

FINAL DRAINAGE REPORT
FOR
CALHAN PUMP STATION UPGRADE
PPR2132

Prepared For:

Phillips 66

Prepared by:

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Time of Concentration -	Fig. C2P
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1. Engineer's Statement:

This attached drainage plan and report for Calhan Pump Station were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the El Paso County for drainage reports. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Reese Lundgren, P.E. #35730

For and on behalf of Tetrattech Rooney

4/4/22

2. Owners / Developer's Statement:

I, the developer have read and will comply with all of the requirements specified in this drainage report and plan.

Type text here

6/6/2022

Phillips 66

Date

By:

Title:

Address: Senior Environmental Consultant

3960 E. 56th Avenue , Commerce City CO 80022

3. El Paso County, Colorado:

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, and the Engineering Criteria Manual as amended.

Jennifer Irvine, P.E.
County Engineer/ECM Administrator

Date

Conditions

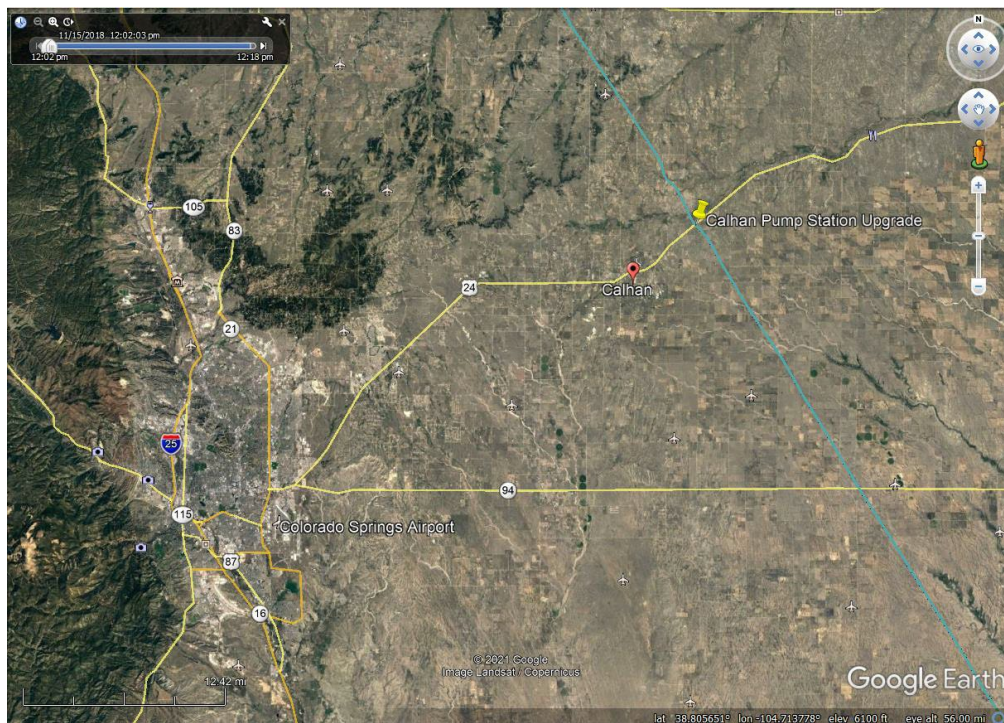
PURPOSE

The purpose of this Final Drainage Report is to identify drainage patterns and quantities within and affecting the proposed Calhan Pump Station. The project is an upgrade to an existing commercial NGL pump station. The report will identify specific solutions to problems on-site and off-site resulting from the proposed upgrade. The report and included maps present results of hydrologic and drainage facilities analysis. The report will discuss the recommended drainage improvements to the site and identify drainage requirements relative to the proposed upgrade. The appendices included with this report provide the pertinent calculations and graphs used in the facility design and drainage analyses.

GENERAL LOCATION AND DESCRIPTION

Location

The Calhan Pump Station property is located in unincorporated El Paso County in the Northeast corner of the north half of Section 21, Township 11 South, Range 61 West of the 6th Principal Meridian, El Paso County, Colorado. 32795 East Highway 24 (See Below).



Description of Property

The site encompasses approximately 5 acres and is currently zoned A-35.

Currently, the site is semi developed and covered with native grasses (pasture) and approximately 1 ac of gravel on the existing facility and access road. The existing topography of the site generally slopes toward the north with grades ranging from 1% to 15%. The existing culvert under Highway 24 allows stormwater to continue flowing north towards Big Sandy Creek. Offsite drainage sheet flows from the south onto the property, and there is concentrated flow at the center of the property into an existing channel flowing to the culvert under Highway 24.

Soils on the site are generally conducive for land development. According to the National Resources Conservation Service (NRCS), there is 1 type of soil in the Calhan Pump Station area, consisting of Razor-Midway complex. The soil is characterized as hydrologic soil group D. A copy of the soil map for the site can be found in Appendix A.

Construction activities will consist of clearing, grubbing, cutting and filling areas for gravel pad preparation. The total size of the land disturbing activities for the construction of the pump station addition will be approximately 0.56 acres.

DRAINAGE BASINS AND SUB-BASINS

Major Basin Descriptions

The major drainageway for Calhan Station is Big Sandy Creek, draining through the Ramah Reservoir. All drainage from the site enters an unnamed channel of Big Sandy Creek. The channel flows north through a culvert under Highway 24 into Big Sandy Creek.

The FEMA Flood Insurance Rate Map (FIRM # 08041C0425G) shows that the proposed development is not located within a mapped 100-year flood plain. A copy of the flood plain map has been included in the Appendix B.

Sub-Basin Description

The existing topography of the site slopes generally from south to north. There are 2 on site basins and 3 off site basins:

Basin EX1 consist of 25.37 acres on the eastern side of the off site area. Runoff values for EX1 are $Q_5=36.46$ cfs, $Q_{25}=55.56$ cfs and $Q_{100}=74.97$ cfs which drains to a branch ditch of Big Sandy Creek. The ditch continues north to Highway 24 where it flows through an existing 84" box culvert at DP-2 and continues to the north.

Basin EX2 consist of 37.36 acres on the southwestern off site area flowing into Basin EX5. Runoff values for EX2 are $Q_5=53.69$ cfs, $Q_{25}=81.82$ cfs and $Q_{100}=110.40$ cfs which drains to a branch ditch of Big Sandy Creek that runs on the East side of the existing facility to DP-1. The ditch continues north to Highway 24 where it flows through an existing 84" box culvert at DP-2 and continues to the north.

Basin EX3 consist of 7.71 acres on the northwestern off site area of the site flowing into Basin EX4. Runoff values for EX3 are $Q_5=11.08$ cfs, $Q_{25}=16.89$ cfs and $Q_{100}=22.78$ cfs which drains to a branch ditch of Big Sandy Creek that runs on the East side of the existing facility to DP-1. The ditch continues north to Highway 24 where it flows through an existing 84" box culvert at DP-2 and continues to the north.

Basin EX4 consist of 2.25 acres on the northern on site area of the site. Runoff values for EX4 are $Q_5=3.34$ cfs, $Q_{25}=5.09$ cfs and $Q_{100}=6.87$ cfs which drains to a branch ditch of Big Sandy Creek that runs on the East side of the existing facility to DP-1. The ditch continues north to Highway 24 where it flows through an existing 84" box culvert at DP-2 and continues to the north.

