of each chemical material used in the laboratory has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable.

The laboratory maintains documentation of hazard assessments and OSHA regulations regarding the safe handling of the chemicals specified in each method. Safety data sheets for all hazardous chemicals are available to all personnel. Employees must abide by the health, safety and environmental (HSE) policies and procedures specified in this SOP and in the Pace Chemical Hygiene / Safety Manual.

Personal protective equipment (PPE) such as safety glasses, gloves, and a laboratory coat must be worn in designated areas and while handling samples and chemical materials to protect against physical contact with samples that contain potentially hazardous chemicals and exposure to chemical materials used in the procedure.

Concentrated corrosives present additional hazards and are damaging to skin and mucus membranes. Use these acids in a fume hood whenever possible with additional PPE designed for handing these materials. If eye or skin contact occurs, flush with large volumes of water. When working with acids, always add acid to water to prevent violent reactions. Any processes that emit large volumes of solvents (evaporation/concentration processes) must be in a hood or apparatus that prevents employee exposure.

Contact your supervisor or local HSE coordinator with questions or concerns regarding safety protocol or safe handling procedures for this procedure.

6.0 SAMPLE COLLECTION, PRESERVATION, HOLDING TIME, AND STORAGE

Samples should be collected in accordance with a sampling plan and procedures appropriate to achieve the regulatory, scientific, and data quality objectives for the project.

The laboratory does not perform sample collection or field measurements for this test method. To assure sample collection and field checks and treatment are performed in accordance with applicable regulations Pace project managers will inform the client of these requirements at the time of request for analytical services when the request for testing is received prior to sample collection. If samples were already collected, the laboratory will record any nonconformance to these requirements in the laboratory's sample receipt record when sufficient information about sample collection is provided with the samples.

The laboratory will provide containers for the collection of samples upon client request for analytical services. Bottle kits are prepared in accordance with laboratory ENV-SOP-MIN4-0009 *Bottle Preparation* (most recent revision or replacement).

Requirements for container type, preservation, and field quality control (QC) for the common list of test methods offered by Pace are included in the laboratory's quality manual.

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TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: Nitrate/Nitrite in Aqueous Samples
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ISSUER: Pace ENV – Minneapolis – MIN4

General Requirements

Matrix	Routine Container	Minimum Sample Amount[1]	Preservation	Holding Time
Aqueous	Glass or polyethylene bottles	25 mL	Thermal: ≤6° Celsius Chemical: pH < 2	28 days

[1]*Minimum amount needed for each discrete analysis.*

Thermal preservation is checked and recorded on receipt in the laboratory in accordance with laboratory SOP ENV-SOP-MIN4-0008 *Sample Management* (most recent revision or replacement).

After receipt, samples are stored at ≤6°C until sample preparation.

7.0 Equipment And Supplies

7.1 Equipment

Equipment	Description
Westco SmartChem Analyzer	SmartChem 200
Analytical balance	Capable of reading to the 0.0001g

8.0 Reagents And Standards

8.1 Reagents

Reagent	Description
E-pure DI water	ASTM Type II - See ENV-SOP-MIN4-0090 *Reagent Water Quality*, or equivalent replacement
Phosphoric acid (H_3PO_4)	85% Store at room temperature. Expires per manufacturer's specifications. Fisher part # A242-1, or equivalent
Sulfanilamide ($H_2NC_6H_2SO_2NH_2$)	Granular Store at room temperature. Expires per manufacturer's specifications. Fisher part # RDCS1160-100B1, or equivalent
N(1-naphthyl) ethylenediamine-dihydrochloride (NED)	98+% Store at room temperature. Expires per manufacturer's specifications. Fisher part # AC42399-0250, or equivalent
Copper Sulfate ($CuSO_4 \cdot 5H_2O$)	Fine crystals Store at room temperature. Expires per manufacturer's specifications. Fisher part # C493-500, or equivalent
Hydrazine Sulfate ($NH_2NH_2 \cdot H_2SO_4$)	Powder Store at room temperature. Expires per manufacturer's specifications. Hach part # 74226, or equivalent
Sodium Hydroxide	Pellets Store at room temperature. Expires per manufacturer's specifications. Fisher part # S318-500, or equivalent
Probe Rinse Solution	Store at room temperature. Expires per manufacturer's specifications. Westco part # 3AS-RN00-21
Cuvette Cleaning Solution	Store at room temperature. Expires per manufacturer's specifications. Westco part # 3AS-RN00-20

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TEST METHOD STANDARD OPERATING PROCEDURE
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8.1.1 **Working Reagents**

Solution	Reagent(s) Used	Reagent(s) Amount	Solvent	Final Solution Volume	Final Concentration
Nitrate Color Reagent	Phosphoric Acid	50 mL	DI Water	250 mL	N/A
	Sulfanilamide	2.5 g			
	N(1-naphthyl) ethylenediamine-dihydrochloride	0.2 g			
	Probe Rinse Solution	2.0 mL			
Copper Sulfate Stock Solution	Copper Sulfate ($CuSO_4 \cdot 5H_2O$)	0.25 g	DI Water	100 mL	N/A
Hydrazine Sulfate Stock Solution	Hydrazine Sulfate ($NH_2NH_2 \cdot H_2SO_4$)	2.75 g	DI Water	100 mL	N/A
Working Hydrazine Reagent	Hydrazine Sulfate Stock Solution	4.4 mL	DI Water	100 mL	N/A
	Probe Rinse Solution	1.0 mL			
Working Copper Sulfate Reagent	Copper Sulfate Stock Solution	2.0 mL	DI Water	100 mL	N/A
	Probe Rinse Solution	1.0 mL			
0.25 N Sodium Hydroxide	Sodium Hydroxide	10.0 g	DI Water	1 L	0.25 N
Probe Rinse Working Solution	Probe Rinse Solution	1 mL	DI Water	1 L	N/A
Cuvette Cleaning Working Solution	Cuvette Cleaning Solution	30 mL	DI Water	2 L	N/A

8.1.1 Nitrate Color Reagent: To approximately 150 mL of DI water, add 50 mL phosphoric acid. Allow to cool to room temp and add 2.5 g sulfanilamide. Then add 0.2 g NED and allow to dissolve. Add 2.0 mL Probe Rinse Solution. Dilute the solution to 250 mL with distilled water and invert to mix. Store in a tightly capped amber glass bottle in refrigerator. Expires in one month.

8.1.2 Hydrazine Sulfate Stock Solution: To approximately 50 mL of DI water, add 2.75 g hydrazine sulfate and allow to dissolve. Dilute the solution to 100 mL with distilled water and invert to mix. Store in tightly capped amber glass bottles. Expires in six months.

8.1.3 Copper Sulfate Stock Solution: To approximately 50 mL of DI water, add 0.25 g copper sulfate and allow to dissolve. Dilute the solution to 100 mL with distilled water and invert to mix. Store in tightly capped amber glass bottles. Expires in six months.

8.1.4 Working Hydrazine Reagent: To approximately 50 mL of DI water, add 4.4 mL of Hydrazine Sulfate Stock Solution and 1.0 mL Probe Rinse Solution. Dilute the solution to 100 mL with distilled water and invert to mix. Store in tightly capped amber glass bottles. Expires in six months.

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8.1.5 Working Copper Sulfate Reagent: To approximately 50 mL of DI water, add 2.0 mL of Copper Sulfate Stock Solution and 1.0 mL Probe Rinse Solution. Dilute the solution to 100 mL with distilled water and invert to mix. Store in tightly capped amber glass bottles. Expires in six months.

8.1.6 Sodium Hydroxide Reagent: Dissolve 10.0 g of sodium hydroxide in approximately 800 mL of DI water. Allow solution to cool and dilute to 1L with DI water and invert to mix. Store in a tightly capped amber glass bottle. Expires in six months.

8.2 Standards

Standard	Concentration/ Description
Nitrate Calibration Stock Standard	1000 mg NO_3-N/L Purchase premade. Store at room temperature. Expires per manufacturer's specifications. ERA part # 991
Nitrate QC Stock Standard	1000 mg NO_3-N/L Purchase premade. Store at room temperature. Expires per manufacturer's specifications. Inorganic Ventures part # ICNNO31
Nitrite QC Stock Standard	1000 mg NO_2-N/L Purchase premade. Store at room temperature. Expires per manufacturer's specifications. Inorganic Ventures part # ICNNO21

8.2.1 Working Standard Dilutions and Concentrations

Solution	Standard(s) Used	Standard(s) Amount	Solvent	Final Solution Volume	Final Concentration
NO_3 Calibration Solution	Nitrate Calibration Stock Solution	0.5 mL	DI Water	100 mL	5.0 mg NO_3/L
NO_3 CCV Solution	Nitrate QC Stock Solution	0.25 mL	DI Water	100 mL	2.5 mg NO_3/L
NO2 Efficiency Check	Nitrite QC Stock Solution	0.25 mL	DI Water	100 mL	2.5 mg NO_2/L

NO3 Calibration Solution: Add 50 mL of DI water to a 100 mL Class A Graduate Cylinder. Add 0.5 mL of Nitrate Calibration Stock Solution. Dilute to the mark and mix. Prepare fresh daily. The calibration curve solution is loaded onto the instrument and all calibration standards are prepared by the automated instrument at the following concentrations using a matrix matched diluent:

CAL0	0 mg/L
CAL1	0.05 mg/L
CAL2	0.10 mg/L
CAL3	0.25 mg/L
CAL4	1.00 mg/L
CAL5	2.00 mg/L
CAL6	3.50 mg/L
CAL7	5.00 mg/L

8.2.1.1 NO3 CCV Solution: Add 50 mL of DI water to a 100 mL Class A Graduate Cylinder. Add 0.25 mL of Nitrate QC Stock Solution. Dilute to the mark and mix. Prepare fresh daily.

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8.2.1.2 NO2 Efficiency Check: Add 50 mL of DI water to a 100 mL Class A Graduate Cylinder. Add 0.5 mL of Nitrite QC Stock Solution. Dilute to the mark and mix. Prepare fresh daily.

9.0 PROCEDURE

9.1 Equipment Preparation & Analysis

9.1.1 SmartChem Startup Routine: Go to 'Sample Entry'. Double click on the selected method to be run. Enter number of samples. Click on the check mark and enter sample IDs. Review the Run Plan sample IDs and click 'Save'. Enter the Run Plan description and click 'Save'. Go to System Monitor. Select and click on the created Run Plan

9.1.2 Load samples, standards, controls, diluent, and empty cups as displayed in the system monitor

9.1.3 Filter any samples displaying a high amount of suspended matter with a 0.45 µm syringe filter. Record the lot number of the filters on the batch traceability sheet. If any samples are filtered, the corresponding method blank and LCS must also be filtered.

9.1.3.1 Fill diluent bottle with DI water. This diluent will be used for over-range samples that require dilution (manual or automated). Fill clean reagent bottles with appropriate working reagents. Pouring slowly helps minimize foaming.

9.1.3.2 Check the probe rinse, DI water, and cleansing solution bottles and refill as needed.

9.1.4 Click 'start' to begin analysis.

9.2 Calibration Design

9.2.1 The calibration curve must consist of a minimum of a calibration blank and three non-zero standards. Using the instrumentation software, prepare a standard curve by plotting absorbance versus concentration. The calibration is a linear regression. Instruments must be calibrated daily prior to analysis of samples.

9.2.2 Additional calibration specifications may be referenced in ENV-SOP-NW-0027 *Calibration Procedures*, or equivalent replacement.

9.3 Reporting Data

9.3.1 All samples with a concentration greater than the highest calibration standard must be diluted within range.

9.3.2 If a sample is more negative than the equivalent of the reporting limit, the sample should be diluted to remove interferences. If the sample has an MS/MSD associated with it, and the spike did not recover, then the MS/MSD should be diluted and post spiked.

9.3.3 Record the necessary traceability information in form L-124 WET Chemistry Batch Traceability Sheet. Information includes batch, analyst, analysis date, and lot numbers of solutions and consumables used.

10.0 Data Analysis And Calculations

10.1 Calculations

See the Laboratory Quality Assurance Manual for equations for common calculations.

10.1.1 **LCS and MS/MSD % Recovery:**

$$\% \text{Recovery} = \frac{SS - PS}{SA} \times 100$$

Where, SS = Spiked Sample result, mg/L
PS = Parent Sample result, mg/L (only applicable to MS/MSD, LCS = 0)
SA = Spike Added from spiking standard, mg/L

10.1.2 **Relative Percent Difference (RPD):**

$$RPD = \frac{|PS - Dup|}{(PS + Dup)/2} \times 100$$

Where, PS = Parent Sample result
Dup = Duplicate sample result

11.0 Quality Control and Method Performance

11.1 Quality Control

The following QC samples are prepared and analyzed with each batch of samples. Refer to Appendix A for acceptance criteria and required corrective action.

QC Item	Frequency
Method Blank (MB)	1 per batch of 20 or fewer samples.
Laboratory Control Sample (LCS)	1 per batch of 20 or fewer samples.
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	A pair of MS/MSD must be analyzed once every ten samples or once per batch, whichever is more frequent.

11.2 Instrument QC

The following Instrument QC checks are performed. Refer to Appendix A for acceptance criteria and required corrective action.

QC Item	Frequency
Initial Calibration	Daily
Initial Calibration Verification	Immediately after each initial calibration
Initial Calibration Blank	Immediately after each initial calibration
NO_2 Efficiency Check	Once per calibration

Continuing Calibration Verification	Prior to the analysis of any samples and after every 10 injections thereafter. Samples must be bracketed with a closing CCV standard.
Continuing Calibration Blank	Following every CCV injection

11.3 Method Performance

11.3.1 Method Validation

11.3.1.1 Detection Limits

Detection limits (DL) and limits of quantitation (LOQ) are established at initial method setup and verified on an on-going basis thereafter. Refer to Pace ENV corporate SOP ENV-SOP-CORQ-0011 Method Validation and Instrument Verification and to the laboratory's SOP SOP ENV-SOP-NW-0018 *Determination of LOD and LOQ* for these procedures.

11.4 Analyst Qualifications and Training

Employees that perform any step of this procedure must have a completed Read and Acknowledgment Statement for this version of the SOP in their training record. In addition, prior to unsupervised (independent) work on any client sample, analysts that prepare or analyze samples must have successful initial demonstration of capability (IDOC) and must successfully demonstrate on-going proficiency on an annual basis. Successful means the initial and on-going DOC met criteria, documentation of the DOC is complete, and the DOC record is in the employee's training file. Refer to laboratory SOP ENV-SOP-NW-0025 *Training and Orientation Procedures* for more information.

12.0 DATA REVIEW AND CORRECTIVE ACTION

12.1 Data Review

Pace's data review process includes a series of checks performed at different stages of the analytical process by different people to ensure that SOPs were followed, the analytical record is complete and properly documented, proper corrective actions were taken for QC failure and other nonconformance(s), and that test results are reported with proper qualification.

The review steps and checks that occur as employee's complete tasks and review their own work is called primary review.

All data and results are also reviewed by an experienced peer or supervisor. Secondary review is performed to verify SOPs were followed, that calibration, instrument performance, and QC criteria were met and/or proper corrective actions were taken, qualitative ID and quantitative measurement is accurate, all manual integrations are justified and documented in accordance with the Pace ENV's SOP for manual integration, calculations are correct, the analytical record is complete and traceable, and that results are properly qualified.

A third-level review, called a completeness check, is performed by reporting or project management staff to verify the data report is not missing information and project specifications were met.

Refer to laboratory SOP ENV-SOP-MIN4-0092 *Data Review Process* for specific instructions and requirements for each step of the data review process.

12.2 Corrective Action

Corrective action is expected any time QC or sample results are not within acceptance criteria. If corrective action is not taken or was not successful, the decision/outcome must be documented in the analytical record. The primary analyst has primary responsibility for taking corrective action when QA/QC criteria are not met. Secondary data reviewers must verify that appropriate action was taken and/or that results reported with QC failure are properly qualified.

Corrective action is also required when carryover is suspected and when results are over range.

Samples analyzed after a high concentration sample must be checked for carryover and reanalyzed if carryover is suspected. Carryover is usually indicated by low concentration detects of the analyte in successive samples analyzed after the high concentration sample.

Sample results at concentrations above the upper limit of quantitation must be diluted and reanalyzed. The result in the diluted samples should be within the upper half of the calibration range. Results less than the mid-range of the calibration indicate the sample was over diluted and analysis should be repeated with a lower level of dilution. If dilution is not performed, any result reported above the upper range is considered a qualitative measurement and must be qualified as an estimated value.

13.0 Pollution Prevention And Waste Management

Pace proactively seeks ways to minimize waste generated during our work processes. Some examples of pollution prevention include but are not limited to: reduced solvent extraction, solvent capture, use of reusable cycletainers for solvent management, and real-time purchasing.

The EPA requires that laboratory waste management practice to be conducted consistent with all applicable federal and state laws and regulations. Excess reagents, samples and method process wastes must be characterized and disposed of in an acceptable manner in accordance with Pace's Chemical Hygiene Plan / Safety Manual.

14.0 Modifications

Not applicable to this SOP

15.0 Responsibilities

Pace ENV employees that perform any part this procedure in their work activities must have a signed Read and Acknowledgement Statement in their training file for this version of the SOP. The employee is responsible for following the procedures in this SOP and handling temporary departures from this SOP in accordance with Pace's policy for temporary departure.

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Pace supervisors/managers are responsible for training employees on the procedures in this SOP and monitoring the implementation of this SOP in their work area.

16.0 ATTACHMENTS

Appendix A – QC Summary

17.0 REFERENCES

Pace Quality Assurance Manual- most current version.

TNI Standard, *Management and Technical Requirements for Laboratories Performing Environmental Analyses*, EL-V1-2009.

TNI Standard, *Management and Technical Requirements for Laboratories Performing Environmental Analyses*, EL-VI-2016-Rev.2.1.

Standard Methods for the Examination of Water and Wastewater, 4500-NO_3 H (1997, 2000, 2011).

SmartChem Operations Manual, Rev.3.0.2.

SmartChem 200 Method 2421-1006 (Rev. A 1006), Nitrate-N by Hydrazine Reduction, SM4500 NO3-H.

40 CFR Appendix B to Part 136, *Definition and Procedure for the Determination of the Method Detection Limit - Rev 2*, August 28, 2017.

18.0 REVISION HISTORY

This Version:

Section	Description of Change
All	Updated to new template
9.2.2.	Added section for reference to Calibration SOP.
17.0	Updated TNI references to current effective versions, added 40 CFR reference for MDLs.

This document supersedes the following document(s):

Document Number	Title	Version
ENV-SOP-MIN4-0113	Nitrate/Nitrite in Aqueous Samples by SM4500-NO3-H	00

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TEST METHOD STANDARD OPERATING PROCEDURE

TITLE: Nitrate/Nitrite in Aqueous Samples

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Appendix A: QC Summary

QC Item	Frequency	Acceptance Criteria	Corrective Action	Qualification
ICAL	Daily	r ≥ 0.995 Low Level %RE 60-140% Each Additional Calibration Level %RE 90-110%	Identify and correct source of problem, repeat.	None. Do not proceed with analysis.
ICV	After Each ICAL	90-110% of the true value	Identify source of problem, re-analyze. If repeat failure, repeat ICAL.	None. Do not proceed with analysis.
ICB	Immediately after the initial calibration verification	Result must be less than the absolute value of the Reporting Limit (LOQ).	Identify source of problem, re-analyze. If repeat failure, repeat ICAL.	None. Do not proceed with analysis.
NO_2 Efficiency Check	Analyze once per calibration	90-110% of the true value	Identify source of problem, re-analyze. If repeat failure, repeat ICAL.	None. Do not proceed with analysis.
CCV	Daily, before sample analysis, after every 10, and at end of analytical window.	All analytes must be within ± 10% of the true value.	Identify source of problem, re-analyze. Analysis may proceed if it can be demonstrated that the CCV exceedance has no impact on analytical measurements. For example, the CCV %R is high, and the analyte is not detected in sample(s).	Qualify analytes with CCV out of criteria.
CCB	Daily, before sample analysis, after every 10, and at end of analytical window	Result must be less than the absolute value of the Reporting Limit (LOQ). Per QAPP or client specifications, alternate criteria such as evaluating to ½ RL may apply.	Identify source of problem, re-analyze. Analysis may proceed if it can be demonstrated that the CCB exceedance has no impact on analytical measurements. For example, the CCB has detections and the analyte is not detected in sample(s).	Qualify analytes with CCB out of criteria.
Method Blank	One per 20 samples	Result must be less than the absolute value of the Reporting Limit (LOQ). Per QAPP or client specifications, alternate criteria such as evaluating to ½ RL may apply.	Identify source of problem, re-analyze. If reanalysis of the MB fails, all samples affected by the failing MB elements need to be re-analyzed. If sample(s) non-detect, report the data. If sample result >10x MB detections, report the data	Qualify outages and explain in case narrative.
LCS	One per 20 samples	90-110% of the true value	Identify source of problem, re-analyze. If reanalysis of the LCS fails, all samples affected by the failing LCS elements need to be re-analyzed. If LCS recovery is > QC limits and these compounds are non-detect in the associated samples, report the data.	Qualify analytes with LCS out of criteria.
MS/MSD	A pair of MS/MSD must be analyzed once every ten samples or once per batch, whichever is more frequent.	80-120% of the true value RPD ≤ 20%	If the MS recovery is not within the criteria, and the LCS is shown to be in control, the recovery problem is judged to be matrix related and the results may be accepted. If the concentration of matrix spike is less than 25% of the background concentration of the matrix, the matrix spike recovery should not be calculated.	Qualify analytes with MS/MSD out of criteria.

ENVIRONMENTAL SCIENCES

Document Information

Document Number: ENV-SOP-MIN4-0122 **Revision:** 02

Document Title: Solids in Aqueous Samples by SM 2540B/C/D, EPA 160.4, TSS

Department(s): Wet Chemistry

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ENV-SOP-MIN4-0122

QM Approval

Name/Signature	Title	Date	Meaning/Reason
Janielle Ward (007319)	Manager - Quality	06 Mar 2020, 01:46:34 PM	Approved

Management Approval

Name/Signature	Title	Date	Meaning/Reason
Andrew Mickelson (009792)	Manager	09 Mar 2020, 11:54:17 AM	Approved
Christina Schmitt (005842)	Administrative Assistant	10 Mar 2020, 11:13:12 AM	Approved
Adam Haugerud (005828)	General Manager 1	31 Mar 2020, 05:55:38 PM	Approved

TEST METHOD STANDARD OPERATING PROCEDURE	
TITLE:	Solids in Aqueous Samples by SM 2540B/C/D, EPA 160.4, TSS
TEST METHOD	SM2540B/C/D, EPA 160.4
ISSUER:	Pace ENV – Minneapolis – MIN4

1.0 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes operations used to measure Total Solids (TS), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), and Total Volatile Solids (TVS) in water samples, and TS and TVS on solids, based on Standard Methods 2540-B, 2540-C, and 2540-D and EPA 160.4.

1.1 **Target Analyte**

Analyte	Matrix (units)	LOQ
Total Solids	Water (mg/L)	10
Total Suspended Solids	Water (mg/L)	10
Total Dissolved Solids	Water (mg/L)	10
Total Volatile Solids	Water (mg/L)	10
Total Volatile Solids	Solid (% w/w)	1.0
Total Volatile Suspended Solids	Water (mg/L)	2.0

All current MDLs are listed in the LIMS and are available by request from the Quality Manager.

LOQ are established in accordance with Pace policy and SOPs for method validation and for the determination of detection limits (DL) and quantitation limits (LOQ). DL and LOQ are routinely verified and updated when needed.

1.2 **Applicable Matrices:** This SOP is applicable to solid samples and water samples, including drinking water, groundwater, municipal and industrial wastewater.

1.3 **Personnel:** The policies and procedures contained in this SOP are applicable to all personnel involved in the analytical and preparation methods.

1.4 **Parameters:** This SOP applies to matter suspended or dissolved in water or wastewater.

2.0 SUMMARY OF METHOD

2.1 Total Solids (TS) – A well-mixed sample is evaporated to dryness and the residue solids are measured gravimetrically.

2.2 Total Suspended Solids (TSS) – A well-mixed sample is filtered. The residue collected by the filter is dried and measured gravimetrically.

2.3 Total Dissolved Solids (TDS) – A well-mixed sample is filtered. The filtrate passing through the filter is evaporated to dryness and the residual solids are measured gravimetrically.

2.4 Total Volatile Solids (TVS, TVSS) – Residue obtained from the determination of TS or TSS is ignited at 550 ºC in a muffle furnace. The loss of weight on ignition is reported as mg/L volatile solid (TVS if the result was obtained from ashing a TS sample, TVSS if the result was from a TSS sample).

2.5 Solid matrices are reported as a percentage for TS and TVS.

3.0 INTERFERENCES

3.1 Non-representative materials, e.g., leaves and sticks should be removed from the sample prior to measurement unless it is determined that their inclusion is desired. If floating oil and grease are present, the sample should be dispersed by blending prior to analysis.

3.2 Measurements are subject to negative bias for samples containing significant quantities of ammonium carbonate, volatile organics, or other volatile materials that could be lost during drying.

3.3 The residue of samples for TS and TDS that are highly mineralized, especially containing significant concentrations of calcium, magnesium, chloride, and/or sulfate may be hydroscopic and will require longer drying, desiccation, and rapid weighing.

3.4 Samples for TS and TDS containing high concentrations of bicarbonate will require careful, and possibly prolonged, drying to ensure that all bicarbonate is converted to carbonate.

3.5 The volumes of aliquots for TS and TDS should be selected to limit the total residue to 200 mg to prevent the residue from crusting over and trapping water during drying.

3.6 Samples for TSS with high TDS, such as saline waters, brines, and some wastes, may be subject to positive bias. Care must be taken to properly rinse the filter to minimize the bias.

4.0 DEFINITIONS

Refer to the Laboratory Quality Manual for a glossary of common lab terms and definitions.

5.0 HEALTH AND SAFETY

The toxicity or carcinogenicity of each chemical material used in the laboratory has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable.

The laboratory maintains documentation of hazard assessments and OSHA regulations regarding the safe handling of the chemicals specified in each method. Safety data sheets for all hazardous chemicals are available to all personnel. Employees must abide by the health, safety and environmental (HSE) policies and procedures specified in this SOP and in the Pace Chemical Hygiene / Safety Manual.

Personal protective equipment (PPE) such as safety glasses, gloves, and a laboratory coat must be worn in designated areas and while handling samples and chemical materials to protect against physical contact with samples that contain potentially hazardous chemicals and exposure to chemical materials used in the procedure.

Concentrated corrosives present additional hazards and are damaging to skin and mucus membranes. Use these acids in a fume hood whenever possible with additional PPE designed for handing these materials. If eye or skin contact occurs, flush with large volumes of water. When working with acids, always add acid to water to prevent violent reactions. Any processes that emit large volumes of solvents (evaporation/concentration processes) must be in a hood or apparatus that prevents employee exposure.

Contact your supervisor or local HSE coordinator with questions or concerns regarding safety protocol or safe handling procedures for this procedure.

6.0 Sample Collection, Preservation, Holding Time, And Storage

Samples should be collected in accordance with a sampling plan and procedures appropriate to achieve the regulatory, scientific, and data quality objectives for the project.

The laboratory does not perform sample collection or field measurements for this test method. To assure sample collection and field checks and treatment are performed in accordance with applicable regulations Pace project managers will inform the client of these requirements at the time of request for analytical services when the request for testing is received prior to sample collection. If samples were already collected, the laboratory will record any nonconformance to these requirements in the laboratory's sample receipt record when sufficient information about sample collection is provided with the samples.

The laboratory will provide containers for the collection of samples upon client request for analytical services. Bottle kits are prepared in accordance with laboratory ENV-SOP-MIN4-0009 *Bottle Preparation* (most recent revision or replacement).

Requirements for container type, preservation, and field quality control (QC) for the common list of test methods offered by Pace are included in the laboratory's quality manual.

General Requirements

Matrix	Routine Container	Minimum Sample Amount[1]	Preservation	Holding Time
Aqueous	Plastic Bottles	100 mL	Thermal: ≤6° Celsius Chemical: N/A	Analyze as soon as possible to minimize microbiological decomposition of organic solids, holding time not to exceed 7 days from collection.
Solid	Wide-mouth glass jars	20.0 g	Thermal: ≤6° Celsius Chemical: N/A	28 days

[1]*Minimum amount needed for each discrete analysis.*

Thermal preservation is checked and recorded on receipt in the laboratory in accordance with laboratory SOP ENV-SOP-MIN4-0008 *Sample Management* (most recent revision or replacement).

After receipt, samples are stored at ≤6°C until sample preparation.

7.0 Equipment And Supplies

7.1 Equipment

Equipment	Description	Vendor/Item #
Analytical Balance	Electronic with RS-232 output, capable of weighing 0.0001g	Mettler Toledo AB135-S, or equivalent
Drying Oven	Capable of maintaining temperature at 103-105°C for TSS, capable of holding temperature at 178-182°C for TDS	Precision Scientific VWR 1370F, or equivalent
Muffle Furnace	Capable of maintaining temperature at 550°C for volatile solids	Fisher Scientific, or equivalent
Vacuum Filtration System	Including filter holder, membrane filter funnel, vacuum flask and vacuum pump	Environmental Express part # TDS600F
Desiccator	General laboratory equipment	Labconco, or equivalent

7.2 Supplies

Supply	Description	Vendor/Item #
Ceramic Evaporating Dishes (Crucibles)	For use in TVS	Fisher Scientific, or equivalent
Beaker	200 mL capacity, tall form. For use in TDS and TS.	Fisher Scientific part # 02-546B, or equivalent
StableWeigh TDS Vessels	Pre-weighed, disposable polymer vessel	Environmental Express part # TDS100
Glass Fiber Filters	Pre-washed and dried. For use in TDS.	Environmental Express part # F92447MM, or equivalent
Glass Fiber Filters	Pre-washed, dried, pre-weighed and barcoded. For use in TSS.	Environmental Express part # F93447MM, or equivalent
Glass Fiber Filter (TVSS)	Pre-washed and dried	Environmental Express part # F92447VOL or equivalent
Glass Fiber Filters (Sand Filtrate)	General laboratory equipment	Millipore part # AP2504700
Aluminum Dish	70 mL. Low form weighing dish, smooth.	Fisher part # 08-732-103

8.0 REAGENTS AND STANDARDS

8.1 Reagents

Reagent	Description	Vendor/Item #
De-Ionized (DI) Water		See ENV-SOP-MIN4-0090 *Reagent Water Quality*, or equivalent replacement
CeLite Filter Aid	TSS dry standard. Diatomaceous earth. Store at room temperature. Expires per manufacturer's specifications or five years after opening, whichever is sooner.	Fisher part # C212-500 or equivalent
Sodium Chloride (NaCl)	TDS dry standard. Store at room temperature. Expires per manufacturer's specifications or five years after opening, whichever is sooner.	Fisher part # S640-500 or equivalent
Hydrochloric Acid (HCl)	6N HCl. For use in cleaning glassware. Store at room temperature. Expires per manufacturer's	Fisher part # 3750.1-1 or equivalent

	specifications or one year after opening, whichever is sooner.	
Drierite	Store at room temperature in a tightly closed glass jar.	Fisher part # 075773B Blue indicator: part # 075783B

8.1.1 **Drierite:** Use a mix of white and blue crystals in a closed desiccator. When the blue crystals begin to turn purple or pink, the drierite is losing its effectiveness and must be replaced or regenerated. See ENV-SOP-MIN4-0146 *Drierite Regeneration* (or equivalent replacement) for drierite regeneration procedure.

8.1.2 **10%HCl:** Add 50 mL of 6 N HCl to a 500 mL volumetric flask containing 300 mL DI water. Dilute to mark, mix thoroughly, cool in fume hood and transfer to 500 mL amber glass container. Expires in 12 months.

8.2 Standards

Standard	Concentration	Vendor/Item #
TSS Standard	100 mg/L	N/A
TDS Standard	1000 mg/L	N/A
TSS/TDS/TS Combined Standard	100 mg TSS/L 1000 mg TDS/L 1100 mg TS/L	N/A

8.2.1 **TSS Standard:** Dissolve 0.1 g of Celite in a 1000 mL volumetric flask containing about 900 mL of DI water. Dilute to the mark and mix thoroughly. Cap tightly and store at room temperature. Expires in six months.

8.2.2 **TDS Standard:** Dissolve 1.0 g of NaCl in a 1000 mL volumetric flask containing about 900 mL of DI water. Dilute to the mark and mix thoroughly. Cap tightly and store at room temperature. Expires in six months.

8.2.3 **TSS/TDS/TS Combined Standard:** Dissolve 0.1 g of Celite and 1.0 g of NaCl in a 1000 mL volumetric flask containing about 900 mL of DI water. Dilute to the mark and mix thoroughly. Cap tightly and store at room temperature. Expires in six months.

9.0 PROCEDURE

9.1 Equipment Preparation

9.1.1 All balances must be certified by an outside agency on an annual basis with documentation of the calibration maintained in the QA office.

9.1.2 Daily calibration of the balance is required following SOP ENV-SOP-NW-0016 – Support Equipment (or equivalent replacement). Record in associated balance calibration logbook. Calibration limits are found in the balance calibration logbook; if values exceed these limits, recalibrate the balance.

9.2 Establishing Constant Weight

9.2.1 Weigh the vessel (filter pad, beaker or crucible) and dry in an oven for at least 1 hour (104 ± 1ºC for TSS filter pads and TS beakers or crucibles, 180 ± 2ºC for TDS beakers, 550ºC muffle furnace for TVSS filter pads and TVS crucibles).

9.2.2 Remove from the oven and allow them to cool to room temperature in a desiccator.

9.2.2.1 If done in a room with < 20% humidity, the vessels may be allowed to cool on a benchtop for approximately 15 minutes to allow more rapid cooling.

9.2.3 Weigh the filter pad, beaker or crucible again. If the second weight is within ±0.5 mg of the first, constant weight is established and analysis is complete, otherwise repeat 11.3.1 through 11.3.3 for a third weight and, if necessary, a fourth weight.

9.2.3.1 4% Rule (only applicable to residue, does not apply to clean vessel weights): If any weight measurement agrees within 4% of a previous weight, it is considered a constant weight and analysis is complete.

9.2.3.2 If the fourth weight is still not within ±0.5 mg, use the fourth weight and qualify the sample data as not having established constant weight.

9.2.3.3 TSS and TVSS filters and TDS vessels may be purchased pre-weighed and may be used immediately. One filter per manufacturer's lot must be weighed to verify correctness.

9.2.3.4 All weights must be recorded and the date/time and oven temperature must be recorded in the electronic prep log.

9.3 **Total Solids (TS)**

9.3.1 Wash beakers (or crucibles if TVS is being performed) with phosphate-free soap and warm tap water. Rinse three times or until free of soap. Rinse three times with DI water and dry at 180±2°C for at least 1 hour.

9.3.2 Assign clean, dry beakers to each sample and record the tare weight to the nearest 0.1 mg using the constant weight procedure described in section 9.2.

9.3.3 Choose a sample volume to yield a residue of at least 25 mg but less than 200 mg. If there is not a reliable indication of solids content, choose 100 mL if the sample appears clean or, as little as 10 mL if the sample appears to have solids.

9.3.4 Shake thoroughly to homogenize the sample and measure the chosen aliquot volume in a graduated cylinder and pour into the respective beaker.

9.3.5 Rinse the graduated cylinder with ~10 mL DI water and pour into the beaker. Repeat this step twice. All three rinses should be poured into the beaker as part of the analysis.

9.3.6 Optional: Evaporate the beakers in an oven no higher than 105ºC to complete dryness, preferably overnight.

9.3.7 Place the evaporated beakers in an oven at 104 ± 1ºC for at least 1 hour.

9.3.8 Remove the beakers from the oven and allow them to cool to room temperature in a desiccator.

9.3.8.1 If done in a room with < 20% humidity, the beakers may be allowed to cool on a benchtop for approximately 5 minutes to allow more rapid cooling.

9.3.9 After cooling to room temperature, weigh each beaker to the nearest 0.1 mg.

9.3.10 Repeat steps 9.3.7 through 9.3.9 and establish constant weight as described in section 9.2.

9.3.11 Record all weights, dates and times of oven and desiccator tracking as well as oven temperatures in the electronic prep log 160.4/2540E | TS/TVS/TFS Water (Template ID 1218023) current version or equivalent replacement.

9.4 **Total Suspended Solids (TSS) & Sand Filtrate**

9.4.1 Use ProWeigh filter pads (prewashed and preweighed) from Environmental Express or equivalent. Verify the weight indicated on the weigh pan or record the actual weight if it differs from the vendor indicated weight.

9.4.2 For sand filtrate or for TSS or TVSS when ProWeigh filter pads are not available, identify and wash each filter pad with three 20 mL aliquots of DI water and vacuum to dryness between each aliquot. Establish constant weight for each filter pad as described in section 9.2.

9.4.2.1 Use Millipore part # AP2504700 for sand filtrate.

9.4.2.2 Use Environmental Express part # F92447VOL for TVSS.

9.4.2.3 Use Environmental Express part # F92447MM for TSS when ProWeigh filter pads are not available.

9.4.3 Choose a sample volume to yield a residue of at least 1 mg but less than 200 mg.

9.4.3.1 For TSS low level, filter a 500 mL volume if the sample appears clean.

9.4.3.2 For wastewaters, choose 100 mL if the sample appears clean. When filtering less than 10 mL, dilute the aliquot of sample in at least 10 mL DI water prior to filtering in order to disperse the sample on the filter pad evenly.

9.4.3.3 For sand filtrate, filter a 1000 mL volume.

9.4.4 Place a clean filter pad on the filtration manifold, handling the filter pad with forceps only. Wet the filter with a small volume of DI water to seat it. Discard the rinsates if the sample is also being analyzed for TDS.

9.4.5 Shake the sample thoroughly to homogenize and measure the chosen aliquot volume using a class A graduated cylinder.

9.4.6 Filter the sample. Rinse the graduated cylinder and wash the filter three times with approximately 10 mL of DI water. Once filtration is complete, maintain the filter vacuum for about three minutes and until filter has come to complete dryness.

9.4.6.1 If the sample is also being analyzed for TDS, retain the filtrate. Transfer the filtrate to an evaporating vessel and complete the analysis for TDS as described in Section 9.5.

9.4.6.2 If total volatile suspended solids (TVSS) are also to be performed, transfer the filter pad to a ceramic evaporating dish and complete the analysis for TVSS as described in Section 9.6.

9.4.7 Remove the filter pad with the forceps and place it back into its respective aluminum pan.

9.4.7.1 If the sample contains oils, solvents, surfactants, dyes and other organic materials that adhere strongly to surfaces, wash all parts of the filter apparatus as well as the graduated cylinder with hot, soapy water and a brush until all solids are thoroughly removed. Failure to do so may result in cross-contamination between samples.

9.4.8 Place the pans with filter pads onto drying racks in oven at 104±1ºC for at least 1 hour.

9.4.9 Remove the samples from the oven and place them in a desiccator to cool.

9.4.10 After cooling to room temperature, weigh each filter pad to the nearest 0.1 mg.

9.4.11 Repeat steps 9.4.8 through 9.4.10 and establish constant weight as described in section 9.2.

9.4.12 Record all weights, dates and times of oven and desiccator tracking as well as oven temperatures in the electronic prep log 2540D | TSS (Template ID 1218021) current version or equivalent replacement.

9.5 **Total Dissolved Solids (TDS)**

9.5.1 StableWeigh TDS Method

9.5.1.1 If using StableWeigh TDS vessels, assign clean vessel to each sample and record the tare weight to the nearest 0.1 mg. Proceed to section 9.5.3.

9.5.2 Beaker TDS Method

9.5.2.1 Wash beakers (or crucibles if TVDS is being performed) with phosphate-free soap and warm tap water. Rinse three times or until free of soap. Rinse three times with DI water and dry at 180 ± 2°C for at least 1 hour.

9.5.2.2 Assign clean, dry beakers to each sample and record the tare weight to the nearest 0.1 mg using the constant weight procedure described in section 11.3. Use prep log LOG | Beaker Pre-Weigh Log (Template ID 377592) current version or equivalent replacement to establish and track tare weights for beakers.

9.5.3 Choose a sample volume to yield a residue of at least 25 mg but less than 200 mg. Choose 100 mL by default but if sample is suspected of having large amounts of TDS, proceed to 9.5.3.1 to prescreen. When filtering less than 10 mL, dilute the aliquot of sample in at least 10 mL DI water prior to filtering in order to evenly disperse the sample on the filter pad.

9.5.3.1 Prescreen samples to determine the general range of TDS using the Total Dissolved Solids Meter.

9.5.4 Prepare the filter system with a prewashed filter pad. Wet the filter with a small volume of DI water to seat.

9.5.4.1 If the sample will also be analyzed for TSS, use a ProWeigh filter pad and handle the filter with forceps only.

9.5.5 Shake the sample thoroughly to homogenize and measure the chosen aliquot volume using a class A graduated cylinder.

9.5.6 Filter the sample. Rinse the graduated cylinder and wash the filter three times with approximately 10 mL of DI water. Once filtration is complete, maintain the filter vacuum for about three minutes.

9.5.7 Transfer the filtrate to its assigned vessel. Rinse the flask three times with approximately 10 mL of DI water and add the rinseates to the vessel.

9.5.7.1 If the sample is also being analyzed for TSS, transfer the filter pad to its respective pan and complete the analysis for TSS as described in Section 9.4.

9.5.7.2 If the sample contains oils, solvents, surfactants, dyes and other organic materials that adhere strongly to surfaces, wash all parts of the filter apparatus as well as the graduated cylinder with hot, soapy water and a brush until all solids are thoroughly removed. Failure to do so may result in cross-contamination between samples.

9.5.8 Evaporate the vessels in an oven at 180±2ºC to complete dryness, preferably overnight.

9.5.8.1 After the initial evaporation, vessels only need to be in an oven at 180±2ºC for at least one hour.

9.5.9 Remove the vessels from the oven and allow them to cool to room temperature in a desiccator.

9.5.9.1 If done in a room with < 20% humidity, the vessels may be allowed to cool on a bench top for approximately 5 minutes to allow more rapid cooling.

9.5.10 After cooling to room temperature, weigh each vessel to the nearest 0.1 mg.

9.5.11 Repeat steps 9.5.8.1 through 9.5.10 and establish constant weight as described in section 9.2.

9.5.12 Record all weights, dates and times of oven and desiccator tracking as well as oven temperatures in the electronic prep log 2540C | TDS (Stableweigh) (Template ID 1631354) current version or equivalent replacement.

9.6 Volatile Solids (TVS or TVSS)

9.6.1 Wash crucibles with phosphate-free soap and warm tap water. Rinse three times or until free of soap. Rinse at least three times with DI water and ignite in a muffle furnace at 550°C for 1 hour.

9.6.2 Assign crucibles to each sample and record the tare weight to the nearest 0.1 mg using the constant weight procedure described in section 9.2. Use prep log LOG | Beaker Pre-Weigh Log (Template ID 377592) current version or equivalent replacement to establish and track tare weights for crucibles.

9.6.3 Obtain the dry residue from a TS or TSS determination. Note: The residue for TS is obtained by drying the sample directly in a prepared crucible through the respective drying process for each analysis. The residue for TSS is obtained by filtering the sample on a pad suitable for volatization (see 9.4.2), dried through the same process for TSS samples and then placed in a clean aluminum dish for TVSS.

9.6.4 Place the crucibles (clean aluminum dishes with TSS filters if TVSS is being analyzed) into the muffle furnace at 550ºC for 30 minutes.

9.6.4.1 Note: 15 to 20 minute ignition times are usually required for a 200 mg residue; however, multiple samples and/or heavier residues may overtax the furnace and therefore necessitate a longer ignition time of 30 minutes.

9.6.5 Remove the crucibles from the furnace and cool for approximately 10 minutes. Place the crucibles in a desiccator to cool to room temperature.

9.6.6 After cooling to room temperature, weigh each beaker to the nearest 0.1 mg.

9.6.7 Repeat steps 9.6.4 through 9.6.6 and establish constant weight as described in section 9.2.

9.6.8 Record all weights, dates and times of oven and desiccator tracking as well as oven temperatures in the electronic prep log. For soil samples use electronic prep log 160.4/2540G | TS/TVS/TFS Soil (Template ID 1218024) current version or equivalent replacement and for waters use electronic prep log 160.4/2540E | TS/TVS/TFS Water (Template ID 1218023) current version or equivalent replacement.

9.7 Cleaning Glassware with HCl

9.7.1 As beakers and other glassware become heavily used, solid deposits may appear on surfaces that are impossible to remove with hot, soapy water and a brush. In this case, a solution of 10% hydrochloric acid (HCl) can be used to remove solids.

9.7.2 Prepare 10% HCl as outlined in section 8.1.2. Fill dirty beakers with as much solution as needed to cover any hard-to-remove solids and allow to sit for several minutes.

9.7.3 Pour out HCl from beaker and scrub with brush. Rinse beaker thoroughly and use normal glassware cleaning procedures.

9.7.4 Note: The 10% HCl solution may be re-used several times, until it has lost its efficacy.

9.8 New Solids Analyst Training

Pace Analytical®

TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: Solids in Aqueous Samples by SM 2540B/C/D, EPA 160.4, TSS
TEST METHOD SM2540B/C/D, EPA 160.4
ISSUER: Pace ENV – Minneapolis – MIN4

9.8.1 Follow the diagram on Attachment I for sample vessel organization when filtering and weighing back analytical batches.

9.8.2 A new analyst who is to learn one or more of the procedures described in this SOP will be audited by the staff supervisor within 30 days of his or her first day of training in solids. The audit will focus on filtering technique and will cover a few key points necessary in proper filtration as described in this SOP which include but are not limited to the following:

9.8.2.1 Seating the filter with a small amount of DI water prior to filtration.

9.8.2.2 Thoroughly homogenizing the sample prior to measuring an aliquot for filtration.

9.8.2.3 Measuring the sample aliquot using a class A graduated cylinder at eye level.

9.8.2.4 Rinsing the graduated cylinder and filter funnel at least three times with 10 mL aliquots of DI water.

9.8.2.5 Allowing the filter pad to vacuum-dry for at least three minutes after the filtration is complete or until it has come to complete dryness.

10.0 Data Analysis And Calculations

10.1 Calculations

See the Laboratory Quality Assurance Manual for equations for common calculations.

10.1.1 **TS, TSS and TDS**

TS, TSS and TDS (mg/L) = (A-B)*1000/V

Where: A = Weight of residue and vessel (g)
B = Tare weight of vessel (g)
V = Volume of sample aliquot (L)

10.1.2 **TVS, TVDS and TVSS**

$$\text{TVS, TVDS or TVSS (mg/L)} = \frac{|A-B|}{V} x100$$

% TVS = (A-B)/(A) *100

Where: A = Weight of dry sample residue and dish before ignition (mg)
B = Weight of ignited sample residue and dish (mg)
V = Volume of sample aliquot (mL)

10.1.3 **LCS and MS/MSD % Recovery**

$$\%\text{Recovery} = \frac{SS - PS}{SA} \times 100$$

TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: Solids in Aqueous Samples by SM 2540B/C/D, EPA 160.4, TSS
TEST METHOD SM2540B/C/D, EPA 160.4
ISSUER: Pace ENV – Minneapolis – MIN4

Where: SS = Spiked Sample result, mg/kg
PS = Parent Sample result, mg/kg (only applicable to MS/MSD, LCS = 0)
SA = Spike Added from spiking standard, mg/kg

10.1.4 **Relative Percent Difference (RPD)**

$$RPD = \frac{|PS - Dup|}{(PS + Dup)/2} \times 100$$

Where: PS = Parent Sample result
Dup = Duplicate sample result

11.0 QUALITY CONTROL AND METHOD PERFORMANCE

11.1 **Quality Control**

QC Sample	Components	Frequency	Acceptance Criteria	Corrective Action
Method Blank (MB)	DI Water	Once per batch of up to 20 samples.	Absolute value must be less than the reporting limit. Per QAPP or client specifications, alternate criteria such as evaluating to ½ RL may apply.	Re-analyze associated samples. ***Exceptions:*** If sample ND, report sample without qualification; If sample result >10x MB detects, report the data as it is not impacted by the blank detections; If sample result <10x MB detects and cannot be reprepared/reanalyzed, report sample with appropriate qualifier to indicate an estimated value. Client must be alerted and authorize this condition.
Laboratory Control Sample (LCS) / Laboratory Control Sample Duplicate (LCSD)	50 mL of TSS Standard, TDS Standard or TSS/TDS/TS Combined Standard	Once per batch of up to 20 samples. An LCSD must be substituted in the event of insufficient sample volume for a duplicate sample. An LCS is not analyzed in any volatile solids analyses.	80-120% of the true value If an LCSD is analyzed, the RPD ≤ 5% For tests undergoing volatizing by EPA 160.4, RPD < 20%	Re-analyze associated samples. ***Exceptions:*** If LCS recovery fails high and the associated samples are non-detect, the sample data may be reported with appropriate data qualifiers.
Duplicate Sample (DUP)	Client-provided sample.	Once every 10 samples.	RPD ≤ 5% For tests undergoing volatizing by EPA 160.4, RPD < 20%	Qualify the parent sample and duplicate with the D6 flag. If RPD is so great (>50%) that it indicates a possible lab error, reanalyze the parent sample in duplicate to confirm either the parent sample result or duplicate result.

				Exception: If the results of the sample and duplicate are less than 5x the RL, the data can be reported with the D8 qualifier and no further corrective action unless it is suspected that the data is in error for any other reason. If either the parent sample or the duplicate is below the MDL, RPD is not generated and no further action is necessary
Pad/Vessel Weight Verification (not reported)	ProWeigh TSS pads & TDS Vessels	One pad or vessel per box of 100 is weighed and the weight is logged on the TSS Filter/TDS Vessel Weight Verification Spreadsheet (Form F-MN-I-423). The spreadsheet is saved the appropriate folder in J:\SHARE\LAB\Wet Chem\ with the lot and box number.	± 0.0005 g of the weight specified by the manufacturer	If outside the acceptance criteria, attempt verification on a second pad in the lot. If the second is also outside the acceptance criteria, discard the lot.

11.2 **Method Performance**

11.2.1 **Method Validation**

11.2.1.1 Detection Limits

Detection limits (DL) and limits of quantitation (LOQ) are established at initial method setup and verified on an on-going basis thereafter. Refer to Pace ENV corporate SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification* and to the laboratory's SOP ENV-SOP-NW-0018 *Determination of LOD and LOQ* for these procedures.

11.2.1.2 Periodic performance evaluation (PE) samples

Periodic performance evaluation (PE) samples are analyzed per ENV-SOP-NW-0011, *Proficiency Testing (PT) Program* (most current revision or replacement), to demonstrate continuing competence. All results are stored in the QA office.

11.3 **Analyst Qualifications and Training**

Employees that perform any step of this procedure must have a completed Read and Acknowledgment Statement for this version of the SOP in their training record. In addition, prior to unsupervised (independent) work on any client sample, analysts that prepare or analyze samples must have successful initial demonstration of capability (IDOC) and must successfully demonstrate on-going proficiency on an annual basis. Successful means the initial and on-going DOC met criteria, documentation of the DOC is complete, and the DOC record is in the employee's training file. Refer to laboratory SOP ENV-SOP-NW-0025 *Orientation and Training Procedures* for more information.

12.0 DATA REVIEW AND CORRECTIVE ACTION

12.1 Data Review

Pace's data review process includes a series of checks performed at different stages of the analytical process by different people to ensure that SOPs were followed, the analytical record is complete and properly documented, proper corrective actions were taken for QC failure and other nonconformance(s), and that test results are reported with proper qualification.

The review steps and checks that occur as employee's complete tasks and review their own work is called primary review.

All data and results are also reviewed by an experienced peer or supervisor. Secondary review is performed to verify SOPs were followed, that calibration, instrument performance, and QC criteria were met and/or proper corrective actions were taken, qualitative ID and quantitative measurement is accurate, all manual integrations are justified and documented in accordance with the Pace ENV's SOP for manual integration, calculations are correct, the analytical record is complete and traceable, and that results are properly qualified.

A third-level review, called a completeness check, is performed by reporting or project management staff to verify the data report is not missing information and project specifications were met.

Refer to laboratory SOP ENV-SOP-MIN4-0092 *Data Review Process* for specific instructions and requirements for each step of the data review process.

12.2 Corrective Action

Corrective action is expected any time QC or sample results are not within acceptance criteria. If corrective action is not taken or was not successful, the decision/outcome must be documented in the analytical record. The primary analyst has primary responsibility for taking corrective action when QA/QC criteria are not met. Secondary data reviewers must verify that appropriate action was taken and/or that results reported with QC failure are properly qualified.

Corrective action is also required when carryover is suspected and when results are over range.

Samples analyzed after a high concentration sample must be checked for carryover and reanalyzed if carryover is suspected. Carryover is usually indicated by low concentration detects of the analyte in successive samples analyzed after the high concentration sample.

Sample results at concentrations above the upper limit of quantitation must be diluted and reanalyzed. The result in the diluted samples should be within the upper half of the calibration range. Results less than the mid-range of the calibration indicate the sample was over diluted and analysis should be repeated with a lower level of dilution. If dilution is not performed, any result reported above the upper range is considered a qualitative measurement and must be qualified as an estimated value.

13.0 Pollution Prevention And Waste Management

Pace proactively seeks ways to minimize waste generated during our work processes. Some examples of pollution prevention include but are not limited to: reduced solvent extraction, solvent capture, use of reusable cycletainers for solvent management, and real-time purchasing.

The EPA requires that laboratory waste management practice to be conducted consistent with all applicable federal and state laws and regulations. Excess reagents, samples and method process wastes must be characterized and disposed of in an acceptable manner in accordance with Pace's Chemical Hygiene Plan / Safety Manual.

14.0 Modifications

A modification is a change to a reference test method made by the laboratory. For example, changes in stoichiometry, technology, quantitation ions, reagent or solvent volumes, reducing digestion or extraction times, instrument runtimes, etc. are all examples of modifications. Refer to Pace ENV corporate SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification* for the conditions under which the procedures in test method SOPs may be modified and for the procedure and document requirements.

14.1 The exception for sample and duplicate results less than 5x the RL is based on the inorganic guidance provided in National Functional Guidelines. This is due to the fact that samples close to the reporting limit can be statistically unreliable.

15.0 Responsibilities

Pace ENV employees that perform any part this procedure in their work activities must have a signed Read and Acknowledgement Statement in their training file for this version of the SOP. The employee is responsible for following the procedures in this SOP and handling temporary departures from this SOP in accordance with Pace's policy for temporary departure.

Pace supervisors/managers are responsible for training employees on the procedures in this SOP and monitoring the implementation of this SOP in their work area.

16.0 Attachments

Attachment I: Filters, Beakers, and Crucibles Orientation

17.0 References

Pace Quality Manual- most current version.

Pace Analytical®

TEST METHOD STANDARD OPERATING PROCEDURE

TITLE:	Solids in Aqueous Samples by SM 2540B/C/D, EPA 160.4, TSS
TEST METHOD	SM2540B/C/D, EPA 160.4
ISSUER:	Pace ENV – Minneapolis – MIN4

TNI Standard, Management and Technical Requirements for Laboratories Performing Environmental Analyses, EL-V1-2009.

TNI Standard, Management and Technical Requirements for Laboratories Performing Environmental Analyses, EL-VI-2016-Rev.2.1.

USEPA Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Method 160.4, Issued 1971.

Methods 2540-B, 2540-C, and 2540-D, Standard Methods for Examination of Water and Wastewater, Online Edition (1997 and 2011).

40 CFR Appendix B to Part 136, *Definition and Procedure for the Determination of the Method Detection Limit - Rev 2*, August 28, 2017.

18.0 REVISION HISTORY

This Version:

Section	Description of Change
All	Converted to new SOP template.
9.5.8	Updated for internal audit findings.

This document supersedes the following document(s):

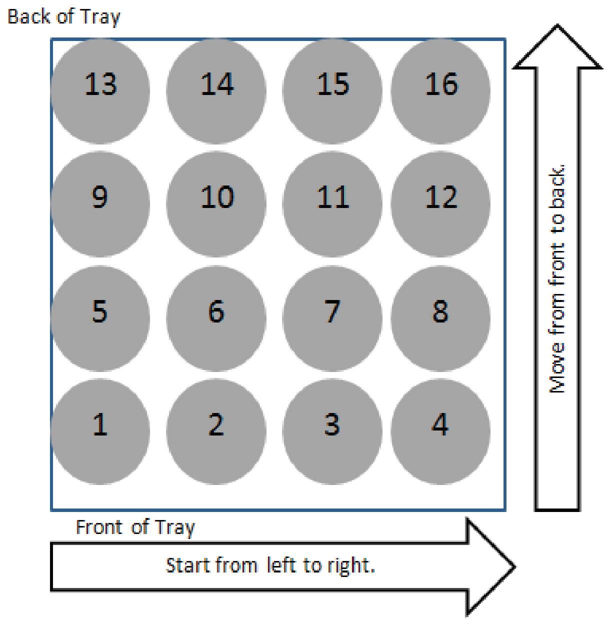
Document Number	Title	Version
ENV-SOP-MIN4-0122	Solids in Aqueous Samples by SM 2540B/C/D, EPA 160.4, TSS	01

TEST METHOD STANDARD OPERATING PROCEDURE

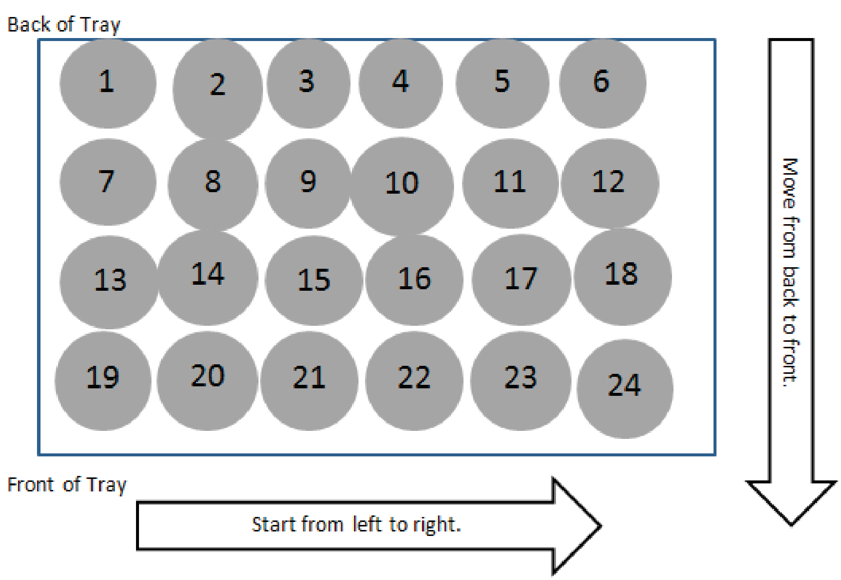
TITLE:	Solids in Aqueous Samples by SM 2540B/C/D, EPA 160.4, TSS
TEST METHOD	SM2540B/C/D, EPA 160.4
ISSUER:	Pace ENV – Minneapolis – MIN4

ATTACHMENT I: Filters, Beakers, and Crucibles Orientation

Filters



Beakers/Crucibles



Pace Analytical®
ENVIRONMENTAL SCIENCES

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All Dates and Times are listed in: Central Time Zone

Signature Manifest

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ENV-MAN-NW-0001 - Quality Manual

QM Approval

Name/Signature	Title	Date	Meaning/Reason
Emily Agola (006966)	Quality Manager II	03 Jan 2020, 08:55:58 AM	Approved

Management Approval

Name/Signature	Title	Date	Meaning/Reason
Vivianne Johnson (004419)	Manager - Lab Services	02 Jan 2020, 05:44:22 PM	Approved
Carrie Jensen (009324)	Manager - Client Services	03 Jan 2020, 08:21:46 AM	Approved
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Stephany Shanley (005243)	Lab Analyst I	03 Jan 2020, 08:57:53 AM	Approved
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Matthew McMann (004761)	Lab Technician III	03 Jan 2020, 09:49:16 AM	Approved
Joseph Bober (009729)	Lab Technician I	03 Jan 2020, 09:55:50 AM	Approved
Adam Haugerud (005828)	Assistant General Manager	03 Jan 2020, 11:09:05 AM	Approved
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Christina Schmitt (005842)	Support Coordinator II	03 Jan 2020, 01:50:04 PM	Approved
Jessica Ries (007351)	Manager - Lab Services	03 Jan 2020, 04:16:25 PM	Approved
Julie Bowser (007380)	Manager - Client Services	03 Jan 2020, 04:36:25 PM	Approved
Charles Sueper (004879)	Technical Director	03 Jan 2020, 06:42:20 PM	Approved
Christine Kne (009327)	Lab Analyst II	06 Jan 2020, 08:13:28 AM	Approved
David Randall (008925)	Manager - Lab Services	06 Jan 2020, 09:48:37 AM	Approved
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Craig Douglas (009316)	Manager - Lab Services	06 Jan 2020, 09:50:20 AM	Approved
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Alexander Reynolds (004831)	Lab Analyst I	07 Jan 2020, 08:40:56 AM	Approved
Dave White (004945)	Systems Manager	07 Jan 2020, 09:55:23 AM	Approved
Keith Sturgeon (003603)	Manager - Lab Services	07 Jan 2020, 12:20:02 PM	Approved
Bishal Thapa (004835)	Lab Analyst I	07 Jan 2020, 02:28:37 PM	Approved
Daniel Toms (009312)	Laboratory Supervisor II	07 Jan 2020, 02:53:16 PM	Approved

TITLE PAGE

LABORATORY QUALITY MANUAL

Prepared for:

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LABORATORY QUALITY MANUAL
Pace Analytical Services, LLC

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Approval of this manual by managerial personnel is recorded on the Signature Manifest located before the Title Page of this manual.

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Andrew Mickelson	Manager - Inorganics[3]	1700 Elm Street SE, Minneapolis, MN 55414	612-656-2259
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[2] *Include if different from the physical address and phone number of the facility.*
[3]*This individual serves as an Acting Technical Manager for TNI for one or more fields of accreditation.*

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[1] *Members of the local management team are subject to change during the life-cycle of this document version.*
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Joseph Bober	Health & Safety, however named	315 Chestnut Street, Virginia, MN 55792	218-735-6700
Dave White	Regional Manager - Systems	1700 Elm St SE, Minneapolis, MN 55414	612-656-2269
Craig Douglas	Manager – Inorganics, Manager - Metals, Technical Specialist[3]	315 Chestnut Street, Virginia, MN 55792	218-735-6700
Kate Flanagan	Lab Technician 1[3]	315 Chestnut Street, Virginia, MN 55792	218-735-6700

[1] *Members of the local management team are subject to change during the life-cycle of this document version.*
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[3] *This individual serves as an Acting Technical Manager for TNI for one or more fields of accreditation.*

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Bishal Thapa	Scientist 1[3]	4730 Oneota Street, Duluth, MN 55807	218-336-2119
Christine Kne	Scientist 2[3]	4730 Oneota Street, Duluth, MN 55807	218-336-2121
Alexander Reynolds	Scientist 1[3]	4730 Oneota Street, Duluth, MN 55807	218-336-2120
Carrie Jensen	Manager – Client Services	315 Chestnut St, Virginia, MN 55792	218-735-6704
Craig Douglas	Manager - Inorganics, Technical Specialist	315 Chestnut St, Virginia, MN 55792	218-404-6275
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[1] *Members of the local management team are subject to change during the life-cycle of this document version.*
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[3] *This individual serves as an Acting Technical Manager for TNI for one or more fields of accreditation.*

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1.0 PURPOSE AND SCOPE

1.1 Purpose

This quality manual (manual) outlines the quality management system and management structure of the laboratories and service centers affiliated with Pace Analytical Services, LLC (PAS). A laboratory is defined by PAS as any PAS facility, however named, that provides testing, sampling, or field measurement services. When the term 'laboratory" is used in this manual, the term refers to all locations listed on the Title Page of this manual and in Section 4.1.3 unless otherwise specified.

The PAS quality management system is also referred to as the quality program throughout this document. In this context, the phrase "quality management system" and "quality program" are synonymous.

The quality management system is the collection of policies and processes established by PAS management to consistently meet customer requirements and expectations, and to achieve the goals to provide PAS customers with high quality, cost-effective, analytical measurements and services.

The quality management system is also intended to establish conformance[1] and compliance with the current versions of the following international and national quality system standards:

- ISO/IEC 17025: *General requirements for the competence of testing and calibration laboratories*
- NELAC/TNI Standard Volume 1: *Management and Technical Requirements for Laboratories Performing Environmental Analysis*

[1]The statement of conformity to these Standards pertains only to testing and sampling activities carried out by the laboratory at its physical address, in temporary or mobile facilities, in-network, or by laboratory personnel at a customer's facility.

In addition to the international and national standards, the quality management system is designed to achieve regulatory compliance with the various federal and state programs for which the laboratory provides compliance testing and/or holds certification or accreditation. When federal or state requirements do not apply to all PAS locations, the requirements for compliance are provided in addendum to this manual or in other documents that supplement the manual. Customer-specific project and program requirements are not included in the manual in order to maintain client confidentiality.

- A list of accreditation and certifications held by each laboratory associated with this manual is provided in Appendix A.
- A list of analytical testing capabilities offered by each laboratory associated with this manual is provided in Appendix B.

1.2 Scope and Application

This manual applies to each of the PAS locations listed on the Title Pages and in Section 4.1.3.

The manual was prepared from a quality manual template (template) created by PAS corporate quality personnel. The template outlines the minimum requirements PAS management considers necessary for every PAS laboratory, regardless of scope of services or number of personnel, to establish in order to maintain a quality management system that achieves the objectives of PAS's Quality Policy (See 4.2.2). In this regard, the template is the mechanism used by the corporate officers (a.k.a. 'top management') to communicate their expectations and commitment for the PAS quality program to all PAS personnel.

The laboratory also has the responsibility to comply with federal and state regulatory and program requirements for which it provides analytical services and holds certification or accreditation. When those requirements are more stringent than the template, the requirements for compliance are provided in addendum to this manual or in other documents that supplement the manual. This document structure maintains consistency in the presentation of the quality management system across the network while providing the laboratory a mechanism to describe and achieve compliance requirements on a program basis.

1.2.1 Quality Manual Template

The quality manual template is developed by the Corporate Quality Director with contribution and input from corporate quality personnel and the corporate officers. Approval of the template by the corporate officers (aka "top management") confirms their commitment to develop and maintain a quality management system appropriate for the analytical services offered by the organization and to communicate their expectations of the quality program to all personnel.

The template and instructions for use of the template are released by corporate quality personnel to quality assurance manager(s) responsible for each laboratory (Local QA). Local QA uses the template to prepare the laboratory's manual by following the instructions provided. Since the template provides the minimum requirements by which all PAS locations must abide, the laboratory may not alter the font, structure or content of the template except where specified by instruction to do so. As previously stated, program specific requirements are provided in addendum or in documents that supplement this manual.

The template is reviewed by corporate quality personnel every two years and updated if needed. More frequent review and revision may be necessary to manage change, to maintain conformance and compliance to relevant standards, or to meet customer expectations.

See standard operating procedure (SOP) ENV-SOP-CORQ-00015 *Document Management and Control* for more information.

1.2.2 Laboratory Quality Manual

The manual is approved and released to personnel under the authority of local management. The manual is reviewed annually and location specific information is updated, if needed. More frequent review and revision may be necessary when there are significant changes to the organizational structure, capabilities, and resources of the laboratory. Review and revision of the manual is overseen by local QA. If review indicates changes to the main body of the manual are necessary to maintain conformance and compliance to relevant standards, or to meet customer expectations, local QA will notify corporate quality personnel to initiate review and/or revision of the template.

See SOP ENV-SOP-CORQ-00015 *Document Management and Control* for more information.

1.2.3 References to Supporting Documents

The template and the manual includes references to other laboratory documents that support the quality management system such as policies and standard operating procedures (SOPs). These references include the document's document control number and may include the document title.

This information is subject to change. For example, an SOP may be converted to a policy or the document's title may change. For these types of administrative changes, the manual and template are updated to reflect the editorial change during the document's next scheduled review/revision cycle or the next time a new version of the document is released, whichever is sooner.

Local QA maintains a current list of controlled documents used at each PAS location to support the quality management system. This list, known as the Master List, lists each document used by document control number, title, version, effective date, and reference to any document(s) that the current version supersedes. When there is a difference between the template and/or manual and the Master List, the document information in the Master List takes precedence. The current Master List is readily available to personnel for their use and cross-reference. Parties external to the laboratory should contact the laboratory for the most current version.

2.0 REFERENCES

References used to prepare this manual include:

- "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act." Federal Register, 40 CFR Part 136, most current version.
- "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods." SW-846.
- "Methods for Chemical Analysis of Water and Wastes", EPA 600-4-79-020, 1979 Revised 1983, U.S. EPA.
- U.S. EPA Contract Laboratory Program Statement of Work for Organic Analysis, current version.
- U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis, current version.
- "Standard Methods for the Examination of Water and Wastewater." Current Edition APHA-AWWA-WPCF.
- "Annual Book of ASTM Standards", Section 4: Construction, Volume 04.04: Soil and Rock; Building Stones, American Society of Testing and Materials.
- "Annual Book of ASTM Standards", Section 11: Water and Environmental Technology, American Society of Testing and Materials.
- "NIOSH Manual of Analytical Methods", U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health, most current version.
- "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water", U.S. EPA, Environmental Monitoring and Support Laboratory – Cincinnati (Sep 1986).
- Quality Assurance of Chemical Measurements, Taylor, John K.; Lewis Publishers, Inc. 1987.
- Methods for Non-conventional Pesticides Chemicals Analysis of Industrial and Municipal Wastewater, Test Methods, EPA-440/1-83/079C.
- Environmental Measurements Laboratory (EML) Procedures Manual, HASL-300, US DOE, February, 1992.
- Requirements for Quality Control of Analytical Data, HAZWRAP, DOE/HWP-65/R1, July, 1990.

- Quality Assurance Manual for Industrial Hygiene Chemistry, AIHA, most current version.
- National Environmental Laboratory Accreditation Conference (NELAC) Standard- most current version.
- ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories- most current version.

  The following are implemented by normative reference to ISO/IEC 17025:

  - ISO/IEC Guide 99, *International vocabulary of metrology –Basic and general concepts and associated terms*
  - ISO/IEC 17000, *Conformity assessment – Vocabulary and general principles*
- Department of Defense Quality Systems Manual (QSM), most current version.
- TNI (The NELAC Institute) Standard- most current version applicable to each lab.
- UCMR Laboratory Approval Requirements and Information Document, most current version.
- US EPA Drinking Water Manual, most current version.

3.0 TERMS AND DEFINITIONS

Refer to Appendix C for terms, acronyms, and definitions used in this manual and in other documents used by the laboratory to support the quality management system.

4.0 MANAGEMENT REQUIREMENTS

4.1 Organization

4.1.1 Legal Identity

Pace Analytical Services, LLC is authorized under the State of Minnesota to do business as a limited liability company.

4.1.1.1 Change of Ownership

If there is a change of ownership, if a location goes out of business, or if the entire organization ceases to exist, Pace Analytical Services, LLC ensures that regulatory authorities are notified of the change within the time-frame required by each state agency for which the location is certified or accredited.

Requirements for records and other business information are addressed in the ownership transfer agreement or in accordance with appropriate regulatory requirements, whichever takes precedence.

4.1.2 Compliance Responsibility

Laboratory management has the responsibility and authority to establish and implement procedures and to maintain sufficient resources necessary to assure its activities are carried out in such a way to meet the compliance requirements of the quality management system.

4.1.3 Scope of the Quality Management System

The quality management system applies to work carried out at each location covered by this manual including permanent facilities, at sites away from its permanent facilities, or in associated temporary or mobile facilities.

This permanent and mobile facilities to which this manual applies includes:

Name	Pace Analytical Services, LLC
Address:	1700 Elm Street SE
City, State, Zip	Minneapolis, MN 55414
Phone Number	612-607-1700
Service Type:	Laboratory

Name	Pace Analytical Services, LLC
Address:	150 N 9th Street
City, State, Zip	Billings, MT 59101
Phone Number	406-254-7726
Service Type:	Laboratory

Name	Pace Analytical Services, LLC
Address:	315 Chestnut Street
City, State, Zip	Virginia, MN 55792
Phone Number	218-735-6700
Service Type:	Laboratory

Name	Pace Analytical Services, LLC
Address:	4730 Oneota Street
City, State, Zip	Duluth, MN 55807
Phone Number	218-727-6380
Service Type:	Laboratory

Name	Pace Analytical Services, LLC
Address:	11001 Hampshire Ave S.
City, State, Zip	Bloomington, MN 55438
Phone Number	612-607-1700
Service Type:	Service Center

Name	Pace Analytical Services, LLC
Address:	3702 E Roeser Rd, Suite 19
City, State, Zip	Phoenix, AZ 85040
Phone Number	612-297-1376
Service Type:	Service Center

4.1.4 Organization History and Information

Founded in 1978, Pace Analytical Services, LLC (PAS) is a privately held scientific services firm operating one of the largest full service contract laboratory and service center networks in the United States. The company's network offer inorganic, organic and radiochemistry testing capabilities; specializing in the analysis of trace level contamination in air, drinking water, groundwater, wastewater, soil, biota, and waste.

With over 90 laboratories and services centers in the contiguous US and in Puerto Rico, the network provides project support for thousands of industry, consulting, engineering and government professionals.

Pace delivers the highest standard of testing and scientific services in the market. We offer the most advanced solutions in the industry, backed by truly transparent data, a highly trained team, and the service and support that comes from four decades of experience.

4.1.4.1 Organization Structure

Each location maintains a local management structure under the oversight and guidance of corporate personnel. Local management is responsible for making day-to-day decisions regarding the operations of the facility, implementing the quality management system, upholding the requirements of the quality program, and for supervision of personnel.

Local management is provided by a General Manager (GM), Quality Manager (QM), Manager – Client Services (MNGR-CS), Information Technology (IT) Manager, Department Managers (DM) and/or Department Supervisors (DS), however named.

Some locations may also have any one of the following management positions: Regional Quality Manager, Manager - Operations (MNGR-OPS), Technical Specialist (TS), or Technical Manager (TM), however named. When the location does not have a TS or TM, technical management is provided jointly by the GM, QM, DM, and DS.

The GM, however named reports to a Regional Operations Manager (RGM), who is responsible for the management of multiple laboratories and service centers within a geographical region, and who reports directly to the Chief Operating Officer (COO). The QMs have indirect reporting relationship to the Corporate Director of Quality.

Refer to the organization charts provided in Appendix D to view the management structure, reporting relationships, and the interrelationships between positions.

4.1.5 Management Requirements

4.1.5.1 Personnel

The laboratory is staffed with administrative and technical personnel who perform and verify work under the supervision of managerial personnel.

- Technical personnel include analysts and technicians that generate or contribute to the generation of analytical data and managerial personnel that oversee day to day supervision of laboratory operations. Including the reporting of analytical data and results, monitoring QA/QC performance, and monitoring the validity of analysis to maintain data integrity and reliability.
- Administrative personnel support the day-to-day activities of the laboratory.
- IT personnel maintain the information technology systems and software used at the laboratory.

- Client services personnel include project managers and support staff that manage projects.
- Managerial personnel make day-to-day and longer term decisions regarding the operations of the facility, supervise personnel, implement the quality management system and uphold the requirements of the quality program.

All personnel regardless of responsibilities are expected to carry out their duties in accordance with the policies and processes outlined in this manual and in accordance with standard operating procedures (SOPs) and other quality system documents. The laboratory's policies and procedures are designed for impartiality and integrity. When these procedures are fully implemented, personnel remain free from undue pressure and other influences that adversely impact the quality of their work or data.

4.1.5.1.1 Key Personnel

Key personnel include the management positions that have the authority and responsibility to plan, direct, and control, activities of the division (corporate) or the laboratory.

The following tables list key personnel positions by PAS job title and the position's primary deputy:

Key Personnel: Corporate

Key Personnel	Primary Deputy
Chief Executive Officer	Chief Operating Officer
Chief Operating Officer	Chief Executive Officer
Chief Compliance Officer	Quality Director
Corporate Quality Director	Chief Compliance Officer
Health and Safety Director	Chief Compliance Officer
IT Director	LIMS Administrator, however named.

Key Personnel: Laboratory

Key Personnel	Primary Deputy
Regional Director - Operations	Chief Operating Officer or as designated.
General Manager	Regional Director - Operations
Manager - Quality	Corporate Quality Manager or as designated.
Manager – Client Services	General Manager
Local IT	Corporate IT Director or as designated.
Department Manager	General Manager
Quality Manager 2[1]	Corporate Quality Manager
Technical Specialist[1]/Manager[1] Acting Technical Manager TNI	Manager - Quality
Manager - Operations[1]	General Manager.

[1] *Position may not be staffed at each location.*

Some state certification programs require the agency to be notified when there has been a change in key personnel. Program-specific requirements and time-frames for notification by agency, are tracked and upheld by local QA, when these requirements apply.

4.1.5.2 Roles and Responsibilities

The qualifications, duties, and responsibilities for each position are detailed in job descriptions maintained by PAS's corporate Human Resource's Department (HR).

The following summaries briefly identify the responsibility of key personnel positions in relation to the quality management system.

Chief Executive Officer (CEO): The CEO has overall responsibility for performance of the organization and endorses the quality program. Working with corporate and laboratory management, the CEO provides the leadership and resources necessary for PAS locations to achieve the goals and objectives of the quality management system and quality policy statement.

Chief Operating Officer (COO): The COO oversees all aspects of operations management including, strategic planning, budget, capital expenditure, and management of senior management personnel. In this capacity, the COO provides leadership and resources necessary to help top management at each PAS location achieve the goals and objectives of the quality management system and quality policy statement.

Chief Compliance Officer (CCO): The CCO oversees the quality assurance and environmental health and safety programs (HSE) for each business unit. The CCO is responsible for planning and policy development for these groups to ensure regulatory compliance and to manage risk. The position provides leadership and guidance necessary for all PAS locations to achieve the goals and objectives of the quality and HSE programs.

The CCO also serves as the Ethics Officer (ECO). The ECO develops the Ethics and Data Integrity Policy and Training Program, and provides oversight for reporting and investigation of ethical misconduct to maintain employee confidentiality during the process. The ECO provide guidance and instruction for follow-up actions necessary to remedy the situation and deter future recurrence.

Corporate Director of Quality: The Corporate Director of Quality is responsible for developing and maintaining the PAS quality program under guidance and assistance from the CEO, COO, and CCO. This position helps develop corporate quality policy and procedure and analyzes metric data and other performance indicators to assess and communicate the effectiveness of the quality program to top management. The position provides leadership and guidance for implementation of the quality program across all PAS locations.

Corporate Director of Information Technology: The Corporate Director of IT oversees the systems and processes of information technology used to support the quality program. These systems include Laboratory Information Management Systems (LIMS); data acquisition, reduction, and reporting software; virus-protection, communication tools, and ensuring the integrity and security of electronic data.

Regional Director - Operations (RGM): The SGM has full responsibility for administrative and operations management and performance of a group of PAS laboratories and service centers. Working with the COO and local laboratory management, the SGM provides leadership, guidance and resources, including allocation of personnel, necessary to achieve the goals of PAS quality program.

General Manager (GM): The GM is responsible for the overall performance and administrative and operations management of a PAS location and associated service center(s). This position is responsible to provide leadership and resources, including allocation and supervision of personnel, necessary for the location to implement and achieve the goals of the PAS quality program. In this capacity, the position assures laboratory personnel are trained on and understand the structure and components of the quality program defined in this manual as well as the policies and procedures in place to implement the quality management system.

The GM of NELAC/TNI Accredited laboratories are also responsible for the designation of technical personnel to serve as acting technical managers for TNI for the fields of accreditation held by the laboratory (See Section 4.1.5.2.1) and for notifying the accreditation body (AB) of any extended absence or reassignment of these designations.

Quality Manager (QM): The QM oversees and monitors implementation of the quality management system and communicates deviations to laboratory management. The QM is independent of the operation activities for which they provide oversight and has the authority to carry out the roles and responsibilities of their position without outside influence.

Additionally, in accordance with the TNI Standard, the QM:

- serves as the focal for QA/QC and oversees review of QC data for trend analysis;
- evaluates data objectively and perform assessments without outside influence;
- has document training and experience in QA/QC procedures and the laboratory's quality system;
- has a general knowledge of the analytical methods offered by the laboratory;
- coordinates and conducts internal systems and technical audits;
- notifies laboratory management of deficiencies in the quality system;
- monitors corrective actions;
- provides supports to technical personnel and may serve as the primary deputy for the acting TNI Technical Manager(s).

Manager - Client Services (MNGR-CS): The MNGR-CS oversees project management personnel. This position is responsible for training and management of client facing staff that serve as the liaison between PAS and the customer to ensure that projects are successfully managed to meet the expectations and needs of PAS customers. This position is also responsible for sharing positive and negative customer feedback with laboratory management so that this information may be used to improve the quality program.

Local IT Manager, however named: Local IT managers are responsible for maintaining the IT systems used to support the quality program. These systems include Laboratory Information Management Systems (LIMS); data acquisition, reduction, and reporting software; virus-protection, communication tools, and ensuring the integrity and security of electronic data.

Department Manager (DM): The DM is responsible for administrative and operations management and implementation of the quality management system in the work area he/she oversees. These responsibilities include but are not limited to: training and supervision of personnel, monitoring work activity to maintain compliance with this manual, SOPs, policies and other instructional documents that support the quality management system; method development, validation and the establishment and implementation of SOPs to assure regulatory compliance and suitability for intended purpose; monitoring QA/QC performance, proper handling and reporting of nonconforming work, purchasing of supplies and equipment adequate for use, maintaining instrumentation and equipment in proper working order and calibration, and general maintenance of administrative and technical processes and procedures established by the laboratory.

Quality Manager 2 (QM2): The QM2 provides support to the quality manager and assists the quality manager with implementation of the quality management system for one or more site locations.

Technical Specialist (TS): The TS provides technical oversight and guidance to laboratory personnel. Responsibilities may include but are not limited to: research and development, method development and validation, development of standard operating procedures, proposal and contract review. The TS may also be responsible for QA/QC trend analysis, technical training, and technology improvement.

Manager - Operations (MNGR-OPS): The MNGR-OPS is responsible for management of production and/or other duties assigned by the GM or SGM.

4.1.5.2.1 Acting Technical Manager (TNI Accreditation):

For PAS locations that are NELAC/TNI accredited:

The TNI Standard specifies requirements for the qualification and duties of technical personnel with managerial responsibility. These requirements are associated in the Standard to the designation 'technical manager(s), however named'. These responsibilities may be assigned to multiple individuals and are not associated with any specific job title.

For PAS, these TNI requirements for personnel that provide technical oversight correlate with PAS's job descriptions for Department Manager or Supervisor. However, the duties may be assigned to any PAS employee that meets the TNI specified qualifications.

Personnel assigned this designation retain their PAS assigned job title. The job title may be appended with *"acting as technical manager for*

TNI" and the technology or field of accreditation for which the employee is approved, if necessary.

When TNI Accreditation Bodies (AB) refer to these employees as 'technical manager' or 'technical director' on the official certificate or the scope of accreditation, this reference is referring to their approval to carry out duties of the 'technical manager, however named' as specified in the TNI Standard.

In accordance with the TNI Standard, the acting Technical Manager(s) for TNI are responsible for monitoring the performance of QC/QA in the work areas they oversee.

If the absence of any employee that is approved as acting technical manager for TNI exceeds 15 calendar days, the duties and responsibilities specified in the TNI Standard are reassigned to another employee that meets the qualifications for the technology or field of accreditation or they are assigned to the position's deputy, the quality manager.

4.1.5.3 Conflict of Interest

A conflict of interest is a situation where a person has competing interests. Laboratory management looks for potential conflict of interest and undue pressures that might arise in work activities and then includes countermeasures in policies and procedures to mitigate or eliminate the conflict.

See policy COR-POL-0004 *Ethics Policy* for more information.

4.1.5.4 Confidentiality

Laboratory management is committed to preserving the confidentiality of PAS customers and confidentiality of business information.

Procedures used by the laboratory to maintain confidentiality include:

- A Confidentiality Agreement which all employees are required to sign at the time of employment and abide by the conditions of throughout employment;
- Record retention and disposal procedures that assure confidentiality is maintained;
- Physical access controls and encryption of electronic data; and
- Protocol for handling Confidential Business Information (CBI).

Client information obtained or created during work activities is considered confidential and is protected from intentional release to any person or entity other than the client or the client's authorized representative information provided to PAS, except when the laboratory is required by law to release confidential information to another party, such as a regulatory agency or for litigation purposes. In which case, the laboratory will notify the client of the release of information and the information provided.

The terms of client confidentiality are included in PAS Standard Terms and Conditions (T&C). With the acceptance of PAS Terms and Conditions and/or the implicit contract for analytical services that occurs when the client sends samples to the laboratory for testing, the client authorizes PAS to release confidential information when required.

See policy COR-POL-0004 *Ethics Policy* for more information.

4.1.5.5 Communication

Communication is defined as the imparting or exchanging of news and information. Effective (good) communication occurs when the person(s) you are exchanging information with actively gets the point and understands it.

4.1.5.5.1 Workplace Communication

Good communication in the workplace is necessary to assure work is done correctly, efficiently, and in accordance with client expectations.

Instructions for how to carry out work activities are communicated to personnel via written policy, standard operating procedures, and standard work instructions.

Information about laboratory performance (positive and negative) and ideas for improvement are communicated using various communication channels such as face to face meetings, video conferencing, conference calls, email, memoranda, written reports, and posters.

4.1.5.5.2 External Communication

Communication with external parties such as customers, vendors, business partners, and regulatory agencies takes place every day.

Laboratory management ensure personnel learn to communicate in professional and respectful ways in order to build strong relationships, and learn to communicate effectively to avoid misunderstanding.

4.2 Quality Management System

4.2.1 Quality Management System Objectives

The objectives of the laboratory's quality management system are to provide clients with consistent, exemplary professional service, and objective work product that is of known and documented quality that meets their requirements for data usability and regulatory compliance.

Objective work product is analytical services, data, test results, and information that is not influenced by personal feeling or opinions. The quality of being objective is also known as 'impartiality'.

4.2.1.1 Impartiality

The laboratory achieves and maintains impartiality by implementing and adhering to the policies and processes of the quality management system, which are based on industry accepted standards and methodologies.

The laboratory's procedures for handling nonconforming work (See 4.9), corrective and preventive actions (See 4.11) and management review (See 4.15) are the primary mechanisms used to identify risk to impartiality and to prompt actions necessary to eliminate or reduce the threat when risk to impartiality is suspected or confirmed.

4.2.1.2 Risk and Opportunity Assessment

Risks are variables that make achieving the goals and objectives of the quality management system uncertain. An opportunity is something that has potential positive consequences for the laboratory.

Laboratory personnel manage risks and opportunities on a daily basis by carrying out the processes that make up the quality management system. Some of the ways in which the quality management system is designed to identify, minimize, or eliminate risk on a daily basis include but are not limited to:

- Capability and capacity reviews of each analytical service request to assure the laboratory can meet the customer's requirements;
- Maintenance of accreditation and certification for test methods in multiple states and programs to cover a broad range of jurisdiction for regulatory compliance;
- SOPs and other controlled instructional documents are provided to personnel to eliminate variability in process. These documents include actions to counter risk factors inherent in the process and are reviewed on a regular basis for on-going suitability and relevancy;
- Participation in proficiency testing programs and auditing activities to verify on-going competency and comparability in performance;
- Provision of on-the-job training and established protocol for quality control (QC) corrective action for nonconforming events;
- An established program for ethics, and data integrity;
- Tiered data review process;
- Culture of continuous improvement;
- Monitoring activities to assess daily and long term performance; and
- Annual critical review of the effectiveness the quality management system.

PAS also promotes a continuous improvement culture based on the principles of lean manufacturing. These principles include 3P (Process, Productivity, Performance) and Kaizen. 3P is a platform used by Pace to share best practices and standardization across the network to achieve operational excellence. Kaizen is a team based process used to implement tools and philosophies of lean to reduce waste and achieve flow with the purpose of improving both external and internal customer satisfaction. PAS's lean programs and activities help to mitigate risk because they generate a collective understanding of vulnerabilities and utilize group-effort to develop and implement solutions at all levels.

Risk and opportunities may also be formally identified using specific risk and opportunity assessment methods such as SWOT Analysis (Strength, Weakness, Opportunity, Threats) and 3-Stage Impact/Probability Grids.

4.2.1.3 Communication of the Quality Management System

This manual is the primary mechanism used by laboratory management to communicate the quality management system to laboratory personnel.

To assure personnel understand and implement the quality program outlined in the manual:

- All laboratory personnel are required to sign a Read and Acknowledgement Statement to confirm the employee has: 1) been informed of the manual by laboratory management, 2) has access to the manual, 3) has read the manual 4) understands the content of the manual, and 5) agrees to abide by the requirements, policies and procedures therein.
- Personnel are informed that the manual provides the "what" of the quality management system. The "how to" implementation of the quality management system is provided in policy, SOPs, standard work instructions, and other controlled instructional documents.

4.2.2 Quality Policy Statement

The quality policy of the laboratory is to provide customers with data of known and documented quality fit for their intended purpose. The laboratory achieves this policy by implementing the quality management system defined in this manual, by following industry accepted protocol for analytical testing and quality assurance and quality control (QA/QC) activities, by conformance with published and industry accepted testing methodologies, and by compliance with international and national standards for the competency and/or accreditation of testing laboratories.

Intrinsic to this policy statement is each of the following principles:

- The laboratory will provide customers with reliable, consistent, and professional service. This is accomplished by making sure the laboratory has the resources necessary to maintain capability and capacity; that staff are trained and competent to perform the tasks they are assigned; that client-facing staff are trained and prepared to find solutions to problems and to assist customers with their needs for analytical services. Customer feedback, both positive and negative, is shared with personnel and used to identify opportunities for improvement.
- The laboratory maintains a quality program that complies with applicable, state, federal, industry standards for analytical testing and competency.

  ISO/IEC 17025 and the TNI (The NELAC Institute) Standard is used by PAS to establish the minimum requirements of the PAS quality program.

ISO/IEC 17025 is a competency standard that outlines the general requirements for the management system for calibration and testing laboratories. It is the primary quality system standard from which other quality system standards, such as the TNI Standard, are based. The TNI Standard are consensus standards that provides management and technical requirements for laboratories performing environmental analysis.

- Laboratory management provides training to personnel so that all personnel are familiar with the quality management system outlined in this manual and that they understand that implementation of the quality management system is achieved by adherence to the organization's policies and procedures.
- Laboratory management continuously evaluates and improves the effectiveness of the quality management system by responding to customer feedback, and other measures of performance, such as but not limited to: the results of internal/external audits, proficiency testing, metrics, trend reports, and annual and periodic management reviews.

4.2.2.1 Ethics Policy / Data Integrity Program

PAS has established a comprehensive ethics and data integrity program that is communicated to all PAS employees in order that they understand what is expected of them. The program is designed to promote a mindset of ethical behavior and professional conduct that is applied to all work activities.

The key elements of the PAS Ethics / Data Integrity Program include:

- Ethics Policy (COR-POL-0004);
- Ethics Compliance Officer;
- Standardized data integrity training course taken by all new employees on hire and a yearly refresher data integrity training course for all existing employees;
- Policy Acknowledgement Statements that all PAS personnel, including contract and temporary, are required to sign at the time of employment and again during annual refresher training to document the employee's commitment and obligation to abide by the company's standards for ethics, data integrity and confidentiality;
- SOPs that provide instructions for how to carry out a test method or process to assure tasks are done correctly and consistently by each employee;
- On the Job Training;
- Data integrity monitoring activities which include, but are not limited to, secondary and tertiary data review, internal technical and system audits, raw data audits, data mining scans, and proficiency testing; and
- Confidential reporting process for alleged ethics and data integrity issues.

All laboratory managers are expected to provide a work environment where personnel feel safe and can report unethical or improper behavior in complete confidence without fear of retaliation. Retaliation against any employee that reports a concern is not tolerated.

PAS has engaged Lighthouse Services, Inc. to provide personnel with an anonymous reporting process available to them 24 hours a day/7 days per week. The alert line may be used by any employee to report possible violations of the company's ethics and data integrity program. When using the reporting process, the employee does need to specify the location of concern and when reporting by email, also include the company name. Messages are collected, documented, reviewed, and will be followed up on by the Ethics Compliance Officer to resolve the matter. Investigations concerning data integrity are kept confidential.

Lighthouse Compliance Alert Lines:

English Speaking US & Canada	(844) 940-0003
Spanish Speaking North America	(800) 216-1288
Internet	www.lighthouse-services.com/pacelabs
Email	reports@lighthouse-services.com

4.2.3 Management Commitment: Quality Management System

Evidence of management's commitment for the development, maintenance, and on-going improvement of the quality management system is provided by the application of their signature of approval to this manual. Their signature confirms they understand their responsibility to implement the quality management system outlined in this manual, to communicate the quality program to personnel, and to uphold requirements of the program during work activities.

4.2.4 Management Commitment: Customer Service

Management communicates the importance of meeting customer and regulatory requirements to personnel by training personnel on the quality management system outlined in this manual, implementing the quality management system outlined in this manual, and upholding these requirements for all work activities.

4.2.5 Supporting Procedures

Documents that support this manual and quality management system are referenced throughout this manual. The structure of the document management system is outlined in SOP ENV-SOP-CORQ-0015 *Document Management and Control* and summarized in the following subsections.

4.2.5.1 Quality Management System Document Structure

Documents associated with the quality management system are classified into document types that identify the purpose of the document and establish how the document is managed and controlled.

Document types are ranked to establish which documents takes precedence when there is an actual or perceived conflict between documents and to establish the hierarchal relationships between documents. The ranking system also provides information to document writers and reviewers to assure downline documents are in agreement with documents of higher rank. Project specific documents are not ranked because client specific requirements are not incorporated into general use documents in order to maintain client confidentiality.

PAS Quality Management System Documents: Internal

Document Type	Purpose
Quality Manual	Outlines the laboratory's quality management system and structure and how it works for a system including policy, goals, objectives and detailed explanation of the system and the requirements for implementation of system. Includes roles and responsibilities, relationships, procedures, systems and other information necessary to meet the objectives of the system described.
Policy	Provide requirements and rules for a PAS process and is used to set course of actions and to guide and influence decisions. Policy describes the "what", not the "how".
Standard Operating Procedure	Provide written and consistent set of instructions or steps for execution of a routine process, method, or set of tasks performed by PAS. Includes both fundamental and operational elements for implementation of the systems described in PAS manual(s). Assures that activities are performed properly in accordance with applicable requirements. Designed to ensure consistency, protect EHS of employees and environment, prevent failure in the process and ensure compliance with company and regulatory requirements. SOPs describes the "how" based on policy.
Standard Work Instruction	Provide step by step visual and/or written instruction to carry out a specific task to improve competency, minimize variability, reduce work injury and strain, or to boost efficiency and quality of work (performance). SWI are associated with an SOP unless the task described is unrelated to generation of or contribution to environmental data or analytical results.
Template	Pre-formatted document that serves as a starting point for a new document.
Guide	Provide assistance to carry out a task. Most often used for software applications.
Form	Used for a variety of purposes such as to provide a standardized format to record observations, to provide information to supplement an SOP.

PAS Quality Management System Documents: External

Certificate	Lists parameters, methods, and matrices for which the laboratory is certified/accredited to perform within the jurisdiction of the issuing regulatory agency or accreditation body.
Reference Document	Provide information, protocol, instructions, and/or requirements. Issued by the specifier. Examples include quality system standards such as ISO/IEC, TNI, DoD and published referenced methods such as Standard Methods, ASTM, SW846, EPA, and federal and state regulatory bodies.
Project Document	Provides requirements necessary to meet individual client expectations for intended use of data. Examples include: project quality assurance plans (QAPP), client-program technical specifications, contracts, and other agreements.

Document Hierarchy

Rank	Document
1	Reference Documents
2	Corporate Manual
3	Corporate Policy
4	Corporate SOP
5	Corporate SWI, Templates & Forms
6	Laboratory Manual
7	Laboratory SOP
8	Laboratory SWI, Templates, & Forms
NA	Project Documents[1]

4.2.6 Roles and Responsibilities

The roles and responsibilities of technical management and of the quality manager are provided in section 4.1.5.1.2.

4.2.7 Change Management

When significant changes to the quality management system are planned, these changes are managed by corporate quality personnel to assure that the integrity of the quality management system is maintained.

4.3 Document Control

4.3.1 General

The laboratory's procedures for document control are provided in SOP ENV-SOP-CORQ-0015 *Document Management and Control.*

The documents that support the quality management system include internally generated documents such as manuals, policies, standard operating procedures, standard work instructions, forms, guides, and templates and external source documents such as but not limited to, regulations, standards, reference methods, manuals, and project-specific documents.

The laboratory uses electronic document management software (eDMS) to carry out the procedures of the SOP. eDMS automates the process for unique document identification, version control, approval, access, and archival.

4.3.2 Document Approval and Issue

Documents that are part of the quality management system are reviewed by qualified personnel and approved by laboratory management prior by to release for general use.

Local QA maintains a master list of controlled documents used at the laboratory. The master list includes the document control number, document title, and current revision status and is made available to personnel for their reference.

Only the approved versions of documents are available to personnel for use. The eDMS system does not allow user access to draft versions of documents except to personnel assigned to work on the draft. eDMS also restricts access to archived documents except to authorized users, such as local QA, in order to prevent the use of obsolete documents.

See SOP ENV-SOP-CORQ-0015 *Document Management and Control* for more information.

4.3.3 Document Review and Change

Unless a more frequent review is required by regulatory, certification or accreditation program. the laboratory formally reviews documents at least every two years to ensure the document remains current, appropriate, and relevant.

Documents are also informally reviewed every time the document is used. Personnel are expected to refer to and follow instructions in controlled documents when they carry out their work activities. Consequently, any concerns or problems with the document should be caught and brought to the attention of laboratory management on an on-going basis.

Documents are revised whenever necessary to ensure the document remains usable and correct. Older document versions and documents no longer needed are made obsolete and archived for historical purposes.

The laboratory does not allow hand-edits to documents. If an interim change is needed pending re-issue of the document, the interim change is communicated to those that use the document using a formal communication channel, such as SOP Change in Progress form, email, or memorandum.

The document review, revision, and archival process is managed by local QA at the location from which the document was released using the procedures established in SOP ENV-SOP-CORQ-0015 *Document Management and Control*.

4.4 Analytical Service Request, Tender, and Contract Review

The laboratory's management and/or client service personnel perform thorough reviews of requests and contracts for analytical services to verify the laboratory has the capability, capacity, and resources necessary to successfully meet the customer's needs. These review procedures are described in laboratory SOP ENV-SOP-NW-0019 *Review of Analytical Requests*.

The procedures in this SOP(s) are established to ensure that:

- The laboratory understands the purpose of data collection in order to ensure the test methods requested are appropriate for the intended use of the data and capable of meeting the client's data quality objectives;
- The laboratory and any subcontractor has the capability, capacity, and resources to meet the project requirements and expectations within the requested time frame for delivery of work product;
- Any concerns that arise from review are discussed and resolved with the client; and
- The results of review and any correspondence with the client related to this process and/or any changes made to the contract are recorded and retained for historical purposes.

Capability review confirms that the in-network laboratories and any potential subcontractors hold required certification/accreditation for the test method, matrix, and analyte and verifies the laboratory can achieve the client's target compound list and data quality objectives (DQOs) for analytical sensitivity and reporting limits, QA/QC protocol, and hardcopy test report and electronic data deliverable (EDD) formats.

Capacity review verifies that the in-network laboratories and any potential subcontractors are able to handle the sample load and deliver work production within the delivery time-frame requested.

Resource review verifies that the laboratory and any potential subcontractors have adequate qualified personnel with the skills and competency to perform the test methods and services requested and sufficient and proper equipment and instrumentation needed to perform the services requested.

4.5 Subcontracting and In-Network Work Transfer

The terms 'subcontract' and "subcontracting" refers to work sent to a business external to PAS Analytical Services, LLC (PAS) and the term 'subcontractor' refers to these external businesses, which are also called vendors.

Work transferred within the PAS network is referred to as interregional work orders (IRWO) and network laboratories are referred to as IRWO or network laboratory.

The network of PAS laboratories offers comprehensive analytical capability and capacity to ensure PAS can meet a diverse range of client needs for any type of project. If the laboratory receives a request for analytical services and it cannot fulfill the project specifications, the laboratory's client services team will work with the client to place the work within the PAS network. When it is not possible to place the work within network, the laboratory will, with client approval, subcontract the work to a subcontractor that has the capabilities to meet the project specifications and can meet the same commitment agreed on between the laboratory and the client. Some client programs require client consent even for IRWO work transfer, and when this applies, the client services team obtains consent as required. The laboratory retains the record of client notification and their consent in the project record for historical purposes.

Whenever work is transferred to a subcontractor or an IRWO laboratory, the laboratory responsible for management of the project verifies each of these qualifications:

- The subcontractor or IRWO laboratory has the proper accreditation/certifications required for the project and these are current; and
- The use of the subcontractor or IRWO laboratory is approved by the client and/or regulatory agency, when approval is required. Record of approval is retained in the project record.

When possible, the laboratory selects subcontractors that maintain a quality management system similar to PAS and that complies with ISO/IEC 17025 and the TNI Standard(s).

PAS also evaluates and pre-qualifies subcontractors as part of company's procurement program. The complete list of approved vendors is maintained by the corporate procurement department and is made available to all PAS locations. Pre-qualification of a subcontractor does not replace the requirement for the placing laboratory to verify the capability, capacity, and resources of any selected subcontractor on a project-specific basis to confirm the subcontractor can meet the client's needs.

For both subcontracting and in-network work transfer, the project specifications are always communicated to the subcontractor or the IRWO laboratory by the project manager so that the laboratory performing the work is aware of and understands these requirements.

The procedures for subcontracting are outlined in laboratory SOPs ENV-SOP-MIN4-0010 *Subcontracting Samples* (Minneapolis, MN, Billings, MT) and ENV-SOP-VIR1-0003 *Subcontracting Samples* (Virginia, MN, Duluth, MN).

4.6 Purchasing Services and Supplies

Vendors that provide services and supplies to the laboratory are prequalified by corporate procurement personnel to verify the vendor's capability to meet the needs of PAS. These needs include but are not limited to: competitive pricing, capacity to fill purchase orders, quality of product, customer service, and business reputation and stability. The records of vendor evaluation and the list of approved vendors is maintained by the corporate procurement department.

The laboratory may purchase goods and services from any supplier on the approved vendor list.

The specifications (type, class, grade, tolerance, purity, etc.) of supplies, equipment, reagents, standard reference materials and other consumables used in the testing process are specified in SOPs. The SOP specifications are based on the governing requirements of the approved reference methods and any additional program driven regulatory specification, such as drinking water compliance. All requisitions for materials and consumables are approved by the department supervisor to confirm the purchase conforms with specified requirements. After approval the requisition is handled by the laboratory's designated purchasing agent. On receipt, the product is inspected and verified before use, when applicable.

The laboratory's procedure for the purchase of services and supplies is specified in laboratory SOP ENV-SOP-NW-0030 *Laboratory Supply Procedures*.

4.7 Customer Service

Project details and management is handled by the laboratory's customer service team. Each customer is assigned a Project Manager (PM) that is responsible for review of contract requirements and handling laboratory to customer communication about the project status.

4.7.1 Commitment to Meet Customer Expectations

The laboratory cooperates and works closely with our customers to ensure their needs are met and to establish their confidence in the laboratory's capability to meet their needs for analytical services and expectations for service.

Each customer's project is handled by a project manager (PM) that is the customer's primary point of contact. The PM gathers information from the customer to ensure the details of their request are understood. After samples are received, the PM monitors the progress of the project and alerts the customer of any delays or excursions that may adversely impact data usability. Laboratory supervisors are expected to keep the PM informed of project status and any delays or major issues, so that the PM can keep the client informed.

PAS also has a team of subject matter experts (SME) available to provide customers with advice and guidance and any other assistance needed. SME are selected by top management based on their knowledge, experience, and qualifications.

The laboratory encourages customers to visit the laboratory to learn more about the laboratory's capabilities, observe performance and to meet laboratory personnel.

PAS customers expect confidentiality. Laboratory personnel will not divulge or release information to a third party without proper authorization unless the information is required for litigation purposes. See Section 4.1.5.3 of this manual and policy COR-POL-0004 *Ethics Policy* for more information on the laboratory's policy for client confidentiality.

4.7.2 Customer Feedback

The laboratory actively seeks positive and negative feedback from customers through surveys and direct communication. Information from the client about their experience working with the laboratory and their satisfaction with work product is used to enhance processes and practices and to improve decision making. Customer feedback is communicated to laboratory management and corporate personnel in monthly reports and analyzed yearly during management review (See 4.15) to identify risk and opportunity. Corrective, preventive, or continuous improvement actions are taken based on nature of and/or feedback trends.

Also see sections 4.9, 4.10, 4.11, 4.12, 4.14, and 4.15 for more information about how customer feedback is managed by the laboratory and used to enhance the quality management system.

4.8 Complaints

Complaints provide opportunities to improve processes and build stronger working relationships with our clients.

The laboratory's complaint resolution process includes three steps. First, handle and resolve the complaint to mutual satisfaction. Second, perform corrective action to prevent recurrence (See 4.11). Third, record and track the complaint and use these records for risk and opportunity assessment and preventive action (See 4.12)

4.9 Nonconforming Work

4.9.1 Definition of Nonconforming Work

Nonconforming work is work that does not conform to customer requirements, standard specifications, laboratory policies and procedures, or that does not meet acceptance criteria.

The discovery of non-conforming work comes come from various sources which include, but are not limited to:

- results of quality control samples and instrument calibrations;
- quality checks on consumables and materials;
- general observations of laboratory personnel;
- data review;
- proficiency testing;
- internal and external audits;
- complaints and feedback;
- management review and reports; and
- regulatory and certification and accreditation actions.

The way in which the laboratory handles nonconforming work depends on the significance and impact (risk) of the issue. Some issues may simply require correction, others may require investigation, corrective action (See 4.11) and/or data recall (See 4.16). When the laboratory releases data and test results associated with nonconforming QC and acceptance criteria test results are qualified or non-conformances are noted in the final analytical report to apprise the data user of the situation. (See 5.10)

Nonconforming work also includes unauthorized departure from laboratory policies, procedures and test methods. Authorized departures are explained in the following subsections. Situations that do not conform to these conditions are considered unauthorized departure(s).

4.9.1.1 Authorized Departure from SOP

An authorized departure from a test method SOP is one that has been reviewed and approved by the Department Manager, Technical Manager, Acting Technical Manager for TNI, Quality Manager, or the General Manager. Review is conducted to confirm the departure does not conflict with regulatory compliance requirements for which the data will be used or does not adversely affect data integrity. The departure may originate from client request or may be necessary to overcome a problem.

An authorized departure from administrative or process-oriented SOP is typically necessary to correct an error in the SOP. These departure requests are reviewed and pre-approved by the local QA Manager. Documentation of SOP departures and approval decisions are retained by the laboratory as evidence that the departure was authorized. When necessary, approved departures from test method SOPs are noted in the final test report to advise the data user of any ramification to data quality.

4.9.1.2 Authorized Departure from Test Methods (Method Modifications)

When test results are associated to a published reference test method, the laboratory's test method SOP must be consistent with the test method. If the test method is mandated for use by a specific regulatory program such as drinking water or wastewater or a certification or accreditation program, such as TNI/NELAC, the SOP must also comply with or include these requirements. If the procedures in the SOP are modified from the test method, these modifications must be clearly identified in the SOP. The conditions under which the laboratory may establish an SOP that is modified from these reference documents, and what is considered a modification are specified in ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification*.

Modifications that do not meet the requirements of this SOP (ENV-SOP-CORQ-0011) are unauthorized. Client requests to deviate from the test method are handled as client requests to depart from the test method SOP since it is the SOP that the laboratory follows when performing work.

4.9.1.3 Stop Work Authority

Stop Work Authority provides laboratory personnel with the responsibility and obligation to stop work when there is a perceived unsafe condition or behavior that may result in an unwanted event.

All laboratory and corporate personnel have the authority to stop work when needed to preserve data integrity or safety of workers.

Once a stop work order has been initiated and the reason for doing so is confirmed valid; laboratory management is responsible for immediate correction and corrective action (see section 4.10) before resumption of work.

4.10 Continuous Improvement

The laboratory's quality management system is designed to achieve continuous improvement through the implementation of the quality policy and objectives outlined in this manual. Information about the laboratory's activities and performance is gained from many sources such as customer feedback, audits, QC, trend analysis, business analytics, management reports, proficiency testing, and management systems review. This information is subsequently used during the laboratory's corrective action (see section 4.11) and preventive action (see section 4.12) processes and to establish goals and objectives during annual review of the management system (see section 4.15).

PAS also promotes a continuous improvement culture based on the principles of lean manufacturing. These principles include 3P (Process, Productivity, Performance) and Kaizen. 3P is a platform used by Pace to share best practices and standardization across the network to achieve operational excellence. Kaizen is a team based process used to implement tools and philosophies of lean to reduce waste and achieve flow with the purpose of improving both external and internal customer satisfaction.

4.11 Corrective Action

Corrective action is process used to eliminate the cause of a detected nonconformity. It is not the same as a correction. A correction is an action taken to fix an immediate problem. The goal of the corrective action process is to find the underlying cause(s) of the problem and to put in place fixes to prevent the problem from happening again. The corrective action process, referred to as CAPA by PAS, is one of the most effective tools used by the laboratory to prevent nonconforming work, identify risk and opportunity, and improve service to our customers.

The laboratory has two general processes for corrective action:

The process used for actions taken in response to day to day quality control (QC) and acceptance criteria exceptions (nonconformance) that occur during the day to day testing process are called corrections. These events do not usually include formal methods for cause analysis; instead the reason for the failure is investigated through troubleshooting or other measures. Required actions for correction of routine nonconformance is specified in laboratory SOPs. When corrective action is not taken, cannot be taken, or is not successful, test results associated with the nonconforming work are qualified in the final test report. Documentation of the nonconformance and corrective action taken is documented in the analytical record.

A formal 7 step corrective action process is used when there is a problem or departure from the quality management system, technical activities, or when the extent of a single problem has significant impact on data, regulatory compliance or customer needs. These problems are identified through various activities such as but not limited to: quality control trends, internal and external audits, management review, customer feedback, and general observation.

The laboratory's 7 Step CAPA Process includes:

1) Define the Problem
2) Define the Scope of the Problem
3) Contain the Problem
4) Root Cause Analysis
5) Plan Corrective Action
6) Implement Corrective Action
7) Follow Up / Effectiveness Check

The formal CAPA process may be initiated by any employee. Once the process is initiated it is overseen and coordinated by laboratory management. The CAPA process is documented using an electronic or paper-based system. The CAPA record includes tracking information, dates, individuals involved, those responsible for action plan implementation and follow-up, and timelines and due dates.

For more information about the laboratory's procedure for corrective action, see laboratory SOP ENV-SOP-NW-0014 *Corrective Action/Preventive Action Process*. Additional explanation about certain aspects of the laboratory's corrective action process are outlined in the next three subsections.

4.11.1 Root Cause Analysis

Root cause analysis (RCA) is the process of investigation used by the laboratory to identify the underlying cause(s) of the problem. Once causal factors are identified, ways to mitigate the causal factors are reviewed and corrective action(s) most likely to eliminate the problem are selected.

The laboratory uses different methods to conduct this analysis. The most common approach is 5-Why, but fishbone diagrams, or even brainstorming may be appropriate depending on the situation. The method used is documented in the CAPA record.

4.11.2 Effectiveness Review

Monitoring corrective actions for effectiveness is shared by laboratory supervisors and quality assurance personnel. Effectiveness means the actions taken were sustainable and appropriate. Sustainable means the change is still in place. Appropriate means the action(s) taken prevented recurrence of the problem since the time corrective action was taken.

The time-frame in which effectiveness review takes place depends on the event and is recorded in the CAPA record with any addition actions that need to be taken.

Corrective action trends are also monitored by laboratory management and used to identify opportunities for preventive action or to gain lessons learned when actions taken were not adequate to solve the problem. See Section 4.12 (Preventive Action) and 4.15 (Management Review) for more information.

4.11.3 Additional Audits

When non-conformances or other problems cast doubt on compliance with the laboratory's policies, procedures, or compliance to regulatory requirements; laboratory management schedules a special audit of the area of activity in accordance with Section 4.14.1 as soon as possible. These special audits are used to determine the scope of the problem and to provide information for the CAPA process. Additional full-scale audits are done when a serious issue or risk to the laboratory's business is identified.

4.12 Preventive Action

Preventive action is an action taken to eliminate the cause of a potential nonconformity and to achieve improvement. Preventive action is a forward thinking process designed to prevent problems opposed to reacting to them (corrective action).

Some examples of preventative action include, but are not limited to:

- Scheduled instrument maintenance (Preventative maintenance)

- Addition of Staff and Equipment
- Professional Development Activities
- Implementation of New Technology

The laboratory looks for opportunities for preventive action from a variety of sources including but not limited to: employee idea's, customer feedback, business partners input, trend analysis, business analytics, management reviews, proficiency testing results, lean management events, and risk-benefit analysis.

