



# **Grandview Reserve Phase 2 Final Drainage Report For Early Grading**

January 2025

HR Green Project No: 201662.202

EPC PCD Filing No.: PUD-SP236

**Prepared For:**

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**Prepared By:**

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Contact: Ken Huhn, P.E.

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### Engineer's Statement:

The attached drainage plan and report 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 County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

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Ken Huhn, P.E.

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Date

State of Colorado No. 54022

For and on behalf of HR Green Development, LLC

### Owner/Developer's Statement:

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

By: \_\_\_\_\_

Authorized Signature

---

Date

Address: D.R. Horton  
9555 S. Kingston Court  
Englewood, CO

### El Paso County Statement

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development code, as amended.

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Joshua Palmer, P.E.

Date

County Engineer/ECM Administrator

Conditions:



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## I. General Purpose, Location and Description

### a. Purpose

The purpose of this Final Drainage Report (FDR) for the Early Grading of Grandview Reserve Subdivision Phase 2 is to describe the onsite and offsite drainage patterns and convey undeveloped runoff to temporary sedimentation facilities while safely routing detained stormwater to adequate outfalls.

### b. Location

The Grandview Reserve Phase 2 site is located in unincorporated El Paso County, Colorado. The Phase 2 location (referred to as the site herein) is located east of Grandview Reserve Filings 1-4 and MST2, north of Grandview Reserve Phase 3, and west of Rex Road.

The site lies within a tract of land within Sections 21, 22, 27 and 28, Township 12 South, Range 64 West of the 6<sup>th</sup> Principal Meridian, in El Paso County, State of Colorado. A Vicinity Map is included in **Appendix A**.

The site is bound by a segment of Rex Road to be developed with the full buildout of this development to the east and undeveloped land that has historically been used as ranching lands. The west of the site is bound by Grandview Reserve Filings 1-4 and MST2. A vicinity map is presented in Appendix A.

The Gieck Ranch Tributary #2 "MST2" (Channel B) is a part of the Gieck Ranch Drainage Basin tributary to Black Squirrel Creek. The channel draining through the site is an ongoing project with associated CLOMR Report and the PCD File No. is CDR228 with El Paso County. The Grandview Reserve improvements will follow any requirements of that report. There is another floodplain channel to the north of Rex Road that will not be disturbed by this phase of development and is studied as a future project.

The existing surrounding platted developments include the Grandview Reserve Phase 1 Filings 1-4 and Grandview Reserve Phase 3.

### c. Description of Property

The site is approximately 68.72 acres of future residential development with associated right of way, open space tracts, public improvements, and stormwater treatment infrastructure.

The existing groundcover and topography of the site is native grasses/weeds and exposed soil on gently rolling hillside with slopes ranging from 2% to 4%.

Per a NRCS soil survey, the site is made up of Type A Columbine gravelly sandy loam. Soils were hydraulically analyzed as 90% Type B to account for being disturbed in the proposed condition. The NRCS soil survey is presented in **Appendix A**.

There is one major drainageway through the site. The Gieck Ranch Tributary #2 (MST2 in the MDDP) traverses through the site and divides it in two. The drainageway generally flows from the northwest to the southeast towards Highway 24, before crossing through existing drainage infrastructure. The CLOMR report by HR Green for MST2 is ongoing and pending approval for this channel. Refer to the CLOMR report for more specific design information regarding the MST2 channel. A tributary referred to as the East Fork Tributary (EFT) in the MDDP traverses the site along its northeastern boundary and forms the northeast boundary for Phase 2 along Rex Road. The initial analysis of this drainage way has been performed by HR Green in

conjunction with Phase 2. The analysis delineated the 100-yr floodplain and ensures the construction of Rex Road will not impact the floodplain. This channel will not be disturbed by this phase of development. A CLOMR report is not required by the County at this time.

There are no known irrigation facilities in the area.

There are no known existing utilities or other encumbrances on site.

#### **d. Floodplain Statement**

Based on FEMA Firm map 08041C0552G & 08041C0556G (eff. 12/7/2018), the site contains flood Zone A through the site which is part of the Gieck Ranch Tributary #2. See FEMA Firm Maps in **Appendix A**. This floodplain is being studied and revised in the Gieck Ranch Tributary # 2 CLOMR report. A copy of the current revised floodplain map is also provided in **Appendix A**. There is a Zone A floodplain northeast of the site which will not be altered with this project's improvements.

## **II. Drainage Design Criteria**

### **a. Drainage Criteria**

Temporary sediment basins were sized using tributary area acreages. The three basins are located at future full spectrum detention facility sites and have associated design calculations. Refer to the GEC Plans in the Appendices of the "Grandview Reserve Phase 2 Early Grading (Initial GEC) Stormwater Management Plan (SWMP)" for sediment basin locations and tributary area delineations. Sizing calculations have been provided in Appendix B. The El Paso County standard detail for the temporary sediment basins is included in Appendix C.

This final drainage report follows any recommendations and is in conformance with the previously approved MDDP for the site prepared by HR Green, "*Grandview Reserve Master Development Drainage Plan*", HR Green, November 2020 (MDDP), as well as the in-progress "*Grandview Phase 2 Preliminary Drainage Report*".

## **III. Drainage Basins and Subbasins**

### **a. Major Basin Description**

The site is located within the Gieck Ranch Drainage Basin. The site's drainage characteristics were previously studied in the following reports:

1. "Gieck Ranch Drainage Basin Planning Study" prepared by Drexel, Barrel & Co, February 2010.
2. "Grandview Reserve Master Development Drainage Plan" prepared by HR Green, August 2021.
3. "Grandview Reserve Filing No. 1 Preliminary Drainage Report" prepared by Galloway & Company, Inc., September 2022.
4. "Grandview Reserve CLOMR REPORT" prepared by HR Green, dated April 2024, approved November 15, 2024 (Case #24-08-0102R).
5. "Grandview Reserve Phase 2 Preliminary Drainage Report" prepared by HR Green, January 2025.
6. "Grandview Reserve Phase 2 Early Grading (Initial GEC) Stormwater Management Plan (SWMP)" prepared by HR Green, dated December 2024.

Gieck Ranch Drainage Basin is a 22.05 square mile watershed located in El Paso County, Colorado. Gieck Ranch Drainage Basin is tributary to Black Squirrel Creek which drains to the Arkansas River. The majority of the basin is undeveloped and rolling range land of 2% - 4% slopes.

The Grandview Reserve MDDP divided the site into 8 major drainage basins (A-H), where each basin is tributary to a full spectrum detention pond facility. The Grandview Reserve Phase 2 improvements are located in subbasins B3 and C1 of the MDDP.

There are no known existing irrigation facilities or other obstructions that could influence or will be influenced by local drainage characteristics. Early Grading local drainage characteristics will continue to follow historic patterns.

## **b. Existing Subbasin Description**

The Grandview Reserve Phase 2 site drains from the northwest to the southeast slopes ranging from 2% - 4%. The site has historically drained into the Gieck Ranch Tributary #2 (the existing MST2).

The existing subbasins for the Grandview Reserve Phase 2 site were studied the approved MDDP for Grandview Reserve. This site is located within subbasins B3 and C1 of this report and are described as follows.

“Subbasin B3 is located between MS and EF and to the northeast of east of basin B2. The existing MST2 tributary runs through the basin. The site drains towards the southeast and towards Detention Pond B. Current planning documents call for high, medium-high, and medium density dwelling units along with a pocket park. The basin is 118.90 acres, with a composite impervious value of 49.42% and runoff rates for the 5 and 100 year of 92.76 cfs and 295.27 cfs respectively.”

“Subbasin C1 is located to the northeast of east of basin B1 and the existing MST2 tributary runs through the middle of the basin. The basin drains towards the southeast and towards Detention Pond C. Current planning documents call for an institutional parcel, medium and high-density dwelling units and a pocket park. The basin is 77.83 acres, with a composite impervious value of 51.20% and runoff rates for the 5 and 100-year of 77.99 cfs and 238.03 cfs respectively.”

Refer to the Appendices for a copy of the approved MDDP. The Early Grading drainage conditions for this development will follow historic drainage patterns as described in the MDDP.

## **c. Early Grading Subbasin Description**

### **Description of Early Grading Project**

The early grading drainage conditions for the site generally follow historic drainage patterns. The site drains from the northwest to the southeast at slopes between 0.6% - 4%, into proposed undercut roadway networks which drain to proposed temporary sedimentation basins for treatment and flood attenuation. Refer to the “Grandview Reserve Phase 2 Early Grading (Initial GEC) Stormwater Management Plan (SWMP)” for a description of construction practices utilized to mitigate erosion and sediment transport potential in this condition.

The central western corner of the site (31.5 tributary acres) will drain to and be treated by “Temporary Sediment Basin A” (Future FSD Pond A), which will outfall into the rerouted channel MST2, henceforth being referred to as “Channel B.” The outfall for this temporary pond directly corresponds to the future planned outfall for Full Spectrum Pond A. Historically, the tributary areas to this pond discharge to Channel B.

Discharge from the future, developed condition of the Full Spectrum Detention facility has been accounted for in the channel re-alignment design and is detailed in the CLOMR report.

The southwestern portion of the site (36.6 tributary acres) will drain to and be treated by “Temporary Sediment Basin B” (Future Pond B). The sediment basin will outfall into the rerouted Channel B. Historically, the tributary areas to this pond discharge to Channel B. Discharge from the future, developed condition of the Full Spectrum Detention facility has been accounted for in the channel re-alignment design and is detailed in the CLOMR report.

The northeastern portion of the site (36.6 tributary acres) will drain to and be treated by “Temporary Sediment Basin C” (Future Pond C). The sediment basin will outfall into an undercut roadway, where it will then be conveyed via the road to Temporary Sediment Basin B, ultimately discharging into the rerouted Channel B. Historically, the tributary areas to this pond discharge to Channel B.

Sediment basin sizing calculations are provided in Appendix B. Refer to the Early Grading Plans in the Appendices of “Grandview Reserve Phase 2 Early Grading (Initial GEC) Stormwater Management Plan (SWMP)” for temporary sediment basin locations and tributary area delineation.

There are minor offsite flows from Phase 2 that discharge to the Phase 3 site which are accounted for. Refer to the Preliminary Drainage Report for Future Subbasin Descriptions under the fully developed condition of this site. Refer to the Preliminary Drainage Report for Phase 3 for a detailed description of how offsite flows from Phase 2 are conveyed through the site.

## IV. Drainage Facility Design

### a. General Concept

Two of the three temporary sediment basins will be converted into Full Spectrum Detention facilities upon final buildout of this development (Temporary Sediment Basin A and Temporary Sediment Basin B). Refer to “Grandview Reserve Phase 2 Preliminary Drainage Report” prepared by HR Green, dated January 2025, for hydraulic designs for these ponds.

### b. Water Quality & Detention

Refer to the Preliminary Drainage Report for a full description of the two private Full Spectrum Detention facilities that will be utilized for water quality treatment and detention.

### c. Channel Improvements

The Gieck Ranch Tributary #2 is proposed to be rerouted. As part of this rerouting of the channel, offsite upstream tributary flows will be captured upstream from the proposed Rex Road extension and be conveyed via culvert to the rerouted channel along the Grandview Reserve Phase 2 western boundary. An analysis has been done for the channel with both existing and future condition flows as described within the approved Grandview Reserve CLOMR Report, HR Green; dated April 2024; approved November 15, 2024 (Case #24-08-0102R) (CLOMR). Both scenarios throughout the channel fall within the channel stability criteria. Channel improvement construction plans have been submitted to El Paso County for review as a separate project (#CDR228).

### d. Inspection and Maintenance

After completion of construction and upon the Board of County Commissioners acceptance, it is anticipated that all drainage facilities within the public Right-of-Way are to be owned and maintained by El Paso County.

All future private detention ponds are to be owned and maintained by the Grandview Reserve Metropolitan District NO. 2 (DISTRICT), once established, unless an agreement is reached stating otherwise. Maintenance access for all future full spectrum detention facilities will be provided from public Right-of-Way. Maintenance access for the drainageways will be provided through the future tracts.

## V. Wetlands Mitigation

There is one existing wetlands on site associated with the Gieck Ranch Tributary #2. The wetlands are contained within the existing channel and classified as non-jurisdictional. The wetlands USACE determination will be provided with the Grandview Reserve CLOMR Report, HR Green; April 2022, which can be found in **the Preliminary Drainage Report appendices**. Wetlands maintenance will be the responsibility of the Grandview Reserve Metropolitan District No. 2.

## VI. Four Step Method to Minimize Adverse Impacts of Urbanization

The four step will be implemented upon urbanization of this development as described in the future, final buildout condition of the Preliminary Drainage Report.

## VII. Drainage and Bridge Fees

Gieck Ranch drainage basin has not been established as a fee basin within El Paso County. Therefore, no drainage basin fees are due at time of platting.

## VIII. Opinion of Probable Cost

An engineer's opinion of probable cost will be provided with the Final Drainage Report (FDR) describing the future, full-buildout condition of the Phase 2 development.

## IX. Hydraulic Grade Line Analysis

Hydraulic grade line analysis and final pipe sizes will be provided with the Final Drainage Report (FDR) describing the future, full-buildout condition of the Phase 2 development.

## X. Summary

The Grandview Reserve Phase 2 site lies within the Gieck Ranch Drainage Basin. Water quality and detention for the site is provided in future full spectrum water quality and detention ponds. There is one major drainageway that traverses the site: Gieck Ranch Tributary #2. The future water quality and detention features ponds will be maintained by the Grandview Reserve Metropolitan District No. 2 (DISTRICT). The Early Grading described in this report will establish four temporary sediment basins to detain and mitigate negative impacts associated with these grading efforts. The associated SWMP report for the early grading describes construction practices that will be utilized to achieve this goal. All Early Grading and future drainage facilities were sized per the El Paso County Drainage Criteria Manuals.

The development of this project will not adversely affect adjacent or downstream properties.



## XI. Drawings

Refer to Appendix A for associated maps. Refer to the “Grandview Reserve Phase 2 Early Grading (Initial GEC) Stormwater Management Plan (SWMP)” for sediment basin locations, sizing information, and tributary area delineation.

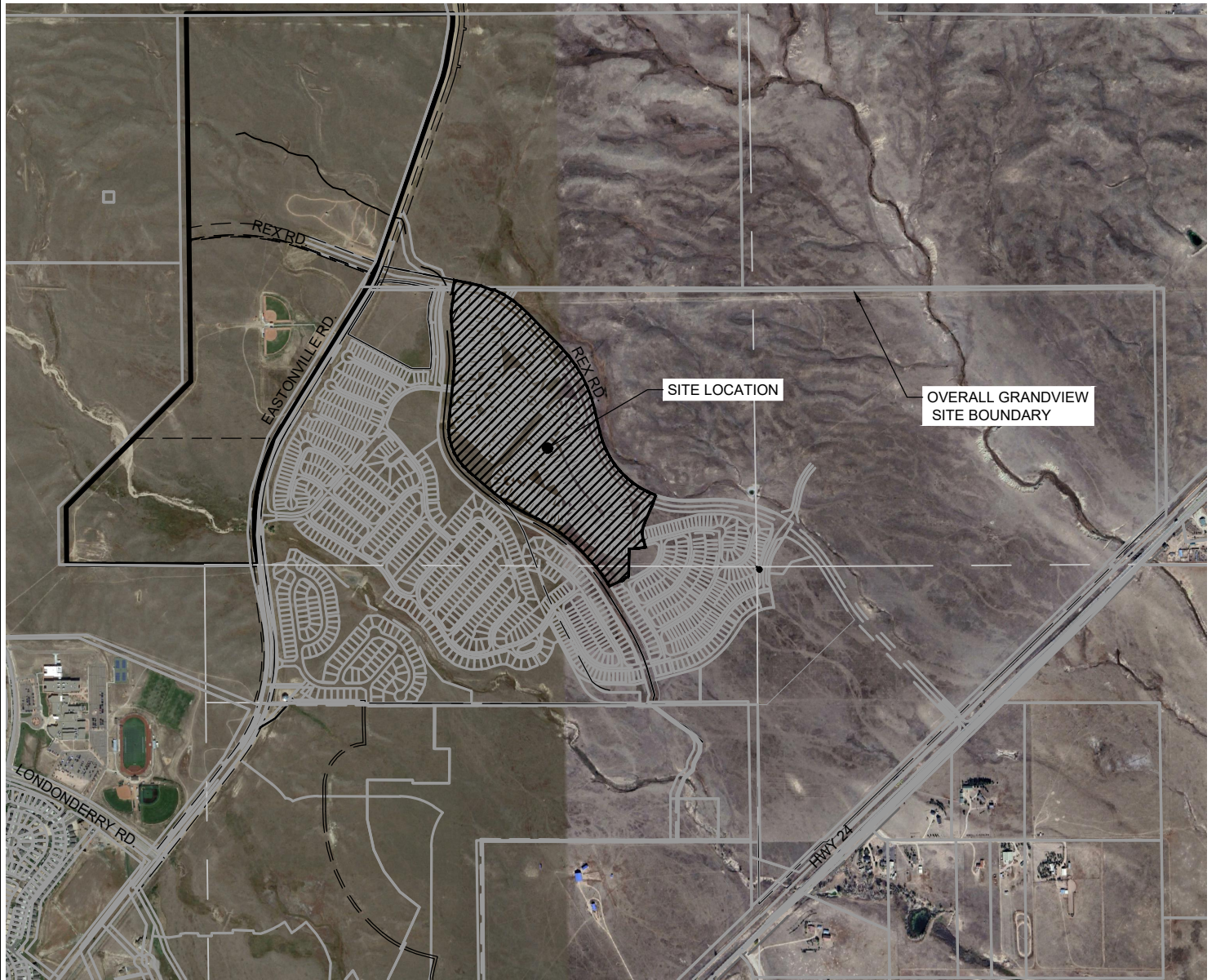
## XII. References

1. City of Colorado Springs – Drainage Criteria Manual, May 2014, Revised January 2021.
2. Drainage Criteria Manual of El Paso, Colorado, October 2018.
3. Urban Storm Drainage Criteria Manual, Urban Drainage Flood Control District, January 2018.
4. “Gieck Ranch Drainage Basin Planning Study” prepared by Drexel, Barrel & Co, February 2010.
5. “Grandview Reserve Master Development Drainage Plan” prepared by HR Green, August 2021.
6. “Grandview Reserve Filing No. 1 Preliminary Drainage Report” prepared by Galloway & Company, Inc., September 2022.
7. “Grandview Reserve CLOMR REPORT” prepared by HR Green, dated April 2024, approved November 15, 2024 (Case #24-08-0102R).
8. “Grandview Reserve Phase 2 Preliminary Drainage Report” prepared by HR Green, January 2025.
9. “Grandview Reserve Phase 2 Early Grading (Initial GEC) Stormwater Management Plan (SWMP)” prepared by HR Green, dated December 2024.



## **APPENDIX A – VICINITY MAP, SOIL MAP, FEMA MAP**

Xrefs: 01-DV-CONCEPT; xc-row-GVR-all; xc-row-F1-662.10; xc-row-F2; xc-row-F3; xc-row-F4; xc-filling-bndys; xc-row\_662.08\_Eastonville; xc-row-PH3; xc-row-PH2; xc-row-Fut\_Phase; 01-XC-channel; xv-row-662; xc-



HRGreen.com

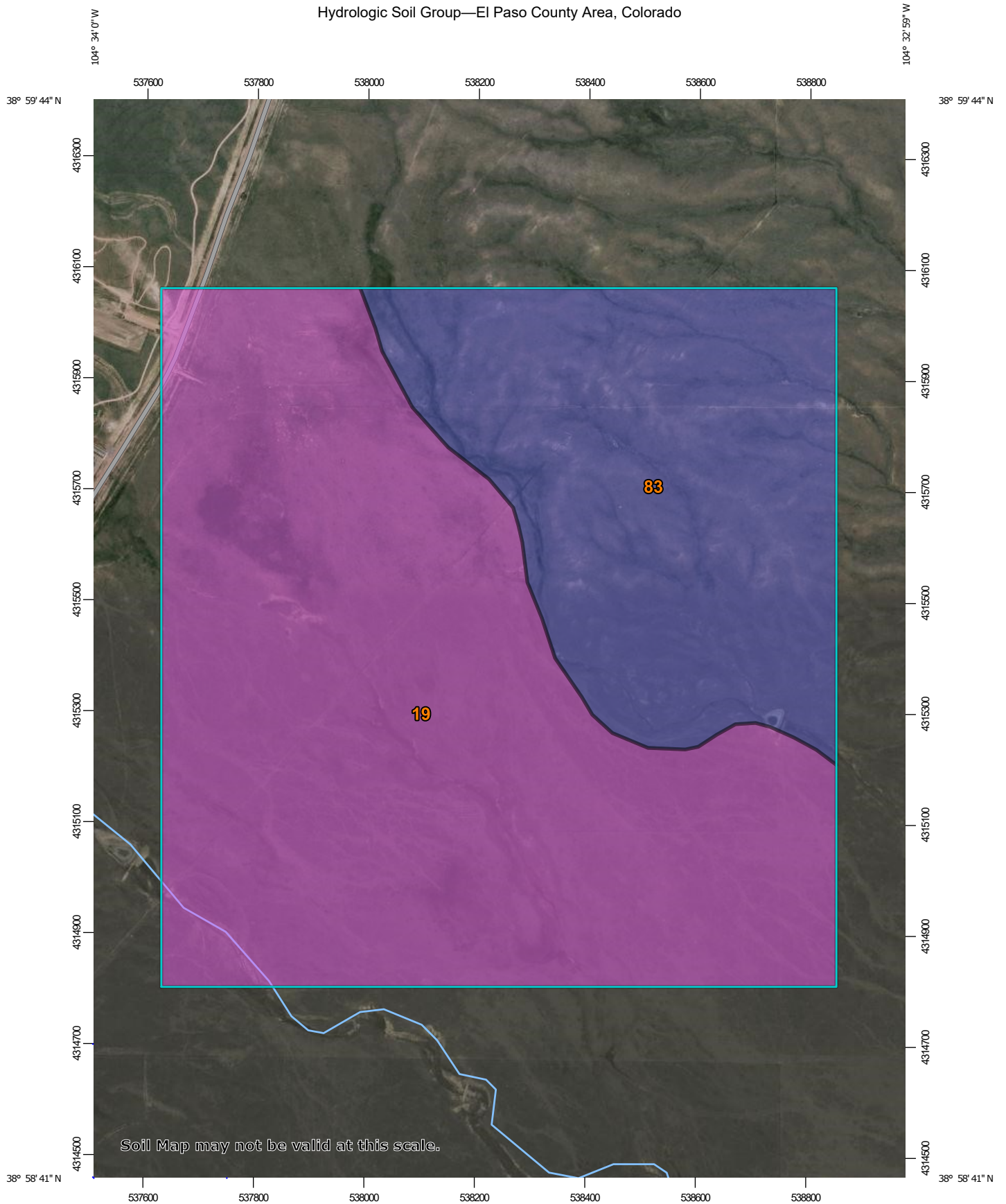
# GRANDVIEW RESERVE

VICINITY MAP

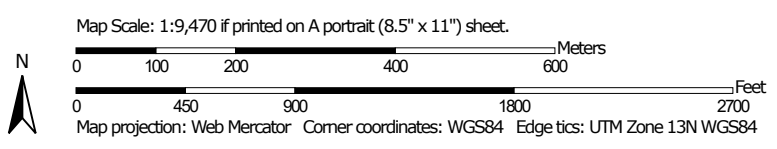
SHEET  
01

SCALE: 1" = 1500'  
DATE: 10/30/24

Hydrologic Soil Group—El Paso County Area, Colorado




Soil Map may not be valid at this scale.



### MAP LEGEND

**Area of Interest (AOI)**









 Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**





-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

**Soil Rating Lines**

-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

**Soil Rating Points**






-  A
-  A/D
-  B
-  B/D

-  C
-  C/D
-  D
-  Not rated or not available

**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 20, Sep 2, 2022

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

Date(s) aerial images were photographed: Sep 11, 2018—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.

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	254.0	66.5%
83	Stapleton sandy loam, 3 to 8 percent slopes	B	127.8	33.5%
<b>Totals for Area of Interest</b>			<b>381.8</b>	<b>100.0%</b>

### Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method: Dominant Condition*

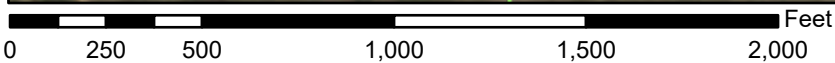
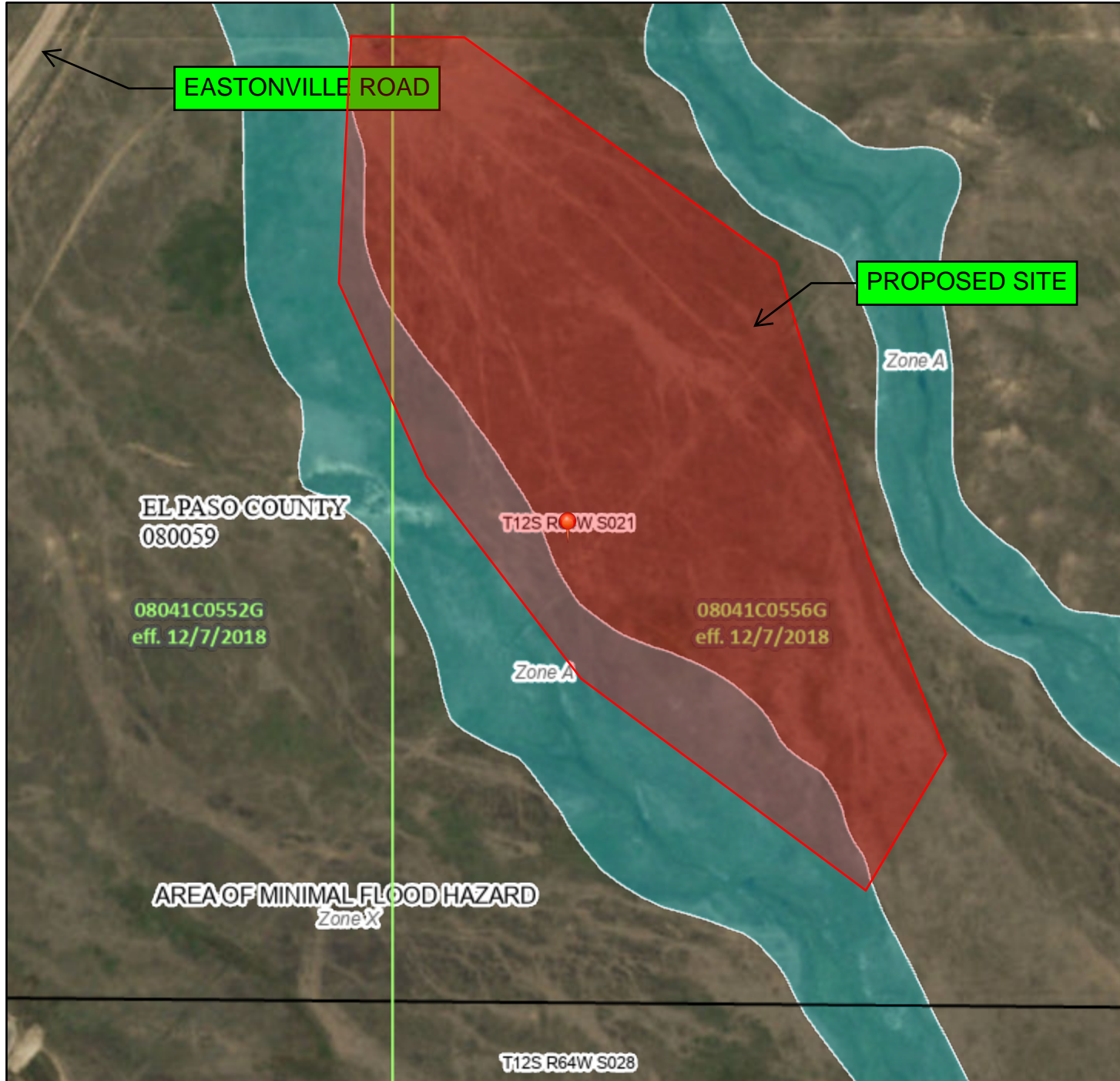
*Component Percent Cutoff: None Specified*

*Tie-break Rule: Higher*

# National Flood Hazard Layer FIRMette



104°33'58"W 38°59'28"N



1:6,000

104°33'20"W 38°59'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) <i>Zone A, V, A99</i>
		With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i>
		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 <i>Zone X</i>
		Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i>
		Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i>
		Area with Flood Risk due to Levee <i>Zone D</i>

OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard <i>Zone D</i>
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall

OTHER AREAS		Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard <i>Zone D</i>
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall

OTHER AREAS		Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard <i>Zone D</i>
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall

OTHER FEATURES		Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
		Area of Undetermined Flood Hazard <i>Zone D</i>
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall

OTHER FEATURES		Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
		Area of Undetermined Flood Hazard <i>Zone D</i>
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall

OTHER FEATURES		Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
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		Effective LOMRs
		Area of Undetermined Flood Hazard <i>Zone D</i>
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall

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 **12/14/2023 at 12:16 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 B – HYDRAULIC CALCULATIONS**

**SEDIMENT BASIN A - POND A**  
**SEDIMENT BASIN STAGE-STORAGE CALCULATIONS**

Elevation	Area	Area	Volume	Volume	Cumm Vol	Cumm Vol	Proration	Proration	Elev.
	S.F.	Acre	Cu. Ft.	Acre-Ft	Cu. Ft.	Acre-Ft	Enter Vol.	Enter Vol.	ft.
							in Cu-Ft*	in Acre-Ft*	
6966.5	0								
6967.0	592		99		99	0.002			
6968.0	11497		4,899		4,998	0.115	20,597	0.473	6,968.89
6969.0	24552		17,617		22,615	0.519			
6970.0	34874		29,562		52,177	1.198	61,792	1.419	6,970.24
6971.0	44697		39,684		91,862	2.109			
6972.0	53878		49,216		141,078	3.239			
6973.0	62472		58,122		199,200	4.573			
6974.0									
6975.0									
6976.0									
6977.0									
6978.0									
6979.0									
6980.0									
6981.0									
6982.0									
6983.0									
6984.0									
6985.0									
6986.0									
6987.0									

COLUMN 1	COLUMN 2	CENTROID EL.
ORIFICE 1-1	ORIFICE 1-2	6,968.89
ORIFICE 2-1	ORIFICE 2-2	6,969.22
ORIFICE 3-1	ORIFICE 3-2	6,969.55
ORIFICE 4-1	ORIFICE 4-2	6,969.88

SED Basin riser pipe orifice calculations		
$A_0 =$		area per row of orifices spaced on 4" centers (in <sup>2</sup> )
$V =$	1.4185	design volume (acre feet) * < 15 ac.
$T_0 =$	72	time to drain the prescribed volume (hrs) (Typically 72 hours for EURV)
$H =$	1.357	depth of volume (ft)
$S =$	0.0001	Trickel channel slope (ft/ft) [Use 0.0001 for flat slope]
		$S = 0\%$
$A_0 =$	3.6810 in <sup>2</sup>	3.6702 in <sup>2</sup>
$Dia =$	2.16 in	*EXCEEDS 1", USE TWO COLUMNS @ $A_0 = 1.86$ in <sup>2</sup>
	4.32	Dia = /2      1.86 in <sup>2</sup> = 1-9/16 in. dia.
	8.65	Dia = /4
	17.29	Dia = /8
	34.59	Dia = /16
	69.18	Dia = /32

SEDIMENT VOLUME CALCULATIONS			
Disturbed area-acres	20.810	Acre	
Undisturbed area-acres	11.210	Acre	
Total Area-acres	32.020	Acre	
Sediment volume	61,792	cu-ft	1.4185 Acres-ft
Volume below lowest hole	20,597	cu-ft	0.4728 Acres-ft
Volume above lowest hole	61,792	cu-ft	1.4185 Acres-ft
Total Volume	82,369	cu-ft	1.8909 Acres-ft

**Note:** Enter values in highlighted cells only.

**SEDIMENT BASIN B - POND B**  
**SEDIMENT BASIN STAGE-STORAGE CALCULATIONS**

Elevation	Area S.F.	Area Acre	Volume Cu. Ft.	Volume Acre-Ft	Cumm Vol Cu. Ft.	Cumm Vol Acre-Ft	Proration Enter Vol. in Cu-Ft*	Proration Enter Vol. in Acre-Ft*	Elev. Cu-Ft
6932.0	0								
6933.0	17869		5,961		5,961	0.137	23,575		6,933.73
6934.0	30861		24,071		30,032	0.689			
6935.0	34515		32,671		62,703	1.439	70,724		6,935.22
6936.0	38511		36,495		99,198	2.277			
6937.0	42664		40,570		139,767	3.209			
6938.0	46975		44,802		184,570	4.237			
6939.0	51087		49,017		233,586	5.362			
6940.0									
6941.0									
6942.0									
6943.0									
6944.0									
6945.0									
6946.0									
6947.0									
6948.0									
6949.0									
6950.0									
6951.0									
6952.0									
6953.0									

COLUMN 1	COLUMN 2	CENTROID EL.
ORIFICE 1-1	ORIFICE 1-2	6,933.73
ORIFICE 2-1	ORIFICE 2-2	6,934.06
ORIFICE 3-1	ORIFICE 3-2	6,934.39
ORIFICE 4-1	ORIFICE 4-2	6,934.72
ORIFICE 5-1	ORIFICE 5-2	6,935.05

SED Basin riser pipe orifice calculations		
$A_0$ =	area per row of orifices spaced on 4" centers (in <sup>2</sup> )	
V=	1.6236 design volume (acre feet) * <15 ac.	
$T_0$ =	72 time to drain the prescribed volume (hrs) (Typically 72 hours for EURV)	
H=	1.488 depth of volume (ft)	
S=	0.0001 Trickle channel slope (ft/ft) [Use 0.0001 for flat slope]	
		S=0%
$A_0$ =	4.0940 in <sup>2</sup>	4.0819 in <sup>2</sup>
Dia	2.28 in	*EXCEEDS 1", USE TWO COLUMNS @ $A_0=2.05$ in <sup>2</sup>
	4.56	Dia=2 2.05 in <sup>2</sup> = 1-5/8" Dia.
	9.12	Dia=4
	18.24	Dia=8
	36.48	Dia=16
	72.95	Dia=32

SEDIMENT VOLUME CALCULATIONS			
Disturbed area-acres	23.820	Acre	
Undisturbed area-acres	12.820	Acre	
Total Area-acres	36.640	Acre	
Sediment volume	70,724	cu-ft	1.6236 Acres-ft
Volume below lowest hole	23,575	cu-ft	0.5412 Acres-ft
Volume above lowest hole	70,724	cu-ft	1.6236 Acres-ft
Total Volume	94,275	cu-ft	2.1643 Acres-ft

Note: Enter values in highlighted cells only.

**SEDIMENT BASIN C**  
**SEDIMENT BASIN STAGE-STORAGE CALCULATIONS**

Elevation	Area S.F.	Area Acre	Volume Cu. Ft.	Volume Acre-Ft	Cumm Vol Cu. Ft.	Cumm Vol Acre-Ft	Proration Enter Vol. in Cu-Ft*	Proration Enter Vol. in Acre-Ft*	Elev. Cu-Ft
6942.5	0								
6943.0	4181		698		698	0.016			
6944.0	7102		5,577		6,275	0.144			
6945.0	8602		7,840		14,115	0.324	15,810		6,945.18
6946.0	10225		9,402		23,517	0.540	31,620		6,946.74
6947.0	11766		10,986		34,504	0.792			
6943.5									
6944.5									
6945.5									
6946.5									
6947.5									
6948.5									
6949.5									
6950.5									
6951.5									
6952.5									
6953.5									
6954.5									
6955.5									
6956.5									
6957.5									
6958.5									

COLUMN 1	COLUMN 2	CENTROID EL.
ORIFICE 1-1	ORIFICE 1-2	6,945.18
ORIFICE 2-1	ORIFICE 2-2	6,945.51
ORIFICE 3-1	ORIFICE 3-2	6,945.84
ORIFICE 4-1	ORIFICE 4-2	6,946.17
ORIFICE 5-1	ORIFICE 5-2	6,946.50

SED Basin riser pipe orifice calculations			
$A_0 =$			area per row of orifices spaced on 4" centers (in <sup>2</sup> )
V=	0.3629		design volume (acre feet) * <15 ac.
$T_0 =$	72		time to drain the prescribed volume (hrs) (Typically 72 hours for EURV)
H=	1.557		depth of volume (ft)
S=	0.0001		Trickel channel slope (ft/ft) [Use 0.0001 for flat slope]
			S=0%
$A_0 =$	1.0301	in <sup>2</sup>	1.0271 in <sup>2</sup>
Dia	1.14	in	*EXCEEDS 1", USE TWO COLUMNS @ $A_0=1.027$ in <sup>2</sup>
	2.29		Dia=/2 Area of 0.51 in <sup>2</sup> = Dia. Of 0.8" =13/16"
	4.57		Dia=/4
	9.15		Dia=/8
	18.30		Dia=/16
	36.59		Dia=/32

SEDIMENT VOLUME CALCULATIONS			
Disturbed area-acres	8.200	Acres	
Undisturbed area-acres	4.200	Acres	
Total Area-acres	12.400	Acres	
Sediment volume	31,620	cu-ft	0.7259 Acres-ft
Volume below lowest hole	15,810	cu-ft	0.3629 Acres-ft
Volume above lowest hole	15,810	cu-ft	0.3629 Acres-ft
Total Volume	31,620	cu-ft	0.7259 Acres-ft

Note: Enter values in highlighted cells only.

<u>BMP FEATURE</u>	<u>TOTAL TRIBUTARY AREA (AC)</u>	<u>DISTURBED AREA (AC)</u>	<u>UNDISTURBED AREA (AC)</u>	<u>BOTTOM SIZE (FT)</u>	<u>SEDIMENT VOLUME (AC-FT)</u>	<u>BASIN VOLUME (AC-FT)</u>	<u>BOTTOM ELEVATION</u>	<u>CREST ELEVATION</u>	<u>CREST WxL (FT)</u>	<u>TOP OF POND ELEVATION</u>	<u>LOWEST ORIFICE ELEVATION</u>	<u>AREA OF ORIFICES (SQ IN)</u>	<u># OF ORIFICE COLUMNS</u>	<u>DIA. OF ORIFICES</u>	<u>RISER PIPE INVERT</u>	<u>DAYLIGHT ELEVATION</u>	<u>OUTLET PIPE LENGTH (FT)</u>	<u>OUTLET PIPE SLOPE</u>
SB-A	32.02	20.81	11.21	400' x 140'	1.42	4.57	6966.50	6971.50	60' x 40'	6973.00	6968.89	1.86	2	1-9/16"	6967.56	6964.75	65	4.3%
SB-B	36.64	23.82	12.82	115' x 260'	1.62	5.36	6932.00	6939.00	77.5' x 40'	6939.00	6933.73	2.05	2	1-5/8"	6932.40	6929.20	72	4.4%
SB-C	12.40	8.20	4.20	85' x 124'	0.73	0.79	6942.50	6946.50	18' x 15'	6947.00	6945.18	0.51	2	13/16"	6943.85	6942.00	50	3.7%



## **APPENDIX C – STANDARD DETAILS**

## Description

A sediment basin is a temporary pond built on a construction site to capture eroded or disturbed soil transported in storm runoff prior to discharge from the site. Sediment basins are designed to capture site runoff and slowly release it to allow time for settling of sediment prior to discharge. Sediment basins are often constructed in locations that will later be modified to serve as post-construction stormwater basins.



**Photograph SB-1.** Sediment basin at the toe of a slope. Photo courtesy of WWE.

## Appropriate Uses

Most large construction sites (typically greater than 2 acres) will require one or more sediment basins for effective management of construction site runoff. On linear construction projects, sediment basins may be impractical; instead, sediment traps or other combinations of BMPs may be more appropriate.

Sediment basins should not be used as stand-alone sediment controls. Erosion and other sediment controls should also be implemented upstream.

When feasible, the sediment basin should be installed in the same location where a permanent post-construction detention pond will be located.

## Design and Installation

The design procedure for a sediment basin includes these steps:

- **Basin Storage Volume:** Provide a storage volume of at least 3,600 cubic feet per acre of drainage area. To the extent practical, undisturbed and/or off-site areas should be diverted around sediment basins to prevent “clean” runoff from mixing with runoff from disturbed areas. For undisturbed areas (both on-site and off-site) that cannot be diverted around the sediment basin, provide a minimum of 500 ft<sup>3</sup>/acre of storage for undeveloped (but stable) off-site areas in addition to the 3,600 ft<sup>3</sup>/acre for disturbed areas. For stable, developed areas that cannot be diverted around the sediment basin, storage volume requirements are summarized in Table SB-1.
- **Basin Geometry:** Design basin with a minimum length-to-width ratio of 2:1 (L:W). If this cannot be achieved because of site space constraints, baffling may be required to extend the effective distance between the inflow point(s) and the outlet to minimize short-circuiting.
- **Dam Embankment:** It is recommended that embankment slopes be 4:1 (H:V) or flatter and no steeper than 3:1 (H:V) in any location.

Sediment Basins	
Functions	
Erosion Control	No
Sediment Control	Yes
Site/Material Management	No

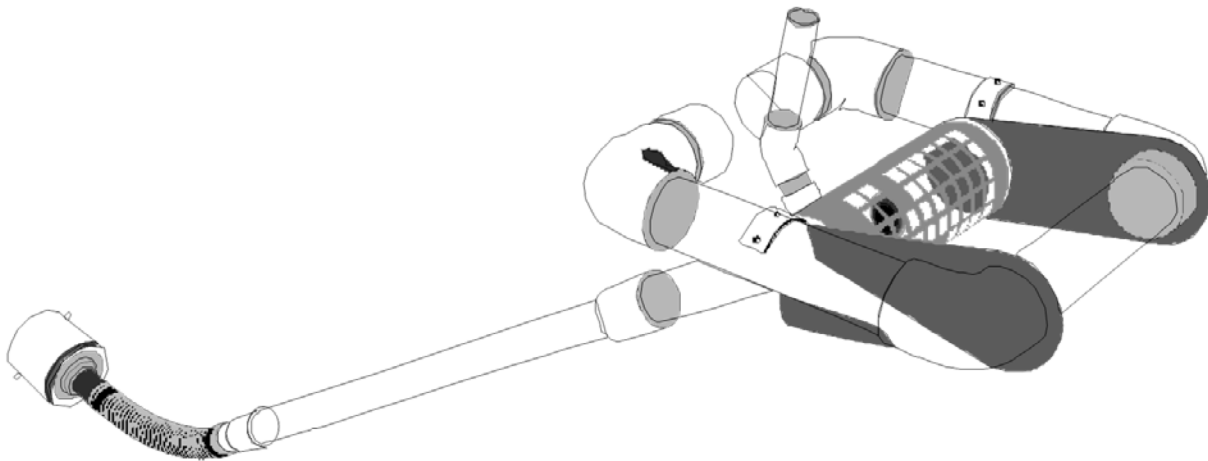
- **Inflow Structure:** For concentrated flow entering the basin, provide energy dissipation at the point of inflow.

**Table SB-1. Additional Volume Requirements for Undisturbed and Developed Tributary Areas Draining through Sediment Basins**

Imperviousness (%)	Additional Storage Volume (ft <sup>3</sup> ) Per Acre of Tributary Area
Undeveloped	500
10	800
20	1230
30	1600
40	2030
50	2470
60	2980
70	3560
80	4360
90	5300
100	6460

- **Outlet Works:** The outlet pipe shall extend through the embankment at a minimum slope of 0.5 percent. Outlet works can be designed using one of the following approaches:
  - **Riser Pipe (Simplified Detail):** Detail SB-1 provides a simplified design for basins treating no more than 15 acres.
  - **Orifice Plate or Riser Pipe:** Follow the design criteria for Full Spectrum Detention outlets in the EDB Fact Sheet provided in Chapter 4 of this manual for sizing of outlet perforations with an emptying time of approximately 72 hours. In lieu of the trash rack, pack uniformly sized 1½ - to 2-inch gravel in front of the plate or surrounding the riser pipe. This gravel will need to be cleaned out frequently during the construction period as sediment accumulates within it. The gravel pack will need to be removed and disposed of following construction to reclaim the basin for use as a permanent detention facility. If the basin will be used as a permanent extended detention basin for the site, a trash rack will need to be installed once contributing drainage areas have been stabilized and the gravel pack and accumulated sediment have been removed.
  - **Floating Skimmer:** If a floating skimmer is used, install it using manufacturer’s recommendations. Illustration SB-1 provides an illustration of a Faircloth Skimmer Floating Outlet™, one of the more commonly used floating skimmer outlets. A skimmer should be designed to release the design volume in no less than 48 hours. The use of a floating skimmer outlet can increase the sediment capture efficiency of a basin significantly. A floating outlet continually decants cleanest water off the surface of the pond and releases cleaner water than would discharge from a perforated riser pipe or plate.





**Illustration SB-1.** Outlet structure for a temporary sediment basin - Faircloth Skimmer Floating Outlet. Illustration courtesy of J. W. Faircloth & Sons, Inc., FairclothSkimmer.com.

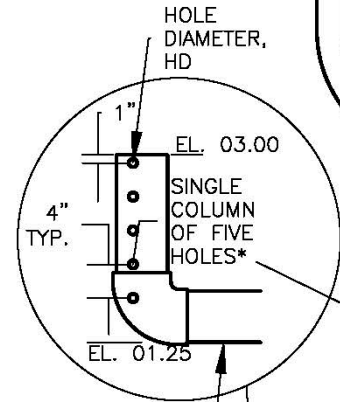
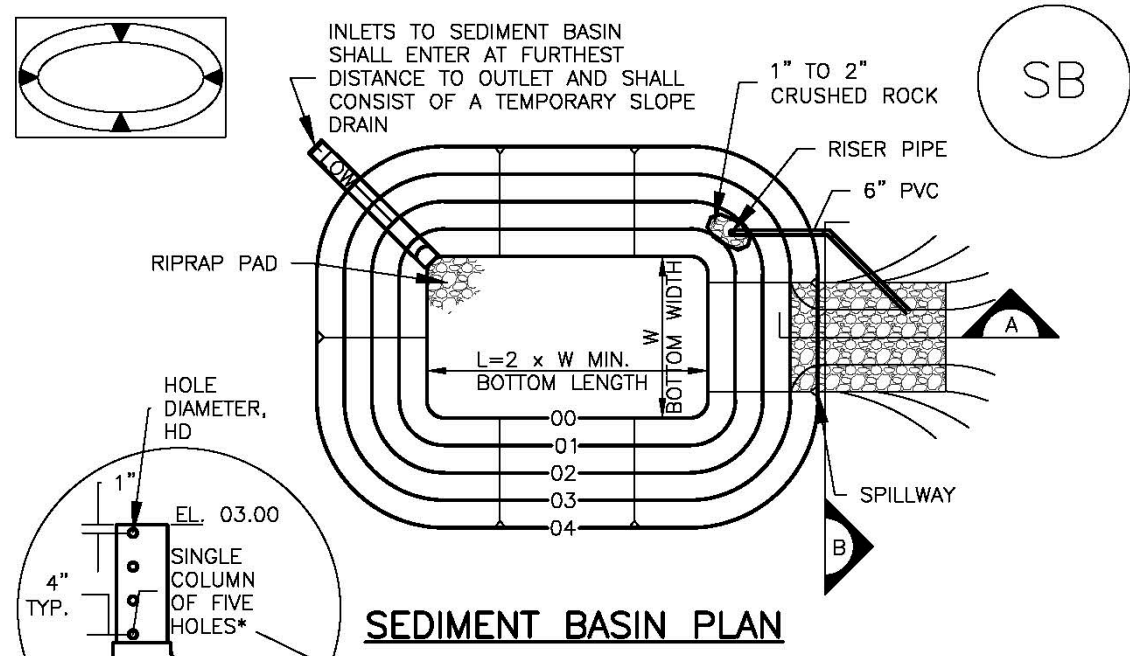
- **Outlet Protection and Spillway:** Consider all flow paths for runoff leaving the basin, including protection at the typical point of discharge as well as overtopping.
  - **Outlet Protection:** Outlet protection should be provided where the velocity of flow will exceed the maximum permissible velocity of the material of the waterway into which discharge occurs. This may require the use of a riprap apron at the outlet location and/or other measures to keep the waterway from eroding.
  - **Emergency Spillway:** Provide a stabilized emergency overflow spillway for rainstorms that exceed the capacity of the sediment basin volume and its outlet. Protect basin embankments from erosion and overtopping. If the sediment basin will be converted to a permanent detention basin, design and construct the emergency spillway(s) as required for the permanent facility. If the sediment basin will not become a permanent detention basin, it may be possible to substitute a heavy polyvinyl membrane or properly bedded rock cover to line the spillway and downstream embankment, depending on the height, slope, and width of the embankments.

## Maintenance and Removal

Maintenance activities include the following:

- Dredge sediment from the basin, as needed to maintain BMP effectiveness, typically when the design storage volume is no more than one-third filled with sediment.
- Inspect the sediment basin embankments for stability and seepage.
- Inspect the inlet and outlet of the basin, repair damage, and remove debris. Remove, clean and replace the gravel around the outlet on a regular basis to remove the accumulated sediment within it and keep the outlet functioning.
- Be aware that removal of a sediment basin may require dewatering and associated permit requirements.
- Do not remove a sediment basin until the upstream area has been stabilized with vegetation.

Final disposition of the sediment basin depends on whether the basin will be converted to a permanent post-construction stormwater basin or whether the basin area will be returned to grade. For basins being converted to permanent detention basins, remove accumulated sediment and reconfigure the basin and outlet to meet the requirements of the final design for the detention facility. If the sediment basin is not to be used as a permanent detention facility, fill the excavated area with soil and stabilize with vegetation.



\*EXCEPT WHERE THE HOLES EXCEED 1" DIAMETER, THEN UP TO TWO COLUMNS OF SAME SIZED HOLES MAY BE USED

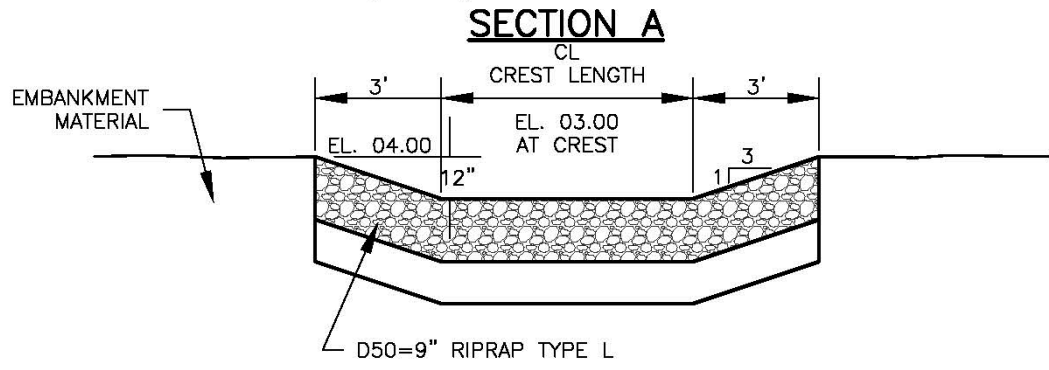
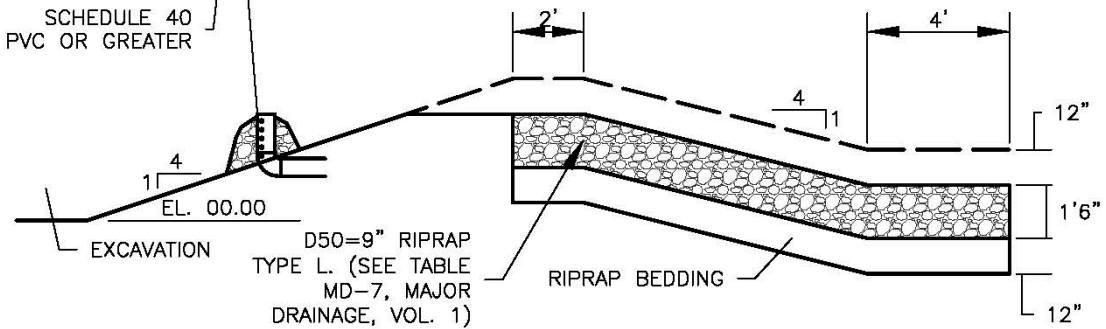


TABLE SB-1. SIZING INFORMATION FOR STANDARD SEDIMENT BASIN			
Upstream Drainage Area (rounded to nearest acre), (ac)	Basin Bottom Width (W), (ft)	Spillway Crest Length (CL), (ft)	Hole Diameter (HD), (in)
1	12 1/2	2	9/32
2	21	3	13/16
3	28	5	1/2
4	33 1/2	6	9/16
5	38 1/2	8	2 1/32
6	43	9	2 1/32
7	47 1/4	11	2 5/32
8	51	12	2 7/32
9	55	13	7/8
10	58 1/4	15	1 5/16
11	61	16	3 1/32
12	64	18	1
13	67 1/2	19	1 1/16
14	70 1/2	21	1 1/8
15	73 1/4	22	1 3/16

SEDIMENT BASIN INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
  - LOCATION OF SEDIMENT BASIN.
  - TYPE OF BASIN (STANDARD BASIN OR NONSTANDARD BASIN).
  - FOR STANDARD BASIN, BOTTOM WIDTH W, CREST LENGTH CL, AND HOLE DIAMETER, HD.
  - FOR NONSTANDARD BASIN, SEE CONSTRUCTION DRAWINGS FOR DESIGN OF BASIN INCLUDING RISER HEIGHT H, NUMBER OF COLUMNS N, HOLE DIAMETER HD AND PIPE DIAMETER D.
2. FOR STANDARD BASIN, BOTTOM DIMENSION MAY BE MODIFIED AS LONG AS BOTTOM AREA IS NOT REDUCED.
3. SEDIMENT BASINS SHALL BE INSTALLED PRIOR TO ANY OTHER LAND-DISTURBING ACTIVITY THAT RELIES ON ON BASINS AS AS A STORMWATER CONTROL.
4. EMBANKMENT MATERIAL SHALL CONSIST OF SOIL FREE OF DEBRIS, ORGANIC MATERIAL, AND ROCKS OR CONCRETE GREATER THAN 3 INCHES AND SHALL HAVE A MINIMUM OF 15 PERCENT BY WEIGHT PASSING THE NO. 200 SIEVE.
5. EMBANKMENT MATERIAL SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D698.
6. PIPE SCH 40 OR GREATER SHALL BE USED.
7. THE DETAILS SHOWN ON THESE SHEETS PERTAIN TO STANDARD SEDIMENT BASIN(S) FOR DRAINAGE AREAS LESS THAN 15 ACRES. SEE CONSTRUCTION DRAWINGS FOR EMBANKMENT, STORAGE VOLUME, SPILLWAY, OUTLET, AND OUTLET PROTECTION DETAILS FOR ANY SEDIMENT BASIN(S) THAT HAVE BEEN INDIVIDUALLY DESIGNED FOR DRAINAGE AREAS LARGER THAN 15 ACRES.

## SEDIMENT BASIN MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. SEDIMENT ACCUMULATED IN BASIN SHALL BE REMOVED AS NEEDED TO MAINTAIN BMP EFFECTIVENESS, TYPICALLY WHEN SEDIMENT DEPTH REACHES ONE FOOT (I.E., TWO FEET BELOW THE SPILLWAY CREST).
5. SEDIMENT BASINS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND GRASS COVER IS ACCEPTED BY THE LOCAL JURISDICTION.
6. WHEN SEDIMENT BASINS ARE REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.



## **APPENDIX D**



# Grandview Reserve Master Development Drainage Plan

November 2020

HR Green Project No: 191850

**Prepared For:**

4 SITE INVESTMENTS, LLC  
Mr. Peter Martz or Paul Howard  
1271 Kelly Johnson Blvd., Ste. 100  
Colorado Springs, CO 80920  
719-499-8416

**Prepared By:**

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720-602-4956



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## Engineer's Statement

This report and plan for the drainage design of the development , Grandview Reserve, was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the *El Paso County Drainage Criteria* Manual and is in conformity with the master plan of the drainage basin. I understand that El Paso County does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

11-3-20

Greg Panza, PE

Date

State of Colorado No. 37081

For and on behalf of HR Green Development, LLC



## Developer's Statement

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

4 Site Investments LLC

By:

PAUL J. HOWARD

Title:

MANAGER

Address:

1271 KEVIN JOHNSON BLVD.

COLORADO SPRINGS, CO 80920

## El Paso County:

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual, Volumes 1 and 2 and the Engineering Criteria Manual, as amended.

Jennifer Irvine, P.E.

County Engineer/ECM Administrator

**APPROVED**  
**Engineering Department**

11/25/2020 1:19:15 PM

*dsdnijkamp*

**EPC Planning & Community**  
**Development Department**

# Master Development Drainage Plan – Grandview Reserve

## I. General Purpose, Location and Description

### a. Purpose and Scope of study

The Purpose of this Master Development Drainage Plan (MDDP) is to describe the onsite and offsite drainage patterns, existing and proposed storm infrastructure as it relates to preliminary water quality and stormwater detention, areas tributary to the site and the planned storm water management for Grandview Reserve 2 development. The items discussed in this report are preliminary in nature and final drainage calculations and design will be required as development proceeds. This reports provides a general drainage concept and guidance for future development of Grandview Reserve.

### b. DBPS Investigations

The Geick Ranch Drainage Basin Planning Study (DBPS) Preliminary Design Report prepared by Drexel, Barrell was reviewed to determine existing plans and constraints that would influence the design of Grandview Reserve. The proposed plans for Grandview Reserve are in general conformance with the DBPS.

The DBPS shows 4 reaches through Grandview Reserve. The Main Stem (MS) in the south western portion of the site, the Main Stem Tributary #2 (MST2) to the north and east of the Main Stem, the East Fork Tributary (EFT) in the middle of the site north and east of MST2, and the East Fork Upper (EF) at the north east side of the site. These drainageways have been reviewed in the following reports and further analysis will be completed of these major drainageways in future planning documents.

- Unnamed Tributary Black Squirrel Creek, Four Way Ranch Letter of Map Revisions, Kiowa Engineering, March 2004
- Haegler and Geick Drainage Basins Letter of Map Revision, Four Way Ranch Subdivision, Kiowa, March 2004
- Unnamed Tributary Black Squirrel Creek Drainage Basin, Letter of Map Revision, Elbert Road Site, Kiowa Engineering, February 2006
- Geick Ranch Drainage Basin Planning Study (DBPS), Drexel Barrell, October 2010 (not approved)
- Meridian Ranch Master Development Drainage Plan (MDDP), Tech Contractors, January 2018

### c. Agency Jurisdictions

Listed below are the jurisdictions that this project will conform to:

El Paso County

Falcon Colorado Municipal Code (where applicable)

Federal Emergency Management Agency

#### d. General Project Description

Grandview Reserve is located in Falcon, Colorado within El Paso County and contains approximately 765 acres within the south half of section 21 and 22 and the north half of section 27 and 28, Township 12 South, and Range 66 West of the Sixth Principal Meridian in El Paso County, Colorado. See below for approximate site location.

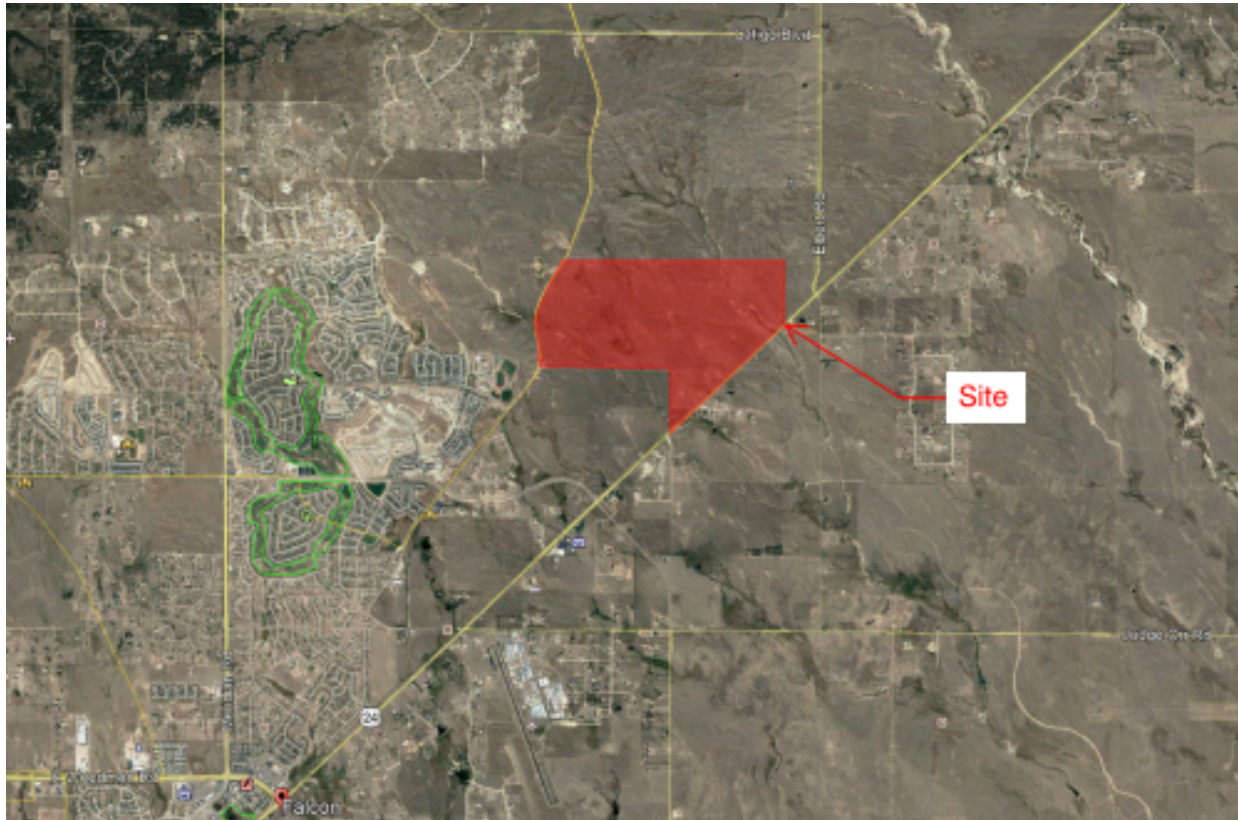


Figure 1 - Site Map

#### e. Data Sources

Listed Below are the technical resources reviewed in the preparation of this MDDP:

City of Colorado Springs Drainage Criteria Manual (DCM), Volumes 1 and 2

Mile High Flood District

NOAA Atlas 14

NRCS Soil Survey for El Paso County Area, Colorado

FEMA FIRM 08041C0556G and FIRM 08041C0552G (eff. 12/7/2018)

El Paso County Assessor Property Records

## **f. Applicable Criteria and Standards**

Per the DBPS, flows from the proposed site will be limited to historic flows in an effort to maintain the stability and of the existing channels with the drainage basin. The master plan follows the Drainage Criteria Manual for El Paso County which refers to the City of Colorado Springs Drainage Criteria Manuals as amended.

# II. Project Characteristics

## **a. Location in Drainage Basin, offsite flows, size**

Grandview Reserve is located within the Geick Ranch Drainage Basin which covers approximately 22 square miles. This drainage basin is tributary to Black Squirrel Creek and joins said creek just to the south of Elicott, CO about 18 miles to the south. Black Squirrel Creek eventually drains to the Arkansas River in Pueblo Colorado. The majority of the Geick Ranch Drainage basin is undeveloped consisting of rural farmland. The Geick Ranch Drainage basin lies north of the Haegler Ranch drainage basin.

As part of the Fourway LOMR discussed above, the study reviewed the hydrology and hydraulics for the Main Stem Tributaries, however only a small portion of the site within Grandview was analyzed. The peak flows rates for the Main Stem for the 100 year event was 413 cfs and for the Main Stem Tributary was 280 cfs.

For the East Fork tributaries (EF and EFT), the DBPS established 100 year flow rates of 595 cfs for the East Fork (EF) and 217 cfs for the East Fork Tributary (EFT)

Generally offsite flows are conveyed through the site via the 4 tributaries. Minor offsite basins may sheet flow onto the site. These flows will be routed through the site via the tributaries.

## **b. Compliance with DBPS**

This MDDP is in general conformance with the guidelines outlined in the Geick Ranch DBPS. Grandview Reserve will construct multiple full spectrum detention facilities to limit the effects of development and mimic natural flow patterns.

Existing downstream infrastructure is currently the historic drainage channels and minimal downstream improvements exist. As such, the site follows the DBPS and limits offsite flow rates to at or below historic rates. Outfalls out of the site will generally be along the same historic tributaries. Although outfall rates will be at or below historic, volume of runoff will increase and therefore downstream facilities may see additional flow volume than historic. This may provide a net benefit to the downstream facilities by providing more water to assist with vegetation however it should be noted that increased volume may also lead to more erosion or channel movement.

## **c. Site Characteristic**

Per the NRCS web soil survey, the site is made up entirely of Type A and B soils. The majority of which are Type A soils. The predominate soils are Blakeland loamy sand, Columbine gravelly sandy loam, and Stapleton sandy loam. The first two soils are Type A soil and cover approximately 55.1% of the site and

the later soil is a Type B soil and covers the remaining 44.9% of the site. See Appendix A for the NRCS soil map.

Current ground cover is predominantly short- to mid-grass prairie grasslands and former farmland which consists of nonnative weeds and grasses. The site has very few, if any, trees and a minimal number of shrubs are found on the site.

**d. Major drainage ways and structures**

As mentioned previously, 4 major drainage ways exist on the site. These convey existing on and off-site flows and current on site flows through the site in a southeasterly direction. The drainageways eventually cross Highway 24 via culverts and other structures; further survey will be conducted to determine their effectiveness as the development of the site progresses.

A breached stock pond is located along the Main Stem and the effects of the existing breached dam are unknown at this time. As development occurs, this dam will be completely removed and improvements will be constructed along the channels to become high functioning low maintenance drainageway corridors.

**e. Existing and proposed land uses**

The existing site is open rangeland and farmland with no visible structures. The proposed development will consist of low, medium, and high density residential, along with two institutional sites, multiple pocket park sites, a large community park and a commercial area adjacent to Highway 24. The current land plan assumes approximately 3,261 dwelling units will be constructed on the site.

Land Use	MAX DU/AC
Low	2
Medium	4
Medium – High	8
High	12

### III. Hydrologic Analysis

**a. Major Basins and subbasins**

**Major Basin Description**

- Previous basin study: Gieck Ranch Drainage Basin Planning Study
- Per FEMA FIRM 08041C0556G and 08041C0552G (eff. 12/7/2018), Grandview Reserve has four mapped channels within its boundaries.
- Per aerial imaging, no major irrigation is in the vicinity that would affect Grandview Reserve.

The site has been divided into 8 major drainage basins per where each basin is tributary to a full spectrum detention pond facility. These basins and associated sub basins are described in more detail in the next section of this report.

**Subbasin Description**

The entire site drains in a south easterly direction and is divided into 8 major drainage basins and a total of 18 subbasins together as described below.

- Subbasin A1 is located in the southwestern corner of the site, to the south and west of MS. The basin drains towards the southeast to proposed detention pond A. Current planning documents call for medium density dwelling units and a small pocket park. The basin is 37.00 acres, with a composite impervious value of 35.22% and runoff rates for the 5 and 100 year of 30.72 cfs and 100.64 cfs respectively. The pond will discharge at predevelopment rates and into MS via the ponds outlet structure.
- Subbasin B1 is located between MS and MST2 to the east of subbasin A1. The basin drains towards the southeast and towards subbasin B2. Current planning documents call for medium density dwelling units and some parkland area. The basin is 37.00 acres, with a composite impervious value of 45.00% and runoff rates for the 5 and 100 year of 29.46 cfs and 97.08 cfs respectively.
- Subbasin B2 is located between MS and MST2 to the northeast of subbasin A1. The basin drains towards the southeast and towards Detention Pond B. Current planning documents call for medium density dwelling units. The basin is 24.89 acres, with a composite impervious value of 43.26% and runoff rates for the 5 and 100 year of 12.02 cfs and 42.26 cfs respectively.
- Subbasin B3 is located between MS and EF and to the northeast of east of basin B2. The existing MST2 tributary runs through the basin. The site drains towards the southeast and towards Detention Pond B. Current planning documents call for high, medium-high, and medium density dwelling units along with a pocket park. The basin is 118.90 acres, with a composite impervious value of 49.42% and runoff rates for the 5 and 100 year of 92.76 cfs and 295.27 cfs respectively.
- Subbasin C1 is located to the northeast of east of basin B1 and the existing MST2 tributary runs through the middle of the basin. The basin drains towards the southeast and towards Detention Pond C. Current planning documents call for an institutional parcel, medium and high density dwelling units and a pocket park. The basin is 77.83 acres, with a composite impervious value of 51.20% and runoff rates for the 5 and 100 year of 77.99 cfs and 238.03 cfs respectively.
- Subbasin D1 is located between MS and MST2 to the east of Basin B3 and adjacent to the MST2 channel. The basin drains towards the southeast and towards drainage basin D2. Current planning documents call for medium density dwelling units along with a pocket park. The basin is 24.33 acres, with a composite impervious value of 53.89% and runoff rates for the 5 and 100 year of 24.15 cfs and 70.07 cfs respectively.
- Subbasin D2 is located between MS and MST2 to the south of basins D1 and B3. The basin drains towards the southwest and towards detention pond D. Current planning documents call for high density dwelling units along with a pocket park and a commercial parcel. The basin is 77.90 acres, with a composite impervious value of 62.10% and runoff rates for the 5 and 100 year of 98.47 cfs and 252.18 cfs respectively.
- Subbasin E1 is located just east of EFT along the northern portion of the site. The basin drains towards the southeast and towards basins F3 and F4. Current planning documents call for low density dwelling units. The basin is 88.60 acres, with a composite impervious value of 19.54% and runoff rates for the 5 and 100 year of 46.88 cfs and 178.04 cfs respectively.

- Subbasin F1 is located east of basin E1 and between EFT and EF along the northern portion of the site. The basin drains towards the southeast and towards basin F3 and F4. Current planning documents call for a large community park, high density dwelling units, commercial site and an institution parcel. The basin is 33.73 acres, with a composite impervious value of 25.00% and runoff rates for the 5 and 100 year of 16.28 cfs and 58.95 cfs respectively.
- Subbasin F2 is located east of the existing drainage channel EFT. The basin drains towards the southwest and towards basin F4 and to the EFT drainage channel which runs parallel to the north east with Highway 24. Current planning documents call for high density dwelling units and commercial space. The basin is 67.64 acres, with a composite impervious value of 51.39% and runoff rates for the 5 and 100 year of 60.11 cfs and 170.90 cfs respectively.
- Subbasin F3 is located west of the existing drainage channel EF. The basin drains towards the southeast towards drainage channel EF but will be conveyed south towards subbasin F4. Current planning documents call for medium density dwelling units. The basin is 12.84 acres, with a composite impervious value of 45.00% and runoff rates for the 5 and 100 year of 11.36 cfs and 32.93 cfs respectively.
- Subbasin F4 is located west of the existing drainage channel EF and south of subbasins F1 and F3. The basin drains towards the southeast towards detention pond F. Current planning documents call for medium and medium-high density dwelling units. The basin is 51.81 acres, with a composite impervious value of 49.54% and runoff rates for the 5 and 100 year of 42.32 cfs and 124.89 cfs respectively.
- Subbasin G1 is located west of the existing drainage channel EFT along the northern property boundary. The basin drains towards the southeast towards detention pond G. Current planning documents call for medium density dwelling units and a park. The basin is 20.13 acres, with a composite impervious value of 36.52% and runoff rates for the 5 and 100 year of 13.78 cfs and 43.95 cfs respectively.
- Subbasin G2 is located east of the existing drainage channel EFT along the northern property boundary. The basin drains towards the southeast towards detention pond G. Current planning documents call for low density dwelling units. The basin is 15.14 acres, with a composite impervious value of 25.00% and runoff rates for the 5 and 100 year of 6.55 cfs and 23.95 cfs respectively.
- Subbasin H1 is located in the northeast corner of the site and east of the existing drainage channel EFT. The basin drains towards the south towards subbasin H4. Current planning documents call for low density dwelling units and smallpark. The basin is 20.71 acres, with a composite impervious value of 24.49% and runoff rates for the 5 and 100 year of 5.68 cfs and 27.62 cfs respectively.
- Subbasin H2 is located south of basin G2 and east of the existing drainage channel EFT. The basin drains towards the south towards subbasin H4. Current planning documents call for medium density dwelling units and smallpark. The basin is 18.55 acres, with a composite impervious value of 46.68% and runoff rates for the 5 and 100 year of 16.24 cfs and 47.62 cfs respectively.



- Subbasin H3 is located south of basin H2 and east of the existing drainage channel EFT. The basin drains towards the southeast towards subbasin H4. Current planning documents call for medium density dwelling units and smallpark. The basin is 6.01 acres, with a composite impervious value of 40.57% and runoff rates for the 5 and 100 year of 5.21 cfs and 15.60 cfs respectively.
- Subbasin H4 is located south of basin H2 and east of the existing drainage channel EFT and basin H3. The basin drains towards the south towards detention pond H. Current planning documents call for medium density dwelling units and park/open space area. The basin is 27.65 acres, with a composite impervious value of 38.24% and runoff rates for the 5 and 100 year of 20.93 cfs and 64.71 cfs respectively.