Basin EX5 consist of 1.13 acres on the southern on site area of the site. Runoff values for EX5 are $Q_5=3.79$ cfs, $Q_{25}=5.77$ cfs and $Q_{100}=7.79$ cfs which drains to a branch ditch of Big Sandy Creek that runs on the East side of the existing facility to DP-1. The ditch continues north to Highway 24 where it flows through an existing 84" box culvert at DP-2 and continues to the north. Existing combined flows at DP-2 are approximately 222 cfs which is well below the existing 84" box culverts capacity of 1108 cfs.

See Appendix D for existing drainage basins and conditions.

DRAINAGE DESIGN CRITERIA

Development Criteria Reference

The analysis and design of the storm drainage system for this project was prepared in accordance with the criteria set forth in the latest edition of the City of Colorado Springs/El Paso County City of Colorado Springs and El Paso County Drainage Criteria Manual (DCM). The onsite hydrologic analysis is based on a collection of data from the DCM, the NRCS Web Soil Survey, a partial topographic survey performed by King

Surveyors combined with publicly available topographic information, and property boundary information provided by King Surveyors.

Hydrologic Criteria

The minor design storm analyzed by this report is the 5-year recurrent storm event. The mid design storm analyzed was the 25-year recurrent storm event. The major design storm analyzed was the 100-year recurrent storm event. Since all basins within this project are less than 100 acres, the Rational Method is used to estimate the peak stormwater runoff discharge. The runoff coefficients are determined based on a weighted average of the various impervious areas in a given basin. The detailed calculations can be found in Appendix C. Rainfall intensities are obtained from Figure 6-5 of Chapter 6 of City DCMV1.

The following Rational Method equation was used to estimate peak storm water runoff:

$$Q = CIA$$

Where Q = Storm runoff in cubic feet per second (cfs)

A = Drainage area in acres

I = Runoff intensity in inches per hour

C = Runoff coefficient

The runoff intensity for the appropriate design storm is based upon the time of concentration and was generated by procedures outlined in Volume I of the DCM.

DRAINAGE FACILITY DESIGN

General Concept

The drainage design for the Calhan Pump Station upgrade intends to convey offsite flows safely through the site while directing on site flows to existing channel and ultimately to Big Sandy Creek.

The existing channel is adequately sized to collect and convey the design storm flows without exceeding the capacity. The existing culvert has been designed to keep the storm runoff flow below the capacity for the 10, 25 and 100 year events.

Appendix C contains all hydrology calculations. The hydrology calculations included are the "C" factors for each basin, the time of concentration for each basin, and the flows based on 10-yr, 25-yr and 100-yr storm events.

The intent of the proposed drainage system design is to safely convey all storm runoff generated from the proposed development to the main channel of Big Sandy Creek. Runoff generated as a result of the development will sheet flow into the existing channel.

Specific Details

The Proposed Pump Station upgrade addition is evaluated and divided into 2 drainage sub-basins in order to assist in the design of the channel capacity, and existing culvert.

PROPOSED DRAINAGE BASINS AND SUB-BASINS

On-site Basin Description

There are 2 onsite sub-basins associated with Calhan Pump Station, totaling 5 acres. There are 3 offsite basins that contribute to the combined flow to the existing 84" box culvert. The proposed pump station upgrade alters 2 existing sub-basins size but does not alter the overall conditions and the runoff generated by the new gravel pad within the facility is insignificant. The gravel pad addition does not alter existing drainage patterns and does not significantly increase stormwater runoff. The stormwater runoff generated by the pump station upgrade will continue overland on existing topology where possible and will be collected in the existing swale and continue to flow to the box culvert at Highway 24. In general, runoff from the site will eventually be directed as follows:

Basin EX1 consist of 25.37 acres on the eastern side of the off site area. Runoff values for EX1 are $Q_5=36.46$ cfs, $Q_{25}=55.56$ cfs and $Q_{100}=74.97$ cfs which drains to a branch ditch of Big Sandy Creek. The ditch continues north to Highway 24 where it flows through an existing 84" box culvert at DP-2 and continues to the north.

Basin EX3 consist of 7.71 acres on the northwestern off site area of the site flowing into Basin EX4. Runoff values for EX3 are $Q_5=11.08$ cfs, $Q_{25}=16.89$ cfs and $Q_{100}=22.78$ cfs which drains to an existing drainage channel of Big Sandy Creek that runs on the East side of the existing facility to DP-1. The ditch continues north to Highway 24 where it flows through an existing 84" box culvert at DP-2 and continues to the north.

Basin EX4 consist of 2.25 acres on the northern on site area of the site. Runoff values for EX4 are $Q_5=3.34$ cfs, $Q_{25}=5.09$ cfs and $Q_{100}=6.87$ cfs which drains to an existing drainage channel of Big Sandy Creek that runs on the East side of the existing facility to DP-1. The ditch continues north to Highway 24 where it flows through an existing 84" box culvert at DP-2 and continues to the north.

Basin PR1 consist of 36.12 acres on the southwestern off site area flowing into Basin PR2. Runoff values for PR2 are $Q_5=51.93$ cfs, $Q_{25}=79.13$ cfs and $Q_{100}=106.78$ cfs which

drains to an existing drainage channel of Big Sandy Creek that runs on the East side of the existing facility to DP-1. The ditch continues north to Highway 24 where it flows through an existing 84" box culvert at DP-2 and continues to the north.

Basin PR2 consist of 2.38 acres on the southern on site area of the site. The existing drainage swale will be extended south and west to capture offsite runoff, and continued conveyance to DP-2. Runoff values for PR2 are $Q_5=8.02$ cfs, $Q_{25}=12.23$ cfs and $Q_{100}=16.50$ cfs which drains to a branch ditch of Big Sandy Creek that runs on the East side of the existing facility to DP-1. The ditch continues north to Highway 24 where it flows through an existing 84" box culvert at DP-2 and continues to the north. Developed combined flows at DP-2 are approximately 226 cfs which is well below the existing 84" box culverts capacity of 1108 cfs. The additional area added to the terminal increases the total flow at DP-2 from 222 cfs to 226 cfs, a 1.8% increase in runoff.

Water Quality and Erosion Control

The proposed addition to the existing facility will disturb approximately 0.56 acres, which is less than the 1 acre threshold for post construction, permanent water quality control measures. Best Management Practices (BMP's) will be utilized post construction and water quality will be provided by grass swales along the proposed channel.

Temporary BMP's such as straw bales, silt fence, inlet protection and seeding will be utilized in accordance with the Erosion Control Plan.

CONCLUSIONS

Compliance with Standards

The proposed drainage facility design is in accordance with the City of Colorado Springs and El Paso County Drainage Criteria Manual (DCM). We are addressing water quality for the run-off from the proposed development by minimizing the directly connected impervious areas by implementing grass-lined swales. As a result, the run-off from this development will have no adverse impacts on any downstream facilities.

Summary of Concept

No adverse effects to surrounding properties are anticipated from the development of this site. The additional area added to the terminal increases the total flow at DP-2 (the existing 84" box culvert under HWY 24) from 222 cfs to 226 cfs, which is well below the box culverts capacity of 1108 cfs. The design, if properly maintained and constructed, conveys and releases the storm water runoff up to, and including, the 100-year storm

event, in a safe manner to protect life and property from damage, without improvement to the existing channel and existing 84" box culvert under HWY 24.

