



Final version will need to be signed
(authorizations and checklist), no
additional revisions needed to the
drainage report.

Phase III Drainage Report

Magellan Pipeline Company, L.P.

Type of document:

Technical Report

Project:

Denver Expansion Project 1041 – Watkins Junction Site

39°42'35.9"N 104°31'43.1"W

Case Number: UASI25-002

Date submitted:

January 2025

Date last revised:

August 2025

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1 Certification Statements

1.1 Engineer Certification Statement

I hereby affirm that this report and plan for the Phase III drainage design of the Watkins Junction Site was prepared by me, or under my direct supervision, for the owners thereof, in accordance with the provisions of Arapahoe County Stormwater Management Manual and the Urban Drainage and Flood Control District Criteria Manual, and approved variances and exceptions thereto. I understand that Arapahoe County does not and will not assume liability for drainage facilities designed by others.

SIGNATURE: _____

Registered Professional Engineer State of Colorado No. _____

[place seal here]

1.2 Developer Certification Statement

Magellan Pipeline Company, L.P. hereby certifies that the drainage facilities for the Watkins Junction Site shall be constructed according to the design presented in this report. I understand that Arapahoe County does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that Arapahoe County reviews drainage plans pursuant to Colorado Revised Statutes Title 30, Article 28; but cannot, on behalf of the Watkins Junction Site, guarantee that final drainage design review will absolve Magellan Pipeline Company, L.P. and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the Final Plat, Final Development Plan, and/or Subdivision Development Plan does not imply approval of my engineer's drainage design.

Name of Developer: _____

Authorized Signature: _____

2 Project Overview

This report has been prepared for Magellan Pipeline Company, L.P to complement the drainage plans generated for the proposed Watkins Junction Site which is part of the Denver Expansion Project. The Watkins Junction site is a new development that will consist of a 22,500-SF gravel area and restoration of the existing gravel access drive. Within the 22,500-SF gravel area, one pipeline will be routed above ground to a gravel junction site enclosed by chain link fence to facilitate connections between the proposed inflow and outflow piping and allow for pig traps and valves to be installed. A stormwater conveyance system including a perimeter swale and circular culvert are proposed on the Watkins Junction site to maintain a connection to the existing surrounding natural system and are sized according to Arapahoe County standards.

3 General Location and Description

3.1 Site Location

The Watkins Junction site is located at Arapahoe County Parcel No. 1979-00-0-00-596, Section 29, Township 5 South, Range 68 West of the 6th Principal Meridian, coordinates 39°42'35.9"N 104°31'43.1"W as shown in the Vicinity Map (Appendix B). The existing site conditions include largely undeveloped agricultural land (zone A-1) with surrounding properties to the north, west, and south consisting of largely the same undeveloped agricultural land (zone A-1) while the east is bounded by South Manila Road. Note that at the time of this report, Magellan Pipeline Company, L.P. is in the process of acquiring Arapahoe County Parcel No. 1979-00-0-00-596 and 1979-00-0-00-595; therefore, both parcels are considered as part of the subject property and report as under the same ownership. The subject property will remain zone A-1. No protected habitats or endangered species are understood to be located within the Watkins Junction site.

3.2 Description of Property

The Watkins Junction site is located on mostly undeveloped agricultural land with limits of proposed work consisting of 2.85-AC. The proposed work area comprises open space with undisturbed native grasses, featuring a total imperviousness of 5%, and sections of gravel, which have a total imperviousness of 60%. An existing gravel access drive connects the proposed junction site to South Manila Road. The existing gravel access drive continues north to an existing deteriorated site approximately 300' north of the proposed junction site, outside of the limits of work, that will remain unchanged. Existing grade on the southern parcel of the 473-AC subject property primarily slopes to the west where a large natural depression exists roughly 500-FT west of the proposed Watkins Junction site. The existing site access driveway entrance at South Manila Road crosses an apparent drainage ditch with a relative high point at the existing driveway. No culvert exists at the existing site access driveway entrance. There appears to be an existing sub-catchment ridge line at the existing site access drive approximately 500-FT west of the site entrance at South Manila Road. The apparent 2-AC sub-catchment east of the ridge line appears to flow to an existing swale along South Manila Road while sub-catchments west of the ridge line appear to flow west to an existing natural depression contained within the site. It appears that no existing waterways or conveyance swales are located to outlet runoff from the existing depressional areas onsite. The site is outside of the Cherry Creek Basin. See Appendix I for existing drainage plan.

The USDA Natural Resources Conservation Service Soil Survey website lists the soils onsite as primarily Nunn-Bresser-Ascalon complex with hydrologic soil type B (Appendix D). No apparent waterways exist within or directly adjacent to a majority of the Watkins Junction site.

The proposed site will consist of a new 22,500-SF (approx. 0.52-AC) gravel area and a 42,250-SF (approx. 0.97-AC) gravel site access drive to upgrade the portion of the existing site access drive located between the proposed junction

site and the site entrance at South Manila Road. An additional 59,500-SF (approx. 1.36-AC) greenspace area will be proposed adjacent to the site access drive and junction site for a proposed swale. A breakdown of the existing and proposed pervious/impervious area is summarized in the table below. The total development area considered is 2.85-AC and the total increase in impervious area from existing to proposed is 0.94-AC.

Table 1: Existing and Proposed Project Area Summary

Land-Use	Existing Site Area (ac)	Proposed Site Area (ac)
Pervious	2.30	1.36
Site Impervious	0.55	1.49
Total:	2.85	2.85

3.3 Groundwater Investigation

No groundwater investigation was performed at this site.

4 Floodplain

The Watkins Junction site is found to be included in Zone X per the FEMA FIRMette obtained online (included in this report as Appendix C). The contributing upstream area that passes through the site is less than 100-AC, therefore there is no local floodplain delineation for this location.

5 Drainage Basins and Sub-Basins

5.1 Major Drainage Basins

The site is in the West Sand Creek drainage basin. The site is located along a small tributary in West Sand Creek basin, one mile from the upstream end of the basin. The basin extends 30 miles north to the confluence with West Sand Creek, which then flows 10 miles northeast to Sand Creek and 40 miles northeast into the South Platte River.

At the time of writing this report, no known drainageway master plans or studies exist within or adjacent to the site. No apparent notable impacts of the proposed development to major basin flow patterns and paths within or adjacent to the site under fully developed conditions.

5.2 Minor Drainage Basins

The existing project site consists of two minor onsite drainage basins- EX-1 and EX-2. Drainage basin EX-1 includes 2.03-AC of open space/undisturbed native grasses (5% imperviousness) and 0.39-AC of gravel (60% imperviousness), is located at the west end of the Watkins Junction site, and mostly drains west to the existing depressional area located west of the Watkins Junction site. Drainage basin EX-1 consists of undeveloped agricultural land and a portion of the existing site access drive. Drainage basin EX-2 includes 0.27-AC of open space/undisturbed native grasses and 0.16-AC of gravel, is located at the east end of the Watkins Junction site, and mostly drains east to the existing roadway swale along South Manila Road. Drainage basin EX-2 consists of mainly the eastern portion of the existing site access drive with a small portion of undeveloped agricultural land. A ridge line exists on the site access drive that delineates flow between drainage basins EX-1 and EX-2 and an existing berm adjacent to the site access drive prevents runoff from entering the site from the south. The Watkins Junction site receives runoff from two off-site

drainage basins- OS-1 and OS-2, located south and east of the proposed junction site which consist of 3.14-AC and 0.90-AC of open space/undisturbed native grasses, respectively.

The proposed Watkins Junction site consists of three minor onsite sub-drainage basins- DA-1, DA-2, and DA-3. See Table 2 for a summary of sub-basin characteristics. A perimeter conveyance system including a swale and a 24-IN culvert are proposed. The swale runs along the north side of the proposed site access drive and the south and east edges of the proposed gravel pad, while the culvert passes beneath the proposed access drive near the proposed junction site entrance. The conveyance system maintains a connection to the existing surrounding natural system and is sized according to Arapahoe County standards. Proposed drainage patterns are outlined in Appendix A and Appendix I and a summary of sub-basin areas is provided in Table 2.

Proposed sub-basin DA-1 primarily consists of the east end of the proposed site access drive with 0.21-AC of grass swale cover (20% imperviousness) and 0.22-AC of gravel. Flow from the gravel access drive in DA-1 is directed north into the proposed site swale where it then flows east to the existing roadway swale along South Manila Road. Existing swale capacity calculations are located in Appendix H and were generated from LiDAR data sourced from OpenTopography publish on 12/22/2021. This drainage area receives no flow from off-site areas.

Proposed sub-basin DA-2 primarily consists of the west end of the proposed site access drive with 0.47-AC of grass swale cover and 0.75-AC of gravel. Flow from the gravel access drive in DA-2 is directed north into the proposed site swale, then conveyed west to a proposed 24-IN culvert before ultimately discharging offsite to an existing depressional area approximately 500-FT west of the Watkins Junction site. Sub-basin DA-1 receives runoff from OS-1 (3.14-AC of open space/undisturbed native grasses as sheet flow) to the northwest. See Appendix H for swale and culvert sizing calculations.

Proposed sub-basin DA-3 is located at the west end of the proposed site and consists of primarily a gravel access pad contained within a proposed site fence with 0.52-AC of gravel and 0.68-AC of grass swale cover. Flow from DA-3 follows the natural existing drainage pattern southwest via sheet flow where it is then intercepted by a proposed site swale. A small portion (approximately 0.1-AC) at the northwest corner of the proposed DA-3 sheet flows directly off site. Sub-basin DA-3 receives runoff from OS-2 (0.90-AC of open space/undisturbed native grasses as sheet flow) to the south where the proposed site swale directs flow to the west before ultimately discharging to an existing depressional area approximately 500-FT west of the Watkins Junction site. It is assumed that minimal infiltration occurs on site, and that runoff is conveyed via swales, with flow regulated by outlets that discharge in accordance with the site's existing natural drainage patterns.

At the time of writing this report, no known drainageway master plans or studies exist within or adjacent to the site. There are no apparent impacts of the proposed development to minor basin flow patterns and paths within or adjacent to the site under fully developed conditions. No drainage studies exist for developments adjacent to the Watkins Junction site and no irrigation facilities are expected to influence or be impacted by the proposed development.

Table 2: Existing and Proposed Sub-Basin Area Summary

Basin ID	Design Point	Area (AC)
EX-1	EX-1	2.42
EX-2	EX-2	0.43
DA-1	1	0.43
DA-2	2	1.22
DA-3	4	1.20

OS-1	3	3.14
OS-2	5	0.90

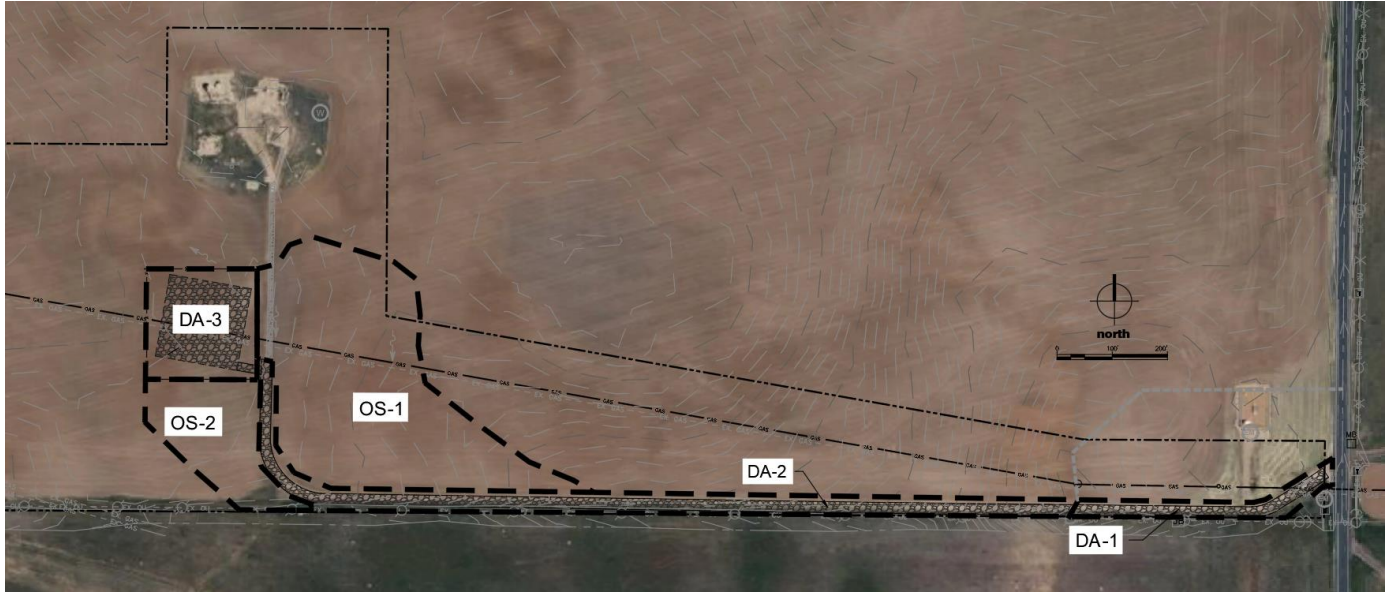


Figure 1: Basin Map

6 Existing Stormwater Conveyance, Storage, and/or Water Quality Facilities

6.1 Existing Stormwater Storage and/or Water Quality Facilities

At the time of writing this report, no existing stormwater storage or water quality facilities exist within or adjacent to the Watkins Junction site. Existing grade on the southern portion of the 473-AC subject property primarily slopes to the west where a large natural depression exists roughly 500-FT west of the proposed Watkins Junction site. A majority of the site flows to this natural depression while a small portion (approximately 2-AC) appears to sheet flow east to an existing swale along South Manila Road.

6.2 Existing Stormwater Conveyance Facilities

The only existing stormwater conveyance facility within or adjacent to the site appears to be the offsite swale along South Manila Road.

7 Drainage Design Criteria

The criteria outlined in the Arapahoe County Stormwater Management Manual (ACSWMM) and the Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual are used as a basis for drainage design in this report.

Per email from Arapahoe County dated December 19, 2024, detention requirements outlined in the Arapahoe County Stormwater Management Manual Section 13.1.1 have been waived for this site and detention calculations are not included in the analyses.

7.1 Hydrologic Design Criteria

Per chapter 6 of the ACSWMM, the rational method is used to estimate peak flow rates of the existing and proposed site using the corresponding design rainfall events outlined in ACSWMM. The 10-year and 100-year, 1-hour rainfall events are evaluated for the minor and major rainfall events, respectively. Due to the site being outside of MS4 permit jurisdictions and as confirmed in meeting with Arapahoe County on November 25, 2024, water quality design is not required. The 2-year water quality rainfall event is not analyzed. Design rainfall depths for major and minor storms are sourced from the ACSWMM and are 1.65-IN and 2.67-IN, respectively, as shown in Appendix E. Per the MHFD Urban Storm Drainage Criteria Manual, rational “C” values for the minor and major rainfall events are calculated using the equations outline in table 6-5 (See Appendix F) and a minimum time of concentration (tc) of 10 minutes for non-urban areas is used. Rainfall intensities for the 10-year and 100-year, 1-hour rainfall events are determined using Intensity-duration curves outlined in Chapter 6 of the ACSWMM as shown in Appendix E and are found to be 4.46-IN/HR and 7.28-IN/HR, respectively. See Table 3 below for sub-basin characteristics and peak flow rates.

Table 3: Existing and Proposed Summary Runoff Table

Basin ID	Design Point	Area	C2	C5	C10	C100	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q100 (CFS)	% Impervious
EX-1	EX-1	2.42	0.08	0.10	0.17	0.49	0.53	0.90	1.82	8.64	0.14
EX-2	EX-2	0.43	0.17	0.19	0.26	0.54	0.19	0.31	0.50	1.70	0.25
DA-1	1	0.43	0.29	0.32	0.38	0.61	0.33	0.51	0.74	1.92	0.40
DA-2	2	1.22	0.32	0.36	0.42	0.63	1.04	1.62	2.27	5.63	0.45
DA-3	4	1.20	0.26	0.29	0.36	0.60	0.83	1.31	1.92	5.24	0.37
OS-1	3	3.14	0.03	0.03	0.10	0.45	0.21	0.38	1.36	10.27	0.05
OS-2	5	0.90	0.03	0.03	0.10	0.45	0.06	0.11	0.39	2.94	0.05

7.2 Hydraulic Design Criteria

Proposed site hydraulics are calculated via the open-channel design methodology outlined in MHFD Urban Storm Drainage Criteria Manual, Chapter 8 and the culvert design methodology outlined in MHFD Urban Storm Drainage Criteria Manual, Chapter 11. All proposed conveyance features are designed for the 100-year, 1-hour rainfall event. One-dimensional, steady uniform flow and negligible head loss is assumed in this analysis.

Manning’s equation is used to calculate flow capacities of the proposed swale at corresponding design points. A Manning’s roughness value (n) of 0.03, minimum side slopes of 5:1 (H:V), and a minimum bottom width of 2-FT are used. The channel bottom slope (S) of 2% is found by taking the average slope of 100' discrete intervals along the length of the proposed swale section. See Appendix H for swale design calculations.

Culvert capacities and design are calculated using UD-Culvert- a companion workbook supplied by MHFD that aids in analyzing the flow conditions in circular culverts. See Appendix H for culvert calculations.

7.3 Water Quality Control Measure Design Criteria

Due to the site being outside of MS4 permit jurisdictions, formal design for water quality is not required and is not conducted in this report.

8 Proposed Stormwater Conveyance or Storage Facilities

8.1 Proposed Stormwater Storage Facilities

Per TRC waiver request response letter (Appendix J) from Arapahoe County dated December 19, 2024, detention requirements outlined in the Arapahoe County Stormwater Management Manual Section 13.1.1 have been waived for this site and detention is not proposed.

8.2 Proposed Stormwater Conveyance Facilities

A perimeter conveyance system including a swale and a 24-IN culvert are proposed. The swale routes along the north side of the proposed site access drive and the south and east ends of the gravel pad and is designed to convey the runoff produced on the site by the 100-year, 1-hour rainfall event. The flow rate capacity of the proposed swale with a bottom slope of 2% is 33.95-CFS which is sufficient to convey the maximum resulting flow rate of 26.00-CFS from the proposed site. A 24-IN culvert with a cover of 1-FT is proposed at the site access drive near the proposed junction site and is designed to convey the runoff produced on DA-2 and OS-1 from the 100-year, 1-hour rainfall event. To facilitate proper culvert construction, an approximately 10' section of the swale upstream of the culvert is proposed to have a 10% slope. See Appendix H for proposed swale and culvert calculations. One-dimensional, steady uniform flow and negligible head loss is assumed in the design of all proposed conveyance features.