The above mentioned basins are large planning area basins and as drainage reports are developed for the individual developed parcels additional drainage reports and calculations will be required. It is expected that storm drainage infrastructure consisting of inlets, storm sewer and open drainage channels will be constructed as the property develops.

- Offsite Basins as shown in the Meridian Ranch MDDP include basins HG4, HG5, HG6A, HG6B, HG13, and HG14. Flow contributing to the site from these basins will be routed through the existing tributaries. Flow rates as shown in the MDDP Ranch report include the following flows and associated tributary areas.

Offsite Flow Summary					
Basin Description	Ultimate Design Point	Basin Area (ac)	Receiving Tributary	5 Year Peak Runoff (cfs)	100 Year Peak Runoff (cfs)
HG4	G6	57	Main Stem	2	42
HG5	G6	72	Main Stem	3	52
HG6A	G6	88	Main Stem	3	51
HG6B	G6	66	Main Stem	2	35
HG13	G08	54	Main Stem Tributary 2	4	59
HG14	G08	147	Main Stem Tributary 2	5	83

Offsite Flow Summary				
Design Point	Basin Area (ac)	Receiving Tributary	5 Year Peak Runoff (cfs)	100 Year Peak Runoff (cfs)
G6	760	Main Stem	36	628
G08	201	Main Stem Tributary 2	8	122

These basins along with the offsite basins which lie east of Eastoneville Road contribute flows onto the site through the major tributaries. Estimate oncoming flows for each tributary are as follows:

Offsite Flow Summary		
Tributary	5 Year Peak Runoff (cfs)	100 Year Peak Runoff (cfs)
Main Stem	36	628
Main Stem Tributary 2	8	122
East Fork Tributary*	56	116
East Fork*	175	357

\*Flows from Gieck Ranch  
DBPS, Oct 2010

As hydraulic analysis continues for the channels, these offsite flows will be used to size the channels for proper conveyance of the flow however it should be noted that the flows mentioned for the Main Stem and Main Stem Tributary 2 assume proper conveyance of the flow through (below or above) Eastonville Road. Due to the unknown nature of these conditions at the time of buildout, a probable scenario of the split flows will require analysis and agreed upon flow rates to each channel will be required. Currently some of the flow shown going to the Main Stem Tributary 2 may be diverted into the Main Stem Tributary. Previous analysis done by JR Engineering assumed approximately 160 additional cfs going to the Main Stem Tributary #2 during the 100 year event and as such it is recommended the following flows be used for analysis of the oncoming offsite flows:

Revised Offsite Flow Summary		
Tributary	5 Year Peak Runoff (cfs)	100 Year Peak Runoff (cfs)
Main Stem**	67	413
Main Stem Tributary 2**	59	280
East Fork Tributary*	61	217
East Fork*	180	595

\*Flows from Gieck Ranch  
DBPS, Oct 2010

\*\*Flows from 4 Way Ranch LOMR, Mar 2004

Please note that the preliminary drainage reports will be required to reconcile any differences between the various reports done for these channels.

## b. Methodology

Design rainfall was determined utilizing figures from the NOAA Atlas 14, Volume 8, Version 2 to determine the 5-year and 100-year rainfall values for 1, 6 and 24-hour events. The 1-hour rainfall depths are 1.22 and 2.50 in/hr respectively, 6 hour 1.79 and 3.87 in/hr respectively and 2.36 and 4.90 in/hr for the 24 hour event. The rainfall values were then used as inputs into the Colorado Urban Hydrograph Procedure (CUHP) spreadsheets to determine runoff values for both pre-development and post-development site.

CUHP is an evolution of the Snyder unit hydrograph and is calibrated for use along the Colorado Front Range. 1 Hour rainfall amounts are input into the program to produce a storm hyetograph that is then used to calculate a storm hydrograph for each basin depending on the subbasins properties including slope, length, shape, impervious area, pervious depression storage area, and various infiltration rates. Tabular hydrographs are then computed and can be used in EPA SWMM. The CUHP results are included within Appendix B.

EPA SWMM was used to determine flow routing via the kinematic wave method. Subbasins were routed to their respective design points and detention ponds for both the developed and predeveloped condition to determine peak runoff amounts for the 5-year and 100-year storm events. Information from these models along with information and calculations performed in the Colorado Springs BMP spreadsheets was used to determine pond sizing calculations and release rates.

### c. Basin Hydrology

A summary of the flows for both the predeveloped and developed cases for each basin, subbasin and Pond are found on next page along with the full computation found in Appendix B.

SWMM Basin and Pond Summary						
Basin Description	Basin Area (ac)	% Impervious	5 Year Peak Runoff (cfs)	100 Year Peak Runoff (cfs)	5 Year Pond Volume (ac-ft)	100 Year Pond Volume (ac-ft)
A1	45.38	35.22%	30.72	100.64		
<b>Pond A</b>					1.83	3.50
B1	37.00	45.00%	29.46	97.08		
B2	24.89	43.26%	12.02	42.26		
B3	118.90	49.42%	92.76	295.27		
<b>Pond B</b>					5.90	19.00
C1	77.83	51.20%	77.99	238.03		
<b>Pond C</b>					3.91	6.87
D1	24.33	44.14%	24.15	70.07		
D2	77.90	62.10%	98.47	252.18		
<b>Pond D</b>					6.61	10.19
E1	88.60	19.54%	46.88	178.04		
<b>Pond E</b>					1.96	2.44
F1	33.73	25.00%	16.28	58.95		
F2	67.64	51.39%	60.11	170.90		
F3	12.84	45.00%	11.36	32.93		
F4	51.81	46.54%	42.32	124.89		
<b>Pond F</b>					7.38	12.62
G1	20.13	36.52%	13.78	43.95		
G2	15.14	25.00%	6.55	23.95		
<b>Pond G</b>					0.72	2.03
H1	20.71	24.49%	5.68	27.62		
H2	18.55	43.68%	16.24	47.62		
H3	6.01	40.57%	5.21	15.60		
H4	27.65	38.24%	20.93	64.71		
<b>Pond H</b>					2.93	6.17

## IV. Hydraulic Analysis

### a. Major Drainageways

In general the site runoff runs into the 4 major drainageways and in a southeasterly direction. These basins are described in more detail below:

The Main Stem (MS) in the south western portion of the site, the Main Stem Tributary #2 (MST2) to the north and east of the Main Stem, the East Fork Tributary (EFT) in the middle of the site north and east of MST2, and the East Fork Upper (EF)

The Main Stem (MS) is in the southwestern portion of the site. Offsite flows collect and are conveyed under Eastonville Road via a culvert. MS travels in a southeasterly direction and combines with the Main Stem Tributary #2 (MST2) just off site and then is conveyed past Highway 24 via a culvert. Jurisdictional wetlands exist within this channel and the area is within a Zone A floodplain towards the southern portion of the site. This channel sees only intermittent flows at this time however once development occurs there may be a more constant baseflow.

MST2 crosses Eastonville road via an existing culvert and flows through the site in a southeasterly direction. An existing breached stock pond exists in the approximate center point of the channel within the site. Portions of this channel are within a mapped floodplain as shown in the existing FIRM Panel. Per a July email from the USACE this drainage channel was determined to be a non-jurisdictional waters/wetland.

The East Fork tributary (EFT) crosses the north property line and are conveyed through the site via a natural channel. The channel has been mapped as a Zone A floodplain per the existing FIRM panel. There is no existing crossing for this section of the drainage channel below Highway 24 and instead the flows are conveyed to the north east towards the East Fork Upper (EF). Per a July email from the USACE this drainage channel was determined to be a non-jurisdictional waters/wetland.

The EF crosses the north property line approximately 1500' east of the EFT crossing. The flow through the site is via a natural channel and travels in a southeasterly direction. The channel is mapped as a Zone A floodplain, and the channel crosses Highway 24 via an existing shallow bridge. The EF and EFT eventually merge approximately 1750 southeast of the site, however as mentioned above Highway 24 blocks the flow of the EFT and flows are conveyed northeast to the EF bridge crossing.

Per SWMM modeling the current velocities will require channel stabilization. The channels are to be engineered later in the design which will likely include a combination of channel widening, lowering of slope facilitated by the implementation of drop structures to meet non erosive velocity requirements. Bank stabilization, should it be necessary, may include coir rolls, erosion control blankets, live willow staking, soil lifts and/or other measures to ensure successful bank stabilization. These drainageways will require further analysis and design which will be completed as the project progresses.

## V. Environmental Evaluations

### a. Significant existing or potential wetland and riparian areas impacts

As part of this work, the developer has engaged Ecosystem Services, LLC (ECOS) to perform environmental studies of the site that will be submitted with the planning documents. Major information from these report related to the wetlands shows that two of the tributaries trough the site, the Main Stem

and the East Fork contain jurisdictional wetlands and the other two tributaries, the East Fork Tributary and the Main Stem Tributary #2 are non-jurisdictional wetlands.

At this time, only minor improvements to the jurisdictional channels are proposed. These stream improvements will be made with keeping the natural habitat intact and the natural function of these channels as it is to maintain the wetland habitat. The non-jurisdictional channels will be modified and the design of those channels is forthcoming.

#### **b. Stormwater quality considerations and proposed practices**

As part of the development, full spectrum detention facilities will be installed to provide water quality for the development. The facilities will be designed using El Paso County criteria and provide stormwater quality by slowing the release of stormwater captured by the ponds and allowing solids to settle out. Additionally when possible the revised drainage channels, which were not jurisdictional wetlands, will be used to convey stormwater via a natural channel. Stormwater must be treated before entering the natural channels. The natural channel will provide an pervious means to transport stormwater and provide some water quality benefits as well.

On site practices for the homes, schools, churches and other buildings should use means such that impervious areas drain across pervious area to allow for infiltration during the minor events. This would include discharge of the gutters onto landscape areas vs. directly connecting to storm sewer and using natural ditches and swales where it is logical and makes sense to convey stormwater inlieu of storm sewer piping.

#### **c. Permitting requirements**

When work infringes upon the wetlands or floodplain a 404 Permit will be required. If the work within the waterways is minimal, it will likely be covered under a nationwide 404 permit; it is however possible that an individual permits will be required.

The Colorado Department of Public Health and Environment will require permits for any disturbance that exceed 1 acre of land. Should groundwater be encountered, a dewatering permit will also be required.

El Paso County will require an Erosion and Stormwater Quality Control Permit and any other construction permits required to complete the construction of the site.

FEMA will require a permit for floodplain development prior to the commencement of any construction or development within any special flood hazard area (SFHA).

FEMA will require a letter of map revision (LOMR) should work alter the base flood elevation (BFE) of any area falling withing the floodplain as shown in FEMA FIRM 08041C0556G and FIRM 08041C0552G (eff. 12/7/2018).

#### **d. 4-Step Process**

In accordance with the Engineering Criteria Manual I.7.2.A and DCM V2, this site has implemented the four-step process to minimize adverse impacts of urbanization. The four-step process includes reducing runoff volumes, stabilizing drainageways, treating the water quality capture volume, and considering the need for Industrial Commercial BMPs.

**Step 1 – Reducing Runoff Volumes:** The development of the project site includes a variety of land uses including open and vegetated areas interspersed to help disconnect imperious areas and reduce runoff volumes.

**Step 2 – Stabilize Drainageways:** Altered channels will be designed in a manner that provides water quality benefits through infiltration and the removal of pollutants via phytoremediation. Vegetation will also be selected to stabilize the channel by reducing the velocity of flows and decreasing any scour. Should the final channel require, grade control structures may be implemented to further reduce flow velocities and protect against erosion. These improvements will help stabilize drainageways.

**Step 3 – Provide WQCV:** Runoff from this development is treated through capture and slow release of the WQCV via detention ponds that are designed per current El Paso County DCM V2.

**Step 4 – Consider the need for Industrial and Commercial BMP's:** A site specific storm water quality and erosion control plan and narrative will be prepared with subsequent land use approvals prepared in conjunction with the report prior to any construction. Site specific temporary source control BMPs as well as permanent BMPs are detailed in this plan and narrative. Guidelines detailed in the El Paso DCM V2 4.2 pertaining to the covering and storage handline and spill containment and control shall be followed as necessary.

## VI. Selected Plan

### a. Plan Hydrology

This MDDP schematically addressed on-site and off-site drainage patterns using the existing topography and proposed land use plan for the overall drainage design. Individual preliminary and final drainage reports will better define the planning areas as the site is developed. These reports will include inlet design, storm sewer hydraulics, street design and other requirements typical of more detailed drainage reports.

The overall site is divided into 8 separate major basins, basins A-H and contribute to individual detention ponds for each major basin. Basin sizes range from 35 acres to 181 acres in size. Basins A, B, C and D drain and eventually discharge into the Main Stem and Main Stem Tributary #2. Basins E, F, G, and H drain towards the East Fork Drainage channel.

The sub-basins are described in additional detail above.

### b. Detention Ponds

The site plans propose the construction of 8 separate full spectrum detention facilities.

- Pond A is located in the southwest corner of the site and discharges into the Main Stem drainageway. The pond is planned to store a maximum of 4.05 ac-ft during the 100 year event and have a peak outflow of 55.9 cfs which is slightly below the pre development peak outflow of 57.1 cfs. The 5 year storage volume is 2.46 ac-ft with a peak outflow of 3.7 cfs.
- Pond B is located to the east of Pond A and the Main Stem and discharges into the Main Stem Tributary #2. The pond is planned to store a maximum of 16.60 ac-ft during the 100 year event and have a peak outflow of 165.4 cfs which is slightly above the pre development peak outflow of 164.2 cfs. The 5 year storage volume is 8.44 ac-ft with a peak outflow of 2.6 cfs.

- Pond C is located near the center of the western portion of the site near the existing Main Stem Tributary #2. The pond discharges into a revised open channel to be designed and discharges to the Main Stem Tributary #2 which merges with the Main Stem Tributary just off site. The pond is planned to store a maximum of 6.91 ac-ft during the 100 year event and have a peak outflow of 119.2 cfs which is slightly below the pre development peak outflow of 120.2 cfs. The 5 year storage volume is 4.07 ac-ft with a peak outflow of 1.5 cfs.
- Pond D is located near the southern portion of the site adjacent to Highway 24. The pond discharges into the Main Stem right after the Main Stem and Main Stem Tributary #2 merge. The pond is planned to store a maximum of 9.41 ac-ft during the 100 year event and have a peak outflow of 154.4 cfs which equals the predevelopment peak flow rate. The 5 year storage volume is 6.28 ac-ft with a peak outflow of 2.0 cfs.
- Pond E is located in the middle of the site just east of the East Fork drainage way. The pond discharges into the East Fork drainageway. The pond is planned to store a maximum of 2.40 ac-ft during the 100 year event and have a peak outflow of 163.4 cfs which is greater than the pre development peak outflow of 157.99 cfs. The 5 year storage volume is 1.70 ac-ft with a peak outflow of 18.8 cfs.
- Pond F is located near the south east corner of the site just west of the East Fork Tributary drainageway. The pond discharges into the East Fork Tributary drainageway. The pond is planned to store a maximum of 12.40 ac-ft during the 100 year event and have a peak outflow of 235.5 cfs which is greater than the pre development peak outflow of 221.11 cfs. The 5 year storage volume is 8.07 ac-ft with a peak outflow of 14.5 cfs.
- Pond G is located near the north east corner of the site just west of the East Fork Tributary drainageway. The pond discharges into the East Fork Tributary drainageway at an upstream location within the site. The pond is planned to store a maximum of 2.54 ac-ft during the 100 year event and have a peak outflow of 50.7 cfs which is slightly greater than the pre development peak outflow of 48.48 cfs. The 5 year storage volume is 1.69 ac-ft with a peak outflow of 9.1 cfs.
- Pond H is located near the south east corner of the site just east of the East Fork Tributary drainageway and adjacent to Highway 24. The pond discharges into the East Fork Tributary drainageway. The pond is planned to store a maximum of 6.60 ac-ft during the 100 year event and have a peak outflow of 99.1 cfs which matches the pred development peak outflow. The 5 year storage volume is 4.03 ac-ft with a peak outflow of 1.3 cfs.

Overall runoff from the site will by and large match the predevelopment peak flows. The volume of water will increase however as the drainage channels are designs, continuous simulation models will be done to see the effects of prolonged runoff rates. Predevelopment and post development flows for the 5-year and 100-year events are summarized in the following table for the 4 site outfalls.

OUTFALL	Predevelopment		Postdevelopment*	
	5 year	100 year	5 year	100 year
1	80.03	479.80	67.69	466.95
2	85.96	597.41	61.68	536.11
3	30.00	154.35	8.58	160.70
4	341.05	1335.77	276.10	1291.25

\*Values to be refined with Preliminary and Final Drainage Reports for each filing

## VII. Drawings

Please refer to the appendices for vicinity maps and drainage basin maps.

## VIII. Summary

Grandview Reserve is a large master planned community consisting of various densities of dwelling units to include single family homes, multifamily homes, parks, institutional sites, and commercial areas. Due to development increased runoff will occur. In order to mitigate downstream impacts 8 large full spectrum detention facilities will be built to reduce the runoff rate to near historic levels. These detention facilities will provide water quality enhancements in order to account for the increased urbanization of the upstream catchment areas.

Additional analysis will be required and completed to review the hydraulics of the proposed major drainage channels and be included in future submittals. The proposed design, as described in this report, is not anticipated to cause any adverse impact to downstream properties however as noted previously due to the increased volume of water, downstream tributaries will see increases in the volume of flow. It is advised that low impact design be taken into account when designing and developing each filling. This shall include those items listed in the four step process above and any additional measures that are within reason to disconnect impervious areas and increase infiltration. This will alleviate the additional volume of water due to development. Although the rate will remain at or below historic levels, the amount of time the channels will see water will increase which may cause more channel movement than historic. Downstream planning efforts should allow for the natural migration and movement of the channel by continuing to provide large floodplain areas to allow movement of the channel.



## IX. References

El Paso County – Drainage Criteria Manual, 2014

City of Colorado Springs – Drainage Criteria Manual, May 2014

Urban Storm Drainage Criteria Manual, Urban Drainage Flood Control District, January 2018

Unnamed Tributary Black Squirrel Cree, Four Way Ranch Letter of Map Revisions, Kiowa Engineering, March 2004

Haegler and Geick Drainage Basins Letter of Map Revision, Four Way Ranch Subdivision, Kiowa, March 2004

Unnamed Tributary Black Squirrel Creek Drainage Basin, Letter of Map Revision, Elbert Road Site, Kiowa Engineering, February 2006

Geick Ranch Drainage Basin Planning Study (DBPS), Drexel Barrell, October 2010 (not approved)

EPC Engineering Criteria Manual (Appendix I updated July, 2019)

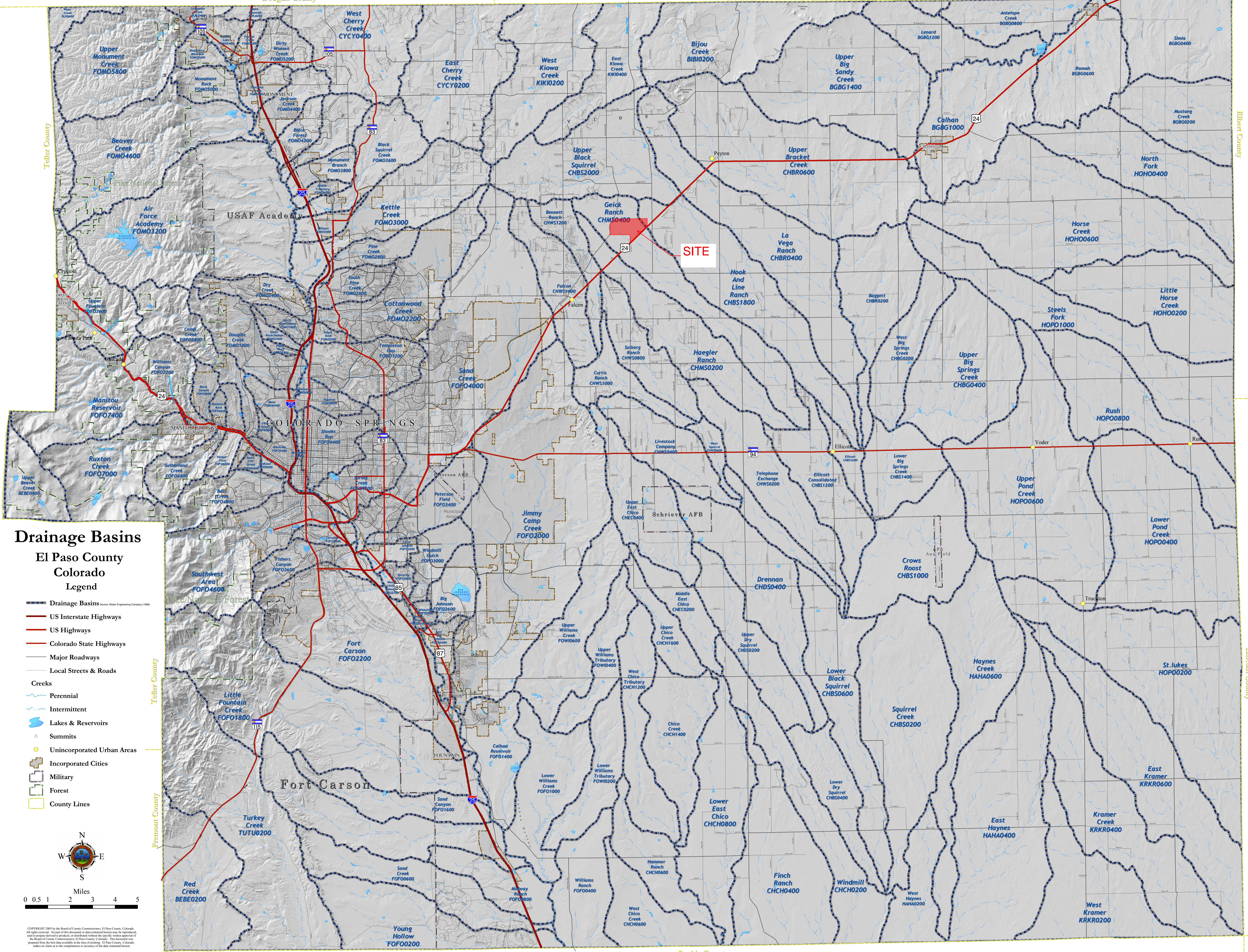
Meridian Ranch MDDP, January 2018



## Appendix A














Douglas County

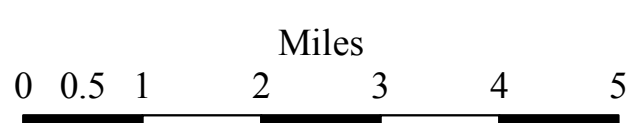
Elbert County



### Drainage Basins

El Paso County  
Colorado  
Legend

-  Drainage Basins (Source: Muler Engineering Company 1986)
-  US Interstate Highways
-  US Highways
-  Colorado State Highways
-  Major Roadways
-  Local Streets & Roads
- Creeks**
-  Perennial
-  Intermittent
-  Lakes & Reservoirs
-  Summits
-  Unincorporated Urban Areas
-  Incorporated Cities
-  Military
-  Forest
-  County Lines



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To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the **Flood Profiles and Floodway Data** and/or **Summary of Stillwater Elevations** tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded, whole-foot elevations and are not intended to be used as the sole source of flood elevation information and/or flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

**Coastal Base Flood Elevations** shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Stillwater Elevations and Flood Profiles and Floodway Data tables for the Flood Insurance Study. The Stillwater Elevations and Flood Profiles and Floodway Data tables shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with the exception of the **Special Flood Hazard Areas** (SFHAs) and **Special Flood Hazard Zones** and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight, positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov/> or contact the National Geodetic Survey at the following address:

NGS Information Services  
NOAA, NINGS12  
National Geodetic Survey  
SSMC-3, #8202  
1315 East-West Highway  
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at <http://www.ngs.noaa.gov/>.

**Base Map** information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report, which contains authoritative hydraulic data may reflect stream channel configurations that are different from those shown on this map. The Flood Profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile and Floodway Data Tables may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

**Corporate limits** shown on this map are based on the best data available at the time of publication. Because changes are to amendments or determinations may have occurred since the last update, users are encouraged to contact appropriate community officials to verify current corporate limit locations.

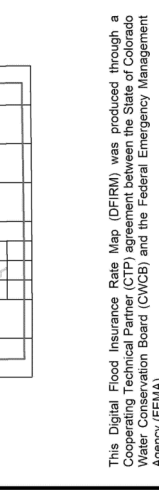
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact **FEMA Map Service Center (MSC)** via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-368-9620 and its website at <http://www.msc.fema.gov/>.

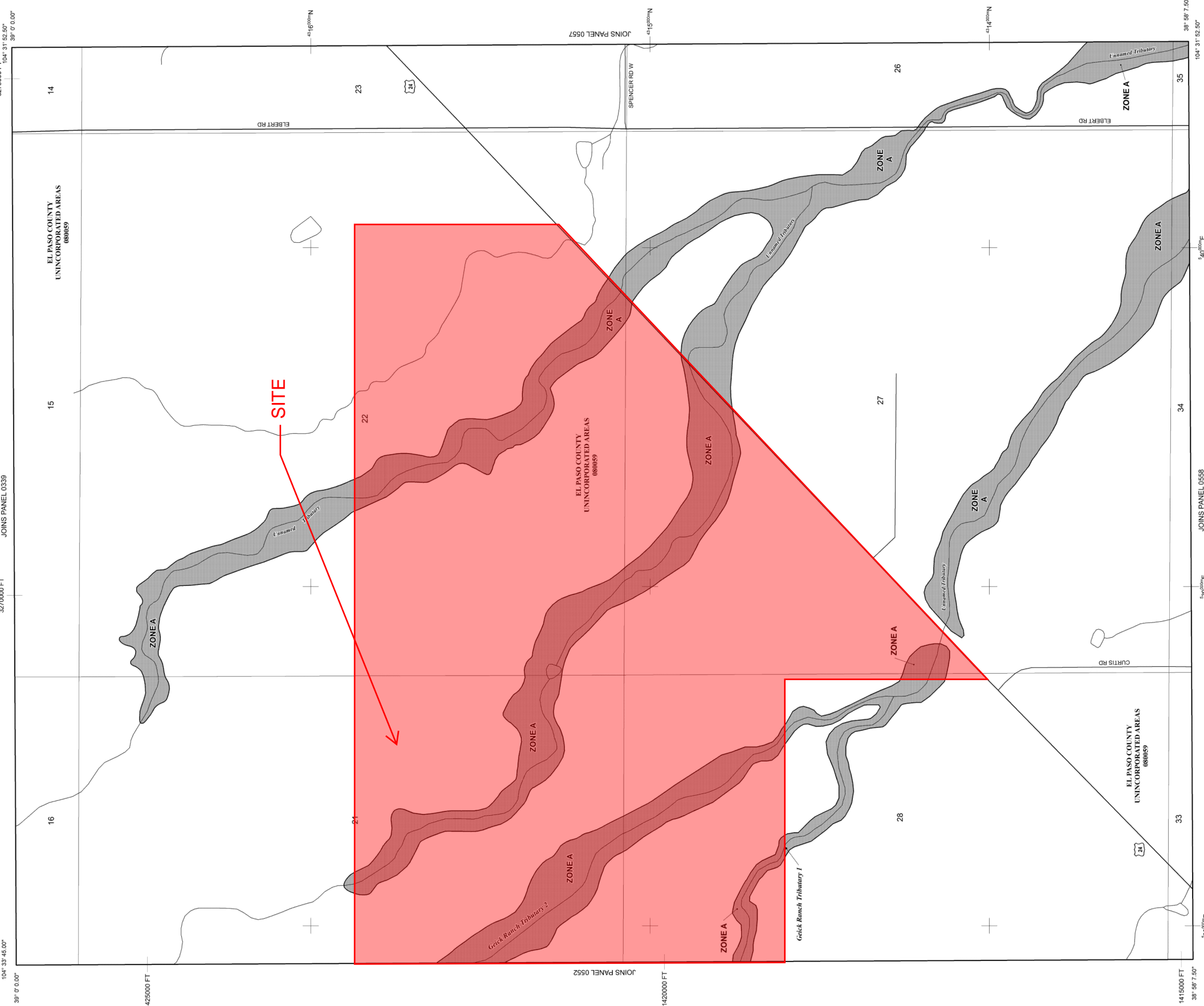
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**El Paso County Vertical Datum Offset Table**  
Floodings Source Vertical Datum Offset (ft)

REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperative Agreement between El Paso County, Colorado Springs Utilities, the Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).



**ZONE A**  
No Base Flood Elevations determined.

**ZONE AE**  
Base Flood Elevations determined.

**ZONE AH**  
Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

**ZONE AO**  
Flood depths of 1 to 3 feet (usually areas of ponding); average depths determined. For areas of abutment flow, velocities also determined.

**ZONE AR**  
Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently identified. Zone boundaries are shown on this map. Flood depths of 1 to 3 feet (usually areas of ponding) are shown. Areas to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

**ZONE V**  
Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

**ZONE VE**  
Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

**FLOODWAY AREAS IN ZONE AE**  
The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

**OTHER FLOOD AREAS**  
**ZONE X**  
Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot, or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

**OTHER AREAS**  
**ZONE X**  
Areas determined to be outside the 0.2% annual chance floodplain.

**ZONE D**  
Areas in which flood hazards are undetermined, but possible.

**COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**  
**OTHERWISE PROTECTED AREAS (OPAs)**  
CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain boundary  
Floodway boundary  
Zone D boundary  
CBRS and OPA boundary  
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flow velocities.  
Base Flood Elevation line and value; elevation in feet\*  
Base Flood Elevation value where uniform within zone; elevation in feet\*  
Cross section line  
Transect line  
Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)  
97° 07' 30.00"  
32° 22' 30.00"  
479°00'N  
1000-meter Universal Transverse Mercator grid ticks, zone 13  
CBRS grid ticks, Colorado State Plane coordinate system, central zone (EPS:ZONE 16502), Lambert Conformal Conic Projection  
Bench mark (see explanation in Notes to Users section of this FIRM panel)  
River Mile  
M1.5

\* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

**MAP REPOSITORIES**  
Refer to Map Repositories list on Map Index

**EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP**  
MARCH 17, 1997

**EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL**  
DECEMBER 7, 2015  
Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide updates, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-9620.

MAP SCALE 1" = 500'

**FIRM**  
FLOOD INSURANCE RATE MAP  
EL PASO COUNTY,  
COLORADO  
AND INCORPORATED AREAS  
PANEL 556 OF 1300  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:  
COMMUNITY NUMBER 08089  
EL PASO COUNTY PANEL 0556  
SUFFIX G

**MAP NUMBER**  
08041C0556G  
**MAP REVISED**

Notes to User: This Map Number is shown below the National Flood Insurance Program logo. A Community Number is shown above the logo. The Community Number is used to identify the community. The Community Number is used to identify the community. The Community Number is used to identify the community.

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REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

**Panel Location Map**

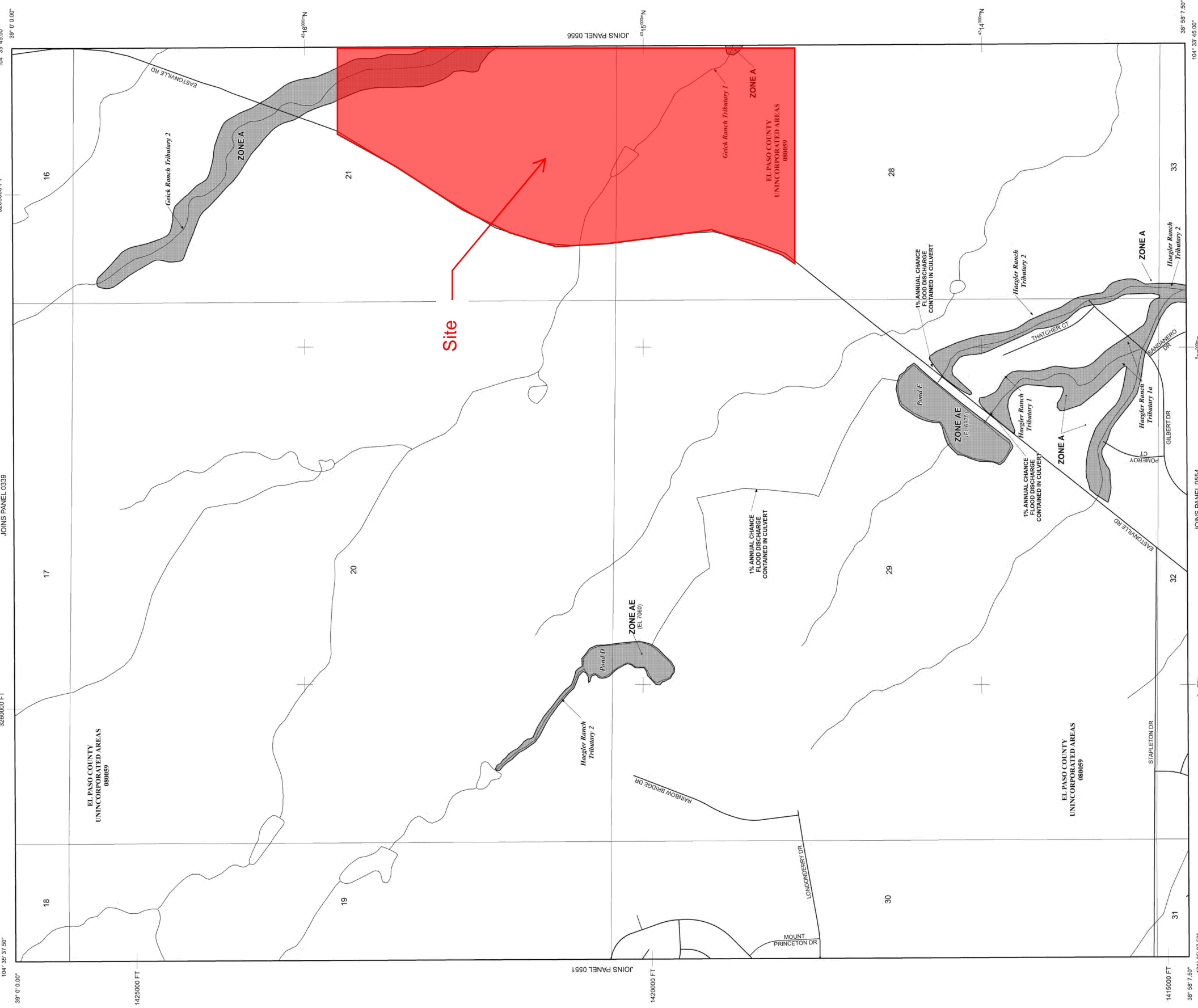


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104° 33' 45.00" W

39° 07' 00.00" N  
104° 33' 45.00" W

39° 07' 00.00" N  
104° 33' 45.00" W

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104° 33' 45.00" W

39° 07' 00.00" N  
104° 33' 45.00" W

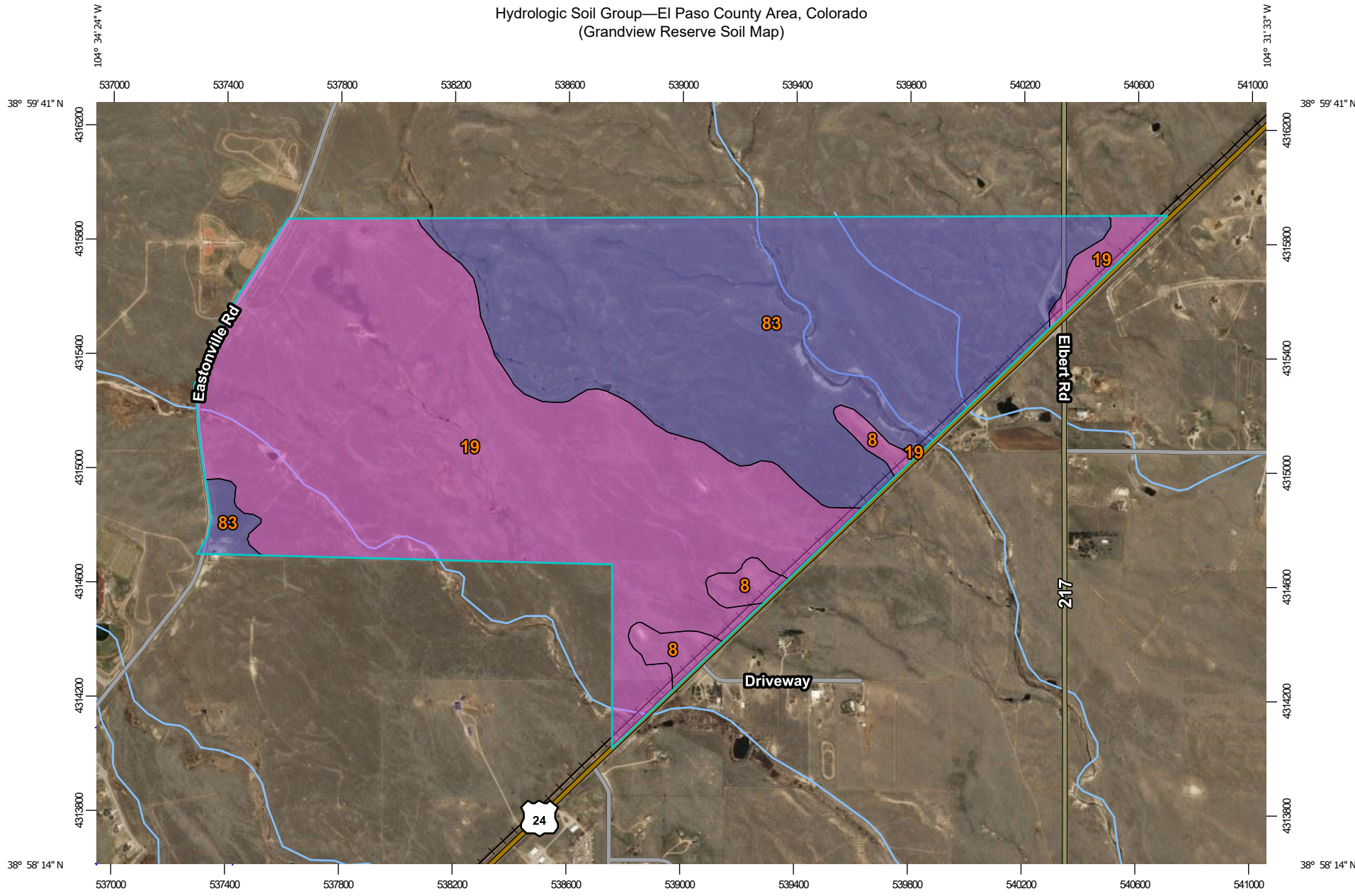
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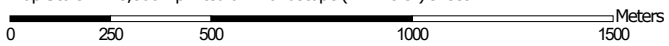
39° 07' 00.00" N  
104° 33' 45.00" W

39° 07' 00.00" N  
104° 33' 45.00" W

Hydrologic Soil Group—El Paso County Area, Colorado  
(Grandview Reserve Soil Map)



Map Scale: 1:18,800 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84



Hydrologic Soil Group—El Paso County Area, Colorado  
(Grandview Reserve Soil Map)

**MAP LEGEND**

**Area of Interest (AOI)**









 Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**





-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

**Soil Rating Lines**

-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

**Soil Rating Points**






-  A
-  A/D
-  B
-  B/D

-  C
-  C/D
-  D
-  Not rated or not available


**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.

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 17, Sep 13, 2019

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

Date(s) aerial images were photographed: Sep 8, 2018—May 26, 2019

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.

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	22.4	2.6%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	450.7	52.5%
83	Stapleton sandy loam, 3 to 8 percent slopes	B	385.4	44.9%
<b>Totals for Area of Interest</b>			<b>858.5</b>	<b>100.0%</b>

### Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.



## Rating Options

*Aggregation Method: Dominant Condition*

*Component Percent Cutoff: None Specified*

*Tie-break Rule: Higher*

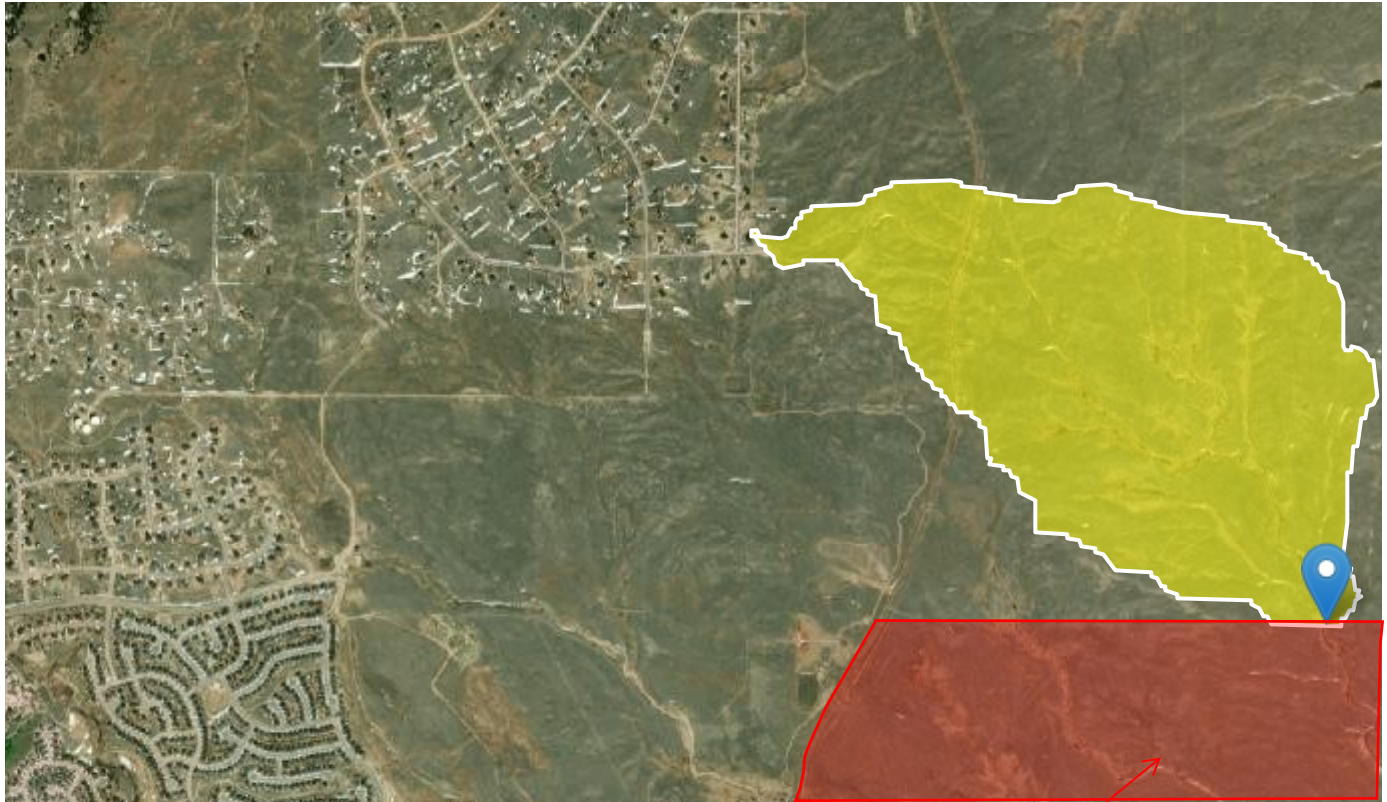
# EAST FORK

Region ID: CO

Workspace ID: CO20200817220340831000

Clicked Point (Latitude, Longitude): 38.99090, -104.54663

Time: 2020-08-17 16:03:57 -0600



Grandview Reserve

## Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	4	percent
DRNAREA	Area that drains to a point on a stream	0.84	square miles
I24H100Y	Maximum 24-hour precipitation that occurs on average once in 100 years	4.9	inches
I24H2Y	Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precipitation intensity index	1.86	inches

<b>Parameter Code</b>	<b>Parameter Description</b>	<b>Value</b>	<b>Unit</b>
RCN	Runoff-curve number as defined by NRCS ( <a href="http://policy.nrcs.usda.gov/OpenNonWebContent.aspx?content=17758.wba">http://policy.nrcs.usda.gov/OpenNonWebContent.aspx?content=17758.wba</a> )	58.28	dimensionless
RUNCO_CO	Soil runoff coefficient as defined by Verdin and Gross (2017)	0.22	dimensionless

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Application Version: 4.4.0

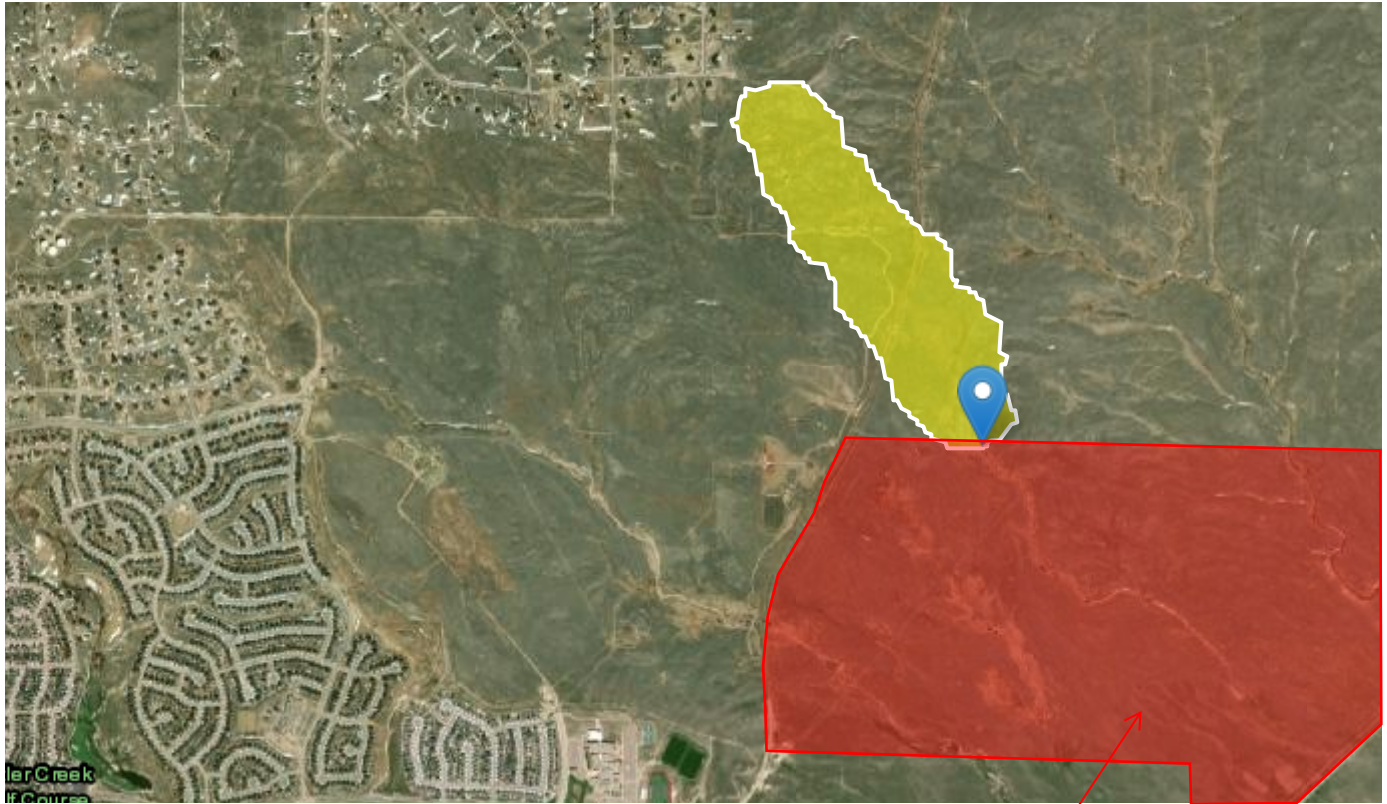
# EAST FORK TRIBUTARY BASIN DELINATION

**Region ID:** CO

**Workspace ID:** C020200817220732890000

**Clicked Point (Latitude, Longitude):** 38.99085, -104.55989

**Time:** 2020-08-17 16:07:50 -0600



Grandview Reserve

## Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	3	percent
DRNAREA	Area that drains to a point on a stream	0.22	square miles
I24H100Y	Maximum 24-hour precipitation that occurs on average once in 100 years	4.92	inches
I24H2Y	Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precipitation intensity index	1.86	inches

<b>Parameter Code</b>	<b>Parameter Description</b>	<b>Value</b>	<b>Unit</b>
RCN	Runoff-curve number as defined by NRCS ( <a href="http://policy.nrcs.usda.gov/OpenNonWebContent.aspx?content=17758.wba">http://policy.nrcs.usda.gov/OpenNonWebContent.aspx?content=17758.wba</a> )	54.53	dimensionless
RUNCO_CO	Soil runoff coefficient as defined by Verdin and Gross (2017)	0.23	dimensionless

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Application Version: 4.4.0

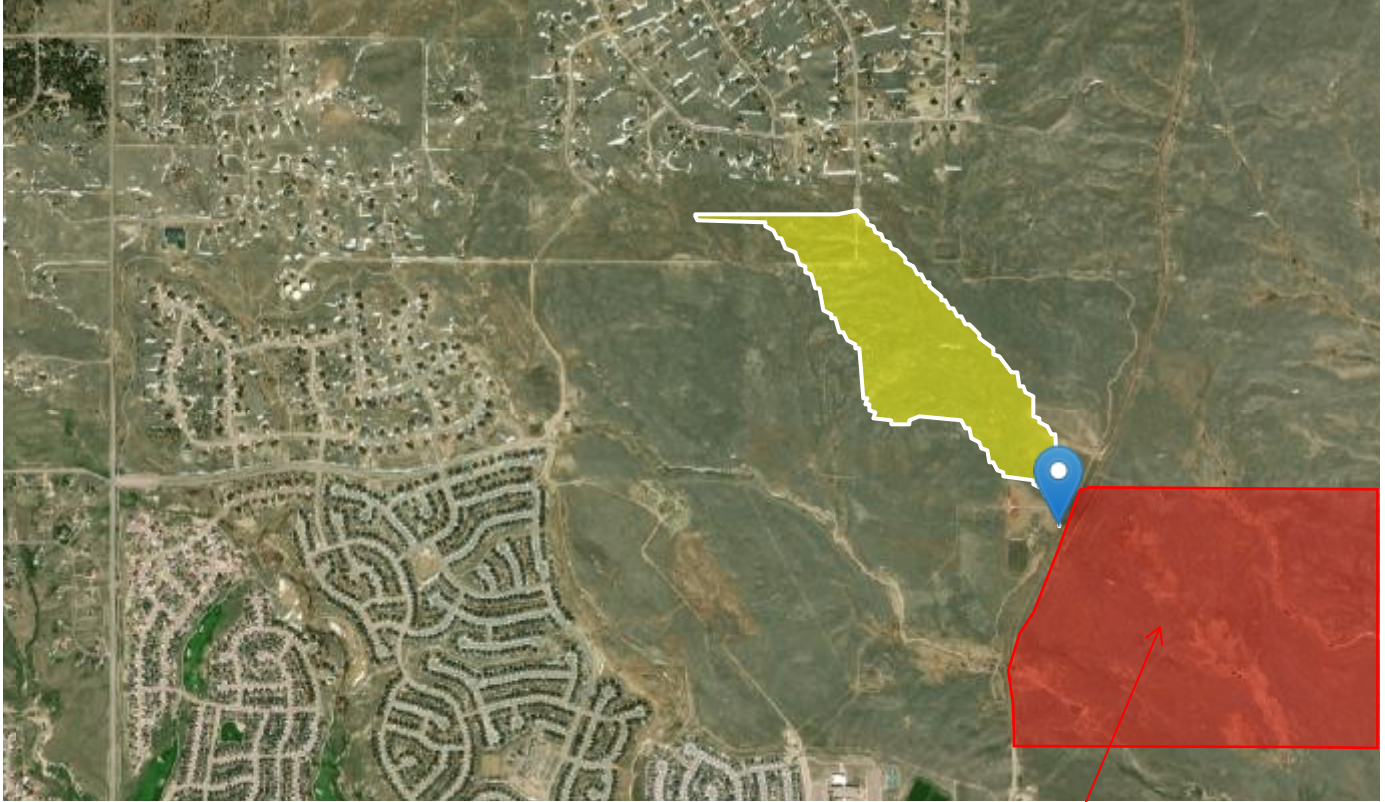
# MAIN STEM

Region ID: CO

Workspace ID: CO20200817221517278000

Clicked Point (Latitude, Longitude): 38.98969, -104.56703

Time: 2020-08-17 16:15:34 -0600



Grandview Reserve

### Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	3	percent
DRNAREA	Area that drains to a point on a stream	0.17	square miles
I24H100Y	Maximum 24-hour precipitation that occurs on average once in 100 years	4	inches
I24H2Y	Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precipitation intensity index	1.87	inches

<b>Parameter Code</b>	<b>Parameter Description</b>	<b>Value</b>	<b>Unit</b>
RCN	Runoff-curve number as defined by NRCS ( <a href="http://policy.nrcs.usda.gov/OpenNonWebContent.aspx?content=17758.wba">http://policy.nrcs.usda.gov/OpenNonWebContent.aspx?content=17758.wba</a> )	55.04	dimensionless
RUNCO_CO	Soil runoff coefficient as defined by Verdin and Gross (2017)	0.22	dimensionless

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Application Version: 4.4.0

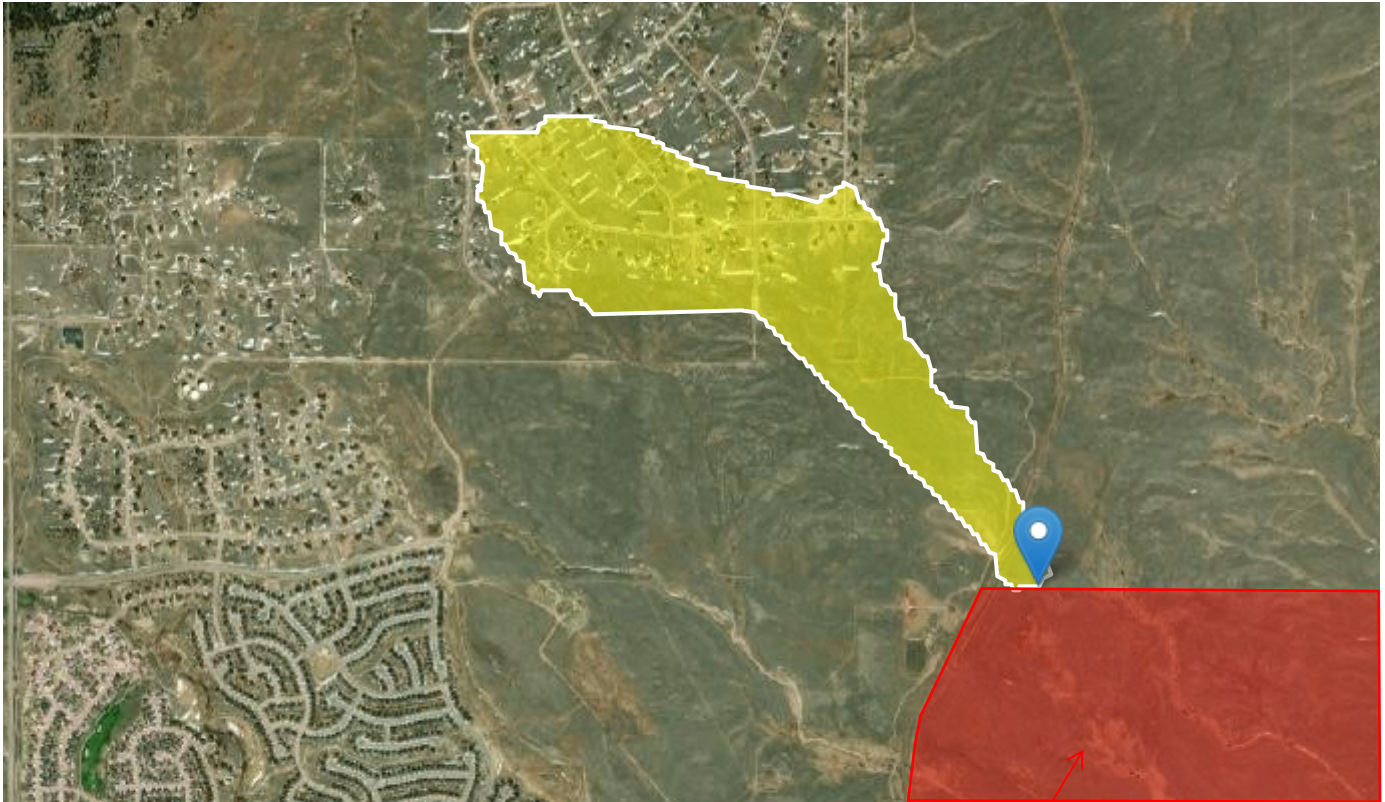
# MAIN STEM TRIBUTARY NUMBER 2

Region ID: CO

Workspace ID: C020200817221139984000

Clicked Point (Latitude, Longitude): 38.99101, -104.56354

Time: 2020-08-17 16:11:57 -0600



Basin Characteristics

Grandview Reserve

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	3	percent
DRNAREA	Area that drains to a point on a stream	0.44	square miles
I24H100Y	Maximum 24-hour precipitation that occurs on average once in 100 years	4.94	inches
I24H2Y	Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precipitation intensity index	1.87	inches



<b>Parameter Code</b>	<b>Parameter Description</b>	<b>Value</b>	<b>Unit</b>
RCN	Runoff-curve number as defined by NRCS ( <a href="http://policy.nrcs.usda.gov/OpenNonWebContent.aspx?content=17758.wba">http://policy.nrcs.usda.gov/OpenNonWebContent.aspx?content=17758.wba</a> )	56.49	dimensionless
RUNCO_CO	Soil runoff coefficient as defined by Verdin and Gross (2017)	0.23	dimensionless

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Application Version: 4.4.0



## Appendix B

Basin Description	Park/Open Space	High Density/Schools	Med/High Density	Med Density	Low Density	Commercial	Total Impervious	Total Acreage	Composite Percent Impervious	Predominant Soil Group	5 Year C Factor	100 Year C Factor
Impervious Percentage	10%	65%	55%	45%	25%	75%						
A1	12.68	0.00	0.00	32.70	0.00	0.00	15.98	45.38	35.22%	B	0.38	0.71
<b>Pond A</b>								<b>45.38</b>	<b>35.22%</b>			
B1	0.00	0.00	0.00	37.00	0.00	0.00	16.65	37.00	45.00%	A	0.4	0.61
B2	1.24	0.00	0.00	23.65	0.00	0.00	10.77	24.89	43.26%	A	0.38	0.59
B3	7.42	12.64	53.20	45.64	0.00	0.00	58.76	118.90	49.42%	A	0.36	0.5
<b>Pond B</b>								<b>180.79</b>	<b>47.66%</b>			
C1	4.19	30.61	1.70	41.33	0.00	0.00	39.85	77.83	51.20%	A	0.38	0.59
<b>Pond C</b>								<b>77.83</b>	<b>51.20%</b>			
D1	0.60	0.00	0.00	23.73	0.00	0.00	10.74	24.33	44.14%	A	0.39	0.6
D2	5.60	64.10	0.00	0.00	0.00	8.20	48.38	77.90	62.10%	A	0.39	0.6
<b>Pond D</b>								<b>102.23</b>	<b>57.82%</b>			
E1	32.26	0.00	0.00	0.00	56.34	0.00	17.31	88.60	19.54%	B	0.12	0.59
<b>Pond E</b>								<b>88.60</b>	<b>19.54%</b>			
F1	0.00	0.00	0.00	0.00	33.73	0.00	8.43	33.73	25.00%	B	0.15	0.61
F2	18.34	40.50	0.00	0.00	0.00	8.80	34.76	67.64	51.39%	B	0.36	0.7
F3	0.00	0.00	0.00	12.84	0.00	0.00	5.78	12.84	45.00%	B	0.45	0.74
F4	6.24	0.00	29.80	15.77	0.00	0.00	24.11	51.81	46.54%	B	0.37	0.64
<b>Pond F</b>								<b>166.02</b>	<b>44.02%</b>			
G1	4.88	0.00	0.00	15.25	0.00	0.00	7.35	20.13	36.52%	B	0.25	0.66
G2	0.00	0.00	0.00	0.00	15.14	0.00	3.79	15.14	25.00%	B	0.45	0.74
<b>Pond G</b>								<b>35.27</b>	<b>31.57%</b>			
H1	0.70	0.00	0.00	0.00	20.01	0.00	5.07	20.71	24.49%	A	0.38	0.75
H2	0.70	0.00	0.00	17.85	0.00	0.00	8.10	18.55	43.68%	B	0.43	0.75
H3	0.76	0.00	0.00	5.25	0.00	0.00	2.44	6.01	40.57%	B	0.4	0.72
H4	5.34	0.00	0.00	22.31	0.00	0.00	10.57	27.65	38.24%	B	0.37	0.7
<b>Pond H</b>								<b>72.92</b>	<b>35.91%</b>			

**Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)**

Catchment Name/ID	User Comment for Catchment	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
		CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f.)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
A1		0.157	0.143	37.3	5.59	19.4	3.95	9.3	57	164,729	0.25	40,666	35.0	13	40,592	0.29
B1		0.158	0.131	33.0	4.82	17.2	3.41	8.0	53	134,310	0.08	11,390	35.0	4	11,363	0.12
B2		0.158	0.109	58.5	6.42	30.4	4.54	10.7	20	90,351	0.08	7,662	40.0	2	7,665	0.07
B3		0.158	0.221	39.1	8.15	20.3	5.76	13.6	142	431,607	0.08	36,602	40.0	12	36,572	0.10
C1		0.158	0.183	30.3	5.75	15.7	4.06	9.6	120	281,797	0.08	23,898	35.0	10	23,870	0.13
D1		0.157	0.108	31.5	4.11	16.4	2.91	6.9	36	88,318	0.25	21,803	35.0	8	21,721	0.33
D2		0.157	0.182	37.7	6.77	19.6	4.78	11.3	97	282,777	0.25	69,809	40.0	22	69,820	0.29
E1		0.157	0.193	28.9	5.77	15.0	4.08	9.6	144	321,618	0.25	79,397	35.0	32	79,287	0.37
F1		0.157	0.125	37.2	5.07	19.4	3.58	8.5	42	122,440	0.25	30,227	35.0	10	30,151	0.29
F2		0.157	0.171	45.1	7.42	23.5	5.24	12.4	70	245,533	0.25	60,614	40.0	16	60,563	0.24
F3		0.157	0.081	37.8	3.84	19.6	2.72	6.4	16	46,609	0.25	11,506	35.0	4	11,472	0.28
F4		0.157	0.151	43.2	6.52	22.5	4.61	10.9	56	186,981	0.25	46,160	40.0	13	46,174	0.25
G1		0.157	0.099	38.8	4.45	20.2	3.14	7.4	24	73,072	0.25	18,039	35.0	6	17,996	0.28
G2		0.157	0.087	42.3	4.33	22.0	3.06	7.2	17	54,958	0.25	13,567	35.0	4	13,536	0.26
H1		0.158	0.101	43.7	4.89	22.7	3.45	8.1	22	75,177	0.08	6,375	35.0	2	6,365	0.09
H2		0.157	0.095	37.0	4.21	19.2	2.97	7.0	24	67,337	0.25	16,623	35.0	5	16,581	0.29
H3		0.157	0.057	32.6	2.94	16.9	2.08	4.9	9	21,816	0.25	5,384	35.0	2	5,324	0.32
H4		0.157	0.114	36.7	4.72	19.1	3.33	7.9	35	100,370	0.25	24,778	35.0	8	24,718	0.29





**Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)**

Catchment Name/ID	User Comment for Catchment	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
		CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f.)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
A1		0.156	0.142	37.3	5.57	19.4	3.93	9.3	57	164,729	1.56	257,605	45.0	67	257,125	1.47
B1		0.157	0.130	33.0	4.80	17.2	3.39	8.0	53	134,310	1.17	157,714	40.0	49	157,336	1.32
B2		0.157	0.109	58.5	6.39	30.4	4.52	10.6	20	90,351	1.17	106,094	50.0	21	106,130	0.83
B3		0.157	0.220	39.1	8.11	20.3	5.73	13.5	142	431,607	1.17	506,815	45.0	140	506,418	1.18
C1		0.157	0.182	30.3	5.72	15.7	4.04	9.5	120	281,797	1.17	330,900	40.0	111	330,490	1.43
D1		0.156	0.107	31.5	4.10	16.4	2.90	6.8	36	88,318	1.56	138,112	40.0	40	137,590	1.64
D2		0.156	0.181	37.7	6.75	19.6	4.77	11.2	97	282,777	1.56	442,208	45.0	115	442,279	1.47
E1		0.156	0.192	28.8	5.76	15.0	4.07	9.6	144	321,618	1.56	502,948	40.0	158	502,220	1.78
F1		0.156	0.124	37.2	5.06	19.4	3.57	8.4	42	122,440	1.56	191,472	45.0	49	190,993	1.47
F2		0.156	0.170	45.1	7.40	23.5	5.23	12.3	70	245,533	1.56	383,966	50.0	87	383,641	1.28
F3		0.156	0.081	37.7	3.83	19.6	2.71	6.4	16	46,609	1.56	72,888	45.0	18	72,670	1.43
F4		0.156	0.150	43.2	6.50	22.5	4.59	10.8	56	186,981	1.56	292,403	45.0	68	292,494	1.32
G1		0.156	0.099	38.8	4.44	20.2	3.14	7.4	24	73,072	1.56	114,270	45.0	28	113,996	1.41
G2		0.156	0.087	42.3	4.31	22.0	3.05	7.2	17	54,958	1.56	85,944	45.0	20	85,743	1.32
H1		0.157	0.100	43.7	4.86	22.7	3.44	8.1	22	75,177	1.17	88,277	45.0	22	88,139	1.06
H2		0.156	0.095	37.0	4.20	19.2	2.97	7.0	24	67,337	1.56	105,301	45.0	27	105,031	1.46
H3		0.156	0.057	32.6	2.93	16.9	2.07	4.9	9	21,816	1.56	34,116	40.0	10	33,729	1.58
H4		0.156	0.114	36.7	4.70	19.1	3.32	7.8	35	100,370	1.56	156,958	45.0	41	156,578	1.48







**Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)**

Catchment Name/ID	User Comment for Catchment	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
		CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f.)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
A1		0.097	0.131	25.0	4.03	13.0	2.84	6.7	85	164,729	0.57	94,676	35.0	31	94,308	0.68
B1		0.092	0.139	18.2	3.44	9.5	2.43	5.7	95	134,310	0.58	77,837	30.0	29	77,220	0.80
B2		0.093	0.113	33.3	4.40	17.3	3.11	7.3	35	90,351	0.56	50,405	35.0	12	50,284	0.48
B3		0.109	0.171	35.1	6.09	18.2	4.30	10.2	159	431,607	0.31	135,184	35.0	37	135,109	0.31
C1		0.089	0.205	15.3	3.91	7.9	2.76	6.5	238	281,797	0.64	181,072	30.0	76	180,336	0.97
D1		0.092	0.115	17.3	3.03	9.0	2.14	5.1	66	88,318	0.67	59,557	30.0	24	58,560	0.99
D2		0.084	0.229	15.9	4.30	8.3	3.04	7.2	229	282,777	0.87	246,138	30.0	98	245,292	1.26
E1		0.114	0.151	26.8	4.61	13.9	3.25	7.7	155	321,618	0.41	131,675	35.0	47	131,227	0.53
F1		0.107	0.097	32.8	3.94	17.1	2.78	6.6	48	122,440	0.47	56,968	35.0	16	56,751	0.48
F2		0.088	0.198	21.9	4.83	11.4	3.41	8.1	145	245,533	0.75	184,862	35.0	60	183,986	0.89
F3		0.092	0.087	20.4	2.87	10.6	2.03	4.8	30	46,609	0.68	31,862	30.0	11	31,302	0.88
F4		0.121	0.121	41.5	5.37	21.6	3.79	8.9	58	186,981	0.36	67,763	35.0	17	67,675	0.34
G1		0.096	0.093	25.2	3.31	13.1	2.34	5.5	37	73,072	0.59	43,083	30.0	14	42,758	0.68
G2		0.107	0.067	37.3	3.43	19.4	2.42	5.7	19	54,958	0.47	25,571	35.0	7	25,468	0.43
H1		0.109	0.078	39.3	3.85	20.4	2.72	6.4	25	75,177	0.31	23,258	35.0	6	23,195	0.27
H2		0.092	0.101	20.5	3.09	10.6	2.18	5.2	42	67,337	0.67	45,076	30.0	16	44,528	0.88
H3		0.094	0.058	19.2	2.36	10.0	1.67	3.9	15	21,816	0.64	13,878	30.0	5	13,432	0.87
H4		0.095	0.111	22.8	3.45	11.9	2.44	5.7	57	100,370	0.61	61,173	30.0	21	60,592	0.76

5-Year Post Development CUHP Output

**Printouts for Unit Hydrographs**

flow in cfs

time in minutes	A1	B1	B2	B3	C1	D1	D2	E1	F1	F2	F3	F4	G1	G2	H1	H2	H3	H4
5	77.33	93.25	30.09	102.59	220.53	65.84	199.90	128.93	44.36	115.64	29.50	42.62	37.03	18.62	23.03	42.42	14.61	55.54
10	82.78	86.57	34.71	158.92	211.37	57.29	212.53	153.31	47.44	142.37	26.77	58.18	35.84	18.73	24.44	38.99	12.72	53.96
15	70.87	64.60	32.47	154.15	146.87	42.55	148.71	136.86	43.94	117.23	20.78	56.54	30.18	17.61	23.25	30.20	9.82	43.13
20	57.63	49.16	28.07	139.10	107.74	32.08	108.63	110.77	37.50	92.72	16.66	52.59	24.96	15.66	21.07	24.25	7.67	35.72
25	47.82	39.67	24.21	116.79	80.83	25.68	83.75	93.90	32.69	72.89	13.46	46.34	20.75	13.62	18.22	19.53	6.26	28.56
30	39.89	30.81	21.23	103.58	53.91	19.28	58.88	77.26	28.57	61.39	11.05	41.06	17.44	12.21	16.48	16.06	5.00	24.34
35	34.20	21.94	18.25	90.37	40.79	13.08	41.89	67.52	24.45	50.16	8.64	37.09	14.97	10.80	14.74	12.59	3.73	20.17
40	28.51	17.08	16.20	78.14	31.82	10.94	33.60	57.77	21.87	38.93	6.23	33.12	12.50	9.45	13.00	9.12	2.78	16.00
45	22.81	14.12	14.45	70.52	22.85	8.81	25.30	48.03	19.44	28.50	5.21	29.15	10.02	8.61	11.70	7.55	2.35	11.83
50	17.12	11.17	12.70	62.89	13.88	6.68	17.01	38.28	17.01	24.76	4.40	26.80	7.55	7.77	10.67	6.39	1.93	10.13
55	15.14	8.21	10.96	55.26	4.91	4.55	8.72	30.20	14.58	21.02	3.60	24.47	6.69	6.93	9.63	5.24	1.51	8.74
60	13.25	5.26	9.21	47.63	0.00	2.41	0.43	26.95	12.15	17.28	2.80	22.14	5.86	6.09	8.60	4.08	1.09	7.35
65	11.35	2.30	7.46	40.01		0.28	0.00	23.70	9.73	13.53	1.99	19.80	5.04	5.25	7.56	2.92	0.66	5.96
70	9.45	0.00	6.57	32.38		0.00		20.45	8.85	9.79	1.19	17.47	4.21	4.41	6.53	1.77	0.24	4.57
75	7.55		5.99	29.45				17.20	8.04	6.05	0.39	15.14	3.39	3.73	5.49	0.61	0.00	3.18
80	5.65		5.41	26.90				13.96	7.23	2.30	0.00	12.80	2.56	3.45	4.78	0.00		1.79
85	3.76		4.83	24.36				10.71	6.42	0.00		11.25	1.74	3.17	4.43			0.40
90	1.86		4.24	21.82				7.46	5.61			10.48	0.92	2.89	4.09			0.00
95	0.00		3.66	19.28				4.21	4.80			9.70	0.09	2.61	3.74			
100			3.08	16.73				0.96	3.99			8.92	0.00	2.33	3.40			
105			2.50	14.19				0.00	3.18			8.14		2.05	3.05			
110			1.91	11.65					2.37			7.37		1.77	2.71			
115			1.33	9.11					1.57			6.59		1.49	2.36			
120			0.75	6.57					0.76			5.81		1.21	2.02			
125			0.16	4.02					0.00			5.03		0.93	1.67			
130			0.00	1.48								4.25		0.65	1.33			
135				0.00								3.48		0.37	0.98			
140												2.70		0.09	0.64			
145												1.92		0.00	0.29			
150												1.14			0.00			
155												0.37						
160												0.00						



**Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)**

Catchment Name/ID	User Comment for Catchment	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
		CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
A1		0.096	0.134	24.4	4.01	12.7	2.83	6.7	87	164,729	1.93	317,756	40.0	101	316,720	2.22
B1		0.091	0.141	17.8	3.42	9.2	2.42	5.7	98	134,310	1.82	243,813	35.0	97	241,630	2.62
B2		0.092	0.115	32.5	4.38	16.9	3.09	7.3	36	90,351	1.79	161,555	40.0	42	161,041	1.70
B3		0.089	0.250	19.5	5.26	10.2	3.72	8.8	285	431,607	1.88	813,554	40.0	295	807,930	2.48
C1		0.088	0.210	14.7	3.88	7.6	2.74	6.5	247	281,797	1.91	539,141	35.0	238	535,192	3.07
D1		0.092	0.116	17.1	3.02	8.9	2.14	5.0	67	88,318	2.03	179,570	35.0	70	176,587	2.88
D2		0.083	0.230	15.8	4.30	8.2	3.04	7.2	231	282,777	2.25	634,968	35.0	252	632,818	3.24
E1		0.113	0.150	26.5	4.56	13.8	3.23	7.6	157	321,618	1.75	563,176	40.0	178	561,356	2.01
F1		0.106	0.096	32.4	3.90	16.9	2.76	6.5	49	122,440	1.81	221,916	40.0	59	221,037	1.75
F2		0.088	0.199	21.7	4.82	11.3	3.40	8.0	146	245,533	2.12	520,116	40.0	171	517,601	2.53
F3		0.091	0.088	20.1	2.86	10.5	2.02	4.8	30	46,609	2.04	95,234	35.0	33	93,473	2.56
F4		0.090	0.168	22.4	4.39	11.7	3.10	7.3	108	186,981	2.06	385,413	40.0	125	383,174	2.42
G1		0.095	0.095	24.6	3.29	12.8	2.33	5.5	38	73,072	1.94	142,048	40.0	44	140,977	2.18
G2		0.106	0.067	36.8	3.40	19.2	2.41	5.7	19	54,958	1.81	99,609	45.0	24	99,196	1.58
H1		0.107	0.078	38.6	3.80	20.1	2.69	6.3	25	75,177	1.49	111,730	45.0	28	111,424	1.33
H2		0.092	0.102	20.2	3.08	10.5	2.18	5.1	43	67,337	2.03	136,549	35.0	48	134,796	2.57
H3		0.093	0.059	18.9	2.36	9.8	1.66	3.9	15	21,816	1.99	43,454	35.0	16	42,019	2.60
H4		0.094	0.113	22.3	3.44	11.6	2.43	5.7	58	100,370	1.96	197,106	35.0	65	195,054	2.34



CUHP 100-Year Post Development

**Printouts for Unit Hydrographs**

flow in cfs

time in minutes	A1	B1	B2	B3	C1	D1	D2	E1	F1	F2	F3	F4	G1	G2	H1	H2	H3	H4
5	79.48	95.51	30.93	212.33	229.82	66.81	201.50	131.02	45.09	117.17	29.92	92.63	37.90	18.89	23.57	43.06	14.85	56.70
10	84.67	87.92	35.54	282.68	215.27	57.76	213.46	154.59	47.98	143.83	27.05	104.96	36.56	18.95	24.84	39.42	12.85	54.86
15	71.63	65.18	33.09	218.45	147.65	42.75	148.95	137.43	44.32	117.53	20.92	85.95	30.43	17.77	23.57	30.43	9.89	43.38
20	58.21	48.97	28.30	170.33	107.98	32.20	108.75	111.17	37.59	92.99	16.68	69.02	25.18	15.74	21.25	24.29	7.66	35.92
25	47.87	39.61	24.48	132.75	78.94	25.61	83.53	93.98	32.85	72.85	13.48	54.84	20.77	13.71	18.39	19.57	6.27	28.68
30	40.08	30.32	21.34	107.50	49.89	19.02	58.31	77.43	28.63	61.37	11.00	46.28	17.51	12.26	16.59	16.00	4.96	24.34
35	34.09	21.04	18.21	82.24	39.94	13.05	41.79	67.50	24.41	49.89	8.52	38.16	14.92	10.82	14.79	12.42	3.65	20.00
40	28.10	16.93	16.26	57.04	30.26	10.85	33.38	57.58	21.90	38.40	6.04	30.04	12.33	9.48	12.98	8.85	2.77	15.66
45	22.11	13.83	14.43	48.62	20.58	8.66	24.98	47.65	19.41	28.45	5.18	21.93	9.74	8.62	11.74	7.51	2.33	11.51
50	16.99	10.74	12.59	40.20	10.90	6.46	16.57	37.72	16.92	24.63	4.35	18.95	7.50	7.76	10.67	6.32	1.89	10.06
55	15.00	7.64	10.76	31.78	1.22	4.26	8.16	30.14	14.43	20.80	3.52	16.25	6.63	6.90	9.60	5.12	1.46	8.61
60	13.00	4.55	8.92	23.36	0.00	2.07	0.00	26.83	11.95	16.97	2.70	13.54	5.77	6.04	8.53	3.93	1.02	7.17
65	11.00	1.45	7.15	14.94		0.00		23.53	9.65	13.14	1.87	10.83	4.91	5.18	7.46	2.74	0.58	5.72
70	9.01	0.00	6.53	6.53				20.22	8.82	9.32	1.04	8.13	4.04	4.32	6.39	1.55	0.15	4.27
75	7.01		5.92	0.00				16.91	7.99	5.49	0.22	5.42	3.18	3.72	5.32	0.36	0.00	2.82
80	5.01		5.31					13.60	7.16	1.66	0.00	2.72	2.31	3.43	4.76	0.00		1.38
85	3.02		4.70					10.29	6.33	0.00		0.01	1.45	3.15	4.41			0.00
90	1.02		4.09					6.98	5.50			0.00	0.59	2.86	4.05			
95	0.00		3.47					3.67	4.67				0.00	2.57	3.69			
100			2.86					0.36	3.84					2.29	3.34			
105			2.25					0.00	3.01					2.00	2.98			
110			1.64						2.18					1.71	2.62			
115			1.03						1.35					1.43	2.27			
120			0.41						0.52					1.14	1.91			
125			0.00						0.00					0.85	1.55			
130														0.57	1.19			
135														0.28	0.84			
140														0.00	0.48			
145															0.12			
150															0.00			



## Appendix C



SWMM Model Pre Development 5 Year

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

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SWMM Pre Development 5 Year

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NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
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\*\*\*\*\*  
Analysis Options  
\*\*\*\*\*

Flow Units ..... CFS  
Process Models:  
  Rainfall/Runoff ..... NO  
  RDII ..... NO  
  Snowmelt ..... NO  
  Groundwater ..... NO  
  Flow Routing ..... YES  
  Ponding Allowed ..... NO  
  Water Quality ..... NO  
Flow Routing Method ..... KINWAVE  
Starting Date ..... 01/01/2005 00:00:00  
Ending Date ..... 01/01/2005 06:00:00  
Antecedent Dry Days ..... 0.0  
Report Time Step ..... 00:05:00  
Routing Time Step ..... 30.00 sec

*****	Volume	Volume
Flow Routing Continuity	acre-feet	10^6 gal
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.000	0.000
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	12.024	3.918
External Outflow .....	12.024	3.918
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	-0.002	

SWMM Model Pre Development 5 Year

\*\*\*\*\*  
 Highest Flow Instability Indexes  
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All links are stable.