REFERENCES

1. Drainage Criteria Manual. City of Colorado Springs and El Paso County. Volume 1 and Volume 2; latest revisions.
2. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas. Map Number 08041C0425G. Federal Emergency Management Agency (July 2021).
3. Web Soil Survey – National Cooperative Soil Survey. NRCS (July 2021).

APPENDIX A:

SOILS MAP

Soil Map—El Paso County Area, Colorado



Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

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 1:24,000.

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: El Paso County Area, Colorado

Survey Area Data: Version 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Jun 7, 2016—Aug 17, 2017

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
75	Razor-Midway complex	56.9	100.0%
Totals for Area of Interest		56.9	100.0%

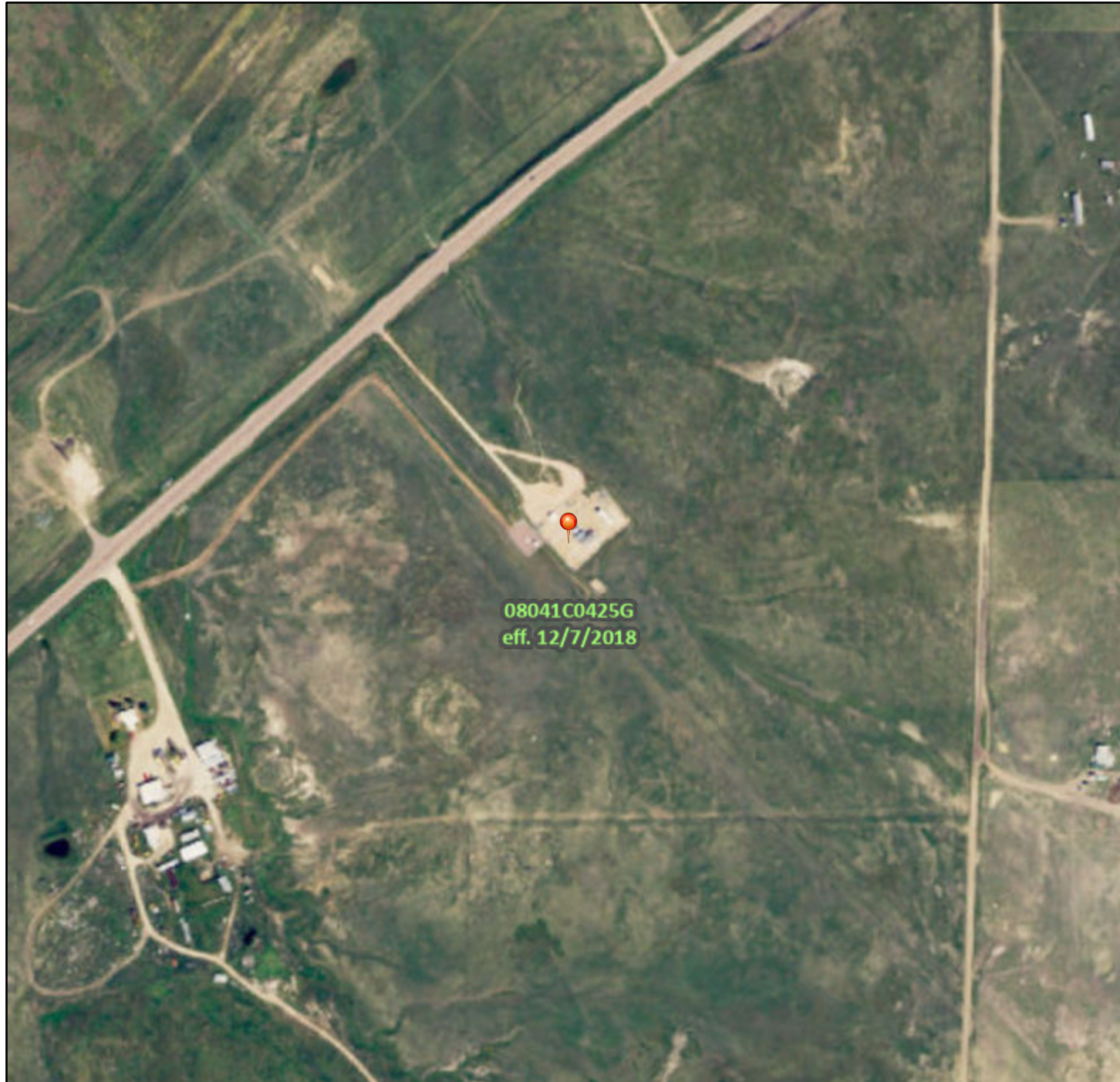
APPENDIX B:

FLOODPLAIN MAP

National Flood Hazard Layer FIRMette



104°13'42"W 39°4'59"N



0 250 500 1,000 1,500 2,000 Feet

1:6,000

104°13'5"W 39°4'31"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		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 7/19/2021 at 2:51 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.

The National Map Advanced Viewer



7/19/2021, 4:05:00 PM

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other

Riverine

- Populated Places
- State Capitol Buildings
- Post Offices
- Local Connecting Roads
- Secondary Highways
- Controlled-access Highways

Airport Runways

- Airport
- Heliport
- Seaplane Anchorage/Base
- Waterbody - Large Scale
- Estuary
- Ice Mass

LakePond

- Playa
- Reservoir
- SwampMarsh
- Area - Large Scale
- Area of Complex Channels
- Area to be Submerged
- BayInlet

Bridge

- CanalDitch
- DamWeir
- Flume
- Foreshore
- Hazard Zone
- Inundation Area

Lock Chamber

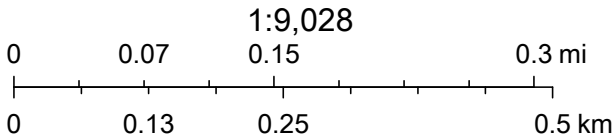
- Rapids
- SeaOcean
- Special Use Zone
- Spillway
- StreamRiver
- Submerged Stream

Wash

- Water IntakeOutflow
- Flowline - Large Scale
- Perennial
- Intermittent
- Ephemeral
- Artificial Path
- Canal Ditch

Coastline

- Connector
- Pipeline



U.S. Fish and Wildlife Service, National Standards and Support Team, wetlands_team@fws.gov, USGS The National Map: National Hydrography Dataset. Data refreshed April, 2021., USGS WBD - Watershed Boundary Dataset. Data refreshed July, 2021., USGS

APPENDIX C:

HYDROLOGY



NOAA Atlas 14, Volume 8, Version 2
Location name: Calhan, Colorado, USA*
Latitude: 39.0791°, Longitude: -104.2227°
Elevation: 6262 ft**
* source: ESRI Maps
** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aeriels](#)