The process for preventive actions follows the same 7 step process for corrective action except "problem" is replaced with "opportunity", "cause analysis" is replaced with "benefit analysis", and "corrective action" is replaced with "preventive action".

Laboratory management evaluates the success of preventive actions taken in any given year during annual management review. See Section 4.15 for more information.

4.12.1 Change Management

Preventive actions may sometimes result in significant changes to processes and procedures used by the laboratory. Laboratory management evaluates the risks and benefits of change and includes in its implementation of change process, actions to minimize or eliminate any risk. The types of changes for which risk are considered and managed include: infrastructure change, change in analytical service offerings, certification or accreditation status, instrumentation, LIMS changes, and changes in key personnel.

For more information about the laboratory's procedures for preventive action see laboratory SOP ENV-SOP-NW-0014 *Corrective Action/Preventive Action Process*.

4.13 Control of Records

A record is a piece of evidence about the past, especially an account of an act or occurrence kept in writing or some other permanent form. Laboratory records document laboratory activities and provide evidence of conformity to the requirements established in the quality management system. These records may be hardcopy or electronic on any form of media.

4.13.1 General Requirements

4.13.1.1 Procedure

The laboratory's procedures for control of records is provided in laboratory SOP ENV-SOP-NW-0026 *Data and Records Archival.*

The procedures in the SOP are established to assure quality and technical records are identified, retained, indexed, and filed to allow for retrieval during the entire retention time frame. During storage, records are kept secure and protected from deterioration. At the end of the retention time, the records are disposed of properly in order to maintain client confidentiality and to protect the interests of the company.

In general, laboratory records fall into three categories: quality, technical, and administrative.

Examples of each are provided in the following table:

Record Type	Includes Records of:
Quality	Documents: Document Types listed in SOP ENV-SOP-CORQ-016 Audits: Internal and External Certificates and Scopes of Accreditation Corrective & Preventive Action Management Review Data Investigations Method Validation Instrument Verification Training Records
Technical	Raw Data Logbooks Certificates of Traceability Analytical Record Test Reports & Project Information Technical Training Records & Demonstration of Capability
Administrative	Personnel Records Finance/Business

4.13.1.2 Record Legibility and Storage

Records are designed to be legible and to clearly identify the information recorded. Manual entries are made in indelible ink; automated entries are in a typeface and of sufficient resolution to be read. The records identify laboratory personnel that performed the activity or entered the information.

Records are archived and stored in a way that they are retrieved. Access to archived records is controlled and managed.

For records stored electronically, the capability to restore or retrieve the electronic record is maintained for the entire retention period. Hardcopy record are filed and stored in a suitable environment to protect from damage, deterioration, or loss. Hardcopy records may be scanned to PDF for retention. Scanned records must be checked against the hardcopy to verify the scan is complete and legible.

Records are kept for a minimum of 10 years unless otherwise specified by the client or regulatory program.

The date from which retention time is calculated depends on the record. In general, the retention time of technical records of original observation and measurement is calculated from the date the record is created. If the technical record is kept in a chronological logbook, the date of retention may be calculated from the date the logbook is archived. The retention time of test reports and project records, which are considered technical records, is calculated from the date the test report was issued. The retention time of quality records is usually calculated from the date the record is archived.

Refer to the laboratory's record management SOP for more information.

4.13.1.3 Security

The laboratory is a secure facility and access to records is restricted to laboratory personnel.

4.13.1.4 Electronic Records

The data systems used to store electronic records is backed up in accordance with laboratory SOP ENV-SOP-NW-0026 *Data and Records Archival*. Access to archived records stored electronically is maintained by personnel responsible for management of the electronic system.

4.13.2 Technical Records

In addition to the requirements identified in subsections 4.13.1.1 through 4.13.1.4, the requirements in the following subsections also apply to technical records.

4.13.2.1 Description

Technical records are the accumulation of data and information generated from the analytical process. These records may include forms, worksheets, workbooks, checklists, notes, raw data, calibration records, final test reports, and project record. The accumulated record essentially need to provide sufficient detail to historically reconstruct the process and identify the personnel that performed the tasks associated with a test result.

4.13.2.2 Real Time Recordkeeping

Personnel are instructed and expected to always record observations, data, and calculations at the time they are made. Laboratory managers are responsible to assure that data entries, whether made electronically or on hardcopy, are identifiable to the task.

4.13.2.3 Error Correction

Errors in records must never erased, deleted or made illegible. Use of correction fluid, such as white-out is prohibited. In hardcopy records, the error is corrected by a single-strike through the original entry and the new entry recorded alongside or footnoted to allow for readability. Corrections are initialed and dated by the person making the correction. If the correction is not self-explanatory, a reason for the correction is recorded.

For electronic records, equivalent measures of error correction or traceability of changes made is kept. For example, audit trails provide records of change.

Maintenance of proper practices for error correction is monitored through the tiered data review process described in Section 5.9.3. Laboratory records are reviewed throughout the data review process. Individuals performing these reviews flag errors that are not properly corrected and bring these to the attention of the department manager or supervisor of the work area in which the record was generated so that the problem may be addressed and corrected with the individual(s) that did not make the correction properly.

4.14 Audits

The laboratory performs internal systems and technical audits to assess compliance to this manual and to other laboratory procedures, such as policy, SOP and SWI. Since the processed in this manual are based on the relevant quality system standards and regulatory and accreditation/certification program requirements the laboratory provides services for, the internal audits also assess on-going compliance to these programs.

The laboratory is also audited by external parties such as regulatory agencies, customers, consultants and non-government assessment bodies (NGAB).

Information from internal and external audits is used by laboratory management to address compliance concerns and opportunities where improvement will increase the reliability of data.

Deficiencies, observations and recommendations from audits are managed by local QA using the laboratory's formal CAPA process. See Section 4.11 for more information.

4.14.1 Internal Audit

The laboratory's internal audit program is managed by local QA in accordance with a pre-determined audit schedule established at the beginning of each calendar year. The schedule is prepared to assure that all areas of the laboratory are reviewed over the course of the year. Conformance to the schedule is reported to both laboratory management and corporate quality personnel in a monthly QA report prepared by the quality manager.

Although the QA Manager creates the audit schedule, it is the shared responsibility of local QA and laboratory managers to assure the schedule is maintained. Laboratory supervisors cooperate with QA to provide the auditors with complete access to the work area, personnel, and records needed.

Internal audits are performed by personnel approved by the quality manager. In general, personnel may not audit their own activities unless it can be demonstrated that an effective and objective audit will be carried out. The auditor must be trained, qualified, and familiar enough with the objectives, principles, and procedures of laboratory operations to be able to perform a thorough and effective evaluation.

The laboratory's internal audit program includes:

- System Audits & Method Audits: The purpose of these audits is to determine if daily practice is consistent with laboratory's SOPs and if SOPs are compliant with adjunct policy and procedures. Auditing techniques includes analyst interviews and observation and records review. These audits are performed per the pre-determined schedule.

- Raw Data / Final Test Report Audits: The purpose of these audits is to review raw data and/or a final test reports to verify the final product is consistent with customer/project requirements and supported as compliant to SOPs, reference methods, with test results that are properly qualified when necessary, accurate, and of known and documented quality. The reviews should also identify opportunities for improvement and best practices.

- Special Audits: Special audits are those performed ad hoc to follow up on specific a specific issue such as a client complaint, negative feedback, concerns of data integrity or ethics, or a problem identified through other audits. Special audits may be scheduled or unscheduled. Unscheduled internal audits are conducted whenever doubts are cast on the laboratory's compliance with regulatory requirements or its own policies and procedures. These unscheduled internal audits may be conducted at any time and may be performed without an announcement to laboratory personnel.

When observations and findings from any audit (internal or external) cast doubt on the validity of the laboratory's testing results, the laboratory takes immediate action to initiate investigate the problem and take corrective action. (Also see 4.11 and 4.16)

The laboratory's internal audit program and auditing procedures are further described in laboratory SOP ENV-SOP-NW-0020 *Internal and External Audits*.

4.14.1.1 Corporate Compliance Audit

The laboratory may also be audited by corporate quality personnel to assess the laboratory's compliance to the company's quality management program and to evaluate the effectiveness of implementation of the policies and procedures that make up the quality management system. The purpose of the compliance audit is to identify risks and opportunities and to assist laboratory management achieve the goals and objectives of the company's quality program.

4.15 Management Review

The laboratory's management team formally reviews the management system on an annual basis to assess for on-going suitability and effectiveness and to establish goals, objectives, and action plans for the upcoming year.

At a minimum, following topics are reviewed and discussed:

- The on-going suitability of policies and procedures including HSE (Health, Safety and Environment) and waste management;
- Reports from managerial and supervisory personnel including topics discussed at regular management meetings held throughout the year;
- The outcome of recent internal audits;
- Corrective and preventive actions;
- Assessments by external bodies;
- The results of interlaboratory comparisons or proficiency tests;
- Changes in the volume and type of the work;
- Customer and personnel feedback, including complaints;
- Effectiveness of improvements / preventive actions made since last review;
- Internal and external issues of relevance and risk identification;
- A review of the status of actions from prior management reviews; and
- Other relevant factors, such as quality control activities, resources, and staff training.

The discussion and results of this review are documented in a formal report prepared by laboratory management. This report includes a determination of the effectiveness of the management system and its processes; goals and objectives for improvements in the coming year with timelines and responsibilities, any other need for change. See laboratory SOP ENV-SOP-CORQ-0005 *Review of Laboratory Management System* for more information.

Goals and action items from annual management systems review are shared with employees to highlight focus areas for improvement in addition to areas in which the laboratory has excelled.

4.16 Data Integrity

The laboratory's procedures for data integrity reviews are described in SOP ENV-SOP-CORQ-0010 *Data Recall*.

Customers whose data are affected by these events are notified in a timely manner, usually within 30 days of discovery. Some accreditation programs also require notification to the accreditation body (AB) within a certain time-frame from date of discovery when the underlying cause of the issue impacts accreditation. The laboratory follows any program or project specific client notification requirements for notification, when applicable.

5.0 TECHNICAL REQUIREMENTS

5.1 General

Many factors contribute to the correctness and reliability of the technical work performed by the laboratory. These factors are fall under these general categories:

- Human Performance
- Facility and Environmental Conditions
- Test Method Performance and Validation
- Measurement Traceability
- Handling of Samples

The impact of each of these factors varies based on the type of work performed. To minimize negative effects from each these factors, the laboratory takes into account the contribution from each of these categories when developing test method and process (administrative) SOPs, evaluating personnel qualifications and competence, and in the selection of equipment and supplies used.

5.2 Personnel

5.2.1 Personnel Qualifications

The laboratory's program for personnel management is structured to ensure personnel are selected, qualified, and competent to perform the roles and responsibilities of their position based on education, experience, and training.

Qualifications, duties, responsibilities, and authorities of each position are specified in job descriptions maintained by corporate HR (See Section 5.2.4). These job descriptions provide the general basis for the selection of personnel for hire and are used by the laboratory to communicate to personnel the duties, responsibilities, and authorities of their position.

The term "personnel" refers to individuals employed by the laboratory directly as full-time, part-time, or temporary, and individuals employed by the laboratory by contract, such as through an employment agency. The term "personnel" is used interchangeably with the term "employee" throughout this manual. For purposes of this manual, these terms are equivalent.

The personnel management program is structured to establish and maintain records for each of the following:

- Selection of personnel;
- Training of personnel;
- Supervision of personnel;
- Authorization of personnel; and
- Monitoring Competence of personnel.

5.2.1.1 Competence

Competence is the ability to apply a skill or series of skills to complete a task or series of tasks correctly within defined expectations.

Competence for technical personnel authorized by PAS to provide opinion and interpretation of data to customers also includes the demonstrated ability to:

- Apply knowledge, experience, and skills needed to safely and properly use equipment, instrumentation, and materials required to carry out testing and other work activities in accordance with manufacturer specifications and laboratory SOPs;
- Understand and apply knowledge of general regulatory requirements necessary to achieve regulatory compliance in work product; and
- Understand the significance of departures and deviations from procedure that may occur during the analytical testing process and the capability and initiative to troubleshoot and correct the problem, document the situation and decision making process, and to properly qualify the data and analytical results.

The laboratory's requirements for the competence of personnel (education, qualification, work experience, technical skills, and responsibilities) are specified in job descriptions created by management and kept by human resources (HR). The job description provides the basis for the selection of personnel for each position.

An employee is considered competent when he/she has completed required training.

The policies and standard operating procedures (SOPs) for the following topics are established by management as minimum required training for all personnel:

- Ethics and Data Integrity
- Quality Manual
- Safety Manual
- Quality Management System
- Technical Process and Procedure relevant to their job tasks
- Successful Demonstration of Capability (DOC) – Analytical Personnel Only

Personnel are initially authorized competent to independently carry out their assigned duties when required training is complete and documented.

Records of training and qualification provide the record of competence for the individual. Qualification records may include but are not limited to diploma, transcripts, and curriculum vitae (CV).

The on-going competence of each employee is monitored by laboratory management through on-the-job performance. Analytical employees are also required to successfully complete another demonstration capability for each test method performed on an annual basis.

5.2.2 Training

Training requirements are outlined in policies COR-POL-0023 *Mandatory Training Policy*. COR-POL-0004 *Ethics Policy*, and laboratory SOP ENV-SOP-NW-0025 *Employee Orientation and Training*. Additional training requirements may also be specified in other documents, such as manuals

5.2.2.1 Training Program and Goals

The laboratory's training program includes 4 elements:

- Identification of Training Needs
- Training Plan Development and Execution
- Documentation and Tracking
- Evaluation of Training Effectiveness

Laboratory management establishes goals and training needs for individual employees based on their role, education, experience, and on-the-job performance.

Training needs for all employees are based on business performance measures that include but are not limited to:

- Quality Control Trends
- Process Error / Rework Trends
- Proficiency Testing Results
- Internal & External Audit Performance
- Management Review Goals

Training is delivered using various methods that incorporate techniques that appeal to the main learning styles: visual, aural, linguistic, and kinesthetic. Techniques include, on-the-job, instructor-led, self-study, eLearning, and blended.

The employee's direct supervisor is responsible for oversight of the employee's training plan and for providing adequate time to the employee to complete training assignments. Both the supervisor and employee are responsible to make sure the employee's training status and training records are current and complete.

The laboratory's QA department monitors the training status of personnel and provides the status to the General Manager (GM) at least monthly or more frequently, if necessary. The status report is used by laboratory management to identify overdue training assignments, the reasons for the gaps, and to make arrangements for completion.

The following subsections highlight specific training requirements:

5.2.2.1.1 New Hire Training

New hire training requirements apply to new personnel and to existing employee's starting in a new position or different work area.

Required new hire training includes each of the following:

- Ethics and Data Integrity (See 5.2.2.1.3)
- Quality Manual / Quality Management System (See 5.2.2.1.4)
- Safety Manual and any training requirements specified in the manual.
- Policies & SOPs relevant to their job tasks
- Technical personnel that test samples must also successfully complete an initial demonstration of capability (IDOC) for the test methods performed before independently testing customer samples. (See 5.2.2.1.5). Independent testing means handling of client samples without direct supervision of the work activity by the supervisor or a qualified trainer.

All required training must be current and complete before the employee is authorized to work independently. Until then, the employee's direct supervisor is responsible for review and acceptance of the employee's work product.

5.2.2.1.2 On-Going Training

Personnel receive on-going training in each of the following topics:

- Ethics and Data Integrity (See 5.2.2.1.3)
- Quality Manual / Quality Management System (See 5.2.2.1.4)
- Safety Training
- Changes to Policies & SOPs
- Specialized Training
- Technical employees that carry of testing must also successfully complete on-going demonstration of capability (ODOC) for all test methods performed on an annual basis. (See 5.2.2.1.5)

Personnel are expected to maintain their training status and records of training current and complete and to complete training assignments in a timely manner.

5.2.2.1.3 Ethics and Data Integrity Training

Data integrity training is provided to all new personnel and refresher data integrity training is provided to all employees on an annual basis. Personnel are required to acknowledge they understand that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious consequences including immediate termination, debarment, or civil/criminal prosecution.

The initial data integrity training and the annual refresher training is documented with a signature attendance sheet or other form of documentation to provide evidence that the employee has participated in training on this topic and understand their obligations related to data integrity.

The following topics and activities are covered:

- Policy for honesty and full disclosure in all analytical reporting;
- Prohibited Practices;
- How and when to report data integrity issues;
- Record keeping. The training emphasizes the importance of proper written documentation on the part of the analyst with respect to those cases where analytical data may be useful, but are in one sense or another partially nonconforming;
- Training Program, including discussion regarding all data integrity procedures;
- Data integrity training documentation;
- In-depth procedures for data monitoring; and
- Specific examples of breaches of ethical behavior such as improper data manipulations, adjustments of instrument time clocks, and inappropriate changes in concentrations of standards.

All PAS personnel, including contract and temporary, are required to sign an "Attestation of Ethics and Confidentiality" at the time of employment and during annual refresher training. This document clearly identifies inappropriate and questionable behavior. Violations of this document result in serious consequences, including prosecution and termination, if necessary.

Also see SOP-ENV-COR-POL-0004 *Ethics Policy* for more information.

5.2.2.1.4 Management System Documents Training

PAS Manuals, policies, and SOPs are the primary documents used by regulatory bodies and PAS customers to verify the laboratory's capability, competency. and compliance with their requirements and expectations.

In addition to on-the-job training, employees must have a signed Read and Acknowledgement Statement on record for the laboratory quality manual, and the policies and SOPs relating to his/her job responsibilities. This statement when signed by the employee electronically or by wet signature, confirms that the employee has received, read, and understands the content of the document, that the employee agrees to follow the document when carrying out their work tasks; and the employee understands that unauthorized change to procedures in an SOP is not allowed except in accordance with the SOP departure policy (See 4.9.9.1) and SOP ENV-CORQ-0016 *Standard Operating Procedures and Standard Work Instructions* for more information.

5.2.2.1.5 Demonstration of Capability (DOC)

Technical employees must also complete an initial demonstration of capability (IDOC) prior to independent work on client samples analyzed by the test methods they perform. After successful IDOC, the employee must demonstrate continued proficiency (CDOC) for the test method on an annual basis. If more than a year has passed since the employee last performed the method; then capability must be re-established with an IDOC.

Demonstration of capability (IDOC and DOC) is based on the employee's capability to achieve acceptable precision and accuracy for each analyte reported by the laboratory for the test method using the laboratory's test method SOP.

Records of IDOC and ODOC are kept in the employee's training file.

For more information, see laboratory SOP ENV-SOP-NW-0025 *Orientation and Training Procedures.*

5.2.2.2 Effectiveness of Training

The results of the performance measures used to identify training needs are the same measures used by the laboratory to measure effectiveness of the training program. Improvement in key performance measures suggest the training program is successful. (See 5.2.2.1)

Effectiveness of individual employee training is measured by their demonstrated ability to comprehend the training material and apply knowledge and skills gained to their job task. Measurements include but are not limited to:

- Testing of the employee's knowledge of the quality management system, policies, and technical and administrative procedures through various mechanisms, such as quizzes, observation, and interviews.
- Demonstrated ability to convey information correctly and factually in written and verbal communication to internal and external parties.
- Demonstrated ability to carry out tasks in accordance with SOPs and other work instructions.
- Demonstrated ability to make sound decisions based on guidance and information available.
- Demonstrated initiative to seek help or guidance when the employee is unsure of how to proceed.

5.2.3 Personnel Supervision

Every employee is assigned a direct supervisor, however named, who is responsible for their supervision. Supervision is the set of activities carried out by the supervisor to oversee the progress and productivity of the employees that report to them.

General supervisory responsibilities may include but are not limited to:

- Hiring Employees
- Training Employees
- Performance Management
- Development, oversight, and execution of personnel training plans
- Monitoring personnel work product to assure the work is carried out in accordance with this quality manual, policies, SOPs, and other documents that support the quality management system.

5.2.4 Job Descriptions

Job Descriptions that define the required education, qualifications, experience, skills, roles and responsibilities, and reporting relationships for each PAS position are established by top management and kept by corporate HR. PAS laboratories use these job descriptions as the source of positions and job titles for the laboratory. The job descriptions apply to employees who are directly employed by PAS, part-time, temporary, technical and administrative and by those that are under contract with PAS through other means.

The job descriptions include the education, expertise, and experience required for the position and the responsibilities and duties, including any supervisory or managerial duties assigned to the position.

5.2.5 Authorization of Technical Personnel

Laboratory management authorizes technical personnel to perform the technical aspects of their position after it has been verified that the employee meets the qualifications for the position, has successfully completed required training, and the employee has demonstrated capability. After initial authorization, technical personnel are expected to maintain a current and complete training record, demonstrate on-going capability at least annually for each test method performed, and produce reliable results through accurate analysis of certified reference materials, proficiency testing samples, and/or routine quality control samples in order to remain authorized to continue to perform their duties.

Records to support authorization including, education, experience, training, and other evaluations are kept by the laboratory.

5.3 Accommodations and Facilities

5.3.1 Facilities

The laboratory is designed to support the correct performance of procedures and to not adversely affect measurement integrity or safety. Access to the laboratory is controlled by various measures, such as card access, locked doors, main entry. Visitors to the laboratory are required to sign-in and to be escorted by laboratory personnel during their visit. A visitor is any person that is not an employee of the laboratory.

5.3.2 Environmental Conditions

The laboratory is equipped with energy sources, lighting, heating, and ventilation necessary to facilitate proper performance of calibrations and tests. The laboratory ensures that housekeeping, electromagnetic interference, humidity, line voltage, temperature, sound and vibration levels are appropriately controlled to ensure the integrity of specific measurement results and to prevent adverse effects on accuracy or increases in the uncertainty of each measurement.

Environmental conditions are monitored, controlled, and recorded as required by the relevant specifications, methods, and procedures. Laboratory operations are stopped if it is discovered that the laboratory's environmental conditions jeopardize the analytical results.

5.3.3 Separation of Incompatible Activities

The layout and infrastructure of each work area including air handling systems, power supplies, and gas supplies of each laboratory work area is specifically designed for the type of analytical activity performed. Effective separation between incompatible work activities is maintained. For example, sample storage, preparation, and chemical handling for volatile organic analysis (VOA) is kept separate from semi-volatile organic (SVOA).

The laboratory separates samples known or suspected to contain high concentration of analytes from other samples to avoid the possibility for cross-contamination. If contamination is found, the source of contamination is investigated and resolved in accordance with laboratory SOPs.

5.3.4 Laboratory Security

Security is maintained by controlled access to the building and by surveillance of work areas by authorized personnel. Access is controlled to each area depending on the required personnel, the sensitivity of the operations performed, and possible safety concerns. The main entrance is kept unlocked during normal business hours for visitors, and is continuously monitored by laboratory staff. All visitors must sign a visitor's log, and a staff member must accompany them during the duration of their stay.

5.3.5 Good Housekeeping

The laboratory ensures good housekeeping practices in work areas to maintain a standard of cleanliness necessary for analytical integrity and personnel health and safety. Minimally, these measure include regular cleaning of the work area. Where necessary, areas are periodically monitored to detect and resolve specific contamination and/or possible safety issues.

5.4 Test Methods

5.4.1 General Requirements

The laboratory uses test methods and procedures that are appropriate for the scope of analytical services the laboratory offers.

Instructions on the use and operation of equipment and sample handling, preparation, and analysis of samples are provided in SOPs. The instructions in SOPs may be supplemented with other documents including but not limited to, standard work instructions (SWI), manuals, guides, project documents and reference documents.

These documents are managed using the procedures described in SOP ENV-SOP-CORQ-0015 *Document Management and Control* and SOP ENV-SOP-CORQ-0016 *Standard Operating Procedures and Standard Work Instructions.*

Deviations to test method and SOPs are allowed under certain circumstances. See sections 4.9.1.1 and 4.9.1.2 for more information.

5.4.2 Method Selection

The test methods and protocols used by the laboratory are selected to meet the needs of the customer, are appropriate for the item tested and intended use of the data, and to conform with regulatory requirements when regulatory requirements apply.

In general, the test methods offered are industry accepted methods published by international, regional, or national standards. The laboratory bases its procedure on the latest approved edition of a method unless it is not appropriate or possible to do so or unless regulatory requirements specify otherwise.

The laboratory confirms that it can perform the test method and achieve desired outcome before analyzing samples (see section 5.4.5). If there is a change in the published analytical method, then the confirmation is repeated.

When a customer does not specify the test method(s) to be used, the laboratory may suggest test methods that are appropriate for the intended use of the data and the type of samples to be tested. The laboratory will also inform customers when test methods requested are considered inappropriate for their purpose and/or out of date. This discourse takes place during review of analytical service requests (See Section 4.4).

5.4.3 Laboratory Developed Methods

A laboratory developed method is a method developed from scratch (no published source method), a procedure that modifies the chemistry from the source method, or a procedure that exceeds the scope and application of the source method.

Laboratory developed methods must be validated prior to use (see section 5.4.5) and the procedure documented in a test method SOP.

The requirements for non-standard methods (Section 5.4.4) also apply to laboratory developed methods.

5.4.4 Non-standard Methods

A non-standard method is a method that is not published or approved for use by conventional industry standards for the intended purpose of the data. Non-standard methods must be validated prior to use (see section 5.4.5) and the procedure developed and documented in a test method SOP.

At a minimum, the following information must be included in the procedure:

- Title / Identification of Method;
- Scope and Application;
- Description of the type of item to be analyzed;
- Parameters or quantities and ranges to be determined;
- Apparatus and equipment, including technical performance requirements;
- Reference standards and reference materials required;
- Environmental conditions required and any stabilization period needed
- Description of the procedure, including:
    - Affixing identification marks, handling, transporting, storing and preparing of items;
    - Checks to be made before the work is started;
    - Verifying equipment function and, where required, calibrating and/or adjusting the equipment before each use;
    - Method of recording the observations and results;
    - Any safety measures to be observed;
    - Criteria and/or requirements for approval/rejection;
    - Data to be recorded and method of analysis and presentation; and
    - Uncertainty or procedure for estimating uncertainty.

Use of a non-standard method for testing must be agreed upon with the customer. The agreement, which is retained by the laboratory in the project record, must include the specifications of the client's requirements, the purpose of testing, and their authorization for use of the non-standard method.

5.4.5 Method Validation

5.4.5.1 Validation Description

Validation is the process of conformation and the provision of objective evidence that the stated requirements for a specific method/procedure are fulfilled.

The laboratory's requirements and procedures for method validation are outlined in SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification.*

5.4.5.2 Validation Summary

All test methods offered by the laboratory are validated before use to confirm the procedure works and the data and results achieved meet the goals for the method. The extent of validation performed is based on technology and other factors as defined in the validation SOP (ENV-SOP-CORQ-0011).

Results of validation are retained are kept in accordance with the laboratory's SOP ENV-SOP-NW-0026 *Data and Records Archival* for retention of technical records.

The need to repeat validation is assessed by laboratory management when there are changes to the test method.

5.4.5.3 Validation of Customer Need

Laboratory management reviews the results of test method validation, which include accuracy, precision, sensitivity, selectivity, linearity, repeatability, reproducibility, robustness, and cross-sensitivity, against general customer needs to ensure the laboratory's procedure for the test method will meet those needs.

The review procedure is detailed in SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification.*

The following subsections highlight some of these concepts:

5.4.5.3.1 Accuracy

Accuracy is the degree to which the result of a measurement, calculation, or specification conforms to the correct value or a standard. When the result recovers within a range from the known value (control limit); the result generated using the laboratory's test method SOP is considered accurate.

5.4.5.3.2 Precision

Precision refers to the closeness of two or more measurements to each other. It is generally measured by calculating the relative percent difference (RPD) or relative standard deviation (RSD) from results of separate analysis of the same sample. Precision provides information about repeatability, reproducibility, and robustness of the laboratory's procedure.

5.4.5.3.3 Limits of Detection (LOD) (Chemistry)

The LOD is the minimum result which can be reliably discriminated from a blank with a predetermined confidence level. The LOD establishes the limit of method sensitivity and is also known as the detection limit (DL) or the method detection limit (MDL).

Values below the LOD cannot be reliably measured and are not reported by the laboratory unless otherwise specified by regulatory program or test method.

The LOD is established during method validation and after major changes to the analytical system or procedure that affect sensitivity are made.

The laboratory's procedure for LOD determination is detailed in laboratory SOP ENV-SOP-NW-0018 *Determination of LOD and LOQ*. The SOP complies with 40 CFR 136 Appendix B or the current industry approved and accepted guidance for this process.

5.4.5.3.4 Limits of Quantitation (LOQ) and Reporting Limit (RL)

The LOQ is the minimum level, concentration, or quantity of a target analyte that can be reported with a specified degree of confidence. The LOQ is established at the same time as the LOD. The laboratory's procedure for determination and verification of the LOQ is detailed in laboratory SOP ENV-SOP-NW-0018 *Determination of LOD and LOQ*.

The LLOQ is the value of the lowest calibration standard. The LOQ establishes the lower limit of quantitation.

The LOQ and LLOQ represent quantitative sensitivity of the test method.

- The LOQ must always be equal to or greater than the LLOQ and the LLOQ must always be greater than the LOD.
- Any reported value (detect or non-detect) less than the LLOQ is a qualitative value.

The RL is the value to which the presence of a target analyte is reported as detected or not-detected. The RL is project-defined based on project data quality objectives (DQO). In the absence of project specific requirements, the RL is usually set to the LOQ or the LLOQ. Depending on the relationship of the RL to the LLOQ or LOQ, both the RL value may be or quantitative.

For more information, refer to laboratory SOP ENV-SOP-NW-0018 *Determination of LOD and LOQ*.

5.4.5.3.5 Linearity

Linearity is a mathematical concept applied to calibration models that employ multiple points to establish a calibration range used for quantitative analysis. Linearity is measured differently based on the calibration model. In general, if linearity is demonstrated than the slope of the response of standards are sufficiently close to one another. The accuracy of the linear regression and non-linear curves is verified by checking percent error or relative standard error (RSE), which is the process of refitting calibration data back to the model to determine if the results are accurate. For linear curves that use average calibration or response factor, error is measured by relative standard difference (RSD).

Linearity also establishes the range of quantitation for the test method used which directly impacts the sensitivity of the test method and uncertainty in measurement results. As previously noted, the LLOQ establishes the lower limit of quantitation. Similarly, the upper range of linearity establishes the upper limit of quantitation. In general, results outside of this range are considered qualitative values. However, some inorganic methods allow for extension of the linear range above the upper limit of quantitation when accuracy at this value is verified.

Linearity can also be used to establish repeatability, reproducibility, and robustness of the laboratory's test method. When linearity is demonstrated using a specific calibration model during method validation, then use of this same calibration model to achieve linearity on a day to day basis confirms the laboratory's method is repeatable, reproducible, and robust.

5.4.5.3.6 Demonstration of Capability (DOC)

The DOC performed during method validation confirms that the test method acceptable precision and accuracy. The procedure used for DOC for method validation is the same as described in section 5.2.2.1.5 for demonstration of analyst capability.

5.4.6 Measurement Uncertainty

The laboratory provides an estimate of uncertainty in testing measurements when required or on client request. In general, the uncertainty of the test method is reflected in the control limits used to evaluate QC performance. (See 5.9.1.1.10). ISO/IEC supports this concept with language that reads when a well-recognized test method specifies limits to the values of the major source of uncertainty of measurement and specifies the form of presentation of calculated results, the laboratory has satisfied the requirements on analytical uncertainty by following the test method and reporting instructions.

When measurement uncertainty cannot be satisfied through control limits, the laboratory will provide a reasonable estimation of uncertainty. A reasonable estimation is based on knowledge of method performance and previous experience. When estimating the analytical uncertainty, all uncertainty components which are of importance in the given situation are taken into account.

5.4.7 Control of Data

The laboratory has policies and processes in place to assure that reported data is free from calculation and transcription errors, that quality control is reviewed and evaluated before data is reported, and to address manual calculation and integration.

5.4.7.1 Calculations, Data Transfer, Reduction and Review

Whenever possible, calculations, transfer of data, and data reduction are performed using validated software programs. (See 5.4.7.2)

If manual calculations are necessary, the results of these calculations are verified during the data review process outlined in section 5.9.3.

5.4.7.1.1 Manual Integration

The laboratory's policy and procedures for manual integration are provided in SOP ENV-SOP-CORQ-0006 *Manual Integration*.

This SOP includes the conditions under which manual integration is allowed and the requirements for documentation.

Required documentation of manual integration includes:

- complete audit trail to permit reconstruction of before and after results;
- identification of the analyst that performed the integration and the reason the integration was performed; and
- the individual(s) that reviewed the integration and verified the integration was done and documented in compliance with the SOP.

5.4.7.2 Use of Computers and Automated Acquisition

Whenever possible the laboratory uses software and automation for the acquisition, processing, recording, reporting, storage, and/or retrieval of data.

Software applications developed by PAS are validated by corporate IT for adequacy before release for general use. Commercial off the shelf software is considered sufficiently validated when the laboratory follows the manufacturer or vendor's manual for set-up and use. Records of validation are kept by the corporate information technology (IT) group or by the local laboratory, whichever group performed the validation.

The laboratory's process for the protection of data stored in electronic systems include:

- Individual user names and passwords for Laboratory Information Management Systems (LIMS) and auxiliary systems used to store or process data.
- Employee Training in Computer Security Awareness
- Validation of spreadsheets used for calculations to verify formulas and logic yield correct results and protection of these cells to prevent unauthorized change.
- Operating system and file access safeguards
- Protection from Computer Viruses
- Regular system backup; and testing of retrieved data

The laboratory's process for software development and testing process includes:

- Verification the software application works as expected and is adequate for use and fulfills compliance requirements, such as the need to record date/time of data generation.
- Change control to assure requests for changes are reviewed and approved by management before the change is made.
- Communication channels to assure all staff are aware of changes made.
- Version Control and maintenance of historical records.

These procedures are detailed in Corporate policies COR-POL-0010 *IT Policy* and COR-POL-0012 *Pace User Virus Protection Policy* and laboratory SOP ENV-SOP-MIN4-0036 *Avalon Software Development*.

5.5 Equipment

5.5.1 Availability of Equipment

The laboratory is furnished with all equipment and instrumentation necessary to correctly perform the tests offered in compliance with the specifications of the test method and to achieve the accuracy and sensitivity required.

5.5.2 Calibration

Equipment and instrumentation is checked prior to use to verify it performs within tolerance for its intended application.

Laboratory management is made aware of the status of equipment and instrumentation and any needs for either on a daily basis. This information is obtained during laboratory walkthroughs (LDM) that are conducted as part of the laboratory's lean program.

5.5.2.1 Support Equipment

The laboratory confirms support equipment is in proper working order and meets the specifications for general laboratory use prior to placement in service and with intermediate checks thereafter. Equipment that does not meet specifications is removed from service until repaired or replaced. Records of repair and maintenance activities are maintained.

Procedures used to carry out and record these checks are outlined laboratory SOP ENV-SOP-NW-0016 *Support Equipment*.

5.5.2.2 Analytical Instruments

Analytical instruments are checked prior to placement in service in accordance with SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification*. After the initial service date, the calibration of instruments and verification calibration is performed in accordance with local test method SOPs.

The calibration procedures in the test method SOPs comply with the requirements for acceptable calibration practices outlined in corporate document ENV-SOT-CORQ-0026 *Acceptable Calibration Practices*, the reference methods, and any applicable regulatory or program requirements.

5.5.3 Equipment Use and Operation

Equipment is operated and maintained by laboratory personnel that are trained on the test method SOP. Up-to-date instructions and procedures for the use and maintenance of analytical equipment are included in SOPs and/or supplemental documents such as standard work instructions (SWI) or instrument manuals which are made readily accessible in the work area to all laboratory personnel.

5.5.4 Equipment Identification

The laboratory uniquely identifies equipment by serial number or any other unique ID system, when practical. The identifier is included in the equipment list maintained by QA.

5.5.5 Equipment Lists and Records

5.5.5.1 Equipment List

The laboratory maintains a master list of equipment that includes information about the equipment including a description, manufacturer, serial number, date placed in service, condition when received, identity, and the current location in the laboratory. The date of purchase is tracked by the procurement record. The equipment list(s) for each location covered by this manual is provided in Appendix F.

5.5.5.2 Equipment Records

In addition to the equipment list, the laboratory maintains records of equipment that include:

- Verification that equipment conforms with specifications.
- Calibration records including dates, results, acceptance criteria, and next calibration dates.
- Maintenance plan and records
- Records of damage, malfunction, or repair

The laboratory follows an equipment maintenance program designed to optimize performance and to prevent instrument failure which is described in laboratory SOPs ENV-SOP-MIN4-0091 *Preventative, Routine, and Non-Routine Maintenance* (Minneapolis, MN, Billings, MT) and ENV-SOP-VIR1-0005 *Preventative, Routine, and Non-Routine Maintenance* (Virginia, MN, Duluth, MN) or individual test method SOPs.

The maintenance program includes routine maintenance activities which are performed as recommended by the manufacturer at the frequency recommended and non-routine maintenance, which is performed to resolve a specific problem such as degradation of peak resolution, shift in calibration relationship, loss of sensitivity, or repeat failure of instrument performance checks and quality control samples.

Maintenance is performed by laboratory personnel or by outside service providers.

All maintenance activities performed by laboratory personnel are recorded by the individual(s) that performed the activity at the time the maintenance was performed in an instrument maintenance log.

The maintenance record minimally includes the date of maintenance, the initials of the person(s) performing maintenance, a description of the activity performed, why (when the maintenance is non-routine), and the return to analytical control. When maintenance is performed by an external vendor, the laboratory staples the service record into hardcopy maintenance logs or scans the record easy retrieval. The laboratory provides unrestricted access to instrument maintenance logs in order to promotes good instrument maintenance and recordkeeping practices.

If an instrument must be moved, the laboratory will use safe practices for handling and transport to minimize damage and contamination.

5.5.6 Out of Service Protocol

Equipment that has been subjected to overloading, mishandling, gives suspect results, has been shown to be defective, or is performing outside of specified limits is taken out of service and either removed from the work area or labeled to prevent accidental use until it has been repaired and verified to perform correctly.

When analytical equipment is taken out of service, the laboratory examines the potential effect it may have had on previous analytical results to identify any non-conforming work. (See section 4.9).

5.5.7 Calibration Status

The laboratory labels support equipment to indicate calibration status, whenever practicable or otherwise maintains the calibration status in a visible location in the work area. These procedures are described in laboratory SOP ENV-SOP-NW-0016 *Support Equipment*.

The calibration status of analytical instruments is documented in the analytical record. Analysts verify on-going acceptability of calibration status prior to use and with instrument performance check standards. These procedures are described in test method SOPs.

5.5.8 Returned Equipment Checks

When equipment or instrument is sent out of the laboratory for service, the laboratory ensures that the function and calibration status of the equipment is checked and shown to be satisfactory before the equipment is returned to service. These procedures are outlined in SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification*.

5.5.9 Intermediate Equipment Checks

The laboratory performs intermediate checks on equipment to verify the on-going calibration status. For example, most test method require some form of continuing calibration verification check and these procedures are included in the test method SOP. Periodic checks of support equipment are also performed; see appendix E for more information.

5.5.10 Safeguarding Equipment Integrity

The laboratory safeguards equipment integrity using a variety of mechanisms that include but are not limited to:

- Adherence to manufacture's specification for instrument use so that settings do not exceed manufacturer's recommendation or stress the performance of the equipment.
- Established maintenance programs.

- Transparent maintenance records and unrestricted access to maintenance logs.
- Validation and approval of software before use.
- Audits to confirm instrument settings are consistent with SOPs.
- On-the-job training for safe and proper use of laboratory equipment.

5.6 Measurement Traceability

5.6.1 General

Measurement traceability refers to a property of a measurement result whereby the result can be related to a reference through an unbroken chain of calibration, each contributing to the measurement uncertainty. Traceability requires an established calibration hierarchy of equipment (instruments) used during testing including equipment used for subsidiary measurements. The laboratory assures this equipment is calibrated prior to being put into service and that the reference standard and materials used for calibration are traceable to the international standard of units (SI) or national measurement standard.

When strict traceability to SI units cannot be made, the laboratory establishes traceability with the use of reference standards and equipment obtained from competent supplier that provide calibration certificates and/or certificates of analysis (COA).

5.6.2 Equipment Correction Factors

When correction factors are used to adjust results the laboratory will assure that results in computer software are also updated. For example, if the direct instrument or reading output must be corrected based on preparation factor or concentration factors, laboratory management will assure the corrected result is also updated in the software, whenever possible.

5.6.3 Specific Requirements

5.6.3.1 Requirements for Calibration Laboratories

The laboratory does not offer calibration services to customers.

5.6.3.2 Requirements for Testing Laboratories

The laboratory has procedures in place to verify equipment is calibrated prior to being put into service. (See 5.5.2) and ensures the reference standard and materials used for calibration are traceable to the international standard of units (SI) or national measurement standard. When strict traceability to SI units cannot be made, the laboratory establishes traceability with the use of reference standards and equipment obtained from competent suppliers that provide calibration certificates and/or certificates of analysis (COA).

5.6.4 Reference Standards and Reference Materials

5.6.4.1 Reference Standards

The laboratory uses reference standards of measurement to verify adequacy of working weights and thermometers. The working weight is the weight(s) used for daily balance calibration checks and the working thermometers are used for temperature measurements on a daily basis.

Intermediate checks of the working reference measurement standards are performed to verify adequacy between calibration from an external calibration laboratory. The measurements from working weights and thermometers are compared to measurement taken by the reference standard which is traceable to SI or a national standard. The reference weights and thermometers are used solely for verification purposes unless the laboratory can prove that daily use does not adversely affect performance of the reference standard.

The laboratory performs intermediate checks of the working weights at least annually.

Working thermometers (glass and digital) are checked against the reference thermometer prior to placement in service to establish a correction factor and then rechecked annually (glass) or quarterly (digital) thereafter.

The calibration of liquid in glass reference thermometers is verified every 5 years and the calibration of digital reference thermometers is verified annually by an ISO/IEC 17025 accredited calibration laboratory or service provider that provides traceability to a national standard.

The calibration of the reference weight(s) is verified every 5 years by an ISO/IEC 17025 accredited calibration laboratory.

If criteria for the intermediate checks or recertification is not acceptable, the impact on previously reported results is evaluated using the process for evaluation of nonconforming work (See 4.9)

See laboratory SOP ENV-SOP-NW-0016 *Support Equipment* for more information about this process.

5.6.4.2 Reference Materials

The laboratory purchases chemical reference materials used (also known as stock standards) from vendors that are accredited to ISO 17034 or Guide 34. Purchased reference materials must be received with a Certificate of Analysis (COA) where available. If a reference material cannot be purchased with a COA, it must be verified by analysis and comparison to a certified reference material and/or there must be a demonstration of capability for characterization. COA are reviewed for adequacy and retained by the laboratory for future reference.

The laboratory procedure for traceability and use of these materials is provided in laboratory SOP ENV-SOP-NW-0030 *Laboratory Supply Procedures*.

This SOP includes each of the following requirements:

- Procedures for documentation of receipt and tracking. The record of entry includes name of the material, the lot number, receipt date, and expiration date.
- Storage conditions and requirements. Reference materials must be stored separately from samples, extracts, and digestates.
- Requirements to assure that preparations of intermediate or working solutions are recorded and assigned a unique identification number for tracking. Records of preparation include the lot number of the stock standard(s) used, the type and

lot number of the solvent, the formulation, date, expiration date, and the preparer's initials. The lot number of the working standards is recorded in the analytical record to provide traceability to the standard preparation record. The preparation record provides traceability to the COA, which is traceable to SI or the national measurement standard.

- A requirement that the expiration dates of prepared standards may not exceed the expiration date of the parent standard. Standards, reference materials, and reagents are not used after their expiration dates unless their reliability is thoroughly documented and verified by the laboratory. If a standard exceeds its expiration date and is not re-certified, the laboratory removes the standard and/or clearly designates it as acceptable for qualitative/troubleshooting purposes only. All prepared standards, reference materials, and reagents are verified to meet the requirements of the test method through routine analyses of quality control samples.

- The second source materials used for verification of instrument calibration are obtained from a different manufacturer or different lot from the same manufacturer.

- Procedures to check reference materials for degradation and replacement of material if degradation or evaporation is suspected.

- Procedures for labeling. At a minimum the container must identify the material, the ID of the material and the expiration date. Original containers should also be labeled with date opened.

5.6.4.3 Intermediate Checks

Checks to confirm the calibration status of standards and materials are described in laboratory SOPs. These checks, include use of second source standards and reference materials reserved only for the purpose of calibration checks.

5.6.4.4 Transport and Storage

The laboratory handles and transports reference standards and materials in a manner that protects the integrity of the materials. Reference standard and material integrity is protected by separation from incompatible materials and/or minimizing exposure to degrading environments or materials. Standards and reference materials are stored separately from samples, extracts, and digestates. All standards are stored according to the manufacturer's recommended conditions. Temperatures colder than the manufacturer's recommendation are acceptable if it does not compromise the integrity of the material (e.g. remains in liquid state and does not freeze solid). In the event a standard is made from more than a single source with different storage conditions, the standard will be stored according to the conditions specified in the analytical method.

See the applicable analytical SOPs for specific reference material storage and transport protocols.

5.7 Sampling

Sampling refers to the field collection of samples and to subsamples taken by the laboratory for analysis from the field collected sample.

Subsampling procedures are included in SOP ENV-SOP-NW-0005 *Sample Homogenization and Sub-Sampling* to assure the aliquot used for testing is representative of the field collected sample.

The requirements in the following subsections apply when field sampling is performed by the laboratory.

5.7.1 Sampling Plans and SOPs

When the laboratory performs field collection of samples, sampling is carried out in accordance with a written sample plan prepared by the customer or by the laboratory and by relevant sampling SOPs. These documents are made readily accessible at the sampling location. Sampling plans and SOPs are, whenever reasonable, based on appropriate governing methods and addresses the factors to be controlled to ensure the validity of the analytical results.

5.7.2 Customer Requested Deviations

When the customer requires deviations, additions, or exclusions from the documented laboratory sampling plan and/or procedure, the laboratory records the client's change request in detail with the sampling record, communicates the change to sampling personnel, and includes this information in the final test report.

5.7.3 Recordkeeping

The laboratory assures the sampling record includes the sampling procedure used, any deviations from the procedure, the date and time of sampling, the identification of the sampler, environmental conditions (if relevant), and the sampling location.

5.8 Sample Management & Handling

5.8.1 Procedures

The laboratory's procedures for sample management and handling are outlined in laboratory SOPs ENV-SOP-MIN4-0008 *Sample Management* (Minneapolis, MN, Bloomington, MN, Phoenix, AZ, Billings, MT), ENV-SOP-DUL1-0001 *Sample Management* (Duluth, MN), ENV-SOP-VIR1-0001 *Sample Management* (Virginia, MN), ENV-SOP-MIN4-0009 *Bottle Preparation* (Minneapolis, MN, Bloomington, MN, Phoenix, AZ, Billings, MT), ENV-SOP-VIR1-0002 *Bottle Preparation* (Virginia, MN), ENV-SOP-DUL1-0002 *Bottle Preparation* (Duluth, MN), ENV-SOP-MIN4-0010 *Subcontracting Samples* (Minneapolis, MN, Billings, MT), and ENV-SOP-VIR1-0003 *Subcontracting Samples* (Virginia, MN, Duluth, MN).

The procedures in these SOPs are established to maintain the safe handling and integrity of samples from transport, storage, to disposal and during all processing steps in-between; to maintain client confidentiality, and to protect the interests of PAS and its customers.

5.8.1.1 Chain of Custody

All samples received by the laboratory must be accompanied with a Chain of Custody (COC) record. The COC provides information about the samples collected and submitted for testing and documents the possession of samples from time of collection to receipt by the laboratory.

The COC record must minimally include the following information:

- Client name, address, phone number
- Project Reference
- Client Sample Identification (Client ID)
- Date, Time, and Location of Sampling
- Samplers Name or Initials
- Matrix
- Type of container, and total number collected each sample
- Preservatives
- Analyses Requested
- Mode of collection
- Any special instructions
- The date and time and signature of each sample transfer from time of collection to receipt in the laboratory. When the COC is transported inside the cooler, independent couriers do not sign the COC. Shipping manifests and/or air bills are the records of possession during transport.

A complete and legible COC is required. If the laboratory observes that the COC is incomplete or illegible, the client is contacted for resolution. The COC must be filled out in indelible ink. Personnel correct errors by drawing a single line through the initial entry so the entry is not obscured, entering the correct information, and initialing, and dating the change.

5.8.1.2 Legal Chain of Custody

Legal chain of custody is a chain of custody protocol used for evidentiary or legal purposes. The protocol is followed by the laboratory when requested by customer or where mandated by a regulatory program.

Legal chain of custody (COC) protocol establishes an intact, continuous record of the physical possession*, storage, and disposal of "samples" which includes, sample aliquots, and sample extracts/digestates/distillates.

Legal COC records account for all time periods associated with the samples, and identifies all individuals who physically handled individual samples. Legal COC begins at the point established by legal authority, which is usually at the time the sample containers are provided by the laboratory for sample collect or when sample collection begins.

*A sample is in someone's custody if:

- It is in one's physical possession;

- It is in one's view after being in one's physical possession;
- It has been in one's physical possession and then locked or sealed so that no one can tamper with it; and/or
- It is kept in a secure area, restricted to authorized personnel only.

Refer to laboratory SOPs ENV-SOP-MIN4-0008 *Sample Management* (Minneapolis, MN, Bloomington, MN, Phoenix, AZ, Billings, MT), ENV-SOP-DUL1-0001 *Sample Management* (Duluth, MN), ENV-SOP-VIR1-0001 *Sample Management* (Virginia, MN) for more information.

5.8.2 Unique Identification

Each sample is assigned a unique identification number by the laboratory (Lab ID) after the sample has been checked and accepted by the laboratory in accordance with the laboratory's sample acceptance policy (See 5.8.3). the Lab ID is affixed to the sample container using a durable label.

The unique identification of samples also applies to subsamples, and prepared samples, such as extracts, digestates, etc.

The lab ID is linked to the field ID (client ID) in the laboratory's record. Both IDs are linked to the testing activities performed on the sample and the documentation records of the test.

Also see 5.8.4.

5.8.3 Sample Receipt Checks and Sample Acceptance Policy

The laboratory checks the condition and integrity of samples on receipt and compares the labels on the sample containers to the COC record. Any problem or discrepancy is recorded. If the problem impacts the suitability of the sample for analysis or if the documentation is incomplete, the client is notified for resolution. Decisions and instructions from the client are maintained in the project record.

5.8.3.1 Sample Receipt Checks

The following checks are performed:

- Verification that the COC is complete and legible.
- Verification that each sample's container label includes the client sample ID, the date and time of collection and the preservative in indelible ink.
- The container type and preservative is appropriate for each test requested.
- Adequate volume is received for each test requested.
- Visual inspection for damage or evidence of tampering.
- Visual inspection for presence of headspace in VOA vials. (VOA = volatile organic analysis).
- Thermal Preservation: For chemical testing methods for which thermal preservation is required, temperature on receipt is acceptable if the measurement is above freezing but <6°C. For samples that are hand-delivered to the laboratory

immediately after sample collection, there must be evidence that the chilling process has begun, such as arrival on ice. The requirements for thermal preservation vary based on the scope of testing performed. For example, for microbiology, temperature on receipt is acceptable if the measurement is <10°C. Refer to the laboratory's SOP for sample receipt for more information.

- Chemical Preservation
- Holding Time: Sample receiving personnel are trained to recognize tests with tests where the holding time is 48 hours or less and to expedite the log-in of these samples. Except for tests with immediate holding times (15 minutes from time of collection or less), when samples are received out of hold, the laboratory will notify the client and request instruction. If the decision is made to proceed with analysis, the final test report will include notation of this instruction.

5.8.3.2 Sample Acceptance Policy

The laboratory maintains a sample acceptance policy in accordance with regulatory guidelines to clearly establish the circumstances in which sample receipt is accepted or rejected. When receipt does not meet acceptance criteria for any one of these conditions, the laboratory must document the noncompliance, contact the customer, and either reject the samples or fully document any decisions to proceed with testing. In accordance with regulatory specifications, test results associated with receipt conditions that do not meet criteria are qualified in the final test report.

All samples received must meet each of the following:

- Be listed on a complete and legible COC.
- Be received in properly labeled sample containers.
- Be received in appropriate containers that identify preservative.
- The COC must include the date and time of collection for each sample.
- The COC must include the test requested for each sample.
- Be in appropriate sample containers with clear documentation of the preservatives used.
- Be received within holding time. Any samples received beyond the holding time will not be processed without prior customer approval.
- Have sufficient sample volume to proceed with the analytical testing. If insufficient sample volume is received, analysis will not proceed without customer approval.
- Be received within appropriate temperature ranges (not frozen but ≤6°C) unless program requirements or customer contractual obligations mandate otherwise. The cooler temperature is recorded directly on the COC. Samples that are delivered to the laboratory immediately after collection are considered acceptable if there is evidence that the chilling process has been started. For example, by the arrival of the samples on ice. If samples arrive that are not compliant with these

temperature requirements, the customer will be notified. The analysis will NOT proceed unless otherwise directed by the customer. If less than 72 hours remain in the hold time for the analysis, the analysis may be started while the customer is contacted to avoid missing the hold time. Data associated with any deviations from the above sample acceptance policy requirements will be appropriately qualified.

5.8.4 Sample Control and Tracking

The samples are controlled and tracked using the Laboratory Information Management System (LIMS). The LIMS stores information about the samples and project. The process of entering information into the LIMS is called login and these procedures are described in laboratory SOPs ENV-SOP-MIN4-0008 *Sample Management* (Minneapolis, MN, Bloomington, MN, Phoenix, AZ, Billings, MT), ENV-SOP-DUL1-0001 *Sample Management* (Duluth, MN), and ENV-SOP-VIR1-0001 *Sample Management* (Virginia, MN). After log-in, a label is generated and affixed to each sample container. Information on this label, such as the lab ID, links the sample container to the information in LIMS.

At a minimum, the following information is entered during log-in:

- Client Name and Contact Information;
- The laboratory ID linked to the client ID;
- Date and time of sample collection;
- Date and time of sample receipt;
- Matrix;
- Tests Requested.

5.8.5 Sample Storage, Handling, and Disposal

The laboratory procedures for sample storage, handling and disposal are detailed in laboratory SOPs ENV-SOP-MIN4-0008 *Sample Management* (Minneapolis, MN, Bloomington, MN, Phoenix, AZ, Billings, MT), ENV-SOP-DUL1-0001 *Sample Management* (Duluth, MN), ENV-SOP-VIR1-0001 *Sample Management* (Virginia, MN), ENV-SOP-MIN4-0009 *Bottle Preparation* (Minneapolis, MN, Bloomington, MN, Phoenix, AZ, Billings, MT), ENV-SOP-VIR1-0002 *Bottle Preparation* (Virginia, MN), ENV-SOP-DUL1-0002 *Bottle Preparation* (Duluth, MN), ENV-SOP-MIN4-0010 *Subcontracting Samples* (Minneapolis, MN, Billings, MT), ENV-SOP-VIR1-0003 *Subcontracting Samples* (Virginia, MN, Duluth, MN), ENV-SOP-MIN4-0098 *Waste Handling and Management* (Minneapolis, MN), ENV-SOP-BILL-0024 *Waste Handling and Management* (Billings, MT), ENV-SOP-DUL1-0004, *Waste Handling and Management* (Duluth, MN), and ENV-SOP-VIR1-0007 *Waste Handling and Management* (Virginia, MN).

5.8.5.1 Sample Storage

The samples are stored according to method and regulatory requirements as per test method SOPs. Samples are stored away from all standards, reagents, or other potential sources of contamination and stored in a manner that prevents cross contamination. Volatile samples are stored separately from other samples. All sample fractions, extracts, leachates, and other sample preparation products are stored in the same manner as actual samples or as specified by the analytical method.

Refrigerated storage areas are maintained at ≤6°C (but not frozen) and freezer storage areas are maintained at <-10°C (unless otherwise required per method or program). The temperature of each storage area is checked and documented at least once for each day of use. If the temperature falls outside the acceptable limits, then corrective actions are taken and appropriately documented.

The laboratory is operated under controlled access protocols to ensure sample and data integrity. Visitors must register at the front desk and be properly escorted at all times. Samples are taken to the appropriate storage location immediately after sample receipt and login procedures are completed. All sample storage areas have limited access. Samples are removed from storage areas by designated personnel and returned to the storage areas as soon as possible after the required sample quantity has been taken.

5.8.5.2 Sample Retention and Disposal

The procedures used by the laboratory for sample retention and disposal are detailed in laboratory SOPs ENV-SOP-MIN4-0008 *Sample Management* (Minneapolis, MN, Bloomington, MN, Phoenix, AZ, Billings, MT), ENV-SOP-DUL1-0001 *Sample Management* (Duluth, MN), ENV-SOP-VIR1-0001 *Sample Management* (Virginia, MN), ENV-SOP-MIN4-0098 *Waste Handling and Management* (Minneapolis, MN), ENV-SOP-BILL-0024 *Waste Handling and Management* (Billings, MT), ENV-SOP-DUL1-0004, *Waste Handling and Management* (Duluth, MN), and ENV-SOP-VIR1-0007 *Waste Handling and Management* (Virginia, MN).

In general, unused sample volume and prepared samples such as extracts, digestates, distillates and leachates (samples) are retained by the laboratory for the period of time necessary to protect the interests of the laboratory and the customer.

Samples may be stored at ambient temperature when all analyses are complete, the hold time is expired, the report has been delivered, and/or when allowed by the customer or program. Samples requiring storage beyond the minimum sample retention time due to special requests or contractual obligations may be stored at ambient temperature unless the laboratory has sufficient capacity and their presence does not compromise the integrity of other samples.

After this period expires, non-hazardous samples are properly disposed of as non-hazardous waste. The preferred method for disposition of hazardous samples is to return the excess sample to the customer.

5.9 Assuring the Quality of Test Results

5.9.1 Quality Control (QC) Procedures

The laboratory monitors the validity and reliability of test results using quality control (QC) samples that are prepared and analyzed concurrently with field samples in the same manner as field samples. QC results are always associated to and reported with the field samples they were prepared and analyzed with from the same preparation or analytical batch. See the glossary for definition of preparation and analytical batch.

The results of QC performed during the testing process are used by the laboratory to assure the results of analysis are consistent, comparable, accurate, and/or precise within a specified limit. When the results are not within acceptance criteria or expectations for method performance, correction and corrective action(s) are taken. These actions may include retesting or reporting of data with qualification to alert the end user of the situation.

Other QC measures performed include the use of certified reference materials (see 5.6.2), participation in interlaboratory proficiency testing (see 5.9.1.1), verification that formulae used for reduction of data and calculation of results is accurate (see 5.9.3), on-going monitoring of environmental conditions that could impact test results (see 5.3.2), and evaluation and verification of method selectivity and sensitivity (see 5.4.5).

QC results are also used by the laboratory to monitor performance statistical trends over time and to establish acceptance criteria when no method or regulatory criteria exist. (see 5.9.1.4).

5.9.1.1 Essential QC

Although the general principles of QC for the testing process apply to all testing, the QC protocol used for each test depends on the type of test performed.

QC protocol used by the laboratory to monitor the validity of the test are specified in test method SOPs. The SOP includes QC type, frequency, acceptance criteria, corrective actions, and procedures for reporting of nonconforming work.

These requirements in the SOP conform to the reference method and any applicable regulations or certification and accreditation program requirement for which results of the test are used. When a project requires more stringent QC protocol than specified in the SOP, project specification is followed. When the project requires less stringent QC protocol, the project specification may be followed as an authorized departure from the SOP when the project specifications meet the requirements in the mandated method and any regulatory compliance requirements for which the data will be used.

The following are examples of essential QC for Chemistry:

5.9.1.1.1 Second Source Standard (ICV/QCS)

The second source standard is a standard obtained from a different vendor than the vendor of the standards used for calibration. It is a positive control used to verify the accuracy of a new calibration relative to the purity of the standards used for calibration. This check is referred to in test method and quality system standards as the initial calibration verification (ICV) or quality control sample (QCS). The second source standard is analyzed immediately after the calibration and before analysis of any samples. When the ICV is not within acceptance criteria, a problem with the purity or preparation of the standards may be indicated.

5.9.1.1.2 Continuing Calibration Verification (CCV)

CCV is to determine if the analytical response has significantly changed since initial calibration. If the response of the CCV is within criteria, the calibration is considered valid. If not, there is a problem that requires further investigation. Actions taken are technology and method specific.

5.9.1.1.3 Method Blank (MB) / Other Blanks

A method blank is a negative control used to assess for contamination during the prep/analysis process. The MB consists of a clean matrix, similar to the associated samples that is known to be free of analytes of interest. The MB is processed with and carried through all preparation and analytical steps as the associated samples.

In general, contamination is suspected when the target analyte is detected in the MB above the reporting limit. Some programs may require evaluation of the MB to ½ the reporting limit or the detection limit. When contamination is evident, the source is investigated and corrections are taken to reduce or eliminate it. Analytical results associated with MB that does not meet criteria are qualified in the final test report.

Other types of blanks that serve as negative controls in the process may include:

- Trip Blanks (VOA)
- Storage Blanks
- Equipment Blanks
- Field Blanks
- Calibration Blanks
- Cleanup Blanks
- Instrument Blanks

5.9.1.1.4 Laboratory Control Sample (LCS)

The LCS is positive control used to measure the accuracy of process in a blank matrix. The LCS is spiked by the laboratory with a known amount of analyte. The spike is a standard solution that is pre-made or prepared from a certified reference standard. The LCS is processed with and carried through all preparation and analytical steps as the associated samples.

When the percent recovery (%R) of the LCS is within the established control limit, sufficient accuracy has been achieved. If not, the source of the problem is investigated and corrected and the procedure may be repeated. Analytical results associated with LCS that does not meet criteria are qualified in the final test report.

5.9.1.1.5 Matrix Spike (MS) and Matrix Spike Duplicate (MSD)

Matrix spikes measures the effect the sample matrix has on precision and accuracy of the determinative test method. The MS and MSD are replicates of a client sample that is spiked with known amount of target analyte.

Due to the heterogeneity of matrices even of the same general matrix type, matrix spike results mostly provide information on the effect of the matrix to the client whose sample was used and on samples of the same matrix from the same sampling site. Therefore, MS should be client-specific when the impact of matrix on accuracy and precision is a project data quality objective. When there is not a client-specified MS for any sample in the batch, the laboratory randomly selects a sample from the batch; the sample selected at random is called a "batch" matrix spike.

The MS/MSD results for percent recovery and relative percent difference are checked against control limits. Because the performance of matrix spikes is matrix-dependent, the result of the matrix spike is not used to determine the acceptability of the test.

5.9.1.1.6 Sample Duplicate (SD)

A sample duplicate is a second replicate of sample that is prepared and analyzed in the laboratory along another replicate. The SD is used to measure precision.

The relative percent difference between replicates are evaluated against the method or laboratory derived criteria for relative percent difference (RPD), when this criterion is applicable. If RPD is not met, associated test results are reported with qualification.

5.9.1.1.7 Surrogates

Surrogates are compounds that mimic the chemistry of target analytes but are not expected to occur naturally in real world samples. Surrogates are added to each sample and matrix QC samples (MS, MSD, SD) at known concentration to measure the impact of the matrix on the accuracy of method performance. Surrogates are also added to the positive and negative control samples (MB, LCS) to evaluate performance in a clean matrix, and included in the calibration standards and calibration check standards.

The percent recovery of surrogates is evaluated against method-specified limits or statistically derived in-house limits. Project-specific limits and/or program-specific limits are used when required. Results with surrogate recovery out of limits in samples are reported with qualification. Samples with surrogate failures can also be re-extracted and/or re-analyzed to confirm that the out-of-control value was caused by the matrix of the sample and not by some other systematic error.

5.9.1.1.8 Internal Standards

Internal Standards are compounds not expected to occur naturally in field samples. They are added to every standard and sample at a known concentration prior to analysis for the purpose of adjusting the response factor used in quantifying target analytes. The laboratory follows specific guidelines for the treatment of internal standard recoveries and further information can be found in the applicable laboratory SOP.

5.9.1.1.9 QC Acceptance Criteria and Control Limits

The QC acceptance criteria are specified in test method SOPs. The criteria in the SOP are based on the requirements in the published test method or regulatory program. When there are no established acceptance criteria, the laboratory develops acceptance criteria in accordance with recognized industry standards.

Some methods and programs require the laboratory to develop and use control limits for LCS, MS/MSD and surrogate evaluation. In laboratory developed limits are referred to as "in-house" control limits. In-house control limits represent ± 3 Standard Deviations (99% confidence level) from the average recovery of at least 20 data points generated using the same preparation and analytical procedure in a similar matrix.

See laboratory SOP ENV-SOP-NW-0006 *Control Chart Generation and Trend Analysis* for more information.

5.9.1.2 Proficiency Testing (PT)

The laboratory participates in interlaboratory proficiency testing (PT) studies to measure performance of the test method and to identify or solve analytical problems. PT samples measure laboratory performance through the analysis of unknown samples provided by an external source.

The PT samples are obtained from accredited proficiency testing providers (PTP) and handled as field samples which means they are included in the laboratory's normal analytical processes and do not receive extraordinary attention due to their nature.

The laboratory does not share PT samples with other laboratories, does not communicate with other laboratories regarding current PT sample results during the duration of the study, and does not attempt to obtain the assigned value of any PT sample from the PT provider.

The laboratory initiates an investigation and corrective action plan whenever PT results are deemed unacceptable by the PT provider.

The frequency of PT participation is based on the certification and accreditation requirements held by the laboratory.

5.9.2 QC Corrective Action

When the results of QC are not within acceptance criteria or expectations for method performance, correction and corrective action(s) are taken per the specifications in the test method SOP. These actions may include retesting or reporting of data with qualification to alert the end user of the situation.

5.9.3 Data Review

The laboratory uses a tiered system for data review. The tiered process provides sequential checks to verify data transfer is complete; manual calculations, if performed, are correct, manual integrations are appropriate and documented, calibration and QC requirements are met, appropriate corrective action was taken when required, test results are properly qualified, process and test method SOPs were followed, project specific requirements were met, when applicable, and the test report is complete.

The sequential process includes three tiers referred to as primary review, secondary review, and administrative/completeness review.

Detailed procedures for the data review process are described in laboratory SOPs ENV-SOP-MIN4-0092 *Data Review Process* (Minneapolis, MN, Billings, MT) and ENV-SOP-VIR1-0006 *Data Review Process* (Virginia, MN, Duluth, MN). The general expectations for the tiered review process are described in the following sections:

5.9.3.1 Primary Review

Primary review is performed by the individual that performed the task. All laboratory personnel are responsible for review of their work product to assure it is complete, accurate, documented, and consistent with policy and SOPs.

Checks performed during primary review include but are not limited to:

- Verification that data transfer and acquisition is complete
- Manual calculations, if performed, are documented and accurate
- Manual integrations, if performed, are documented and comply with SOP ENV-SOP-CORQ-006 *Manual Integration*
- Calibration and QC criteria were met, and/or proper correction and corrective actions were taken, and data and test results associated with QC and criteria exceptions are properly qualified
- Work is consistent with SOPs and any other relevant instructional document such as SWI, program requirements, or project QAPP

5.9.3.2 Secondary Review

Secondary review is performed by qualified peer or supervisor. Secondary review is essentially a repeat of the checks performed during primary review by another person. In addition to the checks of primary review, secondary review includes chromatography review to check the accuracy of quantitative analyte identification.

5.9.3.3 Completeness Review

Completeness review is an administrative review performed prior to release of the test report to the customer. Completeness review verifies that the final test report is complete and meets project specification. This review also assures that information necessary for the client's interpretation of results are explained in the case narrative or footnoted in the test report.

5.9.3.4 Data Audits

In addition to the 3 tier data review process, test reports may be audited by local QA to verify compliance with SOPs and to check for data integrity, technical accuracy, and regulatory compliance. These audits are not usually done prior to issuance of the test report to the customer. The reports chosen for the data audits are selected at random.

If any problems with the data or test results are found during the data audit, the impact of the nonconforming work is evaluated using the process described in Section 4.9.

Also see Section 4.14 for internal audits.

5.10 Reporting

5.10.1 General Requirements

The laboratory reports results of testing in a way that assures the results are clear, and unambiguous. All data and results are reviewed prior to reporting to assure the results reported are accurate and complete.

Test results are summarized in test reports that include all information necessary for the customer's interpretation of the test results. Additional information necessary to clarify the data or disclose nonconformance, exceptions, or deviations that occurred during the analytical process are also reported to the customer in the test report.

The specifications for test reports and electronic data deliverables (EDD) are established between the laboratory and the customer at the time the request for analytical services is initiated. The report specifications include the test report format, protocol for the reporting limit (RL), conventions for the reporting of results less than the limit of quantitation (LOQ), and specification for the use of project or program specific data qualifiers. Information about review of analytical service requests is provided in Section 4.4.

5.10.2 Test Reports: Required Items

Test Reports are prepared by the laboratory at the end of the testing process. The format of the report depends on the level of reporting requested by the customer. The laboratory offers a variety of standardized test report formats and can also can provide custom test report formats, when necessary.

The level of detail required in the test report depends on the customer's needs for data verification, validation, and usability assessments that occur after the laboratory releases the test report to the customer. The test report formats offered by the laboratory provide gradient levels of detail to meet the unique needs of each customer. The laboratory project manager helps the customer select the test report format that best meets their needs. When a specific report format or protocol is required for a regulatory or program compliance, the laboratory project manager must ensure the test report selected meets those requirements.

Every test report issued by the laboratory includes each of the following items:

a) Title

b) Name and phone number of a point of contact from the laboratory issuing the report.

c) Name and address of the laboratory where testing was performed. When testing is done at multiple locations within network (IRWO), the report must clearly identify which network laboratory performed each test and must include the physical address of each laboratory.

d) Unique identification of the test report and an identifier on each page of the report to link each page to the test report and clear identification of the end of the report.

e) The name and address of the customer

f) Identification of test methods used

g) Cross reference between client sample identification number (Sample ID) and the laboratory's identification number for the sample (Lab ID) to provide unambiguous identification of samples.

h) The date of receipt of samples, condition of samples on receipt, and identification of any instance where receipt of the samples did not meet sample acceptance criteria.

i) Date and times of sample collection, receipt, preparation, and analysis.

j) Test results and units of measurement, and qualification of results associated with QC criteria exceptions, and identification of reported results outside of the calibration range.

k) Name, title, signature of the person(s) authorizing release of the test report and date of release.

l) A statement that the results in the test report relate only to the items tested.

m) Statement that the test report may not be reproduced except in full without written approval from the laboratory.

5.10.3 Test Reports: Supplemental Items

5.10.3.1 Supplemental Requirements

The following items are included in the test report when required or relevant:

a) Explanation of departure from test method SOPs including, what the departure was and why it was necessary.

b) Statistical methods used. (Required for Whole Effluent Toxicity)

c) For solid samples, specification that results are reported on a dry weight or wet weight basis.

d) Signed Affidavit, when required by client or regulatory agency.

e) A statement of compliance / non-compliance with requirements or specifications (client, program, or standard) that includes identification of test results that did not meet acceptance criteria.

f) When requested by the client, statement of estimated measurement uncertainty. In general, for environmental testing, estimated uncertainty of measurement is extrapolated from LCS control limits. Control limits incorporate the expected variation of the data derived from the laboratory's procedure. When the control limits are specified by the test method or regulatory program, the control limits represent the expected variation of the test method and/or matrices for which the test method was designed.

g) Opinions and Interpretations.

h) If a claim of accreditation/certification is included in the test report, identification of any test methods or analytes for which accreditation/certification is not held by the laboratory if the accrediting body offers accreditation/certification for the test method/analyte. The fields of accreditation/certification vary between agencies and it cannot be presumed that because accreditation/certification is not held that it is offered or required.

i) Certification Information, including certificate number and issuing body.

5.10.3.2 Test Reports: Sampling Information

The following items are included in the test report when samples are collected by the laboratory or when this information is necessary for the interpretation of test results:

a) Date of Sampling.

b) Unambiguous identification of material samples.

c) Location of sampling including and diagrams, sketches, or photographs.

d) Reference to the sampling plan and procedures used.

e) Details of environmental conditions at time of sample that may impact test results.

f) Any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned.

5.10.4 Calibration Certificates

The laboratory does not perform calibration activities for its customers and calibration certificates are not offered or issued.

5.10.5 Opinions and Interpretations

The laboratory provides objective data and information to its customers of sufficient detail for their interpretation and decision making. Objective data and information is based solely on fact and does not attempt to explain the meaning (interpret) or offer a view or judgement (opinion). Sometimes the customer may request the laboratory provide opinion or interpretation to assist them with their decisions about the data.

When opinions and interpretations are included in the test report, the laboratory will document the basis upon which the opinions and interpretations have been made and clearly identify this content as opinion or interpretation in the test report.

Examples of opinion and interpretation include but are not limited to:

- The laboratory's viewpoint on how a nonconformance impacts the quality of the data or usability of results.
- The laboratory's judgment of fulfillment of contractual requirements.
- Recommendations for how the customer should use the test results and information.
- Suggestions or guidance to the customer for improvement.

When opinions or interpretations are verbally discussed with the customer, the content of these conversations is summarized by the laboratory and kept in the project record.

5.10.6 Subcontractor Reports

When analytical work has been subcontracted to an organization external to PAS, the test report from the subcontractor is included in its entirety as an amendment to the final test report.

Note: Test results for analytical work performed within the PAS network may be are merged into a single test report. The test report issued clearly identifies the location and address of each network location that performed testing and which tests they performed. (See 5.10.2)

5.10.7 Electronic Transmission of Results

When test results and/or reports are submitted to the customer through electronic transmission, follow the procedures established in this manual for confidentiality and protection of data.

5.10.8 Format of Test Reports

The test formats offered by the laboratory are designed to accommodate each type of analytical test method carried out by the laboratory and to minimize the possibility of misunderstanding or misuse of analytical results. The format of electronic data deliverables (EDD) follow the specifications for the EDD.

5.10.9 Amendments to Test Reports

Test reports that are revised or amended by the laboratory after date of release of the final test report to the customer are issued as a new test report that is clearly identified as an amendment or revision and that includes a reference to the originally issued final test report.

The customer is the organization doing business with PAS external to PAS.

Changes made to test results and data before the final test report is issued to the customer are not amendments or revisions, these are corrections to errors found during the laboratory's data verification and review process,

The laboratory's procedure for report amendments and revision are outlined in laboratory SOP ENV-SOP-NW-0028 *Final Report and Deliverable Contents*.

6.0 Revision History

This Version:

Section	Description of Change
All	This version is a complete rewrite of the document this version supersedes.
7.3	Added in % Recovery, RSD, RSE definitions, %R abbreviation for Accuracy.

This document supersedes the following documents:

Document Number	Title	Version
ENV-MAN-NW-0001	Quality Manual	01

7.0 APPENDICES

7.1 Appendix A: Certification / Accreditation Listing

The certifications / accreditation lists provided in this manual represent those that were held by the named location on the effective date of this manual. This information is subject to change without notice and must not be considered valid proof of certification or accreditation status. Current certificates are maintained by Local QA and a copy of the certificate is posted to PAS's eDMS Portal for access by all PAS employees. External parties should contact the laboratory for the most current information.

7.1.1 PAS-Minneapolis

Authority	Certificate Number	Authority	Certificate Number
A2LA	2926.01	Louisiana Dept. of Environmental Quality	03086
Alabama Dept. of Environmental Management	40770	Louisiana Dept. of Health (DW)	LA006
Alaska Dept. of Environmental Conservation (DW)	MN00064	Maine Dept. of Health and Human Services	2019018
Alaska Dept. of Environmental Conservation (Contaminated Sites)	17-009	Maryland Dept. of the Environment	322
Arizona Dept. of Health Services	AZ0014	Massachusetts Dept. of Environmental Protection	M-MN064
Arkansas Dept. of Health (DW)	MN00064	Massachusetts Dept. of Environmental Protection (Drinking Water Program)	via "Minnesota ELAP via Dept. of Health"
Arkansas Dept. of Environmental Quality (WW)	19-039-0	Michigan Dept. of Environmental Quality	9909
California ELAP via State Water Resources Control Board	2929	Minnesota Dept. of Agriculture	via "Minnesota ELAP via Dept. of Health"
CNMI Saipan Bureau of Environmental and Coastal Quality	MP0003	Minnesota Dept. of Commerce (Petrofund)	1240
Colorado Dept. of Public Health and Environment	MN00064	Minnesota ELAP via Dept. of Health	1791786
Connecticut Dept. of Public Health	PH-0256	Mississippi Dept. of Health	MN00064
EPA Region 8+Wyoming	via "Minnesota ELAP via Dept. of Health"	Missouri Dept. of Natural Resources	10100
Florida Dept. of Health	E87605-43-07/01/2019	Montana Dept. of Public Health and Human Services	CERT0092
Georgia Dept. of Natural Resources	959	Nebraska Dept. of Health and Human Services	NE-OS-18-06
Guam Environmental Protection Agency	20-001R	Nevada Dept. of Conservation and Natural Resources	MN000642020-7
Hawaii Dept. of Health	MN00064	New Hampshire ELAP via Dept. of Environmental Services	208119-D

Authority	Certificate Number	Authority	Certificate Number
Idaho Dept. of Health & Welfare (Inorganics)	MN00064	New Jersey Dept. of Environmental Protection	NLC 190003
Idaho Dept. of Health & Welfare (Organics)	MN00064	New York Dept. of Health	11647
Illinois ELAP via Illinois Environmental Protection Agency	004575	North Carolina Dept. of Environmental Quality	530
Indiana Dept. of Health	C-MN-01	North Carolina Dept. of Health and Human Services (DW)	27700
Iowa Dept. of Natural Resources	368	North Dakota Dept. of Health	R-036
Kansas Dept. of Health and Environment	E-10167	Ohio Environmental Protection Agency	41244
Kentucky Dept. for Environmental Protection (DW)	KY90062	Ohio Environmental Protection Agency (VAP)	CL101
Kentucky Dept. for Environmental Protection (WW)	KY90062	Oklahoma Dept. of Environmental Quality	2019-041
Oregon ELAP via Health Authority (Primary)	MN300001-012	Vermont Dept. of Health	VT-027053137
Oregon ELAP via Health Authority (Secondary)	MN200001-012	Virginia Dept. of General Services	10304
Pennsylvania Dept. of Environmental Protection	017	Washington Dept. of Ecology	C486-19c
Puerto Rico Dept. of Health	MN00064	West Virginia Dept. of Environmental Protection	382
South Carolina Dept. of Health and Environmental Control	74003001	West Virginia Dept. of Health & Human Resources	9952 C
Tennessee Dept. of Environment and Conservation	TN02818	Wisconsin Dept. of Natural Resources	999407970
Texas Commission on Environmental Quality	T104704192-19-14	Wyoming Underground Storage Tank via A2LA	2926.1
Utah Dept. of Health	MN000642019-10		

7.1.2 PAS-Billings

Authority	Certificate Number	Authority	Certificate Number
A2LA	3590.01	Nevada-Dept. of Conservation & Natural Resources-Division of Environmental Protection	MT000122018-1
Idaho-Dept. of Health & Welfare	MT00012	North Dakota-Dept. of Health	R-209
Minnesota-Dept. of Health	030-999-442	Washington-Dept. of Ecology	C933
Montana-Dept. of Health & Human Services	CERT0040	Wyoming (UST)	3590.01 (via A2LA)

7.1.3 PAS-Virginia

Authority	Certificate Number	Authority	Certificate Number
Alaska – Contaminated Sites Department of Environmental Conservation	17-007	North Dakota State Department of Health	R-203
Minnesota Department of Agriculture	Via Minnesota Department of Health	Washington Department of Ecology	C1007
Minnesota Department of Health	1733318	Wisconsin Department of Natural Resources	998027470
Montana Department of Public Health and Human Services	CERT0103		

7.1.4 PAS-Duluth

Authority	Certificate Number	Authority	Certificate Number
Minnesota Department of Health	1640609	North Dakota Department of Health	R-105
Minnesota Department of Agriculture	N/A	Wisconsin Department of Agriculture	480341
Montana Department of Health and Human Services	CERT0102	Wisconsin Department of Natural Resources	999446800
Nevada Department of Conservation and Natural Resources	MN000372020-1		

7.2 Appendix B: Capability Listing

The capabilities listed in this Appendix were held by the location referenced on the effective date of this manual. This information is subject to change without notice. External parties should contact the laboratory for the most current information.

Table Legend:

- DW = Drinking Water
- NPW = Non-Potable Water
- SCM = Solid and Chemical Materials
- Waste = Non-Aqueous Phase Liquid (NAPL), Oil
- Tissue = Biota and Tissue

7.2.1 PAS-Minneapolis

Parameter	Method	Matrices							
		Air	DW	NPW	SCM	Waste	Tissue	Wipes	Other
1,2-Dibromo-3-chloropropane	EPA 8011			X					
1,2-Dibromomethane	EPA 8011			X					
Alaska Diesel Range Organics	AK102 DRO			X	X				
Alaska Diesel Range Organics	AK102 DRO-SV			X					
Alaska Gasoline Range Organics	AK101 GRO-MS			X	X				
Alaska Residual Range Organics	AK103 RRO				X				
Alkalinity	SM 2320 B-1997		X	X					
Alkalinity	SM 2320 B-2011		X	X					
Amenable Cyanide	SM 4500-CN¯ G-1999			X					
Amenable Cyanide	SM 4500-CN¯ G-2011		X	X					
Ammonia	EPA 350.1			X					
Apparent Specific Gravity	ASTM D5057-2010			X	X				
Arizona Diesel Range Organics	8015AZ DRO			X	X				

Parameter	Method	Matrices							
		Air	DW	NPW	SCM	Waste	Tissue	Wipes	Other
Arizona Gasoline Range Organics	8015AZ GRO			X	X				
Benzene	EPA 325B	X							
California Waste Extraction	22 CCR Chapter 11, Article 5, Appendix II			X	X				
Chemical Oxygen Demand	EPA 410.4			X					
Chemical Oxygen Demand	SM 5220 D-1997			X					
Chemical Oxygen Demand	SM 5220 D-2011			X					
Chloride	SM 4500-Cl^- E-1997		X	X					
Chloride	SM 4500-Cl^- E-2011		X	X					
Conductivity	EPA 120.1			X					
Conductivity	SM 2510 B-1997		X	X					
Conductivity	SM 2510 B-2011		X	X					
Continuous Liquid-Liquid Extraction	EPA 3520C			X					
Demand (BOD, cBOD)	HACH 10360			X					
Demand (BOD, cBOD)	HACH 10360 Rev 1.2 (2011)			X					
Diesel Range Organics	EPA 8015B			X	X				
Diesel Range Organics	EPA 8015C			X	X				
Diesel Range Organics	EPA 8015D			X	X				
Diesel Range Organics	NwTPH-Dx			X	X				
Diesel Range Organics	WI(95) DRO)			X	X				

Parameter	Method	Matrices							
		Air	DW	NPW	SCM	Waste	Tissue	Wipes	Other
Dioxins and Furans	EPA 1613B			X	X		X	X	
Dioxins and Furans	EPA 8280B			X	X				
Dioxins and Furans	EPA 8290			X	X		X	X	
Dioxins and Furans	EPA 8290A			X	X		X	X	
Dioxins and Furans	EPA Method 23	X							
Dioxins and Furans	EPA TO-9A	X							
Dioxins and Furans (2,3,7,8-TCDD)	EPA 1613B		X						
Dissolved Oxygen	HACH 10360			X					
Dissolved Oxygen	HACH 10360 Rev 1.2 (2011)			X					
Escherichia coli	SM 9223 B (Colilert® Quanti-Tray®)-1997			X					
Escherichia coli	SM 9223 B (Colilert®)-1997		X						
Escherichia coli	SM 9223 B-2004			X					
Fecal Coliforms	SM 9222 D (m-FC)-1997			X					
Fecal Coliforms	SM 9222 D (m-FC)-2006			X					
Ferrous Iron	SM 3500-Fe B-1997			X					
Ferrous Iron	SM 3500-Fe B-2011			X					
Fixed Gases	EPA RSK-175 (GC/FID)			X					
Fluoride	SM 4500-F¯ C-1997		X	X					
Fluoride	SM 4500-F¯ C-2011		X	X					

Parameter	Method	Matrices							
		Air	DW	NPW	SCM	Waste	Tissue	Wipes	Other
Gasoline Range Organics	EPA 8015B			X	X				
Gasoline Range Organics	EPA 8015C			X	X				
Gasoline Range Organics	NwTPH-Gx			X	X				
Gasoline Range Organics	WI (95) GRO			X	X				
Heterotrophic Plate Count	SM 9215 B (R2A)-94		X						
Hexavalent Chromium	SM 3500-Cr B-1997			X					
Hexavalent Chromium	SM 3500-Cr B-2011			X					
ICP Metals	EPA 200.7			X					
ICP Metals	EPA 6010B			X	X				
ICP Metals	EPA 6010C			X	X				
ICP Metals	EPA 6010D (Rev 2014)			X	X				
ICP Metals Extraction (Water)	EPA 3010A			X					
ICP/ICPMS Metals Extraction (Soil/Waste)	EPA 3050A				X	X			
ICPMS Metals	EPA 200.8		X	X					
ICPMS Metals	EPA 6020			X	X				
ICPMS Metals	EPA 6020A			X	X				
ICPMS Metals	EPA 6020B (Rev 2014)			X	X				
ICPMS Metals Extraction (Water)	EPA 3020A			X					
Inorganic Anions	EPA 300.0		X	X					

Parameter	Method	Matrices							
		Air	DW	NPW	SCM	Waste	Tissue	Wipes	Other
Inorganic Anions	EPA 9056A			X					
Lead in Ambient Air	Method IO-3.1	X							
Lead in Ambient Air	Method IO-3.4	X							
Mercury	EPA 245.1		X	X					
Mercury	EPA 6020			X	X				
Mercury	EPA 6020A			X	X				
Mercury	EPA 6020B (Rev 2014)			X	X				
Mercury	EPA 7470A			X					
Mercury	EPA 7471A				X				
Mercury	EPA 7471B				X				
Microwave Extraction	EPA 3546				X				
Moisture (Dry Weight)	ASTM D2974-07				X				
Nitrate	EPA 353.2		X	X					
Nitrate, Nitrite, Nitrate+Nitrite	SM 4500-NO_3^- H-1997			X					
Nitrate, Nitrite, Nitrate+Nitrite	SM 4500-NO_3^- H-2011			X					
Nitrate+Nitrite	EPA 353.2			X					
Nitrite	EPA 353.2		X	X					
Nitrite	SM 4500-NO_2^- B-1993		X	X					
Nitrite	SM 4500-NO_2^- B-2011			X					

Parameter	Method	Matrices							
		Air	DW	NPW	SCM	Waste	Tissue	Wipes	Other
Oil & Grease	EPA 1664A (HEM)			X					
Oil & Grease	EPA 1664B			X					
Oil & Grease	EPA 9071B				X				
Orthophosphosphate	SM 4500-P G-1999			X					
Orthophosphosphate	SM 4500-P G-2011			X					
Paint Filter Liquids Test	EPA 9095B			X					
PCB Congeners	EPA 1668A			X	X	X	X		
PCB Congeners	EPA 1668C			X	X	X	X		
Per- and polyfluoroalkyl substances (PFAS)	EPA 537		X						
Per- and polyfluoroalkyl substances (PFAS)	EPA 537-Modified			X	X				
Per- and polyfluoroalkyl substances (PFAS)	Isotope Dilution per DoD QSM v5.1			X	X				
Per- and polyfluoroalkyl substances (PFAS)	MPCA Guidance PFCs		X	X	X				
Pesticides	EPA 8081A			X	X				
Pesticides	EPA 8081B			X	X				
Petroleum Volatile Organic Compounds	EPA 8021B			X	X				
Petroleum Volatile Organic Compounds	WI(95) GRO			X	X				
pH	EPA 9045D			X					
pH	SM 4500-H+ B-1996		X	X					
pH	SM 4500-H+ B-2011		X	X					

Parameter	Method	Matrices							
		Air	DW	NPW	SCM	Waste	Tissue	Wipes	Other
Phenols	EPA 420.4			X					
PM-10	EPA Quality Assurance Handbook, Volume II, Part II								Filter
Polybrominated Diphenyl Ethers	EPA 1614						X		
Polychlorinated Biphenyls	EPA 8082			X	X	X		X	
Polychlorinated Biphenyls	EPA 8082A (Rev 2007)			X	X	X		X	
Purge and Trap Extraction	EPA 5035				X				
Purge and Trap Extraction	EPA 5035A				X				
Purge and Trap Extraction	EPA 5035B				X				
Purge and Trap Extraction	EPA 5035C				X				
Reformed Gases	ASTM D1946-90 (Rev 2006)	X							
Sample Appearance	SM 2110-2005		X	X					
Semi-Volatile Organic Compounds	EPA 625			X					
Semi-Volatile Organic Compounds	EPA 625.1			X					
Semi-Volatile Organic Compounds	EPA 8270C			X	X				
Semi-Volatile Organic Compounds	EPA 8270C SIM			X	X				
Semi-Volatile Organic Compounds	EPA 8270D (Rev 2014)			X	X				
Semi-Volatile Organic Compounds	EPA 8270D (Rev 2014) SIM			X	X				
Semi-Volatile Organic Compounds	EPA 8270E			X	X				
Semi-Volatile Organic Compounds	EPA 8270E			X	X				

Parameter	Method	Matrices							
		Air	DW	NPW	SCM	Waste	Tissue	Wipes	Other
Separatory Funnel Liquid-Liquid Extraction	EPA 3510C			X					
Sodium Absorption Ratio by Calculation	USDA Handbook No. 60			X					
SPLP Leachate	EPA 1312			X	X				
Sulfate	ASTM D516-1990		X	X					
Sulfate	ASTM D516-2002			X					
Sulfate	ASTM D516-2007			X					
Sulfate	ASTM D516-2011		X	X					
TCLP Leachate	EPA 1311			X	X				
Total Coliforms	SM 9222 B (M-Endo)-1997			X					
Total Coliforms	SM 9222 B-2006			X					
Total Coliforms	SM 9223 B (Colilert®)-1997		X						
Total Cyanide	SM 4500-CN¯ E-1997		X	X					
Total Cyanide	SM 4500-CN¯ E-2011		X	X					
Total Dissolved Solids	SM 2540 C-1997		X	X					
Total Dissolved Solids	SM 2540 C-2011			X					
Total Hardness as CaCO3	SM 2340 B-1997			X					
Total Hardness as CaCO3	SM 2340 B-2011			X					
Total Petroleum Hydrocarbon	EPA 1664A (SGT-HEM)			X					
Total Petroleum Hydrocarbon	EPA 1664B (SGT-HEM)			X					

Parameter	Method	Matrices							
		Air	DW	NPW	SCM	Waste	Tissue	Wipes	Other
Total Petroleum Hydrogen	EPA 9071B				X				
Total Phosphorus	SM 4500-P F-1999			X					
Total Phosphorus	SM 4500-P F-2011			X					
Total Residual Chlorine	SM 4500-Cl G-1993		X	X					
Total Residual Chlorine	SM 4500-Cl G-2011		X	X					
Total Settleable Solids	SM 2540 F-1997			X					
Total Settleable Solids	SM 2540 F-2011			X					
Total Solids	SM 2540 B-1997			X					
Total Solids	SM 2540 B-2011			X					
Total Suspended Particulates (TSP)	EPA Quality Assurance Handbook, Volume II, Part II								Filter
Total Suspended Solids	SM 2540 D-1997			X					
Total Suspended Solids	SM 2540 D-2011			X					
Total Volatile Solids	EPA 160.4			X					
Turbidity	EPA 180.1, Rev 2-1993		X	X					
Ultrasonic Extraction	EPA 3550C				X				
Ultrasonic Extraction	EPA 3550C Modified				X				
Volatile Organic Compounds	EPA 3C	X							
Volatile Organic Compounds	EPA 524.2		X						
Volatile Organic Compounds	EPA 624			X					

Parameter	Method	Matrices							
		Air	DW	NPW	SCM	Waste	Tissue	Wipes	Other
Volatile Organic Compounds	EPA 624.1			X					
Volatile Organic Compounds	EPA 8260B			X	X				
Volatile Organic Compounds	EPA 8260B SIM			X	X				
Volatile Organic Compounds	EPA TO-14A	X							
Volatile Organic Compounds	EPA TO-15	X							
Volatile Organic Compounds	EPA TO-15 SIM	X							
Volatile Organic Compounds	EPA TO-15 SIM Scan	X							
Volatile Organic Compounds	EPA TO-17	X							
Volatile Organic Compounds	EPA TO-3	X							
Waste Dilution	EPA 3580A					X		X	

7.2.2 PAS-Billings

Parameter	Method	Matrices					
		Air	DW	NPW	SCM	Waste	Tissue
Acidity	SM 2310B			X			
Ammonia	EPA 350.1 (MOD)			X			
Anions by IC	EPA 300.0		X	X	X		
Anions by IC	EPA 9056A			X	X		
ASA10-3.3 Specific Conductance	ASA 10-3.3				X		
Available Ammonium	EPA 350.1				X		
Available Nitrate	ASA 33-3.2 / EPA 353.2				X		
Base Saturation Analysis	EPA 6010B				X		
Carbonates as CaCO3	USDA 23				X		
Cation Exchange Capacity	EPA 6010B				X		
Chlorophyll	SM 10200H			X			
Coarse Soil Prep	ASTM D421				X		
Dry Weight	ASTM D2974				X		
GCS THC-Diesel	EPA 8015B			X	X		
GCS THC-Diesel	EPA 8015C			X	X		
GCS THC-Diesel Silica Gel	EPA 8015 Modified w/ SG			X	X		
GCV TPH GAS	EPA 8015B			X	X		
GCV TPH GAS	EPA 8015C			X	X		
Grain Size	ASTM D422				X		
Grain Size by Hydrometer	ASTM D422				X		
Leachate Preparation	1311, 1312				X		
MADEP EPH MA	MADEP EPH			X	X		
MADEP VPH MA	MADEP VPH			X	X		
MSV TCLP	EPA 8260B			X	X		
MSV TCLP	EPA 8260D			X	X		
MSV UST	EPA 8260B			X	X		
MSV UST	EPA 8260D			X	X		
Multi-Incremental Sampling	IRTC 6.2.2				X		
Nitrate + Nitrite (Preserved)	EPA 353.2		X	X			
Nitrite (Unpreserved)	SM 4500-NO2 B		X	X			
Organic Matter	ASA 29-3.5.2				X		
Percent Sand, Silt, Clay (PSA)	ASA 15-5 mod				X		
Percent Saturation	USDA 27a				X		
pH	ASA 10-3.2				X		
pH	EPA 9045D				X		

Parameter	Method	Matrices					
		Air	DW	NPW	SCM	Waste	Tissue
pH	USDA 21A				X		
pH, Electrometric	SM 4500-H+B		X	X			
Phosphate, Ortho	SM 4500-P E		X	X			
Phosphorus, Available	ASA 24-5.4 / SM4500				X		
Phosphorus, Dissolved	SM 4500-P E			X			
Phosphorus, Total	SM 4500-P E			X			
Resitivity, Calculation	D1125-14			X	X		
Salinity, Calculation	Calculated			X	X		
SAR	EPA 6010B / ASA 10.3.2.1				X		
Sieve Procedure					X		
Sobek, Calculation	Modified Sobek 3.2				X		
Sobek Extractable Sulfur	Modified Sobek 3.2				X		
Sobek Neutralization Potential	Modified Sobek 3.2				X		
Sobek SMP Buffer pH	Modified Sobek 3.2				X		
Soil Moisture Content	USDA 26				X		
Specific Conductance	SM 2510B		X	X			
Sulfide as H2S, Calculation	SM 4500-S H			X			
Sulfide Water	SM 4500-S2-D			X			
Total Diss Solids LL	SM 2540C		X	X			
Total Dissolved Solids	SM 2540C		X	X			
Total Inorganic Nitrogen, Calculation	NO2+NO3+NH3 Calculated			X			
Total Kjeldahl Nitrogen (TKN)	EPA 351.2			X			
Total Nitrogen, Calculation	40CFR PART 432.2			X			
Total Organic Nitrogen, Calculation	TKN-NH3 Calculation			X			
Total Persulfate N2	SM 4500-N C			X			
Total Settleable Solids	SM 2540F		X	X			
Total Solids	SM 2540B		X	X			
Total Sulfur	LECO				X		
Total Suspended Solids	SM 2540D		X	X			
Turbidity	SM 2130B		X	X			
VPH Confirmation	EPA 8260B			X	X		
VPH Confirmation	EPA 8260D			X	X		

7.2.3 PAS-Virginia

Parameter	Method	Matrices		
		DW	NPW	SCM
Total Volatile Solids	EPA 160.4		X	X
Turbidity	EPA 180.1	X	X	
Anions	EPA 300.0	X	X	
Anions	EPA 9056A			X
Ammonia	EPA 350.1		X	X
Total Kjeldahl Nitrogen	EPA 351.2		X	X
Nitrate+Nitrite	EPA 353.2	X	X	
Total Phosphorus	EPA 365.1		X	X
Orthophosphate	EPA 365.3		X	
Acidity	SM 2310 B		X	
Alkalinity	SM 2320 B	X	X	
Conductivity	SM 2510 B	X	X	
Salinity	SM 2520 B		X	
Amines	ASTM D2327		X	
Dry Weight	ASTM D2974			X
Total Solids	SM 2540 B		X	X
Total Dissolved Solids	SM 2540 C		X	
Total Suspended Solids	SM 2540 D		X	
Total Suspended Solids	USGS I-3765		X	
Residual Chlorine	SM 4500 Cl-G	X	X	
Chloride	SM 4500 Cl-E		X	
pH	SM 4500 H+B	X	X	
pH	EPA 9045 D			X
Sulfide	SM 4500 S-2 F		X	
BOD/CBOD	SM 5210 B		X	
COD	SM 5220 D		X	
TOC/DOC	SM 5310C		X	
TOC/DOC	EPA 9060 A		X	
TOC, 2 rep and 4 rep	EPA 9060 A			X
ICP Metals	EPA 200.7	X	X	
ICP Metals	SW846 6010C		X	X

Parameter	Method	Matrices		
		DW	NPW	SCM
ICPMS Metals	EPA 200.8	X	X	
ICPMS Metals	SW846 6020A		X	X
Mercury	EPA 245.1	X	X	
Mercury	EPA 7470 A		X	
Mercury	EPA 7471 A,B			X
Hexavalent Chromium	SM 3500 Cr-B		X	
Paint Filter	EPA 9095 B			x
Closed Cup Flash Point	EPA 1010 A		X	
T Coli, MF	SM 9222B		X	
Fecal Coliform	SM 9222D		X	
Total, E coli	SM 9223 B QT	X	X	
Total, E coli (Colilert)	SM 9223 B P/A	X		
Total, E coli (Colilert-18)	SM 9223 B P/A	X		
Total, E coli (Colisure)	SM 9223 B P/A	X		
Heterotropic Plate Count	SimPlate	X		
Chlorophyll-a	SM 10200 H		X	

7.2.4 PAS-Duluth

Parameter	Method	Matrices					
		Air	DW	NPW	SCM	Waste	Tissue
Oxidation-Reduction Potential (ORP)	ASTM 1498 2014			X			
Percent Moisture	ASTM D2974 2013				X		
Humidity Cell Testing	ASTM D5744 2018				X		
Escherichia coli (E. coli)	Colilert-18		X				
Total Coliforms	Colilert-18		X				
Fecal Coliforms	Colilert-18 Quanti-Tray			X			
Escherichia coli (E. coli)	Colilert-18 Quanti-Tray		X	X			
Total Coliforms	Colilert-18 Quanti-Tray		X				
Escherichia coli (E. coli)	ColiSure		X				
Total Coliforms	ColiSure		X				
IC25 (ON) Growth Fathead Minnow Chronic	EPA 1000			X			
NOEC (ON) Growth Fathead Minnow Chronic	EPA 1000			X			
NOEC (ON) Survival Fathead Minnow Chronic	EPA 1000			X			
IC25 Reproduction Ceriodaphnia dubia Chronic	EPA 1002			X			
NOEC Reproduction Ceriodaphnia dubia Chronic	EPA 1002			X			
NOEC Survival Ceriodaphnia dubia Chronic	EPA 1002			X			
Conductivity	EPA 120.1 1982			X			
Mass Transfer Rates of Constituents in Materials	EPA 1315 2017				X		
Total Volatile Solids (TVS)	EPA 160.4 1971			X			
Methyl Mercury	EPA 1630 1998			X	X		X
Low Level Mercury	EPA 1631 2002			X	X		
Hexane Extractable Materials (HEM, Oil and Grease)	EPA 1664A 1999			X			
Silica-Gel Treated Hexane Extractable Material (SGT-HEM)	EPA 1664A 1999			X			

Parameter	Method	Matrices					
		Air	DW	NPW	SCM	Waste	Tissue
Turbidity	EPA 180.1 1993		X	X			
LC50 Survival Fathead Minnow Acute	EPA 2000			X			
LC50 Survival Ceriodaphnia dubia Acute	EPA 2002			X			
LC50 Survival Daphnia magna Acute	EPA 2021			X			
Ammonia	EPA 350.1 1993			X	X		
Total Kjeldahl Nitrogen (TKN)	EPA 351.2 1993			X	X		
Organic Nitrogen	EPA 351.2 Minus EPA 350.1			X			
Nitrate (NO3)	EPA 353.2 1993		X	X	X		
Nitrite (NO2)	EPA 353.2 1993		X	X			
Nitrate-Nitrite (NO3+NO2)	EPA 353.2 1993			X	X		
Total Phosphorus	EPA 365.1 1993			X	X		
Orthophosphate	EPA 365.3 1993			X			
Total Phosphorus	EPA 365.3 1993			X			
Total Phenolics	EPA 420.1 1978			X			
Biochemical Oxygen Demand (BOD)	Hach 10360 2011			X			
Carbonaceous Biochemical Oxygen Demand (CBOD)	Hach 10360 2011			X			
Dissolved Oxygen	Hach 10360 2011			X			
Heteretrophic Plate Count	SimPlate		X				
Chlorophyll-A	SM 10200 H 2011			X			
Chlorophyll-A (Non-Pheophytin Corrected)	SM 10200 H 2011			X			
Pheophytin	SM 10200 H 2011			X			
Color	SM 2120 B 2011			X			
Alkalinity	SM 2320 B 2011		X	X			
Conductivity	SM 2510 B 2011		X	X			
Total Dissolved Solids (TDS)	SM 2540 C 2011		X	X			

Parameter	Method	Matrices					
		Air	DW	NPW	SCM	Waste	Tissue
Chromium VI (Hexavalent Chromium)	SM 3500 Cr B 2011			X			
Total Residual Chlorine	SM 4500 Cl E 2011			X			
Chloride	SM 4500 Cl- E 2011			X			
Total Residual Chlorine	SM 4500 Cl G 2011		X	X			
Cyanide	SM 4500 CN- E 2011		X	X			
Amenable Cyanide	SM 4500 CN- G 2011			X			
pH	SM 4500 H+ B 2011			X			
Dissolved Oxygen	SM 4500 O C 2011			X			
Sulfide	SM 4500 S2- D 2011			X			
Chemical Oxygen Demand	SM 5220 D 2011			X			
Surfactants MBAS	SM 5540 C 2011			X			
Heterotrophic Plate Count	SM 9215 E 2004		X				
Escherichia coli (E. coli)	SM 9223B 2004		X				
Total Coliforms	SM 9223B 2004		X				
Total Hardness	USGS I-1338-85			X			
Total Suspended Solids (TSS)	USGS I-3765-85			X			
Activated Sludge, Respiration Inhibition Test	OECD 209 1984				X	X	
Algae Toxicity, Growth Inhibition Test	OECD 201 2011				X	X	

7.3 Appendix C: Glossary

This glossary provides common terms and definitions used in the laboratory. **It is not intended to be a complete list of all terms and definitions used.** The definitions have been compiled mostly from the TNI Standard and DoD QSM. Although this information has been reproduced with care, errors cannot be entirely excluded. Definitions for the same term also vary between sources. When the meaning of a term used in a laboratory document is different from this glossary or when the glossary does not include the term, the term and definition is included or defined in context in the laboratory document.

Term	Definition
3P Program	PAS-The continuous improvement program used by PAS that focuses on Process, Productivity, and Performance.
Acceptance Criteria	TNI- Specified limits placed on characteristics of an item, process, or service defined in requirement documents.
Accreditation	TNI- The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. DoD- Refers to accreditation in accordance with the DoD ELAP.
Accreditation Body (AB)	TNI- The organization having responsibility and accountability for environmental laboratory accreditation and which grants accreditation under this program. DoD- Entities recognized in accordance with the DoD-ELAP that are required to operate in accordance with ISO/IEC 17011, *Conformity assessment: General requirements for accreditation bodies accrediting conformity assessment bodies.* The AB must be a signatory, in good standing, to the International Laboratory Accreditation Cooperation (ILAC) mutual recognition arrangement (MRA) that verifies, by evaluation and peer assessment, that its signatory members are in full compliance with ISO/IEC 17011 and that its accredited laboratories comply with ISO/IEC 17025.
Accuracy (%R)	TNI- The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.
Activity, Absolute	TNI- Rate of nuclear decay occurring in a body of material, equal to the number of nuclear disintegrations per unit time. NOTE: Activity (absolute) may be expressed in becquerels (Bq), curies (Ci), or disintegrations per minute (dpm), and multiples or submultiples of these units.
Activity, Areic	TNI- Quotient of the activity of a body of material and its associated area.
Activity, Massic	TNI- Quotient of the activity of a body of material and its mass; also called specific activity.
Activity, Volumic	TNI- Quotient of the activity of a body of material and its volume; also called activity concentration. NOTE: In this module [TNI Volume 1, Module 6], unless otherwise stated, references to activity shall include absolute activity, areic activity, massic activity, and volumic activity.
Activity Reference Date	TNI- The date (and time, as appropriate to the half-life of the radionuclide) to which a reported activity result is calculated. NOTE: The sample collection date is most frequently used as the Activity Reference Date for environmental measurements, but different programs may specify other points in time for correction of results for decay and ingrowth.
Aliquot	DoD- A discrete, measured, representative portion of a sample taken for analysis.
American Society for Testing and Materials (ASTM)	An international standards organization that develops and publishes voluntary consensus standards for a wide range of materials, products, systems and services.
Analysis	DoD- A combination of sample preparation and instrument determination.
Analysis Code (Acode)	All the set parameters of a test, such as Analytes, Method, Detection Limits and Price.
Analysis Sequence	A compilation of all samples, standards and quality control samples run during a specific amount of time on a particular instrument in the order they are analyzed.
Analyst	TNI- The designated individual who performs the “hands-on” analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analyte	TNI- A substance, organism, physical parameter, property, or chemical constituent(s) for which an environmental sample is being analyzed. DoD- The specific chemicals or components for which a sample is analyzed; it may be a group of chemicals that belong to the same chemical family and are analyzed together.
Analytical Method	DoD- A formal process that identifies and quantifies the chemical components of interest (target analytes) in a sample.
Analytical Uncertainty	TNI- A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.
Aliquot	DoD- A discrete, measured, representative portion of a sample taken for analysis.
Annual (or Annually)	Defined by PAS as every 12 months ± 30 days.
Assessment	TNI - The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its system to defined criteria (to the standards and requirements of laboratory accreditation). DoD- An all-inclusive term used to denote any of the following: audit, performance evaluation, peer review, inspection, or surveillance conducted on-site.
Atomic Absorption Spectrometer	Instrument used to measure concentration in metals samples.
Atomization	A process in which a sample is converted to free atoms.
Audit	TNI- A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives.
Batch	TNI- Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same quality systems matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours or the time-frame specified by the regulatory program. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed 20 samples.
Batch, Radiation Measurements (RMB)	TNI- An RMB is composed of 1 to 20 environmental samples that are counted directly without preliminary physical or chemical processing that affects the outcome of the test (e.g., non-destructive gamma spectrometry, alpha/beta counting of air filters, or swipes on gas proportional detectors). The samples in an RMB share similar physical and chemical parameter, and analytical configurations (e.g., analytes, geometry, calibration, and background corrections). The maximum time between the start of processing of the first and last in an RMB is 14 calendar days.
Bias	TNI- The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).
Blank	TNI and DoD- A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results (See Method Blank). DoD- Blank samples are negative control samples, which typically include field blank samples (e.g., trip blank, equipment (rinsate) blank, and temperature blank) and laboratory blank samples (e.g., method blank, reagent blank, instrument blank, calibration blank, and storage blank).
Blind Sample	A sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.
BNA (Base Neutral Acid compounds)	A list of semi-volatile compounds typically analyzed by mass spectrometry methods. Named for the way they can be extracted out of environmental samples in an acidic, basic or neutral environment.
BOD (Biochemical Oxygen Demand)	Chemical procedure for determining how fast biological organisms use up oxygen in a body of water.

Calibration	TNI- A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. 1) In calibration of support equipment, the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI); 2) In calibration according to test methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.
Calibration Curve	TNI- The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.
Calibration Method	A defined technical procedure for performing a calibration.
Calibration Range	DoD- The range of values (concentrations) between the lowest and highest calibration standards of a multi-level calibration curve. For metals analysis with a single-point calibration, the low-level calibration check standard and the high standard establish the linear calibration range, which lies within the linear dynamic range.
Calibration Standard	TNI- A substance or reference material used for calibration.
Certified Reference Material (CRM)	TNI- Reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute.
Chain of Custody	An unbroken trail of accountability that verifies the physical security of samples, data, and records.
Chain of Custody Form (COC)	TNI- Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and type of containers; the mode of collection, the collector, time of collection; preservation; and requested analyses.
Chemical Oxygen Demand (COD)	A test commonly used to indirectly measure the amount of organic compounds in water.
Client (referred to by ISO as Customer)	Any individual or organization for whom items or services are furnished or work performed in response to defined requirements and expectations.
Code of Federal Regulations (CFR)	A codification of the general and permanent rules published in the Federal Register by agencies of the federal government.
Comparability	An assessment of the confidence with which one data set can be compared to another. Comparable data are produced through the use of standardized procedures and techniques.
Completeness	The percent of valid data obtained from a measurement system compared to the amount of valid data expected under normal conditions. The equation for completeness is: % Completeness = (Valid Data Points/Expected Data Points)*100
Confirmation	TNI- Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to: second-column confirmation; alternate wavelength; derivatization; mass spectral interpretation; alternative detectors; or additional cleanup procedures. DoD- Includes verification of the identity and quantity of the analyte being measured by another means (e.g., by another determinative method, technology, or column). Additional cleanup procedures alone are not considered confirmation techniques.
Conformance	An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.
Congener	A member of a class of related chemical compounds (e.g., PCBs, PCDDs).
Consensus Standard	DoD- A standard established by a group representing a cross-section of a particular industry or trade, or a part thereof.
Continuing Calibration Blank (CCB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method.
Continuing Calibration Check Compounds (CCC)	Compounds listed in mass spectrometry methods that are used to evaluate an instrument calibration from the standpoint of the integrity of the system. High variability would suggest leaks or active sites on the instrument column.
Continuing Calibration Verification	DoD- The verification of the initial calibration. Required prior to sample analysis and at periodic intervals. Continuing calibration verification applies to both external and internal standard calibration techniques, as well as to linear and non-linear calibration models.
Continuing Calibration Verification (CCV) Standard	Also referred to as a Calibration Verification Standard (CVS) in some methods, it is a standard used to verify the initial calibration of compounds in an analytical method. CCVs are analyzed at a frequency determined by the analytical method.

Continuous Emission Monitor (CEM)	A flue gas analyzer designed for fixed use in checking for environmental pollutants.
Continuous Improvement Plan (CIP)	The delineation of tasks for a given laboratory department or committee to achieve the goals of that department.
Contract Laboratory Program (CLP)	A national network of EPA personnel, commercial labs, and support contractors whose fundamental mission is to provide data of known and documented quality.
Contract Required Detection Limit (CRDL)	Detection limit that is required for EPA Contract Laboratory Program (CLP) contracts.
Contract Required Quantitation Limit (CRQL)	Quantitation limit (reporting limit) that is required for EPA Contract Laboratory Program (CLP) contracts.
Control Chart	A graphic representation of a series of test results, together with limits within which results are expected when the system is in a state of statistical control (see definition for Control Limit)
Control Limit	A range within which specified measurement results must fall to verify that the analytical system is in control. Control limit exceedances may require corrective action or require investigation and flagging of non-conforming data.
Correction	DoD- Action taken to eliminate a detected non-conformity.
Corrective Action	DoD- The action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence. A root cause analysis may not be necessary in all cases.
Corrective and Preventative Action (CAPA)	The primary management tools for bringing improvements to the quality system, to the management of the quality system's collective processes, and to the products or services delivered which are an output of established systems and processes.
Critical Value	TNI- Value to which a measurement result is compared to make a detection decision (also known as critical level or decision level). NOTE: The Critical Value is designed to give a specified low probability α of false detection in an analyte-free sample, which implies that a result that exceeds the Critical Value, gives high confidence $(1 – \alpha)$ that the radionuclide is actually present in the material analyzed. For radiometric methods, α is often set at 0.05.
Customer	DoD- Any individual or organization for which products or services are furnished or work performed in response to defined requirements and expectations.
Data Integrity	TNI- The condition that exists when data are sound, correct, and complete, and accurately reflect activities and requirements.
Data Quality Objective (DQO)	Systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use or end user.
Data Reduction	TNI- The process of transforming the number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more usable form.
Definitive Data	DoD- Analytical data of known quantity and quality. The levels of data quality on precision and bias meet the requirements for the decision to be made. Data that is suitable for final decision-making.
Demonstration of Capability (DOC)	TNI- A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. DoD- A procedure to establish the ability of the analyst to generate analytical results by a specific method that meet measurement quality objectives (e.g., for precision and bias).
Department of Defense (DoD)	An executive branch department of the federal government of the United States charged with coordinating and supervising all agencies and functions of the government concerned directly with national security.
Detection Limit (DL)	DoD- The smallest analyte concentration that can be demonstrated to be different than zero or a blank concentration with 99% confidence. At the DL, the false positive rate (Type 1 error) is 1%. A DL may be used as the lowest concentration for reliably reporting a detection of a specific analyte in a specific matrix with a specific method with 99% confidence.
Detection Limit (DL) for Safe Drinking Water Act (SDWA) Compliance	TNI- Laboratories that analyze drinking-water samples for SDWA compliance monitoring must use methods that provide sufficient detection capability to meet the detection limit requirements established in 40 CFR 141. The SDWA DL for radioactivity is defined in 40 CFR Part 141.25.c as the radionuclide concentration, which can be counted with a precision of plus or minus 100% at the 95% confidence level (1.96σ where σ is the standard deviation of the net counting rate of the sample).
Deuterated Monitoring Compounds (DMCs)	DoD- SIM specific surrogates as specified for GC/MS SIM analysis.
Diesel Range Organics (DRO)	A range of compounds that denote all the characteristic compounds that make up diesel fuel (range can be state or program specific).