A rip rap outlet section is proposed at the outlets of the proposed conveyance system. Given the size of the development and the absence of nearby drainage facilities, no offsite conveyance facilities are proposed and no additional energy dissipation features are proposed at the outlets. The proposed conveyance system maintains a free-flowing connection to the natural surrounding system.

9 Water Quality Control Measure

The site is located outside of MS4 permit jurisdictions and detention requirements have been waived; therefore, no non-structural or structural water quality best management practices (BMPs) are proposed.

10 Additional Permitting Requirements

A Colorado State Stormwater Discharge Permit is required.

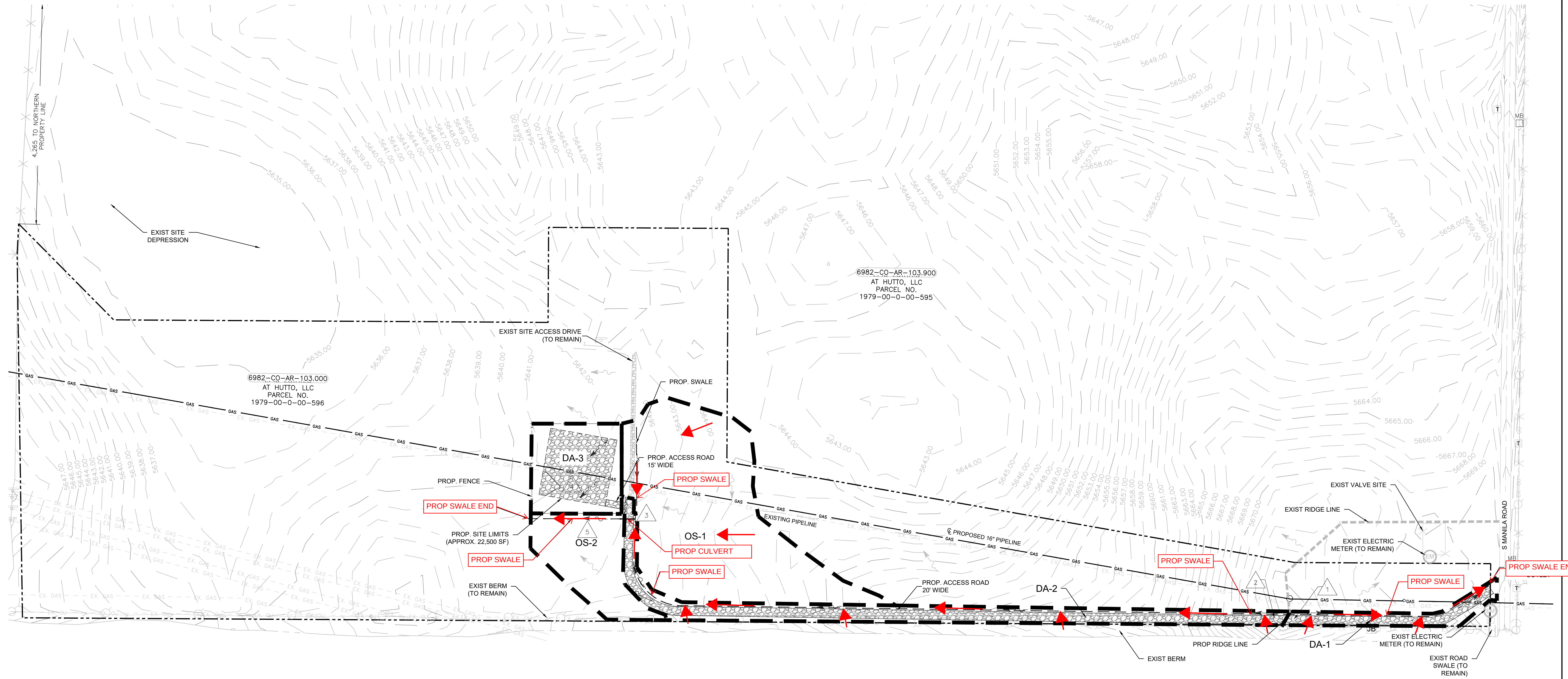
11 References

1. Arapahoe County Stormwater Management Manual, online.
2. MHFD Urban Storm Drainage Criteria Manual, prepared by Wright-McLaughlin Engineers, March 1969, Revised 2016.
3. FEMA Flood Insurance Rate Map Study, Arapahoe County, Colorado FIRM panel 08005C0233L.
4. USDA NRCS Web Soil Survey, online.

12 Conclusion

In summary, the Magellan Pipeline Watkins Junction Site is proposed to meet the drainage standards put forth by Arapahoe County and MHFD. Per TRC waiver request response letter (Appendix J) from Arapahoe County dated December 19, 2024, detention requirements outlined in the Arapahoe County Stormwater Management Manual Section 13.1.1 have been waived for this site and detention is not proposed. Additionally, the site is located outside of MS4 permit jurisdictions and detention requirements have been waived; therefore, no water quality best management practices (BMPs) are proposed. A perimeter swale and culvert are proposed to convey runoff generated by the proposed site and is designed per MHFD Urban Storm Drainage Criteria Manual.

Appendix A – Conveyance Diagram



LEGEND

- PROPERTY LINE
- PROPOSED DRAINAGE AREA
- EXISTING CONTOUR
- EX. GAS
- EX. OVERHEAD ELECTRIC
- EX. WATER STRUCTURE
- EX. ELECTRICAL STRUCTURE
- EXISTING RIDGE LINE
- EXISTING GRAVEL
- EXISTING FLOW ARROW
- PROPOSED FLOW ARROW
- PROPOSED FENCE
- PROPOSED PIPELINE
- PROPOSED GRAVEL
- PROPOSED SWALE
- DESIGN POINT

GENERAL NOTES

- ALL PROPOSED IMPROVEMENTS ARE CONCEPTUAL AND SUBJECT TO CHANGE UPON DEVELOPMENT OF DESIGN AND AGENCY APPROVAL.
- REFER TO PHASE III DRAINAGE REPORT BY EXP DATED JANUARY 2025 FOR CALCULATIONS.
- THE TOPOGRAPHIC SURVEY WAS PROVIDED BY LW SURVEY COMPANY CONSULTING GROUP ON 11/7/2024. THESE IMPROVEMENT PLANS DO NOT WARRANT THE ACCURACY OF THE PROVIDED SURVEY.
- EXISTING UTILITY INFORMATION AS SHOWN ON PLANS ARE FOR REFERENCE ONLY AND SHALL NOT BE TAKEN AS EXACT. CONTRACTOR SHALL FIELD VERIFY ALL EXISTING UTILITY LOCATIONS WITHIN THE LIMITS OF DISTURBANCE AND AS IT RELATES TO THE WORK HEREIN.

REVISION NUMBER	DATE	BY	DATE	BY	DATE	BY
1	1/8/2025	JPT	1/8/2025	JPT	1/8/2025	NSK



DRAINAGE EXHIBIT – PROPOSED WATKINS JUNCTION SITE

DRAWN BY	REE	SCALE	AS NOTED	A.F.E.	
DATE DRAWN	1/8/2025	DRAWING NO.			
CHECKED BY	JPT				
PROJECT ENGINEER	JPT				
APPROVED BY	NSK				

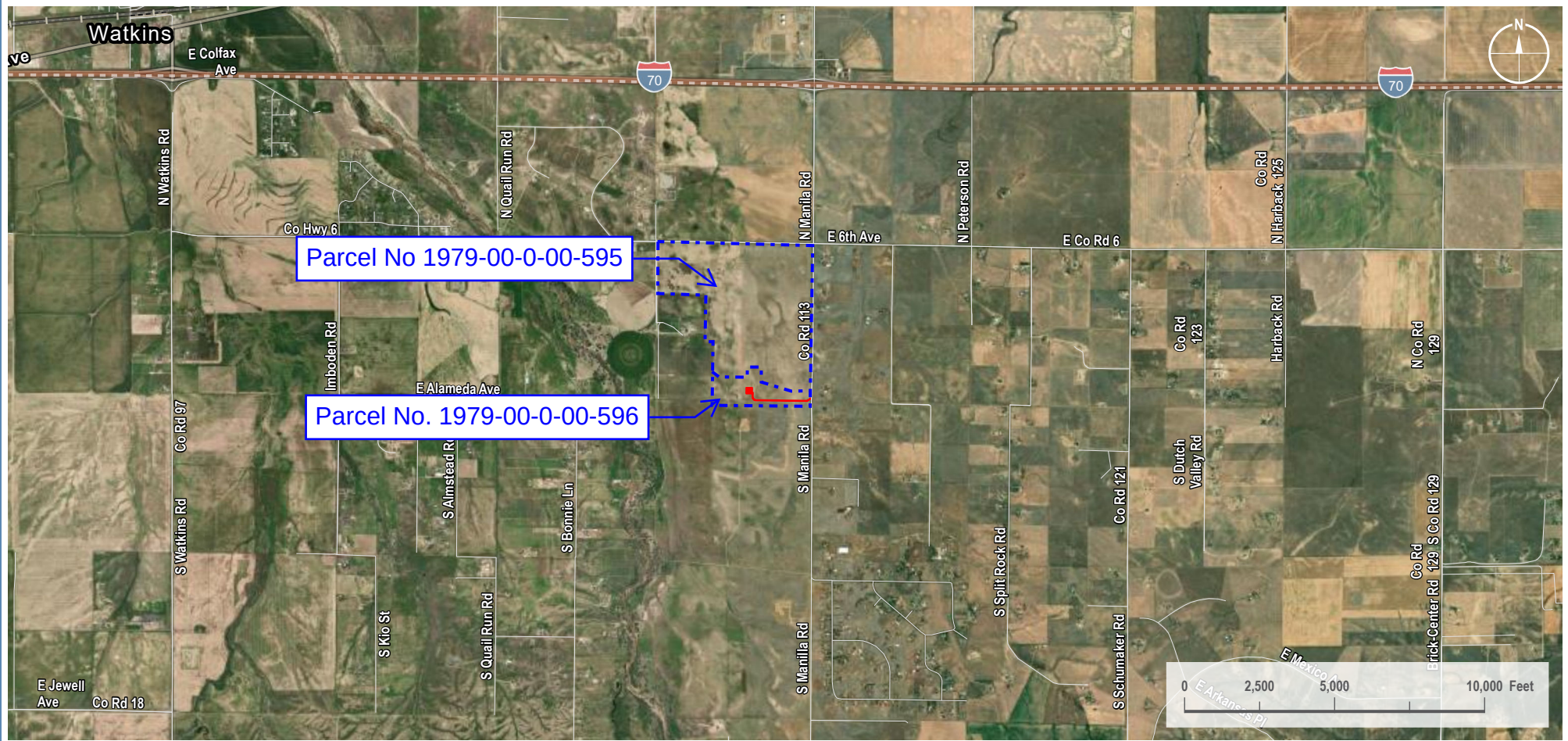
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• BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

Appendix B – Site Vicinity Map

WATKINS JUNCTION SITE & ACCESS ROAD, OVERVIEW MAP (AERIAL) - ARAPAHOE CO.



Disclaimer: Content on this figure is preliminary, and must be treated as confidential and proprietary. Sources are believed to be reliable and EXP does not assume responsibility for accuracy of data.

VICINITY MAP



LEGEND

 Proposed Project Area

PREPARED BY

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11330 Clay Road, Suite 550
Houston, TX 77041
United States of America
www.exp.com



REVISIONS

Date: 2024-12-06 Revised by: DH Checked by: JW
1 - Submit to ARAP. CO.
Submitted to ARAP. CO.

Date: Revised by: Checked by:

DENVER EXPANSION PROJECT

Client:


Figure Title: Watkins Junction Site & Access Road
Overview Map (Aerial) - Arapahoe Co.

Scale:
1 : 60,000
1 inch equals 5,000 feet

Projection:
Transverse Mercator
NAD 1983 UTM Zone 13N

Sheet:
1
1 of 1

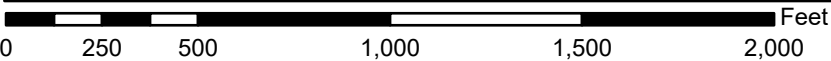
Drawing Number:
1002-01-001-01
Revision 1

Appendix C – FEMA FIRMette

National Flood Hazard Layer FIRMMette



104°32'25"W 39°42'53"N



1:6,000

104°31'47"W 39°42'25"N

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **11/20/2024 at 1:42 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Appendix D – NRCS Custom Soil Report



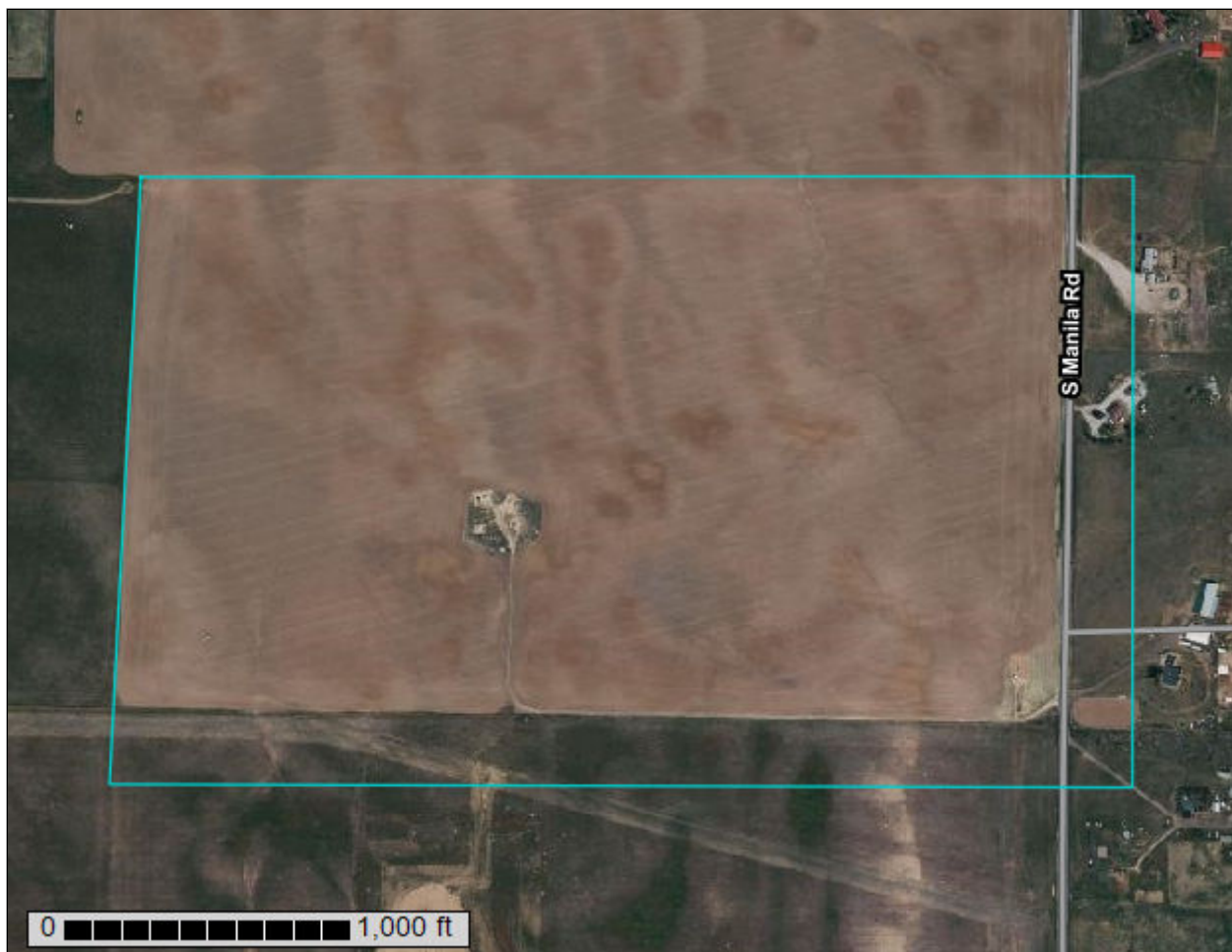
United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for **Arapahoe County, Colorado**



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

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identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

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MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot

 Sinkhole

 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Arapahoe County, Colorado
Survey Area Data: Version 20, Aug 29, 2024

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 9, 2021—Jun 12, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BvC	Bresser-Truckton sandy loams, 3 to 5 percent slopes	80.9	46.9%
NrB	Nunn-Bresser-Ascalon complex, 0 to 3 percent slopes	84.1	48.7%
TrC	Truckton loamy sand, 3 to 5 percent slopes	5.6	3.2%
TrD	Truckton loamy sand, 5 to 9 percent slopes	2.1	1.2%
Totals for Area of Interest		172.7	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Arapahoe County, Colorado

BvC—Bresser-Truckton sandy loams, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 34y5

Elevation: 4,500 to 6,800 feet

Mean annual precipitation: 12 to 18 inches

Mean annual air temperature: 46 to 52 degrees F

Frost-free period: 125 to 180 days

Farmland classification: Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60

Map Unit Composition

Bresser and similar soils: 55 percent

Truckton and similar soils: 30 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bresser

Setting

Landform: Stream terraces, drainageways, playas

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Noncalcareous sandy alluvium and/or noncalcareous sandy eolian deposits

Typical profile

H1 - 0 to 6 inches: sandy loam

H2 - 6 to 26 inches: sandy clay loam

H3 - 26 to 32 inches: gravelly sandy loam

H4 - 32 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 3 to 5 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.57 to 2.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 10 percent

Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B

Ecological site: R049XB210CO - Sandy Foothill

Hydric soil rating: No

Description of Truckton

Setting

Landform: Ridges
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits

Typical profile

H1 - 0 to 5 inches: sandy loam
H2 - 5 to 20 inches: sandy loam
H3 - 20 to 60 inches: sandy loam

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Nunn

Percent of map unit: 8 percent
Hydric soil rating: No

Ascalon

Percent of map unit: 7 percent
Hydric soil rating: No

NrB—Nunn-Bresser-Ascalon complex, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 34yw
Elevation: 4,500 to 6,800 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 115 to 180 days

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Farmland classification: Prime farmland if irrigated

Map Unit Composition

Nunn and similar soils: 40 percent

Bresser and similar soils: 25 percent

Ascalon and similar soils: 20 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nunn

Setting

Landform: Stream terraces, streams, playas

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Eolian deposits

Typical profile

H1 - 0 to 8 inches: loam

H2 - 8 to 28 inches: clay

H3 - 28 to 60 inches: sandy clay loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 15 percent

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water supply, 0 to 60 inches: Moderate (about 8.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3c

Hydrologic Soil Group: C

Ecological site: R049XB202CO - Loamy Foothill

Hydric soil rating: No

Description of Bresser

Setting

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Noncalcareous sandy alluvium and/or noncalcareous sandy eolian deposits