PF tabular

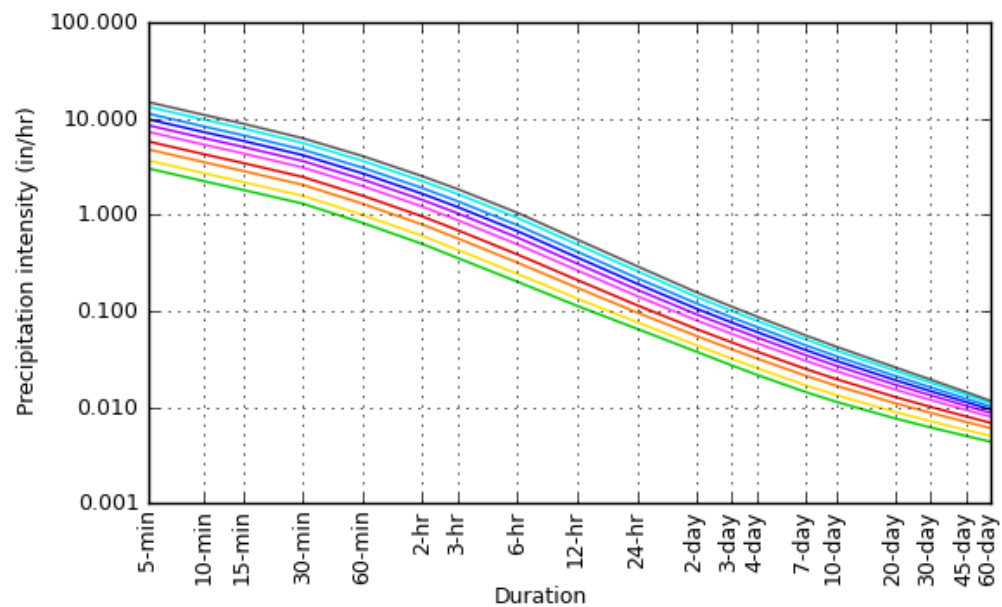
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	3.04 (2.44-3.80)	3.67 (2.95-4.61)	4.79 (3.83-6.01)	5.80 (4.61-7.31)	7.30 (5.65-9.58)	8.53 (6.44-11.3)	9.85 (7.19-13.3)	11.3 (7.88-15.5)	13.3 (8.93-18.7)	14.9 (9.72-21.1)
10-min	2.23 (1.79-2.78)	2.69 (2.16-3.37)	3.51 (2.81-4.40)	4.24 (3.37-5.35)	5.34 (4.14-7.01)	6.25 (4.72-8.26)	7.21 (5.26-9.73)	8.25 (5.78-11.4)	9.71 (6.54-13.7)	10.9 (7.12-15.4)
15-min	1.81 (1.45-2.26)	2.19 (1.76-2.74)	2.85 (2.28-3.58)	3.45 (2.74-4.35)	4.34 (3.36-5.70)	5.08 (3.84-6.72)	5.86 (4.28-7.91)	6.71 (4.70-9.25)	7.90 (5.32-11.1)	8.85 (5.78-12.6)
30-min	1.30 (1.05-1.63)	1.57 (1.26-1.97)	2.05 (1.64-2.57)	2.47 (1.96-3.11)	3.10 (2.40-4.06)	3.61 (2.73-4.78)	4.16 (3.04-5.61)	4.75 (3.32-6.55)	5.58 (3.75-7.86)	6.24 (4.08-8.85)
60-min	0.822 (0.660-1.03)	0.995 (0.798-1.25)	1.30 (1.04-1.63)	1.58 (1.25-1.99)	1.99 (1.54-2.61)	2.33 (1.76-3.08)	2.69 (1.96-3.63)	3.08 (2.16-4.25)	3.63 (2.44-5.12)	4.07 (2.66-5.78)
2-hr	0.496 (0.400-0.616)	0.602 (0.486-0.748)	0.790 (0.634-0.984)	0.958 (0.766-1.20)	1.21 (0.946-1.58)	1.42 (1.08-1.87)	1.65 (1.21-2.21)	1.89 (1.33-2.59)	2.24 (1.52-3.13)	2.51 (1.65-3.54)
3-hr	0.356 (0.288-0.440)	0.432 (0.350-0.535)	0.568 (0.458-0.705)	0.692 (0.555-0.861)	0.879 (0.689-1.14)	1.04 (0.791-1.36)	1.20 (0.888-1.61)	1.39 (0.981-1.89)	1.64 (1.12-2.29)	1.85 (1.22-2.60)
6-hr	0.201 (0.164-0.247)	0.243 (0.198-0.298)	0.318 (0.258-0.391)	0.387 (0.312-0.478)	0.492 (0.389-0.636)	0.580 (0.446-0.756)	0.676 (0.503-0.898)	0.780 (0.557-1.06)	0.928 (0.638-1.29)	1.05 (0.699-1.46)
12-hr	0.113 (0.093-0.137)	0.135 (0.110-0.164)	0.174 (0.142-0.212)	0.210 (0.170-0.257)	0.264 (0.210-0.339)	0.310 (0.240-0.401)	0.360 (0.269-0.475)	0.414 (0.297-0.558)	0.490 (0.339-0.676)	0.552 (0.371-0.765)
24-hr	0.065 (0.054-0.079)	0.076 (0.063-0.092)	0.096 (0.079-0.117)	0.115 (0.094-0.139)	0.143 (0.114-0.182)	0.166 (0.130-0.213)	0.192 (0.145-0.251)	0.220 (0.159-0.294)	0.260 (0.181-0.355)	0.292 (0.198-0.401)
2-day	0.037 (0.031-0.045)	0.044 (0.036-0.052)	0.055 (0.045-0.066)	0.065 (0.053-0.078)	0.079 (0.064-0.100)	0.092 (0.072-0.117)	0.105 (0.080-0.136)	0.119 (0.087-0.158)	0.139 (0.098-0.189)	0.156 (0.106-0.212)
3-day	0.027 (0.023-0.032)	0.032 (0.026-0.038)	0.040 (0.033-0.048)	0.047 (0.039-0.057)	0.058 (0.046-0.072)	0.066 (0.052-0.084)	0.076 (0.058-0.098)	0.086 (0.063-0.113)	0.100 (0.070-0.134)	0.111 (0.076-0.150)
4-day	0.022 (0.018-0.026)	0.025 (0.021-0.030)	0.032 (0.027-0.038)	0.038 (0.031-0.045)	0.046 (0.037-0.058)	0.053 (0.042-0.067)	0.060 (0.046-0.078)	0.068 (0.050-0.090)	0.079 (0.056-0.106)	0.088 (0.060-0.119)
7-day	0.014 (0.012-0.017)	0.017 (0.014-0.020)	0.021 (0.018-0.025)	0.025 (0.021-0.030)	0.030 (0.025-0.038)	0.035 (0.028-0.043)	0.039 (0.030-0.050)	0.044 (0.033-0.058)	0.051 (0.036-0.068)	0.056 (0.039-0.075)
10-day	0.011 (0.010-0.013)	0.013 (0.011-0.016)	0.017 (0.014-0.020)	0.020 (0.016-0.023)	0.024 (0.019-0.029)	0.027 (0.021-0.033)	0.030 (0.023-0.039)	0.034 (0.025-0.044)	0.039 (0.028-0.052)	0.043 (0.030-0.057)
20-day	0.008 (0.006-0.009)	0.009 (0.007-0.010)	0.011 (0.009-0.013)	0.013 (0.011-0.015)	0.015 (0.012-0.018)	0.017 (0.014-0.021)	0.019 (0.015-0.024)	0.021 (0.016-0.027)	0.024 (0.017-0.031)	0.026 (0.018-0.034)
30-day	0.006 (0.005-0.007)	0.007 (0.006-0.008)	0.009 (0.007-0.010)	0.010 (0.008-0.012)	0.012 (0.010-0.014)	0.013 (0.011-0.016)	0.015 (0.011-0.018)	0.016 (0.012-0.020)	0.018 (0.013-0.023)	0.019 (0.014-0.026)
45-day	0.005 (0.004-0.006)	0.006 (0.005-0.007)	0.007 (0.006-0.008)	0.008 (0.007-0.009)	0.009 (0.008-0.011)	0.010 (0.008-0.013)	0.011 (0.009-0.014)	0.012 (0.009-0.016)	0.014 (0.010-0.018)	0.014 (0.010-0.019)
60-day	0.004 (0.004-0.005)	0.005 (0.004-0.006)	0.006 (0.005-0.007)	0.007 (0.006-0.008)	0.008 (0.006-0.009)	0.009 (0.007-0.010)	0.009 (0.007-0.012)	0.010 (0.008-0.013)	0.011 (0.008-0.014)	0.012 (0.008-0.015)
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.										