Digestion	DoD- A process in which a sample is treated (usually in conjunction with heat and acid) to convert the target analytes in the sample to a more easily measured form.
Document Control	The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.
Documents	DoD- Written components of the laboratory management system (e.g., policies, procedures, and instructions).
Dry Weight	The weight after drying in an oven at a specified temperature.
Duplicate (also known as Replicate or Laboratory Duplicate)	The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results of duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.
Electron Capture Detector (ECD)	Device used in GC methods to detect compounds that absorb electrons (e.g., PCB compounds).
Electronic Data Deliverable (EDD)	A summary of environmental data (usually in spreadsheet form) which clients request for ease of data review and comparison to historical results.
Eluent	A solvent used to carry the components of a mixture through a stationary phase.
Elute	To extract, specifically, to remove (absorbed material) from an absorbent by means of a solvent.
Elution	A process in which solutes are washed through a stationary phase by movement of a mobile phase.
Environmental Data	DoD- Any measurements or information that describe environmental processes, locations, or conditions; ecological or health effects and consequences; or the performance of environmental technology.
Environmental Monitoring	The process of measuring or collecting environmental data.
Environmental Protection Agency (EPA)	An agency of the federal government of the United States which was created for the purpose of protecting human health and the environment by writing and enforcing regulations based on laws passed by Congress.
Environmental Sample	A representative sample of any material (aqueous, non-aqueous, or multimedia) collected from any source for which determination of composition or contamination is requested or required. Environmental samples can generally be classified as follows: • Non Potable Water (Includes surface water, ground water, effluents, water treatment chemicals, and TCLP leachates or other extracts) • Drinking Water - Delivered (treated or untreated) water designated as potable water • Water/Wastewater - Raw source waters for public drinking water supplies, ground waters, municipal influents/effluents, and industrial influents/effluents • Sludge - Municipal sludges and industrial sludges. • Soil - Predominately inorganic matter ranging in classification from sands to clays. • Waste - Aqueous and non-aqueous liquid wastes, chemical solids, and industrial liquid and solid wastes
Equipment Blank	A sample of analyte-free media used to rinse common sampling equipment to check effectiveness of decontamination procedures.
Extracted Internal Standard Analyte	Isotopically labeled analogs of analytes of interest added to all standards, blanks and samples analyzed. Added to samples and batch QC samples prior to the first step of sample extraction and to standards and instrument blanks prior to analysis. Used for isotope dilution methods.
Facility	A distinct location within the company that has unique certifications, personnel and waste disposal identifications.
False Negative	DoD- A result that fails to identify (detect) an analyte or reporting an analyte to be present at or below a level of interest when the analyte is actually above the level of interest.
False Positive	DoD- A result that erroneously identifies (detects) an analyte or reporting an analyte to be present above a level of interest when the analyte is actually present at or below the level of interest.
Field Blank	A blank sample prepared in the field by filling a clean container with reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken.
Field Measurement	Determination of physical, biological, or radiological properties, or chemical constituents that are measured on-site, close in time and sPAS to the matrices being sampled/measured, following accepted test methods. This testing is performed in the field outside of a fixed-laboratory or outside of an enclosed structure that meets the requirements of a mobile laboratory.
Field of Accreditation	TNI- Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Field of Proficiency Testing (FoPT)	TNI- Matrix, technology/method, analyte combinations for which the composition, spike concentration ranges and acceptance criteria have been established by the PTPEC.
Finding	TNI- An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement. DoD- An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive, negative, or neutral and is normally accompanied by specific examples of the observed condition. The finding must be linked to a specific requirement (e.g., this standard, ISO requirements, analytical methods, contract specifications, or laboratory management systems requirements).
Flame Atomic Absorption Spectrometer (FAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the fact that ground state metals absorb light at different wavelengths. Metals in a solution are converted to the atomic state by use of a flame.
Flame Ionization Detector (FID)	A type of gas detector used in GC analysis where samples are passed through a flame which ionizes the sample so that various ions can be measured.
Gas Chromatography (GC)	Instrumentation which utilizes a mobile carrier gas to deliver an environmental sample across a stationary phase with the intent to separate compounds out and measure their retention times.
Gas Chromatograph/ Mass Spectrometry (GC/MS)	In conjunction with a GC, this instrumentation utilizes a mass spectrometer which measures fragments of compounds and determines their identity by their fragmentation patterns (mass spectra).
Gasoline Range Organics (GRO)	A range of compounds that denote all the characteristic compounds that make up gasoline (range can be state or program specific).
Graphite Furnace Atomic Absorption Spectrometry (GFAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the absorption of light at different wavelengths that are characteristic of different analytes.
High Pressure Liquid Chromatography (HPLC)	Instrumentation used to separate, identify and quantitate compounds based on retention times which are dependent on interactions between a mobile phase and a stationary phase.
Holding Time	TNI- The maximum time that can elapse between two specified activities. 40 CFR Part 136- The maximum time that samples may be held prior to preparation and/or analysis as defined by the method and still be considered valid or not compromised. For sample prep purposes, hold times are calculated using the time of the start of the preparation procedure. DoD- The maximum time that may elapse from the time of sampling to the time of preparation or analysis, or from preparation to analysis, as appropriate.
Homogeneity	The degree to which a property or substance is uniformly distributed throughout a sample.
Homologue	One in a series of organic compounds in which each successive member has one more chemical group in its molecule than the next preceding member. For instance, methanol, ethanol, propanol, butanol, etc., form a homologous series.
Improper Actions	DoD- Intentional or unintentional deviations from contract-specified or method-specified analytical practices that have not been authorized by the customer (e.g., DoD or DOE).
Incremental Sampling Method (ISM)	Soil preparation for large volume (1 kg or greater) samples.
In-Depth Data Monitoring	TNI- When used in the context of data integrity activities, a review and evaluation of documentation related to all aspects of the data generation process that includes items such as preparation, equipment, software, calculations, and quality controls. Such monitoring shall determine if the laboratory uses appropriate data handling, data use and data reduction activities to support the laboratory's data integrity policies and procedures.
Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)	Analytical technique used for the detection of trace metals which uses plasma to produce excited atoms that emit radiation of characteristic wavelengths.
Inductively Coupled Plasma- Mass Spectrometry (ICP/MS)	An ICP that is used in conjunction with a mass spectrometer so that the instrument is not only capable of detecting trace amounts of metals and non-metals but is also capable of monitoring isotopic speciation for the ions of choice.
Infrared Spectrometer (IR)	An instrument that uses infrared light to identify compounds of interest.

Initial Calibration (ICAL)	The process of analyzing standards, prepared at specified concentrations, to define the quantitative response relationship of the instrument to the analytes of interest. Initial calibration is performed whenever the results of a calibration verification standard do not conform to the requirements of the method in use or at a frequency specified in the method.
Initial Calibration Blank (ICB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method. This blank is specifically run in conjunction with the Initial Calibration Verification (ICV) where applicable.
Initial Calibration Verification (ICV)	DoD- Verifies the initial calibration with a standard obtained or prepared from a source independent of the source of the initial calibration standards to avoid potential bias of the initial calibration.
Injection Internal Standard Analyte	Isotopically labeled analogs of analytes of interest (or similar in physiochemical properties to the target analytes but with a distinct response) to be quantitated. Added to all blanks, standards, samples and batch QC after extraction and prior to analysis.
Instrument Blank	A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination.
Instrument Detection Limits (IDLs)	Limits determined by analyzing a series of reagent blank analyses to obtain a calculated concentration. IDLs are determined by calculating the average of the standard deviations of three runs on three non-consecutive days from the analysis of a reagent blank solution with seven consecutive measurements per day.
Interference, spectral	Occurs when particulate matter from the atomization scatters incident radiation from the source or when the absorption or emission from an interfering species either overlaps or is so close to the analyte wavelength that resolution becomes impossible.
Interference, chemical	Results from the various chemical processes that occur during atomization and later the absorption characteristics of the analyte.
Internal Standard	TNI and DoD- A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.
International Organization for Standardization (ISO)	An international standard-setting body composed of representatives from various national standards organizations.
Intermediate Standard Solution	Reference solutions prepared by dilution of the stock solutions with an appropriate solvent.
International System of Units (SI)	The coherent system of units adopted and recommended by the General Conference on Weights and Measures.
Ion Chromatography (IC)	Instrumentation or process that allows the separation of ions and molecules based on the charge properties of the molecules.
Isomer	One of two or more compounds, radicals, or ions that contain the same number of atoms of the same element but differ in structural arrangement and properties. For example, hexane (C_6H_{14}) could be n-hexane, 2-methylpentane, 3-methylpentane, 2,3-dimethylbutane, 2,2-dimethylbutane.
Laboratory	A body that calibrates and/or tests.
Laboratory Control Sample (LCS)	TNI- (also known as laboratory fortified blank (LFB), spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to evaluate the performance of all or a portion of the measurement system.
Laboratory Duplicate	Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently.
Laboratory Information Management System (LIMS)	DoD- The entirety of an electronic data system (including hardware and software) that collects, analyzes, stores, and archives electronic records and documents.
Learning Management System (LMS)	A web-based database used by the laboratories to track and document training activities. The system is administered by the corporate training department and each laboratory's learn centers are maintained by a local administrator.
Legal Chain-of-Custody Protocols	TNI- Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the client or program. These procedures are performed at the special request of the client and include the use of a Chain-of-Custody (COC) Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory.

Limit(s) of Detection (LOD)	TNI- The minimum result, which can be reliably discriminated from a blank with predetermined confidence level. DoD- The smallest concentration of a substance that must be present in a sample in order to be detected at the DL with 99% confidence. At the LOD, the false negative rate (Type II error) is 1%. A LOD may be used as the lowest concentration for reliably reporting a non-detect of a specific analyte in a specific matrix with a specific method at 99% confidence.
Limit(s) of Quantitation (LOQ)	TNI- The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. DoD- The smallest concentration that produces a quantitative result with known and recorded precision and bias. For DoD/DOE projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard and within the calibration range.
Linear Dynamic Range	DoD- Concentration range where the instrument provides a linear response.
Liquid chromatography/ tandem mass spectrometry (LC/MS/MS)	Instrumentation that combines the physical separation techniques of liquid chromatography with the mass analysis capabilities of mass spectrometry.
Lot	TNI- A definite amount of material produced during a single manufacturing cycle, and intended to have uniform character and quality.
Management	Those individuals directly responsible and accountable for planning, implementing, and assessing work.
Management System	System to establish policy and objectives and to achieve those objectives.
Manager (however named)	The individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual.
Matrix	TNI- The substrate of a test sample.
Matrix Duplicate	TNI- A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision.
Matrix Spike (MS) (spiked sample or fortified sample)	TNI- A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.
Matrix Spike Duplicate (MSD) (spiked sample or fortified sample duplicate)	TNI- A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.
Measurement Performance Criteria (MPC)	DoD- Criteria that may be general (such as completion of all tests) or specific (such as QC method acceptance limits) that are used by a project to judge whether a laboratory can perform a specified activity to the defined criteria.
Measurement Quality Objective (MQO)	TNI- The analytical data requirements of the data quality objectives are project- or program-specific and can be quantitative or qualitative. MQOs are measurement performance criteria or objectives of the analytical process. Examples of quantitative MQOs include statements of required analyte detectability and the uncertainty of the analytical protocol at a specified radionuclide activity, such as the action level. Examples of qualitative MQOs include statements of the required specificity of the analytical protocol, e.g., the ability to analyze for the radionuclide of interest given the presence of interferences.
Measurement System	TNI- A method, as implemented at a particular laboratory, and which includes the equipment used to perform the test and the operator(s). DoD- A test method, as implemented at a particular laboratory, and which includes the equipment used to perform the sample preparation and test and the operator(s).
Measurement Uncertainty	DoD- An estimate of the error in a measurement often stated as a range of values that contain the true value within a certain confidence level. The uncertainty generally includes many components which may be evaluated from experimental standard deviations based on repeated observations or by standard deviations evaluated from assumed probability distributions based on experience or other information. For DoD/DOE, a laboratory's Analytical Uncertainty (such as use of LCS control limits) can be reported as the minimum uncertainty.
Method	TNI- A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.
Method Blank	TNI- A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit (MDL)	TNI- One way to establish a Detection Limit; defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.
Method of Standard Additions	A set of procedures adding one or more increments of a standard solution to sample aliquots of the same size in order to overcome inherent matrix effects. The procedures encompass the extrapolation back to obtain the sample concentration.
Minimum Detectable Activity (MDA)	TNI- Estimate of the smallest true activity that ensures a specified high confidence, 1 – β, of detection above the Critical Value, and a low probability β of false negatives below the Critical Value. For radiometric methods, β is often set at 0.05. NOTE 1: The MDS is a measure of the detection capability of a measurement process and as such, it is an a priori concept. It may be used in the selection of methods to meet specified MQOs. Laboratories may also calculate a "sample specific" MDA, which indicates how well the measurement process is performing under varying real-world measurement conditions, when sample-specific characteristics (e.g., interferences) may affect the detection capability. However, the MDA must never be used instead of the Critical Value as a detection threshold. NOTE 2: For the purpose of this Standard, the terms MDA and minimum detectable concentration (MDC) are equivalent.
MintMiner	Program used by PAS to review large amounts of chromatographic data to monitor for errors or data integrity issues.
Mobile Laboratory	TNI- A portable enclosed structure with necessary and appropriate accommodation and environmental conditions for a laboratory, within which testing is performed by analysts. Examples include but are not limited to trailers, vans, and skid-mounted structures configured to house testing equipment and personnel.
National Environmental Laboratory Accreditation Conference (NELAC)	See definition of The NELAC Institute (TNI).
National Institute of Occupational Safety and Health (NIOSH)	National institute charged with the provision of training, consultation and information in the area of occupational safety and health.
National Institute of Standards and Technology (NIST)	TNI- A federal agency of the US Department of Commerce's Technology Administration that is designed as the United States national metrology institute (or NMI).
National Pollutant Discharge Elimination System (NPDES)	A permit program that controls water pollution by regulating point sources that discharge pollutants into U.S. waters.
Negative Control	Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.
Nitrogen Phosphorus Detector (NPD)	A detector used in GC analyses that utilizes thermal energy to ionize an analyte. With this detector, nitrogen and phosphorus can be selectively detected with a higher sensitivity than carbon.
Nonconformance	An indication or judgment that a product or service has not met the requirement of the relevant specifications, contract, or regulation; also the state of failing to meet the requirements.
Not Detected (ND)	The result reported for a compound when the detected amount of that compound is less than the method reporting limit.
Operator Aid	DoD- A technical posting (such as poster, operating manual, or notepad) that assists workers in performing routine tasks. All operator aids must be controlled documents (i.e., a part of the laboratory management system).
Percent Recovery (%)	A measure of precision defined as the difference between the spiked concentration and the sample concentration divided by the true value. For LCS and Surrogate calculations the sample concentration is zero.
Performance Based Measurement System (PBMS)	An analytical system wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner.
Physical Parameter	TNI- A measurement of a physical characteristic or property of a sample as distinguished from the concentrations of chemical and biological components.
Photo-ionization Detector (PID)	An ion detector which uses high-energy photons, typically in the ultraviolet range, to break molecules into positively charged ions.
Polychlorinated Biphenyls (PCB)	A class of organic compounds that were used as coolants and insulating fluids for transformers and capacitors. The production of these compounds was banned in the 1970's due to their high toxicity.

Positive Control	Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.
Post-Digestion Spike	A sample prepared for metals analyses that has analytes spike added to determine if matrix effects may be a factor in the results.
Power of Hydrogen (pH)	The measure of acidity or alkalinity of a solution.
Practical Quantitation Limit (PQL)	Another term for a method reporting limit. The lowest reportable concentration of a compound based on parameters set up in an analytical method and the laboratory's ability to reproduce those conditions.
Precision	TNI- The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.
Preservation	TNI and DoD- Any conditions under which a sample must be kept in order to maintain chemical, physical, and/or biological integrity prior to analysis.
Primary Accreditation Body (Primary AB)	TNI- The accreditation body responsible for assessing a laboratory's total quality system, on-site assessment, and PT performance tracking for fields of accreditation.
Procedure	TNI- A specified way to carry out an activity or process. Procedures can be documented or not.
Proficiency Testing (PT)	TNI- A means to evaluate a laboratory's performance under controlled conditions relative to a given set of criteria, through analysis of unknown samples provided by an external source.
Proficiency Testing Program (PT Program)	TNI- The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories.
Proficiency Testing Provider (PT Provider)	TNI- A person or organization accredited by a TNI-approved Proficiency Testing Provider Accreditor to operate a TNI-compliant PT Program.
Proficiency Testing Provider Accreditor (PTPA)	TNI- An organization that is approved by TNI to accredit and monitor the performance of proficiency testing providers.
Proficiency Testing Reporting Limit (PTRL)	TNI- A statistically derived value that represents the lowest acceptable concentration for an analyte in a PT sample, if the analyte is spiked into the PT sample. The PTRLs are specified in the TNI FoPT tables.
Proficiency Testing Sample (PT)	TNI- A sample, the composition of which is unknown to the laboratory, and is provided to test whether the laboratory can produce analytical results within the specified acceptance criteria.
Proficiency Testing (PT) Study	TNI- a) Scheduled PT Study: A single complete sequence of circulation and scoring of PT samples to all participants in a PT program. The study must have the same pre-defined opening and closing dates for all participants; b) Supplemental PT Study: A PT sample that may be from a lot previously released by a PT Provider that meets the requirements for supplemental PT samples given in Volume 3 of this Standard [TNI] but that does not have a pre-determined opening date and closing date.
Proficiency Testing Study Closing Date	TNI- a) Scheduled PT Study: The calendar date by which all participating laboratories must submit analytical results for a PT sample to a PT Provider; b) Supplemental PT Study: The calendar date a laboratory submits the results for a PT sample to the PT Provider.
Proficiency Testing Study Opening Date	TNI- a) Scheduled PT Study: The calendar date that a PT sample is first made available to all participants of the study by a PT Provider; b) Supplemental PT Study: The calendar date the PT Provider ships the sample to a laboratory.
Protocol	TNI- A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) that must be strictly followed.
Qualitative Analysis	DoD- Analysis designed to identify the components of a substance or mixture.
Quality Assurance (QA)	TNI- An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.
Quality Assurance Manual (QAM)	A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.
Quality Assurance Project Plan (QAPP)	A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.
Quality Control (QC)	TNI- The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality.

Quality Control Sample (QCS)	TNI- A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control.
Quality Manual	TNI- A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.
Quality System	TNI and DoD- A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance and quality control activities.
Quality System Matrix	TNI and DoD- These matrix definitions shall be used for purposes of batch and quality control requirements and may be different from a field of accreditation matrix: • **Air and Emissions**: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device • **Aqueous**: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts. • **Biological Tissue**: Any sample of a biological origin such as fish tissue, shellfish or plant material. Such samples shall be grouped according to origin. • **Chemical Waste**: A product or by-product of an industrial process that results in a matrix not previously defined. • **Drinking Water**: Any aqueous sample that has been designated a potable or potentially potable water source. • **Non-aqueous liquid**: Any organic liquid with <15% settleable solids • **Saline/Estuarine**: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake. • **Solids**: Includes soils, sediments, sludges, and other matrices with >15% settleable solids.
Quantitation Range	DoD- The range of values (concentrations) in a calibration curve between the LOQ and the highest successively analyzed initial calibration standard used to relate instrument response to analyte concentration. The quantitation range (adjusted for initial sample volume/weight, concentration/dilution and final volume) lies within the calibration range.
Quantitative Analysis	DoD- Analysis designed to determine the amounts or proportions of the components of a substance.
Random Error	The EPA has established that there is a 5% probability that the results obtained for any one analyte will exceed the control limits established for the test due to random error. As the number of compounds measured increases in a given sample, the probability for statistical error also increases.
Raw Data	TNI- The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records.
Reagent Blank (method reagent blank)	A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps.
Reagent Grade	Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents that conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.
Records	DoD- The output of implementing and following management system documents (e.g., test data in electronic or hand-written forms, files, and logbooks).
Reference Material	TNI- Material or substance one or more of whose property values are sufficiently homogenized and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Reference Method	TNI- A published method issued by an organization generally recognized as competent to do so. (When the ISO language refers to a "standard method", that term is equivalent to "reference method"). When a laboratory is required to analyze by a specified method due to a regulatory requirement, the analyte/method combination is recognized as a reference method. If there is no regulatory requirement for the analyte/method combination, the analyte/method combination is recognized as a reference method if it can be analyzed by another reference method of the same matrix and technology.
Reference Standard	TNI- Standard used for the calibration of working measurement standards in a given organization or at a given location.
Relative Percent Difference (RPD)	A measure of precision defined as the difference between two measurements divided by the average concentration of the two measurements.
Relative Standard Deviation (RSD)	A measure of precision defined by dividing the standard deviation of a series of values by the average of those values.
Relative Standard Error (RSE)	A measurement to determine if the standard error (SE) is large relative to the results.
Reporting Limit (RL)	The level at which method, permit, regulatory and customer-specific objectives are met. The reporting limit may never be lower than the Limit of Detection (i.e., statistically determined MDL). Reporting limits are corrected for sample amounts, including the dry weight of solids, unless otherwise specified. There must be a sufficient buffer between the Reporting Limit and the MDL. DoD- A customer-specified lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.
Reporting Limit Verification Standard (RLVS)	A standard analyzed at the reporting limit for an analysis to verify the laboratory's ability to report to that level.
Representativeness	A quality element related to the ability to collect a sample reflecting the characteristics of the part of the environment to be assessed. Sample representativeness is dependent on the sampling techniques specified in the project work plan.
Requirement	Denotes a mandatory specification; often designated by the term "shall".
Retention Time	The time between sample injection and the appearance of a solute peak at the detector.
Revocation	TNI- The total or partial withdrawal of a laboratory's accreditation by an accreditation body.
Sample	Portion of material collected for analysis, identified by a single, unique alphanumeric code. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analysis.
Sample Condition Upon Receipt Form (SCURF)	Form used by sample receiving personnel to document the condition of sample containers upon receipt to the laboratory (used in conjunction with a COC).
Sample Delivery Group (SDG)	A unit within a single project that is used to identify a group of samples for delivery. An SDG is a group of 20 or fewer field samples within a project, received over a period of up to 14 calendar days. Data from all samples in an SDG are reported concurrently.
Sample Receipt Form (SRF)	Letter sent to the client upon login to show the tests requested and pricing.
Sample Tracking	Procedures employed to record the possession of the samples from the time of sampling until analysis, reporting and archiving. These procedures include the use of a chain-of-custody form that documents the collection, transport, and receipt of compliance samples to the laboratory. In addition, access to the laboratory is limited and controlled to protect the integrity of the samples.
Sampling	TNI- Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.
Selected Ion Monitoring (SIM)	A mode of analysis in mass spectrometry where the detector is set to scan over a very small mass range, typically one mass unit. The narrower the range, the more sensitive the detector. DoD- Using GC/MS, characteristic ions specific to target compounds are detected and used to quantify in applications where the normal full scan mass spectrometry results in excessive noise.
Selectivity	TNI- The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system.
Sensitivity	TNI- The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.
Serial Dilution	The stepwise dilution of a substance in a solution.
Shall	Denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification as long as the requirement is fulfilled.

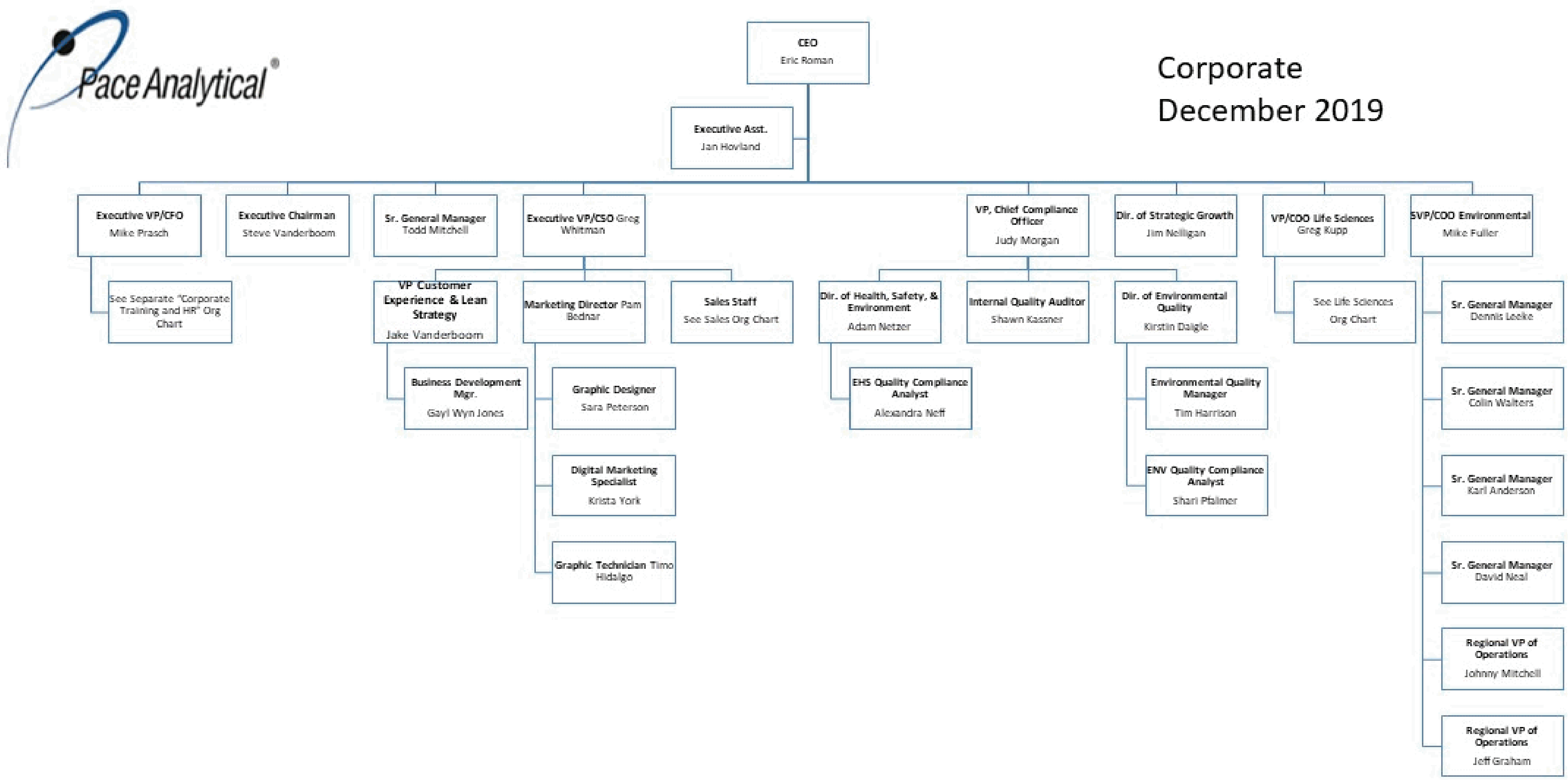
Should	Denotes a guideline or recommendation whenever noncompliance with the specification is permissible.
Signal-to-Noise Ratio (S/N)	DoD- A measure of signal strength relative to background noise. The average strength of the noise of most measurements is constant and independent of the magnitude of the signal. Thus, as the quantity being measured (producing the signal) decreases in magnitude, S/N decreases and the effect of the noise on the relative error of a measurement increases.
Source Water	TNI- When sampled for drinking water compliance, untreated water from streams, rivers, lakes, or underground aquifers, which is used to supply private and public drinking water supplies.
Spike	A known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.
Standard (Document)	TNI- The document describing the elements of a laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies.
Standard (Chemical)	Standard samples are comprised of a known amount of standard reference material in the matrix undergoing analysis. A standard reference material is a certified reference material produced by US NIST and characterized for absolute content, independent of analytical test method.
Standard Blank (or Reagent Blank)	A calibration standard consisting of the same solvent/reagent matrix used to prepare the calibration standards without the analytes. It is used to construct the calibration curve by establishing instrument background.
Standard Method	A test method issued by an organization generally recognized as competent to do so.
Standard Operating Procedure (SOP)	TNI- A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks.
Standard Reference Material (SRM)	A certified reference material produced by the US NIST or other equivalent organization and characterized for absolute content, independent of analytical method.
Statement of Qualifications (SOQ)	A document that lists information about a company, typically the qualifications of that company to compete on a bid for services.
Stock Standard	A concentrated reference solution containing one or more analytes prepared in the laboratory using an assayed reference compound or purchased from a reputable commercial source.
Storage Blank	DoD- A sample of analyte-free media prepared by the laboratory and retained in the sample storage area of the laboratory. A storage blank is used to record contamination attributable to sample storage at the laboratory.
Supervisor	The individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses.
Surrogate	DoD- A substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them for quality control purposes.
Suspension	TNI- The temporary removal of a laboratory's accreditation for a defined period of time, which shall not exceed 6 months or the period of accreditation, whichever is longer, in order to allow the laboratory time to correct deficiencies or area of non-conformance with the Standard.
Systems Audit	An on-site inspection or assessment of a laboratory's quality system.
Target Analytes	DoD- Analytes or chemicals of primary concern identified by the customer on a project-specific basis.
Technical Director	Individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory.
Technology	TNI- A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.
Test	A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate.
Test Method	DoD- A definitive procedure that determines one or more characteristics of a given substance or product.
Test Methods for Evaluating Solid Waste, Physical/ Chemical (SW-846)	EPA Waste's official compendium of analytical and sampling methods that have been evaluated and approved for use in complying with RCRA regulations.

Test Source	TNI- A radioactive source that is tested, such as a sample, calibration standard, or performance check source. A Test Source may also be free of radioactivity, such as a Test Source counted to determine the subtraction background, or a short-term background check.
The NELAC Institute (TNI)	A non-profit organization whose mission is to foster the generation of environmental data of known and documented quality through an open, inclusive, and transparent process that is responsive to the needs of the community. Previously known as NELAC (National Environmental Laboratory Accreditation Conference).
Total Petroleum Hydrocarbons (TPH)	A term used to denote a large family of several hundred chemical compounds that originate from crude oil. Compounds may include gasoline components, jet fuel, volatile organics, etc.
Toxicity Characteristic Leaching Procedure (TCLP)	A solid sample extraction method for chemical analysis employed as an analytical method to simulate leaching of compounds through a landfill.
Traceability	TNI- The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical conditions or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.
Training Document	A training resource that provides detailed instructions to execute a specific method or job function.
Trip Blank	This blank sample is used to detect sample contamination from the container and preservative during transport and storage of the sample. A cleaned sample container is filled with laboratory reagent water and the blank is stored, shipped, and analyzed with its associated samples.
Tuning	A check and/or adjustment of instrument performance for mass spectrometry as required by the method.
Ultraviolet Spectrophotometer (UV)	Instrument routinely used in quantitative determination of solutions of transition metal ions and highly conjugated organic compounds.
Uncertainty, Counting	TNI- The component of Measurement Uncertainty attributable to the random nature of radioactive decay and radiation counting (often estimated as the square root of observed counts (MARLAP). Older references sometimes refer to this parameter as Error, Counting Error or Count Error (c.f., Total Uncertainty).
Uncertainty, Expanded	TNI- The product of the Standard Uncertainty and a coverage factor, k, which is chosen to produce an interval about the result that has a high probability of containing the value of the measurand (c.f., Standard Uncertainty). NOTE: Radiochemical results are generally reported in association with the Total Uncertainty. Either if these estimates of uncertainty can be reported as the Standard Uncertainty (one-sigma) or as an Expanded Uncertainty (k-sigma, where $k > 1$).
Uncertainty, Measurement	TNI- Parameter associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand.
Uncertainty, Standard	TNI- An estimate of the Measurement Uncertainty expressed as a standard deviation (c.f., Expanded Uncertainty).
Uncertainty, Total	TNI- An estimate of the Measurement Uncertainty that accounts for contributions from all significant sources of uncertainty associated with the analytical preparation and measurement of a sample. Such estimates are also commonly referred to as Combined Standard Uncertainty or Total Propagated Uncertainty, and in some older references as the Total Propagated Error, among other similar items (c.f., Counting Uncertainty).
Unethical actions	DoD- Deliberate falsification of analytical or quality control results where failed method or contractual requirements are made to appear acceptable.
United States Department of Agriculture (USDA)	A department of the federal government that provides leadership on food, agriculture, natural resources, rural development, nutrition and related issues based on public policy, the best available science, and effective management.
United States Geological Survey (USGS)	Program of the federal government that develops new methods and tools to supply timely, relevant, and useful information about the Earth and its processes.
Unregulated Contaminant Monitoring Rule (UCMR)	EPA program to monitor unregulated contaminants in drinking water.
Validation	DoD- The confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

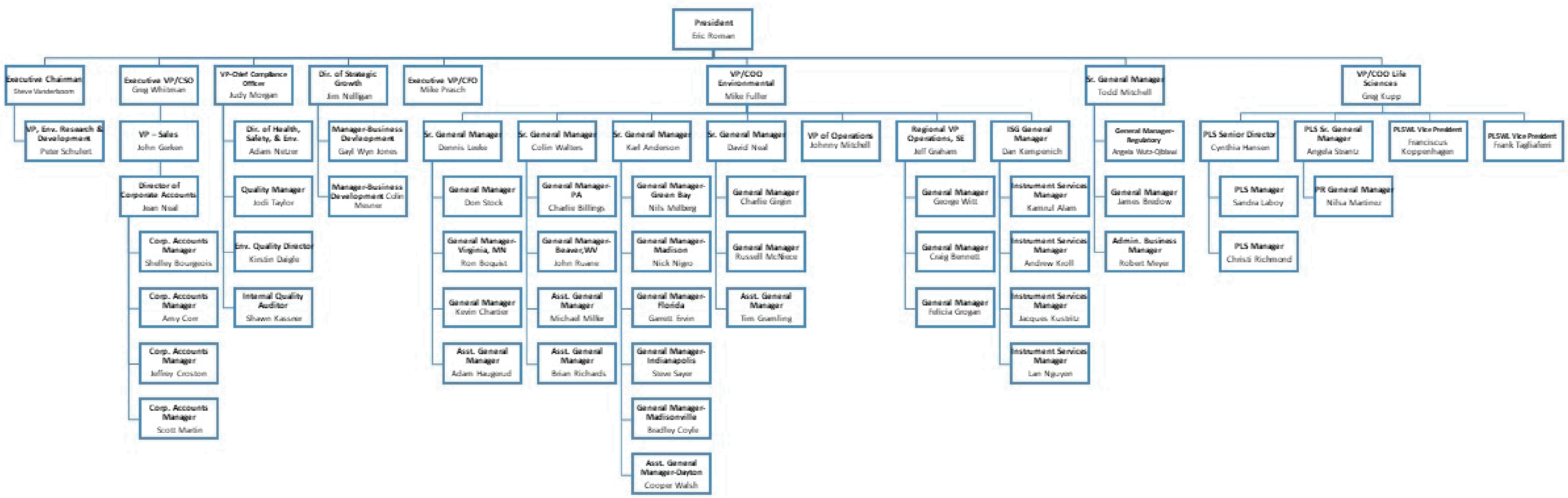
Verification	TNI- Confirmation by examination and objective evidence that specified requirements have been met. In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment.
Voluntary Action Program (VAP)	A program of the Ohio EPA that gives individuals a way to investigate possible environmental contamination, clean it up if necessary and receive a promise from the State of Ohio that no more cleanup is needed.
Whole Effluent Toxicity (WET)	The aggregate toxic effect to aquatic organisms from all pollutants contained in a facility's wastewater (effluent).

7.4 Appendix D: Organization Chart(s)

7.4.1 PAS-Corporate

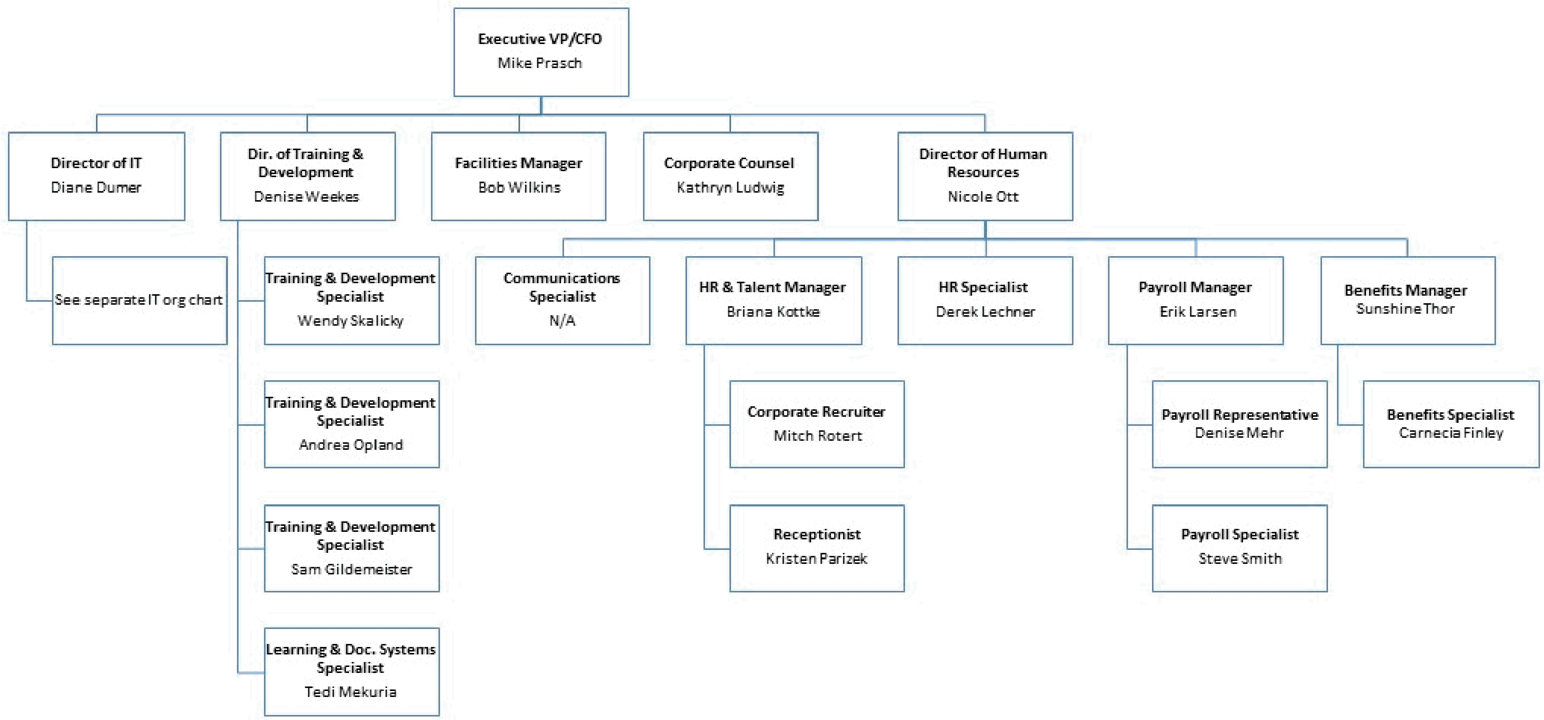


Management Staff
December 2019

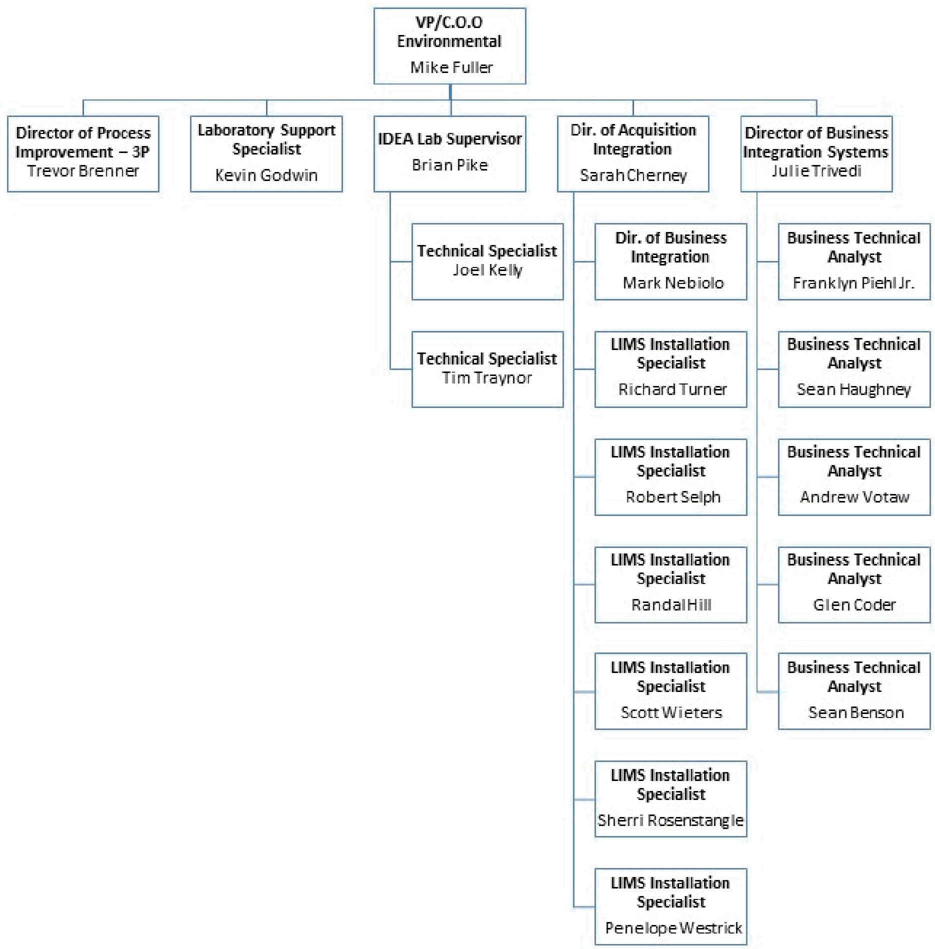


LABORATORY QUALITY MANUAL
Pace Analytical Services, LLC

Corporate Staff
Training and HR
December 2019

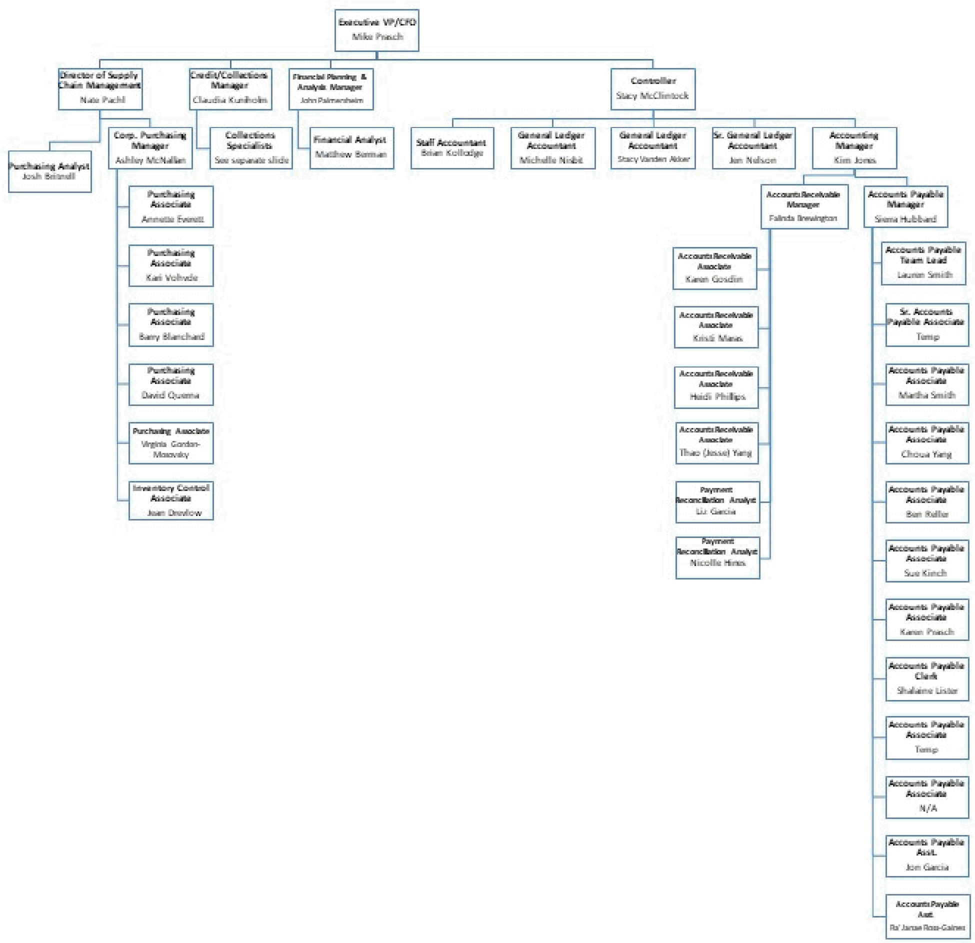


Corporate Staff
ENV Operations
December 2019



LABORATORY QUALITY MANUAL
Pace Analytical Services, LLC

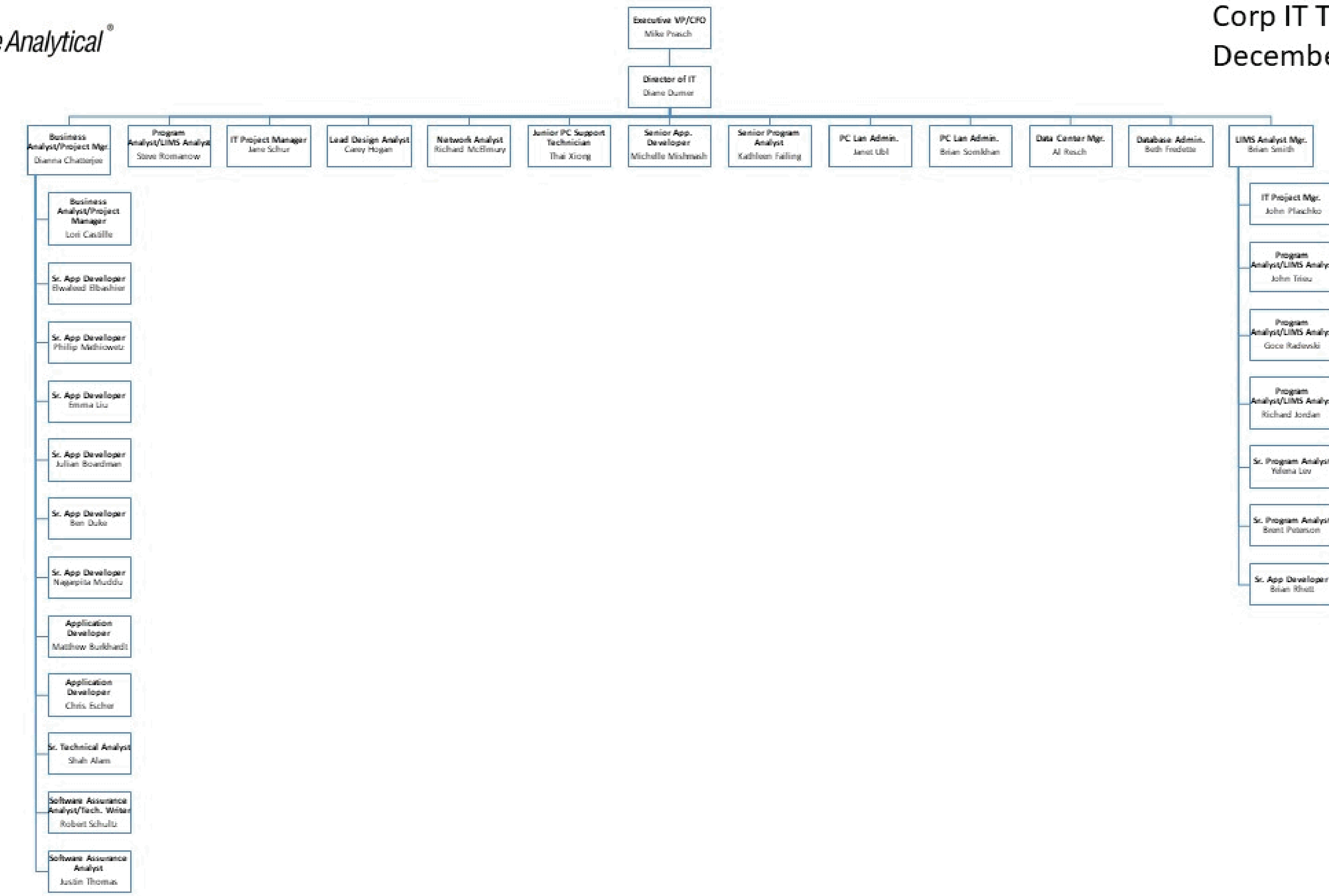
Corp. Finance Team
December 2019



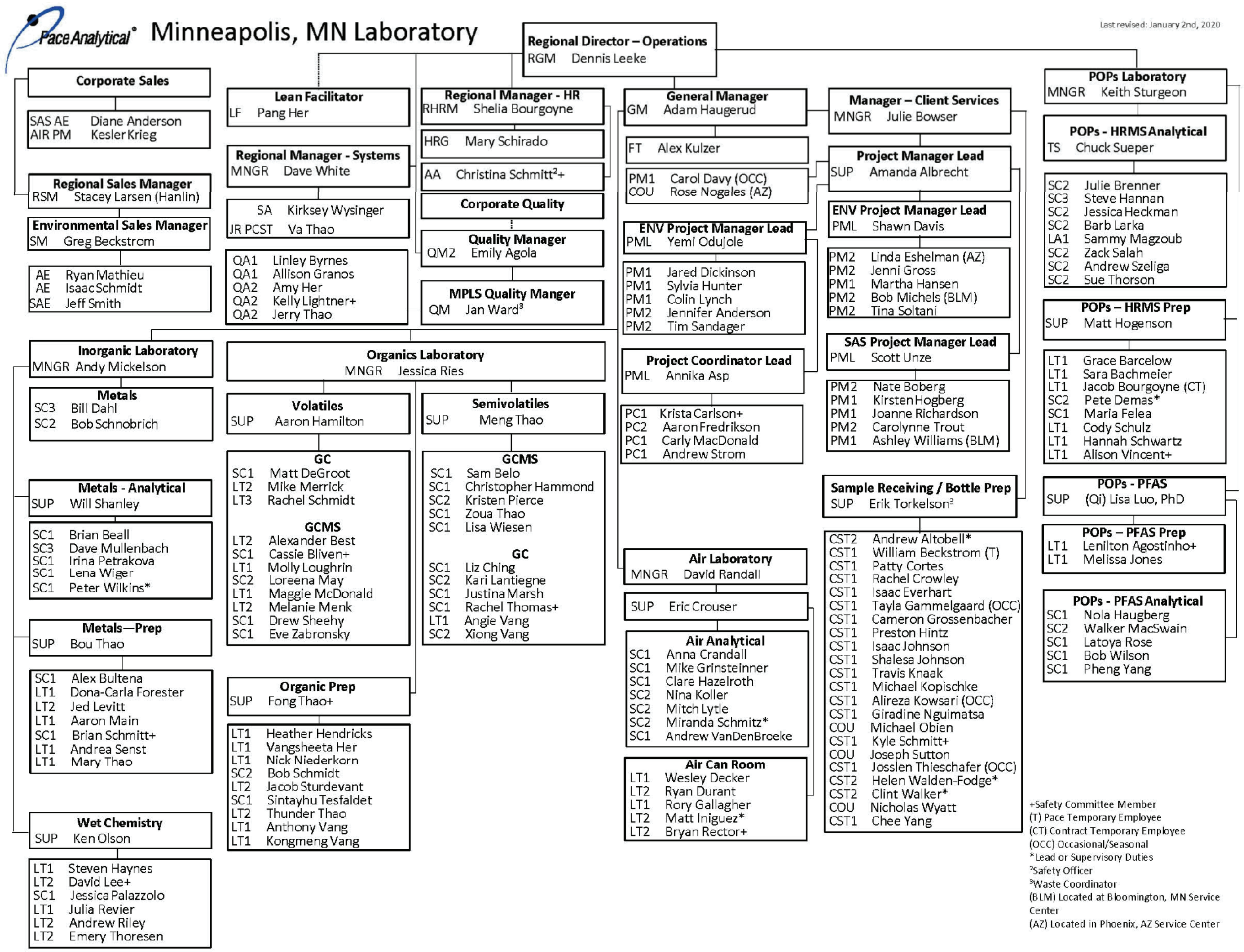
Corporate Credit & Collections Team
December 2019

LABORATORY QUALITY MANUAL
Pace Analytical Services, LLC

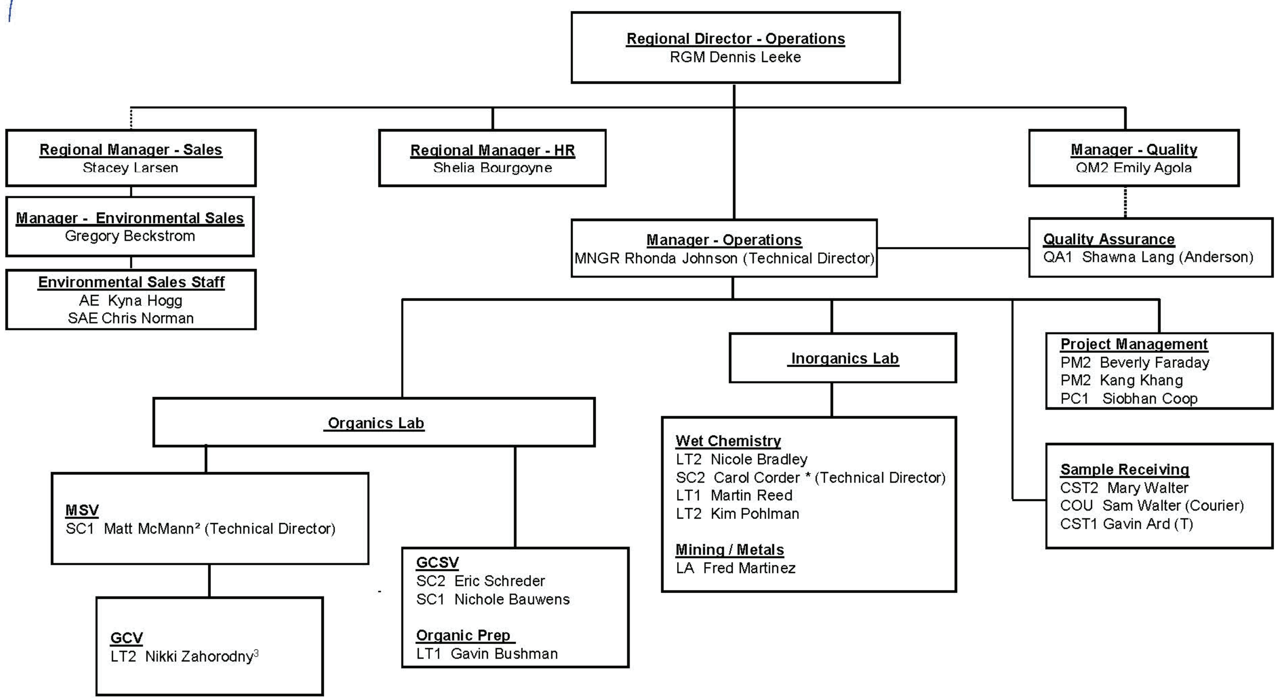
Corp IT Team
December 2019



7.4.2 PAS-Minneapolis, Bloomington, and Phoenix



7.4.3 PAS-Billings



Dennis Leeke, Regional Director - Operations
Rhonda Johnson, Manager - Operations
Last Revised: January, 2020
*Lead / Supervisory Duties
² Safety Officer
³ Waste Coordinator
(T) Temporary Employee
(CT) Contract Temporary Employee
(OCC) Occasional Employment

Billings, Montana Laboratory

7.4.4 PAS-Duluth and Virginia

Northern MN Laboratories (VIR1/DUL1)

Regional Director – Operations
RGM Dennis Leeke

Regional Manager - HR
HRRM Shelia Bourgoyne

Regional Manager - Sales
RSM Stacey Larsen

Manager - Environmental Sales
SM Greg Beckstrom

AE IsaacSchmidt
SAE Jeff Smith

Corporate Quality

Manager - Quality
QM2 Emily Agola

VM Quality Assurance
QA2 Jodi Carlon[3]

Duluth Quality Assurance
QA1 Mallory Williamson

General Manager
GM2 Ron Boquist

Duluth Administration
AA Peggy Donahue

Client Services
MNGR Carrie Jensen

Client Services —VM
CST1 Tony Block
COU Dave Chopp
PM1 Nikki Jarve
CST2 Becky Mathews
PC1 Katie Richards
PM1 MeLisa Woods

Client Services —Duluth
PM1 Laura Flood
PM1 Ravena Kerur
CST1 John Potti
CST1 Brianna MacKenzie(P/T)
COU Shelly Velacich

Inorganics Laboratory
MNGR Craig Douglas (Technical Director)

Wet Chemistry / Micro Lab—VM
SC2 Dena Bober*
LT1 Joe Bober[2]
SC1 Lynne Pelkey (P/T)
LT1 Kate Ramponi /Flanagan (Technical Manager)
SC1 Zach Turner
SC1 Anna Pietz
LT1 Russell Carlson

Metals Lab—VM
SC2 Dennis Staton
SC1 Ashley Kinnett

LL Mercury Lab—Duluth
SC2 Christine Kne (Technical Manager)

Wet Chemistry / Micro Lab—Duluth
SC2 Kevin Donahue
SC1 Stephany Shanley [2] (Technical Manager)
SC1 Andrew Pykkonen*
SC1 Dyllon Dalquist
SC1 Bishal Thapa[3] (Technical Manager)
SC2 Dawn Witherill
SC1 Erin Hoxsie
LT1 Kate Ramponi/Flanagan

Bioassay Laboratory
SUP Dan Toms

Bioassay—Duluth
SC1 Kelli Graham
SC2 Lynn Kingsbury
LT1 Annette Panfil
SC1 Alex Reynolds (Technical Director)
LT1 Megan Hanson

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(T) Pace Temporary Employee
*Lead / Supervisory Duties
[2]Safety Officer
[3]Waste Coordinator
Last Revised: 01/02/2020

7.5 Appendix E: Equipment Listing

The equipment listed represents equipment were held by each location on the effective date of this manual. This information is subject to change without notice. External parties should contact the location for the most current information.

7.5.1 PAS-Minneapolis, Bloomington, and Phoenix

Equipment List: PAS-Minneapolis, Bloomington, and Phoenix

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
GC	Agilent Technologies	6890N	CN10429060	2005	Unknown	Air	10AIR0	To Be Determined (TBD)
MS	Agilent Technologies	5973 Network	US43146819	2005	Unknown	Air	10AIR0	TBD
PreConcentrator	Entech Instruments, Inc.	7100A	1299	2007	Unknown	Air	10AIR0	TBD
Canister Autosampler	Entech Instruments, Inc.	7016 CA	1283	1985	Unknown	Air	10AIR0	TBD
Canister Autosampler	Entech Instruments, Inc.	7016D	1587	2004	Unknown	Air	10AIR0	TBD
GC	HP	5890	2843A20766	2004	Unknown	Air	10AIR5	TBD
GC	Agilent Technologies	6890N	CN10429056	2004	Unknown	Air	10AIR7	TBD
MS	Agilent Technologies	5973 Network	US43146821	2009	Unknown	Air	10AIR7	TBD
PreConcentrator	Entech Instruments, Inc.	7100A	1611	2008	Unknown	Air	10AIR7	TBD
Canister Autosampler	Entech Instruments, Inc.	7016 CA	1239	2009	Unknown	Air	10AIR7	TBD
Canister Autosampler	Entech Instruments, Inc.	7016 CA-2	115	2009	Unknown	Air	10AIR7	TBD
GC	ALS Ready	6890A	US00034289	2013	Unknown	Air	10AIRA	TBD
Concentrator	Entech Instruments, Inc.	7032 AQ-L	1164	2013	Unknown	Air	10AIRA	TBD
MS	Agilent Technologies	5973 inert	US44621387	2010	Unknown	Air	10AIRB	TBD
GC	Agilent Technologies	6890	CN10517058	2010	Unknown	Air	10AIRB	TBD
PreConcentrator	Entech Instruments, Inc.	7200	1300	2010	Unknown	Air	10AIRB	TBD
Canister Autosampler	Entech Instruments, Inc.	7016D	1488	2010	Unknown	Air	10AIRB	TBD
Canister Autosampler	Entech Instruments, Inc.	7016D	1487	2010	Unknown	Air	10AIRB	TBD
GC	Agilent Technologies	7890A	CN10742037	2010	Unknown	Air	10AIRD	TBD
MS	Agilent Technologies	5975C	US73317788	2010	Unknown	Air	10AIRD	TBD
PreConcentrator	Entech Instruments, Inc.	7200	1278	2003	Unknown	Air	10AIRD	TBD
Canister Autosampler	Entech Instruments, Inc.	7016D	1497	2003	Unknown	Air	10AIRD	TBD
Canister Autosampler	Entech Instruments, Inc.	7016 CA	1284	2009	Unknown	Air	10AIRD	TBD
MS	Agilent Technologies	5975C	US10407503	2009	Unknown	Air	10AIRE	TBD
GC	Agilent Technologies	7890A	CN10241030	2000	Unknown	Air	10AIRE	TBD
Thermal Desorber	Perkin Elmer	Turbomatrix 650	TD650L1009271	2000	Unknown	Air	10AIRE	TBD
Can Cleaning Rack	Pace	N/A	N/A	2010	Unknown	Air	Rack 1	TBD

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Can Cleaning Rack	Pace	N/A	N/A	2010	Unknown	Air	Rack 2	TBD
Can Cleaning Rack	Pace	N/A	N/A	Unknown	Unknown	Air	Rack 3	TBD
Refrigerator/Freezer	Keystone	KSTRC312AW	DK25BZ	Unknown	Unknown	Air	A4	TBD
Oven	Despatch	LDB Series	149432	Unknown	Unknown	Air	10AIR10	TBD
Tube Conditioner/ Dry Purger	Perkin Elmer	Turbomatrix TC220	820R4051501	Unknown	Unknown	Air	10AIR24	TBD
GC	Agilent Technologies	6890A	US00040933	Unknown	Unknown	Air	10AIRG	TBD
MSD	Agilent Technologies	5973	US10360131	Unknown	Unknown	Air	10AIRG	TBD
Thermal Desorber	Perkin Elmer	Turbomatrix 650	TD650L1210081	Unknown	Unknown	Air	10AIRG	TBD
GC	Agilent Technologies	7890A	CN10803059	2015	Used	Air	10AIRH	TBD
MS	Agilent Technologies	5975C	US80848612	Unknown	New	Air	10AIRH	TBD
Preconcentrator	Entech Instruments, Inc.	7200	1450	Unknown	New	Air	10AIRH	TBD
Canister Autosampler	Entech Instruments, Inc.	7016D	1586	Unknown	New	Air	10AIRH	TBD
Canister Autosampler	Entech Instruments, Inc.	7016D	1579	Unknown	New	Air	10AIRH	TBD
GC	Agilent	6890N	CN10514046	Unknown	New	Air	10AIRI	TBD
MS	Agilent	5973	US44621373	2018	New	Air	10AIRI	TBD
Preconcentrator	Entech Instruments, Inc.	7200	1623	2018	New	Air	10AIRI	TBD
Canister Autosampler	Entech Instruments, Inc.	7016D	1660	2018	New	Air	10AIRI	TBD
Canister Autosampler	Entech Instruments, Inc.	7016D	1661	2018	New	Air	10AIRI	TBD
Refrigerator	Beverage Air	KR48-1AS	5227060	7/1/2014	Unknown	Bloomington	Q325	TBD
GCMS	Waters/Micromass	Autospec	CN10705008	2018	New	HRMS	10MSHR14	TBD
Autosampler	Waters/Micromass	Autospec	CN21920651	2018	New	HRMS	10MSHR14	TBD
GCMS	Waters/Micromass	Autospec	M590	2018	New	HRMS	10MSHR14	TBD
Freezer	Kenmore	564.285027	80200474	Unknown	Unknown	HRMS	H2	TBD
Freezer	Dynasty	E-400-C	1206544	Unknown	Unknown	HRMS	H1	TBD
GCMS	Agilent	6890N	US10544001	2006	Unknown	HRMS	10MSHR09	TBD
GCMS	Waters/Micromass	Autospec Premier	P669	2006	Unknown	HRMS	10MSHR09	TBD
GCMS	Agilent	6890A	US00033386	2000	Unknown	HRMS	10MSHR06	TBD
GCMS	Waters/Micromass	Autospec Ultima	M496	2000	Unknown	HRMS	10MSHR06	TBD
GCMS	Waters/Micromass	Autospec Premier	P808	2015	New	HRMS	10MSHR12	TBD
Autosampler - Y	Waters/Micromass	Autospec P808	280399	Unknown	New	HRMS	10MSHR12	TBD
GCMS	Agilent	Autospec Premier	CN10471195	2015	New	HRMS	10MSHR12	TBD
GCMS	Agilent	Autospec Premier	CN11301038	2015	New	HRMS	10MSHR12	TBD
GCMS	Agilent	6890A	US00036565	2000	Unknown	HRMS	10MSHR05	TBD
GCMS	Waters/ Micromass	Autospec Ultima	M488	2000	Unknown	HRMS	10MSHR05	TBD
Autosampler F	Waters/ Micromass	Autospec	280398	Unknown	Unknown	HRMS	10MSHR05	TBD
LC-MS/MS	Sciex	4000	V23210806	2017	New	HRMS	10LCMS01	TBD
Autosampler	Agilent	1100	DE83103146	2018	New	HRMS	10LCMS01	TBD
LC-MS/MS	Sciex	4000	V1390304	2017	New	HRMS	10LCMS02	TBD
Autosampler	Agilent	1290	DE91604387	2018	New	HRMS	10LCMS02	TBD
Degassing Unit	SHIMADZU	DGU-20A5R	L20705569194 IX	2019	New	HRMS	10LCMS03	TBD
Liquid Chromatograph	SHIMADZU	Nexera X2 LC-30AD	L20555653493 US G	2019	New	HRMS	10LCMS03	TBD
Liquid Chromatograph	SHIMADZU	Nexera X2 LC-30AD	L20555653492 US G	2019	New	HRMS	10LCMS03	TBD
Autosampler	SHIMADZU	Nexera X2 SIL-30AC	L20565650974	2019	New	HRMS	10LCMS03	TBD
Reservoir Tray	SHIMADZU	Reservoir tray (Cat. No. 2258-45041-91)	L20305567270 SL	2019	New	HRMS	10LCMS03	TBD

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Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Liquid Chromatograph	SHIMADZU	LC-20AB	L20125650517 US D	2019	New	HRMS	10LCMS03	TBD
Communications Bus Module	SHIMADZU	CBM-20A	L20235657676 US E	2019	New	HRMS	10LCMS03	TBD
Column Oven	SHIMADZU	Nexera X2 CTO-30A	L20575550727 US	2019	New	HRMS	10LCMS03	TBD
LCMS	SCIEX	QTRAP 5500	EG250621812	2019	New	HRMS	10LCMS03	TBD
Degassing Unit	SHIMADZU	DGU-20A5R	L20705569193 IX	2019	New	HRMS	10LCMS04	TBD
Liquid Chromatograph	SHIMADZU	Nexera X2 LC-30AD	L20555653490 US G	2019	New	HRMS	10LCMS04	TBD
Autosampler	SHIMADZU	Nexera X2 SIL-30AC	L20565650975 US F	2019	New	HRMS	10LCMS04	TBD
Reservoir Tray	SHIMADZU	Reservoir tray (Cat. No. 2258-45041-91)	L20305567264 SL	2019	New	HRMS	10LCMS04	TBD
Liquid Chromatograph	SHIMADZU	LC-20AB	L20125650516 US C	2019	New	HRMS	10LCMS04	TBD
Communications Bus Module	SHIMADZU	CBM-20A	L20235657718 US F	2019	New	HRMS	10LCMS04	TBD
Column Oven	SHIMADZU	Nexera X2 CTO-30A	L20575550728 US	2019	New	HRMS	10LCMS04	TBD
LCMS	SCIEX	QTRAP 5500	EG250611812	2019	New	HRMS	10LCMS04	TBD
Liquid Chromatograph	SHIMADZU	Nexera X2 LC-30AD	L20555653491 US G	2019	New	HRMS	10LCMS04	TBD
Vortex	Fisher Scientific	cat #02215375	111220005	Unknown	Unknown	Dioxin Prep	10HR21	TBD
Freezer	Kenmore Elite	Freezer chest	W834049450	Unknown	Unknown	Dioxin Prep	DP2	TBD
Micro 100 Turbidimeter	Scientific Inc.	Micro 100 Turbidimeter	201309191	2005	Unknown	Dioxin Prep	10HR14	TBD
Microwave extraction	CEM	MarsXpress	M09903	2013	Unknown	Dioxin Prep	10HR13	TBD
Accelerated Solvent Extractor	ACE	200	1020363	Unknown	Unknown	Dioxin Prep	10HR12	TBD
N-EVAP	Organomation	8125	57966	2012	Unknown	Dioxin Prep	DW1	TBD
N-EVAP	Organomation	8125	57529	2012	Unknown	Dioxin Prep	DW2	TBD
N-EVAP	Organomation	8125	57964	2012	Unknown	Dioxin Prep	N-EVAP 4	TBD
N-EVAP	Organomation	8125	57410	2012	Unknown	Dioxin Prep	N-EVAP 5	TBD
N-EVAP	Organomation	8125	57527	2012	Unknown	Dioxin Prep	N-EVAP 6	TBD
N-EVAP	Organomation	112	57528	Unknown	Unknown	Dioxin Prep	N-EVAP 7	TBD
Hypersep Vaccuum Manifold	Thermo Scientific	60104233	1632	2017	Unknown	Dioxin Prep	10HR17	TBD
Hypersep Vaccuum Manifold	Thermo Scientific	60104233	1552	2017	Unknown	Dioxin Prep	10HR16	TBD
Hypersep Vaccuum Manifold	Thermo Scientific	60104233	1713-1	2017	Unknown	Dioxin Prep	10HR15	TBD
Centrifuge	IEC - International Equipment Company	HNS II	235525200	2018	New	Dioxin Prep	10HR18	TBD
Ultrasonic Bath	Branson	3510	AAH067 (no serial number present)	2018	New	Dioxin Prep	10HR19	TBD
Orbital Shaker	VWR	DS500	416G	2018	New	Dioxin Prep	10HR20	TBD
Oven	Lindberg Blue	GO1340A-1	O06M-568117-RM	2012	Unknown	Dioxin Prep	DP4	TBD
Oven	Thermo	F6018 (Med Level)	15031960120316	Unknown	Unknown	Dioxin Prep	DP5	TBD
Oven	Thermo	F6018 (Low Level)	15032170120319	Unknown	Unknown	Dioxin Prep	DP6	TBD
Oven	Carbolite	LHT/120	21-400729	Unknown	Unknown	Dioxin Prep	DP7	TBD
freezer	SPT	UF-214W	AS0115A228W20498	2017	New	Dioxin Prep	DP6	TBD
Kiln	SKUTT Automatic Kiln	GM-1414	000489	Unknown	Unknown	Dioxin Prep	10HR22	TBD
Vortex	Fisher Scientific	cat #02215375	111220001	Unknown	Unknown	Dioxin Prep	10HR23	TBD
Centrifuge	IEC - International Equipment Company	CL Centrifuge	428-15985	Unknown	Unknown	Dioxin Prep	10HR24	TBD
Chiller	ThermoFisher Scientific	Thermoflex2500	0127680201150721	Unknown	Unknown	Dioxin Prep	10HR25	TBD

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Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Chiller	ThermoFisher Scientific	Thermoflex2500	0145040401120413	Unknown	Unknown	Dioxin Prep	10HR26	TBD
Chiller	ThermoFisher Scientific	Thermoflex2500	0145032201120413	Unknown	Unknown	Dioxin Prep	10HR27	TBD
Vortex	Fisher Brand	G-560	2-131226	Unknown	Unknown	Dioxin Prep	10HR28	TBD
Hypersep Vacuum Manifold	Thermo Scientific	60104233	1713-2	Unknown	Unknown	Dioxin Prep	10HR29	TBD
Capping Station	CEM	574100	XC2871	Unknown	Unknown	Dioxin Prep	10HR30	TBD
1L SPE Station	CPI International	N/A	N/A	Unknown	Unknown	Dioxin Prep	19562	TBD
Ultrasonic Bath	Branson	8510E-MT	EPA120597932F	Unknown	Unknown	Dioxin Prep	10HR31	TBD
PowrTrol Temperature Regulators	Glas-Col	104A PL120	11819758	Unknown	Unknown	Dioxin Prep	10HR32	TBD
PowrTrol Temperature Regulators	Glas-Col	104A PL120	11819751	Unknown	Unknown	Dioxin Prep	10HR33	TBD
PowrTrol Temperature Regulators	Glas-Col	104A PL120	11334540	Unknown	Unknown	Dioxin Prep	10HR34	TBD
PowrTrol Temperature Regulators	Glas-Col	104A PL120	11309113	Unknown	Unknown	Dioxin Prep	10HR35	TBD
PowrTrol Temperature Regulators	Glas-Col	104A PL120	11706611	Unknown	Unknown	Dioxin Prep	10HR36	TBD
PowrTrol Temperature Regulators	Glas-Col	104A PL120	11336607	Unknown	Unknown	Dioxin Prep	10HR37	TBD
Temperature Regulators	Thermolyne	CN45515	455000964338	Unknown	Unknown	Dioxin Prep	10HR38	TBD
PowrTrol Temperature Regulators	Glas-Col	104A PL120	11327046	Unknown	Unknown	Dioxin Prep	10HR39	TBD
PowrTrol Temperature Regulators	Glas-Col	104A PL120	11705717	Unknown	Unknown	Dioxin Prep	10HR40	TBD
PowrTrol Temperature Regulators	Glas-Col	104A PL120	11309114	Unknown	Unknown	Dioxin Prep	10HR41	TBD
PowrTrol Temperature Regulators	Glas-Col	104A PL120	11705712	Unknown	Unknown	Dioxin Prep	10HR42	TBD
PowrTrol Temperature Regulators	Glas-Col	104A PL120	11331266	Unknown	Unknown	Dioxin Prep	10HR43	TBD
PowrTrol Temperature Regulators	Glas-Col	104A PL120	11705714	Unknown	Unknown	Dioxin Prep	10HR44	TBD
PowrTrol Temperature Regulators	Glas-Col	104A PL120	11312697	Unknown	Unknown	Dioxin Prep	10HR45	TBD
PowrTrol Temperature Regulators	Glas-Col	104A PL120	11327705	Unknown	Unknown	Dioxin Prep	10HR46	TBD
PowrTrol Temperature Regulators	Glas-Col	104A PL120	11312700	Unknown	Unknown	Dioxin Prep	10HR47	TBD
Chiller	ThermoFisher Scientific	ThermoFlex900	0110204001120820	Unknown	Unknown	Dioxin Prep	10HR48	TBD
Refrigerator	Homelabs	HME030210N	HME030210N-2163	Unknown	Unknown	Dioxin Prep	10HR49	TBD
Refrigerator	Homelabs	HME030210N	HME030210N-865	Unknown	Unknown	Dioxin Prep	10HR50	TBD
Low speed Centrifuge	Premiere	XC-2450	C&AU070144	Unknown	Unknown	Dioxin Prep	10HR51	TBD

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
SPE manifold	Thermo Scientific	60104233	1848	2019	New	Dioxin Prep	10HR52	TBD
SPE manifold	Thermo Scientific	60104233	1833	2019	New	Dioxin Prep	10HR53	TBD
Ultrasonic bath	Fisher Scientific	FS30H	RTB011069292A	2019	Used	Dioxin Prep	10HR54	TBD
NEVAP	Organomation	112	8213	2019	Used	Dioxin Prep	NEVAP 8	TBD
Hypersep Vacuum Manifold	Thermo Scientific	60104233	1848-1	2019	New	Dioxin Prep	10HR55	TBD
Kiln	SKUTT Automatic Kiln	GM-1414	19G23-584	2019	New	Dioxin Prep	10HR56	TBD
SPE manifold	Thermo Scientific	60104233	1909	2019	New	Dioxin Prep	10HR57	TBD
SPE manifold	Thermo Scientific	60104233	1909	2019	New	Dioxin Prep	10HR58	TBD
Centrifuge	Damon/IEC Division	HN-SII	235511220	2019	New	Dioxin Prep	10HR59	TBD
Orbital Shaker	Lab-Line Instruments, Inc	3520	0185-0416	2019	New	Dioxin Prep	10HR60	TBD
ICPMS	Thermo Scientific	Xseries 2	SN-01298-C	2008	Unknown	Metals	10ICM3	TBD
ICPMS - autosampler	Teledyne Cetac	ASX560	071778A560	Unknown	Unknown	Metals	10ICM3	TBD
ICPMS - chiller	Thermo	NESLAB Thermoflex2500	110140001120717	Unknown	Unknown	Metals	10ICM3	TBD
ICPMS - pump	SOGEVAC pump	SV40BIFC960365V2 016	31001424325	Unknown	Unknown	Metals	10ICM3	TBD
ICPMS	Aglient 7700	G3281A	5P13142395	6/1/2013	Unknown	Metals	10ICM8	TBD
ICPMS - autosampler	Teledyne Cetac	ASX520	US011191A520	Unknown	Unknown	Metals	10ICM8	TBD
ICPMS - chiller	Agilent	G3292-80000	2U1551028	Unknown	Unknown	Metals	10ICM8	TBD
ICPMS - pump	Edwards	G31989	129449393	Unknown	Unknown	Metals	10ICM8	TBD
ICPMS	Aglient 7700	G3281A	JP12412084	Unknown	Unknown	Metals	10ICM9	TBD
ICPMS - autosampler	Teledyne Cetac	ASX520	US0312120AS520	Unknown	Unknown	Metals	10ICM9	TBD
ICPMS - chiller	Agilent	6160T21QR301	3U1621341	Unknown	Unknown	Metals	10ICM9	TBD
ICPMS - pump	Edwards	16436540	169436540	Unknown	Unknown	Metals	10ICM9	TBD
ICPMS	Agilent ICPM	7800	JP16120262	7/1/2005	New	Metals	10ICMB	TBD
ICP	Agilent Technologies	700 Series-ICP-OES	MY14160002	Unknown	New	Metals	10ICP4	TBD
ICP - autosampler	Teledyne Cetac	ASX520	12140A520	Unknown	New	Metals	10ICP4	TBD
ICP - chiller	Agilent	G8481-80003	1B13C1081	Unknown	New	Metals	10ICP4	TBD
ICP	Agilent Technologies	5100 -ICP-OES	MY15180003	2015	New	Metals	10ICP5	TBD
ICP - autosampler	Agilent	SPS4	AU15140009	Unknown	New	Metals	10ICP5	TBD
ICP - chiller	Agilent	G8481-80003	1A1550426	Unknown	New	Metals	10ICP5	TBD
Mercury Analyzer	Cetac	M7600	06201Q76	2012	Unknown	Metals	10HG4	TBD
Mercury Autosampler	Cetac	AX-520	061289A520	2010	Unknown	Metals	10HG4	TBD
Mercury Analyzer	Cetac	M7600	US15254007	2012	New	Metals	10HG08	TBD
Mercury Autosampler	Cetac	ASX-520	0315134A520	2010	New	Metals	10HG08	TBD
Mercury Analyzer	Teledyne Leeman Labs	M-7600	US18309003	2019	New	Metals	10HG09	TBD
Mercury Autosampler	Teledyne Cetac Technologies	ASX-560	0219146A560	2019	New	Metals	10HG09	TBD
Hot Block	Environmental Express	SC154	6266CECW2910	2006	Unknown	Metals	10MET02	TBD
Hot Block	Environmental Express	N/A	6083CECW2815	2006	Unknown	Metals	10MET04	TBD
Hot Block	Environmental Express	N/A	8031CECW3358	2012	Unknown	Metals	10MET08	TBD
Hot Block	Environmental Express	N/A	8031CECW3346	2012	Unknown	Metals	10MET10	TBD
Hot Block	Environmental Express	SC154	5388CEC2469	2013	Unknown	Metals	10MET22	TBD
Hot Block	Environmental Express	SC154	8708CECW3720	2013	Unknown	Metals	10MET23	TBD
Hot Block	Environmental Express	SC154	8793CECW3764	Unknown	Unknown	Metals	10MET26	TBD
Hot Block	Environmental Express	N/A	8031CECW3342	2012	Unknown	Metals	10MET09	TBD
Hot Plate	Cole Parmer	N/A	N/A	Unknown	Unknown	Metals	10MP02	TBD

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Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Hot Plate	Cole Parmer	N/A	N/A	Unknown	Unknown	Metals	10MP03	TBD
TCLP agitator/tumbler	Analytical Testing Corp	DC-20	0685RKME0010	6/19/2008	Unknown	Metals	10MET34	TBD
Hot Plate/hot block	Thermolyne	HP47135	1073970926967	1/1/2015	Unknown	Metals	10MET35	TBD
pH meter	Scientific Instruments	IQ180GLP	10240	1/1/2015	Unknown	Metals	10MP05	TBD
pH meter	Orion Research	Expandable Ion Analyzer EA 940	1343	Unknown	Unknown	Metals	10MP06	TBD
Tumbler	Analytical Testing Corp	42R5BFC1-E3	0685SAMH002	4/1/2015	Unknown	Metals	10MET36	TBD
Tumbler	Analytical Testing Corp	42R5BFC1-E3	0685SGMP0002	Unknown	Unknown	Metals	10MET38	TBD
Fridge	Danby Designer	DBC120BLS	4316063619504	2016	New	Metals	MP1	TBD
Tumbler	Analytical Testing Corp	42R5BFC1-E3	0685SGMQ0006	Unknown	Unknown	Metals	10MET39	TBD
pH meter	Oakton	pH700	2404439	Unknown	Unknown	Metals	10MP07	TBD
Temperature probe	Oakton	35613-13 (Lot code: 298)	93X052911	Unknown	Unknown	Metals	10MP07	TBD
Oven/Desiccator	Fisher Isotemp	725F	903N0075	Unknown	Unknown	Metals	10MET40	TBD
Oven - moved 07.07.15	Fisher Scientific	Isotemp Oven	510N0239	2005	Unknown	Metals	10WET20	TBD
Oven	Fisher Scientific	851F	1589080190130	Unknown	Unknown	Metals	10WET49	TBD
Stir plate	Fisher Scientific	S88857200	C272000401175991	Unknown	Unknown	Metals	10MET44	TBD
Oven/Desiccator	Fisher Isotemp	725F	903N0078	Unknown	Unknown	Metals	10MET41	TBD
Centrifuge	ThermoScientfic	Legend XT	42243876	2018	New	Metals	10MET45	TBD
Turbidity Meter	HACH	TU5200	1808718	2018	Used	Metals	10WT46 (10MET46)	TBD
Oven	Quincy Labs	10GC	G1-015608	2019	New	Metals	10MET47	TBD
ICPMS	Agilent 7900 ICP-MS	G8403A	SG19304531	2019	New	Metals	10ICMC	TBD
ICPMS - chiller	Agilent	G3292-80200	1908-01399	2019	New	Metals	10ICMC	TBD
ICPMS - pump	Agilent	9599225M013	1f19325139	2019	New	Metals	10ICMC	TBD
ICPMS - autosampler	Agilent	G8410A	AU19156705	2019	New	Metals	10ICMC	TBD
UltraSonicator	Branson	8510	RPC10096911F	2010	Unknown	O-Prep	10OP17	TBD
Sonicator	Misonix	XL 2020	G3914	2007	Unknown	O-Prep	10OP01	TBD
Sonicator	Misonix	XL 2015	G4180	2007	Unknown	O-Prep	10OP02	TBD
Sonicator	Misonix	Sonicator 3000	R1638	2007	Unknown	O-Prep	10OP04	TBD
N-EVAP	Organomation	112	8169	Unknown	Unknown	O-Prep	10OP10	TBD
N-EVAP	Organomation	112	7537	Unknown	Unknown	O-Prep	10OP11	TBD
Refrigerator	Traulsen	G20010	T34931C10	Unknown	Unknown	O-Prep	OP1	TBD
Centrifuge	IEC	Centra GP8	31210390	Unknown	Unknown	O-Prep	10OP13	TBD
Centrifuge	Damon/IEC Division	N/A	9304	Unknown	Unknown	O-Prep	10OP14	TBD
Centrifuge	International Clinical Centrifuge	CL28899M	28899M	Unknown	Unknown	O-Prep	10OP15	TBD
Muffle Furnace	Lindberg/Blue M	BF51828C-1	505296	Unknown	Unknown	O-Prep	10OP16	TBD
N-EVAP	Organomation	II2	4185	2014	Unknown	O-Prep	10OP18	TBD
Buchi Concentrator-vacuum controller	Buchi Labortenchik Ag	V-855	10000162387	2014	Unknown	O-Prep	10OP21	TBD
Buchi Concentrator-vacuum pump	Buchi Labortenchik Ag	V-700	1000166230	2014	Unknown	O-Prep	10OP21	TBD
Buchi Concentrator-Recirculating Chiller	Buchi Labortenchik Ag	F-108	1019513	2014	Unknown	O-Prep	10OP21	TBD
Buchi Concentrator System	Buchi Labortenchik Ag	Q101	1000167481	2014	Unknown	O-Prep	10OP21	TBD
Microwave extraction	CEM	MarsXpress 230/60	MD3483	7/1/2014	Unknown	O-Prep	10OP19	TBD
Sonicator	Bransonic	B8200R-3	Not readable	Unknown	Unknown	O-Prep	10OP23	TBD
Sonicator	Heat Systems	XL2020	G1879	Unknown	Unknown	O-Prep	10OP22	TBD
Buchi Concentrator-vacuum controller	Buchi Labortenchik Ag	V-855	1000171188	2014	Unknown	O-Prep	10OP24	TBD
Buchi Concentrator-vacuum pump	Buchi Labortenchik Ag	V-700	1000176128	2014	Unknown	O-Prep	10OP24	TBD

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Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Buchi Concentrator-Recirculating Chiller	Buchi Labortenchik Ag	F-108	1000174259	2014	Unknown	O-Prep	10OP24	TBD
Buchi Concentrator System	Buchi Labortenchik Ag	Q101	1000176659	2014	Unknown	O-Prep	10OP24	TBD
Buchi Concentrator-vacuum controller	Buchi Labortenchik Ag	V-855	1000174543	2014	Unknown	O-Prep	10OP25	TBD
Buchi Concentrator-vacuum pump	Buchi Labortenchik Ag	V-700	1000176882	2014	Unknown	O-Prep	10OP25	TBD
Buchi Concentrator-Recirculating Chiller	Buchi Labortenchik Ag	F-108	1000172490	2014	Unknown	O-Prep	10OP25	TBD
Buchi Concentrator System	Buchi Labortenchik Ag	Q101	1000176601	2014	Unknown	O-Prep	10OP25	TBD
Buchi Concentrator-vacuum controller	Buchi Labortenchik Ag	V-855	1000171253	2014	Unknown	O-Prep	10OP26	TBD
Buchi Concentrator-vacuum pump	Buchi Labortenchik Ag	V-700	1000174270	2014	Unknown	O-Prep	10OP26	TBD
Buchi Concentrator-Recirculating Chiller	Buchi Labortenchik Ag	F-108	1000174257	2014	Unknown	O-Prep	10OP26	TBD
Buchi Concentrator System	Buchi Labortenchik Ag	Q101	1000176658	2014	Unknown	O-Prep	10OP26	TBD
Refrigerator/freezer	Whirlpool	WH43S1E	T127161605028	Unknown	New	O-Prep	OP4	TBD
Refrigerator	Crown-Tonka Walk-Ins	Walk-in	63278-01	Unknown	Unknown	SR	C10	TBD
Refrigerator	Crown	Walk-in	N/A	Unknown	Unknown	SR	C1	TBD
Freezer	Frigidaire	FFU21F5HWK	WB12555570	Unknown	Unknown	SR	C3	TBD
Refrigerator	Beverage Air	KR48-1AS	KR48-1AS 9029136	9/1/2011	Unknown	SR	C17	TBD
Refrigerator	U.S. Cooler	Walk-in/FCL3476GL1	30692	6/1/2013	Unknown	SR	C18	TBD
Refrigerator	Carroll Coolers LLC	Walk-in	34365	9/24/2013	Unknown	SR	C16	TBD
Refrigerator	TRUE	GDM-47-HC-LD	9199842	2011	Unknown	SR	C22	TBD
Freezer	ATOSA	MBF8003	MBF800307916061700C40007	Unknown	Unknown	SR	C23	TBD
Freezer	Kenmore	22042410	WB65148072	2018	New	SR	C21	TBD
Refrigerator	Volition	R49-S	R49S-18010046	12/28/2019	New	SR	C24	TBD
Freezer	ATOSA	MBF8003	MBF8003AUS100317041900C40004	2018	New	SR	C25	TBD
Freezer	Artic Air	AF49EZ	H8148251	2018	New	SR	C26	TBD
Freezer	Whirlpool	Freezer chest	EWR223703	2018	New	SR	DP5	TBD
Refrigerator	Premium	PRF90DX	M88282086660000167	Unknown	Unknown	SR	C27	TBD
GC System	Agilent	7890A	CN10021030	2010	New	SVOA	10MSSA	TBD
Autosampler Tower	Agilent/HP	7693 Series	CN95203168	2010	New	SVOA	10MSSA	TBD
Autosampler Tray	Agilent/HP	7693 Series	CN10020004	2010	New	SVOA	10MSSA	TBD
MS Detector	Agilent/HP	5975C	US10030005	2010	New	SVOA	10MSSA	TBD
AutoSampler Tower	Agilent	7863B	CN75045773	2010	New	SVOA	10MSSB	TBD
GC/Oven	Agilent	7890	CN10842006	2010	New	SVOA	10MSSB	TBD
MS Detector	Agilent	5975C	US73317796	2010	New	SVOA	10MSSB	TBD
AutoSampler Tray	Agilent	7683	CN54237163	2010	New	SVOA	10MSSB	TBD
GC	Agilent	6890N	CN10550045	2011	Used	SVOA	10MSSD	TBD
MS	Agilent	5975	US53931370	2011	Used	SVOA	10MSSD	TBD
Autosampler	Agilent	G2614 A	CN54337193	2011	Used	SVOA	10MSSD	TBD
Tower 7683B	Agilent	62915A	CN52425737	2011	Used	SVOA	10MSSD	TBD
GC	Agilent	6890N	US10245155	2001	Unknown	SVOA	10MSS6	TBD
Autosampler Tower	Agilent/HP	7683	US82901662	2001	Unknown	SVOA	10MSS6	TBD
MS	Agilent/HP	5973N	US21854348	2001	Unknown	SVOA	10MSS6	TBD
Autosampler Tray	Agilent/HP	7683	US81100461	2001	Unknown	SVOA	10MSS6	TBD
GC	Agilent	6890N	CN10319023	2006	Unknown	SVOA	10MSS7	TBD
Tower 7683	Agilent	62613A	CN24728345	2006	Unknown	SVOA	10MSS7	TBD
Turret 7683	Hewlet Packard	62614A	US90403281	2006	Unknown	SVOA	10MSS7	TBD
Mass Spec 5973	Agilent	62579A	US21864477	2006	Unknown	SVOA	10MSS7	TBD
AutoSampler Tower	Agilent/HP	7683	US10417469	2008	Unknown	SVOA	10MSS8	TBD
GC/Oven	Agilent	6890 N	US10123035	2008	Unknown	SVOA	10MSS8	TBD

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
MS Detector	Agilent	5973 N	US10440794	2008	Unknown	SVOA	10MSS8	TBD
AutoSampler Tray	Agilent/HP	7683	CN53536362	2008	Unknown	SVOA	10MSS8	TBD
GC/Oven	Agilent	6890 A	US00033558	1999	Unknown	SVOA	10MSS9	TBD
AutoSampler Tower	Agilent	18593B	3545A44770	1999	Unknown	SVOA	10MSS9	TBD
MS Detector	Agilent	5973 N	US90440006	1999	Unknown	SVOA	10MSS9	TBD
AutoSampler Tray	Agilent	18596C	US11207088	1999	Unknown	SVOA	10MSS9	TBD
AutoSampler Tray	Agilent	18596M	3643A43317	7/1/2014	Used	SVOA	10MSSE	TBD
Injector Tower	Agilent	G1513A	US10512270	7/1/2014	Used	SVOA	10MSSE	TBD
GC/Oven	Agilent	G1530A	US00006288	7/1/2014	Used	SVOA	10MSSE	TBD
MS Detector	Agilent	G1098A	US63810194	7/1/2014	Used	SVOA	10MSSE	TBD
Autosampler Tray	Agilent	7683B Series	CN91252935	7/1/2014	Used	SVOA	10MSSF	TBD
Injector Tower	Agilent	7683	CN54128250	7/1/2014	Used	SVOA	10MSSF	TBD
MS Detector	Agilent	5975C	US91732455	7/1/2014	Used	SVOA	10MSSF	TBD
GC	Agilent	7890A	CN10920003	7/1/2014	Used	SVOA	10MSSF	TBD
GC	Agilent	G1530A	US00025032	7/1/2014	Used	SVOA	10MSSG	TBD
MS	Agilent	G1098A	US82311330	7/1/2014	Used	SVOA	10MSSG	TBD
Autosampler Tray	HP	G2614A	US90403281	7/1/2014	Used	SVOA	10MSSG	TBD
Injector Tower	HP	G2613A	US95310976	7/1/2014	Used	SVOA	10MSSG	TBD
MS	HP	5977B	US1703R003	2000	Unknown	SVOA	10MSSH	TBD
GC	HP	7890B	CN17013216	2000	Unknown	SVOA	10MSSH	TBD
Autosampler Tray	Agilent/HP	7693	CN16480039	2000	Unknown	SVOA	10MSSH	TBD
Injector Tower	Agilent/HP	G4513A	CN95203168	2000	Unknown	SVOA	10MSSH	TBD
GC	Agilent	6890N	CN10549055	2011	Unknown	SVOA	10GCSA	TBD
Autosampler Tray	Agilent	G2614A	CN54237066	2011	Unknown	SVOA	10GCSA	TBD
Tower	Agilent	G2613A	CN54929639	Unknown	Unknown	SVOA	10GCSA	TBD
ECD 1	Agilent	G2397A	U8977	Unknown	Unknown	SVOA	10GCSA	TBD
ECD 2	Agilent	G2397A	U8978	Unknown	Unknown	SVOA	10GCSA	TBD
GC	Agilent	7890A	CN11201069	2011	Unknown	SVOA	10GCSB	TBD
Autosampler Tray	Agilent	64514A	CN11130097	2011	Unknown	SVOA	10GCSB	TBD
Tower	Agilent	64513A	CN91200383	2011	Unknown	SVOA	10GCSB	TBD
ECD 1	Agilent	G2397A	U19081	Unknown	Unknown	SVOA	10GCSB	TBD
ECD 2	Agilent	G2397A	U19082	Unknown	Unknown	SVOA	10GCSB	TBD
GC Oven	HP	5890	2750A16953	1990	Unknown	SVOA	10GCS4	TBD
AutoSampler /Tower	HP	7673A	2704A09552	1990	Unknown	SVOA	10GCS4	TBD
AutoSampler Tray	HP	7673A	2718A06429	1990	Unknown	SVOA	10GCS4	TBD
GC	Agilent	6890 N	US10126008	2004	Unknown	SVOA	10GCS7	TBD
AutoSampler Tray	Agilent/HP	G2614A	US13612659	2004	Unknown	SVOA	10GCS7	TBD
Tower	Agilent/HP	G2613A	US93809196	2004	Unknown	SVOA	10GCS7	TBD
ECD 1	Agilent	G2397A	U10055	Unknown	Unknown	SVOA	10GCS7	TBD
ECD 2	Agilent	G2397A	U2932	Unknown	Unknown	SVOA	10GCS7	TBD
GC	Agilent	7890A	CN10915106	2009	Unknown	SVOA	10GCS9	TBD
Tower	Agilent	64513A	CN10020012	2009	Unknown	SVOA	10GCS9	TBD
Autosampler Tray	Agilent	64514A	CN91100084	2009	Unknown	SVOA	10GCS9	TBD
GC	Agilent	7890B	CN18203068	2018	Unknown	SVOA	10GSLF	TBD
Autosampler	Agilent	G4514A	CN18140044	2018	Unknown	SVOA	10GSLF	TBD
AutoInjector - Front	Agilent	G4513A	CN18160191	2018	Unknown	SVOA	10GSLF	TBD
GC	Agilent	7890B	CN18203068	2018	Unknown	SVOA	10GSLR	TBD
Autosampler	Agilent	G4514A	CN18140044	2018	Unknown	SVOA	10GSLR	TBD
AutoInjector - Rear	Agilent	G4513A	CN18160194	2018	Unknown	SVOA	10GCSR	TBD
Freezer	Frigidaire	FFTR1814LW7	BA14703423	3/16/2012	Unknown	SVOA	SV3	TBD
Refrigerator	Frigidaire	FFTR1814LW7	BA14703423	3/16/2012	Unknown	SVOA	SV3	TBD
Freezer	Haier	HUM013EA	BB01H1E0100BHD 7S0358	Unknown	Unknown	SVOA	SV4	TBD
GC	Agilent	7890A	CN10848062	7/1/2014	Unknown	SVOA	10GCSFF	TBD
Autoinjector - Front	Agilent	G2913	CN44659505	7/1/2014	Unknown	SVOA	10GCSFF	TBD
Autosampler	Agilent	G2614A	CN00654640	7/1/2014	Unknown	SVOA	10GCSFF	TBD
GC	Agilent	7890A	CN10848062	7/1/2014	Unknown	SVOA	10GSFR	TBD
Autoinjector-Back	Agilent	G2913A	CN91756454	7/1/2014	Unknown	SVOA	10GSFR	TBD
Autosampler	Agilent	G2614A	CN00654640	7/1/2014	Unknown	SVOA	10GSFR	TBD
GC	Agilent	6890A	US00035764	Unknown	Unknown	SVOA	10GCSG	TBD
Autosampler Tray	Agilent	G2614A	CN43530410	Unknown	Unknown	SVOA	10GCSG	TBD

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Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Tower	Agilent	G2613A	US11818906	Unknown	Unknown	SVOA	10GCSG	TBD
ECD 1	Agilent	G2397A	U26804	Unknown	Unknown	SVOA	10GCSG	TBD
ECD 2	Agilent	G2397A	U26805	Unknown	Unknown	SVOA	10GCSG	TBD
Agilent	Agilent	6890A	US10238103	Unknown	Unknown	SVOA	10GCSH	TBD
GC	Agilent	7890A	CN11141025	6/1/2017	Used	SVOA	10GCSI	TBD
Autosampler Tray	Agilent	G2614A	CN84951713	6/1/2017	Used	SVOA	10GCSI	TBD
Tower	Agilent	G2613A	CN85154856	6/1/2017	Used	SVOA	10GCSI	TBD
ECD 1	Agilent	G2397A	U128247	6/1/2017	Used	SVOA	10GCSI	TBD
ECD 2	Agilent	G2397A	U30564	6/1/2017	Used	SVOA	10GCSI	TBD
GC	Agilent	7890A	CN10906059	6/1/2017	Used	SVOA	10GCSJ	TBD
Autosampler	Agilent	G2614A	CN85252214	6/1/2017	Used	SVOA	10GCSJ	TBD
Tower	Agilent	G2313A	CN85154864	6/1/2017	Used	SVOA	10GCSJ	TBD
ECD 1	Agilent	G2397A	U27008	6/1/2017	Used	SVOA	10GCSJ	TBD
ECD 2	Agilent	G2397A	U30558	6/1/2017	Used	SVOA	10GCSJ	TBD
GC	Agilent	7890A	CN10906049	6/1/2017	Used	SVOA	10GCSK	TBD
Autosampler Tray	Agilent	G4514A	CN11080020	6/1/2017	Used	SVOA	10GCSK	TBD
Tower	Agilent	G4513A	CN16480250	6/1/2017	Used	SVOA	10GCSK	TBD
ECD 1	Agilent	G2397A	U27007	6/1/2017	Used	SVOA	10GCSK	TBD
ECD 2	Agilent	G2397A	U16942	6/1/2017	Used	SVOA	10GCSK	TBD
AutoSampler	Environmental Sample Tech, Inc.	N/A	13719	1999	Unknown	VOA	10MSV1	TBD
Concentrator	Tekmar	3000	93081004	1999	Unknown	VOA	10MSV1	TBD
GC	HP	6890	US00005556	1999	Unknown	VOA	10MSV1	TBD
MS	HP	5973	US63810130	1999	Unknown	VOA	10MSV1	TBD
AutoSampler	EST Analytical	Centurion	cents211121510	2000	Unknown	VOA	10MSV5	TBD
Concentrator	Encon Evolution	N/A	EV331120210	2000	Unknown	VOA	10MSV5	TBD
GC	HP	6890	DE00020316	2000	Unknown	VOA	10MSV5	TBD
MS	HP MS	5973	US81221500	2000	Unknown	VOA	10MSV5	TBD
Concentrator	Tekmar	3000	173001	2006	Unknown	VOA	10MSV6	TBD
AutoSampler	Varian Archon	N/A	13352	2006	Unknown	VOA	10MSV6/10 MSV9	TBD
GC	Agilent	6890A	US00036184	2006	Unknown	VOA	10MSV6/10 MSV9	TBD
MS	Agilent	5973	US01140180	2006	Unknown	VOA	10MSV6/10 MSV9	TBD
AutoSampler	Environmental Sample Tech, Inc.	N/A	cents207121110	2008	Unknown	VOA	10MSV7	TBD
GC	Agilent Technologies	6850	CN107520005	2008	Unknown	VOA	10MSV7	TBD
Concentrator	Tekmar	3000	(94251012) US02060004	2008	Unknown	VOA	10MSV7	TBD
MS	Agilent Technologies	5975C	US74818132	2008	Unknown	VOA	10MSV7	TBD
GC	5975C	5975C	(CN10742012) US73337433	2011	Unknown	VOA	10MSV8	TBD
AutoSampler	EST Analytical	Centurion	cents205112310	2011	Unknown	VOA	10MSV8	TBD
Concentrator	Encon Evolution	N/A	EV333120210	2011	Unknown	VOA	10MSV8	TBD
MS	Agilent	5975C	US73337433	2011	Unknown	VOA	10MSV8	TBD
Concentrator	Tekmar	14-3100-OEL	1064004	2012	Unknown	VOA	10MSV9	TBD
GC	Agilent	6890	US10215113	2013	Unknown	VOA	10MSVA	TBD
MS	Agilent	5973	US10442746	2013	Unknown	VOA	10MSVA	TBD
autosampler/concentrator	Tekmar	Atomx 15-0000-100	US11203002	2013	Unknown	VOA	10MSVA	TBD
GC	HP	6890	US40620426	Unknown	Unknown	VOA	10MSVE	TBD
Concentrator	Teledyne Tekmar	14-9800-100	CN10427049	Unknown	Unknown	VOA	10MSVE	TBD
AutoSampler	Teledyne Tekmar	15-0500-000	US12058001	Unknown	Unknown	VOA	10MSVE	TBD
MS	HP	5973	US40620426	Unknown	Unknown	VOA	10MSVE	TBD
GC	Agilent	7890B	CN16433144	2017	New	VOA	10MSVF	TBD
AutoSampler	EST Analytical	Centurion	CENTS205112310	2000	New	VOA	10MSVF	TBD
Concentrator	EST Analytical	Encon Evolution	EV332120210	2000	New	VOA	10MSVF	TBD
MS	Agilent	5977B	US1701R009	2017	New	VOA	10MSVF	TBD
GC	Agilent	7890B	CN18043128	2018	New	VOA	10MSVG	TBD

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Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
MS	Agilent	5977B	US1816R028	2018	New	VOA	10MSVG	TBD
Auto-sampler	EST	CenturionW	CENTW646061218	2018	New	VOA	10MSVG	TBD
Concentrator	EST	Encon EV	EV974061218	2018	New	VOA	10MSVG	TBD
AutoSampler	EST Analytical	Centurion	cent132042304	1990	Unknown	VOA	10GCV3	TBD
Concentrator	Tekmar Dohrmann	3000	94189002	1990	Unknown	VOA	10GCV3	TBD
GC	HP	5890 Series II	3133A37290	1990	Unknown	VOA	10GCV3	TBD
AutoSampler	Environmental Sample Tech, Inc.	N/A	13713	1990	Unknown	VOA	10GCV5	TBD
Concentrator	Tekmar	3100	99343009	1990	Unknown	VOA	10GCV5	TBD
GC	HP	G1530A	US00020223	2012	Unknown	VOA	10GCV5	TBD
AutoSampler	EST Analytical	Archon 8100	13719	2012	Unknown	VOA	10GCV6	TBD
Concentrator	Tekmar	14-3100-EOL	US020600004	2012	Unknown	VOA	10GCV6	TBD
GC	Agilent/HP	HP 6890	US00042909	6/1/2013	Unknown	VOA	10GCV6	TBD
AutoSampler	EST Analytical	Centurion	CENT244112907	7/1/2014	Unknown	VOA	10GCV9	TBD
Concentrator	EST Analytical	Encon	580013108P	7/1/2014	Unknown	VOA	10GCV9	TBD
GC	Agilent Technologies	7890A	CN12071022	Unknown	Unknown	VOA	10GCV9	TBD
GC	Agilent Technologies	G1530A	US00002531	2005	Used	VOA	10AIR9--renamed to 10GCVA	TBD
Headspace Sampler	Agilent Technologies	G1888	IT00507022	2005	Used	VOA	10AIR9--renamed to 10GCVA	TBD
Oven	Thermo Scientific	N/A	6520-6528	Unknown	Unknown	VOA	10VOA03	TBD
Refrigerator	Crown	Walk-in	N/A	Unknown	Unknown	VOA	C2	TBD
Refrigerator	Beverage Air	KR74-1AS	6331221	Unknown	Unknown	VOA	C7	TBD
Sonicator	Fisher Scientific	FS220	RWA040963796A	Unknown	Unknown	VOA	10VOA04	TBD
Freezer	Frigidaire	LFFH21F7HWG	WB94954367	2013	Unknown	VOA	V5	TBD
Refrigerator	Norlake Scientific	NSLF482WAW/1	96020404	Unknown	Unknown	VOA	V6	TBD
Oven	Lindberg/Blue M	MO1450PSA-1	U19R-507936-UR	Unknown	Unknown	VOA	10WT56	TBD
Refrigerator/Freezer	Frigidaire	FRT8G7HW0	BA72845548	Unknown	Unknown	VOA	V8	TBD
Refrigerator	Amana	ABB2221WEB1	K13809596	7/1/2014	Used	VOA	V7	TBD
Incubator	Fisher Scientific	Isotemp Incubator	115770704-57744	2006	Unknown	Wet Chem	10WET16	TBD
Incubator	Fisher Scientific	307	30100031/WB24501232	1996	Unknown	Wet Chem	10WET22	TBD
Incubator	Fisher Scientific	307C	2018090423462	2009	Unknown	Wet Chem	10WET35	TBD
Incubator	Thermo Forma	3940	300789-1711	2012	Unknown	Wet Chem	10WET60	TBD
Autotitrator	Metrohm	888 Titrando Titrator	1888001004148	2010	Unknown	Wet Chem	10WET6	TBD
Autosampler	Metrohm	778 Sample Processor	1778001003123	2010	Unknown	Wet Chem	10WET6	TBD
probe	Metrohm	778 Sample Processor	263664	2010	Unknown	Wet Chem	10WET6	TBD
AutoClave	Harvey	N/A	12770804/02244	2009	Unknown	Wet Chem	10WET29	TBD
Thermoreactor	Neutec Group Inc.	ECO 25	89543	Unknown	Unknown	Wet Chem	10WET26	TBD
COD Reactor	Bioscience, Inc.	N/A	COD-B0140	1996	Unknown	Wet Chem	10WET11	TBD
Conductivity meter	Oaktom	Con 110 Series	206454	2000	Unknown	Wet Chem	10WET9	TBD
Conductivity meter - probe	Oaktom	Con 110 Series	204/02	2000	Unknown	Wet Chem	10WET9	TBD
Colony Counter	Gallenkamp	Colony Counter	N/A	2004	Unknown	Wet Chem	10WET30	TBD
Colony Counter	Darkfield Quebec	Colony Counter	N/A	Unknown	Unknown	Wet Chem	10WET38	TBD
Water Bath	Fisher Scientific	Isotemp 210	1605680347017	Unknown	Unknown	Wet Chem	10WET27	TBD
Refrigerator	Carroll Coolers LLC	Walk-in	6584	Unknown	Unknown	Wet Chem	C11	TBD
Refrigerator	Sanyo	SR-952	10200716	Unknown	Unknown	Wet Chem	WC3	TBD
Spectrometer	Hach	DR 3900	1811411	Unknown	Unknown	Wet Chem	10WETF	TBD
Hot Plate	Presto	Tilt'n Drain Big Griddle	2608US	2009	Unknown	Wet Chem	10WET34	TBD
Smart Chem Discrete Analyzer	West Co Scientific Instruments	Smart Chem 200	W0902154	2009	Unknown	Wet Chem	10WT36	TBD
Hot Plate	Corning	N/A	440895	Unknown	Unknown	Wet Chem	10WET40	TBD
Stir Plate	Fisher Scientific	N/A	1889080719259	Unknown	Unknown	Wet Chem	10WET41	TBD
Stir Plate	Barnstead/Thermolyne	S46725/Cimarec 2	776940355770	Unknown	Unknown	Wet Chem	10WET42	TBD

