Summer 8-4-2022

Final BPSOU Insufficiently Reclaimed Sites Colorado Dump-West Lot Remedial Action Work Plan (RAWP)

Pioneer Technical Services, Inc.

Atlantic Richfield Company

317 Anaconda Road
Butte MT 59701

Mike Mc Anulty
Liability Manager

Direct (406) 782-9964
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August 4, 2022

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DEQ, Legal Counsel
P.O. Box 200901
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RE: Butte Priority Soils Operable Unit (BPSOU) Final Insufficiently Reclaimed Sites Colorado Dump – West Lot Remedial Action Work Plan (RAWP)

Agency Representatives:

I am writing to you on behalf of Atlantic Richfield Company to distribute the Butte Priority Soils Operable Unit (BPSOU) Final Insufficiently Reclaimed Sites Colorado Dump – West Lot Remedial Action Work Plan (RAWP) per the Agency approval letter dated August 2, 2022. The work plan including associated attachments may be downloaded at the following link:

https://pioneertechnicalservices.sharepoint.com/:f:/s/submitted/EogRh1lStk5KgeRQ_K5ZtpIBRcfFzWFUmD5pVgeDr8lYVA.

If you have any questions or comments, please call me at (907) 355-3914.

Sincerely,

Mike McAnulty

Mike Mc Anulty
Liability Manager
Remediation Management Services Company
An affiliate of **Atlantic Richfield Company**

Atlantic Richfield Company

317 Anaconda Road
Butte MT 59701
Direct (406) 782-9964
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Jim Ford / NRDP - email
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Karen Helfrich / Pioneer – email
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Randa Colling / Pioneer – email
Ian Magruder/ CTEC- email
CTEC of Butte – email
Scott Juskiewicz / Montana Tech – email

File: MiningSharePoint@bp.com - email
BPSOU SharePoint - upload

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

Final

BPSOU Insufficiently Reclaimed Sites
Colorado Dump-West Lot
Remedial Action Work Plan (RAWP)

Atlantic Richfield Company

July 2022

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8, MONTANA OFFICE
FEDERAL BUILDING, 10 West 15TH Street, Suite 3200
Helena, MT 59626-0096
Phone 866-457-2690
www.epa.gov/region8

Ref: 8MO

August 2, 2022

Mr. Mike McAnulty
Liability Manager
Atlantic Richfield Company
317 Anaconda Road
Butte, Montana 59701

Re: Approval letter for the Butte Priority Soils Operable Unit (BPSOU) Revised Draft Final Insufficiently Reclaimed Sites Colorado Dump – West Lot Remedial Action Work Plan (RAWP) (dated July 29, 2022)

Dear Mike:

The U. S. Environmental Protection Agency (EPA), in consultation with the Montana Department of Environmental Quality (DEQ), is approving the revised *Draft Final Insufficiently Reclaimed Sites Colorado Dump – West Lot Remedial Action Work Plan (RAWP) (dated July 29, 2022).* Please distribute this document as final.

If you have any questions or concerns, please call me at (406) 457-5019.

Sincerely,

NIKIA GREENE

Digitally signed by NIKIA GREENE
Date: 2022.08.02 12:35:44 -06'00'

Nikia Greene
Remedial Project Manager

cc: (email only)
Butte File
Matt Dorrington, DEQ
Daryl Reed; DEQ

Will George; DEQ
Jon Morgan; DEQ counsel
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Harley Harris; NRDP
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Ian Magruder; CTEC (Tech Advisor)
Janice Hogan; CTEC
Marissa Stockton; Rosendale State Director
Kristi Carroll; Montana Tech Library

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

Final

BPSOU Insufficiently Reclaimed Sites
Colorado Dump-West Lot
Remedial Action Work Plan (RAWP)

Prepared for:

Atlantic Richfield Company
317 Anaconda Road
Butte, Montana 59701

Prepared by:

Pioneer Technical Services, Inc.
1101 S. Montana Street
Butte, Montana 59701

July 2022

TABLE OF CONTENTS

LIST OF APPENDICES

REVISION SUMMARY

Revision	Author	Version	Description of Change	Date
0	Drew Conrady	Draft	Issued for Internal Review	6/10/2022
1	Drew Conrady	Draft Final	Issued for Agency Review	07/13/2022
2	Drew Conrady	Final	Issued for Agency Review	07/29/2022

1.0 INTRODUCTION AND PURPOSE

The purpose of this Butte Priority Soils Operable Unit (BPSOU) Insufficiently Reclaimed (IR) Sites Remedial Action Work Plan (RAWP) is to describe the work that will take place at the Colorado Dump – West Lot within the BPSOU (referred to herein as Colorado Dump Site, Colorado Dump – West Lot or Site).

The purpose of this Remedial Action (RA) is to mitigate soil erosion issues and provide remediation measures to prevent potentially impacted sediments from entering the existing storm water infrastructure. Tasks associated with the RA include installing manholes/inlets and subsurface storm water piping, site grading, constructing a storm channel, and installing a gravel cap. The Colorado Dump Site will be completed in a single phase with individual tasks scheduled to prevent work-flow conflicts. Appendix A of this RAWP contains the Construction Drawings, Appendix B contains the Technical Specifications, and Appendix C contains the hydrology design report.

2.0 BACKGROUND

The Site was evaluated as detailed in the *Butte Priority Soils Operable Unit (BPSOU) Insufficiently Reclaimed Sites – Field Sampling Plan (FSP) BRES No. 104 – Colorado Dump* (Atlantic Richfield Company, 2021) to determine site reclamation requirements. The 2021 Site investigation was completed on December 7, 2021. Site sampling and site evaluation activities are summarized in the *2021 IR Sites Sampling BRES No. 104 Site Evaluation Summary Report* (Atlantic Richfield Company, 2022). Site sampling results from this area exceeded storm water action levels, and the site sedimentation analysis determined sediment and storm water are translocated to the adjacent roadway.

This RAWP describes the work that will take place at the Colorado Dump Site. Temporary Best Management Practices (BMPs) were installed at the Site in 2021 to mitigate erosion of sediments and support related remedial activities implemented under the Residential Metals Abatement Program (RMAP) scope of work. The Colorado Dump – West Lot RA will include storm water mitigation measures, site grading, and capping. Site remediation will be completed using various measures such as site grading, gravel cover, storm channels, and inlet/manhole and storm water piping installation.

2.1 Site Location and Work Plan

The Colorado Dump – West Lot is west of the AWARE Early Head Start daycare center on East Mercury Street in the city of Butte, Montana, 59701. Most of the Site is a barren, non-vegetated area currently used for vehicle parking, and there is an alleyway that runs north from East Park Street toward East Mercury Street. Storm water flows south from the alleyway and parking area, and deposits sediments directly onto East Mercury Street. The proposed work will involve the following:

- Installing two new manhole/drop inlets at the Site for storm water collection.

- Installing a storm water channel to capture and direct storm water run-on from adjacent property to the western proposed manhole/inlets.
- Installing subsurface piping to tie the western manhole/inlet (MH-1) into the eastern manhole/inlet (MH-2).
- Tie-in MH-2 discharge piping to existing stormwater infrastructure south of the site.
- Grading the Site to promote storm water flow to MH-2.
- Installing an engineered base course cap to the West Lot area and alleyway.

The entire Site will be covered by a 12-inch engineered base course cap, and one riprap storm water channel will be installed to capture and convey storm water and to prevent future erosion. The proposed storm water channel is designed for a 25-year, 24-hour Soil Conservation Service (SCS), Type I storm event (refer to Appendix C for design details).

3.0 DESCRIPTION OF RESPONSIBILITIES

Primary responsibilities for execution of the project are described in the sections below.

3.1 Roles and Responsibilities

Agency Oversight

Regulatory agency oversight is provided by U.S. Environmental Protection Agency (EPA) Region 8 and Montana Department of Environmental Quality (DEQ). EPA is the lead regulatory agency and acts in consultation with the DEQ. The EPA Remedial Project Manager and Montana DEQ Project Officer, referred to collectively as the Agencies, are responsible for ensuring remedial work is completed as described in the approved work plan. Agency oversight personnel will observe implementation of remedial activities as appropriate.

Atlantic Richfield Company - Liability Manager

The Liability Manager monitors the performance of the Prime Contractor and interfaces with the contractor project manager, Butte-Silver Bow, and Agencies.

Pioneer Technical Services, Inc. – Prime Contractor

Pioneer Technical Services, Inc. (Pioneer) will serve as the Prime Contractor of remedial services and will be responsible for completing the work described in this RAWP. Pioneer is responsible for project management, field/construction oversight of subcontractor personnel, and project reporting. Pioneer will provide oversight to complete the work and will notify Atlantic Richfield Company (Atlantic Richfield) and Agency oversight personnel before initiating and completing RA. Pioneer construction oversight representative will interface directly with the subcontractor foreman regarding implementation of the work and will communicate project status to the project manager.

Subcontractor

The subcontractor will provide a foreman/supervisor, safety professional, and all other labor, equipment, and materials necessary to complete the work detailed in this RAWP and associated construction drawings.

3.2 Safety Considerations

Safety concerns that could affect the work tasks include the following:

- Weather.
- Working around uneven/unstable walking surfaces.
- Working around traffic.
- Working around heavy equipment.
- Ground disturbance.
- Working around and under overhead utilities.
- Simultaneous operations (SIMOPs).

To minimize the potential for harm to personnel, equipment, and/or the environment, the work will be reviewed and the appropriate Control of Work (CoW) items such as Daily Toolbox Meeting Records, Hazard Identification (HAZID), Task Risk Assessments (TRAs), and any applicable permits will be completed prior to initiating any tasks.

Required personal protective equipment (PPE) will include work gloves, hardhats, safety glasses with side shields, long-sleeved shirts, high visibility outer wear, and steel-toed boots. The Contractor will be responsible for developing an Atlantic Richfield-approved Site-Specific Health and Safety Plan (SSHASP) that identifies the risks/hazards and appropriate control measures associated with completing the work described in this Work Plan. Work will be conducted according to the policies and procedures outlined in the contractor's SSHASP, and the Remediation Management (RM) *Site Remediation Technologies Engineering Integrity Manual* (BP, 2016).

3.2.1 Working Around Heavy Equipment

The tasks necessary to complete the Colorado Dump RA will require working with and around heavy equipment. The contractor will be responsible for following policies and procedures outlined in the RM Heavy Equipment Defined Procedure.

3.2.2 Ground Disturbance

The work necessary to complete the Colorado Dump RA will require excavation and backfilling, which by definition is considered Ground Disturbance. The Contractor will be responsible for following policies and procedures outlined in the RM Ground Disturbance Defined Procedure, including completing all applicable permits.

3.2.3 Working Around Overhead Utilities

The tasks necessary to complete the Colorado Dump RA will require working around high voltage overhead power lines, which by definition is considered an overhead hazard. The contractor will be responsible for following policies and procedures outlined in the RM Overhead Utilities Defined Procedure including completing all applicable permits.

3.2.4 Simultaneous Operations

All SIMOPs will be conducted as outlined in the RM Simultaneous Operations Defined Procedure.

3.2.5 Job Zone Control and Traffic Management

The tasks necessary to complete the work will require conducting activities that affect the public (public roadways and adjacent private property). The contractor will be responsible for following policies and procedures as outlined in the RM Job Zone Control and Traffic Management Defined Procedure.

4.0 DESCRIPTION OF WORK

The Project is scheduled to be completed in the 2022 construction season. Site remediation will be completed using various measures such as storm water control, site regrading, engineered cap (12-inch base course cover), storm channel, storm inlet structures, and subsurface piping.

4.1 Pre-Job Safety Meeting

A pre-job safety meeting will be held to coordinate all work activities, safety roles, and complete any necessary permits. All necessary Atlantic Richfield, Pioneer, and subcontractor personnel will be present at the pre-job safety meeting.

4.2 Colorado Dump – West Lot Project

As stated above, the Colorado Dump Site RAWP has been designed to mitigate metals-laden sediment exposure and loading onto adjacent roadways. Storm water flows and sediment movement will be controlled by slope grading, constructing a storm channel, installing manholes/inlets, and installing an engineered cap. Remediation efforts will follow the Construction Drawings (Appendix A), Technical Specifications (Appendix B), and Hydrology Report (Appendix C).

4.2.1 Engineered Cap

The Site will incorporate a 12-inch base course cap over all areas apart from the proposed storm water channel. Sheet C-3 of the Construction Drawings (Appendix A) shows the Final Cover Plan with the incorporated cap. The cap will be a 1.5-inch minus base course material from an

Atlantic Richfield-approved source. The Technical Specifications in Appendix B show the gradation of this material.

4.2.2 Storm Channel Construction

One storm water channel will be constructed during the RA work. The channel will be installed to capture storm water runoff upgradient of the installed cap as detailed in the Construction Drawings (Appendix A). The channel will be constructed with Filter Bedding Material (Type F) and Riprap Material (Type III). The Type F Filter Bedding Material will be a minimum 6-inch-thick layer on top of native compacted subgrade. The Type III-Riprap Material will be a minimum 12-inch-thick layer on top of the Type F-Filter Bedding Material. The Technical Specifications (Appendix B) outline these materials, and details of the riprap and filter bedding are shown in Appendix A.

4.2.3 Storm Water Manhole/Inlets and Subsurface Piping Installation

Two storm water manhole/drop inlets will be installed during the RA Work, hereafter referred to as MH-1 (west) and MH-2 (east). Storm water run-on to the site will be captured by the proposed storm water channel that routes water downgradient or south to the proposed MH-1. Subsurface piping will be installed from MH-1 to MH-2, which will collect Site storm water via the proposed grading. MH-2 will then route storm water via existing subsurface piping to the existing storm water infrastructure. The Construction Drawings in Appendix A show the locations and alignments of these manholes/inlets and subsurface piping, respectively.

The manholes/inlets will be precast of 48-inch inlet/outlet tie-ins and Type V Concrete material (see Appendix B). Subsurface piping from MH-1 to MH-2 will consist of 6-inch polyvinyl chloride (PVC) and will have an approximate total length of 100 feet. MH-2 will discharge to existing subsurface piping from the existing manhole north of East Mercury Street. Subsurface pipe bedding material will be Type I Pipe Bedding Material (see Appendix B).

4.2.4 Landscape Boulders

Landscape boulders will be installed as shown on the Construction Drawings (Appendix A) at the locations determined by (or staked by) the engineer. Boulders will be approximately 2 feet in width and 2 feet in height, or as approved by the engineer, and will be partially buried and set in position. The purpose of boulder installation is to prevent vehicular traffic from the storm channel and non-traffic areas.

5.0 MANAGEMENT OF CHANGE REVIEW

The following list is intended to provide a brief explanation of the potential Management of Change (MoC) issues related to this Work Plan and the anticipated effects of the work, if any.

- Design – The Site has been designed to mitigate metals-laden sediment loading onto adjacent roadways. Storm water flows and sediment movement will be controlled by slope grading,

constructing storm water channels, completing cap and cover operations, installing riprap channel slope protection, and installing storm inlets and manholes.

- Health – Adverse effects to human health due to completing the project are not expected. Individuals performing the work will be required to use appropriate PPE and conduct work according to Section 4.0.
- Safety – Risks associated with work activities will be mitigated through implementing TRAs, HAZIDs, and CoW practices. Due to the safety precautions being taken, hazards such as weather, working surfaces, working around traffic, heavy equipment operation, disturbed ground, overhead power lines, and SIMOPS will be minimized. All necessary CoW items and work permits will be completed before initiating any of the tasks discussed above.
- Security – On-site personnel will monitor security during working hours. Little to no security issues are expected.
- Integrity Management – Work is to be conducted according to the BP RM *Site Remediation Technologies Engineering Integrity Manual* (BP, 2016).
- Engineering – All necessary engineering efforts associated with the Colorado Dump – West Lot Project are complete.
- Environment – Adverse effects to the environment are not expected to occur because of this work.
- Regulatory – Regulatory effects are not anticipated as a result of performing the work.
- Compliance – Completing the work is expected to have a positive impact on compliance.
- Reputation – No impact is expected regarding the reputation of Atlantic Richfield.

6.0 CONSTRUCTION DRAWINGS AND TECHNICAL SPECIFICATIONS

The Construction Drawings and Technical Specifications for the Colorado Dump RA are included as Appendix A and Appendix B, respectively.

7.0 POST-CONSTRUCTION OPERATIONS AND MAINTENANCE

Once the Colorado Dump RA is complete, post-construction operations will consist of monitoring performance and providing as-needed maintenance for the installed infrastructure. Pioneer will document the construction and will draft As-Built Drawings. A final construction completion report will be provided to Atlantic Richfield after the project is completed.

8.0 REFERENCES

Atlantic Richfield Company, 2021. Butte Priority Soils Operable Unit (BPSOU) Insufficiently Reclaimed Sites – Field Sampling Plan (FSP) BRES No. 104 – Colorado Dump. October 2021.

Atlantic Richfield Company, 2022. Draft Final 2021 Insufficiently Reclaimed Sites Sampling BRES No. 104 Site Evaluation Summary Report. Prepared by Pioneer Technical Services, Inc. April 15, 2022.

BP, 2016. Remediation Management Site Remediation Technologies Engineering Integrity Manual. March 2016.

Appendix A
Construction Drawings

BUTTE PRIORITY SOILS OPERABLE UNIT
INSUFFICIENTLY RECLAIMED SITES
COLORADO DUMP WEST LOT
REMEDIAL ACTION PROJECT

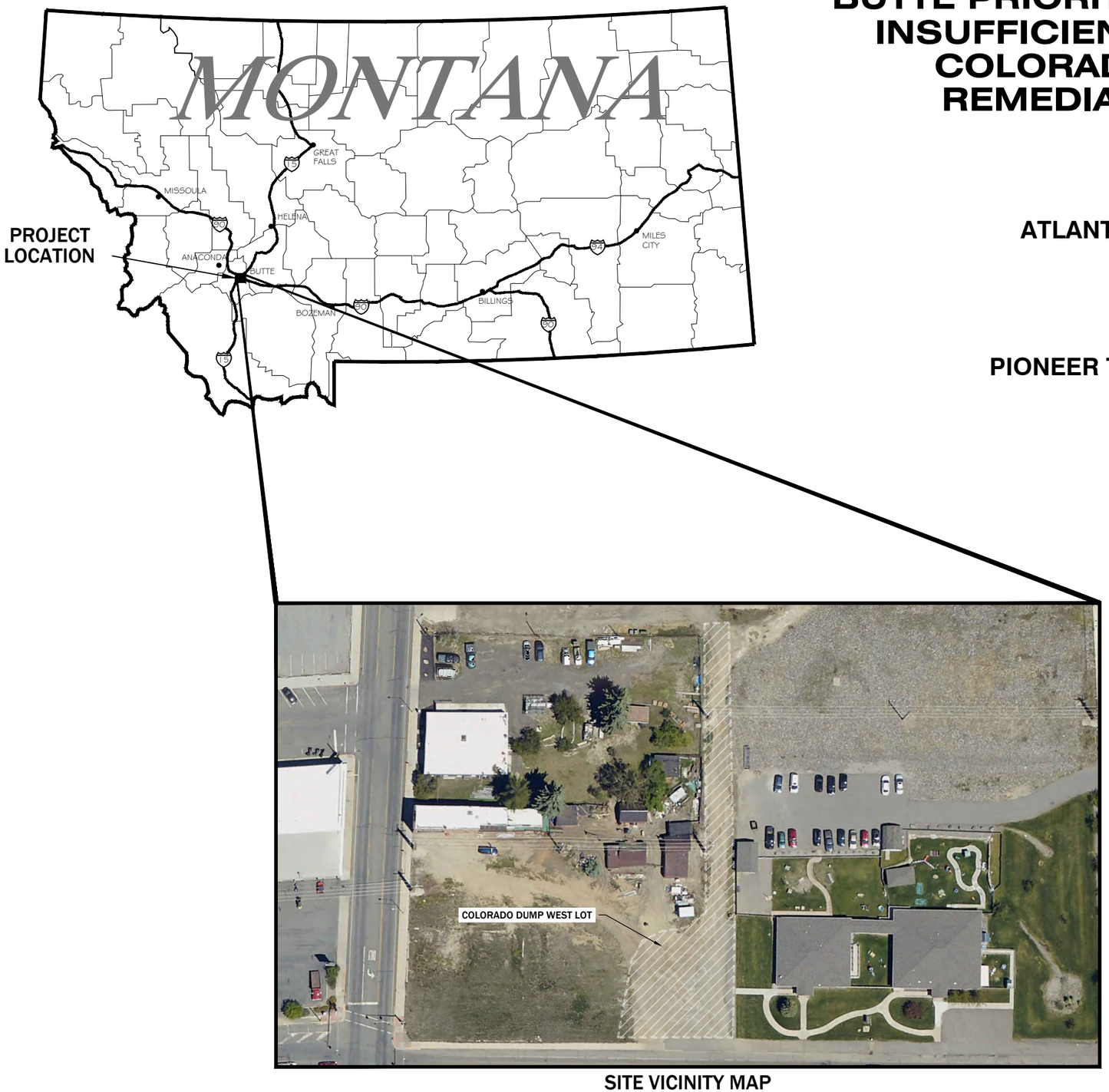
PREPARED FOR

ATLANTIC RICHFIELD COMPANY

PREPARED BY

PIONEER TECHNICAL SERVICES, INC.

JUNE, 2022



SITE VICINITY MAP

SOURCE: QSI 2021

LEGEND

EXISTING - PLAN VIEW

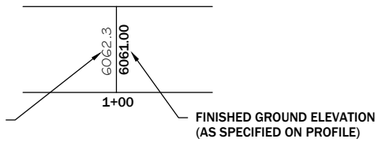
- 7700 — INDEX CONTOURS
- INTERMEDIATE CONTOURS
- CULVERT
- EXISTING ROAD
- PROPERTY LINE
- OHP — OHP — OVERHEAD ELECTRICAL LINE
- GAS — GAS — GAS LINE
- SD — SD — STORM DRAIN
- TEL — TEL — TELEPHONE LINE
- WTR — WTR — WATER LINE
- WTR — WTR — ABANDONED WATER LINE
- PWR — PWR — POWER LINE
- CHAIN LINK FENCE
- EXISTING DIVERSION SWALE
- POWER POLE
- GUY WIRE
- STREET LIGHT
- (S) SANITARY SEWER MANHOLE
- (D) STORM DRAIN MANHOLE
- EXISTING APPROACH

PROPOSED - PLAN VIEW

- 7700 — INDEX CONTOURS
- INTERMEDIATE CONTOURS
- 2+00 — 100 FT. STATIONING
- 2% — GRADE OR SURFACE SLOPE (PERCENT)
- x — CONSTRUCTION FENCE
- (D) STORM MANHOLE
- BOULDER PLACEMENT
- GRADING EXTENTS

- CENTERLINE
- ℄ CENTERLINE
- SLOPE DESIGNATION (ARROWS POINT DOWN SLOPE)
- 3 / 1 SLOPE DESIGNATION

PROFILE ELEVATIONS



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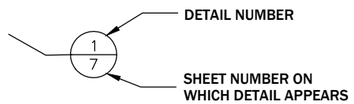
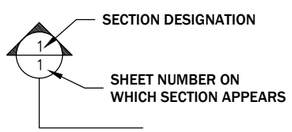


ON PLAN

SECTION INDICATOR



ON PLAN

DETAIL  DETAIL NUMBER; SHEET NUMBER ON WHICH DETAIL IS REFERENCED.

AT DETAIL

SECTION  SECTION DESIGNATION; SHEET NUMBER ON WHICH SECTION IS REFERENCED.

AT SECTION

NOTES:
ON PLANS: "–" SYMBOL IN UPPER HALF OF BUBBLE INDICATES GENERAL REFERENCE TO NOTED DRAWING NUMBER.
AT DETAIL/SECTIONS: "–" SYMBOL (NO DRAWING NUMBER) IN LOWER HALF OF BUBBLE INDICATES DETAIL/SECTION IS REFERENCED ON MORE THAN ONE DRAWING.

SHEET INDEX

GENERAL NOTES

1. ALL WORK SHALL MEET THE REQUIREMENTS SET FORTH IN THE CURRENT VERSIONS OF BUTTE-SILVER BOW MATERIAL SPECIFICATIONS, MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS, AND PROJECT SPECIFICATIONS.
2. CONTRACTOR SHALL NOTIFY IN WRITING ALL UTILITY COMPANIES AND UTILITY OWNERS AND DETERMINE THE EXACT LOCATION OF ALL UNDERGROUND UTILITIES BEFORE COMMENCING WORK. CONTRACTOR IS RESPONSIBLE FOR PROTECTING AND REPAIRING ANY DAMAGED UTILITIES. CONTRACTOR SHALL NOTIFY ONE-CALL UTILITY LOCATE AT 811 OR (800) 424-5555 AND/OR OTHER APPROPRIATE UTILITIES AT LEAST 48-HOURS PRIOR TO CONSTRUCTION.
3. UTILITY LOCATIONS SHOWN ON THE DRAWINGS ARE APPROXIMATED BASED ON RECORDS PROVIDED BY THE UTILITY OWNERS. ALL UTILITY LOCATIONS SHOWN ARE SUBJECT TO THE ACCURACY OF THE LOCATION METHODS AND RECORDS EMPLOYED BY THE UTILITY OWNERS. UTILITIES ARE ALSO SUBJECT TO RELOCATION SINCE DRAWINGS WERE PREPARED. NO EXCAVATION WAS PERFORMED IN LOCATING THESE UTILITIES. UTILITY LOCATIONS SHOWN SHOULD BE CONSIDERED APPROXIMATE AND ACTUAL DEPTHS MAY VARY.
4. CONTRACTOR SHALL COORDINATE WITH UTILITY OWNERS TO DETERMINE MEANS OF MAINTAINING AND PROTECTING UNDERGROUND UTILITY SERVICES DURING AND AFTER CONSTRUCTION.
5. CONTRACTOR SHALL FIELD VERIFY EXISTING STORMWATER INFRASTRUCTURE DIMENSIONS AND LOCATION BEFORE BEGINNING CONSTRUCTION. THE CONTRACTOR IS SOLELY RESPONSIBLE TO MAKE SURE NEW FITTINGS, COUPLINGS, ETC., ARE COMPATIBLE WITH AND PROVIDE A PROPER FIT TO STORM DRAIN PIPING.
6. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DESIGNING AND CONSTRUCTING STABLE, TEMPORARY EXCAVATIONS AND SHOULD SHORE, SLOPE OR BENCH THE SIDES OF EXCAVATIONS AS REQUIRED TO MAINTAIN STABILITY OF THE EXCAVATION SIDES AND BOTTOM. ALL EXCAVATIONS SHOULD COMPLY WITH THE APPLICABLE LOCAL, STATE, AND FEDERAL REGULATIONS INCLUDING THE CURRENT OSHA EXCAVATION AND TRENCH SAFETY STANDARDS. CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR, WHO SHALL ALSO BE SOLELY RESPONSIBLE FOR THE MEANS, METHODS, AND SEQUENCING OF CONSTRUCTION OPERATIONS.
7. CONTRACTOR IS TO PROVIDE HIS OWN WATER FOR DUST CONTROL AND COMPACTION.
8. STORM DRAIN CALLED OUT IN PLANS IS MINIMUM SIZE AND SLOPE REQUIRED. STORM DRAINS MAY BE ADJUSTED TO MATCH GRADING AND DRAINAGE NEEDS AS LONG AS MINIMUM REQUIREMENTS ARE MET.
9. ALL MATERIALS AND DETAILS CAN BE SUBSTITUTED WITH APPROVED EQUAL UPON ENGINEER'S APPROVAL.
10. TRAFFIC CONTROL:
    A. GENERAL: CONSTRUCTION SHALL NOT COMMENCE ON THE PROJECT UNTIL NECESSARY CONSTRUCTION WARNING SIGNS AND TRAFFIC CONTROL IS IN PLACE AND APPROVED BY ENGINEER.