[Back to Top](#)

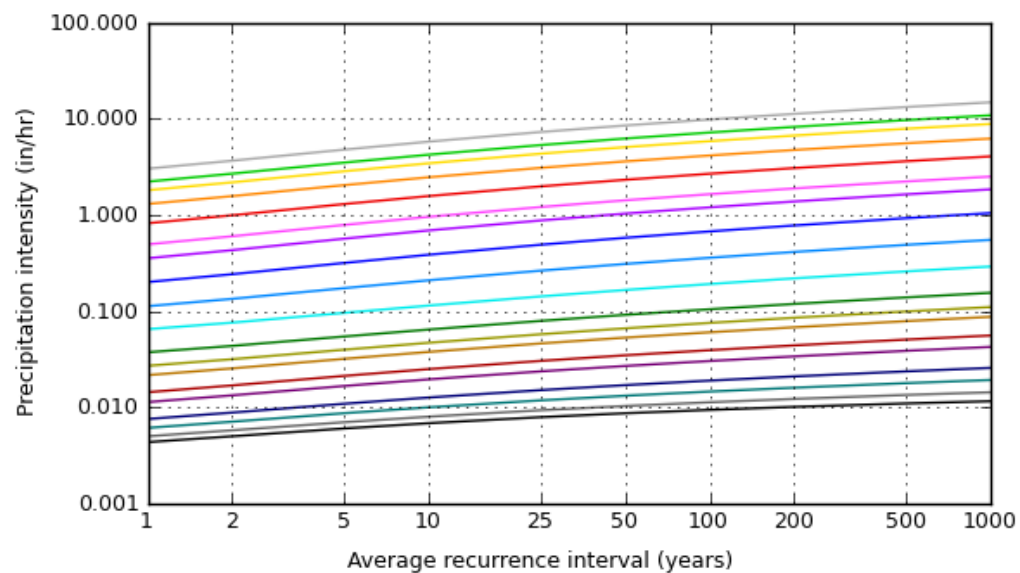
PF graphical

PDS-based intensity-duration-frequency (IDF) curves

Latitude: 39.0791°, Longitude: -104.2227°



Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000



Duration	
5-min	2-day
10-min	3-day
15-min	4-day
30-min	7-day
60-min	10-day
2-hr	20-day
3-hr	30-day
6-hr	45-day
12-hr	60-day
24-hr	

Maps & aerials

Small scale terrain

APPENDIX D:

STORMCAD

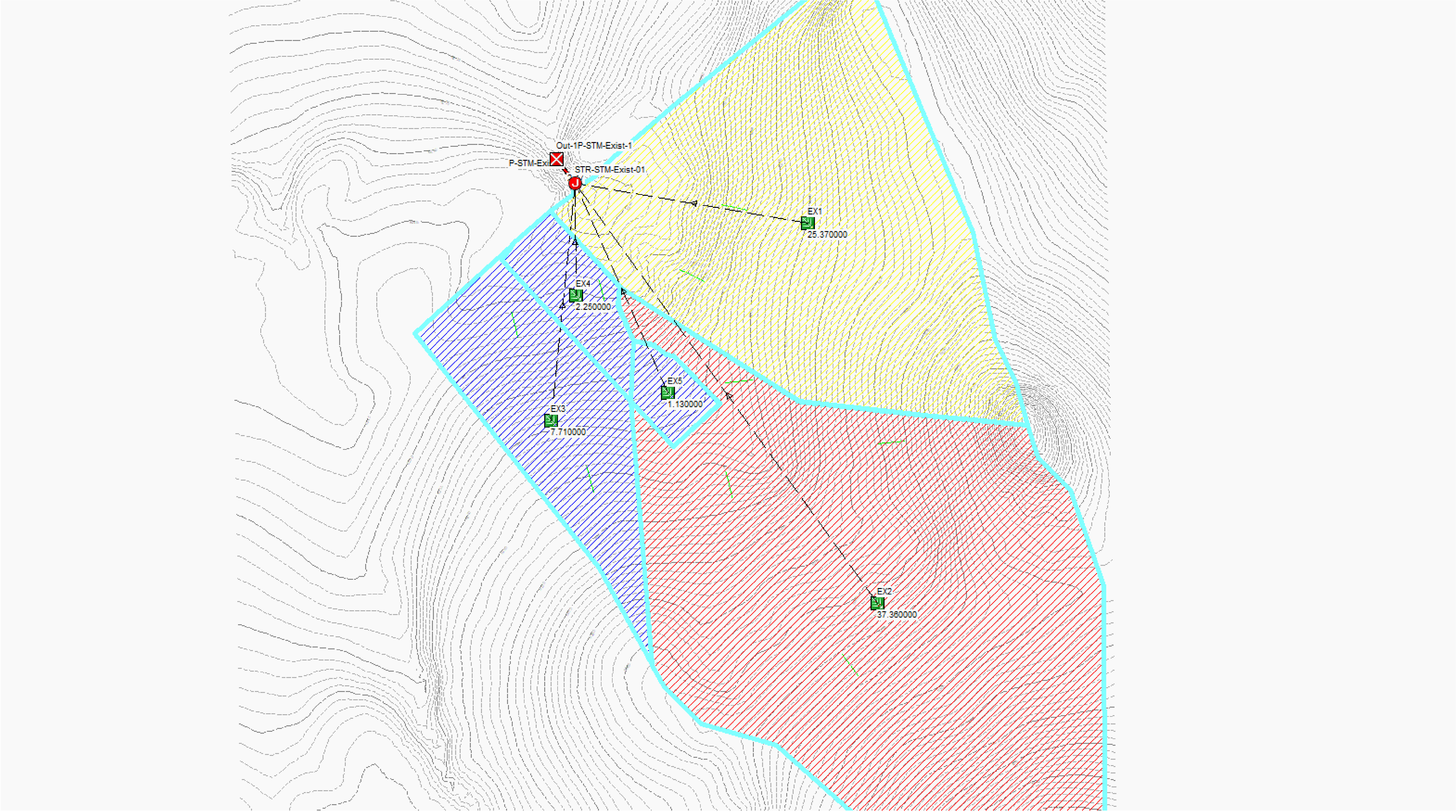
PIPES																								
Element ID	Storm	From (Inlet Node)	To (Outlet Node)	Length	Inlet Invert Elevation	Inlet Invert Offset	Outlet Invert Elevation	Outlet Invert Offset	Total Drop	Average Slope	Pipe Shape	Pipe Diameter or Height	Pipe Width											
				(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(%)			(inches)	(inches)										
Existing Conditions																								
P-STM-Exist-1	5yr	STR-STM-Exist-01	Out-1P-STM-Exist-1	94.34	6236.57	0.00	6234.24	0.00	2.33	2.4700	Rectangular	84.000	84.00											
P-STM-Exist-1	10yr	STR-STM-Exist-01	Out-1P-STM-Exist-1	94.34	6236.57	0.00	6234.24	0.00	2.33	2.4700	Rectangular	84.000	84.00											
P-STM-Exist-1	25yr	STR-STM-Exist-01	Out-1P-STM-Exist-1	94.34	6236.57	0.00	6234.24	0.00	2.33	2.4700	Rectangular	84.000	84.00											
P-STM-Exist-1	100yr	STR-STM-Exist-01	Out-1P-STM-Exist-1	94.34	6236.57	0.00	6234.24	0.00	2.33	2.4700	Rectangular	84.000	84.00											
Proposed Conditions																								
P-STM-Exist-1	5yr	STR-STM-Exist-01	Out-1P-STM-Exist-1	94.34	6236.57	0.00	6234.24	0.00	2.33	2.4700	Rectangular	84.000	84.00											
P-STM-Exist-1	10yr	STR-STM-Exist-01	Out-1P-STM-Exist-1	94.34	6236.57	0.00	6234.24	0.00	2.33	2.4700	Rectangular	84.000	84.00											
P-STM-Exist-1	25yr	STR-STM-Exist-01	Out-1P-STM-Exist-1	94.34	6236.57	0.00	6234.24	0.00	2.33	2.4700	Rectangular	84.000	84.00											
P-STM-Exist-1	100yr	STR-STM-Exist-01	Out-1P-STM-Exist-1	94.34	6236.57	0.00	6234.24	0.00	2.33	2.4700	Rectangular	84.000	84.00											