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Refrigerator	Summit Commercial	SCR485L	A091200156	Unknown	Unknown	Wet Chem	WC2	TBD
BOD meter	Hach	HQ40d	80900024869	2011	Unknown	Wet Chem	10WT54	TBD
BOD/pH probe	Hach	LBOD10101	123213032021	2011	Unknown	Wet Chem	10WT54	TBD
pH probe	HACH	PHC108	191282867899	Unknown	Unknown	Wet Chem	10WT54	TBD
pH/BOD meter/Fluoride	Hach	HQ40d	110300052350	2011	Unknown	Wet Chem	10WT53	TBD
pH/BOD meter/Fluoride - probe	Hach	HQ40d	152392938004	2011	Unknown	Wet Chem	10WT53	TBD
Hot Block	Environmental Express	N/A	N/A	Unknown	Unknown	Wet Chem	10WET55	TBD
Oven	Fisher Scientific	13-247-650G(6905)	611729-434	2012	Unknown	Wet Chem	10WET65	TBD
pH Probe	Hach	PHC301	11662571034	2011	Unknown	Wet Chem	1166257103 4	TBD
pH Probe	Hach	PHC301	121952571033	2012	Unknown	Wet Chem	1219525710 33	TBD
pH Probe	Hach	LBOD101	122143032067	2012	Unknown	Wet Chem	1221430320 67	TBD
pH Probe	Switchcraft	PHW77-SS	712202002	2012	Unknown	Wet Chem	712202002	TBD
Turbidity Meter	Hach	2100Q	11050C0092997	2011	Unknown	Wet Chem	10WT59	TBD
Hand Held Brix Refractometer	Fisher	N/A	Fisher catalog # 13-946-21	2011	Unknown	Wet Chem	10WT60	TBD
Quanti-Tray Sealer Model 2x	Quanti-Tray	89-10894-02	4836	2012	Unknown	Wet Chem	10WET56	TBD
IC	Metrohm	881 Compact IC	1881000121132	2012	Unknown	Wet Chem	10WT61	TBD
Lachat	Quick Chem	8500	120400001409	5/7/2012	Unknown	Wet Chem	10WT62	TBD
Autotitrator	Metromn	905 USB Sample Processor	1814001009181	5/7/2012	Unknown	Wet Chem	10WT63	TBD
Probe	Metromn	905 USB Sample Processor	1281705	5/7/2012	Unknown	Wet Chem	10WT63	TBD
JT Backer Speedisk Expanded Extraction Station	J.T. Baker	Speedisk Expanded Extraction Station	L02N23	2012	Unknown	Wet Chem	10WET66	TBD
Desiccator	Sanplatec Corp	DryKeeper	N/A	Unknown	Unknown	Wet Chem	10WET68	TBD
Desiccator	Boekel	N/A	N/A	Unknown	Unknown	Wet Chem	10WET69	TBD
Desiccator	Boekel	N/A	N/A	Unknown	Unknown	Wet Chem	10WET70	TBD
Desiccator	Boekel	N/A	N/A	Unknown	Unknown	Wet Chem	10WET71	TBD
Desiccator	Boekel	N/A	N/A	Unknown	Unknown	Wet Chem	10WET72	TBD
Desiccator	Boekel	N/A	N/A	Unknown	Unknown	Wet Chem	10WET73	TBD
Desiccator	Boekel	N/A	N/A	Unknown	Unknown	Wet Chem	10WET74	TBD
Desiccator	Boekel	N/A	N/A	Unknown	Unknown	Wet Chem	10WET75	TBD
Meter	Hach	HQ440d	120400069964	7/1/2013	Unknown	Wet Chem	10WETE	TBD
Meter - probe	Hach	PHC20101	172612618021	7/1/2013	Unknown	Wet Chem	10WETE	TBD
Oven	Fisher Isotemp Oven	6905	614389-852	2014	Unknown	Wet Chem	10WT77	TBD
Oven	Fisher Isotemp Oven	6905	614389-853	2014	Unknown	Wet Chem	10WET78	TBD
Hot Plate	Presto	Tilt'n Drain Big Griddle	21-697	2014	Unknown	Wet Chem	10WT81	TBD
Water Bath	Precision Scientific Water Bath	Coliform Incubator Bath	601061689	Unknown	Unknown	Wet Chem	10WT86	TBD
Oven	Fisher Scientific	151030521	41762572	Unknown	Unknown	Wet Chem	10WT88	TBD
Fridge	Danby Designer	DBC120BLS	4315123638037	2016	New	Wet Chem	WC4	TBD
COD Reactor block	HACH	DRB 200	160200C0071	Unknown	Unknown	Wet Chem	10WET57	TBD
Hot Block	Environmental Express	N/A	4952CEC2361	2006	Unknown	Wet Chem	10MET03	TBD
Distillation Block	Midi-Vap 4000	Midi-Vap 4000	4071305	Unknown	Unknown	Wet Chem	10WT89	TBD

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7.5.2 PAS-Billings

Equipment List: PAS-Billings

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Balance	Fisher	A200DS	B027060	Unknown	Used	Sulfur Bench	11BAL1	Inorganics bookshelf
Balance	Ohaus	ARC120	G3251202300491	Unknown	New	EPH Prep	11BAL2	SVOA file cabinet
Balance	Ohaus	SP202	B504529759	Unknown	New	VOA Prep	11BAL4	Organics file cabinet
Balance	Mettler-Toledo	ML3002E	B508634908	Unknown	New	Mining	11BAL5	SR file cabinet
Balance	Mettler-Toledo	X5105DU	B525074608	Unknown	New	Solids Room	11BAL6	SR file cabinet
Balance	AND	GF-3000	T0370959	Unknown	New	Wet Chem Prep Bench	11BAL07	Inorganics bookshelf
Balance	Ohaus	STX223	B805364908	Unknown	New	Organics	11BAL08	Organics file cabinet
Autosampler	Hewlett-Packard	18596B	3050A23871	Unknown	Used	SemiVoa Lab	11MT04	SVOA file cabinet
Autosampler	Hewlett-Packard	18594B	3049A23850	Unknown	Used	SemiVoa Lab	11MT04	SVOA file cabinet
SVOA GC	Hewlett-Packard	5890	275A16778	Unknown	Used	SemiVoa Lab	11MT04	SVOA file cabinet
IC Autosampler	Dionex	AS-DV	190815063	8/2019	New	IC Room	11MT05	IC file cabinet
Ion Chromatograph	Dionex	ICS1000	05120175	Unknown	Used	IC Room	11MT05	IC file cabinet
IC Autosampler	Dionex	AS40-1	7101378	Unknown	Used	IC Room	11MT92	IC file cabinet
Ion Chromatograph	Dionex	ICS 2100	04090402	Unknown	Used	IC Room	11MT92	IC file cabinet
Autoanalyzer Autosampler	Astoria Pacific	411	41150160	Unknown	New	Wet Chem	11MT06	Inorganics bookshelf
Autoanalyzer Detector	Astoria Pacific	307	307064	Unknown	New	Wet Chem	11MT06	Inorganics bookshelf
Autoanalyzer Heater Unit	Perstop	303A	303437	Unknown	New	Wet Chem	11MT06	Inorganics bookshelf
Autosampler power supply	Perstorp	509	005766	Unknown	New	Wet Chem	11MT06	Inorganics bookshelf
Autosampler pump	Ismatec	IP	K16004541	Unknown	New	Wet Chem	11MT06	Inorganics bookshelf
Auto dilutor	Dilutus	NA	412115	Unknown	New	Wet Chem	11MT06	Inorganics bookshelf
Spectrophotometer	Thermo Spectronic	Aquamate	104218	Unknown	New	Wet Chem	11MT08	Inorganics bookshelf
Oven	Fisher	Isotemp 255D	1451	Unknown	New	Wet Chem	11MT10	SR file cabinet
Oven	Fisher	Isotemp 630F	20900168	Unknown	New	Wet Chem	11MT11	SR file cabinet
Concentrator	Zymark	TurboVap II	TB9814N8062	Unknown	Used	Organic Prep	11MT13	Organics file cabinet
Concentrator	Zymark	TurboVap II	4082	Unknown	Used	Organic Prep	11MT14	Organics file cabinet
Furnace	Sybron Thermolyne	1300	0479 16654	Unknown	Used	Wet Chem	11MT15	Inorganics bookshelf
N-Evap	Organomation	112	11771	Unknown	Used	Organic Prep	11MT16	Organics file cabinet
Waterbath	Precision Scientific	66586	698100224	Unknown	Used	Wet Chem	11MT17	Inorganics bookshelf
Sonicator	Fisher Scientific	FS60	RUA080390744	Unknown	Used	Voa	11MT19	Organics file cabinet
Furnace	Leco	606-000-300	3167	Unknown	Used	Wet Chem	11MT22	Inorganics bookshelf
Turbidimeter	HF Scientific	Micro 1000	610064	Unknown	New	Wet Chem	11MT23	Inorganics bookshelf
Sonicator	Heat Systems	Sonicator XL	NA	Unknown	Used	Organic Prep	11MT24	Organics file cabinet
Sonicator	Branson	Sonfier 450	B1090019	Unknown	Used	Organic Prep	11MT25	Organics file cabinet

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Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Concentrator	Tekmar/Dohrmann	3000	96312005	Unknown	Used	Voa Lab	11MT33	Organics file cabinet
GC/GCMS	Aglient	6890	US00009537	Unknown	Used	Voa Lab	11MT33	Organics file cabinet
Autosampler	EST Analytical	Centurion W	CENTW416041012	Unknown	New	Voa Lab	11MT33	Organics file cabinet
Block Digestor	Lachat	BD-46	1800-733	Unknown	New	Wet Chem	11MT34	Inorganics bookshelf
AutoSampler	EST Analytical	Centurion W	CENTW417042312	Unknown	New	Voa Lab	11MT38	Organics file cabinet
Concentrator	EST Analytical	Evolution	EV431073112	Unknown	New	Voa Lab	11MT38	Organics file cabinet
GC System	Agilent	5973	US00032765	Unknown	New	Voa Lab	11MT38	Organics file cabinet
MS Detector	Agilent	5973	US94240027	Unknown	Used	Voa Lab	11MT38	Organics file cabinet
pH meter	Accumet	AB15+	AB92338386	Unknown	New	Wet Chem	11MT40	Inorganics bookshelf
Oven	Fisher	Isotemp 630F	20600109	Unknown	New	Wet Chem	11MT41	SR file cabinet
Oven	Precision Scientific	Thelco 130 DM	9212-016	Unknown	New	Mining	11MT42	SR file cabinet
GC System	Agilent	6890	US00021845	Unknown	Used	Voa Lab	11MT43	Organics file cabinet
Concentrator	Tekmar/Dohrman	3000	97251005	Unknown	Used	Voa Lab	11MT43	Organics file cabinet
AutoSampler	EST Analytical	Centurion W	CENT-W-416041012	Unknown	New	Voa Lab	11MT43	Organics file cabinet
Flow Analyzer	Lachat	8500	120400001407	Unknown	New	Wet Chem	11MT44	Inorganics bookshelf
For Calculation acodes	NA	NA	NA	NA	NA	NA	11MT45	NA
listed as generic instrument in Epic	NA	NA	NA	NA	NA	NA	11MT46	NA
Sieve Shaker	W.S. Tyler	RX_29	10-2394	Unknown	New	Mining	11MT48	Mining drawer
Concentrator	Zymark	Turbo Vap II	4254	Unknown	Used	Organic Prep	11MT51	Organics file cabinet
Custom Shaker	Custom	NA	NA	Unknown	New	Wet Chem	11MT55	NA
Oven	Fisher Scientific	516G	801N0068	Unknown	New	Garage (VOA)	11MT56	SR file cabinet
Autoclave	ThermoFisher	ST75925	1277081210300	Unknown	Used	Wet Chem	11MT57	Inorganics bookshelf
Autoclave	Fisher	SA-260 FA	FUSA 170822010-030	Unknown	Used	WetChem	11MT113	Inorganics Bookshelf
Metals Block Digester	Environmental Express	SC154	S388CEC2479	Unknown	Used	Metals Hood	11MT58	Inorganics bookshelf
ICP	ThermoFisher	ICAP6500 Duo	20071505	Unknown	Used	Metals Bench	11MT60	Inorganics bookshelf
Autosampler	CETAC	ASX-520	030660A520	Unknown	Used	Mercury Bench	11MT60	Inorganics bookshelf
Chiller	ThermoFisher	ThermoFlex900	111305048	Unknown	Used	Metals Bench	11MT60	Inorganics bookshelf
Centrifuge	Damon	IEC HN-S	34721368	Unknown	Used	Wet Chem	11MT61	Inorganics bookshelf
Block Digestor	Lachat	BD-46	1800-296	Unknown	Used	TKN Hood	11MT62	Inorganics bookshelf
Handheld pH	Thermo Scientific	Star A121	H00013	Unknown	New	Wet Chem	11MT64	Inorganics bookshelf
Spectrophotometer	Thermo Scientific	Evolution 201	5A4S008017	Unknown	New	Wet Chem	11MT65	Inorganics bookshelf
Hood	NA	NA	NA	Unknown	Used	TKN Hood	11MT66	Inorganics bookshelf

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Hood	NA	NA	NA	Unknown	Used	T Phos Hood	11MT67	Inorganics bookshelf
Hood	NA	NA	NA	Unknown	Used	Organic Prep	11MT68	Organics file cabinet
Hood	NA	NA	NA	Unknown	Used	Organic Prep	11MT69	Organics file cabinet
Hood	NA	NA	NA	Unknown	Used	Organic Prep	11MT70	Organics file cabinet
Hood	NA	NA	NA	Unknown	Used	Wet Chem	11MT71	Inorganics bookshelf
Hood	NA	NA	NA	Unknown	Used	Metals	11MT72	Inorganics bookshelf
Hood	NA	NA	NA	Unknown	Used	Voa	11MT73	Organics file cabinet
Oven	Fisher Scientific	116G	972	Unknown	New	Wet Chem	11MT76	SR file cabinet
GC System	Agilent	6890	US10238089	Unknown	Used	SemiVoa	11MT78	SVOA file cabinet
Autosampler	Agilent	G2913A	CN81047578	Unknown	Used	SemiVoa	11MT78	SVOA file cabinet
Autosampler	Agilent	G2913A	CN82750941	Unknown	Used	SemiVoa	11MT78	SVOA file cabinet
Autosampler Tray	Agilent	G2614A	CN21720602	Unknown	Used	SemiVoa	11MT78	SVOA file cabinet
TCLP Rotator A	NA	NA	NA	Unknown	Used	TCLP Area	11MT79	NA
TCLP Rotator B	NA	NA	NA	Unknown	Used	TCLP Area	11MT79	NA
TCLP Rotator C	NA	NA	NA	Unknown	Used	TCLP Area	11MT79	NA
Filter Pump 1.5	Edwards	904160	996305884	Unknown	Used	TDS	11MT80	Inorganics bookshelf
Filter Pump 2	Edwards	E2M2	42396	Unknown	Used	Mining	11MT81	Inorganics bookshelf
pH meter	Thermo Scientific	OrionSTARA2 15	X27760	Unknown	New	pH/Conduc tivity Bench	11MT82	Inorganics bookshelf
pH Meter	ThermoScientifi c	OrionSTARA2 15	X49331	Unknown	New	WetChem Prep	11MT107	Inorganics bookshelf
TKN Digestor	Hatch, Lachat BD40HT	BD-40	1800-808	Unknown	Used	TKN Hood	11MT83	Inorganics bookshelf
Filter Pump 2	Edwards	5KC37NN470 GX	25963	Unknown	Used	SPLP/TCL P	11MT84	Inorganics bookshelf
Oven	ThermoFisher Scientific	Hermathern OGS10	42022678	Unknown	New	Mining	11MT86	SR file cabinet
Drying Cabinet	NA	NA	NA	Unknown	New	Mining	11MT87	NA
Sieve Shaker	Endecotts	Minor200	1217120535J	Unknown	New	Mining	11MT88	Mining drawer
Oven	Fisher Sci 180L	180L	42087930	Unknown	New	Mining	11MT89	SR file cabinet
Muffle Furnace Kiln	Delphi	EZ-Pro 15/6	SN 035988	Unknown	New	Organic Prep	11MT90	Organics file cabinet
IC Autosampler	Dionex	AS,ICS Series, ICS-2100,ICS-3000 DC, ICS-3000 SP	09090574, 09080900, 09100402, 09090060, 09090425	Unknown	Used	IC Room	11MT92	IC file cabinet
IC Autosampler	Dionex	ICS-3000 DC, ICS 3000 SP	9090060, 9090425	Unknown	Used	IC Room	11MT93	IC file cabinet
Metals Block Digester	Smartblock	NA	NA	Unknown	Used	Metals/T Phos hood	11MT94	Inorganics bookshelf
Sieve Shaker	Endecotts	Octagon 200	1218020515	Unknown	New	Mining	11MT95	Mining drawer
Pulverizer	Retsch	RS200	1217170524F	Unknown	New	Mining	11MT96	Mining drawer
pH probe	Orion	013005MD conductivity reli	NA	Unknown	New	Wet Chem	11MT98	Inorganics bookshelf
pH probe	Orion	8107BNUMD Ross Ultra pH/ATC Triode	NA	Unknown	New	Wet Chem	11MT100	Inorganics bookshelf

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Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
pH probe	Thermo Scientific	8757	NA	Unknown	New	Wet Chem	11MT105	Inorganics bookshelf
Oven	Thermo Scientific	Hermathern OGS100	42296560	Unknown	New	Wet Chem	11MT106	SR file cabinet
Conductivity meter	Thermo Scientific	OrionSTARA2 15	49331	Unknown	New	Wet Chem	11MT107	Inorganics bookshelf
Filter Pump 2	Edwards	E2M2	11934	Unknown	Used	GCMS	11MT108	Inorganics bookshelf
pH probe	Accumet	13-620-530A lot code VWU1	NA	Unknown	New	Wet Chem	11MT109	Inorganics bookshelf
pH Probe	Thermo Scientific	Orion 8107BNUMD	NA	7/25/2019	New	Wet Chem	11MT110	Inorganics bookshelf
pH Probe	Thermo Scientific	Orion 8157BNUMD	NA	11/1/2019	New	Wet Chem	11MT111	Inorganics bookshelf
Conductivity/pH Pen	Fisher Scientific	15-078-201	192323805	11/7/2019	New	Wet Chem	11MT112	Inorganics bookshelf
GC System	Agilent	7890A	US20314075	Unknown	Used	SemiVoa	11MTG1/ G2	SVOA file cabinet
Autosampler Tray	Agilent	7890A	CN10752102	Unknown	Used	SemiVoa	11MTG1/ G2	SVOA file cabinet
Injector	Agilent	7683B	US01913416	Unknown	Used	SemiVoa	11MTG1/ G2	SVOA file cabinet
Injector	Agilent	7683	CN82349867	Unknown	Used	SemiVoa	11MTG1/ G2	SVOA file cabinet
Bottletop Dispenser	Brinkmann	NA	NA	Unknown	New	Wet Chem Hood	BT1	Inorganics bookshelf
Bottletop Dispenser	Dispensette	NA	17L34997	Unknown	New	Wet Chem Hood	BT2	Organics file cabinet
Bottletop Dispenser	Eppendorf	NA	12M10591	Unknown	New	Organic Prep	BT3	SVOA file cabinet
Bottletop Dispenser	Dispensette	NA	07Z7769	Unknown	New	Organic Prep	BT4	SVOA file cabinet
Bottletop Dispenser	Fisher	NA	AF 2153	Unknown	New	Wet Chem Hood	BT5	Inorganics bookshelf
Bottletop Dispenser	Fisher	NA	AF6770	Unknown	New	Metals	BT6	Inorganics bookshelf
Bottletop Dispenser	Fisher	NA	AF6862	Unknown	New	Metals	BT7	Inorganics bookshelf
Bottletop Dispenser	Fisher	NA	AF9468	Unknown	New	Wet Chem Hood	BT8	Inorganics bookshelf
Bottletop Dispenser	Fisher	NA	AG4962	Unknown	New	Wet Chem Hood	BT9	Inorganics bookshelf
Bottletop Dispenser	Fisher	NA	14024979	Unknown	New	Wet Chem Hood	BT10	Inorganics bookshelf
Bottletop Dispenser	Fisher	NA	14024938	Unknown	New	Wet Chem Hood	BT11	Inorganics bookshelf
Bottletop Dispenser	Satorius	EMD	AK6234	Unknown	New	Wet Chem Hood	BT12	Inorganics bookshelf
Bottletop Dispenser	Fisher	NA	14200358	Unknown	New	Wet Chem Hood	BT14	Inorganics bookshelf
Bottletop Dispenser	Brinkmann	NA	75123	Unknown	New	Wet Chem Hood	BT15	Inorganics bookshelf
Bottletop Dispenser	Fisher	NA	17309419	Unknown	New	Wet Chem Hood	BT16	Inorganics bookshelf
Bottletop Dispenser	Fisher	NA	17309419	Unknown	New	Metals Hood	BT17	Inorganics bookshelf
Bottletop Dispenser	Dispensette	NA	17309419	Unknown	New	IC Room	BT18	Inorganics bookshelf
IR Gun	Fisher Scientific	2267-20	160285052	Unknown	New	SR	160285052	SR file cabinet
IR Gun	Omega	NA	OS418-LS	Unknown	New	SR	OS418-LS	SR file cabinet
NIST Thermometer	Fisher Scientific	PT-100	111855001	Unknown	New	QA	111855001	QA file cabinet
NIST Thermometer	Fisher Scientific	PT-100	160283107	Unknown	New	QA	160283107	QA file cabinet

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Refrigerator/ Freezer	Sanyo	SR-170X	9400302476	Unknown	New	Wet Chem	MTC-1	SR file cabinet
Refrigerator	Kenmore	5649901741	920940742	Unknown	New	Organic Prep	MTC-4	SR file cabinet
Refrigerator	Traulsen	G20010	T33587106	Unknown	New	SR	MTC-9	SR file cabinet
Refrigerator	Frigidaire	FRU17B2JW18	WA93300079	Unknown	New	Wet Chem	MTC-11	SR file cabinet
Freezer	SPT	B-PCZ5	A100600186	Unknown	New	Wet Chem	MTC-13	SR file cabinet
Refrigerator	Saturn	549R	A94B200112T	Unknown	New	Garage (VOA)	MTC-14	SR file cabinet
Refrigerator	Centaur Plus	CSD-2DR-BAL	120KENH00159	Unknown	New	Garage (VOA)	MTC-16	SR file cabinet
Refrigerator	Imperial	GMF-600	NA	Unknown	New	Main Walk-in	MTC-18	SR file cabinet
Refrigerator	Kenmore	253.165421	WB64429495	Unknown	New	Garage (SR)	MTC-21	SR file cabinet
Freezer	Arctic King	AFRM016AEB	D80-24154501-16A18-211121	Unknown	New	Wet Chem	MTC-22	SR file cabinet
Freezer	Haier	HF71CW20	B300G7B0600W	Unknown	New	Garage	MTC-24	SR file cabinet
Freezer	Whirlpool	WZF34X16DW04	480308106	Unknown	New	Garage	MTC-25	SR file cabinet
Freezer	Whirlpool	WZF34X18DW02	U80403444	Unknown	New	Garage	MTC-26	SR file cabinet
Freezer	Hisense	BE170	1B0088Z0062JBE170520055	7/12/19	New	VOA	MTC-27	SR file cabinet
Eye Wash Station	Guardian	NA	NA	Unknown	New	Main lab	SE-1	SR file cabinet
Fire Extinguisher	Halon	A355	V-983066	Unknown	New	VOA	FE-1	SR file cabinet
Fire Extinguisher	Ansul Sentry	A10H	ZT-849854	Unknown	New	Garage	FE-2	SR file cabinet
Fire Extinguisher	Ansul Sentry	A02VB	ZU-092145	Unknown	New	Courier van	FE-3	SR file cabinet
Fire Extinguisher	Fire Master	AA05-1	CF-322188	Unknown	New	Main lab back exit	FE-4	SR file cabinet
Fire Extinguisher	Fire Master	AA0S	V-185947	Unknown	New	Organic prep	FE-5	SR file cabinet
Fire Extinguisher	Fire Master	AA10S	BZ-614843	Unknown	New	Mining lab	FE-6	SR file cabinet
Fire Extinguisher	Fire Master	AA10S	BZ-614849	Unknown	New	Mining lab back room	FE-7	SR file cabinet
Fire Extinguisher	Fire Master	AA05-1	CF-322139	Unknown	New	Mining lab back room exit	FE-8	SR file cabinet
Fire Extinguisher	Ansul Sentry	A10H	ZD589859	Unknown	New	Main lab to office	FE-9	SR file cabinet
Fire Extinguisher	Fire Master	AA05S-1	C-93705476	Unknown	New	Front desk	FE-10	SR file cabinet
Fire Extinguisher	Fire Master	AA05S-1	E-62140500	Unknown	New	Break room	FE-11	SR file cabinet
Fire Extinguisher	Ansul Sentry	A10H	ZD-589837	Unknown	New	Garage (hydrogen storage)	FE-12	SR file cabinet
First Aid Kit	ALSCO	E2M2	41032	Unknown	New	Main lab	FA-1	NA
Leak Detector	Restek	22655	117653	Unknown	New	Lab Managers Office	LD-1	QA file cabinet

7.5.3 PAS-Virginia

Equipment List: PAS-Virginia

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
CVAA Mercury Analyzer	Cetac	M-6100	060402 QT6	10/1/2004	New	Metals	12HG1	At instrument
Autosampler	Cetac	ASX-400	070401 ASX 4	Unknown	Unknown	Metals		TBD
Hardware	Venture Systemax	SYX PHM800PRO	106381144	Unknown	Unknown	Metals		TBD
Software	Cetac	Quicktrace Hg Analyzer System V 1.2.1		Unknown	Unknown	Metals		TBD
ICP Atomic Emission Spectrometer	Agilent	5110	MY18260006	9/7/2018	New	Metals	12ICP4	At instrument
Autosampler	Agilent	SPS4	AU18144765	Unknown	Unknown	Metals		TBD
Hardware	Hewlett Packard	HP Z 240	2UA82127HC	Unknown	Unknown	Metals		TBD
Software	Agilent	ICPExpert		Unknown	Unknown	Metals		TBD
ICPMS	Perkin Elmer	ELAN 9000	AJ11920712	3/18/2011	New	Metals	12ICM1	At instrument
Autosampler /pump	ESI Fast System	SC 4DX	X4DX-HS-TSP-16-101109	Unknown	Unknown	Metals		TBD
Recirculator	Agilent	G8481A	1B07-00914	Unknown	Unknown	Metals		TBD
Software	Perkin Elmer	Version 3.4		Unknown	Unknown	Metals		TBD
Hardware	Dell XP	X12-51522		Unknown	Unknown	Metals		TBD
ICPMS	Perkin Elmer	ELAN 9000	AJ3050909	3/1/2016	Used	Metals	12ICM3	At instrument
Autosampler /pump	ESI Fast System	SC 4DX	X4DX-HS-TSP-16-100803	Unknown	Unknown	Metals		TBD
Recirculator	Polyscience	3370	C07B00394	Unknown	Unknown	Metals		TBD
Hardware	Lenovo			Unknown	Unknown	Metals		TBD
Software	Perkin Elmer	Version 3.4		Unknown	Unknown	Metals		TBD
ICPMS	Agilent	7900 ICP-MS	SG19374593	11/4/19	New	Metals	12ICM4	At instrument
Autosampler / pump	Agilent	SPS 4	AU19156702	11/4/19	New	Metals		TBD
Recirculator	Agilent	G3292-80200	1908-02202	11/4/19	New	Metals		TBD
Hardware	Hewlitt Packard		MXL9193WHM	11/4/19	New	Metals		TBD
Software	Agilent	ICPMS Mass Hunter 4.5		11/4/19	New	Metals		TBD
Lachat	Lachat	QC 8500 Series 2	181200002196	1/7/2019	New	Wet Chem	12WTAA	At instrument
Lachat Regenerant Pump	Lachat	RP-150 Series	L18002784	Unknown	Unknown	Wet Chem		TBD
Autosampler	Cetac	ASX-580 XYZ	111839A560	Unknown	Unknown	Wet Chem		TBD
Autodiluter	Zellweger Analytics	PDS 200 Precision Diluter	181200000877	Unknown	Unknown	Wet Chem		TBD
Hardware	Midwest Comp Depot	3035		Unknown	Unknown	Wet Chem		TBD
Software	Omnion	FIA Data System		Unknown	Unknown	Wet Chem		TBD
Lachat	Lachat	QC 8500 Series 2	10070000129	Unknown	New	Wet Chem	12WTAB	At instrument
Reagent Pump	Lachat	RP 150 Series	A82000-1961	Unknown	Unknown	Wet Chem		TBD
Autosampler	Cetac	ASX500 Model 510	010025ASX	Unknown	Unknown	Wet Chem		TBD
Hardware	Hewlitt Packard	HP Compaq		Unknown	Unknown	Wet Chem		TBD
Software	Omnion	FIA Data System		Unknown	Unknown	Wet Chem		TBD
Ion Chromatograph	Metrohm	930 Flex IC		Unknown	New	Wet Chem	12WTAC	Available online
Regenerant Dispenser	Metrohm	IC-05		Unknown	Unknown	Wet Chem		TBD

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Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Autosampler	Metrohm	Model 850 Sample Processor		Unknown	Unknown	Wet Chem		TBD
Hardware	Dell		CBDUC284-70821-553-OGIP	Unknown	Unknown	Wet Chem		TBD
Software	Metrohm	IC Net 2.3		Unknown	Unknown	Wet Chem		TBD
Ion Chromatograph	Metrohm	Model 881 Advanced Compact IC	1881000122119	Unknown	New	Wet Chem	12WTA7	Available online
Regenerant Dispenser	Metrohm	800 Dosino		Unknown	Unknown	Wet Chem		TBD
Autosampler	Metrohm	Model 858 Advanced Sample Processor		Unknown	Unknown	Wet Chem		TBD
Hardware	Dell	Optiplex 790		Unknown	Unknown	Wet Chem		TBD
Software	Metrohm	IC Net 2.3		Unknown	Unknown	Wet Chem		TBD
Ammonia Distillation Block	Lachat	Micro Dist	081200001033	5/1/2009	New	Wet Chem	12DST1	TBD
TKN Block Digester	Lachat	Model BD-40	TSLA1013511403	8/4/17	New	Wet Chem	12TKN2	TBD
Autotitrator	ManTech	TitraSip	MT-1B5-957	Unknown	New	Wet Chem	12WETD	Available online
Autosampler	ManTech	AutoMax 73 Sampler		Unknown	Unknown	Wet Chem		TBD
Hardware	Hewlitt Packard	Prodesk		Unknown	Unknown	Wet Chem		TBD
Software	ManTech	PC Titrate for Windows v.3		Unknown	Unknown	Wet Chem		TBD
BOD Warmer #1	Thermo Precision		60541072	Unknown	Unknown	Wet Chem		TBD
BOD Incubator #4	Fisher	Model 3720	300007704	Unknown	New	Wet Chem	12BOD4	TBD
BOD Incubator #5	Fisher	Model 3720A	300064399	2/26/16	New	Wet Chem	12BOD5	TBD
BOD Incubator #6	Fisher	Model 3720A	300088990	Unknown	New	Wet Chem	12BOD6	TBD
BOD Reader	Thermo Electron	BOD Auto EZ Reader	10060020/A0074	Unknown	Unknown	Wet Chem	12WET2	At instrument
D.O. Meter	YSI	R5100	02C0340AA	Unknown	Unknown	Wet Chem	12WET0	TBD
BOD Hardware	Lenovo	Think Centre 001XUS	MJ07T8HE	Unknown	Unknown	Wet Chem		TBD
BOD Software		BOD Auto EZ		Unknown	Unknown	Wet Chem		TBD
TOC Analyzer	OI	OI Analyzer	H129732449E	New	Unknown	Wet Chem	12WTA3	At instrument
TOC Autosampler	OI	OI Autosampler	E129788451	Unknown	Unknown	Wet Chem		TBD
TOC Analyzer	OI	OI Solids Analyzer	A1129733824	New	Unknown	Wet Chem	12WTA9	At instrument
Autosampling Module	OI Corporation		621290637-92120	Unknown	Unknown	Wet Chem		TBD
IR Detector	OI Corporation	1030	2A0002T	Unknown	Unknown	Wet Chem		TBD
Hardware	HP	Compaq		Unknown	Unknown	Wet Chem		TBD
Software	OI Corporation	V1.4.2		Unknown	Unknown	Wet Chem		TBD
TOC Analyzer	OI	OI Analyzer	P407730312P	4/1/2014	New	Wet Chem	12WTA8	At instrument
Autosampling Module	OI Corporation	Model 1088 AS		Unknown	Unknown	Wet Chem		TBD
IR Detector	OI Corporation	1030	B622737366	Unknown	Unknown	Wet Chem		TBD
Hardware	Lenovo	Think Centre		Unknown	Unknown	Wet Chem		TBD
Software	OI Corporation	V1.4.2		Unknown	Unknown	Wet Chem		TBD
Bacteria Incubator	Shel Lab	1545	11052906	Unknown	Unknown	Wet Chem	12INC1	TBD
Coliform Incubator Bath	Thermo Fisher	253	202682-185	Unknown	Unknown	Wet Chem	12INC2	TBD
Bacteria Incubator	Shel Lab	1520		Unknown	Unknown	Wet Chem	12INC3	TBD
Coliform Incubator Bath	Thermo Fisher	253	605041072	Unknown	Used	Wet Chem	12INC4	TBD
Microscope	National Optical		446TBL-10	Unknown	Unknown	Wet Chem		TBD
QuantiTray Sealer	IDEXX	89-10894-02	4788	Unknown	Unknown	Wet Chem	12QTS1	TBD

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Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
UV Lamp	Entala	UVL-56		Unknown	Unknown	Wet Chem	12UVL1	TBD
Oven	VWR	1330GM	05039804	Unknown	Unknown	Wet Chem	12O010	TBD
Oven	Fisher	6926	614203-180	Unknown	Unknown	Wet Chem	12OV3	TBD
Oven	Shel Lab	SM05	0405Z114	Unknown	Unknown	Wet Chem	12OV4	TBD
Oven	Fisher	100L	42130594	Unknown	Unknown	Wet Chem	12OV6	TBD
Muffle Furnace	Fisher	IsoTemp	70100004	Unknown	Unknown	Wet Chem		TBD
Metals Digestion Block	CPI	05-C0530	000424	Unknown	Unknown	Metals	12HB1	TBD
Metals Digestion Block	CPI			Unknown	Unknown	Metals	12HB2	TBD
Metals Digestion Block	CAi	SmartBlock 125i		6/27/2016	Used	Metals	12HB3	TBD
Metals Digestion Block	AGS Scientific	Durablock QB17064		Unknown	New	Metals	12HB4	TBD
Balance	AND	GF 1200	10318953	Unknown	Unknown	Metals	12BAL3	TBD
Balance	Sartorius	LA3200D	13407528	Unknown	Unknown	Wet Chem	12BAL4	TBD
Balance	Sartorius	BP1105	50206779	Unknown	Unknown	Metals	12BALB	TBD
Balance	Denver Instruments	A200P	040DCD057	Unknown	Unknown	Wet Chem	12BALC	TBD
Balance	Mettler	XSE 104	B549797353	10/13/2017	Used	Wet Chem	12BALD	TBD
Stir Plate	Thermoline	Type 7200	903971255007	Unknown	Unknown	Wet Chem		TBD
Refrigerator 2R	Sanyo	SR-362OK	051105496	Unknown	Unknown	Metals		TBD
Refrigerator #3	True Mfg Co.	T-49	1-2953805	Unknown	Unknown	Sample Receiving		TBD
Refrigerator #5	True Mfg Co.	T-49	1-3060851	Unknown	Unknown	Metals		TBD
Refrigerator #8	True Mfg Co.	T-35	I-3016399	Unknown	Unknown	Sample Receiving		TBD
Refrigerator /Freezer #10	Gibson	GRT17B3BW1	BA31823513	Unknown	Unknown	Wet Chem		TBD
Refrigeratot #12	Beverage-Air	9029136	KR481AS	Unknown	Unknown	Wet Chem		TBD
Refrigerator #13	US Cooler Walk-in		29716	Unknown	Unknown	Sample Receiving		TBD
Refrigerator #14	SubZero	249R	234547	Unknown	Unknown	Wet Chem		TBD
Mixer	Thermolyne	M37615	376950140798	Unknown	Unknown	Wet Chem		TBD
Rotator	LabLine	1345	1002-1791	Unknown	Unknown	Wet Chem	12RTR1	TBD
Stir/Hotplate	VWR	12365-392	14023	Unknown	Unknown	Wet Chem		TBD
COD Reactor	HACH	45600-00	920600007477	Unknown	Unknown	Wet Chem	COD-R1	TBD
COD Reactor	HACH	16500-10	5944	Unknown	Unknown	Wet Chem	COD-R2	TBD
Dessicator	Labconco			Unknown	Unknown	Wet Chem	12DES1	TBD
Dessicator	Labconco			Unknown	Unknown	Wet Chem	12DES2	TBD
Dessicator	Glass			Unknown	Unknown	Wet Chem	12DES3	TBD
Dessicator	Fisher			Unknown	Unknown	Wet Chem	12DES4	TBD
Dessicator	Boeke;			Unknown	Unknown	Wet Chem	12DES5	TBD
Dessicator	Plas Labs			Unknown	Unknown	Wet Chem	12DES6	TBD
Dessicator	Plas Labs			Unknown	Unknown	Wet Chem	12DES7	TBD
Dessicator	Plas Labs			Unknown	Unknown	Wet Chem	12DES8	TBD
Dessicator	SanPlatec			Unknown	Unknown	Wet Chem	12DES9	TBD
Sonicator	NEY	300 Ultrasonik	NEY010507	Unknown	Unknown	Wet Chem	12SON1	TBD
Centrifuge	Sorvall	RT6000B		Unknown	Unknown	Wet Chem	12CFG2	TBD
Autoclave	Tuttnaur / Brinkman	3545 EP	2105018	Unknown	Unknown	Wet Chem	12CLV2	TBD
pH Meter	OrionStar	A215	X27234	Unknown	Unknown	Wet Chem	12WETG	Available online
Turbidimeter	Orion	AQ3010	3494427	10/4/17	New	Wet Chem	12WETF	At instrument
Spectrophotometer	HACH	DR 5000	1271479	Unknown	New	Wet Chem	12WTA1	At instrument
Flash Point Tester	Koehler	K16200		Unknown	New	Metals	12FP1	TBD
DI Water System	Barnstead Thermolyne	EPure System		Unknown	Unknown	Lab		TBD
LP RO System	Barnstead Thermolyne	D2622	496000209600	Unknown	Unknown	Lab		TBD
Resistivity Meter for RO System	Sybron Barnstead	02770		Unknown	Unknown	Lab		TBD

7.5.4 PAS-Duluth

Equipment List: PAS-Duluth

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Balance	Mettler	AT261	M89136	6/26/2018	Used	Bioassay	13BAL8	Electronic copy on Server
Incubator	Precision Scientific	4YW71	605031679	3/12/2019	Unknown	Bioassay	13INC8	Online
pH Meter	Thermo Orion	420	069292	Unknown	Unknown	Bioassay	13WETA	Online
Conductivity Meter	Hach	Sension5	020500007046	Unknown	Unknown	Bioassay	13WETB	Bioassay Lab above chemistry bench
DO Meter/Probe	Hach	HQ30d Flexi	071200016294	Unknown	Unknown	Bioassay	13WETC	Electronic copy on Server
Amperometric Titrator	Hach	19299-00	96090001089	Unknown	Unknown	Bioassay	13WETD	Electronic copy on Server
pH Pen	Fisher	S35927	2812765	1/14/2019	New	Bioassay	13WETN	Bioassay Lab above chemistry bench
Light Box	Hall Productions	1218	N/A	Unknown	Unknown	Bioassay	NA	Online
Light Meter	Fisher	06-662-63, 11774266	181138991	7/3/2018	New	Bioassay	13LM2	Online
Light Timer	Intermatic	E1600	-	Unknown	Unknown	Bioassay	13TIMER1	Bioassay Lab above chemistry bench
Light Timer	Intermatic	E1600	-	Unknown	Unknown	Bioassay	13TIMER2	Bioassay Lab above chemistry bench
Light Timer	Intermatic	E1600	-	Unknown	Unknown	Bioassay	13TIMER3	Bioassay Lab above chemistry bench
Water Filtration/DIW System	Barnstead	B Pure	06810	7/12/2019	Unknown	Bioassay	13DI2	Online
Fridge	TurboAir	TSR49	009495009MR	Unknown	Unknown	Bioassay	13DUL3	Online
Fridge	USBC	564.8993640	900819697	Unknown	Unknown	Bioassay	13DUL4	Online
Water Filtration/DIW System (main)	Culligan	NA	NA	Unknown	Unknown	Glassware Cleaning	13DI1	Online
Balance	Mettler	PC 4400	0145	3/6/19	Used	HCT	13BAL10	Online
pH Meter	Thermo Orion	Star Series	B07284	9/1/2015	Unknown	HCT	13WET6	HCT Desk Drawer
pH/Conductivity Meter	Thermo	Star A215 Benchtop	X45992	9/1/2015	Unknown	HCT	13WETM	Online
Balance	Sartorius	ME4145	13003775	Unknown	Unknown	LL Hg	12BAL5	Online
Oven	Blue-M	MO1440A-1	S175-517150-SS	Unknown	Unknown	LL Hg	13OVN4	Online
Mercury Analyzer	Brooks Rand	Model III CVAFS	1103401	10/19/2017	Unknown	LL Hg	12Hg2	LL Hg Desk Drawer
Autosampler	Brooks Rand	Brooks Rand 17420	4936A14632	5/1/2018	Unknown	LL Hg	-	LL Hg Desk Drawer

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Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Total Hg Purge and Trap	Brooks Rand	N/A	11078001	Unknown	Unknown	LL Hg	-	LL Hg Desk Drawer
Hg Speciation Purge and Trap	Brooks Rand	N/A	41107301	Unknown	Unknown	LL Hg	-	LL Hg Desk Drawer
Software	Hg Guru	version 4.1	-	Unknown	Unknown	LL Hg	-	Online
Hood	N/A	N/A	N/A	6/23/2017	Unknown	LL Hg	13HOOD5	Online
Hood	Hamilton	SAFEAIRE II	DLLKA-PTD	Unknown	Unknown	LL Hg	13HOOD6	Online
Hood	ESCO	STL/04-EVC	2001-2764	Unknown	Unknown	LL Hg	DB-1	Online
Distillation Block	Brooks Rand	Distillation Block AB	1021401	Unknown	Unknown	LL Hg	MDS-A	LL Hg Desk Drawer
Distillation Block	Brooks Rand	Distillation Block CD	1034401	Unknown	Unknown	LL Hg	MDS-C	LL Hg Desk Drawer
Water Filtration/DIW System	Barnstead	D4641	1090090938202	Unknown	Unknown	LL Hg	13DI1-A	Online
Fridge	Magic Chef	MCBR445W 1	N/A	Unknown	Unknown	LL Hg	13DUL14	Online
Fridge	Absocold	AR101MW13 R	951005923	Unknown	Unknown	LL Hg	13DUL15	Online
Fridge	Gibson	RM18F6WS	NG188716/DG19 0389	9/1/2016	Unknown	Sample Receiving	13DUL2	Online
Walk In Cooler	Carroll Coolers	N016898	CL-251150	3/7/2019	New	Sample Receiving	13DUL13	Online
Freezer	Arctic King	WHS-185C1WS	D80-28459101-17105-130313	10/26/17	New	Storage Room	13FRZ2	Online
Balance	Mettler	P1200	304562	Unknown	Unknown	Wet Chem	13BAL1	Online
Balance	Mettler	XSE 204	B551880610	9/1/2015	Unknown	Wet Chem	13BAL5	Online
Balance	Mettler	XSE 104	B549797355	9/1/2015	Unknown	Wet Chem	13BAL7	Online
COD Reactor	Hach	45600-00	950900013204	Unknown	Unknown	Wet Chem	13COD1	Online
Incubator	LabLine	460NS	0469	Unknown	Unknown	Wet Chem	13INC3	Online
Incubator	Thermo	Isotemp	300168083	10/19/2017	New	Glassware Cleaning	13INC5	In drawer under 13BOD1
Incubator	Precision Scientific	66551	9209-113	5/1/2018	Used	Wet Chem	13INC7	Online
Muffle Furnace	Lindberg	51442	899152	Unknown	Unknown	Wet Chem	13MFL1	Online
Oven	VWR	1370G	1200600	Unknown	Unknown	Wet Chem	13OVN1	Online
Oven	Precision Scientific	Thelco Model 28	N/A	Unknown	Unknown	Wet Chem	13OVN2	Online
Oven	ThermoFisher	cat#1510305 08	42094122	6/23/2017	Unknown	Wet Chem	13OVN5	Online
Spectrophotome ter UV VIS	Thermo	9423AQ2100 E	HEDN238001	Unknown	Unknown	Wet Chem	13WET1	Online
Lachat	Hach	8500	50100000097	Unknown	Unknown	Wet Chem	13WET3	Online
Lachat Autosampler	Hach	ASX 520	010591A520	Unknown	Unknown	Wet Chem	-	Online
Lachat	Hach	8500	40900000051	Unknown	Unknown	Wet Chem	13WET5	Online
Lachat Autosampler	Hach	ASX 600	A81010-007	Unknown	Unknown	Wet Chem	-	Online
LDO Meter/Probe	Hach	HQ30d Flexi	121000079722	Unknown	Unknown	Wet Chem	13WET7	Online
pH Meter	Orion	720A	13043	Unknown	Unknown	Wet Chem	13WET8	In drawer by pH supplies
pH pen	Sper Scientific	850051	143496	9/1/2016	New	Wet Chem	13WET11	In drawer under 13WET5

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
pH pen	Eutech Instruments	pHTestr 30	68X546501	3/7/2019	New	Wet Chem	13WET13	In drawer under 13WET5
Distillation Unit Microblock	Environmental Express	EMD1920-106	2109	Unknown	Unknown	Wet Chem	13WETE	Online
Distillation Unit Microblock	Lachat	1700-000	2000-209	Unknown	Unknown	Wet Chem	13WETF	Online
Spectrophotometer UV VIS	Hach	DR 3900	1648363	Unknown	Unknown	Wet Chem	13WETJ	Online
pH/Conductivity Meter	Orion	A215	X37428	8/1/2017	New	Wet Chem	13WETK	In drawer by pH supplies
Autoclave	Market Forge	Sterilmatic STM-E	37827	1/1/2018	Unknown	Wet Chem	13CLV1	Online
Autoclave Temperature Gauge	Market Forge	BUILT-IN	-	1/1/2018	Unknown	Wet Chem	13CLV1T	Online
Autoclave Pressure Gauge	Market Forge	BUILT-IN	-	1/1/2018	Unknown	Wet Chem	13CLV1P	Online
Buret, Class A	Kimax	Class-A	0230	Unknown	Unknown	Wet Chem	13BUR1	Online
Buret, Class A	Pyrex	Class-A	2103	Unknown	Unknown	Wet Chem	13BUR2	Online
Buret, Class A	Kimax	Class-A	7249	Unknown	Unknown	Wet Chem	13BUR3	Online
Autodispenser	North Central Labs	DO-250	-	Unknown	Unknown	Wet Chem	13DSP1	Online
Autodispenser	SCILOGEX	Dispense-Mate Plus	JY16291	Unknown	Unknown	Wet Chem	13DSP2	Online
Autodispenser	Hach	2105560 Swifttest	-	1/1/2018	New	Wet Chem	13DSP3	Online
Autodispenser	Hach	2105560 Swifttest	-	1/1/2018	New	Wet Chem	13DSP4	Online
Digester (Phos)	CA1	Smartblock 226	NA	Unknown	Unknown	Wet Chem	13DIG1	Online
Hotblock (TKN)	Technicon	BD 40	CG-052	Unknown	Unknown	Wet Chem	13TKN1	Online
Hotblock (TKN)	Seal Analytical	BD 50 Block	STU6U00860	8/9/2017	Unknown	Wet Chem	13TKN2	In rack by 13WET7
Microscope	American Optical Corp	Forty	814602	Unknown	Unknown	Wet Chem	NA	Online
Stir Plate	Thermolyne	SP18425	757960584897	Unknown	Unknown	Wet Chem	NA	Online
Hot Plate	Thermolyne	Ciramec 3 HP 47135	61920359996	Unknown	Unknown	Wet Chem	13HTP1	Online
Hot Plate	Thermolyne	Ciramec 3 HP 47135-60	1073030511305	Unknown	Unknown	Wet Chem	13HTP2	Online
Sonicator	VWR	Auqasonic 50-T	N/A	Unknown	Unknown	Wet Chem	13SON1	Online
Shaker	Labline Instruments	1345	10021791	Unknown	Unknown	Wet Chem	13SH1	Online
QuantiTray Sealer	IDEXX	2x/89-10894-00	01174	Unknown	Unknown	Wet Chem	13QT1	Online
Sterilizer	EZE	NA	NA	Unknown	Unknown	Wet Chem	13STL1	Online
UV Lamp	UVP, Inc.	UVGL-25	691	Unknown	Unknown	Wet Chem	13UVL1	Online
UV Lamp	UVL	UVGL-58	OCT-2011	Unknown	Unknown	Wet Chem	13UVL2	Online
Hood	LABCONCO	728040010814	031214227 H	Unknown	Unknown	Wet Chem	13HOOD1	Online
Hood	NA	NA	NA	Unknown	Unknown	Wet Chem	13HOOD2	Online
Water Filtration /DIW System	Barnstead	Nanopure II	na	Unknown	Unknown	Wet Chem	13DI1-B	Online
Fridge	TurboAir	M3R47-2	M3R4L43095	Unknown	Unknown	Wet Chem	13DUL5	Online
Fridge	Gibson	RM18F5WX	N/A	Unknown	Unknown	Wet Chem	13DUL6	Online
Fridge	TurboAir	TSR49	01749500MR	Unknown	Unknown	Wet Chem	13DUL7	Online
Freezer	Wood's	CO5BBA	01778768HJ	Unknown	Unknown	Wet Chem	13FRZ1	Online
Incubator	LabLine CO2	3010	12	Unknown	Unknown	Wet Chem 2	13INC4	Online

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Fridge	TurboAir	MSR23NM	MR23101012	Unknown	Unknown	Wet Chem 2	13DUL9	Online
Balance	Denver Instruments	XL-1810	N0088210	Unknown	Unknown	Wet Chem 2	13BAL4	Online
Color Test Kit	Hach	co-1	LOT#A8068	Unknown	Unknown	Wet Chem 2	13WETG	Online
SPE StepSaver 7-station Funnel	Environmental Express	Cat#G1106	NA	6/14/2016	Unknown	Wet Chem 2	13SPE1	Online
SPE StepSaver 7-station Funnel	Environmental Express	Cat#G1106	NA	6/14/2016	Unknown	Wet Chem 2	13SPE2	Online
Evaporator for SPE System	Horizon Technology	Speed Vap III	08-0701	9/1/2015	Unknown	Wet Chem 2	13VAP01	Online
Hood	KEWAUNEE	NA	NA	9/1/2015	Unknown	Wet Chem 2	13HOOD3	Online
Hood	KEWAUNEE	NA	NA	9/1/2015	Unknown	Wet Chem 2	13HOOD4	Online
pH Meter	Orion	301	43996	Unknown	Unknown	Wet Chem 2	13WET9	Online

8.0 ADDENDUM: PROGRAM REQUIREMENTS

Program specific information provided in this addendum supplements the main body of this manual. Each subsection is stand-alone, meaning the requirements for the quality management system in each subsection only apply to the program referenced. Additionally, only program requirements for the quality management system that are more stringent than the content of the main body of the manual are included.

8.1 DoD/DOE

PAS-Minneapolis maintains accreditation for DoD/DoE Environmental Laboratory Approval Program (ELAP)

This addendum outlines additional policies and processes established by this laboratory to maintain compliance with DoD/DOE program specific requirements as outlined in the DoD/DOE Consolidated Quality Systems Manual (QSM) for Environmental Laboratories. The QSM incorporates ISO/IEC 17025 and the TNI Standard and includes additional program-specific requirements for laboratories that perform analytical testing services for DoD and DoE and which must be followed for DoD / DoE projects.

Section 4.2.5: Supporting Documents

Technical SOPs used for DoD/DoE testing must also include instructions for equipment and instrument maintenance, computer software/hardware, and troubleshooting.

The review frequency for technical SOPs used for DoD/DoE testing is annual, instead of every 2 years.

Section 4.4: Review of Analytical Service Requests

If the DoD/DoE customer requests a statement of conformity, the standard used for the decision rule must be communicated to and agreed on with the customer and identified in the final test report.

Laboratory requests to deviate from the requirements specified in the DoD/DoE QSM must be requested on a project-basis and include technical justifications for the deviation. These requests are submitted to and approved by the DoD/DoE project chemist or contractor, however name, in addition to the PAS client.

For DoD / DoE projects, will also seek clarification from the customer when the customer has requested an incorrect, obsolete or improper method for the intended use of data; the laboratory needs to depart from its test method SOP in order to meet project-specific data quality objectives; information in project planning documents is missing or is unclear,

Section 4.5: Subcontracting

In addition to written client approval of any subcontractor for testing, the customer is notified of the laboratory's intent to use of a subcontractor for any management system element (such as data review, data processing, project management or IT support) and consent for subcontracting is obtained approved in writing by the DoD/DoE customer and record of consent kept in the project record.

Section 4.6: Purchasing and Supplies

The laboratory procedure for records of receipt of materials and supplies used in testing also include a specification to record the date opened (DoE only).

Section 4.9.3: Nonconforming Work

The laboratory's procedure for client notification includes the 15 business day DoD /DOE time-frame for notification of the problem and the 30 business day time-frame for submission of the corrective action plan or corrective actions taken. This procedure also includes the DoD/DoE requirement for AB notification of discovery.

Section 4.13: Control of Records

Technical Records: The laboratory's procedure for logbooks includes measures to prevent the removal of or addition of pages to the logbook (applies to both hardcopy and electronic). Hardcopy logbooks are version controlled, pre-numbered and bound. Initials and entries and are signed or initialed and dated by the person making the entry and the entry is made at the time the activity is performed and in chronological order. Each page of the logbook must be closed by the last person making the entry on the page. Closure is recorded by the initial and date of the person making the last entry.

Section 5.4.7: Control of Data

The laboratory will assure LIMS passwords are changed at least once per year.

An audit of the LIMS will be incorporated into the laboratory's annual internal audit schedule.

The laboratory will have procedures in place to notify DoD/DoE customers of changes to LIMS software or hardware configurations that may impact the customer's integrity of electronic data

Section 5.9.1: Quality Control

For DoD/DOE, storage blanks are essential QC to monitor the storage of samples for volatile organic analysis (VOA). The laboratory's SOP for storage of VOA samples must include a contamination monitoring program based on the performance of storage blanks. (See QSM 5.3.3)

Section 5.8.5: Sample Disposal

For DoE projects, the record of disposal must also include how the sample was disposed and the name of the person that performed the task.

Appendix E: Support Equipment Calibration

Mechanical Volumetric Pipette: In addition to the quarterly verification check, pipettes used for DoD/DoE projects are checked daily before use using the same procedure and criteria specified for the quarterly check.

Water Purification System: The performance of the water purification system is checked daily prior to use in accordance with laboratory SOP XYZ.

Radiological Survey Equipment: The performance of the radiological survey equipment is checked daily prior to use in accordance with laboratory SOP XYZ.

Additional: (DoE): Section 6.0 of the QSM outlines additional management system requirements for the management of hazardous and radioactive materials management and health and safety practices. The laboratory, if approved for DoE, will work with the PAS Health and Safety Director to establish plans, policies and procedures that conform to these comprehensive specifications and incorporate these documents into the quality management system.

8.2 Ohio VAP

PAS–Minneapolis maintains accreditation for Ohio's Voluntary Action Program (VAP).

This addendum outlines additional policies and processes established by the laboratory to maintain compliance with Ohio's Voluntary Action Program (VAP). Specific requirements outlined in Ohio Administrative Code (OAC) 3745-300-04 include additional program-specific requirements for laboratories that perform analytical testing services for Ohio VAP and which must be followed for Ohio VAP projects.

This addendum is used in conjunction with the main body of the quality manual and with standard operating procedures (SOPs) and other quality management documents used to carry out activities. Only program requirements for the quality management system that are more stringent than the content of the main body of the manual are listed in this addendum.

In addition to the requirements outlined in the main body of the quality manual; the laboratory's procedures for implementation will also include the following:

Section 4.3.2 Document Approval and Issue
The laboratory must seek Ohio VAP review and approval of all SOPs and Quality Manual subsequent modifications prior to implementation.

Section 5.4.5.3.1 Limit of Detection (LOD)
A valid MDL must be in place prior to sample analysis. MDLs must be spiked at or below the reporting limit and will not be accepted if it was spiked higher than the reporting limit.

Section 5.5.2.2 Analytical Instrument Calibration
Samples must be reanalyzed to obtain results within the linear range unless there is insufficient sample volume for reanalysis.

Section 5.6.3.2 Reference Materials

The use of expired standards is prohibited even if they can be verified, with the exception of air standards that are revalidated against unexpired reference material or recertified by the vendor (documentation is required to be kept on file).

Section 5.8.3.2 Sample Acceptance Policy
a. The narrative for any report that includes qualified data must also include a discussion of any bias in the results when requirements outlined in the SOP cannot be performed, for example: insufficient volume for re-extraction/re-analysis, holding time exceedances, and incorrect preservative.
b. The case narrative must also include, at a minimum, discussion of any issues that impact the quality of the data with sample receipt, sample processes, or sample analyses.

Section 5.9.1: Quality Control
a. For Ohio VAP projects, the laboratory must minimize the use of qualified data. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies prior to reporting. When requirements outlined in the SOP cannot be performed, the narrative for any report that includes qualified data must also include a discussion of any bias in the results.
b. In the event of method blank having any reportable contamination, the laboratory is required to reanalyze the associated samples and the method blank if there is sufficient sample remaining. Acceptable method blanks are those that are free of contamination below the reporting limit. If the

method blank fails, appropriate corrective actions may include flagging, elevating reporting limits, or re-preparation of the entire batch, including re-digestion, re-distillation, or re-extraction, as appropriate.

c. In the event of LCS failures, the laboratory is required to reanalyze the associated samples and the LCS for all target compounds if there is sufficient sample remaining. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding LCS's and the MS may not be used in place of passing LCS. If the LCS fails, appropriate corrective actions may include re-preparation of the entire batch, including re-digestion, re-distillation, or re-extraction, as appropriate.

d. MS/MSD's are optional and will be directed by the Certified Professional. In the case of MS/MSD failures, the laboratory is required to reanalyze the associated samples only when the associated LCS also fails acceptance criteria and if there is sufficient sample remaining. When an LCS is acceptable and the MS results are outside of criteria, and no system anomaly is detected, the samples will be reported with appropriate data qualifiers indicating matrix interference.

e. Sample duplicates are optional and will be directed by the Certified Professional. In the case of duplicate samples exceeding the RPD criteria found in applicable analytical SOPs, the laboratory is required to reanalyze the associated sample and duplicate as long as no sampling error was detected if there is sufficient sample remaining. If the sample and duplicate still do not agree, a comment would be made stating there may be sample non-homogeneity.

f. Surrogates are not evaluated for Ohio VAP samples analyzed via EPA Method TO-15.

g. Samples with internal standard that are outside of method criteria must be reanalyzed to confirm sample matrix effect.

Section 5.8.5: Sample Disposal

All documents and data prepared or acquired in connection to VAP work must be retained for a period of 10 years after the data of reporting. After 10 years, if the laboratory wishes to dispose of the records, the laboratory must notify the VAP agency by certified mail of such intent and provide the agency an opportunity to request the materials from Pace. The documents must not be disposed of until notification has been received in response to the Pace request for disposal.

Section 5.10.3 Test Reports: Supplemental Items

a. Affidavits that summarize any exceptions to what has been reported, including but not limited to, itemizing any analytes or methods that the laboratory is not approved for under the VAP program must be prepared by project, notarized and submitted with each final report. Any analytes reported that are not part of a scope of accreditation or approval program must be clearly identified as such on the final report.

b. The report must be accompanied by a copy of a sample receipt form that records, at a minimum, the following information:

(i) Temperature of samples when received by the laboratory, if the method requires monitoring.

(ii) Date and time samples were received by the laboratory.

(iii) Notation of whether holding times specified in standard operating procedures for sample preparation and analysis were exceeded.

(iv) Any exceptions or special instructions for sample handling, analysis, or reporting.

(v) Notation of whether samples have appropriate labeling, such as the date and time of sample collection and a sample identification notation.

(vi) Notation of whether sample containers contain appropriate sample preservatives, if applicable.

(vii) Description of the general condition of sample containers, including whether any containers are damaged or improperly filled.

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ENVIRONMENTAL SCIENCES

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ENV-MAN-LENE-0001 Quality Manual

QM Approval

Name/Signature	Title	Date	Meaning/Reason
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Management Approval

Name/Signature	Title	Date	Meaning/Reason
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Jamie Church (008527)	Project Manager Team Lead	31 Jan 2020, 09:56:10 AM	Approved
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TITLE PAGE

LABORATORY QUALITY MANUAL

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[2] *Include if different from the physical address and phone number of the facility.*

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1.0 PURPOSE AND SCOPE

1.1 Purpose

This quality manual (manual) outlines the quality management system and management structure of the laboratories and service centers affiliated with Pace Analytical Services, LLC (PAS). A laboratory is defined by PAS as any PAS facility, however named, that provides testing, sampling, or field measurement services. When the term 'laboratory" is used in this manual, the term refers to all locations listed on the Title Page of this manual and in Section 4.1.3 unless otherwise specified.

The PAS quality management system is also referred to as the quality program throughout this document. In this context, the phrase "quality management system" and "quality program" are synonymous.

The quality management system is the collection of policies and processes established by PAS management to consistently meet customer requirements and expectations, and to achieve the goals to provide PAS customers with high quality, cost-effective, analytical measurements and services.

The quality management system is also intended to establish conformance[1] and compliance with the current versions of the following international and national quality system standards:

- ISO/IEC 17025: *General requirements for the competence of testing and calibration laboratories*
- NELAC/TNI Standard Volume 1: *Management and Technical Requirements for Laboratories Performing Environmental Analysis*

[1]The statement of conformity to these Standards pertains only to testing and sampling activities carried out by the laboratory at its physical address, in temporary or mobile facilities, in-network, or by laboratory personnel at a customer's facility.

In addition to the international and national standards, the quality management system is designed to achieve regulatory compliance with the various federal and state programs for which the laboratory provides compliance testing and/or holds certification or accreditation. When federal or state requirements do not apply to all PAS locations, the requirements for compliance are provided in addendum to this manual or in other documents that supplement the manual. Customer-specific project and program requirements are not included in the manual in order to maintain client confidentiality.

- A list of accreditation and certifications held by each laboratory associated with this manual is provided in Appendix A.
- A list of analytical testing capabilities offered by each laboratory associated with this manual is provided in Appendix B.

1.2 Scope and Application

This manual applies to each of the PAS locations listed on the Title Page and in Section 4.1.3.

The manual was prepared from a quality manual template (template) created by PAS corporate quality personnel. The template outlines the minimum requirements PAS management considers necessary for every PAS laboratory, regardless of scope of services or number of personnel, to establish in order to maintain a quality management system that achieves the objectives of PAS's Quality Policy (See 4.2.2). In this regard, the template is the mechanism used by the corporate officers (a.k.a. 'top management') to communicate their expectations and commitment for the PAS quality program to all PAS personnel.

The laboratory also has the responsibility to comply with federal and state regulatory and program requirements for which it provides analytical services and holds certification or accreditation. When those requirements are more stringent than the template, the requirements for compliance are provided in addendum to this manual or in other documents that supplement the manual. This document structure maintains consistency in the presentation of the quality management system across the network while providing the laboratory a mechanism to describe and achieve compliance requirements on a program basis.

1.2.1 Quality Manual Template

The quality manual template is developed by the Corporate Quality Director with contribution and input from corporate quality personnel and the corporate officers. Approval of the template by the corporate officers (aka "top management") confirms their commitment to develop and maintain a quality management system appropriate for the analytical services offered by the organization and to communicate their expectations of the quality program to all personnel.

The template and instructions for use of the template are released by corporate quality personnel to quality assurance manager(s) responsible for each laboratory (Local QA). Local QA uses the template to prepare the laboratory's manual by following the instructions provided. Since the template provides the minimum requirements by which all PAS locations must abide, the laboratory may not alter the font, structure or content of the template except where specified by instruction to do so. As previously stated, program specific requirements are provided in addendum or in documents that supplement this manual.

The template is reviewed by corporate quality personnel every two years and updated if needed. More frequent review and revision may be necessary to manage change, to maintain conformance and compliance to relevant standards, or to meet customer expectations.

See standard operating procedure (SOP) ENV-SOP-CORQ-00015 *Document Management and Control* for more information.

1.2.2 Laboratory Quality Manual

The manual is approved and released to personnel under the authority of local management. The manual is reviewed annually and location specific information is updated, if needed. More frequent review and revision may be necessary when there are significant changes to the organizational structure, capabilities, and resources of the laboratory. Review and revision of the manual is overseen by local QA. If review indicates changes to the main body of the manual are necessary to maintain conformance and compliance to relevant standards, or to meet customer expectations, local QA will notify corporate quality personnel to initiate review and/or revision of the template.

See SOP ENV-SOP-CORQ-00015 *Document Management and Control* for more information.

1.2.3 References to Supporting Documents

The template and the manual includes references to other laboratory documents that support the quality management system such as policies and standard operating procedures (SOPs). These references include the document's document control number and may include the document title.

This information is subject to change. For example, an SOP may be converted to a policy or the document's title may change. For these types of administrative changes, the manual and template are updated to reflect the editorial change during the document's next scheduled review/revision cycle or the next time a new version of the document is released, whichever is sooner.

Local QA maintains a current list of controlled documents used at each PAS location to support the quality management system. This list, known as the Master List, lists each document used by document control number, title, version, effective date, and reference to any document(s) that the current version supersedes. When there is a difference between the template and/or manual and the Master List, the document information in the Master List takes precedence. The current Master List is readily available to personnel for their use and cross-reference. Parties external to the laboratory should contact the laboratory for the most current version.

2.0 REFERENCES

References used to prepare this manual include:

- "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act." Federal Register, 40 CFR Part 136, most current version.
- "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods." SW-846.
- "Methods for Chemical Analysis of Water and Wastes", EPA 600-4-79-020, 1979 Revised 1983, U.S. EPA.
- U.S. EPA Contract Laboratory Program Statement of Work for Organic Analysis, current version.
- U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis, current version.
- "Standard Methods for the Examination of Water and Wastewater." Current Edition APHA-AWWA-WPCF.
- "Annual Book of ASTM Standards", Section 4: Construction, Volume 04.04: Soil and Rock; Building Stones, American Society of Testing and Materials.
- "Annual Book of ASTM Standards", Section 11: Water and Environmental Technology, American Society of Testing and Materials.
- "NIOSH Manual of Analytical Methods", U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health, most current version.
- "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water", U.S. EPA, Environmental Monitoring and Support Laboratory – Cincinnati (Sep 1986).
- Quality Assurance of Chemical Measurements, Taylor, John K.; Lewis Publishers, Inc. 1987.
- Methods for Non-conventional Pesticides Chemicals Analysis of Industrial and Municipal Wastewater, Test Methods, EPA-440/1-83/079C.
- Environmental Measurements Laboratory (EML) Procedures Manual, HASL-300, US DOE, February, 1992.
- Requirements for Quality Control of Analytical Data, HAZWRAP, DOE/HWP-65/R1, July, 1990.

- Quality Assurance Manual for Industrial Hygiene Chemistry, AIHA, most current version.
- National Environmental Laboratory Accreditation Conference (NELAC) Standard- most current version.
- ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories- most current version.

  The following are implemented by normative reference to ISO/IEC 17025:

  - ISO/IEC Guide 99, *International vocabulary of metrology –Basic and general concepts and associated terms*
  - ISO/IEC 17000, *Conformity assessment – Vocabulary and general principles*
- Department of Defense Quality Systems Manual (QSM), most current version.
- TNI (The NELAC Institute) Standard- most current version applicable to each lab.
- UCMR Laboratory Approval Requirements and Information Document, most current version.
- US EPA Drinking Water Manual, most current version.

3.0 TERMS AND DEFINITIONS

Refer to Appendix C for terms, acronyms, and definitions used in this manual and in other documents used by the laboratory to support the quality management system.

4.0 MANAGEMENT REQUIREMENTS

4.1 Organization

4.1.1 Legal Identity

Pace Analytical Services, LLC is authorized under the State of Minnesota to do business as a limited liability company.

4.1.1.1 Change of Ownership

If there is a change of ownership, if a location goes out of business, or if the entire organization ceases to exist, Pace Analytical Services, LLC ensures that regulatory authorities are notified of the change within the time-frame required by each state agency for which the location is certified or accredited.

Requirements for records and other business information are addressed in the ownership transfer agreement or in accordance with appropriate regulatory requirements, whichever takes precedence.

4.1.2 Compliance Responsibility

Laboratory management has the responsibility and authority to establish and implement procedures and to maintain sufficient resources necessary to assure its activities are carried out in such a way to meet the compliance requirements of the quality management system.

4.1.3 Scope of the Quality Management System

The quality management system applies to work carried out at each location covered by this manual including permanent facilities, at sites away from its permanent facilities, or in associated temporary or mobile facilities.

This permanent and mobile facilities to which this manual applies includes:

Name	Pace Analytical Services, LLC
Address:	9608 Loiret Blvd.
City, State, Zip	Lenexa, Kansas 66219
Phone Number	913-599-5665
Service Type:	Laboratory
Name	Pace Analytical Services, LLC
Address:	808 W. McKay
City, State, Zip	Frontenac, Kansas 66219
Phone Number	620-249-9990
Service Type:	Laboratory
Name	Pace Analytical Services, LLC
Address:	525 N. Eighth St.
City, State, Zip	Salina, Kansas 67401
Phone Number	785-827-1273
Service Type:	Laboratory
Name	Pace Analytical Services, LLC
Address:	5460 S. Garnett, Suite P
City, State, Zip	Tulsa, Oklahoma 74146
Phone Number	918-270-3901
Service Type:	Laboratory
Name	Pace Analytical Services, LLC
Address:	4120 Seven Hills Drive
City, State, Zip	Florissant, MO 63033
Phone Number	314-838-7223
Service Type:	Service Center

4.1.4 Organization History and Information

Founded in 1978, Pace Analytical Services, LLC (PAS) is a privately held scientific services firm operating one of the largest full service contract laboratory and service center networks in the United States. The company's network offer inorganic, organic and radiochemistry testing capabilities; specializing in the analysis of trace level contamination in air, drinking water, groundwater, wastewater, soil, biota, and waste.

With over 90 laboratories and services centers in the contiguous US and in Puerto Rico, the network provides project support for thousands of industry, consulting, engineering and government professionals.

Pace delivers the highest standard of testing and scientific services in the market. We offer the most advanced solutions in the industry, backed by truly transparent data, a highly trained team, and the service and support that comes from four decades of experience.

4.1.4.1 Organization Structure

Each location maintains a local management structure under the oversight and guidance of corporate personnel. Local management is responsible for making day-to-day decisions regarding the operations of the facility, implementing the quality management system, upholding the requirements of the quality program, and for supervision of personnel.

Local management is provided by a General Manager (GM) Quality Manager (QM), Client Services Manager (CSM), Information Technology (IT) Manager, Department Managers (DM) and/or Department Supervisors (DS), however named.

Some locations may also have any one of the following management positions: Senior Quality Manager (SQM), Operations Manager (OM), Technical Director (TD), or Technical Manager (TM). When the location does not have a TD or TM, technical management is provided jointly by the GM, QM, DM, and DS.

The GM however named reports to a Senior General Manager (SGM), who is responsible for the management of multiple laboratories and service centers within a geographical region, and who reports directly to the Chief Operating Officer (COO). The QM and SQM have indirect reporting relationship to the Corporate Director of Quality.

Refer to the organization charts provided in Appendix D to view the management structure, reporting relationships, and the interrelationships between positions.

4.1.5 Management Requirements

4.1.5.1 Personnel

The laboratory is staffed with administrative and technical personnel who perform and verify work under the supervision of managerial personnel.

- Technical personnel include analysts and technicians that generate or contribute to the generation of analytical data and managerial personnel that oversee day to day supervision of laboratory operations. Including the reporting of analytical data and results, monitoring QA/QC performance, and monitoring the validity of analysis to maintain data integrity and reliability.
- Administrative personnel support the day-to-day activities of the laboratory.
- IT personnel maintain the information technology systems and software used at the laboratory.
- Client services personnel include project managers and support staff that manage projects.
- Managerial personnel make day-to-day and longer term decisions regarding the operations of the facility, supervise personnel, implement the quality management system and uphold the requirements of the quality program.

All personnel regardless of responsibilities are expected to carry out their duties in accordance with the policies and processes outlined in this manual and in accordance with standard operating procedures (SOPs) and other quality system documents. The laboratory's policies and procedures are designed for impartiality and integrity. When these procedures are fully implemented, personnel remain free from undue pressure and other influences that adversely impact the quality of their work or data.

4.1.5.1.1 Key Personnel

Key personnel include the management positions that have the authority and responsibility to plan, direct, and control, activities of the division (corporate) or the laboratory.

The following tables list key personnel positions by PAS job title and the position's primary deputy:

Key Personnel: Corporate

Key Personnel	Primary Deputy
Chief Executive Officer	Chief Operating Officer
Chief Operating Officer	Chief Executive Officer
Chief Compliance Officer	Quality Director
Corporate Quality Director	Chief Compliance Officer
Health and Safety Director	Chief Compliance Officer
IT Director	LIMS Administrator, however named.

Key Personnel: Laboratory

Key Personnel	Primary Deputy
Senior General Manager	Chief Operating Officer or as designated.
General Manager / Assistant GM	Senior General Manager
Quality Manager	Corporate Quality Manager or as designated.
Client Services Manager	General Manager
Local IT	Corporate IT Director or as designated.
Department Manager	General Manager
Senior Quality Manager[1]	Corporate Quality Manager
Technical Director[1]/Manager[1] Acting Technical Manager TNI	Quality Manager
Operations Manager[1]	General Manager or Assistant GM.

[1] *Position may not be staffed at each location.*

Some state certification programs require the agency to be notified when there has been a change in key personnel. Program-specific requirements and time-frames for notification by agency, are tracked and upheld by local QA, when these requirements apply.

4.1.5.2 Roles and Responsibilities

The qualifications, duties, and responsibilities for each position are detailed in job descriptions maintained by PAS's corporate Human Resource's Department (HR).

The following summaries briefly identify the responsibility of key personnel positions in relation to the quality management system.

Chief Executive Officer (CEO): The CEO has overall responsibility for performance of the organization and endorses the quality program. Working with corporate and laboratory management, the CEO provides the leadership and resources necessary for PAS locations to achieve the goals and objectives of the quality management system and quality policy statement.

Chief Operating Officer (COO): The COO oversees all aspects of operations management including, strategic planning, budget, capital expenditure, and management of senior management personnel. In this capacity, the COO provides leadership and resources necessary to help top management at each PAS location achieve the goals and objectives of the quality management system and quality policy statement.

Chief Compliance Officer (CCO): The CCO oversees the quality assurance and environmental health and safety programs (HSE) for each business unit. The CCO is responsible for planning and policy development for these groups to ensure regulatory compliance and to manage risk. The position provides leadership and guidance necessary for all PAS locations to achieve the goals and objectives of the quality and HSE programs.

The CCO also serves as the Ethics Officer (ECO). The ECO develops the Ethics and Data Integrity Policy and Training Program, and provides oversight for reporting and investigation of ethical misconduct to maintain employee confidentiality during the process. The ECO provide guidance and instruction for follow-up actions necessary to remedy the situation and deter future recurrence.

Corporate Director of Quality: The Corporate Director of Quality is responsible for developing and maintaining the PAS quality program under guidance and assistance from the CEO, COO, and CCO. This position helps develop corporate quality policy and procedure and analyzes metric data and other performance indicators to assess and communicate the effectiveness of the quality program to top management. The position provides leadership and guidance for implementation of the quality program across all PAS locations.

Corporate Director of Information Technology: The Corporate Director of IT oversees the systems and processes of information technology used to support the quality program. These systems include Laboratory Information Management Systems (LIMS); data acquisition, reduction, and reporting software; virus-protection, communication tools, and ensuring the integrity and security of electronic data.

Senior General Manager (SGM): The SGM has full responsibility for administrative and operations management and performance of a group of PAS laboratories and service centers. Working with the COO and local laboratory management, the SGM provides leadership, guidance and resources, including allocation of personnel, necessary to achieve the goals of PAS quality program.

General Manager (GM) / Assistant General Manager (AGM): The GM or AGM is responsible for the overall performance and administrative and operations management of a PAS location and associated service center(s). This position is responsible to provide leadership and resources, including allocation and supervision of personnel, necessary for the location to implement and achieve the goals of the PAS quality program. In this capacity, the position assures laboratory personnel are trained on and understand the structure and components of the quality program defined in this manual as well as the policies and procedures in place to implement the quality management system.

The GM/AGM of NELAC/TNI Accredited laboratories are also responsible for the designation of technical personnel to serve as acting technical managers for TNI for the fields of accreditation held by the laboratory (See Section 4.1.5.2.2) and for notifying the accreditation body (AB) of any extended absence or reassignment of these designations.

Quality Manager (QM): The QM oversees and monitors implementation of the quality management system and communicates deviations to laboratory management. The QM is independent of the operation activities for which they provide oversight and has the authority to carry out the roles and responsibilities of their position without outside influence.

Additionally, in accordance with the TNI Standard, the QM:

- serves as the focal for QA/QC and oversees review of QC data for trend analysis;
- evaluates data objectively and perform assessments without outside influence;
- has document training and experience in QA/QC procedures and the laboratory's quality system;
- has a general knowledge of the analytical methods offered by the laboratory;
- coordinates and conducts internal systems and technical audits;
- notifies laboratory management of deficiencies in the quality system;
- monitors corrective actions;
- provides supports to technical personnel and may serve as the primary deputy for the acting TNI Technical Manager(s).

Client Services Manager (CSM): The CSM oversees project management personnel. This position is responsible for training and management of client facing staff that serve as the liaison between PAS and the customer to ensure that projects are successfully managed to meet the expectations and needs of PAS customers. This position is also responsible for sharing positive and negative customer feedback with laboratory management so that this information may be used to improve the quality program.

Local IT Manager, however named: Local IT managers are responsible for maintaining the IT systems used to support the quality program. These systems include Laboratory Information Management Systems (LIMS); data acquisition, reduction, and reporting software; virus-protection, communication tools, and ensuring the integrity and security of electronic data.

Department Manager (DM): The DM is responsible for administrative and operations management and implementation of the quality management system in the work area he/she oversees. These responsibilities include but are not limited to:

training and supervision of personnel, monitoring work activity to maintain compliance with this manual, SOPs, policies and other instructional documents that support the quality management system; method development, validation and the establishment and implementation of SOPs to assure regulatory compliance and suitability for intended purpose; monitoring QA/QC performance, proper handling and reporting of nonconforming work, purchasing of supplies and equipment adequate for use, maintaining instrumentation and equipment in proper working order and calibration, and general maintenance of administrative and technical processes and procedures established by the laboratory.

Senior Quality Manager (SQM): The SQM provides support to the quality manager and assists the quality manager with implementation of the quality management system for one or more site locations.

Technical Director (TD): The TD provides technical oversight and guidance to laboratory personnel. Responsibilities may include but are not limited to: research and development, method development and validation, development of standard operating procedures, proposal and contract review. The TD may also be responsible for QA/QC trend analysis, technical training, and technology improvement.

Operations Manager (OM): The OM is responsible for management of production and/or other duties assigned by the GM or SGM.

4.1.5.2.1 Acting Technical Manager (TNI Accreditation):

For PAS locations that are NELAC/TNI accredited:

The TNI Standard specifies requirements for the qualification and duties of technical personnel with managerial responsibility. These requirements are associated in the Standard to the designation 'technical manager(s), however named'. These responsibilities may be assigned to multiple individuals and are not associated with any specific job title.

For PAS, these TNI requirements for personnel that provide technical oversight correlate with PAS's job descriptions for Department Manager or Supervisor. However, the duties may be assigned to any PAS employee that meets the TNI specified qualifications.

Personnel assigned this designation retain their PAS assigned job title. The job title may be appended with *"acting as technical manager for TNI"* and the technology or field of accreditation for which the employee is approved, if necessary.

When TNI Accreditation Bodies (AB) refer to these employees as 'technical manager' or 'technical director' on the official certificate or the scope of accreditation, this reference is referring to their approval to carry out duties of the 'technical manager, however named' as specified in the TNI Standard.

In accordance with the TNI Standard, the acting Technical Manager(s) for TNI are responsible for monitoring the performance of QC/QA in the work areas they oversee.

If the absence of any employee that is approved as acting technical manager for TNI exceeds 15 calendar days, the duties and responsibilities specified in the TNI Standard are reassigned to another employee that meets the qualifications for the technology or field of accreditation or they are assigned to the position's deputy, the quality manager.

4.1.5.3 Conflict of Interest

A conflict of interest is a situation where a person has competing interests. Laboratory management looks for potential conflict of interest and undue pressures that might arise in work activities and then includes countermeasures in policies and procedures to mitigate or eliminate the conflict.

See policy COR-POL-0004 *Ethics Policy* for more information.

4.1.5.4 Confidentiality

Laboratory management is committed to preserving the confidentiality of PAS customers and confidentiality of business information.

Procedures used by the laboratory to maintain confidentiality include:

- A Confidentiality Agreement which all employees are required to sign at the time of employment and abide by the conditions of throughout employment;
- Record retention and disposal procedures that assure confidentiality is maintained;
- Physical access controls and encryption of electronic data; and
- Protocol for handling Confidential Business Information (CBI).

Client information obtained or created during work activities is considered confidential and is protected from intentional release to any person or entity other than the client or the client's authorized representative information provided to PAS, except when the laboratory is required by law to release confidential information to another party, such as a regulatory agency or for litigation purposes. In which case, the laboratory will notify the client of the release of information and the information provided.

The terms of client confidentiality are included in PAS Standard Terms and Conditions (T&C). With the acceptance of PAS Terms and Conditions and/or the implicit contract for analytical services that occurs when the client sends samples to the laboratory for testing, the client authorizes PAS to release confidential information when required.

See policy COR-POL-0004 *Ethics Policy* for more information.

4.1.5.5 Communication

Communication is defined as the imparting or exchanging of news and information. Effective (good) communication occurs when the person(s) you are exchanging information with actively gets the point and understands it.

4.1.5.5.1 Workplace Communication

Good communication in the workplace is necessary to assure work is done correctly, efficiently, and in accordance with client expectations.

Instructions for how to carry out work activities are communicated to personnel via written policy, standard operating procedures, and standard work instructions.

Information about laboratory performance (positive and negative) and ideas for improvement are communicated using various communication channels such as face to face meetings, video conferencing, conference calls, email, memoranda, written reports, and posters.

4.1.5.5.2 External Communication

Communication with external parties such as customers, vendors, business partners, and regulatory agencies takes place every day.

Laboratory management ensure personnel learn to communicate in professional and respectful ways in order to build strong relationships, and learn to communicate effectively to avoid misunderstanding.

4.2 Quality Management System

4.2.1 Quality Management System Objectives

The objectives of the laboratory's quality management system are to provide clients with consistent, exemplary professional service, and objective work product that is of known and documented quality that meets their requirements for data usability and regulatory compliance.

Objective work product is analytical services, data, test results, and information that is not influenced by personal feeling or opinions. The quality of being objective is also known as 'impartiality'.

4.2.1.1 Impartiality

The laboratory achieves and maintains impartiality by implementing and adhering to the policies and processes of the quality management system, which are based on industry accepted standards and methodologies.

The laboratory's procedures for handling nonconforming work (See 4.9), corrective and preventive actions (See 4.11) and management review (See 4.15) are the primary mechanisms used to identify risk to impartiality and to prompt actions necessary to eliminate or reduce the threat when risk to impartiality is suspected or confirmed.

4.2.1.2 Risk and Opportunity Assessment

Risks are variables that make achieving the goals and objectives of the quality management system uncertain. An opportunity is something that has potential positive consequences for the laboratory.

Laboratory personnel manage risks and opportunities on a daily basis by carrying out the processes that make up the quality management system. Some of the ways in which the quality management system is designed to identify, minimize, or eliminate risk on a daily basis include but are not limited to:

- Capability and capacity reviews of each analytical service request to assure the laboratory can meet the customer's requirements;
- Maintenance of accreditation and certification for test methods in multiple states and programs to cover a broad range of jurisdiction for regulatory compliance;
- SOPs and other controlled instructional documents are provided to personnel to eliminate variability in process. These documents include actions to counter risk factors inherent in the process and are reviewed on a regular basis for on-going suitability and relevancy;
- Participation in proficiency testing programs and auditing activities to verify on-going competency and comparability in performance;
- Provision of on-the-job training and established protocol for quality control (QC) corrective action for nonconforming events;
- An established program for ethics, and data integrity;
- Tiered data review process;
- Culture of continuous improvement;
- Monitoring activities to assess daily and long term performance; and
- Annual critical review of the effectiveness the quality management system.

PAS also promotes a continuous improvement culture based on the principles of lean manufacturing. These principles include 3P (Process, Productivity, Performance) and Kaizen. 3P is a platform used by Pace to share best practices and standardization across the network to achieve operational excellence. Kaizen is a team based process used to implement tools and philosophies of lean to reduce waste and achieve flow with the purpose of improving both external and internal customer satisfaction. PAS's lean programs and activities help to mitigate risk because they generate a collective understanding of vulnerabilities and utilize group-effort to develop and implement solutions at all levels.

Risk and opportunities may also be formally identified using specific risk and opportunity assessment methods such as SWOT Analysis (Strength, Weakness, Opportunity, Threats) and 3-Stage Impact/Probability Grids.

4.2.1.3 Communication of the Quality Management System

This manual is the primary mechanism used by laboratory management to communicate the quality management system to laboratory personnel.

To assure personnel understand and implement the quality program outlined in the manual:

- All laboratory personnel are required to sign a Read and Acknowledgement Statement to confirm the employee has: 1) been informed of the manual by laboratory management, 2) has access to the manual, 3) has read the manual 4) understands the content of the manual, and 5) agrees to abide by the requirements, policies and procedures therein.
- Personnel are informed that the manual provides the "what" of the quality management system. The "how to" implementation of the quality management system is provided in policy, SOPs, standard work instructions, and other controlled instructional documents.

4.2.2 Quality Policy Statement

The quality policy of the laboratory is to provide customers with data of known and documented quality fit for their intended purpose. The laboratory achieves this policy by implementing the quality management system defined in this manual, by following industry accepted protocol for analytical testing and quality assurance and quality control (QA/QC) activities, by conformance with published and industry accepted testing methodologies, and by compliance with international and national standards for the competency and/or accreditation of testing laboratories.

Intrinsic to this policy statement is each of the following principles:

- The laboratory will provide customers with reliable, consistent, and professional service. This is accomplished by making sure the laboratory has the resources necessary to maintain capability and capacity; that staff are trained and competent to perform the tasks they are assigned; that client-facing staff are trained and prepared to find solutions to problems and to assist customers with their needs for analytical services. Customer feedback, both positive and negative, is shared with personnel and used to identify opportunities for improvement.
- The laboratory maintains a quality program that complies with applicable, state, federal, industry standards for analytical testing and competency.

  ISO/IEC 17025 and the TNI (The NELAC Institute) Standard is used by PAS to establish the minimum requirements of the PAS quality program.

  ISO/IEC 17025 is a competency standard that outlines the general requirements for the management system for calibration and testing laboratories. It is the primary quality system standard from which other quality system standards, such as the TNI Standard, are based. The TNI Standard are consensus standards that provides management and technical requirements for laboratories performing environmental analysis.

- Laboratory management provides training to personnel so that all personnel are familiar with the quality management system outlined in this manual and that they understand that implementation of the quality management system is achieved by adherence to the organization's policies and procedures.
- Laboratory management continuously evaluates and improves the effectiveness of the quality management system by responding to customer feedback, and other measures of performance, such as but not limited to: the results of internal/external audits, proficiency testing, metrics, trend reports, and annual and periodic management reviews.

4.2.2.1 Ethics Policy / Data Integrity Program

PAS has established a comprehensive ethics and data integrity program that is communicated to all PAS employees in order that they understand what is expected of them. The program is designed to promote a mindset of ethical behavior and professional conduct that is applied to all work activities.

The key elements of the PAS Ethics / Data Integrity Program include:

- Ethics Policy (COR-POL-0004);
- Ethics Compliance Officer;
- Standardized data integrity training course taken by all new employees on hire and a yearly refresher data integrity training course for all existing employees;
- Policy Acknowledgement Statements that all PAS personnel, including contract and temporary, are required to sign at the time of employment and again during annual refresher training to document the employee's commitment and obligation to abide by the company's standards for ethics, data integrity and confidentiality;
- SOPs that provide instructions for how to carry out a test method or process to assure tasks are done correctly and consistently by each employee;
- On the Job Training;
- Data integrity monitoring activities which include, but are not limited to, secondary and tertiary data review, internal technical and system audits, raw data audits, data mining scans, and proficiency testing; and
- Confidential reporting process for alleged ethics and data integrity issues.

All laboratory managers are expected to provide a work environment where personnel feel safe and can report unethical or improper behavior in complete confidence without fear of retaliation. Retaliation against any employee that reports a concern is not tolerated.

PAS has engaged Lighthouse Services, Inc. to provide personnel with an anonymous reporting process available to them 24 hours a day/7 days per week. The alert line may be used by any employee to report possible violations of the company's ethics and data integrity program. When using the reporting process, the employee does need to specify the location of concern and when reporting by email, also include the company name. Messages are collected, documented, reviewed, and will be followed up on by the Ethics Compliance Officer to resolve the matter. Investigations concerning data integrity are kept confidential.

Lighthouse Compliance Alert Lines:

English Speaking US & Canada	(844) 940-0003
Spanish Speaking North America	(800) 216-1288
Internet	www/lighthouse-services.com/pacelabs
Email	reports@lighthouse-services.com

4.2.3 Management Commitment: Quality Management System

Evidence of management's commitment for the development, maintenance, and on-going improvement of the quality management system is provided by the application of their signature of approval to this manual. Their signature confirms they understand their responsibility to implement the quality management system outlined in this manual, to communicate the quality program to personnel, and to uphold requirements of the program during work activities.

4.2.4 Management Commitment: Customer Service

Management communicates the importance of meeting customer and regulatory requirements to personnel by training personnel on the quality management system outlined in this manual, implementing the quality management system outlined in this manual, and upholding these requirements for all work activities.

4.2.5 Supporting Procedures

Documents that support this manual and quality management system are referenced throughout this manual. The structure of the document management system is outlined in SOP ENV-SOP-CORQ-0015, *Document Management and Control* and summarized in the following subsections.

4.2.5.1 Quality Management System Document Structure

Documents associated with the quality management system are classified into document types that identify the purpose of the document and establish how the document is managed and controlled.

Document types are ranked to establish which documents takes precedence when there is an actual or perceived conflict between documents and to establish the hierarchal relationships between documents. The ranking system also provides information to document writers and reviewers to assure downline documents are in agreement with documents of higher rank. Project specific documents are not ranked because client specific requirements are not incorporated into general use documents in order to maintain client confidentiality.

PAS Quality Management System Documents: Internal

Document Type	Purpose
Quality Manual	Outlines the laboratory's quality management system and structure and how it works for a system including policy, goals, objectives and detailed

	explanation of the system and the requirements for implementation of system. Includes roles and responsibilities, relationships, procedures, systems and other information necessary to meet the objectives of the system described.
Policy	Provide requirements and rules for a PAS process and is used to set course of actions and to guide and influence decisions. Policy describes the "what", not the "how".
Standard Operating Procedure	Provide written and consistent set of instructions or steps for execution of a routine process, method, or set of tasks performed by PAS. Includes both fundamental and operational elements for implementation of the systems described in PAS manual(s). Assures that activities are performed properly in accordance with applicable requirements. Designed to ensure consistency, protect EHS of employees and environment, prevent failure in the process and ensure compliance with company and regulatory requirements. SOPs describes the "how" based on policy.
Standard Work Instruction	Provide step by step visual and/or written instruction to carry out a specific task to improve competency, minimize variability, reduce work injury and strain, or to boost efficiency and quality of work (performance). SWI are associated with an SOP unless the task described is unrelated to generation of or contribution to environmental data or analytical results.
Template	Pre-formatted document that serves as a starting point for a new document.
Guide	Provide assistance to carry out a task. Most often used for software applications.
Form	Used for a variety of purposes such as to provide a standardized format to record observations, to provide information to supplement an SOP.

PAS Quality Management System Documents: External

Certificate	Lists parameters, methods, and matrices for which the laboratory is certified/accredited to perform within the jurisdiction of the issuing regulatory agency or accreditation body.
Reference Document	Provide information, protocol, instructions, and/or requirements. Issued by the specifier. Examples include quality system standards such as ISO/IEC, TNI, DoD and published referenced methods such as Standard Methods, ASTM, SW846, EPA, and federal and state regulatory bodies.
Project Document	Provides requirements necessary to meet individual client expectations for intended use of data. Examples include: project quality assurance plans (QAPP), client-program technical specifications, contracts, and other agreements.

Document Hierarchy

Rank	Document
1	Reference Documents
2	Corporate Manual
3	Corporate Policy
4	Corporate SOP
5	Corporate SWI, Templates & Forms
6	Laboratory Manual
7	Laboratory SOP
8	Laboratory SWI, Templates, & Forms
NA	Project Documents[1]

4.2.6 Roles and Responsibilities

The roles and responsibilities of technical management and of the quality manager are provided in section 4.1.5.1.2.

4.2.7 Change Management

When significant changes to the quality management system are planned, these changes are managed by corporate quality personnel to assure that the integrity of the quality management system is maintained.

4.3 Document Control

4.3.1 General

The laboratory's procedures for document control are provided in SOP ENV-SOP-CORQ-0015 *Document Management and Control.*

The documents that support the quality management system include internally generated documents such as manuals, policies, standard operating procedures, standard work instructions, forms, guides, and templates and external source documents such as but not limited to, regulations, standards, reference methods, manuals, and project-specific documents.

The laboratory uses electronic document management software (eDMS)to carry out the procedures of the SOP. eDMS automates the process for unique document identification, version control, approval, access, and archival.

4.3.2 Document Approval and Issue

Documents that are part of the quality management system are reviewed by qualified personnel and approved by laboratory management prior by to release for general use.

Local QA maintains a master list of controlled documents used at the laboratory. The master list includes the document control number, document title, and current revision status and is made available to personnel for their reference.

Only the approved versions of documents are available to personnel for use. The eDMS system does not allow user access to draft versions of documents except to personnel assigned to work on the draft. eDMS also restricts access to archived documents except to authorized users, such as local QA, in order to prevent the use of obsolete documents.

See SOP ENV-SOP-CORQ-0015 *Document Management and Control* for more information.

4.3.3 Document Review and Change

Unless a more frequent review is required by regulatory, certification or accreditation program. the laboratory formally reviews documents at least every two years to ensure the document remains current, appropriate, and relevant.

Documents are also informally reviewed every time the document is used. Personnel are expected to refer to and follow instructions in controlled documents when they carry out their work activities. Consequently, any concerns or problems with the document should be caught and brought to the attention of laboratory management on an on-going basis.

Documents are revised whenever necessary to ensure the document remains usable and correct. Older document versions and documents no longer needed are made obsolete and archived for historical purposes.

The laboratory does not allow hand-edits to documents. If an interim change is needed pending re-issue of the document, the interim change is communicated to those that use the document using a formal communication channel, such as SOP Change in Progress form, email, or memorandum.

The document review, revision, and archival process is managed by local QA at the location from which the document was released using the procedures established in SOP ENV-SOP-CORQ-0015 *Document Management and Control.*

4.4 Analytical Service Request, Tender, and Contract Review

The laboratory's management and/or client service personnel perform thorough reviews of requests and contracts for analytical services to verify the laboratory has the capability, capacity, and resources necessary to successfully meet the customer's needs. These review procedures are described in laboratory SOP ENV-SOP-LENE-0001, *Review of Analytical Requests.*

The procedures in this SOP(s) are established to ensure that:

- The laboratory understands the purpose of data collection in order to ensure the test methods requested are appropriate for the intended use of the data and capable of meeting the client's data quality objectives;
- The laboratory and any subcontractor has the capability, capacity, and resources to meet the project requirements and expectations within the requested time frame for delivery of work product;
- Any concerns that arise from review are discussed and resolved with the client; and
- The results of review and any correspondence with the client related to this process and/or any changes made to the contract are recorded and retained for historical purposes.

Capability review confirms that the in-network laboratories and any potential subcontractors hold required certification/accreditation for the test method, matrix, and analyte and verifies the laboratory can achieve the client's target compound list and data quality objectives (DQOs) for analytical sensitivity and reporting limits, QA/QC protocol, and hardcopy test report and electronic data deliverable (EDD) formats.

Capacity review verifies that the in-network laboratories and any potential subcontractors are able to handle the sample load and deliver work production within the delivery time-frame requested.

Resource review verifies that the laboratory and any potential subcontractors have adequate qualified personnel with the skills and competency to perform the test methods and services requested and sufficient and proper equipment and instrumentation needed to perform the services requested.

4.5 Subcontracting and In-Network Work Transfer

The terms 'subcontract' and "subcontracting" refers to work sent to a business external to PAS Analytical Services, LLC (PAS) and the term 'subcontractor' refers to these external businesses, which are also called vendors.

Work transferred within the PAS network is referred to as interregional work orders (IRWO) and network laboratories are referred to as IRWO or network laboratory.

The network of PAS laboratories offers comprehensive analytical capability and capacity to ensure PAS can meet a diverse range of client needs for any type of project. If the laboratory receives a request for analytical services and it cannot fulfill the project specifications, the laboratory's client services team will work with the client to place the work within the PAS network. When it is not possible to place the work within network, the laboratory will, with client approval, subcontract the work to a subcontractor that has the capabilities to meet the project specifications and can meet the same commitment agreed on between the laboratory and the client. Some client programs require client consent even for IRWO work transfer, and when this applies, the client services team obtains consent as required. The laboratory retains the record of client notification and their consent in the project record for historical purposes.

Whenever work is transferred to a subcontractor or an IRWO laboratory, the laboratory responsible for management of the project verifies each of these qualifications:

- The subcontractor or IRWO laboratory has the proper accreditation/certifications required for the project and these are current; and
- The use of the subcontractor or IRWO laboratory is approved by the client and/or regulatory agency, when approval is required. Record of approval is retained in the project record.

When possible, the laboratory selects subcontractors that maintain a quality management system similar to PAS and that complies with ISO/IEC 17025 and the TNI Standard(s).

PAS also evaluates and pre-qualifies subcontractors as part of company's procurement program. The complete list of approved vendors is maintained by the corporate procurement department and is made available to all PAS locations. Pre-qualification of a subcontractor does not replace the requirement for the placing laboratory to verify the capability, capacity, and resources of any selected subcontractor on a project-specific basis to confirm the subcontractor can meet the client's needs.

For both subcontracting and in-network work transfer, the project specifications are always communicated to the subcontractor or the IRWO laboratory by the project manager so that the laboratory performing the work is aware of and understands these requirements.

The procedures for subcontracting are outlined in laboratory SOP ENV-SOP-LENE-0009, *Subcontracting Samples*.

4.6 Purchasing Services and Supplies

Vendors that provide services and supplies to the laboratory are prequalified by corporate procurement personnel to verify the vendor's capability to meet the needs of PAS. These needs include but are not limited to: competitive pricing, capacity to fill purchase orders, quality of product, customer service, and business reputation and stability. The records of vendor evaluation and the list of approved vendors is maintained by the corporate procurement department.

The laboratory may purchase goods and services from any supplier on the approved vendor list.

The specifications (type, class, grade, tolerance, purity, etc.) of supplies, equipment, reagents, standard reference materials and other consumables used in the testing process are specified in SOPs. The SOP specifications are based on the governing requirements of the approved reference methods and any additional program driven regulatory specification, such as drinking water compliance. All requisitions for materials and consumables are approved by the department supervisor to confirm the purchase conforms with specified requirements. After approval the requisition is handled by the laboratory's designated purchasing agent. On receipt, the product is inspected and verified before use, when applicable.

The laboratory's procedure for the purchase of services and supplies is specified in laboratory SOP ENV-SOP-LENE-0106, *Purchasing of Lab Supplies*.

4.7 Customer Service

Project details and management is handled by the laboratory's customer service team. Each customer is assigned a Project Manager (PM) that is responsible for review of contract requirements and handling laboratory to customer communication about the project status.

4.7.1 Commitment to Meet Customer Expectations

The laboratory cooperates and works closely with our customers to ensure their needs are met and to establish their confidence in the laboratory's capability to meet their needs for analytical services and expectations for service.

Each customer's project is handled by a project manager (PM) that is the customer's primary point of contact. The PM gathers information from the customer to ensure the details of their request are understood. After samples are received, the PM monitors the progress of the project and alerts the customer of any delays or excursions that may adversely impact data usability. Laboratory supervisors are expected to keep the PM informed of project status and any delays or major issues, so that the PM can keep the client informed.

PAS also has a team of subject matter experts (SME) available to provide customers with advice and guidance and any other assistance needed. SME are selected by top management based on their knowledge, experience, and qualifications.

The laboratory encourages customers to visit the laboratory to learn more about the laboratory's capabilities, observe performance and to meet laboratory personnel.

PAS customers expect confidentiality. Laboratory personnel will not divulge or release information to a third party without proper authorization unless the information is required for litigation purposes. See Section 4.1.5.3 of this manual and policy COR-POL-0004 *Ethics Policy* for more information on the laboratory's policy for client confidentiality.

4.7.2 Customer Feedback

The laboratory actively seeks positive and negative feedback from customers through surveys and direct communication. Information from the client about their experience working with the laboratory and their satisfaction with work product is used to enhance processes and practices and to improve decision making. Customer feedback is communicated to laboratory management and corporate personnel in monthly reports and analyzed yearly during management review (See 4.15) to identify risk and opportunity. Corrective, preventive, or continuous improvement actions are taken based on nature of and/or feedback trends.

Also see sections 4.9, 4.10, 4.11, 4.12, 4.14, and 4.15 for more information about how customer feedback is managed by the laboratory and used to enhance the quality management system.

4.8 Complaints

Complaints provide opportunities to improve processes and build stronger working relationships with our clients.

The laboratory's complaint resolution process includes three steps. First, handle and resolve the complaint to mutual satisfaction. Second, perform corrective action to prevent recurrence (See 4.11). Third, record and track the complaint and use these records for risk and opportunity assessment and preventive action (See 4.12)

4.9 Nonconforming Work

4.9.1 Definition of Nonconforming Work

Nonconforming work is work that does not conform to customer requirements, standard specifications, laboratory policies and procedures, or that does not meet acceptance criteria.

The discovery of non-conforming work comes come from various sources which include, but are not limited to:

- results of quality control samples and instrument calibrations;
- quality checks on consumables and materials;
- general observations of laboratory personnel;
- data review;
- proficiency testing;
- internal and external audits;
- complaints and feedback;
- management review and reports; and
- regulatory and certification and accreditation actions.

The way in which the laboratory handles nonconforming work depends on the significance and impact (risk) of the issue. Some issues may simply require correction, others may require investigation, corrective action (See 4.11) and/or data recall (See 4.16). When the laboratory releases data and test results associated with nonconforming QC and acceptance criteria test results are qualified or non-conformances are noted in the final analytical report to apprise the data user of the situation. (See 5.10)

Nonconforming work also includes unauthorized departure from laboratory policies, procedures and test methods. Authorized departures are explained in the following subsections. Situations that do not conform to these conditions are considered unauthorized departure(s).

4.9.1.1 Authorized Departure from SOP

An authorized departure from a test method SOP is one that has been reviewed and approved by the Department Manager, Technical Manager, Acting Technical Manager for TNI, Quality Manager, or the General Manager. Review is conducted to confirm the departure does not conflict with regulatory compliance requirements for which the data will be used or does not adversely affect data integrity. The departure may originate from client request or may be necessary to overcome a problem.

An authorized departure from administrative or process-oriented SOP is typically necessary to correct an error in the SOP. These departure requests are reviewed and pre-approved by the local QA Manager. Documentation of SOP departures and approval decisions are retained by the laboratory as evidence that the departure was authorized. When necessary, approved departures from test method SOPs are noted in the final test report to advise the data user of any ramification to data quality.

4.9.1.2 Authorized Departure from Test Methods (Method Modifications)

When test results are associated to a published reference test method, the laboratory's test method SOP must be consistent with the test method. If the test method is mandated for use by a specific regulatory program such as drinking water or wastewater or a certification or accreditation program, such as TNI/NELAC, the SOP must also comply with or include these requirements. If the procedures in the SOP are modified from the test method, these modifications must be clearly identified in the SOP. The conditions under which the laboratory may establish an SOP that is modified from these reference documents, and what is considered a modification are specified in ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification*.

Modifications that do not meet the requirements of this SOP (ENV-SOP-CORQ-0011) are unauthorized. Client requests to deviate from the test method are handled as client requests to depart from the test method SOP since it is the SOP that the laboratory follows when performing work.

4.9.1.3 Stop Work Authority

Stop Work Authority provides laboratory personnel with the responsibility and obligation to stop work when there is a perceived unsafe condition or behavior that may result in an unwanted event.

All laboratory and corporate personnel have the authority to stop work when needed to preserve data integrity or safety of workers.

Once a stop work order has been initiated and the reason for doing so is confirmed valid; laboratory management is responsible for immediate correction and corrective action (see section 4.10) before resumption of work.

4.10 Continuous Improvement

The laboratory's quality management system is designed to achieve continuous improvement through the implementation of the quality policy and objectives outlined in this manual. Information about the laboratory's activities and performance is gained from many sources such as customer feedback, audits, QC, trend analysis, business analytics, management reports, proficiency testing, and management systems review. This information is subsequently used during the laboratory's corrective action (see section 4.11) and preventive action (see section 4.12) processes and to establish goals and objectives during annual review of the management system (see section 4.15).

PAS also promotes a continuous improvement culture based on the principles of lean manufacturing. These principles include 3P (Process, Productivity, Performance) and Kaizen. 3P is a platform used by Pace to share best practices and standardization across the network to achieve operational excellence. Kaizen is a team based process used to implement tools and philosophies of lean to reduce waste and achieve flow with the purpose of improving both external and internal customer satisfaction.

4.11 Corrective Action

Corrective action is process used to eliminate the cause of a detected nonconformity. It is not the same as a correction. A correction is an action taken to fix an immediate problem. The goal of the corrective action process is to find the underlying cause(s) of the problem and to put in place fixes to prevent the problem from happening again. The corrective action process, referred to as CAPA by PAS, is one of the most effective tools used by the laboratory to prevent nonconforming work, identify risk and opportunity, and improve service to our customers.

The laboratory has two general processes for corrective action:

The process used for actions taken in response to day to day quality control (QC) and acceptance criteria exceptions (nonconformance) that occur during the day to day testing process are called corrections. These events do not usually include formal methods for cause analysis; instead the reason for the failure is investigated through troubleshooting or other measures. Required actions for correction of routine nonconformance is specified in laboratory SOPs. When corrective action is not taken, cannot be taken, or is not successful, test results associated with the nonconforming work are qualified in the final test report. Documentation of the nonconformance and corrective action taken is documented in the analytical record.

A formal 7 step corrective action process is used when there is a problem or departure from the quality management system, technical activities, or when the extent of a single problem has significant impact on data, regulatory compliance or customer needs. These problems are identified through various activities such as but not limited to: quality control trends, internal and external audits, management review, customer feedback, and general observation.

The laboratory's 7 Step CAPA Process includes:

1) Define the Problem
2) Define the Scope of the Problem
3) Contain the Problem
4) Root Cause Analysis
5) Plan Corrective Action
6) Implement Corrective Action
7) Follow Up / Effectiveness Check

The formal CAPA process may be initiated by any employee. Once the process is initiated it is overseen and coordinated by laboratory management. The CAPA process is documented using an electronic or paper-based system. The CAPA record includes tracking information, dates, individuals involved, those responsible for action plan implementation and follow-up, and timelines and due dates.

For more information about the laboratory's procedure for corrective action, see laboratory SOP ENV-SOP-LENE-0033, *Corrective and Preventive Actions.* Additional explanation about certain aspects of the laboratory's corrective action process are outlined in the next three subsections.

4.11.1 Root Cause Analysis

Root cause analysis (RCA) is the process of investigation used by the laboratory to identify the underlying cause(s) of the problem. Once causal factors are identified, ways to mitigate the causal factors are reviewed and corrective action(s) most likely to eliminate the problem are selected.

The laboratory uses different methods to conduct this analysis. The most common approach is 5-Why, but fishbone diagrams, or even brainstorming may be appropriate depending on the situation. The method used is documented in the CAPA record.

4.11.2 Effectiveness Review

Monitoring corrective actions for effectiveness is shared by laboratory supervisors and quality assurance personnel. Effectiveness means the actions taken were sustainable and appropriate. Sustainable means the change is still in place. Appropriate means the action(s) taken prevented recurrence of the problem since the time corrective action was taken.

The time-frame in which effectiveness review takes place depends on the event and is recorded in the CAPA record with any addition actions that need to be taken.

Corrective action trends are also monitored by laboratory management and used to identify opportunities for preventive action or to gain lessons learned when actions taken were not adequate to solve the problem. See Section 4.12 (Preventive Action) and 4.15 (Management Review) for more information.

4.11.3 Additional Audits

When non-conformances or other problems cast doubt on compliance with the laboratory's policies, procedures, or compliance to regulatory requirements; laboratory management schedules a special audit of the area of activity in accordance with Section 4.14.1 as soon as possible. These special audits are used to determine the scope of the problem and to provide information for the CAPA process. Additional full-scale audits are done when a serious issue or risk to the laboratory's business is identified.

4.12 Preventive Action

Preventive action is an action taken to eliminate the cause of a potential nonconformity and to achieve improvement. Preventive action is a forward thinking process designed to prevent problems opposed to reacting to them (corrective action).

Some examples of preventative action include, but are not limited to:

- Scheduled instrument maintenance (Preventative maintenance)
- Addition of Staff and Equipment
- Professional Development Activities
- Implementation of New Technology

The laboratory looks for opportunities for preventive action from a variety of sources including but not limited to: employee idea's, customer feedback, business partners input, trend analysis, business analytics, management reviews, proficiency testing results, lean management events, and risk-benefit analysis.

The process for preventive actions follows the same 7 step process for corrective action except "problem" is replaced with "opportunity", "cause analysis" is replaced with "benefit analysis", and "corrective action" is replaced with "preventive action".

Laboratory management evaluates the success of preventive actions taken in any given year during annual management review. See Section 4.15 for more information.

4.12.1 Change Management

Preventive actions may sometimes result in significant changes to processes and procedures used by the laboratory. Laboratory management evaluates the risks and benefits of change and includes in its implementation of change process, actions to minimize or eliminate any risk. The types of changes for which risk are considered and managed include: infrastructure change, change in analytical service offerings, certification or accreditation status, instrumentation, LIMS changes, and changes in key personnel.

For more information about the laboratory's procedures for preventive action see laboratory SOP ENV-SOP-LENE-0033, *Corrective and Preventive Actions.*

4.13 Control of Records

A record is a piece of evidence about the past, especially an account of an act or occurrence kept in writing or some other permanent form. Laboratory records document laboratory activities and provide evidence of conformity to the requirements established in the quality management system. These records may be hardcopy or electronic on any form of media.

4.13.1 General Requirements

4.13.1.1 Procedure

The laboratory's procedures for control of records is provided in laboratory SOP ENV-SOP-LENE-0115, *Control of Records.*

The procedures in the SOP are established to assure quality and technical records are identified, retained, indexed, and filed to allow for retrieval during the entire retention time frame. During storage, records are kept secure and protected from deterioration. At the end of the retention time, the records are disposed of properly in order to maintain client confidentiality and to protect the interests of the company.

In general, laboratory records fall into three categories: quality, technical, and administrative.

Examples of each are provided in the following table:

Record Type	Includes Records of:
Quality	Documents: Document Types listed in SOP ENV-SOP-CORQ-016 Audits: Internal and External Certificates and Scopes of Accreditation Corrective & Preventive Action Management Review Data Investigations Method Validation Instrument Verification Training Records
Technical	Raw Data

	Logbooks Certificates of Traceability Analytical Record Test Reports & Project Information Technical Training Records & Demonstration of Capability
Administrative	Personnel Records Finance/Business

4.13.1.2 Record Legibility and Storage

Records are designed to be legible and to clearly identify the information recorded. Manual entries are made in indelible ink; automated entries are in a typeface and of sufficient resolution to be read. The records identify laboratory personnel that performed the activity or entered the information.

Records are archived and stored in a way that they are retrieved. Access to archived records is controlled and managed.

For records stored electronically, the capability to restore or retrieve the electronic record is maintained for the entire retention period. Hardcopy record are filed and stored in a suitable environment to protect from damage, deterioration, or loss. Hardcopy records may be scanned to PDF for retention. Scanned records must be checked against the hardcopy to verify the scan is complete and legible.

Records are kept for a minimum of 5 years unless otherwise specified by the client or regulatory program.

The date from which retention time is calculated depends on the record. In general, the retention time of technical records of original observation and measurement is calculated from the date the record is created. If the technical record is kept in a chronological logbook, the date of retention may be calculated from the date the logbook is archived. The retention time of test reports and project records, which are considered technical records, is calculated from the date the test report was issued. The retention time of quality records is usually calculated from the date the record is archived.

Refer to the laboratory's record management SOP for more information.

4.13.1.3 Security

The laboratory is a secure facility and access to records is restricted to laboratory personnel.

4.13.1.4 Electronic Records

The data systems used to store electronic records is backed up in accordance with laboratory SOP ENV-SOP-LENE-0133, *Target Data Backup*. Access to archived records stored electronically is maintained by personnel responsible for management of the electronic system.

4.13.2 Technical Records

In addition to the requirements identified in subsections 4.13.1.1 through 4.13.1.4, the requirements in the following subsections also apply to technical records.

4.13.2.1 Description

Technical records are the accumulation of data and information generated from the analytical process. These records may include forms, worksheets, workbooks, checklists, notes, raw data, calibration records, final test reports, and project record. The accumulated record essentially need to provide sufficient detail to historically reconstruct the process and identify the personnel that performed the tasks associated with a test result.

4.13.2.2 Real Time Recordkeeping

Personnel are instructed and expected to always record observations, data, and calculations at the time they are made. Laboratory managers are responsible to assure that data entries, whether made electronically or on hardcopy, are identifiable to the task.

4.13.2.3 Error Correction

Errors in records must never erased, deleted or made illegible. Use of correction fluid, such as white-out is prohibited. In hardcopy records, the error is corrected by a single-strike through the original entry and the new entry recorded alongside or footnoted to allow for readability. Corrections are initialed and dated by the person making the correction. If the correction is not self-explanatory, a reason for the correction is recorded.

For electronic records, equivalent measures of error correction or traceability of changes made is kept. For example, audit trails provide records of change.