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 Routing Time Step Summary  
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Minimum Time Step : 30.00 sec  
 Average Time Step : 30.00 sec  
 Maximum Time Step : 30.00 sec  
 Percent in Steady State : 0.00  
 Average Iterations per Step : 1.00  
 Percent Not Converging : 0.00

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 Node Depth Summary  
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Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
10	JUNCTION	0.00	0.00	6975.00	0 00:00	0.00
20	JUNCTION	0.00	0.00	6982.00	0 00:00	0.00
21	JUNCTION	0.00	0.00	6953.00	0 00:00	0.00
22	JUNCTION	0.00	0.00	6936.00	0 00:00	0.00
23	JUNCTION	0.08	0.31	6945.31	0 00:35	0.30
24	JUNCTION	0.10	0.44	6934.44	0 00:40	0.44
30	JUNCTION	0.00	0.00	6985.00	0 00:00	0.00
40	JUNCTION	0.00	0.00	6918.00	0 00:00	0.00
41	JUNCTION	0.00	0.00	6888.00	0 00:00	0.00
42	JUNCTION	0.10	0.48	6911.48	0 00:35	0.48
50	JUNCTION	0.00	0.00	6945.00	0 00:00	0.00
60	JUNCTION	0.00	0.00	6942.00	0 00:00	0.00
61	JUNCTION	0.00	0.00	6893.00	0 00:00	0.00
62	JUNCTION	0.00	0.00	6908.00	0 00:00	0.00
63	JUNCTION	0.00	0.00	6882.00	0 00:00	0.00
64	JUNCTION	0.11	0.48	6900.48	0 00:35	0.48
65	JUNCTION	0.17	0.69	6880.69	0 00:36	0.69
66	JUNCTION	0.24	0.89	6868.89	0 00:40	0.89
70	JUNCTION	0.00	0.00	6923.00	0 00:00	0.00
71	JUNCTION	0.00	0.00	6908.00	0 00:00	0.00
72	JUNCTION	0.00	0.00	6904.00	0 00:00	0.00
73	JUNCTION	0.11	0.43	6902.43	0 00:35	0.42

SWMM Model Pre Development 5 Year

80	JUNCTION	0.00	0.00	6890.00	0	00:00	0.00
81	JUNCTION	0.00	0.00	6896.00	0	00:00	0.00
82	JUNCTION	0.00	0.00	6886.00	0	00:00	0.00
83	JUNCTION	0.00	0.00	6878.00	0	00:00	0.00
84	JUNCTION	0.11	0.48	6872.48	0	00:35	0.47
85	JUNCTION	0.06	0.30	6874.30	0	00:35	0.30
PondC	JUNCTION	0.00	0.00	6956.00	0	00:00	0.00
PondA	JUNCTION	0.00	0.00	6949.00	0	00:00	0.00
PondB	JUNCTION	0.11	0.44	6911.44	0	00:41	0.43
PondE	JUNCTION	0.00	0.00	6923.00	0	00:00	0.00
PondG	JUNCTION	0.11	0.42	6900.42	0	00:36	0.42
PondH	JUNCTION	0.11	0.47	6866.47	0	00:36	0.47
PondF	JUNCTION	0.24	0.89	6866.89	0	00:41	0.88
PondD	JUNCTION	0.10	0.48	6881.48	0	00:37	0.47
Outfall12	OUTFALL	0.00	0.00	6910.00	0	00:00	0.00
Outfall11	OUTFALL	0.00	0.00	6947.00	0	00:00	0.00
Outfall14	OUTFALL	0.00	0.00	6865.00	0	00:00	0.00
Outfall13	OUTFALL	0.00	0.00	6880.00	0	00:00	0.00
31	OUTFALL	0.00	0.00	6953.00	0	00:00	0.00
51	OUTFALL	0.00	0.00	6920.00	0	00:00	0.00
74	OUTFALL	0.00	0.00	6897.00	0	00:00	0.00
67	OUTFALL	0.00	0.00	6865.50	0	00:00	0.00

\*\*\*\*\*  
Node Inflow Summary  
\*\*\*\*\*

Total Flow		Maximum Lateral	Maximum Total	Time of Max Occurrence	Lateral Inflow Volume
Inflow Volume	Balance Error	Inflow CFS	Inflow CFS	days hr:min	10^6 gal
Node gal	Percent	Type			10^6
10	0.304	JUNCTION	13.03	0 00:35	0.304
20	0.085	JUNCTION	4.33	0 00:35	0.085
21	0.0573	JUNCTION	1.66	0 00:40	0.0573

SWMM Model Pre Development 5 Year

22		JUNCTION	11.85	11.85	0	00:40	0.274
0.274	0.000						
23		JUNCTION	0.00	5.99	0	00:35	0
0.142	0.000						
24		JUNCTION	0.00	11.85	0	00:40	0
0.274	0.000						
30		JUNCTION	9.95	9.95	0	00:35	0.179
0.179	0.000						
40		JUNCTION	8.12	8.12	0	00:35	0.162
0.162	0.000						
41		JUNCTION	22.23	22.23	0	00:40	0.522
0.522	0.000						
42		JUNCTION	0.00	8.12	0	00:35	0
0.162	0.000						
50		JUNCTION	32.34	32.34	0	00:35	0.593
0.593	0.000						
60		JUNCTION	9.70	9.70	0	00:35	0.226
0.226	0.000						
61		JUNCTION	16.46	16.46	0	00:40	0.453
0.453	0.000						
62		JUNCTION	3.65	3.65	0	00:35	0.0858
0.0858	0.000						
63		JUNCTION	12.98	12.98	0	00:40	0.345
0.345	0.000						
64		JUNCTION	0.00	13.35	0	00:35	0
0.311	0.000						
65		JUNCTION	0.00	26.04	0	00:36	0
0.657	0.000						
66		JUNCTION	0.00	16.46	0	00:40	0
0.453	0.000						
70		JUNCTION	5.57	5.57	0	00:35	0.135
0.135	0.000						
71		JUNCTION	3.87	3.87	0	00:35	0.101
0.101	0.000						
72		JUNCTION	0.00	3.87	0	00:35	0
0.101	0.000						
73		JUNCTION	0.00	3.87	0	00:35	0
0.101	0.000						
80		JUNCTION	1.85	1.85	0	00:35	0.0476
0.0476	0.000						
81		JUNCTION	5.37	5.37	0	00:35	0.124
0.124	0.000						
82		JUNCTION	1.92	1.92	0	00:35	0.0398
0.0398	0.000						
83		JUNCTION	8.07	8.07	0	00:35	0.185
0.185	0.000						
84		JUNCTION	0.00	7.22	0	00:35	0
0.172	0.000						

SWMM Model Pre Development 5 Year

85		JUNCTION	0.00	1.92	0	00:35	0
0.0398	0.000						
PondC		JUNCTION	0.00	9.95	0	00:35	0
0.179	0.000						
PondA		JUNCTION	0.00	13.03	0	00:35	0
0.304	0.000						
PondB		JUNCTION	0.00	17.56	0	00:41	0
0.416	0.000						
PondE		JUNCTION	0.00	32.34	0	00:35	0
0.593	0.000						
PondG		JUNCTION	0.00	9.42	0	00:36	0
0.236	0.000						
PondH		JUNCTION	0.00	17.11	0	00:36	0
0.397	0.000						
PondF		JUNCTION	0.00	42.32	0	00:41	0
1.11	0.000						
PondD		JUNCTION	0.00	30.00	0	00:38	0
0.685	0.000						
Outfall2		OUTFALL	0.00	17.56	0	00:41	0
0.416	0.000						
Outfall1		OUTFALL	0.00	13.03	0	00:35	0
0.304	0.000						
Outfall4		OUTFALL	0.00	17.11	0	00:36	0
0.397	0.000						
Outfall3		OUTFALL	0.00	30.00	0	00:38	0
0.685	0.000						
31		OUTFALL	0.00	9.95	0	00:35	0
0.179	0.000						
51		OUTFALL	0.00	32.34	0	00:35	0
0.593	0.000						
74		OUTFALL	0.00	9.42	0	00:36	0
0.236	0.000						
67		OUTFALL	0.00	42.32	0	00:41	0
1.11	0.000						

\*\*\*\*\*  
Node Flooding Summary  
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No nodes were flooded.

\*\*\*\*\*  
Outfall Loading Summary  
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Outfall Node	SWMM Model Pre Development 5 Year			
	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10 <sup>6</sup> gal
Outfall2	67.36	3.82	17.56	0.416
Outfall11	55.28	3.40	13.03	0.304
Outfall4	59.31	4.14	17.11	0.397
Outfall3	60.56	7.00	30.00	0.685
31	50.97	2.17	9.95	0.179
51	51.53	7.12	32.34	0.593
74	58.61	2.49	9.42	0.236
67	65.97	10.41	42.32	1.110
System	58.70	40.55	169.75	3.918

\*\*\*\*\*  
Link Flow Summary  
\*\*\*\*\*

Link	Type	Maximum  Flow  CFS	Time of Max Occurrence days hr:min	Maximum  Veloc  ft/sec	Max/ Full Flow	Max/ Full Depth
100	DUMMY	13.03	0 00:35			
200	DUMMY	4.33	0 00:35			
201	DUMMY	1.66	0 00:40			
202	CONDUIT	5.95	0 00:36	10.09	0.00	0.04
204	DUMMY	11.85	0 00:40			
205	CONDUIT	11.83	0 00:41	11.82	0.01	0.06
300	DUMMY	9.95	0 00:35			
400	DUMMY	8.12	0 00:35			
401	CONDUIT	8.03	0 00:37	8.38	0.02	0.10
402	DUMMY	22.23	0 00:40			
500	DUMMY	32.34	0 00:35			
601	DUMMY	16.46	0 00:40			
602	CONDUIT	16.42	0 00:41	6.99	0.07	0.18
603	DUMMY	9.70	0 00:35			
604	DUMMY	3.65	0 00:35			
605	CONDUIT	13.32	0 00:36	11.62	0.01	0.07
606	DUMMY	12.98	0 00:40			
607	CONDUIT	26.04	0 00:36	12.42	0.02	0.09
700	DUMMY	5.57	0 00:35			
701	DUMMY	3.87	0 00:35			
702	DUMMY	3.87	0 00:35			
703	CONDUIT	3.86	0 00:36	4.80	0.01	0.08
801	DUMMY	1.85	0 00:35			

SWMM Model Pre Development 5 Year

802	DUMMY	5.37	0	00:35			
803	CONDUIT	7.18	0	00:36	6.34	0.01	0.07
804	DUMMY	1.92	0	00:35			
806	DUMMY	8.07	0	00:35			
805	CONDUIT	1.91	0	00:37	4.00	0.01	0.06
301	DUMMY	9.95	0	00:35			
101	DUMMY	13.03	0	00:35			
206	DUMMY	17.56	0	00:41			
501	DUMMY	32.34	0	00:35			
704	DUMMY	9.42	0	00:36			
807	DUMMY	17.11	0	00:36			
608	DUMMY	42.32	0	00:41			
403	DUMMY	30.00	0	00:38			

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Conduit Surcharge Summary

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No conduits were surcharged.

Analysis begun on: Fri Apr 10 17:42:01 2020

Analysis ended on: Fri Apr 10 17:42:01 2020

Total elapsed time: < 1 sec

SWMM 5 Year Output Ex 9-21-20

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
 \*\*\*\*\*

\*\*\*\*\*  
 Analysis Options  
 \*\*\*\*\*

Flow Units ..... CFS  
 Process Models:  
   Rainfall/Runoff ..... NO  
   RDII ..... NO  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... YES  
   Ponding Allowed ..... NO  
   Water Quality ..... NO  
 Flow Routing Method ..... KINWAVE  
 Starting Date ..... 01/01/2005 00:00:00  
 Ending Date ..... 01/01/2005 06:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 00:05:00  
 Routing Time Step ..... 30.00 sec

*****	Volume	Volume
Flow Routing Continuity	acre-feet	10 <sup>6</sup> gal
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.000	0.000
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	193.874	63.177
External Outflow .....	193.874	63.177
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	-0.000	



SWMM 5 Year Output Ex 9-21-20

\*\*\*\*\*  
 Highest Flow Instability Indexes  
 \*\*\*\*\*

Link 205 (1)  
 Link 206 (1)

\*\*\*\*\*  
 Routing Time Step Summary  
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Minimum Time Step : 30.00 sec  
 Average Time Step : 30.00 sec  
 Maximum Time Step : 30.00 sec  
 Percent in Steady State : 0.00  
 Average Iterations per Step : 1.00  
 Percent Not Converging : 0.00

\*\*\*\*\*  
 Node Depth Summary  
 \*\*\*\*\*

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
10	JUNCTION	0.00	0.00	6975.00	0 00:00	0.00
20	JUNCTION	0.00	0.00	6982.00	0 00:00	0.00
21	JUNCTION	0.00	0.00	6953.00	0 00:00	0.00
22	JUNCTION	0.00	0.00	6936.00	0 00:00	0.00
23	JUNCTION	0.08	0.31	6945.31	0 00:35	0.30
24	JUNCTION	0.13	0.58	6934.58	0 00:40	0.58
30	JUNCTION	0.00	0.00	6985.00	0 00:00	0.00
40	JUNCTION	0.00	0.00	6918.00	0 00:00	0.00
41	JUNCTION	0.00	0.00	6888.00	0 00:00	0.00
42	JUNCTION	0.10	0.48	6911.48	0 00:35	0.48
50	JUNCTION	0.00	0.00	6945.00	0 00:00	0.00
60	JUNCTION	0.00	0.00	6942.00	0 00:00	0.00
61	JUNCTION	0.00	0.00	6893.00	0 00:00	0.00
62	JUNCTION	0.00	0.00	6908.00	0 00:00	0.00
63	JUNCTION	0.00	0.00	6882.00	0 00:00	0.00
64	JUNCTION	0.11	0.48	6900.48	0 00:35	0.48
65	JUNCTION	0.17	0.69	6880.69	0 00:36	0.69
66	JUNCTION	0.24	0.89	6868.89	0 00:40	0.89
70	JUNCTION	0.00	0.00	6923.00	0 00:00	0.00
71	JUNCTION	0.00	0.00	6908.00	0 00:00	0.00
72	JUNCTION	0.00	0.00	6904.00	0 00:00	0.00

SWMM 5 Year Output Ex 9-21-20

73	JUNCTION	0.11	0.43	6902.43	0	00:35	0.42
80	JUNCTION	0.00	0.00	6890.00	0	00:00	0.00
81	JUNCTION	0.00	0.00	6896.00	0	00:00	0.00
82	JUNCTION	0.00	0.00	6886.00	0	00:00	0.00
83	JUNCTION	0.00	0.00	6878.00	0	00:00	0.00
84	JUNCTION	0.11	0.48	6872.48	0	00:35	0.47
85	JUNCTION	0.06	0.30	6874.30	0	00:35	0.30
PondC	JUNCTION	0.00	0.00	6956.00	0	00:00	0.00
PondA	JUNCTION	0.00	0.00	6949.00	0	00:00	0.00
PondB	JUNCTION	0.13	0.58	6911.58	0	00:40	0.58
PondE	JUNCTION	0.00	0.00	6923.00	0	00:00	0.00
PondG	JUNCTION	0.11	0.42	6900.42	0	00:36	0.42
PondH	JUNCTION	0.11	0.47	6866.47	0	00:36	0.47
PondF	JUNCTION	0.24	0.89	6866.89	0	00:41	0.88
PondD	JUNCTION	0.10	0.48	6881.48	0	00:37	0.47
31	JUNCTION	0.00	0.00	6953.00	0	00:00	0.00
51	JUNCTION	0.00	0.00	6920.00	0	00:00	0.00
67	JUNCTION	0.00	0.00	6865.50	0	00:00	0.00
74	JUNCTION	0.00	0.00	6897.00	0	00:00	0.00
OS1	JUNCTION	0.00	0.00	6950.00	0	00:00	0.00
OS2	JUNCTION	0.00	0.00	6924.00	0	00:00	0.00
OS3	JUNCTION	0.00	0.00	6930.00	0	00:00	0.00
OS4	JUNCTION	0.00	0.00	6905.00	0	00:00	0.00
Outfall2	OUTFALL	0.00	0.00	6910.00	0	00:00	0.00
Outfall1	OUTFALL	0.00	0.00	6947.00	0	00:00	0.00
Outfall4	OUTFALL	0.00	0.00	6865.00	0	00:00	0.00
Outfall3	OUTFALL	0.00	0.00	6880.00	0	00:00	0.00

\*\*\*\*\*  
Node Inflow Summary  
\*\*\*\*\*

Total Inflow Volume		Flow Balance Error	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence	Lateral Inflow Volume
gal	Percent			CFS	CFS	days hr:min	10^6 gal
10			JUNCTION	13.03	13.03	0 00:35	0.304

SWMM 5 Year Output Ex 9-21-20

0.304	0.000						
20		JUNCTION	4.33	4.33	0	00:35	0.085
0.085	0.000						
21		JUNCTION	1.66	1.66	0	00:40	0.0573
0.0573	0.000						
22		JUNCTION	11.85	11.85	0	00:40	0.274
0.274	0.000						
23		JUNCTION	0.00	5.99	0	00:35	0
0.142	0.000						
24		JUNCTION	0.00	21.23	0	00:40	0
0.452	0.000						
30		JUNCTION	9.95	9.95	0	00:35	0.179
0.179	0.000						
40		JUNCTION	8.12	8.12	0	00:35	0.162
0.162	0.000						
41		JUNCTION	22.23	22.23	0	00:40	0.522
0.522	0.000						
42		JUNCTION	0.00	8.12	0	00:35	0
0.162	0.000						
50		JUNCTION	32.34	32.34	0	00:35	0.593
0.593	0.000						
60		JUNCTION	9.70	9.70	0	00:35	0.226
0.226	0.000						
61		JUNCTION	16.46	16.46	0	00:40	0.453
0.453	0.000						
62		JUNCTION	3.65	3.65	0	00:35	0.0858
0.0858	0.000						
63		JUNCTION	12.98	12.98	0	00:40	0.345
0.345	0.000						
64		JUNCTION	0.00	13.35	0	00:35	0
0.311	0.000						
65		JUNCTION	0.00	26.04	0	00:36	0
0.657	0.000						
66		JUNCTION	0.00	16.46	0	00:40	0
0.453	0.000						
70		JUNCTION	5.57	5.57	0	00:35	0.135
0.135	0.000						
71		JUNCTION	3.87	3.87	0	00:35	0.101
0.101	0.000						
72		JUNCTION	0.00	3.87	0	00:35	0
0.101	0.000						
73		JUNCTION	0.00	3.87	0	00:35	0
0.101	0.000						
80		JUNCTION	1.85	1.85	0	00:35	0.0476
0.0476	0.000						
81		JUNCTION	5.37	5.37	0	00:35	0.124
0.124	0.000						
82		JUNCTION	1.92	1.92	0	00:35	0.0398

SWMM 5 Year Output Ex 9-21-20

0.0398	0.000						
83		JUNCTION	8.07	8.07	0	00:35	0.185
0.185	0.000						
84		JUNCTION	0.00	7.22	0	00:35	0
0.172	0.000						
85		JUNCTION	0.00	1.92	0	00:35	0
0.0398	0.000						
PondC		JUNCTION	0.00	9.95	0	00:35	0
0.179	0.000						
PondA		JUNCTION	0.00	13.03	0	00:35	0
0.304	0.000						
PondB		JUNCTION	0.00	26.96	0	00:40	0
0.594	0.000						
PondE		JUNCTION	0.00	32.34	0	00:35	0
0.593	0.000						
PondG		JUNCTION	0.00	189.42	0	00:36	0
29.3	0.000						
PondH		JUNCTION	0.00	17.11	0	00:36	0
0.397	0.000						
PondF		JUNCTION	0.00	42.32	0	00:41	0
1.11	0.000						
PondD		JUNCTION	0.00	30.00	0	00:38	0
0.685	0.000						
31		JUNCTION	0.00	9.95	0	00:35	0
0.179	0.000						
51		JUNCTION	0.00	93.34	0	00:35	0
10.4	0.000						
67		JUNCTION	0.00	231.47	0	00:40	0
30.4	0.000						
74		JUNCTION	0.00	189.42	0	00:36	0
29.3	0.000						
OS1		JUNCTION	67.00	67.00	0	00:00	10.8
10.8	0.000						
OS2		JUNCTION	59.00	59.00	0	00:00	9.53
9.53	0.000						
OS3		JUNCTION	61.00	61.00	0	00:00	9.86
9.85	0.000						
OS4		JUNCTION	180.00	180.00	0	00:00	29.1
29.1	0.000						
Outfall2		OUTFALL	0.00	85.96	0	00:40	0
10.1	0.000						
Outfall1		OUTFALL	0.00	80.03	0	00:35	0
11.1	0.000						
Outfall4		OUTFALL	0.00	341.05	0	00:36	0
41.2	0.000						
Outfall3		OUTFALL	0.00	30.00	0	00:38	0
0.685	0.000						

SWMM 5 Year Output Ex 9-21-20

\*\*\*\*\*  
 Node Flooding Summary  
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No nodes were flooded.

\*\*\*\*\*  
 Outfall Loading Summary  
 \*\*\*\*\*

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10 <sup>6</sup> gal
Outfall12	100.00	62.68	85.96	10.120
Outfall11	100.00	68.88	80.03	11.121
Outfall14	100.00	255.45	341.05	41.246
Outfall13	60.56	7.00	30.00	0.685
System	90.14	394.01	536.81	63.172

\*\*\*\*\*  
 Link Flow Summary  
 \*\*\*\*\*

Link	Type	Maximum  Flow  CFS	Time of Max Occurrence days hr:min	Maximum  Veloc  ft/sec	Max/ Full Flow	Max/ Full Depth
100	DUMMY	13.03	0 00:35			
200	DUMMY	4.33	0 00:35			
201	DUMMY	1.66	0 00:40			
202	CONDUIT	5.95	0 00:36	10.09	0.00	0.04
204	DUMMY	11.85	0 00:40			
205	CONDUIT	21.20	0 00:40	14.13	0.01	0.08
300	DUMMY	9.95	0 00:35			
400	DUMMY	8.12	0 00:35			
401	CONDUIT	8.03	0 00:37	8.38	0.02	0.10
402	DUMMY	22.23	0 00:40			
500	DUMMY	32.34	0 00:35			
601	DUMMY	16.46	0 00:40			
602	CONDUIT	16.42	0 00:41	6.99	0.07	0.18
603	DUMMY	9.70	0 00:35			

SWMM 5 Year Output Ex 9-21-20

604	DUMMY	3.65	0	00:35			
605	CONDUIT	13.32	0	00:36	11.62	0.01	0.07
606	DUMMY	12.98	0	00:40			
607	CONDUIT	26.04	0	00:36	12.42	0.02	0.09
700	DUMMY	5.57	0	00:35			
701	DUMMY	3.87	0	00:35			
702	DUMMY	3.87	0	00:35			
703	CONDUIT	3.86	0	00:36	4.80	0.01	0.08
801	DUMMY	1.85	0	00:35			
802	DUMMY	5.37	0	00:35			
803	CONDUIT	7.18	0	00:36	6.34	0.01	0.07
804	DUMMY	1.92	0	00:35			
806	DUMMY	8.07	0	00:35			
805	CONDUIT	1.91	0	00:37	4.00	0.01	0.06
301	DUMMY	9.95	0	00:35			
101	DUMMY	13.03	0	00:35			
206	DUMMY	26.96	0	00:40			
501	DUMMY	32.34	0	00:35			
704	DUMMY	189.42	0	00:36			
807	DUMMY	17.11	0	00:36			
608	DUMMY	42.32	0	00:41			
403	DUMMY	30.00	0	00:38			
41	DUMMY	9.95	0	00:35			
42	DUMMY	93.34	0	00:35			
43	DUMMY	231.47	0	00:40			
44	DUMMY	189.42	0	00:36			
45	DUMMY	180.00	0	00:00			
46	DUMMY	67.00	0	00:00			
47	DUMMY	59.00	0	00:00			
48	DUMMY	61.00	0	00:00			

\*\*\*\*\*  
 Conduit Surcharge Summary  
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No conduits were surcharged.

Analysis begun on: Mon Sep 21 16:32:27 2020  
 Analysis ended on: Mon Sep 21 16:32:27 2020  
 Total elapsed time: < 1 sec

SWMM Model Pre Development 100 Year

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

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SWMM 100 Year Pre Development

\*\*\*\*\*  
NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
\*\*\*\*\*

\*\*\*\*\*  
Analysis Options  
\*\*\*\*\*

Flow Units ..... CFS  
Process Models:  
  Rainfall/Runoff ..... NO  
  RDII ..... NO  
  Snowmelt ..... NO  
  Groundwater ..... NO  
  Flow Routing ..... YES  
  Ponding Allowed ..... NO  
  Water Quality ..... NO  
Flow Routing Method ..... KINWAVE  
Starting Date ..... 01/01/2005 00:00:00  
Ending Date ..... 01/01/2005 06:00:00  
Antecedent Dry Days ..... 0.0  
Report Time Step ..... 00:05:00  
Routing Time Step ..... 30.00 sec

*****	Volume	Volume
Flow Routing Continuity	acre-feet	10 <sup>6</sup> gal
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.000	0.000
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	82.644	26.931
External Outflow .....	82.609	26.919
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.043	

SWMM Model Pre Development 100 Year

\*\*\*\*\*  
 Highest Flow Instability Indexes  
 \*\*\*\*\*

Link 608 (1)

\*\*\*\*\*  
 Routing Time Step Summary  
 \*\*\*\*\*

Minimum Time Step : 30.00 sec  
 Average Time Step : 30.00 sec  
 Maximum Time Step : 30.00 sec  
 Percent in Steady State : 0.00  
 Average Iterations per Step : 1.04  
 Percent Not Converging : 0.00

\*\*\*\*\*  
 Node Depth Summary  
 \*\*\*\*\*

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
10	JUNCTION	0.00	0.00	6975.00	0 00:00	0.00
20	JUNCTION	0.00	0.00	6982.00	0 00:00	0.00
21	JUNCTION	0.00	0.00	6953.00	0 00:00	0.00
22	JUNCTION	0.00	0.00	6936.00	0 00:00	0.00
23	JUNCTION	0.21	0.59	6945.59	0 00:45	0.58
24	JUNCTION	0.36	1.43	6935.43	0 00:45	1.42
30	JUNCTION	0.00	0.00	6985.00	0 00:00	0.00
40	JUNCTION	0.00	0.00	6918.00	0 00:00	0.00
41	JUNCTION	0.00	0.00	6888.00	0 00:00	0.00
42	JUNCTION	0.24	1.05	6912.05	0 00:40	1.05
50	JUNCTION	0.00	0.00	6945.00	0 00:00	0.00
60	JUNCTION	0.00	0.00	6942.00	0 00:00	0.00
61	JUNCTION	0.00	0.00	6893.00	0 00:00	0.00
62	JUNCTION	0.00	0.00	6908.00	0 00:00	0.00
63	JUNCTION	0.00	0.00	6882.00	0 00:00	0.00
64	JUNCTION	0.27	1.04	6901.04	0 00:45	1.03
65	JUNCTION	0.43	1.52	6881.52	0 00:45	1.52
66	JUNCTION	0.61	2.08	6870.08	0 00:50	2.08
70	JUNCTION	0.00	0.00	6923.00	0 00:00	0.00
71	JUNCTION	0.00	0.00	6908.00	0 00:00	0.00
72	JUNCTION	0.00	0.00	6904.00	0 00:00	0.00
73	JUNCTION	0.27	0.94	6902.94	0 00:45	0.94



SWMM Model Pre Development 100 Year

80	JUNCTION	0.00	0.00	6890.00	0	00:00	0.00
81	JUNCTION	0.00	0.00	6896.00	0	00:00	0.00
82	JUNCTION	0.00	0.00	6886.00	0	00:00	0.00
83	JUNCTION	0.00	0.00	6878.00	0	00:00	0.00
84	JUNCTION	0.32	1.19	6873.19	0	00:45	1.18
85	JUNCTION	0.15	0.64	6874.64	0	00:40	0.64
PondC	JUNCTION	0.00	0.00	6956.00	0	00:00	0.00
PondA	JUNCTION	0.00	0.00	6949.00	0	00:00	0.00
PondB	JUNCTION	0.39	1.43	6912.43	0	00:46	1.42
PondE	JUNCTION	0.00	0.00	6923.00	0	00:00	0.00
PondG	JUNCTION	0.27	0.94	6900.94	0	00:46	0.94
PondH	JUNCTION	0.32	1.18	6867.18	0	00:46	1.18
PondF	JUNCTION	0.61	2.08	6868.08	0	00:51	2.08
PondD	JUNCTION	0.25	1.05	6882.05	0	00:42	1.05
Outfall12	OUTFALL	0.00	0.00	6910.00	0	00:00	0.00
Outfall11	OUTFALL	0.00	0.00	6947.00	0	00:00	0.00
Outfall14	OUTFALL	0.00	0.00	6865.00	0	00:00	0.00
Outfall13	OUTFALL	0.00	0.00	6880.00	0	00:00	0.00
31	OUTFALL	0.00	0.00	6953.00	0	00:00	0.00
51	OUTFALL	0.00	0.00	6920.00	0	00:00	0.00
74	OUTFALL	0.00	0.00	6897.00	0	00:00	0.00
67	OUTFALL	0.00	0.00	6865.50	0	00:00	0.00

\*\*\*\*\*  
Node Inflow Summary  
\*\*\*\*\*

Total Flow		Maximum Lateral	Maximum Total	Time of Max Occurrence	Lateral Inflow Volume
Inflow Volume	Balance Error	Inflow CFS	Inflow CFS	days hr:min	10^6 gal
Node gal	Percent	Type			10^6
10	0.304	JUNCTION	13.03	0 00:35	0.304
20	0.085	JUNCTION	4.33	0 00:35	0.085
21	0.794	JUNCTION	20.74	0 00:50	0.794

		SWMM Model Pre Development 100 Year				
22		JUNCTION	140.35	140.35	0 00:45	3.79
3.79	0.000					
23		JUNCTION	0.00	23.90	0 00:45	0
0.879	0.000					
24		JUNCTION	0.00	140.35	0 00:45	0
3.79	0.000					
30		JUNCTION	110.70	110.70	0 00:40	2.47
2.47	0.000					
40		JUNCTION	40.00	40.00	0 00:40	1.03
1.03	0.000					
41		JUNCTION	114.87	114.87	0 00:45	3.31
3.31	0.000					
42		JUNCTION	0.00	40.00	0 00:40	0
1.03	0.000					
50		JUNCTION	157.99	157.99	0 00:40	3.76
3.76	0.000					
60		JUNCTION	49.45	49.45	0 00:45	1.43
1.43	0.000					
61		JUNCTION	86.73	86.73	0 00:50	2.87
2.87	0.000					
62		JUNCTION	18.42	18.42	0 00:45	0.544
0.544	0.000					
63		JUNCTION	67.82	67.82	0 00:45	2.19
2.19	0.000					
64		JUNCTION	0.00	67.87	0 00:45	0
1.97	0.000					
65		JUNCTION	0.00	135.62	0 00:45	0
4.16	0.000					
66		JUNCTION	0.00	86.73	0 00:50	0
2.87	0.000					
70		JUNCTION	28.46	28.46	0 00:45	0.853
0.853	0.000					
71		JUNCTION	20.06	20.06	0 00:45	0.641
0.641	0.000					
72		JUNCTION	0.00	20.06	0 00:45	0
0.641	0.000					
73		JUNCTION	0.00	20.06	0 00:45	0
0.641	0.000					
80		JUNCTION	21.89	21.89	0 00:45	0.659
0.659	0.000					
81		JUNCTION	27.12	27.12	0 00:45	0.786
0.786	0.000					
82		JUNCTION	9.51	9.51	0 00:40	0.252
0.252	0.000					
83		JUNCTION	40.86	40.86	0 00:45	1.17
1.17	0.000					
84		JUNCTION	0.00	49.01	0 00:45	0
1.44	0.000					

		SWMM Model Pre Development 100 Year					
85		JUNCTION	0.00	9.51	0	00:40	0
0.252	0.000						
PondC		JUNCTION	0.00	110.70	0	00:40	0
2.47	0.000						
PondA		JUNCTION	0.00	13.03	0	00:35	0
0.304	0.000						
PondB		JUNCTION	0.00	164.21	0	00:46	0
4.66	0.000						
PondE		JUNCTION	0.00	157.99	0	00:40	0
3.76	0.000						
PondG		JUNCTION	0.00	48.48	0	00:45	0
1.49	0.000						
PondH		JUNCTION	0.00	99.16	0	00:45	0
2.87	0.000						
PondF		JUNCTION	0.00	221.11	0	00:46	0
7.02	0.000						
PondD		JUNCTION	0.00	154.35	0	00:45	0
4.34	0.000						
Outfall2		OUTFALL	0.00	164.21	0	00:46	0
4.66	0.000						
Outfall1		OUTFALL	0.00	13.03	0	00:35	0
0.304	0.000						
Outfall4		OUTFALL	0.00	99.16	0	00:45	0
2.87	0.000						
Outfall3		OUTFALL	0.00	154.35	0	00:45	0
4.34	0.000						
31		OUTFALL	0.00	110.70	0	00:40	0
2.47	0.000						
51		OUTFALL	0.00	157.99	0	00:40	0
3.76	0.000						
74		OUTFALL	0.00	48.48	0	00:45	0
1.49	0.000						
67		OUTFALL	0.00	221.11	0	00:46	0
7.02	0.000						

\*\*\*\*\*  
Node Flooding Summary  
\*\*\*\*\*

No nodes were flooded.

\*\*\*\*\*  
Outfall Loading Summary  
\*\*\*\*\*

Outfall Node	SWMM Model Pre Development 100 Year			
	Flow Freq Pcmt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Outfall2	76.53	37.73	164.21	4.665
Outfall11	55.28	3.40	13.03	0.304
Outfall4	67.08	26.46	99.16	2.867
Outfall3	67.92	39.52	154.35	4.336
31	53.89	28.39	110.70	2.472
51	58.47	39.76	157.99	3.757
74	67.08	13.78	48.48	1.494
67	74.31	58.49	221.11	7.022
System	65.07	247.53	962.28	26.917

\*\*\*\*\*  
Link Flow Summary  
\*\*\*\*\*

Link	Type	Maximum  Flow  CFS	Time of Max Occurrence days hr:min	Maximum  Veloc  ft/sec	Max/ Full Flow	Max/ Full Depth
100	DUMMY	13.03	0 00:35			
200	DUMMY	4.33	0 00:35			
201	DUMMY	20.74	0 00:50			
202	CONDUIT	23.89	0 00:46	15.49	0.01	0.08
204	DUMMY	140.35	0 00:45			
205	CONDUIT	140.32	0 00:46	24.86	0.09	0.20
300	DUMMY	110.70	0 00:40			
400	DUMMY	40.00	0 00:40			
401	CONDUIT	39.84	0 00:42	13.30	0.10	0.21
402	DUMMY	114.87	0 00:45			
500	DUMMY	157.99	0 00:40			
601	DUMMY	86.73	0 00:50			
602	CONDUIT	86.65	0 00:51	11.22	0.36	0.42
603	DUMMY	49.45	0 00:45			
604	DUMMY	18.42	0 00:45			
605	CONDUIT	67.80	0 00:45	19.12	0.05	0.15
606	DUMMY	67.82	0 00:45			
607	CONDUIT	135.63	0 00:46	20.33	0.08	0.19
700	DUMMY	28.46	0 00:45			
701	DUMMY	20.06	0 00:45			
702	DUMMY	20.06	0 00:45			
703	CONDUIT	20.04	0 00:46	7.87	0.08	0.19
801	DUMMY	21.89	0 00:45			

SWMM Model Pre Development 100 Year							
802	DUMMY	27.12	0	00:45			
803	CONDUIT	48.96	0	00:46	11.36	0.06	0.17
804	DUMMY	9.51	0	00:40			
806	DUMMY	40.86	0	00:45			
805	CONDUIT	9.46	0	00:42	6.45	0.04	0.13
301	DUMMY	110.70	0	00:40			
101	DUMMY	13.03	0	00:35			
206	DUMMY	164.21	0	00:46			
501	DUMMY	157.99	0	00:40			
704	DUMMY	48.48	0	00:45			
807	DUMMY	99.16	0	00:45			
608	DUMMY	221.11	0	00:46			
403	DUMMY	154.35	0	00:45			

\*\*\*\*\*  
 Conduit Surcharge Summary  
 \*\*\*\*\*

No conduits were surcharged.

Analysis begun on: Fri Apr 10 13:11:18 2020  
 Analysis ended on: Fri Apr 10 13:11:18 2020  
 Total elapsed time: < 1 sec

SWMM 100 Year Output EX 9-21-20

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

\*\*\*\*\*  
NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
\*\*\*\*\*

\*\*\*\*\*  
Analysis Options  
\*\*\*\*\*

Flow Units ..... CFS  
Process Models:  
  Rainfall/Runoff ..... NO  
  RDII ..... NO  
  Snowmelt ..... NO  
  Groundwater ..... NO  
  Flow Routing ..... YES  
  Ponding Allowed ..... NO  
  Water Quality ..... NO  
Flow Routing Method ..... KINWAVE  
Starting Date ..... 01/01/2005 00:00:00  
Ending Date ..... 01/01/2005 06:00:00  
Antecedent Dry Days ..... 0.0  
Report Time Step ..... 00:05:00  
Routing Time Step ..... 30.00 sec

*****	Volume	Volume
Flow Routing Continuity	acre-feet	10 <sup>6</sup> gal
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.000	0.000
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	836.701	272.651
External Outflow .....	836.646	272.634
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.007	

SWMM 100 Year Output EX 9-21-20

\*\*\*\*\*  
 Highest Flow Instability Indexes  
 \*\*\*\*\*

Link 205 (1)  
 Link 608 (1)  
 Link 206 (1)

\*\*\*\*\*  
 Routing Time Step Summary  
 \*\*\*\*\*

Minimum Time Step : 30.00 sec  
 Average Time Step : 30.00 sec  
 Maximum Time Step : 30.00 sec  
 Percent in Steady State : 0.00  
 Average Iterations per Step : 1.03  
 Percent Not Converging : 0.00

\*\*\*\*\*  
 Node Depth Summary  
 \*\*\*\*\*

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
10	JUNCTION	0.00	0.00	6975.00	0 00:00	0.00
20	JUNCTION	0.00	0.00	6982.00	0 00:00	0.00
21	JUNCTION	0.00	0.00	6953.00	0 00:00	0.00
22	JUNCTION	0.00	0.00	6936.00	0 00:00	0.00
23	JUNCTION	0.28	0.97	6945.97	0 00:45	0.97
24	JUNCTION	0.45	1.91	6935.91	0 00:45	1.91
30	JUNCTION	0.00	0.00	6985.00	0 00:00	0.00
40	JUNCTION	0.00	0.00	6918.00	0 00:00	0.00
41	JUNCTION	0.00	0.00	6888.00	0 00:00	0.00
42	JUNCTION	0.24	1.05	6912.05	0 00:40	1.05
50	JUNCTION	0.00	0.00	6945.00	0 00:00	0.00
60	JUNCTION	0.00	0.00	6942.00	0 00:00	0.00
61	JUNCTION	0.00	0.00	6893.00	0 00:00	0.00
62	JUNCTION	0.00	0.00	6908.00	0 00:00	0.00
63	JUNCTION	0.00	0.00	6882.00	0 00:00	0.00
64	JUNCTION	0.27	1.04	6901.04	0 00:45	1.03
65	JUNCTION	0.43	1.52	6881.52	0 00:45	1.52
66	JUNCTION	0.61	2.08	6870.08	0 00:50	2.08
70	JUNCTION	0.00	0.00	6923.00	0 00:00	0.00
71	JUNCTION	0.00	0.00	6908.00	0 00:00	0.00

SWMM 100 Year Output EX 9-21-20

72	JUNCTION	0.00	0.00	6904.00	0	00:00	0.00
73	JUNCTION	0.27	0.94	6902.94	0	00:45	0.94
80	JUNCTION	0.00	0.00	6890.00	0	00:00	0.00
81	JUNCTION	0.00	0.00	6896.00	0	00:00	0.00
82	JUNCTION	0.00	0.00	6886.00	0	00:00	0.00
83	JUNCTION	0.00	0.00	6878.00	0	00:00	0.00
84	JUNCTION	0.32	1.19	6873.19	0	00:45	1.18
85	JUNCTION	0.15	0.64	6874.64	0	00:40	0.64
PondC	JUNCTION	0.00	0.00	6956.00	0	00:00	0.00
PondA	JUNCTION	0.00	0.00	6949.00	0	00:00	0.00
PondB	JUNCTION	0.48	1.91	6912.91	0	00:45	1.90
PondE	JUNCTION	0.00	0.00	6923.00	0	00:00	0.00
PondG	JUNCTION	0.27	0.94	6900.94	0	00:46	0.94
PondH	JUNCTION	0.32	1.18	6867.18	0	00:46	1.18
PondF	JUNCTION	0.61	2.08	6868.08	0	00:51	2.08
PondD	JUNCTION	0.25	1.05	6882.05	0	00:42	1.05
31	JUNCTION	0.00	0.00	6953.00	0	00:00	0.00
51	JUNCTION	0.00	0.00	6920.00	0	00:00	0.00
67	JUNCTION	0.00	0.00	6865.50	0	00:00	0.00
74	JUNCTION	0.00	0.00	6897.00	0	00:00	0.00
OS1	JUNCTION	0.00	0.00	6950.00	0	00:00	0.00
OS2	JUNCTION	0.00	0.00	6924.00	0	00:00	0.00
OS3	JUNCTION	0.00	0.00	6930.00	0	00:00	0.00
OS4	JUNCTION	0.00	0.00	6905.00	0	00:00	0.00
Outfall2	OUTFALL	0.00	0.00	6910.00	0	00:00	0.00
Outfall1	OUTFALL	0.00	0.00	6947.00	0	00:00	0.00
Outfall4	OUTFALL	0.00	0.00	6865.00	0	00:00	0.00
Outfall3	OUTFALL	0.00	0.00	6880.00	0	00:00	0.00

\*\*\*\*\*  
Node Inflow Summary  
\*\*\*\*\*

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Total	Flow		Maximum	Maximum		Lateral	
Inflow	Balance		Lateral	Total	Time of Max	Inflow	
Volume	Error	Type	Inflow	Inflow	Occurrence	Volume	
Node	Percent		CFS	CFS	days hr:min	10^6 gal	10^6
gal							

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SWMM 100 Year Output EX 9-21-20

10		JUNCTION	66.80	66.80	0	00:45	1.92
1.92	0.000						
20		JUNCTION	48.76	48.76	0	00:40	1.18
1.18	0.000						
21		JUNCTION	20.74	20.74	0	00:50	0.794
0.794	0.000						
22		JUNCTION	140.35	140.35	0	00:45	3.79
3.79	0.000						
23		JUNCTION	0.00	68.56	0	00:45	0
1.97	0.000						
24		JUNCTION	0.00	249.20	0	00:45	0
6.26	0.000						
30		JUNCTION	110.70	110.70	0	00:40	2.47
2.47	0.000						
40		JUNCTION	40.00	40.00	0	00:40	1.03
1.03	0.000						
41		JUNCTION	114.87	114.87	0	00:45	3.31
3.31	0.000						
42		JUNCTION	0.00	40.00	0	00:40	0
1.03	0.000						
50		JUNCTION	157.99	157.99	0	00:40	3.76
3.76	0.000						
60		JUNCTION	49.45	49.45	0	00:45	1.43
1.43	0.000						
61		JUNCTION	86.73	86.73	0	00:50	2.87
2.87	0.000						
62		JUNCTION	18.42	18.42	0	00:45	0.544
0.544	0.000						
63		JUNCTION	67.82	67.82	0	00:45	2.19
2.19	0.000						
64		JUNCTION	0.00	67.87	0	00:45	0
1.97	0.000						
65		JUNCTION	0.00	135.62	0	00:45	0
4.16	0.000						
66		JUNCTION	0.00	86.73	0	00:50	0
2.87	0.000						
70		JUNCTION	28.46	28.46	0	00:45	0.853
0.853	0.000						
71		JUNCTION	20.06	20.06	0	00:45	0.641
0.641	0.000						
72		JUNCTION	0.00	20.06	0	00:45	0
0.641	0.000						
73		JUNCTION	0.00	20.06	0	00:45	0
0.641	0.000						
80		JUNCTION	21.89	21.89	0	00:45	0.659
0.659	0.000						
81		JUNCTION	27.12	27.12	0	00:45	0.786
0.786	0.000						

SWMM 100 Year Output EX 9-21-20

82		JUNCTION	9.51	9.51	0	00:40	0.252
0.252	0.000						
83		JUNCTION	40.86	40.86	0	00:45	1.17
1.17	0.000						
84		JUNCTION	0.00	49.01	0	00:45	0
1.44	0.000						
85		JUNCTION	0.00	9.51	0	00:40	0
0.252	0.000						
PondC		JUNCTION	0.00	110.70	0	00:40	0
2.47	0.000						
PondA		JUNCTION	0.00	66.80	0	00:45	0
1.92	0.000						
PondB		JUNCTION	0.00	317.41	0	00:45	0
8.22	0.000						
PondE		JUNCTION	0.00	157.99	0	00:40	0
3.76	0.000						
PondG		JUNCTION	0.00	643.48	0	00:45	0
97.6	0.000						
PondH		JUNCTION	0.00	99.16	0	00:45	0
2.87	0.000						
PondF		JUNCTION	0.00	221.11	0	00:46	0
7.02	0.000						
PondD		JUNCTION	0.00	154.35	0	00:45	0
4.34	0.000						
31		JUNCTION	0.00	110.70	0	00:40	0
2.47	0.000						
51		JUNCTION	0.00	374.99	0	00:40	0
38.8	0.000						
67		JUNCTION	0.00	864.52	0	00:46	0
105	0.000						
74		JUNCTION	0.00	643.48	0	00:45	0
97.6	0.000						
OS1		JUNCTION	413.00	413.00	0	00:00	66.7
66.7	0.000						
OS2		JUNCTION	280.00	280.00	0	00:00	45.2
45.2	0.000						
OS3		JUNCTION	217.00	217.00	0	00:00	35.1
35	0.000						
OS4		JUNCTION	595.00	595.00	0	00:00	96.1
96.1	0.000						
Outfall2		OUTFALL	0.00	597.41	0	00:45	0
53.4	0.000						
Outfall1		OUTFALL	0.00	479.80	0	00:45	0
68.6	0.000						
Outfall4		OUTFALL	0.00	1335.77	0	00:45	0
146	0.000						
Outfall3		OUTFALL	0.00	154.35	0	00:45	0
4.34	0.000						

SWMM 100 Year Output EX 9-21-20

\*\*\*\*\*  
Node Flooding Summary  
\*\*\*\*\*

No nodes were flooded.

\*\*\*\*\*  
Outfall Loading Summary  
\*\*\*\*\*

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Outfall2	100.00	330.89	597.41	53.430
Outfall1	100.00	424.90	479.80	68.605
Outfall4	100.00	905.71	1335.77	146.242
Outfall3	67.92	39.52	154.35	4.336
System	91.98	1701.02	2567.34	272.613

\*\*\*\*\*  
Link Flow Summary  
\*\*\*\*\*

Link	Type	Maximum  Flow  CFS	Time of Max Occurrence days hr:min	Maximum  Veloc  ft/sec	Max/ Full Flow	Max/ Full Depth
100	DUMMY	66.80	0 00:45			
200	DUMMY	48.76	0 00:40			
201	DUMMY	20.74	0 00:50			
202	CONDUIT	68.51	0 00:45	21.36	0.04	0.14
204	DUMMY	140.35	0 00:45			
205	CONDUIT	248.90	0 00:45	29.30	0.16	0.27
300	DUMMY	110.70	0 00:40			
400	DUMMY	40.00	0 00:40			
401	CONDUIT	39.84	0 00:42	13.30	0.10	0.21
402	DUMMY	114.87	0 00:45			
500	DUMMY	157.99	0 00:40			
601	DUMMY	86.73	0 00:50			
602	CONDUIT	86.65	0 00:51	11.22	0.36	0.42

SWMM 100 Year Output EX 9-21-20

603	DUMMY	49.45	0	00:45			
604	DUMMY	18.42	0	00:45			
605	CONDUIT	67.80	0	00:45	19.12	0.05	0.15
606	DUMMY	67.82	0	00:45			
607	CONDUIT	135.63	0	00:46	20.33	0.08	0.19
700	DUMMY	28.46	0	00:45			
701	DUMMY	20.06	0	00:45			
702	DUMMY	20.06	0	00:45			
703	CONDUIT	20.04	0	00:46	7.87	0.08	0.19
801	DUMMY	21.89	0	00:45			
802	DUMMY	27.12	0	00:45			
803	CONDUIT	48.96	0	00:46	11.36	0.06	0.17
804	DUMMY	9.51	0	00:40			
806	DUMMY	40.86	0	00:45			
805	CONDUIT	9.46	0	00:42	6.45	0.04	0.13
301	DUMMY	110.70	0	00:40			
101	DUMMY	66.80	0	00:45			
206	DUMMY	317.41	0	00:45			
501	DUMMY	157.99	0	00:40			
704	DUMMY	643.48	0	00:45			
807	DUMMY	99.16	0	00:45			
608	DUMMY	221.11	0	00:46			
403	DUMMY	154.35	0	00:45			
41	DUMMY	110.70	0	00:40			
42	DUMMY	374.99	0	00:40			
43	DUMMY	864.52	0	00:46			
44	DUMMY	643.48	0	00:45			
45	DUMMY	595.00	0	00:00			
46	DUMMY	413.00	0	00:00			
47	DUMMY	280.00	0	00:00			
48	DUMMY	217.00	0	00:00			

\*\*\*\*\*  
 Conduit Surcharge Summary  
 \*\*\*\*\*

No conduits were surcharged.

Analysis begun on: Mon Sep 21 16:37:19 2020  
 Analysis ended on: Mon Sep 21 16:37:19 2020  
 Total elapsed time: < 1 sec

SWMM 5 Year Output

SWMM 5 Year Post Development

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
 \*\*\*\*\*

\*\*\*\*\*  
 Analysis Options  
 \*\*\*\*\*

Flow Units ..... CFS  
 Process Models:  
   Rainfall/Runoff ..... NO  
   RDII ..... NO  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... YES  
   Ponding Allowed ..... NO  
   Water Quality ..... NO  
 Flow Routing Method ..... KINWAVE  
 Starting Date ..... 01/01/2005 00:00:00  
 Ending Date ..... 01/02/2005 06:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 00:05:00  
 Routing Time Step ..... 30.00 sec

*****	Volume	Volume
Flow Routing Continuity	acre-feet	10^6 gal
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.000	0.000
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	39.629	12.914
External Outflow .....	23.957	7.807
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	15.654	5.101
Continuity Error (%) .....	0.045	

SWMM 5 Year Output

\*\*\*\*\*  
 Highest Flow Instability Indexes  
 \*\*\*\*\*  
 All links are stable.

\*\*\*\*\*  
 Routing Time Step Summary  
 \*\*\*\*\*  
 Minimum Time Step : 30.00 sec  
 Average Time Step : 30.00 sec  
 Maximum Time Step : 30.00 sec  
 Percent in Steady State : 0.00  
 Average Iterations per Step : 1.01  
 Percent Not Converging : 0.00

\*\*\*\*\*  
 Node Depth Summary  
 \*\*\*\*\*

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
10	JUNCTION	0.00	0.00	6975.00	0 00:00	0.00
20	JUNCTION	0.00	0.00	6982.00	0 00:00	0.00
21	JUNCTION	0.00	0.00	6953.00	0 00:00	0.00
22	JUNCTION	0.00	0.00	6936.00	0 00:00	0.00
23	JUNCTION	0.04	0.75	6945.75	0 00:30	0.74
24	JUNCTION	0.21	1.17	6935.17	0 00:30	1.16
30	JUNCTION	0.00	0.00	6985.00	0 00:00	0.00
31	JUNCTION	0.17	0.20	6953.20	0 02:23	0.20
67	JUNCTION	0.16	0.59	6866.09	0 01:57	0.59
40	JUNCTION	0.00	0.00	6918.00	0 00:00	0.00
41	JUNCTION	0.00	0.00	6888.00	0 00:00	0.00
42	JUNCTION	0.03	0.82	6911.82	0 00:30	0.81
50	JUNCTION	0.00	0.00	6945.00	0 00:00	0.00
51	JUNCTION	0.03	0.21	6920.21	0 01:12	0.21
60	JUNCTION	0.00	0.00	6942.00	0 00:00	0.00
61	JUNCTION	0.00	0.00	6893.00	0 00:00	0.00
62	JUNCTION	0.00	0.00	6908.00	0 00:00	0.00
63	JUNCTION	0.00	0.00	6882.00	0 00:00	0.00
64	JUNCTION	0.03	0.66	6900.66	0 00:35	0.66
65	JUNCTION	0.05	1.10	6881.10	0 00:35	1.10
66	JUNCTION	0.08	1.71	6869.71	0 00:35	1.71

SWMM 5 Year Output

70	JUNCTION	0.00	0.00	6923.00	0	00:00	0.00
71	JUNCTION	0.00	0.00	6908.00	0	00:00	0.00
72	JUNCTION	0.00	0.00	6904.00	0	00:00	0.00
73	JUNCTION	0.03	0.55	6902.55	0	00:35	0.54
74	JUNCTION	0.02	0.24	6897.24	0	01:15	0.24
80	JUNCTION	0.00	0.00	6890.00	0	00:00	0.00
81	JUNCTION	0.00	0.00	6896.00	0	00:00	0.00
82	JUNCTION	0.00	0.00	6886.00	0	00:00	0.00
83	JUNCTION	0.00	0.00	6878.00	0	00:00	0.00
84	JUNCTION	0.04	0.80	6872.80	0	00:30	0.79
85	JUNCTION	0.02	0.48	6874.48	0	00:30	0.47
Outfall2	OUTFALL	0.00	0.00	6910.00	0	00:00	0.00
Outfall1	OUTFALL	0.00	0.00	6947.00	0	00:00	0.00
Outfall4	OUTFALL	0.16	0.59	6865.59	0	01:57	0.59
Outfall3	OUTFALL	0.00	0.00	6880.00	0	00:00	0.00
PondB	STORAGE	5.89	6.37	6917.37	0	01:30	6.37
PondC	STORAGE	4.70	5.56	6961.56	0	02:23	5.56
PondA	STORAGE	4.01	4.67	6953.67	0	01:46	4.67
PondD	STORAGE	5.54	6.51	6887.51	0	02:25	6.51
PondE	STORAGE	4.04	4.77	6927.77	0	01:12	4.77
PondF	STORAGE	5.76	6.73	6872.73	0	02:02	6.73
PondG	STORAGE	0.11	1.20	6901.20	0	01:15	1.20
PondH	STORAGE	4.49	5.12	6871.12	0	02:09	5.12

\*\*\*\*\*  
Node Inflow Summary  
\*\*\*\*\*

Total Inflow Volume gal	Flow Balance Error Percent	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal
10 0.705	0.000	JUNCTION	30.72	30.72	0 00:35	0.705
20 0.578	0.000	JUNCTION	29.46	29.46	0 00:30	0.578
21		JUNCTION	12.02	12.02	0 00:35	0.376

SWMM 5 Year Output

0.376	0.000						
22		JUNCTION	92.76	92.76	0	00:30	2.04
2.04	0.000						
23		JUNCTION	0.00	40.92	0	00:30	0
0.954	0.000						
24		JUNCTION	0.00	93.26	0	00:30	0
2.96	0.000						
30		JUNCTION	77.99	77.99	0	00:30	1.38
1.38	0.000						
31		JUNCTION	0.00	1.52	0	02:23	0
0.925	0.000						
67		JUNCTION	0.00	23.06	0	01:57	0
2.4	-0.000						
40		JUNCTION	24.15	24.15	0	00:30	0.438
0.438	0.000						
41		JUNCTION	98.47	98.47	0	00:30	1.83
1.83	0.000						
42		JUNCTION	0.00	24.15	0	00:30	0
0.438	-0.000						
50		JUNCTION	46.88	46.88	0	00:35	0.982
0.982	0.000						
51		JUNCTION	0.00	18.70	0	01:12	0
0.69	0.000						
60		JUNCTION	16.28	16.28	0	00:35	0.424
0.424	0.000						
61		JUNCTION	60.11	60.11	0	00:35	1.38
1.38	0.000						
62		JUNCTION	11.36	11.36	0	00:30	0.234
0.234	0.000						
63		JUNCTION	42.32	42.32	0	00:30	0.975
0.975	0.000						
64		JUNCTION	0.00	26.88	0	00:35	0
0.659	0.000						
65		JUNCTION	0.00	69.12	0	00:35	0
1.63	0.000						
66		JUNCTION	0.00	60.11	0	00:35	0
1.38	0.000						
70		JUNCTION	13.78	13.78	0	00:30	0.32
0.32	0.000						
71		JUNCTION	6.55	6.55	0	00:35	0.191
0.191	0.000						
72		JUNCTION	0.00	6.55	0	00:35	0
0.191	0.000						
73		JUNCTION	0.00	6.55	0	00:35	0
0.191	0.000						
74		JUNCTION	0.00	9.05	0	01:15	0
0.51	-0.000						
80		JUNCTION	5.68	5.68	0	00:35	0.173



SWMM 5 Year Output

0.173	0.000						
81		JUNCTION	16.24	16.24	0	00:30	0.333
0.333	0.000						
82		JUNCTION	5.21	5.21	0	00:30	0.1
0.1	0.000						
83		JUNCTION	20.93	20.93	0	00:30	0.453
0.453	0.000						
84		JUNCTION	0.00	21.67	0	00:30	0
0.507	0.000						
85		JUNCTION	0.00	5.21	0	00:30	0
0.1	0.000						
Outfall12		OUTFALL	0.00	34.45	0	01:30	0
2.22	0.000						
Outfall11		OUTFALL	0.00	5.43	0	01:46	0
0.441	0.000						
Outfall14		OUTFALL	0.00	35.27	0	01:51	0
3.71	0.000						
Outfall13		OUTFALL	0.00	2.52	0	02:25	0
1.43	0.000						
PondB		STORAGE	0.00	134.27	0	00:31	0
3.91	0.047						
PondC		STORAGE	0.00	77.99	0	00:30	0
1.38	0.005						
PondA		STORAGE	0.00	30.72	0	00:35	0
0.705	0.012						
PondD		STORAGE	0.00	120.96	0	00:30	0
2.27	0.003						
PondE		STORAGE	0.00	46.88	0	00:35	0
0.982	0.118						
PondF		STORAGE	0.00	129.20	0	00:35	0
3.01	0.014						
PondG		STORAGE	0.00	20.07	0	00:35	0
0.51	0.116						
PondH		STORAGE	0.00	47.25	0	00:32	0
1.06	0.001						

\*\*\*\*\*  
Node Flooding Summary  
\*\*\*\*\*

No nodes were flooded.

\*\*\*\*\*  
Storage Volume Summary  
\*\*\*\*\*

SWMM 5 Year Output

of Max Occurrence Storage Unit hr:min	Maximum Outflow Unit CFS	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time days
PondB 01:30	34.45	241.825	30	0	0	296.729	37	0
PondC 02:23	1.52	111.256	19	0	0	174.130	30	0
PondA 01:46	5.43	53.736	15	0	0	79.797	22	0
PondD 02:24	2.52	192.634	28	0	0	287.984	41	0
PondE 01:11	18.70	56.473	16	0	0	85.437	24	0
PondF 02:02	16.38	235.289	29	0	0	351.325	44	0
PondG 01:15	9.05	2.647	0	0	0	31.290	6	0
PondH 02:09	4.21	88.617	17	0	0	127.653	25	0

\*\*\*\*\*  
 Outfall Loading Summary  
 \*\*\*\*\*

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Outfall2	99.64	2.76	34.45	2.223
Outfall1	99.67	0.55	5.43	0.441
Outfall4	99.67	4.61	35.27	3.709
Outfall3	99.69	1.78	2.52	1.434
System	99.67	9.70	73.13	7.806

\*\*\*\*\*

SWMM 5 Year Output

Link Flow Summary

\*\*\*\*\*

Link	Type	Maximum  Flow  CFS	Time of Max Occurrence days hr:min	Maximum  Veloc  ft/sec	Max/ Full Flow	Max/ Full Depth
100	DUMMY	30.72	0 00:35			
200	DUMMY	29.46	0 00:30			
201	DUMMY	12.02	0 00:35			
202	CONDUIT	40.84	0 00:31	18.27	0.02	0.11
203	CONDUIT	1.52	0 02:24	6.34	0.00	0.05
204	DUMMY	92.76	0 00:30			
205	CONDUIT	93.43	0 00:31	22.09	0.06	0.17
300	DUMMY	77.99	0 00:30			
400	DUMMY	24.15	0 00:30			
401	CONDUIT	23.53	0 00:32	11.46	0.06	0.16
402	DUMMY	98.47	0 00:30			
500	DUMMY	46.88	0 00:35			
601	DUMMY	60.11	0 00:35			
602	CONDUIT	60.09	0 00:35	10.17	0.25	0.34
603	DUMMY	16.28	0 00:35			
604	DUMMY	11.36	0 00:30			
605	CONDUIT	26.88	0 00:35	14.61	0.02	0.09
606	DUMMY	42.32	0 00:30			
607	CONDUIT	69.12	0 00:31	16.65	0.04	0.14
700	DUMMY	13.78	0 00:30			
701	DUMMY	6.55	0 00:35			
702	DUMMY	6.55	0 00:35			
703	CONDUIT	6.54	0 00:36	5.62	0.03	0.11
801	DUMMY	5.68	0 00:35			
802	DUMMY	16.24	0 00:30			
803	CONDUIT	21.49	0 00:32	8.87	0.03	0.11
804	DUMMY	5.21	0 00:30			
806	DUMMY	20.93	0 00:30			
805	CONDUIT	5.08	0 00:32	5.42	0.02	0.09
808	CONDUIT	23.06	0 01:57	2.25	0.00	0.06
800	CONDUIT	8.95	0 01:25	2.34	0.00	0.02
600	CONDUIT	18.26	0 01:17	5.75	0.00	0.03
101	DUMMY	5.43	0 01:46			
206	DUMMY	34.45	0 01:30			
301	DUMMY	1.52	0 02:23			
501	DUMMY	18.70	0 01:12			
704	DUMMY	9.05	0 01:15			
807	DUMMY	4.21	0 02:09			
608	DUMMY	16.38	0 02:02			
403	DUMMY	2.52	0 02:25			

SWMM 5 Year Output

\*\*\*\*\*  
Conduit Surcharge Summary  
\*\*\*\*\*

No conduits were surcharged.

Analysis begun on: Mon Apr 13 19:10:46 2020  
Analysis ended on: Mon Apr 13 19:10:46 2020  
Total elapsed time: < 1 sec

SWMM 5 Year Output 9-21-20

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
 \*\*\*\*\*

\*\*\*\*\*  
 Analysis Options  
 \*\*\*\*\*

Flow Units ..... CFS  
 Process Models:  
   Rainfall/Runoff ..... NO  
   RDII ..... NO  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... YES  
   Ponding Allowed ..... NO  
   Water Quality ..... NO  
 Flow Routing Method ..... KINWAVE  
 Starting Date ..... 01/01/2005 00:00:00  
 Ending Date ..... 01/02/2005 06:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 00:05:00  
 Routing Time Step ..... 30.00 sec

*****	Volume	Volume
Flow Routing Continuity	acre-feet	10 <sup>6</sup> gal
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.000	0.000
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	949.387	309.372
External Outflow .....	930.375	303.177
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	20.095	6.548
Continuity Error (%) .....	-0.114	

SWMM 5 Year Output 9-21-20

\*\*\*\*\*  
 Highest Flow Instability Indexes  
 \*\*\*\*\*

All links are stable.