    B. TRAFFIC PLAN: CONTRACTOR SHALL PREPARE AND SUBMIT FOR REVIEW BY BSB A TRAFFIC CONTROL PLAN. ALL TRAFFIC CONTROL SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES.
11. CONTRACTOR SHALL INSTALL AND MAINTAIN TEMPORARY BMP'S ON-SITE AS DIRECTED BY ENGINEER. UPON COMPLETION OF WORK CONTRACTOR SHALL REMOVE AND DISPOSE OF TEMPORARY BMP'S AS DIRECTED BY ENGINEER.
12. CONTRACTOR SHALL COORDINATE WORKING HOURS AND CONSTRUCTION DISTURBANCE WITH LANDOWNERS AND ADJACENT LANDOWNERS PRIOR TO BEGINNING WORK.

REVISION:

DATE:	BY:	DESC:

DRAWN BY: CLA
DESIGNED BY: CJG
CHECKED BY: AMD
APPROVED BY:
PROJECT NO:
DATE: 6/2022

DISPLAYED AS:
COORD SYS/ZONE: N/A
DATUM: N/A
UNITS: N/A
SOURCE: PIONEER

SCALE IN FEET
0

ATLANTIC RICHFIELD COMPANY
COLORADO DUMP WEST LOT
REMEDIAL ACTION WORKPLAN

INDEX,
LEGEND, AND NOTES

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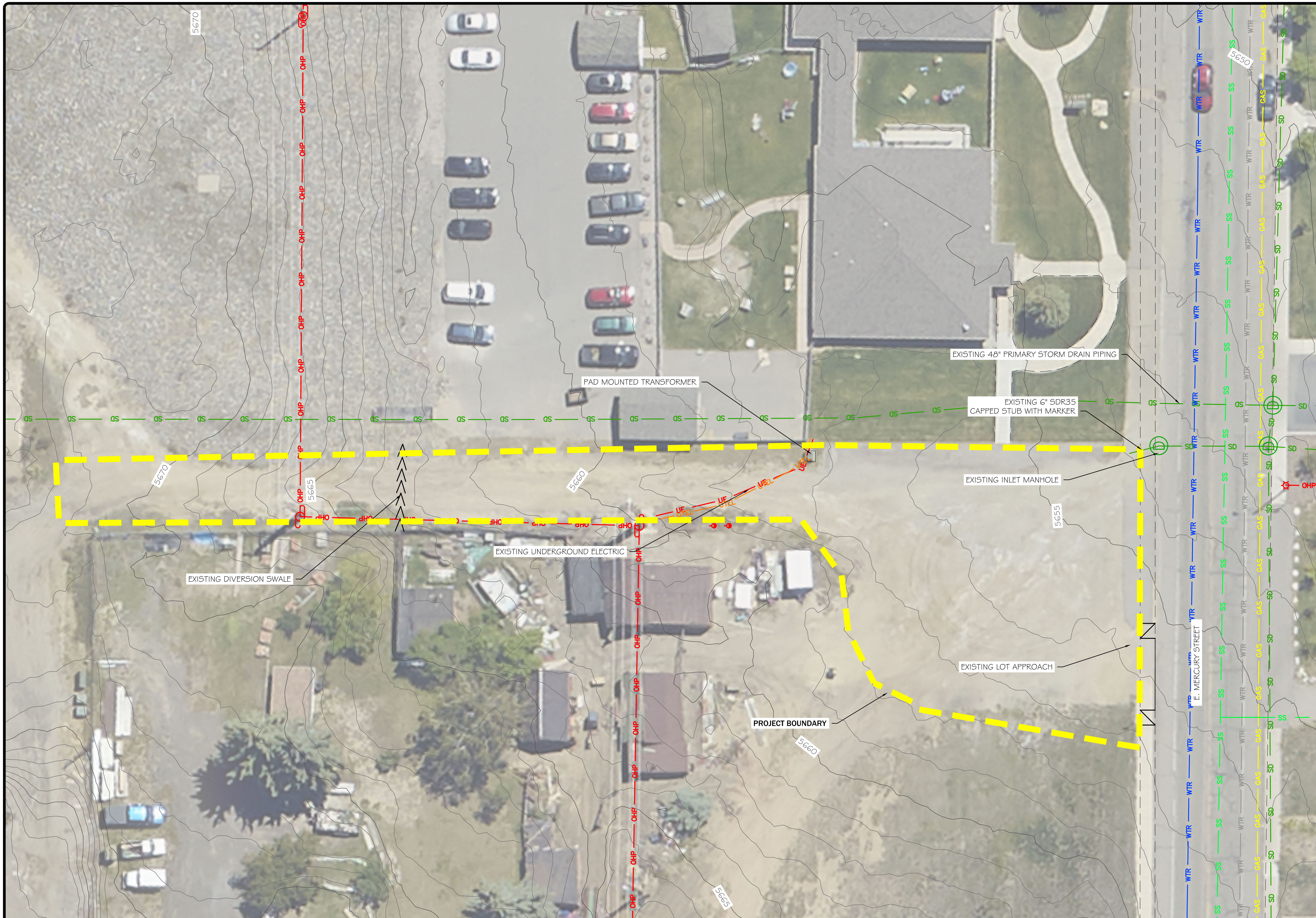
SHEET
G-2



REVISION:

DATE:	BY:	DESC:

DRAWN BY: CLA
DESIGNED BY: CJG
CHECKED BY: AMD
APPROVED BY:
PROJECT NO:
DATE: 6/2022

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

SCALE IN FEET
0 15 30

ATLANTIC RICHFIELD COMPANY
COLORADO DUMP WEST LOT
REMEDIAL ACTION WORKPLAN

EXISTING CONDITIONS PLAN VIEW

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SHEET
G-3

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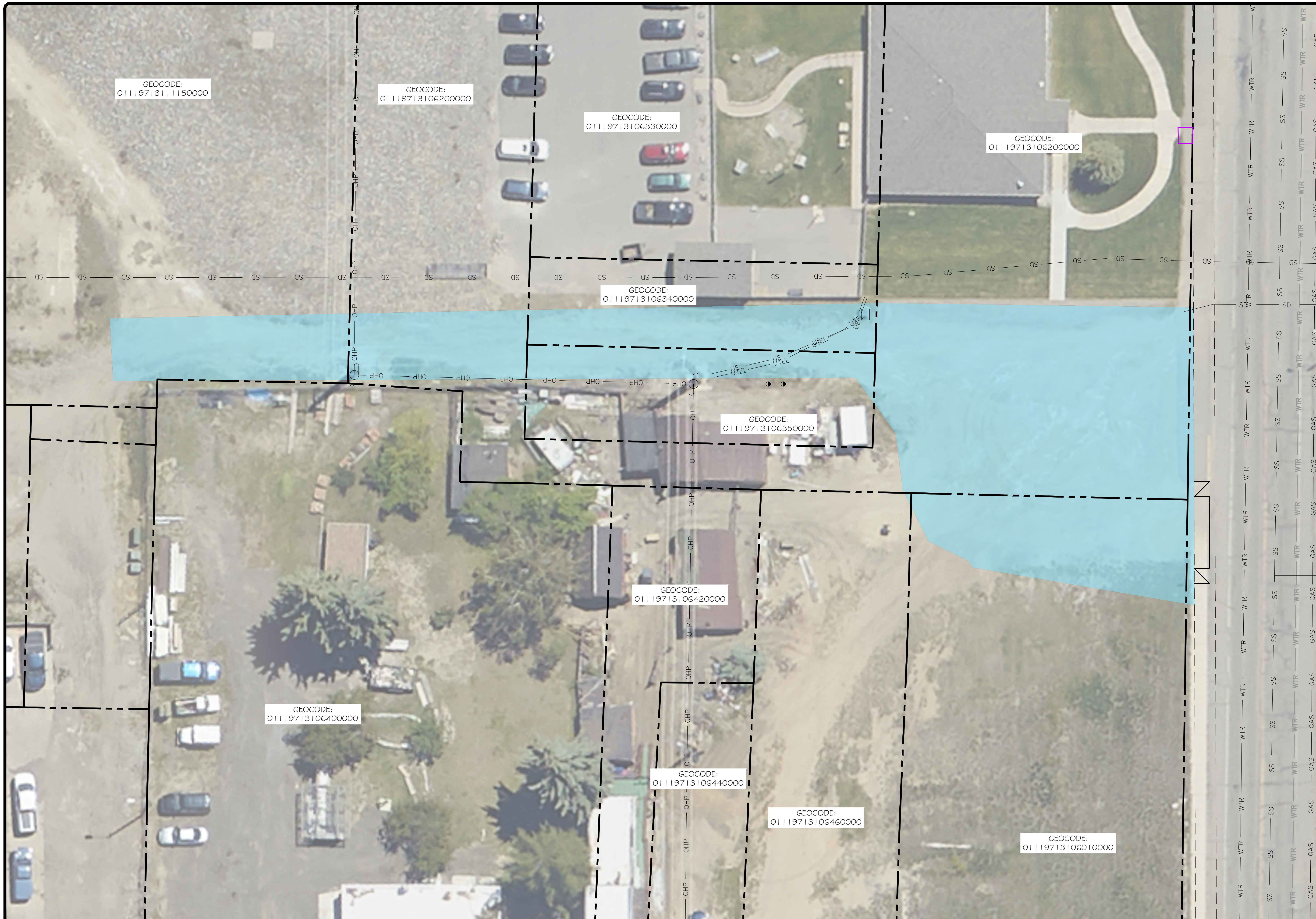

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DATE:	BY:	DESC:

DRAWN BY: CLA
DESIGNED BY: CJG
CHECKED BY: AMD
APPROVED BY:
PROJECT NO:
DATE: 6/2022

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

SCALE IN FEET
0 15 30

ATLANTIC RICHFIELD COMPANY
COLORADO DUMP WEST LOT
REMEDIAL ACTION WORKPLAN

SITE
PROPERTY
OWNERSHIP

PIONEER
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SHEET
G-4

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NOTES:
1. INSTALL 2' - 3' DIAMETER BOULDERS AT 7 FOOT ON CENTER OR AS DIRECTED BY ENGINEER.

LEGEND:

INSTALL CAP

REGRADE EXISTING MATERIALS AND INSTALL CAP

RUN-ON CHANNEL

INSTALL CAP, SEE SHEET C-4

REGRADE EXISTING MATERIALS AND INSTALL CAP, SEE SHEETS C1 THROUGH C4

INSTALL LANDSCAPE BOULDERS, SEE NOTES AND SHEET D-1

INSTALL INLET MANHOLE MH-2, SEE SHEET C-6

TIE IN NEW 6" STORM DRAIN PIPE TO EXISTING SDR35 CAPPED STUB, SEE SHEET C-6

INSTALL 6" PVC STORM DRAIN PIPE, SEE SHEET C-6

CONSTRUCT RUN-ON CHANNEL, SEE SHEET C-5

RETAIN EXISTING SWALE

INSTALL LANDSCAPE BOULDERS, SEE NOTES AND SHEET D-1

INSTALL INLET MANHOLE, MH-1 SEE SHEET C-6

E. MERCURY STREET

REVISION:

DATE:	BY:	DESC:

DRAWN BY: CLA
DESIGNED BY: CJG
CHECKED BY: AMD
APPROVED BY:
PROJECT NO:
DATE: 6/2022

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

SCALE IN FEET
0 15 30

ATLANTIC RICHFIELD COMPANY
COLORADO DUMP WEST LOT
REMEDIAL ACTION WORKPLAN

PROJECT OVERVIEW

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SHEET G-5

NOTES:

1. PROPOSED CONTOURS REPRESENT SITE GRADING ACTIVITIES TO BE PERFORMED USING EXISTING MATERIAL AND DO NOT REPRESENT FINAL SURFACE AND COVER. SEE SHEET C-4 FOR FINAL COVER.
2. CONTRACTOR SHALL GRADE EXISTING MATERIALS TO PROMOTE POSITIVE DRAINAGE TO LOCATION OF NEW MANHOLE MH-2 INLET.

INLET MANHOLE, MH-2 SEE SHEET C-6

CONSTRUCT RUN-ON CHANNEL, SEE SHEET C-5

GRADING EXTENTS

MANHOLE, MH-1 SEE SHEET C-6

E. MERCURY STREET

2+49 2+00 1+00 0+00

5670 5665 5660 5655

REVISION:

DATE:	BY:	DESC:

DRAWN BY: CLA
DESIGNED BY: CJG
CHECKED BY: AMD
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PROJECT NO:
DATE: 6/2022

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SCALE IN FEET
0 15 30

ATLANTIC RICHFIELD COMPANY COLORADO DUMP WEST LOT REMEDIAL ACTION WORKPLAN

SITE GRADING PLAN

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SHEET C-1

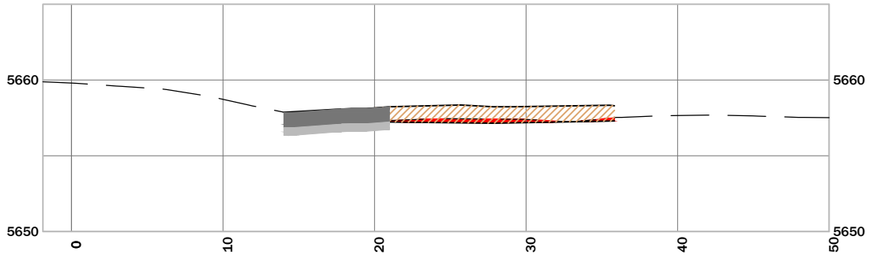
LEGEND

- CUT
- FILL
- 12" CAP (IMPORT)
- RIPRAP
- FILTER BEDDING

NOTES:

1. CROSS-SECTIONS AND VOLUME TABLES DO NOT SHOW ADDITIONAL EXCAVATION REQUIRED FOR RUN-ON CHANNEL CONSTRUCTION, SEE SHEET D1 FOR DETAIL.
2. REGRADED MATERIAL SHALL BE COMPACTED TO 95% COMPACTION, SEE TECHNICAL SPECIFICATIONS.

STA 1+25



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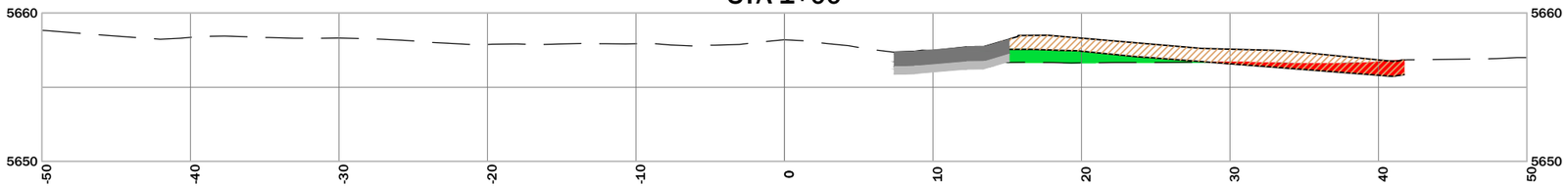

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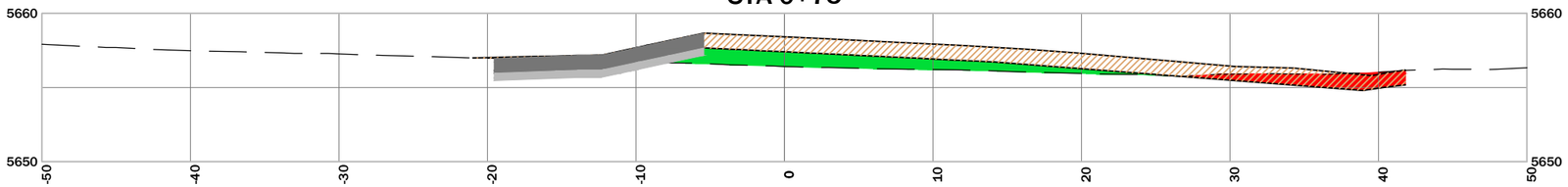

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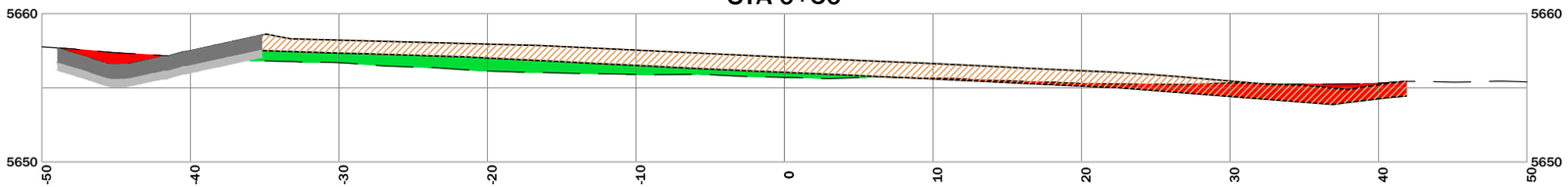
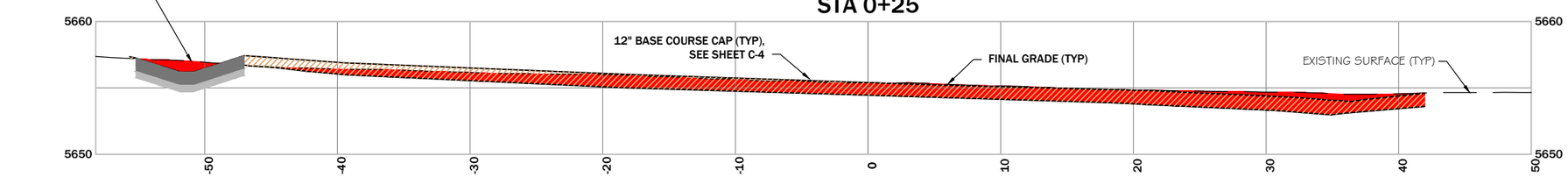


STA 0+25



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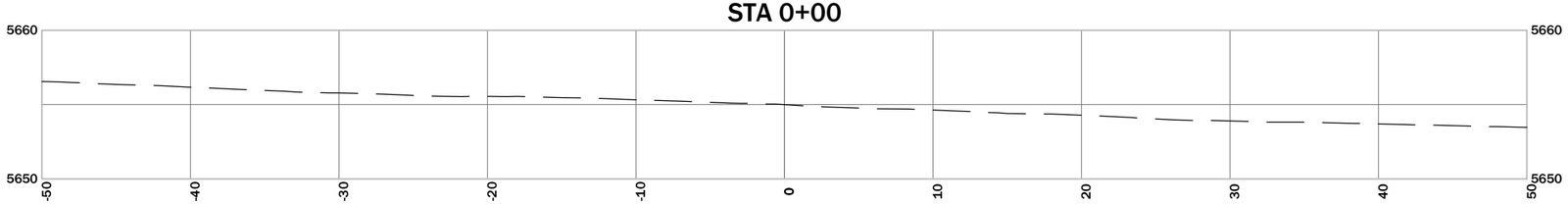

REVISION:

DATE:	BY:	DESC:

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CHECKED BY: AMD
APPROVED BY:
PROJECT NO:
DATE: 6/2022

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

SCALE IN FEET
0 5 10

ATLANTIC RICHFIELD COMPANY
COLORADO DUMP WEST LOT
REMEDIAL ACTION WORKPLAN

CROSS SECTIONS
STATION
0+00 TO 1+25

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SHEET
C-2

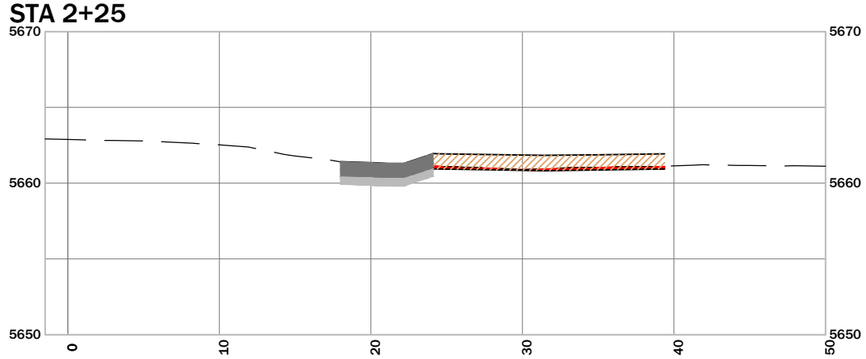
LEGEND

- CUT
- FILL
- 12" CAP (IMPORT)
- RIPRAP
- FILTER BEDDING

NOTES:

1. CROSS-SECTIONS AND VOLUME TABLES DO NOT SHOW ADDITIONAL EXCAVATION REQUIRED FOR RUN-ON CHANNEL CONSTRUCTION, SEE SHEET D1 FOR DETAIL.
2. REGRADED MATERIAL SHALL BE COMPACTED TO 95% COMPACTION, SEE TECHNICAL SPECIFICATIONS.

STA 2+25



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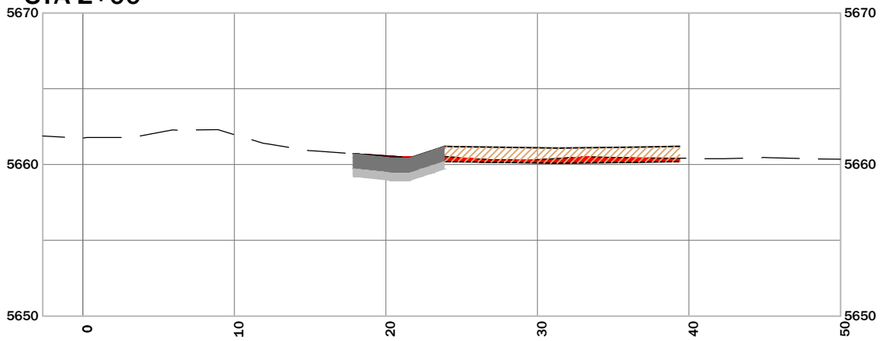

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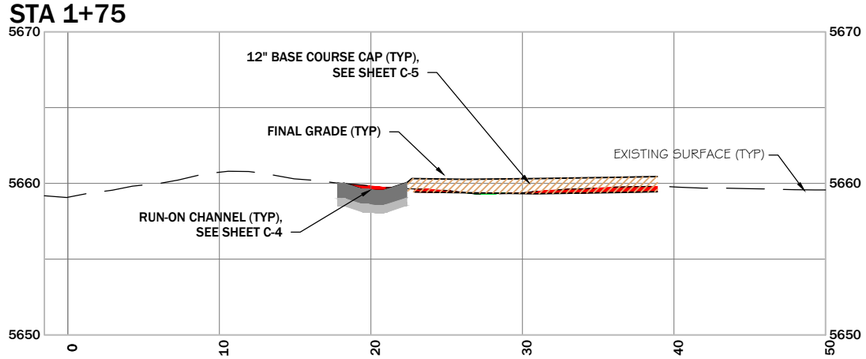

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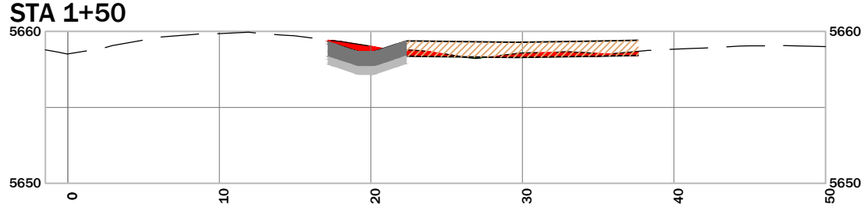

Total Volume Table

Station	Fill Area	Cut Area	Fill Volume	Cut Volume	Cumulative Fill Vol	Cumulative Cut Vol
0+00.00	0.00	0.00	0.00	0.00	0.00	0.00
0+25.00	0.00	79.67	0.00	36.88	0.00	36.88
0+50.00	27.29	19.24	12.64	45.79	12.64	82.67
0+75.00	24.91	10.58	24.17	13.81	36.81	96.48
1+00.00	8.92	6.18	15.66	7.76	52.47	104.24
1+25.00	0.00	2.70	4.13	4.11	56.60	108.35
1+50.00	0.08	3.52	0.04	2.88	56.64	111.23
1+75.00	0.13	2.96	0.10	3.00	56.74	114.22
2+00.00	0.00	4.45	0.06	3.43	56.80	117.65
2+25.00	0.00	2.38	0.00	3.16	56.80	120.82
2+49.20	0.00	0.00	0.00	1.07	56.80	121.88

Cap Total Volume Table

Station	Fill Area	Fill Volume	Cumulative Fill Vol
0+00.00	0.00	0.00	0.00
0+25.00	86.93	40.25	40.25
0+50.00	78.96	76.80	117.05
0+75.00	52.21	60.73	177.78
1+00.00	26.53	36.46	214.23
1+25.00	16.91	20.11	234.35
1+50.00	15.60	15.05	249.40
1+75.00	15.65	14.47	263.87
2+00.00	16.21	14.75	278.62
2+25.00	15.42	14.64	293.26
2+49.20	0.00	6.91	300.17

RipRap Total Volume Table

Station	Fill Area	Fill Volume	Cumulative Fill Vol
0+00.00	0.00	0.00	0.00
0+25.00	8.17	3.78	3.78
0+50.00	13.73	10.14	13.92
0+75.00	14.13	12.89	26.81
1+00.00	7.75	10.13	36.94
1+25.00	6.96	6.81	43.75
1+50.00	5.17	5.61	49.37
1+75.00	4.57	4.51	53.87
2+00.00	6.02	4.90	58.78
2+25.00	6.13	5.62	64.40
2+49.20	0.00	2.75	67.15

Filter Bedding Total Volume Table

Station	Fill Area	Fill Volume	Cumulative Fill Vol
0+00.00	0.00	0.00	0.00
0+25.00	4.08	1.89	1.89
0+50.00	6.86	5.07	6.96
0+75.00	7.06	6.45	13.41
1+00.00	3.88	5.06	18.47
1+25.00	3.48	3.41	21.88
1+50.00	2.58	2.81	24.68
1+75.00	2.29	2.25	26.94
2+00.00	3.01	2.45	29.39
2+25.00	3.07	2.81	32.20
2+49.20	0.00	1.37	33.57

REVISION:

DATE:	BY:	DESC:

DRAWN BY: CLA
DESIGNED BY: CJG
CHECKED BY: AMD
APPROVED BY:
PROJECT NO:
DATE: 6/2022

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

SCALE IN FEET
0 5 10

ATLANTIC RICHFIELD COMPANY
COLORADO DUMP WEST LOT
REMEDIAL ACTION WORKPLAN

CROSS SECTIONS
STATION
1+50 TO 2+25

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SHEET
C-3

NOTES:

1. CONTRACTOR SHALL PLACE 12" BASE COURSE CAP PER PROJECT SPECIFICATIONS.
2. CONTRACTOR SHALL COMPACT BASE COURSE CAP TO 95% COMPACTION, SEE TECHNICAL SPECIFICATIONS.
3. CONTRACTOR SHALL INSTALL CAP WITHIN SITE GRADING AREAS WITH FINAL MINIMUM THICKNESS OF 12".
4. CAP SHALL BE INSTALLED TO PROMOTE POSITIVE DRAINAGE TO NEW MANHOLE MH-2 INLET.
5. CAP INSTALLATION OUTSIDE OF SITE GRADING AREA SHALL BE PLACED AND GRADED TO ACCEPT RUNOFF FROM UPGRADIENT DRAINAGE AREAS AND MAINTAIN EXISTING DRAINAGE PROPERTIES. CAP THICKNESS MAY VARY.

