DRAINAGE LETTER

for

WATER TREATMENT PLANT BUILDING ADDITION

Prepared for the

SECURITY WATER DISTRICT

GMS, Inc.
Consulting Engineers

DRAINAGE LETTER
for
SECURITY WATER DISTRICT
WATER TREATMENT PLANT BUILDING ADDITION

1.0 CERTIFICATION STATEMENTS

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 city/county for drainage reports and said report is in conformity with the 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.

SIGNATURE (Affix Seal): Roger J. Sams 11-18-2025

For and on behalf of Meyer & Sams, Inc., dba GMS, Inc. Date
Roger J. Sams, P.E. #11884

Developer's Statement

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

Roy E. Heald 11/19/2025

Authorized Signature By: Roy E. Heald, General Manager Date
Security Water District Acting by and Through It's Water Enterprise

El Paso County

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.

Joshua Palmer, P.E. Date
County Engineer / ECM Administrator

Conditions:

DRAINAGE LETTER

FOR

WATER TREATMENT PLANT BUILDING ADDITION

PROJECT NO. 2022-076.130

AUGUST 2025
FINAL: JUNE 2026

OWNER:

SECURITY WATER DISTRICT ENTERPRISE
231 SECURITY BOULEVARD
COLORADO SPRINGS, CO 80911

PREPARED BY:

GMS, INC.
CONSULTING ENGINEERS
611 NORTH WEBER, SUITE 300
COLORADO SPRINGS, COLORADO 80903

TELEPHONE: (719) 475-2935
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SECTION I
PURPOSE AND BACKGROUND

A. PURPOSE AND SCOPE

This drainage letter and report has been prepared in support of the Security Water District Enterprise ("District") water treatment plant (WTP) building addition improvements. The purpose of this report is to present the findings of a hydrologic evaluation and development of stormwater management infrastructure at the WTP site.

The stormwater management plan is to conform with criteria established by El Paso County as the local land use authority having jurisdiction. The construction of the existing WTP was accomplished by the United States Air Force by agreement with the U.S. Army Corps of Engineers as project manager. At the beginning of that design and construction effort, the federal agencies agreed to comply with and provide submittals consistent with the El Paso County stormwater management criteria applicable at that time. Those submittals were not subject to the "approval" of El Paso County. The file materials submitted are identified as File Number AASI192 in the El Paso County Planning and Community Development system (EDARP).

B. BACKGROUND

The Security Water District Enterprise currently owns, operates and maintains a water treatment plant (WTP) in the unincorporated Security community in central El Paso County, Colorado. The WTP was constructed as a joint project between the District and the United States Air Force to address per- and polyfluoroalkyl (PFAS) compounds in the District's local source water supply. Due to funding constraints, the water treatment plant was built without personnel accommodations such as toilet rooms, workspaces, and designated storage areas for expendable supplies utilized in the water treatment management, record keeping and daily operations.

This project will add to the existing WTP building, providing toilet facilities, maintenance and janitorial space, areas for record keeping and technical reference material storage, and

improved access for periodic delivery of large quantities of ion exchange media. The addition will include a building with a similar profile, height and geometric configuration as the existing WTP building. The building will be a slab-on grade, pre-engineered metal building with an exterior foundation footprint of 51-feet by 40-feet and a projected floor area of 2,040 square feet.

As part of the project, hot mix bituminous pavement will replace the existing gravel vehicular travel ways within the treatment plant facility. This site is not accessible to the public and is enclosed with a 6-foot-high chain link fence with top treatment to deter intrusion.

SECTION II
GENERAL LOCATION AND DESCRIPTION

A. SITE LOCATION

The Security Water District is located in the northwest area of the Security-Widefield region, south and west of the municipal limits of Colorado Springs in El Paso County, Colorado. The WTP is located within the Northeast one quarter Southeast one quarter of Section 2, Township 15 South, Range 66 West of the Sixth Meridian.

The District's WTP is located on a parcel of land encompassing 70.041 acres north of the Bradley Road and Lincoln Plaza Drive intersection. This larger parcel of land, owned by the District is confined by Bradley Road to the south, Hancock Expressway to the east, Milton Proby Parkway to the north, and Academy Boulevard to the west. The eastern edge of the District's property is constrained by the Fountain Mutual Irrigation Canal and Clearview Loop as platted in Clearview Industrial Park Filing No. 1.