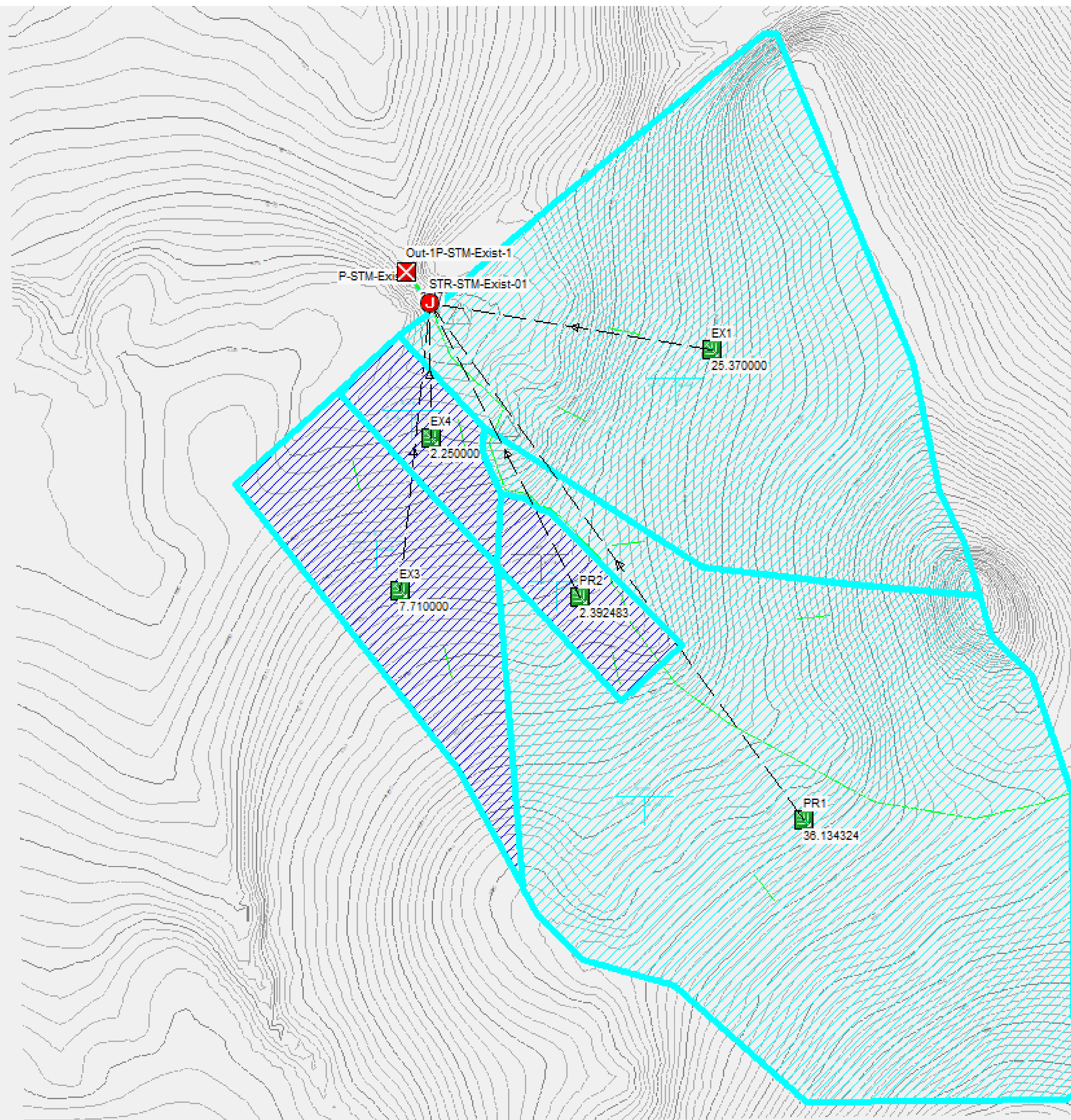
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|

OUTFALLS																					
Element ID	Storm	X Coordinate	Y Coordinate	Invert Elevation	Boundary Type	Flap Gate	Fixed Water Elevation (ft)	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Maximum HGL Depth Attained (ft)	Maximum HGL Elevation Attained (ft)										
Existing Conditions				(ft)				(cfs)		(ft)											
Out-1P-STM-Exist-1	5yr	3362096.93	1457113.15	6234.24	FREE	NO		107.79	0.00	1.11	6235.35										
Out-1P-STM-Exist-1	10yr	3362096.93	1457113.15	6234.24	FREE	NO		130.56	0.00	1.26	6235.50										
Out-1P-STM-Exist-1	25yr	3362096.93	1457113.15	6234.24	FREE	NO		164.37	0.00	1.47	6235.71										
Out-1P-STM-Exist-1	100yr	3362096.93	1457113.15	6234.24	FREE	NO		221.84	0.00	1.81	6236.05										
Proposed Conditions																					
Out-1P-STM-Exist-1	5yr	3362096.93	1457113.15	6234.24	FREE	NO		110.25	0.00	1.13	6235.36										
Out-1P-STM-Exist-1	10yr	3362096.93	1457113.15	6234.24	FREE	NO		133.54	0.00	1.28	6235.52										
Out-1P-STM-Exist-1	25yr	3362096.93	1457113.15	6234.24	FREE	NO		168.12	0.00	1.50	6235.73										
Out-1P-STM-Exist-1	100yr	3362096.93	1457113.15	6234.24	FREE	NO		226.91	0.00	1.84	6236.08										