Typical profile

H1 - 0 to 6 inches: sandy loam

H2 - 6 to 26 inches: sandy clay loam

H3 - 26 to 60 inches: gravelly loamy coarse sand

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Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water supply, 0 to 60 inches: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: R049XB202CO - Loamy Foothill
Hydric soil rating: No

Description of Ascalon

Setting

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Reworked by wind outwash

Typical profile

H1 - 0 to 6 inches: sandy loam
H2 - 6 to 17 inches: sandy clay loam
H3 - 17 to 60 inches: fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R049XB202CO - Loamy Foothill
Hydric soil rating: No

Minor Components

Olney

Percent of map unit: 10 percent

Hydric soil rating: No

Aquic ustochrepts

Percent of map unit: 5 percent

Landform: Swales

Hydric soil rating: Yes

TrC—Truckton loamy sand, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 31gjy

Elevation: 4,200 to 5,600 feet

Mean annual precipitation: 12 to 17 inches

Mean annual air temperature: 46 to 52 degrees F

Frost-free period: 125 to 155 days

Map Unit Composition

Truckton and similar soils: 80 percent

Minor components: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Truckton

Setting

Landform: Hills

Landform position (two-dimensional): Backslope, footslope

Landform position (three-dimensional): Side slope

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Wind re-worked alluvium derived from arkose

Typical profile

A - 0 to 6 inches: loamy sand

Bt1 - 6 to 10 inches: sandy loam

Bt2 - 10 to 16 inches: sandy loam

C - 16 to 80 inches: loamy coarse sand

Properties and qualities

Slope: 3 to 5 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): High (2.13 to 7.09 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 1 percent

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Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)

Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: A

Ecological site: R067BY024CO - Sandy Plains

Hydric soil rating: No

Minor Components

Vona

Percent of map unit: 8 percent

Landform: Hills, dunes

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope

Down-slope shape: Convex, linear

Across-slope shape: Convex, linear

Ecological site: R067BY024CO - Sandy Plains

Hydric soil rating: No

Valent

Percent of map unit: 5 percent

Landform: Dunes

Landform position (two-dimensional): Shoulder, backslope

Landform position (three-dimensional): Side slope

Down-slope shape: Convex, linear

Across-slope shape: Convex, linear

Ecological site: R067BY015CO - Deep Sand

Hydric soil rating: No

Blakeland

Percent of map unit: 3 percent

Landform: Hills, interfluves

Landform position (two-dimensional): Shoulder, backslope, summit

Landform position (three-dimensional): Side slope, crest

Down-slope shape: Convex, linear

Across-slope shape: Convex, linear

Ecological site: R067BY015CO - Deep Sand

Hydric soil rating: No

Bresser

Percent of map unit: 2 percent

Landform: Interfluves

Down-slope shape: Linear

Across-slope shape: Linear

Ecological site: R067BY024CO - Sandy Plains

Hydric soil rating: No

Urban land

Percent of map unit: 2 percent

Hydric soil rating: No

TrD—Truckton loamy sand, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 31gjz
Elevation: 4,200 to 5,600 feet
Mean annual precipitation: 12 to 17 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 125 to 155 days

Map Unit Composition

Truckton and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Truckton

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Wind re-worked alluvium derived from arkose

Typical profile

A - 0 to 6 inches: loamy sand
Bt1 - 6 to 10 inches: sandy loam
Bt2 - 10 to 16 inches: sandy loam
C - 16 to 80 inches: loamy coarse sand

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.13 to 7.09 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R067BY015CO - Deep Sand
Hydric soil rating: No

Minor Components

Valent

Percent of map unit: 8 percent
Landform: Dunes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: R067BY015CO - Deep Sand
Hydric soil rating: No

Vona

Percent of map unit: 7 percent
Landform: Hills, dunes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: R067BY015CO - Deep Sand
Hydric soil rating: No

Blakeland

Percent of map unit: 2 percent
Landform: Hills, interfluves
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: R067BY015CO - Deep Sand
Hydric soil rating: No

Urban land

Percent of map unit: 2 percent
Hydric soil rating: No

Bresser

Percent of map unit: 1 percent
Landform: Interfluves
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

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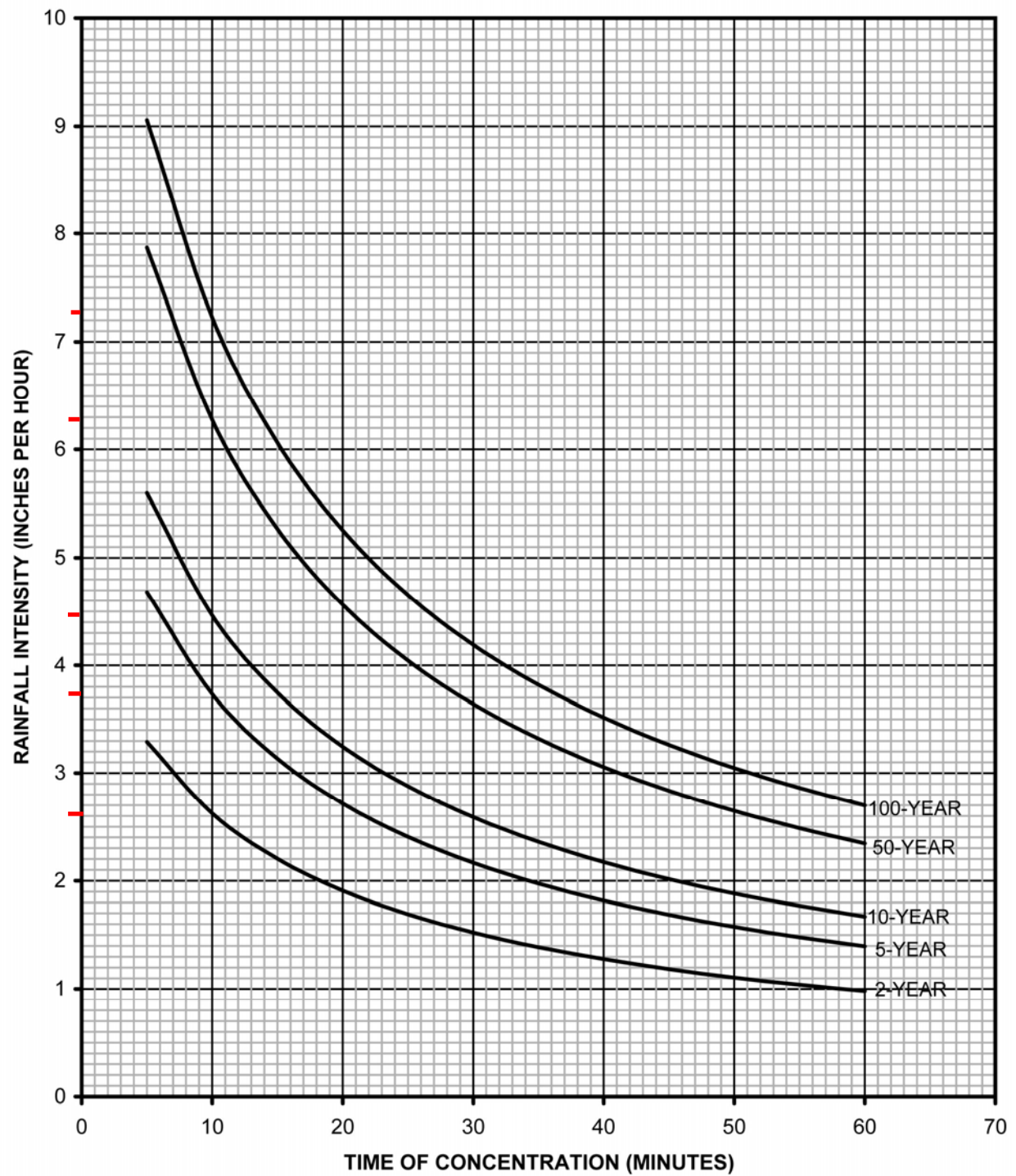
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Appendix E – Rainfall Source

TABLE 6-1
1-HOUR POINT RAINFALL VALUES FOR ARAPAHOE COUNTY (INCHES)

2- YR	5-YR	10-YR	50-YR	100-YR
0.97	1.38	1.65	2.32	2.67

FIGURE 6-1
RAINFALL INTENSITY-DURATION CURVE
ARAPAHOE COUNTY, COLORADO



Appendix F – C-Value and Imperviousness Source

4.5 RAINFALL INTENSITY

The calculated rainfall intensity, I , is the average rainfall rate in inches per hour over a duration equal to t_c . Obtain 1-hour point precipitation depths from National Oceanic and Atmospheric Administration (NOAA) Atlas 14 for the average return periods of interest and apply Equation 5-1 in the *Rainfall* chapter using t_c as the storm duration, t_d . Use the centroid of the catchment to determine the 1-hour point precipitation depths. The MHFD-Rational and MHFD-Inlet Excel workbooks automatically calculate rainfall intensity based on 1-hour point precipitation depths for a specified location.

4.6 RUNOFF COEFFICIENTS

Any watershed can be conceptualized as a combination of pervious and impervious surfaces. Pervious surfaces allow water to infiltrate into the ground, while impervious surfaces do not allow for infiltration. In urban hydrology, the relationships between pervious and impervious surfaces is important. Urbanization increases impervious area, causing rainfall-runoff relationships to change significantly. In the absence of stormwater management controls that infiltrate or detain runoff, urbanization increases peak runoff rates, volumes, and frequency of runoff and decreases the time to peak.

When analyzing a catchment for planning or design purposes, estimates of the existing and probable future imperviousness of the drainage area are needed. In some cases, the pre-development (i.e., historic) condition also must be analyzed. Table 6-2 provides recommended imperviousness values based on land use types and is appropriate for master planning analysis and conceptual design. Note that the land use classifications in Table 6-2 incorporate roads that are included within the land use. Table 6-3 provides recommended imperviousness values for different surface types and is appropriate for use during later stages of design when the layout of different types of impervious and pervious areas on the site is known and the area of each surface type can be quantified.

The runoff coefficient, C , represents the integrated effects of infiltration, evaporation, depression storage, and interception, all of which affect the rate and volume of runoff. Determining representative runoff coefficients requires judgment based on the experience and expertise of the engineer.

Volume-based runoff coefficients were derived to improve consistency between CUHP and the Rational Method for peak flow predictions (Guo 2013; Guo and Urbonas 2013). The coefficients developed by Dr. Guo were recalibrated using CUHP Version 2.0.0 (Rapp et al. 2017). Using imperviousness, expressed as a decimal, and the Natural Resources Conservation Service (NRCS) Hydrologic Soil Group (HSG), the equations in Table 6-5 can be used to calculate runoff coefficients for design storm return periods for the Rational Method.

TABLE 6-5. RUNOFF COEFFICIENT EQUATIONS BASED ON NRCS HSG AND STORM RETURN PERIOD

NRCS HSG	STORM RETURN PERIOD						
	WQE & 2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	$C_A = 0.840I^{1.302}$	$C_A = 0.861I^{1.276}$	$C_A = 0.873I^{1.232}$	$C_A = 0.884I^{1.124}$	$C_A = 0.854I + 0.025$	$C_A = 0.779I + 0.110$	$C_A = 0.645I + 0.254$
B	$C_B = 0.835I^{1.169}$	$C_B = 0.857I^{1.088}$	$C_B = 0.807I + 0.057$	$C_B = 0.628I + 0.249$	$C_B = 0.558I + 0.328$	$C_B = 0.465I + 0.426$	$C_B = 0.366I + 0.536$
C/D	$C_{C/D} = 0.834I^{1.122}$	$C_{C/D} = 0.815I + 0.035$	$C_{C/D} = 0.735I + 0.132$	$C_{C/D} = 0.560I + 0.319$	$C_{C/D} = 0.494I + 0.393$	$C_{C/D} = 0.409I + 0.484$	$C_{C/D} = 0.315I + 0.588$

TABLE 6-7. RUNOFF COEFFICIENTS, C, NRCS HSG B

TOTAL OR EFFECTIVE % IMPERVIOUS	NRCS HSG B						
	WQE & 2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
2%	0.01	0.01	0.07	0.26	0.34	0.44	0.54
5%	0.03	0.03	0.10	0.28	0.36	0.45	0.55
10%	0.06	0.07	0.14	0.31	0.38	0.47	0.57
15%	0.09	0.11	0.18	0.34	0.41	0.50	0.59
20%	0.13	0.15	0.22	0.37	0.44	0.52	0.61
25%	0.17	0.19	0.26	0.41	0.47	0.54	0.63
30%	0.20	0.23	0.30	0.44	0.50	0.57	0.65
35%	0.24	0.27	0.34	0.47	0.52	0.59	0.66
40%	0.29	0.32	0.38	0.50	0.55	0.61	0.68
45%	0.33	0.36	0.42	0.53	0.58	0.64	0.70
50%	0.37	0.40	0.46	0.56	0.61	0.66	0.72
55%	0.42	0.45	0.50	0.59	0.63	0.68	0.74
60%	0.46	0.49	0.54	0.63	0.66	0.71	0.76
65%	0.50	0.54	0.58	0.66	0.69	0.73	0.77
70%	0.55	0.58	0.62	0.69	0.72	0.75	0.79
75%	0.60	0.63	0.66	0.72	0.75	0.77	0.81
80%	0.64	0.67	0.70	0.75	0.77	0.80	0.83
85%	0.69	0.72	0.74	0.78	0.80	0.82	0.85
90%	0.74	0.76	0.78	0.81	0.83	0.84	0.87
95%	0.79	0.81	0.82	0.85	0.86	0.87	0.88
100%	0.84	0.86	0.86	0.88	0.89	0.89	0.90

Site-specific conditions may vary from the representative values presented in this chapter. The engineer is responsible for assuring that the selected imperviousness values represent the imperviousness of the catchment or the proposed development. During master planning or in early stages of design, select imperviousness values that are unlikely to be exceeded as final design plans are developed to avoid the need to increase the size of infrastructure during later design stages.

TABLE 6-2. RECOMMENDED IMPERVIOUSNESS BY LAND USE

LAND USE/DENSITY	IMPERVIOUSNESS
Residential	
Single-family Housing (SFH) – Rural (0 – 3 du/ac)	35%
SFH – Low & Medium-density (3 – 5 du/ac)	55%
SFH – High-density (5 – 20 du/ac)	65%
Manufactured Housing (≥ 10 du/ac)	65%
Multi-family Housing (MFH) – Medium-density (5 – 20 du/ac)	65%
MFH – High-density MFH (>20 du/ac)	70%
Commercial	
Commercial – Low-density	65%
Commercial – Medium- to High-density	80%
Commercial – Urban Core	90%
Industrial/Institutional	
Schools	55%
Office/institutional	65%
Industrial Areas	75%
Solar Fields, Gravel Cover ^{1,2}	60%
Solar Fields, Grass Cover ^{1,2}	45%
Parks and Open Space	
Open Space, Undisturbed Native Grasses	5%
Community Parks	25%
Neighborhood Parks	15%
Golf Courses	30%
Cemeteries	25%

Note: Recommended imperviousness values shown in the table are the minimum imperviousness values for a specific land use. It is the engineer's responsibility to select imperviousness values that appropriately reflect the actual density of the proposed development.

¹ Use these values at the master planning scale or when the specific layout of panels is not known. Use values from the surface type (Table 6-3) at the site planning and design stage when panel width, panel spacing, and panel orientation relative to contours are known.

² Assumes 1:1 ratio of panels to aisles. See MHFD's technical memorandum regarding *Determination of Solar Panel Field Runoff Coefficients and Imperviousness Values* for additional information on procedures to reflect other impervious areas such as roads and pads that may be part of a solar field and layouts with wider inter-panel spacing.

TABLE 6-3. RECOMMENDED IMPERVIOUSNESS BY SURFACE TYPES

SURFACE TYPES		IMPERVIOUSNESS
Roadways and Paved Streets		95%
Concrete Driveways and Walks		95%
Roofs		95%
Gravel	No Traffic (Pedestrian Use)	40%
	Low-traffic Areas (Maintenance Paths and Substations)	60%
	High-traffic Areas (Roadways and Parking)	80%
Disturbed Soil (Including Lawns, Managed/Active Turf, Landscaped Areas with Water-Wise Vegetation, and Uncompacted Gravel/Mulch Planting Beds)		20%
Undisturbed or Decompacted Soil (Native Grasses and Open Space Areas)		5%
Artificial Turfs ¹	Landscape Applications (without Subgrade Drainage Layer)	25% – 45%
	Sport Fields (with Underdrain Pipe System)	60% – 80%
Water Surfaces (Lakes/Reservoirs/Irrigation Ponds)		100%
Solar Fields ²	Grass Cover (Varies with Panel Orientation Relative to Ground Contours)	10% – 45%
	Gravel Cover (Varies with Panel Orientation Relative to Ground Contours)	50% – 75%
Historic Flow Analysis, Greenbelts, Agricultural		5%
Newly Graded Areas		65%
Stormwater Control Measures ³	Retention Ponds & Constructed Wetland Ponds	100%
	Rooftop Systems – Blue Roofs	95%
	Rooftop Systems – Green Roofs (extensive)	65%
	Rooftop Systems – Green Roofs (intensive)	50%
	Permeable Pavement – CGP/PGP/RGP	55%
	Permeable Pavement – PICP	45%
	Extended Detention Basins	25%
	Receiving Pervious Areas (incl. Grass Buffers & Grass Swales)	20%
	Bioretention & Sand Filters	10%

¹ Consult with the manufacturer to get a recommended value.

² Assumes 1:1 ratio of panels to aisles. See MHFD's technical memorandum regarding *Determination of Solar Panel Field Runoff Coefficients and Imperviousness Values* for additional information on procedures for determining percent imperviousness based on panel width, panel spacing, and panel orientation relative to ground contours and how to reflect other impervious areas such as roads and pads that may be part of a solar field and layouts with wider inter-panel spacing.

³ See MHFD's technical memorandum regarding *Evaluation of Percent Imperviousness for Stormwater Control Measures* for background information.