\*\*\*\*\*  
 Routing Time Step Summary  
 \*\*\*\*\*

Minimum Time Step : 30.00 sec  
 Average Time Step : 30.00 sec  
 Maximum Time Step : 30.00 sec  
 Percent in Steady State : 0.00  
 Average Iterations per Step : 1.00  
 Percent Not Converging : 0.00

\*\*\*\*\*  
 Node Depth Summary  
 \*\*\*\*\*

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
10	JUNCTION	0.00	0.00	6975.00	0 00:00	0.00
20	JUNCTION	0.00	0.00	6982.00	0 00:00	0.00
21	JUNCTION	0.00	0.00	6953.00	0 00:00	0.00
22	JUNCTION	0.00	0.00	6936.00	0 00:00	0.00
23	JUNCTION	0.04	0.75	6945.75	0 00:30	0.74
24	JUNCTION	0.21	1.17	6935.17	0 00:30	1.16
30	JUNCTION	0.00	0.00	6985.00	0 00:00	0.00
31	JUNCTION	0.17	0.20	6953.20	0 02:23	0.20
67	JUNCTION	1.87	1.97	6867.47	0 01:59	1.97
40	JUNCTION	0.00	0.00	6918.00	0 00:00	0.00
41	JUNCTION	0.00	0.00	6888.00	0 00:00	0.00
42	JUNCTION	0.03	0.82	6911.82	0 00:30	0.81
50	JUNCTION	0.00	0.00	6945.00	0 00:00	0.00
51	JUNCTION	0.71	0.71	6920.71	0 00:32	0.71
60	JUNCTION	0.00	0.00	6942.00	0 00:00	0.00
61	JUNCTION	0.00	0.00	6893.00	0 00:00	0.00
62	JUNCTION	0.00	0.00	6908.00	0 00:00	0.00
63	JUNCTION	0.00	0.00	6882.00	0 00:00	0.00
64	JUNCTION	0.03	0.66	6900.66	0 00:35	0.66
65	JUNCTION	0.05	1.10	6881.10	0 00:35	1.10
66	JUNCTION	0.08	1.71	6869.71	0 00:35	1.71
70	JUNCTION	0.00	0.00	6923.00	0 00:00	0.00

SWMM 5 Year Output 9-21-20

71	JUNCTION	0.00	0.00	6908.00	0	00:00	0.00
72	JUNCTION	0.00	0.00	6904.00	0	00:00	0.00
73	JUNCTION	0.03	0.55	6902.55	0	00:35	0.54
74	JUNCTION	1.36	1.40	6898.40	0	01:15	1.40
80	JUNCTION	0.00	0.00	6890.00	0	00:00	0.00
81	JUNCTION	0.00	0.00	6896.00	0	00:00	0.00
82	JUNCTION	0.00	0.00	6886.00	0	00:00	0.00
83	JUNCTION	0.00	0.00	6878.00	0	00:00	0.00
84	JUNCTION	0.04	0.80	6872.80	0	00:30	0.79
85	JUNCTION	0.02	0.48	6874.48	0	00:30	0.47
OS1	JUNCTION	0.45	0.45	6953.05	0	00:00	0.45
OS3	JUNCTION	0.71	0.71	6923.51	0	00:00	0.71
OS4	JUNCTION	1.21	1.21	6901.01	0	00:00	1.21
OS2	JUNCTION	0.42	0.42	6924.42	0	00:00	0.42
Outfall12	OUTFALL	0.42	0.42	6910.42	0	03:03	0.42
Outfall11	OUTFALL	0.45	0.45	6947.45	0	01:12	0.45
Outfall14	OUTFALL	1.87	1.97	6866.97	0	01:59	1.97
Outfall13	OUTFALL	0.00	0.00	6880.00	0	00:00	0.00
PondB	STORAGE	6.42	6.96	6917.96	0	02:52	6.96
PondC	STORAGE	4.70	5.56	6961.56	0	02:23	5.56
PondA	STORAGE	5.16	6.43	6955.43	0	02:35	6.43
PondD	STORAGE	5.57	6.66	6887.66	0	02:07	6.65
PondE	STORAGE	3.99	4.85	6927.85	0	01:03	4.85
PondF	STORAGE	5.76	6.72	6872.72	0	02:04	6.72
PondG	STORAGE	0.11	1.20	6901.20	0	01:15	1.20
PondH	STORAGE	4.38	5.01	6871.01	0	02:39	5.01

\*\*\*\*\*  
Node Inflow Summary  
\*\*\*\*\*

Total Inflow Volume		Flow Balance Error	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence	Lateral Inflow Volume
gal	Percent			CFS	CFS	days hr:min	10^6 gal
10	0.705	0.000	JUNCTION	30.72	30.72	0 00:35	0.705

SWMM 5 Year Output 9-21-20

20		JUNCTION	29.46	29.46	0	00:30	0.578
0.578	0.000						
21		JUNCTION	12.02	12.02	0	00:35	0.376
0.376	0.000						
22		JUNCTION	92.76	92.76	0	00:30	2.04
2.04	0.000						
23		JUNCTION	0.00	40.92	0	00:30	0
0.954	0.000						
24		JUNCTION	0.00	93.26	0	00:30	0
2.96	0.000						
30		JUNCTION	77.99	77.99	0	00:30	1.38
1.38	0.000						
31		JUNCTION	0.00	1.52	0	02:23	0
0.925	0.000						
67		JUNCTION	0.00	201.42	0	01:59	0
147	0.000						
40		JUNCTION	24.15	24.15	0	00:30	0.438
0.438	0.000						
41		JUNCTION	98.47	98.47	0	00:30	1.83
1.83	0.000						
42		JUNCTION	0.00	24.15	0	00:30	0
0.438	-0.000						
50		JUNCTION	46.88	46.88	0	00:35	0.982
0.982	0.000						
51		JUNCTION	0.00	85.04	0	01:03	0
50	0.000						
60		JUNCTION	16.28	16.28	0	00:35	0.424
0.424	0.000						
61		JUNCTION	60.11	60.11	0	00:35	1.38
1.38	0.000						
62		JUNCTION	11.36	11.36	0	00:30	0.234
0.234	0.000						
63		JUNCTION	42.32	42.32	0	00:30	0.975
0.975	0.000						
64		JUNCTION	0.00	26.88	0	00:35	0
0.659	0.000						
65		JUNCTION	0.00	69.12	0	00:35	0
1.63	0.000						
66		JUNCTION	0.00	60.11	0	00:35	0
1.38	0.000						
70		JUNCTION	13.78	13.78	0	00:30	0.32
0.32	0.000						
71		JUNCTION	6.55	6.55	0	00:35	0.191
0.191	0.000						
72		JUNCTION	0.00	6.55	0	00:35	0
0.191	0.000						
73		JUNCTION	0.00	6.55	0	00:35	0
0.191	0.000						



SWMM 5 Year Output 9-21-20

74		JUNCTION	0.00	189.05	0	01:15	0
146	0.000						
80		JUNCTION	5.68	5.68	0	00:35	0.173
0.173	0.000						
81		JUNCTION	16.24	16.24	0	00:30	0.333
0.333	0.000						
82		JUNCTION	5.21	5.21	0	00:30	0.1
0.1	0.000						
83		JUNCTION	20.93	20.93	0	00:30	0.453
0.453	0.000						
84		JUNCTION	0.00	21.67	0	00:30	0
0.507	0.000						
85		JUNCTION	0.00	5.21	0	00:30	0
0.1	0.000						
OS1		JUNCTION	67.00	67.00	0	00:00	54.1
54.1	0.000						
OS3		JUNCTION	61.00	61.00	0	00:00	49.3
49.3	0.000						
OS4		JUNCTION	180.00	180.00	0	00:00	145
145	0.000						
OS2		JUNCTION	59.00	59.00	0	00:00	47.7
47.7	0.000						
Outfall12		OUTFALL	0.00	61.68	0	02:52	0
49.4	0.000						
Outfall11		OUTFALL	0.00	67.69	0	02:35	0
54.5	0.000						
Outfall14		OUTFALL	0.00	276.10	0	01:07	0
198	0.000						
Outfall13		OUTFALL	0.00	8.58	0	02:07	0
1.45	0.000						
PondB		STORAGE	0.00	134.27	0	00:31	0
3.91	-0.000						
PondC		STORAGE	0.00	77.99	0	00:30	0
1.38	0.005						
PondA		STORAGE	0.00	30.72	0	00:35	0
0.705	0.003						
PondD		STORAGE	0.00	120.96	0	00:30	0
2.27	0.003						
PondE		STORAGE	0.00	46.88	0	00:35	0
0.982	0.190						
PondF		STORAGE	0.00	129.20	0	00:35	0
3.01	0.010						
PondG		STORAGE	0.00	20.07	0	00:35	0
0.51	0.116						
PondH		STORAGE	0.00	47.25	0	00:32	0
1.06	0.003						

SWMM 5 Year Output 9-21-20

\*\*\*\*\*  
 Node Flooding Summary  
 \*\*\*\*\*

No nodes were flooded.

\*\*\*\*\*  
 Storage Volume Summary  
 \*\*\*\*\*

of Max Occurrence hr:min	Maximum Outflow Unit CFS	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time days
PondB 02:51	2.68	321.956	38	0	0	389.908	46	0
PondC 02:23	1.52	111.256	19	0	0	174.130	30	0
PondA 02:35	0.69	59.417	29	0	0	88.970	44	0
PondD 02:07	8.58	184.527	30	0	0	278.950	45	0
PondE 01:03	24.04	46.471	16	0	0	72.497	25	0
PondF 02:03	15.59	238.240	29	0	0	353.902	43	0
PondG 01:15	9.05	2.647	0	0	0	31.289	6	0
PondH 02:39	1.11	86.593	14	0	0	132.766	21	0

\*\*\*\*\*  
 Outfall Loading Summary  
 \*\*\*\*\*

Flow Freq	Avg Flow	Max Flow	Total Volume
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SWMM 5 Year Output 9-21-20

Outfall Node	Pcnt	CFS	CFS	10 <sup>6</sup> gal
Outfall2	99.97	61.16	61.68	49.385
Outfall1	99.97	67.44	67.69	54.456
Outfall4	99.89	245.24	276.10	197.866
Outfall3	99.69	1.80	8.58	1.447
System	99.88	375.63	407.24	303.154

\*\*\*\*\*  
 Link Flow Summary  
 \*\*\*\*\*

Link	Type	Maximum  Flow  CFS	Time of Max Occurrence days hr:min	Maximum  Veloc  ft/sec	Max/ Full Flow	Max/ Full Depth
100	DUMMY	30.72	0 00:35			
200	DUMMY	29.46	0 00:30			
201	DUMMY	12.02	0 00:35			
202	CONDUIT	40.84	0 00:31	18.27	0.02	0.11
203	CONDUIT	1.52	0 02:24	6.34	0.00	0.05
204	DUMMY	92.76	0 00:30			
205	CONDUIT	93.43	0 00:31	22.09	0.06	0.17
300	DUMMY	77.99	0 00:30			
400	DUMMY	24.15	0 00:30			
401	CONDUIT	23.53	0 00:32	11.46	0.06	0.16
402	DUMMY	98.47	0 00:30			
500	DUMMY	46.88	0 00:35			
601	DUMMY	60.11	0 00:35			
602	CONDUIT	60.09	0 00:35	10.17	0.25	0.34
603	DUMMY	16.28	0 00:35			
604	DUMMY	11.36	0 00:30			
605	CONDUIT	26.88	0 00:35	14.61	0.02	0.09
606	DUMMY	42.32	0 00:30			
607	CONDUIT	69.12	0 00:31	16.65	0.04	0.14
700	DUMMY	13.78	0 00:30			
701	DUMMY	6.55	0 00:35			
702	DUMMY	6.55	0 00:35			
703	CONDUIT	6.54	0 00:36	5.62	0.03	0.11
801	DUMMY	5.68	0 00:35			
802	DUMMY	16.24	0 00:30			
803	CONDUIT	21.49	0 00:32	8.87	0.03	0.11
804	DUMMY	5.21	0 00:30			
806	DUMMY	20.93	0 00:30			
805	CONDUIT	5.08	0 00:32	5.42	0.02	0.09

SWMM 5 Year Output 9-21-20								
808	CONDUIT	201.42	0	01:59	4.47	0.03	0.20	
800	CONDUIT	189.04	0	01:19	6.57	0.02	0.14	
600	CONDUIT	84.88	0	01:06	9.93	0.00	0.06	
EastForkTrib	CONDUIT	61.00	0	00:32	3.08	0.01	0.07	
EastFork	CONDUIT	180.00	0	00:24	4.29	0.03	0.15	
MainStem	CONDUIT	67.00	0	01:15	2.39	0.00	0.05	
MainStemTrib	CONDUIT	59.00	0	03:06	2.28	0.00	0.04	
101	DUMMY	0.69	0	02:35				
206	DUMMY	2.68	0	02:52				
301	DUMMY	1.52	0	02:23				
501	DUMMY	24.04	0	01:03				
704	DUMMY	9.05	0	01:15				
807	DUMMY	1.11	0	02:39				
608	DUMMY	15.59	0	02:04				
403	DUMMY	8.58	0	02:07				

\*\*\*\*\*  
 Conduit Surcharge Summary  
 \*\*\*\*\*

No conduits were surcharged.

Analysis begun on: Mon Sep 21 16:22:13 2020  
 Analysis ended on: Mon Sep 21 16:22:14 2020  
 Total elapsed time: 00:00:01

SWMM 100 Year Output

SWMM 100 Year Post Development

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

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\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
 \*\*\*\*\*

\*\*\*\*\*  
 Analysis Options  
 \*\*\*\*\*

Flow Units ..... CFS  
 Process Models:  
   Rainfall/Runoff ..... NO  
   RDII ..... NO  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... YES  
   Ponding Allowed ..... NO  
   Water Quality ..... NO  
 Flow Routing Method ..... KINWAVE  
 Starting Date ..... 01/01/2005 00:00:00  
 Ending Date ..... 01/02/2005 06:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 00:05:00  
 Routing Time Step ..... 30.00 sec

*****	Volume	Volume
Flow Routing Continuity	acre-feet	10 <sup>6</sup> gal
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.000	0.000
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	123.320	40.186
External Outflow .....	105.086	34.244
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	18.084	5.893
Continuity Error (%) .....	0.122	

SWMM 100 Year Output

\*\*\*\*\*  
 Highest Flow Instability Indexes  
 \*\*\*\*\*  
 All links are stable.

\*\*\*\*\*  
 Routing Time Step Summary  
 \*\*\*\*\*  
 Minimum Time Step : 30.00 sec  
 Average Time Step : 30.00 sec  
 Maximum Time Step : 30.00 sec  
 Percent in Steady State : 0.00  
 Average Iterations per Step : 1.02  
 Percent Not Converging : 0.00

\*\*\*\*\*  
 Node Depth Summary  
 \*\*\*\*\*

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
10	JUNCTION	0.00	0.00	6975.00	0 00:00	0.00
20	JUNCTION	0.00	0.00	6982.00	0 00:00	0.00
21	JUNCTION	0.00	0.00	6953.00	0 00:00	0.00
22	JUNCTION	0.00	0.00	6936.00	0 00:00	0.00
23	JUNCTION	0.06	1.35	6946.35	0 00:35	1.34
24	JUNCTION	0.27	2.22	6936.22	0 00:51	2.22
30	JUNCTION	0.00	0.00	6985.00	0 00:00	0.00
31	JUNCTION	0.24	1.68	6954.68	0 00:59	1.68
67	JUNCTION	0.24	2.30	6867.80	0 01:13	2.30
40	JUNCTION	0.00	0.00	6918.00	0 00:00	0.00
41	JUNCTION	0.00	0.00	6888.00	0 00:00	0.00
42	JUNCTION	0.05	1.40	6912.40	0 00:35	1.38
50	JUNCTION	0.00	0.00	6945.00	0 00:00	0.00
51	JUNCTION	0.04	0.74	6920.74	0 00:49	0.74
60	JUNCTION	0.00	0.00	6942.00	0 00:00	0.00
61	JUNCTION	0.00	0.00	6893.00	0 00:00	0.00
62	JUNCTION	0.00	0.00	6908.00	0 00:00	0.00
63	JUNCTION	0.00	0.00	6882.00	0 00:00	0.00
64	JUNCTION	0.06	1.19	6901.19	0 00:40	1.19
65	JUNCTION	0.09	1.92	6881.92	0 00:40	1.92

SWMM 100 Year Output

66	JUNCTION	0.13	3.12	6871.12	0	00:40	3.12
70	JUNCTION	0.00	0.00	6923.00	0	00:00	0.00
71	JUNCTION	0.00	0.00	6908.00	0	00:00	0.00
72	JUNCTION	0.00	0.00	6904.00	0	00:00	0.00
73	JUNCTION	0.06	1.02	6903.02	0	00:45	1.02
74	JUNCTION	0.05	0.60	6897.60	0	01:12	0.60
80	JUNCTION	0.00	0.00	6890.00	0	00:00	0.00
81	JUNCTION	0.00	0.00	6896.00	0	00:00	0.00
82	JUNCTION	0.00	0.00	6886.00	0	00:00	0.00
83	JUNCTION	0.00	0.00	6878.00	0	00:00	0.00
84	JUNCTION	0.07	1.45	6873.45	0	00:40	1.45
85	JUNCTION	0.03	0.82	6874.82	0	00:35	0.81
Outfall2	OUTFALL	0.00	0.00	6910.00	0	00:00	0.00
Outfall1	OUTFALL	0.00	0.00	6947.00	0	00:00	0.00
Outfall4	OUTFALL	0.24	2.30	6867.30	0	01:13	2.30
Outfall3	OUTFALL	0.00	0.00	6880.00	0	00:00	0.00
PondB	STORAGE	6.72	9.85	6920.85	0	01:16	9.85
PondC	STORAGE	5.17	7.08	6963.08	0	00:59	7.08
PondA	STORAGE	5.81	8.60	6957.60	0	01:13	8.59
PondD	STORAGE	5.66	8.08	6889.08	0	01:04	8.08
PondE	STORAGE	4.04	5.84	6928.84	0	00:49	5.84
PondF	STORAGE	5.86	8.17	6874.17	0	01:09	8.17
PondG	STORAGE	0.20	2.69	6902.69	0	01:12	2.68
PondH	STORAGE	4.95	6.51	6872.51	0	01:12	6.51

\*\*\*\*\*  
Node Inflow Summary  
\*\*\*\*\*

Total Inflow Volume		Flow Balance Error	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence	Lateral Inflow Volume
gal	Percent			CFS	CFS	days hr:min	10^6 gal
10	2.37	0.000	JUNCTION	100.64	100.64	0 00:40	2.37
20	1.81	0.000	JUNCTION	97.08	97.08	0 00:35	1.81

SWMM 100 Year Output

21		JUNCTION	42.26	42.26	0	00:40	1.2
1.2	0.000						
22		JUNCTION	295.27	295.27	0	00:40	6.04
6.04	0.000						
23		JUNCTION	0.00	136.17	0	00:35	0
3.01	0.000						
24		JUNCTION	0.00	334.84	0	00:51	0
9.43	-0.000						
30		JUNCTION	238.03	238.03	0	00:35	4
4	0.000						
31		JUNCTION	0.00	115.75	0	00:59	0
3.39	0.000						
67		JUNCTION	0.00	270.41	0	01:13	0
9.72	-0.000						
40		JUNCTION	70.07	70.07	0	00:35	1.32
1.32	0.000						
41		JUNCTION	252.18	252.18	0	00:35	4.73
4.73	0.000						
42		JUNCTION	0.00	70.07	0	00:35	0
1.32	0.000						
50		JUNCTION	178.04	178.04	0	00:40	4.2
4.2	0.000						
51		JUNCTION	0.00	164.75	0	00:49	0
3.95	0.000						
60		JUNCTION	58.95	58.95	0	00:40	1.65
1.65	0.000						
61		JUNCTION	170.90	170.90	0	00:40	3.87
3.87	0.000						
62		JUNCTION	32.93	32.93	0	00:35	0.699
0.699	0.000						
63		JUNCTION	124.89	124.89	0	00:40	2.87
2.87	0.000						
64		JUNCTION	0.00	90.88	0	00:40	0
2.35	0.000						
65		JUNCTION	0.00	215.63	0	00:40	0
5.22	0.000						
66		JUNCTION	0.00	170.90	0	00:40	0
3.87	0.000						
70		JUNCTION	43.95	43.95	0	00:40	1.05
1.05	0.000						
71		JUNCTION	23.95	23.95	0	00:45	0.742
0.742	0.000						
72		JUNCTION	0.00	23.95	0	00:45	0
0.742	0.000						
73		JUNCTION	0.00	23.95	0	00:45	0
0.742	0.000						
74		JUNCTION	0.00	42.13	0	01:12	0
1.79	-0.000						



		SWMM 100 Year Output				
80		JUNCTION	27.62	27.62	0 00:45	0.833
0.833	0.000					
81		JUNCTION	47.62	47.62	0 00:35	1.01
1.01	0.000					
82		JUNCTION	15.60	15.60	0 00:35	0.314
0.314	0.000					
83		JUNCTION	64.71	64.71	0 00:35	1.46
1.46	0.000					
84		JUNCTION	0.00	73.73	0 00:40	0
1.84	0.000					
85		JUNCTION	0.00	15.60	0 00:35	0
0.314	0.000					
Outfall12		OUTFALL	0.00	256.11	0 01:16	0
10.3	0.000					
Outfall11		OUTFALL	0.00	53.95	0 01:13	0
2.03	0.000					
Outfall14		OUTFALL	0.00	478.86	0 01:05	0
16.7	0.000					
Outfall13		OUTFALL	0.00	160.70	0 01:04	0
5.21	0.000					
PondB		STORAGE	0.00	447.00	0 00:49	0
12.4	0.062					
PondC		STORAGE	0.00	238.03	0 00:35	0
4	0.130					
PondA		STORAGE	0.00	100.64	0 00:40	0
2.37	0.096					
PondD		STORAGE	0.00	320.21	0 00:35	0
6.05	0.105					
PondE		STORAGE	0.00	178.04	0 00:40	0
4.2	0.178					
PondF		STORAGE	0.00	385.87	0 00:41	0
9.08	0.109					
PondG		STORAGE	0.00	67.73	0 00:40	0
1.8	0.079					
PondH		STORAGE	0.00	153.03	0 00:38	0
3.61	0.143					

\*\*\*\*\*  
Node Flooding Summary  
\*\*\*\*\*

No nodes were flooded.

\*\*\*\*\*  
Storage Volume Summary  
\*\*\*\*\*

SWMM 100 Year Output

of Max Occurrence Storage Unit hr:min	Maximum Outflow Unit CFS	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time days
PondB 01:15	256.11	363.135	43	0	0	827.701	97	0
PondC 00:58	115.75	146.763	26	0	0	299.338	52	0
PondA 01:12	53.95	75.030	37	0	0	152.554	76	0
PondD 01:04	160.70	192.591	31	0	0	418.291	67	0
PondE 00:48	164.75	48.028	17	0	0	106.230	37	0
PondF 01:09	229.20	250.108	31	0	0	549.589	67	0
PondG 01:11	42.13	5.811	1	0	0	88.594	16	0
PondH 01:12	80.17	131.315	21	0	0	268.983	42	0

\*\*\*\*\*  
 Outfall Loading Summary  
 \*\*\*\*\*

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Outfall2	99.64	12.77	256.11	10.280
Outfall1	99.69	2.53	53.95	2.035
Outfall4	99.67	20.76	478.86	16.717
Outfall3	99.69	6.47	160.70	5.209
System	99.67	42.53	924.48	34.241

SWMM 100 Year Output

\*\*\*\*\*  
 Link Flow Summary  
 \*\*\*\*\*

Link	Type	Maximum  Flow  CFS	Time of Max Occurrence days hr:min	Maximum  Veloc  ft/sec	Max/ Full Flow	Max/ Full Depth
100	DUMMY	100.64	0 00:40			
200	DUMMY	97.08	0 00:35			
201	DUMMY	42.26	0 00:40			
202	CONDUIT	136.36	0 00:36	26.17	0.08	0.19
203	CONDUIT	115.74	0 00:59	23.03	0.37	0.42
204	DUMMY	295.27	0 00:40			
205	CONDUIT	334.86	0 00:51	31.89	0.22	0.32
300	DUMMY	238.03	0 00:35			
400	DUMMY	70.07	0 00:35			
401	CONDUIT	69.37	0 00:36	15.63	0.17	0.28
402	DUMMY	252.18	0 00:35			
500	DUMMY	178.04	0 00:40			
601	DUMMY	170.90	0 00:40			
602	CONDUIT	170.58	0 00:41	13.26	0.71	0.62
603	DUMMY	58.95	0 00:40			
604	DUMMY	32.93	0 00:35			
605	CONDUIT	90.74	0 00:41	20.83	0.06	0.17
606	DUMMY	124.89	0 00:40			
607	CONDUIT	215.42	0 00:40	23.26	0.13	0.24
700	DUMMY	43.95	0 00:40			
701	DUMMY	23.95	0 00:45			
702	DUMMY	23.95	0 00:45			
703	CONDUIT	23.94	0 00:45	8.29	0.09	0.20
801	DUMMY	27.62	0 00:45			
802	DUMMY	47.62	0 00:35			
803	CONDUIT	73.66	0 00:40	12.80	0.09	0.21
804	DUMMY	15.60	0 00:35			
806	DUMMY	64.71	0 00:35			
805	CONDUIT	15.43	0 00:37	7.47	0.06	0.16
808	CONDUIT	270.40	0 01:13	4.87	0.04	0.23
800	CONDUIT	41.98	0 01:17	4.06	0.00	0.06
600	CONDUIT	164.38	0 00:51	12.48	0.01	0.09
101	DUMMY	53.95	0 01:13			
206	DUMMY	256.11	0 01:16			
301	DUMMY	115.75	0 00:59			
501	DUMMY	164.75	0 00:49			
704	DUMMY	42.13	0 01:12			
807	DUMMY	80.17	0 01:12			
608	DUMMY	229.20	0 01:09			

403 DUMMY SWMM 100 Year Output  
160.70 0 01:04

\*\*\*\*\*

Conduit Surcharge Summary

\*\*\*\*\*

No conduits were surcharged.

Analysis begun on: Mon Apr 13 19:00:38 2020

Analysis ended on: Mon Apr 13 19:00:38 2020

Total elapsed time: < 1 sec

SWMM 100 Year Output 9-21-20

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
 \*\*\*\*\*

\*\*\*\*\*  
 Analysis Options  
 \*\*\*\*\*

Flow Units ..... CFS  
 Process Models:  
   Rainfall/Runoff ..... NO  
   RDII ..... NO  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... YES  
   Ponding Allowed ..... NO  
   Water Quality ..... NO  
 Flow Routing Method ..... KINWAVE  
 Starting Date ..... 01/01/2005 00:00:00  
 Ending Date ..... 01/02/2005 06:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 00:05:00  
 Routing Time Step ..... 30.00 sec

*****	Volume	Volume
Flow Routing Continuity	acre-feet	10 <sup>6</sup> gal
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.000	0.000
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	3854.070	1255.906
External Outflow .....	3828.229	1247.485
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	28.186	9.185
Continuity Error (%) .....	-0.061	

SWMM 100 Year Output 9-21-20

\*\*\*\*\*  
 Highest Flow Instability Indexes  
 \*\*\*\*\*

All links are stable.

\*\*\*\*\*  
 Routing Time Step Summary  
 \*\*\*\*\*

Minimum Time Step : 30.00 sec  
 Average Time Step : 30.00 sec  
 Maximum Time Step : 30.00 sec  
 Percent in Steady State : 0.00  
 Average Iterations per Step : 1.02  
 Percent Not Converging : 0.00

\*\*\*\*\*  
 Node Depth Summary  
 \*\*\*\*\*

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
10	JUNCTION	0.00	0.00	6975.00	0 00:00	0.00
20	JUNCTION	0.00	0.00	6982.00	0 00:00	0.00
21	JUNCTION	0.00	0.00	6953.00	0 00:00	0.00
22	JUNCTION	0.00	0.00	6936.00	0 00:00	0.00
23	JUNCTION	0.06	1.35	6946.35	0 00:35	1.34
24	JUNCTION	0.27	2.22	6936.22	0 00:51	2.22
30	JUNCTION	0.00	0.00	6985.00	0 00:00	0.00
31	JUNCTION	0.24	1.68	6954.68	0 00:59	1.68
67	JUNCTION	3.45	4.11	6869.61	0 01:12	4.11
40	JUNCTION	0.00	0.00	6918.00	0 00:00	0.00
41	JUNCTION	0.00	0.00	6888.00	0 00:00	0.00
42	JUNCTION	0.05	1.40	6912.40	0 00:35	1.38
50	JUNCTION	0.00	0.00	6945.00	0 00:00	0.00
51	JUNCTION	1.48	1.48	6921.48	0 00:21	1.48
60	JUNCTION	0.00	0.00	6942.00	0 00:00	0.00
61	JUNCTION	0.00	0.00	6893.00	0 00:00	0.00
62	JUNCTION	0.00	0.00	6908.00	0 00:00	0.00
63	JUNCTION	0.00	0.00	6882.00	0 00:00	0.00
64	JUNCTION	0.06	1.19	6901.19	0 00:40	1.19
65	JUNCTION	0.09	1.92	6881.92	0 00:40	1.92
66	JUNCTION	0.13	3.12	6871.12	0 00:40	3.12
70	JUNCTION	0.00	0.00	6923.00	0 00:00	0.00

SWMM 100 Year Output 9-21-20

71	JUNCTION	0.00	0.00	6908.00	0	00:00	0.00
72	JUNCTION	0.00	0.00	6904.00	0	00:00	0.00
73	JUNCTION	0.06	1.02	6903.02	0	00:45	1.02
74	JUNCTION	2.57	2.66	6899.66	0	01:12	2.66
80	JUNCTION	0.00	0.00	6890.00	0	00:00	0.00
81	JUNCTION	0.00	0.00	6896.00	0	00:00	0.00
82	JUNCTION	0.00	0.00	6886.00	0	00:00	0.00
83	JUNCTION	0.00	0.00	6878.00	0	00:00	0.00
84	JUNCTION	0.07	1.45	6873.45	0	00:40	1.45
85	JUNCTION	0.03	0.82	6874.82	0	00:35	0.81
OS1	JUNCTION	1.33	1.33	6953.93	0	00:00	1.33
OS3	JUNCTION	1.48	1.48	6924.28	0	00:00	1.48
OS4	JUNCTION	2.38	2.38	6902.18	0	00:00	2.38
OS2	JUNCTION	1.06	1.06	6925.06	0	00:00	1.06
Outfall12	OUTFALL	1.06	1.06	6911.06	0	01:47	1.06
Outfall11	OUTFALL	1.33	1.33	6948.33	0	00:39	1.33
Outfall14	OUTFALL	3.45	4.11	6869.11	0	01:12	4.11
Outfall13	OUTFALL	0.00	0.00	6880.00	0	00:00	0.00
PondB	STORAGE	6.72	9.85	6920.85	0	01:16	9.85
PondC	STORAGE	5.17	7.08	6963.08	0	00:59	7.08
PondA	STORAGE	5.81	8.60	6957.60	0	01:13	8.59
PondD	STORAGE	5.66	8.08	6889.08	0	01:04	8.08
PondE	STORAGE	4.04	5.84	6928.84	0	00:49	5.84
PondF	STORAGE	5.86	8.17	6874.17	0	01:09	8.17
PondG	STORAGE	0.20	2.69	6902.69	0	01:12	2.68
PondH	STORAGE	4.95	6.51	6872.51	0	01:12	6.51

\*\*\*\*\*  
Node Inflow Summary  
\*\*\*\*\*

Total Flow		Maximum Lateral	Maximum Total	Time of Max Occurrence	Lateral Inflow Volume
Inflow Volume	Balance Error	Inflow CFS	Inflow CFS	days hr:min	10^6 gal
Node gal	Percent	Type			10^6
10	0.000	JUNCTION	100.64	0 00:40	2.37
2.37					

SWMM 100 Year Output 9-21-20

20		JUNCTION	97.08	97.08	0	00:35	1.81
1.81	0.000						
21		JUNCTION	42.26	42.26	0	00:40	1.2
1.2	0.000						
22		JUNCTION	295.27	295.27	0	00:40	6.04
6.04	0.000						
23		JUNCTION	0.00	136.17	0	00:35	0
3.01	0.000						
24		JUNCTION	0.00	334.84	0	00:51	0
9.43	-0.000						
30		JUNCTION	238.03	238.03	0	00:35	4
4	0.000						
31		JUNCTION	0.00	115.75	0	00:59	0
3.39	0.000						
67		JUNCTION	0.00	865.98	0	01:12	0
489	0.000						
40		JUNCTION	70.07	70.07	0	00:35	1.32
1.32	0.000						
41		JUNCTION	252.18	252.18	0	00:35	4.73
4.73	0.000						
42		JUNCTION	0.00	70.07	0	00:35	0
1.32	0.000						
50		JUNCTION	178.04	178.04	0	00:40	4.2
4.2	0.000						
51		JUNCTION	0.00	381.75	0	00:49	0
179	0.000						
60		JUNCTION	58.95	58.95	0	00:40	1.65
1.65	0.000						
61		JUNCTION	170.90	170.90	0	00:40	3.87
3.87	0.000						
62		JUNCTION	32.93	32.93	0	00:35	0.699
0.699	0.000						
63		JUNCTION	124.89	124.89	0	00:40	2.87
2.87	0.000						
64		JUNCTION	0.00	90.88	0	00:40	0
2.35	0.000						
65		JUNCTION	0.00	215.63	0	00:40	0
5.22	0.000						
66		JUNCTION	0.00	170.90	0	00:40	0
3.87	0.000						
70		JUNCTION	43.95	43.95	0	00:40	1.05
1.05	0.000						
71		JUNCTION	23.95	23.95	0	00:45	0.742
0.742	0.000						
72		JUNCTION	0.00	23.95	0	00:45	0
0.742	0.000						
73		JUNCTION	0.00	23.95	0	00:45	0
0.742	0.000						



SWMM 100 Year Output 9-21-20							
74		JUNCTION	0.00	637.13	0	01:12	0
482	0.000						
80		JUNCTION	27.62	27.62	0	00:45	0.833
0.833	0.000						
81		JUNCTION	47.62	47.62	0	00:35	1.01
1.01	0.000						
82		JUNCTION	15.60	15.60	0	00:35	0.314
0.314	0.000						
83		JUNCTION	64.71	64.71	0	00:35	1.46
1.46	0.000						
84		JUNCTION	0.00	73.73	0	00:40	0
1.84	0.000						
85		JUNCTION	0.00	15.60	0	00:35	0
0.314	0.000						
OS1		JUNCTION	413.00	413.00	0	00:00	334
334	0.000						
OS3		JUNCTION	217.00	217.00	0	00:00	175
175	-0.000						
OS4		JUNCTION	595.00	595.00	0	00:00	481
481	0.000						
OS2		JUNCTION	280.00	280.00	0	00:00	226
226	0.000						
Outfall2		OUTFALL	0.00	536.11	0	01:16	0
236	0.000						
Outfall1		OUTFALL	0.00	466.95	0	01:13	0
335	0.000						
Outfall4		OUTFALL	0.00	1291.25	0	01:05	0
671	0.000						
Outfall3		OUTFALL	0.00	160.70	0	01:04	0
5.21	0.000						
PondB		STORAGE	0.00	447.00	0	00:49	0
12.4	0.062						
PondC		STORAGE	0.00	238.03	0	00:35	0
4	0.130						
PondA		STORAGE	0.00	100.64	0	00:40	0
2.37	0.096						
PondD		STORAGE	0.00	320.21	0	00:35	0
6.05	0.105						
PondE		STORAGE	0.00	178.04	0	00:40	0
4.2	0.178						
PondF		STORAGE	0.00	385.87	0	00:41	0
9.08	0.109						
PondG		STORAGE	0.00	67.73	0	00:40	0
1.8	0.079						
PondH		STORAGE	0.00	153.03	0	00:38	0
3.61	0.143						

SWMM 100 Year Output 9-21-20

\*\*\*\*\*  
Node Flooding Summary  
\*\*\*\*\*

No nodes were flooded.

\*\*\*\*\*  
Storage Volume Summary  
\*\*\*\*\*

of Max Occurrence		Maximum Outflow	Average Volume	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume	Max Pcnt Full	Time days
hr:min	Storage Unit	Unit CFS	1000 ft3	Full	Loss	Loss	1000 ft3	Full	days
PondB 01:15	256.11		363.135	43	0	0	827.701	97	0
PondC 00:58	115.75		146.763	26	0	0	299.338	52	0
PondA 01:12	53.95		75.030	37	0	0	152.554	76	0
PondD 01:04	160.70		192.591	31	0	0	418.291	67	0
PondE 00:48	164.75		48.028	17	0	0	106.230	37	0
PondF 01:09	229.20		250.108	31	0	0	549.589	67	0
PondG 01:11	42.13		5.811	1	0	0	88.594	16	0
PondH 01:12	80.17		131.315	21	0	0	268.983	42	0

\*\*\*\*\*  
Outfall Loading Summary  
\*\*\*\*\*

Flow Freq	Avg Flow	Max Flow	Total Volume
-----------	----------	----------	--------------

SWMM 100 Year Output 9-21-20

Outfall Node	Pcnt	CFS	CFS	10 <sup>6</sup> gal
Outfall12	99.97	292.00	536.11	235.796
Outfall11	99.97	415.18	466.95	335.258
Outfall14	99.92	831.58	1291.25	671.130
Outfall13	99.69	6.47	160.70	5.209
System	99.89	1545.23	2428.13	1247.393

\*\*\*\*\*  
 Link Flow Summary  
 \*\*\*\*\*

Link	Type	Maximum  Flow  CFS	Time of Max Occurrence days hr:min	Maximum  Veloc  ft/sec	Max/ Full Flow	Max/ Full Depth
100	DUMMY	100.64	0 00:40			
200	DUMMY	97.08	0 00:35			
201	DUMMY	42.26	0 00:40			
202	CONDUIT	136.36	0 00:36	26.17	0.08	0.19
203	CONDUIT	115.74	0 00:59	23.03	0.37	0.42
204	DUMMY	295.27	0 00:40			
205	CONDUIT	334.86	0 00:51	31.89	0.22	0.32
300	DUMMY	238.03	0 00:35			
400	DUMMY	70.07	0 00:35			
401	CONDUIT	69.37	0 00:36	15.63	0.17	0.28
402	DUMMY	252.18	0 00:35			
500	DUMMY	178.04	0 00:40			
601	DUMMY	170.90	0 00:40			
602	CONDUIT	170.58	0 00:41	13.26	0.71	0.62
603	DUMMY	58.95	0 00:40			
604	DUMMY	32.93	0 00:35			
605	CONDUIT	90.74	0 00:41	20.83	0.06	0.17
606	DUMMY	124.89	0 00:40			
607	CONDUIT	215.42	0 00:40	23.26	0.13	0.24
700	DUMMY	43.95	0 00:40			
701	DUMMY	23.95	0 00:45			
702	DUMMY	23.95	0 00:45			
703	CONDUIT	23.94	0 00:45	8.29	0.09	0.20
801	DUMMY	27.62	0 00:45			
802	DUMMY	47.62	0 00:35			
803	CONDUIT	73.66	0 00:40	12.80	0.09	0.21
804	DUMMY	15.60	0 00:35			
806	DUMMY	64.71	0 00:35			
805	CONDUIT	15.43	0 00:37	7.47	0.06	0.16

SWMM 100 Year Output 9-21-20

808	CONDUIT	865.97	0	01:12	6.70	0.14	0.41
800	CONDUIT	637.10	0	01:15	9.35	0.06	0.27
600	CONDUIT	381.54	0	00:50	16.34	0.02	0.15
EastForkTrib	CONDUIT	217.00	0	00:21	4.75	0.02	0.15
EastFork	CONDUIT	595.00	0	00:16	6.34	0.10	0.30
MainStem	CONDUIT	413.00	0	00:40	4.75	0.03	0.13
MainStemTrib	CONDUIT	280.00	0	01:49	4.12	0.02	0.11
101	DUMMY	53.95	0	01:13			
206	DUMMY	256.11	0	01:16			
301	DUMMY	115.75	0	00:59			
501	DUMMY	164.75	0	00:49			
704	DUMMY	42.13	0	01:12			
807	DUMMY	80.17	0	01:12			
608	DUMMY	229.20	0	01:09			
403	DUMMY	160.70	0	01:04			

\*\*\*\*\*  
Conduit Surcharge Summary  
\*\*\*\*\*

No conduits were surcharged.

Analysis begun on: Mon Sep 21 16:06:21 2020  
Analysis ended on: Mon Sep 21 16:06:21 2020  
Total elapsed time: < 1 sec



## Appendix D

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

Sheet 1 of 3



Designer: Chris McFarland

Project: Grandview Reserve Pond A

Date: April 6, 2020

Last Edited: April 13, 2020

1. Select WQCV/EURV PCM Type:  
Imports the Stage-Area-Volume-Discharge information from the corresponding PCM worksheet. The selected PCM worksheet must be completed before the import will work.

Extended Detention Basin (EDB) ▼

2. WQCV/EURV Outlet Details

- A) Average Infiltration Rate of WQCV
- B) Depth to Centroid of Underdrain Outlet Orifice from filter media surface
- C) Underdrain Outlet Orifice Area
- D) Number of WQCV Orifice Rows
- E) Vertical Spacing between WQCV Orifice Rows
- F) WQCV Orifice Area (A<sub>o</sub>) per Row
- G) Maximum Stage of WQCV (includes ISD and Trickle Channel Depth)
- H) EURV Orifice Area (A<sub>o</sub>) in Single Row
- I) Maximum Stage of EURV (includes ISD and Trickle Channel Depth)
- J) Discharge Coefficient for all WQCV/EURV Outlet Orifice(s)

Input Parameters		
	User Input	COS DCM
i =	N/A	N/A
y =	N/A	N/A
Underdrain Ao =	N/A	N/A
# WQCV rows =	10	10
Orifice Spacing =	4.0	4.0
WQCV Ao =	0.61	0.61
Max Stage wqcv =	3.40	3.40
EURV Ao =	2.06	2.06
Max Stage EURV =	4.50	4.50
Cd =	0.60	0.60

3. Flood Control Surcharge Basin Geometry (above EURV) - See Figure  
Default Flood Surcharge Geometry inputs represent a continuation of the PCM Geometry in an upward direction without a transition bench.

- A) Length of Basin at Top of EURV
- B) Width of Basin at Top of EURV
- C) Stage at Top of Transition Bench (Bottom of Flood Control Surcharge)
- D) Length of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)
- E) Width of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)
- F) Average Side Slopes of Flood Control Surcharge above Transition Bench (Recommend no steeper than 3H:1V slope. Use zero for vertical walls.)

Input Parameters		
	User Input	COS DCM
L <sub>PCM</sub> =	370.3	370.3
W <sub>PCM</sub> =	113.6	113.6
Stage at Top of Bench =	4.60	4.60
L <sub>Bench</sub> =	371.1	371.1
W <sub>Bench</sub> =	114.4	114.4
Z <sub>Surcharge</sub> =	4.00	4.00

User can override default flood surcharge geometry inputs to create a transition bench between the top of the PCM and the Flood Surcharge Volume by entering larger dimensions in C), D), and E). See the Figure to the right.

Bench Slope is 4H:1V in length direction  
Bench Slope is 4H:1V in width direction

4. Tributary Watershed Hydrology

A) Input hydrology data (copy/paste) from model runs

Pre-Development Peak Flow (cfs)						
	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
		13.03				57.08

B) Adjust "Time Interval" to match hydrograph data

5-yr and 100-yr Hydrology Required (Other Storms are Optional)

Post-Development Storm Inflow Hydrographs (cfs)							
Time (min)	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
0:00		0.00				0.00	
0:05		0.32				0.84	
0:10		2.12				2.93	
0:15		6.24				8.14	
0:20		19.45				26.66	
0:25		29.43				70.19	
0:30		30.68				95.65	
0:35		28.10				100.37	
0:40		24.84				96.25	
0:45		22.05				89.32	
0:50		19.61				81.43	
0:55		17.40				74.41	
1:00		15.33				68.04	
1:05		13.43				58.60	
1:10		11.93				49.54	
1:15		10.74				42.06	
1:20		9.68				35.93	
1:25		8.69				30.71	
1:30		7.74				26.07	
1:35		6.89				21.81	
1:40		6.13				17.82	
1:45		5.44				14.14	
1:50		4.81				10.94	
1:55		4.24				8.55	
2:00		3.72				6.51	
2:05		3.24				4.89	
2:10		2.80				3.64	
2:15		2.39				2.70	
2:20		2.00				1.98	
2:25		1.71				1.45	
2:30		1.48				1.07	
2:35		1.29				0.82	
2:40		1.13				0.64	
2:45		1.00				0.50	
2:50		0.89				0.39	
2:55		0.80				0.29	
3:00		0.72				0.20	
3:05		0.65				0.13	
3:10		0.59				0.07	
3:15		0.54				0.03	
3:20		0.50				0.01	
3:25		0.46				0.00	
3:30		0.42					
3:35		0.38					
3:40		0.34					
3:45		0.30					
3:50		0.26					
3:55		0.22					
4:00		0.18					
4:05		0.14					
4:10		0.10					
4:15		0.06					
4:20		0.02					
4:25		0.00					
4:30							
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4:40							
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5:00							
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5:35							

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

5.40								
5.45								
5.50								
5.55								
6.00								



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

Sheet 2 of 3



Designer: Chris McFarland

Project: Grandview Reserve Pond A

Date: April 6, 2020

Last Edited: April 13, 2020

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

5. Flood Control Outlet Structure Type

A) Select Flood Control Outlet Structure Type

Overflow Weir/Grate, Outlet Pipe Restriction & Emergency Spillway

6. Overflow Weir (Dropbox) and Grate (Flat or Sloped)  
(Assumes that top of grate is flush with the top of the concrete dropbox)

- A) Overflow Weir Front Edge Height (relative to Stage = 0 ft)
- B) Overflow Weir Front Edge Length (inside edge of dropbox)
- C) Overflow Weir Grate Slope (H:V, enter zero for flat grate)
- D) Horizontal Length of Weir Sides (inside edge of dropbox)
- E) Overflow Grate Open Area % (grate open area / total grate area)
- F) Debris Clogging %
- G) Height of Grate Upper Edge (at back side of dropbox)
- H) Overflow Grate Slope Length (inside edge of dropbox)
- I) Overflow Grate Open Area (without debris)
- J) Overflow Grate Open Area (with debris)

	Input Parameters		
	User Input	COS DCM	
H <sub>weir front</sub> =	4.50	4.50	ft
L <sub>weir front</sub> =	8.00	9.00	ft
S <sub>weir sides</sub> =	0.00	0.00	ft / ft
Horizontal L <sub>weir sides</sub> =	8.00	5.00	ft
Grate Open Area =	70%	70%	%
Debris Clogging =	50%	50%	%
H <sub>grate top</sub> =	4.50	4.50	ft
Slope L <sub>weir sides</sub> =	8.00	5.00	ft
Open Area (No Clogging) =	44.80	31.50	sq ft
Open Area (Clogged) =	22.40	15.75	sq ft

7. Outlet Pipe with Flow Restriction Plate

A) Select Type of Outlet Restriction  
(Circular Pipe w/ Restrictor Plate, Circular Orifice or Rectangular Orifice)

Circular Outlet Pipe w/ Restrictor Plate

- B) Depth to Invert of Outlet Pipe (relative to Stage = 0 ft)
- C) Outlet Pipe Diameter
- D) Restrictor Plate Height above Pipe Invert
- E) Half-Central Angle of Restrictor Plate on Pipe
- F) Outlet Orifice Area
- G) Height of Outlet Orifice Centroid above Outlet Pipe Invert
- H) Ratio of Grate Open Area / 100-yr Orifice Area (should be ≥ 4)

	Input Parameters		
	User Input	COS DCM	
Pipe Invert Depth =	1.50	1.50	ft
Pipe Diameter =	36.00	30.00	inches
Plate Height =	22.42	28.11	inches
Theta =	1.82	2.63	radians
Outlet Ao =	4.63	4.78	sq ft
Outlet <sub>centroid</sub> =	1.06	1.22	ft
Open Area Ratio =	9.68	6.59	

8. Emergency Spillway (Rectangular or Trapezoidal)

- A) Spillway Invert Stage (relative to Stage = 0 ft)
- B) Spillway Crest Length
- C) Spillway End Slopes (H:V)
- D) Freeboard above Maximum Water Surface
- E) Spillway Design Flow Depth
- F) Stage at Top of Freeboard
- G) Basin Area at Top of Freeboard

	Input Parameters		
	User Input	COS DCM	
H <sub>spillway invert</sub> =	5.90	6.00	ft
L <sub>spillway crest</sub> =	42.00	33.00	ft
S <sub>spillway ends</sub> =	4.00	4.00	ft / ft
Freeboard Depth =	1.00	1.00	ft
Flow Depth <sub>spillway</sub> =	0.80	1.00	ft
Freeboard Top Stage =	7.70	8.00	ft
Max Basin Area =	1.27	1.29	acres

9. Routed Hydrograph Results

	Results based on User Input								
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	0.64	1.66		2.16					7.27
Inflow Hydrograph Volume (ac-ft) =	N/A	N/A		13.0					57.1
Predevelopment Peak Q (cfs) =	N/A	N/A		30.7					100.4
Peak Inflow (cfs) =	0.3	0.5		4.6					56.3
Peak Outflow (cfs) =	N/A	N/A		0.4					1.0
Ratio (Outflow/Predevelopment) =	Orifice Plate	Orifice Plate		Overflow Grate					Outlet Pipe
Structure Controlling Flow =	N/A	N/A		0.1					1.2
Max Velocity through Grate =	39	69		73					61
Time to Drain 97% of Volume (hr) =	41	72		77					72
Time to Drain 99% of Volume (hr) =	3.40	4.50		4.70					5.90
Maximum Ponding Depth (ft) =	0.80	0.97		0.98					1.09
Area at Max Ponding Depth (ac) =	0.64	1.66		1.87					3.11
Maximum Volume Stored (ac-ft) =									
	Results based on COS DCM Inputs								
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	0.64	1.66		2.16					7.27
Inflow Hydrograph Volume (ac-ft) =	N/A	N/A		13.0					57.1
Predevelopment Peak Q (cfs) =	N/A	N/A		30.7					100.4
Peak Inflow (cfs) =	0.3	0.5		4.3					57.5
Peak Outflow (cfs) =	N/A	N/A		0.3					1.0
Ratio (Outflow/Predevelopment) =	Orifice Plate	Orifice Plate		Overflow Grate					Outlet Pipe
Structure Controlling Flow =	N/A	N/A		0.2					1.8
Max Velocity through Grate =	39	69		73					61
Time to Drain 97% of Volume (hr) =	41	72		77					72
Time to Drain 99% of Volume (hr) =	3.40	4.50		4.70					5.90
Maximum Ponding Depth (ft) =	0.80	0.97		0.98					1.09
Area at Max Ponding Depth (ac) =	0.64	1.66		1.87					3.11
Maximum Volume Stored (ac-ft) =									



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

Sheet 3 of 3

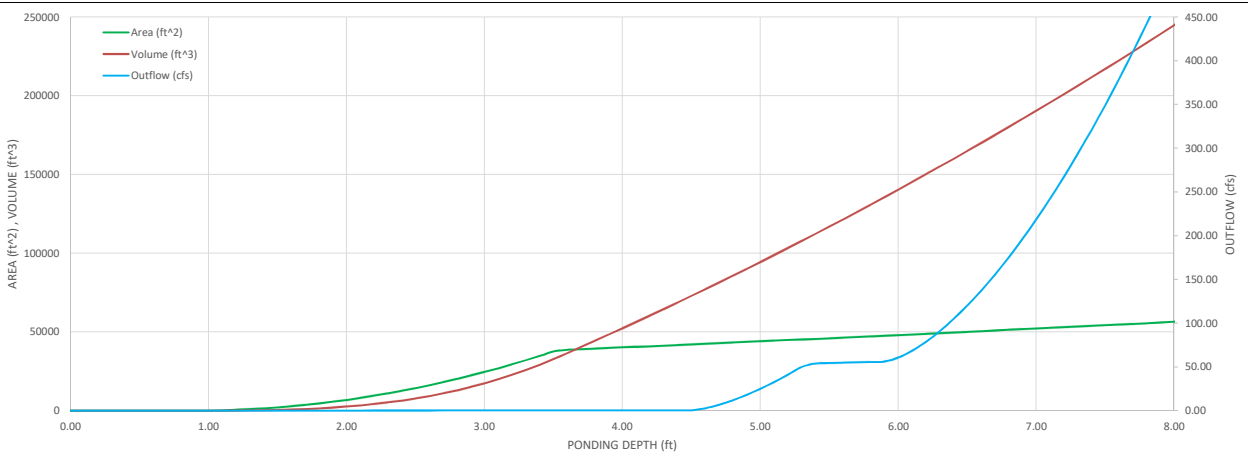
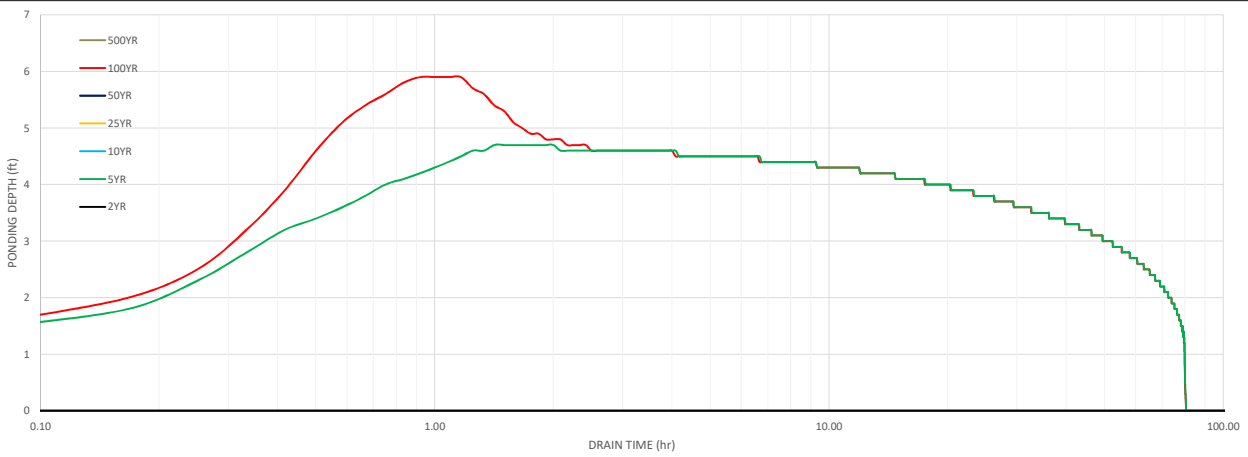
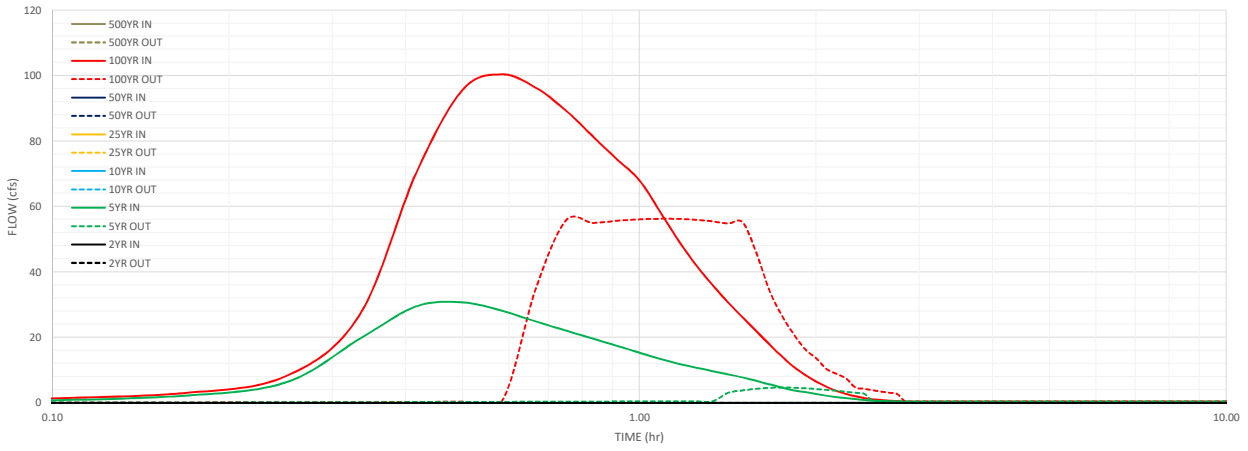


Designer: Chris McFarland

Project: Grandview Reserve Pond A

Date: April 6, 2020

Last Edited: April 13, 2020



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

Sheet 1 of 3



Designer: Chris McFarland

Project: Grandview Reserve Pond B

Date: April 6, 2020

Last Edited: April 13, 2020

1. Select QOCV/EURV PCM Type:  
Imports the Stage-Area-Volume-Discharge information from the corresponding PCM worksheet. The selected PCM worksheet must be completed before the import will work.

Extended Detention Basin (EDB) ▼

2. WQCV/EURV Outlet Details  
A) Average Infiltration Rate of WQCV  
B) Depth to Centroid of Underdrain Outlet Orifice from filter media surface  
C) Underdrain Outlet Orifice Area  
D) Number of WQCV Orifice Rows  
E) Vertical Spacing between WQCV Orifice Rows  
F) WQCV Orifice Area (A<sub>o</sub>) per Row  
G) Maximum Stage of WQCV (includes ISD and Trickle Channel Depth)  
H) EURV Orifice Area (A<sub>o</sub>) in Single Row  
I) Maximum Stage of EURV (includes ISD and Trickle Channel Depth)  
J) Discharge Coefficient for all WQCV/EURV Outlet Orifice(s)

Input Parameters		
	User Input	COS DCM
i =	N/A	N/A
y =	N/A	N/A
Underdrain A <sub>o</sub> =	N/A	N/A
# WQCV rows =	14	14
Orifice Spacing =	4.0	4.0
WQCV A <sub>o</sub> =	1.49	1.49
Max Stage wqcv =	4.70	4.70
EURV A <sub>o</sub> =	1.49	1.49
Max Stage EURV =	6.00	6.00
Cd =	0.60	0.60

3. Flood Control Surcharge Basin Geometry (above EURV) - See Figure  
Default Flood Surcharge Geometry inputs represent a continuation of the PCM Geometry in an upward direction without a transition bench.

A) Length of Basin at Top of EURV  
B) Width of Basin at Top of EURV  
C) Stage at Top of Transition Bench (Bottom of Flood Control Surcharge)  
D) Length of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)  
E) Width of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)  
F) Average Side Slopes of Flood Control Surcharge above Transition Bench (Recommend no steeper than 3H:1V slope. Use zero for vertical walls.)

Input Parameters		
	User Input	COS DCM
L <sub>PCM</sub> =	644.7	644.7
W <sub>PCM</sub> =	191.2	191.2
Stage at Top of Bench =	6.10	6.10
L <sub>Bench</sub> =	645.5	645.5
W <sub>Bench</sub> =	192.0	192.0
Z <sub>Surcharge</sub> =	4.00	4.00

User can override default flood surcharge geometry inputs to create a transition bench between the top of the PCM and the Flood Surcharge Volume by entering larger dimensions in C), D), and E). See the Figure to the right.

Bench Slope is 4H:1V in length direction  
Bench Slope is 4H:1V in width direction

4. Tributary Watershed Hydrology

A) Input hydrology data (copy/paste) from model runs

Pre-Development Peak Flow (cfs)						
	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
		17.56				164.21

B) Adjust "Time Interval" to match hydrograph data

5-yr and 100-yr Hydrology Required (Other Storms are Optional)

Post-Development Storm Inflow Hydrographs (cfs)							
Time (min)	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
0:00		0.00				0.00	
0:05		0.69				2.08	
0:10		5.80				8.30	
0:15		16.64				20.58	
0:20		42.42				58.80	
0:25		68.16				179.82	
0:30		75.65				276.49	
0:35		71.78				307.62	
0:40		64.91				331.81	
0:45		58.24				366.22	
0:50		52.24				365.58	
0:55		47.02				346.26	
1:00		42.99				321.76	
1:05		39.68				290.00	
1:10		36.25				252.97	
1:15		32.60				216.52	
1:20		29.09				182.15	
1:25		26.07				152.09	
1:30		23.97				127.70	
1:35		22.28				109.78	
1:40		20.74				95.42	
1:45		19.35				83.46	
1:50		18.07				73.27	
1:55		16.77				63.53	
2:00		14.81				60.20	
2:05		12.66				51.42	
2:10		10.67				42.95	
2:15		8.88				35.32	
2:20		7.28				28.18	
2:25		5.90				21.64	
2:30		4.82				15.96	
2:35		4.08				11.89	
2:40		3.58				9.39	
2:45		3.19				7.53	
2:50		2.86				6.09	
2:55		2.60				4.98	
3:00		2.39				4.12	
3:05		2.22				3.47	
3:10		2.09				2.97	
3:15		1.97				2.55	
3:20		1.86				2.21	
3:25		1.77				2.08	
3:30		1.70				1.98	
3:35		1.63				1.88	
3:40		1.58				1.81	
3:45		1.54				1.75	
3:50		1.51				1.70	
3:55		1.49				1.67	
4:00		1.47				1.65	
4:05		1.46				1.64	
4:10		1.46				1.64	
4:15		1.46				1.64	
4:20		1.46				1.64	
4:25		1.45				1.64	
4:30		1.45				1.63	
4:35		1.45				1.63	
4:40		1.45				1.63	
4:45		1.45				1.63	
4:50		1.44				1.63	
4:55		1.44				1.63	
5:00		1.44				1.62	
5:05		1.44				1.62	
5:10		1.44				1.62	
5:15		1.43				1.62	
5:20		1.43				1.62	
5:25		1.43				1.61	
5:30		1.43				1.61	
5:35		1.43				1.61	

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

5.40		1.42				1.61	
5.45		1.42				1.61	
5.50		1.42				1.60	
5.55		1.42				1.60	
6.00							



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

Sheet 2 of 3



Designer: Chris McFarland

Project: Grandview Reserve Pond B

Date: April 6, 2020

Last Edited: April 13, 2020

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

5. Flood Control Outlet Structure Type

A) Select Flood Control Outlet Structure Type

Overflow Weir/Grate, Outlet Pipe Restriction & Emergency Spillway

6. Overflow Weir (Dropbox) and Grate (Flat or Sloped)  
(Assumes that top of grate is flush with the top of the concrete dropbox)

- A) Overflow Weir Front Edge Height (relative to Stage = 0 ft)
- B) Overflow Weir Front Edge Length (inside edge of dropbox)
- C) Overflow Weir Grate Slope (H:V, enter zero for flat grate)
- D) Horizontal Length of Weir Sides (inside edge of dropbox)
- E) Overflow Grate Open Area % (grate open area / total grate area)
- F) Debris Clogging %
- G) Height of Grate Upper Edge (at back side of dropbox)
- H) Overflow Grate Slope Length (inside edge of dropbox)
- I) Overflow Grate Open Area (without debris)
- J) Overflow Grate Open Area (with debris)

	Input Parameters		
	User Input	COS DCM	
H <sub>weir front</sub> =	6.00	6.00	ft
L <sub>weir front</sub> =	17.00	17.00	ft
S <sub>weir sides</sub> =	0.00	0.00	ft / ft
Horizontal L <sub>weir sides</sub> =	17.00	7.00	ft
Grate Open Area =	70%	70%	%
Debris Clogging =	50%	50%	%
H <sub>grate top</sub> =	6.00	6.00	ft
Slope L <sub>weir sides</sub> =	17.00	7.00	ft
Open Area (No Clogging) =	202.30	83.30	sq ft
Open Area (Clogged) =	101.15	41.65	sq ft

7. Outlet Pipe with Flow Restriction Plate

A) Select Type of Outlet Restriction  
(Circular Pipe w/ Restrictor Plate, Circular Orifice or Rectangular Orifice)

Circular Outlet Pipe w/ Restrictor Plate

- B) Depth to Invert of Outlet Pipe (relative to Stage = 0 ft)
- C) Outlet Pipe Diameter
- D) Restrictor Plate Height above Pipe Invert
- E) Half-Central Angle of Restrictor Plate on Pipe
- F) Outlet Orifice Area
- G) Height of Outlet Orifice Centroid above Outlet Pipe Invert
- H) Ratio of Grate Open Area / 100-yr Orifice Area (should be ≥ 4)

	Input Parameters		
	User Input	COS DCM	
Pipe Invert Depth =	1.50	1.50	ft
Pipe Diameter =	54.00	48.00	inches
Plate Height =	37.00	42.00	inches
Theta =	1.95	2.42	radians
Outlet Ao =	11.61	11.66	sq ft
Outlet <sub>centroid</sub> =	1.73	1.87	ft
Open Area Ratio =	17.42	7.14	

8. Emergency Spillway (Rectangular or Trapezoidal)

- A) Spillway Invert Stage (relative to Stage = 0 ft)
- B) Spillway Crest Length
- C) Spillway End Slopes (H:V)
- D) Freeboard above Maximum Water Surface
- E) Spillway Design Flow Depth
- F) Stage at Top of Freeboard
- G) Basin Area at Top of Freeboard

	Input Parameters		
	User Input	COS DCM	
H <sub>spillway invert</sub> =	9.50	9.30	ft
L <sub>spillway crest</sub> =	136.00	122.00	ft
S <sub>spillway ends</sub> =	4.00	4.00	ft / ft
Freeboard Depth =	1.00	1.00	ft
Flow Depth <sub>spillway</sub> =	0.90	1.00	ft
Freeboard Top Stage =	11.40	11.30	ft
Max Basin Area =	3.70	3.68	acres

9. Routed Hydrograph Results

	Results based on User Input								
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	2.41	5.73		6.67					31.72
Inflow Hydrograph Volume (ac-ft) =	N/A	N/A		17.6					164.2
Predevelopment Peak Q (cfs) =	N/A	N/A		75.7					366.2
Peak Inflow (cfs) =	1.1	1.4		1.4					166.4
Peak Outflow (cfs) =	N/A	N/A		0.1					1.0
Ratio (Outflow/Predevelopment) =	Orifice Plate	Orifice Plate		Overflow Grate					Outlet Pipe
Structure Controlling Flow =	N/A	N/A		0.0					0.8
Max Velocity through Grate =	40	68		76					61
Time to Drain 97% of Volume (hr) =	42	72		80					73
Time to Drain 99% of Volume (hr) =	4.70	6.00		6.10					9.10
Maximum Ponding Depth (ft) =	1.92	2.83		2.85					3.32
Area at Max Ponding Depth (ac) =	2.41	5.73		6.04					15.28
Maximum Volume Stored (ac-ft) =									
	Results based on COS DCM Inputs								
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	2.41	5.73		6.67					31.72
Inflow Hydrograph Volume (ac-ft) =	N/A	N/A		17.6					164.2
Predevelopment Peak Q (cfs) =	N/A	N/A		75.7					366.2
Peak Inflow (cfs) =	1.1	1.4		1.4					166.5
Peak Outflow (cfs) =	N/A	N/A		0.1					1.0
Ratio (Outflow/Predevelopment) =	Orifice Plate	Orifice Plate		Overflow Grate					Outlet Pipe
Structure Controlling Flow =	N/A	N/A		0.0					2.0
Max Velocity through Grate =	40	68		76					61
Time to Drain 97% of Volume (hr) =	42	72		80					73
Time to Drain 99% of Volume (hr) =	4.70	6.00		6.10					9.20
Maximum Ponding Depth (ft) =	1.92	2.83		2.85					3.34
Area at Max Ponding Depth (ac) =	2.41	5.73		6.04					15.62
Maximum Volume Stored (ac-ft) =									

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

Sheet 3 of 3

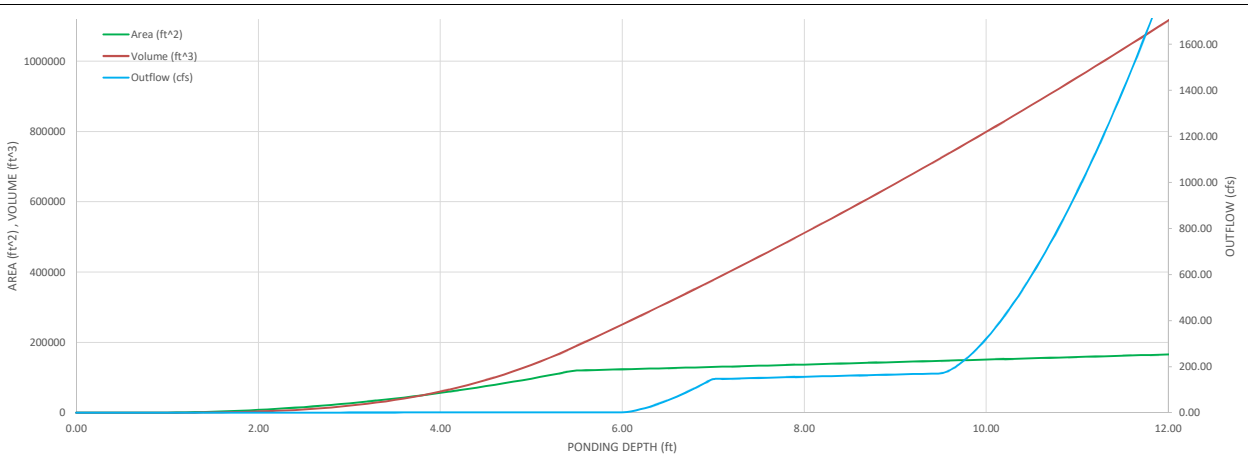
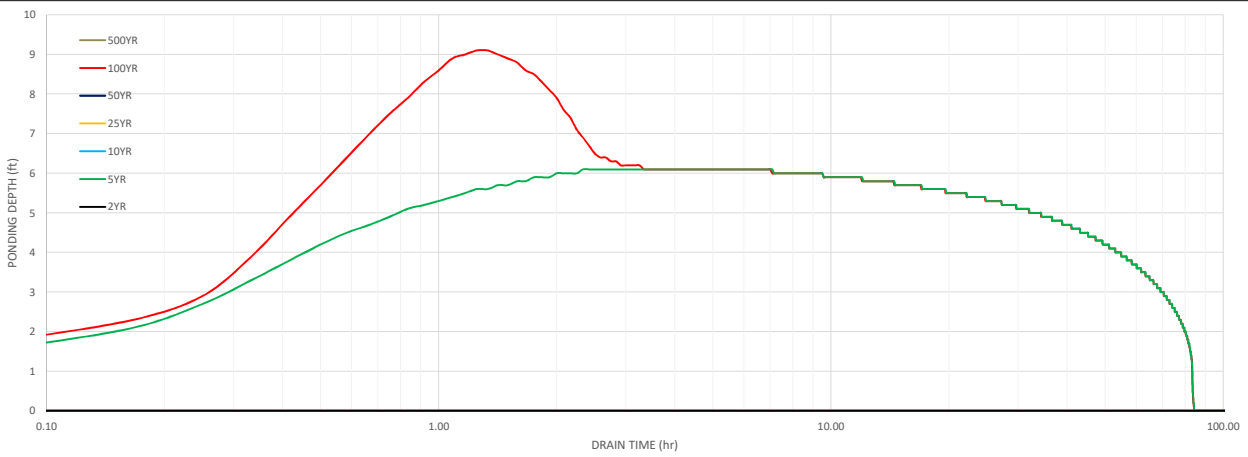
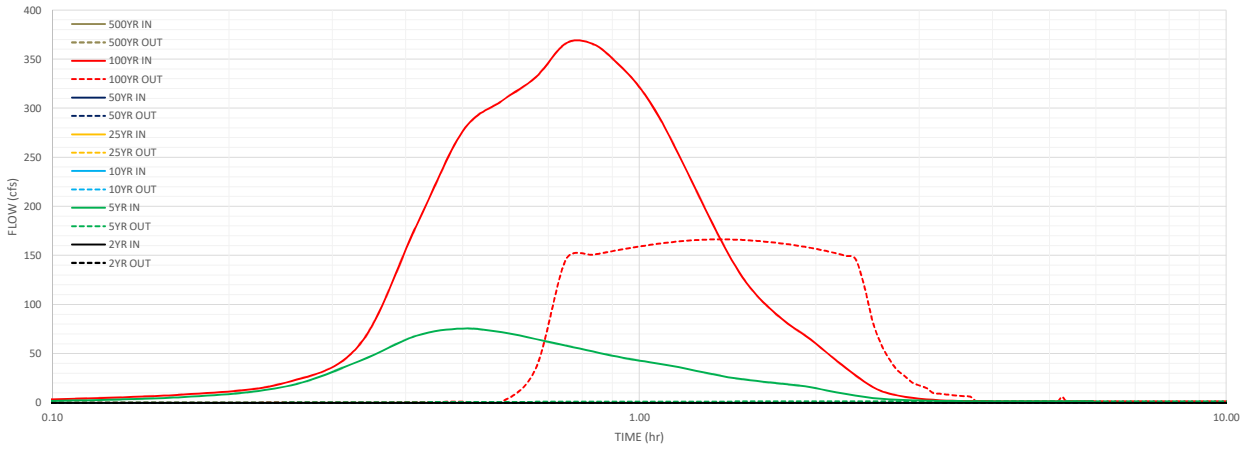


Designer: Chris McFarland

Project: Grandview Reserve Pond B

Date: April 6, 2020

Last Edited: April 13, 2020



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

Sheet 1 of 3



Designer: Chris McFarland

Project: Grandview Reserve Pond C

Date: April 6, 2020

Last Edited: April 08, 2020

1. Select WQCV/EURV PCM Type:  
Imports the Stage-Area-Volume-Discharge information from the corresponding PCM worksheet. The selected PCM worksheet must be completed before the import will work.

Extended Detention Basin (EDB) ▼

2. WQCV/EURV Outlet Details

- A) Average Infiltration Rate of WQCV
- B) Depth to Centroid of Underdrain Outlet Orifice from filter media surface
- C) Underdrain Outlet Orifice Area
- D) Number of WQCV Orifice Rows
- E) Vertical Spacing between WQCV Orifice Rows
- F) WQCV Orifice Area (A<sub>o</sub>) per Row
- G) Maximum Stage of WQCV (includes ISD and Trickle Channel Depth)
- H) EURV Orifice Area (A<sub>o</sub>) in Single Row
- I) Maximum Stage of EURV (includes ISD and Trickle Channel Depth)
- J) Discharge Coefficient for all WQCV/EURV Outlet Orifice(s)

Input Parameters		
	User Input	COS DCM
i =	N/A	N/A
y =	N/A	N/A
Underdrain Ao =	N/A	N/A
# WQCV rows =	12	12
Orifice Spacing =	4.0	4.0
WQCV Ao =	1.05	1.05
Max Stage wqcv =	4.00	4.00
EURV Ao =	17.07	17.07
Max Stage EURV =	6.00	6.00
Cd =	0.60	0.60

3. Flood Control Surcharge Basin Geometry (above EURV) - See Figure  
Default Flood Surcharge Geometry inputs represent a continuation of the PCM Geometry in an upward direction without a transition bench.