JUNCTIONS																								
Element ID	Storm	X Coordinate	Y Coordinate	Invert Elevation	Ground/Rim (Max) Elevation	Ground/Rim (Max) Offset	Initial Water Elevation	Initial Water Depth	Surcharge Elevation	Surcharge Depth	Ponded Area	Minimum Pipe Cover	Peak Inflow	Peak Lateral Inflow	Maximum HGL Elevation Attained	Maximum HGL Depth Attained	Maximum Surcharge Depth Attained	Minimum Freeboard Attained	Average HGL Elevation Attained	Average HGL Depth Attained	Time of Maximum HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-inches)	Total Time Flooded (minutes)
Existing Conditions				(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft²)	(inches)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-inches)	(minutes)
STR-STM-Exist-01	5yr	3362153.34	1457037.54	6236.57	6238.03	1.46	6236.57	0.00	6238.03	0.00	0.00	0.00	108.35	108.35	6237.68	1.11	0.00	5.89	6236.57	0.00	0 00:05	0 00:00	0.00	0.00
STR-STM-Exist-01	10yr	3362153.34	1457037.54	6236.57	6238.03	1.46	6236.57	0.00	6238.03	0.00	0.00	0.00	131.20	131.20	6237.83	1.26	0.00	5.74	6236.57	0.00	0 00:05	0 00:00	0.00	0.00
STR-STM-Exist-01	25yr	3362153.34	1457037.54	6236.57	6238.03	1.46	6236.57	0.00	6238.03	0.00	0.00	0.00	165.13	165.13	6238.04	1.47	0.00	5.52	6236.57	0.00	0 00:05	0 00:00	0.00	0.00
STR-STM-Exist-01	100yr	3362153.34	1457037.54	6236.57	6238.03	1.46	6236.57	0.00	6238.03	0.00	0.00	0.00	222.81	222.81	6238.38	1.81	0.00	5.18	6236.57	0.00	0 00:05	0 00:00	0.00	0.00
Proposed Conditions																								
STR-STM-Exist-01	5yr	3362153.34	1457037.54	6236.57	6238.03	1.46	6236.57	0.00	6238.03	0.00	0.00	0.00	110.82	110.82	6237.70	1.13	0.00	5.87			0 00:05	0 00:00	0.00	0.00
STR-STM-Exist-01	10yr	3362153.34	1457037.54	6236.57	6238.03	1.46	6236.57	0.00	6238.03	0.00	0.00	0.00	134.19	134.19	6237.85	1.28	0.00	5.72	6236.57	0.00	0 00:05	0 00:00	0.00	0.00
STR-STM-Exist-01	25yr	3362153.34	1457037.54	6236.57	6238.03	1.46	6236.57	0.00	6238.03	0.00	0.00	0.00	168.90	168.90	6238.07	1.50	0.00	5.50	6236.57	0.00	0 00:05	0 00:00	0.00	0.00
STR-STM-Exist-01	100yr	3362153.34	1457037.54	6236.57	6238.03	1.46	6236.57	0.00	6238.03	0.00	0.00	0.00	227.89	227.89	6238.41	1.84	0.00	5.16	6236.58	0.01	0 00:05	0 00:00	0.00	0.00

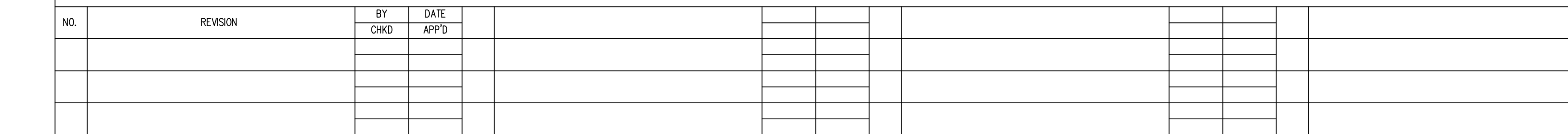
SUBBASIN										SUBBASIN									
Element ID	Storm	Area (acres)	Drainage Node ID	Weighted Runoff Coefficient	Accumulated Precipitation (inches)	Total Runoff (inches)	Peak Runoff (cfs)	Rainfall Intensity (inches/hr)	T.O.C (days hh:mm:ss)	Element ID	Storm	Area (acres)	Drainage Node ID	Weighted Runoff Coefficient	Accumulated Precipitation (inches)	Total Runoff (inches)	Peak Runoff (cfs)	Rainfall Intensity (inches/hr)	T.O.C (days hh:mm:ss)
Existing Conditions										Proposed Conditions									
EX1	5yr	25.37	STR-STM-Exist-01	0.3000	0.40	0.12	36.46	4.790	0 00:05:00	EX1	5yr	25.37	STR-STM-Exist-01	0.3000	0.40	0.12	36.46	4.790	0 00:05:00
EX2	5yr	37.36	STR-STM-Exist-01	0.3000	0.40	0.12	53.69	4.790	0 00:05:00	EX3	5yr	7.71	STR-STM-Exist-01	0.3000	0.40	0.12	11.08	4.790	0 00:05:00
EX3	5yr	7.71	STR-STM-Exist-01	0.3000	0.40	0.12	11.08	4.790	0 00:05:00	EX4	5yr	2.25	STR-STM-Exist-01	0.3100	0.40	0.12	3.34	4.790	0 00:05:00
EX4	5yr	2.25	STR-STM-Exist-01	0.3100	0.40	0.12	3.34	4.790	0 00:05:00	PR1	5yr	36.13	STR-STM-Exist-01	0.3000	0.40	0.12	51.93	4.790	0 00:05:00
EX5	5yr	1.13	STR-STM-Exist-01	0.7000	0.40	0.28	3.79	4.790	0 00:05:00	PR2	5yr	2.39	STR-STM-Exist-01	0.7000	0.40	0.28	8.02	4.790	0 00:05:00
EX1	10yr	25.37	STR-STM-Exist-01	0.3000	0.48	0.15	44.14	5.800	0 00:05:00	EX1	10yr	25.37	STR-STM-Exist-01	0.3000	0.48	0.15	44.14	5.800	0 00:05:00
EX2	10yr	37.36	STR-STM-Exist-01	0.3000	0.48	0.15	65.01	5.800	0 00:05:00	EX3	10yr	7.71	STR-STM-Exist-01	0.3000	0.48	0.15	13.42	5.800	0 00:05:00
EX3	10yr	7.71	STR-STM-Exist-01	0.3000	0.48	0.15	13.42	5.800	0 00:05:00	EX4	10yr	2.25	STR-STM-Exist-01	0.3100	0.48	0.15	4.05	5.800	0 00:05:00
EX4	10yr	2.25	STR-STM-Exist-01	0.3100	0.48	0.15	4.05	5.800	0 00:05:00	PR1	10yr	36.13	STR-STM-Exist-01	0.3000	0.48	0.15	62.87	5.800	0 00:05:00
EX5	10yr	1.13	STR-STM-Exist-01	0.7000	0.48	0.34	4.59	5.800	0 00:05:00	PR2	10yr	2.39	STR-STM-Exist-01	0.7000	0.48	0.34	9.71	5.800	0 00:05:00
EX1	25yr	25.37	STR-STM-Exist-01	0.3000	0.61	0.18	55.56	7.300	0 00:05:00	EX1	25yr	25.37	STR-STM-Exist-01	0.3000	0.61	0.18	55.56	7.300	0 00:05:00
EX2	25yr	37.36	STR-STM-Exist-01	0.3000	0.61	0.18	81.82	7.300	0 00:05:00	EX3	25yr	7.71	STR-STM-Exist-01	0.3000	0.61	0.18	16.89	7.300	0 00:05:00
EX3	25yr	7.71	STR-STM-Exist-01	0.3000	0.61	0.18	16.89	7.300	0 00:05:00	EX4	25yr	2.25	STR-STM-Exist-01	0.3100	0.61	0.19	5.09	7.300	0 00:05:00
EX4	25yr	2.25	STR-STM-Exist-01	0.3100	0.61	0.19	5.09	7.300	0 00:05:00	PR1	25yr	36.13	STR-STM-Exist-01	0.3000	0.61	0.18	79.13	7.300	0 00:05:00
EX5	25yr	1.13	STR-STM-Exist-01	0.7000	0.61	0.43	5.77	7.300	0 00:05:00	PR2	25yr	2.39	STR-STM-Exist-01	0.7000	0.61	0.43	12.23	7.300	0 00:05:00
EX1	100yr	25.37	STR-STM-Exist-01	0.3000	0.82	0.25	74.97	9.850	0 00:05:00	EX1	100yr	25.37	STR-STM-Exist-01	0.3000	0.82	0.25	74.97	9.850	0 00:05:00
EX2	100yr	37.36	STR-STM-Exist-01	0.3000	0.82	0.25	110.40	9.850	0 00:05:00	EX3	100yr	7.71	STR-STM-Exist-01	0.3000	0.82	0.25	22.78	9.850	0 00:05:00
EX3	100yr	7.71	STR-STM-Exist-01	0.3000	0.82	0.25	22.78	9.850	0 00:05:00	EX4	100yr	2.25	STR-STM-Exist-01	0.3100	0.82	0.25	6.87	9.850	0 00:05:00
EX4	100yr	2.25	STR-STM-Exist-01	0.3100	0.82	0.25	6.87	9.850	0 00:05:00	PR1	100yr	36.13	STR-STM-Exist-01	0.3000	0.82	0.25	106.78	9.850	0 00:05:00
EX5	100yr	1.13	STR-STM-Exist-01	0.7000	0.82	0.58	7.79	9.850	0 00:05:00	PR2	100yr	2.39	STR-STM-Exist-01	0.7000	0.82	0.58	16.50	9.850	0 00:05:00