BASE COURSE CAP PLACEMENT OUTSIDE OF SITE GRADING AREA, SEE NOTE 5

12" BASE COURSE CAP, SEE SHEET D-1

CONSTRUCT RUN-ON CHANNEL, SEE SHEET D-1

EXISTING SWALE

E. MERCURY STREET

5670 5665 5660 5655

OHP SD WTR SS GAS UFEL

REVISION:		
DATE:	BY:	DESC:

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DESIGNED BY: CJG
CHECKED BY: AMD
APPROVED BY:
PROJECT NO:
DATE: 6/2022

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

SCALE IN FEET
0 15 30

ATLANTIC RICHFIELD COMPANY
COLORADO DUMP WEST LOT
REMEDIAL ACTION WORKPLAN

FINAL COVER PLAN

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SHEET C-4

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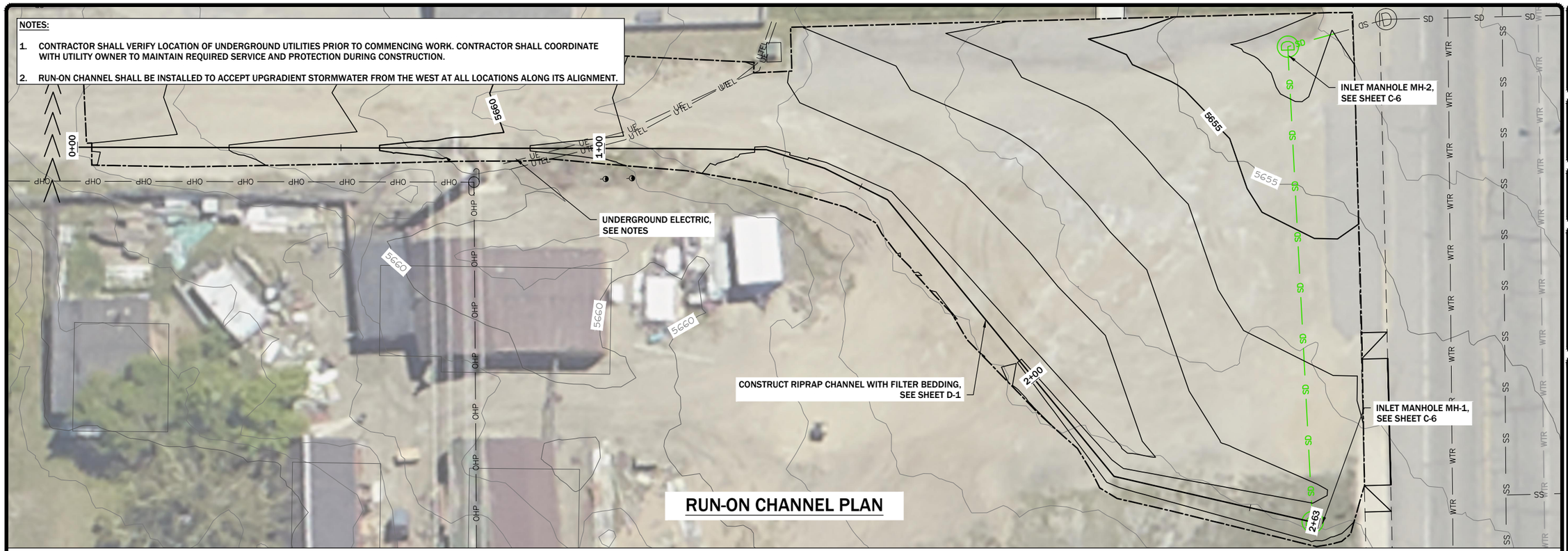
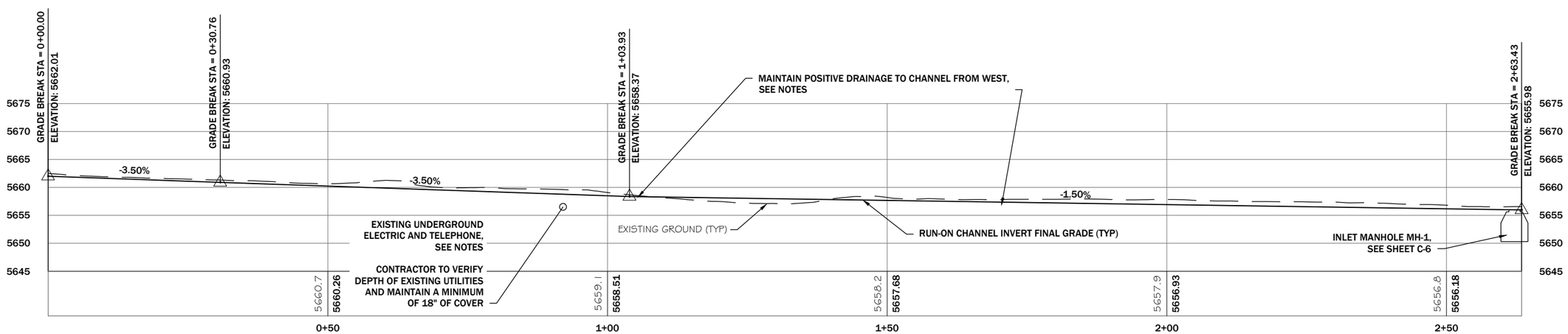
NOTES:

1. CONTRACTOR SHALL VERIFY LOCATION OF UNDERGROUND UTILITIES PRIOR TO COMMENCING WORK. CONTRACTOR SHALL COORDINATE WITH UTILITY OWNER TO MAINTAIN REQUIRED SERVICE AND PROTECTION DURING CONSTRUCTION.
2. RUN-ON CHANNEL SHALL BE INSTALLED TO ACCEPT UPGRADIENT STORMWATER FROM THE WEST AT ALL LOCATIONS ALONG ITS ALIGNMENT.



RUN-ON CHANNEL PLAN



RUN-ON CHANNEL PROFILE

REVISION:
DATE: BY: DESC:

DRAWN BY: CLA
DESIGNED BY: CJG
CHECKED BY: AMD
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PROJECT NO:
DATE: 6/2022

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

SCALE IN FEET
0 10 20

ATLANTIC RICHFIELD COMPANY
COLORADO DUMP WEST LOT
REMEDIAL ACTION WORKPLAN

RUN-ON CHANNEL PLAN AND PROFILE

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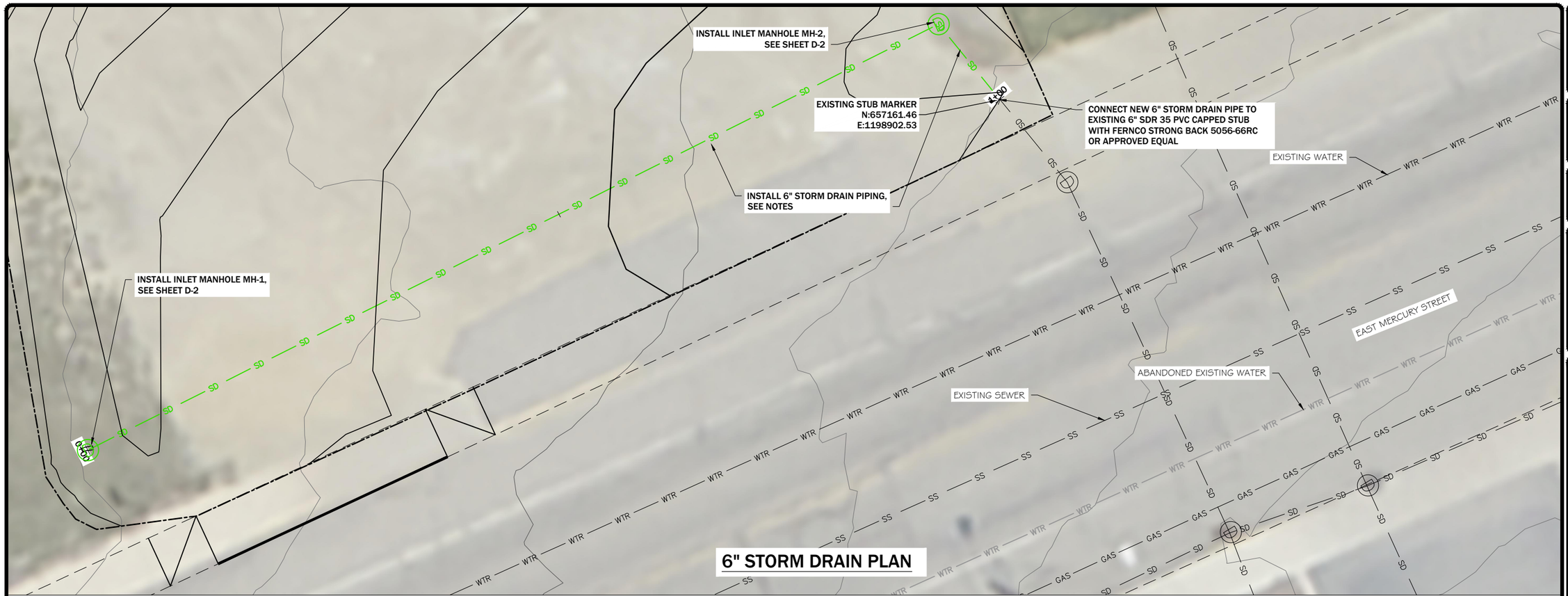
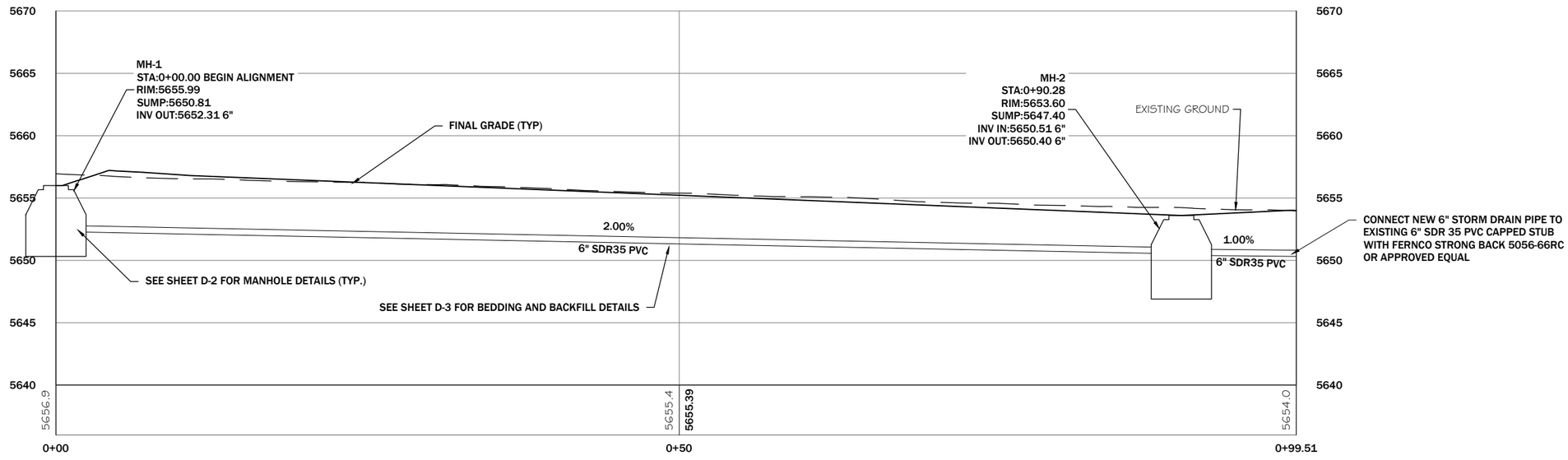
SHEET C-5



6" STORM DRAIN PLAN



6" STORM DRAIN PROFILE

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DATE:	BY:	DESC:

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CHECKED BY: AMD
APPROVED BY:
PROJECT NO:
DATE: 6/2022

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SOURCE: PIONEER

N

SCALE IN FEET
0 5 10

ATLANTIC RICHFIELD COMPANY
COLORADO DUMP WEST LOT
REMEDIAL ACTION WORKPLAN

STORM DRAIN PLAN AND PROFILE

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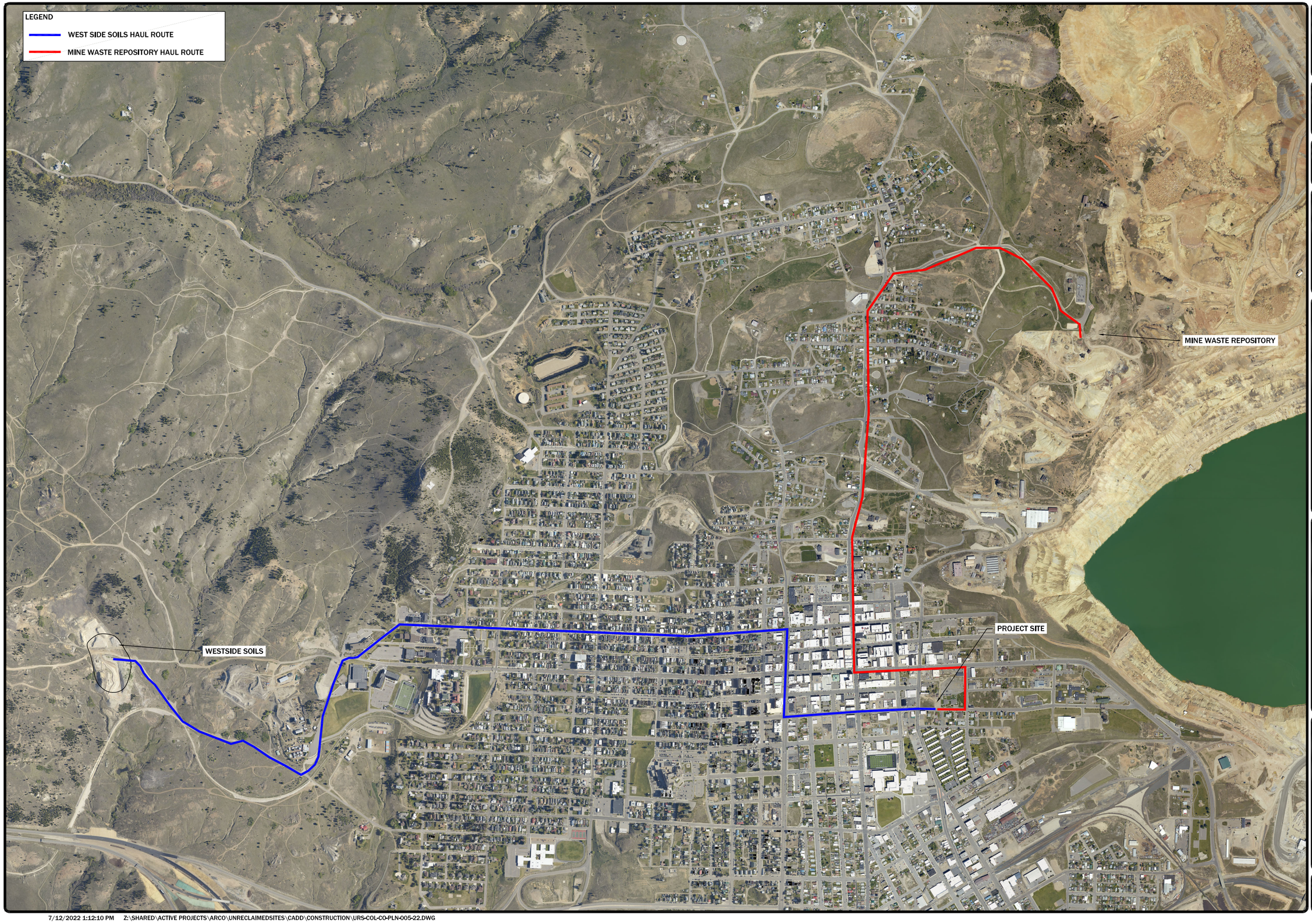
SHEET C-6



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DESIGNED BY: DSC
CHECKED BY: AMD
APPROVED BY:
PROJECT NO:
DATE: 6/2022

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COORD SYS/ZONE: MSP
DATUM: NAD 83
UNITS: IF
SOURCE: PIONEER/QSI 2021

N

SCALE IN FEET
0 600 1200

ATLANTIC RICHFIELD COMPANY
COLORADO DUMP WEST LOT
REMEDIAL ACTION WORKPLAN

HAUL ROUTES
PLAN VIEW

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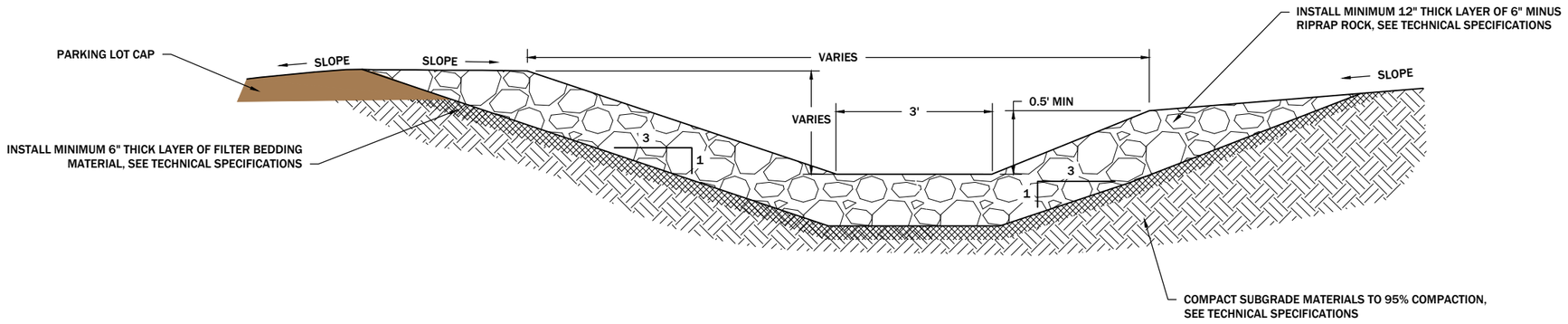
SHEET
H-1

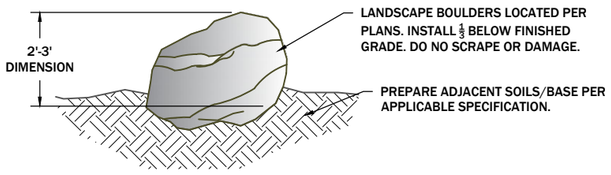
NOTES:

1. RUN-ON CHANNEL TO BE INSTALLED TO PROVIDE POSITIVE DRAINAGE FROM UPGRADIENT AREAS TO THE WEST AT ALL LOCATIONS ALONG THE ALIGNMENT. SOME LOCATIONS MAY REQUIRE WIDENING TO PROVIDE PROPER DRAINAGE AS DIRECTED BY ENGINEER.
2. LANDSCAPE BOULDERS TO BE INSTALLED AT 7 FOOT ON CENTER OR AS DIRECTED BY ENGINEER.



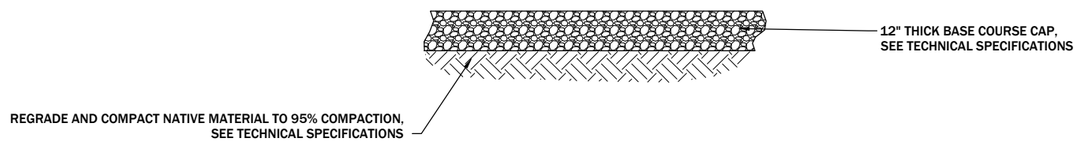
RUN-ON CHANNEL DETAIL

NOT TO SCALE



BOULDER DETAIL

NOT TO SCALE



PARKING LOT CAP DETAIL

NOT TO SCALE

REVISION:

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CHECKED BY: AMD
APPROVED BY:
PROJECT NO:
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DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER

SCALE IN FEET
0 N.T.S.

ATLANTIC RICHFIELD COMPANY
COLORADO DUMP WEST LOT
REMEDIAL ACTION WORKPLAN

STORM CHANNEL AND CAP DETAILS

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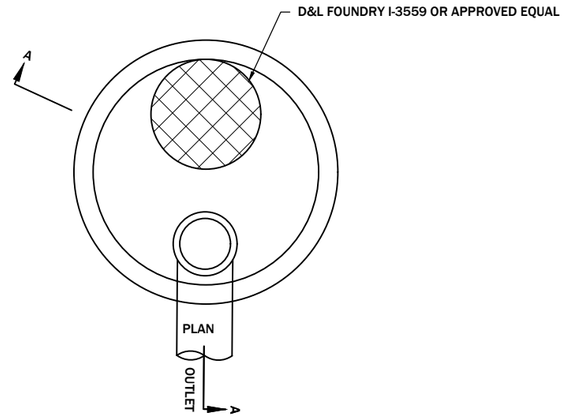
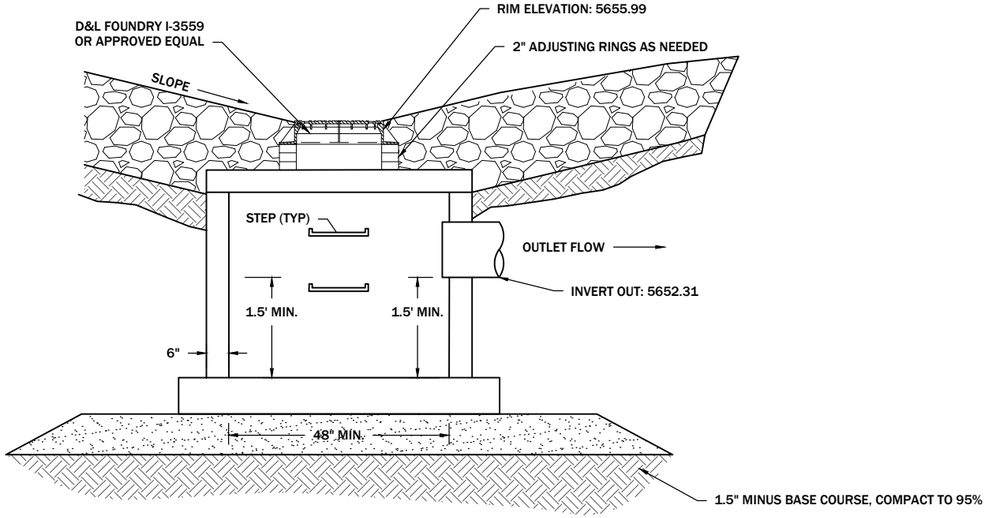
SHEET D-1

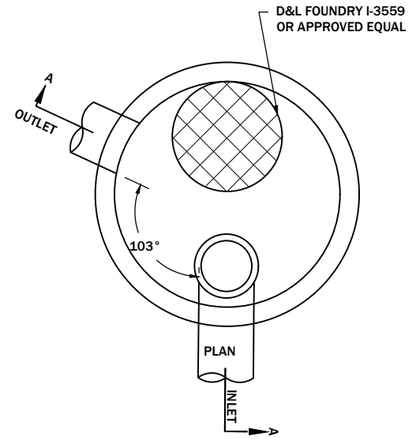
NOTES:

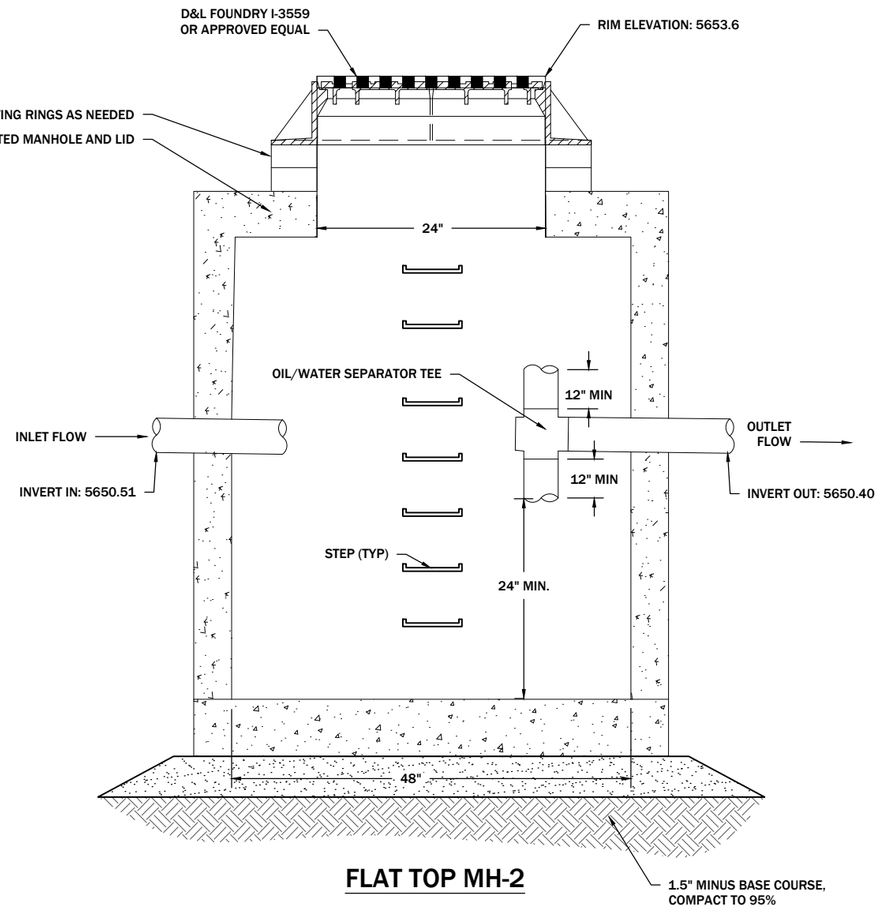
1. MANHOLES, MANHOLE RINGS, AND MANHOLE LIDS SHALL CONFORM WITH MOST RECENT MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS.
2. WASTE ENCOUNTERED DURING STORM WATER INFRASTRUCTURE INSTALLATION SHALL BE HAULED TO THE MINE WASTE REPOSITORY AS DIRECTED BY ATLANTIC RICHFIELD REPRESENTATIVE.
3. STORM WATER INFRASTRUCTURE SHALL BE BACKFILLED AND COMPACTED PER TECHNICAL SPECIFICATIONS.