Appendix G – Runoff Coefficient, Time of Concentration, and Runoff Calculations

exp US Services

PROJECT: Magellan Pipeline- Watkins Junction Site
NUMBER: TAL-24003094-00
LOCATION: 39°42'35.9"N 104°31'43.1"W

DESIGNED BY: JPT
CHECKED BY: NSK
DATE: 01/08/25

	Hydrologic Soil Group B
Land use/Surface type	% Imperviousness (I)
Open Space, Undisturbed Native Grasses	5%
Gravel, Low-traffic Areas	60%
Grass Swale	20%

Note:
-Percent Impervious values are found in table 6-2 and 6-3 in the Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual

10-Year

$C_B = 0.807I + 0.057$

100-Year

$C_B = 0.465I + 0.426$

		Area (ac)				Runoff Coefficients	
Basin ID	Total Area (ac)	Open Space (ac)	Gravel (ac)	Grass Swale/Landscaping (ac)	%I (weighted)	C10	C100
EX-1	2.42	2.03	0.39		0.14	0.17	0.49
EX-2	0.43	0.27	0.16		0.25	0.26	0.54
DA-1	0.43		0.22	0.21	0.40	0.38	0.61
DA-2	1.22		0.75	0.47	0.45	0.42	0.63
DA-3	1.20		0.52	0.68	0.37	0.36	0.60
OS-1	3.14	3.14	0.00		0.05	0.10	0.45
OS-2	0.90	0.90	0.00		0.05	0.10	0.45

exp US Services

PROJECT: Magellan Pipeline- Watkins Junction Site
NUMBER: TAL-24003094-00
LOCATION: 39°42'35.9"N 104°31'43.1"W

DESIGNED BY: JPT
CHECKED BY: NSK
DATE: 01/08/25

Notes:

-A minimum time of concentration (t_c) of 10 minutes for non-urban areas are used in calculations per Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual Section 4.4.4

-Rainfall intensities (i) for each design rainfall event are found from IDF curves found in the Arapahoe County Stormwater Management Manual (See appendices).

[illegible]

Appendix H – Hydraulic Calculations

exp US Services

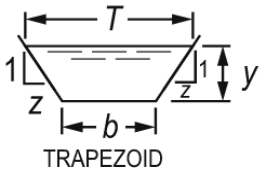
PROJECT: Magellan Pipeline- Watkins Junction Site
NUMBER: TAL-24003094-00
LOCATION: 39°42'35.9"N 104°31'43.1"W

DESIGNED BY: JPT
CHECKED BY: NSK
DATE: 01/08/25

- Notes:
- The 1-hr, 100-year rainfall event is used to design all conveyence features per guidance from the Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual.
 - A manning's roughness value of 0.03 is found from table 8-5 of the Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual.
 - Conceptual swale geometry is found with guidance from the Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual, Chapter 8.
 - One-dimensional, steady uniform flow and negligible head loss is assumed in this analysis.
 - Channel slope (S) is found by taking the average slope of 100' discrete intervals along length of swale section.

Prop Swale Section, ft

b 2
z 5
y 1



$$Q = \frac{1.486}{n} A R_H^{2/3} S^{1/2}$$
$$v = \frac{1.486}{n} R_H^{2/3} S^{1/2}$$

Design Point	Basin ID	ΣQ100 (cfs)	n	A (sf)	R (ft)	S	Qdes(cfs)	ΣQ100 < Qdes?
1	DA-1	1.92	0.03	7	0.57	0.02	33.95	Yes
2	DA-2	7.55	0.03	7	0.57	0.02	33.95	Yes
3	OS-1	12.79	0.03	7	0.57	0.02	33.95	Yes
4	DA-3	23.06	0.03	7	0.57	0.02	33.95	Yes
5	OS-2	26.00	0.03	7	0.57	0.02	33.95	Yes

exp US Services

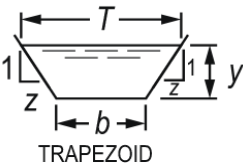
PROJECT: Magellan Pipeline- Watkins Junction Site
NUMBER: TAL-24003094-00
LOCATION: 39°42'35.9"N 104°31'43.1"W

DESIGNED BY: JPT
CHECKED BY: NSK
DATE: 07/09/2025

- Notes:
- The 1-hr, 100-year rainfall event is used to design all conveyence features per guidance from the Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual.
 - A manning's roughness value of 0.03 is found from table 8-5 of the Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual.
 - Actual swale geometry is found with guidance from the Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual, Chapter 8.
 - One-dimensional, steady uniform flow and negligible head loss is assumed in this analysis.
 - Channel slope (S) is found by taking the average slope of 100' discrete intervals along length of swale section.
 - Existing Swale mapped via LiDAR data from OpenTopograpy published on 12/22/2021 (https://portal.opentopography.org/usgsDataset?dsid=CO_DRCOG_1_2020)

Proposed Swale Section, ft

b 2
z 5
y 1



$$Q = \frac{1.486}{n} A R_H^{2/3} S^{1/2}$$

$$v = \frac{1.486}{n} R_H^{2/3} S^{1/2}$$

Existing Swale Section, ft

b 6.9
z 8.25
y 0.66

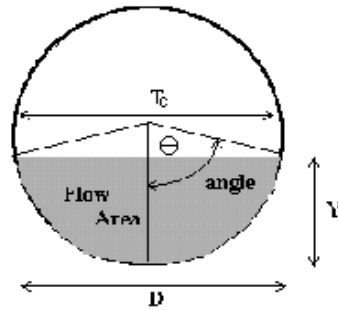
Design Point	Basin ID	ΣQ100 (cfs)	n	A (sf)	R (ft)	S	Qcap(cfs)	ΣQ100 < Qcap?
1	DA-1	1.92	0.03	7	0.57	0.02	33.95	Yes
EXIST SWALE	NA	1.92	0.03	8.1477	0.46	0.008	21.44	Yes

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Magellan Pipeline- Watkins Junction Site**

Pipe ID: **N/A**



Design Information (Input)

Pipe Invert Slope	So =	0.1000	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	24.00	inches
Design discharge	Q =	33.95	cfs

Full-Flow Capacity (Calculated)

Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	71.73	cfs

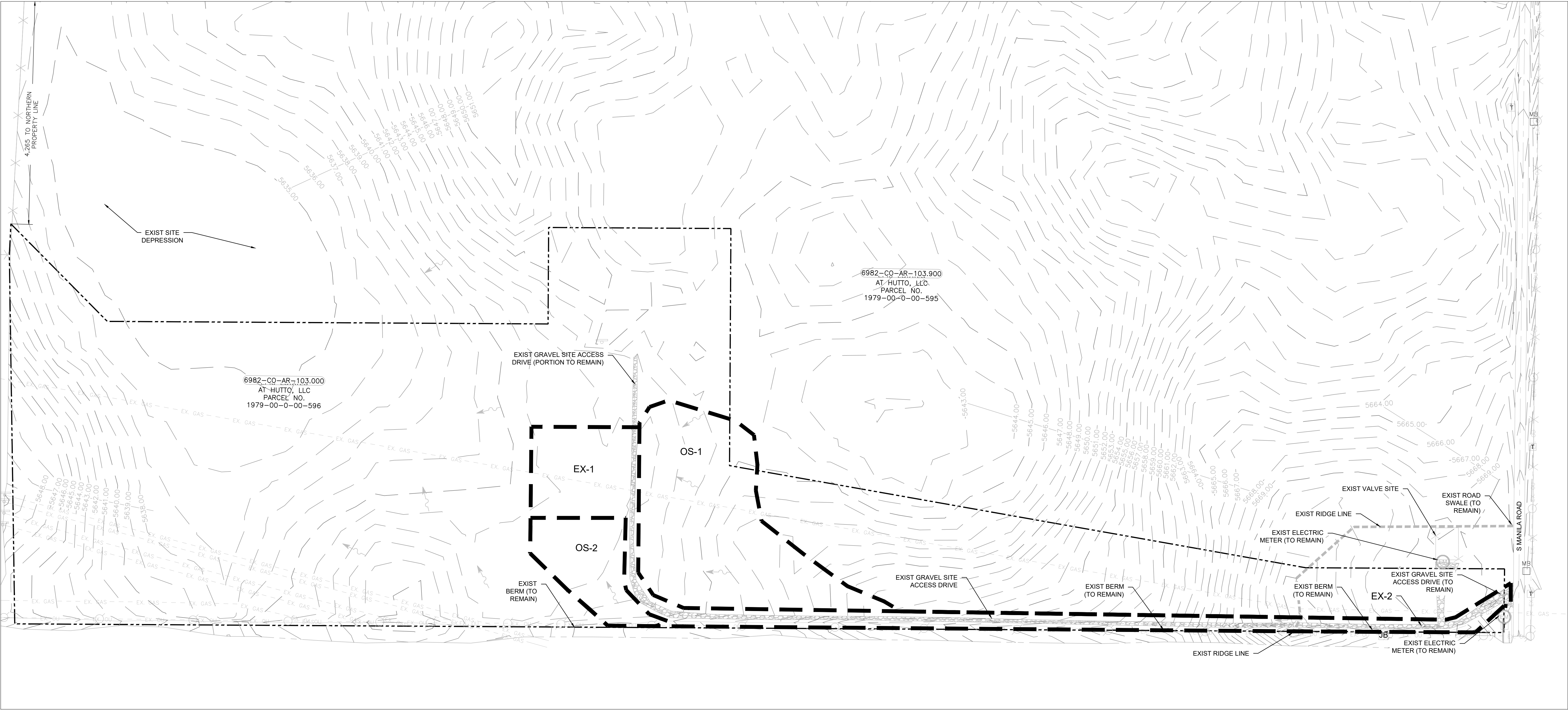
Calculation of Normal Flow Condition

Half Central Angle ($0 < \theta < 3.14$)	Theta =	1.54	radians
Flow area	An =	1.51	sq ft
Top width	Tn =	2.00	ft
Wetted perimeter	Pn =	3.08	ft
Flow depth	Yn =	0.97	ft
Flow velocity	Vn =	22.52	fps
Discharge	Qn =	33.95	cfs
Percent of Full Flow	Flow =	47.3%	of full flow
Normal Depth Froude Number	Fr _n =	4.57	supercritical

Calculation of Critical Flow Condition

Half Central Angle ($0 < \theta_c < 3.14$)	Theta-c =	2.72	radians
Critical flow area	Ac =	3.09	sq ft
Critical top width	Tc =	0.83	ft
Critical flow depth	Yc =	1.91	ft
Critical flow velocity	Vc =	10.98	fps
Critical Depth Froude Number	Fr _c =	1.00	

Appendix I – Drainage Plan



LEGEND

- PROPERTY LINE
- - - EXISTING DRAINAGE AREA
- - - EXISTING CONTOUR
- - - EX. GAS
- - - EX. QU
- - - EXISTING FENCE
- - - EXISTING OVERHEAD ELECTRIC
- - - EXISTING WATER STRUCTURE
- - - EXISTING ELECTRICAL STRUCTURE
- - - EXISTING RIDGE LINE
- - - EXISTING GRAVEL
- - - EXISTING FLOW ARROW

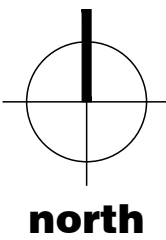
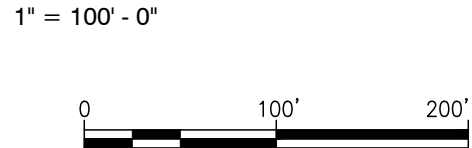
SUMMARY OF RUNOFF TABLE						
BASIN ID	AREA (AC)	C5	C100	Q5	Q100	% IMPERVIOUS
EX-1	2.42	0.10	0.49	0.90	8.64	0.14
EX-2	0.43	0.19	0.54	0.31	1.70	0.25
OS-1	3.14	0.03	0.45	0.38	10.27	0.05
OS-2	0.90	0.03	0.45	0.11	2.94	0.05

GENERAL NOTES

- ALL PROPOSED IMPROVEMENTS ARE CONCEPTUAL AND SUBJECT TO CHANGE UPON DEVELOPMENT OF DESIGN AND AGENCY APPROVAL.
- REFER TO PHASE III DRAINAGE REPORT BY EXP DATED JANUARY 2025 FOR CALCULATIONS.
- THE TOPOGRAPHIC SURVEY WAS PROVIDED BY LW SURVEY COMPANY CONSULTING GROUP ON 1/17/2024. THESE IMPROVEMENT PLANS DO NOT WARRANT THE ACCURACY OF THE PROVIDED SURVEY.
- EXISTING UTILITY INFORMATION AS SHOWN ON PLANS ARE FOR REFERENCE ONLY AND SHALL NOT BE TAKEN AS EXACT. CONTRACTOR SHALL FIELD VERIFY ALL EXISTING UTILITY LOCATIONS WITHIN THE LIMITS OF DISTURBANCE AND AS IT RELATES TO THE WORK HEREIN.

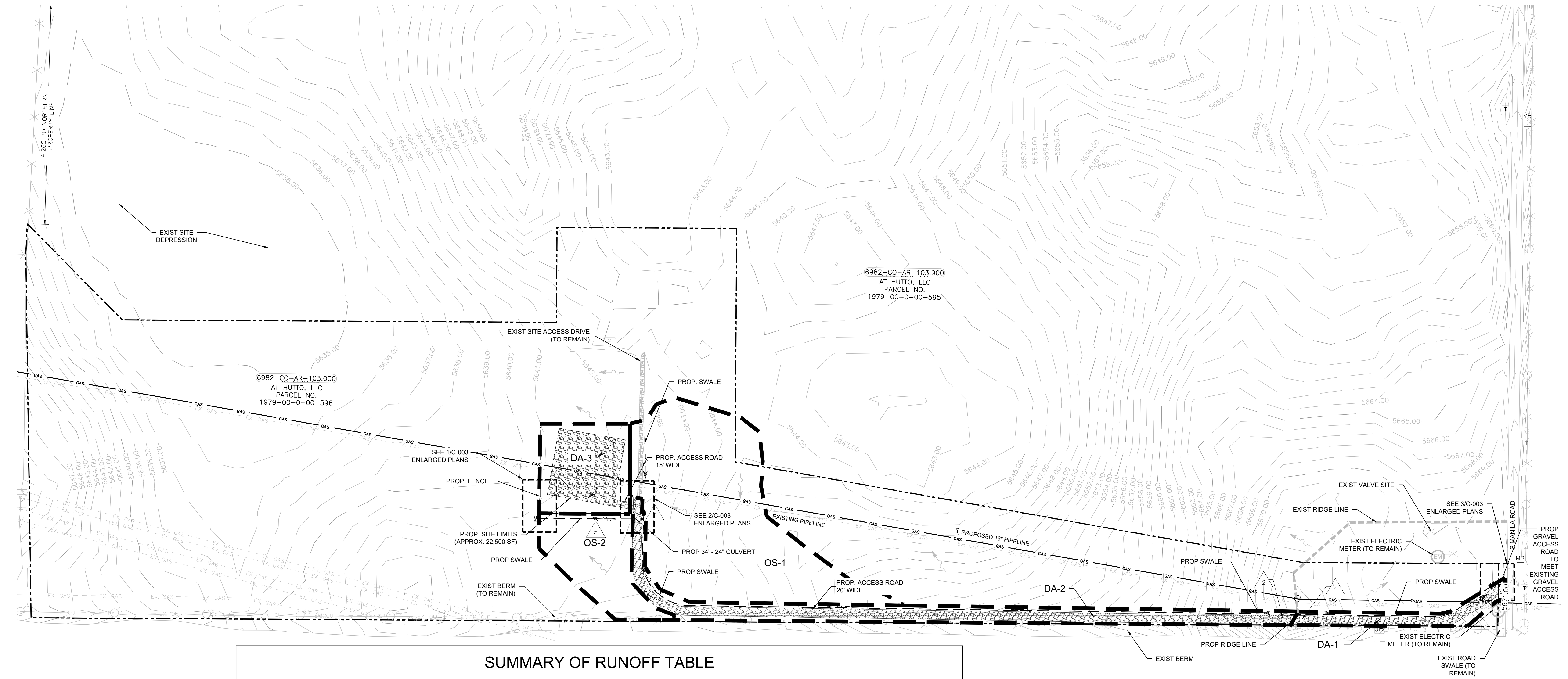
MAGELLAN PIPELINE COMPANY, L.P.				
REVISION NUMBER	DATE	DATE	DATE	DATE
BY	BY	BY	BY	BY
DRAWN BY: REE, DATE: 7/9/2025, CHECKED BY: JPT, PROJECT ENGINEER: JPT, APPROVED BY: NSK				
DRAINAGE EXHIBIT – EXISTING WATKINS JUNCTION SITE				
DRAWING NO. C-001				

1 DRAINAGE EXHIBIT-EXISTING



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LEGEND

- PROPERTY LINE
- PROPOSED DRAINAGE AREA
- EXISTING CONTOUR
- EX. GAS
- EX. OU
- EX. FENCE
- EX. OVERHEAD ELECTRIC
- EX. WATER STRUCTURE
- EX. ELECTRICAL STRUCTURE
- EX. RIDGE LINE
- EX. GRAVEL
- EX. FLOW ARROW
- PROPOSED FLOW ARROW
- x --- PROPOSED FENCE
- GAS --- PROPOSED PIPELINE
- PROPOSED GRAVEL
- PROPOSED SWALE
- DESIGN POINT

CASE NO.: UAIS25-002

SUMMARY OF RUNOFF TABLE							
BASIN ID	AREA (AC)	DESIGN POINT	C5	C100	Q5	Q100	% IMPERVIOUS
DA-1	0.43	1	0.32	0.61	0.51	1.92	0.40
DA-2	1.33	2	0.36	0.63	1.62	5.63	0.45
DA-3	1.20	4	0.29	0.60	1.31	5.24	0.37
OS-1	3.14	3	0.03	0.45	0.38	10.27	0.05
OS-2	0.90	5	0.03	0.45	0.11	2.94	0.05

1 DRAINAGE EXHIBIT- PROPOSED

1" = 100' - 0"

0 100' 200'

north

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GENERAL NOTES

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- REFER TO PHASE III DRAINAGE REPORT BY EXP DATED JANUARY 2025 FOR CALCULATIONS
- THE TOPOGRAPHIC SURVEY WAS PROVIDED BY LW SURVEY COMPANY CONSULTING GROUP ON 11/7/2024. THESE IMPROVEMENT PLANS DO NOT WARRANT THE ACCURACY OF THE PROVIDED SURVEY.
- EXISTING UTILITY INFORMATION AS SHOWN ON PLANS ARE FOR REFERENCE ONLY AND SHALL NOT BE TAKEN AS EXACT. CONTRACTOR SHALL FIELD VERIFY ALL EXISTING UTILITY LOCATIONS WITHIN THE LIMITS OF DISTURBANCE AND AS IT RELATES TO THE WORK HEREIN.