Maintenance of proper practices for error correction is monitored through the tiered data review process described in Section 5.9.3. Laboratory records are reviewed throughout the data review process. Individuals performing these reviews flag errors that are not properly corrected and bring these to the attention of the department manager or supervisor of the work area in which the record was generated so that the problem may be addressed and corrected with the individual(s) that did not make the correction properly.

4.14 Audits

The laboratory performs internal systems and technical audits to assess compliance to this manual and to other laboratory procedures, such as policy, SOP and SWI. Since the processed in this manual are based on the relevant quality system standards and regulatory and accreditation/certification program requirements the laboratory provides services for, the internal audits also assess on-going compliance to these programs.

The laboratory is also audited by external parties such as regulatory agencies, customers, consultants and non-government assessment bodies (NGAB).

Information from internal and external audits is used by laboratory management to address compliance concerns and opportunities where improvement will increase the reliability of data.

Deficiencies, observations and recommendations from audits are managed by local QA using the laboratory's formal CAPA process. See Section 4.11 for more information.

4.14.1 Internal Audit

The laboratory's internal audit program is managed by local QA in accordance with a pre-determined audit schedule established at the beginning of each calendar year. The schedule is prepared to assure that all areas of the laboratory are reviewed over the course of the year. Conformance to the schedule is reported to both laboratory management and corporate quality personnel in a monthly QA report prepared by the quality manager.

Although the QA Manager creates the audit schedule, it is the shared responsibility of local QA and laboratory managers to assure the schedule is maintained. Laboratory supervisors cooperate with QA to provide the auditors with complete access to the work area, personnel, and records needed.

Internal audits are performed by personnel approved by the quality manager. In general, personnel may not audit their own activities unless it can be demonstrated that an effective and objective audit will be carried out. The auditor must be trained, qualified, and familiar enough with the objectives, principles, and procedures of laboratory operations to be able to perform a thorough and effective evaluation.

The laboratory's internal audit program includes:

- System Audits & Method Audits: The purpose of these audits is to determine if daily practice is consistent with laboratory's SOPs and if SOPs are compliant with adjunct policy and procedures. Auditing techniques includes analyst interviews and observation and records review. These audits are performed per the pre-determined schedule.

- Raw Data / Final Test Report Audits: The purpose of these audits is to review raw data and/or a final test reports to verify the final product is consistent with customer/project requirements and supported as compliant to SOPs, reference methods, with test results that are properly qualified when necessary, accurate, and of known and documented quality. The reviews should also identify opportunities for improvement and best practices

- Special Audits: Special audits are those performed ad hoc to follow up on specific a specific issue such as a client complaint, negative feedback, concerns of data integrity or ethics, or a problem identified through other audits. Special audits may be scheduled or unscheduled. Unscheduled internal audits are conducted whenever doubts are cast on the laboratory's compliance with regulatory requirements or its own policies and procedures. These unscheduled internal audits may be conducted at any time and may be performed without an announcement to laboratory personnel.

When observations and findings from any audit (internal or external) cast doubt on the validity of the laboratory's testing results, the laboratory takes immediate action to initiate investigate the problem and take corrective action. (Also see 4.11 and 4.16)

The laboratory's internal audit program and auditing procedures are further described in laboratory SOP ENV-SOP-LENE-0126, *Internal and External Audits*.

4.14.1.1 Corporate Compliance Audit

The laboratory may also be audited by corporate quality personnel to assess the laboratory's compliance to the company's quality management program and to evaluate the effectiveness of implementation of the policies and procedures that make up the quality management system. The purpose of the compliance audit is to identify risks and opportunities and to assist laboratory management achieve the goals and objectives of the company's quality program.

4.15 Management Review

The laboratory's management team formally reviews the management system on an annual basis to assess for on-going suitability and effectiveness and to establish goals, objectives, and action plans for the upcoming year.

At a minimum, following topics are reviewed and discussed:

- The on-going suitability of policies and procedures including HSE (Health, Safety and Environment) and waste management;
- Reports from managerial and supervisory personnel including topics discussed at regular management meetings held throughout the year;
- The outcome of recent internal audits;
- Corrective and preventive actions;
- Assessments by external bodies;
- The results of interlaboratory comparisons or proficiency tests;
- Changes in the volume and type of the work;
- Customer and personnel feedback, including complaints;
- Effectiveness of improvements / preventive actions made since last review;
- Internal and external issues of relevance and risk identification;
- A review of the status of actions from prior management reviews; and
- Other relevant factors, such as quality control activities, resources, and staff training.

The discussion and results of this review are documented in a formal report prepared by laboratory management. This report includes a determination of the effectiveness of the management system and its processes; goals and objectives for improvements in the coming year with timelines and responsibilities, any other need for change. See laboratory SOP ENV-SOP-CORQ-0005 *Review of Laboratory Management Systems-* for more information.

Goals and action items from annual management systems review are shared with employees to highlight focus areas for improvement in addition to areas in which the laboratory has excelled.

4.16 Data Integrity

The laboratory's procedures for data integrity reviews are described in SOP ENV-SOP-CORQ-0010 *Data Recall.*

Customers whose data are affected by these events are notified in a timely manner, usually within 30 days of discovery. Some accreditation programs also require notification to the accreditation body (AB) within a certain time-frame from date of discovery when the underlying cause of the issue impacts accreditation. The laboratory follows any program or project specific client notification requirements for notification, when applicable.

5.0 TECHNICAL REQUIREMENTS

5.1 General

Many factors contribute to the correctness and reliability of the technical work performed by the laboratory. These factors are fall under these general categories:

- Human Performance
- Facility and Environmental Conditions
- Test Method Performance and Validation
- Measurement Traceability
- Handling of Samples

The impact of each of these factors varies based on the type of work performed. To minimize negative effects from each these factors, the laboratory takes into account the contribution from each of these categories when developing test method and process (administrative) SOPs, evaluating personnel qualifications and competence, and in the selection of equipment and supplies used.

5.2 Personnel

5.2.1 Personnel Qualifications

The laboratory's program for personnel management is structured to ensure personnel are selected, qualified, and competent to perform the roles and responsibilities of their position based on education, experience, and training.

Qualifications, duties, responsibilities, and authorities of each position are specified in job descriptions maintained by corporate HR (See Section 5.2.4). These job descriptions provide the general basis for the selection of personnel for hire and are used by the laboratory to communicate to personnel the duties, responsibilities, and authorities of their position.

The term "personnel" refers to individuals employed by the laboratory directly as full-time, part-time, or temporary, and individuals employed by the laboratory by contract, such as through an employment agency. The term "personnel" is used interchangeably with the term "employee" throughout this manual. For purposes of this manual, these terms are equivalent.

The personnel management program is structured to establish and maintain records for each of the following:

- Selection of personnel;
- Training of personnel;
- Supervision of personnel;
- Authorization of personnel; and
- Monitoring Competence of personnel.

5.2.1.1 Competence

Competence is the ability to apply a skill or series of skills to complete a task or series of tasks correctly within defined expectations.

Competence for technical personnel authorized by PAS to provide opinion and interpretation of data to customers also includes the demonstrated ability to:

- Apply knowledge, experience, and skills needed to safely and properly use equipment, instrumentation, and materials required to carry out testing and other work activities in accordance with manufacturer specifications and laboratory SOPs;
- Understand and apply knowledge of general regulatory requirements necessary to achieve regulatory compliance in work product; and
- Understand the significance of departures and deviations from procedure that may occur during the analytical testing process and the capability and initiative to troubleshoot and correct the problem, document the situation and decision making process, and to properly qualify the data and analytical results.

The laboratory's requirements for the competence of personnel (education, qualification, work experience, technical skills, and responsibilities) are specified in job descriptions created by management and kept by human resources (HR). The job description provides the basis for the selection of personnel for each position.

An employee is considered competent when he/she has completed required training.

The policies and standard operating procedures (SOPs) for the following topics are established by management as minimum required training for all personnel:

- Ethics and Data Integrity
- Quality Manual
- Safety Manual
- Quality Management System
- Technical Process and Procedure relevant to their job tasks
- Successful Demonstration of Capability (DOC) – Analytical Personnel Only

Personnel are initially authorized competent to independently carry out their assigned duties when required training is complete and documented.

Records of training and qualification provide the record of competence for the individual. Qualification records may include but are not limited to diploma, transcripts, and curriculum vitae (CV).

The on-going competence of each employee is monitored by laboratory management through on-the-job performance. Analytical employees are also required to successfully complete another demonstration capability for each test method performed on an annual basis.

5.2.2 Training

Training requirements are outlined in policies COR-POL-0023 *Mandatory Training Policy*. COR-POL-0004 *Ethics Policy*, and laboratory SOP ENV-SOP-LENE0110, *Training Procedures*. Additional training requirements may also be specified in other documents, such as manuals

5.2.2.1 Training Program and Goals

The laboratory's training program includes 4 elements:

- Identification of Training Needs
- Training Plan Development and Execution
- Documentation and Tracking
- Evaluation of Training Effectiveness

Laboratory management establishes goals and training needs for individual employees based on their role, education, experience, and on-the-job performance.

Training needs for all employees are based on business performance measures that include but are not limited to:

- Quality Control Trends
- Process Error / Rework Trends
- Proficiency Testing Results
- Internal & External Audit Performance
- Management Review Goals

Training is delivered using various methods that incorporate techniques that appeal to the main learning styles: visual, aural, linguistic, and kinesthetic. Techniques include, on-the-job, instructor-led, self-study, eLearning, and blended.

The employee's direct supervisor is responsible for oversight of the employee's training plan and for providing adequate time to the employee to complete training assignments. Both the supervisor and employee are responsible to make sure the employee's training status and training records are current and complete.

The laboratory's QA department monitors the training status of personnel and provides the status to the General Manager (GM or AGM) at least monthly or more frequently, if necessary. The status report is used by laboratory management to identify overdue training assignments, the reasons for the gaps, and to make arrangements for completion.

The following subsections highlight specific training requirements:

5.2.2.1.1 New Hire Training

New hire training requirements apply to new personnel and to existing employee's starting in a new position or different work area.

Required new hire training includes each of the following:

- Ethics and Data Integrity (See 5.2.2.1.3)
- Quality Manual / Quality Management System (See 5.2.2.1.4)
- Safety Manual and any training requirements specified in the manual.
- Policies & SOPs relevant to their job tasks
- Technical personnel that test samples must also successfully complete an initial demonstration of capability (IDOC) for the test methods performed before independently testing customer samples. (See 5.2.2.1.5). Independent testing means handling of client samples without direct supervision of the work activity by the supervisor or a qualified trainer.

All required training must be current and complete before the employee is authorized to work independently. Until then, the employee's direct supervisor is responsible for review and acceptance of the employee's work product.

5.2.2.1.2 On-Going Training

Personnel receive on-going training in each of the following topics:

- Ethics and Data Integrity (See 5.2.2.1.3)
- Quality Manual / Quality Management System (See 5.2.2.1.4)
- Safety Training
- Changes to Policies & SOPs
- Specialized Training
- Technical employees that carry of testing must also successfully complete on-going demonstration of capability (ODOC) for all test methods performed on an annual basis. (See 5.2.2.1.5)

Personnel are expected to maintain their training status and records of training current and complete and to complete training assignments in a timely manner.

5.2.2.1.3 Ethics and Data Integrity Training

Data integrity training is provided to all new personnel and refresher data integrity training is provided to all employees on an annual basis. Personnel are required to acknowledge they understand that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious consequences including immediate termination, debarment, or civil/criminal prosecution.

The initial data integrity training and the annual refresher training is documented with a signature attendance sheet or other form of documentation to provide evidence that the employee has participated in training on this topic and understand their obligations related to data integrity.

The following topics and activities are covered:

- Policy for honesty and full disclosure in all analytical reporting;
- Prohibited Practices;
- How and when to report data integrity issues;
- Record keeping. The training emphasizes the importance of proper written documentation on the part of the analyst with respect to those cases where analytical data may be useful, but are in one sense or another partially nonconforming;
- Training Program, including discussion regarding all data integrity procedures;
- Data integrity training documentation;
- In-depth procedures for data monitoring; and
- Specific examples of breaches of ethical behavior such as improper data manipulations, adjustments of instrument time clocks, and inappropriate changes in concentrations of standards.

All PAS personnel, including contract and temporary, are required to sign an "Attestation of Ethics and Confidentiality" at the time of employment and during annual refresher training. This document clearly identifies inappropriate and questionable behavior. Violations of this document result in serious consequences, including prosecution and termination, if necessary.

Also see SOP-ENV-COR-POL-0004 *Ethics Policy* for more information.

5.2.2.1.4 Management System Documents Training

PAS Manuals, policies, and SOPs are the primary documents used by regulatory bodies and PAS customers to verify the laboratory's capability, competency and compliance with their requirements and expectations.

In addition to on-the-job training, employees must have a signed Read and Acknowledgement Statement on record for the laboratory quality manual, and the policies and SOPs relating to his/her job responsibilities. This statement when signed by the employee electronically or by wet signature, confirms that the employee has received, read, and understands the content of the document, that the employee agrees to follow the document when carrying out their work tasks; and the employee understands that unauthorized change to procedures in an SOP is not allowed except in accordance with the SOP departure policy (See 4.9.9.1) and SOP ENV-CORQ-0016 *Standard Operating Procedures and Standard Work Instructions* for more information.

5.2.2.1.5 Demonstration of Capability (DOC)

Technical employees must also complete an initial demonstration of capability (IDOC) prior to independent work on client samples analyzed by the test methods they perform. After successful IDOC, the employee must demonstrate continued proficiency (CDOC) for the test method on an annual basis. If more than a year has passed since the employee last performed the method; then capability must be re-established with an IDOC.

Demonstration of capability (IDOC and DOC) is based on the employee's capability to achieve acceptable precision and accuracy for each analyte reported by the laboratory for the test method using the laboratory's test method SOP.

Records of IDOC and ODOC are kept in the employee's training file.

For more information, see laboratory SOP ENV-SOP-LENE-0110, *Training Procedures*.

5.2.2.2 Effectiveness of Training

The results of the performance measures used to identify training needs are the same measures used by the laboratory to measure effectiveness of the training program. Improvement in key performance measures suggest the training program is successful. (See 5.2.2.1)

Effectiveness of individual employee training is measured by their demonstrated ability to comprehend the training material and apply knowledge and skills gained to their job task. Measurements include but are not limited to:

- Testing of the employee's knowledge of the quality management system, policies, and technical and administrative procedures through various mechanisms, such as quizzes, observation, and interviews.
- Demonstrated ability to convey information correctly and factually in written and verbal communication to internal and external parties.
- Demonstrated ability to carry out tasks in accordance with SOPs and other work instructions.
- Demonstrated ability to make sound decisions based on guidance and information available.
- Demonstrated initiative to seek help or guidance when the employee is unsure of how to proceed.

5.2.3 Personnel Supervision

Every employee is assigned a direct supervisor, however named, who is responsible for their supervision. Supervision is the set of activities carried out by the supervisor to oversee the progress and productivity of the employees that report to them.

General supervisory responsibilities may include but are not limited to:

- Hiring Employees
- Training Employees
- Performance Management
- Development, oversight, and execution of personnel training plans
- Monitoring personnel work product to assure the work is carried out in accordance with this quality manual, policies, SOPs, and other documents that support the quality management system.

5.2.4 Job Descriptions

Job Descriptions that define the required education, qualifications, experience, skills, roles and responsibilities, and reporting relationships for each PAS position are established by top management and kept by corporate HR. PAS laboratories use these job descriptions as the source of positions and job titles for the laboratory. The job descriptions apply to employees who are directly employed by PAS, part-time, temporary, technical and administrative and by those that are under contract with PAS through other means.

The job descriptions include the education, expertise, and experience required for the position and the responsibilities and duties, including any supervisory or managerial duties assigned to the position.

5.2.5 Authorization of Technical Personnel

Laboratory management authorizes technical personnel to perform the technical aspects of their position after it has been verified that the employee meets the qualifications for the position, has successfully completed required training, and the employee has demonstrated capability. After initial authorization, technical personnel are expected to maintain a current and complete training record, demonstrate on-going capability at least annually for each test method performed, and produce reliable results through accurate analysis of certified reference materials, proficiency testing samples, and/or routine quality control samples in order to remain authorized to continue to perform their duties.

Records to support authorization including, education, experience, training, and other evaluations are kept by the laboratory.

5.3 Accommodations and Facilities

5.3.1 Facilities

The laboratory is designed to support the correct performance of procedures and to not adversely affect measurement integrity or safety. Access to the laboratory is controlled by various measures, such as card access, locked doors and main entry. Visitors to the laboratory are required to sign-in and to be escorted by laboratory personnel during their visit. A visitor is any person that is not an employee of the laboratory.

5.3.2 Environmental Conditions

The laboratory is equipped with energy sources, lighting, heating, and ventilation necessary to facilitate proper performance of calibrations and tests. The laboratory ensures that housekeeping, electromagnetic interference, humidity, line voltage, temperature, sound and vibration levels are appropriately controlled to ensure the integrity of specific measurement results and to prevent adverse effects on accuracy or increases in the uncertainty of each measurement.

Environmental conditions are monitored, controlled, and recorded as required by the relevant specifications, methods, and procedures. Laboratory operations are stopped if it is discovered that the laboratory's environmental conditions jeopardize the analytical results.

5.3.3 Separation of Incompatible Activities

The layout and infrastructure of each work area including air handling systems, power supplies, and gas supplies of each laboratory work area is specifically designed for the type of analytical activity performed. Effective separation between incompatible work activities is maintained. For example, sample storage, preparation, and chemical handling for volatile organic analysis (VOA) is kept separate from semi-volatile organic (SVOA).

The laboratory separates samples known or suspected to contain high concentration of analytes from other samples to avoid the possibility for cross-contamination. If contamination is found, the source of contamination is investigated and resolved in accordance with laboratory SOPs.

5.3.4 Laboratory Security

Security is maintained by controlled access to the building and by surveillance of work areas by authorized personnel. Access is controlled to each area depending on the required personnel, the sensitivity of the operations performed, and possible safety concerns. The main entrance is kept unlocked during normal business hours for visitors, and is continuously monitored by laboratory staff. All visitors must sign a visitor's log, and a staff member must accompany them during the duration of their stay.

5.3.5 Good Housekeeping

The laboratory ensures good housekeeping practices in work areas to maintain a standard of cleanliness necessary for analytical integrity and personnel health and safety. Minimally, these measure include regular cleaning of the work area. Where necessary, areas are periodically monitored to detect and resolve specific contamination and/or possible safety issues.

5.4 Test Methods

5.4.1 General Requirements

The laboratory uses test methods and procedures that are appropriate for the scope of analytical services the laboratory offers.

Instructions on the use and operation of equipment and sample handling, preparation, and analysis of samples are provided in SOPs. The instructions in SOPs may be supplemented with other documents including but not limited to, standard work instructions (SWI), manuals, guides, project documents and reference documents.

These documents are managed using the procedures described in SOP ENV-SOP-CORQ-0015 *Document Management and Control* and SOP ENV-SOP-CORQ-0016 *Standard Operating Procedures and Standard Work Instructions.*

Deviations to test method and SOPs are allowed under certain circumstances. See sections 4.9.1.1 and 4.9.1.2 for more information.

5.4.2 Method Selection

The test methods and protocols used by the laboratory are selected to meet the needs of the customer, are appropriate for the item tested and intended use of the data, and to conform with regulatory requirements when regulatory requirements apply.

In general, the test methods offered are industry accepted methods published by international, regional, or national standards. The laboratory bases its procedure on the latest approved edition of a method unless it is not appropriate or possible to do so or unless regulatory requirements specify otherwise.

The laboratory confirms that it can perform the test method and achieve desired outcome before analyzing samples (see section 5.4.5). If there is a change in the published analytical method, then the confirmation is repeated.

When a customer does not specify the test method(s) to be used, the laboratory may suggest test methods that are appropriate for the intended use of the data and the type of samples to be tested. The laboratory will also inform customers when test methods requested are considered inappropriate for their purpose and/or out of date. This discourse takes place during review of analytical service requests (See Section 4.4).

5.4.3 Laboratory Developed Methods

A laboratory developed method is a method developed from scratch (no published source method), a procedure that modifies the chemistry from the source method, or a procedure that exceeds the scope and application of the source method.

Laboratory developed methods must be validated prior to use (see section 5.4.5) and the procedure documented in a test method SOP.

The requirements for non-standard methods (Section 5.4.4) also apply to laboratory developed methods.

5.4.4 Non-standard Methods

A non-standard method is a method that is not published or approved for use by conventional industry standards for the intended purpose of the data. Non-standard methods must be validated prior to use (see section 5.4.5) and the procedure developed and documented in a test method SOP.

At a minimum, the following information must be included in the procedure:

- Title / Identification of Method;
- Scope and Application;

- Description of the type of item to be analyzed;
- Parameters or quantities and ranges to be determined;
- Apparatus and equipment, including technical performance requirements;
- Reference standards and reference materials required;
- Environmental conditions required and any stabilization period needed
- Description of the procedure, including:
    - Affixing identification marks, handling, transporting, storing and preparing of items;
    - Checks to be made before the work is started;
    - Verifying equipment function and, where required, calibrating and/or adjusting the equipment before each use;
    - Method of recording the observations and results;
    - Any safety measures to be observed;
    - Criteria and/or requirements for approval/rejection;
    - Data to be recorded and method of analysis and presentation; and
    - Uncertainty or procedure for estimating uncertainty.

Use of a non-standard method for testing must be agreed upon with the customer. The agreement, which is retained by the laboratory in the project record, must include the specifications of the client's requirements, the purpose of testing, and their authorization for use of the non-standard method.

5.4.5 Method Validation

5.4.5.1 Validation Description

Validation is the process of conformation and the provision of objective evidence that the stated requirements for a specific method/procedure are fulfilled.

The laboratory's requirements and procedures for method validation are outlined in SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification.*

5.4.5.2 Validation Summary

All test methods offered by the laboratory are validated before use to confirm the procedure works and the data and results achieved meet the goals for the method. The extent of validation performed is based on technology and other factors as defined in the validation SOP (ENV-SOP-CORQ-0011).

Results of validation are retained are kept in accordance with the laboratory's SOP ENV-SOP-LENE-0115, *Control of Records* for retention of technical records.

The need to repeat validation is assessed by laboratory management when there are changes to the test method.

5.4.5.3 Validation of Customer Need

Laboratory management reviews the results of test method validation, which include accuracy, precision, sensitivity, selectivity, linearity, repeatability, reproducibility, robustness, and cross-sensitivity, against general customer needs to ensure the laboratory's procedure for the test method will meet those needs.

The review procedure is detailed in SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification.*

The following subsections highlight some of these concepts:

5.4.5.3.1 Accuracy

Accuracy is the degree to which the result of a measurement, calculation, or specification conforms to the correct value or a standard. When the result recovers within a range from the known value (control limit); the result generated using the laboratory's test method SOP is considered accurate.

5.4.5.3.2 Precision

Precision refers to the closeness of two or more measurements to each other. It is generally measured by calculating the relative percent difference (RPD) or relative standard deviation (RSD) from results of separate analysis of the same sample. Precision provides information about repeatability, reproducibility, and robustness of the laboratory's procedure.

5.4.5.3.3 Limits of Detection (LOD) (Chemistry)

The LOD is the minimum result which can be reliably discriminated from a blank with a predetermined confidence level. The LOD establishes the limit of method sensitivity and is also known as the detection limit (DL) or the method detection limit (MDL).

Values below the LOD cannot be reliably measured and are not reported by the laboratory unless otherwise specified by regulatory program or test method.

The LOD is established during method validation and after major changes to the analytical system or procedure that affect sensitivity are made.

The laboratory's procedure for LOD determination is detailed in laboratory SOP ENV-SOP-LENE-0117, *Limit of Detection*. The SOP complies with 40 CFR 136 Appendix B or the current industry approved and accepted guidance for this process.

5.4.5.3.4 Limits of Quantitation (LOQ) and Reporting Limit (RL)

The LOQ is the minimum level, concentration, or quantity of a target analyte that can be reported with a specified degree of confidence. The LOQ is established at the same time as the LOD.

The laboratory's procedure for determination and verification of the LOQ is detailed in laboratory SOP ENV-SOP-LENE-0117, *Limit of Detection*.

The LLOQ is the value of the lowest calibration standard. The LOQ establishes the lower limit of quantitation.

The LOQ and LLOQ represent quantitative sensitivity of the test method.

- The LOQ must always be equal to or greater than the LLOQ and the LLOQ must always be greater than the LOD.
- Any reported value (detect or non-detect) less than the LLOQ is a qualitative value.

The RL is the value to which the presence of a target analyte is reported as detected or not-detected. The RL is project-defined based on project data quality objectives (DQO). In the absence of project specific requirements, the RL is usually set to the LOQ or the LLOQ. Depending on the relationship of the RL to the LLOQ or LOQ, both the RL value may be or quantitative.

For more information, refer to laboratory SOP SOP-LENE-0117, *Limit of Detection*.

5.4.5.3.5 Linearity

Linearity is a mathematical concept applied to calibration models that employ multiple points to establish a calibration range used for quantitative analysis. Linearity is measured differently based on the calibration model. In general, if linearity is demonstrated than the slope of the response of standards are sufficiently close to one another. The accuracy of the linear regression and non-linear curves is verified by checking percent error or relative standard error (RSE), which is the process of refitting calibration data back to the model to determine if the results are accurate. For linear curves that use average calibration or response factor, error is measured by relative standard difference (RSD).

Linearity also establishes the range of quantitation for the test method used which directly impacts the sensitivity of the test method and uncertainty in measurement results. As previously noted, the LLOQ establishes the lower limit of quantitation. Similarly, the upper range of linearity establishes the upper limit of quantitation. In general, results outside of this range are considered qualitative values. However, some inorganic methods allow for extension of the linear range above the upper limit of quantitation when accuracy at this value is verified.

Linearity can also be used to establish repeatability, reproducibility, and robustness of the laboratory's test method. When linearity is demonstrated using a specific calibration model during method validation, then use of this same calibration model to achieve linearity on a day to day basis confirms the laboratory's method is repeatable, reproducible, and robust.

5.4.5.3.6 Demonstration of Capability (DOC)

The DOC performed during method validation confirms that the test method acceptable precision and accuracy. The procedure used for DOC for method validation is the same as described in section 5.2.2.1.5 for demonstration of analyst capability.

5.4.6 Measurement Uncertainty

The laboratory provides an estimate of uncertainty in testing measurements when required or on client request. In general, the uncertainty of the test method is reflected in the control limits used to evaluate QC performance. (See 5.9.1.1.10). ISO/IEC supports this concept with language that reads when a well-recognized test method specifies limits to the values of the major source of uncertainty of measurement and specifies the form of presentation of calculated results, the laboratory has satisfied the requirements on analytical uncertainty by following the test method and reporting instructions.

When measurement uncertainty cannot be satisfied through control limits, the laboratory will provide a reasonable estimation of uncertainty. A reasonable estimation is based on knowledge of method performance and previous experience. When estimating the analytical uncertainty, all uncertainty components which are of importance in the given situation are taken into account.

5.4.7 Control of Data

The laboratory has policies and processes in place to assure that reported data is free from calculation and transcription errors, that quality control is reviewed and evaluated before data is reported, and to address manual calculation and integration.

5.4.7.1 Calculations, Data Transfer, Reduction and Review

Whenever possible, calculations, transfer of data, and data reduction are performed using validated software programs. (See 5.4.7.2)

If manual calculations are necessary, the results of these calculations are verified during the data review process outlined in section 5.9.3.

5.4.7.1.1 Manual Integration

The laboratory's policy and procedures for manual integration are provided in SOP ENV-SOP-CORQ-0006, *Manual Integration*.

This SOP includes the conditions under which manual integration is allowed and the requirements for documentation.

Required documentation of manual integration includes:

- complete audit trail to permit reconstruction of before and after results;

- identification of the analyst that performed the integration and the reason the integration was performed; and
- the individual(s) that reviewed the integration and verified the integration was done and documented in compliance with the SOP.

5.4.7.2 Use of Computers and Automated Acquisition

Whenever possible the laboratory uses software and automation for the acquisition, processing, recording, reporting, storage, and/or retrieval of data.

Software applications developed by PAS are validated by corporate IT for adequacy before release for general use. Commercial off the shelf software is considered sufficiently validated when the laboratory follows the manufacturer or vendor's manual for set-up and use. Records of validation are kept by the corporate information technology (IT) group or by the local laboratory, whichever group performed the validation.

The laboratory's process for the protection of data stored in electronic systems include:

- Individual user names and passwords for Laboratory Information Management Systems (LIMS) and auxiliary systems used to store or process data.
- Employee Training in Computer Security Awareness
- Validation of spreadsheets used for calculations to verify formulas and logic yield correct results and protection of these cells to prevent unauthorized change.
- Operating system and file access safeguards
- Protection from Computer Viruses
- Regular system backup; and testing of retrieved data

The laboratory's process for software development and testing process includes:

- Verification the software application works as expected and is adequate for use and fulfills compliance requirements, such as the need to record date/time of data generation.
- Change control to assure requests for changes are reviewed and approved by management before the change is made.
- Communication channels to assure all staff are aware of changes made.
- Version Control and maintenance of historical records.

These procedures are detailed in laboratory SOPs ENV-SOP-LENE-0116, *Spreadsheet Validation*. ENV-COR-POL-0010, *IT Policy*, COR-POL-0012, *Pace User Virus Protection Policy*.

5.5 Equipment

5.5.1 Availability of Equipment

The laboratory is furnished with all equipment and instrumentation necessary to correctly perform the tests offered in compliance with the specifications of the test method and to achieve the accuracy and sensitivity required.

5.5.2 Calibration

Equipment and instrumentation is checked prior to use to verify it performs within tolerance for its intended application.

Laboratory management is made aware of the status of equipment and instrumentation and any needs for either on a daily basis. This information is obtained during laboratory walkthroughs (LDM) that are conducted as part of the laboratory's lean program.

5.5.2.1 Support Equipment

The laboratory confirms support equipment is in proper working order and meets the specifications for general laboratory use prior to placement in service and with intermediate checks thereafter. Equipment that does not meet specifications is removed from service until repaired or replaced. Records of repair and maintenance activities are maintained.

Procedures used to carry out and record these checks are outlined laboratory SOP ENV-SOP-LENE-0030, *Support Equipment*.

5.5.2.2 Analytical Instruments

Analytical instruments are checked prior to placement in service in accordance with SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification*. After the initial service date, the calibration of instruments and verification calibration is performed in accordance with local test method SOPs.

The calibration procedures in the test method SOPs comply with the requirements for acceptable calibration practices outlined in corporate document ENV-SOT-CORQ-0026 *Acceptable Calibration Practices*, the reference methods, and any applicable regulatory or program requirements.

5.5.3 Equipment Use and Operation

Equipment is operated and maintained by laboratory personnel that are trained on the test method SOP. Up-to-date instructions and procedures for the use and maintenance of analytical equipment are included in SOPs and/or supplemental documents such as standard work instructions (SWI) or instrument manuals which are made readily accessible in the work area to all laboratory personnel.

5.5.4 Equipment Identification

The laboratory uniquely identifies equipment by serial number or any other unique ID system, when practical. The identifier is included in the equipment list maintained by QA.

5.5.5 Equipment Lists and Records

5.5.5.1 Equipment List

The laboratory maintains a master list of equipment that includes information about the equipment including a description, manufacturer, serial number, date placed in service, condition when received, identity, and the current location in the laboratory. The date of purchase is tracked by the procurement record. The equipment list(s) for each location covered by this manual is provided in Appendix F.

5.5.5.2 Equipment Records

In addition to the equipment list, the laboratory maintains records of equipment that include:

- Verification that equipment conforms with specifications.
- Calibration records including dates, results, acceptance criteria, and next calibration dates.
- Maintenance plan and records
- Records of damage, malfunction, or repair

The laboratory follows an equipment maintenance program designed to optimize performance and to prevent instrument failure which is described in individual test method SOPs.

The maintenance program includes routine maintenance activities which are performed as recommended by the manufacturer at the frequency recommended and non-routine maintenance, which is performed to resolve a specific problem such as degradation of peak resolution, shift in calibration relationship, loss of sensitivity, or repeat failure of instrument performance checks and quality control samples.

Maintenance is performed by laboratory personnel or by outside service providers.

All maintenance activities performed by laboratory personnel are recorded by the individual(s) that performed the activity at the time the maintenance was performed in an instrument maintenance log.

The maintenance record minimally includes the date of maintenance, the initials of the person(s) performing maintenance, a description of the activity performed, why (when the maintenance is non-routine), and the return to analytical control. When maintenance is performed by an external vendor, the laboratory staples the service record into hardcopy maintenance logs or scans the record easy retrieval. The laboratory provides unrestricted access to instrument maintenance logs in order to promote good instrument maintenance and recordkeeping practices.

If an instrument must be moved, the laboratory will use safe practices for handling and transport to minimize damage and contamination.

5.5.6 Out of Service Protocol

Equipment that has been subjected to overloading, mishandling, gives suspect results, has been shown to be defective, or is performing outside of specified limits is taken out of service and either removed from the work area or labeled to prevent accidental use until it has been repaired and verified to perform correctly.

When analytical equipment is taken out of service, the laboratory examines the potential effect it may have had on previous analytical results to identify any non-conforming work. (See section 4.9).

5.5.7 Calibration Status

The laboratory labels support equipment to indicate calibration status, whenever practicable or otherwise maintains the calibration status in a visible location in the work area. These procedures are described in laboratory SOP ENV-SOP-LENE-0113, *Calibration Procedures.*

The calibration status of analytical instruments is documented in the analytical record. Analysts verify on-going acceptability of calibration status prior to use and with instrument performance check standards. These procedures are described in test method SOPs.

5.5.8 Returned Equipment Checks

When equipment or instrument is sent out of the laboratory for service, the laboratory ensures that the function and calibration status of the equipment is checked and shown to be satisfactory before the equipment is returned to service. These procedures are outlined in SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification* and SOP ENV-SOP-LENE-0041*, Instrument Transport.*

5.5.9 Intermediate Equipment Checks

The laboratory performs intermediate checks on equipment to verify the on-going calibration status. For example, most test method require some form of continuing calibration verification check and these procedures are included in the test method SOP. Periodic checks of support equipment are also performed; see appendix E for more information.

5.5.10 Safeguarding Equipment Integrity

The laboratory safeguards equipment integrity using a variety of mechanisms that include but are not limited to:

- Adherence to manufacture's specification for instrument use so that settings do not exceed manufacturer's recommendation or stress the performance of the equipment.
- Established maintenance programs.
- Transparent maintenance records and unrestricted access to maintenance logs.
- Validation and approval of software before use.
- Audits to confirm instrument settings are consistent with SOPs.
- On-the-job training for safe and proper use of laboratory equipment.

5.6 Measurement Traceability

5.6.1 General

Measurement traceability refers to a property of a measurement result whereby the result can be related to a reference through an unbroken chain of calibration, each contributing to the measurement uncertainty. Traceability requires an established calibration hierarchy of equipment (instruments) used during testing including equipment used for subsidiary measurements. The laboratory assures this equipment is calibrated prior to being put into service and that the reference standard and materials used for calibration are traceable to the international standard of units (SI) or national measurement standard.

When strict traceability to SI units cannot be made, the laboratory establishes traceability with the use of reference standards and equipment obtained from competent supplier that provide calibration certificates and/or certificates of analysis (COA).

5.6.2 Equipment Correction Factors

When correction factors are used to adjust results the laboratory will assure that results in computer software are also updated. For example, if the direct instrument or reading output must be corrected based on preparation factor or concentration factors, laboratory management will assure the corrected result is also updated in the software, whenever possible.

5.6.3 Specific Requirements

5.6.3.1 Requirements for Calibration Laboratories

The laboratory does not offer calibration services to customers.

5.6.3.2 Requirements for Testing Laboratories

The laboratory has procedures in place to verify equipment is calibrated prior to being put into service. (See 5.5.2) and ensures the reference standard and materials used for calibration are traceable to the international standard of units (SI) or national measurement standard. When strict traceability to SI units cannot be made, the laboratory establishes traceability with the use of reference standards and equipment obtained from competent suppliers that provide calibration certificates and/or certificates of analysis (COA).

5.6.4 Reference Standards and Reference Materials

5.6.4.1 Reference Standards

The laboratory uses reference standards of measurement to verify adequacy of working weights and thermometers. The working weight is the weight(s) used for daily balance calibration checks and the working thermometers are used for temperature measurements on a daily basis.

Intermediate checks of the working reference measurement standards are performed to verify adequacy between calibrations from an external calibration laboratory. The measurements from working weights and thermometers are compared to measurement taken by the reference standard which is traceable to SI or a national standard. The reference weights and thermometers are used solely for verification purposes unless the laboratory can prove that daily use does not adversely affect performance of the reference standard.

The laboratory performs intermediate checks of the working weights at least annually.

Working thermometers (glass and digital) are checked against the reference thermometer prior to placement in service to establish a correction factor and then rechecked annually (glass) or quarterly (digital) thereafter.

The calibration of liquid in glass reference thermometers is verified every 5 years and the calibration of digital reference thermometers is verified annually by an ISO/IEC 17025 accredited calibration laboratory or service provider that provides traceability to a national standard.

The calibration of the reference weight(s) is verified every 5 years by an ISO/IEC 17025 accredited calibration laboratory.

If criteria for the intermediate checks or recertification is not acceptable, the impact on previously reported results is evaluated using the process for evaluation of nonconforming work (See 4.9)

See laboratory SOP ENV-SOP-LENE-0030, *Support Equipment* for more information about this process.

5.6.4.2 Reference Materials

The laboratory purchases chemical reference materials used (also known as stock standards) from vendors that are accredited to ISO 17034 or Guide 34. Purchased reference materials must be received with a Certificate of Analysis (COA) where available. If a reference material cannot be purchased with a COA, it must be verified by analysis and comparison to a certified reference material and/or there must be a demonstration of capability for characterization. COA are reviewed for adequacy and retained by the laboratory for future reference.

The laboratory procedure for traceability and use of these materials is provided in laboratory SOP ENV-SOP-LENE-0068, *Standard and Reagent Preparation and Traceability*.

This SOP includes each of the following requirements:

- Procedures for documentation of receipt and tracking. The record of entry includes name of the material, the lot number, receipt date, and expiration date.
- Storage conditions and requirements. Reference materials must be stored separately from samples, extracts, and digestates.
- Requirements to assure that preparations of intermediate or working solutions are recorded and assigned a unique identification number for tracking. Records of preparation include the lot number of the stock standard(s) used, the type and lot number of the solvent, the formulation, date, expiration date, and the preparer’s initials. The lot number of the working standards is recorded in the analytical record to provide traceability to the standard preparation record. The

preparation record provides traceability to the COA, which is traceable to SI or the national measurement standard.

- A requirement that the expiration dates of prepared standards may not exceed the expiration date of the parent standard. Standards, reference materials, and reagents are not used after their expiration dates unless their reliability is thoroughly documented and verified by the laboratory. If a standard exceeds its expiration date and is not re-certified, the laboratory removes the standard and/or clearly designates it as acceptable for qualitative/troubleshooting purposes only. All prepared standards, reference materials, and reagents are verified to meet the requirements of the test method through routine analyses of quality control samples.
- The second source materials used for verification of instrument calibration are obtained from a different manufacturer or different lot from the same manufacturer.
- Procedures to check reference materials for degradation and replacement of material if degradation or evaporation is suspected.
- Procedures for labeling. At a minimum the container must identify the material, the ID of the material and the expiration date. Original containers should also be labeled with date opened.

5.6.4.3 Intermediate Checks

Checks to confirm the calibration status of standards and materials are described in laboratory SOPs. These checks, include use of second source standards and reference materials reserved only for the purpose of calibration checks.

5.6.4.4 Transport and Storage

The laboratory handles and transports reference standards and materials in a manner that protects the integrity of the materials. Reference standard and material integrity is protected by separation from incompatible materials and/or minimizing exposure to degrading environments or materials. Standards and reference materials are stored separately from samples, extracts, and digestates. All standards are stored according to the manufacturer's recommended conditions. Temperatures colder than the manufacturer's recommendation are acceptable if it does not compromise the integrity of the material (e.g. remains in liquid state and does not freeze solid). In the event a standard is made from more than a single source with different storage conditions, the standard will be stored according to the conditions specified in the analytical method.

See the applicable analytical SOPs for specific reference material storage and transport protocols.

5.7 Sampling

Sampling refers to the field collection of samples and to subsamples taken by the laboratory for analysis from the field collected sample.

Subsampling procedures are included in SOP ENV-SOP-LENE-0135, *Sample Homogenization and Sub-Sampling*, to assure the aliquot used for testing is representative of the field collected sample.

The requirements in the following subsections apply when field sampling is performed by the laboratory.

5.7.1 Sampling Plans and SOPs

When the laboratory performs field collection of samples, sampling is carried out in accordance with a written sample plan prepared by the customer or by the laboratory and by relevant sampling SOPs. These documents are made readily accessible at the sampling location. Sampling plans and SOPs are, whenever reasonable, based on appropriate governing methods and addresses the factors to be controlled to ensure the validity of the analytical results.

5.7.2 Customer Requested Deviations

When the customer requires deviations, additions, or exclusions from the documented laboratory sampling plan and/or procedure, the laboratory records the client's change request in detail with the sampling record, communicates the change to sampling personnel, and includes this information in the final test report.

5.7.3 Recordkeeping

The laboratory assures the sampling record includes the sampling procedure used, any deviations from the procedure, the date and time of sampling, the identification of the sampler, environmental conditions (if relevant), and the sampling location.

5.8 Sample Management & Handling

5.8.1 Procedures

The laboratory's procedures for sample management and handling are outlined in laboratory SOP ENV-SOP-LENE-0021, *Sample Management*.

The procedures in these SOPs are established to maintain the safe handling and integrity of samples from transport, storage, to disposal and during all processing steps in-between; to maintain client confidentiality, and to protect the interests of PAS and its customers.

5.8.1.1 Chain of Custody

All samples received by the laboratory must be accompanied with a Chain of Custody (COC) record. The COC provides information about the samples collected and submitted for testing and documents the possession of samples from time of collection to receipt by the laboratory.

The COC record must minimally include the following information:

- Client name, address, phone number
- Project Reference
- Client Sample Identification (Client ID)
- Date, Time, and Location of Sampling
- Samplers Name or Initials

- Matrix
- Type of container, and total number collected each sample
- Preservatives
- Analyses Requested
- Mode of collection
- Any special instructions
- The date and time and signature of each sample transfer from time of collection to receipt in the laboratory. When the COC is transported inside the cooler, independent couriers do not sign the COC. Shipping manifests and/or air bills are the records of possession during transport.

A complete and legible COC is required. If the laboratory observes that the COC is incomplete or illegible, the client is contacted for resolution. The COC must be filled out in indelible ink. Personnel correct errors by drawing a single line through the initial entry so the entry is not obscured, entering the correct information, and initialing, and dating the change.

5.8.1.2 Legal Chain of Custody

Legal chain of custody is a chain of custody protocol used for evidentiary or legal purposes. The protocol is followed by the laboratory when requested by customer or where mandated by a regulatory program.

Legal chain of custody (COC) protocol establishes an intact, continuous record of the physical possession*, storage, and disposal of "samples" which includes, sample aliquots, and sample extracts/digestates/distillates.

Legal COC records account for all time periods associated with the samples, and identifies all individuals who physically handled individual samples. Legal COC begins at the point established by legal authority, which is usually at the time the sample containers are provided by the laboratory for sample collect or when sample collection begins.

*A sample is in someone's custody if:

- It is in one's physical possession;
- It is in one's view after being in one's physical possession;
- It has been in one's physical possession and then locked or sealed so that no one can tamper with it; and/or
- It is kept in a secure area, restricted to authorized personnel only.

Refer to laboratory SOP ENV-SOP-LENE-0021, *Sample Management* for more information.

5.8.2 Unique Identification

Each sample is assigned a unique identification number by the laboratory (Lab ID) after the sample has been checked and accepted by the laboratory in accordance with the laboratory's sample acceptance policy (See 5.8.3). the Lab ID is affixed to the sample container using a durable label.

The unique identification of samples also applies to subsamples, and prepared samples, such as extracts, digestates, etc.

The lab ID is linked to the field ID (client ID) in the laboratory's record. Both IDs are linked to the testing activities performed on the sample and the documentation records of the test.

Also see 5.8.4.

5.8.3 Sample Receipt Checks and Sample Acceptance Policy

The laboratory checks the condition and integrity of samples on receipt and compares the labels on the sample containers to the COC record. Any problem or discrepancy is recorded. If the problem impacts the suitability of the sample for analysis or if the documentation is incomplete, the client is notified for resolution. Decisions and instructions from the client are maintained in the project record.

5.8.3.1 Sample Receipt Checks

The following checks are performed:

- Verification that the COC is complete and legible.
- Verification that each sample's container label includes the client sample ID, the date and time of collection and the preservative in indelible ink.
- The container type and preservative is appropriate for each test requested.
- Adequate volume is received for each test requested.
- Visual inspection for damage or evidence of tampering.
- Visual inspection for presence of headspace in VOA vials. (VOA = volatile organic analysis).
- Thermal Preservation: For chemical testing methods for which thermal preservation is required, temperature on receipt is acceptable if the measurement is above freezing but <6°C. For samples that are hand-delivered to the laboratory immediately after sample collection, there must be evidence that the chilling process has begun, such as arrival on ice. The requirements for thermal preservation vary based on the scope of testing performed. For example, for microbiology, temperature on receipt is acceptable if the measurement is <10°C. Refer to the laboratory's SOP for sample receipt for more information.
- Chemical Preservation
- Holding Time: Sample receiving personnel are trained to recognize tests with tests where the holding time is 48 hours or less and to expedite the log-in of these samples. Except for tests with immediate holding times (15 minutes from time

of collection or less), when samples are received out of hold, the laboratory will notify the client and request instruction. If the decision is made to proceed with analysis, the final test report will include notation of this instruction.

5.8.3.2 Sample Acceptance Policy

The laboratory maintains a sample acceptance policy in accordance with regulatory guidelines to clearly establish the circumstances in which sample receipt is accepted or rejected. When receipt does not meet acceptance criteria for any one of these conditions, the laboratory must document the noncompliance, contact the customer, and either reject the samples or fully document any decisions to proceed with testing. In accordance with regulatory specifications, test results associated with receipt conditions that do not meet criteria are qualified in the final test report.

All samples received must meet each of the following:

- Be listed on a complete and legible COC.
- Be received in properly labeled sample containers.
- Be received in appropriate containers that identify preservative.
- The COC must include the date and time of collection for each sample.
- The COC must include the test requested for each sample.
- Be in appropriate sample containers with clear documentation of the preservatives used.
- Be received within holding time. Any samples received beyond the holding time will not be processed without prior customer approval.
- Have sufficient sample volume to proceed with the analytical testing. If insufficient sample volume is received, analysis will not proceed without customer approval.
- Be received within appropriate temperature ranges (not frozen but ≤6°C) unless program requirements or customer contractual obligations mandate otherwise. The cooler temperature is recorded directly on the COC. Samples that are delivered to the laboratory immediately after collection are considered acceptable if there is evidence that the chilling process has been started. For example, by the arrival of the samples on ice. If samples arrive that are not compliant with these temperature requirements, the customer will be notified. The analysis will NOT proceed unless otherwise directed by the customer. If less than 72 hours remain in the hold time for the analysis, the analysis may be started while the customer is contacted to avoid missing the hold time. Data associated with any deviations from the above sample acceptance policy requirements will be appropriately qualified.

5.8.4 Sample Control and Tracking

The samples are controlled and tracked using the Laboratory Information Management System (LIMS). The LIMS stores information about the samples and project. The process of entering information into the LIMS is called login and these procedures are described in laboratory SOP ENV-SOP-LENE-0021, *Sample Management*. After log-in, a label is generated and affixed to each sample container. Information on this label, such as the lab ID, links the sample container to the information in LIMS.

At a minimum, the following information is entered during log-in:

- Client Name and Contact Information;
- The laboratory ID linked to the client ID;
- Date and time of sample collection;
- Date and time of sample receipt;
- Matrix;
- Tests Requested.

5.8.5 Sample Storage, Handling, and Disposal

The laboratory procedures for sample storage, handling and disposal are detailed in laboratory SOPs ENV-SOP-LENE-0021, *Sample Management*.

5.8.5.1 Sample Storage

The samples are stored according to method and regulatory requirements as per test method SOPs. Samples are stored away from all standards, reagents, or other potential sources of contamination and stored in a manner that prevents cross contamination. Volatile samples are stored separately from other samples. All sample fractions, extracts, leachates, and other sample preparation products are stored in the same manner as actual samples or as specified by the analytical method.

Refrigerated storage areas are maintained at ≤6°C (but not frozen) and freezer storage areas are maintained at <-10°C (unless otherwise required per method or program). The temperature of each storage area is checked and documented at least once for each day of use. If the temperature falls outside the acceptable limits, then corrective actions are taken and appropriately documented.

The laboratory is operated under controlled access protocols to ensure sample and data integrity. Visitors must register at the front desk and be properly escorted at all times. Samples are taken to the appropriate storage location immediately after sample receipt and login procedures are completed. All sample storage areas have limited access. Samples are removed from storage areas by designated personnel and returned to the storage areas as soon as possible after the required sample quantity has been taken.

5.8.5.2 Sample Retention and Disposal

The procedures used by the laboratory for sample retention and disposal are detailed in laboratory SOP ENV-SOP-LENE-0021, *Sample Management*.

In general, unused sample volume and prepared samples such as extracts, digestates, distillates and leachates (samples) are retained by the laboratory for the period of time necessary to protect the interests of the laboratory and the customer.

Samples may be stored at ambient temperature when all analyses are complete, the hold time is expired, the report has been delivered, and/or when allowed by the customer or program. Samples requiring storage beyond the minimum sample retention time due to special requests or contractual obligations may be stored at ambient temperature unless the laboratory has sufficient capacity and their presence does not compromise the integrity of other samples.

After this period expires, non-hazardous samples are properly disposed of as non-hazardous waste. The preferred method for disposition of hazardous samples is to return the excess sample to the customer.

5.9 Assuring the Quality of Test Results

5.9.1 Quality Control (QC) Procedures

The laboratory monitors the validity and reliability of test results using quality control (QC) samples that are prepared and analyzed concurrently with field samples in the same manner as field samples. QC results are always associated to and reported with the field samples they were prepared and analyzed with from the same preparation or analytical batch. See the glossary for definition of preparation and analytical batch.

The results of QC performed during the testing process are used by the laboratory to assure the results of analysis are consistent, comparable, accurate, and/or precise within a specified limit. When the results are not within acceptance criteria or expectations for method performance, correction and corrective action(s) are taken. These actions may include retesting or reporting of data with qualification to alert the end user of the situation.

Other QC measures performed include the use of certified reference materials (see 5.6.2), participation in interlaboratory proficiency testing (see 5.9.1.1), verification that formulae used for reduction of data and calculation of results is accurate (see 5.9.3), on-going monitoring of environmental conditions that could impact test results (see 5.3.2), and evaluation and verification of method selectivity and sensitivity (see 5.4.5).

QC results are also used by the laboratory to monitor performance statistical trends over time and to establish acceptance criteria when no method or regulatory criteria exist. (see 5.9.1.4).

5.9.1.1 Essential QC

Although the general principles of QC for the testing process apply to all testing, the QC protocol used for each test depends on the type of test performed.

QC protocol used by the laboratory to monitor the validity of the test are specified in test method SOPs. The SOP includes QC type, frequency, acceptance criteria, corrective actions, and procedures for reporting of nonconforming work.

These requirements in the SOP conform to the reference method and any applicable regulations or certification and accreditation program requirement for which results of the test are used. When a project requires more stringent QC protocol than specified in the SOP, project specification is followed. When the project requires less stringent QC protocol, the project specification may be followed as an authorized departure from the SOP when the project specifications meet the requirements in the mandated method and any regulatory compliance requirements for which the data will be used.

The following are examples of essential QC for Chemistry:

5.9.1.1.1 Second Source Standard (ICV/QCS)

The second source standard is a standard obtained from a different vendor than the vendor of the standards used for calibration. It is a positive control used to verify the accuracy of a new calibration relative to the purity of the standards used for calibration. This check is referred to in test method and quality system standards as the initial calibration verification (ICV) or quality control sample (QCS). The second source standard is analyzed immediately after the calibration and before analysis of any samples. When the ICV is not within acceptance criteria, a problem with the purity or preparation of the standards may be indicated.

5.9.1.1.2 Continuing Calibration Verification (CCV)

CCV is to determine if the analytical response has significantly changed since initial calibration. If the response of the CCV is within criteria, the calibration is considered valid. If not, there is a problem that requires further investigation. Actions taken are technology and method specific.

5.9.1.1.3 Method Blank (MB) / Other Blanks

A method blank is a negative control used to assess for contamination during the prep/analysis process. The MB consists of a clean matrix, similar to the associated samples that is known to be free of analytes of interest. The MB is processed with and carried through all preparation and analytical steps as the associated samples.

In general, contamination is suspected when the target analyte is detected in the MB above the reporting limit. Some programs may require evaluation of the MB to ½ the reporting limit or the detection limit. When contamination is evident, the source is investigated and corrections are taken to reduce or eliminate it. Analytical results associated with MB that does not meet criteria are qualified in the final test report.

Other types of blanks that serve as negative controls in the process may include:

- Trip Blanks (VOA)
- Storage Blanks
- Equipment Blanks
- Field Blanks
- Calibration Blanks
- Cleanup Blanks
- Instrument Blanks

5.9.1.1.4 Laboratory Control Sample (LCS)

The LCS is positive control used to measure the accuracy of process in a blank matrix. The LCS is spiked by the laboratory with a known amount of analyte. The spike is a standard solution that is pre-made or prepared from a certified reference standard. The LCS is processed with and carried through all preparation and analytical steps as the associated samples.

When the percent recovery (%R) of the LCS is within the established control limit, sufficient accuracy has been achieved. If not, the source of the problem is investigated and corrected and the procedure may be repeated. Analytical results associated with LCS that does not meet criteria are qualified in the final test report.

5.9.1.1.5 Matrix Spike (MS) and Matrix Spike Duplicate (MSD)

Matrix spikes measures the effect the sample matrix has on precision and accuracy of the determinative test method. The MS and MSD are replicates of a client sample that is spiked with known amount of target analyte.

Due to the heterogeneity of matrices even of the same general matrix type, matrix spike results mostly provide information on the effect of the matrix to the client whose sample was used and on samples of the same matrix from the same sampling site. Therefore, MS should be client-specific when the impact of matrix on accuracy and precision is a project data quality objective. When there is not a client-specified MS for any sample in the batch, the laboratory randomly selects a sample from the batch; the sample selected at random is called a "batch" matrix spike.

The MS/MSD results for percent recovery and relative percent difference are checked against control limits. Because the performance of matrix spikes is matrix-dependent, the result of the matrix spike is not used to determine the acceptability of the test.

5.9.1.1.6 Sample Duplicate (SD)

A sample duplicate is a second replicate of sample that is prepared and analyzed in the laboratory along another replicate. The SD is used to measure precision.

The relative percent difference between replicates are evaluated against the method or laboratory derived criteria for relative percent difference (RPD), when this criterion is applicable. If RPD is not met, associated test results are reported with qualification.

5.9.1.1.7 Surrogates

Surrogates are compounds that mimic the chemistry of target analytes but are not expected to occur naturally in real world samples. Surrogates are added to each sample and matrix QC samples (MS, MSD, SD) at known concentration to measure the impact of the matrix on the accuracy of method performance. Surrogates are also added to the positive and negative control samples (MB, LCS) to evaluate performance in a clean matrix, and included in the calibration standards and calibration check standards.

The percent recovery of surrogates is evaluated against method-specified limits or statistically derived in-house limits. Project-specific limits and/or program-specific limits are used when required. Results with surrogate recovery out of limits in samples are reported with qualification. Samples with surrogate failures can also be re-extracted and/or re-analyzed to confirm that the out-of-control value was caused by the matrix of the sample and not by some other systematic error.

5.9.1.1.8 Internal Standards

Internal Standards are compounds not expected to occur naturally in field samples. They are added to every standard and sample at a known concentration prior to analysis for the purpose of adjusting the response factor used in quantifying target analytes. The laboratory follows specific guidelines for the treatment of internal standard recoveries and further information can be found in the applicable laboratory SOP.

5.9.1.1.9 QC Acceptance Criteria and Control Limits

The QC acceptance criteria are specified in test method SOPs. The criteria in the SOP are based on the requirements in the published test method or regulatory program. When there are no established acceptance criteria, the laboratory develops acceptance criteria in accordance with recognized industry standards.

Some methods and programs require the laboratory to develop and use control limits for LCS, MS/MS and surrogate evaluation. In laboratory developed limits are referred to as "in-house" control limits. In-house control limits represent ± 3 Standard Deviations (99% confidence level) from the average recovery of at least 20 data points generated using the same preparation and analytical procedure in a similar matrix.

See laboratory SOP ENV-SOP-LENE-0069, *Control Chart Generation*, for more information.

5.9.1.2 Proficiency Testing (PT)

The laboratory participates in interlaboratory proficiency testing (PT) studies to measure performance of the test method and to identify or solve analytical problems. PT samples measure laboratory performance through the analysis of unknown samples provided by an external source.

The PT samples are obtained from accredited proficiency testing providers (PTP) and handled as field samples which means they are included in the laboratory's normal analytical processes and do not receive extraordinary attention due to their nature.

The laboratory does not share PT samples with other laboratories, does not communicate with other laboratories regarding current PT sample results during the duration of the study, and does not attempt to obtain the assigned value of any PT sample from the PT provider.

The laboratory initiates an investigation and corrective action plan whenever PT results are deemed unacceptable by the PT provider.

The frequency of PT participation is based on the certification and accreditation requirements held by the laboratory.

5.9.2 QC Corrective Action

When the results of QC are not within acceptance criteria or expectations for method performance, correction and corrective action(s) are taken per the specifications in the test method SOP. These actions may include retesting or reporting of data with qualification to alert the end user of the situation.

5.9.3 Data Review

The laboratory uses a tiered system for data review. The tiered process provides sequential checks to verify data transfer is complete; manual calculations, if performed, are correct, manual integrations are appropriate and documented, calibration and QC requirements are met, appropriate corrective action was taken when required, test results are properly qualified, process and test method SOPs were followed, project specific requirements were met, when applicable, and the test report is complete.

The sequential process includes three tiers referred to as primary review, secondary review, and administrative/completeness review.

Detailed procedures for the data review process are described in laboratory SOP ENV-SOP-LENE-0088, *Data Reduction, Review and Reporting*. The general expectations for the tiered review process are described in the following sections:

5.9.3.1 Primary Review

Primary review is performed by the individual that performed the task. All laboratory personnel are responsible for review of their work product to assure it is complete, accurate, documented, and consistent with policy and SOPs.

Checks performed during primary review include but are not limited to:

- Verification that data transfer and acquisition is complete
- Manual calculations, if performed, are documented and accurate
- Manual integrations, if performed, are documented and comply with SOP ENV-SOP-CORQ-006 *Manual Integration*

- Calibration and QC criteria were met, and/or proper correction and corrective actions were taken, and data and test results associated with QC and criteria exceptions are properly qualified
- Work is consistent with SOPs and any other relevant instructional document such as SWI, program requirements, or project QAPP

5.9.3.2 Secondary Review

Secondary review is performed by qualified peer or supervisor. Secondary review is essentially a repeat of the checks performed during primary review by another person. In addition to the checks of primary review, secondary review includes chromatography review to check the accuracy of quantitative analyte identification.

5.9.3.3 Completeness Review

Completeness review is an administrative review performed prior to release of the test report to the customer. Completeness review verifies that the final test report is complete and meets project specification. This review also assures that information necessary for the client's interpretation of results are explained in the case narrative or footnoted in the test report.

5.9.3.4 Data Audits

In addition to the 3 tier data review process, test reports may be audited by local QA to verify compliance with SOPs and to check for data integrity, technical accuracy, and regulatory compliance. These audits are not usually done prior to issuance of the test report to the customer. The reports chosen for the data audits are selected at random.

If any problems with the data or test results are found during the data audit, the impact of the nonconforming work is evaluated using the process described in Section 4.9.

Also see Section 4.14 for internal audits.

5.10 Reporting

5.10.1 General Requirements

The laboratory reports results of testing in a way that assures the results are clear, and unambiguous. All data and results are reviewed prior to reporting to assure the results reported are accurate and complete.

Test results are summarized in test reports that include all information necessary for the customer's interpretation of the test results. Additional information necessary to clarify the data or disclose nonconformance, exceptions, or deviations that occurred during the analytical process are also reported to the customer in the test report.

The specifications for test reports and electronic data deliverables (EDD) are established between the laboratory and the customer at the time the request for analytical services is initiated. The report specifications include the test report format, protocol for the reporting limit (RL), conventions for the reporting of results less than the limit of quantitation (LOQ), and specification for the use of project or program specific data qualifiers. Information about review of analytical service requests is provided in Section 4.4.

5.10.2 Test Reports: Required Items

Test Reports are prepared by the laboratory at the end of the testing process. The format of the report depends on the level of reporting requested by the customer. The laboratory offers a variety of standardized test report formats and can also can provide custom test report formats, when necessary.

The level of detail required in the test report depends on the customer's needs for data verification, validation, and usability assessments that occur after the laboratory releases the test report to the customer. The test report formats offered by the laboratory provide gradient levels of detail to meet the unique needs of each customer. The laboratory project manager helps the customer select the test report format that best meets their needs. When a specific report format or protocol is required for a regulatory or program compliance, the laboratory project manager must ensure the test report selected meets those requirements.

Every test report issued by the laboratory includes each of the following items:

a) Title

b) Name and phone number of a point of contact from the laboratory issuing the report.

c) Name and address of the laboratory where testing was performed. When testing is done at multiple locations within network (IRWO), the report must clearly identify which network laboratory performed each test and must include the physical address of each laboratory.

d) Unique identification of the test report and an identifier on each page of the report to link each page to the test report and clear identification of the end of the report.

e) The name and address of the customer

f) Identification of test methods used

g) Cross reference between client sample identification number (Sample ID) and the laboratory's identification number for the sample (Lab ID) to provide unambiguous identification of samples.

h) The date of receipt of samples, condition of samples on receipt, and identification of any instance where receipt of the samples did not meet sample acceptance criteria.

i) Date and times of sample collection, receipt, preparation, and analysis.

j) Test results and units of measurement, and qualification of results associated with QC criteria exceptions, and identification of reported results outside of the calibration range.

k) Name, title, signature of the person(s) authorizing release of the test report and date of release.

l) A statement that the results in the test report relate only to the items tested.

m) Statement that the test report may not be reproduced except in full without written approval from the laboratory.

5.10.3 Test Reports: Supplemental Items

5.10.3.1 Supplemental Requirements

The following items are included in the test report when required or relevant:

a) Explanation of departure from test method SOPs including, what the departure was and why it was necessary.

b) Statistical methods used. (Required for Whole Effluent Toxicity)

c) For solid samples, specification that results are reported on a dry weight or wet weight basis.

d) Signed Affidavit, when required by client or regulatory agency.

e) A statement of compliance / non-compliance with requirements or specifications (client, program, or standard) that includes identification of test results that did not meet acceptance criteria.

f) When requested by the client, statement of estimated measurement uncertainty. In general, for environmental testing, estimated uncertainty of measurement is extrapolated from LCS control limits. Control limits incorporate the expected variation of the data derived from the laboratory's procedure. When the control limits are specified by the test method or regulatory program, the control limits represent the expected variation of the test method and/or matrices for which the test method was designed.

g) Opinions and Interpretations.

h) If a claim of accreditation/certification is included in the test report, identification of any test methods or analytes for which accreditation/certification is not held by the laboratory if the accrediting body offers accreditation/certification for the test method/analyte. The fields of accreditation/certification vary between agencies and it cannot be presumed that because accreditation/certification is not held that it is offered or required.

i) Certification Information, including certificate number and issuing body.

5.10.3.2 Test Reports: Sampling Information

The following items are included in the test report when samples are collected by the laboratory or when this information is necessary for the interpretation of test results:

a) Date of Sampling.

b) Unambiguous identification of material samples.

c) Location of sampling including and diagrams, sketches, or photographs.

d) Reference to the sampling plan and procedures used.

e) Details of environmental conditions at time of sample that may impact test results.

f) Any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned.

5.10.4 Calibration Certificates

The laboratory does not perform calibration activities for its customers and calibration certificates are not offered or issued.

5.10.5 Opinions and Interpretations

The laboratory provides objective data and information to its customers of sufficient detail for their interpretation and decision making. Objective data and information is based solely on fact and does not attempt to explain the meaning (interpret) or offer a view or judgement (opinion). Sometimes the customer may request the laboratory provide opinion or interpretation to assist them with their decisions about the data.

When opinions and interpretations are included in the test report, the laboratory will document the basis upon which the opinions and interpretations have been made and clearly identify this content as opinion or interpretation in the test report.

Examples of opinion and interpretation include but are not limited to:

- The laboratory's viewpoint on how a nonconformance impacts the quality of the data or usability of results.
- The laboratory's judgment of fulfillment of contractual requirements.
- Recommendations for how the customer should use the test results and information.
- Suggestions or guidance to the customer for improvement.

When opinions or interpretations are verbally discussed with the customer, the content of these conversations is summarized by the laboratory and kept in the project record.

5.10.6 Subcontractor Reports

When analytical work has been subcontracted to an organization external to PAS, the test report from the subcontractor is included in its entirety as an amendment to the final test report.

Note: Test results for analytical work performed within the PAS network may be are merged into a single test report. The test report issued clearly identifies the location and address of each network location that performed testing and which tests they performed. (See 5.10.2)

5.10.7 Electronic Transmission of Results

When test results and/or reports are submitted to the customer through electronic transmission, follow the procedures established in this manual for confidentiality and protection of data.

5.10.8 Format of Test Reports

The test formats offered by the laboratory are designed to accommodate each type of analytical test method carried out by the laboratory and to minimize the possibility of misunderstanding or misuse of analytical results. The format of electronic data deliverables (EDD) follow the specifications for the EDD.

5.10.9 Amendments to Test Reports

Test reports that are revised or amended by the laboratory after date of release of the final test report to the customer are issued as a new test report that is clearly identified as an amendment or revision and that includes a reference to the originally issued final test report.

The customer is the organization doing business with PAS external to PAS.

Changes made to test results and data before the final test report is issued to the customer are not amendments or revisions, these are corrections to errors found during the laboratory's data verification and review process,

The laboratory's procedure for report amendments and revision are outlined in laboratory SOP ENV-SOP-LENE-0088, *Data Reduction, Review and Reporting*.

6.0 REVISION HISTORY

This Version:

Section	Description of Change
All	This version is a complete rewrite of the document this version supersedes.

This document supersedes the following documents:

Document Number	Title	Version
ENV-MAN-CORQ-0001	Quality Manual	00

7.0 APPENDICES

7.1 Appendix A: Certification / Accreditation Listing

The certifications / accreditation lists provided in this manual represent those that were held by the named location on the effective date of this manual. This information is subject to change without notice and must not be considered valid proof of certification or accreditation status. Current certificates are maintained by Local QA and a copy of the certificate is posted to PAS's eDMS Portal for access by all PAS employees. External parties should contact the laboratory for the most current information.

7.1.1 PAS-FRON

Authority	Certificate Number
Arkansas Department of Environmental Quality	19-021-0
Arkansas Department of Health	Reciprocity Letter
Florida Department of Health	E871149
Kansas Department of Health and Environment	E-10426
Kansas Department of Health and Environment	E-92729 (Field)
Missouri Department of Natural Resources	10070
Oklahoma Department of Environmental Quality	2019-130
Texas Commission on Environmental Quality	T104704558-19-1

7.1.2 PAS-LENE

Authority	Certificate Number
Arkansas Department of Environmental Quality	19-016-0
Illinois Environmental Protection Agency	004592
Iowa Department of Natural Resources	118
Kansas Department of Health and Environment	E-10116
Kansas Department of Health and Environment	E-92587 (Field)
Louisiana Department of Environmental Quality	03055
Missouri Department of Natural Resources	10090
Nevada Division of Environmental Protection	KS000212020-2
Oklahoma Department of Environmental Quality	2019-132
Texas Commission on Environmental Quality	T104704407-19-12
Utah Department of Health	TBD

7.1.3 PAS-SAL1

Authority	Certificate Number
Kansas Department of Health and Environment	E-10146
Kansas Department of Health and Environment	E-92593 (Field)
Oklahoma Department of Environmental Quality	2019-133
Texas Commission on Environmental Quality	T104704246-18-0

7.1.4 PAS-TULS

Authority	Certificate Number
Oklahoma Department of Environmental Quality	2019-131

7.2 Appendix B: Capability Listing

The capabilities listed in this Appendix were held by the location referenced on the effective date of this manual. This information is subject to change without notice. External parties should contact the laboratory for the most current information.

Table Legend:

- DW = Drinking Water
- NPW = Non-Potable Water
- SCM = Solid and Chemical Materials

7.2.1 PAS-FRON

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Escherichia coli	Colilert®	X	X	
Total coliforms	Colilert®	X		
Escherichia coli	Colilert® Quanti-Tray®	X	X	
Total coliforms	Colilert® Quanti-Tray®	X		
Chronic toxicity	EPA 1000.0		X	
Chronic toxicity	EPA 1002.0		X	
Acute toxicity	EPA 2000.0		X	
Acute toxicity	EPA 2002.0		X	
Acute toxicity	EPA 2021.0		X	
Heterotrophic plate count	SM 9215 B (PCA)	X		
Fecal coliforms	SM 9222 D (m-FC)		X	
Temperature, deg. °C	SM 2550 B		X	
pH	SM 4500-H+ B		X	
Oxygen, dissolved	SM 4500-O G		X	

7.2.2 PAS-LENE

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Ignitability	EPA 1010A		X	
Toxicity Characteristic Leaching Procedure	EPA 1311		X	X
Synthetic Precipitation Leaching Procedure	EPA 1312		X	X
Oil & Grease	EPA 1664A		X	
Aluminum	EPA 200.7	X	X	
Antimony	EPA 200.7		X	
Arsenic	EPA 200.7		X	
Barium	EPA 200.7	X	X	
Beryllium	EPA 200.7		X	

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Boron	EPA 200.7		X	
Cadmium	EPA 200.7	X	X	
Calcium	EPA 200.7	X	X	
Chromium	EPA 200.7	X	X	
Cobalt	EPA 200.7		X	
Copper	EPA 200.7	X	X	
Hardness	EPA 200.7	X	X	
Iron	EPA 200.7	X	X	
Lead	EPA 200.7		X	
Magnesium	EPA 200.7	X	X	
Manganese	EPA 200.7	X	X	
Molybdenum	EPA 200.7		X	
Nickel	EPA 200.7	X	X	
Potassium	EPA 200.7		X	
Selenium	EPA 200.7		X	
Silica-dissolved	EPA 200.7		X	
Silver	EPA 200.7	X	X	
Sodium	EPA 200.7	X	X	
Thallium	EPA 200.7		X	
Tin	EPA 200.7		X	
Titanium	EPA 200.7		X	
Vanadium	EPA 200.7		X	
Zinc	EPA 200.7	X	X	
Zirconium	EPA 200.7		X	
Aluminum	EPA 200.8		X	
Antimony	EPA 200.8		X	
Arsenic	EPA 200.8		X	
Barium	EPA 200.8		X	
Beryllium	EPA 200.8		X	
Cadmium	EPA 200.8		X	
Chromium	EPA 200.8		X	
Cobalt	EPA 200.8		X	
Copper	EPA 200.8	X	X	
Iron	EPA 200.8		X	
Lead	EPA 200.8	X	X	
Manganese	EPA 200.8		X	

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Molybdenum	EPA 200.8		X	
Nickel	EPA 200.8		X	
Selenium	EPA 200.8		X	
Silver	EPA 200.8		X	
Thallium	EPA 200.8		X	
Vanadium	EPA 200.8		X	
Zinc	EPA 200.8		X	
Zirconium	EPA 200.8		X	
Mercury	EPA 245.1	X	X	
Bromide	EPA 300.0		X	
Chloride	EPA 300.0	X	X	
Fluoride	EPA 300.0	X	X	
Nitrate	EPA 300.0	X	X	
Nitrite	EPA 300.0	X	X	
Sulfate	EPA 300.0	X	X	
Ammonia as N	EPA 350.1		X	
Total Kjeldahl Nitrogen (TKN)	EPA 351.2		X	
Nitrate	EPA 353.2	X	X	
Nitrate plus nitrite as N	EPA 353.2		X	
Nitrite	EPA 353.2	X	X	
Organic Nitrogen	EPA 353.2 (calc)	X		
Orthophosphate as P	EPA 365.1	X	X	
Total Phosphorus	EPA 365.4		X	
Chemical Oxygen Demand (COD)	EPA 410.4		X	
Total Phenolics	EPA 420.4		X	
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504.1	X		
1,2-Dibromoethane	EPA 504.1	X		
alpha-BHC	EPA 508	X		
beta-BHC	EPA 508	X		
delta-BHC	EPA 508	X		
gamma-BHC	EPA 508	X		
Hexachlorobenzene	EPA 508	X		
Aluminum	EPA 6010B		X	X
Antimony	EPA 6010B		X	X
Arsenic	EPA 6010B		X	X
Barium	EPA 6010B		X	X

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Beryllium	EPA 6010B		X	X
Boron	EPA 6010B		X	X
Cadmium	EPA 6010B		X	X
Calcium	EPA 6010B		X	X
Chromium	EPA 6010B		X	X
Cobalt	EPA 6010B		X	X
Copper	EPA 6010B		X	X
Iron	EPA 6010B		X	X
Lead	EPA 6010B		X	X
Lithium	EPA 6010B		X	X
Magnesium	EPA 6010B		X	X
Manganese	EPA 6010B		X	X
Molybdenum	EPA 6010B		X	X
Nickel	EPA 6010B		X	X
Potassium	EPA 6010B		X	X
Selenium	EPA 6010B		X	X
Silica as SiO2	EPA 6010B		X	X
Silver	EPA 6010B		X	X
Sodium	EPA 6010B		X	X
Strontium	EPA 6010B		X	X
Thallium	EPA 6010B		X	X
Tin	EPA 6010B		X	X
Titanium	EPA 6010B		X	X
Vanadium	EPA 6010B		X	X
Zinc	EPA 6010B		X	X
Zirconium	EPA 6010B		X	X
Aluminum	EPA 6010C		X	X
Antimony	EPA 6010C		X	X
Arsenic	EPA 6010C		X	X
Barium	EPA 6010C		X	X
Beryllium	EPA 6010C		X	X
Boron	EPA 6010C		X	X
Cadmium	EPA 6010C		X	X
Calcium	EPA 6010C		X	X
Cobalt	EPA 6010C		X	X
Copper	EPA 6010C		X	X

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Iron	EPA 6010C		X	X
Lead	EPA 6010C		X	X
Lithium	EPA 6010C		X	X
Magnesium	EPA 6010C		X	X
Manganese	EPA 6010C		X	X
Molybdenum	EPA 6010C		X	X
Nickel	EPA 6010C		X	X
Potassium	EPA 6010C		X	X
Selenium	EPA 6010C		X	X
Silica as SiO2	EPA 6010C		X	X
Silver	EPA 6010C		X	X
Sodium	EPA 6010C		X	X
Strontium	EPA 6010C		X	X
Thallium	EPA 6010C		X	X
Tin	EPA 6010C		X	X
Titanium	EPA 6010C		X	X
Total Chromium	EPA 6010C		X	X
Vanadium	EPA 6010C		X	X
Zinc	EPA 6010C		X	X
Aluminum	EPA 6020A		X	X
Antimony	EPA 6020A		X	X
Arsenic	EPA 6020A		X	X
Barium	EPA 6020A		X	X
Beryllium	EPA 6020A		X	X
Cadmium	EPA 6020A		X	X
Chromium	EPA 6020A		X	X
Cobalt	EPA 6020A		X	X
Copper	EPA 6020A		X	X
Iron	EPA 6020A		X	X
Lead	EPA 6020A		X	X
Manganese	EPA 6020A		X	X
Mercury	EPA 6020A			X
Molybdenum	EPA 6020A		X	X
Nickel	EPA 6020A		X	X
Selenium	EPA 6020A		X	X
Silver	EPA 6020A		X	X

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Strontium	EPA 6020A		X	X
Thallium	EPA 6020A		X	X
Tin	EPA 6020A		X	X
Titanium	EPA 6020A		X	X
Uranium	EPA 6020A		X	X
Vanadium	EPA 6020A			X
Zinc	EPA 6020A		X	X
alpha-BHC	EPA 608.3		X	
beta-BHC	EPA 608.3		X	
gamma-BHC	EPA 608.3		X	
Aroclor-1016	EPA 608.3		X	
Aroclor-1221	EPA 608.3		X	
Aroclor-1232	EPA 608.3		X	
Aroclor-1242	EPA 608.3		X	
Aroclor-1248	EPA 608.3		X	
Aroclor-1254	EPA 608.3		X	
Aroclor-1260	EPA 608.3		X	
1,1,1,2-Tetrachloroethane	EPA 624.1		X	
1,1,1-Trichloroethane	EPA 624.1		X	
1,1,2,2-Tetrachloroethane	EPA 624.1		X	
1,1,2-Trichloroethane	EPA 624.1		X	
1,1-Dichloroethane	EPA 624.1		X	
1,1-Dichloroethylene	EPA 624.1		X	
1,1-Dichloropropene	EPA 624.1		X	
1,2,3-Trichlorobenzene	EPA 624.1		X	
1,2,3-Trichloropropane	EPA 624.1		X	
1,2,4-Trichlorobenzene	EPA 624.1		X	
1,2,4-Trimethylbenzene	EPA 624.1		X	
1,2-Dibromo-3-chloropropane (DBCP)	EPA 624.1		X	
1,2-Dibromoethane	EPA 624.1		X	
1,2-Dichlorobenzene	EPA 624.1		X	
1,2-Dichloroethane	EPA 624.1		X	
1,2-Dichloropropane	EPA 624.1		X	
1,3,5-Trimethylbenzene	EPA 624.1		X	
1,3-Dichlorobenzene	EPA 624.1		X	
1,3-Dichloropropane	EPA 624.1		X	

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
1,4-Dichlorobenzene	EPA 624.1		X	
1,4-Dioxane	EPA 624.1		X	
2,2-Dichloropropane	EPA 624.1		X	
2-Butanone	EPA 624.1		X	
2-Chloroethyl vinyl ether	EPA 624.1		X	
2-Chlorotoluene	EPA 624.1		X	
2-Hexanone	EPA 624.1		X	
4-Chlorotoluene	EPA 624.1		X	
4-Isopropyltoluene	EPA 624.1		X	
4-Methyl-2-pentanone	EPA 624.1		X	
Acetone	EPA 624.1		X	
Acetonitrile	EPA 624.1		X	
Acrolein (Propenal)	EPA 624.1		X	
Acrylonitrile	EPA 624.1		X	
Benzene	EPA 624.1		X	
Bromobenzene	EPA 624.1		X	
Bromochloromethane	EPA 624.1		X	
Bromodichloromethane	EPA 624.1		X	
Bromoform	EPA 624.1		X	
Carbon disulfide	EPA 624.1		X	
Carbon tetrachloride	EPA 624.1		X	
Chlorobenzene	EPA 624.1		X	
Chlorodibromomethane	EPA 624.1		X	
Chloroethane	EPA 624.1		X	
Chloroform	EPA 624.1		X	
cis-1,2-Dichloroethylene	EPA 624.1		X	
cis-1,3-Dichloropropene	EPA 624.1		X	
Dibromomethane	EPA 624.1		X	
Dichlorodifluoromethane	EPA 624.1		X	
Diethyl ether	EPA 624.1		X	
Di-isopropylether (DIPE)	EPA 624.1		X	
Ethylbenzene	EPA 624.1		X	
Ethyl-t-butylether (ETBE)	EPA 624.1		X	
Gasoline Range Organics (GRO)	EPA 624.1		X	
Hexachlorobutadiene	EPA 624.1		X	
Iodomethane	EPA 624.1		X	

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Isopropylbenzene	EPA 624.1		X	
Methyl bromide (Bromomethane)	EPA 624.1		X	
Methyl chloride (Chloromethane)	EPA 624.1		X	
Methyl tert-butyl ether (MTBE)	EPA 624.1		X	
Methylene chloride	EPA 624.1		X	
m-Xylene	EPA 624.1		X	
Naphthalene	EPA 624.1		X	
n-Butylbenzene	EPA 624.1		X	
n-Propylbenzene	EPA 624.1		X	
o-Xylene	EPA 624.1		X	
p-Xylene	EPA 624.1		X	
sec-Butylbenzene	EPA 624.1		X	
Styrene	EPA 624.1		X	
tert-amyl methyl ether (TAME)	EPA 624.1		X	
tert-Butyl alcohol	EPA 624.1		X	
tert-Butylbenzene	EPA 624.1		X	
Tetrachloroethylene	EPA 624.1		X	
Toluene	EPA 624.1		X	
Total Trihalomethanes (TTHMs)	EPA 624.1		X	
trans-1,2-Dichloroethylene	EPA 624.1		X	
trans-1,3-Dichloropropylene	EPA 624.1		X	
trans-1,4-Dichloro-2-butene	EPA 624.1		X	
Trichloroethene	EPA 624.1		X	
Vinyl acetate	EPA 624.1		X	
Vinyl chloride	EPA 624.1		X	
Trichlorofluoromethane (Freon 11)	EPA 624.1		X	
1,2,4,5-Tetrachlorobenzene	EPA 625.1		X	
1,2,4-Trichlorobenzene	EPA 625.1		X	
1,2-Dichlorobenzene	EPA 625.1		X	
1,3-Dichlorobenzene	EPA 625.1		X	
1,4-Dichlorobenzene	EPA 625.1		X	
2,2'-Oxybis(1-chloropropane)	EPA 625.1		X	
2,3,4,6-Tetrachlorophenol	EPA 625.1		X	
2,4,5-Trichlorophenol	EPA 625.1		X	
2,4,6-Trichlorophenol	EPA 625.1		X	
2,4-Dichlorophenol	EPA 625.1		X	

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
2,4-Dimethylphenol	EPA 625.1		X	
2,4-Dinitrophenol	EPA 625.1		X	
2,4-Dinitrotoluene (2,4-DNT)	EPA 625.1		X	
2,6-Dichlorophenol	EPA 625.1		X	
2,6-Dinitrotoluene (2,6-DNT)	EPA 625.1		X	
2-Chlorophenol	EPA 625.1		X	
2-Methylnaphthalene	EPA 625.1		X	
2-Methylphenol (o-Cresol)	EPA 625.1		X	
2-Nitroaniline	EPA 625.1		X	
2-Nitrophenol	EPA 625.1		X	
3-Methylphenol (m-Cresol)	EPA 625.1		X	
3-Nitroaniline	EPA 625.1		X	
4,6-Dinitro-2-methylphenol	EPA 625.1		X	
4-Chloro-3-methylphenol	EPA 625.1		X	
4-Chloroaniline	EPA 625.1		X	
4-Chlorophenyl phenylether	EPA 625.1		X	
4-Methylphenol (p-Cresol)	EPA 625.1		X	
4-Nitroaniline	EPA 625.1		X	
4-Nitrophenol	EPA 625.1		X	
7,12-Dimethylbenz(a)anthracene	EPA 625.1		X	
Acenaphthene	EPA 625.1		X	
Acenaphthylene	EPA 625.1		X	
Aniline	EPA 625.1		X	
Anthracene	EPA 625.1		X	
Azobenzene	EPA 625.1		X	
Benzidine	EPA 625.1		X	
Benzo(a)anthracene	EPA 625.1		X	
Benzo(a)pyrene	EPA 625.1		X	
Benzo(g,h,i)perylene	EPA 625.1		X	
Benzo(k)fluoranthene	EPA 625.1		X	
Benzo[b]fluoranthene	EPA 625.1		X	
Benzoic acid	EPA 625.1		X	
Benzyl alcohol	EPA 625.1		X	
bis(2-Chloroethoxy)methane	EPA 625.1		X	
bis(2-Chloroethyl) ether	EPA 625.1		X	
bis(2-Ethylhexyl)phthalate	EPA 625.1		X	

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Butyl benzyl phthalate	EPA 625.1		X	
Carbazole	EPA 625.1		X	
Chrysene	EPA 625.1		X	
Dibenz(a, j) acridine	EPA 625.1		X	
Dibenz(a,h) anthracene	EPA 625.1		X	
Dibenzofuran	EPA 625.1		X	
Diethyl phthalate	EPA 625.1		X	
Dimethyl phthalate	EPA 625.1		X	
Di-n-butyl phthalate	EPA 625.1		X	
Di-n-octyl phthalate	EPA 625.1		X	
Fluoranthene	EPA 625.1		X	
Fluorene	EPA 625.1		X	
Hexachlorobenzene	EPA 625.1		X	
Hexachlorobutadiene	EPA 625.1		X	
Hexachlorocyclopentadiene	EPA 625.1		X	
Hexachloroethane	EPA 625.1		X	
Indeno(1,2,3-cd) pyrene	EPA 625.1		X	
Isophorone	EPA 625.1		X	
Naphthalene	EPA 625.1		X	
Nitrobenzene	EPA 625.1		X	
n-Nitrosodimethylamine	EPA 625.1		X	
n-Nitroso-di-n-butylamine	EPA 625.1		X	
n-Nitrosodi-n-propylamine	EPA 625.1		X	
n-Nitrosodiphenylamine	EPA 625.1		X	
n-Nitrosomethylethylamine	EPA 625.1		X	
Pentachlorophenol	EPA 625.1		X	
Phenanthrene	EPA 625.1		X	
Phenol	EPA 625.1		X	
Pyrene	EPA 625.1		X	
Pyridine	EPA 625.1		X	
3,3'-Dichlorobenzidine	EPA 625.1		X	
4-Bromophenyl phenyl ether (BDE-3)	EPA 625.1		X	
Chromium (VI)	EPA 7196A		X	
Mercury	EPA 7470A		X	X
Mercury	EPA 7471B		X	X
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011		X	

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
1,2-Dibromoethane	EPA 8011		X	
Diesel Range Organics (GRO)	EPA 8015B		X	X
Gasoline Range Organics (GRO)	EPA 8015B		X	X
Diesel Range Organics (GRO)	EPA 8015C		X	X
Gasoline Range Organics (GRO)	EPA 8015C		X	X
Aroclor-1016	EPA 8082		X	X
Aroclor-1221	EPA 8082		X	X
Aroclor-1232	EPA 8082		X	X
Aroclor-1242	EPA 8082		X	X
Aroclor-1248	EPA 8082		X	X
Aroclor-1254	EPA 8082		X	X
Aroclor-1260	EPA 8082		X	X
1,2,3,4-Tetrachlorobenzene	EPA 8121		X	X
1,2,3,5-Tetrachlorobenzene	EPA 8121		X	X
1,2,3-Trichlorobenzene	EPA 8121		X	X
1,2,4,5-Tetrachlorobenzene	EPA 8121		X	X
1,2,4-Trichlorobenzene	EPA 8121		X	X
1,2-Dichlorobenzene	EPA 8121		X	X
1,3,5-Trichlorobenzene	EPA 8121		X	X
1,3-Dichlorobenzene	EPA 8121		X	X
1,4-Dichlorobenzene	EPA 8121		X	X
2-Chloronaphthalene	EPA 8121		X	X
alpha-BHC	EPA 8121		X	X
Benzal chloride	EPA 8121		X	X
Benzotrichloride	EPA 8121		X	X
Benzyl chloride	EPA 8121		X	X
beta-BHC	EPA 8121		X	X
delta-BHC	EPA 8121		X	X
gamma-BHC	EPA 8121		X	X
Hexachlorobenzene	EPA 8121		X	X
Hexachlorobutadiene	EPA 8121		X	X
Hexachlorocyclopentadiene	EPA 8121		X	X
Hexachloroethane	EPA 8121		X	X
Pentachlorobenzene	EPA 8121		X	X
1,1,1,2-Tetrachloroethane	EPA 8260B		X	X
1,1,1-Trichloroethane	EPA 8260B		X	X

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
1,1,2,2-Tetrachloroethane	EPA 8260B		X	X
1,1,2-Trichloroethane	EPA 8260B		X	X
1,1-Dichloroethane	EPA 8260B		X	X
1,1-Dichloroethylene	EPA 8260B		X	X
1,1-Dichloropropene	EPA 8260B		X	X
1,2,3-Trichlorobenzene	EPA 8260B		X	X
1,2,3-Trichloropropane	EPA 8260B		X	X
1,2,4-Trichlorobenzene	EPA 8260B		X	X
1,2,4-Trimethylbenzene	EPA 8260B		X	X
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260B		X	X
1,2-Dibromoethane	EPA 8260B		X	X
1,2-Dichlorobenzene	EPA 8260B		X	X
1,2-Dichloroethane	EPA 8260B		X	X
1,2-Dichloropropane	EPA 8260B		X	X
1,3,5-Trimethylbenzene	EPA 8260B		X	X
1,3-Dichlorobenzene	EPA 8260B		X	X
1,3-Dichloropropane	EPA 8260B		X	X
1,4-Dichlorobenzene	EPA 8260B		X	X
1,4-Dioxane	EPA 8260B		X	X
2,2-Dichloropropane	EPA 8260B		X	X
2-Butanone	EPA 8260B		X	X
2-Chloroethyl vinyl ether	EPA 8260B		X	X
2-Chlorotoluene	EPA 8260B		X	X
2-Hexanone	EPA 8260B		X	X
4-Chlorotoluene	EPA 8260B		X	X
4-Isopropyltoluene	EPA 8260B		X	X
4-Methyl-2-pentanone	EPA 8260B		X	X
Acetone	EPA 8260B		X	X
Acetonitrile	EPA 8260B		X	X
Acrolein (Propenal)	EPA 8260B		X	X
Acrylonitrile	EPA 8260B		X	X
Benzene	EPA 8260B		X	X
Bromobenzene	EPA 8260B		X	X
Bromochloromethane	EPA 8260B		X	X
Bromodichloromethane	EPA 8260B		X	X
Bromoform	EPA 8260B		X	X

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Carbon disulfide	EPA 8260B		X	X
Carbon tetrachloride	EPA 8260B		X	X
Chlorobenzene	EPA 8260B		X	X
Chlorodibromomethane	EPA 8260B		X	X
Chloroethane	EPA 8260B		X	X
Chloroform	EPA 8260B		X	X
cis-1,2-Dichloroethylene	EPA 8260B		X	X
cis-1,3-Dichloropropene	EPA 8260B		X	X
Dibromomethane	EPA 8260B		X	X
Dichlorodifluoromethane	EPA 8260B		X	X
Diethyl ether	EPA 8260B		X	X
Di-isopropylether (DIPE)	EPA 8260B		X	X
Ethylbenzene	EPA 8260B		X	X
Ethyl-t-butylether (ETBE)	EPA 8260B		X	X
Gasoline Range Organics (GRO)	EPA 8260B		X	X
Hexachlorobutadiene	EPA 8260B		X	X
Iodomethane (Methyl iodide)	EPA 8260B		X	X
Isopropylbenzene	EPA 8260B		X	X
Methyl bromide (Bromomethane)	EPA 8260B		X	X
Methyl chloride (Chloromethane)	EPA 8260B		X	X
Methyl tert-butyl ether (MTBE)	EPA 8260B		X	X
Methylene chloride	EPA 8260B		X	X
m-Xylene	EPA 8260B		X	X
Naphthalene	EPA 8260B		X	X
n-Butylbenzene	EPA 8260B		X	X
n-Propylbenzene	EPA 8260B		X	X
o-Xylene	EPA 8260B		X	X
p-Xylene	EPA 8260B		X	X
sec-Butylbenzene	EPA 8260B		X	X
Styrene	EPA 8260B		X	X
tert-amyl methyl ether (TAME)	EPA 8260B		X	X
tert-Butyl alcohol	EPA 8260B		X	X
tert-Butylbenzene	EPA 8260B		X	X
Tetrachloroethylene	EPA 8260B		X	X
Toluene	EPA 8260B		X	X
trans-1,2-Dichloroethylene	EPA 8260B		X	X

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
trans-1,3-Dichloropropylene	EPA 8260B		X	X
trans-1,4-Dichloro-2-butene	EPA 8260B		X	X
Trichloroethene	EPA 8260B		X	X
Vinyl acetate	EPA 8260B		X	X
Vinyl chloride	EPA 8260B		X	X
Trichlorofluoromethane (Freon 11)	EPA 8260B		X	X
1,2,4,5-Tetrachlorobenzene	EPA 8270C		X	X
1,2,4-Trichlorobenzene	EPA 8270C		X	X
1,2-Dichlorobenzene	EPA 8270C		X	X
1,3-Dichlorobenzene	EPA 8270C		X	X
1,4-Dichlorobenzene	EPA 8270C		X	X
2,2'-Oxybis(1-chloropropane)	EPA 8270C		X	X
2,3,4,5-Tetrachlorophenol	EPA 8270C		X	X
2,3,4,6-Tetrachlorophenol	EPA 8270C		X	X
2,3,4-Trichlorophenol	EPA 8270C		X	X
2,3,5,6-Tetrachlorophenol	EPA 8270C		X	X
2,4,5-Trichlorophenol	EPA 8270C		X	X
2,4,6-Trichlorophenol	EPA 8270C		X	X
2,4-Dichlorophenol	EPA 8270C		X	X
2,4-Dimethylphenol	EPA 8270C		X	X
2,4-Dimethylphenol	EPA 8270C		X	X
2,4-Dinitrophenol	EPA 8270C		X	X
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270C		X	X
2,5-Dichlorophenol	EPA 8270C		X	X
2,5-Dimethylphenol	EPA 8270C		X	X
2,6-Dichlorophenol	EPA 8270C		X	X
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270C		X	X
2-Chloronaphthalene	EPA 8270C		X	X
2-Chlorophenol	EPA 8270C		X	X
2-Methylnaphthalene	EPA 8270C		X	X
2-Methylphenol (o-Cresol)	EPA 8270C		X	X
2-Nitroaniline	EPA 8270C		X	X
2-Nitrophenol	EPA 8270C		X	X
3,4,5-Trichlorophenol	EPA 8270C		X	X
3,4-Dichlorophenol	EPA 8270C		X	X
3-Chlorophenol	EPA 8270C		X	X

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
3-Methylphenol (m-Cresol)	EPA 8270C		X	X
3-Nitroaniline	EPA 8270C		X	X
4,6-Dinitro-2-methylphenol	EPA 8270C		X	X
4-Chloro-3-methylphenol	EPA 8270C		X	X
4-Chloroaniline	EPA 8270C		X	X
4-Chlorophenol	EPA 8270C		X	X
4-Chlorophenyl phenylether	EPA 8270C		X	X
4-Methylphenol (p-Cresol)	EPA 8270C		X	X
4-Nitroaniline	EPA 8270C		X	X
4-Nitrophenol	EPA 8270C		X	X
7,12-Dimethylbenz(a)anthracene	EPA 8270C		X	X
Acenaphthene	EPA 8270C		X	X
Acenaphthylene	EPA 8270C		X	X
Aniline	EPA 8270C		X	X
Anthracene	EPA 8270C		X	X
Azobenzene	EPA 8270C		X	X
Benzidine	EPA 8270C		X	X
Benzo(a)anthracene	EPA 8270C		X	X
Benzo(a)pyrene	EPA 8270C		X	X
Benzo(g,h,i)perylene	EPA 8270C		X	X
Benzo(k)fluoranthene	EPA 8270C		X	X
Benzo[b]fluoranthene	EPA 8270C		X	X
Benzoic acid	EPA 8270C		X	X
Benzyl alcohol	EPA 8270C		X	X
bis(2-Chloroethoxy)methane	EPA 8270C		X	X
bis(2-Chloroethyl) ether	EPA 8270C		X	X
bis(2-Ethylhexyl)adipate	EPA 8270C		X	X
bis(2-Ethylhexyl)phthalate	EPA 8270C		X	X
Butyl benzyl phthalate	EPA 8270C		X	X
Carbazole	EPA 8270C		X	X
Chrysene	EPA 8270C		X	X
Dibenz(a, h) acridine	EPA 8270C		X	X
Dibenz(a, j) acridine	EPA 8270C		X	X
Dibenz(a,h) anthracene	EPA 8270C		X	X
Dibenzofuran	EPA 8270C		X	X
Diethyl phthalate	EPA 8270C		X	X

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Dimethyl phthalate	EPA 8270C		X	X
Di-n-butyl phthalate	EPA 8270C		X	X
Di-n-octyl phthalate	EPA 8270C		X	X
Fluoranthene	EPA 8270C		X	X
Fluorene	EPA 8270C		X	X
Hexachlorobenzene	EPA 8270C		X	X
Hexachlorobutadiene	EPA 8270C		X	X
Hexachlorocyclopentadiene	EPA 8270C		X	X
Hexachloroethane	EPA 8270C		X	X
Indeno(1,2,3-cd) pyrene	EPA 8270C		X	X
Isophorone	EPA 8270C		X	X
Naphthalene	EPA 8270C		X	X
Nitrobenzene	EPA 8270C		X	X
n-Nitrosodimethylamine	EPA 8270C		X	X
n-Nitroso-di-n-butylamine	EPA 8270C		X	X
n-Nitrosodi-n-propylamine	EPA 8270C		X	X
n-Nitrosodiphenylamine	EPA 8270C		X	X
n-Nitrosomethylethylamine	EPA 8270C		X	X
Pentachlorophenol	EPA 8270C		X	X
Phenanthrene	EPA 8270C		X	X
Phenol	EPA 8270C		X	X
Pyrene	EPA 8270C		X	X
Pyridine	EPA 8270C		X	X
Quinoline	EPA 8270C		X	X
3,3'-Dichlorobenzidine	EPA 8270C		X	X
4-Bromophenyl phenyl ether (BDE-3)	EPA 8270C		X	X
1,4-Dioxane	EPA 8270C SIM		X	X
1-Methylnaphthalene	EPA 8270C SIM		X	X
2-Methylnaphthalene	EPA 8270C SIM		X	X
Acenaphthene	EPA 8270C SIM		X	X
Acenaphthylene	EPA 8270C SIM		X	X
Anthracene	EPA 8270C SIM		X	X
Benzo(a)anthracene	EPA 8270C SIM		X	X
Benzo(a)pyrene	EPA 8270C SIM		X	X
Benzo(g,h,i)perylene	EPA 8270C SIM		X	X
Benzo(k)fluoranthene	EPA 8270C SIM		X	X

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Benzo[b]fluoranthene	EPA 8270C SIM		X	X
Chrysene	EPA 8270C SIM		X	X
Dibenz(a,h) anthracene	EPA 8270C SIM		X	X
Fluoranthene	EPA 8270C SIM		X	X
Fluorene	EPA 8270C SIM		X	X
Indeno(1,2,3-cd) pyrene	EPA 8270C SIM		X	X
Naphthalene	EPA 8270C SIM		X	X
Phenanthrene	EPA 8270C SIM		X	X
Pyrene	EPA 8270C SIM		X	X
Amenable Cyanide	EPA 9012A		X	X
Total Cyanide	EPA 9012A		X	X
pH	EPA 9040B		X	
pH	EPA 9045C			X
Conductivity	EPA 9050A		X	X
Bromide	EPA 9056A		X	X
Chloride	EPA 9056A		X	X
Fluoride	EPA 9056A		X	X
Nitrate	EPA 9056A		X	X
Nitrite	EPA 9056A		X	X
Sulfate	EPA 9056A		X	X
Total Phenolics	EPA 9066		X	X
Oil & Grease	EPA 9070A		X	
Oil & Grease	EPA 9071B		X	X
Cation exchange capacity	EPA 9081		X	
Paint Filter Test	EPA 9095B		X	X
Benzene	IDNR OA-1		X	X
Ethylbenzene	IDNR OA-1		X	X
Methyl tert-butyl ether	IDNR OA-1		X	X
Toluene	IDNR OA-1		X	X
Volatile Petroleum Hydrocarbons	IDNR OA-1		X	X
Xylenes (Total)	IDNR OA-1		X	X
Total Extractable Hydrocarbons	IDNR OA-2		X	X
Total Petroleum Hydrocarbons C5 - C8	KS LRH		X	X
Total Petroleum Hydrocarbons C19 - C35	KS MRH/HRH		X	X
Total Petroleum Hydrocarbons C9 - C18	KS MRH/HRH		X	X
Diesel range organics	OK DEQ DRO		X	X

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Gasoline range organics	OK DEQ GRO		X	X
Color	SM 2120 B	X	X	
Acidity, as CaCO3	SM 2310 B		X	
Alkalinity as CaCO3	SM 2320 B	X	X	
Hardness	SM 2340 B	X	X	
Residue-total (TS)	SM 2540 B		X	
Residue-filterable (TDS)	SM 2540 C	X	X	
Residue-nonfilterable (TSS)	SM 2540 D		X	
Residue-settleable	SM 2540 F		X	
Total, Fixed, and Volatile Residue	SM 2540 G		X	
Temperature, deg. C	SM 2550 B	X	X	
Specific Oxygen Uptake Rate (SOUR)	SM 2710 B		X	
Chromium (VI)	SM 3500-Cr B		X	
Iron (II)	SM 3500-Fe B		X	
Chloride	SM 4500-Cl E		X	
Total Residual Chlorine	SM 4500-Cl G	X	X	
Cyanide	SM 4500-CN^- E	X		
Total Cyanide	SM 4500-CN^- E		X	
Available Cyanide	SM 4500-CN^- G		X	
Weak Acid Dissociable Cyanide	SM 4500-CN^- I		X	
pH	SM 4500-H+ B	X	X	
Oxygen, dissolved	SM 4500-O G		X	
Sulfide	SM 4500-$S2^-$ D		X	
Sulfide	SM 4500-$S2^-$ F		X	
Sulfite-SO3	SM 4500-$SO3^-$ B		X	
Biochemical Oxygen Demand (BOD)	SM 5210 B		X	
Carbonaceous BOD (CBOD)	SM 5210 B		X	
Total Organic Carbon (TOC)	SM 5310 C	X	X	
Surfactants – MBAS	SM 5540 C		X	
Total Petroleum Hydrocarbons (TPH)	TNRCC 1005		X	X

7.2.3 PAS-SAL1

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Bromide	EPA 300.0		X	
Chloride	EPA 300.0	X	X	

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Fluoride	EPA 300.0	X	X	
Nitrate	EPA 300.0	X	X	
Nitrate plus nitrite as N	EPA 300.0		X	
Nitrite	EPA 300.0	X	X	
Sulfate	EPA 300.0	X	X	
Chromium (VI)	EPA 7196A		X	X
pH	EPA 9040C		X	
pH	EPA 9045D			X
Bromide	EPA 9056A		X	X
Chloride	EPA 9056A		X	X
Fluoride	EPA 9056A		X	X
Nitrate	EPA 9056A		X	X
Nitrite	EPA 9056A		X	X
Sulfate	EPA 9056A		X	X
Chromium (VI)	HACH 8023		X	
Total Residual Chlorine	HACH 8167	X	X	
Color	SM 2120 B	X		
Turbidity	SM 2130 B	X	X	
Residue-nonfilterable (TSS)	SM 2540 D		X	
Residue-settleable	SM 2540 F		X	
Total, Fixed, and Volatile Residue	SM 2540 G		X	
Temperature, deg. C	SM 2550 B		X	
Specific Oxygen Uptake Rate	SM 2710 B		X	
Chromium (VI)	SM 3500-Cr B		X	
Free Chlorine	SM 4500-Cl G	X		
Total Residual Chlorine	SM 4500-Cl G	X	X	
pH	SM 4500-H+ B	X	X	
Oxygen, dissolved	SM 4500-O G		X	
Orthophosphate as P	SM 4500-P E		X	
Orthophosphate as P	SM 4500-P G		X	
Biochemical Oxygen Demand	SM 5210 B		X	
Carbonaceous BOD	SM 5210 B		X	
Heterotrophic plate count	SM 9215 E (SimPlate®)	X		
Fecal coliforms	SM 9222 D (m-FC)		X	
Escherichia coli (E. coli)	SM 9223 B (Colilert® Quanti-Tray®)	X	X	
Escherichia coli (E. coli)	SM 9223 B (Colilert®)	X	X	
Total coliforms	SM 9223 B (Colilert®)	X		

7.2.4 PAS-TULS

		Matrices		
Parameter	**Method**	**DW**	**NPW**	**SCM**
Temperature, deg. °C	SM 2550 B		X	
pH	SM 4500-H+ B		X	

7.3 Appendix C: Glossary

This glossary provides common terms and definitions used in the laboratory. **It is not intended to be a complete list of all terms and definitions used.** The definitions have been compiled mostly from the TNI Standard and DoD QSM. Although this information has been reproduced with care, errors cannot be entirely excluded. Definitions for the same term also vary between sources. When the meaning of a term used in a laboratory document is different from this glossary or when the glossary does not include the term, the term and definition is included or defined in context in the laboratory document.

Term	**Definition**
3P Program	PAS-The continuous improvement program used by PAS that focuses on Process, Productivity, and Performance.
Acceptance Criteria	TNI- Specified limits placed on characteristics of an item, process, or service defined in requirement documents.
Accreditation	TNI- The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. DoD- Refers to accreditation in accordance with the DoD ELAP.
Accreditation Body (AB)	TNI- The organization having responsibility and accountability for environmental laboratory accreditation and which grants accreditation under this program. DoD- Entities recognized in accordance with the DoD-ELAP that are required to operate in accordance with ISO/IEC 17011, *Conformity assessment: General requirements for accreditation bodies accrediting conformity assessment bodies.* The AB must be a signatory, in good standing, to the International Laboratory Accreditation Cooperation (ILAC) mutual recognition arrangement (MRA) that verifies, by evaluation and peer assessment, that its signatory members are in full compliance with ISO/IEC 17011 and that its accredited laboratories comply with ISO/IEC 17025.
Accuracy	TNI- The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.
Activity, Absolute	TNI- Rate of nuclear decay occurring in a body of material, equal to the number of nuclear disintegrations per unit time. NOTE: Activity (absolute) may be expressed in becquerels (Bq), curies (Ci), or disintegrations per minute (dpm), and multiples or submultiples of these units.
Activity, Areic	TNI- Quotient of the activity of a body of material and its associated area.
Activity, Massic	TNI- Quotient of the activity of a body of material and its mass; also called specific activity.
Activity, Volumic	TNI- Quotient of the activity of a body of material and its volume; also called activity concentration. NOTE: In this module [TNI Volume 1, Module 6], unless otherwise stated, references to activity shall include absolute activity, areic activity, massic activity, and volumic activity.
Activity Reference Date	TNI- The date (and time, as appropriate to the half-life of the radionuclide) to which a reported activity result is calculated. NOTE: The sample collection date is most frequently used as the Activity Reference Date for environmental measurements, but different programs may specify other points in time for correction of results for decay and ingrowth.
Aliquot	DoD- A discrete, measured, representative portion of a sample taken for analysis.
American Society for Testing and Materials (ASTM)	An international standards organization that develops and publishes voluntary consensus standards for a wide range of materials, products, systems and services.
Analysis	DoD- A combination of sample preparation and instrument determination.

Analysis Code (Acode)	All the set parameters of a test, such as Analytes, Method, Detection Limits and Price.
Analysis Sequence	A compilation of all samples, standards and quality control samples run during a specific amount of time on a particular instrument in the order they are analyzed.
Analyst	TNI- The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.
Analyte	TNI- A substance, organism, physical parameter, property, or chemical constituent(s) for which an environmental sample is being analyzed. DoD- The specific chemicals or components for which a sample is analyzed; it may be a group of chemicals that belong to the same chemical family and are analyzed together.
Analytical Method	DoD- A formal process that identifies and quantifies the chemical components of interest (target analytes) in a sample.
Analytical Uncertainty	TNI- A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.
Aliquot	DoD- A discrete, measured, representative portion of a sample taken for analysis.
Annual (or Annually)	Defined by PAS as every 12 months ± 30 days.
Assessment	TNI - The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its system to defined criteria (to the standards and requirements of laboratory accreditation). DoD- An all-inclusive term used to denote any of the following: audit, performance evaluation, peer review, inspection, or surveillance conducted on-site.
Atomic Absorption Spectrometer	Instrument used to measure concentration in metals samples.
Atomization	A process in which a sample is converted to free atoms.
Audit	TNI- A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives.
Batch	TNI- Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same quality systems matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours or the time-frame specified by the regulatory program. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed 20 samples.
Batch, Radiation Measurements (RMB)	TNI- An RMB is composed of 1 to 20 environmental samples that are counted directly without preliminary physical or chemical processing that affects the outcome of the test (e.g., non-destructive gamma spectrometry, alpha/beta counting of air filters, or swipes on gas proportional detectors). The samples in an RMB share similar physical and chemical parameter, and analytical configurations (e.g., analytes, geometry, calibration, and background corrections). The maximum time between the start of processing of the first and last in an RMB is 14 calendar days.
Bias	TNI- The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).
Blank	TNI and DoD- A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results (See Method Blank). DoD- Blank samples are negative control samples, which typically include field blank samples (e.g., trip blank, equipment (rinsate) blank, and temperature blank) and laboratory blank samples (e.g., method blank, reagent blank, instrument blank, calibration blank, and storage blank).
Blind Sample	A sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.
BNA (Base Neutral Acid compounds)	A list of semi-volatile compounds typically analyzed by mass spectrometry methods. Named for the way they can be extracted out of environmental samples in an acidic, basic or neutral environment.
BOD (Biochemical Oxygen Demand)	Chemical procedure for determining how fast biological organisms use up oxygen in a body of water.

Calibration	TNI- A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. 1) In calibration of support equipment, the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI); 2) In calibration according to test methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.
Calibration Curve	TNI- The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.
Calibration Method	A defined technical procedure for performing a calibration.
Calibration Range	DoD- The range of values (concentrations) between the lowest and highest calibration standards of a multi-level calibration curve. For metals analysis with a single-point calibration, the low-level calibration check standard and the high standard establish the linear calibration range, which lies within the linear dynamic range.
Calibration Standard	TNI- A substance or reference material used for calibration.
Certified Reference Material (CRM)	TNI- Reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute.
Chain of Custody	An unbroken trail of accountability that verifies the physical security of samples, data, and records.
Chain of Custody Form (COC)	TNI- Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and type of containers; the mode of collection, the collector, time of collection; preservation; and requested analyses.
Chemical Oxygen Demand (COD)	A test commonly used to indirectly measure the amount of organic compounds in water.
Client (referred to by ISO as Customer)	Any individual or organization for whom items or services are furnished or work performed in response to defined requirements and expectations.
Code of Federal Regulations (CFR)	A codification of the general and permanent rules published in the Federal Register by agencies of the federal government.
Comparability	An assessment of the confidence with which one data set can be compared to another. Comparable data are produced through the use of standardized procedures and techniques.
Completeness	The percent of valid data obtained from a measurement system compared to the amount of valid data expected under normal conditions. The equation for completeness is: % Completeness = (Valid Data Points/Expected Data Points)*100
Confirmation	TNI- Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to: second-column confirmation; alternate wavelength; derivatization; mass spectral interpretation; alternative detectors; or additional cleanup procedures. DoD- Includes verification of the identity and quantity of the analyte being measured by another means (e.g., by another determinative method, technology, or column). Additional cleanup procedures alone are not considered confirmation techniques.
Conformance	An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.
Congener	A member of a class of related chemical compounds (e.g., PCBs, PCDDs).
Consensus Standard	DoD- A standard established by a group representing a cross-section of a particular industry or trade, or a part thereof.
Continuing Calibration Blank (CCB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method.
Continuing Calibration Check Compounds (CCC)	Compounds listed in mass spectrometry methods that are used to evaluate an instrument calibration from the standpoint of the integrity of the system. High variability would suggest leaks or active sites on the instrument column.
Continuing Calibration Verification	DoD- The verification of the initial calibration. Required prior to sample analysis and at periodic intervals. Continuing calibration verification applies to both external and internal standard calibration techniques, as well as to linear and non-linear calibration models.
Continuing Calibration Verification (CCV) Standard	Also referred to as a Calibration Verification Standard (CVS) in some methods, it is a standard used to verify the initial calibration of compounds in an analytical method. CCVs are analyzed at a frequency determined by the analytical method.