- A) Length of Basin at Top of EURV
- B) Width of Basin at Top of EURV
- C) Stage at Top of Transition Bench (Bottom of Flood Control Surcharge)
- D) Length of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)
- E) Width of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)
- F) Average Side Slopes of Flood Control Surcharge above Transition Bench (Recommend no steeper than 3H:1V slope. Use zero for vertical walls.)

Input Parameters		
	User Input	COS DCM
L <sub>PCM</sub> =	453.3	453.3
W <sub>PCM</sub> =	177.8	177.8
Stage at Top of Bench =	6.10	6.10
L <sub>Bench</sub> =	454.1	454.1
W <sub>Bench</sub> =	178.6	178.6
Z <sub>Surcharge</sub> =	4.00	4.00

User can override default flood surcharge geometry inputs to create a transition bench between the top of the PCM and the Flood Surcharge Volume by entering larger dimensions in C), D), and E). See the Figure to the right.

Bench Slope is 4H:1V in length direction  
Bench Slope is 4H:1V in width direction

4. Tributary Watershed Hydrology

A) Input hydrology data (copy/paste) from model runs

Pre-Development Peak Flow (cfs)						
2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
	9.95				120.21	

B) Adjust "Time Interval" to match hydrograph data

Post-Development Storm Inflow Hydrographs (cfs)							
Time (min)	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
0:00		0.00				0.00	
0:05		1.75				4.56	
0:10		11.33				15.20	
0:15		27.93				32.42	
0:20		61.14				76.70	
0:25		78.99				190.43	
0:30		71.29				238.04	
0:35		58.22				222.59	
0:40		47.28				193.29	
0:45		38.58				162.70	
0:50		32.22				131.89	
0:55		27.64				110.47	
1:00		23.60				95.05	
1:05		20.00				74.37	
1:10		16.49				54.92	
1:15		14.05				38.35	
1:20		12.80				27.93	
1:25		12.09				21.76	
1:30		11.62				18.07	
1:35		10.55				15.64	
1:40		9.55				14.06	
1:45		8.84				12.98	
1:50		8.33				12.35	
1:55		7.74				12.15	
2:00		5.88				9.32	
2:05		4.08				6.49	
2:10		2.79				4.48	
2:15		1.86				3.04	
2:20		1.21				1.99	
2:25		0.80				1.32	
2:30		0.49				0.80	
2:35		0.25				0.40	
2:40		0.09				0.14	
2:45		0.01				0.01	
2:50		0.00				0.00	
2:55							
3:00							
3:05							
3:10							
3:15							
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5:20							
5:25							
5:30							
5:35							

5-yr and 100-yr Hydrology Required (Other Storms are Optional)

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

5.40								
5.45								
5.50								
5.55								
6.00								



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

Sheet 2 of 3



Designer: Chris McFarland

Project: Grandview Reserve Pond C

Date: April 6, 2020

Last Edited: April 08, 2020

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

5. Flood Control Outlet Structure Type

A) Select Flood Control Outlet Structure Type

Overflow Weir/Grate, Outlet Pipe Restriction & Emergency Spillway

6. Overflow Weir (Dropbox) and Grate (Flat or Sloped)  
(Assumes that top of grate is flush with the top of the concrete dropbox)

- A) Overflow Weir Front Edge Height (relative to Stage = 0 ft)
- B) Overflow Weir Front Edge Length (inside edge of dropbox)
- C) Overflow Weir Grate Slope (H:V, enter zero for flat grate)
- D) Horizontal Length of Weir Sides (inside edge of dropbox)
- E) Overflow Grate Open Area % (grate open area / total grate area)
- F) Debris Clogging %
- G) Height of Grate Upper Edge (at back side of dropbox)
- H) Overflow Grate Slope Length (inside edge of dropbox)
- I) Overflow Grate Open Area (without debris)
- J) Overflow Grate Open Area (with debris)

	Input Parameters		
	User Input	COS DCM	
H <sub>weir front</sub> =	6.00	5.00	ft
L <sub>weir front</sub> =	12.00	11.00	ft
S <sub>weir sides</sub> =	0.00	0.00	ft / ft
Horizontal L <sub>weir sides</sub> =	12.00	11.00	ft
Grate Open Area =	70%	70%	%
Debris Clogging =	50%	50%	%
H <sub>grate top</sub> =	6.00	6.00	ft
Slope L <sub>weir sides</sub> =	12.00	11.00	ft
Open Area (No Clogging) =	100.80	84.70	sq ft
Open Area (Clogged) =	50.40	42.35	sq ft

7. Outlet Pipe with Flow Restriction Plate

A) Select Type of Outlet Restriction  
(Circular Pipe w/ Restrictor Plate, Circular Orifice or Rectangular Orifice)

Circular Outlet Pipe w/ Restrictor Plate

- B) Depth to Invert of Outlet Pipe (relative to Stage = 0 ft)
- C) Outlet Pipe Diameter
- D) Restrictor Plate Height above Pipe Invert
- E) Half-Central Angle of Restrictor Plate on Pipe
- F) Outlet Orifice Area
- G) Height of Outlet Orifice Centroid above Outlet Pipe Invert
- H) Ratio of Grate Open Area / 100-yr Orifice Area (should be ≥ 4)

	Input Parameters		
	User Input	COS DCM	
Pipe Invert Depth =	1.50	1.50	ft
Pipe Diameter =	48.00	42.00	inches
Plate Height =	33.13	39.36	inches
Theta =	1.96	2.63	radians
Outlet Ao =	9.25	9.37	sq ft
Outlet <sub>centroid</sub> =	1.54	1.71	ft
Open Area Ratio =	10.90	9.04	

8. Emergency Spillway (Rectangular or Trapezoidal)

- A) Spillway Invert Stage (relative to Stage = 0 ft)
- B) Spillway Crest Length
- C) Spillway End Slopes (H:V)
- D) Freeboard above Maximum Water Surface
- E) Spillway Design Flow Depth
- F) Stage at Top of Freeboard
- G) Basin Area at Top of Freeboard

	Input Parameters		
	User Input	COS DCM	
H <sub>spillway invert</sub> =	8.00	999.00	ft
L <sub>spillway crest</sub> =	79.00	42.00	ft
S <sub>spillway ends</sub> =	4.00	4.00	ft / ft
Freeboard Depth =	1.00	1.00	ft
Flow Depth <sub>spillway</sub> =	1.00		ft
Freeboard Top Stage =	10.00		ft
Max Basin Area =	2.34		acres

9. Routed Hydrograph Results

	Results based on User Input								
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	1.36	4.79		4.34				12.42	
Inflow Hydrograph Volume (ac-ft) =	1.36	4.79		4.34				12.42	
Predevelopment Peak Q (cfs) =	N/A	N/A		10.0				120.2	
Peak Inflow (cfs) =	N/A	N/A		79.0				238.0	
Peak Outflow (cfs) =	0.6	1.7		1.5				119.2	
Ratio (Outflow/Predevelopment) =	N/A	N/A		0.2				1.0	
Structure Controlling Flow =	Orifice Plate	Orifice Plate		Orifice Plate				Outlet Pipe	
Max Velocity through Grate =	N/A	N/A		N/A				1.2	
Time to Drain 97% of Volume (hr) =	39	67		65				63	
Time to Drain 99% of Volume (hr) =	41	72		69				72	
Maximum Ponding Depth (ft) =	4.00	6.00		5.60				7.10	
Area at Max Ponding Depth (ac) =	1.32	1.85		1.80				1.98	
Maximum Volume Stored (ac-ft) =	1.36	4.79		4.07				6.91	

	Results based on COS DCM Inputs								
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	1.36	4.79		4.34				12.42	
Inflow Hydrograph Volume (ac-ft) =	1.36	4.79		4.34				12.42	
Predevelopment Peak Q (cfs) =	N/A	N/A		10.0				120.2	
Peak Inflow (cfs) =	N/A	N/A		79.0				238.0	
Peak Outflow (cfs) =	0.6	1.7		1.5				116.8	
Ratio (Outflow/Predevelopment) =	N/A	N/A		0.2				1.0	
Structure Controlling Flow =	Orifice Plate	Orifice Plate		Orifice Plate				Overflow Grate	
Max Velocity through Grate =	N/A	N/A		N/A				1.3	
Time to Drain 97% of Volume (hr) =	39	67		65				63	
Time to Drain 99% of Volume (hr) =	41	72		69				72	
Maximum Ponding Depth (ft) =	4.00	6.00		5.60				7.10	
Area at Max Ponding Depth (ac) =	1.32	1.85		1.80				1.98	
Maximum Volume Stored (ac-ft) =	1.36	4.79		4.07				6.91	



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

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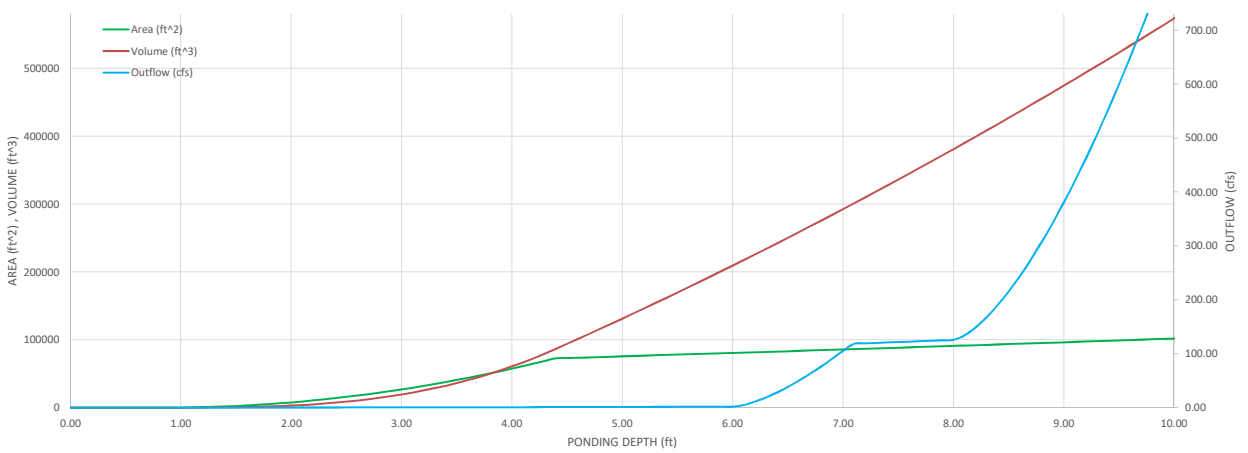
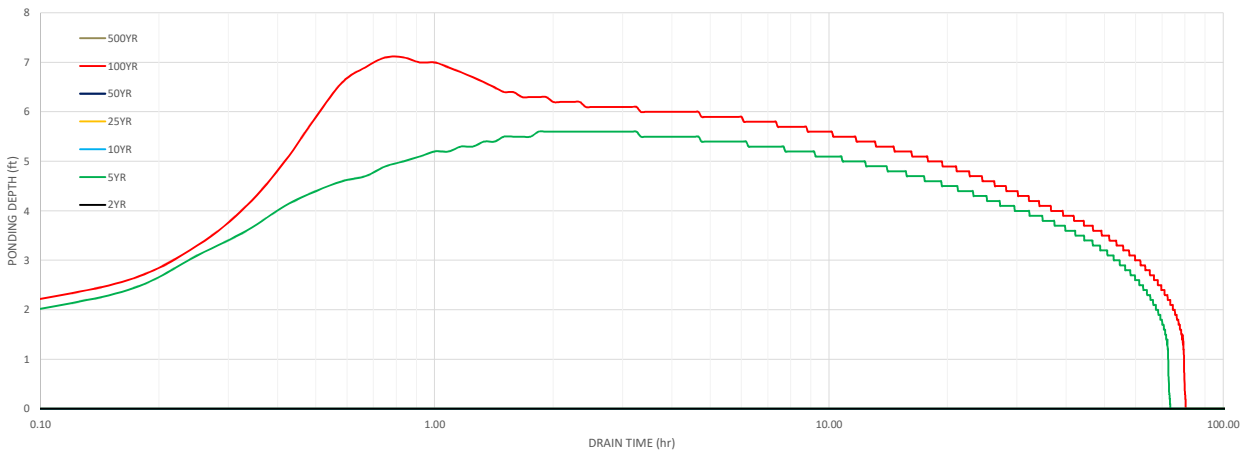
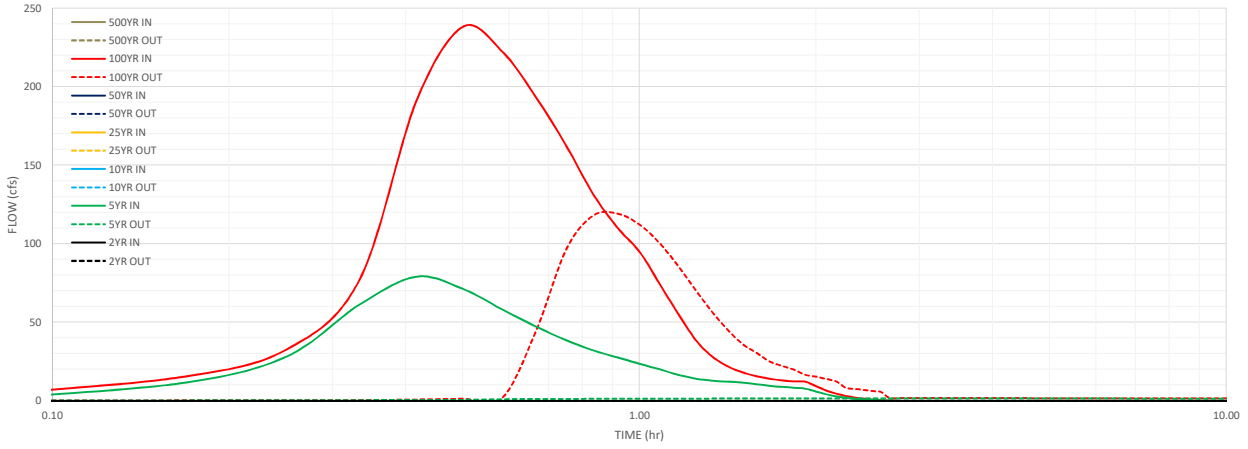


Designer: Chris McFarland

Project: Grandview Reserve Pond C

Date: April 6, 2020

Last Edited: April 08, 2020



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

Sheet 1 of 3



Designer: Chris McFarland

Project: Grandview Reserve Pond D

Date: April 6, 2020

Last Edited: April 13, 2020

1. Select WQCV/EURV PCM Type:  
Imports the Stage-Area-Volume-Discharge information from the corresponding PCM worksheet. The selected PCM worksheet must be completed before the import will work.

Extended Detention Basin (EDB) ▼

2. WQCV/EURV Outlet Details  
A) Average Infiltration Rate of WQCV  
B) Depth to Centroid of Underdrain Outlet Orifice from filter media surface  
C) Underdrain Outlet Orifice Area  
D) Number of WQCV Orifice Rows  
E) Vertical Spacing between WQCV Orifice Rows  
F) WQCV Orifice Area (A<sub>o</sub>) per Row  
G) Maximum Stage of WQCV (includes ISD and Trickle Channel Depth)  
H) EURV Orifice Area (A<sub>o</sub>) in Single Row  
I) Maximum Stage of EURV (includes ISD and Trickle Channel Depth)  
J) Discharge Coefficient for all WQCV/EURV Outlet Orifice(s)

Input Parameters		
	User Input	COS DCM
i =	N/A	N/A
y =	N/A	N/A
Underdrain A <sub>o</sub> =	N/A	N/A
# WQCV rows =	13	13
Orifice Spacing =	4.0	4.0
WQCV A <sub>o</sub> =	1.34	1.34
Max Stage wqcv =	4.50	4.50
EURV A <sub>o</sub> =	20.83	20.83
Max Stage EURV =	6.50	6.50
Cd =	0.60	0.60

3. Flood Control Surcharge Basin Geometry (above EURV) - See Figure  
Default Flood Surcharge Geometry inputs represent a continuation of the PCM Geometry in an upward direction without a transition bench.

A) Length of Basin at Top of EURV  
B) Width of Basin at Top of EURV  
C) Stage at Top of Transition Bench (Bottom of Flood Control Surcharge)  
D) Length of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)  
E) Width of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)  
F) Average Side Slopes of Flood Control Surcharge above Transition Bench (Recommend no steeper than 3H:1V slope. Use zero for vertical walls.)

Input Parameters		
	User Input	COS DCM
L <sub>PCM</sub> =	588.5	588.5
W <sub>PCM</sub> =	180.1	180.1
Stage at Top of Bench =	6.60	6.60
L <sub>Bench</sub> =	589.3	589.3
W <sub>Bench</sub> =	180.9	180.9
Z <sub>Surcharge</sub> =	4.00	4.00

User can override default flood surcharge geometry inputs to create a transition bench between the top of the PCM and the Flood Surcharge Volume by entering larger dimensions in C), D), and E). See the Figure to the right.

Bench Slope is 4H:1V in length direction  
Bench Slope is 4H:1V in width direction

4. Tributary Watershed Hydrology

A) Input hydrology data (copy/paste) from model runs

Pre-Development Peak Flow (cfs)					
2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
	30.00				154.35

B) Adjust "Time Interval" to match hydrograph data

5-yr and 100-yr Hydrology Required (Other Storms are Optional)

Post-Development Storm Inflow Hydrographs (cfs)							
Time (min)	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
0:00		0.00				0.00	
0:05		1.91				5.05	
0:10		13.55				18.88	
0:15		36.44				44.44	
0:20		87.25				108.47	
0:25		118.48				244.10	
0:30		113.01				314.40	
0:35		95.70				305.49	
0:40		80.03				273.09	
0:45		67.12				239.63	
0:50		56.09				204.40	
0:55		48.05				175.96	
1:00		41.91				156.02	
1:05		36.47				129.55	
1:10		30.68				102.47	
1:15		25.11				77.55	
1:20		21.41				56.75	
1:25		19.34				42.46	
1:30		18.14				33.79	
1:35		16.52				28.16	
1:40		14.92				24.40	
1:45		13.77				21.60	
1:50		12.92				19.98	
1:55		12.02				18.83	
2:00		9.58				15.10	
2:05		6.95				10.86	
2:10		4.98				7.82	
2:15		3.53				5.61	
2:20		2.44				3.93	
2:25		1.66				2.73	
2:30		1.13				1.86	
2:35		0.72				1.18	
2:40		0.41				0.67	
2:45		0.20				0.31	
2:50		0.08				0.11	
2:55		0.04				0.05	
3:00		0.02				0.02	
3:05		0.01				0.01	
3:10		0.01				0.01	
3:15		0.00				0.00	
3:20						0.00	
3:25							
3:30							
3:35							
3:40							
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5:30							
5:35							

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

5.40								
5.45								
5.50								
5.55								
6.00								



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

Sheet 2 of 3



Designer: Chris McFarland

Project: Grandview Reserve Pond D

Date: April 6, 2020

Last Edited: April 13, 2020

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

5. Flood Control Outlet Structure Type

A) Select Flood Control Outlet Structure Type

Overflow Weir/Grate, Outlet Pipe Restriction & Emergency Spillway

6. Overflow Weir (Dropbox) and Grate (Flat or Sloped)  
(Assumes that top of grate is flush with the top of the concrete dropbox)

- A) Overflow Weir Front Edge Height (relative to Stage = 0 ft)
- B) Overflow Weir Front Edge Length (inside edge of dropbox)
- C) Overflow Weir Grate Slope (H:V, enter zero for flat grate)
- D) Horizontal Length of Weir Sides (inside edge of dropbox)
- E) Overflow Grate Open Area % (grate open area / total grate area)
- F) Debris Clogging %
- G) Height of Grate Upper Edge (at back side of dropbox)
- H) Overflow Grate Slope Length (inside edge of dropbox)
- I) Overflow Grate Open Area (without debris)
- J) Overflow Grate Open Area (with debris)

	Input Parameters		
	User Input	COS DCM	
H <sub>weir front</sub> =	6.50	6.50	ft
L <sub>weir front</sub> =	11.00	9.00	ft
S <sub>weir sides</sub> =	0.00	0.00	ft / ft
Horizontal L <sub>weir sides</sub> =	11.00	9.00	ft
Grate Open Area =	70%	70%	%
Debris Clogging =	50%	50%	%
H <sub>grate top</sub> =	6.50	6.50	ft
Slope L <sub>weir sides</sub> =	11.00	9.00	ft
Open Area (No Clogging) =	84.70	56.70	sq ft
Open Area (Clogged) =	42.35	28.35	sq ft

7. Outlet Pipe with Flow Restriction Plate

A) Select Type of Outlet Restriction  
(Circular Pipe w/ Restrictor Plate, Circular Orifice or Rectangular Orifice)

Circular Outlet Pipe w/ Restrictor Plate

- B) Depth to Invert of Outlet Pipe (relative to Stage = 0 ft)
- C) Outlet Pipe Diameter
- D) Restrictor Plate Height above Pipe Invert
- E) Half-Central Angle of Restrictor Plate on Pipe
- F) Outlet Orifice Area
- G) Height of Outlet Orifice Centroid above Outlet Pipe Invert
- H) Ratio of Grate Open Area / 100-yr Orifice Area (should be ≥ 4)

	Input Parameters		
	User Input	COS DCM	
Pipe Invert Depth =	1.50	1.50	ft
Pipe Diameter =	48.00	48.00	inches
Plate Height =	44.00	44.00	inches
Theta =	2.56	2.56	radians
Outlet Ao =	12.07	12.07	sq ft
Outlet <sub>centroid</sub> =	1.93	1.93	ft
Open Area Ratio =	7.02	4.70	

8. Emergency Spillway (Rectangular or Trapezoidal)

- A) Spillway Invert Stage (relative to Stage = 0 ft)
- B) Spillway Crest Length
- C) Spillway End Slopes (H:V)
- D) Freeboard above Maximum Water Surface
- E) Spillway Design Flow Depth
- F) Stage at Top of Freeboard
- G) Basin Area at Top of Freeboard

	Input Parameters		
	User Input	COS DCM	
H <sub>spillway invert</sub> =	8.00	999.00	ft
L <sub>spillway crest</sub> =	105.00	42.00	ft
S <sub>spillway ends</sub> =	4.00	4.00	ft / ft
Freeboard Depth =	1.00	1.00	ft
Flow Depth <sub>spillway</sub> =	1.00		ft
Freeboard Top Stage =	10.00		ft
Max Basin Area =	2.95		acres

9. Routed Hydrograph Results

	Results based on User Input								
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	1.96	6.56		6.97				18.57	
Inflow Hydrograph Volume (ac-ft) =								154.4	
Predevelopment Peak Q (cfs) =	N/A	N/A		30.0				314.4	
Peak Inflow (cfs) =	N/A	N/A		118.5				161.7	
Peak Outflow (cfs) =	0.9	2.2		2.2				1.0	
Ratio (Outflow/Predevelopment) =	N/A	N/A		0.1				1.0	
Structure Controlling Flow =	Orifice Plate	Orifice Plate		Orifice Plate				Outlet Pipe	
Max Velocity through Grate =	N/A	N/A		N/A				1.8	
Time to Drain 97% of Volume (hr) =	40	67		70				62	
Time to Drain 99% of Volume (hr) =	42	72		75				72	
Maximum Ponding Depth (ft) =	4.50	6.50		6.50				7.90	
Area at Max Ponding Depth (ac) =	1.71	2.43		2.43				2.63	
Maximum Volume Stored (ac-ft) =	1.96	6.56		6.59				10.13	

	Results based on COS DCM Inputs								
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	1.96	6.56		6.97				18.57	
Inflow Hydrograph Volume (ac-ft) =								154.4	
Predevelopment Peak Q (cfs) =	N/A	N/A		30.0				314.4	
Peak Inflow (cfs) =	N/A	N/A		118.5				161.7	
Peak Outflow (cfs) =	0.9	2.2		2.2				1.0	
Ratio (Outflow/Predevelopment) =	N/A	N/A		0.1				1.0	
Structure Controlling Flow =	Orifice Plate	Orifice Plate		Orifice Plate				Overflow Grate	
Max Velocity through Grate =	N/A	N/A		N/A				2.3	
Time to Drain 97% of Volume (hr) =	40	67		70				63	
Time to Drain 99% of Volume (hr) =	42	72		75				72	
Maximum Ponding Depth (ft) =	4.50	6.50		6.50				8.10	
Area at Max Ponding Depth (ac) =	1.71	2.43		2.43				2.66	
Maximum Volume Stored (ac-ft) =	1.96	6.56		6.59				10.66	

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

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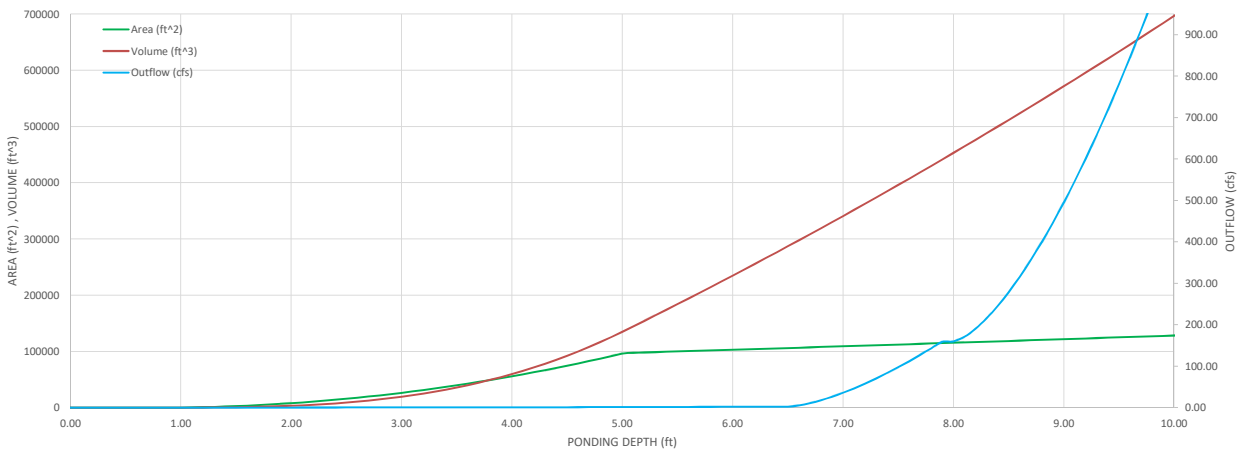
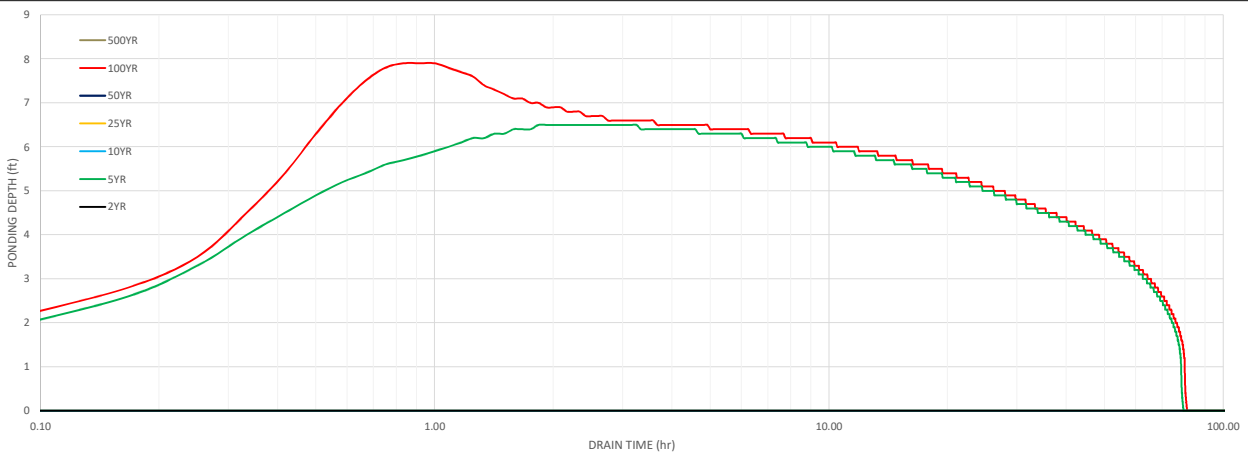
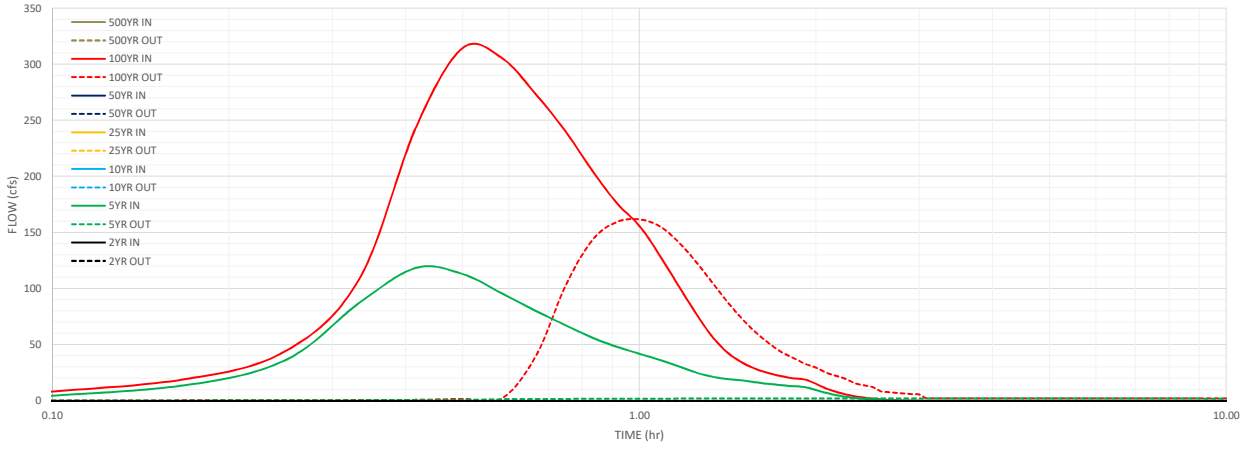


Designer: Chris McFarland

Project: Grandview Reserve Pond D

Date: April 6, 2020

Last Edited: April 13, 2020



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

Sheet 1 of 3



Designer: Chris McFarland

Project: Grandview Reserve Pond E

Date: April 6, 2020

Last Edited: April 13, 2020

1. Select WQCV/EURV PCM Type:  
Imports the Stage-Area-Volume-Discharge information from the corresponding PCM worksheet. The selected PCM worksheet must be completed before the import will work.

Extended Detention Basin (EDB)

2. WQCV/EURV Outlet Details

- A) Average Infiltration Rate of WQCV
- B) Depth to Centroid of Underdrain Outlet Orifice from filter media surface
- C) Underdrain Outlet Orifice Area
- D) Number of WQCV Orifice Rows
- E) Vertical Spacing between WQCV Orifice Rows
- F) WQCV Orifice Area (A<sub>o</sub>) per Row
- G) Maximum Stage of WQCV (includes ISD and Trickle Channel Depth)
- H) EURV Orifice Area (A<sub>o</sub>) in Single Row
- I) Maximum Stage of EURV (includes ISD and Trickle Channel Depth)
- J) Discharge Coefficient for all WQCV/EURV Outlet Orifice(s)

Input Parameters		
	User Input	COS DCM
i =	N/A	N/A
y =	N/A	N/A
Underdrain Ao =	N/A	N/A
# WQCV rows =	10	10
Orifice Spacing =	4.0	4.0
WQCV Ao =	0.67	0.67
Max Stage wqcv =	3.60	3.60
EURV Ao =	0.67	0.67
Max Stage EURV =	4.50	4.50
Cd =	0.60	0.60

3. Flood Control Surcharge Basin Geometry (above EURV) - See Figure  
Default Flood Surcharge Geometry inputs represent a continuation of the PCM Geometry in an upward direction without a transition bench.

- A) Length of Basin at Top of EURV
- B) Width of Basin at Top of EURV
- C) Slope at Top of Transition Bench (Bottom of Flood Control Surcharge)
- D) Length of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)
- E) Width of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)
- F) Average Side Slopes of Flood Control Surcharge above Transition Bench (Recommend no steeper than 3H:1V slope. Use zero for vertical walls.)

Input Parameters		
	User Input	COS DCM
L <sub>PCM</sub> =	327.0	327.0
W <sub>PCM</sub> =	127.7	127.7
Stage at Top of Bench =	4.60	4.60
L <sub>Bench</sub> =	327.8	327.8
W <sub>Bench</sub> =	128.5	128.5
Z <sub>Surcharge</sub> =	4.00	4.00

User can override default flood surcharge geometry inputs to create a transition bench between the top of the PCM and the Flood Surcharge Volume by entering larger dimensions in C), D), and E). See the Figure to the right.

Bench Slope is 4H:1V in length direction  
Bench Slope is 4H:1V in width direction

4. Tributary Watershed Hydrology

A) Input hydrology data (copy/paste) from model runs

Pre-Development Peak Flow (cfs)						
	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
		32.34				157.99

B) Adjust "Time Interval" to match hydrograph data

Post-Development Storm Inflow Hydrographs (cfs)							
Time (min)	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
0:00		0.00				0.00	
0:05		0.16				0.43	
0:10		1.11				1.54	
0:15		5.07				7.00	
0:20		23.64				35.29	
0:25		41.87				110.52	
0:30		46.56				162.17	
0:35		43.13				176.94	
0:40		37.83				172.03	
0:45		33.03				161.08	
0:50		29.04				147.26	
0:55		25.75				135.35	
1:00		22.65				124.96	
1:05		19.67				109.31	
1:10		16.82				92.46	
1:15		14.63				77.36	
1:20		13.01				65.86	
1:25		11.61				56.57	
1:30		10.30				48.68	
1:35		8.90				41.54	
1:40		7.47				34.92	
1:45		6.08				28.67	
1:50		4.75				22.81	
1:55		3.50				17.32	
2:00		2.49				12.10	
2:05		1.86				8.45	
2:10		1.45				6.02	
2:15		1.16				4.29	
2:20		0.92				3.03	
2:25		0.73				2.11	
2:30		0.57				1.42	
2:35		0.44				0.96	
2:40		0.34				0.71	
2:45		0.26				0.55	
2:50		0.20				0.44	
2:55		0.15				0.34	
3:00		0.11				0.26	
3:05		0.07				0.19	
3:10		0.05				0.13	
3:15		0.03				0.08	
3:20		0.02				0.04	
3:25		0.01				0.02	
3:30		0.00				0.00	
3:35		0.00				0.00	
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Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

5.40								
5.45								
5.50								
5.55								
6.00								



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

Sheet 2 of 3



Designer: Chris McFarland

Project: Grandview Reserve Pond E

Date: April 6, 2020

Last Edited: April 13, 2020

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

5. Flood Control Outlet Structure Type

A) Select Flood Control Outlet Structure Type

Overflow Weir/Grate, Outlet Pipe Restriction & Emergency Spillway

6. Overflow Weir (Dropbox) and Grate (Flat or Sloped)  
(Assumes that top of grate is flush with the top of the concrete dropbox)

- A) Overflow Weir Front Edge Height (relative to Stage = 0 ft)
- B) Overflow Weir Front Edge Length (inside edge of dropbox)
- C) Overflow Weir Grate Slope (H:V, enter zero for flat grate)
- D) Horizontal Length of Weir Sides (inside edge of dropbox)
- E) Overflow Grate Open Area % (grate open area / total grate area)
- F) Debris Clogging %
- G) Height of Grate Upper Edge (at back side of dropbox)
- H) Overflow Grate Slope Length (inside edge of dropbox)
- I) Overflow Grate Open Area (without debris)
- J) Overflow Grate Open Area (with debris)

	Input Parameters		
	User Input	COS DCM	
H <sub>weir front</sub> =	4.50	4.50	ft
L <sub>weir front</sub> =	15.00	9.00	ft
S <sub>weir sides</sub> =	0.00	0.00	ft / ft
Horizontal L <sub>weir sides</sub> =	15.00	9.00	ft
Grate Open Area =	70%	70%	%
Debris Clogging =	50%	50%	%
H <sub>grate top</sub> =	4.50	4.50	ft
Slope L <sub>weir sides</sub> =	15.00	9.00	ft
Open Area (No Clogging) =	157.50	56.70	sq ft
Open Area (Clogged) =	78.75	28.35	sq ft

7. Outlet Pipe with Flow Restriction Plate

A) Select Type of Outlet Restriction  
(Circular Pipe w/ Restrictor Plate, Circular Orifice or Rectangular Orifice)

Circular Outlet Pipe w/ Restrictor Plate

- B) Depth to Invert of Outlet Pipe (relative to Stage = 0 ft)
- C) Outlet Pipe Diameter
- D) Restrictor Plate Height above Pipe Invert
- E) Half-Central Angle of Restrictor Plate on Pipe
- F) Outlet Orifice Area
- G) Height of Outlet Orifice Centroid above Outlet Pipe Invert
- H) Ratio of Grate Open Area / 100-yr Orifice Area (should be ≥ 4)

	Input Parameters		
	User Input	COS DCM	
Pipe Invert Depth =	1.50	1.50	ft
Pipe Diameter =	60.00	54.00	inches
Plate Height =	43.00	50.00	inches
Theta =	2.02	2.59	radians
Outlet Ao =	15.06	15.37	sq ft
Outlet <sub>centroid</sub> =	1.99	2.18	ft
Open Area Ratio =	10.46	3.69	

8. Emergency Spillway (Rectangular or Trapezoidal)

- A) Spillway Invert Stage (relative to Stage = 0 ft)
- B) Spillway Crest Length
- C) Spillway End Slopes (H:V)
- D) Freeboard above Maximum Water Surface
- E) Spillway Design Flow Depth
- F) Stage at Top of Freeboard
- G) Basin Area at Top of Freeboard

	Input Parameters		
	User Input	COS DCM	
H <sub>spillway invert</sub> =	5.80	999.00	ft
L <sub>spillway crest</sub> =	100.00	42.00	ft
S <sub>spillway ends</sub> =	4.00	4.00	ft / ft
Freeboard Depth =	1.00	1.00	ft
Flow Depth <sub>spillway</sub> =	0.70		ft
Freeboard Top Stage =	7.50		ft
Max Basin Area =	1.22		acres

9. Routed Hydrograph Results

	Results based on User Input								
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	0.81	1.70		3.01					
Inflow Hydrograph Volume (ac-ft) =								12.89	
Predevelopment Peak Q (cfs) =	N/A	N/A		32.3				158.0	
Peak Inflow (cfs) =	N/A	N/A		46.6				176.9	
Peak Outflow (cfs) =	0.3	0.4		18.0				164.2	
Ratio (Outflow/Predevelopment) =	N/A	N/A		0.6				1.0	
Structure Controlling Flow =	Orifice Plate	Orifice Plate		Overflow Grate				Outlet Pipe	
Max Velocity through Grate =	N/A	N/A		0.1				1.0	
Time to Drain 97% of Volume (hr) =	44	69		71				54	
Time to Drain 99% of Volume (hr) =	46	72		76				69	
Maximum Ponding Depth (ft) =	3.60	4.50		4.80				5.70	
Area at Max Ponding Depth (ac) =	0.88	0.96		0.98				1.05	
Maximum Volume Stored (ac-ft) =	0.81	1.70		1.99				2.91	

	Results based on COS DCM Inputs								
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	0.81	1.70		3.01					
Inflow Hydrograph Volume (ac-ft) =								12.89	
Predevelopment Peak Q (cfs) =	N/A	N/A		32.3				158.0	
Peak Inflow (cfs) =	N/A	N/A		46.6				176.9	
Peak Outflow (cfs) =	0.3	0.4		16.3				153.2	
Ratio (Outflow/Predevelopment) =	N/A	N/A		0.5				1.0	
Structure Controlling Flow =	Orifice Plate	Orifice Plate		Overflow Grate				Overflow Grate	
Max Velocity through Grate =	N/A	N/A		0.3				2.3	
Time to Drain 97% of Volume (hr) =	44	69		71				54	
Time to Drain 99% of Volume (hr) =	46	72		76				69	
Maximum Ponding Depth (ft) =	3.60	4.50		4.90				6.10	
Area at Max Ponding Depth (ac) =	0.88	0.96		0.99				1.10	
Maximum Volume Stored (ac-ft) =	0.81	1.70		2.09				3.34	



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

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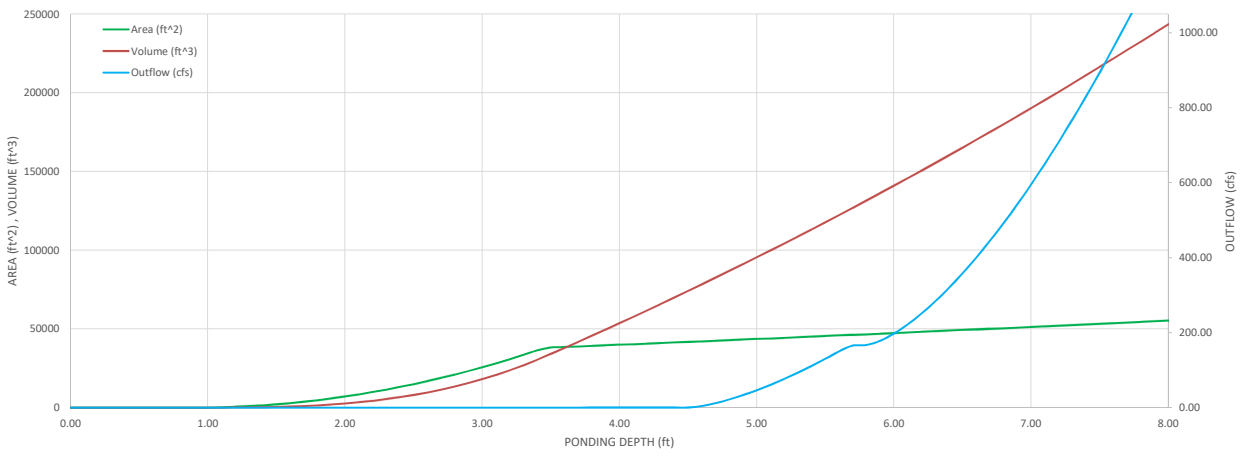
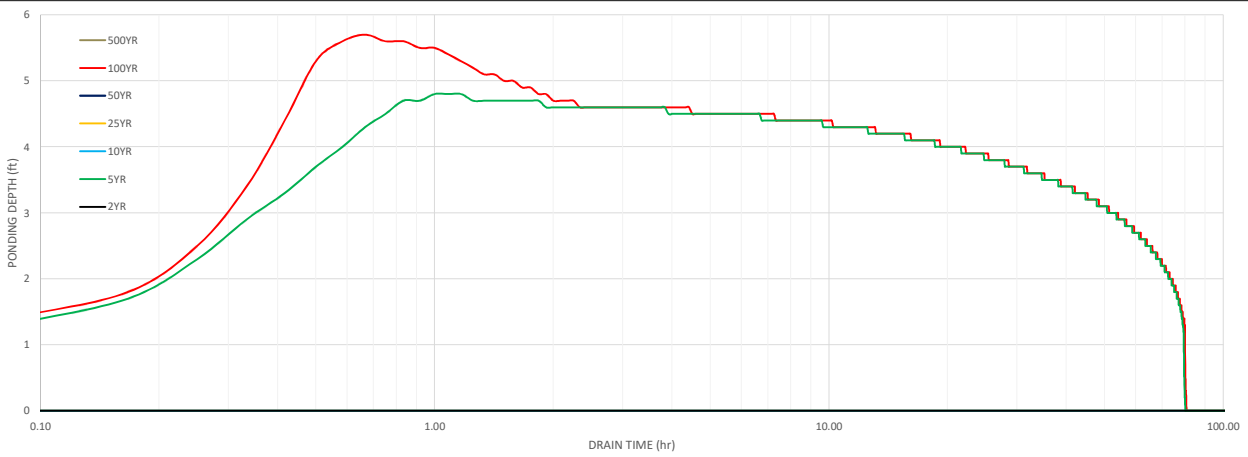
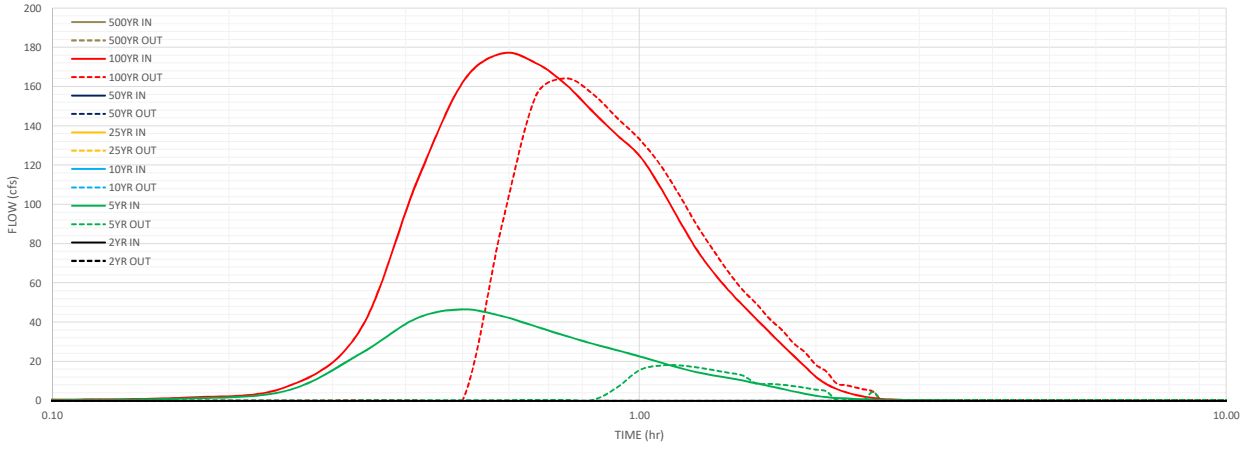


Designer: Chris McFarland

Project: Grandview Reserve Pond E

Date: April 6, 2020

Last Edited: April 13, 2020



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

Sheet 1 of 3



Designer: Chris McFarland

Project: Grandview Reserve Pond F

Date: April 6, 2020

Last Edited: April 13, 2020

1. Select WQCV/EURV PCM Type:  
Imports the Stage-Area-Volume-Discharge information from the corresponding PCM worksheet. The selected PCM worksheet must be completed before the import will work.

Extended Detention Basin (EDB)

2. WQCV/EURV Outlet Details

- A) Average Infiltration Rate of WQCV
- B) Depth to Centroid of Underdrain Outlet Orifice from filter media surface
- C) Underdrain Outlet Orifice Area
- D) Number of WQCV Orifice Rows
- E) Vertical Spacing between WQCV Orifice Rows
- F) WQCV Orifice Area (A<sub>o</sub>) per Row
- G) Maximum Stage of WQCV (includes ISD and Trickle Channel Depth)
- H) EURV Orifice Area (A<sub>o</sub>) in Single Row
- I) Maximum Stage of EURV (includes ISD and Trickle Channel Depth)
- J) Discharge Coefficient for all WQCV/EURV Outlet Orifice(s)

Input Parameters		
	User Input	COS DCM
i =	N/A	N/A
y =	N/A	N/A
Underdrain Ao =	N/A	N/A
# WQCV rows =	14	13
Orifice Spacing =	4.0	4.0
WQCV Ao =	1.55	1.47
Max Stage wqcv =	4.80	4.50
EURV Ao =	1.55	7.84
Max Stage EURV =	6.00	6.00
Cd =	0.60	0.60

3. Flood Control Surcharge Basin Geometry (above EURV) - See Figure  
Default Flood Surcharge Geometry inputs represent a continuation of the PCM Geometry in an upward direction without a transition bench.

- A) Length of Basin at Top of EURV
- B) Width of Basin at Top of EURV
- C) Slope at Top of Transition Bench (Bottom of Flood Control Surcharge)
- D) Length of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)
- E) Width of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)
- F) Average Side Slopes of Flood Control Surcharge above Transition Bench (Recommend no steeper than 3H:1V slope. Use zero for vertical walls.)

Input Parameters		
	User Input	COS DCM
L <sub>PCM</sub> =	570.9	570.9
W <sub>PCM</sub> =	217.0	217.0
Stage at Top of Bench =	6.10	6.10
L <sub>Bench</sub> =	571.7	571.7
W <sub>Bench</sub> =	217.8	217.8
Z <sub>Surcharge</sub> =	4.00	4.00

User can override default flood surcharge geometry inputs to create a transition bench between the top of the PCM and the Flood Surcharge Volume by entering larger dimensions in C), D), and E). See the Figure to the right.

Bench Slope is 4H:1V in length direction  
Bench Slope is 4H:1V in width direction

4. Tributary Watershed Hydrology

A) Input hydrology data (copy/paste) from model runs

Pre-Development Peak Flow (cfs)						
	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
		42.34				221.11

B) Adjust "Time Interval" to match hydrograph data

5-yr and 100-yr Hydrology Required (Other Storms are Optional)

Post-Development Storm Inflow Hydrographs (cfs)							
Time (min)	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
0:00		0.00				0.00	
0:05		0.52				1.80	
0:10		5.98				8.99	
0:15		19.71				25.32	
0:20		58.79				77.64	
0:25		94.74				207.48	
0:30		103.82				301.83	
0:35		97.47				329.97	
0:40		87.23				323.46	
0:45		77.84				304.34	
0:50		69.34				281.05	
0:55		61.26				257.82	
1:00		54.52				237.51	
1:05		49.46				211.11	
1:10		45.22				185.26	
1:15		40.70				161.15	
1:20		36.24				139.03	
1:25		32.06				119.17	
1:30		28.34				101.90	
1:35		24.61				86.26	
1:40		21.24				72.79	
1:45		19.05				62.33	
1:50		17.44				54.79	
1:55		16.04				48.91	
2:00		13.99				42.35	
2:05		11.69				35.81	
2:10		9.57				29.96	
2:15		7.79				24.91	
2:20		6.28				20.57	
2:25		5.03				16.95	
2:30		4.03				13.95	
2:35		3.21				11.42	
2:40		2.52				9.20	
2:45		1.92				7.18	
2:50		1.38				5.32	
2:55		0.95				3.69	
3:00		0.65				2.49	
3:05		0.46				1.70	
3:10		0.33				1.17	
3:15		0.24				0.81	
3:20		0.18				0.56	
3:25		0.14				0.38	
3:30		0.11				0.26	
3:35		0.08				0.18	
3:40		0.06				0.13	
3:45		0.05				0.10	
3:50		0.03				0.07	
3:55		0.02				0.05	
4:00		0.02				0.04	
4:05		0.01				0.03	
4:10		0.01				0.02	
4:15		0.00				0.01	
4:20						0.01	
4:25						0.00	
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4:50							
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5:35							

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5.40								
5.45								
5.50								
5.55								
6.00								



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

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Sheet 2 of 3



Designer: Chris McFarland

Project: Grandview Reserve Pond F

Date: April 6, 2020

Last Edited: April 13, 2020

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

5. Flood Control Outlet Structure Type

A) Select Flood Control Outlet Structure Type

Overflow Weir/Grate, Outlet Pipe Restriction & Emergency Spillway

6. Overflow Weir (Dropbox) and Grate (Flat or Sloped)  
(Assumes that top of grate is flush with the top of the concrete dropbox)

- A) Overflow Weir Front Edge Height (relative to Stage = 0 ft)
- B) Overflow Weir Front Edge Length (inside edge of dropbox)
- C) Overflow Weir Grate Slope (H:V, enter zero for flat grate)
- D) Horizontal Length of Weir Sides (inside edge of dropbox)
- E) Overflow Grate Open Area % (grate open area / total grate area)
- F) Debris Clogging %
- G) Height of Grate Upper Edge (at back side of dropbox)
- H) Overflow Grate Slope Length (inside edge of dropbox)
- I) Overflow Grate Open Area (without debris)
- J) Overflow Grate Open Area (with debris)

Input Parameters		
	User Input	COS DCM
H <sub>weir front</sub> =	6.00	5.00
L <sub>weir front</sub> =	13.00	10.00
S <sub>weir sides</sub> =	0.00	0.00
Horizontal L <sub>weir sides</sub> =	13.00	10.00
Grate Open Area =	70%	70%
Debris Clogging =	50%	50%
H <sub>grate top</sub> =	6.00	6.00
Slope L <sub>weir sides</sub> =	13.00	10.00
Open Area (No Clogging) =	118.30	70.00
Open Area (Clogged) =	59.15	35.00

7. Outlet Pipe with Flow Restriction Plate

A) Select Type of Outlet Restriction  
(Circular Pipe w/ Restrictor Plate, Circular Orifice or Rectangular Orifice)

Circular Outlet Pipe w/ Restrictor Plate

- B) Depth to Invert of Outlet Pipe (relative to Stage = 0 ft)
- C) Outlet Pipe Diameter
- D) Restrictor Plate Height above Pipe Invert
- E) Half-Central Angle of Restrictor Plate on Pipe
- F) Outlet Orifice Area
- G) Height of Outlet Orifice Centroid above Outlet Pipe Invert
- H) Ratio of Grate Open Area / 100-yr Orifice Area (should be ≥ 4)

Input Parameters		
	User Input	COS DCM
Pipe Invert Depth =	1.50	1.50
Pipe Diameter =	66.00	60.00
Plate Height =	46.05	54.00
Theta =	1.98	2.50
Outlet Ao =	17.70	18.61
Outlet <sub>centroid</sub> =	2.14	2.38
Open Area Ratio =	6.68	3.76

8. Emergency Spillway (Rectangular or Trapezoidal)

- A) Spillway Invert Stage (relative to Stage = 0 ft)
- B) Spillway Crest Length
- C) Spillway End Slopes (H:V)
- D) Freeboard above Maximum Water Surface
- E) Spillway Design Flow Depth
- F) Stage at Top of Freeboard
- G) Basin Area at Top of Freeboard

Input Parameters		
	User Input	COS DCM
H <sub>spillway invert</sub> =	7.60	999.00
L <sub>spillway crest</sub> =	126.00	42.00
S <sub>spillway ends</sub> =	4.00	4.00
Freeboard Depth =	1.00	1.00
Flow Depth <sub>spillway</sub> =	0.90	
Freeboard Top Stage =	9.50	
Max Basin Area =	3.37	

9. Routed Hydrograph Results

		Results based on User Input								
		WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =		2.62	5.94		7.80				26.37	
Inflow Hydrograph Volume (ac-ft) =		N/A	N/A		42.3				221.1	
Predevelopment Peak Q (cfs) =		N/A	N/A		103.8				330.0	
Peak Inflow (cfs) =		1.1	1.5		15.1				227.3	
Peak Outflow (cfs) =		N/A	N/A		0.4				1.0	
Ratio (Outflow/Predevelopment) =		Orifice Plate	Orifice Plate		Overflow Grate				Outlet Pipe	
Structure Controlling Flow =		N/A	N/A		0.2				1.9	
Max Velocity through Grate =		42	68		72				61	
Time to Drain 97% of Volume (hr) =		45	72		77				72	
Time to Drain 99% of Volume (hr) =		4.80	6.00		6.30				7.60	
Maximum Ponding Depth (ft) =		2.12	2.84		2.89				3.08	
Area at Max Ponding Depth (ac) =		2.62	5.94		6.82				10.70	
Maximum Volume Stored (ac-ft) =										
		Results based on COS DCM Inputs								
		WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =		2.21	5.94		7.80				26.37	
Inflow Hydrograph Volume (ac-ft) =		N/A	N/A		42.3				221.1	
Predevelopment Peak Q (cfs) =		N/A	N/A		103.8				330.0	
Peak Inflow (cfs) =		1.1	1.4		13.2				214.5	
Peak Outflow (cfs) =		N/A	N/A		0.3				1.0	
Ratio (Outflow/Predevelopment) =		Orifice Plate	Orifice Plate		Overflow Grate				Overflow Grate	
Structure Controlling Flow =		N/A	N/A		0.2				3.0	
Max Velocity through Grate =		36	69		74				63	
Time to Drain 97% of Volume (hr) =		38	73		78				73	
Time to Drain 99% of Volume (hr) =		4.50	6.00		6.30				7.80	
Maximum Ponding Depth (ft) =		1.81	2.84		2.89				3.11	
Area at Max Ponding Depth (ac) =		2.21	5.94		6.82				11.32	
Maximum Volume Stored (ac-ft) =										

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

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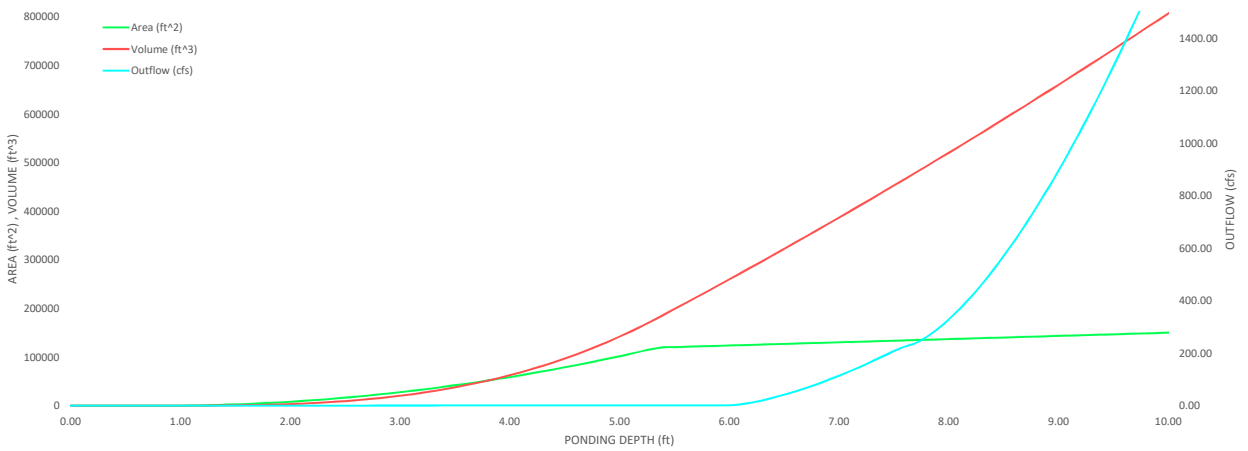
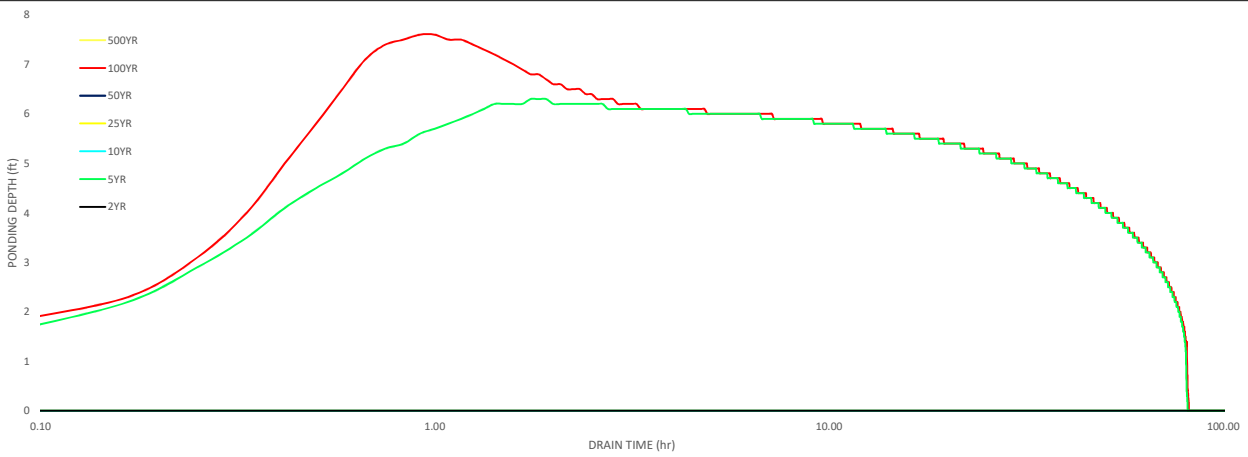
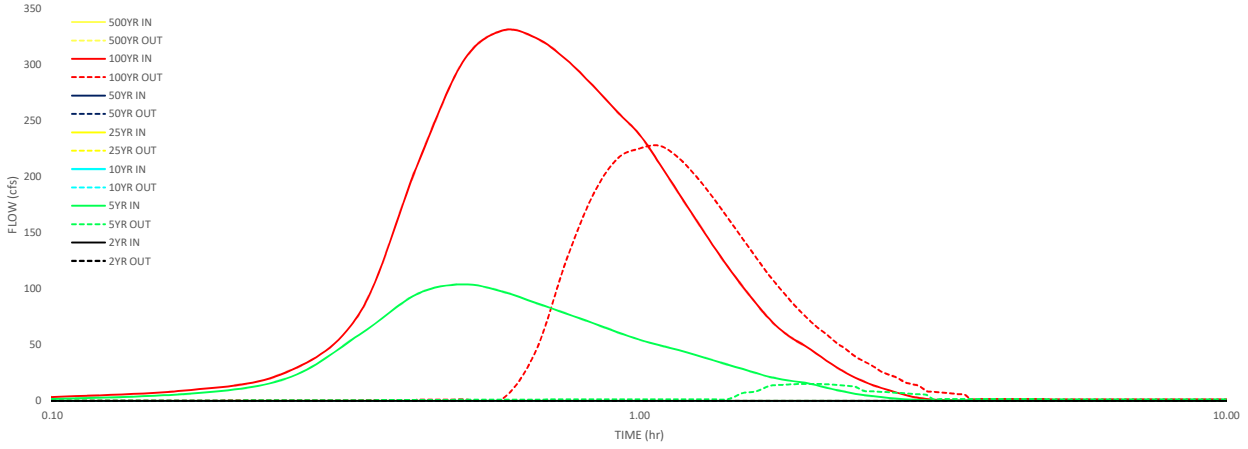


Designer: Chris McFarland

Project: Grandview Reserve Pond F

Date: April 6, 2020

Last Edited: April 13, 2020



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

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Designer: Chris McFarland

Project: Grandview Reserve Pond G

Date: April 6, 2020

Last Edited: April 13, 2020

1. Select QWCV/EURV PCM Type:  
Imports the Stage-Area-Volume-Discharge information from the corresponding PCM worksheet. The selected PCM worksheet must be completed before the import will work.

Extended Detention Basin (EDB) ▼

2. WQCV/EURV Outlet Details

- A) Average Infiltration Rate of WQCV
- B) Depth to Centroid of Underdrain Outlet Orifice from filter media surface
- C) Underdrain Outlet Orifice Area
- D) Number of WQCV Orifice Rows
- E) Vertical Spacing between WQCV Orifice Rows
- F) WQCV Orifice Area (A<sub>o</sub>) per Row
- G) Maximum Stage of WQCV (includes ISD and Trickle Channel Depth)
- H) EURV Orifice Area (A<sub>o</sub>) in Single Row
- I) Maximum Stage of EURV (includes ISD and Trickle Channel Depth)
- J) Discharge Coefficient for all WQCV/EURV Outlet Orifice(s)

Input Parameters		
	User Input	COS DCM
i =	N/A	N/A
y =	N/A	N/A
Underdrain Ao =	N/A	N/A
# WQCV rows =	9	9
Orifice Spacing =	4.0	4.0
WQCV Ao =	0.49	0.49
Max Stage wqcv =	3.20	3.20
EURV Ao =	1.94	1.94
Max Stage EURV =	4.00	4.00
Cd =	0.60	0.60

3. Flood Control Surcharge Basin Geometry (above EURV) - See Figure  
Default Flood Surcharge Geometry inputs represent a continuation of the PCM Geometry in an upward direction without a transition bench.

- A) Length of Basin at Top of EURV
- B) Width of Basin at Top of EURV
- C) Stage at Top of Transition Bench (Bottom of Flood Control Surcharge)
- D) Length of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)
- E) Width of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)
- F) Average Side Slopes of Flood Control Surcharge above Transition Bench (Recommend no steeper than 3H:1V slope. Use zero for vertical walls.)

Input Parameters		
	User Input	COS DCM
L <sub>PCM</sub> =	349.7	349.7
W <sub>PCM</sub> =	105.4	105.4
Stage at Top of Bench =	4.10	4.10
L <sub>Bench</sub> =	350.5	350.5
W <sub>Bench</sub> =	106.2	106.2
Z <sub>Surcharge</sub> =	4.00	4.00

User can override default flood surcharge geometry inputs to create a transition bench between the top of the PCM and the Flood Surcharge Volume by entering larger dimensions in C), D), and E). See the Figure to the right.

Bench Slope is 4H:1V in length direction  
Bench Slope is 4H:1V in width direction

4. Tributary Watershed Hydrology

A) Input hydrology data (copy/paste) from model runs

Pre-Development Peak Flow (cfs)						
2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
	9.42				48.48	

B) Adjust "Time Interval" to match hydrograph data

5-yr and 100-yr Hydrology Required (Other Storms are Optional)

Post-Development Storm Inflow Hydrographs (cfs)							
Time (min)	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
0:00		0.00				0.00	
0:05		0.18				0.49	
0:10		1.27				1.75	
0:15		3.86				5.05	
0:20		12.69				17.55	
0:25		19.21				47.38	
0:30		20.06				63.86	
0:35		18.72				67.51	
0:40		16.88				66.01	
0:45		15.24				62.38	
0:50		13.74				57.86	
0:55		12.37				53.71	
1:00		11.12				49.93	
1:05		10.01				44.10	
1:10		9.05				38.52	
1:15		8.20				33.58	
1:20		7.42				29.30	
1:25		6.67				25.48	
1:30		5.98				22.03	
1:35		5.28				18.97	
1:40		4.64				16.31	
1:45		4.05				13.93	
1:50		3.52				11.83	
1:55		3.12				10.10	
2:00		2.67				8.48	
2:05		2.26				7.10	
2:10		1.90				5.93	
2:15		1.58				4.93	
2:20		1.30				4.04	
2:25		1.05				3.25	
2:30		0.82				2.54	
2:35		0.62				1.90	
2:40		0.46				1.36	
2:45		0.35				0.99	
2:50		0.28				0.73	
2:55		0.22				0.54	
3:00		0.17				0.39	
3:05		0.13				0.28	
3:10		0.10				0.19	
3:15		0.07				0.13	
3:20		0.05				0.09	
3:25		0.04				0.07	
3:30		0.03				0.06	
3:35		0.02				0.04	
3:40		0.02				0.03	
3:45		0.01				0.03	
3:50		0.01				0.02	
3:55		0.01				0.01	
4:00		0.00				0.01	
4:05						0.00	
4:10							
4:15							
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5:30							
5:35							

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5.40								
5.45								
5.50								
5.55								
6.00								



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

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Designer: Chris McFarland

Project: Grandview Reserve Pond G

Date: April 6, 2020

Last Edited: April 13, 2020

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

5. Flood Control Outlet Structure Type

A) Select Flood Control Outlet Structure Type

Overflow Weir/Grate, Outlet Pipe Restriction & Emergency Spillway

6. Overflow Weir (Dropbox) and Grate (Flat or Sloped)  
(Assumes that top of grate is flush with the top of the concrete dropbox)

- A) Overflow Weir Front Edge Height (relative to Stage = 0 ft)
- B) Overflow Weir Front Edge Length (inside edge of dropbox)
- C) Overflow Weir Grate Slope (H:V, enter zero for flat grate)
- D) Horizontal Length of Weir Sides (inside edge of dropbox)
- E) Overflow Grate Open Area % (grate open area / total grate area)
- F) Debris Clogging %
- G) Height of Grate Upper Edge (at back side of dropbox)
- H) Overflow Grate Slope Length (inside edge of dropbox)
- I) Overflow Grate Open Area (without debris)
- J) Overflow Grate Open Area (with debris)

	Input Parameters		
	User Input	COS DCM	
H <sub>Weir front</sub> =	4.00	4.00	ft
L <sub>Weir front</sub> =	26.00	26.00	ft
S <sub>Weir sides</sub> =	0.00	0.00	ft / ft
Horizontal L <sub>Weir sides</sub> =	26.00	26.00	ft
Grate Open Area =	70%	70%	%
Debris Clogging =	50%	50%	%
H <sub>Grate top</sub> =	4.00	4.00	ft
Slope L <sub>Weir sides</sub> =	26.00	26.00	ft
Open Area (No Clogging) =	473.20	473.20	sq ft
Open Area (Clogged) =	236.60	236.60	sq ft

7. Outlet Pipe with Flow Restriction Plate

A) Select Type of Outlet Restriction  
(Circular Pipe w/ Restrictor Plate, Circular Orifice or Rectangular Orifice)

Circular Outlet Pipe w/ Restrictor Plate

- B) Depth to Invert of Outlet Pipe (relative to Stage = 0 ft)
- C) Outlet Pipe Diameter
- D) Restrictor Plate Height above Pipe Invert
- E) Half-Central Angle of Restrictor Plate on Pipe
- F) Outlet Orifice Area
- G) Height of Outlet Orifice Centroid above Outlet Pipe Invert
- H) Ratio of Grate Open Area / 100-yr Orifice Area (should be ≥ 4)

	Input Parameters		
	User Input	COS DCM	
Pipe Invert Depth =	1.50	1.50	ft
Pipe Diameter =	30.00	27.00	inches
Plate Height =	22.22	26.24	inches
Theta =	2.07	2.80	radians
Outlet Ao =	3.90	3.94	sq ft
Outlet <sub>centroid</sub> =	1.03	1.12	ft
Open Area Ratio =	121.39	119.97	

8. Emergency Spillway (Rectangular or Trapezoidal)

- A) Spillway Invert Stage (relative to Stage = 0 ft)
- B) Spillway Crest Length
- C) Spillway End Slopes (H:V)
- D) Freeboard above Maximum Water Surface
- E) Spillway Design Flow Depth
- F) Stage at Top of Freeboard
- G) Basin Area at Top of Freeboard

	Input Parameters		
	User Input	COS DCM	
H <sub>spillway invert</sub> =	5.40	4.90	ft
L <sub>spillway crest</sub> =	136.00	23.00	ft
S <sub>spillway ends</sub> =	4.00	4.00	ft / ft
Freeboard Depth =	1.00	1.00	ft
Flow Depth <sub>spillway</sub> =	0.30	0.90	ft
Freeboard Top Stage =	6.70	6.80	ft
Max Basin Area =	1.08	1.09	acres

9. Routed Hydrograph Results

	Results based on User Input								
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	0.47	1.15		1.57					5.51
Inflow Hydrograph Volume (ac-ft) =	N/A	N/A		9.4					48.5
Predevelopment Peak Q (cfs) =	N/A	N/A		20.1					67.5
Peak Inflow (cfs) =	0.2	0.3		9.4					47.1
Peak Outflow (cfs) =	N/A	N/A		1.0					1.0
Ratio (Outflow/Predevelopment) =	Orifice Plate	Orifice Plate		Overflow Grate					Outlet Pipe
Structure Controlling Flow =	N/A	N/A		0.0					0.1
Max Velocity through Grate =	41	69		73					63
Time to Drain 97% of Volume (hr) =	43	72		78					74
Time to Drain 99% of Volume (hr) =	3.20	4.00		4.10					4.80
Maximum Ponding Depth (ft) =	0.67	0.85		0.85					0.91
Area at Max Ponding Depth (ac) =	0.47	1.15		1.24					1.85
Maximum Volume Stored (ac-ft) =									
	Results based on COS DCM Inputs								
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	0.47	1.15		1.57					5.51
Inflow Hydrograph Volume (ac-ft) =	N/A	N/A		9.4					48.5
Predevelopment Peak Q (cfs) =	N/A	N/A		20.1					67.5
Peak Inflow (cfs) =	0.2	0.3		9.4					47.1
Peak Outflow (cfs) =	N/A	N/A		1.0					1.0
Ratio (Outflow/Predevelopment) =	Orifice Plate	Orifice Plate		Overflow Grate					Outlet Pipe
Structure Controlling Flow =	N/A	N/A		0.0					0.1
Max Velocity through Grate =	41	69		73					63
Time to Drain 97% of Volume (hr) =	43	72		78					74
Time to Drain 99% of Volume (hr) =	3.20	4.00		4.10					4.80
Maximum Ponding Depth (ft) =	0.67	0.85		0.85					0.91
Area at Max Ponding Depth (ac) =	0.47	1.15		1.24					1.85
Maximum Volume Stored (ac-ft) =									



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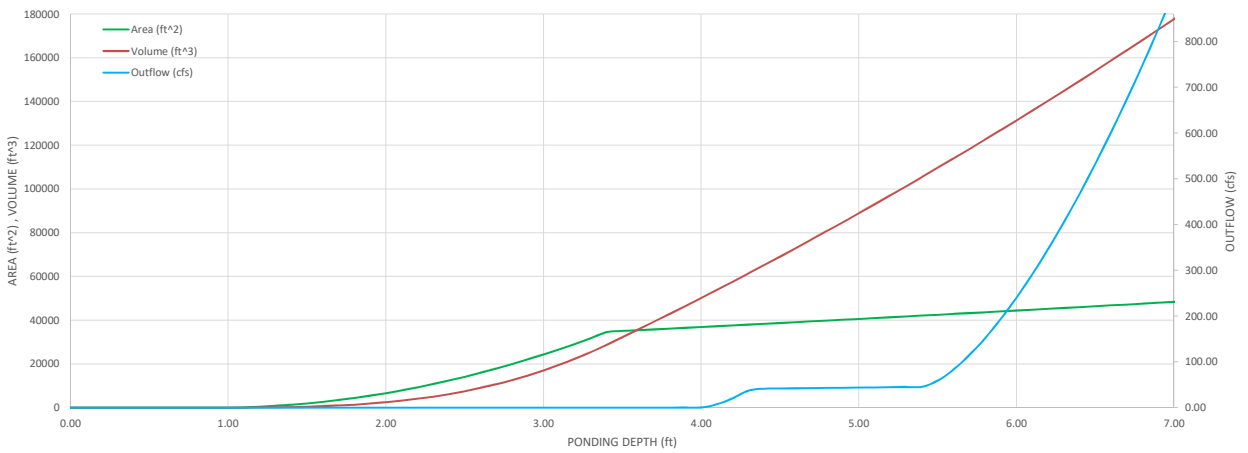
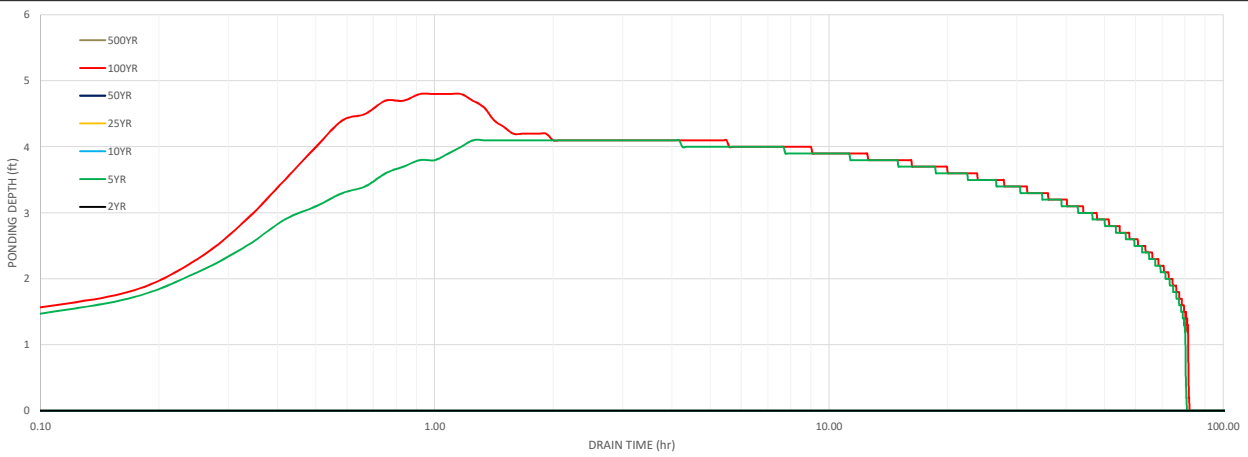
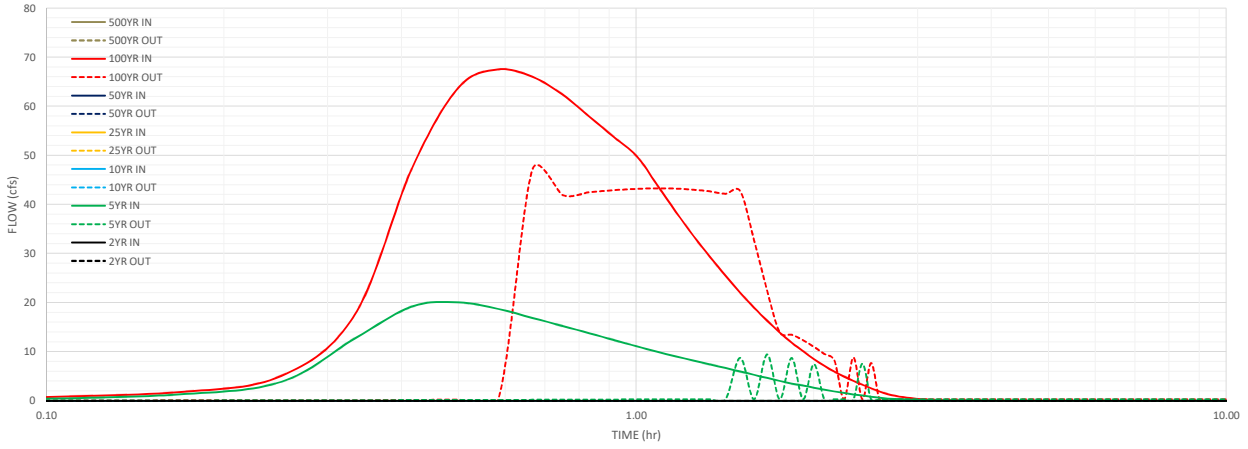


Designer: Chris McFarland

Project: Grandview Reserve Pond G

Date: April 6, 2020

Last Edited: April 13, 2020



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

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Designer: Chris McFarland

Project: Grandview Reserve Pond G

Date: April 6, 2020

Last Edited: April 13, 2020

1. Select QOCV/EURV PCM Type:  
Imports the Stage-Area-Volume-Discharge information from the corresponding PCM worksheet. The selected PCM worksheet must be completed before the import will work.