MAGELLAN PIPELINE - WATKINS JUNCTION SITE				
REVISION NUMBER	LWS	NSK	JPT	JH
DRAWN BY	DATE	CHECKED BY	PROJECT ENGINEER	APPROVED BY
DATE	8/7/2025	DATE	DATE	DATE
CHECKED BY	NSK	CHECKED BY	JPT	CHECKED BY
PROJECT ENGINEER	JPT	PROJECT ENGINEER	JH	PROJECT ENGINEER
APPROVED BY	JH	APPROVED BY	JH	APPROVED BY

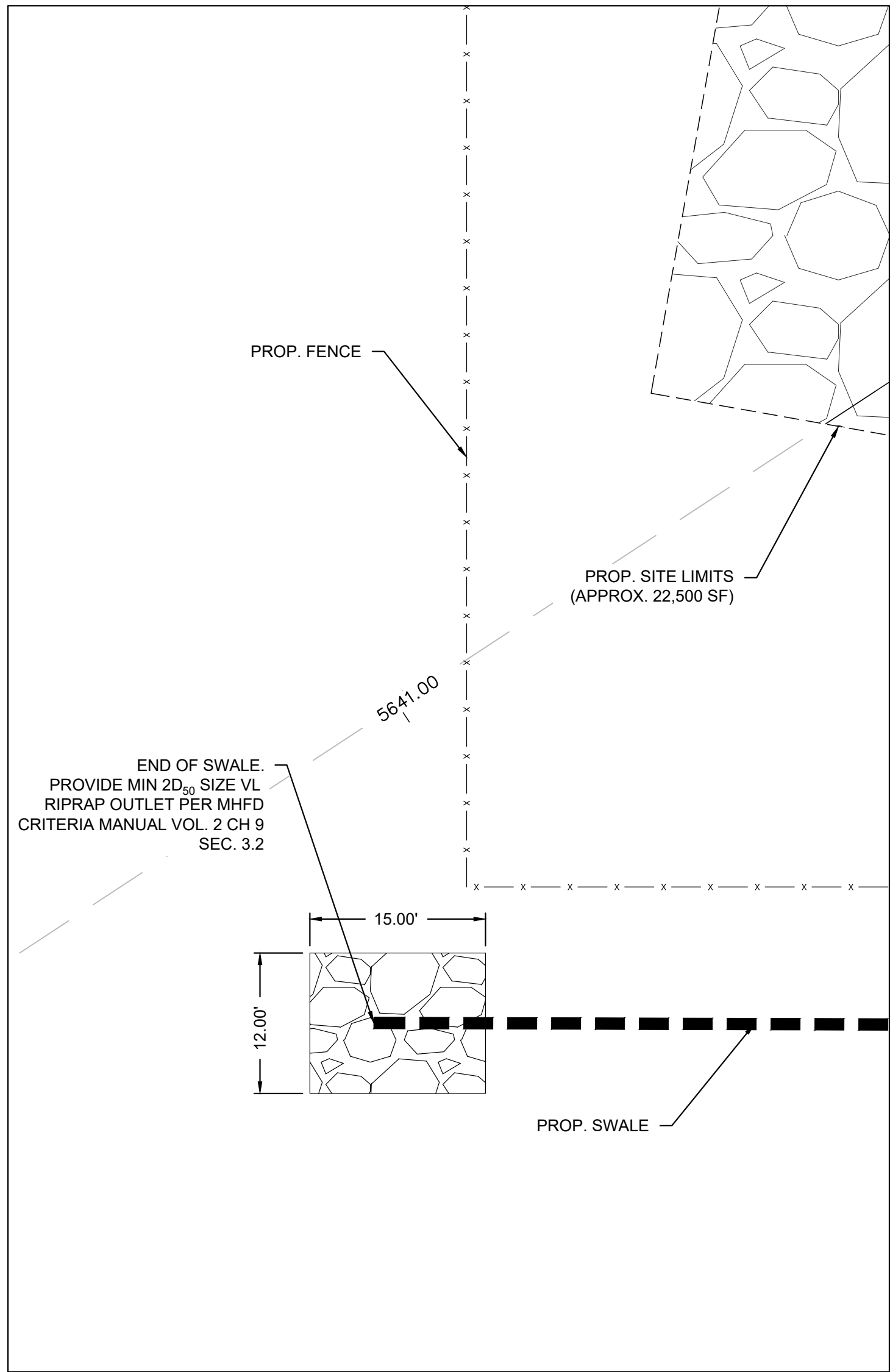
MAGELLAN
PIPELINE COMPANY, L.P.

DRAINAGE EXHIBIT - PROPOSED WATKINS JUNCTION SITE

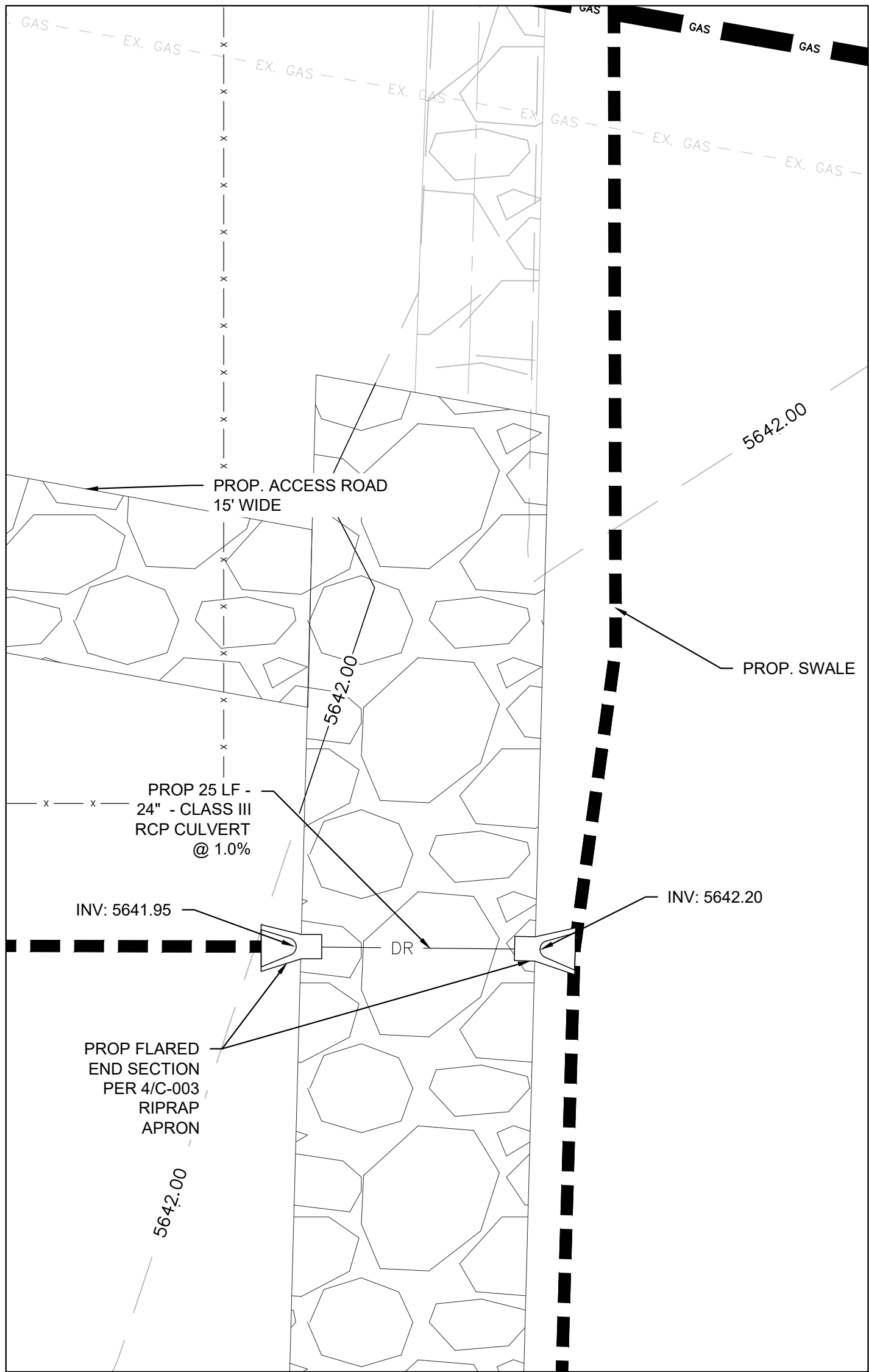
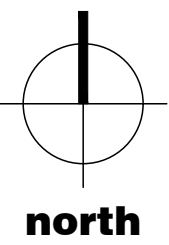
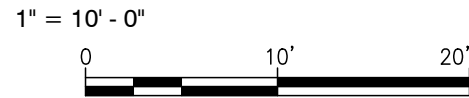
DRAWN BY: LWS
DATE: 8/7/2025
CHECKED BY: NSK
PROJECT ENGINEER: JPT
APPROVED BY: JH

SCALE: AS NOTED
DRAWING NO. C-002

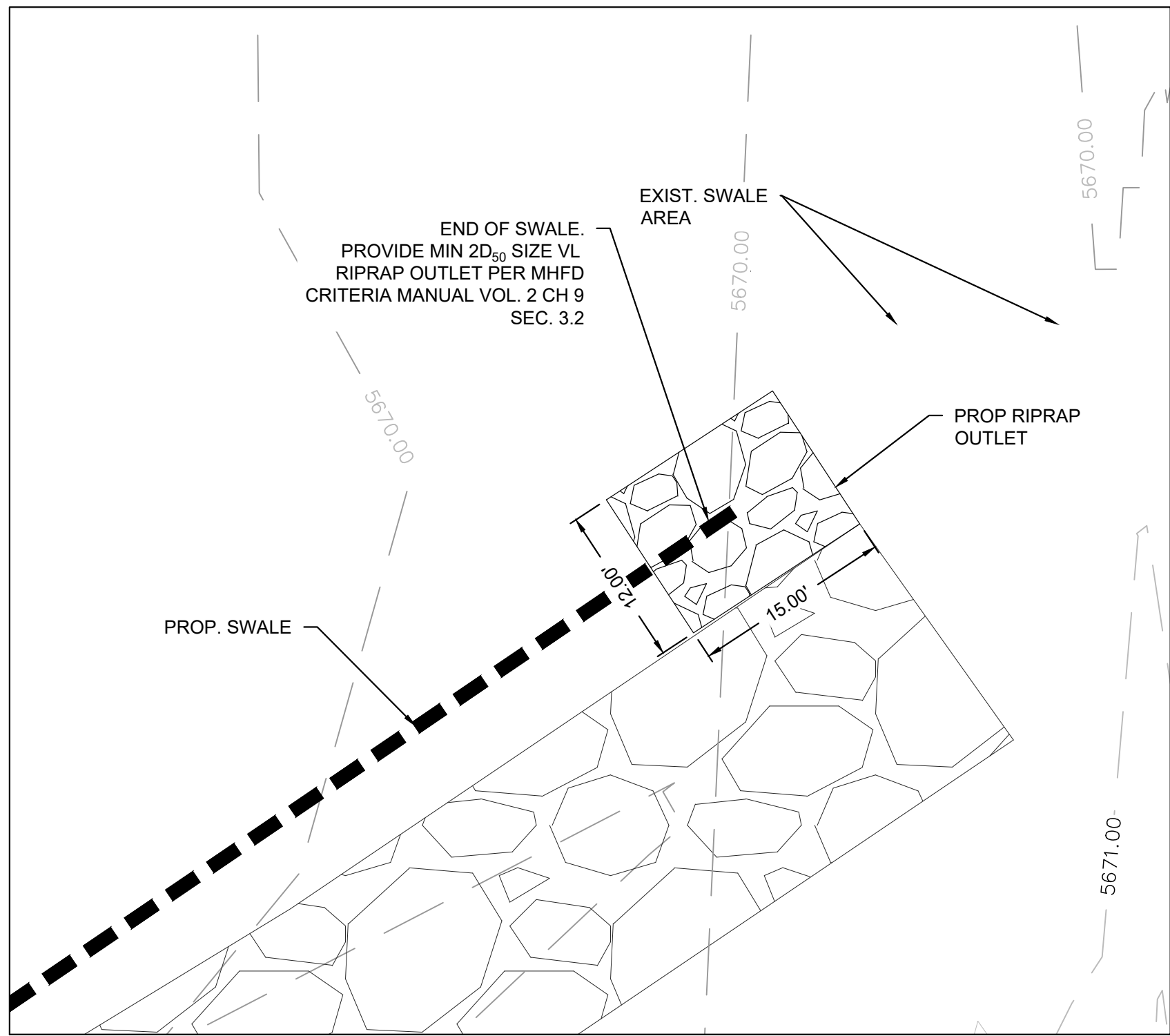
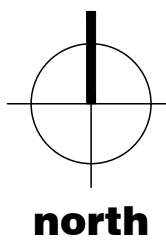
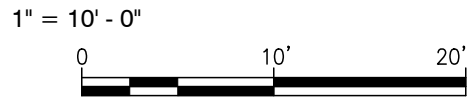
DEPARTMENT OF PUBLIC WORKS AND DEVELOPMENT APPROVAL BLOCK



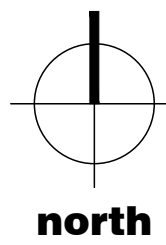
1 PROPOSED RIPRAP INSET (WEST)



2 PROPOSED CULVERT INSET



3 PROPOSED RIPRAP INSET (EAST)



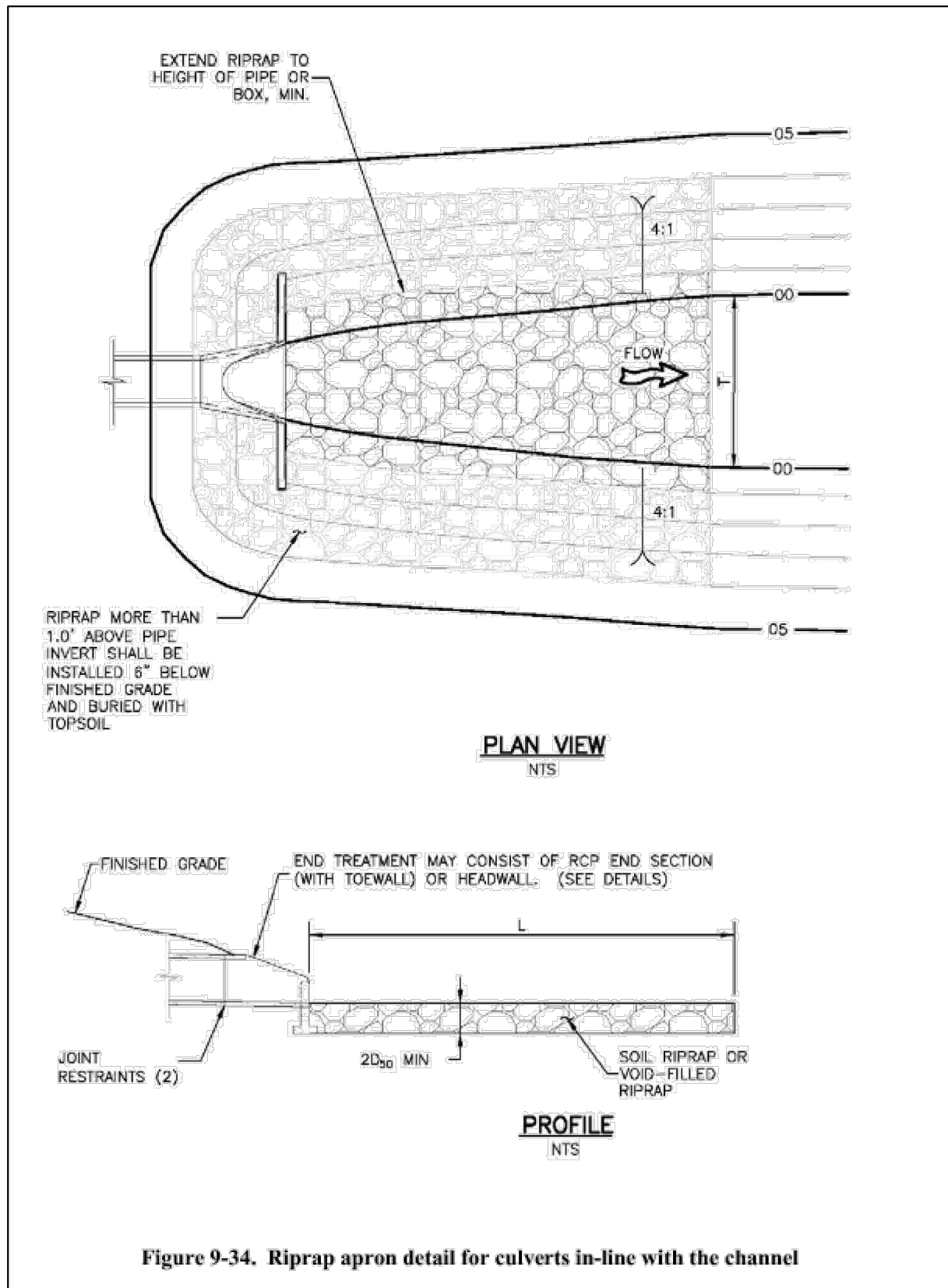
This needs to be included in the construction drawings; if access road and culvert information are not included in this set of construction drawings, plan sheets will be required prior to the access permit

LEGEND

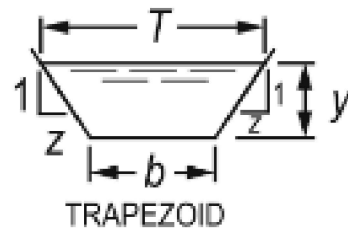
- PROPERTY LINE
- PROPOSED DRAINAGE AREA
- EXISTING CONTOUR
- EXISTING UNDERGROUND GAS
- EXISTING FENCE
- EXISTING OVERHEAD ELECTRIC
- EXISTING WATER STRUCTURE
- EXISTING ELECTRICAL STRUCTURE
- EXISTING RIDGE LINE
- EXISTING GRAVEL
- EXISTING FLOW ARROW
- PROPOSED FLOW ARROW
- PROPOSED FENCE
- PROPOSED PIPELINE
- PROPOSED GRAVEL
- PROPOSED SWALE
- DESIGN POINT

4 PROPOSED RIPRAP APRON

N.T.S.



Prop Swale Section, ft
b 2
z 5
y 1



5 PROPOSED SWALE SECTION

N.T.S.

EXP Energy Services Inc.
t: +1.713.439.3600 | f: +1.713.963.9085
11330 Clay Road, suite 550,
Houston, TX 77041
U.S.A.

www.exp.com



• BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

GENERAL NOTES

- ALL PROPOSED IMPROVEMENTS ARE CONCEPTUAL AND SUBJECT TO CHANGE UPON DEVELOPMENT OF DESIGN AND AGENCY APPROVAL.
- REFER TO PHASE III DRAINAGE REPORT BY EXP DATED JANUARY 2025 FOR CALCULATIONS.
- THE TOPOGRAPHIC SURVEY WAS PROVIDED BY LW SURVEY COMPANY CONSULTING GROUP ON 11/7/2024. THESE IMPROVEMENT PLANS DO NOT WARRANT THE ACCURACY OF THE PROVIDED SURVEY.
- EXISTING UTILITY INFORMATION AS SHOWN ON PLANS ARE FOR REFERENCE ONLY AND SHALL NOT BE TAKEN AS EXACT. CONTRACTOR SHALL FIELD VERIFY ALL EXISTING UTILITY LOCATIONS WITHIN THE LIMITS OF DISTURBANCE AND AS IT RELATES TO THE WORK HEREIN.