Figure II-1 provides an area map showing the generalized project limits, surrounding street configurations, topography, drainage features, and irrigation canal and ditches. The map is adapted from a U.S. Geological Survey 7.5 minutes quadrangle.

B. DESCRIPTION OF PROPERTY

The District-owned parcel of land is identified as El Paso County Assessor's schedule number 65020-00-138. The 1.7-acre fenced WTP site contains the treatment plant building, a raw water storage tank, and an on-site power generator. The proposed improvements will not change the property's current land use as the property is already being used for water treatment.

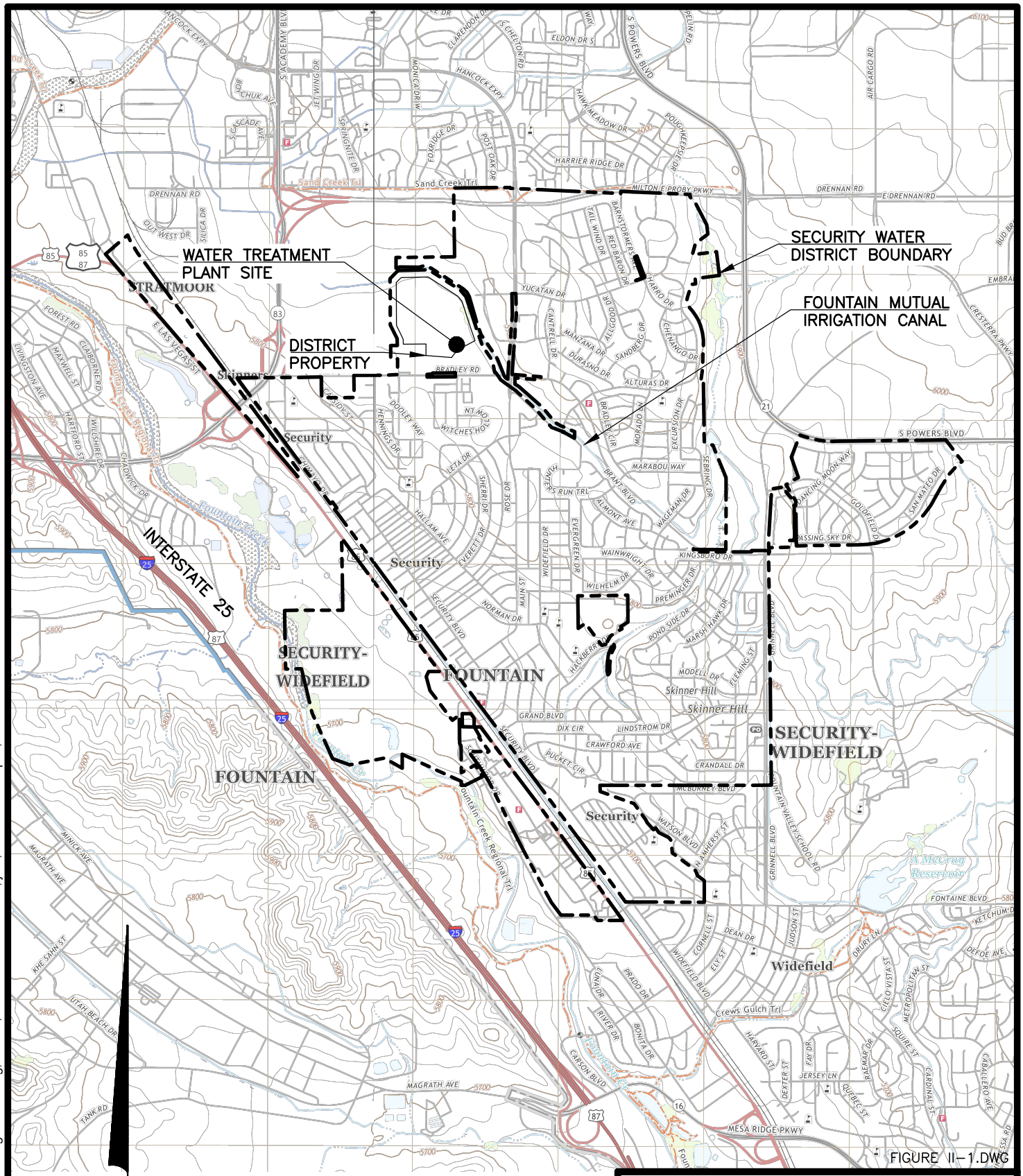

FIGURE II–1
LOCATION MAP
SECURITY WATER DISTRICT

SCALE: 1" = 3,000'

SOURCE: COLORADO SPRINGS, ELSMERE, CHEYENNE MOUNTAIN, AND FOUNTAIN QUADRANGLE MAPS

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MAY 2026

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C. PHYSIOGRAPHY, TOPOGRAPHY AND VEGETATION

The District's WTP is located at approximately 5,859 feet AMSL in elevation. The general topography in the area falls from the northeast to the southwest. No prominent topographic features exist within the District's WTP property. Figure II-1 shows the general topography in and around the District's WTP.

The area immediately north of the WTP within the District's ownership is currently leased by the District for solar power generation. The land to the southeast outside the District's ownership is occupied by a self-storage commercial business. There are no delineated wetlands around the WTP site. The only wetlands associated around the District's property are delineated as riverine and a freshwater pond. The riverine is the Fountain Mutual Irrigation Canal, which flows southeasterly through the majority of the District and just east of the District's property. The 37-acre delineated freshwater pond mapped in published wetlands inventory documents was formerly a portion of a facility commonly referred to as the Little Johnson Reservoir. This reservoir use no longer exists and is replaced by land leased for solar power generation. A smaller 0.5-acre pond exists at the topographic low point subject to local runoff conditions.