Extended Detention Basin (EDB)

2. WQCV/EURV Outlet Details

- A) Average Infiltration Rate of WQCV
- B) Depth to Centroid of Underdrain Outlet Orifice from filter media surface
- C) Underdrain Outlet Orifice Area
- D) Number of WQCV Orifice Rows
- E) Vertical Spacing between WQCV Orifice Rows
- F) WQCV Orifice Area (A<sub>o</sub>) per Row
- G) Maximum Stage of WQCV (includes ISD and Trickle Channel Depth)
- H) EURV Orifice Area (A<sub>o</sub>) in Single Row
- I) Maximum Stage of EURV (includes ISD and Trickle Channel Depth)
- J) Discharge Coefficient for all WQCV/EURV Outlet Orifice(s)

Input Parameters		
	User Input	COS DCM
i =	N/A	N/A
y =	N/A	N/A
Underdrain Ao =	N/A	N/A
# WQCV rows =	11	11
Orifice Spacing =	4.0	4.0
WQCV Ao =	0.66	0.66
Max Stage wqcv =	3.60	3.60
EURV Ao =	4.73	4.73
Max Stage EURV =	5.00	5.00
Cd =	0.60	0.60

3. Flood Control Surcharge Basin Geometry (above EURV) - See Figure  
Default Flood Surcharge Geometry inputs represent a continuation of the PCM Geometry in an upward direction without a transition bench.

- A) Length of Basin at Top of EURV
- B) Width of Basin at Top of EURV
- C) Slope at Top of Transition Bench (Bottom of Flood Control Surcharge)
- D) Length of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)
- E) Width of Basin at Top of Transition Bench (Bottom of Flood Control Surcharge)
- F) Average Side Slopes of Flood Control Surcharge above Transition Bench (Recommend no steeper than 3H:1V slope. Use zero for vertical walls.)

Input Parameters		
	User Input	COS DCM
L <sub>PCM</sub> =	468.4	468.4
W <sub>PCM</sub> =	141.1	141.1
Stage at Top of Bench =	5.10	5.10
L <sub>Bench</sub> =	469.2	469.2
W <sub>Bench</sub> =	141.9	141.9
Z <sub>Surcharge</sub> =	4.00	4.00

User can override default flood surcharge geometry inputs to create a transition bench between the top of the PCM and the Flood Surcharge Volume by entering larger dimensions in C), D), and E). See the Figure to the right.

Bench Slope is 4H:1V in length direction  
Bench Slope is 4H:1V in width direction

4. Tributary Watershed Hydrology

A) Input hydrology data (copy/paste) from model runs

Pre-Development Peak Flow (cfs)						
2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
	17.11				99.16	

B) Adjust "Time Interval" to match hydrograph data

5-yr and 100-yr Hydrology Required (Other Storms are Optional)

Post-Development Storm Inflow Hydrographs (cfs)							
Time (min)	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
0:00		0.00				0.00	
0:05		0.41				1.20	
0:10		3.42				4.91	
0:15		10.22				13.16	
0:20		29.97				40.46	
0:25		45.35				109.08	
0:30		46.22				147.68	
0:35		41.85				152.97	
0:40		36.79				145.92	
0:45		32.51				134.77	
0:50		28.57				122.07	
0:55		24.90				110.10	
1:00		21.86				99.42	
1:05		19.69				85.33	
1:10		17.78				73.97	
1:15		15.86				63.12	
1:20		14.00				53.39	
1:25		12.24				44.73	
1:30		10.61				36.81	
1:35		9.00				29.60	
1:40		7.68				24.16	
1:45		6.80				19.99	
1:50		6.25				17.20	
1:55		5.79				15.20	
2:00		4.96				12.77	
2:05		4.07				10.46	
2:10		3.32				8.57	
2:15		2.70				7.04	
2:20		2.18				5.80	
2:25		1.75				4.76	
2:30		1.37				3.85	
2:35		1.07				3.04	
2:40		0.81				2.31	
2:45		0.60				1.65	
2:50		0.43				1.12	
2:55		0.31				0.76	
3:00		0.23				0.51	
3:05		0.17				0.34	
3:10		0.12				0.23	
3:15		0.09				0.16	
3:20		0.07				0.12	
3:25		0.06				0.09	
3:30		0.05				0.07	
3:35		0.04				0.06	
3:40		0.03				0.05	
3:45		0.03				0.04	
3:50		0.02				0.03	
3:55		0.01				0.02	
4:00		0.01				0.01	
4:05		0.01				0.01	
4:10		0.00				0.01	
4:15						0.00	
4:20							
4:25							
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4:40							
4:45							
4:50							
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5:00							
5:05							
5:10							
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5:20							
5:25							
5:30							
5:35							

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5.40								
5.45								
5.50								
5.55								
6.00								



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Designer: Chris McFarland

Project: Grandview Reserve Pond G

Date: April 6, 2020

Last Edited: April 13, 2020

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

5. Flood Control Outlet Structure Type

A) Select Flood Control Outlet Structure Type

Overflow Weir/Grate, Outlet Pipe Restriction & Emergency Spillway

6. Overflow Weir (Dropbox) and Grate (Flat or Sloped)  
(Assumes that top of grate is flush with the top of the concrete dropbox)

- A) Overflow Weir Front Edge Height (relative to Stage = 0 ft)
- B) Overflow Weir Front Edge Length (inside edge of dropbox)
- C) Overflow Weir Grate Slope (H:V, enter zero for flat grate)
- D) Horizontal Length of Weir Sides (inside edge of dropbox)
- E) Overflow Grate Open Area % (grate open area / total grate area)
- F) Debris Clogging %
- G) Height of Grate Upper Edge (at back side of dropbox)
- H) Overflow Grate Slope Length (inside edge of dropbox)
- I) Overflow Grate Open Area (without debris)
- J) Overflow Grate Open Area (with debris)

Input Parameters		
	User Input	COS DCM
H <sub>weir front</sub> =	5.00	5.00
L <sub>weir front</sub> =	9.00	7.00
S <sub>weir sides</sub> =	0.00	0.00
Horizontal L <sub>weir sides</sub> =	9.00	7.00
Grate Open Area =	70%	70%
Debris Clogging =	50%	50%
H <sub>grate top</sub> =	5.00	5.00
Slope L <sub>weir sides</sub> =	9.00	7.00
Open Area (No Clogging) =	56.70	34.30
Open Area (Clogged) =	28.35	17.15

7. Outlet Pipe with Flow Restriction Plate

A) Select Type of Outlet Restriction  
(Circular Pipe w/ Restrictor Plate, Circular Orifice or Rectangular Orifice)

Circular Outlet Pipe w/ Restrictor Plate

- B) Depth to Invert of Outlet Pipe (relative to Stage = 0 ft)
- C) Outlet Pipe Diameter
- D) Restrictor Plate Height above Pipe Invert
- E) Half-Central Angle of Restrictor Plate on Pipe
- F) Outlet Orifice Area
- G) Height of Outlet Orifice Centroid above Outlet Pipe Invert
- H) Ratio of Grate Open Area / 100-yr Orifice Area (should be ≥ 4)

Input Parameters		
	User Input	COS DCM
Pipe Invert Depth =	1.50	1.50
Pipe Diameter =	42.00	42.00
Plate Height =	34.00	34.00
Theta =	2.24	2.24
Outlet Ao =	8.34	8.34
Outlet <sub>centroid</sub> =	1.54	1.54
Open Area Ratio =	6.80	4.11

8. Emergency Spillway (Rectangular or Trapezoidal)

- A) Spillway Invert Stage (relative to Stage = 0 ft)
- B) Spillway Crest Length
- C) Spillway End Slopes (H:V)
- D) Freeboard above Maximum Water Surface
- E) Spillway Design Flow Depth
- F) Stage at Top of Freeboard
- G) Basin Area at Top of Freeboard

Input Parameters		
	User Input	COS DCM
H <sub>spillway invert</sub> =	6.70	999.00
L <sub>spillway crest</sub> =	136.00	27.00
S <sub>spillway ends</sub> =	4.00	4.00
Freeboard Depth =	1.00	1.00
Flow Depth <sub>spillway</sub> =	0.50	
Freeboard Top Stage =	8.20	
Max Basin Area =	1.89	

9. Routed Hydrograph Results

		Results based on User Input							
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	1.03	2.73		3.25					11.08
Inflow Hydrograph Volume (ac-ft) =	N/A	N/A		17.1					99.2
Predevelopment Peak Q (cfs) =	N/A	N/A		46.2					153.0
Peak Inflow (cfs) =	0.4	0.7		4.2					101.9
Peak Outflow (cfs) =	N/A	N/A		0.2					1.0
Ratio (Outflow/Predevelopment) =	Orifice Plate	Orifice Plate		Overflow Grate					Outlet Pipe
Structure Controlling Flow =	N/A	N/A		0.0					1.7
Max Velocity through Grate =	39	68		73					62
Time to Drain 97% of Volume (hr) =	41	72		77					72
Time to Drain 99% of Volume (hr) =	3.80	5.00		5.10					6.20
Maximum Ponding Depth (ft) =	1.09	1.52		1.53					1.65
Area at Max Ponding Depth (ac) =	1.03	2.73		2.90					4.65
Maximum Volume Stored (ac-ft) =									
		Results based on COS DCM Inputs							
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	1.03	2.73		3.25					11.08
Inflow Hydrograph Volume (ac-ft) =	N/A	N/A		17.1					99.2
Predevelopment Peak Q (cfs) =	N/A	N/A		46.2					153.0
Peak Inflow (cfs) =	0.4	0.7		3.6					98.1
Peak Outflow (cfs) =	N/A	N/A		0.2					1.0
Ratio (Outflow/Predevelopment) =	Orifice Plate	Orifice Plate		Overflow Grate					Overflow Grate
Structure Controlling Flow =	N/A	N/A		0.2					2.8
Max Velocity through Grate =	39	68		73					62
Time to Drain 97% of Volume (hr) =	41	72		77					73
Time to Drain 99% of Volume (hr) =	3.80	5.00		5.20					6.40
Maximum Ponding Depth (ft) =	1.09	1.52		1.54					1.68
Area at Max Ponding Depth (ac) =	1.03	2.73		3.05					4.98
Maximum Volume Stored (ac-ft) =									

Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing

COS PCM-FSD Preliminary Design (Beta Version 1.00, September 2019)

Sheet 3 of 3

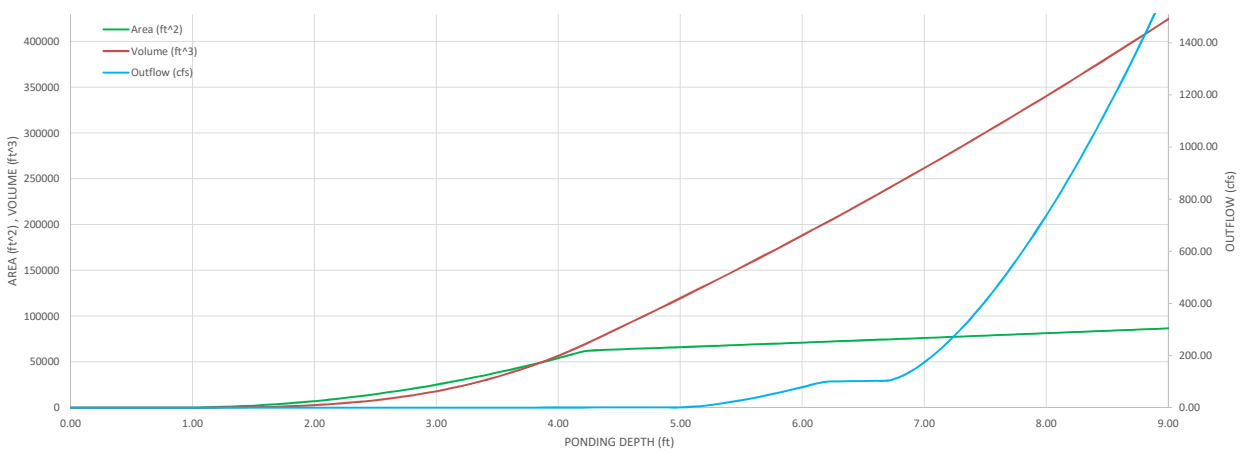
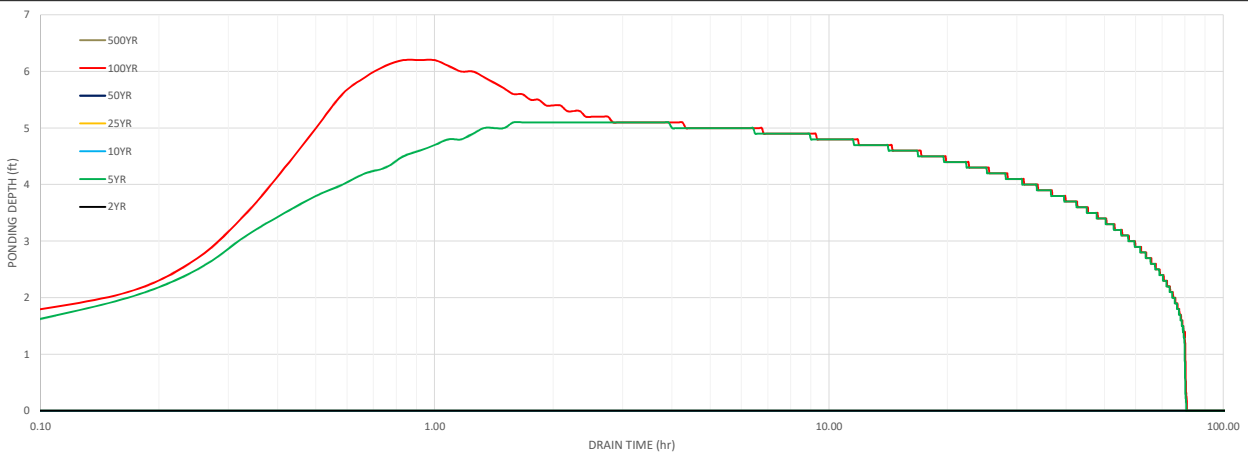
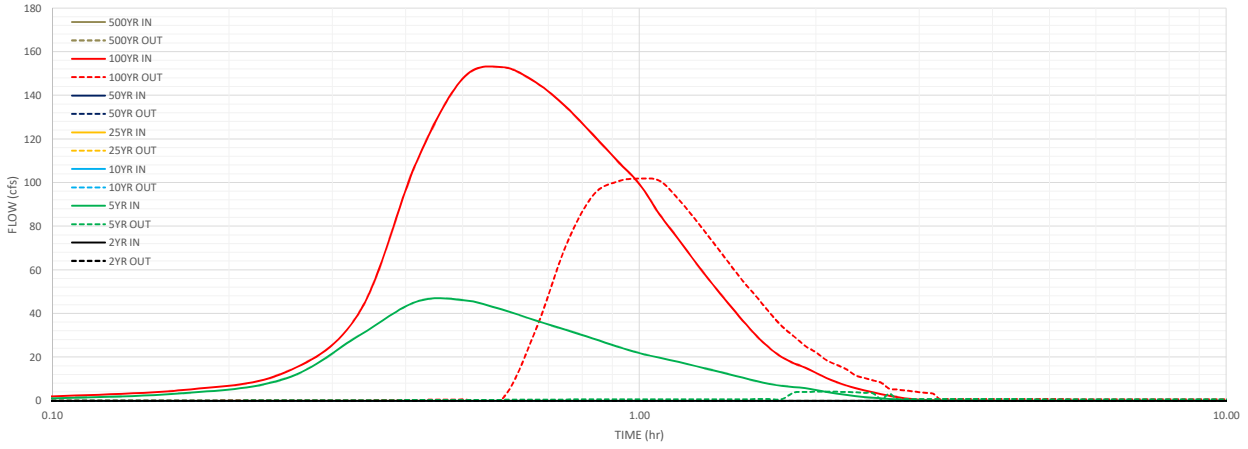


Designer: Chris McFarland

Project: Grandview Reserve Pond G

Date: April 6, 2020

Last Edited: April 13, 2020



Preliminary Design Procedure Form: Full Spectrum Detention (FSD) Routing







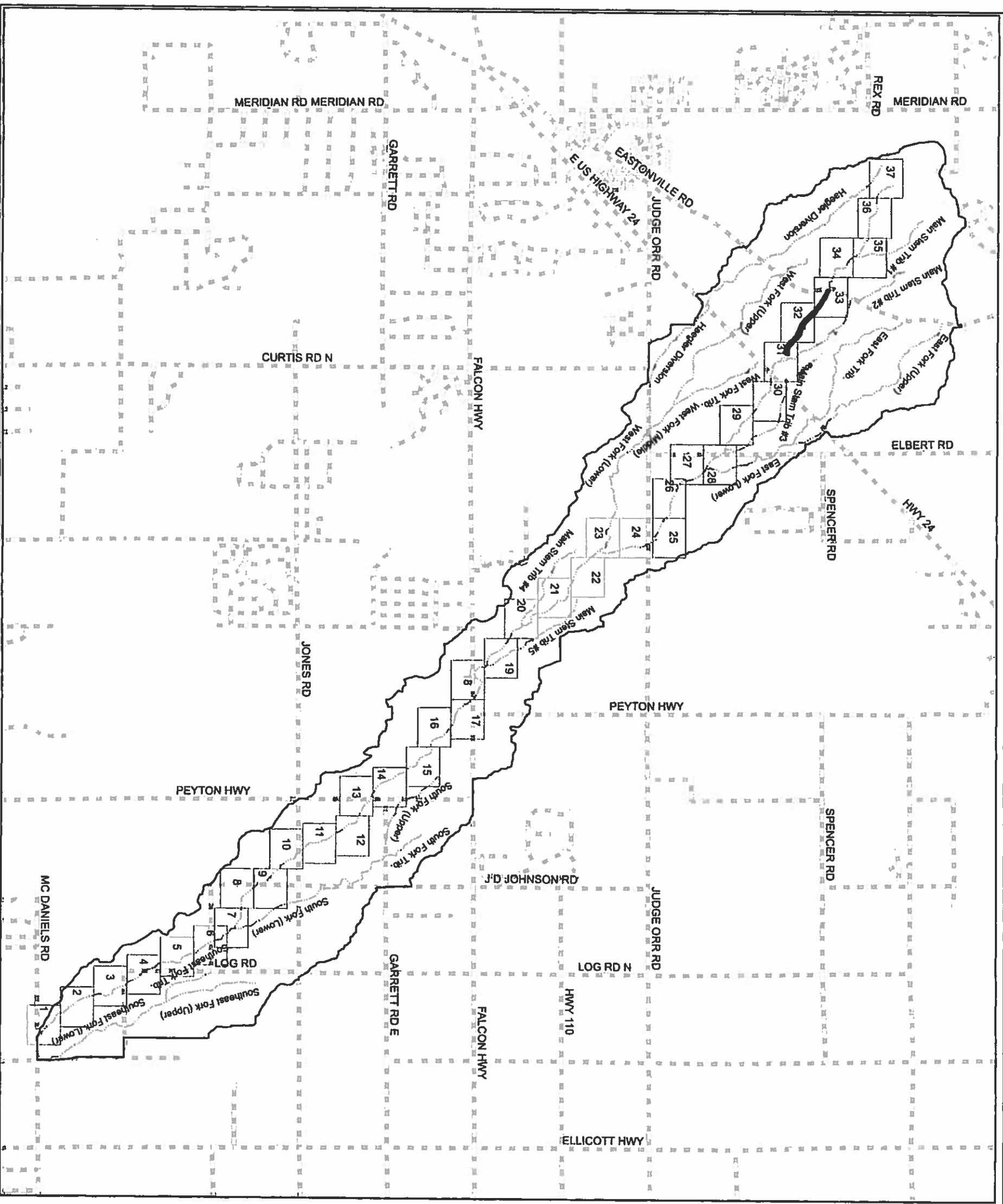
## Appendix E



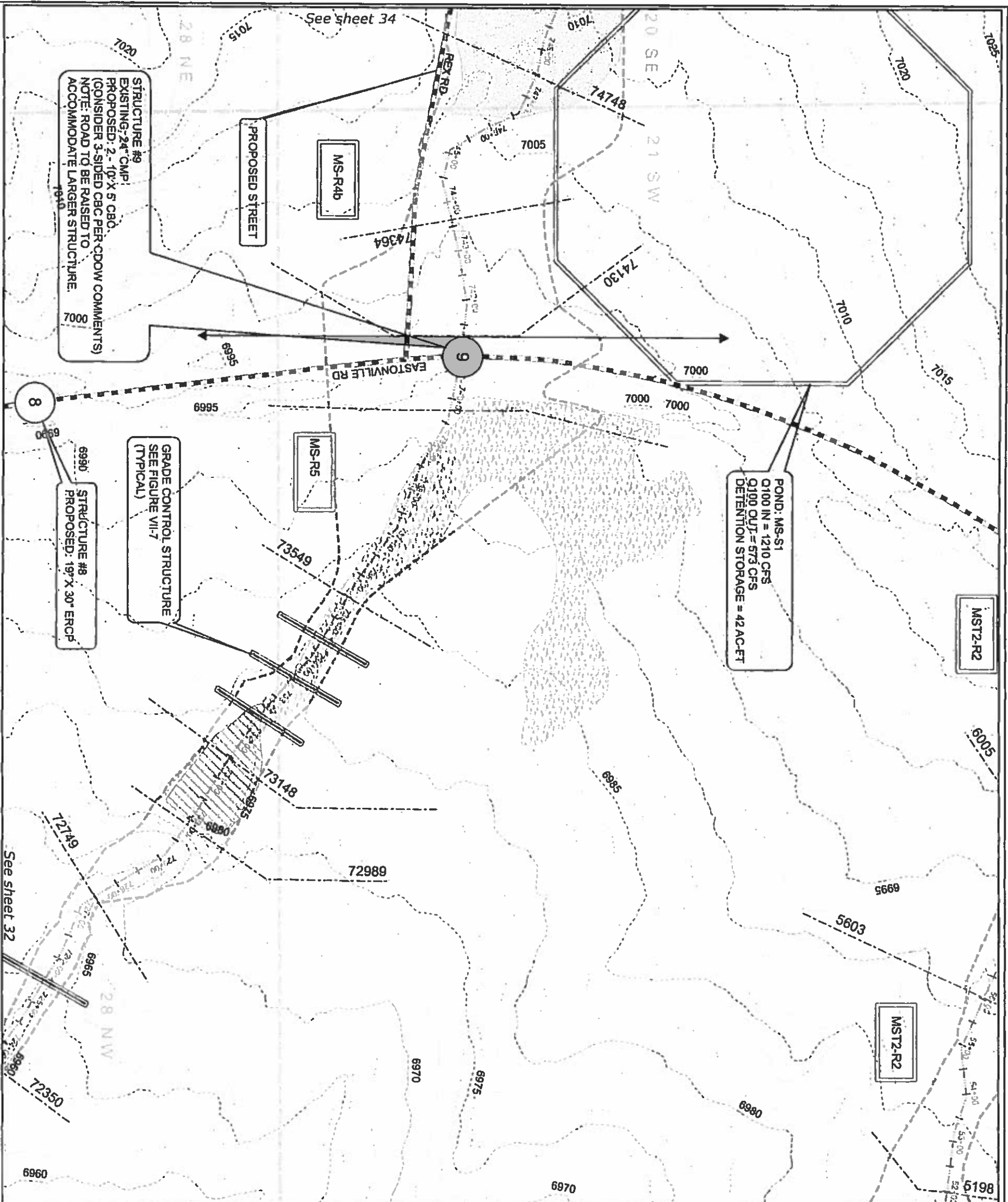
THIS DRAWING IS CONCEPTUAL IN NATURE AND IS NOT TO BE USED AS THE SOLE BASIS FOR FINAL DESIGN, CONSTRUCTION, OR REMEDIAL ACTION. FURTHER STUDIES UNDER EPC DOTS DIRECTION SHOULD BE PERFORMED PRIOR TO SUCH DECISIONS.

**Legend**

-  Streams
-  Roads
-  Basin Boundary
-  Matchlines



<p><b>Drexel, Battell &amp; Co.</b> Engineers - Surveyors          1800 18TH STREET          315 7TH STREET          315 W. COLFAX STREET          COLORADO SPRINGS, COLORADO 80905 (719) 264-4447          COLORADO SPRINGS, COLORADO 80905 (719) 264-4447          CONTACT: ROBERT BEHRETT</p>	<p><b>REALTY DEVELOPMENT SERVICES</b>          25 NORTH TULSA STREET, SUITE 200          COLORADO SPRINGS, COLORADO 80905          CONTACT: NAY O'SULLIVAN (719) 277-1822</p>	<p><b>GIECK RANCH</b>          DRAINAGE BASIN PLANNING STUDY          EL PASO COUNTY, COLORADO</p>	<p>DATE: _____</p>	<p>DATE: _____</p>
			<p>DESIGNED BY: RJB</p>	<p>DESIGNED BY: RJB</p>
<p>PROJECT NO: _____</p>	<p>PROJECT NO: _____</p>	<p>PROJECT NO: _____</p>	<p>DATE: _____</p>	<p>DATE: _____</p>
<p>SCALE: 1" = 5000'</p>	<p>DATE: AUGUST 2007</p>	<p>PROJECT NO: C7706-1</p>	<p>DATE: _____</p>	<p>DATE: _____</p>
<p>PROJECT NO: 6D 038</p>	<p>PROJECT NO: 6D 038</p>	<p>PROJECT NO: 6D 038</p>	<p>DATE: _____</p>	<p>DATE: _____</p>
<p>PROJECT NO: _____</p>	<p>PROJECT NO: _____</p>	<p>PROJECT NO: _____</p>	<p>DATE: _____</p>	<p>DATE: _____</p>



**STRUCTURE #9**  
 EXISTING-24" CMP  
 PROPOSED: 2'-10" X 5' CBO  
 (CONSIDER 3-SIDED CBO PER CDOW COMMENTS)  
 NOTE: ROAD TO BE RAISED TO  
 ACCOMMODATE LARGER STRUCTURE.

**STRUCTURE #8**  
 PROPOSED: 19" X 30" ERCS

**POND: MS-S1**  
 Q100 IN = 1210 CFS  
 Q100 OUT = 573 CFS  
 DETENTION STORAGE = 42 AC-FT

**GRADE CONTROL STRUCTURE**  
 SEE FIGURE VII-7  
 (TYPICAL)

See sheet 34

See sheet 32

**Environmental Key**

- Ponds
- Riparian: Good
- Riparian: Poor
- Potential Wetlands

**Legend**

- Proposed Future Conditions 100-yr Flood Limits
- Streams
- Reaches
- Reach Breaklines
- Cross-sections
- Roads
- Structures
- Section Lines
- 5-ft contours
- 2-ft contours

0 100 200 Feet



Reach	Slope (%)	Q <sub>100</sub> (cfs)	V <sub>100</sub> (ft/s)
MS-R4b	1.76	1094	4.24
MS-R5	1.88	573	5.00

**RECOMMENDED PLAN IMPROVEMENTS**

- Reach
- MS-R4b Channelization
- MS-R5 Vegetation Augmentation




Note:  
 See Technical Addenda for grade control data.  
 THIS DRAWING IS CONCEPTUAL IN NATURE AND IS NOT TO BE USED AS THE SOLE BASIS FOR FINAL DESIGN, CONSTRUCTION, OR REMEDIAL ACTION. FURTHER STUDIES UNDER EPC DOT'S DIRECTION SHOULD BE PERFORMED PRIOR TO SUCH DECISIONS.

<b>Drexel, Barrell &amp; Co.</b> Engineers, Surveyors 1800 S. W. 10th Street Colorado Springs, Colorado 80904 CONTACT: ROBERT BENNETT, P.E., CEM	<b>REALTY DEVELOPMENT SERVICES</b> 25 NORTH TOWN STREET, SUITE 200 COLORADO SPRINGS, COLORADO 80904 CONTACT: TONY O'NEILL, (719) 277-7122	<b>GIECK RANCH</b> DRAINAGE BASIN PLANNING STUDY EL PASO COUNTY, COLORADO	DRAWN BY: RJB CHECKED BY: RJB DATE:	PROJECT NO.: DRAWING NO.:
			AUGUST 2007 SCALE: 1" = 200' NONE	JOB NO.: C7706-2 SHEET NO.: 6D 038 TOTAL SHEETS: 33

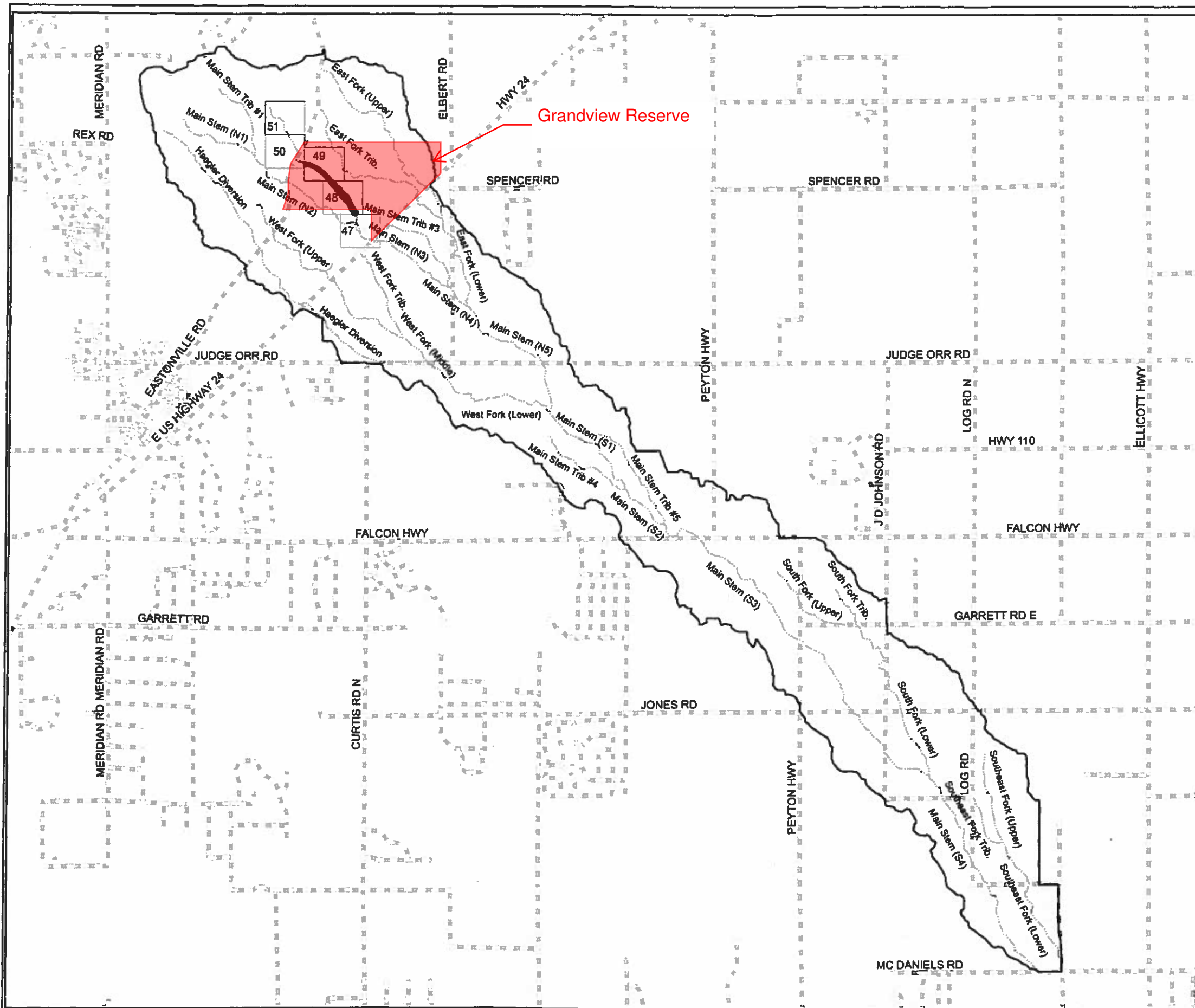




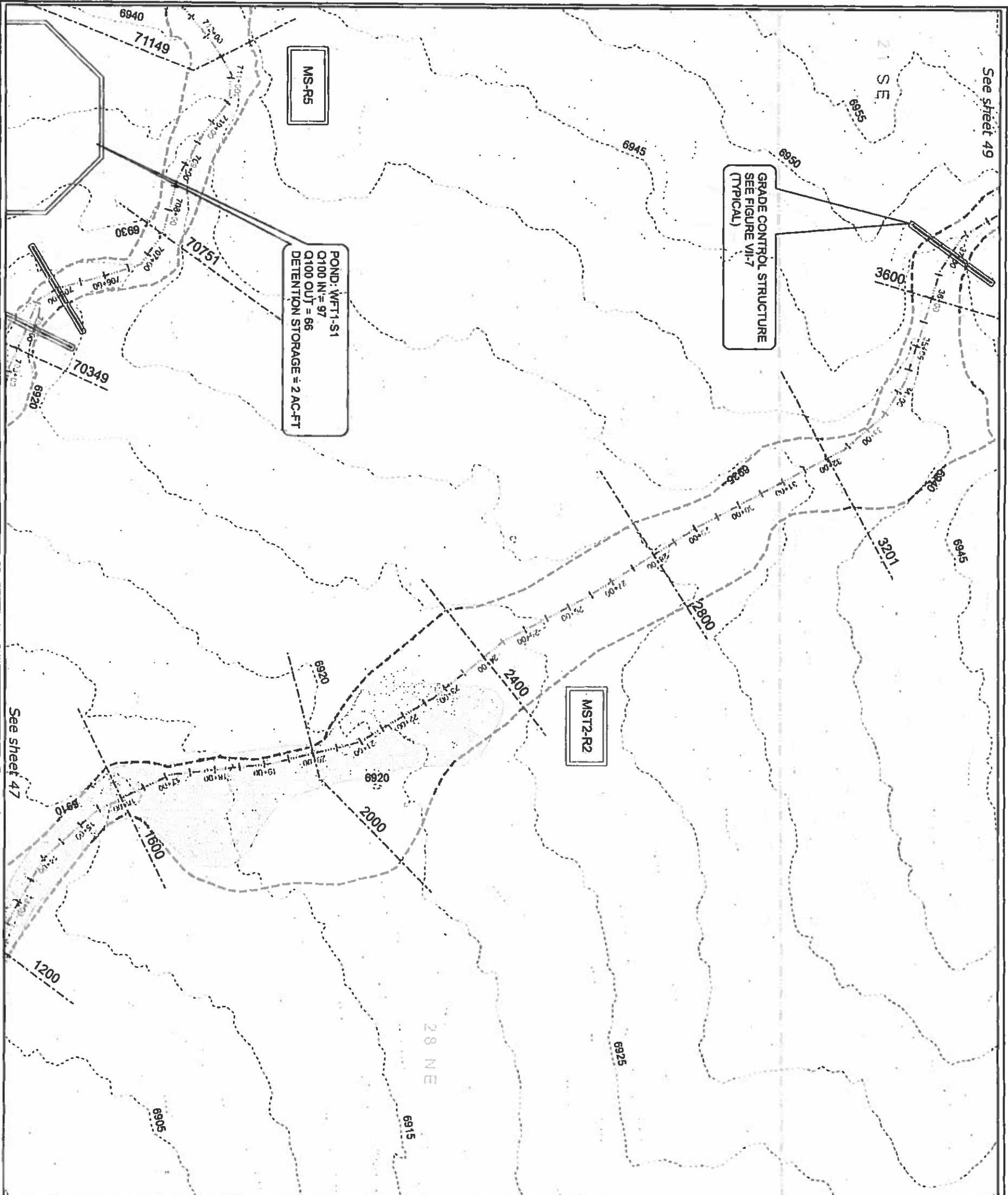
### Legend

-  Streams
-  Roads
-  Basin Boundary
-  Matchlines

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See sheet 49



GRADE CONTROL STRUCTURE  
SEE FIGURE VII-7  
(TYPICAL)

POND: WFT1-S1  
Q100 IN = 97  
Q100 OUT = 66  
DETENTION STORAGE = 2 AC-FT

MST2-R2










MS-R5

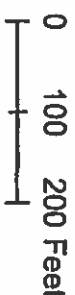
**Environmental Key**

-  Ponds
-  Riparian: Good
-  Riparian: Poor
-  Potential Wetlands

The channel is considered dry unless shown as one of the above environmental categories.

**Legend**

-  Proposed Future Conditions 100-yr Flood Limits
-  Streams
-  Reaches
-  Reach Breaklines
-  Cross-sections
-  Roads
-  Structures
-  Section Lines
-  2-ft contours



Reach	Slope (%)	Q <sub>100</sub> (cfs)	V <sub>100</sub> (ft/s)
MST2-R2	1.93	271	3.16

**RECOMMENDED PLAN IMPROVEMENTS**  
Reach MST2-R2 Vegetation Augmentation

**Note:**  
See Technical Addenda for grade control data.  
  
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Prepared by: **Drexel Bartell & Co.** Engineers - Surveyors  
1889 SPRING STREET  
3131 W 11TH STREET  
CONTACT: ROBERT SEMNETT, P.E., CEM

Prepared by: **REALTY DEVELOPMENT SERVICES**  
23 HIGHLAND TERRACE, SUITE 200  
COLORADO SPRING, COLORADO 80905  
CONTACT: PAUL O'BOULMAN (719) 277-1822

Prepared by: **GIECK RANCH DRAINAGE BASIN PLANNING STUDY**  
EL PASO COUNTY, COLORADO

DATE	REVISIONS	BY	FOR
JANUARY 2010	REGULAR UPDATE	RUB	FOR EPC DOT COUNTY
	THE EPC DOT CENTER	BULFALL	
			FOR EPC DOT COUNTY
			FOR EPC DOT COUNTY

Prepared by: **GIECK RANCH DBPS PLAN VIEW**  
MAIN STEM TRIBUTARY-2 #2  
DATE: AUGUST 2007  
SCALE: 1" = 200'  
DRAWING NO.: C7706-2  
SHEET NO.: 48

Prepared by: **Drexel, Bartell & Co.**  
 1800 W. 17TH STREET  
 3.8 7TH STREET  
 5813 W. 17TH STREET  
 CONTACT: ROBERT BEHRETT

Engineers - Surveyors  
 BOULDER, COLORADO 80501 (303) 442-4338  
 COLORADO SPRINGS, COLORADO 80905 (719) 364-8887  
 DENVER, COLORADO 80202 (303) 733-4444

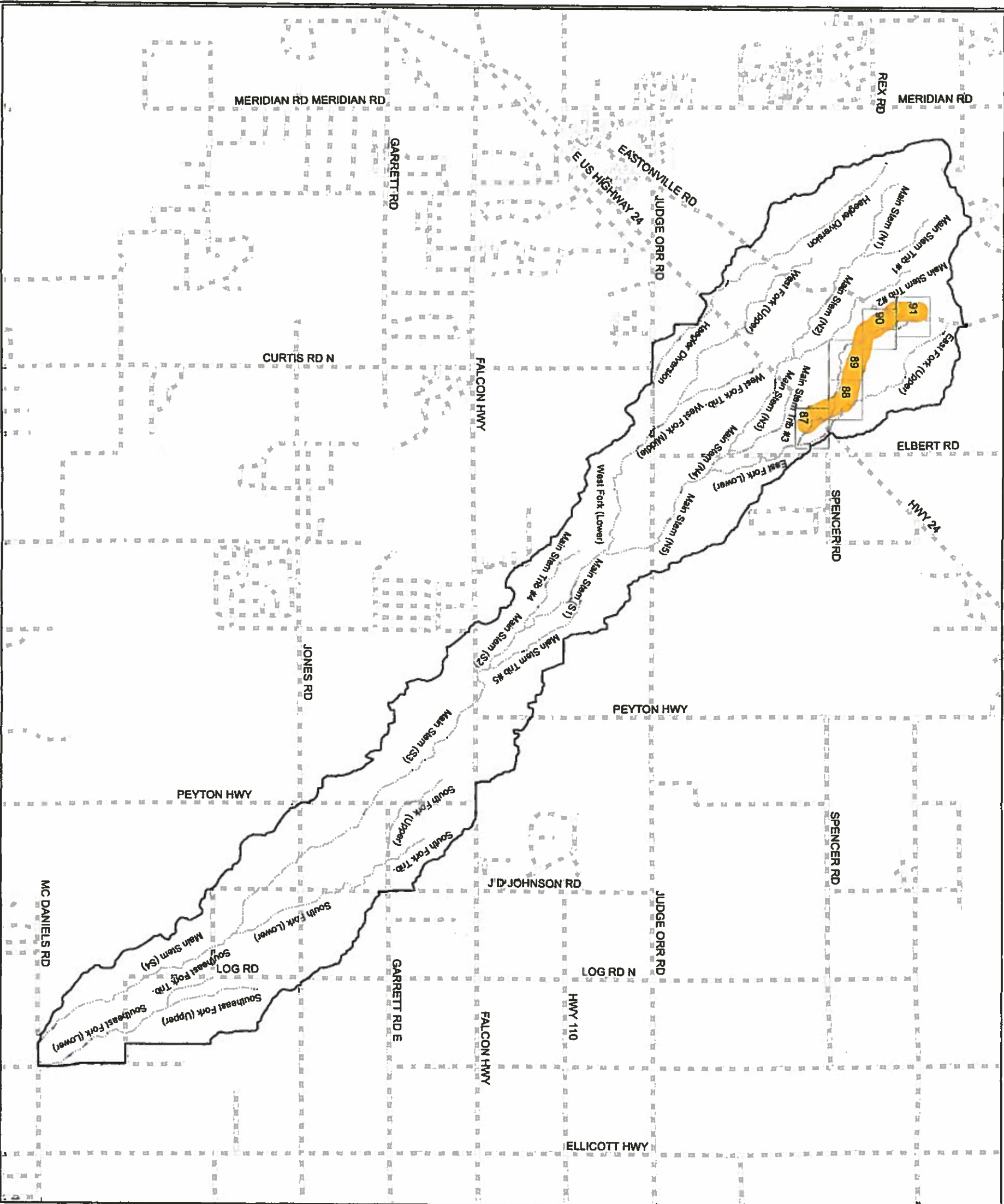
Prepared for: **REALTY DEVELOPMENT SERVICES**  
 25 NORTH TULSA STREET, SUITE 200  
 COLORADO SPRINGS, COLORADO 80905  
 CONTACT: RAY D'AMICO (719) 277-1822

Project: **GIECK RANCH**  
 DRAINAGE BASIN PLANNING STUDY  
 EL PASO COUNTY, COLORADO

DATE	BY	REVISION
8/1/07	RLB	INITIAL DRAINAGE STUDY
8/1/07	RLB	FINAL DRAINAGE STUDY
8/1/07	RLB	FINAL DRAINAGE STUDY

Project: **GIECK RANCH**  
 KEY MAP  
 EAST FORK TRIBUTARY

DATE	BY	REVISION
AUGUST 2007	C7706-1	PL
8/1/07	6D 038	K11

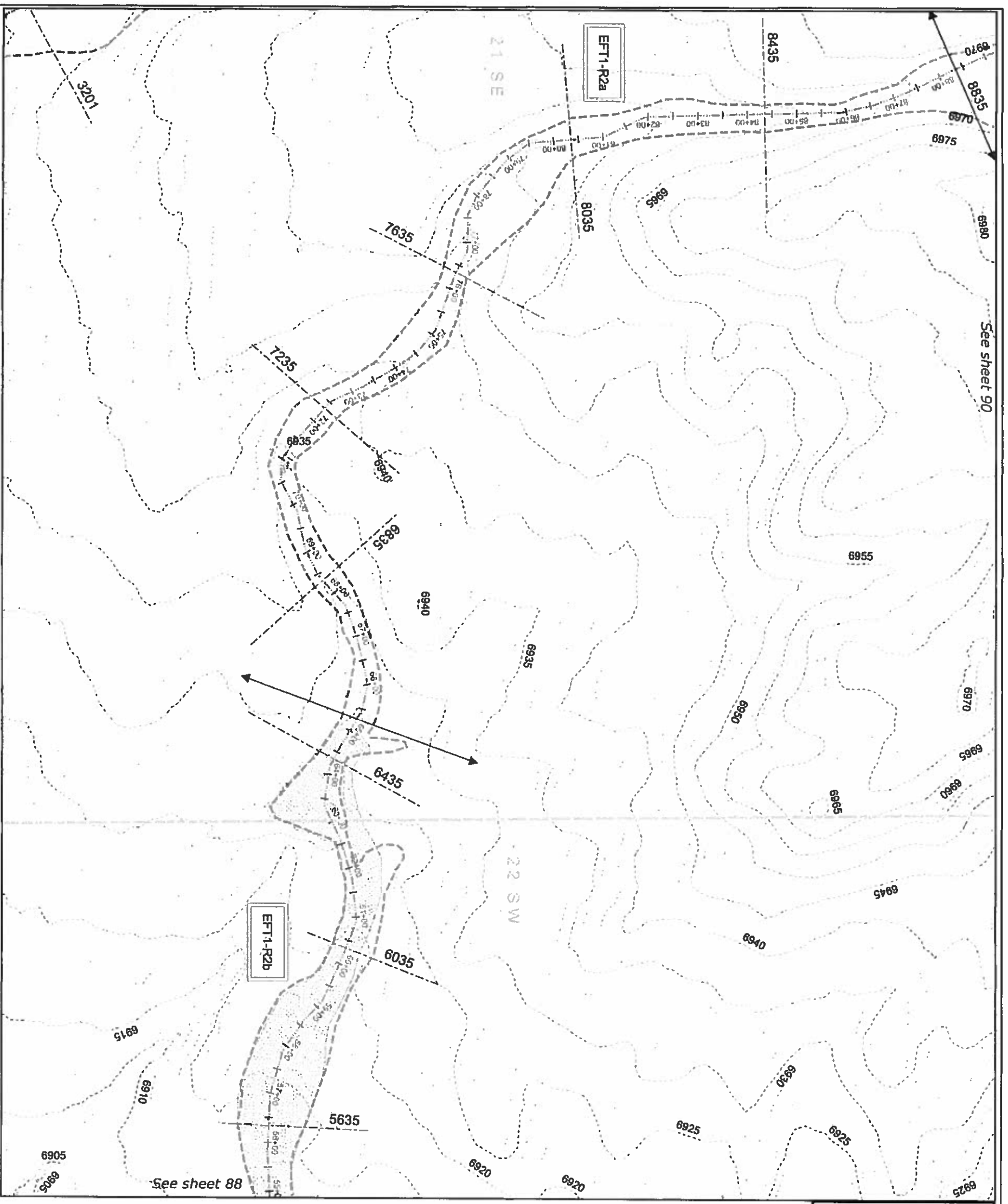


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**Legend**

- Streams
- Roads
- Basin Boundary
- Matchlines





**Environmental Key**

- Ponds
- Riparian: Good
- Riparian: Poor
- Potential Wetlands

**Legend**

- Proposed Future Conditions 100-yr Flood Limits
- Streams
- Reaches
- Reach Breaklines
- Cross-sections
- Roads
- Structures
- Section Lines
- 5-ft contours
- 2-ft contours

The channel is considered dry unless shown as one of the above environmental categories.

0 100 200 Feet

Reach	Slope (%)	Q <sub>100</sub> (cfs)	V <sub>100</sub> (ft/s)
EFT1-R2a	1.83	217	3.73
EFT1-R2b	1.60	217	2.68

**RECOMMENDED PLAN IMPROVEMENTS**

Reach

EFT1-R2a As-needed Improvements

EFT1-R2b As-needed Improvements

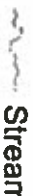



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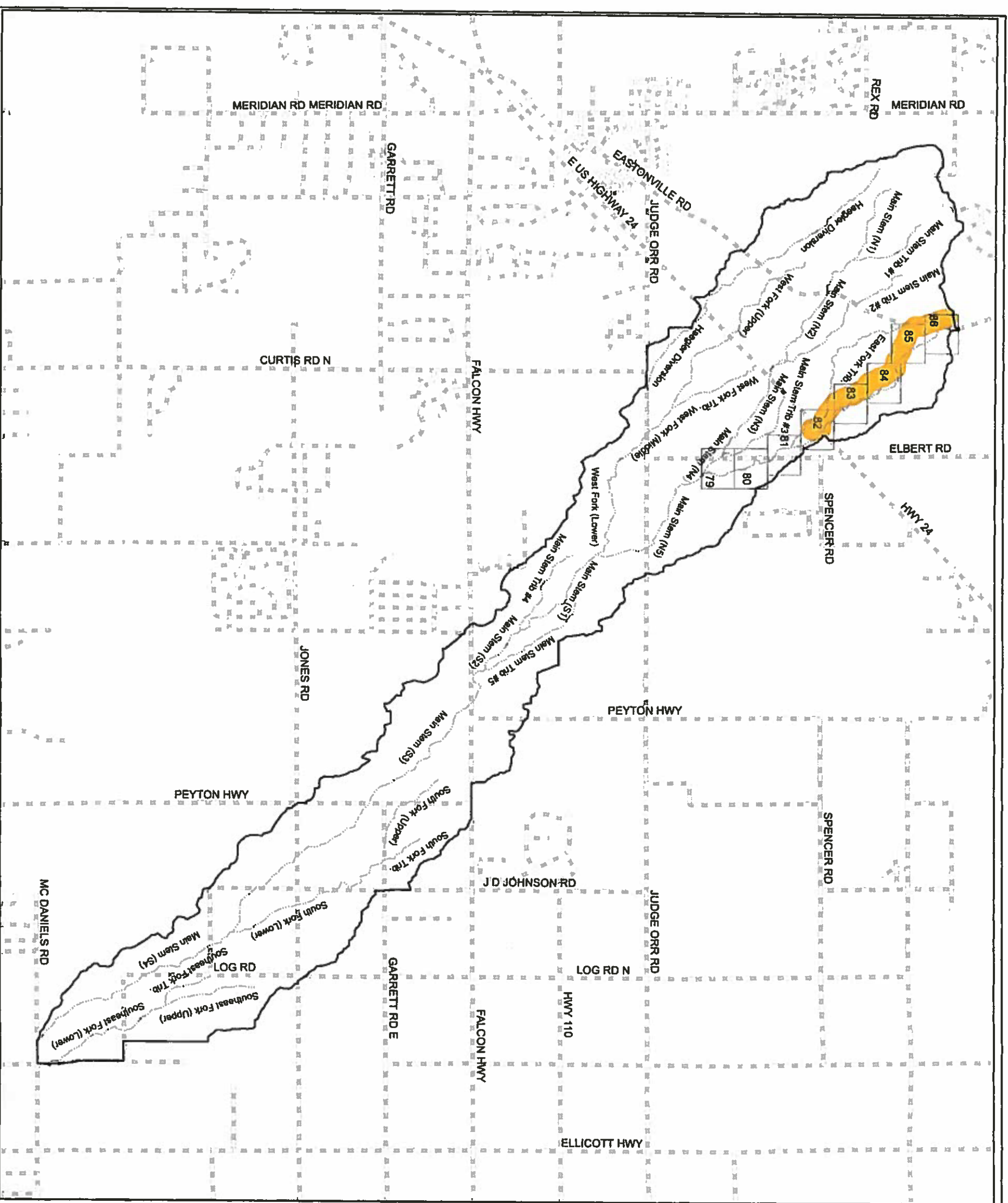
<b>Drexel, Barrell &amp; Co. Engineers - Surveyors</b> 1310 NORTH STREET COLORADO SPRING, COLORADO 80905 CONTACT: ROBERT BENNETT, P.E. CFSI	<b>REALTY DEVELOPMENT SERVICES</b> 23 NORTH TULSA STREET, SUITE 200 COLORADO SPRING, COLORADO 80905 CONTACT: PAUL O'SULLIVAN (719) 527-1022	<b>GIECK RANCH</b> DRAINAGE BASIN PLANNING STUDY EL PASO COUNTY, COLORADO	DRAWN BY: RLB CHECKED BY: ULTIMA APPROVED BY: RENTAL	DATE: JANUARY 2010	<b>GIECK RANCH DBPS</b> PLAN VIEW EAST FORK TRIBUTARY #3	DATE: AUGUST 2007 SCALE: 1" = 200' NONE	JOB NO: C7706-2 DRAWING NO: 6D 038	SHEET NO: 89
	<p>PROJECT AREA: GIECK RANCH DRAINAGE BASIN PLANNING STUDY EL PASO COUNTY, COLORADO</p>							



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### Legend

-  Streams
-  Roads
-  Basin Boundary
-  Matchlines



**Drexel, Bartell & Co.** Engineers, Surveyors  
 1800 27th STREET  
 30 7TH STREET  
 6115 W 7TH STREET  
 CONTACT: ROBERT BENNETT

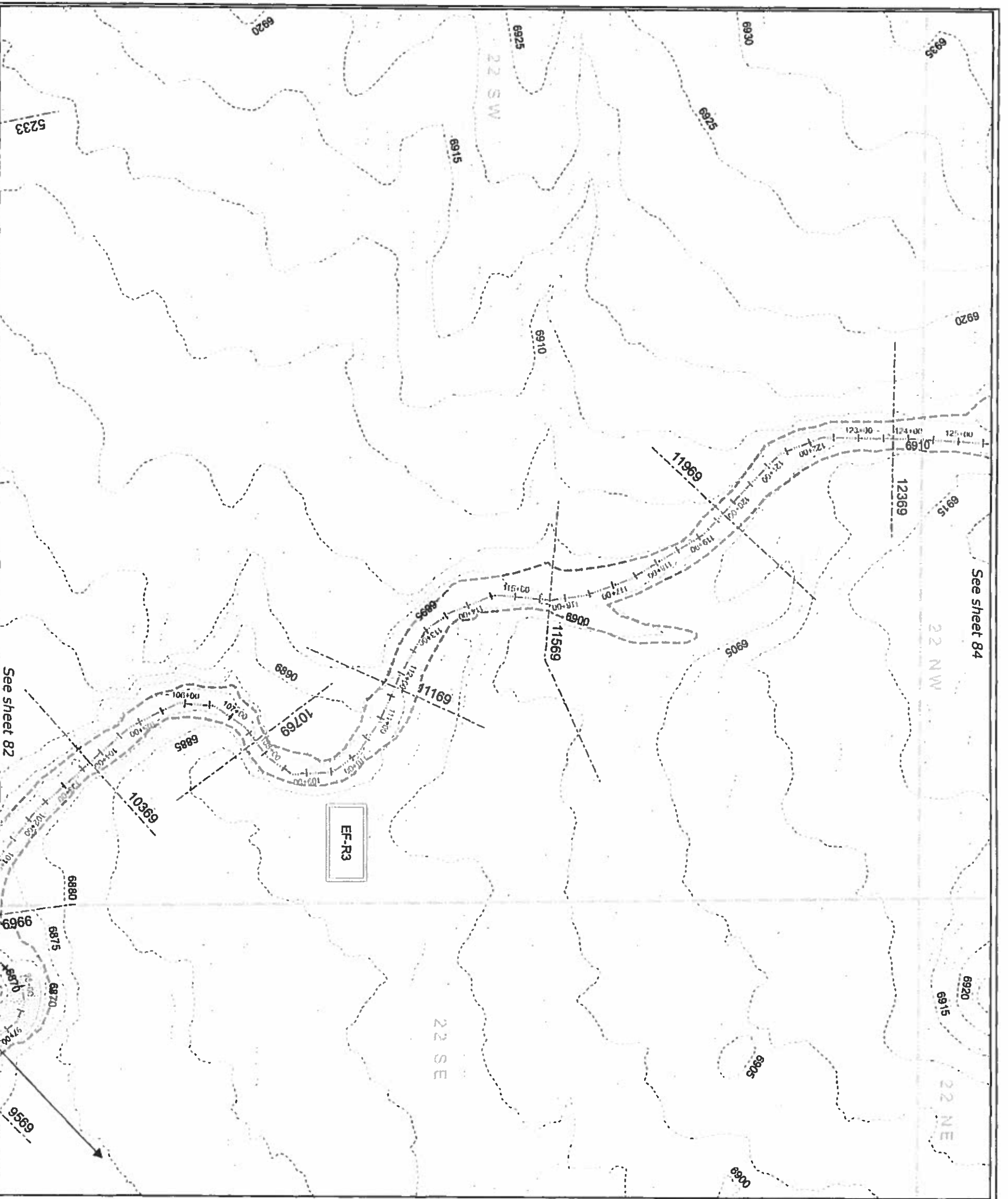
**REALTY DEVELOPMENT SERVICES**  
 30 NORTH TULSA STREET SUITE 200  
 COLORADO SPRINGS, COLORADO 80905  
 CONTACT: RAY C SULLIVAN (719) 277-1622

**GIECK RANCH**  
 DRAINAGE BASIN PLANNING STUDY  
 EL PASO COUNTY, COLORADO

DATE	BY	REVISION

**GIECK RANCH**  
 KEY MAP  
 EAST FORK

DATE: AUGUST 2007  
 SCALE: 1" = 6000'  
 DRAWING NO.: C7706-1  
 SHEET NO.: 6D\_038  
 PROJECT: PL K10



**Environmental Key**

	Ponds
	Riparian: Good
	Riparian: Poor
	Potential Wetlands

**Legend**

	Proposed Future Conditions 100-yr Flood Limits
	Streams
	Reaches
	Reach Breaklines
	Cross-sections
	Roads
	Structures
	Section Lines
	5-ft contours
	2-ft contours

The channel is considered dry unless shown as one of the above environmental categories.

0 100 200 Feet

Reach	Slope (%)	Q <sub>100</sub> (cfs)	V <sub>100</sub> (ft/s)
EF-R3	1.53	595	5.09

**RECOMMENDED PLAN IMPROVEMENTS**

Reach EF-R3 As-needed Improvements

THIS DRAWING IS CONCEPTUAL IN NATURE AND IS NOT TO BE USED AS THE SOLE BASIS FOR FINAL DESIGN, CONSTRUCTION, OR REMEDIAL ACTION. FURTHER STUDIES UNDER EPC DOT'S DIRECTION SHOULD BE PERFORMED PRIOR TO SUCH DECISIONS.