FLAT TOP MH-1





FLAT TOP MH-2

PROPOSED MANHOLE DETAILS

NOT TO SCALE

REVISION:

DATE:	BY:	DESC:

DRAWN BY: CLA
DESIGNED BY: CJG
CHECKED BY: AMD
APPROVED BY:
PROJECT NO:
DATE: 6/2022

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

SCALE IN FEET
0 N.T.S.

ATLANTIC RICHFIELD COMPANY
COLORADO DUMP WEST LOT
REMEDIAL ACTION WORKPLAN

STORM DRAIN MANHOLE DETAILS

PIONEER TECHNICAL SERVICES, INC.
www.pioneer-technical.com
(406) 782-5177

SHEET D-2

NOTES:

1. PIPE BEDDING (TYPE 1) AND TRENCH BACKFILL (TYPE A) SHALL BE IN ACCORDANCE WITH MPW SPECIFICATION 02221.

2. WHERE TRENCH PASSES THROUGH EXISTING PAVEMENT, THE PAVEMENT SHALL BE CUT ALONG A NEAT VERTICAL LINE A MINIMUM OF 12" FROM THE EDGE OF THE TRENCH OPENING.

3. CONTRACTOR SHALL APPLY EMULSIFIED ASPHALT, TACK COAT (SS-1) OR APPROVED EQUAL TO CUT EDGE PRIOR TO PLACEMENT OF NEW ASPHALT.

4. WHERE TRENCH PASSES THROUGH EXISTING GRAVEL, THE GRAVEL SHALL BE REMOVED A MINIMUM OF 12" FROM THE EDGE OF THE TRENCH OPENING.

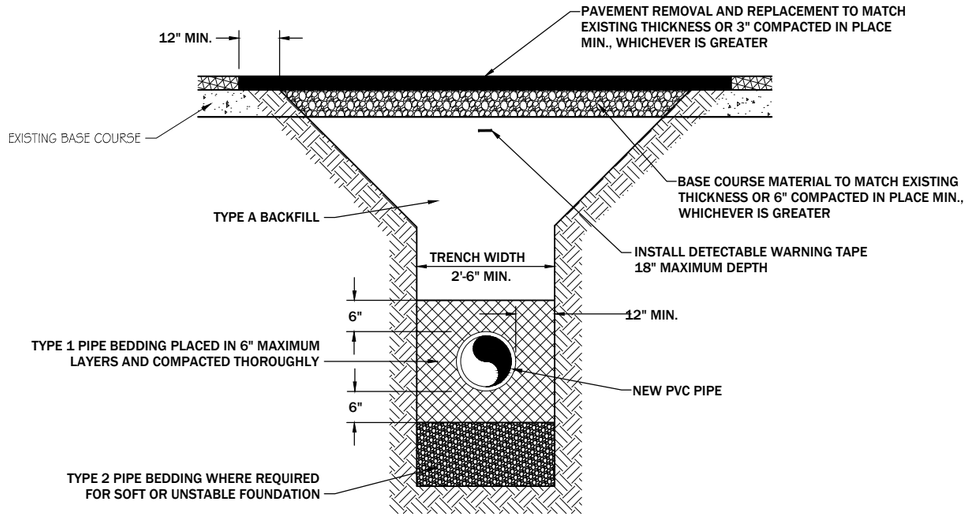
5. WHERE TRENCH PASSES THROUGH TOPSOIL, THE TOPSOIL SHALL BE REMOVED A MINIMUM OF 12'" FROM THE EDGE OF THE TRENCH OPENING.

6. TRENCH SHALL BE CONSTRUCTED TO OSHA SPECIFICATIONS FOR EXCAVATION, SECTION 1926, SUBPART P.

7. ALL SPOILS SHALL BE REMOVED AND DISPOSED OF AT AN APPROVED LOCATION.

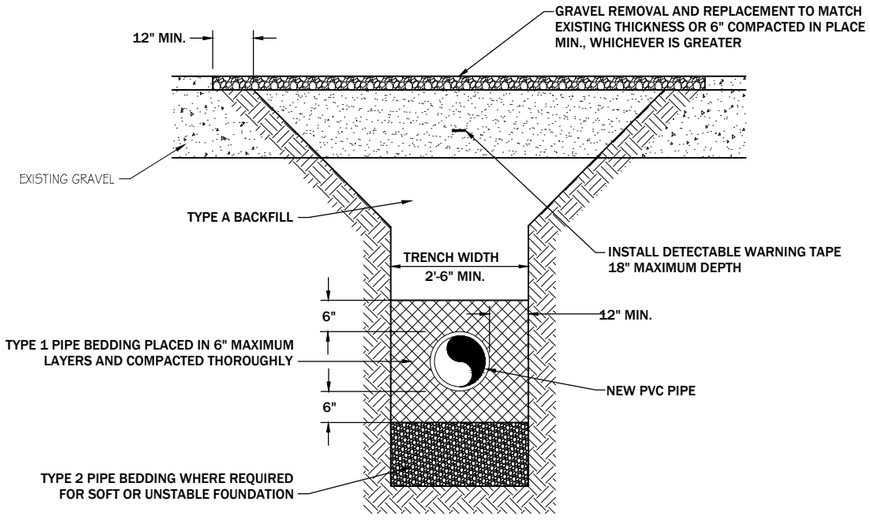
8. NO ROCKS OR LUMPS LARGER THAN 2" IN ANY DIMENSION SHALL BE ALLOWED WITHIN 6" OF THE PIPE.

9. NON-SHRINK BACKFILL REQUIRED BELOW ROADWAY FOR ALL MAINS AND SERVICES.



PIPE BEDDING AND BACKFILL DETAIL FOR PAVED SURFACE

NOT TO SCALE



PIPE BEDDING AND BACKFILL DETAIL FOR NON-PAVED SURFACE

NOT TO SCALE

REVISION:
DATE: BY: DESC:

DRAWN BY: CLA
DESIGNED BY: CJG
CHECKED BY: AMD
APPROVED BY:
PROJECT NO:
DATE: 6/2022

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

SCALE IN FEET
0 N.T.S.

ATLANTIC RICHFIELD COMPANY
COLORADO DUMP WEST LOT
REMEDIAL ACTION WORKPLAN

PIPE BEDDING AND BACKFILL DETAILS

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SHEET
D-3

Appendix B
Technical Specifications

SECTION 01000
GENERAL PROCEDURES

A. TEMPORARY FACILITIES AND SITE CONTROL

1. Contractor shall implement an appropriate program to protect the work in progress and Atlantic Richfield Company's operations from theft, vandalism, and unauthorized entry.

2. Contractor shall provide temporary parking areas for project personnel.

3. Contractor shall use only those haul roads outside of the Project Area boundaries as approved by Atlantic Richfield Company prior to hauling. Contractor shall maintain all haul roads in good condition. Contractor shall provide dust control to ensure that dust levels are minimized, and to comply with current standards.

4. Contractor shall notify and coordinate with all appropriate utility companies and Atlantic Richfield Company before conducting work proximate to overhead and buried utilities.

5. Contractor shall only cross the existing railroad at existing crossings or newly installed crossings as approved by the railroad owner and Atlantic Richfield Company. The railroad owner has the right to limit the crossings where loaded haul trucks will be allowed to cross.

6. Contractor shall contact the utility owner to determine cover or clearance requirements of the existing utilities. The Contractor shall be responsible for improving existing roads or installing new roads so that they will satisfy these requirements.

B. SURVEYING

1. Construction staking services for control points, reference grid, initial location of site structures, initial setting of centerlines, and surveys to determine pay quantities will be provided by Atlantic Richfield Company. Contractor shall be responsible for providing all other surveying and staking requirements necessary to conduct the Work.

2. Original Survey Control monuments will be furnished by Atlantic Richfield Company and are shown on the Construction Drawings. Maintenance of the original staking is the obligation of the Contractor. Any additional staking is at the Contractor’s expense.

3. A licensed land surveyor shall reset any property corner or monument, including MDT right-of-way markers, that are damaged or buried by Contractor due to construction, at the expense of the Contractor. Contractor shall reset all survey monuments disturbed or buried during the Remedial Action (RA). A licensed surveyor shall complete all work related to this item.

C. SUBMITTALS

1. The Contractor shall provide to Atlantic Richfield Company complete product information and shop drawings, where required, for all materials and equipment proposed for incorporation into the project. Information shall include manufacturer, model or catalog designation, reference standards, complete installation instructions, and shop drawings that show dimensions and locations of all parts. Information shall be submitted in a timely manner before ordering to provide Atlantic Richfield Company time for review and approval.

2. In connection with all of the activities described in these Technical Specifications, the Contractor shall be responsible and shall notify Atlantic Richfield Company and Atlantic Richfield Company's representatives of any governmental laws or regulations, in addition to those identified in these specifications and the Remedial Action Work Plan (RAWP), including those relating to environmental protection and zoning, that would regulate, prohibit, or control the Contractor's performance under these Technical Specifications.

3. Contractor will not be responsible for submittal of materials testing results for the materials being provided by Atlantic Richfield Company. Contractor will be responsible for materials testing results for Contractor-supplied materials for the project.

D. SITE SAFETY AND CONTROL OF WORK

All Work will be performed in a safe manner and will conform to Atlantic Richfield Company's Control of Work criteria. Site Safety during the course of Work (including traffic and dust control operations) will be the sole responsibility of the Contractor. Adequate signs, barricades, cones, drum, barriers, lighting, persons or flaggers, security guards, and other methods or devices shall be used.

E. EROSION AND SEDIMENT CONTROL

The Contractor shall plan and execute work to control and minimize surface runoff from cuts, fills, and other disturbed areas. The Contractor shall prevent sediment and/or sediment-laden water from entering nearby waterways. The Contractor shall comply with the substantial requirements of the Montana Department of Environmental Quality's *General Permit for Storm Water Discharges Associated with Construction Activity.*

F. CONSTRUCTION SEQUENCING AND OTHER CONTRACTORS

1. The Contractor shall coordinate his construction activities with those of any and all other contractors that may be working on the Site. The Contractor's work will be conducted in a manner that will not impede the progress of other concurrent construction activities or landowner(s) operations.

2. Areas receiving cover soil will be seeded in the spring or fall depending on construction sequencing, or as approved by Atlantic Richfield Company.

3. Contractor shall dispose of debris and all material excavated during the project in areas designated by Atlantic Richfield Company or its representative.

G. EXISTING STRUCTURES

The contractor shall be responsible for protecting all existing structures within and external to the construction area. Damage to existing structures shall be corrected by the Contractor at no additional cost to Atlantic Richfield Company.

H. COMMUNICATIONS

All notices, demands, requests, instructions, approvals, proposals, and claims by the Contractor must be in writing. All correspondence is required to be delivered to Atlantic Richfield Company, unless otherwise specified in writing to the Contractor.

I. PROGRESS MEETINGS

Project coordination will be facilitated through weekly job site meetings. At a minimum, the Contractor's on-site Project Manager, Health and Safety Manager, and appropriate field personnel shall be present at the progress meetings. The Contractor shall develop the agenda and record and distribute meeting minutes for the progress meetings. The topics shall include but not be limited to the following:

1. Health and safety issues.
2. Status of work items initiated to date.
3. Scheduled items for the following week.
4. Quality Control and Quality Assurance.
5. Problems encountered and proposed solutions.
6. Other items identified by Atlantic Richfield Company or Contractor.
7. Coordination of work activities with property owner(s).

A landowner site walk is required with Atlantic Richfield Company and/or their representative(s), Agency personnel, and others as required prior to beginning work. Meeting minutes will be incorporated into the project records.

J. RECORD KEEPING REQUIREMENTS

The contractor shall maintain a complete set of all Contract Documents, addenda, change orders, and other modifications to the Work on site, at all times.

The Contractor shall be responsible for furnishing detailed Project Record Documents (Record Drawings). Record Drawings may be submitted on grid paper drawn to the proper scale. Record Drawings must be updated on a weekly basis, and an updated Project Record Document must be attached with the final Application for Payment (unless waived by Atlantic Richfield Company).

K. SUPPLEMENTAL SPECIFICATIONS

The Technical Specifications for the RAWP are supplemented by the Montana Public Works Standard Specifications, Latest Edition (MPW Specifications), and Butte-Silver Bow Public Works Material Specifications, Latest Edition (BSB Specifications)

In performance of the Work, these Technical Specifications shall take precedence over the Standard Specifications. If, during the performance of the Work, the Contractor finds a conflict, error, or discrepancy between these Technical Specifications and the MPW Specifications or BSB Specifications, the conflict, error, or discrepancy shall be reported to Atlantic Richfield Company at once, before proceeding with the affected Work. The Contractor may proceed with the work only after receiving a written interpretation or clarification from Atlantic Richfield Company.

END OF SECTION 01000

SECTION 01300
SUBMITTALS

A. GENERAL

1. DESCRIPTION: The following specification includes the procedures for submitting "Shop Drawings" as required in these specifications. Items that need to be reviewed by the Engineer are included with this specification. Also refer to the "Submittal" section of each Technical Specification section for additional requirements.

2. DEFINITIONS:

    a. Shop Drawings: The term "shop drawings" includes drawings, diagrams, layouts, schematics, descriptive literature, manufacturer's information, illustrations, schedules, performance and test data, and similar materials requested by the Engineer to be furnished by the Contractor to explain in detail specific portions of the Work required by the Contract.

    b. Contractor's Review and Approval: The Contractor shall coordinate all submittals and review them for accuracy, completeness, and compliance with contract requirements and shall indicate his approval thereon as evidence of such coordination and review. All submittals shall be attached to the "Shop Drawing Submission" Form that is included in this Contract Document. The form shall be filled out, signed, and stamped by the Contractor. Items submitted to Engineer without this form or Contractor's stamp and approval will be returned for resubmission. By attaching this form to the submittal, the Contractor is representing that he has reviewed the entire submittal, that the submittal is in compliance with the Contract Documents, except as noted, and that the cover form applies to all documents that are attached to the form.

B. PRODUCTS

1. NONE.

C. EXECUTION

1. SUBMITTAL PROCEDURE: Shop Drawings shall be submitted as follows:

    a. Date and Number: Contractor shall forward to Engineer all submittals required by the individual sections of the Technical Specifications. All submittals shall be returned to the Contractor within 7 days following their initial review. If follow-up reviews are required, they shall be reviewed within 5 days. Unless a different number is called for in the individual sections, submit 6 copies of each shop drawing, 6 copies of all operation and maintenance instructions, and 4 specimens of each sample requested, of which all but 2 copies will be retained by the Engineer. The other copies shall be returned to the Contractor along with the

Engineer's comments. If the Contractor wants more than two copies sent to him, he shall submit whatever additional copies he desires.

b. Cover Letter: All submittals shall be forwarded with a cover letter from the Contractor, identifying the project and the portion of the project to which it applies. Submittals that are related to or affect each other shall be forwarded simultaneously as a package to facilitate a coordinated review. Uncoordinated submittals will be rejected.

c. Modifications: Any modifications to the design proposed by the Contractor shall be fully explained in the submittal. All necessary calculations and supporting documentation shall be included. If requested by the Engineer, the Contractor shall provide design drawings of the modification stamped by a professional engineer licensed to practice in the State of Montana.

D. ENGINEER'S APPROVAL

The Engineer will indicate his approval or disapproval of each submittal; if the Engineer does not approve the submittal as submitted, he will indicate his reasons. Any work done prior to approval shall be at the Contractor's own risk. Neither approvals nor lack of reviews or approval shall relieve the Contractor from responsibility for supplying materials and performing all work according to the requirements of these Contract Documents. If submittals show variations from the Contract requirements, the Contractor shall describe such variations in writing, on the before mentioned form at the time of submission. Approval of such variation(s) shall be accompanied with a Contract Modification. Minor variations not involving a change in price or time of performance will not be issued a modification.

E. REQUIRED SUBMITTALS

1. Permits: Submit to the Engineer a copy of all permits required by the governing authorities, for which the Contractor is responsible.

2. Subcontractors: The Contractor shall supply a list of all suppliers and Subcontractors to be used on the project.

3. Certificates: For those items called for in individual sections, furnish certificates from manufacturers, suppliers, or others certifying that materials or equipment being furnished under the Contract comply with the requirements of these specifications.

4. Shop Drawings: Include all materials and equipment supplied on the project. See the individual sections for specific requirements. If an alternate is proposed, explain fully and, if approved, make all necessary adjustments needed to accommodate any differences in the product.

5. Progress Schedule and Sequence of Work Schedule: The Contractor shall submit to the Engineer a Progress Schedule and Sequence of Work Schedule with the completed

Agreement. The Sequence of Work Schedule shall show the order in which work shall be undertaken by the Contractor and shall show which items of Work shall be going on simultaneously. The Progress Schedule shall show estimated starting and completion dates for each part of the Work. The Progress Schedule shall be revised monthly to show project progress revisions to the schedules. The revised schedule shall be submitted monthly.

If the Contractor is behind schedule, he shall also submit a plan as to how he will get back on schedule.

6. Site-Specific Health and Safety Plan:

CONTRACTOR shall submit a written Site-Specific Health and Safety Plan prior to commencing work. The plan, at a minimum, shall include:

- Site Characterization.
- Description of Work Summary.
- Location Map and Site Characteristics.
- Emergency Response Plans.
- Security Arrangements/Instructions.
- Physical and Chemical Hazard Analyses.
- Specific Task Job Safety Analyses (JSA) for all work tasks.
- Authorization to Work Procedures.
- Personal Protective Equipment (PPE) Requirements.
- Medical Surveillance.
- Permits Required.
- Decontamination Procedures.
- Site Sanitation Requirements.
- Standard Operating Procedures (SOPs).
- Heavy Equipment Operational Safety.
- Underground and Overhead Utilities.
- Trenching and Excavation.
- Confined Space.
- Hand and Power Tools.
- Hearing Conservation.
- Electrical Safety.
- Fall Protection.
- Fire Prevention.
- Respiratory Protection.
- Site Authorities and Responsibilities.
- Applicable Material Safety Data Sheets (MSDSs).
- Kick-off Meeting Content/Project Safety Reviews.
- Sign-Off Lines.

7. Traffic Control Program: Traffic control will be the sole responsibility of the Contractor during the course of Work. Adequate signs, barricades, cones, drums, barriers, lighting, persons or flaggers, security guards, and other methods shall be used as needed. Contractor will also be responsible for dust control.

8. Materials Samples: The Contractor shall also submit all samples (furnished by the Contractor) required by the Contract Documents to the Engineer for review and approval with such promptness as to cause no delay in Work. All samples will have been checked by and accompanied by a specific written indication that Contractor has satisfied Contractor's responsibilities under the Contract Documents with respect to the review of the submission and will be identified clearly as to material, Supplier, pertinent data such as catalog numbers, and the use for which it is intended.

9. Closeout Submittals: Contractor shall provide all required closeout submittals. For example, As-Built Drawings, manufacturer's help and product lines necessary to maintain and install equipment. Contractor will provide all submittal requirements necessary to properly close out the project.

END OF SECTION 01300

TRANSMITTAL OF SHOP DRAWINGS	DATE		NEW SUBMITTAL		RESUBMITTAL
Pioneer Technical Services, Inc. P.O. Box 3445 1101 South Montana St Butte, Montana 59701 ATTN: CC:	FROM:			TRANSMITTAL NO. PROJECT NO.	
	PROJECT TITLE AND LOCATION:				

ITEM NO.	DESCRIPTION OF ITEM SUBMITTED (Type, Size, Model Number, Etc.)		MANUFACTURER OR SUPPLIER	NO. OF COPIES	SPECIFICATION PARAGRAPH & PAGE NO.	DRAWING NO.	BID TEM NO.
1							
2							
3							
4							
5							

LIST ALL VARIANCES FROM CONTRACT DOCUMENT REQUIREMENTS

I hereby certify that all Contractor's responsibilities under the Contract Documents with respect to review and submission of the above shop drawings have been satisfied and that each shop drawing has been stamped and/or marked to indicate Contractor's compliance with the Shop Drawing review requirements.

SIGNED_____

(NAME & TITLE)

SECTION 02010
MOBILIZATION

PART 1 GENERAL

A. WORK INCLUDED

This work item constitutes all preparatory work and operations performed by the Contractor, including but not limited to those actions necessary for the transportation and movement of personnel, equipment, supplies, and incidentals to the project site; and for the establishment of all offices and other facilities necessary to work on the project. Mobilization for subcontractors and subcontracted work will be considered to be included.

Mobilization shall include the preparation of staging area(s). Drainage and erosion protection for staging areas shall be provided during construction as approved by Atlantic Richfield Company. Oil, grease, and other solid or liquid wastes shall not be disposed of in the staging area or on the project site. All solid or liquid wastes shall be disposed of off site at a properly licensed facility. Immediately following completion of construction, the staging area(s) shall be thoroughly cleaned of all trash and debris, scarified, and revegetated.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

A. REQUIREMENTS

Provide all labor, tools, equipment, materials, staging area(s), offices, facilities, and incidentals necessary to complete the work as specified.

B. Adequate notification (not less than 72 hours) to the property owner(s) of Contractor mobilization requirements shall be completed by the Contractor prior to beginning any work, including but not limited to utility locates.

END OF SECTION 02010

SECTION 02110
SITE CLEARING

PART 1 GENERAL

A. CONDITIONS

Work covered by this section consists of furnishing all materials, labor, and equipment for the clearing and grubbing required to complete the work specified on the Construction Drawings, including the removal and satisfactory disposal of all trees, downed timber, brush, projecting roots, stumps, rubbish, and all other objectionable material within the clearing lines approved by Atlantic Richfield Company, subject to the terms and conditions of the Contract. During clearing, grubbing, and stump removal, topsoil will be protected at all times.

B. SECTION INCLUDES

1. Removal of surface debris.

2. Clearing and grubbing of trees, shrubs, and other plant life and grass in the area directly affected by the construction activities associated with this Contract.

3. Preservation of trees and shrubs designated to remain.

C. RELATED SECTIONS

Section 02112 – Removal of Existing Structures
Section 02205 – Fill Materials and Placement
Section 02222 – Site Grading, Excavation & Embankment

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

A. PREPARATION

1. Contractor shall verify that existing plant life designated to remain is flagged or otherwise identified.

2. Contractor shall protect all property corners or other items from disturbance.

3. Prior to clearing, Contractor shall ascertain the limits of the structures so as not to remove any vegetation that does not require removal. This responsibility will rest

solely with the Contractor, and any damage caused by the Contractor as a result of such negligence will be at Contractor's own risk. Contractor must confine the operation of equipment to within excavation limits, setbacks from surface water/wetland areas, easements, and approved haul roads except as otherwise approved in writing by Atlantic Richfield Company. Any damage occurring outside these areas will be repaired at Contractor's expense.

B. PROTECTION

1. Contractor shall locate, identify, and protect from damage, existing utilities, monitoring wells, or other items identified on the Construction Drawings that will remain in service during and/or after construction. Any monitoring wells, survey control points, towers, or other unique structures not shown on the Construction Drawings or specified as being removed, will be preserved, unless otherwise directed by Atlantic Richfield Company.

2. Contractor shall protect survey monuments and existing structures from damage or displacement, including all monitoring wells.

C. CLEARING

1. Contractor shall clear areas as required for access to the Site and for execution of the Work as approved by Atlantic Richfield Company.

2. Contractor shall locate all stockpiles in areas approved by Atlantic Richfield Company.

3. Contractor shall remove identified trees, shrubs, stumps, roots, brush, rubbish, and other objectionable materials as designated by Atlantic Richfield Company.

4. At any time during construction, Atlantic Richfield Company may designate certain trees to be removed or retained.

5. Areas that are disturbed shall be graded, seeded, fertilized, and mulched as directed by Atlantic Richfield Company.

D. REMOVAL

Disposal of all trees, branches, snags, brush, stumps, debris, etc. resulting from clearing and grubbing will be the responsibility of Contractor and will be disposed of within an Atlantic Richfield Company-designated disposal area at Contractor's expense.

END OF SECTION 02110

SECTION 02112
REMOVAL OF EXISTING STRUCTURES

PART 1 GENERAL

A. DESCRIPTION

Work covered in this section consists of removing and disposing of structures designated for removal on the Construction Drawings or as approved by Atlantic Richfield Company.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

A. REMOVAL

Contractor shall dispose of all existing structures specified in the Construction Drawings or directed by Atlantic Richfield Company. Exercise care in such removal to ensure that remaining nearby facilities and/or existing facilities are not disturbed. Contractor shall restore to original condition any such existing facilities or structures damaged by construction activities.

Removal and replacement of structures not specified in the Construction Drawings or directed by Atlantic Richfield Company will be performed at no additional cost to Atlantic Richfield Company.