Continuous Emission Monitor (CEM)	A flue gas analyzer designed for fixed use in checking for environmental pollutants.
Continuous Improvement Plan (CIP)	The delineation of tasks for a given laboratory department or committee to achieve the goals of that department.
Contract Laboratory Program (CLP)	A national network of EPA personnel, commercial labs, and support contractors whose fundamental mission is to provide data of known and documented quality.
Contract Required Detection Limit (CRDL)	Detection limit that is required for EPA Contract Laboratory Program (CLP) contracts.
Contract Required Quantitation Limit (CRQL)	Quantitation limit (reporting limit) that is required for EPA Contract Laboratory Program (CLP) contracts.
Control Chart	A graphic representation of a series of test results, together with limits within which results are expected when the system is in a state of statistical control (see definition for Control Limit)
Control Limit	A range within which specified measurement results must fall to verify that the analytical system is in control. Control limit exceedances may require corrective action or require investigation and flagging of non-conforming data.
Correction	DoD- Action taken to eliminate a detected non-conformity.
Corrective Action	DoD- The action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence. A root cause analysis may not be necessary in all cases.
Corrective and Preventative Action (CAPA)	The primary management tools for bringing improvements to the quality system, to the management of the quality system's collective processes, and to the products or services delivered which are an output of established systems and processes.
Critical Value	TNI- Value to which a measurement result is compared to make a detection decision (also known as critical level or decision level). NOTE: The Critical Value is designed to give a specified low probability α of false detection in an analyte-free sample, which implies that a result that exceeds the Critical Value, gives high confidence $(1 – \alpha)$ that the radionuclide is actually present in the material analyzed. For radiometric methods, α is often set at 0.05.
Customer	DoD- Any individual or organization for which products or services are furnished or work performed in response to defined requirements and expectations.
Data Integrity	TNI- The condition that exists when data are sound, correct, and complete, and accurately reflect activities and requirements.
Data Quality Objective (DQO)	Systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use or end user.
Data Reduction	TNI- The process of transforming the number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more usable form.
Definitive Data	DoD- Analytical data of known quantity and quality. The levels of data quality on precision and bias meet the requirements for the decision to be made. Data that is suitable for final decision-making.
Demonstration of Capability (DOC)	TNI- A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. DoD- A procedure to establish the ability of the analyst to generate analytical results by a specific method that meet measurement quality objectives (e.g., for precision and bias).
Department of Defense (DoD)	An executive branch department of the federal government of the United States charged with coordinating and supervising all agencies and functions of the government concerned directly with national security.
Detection Limit (DL)	DoD- The smallest analyte concentration that can be demonstrated to be different than zero or a blank concentration with 99% confidence. At the DL, the false positive rate (Type 1 error) is 1%. A DL may be used as the lowest concentration for reliably reporting a detection of a specific analyte in a specific matrix with a specific method with 99% confidence.
Detection Limit (DL) for Safe Drinking Water Act (SDWA) Compliance	TNI- Laboratories that analyze drinking-water samples for SDWA compliance monitoring must use methods that provide sufficient detection capability to meet the detection limit requirements established in 40 CFR 141. The SDWA DL for radioactivity is defined in 40 CFR Part 141.25.c as the radionuclide concentration, which can be counted with a precision of plus or minus 100% at the 95% confidence level (1.96σ where σ is the standard deviation of the net counting rate of the sample).
Deuterated Monitoring Compounds (DMCs)	DoD- SIM specific surrogates as specified for GC/MS SIM analysis.
Diesel Range Organics (DRO)	A range of compounds that denote all the characteristic compounds that make up diesel fuel (range can be state or program specific).

Digestion	DoD- A process in which a sample is treated (usually in conjunction with heat and acid) to convert the target analytes in the sample to a more easily measured form.
Document Control	The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.
Documents	DoD- Written components of the laboratory management system (e.g., policies, procedures, and instructions).
Dry Weight	The weight after drying in an oven at a specified temperature.
Duplicate (also known as Replicate or Laboratory Duplicate)	The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results of duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.
Electron Capture Detector (ECD)	Device used in GC methods to detect compounds that absorb electrons (e.g., PCB compounds).
Electronic Data Deliverable (EDD)	A summary of environmental data (usually in spreadsheet form) which clients request for ease of data review and comparison to historical results.
Eluent	A solvent used to carry the components of a mixture through a stationary phase.
Elute	To extract, specifically, to remove (absorbed material) from an absorbent by means of a solvent.
Elution	A process in which solutes are washed through a stationary phase by movement of a mobile phase.
Environmental Data	DoD- Any measurements or information that describe environmental processes, locations, or conditions; ecological or health effects and consequences; or the performance of environmental technology.
Environmental Monitoring	The process of measuring or collecting environmental data.
Environmental Protection Agency (EPA)	An agency of the federal government of the United States which was created for the purpose of protecting human health and the environment by writing and enforcing regulations based on laws passed by Congress.
Environmental Sample	A representative sample of any material (aqueous, non-aqueous, or multimedia) collected from any source for which determination of composition or contamination is requested or required. Environmental samples can generally be classified as follows: • Non Potable Water (Includes surface water, ground water, effluents, water treatment chemicals, and TCLP leachates or other extracts) • Drinking Water - Delivered (treated or untreated) water designated as potable water • Water/Wastewater - Raw source waters for public drinking water supplies, ground waters, municipal influents/effluents, and industrial influents/effluents • Sludge - Municipal sludges and industrial sludges. • Soil - Predominately inorganic matter ranging in classification from sands to clays. • Waste - Aqueous and non-aqueous liquid wastes, chemical solids, and industrial liquid and solid wastes
Equipment Blank	A sample of analyte-free media used to rinse common sampling equipment to check effectiveness of decontamination procedures.
Extracted Internal Standard Analyte	Isotopically labeled analogs of analytes of interest added to all standards, blanks and samples analyzed. Added to samples and batch QC samples prior to the first step of sample extraction and to standards and instrument blanks prior to analysis. Used for isotope dilution methods.
Facility	A distinct location within the company that has unique certifications, personnel and waste disposal identifications.
False Negative	DoD- A result that fails to identify (detect) an analyte or reporting an analyte to be present at or below a level of interest when the analyte is actually above the level of interest.
False Positive	DoD- A result that erroneously identifies (detects) an analyte or reporting an analyte to be present above a level of interest when the analyte is actually present at or below the level of interest.
Field Blank	A blank sample prepared in the field by filling a clean container with reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken.
Field Measurement	Determination of physical, biological, or radiological properties, or chemical constituents that are measured on-site, close in time and sPAS to the matrices being sampled/measured, following accepted test methods. This testing is performed in the field outside of a fixed-laboratory or outside of an enclosed structure that meets the requirements of a mobile laboratory.
Field of Accreditation	TNI- Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Field of Proficiency Testing (FoPT)	TNI- Matrix, technology/method, analyte combinations for which the composition, spike concentration ranges and acceptance criteria have been established by the PTPEC.
Finding	TNI- An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement. DoD- An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive, negative, or neutral and is normally accompanied by specific examples of the observed condition. The finding must be linked to a specific requirement (e.g., this standard, ISO requirements, analytical methods, contract specifications, or laboratory management systems requirements).
Flame Atomic Absorption Spectrometer (FAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the fact that ground state metals absorb light at different wavelengths. Metals in a solution are converted to the atomic state by use of a flame.
Flame Ionization Detector (FID)	A type of gas detector used in GC analysis where samples are passed through a flame which ionizes the sample so that various ions can be measured.
Gas Chromatography (GC)	Instrumentation which utilizes a mobile carrier gas to deliver an environmental sample across a stationary phase with the intent to separate compounds out and measure their retention times.
Gas Chromatograph/ Mass Spectrometry (GC/MS)	In conjunction with a GC, this instrumentation utilizes a mass spectrometer which measures fragments of compounds and determines their identity by their fragmentation patterns (mass spectra).
Gasoline Range Organics (GRO)	A range of compounds that denote all the characteristic compounds that make up gasoline (range can be state or program specific).
Graphite Furnace Atomic Absorption Spectrometry (GFAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the absorption of light at different wavelengths that are characteristic of different analytes.
High Pressure Liquid Chromatography (HPLC)	Instrumentation used to separate, identify and quantitate compounds based on retention times which are dependent on interactions between a mobile phase and a stationary phase.
Holding Time	TNI- The maximum time that can elapse between two specified activities. 40 CFR Part 136- The maximum time that samples may be held prior to preparation and/or analysis as defined by the method and still be considered valid or not compromised. For sample prep purposes, hold times are calculated using the time of the start of the preparation procedure. DoD- The maximum time that may elapse from the time of sampling to the time of preparation or analysis, or from preparation to analysis, as appropriate.
Homogeneity	The degree to which a property or substance is uniformly distributed throughout a sample.
Homologue	One in a series of organic compounds in which each successive member has one more chemical group in its molecule than the next preceding member. For instance, methanol, ethanol, propanol, butanol, etc., form a homologous series.
Improper Actions	DoD- Intentional or unintentional deviations from contract-specified or method-specified analytical practices that have not been authorized by the customer (e.g., DoD or DOE).
Incremental Sampling Method (ISM)	Soil preparation for large volume (1 kg or greater) samples.
In-Depth Data Monitoring	TNI- When used in the context of data integrity activities, a review and evaluation of documentation related to all aspects of the data generation process that includes items such as preparation, equipment, software, calculations, and quality controls. Such monitoring shall determine if the laboratory uses appropriate data handling, data use and data reduction activities to support the laboratory's data integrity policies and procedures.
Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)	Analytical technique used for the detection of trace metals which uses plasma to produce excited atoms that emit radiation of characteristic wavelengths.
Inductively Coupled Plasma- Mass Spectrometry (ICP/MS)	An ICP that is used in conjunction with a mass spectrometer so that the instrument is not only capable of detecting trace amounts of metals and non-metals but is also capable of monitoring isotopic speciation for the ions of choice.
Infrared Spectrometer (IR)	An instrument that uses infrared light to identify compounds of interest.

Initial Calibration (ICAL)	The process of analyzing standards, prepared at specified concentrations, to define the quantitative response relationship of the instrument to the analytes of interest. Initial calibration is performed whenever the results of a calibration verification standard do not conform to the requirements of the method in use or at a frequency specified in the method.
Initial Calibration Blank (ICB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method. This blank is specifically run in conjunction with the Initial Calibration Verification (ICV) where applicable.
Initial Calibration Verification (ICV)	DoD- Verifies the initial calibration with a standard obtained or prepared from a source independent of the source of the initial calibration standards to avoid potential bias of the initial calibration.
Injection Internal Standard Analyte	Isotopically labeled analogs of analytes of interest (or similar in physiochemical properties to the target analytes but with a distinct response) to be quantitated. Added to all blanks, standards, samples and batch QC after extraction and prior to analysis.
Instrument Blank	A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination.
Instrument Detection Limits (IDLs)	Limits determined by analyzing a series of reagent blank analyses to obtain a calculated concentration. IDLs are determined by calculating the average of the standard deviations of three runs on three non-consecutive days from the analysis of a reagent blank solution with seven consecutive measurements per day.
Interference, spectral	Occurs when particulate matter from the atomization scatters incident radiation from the source or when the absorption or emission from an interfering species either overlaps or is so close to the analyte wavelength that resolution becomes impossible.
Interference, chemical	Results from the various chemical processes that occur during atomization and later the absorption characteristics of the analyte.
Internal Standard	TNI and DoD- A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.
International Organization for Standardization (ISO)	An international standard-setting body composed of representatives from various national standards organizations.
Intermediate Standard Solution	Reference solutions prepared by dilution of the stock solutions with an appropriate solvent.
International System of Units (SI)	The coherent system of units adopted and recommended by the General Conference on Weights and Measures.
Ion Chromatography (IC)	Instrumentation or process that allows the separation of ions and molecules based on the charge properties of the molecules.
Isomer	One of two or more compounds, radicals, or ions that contain the same number of atoms of the same element but differ in structural arrangement and properties. For example, hexane (C_6H_{14}) could be n-hexane, 2-methylpentane, 3-methylpentane, 2,3-dimethylbutane, 2,2-dimethylbutane.
Laboratory	A body that calibrates and/or tests.
Laboratory Control Sample (LCS)	TNI- (also known as laboratory fortified blank (LFB), spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to evaluate the performance of all or a portion of the measurement system.
Laboratory Duplicate	Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently.
Laboratory Information Management System (LIMS)	DoD- The entirety of an electronic data system (including hardware and software) that collects, analyzes, stores, and archives electronic records and documents.
Learning Management System (LMS)	A web-based database used by the laboratories to track and document training activities. The system is administered by the corporate training department and each laboratory's learn centers are maintained by a local administrator.
Legal Chain-of-Custody Protocols	TNI- Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the client or program. These procedures are performed at the special request of the client and include the use of a Chain-of-Custody (COC) Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory.

Limit(s) of Detection (LOD)	TNI- The minimum result, which can be reliably discriminated from a blank with predetermined confidence level. DoD- The smallest concentration of a substance that must be present in a sample in order to be detected at the DL with 99% confidence. At the LOD, the false negative rate (Type II error) is 1%. A LOD may be used as the lowest concentration for reliably reporting a non-detect of a specific analyte in a specific matrix with a specific method at 99% confidence.
Limit(s) of Quantitation (LOQ)	TNI- The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. DoD- The smallest concentration that produces a quantitative result with known and recorded precision and bias. For DoD/DOE projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard and within the calibration range.
Linear Dynamic Range	DoD- Concentration range where the instrument provides a linear response.
Liquid chromatography/ tandem mass spectrometry (LC/MS/MS)	Instrumentation that combines the physical separation techniques of liquid chromatography with the mass analysis capabilities of mass spectrometry.
Lot	TNI- A definite amount of material produced during a single manufacturing cycle, and intended to have uniform character and quality.
Management	Those individuals directly responsible and accountable for planning, implementing, and assessing work.
Management System	System to establish policy and objectives and to achieve those objectives.
Manager (however named)	The individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual.
Matrix	TNI- The substrate of a test sample.
Matrix Duplicate	TNI- A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision.
Matrix Spike (MS) (spiked sample or fortified sample)	TNI- A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.
Matrix Spike Duplicate (MSD) (spiked sample or fortified sample duplicate)	TNI- A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.
Measurement Performance Criteria (MPC)	DoD- Criteria that may be general (such as completion of all tests) or specific (such as QC method acceptance limits) that are used by a project to judge whether a laboratory can perform a specified activity to the defined criteria.
Measurement Quality Objective (MQO)	TNI- The analytical data requirements of the data quality objectives are project- or program-specific and can be quantitative or qualitative. MQOs are measurement performance criteria or objectives of the analytical process. Examples of quantitative MQOs include statements of required analyte detectability and the uncertainty of the analytical protocol at a specified radionuclide activity, such as the action level. Examples of qualitative MQOs include statements of the required specificity of the analytical protocol, e.g., the ability to analyze for the radionuclide of interest given the presence of interferences.
Measurement System	TNI- A method, as implemented at a particular laboratory, and which includes the equipment used to perform the test and the operator(s). DoD- A test method, as implemented at a particular laboratory, and which includes the equipment used to perform the sample preparation and test and the operator(s).
Measurement Uncertainty	DoD- An estimate of the error in a measurement often stated as a range of values that contain the true value within a certain confidence level. The uncertainty generally includes many components which may be evaluated from experimental standard deviations based on repeated observations or by standard deviations evaluated from assumed probability distributions based on experience or other information. For DoD/DOE, a laboratory's Analytical Uncertainty (such as use of LCS control limits) can be reported as the minimum uncertainty.
Method	TNI- A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.
Method Blank	TNI- A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit (MDL)	TNI- One way to establish a Detection Limit; defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.
Method of Standard Additions	A set of procedures adding one or more increments of a standard solution to sample aliquots of the same size in order to overcome inherent matrix effects. The procedures encompass the extrapolation back to obtain the sample concentration.
Minimum Detectable Activity (MDA)	TNI- Estimate of the smallest true activity that ensures a specified high confidence, 1 – β, of detection above the Critical Value, and a low probability β of false negatives below the Critical Value. For radiometric methods, β is often set at 0.05. NOTE 1: The MDS is a measure of the detection capability of a measurement process and as such, it is an a priori concept. It may be used in the selection of methods to meet specified MQOs. Laboratories may also calculate a "sample specific" MDA, which indicates how well the measurement process is performing under varying real-world measurement conditions, when sample-specific characteristics (e.g., interferences) may affect the detection capability. However, the MDA must never be used instead of the Critical Value as a detection threshold. NOTE 2: For the purpose of this Standard, the terms MDA and minimum detectable concentration (MDC) are equivalent.
MintMiner	Program used by PAS to review large amounts of chromatographic data to monitor for errors or data integrity issues.
Mobile Laboratory	TNI- A portable enclosed structure with necessary and appropriate accommodation and environmental conditions for a laboratory, within which testing is performed by analysts. Examples include but are not limited to trailers, vans, and skid-mounted structures configured to house testing equipment and personnel.
National Environmental Laboratory Accreditation Conference (NELAC)	See definition of The NELAC Institute (TNI).
National Institute of Occupational Safety and Health (NIOSH)	National institute charged with the provision of training, consultation and information in the area of occupational safety and health.
National Institute of Standards and Technology (NIST)	TNI- A federal agency of the US Department of Commerce's Technology Administration that is designed as the United States national metrology institute (or NMI).
National Pollutant Discharge Elimination System (NPDES)	A permit program that controls water pollution by regulating point sources that discharge pollutants into U.S. waters.
Negative Control	Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.
Nitrogen Phosphorus Detector (NPD)	A detector used in GC analyses that utilizes thermal energy to ionize an analyte. With this detector, nitrogen and phosphorus can be selectively detected with a higher sensitivity than carbon.
Nonconformance	An indication or judgment that a product or service has not met the requirement of the relevant specifications, contract, or regulation; also the state of failing to meet the requirements.
Not Detected (ND)	The result reported for a compound when the detected amount of that compound is less than the method reporting limit.
Operator Aid	DoD- A technical posting (such as poster, operating manual, or notepad) that assists workers in performing routine tasks. All operator aids must be controlled documents (i.e., a part of the laboratory management system).
Performance Based Measurement System (PBMS)	An analytical system wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner.
Physical Parameter	TNI- A measurement of a physical characteristic or property of a sample as distinguished from the concentrations of chemical and biological components.
Photo-ionization Detector (PID)	An ion detector which uses high-energy photons, typically in the ultraviolet range, to break molecules into positively charged ions.
Polychlorinated Biphenyls (PCB)	A class of organic compounds that were used as coolants and insulating fluids for transformers and capacitors. The production of these compounds was banned in the 1970's due to their high toxicity.
Positive Control	Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.
Post-Digestion Spike	A sample prepared for metals analyses that has analytes spike added to determine if matrix effects may be a factor in the results.

Power of Hydrogen (pH)	The measure of acidity or alkalinity of a solution.
Practical Quantitation Limit (PQL)	Another term for a method reporting limit. The lowest reportable concentration of a compound based on parameters set up in an analytical method and the laboratory's ability to reproduce those conditions.
Precision	TNI- The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.
Preservation	TNI and DoD- Any conditions under which a sample must be kept in order to maintain chemical, physical, and/or biological integrity prior to analysis.
Primary Accreditation Body (Primary AB)	TNI- The accreditation body responsible for assessing a laboratory's total quality system, on-site assessment, and PT performance tracking for fields of accreditation.
Procedure	TNI- A specified way to carry out an activity or process. Procedures can be documented or not.
Proficiency Testing (PT)	TNI- A means to evaluate a laboratory's performance under controlled conditions relative to a given set of criteria, through analysis of unknown samples provided by an external source.
Proficiency Testing Program (PT Program)	TNI- The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories.
Proficiency Testing Provider (PT Provider)	TNI- A person or organization accredited by a TNI-approved Proficiency Testing Provider Accreditor to operate a TNI-compliant PT Program.
Proficiency Testing Provider Accreditor (PTPA)	TNI- An organization that is approved by TNI to accredit and monitor the performance of proficiency testing providers.
Proficiency Testing Reporting Limit (PTRL)	TNI- A statistically derived value that represents the lowest acceptable concentration for an analyte in a PT sample, if the analyte is spiked into the PT sample. The PTRLs are specified in the TNI FoPT tables.
Proficiency Testing Sample (PT)	TNI- A sample, the composition of which is unknown to the laboratory, and is provided to test whether the laboratory can produce analytical results within the specified acceptance criteria.
Proficiency Testing (PT) Study	TNI- a) Scheduled PT Study: A single complete sequence of circulation and scoring of PT samples to all participants in a PT program. The study must have the same pre-defined opening and closing dates for all participants; b) Supplemental PT Study: A PT sample that may be from a lot previously released by a PT Provider that meets the requirements for supplemental PT samples given in Volume 3 of this Standard [TNI] but that does not have a pre-determined opening date and closing date.
Proficiency Testing Study Closing Date	TNI- a) Scheduled PT Study: The calendar date by which all participating laboratories must submit analytical results for a PT sample to a PT Provider; b) Supplemental PT Study: The calendar date a laboratory submits the results for a PT sample to the PT Provider.
Proficiency Testing Study Opening Date	TNI- a) Scheduled PT Study: The calendar date that a PT sample is first made available to all participants of the study by a PT Provider; b) Supplemental PT Study: The calendar date the PT Provider ships the sample to a laboratory.
Protocol	TNI- A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) that must be strictly followed.
Qualitative Analysis	DoD- Analysis designed to identify the components of a substance or mixture.
Quality Assurance (QA)	TNI- An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.
Quality Assurance Manual (QAM)	A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.
Quality Assurance Project Plan (QAPP)	A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.
Quality Control (QC)	TNI- The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality.
Quality Control Sample (QCS)	TNI- A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control.

Quality Manual	TNI- A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.
Quality System	TNI and DoD- A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance and quality control activities.
Quality System Matrix	TNI and DoD- These matrix definitions shall be used for purposes of batch and quality control requirements and may be different from a field of accreditation matrix: • **Air and Emissions**: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device • **Aqueous**: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts. • **Biological Tissue**: Any sample of a biological origin such as fish tissue, shellfish or plant material. Such samples shall be grouped according to origin. • **Chemical Waste**: A product or by-product of an industrial process that results in a matrix not previously defined. • **Drinking Water**: Any aqueous sample that has been designated a potable or potentially potable water source. • **Non-aqueous liquid**: Any organic liquid with <15% settleable solids • **Saline/Estuarine**: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake. • **Solids**: Includes soils, sediments, sludges, and other matrices with >15% settleable solids.
Quantitation Range	DoD- The range of values (concentrations) in a calibration curve between the LOQ and the highest successively analyzed initial calibration standard used to relate instrument response to analyte concentration. The quantitation range (adjusted for initial sample volume/weight, concentration/dilution and final volume) lies within the calibration range.
Quantitative Analysis	DoD- Analysis designed to determine the amounts or proportions of the components of a substance.
Random Error	The EPA has established that there is a 5% probability that the results obtained for any one analyte will exceed the control limits established for the test due to random error. As the number of compounds measured increases in a given sample, the probability for statistical error also increases.
Raw Data	TNI- The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records.
Reagent Blank (method reagent blank)	A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps.
Reagent Grade	Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents that conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.
Records	DoD- The output of implementing and following management system documents (e.g., test data in electronic or hand-written forms, files, and logbooks).
Reference Material	TNI- Material or substance one or more of whose property values are sufficiently homogenized and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.
Reference Method	TNI- A published method issued by an organization generally recognized as competent to do so. (When the ISO language refers to a "standard method", that term is equivalent to "reference method"). When a laboratory is required to analyze by a specified method due to a regulatory requirement, the analyte/method combination is recognized as a reference method. If there is no regulatory requirement for the analyte/method combination, the analyte/method combination is recognized as a reference method if it can be analyzed by another reference method of the same matrix and technology.
Reference Standard	TNI- Standard used for the calibration of working measurement standards in a given organization or at a given location.

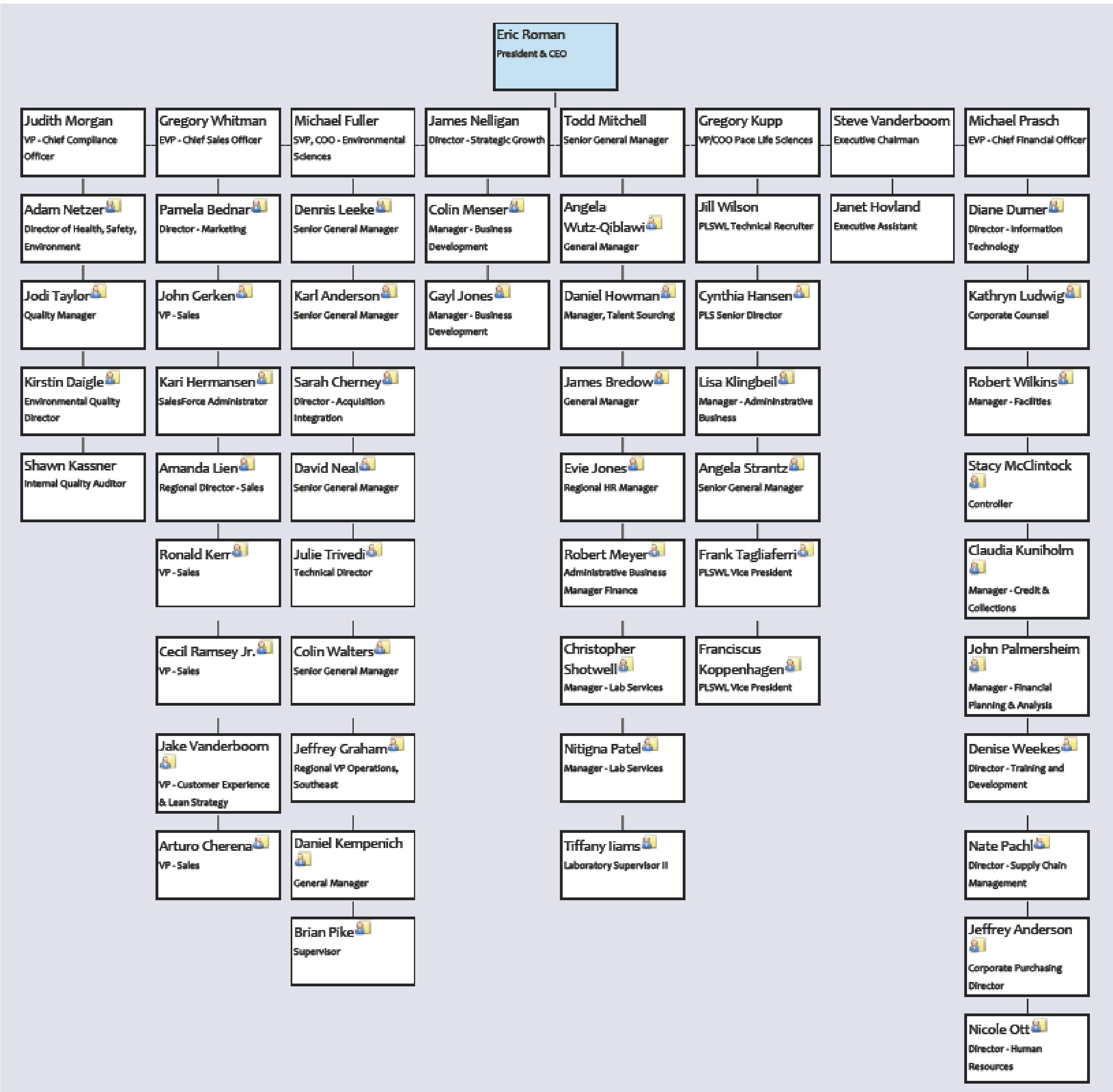
Relative Percent Difference (RPD)	A measure of precision defined as the difference between two measurements divided by the average concentration of the two measurements.
Reporting Limit (RL)	The level at which method, permit, regulatory and customer-specific objectives are met. The reporting limit may never be lower than the Limit of Detection (i.e., statistically determined MDL). Reporting limits are corrected for sample amounts, including the dry weight of solids, unless otherwise specified. There must be a sufficient buffer between the Reporting Limit and the MDL. DoD- A customer-specified lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.
Reporting Limit Verification Standard (RLVS)	A standard analyzed at the reporting limit for an analysis to verify the laboratory's ability to report to that level.
Representativeness	A quality element related to the ability to collect a sample reflecting the characteristics of the part of the environment to be assessed. Sample representativeness is dependent on the sampling techniques specified in the project work plan.
Requirement	Denotes a mandatory specification; often designated by the term "shall".
Retention Time	The time between sample injection and the appearance of a solute peak at the detector.
Revocation	TNI- The total or partial withdrawal of a laboratory's accreditation by an accreditation body.
Sample	Portion of material collected for analysis, identified by a single, unique alphanumeric code. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analysis.
Sample Condition Upon Receipt Form (SCURF)	Form used by sample receiving personnel to document the condition of sample containers upon receipt to the laboratory (used in conjunction with a COC).
Sample Delivery Group (SDG)	A unit within a single project that is used to identify a group of samples for delivery. An SDG is a group of 20 or fewer field samples within a project, received over a period of up to 14 calendar days. Data from all samples in an SDG are reported concurrently.
Sample Receipt Form (SRF)	Letter sent to the client upon login to show the tests requested and pricing.
Sample Tracking	Procedures employed to record the possession of the samples from the time of sampling until analysis, reporting and archiving. These procedures include the use of a chain-of-custody form that documents the collection, transport, and receipt of compliance samples to the laboratory. In addition, access to the laboratory is limited and controlled to protect the integrity of the samples.
Sampling	TNI- Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.
Selected Ion Monitoring (SIM)	A mode of analysis in mass spectrometry where the detector is set to scan over a very small mass range, typically one mass unit. The narrower the range, the more sensitive the detector. DoD- Using GC/MS, characteristic ions specific to target compounds are detected and used to quantify in applications where the normal full scan mass spectrometry results in excessive noise.
Selectivity	TNI- The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system.
Sensitivity	TNI- The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.
Serial Dilution	The stepwise dilution of a substance in a solution.
Shall	Denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification as long as the requirement is fulfilled.
Should	Denotes a guideline or recommendation whenever noncompliance with the specification is permissible.
Signal-to-Noise Ratio (S/N)	DoD- A measure of signal strength relative to background noise. The average strength of the noise of most measurements is constant and independent of the magnitude of the signal. Thus, as the quantity being measured (producing the signal) decreases in magnitude, S/N decreases and the effect of the noise on the relative error of a measurement increases.
Source Water	TNI- When sampled for drinking water compliance, untreated water from streams, rivers, lakes, or underground aquifers, which is used to supply private and public drinking water supplies.
Spike	A known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.
Standard (Document)	TNI- The document describing the elements of a laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies.

Standard (Chemical)	Standard samples are comprised of a known amount of standard reference material in the matrix undergoing analysis. A standard reference material is a certified reference material produced by US NIST and characterized for absolute content, independent of analytical test method.
Standard Blank (or Reagent Blank)	A calibration standard consisting of the same solvent/reagent matrix used to prepare the calibration standards without the analytes. It is used to construct the calibration curve by establishing instrument background.
Standard Method	A test method issued by an organization generally recognized as competent to do so.
Standard Operating Procedure (SOP)	TNI- A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks.
Standard Reference Material (SRM)	A certified reference material produced by the US NIST or other equivalent organization and characterized for absolute content, independent of analytical method.
Statement of Qualifications (SOQ)	A document that lists information about a company, typically the qualifications of that company to compete on a bid for services.
Stock Standard	A concentrated reference solution containing one or more analytes prepared in the laboratory using an assayed reference compound or purchased from a reputable commercial source.
Storage Blank	DoD- A sample of analyte-free media prepared by the laboratory and retained in the sample storage area of the laboratory. A storage blank is used to record contamination attributable to sample storage at the laboratory.
Supervisor	The individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses.
Surrogate	DoD- A substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them for quality control purposes.
Suspension	TNI- The temporary removal of a laboratory's accreditation for a defined period of time, which shall not exceed 6 months or the period of accreditation, whichever is longer, in order to allow the laboratory time to correct deficiencies or area of non-conformance with the Standard.
Systems Audit	An on-site inspection or assessment of a laboratory's quality system.
Target Analytes	DoD- Analytes or chemicals of primary concern identified by the customer on a project-specific basis.
Technical Director	Individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory.
Technology	TNI- A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.
Test	A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate.
Test Method	DoD- A definitive procedure that determines one or more characteristics of a given substance or product.
Test Methods for Evaluating Solid Waste, Physical/ Chemical (SW-846)	EPA Waste's official compendium of analytical and sampling methods that have been evaluated and approved for use in complying with RCRA regulations.
Test Source	TNI- A radioactive source that is tested, such as a sample, calibration standard, or performance check source. A Test Source may also be free of radioactivity, such as a Test Source counted to determine the subtraction background, or a short-term background check.
The NELAC Institute (TNI)	A non-profit organization whose mission is to foster the generation of environmental data of known and documented quality through an open, inclusive, and transparent process that is responsive to the needs of the community. Previously known as NELAC (National Environmental Laboratory Accreditation Conference).
Total Petroleum Hydrocarbons (TPH)	A term used to denote a large family of several hundred chemical compounds that originate from crude oil. Compounds may include gasoline components, jet fuel, volatile organics, etc.
Toxicity Characteristic Leaching Procedure (TCLP)	A solid sample extraction method for chemical analysis employed as an analytical method to simulate leaching of compounds through a landfill.

Traceability	TNI- The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical conditions or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.
Training Document	A training resource that provides detailed instructions to execute a specific method or job function.
Trip Blank	This blank sample is used to detect sample contamination from the container and preservative during transport and storage of the sample. A cleaned sample container is filled with laboratory reagent water and the blank is stored, shipped, and analyzed with its associated samples.
Tuning	A check and/or adjustment of instrument performance for mass spectrometry as required by the method.
Ultraviolet Spectrophotometer (UV)	Instrument routinely used in quantitative determination of solutions of transition metal ions and highly conjugated organic compounds.
Uncertainty, Counting	TNI- The component of Measurement Uncertainty attributable to the random nature of radioactive decay and radiation counting (often estimated as the square root of observed counts (MARLAP). Older references sometimes refer to this parameter as Error, Counting Error or Count Error (c.f., Total Uncertainty).
Uncertainty, Expanded	TNI- The product of the Standard Uncertainty and a coverage factor, k, which is chosen to produce an interval about the result that has a high probability of containing the value of the measurand (c.f., Standard Uncertainty). NOTE: Radiochemical results are generally reported in association with the Total Uncertainty. Either if these estimates of uncertainty can be reported as the Standard Uncertainty (one-sigma) or as an Expanded Uncertainty (k-sigma, where k > 1).
Uncertainty, Measurement	TNI- Parameter associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand.
Uncertainty, Standard	TNI- An estimate of the Measurement Uncertainty expressed as a standard deviation (c.f., Expanded Uncertainty).
Uncertainty, Total	TNI- An estimate of the Measurement Uncertainty that accounts for contributions from all significant sources of uncertainty associated with the analytical preparation and measurement of a sample. Such estimates are also commonly referred to as Combined Standard Uncertainty or Total Propagated Uncertainty, and in some older references as the Total Propagated Error, among other similar items (c.f., Counting Uncertainty).
Unethical actions	DoD- Deliberate falsification of analytical or quality control results where failed method or contractual requirements are made to appear acceptable.
United States Department of Agriculture (USDA)	A department of the federal government that provides leadership on food, agriculture, natural resources, rural development, nutrition and related issues based on public policy, the best available science, and effective management.
United States Geological Survey (USGS)	Program of the federal government that develops new methods and tools to supply timely, relevant, and useful information about the Earth and its processes.
Unregulated Contaminant Monitoring Rule (UCMR)	EPA program to monitor unregulated contaminants in drinking water.
Validation	DoD- The confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.
Verification	TNI- Confirmation by examination and objective evidence that specified requirements have been met. In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment.
Voluntary Action Program (VAP)	A program of the Ohio EPA that gives individuals a way to investigate possible environmental contamination, clean it up if necessary and receive a promise from the State of Ohio that no more cleanup is needed.
Whole Effluent Toxicity (WET)	The aggregate toxic effect to aquatic organisms from all pollutants contained in a facility's wastewater (effluent).

7.4 Appendix D: Organization Chart(s)

7.4.1 PAS - Corporate (Effective 12/18/2019)



7.4.2 PAS-FRON, -LENE, - SAL1, -TULS

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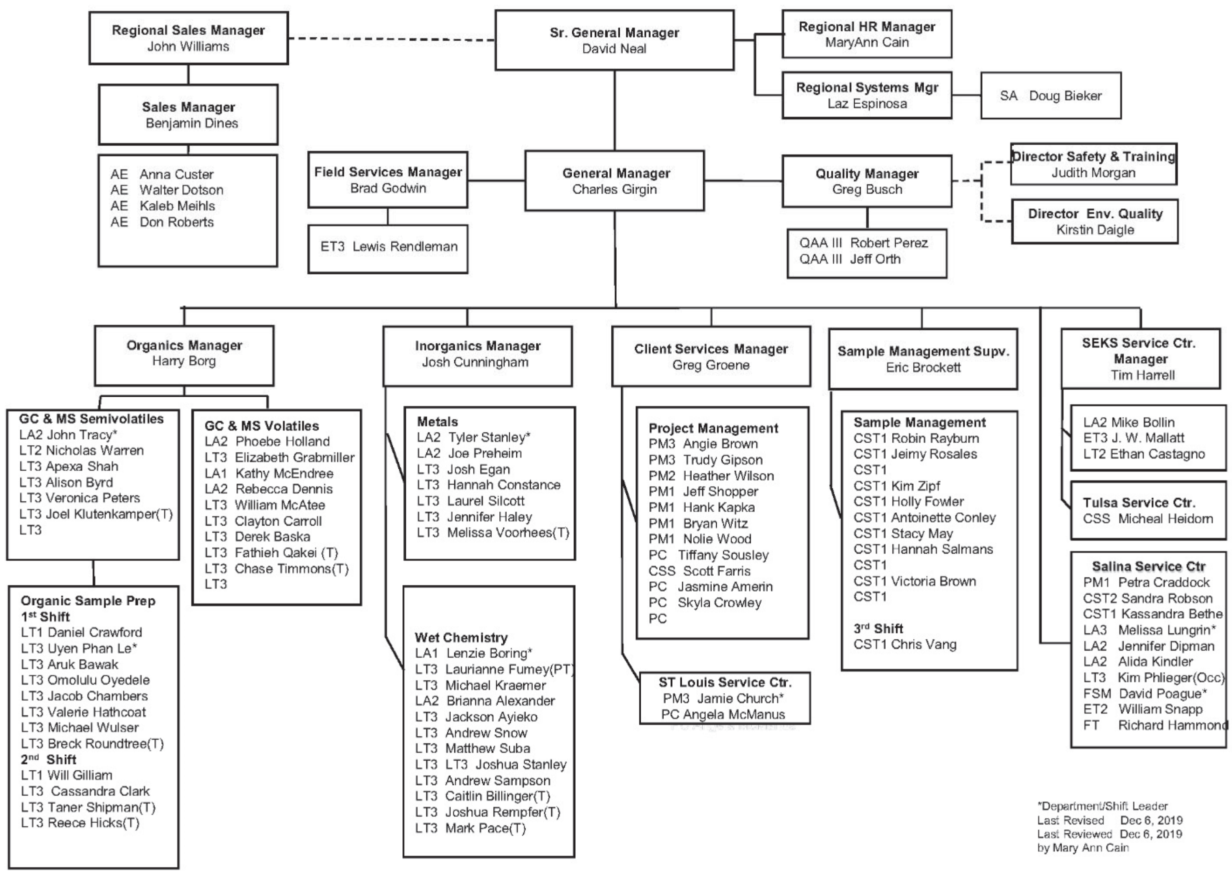

7.5 Appendix E: Equipment Listing

The equipment listed represents equipment were held by each location on the effective date of this manual. This information is subject to change without notice. External parties should contact the location for the most current information.

7.5.1 PAS-FRON

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Balance	Mettler-Toledo	AE240	H20889	Unknown	New	PAS-FRON	60SEKS1	Online
Balance	Mettler-Toledo	XS105DU	B421614751	6/12/2014	New	PAS-FRON	60SEKS1	Online
Conductivity Meter	Accumet	AB30	AB81211072	2001	New	PAS-FRON	AB-30	Online

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Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
DO Meter	YSI	Pro20i	19A104599	8/13/2019	New	Field vehicle	P-11	Online
pH meter	Oakton	150	2798093	2019	New	PAS-FRON	P-10	Online
pH/Conductivity Meter	Oakton	PC450	2881231	8/13/2019	New	Field vehicle	P-12	Online
pH/DO meter	Hach	HQ40d	110300005581	2/14/2013	2011	PAS-FRON	P-8	Online

7.5.1 PAS-LENE

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Balance	Ohaus Corporation	SP202	7130020027	Unknown	New	Extractions Lab	60BAL2	Online
Balance	Mettler-Toledo	PL1502E	B502452866	6/29/2015	New	Extractions Lab	60BAL3	Online
Balance	Mettler-Toledo	PL1502E	B849889962	12/24/2018	New	Extractions Lab	60BL13	Online
Balance	Ohaus Corp.	AV812	1203190144	Unknown	New	Extractions Lab	60BL17	Online
Balance	Mettler-Toledo	PB3002-S	1120331402	Unknown	New	Metals Prep	60BL14	Online
Balance	Mettler-Toledo	PL1502E	B850929643	1/7/2019	New	Metals Prep	60BL15	Online
Balance	Mettler-Toledo	PL1502E	B849889960	12/24/2018	New	Semivolatiles Lab	60BAL4	Online
Balance	Mettler-Toledo	PL1502E	B849889961	12/24/2018	New	Volatiles Lab	60BAL5	Online
Balance	Mettler-Toledo	PL1502E	7131250904	Unknown	New	Volatiles Lab	60BAL6	Online
Balance	Denver Inst.	MXX612	23755085	Unknown	New	Volatiles Lab	60BAL7	Online
Balance	Mettler-Toledo	PL1502E	B849889959	1/7/2019	New	Wet Chemistry Lab	60BAL8	Online
Balance	Mettler-Toledo	XS105DU	B710783211	4/19/2017	New	Wet Chemistry Lab	60BL10	Online
Balance	Mettler-Toledo	ME1002E	B721153179	9/20/2017	New	Wet Chemistry Lab	60BL11	Online
Balance	Mettler-Toledo	XS105DU	B509639154	Unknown	New	Wet Chemistry Lab	60BL12	Online
Balance	Mettler-Toledo	PL1502E	B850929644	1/7/2019	New	Wet Chemistry Lab	60BL16	Online
Conductivity Meter	Control Co.	1469	140203191	11/23/2015	New	Wet Chemistry Lab	60WETK	Online
Conductivity Meter	Thermo Scientific	Orion Star A212	X35982	4/10/2017	New	Wet Chemistry Lab	60WETM	Online
Discrete Analyzer	SEAL Analytical	AQ400	241083	7/29/2018	New	Wet Chemistry Lab	60WTAQ	Online
DO Meter	Fisher Scientific	150	E00000809	1998	New	Wet Chemistry Lab	60WET1	Online
DO meter	Hach Company	HQ430D	150200016284	3/27/2015	New	Wet Chemistry Lab	60WETG	Online
Flashpoint Tester	Tanaka Scientific	apm-8	33824	5/22/2019	New	Wet Chemistry Lab	60WETS	Online
Flashpoint Tester	Humboldt Manuf.	H-2085	K4200110095SPE	11/27/2017	New	Wet Chemistry Lab	60WTAL	Online
Flow Injection Analyzer	Lachat Instruments	QuikChem 8500	090600001117	2009	New	Wet Chemistry Lab	60WTA0	Online
Flow Injection Analyzer	Lachat Instruments	8500 Series II	111000001367	10/16/2011	New	Wet Chemistry Lab	60WTAB	Online
Flow Injection Analyzer	Lachat Instruments	8500 Series II	171100002103	8/15/2018	New	Wet Chemistry Lab	60WTAR	Online
GC	Agilent Technologies	6890	US00009536	2005	New	Semivolatiles Lab	60GCS8	Online
GC	Agilent Technologies	7890A	CN10809077	2008	New	Semivolatiles Lab	60GCS9	Online
GC	Agilent Technologies	7890A	CN10912010	2009	New	Semivolatiles Lab	60GCSA	Online
GC	Agilent Technologies	7890A	CN11321147	4/17/2013	New	Semivolatiles Lab	60GCSF	Online

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Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
GC	Agilent Technologies	7890B	CN13133038	4/17/2013	New	Semivolatiles Lab	60GCSG	Online
GC	Agilent Technologies	7890B	CN17513179	2/26/2018	New	Semivolatiles Lab	60GCSH	Online
GC	Agilent Technologies	6890	US00003943	4/12/2012	New	Volatiles Lab	60GCV2	Online
GC	Agilent Technologies	6890	US00007509	8/14/2019	New	Volatiles Lab	60GCV5	Online
GC/MS	Agilent Technologies	6890N/5973	US00030650/ US93112020	2002	New	Semivolatiles Lab	60MSS2	Online
GC/MS	Agilent Technologies	7890A/5975C	CN10803118/ US71236181	3/31/2008	New	Semivolatiles Lab	60MSS3	Online
GC/MS	Agilent Technologies	7890A/5975C	CN10822107/ US80138409	8/6/2009	New	Semivolatiles Lab	60MSS4	Online
GC/MS	Agilent Technologies	7890A/5975C	CN10816120/ US80128247	11/15/2010	New	Semivolatiles Lab	60MSS5	Online
GC/MS	Agilent Technologies	7890B/5977A	CN15393233/ US1539L416	10/29/2015	New	Semivolatiles Lab	60MSS6	Online
GC/MS	Agilent Technologies	6890N/5973	US103349090/ US43120903	1/14/2019	New	Semivolatiles Lab	60MSS7	Online
GC/MS	Agilent Technologies	6850/5975	CN10703008/ US65115300	2009	New	Volatiles Lab	60MSV1	Online
GC/MS	Agilent Technologies	6850/5975B	CN10651005/ US63214900	2007	New	Volatiles Lab	60MSV8	Online
GC/MS	Agilent Technologies	6850A/5975C	CN10802010/ US80118344	2008	New	Volatiles Lab	60MSV9	Online
GC/MS	Agilent Technologies	6850/5975C	CN10949004/ US80118347	2010	New	Volatiles Lab	60MSVA	Online
GC/MS	Agilent Technologies	6850/5975C	7356594/ G31A8626	2/11/2010	New	Volatiles Lab	60MSVB	Online
GC/MS	Agilent Technologies	6850/5977A	86417/ 160259	11/10/2014	New	Volatiles Lab	60MSVC	Online
GC/MS	Agilent Technologies	6850/5977	CN11626003/ US1626P001	10/1/2016	New	Volatiles Lab	60MSVD	Online
ICP	Thermo Scientific	iCAP6500	20090302	2009	New	Metals Lab	60ICP3	Online
ICP	Thermo Scientific	iCAP6500	20104904	2/10/2011	New	Metals Lab	60ICP4	Online
ICP	Thermo Scientific	iCAP6500	20085001	2018	New	Metals Lab	60ICP5	Online
ICPMS	Thermo Scientific	iCAP RQ ICP-MS	iCAPRQ00720	4/17/2018	New	Metals Lab	60ICM2	Online
ICPMS	Thermo Scientific	iCAP RQ ICP-MS	iCAPRQ01241	10/17/2018	New	Metals Lab	60ICM3	Online
Ion Chromatograph	Dionex Corporation	ICS-2000	8070980	2008	New	Wet Chemistry Lab	60WTA2	Online
Ion chromatograph	Dionex Corporation	ICS-1600	12042533	5/10/2012	Used	Wet Chemistry Lab	60WTAC	Online
Ion chromatograph	Dionex Corporation	ICS-1500	8090258	4/30/2012	Used	Wet Chemistry Lab	60WTAD	Online
Ion chromatograph	Thermo Scientific	Aqueon	180946187	3/20/2019	New	Wet Chemistry Lab	60WTAT	Online
Mercury Analyzer	Perkin-Elmer	FIMS-400	401S6111701	12/1/2017	New	Metals Lab	60HG02	Online
Mercury Analyzer	Teledyne CETAC	M7600	US16354007	2/18/2017	New	Metals Lab	60HG05	Online
Mercury Analyzer	Teledyne CETAC	M7600	US19101001	7/3/2019	New	Metals Lab	60HG06	Online
pH meter	Thermo Scientific	Star A214	X18772	5/8/2019	New	Extractions Lab	60WETH	Online
pH meter	Thermo Scientific	Star A214	X18931	5/26/2015	New	Extractions Lab	60WETI	Online
pH meter	Mettler-Toledo	Seven2Go	B725265287	2018	New	Field vehicle	BLG1	Online
pH meter	Mettler-Toledo	Seven2Go	B538441796	2018	New	Field vehicle	LGR1	Online
pH meter	Thermo Scientific	Orion Star LogR	L00660	10/4/2011	New	Wet Chemistry Lab	60WETC	Online

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
pH meter	Thermo Scientific	Orion Star A216	X38482	8/16/2017	New	Wet Chemistry Lab	60WETO	Online
pH meter	Thermo Scientific	Orion Star	X49373	5/22/2019	New	Wet Chemistry Lab	60WETT	Online
Robotic BOD Analyzer	Skalar Analytical	21088905-01	14145	12/11/2015	New	Wet Chemistry Lab	60WETL	Online
Titration Module	Mantech Inc.	PC-1040-00	MT-1D2-303	7/30/2012	New	Wet Chemistry Lab	60WTAE	Online
TOC Analyzer	GE Sievers	InnovOx	10100210	10/28/2010	New	Wet Chemistry Lab	60WTAA	Online
TOC Analyzer	Teledyne Tekmar	Fusion	US13281005	10/17/2013	Used	Wet Chemistry Lab	60WTAG	Online
Turbidimeter	HF Scientific	Micro-100	201709180	12/11/2017	New	Wet Chemistry Lab	60WETQ	Online
UV-Vis Spectrometer	Shimadzu Scientific	UV-1800	A11454630081	2008	New	Wet Chemistry Lab	60WTA9	Online

7.5.2 PAS-SAL1

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
Balance	Mettler-Toledo	XS-205DU	B310112174	Unknown	New	PAS-SAL1	SABL01	Online
Balance	A&D Weighing	FX-300i WP	15804127	Unknown	New	PAS-SAL1	SABL02	Online
Balance	Ohaus Corporation	SPX 422	B718069738	Unknown	New	PAS-SAL1	SABL03	Online
Balance	Mettler-Toledo	PL1502E	B849889958	7/11/2019	New	PAS-SAL1	SABL04	Online
Balance	Mettler-Toledo	PL1502E	B850929645	7/11/2019	New	PAS-SAL1	SABL05	Online
Conductivity meter	Thermo Scientific	Orion 162	81252038	Unknown	New	PAS-SAL1	SAWT04	Online
DO Meter	Hach Company	HQ440D	120600072408	6/28/2012	New	PAS-SAL1	SAWT06	Online
Flow Injection Analyzer	Lachat Instruments	QuikChem 8000	A83000-1454	10/1/1999	Used	PAS-SAL1	SAWA02	Online
Ion Chromatograph	Dionex Corporation	ICS-1600	10120314	1/12/2011	New	PAS-SAL1	SAWA01	Online
pH Meter	Oakton Instruments	pH 2700	931019	10/9/2012	New	PAS-SAL1	SAWT02	Online
pH Meter	Thermo Scientific	Orion 2-Star	B12301	3/11/2010	New	PAS-SAL1	SAWT03	Online
Spectrophotometer	Hach Company	DR/4000 U	0201U0004117	2/1/2001	New	PAS-SAL1	SAWA03	Online
Spectrophotometer	Hach Company	DR-3900	1470881	1/10/2013	New	PAS-SAL1	SAWT01	Online
Turbidimeter	Hach Company	2100Q	18070C068129	10/1/2018	New	PAS-SAL1	SAWT07	Online

7.5.3 PAS-TULS

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Manual Location
pH meter	Oakton	150	2313384	10/19/2016	New	Field vehicle	P-9	Online

8.0 ADDENDUM: PROGRAM REQUIREMENTS

Program specific information provided in this addendum supplements the main body of this manual. Each subsection is stand-alone, meaning the requirements for the quality management system in each subsection only apply to the program referenced. Additionally, only program requirements for the quality management system that are more stringent than the content of the main body of the manual are included.

Appendix D
Operating Tables, Forms, and Checklists

Appendix D.1
Field Forms

FIELD SAMPLE DATA SHEET

Project Name: BTL/LAO

WELL/STATION ___________ EFS-07 DATE ___________________ TIME _________________

SAMPLERS _________________________ WEATHER CONDITIONS ____________________________

SAMPLE TIME ______________________ Grab Composite Yes

SAMPLE DATA:

SAMPLE #	VOLUME	CHECK IF FILTERED	PRES.	ANALYSIS REQUESTED
LAO-SS-1-	250 ml		HNO3	Al, As, Cd, Cu, Ca, Fe, Pb, Mg, Hg, Ag, Zn, Hardness Calc.
LAO-SS-1-	250ml	√	HNO3	Al, As, Cd, Cu, Ca, Fe, Pb, Mg, Hg, Ag, Zn, Hardness Calc.
LAO-SS-1-	1 Liter		Raw	Alkalinity, TDS, TSS, Sulfate
LAO-SS-1-	250 ml		H2SO4	NO2/NO3

FIELD PARAMATERS:

TIME		Temp °C	pH SU	SC µS/cm	ORP mV	DO mg/L	
FINAL FIELD PARAMETERS PRIOR TO SAMPLING							

FIELD REMARKS: ____

FIELD SAMPLE DATA SHEET

Project Name: BTL/LAO
WELL/STATION ________ INF-04 DATE ________ TIME ________
SAMPLERS ________ WEATHER CONDITIONS ________

SAMPLE TIME ________ Grab Composite Yes

SAMPLE DATA:

SAMPLE #	VOLUME	CHECK IF FILTERED	PRES.	ANALYSIS REQUESTED
LAO-SS-2-	250 ml		HNO3	Al, As, Cd, Cu, Ca, Fe, Pb, Mg, Hg, Ag, Zn, Hardness Calc.
LAO-SS-2-	1 Liter		Raw	Alkalinity, TDS, TSS, Sulfate
LAO-SS-2-	250 ml		H2SO4	NO2/NO3

FIELD PARAMATERS:

TIME		Temp °C	pH SU	SC µS/cm	ORP mV	DO mg/L	
FINAL FIELD PARAMETERS PRIOR TO SAMPLING							

FIELD REMARKS: ________

FIELD SAMPLE DATA SHEET

Project Name: BTL/LAO
WELL/STATION __________ MSD-HCC
SAMPLERS ______________________
DATE ________________ TIME ______________
WEATHER CONDITIONS ______________________

SAMPLE TIME ____________________ Grab Yes Composite

SAMPLE DATA:

SAMPLE #	VOLUME	CHECK IF FILTERED	PRES.	ANALYSIS REQUESTED
LAO-SS-3-	250 ml		HNO3	Al, As, Cd, Cu, Ca, Fe, Pb, Mg, Hg, Ag, Zn, Hardness Calc.
LAO-SS-3-	1 Liter		Raw	Alkalinity, TDS, TSS, Sulfate
LAO-SS-3-	250 ml		H2SO4	NO2/NO3

FIELD PARAMATERS:

TIME		Temp °C	pH SU	SC µS/cm	ORP mV	DO mg/L	
FINAL FIELD PARAMETERS PRIOR TO SAMPLING							

FIELD REMARKS: ____

FIELD SAMPLE DATA SHEET

Project Name: BTL/LAO
WELL/STATION ___________ EFS-07
SAMPLERS ___________
DATE ___________ TIME ___________
WEATHER CONDITIONS ___________

SAMPLE TIME ___________ Grab Composite Yes

SAMPLE DATA:

SAMPLE #	VOLUME	CHECK IF FILTERED	PRES.	ANALYSIS REQUESTED
LAO-SS-1T-	250 ml		HNO3	Al, As, Cd, Cu, Ca, Fe, Pb, Mg, Hg, Ag, Zn, Hardness Calc.
LAO-SS-1T-	250ml	√	HNO3	Al, As, Cd, Cu, Ca, Fe, Pb, Mg, Hg, Ag, Zn, Hardness Calc.
LAO-SS-1T-	1 Liter		Raw	Alkalinity, TDS, TSS, Sulfate
LAO-SS-1T-	250 ml		H2SO4	NO2/NO3

FIELD PARAMATERS:

TIME		Temp °C	pH SU	SC µS/cm	ORP mV	DO mg/L	
FINAL FIELD PARAMETERS PRIOR TO SAMPLING							

FIELD REMARKS: Field duplicate of LAO-SS-1-

FIELD SAMPLE DATA SHEET

Project Name: BTL/LAO
WELL/STATION ___________ Field Blank
DATE ___________________ TIME _________________
SAMPLERS ___________________________
WEATHER CONDITIONS ___________________________

SAMPLE TIME ______________________ Grab Yes Composite

SAMPLE DATA:

SAMPLE #	VOLUME	CHECK IF FILTERED	PRES.	ANALYSIS REQUESTED
LAO-SS-4-	250 ml		HNO3	Al, As, Cd, Cu, Ca, Fe, Pb, Mg, Hg, Ag, Zn, Hardness Calc.
LAO-SS-4-	1 Liter		Raw	Alkalinity, TDS, TSS, Sulfate
LAO-SS-4-	250 ml		H2SO4	NO2/NO3

FIELD PARAMATERS:

TIME		Temp °C	pH SU	SC µS/cm	ORP mV	DO mg/L	
FINAL FIELD PARAMETERS PRIOR TO SAMPLING							

FIELD REMARKS: ____

FIELD SAMPLE DATA SHEET

Project Name: BTL/LAO

WELL/STATION ___________ Equipment Blank   DATE ____________________ TIME __________________

SAMPLERS __________________________   WEATHER CONDITIONS ____________________________

SAMPLE TIME ______________________   Grab   Yes   Composite

SAMPLE DATA:

SAMPLE #	VOLUME	CHECK IF FILTERED	PRES.	ANALYSIS REQUESTED
LAO-SS-4-	250 ml		HNO3	Al, As, Cd, Cu, Ca, Fe, Pb, Mg, Hg, Ag, Zn, Hardness Calc.
LAO-SS-4-	1 Liter		Raw	Alkalinity, TDS, TSS, Sulfate
LAO-SS-4-	250 ml		H2SO4	NO2/NO3

FIELD PARAMATERS:

TIME		Temp °C	pH SU	SC µS/cm	ORP mV	DO mg/L	
FINAL FIELD PARAMETERS PRIOR TO SAMPLING							

FIELD REMARKS: ____

Excursion Investigation Form

Agency Notification Plan		
Project Name/Location		**Document ID**
Preparer's Name/ Submittal Date		**Submitted to:/Method**
Person Providing Notification/Date		**Submitted to:/Method**
Reason for Notification/Description		**Operations/Compliance (circle as appropriate)**

Actions Taken	**Analytical**	**Yes**	**No**	**Operations**	**Yes**	**No**
	Review and verify sample laboratory results and associated QA/QC parameters.			Review and verify OM&M procedures and relevent SOP's followed.		
	Discuss results with laboratory PM/QAM.			Discussion with field personnel.		
	Discussion with field personnel.			Discussion with AR PM.		
	Discussion with AR PM.			Where alarm notifications received and addressed?		
	Request confirmation analysis from the laboratory, if necessary.			Where inspections and maintenance activities completed as scheduled?		
	Inspect materials and review procedures used to obtain the sample(s).			Any unusual weather or non-routine events prior?		
	Review of historic data/parameters (previous sample results, lime addition, flow rate, etc.).			Duration and type of event		

Description of Investigation Findings:		
Corrective Actions Taken		
Corrective Action Planning		**Concurrence:**
Corrective Action Implimentation/Date		**Concurrence:**
Close out/Date		**Concurrence:**

	SAT.	SUN.	MON.	TUES.	WED.	THURS.	FRI.	LOCATION
GENERAL DATA								
OPERATOR								
DATE								
TIME								
INFLOW READINGS								
INSTANT. FLOW RATE (gpm)								FIT-IPS-3005
TOTAL FLOW READING (gal)								FIT-CAS-TOTAL
WATER TEMPERATURE (Cel.)								CT-IN04
CONDUCTIVITY (umhos/cm)								CT-IN04
pH (S.U.)								CT-IN04
Notes								CT-IN04
POST-C.A.S. READINGS								
INSTANT. FLOW RATE (gpm)								LT-CAS-1056
INSTANT. FLOW RATE (gpm)								LT-CAS-1057
INSTANT. FLOW RATE (gpm)								LT-CAS-1058
Lime Rate (mg/L)								Feeder Setpoint
Total Lime (Kg)								HS-CAS-1033
Channel pH								Channel PH
A2 pH (S.U.)								A2
A3 pH (S.U.)								A3
B2 pH (S.U.)								B2
B3 pH (S.U.)								B3
C2 pH (S.U.)								C2
C3 pH (S.U.)								C3
Notes								
EFFLUENT READINGS								
INSTANT. FLOW RATE (gpm)								FIT-ASB-4000
TOTAL FLOW READING (gal)								FIT-ASB-Total
WATER TEMPERATURE (Cel.)								EFS7
CONDUCTIVITY (umhos/cm)								EFS7
pH (S.U.)								EFS7
Notes								
WEST CAMP READINGS								
INSTANT. FLOW RATE (gpm)								FIT-WCP-5008
TOTAL FLOW READING (gal)								FIT-WCP-Total
WATER LEVEL (ft.)								LT-WCP-5001A
Notes								
BPSOU SUB-DRAIN READING								
INSTANT. FLOW RATE (gpm)								FIT-BRW-6025
TOTAL FLOW READING (gal)								FIT-BRW-Total
INSTANT. FLOW RATE (gpm)								FIT-BRW-6062
TOTAL FLOW READING (gal)								FIT-BRW-Total
WATER LEVEL (IN)								LT-MSD-6003
Notes								
BRW READINGS								
Stage (ft)								BRW-00
Stage (ft)								
Stage (ft)								BRW-01W
Notes								
Notes								
D4 Elevation								LT-LAO-2013

Appendix D.2
Checklists

Subdrain Checklist

Date	Check Dry Vault	Inspect Backup Generator. Belts, Hoses, Coolant /Oil Levels.	Inspect Fittings and Piping	Eye Wash Bottles	North Pump Flow, % maximum		South Pump Flow, % maximum		Comments

Site-Wide Checklist

Date	Gate, Locks, Doors Check	Fire Extinguishers Check	Eye Wash Stations Check/ Emergency Lighting Test	Inspect LAO Site Vehicle -complete inspection form.	Comments

IPS Checklist

Date	Inspect IPS Pumps and Vaults	Check Water Jacket Flow Pump End	Check Oil Level Compressor	Inspect Backup Generator. Belts, Hoses, Coolant /Oil Levels.	Eye Wash Bottles	Change Oil Pump End	Change Oil Compressor	Check/Clean Discharge Check Valve	Comments

ASB/OPS Checklist

Date	Calibrate pH Meter	Check Sample Well Recirculation Pump	Eye Wash Bottles	Clean ASB Pump Inlet Line	Collect Effluent Composite Samples	Clean Auto-sampler	Change pH Calibration Solution	Collect Monthly Samples	Comments

West Camp Pump Station Checklist

Date	Inspect Backup Generator. Belts, Hoses, Coolant /Oil Levels.	Record Generator Run Hours	Visually Inspect Piping & Fittings	Site Security-Fencing, Gates, Doors, Locks	Eye wash bottles	General Site Conditions	Comments

Date	Manually Measure Lime Silo	Check alarm log on HMI	Inspect Lime Screw Conveyor	Bleed Air Compressor Line	Clean Conductivity Sensor	Collect Influent Composite Samples	Inspect Backup Generator: Belts, Hoses, Coolant /Oil Levels.	Clean Grates and Distribution Tank	Collect Monthly Samples	Clean Auto-sampler	Move/Archive Files from HMI	Inspect Air Compressor-Desecant Oil	Baghouse Check	Lubricate Moving Equipment	Clean Electric Heaters	Clean Slurry Tank Discharge Line	Clean Slurry Tank/Sluice Box	Comments

Instructions for Completing Chain Of Custody

All applicable fields must be filled in legibly and completely in ink. All fields are r**equired** except those noted below as *optional* or *for lab use only* . Any corrections must be lined out with a single stroke, initialed, and dated.

ARC = Atlantic Richfield Company, a BP affiliated company

Page ___ of ___: Page numbers should always be indicated.

BP/ARC Project Name: Assigned by BP/ARC and provided to Laboratory by BP/ARC or the Consultant/Contractor, whoever is completing the COC.
BP/ARC Facility No: The facility number assigned by BP/ARC, as applicable.
Req Due Date (mm/dd/yy): Requested due date in calendar days for receipt of laboratory report (regular TAT is 14 days).
Rush TAT: Check 'Yes' if rush turnaround time is requested; 'No' otherwise. The lab should be notified in advance if rush TAT is requested.
Lab Work Order Number: Laboratory's work order number. *(for lab use only)*

Lab Name: Name of the laboratory to which the samples will be submitted.
Lab Address: Laboratory address; please include street address, city, state and ZIP code.
Lab PM: Laboratory project manager or primary contact.
Lab Phone: Laboratory telephone number.
Lab Shipping Accnt: Laboratory's shipping account number to charge to if shipping samples to lab. Include name of shipping company. *(optional)*
Lab Bottle Order No: Number on laboratory bottle order sheet for tracking of bottle lot numbers. *(optional)*
Other Info: Available field for other information. *(optional)*

BP/ARC EBM: The BP/ARC Environmental Business Manager / Project Manager.
EBM Phone: EBM's telephone number.
EBM Email: EBM's email address.

BP/ARC Facility Address: Street address of facility.
City, State, ZIP Code: City, state, and ZIP code of facility.
Lead Regulatory Agency: State or lead regulatory agency - especially where state or agency has specific laboratory requirements.
California Global ID No: Specific requirement for California sites. Required for California sites; *optional* for other states.
Enfos Proposal No: Enfos Proposal Number must be included.
Accounting Mode: Select either 'Provision', 'OOC-BU', or 'OOC-RM' as applies to this project.
Stage: BP/ARC WBS Stage.
Activity: BP/ARC WBS Activity.

Consultant/Contractor: Consultant/contractor company name.
Consultant/Contractor Project No: Number used by consultant/contractor for project.
Address: Consultant/contractor's address; please include street address, city, state and ZIP code.
Consultant/Contractor PM: Consultant/contractor project manager.
Phone: Consultant/contractor's telephone number.
Email EDD To: Email address of consultant/contractor to whom the EDD should be emailed to.
Invoice to: Select 'BP/ARC' unless laboratory work should be directly billed to the consultant/contractor; then select 'Contractor'.

Lab No.: Laboratory assigned sample number. *(for lab use only)*
Sample Description: Sample name, number, or other identification listed as it should be in the laboratory report and EDD.
Date: Date the sample was collected.
Time: Time the sample was collected.
Matrix: Check the sample matrix. Use the blank field if not 'Soil/Solid', 'Water/Liquid', or 'Air/Vapor' and describe matrix.
No. Containers / Preservative: Indicate the number of each type of container by preservative and enter the 'Total Number of Containers'. The numbers in the individual preservative type columns should add to the same number as the 'Total Number of Containers'.
Requested Analyses: Enter each requested analysis in the header and check the requested analyses for each sample.
Report Type & QC Level: Check either 'Standard' or 'Full Data Package'.
Comments: Enter any comments that apply to a particular sample such as 'Hold', etc. When a pre-printed COC is used and a sample is not collected, indicate 'No Sample' in the comments and single-strike the line, initial, and date.

Sampler's Name: Legibly print the sampler's first and last name.
Samplers Company: Name of sampler's company.
Shipment Method: Indicate the shipment method if samples are shipped (e.g., FedEx, UPS, Greyhound, etc.). *(optional)*
Shipment Date: Actual date the samples are shipped. *(optional)*
Shipment Tracking No: Shipping number from lading ticket or air bill. *(optional)*

Relinquished By / Affiliation: Signature and company of person relinquishing custody of samples.
Date and Time: Date and time samples are relinquished.
Accepted By / Affiliation: Signature and company of person accepting custody of samples.
Date and Time: Date and time samples are accepted.

Special Instructions: Information that applies to all of the samples such as special reporting limits and/or permits (e.g., NPDES), etc. *(optional)*

THIS LINE - LAB USE ONLY: Custody Seals in Place, Temp Blank, Cooler Temp on Receipt, Trip Blank, MS/MSD Sample Submitted to be filled out by laboratory personnel upon receipt of samples

Laboratory Management Program LaMP **Chain of Custody Record**

Page _____ of _____

BP Site Node Path: ____________________ **Req Due Date (mm/dd/yy):** ____________________ **Rush TAT:** Yes ____ No _X_

BP Facility No: ____________________ **Lab Work Order Number:** ____________________

Lab Name: Pace Analytical Services	Facility Address:	Consultant/Contractor:
Lab Address: 1700 Elm Street, Minneapolis, MN 55414	City, State, ZIP Code:	Consultant/Contractor Project No:
Lab PM: Jennifer Anderson	Lead Regulatory Agency:	Address: 1101 S. Montana, Butte, Mt 59701
Lab Phone:	California Global ID No.:	Consultant/Contractor PM:
Lab Shipping Accnt: 1797-5692-7	Enfos Proposal No:	Phone: Email:
Lab Bottle Order No:	Accounting Mode: Provision _x_ OOC-BU ____ OOC-RM ____	Email EDD To:
Other Info:	Stage: Activity: OMM	Invoice To: BP _x_ Contractor ____
BP Project Manager (PM):	Matrix / No. Containers / Preservative / Requested Analyses	Report Type & QC Level
BP PM Phone:		Standard _X_
BP PM Email:		Full Data Package ____

Lab No.	Sample Description	Date	Time	Soil / Solid	Water / Liquid	Is this location a well?	Total Number of Container:	Filtered/ HNO3					Dissolved Metals											Comments Note: If sample not collected, indicate "No Sample" in comments and single-strike out and initial any preprinted sample description.

	Relinquished By / Affiliation	Date	Time	Accepted By / Affiliation	Date	Time
Sampler's Name:						
Sampler's Company: Pioneer Technical Services						
Shipment Method: FedEx Ship Date:						
Shipment Tracking No:						

Special Instructions:

THIS LINE - LAB USE ONLY: Custody Seals In Place: Yes / No | Temp Blank: Yes / No | Cooler Temp on Receipt: ________ °F/C | Trip Blank: Yes / No | MS/MSD Sample Submitted: Yes / No

ATTACHMENT 4

LaMP Project Information Form (PIF)

Date: _________

Project Information

Project Name: ______________________________
Site Address: ______________________________
____
City: __________ State ______ Zip __________
Regulatory Agency: ______________________________
Project Type (circle): RCRA CERCLA Other (specify): __________
Anticipated Start Date: __________ Anticipated Completion Date: __________
ENFOS Node: ______________________________
ENFOS Project Number: ______________________________
ENFOS Work Release Number: ______________________________

Project Management Contacts

ARC Contact

EBM: ______________________________
Address: ______________________________ E-mail __________
______________________________ Phone # __________
City: __________ State ______ Zip __________ FAX # __________

Consultant Contact

Consultant Firm Name: ______________________________
Consultant Project Manager: ______________________________
Address: ______________________________ E-mail __________
______________________________ Phone # ( ) __________
City: __________ State ______ Zip __________ FAX # ( ) __________

Laboratory Contact

Laboratory Name: ______________________________
Laboratory Project Manager: ______________________________
Address ______________________________ E-mail __________
______________________________ Phone # ( ) __________
City __________ State ______ Zip __________ FAX # ( ) __________

Deliverable Information

Are special regulatory requirements for reporting limits needed? __________
Are results to be reported to the method detection limit ("J" reporting)? __________
Are Tentatively Identified Coumpounds (TICs) required for volatiles? __________
Are TICs required for semivolatiles? __________
Does an approved QAPjP exist and has a copy been provided to laboratory? __________
Is a specific target analyte/compound list needed and been provided to laboratory? __________

Generator and Notifications

Author Name and Firm: ______________________________

Project Accepted by Laboratory (Name): ______________________________

Project Accepted by Laboratory (Date): ______________________________

ATTACHMENT 4

ENFOS Node: ______________________________ Date: ______________

ENFOS Work Release Number: ______________________________

ENFOS Project Number: ______________________________

Parameters and Analytical Methods Requested

		Projected Samples to be Collected				**Actual Samples Collected**				
Analytical Unit Code	TAT/DP Unit Code	Number of Samples	MS/MSD Requested	Trip Blanks	Field Blanks	Number of Samples	Trip Blanks	Field Blanks	Intact?	Temperature Requirement Met?

Are MS/MSD samples billable (if < 10 samples/SDG)? ______________

Bottle type requested*: Prepreserved? ________ Unpreserved (with preservation kit)? ________

Ship Bottles To: ______________________________

Name: ______________________________

Address: ______________________________

____

City: ______________ State ________ Zip ________

Phone Number: ______________

Is analyte-free water needed for field blanks? ______________ If so, how much volume? ______________

Are trip blanks needed? ______________ If so, how many vials? ______________

Additional Request Description. ______________________________

____

*Note: Sample volume sufficient for a minimum of two sample preparations must be collected for each sampling point.

Routine Operation, Maintenance, and Monitoring Tasks

Activity				
Reporting	**Frequency**	**Number/yr**	**Routine OMM Reference**	**SOP Reference**
Daily Data	Daily	365	7.1	NA
Weekly Operations Report	Weekly	52	7.2	NA
Monthly BPSOU Report	Monthly	12	7.3	NA
UAO Quarterly OMM Reporting	Quarterly	4	7.4	NA
UAO Annual OMM Reporting	Annual	1	7.6	NA
Generator Runtime	Quarterly	4	7.5	NA
Inspections	**Frequency**	**Number/yr**	**O&M Section**	**SOP Reference**
Site Overview	Weekly	52	8.1.1	BTL-SOP-47
Site Overview	Quarterly	4	8.1.2	BTL-SOP-47
Flood Control Dike Stability	Annual	1	8.3	Checklist
Generator Inspection	Monthly	48	4.8	BTL-SOP-9
Fire Exinguishers (Multiple locations)	Monthly	144	9.2.1	BTL-SOP-50
Fire Exinguishers Recertification (Multiple locations)	Annual	12	9.2.1	Contractor
Site Eyewash Stations	Monthly	72	Appendix D Checklist	BTL-SOP-50
Level Transducer Calibration	Annual	12	8.2.2	BTL-SOP-39
Lime Feeder Calibration	Annual	12	8.2.2	BTL-SOP-35
H2S Detector Calibration	Annual	12	8.2.2	BTL-SOP-41
Level Device Calibration	Annual	12	8.2.2	Contractor
Sampling	**Frequency**	**Number/yr**	**O&M Section**	**SOP Reference**
Effluent Composite Sample	2X /Week	104	QAPP Section 3.1.1	BTL-SOP-17
Effluent Composite Sample	Monthly	12	QAPP Section 3.1.1	BTL-SOP-17
Influent Composite Sample	Weekly	52	QAPP Section 3.1.1	BTL-SOP-17
Influent Composite Sample	Monthly	12	QAPP Section 3.1.1	BTL-SOP-17
MSD-HCC Grab Sample	Monthly	12	QAPP Section 3.1.1	BTL-SOP-13
QA/QC Samples	Monthly	12	QAPP Section 3.7.1	QAPP
Subdrain Sampling	Semi-Annual	2	QAPP Section 3.2.1	BTL-SOP-02
Monitoring	**Frequency**	**Number/yr**	**O&M Section**	**SOP Reference**
Daily Grab Samples and pH	Daily	3285	4.1	BTL-SOP-13
Distribution Channel pH Monitoring	Daily	365	4.2.3	BTL-SOP-13
Transducer Verification	Quarterly	64	8.2.1	BTL-SOP-39
Subdrain Flowmeter Download	Monthly	60	4.7.2.5	BTL-SOP-08
Maintenance	**Frequency**	**Number/yr**	**O&M Section**	**SOP Reference**
Subdrain Jetting	Semi-Annual	2	4.7.2.2	BTL-SOP-20
Subdrain Forced Main Piping Pigging	Semi-Annual	2	4.7.2.3	BTL-SOP-21
Lagoon Cell Dredging	Semi-Annual	2	4.6.4	Contractor
Sludge Removal and Haul	Semi-Annual	2	4.6.4	Contractor
Equipment Lube, Filter, Belts, Hose, etc.	Monthly	84	8.2	Checklist
Generator Service (Multiple units)	Annual	4	4.8	Contractor
Drying Bed Floor Survey and Grading	Annual	1	4.6.4.1	Survey
Specific Area Tasks				
ASB	**Frequency**	**Number/yr**	**O&M Section**	**SOP Reference**
pH Meter Calibration	Daily	365	4.6.1	BTL-SOP-36
ASB Sample Pump Replacement/Filter Cleaning	Weekly	52	8.1/ Appendix D Checklist	BTL-SOP-26
ISCO Auto Sampler Procedures	Monthly	12	4.6.1/ Appendix D Checklist	BTL-SOP-17
Change pH Buffer Solution	Monthly	72	8.1/ Appendix D Checklist	BTL-SOP-36
CAS/OPS	**Frequency**	**Number/yr**	**O&M Section**	**SOP Reference**
Water Quality Monitoring Measurements	Daily	365	2.3.8	QAPP
Manual Silo Lime Level Check	Daily	365	4.6.2	BTL-SOP-1
Initial Arrival / Verify HMI Alarm Log	Daily	365	4.1.1	BTL-SOP-1
Inspect/Clean Lime Screw Conveyor	Daily	365	4.6.2	BTL-SOP-37
Verify Lime Feed, Flow, and pH parameters	Daily	365	4.1.2	BTL-SOP-1
Compressed Air Line Blowdown	Daily	365	4.6.2/ Appendix D	BTL-SOP-38
Clean Conductivity Sensors	2X/wk	208	4.6.2/ Appendix D	BTL-SOP-19
Clean Distribution Tank and Grates	Weekly	52	4.6.2/ Appendix D	Weekly checklist

Routine Operation, Maintenance, and Monitoring Tasks

Activity				
Reporting	**Frequency**	**Number/yr**	**Routine OMM Reference**	**SOP Reference**
Distrubution Tank Sludge Removal	Annual	1	4.6.2	Contractor
Housekeeping/Lime Dust Removal	Monthly	12	4.6	BTL-SOP-18
Lime Silo Loading	2X/Month	26	4.2.4.2	Contractor
Clean Influent ISCO Auto Sampler	Monthly	12	4.6.1/Appendix D Checklist	BTL-SOP-17
Visually Inspect Compressed Air Desiccant	Monthly	12	4.6.2/ Appendix D	BTL-SOP-38
Check Lime Silo Baghouse	Quarterly	4	4.6.2/ Appendix D	Contractor
Clean Heaters	Monthly	72	4.6.2/ Appendix D	BTL-SOP-18
Clean Slurry Tank Discharge Lines	Periodic	*24	4.6.2/ Appendix D	BTL-SOP-19
Clean Slurry Tank/Sluice Box	Periodic	*12	4.6.2/ Appendix D	BTL-SOP-19
IPS	**Frequency**	**Number/yr**	**O&M Section**	**SOP Reference**
Inspect VFD, IPS Pumps and Intake Vaults	Daily	365	4.6.3	BTL-SOP-14
Check Pump Intake Compressor Oil Level	Daily	730	Appendix D	Checklist
IPS Pump Maintenance	Bi-Monthly	24	Appendix D	BTL-SOP-14
Clean Discharge Check Valve	Periodic	*12	Appendix D	Checklist
Clean Intake Vault Screens/Grates	Periodic	*12	4.6.3	BTL-SOP-22
Subdrain Pump Station	**Frequency**	**Number/yr**	**O&M Section**	**SOP Reference**
Pump System Arrival and System Operation Check	Daily	365	4.1.5 /4.7.2/Appendix D	BTL-SOP-5A
Site, Building, Security Inspection	Daily	365	4.7.2	BTL-SOP-5A
Subdrain Manhole/Flowmeter Maintenance	Monthly	60	4.7.2.5	BTL-SOP-08
WCP-1	**Frequency**	**Number/yr**	**O&M Section**	**SOP Reference**
WCP Site Arrival and System Operation Check	Daily	120	4.1.4/Appendix D	BTL-SOP-4
Building Heater, Fan & H_2S System Maintenance	Semi-Annual	2	4.7.1	BTL-SOP-44
BRW	**Frequency**	**Number/yr**	**O&M Section**	**SOP Reference**
Drying Bed Floor Survey & Grading	Periodic	1	4.6.4.1	Contractor
Sitewide	**Frequency**	**Number/yr**	**O&M Section**	**SOP Reference**
Vegetation Inspection & Weed Spraying	Seasonal 2X/yr	10	4.6.5	Contractor
Perimeter Fence Access Gate Inspection	Quarterly	16	8.3	Visual inspection
Silver Bow Creek Channel Inspection	Seasonal 2X/yr	2	8.3	Visual inspection
Snow Removal / Site Grading	Periodic	12	8.3	Contractor
Other	**Frequency**	**Number/yr**	**O&M Section**	**SOP Reference**
Maintain Outlet Structure, Culverts, etc.	Periodic	24	3.1.1	Visual inspection
Missoula Gulch System	Weekly	52	4.1.3	Others

*estimated number/yr

Butte Treatment Lagoons
Operator SOP Training Log

Operator: Robert Neff

SOP Number	SOP Title	Operator Trained on Procedure (Date)	Operator Demonstrated Procedure (Date)	Supervisor Observing Procedure (Initials)	Operator Re-Trained on Procudure (Date)	Operator Annual Refresher (Date)	Notes/Comments, etc.
SOP	**Procedure Title**						
1	Chemical Addition System (CAS) Building Initial Arrival Operation Status Check	January-17	February-17	BH	July-17	Jan. 2021	
2	Daily Lower Area One (LAO) Cell Sampling and Analyzing.	January-17	February-17	BH	July-17	Jan. 2021	
3	Gravimetric Lime Addition System Startup.	February-17	March-17	BH	May. 2020		
4	West Camp Weekly Operations Check Procedure.	January-17	February-17	BH	July-17	May-19	
5	Metro Storm Drain Daily Inspection and Startup.	January-17	February-17	BH	July-17	October-19	
6	Influent Pump Station Startup.	February-17	March-17	BH	July-17	May. 2020	
7	Slurry Tank Feed Water Re-establishment.	February-17	March-17	BH			
8	Lower Area One (LAO) Lime Weighing Procedure						
9	Generator Inspection.	January-17	February-17	BH	July-17	May-19	
10	Screw Conveyor Cleaning.	January-17	February-17	BH			
11	Stop Log Removal/Installation.						
12	Accurate Feeder Helix Modification						
13	Outlet Structure Grab Sampling.	January-17	February-17	BH	July-17	Jan. 2021	
14	IPS Pump and Compressor Oil Change/Greasing.	February-17					
15	Super Sax Redundant Lime Feed System Start-Up/Shutdown						
16	Super Sax Lime Loading Procedure						
17	ISCO® Automatic Composite Water Sampling Procedures.	January-17	February-17	BH	July-17	Jan. 2021	
18	LAO CAS Building cleaning procedure	February-17	March-17	BH	July-17	May-19	
19	Slurry Tank and Discharge Pipe Cleaning.	February-17	March-17	BH			
20	MSD Jetting.	March-17					
21	MSD Pigging.	March-17					
22	IPS Intake Screen Cleaning	January-17	February-17	BH	July-17	Jan. 2021	
23	Maintenance of the Freeway Wetlands	February-17	March-17	BH	July-17	May-19	
24	Effluent Grab Sample.	January-17	February-17	BH	July-17	Jan. 2021	
25	Startup/Shutdown/Emergency Shutdown Procedure for the MSD Generator	February-17					
26	ASB Grunfos Pump Replacement/Filter Cleaning						
27	Quarterly Valve Exercise	February-17					
28	Volumetric Lime Addition Startup.						
29	UltraMeg Flowmeter Maintenance						
30	BRW Staff Gauge Monitoring	February-17	March-17	BH	July-17	May-19	
31	MSD Dry Vault Monitoring and Dewatering	January-17	February-17	BH	July-17	May-19	
32	Relay Switch Replacements						
33	LAO Dialer Alarm Callout Update.	February-17	March-17	BH	October-19		
34	LAO Security Procedures	January-17	February-17	BH	July-17	Jan. 2021	
35	Calibrate Accurate Feeder.	February-17					
36	Calibrate pH meter	January-17	February-17	BH	July-17	Jan. 2021	
37	Lime Silo Cleaning.	February-17	March-17	BH	July-17	April. 2020	
38	Air Compressor Maintenance.	February-17	March-17	BH			
39	Quarterly Level Tranducer Verification	February-17	May-19	TS			
40	Screw Conveyor Oil Change						
41	ISCO Automatic Sampler Programming/ Cleaning	January-17	February-17	BH	May-19	April. 2020	
42	WCP-1 Stop/Restart.	February-17	March-17	BH			
43	SoleinoidAir Cylinder Replacement-Salina Knife Gate						
44	WCP H2S Alarm Response.	January-17	February-17	BH	May-19		
45	CO2 Addition Monitoring/Adjustement	January-17	February-17	BH	October-19		
46	MSD Loading Study Sampling/Transducer Downloading	February-17	March-17	BH	July-17	April-19	
47	Site Overview Inspections	February-17	May-19	TS			
48	MSD Pump Station Start Up/Shut Down.	January-17	February-17	BH			
49	Transducer Verification/Replacement	February-17	May-19	TS			
50	Monthy Fire Extinguisher/Eye Wash Inspections	February-17	March-17	BH	July-17	May-19	

Employee Signature: Signature on Hard Copy Date:

PIONEER TECHNICAL SERVICES, INC.

Butte Treatment Lagoons
Operator SOP Training Log

Operator: Steve Lubick

SOP Number	SOP Title	Operator Trained on Procedure (Date)	Operator Demonstrated Procedure (Date)	Supervisor Observing Procedure (Initials)	Operator Re-Trained on Procudure (Date)	Operator Annual Refresher (Date)	Notes/Comments, etc.
SOP	**Procedure Title**						
1	Chemical Addition System (CAS) Building Initial Arrival Operation Status Check	January-15	February-15	BH	April-19	Jan. 2021	
2	Daily Lower Area One (LAO) Cell Sampling and Analyzing.	January-15	February-15	BH	April-19	Jan. 2021	
3	Gravimetric Lime Addition System Startup.	January-15	February-15	BH			
4	West Camp Weekly Operations Check Procedure.	February-17	March-17	BH	June. 2020		
5	Metro Storm Drain Daily Inspection and Startup.	January-15	February-15	BH			
6	Influent Pump Station Startup.	January-15	February-15	BH			
7	Slurry Tank Feed Water Re-establishment.	January-15	February-15	BH			
8	Lower Area One (LAO) Lime Weighing Procedure						
9	Generator Inspection.	February-17	March-17	BH			
10	Screw Conveyor Cleaning.						
11	Stop Log Removal/Installation.						
12	Accurate Feeder Helix Modification						
13	Outlet Structure Grab Sampling.	January-15	February-15	BH	April-19	Jan. 2021	
14	IPS Pump and Compressor Oil Change/Greasing.						
15	Super Sax Redundant Lime Feed System Start-Up/Shutdown						
16	Super Sax Lime Loading Procedure						
17	ISCO® Automatic Composite Water Sampling Procedures.	January-15	February-15	BH	April-19	Jan. 2021	
18	LAO CAS Building cleaning procedure						
19	Slurry Tank and Discharge Pipe Cleaning.						
20	MSD Jetting.	Sept.-15	April-16	BH	April-19	April. 2020	
21	MSD Pigging.						
22	IPS Intake Screen Cleaning	January-15	February-15	BH	May-19	Jan. 2021	
23	Maintenance of the Freeway Wetlands	May-19					
24	Effluent Grab Sample.	January-15	February-15	BH	April-19	Jan. 2021	
25	Startup/Shutdown/Emergency Shutdown Procedure for the MSD Generator						
26	ASB Grunfos Pump Replacement/Filter Cleaning						
27	Quarterly Valve Exercise						
28	Volumetric Lime Addition Startup.						
29	UltraMeg Flowmeter Maintenance						
30	BRW Staff Gauge Monitoring	May-19					
31	MSD Dry Vault Monitoring and Dewatering	January-15	February-15	BH	April-19	April. 2020	
32	Relay Switch Replacements						
33	LAO Dialer Alarm Callout Update.	May-19	October-19	TS			
34	LAO Security Procedures	January-15	February-15	BH	April-19	Jan. 2021	
35	Calibrate Accurate Feeder.						
36	Calibrate pH meter	January-15	February-15	BH	April-19	Jan. 2021	
37	Lime Silo Cleaning.						
38	Air Compressor Maintenance.						
39	Quarterly Level Tranducer Verification						
40	Screw Conveyor Oil Change						
41	ISCO Automatic Sampler Programming/ Cleaning	April. 2020					
42	WCP-1 Stop/Restart.	January-15	February-15	BH	June. 2020		
43	SoleinoidAir Cylinder Replacement-Salina Knife Gate						
44	WCP H2S Alarm Response.	January-15	February-15	BH			
45	CO2 Addition Monitoring/Adjustement	January-15	February-15	BH	October-19	Jan. 2021	
46	MSD Loading Study Sampling/Transducer Downloading						
47	Site Overview Inspections						
48	MSD Pump Station Start Up/Shut Down.	January-15	February-15	BH	April-19		
49	Transducer Verification/Replacement						
50	Monthy Fire Extinguisher/Eye Wash Inspections						

Employee Signature: Signature on Hard Copy Date: ____________

PIONEER TECHNICAL SERVICES, INC.

Butte Treatment Lagoons
Operator SOP Training Log

Operator: Taylor Stanich

SOP Number	SOP Title	Operator Trained on Procedure (Date)	Operator Demonstrated Procedure (Date)	Supervisor Observing Procedure (Initials)	Operator Re-Trained on Procudure (Date)	Operator Annual Refresher (Date)	Notes/Comments, etc.
SOP	**Procedure Title**						
1	Chemical Addition System (CAS) Building Initial Arrival Operation Status Check	Dec. 2017	Jan. 2018	BH	April-19	Jan. 2021	
2	Daily Lower Area One (LAO) Cell Sampling and Analyzing.	Dec. 2017	Jan. 2018	BH	April-19	Jan. 2021	
3	Gravimetric Lime Addition System Startup.	Jan. 2019	April-19	BH	November-19	Jan. 2021	
4	West Camp Weekly Operations Check Procedure.	Dec. 2017	Jan. 2018	BH	April-19	Jan. 2021	
5	Metro Storm Drain Daily Inspection and Startup.	Dec. 2017	Jan. 2018	BH	April-19	Jan. 2021	
6	Influent Pump Station Startup.	Dec. 2017	Jan. 2018	BH	April-19	Jan. 2021	
7	Slurry Tank Feed Water Re-establishment.	Feb. 2018	April-19	BH	November-19	Jan. 2021	
8	Lower Area One (LAO) Lime Weighing Procedure						
9	Generator Inspection.	Dec. 2017	Jan. 2018	BH	April-19	Jan. 2021	
10	Screw Conveyor Cleaning.	July-18	June. 2020	BH	Dec. 2020		
11	Stop Log Removal/Installation.	Mar. 2018	June-19	BH	June. 2020	July. 2020	
12	Accurate Feeder Helix Modification	Jan. 2019	April-19	BH			
13	Outlet Structure Grab Sampling.	Dec. 2017	Jan. 2018	BH	April-19	Jan. 2021	
14	IPS Pump and Compressor Oil Change/Greasing.	Mar. 2018					
15	Super Sax Redundant Lime Feed System Start-Up/Shutdown						
16	Super Sax Lime Loading Procedure						
17	ISCO® Automatic Composite Water Sampling Procedures.	Dec. 2017	Jan. 2018	BH	April-19	Jan. 2021	
18	LAO CAS Building cleaning procedure	Mar. 2018	Aug. 2018	BH	April-19	April. 2020	
19	Slurry Tank and Discharge Pipe Cleaning.	Mar. 2018	April. 2020	BH	July. 2020	Dec. 2020	
20	MSD Jetting.						
21	MSD Pigging.	April-18	Oct. 2018	BH	April-19	Jan. 2021	
22	IPS Intake Screen Cleaning	Dec. 2017	Jan. 2018	BH	April-19	Jan. 2021	
23	Maintenance of the Freeway Wetlands	Feb. 2018	Aug. 2018	BH	April-19	Jan. 2021	
24	Effluent Grab Sample.	Dec. 2017	Jan. 2018	BH	April-19	Jan. 2021	
25	Startup/Shutdown/Emergency Shutdown Procedure for the MSD Generator						
26	ASB Grunfos Pump Replacement/Filter Cleaning	Feb. 2018	Dec. 2018	BH	April-19	April. 2020	
27	Quarterly Valve Exercise	Dec. 2017	Mar. 2018	BH	November-19	Mar. 2021	
28	Volumetric Lime Addition Startup.	Jan. 2019					
29	UltraMeg Flowmeter Maintenance	Sept. 2019	July. 2020	BH			
30	BRW Staff Gauge Monitoring	Dec. 2017	Jan. 2018	BH	April-19	Jan. 2021	
31	MSD Dry Vault Monitoring and Dewatering	Dec. 2017	Jan. 2018	BH	April-19	Jan. 2021	
32	Relay Switch Replacements						
33	LAO Dialer Alarm Callout Update.	Jan. 2019	October-19	BH	April. 2020	Jan. 2021	
34	LAO Security Procedures	Jan. 2018	Aug. 2018	BH	April-19	Jan. 2021	
35	Calibrate Accurate Feeder.	June-18	April-19	BH	November-19	Jan. 2021	
36	Calibrate pH meter	Dec. 2017	Jan. 2018	BH	April-19	Jan. 2021	
37	Lime Silo Cleaning.	Jan. 2018	June-18	BH	April-19	April. 2020	
38	Air Compressor Maintenance.	Mar. 2018	November-19	BH	May. 2020		
39	Quarterly Level Tranducer Verification	Dec. 2017	Mar. 2018	BH	May-20	Mar. 2021	
40	Screw Conveyor Oil Change	April-19					
41	ISCO Automatic Sampler Programming/ Cleaning	Jan. 2018	Feb. 2018	BH	April-19	Jan. 2021	
42	WCP-1 Stop/Restart.	April-19	May. 2020	BH	Aug. 2020		
43	SoleinoidAir Cylinder Replacement-Salina Knife Gate						
44	WCP H2S Alarm Response.	Dec. 2017	Jan. 2018	BH	April-19	May. 2020	
45	CO2 Addition Monitoring/Adjustement	Dec. 2017	Jan. 2018	BH	Jan. 2020	Jan. 2021	
46	MSD Loading Study Sampling/Transducer Downloading	Dec. 2017	Jan. 2018	BH	April-19	Feb. 2021	
47	Site Overview Inspections	Dec. 2017	Mar. 2018	BH	Nov. 2019	Feb. 2021	
48	MSD Pump Station Start Up/Shut Down.	April-19	October-20	BH	May. 2020	Feb. 2021	
49	Transducer Verification/Replacement	Mar. 2018	June-18	BH	May-19	Mar. 2021	
50	Monthy Fire Extinguisher/Eye Wash Inspections	Dec. 2017	Jan. 2018	BH	April-19	Jan. 2021	

Employee Signature: Signature on Hard Copy Date:

PIONEER TECHNICAL SERVICES, INC.

Butte Treatment Lagoons
Operator SOP Training Log

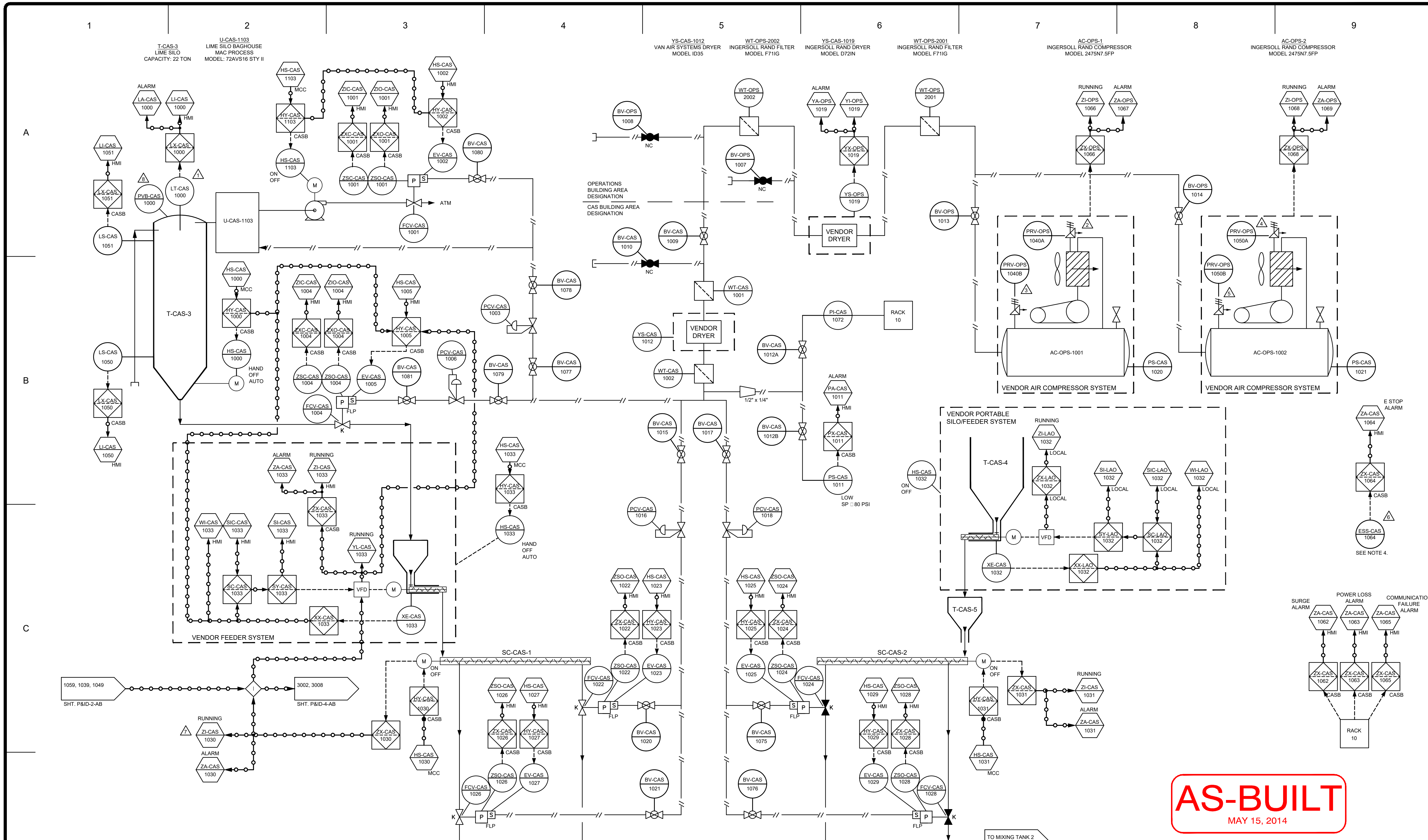
Operator: Kaleb Ferriter

SOP Number	SOP Title	Operator Trained on Procedure (Date)	Operator Demonstrated Procedure (Date)	Supervisor Observing Procedure (Initials)	Operator Re-Trained on Procudure (Date)	Operator Annual Refresher (Date)	Notes/Comments, etc.
SOP	**Procedure Title**						
1	Chemical Addition System (CAS) Building Initial Arrival Operation Status Check	Feb. 2020	April. 2020	TS	Jan. 2021		
2	Daily Lower Area One (LAO) Cell Sampling and Analyzing.	Feb. 2020	April. 2020	TS			
3	Gravimetric Lime Addition System Startup.	Jan. 2021					
4	West Camp Weekly Operations Check Procedure.	Feb. 2020	April. 2020	TS	Jan. 2021		
5	Metro Storm Drain Daily Inspection and Startup.	April. 2020	Oct. 2020	TS			
6	Influent Pump Station Startup.						
7	Slurry Tank Feed Water Re-establishment.						
8	Lower Area One (LAO) Lime Weighing Procedure						
9	Generator Inspection.	Feb. 2020	April. 2020	TS	Jan. 2021		
10	Screw Conveyor Cleaning.	July. 2020	Dec. 2020	TS			
11	Stop Log Removal/Installation.	Jan. 2021					
12	Accurate Feeder Helix Modification						
13	Outlet Structure Grab Sampling.	Feb. 2020	April. 2020	TS	Jan. 2021		
14	IPS Pump and Compressor Oil Change/Greasing.	Oct. 2020					
15	Super Sax Redundant Lime Feed System Start-Up/Shutdown						
16	Super Sax Lime Loading Procedure						
17	ISCO® Automatic Composite Water Sampling Procedures.	April. 2020	Oct. 2020	TS	Jan. 2021		
18	LAO CAS Building cleaning procedure	July. 2020	Oct. 2020	TS			
19	Slurry Tank and Discharge Pipe Cleaning.	Mar. 2020	June. 2020	TS			
20	MSD Jetting.						
21	MSD Pigging.						
22	IPS Intake Screen Cleaning	Feb. 2020	April. 2020	TS	Jan. 2021		
23	Maintenance of the Freeway Wetlands	July. 2020					
24	Effluent Grab Sample.	Feb. 2020	April. 2020	TS	Jan. 2021		
25	Startup/Shutdown/Emergency Shutdown Procedure for the MSD Generator						
26	ASB Grunfos Pump Replacement/Filter Cleaning						
27	Quarterly Valve Exercise	Mar. 2020	June. 2020	TS			
28	Volumetric Lime Addition Startup.						
29	UltraMeg Flowmeter Maintenance						
30	BRW Staff Gauge Monitoring	Feb. 2020	April. 2020	TS			
31	MSD Dry Vault Monitoring and Dewatering	Mar. 2020	Oct. 2020	TS	Jan. 2021		
32	Relay Switch Replacements						
33	LAO Dialer Alarm Callout Update.						
34	LAO Security Procedures	Feb. 2020	April. 2020	TS	Jan. 2021		
35	Calibrate Accurate Feeder.	Jan. 2021					
36	Calibrate pH meter	Feb. 2020	April. 2020	TS	Jan. 2021		
37	Lime Silo Cleaning.	Feb. 2020	July. 2020	TS			
38	Air Compressor Maintenance.						
39	Quarterly Level Tranducer Verification	Mar. 2020	June. 2020	TS			
40	Screw Conveyor Oil Change						
41	ISCO Automatic Sampler Programming/ Cleaning	April. 2020	Oct. 2020	TS			
42	WCP-1 Stop/Restart.						
43	SoleinoidAir Cylinder Replacement-Salina Knife Gate						
44	WCP H2S Alarm Response.	Feb. 2020					
45	CO2 Addition Monitoring/Adjustement	Feb. 2020	Nov. 2020	TS	Jan. 2021		
46	MSD Loading Study Sampling/Transducer Downloading	Mar. 2020	April. 2020	TS	Feb. 2021		
47	Site Overview Inspections	Mar. 2020	June. 2020	TS	Feb. 2021		
48	MSD Pump Station Start Up/Shut Down.						
49	Transducer Verification/Replacement	Mar. 2020	June. 2020	TS	Mar. 2021		
50	Monthy Fire Extinguisher/Eye Wash Inspections	Feb. 2020	April. 2020	TS			

Employee Signature: Signature on Hard Copy   Date: ______________

Appendix E
System Drawings

Appendix E.1
Piping and Instrumentation diagrams (P&ID)



AS-BUILT
MAY 15, 2014

NOTES:

1. ◇ INTERLOCKS WILL ENSURE THAT BTL SYSTEM FLOW WILL BE TREATED WITH LIME. D4 PUMPS WILL TURN OFF WITH THE LOSS OF ACCURATE FEEDER SYSTEM OPERATION, LOSS OF SCREW CONVEYOR DELIVERY SYSTEM, OR LOSS OF FLOW.
2. K = KNIFE GATE VALVE.
3. FLP = FAIL TO LAST POSITION.
4. MANUAL ACTIVATION OF E-STOP DE-ENERGIZES HS-CAS-1033, M-CAS-1038, M-CAS-1048, AND SC-CAS-1.

Δ	Tag Name	Functional Description	Setpoint
1	LT-CAS-1000	Lime Silo Level; low level alarm activated at 4FT (non PSD)	4 FT, 26 FT
2	PRV-CAS-1040A	CAS Air Compressor #1, 1st Stage Pressure Relief; poppet	200 PSI
3	PRV-CAS-1040B	CAS Air Compressor #1, 2nd Stage Pressure Relief; poppet	325 PSI
4	PRV-CAS-1050A	CAS Air Compressor #2, 1st Stage Pressure Relief; poppet	200 PSI
5	PRV-CAS-1050B	CAS Air Compressor #2, 2nd Stage Pressure Relief; poppet	325 PSI
6	ESS-CAS-1064	Main Panel E-Stop; local hard-wired, manually activated	NA
7	ZI-CAS-1030	Primary Screw Conveyor Run Status; alarm activated at OFF	NA
8	PVB-CAS-1000	24" Spring Type Pressure/Vacuum Relief	0.5 oz, 8 oz

REVISION: DATE:	BY:	DESC:
5/14	JTB	AS-BUILTS

DRAWN BY: CFB
DESIGNED BY: AMD
CHECKED BY: SDS
APPROVED BY: DSG
PROJECT NO:
DATE: 4/21/2014

DISPLAYED AS:
COORD SYS/ZONE:
DATUM:
UNITS:
SOURCE:

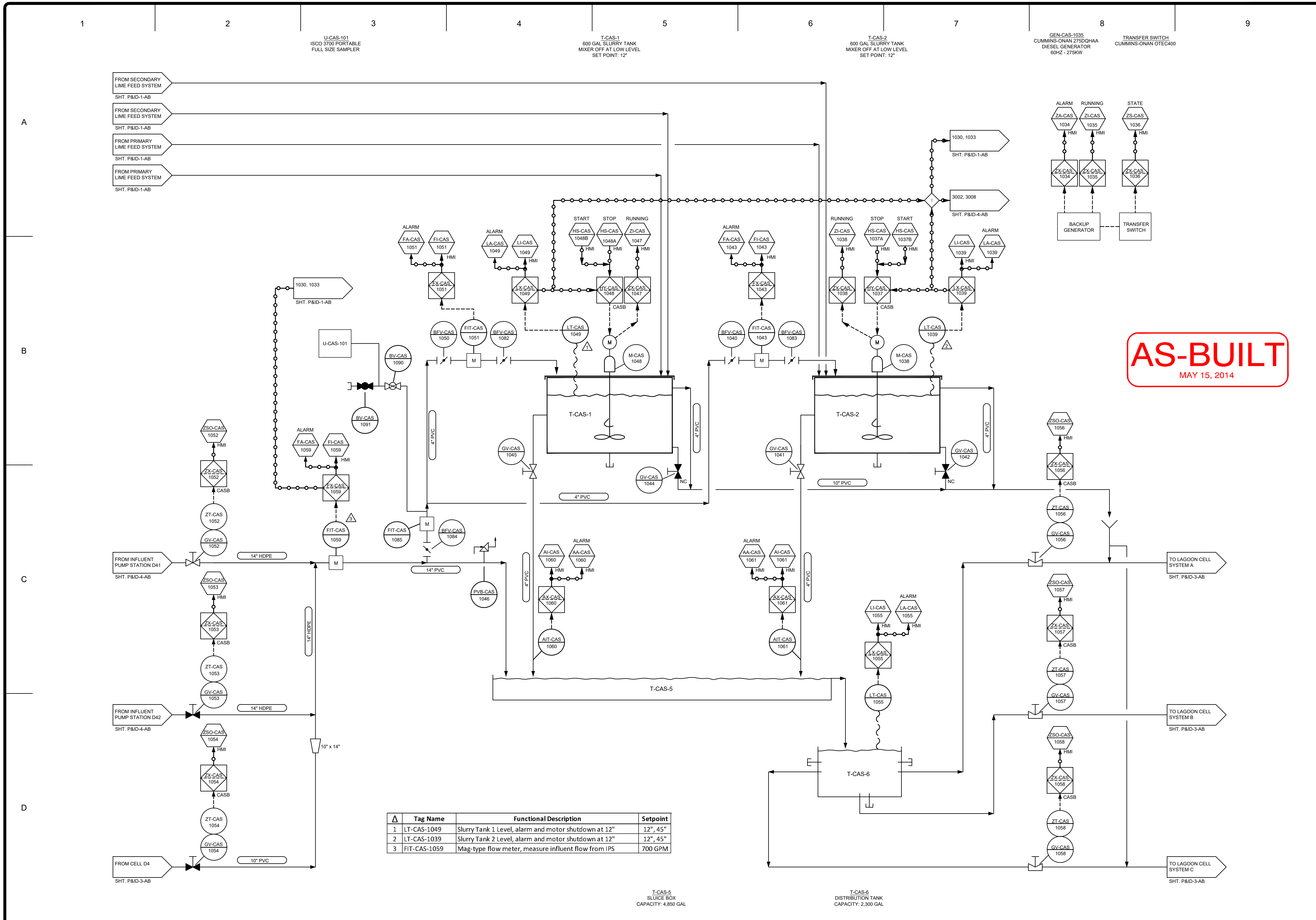
SCALE IN FEET
0 NTS NTS

ATLANTIC RICHFIELD COMPANY
BUTTE PRIORITY SOILS OU
BTL AND WCP-1 UPGRADES

LIME FEED
PIPING AND
INSTRUMENTATION
DIAGRAM AS-BUILT

PIONEER
TECHNICAL SERVICES, INC.
307 EAST PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

SHEET
P&ID1AB



Δ	Tag Name	Functional Description	Setpoint
1	LT-CAS-1049	Slurry Tank 1 Level, alarm and motor shutdown at 12"	12", 45"
2	LT-CAS-1039	Slurry Tank 2 Level, alarm and motor shutdown at 12"	12", 45"
3	FIT-CAS-1059	Mag-type flow meter, measure influent flow from IPS	700 GPM

AS-BUILT
MAY 15, 2014

REVISION:
DATE: 5/14 BY: JTB DESC: AS-BUILT

DRAWN BY: CFB
DESIGNED BY: AMD
CHECKED BY: SDS
APPROVED BY: DSG
PROJECT NO:
DATE: MAY 15, 2014

DISPLAYED AS:
COORD SYS/ZONE:
DATUM:
UNITS:
SOURCE:

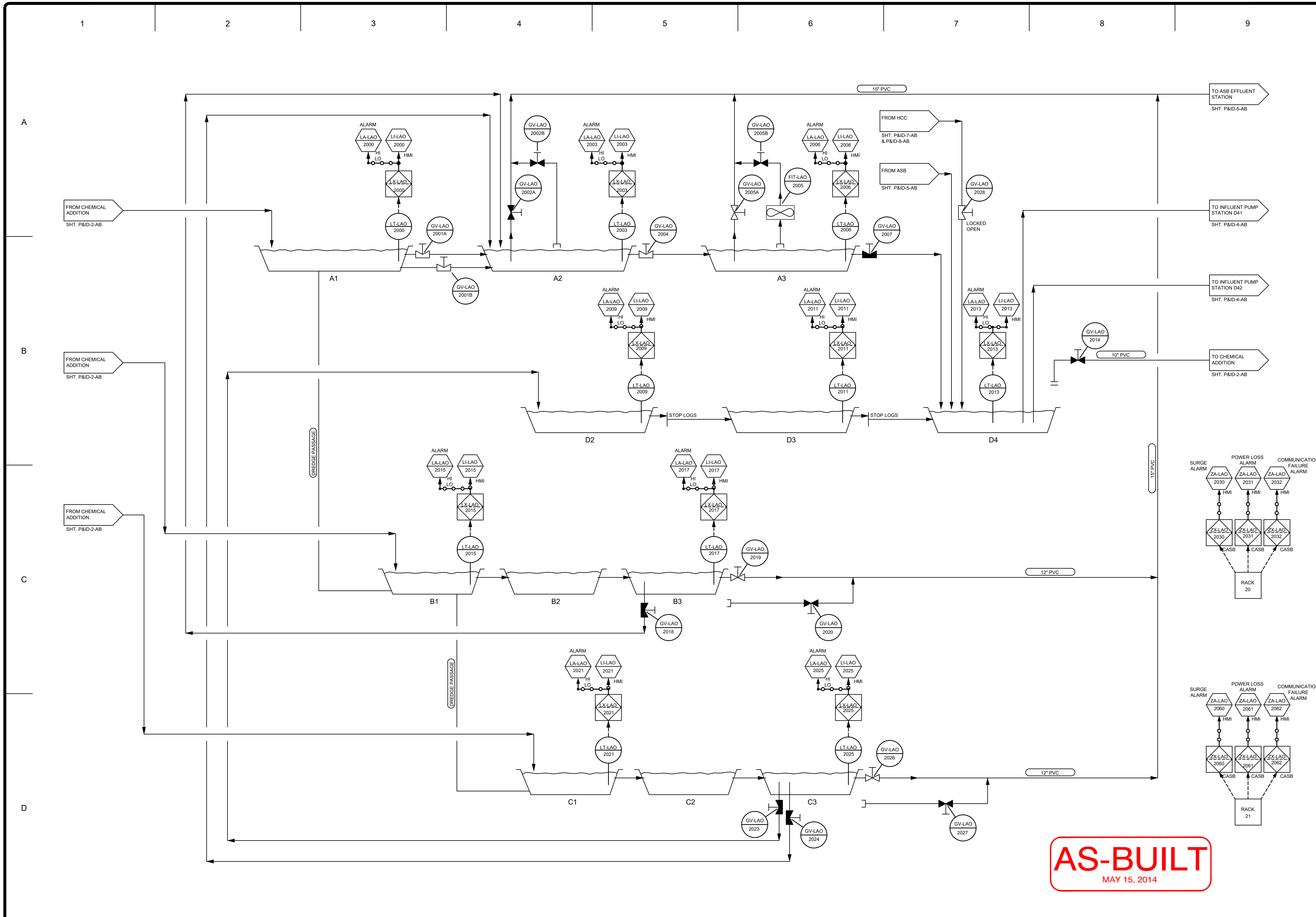
SCALE IN FEET
0 NTS NTS

ATLANTIC RICHFIELD COMPANY
BUTTE PRIORITY SOILS OU
BTL AND WCP-1 UPGRADES

CAS PIPING AND INSTRUMENTATION DIAGRAM AS-BUILT

PIONEER TECHNICAL SERVICES, INC.
307 EAST PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

SHEET
P&ID2AB



REVISION: DATE:	BY:	DESC:
5/14	JTB	AS-BUILT

DRAWN BY: CFB
DESIGNED BY: AMD
CHECKED BY: SDS
APPROVED BY: DSG
PROJECT NO:
DATE: 4/21/2014

DISPLAYED AS:
COORD SYS/ZONE:
DATUM:
UNITS:
SOURCE:

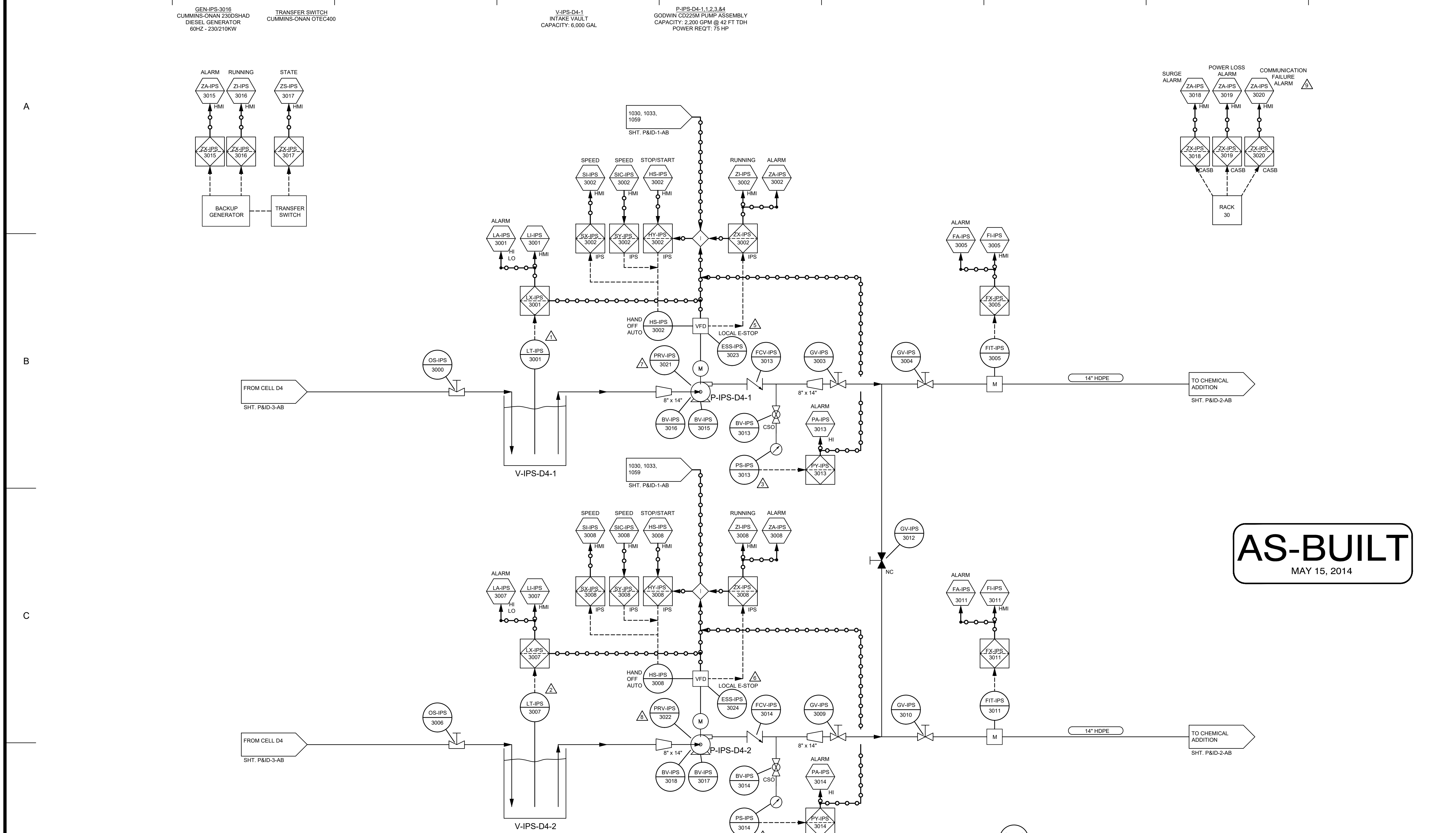
SCALE IN FEET
0 NTS NTS

ATLANTIC RICHFIELD COMPANY
BUTTE PRIORITY SOILS OU
BTL AND WCP-1 UPGRADES

LAGOON SYSTEM PIPING AND INSTRUMENTATION DIAGRAM AS-BUILT

PIONEER TECHNICAL SERVICES, INC.
307 EAST PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

SHEET
P&ID3AB



Δ	Tag Name	Functional Description	Setpoint
1	LT-IPS-3001	D4 Vault 1 Level Transducer; low level alarm & shutdown	5418.35'
2	LT-IPS-3007	D4 Vault 2 Level Transducer; low level alarm & shutdown	5418.35'
3	PS-IPS-3013	P-D4-1 discharge pressure switch; high pressure shutdown	80 PSI
4	PS-IPS-3014	P-D4-2 discharge pressure switch; high pressure shutdown	80 PSI
5	ESS-IPS-3023	Local P-IPS-D4-1 E-stop, located on VFD panel	NA
6	ESS-IPS-3024	Local P-IPS-D4-2 E-stop, located on VFD panel	NA
7	PRV-IPS-3021	P-D4-1 suction compressor relief; poppet style	125 PSI
8	PRV-IPS-3022	P-D4-2 suction compressor relief; poppet style	125 PSI
9	ZA-IPS-3020	Comm Failure Alarm	NA

NOTES:

1. INTERLOCKS WILL ENSURE THAT BTL SYSTEM FLOW WILL BE TREATED WITH LIME. D4 PUMPS WILL TURN OFF WITH THE LOSS OF ACCURATE FEEDER SYSTEM OPERATION, LOSS OF SCREW CONVEYOR DELIVERY SYSTEM, OR LOSS OF FLOW.