The Little Johnson Reservoir ceased to be used for irrigation impoundment/storage purposes by the Fountain Mutual Irrigation Company approximately 65 to 70 years ago. The topographic geometry remains as it was last used and serves as a permanent detention area for local runoff. The Security Water District has no intention of modifying that historical topographic condition and will maintain the runoff from its property on the historic site and within the District's ownership. Current runoff entering the former Little Johnson Reservoir ultimately collects in the smaller 0.5-acre pond located at the low point within the former reservoir. From there, stormwater will either infiltrate into the ground or evaporate into the atmosphere. A bioretention pond is proposed on the southwest corner of the smaller 1.7-acre property to ensure the WQCV from the improved site will be infiltrated prior to the existing pond. Since use of this reservoir as an irrigation storage facility ceased about 65 years ago, it has never been known to overflow from natural precipitation in the local watershed. The District's WTP is located in the plains/grassland region of Colorado. Native vegetation includes blue grama and buffalo grass, with scattered species such as rabbitbrush, sagebrush, yucca, and various wildflowers.

D. SOILS

The US Department of Agriculture through the Natural Resources Conservation Service (NRCS) has compiled detailed soil information for El Paso County. This data is available on the NRCS' web soil survey website. Soil type information within and surrounding the District's WTP is relevant as it relates to constructability within the area and the soil's ability to convey surface water.

The following soils have been identified in the NRCS mapping of the Security WTP area as shown on the following Figures II-2A, II-2B and II-2C. General information is presented in terms of the characteristics of these different soil classifications. None of the identified soils are classified as prime farmland.

8 - Blakeland Loamy Sand - 1 to 9% Slopes:

This is the primary soil group within the District's WTP property, found in the southeastern part of the property and extending northwest of the property. This soil group consists of loamy sand; these soils are somewhat excessively drained with a low runoff class. These soils are classified as hydrologic soil group "A". Depth to water table is more than 80 inches.

111 – Water:

This group is prevalent in the northwest corner of the District's 70-acre property. This group is entirely composed of open water with high runoff potential. The soil survey still depicts the former Little Johnson Reservoir, which is no longer in use and remains unfilled except for ponding of local runoff in the property's topographic low point.