END OF SECTION 02112

SECTION 02205
FILL MATERIALS AND PLACEMENT

PART 1 GENERAL

A. SECTION INCLUDES

This section specifies fill materials, identifies sources of fill materials, and specifies fill placement requirements for the Colorado Dump – West Lot Remedial Action Design.

B. RELATED SECTIONS

Section 02110 – Site Clearing
Section 02207 – Aggregate Materials
Section 02222 – Site Grading, Excavation, and Embankments
Section 02250 - Channel Construction

C. DEFINITIONS

Several types of fill materials will be used in the Colorado Dump Remedial Action Construction. Imported fill materials will include Engineered Cap Material, Type III Riprap, Type F Filter Bedding Material, Type I Pipe Bedding Material, Type A Trench Backfill (if necessary), and Debris. Descriptions of the fill materials and their components are as follows:

General On-Site Fill Material

General On-Site Fill Material consists of all existing soil materials that may be encountered on site. This material will be used for preliminary cut-fill operations to aid in landscaping and grading of the site.

Engineered Cap Material (1½-inch Minus)

Engineered Cap Material will consist of material that is free of organic material, such as vegetation, roots, or peat. Engineered Cap Material may not contain rocks greater than 1½ inches in average dimension unless approved by Atlantic Richfield Company. All rocks shall be dispersed so that they are surrounded by fine grain material to form a dense layer. The Engineered Cap will be a well graded material meeting the gradation requirements specified in Section 02207-Aggregate Materials.

Type III – Riprap

Type III Riprap will consist of well graded, clean, angular material as described in Section 02207-Aggregate Materials. Type III Riprap will not contain fine materials and will have a maximum size of 6 inches.

Type F – Filter Bedding Material (for Type III Riprap)

Type F Filter Bedding Material will consist of material less than 4 inches in average diameter unless approved by Atlantic Richfield Company. This material will be the bedding for Type III Riprap and will meet the gradation requirements specified in Section 02207 – Aggregate Materials.

Type I Pipe Bedding Material (for subsurface piping)

Pipe Bedding Material will be Type I Pipe Bedding from the Montana Public Works (MPW) Standard Specifications (7th Edition). This material will consist of crushed stone or gravel free of cementitious substances or thin, flat particles. Gradation requirements for Type I Pipe Bedding Material is specified in Section 02207 – Aggregate Materials.

Type A Trench Backfill (for unsuitable backfill)

Trench Backfill will be Type A Trench Backfill from the MPW Standard Specifications (7th Edition). This material will be used only if the existing on-site material is deemed unsuitable by the Engineer. Unsuitable material includes excavated soil that is saturated or contain deleterious materials. Gradation requirements for Type A Trench Backfill are specified in Section 02207 – Aggregate Materials.

Debris

Debris within the Project Area will be removed and disposed of at areas designated by Atlantic Richfield Company. Any wood, concrete, bricks, scrap iron, or any other debris encountered during construction will be removed and disposed of as directed by Atlantic Richfield Company.

D. REFERENCES

1. Sampling and Preparation.

    a. ASTM D75 - Standard Practice for Sampling Aggregates.

    b. ASTM D420 - Recommended Practice for Investigating and Sampling Soil and Rock.

2. Classification.

    a. USDA – USDA Methods for Soil Analysis, Agronomy Society of America, 1982.

    b. ASTM D421 - Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants.

    c. Modified Day, Method 15-5 (ASA, 1986) hydrometer test for determining particle size (includes % sand, silt, and clay).

    d. Soil Survey Staff (1993), textural triangle for determining texture classification (Based on % sand, silt, and clay).

    e. ASTM D2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

    f. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

g. AASHTO T89 – Determining the Liquid Limit of Soils.

h. AASHTO T90 – Determining the Plastic Limit and Plasticity Index of Soils.

3. Density and Moisture Content: Field.

a. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Willow Depth).

b. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

4. Density and Moisture Content: Laboratory.

a. ASTM D698 or AASHTO T99 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.

b. ASTM D1557 or AASHTO T180 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10.0 lb Rammer and 18 inch Drop.

c. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil, Rock and Soil Aggregate Mixtures.

d. ASTM D4643 - Determination of Water (Moisture) Content of Soil, Microwave Oven Method.

e. ASTM D4718 - Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.

PART 2 PRODUCTS

A. SOIL MATERIALS

(Not used)

B. SOURCE QUALITY CONTROL

1. Testing and analysis of soil materials will be performed according to applicable AASHTO or ASTM test methods, as listed under Part 1D of this section. Atlantic Richfield Company will conduct the testing and analysis of the soil materials and provide the results to the Contractor.

2. The frequency and need for testing will be determined by Atlantic Richfield Company.

3. Testing and analysis of soil materials supplied by the Contractor will be performed according to applicable AASHTO or ASTM test methods, as listed under Part 1D of this section. Contractor will be responsible for conducting the testing and analysis of the Contractor-provided materials. Contractor will provide test results to Atlantic Richfield Company prior to procurement and transportation to the site for review and approval as outlined in Section 1300 – Submittals.

4. The frequency of testing of Contractor-supplied materials will be 1 out of every 500 loose cubic yards or a minimum of two samples. It is the Contractor's responsibility to obtain, from the source, representative samples to be tested to avoid conflict with field density testing.

PART 3 EXECUTION

A. SOURCE OF MATERIALS

1. **Type III Riprap Material:** Obtain from Atlantic Richfield Company-approved sources. Material shall meet specifications as defined in Section 02207.
2. **Type F Filter Bedding Material:** Obtain from Atlantic Richfield Company-approved sources. Material shall meet specifications as defined in Section 02207.
3. **Engineered Cap Material (1½-inch Minus):** Obtain from Atlantic Richfield Company-approved sources. Material shall meet specifications as defined in Section 02207.
4. **Type I Pipe Bedding (MPW):** Obtain from Atlantic Richfield Company-approved sources. Material shall meet specifications as defined in Section 02207.
5. **Type A Trench Backfill (MPW):** If necessary, obtain from Atlantic Richfield Company-approved sources. Material shall meet specifications as defined in Section 02207.
6. **Debris:** Potential for encountering debris in the Project Area is high. Debris shall be disposed of as directed by Atlantic Richfield Company.

B. PREPARATION FOR PLACEMENT

1. **All Imported Fill Materials:** For all areas receiving imported materials, determine boundaries from the Construction Drawings. Stake the boundaries of each area as shown on the Construction Drawings with Atlantic Richfield Company oversight. Each boundary will be field verified by Atlantic Richfield Company prior to placement of soil materials. Clear, grub, and remove debris and grade areas prior to material placement. Verify that all necessary grading is completed and approved.

C. IMPORTED MATERIAL PLACEMENT

1. Riprap, Filter Bedding Material, Pipe Bedding Material, Engineered Cap Material, and Trench Backfill (if necessary)

a. Contractor shall place material in designated areas and to the designated depths and quantities as stated on the Construction Drawings.

b. Contractor shall ensure that material does not mix with existing soil material or other backfill materials prior to placement.

2. Debris

Contractor shall distribute debris evenly throughout the debris disposal areas designated by Atlantic Richfield Company. Contractor shall fill large voids within the debris with other on-site soil as directed by Atlantic Richfield Company.

D. COMPACTION

1. General On-Site Fill Material

a. Contractor shall compact general on-site fill material that will be used as subgrade (to engineered cap, filter bedding, pipe bedding) to a minimum 95% maximum dry density (AASHTO T-99/ASTM 698) while the material is within plus or minus 3% of the optimum moisture content.

2. Engineered Cap Material

a. Contractor shall compact Engineered Cap Material to a minimum of 95% maximum dry density (AASHTO T-99/ASTM 698) while the material is within plus or minus 3% of the optimum moisture content.

3. Trench Backfill (if necessary)

a. Contractor shall compact Trench Backfill to a minimum of 95% maximum dry density (AASHTO T-99/ASTM 698) while the material is within plus or minus 3% of the optimum moisture content.

4. Debris

a. Debris material shall be compacted in debris disposal areas to minimize settlement. Debris shall be crushed and reduced in size to the extent possible before covering with fill. Debris placed in designated disposal areas shall be compacted to the extent possible in lifts not to exceed 24-inches thick (unless otherwise approved by Atlantic Richfield Company due to the size of the debris) to minimize future settlement of the fill.

END OF SECTION 02205

SECTION 02207
AGGREGATE MATERIALS

PART 1 GENERAL

A. SECTION INCLUDES

Aggregate materials for use in the engineered cap, riprap, construction of storm water channel, and structural fill as shown on the Construction Drawings.

B. RELATED SECTIONS

Section 02205 - Fill Materials and Placement
Section 02250 - Channel Construction

C. REFERENCES

None

D. SUBMITTALS

Contractor will not be required to submit material testing results for materials provided by Atlantic Richfield Company. Contractor will be required to submit materials testing results to Atlantic Richfield for materials provided by Contractor.

PART 2 PRODUCTS

A. AGGREGATE MATERIALS

1. Type III Riprap: Rock, solid, durable, and nonfriable; free of thin, slab-type rock; minimum specific gravity of 2.5 or as approved by Atlantic Richfield Company. Riprap will be angular rock. Gradation for rock riprap shall be as follows:

Equivalent Spherical Diameter	Percent Passing
6 inches	100
5 inches	70 to 85
4 inches	40 to 70
3 inches	10 to 30

2. Type F Riprap Filter Bedding (For use beneath Type III riprap): 4-inch maximum thickness of Atlantic Richfield Company-approved soil meeting the following gradation requirements:

Sieve Size	Percent Passing
4 inches	100
1½ inches	65 to 95
No. 4	5 to 35
No. 200	0 to 5

3. Engineered Cap Material (1 ½-inch Minus): Crushed rock with a maximum diameter of 1½ inches. Material will be obtained from an Atlantic Richfield Company approved source following the gradation requirements below:

Sieve Size	Percent Passing
1½ inches	100
1 inches	90 to 96
½ inch	70 to 90
No. 4	40 to 70
No. 200	0 to 15

4. Type I Pipe Bedding Material (MPW): Bedding for subsurface piping shall have a maximum diameter of 1 inch and must be obtained from an Atlantic Richfield Company-approved source. Pipe Bedding Material shall follow the gradation requirements below:

Sieve Size	Percent Passing
1 inch	100
¾ inch	90 to 100
⅜ inch	20 to 55
No. 4	5 to 10
No. 8	0 to 5

5. Type A Trench Backfill (MPW): Trench backfill used for unsuitable existing on-site backfill will have a maximum diameter of 1 inch and must be obtained from an Atlantic Richfield Company-approved source following the gradation below:

Sieve Size	Percent Passing
1 inch	70 to 100
No. 4	40 to 80
No. 10	25 to 60
No. 200	2 to 35

B. SOURCE QUALITY ASSURANCE

Contractor shall supply documentation to Atlantic Richfield Company verifying that materials meet requirements outlined herein.

PART 3 EXECUTION

A. STOCKPILING

1. Contractor shall stockpile materials on site at locations designated by Atlantic Richfield Company. Stockpile areas may require stripping, as directed by Atlantic Richfield Company.

2. Stockpile in sufficient quantities to meet project schedule and requirements.

3. Separate different materials with dividers or stockpile separately to prevent mixing.

4. Direct surface water away from stockpile areas to minimize erosion or deterioration of materials.

5. Manage stockpile in a manner that minimizes segregation of graded materials.

B. STOCKPILE CLEAN UP

1. Contractor shall completely remove stockpile, unless otherwise directed by Atlantic Richfield Company, and leave the area in a clean and neat condition. Grade site surface to promote surface drainage and to prevent free-standing surface water.

2. Leave borrow areas in a clean and neat condition. Grade site surface to promote surface drainage and to prevent free-standing surface water.

END OF SECTION 02207

SECTION 02222
SITE GRADING, EXCAVATION AND EMBANKMENT

PART 1 GENERAL

The work of this section covers all site grading, earthwork, and embankments required for the completion of the Colorado Dump Remedial Action (RA) Project. The Contractor shall perform all site grading, excavation, and embankment work required on the sites to the lines, dimensions, contours, and elevations indicated on the Construction Drawings (Drawings). This work shall include site grading, materials removal and disposal, final grading, excavation, construction of embankments, importation of borrow material, dressing, and cleanup of the site as required by the Drawings and specifications.

1. Classification of Excavation. All excavation shall be unclassified and shall consist of all materials encountered.

A APPLICABLE PUBLICATIONS

The publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American Association of State Highway and Transportation Officials (AASHTO).

AASHTO T-88	Particle Size Analysis of Soils
AASHTO T-180	Moisture-Density Relations of Soil Using a 10-lb. Rammer and an 18-in. Drop

2. Montana Department of Transportation Materials Manual of Test Procedures (MDT).

MT-412	Topsoil Sampling, Sample Preparation and Testing

PART 2 PRODUCTS

1. Embankment Materials. All material to be used in embankments shall be approved for suitability by Atlantic Richfield Company. Material to be used in embankments shall be existing on-site material and be free of organic material, such as vegetation, roots, or peat. Rocks larger than 6 inches (6") in average dimension shall not be used in embankments unless approved by Atlantic Richfield Company. All rocks shall be dispersed throughout the embankments to form a dense embankment.

2. Borrow or Waste Material. The intent for earthwork is to grade slopes and contours as shown on the Drawings using on-site soils. Although not anticipated, this may result in excess material or the importation of additional material (borrow). Excess material may be incorporated

elsewhere on the site or graded smooth in areas outside channel embankments at locations designated by Atlantic Richfield Company.

Borrow materials, if required, will be borrowed from the areas designated by Atlantic Richfield Company. Borrow materials shall be inorganic clays, loams, silts, sands, and clayey or silty gravels with rocks less than 1-½ inches in their largest dimension. Borrow material shall be free of stones greater than 12 inches in their maximum dimensions and free of organic materials.

PART 3
EXECUTION

1. Site Preparation

1 Clearing and Grubbing. Clearing and grubbing of the Site in both areas of excavation and embankment shall be done according to Section 02110 – Site Clearing. Topsoil, if encountered, shall be stripped.

2. Excavation

2.1. General. Excavation shall be performed to the lines, grades and elevations shown on the Drawings. Atlantic Richfield Company reserves the right to make minor adjustments or revisions in lines or grades if determined to be necessary as the work progresses to obtain satisfactory construction. The Contractor is responsible for field staking the earthwork. No excavation shall be started until the staking is complete and approved. Should the Contractor excavate below the designated limits through fault or negligence, the Contractor shall replace such unauthorized over excavation with approved materials in an approved manner at his own expense.

2.2. Classification. All excavation shall be considered unclassified. All material encountered of whatever nature shall be removed and used or disposed of as specified in this section. The presence of rock or frozen material shall not constitute a claim by the Contractor for extra work.

2.3. Stockpiling. If at the time of excavation it is not possible to place suitable excavated material as fill (if needed), the material shall be stockpiled in approved areas for later use.

2.4. Blasting. Blasting for excavation or other purposes will not be permitted without prior approval by Atlantic Richfield Company.

3. Embankment

3.1. Limits of Embankment. Embankment shall be placed to the lines, grades, and elevations shown on the Drawings. Atlantic Richfield Company reserves the right to make minor adjustments or revisions in lines or grades, if determined to be necessary as the work progresses to obtain satisfactory results.

3.2. Scarifying. Following clearing and grubbing and immediately prior to placing embankment material or concrete structures and concrete ditches, the entire area underlying the embankment shall be scarified and broken by means of a disc harrow, plow, or other approved equipment to a depth of 6 inches (6”). Scarifying shall be done approximately parallel to the longitudinal axis of the embankment. Where embankment is to be placed against an existing slope or bank, steps shall be cut into the existing slope or bank to key the new embankment into the existing slope or bank. All topsoil, roots, debris, large stones, or other unsuitable material exposed by this operation shall be removed and disposed of as specified by Section 02110 – Site Clearing. Following scarification, the surface shall be recompacted to at least 95% of the maximum dry density per AASHTO T-180.

3.3. Placing of Material. Embankment material, or native subgrade material, shall be placed in successive horizontal layers of not more than 8 inches (8") in compacted depth across the full width of the cross-section. Another layer shall not be placed until the preceding layer is compacted as specified below. Layers shall be constructed approximately parallel to the finished grade line, starting in the deepest portion of the embankment. Rocks or clods larger than 2 inches (2") in their greatest dimension shall not be placed in the top or outside 6 inches (6") of the finished grade. Excessively wet material or frozen material shall not be placed in the embankment nor shall material be placed upon frozen material. Embankments shall be constructed larger than final grading such that the embankment can be cut to its final lines and contours during final grading leaving a compacted, finished surface.

3.4. Compaction of Material. Native subgrade material shall be compacted to at least 95% of the maximum dry density as determined by AASHTO Method T-180. Before compaction, subgrade material shall be moisture-conditioned. Wetting, drying, or manipulation of the material may be required to maintain a uniform moisture content throughout the cross-section. Subgrade compaction shall extend completely across the cross-section, commencing at the sides and progressing toward the center, overlapping at each preceding passage by approximately one-half the width of the compacting equipment. The equipment, unless otherwise directed, shall operate at a speed between 2 and 3 miles per hour. In order to equalize compaction across the cross-section, the Contractor shall route incidental travel of both his placing and compaction equipment evenly across the embankment cross-section. Any moisture conditioning required to wet or dry subgrade material shall be accomplished at no additional cost to Atlantic Richfield Company. Subgrade compaction in trenches within embankment shall be no less than 95% of the maximum dry density as determined by AASHTO T-180.

3.5. Density Testing. Field density tests of the compacted fill will run on all lifts at a frequency no less than one test per 5,000 square feet on each compacted lift. The next lift will not be started until compaction is approved on the preceding lift. The Contractor will remove any excess material above the layer to be tested. Tests will be made at locations selected by Atlantic Richfield Company. These tests will be performed by Atlantic Richfield Company. Such testing does not relieve the Contractor from his obligation of thoroughly compacting the embankment.

3.6. Drying. Subgrade material may require drying to achieve the proper moisture content before installation of overlay material. In some cases, mixing the wet material with dryer material may be allowed to reduce moisture content in lieu of drying.

4. Tolerances

The bottom surface and slopes of embankment sections shall be of such a degree of levelness that they will not vary more than 0.15 feet above or below the specified grade at any point. Gradeline elevations shall be within 0.15 feet of the elevations shown on the Drawings for slopes greater than 2%. The maximum elevation difference shall be 0.1 feet for channels with slopes of 2% or less. Any deviation in excess of this amount shall be corrected by the Contractor in an approved manner at no additional expense to Atlantic Richfield Company. Gradeline elevations and slopes cannot be changed from those shown on the Drawings without Atlantic Richfield Company written approval.

5. Weather Conditions

Earthwork operation shall be suspended at any time when satisfactory results cannot be obtained on account of rain, freezing weather, or other unsatisfactory field conditions. Should the Contractor obtain a job suspension due to weather as provided in the General Conditions, then all work on all portions of the project shall cease.

6. Drainage

During earthwork operations the grade shall be maintained in such a condition that it will be well drained at all times. If necessary, temporary drains or diversion ditches shall be installed to intercept or divert surface water which could affect the work. It is the responsibility of the Contractor to remove temporary drains or diversion ditches prior to the completion of work.

7. Surface and Groundwater Disposal

Any disturbed area that could allow surface water or trench dewatering water to reach a flowing stream shall meet the requirements of the project temporary erosion requirements.

8. Cleanup

Excess material will not be permitted to be accumulated and shall be removed concurrently with the finishing operation. Care will be taken to prevent the entrance of the material into drainage structures, other waterways, or storm sewers during the construction period.

END OF SECTION 02222

SECTION 02250
CHANNEL CONSTRUCTION

1.0 GENERAL

The work of this section covers storm water channel construction. The Contractor shall perform all site grading, excavation, and embankment needed to shape and construct the channels. All channels shall be constructed to the lines, dimensions, and elevations shown on the Construction Drawings.

2.0 APPLICABLE PUBLICATIONS

The publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM D698 or AASHTO T99 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.

3.0 MATERIALS

3.1 Riprap

Riprap shall meet the gradation requirements in Section 02207 – Aggregate Materials and shall be Type III Riprap Material, as designated on the Drawings.

3.2 Filter Bedding Materials

Filter Bedding Materials shall meet gradation requirements in Section: 02207 – Aggregate Materials. Filter Bedding Materials shall be Type F and used accordingly for Type III Riprap as outlined in Section 02207 – Aggregate Materials and on the Construction Drawings.

4.0 CONSTRUCTION

4.1 General

All channels shall be constructed to the lines, grades, elevations, and sections as shown on the Drawings. Grades shall be true and uniform between designated elevation points. Channel subgrades shall be carefully cut to match the required sections. The subgrade for channels shall be compacted to a minimum 95% maximum dry density (AASHTO T-180 Method-D/ASTM -1557 Method-D), as outlined in Section 02222 – Site Grading, Excavation, and Embankments.

4.2 Channel Construction

After the subgrade has been cut to the proper line and grade, the channels are to be covered by a 6-inch (6”) layer of Type F Filter Bedding Material, used for Type III Riprap Material. The Type III Riprap shall then cover the surface of the channels, as seen on the Construction Drawings, and shall have a thickness of 12 inches (12”).

5.0 TOLERANCES

Channels shall be constructed to plus or minus 0.10 feet of the final grades as shown on the Construction Drawings. The filter bedding materials shall be placed to a finished thickness of 6 inches (6”). Type III riprap shall be placed to a finished thickness of 12 inches (12”). Riprap shall be carefully placed on the filter bedding materials using a backhoe, loader, or similar machine in such a manner that the filter bedding materials will not be displaced. If the filter bedding materials are displaced, the riprap shall be removed, and the filter bedding materials repaired before carefully replacing riprap.

END OF SECTION 02250

SECTION 03310
STRUCTURAL CONCRETE

PART 1 - GENERAL

A. SECTION INCLUDES

Furnish structural concrete and grout meeting all specified requirements that is composed of Portland cement, aggregates, and water. Furnish ready-mixed concrete meeting ASTM C94 unless otherwise specified. Grout connections are anticipated for completion of manhole installation, but concrete installation is not anticipated for the completion of the Remedial Action Work at the Colorado Dump West Lot.

PART 2 - PRODUCT

A. CLASSIFICATION

Concrete is classified as set forth below. Place the specified class of concrete for each structure element as directed. Concrete with prefixes "C" contains 1½-inch (38.1 millimeter [mm]) size aggregate and those with "M" contain ¾-inch (19.05 mm) size aggregate. Concrete with prefixes "M" may be substituted for concrete with prefixes "C."

1. Use M-4000 concrete for curb and gutter, sidewalks, driveways, approaches, curb turn fillets, valley gutters, and structural concrete.

2. Use M-3000* concrete for pipe diversion manholes and miscellaneous or C-3,000 Concrete Construction class.

3. M-3000 is concrete with ¾-inch (19.05 mm) maximum aggregate and a 28-day strength of 3,000 pounds per square inch (psi) (20.7 Megapascals [Mpa]).

4. M-4000 is concrete with ¾ inch (19.05mm) maximum aggregate and a 28- day compressive strength of 4000 pounds per square inch (psi) (27.6 Mpa)

5. C-3000 is concrete with 1½-inch (38.1 mm) maximum aggregate and a 28-day strength of 3,000 psi (20.7 Mpa).

If concrete strength or durability requirements established by design exceed the above strength classifications, the Engineer may specify additional concrete classifications to meet those requirements.

*C-3000 may be used if the narrowest dimension between forms exceeds 7½ inches (190.5 mm) or if the slab thickness exceeds 4½ inches (114.3 mm).

Grout material shall be comprised of the same concrete as used in other concrete materials on site.

B. COMPOSITION OF CONCRETE AND GROUT MATERIALS

Upon receipt of the notice of award of the contract, furnish the Engineer with names of suppliers and locations of sources of materials proposed for use.

1. Materials

a. Cementitious Material

Cementitious material consists of Portland cement meeting ASTM C150, with or without the addition of cementitious or pozzolanic mineral admixtures meeting ASTM C618 or ASTM C989, or blended hydraulic cement meeting ASTM C595 or ASTM 1157. Unless otherwise specified, ensure cementitious material meets ASTM C150 Type V specifications. Compliance can be met by using Type V cement or by combining a minimum 20% Class F fly ash to a standard Type I or II cement to meet high sulfate resistance requirements (ASTM C-1202 testing). Ensure cementitious material used in concrete is the same brand and type and from the same plant of manufacture as the cementitious material used in the concrete represented by the submitted field test date or used in the trial mixtures.

b. Aggregates

Ensure aggregates meet ASTM C33. When a single size or a combination of two or more sizes of coarse aggregates is used, ensure the final gradation meets the grading requirements of ASTM C33. Obtain concrete aggregates from the same source and use the same size ranges as the aggregates used in the concrete represented by submitted historical data, or used in trial mixtures.

c. Water and Ice

Use concrete mixing water and water used to make ice meeting the requirements of ASTM C94.

d. Admixtures

Use admixtures meeting the following requirements:

1. Air entraining admixtures - ASTM C260.
2. Chemical admixtures - ASTM C494.
3. Chemical admixtures for use in producing flowing concrete - ASTM C1017.
4. Calcium Chloride - ASTM D98.

Use admixtures in the concrete that are the same as those used in the concrete represented by submitted field test data or in trial mixtures.

e. Change of materials

When brand, type, size, or source of cementitious materials, aggregates, water, ice, or admixtures are requested to be changed, submit new field data or data from new trial mixtures or furnish evidence that indicates that the change will not adversely affect the relevant properties of the concrete for acceptance before using the concrete.

2. Performance and Design Requirements

a. Cementitious Material Content

Ensure the cementitious material content is adequate to meet the specified requirements for strength, water-cement ratio, and finishing requirements. For concrete used in floors, ensure the cement content is at least that indicated in Table 2a. Acceptance of lower cement content is contingent upon verification that concrete mixtures with a lower cement content will meet the specified strength requirements and will produce concrete with equal finish quality, appearance, durability, and surface hardness. When a history of finishing quality is not available, evaluate the proposed mixture by placing concrete in a slab at the job using job materials, equipment, and personnel. Ensure the slab is as least 8 feet (2.5 m) square and has an approved thickness. Slump cannot exceed the specified slump. Submit evaluation results for acceptance.