**Drexel, Bartell & Co.** Engineers - Surveyors  
 1840 27TH STREET  
 313 W 4TH STREET  
 COLORADO SPRINGS, COLORADO 80904 (719) 268-9887  
 CONTACT: ROBERT BARNETT, P.E., CSM

**REALTY DEVELOPMENT SERVICES**  
 23 NORTH TULSA STREET, SUITE 201  
 COLORADO SPRINGS, COLORADO 80902  
 CONTACT: NAY O'SULLIVAN (719) 227-1022

**GIECK RANCH DRAINAGE BASIN PLANNING STUDY**  
 EL PASO COUNTY, COLORADO

DESIGNED BY: PUB	DATE: 08/2007
DRAWN BY: B.F./J.A.L.	
CHECKED BY: B.F./J.A.L.	
APPROVED BY: [Signature]	

**GIECK RANCH DBPS PLAN VIEW EAST FORK #5**

DATE: AUGUST 2007	APP NO: C7706-2	PL
SCALE: 1" = 200'	PROVISED NO: 6D 038	83

# Channel Report

## East Fork Tributary 1 Reach 3 - Proposed Channel\_Capacity

### Trapezoidal

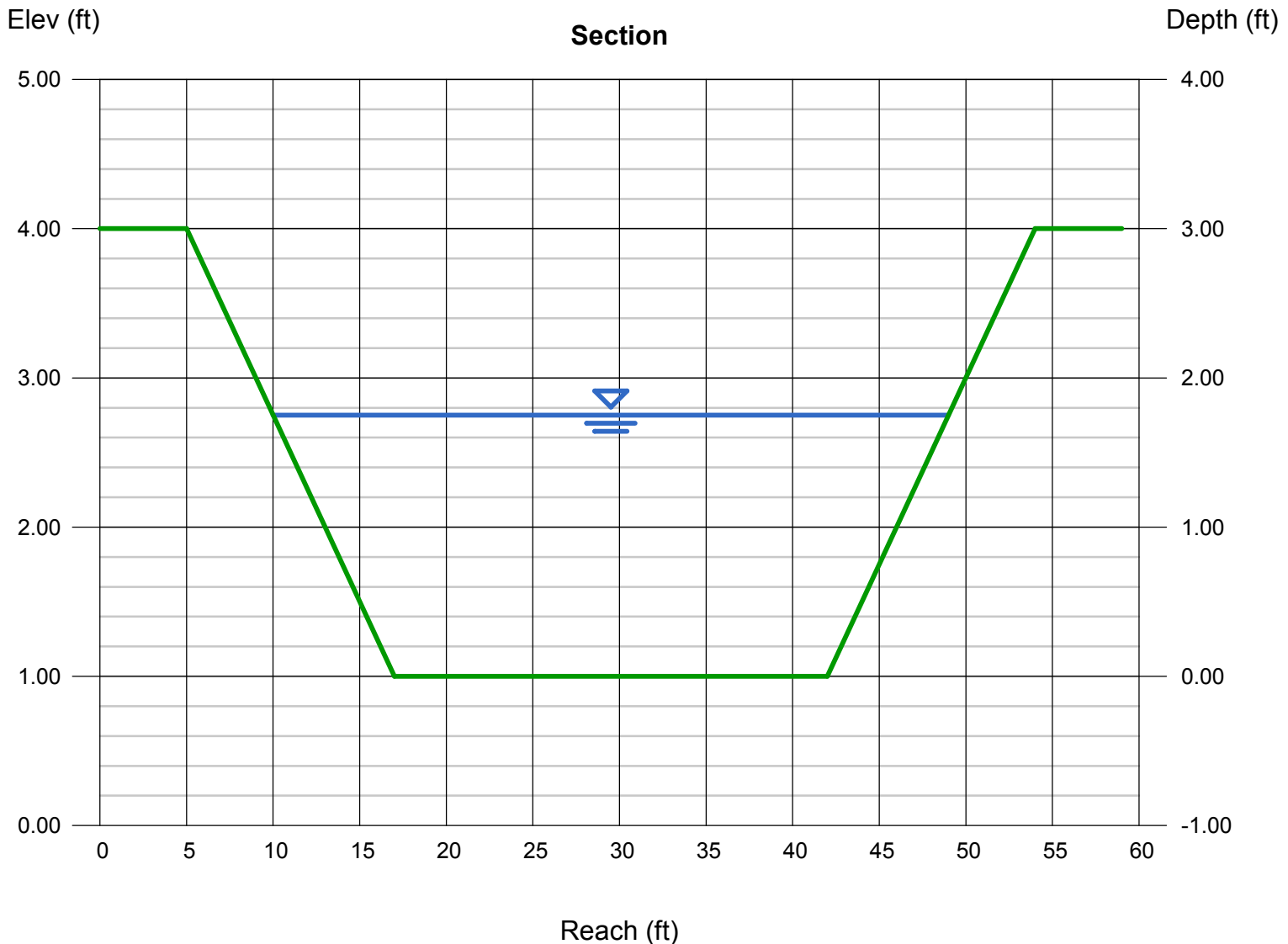
Bottom Width (ft) = 25.00  
Side Slopes (z:1) = 4.00, 4.00  
Total Depth (ft) = 3.00  
Invert Elev (ft) = 1.00  
Slope (%) = 0.69  
N-Value = 0.040

### Highlighted

Depth (ft) = 1.75  
Q (cfs) = 217.00  
Area (sqft) = 56.00  
Velocity (ft/s) = 3.88  
Wetted Perim (ft) = 39.43  
Crit Depth, Yc (ft) = 1.24  
Top Width (ft) = 39.00  
EGL (ft) = 1.98

### Calculations

Compute by: Known Q  
Known Q (cfs) = 217.00



# Channel Report

## East Fork Tributary 1 Reach 3 - Proposed Channel\_Velocity

### Trapezoidal

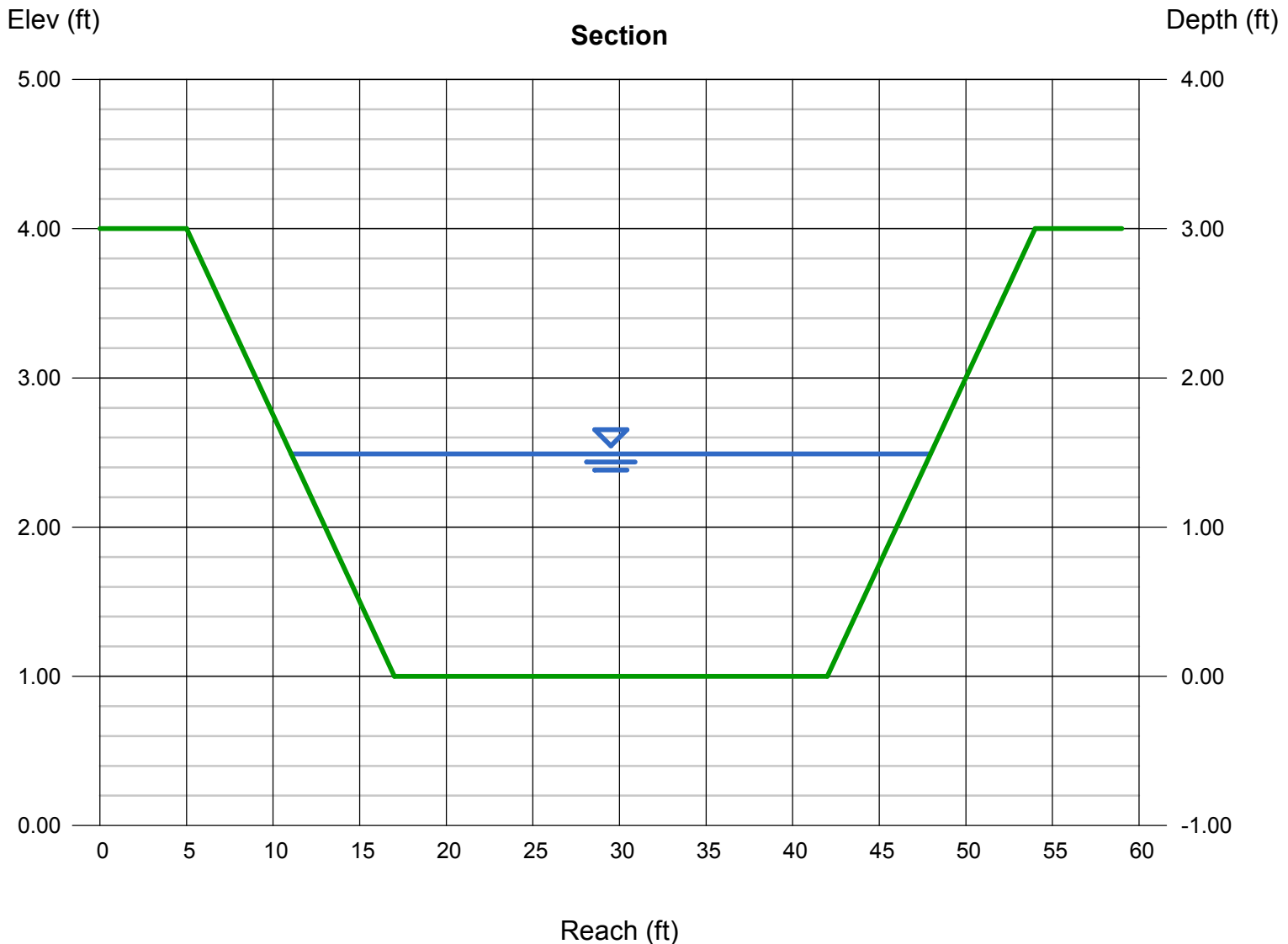
Bottom Width (ft) = 25.00  
Side Slopes (z:1) = 4.00, 4.00  
Total Depth (ft) = 3.00  
Invert Elev (ft) = 1.00  
Slope (%) = 0.69  
N-Value = 0.030

### Highlighted

Depth (ft) = 1.49  
Q (cfs) = 217.00  
Area (sqft) = 46.13  
Velocity (ft/s) = 4.70  
Wetted Perim (ft) = 37.29  
Crit Depth, Yc (ft) = 1.24  
Top Width (ft) = 36.92  
EGL (ft) = 1.83

### Calculations

Compute by: Known Q  
Known Q (cfs) = 217.00





# Channel Report

## East Fork Tributary 1 Reach 2 - Proposed Channel\_Capacity

### Trapezoidal

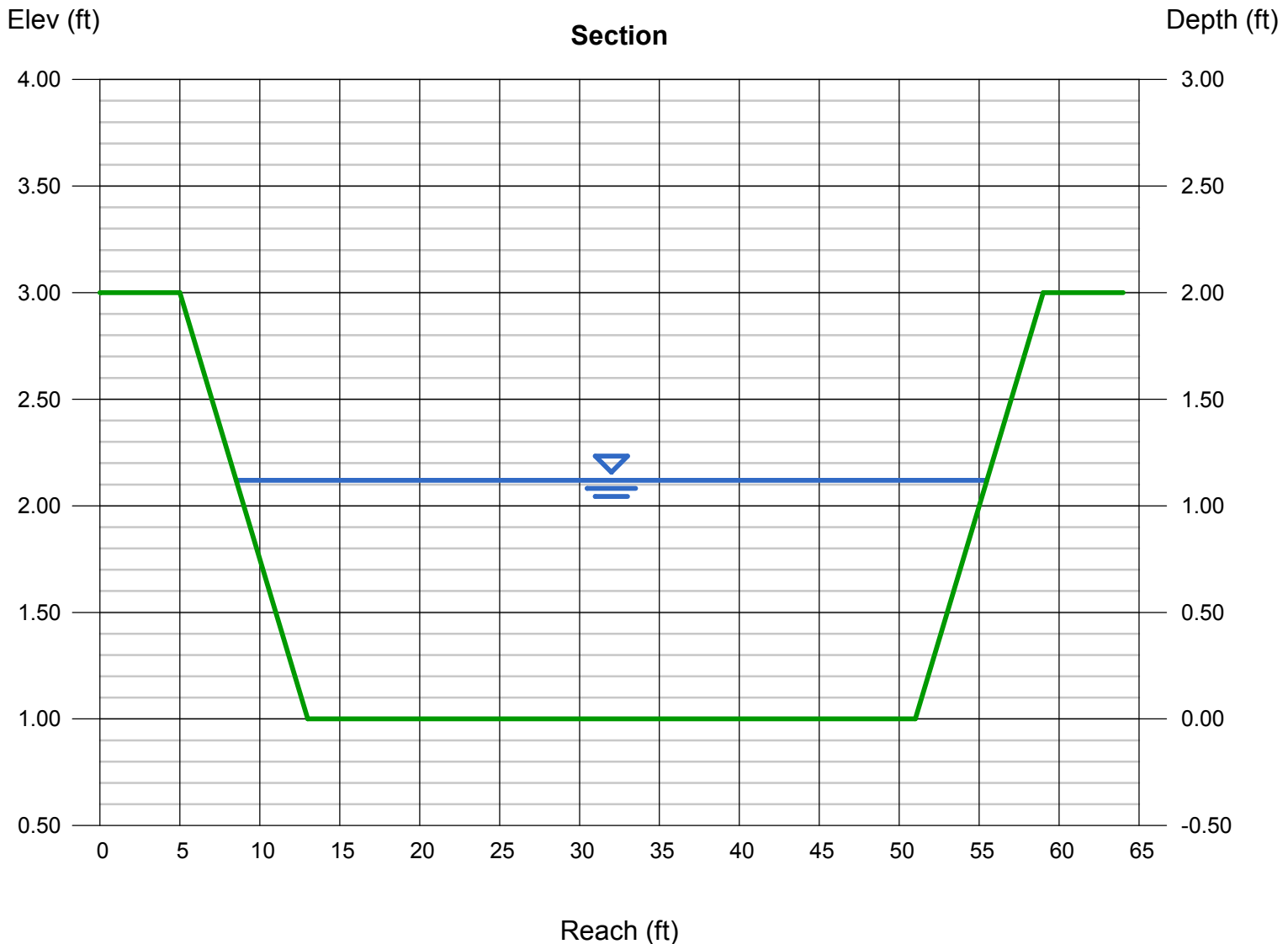
Bottom Width (ft) = 38.00  
Side Slopes (z:1) = 4.00, 4.00  
Total Depth (ft) = 2.00  
Invert Elev (ft) = 1.00  
Slope (%) = 1.58  
N-Value = 0.050

### Highlighted

Depth (ft) = 1.12  
Q (cfs) = 177.00  
Area (sqft) = 47.58  
Velocity (ft/s) = 3.72  
Wetted Perim (ft) = 47.24  
Crit Depth, Yc (ft) = 0.86  
Top Width (ft) = 46.96  
EGL (ft) = 1.34

### Calculations

Compute by: Known Q  
Known Q (cfs) = 177.00



# Channel Report

## East Fork Tributary 1 Reach 2 - Proposed Channel\_Velocity

### Trapezoidal

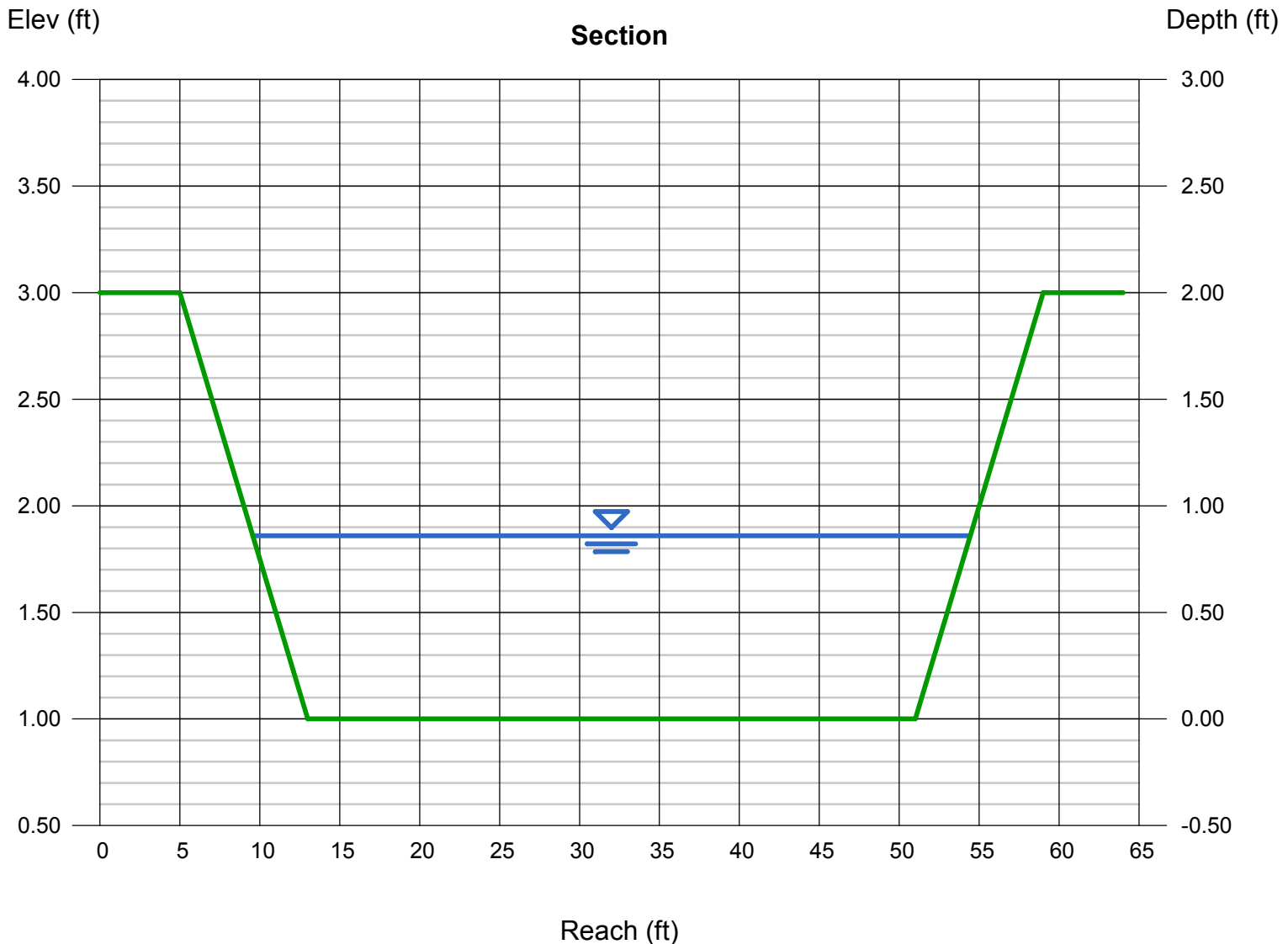
Bottom Width (ft) = 38.00  
Side Slopes (z:1) = 4.00, 4.00  
Total Depth (ft) = 2.00  
Invert Elev (ft) = 1.00  
Slope (%) = 1.58  
N-Value = 0.032

### Highlighted

Depth (ft) = 0.86  
Q (cfs) = 177.00  
Area (sqft) = 35.64  
Velocity (ft/s) = 4.97  
Wetted Perim (ft) = 45.09  
Crit Depth, Yc (ft) = 0.86  
Top Width (ft) = 44.88  
EGL (ft) = 1.24

### Calculations

Compute by: Known Q  
Known Q (cfs) = 177.00



# Channel Report

Main Stem Trib 2

## Gieck Ranch Tributary 2 - Proposed Channel Section Capacity Check

### Trapezoidal

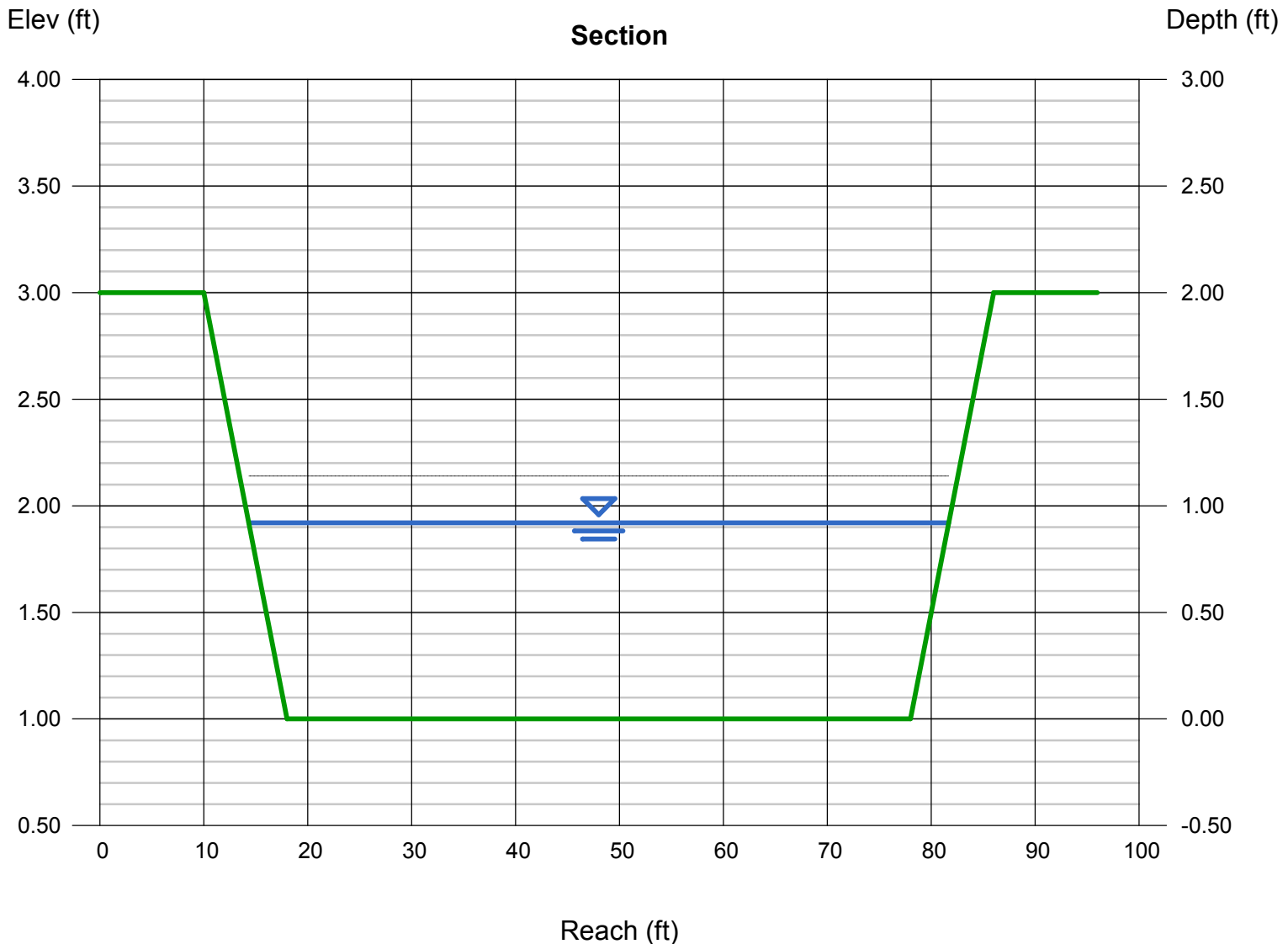
Bottom Width (ft) = 60.00  
Side Slopes (z:1) = 4.00, 4.00  
Total Depth (ft) = 2.00  
Invert Elev (ft) = 1.00  
Slope (%) = 2.00  
N-Value = 0.050

### Highlighted

Depth (ft) = 0.92  
Q (cfs) = 220.00  
Area (sqft) = 58.59  
Velocity (ft/s) = 3.76  
Wetted Perim (ft) = 67.59  
Crit Depth, Yc (ft) = 0.74  
Top Width (ft) = 67.36  
EGL (ft) = 1.14

### Calculations

Compute by: Known Q  
Known Q (cfs) = 220.00



# Channel Report

Main Stem Trib 2

## Gieck Ranch Tributary 2 - Proposed Channel Section Velocity Check

### Trapezoidal

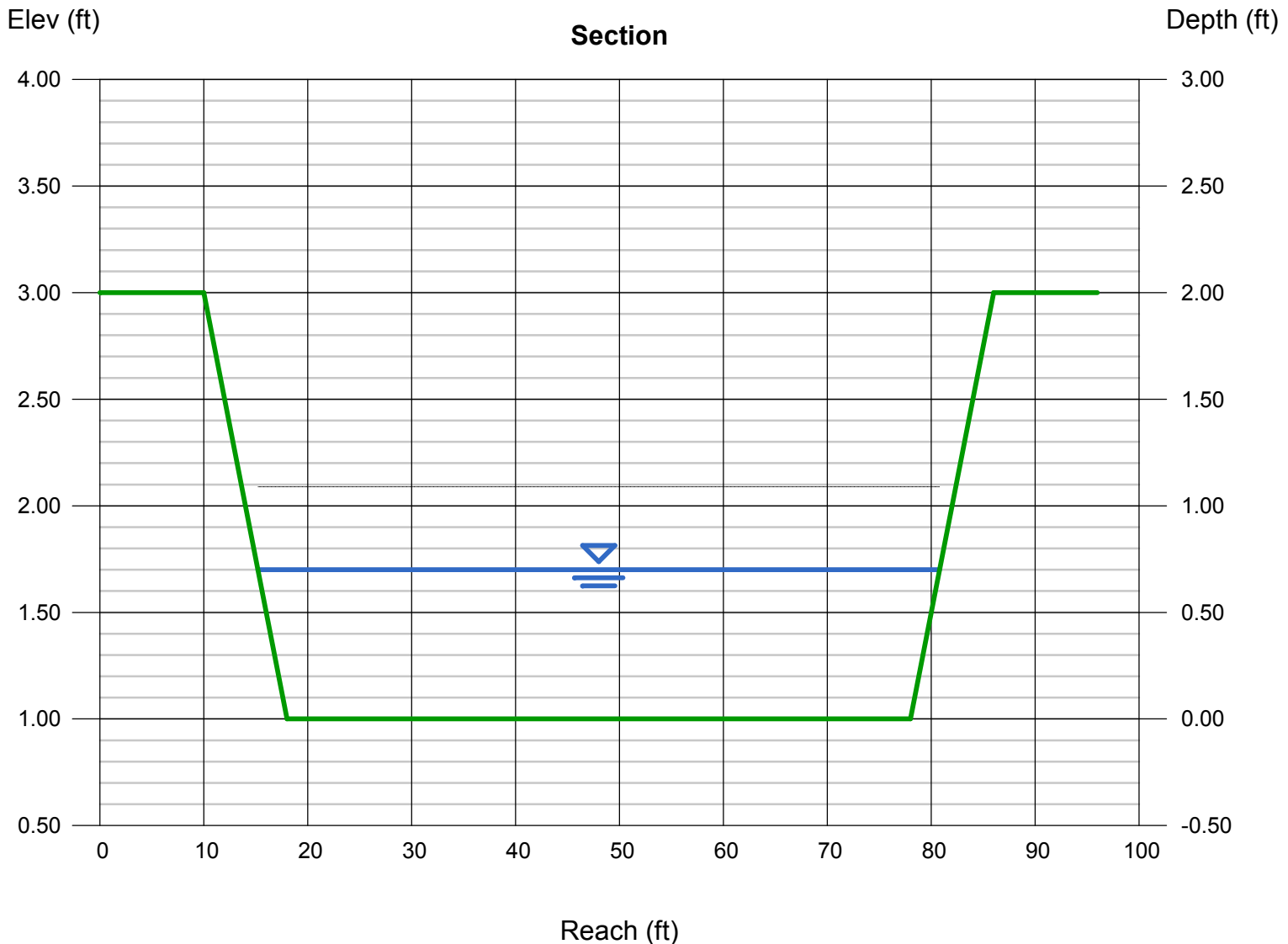
Bottom Width (ft) = 60.00  
Side Slopes (z:1) = 4.00, 4.00  
Total Depth (ft) = 2.00  
Invert Elev (ft) = 1.00  
Slope (%) = 2.00  
N-Value = 0.032

### Highlighted

Depth (ft) = 0.70  
Q (cfs) = 220.00  
Area (sqft) = 43.96  
Velocity (ft/s) = 5.00  
Wetted Perim (ft) = 65.77  
Crit Depth, Yc (ft) = 0.74  
Top Width (ft) = 65.60  
EGL (ft) = 1.09

### Calculations

Compute by: Known Q  
Known Q (cfs) = 220.00



# Channel Report

## Gieck Ranch Tributary 2 Reach 1 - Proposed Channel Section Capacity Check

Main Stem

### Trapezoidal

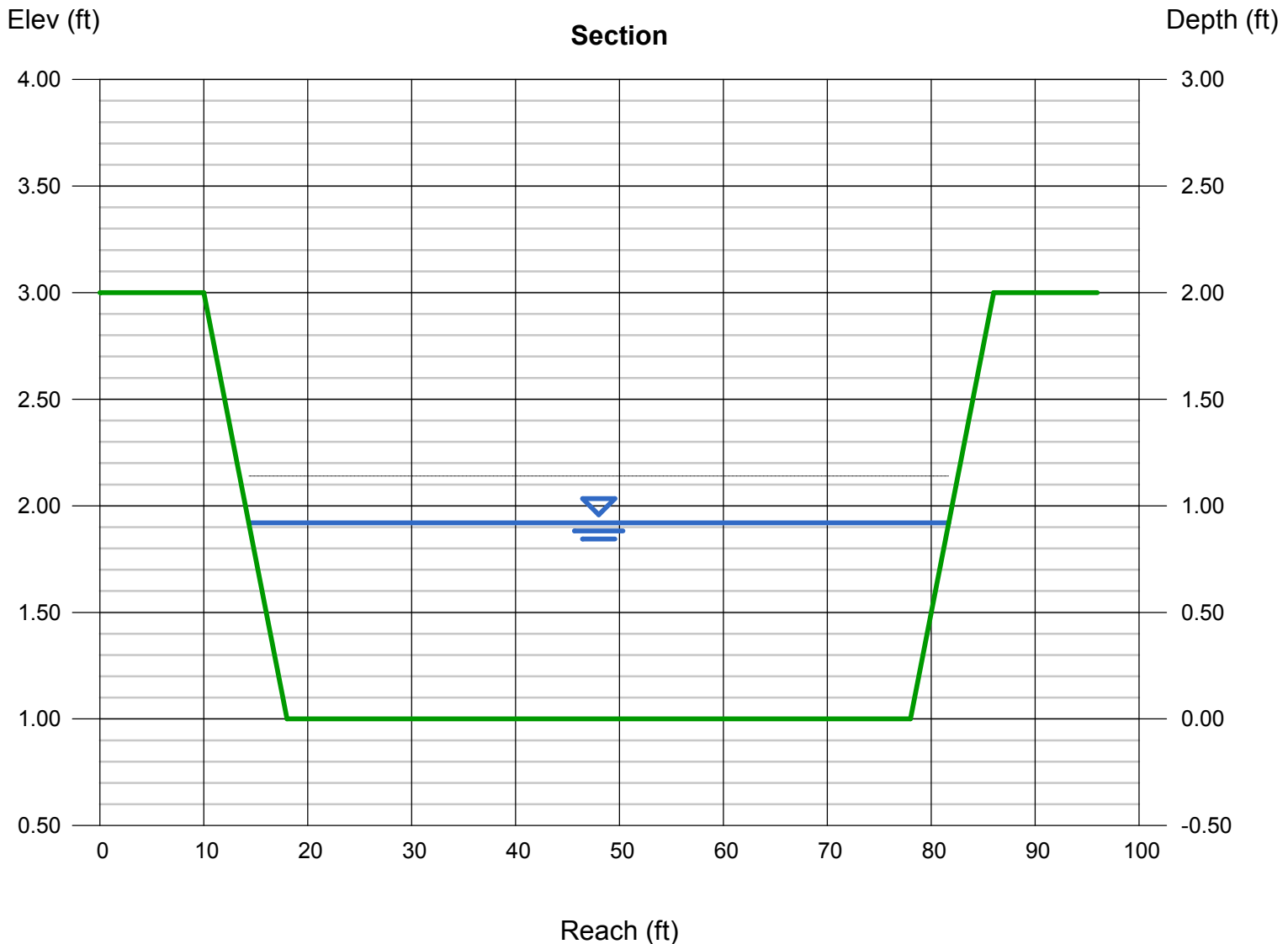
Bottom Width (ft) = 60.00  
Side Slopes (z:1) = 4.00, 4.00  
Total Depth (ft) = 2.00  
Invert Elev (ft) = 1.00  
Slope (%) = 2.00  
N-Value = 0.050

### Highlighted

Depth (ft) = 0.92  
Q (cfs) = 220.00  
Area (sqft) = 58.59  
Velocity (ft/s) = 3.76  
Wetted Perim (ft) = 67.59  
Crit Depth, Yc (ft) = 0.74  
Top Width (ft) = 67.36  
EGL (ft) = 1.14

### Calculations

Compute by: Known Q  
Known Q (cfs) = 220.00



# Channel Report

## Gieck Ranch Tributary 2 Reach 1 - Proposed Channel Section Velocity Check

Main Stem

### Trapezoidal

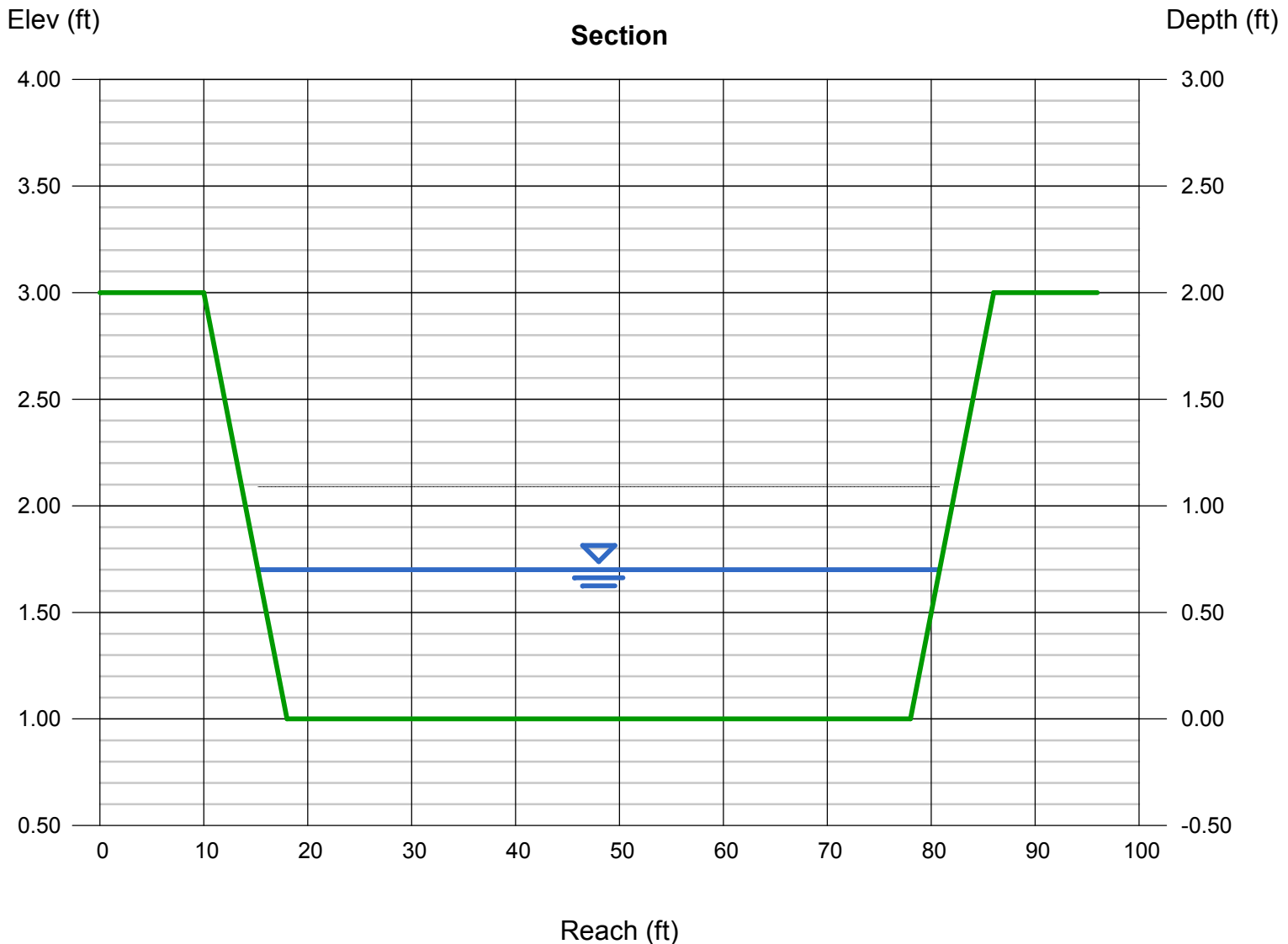
Bottom Width (ft) = 60.00  
Side Slopes (z:1) = 4.00, 4.00  
Total Depth (ft) = 2.00  
Invert Elev (ft) = 1.00  
Slope (%) = 2.00  
N-Value = 0.032

### Highlighted

Depth (ft) = 0.70  
Q (cfs) = 220.00  
Area (sqft) = 43.96  
Velocity (ft/s) = 5.00  
Wetted Perim (ft) = 65.77  
Crit Depth, Yc (ft) = 0.74  
Top Width (ft) = 65.60  
EGL (ft) = 1.09

### Calculations

Compute by: Known Q  
Known Q (cfs) = 220.00



# Channel Report

## Gieck Ranch Tributary 2 Reach 2 - Proposed Channel Section Capacity Check

Main Stem

### Trapezoidal

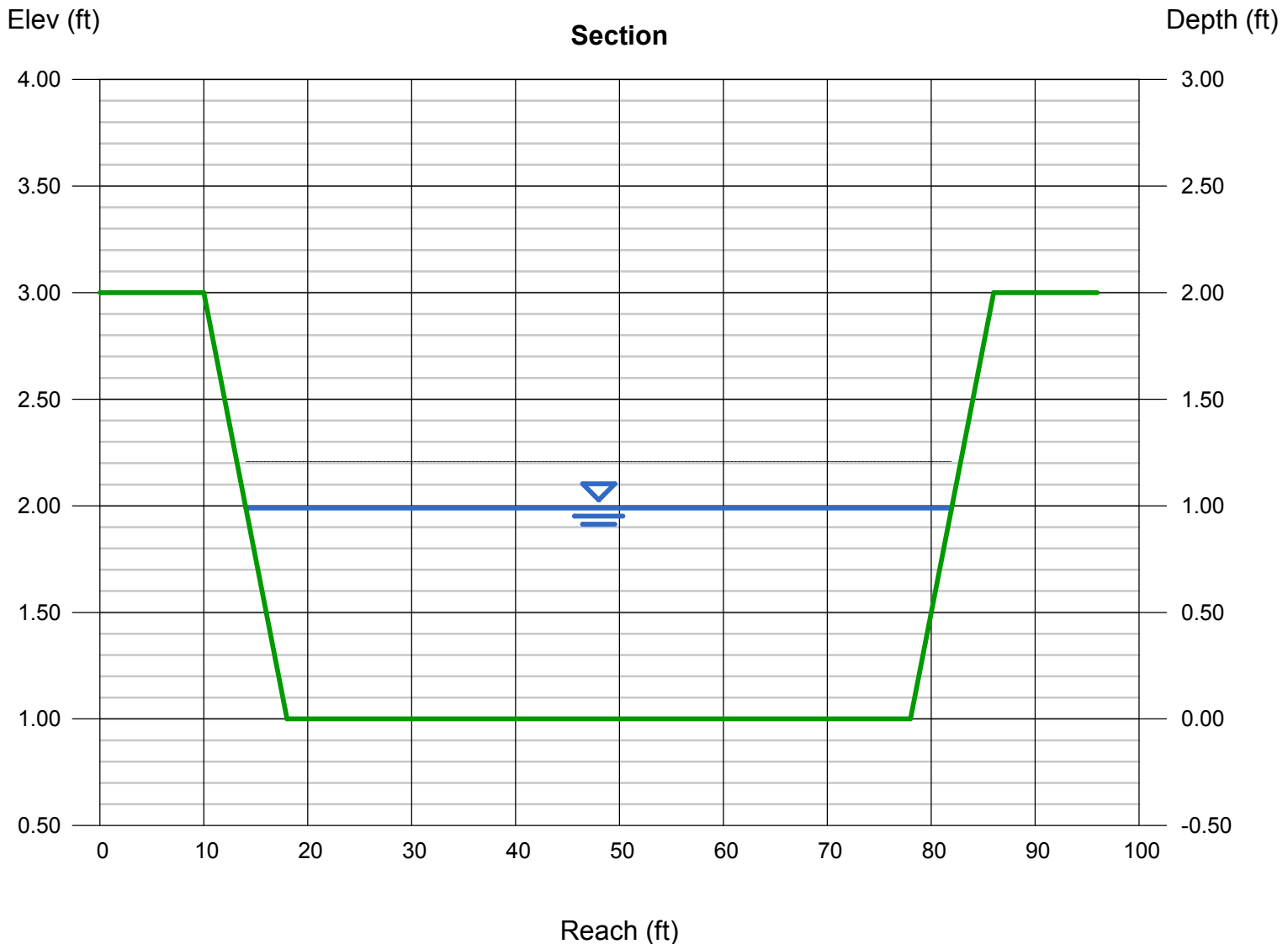
Bottom Width (ft) = 60.00  
Side Slopes (z:1) = 4.00, 4.00  
Total Depth (ft) = 2.00  
Invert Elev (ft) = 1.00  
Slope (%) = 1.80  
N-Value = 0.050

### Highlighted

Depth (ft) = 0.99  
Q (cfs) = 237.00  
Area (sqft) = 63.32  
Velocity (ft/s) = 3.74  
Wetted Perim (ft) = 68.16  
Crit Depth, Yc (ft) = 0.78  
Top Width (ft) = 67.92  
EGL (ft) = 1.21

### Calculations

Compute by: Known Q  
Known Q (cfs) = 237.00



# Channel Report

## Gieck Ranch Tributary 2\_Reach 2 - Proposed Channel Section Velocity Check

### Trapezoidal

Main Stem

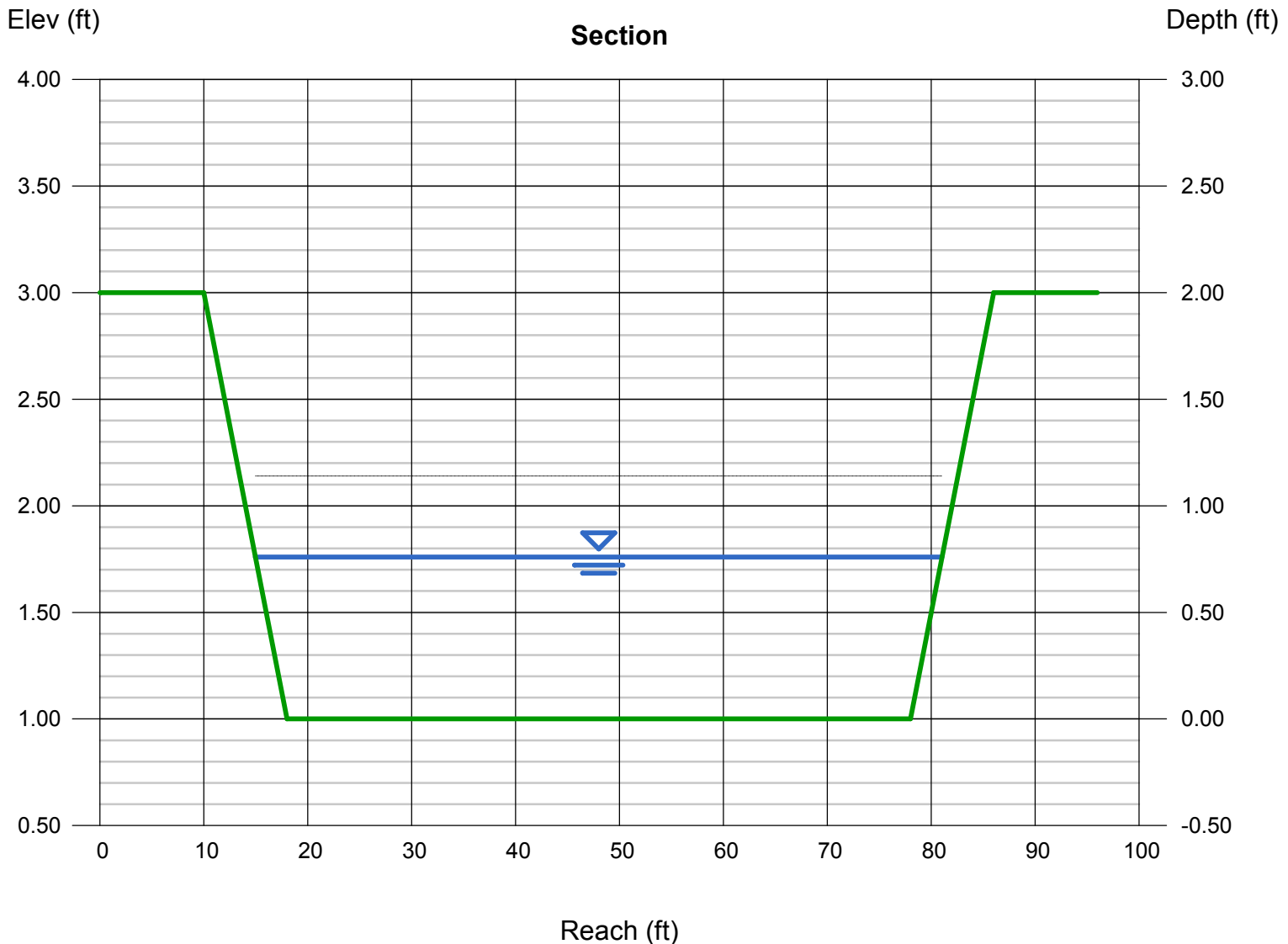
Bottom Width (ft) = 60.00  
Side Slopes (z:1) = 4.00, 4.00  
Total Depth (ft) = 2.00  
Invert Elev (ft) = 1.00  
Slope (%) = 1.80  
N-Value = 0.032

### Highlighted

Depth (ft) = 0.76  
Q (cfs) = 237.00  
Area (sqft) = 47.91  
Velocity (ft/s) = 4.95  
Wetted Perim (ft) = 66.27  
Crit Depth, Yc (ft) = 0.78  
Top Width (ft) = 66.08  
EGL (ft) = 1.14

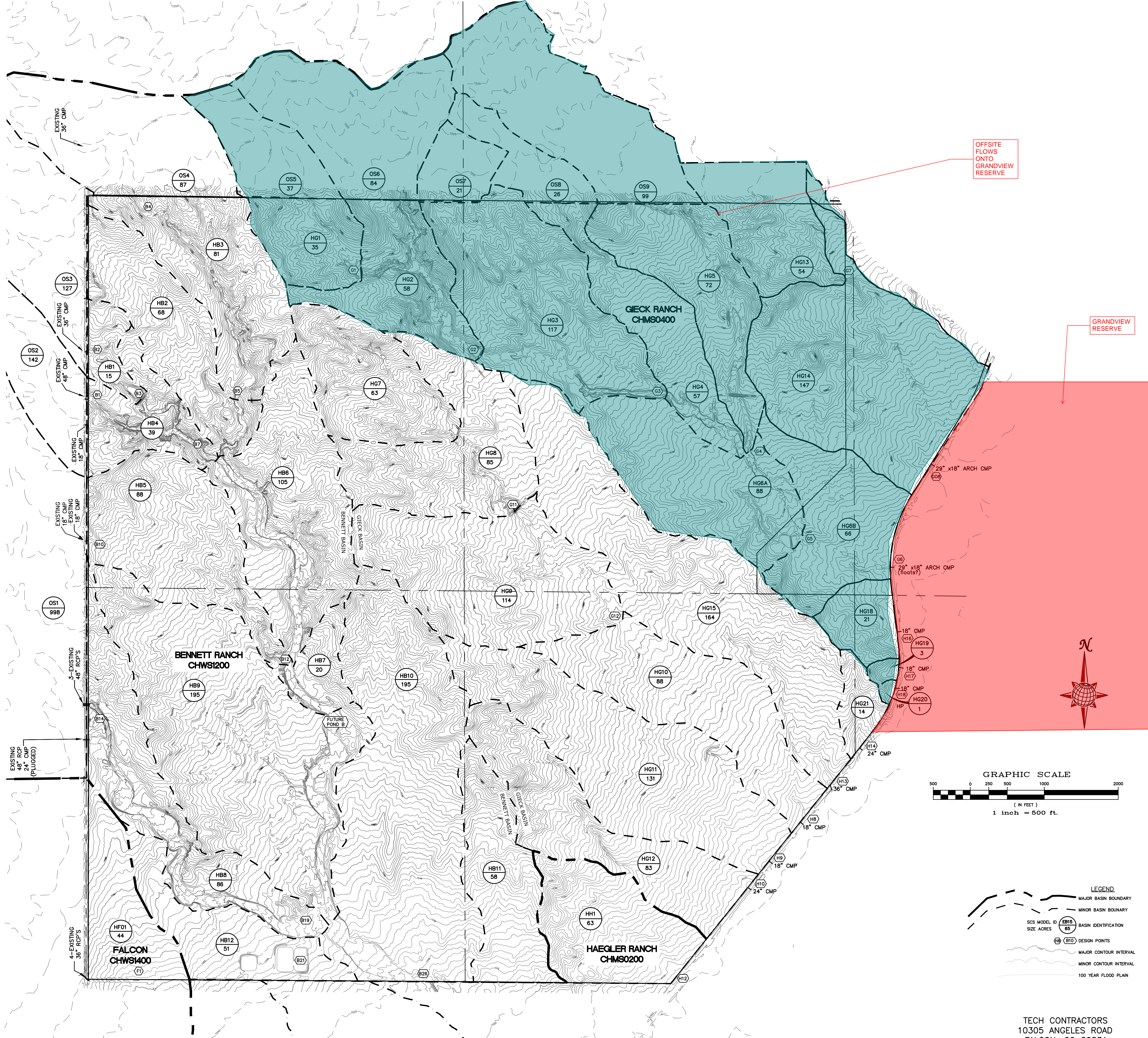
### Calculations

Compute by: Known Q  
Known Q (cfs) = 237.00



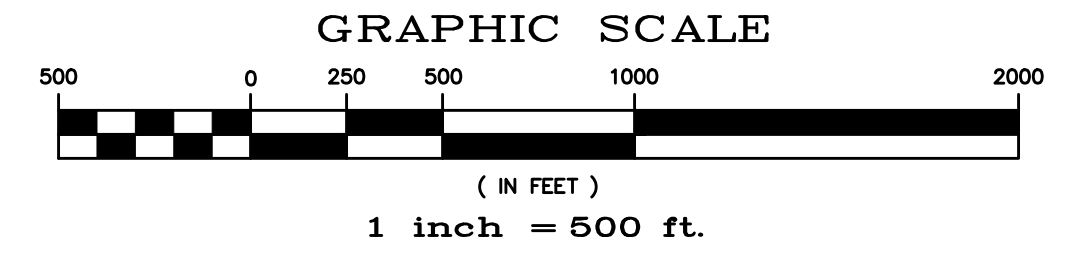


# MASTER DEVELOPMENT DRAINAGE PLAN MERIDIAN RANCH



OFFSITE FLOWS ONTO GRANDVIEW RESERVE

GRANDVIEW RESERVE



- LEGEND**
- MAJOR BASIN BOUNDARY
  - MINOR BASIN BOUNDARY
  - SCS MODEL ID **EB15** BASIN IDENTIFICATION
  - SIZE ACRES **65**
  - HB** **B10** DESIGN POINTS
  - MAJOR CONTOUR INTERVAL
  - MINOR CONTOUR INTERVAL
  - 100 YEAR FLOOD PLAIN

**HISTORIC CONDITIONS - SCS MAP**

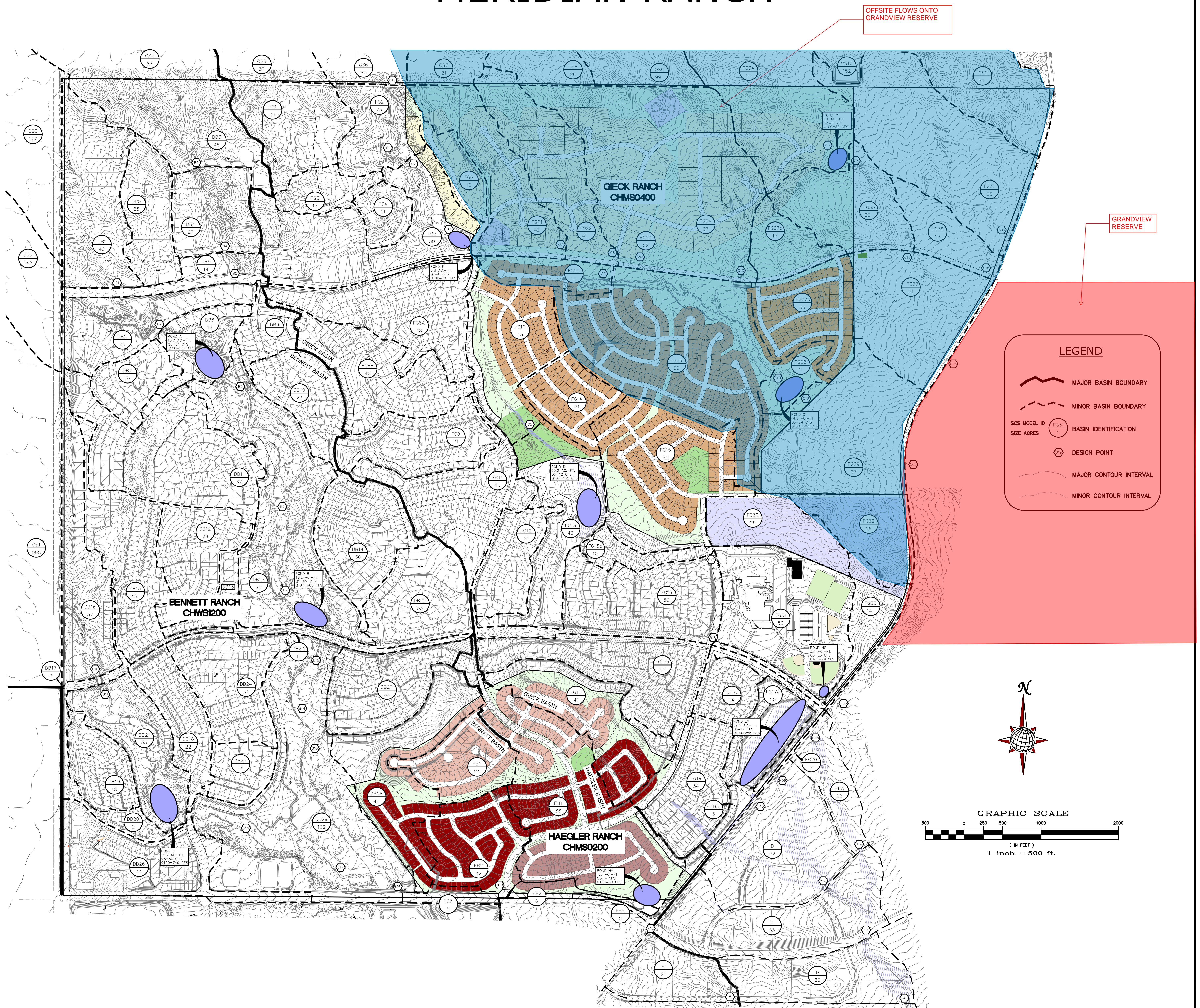
AUG 2017

TECH CONTRACTORS  
10305 ANGELES ROAD  
FALCON, CO 80831  
TELEPHONE: 719.495.7444  
FAX: 719.495.7608

**FIGURE 4**

S:\C:\p\p\Meridian Ranch\_MDDP\p\p\Plan\_Sheets\2017\_Basin Maps\2017\_MDDP-HIST.dwg - HS - SCS MAP - 8/17/2017 10:59:19 AM

# MASTER DEVELOPMENT DRAINAGE PLAN MERIDIAN RANCH



\*NOTE: PRELIMINARY STORAGE VOLUMES AND OUTFLOW QUANTITIES HAVE BEEN PROVIDED FOR EACH OF THE FUTURE DETENTION FACILITIES LOCATED WITHIN THE DEVELOPMENT. THE ACTUAL STORAGE VOLUMES AND DISCHARGE RATES WILL BE DETERMINED UPON A COMPLETE ANALYSIS FOR EACH DETENTION FACILITY PRIOR TO CONSTRUCTION. THE VALUES GIVEN FOR DISCHARGE AND VOLUME ARE ESTIMATES FOR PLANNING PURPOSES ONLY.

## DEVELOPED CONDITIONS - SCS MAP

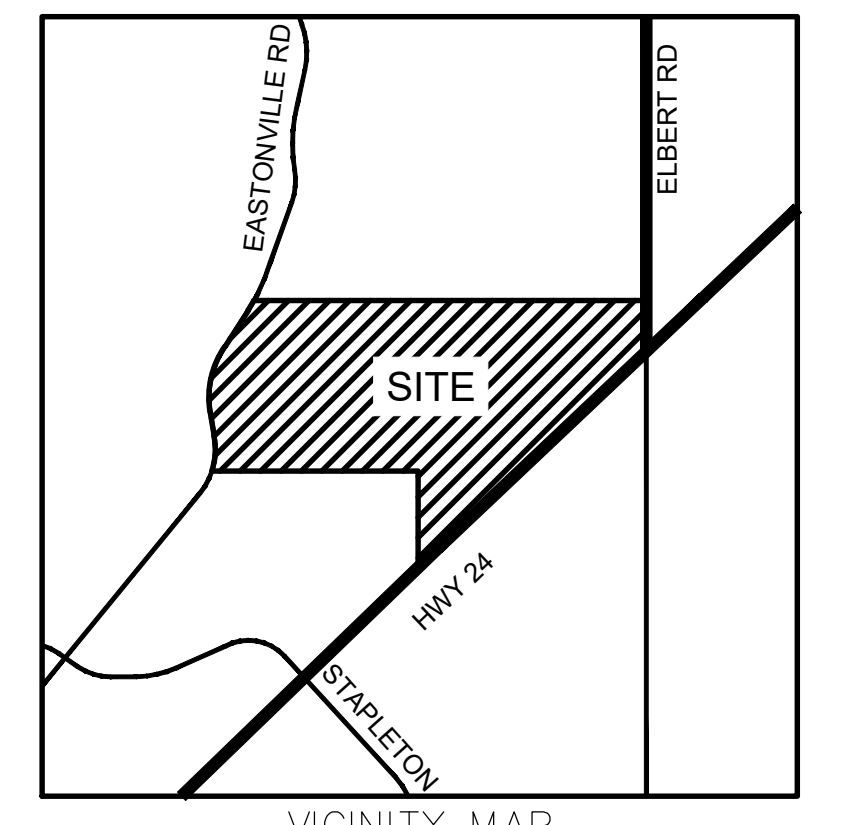
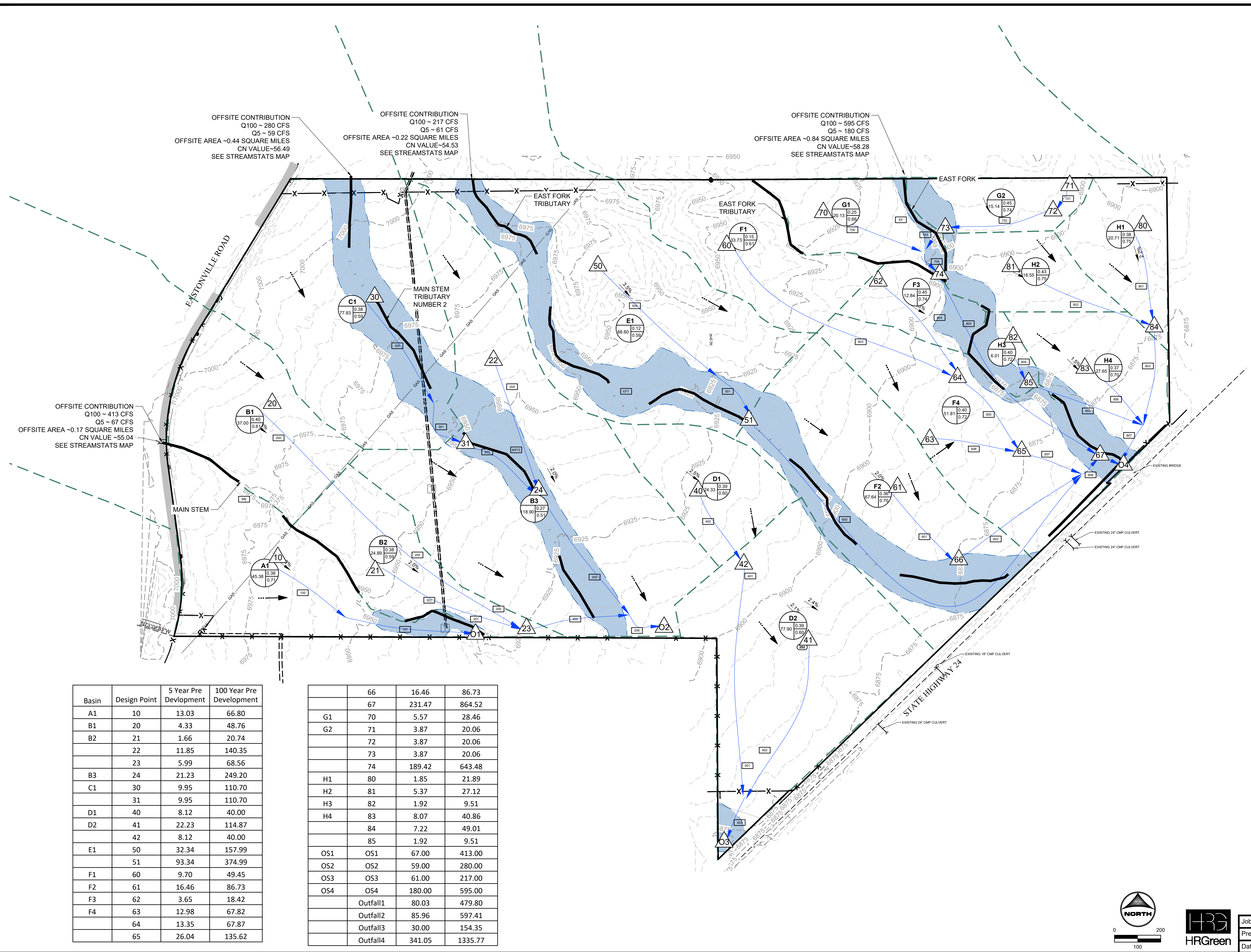
TECH CONTRACTORS  
10305 ANGELES ROAD  
FALCON, CO 80831  
TELEPHONE: 719.495.7444  
FAX: 719.495.7608

NOV 2017

FIGURE 5



## Appendix F



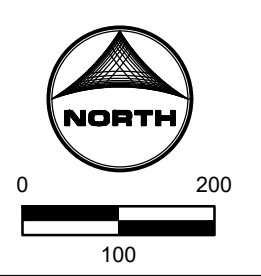
**LEGEND:**

- PROPOSED MAJOR CONTOUR: 5250
- PROPOSED MINOR CONTOUR
- EXISTING MAJOR CONTOUR: 5250
- EXISTING MINOR CONTOUR
- PROPOSED STORM DRAIN PIPE
- EXISTING STORM DRAIN PIPE
- PROPOSED DRAINAGE CHANNEL
- PROPOSED ROAD
- PROPERTY LINE
- DIRECTIONAL FLOW ARROW
- EMERGENCY OVERFLOW ARROW
- EXISTING 100-YR FLOODWAY
- EXISTING 100-YR FLOODPLAIN
- PROPOSED 100-YR FLOODPLAIN
- WATERSHED BOUNDARY
- MAJOR BASIN LINE
- 100YR ZONE A FLOODPLAIN
- PROPOSED DETENTION LOCATION
- POTENTIAL WATER QUALITY LOCATION (WQ)
- SWMM CONVEYANCE ELEMENT (SWMM)
- PROPOSED PEAK FLOW RATE (CFS) 850
- DESIGN POINT
- PROPOSED BASIN LABEL: XX BASIN DESIGNATION, XX C5, XX C100
- LAND USE: LOW DENSITY, MEDIUM DENSITY, HIGH/MED DENSITY, HIGH DENSITY, CHURCH, COMMERCIAL, ELEMENTARY SCHOOL, COMMUNITY PARK

NOTES:

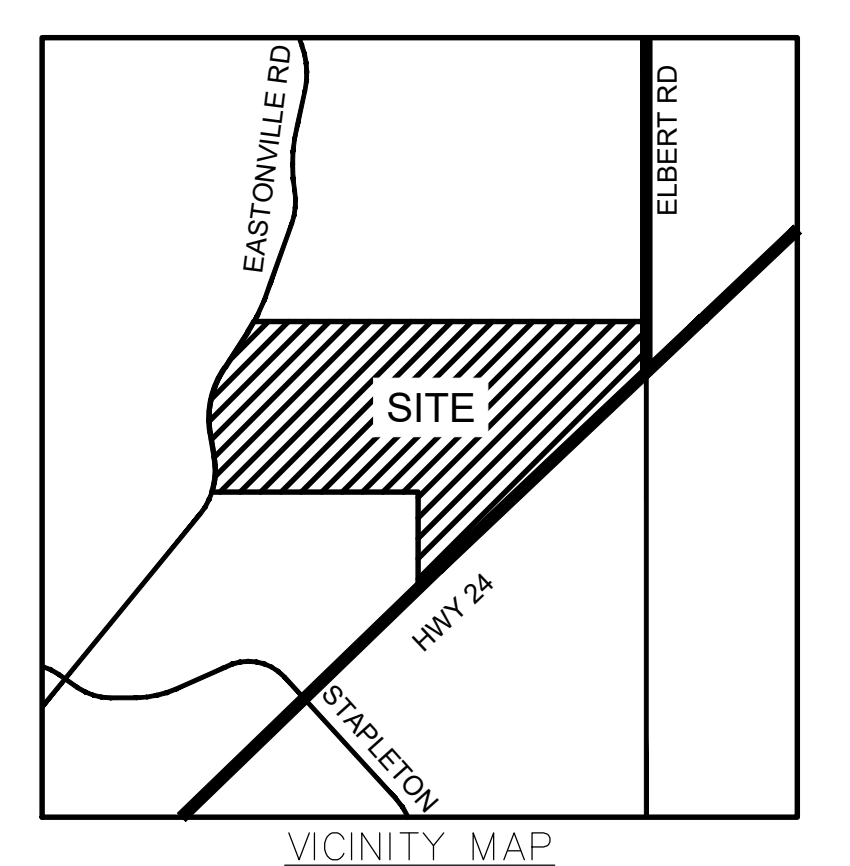
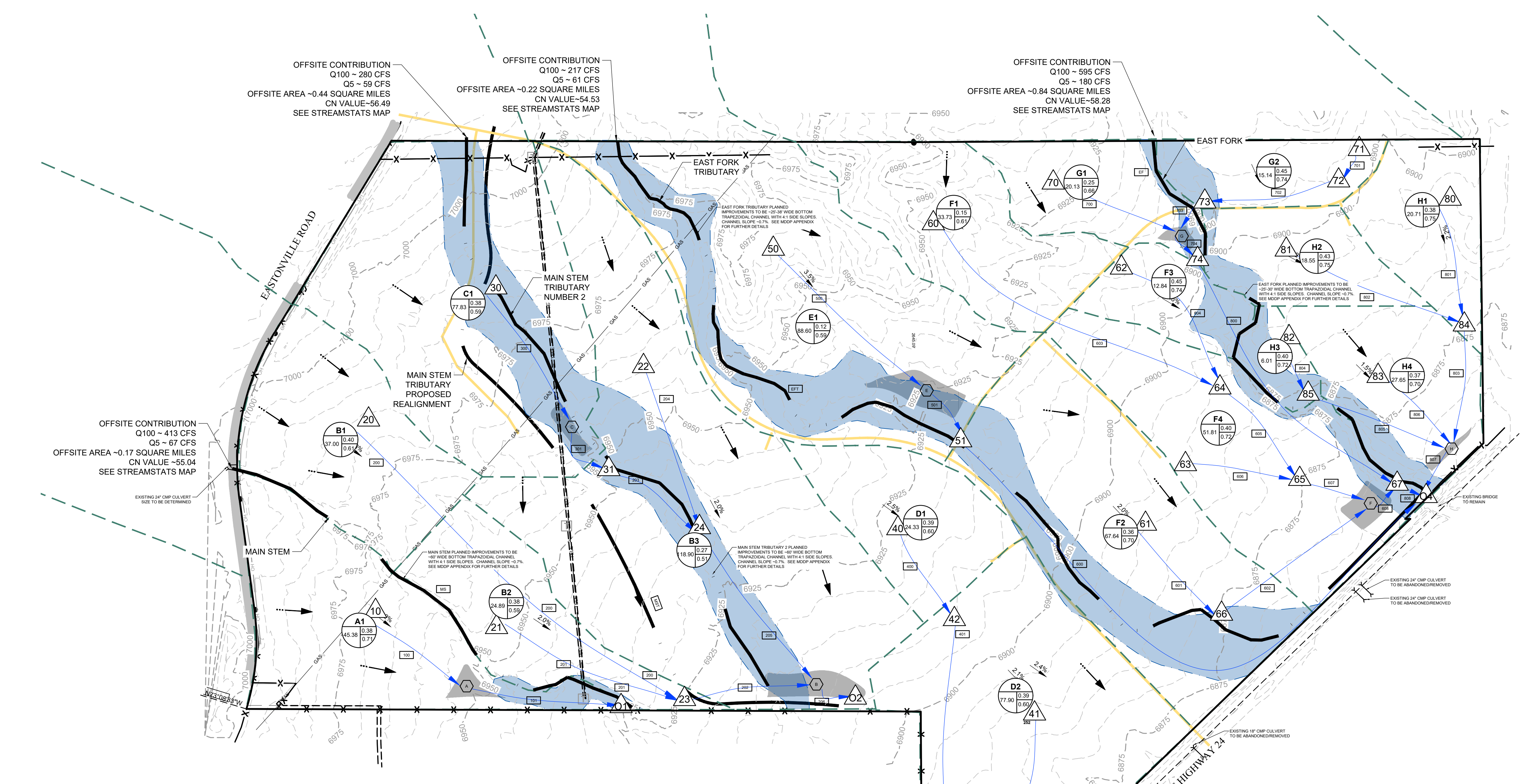
Basin	Design Point	5 Year Pre Development	100 Year Pre Development
A1	10	13.03	66.80
B1	20	4.33	48.76
B2	21	1.66	20.74
	22	11.85	140.35
	23	5.99	68.56
B3	24	21.23	249.20
C1	30	9.95	110.70
	31	9.95	110.70
D1	40	8.12	40.00
D2	41	22.23	114.87
	42	8.12	40.00
E1	50	32.34	157.99
	51	93.34	374.99
F1	60	9.70	49.45
F2	61	16.46	86.73
F3	62	3.65	18.42
F4	63	12.98	67.82
	64	13.35	67.87
	65	26.04	135.62

	66	16.46	86.73
	67	231.47	864.52
G1	70	5.57	28.46
G2	71	3.87	20.06
	72	3.87	20.06
	73	3.87	20.06
	74	189.42	643.48
H1	80	1.85	21.89
H2	81	5.37	27.12
H3	82	1.92	9.51
H4	83	8.07	40.86
	84	7.22	49.01
	85	1.92	9.51
OS1	OS1	67.00	413.00
OS2	OS2	59.00	280.00
OS3	OS3	61.00	217.00
OS4	OS4	180.00	595.00
	Outfall1	80.03	479.80
	Outfall2	85.96	597.41
	Outfall3	30.00	154.35
	Outfall4	341.05	1335.77



Job No.: 191897.01  
 Prepared By: TBI  
 Date: 04/14/2020

EXISTING EX1



**LEGEND:**

- PROPOSED MAJOR CONTOUR: 5250
- PROPOSED MINOR CONTOUR
- EXISTING MAJOR CONTOUR: 5250
- EXISTING MINOR CONTOUR
- PROPOSED STORM DRAIN PIPE
- EXISTING STORM DRAIN PIPE
- PROPOSED DRAINAGE CHANNEL
- PROPOSED ROAD
- PROPERTY LINE
- DIRECTIONAL FLOW ARROW
- EMERGENCY OVERFLOW ARROW
- EXISTING 100-YR FLOODWAY
- EXISTING 100-YR FLOODPLAIN
- PROPOSED 100-YR FLOODPLAIN
- WATERSHED BOUNDARY
- MAJOR BASIN LINE
- 100YR ZONE A FLOODPLAIN
- PROPOSED DETENTION LOCATION
- POTENTIAL WATER QUALITY LOCATION
- SWMM CONVEYANCE ELEMENT
- PROPOSED PEAK FLOW RATE (CFS) 850
- DESIGN POINT
- PROPOSED BASIN LABEL: XX BASIN DESIGNATION, XX C5, XX C100
- LAND USE: LOW DENSITY, MEDIUM DENSITY, HIGH/MED DENSITY, HIGH DENSITY, CHURCH, COMMERCIAL, ELEMENTARY SCHOOL, COMMUNITY PARK

Basin	Design Point	5 Year Pre Development	5 Year Post Development	100 Year Pre Development	100 Year Post Development
A1	10	13.03	30.72	66.80	100.64
B1	20	4.33	29.46	48.76	97.08
B2	21	1.66	12.02	20.74	42.26
B2	22	11.85	92.76	140.35	295.27
B2	23	5.99	40.92	68.56	136.17
B3	24	21.23	93.26	249.20	334.84
C1	30	9.95	77.99	110.70	238.03
C1	31	9.95	1.52	110.70	115.75
D1	40	8.12	24.15	40.00	70.07
D2	41	22.23	98.47	114.87	252.18
D2	42	8.12	24.15	40.00	70.07
E1	50	32.34	46.88	157.99	178.04
E1	51	93.34	85.04	374.99	381.75
F1	60	9.70	16.28	49.45	58.95
F2	61	16.46	60.11	86.73	170.90
F3	62	3.65	11.36	18.42	32.93
F4	63	12.98	42.32	67.82	124.89
F4	64	13.35	26.88	67.87	90.88
F4	65	26.04	69.12	135.62	215.63
F4	66	16.46	60.11	86.73	170.90

G1	67	231.47	201.42	864.52	865.98
G2	70	5.57	13.78	28.46	43.95
G2	71	3.87	6.55	20.06	23.95
G2	72	3.87	6.55	20.06	23.95
G2	73	3.87	6.55	20.06	23.95
G2	74	189.42	189.05	643.48	637.13
H1	80	1.85	5.68	21.89	27.62
H2	81	5.37	16.24	27.12	47.62
H3	82	1.92	5.21	9.51	15.60
H4	83	8.07	20.93	40.86	64.71
H4	84	7.22	21.67	49.01	73.73
H4	85	1.92	5.21	9.51	15.60
OS1	OS1	67.00	67.00	413.00	413.00
OS2	OS2	59.00	59.00	280.00	280.00
OS3	OS3	61.00	61.00	217.00	217.00
OS4	OS4	180.00	180.00	595.00	595.00
Outfall1	Outfall1	80.03	67.69	479.80	466.95
Outfall2	Outfall2	85.96	61.68	597.41	536.11
Outfall3	Outfall3	30.00	8.58	154.35	160.70*
Outfall4	Outfall4	341.05	276.10	1335.77	1291.25

\*THIS VALUE IS HIGHER THAN PRE-EXISTING AND WILL BE ADJUSTED TO MEET CRITERIA WITH THE PRELIMINARY DRAINAGE REPORT

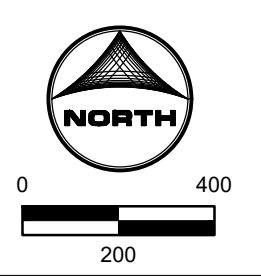
**NOTES:**

PRELIMINARY CHANNEL GEOMETRY (BY OTHERS):  
 MAIN STEM  
 BOTTOM WIDTH: 60'  
 SIDE SLOPES: 4:1

MAIN STEM TRIBUTARY 2  
 BOTTOM WIDTH: 60'  
 SIDE SLOPES: 4:1

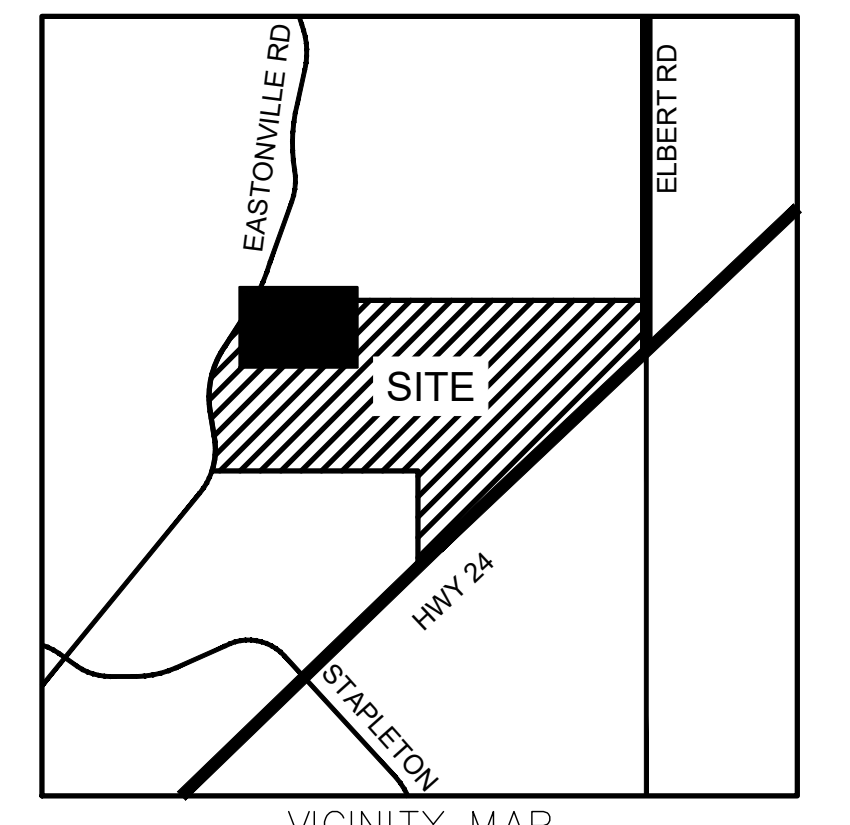
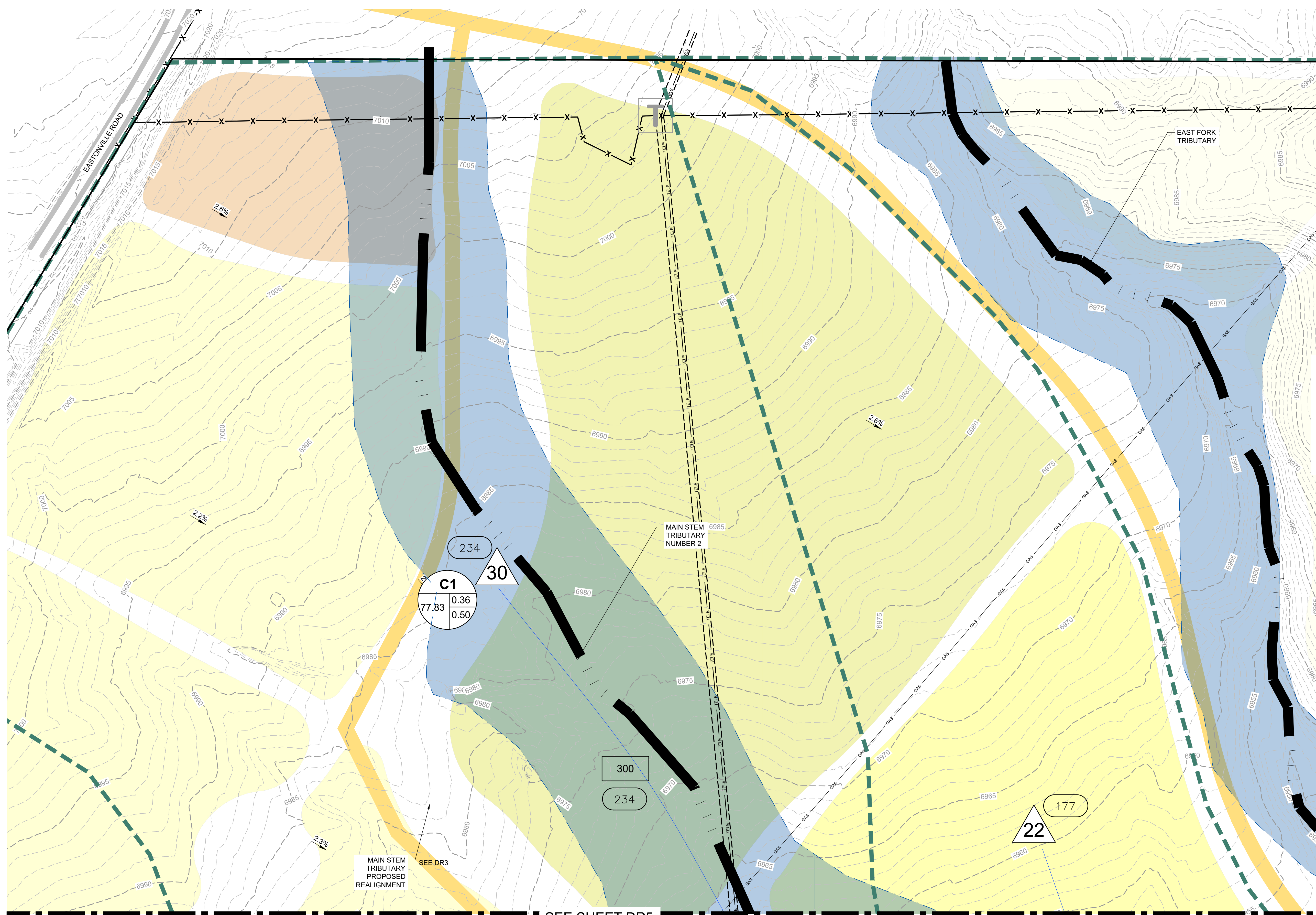
EAST FORK TRIBUTARY 1 REACH 2  
 BOTTOM WIDTH: 38'  
 SIDE SLOPES: 4:1

EAST FORK TRIBUTARY 1 REACH 1  
 BOTTOM WIDTH: 25'  
 SIDE SLOPES: 4:1



Job No.: 191897.01  
 Prepared By: TBI  
 Date: 04/14/2020

PROPOSED DR1

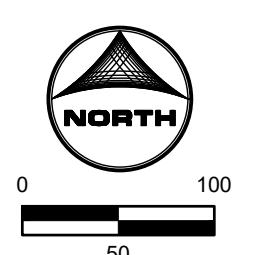


- LEGEND:**
- PROPOSED MAJOR CONTOUR — 5250 —
  - PROPOSED MINOR CONTOUR —
  - EXISTING MAJOR CONTOUR - - - 5250 - - -
  - EXISTING MINOR CONTOUR - - -
  - PROPOSED STORM DRAIN PIPE —
  - EXISTING STORM DRAIN PIPE —
  - PROPOSED DRAINAGE CHANNEL —
  - PROPOSED ROAD —
  - PROPERTY LINE —
  - DIRECTIONAL FLOW ARROW —
  - EMERGENCY OVERFLOW ARROW —
  - EXISTING 100-YR FLOODWAY —
  - EXISTING 100-YR FLOODPLAIN —
  - PROPOSED 100-YR FLOODPLAIN —
  - WATERSHED BOUNDARY —
  - MAJOR BASIN LINE —
  - 100YR ZONE A FLOODPLAIN —
  - PROPOSED DETENTION LOCATION — A
  - POTENTIAL WATER QUALITY LOCATION — WQ
  - SWMM CONVEYANCE ELEMENT — SWMM
  - PROPOSED PEAK FLOW RATE (CFS) — 850
  - DESIGN POINT —
  - PROPOSED BASIN LABEL — XX BASIN DESIGNATION
  - AREA (AC.) — XX XX % IMPERVIOUSNESS
- LAND USE**
- LOW DENSITY
  - MEDIUM DENSITY
  - HIGH/MED DENSITY
  - HIGH DENSITY
  - CHURCH
  - COMMERCIAL
  - ELEMENTARY SCHOOL
  - COMMUNITY PARK