E. MAJOR DRAINAGEWAYS

The District's WTP resides in the Little Johnson Drainage Basin which drains to the Windmill Gulch Basin upstream of its confluence with Fountain Creek. The Security-Widefield area generally drains southwest towards Fountain Creek, which is ultimately tributary to the Arkansas River. A minor drainageway near the District's WTP is the Fountain Mutual Irrigation Canal, owned by Fountain Mutual Irrigation Company who supports agricultural irrigation uses and water resource management in the surrounding region. This 20-foot-wide canal flows four miles southeast, passing 400 feet east of the District's WTP, and into Big Johnson Reservoir. The company typically fills the reservoir in the fall and winter, then releases water in the spring for downstream irrigation and release to Fountain Creek as

Soil Map—El Paso County Area, Colorado
(Security Water District - Soils Map)

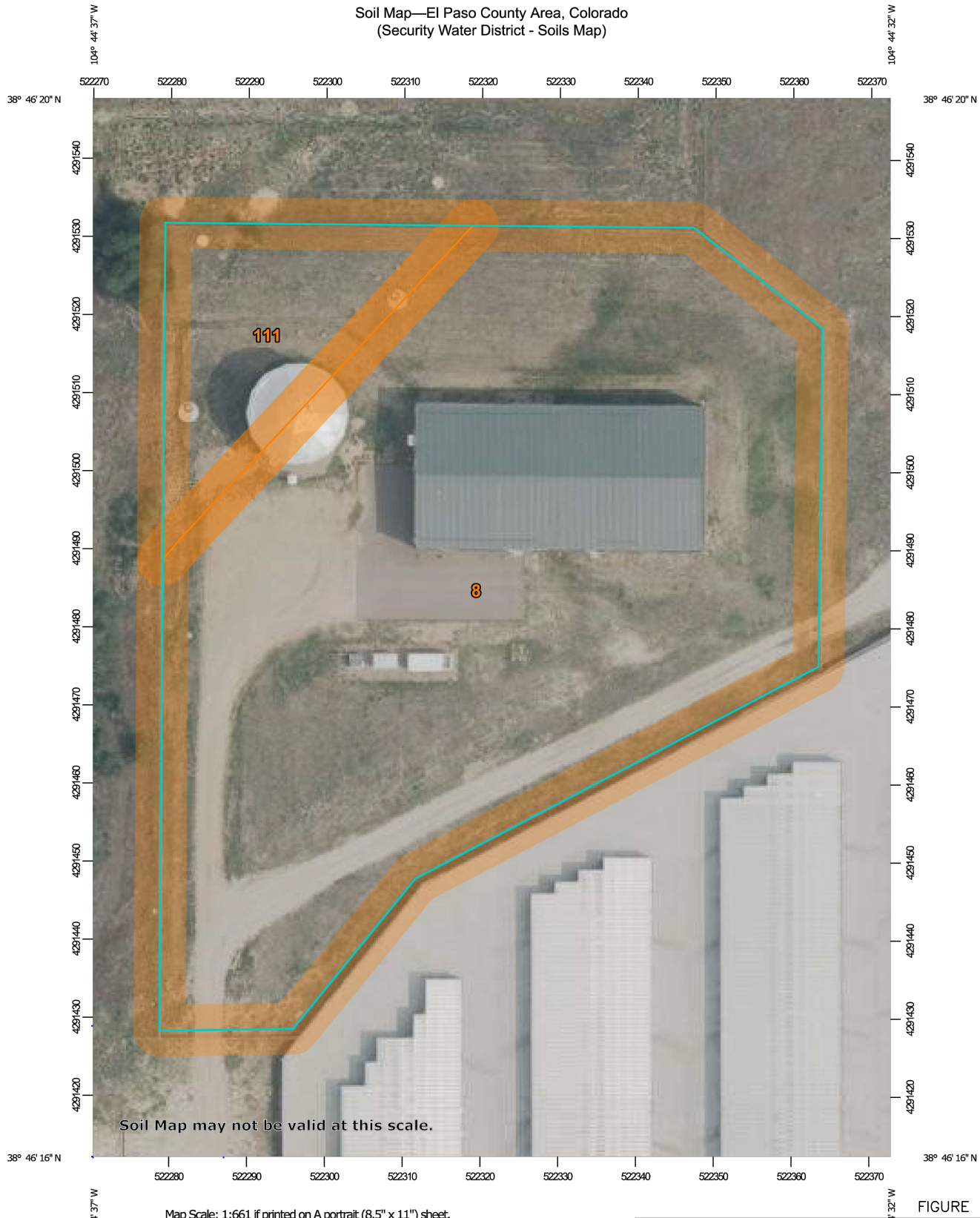

FIGURE II-2A.DWG

Map Scale: 1:661 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 5 10 20 30