Table 2a- MINIMUM CEMENT CONTENT REQUIREMENTS

Nominal Maximum size of aggregate, inches (mm)	Minimum cement content lb/yd^3 (kg/m^3)
1½ (38.1)	470* (163.0)
1 (25.4)	520 (180.3)
¾ (19.05)	540 (187.3)
⅜ (9.5)	641 (222.3)

*Minimum cement content is 520 lb/yd^3 (180.3 kg/m^3) if concrete will be exposed to freezing and thawing in the presence of deicing chemicals.
kg/m^3: kilograms per cubic meter; lb/yd^3: pound per cubic yard; mm: millimeter

b. Slump

Furnish concrete at the point of delivery having a slump of 4 inches (100 mm) determined by ASTM C143. Meet slump tolerances in ACI 117. When a plasticizing admixture is used meeting ASTM C1017 or when a Type F or G high range water reducing admixture meeting ASTM C494 is approved to increase the concrete slump, ensure the concrete has a slump of 2 to 4 inches (50 to 100 mm)

before the admixture is added and a maximum slump of 8 inches (200 mm) at the point of delivery after the admixture is added.

For extrusion curbs the slump at the point of delivery shall be 0 to 1 inch (0 to 25 mm).

c. Size of Coarse Aggregate

Ensure the nominal maximum size of coarse aggregate does not exceed ¾ of the minimum clear spacing between reinforcing bars, ⅕ of the narrowest dimension between sided of forms or ⅓ of the thickness of slabs or toppings.

d. Air Content

Concrete must be air entrained. Ensure air content at the point of delivery meets Table 2d requirements for severe exposure. For compressive strengths above 5,000 psi (34.5 Mpa), the total air content in Table 2d may be reduced by 1%. Measure air content under ASTM Cl38, C173, or C231. Unless otherwise specified, ASTM C231 shall be used.

TABLE 2d
TOTAL AIR CONTENT* OF CONCRETE FOR VARIOUS SIZES OF COARSE AGGREGATE

Nominal maximum Size of aggregate, mm (inches)	**Total Air Content **, %**		
	Severe Exposure	Moderate Exposure	Mild Exposure
Less than 9.53 (⅜)	9	7	5
9.53 (⅜)	7.5	6	4.5
12.7 (½)	7	5.5	4
19.05 (¾)	**6**	**5**	**3.5**
25.4 (1)	6	4.5	3
12.7 (1½)	5.5	4.5	3
50.8 (2)	5	4	2
76.2 (3)	4.5	3.5	1.5
152.4 (6)	4	3	1

* Measure in accordance with ASTM C138, C173 or C231
** Air content tolerance is plus or minus 1 to 1½ percent.
mm: millimeters.

e. Admixtures

When admixtures are specified in the Contract documents for particular parts of the work, use types specified. Use of calcium chloride or other admixtures containing chloride ions is subject to the limitations in Section B.2.g, Chloride Ion Concentration. When approved, use calcium chloride in solution form only when introduced into the mixture.

f. Chloride Ion Concentrations.

Ensure the maximum water-soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days, attributed to the ingredients including water, aggregates, cementitious materials, and admixtures, do not exceed the limits of Table 2f. Use tests to determine water soluble chloride ion content meeting AASHTO T260. The type of member described in Table 2f applies to the work as indicated in the Contract Documents.

TABLE 2f
MAXIMUM ALLOWABLE CHLORIDE ION CONTENT

Type of member	Maximum Water-Soluble Chloride Ion (CI) Content in Concrete (% by weight of cement)
Pre-stressed concrete	0.06
Reinforced concrete exposed to chloride in service	0.15
Reinforced concrete that will be dry or protected from moisture in service	1.00
Other reinforced concrete construction	0.030

g. Concrete Temperature

When the average of the highest and lowest temperature during the period from midnight to midnight is expected to drop below 40 degrees Fahrenheit (°F) (4 degrees Celsius [°C]) for more than three successive days, deliver concrete meeting the following minimum temperature immediately after placement:

55 °F (13 °C) for sections less than 12 inches (300 mm) in the least dimension
50 °F (10 °C) for sections 12 inches to 36 inches (300 mm to 900 mm) in the least dimension
45 °F (7 °C) for sections 36 inches to 72 inches (900 mm to 1800 mm) in the least dimension
40 °F (4 °C) for sections 72 inches (1800 mm) in the least dimension

Ensure the concrete temperature as placed does not exceed these values by more than 20 °F (7 °C). The ENGINEER may terminate these minimum requirements when the temperature remains above 50 °F (10 °C) for more than half of any 24-hour period. The temperature of concrete as delivered cannot exceed 90 °F (32 °C).

h. Strength and Water-Cementitious Material Ratio

Furnish the compressive strength and, when required, the water-cement or water-cementitious material ratio of concrete for each portion of the work as specified in the Contract documents.

(1) If cementitious or pozzolanic mineral admixtures meeting ASTM C618 or ASTM C989 are used, the cement portion of the water-cement ratio must be the total weight of cementitious material.

(2) The maximum weight of fly ash, pozzolan, or ground granulated blast furnace slag included in the calculation of water-cementitious material ratio cannot exceed the following percentages of the total weight of Portland cement plus fly ash, pozzolan, and ground granulated blast-furnace slag:

a) The combined weight of fly ash and pozzolan meeting ASTM C618 cannot exceed 25 percent of the total weight of cementitious material. The fly ash and pozzolan present in an ASTM Type IP or 1PM blended cement meeting ASTM C595 must be included in the calculated percentage.

b) The weight of ground granulated blast-furnace slag meeting ASTM C989 cannot exceed 50 percent of the total weight of cementitious material. The slag used in manufacture of a Type IS or ISM blended hydraulic cement meeting ASTM C595 must be included in the calculated percentage.

c) If fly ash or pozzolan is used in concrete with ground granulated blast-furnace slag, the Portland cement constituent meeting ASTM C150 cannot be less than 50 percent of the total weight of cementitious material. Fly ash or pozzolan must not constitute more than 25 percent of the total weight of cementitious material.

(3) Strength requirements are based on the 28-day compressive strength determined on 6-inch x 12-inch (150 mm x 300 mm) cylindrical specimens made and tested under ASTM C31 and C39, respectively.

3. Proportioning

a. Proportion Concrete.

Proportion Concrete meeting Section B.2.b, Performance and Design Requirements, to provide workability and consistency so concrete can be worked readily into forms and around reinforcement without segregation or bleeding and to provide an average compressive strength adequate to meet acceptance requirements. If the production facility has records of field tests performed within the past 12 months and spanning a period of at least 60 calendar days for a class of concrete within 1,000 psi (7,000 kPa) of that specified for the work, calculate a standard deviation and establish the required average strength fcr', meeting Sections B.3.b and B.3.c(1), below. If field test records are not available, select the required average strength from Table 3c.

b. Standard Deviation

(1) Field Test Data. Ensure field test records used to calculate standard deviation represent materials, quality control procedures, and climatic conditions similar to those expected in the work. Changes in materials and proportions in concrete represented by the test records cannot not have been more closely restricted than those in the work. Ensure test records comply with one of the following:

a. Data from a single group of at least 15 consecutive compressive strength tests with the same mixture proportions.

b. Data from two groups of consecutive compressive strength tests totaling at least 30. None of the two groups can consist of less than 10 tests.

(2) Standard Deviation. Calculate the standard deviations of the strength test data as follows:

For a single group of consecutive test results:

$$S=\sum_{I=1}^{I=n}(X_i - X)^2 (n-1)^{1/2} (2-1)$$

where:

S = standard deviation
X_i = individual test result
X = average of all n test results considered
n = number of tests considered

For two groups of consecutive test results:

$$S = \{[(n_1-1)(s_1)^2 + (n_2 - 1)(s_2)^2] / (n_1 + n_2 - 2)\}^{1/2} \quad (2\text{-}2)$$

where:

s = standard deviation for the two groups combined
s_1, s_2 = standard deviations for Groups 1 and 2, respectively, calculated in accordance with Eq. (2-1)
n_1, n_2 = number of test results in Groups 1 and 2 respectively

c. Required Average Compressive Strength

Calculate the required average compressive strength fcr' for the specified class of concrete meeting one of the following:

(1) Use the standard deviation calculated according to Section B.3.b(2) to establish the required average compressive strength as follows:

fcr' = fc' + 1.3 *ks*

fcr' +2.33 *ks* - 3.5(fcr' + 2.33ks - 500)

where

fcr' = required average compressive strength in psi (Mpa)
fc = specified compressive strength in psi (Mpa)
S = standard deviation calculated according to Section B.3.b(2)
k = factor from Table 3c-1 for increase for standard deviation if the total number of tests is less than 30; the larger of the two values of fcr' calculated according to B.3.c(1) must be used.

TABLE 3c-1
k FACTOR FOR INCREASING THE STANDARD DEVIATION FOR NUMBER OF TESTS CONSIDERED

Total Number of Tests Considered	k-Factor for Increasing Standard Deviation
15	1.16
20	1.08
25	1.03
30	1.0

Linear interpolation for intermediate number of tests is acceptable.

(2) When field test date is not available to establish a standard deviation, select the required average compressive strength fcr' from Table 3c-2.

TABLE 3c-2
REQUIRED AVERAGE COMPRESSIVE STRENGTH fcr' WHEN DATA IS NOT AVAILABLE TO ESTABLISH A STANDARD DEVIATION

Specified Strength fc' in MPa (psi)	Required Average Compressive Strength fcr'in Mpa (psi)
Less than 20.7 MPa (3,000 psi)	fc' + 6.9 MPa (1,000 psi)
20.7 to 34.5 MPa (3,000 to 5,000 psi)	fc' + 8.3 MPa (1,200 psi)
Over 34.5 to 69.0 Mpa (5,000 to 10,000 psi)	fc' + 9.7 MPa (1,400 psi)
Over 69.0 to 103.4 Mpa (10,000 to 15,000 psi)	fc' + 12.4 MPa (1,800 psi)

MPa: Megapascals. psi: pounds per square inch.

d. Documentation of Required Average Compressive Strength

Documentation in dictating the proposed concrete proportions will produce an average compressive strength equal to or greater than the required average compressive strength fcr' must consist of field strength records or trial mixture.

(1) Field Test Data. If field test data are available and represent a single group of at least 10 consecutive strength tests for one mixture, using the same materials and under the same conditions for at least 60 days, verify that the average of the field test results equals or exceeds fcr'. Submit the mixture proportions and the field test data for the acceptance. If the field test data represent two groups of compressive strength tests for two mixtures, plot the average strength X_1 and X_2, of each group versus the corresponding mixture proportions, and interpolate between corresponding mixture proportions to establish mixture proportions for fcr'.

(2) Trial Mixtures. Establish mixture proportions based on trial mixtures according to the following requirements:

a) Use materials and material combinations proposed for the work.

b) Determine the required average compressive strength according to Section 3.c if suitable field test data is available or use Table 3c-2.

c) Make at least three trial mixtures complying with Section 2, Performance and Design Requirements. Each trial mixture shall have a different cementitious material content. Select water-cementitious material ratios that will produce a range of compressive strengths encompassing the required average compressive strength fcr'.

d) Proportion trial mixtures to produce a slump within ¾ inch (19 mm) of the maximum specified and, for air-entrained concrete, an air content within 0.5 percent of the required total air content indicated in Table 2d. Record

the temperature of the freshly mixed concrete and ensure it is within 10 °F (38 °C) of the intended maximum temperature of the concrete as mixed and delivered.

e) For each trial mixture, make and cure three compressive strength cylinders for each test age meeting ASTM C192. Test for compressive strength meeting ASTM C39 at 28 days or at the test age specified in the Contract Documents.

f) From results of these tests, plot a curve showing the relationship between water cementitious material ratio and compressive strength.

g) From the curve of water-cementitious material ratio versus compressive strength, select the water-cementitious material ratio corresponding to the required average compressive strength fcr'. This is the maximum water-cementitious material ratio that may be used to establish mixture proportions unless a lower water-cement ratio is specified in Section B.2.g, Strength and Water-Cementitious Material Ratio.

h) Establish mixture proportions so that the maximum water to cementitious material ratio is not exceeded when slump is at the maximum specified.

e. Field Verification of Adequacy of Selected Proportions

Using materials accepted for use in the work, verify in the field the adequacy of the selected proportions to produce concrete with the required total air content, consistency, and workability compatible with the intended placing method. Make corrections as necessary and submit the adjusted proportions for acceptance.

f. Revisions to Concrete Mixtures

When 15 consecutive compressive strength test results become available from the field, calculate the actual average compressive strength and standard deviation. Calculate a revised value for the average required compressive strength fcr' according to Section B.3.c.

(1) When the actual average compressive strength X exceeds the revised value of fcr' and requirements of Section 3.f are met, the required average compressive strength of the concrete fcr' may be decreased if the requirements of Section B.2 are met.

(2) If the actual average compressive strength X is less than the revised value of fcr' or if either of the two requirements in Section B.3.f are not met, take immediate steps to increase average compressive strength of the concrete.

(3) Submit revised mixture proportions for acceptance before placing in the Work.

C. GROUT

Subcontractor shall supply grout material consisting of the same materials as the cement.

PART 3 - EXECUTION

A. SAMPLING, HANDLING, MEASURING AND BATCHING MATERIALS

Furnish concrete of the classes specified made up of acceptable material batched in the proportions specified by section 2.B.3 Proportioning. Make corrections necessitated by variations in the moisture content of the component materials or for other similar reasons, as directed, based upon laboratory and field determination. The fine and coarse aggregates are sampled under the method described in Montana Test Method 201 with sample sizes corresponding to those used in MT 202.

Proportion the water by weight or volume. The cement, fine aggregate, and both sizes of coarse aggregate must be weighed.

1. Water

The allowable error in accuracy of water measuring or weighing equipment cannot exceed 2%. Ensure the weighing equipment is arranged so that the accuracy of the measurement will not be affected by variations in pressure in the water supply lines. An auxiliary tank from which the measuring or weighing tank is filled may be required.

When water is measured by volume, meter it through an approved recording water meter device. Ensure metering devices are accurate to within “1 percent of the required volume” or “1 gallon” (3.8 Liters [L]), whichever is greater. This device is required on all batching and mixing equipment during warm weather operations. Other approved methods of water measurement will be permitted during cold weather operations. Ensure wash water is completely discharged before performing any batching operation.

2. Cement

Cement may be measured either by weight or by volume. Volume is 94-pound (lb) (42.6 kilogram [kg]) bags as packed by the manufacturer. If the volume method is used, cement in all mixed batches of concrete must be in full bags. Do not make batches using fractional bags of cement. When cement is measured by weight, weigh it on a separate scale which is accurate and maintained within a maximum tolerance of 1% of the load being weighed.

3. Equipment for Weighing Aggregates

Furnish weighing equipment and weighing methods meeting the following requirements:

a. Ensure the weighing equipment capacity is adequate to permit weighing of materials without delaying the production of the mixer. The balance of the

weighing mechanism must be of the beam or springless dial type, designed and built so that it may be maintained within a maximum tolerance of 1% of the load being weighed. The weighing equipment is subject to such tests as the Engineer directs to determine its accuracy.

b. The value of the graduations shown on the scale must permit weighing of materials within the accuracy specified. The Engineer will determine acceptability of the graduation value when fractional batches are used.

c. Ensure scales of the suspended hopper type are equipped with a telltale dial or similar device that indicates at least the last 50 lb (22.6 kg) of load. Locate the telltale dial or similar device in a position that allows easy observation by the batch operator.

d. The batching plant may include bins, weighing hoppers and scales for the fine aggregate and for each size of coarse aggregate. A single weighing hopper with an accumulative scale will be permitted, provided a separate scale is used for weighing the cement.

e. The batch plant will meet the requirements of having a separate scale for weighing the cement if:

(1) The batch plant scales are maintained within the maximum tolerances that are specified for weighing cement.
(2) The cement is always batched and weighed first in the batching sequence.

f. Batching plants are permitted which are equipped to proportion aggregates and bulk cement by automatic weighing devices of an approved type.

g. Provide each scale installation with 10 standard, 50 lb (22.6 kg) test weights.

4. Truck Mixers and Agitators

Use truck mixers having a closed, watertight, revolving drum, suitably powered and mounted. The drum must be fitted with blades capable of thoroughly mixing the concrete and completely discharging it without segregation. Make available copies of the design of the mixer showing dimensions and arrangement of blades. Mixers having blades worn down more than ¾ inch (19 mm) from the new condition, as shown in the design, cannot be used until the blades are replaced or repaired. Clean the drum of hardened concrete.

Truck mixers must have the manufacturer's plate attached showing the rated mixing and agitating capacity and the rated drum speed for mixing and agitating.

Equip truck mixers with a revolution counter that registers the number of drum revolutions. Mount the counter so that it can be easily ready by both the operator and inspector.

Equip truck mixers with a water metering device to accurately indicate water added to the batch. Ensure metering devices are accurate to within plus or minus 1% of the required volume or plus or minus 1 gallon (3.8 L), whichever is greater. The truck mixer metering device will not be required where all batch water is added at the plant or other location through an approved metering device.

B. CONSISTENCY

Ensure concrete is of such consistency that it will flow around reinforcing steel, but individual particles of the coarse aggregate, when isolated, show a coating of mortar containing its proportionate quantity of sand. The consistency of the concrete will be gauged by the ability of the equipment to properly place the concrete in its final position and not by the difficulty in mixing or transporting. Use the minimum quantity of mixing water necessary to provide workability within the ranges of slump specified. The quantity of the mixing water cannot be varied without approval.

C. MIXING

Thoroughly mix concrete to ensure a uniform distribution of the materials throughout the mass.

Mix concrete only in quantities required for immediate use and place it within the time limits specified. Waste all concrete in which initial set has begun. Retempering of concrete is prohibited.

Aggregates or bags of cement, containing lumps or crusts of hardened material cannot be used.

Mix concrete in an approved truck mixer meeting the requirements of Section 3.A.4 herein.

The capacity of the plant and the transportation equipment must ensure delivery at a rate that will permit proper handling, placement and finishing at the point of delivery. Maintain the concrete delivery rate to provide for the continuous operation of placing, handling, and finishing concrete as is practical. Maintain the interval between delivery of loads so that layers or lifts of concrete in place do not harden before succeeding layers or lifts are placed. In general, no lift or layer of concrete can remain exposed for more than 20 minutes before being covered by fresh concrete.

The method and time of delivery is controlled by plant slips issued to the driver and signed by the Engineer or the inspector at the plant. Deliver the slip to the inspector or Engineer upon arrival at the site of the work.

The volume of mixed concrete in the mixing drum cannot exceed the manufacturer's rating on the capacity plate.

Equip truck mixers with a water metering device that accurately indicates water added to the batch. The truck mixer metering device is not required where all batch water is added at the plant or other location through an approved metering device.

During freezing weather, other approved methods of measuring water will be permitted.

A recording water metering device is always required at the primary point of the batching operation.

Water, cement, and aggregates may be introduced either at a central plant or at the site of the concrete construction. With the Engineers approval, water, cement and aggregates may be introduced into the mixer in any sequence that produces a concrete that meets all the specifications, except that cement and water must be batched as simultaneously as batching equipment will permit. Do not add water to concrete in transit. Water may be introduced into the mixer at the job site under direction of the Engineer, if the specified water-cement ratio is not exceeded. Ensure the drum revolves continuously after the introduction of the cement and water until the concrete is discharged.

Begin mixing immediately after introducing the cement and water and continue for at least 70 revolutions of the drum at mixing speed. This minimum revolution count will be waived when the concrete is produced at a central mixing plant. Not more than 100 drum revolutions can exceed 6 revolutions per minute. All other revolutions must be at an agitating speed of not less than 2 or more than 6 revolutions per minute.

Discharge the concrete at the job and place in its final position within 1½ hours after the introduction of the mixing water and cement. When the air temperature is 85 °F (30 °C) or above, place the concrete in its final position within 1 hour after the introducing the mixing water and cement. Concrete mixes with an approved set retarding admixture may be held an additional ½ hour beyond limits specified above.

No mixed or agitated concrete that has remained in the drum of the truck mixer more than 10 minutes without agitation can be used. If the Engineer determines the concrete has not suffered any detrimental effects, it may be used after remixing for a minimum of 20 revolutions of the drum at mixing speed if it can still be placed in the forms within the specified time limits.

Provide a revolution counter on each truck that registers the number of revolutions of the drum.

Mount the counter so it can be easily read by both the operator and the Engineer. If a truckload of concrete is rejected for any reason, the unit delivering it will not be allowed back on the job for three hours.

Prepare grout material in same manner as concrete.

D. PLACING CONCRETE

Thoroughly compact concrete into its final position. Ensure it is thoroughly consolidated around fittings and embedded items. Ensure all reinforcement and embedded items are

accurately placed as shown on the plans and are clean and free from coatings of dried mortar, detrimental rust, scale, oil, or foreign matter.

E. CURING CONCRETE

Protect concrete surfaces subject to premature drying by covering as soon as possible with canvas, plastic sheets with sealed joints, burlap and sand or other satisfactory materials and keep concrete moist. If the concrete surfaces are not covered, keep them moist by flushing or sprinkling. Continue curing for at least 7 days after placing the concrete. Concrete surfaces placed against forms may be cured by leaving the forms in place for at least 7 days, when approved.

Protect concrete against freezing or other conditions detrimental to strength development meeting the applicable requirements of this specification.

To aid finishing, side forms on ornamental work, curbs and sidewalks, railing and parapets may be removed after 12 hours, not to exceed 48 hours, depending on weather conditions. Continue moist curing during the concrete finishing operation.

Untreated forms and existing concrete must be kept continuously wet for at least 1 hour before any concrete is placed therein. Keep wet until covered with concrete except that adequately treated forms must be thoroughly washed with a water spray immediately before placing the concrete.

The curing of concrete, by either water curing or membrane curing, must be as follows unless otherwise approved by the Engineer.

1. Water Curing

Keep all concrete top surfaces continuously moist after finishing with a fine water spray until the concrete has set. Cover the moist concrete with water or an approved curing covering.

a. Keep all concrete top surfaces continuously moist after finishing, with a fine water spray, until the concrete has set. Cover the moist concrete with water or an approved curing covering.

b. Cure concrete deck slabs and concrete floors for at least 7 days. Cure by placing burlap, cotton mats or other absorptive material as close behind the finishing operation as possible without marring the finished surface. Keep the absorptive material continuously moist for the full time it is used. The absorptive material may be kept in place for the entire curing period or it may be removed as soon as practical and the entire surface covered with approximately 1½ inches (38.1 mm) of sand, kept continuously moist for the entire curing period.

c. Remove forms and repair surface irregularities without interfering with any of the curing requirements. As soon as the vertical forms have been removed and the surface irregularities repaired, cover the concrete with absorptive material, kept continuously wet for the balance of the curing period.

2. Impervious Membrane Curing

Ensure membrane curing compounds are delivered to the job in the manufacturer's original container, clearly labeled to show the name of the manufacturer and the contents. The clear curing compound must be sufficiently transparent and free from permanent color that would change the color of the natural concrete. Use clear compound containing a fugitive dye having color sufficient to render the film visible on the concrete for at least 4 hours after application. The concrete surface must maintain its natural color after curing.

a. Use a compound ready for use as shipped by the manufacturer. Dilute following the manufacturer's recommendations. Use curing compound only with written approval. Sampling will not be required if manufacturer's certification is available. Apply the curing compound under pressure with a spray nozzle to cover the entire exposed surface thoroughly and completely with a uniform film not exceeding manufacturer's specifications. Maintain the required pressure in the spray machine to force the material to leave the nozzle in a fine mist. Keep all concrete surfaces moist with a fine water spray or with wetted burlap until the sealing compound is applied. Keep the curing compound application close to the finishers of the top surface of concrete at all times. Seal the concrete immediately after the finishing operations have been completed to the satisfaction of the Engineer.

b. If it is necessary to allow workers or equipment on the surface before the 7-day curing period is complete, cover the top surface of sealed concrete with a protective cushion for runways. Use a cushion consisting of a moist, 1-inch (25 mm) minimum thick layer of fine sand, or layers of moist burlap that will prevent damage to the finished concrete. Cover the approved cushion with four by eight-foot sheets of ¾ inch (19 mm) plywood laid over the cushion. Do not place the cushion material for at least 8 hours after the final application of the curing compound. Obtain the Engineer written approval for any other proposed cushion material before use. Layers of plastic, visqueen, or canvas are not an acceptable cushion material.

c. Keep concrete, which has not completed its curing period, continuously moist during the stripping and surface repair operations. Remove all surface irregularities, repair all depressions, voids or holes, including those

formed by trapped air, to the satisfaction of the Engineer. Immediately apply the curing compound before the surface has had an opportunity to dry. Keep concrete, from which forms have been stripped, continuously moist until surface repair and finishing are complete and the impervious membrane curing has been applied.

F. WEATHER AND NIGHT LIMITATIONS

1. General

Stop concreting operations when darkness prevents obtaining the specified placing and finishing work. Night operations may be conducted with written approval and when approved artificial lighting is provided.

Cold weather concreting is governed by ACI 306 unless otherwise specified herein. Hot weather concreting methods is governed by ACI 305 unless otherwise specified herein. Except by specific written authorization, stop concreting operations when a descending air temperature in the shade and away from artificial heat falls below 40 °F (4 °C) and do not resume until an ascending air temperature in the shade and away from artificial heat reaches frozen foundation course or subgrade.

Assume all risk of placing concrete in cold weather. Placing concrete during cold weather does not relieve the Subcontractor of the responsibility for obtaining the specified results. Remove and replace all concrete injured by frost at Subcontractor expense.

Before any concrete is placed, remove all ice, snow, and frost completely from the formwork receiving the concrete.

2. Heating and Placing Concrete

When concreting is authorized during cold weather, assure concrete temperature meets 2.B.2.g.

3. Protection of Concrete

During the curing period, if the air temperature is anticipated to fall below 32 °F (0 °C), provide an approved blanket type insulating material along the work for covering all concrete that has been in place for 7 days or fewer. If, at any time, the ambient temperature drops to 32 °F (0 °C) or less, protect the concrete using a method approved by the Engineer. The minimum method of protection under such conditions is as follows:

Loosely spread insulating materials, with the exception of commercial blankets, between two layers of plastic sheeting to a minimum depth of 6 inches (150 mm), but in all cases, to the depth required to prevent freezing of, or frost damage to, the concrete. Maintain the blanketing material at least until the end of the regular specified curing period which is not less than 7 days. The Engineer may direct leaving the blanketing material in place for

an additional period if the recorded temperatures indicate that additional curing may be necessary. If during the construction period the mean daily temperature is expected to fall below 40 °F(4 °C) for 3 consecutive days, furnish approved heating enclosures and devices capable of maintaining the surface temperature of the concrete in place between 55 °F(13 °C*)* and 80 °F(26 °C). The curing period under these conditions is 7 days when I-II cement is used and 5 days when a pre-approved "high early strength" mix is used. At the close of the curing period, the heat may be reduced so that the temperature inside the housing does not decrease faster than 15 °F per hour until the temperature inside the housing is the same as outside.