REVISION:

DATE:	BY:	DESC:
5/14	JTB	AS-BUILT

DRAWN BY: CFB
DESIGNED BY: AMD
CHECKED BY: SDS
APPROVED BY: DSG
PROJECT NO:
DATE: 4/21/2014

DISPLAYED AS:
COORD SYS/ZONE:
DATUM:
UNITS:
SOURCE:

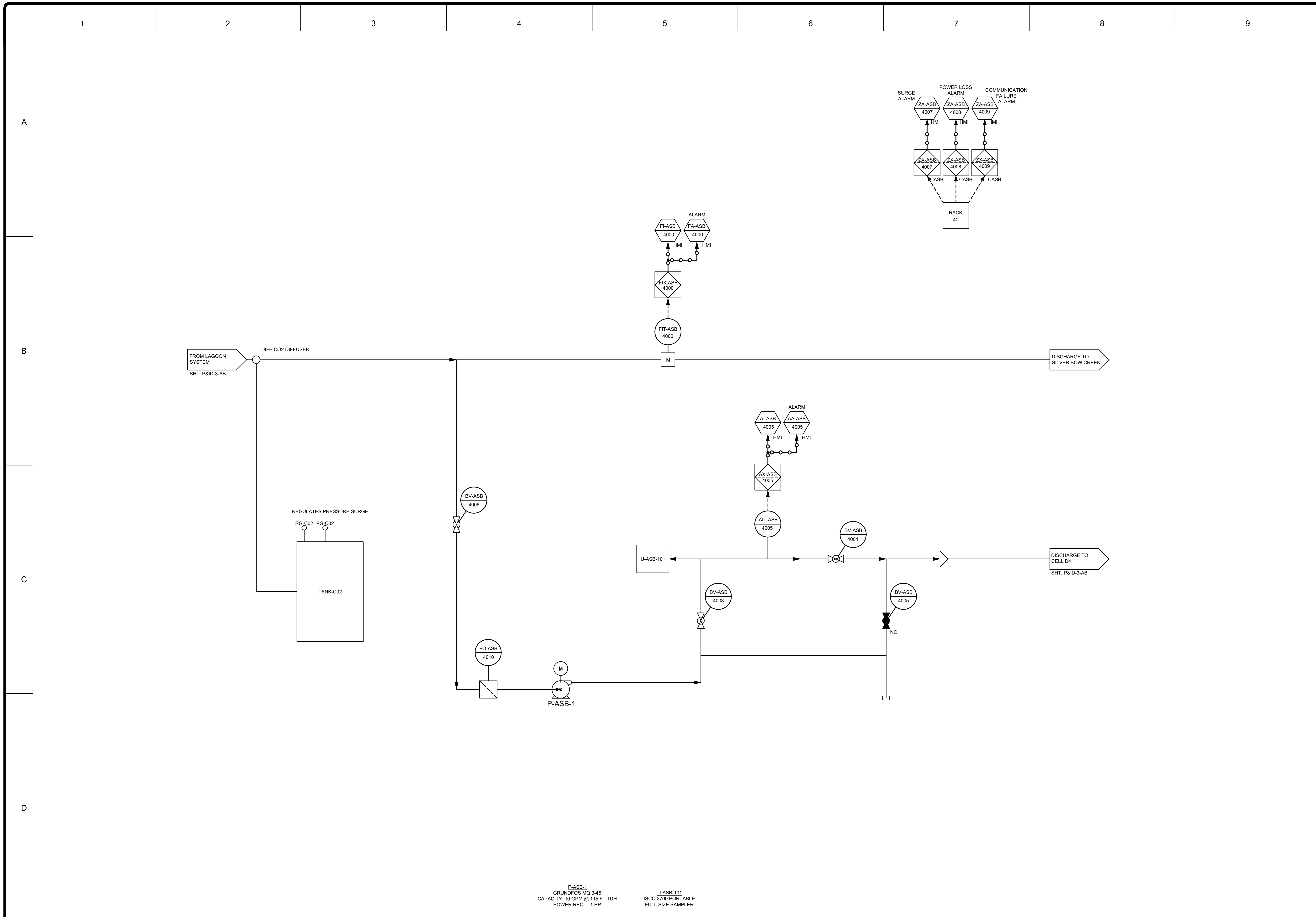
SCALE IN FEET
0 NTS NTS

ATLANTIC RICHFIELD COMPANY
BUTTE PRIORITY SOILS OU
BTL AND WCP-1 UPGRADES

INFLUENT PUMP STATION PIPING AND INSTRUMENTATION DIAGRAM AS-BUILT

PIONEER TECHNICAL SERVICES, INC.
307 EAST PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

SHEET
P&ID4AB



REVISION: DATE:	BY:	DESC:
5/14	JTB	AS-BUILT
7/19	NH	REVISION

DRAWN BY: CFB
DESIGNED BY: AMD
CHECKED BY: SDS
APPROVED BY: DSG
PROJECT NO:
DATE: APRIL 21, 2014

DISPLAYED AS:
COORD SYS/ZONE:
DATUM:
UNITS:
SOURCE:

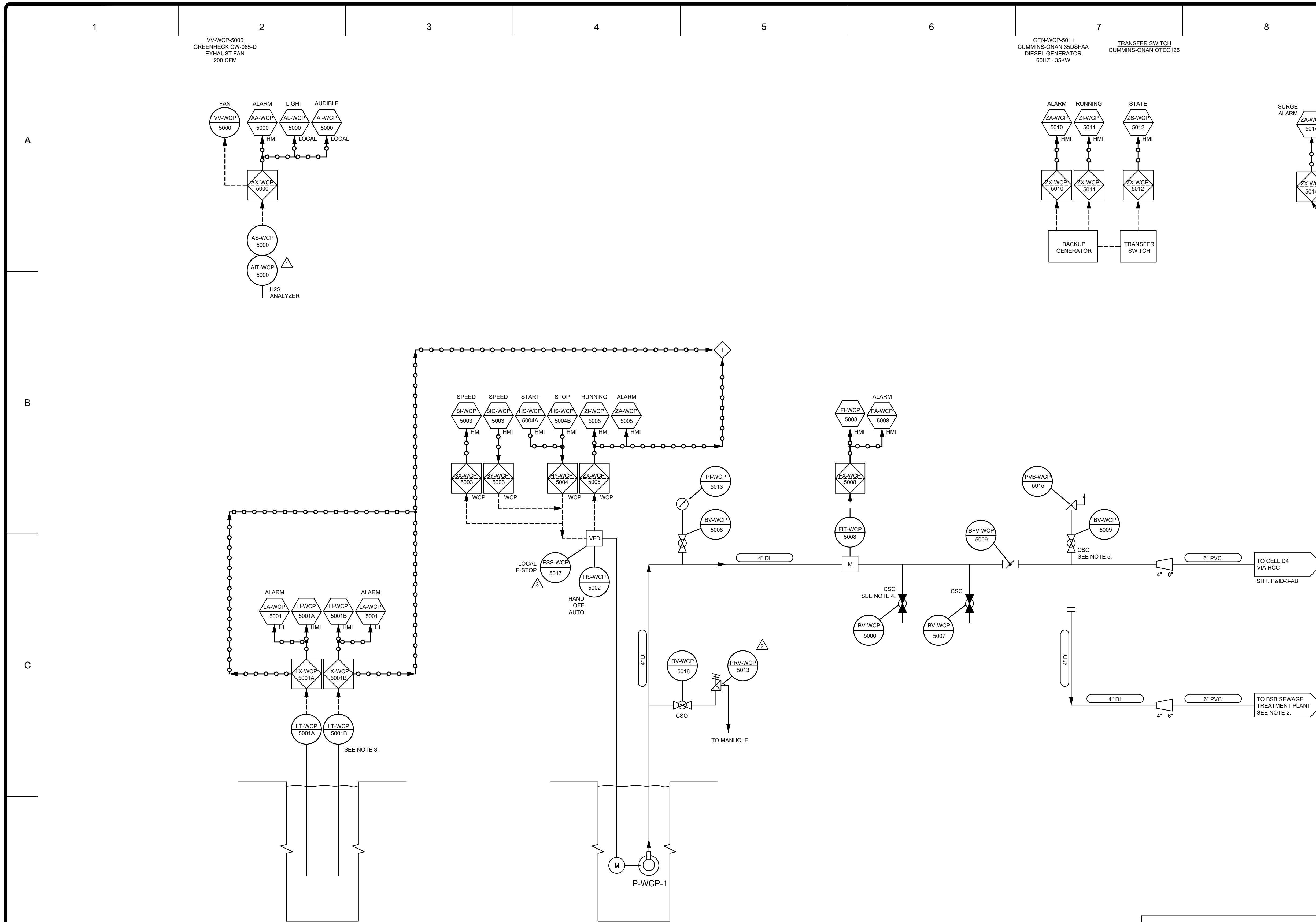
SCALE IN FEET
0 NTS

ATLANTIC RICHFIELD COMPANY
BUTTE PRIORITY SOILS OU
BTL AND WCP-1 UPGRADES

ASB PIPING AND INSTRUMENTATION DIAGRAM AS-BUILT

PIONEER TECHNICAL SERVICES, INC.
307 EAST PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

SHEET
P&ID5



BMF96-1D
MONITORING WELL

P-WCP-1
GOULDS 320L15
CAPACITY: 400 GPM TDH: 360 FT
POWER REQ'T: 15 HP 480V 3-PHASE

Δ	Tag Name	Functional Description	Setpoint
1	AIT-WCP-5000	H2S Sensor; Audible and visual alarm at 10PPM in building	10 PPM
2	PRV-WCP-5013	Spring over diaphram; Overpressure relief from P-WCP-1	130 PSI
3	ESS-WCP-5017	Local P-WCP-1 E-stop, located on VFD panel	NA

NOTES:

1. INTERLOCKS WILL ENSURE THAT BTL SYSTEM FLOW WILL BE TREATED WITH LIME. D4 PUMPS WILL TURN OFF WITH THE LOSS OF ACCURATE FEEDER SYSTEM OPERATION, LOSS OF SCREW CONVEYOR DELIVERY SYSTEM, OR LOSS OF FLOW.
2. EXISTING PIPE TO BSB SEWAGE TREATMENT PLANT IS CAPPED.
3. BACKUP LEVEL TRANSDUCER.
4. BV-WCP-5006 & BV-WCP-5007 ARE CAR SEAL CLOSED (CSC).
5. BV-WCP-5018 & BV-WCP-5020 ARE CAR SEAL OPEN (CSO).

REVISION:

DATE:	BY:	DESC:
5/14	JTB	AS-BUILT
7/17		RM EMOC 10234
7/19	NH	REVISION

DRAWN BY: CFB
DESIGNED BY: AMD
CHECKED BY: SDS
APPROVED BY: DSG
PROJECT NO:
DATE: APRIL 21, 2014

DISPLAYED AS:
COORD SYS/ZONE:
DATUM:
UNITS:
SOURCE:

SCALE IN FEET
0 NTS

ATLANTIC RICHFIELD COMPANY
BUTTE PRIORITY SOILS OU
BTL AND WCP-1 UPGRADES

WCP-1
PIPING AND
INSTRUMENTATION
DIAGRAM AS-BUILT

PIONEER TECHNICAL SERVICES, INC.
307 EAST PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

SHEET
P&ID6

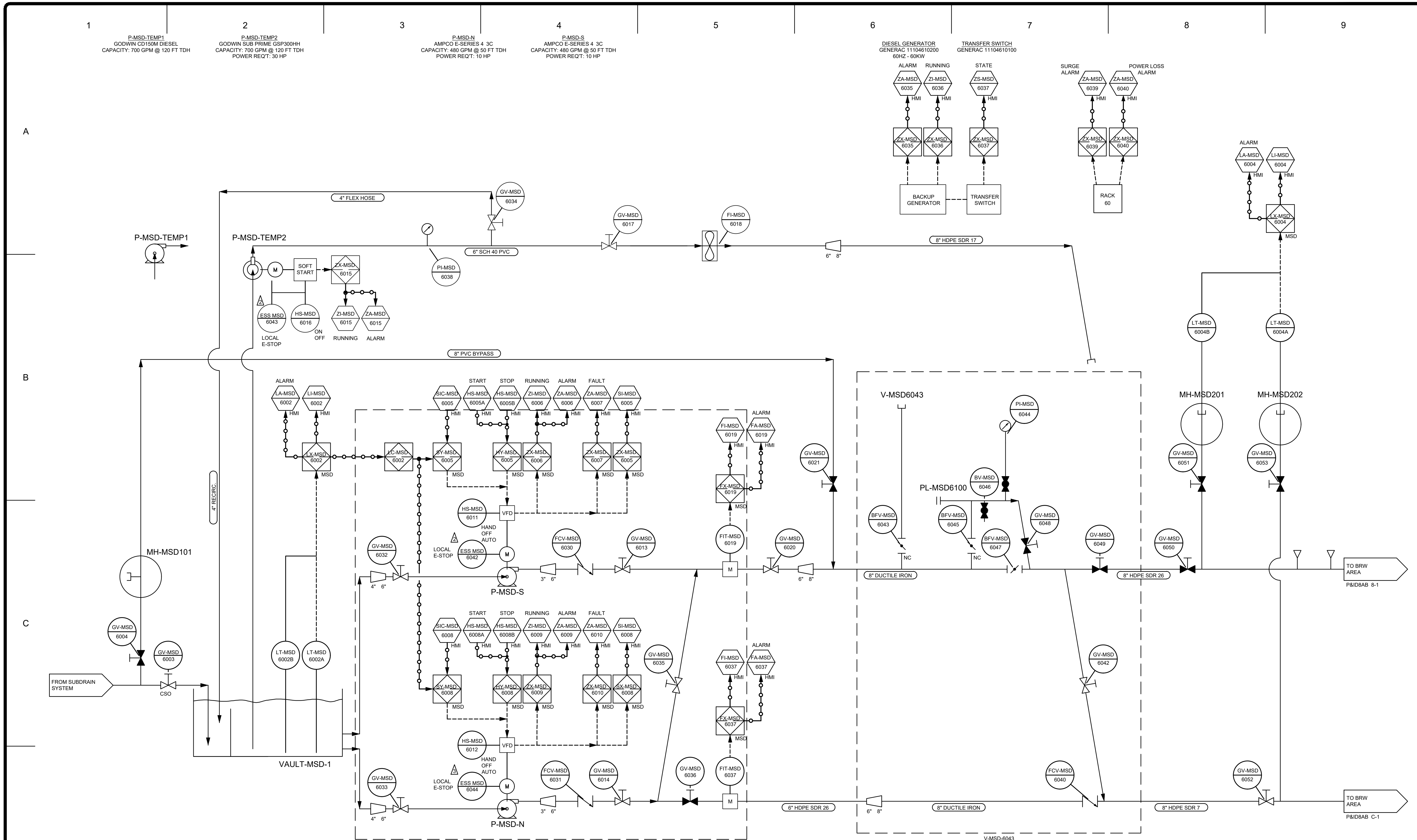


Table 1. BPSOU Subdrain Protective System Devices				
Δ	DEVICE ID	FUNCTIONAL DESCRIPTION	SET POINT	UNITS
1	ESS-MSD-6043	WEG SOFT START EMERGENCY STOP SWITCH	STOP	NA
2	ESS-MSD-6042	P-MSD-N EMERGENCY STOP SWITCH	STOP	NA
3	ESS-MSD-6044	P-MSD-S EMERGENCY STOP SWITCH	STOP	NA

NOTE:

1. GV-MSD 6003 IS CAR SEAL OPEN (CSO).

MH-MSD-101
BYPASS EXTRACTION
IN ECTION ACCESS MANHOLE

VAULT-MSD-1
INTAKE VAULT
CAPACITY: 5 750 GAL

V-MSD-6043
IN ECTION LINE
VAULT ACCESS

PL-MSD-6100
AMISON PRODUCTS
8" 150LB STANDARD
PIG LAUNCHER RECEIVER

MH-MSD-201
IN ECTION LINE
MANHOLE ACCESS

MH-MSD-202
IN ECTION LINE
MANHOLE ACCESS

REVISION: DATE:	BY:	DESC:
4/14	AMD	FINAL
7/15	AMD	SHAKEDOWN PLAN
8/15	AMD	SHAKEDOWN PLAN
7/19	NH	REVISION DIAGRAM

DRAWN BY: AMD
DESIGNED BY: AMD
CHECKED BY:
APPROVED BY:
PROJECT NO:
DATE: AUGUST, 2014

DISPLAYED AS:
COORD SYS/ZONE:
DATUM:
UNITS:
SOURCE:

SCALE IN FEET
0 NTS NTS

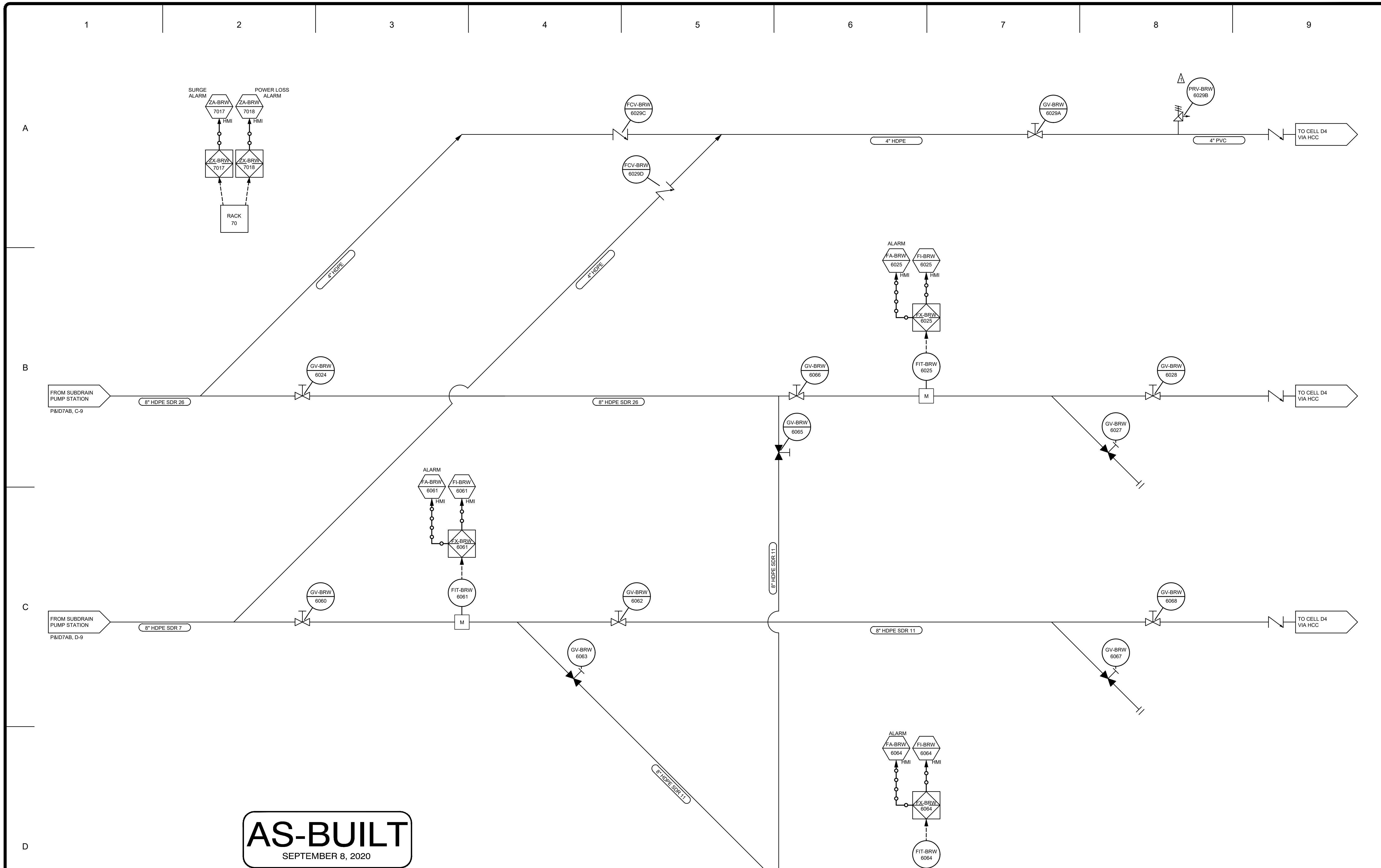
ATLANTIC RICHFIELD COMPANY
BUTTE PRIORITY SOILS OU
PUMP STATION UPGRADE

BPSOU SUBDRAIN PUMP STATION UPGRADE
PIPING AND INSTRUMENTATION DIAGRAM

PIONEER TECHNICAL SERVICES, INC.
307 EAST PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

SHEET
P&ID 7

8/13/2019 10:39:54 AM N:\ARCO\BPSOU\BTL-LAO\2019 OM&M DRAFTER REVISED FIGURES AND DRAWINGS\VOLUME II\APPENDICES\APPENDIX A\P&IDS\MSD-SDL-P&ID-CO-DET-002-16.DWG



AS-BUILT
SEPTEMBER 8, 2020

Table 1. BRW Protective System Devices

Δ	DEVICE ID	FUNCTIONAL DESCRIPTION	SET POINT	UNITS
1	PRV-BRW 6029B	SPRING OVER DIAPHRAM PRESSURE RELIEF VALVE	60	psi

REVISION:

DATE:	BY:	DESC:
4/14	AMD	FINAL
7/15	AMD	SHAKEDOWN PLAN
8/15	AMD	SHAKEDOWN PLAN
7/19	NH	REVISION
9/20	AMD	AS-BUILT

DRAWN BY: AMD
DESIGNED BY: AMD
CHECKED BY:
APPROVED BY:
PROJECT NO:
DATE: SEPTEMBER 2020

DISPLAYED AS:
COORD SYS/ZONE:
DATUM:
UNITS:
SOURCE: PIONEER

SCALE IN FEET
0 NTS

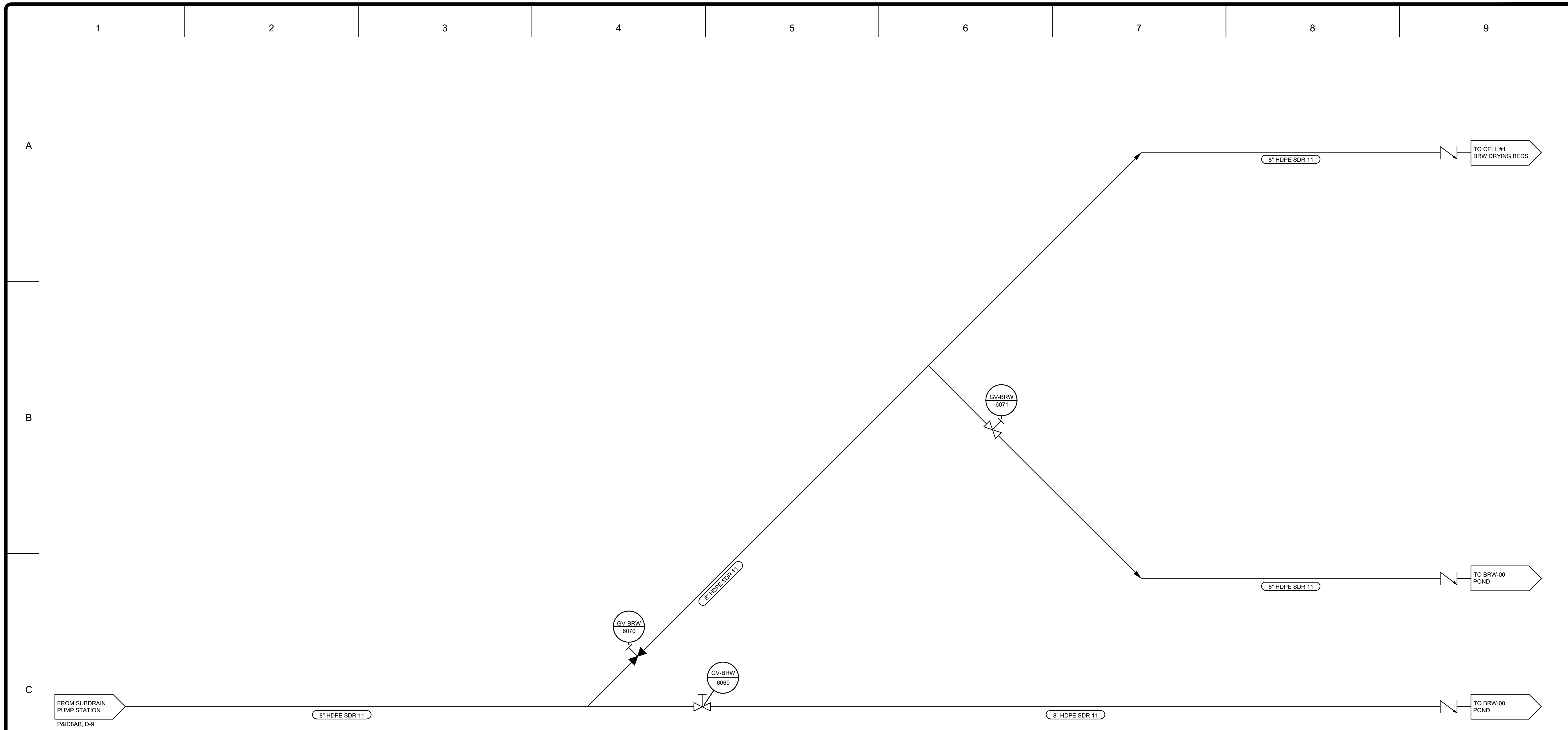
ATLANTIC RICHFIELD COMPANY
BUTTE PRIORITY SOILS OU
IRON PRECIPITATION CAPTURE

BRW DISCHARGE PIPING AND INSTRUMENTATION DIAGRAM

PIONEER TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

SHEET
P&ID 8AB

9/8/2020 1:48:25 PM P:\ARCO\BPSOU\2019\BTL-LAO\MSD IPC\P&ID\MSD-SDL-P&ID-CO-DET-002-16_UPDATE 090519.DWG



AS-BUILT
SEPTEMBER 8, 2020

REVISION:

DATE:	BY:	DESC:
9/19	AMD	DRAFT
9/20	AMD	AS-BUILT

DRAWN BY: AMD
DESIGNED BY: AMD
CHECKED BY:
APPROVED BY:
PROJECT NO:
DATE: SEPTEMBER 2020

DISPLAYED AS:
COORD SYS/ZONE:
DATUM:
UNITS:
SOURCE: PIONEER

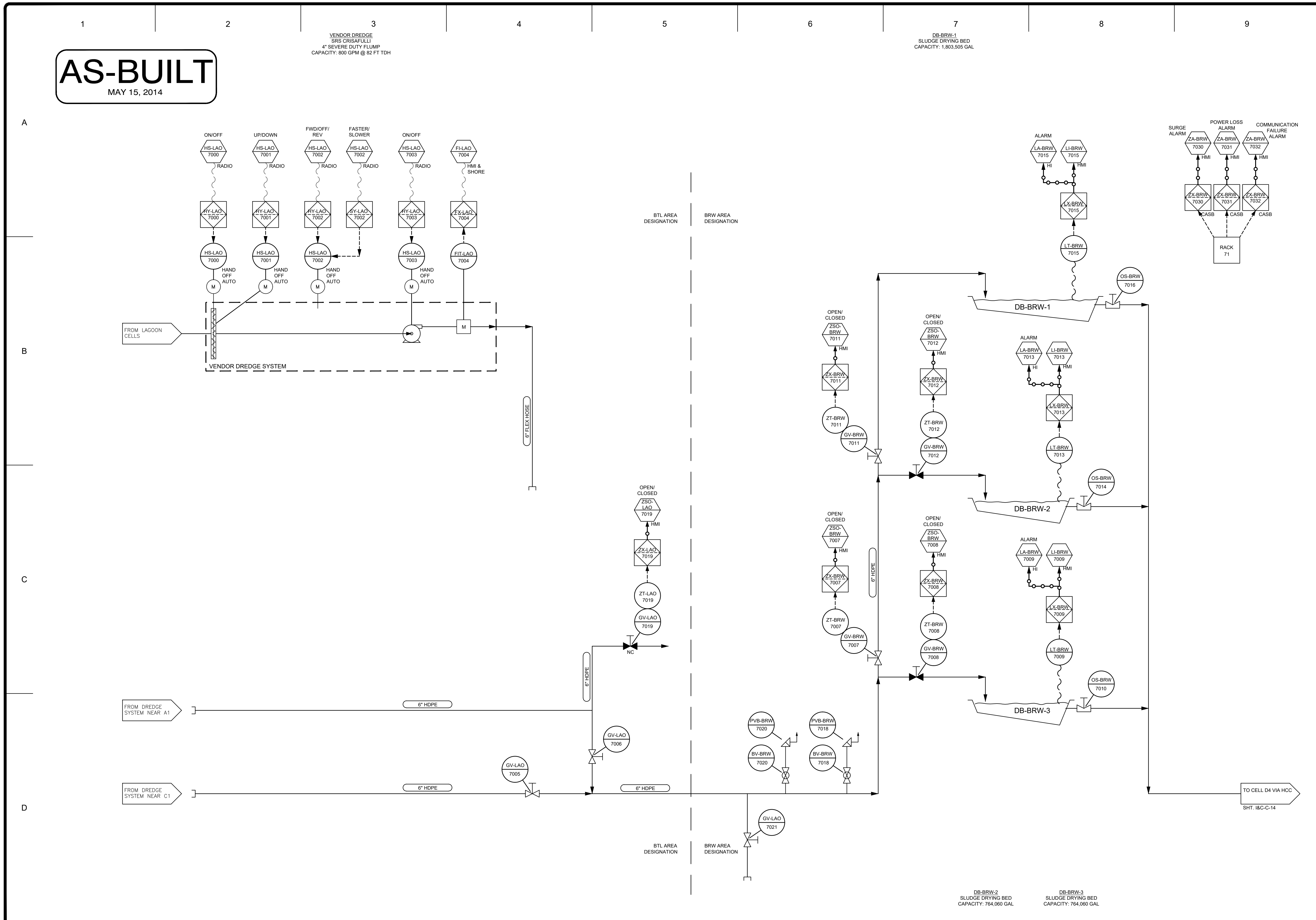
SCALE IN FEET
0 NTS

ATLANTIC RICHFIELD COMPANY
BUTTE PRIORITY SOILS OU
IRON PRECIPITATION CAPTURE

BRW DISCHARGE PIPING AND INSTRUMENTATION DIAGRAM

PIONEER TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

SHEET
P&ID 8AAB



REVISION:

DATE:	BY:	DESC:
5/14	JTB	AS-BUILT

DRAWN BY: CFB
DESIGNED BY: AMD
CHECKED BY: SDS
APPROVED BY: DSG
PROJECT NO:
DATE: 4/21/2014

DISPLAYED AS:
COORD SYS/ZONE:
DATUM:
UNITS:
SOURCE:

SCALE IN FEET
0 NTS NTS

ATLANTIC RICHFIELD COMPANY
BUTTE PRIORITY SOILS OU
BTL AND WCP-1 UPGRADES

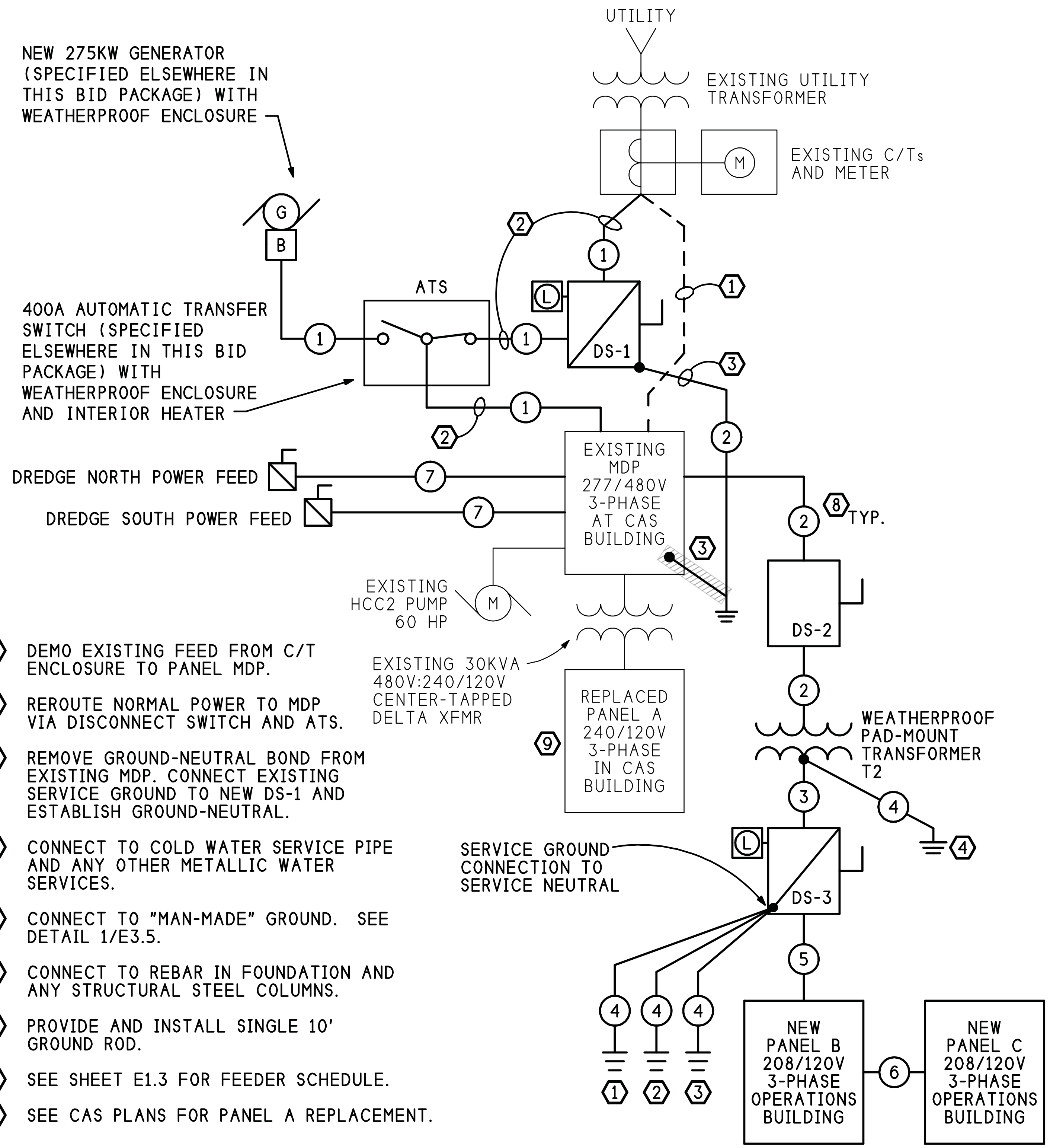
BRW DRYING BED PIPING AND INSTRUMENTATION DIAGRAM AS-BUILT

PIONEER TECHNICAL SERVICES, INC.
307 EAST PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

SHEET
P&ID9AB

7/29/2019 10:34:29 AM N:\ARCO\BPSOU\BTL & WCP-1 UPGRADES\CCR\AS-BUILT DRAWINGS\I&C\P&IDS\P&ID-AB-DET-007-14.DWG

Appendix E.2
Electrical One-Line Diagrams



1. DEMO EXISTING FEED FROM C/T ENCLOSURE TO PANEL MDP.
2. REROUTE NORMAL POWER TO MDP VIA DISCONNECT SWITCH AND ATS.
3. REMOVE GROUND-NEUTRAL BOND FROM EXISTING MDP. CONNECT EXISTING SERVICE GROUND TO NEW DS-1 AND ESTABLISH GROUND-NEUTRAL.
4. CONNECT TO COLD WATER SERVICE PIPE AND ANY OTHER METALLIC WATER SERVICES.
5. CONNECT TO "MAN-MADE" GROUND. SEE DETAIL 1/E3.5.
6. CONNECT TO REBAR IN FOUNDATION AND ANY STRUCTURAL STEEL COLUMNS.
7. PROVIDE AND INSTALL SINGLE 10' GROUND ROD.
8. SEE SHEET E1.3 FOR FEEDER SCHEDULE.
9. SEE CAS PLANS FOR PANEL A REPLACEMENT.

1 E1.1 FEEDER SCHEMATIC

DE420A02 N.T.S.

ELECTRICAL LEGEND

SYMBOL	DESCRIPTION
	HOMERUN TO PANEL (ARROWS INDICATE CIRCUITS)
	NUMBER OF HASH MARKS INDICATES NUMBER OF CURRENT CARRYING CONDUCTORS IN CONDUIT. NO HASH MARKS INDICATES TWO CURRENT CARRYING CONDUCTORS. GROUND WIRES ARE NOT SHOWN BUT ARE PULLED IN ALL CONDUIT RUNS. SEE PANEL AND FEEDER SCHEDULES FOR MINIMUM WIRE AND CONDUIT SIZES. AS WIRE SIZES ARE UPGRADED FOR DERATING, CONDUIT SIZE SHALL BE INCREASED TO PROPERLY ACCOMODATE ALL WIRES MAINTAINING MAXIMUM 40% CONDUIT FILL.
	LOW VOLTAGE CABLE IN CONDUIT
J	JUNCTION BOX
T	TRANSFORMER - FLOOR OR WALL MOUNTED
	PANELBOARD - 480/277V
	PANELBOARD - 120/240V
	DISCONNECT SWITCH - NON-FUSED
	DISCONNECT SWITCH - FUSED
	MOTOR STARTER - MAGNETIC
	DISCONNECT SWITCH - FUSED
B	OVERLOAD PROTECTION - CIRCUIT BREAKER
L	LIGHTNING ARRESTOR
$M	MOTOR STARTER - MANUAL WITH OVERLOAD
$F	MOTOR STARTER - COMBINATION
M	MOTOR
	CONNECTION - HARD WIRED TO EQUIPMENT
	CONNECTION - CONTROL
	RECEPTACLE - DUPLEX
G	GENERATOR
ATS	AUTOMATIC TRANSFER SWITCH

SYMBOL	DESCRIPTION
	RECEPTACLE - 4-PLEX
GFI	RECEPTACLE - GROUND FAULT PROTECTED
T	WALL MOUNT LOW VOLTAGE THERMOSTAT (SUPPLIED WITH EQUIP., INSTALLED BY E.C.)
T	LINE VOLTAGE THERMOSTAT (SUPPLIED WITH EQUIP., INSTALLED BE E.C.)
	LIGHT FIXTURE - 2'x4' LAY-IN, FLUORESCENT
	LIGHT FIXTURE - 1'x4' SURFACE, FLUORESCENT
	LIGHT FIXTURE - SURFACE, INCANDESCENT, COMPACT FLUORESCENT OR H.I.D.
	LIGHT FIXTURE - WALL-MOUNTED, INCANDESCENT, COMPACT FLUORESCENT OR H.I.D.
	EXIT LIGHT - WALL MOUNTED, SINGLE-FACE
	EGRESS LIGHT - WALL OR CEILING MOUNTED, BATTERY PACK
	EGRESS LIGHT - WALL MOUNTED REMOTE HEAD
PC	PHOTO CELL
D	DUAL TECHNOLOGY (INFRARED/ULTRASONIC) OCCUPANCY SENSOR, CEILING MOUNTED
$	SWITCH - SINGLE POLE
$3	SWITCH - 3-WAY
$P	SWITCH - WITH PILOT LIGHT
	TELEPHONE OUTLET
	DATA OUTLET
	COMBINATION TELEPHONE / DATA OUTLET
$T	SWITCH - TIMER
$V	SWITCH - VARIABLE SPEED

MONTANA GARTH L. STEVENS 11492PE REGISTERED PROFESSIONAL ENGINEER

SMA SCHLENKER & McKITTRICK ARCHITECTS, P.C.

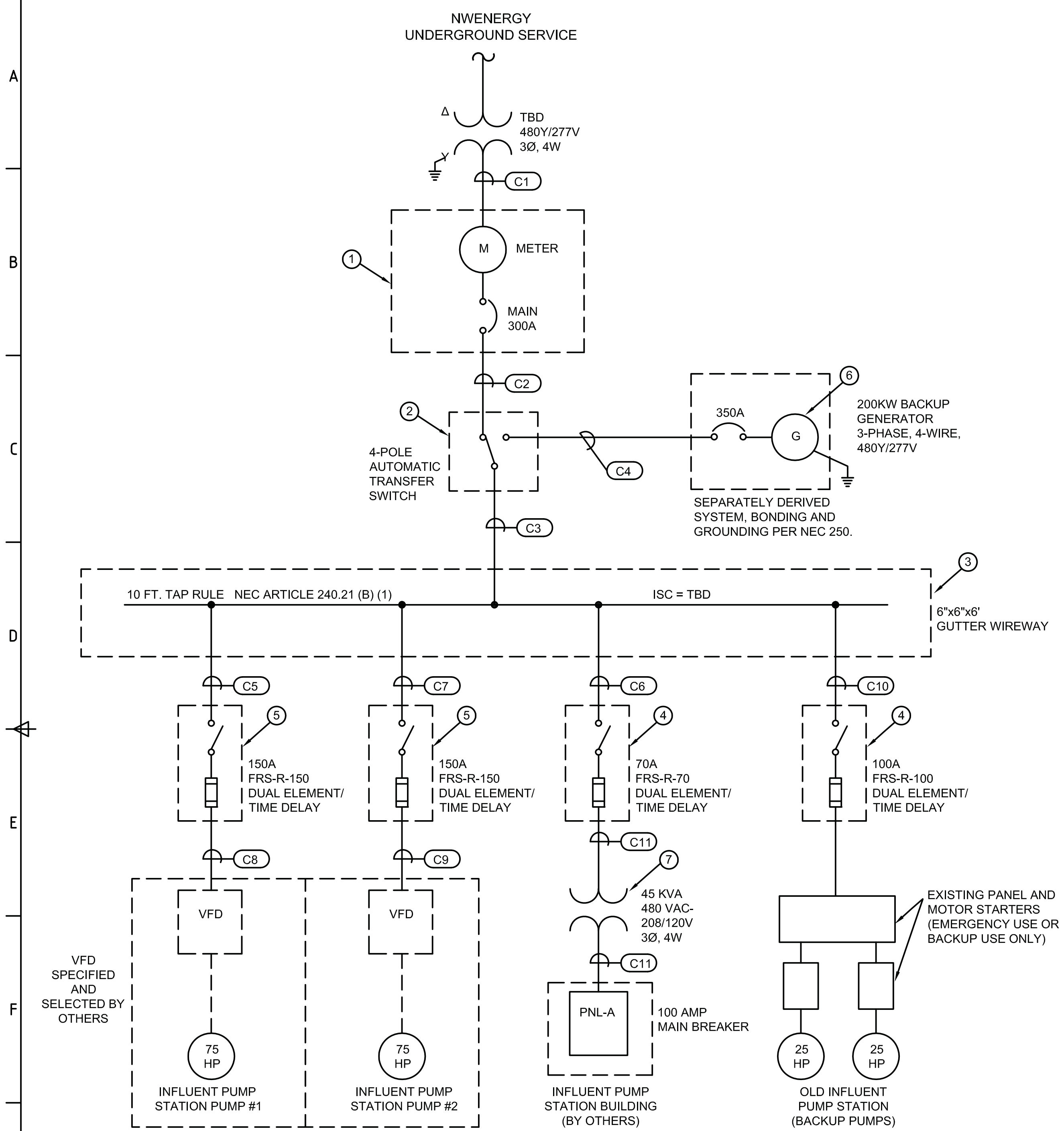
50 SOUTH LAST CHANCE GULCH, HELENA, MT 59601 PHONE: (406)442-4933 FAX: (406)442-4936 WEB: WWW.ARCHITECTS-SMA.COM

Operations Building
Butte, MT

PROJECT NO. 0742

DATE: 3-23-12
DRWN. BY: DS
DWG No.: E1.1

MATERIALS DESCRIPTION			
ITEM	QUANTITY	PART NUMBER	DESCRIPTION
1	1		METER BASE WITH DISCONNECT (300A)
2	1	GTS040W-4K2LDNCY	GENERAC AUTOMATIC TRANSFER SWITCH
3	1		GUTTER WIREWAY, 6"x6"x6', NEMA 1
4	2	DH363NGK	CUTLER-HAMMER 100A FUSED DISCONNECT SWITCH
5	2	DH364NGK	CUTLER-HAMMER 200A FUSED DISCONNECT SWITCH
6	1	SD0200KG178.7018HP3Y3	GENERAC PACKAGE GENERATOR WITH WEATHER ENCLOSURE, 200KW
7	1	Y48M28T45N	45KVA 480VAC/208Y/120V TRANSFORMER



MOTORS ARE AT ½ DUTY CYCLE
MOTOR FLA @ 75 Hp = 96A @ 3Ø, 480V

VFD OVERCURRENT DEVICE PER MANUFACTURER'S DATA SHEET

INFLUENT PUMP STATION ELECTRICAL FEEDER CONDUIT SCHEDULE

CONDUIT NUMBER	FROM	TO	CIRCUIT			CONDUCTORS							CONDUIT		NOTES
			PHASE & VOLTAGE	HP, KW, KVA	AMPS	PHASE		NEUTRAL		GROUND		TYPE	SIZE	TYPE	
						No.	SIZE	No.	SIZE	No.	SIZE				
C1	NORTHWESTERN XFMR SECONDARY	INFLUENT PUMP STATION METER BASE				PROVIDED BY THE UTILITY									UNDERGROUND FEED RIGID SCHEDULE 80 (BY UTILITY)
C2	INFLUENT PUMP STATION METER BASE	GENERATOR TRANSFER SWITCH	3-PHASE 4-WIRE 480Y/277V	TBD KVA	300 A	6	#1/0 AWG	2	#1/0 AWG	2	#4 AWG	THHN/THWN	2-2"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40
C3	GENERATOR TRANSFER SWITCH	480V WIRE GUTTER	3-PHASE 3-WIRE 480V		350 A	6	#2/0 AWG			2	#3 AWG	THHN/THWN	2-2"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40
C4	GENERATOR	GENERATOR TRANSFER SWITCH	3-PHASE 3-WIRE 480V	200 KW	350 A	6	#2/0 AWG	2	#2/0 AWG	2	#3 AWG	THHN/THWN	2-2"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40
C5	480V WIRE GUTTER	VFD DRIVE DISCONNECT PUMP #1	3-PHASE 3-WIRE 480V	75 HP	150 A	3	#1/0 AWG	0	----	1	#4 AWG	THHN/THWN	1½"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40
C6	480V WIRE GUTTER	208Y/120V, 45KVA	3-PHASE 3-WIRE 480V		70 A	3	#4 AWG	0	----	1	#8 AWG	THHN/THWN	1"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40, USE FLEX TO TRANSFORMER
C7	480V WIRE GUTTER	VFD DRIVE DISCONNECT PUMP #2	3-PHASE 3-WIRE 480V	75 HP	150 A	3	#1/0 AWG	0	----	1	#4 AWG	THHN/THWN	1½"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40
C8	VFD DRIVE DISCONNECT PUMP #1	VFD DRIVE PUMP #1	3-PHASE 3-WIRE 480V	75 HP	105 A	3	#1/0 AWG	0	----	1	#4 AWG	THHN/THWN	1½"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40
C9	VFD DRIVE DISCONNECT PUMP #2	VFD DRIVE PUMP #2	3-PHASE 3-WIRE 480V	75 HP	105 A	3	#1/0 AWG	0	----	1	#4 AWG	THHN/THWN	1½"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40
C10	WIRE GUTTER	BACKUP PUMPS	3-PHASE 3-WIRE 480V	28.2 KVA	100 A	3	#3 AWG	0	----	1	#8 AWG	THHN/THWN	1"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40
C11	45KVA TRANSFORMER	PANEL A	3-PHASE 4-WIRE 208Y/120V	29.6 KVA	100 A	3	#3 AWG	1	#3 AWG	1	#8 AWG	THHN/THWN	1¼"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40
C12	TRANSFORMER DISCONNECT	45 KVA TRANSFORMER	3-PHASE 3-WIRE 480V	45 KVA	54 A	3	#4 AWG	0	----	1	#8 AWG	THHN/THWN	1"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40

INFLUENT PUMP STATION SCADA PANEL ONE-LINE DIAGRAM

MONTANA
BRYAN JOSEPH LOUSHIN
16159
REGISTERED PROFESSIONAL ENGINEER
8/6/10

D46-15IN-035	POWER GEN. ARRANGEMENT	
DRAWING NUMBER	DESCRIPTION	
REFERENCES		

DATE PLOTTED: 8/5/10
TIME PLOTTED: 1300

REV.	RELEASE	DESCRIPTION	DFTR	CK	R.ENG	P. ENG	P. MAG.	C. ENG
-	8/6/10	ISSUED PER WCO 15185	DB	-	-	-	-	-

REVISIONS

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES TOLERANCES ON
FRAC. DEC.
ANGLES
MATERIAL: N/A
SURFACE FINISH N/A

DRAWN BY: Dana Bane
CHECKED BY: PATRICK CASHELL
APPROVALS
RESPONSIBLE ENG.: BRYAN LOUSHIN
PROJECT ENG.: N/A
PROJECT MANAGER: N/A
CHIEF ENG.: N/A
SPEC # N/A
CAD # 4615IN035_R-

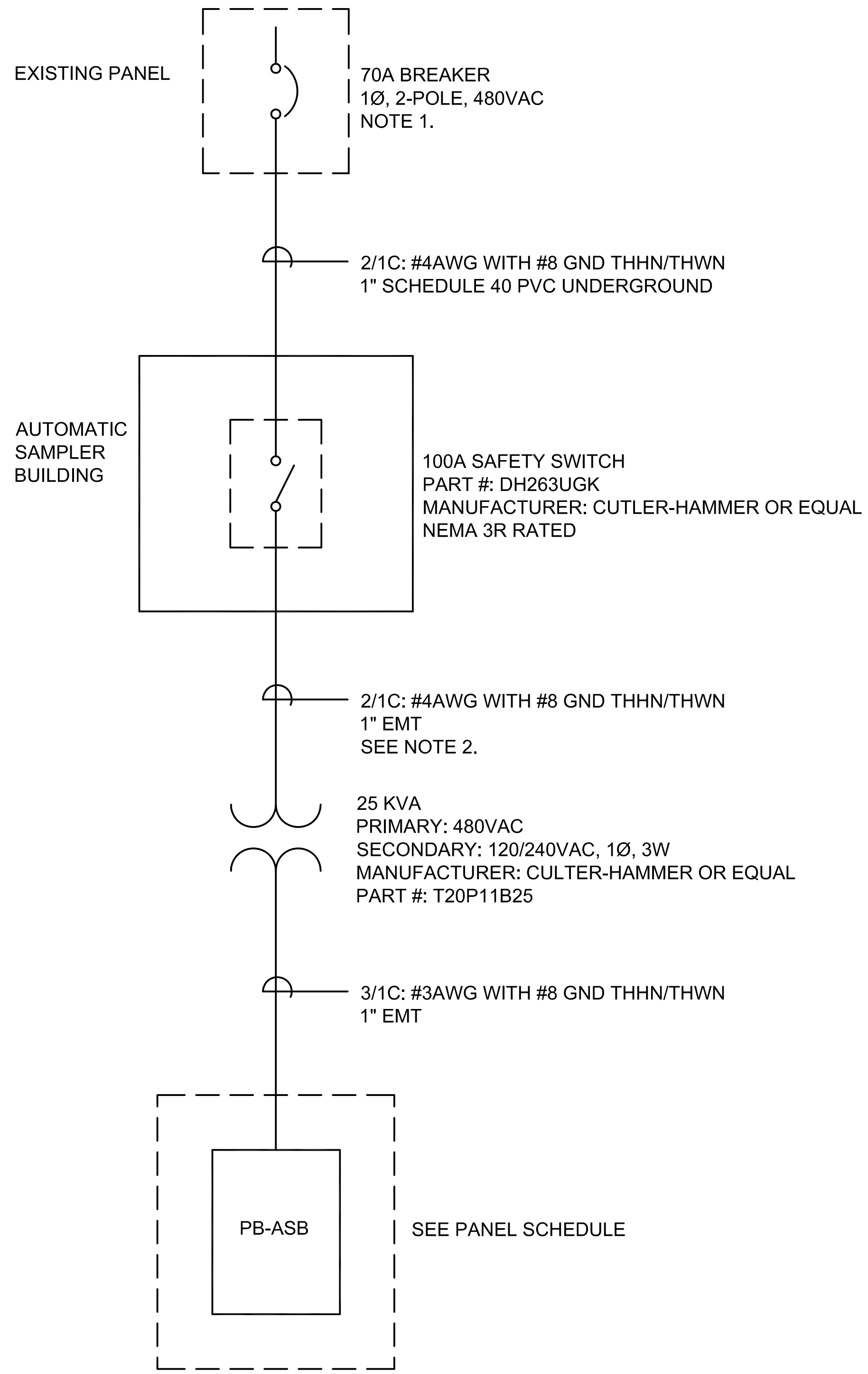
MSE TECHNOLOGY APPLICATIONS, INC.
200 TECHNOLOGY WAY
P.O. Box 4078
Butte, MT 59702
PHONE (406) 494-7100
FAX (406) 494-7230

ARCO - PIONEER
LOWER AREA ONE SCADA PROJECT
BUTTE, MONTANA

TITLE ARCO - LOWER AREA ONE INFLUENT PUMP STATION ONE-LINE DIAGRAM & CONDUIT SCHEDULE

DWG. NO. D46-15IN-035 REV. -

SCALE: NONE SHEET 1 OF 1



ASB ELECTRICAL ONE-LINE DIAGRAM

NOTES

1. REPLACE EXISTING 20A MCCB WITH NEW 70A.
2. COMPRESSION FITTINGS SHALL BE USED FOR ALL EMT CONDUIT.
3. ALL BONDING/GROUNDING SHALL BE COMPLETED PER NEC ARTICLE 250, LOCAL CODES, AND UTILITY SPECIFICATIONS.

ELECTRICAL PANEL SCHEDULE

PANEL NO.: PB-ASB | MFR: ----- | PART NUMBER: ----- | LOCATION: ASB | MOUNTING: Surface

DESCRIPTION	BREAKER		WIRES			COND	Volt Amps		CKT	BUS	CKT	Volt Amps		COND	WIRES			BREAKER		DESCRIPTION
	POLE	AMP	PH	N	G	SIZE	A	B	NO.		NO.	A	B	SIZE	PH	N	G	POLE	AMP	
							1250		1	A	2	1250								
2500W RESITIVE SPACE HEATER	2	20	12	--	12	1/2"		1250	3	B	4		1250	1/2"	12	--	12	2	20	2500W RESITIVE SPACE HEATER
INTERIOR LIGHTING	1	20	12	12	12	1/2"	240		5	A	6	600		1/2"	12	12	12	1	20	SCADA RTU
GFCI RECEPTACLES	1	20	12	12	12	1/2"		720	7	B	8		75	1/2"	12	12	12	1	20	EXTERIOR LIGHTING
	1	20					-----		9	A	10	-----						1	20	
	1	20						-----	11	B	12		-----					1	20	
	1	20					-----		13	A	14	-----						1	20	
	1	20						-----	15	B	16		-----					1	20	
	1	20					-----		17	A	18	-----						1	20	
	1	20						-----	19	B	20		-----					1	20	
	1	20					-----		21	A	22	-----						1	20	
	1	20						-----	23	B	24		-----					1	20	
TOTALS							1490	1970				1850	1325							

BUS A (VA): 3340	MAIN BRKER: 100A	NEMA: 1	L-N VOLTAGE: 120	WIRES: 3			
BUS B (VA) 3295	FEED: BOTTOM	FEEDER SIZE: #3	L-L VOLTAGE: 240	BUS: 100A			
	WIDTH: ---	SOURCE: XFM-1	AMPERAGE: 100	NEUT: 100%			
TOTAL 6,635	DEPTH: ---		PHASES 1				

MONTANA BRYAN JOSEPH LOUSHIN 16159 REGISTERED PROFESSIONAL ENGINEER
8/10/10

REV.	RELEASE	DESCRIPTION	DFTR	CK	R.ENG	P. ENG	P. MAG.	C. ENG
-	8/10/10	ORIGINATED PER WCO 15185	DB	-	-	-	-	-

REVISIONS

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES TOLERANCES ON FRAC. DEC. ANGLES
MATERIAL: N/A
SURFACE FINISH N/A

DRAWN BY: Dana Bane
CHECKED BY: PATRICK CASHELL
APPROVALS
RESPONSIBLE ENG.: BRYAN LOUSHIN
PROJECT ENG.: N/A
PROJECT MANAGER: N/A
CHIEF ENG.:
SPEC # N/A
CAD # 4615EE003

MSE TECHNOLOGY APPLICATIONS, INC.
200 TECHNOLOGY WAY
P.O. Box 4078
Butte, MT 59702
PHONE (406) 494-7100
FAX (406) 494-7230

ARCO - PIONEER
LOWER AREA ONE SCADA PROJECT
BUTTE, MONTANA

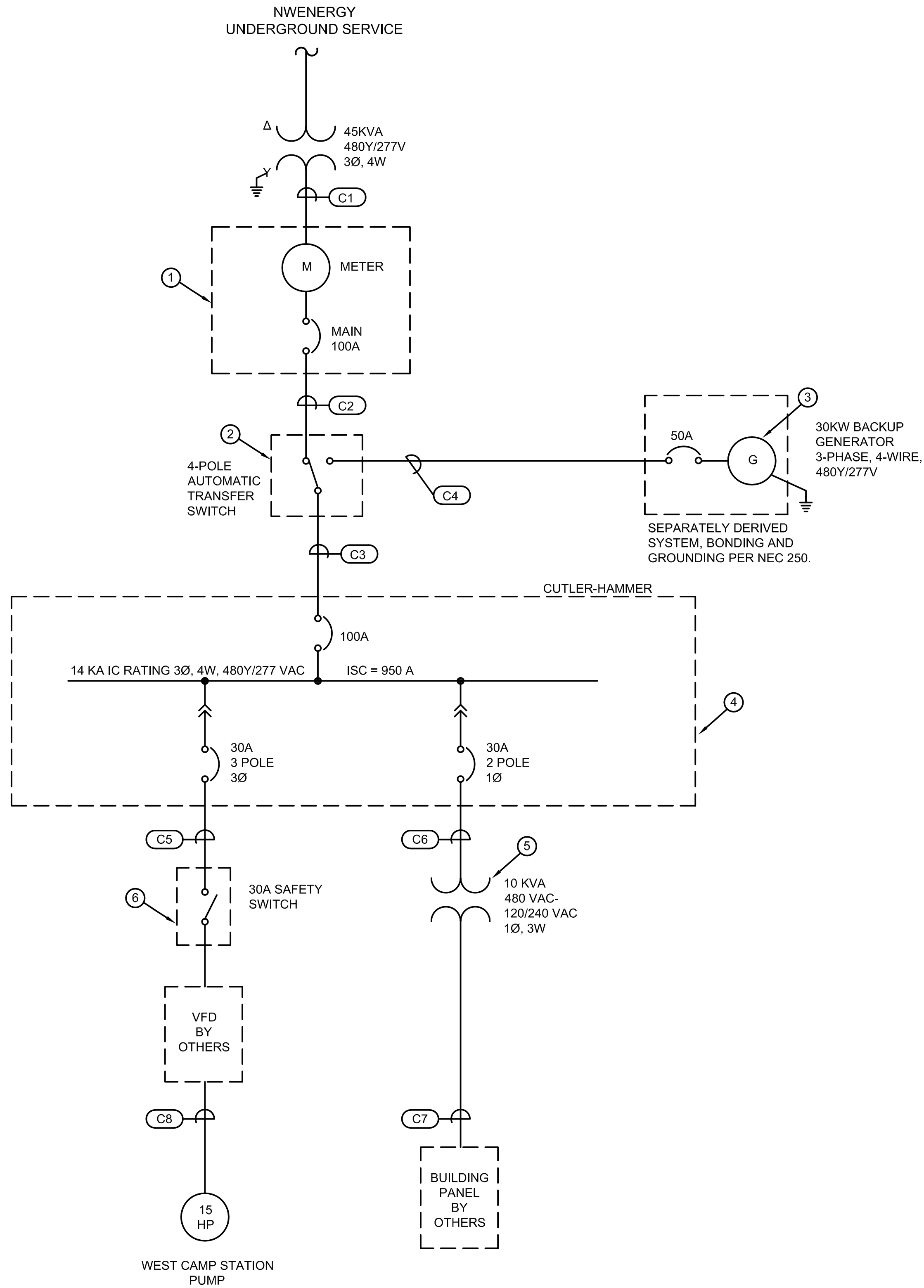
TITLE ARCO - LOWER AREA ONE
AUTOMATIC SAMPLER BUILDING
ONE-LINE DIAGRAM & CONDUIT SCHEDULE

DWG. NO. D46-15EE-003 | REV. -
SCALE: NONE | SHEET 1 OF 1

DRAWING NUMBER	DESCRIPTION
D46-15IN-030	PANEL LAYOUT

REFERENCES

DATE PLOTTED: 8/10/10
TIME PLOTTED: 1300
PLOTTED BY: DB



WEST CAMP STATION SCADA PANEL ONE-LINE DIAGRAM

MATERIALS DESCRIPTION			
ITEM	QUANTITY	PART NUMBER	DESCRIPTION
1	1	CHU217MTBMS15	METER BASE WITH DISCONNECT (100A)
2	1	GTS 100A	GENERAC AUTOMATIC TRANSFER SWITCH, 100A, 4-POLE
3	1	SD030	GENERAC GENERATOR WITH WEATHER ENCLOSURE-32 HR RUN TIME
4	1	PRL2a	CUTLER-HAMMER PANELBOARD, 15 CIRCUIT, 100A, TYPE 3R*
5	1	S20N11S10N	CUTLER-HAMMER 10KVA, 480-120/240 XFMR, TYPE 3R
6	1	DH361UDK	CUTLER-HAMMER SAFETY SWITCH, 30A

* PANEL BOARD REQUIRES QUANTITY 1, 30A, 3-POLE BREAKER AND QUANTITY 1, 30A, 2-POLE BREAKER. ALL OTHER SPACES MAYBE RESERVED FOR SPARES.

WEST CAMP STATION ELECTRICAL FEEDER CONDUIT SCHEDULE

CONDUIT NUMBER	FROM	TO	CIRCUIT			CONDUCTORS							CONDUIT		NOTES
			PHASE & VOLTAGE	HP, KW, KVA	AMPS	PHASE		NEUTRAL		GROUND		TYPE	SIZE	TYPE	
						No.	SIZE	No.	SIZE	No.	SIZE				
C1	NORTHWESTERN XFMR SECONDARY	WEST CAMP STATION METER BASE				PROVIDED BY UTILITY							2"	PVC	UNDERGROUND FEED RIGID SCHEDULE 80 (BY UTILITY)
C2	WEST CAMP STATION METER BASE	PORTABLE GENERATOR TRANSFER SWITCH	3-PHASE 3-WIRE 480Y/277V	45 KVA	100 A	3	#3 AWG	1	#3 AWG	1	#8 AWG	THHN/THWN	1 ½"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40
C3	PORTABLE GENERATOR TRANSFER SWITCH	480Y/277V DISTRIBUTION PANEL	3-PHASE 3-WIRE 480Y/277V		100 A	3	#3 AWG	1	#3 AWG	1	#8 AWG	THHN/THWN	1 ½"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40
C4	GENERATOR CONNECTION	GENERATOR TRANSFER SWITCH		----	----	3	#6 AWG	1	#6 AWG	1	#10 AWG	THHN/THWN	1 ½"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40
C5	480Y/277V DISTRIBUTION PANEL	VFD DRIVE	3-PHASE 3-WIRE 480V	15 HP	24 A	3	#10 AWG	0	----	1	#10 AWG	THHN/THWN	1/2"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40
C6	480Y/277V DISTRIBUTION PANEL	120/240V, 10KVA XFMR	1-PHASE 2-WIRE 480V	10 KVA	21 A	2	#10 AWG	0	----	1	#10 AWG	THHN/THWN	1/2"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40, USE FLEX TO TRANSFORMER
C7	120/240V, 10KVA XFMR	BUILDING DISTRIBUTION PANEL	1-PHASE 3-WIRE 120/240V	10 KVA	42 A	2	#6 AWG	1	#6 AWG	1	#8 AWG	THHN/THWN	1"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40
C8	VFD DRIVE	15Hp PUMP	3-PHASE 3-WIRE 480V	15 HP	21 A	3	#10 AWG	0	----	1	#10 AWG	VFD SHIELDED CABLE	3/4"	PVC	ALL FITTINGS OUTDOOR RATED SCHEDULE 40

MONTANA BRYAN JOSEPH LOUSHIN 16159 REGISTERED PROFESSIONAL ENGINEER 8/6/10

DRAWING NUMBER	DESCRIPTION
D46-15IN-025	I/O MODICON PIN LAYOUT
D46-15IN-024	POWER DISTRIBUTION
D46-15IN-022	PANEL LAYOUT

REFERENCES

DATE PLOTTED: 8/4/10
TIME PLOTTED: 1300
PLOTTED BY: DB
3

REV.	RELEASE	DESCRIPTION	DFTR	CK	R.ENG	P. ENG	P. MAG.	C. ENG
A	8/6/10	ISSUED PER WO 15185	DB-P	PVC	BJL	-	-	-
-	5/19/08	ISSUED FOR APPROVAL NOT FOR CONSTRUCTION	DB	-	-	-	-	-

REVISIONS

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES TOLERANCES ON
FRAC. DEC.
ANGLES
MATERIAL: N/A
SURFACE FINISH N/A

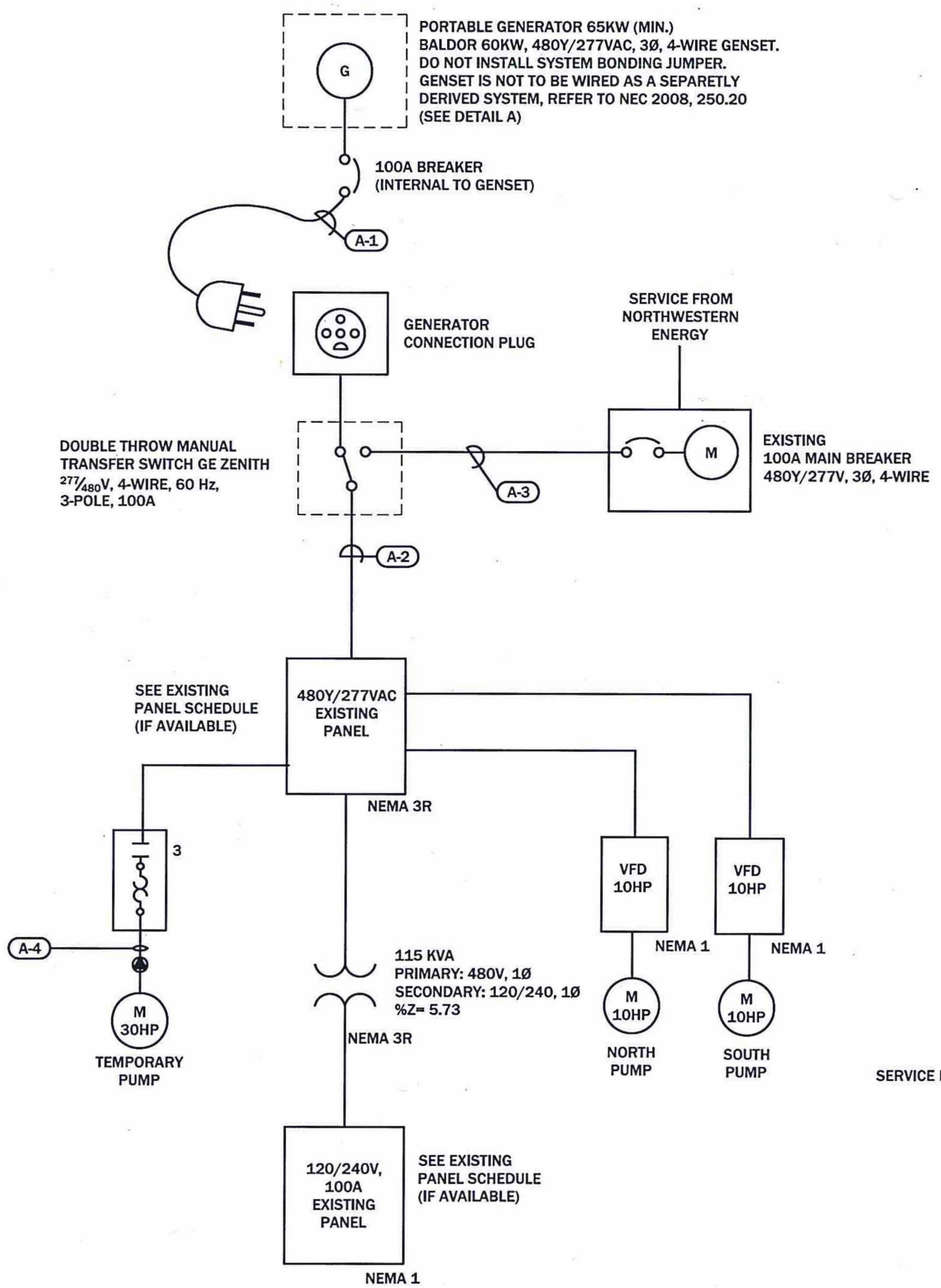
DRAWN BY: Dane Bane
CHECKED BY: D. BANE-PARSONS
APPROVALS
RESPONSIBLE ENG.: BRYAN LOUSHIN
PROJECT ENG.:
PROJECT MANAGER: CHAD CARPENTER
CHIEF ENG.: D. BATTLESON
SPEC # N/A
CAD # 4615IN023

MSE TECHNOLOGY APPLICATIONS, INC.
200 TECHNOLOGY WAY
P.O. Box 4078
Butte, MT 59702
PHONE (406) 494-7100
FAX (406) 494-7230

ARCO - PIONEER
LOWER AREA ONE SCADA PROJECT
BUTTE, MONTANA

TITLE ARCO - LOWER AREA ONE
WEST CAMP STATION
ONE-LINE DIAGRAM & CONDUIT SCHEDULE

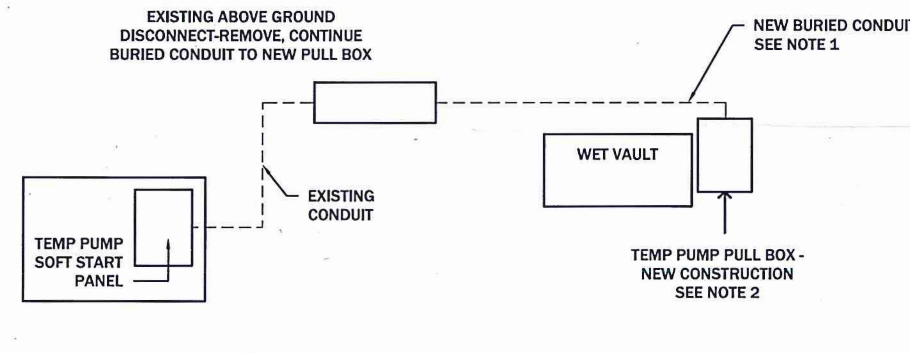
DWG. NO. D46-15IN-023
REV. A
SCALE: NONE
SHEET 1 OF 1



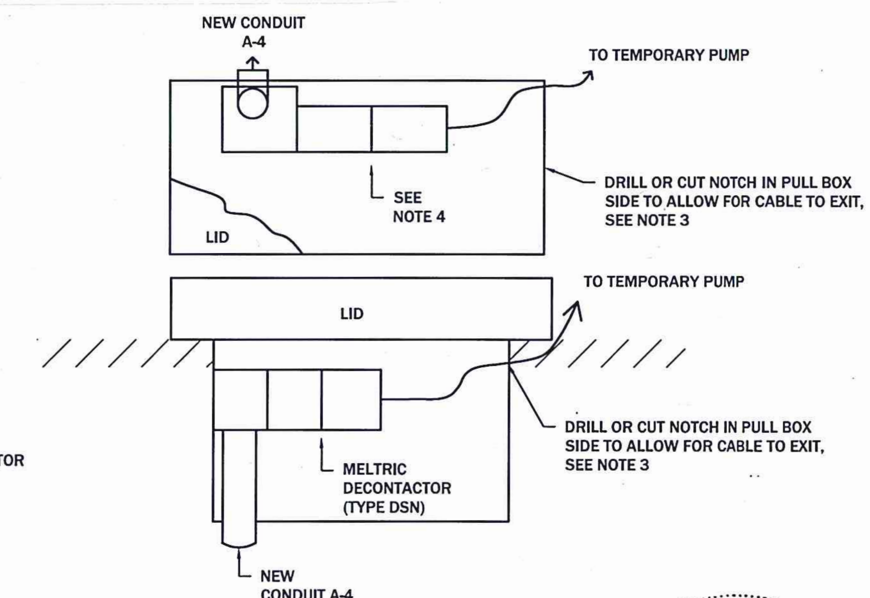
MSD ELECTRICAL ONE-LINE DIAGRAM

METRO STORM DRAIN PUMP STATION ELECTRICAL FEEDER CONDUIT SCHEDULE

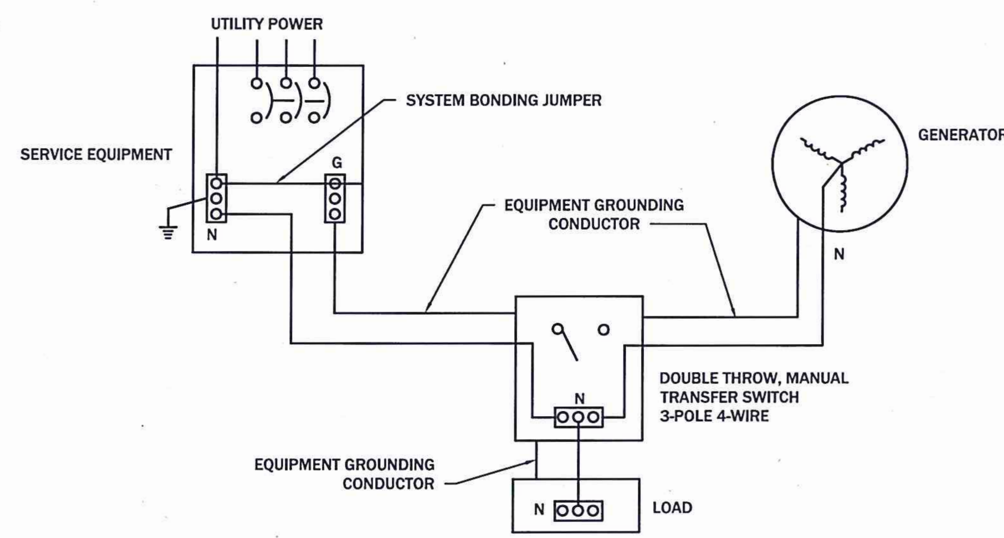
CONDUIT OR CABLE NUMBER	FROM	TO	CIRCUIT PHASE & VOLTAG	CIRCUIT HP,KW ,KVA	CIRCUIT AMPS	CONDUCTORS PHASE NO.	CONDUCTORS PHASE SIZE	CONDUCTORS NEUTRAL NO.	CONDUCTORS NEUTRAL SIZE	CONDUCTORS GROUND NO.	CONDUCTORS GROUND SIZE	CONDUCTORS TYPE	CONDUIT SIZE	CONDUIT TYPE	NOTES
A-1	GENERATOR	MANUAL TRANSFER SWITCH	3-PHASE 480V	NA	100 A	3	#3 AWG	1	#3 AWG	1	#8 AWG	THHN/THHW	1-1/2"	EMT	LIQUIDTIGHT FLEXIBLE CONDUIT SHALL BE USED AT GENERATOR FOR CONNECTION DUE TO GENERATOR VIBRATION. FLEXIBLE CONDUIT SHALL BE A MAXIMUM OF 3 FT. IN LENGTH
A-2	METER BASE/ UTILITY MAIN	MANUAL TRANSFER SWITCH	3-PHASE 480V	NA	101 A	3	#3 AWG	1	#3 AWG	1	#8 AWG	THHN/THHW	1-1/2"	EMT	
A-3	AUTOMATIC TRANSFER SWITCH	EXISTING 480VAC DISTRIBUTION PANEL	3-PHASE 480V	NA	102 A	3	#3 AWG	1	#3 AWG	1	#8 AWG	THHN/THHW	1-1/2"	EMT	
A-4	SOFT START PANEL	TEMPORARY ELECTRICAL PUMP PULL BOX	3-PHASE 480V	30 HP	39A	3	#4 AWG	1	#4 AWG	1	#8 AWG	SO/SOOW	2"	A/C	SEE NOTE 1



DETAIL B - TEMP PUMP CONDUIT & PULL BOX OVERHEAD VIEW



DETAIL C - TEMP PUMP CONDUIT & PULL BOX TOP VIEW



DETAIL A - NEUTRAL/GROUND GENERATOR CONNECTIONS

MONTANA
BRANDON
DeSHAW
No. 15109
LICENSED
PROFESSIONAL ENGINEER

NOTES:

1. NEW CONSTRUCTION CONDUIT SHOULD MATCH EXISTING CONDUIT. EXTEND THE BURIED CONDUIT FROM THE EXISTING DISCONNECT PANEL. REMOVE THE EXISTING DISCONNECT PANEL.
2. PIONEER TO SPECIFY EXACT LOCATION FOR THE PULL BOX, IN ORDER TO BEST ENABLE ACCESS.
3. PULL BOX SPECIFICATIONS- USE OLDCASTLE PRECAST H1730 HEAVY DUTY, OR EQUIVALENT. MUST BE RATED TO HANDLE INCIDENTAL TRAFFIC, HAVE A BOLTED LID, HAVE A PULL SLOT, BE LARGE ENOUGH TO FIT THE SPECIFIED CONNECTORS, AND BE MADE OF MATERIAL THAT CAN BE DRILLED OR CUT FOR THE CABLE NOTCH (SEE THE DRAWING).
4. CONNECTOR SPECIFICATIONS- MELTRIC DSN 60 OR EQUIVALENT. MUST BE RATED FOR WET LOCATION, ALLOW SAFE DISCONNECT WHILE UNDER LOAD FOR THIS PUMP (APPROXIMATELY 39A RATING ON FULL LOAD). ENSURE SUPPLY CABLE CONNECTOR FROM THE SOFT START PANEL HAS A LID TO PROTECT THE CONNECTOR WHEN NOT IN USE.

DISPLAYED AS:
COORD SYS/ZONE: N/A
DATUM: N/A
UNITS: N/A
SOURCE: PIONEER

SCALE IN FEET
0 NTS

FIGURE

PIONEER TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

METRO STORM DRAIN ELECTRICAL ONE-LINE DIAGRAM & CONDUIT SCHEDULE

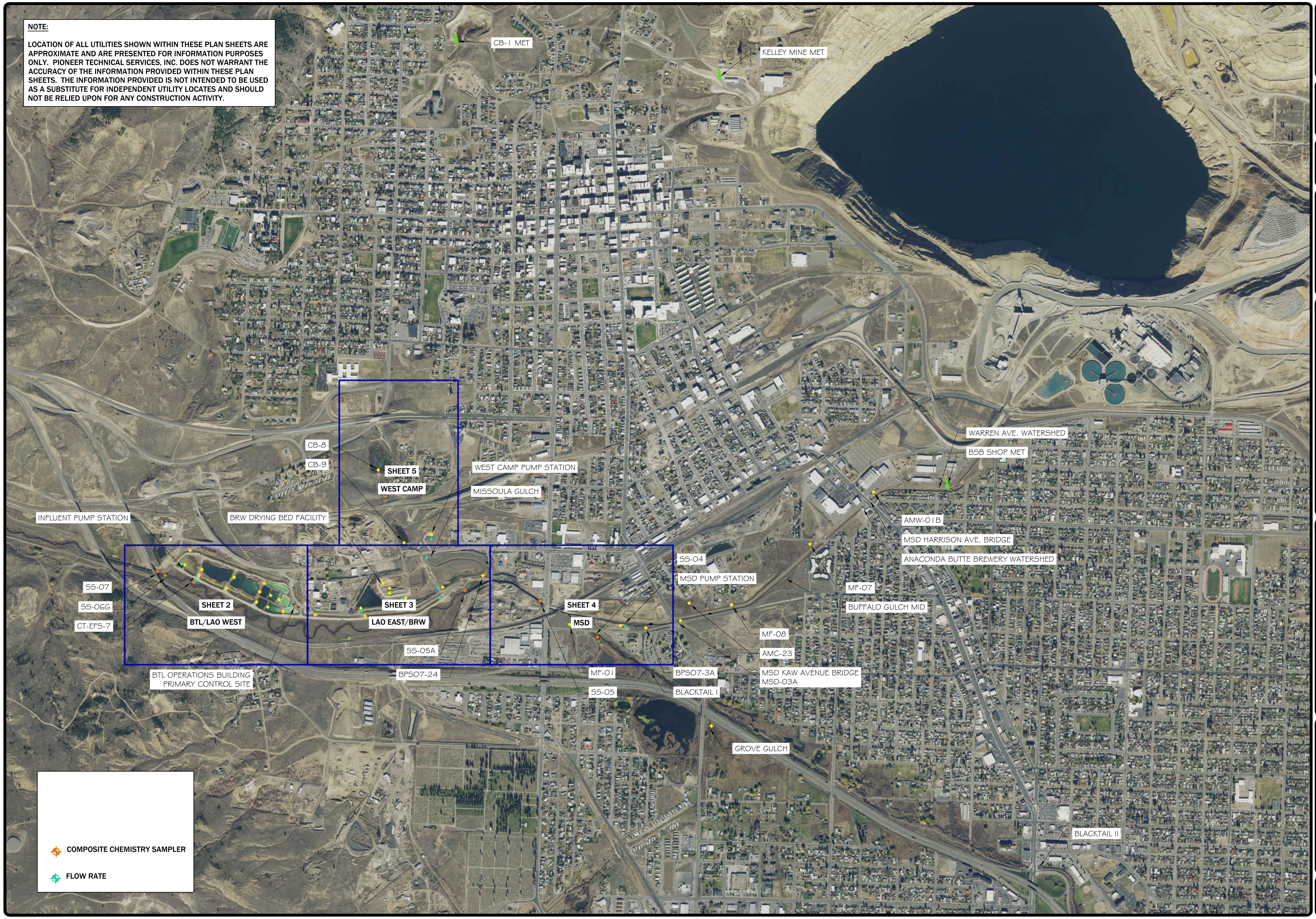
DATE: 4/11/16

5/4/2016 1:13:56 PM P:\ARCO\BUTTE\BPSOU\2016\LAO\DESHAW-ELECTRICAL DRAWING.DWG

Appendix E.3
Plot Plans

NOTE:

LOCATION OF ALL UTILITIES SHOWN WITHIN THESE PLAN SHEETS ARE APPROXIMATE AND ARE PRESENTED FOR INFORMATION PURPOSES ONLY. PIONEER TECHNICAL SERVICES, INC. DOES NOT WARRANT THE ACCURACY OF THE INFORMATION PROVIDED WITHIN THESE PLAN SHEETS. THE INFORMATION PROVIDED IS NOT INTENDED TO BE USED AS A SUBSTITUTE FOR INDEPENDENT UTILITY LOCATES AND SHOULD NOT BE RELIED UPON FOR ANY CONSTRUCTION ACTIVITY.



10/18/2019 7:53:35 AM N:\ARCO\BPSOU\SITE PLOT PLANS\BLT-LAO-FG-PLN-001-19.DWG

REVISION: DATE:	BY:	DESC:
3-11-13	AMD	BTL & WCP-1 UPGRADES
6-4-14	AMD	REVISION
4-6-16	AMD	REVISION
9-1-17	SDS	ONE-CALL VERIFICATION
10-18-19	BH	HBEL UPDATE

DRAWN BY: JKE
DESIGNED BY: AMD
CHECKED BY: SDS
APPROVED BY: DSG
PROJECT NO:
DATE: DECEMBER 5, 2011

DISPLAYED AS:
COORD SYS/ZONE: MT STATE PLANE
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER TECHNICAL

N
SCALE IN FEET
0 100 200

ATLANTIC RICHFIELD COMPANY
BUTTE PRIORITY SOILS OU
BTL, WCP-1, AND MSD OPERATIONS

PLOT PLAN
OVERVIEW

PIONEER
TECHNICAL SERVICES, INC.
307 EAST PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

SHEET
1 OF 5

NOTE:

LOCATION OF ALL UTILITIES SHOWN WITHIN THESE PLAN SHEETS ARE APPROXIMATE AND ARE PRESENTED FOR INFORMATION PURPOSES ONLY. PIONEER TECHNICAL SERVICES, INC. DOES NOT WARRANT THE ACCURACY OF THE INFORMATION PROVIDED WITHIN THESE PLAN SHEETS. THE INFORMATION PROVIDED IS NOT INTENDED TO BE USED AS A SUBSTITUTE FOR INDEPENDENT UTILITY LOCATES AND SHOULD NOT BE RELIED UPON FOR ANY CONSTRUCTION ACTIVITY.

LEGEND:

- REMOTE SURFACE WATER MONITORING EQUIPMENT
- WATER SURFACE ELEVATION
- COMPOSITE CHEMISTRY SAMPLER
- FLOW RATE
- GAS — GAS LINE
- UE — UNDERGROUND ELECTRICAL LINE
- OE — OVERHEAD ELECTRICAL LINE
- COM — TELEPHONE LINE
- SS — SANITARY SEWER LINE
- WTR — WATER LINE
- SLW — SILVER LAKE WATER LINE
- SD — STORM DRAIN
- MSD — METRO STORM DRAIN
- INF — BTL INFLUENT LINE
- EFF — BSB METRO EFFLUENT LINE
- WTR — BTL EFFLUENT LINE

REVISION: DATE:	BY:	DESC:
3-11-13	AMD	BTL & WCP-1 UPGRADES
6-4-14	AMD	REVISION
4-6-16	AMD	REVISION
9-1-17	SDS	ONE-CALL VERIFICATION
10-18-19	BH	HBEL UPDATE

DRAWN BY: JKE
DESIGNED BY: AMD
CHECKED BY: SDS
APPROVED BY: DSG
PROJECT NO:
DATE: DECEMBER 5, 2011

DISPLAYED AS:
COORD SYS/ZONE: MT STATE PLANE
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER TECHNICAL

N
SCALE IN FEET
0 100 200

ATLANTIC RICHFIELD COMPANY
BUTTE PRIORITY SOILS OU
BTL, WCP-1, AND MSD OPERATIONS

PLOT PLAN
BTL/WESTERN
PORTION LAO

PIONEER
TECHNICAL SERVICES, INC.
307 EAST PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

SHEET
2 OF 5

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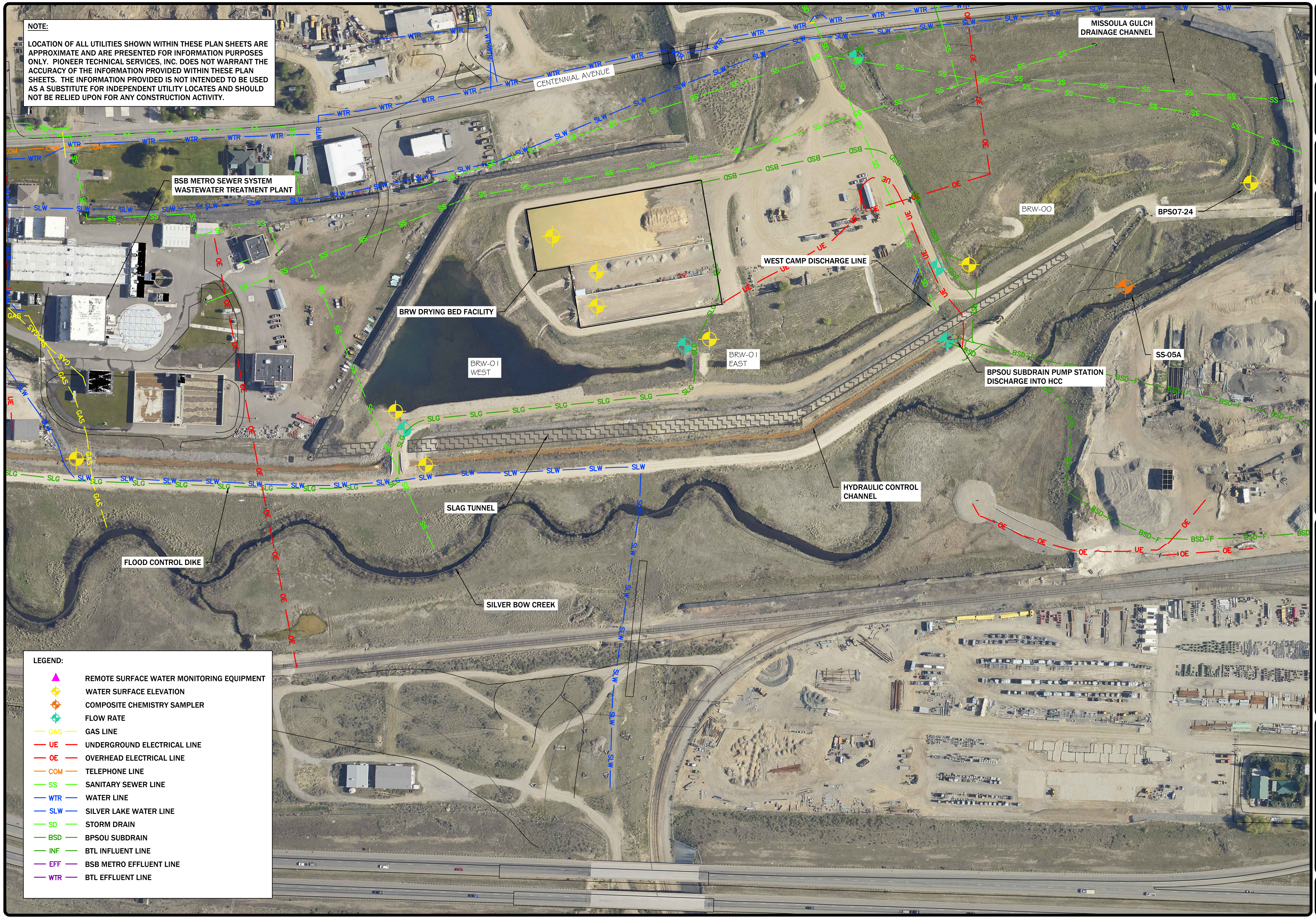

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REVISION: DATE:	BY:	DESC:
6-4-14	AMD	REVISION
4-6-16	AMD	REVISION
9-1-17	SDS	ONE-CALL VERIFICATION
10-18-19	BH	HBEL UPDATE
9-9-20	BH	MSD DISCHARGE UPDATE

DRAWN BY: JKE
DESIGNED BY: AMD
CHECKED BY: SDS
APPROVED BY: DSG
PROJECT NO:
DATE: DECEMBER 5, 2011

DISPLAYED AS:
COORD SYS/ZONE: MT STATE PLANE
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER TECHNICAL

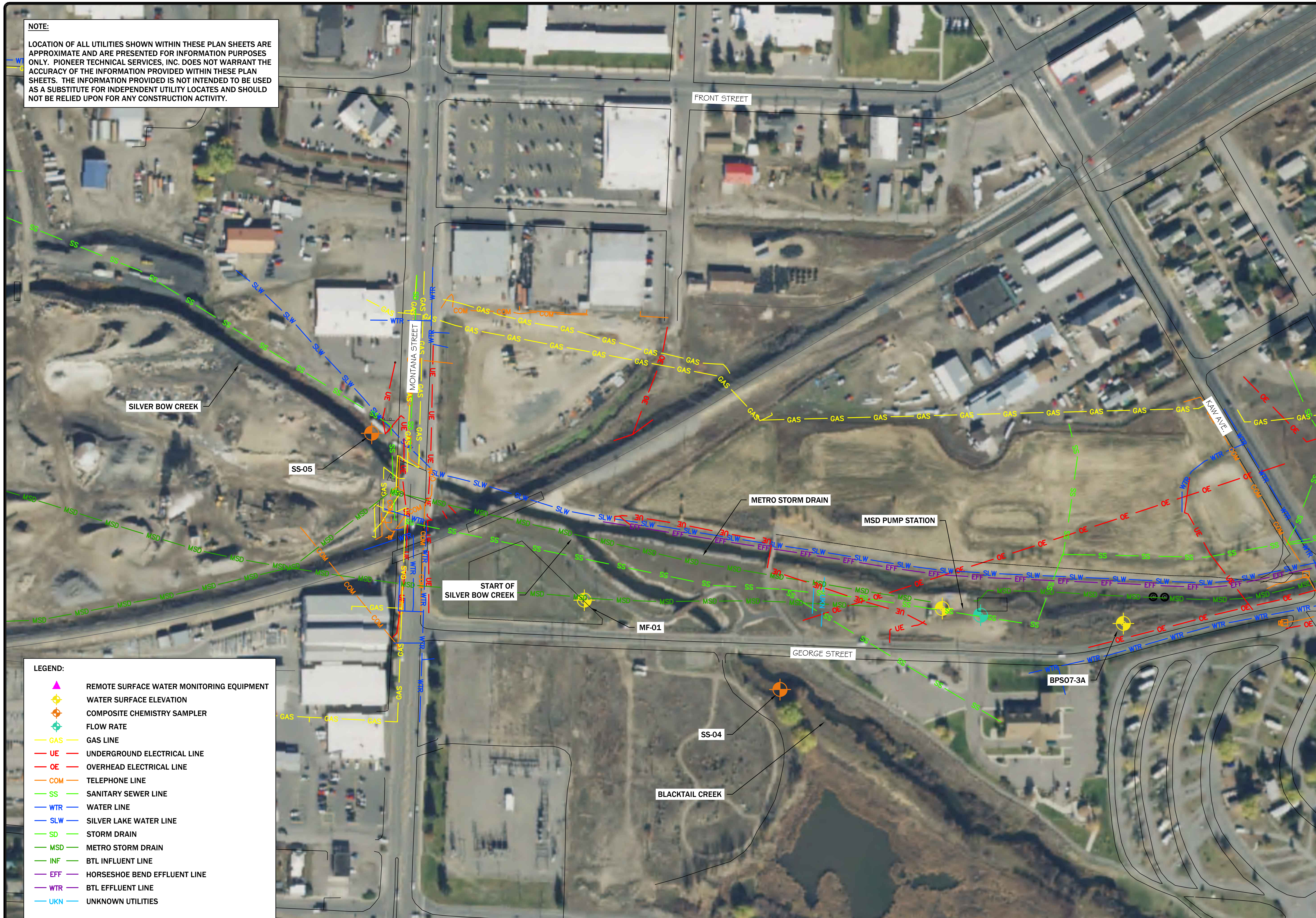
N
SCALE IN FEET
0 100 200

ATLANTIC RICHFIELD COMPANY
BUTTE PRIORITY SOILS OU
BTL, WCP-1, AND MSD OPERATIONS

PLOT PLAN
BRW/EASTERN
PORTION OF LAO

PIONEER
TECHNICAL SERVICES, INC.
307 EAST PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

SHEET
3 OF 5



NOTE:

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LEGEND:

	REMOTE SURFACE WATER MONITORING EQUIPMENT
	WATER SURFACE ELEVATION
	COMPOSITE CHEMISTRY SAMPLER
	FLOW RATE
GAS	GAS LINE
UE	UNDERGROUND ELECTRICAL LINE
OE	OVERHEAD ELECTRICAL LINE
COM	TELEPHONE LINE
SS	SANITARY SEWER LINE
WTR	WATER LINE
SLW	SILVER LAKE WATER LINE
SD	STORM DRAIN
MSD	METRO STORM DRAIN
INF	BTL INFLUENT LINE
EFF	HORSESHOE BEND EFFLUENT LINE
WTR	BTL EFFLUENT LINE
UKN	UNKNOWN UTILITIES

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REVISION:

DATE:	BY:	DESC:
3-11-13	AMD	BTL & WCP-1 UPGRADES
6-4-14	AMD	REVISION
4-6-16	AMD	REVISION
9-1-17	SDS	ONE-CALL VERIFICATION
10-18-19	BH	HBEL UPDATE

DRAWN BY: JKE
DESIGNED BY: AMD
CHECKED BY: SDS
APPROVED BY: DSG
PROJECT NO:
DATE: DECEMBER 5, 2011

DISPLAYED AS:
COORD SYS/ZONE: MT STATE PLANE
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER TECHNICAL

N

SCALE IN FEET
0 100 200

ATLANTIC RICHFIELD COMPANY
BUTTE PRIORITY SOILS OU
BTL, WCP-1, AND MSD OPERATIONS

PLOT PLAN
METRO STORM DRAIN
PUMPING STATION

PIONEER
TECHNICAL SERVICES, INC.
307 EAST PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

SHEET
4 OF 5

NOTE:

LOCATION OF ALL UTILITIES SHOWN WITHIN THESE PLAN SHEETS ARE APPROXIMATE AND ARE PRESENTED FOR INFORMATION PURPOSES ONLY. PIONEER TECHNICAL SERVICES, INC. DOES NOT WARRANT THE ACCURACY OF THE INFORMATION PROVIDED WITHIN THESE PLAN SHEETS. THE INFORMATION PROVIDED IS NOT INTENDED TO BE USED AS A SUBSTITUTE FOR INDEPENDENT UTILITY LOCATES AND SHOULD NOT BE RELIED UPON FOR ANY CONSTRUCTION ACTIVITY.

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REVISION:

DATE:	BY:	DESC:
3-11-13	AMD	BTL & WCP-1 UPGRADES
6-4-14	AMD	REVISION
4-6-16	AMD	REVISION
9-1-17	SDS	ONE-CALL VERIFICATION
10-18-19	BH	HBEL UPDATE

DRAWN BY: JKE
DESIGNED BY: AMD
CHECKED BY: SDS
APPROVED BY: DSG
PROJECT NO:
DATE: DECEMBER 5, 2011

DISPLAYED AS:
COORD SYS/ZONE: MT STATE PLANE
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER TECHNICAL

N

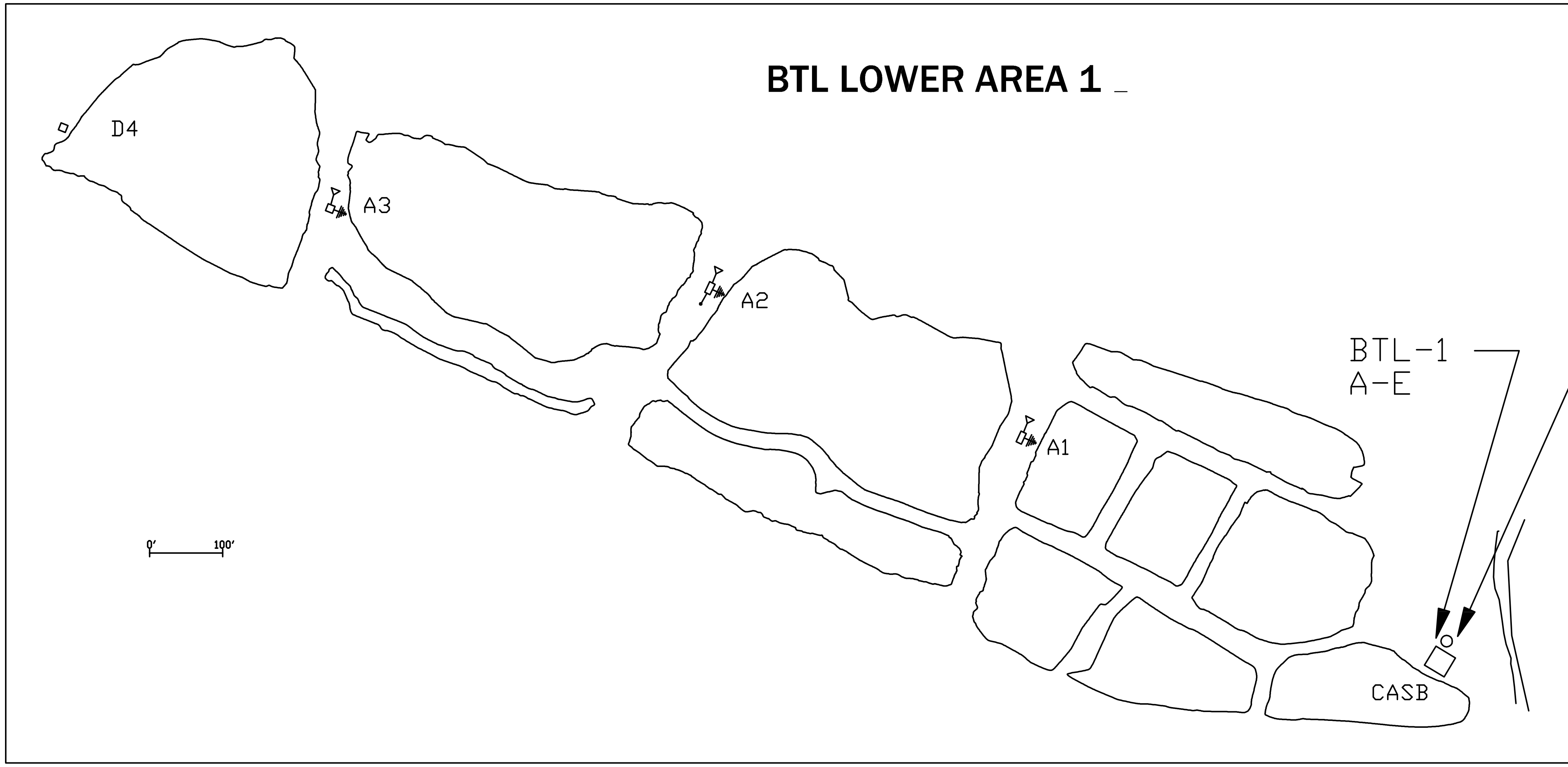
SCALE IN FEET
0 100 200

ATLANTIC RICHFIELD COMPANY
BUTTE PRIORITY SOILS OU
BTL, WCP-1, AND MSD OPERATIONS

PLOT PLAN
WCP-1/LOWER MISSOULA GULCH

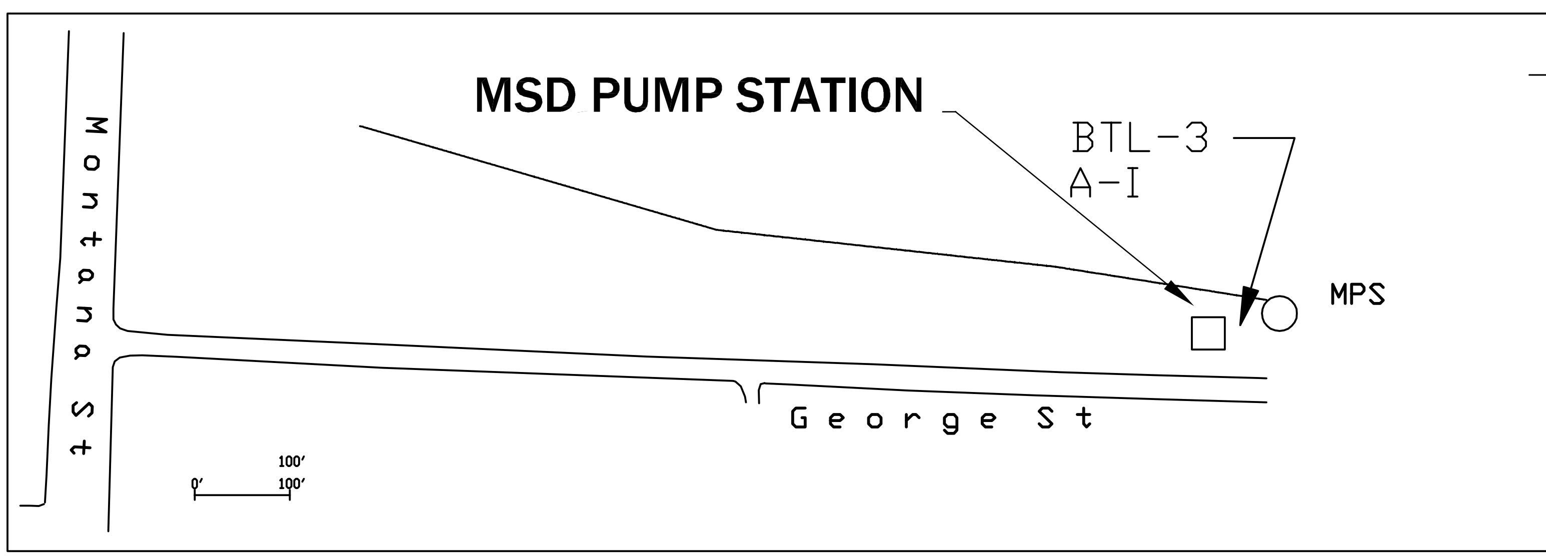
PIONEER
TECHNICAL SERVICES, INC
307 EAST PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

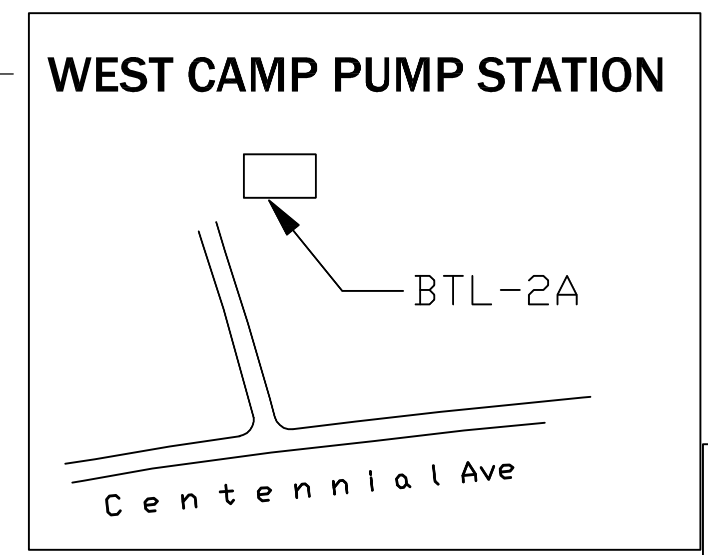
SHEET
5 OF 5



NOTE:
THE HYDRATED LIME (CALCIUM HYDROXIDE) STORAGE BIN AND HANDLING SYSTEMS WERE EVALUATED FOR HAZARDOUS CLASSIFICATION. THE MSDS SHEET STATES THAT THIS SUBSTANCE IS NON-COMBUSTABLE AND THE NFPA FLAMMABILITY = 0. THIS AREA DOES NOT NEED TO BE CLASSIFIED.

NOTE:
THERE WERE NO AREAS ENCOUNTER DURING THIS AUDIT THAT WERE DETERMINED TO REQUIRE HAZARDOUS AREA CLASSIFICATION.





I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly registered Professional Engineer under the laws of the State of Minnesota.