NOTES:

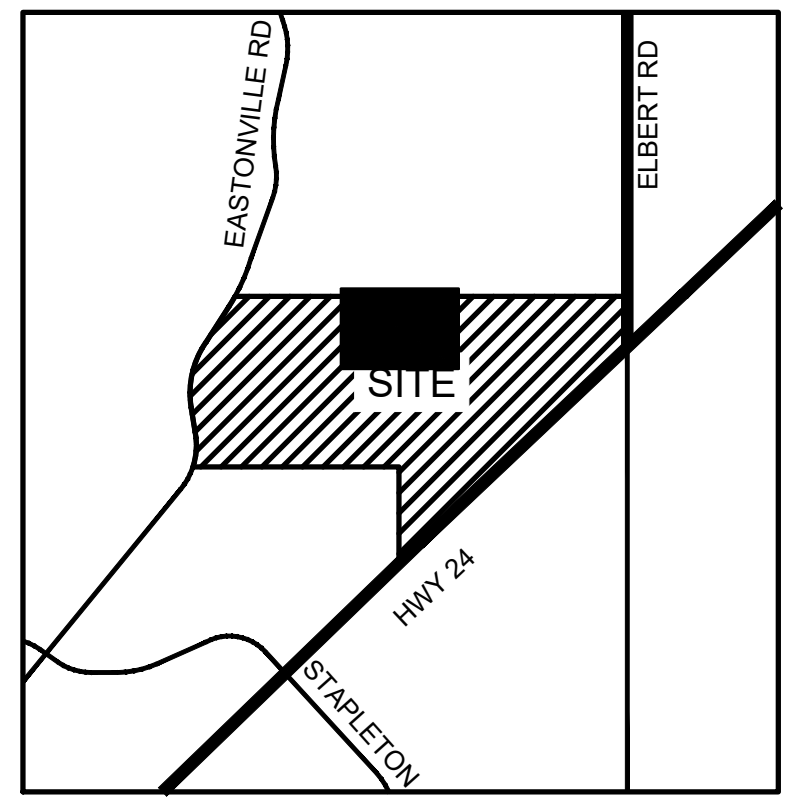
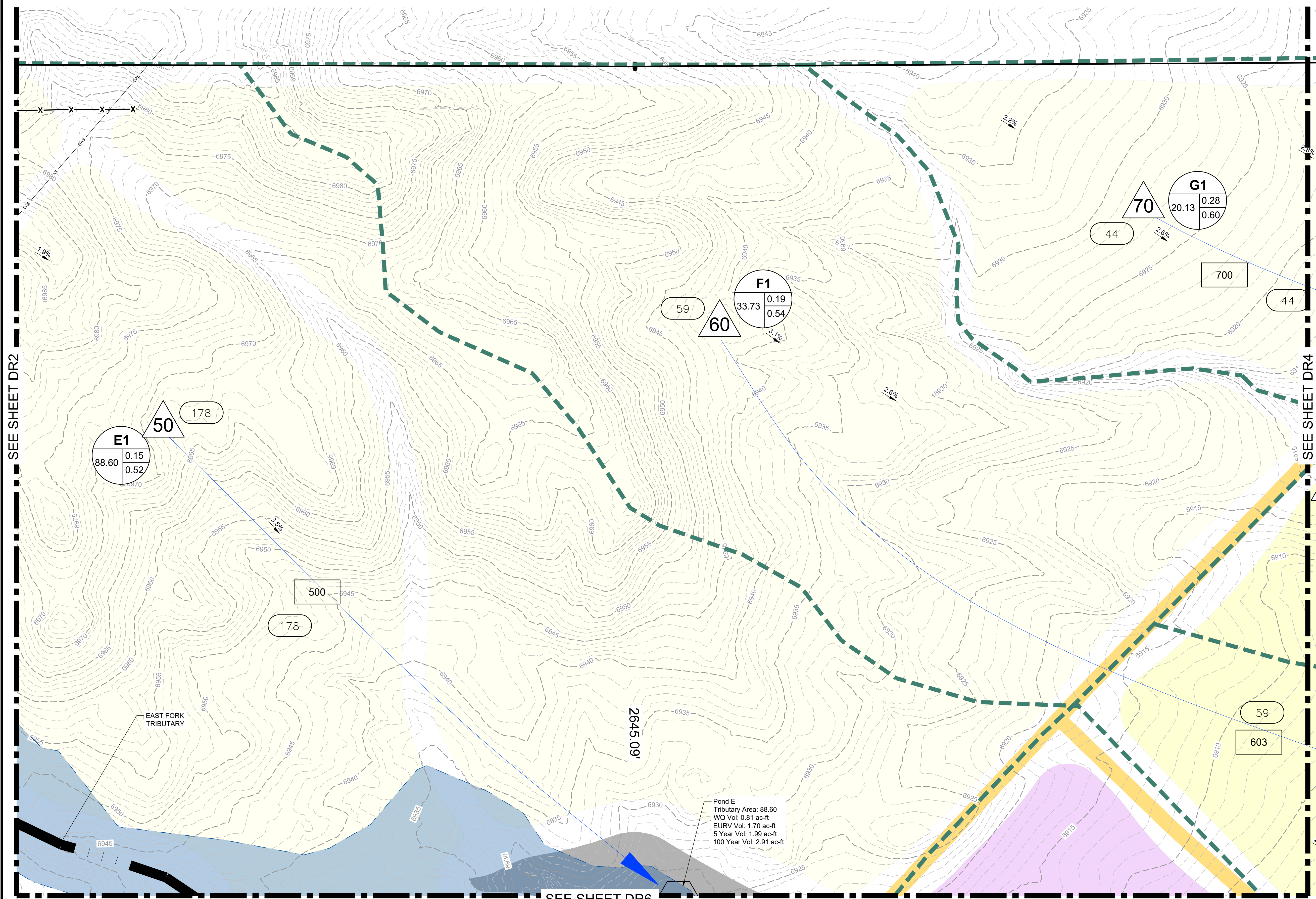
SEE SHEET DR5

SEE SHEET DR3



Job No.: 191897.01  
 Prepared By: CMM  
 Date: 4/9/2020

PROPOSED DR2

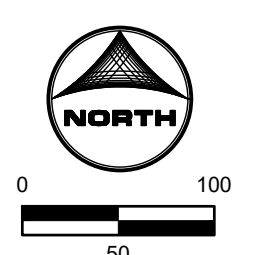


- LEGEND:**
- PROPOSED MAJOR CONTOUR: 5250
  - PROPOSED MINOR CONTOUR:
  - EXISTING MAJOR CONTOUR: 5250
  - EXISTING MINOR CONTOUR:
  - PROPOSED STORM DRAIN PIPE:
  - EXISTING STORM DRAIN PIPE:
  - PROPOSED DRAINAGE CHANNEL:
  - PROPOSED ROAD:
  - PROPERTY LINE:
  - DIRECTIONAL FLOW ARROW:
  - EMERGENCY OVERFLOW ARROW:
  - EXISTING 100-YR FLOODWAY:
  - EXISTING 100-YR FLOODPLAIN:
  - PROPOSED 100-YR FLOODPLAIN:
  - WATERSHED BOUNDARY:
  - MAJOR BASIN LINE:
  - 100YR ZONE A FLOODPLAIN:
  - PROPOSED DETENTION LOCATION:
  - POTENTIAL WATER QUALITY LOCATION:
  - SWMM CONVEYANCE ELEMENT:
  - PROPOSED PEAK FLOW RATE (CFS):
  - DESIGN POINT:
  - PROPOSED BASIN LABEL: BASIN DESIGNATION
  - AREA (AC.): % IMPERVIOUSNESS

- LAND USE**
- LOW DENSITY:
  - MEDIUM DENSITY:
  - HIGH/MED DENSITY:
  - HIGH DENSITY:
  - CHURCH:
  - COMMERCIAL:
  - ELEMENTARY SCHOOL:
  - COMMUNITY PARK:

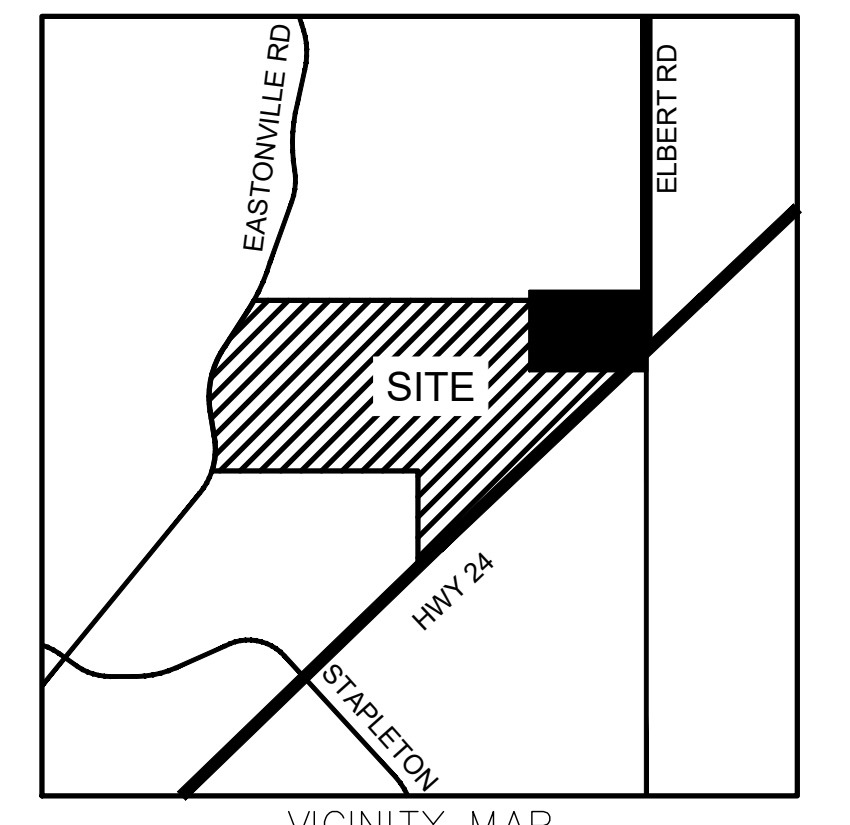
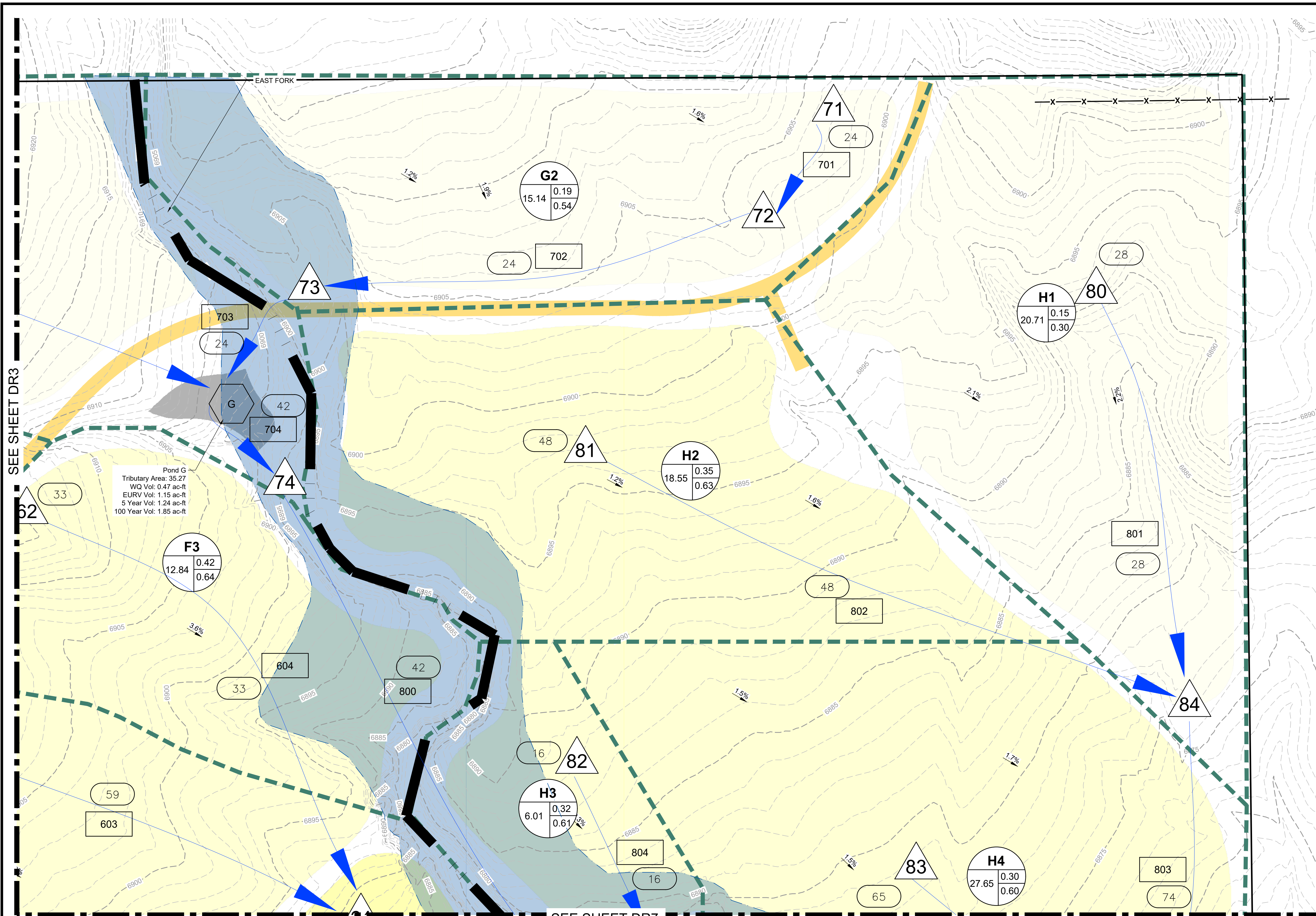
NOTES:

Pond E  
 Tributary Area: 88.60  
 WQ Vol: 0.81 ac-ft  
 EURV Vol: 1.70 ac-ft  
 5 Year Vol: 1.99 ac-ft  
 100 Year Vol: 2.91 ac-ft



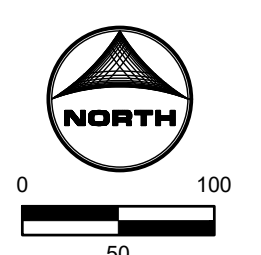
Job No.: 191897.01  
 Prepared By: TBI  
 Date: 04/14/2020

PROPOSED DR3



- LEGEND:**
- PROPOSED MAJOR CONTOUR: Solid pink line (5250)
  - PROPOSED MINOR CONTOUR: Dashed pink line
  - EXISTING MAJOR CONTOUR: Solid black line (5250)
  - EXISTING MINOR CONTOUR: Dashed black line
  - PROPOSED STORM DRAIN PIPE: Solid black line with arrow
  - EXISTING STORM DRAIN PIPE: Dashed black line with arrow
  - PROPOSED DRAINAGE CHANNEL: Solid blue line
  - PROPOSED ROAD: Solid yellow line
  - PROPERTY LINE: Dashed black line
  - DIRECTIONAL FLOW ARROW: Solid black arrow
  - EMERGENCY OVERFLOW ARROW: Solid black arrow with 'X' inside
  - EXISTING 100-YR FLOODWAY: Solid blue line
  - EXISTING 100-YR FLOODPLAIN: Dashed blue line
  - PROPOSED 100-YR FLOODPLAIN: Solid blue line
  - WATERSHED BOUNDARY: Dashed purple line
  - MAJOR BASIN LINE: Dashed green line
  - 100YR ZONE A FLOODPLAIN: Solid blue line
  - PROPOSED DETENTION LOCATION: Hexagon with 'A'
  - POTENTIAL WATER QUALITY LOCATION: Hexagon with 'WQ'
  - SWMM CONVEYANCE ELEMENT: Square with 'SWMM'
  - PROPOSED PEAK FLOW RATE (CFS): Circle with '850'
  - DESIGN POINT: Triangle with 'A'
  - PROPOSED BASIN LABEL: Circle with 'XX'
  - BASIN DESIGNATION: Circle with 'A'
  - AREA (AC.): Circle with 'XX XX'
  - % IMPERVIOUSNESS: Circle with 'XX XX'
- LAND USE**
- LOW DENSITY: Light yellow
  - MEDIUM DENSITY: Yellow
  - HIGH/MED DENSITY: Orange
  - HIGH DENSITY: Red
  - CHURCH: Pink
  - COMMERCIAL: Purple
  - ELEMENTARY SCHOOL: Green
  - COMMUNITY PARK: Dark green

NOTES:



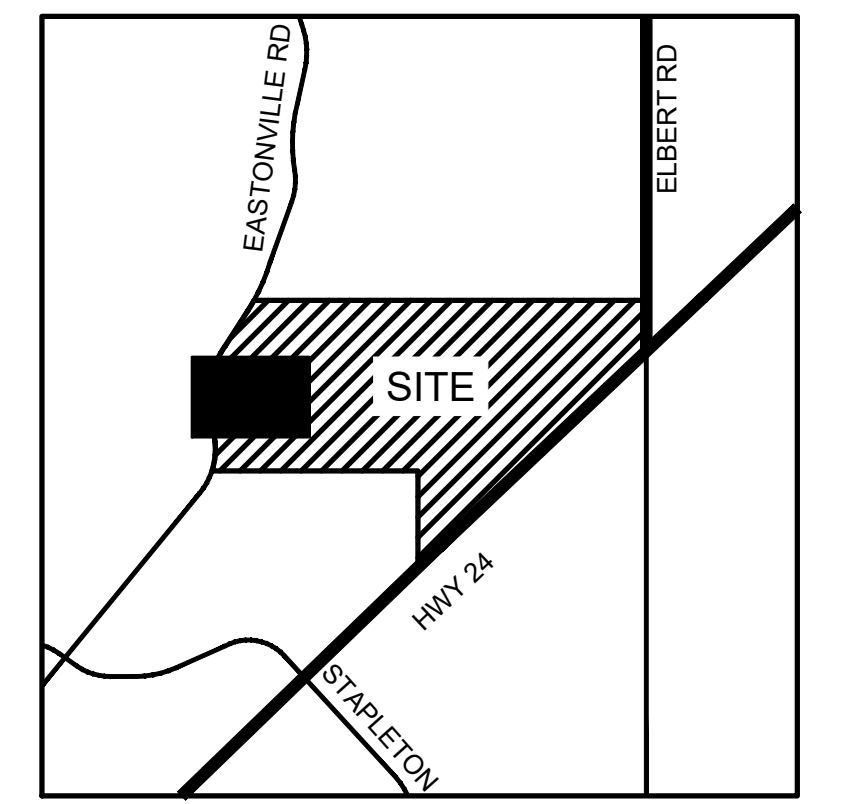
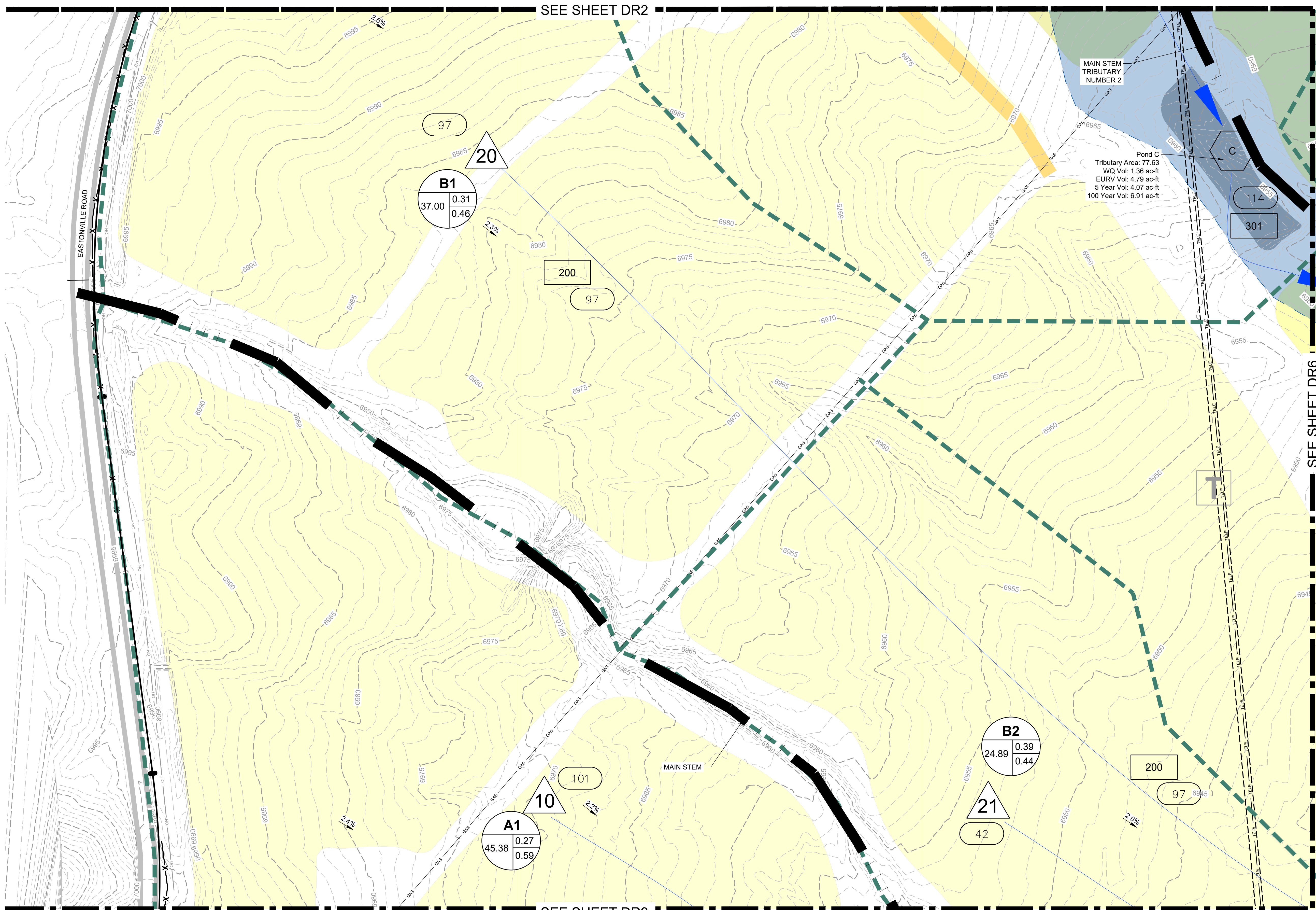
Job No.: 191897.01  
 Prepared By: TBI  
 Date: 04/14/2020

PROPOSED DR4



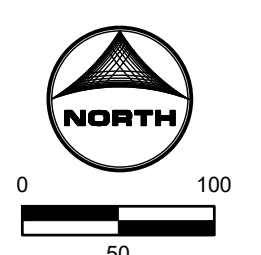
SEE SHEET DR2

SEE SHEET DR9



- LEGEND:**
- PROPOSED MAJOR CONTOUR: Solid pink line (5250)
  - PROPOSED MINOR CONTOUR: Dashed pink line
  - EXISTING MAJOR CONTOUR: Solid black line (5250)
  - EXISTING MINOR CONTOUR: Dashed black line
  - PROPOSED STORM DRAIN PIPE: Solid black line with cross-ticks
  - EXISTING STORM DRAIN PIPE: Dashed black line with cross-ticks
  - PROPOSED DRAINAGE CHANNEL: Solid blue line
  - PROPOSED ROAD: Solid yellow line
  - PROPERTY LINE: Dashed grey line
  - DIRECTIONAL FLOW ARROW: Arrow with tail
  - EMERGENCY OVERFLOW ARROW: Arrow with tail and cross-ticks
  - EXISTING 100-YR FLOODWAY: Dashed blue line
  - EXISTING 100-YR FLOODPLAIN: Dotted blue line
  - PROPOSED 100-YR FLOODPLAIN: Dotted blue line
  - WATERSHED BOUNDARY: Dashed purple line
  - MAJOR BASIN LINE: Dashed green line
  - 100YR ZONE A FLOODPLAIN: Solid blue area
  - PROPOSED DETENTION LOCATION: Hexagon with 'A'
  - POTENTIAL WATER QUALITY LOCATION: Hexagon with 'WQ'
  - SWM CONVEYANCE ELEMENT: Square with 'SWM'
  - PROPOSED PEAK FLOW RATE (CFS): Circle with '850'
  - DESIGN POINT: Triangle with 'A'
  - PROPOSED BASIN LABEL: Circle with 'XX' (Basin Designation)
  - AREA (AC.): Circle with 'XX XX' (Area and % Imperviousness)
- LAND USE:**
- LOW DENSITY: Light yellow
  - MEDIUM DENSITY: Yellow
  - HIGH/MED DENSITY: Orange
  - HIGH DENSITY: Red
  - CHURCH: Pink
  - COMMERCIAL: Light blue
  - ELEMENTARY SCHOOL: Green
  - COMMUNITY PARK: Dark green

NOTES:



Job No.: 191897.01  
 Prepared By: TBI  
 Date: 04/14/2020

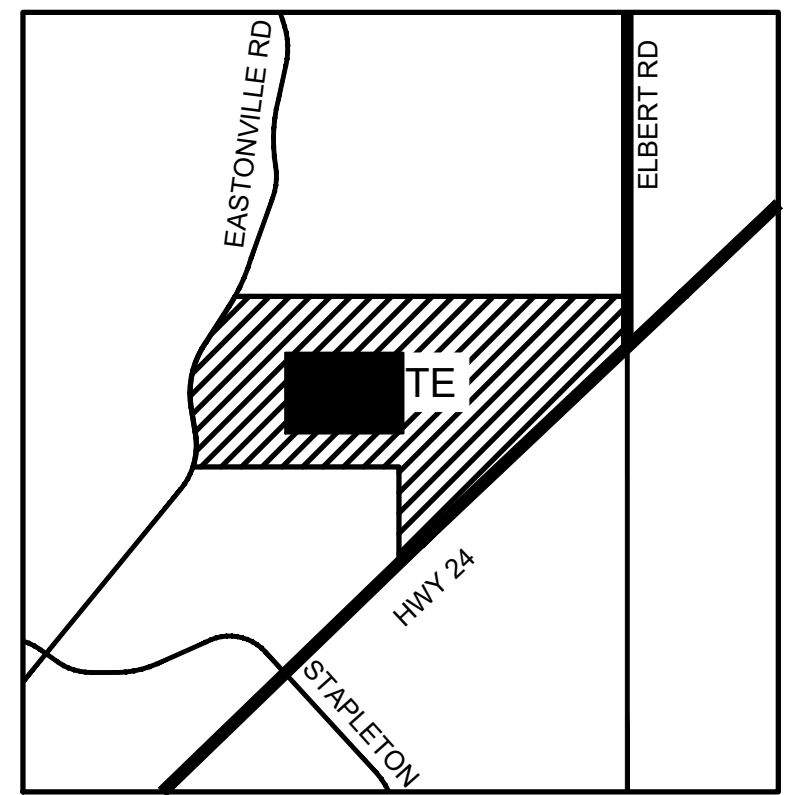
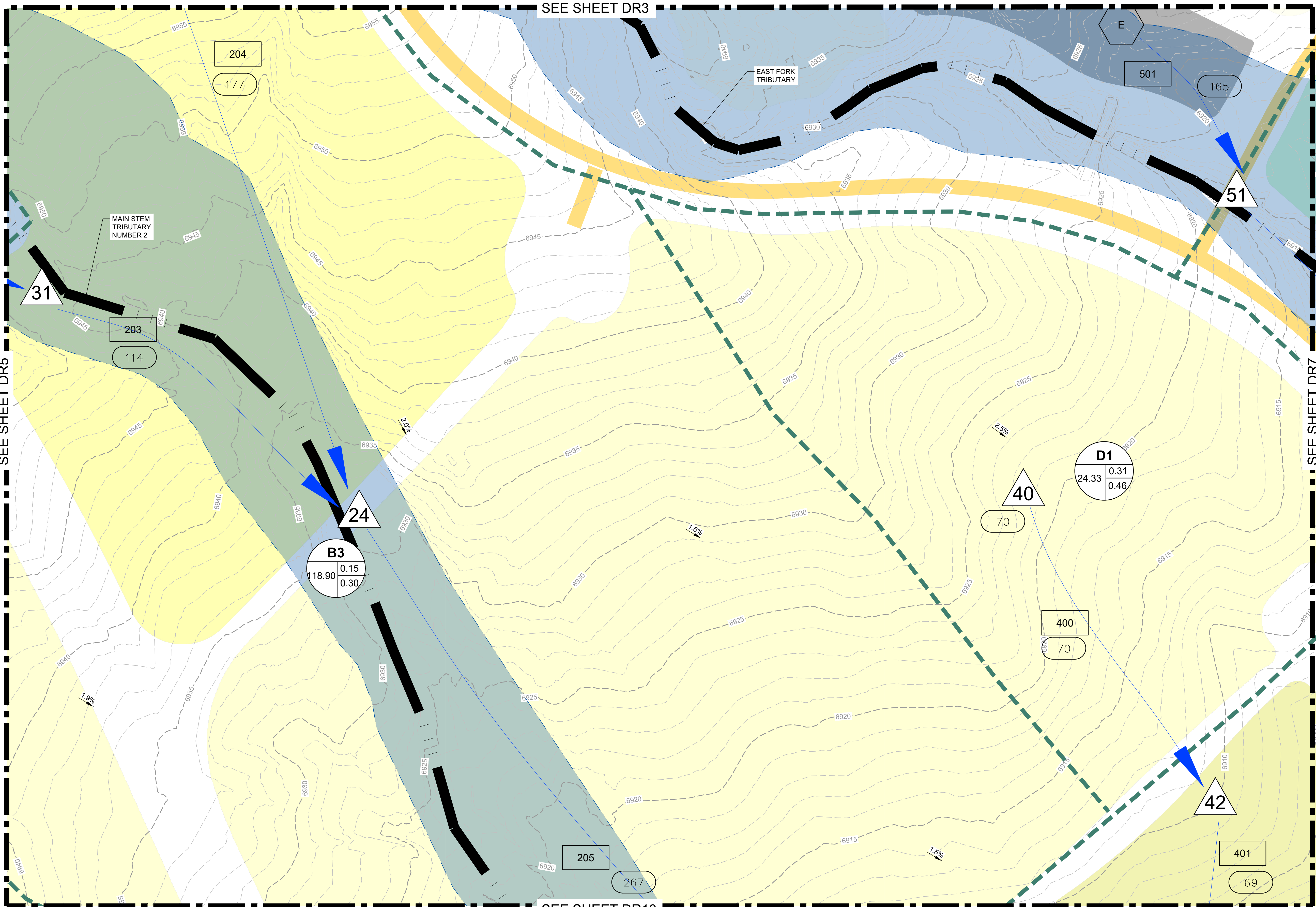
PROPOSED DR5

SEE SHEET DR3

SEE SHEET DR10

SEE SHEET DR5

SEE SHEET DR7

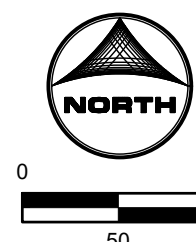


VICINITY MAP

LEGEND:

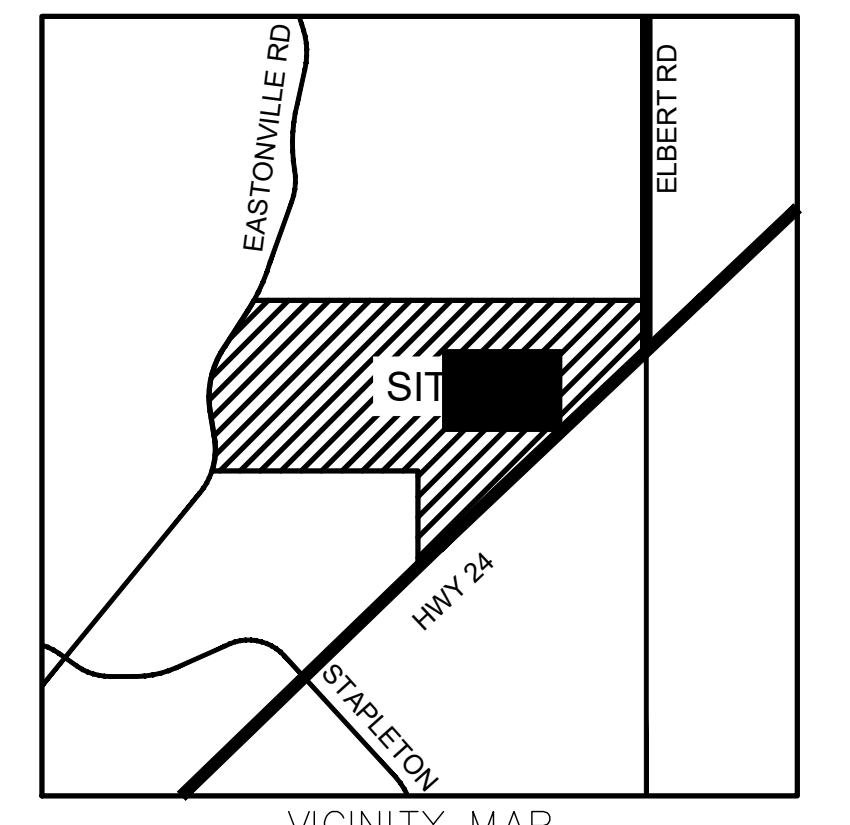
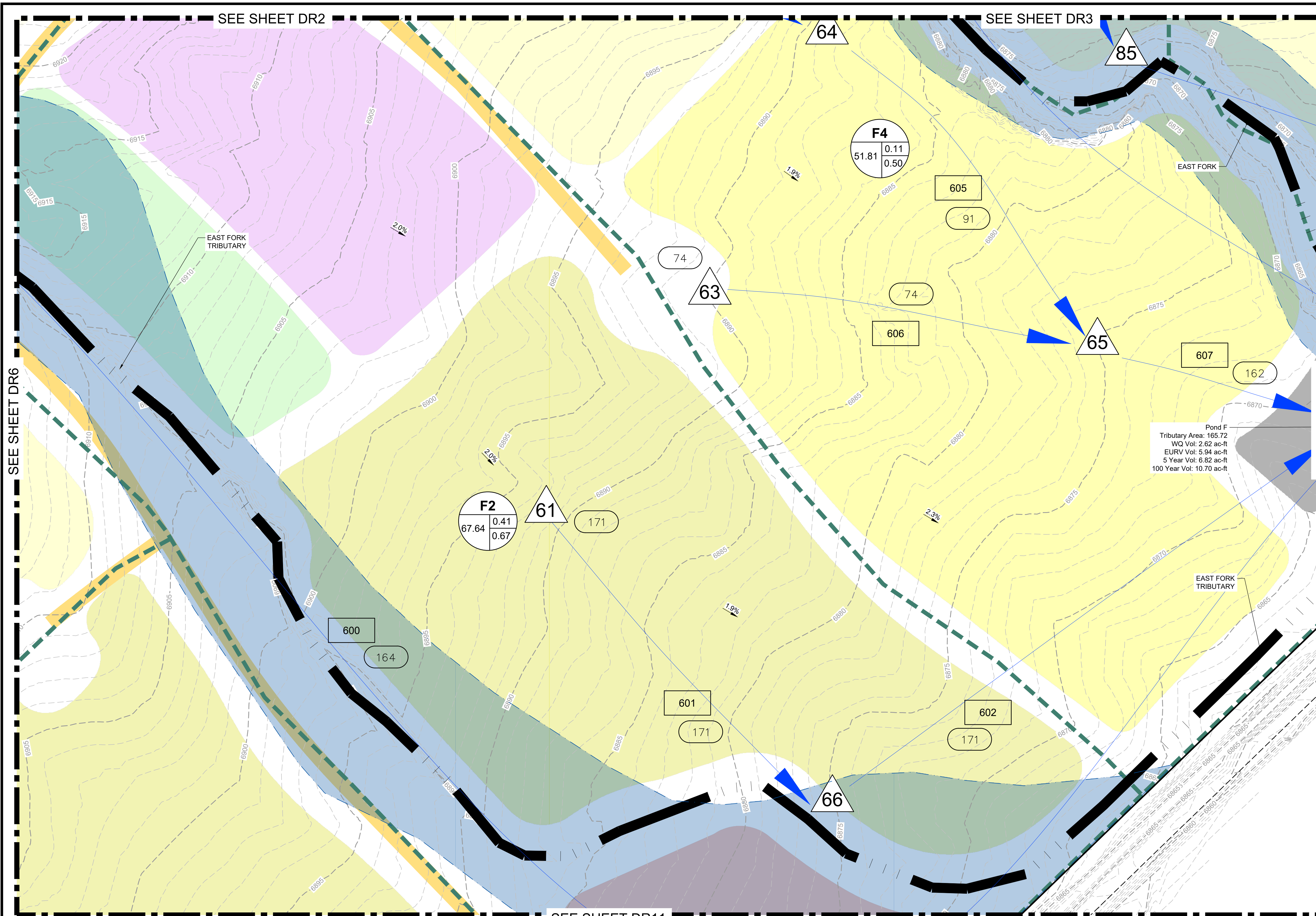
- PROPOSED MAJOR CONTOUR ——— 5250 ———
- PROPOSED MINOR CONTOUR ——— ———
- EXISTING MAJOR CONTOUR - - - - - 5250 - - - - -
- EXISTING MINOR CONTOUR - - - - -
- PROPOSED STORM DRAIN PIPE ———
- EXISTING STORM DRAIN PIPE ———
- PROPOSED DRAINAGE CHANNEL ———
- PROPOSED ROAD ———
- PROPERTY LINE ———
- DIRECTIONAL FLOW ARROW ———
- EMERGENCY OVERFLOW ARROW ———
- EXISTING 100-YR FLOODWAY ———
- EXISTING 100-YR FLOODPLAIN ———
- PROPOSED 100-YR FLOODPLAIN ———
- WATERSHED BOUNDARY ———
- MAJOR BASIN LINE ———
- 100YR ZONE A FLOODPLAIN ———
- PROPOSED DETENTION LOCATION ———
- POTENTIAL WATER QUALITY LOCATION ———
- SWMM CONVEYANCE ELEMENT ———
- PROPOSED PEAK FLOW RATE (CFS) ———
- DESIGN POINT ———
- PROPOSED BASIN LABEL ———
- AREA (AC.) ———
- XX XX % IMPERVIOUSNESS
- LAND USE
- LOW DENSITY
- MEDIUM DENSITY
- HIGH/MED DENSITY
- HIGH DENSITY
- CHURCH
- COMMERCIAL
- ELEMENTARY SCHOOL
- COMMUNITY PARK

NOTES:



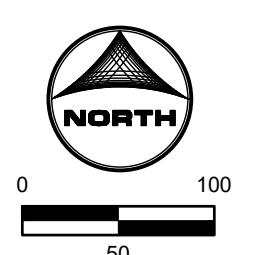
Job No.: 191897.01  
 Prepared By: TBI  
 Date: 04/14/2020

PROPOSED DR6



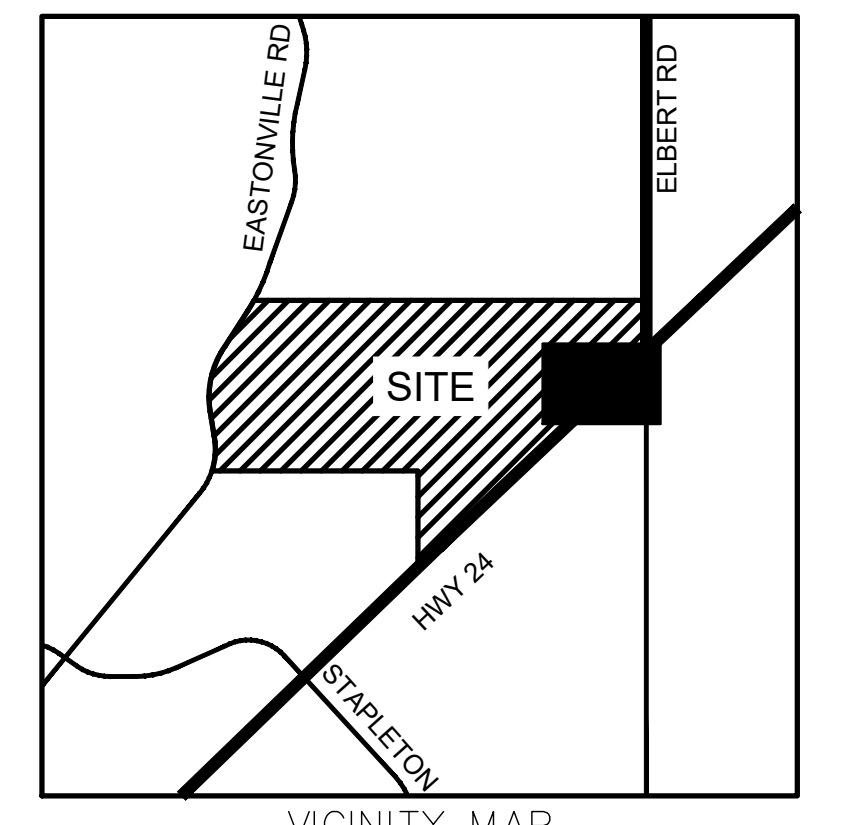
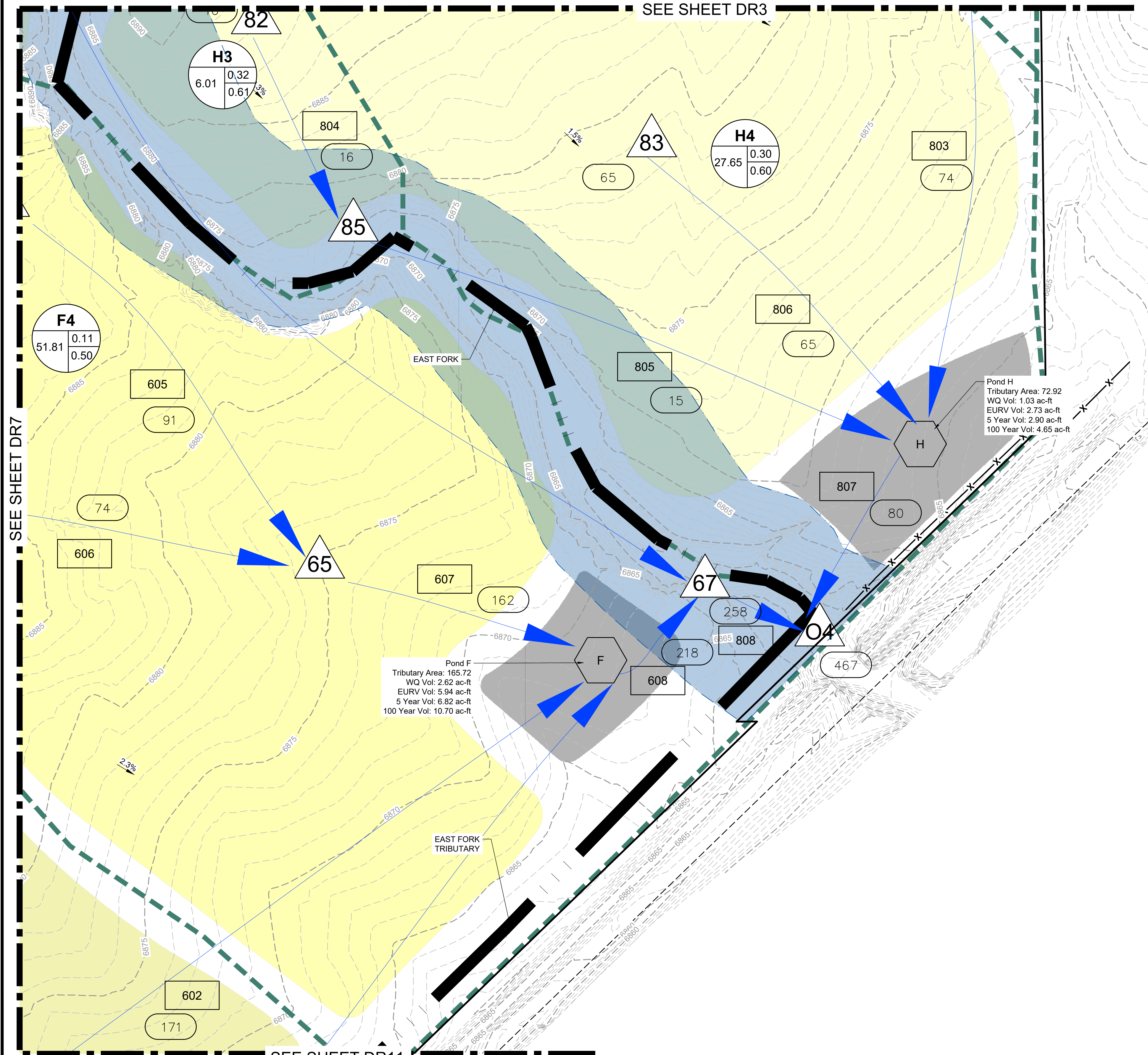
- LEGEND:**
- PROPOSED MAJOR CONTOUR — 5250 —
  - PROPOSED MINOR CONTOUR —
  - EXISTING MAJOR CONTOUR - - - 5250 - - -
  - EXISTING MINOR CONTOUR - - -
  - PROPOSED STORM DRAIN PIPE —
  - EXISTING STORM DRAIN PIPE —
  - PROPOSED DRAINAGE CHANNEL —
  - PROPOSED ROAD —
  - PROPERTY LINE —
  - DIRECTIONAL FLOW ARROW —
  - EMERGENCY OVERFLOW ARROW —
  - EXISTING 100-YR FLOODWAY —
  - EXISTING 100-YR FLOODPLAIN —
  - PROPOSED 100-YR FLOODPLAIN —
  - WATERSHED BOUNDARY —
  - MAJOR BASIN LINE —
  - 100YR ZONE A FLOODPLAIN —
  - PROPOSED DETENTION LOCATION —
  - POTENTIAL WATER QUALITY LOCATION —
  - SWM CONVEYANCE ELEMENT —
  - PROPOSED PEAK FLOW RATE (CFS) —
  - DESIGN POINT —
  - PROPOSED BASIN LABEL —
- LAND USE**
- LOW DENSITY
  - MEDIUM DENSITY
  - HIGH/MED DENSITY
  - HIGH DENSITY
  - CHURCH
  - COMMERCIAL
  - ELEMENTARY SCHOOL
  - COMMUNITY PARK

NOTES:



Job No.: 191897.01  
 Prepared By: TBI  
 Date: 04/14/2020

PROPOSED DR7



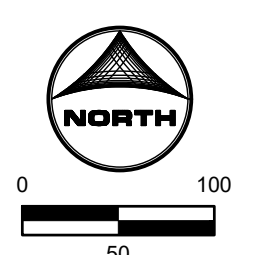
**LEGEND:**

- PROPOSED MAJOR CONTOUR: 5250
- PROPOSED MINOR CONTOUR
- EXISTING MAJOR CONTOUR: 5250
- EXISTING MINOR CONTOUR
- PROPOSED STORM DRAIN PIPE
- EXISTING STORM DRAIN PIPE
- PROPOSED DRAINAGE CHANNEL
- PROPOSED ROAD
- PROPERTY LINE
- DIRECTIONAL FLOW ARROW
- EMERGENCY OVERFLOW ARROW
- EXISTING 100-YR FLOODWAY
- EXISTING 100-YR FLOODPLAIN
- PROPOSED 100-YR FLOODPLAIN
- WATERSHED BOUNDARY
- MAJOR BASIN LINE
- 100YR ZONE A FLOODPLAIN
- PROPOSED DETENTION LOCATION
- POTENTIAL WATER QUALITY LOCATION
- SWMM CONVEYANCE ELEMENT
- PROPOSED PEAK FLOW RATE (CFS)
- DESIGN POINT
- PROPOSED BASIN LABEL

**LAND USE**

- LOW DENSITY
- MEDIUM DENSITY
- HIGH/MED DENSITY
- HIGH DENSITY
- CHURCH
- COMMERCIAL
- ELEMENTARY SCHOOL
- COMMUNITY PARK

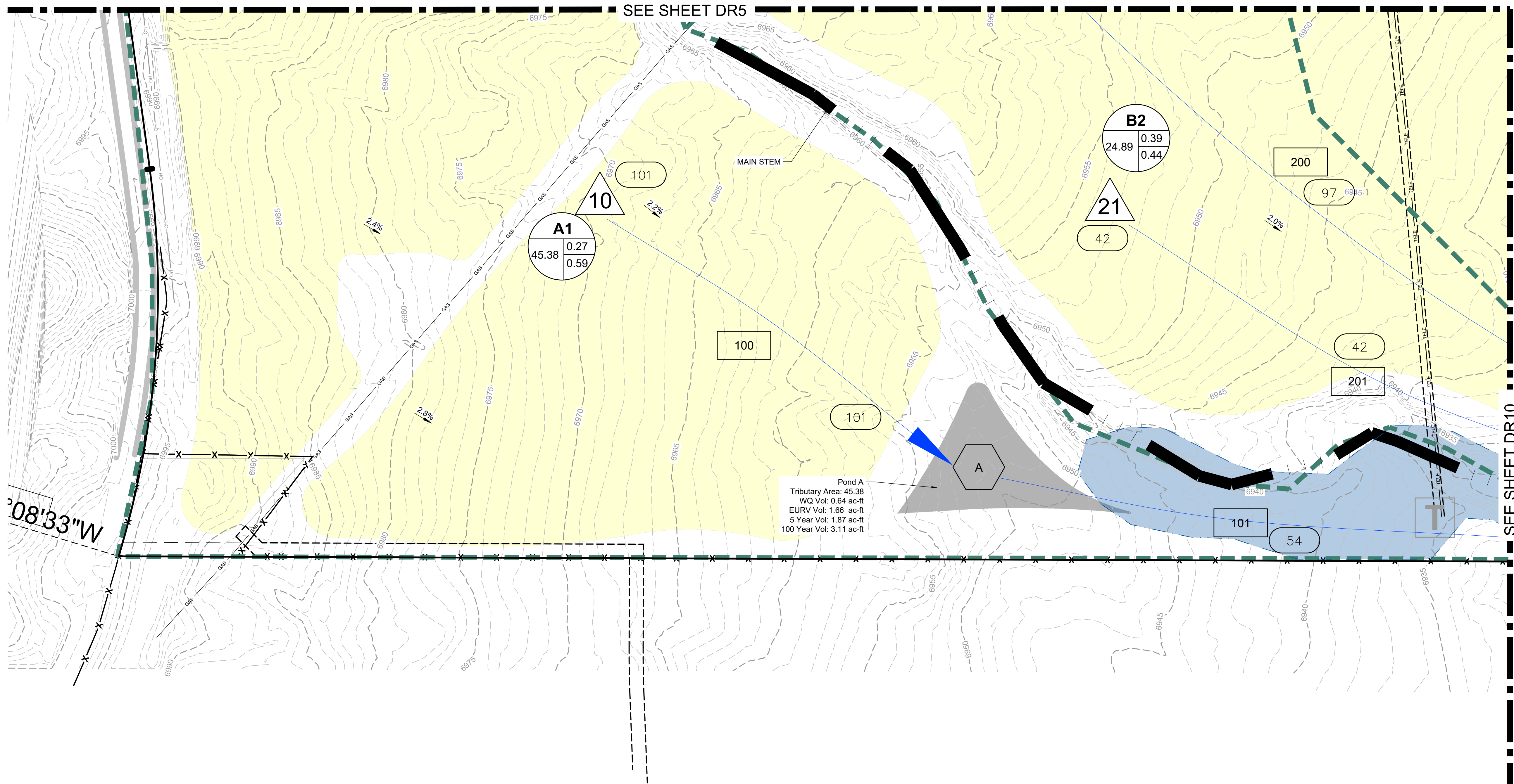
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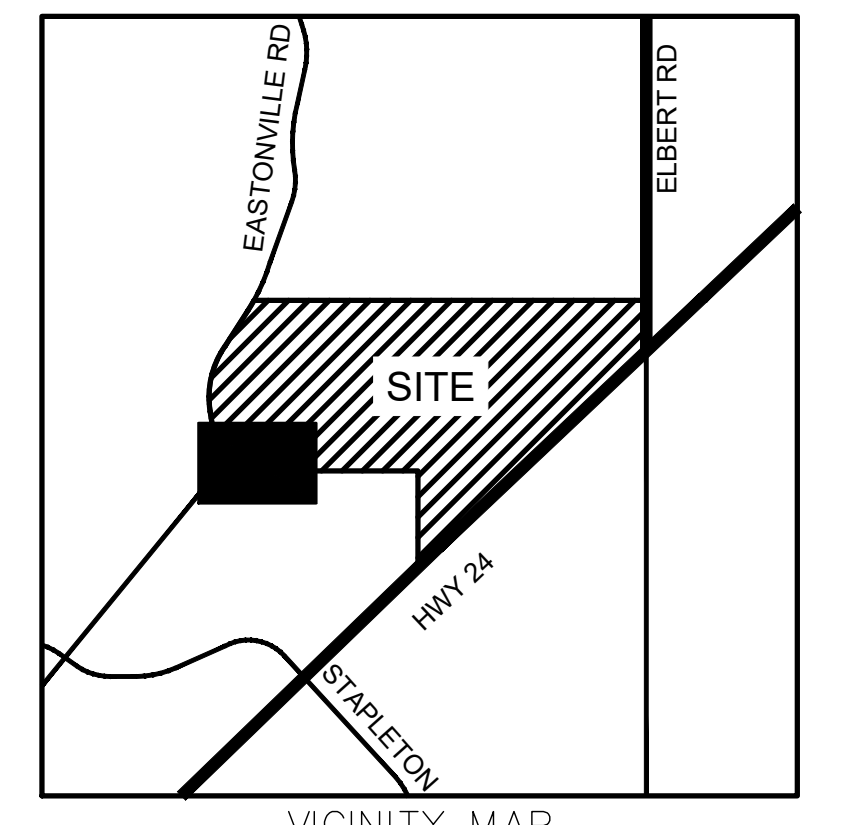
Job No.: 191897.01  
 Prepared By: TBI  
 Date: 04/14/2020

PROPOSED DR8

SEE SHEET DR5

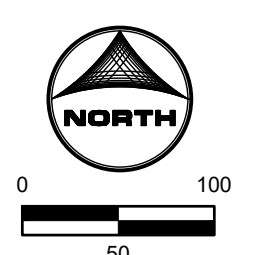


Pond A  
 Tributary Area: 45.38  
 WQ Vol: 0.64 ac-ft  
 EURV Vol: 1.66 ac-ft  
 5 Year Vol: 1.87 ac-ft  
 100 Year Vol: 3.11 ac-ft



- LEGEND:**
- PROPOSED MAJOR CONTOUR: 5250
  - PROPOSED MINOR CONTOUR: 5250
  - EXISTING MAJOR CONTOUR: 5250
  - EXISTING MINOR CONTOUR: 5250
  - PROPOSED STORM DRAIN PIPE: (thick dashed line)
  - EXISTING STORM DRAIN PIPE: (thin dashed line)
  - PROPOSED DRAINAGE CHANNEL: (thick solid line)
  - PROPOSED ROAD: (thick solid line)
  - PROPERTY LINE: (dashed line with 'x' markers)
  - DIRECTIONAL FLOW ARROW: (arrow with tail)
  - EMERGENCY OVERFLOW ARROW: (arrow with tail and crossbar)
  - EXISTING 100-YR FLOODWAY: (dashed line)
  - EXISTING 100-YR FLOODPLAIN: (dotted line)
  - PROPOSED 100-YR FLOODPLAIN: (dotted line)
  - WATERSHED BOUNDARY: (dashed line)
  - MAJOR BASIN LINE: (thick dashed line)
  - 100YR ZONE A FLOODPLAIN: (shaded area)
  - PROPOSED DETENTION LOCATION: (hexagon with 'A')
  - POTENTIAL WATER QUALITY LOCATION: (hexagon with 'WQ')
  - SWMM CONVEYANCE ELEMENT: (rectangle with 'SWMM')
  - PROPOSED PEAK FLOW RATE (CFS): (circle with '850')
  - DESIGN POINT: (triangle with 'XX')
  - PROPOSED BASIN LABEL: (circle with 'XX' and 'XX' for area and imperviousness)
- LAND USE**
- LOW DENSITY: (light yellow)
  - MEDIUM DENSITY: (yellow)
  - HIGH/MED DENSITY: (orange)
  - HIGH DENSITY: (red)
  - CHURCH: (pink)
  - COMMERCIAL: (purple)
  - ELEMENTARY SCHOOL: (green)
  - COMMUNITY PARK: (light green)

NOTES:



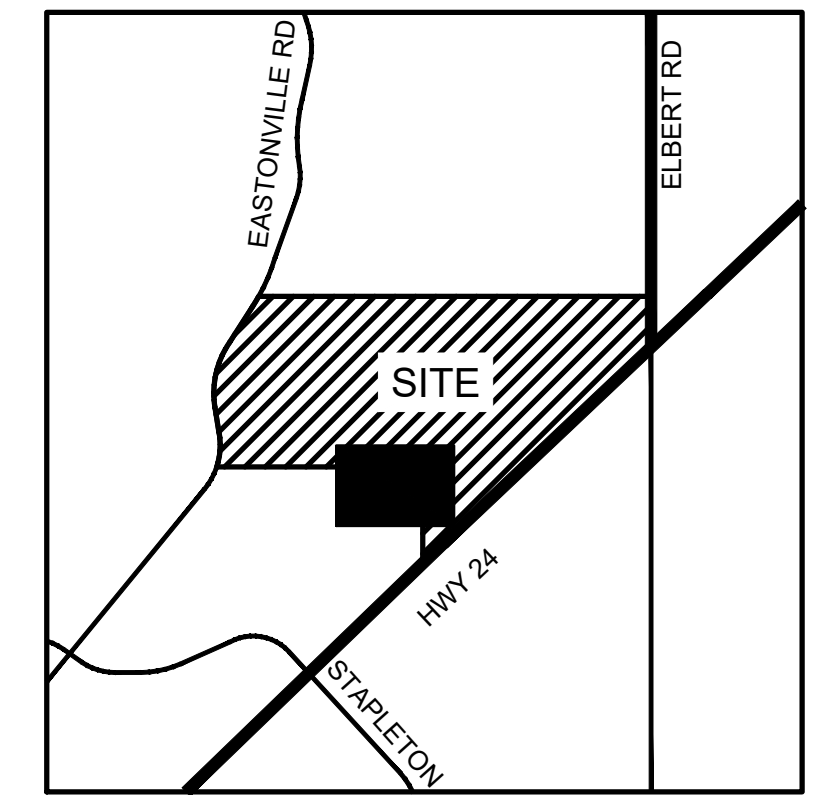
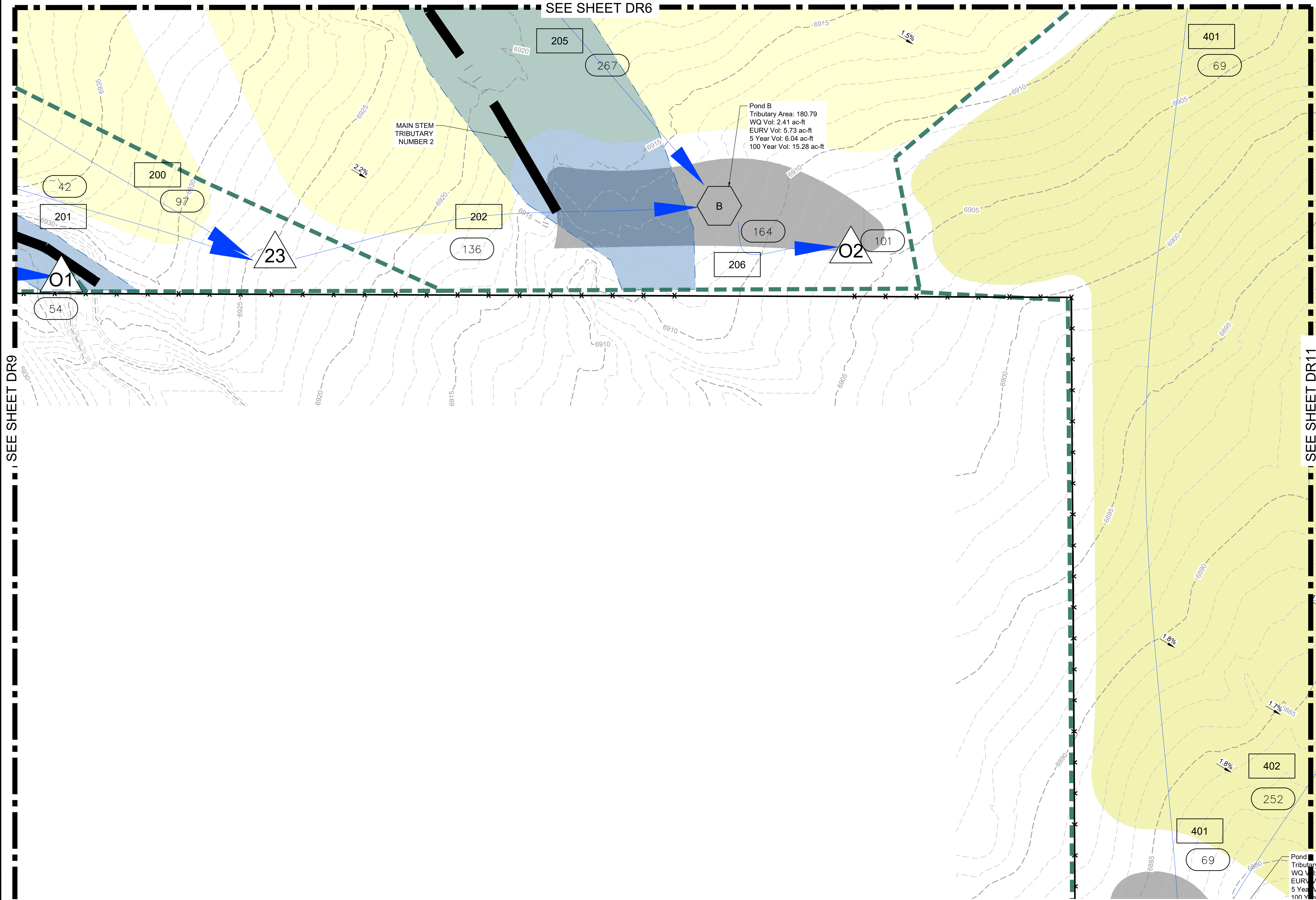
Job No.: 191897.01  
 Prepared By: TBI  
 Date: 04/14/2020

PROPOSED DR9

SEE SHEET DR6

SEE SHEET DR9

SEE SHEET DR11



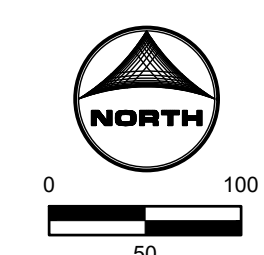
VICINITY MAP

LEGEND:

- PROPOSED MAJOR CONTOUR — 5250 —
- PROPOSED MINOR CONTOUR — —
- EXISTING MAJOR CONTOUR - - - 5250 - - -
- EXISTING MINOR CONTOUR - - - -
- PROPOSED STORM DRAIN PIPE —●—
- EXISTING STORM DRAIN PIPE —●—
- PROPOSED DRAINAGE CHANNEL —■—
- PROPOSED ROAD —■—
- PROPERTY LINE —x—
- DIRECTIONAL FLOW ARROW —→—
- EMERGENCY OVERTFLOW ARROW —↑—
- EXISTING 100-YR FLOODWAY ———
- EXISTING 100-YR FLOODPLAIN ———
- PROPOSED 100-YR FLOODPLAIN ———
- WATERSHED BOUNDARY ———
- MAJOR BASIN LINE ———
- 100YR ZONE A FLOODPLAIN —■—
- PROPOSED DETENTION LOCATION —A—
- POTENTIAL WATER QUALITY LOCATION —WQ—
- SWMM CONVEYANCE ELEMENT —SWMM—
- PROPOSED PEAK FLOW RATE (CFS) —850—
- DESIGN POINT —x—
- PROPOSED BASIN LABEL —XX— BASIN DESIGNATION
- AREA (AC.) —XX— % IMPERVIOUSNESS

- LAND USE**
- LOW DENSITY
  - MEDIUM DENSITY
  - HIGH/MED DENSITY
  - HIGH DENSITY
  - CHURCH
  - COMMERCIAL
  - ELEMENTARY SCHOOL
  - COMMUNITY PARK

NOTES:

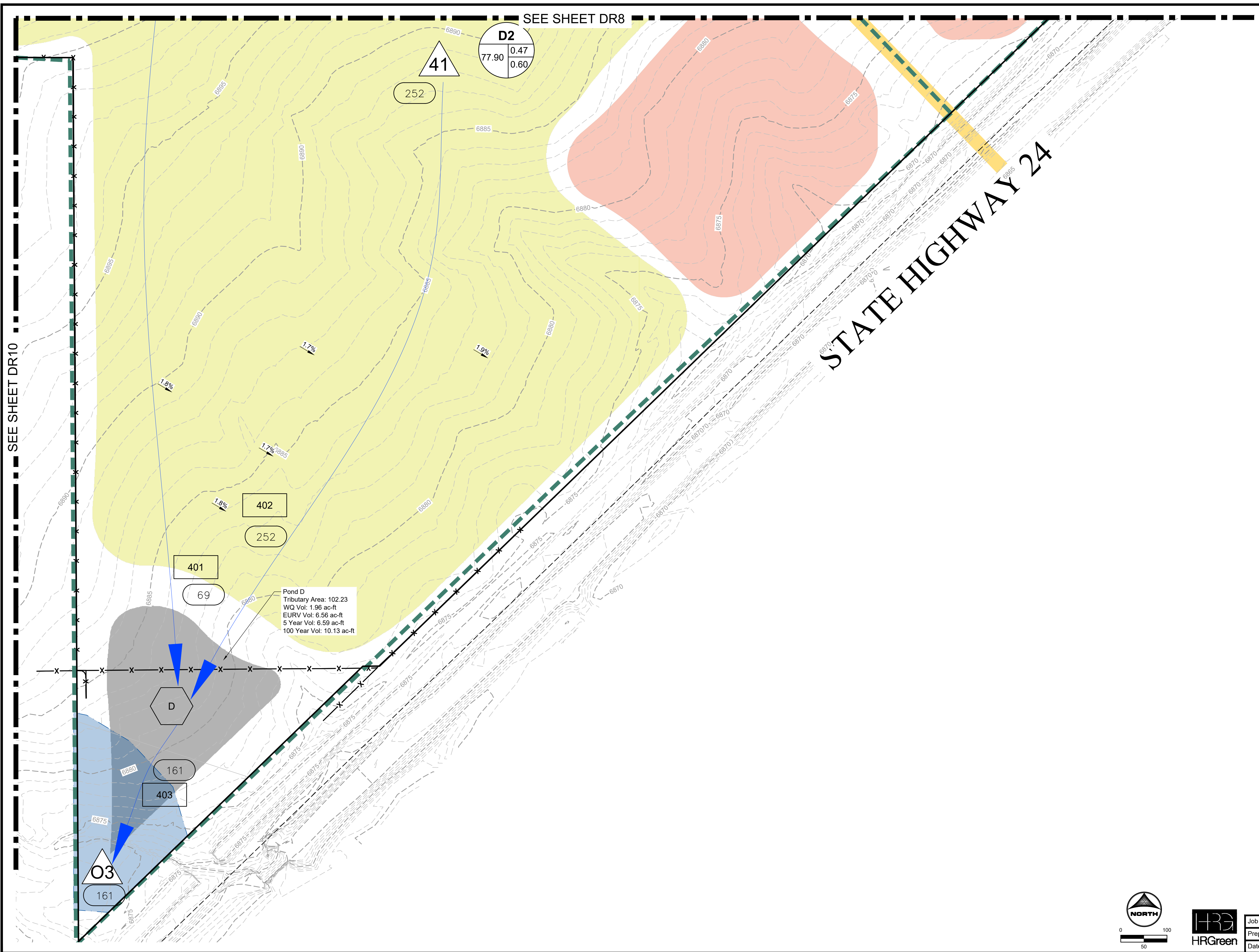


Job No.: 191897.01  
 Prepared By: TBI  
 Date: 04/14/2020

PROPOSED DR10

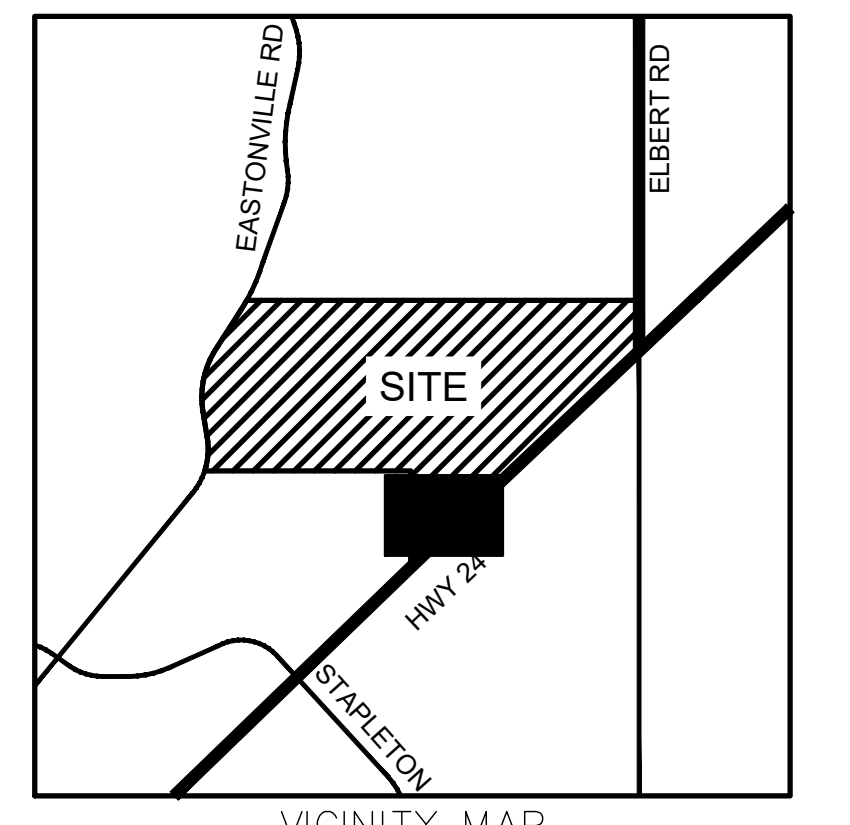
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SEE SHEET DR10

SEE SHEET DR8

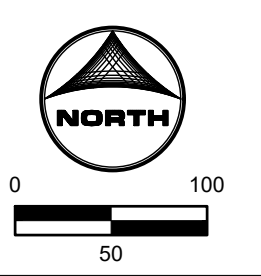


VICINITY MAP

LEGEND:

- PROPOSED MAJOR CONTOUR — 5250
  - PROPOSED MINOR CONTOUR —
  - EXISTING MAJOR CONTOUR - - - 5250
  - EXISTING MINOR CONTOUR - - -
  - PROPOSED STORM DRAIN PIPE —
  - EXISTING STORM DRAIN PIPE - - -
  - PROPOSED DRAINAGE CHANNEL —
  - PROPOSED ROAD —
  - PROPERTY LINE - - -
  - DIRECTIONAL FLOW ARROW →
  - EMERGENCY OVERFLOW ARROW ↑
  - EXISTING 100-YR FLOODWAY - - -
  - EXISTING 100-YR FLOODPLAIN —
  - PROPOSED 100-YR FLOODPLAIN - - -
  - WATERSHED BOUNDARY - - -
  - MAJOR BASIN LINE - - -
  - 100YR ZONE A FLOODPLAIN —
  - PROPOSED DETENTION LOCATION A
  - POTENTIAL WATER QUALITY LOCATION WQ
  - SWMM CONVEYANCE ELEMENT SWMM
  - PROPOSED PEAK FLOW RATE (CFS) 850
  - DESIGN POINT XX
  - PROPOSED BASIN LABEL XX BASIN DESIGNATION
  - AREA (AC.) XX % IMPERVIOUSNESS
- LAND USE**
- LOW DENSITY —
  - MEDIUM DENSITY —
  - HIGH/MED DENSITY —
  - HIGH DENSITY —
  - CHURCH —
  - COMMERCIAL —
  - ELEMENTARY SCHOOL —
  - COMMUNITY PARK —

NOTES:



Job No.: 191897.01  
 Prepared By: TBI  
 Date: 04/14/2020

PROPOSED DR11