Feet: 0 30 60 120 180

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

USDA **Natural Resources Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

FIGURE II-2A
SOILS MAP
SECURITY WATER DISTRICT

GMS, INC.

CONSULTING ENGINEERS
611 N. WEBER, SUITE 300
COLORADO SPRINGS, COLORADO 80903

MAY 2026

G:\SECURITY\2023-053\130\Drainage Report\Figure II-2A.dwg, 8.5x11, 5/8/2026 11:47:13 AM, jms, DWG To PDF.pc3, 1:1

Soil Map—El Paso County Area, Colorado
(Security Water District - Soils Map)

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 22, Sep 3, 2024

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

Date(s) aerial images were photographed: Jul 23, 2024—Aug 4, 2024

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.

FIGURE II-2B.DWG

Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

FIGURE II-2B
SOILS MAP LEGEND
SECURITY WATER DISTRICT

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611 N. WEBER, SUITE 300
COLORADO SPRINGS, COLORADO 80903

MAY 2026

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	1.5	87.4%
111	Water	0.2	12.6%
Totals for Area of Interest		**1.7**	**100.0%**

FIGURE II–2C.DWG

FIGURE II–2C
SOILS MAP UNIT LEGEND
SECURITY WATER DISTRICT

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MAY 2026

replacement water for out-of-priority diversions, usually by pumping of alluvial ground water tributary to Fountain Creek. This canal intercepts storm water runoff from areas to the north and east of the District's property. That stormwater is released from the irrigation ditch at it's crossing of Windmill Gulch in accordance with the requirements of local water rights administration.

F. UTILITIES

There is no additional utility service required to accommodate the building addition. Gas and electric are provided to this site by Colorado Springs Utilities. Additional energy delivery capacity is not required, either as a result of prior planning for the demand of the building addition or through analysis of the energy demand over the last five years in accordance with the policy of Colorado Springs Utilities.

Wastewater services are provided to this site by Security Sanitation District. The existing waste piping from floor drains in the treatment plant facility will convey wastewater generated by the new toilet room, employee accommodations and additional floor drains in the building addition. Potable water is provided to this site by the Security Water District. The building addition provides potable water for handwashing, drinking and sanitary accommodations. Potable water delivery to this facility is not required to be enlarged to accommodate the building addition. Communications to facilitate operations are owned, operated, maintained, renewed and replaced in accordance with District policy and federal regulation.