Date: 01/7/2012 Reg. No. 012024

REFERENCE DRAWINGS	REV	REVISION DESCRIPTION	BY	DATE
	0	RELEASED FOR REPORT	JVC	1/06/2012

Rockwell Automation
INDUSTRIAL PLANT SERVICES

BP
BUTTE MONTANA
REMEDIATION MANAGEMENT
BTL ELECTRICAL CODE AUDIT
PLOT PLAN

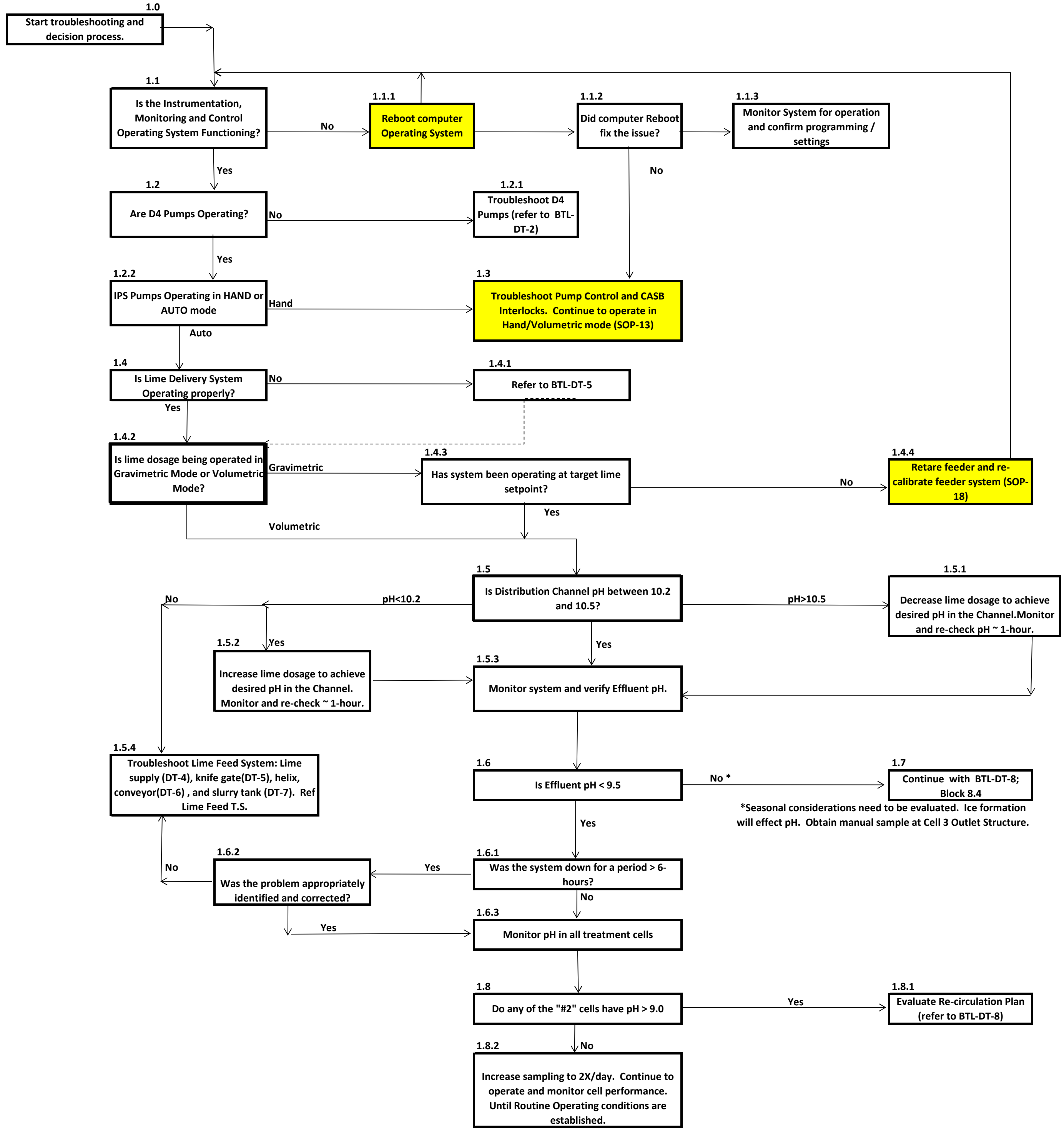
DRN: JVC	CHK: JVC	APR:
SCALE: 1"=100'	TAG: N/A	SHT: 1 OF: 1
DATE 1/6/2012	DRAWING NUMBER D-001-E-001	REVISION 0

Appendix F
BTL Systems Operation Decision Diagrams

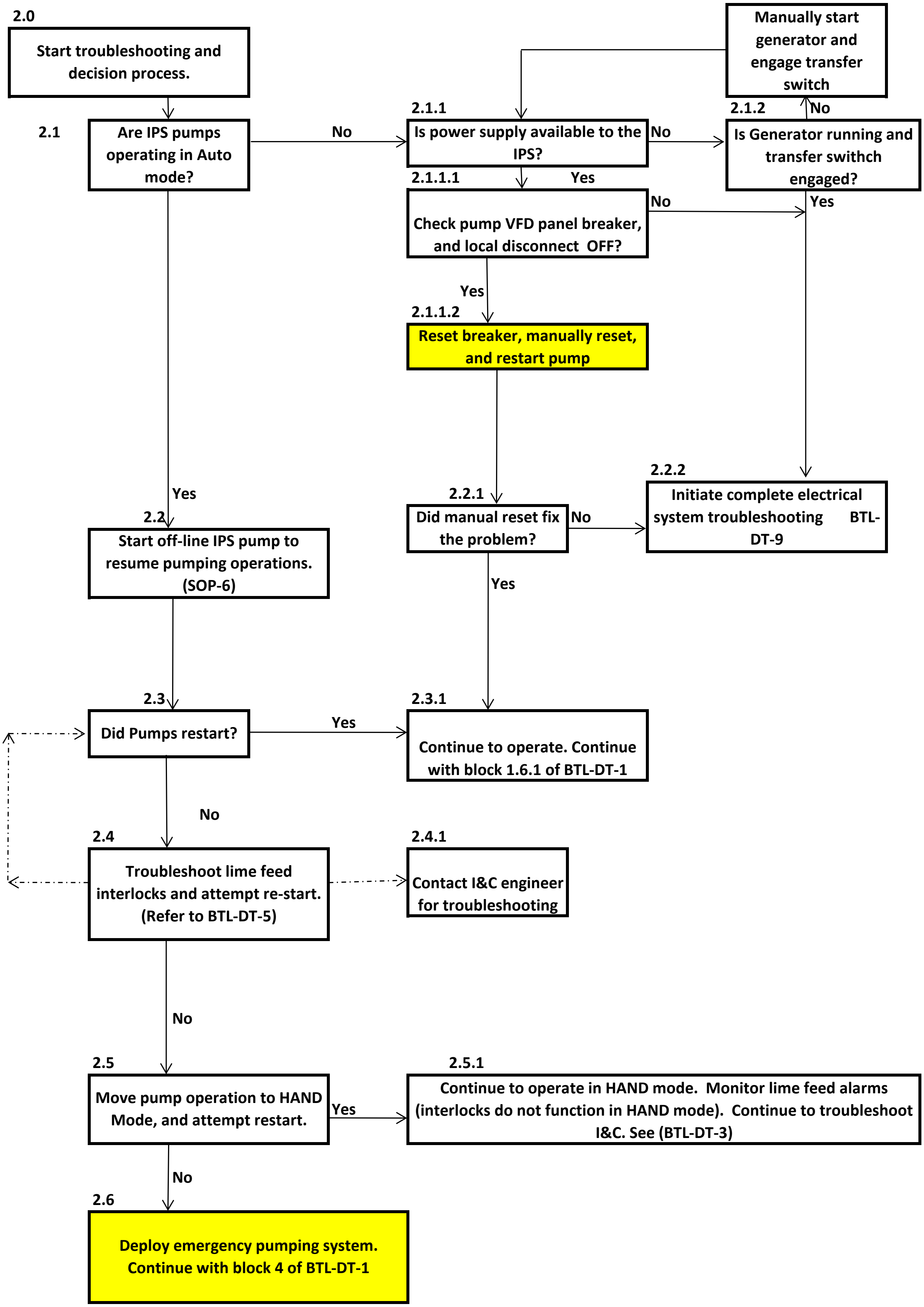
BTL-DT-1: Cell pH Based Decisions
BTL-DT-2: Influent Pump Station
BTL-DT-3: SCADA and HMI
BTL-DT-4: Screw Conveyor
BTL-DT-5: Lime Feed System
BTL-DT-6: AccuRate® Feeder
BTL-DT-7: Slurry Tanks
BTL-DT-8: Cell Recirculation
BTL-DT-9: Electric Motors
BTL-DT-10: WCP Operator’s Decision Tree
BTL-DT-11: BPSOU Subdrain Operator’s Decision Tree
Routine Valve Alignment Table
BTL Valve Cause and Effect, Routing Options
BTL Contingency Operations – Flow Mitigation Measures
BTL Contingency Operations – Redistribution of Retained Water

PIONEER TECHNICAL SERVICES, INC.

BTL-DT-1; BTL-LAO operator's decision tree. Referenced to remedy performace issues after an upset condition has been identified.



BTL-DT-2; IPS troubleshooting / decision tree.

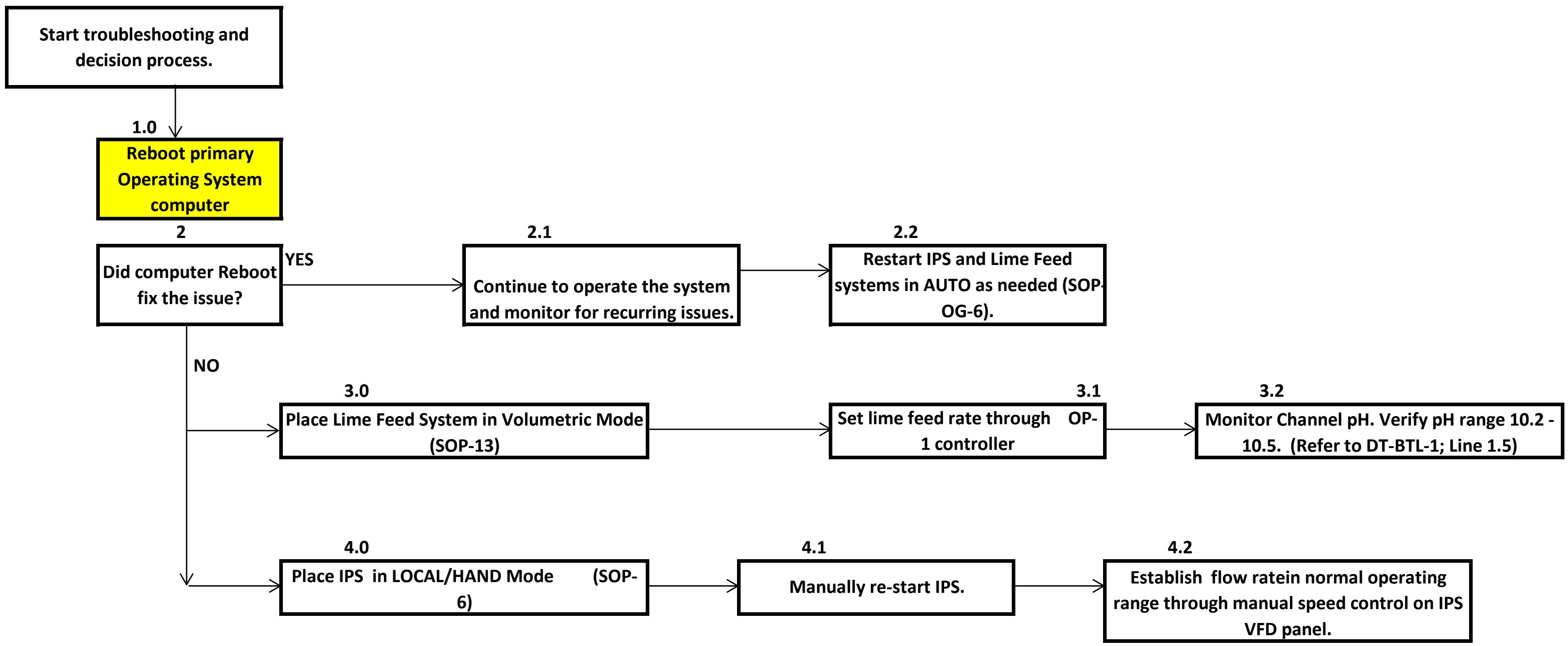


PIONEER TECHNICAL SERVICES, INC.

BTL-DT-3; SCADA/HMI troubleshooting / decision tree.

SCADA & HMI Symptoms

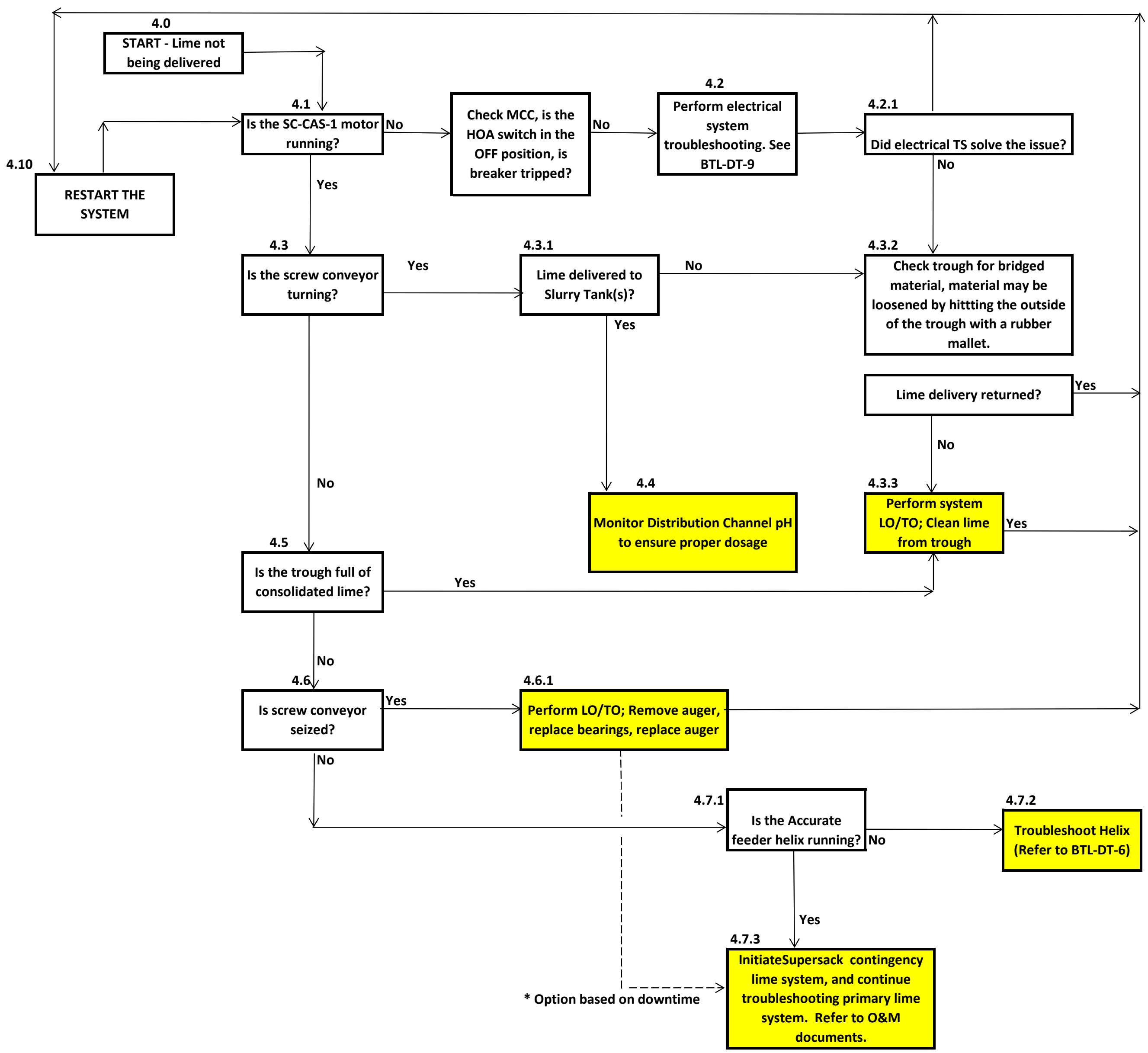
HMI screen is frozen, no updates to system status
HMI screen is blank, no display
HMI screen is off



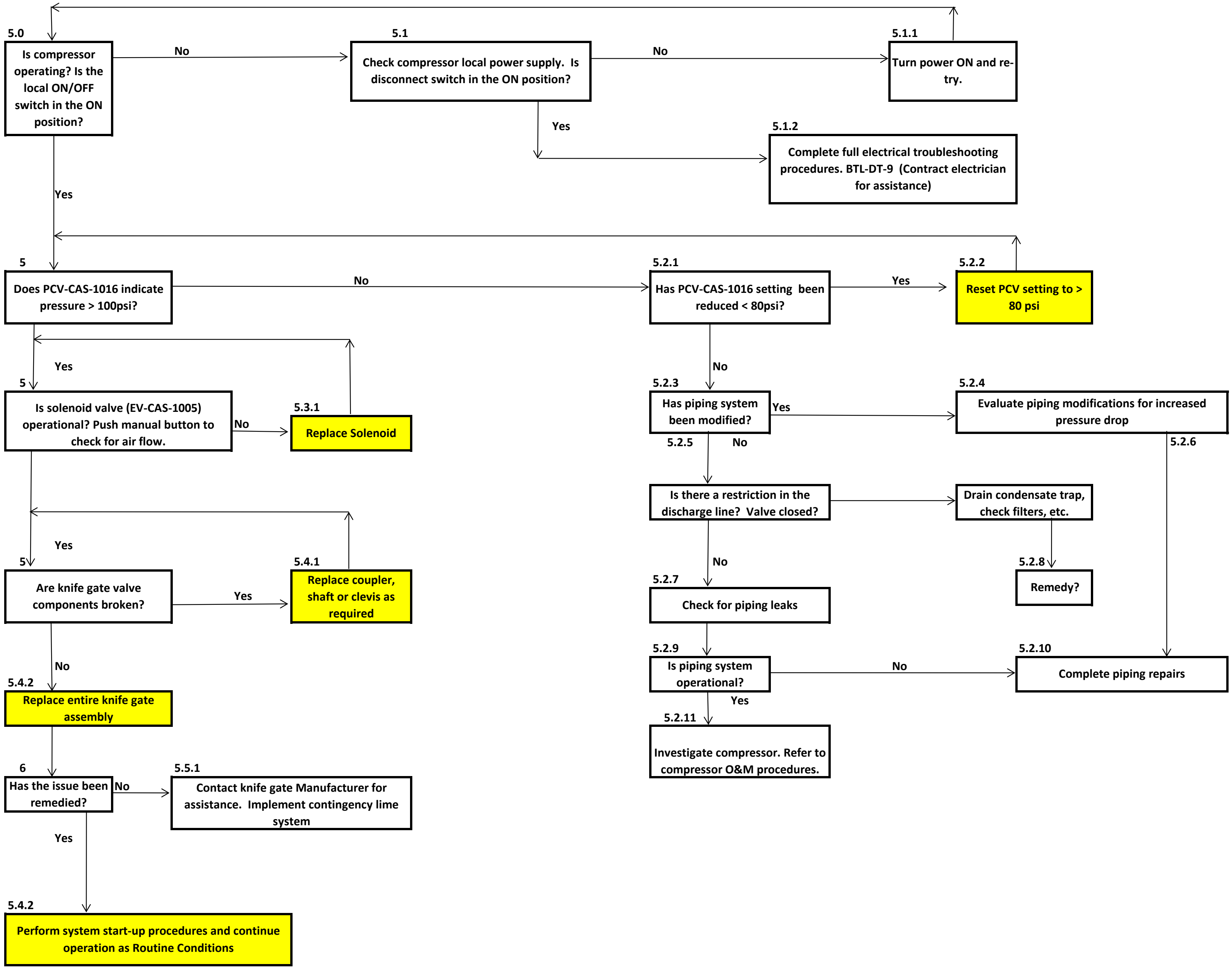
***Continue to operate in Volumetric and HAND mode while SCADA system issues are corrected**

***Increase manual system monitoring intervals. Interlocks are disabled in Volumetric and HAND mode.**

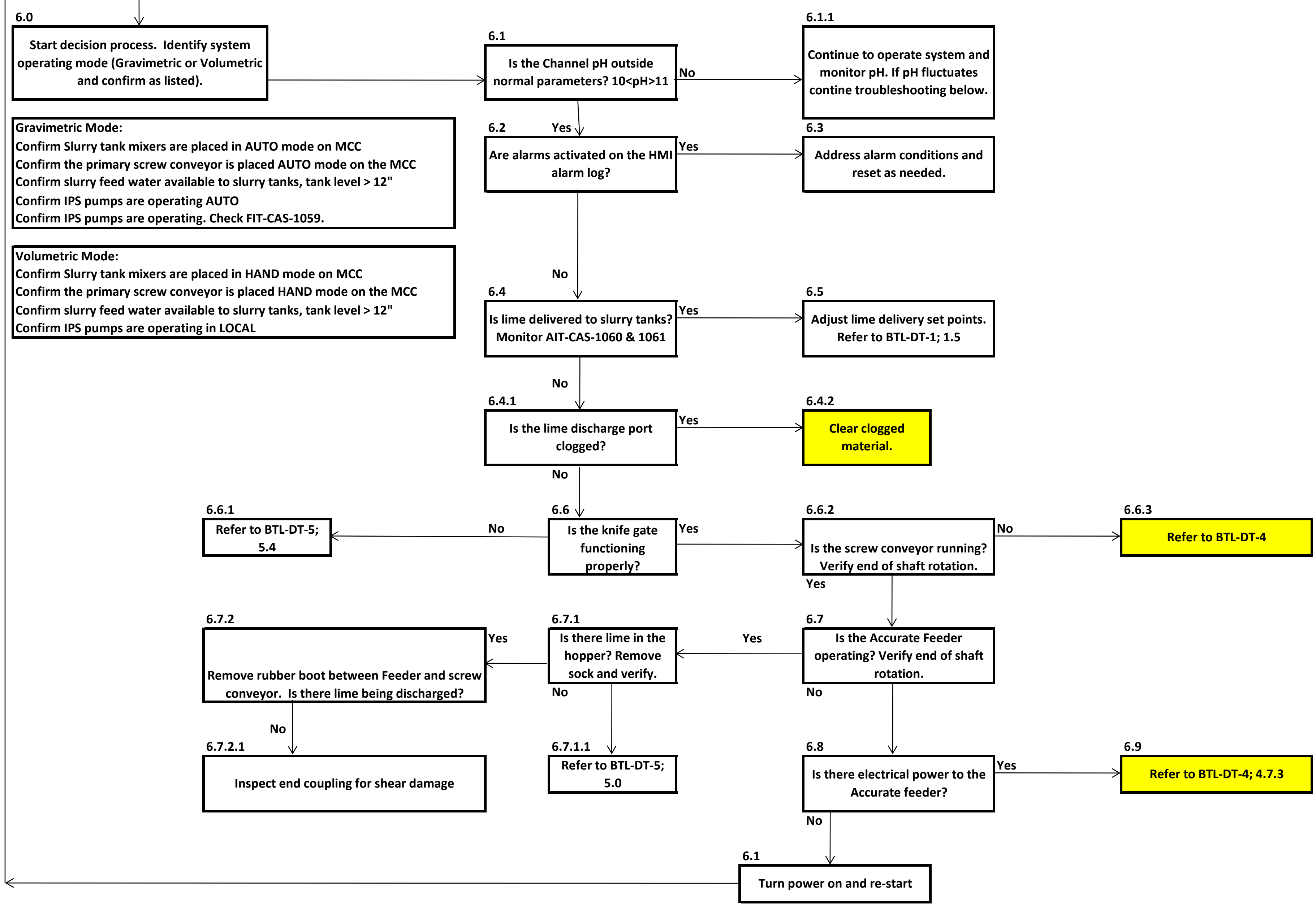
BTL-DT-4; Screw conveyor troubleshooting / decision tree.



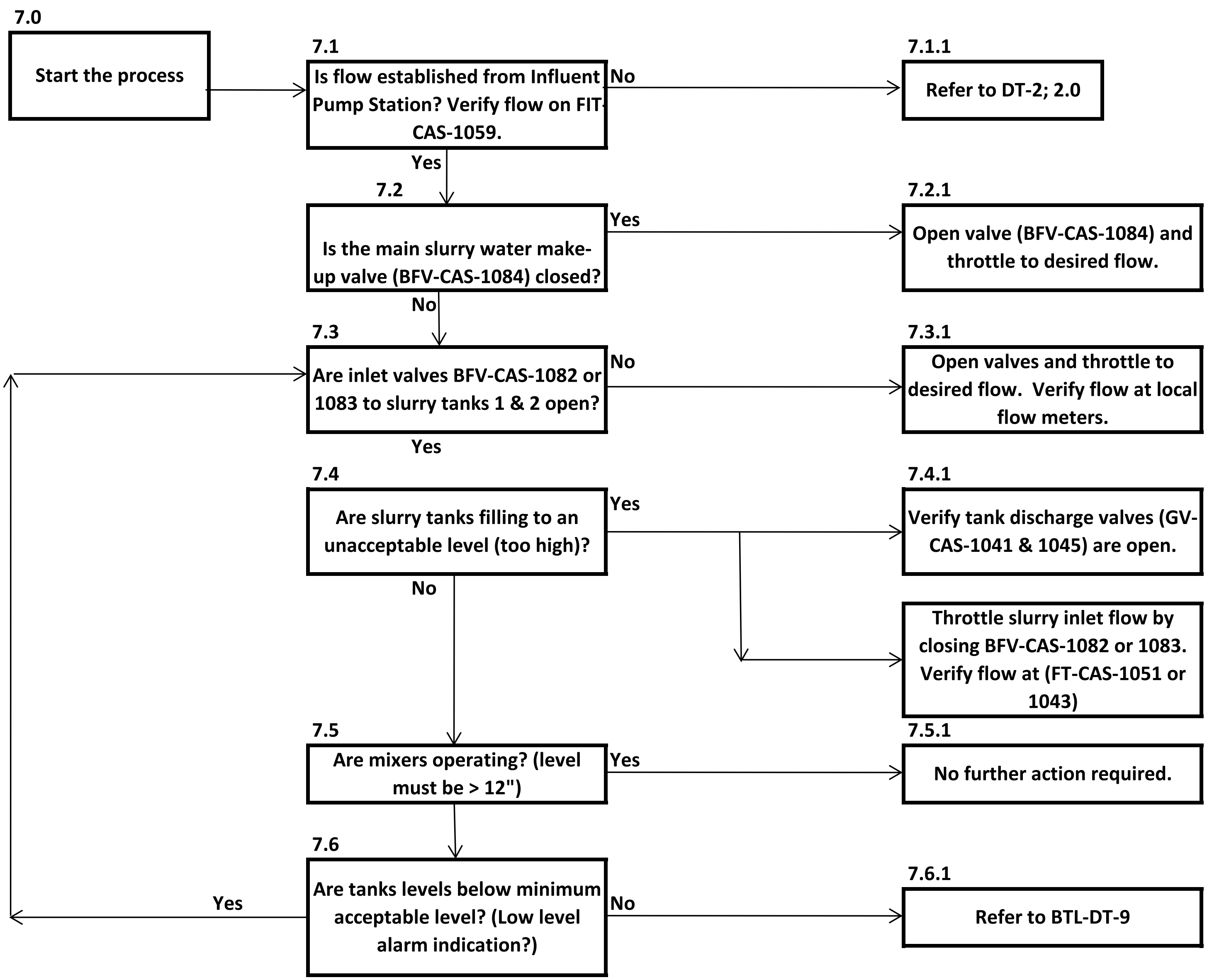
BTL-DT-5, Knife gate and compressed air system troubleshooting / decision tree.



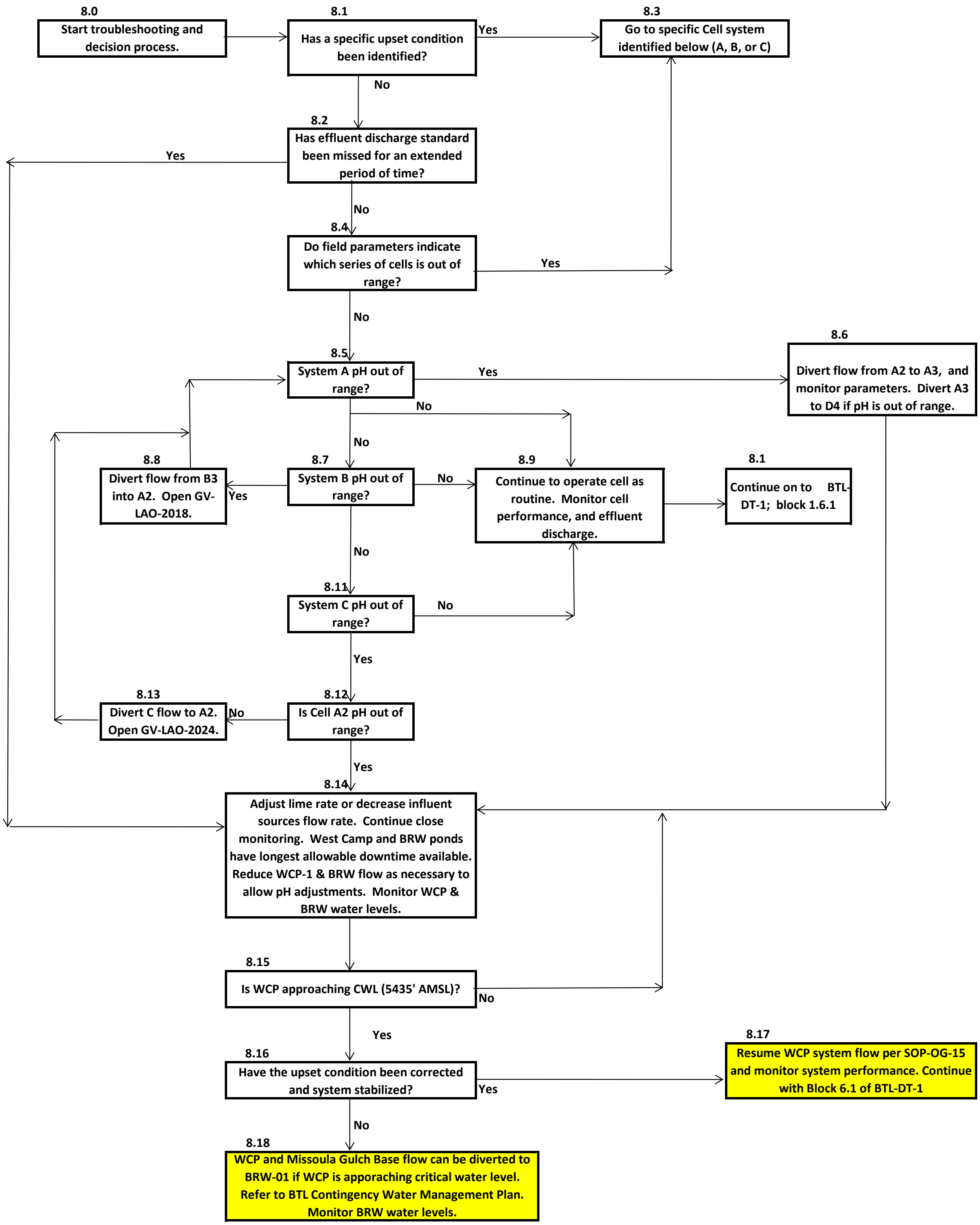
BTL-LDT-6; Helix troubleshooting, decision tree.



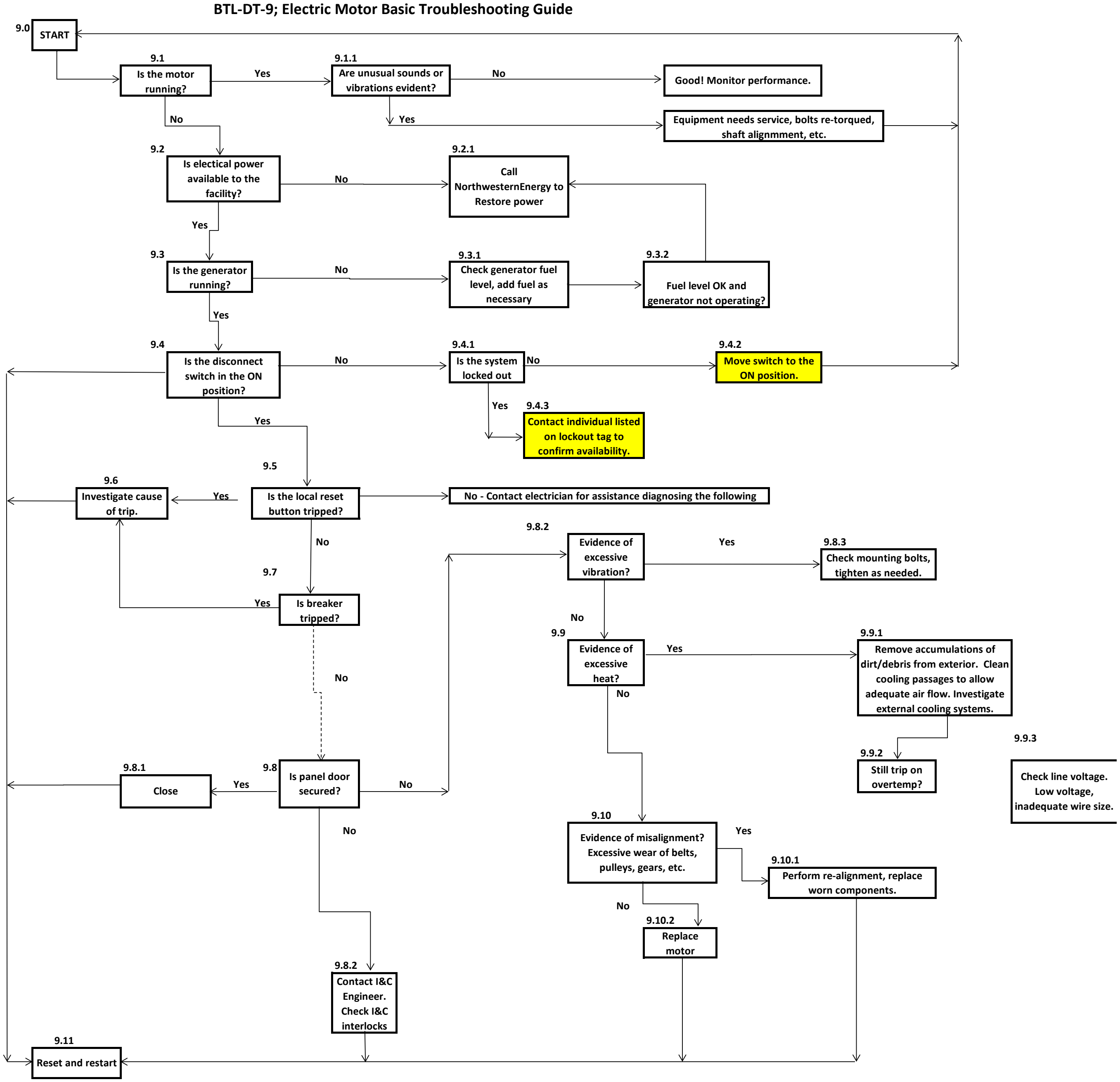
BTL-LDT-7; Slurry tanks, make-up water decision tree.



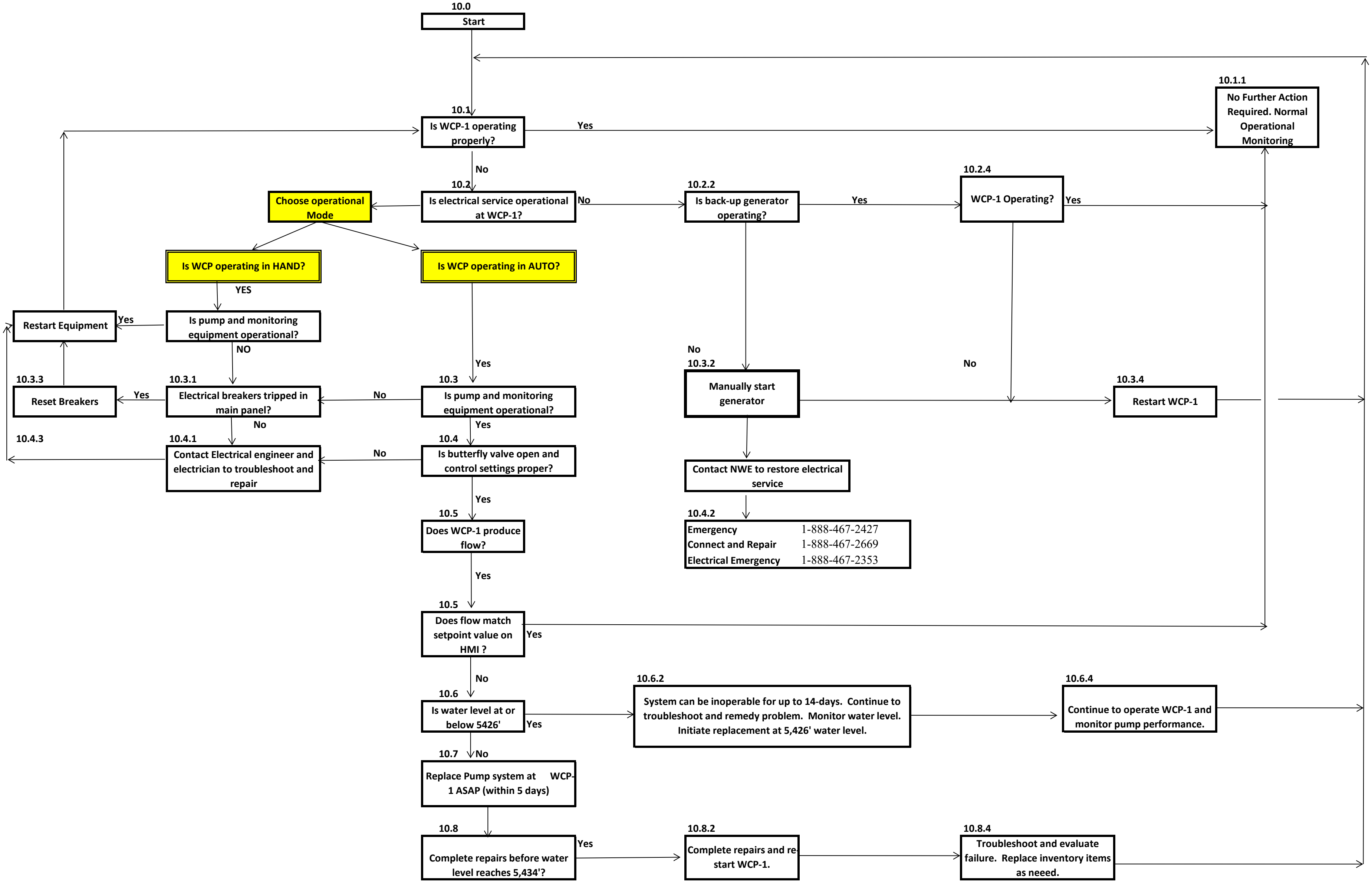
BTL-DT-8; BTL Effluent recirculation based decision tree



BTL-DT-9; Electric Motor Basic Troubleshooting Guide

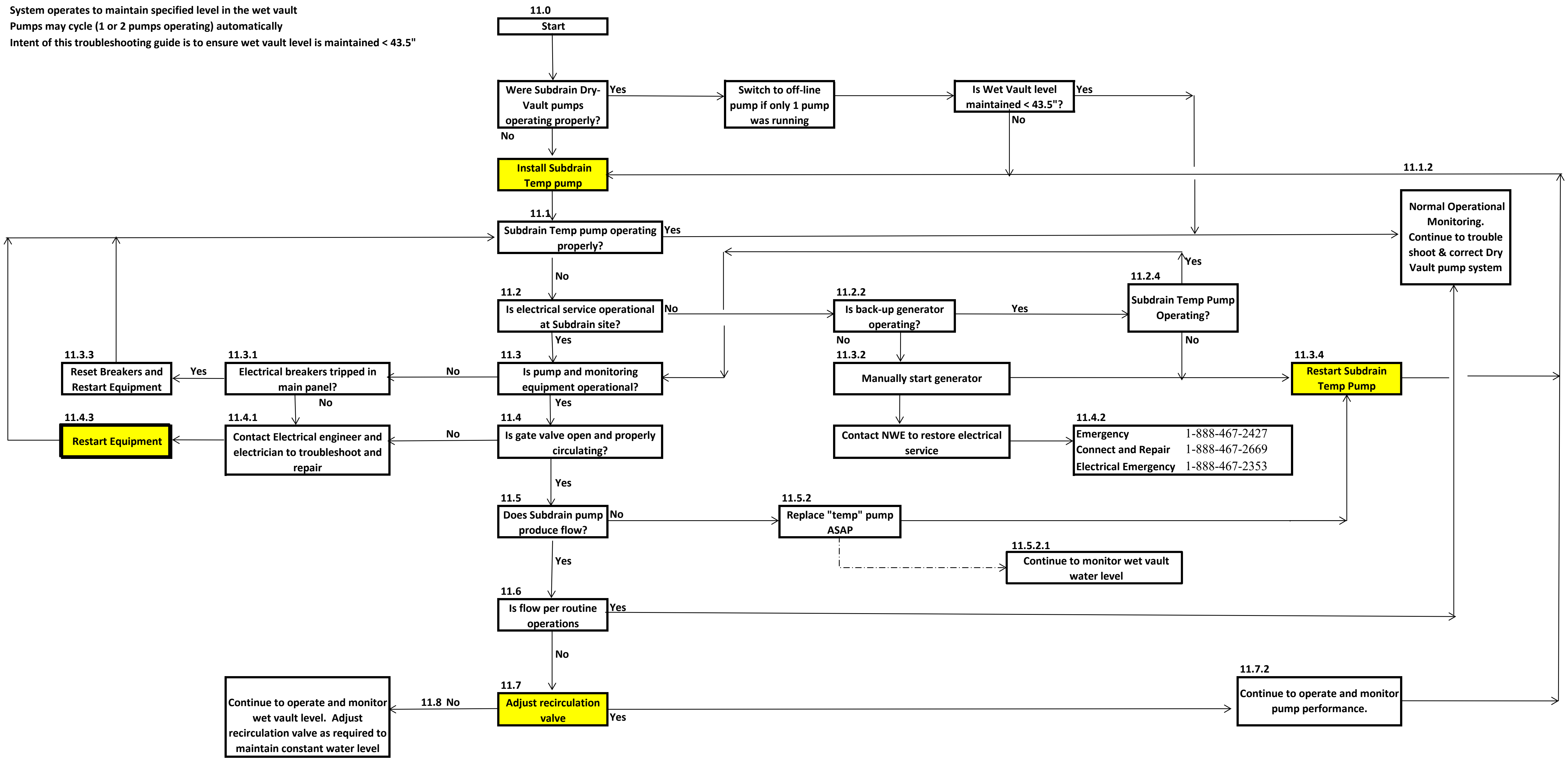


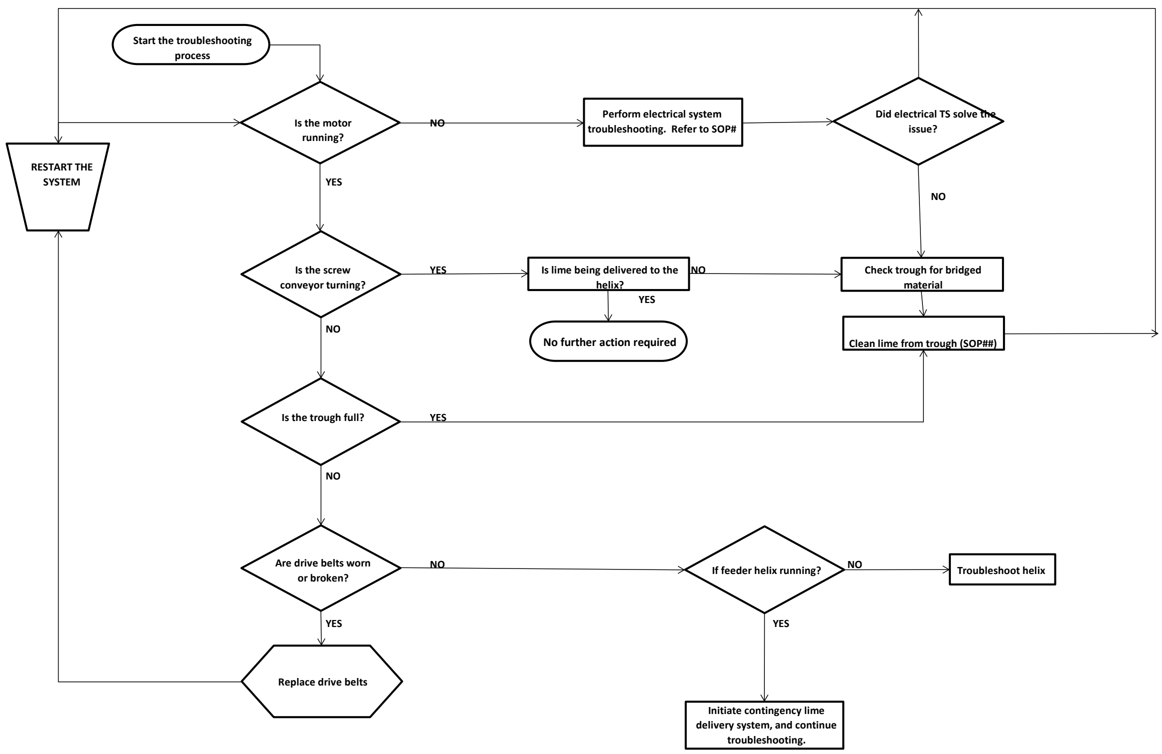
BTL-DT-10; WCP Operator's Decision Tree



BTL-DT-11; BPSOU Subdrain Operator's Decision Tree

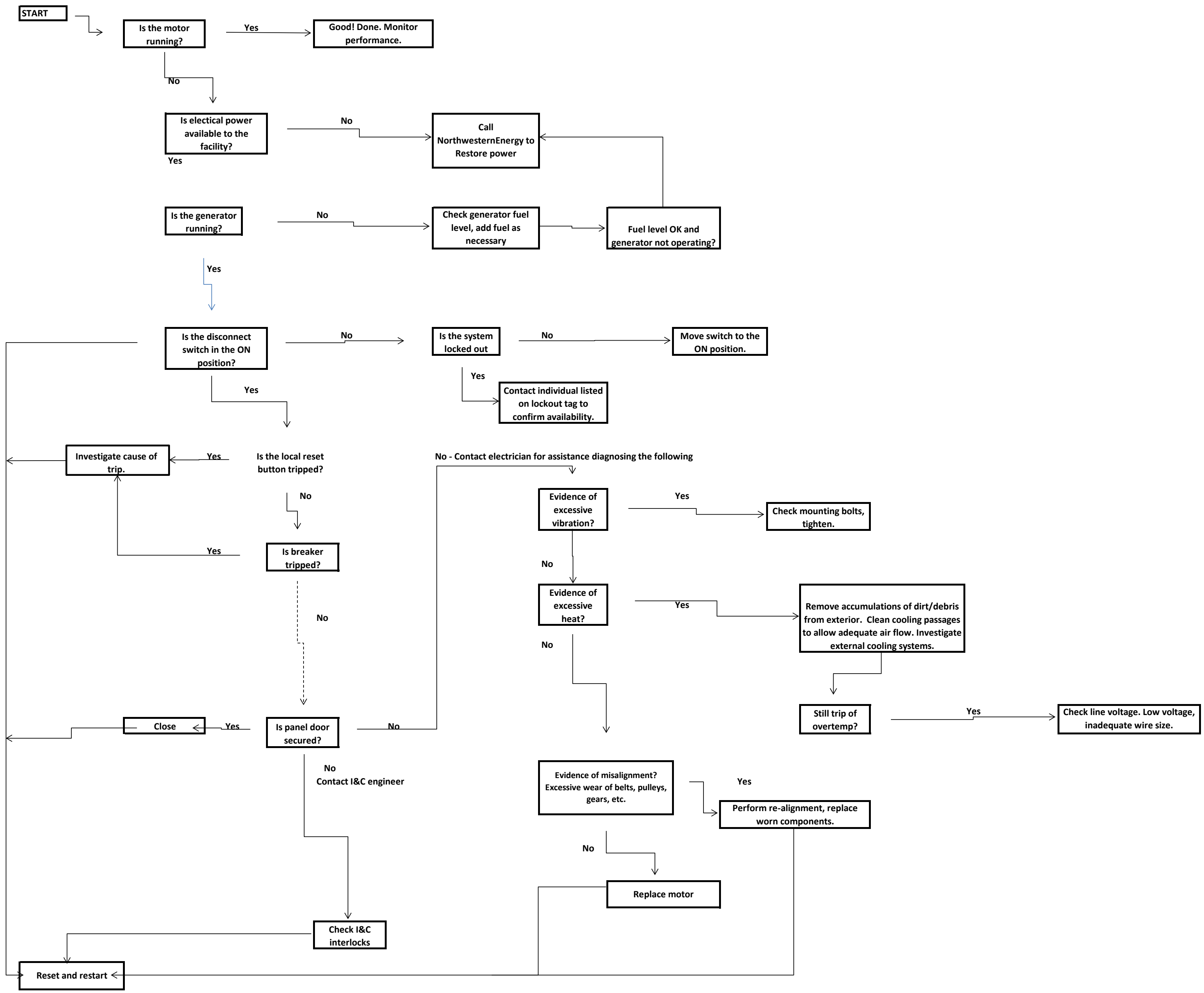
System operates to maintain specified level in the wet vault
Pumps may cycle (1 or 2 pumps operating) automatically
Intent of this troubleshooting guide is to ensure wet vault level is maintained < 43.5"



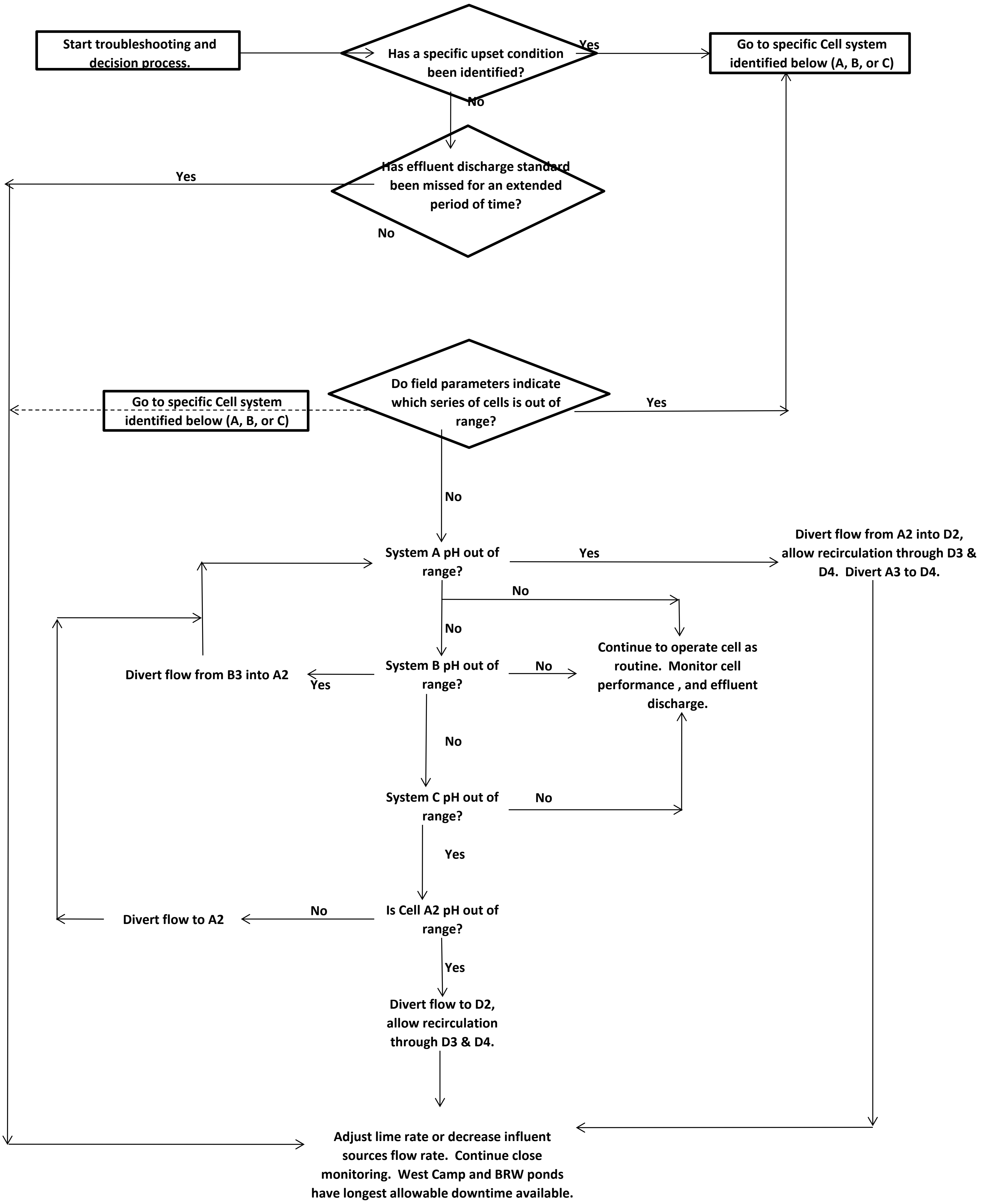


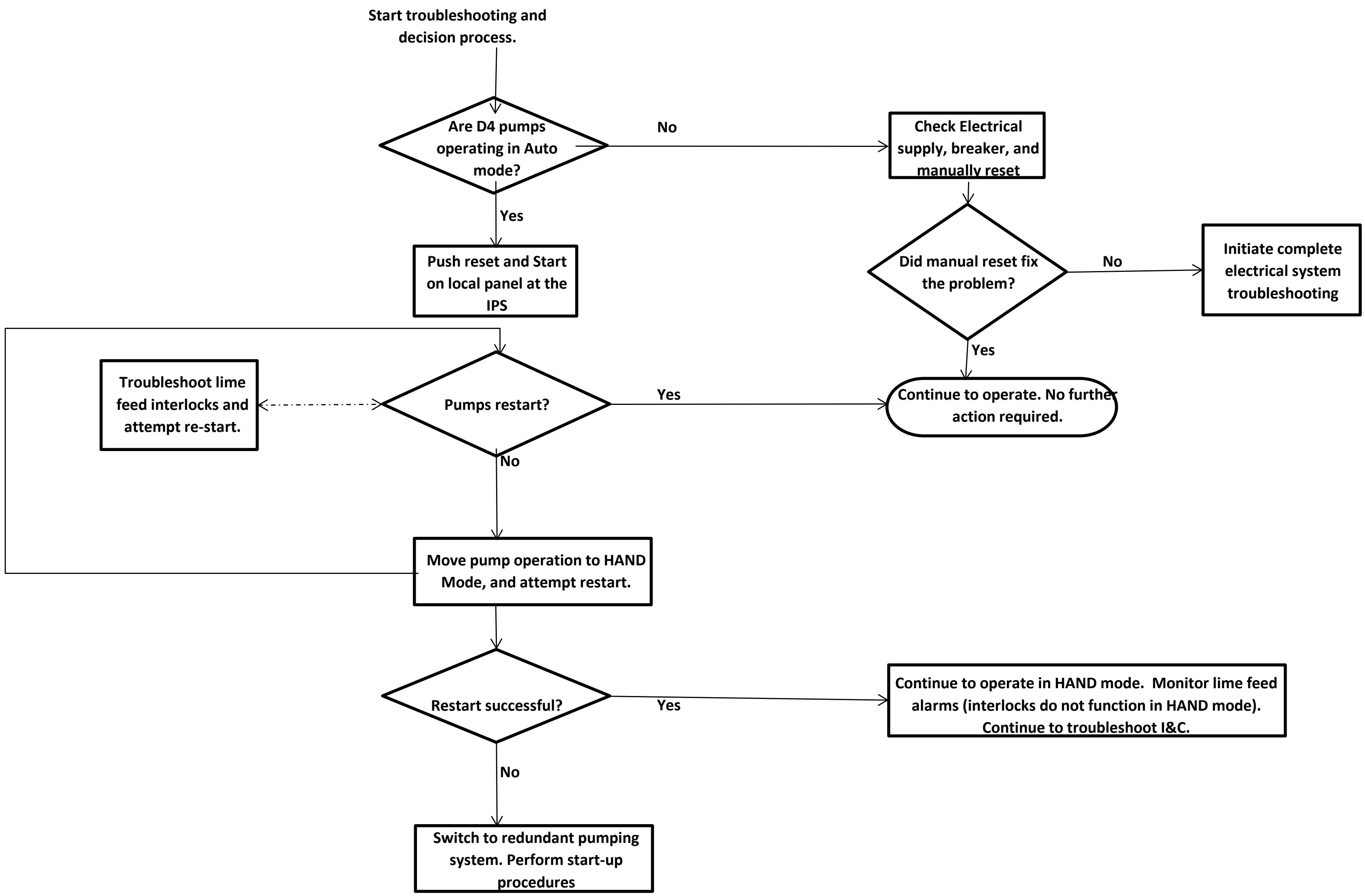
Start the troubleshooting process
Is the motor running?
NO
Perform electrical system troubleshooting. Refer to SOP#
Did electrical TS solve the issue?
NO
RESTART THE SYSTEM
YES
Is the screw conveyor turning?
YES
Is lime being delivered to the helix?
NO
Check trough for bridged material
YES
No further action required
Clean lime from trough (SOP##)
NO
Is the trough full?
YES
NO
Are drive belts worn or broken?
NO
If feeder helix running?
NO
Troubleshoot helix
YES
YES
Replace drive belts
Initiate contingency lime delivery system, and continue troubleshooting.

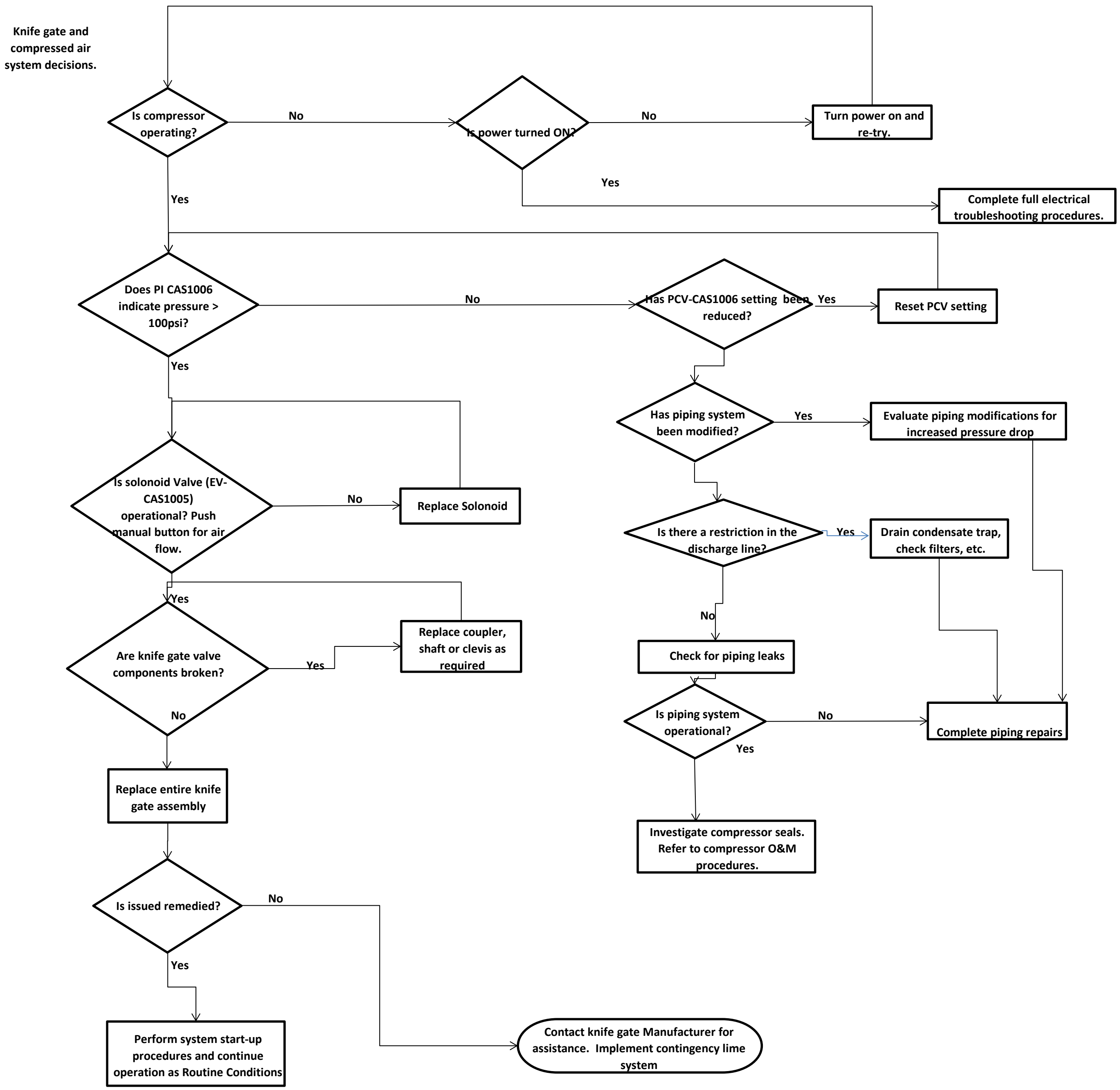
Electric Motor Basic Troubleshooting Guide



BTL recirculation based decisions are made according to the following process.




Start troubleshooting and decision process.
Are D4 pumps operating in Auto mode?
No
Check Electrical supply, breaker, and manually reset
Yes
Push reset and Start on local panel at the IPS
Did manual reset fix the problem?
No
Initiate complete electrical system troubleshooting
Yes
Troubleshoot lime feed interlocks and attempt re-start.
Pumps restart?
Yes
Continue to operate. No further action required.
No
Move pump operation to HAND Mode, and attempt restart.
Restart successful?
Yes
Continue to operate in HAND mode. Monitor lime feed alarms (interlocks do not function in HAND mode). Continue to troubleshoot I&C.
No
Switch to redundant pumping system. Perform start-up procedures


Knife gate and compressed air system decisions.
Is compressor operating?
No
Is power turned ON?
No
Turn power on and re-try.
Yes
Complete full electrical troubleshooting procedures.
Yes
Does PI CAS1006 indicate pressure > 100psi?
No
Has PCV-CAS1006 setting been reduced?
Yes
Reset PCV setting
Yes
Has piping system been modified?
Yes
Evaluate piping modifications for increased pressure drop
Is solonoid Valve (EV-CAS1005) operational? Push manual button for air flow.
No
Replace Solonoid
Is there a restriction in the discharge line?
Yes
Drain condensate trap, check filters, etc.
Yes
Are knife gate valve components broken?
Yes
Replace coupler, shaft or clevis as required
No
Check for piping leaks
No
Is piping system operational?
No
Complete piping repairs
Yes
Replace entire knife gate assembly
Investigate compressor seals. Refer to compressor O&M procedures.
Is issued remedied?
No
Yes
Perform system start-up procedures and continue operation as Routine Conditions
Contact knife gate Manufacturer for assistance. Implement contingency lime system

REFERENCE	VALVE NUMBER	VALVE TYPE	DESCRIPTION	FUNCTION	NON-FREEZING ALIGNMENT	FREEZING ALIGNMENT
P&ID1AB LIME FEED SYSTEM	BV-CAS-1009	Ball, 1"	Air supply isolation (upstream of PS-1011)	Isolation	Open	Open
	BV-CAS-1013	Ball, 1"	AC-LAO-101 isolation	Isolation	Open	Open
	BV-CAS-1014	Ball, 3/4"	AC-LAO-201 isolation	Isolation	Closed	Closed
	BV-CAS-1007	Ball, 3/4"	Instrument air service connection	Isolation/Service connection	Closed	Closed
	BV-CAS-1008	Ball, 3/4"	Instrument air service connection	Isolation/Service connection	Closed	Closed
	BV-CAS-1010	Ball, 3/4"	Instrument air service connection	Isolation/Service connection	Closed	Closed
	BV-CAS-1077	Ball, 3/4"	Air supply isolation to baghouse	Isolation	Open	Open
	BV-CAS-1078	Ball, 3/4"	Air supply isolation to baghouse downstream of PCV-CAS-1003	Isolation	Open	Open
	BV-CAS-1079	Ball, 3/4"	Air supply isolation to silo knife gate valve FCV-CAS-1004	Isolation	Open	Open
	BV-CAS-1080	Ball, 3/4"	Air supply isolation to silo knife gate valve FCV-CAS-1004	Isolation	Open	Open
	BV-CAS-1081	Ball, 3/4"	Air supply isolation to baghouse knife gate valve FCV-CAS-1001	Isolation	Open	Open
	BV-CAS-1015	Ball, 3/4"	Air supply isolation to SC-CAS-1	Isolation	Open	Open
	BV-CAS-1020	Ball, 3/4"	Air supply isolation to knife gate valve to T-CAS-2	Isolation	Open	Open
	BV-CAS-1021	Ball, 3/4"	Air supply isolation to knife gate valve to T-CAS-1	Isolation	Open	Open
	BV-CAS-1012A	Ball, 3/4"	Air supply isolation to Rack 10 - CAS PLC Encclosure overpressure	Isolation	Open	Open
	BV-CAS-1012B	Ball, 3/4"	Air supply isolation to PS-CAS-1011	Isolation	Open	Open
	BV-CAS-1017	Ball, 3/4"	Instrument air service to secondary lime feed system	Isolation	Closed	Closed
REFERENCE	**VALVE NUMBER**	**VALVE TYPE**	**DESCRIPTION**	**FUNCTION**	**NON-FREEZING ALIGNMENT**	**FREEZING ALIGNMENT**
P&ID2AB CAS BUILDING	GV-CAS-1052	Gate	Influent supply from IPS	Isolation	Open	Open
	GV-CAS-1053	Gate	Influent supply from IPS (redundant pipeline)	Isolation	Open	Open
	GV-CAS-1054	Gate	Influent supply from IPS (redundant pump system)	Isolation	Closed	Closed
	BFV-CAS-1084	Butterfly	Lime Slurry INFLUENT SUPPLY	Slurry Flow	Open, partial	Open, partial
	BFV-CAS-1082	Butterfly	Lime Slurry INFLUENT SUPPLY, Tank #1 (T-CAS-1)	Slurry Flow control to T-LAO-1	Open, partial	Open, partial
	BFV-CAS-1050	Butterfly	Lime Slurry INFLUENT SUPPLY, Tank #1 (T-CAS-1)	FIT-CAS-1051 Isolation	Open	Open
	GV-CAS-1041	Gate	Slurry Tank #2 Discharge to T-CAS-6	Isolation	Open	Open
	GV-CAS-1042	Gate	SlurryTank #2 DRAIN	Isolation	Closed	Closed
	GV-CAS-1045	Gate	Slurry Tank #1 Discharge to T-CAS-6	Isolation	Open	Open
	GV-CAS-1044	Gate	Slurry Tank #1 Drain	Isolation	Normally Closed	Normally Closed
	BV-CAS-1090	Ball	Isolation, U-CAS-101	Isolation	Open	Open
	BV-CAS-1091	Ball	Sample port manual isolation	Isolation	Closed	Closed
	GV-CAS-1046	Gate	Influent supply to T-LAO-6	Isolation	Open	Open
	BFV-CAS-1083	Butterfly	Lime Slurry INFLUENT SUPPLY, Tank #2 (T-CAS-2)	Slurry Flow control to T-LAO-2	Open, partial	Open, partial
	BFV-CAS-1040	Butterfly	Lime Slurry INFLUENT SUPPLY, Tank #2 (T-CAS-2)	FIT-CAS-1051 Isolation	Open	Open

REFERENCE	VALVE NUMBER	VALVE TYPE	DESCRIPTION	FUNCTION	NON-FREEZING ALIGNMENT	FREEZING ALIGNMENT
P&ID3AB LAGOON SYSTEM	GV-LAO-2001A	Gate, Weir	A1 outlet	Cell Level, discharge	Open, partial	Open, partial
	GV-LAO-2001B	Gate	A1 emergency by-pass outlet	Cell Level, discharge	Closed	Closed
	GV-LAO-2002	Gate	Bypass from A2 to Effluent	Discharge/isolation	Closed	Closed
	GV-LAO-2002B	Gate	A2 emergency by-pass outlet, pump connection	Recirculaton	Closed	Closed
	GV-LAO-2004	Gate	A2 Outlet	Cell Level, discharge	Open, partial	Open, partial
	GV-LAO-2005A	Gate	Bypass From A3 to Effluent	Discharge/isolation	Closed	Closed
	GV-LAO-2005B	Gate	A3 emergency by-pass outlet, pump connection	Recirculaton	Closed	Closed
	GV-LAO-2007	Gate	A3 emergency outlet to D4	Recirculaton	Closed	Closed
	GV-LAO-2014	Gate	Redundant pumping system to CAS	Isolation	Closed	Closed
	GV-LAO-2018	Gate	B3 Outlet to A2	Isolation	**Closed**	**Open**
	GV-LAO-2019	Gate	B3 Outlet to Effluent line	Isolation	Open	Closed
	GV-LAO-2023	Gate	C3 Outlet to D2	Reciculation	Closed	Closed
	GV-LAO-2020	Gate	B3 emergency by-pass outlet	Recirculaton	Closed	Closed
	GV-LAO-2027	Gate	C3 emergency by-pass outlet	Recirculaton	Closed	Closed
	GV-LAO-2024	Gate	C3 Outlet to A2	Isolation	**Closed**	**Open**
	GV-LAO-2026	Gate	C3 Outlet to Effluent Line	Isolation	Open	Closed
	GV-LAO-2028	Gate	Main influent supply from HCC	Isolation	Open, Locked	Open, Locked
REFERENCE	**VALVE NUMBER**	**VALVE TYPE**	**DESCRIPTION**	**FUNCTION**	**NON-FREEZING ALIGNMENT**	**FREEZING ALIGNMENT**
P&ID4AB INLFUENT PUMP STATION	GV-IPS-3003	Gate	West Pump Discharge Shutoff Valve	Isolation	Open	Open
	GV-IPS-3004	Gate	West Piping Flow Valve	Isolation	Open	Open
	GV-IPS-3009	Gate	East Pump Discharge Shutoff Valve	Isolation	Open	Open
	GV-IPS-3010	Gate	East Flow Piping Valve	Isolation	Open	Open
	GV-IPS-3012	Gate	Crossover Flow Diversion Valve	Flow diversion	Closed	Closed
	BV-IPS-3013	Ball	Isolation valve to Pressure switch (PS-IPS-3013)	Isolation	Open, Car Sealed	Open, Car Sealed
	BV-IPS-3014	Ball	Isolation valve to Pressure switch (PS-IPS-3014)	Isolation	Open, Car Sealed	Open, Car Sealed
REFERENCE	**VALVE NUMBER**	**VALVE TYPE**	**DESCRIPTION**	**FUNCTION**	**NON-FREEZING ALIGNMENT**	**FREEZING ALIGNMENT**
P&ID5AB AUTOMATIC SAMPLE	BV-ASB-4003	Ball, 1/4 turn	P-ASB-101 discharge to Auto-Sampler	Isolation	Open	Open
	BV-ASB-4004	Ball, 1/4 turn	ASB pump to D4	Isolation	Open	Open
	BV-ASB-4005	Ball, 1/4 turn	Manual Sample Port isolation	Service connection	Closed	Closed

REFERENCE	VALVE NUMBER	VALVE TYPE	DESCRIPTION	FUNCTION	NON-FREEZING ALIGNMENT	FREEZING ALIGNMENT
P&ID6AB WEST CAMP	BV-WCP-5006	Ball, 1/4 turn	1" Apollo ball valve, 1/4 turn, Carbon Steel, Unibody, 92-105-01	Sampling	Closed, Car Sealed	Closed, Car Sealed
	BV-WCP-5018	Ball, 1/4 turn	1" Apollo ball valve, 1/4 turn, Carbon Steel, Unibody, 92-105-01	Isolation; PRV-WCP-5013	Open	Open
	BV-WCP-5009	Ball, 1/4 turn	1" Apollo ball valve, 1/4 turn, Carbon Steel, Unibody, 92-105-01	Isolation; PVB-WCP-5015	Open	Open
	BV-WCP-5007	Ball, 1/4 turn	1" Apollo ball valve, 1/4 turn, Carbon Steel, Unibody, 92-105-01	Sampling	Closed, car Sealed	Closed, car Sealed
	BV-WCP-5008	Ball, 1/4 turn	1" Apollo ball valve, 1/4 turn, Carbon Steel, Unibody, 92-105-01	Isolation; PI-WCP-5013	Open	Open
	BFV-WCP-5009	Butterfly	Effluent Flow Control Valve	Flow Control	Open, partial	Open, partial
REFERENCE	**VALVE NUMBER**	**VALVE TYPE**	**DESCRIPTION**	**FUNCTION**	**NON-FREEZING ALIGNMENT**	**FREEZING ALIGNMENT**
P&ID7AB BPSOU SUBDRAIN PUMP SYSTEM	GV-MSD-6003	Gate	Inlet Valve to vault from under drain	Isolation	Open	Open
	GV-MSD-6004	Gate	Bypass Inlet Valve	Isolation, bypass	Closed	Closed
	GV-MSD-6020	Gate	Main Line Discharge Valve	Isolation	Open	Open
	GV-MSD-6021	Gate	Injection Line Inlet Valve	Isolation, bypass	Closed	Closed
	GV-MSD-6020	Gate	Dry vault discharge valve to HCC	Discharge/isolation	Open	Open
	GV-MSD-6034	Gate	Temp pump recirculation valve	Recirculation	Closed	Closed
	GV-MSD-6022	Gate	Bypass Discharge Valve	Isolation, bypass	Closed	Closed
	GV-MSD-6032	Gate	Stationary Pump Inlet Valve #1 (South Pump)	Pump supply	Open	Open
	GV-MSD-6033	Gate	Stationary Pump Inlet Valve #2 (North Pump)	Pump supply	Open	Open
	GV-MSD-6013	Gate	Stationary Pump Mainline Discharge Valve #1 (South Pump)	Pump discharge	Open	Open
	GV-MSD-6014	Gate	Stationary Pump Mainline Discharge Valve #2 (North Pump)	Pump discharge	Open	Open
	GV-MSD-6036	Gate	6" Mueller Gate valve	Isolation	Closed	Closed
	GV-MSD-6035	Gate	6" Mueller Gate valve	Cross over Isolation	Open	Open
	BV-MSD-6046	1/4-Turn; Ball Valve	Pig Launcher Drain Valve	Isolation	Closed	Closed
	GV-MSD-6048	Gate	8" Mueller Gate valve	Isolation; Pig Launch	Closed	Closed
	GV-MSD-6049	Gate	8" Mueller Gate valve	Isolation	Open	Open
	GV-MSD-6050	Gate	8" Mueller Gate valve	Isolation	Open	Open
	GV-MSD-6051	Gate	8" Mueller Gate valve	Isolation	Closed	Closed
	GV-MSD-6053	Gate	8" Mueller Gate valve	Isolation	Closed	Closed
	GV-MSD-6052	Gate	8" Mueller Gate valve	Isolation	Closed	Closed
	GV-MSD-6042	Gate	8" Mueller Gate valve	Cross over Isolation	Open	Open
	BFV-MSD-6043	Butterfly	MSD By-Pass Manhole	Isolation	Closed	Closed
	BFV-MSD-6045	Butterfly	8" Lineseal Butterfly Valve	Isolation/Pressurization	Closed	Closed
	BFV-MSD-6047	Butterfly	8" Lineseal Butterfly Valve	BPSOU Subdrain Discharge South Line; Pig Launcher Diversion	Open	Open
	*Additional valve alignment details for BPSOU subdrain discharge are available in SOP-39.					
REFERENCE	**VALVE NUMBER**	**VALVE TYPE**	**DESCRIPTION**	**FUNCTION**	**NON-FREEZING ALIGNMENT**	**FREEZING ALIGNMENT**
P&ID8AB BRW AREA	GV-BRW-6024	Gate	8" Mueller Gate valve	Isolation to FIT-BRW-6025	Open	Open
	GV-BRW-6029A	Gate	4" Mueller Gate valve	of PCV6028	Open	Open
	GV-BRW-6066	Gate	8" Mueller Gate valve	Isolation to FIT-BRW-6025	Open	Open
	GV-BRW-6028	Gate	8" Gate valve	Isolation flow to HCC	Open	Open
	GV-BRW-6027	Gate	To BRW-00; future development	Isolation	Closed	Closed
	GV-BRW-6060	Gate	8" Mueller Gate valve	Isolation to FIT-BRW-6061	Open	Open
	GV-BRW-6062	Gate	8" Mueller Gate valve	Isolation	Open	Open
	GV-BRW-6065	Gate	8" Mueller Gate valve	Isolation/Diversion to BRW-00	Closed	Closed
	GV-BRW-6067	Gate	8" Mueller Gate valve	Isolation; future development	Closed	Closed
	GV-BRW-6063	Gate	8" Mueller Gate valve	Isolation/diversion to FIT-BRW-6064	Closed	Closed
	GV-BRW-6070	Gate	8" Mueller Gate valve	Isolation/diversion to North Drying Bed	Closed	Closed
	GV-BRW-6071	Gate	8" Mueller Gate valve	Isolation/diversion drain to BRW-00	Closed	Closed

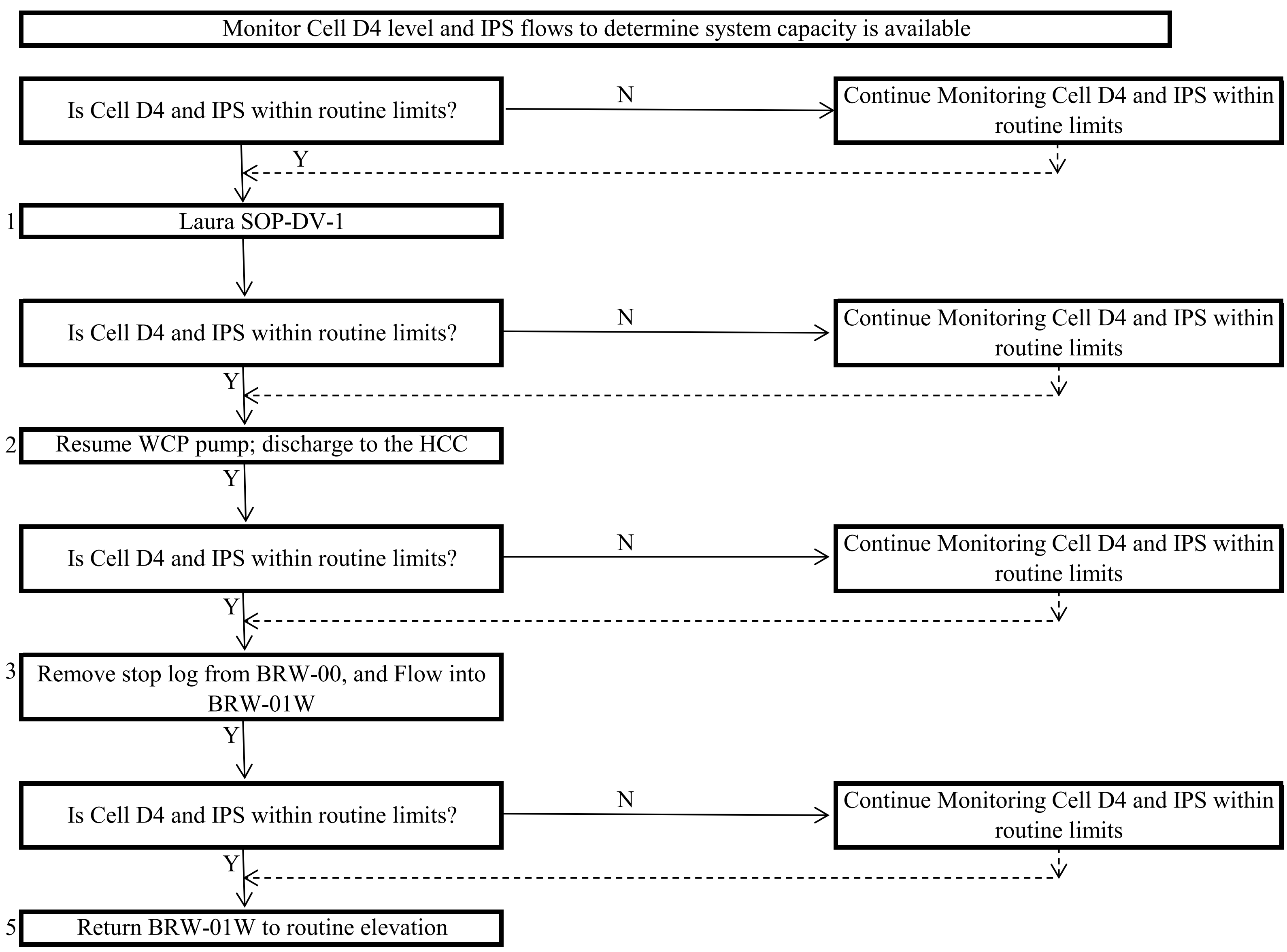
REFERENCE	VALVE NUMBER	VALVE TYPE	DESCRIPTION	FUNCTION	NON-FREEZING ALIGNMENT	FREEZING ALIGNMENT
P&ID9AB DRYING BEDS	GV-LAO-7006	Gate	6" Gate valve; service connection	Sludge service connection near A1	Closed	Closed
	GV-LAO-7005	Gate	6" Gate valve; service connection	Sludge service connection near C1	Closed	Closed
	GV-LAO-7007	Gate	6" Gate Valve	Isolation of Drying Bed cells 1 & 2	Closed	Closed
	GV-BRW-7008	Gate	6" Gate Valve	Drying Bed #3 Isolation Valve	Closed	Closed
	GV-BRW-7011	Gate	6" Gate Valve	Drying Bed #1 Isolation Valve	Closed	Closed
	GV-BRW-7012	Gate	6" Gate Valve	Drying Bed #2 Isolation Valve	Closed	Closed
	BV-BRW-7018	Ball	Ball valve, 1/4-turn	Isolation of PVB-BRW-7018	Open	Open
	BV-BRW-7019	Gate	6" Gate Valve	Auxillary sludge discharge	Closed	Closed
	BV-BRW-7020	Ball	Ball valve, 1/4-turn	Isolation of PVB-BRW-7020	Open	Open
	BV-BRW-7021	Gate	6" Gate Valve	Auxillary sludge discharge	Closed	Closed

REFERENCE	VALVE NUMBER	VALVE TYPE	DESCRIPTION	Function	NORMAL ORIENTATION	UPSET	IMMEDIATE EFFECT
	PCV-CAS-1003	Pressure Regulator	Regulates air pressure to baghouse FCV-1001 & EV-1002	Pressure reduction/control	Open	CLOSE	Loss of air supply to baghouse pulse jet
	EV-CAS-1002	Solonoid	Solonoid to baghouse pulse valve actuator	Actuation	Last position	FAIL	Loss of valve actuation
	FCV-CAS-1001	Control	Controls AIR flow to bag house pulse jet	ON/OFF	Open	CLOSE	Loss of air supply to baghouse pulse jet
	PCV-CAS-1006	Regulator	Regulates instrument air pressure to EV-1005	Pressure control	Open	CLOSE	Loss of air supply to silo knife gate
	EV-CAS-1005	Solonoid	Solonoid to FCV-1004, silo knife gate	ON/OFF	Last position	FAIL	Loss of valve actuation
	FCV-CAS-1004	Control	Controls lime flow from silo to feeder	OPEN/CLOSE	Closed	OPEN	Loss of lime feed control
	BV-CAS-1009	Ball, 1"	Air supply isolation (upstream of PS-1011)	Isolation	Open	CLOSE	Loss of air to all dowstream components
	PCV-CAS-1016	Regulator	Regulates instrument air pressure to EV-1023 & 1027	Pressure reduction/control	Open	CLOSE	Loss of air supply to screw conveyor discharge valves
	EV-CAS-1025	Solonoid	Solonoid to valve actuator FCV-1024	ON/OFF	Closed	FAIL	
	FCV-CAS-1022	Control	Controls lime flow from SC-LAO-1 to SLURRY TANK #2	OPEN/CLOSE	Closed	OPEN	Lime feed to Tank #2
	EV-CAS-1023	Solonoid	Solonoid to valve actuator FCV-1022	ON/OFF	Closed	FAIL	Loss of valve actuation
	FCV-CAS-1026	Control	Controls lime flow from SC-LAO-1 to SLURRY MIX TANK #1	OPEN/CLOSE	Closed	OPEN	Lime feed to Tank #1
P&ID1AB	PCV-CAS-1018	Regulator	Regulates instrument air pressure to EV-1025 & 1028	Pressure reduction/control	Open, partial	OPEN	Loss of pressure reduction
	EV-CAS-1027	Solonoid	Solonoid to valve actuator FCV-1026	ON/OFF	Open	CLOSE	Loss primary lime feed to Mixing tank #1
	FCV-CAS-1024	Control	Controls lime flow from SC-LAO-2 to SLURRY MIX TANK #1	OPEN/CLOSE	Closed	Secondary lime feed system is not functional during normal operation.	
	EV-CAS-1029	Solonoid	Solonoid to valve actuator FCV-1028	ON/OFF	Closed	Secondary lime feed system is not functional during normal operation.	
	FCV-CAS-1028	Control	Controls lime flow from SC-LAO-2 to SLURRY MIX TANK #2	OPEN/CLOSE	Closed	Secondary lime feed system is not functional during normal operation.	
	BV-CAS-1013	Ball, 1"	AC-LAO-101 isolation	Isolation	Open	CLOSE	Loss of air supply from AC-LAO-101
	BV-CAS-1014	Ball, 3/4"	AC-LAO-201 isolation	Isolation	Closed	CLOSE	Loss of air supply from AC-LAO-201
	BV-CAS-1007	Ball, 3/4"	Instrument air service connection	Isolation/Service connection	Closed	OPEN	Air to atm, or connected device
	BV-CAS-1010	Ball, 3/4"	Instrument air service connection	Service connection	Closed	OPEN	Air to atm, or connected device
	BV-CAS-1012	Ball, 1"	Air supply isolation (downstream of PS-1011)	Isolation	Open	CLOSE	Loss of air to all dowstream components
	BV-CAS-1015	Ball, 1"	Air supply isolation to primary lime feed system	Isolation	Open	CLOSE	Loss of air supply to FCV 1026 & 1022
	BV-CAS-1017	Ball, 1"	Air supply isolation to secondary lime feed system	Isolation	Closed	Secondary lime feed system is not functional during normal operation.	
	BV-CAS-1008	Ball, 3/4"	Instrument air service connection	Isolation	Closed	OPEN	Air to atm, or connected device
REFERENCE	VALVE NUMBER	VALVE TYPE	DESCRIPTION	Function	NORMAL ORIENTATION	UPSET	IMMEDIATE EFFECT
	GV- CAS-1044	Gate	Slurry Tank #1 DRAIN	Isolation	Closed	OPEN	Drain slurry tank #1 to C1
	GV-CAS-1041	Gate	Slurry Tank #2 Discharge to T-LAO-6	Isolation	Open	CLOSE	Fluid level rise in Slurry Tank #2
	BFV-CAS-1040	Butterfly	Lime Slurry INFLUENT SUPPLY, Tank #2 (T-LAO-2)	Slurry Flow control to T-LAO-2	Open, partial	CLOSE	Loss of slurry make-up water in T-LAO-2
	GV-CAS-1042	Gate	SlurryTank #2 DRAIN	Slurry Flow control to T-CAS-103	Closed	OPEN	Drain slurry tank #2 to C1
	BFV-CAS-1050	Butterfly	Lime Slurry INFLUENT SUPPLY, Tank #1 (T-LAO-1)	Slurry Flow control to T-LAO-1	Open, partial	CLOSE	Loss of slurry make-up water in T-LAO-1
	GV-CAS-1045	Gate	Slurry Tank #1 Discharge to T-LAO-6	Isolation	Open	CLOSE	Fluid level rise in Slurry Tank #1
P&ID2AB	GVW-CAS-1056	Gate, Weir	Effluent to A- cells	Regulation	Open	CLOSE	Loss of flow to A-cells
	GVW-CAS-1057	Gate, Weir	Effluent to B-cells	Regulation	Open	CLOSE	Loss of flow to B-cells
	GVW-CAS-1058	Gate, Weir	Effluent to C-cells	Regulation	Open	CLOSE	Loss of flow to C-cells
	GV-CAS-1052	Gate	Influent supply from IPS	Isolation	Open	CLOSE	Loss of influent flow to CAS
	GV-CAS-1053	Gate	Influent supply from IPS (redundant pipeline)	Isolation	Open	CLOSE	Flow from contingency pond into wet vault
	GV-CAS-1054	Gate	Influent supply from IPS (redundant pump system)	Isolation	Closed	OPEN	During routine operations, open valve would recirc untreated water back to D4
	GV-CAS-1046	Gate	Influent supply to T-LAO-6	Isolation	Open	CLOSE	Severe reduction in treated flow
REFERENCE	VALVE NUMBER	VALVE TYPE	DESCRIPTION	Function	NORMAL ORIENTATION	UPSET	IMMEDIATE EFFECT
	GV-LAO-2001A	Gate, Weir	A1 outlet	Cell Level, discharge	Open, partial	CLOSE	Lose of flow to A2, A3 effluent
	GV-LAO-2001B	Gate	A1 emergency by-pass outlet	Cell Level, discharge	Closed	OPEN	Discharge from A1 to A2
	GVW-LAO-2004	Gate, Weir	A2 Outlet	Cell Level, discharge	Open, partial	CLOSE	Lose of flow to A3
	GVW-LAO-2007	Gate, Weir	A3 recirc to D4	Recirculaton	Closed	OPEN	Allow for to D4, no flow to SBC
	GV-LAO-2002	Gate	Bypass from A2 to Effluent	Recirculaton	Closed	OPEN	Allow from to effluent
	GV-LAO-2005A	Gate	Bypass From A3 to Effluent	Recirculaton	Closed	OPEN	Allow from to effluent
	GV-LAO-2005B	Gate	A3 emergency by-pass outlet	Recirculaton	Closed	OPEN	Treated Effluent flow to grade, back to A3
	GVW-LAO-2010	Gate, Weir	D2 outlet to D3	Recirculaton	Open, partial	CLOSE	Loss of dischrage from D2
P&ID3AB	GVW-LAO-2012	Gate, Weir	D3 outlet to D4	Recirculaton	Open, partial	CLOSE	Loss of dischrage from D3
	GV-LAO-2014	Gate	Redundant pumping system to CAS	Isolation	Closed	OPEN	Must implement redundant D4 pump system
	GVW-LAO-2019	Gate, Weir	B3 outlet to Effluent	Cell Level, discharge	Open	CLOSE	Loss of flow to effluent
	GVW-LAO-2018	Gate, Weir	B3 outlet to A2 (recirc.)	Recirculaton	Closed	OPEN	Allow flow to A2
	GV-LAO-2020	Gate	B3 emergency by-pass outlet	Recirculaton	Closed	OPEN	Must implement emergency pumping system
	GVW-LAO-2023	Gate, Weir	C3 outlet to D2 (recirc.)	Recirculaton	Closed	OPEN	Allow flow into D2
	GVW-LAO-2024	Gate, Weir	C3 outlet to A2 (recirc.)	Recirculaton	Closed	OPEN	Allow flow to A2
	GVW-LAO-2026	Gate, Weir	C3 outlet to Effluent	Cell Level, discharge	Open, partial	CLOSE	Loss of flow to effluent
	GV-LAO-2027	Gate	C3 emergency by-pass outlet	Recirculaton	Closed	OPEN	Must implement emergency pumping system
REFERENCE	VALVE NUMBER	VALVE TYPE	DESCRIPTION	Function	NORMAL ORIENTATION	UPSET	IMMEDIATE EFFECT
	OS-IPS-3000	Outlet stucture	West Vault Inlet Stop Log Structure	Isolation	Open	CLOSE	Prevent flow into Vault-D41
	FCV-IPS-3013	Swing Check	West Pump Discharge Check Valve	Equipment protection; backflow	Closed	OPEN	Allow backflow discharge through pump
	GV-IPS-3003	Gate	West Pump Discharge Shutoff Valve	Isolation	Open	CLOSE	Prevent flow discharge
	GV-IPS-3004	Gate	West Piping Flow Valve	Isolation	Open	CLOSE	Prevent flow discharge
	OS-IPS-3006	Gate	East Vault Inlet Stop Log Structure	Isolation	Open	CLOSE	Prevent flow into Vault-D42
P&ID4AB	FCV-IPS-3014	Swing Check	East Pump Discharge Check Valve	Equipment protection; backflow	Closed	OPEN	Allow backflow discharge through pump
	GV-IPS-3009	Gate	East Pump Discharge Shutoff Valve	Isolation	Open	CLOSE	Prevent flow discharge
	GV-IPS-3010	Gate	East Flow Piping Valve	Isolation	Open	CLOSE	Prevent flow discharge
	GV-IPS-3012	Gate	Crossover Flow Diversion Valve	Flow diversion	Closed	OPEN	Allow flow diversion
	BV-IPS-3013	Ball	Isolation valve to Pressure switch (PS-IPS-3013)	Isolation	Open	CLOSE	Pressure switch isolated from system pressure
	BV-IPS-3014	Ball	Isolation valve to Pressure switch (PS-IPS-3014)	Isolation	Open	CLOSE	Pressure switch isolated from system pressure
REFERENCE	VALVE NUMBER	VALVE TYPE	DESCRIPTION	Function	NORMAL ORIENTATION	UPSET	IMMEDIATE EFFECT
	BV-ASB-4003	Ball, 1/4 turn	P-ASB-101 discharge to Auto-Sampler	Isolation	Open	CLOSE	Loss of flow from pump discharge
P&ID5AB	BV-ASB-4004	Ball, 1/4 turn	ASB pump to D4	Isolation	Open	CLOSE	Loss of flow to AIT-ASB-4005
	BV-ASB-4006	Ball, 1/4 turn	Sample port manual isolation	Service connection	Closed	OPEN	Effluent flow to grade

REFERENCE	VALVE NUMBER	VALVE TYPE	DESCRIPTION	Function	NORMAL ORIENTATION	UPSET	IMMEDIATE EFFECT
P&ID6AB	BFV-WCP-5009	Butterfly	Effluent Flow Control Valve	Flow Control	Open, partial	CLOSE	Prevent flow discharge
	PVB-WCP-5015	Vacuum Relief	1" Pressure & Vacuum Breaker	Relieves pressure @ start up, & vacuum on shutdown	Closed	OPEN	Drain back into well
	BV-WCP-5006	Ball, 1/4 turn	1" Apollo ball valve, 1/4 turn, Carbon Steel, Unibody, 92-105-01	Sampling	Closed	OPEN	Untreated GW discharge
	PRV-WCP-5013	Spring over diaphram	Pressure relief valve	Pressure Relief	Open, partial	CLOSE	Prevent flow discharge
	BV-WCP-5018	Ball, 1/4 turn	1" Apollo ball valve, 1/4 turn, Carbon Steel, Unibody, 92-105-01	Isolation; PRV-WCP-5013	Open	CLOSE	Prevent pressure revief from PRV-WCP-5013
	BV-WCP-5009	Ball, 1/4 turn	1" Apollo ball valve, 1/4 turn, Carbon Steel, Unibody, 92-105-01	Isolation; PVB-WCP-5015	Open	CLOSE	Prevent pressure/vacuum revief from PVB-WCP-5015
	BV-WCP-5007	Ball, 1/4 turn	1" Apollo ball valve, 1/4 turn, Carbon Steel, Unibody, 92-105-01	Sampling	Closed	OPEN	Untreated GW discharge
	BV-WCP-5014	Ball, 1/4 turn	1" Apollo ball valve, 1/4 turn, Carbon Steel, Unibody, 92-105-01	Isolation; PI-WCP-5013	Open	CLOSE	No pressure indication at PI-WCP-5013
REFERENCE	VALVE NUMBER	VALVE TYPE	DESCRIPTION	Function	NORMAL ORIENTATION	UPSET	IMMEDIATE EFFECT
P&ID7AB	GV-MSD-6003	Gate	Inlet Valve to vault from under drain	Isolation	Open	CLOSE	BPSOU subdrain flow stopped
	GV-MSD-6004	Gate	Bypass Inlet Valve	Isolation, bypass	Closed	OPEN	By pass BPSOU vault pump system
	GV-MSD-6020	Gate	Main Line Discharge Valve	Isolation	Open	CLOSE	Prevent flow discharge
	GV-MSD-6021	Gate	Injection Line Inlet Valve	Isolation, bypass	Closed	CLOSE	Re-circulation from BPSOU vault pumps to wet vault
	GV-MSD-6017	Gate	Temp Pump Discharge Valve	Jetting, injection	Open	CLOSE	Prevent flow discharge
	GV-MSD-6020	Gate	Dry vault discharge valve to HCC	Discharge/isolation	Open	CLOSE	Prevent flow discharge
	GV-MSD-6034	Gate	Temp pump recirculation valve	Recirculation	Closed	OPEN	Allow water recirc to wet vault
	GV-MSD-6022	Gate	Bypass Discharge Valve	Isolation, bypass	Closed	OPEN	Discharge from temp pump
	GV-MSD-6032	Gate	Stationary Pump Inlet Valve #1 (South Pump)	Pump supply	Open	CLOSE	Prevent flow into P-MSD-S
	GV-MSD-6033	Gate	Stationary Pump Inlet Valve #2 (North Pump)	Pump supply	Open	CLOSE	Prevent flow into P-MSD-N
	GV-MSD-6013	Gate	Stationary Pump Mainline Discharge Valve #1 (South Pump)	Pump discharge	Open	CLOSE	Prevent flow discharge
	GV-MSD-6014	Gate	Stationary Pump Mainline Discharge Valve #2 (North Pump)	Pump discharge	Open	CLOSE	Prevent flow discharge
	FCV-MSD-6030	Swing Check	Stationary Pump Discharge Check Valve #1 (South Pump)	Isolation	Closed	OPEN	Allow flow discharge
	FCV-MSD-6031	Swing Check	Stationary Pump Discharge Check Valve #2 (North Pump)	Isolation	Closed	OPEN	Allow flow discharge
	GV-MSD-6036	Gate	6" Mueller Gate valve	Isolation	Closed	OPEN	Flow Divertion to North BPSOU Subdrain Effluent Line
	GV-MSD-6035	Gate	6" Mueller Gate valve	Cross over Isolation	Open	NA	Flow Divertion to South BPSOU Subdrain Effluent Line
	BFV-MSD-6043	Butterfly	MSD By-Pass Manhole	Isolation	Closed	OPEN	Loss of containment from BPSOU Subdrain South Effluent Line
	BFV-MSD-6045	Butterfly	8" Lineseal Butterfly Valve	Isolation/Pressurization	Closed	NA	Allow pressurization/motive fluid ot PL-MSD-6100
	BFV-MSD-6047	Butterfly	8" Lineseal Butterfly Valve	BPSOU Subdrain Discharge South Line; Pig Launcher Diversion	Open		
	BV-MSD-6046	1/4-Turn Ball Valve	Pig Launcher Drain Valve	Isolation	Closed	OPEN	Loss of Pig Launcher Motive Fluid
	GV-MSD-6048	Gate	8" Mueller Gate valve	Isolation; Pig Launch	Closed	OPEN	Pig/swap launch from PL-MSD-6100
	GV-MSD-6049	Gate	8" Mueller Gate valve	Isolation	Open	NA	Loss of flow in BPSOU Subdrain Discharge South line
	GV-MSD-6050	Gate	8" Mueller Gate valve	Isolation	Open	NA	Loss of flow in BPSOU Subdrain Discharge North line
	GV-MSD-6051	Gate	8" Mueller Gate valve	Isolation	Closed	OPEN	Potential loss of containment when opened while BPSOU Subdrain-South line pressurized
	GV-MSD-6053	Gate	8" Mueller Gate valve	Isolation	Closed	OPEN	Potential loss of containment when opened while BPSOU Subdrain-North line pressurized
	GV-MSD-6052	Gate	8" Mueller Gate valve	Isolation	Open	CLOSE	Loss of flow in BPSOU Subdrain Discharge-North Line
	GV-MSD-6042	Gate	8" Mueller Gate valve	Cross over Isolation	Open	NA	Flow Divertion from South BPSOU Subdrain Discharge Effluent Line
REFERENCE	VALVE NUMBER	VALVE TYPE	DESCRIPTION	Function	NORMAL ORIENTATION	UPSET	IMMEDIATE EFFECT
P&ID8AB	GV-BRW-6024	Gate	8" Mueller Gate valve	Isolation to FIT-BRW-6025	Open	CLOSE	Loss of BPSOU Subdrain discharge flow
	GV-BRW-6029A	Gate	To cell D4 via HCC; isolation of PCV6028	Isolation	Open	CLOSE	Loss of alternate flow path to HCC around HV-BRW-6028
	GV-BRW-6066	Gate	8" Mueller Gate valve	Isolation to FIT-BRW-6025	Open	CLOSE	Loss of BPSOU Subdrain discharge flow
	GV-BRW-6028	Gate	8" Gate valve	Isolation flow to HCC	Open	CLOSE	Loss of primary flow path from BPSOU Subdrain discharge to HCC
	GV-BRW-6027	Gate	To BRW-00; future development	Isolation	Closed	OPEN	No effect, Pipeline is blind flanged
	GV-BRW-6060	Gate	8" Mueller Gate valve	Isolation to FIT-BRW-6061	Open	CLOSE	Loss of BPSOU Subdrain discharge flow
	GV-BRW-6062	Gate	8" Mueller Gate valve	Isolation	Open	CLOSE	Loss of BPSOU Subdrain discharge flow
	GV-BRW-6066	Gate	8" Mueller Gate valve	Isolation	Open	CLOSE	Loss of BPSOU Subdrain discharge flow
	GV-BRW-6067	Gate	To BRW-00; future development	Isolation	Closed	OPEN	No effect, Pipeline is blind flanged
	GV-BRW-6063	Gate	8" Mueller Gate valve	Isolation FIT-BRW-6064	Closed	OPEN	Dicharge to BRW-00; Measured through BRW-FIT-6064
	FCV-BRW-6029C	Swing Check	Backflow prevention; Into BPSOU Subdrain-North Line	Backflow Prevention	Closed	OPEN	Flow diverted to PRV-MSD-6029B
	FCV-BRW-6029D	Swing Check	Backflow prevention; Into BPSOU Subdrain-South Line	Backflow Prevention	Closed	OPEN	Flow diverted to PRV-MSD-6029B
	PRV-BRW-6029B	Spring over diaphram	Pressure relief valve	Pressure Relief	Closed	Open; partial	Relief flow to HCC
REFERENCE	VALVE NUMBER	VALVE TYPE	DESCRIPTION	Function	NORMAL ORIENTATION	UPSET	IMMEDIATE EFFECT
P&ID9AB	GV-LAO-7005	Gate	6" Gate valve; service connection	Sludge service connection near A1	Closed	Sludge removal associated tasks are used intermittently, during periodic lagoon maintenance tasks. Lines assocaited with the systems will only contain material during scheduled maintenance tasks.	
	GV-LAO-7006	Gate	6" Gate valve; service connection	Sludge service connection near C1	Closed		
	GV-LAO-7007	Gate	6" Gate Valve	Isolation of Drying Bed cells 1 & 2	Open		
	GV-BRW-7008	Gate	6" Gate Valve	Drying Bed #3 Isolation Valve	Closed		
	GV-BRW-7011	Gate	6" Gate Valve	Drying Bed #1 Isolation Valve	Open		
	GV-BRW-7012	Gate	6" Gate Valve	Drying Bed #2 Isolation Valve	Closed		
	BV-BRW-7019	Ball	Ball valve, 1/4-turn	Isolation of PVB-BRW-7018	Open		
	OS-BRW-7010	Weir, outlet structure	Outlet structure from drying bed #3 to BRW-01W	Decant water from drying bed cell #3	Open		
	OS-BRW-7014	Weir, outlet structure	Outlet structure from drying bed #2 to BRW-01W	Decant water from drying bed cell #2	Open		
	OS-BRW-7016	Weir, outlet structure	Outlet structure from drying bed #1 to BRW-01W	Decant water from drying bed cell #1	Open		

Redistribution of Retained Flow

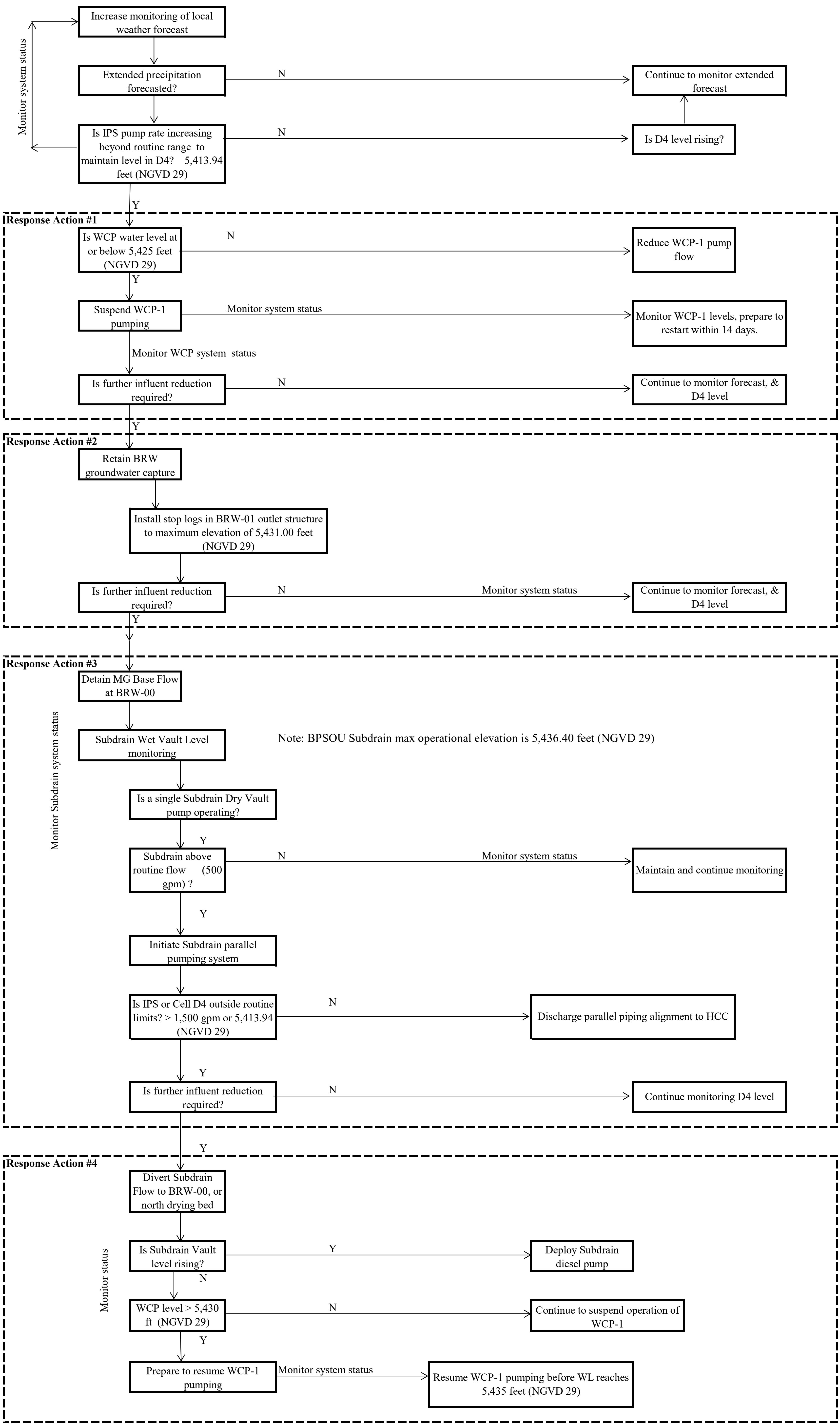
After IPS flows and levels have stabilized to routine limits, retained flow should be redistributed to the HCC, treatment, and effluent release to Silver Bow Creek.



Wet-Weather Contingency Decision Guide

During period of extended wet weather, or unseasonably warm winter weather periods the following decision guide can be implemented to assist operations with mitigation strategies.

Typical wet weather season: April - June; September - October



Appendix G
Device Register and Supplier Contact Information

Butte Treatment Lagoons Treatment System, Site Contact Information

Federal Regulatory Agency, Environmental

EPA	**Office (406)**	**Mobile (406)**
Nikia Greene - Remedial Project Manager	457-5019	452-3703

State Regulatory Agency, Environmental

Montana DEQ	**Office (406)**	**Mobile (406)**
Daryl Reed - State Project Officer	444-6433	459-8569

Responsible Party, System Owner

Atlantic Richfield	**Office**	**Mobile**
Chris Greco,US Mining Assets Operations Manager	312-809-4224	630-299-9743
Garrick Milkeris, HSSE & C Advisor	331-239-9521	630-803-7808
	(406)	(406)
Lindy Hanson, Deputy Operations Manager	723-1810	490-4473
Josh Bryson - Liability Manager, BPSOU - AA	723-1834	565-7164
Dave Griffis - Operations Project Manager, BTL - AA	723-1820	490-4210
David Gratson, Quality Assurance Manager		(505)-660-8521

System Operations, Maintenance and Monitoring

Pioneer Technical Services, Inc. - OM&M	**Office (406)**	**Mobile (406)**
Brad Archibald, CEO	497-8019	490-3032
Shawn Bisch, Project Manager	723-1930	498-3923
Tara Schleeman, Safety Manager - IA, SPA HSSE	497-8026	490-8272
Scott Sampson - SPA IM	497-8022	490-1253
Brad Hollamon, System Lead Operator - PIC	723-1882	490-7876
Heather Brown, Quality Assurance Officer	782-8047	939-0475

Site Operators - Pioneer Technical

Site Visitors - TREC, MBMG, USFWP, CFWEP

Subcontractors - Listed in Appendices

AA - Area Authority
HSSE - Health Safety Security Enviroment
IA - Issuing Authority
IM - Intergrity Management
PA - Performing Authority
PIC - Person in Charge
SPA - Single Point of Accountability

Site visitors and subcontractors must check in with PIC upon site arrival

Emergency callout information is provided in the Site Specific Health and Safety Plan

BTL Suppliers and Contact Information

Item	Lime order contact information:	Generator Maintenace	SCADA/PLC	Wonderware/HMI	IPS Pumps	Subdrain Pumps
Contact	Marla Yuhas	Mike Greene	Joe Mullaney	Steve Neal	Mike Fisher	Montana Electric Motors
Alternate Contact						
Phone - Office	801-716-2668	800-955-3795	406-532-2240	801-492-1000	406-495-1335	406-494-1645
Phone - Mobile		406-672-1741	406-560-7153	801-361-9078	406-461-5384	
E-mail Address	icorderdesk@graymont.com	mikeg@twegen.com	joseph.mullaney@hdrinc.com	steve.neal@wonderwarewest.com	Andy.Fitzhugh@Xyleminc.com	
Business	Graymont Western US Inc.	Generac Power Systems Inc	**HDR**	**Wonderware West**	Xylem	Montana Electric Motors
Street/Physical Location	"Indian Creek Plant"	Service Center	465 East Galena	623 West 900 North	3860 Helberg Drive	300 Holmes Ave.
Steet Address	P.O. Box 550 (4.12 miles west Indian Creek Road)	636 Logan Ave.	465 East Galena	623 West 900 North	3860 Helberg Drive	300 Holmes Ave.
City/State	Townsend, Montana 59644	Billings, MT 59105	Butte, MT 59701	American Fork, UT 84003	Helena, Mt 59602	Butte, MT 59701
Corporate Office	Graymont Western US Inc.			www.wonderwarewest.com	Xylem Global Headquarters	
Street	3950 South 700 East				1 International Drive	
City/State	Salt Lake City, Utah 84107				Rye Brook, NY 10573	

Item	Lime Feeder	Air Compressors	H2S System	Dredge System	Silo Baghouse	Laboratory Analytical Services
Contact	Larry Ferrell	Mike W/ Tech Support		Eric Lillberg, Applications Engineer	Larry Ferrell	Jennifer Anderson
Alternate Contact	Brian Higgins				Brian Higgins	
Phone - Office	800-558-0184	1-406-254-1200	(713) 559-9200	406-365-3393, 800-442-7867	800-558-0184	612-607-6436
Phone - Mobile				406-299-2824		
E-mail Address	larry.ferrell@ sarinc.com				larry.ferrell@ sarinc.com	Jennifer.Anderson@pacelabs.com
Business	SchenkAccuRate	Energy Equipment and Supply	Detcon Inc.	SRS Crisafulli, Inc.	SchenkAccuRate	Pace Analytical Services, Inc.
Street/Physical Location	746 E. Milwaukee St.	1919 Lampman Dr	3200 Research Forest Dr	1610 Crisafulli Drive	746 E. Milwaukee St.	1700 Elm Street, Suite 200
City/State	Whitewater, WI. 53190	Billings, MT, US, 59102	The Woodlands, TX	Glendive, MT 59330	Whitewater, WI. 53190	Minneapolis, MN 55414

Item	System Operation	System Owner; Resposible Party	Lagoon Particulate Control Structures	
Contact	Shawn Bisch, Project Manager	Dave Griffis, Operations Project Manager		
Alternate Contact	Brad Hollamon, Lead Operator	Josh Bryson, Liability Manager		
Phone - Office	406-723-1945	406-723-1820; 406-723-1834		Refer to Section 1.4 of the Routine OM&M Plan for additional contact information related to system operation and emergency services contact information
Phone - Mobile	Shawn: 406-498-3923; Brad: 406-490-7678	406-490-4210; 406-565-7164		
E-mail Address	SBisch@pioneer-technical.com	Dave.Griffis@BP.com		
Business	Pioneer Technical Services, Inc.	Atlantic Richfield Company	Mackworth Enviro	
Street/Physical Location	1101 South Montana Street	317 Anaconda Rd.		
City/State	Butte, MT 59701	Butte, MT 59701		

Appendix H
Document Revision Summary