The Subcontractor may, at their own expense, field cure concrete cylinders with their in-place concrete and discontinue protection when those field cylinders reach 70 percent of design strength as indicated by the 28-day requirement of these specifications.

Perform all concrete protection using methods consistent with ACI-306-1-87 and approved by the Engineer.

G. TESTING

All concrete must be tested by a certified testing technician.

1. Materials

The Engineer or their representative must have access to the ready-mix production facility for sampling constituent materials during production to ensure the materials meet these specifications and represent those stated on the approved mix design.

2. Standard Slump Tests

The Engineer will, during each day's pour, check the consistency of the concrete by slump test. A slump test will also be made each time that a test cylinder is made. Slump tests are performed meeting ASTM C143,"Method of Test for the Slump of Portland Cement Concrete".

3. Compression Tests

Make a set of at least 3 standard, 6-inch (150 mm) diameter test cylinders and test for every concrete pour and make one set of test cylinders for every 100 yards (76.5 cubic meters) of concrete or fraction thereof placed in each pour. On a given project, if the total volume of concrete is such that the frequency of testing required above would generate less than 5 strength tests for a given class of concrete, make tests from at least 5 randomly selected batches or from each batch if fewer than 5 batches are used. Cure these cylinders under laboratory conditions except that additional test cylinders cured entirely under field conditions may be required by the Engineer to check the adequacy of curing and protection of the concrete.

Take samples for strength tests meeting "Method of Sampling Fresh Concrete" (ASTM C172) specified strength.

Make test cylinders and laboratory-cure meeting the standard method of making and curing concrete compression specimens in the field (ASTM C31). Test cylinders meeting "Method of Test for Compressive Strength of Cylindrical Concrete Specimens", ASTM C39, using an independent testing laboratory, as approved by the Engineer All charges for testing cylinders are to be paid for by the Subcontractor.

Of each of the 3 cylinders taken from a pour, test 1 for information strength at 7 days and test 2 for acceptance strength at 28 days. To meet this specification, average strength of two cylinders from the same sample tested at 28 days or the specified earlier age is required for each strength test. Strength level of an individual class of concrete is considered satisfactory if both of the following requirements are met:

a. The average of all sets of 3 consecutive tests equals or exceeds the specified strength.
b. No individual strength test (average of two cylinders) falls below specified strength by more than 500 psi (3,400 kPa).

Cure field cured cylinders under field conditions meeting Section 7.4 of "Method of Making and Curing Concrete Test Specimens in the Field" (ASTM C31).

Mold field cured test cylinders at the same time and from the same samples as laboratory cured test cylinders. Improve procedures for protecting and curing concrete when strength of field cured cylinders at the test age designated for measuring specified strength is less than 85 percent of that of companion laboratory cured cylinders. When laboratory cured cylinder strengths are appreciably higher than the specified strength, field cured cylinder strengths need not exceed the specified strength by more than 500 psi (3,400 kPa) even though the 85 percent criterion is met.

When it appears that the laboratory cured specimens will fail to meet the requirements for strength, the Engineer has the right to reject the concrete, change the mix proportions, or both at the Subcontractor expense. The strengths of any specimens cured on the job are to indicate the adequacy of protection and curing of the concrete and may be used to determine when the forms may be stripped, shoring removed, or the structure placed in service. When the strengths of the job cured specimens are below those specified above, the Subcontractor must improve the procedures for protecting and curing the concrete.

In addition, when concrete fails to meet the requirements above or when tests of field cured cylinders indicate deficiencies in protection and curing, the Engineer may order tests on the hardened concrete under Chapter 17.3 of ACI-301-84 or order load tests in Chapter 20 of the ACI Building Code (ACI 318-83) for that portion of the structure where the questionable concrete has been placed. No additional compensation is allowed for load tests or coring. In the event the load or core tests indicate that the structure is

unsatisfactory, make all modifications as directed by the Engineer to make the structure sound.

4. Air Content Tests

The Engineer will, during each strength test, check the air content by either the "Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method" (ASTM C23 1), "Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method" (ASTM C173) or "Method of Test for Unit Weight, Yield and Air Content (Gravimetric) of Concrete" (ASTM C138)

END OF SECTION 03310

Appendix C
Site Hydrology Design Reports

Date:	6/8/2022	Project:	Colorado Dump West Lot	Prepared By:	CJG
Rev. No.		Office:	Butte	Checked By:	KLH
Rev. Date:		Calc. No.		Approved By:	SDS
Subject:	Calculation Summary				

Draft Final Calculation Summary: Storm Water Hydrology and Conveyance

Table of Contents

1 PURPOSE AND OBJECTIVES

During storm events, storm water runoff transports sediment through the Colorado Dump West Lot (Site) and onto East Mercury Street (Figure 1). Storm water controls will be installed to manage the exposure and transportation of metals-impacted sediments located on and upgradient to the site. Storm water controls that will be installed include a 12-inch base course remediation cap, storm water run-on control channel, and storm water manholes and piping. The purpose of this calculation summary is to determine if the proposed and existing storm water controls at this Site will convey the 25-year, 24-hour Soil Conservation Service (SCS) Type I design storm event (25-year event).

The objectives of this calculation summary are as follows:

- Determine storm water hydrology.
- Determine storm water hydraulics.
- Determine proposed storm water channel stability.
- Determine if Site storm water flow will overwhelm existing storm water conveyances.

2 BACKGROUND

The Site is located to the west of the AWARE Head Start facility on the north side of East Mercury Street (Figure 1). The Site currently serves as a parking area for the AWARE Head Start facility. When storm events occur, storm water transports sediment through the Site and onto East Mercury Street. The storm water from the existing Site drains to a secondary storm drain located approximately 350 feet to the east of the Site (Figure 1).

3 ANALYSIS

The 25-year event hydrology for the Site was calculated using Hydraflow Hydrographs Extension for Autodesk Civil 3D. The storm water conveyance size and stability were calculated to demonstrate conveyance of the 25-year event using Hydraflow Express Extension for Autodesk Civil 3D and Hydraulic Tool Box 5.0.

3.1 Hydrology

The drainage area contributing storm water to the Site consists of approximately 1.9 acres of mixed land uses (open spaces, 1 acre residential, and gravel). The Site consists of hydrologic soil group B (NCRS, 2019). The drainage area was divided into two sub-drainage areas: cap runoff and cap run-on as shown on Figure 2. The cap run-on area consists of approximately 1.6 acres made up of existing buildings/residential areas and open spaces. The cap runoff area consists of approximately 0.2 acres of new base course. The cap runoff area is given a curve number of 85. The cap run-on area was given a composite curve number of 68, factoring in the mixed cover curve numbers of 68 (residential) and 69 (open space). Storm water drainage properties, flow path properties, and model inputs are shown on Figure 2. The expected peak flow during the 25-year event is approximately 0.12 cubic feet per second (cfs), and storm water model results are included in Attachment A.

3.2 Hydraulics

This section includes the storm water conveyance calculations that demonstrate the capacity and stability of the proposed storm water conveyances and the available conveyance capacity of the existing infrastructure.

3.2.1 Run-on Channel

The run-on channel (channel) is located along the upgradient edge of the cap as shown on Figure 2. The channel cross-section geometry is trapezoidal. The channel bottom is 3 feet wide and 0.5 feet deep with a side slope of 3 Horizontal: 1 Vertical (3H:1V). The channel will be installed at a minimum slope of 1.5%. The channel is constructed with a filter bedding and 1-foot-thick, 6-inch minus riprap. Channel conveyance calculations are provided in Attachment B. Channel stability calculations are provided in Attachment C.

3.2.2 New Storm Water Piping

Six-inch polyvinyl chloride (PVC) storm water piping will convey collected storm water from the new inlets and manholes to the existing storm drain on the south side of East Mercury Street as shown on Figure 2. Storm water piping will be installed at a minimum 1% slope. Storm water conveyance calculations for the 25-year event are included in Attachment A.

3.2.3 Existing Storm Water Infrastructure

New storm water piping will be connected to an existing stub 6-inch PVC pipe that allows discharge to an existing storm water manhole located on the north side of East Mercury Street. The existing Manhole on the north side of East Mercury Street collects storm water from East Mercury Street and the only pipe inlet is the 6-inch PVC pipe that was previously installed to

accept storm water from the Site. The existing manhole on the north side of East Mercury Street outlet is an 8-inch PVC pipe installed at approximately 8% slope with a maximum capacity of approximately 4.3 cfs. The existing manhole on the south side of East Mercury Street conveys storm water to the Anaconda Road/Butte Brewery Primary storm drain. The existing manhole on the south side of East Mercury Street only accepts storm water from the East Mercury Street inlet and from the Existing Manhole located on the north side of East Mercury Street. The existing manhole outlet is a 10-inch PVC pipe installed at a 1% slope with a maximum capacity of approximately 2.7 cfs. Conveyance calculations are included in Attachment B.

4 RESULTS AND DISCUSSION

To control storm water run-on from the upgradient drainage area and runoff from the Site, the proposed conveyances will collect and convey the storm water to existing storm water infrastructure. Additionally, the conveyances will allow additional sediment collection and reduce exposure to transported sediment by reducing sediment transport off the Site.

4.1 Run-on Channel

The run-on channel is sized to convey up to approximately 6.8 cfs, and the 25-year event is modeled at approximately 0.03 cfs. The run-on channel is significantly oversized to allow storm water flow to spread out and slow down to promote sediment drop out during channel flow. This is intended to reduce cleanout maintenance on the proposed manhole sumps. The channel stability calculations determine that the channel is stable during the 25-year event.

4.2 New Storm Water Piping

The new 6-inch storm water piping is sized to convey up to approximately 0.7 cfs, and the 25-year event is modeled at approximately 0.12 cfs. The new 6-inch storm water piping will convey the 25-year event with additional available capacity.

4.3 Existing Storm Water Infrastructure

The existing 8-inch, and 10-inch outlet pipe are capable of conveying approximately 2.7 cfs as described in Section 3.2.3. The storm water runoff inflow at the East Mercury Street inlets are unknown, and no additional hydrology calculations have been completed. The expected peak flow from this Site during the 25-year event is approximately 0.12 cfs. This is approximately 5% of the total flow capacity of the existing 10-inch PVC (2.7 cfs maximum conveyance) storm water pipe. This new input into the existing storm water infrastructure is considered minor and is not anticipated to overwhelm the existing storm water infrastructure during the 25-year event.

5 REFERENCES

NRCS, 2019. Published Soil Surveys for Montana: Silver Bow County Area and Parts of Beaverhead and Jefferson Counties. United States Department of Agriculture National Resources Conservation Service. Accessed at Soil Surveys by State | NRCS Soils (usda.gov) in May, 2022.

6 DOCUMENT REVISION SUMMARY

Revision No.	Author	Version	Description	Date
1	Caleb Gillis		Draft	05/11/2022
2	Caleb Gillis		Draft Final	06/08/2022

FIGURES

Figure 1. Colorado Dump West Lot Site Location

Figure 2. Colorado Dump West Lot Area Hydrology

PROJECT SITE LOCATION

AWARE HEAD START FACILITY

EXISTING SECONDARY STORM DRAIN INLET

S. ARIZONA AVENUE

OHIO AVENUE

E. MERCURY STREET

5680 5675 5670 5665 5665 5660 5655 5655

LEGEND:

- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN
- EXISTING STORM DRAIN MANHOLE
- PROPOSED STORM DRAIN MANHOLE
- EXISTING GRADE
- PROPOSED GRADE
- EXISTING DIVERSION SWALE

DISPLAYED AS:
COORD SYS/ZONE: MSP
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER/QSI 2020

SCALE IN FEET
0 25 50

FIGURE 1

COLORADO DUMP WEST LOT SITE LOCATION

PIONEER TECHNICAL SERVICES, INC.
63-1/2 WEST BROADWAY
BUTTE, MONTANA 59701
(406) 782-5177

DATE: 5/2022

SHEET FLOW
LENGTH = 290'
SLOPE = 6.9%
MANNING'S N = 0.025

CAP RUN-ON AREA
1.64 ACRES
CN=68

CHANNEL FLOW
LENGTH = 225'
SLOPE = 1.9%
MANNING'S N = 0.025

RUN-ON CHANNEL

EXISTING DIVERSION SWALE

SHEET FLOW
LENGTH = 230'
SLOPE = 3.3%
MANNING'S N = 0.025

EXISTING PRIMARY STORM DRAIN

CAP RUN OFF AREA
0.2 ACRES
CN=85

INLET MANHOLE MH-1

INLET MANHOLE MH-2

EXISTING SECONDARY STORM DRAIN INLET

EXISTING MANHOLE WITH 8" PVC OUTLET PIPE

EXISTING 8" PVC STORM DRAIN PIPE

EXISTING 10" PVC STORM DRAIN

6" PVC PIPE FLOW
LENGTH = 90'
SLOPE = 2.0%
MANNING'S N = 0.011

6" PVC STORM DRAIN PIPE

EXISTING MANHOLE WITH 10" PVC OUTLET PIPE

S. ARIZONA AVENUE

E. MERCURY STREET

5680 5675 5670 5665 5660 5655

LEGEND:

- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN
- EXISTING STORM DRAIN MANHOLE
- PROPOSED STORM DRAIN MANHOLE
- EXISTING GRADE
- PROPOSED GRADE
- EXISTING DIVERSION SWALE
- FLOW PATH
- FLOW DIRECTION
- WHITE LINE- DRAINAGE AREA BOUNDARY
- RESIDENTIAL = 1.07 ACRES
- OPEN SPACES = 0.57 ACRES
- GRAVEL CAP = 0.2 ACRES

NOTES:

1. FLOW PATH CALL OUTS INDICATE START OF FLOW PATH TYPE.

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

SCALE IN FEET
0 25 30

FIGURE 2

COLORADO DUMP WEST LOT HYDROLOGY

PIONEER TECHNICAL SERVICES, INC.
63-1/2 WEST BROADWAY
BUTTE, MONTANA 59701
(406) 782-5177

DATE: 5/2022

6/9/2022 8:00:44 AM Z:\SHARED\ACTIVE PROJECTS\ARCO\UNRECLAIMEDSITES\CADD\FIGURES\UR-COL-SW-FG-002-22.DWG

Attachment A

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
3	SCS Runoff	------	-------	0.004	-------	-------	-------	0.025	-------	0.118	CAP RUN ON AREA
5	SCS Runoff	------	-------	0.039	-------	-------	-------	0.115	-------	0.158	CAP RUN OFF AREA
7	Reach	3	-------	0.004	-------	-------	-------	0.025	-------	0.107	MH-1 to MH-2
9	Combine	5, 7,	-------	0.039	-------	-------	-------	0.115	-------	0.223	MH-2

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
3	SCS Runoff	0.025	1	748	1,035	------	------	------	CAP RUN ON AREA
5	SCS Runoff	0.115	1	598	552	------	------	------	CAP RUN OFF AREA
7	Reach	0.025	1	756	1,029	3	------	------	MH-1 to MH-2
9	Combine	0.115	1	598	1,581	5, 7,	------	------	MH-2

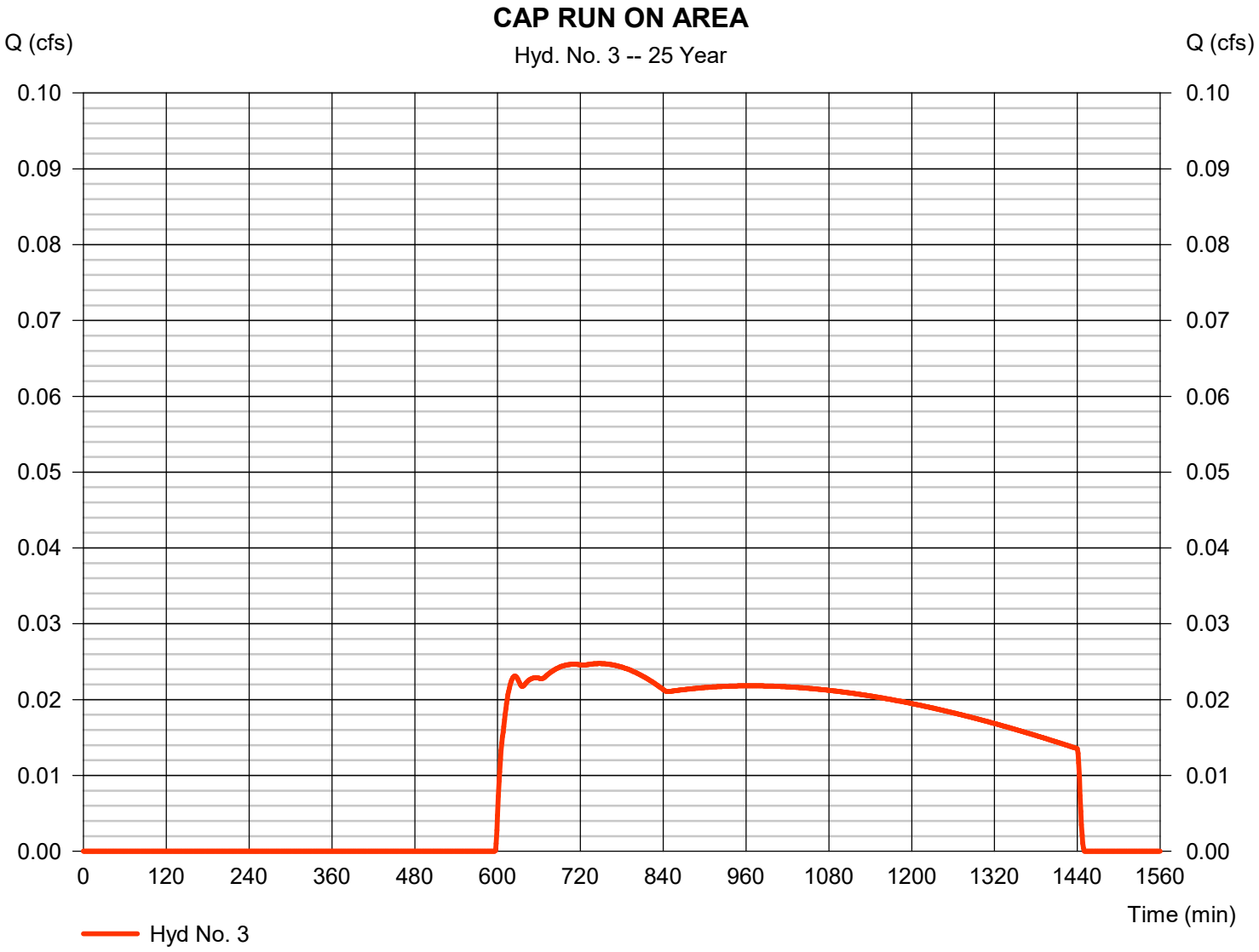
Hydrograph Report

Hyd. No. 3

CAP RUN ON AREA

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.025 cfs
Storm frequency	=	25 yrs	Time to peak	=	748 min
Time interval	=	1 min	Hyd. volume	=	1,035 cuft
Drainage area	=	1.640 ac	Curve number	=	68*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.20 min
Total precip.	=	1.92 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.570 x 69) + (1.070 x 68)] / 1.640



TR55 Tc Worksheet

Hyd. No. 3

CAP RUN ON AREA

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.025		0.011		0.011		
Flow length (ft)	= 278.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.26		0.00		0.00		
Land slope (%)	= 6.90		0.00		0.00		
Travel Time (min)	**= 5.14**	**+**	**0.00**	**+**	**0.00**	**=**	**5.14**
Shallow Concentrated Flow							
Flow length (ft)	= 0.00		0.00		0.00		
Watercourse slope (%)	= 0.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow							
X sectional flow area (sqft)	= 1.25		0.00		0.00		
Wetted perimeter (ft)	= 4.16		0.00		0.00		
Channel slope (%)	= 1.90		0.00		0.00		
Manning's n-value	= 0.025		0.025		0.015		
Velocity (ft/s)	=3.67						
			0.00				
					0.00		
Flow length (ft)	({0})225.0		0.0		0.0		
Travel Time (min)	**= 1.02**	**+**	**0.00**	**+**	**0.00**	**=**	**1.02**

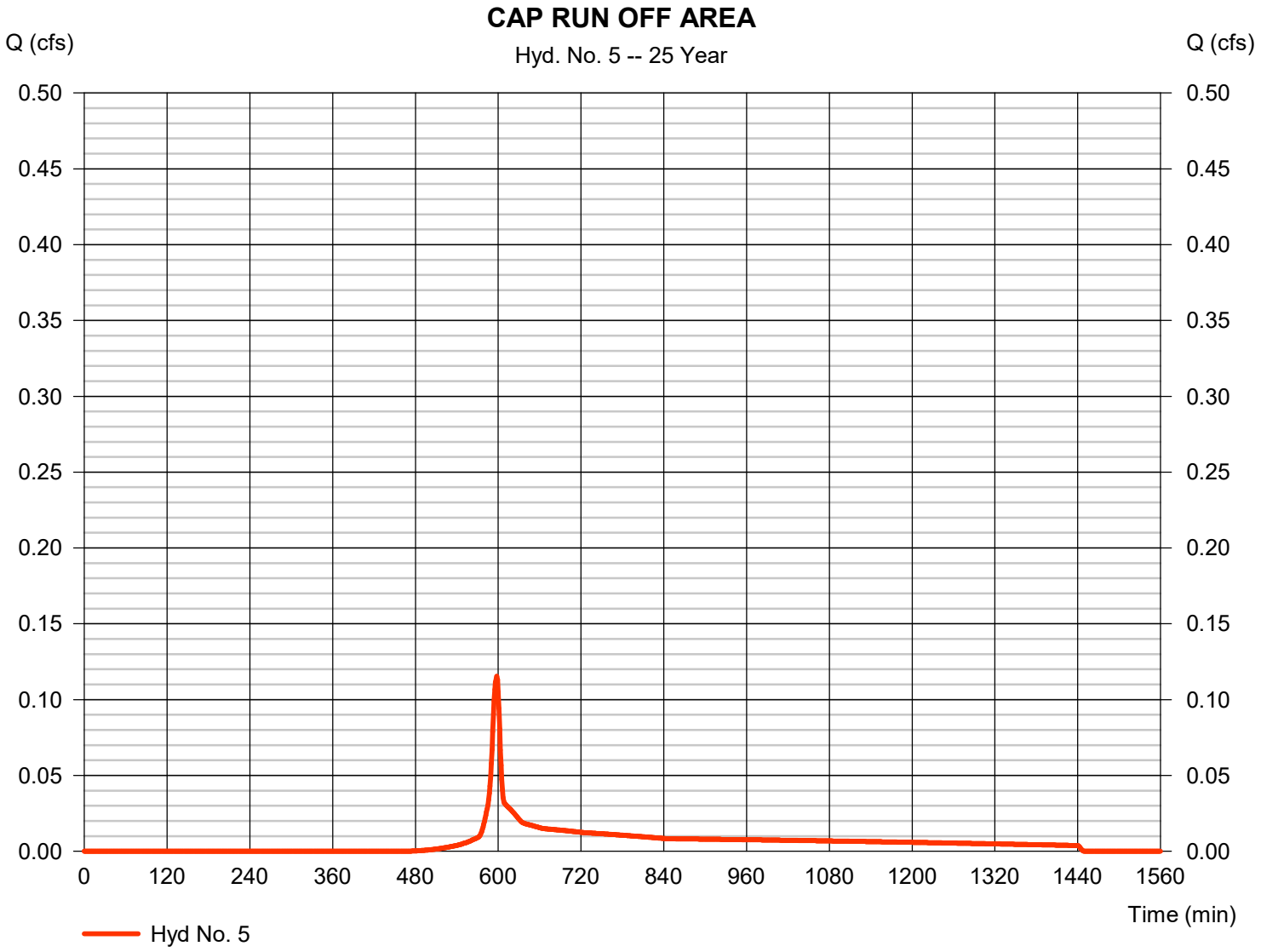
Total Travel Time, Tc ..... 6.20 min

Hydrograph Report

Hyd. No. 5

CAP RUN OFF AREA

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.115 cfs
Storm frequency	=	25 yrs	Time to peak	=	598 min
Time interval	=	1 min	Hyd. volume	=	552 cuft
Drainage area	=	0.200 ac	Curve number	=	85
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	5.90 min
Total precip.	=	1.92 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

Hyd. No. 5

CAP RUN OFF AREA

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.025		0.011		0.011		
Flow length (ft)	= 230.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.26		0.00		0.00		
Land slope (%)	= 3.30		0.00		0.00		
Travel Time (min)	**= 5.93**	**+**	**0.00**	**+**	**0.00**	**=**	**5.93**
Shallow Concentrated Flow							
Flow length (ft)	= 0.00		0.00		0.00		
Watercourse slope (%)	= 0.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow							
X sectional flow area (sqft)	= 2.25		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.025		0.025		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 5.90 min

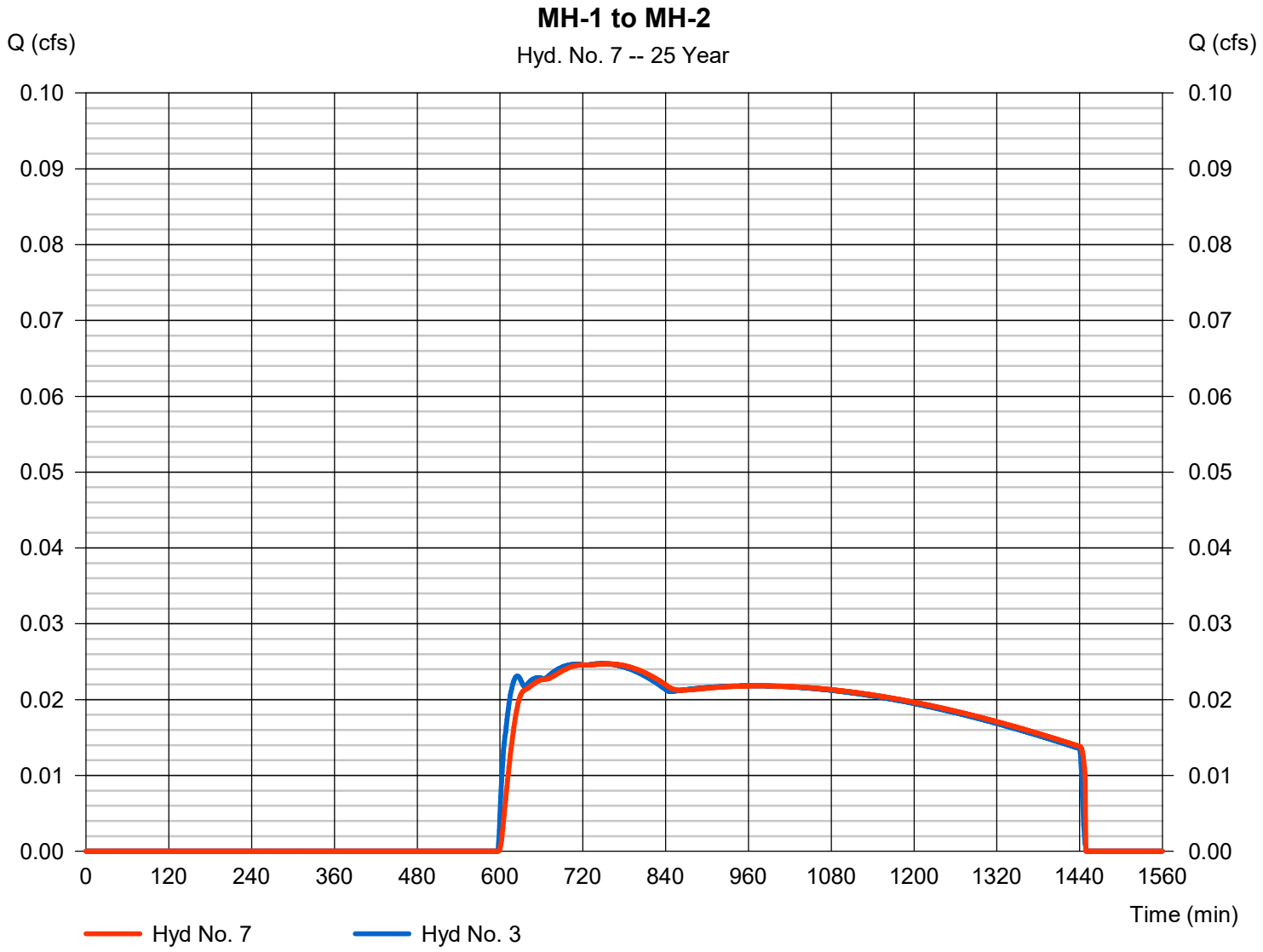
Hydrograph Report

Hyd. No. 7

MH-1 to MH-2

Hydrograph type	=	Reach	Peak discharge	=	0.025 cfs
Storm frequency	=	25 yrs	Time to peak	=	756 min
Time interval	=	1 min	Hyd. volume	=	1,029 cuft
Inflow hyd. No.	=	3 - CAP RUN ON AREA	Section type	=	Circular
Reach length	=	90.0 ft	Channel slope	=	2.0 %
Manning's n	=	0.011	Bottom width	=	0.5 ft
Side slope	=	0.0:1	Max. depth	=	0.0 ft
Rating curve x	=	9.209	Rating curve m	=	1.250
Ave. velocity	=	0.13 ft/s	Routing coeff.	=	0.0998

Modified Att-Kin routing method used.