SECTION III

BASIN DESCRIPTION AND FLOODPLAIN IMPACTS

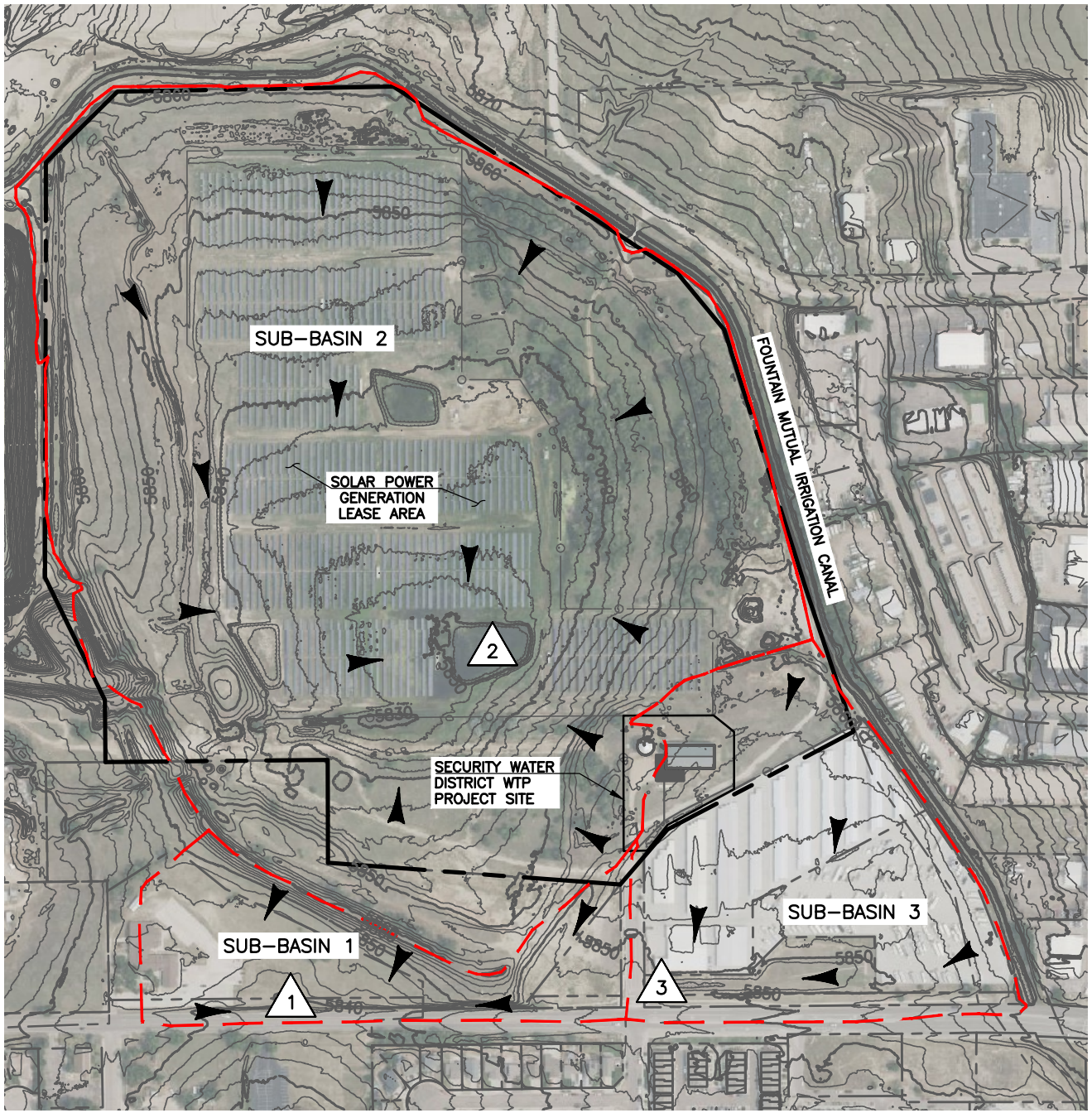
A. MAJOR BASIN DESCRIPTION

The Little Johnson / Security Creek Drainage Basin Planning Study was prepared in April 1988 for the El Paso County Planning Commission. This basin study consisted of three drainage zones: (1) area to the north of Canal No. 4 (aka Fountain Mutual Irrigation Canal), (2) area between Canal No. 4 and U.S. Highway 85, and (3) area between U.S. Highway 85 and Fountain Creek. The report evaluated existing drainage conditions within the basin and identified flooding risks due to insufficient stormwater infrastructure and channel capacity. The study recommended improvements including channel widening and stabilization, construction of detention basins, upgrades to culverts and storm sewer systems, and erosion control measures to mitigate flooding and enhance stormwater management with future developments.

The considerations for development and associated stormwater infrastructure at the project site has not been implemented. The residential development contemplated in the DBPS has not occurred, and, due to the Security Water District's ownership, the probability of it ever occurring is low. That future development will be responsible for supporting stormwater management infrastructures. The District's Water Treatment Plant (WTP) is located on a 1.7-acre fenced area situated in the southeast portion of the District's larger 70-acre property. The following figure provides contour mapping in 2- and 10-foot increments of the District's entire property, generated using LiDAR data from 2018 through the Colorado Hazard Mapping and Risk Map Portal maintained by the Colorado Water Conservation Board. Site specific contour mapping of the smaller 1.7-acre lot utilized on-site field survey equipment.