MAGELLAN PIPELINE - WATKINS JUNCTION SITE				
REVISION NUMBER	LWS DRAWN BY	DATE REVISED	NSK CHECKED BY	JPT PROJECT ENGINEER



DRAINAGE EXHIBIT - PROPOSED WATKINS JUNCTION SITE

DRAWN BY	LWS	SCALE	AS NOTED	A.F.E.	
DATE DRAWN	8/7/2025	DRAWING NO.			
CHECKED BY	NSK				
PROJECT ENGINEER	JPT				
APPROVED BY	JH				

C-003

DEPARTMENT OF PUBLIC WORKS AND DEVELOPMENT
APPROVAL BLOCK

ARAPAHOE COUNTY
CHECKLIST FOR DRAINAGE REPORT – PHASE 3

Yes No N/A Report Requirements

I. COVER SHEET

X			A. Name of Project/Site Name
X			B. Address
X			C. Owner Contact Information (Name, Company, Address, Phone)
X			D. Developer Contact Info (Name, Company, Address, Phone)
X			E. Engineer Contact Info (Name, Company, Address, Phone)
X			F. Submittal date and revision date(s) as applicable
X			G. Case Number(s)
X			Table of Contents
X			Certification Statement** - Engineer
X			Certification Statement** - Developer
			** see Stormwater Management Manual for Certification verbiage

II. GENERAL LOCATION AND DESCRIPTION

			A. Site Location
X			1. Site Vicinity Map
X			2. Legal Description include Township, Range, Section, and ¼ Section
X			3. Existing and proposed streets adjacent to and within proposed development, or within area of proposed drainage improvements
X			4. Names of surrounding or adjacent developments, including land use or zoning information
			B. Description of Property
X			1. Total Site/Project Area in Acres
X			2. Current and Proposed Zoning
X			3. Existing Site Conditions Ground cover, vegetation, site topography and slopes
X			4. Existing irrigation canals or ditches
X			5. Significant geologic features
X			6. NRCS Soils Classification Map and discussion
X			7. Proposed Land Use, site activities and operations
X			8. Total Proposed Impervious Area – existing and proposed. Include removed, replaced, and new impervious area (square feet and acres) and total change in impervious area
X			9. Total Disturbed Area
			C. Groundwater Investigation
X			1. Discuss groundwater investigations and results
		X	2. Identify potential groundwater issues
		X	3. Discuss improvements to mitigate groundwater impacts

III. FLOODPLAIN

			A. Major Drainageway – Designated Floodplain
X			1. Identify site Floodplain Zone

ARAPAHOE COUNTY
CHECKLIST FOR DRAINAGE REPORT – PHASE 3

Yes	No	N/A	Report Requirements
X			2. Source of Floodplain Delineation. FEMA Flood Insurance Rate Map(s) including panel date and number and/or UDFCD Flood Hazard Area Delineation (FHAD) study
		X	3. Floodplain Modifications required, including level of encroachment, velocities, depths, stabilization measures, water surface elevations, etc.
		X	4. Floodplain Modification Studies required, including Conditional Letter of Map Revision (CLOMR) and Letter of Map Revision (LOMR) requirements
		X	5. County Floodplain Development Regulations and Floodplain Development Permit
			B. Major Drainageway – Undesignated Floodplain (non-FEMA>130ac)
		X	1. Discuss methodology of Floodplain Delineation
		X	2. Floodplain modifications required, including level of encroachment, velocities, depths, stabilization measures, water surface elevations, etc.
		X	3. Floodplain development regulations and Floodplain Development Permit

IV. DRAINAGE BASINS AND SUB-BASINS

			A. Major Drainage Basins
X			1. Major drainage basin characteristics and flow patterns and paths adjacent to and within the proposed development
X			2. Existing and proposed land uses and impervious values within the basins
X			3. Discussion of all drainageway master planning or studies that affect the major drainageways, i.e. UDFCD Major Drainageway Plan (MDP) and Outfall Systems Planning (OSP) studies
		X	4. Discuss site restrictions imposed by Master Plans, including design imperviousness
X			5. Condition of the drainage channel within or adjacent to the development, including existing condition, need for improvements, and impact on proposed development
X			6. Impacts of proposed development to major basin flow patterns and paths, under fully developed conditions
		X	7. If within the Cherry Creek Basin, note additional requirements from Control Regulation 72 that shall apply.
			B. Minor Drainage Basins
X			1. On-site and Off-site minor drainage basin characteristics and flow patterns and paths
X			2. Existing and proposed land uses within the basins
X			3. Discuss previous Drainage Studies or Master Development Plans for the Site or Project
X			4. Discuss Drainage Studies for Adjacent Developments
X			5. Discuss impacts of the Minor Basin Characteristics, flow patterns and paths, under both historic and developed conditions
X			6. Summary of Sub-Basin Characteristics, size in acres, C2, C5 and C100 values and Q2, Q5 and Q100 values. Values to match calculations in appendix.

ARAPAHOE COUNTY
CHECKLIST FOR DRAINAGE REPORT – PHASE 3

Yes	No	N/A	Report Requirements
X			7. Discuss impacts of the off-site flow patterns and paths, under fully developed conditions
X			8. Discussion of irrigation facilities that will influence or be impacted by the site drainage

V. EXISTING STORMWATER CONVEYANCE, STORAGE, AND/OR WATER QUALITY FACILITIES

			A. Existing Stormwater Storage and/or Water Quality Facilities
X			1. Accessibility to existing regional or sub-regional detention and/or water quality facility, include name and location of facility
		X	2. If utilizing a regional facility, discuss conformance with each of the requirements noted in the SMM (channel stability, facility must be implemented and functional, maintenance/ownership, adequate capacity, water quality or flood control as primary use). Is it named as impaired water body list per CDPHE? Discuss conformance with each of these requirements.
		X	3. Discuss limitations and restrictions from Master development or drainageway plan, mentioning capacity and water quality. Include relevant source pages in Appendix
		X	4. Does existing facility meet current Standards and Regulations?
		X	5. Discuss existing storage facility modifications needed, including rebuild or abandonment
			B. Existing Stormwater Conveyance Facilities
X			1. Existing Conveyance Facilities and how it will be incorporated into proposed development design
X			2. Discuss limitations and restrictions from Master development or drainageway plan, including capacity. Include relevant source pages in Appendix
X			3. Existing Conveyance Facility Modifications, including rebuild or abandonment
X			4. Discuss any known issues with existing conveyance system

VI. DRAINAGE DESIGN CRITERIA

			A. Regulations
X			1. County Criteria and optional provisions selected, as applicable
X			2. UDFCD criteria and optional provisions selected, as applicable
		X	3. Cherry Creek Basin Control Regulation No. 72
			B. Compliance with Phase II Assumptions
		X	1. State any changes from the design assumptions used in the Phase II drainage calculations (i.e. the maximum % imperviousness value, slope of the basin, etc.)
		X	2. State any conditions of Approval from the Phase II Drainage Report (i.e. completion of Master Drainage Plan or FHAD, etc.)
			C. Hydrologic Design Criteria
X			1. Methods used to determine runoff calculations

ARAPAHOE COUNTY
CHECKLIST FOR DRAINAGE REPORT – PHASE 3

Yes	No	N/A	Report Requirements
X			2. Design storm recurrence intervals, including water quality, minor and major storms
X			3. Design rainfall
		X	4. Detention storage calculation method(s)
		X	5. Detention storage release rate calculation method
			D. Hydraulic Design Criteria
X			1. Methods used to determine conveyance facility capacities
X			2. Hydraulic grade line calculation method and loss coefficients
X			3. Methods used to calculate water surface profiles
		X	4. Detention pond routing
			E. Water Quality Control Measure (CM) Design Criteria
X			1. Water quality CM requirements
		X	2. Methods used to determine and size water quality CM facilities, including 20/10 Pretreatment, WQCV, mean concentration of TSS median value of 30 mg/L or less for Pollutant Removal Standard, etc.

VII. PROPOSED STORMWATER CONVEYANCE OR STORAGE FACILITIES

			A. Proposed Stormwater Storage Facilities
		X	1. Detention pond designs, including release rates, storage volumes and water surface elevations for the Water Quality Capture Volume, Excess Urban Runoff Volume, 100-year, and emergency overflow conditions, outlet structure design, emergency spillway design, etc.
		X	2. Pond outfall locations and design, including method of energy dissipation
		X	3. How is runoff conveyed from all pond outfalls to the nearest major drainageway, including a discussion of the flow path and capacity downstream of the outfall to the nearest major drainageway
		X	4. Discuss maintenance aspects of the design and easements and tracts that are required for stormwater storage purposes
		X	5. Discuss impacts to stormwater management facility design, caused by site constraints, such as streets, utilities, light rail rapid transit, existing structures, etc.
			B. Proposed Stormwater Conveyance Facilities
X			1. General onsite conveyance concepts, including drainage paths and patterns
X			2. Storm sewer design, including inlet and pipe locations and sizes, tributary basins and areas, peak flow rates at design points, hydraulic grade lines, etc.
X			3. Discuss storm sewer outfall locations and design, including method of energy dissipation
X			4. Discuss open channel and swale designs, including dimensions, alignments, tributary basins and areas, peak flow rates at design points, stabilization and grade control improvements, low flow or trickle channel capacities, water surface elevations, etc.

ARAPAHOE COUNTY
CHECKLIST FOR DRAINAGE REPORT – PHASE 3

Yes	No	N/A	Report Requirements
		X	5. Discuss allowable street capacities
X			6. Discuss general offsite conveyance concepts, including drainage paths and patterns. Discuss how proposed conveyance will connect to ultimate outfall.
X			7. Discussion of the facilities needed offsite for the conveyance of minor and major flows to the major drainageway
		X	8. Discuss maintenance aspects of the design and easements and tracts that are required for stormwater conveyance purposes

VIII. WATER QUALITY CONTROL MEASURE

			A. Non-Structural Control Measures
X			1. Discussion of non-structural control measures that will be part of the stormwater management plan; i.e. preserving open space, protecting natural systems, and incorporating existing landscape features into proposed development
			B. Structural Control Measures (CM)
X			1. Discuss CM Standard(s) which will be utilized to meet water quality requirements (WQCV, Pollutant Reduction, Runoff Reduction, Regional WQCV, Constrained Redevelopment).
		X	2. For the CM Standard selected, discuss treatment and/or infiltration provided (such as 100% of calculated WQCV for WQCV Standard, reduction in mean concentration of TSS to 30 mg/L or less for Pollutant Removal Standard, 60% of calculated WQCV for Runoff Reduction Standard, 20/10 pretreatment for Regional WQCV)
		X	3. Discuss CM(s) that will be utilized to meet water quality requirements (EDB, MEDB, SF, RG, GS, GB or other)
		X	4. Discuss design of the CM(s), including tributary areas, sizing, treatment volumes or areas (as applicable), design features, etc.
		X	5. If Pollutant Removal Standard is utilized: (a) discuss how event mean concentration of TSS may be reduced to median value of 30 mg/L or less. Include references to manufacturer specifications in appendices of drainage report and (b) discuss how project meets SMM requirements.
		X	6. If Constrained Redevelopment Site is utilized, discuss how project meets SMM requirements.
		X	7. If the Runoff Reduction Standard is utilized as the only means for meeting water quality requirements onsite, a soils analysis and recommendation from a geotechnical engineer is required to justify that Site geology and other factors allow appropriate infiltration to occur.
		X	8. Justify MDCIA techniques have been maximized for proposed Site.
		X	9. Justify that hierarchy for MDCIA has been followed to obtain the maximum benefit for reduction in runoff volume in terms of stormwater quality, as follows: (a) Parking lot(s) and driveway(s) or other paved surfaces subject to routine vehicular use and/or deicing activities, (b) Other paved areas (not parking lot or driveways), (c) Roof areas or sidewalks, or (d) Other areas identified with potential pollutants.

ARAPAHOE COUNTY
CHECKLIST FOR DRAINAGE REPORT – PHASE 3

Yes	No	N/A	Report Requirements
		X	10. Discuss how runoff is conveyed from all CM outfalls in a storm sewer system, drainageway, or other designated drainage system (to the nearest major drainageway), including a discussion of the flow path and capacity downstream of the outfall to the nearest major drainageway.
		X	11. Discuss design constraints, including any special requirements for operations and maintenance
		X	12. Subsurface Soils Analysis: • Recommendation for a full infiltration, partial infiltration, or no infiltration section, based on the requirements noted in Volume 3 of the USDCM • Recommendation of the use of onsite soils (amended, as necessary), or import of suitable materials. • If Rain Garden or Sand Filter, discuss soils analysis by geotechnical engineer for suitability of onsite soils for infiltration.
			C. Source Controls
		X	1. Discuss site activities or operations that have potential to impact stormwater quality
		X	2. Discuss source controls that are necessary to prevent potential illicit discharge from site activities
		X	3. Discuss any proposed non-stormwater direct connection to the storm sewer. Proposed connections, in accordance with the SMM, IDDE Plan, and allowed by the CDPHE. Also note that any non-stormwater direct connections will require a Direct Connection License Agreement.
			D. Exclusions
X			1. Discuss exclusion(s) from Water Quality (if applicable). Include for which exclusion(s) project qualifies and state conditions which project meets.
		X	2. For Sites that utilize Pavement Management, Roadway Redevelopment, Existing Roadway Areas, Non-residential and Non-commercial Infiltration Conditions, Sites with Land Disturbance that will Remain Undisturbed, Stream Stabilization, and/or Trail Exclusions, list and include reason for exclusion and acreage of excluded impervious area.
		X	3. For Sites that utilize WQCV Standard, and cannot capture 100%, justification as to why it is not practicable to capture portions of site and drain to that control measure or to implement a separate control measure.
IX. ADDITIONAL PERMITTING REQUIREMENTS			
		X	A. Compliance with Section 404 of the Clean Water Act
		X	B. Compliance with the Endangered Species Act
		X	C. Other local, State, or Federal requirements

ARAPAHOE COUNTY
CHECKLIST FOR DRAINAGE REPORT – PHASE 3

Yes No N/A Report Requirements

X. CONCLUSIONS			
			A. Compliance with Standards
X			1. Arapahoe County Criteria/ SMM
X			2. UDFCD Criteria
		X	3. Master Plans and UDFCD Outfall Systems Plans
		X	4. Cherry Creek Basin Control Regulation No. 72
			B. Variances
X			1. Identify provisions by section number for which a variance will be requested, or has been approved by County
X			2. Provide justification for each variance requested noting the criteria for variances from the SMM
			C. Drainage Concept
X			1. Discuss overall effectiveness of stormwater management design to properly convey, store and treat stormwater
XI. REFERENCES			
X			A. Source all tables, figures, charts, drawings, etc. used in design of stormwater facilities and included in appendix of the report
X			B. Reference all criteria, master plans, reports, or other technical information discussed in the drainage report
XII. APPENDICES			
			A. Reference and Miscellaneous Material
X			1. Vicinity Map. North Arrow, Scale, label adjacent arterial roadways and drainageways. No copyrighted material
X			2. FEMA FIRM panel, with site location shown
X			3. NRCS Custom Soil Resource Report (all pages)
		X	4. Relevant portions of the FHAD/OSP/MDP
		X	5. Relevant portions of the previous drainage study for the project
		X	6. If project is in multiple MS4 permit jurisdictions, provide a copy of the agreement between agencies how project is managed.
X			7. Variance Request and Response Letters
			B. Hydrologic Computations
X			1. Design Rainfall Values, ACSWMM Table 6-1 or NOAA Atlas 14
X			2. Land Use Assumptions, C values, both existing and proposed
X			3. Determination of runoff coefficients, times of concentration, and runoff calculations, existing and developed conditions
		X	4. Colorado Urban Hydrograph Procedure (CUHP) input parameter determination
		X	5. EPA SWMM Input parameter determination
X			6. Peak flow rate calculations for the minor and major storms
		X	7. CUHP/EPA SWMM input and output
		X	8. Hydrograph data, if applicable

ARAPAHOE COUNTY
CHECKLIST FOR DRAINAGE REPORT – PHASE 3

Yes	No	N/A	Report Requirements
X			9. Connectivity diagram showing relationship/connectivity of basins, conveyance facilities, detention ponds, and design points
		X	10. Floodplain hydrology
			C. Hydraulic Computations
		X	1. UD Detention Worksheet
		X	2. Stage-storage-discharge determination for detention ponds
		X	3. Detention pond routing calculations
		X	4. Orifice sizing calculations
		X	5. Emergency spillway sizing calculations
X			6. Culvert Capacities
		X	7. Storm sewer capacities and hydraulic grade lines, including loss coefficients
		X	8. Street capacity calculations
		X	9. Crossspan capacity calculations
		X	10. Inlet capacities
		X	11. Manhole sizing
		X	12. Curb Cut capacity calculations
X			13. Open channel or swale capacities
		X	14. Low flow and trickle channels
		X	15. Stabilization and grade control improvements
		X	16. Water surface profiles
		X	17. Downstream/outfall capacity to the nearest major drainageway
		X	18. Energy dissipation at pipe outfalls
		X	19. Floodplain modeling
		X	20. Design and sizing of WQ CM, include USDCM T-0 “Quantify Runoff Reduction” and the 20/10 Calculator for regional pretreatment
			D. Drainage Plans
			HISTORIC/EXISTING DRAINAGE PLAN
X			1. 24” x 36” in size (22” x 34” also acceptable for half size sets)
X			2. Title block and legend
X			3. Scale 1” = 20’ to 1” = 100’, as required to show sufficient detail
X			4. Show boundaries of entire development or project and any off-site areas which flow to/through the development or project
X			5. Existing topographic contours with labels with a 5-foot maximum contour interval a minimum of 100-feet beyond property lines
X			6. Show and label all existing stormwater conveyance, water quality and/or storage facilities
X			7. Floodplain limits, based on available information or preliminary delineation information
X			8. Drainage basin and sub-basin boundaries
X			9. Show and label existing utilities and structures
X			10. All property lines and existing drainage easements
X			11. Streets and roadways with ROW and flowline widths, type of curb and gutter or roadside swale, slopes, flow directions and crosspans

ARAPAHOE COUNTY
CHECKLIST FOR DRAINAGE REPORT – PHASE 3

Yes	No	N/A	Report Requirements
X			12. Location and elevation of all existing 100-year floodplain boundaries, including source of designation. All floodplain designations that exist for the site should be included, i.e. FEMA FIS, FHAD, and others.
X			13. Adjacent developments or ownerships
X			14. Summary Runoff Table
X			15. Case Number(s) in the lower left-hand corner
X			16. Approval block (located in the lower, right-hand corner, IDCS 3.7.3)
			PROPOSED DRAINAGE PLAN
X			1. 24" x 36" in size (22" x 34" also acceptable for half size sets)
X			2. Title block and legend
X			3. Scale 1" = 20' to 1" = 100', as required to show sufficient detail
X			4. Show boundaries of entire development or project and any off-site areas which flow to/through the development or project
X			5. Existing (dashed or screened) and proposed (solid) topographic contours with labels with a 5-foot maximum contour interval (existing contours must extend a minimum of 100-feet beyond the property lines)
X			6. Show and label all <u>existing</u> stormwater management facilities, including irrigation ditches, roadside swales, open channels, drainageways, storm sewers, culverts, detention ponds, WQ structures, etc. Information must be included regarding materials, sizes, lengths, shapes and slopes
X			7. Drainage basin and sub-basin boundaries with basin designations and design points
X			8. Show and label <u>proposed</u> stormwater management facilities, including irrigation ditches, roadside swales, open channels, drainageways, storm sewers, culverts, detention ponds, WQ structures, etc. Information must be included regarding materials, sizes, lengths, shapes and slopes
X			9. Proposed flow directions
X			10. Show and label existing utilities and structures
X			11. Label and dimension all property lines, existing and proposed drainage easements
X			12. Streets and roadways with ROW and flowline widths, type of curb and gutter or roadside swale, slopes, flow directions and crosspans
X			13. Proposed outfall points and existing or proposed facilities to convey runoff to nearest major drainageway, without damage to downstream properties
X			14. Location and elevation of all existing and proposed 100-year floodplain boundaries, including the source of designation. All floodplain designations that exist for the site should be included, i.e. FEMA FIS, FHAD, and others.
X			15. Adjacent developments or ownerships
X			16. Summary Runoff Table, includes Basin ID, contributing area, runoff coefficient, % imperviousness, runoff value, design point and routed flows.
		X	17. Appropriate warning signage provided for the storage facilities
X			18. Case Number(s) in the lower left-hand corner
X			19. Approval block (located in the lower, right-hand corner, IDCS 3.7.3)

Appendix J – TRC Waiver Response Letter



January 16th, 2025

Attn: Virginia Steen, Applicant

Project Name: Denver Expansion Project – Watkins Junction
Case Number: Q24-067
Address: Parcel No. 1979-00-0-00-595

The Arapahoe County Technical Review Committee (TRC) and Southeast Metro Stormwater Authority (SEMSWA) met on December 18th, 2024 for a regularly scheduled meeting to discuss the Copperleaf Commercial project and associated request. The following variance/waiver is requested:

1. Section 13.1.1 of the Arapahoe County Stormwater Management Manual states that detention shall be provided for all new development, redevelopment, or site expansion.