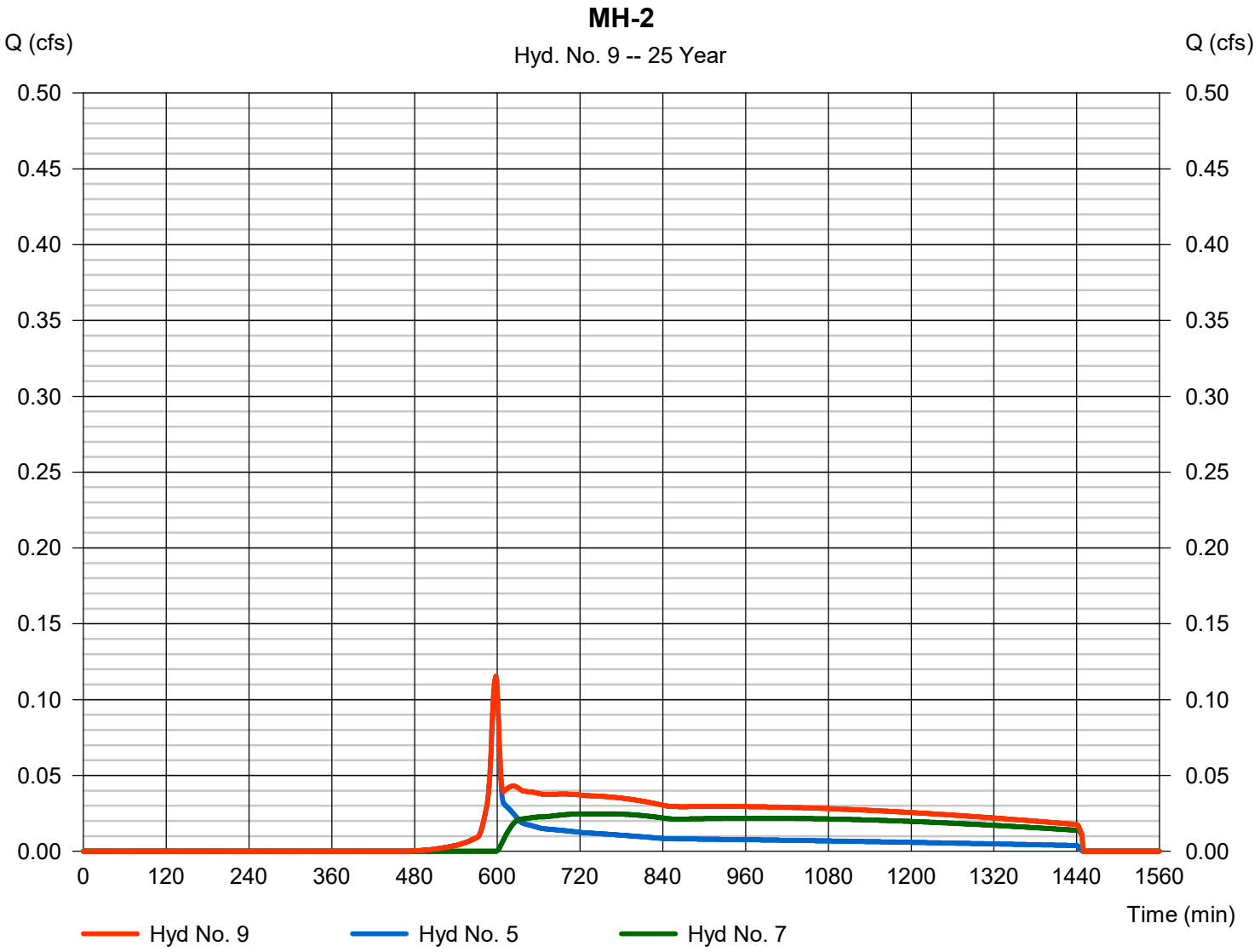


Hydrograph Report

Hyd. No. 9

MH-2

Hydrograph type	=	Combine	Peak discharge	=	0.115 cfs
Storm frequency	=	25 yrs	Time to peak	=	598 min
Time interval	=	1 min	Hyd. volume	=	1,581 cuft
Inflow hyds.	=	5, 7	Contrib. drain. area	=	0.200 ac



Attachment B

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jun 8 2022

6-inch Storm Drain

Circular

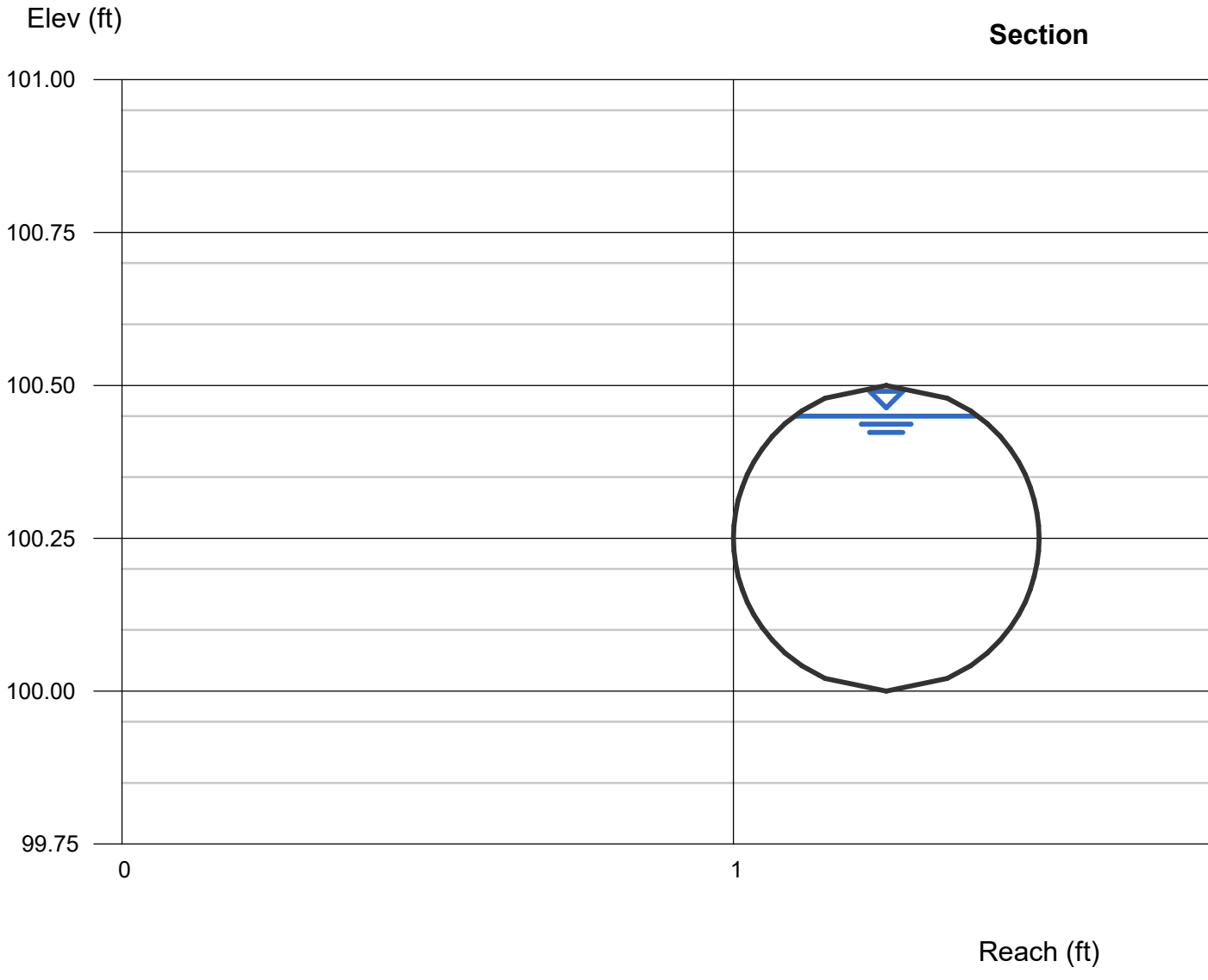
Diameter (ft)	= 0.50
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.011

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 0.45
Q (cfs)	= 0.706
Area (sqft)	= 0.19
Velocity (ft/s)	= 3.79
Wetted Perim (ft)	= 1.25
Crit Depth, Yc (ft)	= 0.43
Top Width (ft)	= 0.30
EGL (ft)	= 0.67



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jun 8 2022

Existing 8 Inch

Circular

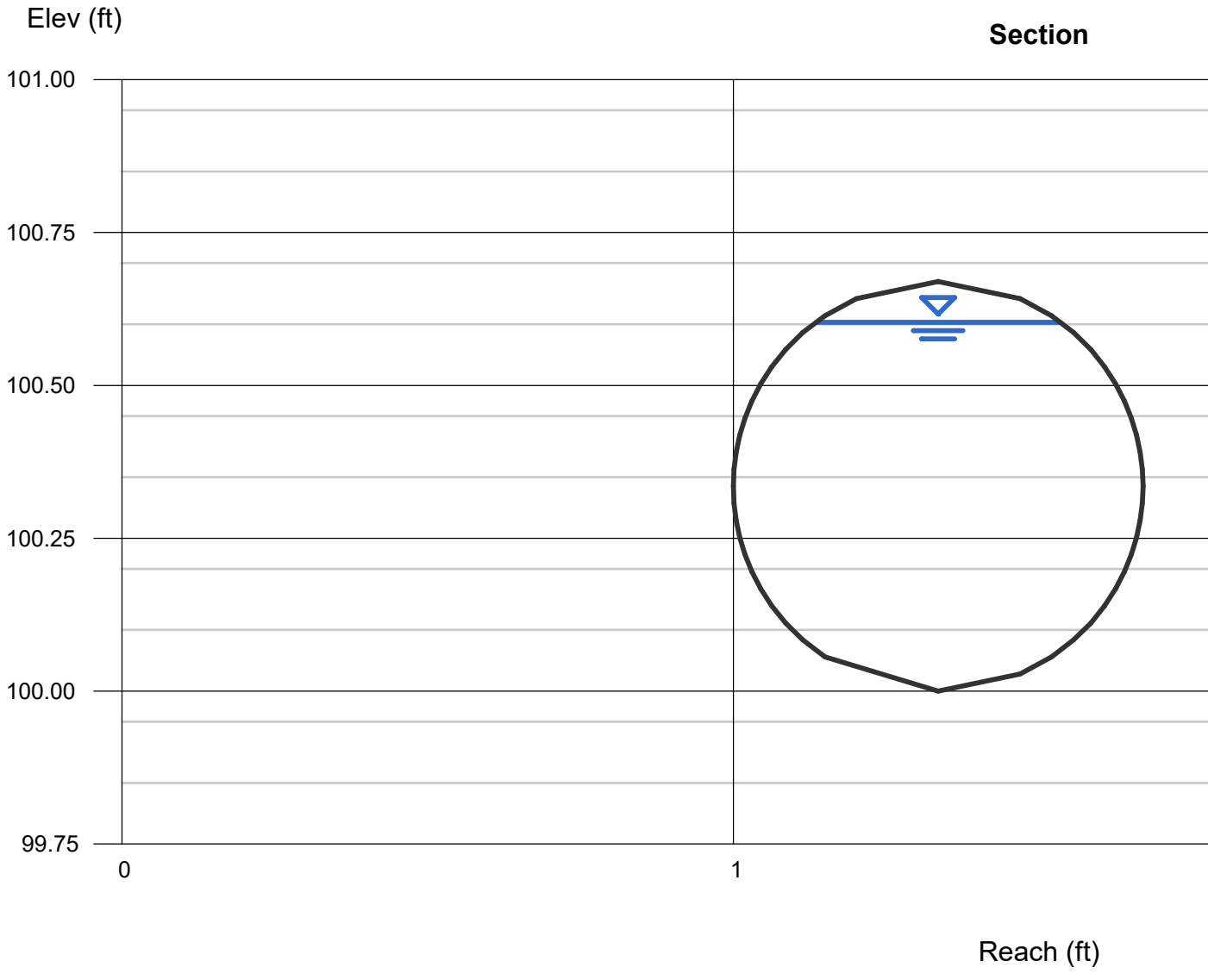
Diameter (ft)	= 0.67
Invert Elev (ft)	= 100.00
Slope (%)	= 8.00
N-Value	= 0.011

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 0.60
Q (cfs)	= 4.362
Area (sqft)	= 0.33
Velocity (ft/s)	= 13.04
Wetted Perim (ft)	= 1.68
Crit Depth, Yc (ft)	= 0.67
Top Width (ft)	= 0.40
EGL (ft)	= 3.25



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jun 8 2022

Existing 10-inch

Circular

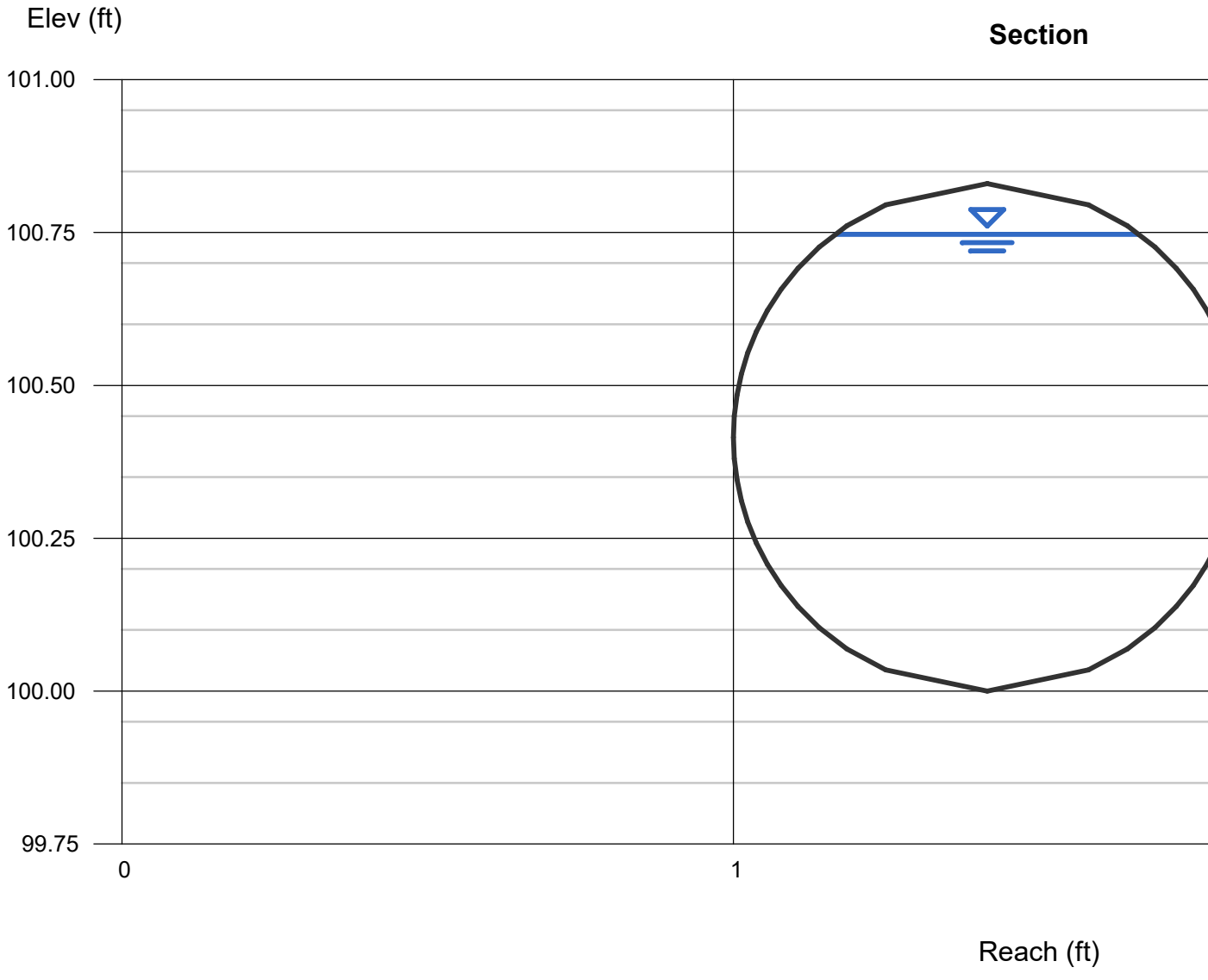
Diameter (ft)	= 0.83
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.011

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 0.75
Q (cfs)	= 2.730
Area (sqft)	= 0.51
Velocity (ft/s)	= 5.32
Wetted Perim (ft)	= 2.08
Crit Depth, Yc (ft)	= 0.73
Top Width (ft)	= 0.50
EGL (ft)	= 1.19



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, May 11 2022

Run-On Channel

Trapezoidal

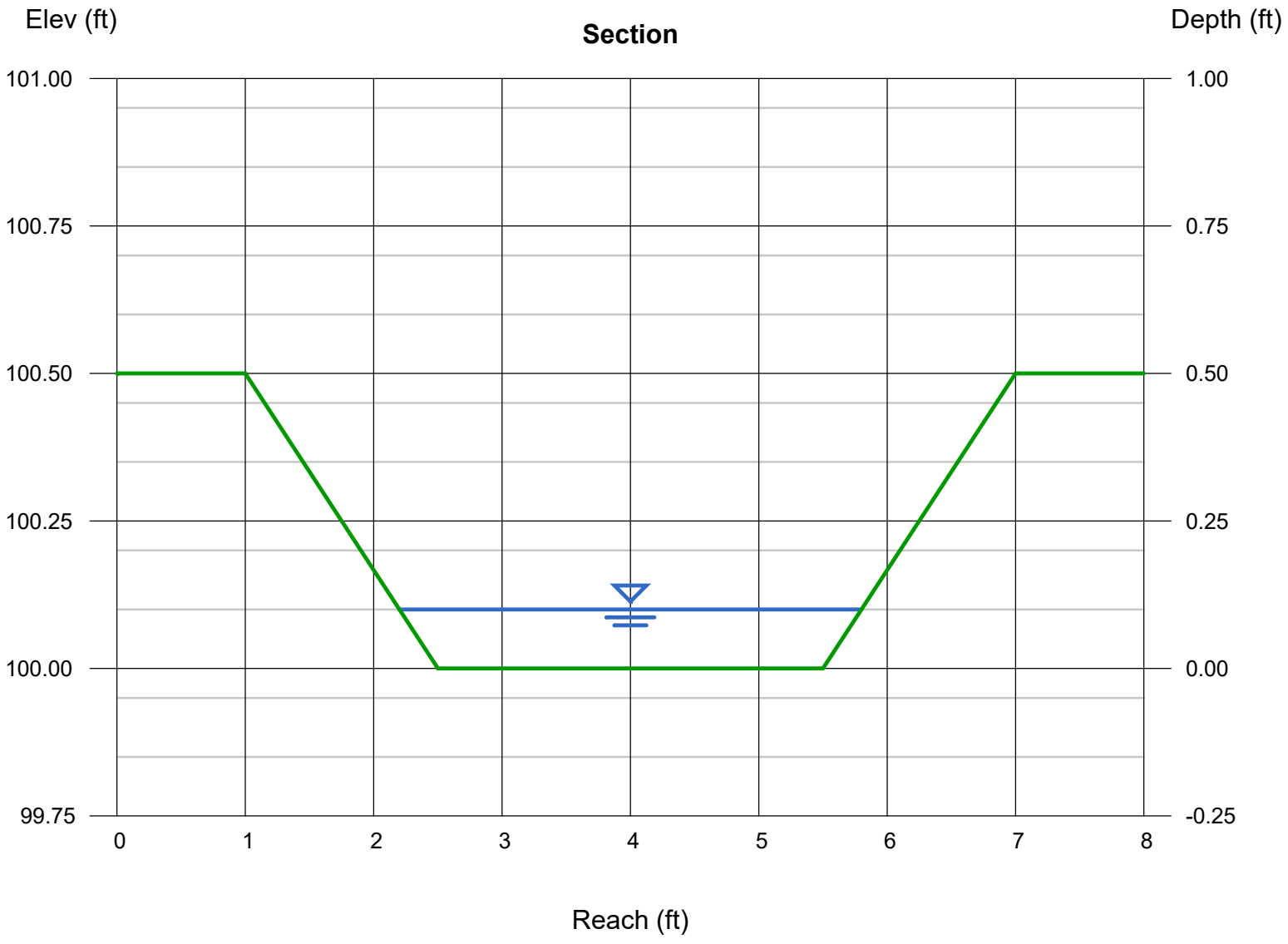
Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.025

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 0.10
Q (cfs)	= 0.396
Area (sqft)	= 0.33
Velocity (ft/s)	= 1.20
Wetted Perim (ft)	= 3.63
Crit Depth, Yc (ft)	= 0.08
Top Width (ft)	= 3.60
EGL (ft)	= 0.12



Attachment C

Hydraulic Analysis Report

Project Data

Project Title: Run-On Channel

Designer:

Project Date: Sunday, May 1, 2022

Project Units: U.S. Customary Units

Notes:

Channel Lining Analysis: Channel Lining Design Analysis

Notes:

Lining Input Parameters

Channel Lining Type: Riprap, Cobble, or Gravel

D50: 0.2 ft

Riprap Specific Weight: 165 lb/ft^3

Water Specific Weight: 62.4 lb/ft^3

Riprap Shape is Angular

Safety Factor: 1

Calculated Safety Factor: 1.00016

Lining Results

Angle of Repose: 40.15 degrees

Relative Flow Depth: 0.857143

Manning's n method: Bathurst

Manning's n: 0.0786755

Channel Bottom Shear Results

V*: 0.439545

Reynold's Number: 7223.42

Shield's Parameter: 0.047

shear stress on channel bottom: 0.3744 lb/ft^2

Permissible shear stress for channel bottom: 0.96444 lb/ft^2

channel bottom is stable

Stable D50: 0.077653 ft

Channel Side Shear Results

K1: 0.868

K2: 0.871478

Kb: 1.05

shear stress on side of channel: 0.3744 lb/ft^2

Permissible shear stress for side of channel: 0.840488 lb/ft^2

Stable Side D50: 0.0773431 lb/ft^2

side of channel is stable

Channel Bend Shear Results

Curvature Radius: 50 ft

No further correction will occur once R/T > 10

shear stress on bottom of channel in bend: 0.39312 lb/ft^2

bottom of bend of the channel is stable

Length of Protection beyond PT: 0.95713 ft

Additional Freeboard required because of Superelevation: 0.00260616 ft

Channel Bend Side Shear Results

shear stress on side of channel in bend: 0.341228 lb/ft^2

The side of the bend of the channel is stable

Channel Lining Stability Results

the channel is stable

Channel Summary

Report for channel

Channel Analysis: Channel Analysis

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 3.0000 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Channel Width: 3.0000 ft

Longitudinal Slope: 0.0300 ft/ft

Manning's n: 0.0787

Lining Type: Rock Riprap - 150 mm (6-inch)

Depth: 0.2000 ft

Result Parameters

Flow: 0.7195 cfs

Area of Flow: 0.7200 ft^2

Wetted Perimeter: 4.2649 ft

Hydraulic Radius: 0.1688 ft

Average Velocity: 0.9993 ft/s

Top Width: 4.2000 ft

Froude Number: 0.4253

Critical Depth: 0.1165 ft

Critical Velocity: 1.8433 ft/s

Critical Slope: 0.1936 ft/ft

Critical Top Width: 3.70 ft

Calculated Max Shear Stress: 0.3744 lb/ft^2

Calculated Avg Shear Stress: 0.3160 lb/ft^2