Much of the District's property was formerly a reservoir, as evidenced by the contour mapping around its perimeter. This sub-basin, comprising the majority of the District's property, is bounded by the Fountain Mutual Irrigation Canal to the north and east, and by the remnants of the Little Johnson Reservoir dam embankment to the west and south. Existing structures on the property include solar panels, a water storage tank, the WTP building, and an on-site power generator.

G:\SECURITY\2023-053\130\Drainage Report\Figure III-1.dwg, 8.5x11 (2), 5/8/2026 5:01:37 PM, jms



SCALE: 1" = 400'

DRAINAGE BOUNDARY

DISTRICT PROPERTY LINE

1 DESIGN POINT

FLOW ARROW

N

SOURCE:

GENERAL CONTOUR MAPPING IS LIDAR DATA FROM THE COLORADO HAZARD MAPPING AND RISK MAP PORTAL BY THE COLORADO WATER CONSERVATION BOARD DATED 2018. WATERSHED BOUNDARIES IN AND AROUND THE PROJECT SITE WERE DELINEATED USING ON-SITE FIELD SURVEY CONDUCTED IN MAY 2026 AND HAVE BEEN SUPERIMPOSED ONTO THIS FIGURE. REFER TO FIGURE IV-1 FOR EXISTING SITE GRADING.

FIGURE III-1.DWG

FIGURE III-1
MAJOR DRAINAGE BASIN
SECURITY WATER DISTRICT

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611 N. WEBER, SUITE 300
COLORADO SPRINGS, COLORADO 80903

MAY 2026

A description of the major sub-basins that the WTP site is tributary to is identified in the following table, Table III-1. The Security Water District ownership extends over the majority of Sub-Basin 2 and includes about 35 to 40 percent of Sub-Basin 1. In addition to the designated 1.7 acre water treatment plant site, an area of approximately one acre is used for temporary storage of waste soil and street surfacing material by the District. When the District must repair underground distribution system infrastructure due to failure of pipelines, saturated soil is removed from excavation and temporarily stored on the District's property near the water treatment plant site. In addition street surfacing consisting of hot mix asphalt (HMA) pavement is required to be removed and is likewise temporarily stored at this site. When sufficient quantities are accumulated, it has been the District's practice in the past to pulverize or otherwise recover the HMA for use as aggregate and temporary surfacing of excavations and drive surfaces.

The area surrounding this temporary storage area is protected from runoff and erosion with low earthen berms and wattles which are periodically maintained. The District's operations require 24/7 access to this site, often at times other than daylight hours. With these conditions for haul truck access, a complete perimeter enclosure of silt fence or other runoff retention means is not practical. However, the District's use of this site over the last 30 years for this purpose has proven to be successful in preventing unacceptable erosion or sediment transport. This area is accessed through the secure water treatment site.