Project and Requirement Summary:

TRC has the following comments as it relates to said request:

- A. An existing gravel road is being utilized and extended for the site, but the property will remain largely undeveloped; the applicant has also adjusted the location of the site and length of the roadway to reduce added impervious area.
- B. There are no existing drainageways or swales in the vicinity of the property.

The Technical Review Committee has reviewed the justification you provided in your waiver requests (copy attached) and has agreed to the following:

1. TRC agrees to waive detention for this project per the attached justification. The project should still take care not to cause any adverse effects to adjacent properties.

If the development intentions deviate from what was presented within this request, a new request(s) shall be sought from the Engineering Services Division.

If you have any questions, please feel free to contact me at 720-874-6500.

Sincerely,

Emily Gonzalez, PE
Engineering Services Division

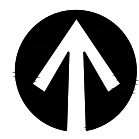
cc: Arapahoe County Case Files: Q24-067, UASI25-002

Appendix K – Final Grading, Erosion, & Sediment Control (GESC) Plan

DENVER EXPANSION PROJECT 1041 - WATKINS JUNCTION SITE

39°42'35.9"N 104°31'43.1"W





LOCATION MAP

1:3000

NORTH

0

3000'

6000'

SHEET INDEX	
C-100	GESC COVER SHEET
C-101	GRADING, EROSION & SEDIMENT CONTROL PLAN
C-201	GESC DETAILS
C-202	GESC DETAILS

NOTE:

THIS GRADING, EROSION, AND SEDIMENT CONTROL (GESC) DOCUMENT HAS BEEN PLACED IN THE PROJECT FILE FOR THIS PROJECT AND APPEARS TO FULFILL THE LATEST VERSION OF THE GRADING, EROSION, AND SEDIMENT CONTROL MANUAL. ADDITIONAL GRADING, EROSION, AND SEDIMENT CONTROL MEASURES MAY BE REQUIRED BY THE OWNER, OR HIS/HER AGENTS, DUE TO UNFORESEEN EROSION PROBLEMS OR IF THE SUBMITTED PLAN DOES NOT FUNCTION AS INTENDED. THE REQUIREMENTS OF THIS GESC DOCUMENT SHALL RUN WITH THE LAND AND BE THE OBLIGATION OF THE LAND OWNER, OR HIS/HER DESIGNATED REPRESENTATIVE(S) UNTIL SUCH TIME AS THE PLAN IS PROPERLY COMPLETED, MODIFIED, OR VOIDED.

ENGINEER CONTACT INFORMATION

EXP
163 WELTON STREET, SUITE 600A
DENVER, CO 80202
t: +1.303-296-5017

OWNER/DEVELOPER CONTACT INFORMATION

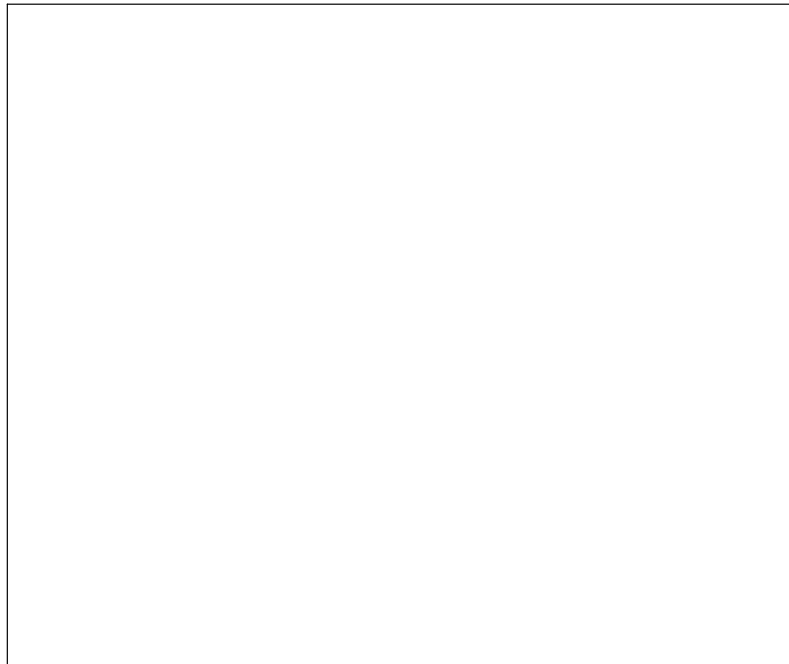
MAGELLAN PIPELINE COMPANY, L.P.
ONEOK PLAZA
100 WEST FIFTH STREET
TULSA, OK 74103
t: +1.918-588-700

PROFESSIONAL ENGINEER CERTIFICATION STATEMENT

I HEREBY ATTEST THAT THIS GRADING, EROSION, AND SEDIMENT CONTROL (GESC) DOCUMENT FOR THE DENVER EXPANSION PROJECT 1041- WATKINS JUNCTION SITE HAS BEEN PREPARED BY ME OR UNDER MY DIRECT SUPERVISION, AND TO THE BEST OF MY KNOWLEDGE AND ABILITY HAS BEEN PREPARED IN ACCORDANCE WITH THE LATEST VERSION OF THE GESC MANUAL. THE SIGNATURE AND STAMP AFFIXED HEREON CERTIFIES THAT THIS GESC DOCUMENT WAS PREPARED IN ACCORDANCE WITH THE REQUIRED REGULATIONS AND CRITERIA; HOWEVER, THE STAMP AND SIGNATURE DOES NOT CERTIFY OR GUARANTEE FUTURE PERFORMANCE OF THE EXECUTION OF THE PLAN BY THE CONTRACTOR. THE CONTRACTOR IS RESPONSIBLE FOR EXECUTING THE CONSTRUCTION WORK ACCORDING TO THE INFORMATION SET FORTH IN THE PLAN AND IN ACCORDANCE WITH ALL APPLICABLE REQUIREMENTS.

REGISTERED PROFESSIONAL ENGINEER _____

STATE OF COLORADO NO. _____

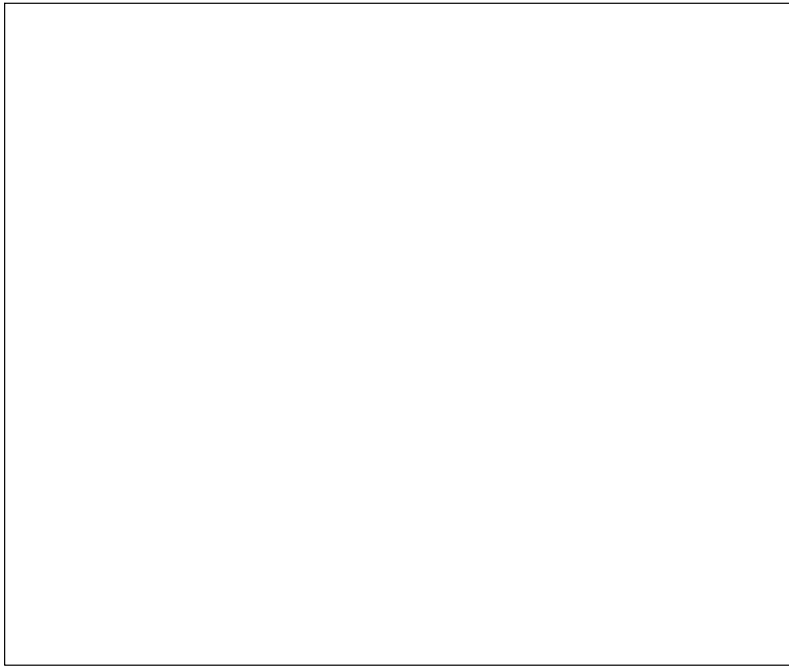


LANDOWNER/AUTHORIZED AGENT CERTIFICATION STATEMENT

I HEREBY CERTIFY THAT THE GRADING, EROSION, AND SEDIMENT CONTROL MEASURES FOR THE DENVER EXPANSION PROJECT 1041- WATKINS JUNCTION SITE SHALL BE CONSTRUCTED ACCORDING TO THE DESIGN PRESENTED WITHIN THIS DOCUMENT. I UNDERSTAND THAT ADDITIONAL EROSION CONTROL, SEDIMENT CONTROL, AND WATER QUALITY ENHANCING MEASURES MAY BE REQUIRED OF THE OWNER AND HIS OR HER AGENTS DUE TO UNFORESEEN POLLUTANT DISCHARGES OR IF THE SUBMITTED PLAN DOES NOT FUNCTION AS INTENDED. THE REQUIREMENTS OF THE PLAN SHALL BE THE OBLIGATION OF THE LAND OWNER AND/OR HIS SUCCESSORS OR HEIRS, UNTIL SUCH TIME AS THE PLAN IS PROPERLY COMPLETED, MODIFIED, OR VOIDED.

OWNER OR AUTHORIZED AGENT _____

AUTHORIZED SIGNATURE DATE _____



SESC GENERAL NOTES

- CONTRACTOR SHALL BE RESPONSIBLE FOR EROSION AND SEDIMENTATION CONTROL AS DETAILED IN THE SOIL EROSION AND SEDIMENTATION CONTROL (SESC) PLAN TO PREVENT TRANSMISSION OF SEDIMENT TO THE DRAINAGE FACILITIES.
- EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE PLACED PRIOR TO, OR AS THE FIRST PART OF CONSTRUCTION. SEDIMENT CONTROL MEASURES MUST PROTECT ALL DRAINAGE FACILITIES FROM SEDIMENTATION.
- EROSION AND SEDIMENT CONTROL MEASURES TO BE INSPECTED DAILY. REPAIRS TO BE MADE AS NECESSARY AND WITHIN 24 HOURS OF INSPECTION.
- EROSION CONTROL MEASURES SHALL BE INSTALLED AROUND ANY DIRT OR TOPSOIL STOOPILES AND OTHER TEMPORARILY DISTURBED AREAS.
- ALL EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE REMOVED AND DISPOSED OF IN ACCORDANCE WITH ALL JURISDICTIONAL GOVERNMENTAL AGENCY REQUIREMENTS WITHIN 30 DAYS OF FINAL STABILIZATION.
- SILT WORM SHALL REMAIN IN PLACE UNTIL A GOOD STAND OF GRASS HAS BEEN OBTAINED AFTER COMPLETE VEGETATION ESTABLISHMENT. ALL SILT WITHIN PIPES AND DRAINAGE SWALES SHALL BE REMOVED WITHIN 10 DAYS SO THAT FINISHED GRADES ARE MET.

MAGELLAN PIPELINE - WATKINS JUNCTION SITE					
REVISION NUMBER	LWS	DATE	JPT	JPT	NSK
	DRAWN BY	REVISED	CHECKED BY	PROJECT ENGINEER	APPROVED BY
					
GESC COVER SHEET WATKINS JUNCTION SITE					
DRAWN BY	LWS	SCALE:	AS NOTED	A.F.E.	
DATE DRAWN	7/9/2025	DRAWING NO.			
CHECKED BY	JPT	C-100			
PROJECT ENGINEER	JPT				
APPROVED BY	NSK				

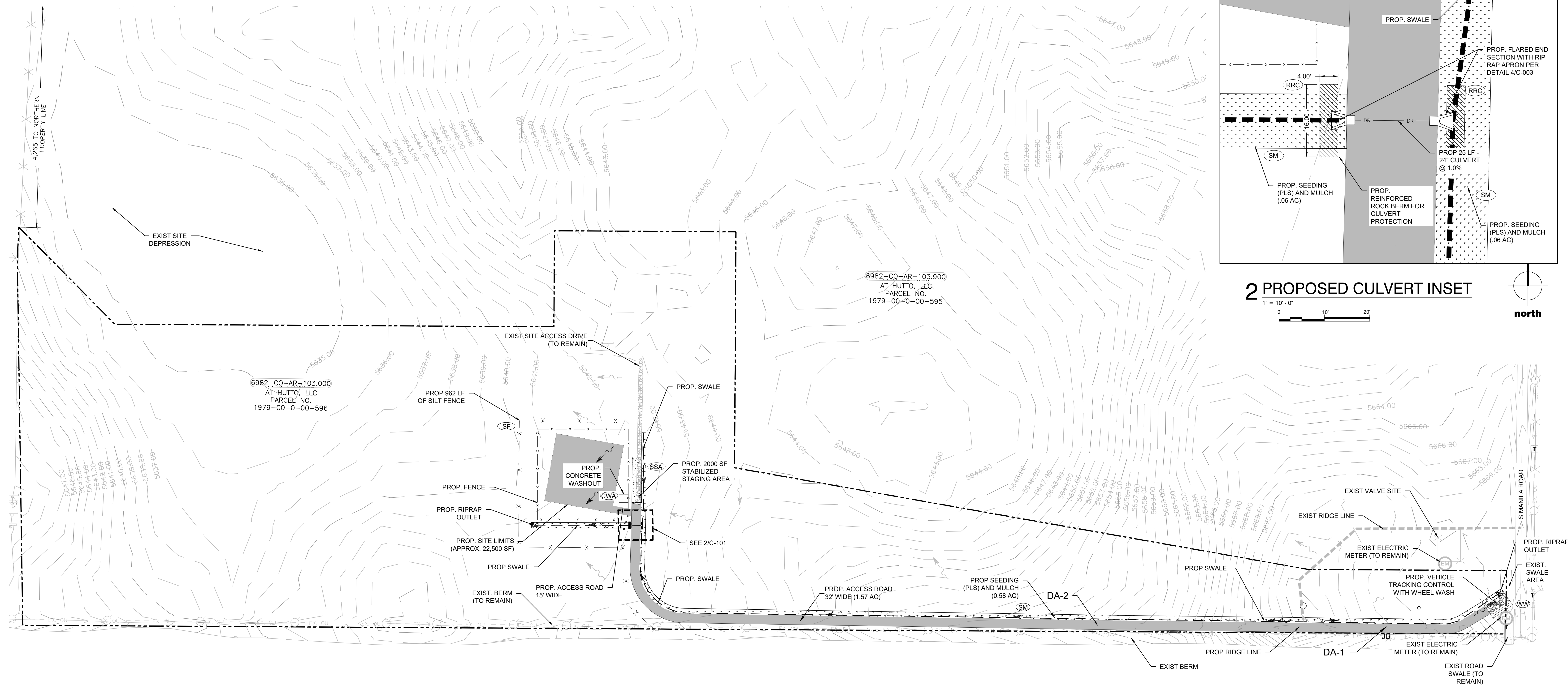
EXP Energy Services Inc.
t: +1.713.439.3600 | f: +1.713.963.9085
11330 Clay Road, suite 550,
Houston, TX 77041
U.S.A.

www.exp.com



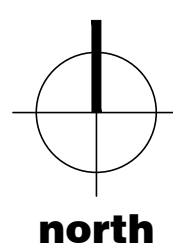
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• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

DEPARTMENT OF PUBLIC WORKS AND
DEVELOPMENT APPROVAL BLOCK



1 GRADING, EROSION, AND SEDIMENT CONTROL PLAN

1" = 100' - 0"



LEGEND

---	PROPERTY LINE
5X996XX	EXISTING CONTOUR
- - - EX GAS	EXISTING UNDERGROUND GAS
- - - OU	EXISTING FENCE
W	EXISTING OVERHEAD ELECTRIC
EM	EXISTING WATER STRUCTURE
W	EXISTING ELECTRICAL STRUCTURE
EM	EXISTING RIDGE LINE
---	EXISTING GRAVEL
---	EXISTING FLOW ARROW
---	PROPOSED FLOW ARROW
X	PROPOSED SILT FENCE
x x	PROPOSED FENCE
---	PROPOSED CONCRETE WASHOUT
---	PROPOSED STABILIZED STAGING AREA
---	PROPOSED VEHICLE TRACKING CONTROL
---	PROPOSED GRAVEL
---	PROPOSED SEEDING AND MULCH
---	PROPOSED REINFORCED ROCK BERM
---	PROPOSED SWALE