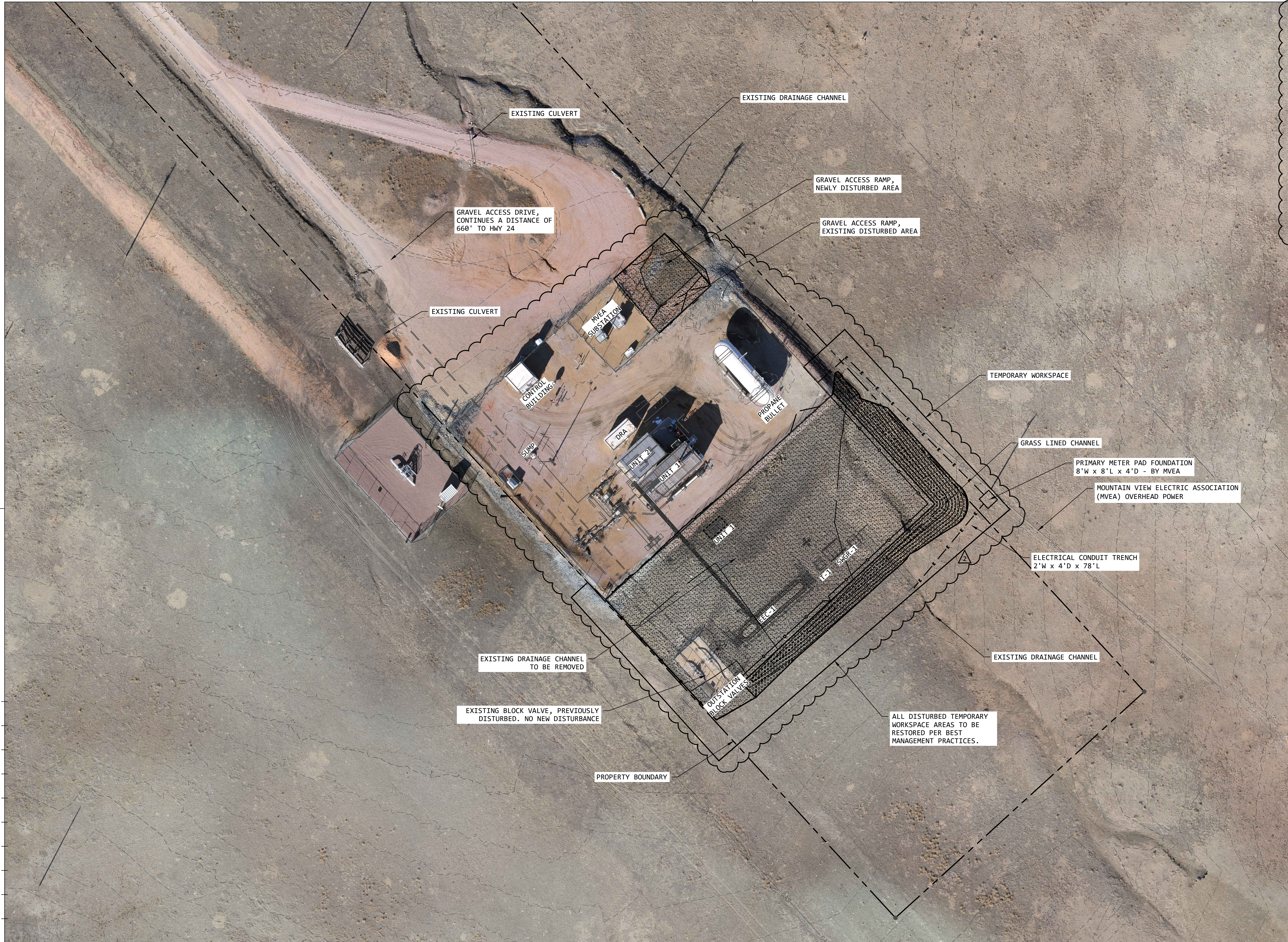
APPENDIX E:

DRAINAGE MAP



SCALE	
AS NOTED	
PROJECT NO	03417
FILE NAME (aka)	DOCUMENT NUMBER
DRN-001	





FOR BIDS		
FOR APPR		
FOR CONST		
DRAWN	SKC	12/05/19
CHECKED	SKC	11/16/20
APP'D	RML	11/16/20

CALHAN
LIMITS OF DISTURBANCE
SITE PLAN
EL PASO COUNTY, COLORADO

SCALE AS NOTED	
PROJECT NO 03417	
FILE NAME (aka) DOCUMENT NUMBER CALH-EXB-1000	