GENERAL NOTES

- ALL PROPOSED IMPROVEMENTS ARE CONCEPTUAL AND SUBJECT TO CHANGE UPON DEVELOPMENT OF DESIGN AND AGENCY APPROVAL.
- REFER TO PHASE III DRAINAGE REPORT BY EXP DATED JULY 2025 FOR CALCULATIONS.
- THE TOPOGRAPHIC SURVEY WAS PROVIDED BY LW SURVEY COMPANY CONSULTING GROUP ON 11/7/2024. THESE IMPROVEMENT PLANS DO NOT WARRANT THE ACCURACY OF THE PROVIDED SURVEY.
- EXISTING UTILITY INFORMATION AS SHOWN ON PLANS ARE FOR REFERENCE ONLY AND SHALL NOT BE TAKEN AS EXACT. CONTRACTOR SHALL FIELD VERIFY ALL EXISTING UTILITY LOCATIONS WITHIN THE LIMITS OF DISTURBANCE AND AS IT RELATES TO THE WORK HEREIN.
- APPROPRIATE CONTROL MEASURES MUST BE IMPLEMENTED PRIOR TO THE START OF LAND DISTURBANCE ACTIVITY. MUST CONTROL POTENTIAL POLLUTANTS DURING EACH PHASE OF CONSTRUCTION, AND MUST BE CONTINUED THROUGH FINAL STABILIZATION. APPROPRIATE STRUCTURE AND NON-STRUCTURAL CONTROL MEASURES MUST BE MAINTAINED IN OPERATIONAL CONDITION.
- SEE STANDARD NOTES AND DETAILS (C-201) FOR LEGEND OF NAMES AND SYMBOLS.
- SCREENED/SHADED BACK CONTROL MEASURES WERE INSTALLED IN THE INITIAL OR INTERIM STAGE AND, UNLESS OTHERWISE INDICATED, SHALL BE LEFT IN PLACE UNTIL APPROVED BY THE GESC INSPECTOR.
- ALL INTERIM CONTROL MEASURES, INCLUDING SEEDING AND MULCHING OR DISTURBED AREAS, MUST BE COMPLETED WITHIN 14 DAYS IF THE AREAS WILL REMAIN UNDISTURBED FOR A PERIOD GREATER THAN 30 DAYS.
- ALL PROPOSED SLOPES ON THIS PLAN HAVE A MAXIMUM SLOPE OF 3:1. ANY SLOPES BETWEEN 3:1 AND 4:1 WILL REQUIRE THE USE OF EROSION CONTROL BLANKETS OR FLEXIBLE GROWTH MEDIUM, AS APPROVED BY THE GESC INSPECTOR.
- SEE CONSTRUCTION PLANS FOR DETAILS OF PERMANENT DRAINAGE FACILITIES SUCH AS DETENTION FACILITIES, WATER QUALITY FACILITIES, CULVERTS, STORM DRAINS, AND INLET AND OUTLET PROTECTION.
- ACCEPTANCE OF THE POST-CONSTRUCTION PERMANENT CONTROL MEASURES WILL NOT OCCUR UNTIL ALL TRIBUTARY AREAS TO THE PERMANENT CONTROL MEASURES ARE FINAL STABILIZED.
- ALL TEMPORARY SEDIMENT & EROSION CONTROL MEASURES INCLUDING VEHICLE TRACKING CONTROL, SILT FENCE, CONCRETE WASHOUT, AND STABILIZED STAGING AREA ARE TO BE REMOVED UPON COMPLETION OF CONSTRUCTION.

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11330 Clay Road, suite 550
Houston, TX 77041
U.S.A.

www.exp.com



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• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

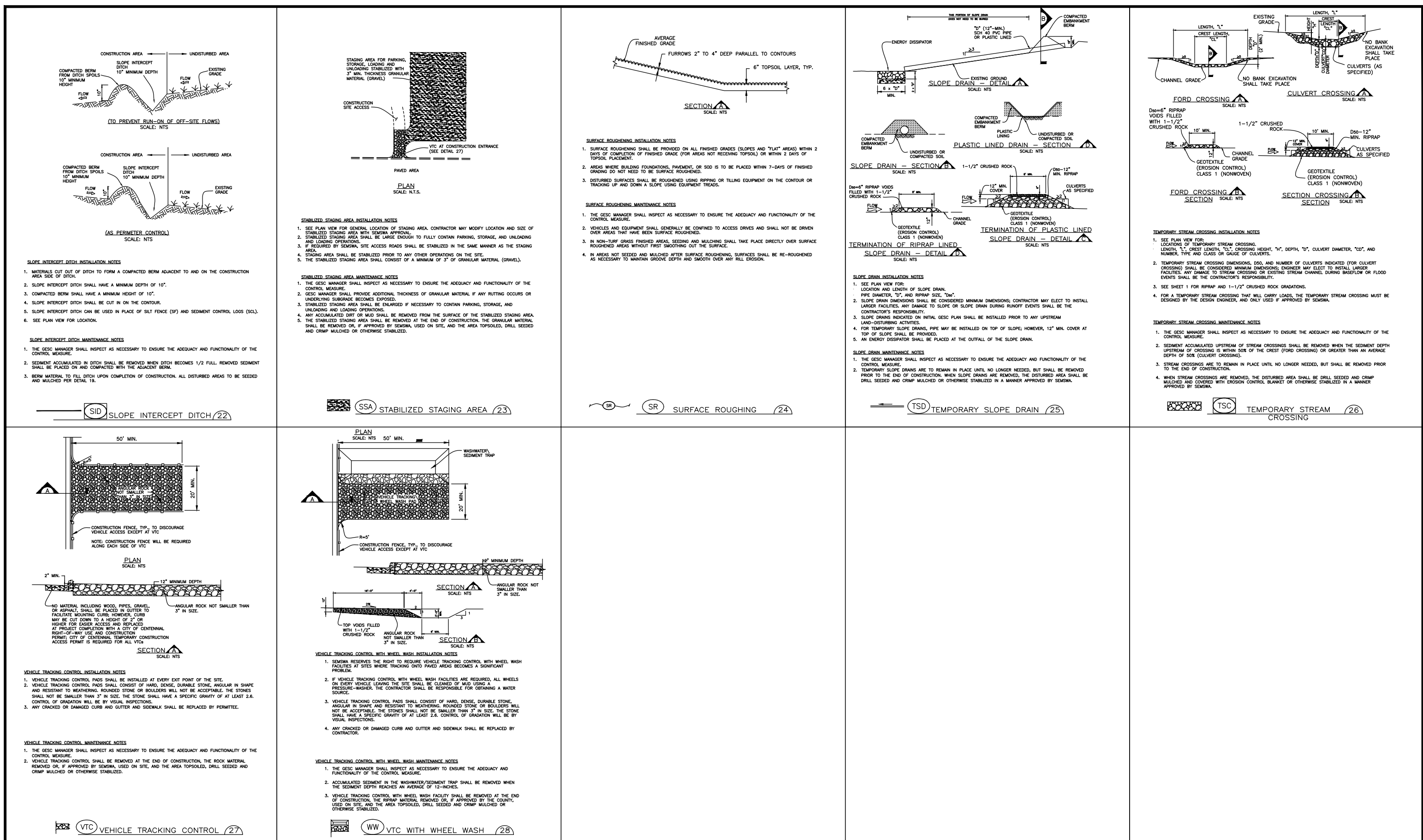
DEPARTMENT OF PUBLIC WORKS AND
DEVELOPMENT APPROVAL BLOCK

MAGELLAN PIPELINE - WATKINS JUNCTION SITE					
REVISION NUMBER	LWS DRAWN BY	DATE REVISED	NSK CHECKED BY	JPT PROJECT ENGINEER	JH APPROVED BY
GRADING, EROSION, & SEDIMENT CONTROL PLAN WATKINS JUNCTION SITE					
DRAWN BY	LWS	SCALE:	AS NOTED	A.F.E.	STATE
DATE DRAWN	7/9/2025	DRAWING NO.			
CHECKED BY	NSK				
PROJECT ENGINEER	JPT				
APPROVED BY	JH				

C-101

[illegible]

MAGELLAN PIPELINE - WATKINS JUNCTION SITE								NISK
REVISION NUMBER	LWS DRAWN BY	DATE REVISED	JPT CHECKED BY	JPT PROJECT ENGINEER			APPROVED BY	
 MAGELLAN PIPELINE COMPANY, L.P.								
GRADING, EROSION, AND SEDIMENT CONTROL DETAILS WATKINS JUNCTION SITE								STATE
DRAWN BY	LWS	SCALE: AS' NOTED		A.F.E.	DRAWING NO.			
DATE	7/9/2025	C-201						
CHECKED BY	JPT							
PROJECT ENGINEER	JPT							
APPROVED BY	NISK							



Yes	No	N/A	GESC Requirements
II. GESC PLANS (shall be a stand-alone document and not included in the Construction Drawings)			
			A. GESC PLAN COVER SHEET
X			1. Name of Project/Site Name
X			2. Project Address
X			3. Owner Contact Information (Name, Company, Address, Phone)
X			4. Engineer Contact Information (Name, Company, Address, Phone)
X			5. Plan Sheet Index
X			6. Case Number(s) in the lower left-hand corner
X			7. The following note: <i>"This Grading, Erosion and Sediment Control (GESC) document has been placed in the project file for this project and appears to fulfill the latest version of the Grading, Erosion and Sediment Control Manual. Additional grading, erosion and sediment Control Measures may be required of the owner or his/her agents, due to unforeseen erosion problems or if the submitted plan does not function as intended. The requirements of this GESC document shall run with the land and be the obligation of the land owner, or his/her designated representative(s) until such time as the plan is properly completed, modified or voided."</i>
X			8. GESC Drawing Design Engineer's signature block with name, date, and Professional Engineer registration number. Signature block shall include the following certification statement: <i>"I hereby attest that this Grading, Erosion, and Sediment Control (GESC) document for (name of subdivision/development) has been prepared by me or under my direct supervision, and to the best of my knowledge and ability has been prepared in accordance with the latest version of the GESC Manual. The signature and stamp affixed hereon certifies that this GESC document was prepared in accordance with the required regulations and criteria; however, the stamp and signature does not certify or guarantee future performance of the execution of the plan by the Contractor. The Contractor is responsible for executing the construction work according to the information set forth in the plan and in accordance with all applicable requirements."</i> Registered Professional Engineer _____ State of Colorado No. _____ Affix Seal w/date
			9. Landowner/authorized agent acknowledging GESC review and the acceptance of GESC responsibility. Signature block shall include the following certification statement: <i>"I hereby certify that the Grading, Erosion, and Sediment Control Measures for (Name of Subdivision/Development) shall be constructed according to the design presented in this document. I understand that additional</i>

Yes	No	N/A	GESC Requirements
			erosion control, sediment control and water quality enhancing measures may be required of the owner and his or her agents due to unforeseen pollutant discharges or if the submitted plan does not function as intended. The requirements of the plan shall be the obligation of the land owner and/or his successors or heirs; until such time as the plan is properly completed, modified or voided.” Owner or Authorized Agent _____ Authorized Signature _____ Date _____
X			10. Approval Block (see Appendix G) 4.5” x 5.5”
X			11. General Location Map at a Scale of 1-inch to 1000-feet to 8000-feet indicating:
X			a. General vicinity of the site location
X			b. Major roadway names and drainageways
X			c. North arrow and scale
			B. GESC DRAWING INDEX SHEET
X			For projects that require multiple plan-view sheets to adequately show the project area (based on the specified scale ranges), a single plan-view sheet shall be provided at a scale appropriate to show the entire site on one sheet. Areas of coverage of the multiple blow-up sheets are to be indicated as rectangles on the index sheet.
			C. INITIAL GESC DRAWING
			This plan sheet shall provide grading, erosion and sediment Control Measures for the initial clearing, grubbing and preparation of a project. At a minimum, it shall contain:
X			1. Property lines, adjacent roads and drainageways
X			2. Existing and proposed easements
X			3. Existing topography at 1- or 2-foot contour intervals, extending a minimum of 100 feet beyond the property line or the limits of construction if the project goes beyond property lines
X			4. Labeled location of any existing structures or hydrologic features within the mapping boundary
X			5. Flow arrows
		X	6. Labeled floodplain delineation including Control Measures to delineate and protect floodplain (e.g. construction fence, construction markers, wire-backed silt fence)
X			7. North arrow and scale
X			8. Approval Block (see Appendix G) 4.5” x 2”
X			9. Limits of construction encompassing all areas of work access points, storage and staging areas, borrow areas, stockpiles, construction trailer, and utility tie-in location in on-site and off-site locations.
X			10. Stream corridors and other resource areas to be preserved and all other areas outside the limits of construction shall be lightly shaded to clearly show area not to be disturbed

Yes	No	N/A	GESC Requirements
X			11. Location of stockpiles, including topsoil, imported aggregates, and excess material
X			12. Location of storage and staging areas for equipment, equipment maintenance, fuel, lubricant, chemical (and other materials) and waste storage
		X	13. Location of borrow or disposal areas
		X	14. Location of temporary roads, including haul roads
			15. Location, map symbol, and letter callouts of all initial erosion and sediment Control Measures
X			16. Location, map symbol, and letter callouts of Vehicle Tracking Control(s) (VTC)
X			17. Location, map symbol, and letter callouts of Concrete Washout Area(s) (CWA)
		X	18. Location, map symbol, and letter callouts of dedicated asphalt and concrete batch plants.
		X	19. Locations of other areas or operations where spills can occur – Refer to Chapter 10.
		X	20. Location, map symbol, and letter callouts for any anticipated Dewatering (DW) activities. Note: Dewatering of groundwater is covered by State permits. The Permittee is responsible for obtaining and complying with State-issued permits
X			21. Information to be specified for each Control Measure, such as type and dimensions as called for in Chapter 11 of the GESC Manual.
			22. The following notes:
X			a. Appropriate Control Measures must be implemented prior to the start of land disturbance activity, must control potential pollutants during each phase of construction, and must be continued through final stabilization. Appropriate structural and non-structural Control Measures must be maintained in operational condition.
X			b. See Standard Notes and Details (Sheet 1) for legend of Control Measures names and symbols.
X			c. Any Control Measures shown that require grading, (e.g. sediment basins, sediment traps, concrete washout areas, etc.), shall not be placed until after the pre-construction meeting and issuance of the GESC permit, but must be fully functional prior to any large-scale grading. The initial plan illustrates existing conditions. No proposed infrastructure is shown.
			D. INTERIM GESC DRAWING
			This plan sheet shows Control Measures to control grading, erosion and sediment during the initial over lot grading, site construction and site re-vegetation process. The Interim GESC Plan shall show all the information included on the Initial GESC Plan, as noted below. At a minimum, it shall contain the following information:

This checklist must be filled out and included in the Appendix of the GESC Report

Revised February 2019

Yes	No	N/A	GESC Requirements
X			1. Existing topography and location of all existing erosion and sediment Control Measures on site, as shown on the Initial GESC Plan shall be screened/shaded back.
X			2. Dimension and quantity information for Initial stage Control Measures shall not be shown.
X			3. Items from the Initial GESC Plan (except #20 and #21).
X			4. Proposed topography at 1- or 2-foot contour intervals, showing elevations, dimensions, locations, and slope of all proposed grading with flow arrows.
X			5. Outlines of cut and fill areas. Summary of cut and fill volumes. If export occurs, note location where export will likely be transported to. Separate cut/fill sheet is permissible.
X			6. Location of all interim erosion and sediment Control Measures designed in conjunction with the proposed site topography and implementing the Control Measures installed in the Initial GESC Plan.
X			7. Locations of all improvements, drainage features and facilities, and other permanent features to be constructed in connection with, or as a part of, the proposed work, per approved plat or land use plan.
			8. The following notes:
X			a. Appropriate Control Measures must be implemented prior to the start of land disturbance activity, must control potential pollutants during each phase of construction, and must be continued through final stabilization. Appropriate structural and non-structural Control Measures must be maintained in operational condition.
X			b. See Standard Notes and Details (Sheet 1) for legend of names and symbols.
X			c. Screened/shaded back Control Measures were installed in the Initial stage and shall be left in place in the Interim stage unless otherwise noted.
X			d. Control Measures, including seeding and mulching of disturbed areas, must be completed within 14 days, if the area will remain undisturbed for a period greater than 30 days.
X			e. All proposed slopes on this plan have a maximum slope of 3:1. Any slopes between 3:1 and 4:1 will require the use of erosion control blankets or flexible growth medium, as approved by the GESC Inspector.
		X	f. See Construction Plans for details of permanent drainage facilities such as detention facilities, water quality facilities, culverts, storm drains, and inlet and outlet protection.
		X	g. If site runoff enters the post-construction permanent Control Measure(s), sediment contamination of the materials may result in the post-construction permanent Control Measures(s) having to be reconstructed in its entirety. (Where applicable) Removal of sediment basin on site shall only occur after <u>all</u> areas tributary to

Yes	No	N/A	GESC Requirements
			the sediment basin have been stabilized. Removal must be approved by the GESC Inspector.
			E. FINAL GESC DRAWING
This plan sheet shows controls for final completion of the site. The Final GESC Plan shall include all information shown on the Initial and Interim Plans, as noted below. At a minimum, this plan sheet shall contain the following information:			
X			1. Existing topography in areas of proposed contours need not be shown.
X			2. Existing Initial and Interim Control Measures shall be shown, (screened/shaded back) . Dimension and quantity information shall not be shown for Initial and Interim Control Measures except for Control Measures to remain during final stabilization.
X			3. Directional flow arrows on all drainage features.
X			4. Items from the Interim GESC Plan (except #5 and #8).
X			5. Label all Initial or Interim Control Measures (e.g. SSA, VTC, DW, etc.) that are to be removed and any resulting disturbed areas to be stabilized.
X			6. Location of all Final erosion and sediment Control Measures (including seeding and mulching of any areas not stabilized in the Interim Plan), permanent landscaping, and any Control Measures necessary to minimize the movement of sediment off site until permanent vegetation can be established.
X			7. Show and label areas of sod and permanent landscaping classifications per approved land use plan.
			8. The following notes:
X			a. Appropriate Control Measures must be implemented prior to the start of land disturbance activity, must control potential pollutants during each phase of construction, and must be continued through final stabilization. Appropriate structural and non-structural Control Measures must be maintained in operational condition.
X			b. See Standard Notes and Details (Sheet 1) for legend of names and symbols.
X			c. Screened/shaded back Control Measures were installed in the Initial or Interim stage and, unless otherwise indicated, shall be left in place until approved by the GESC Inspector.
X			d. All Interim Control Measures, including seeding and mulching or disturbed areas, must be completed within 14 days if the areas will remain undisturbed for a period greater than 30 days.
X			e. All proposed slopes on this plan have a maximum slope of 3:1. Any slopes between 3:1 and 4:1 will require the use of erosion control blankets or flexible growth medium, as approved by the GESC Inspector
		X	f. See Construction Plans for details of permanent drainage facilities such as detention facilities, water quality facilities, culverts, storm drains, and inlet and outlet protection.

Yes	No	N/A	GESC Requirements
		X	g. Acceptance of the post-construction permanent Control Measures will not occur until all tributary areas to the permanent Control Measures are final stabilized.
X			F. GESC PLAN - STANDARD NOTES AND DETAILS
A copy of the GESC Plan - Standard Notes and Details (included in Appendix F) shall be bound into each set of GESC Plans.			

Signature of Designer