TABLE III-1

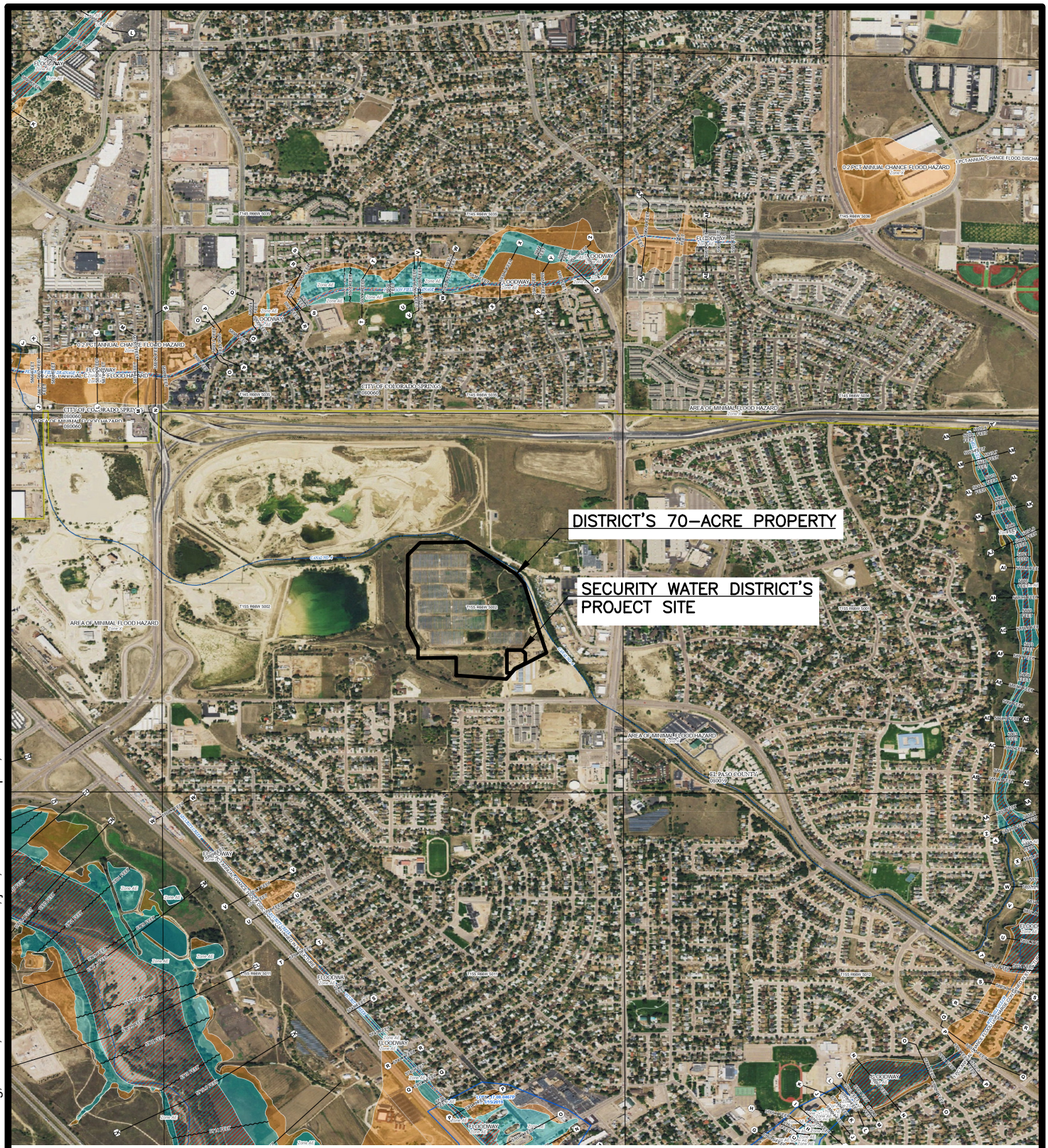
MAJOR DRAINAGE BASIN CHARACTERISTICS

SECURITY WATER DISTRICT

Basin ID	Area (ac)	Slopes	Description
SUB 1	9.56	5 to 20%	SUB 1 is located southwest of the District's fenced WTP site, south of the District's larger 70-acre property. Flow is conveyed to the south and southwest, extending to the low point on the north side of Bradley Road. This sub-basin is mostly comprised in adjacent property lots to the southwest of the WTP. The primary ground cover consists of bare soil, sparse native grass and asphalt roadways.
SUB 2	69.62	4 to 9%	SUB 2 primarily covers the District's 70-acre property and consists mostly of native grasses and shrubs. Runoff is directed by existing topographic conditions to the existing retention area within the impoundment area of the Little Johnson Reservoir.
SUB 3	15.57	4 to 12%	SUB 3 is located to the southeast of the 1.7-acre fenced WTP property. At the present time, there is a graded swale adjacent to the south edge of the access road through the District's WTP property. That graded swale generally intercepts runoff from the District's property naturally flowing southerly and directs it to culverts under the District's access road (extension of Lincoln Plaza Drive). At the present time, it is not recognized that any runoff from the District's property enters the adjacent mini storage development (Bradley Storage Subdivision). The Bradley Storage Subdivision is completely drained to an on-site detention facility with a piped outlet to the roadside ditch along the north side of Badley Road.

B. FLOODPLAIN IMPACTS

There is no FEMA designated floodplain associated with Fountain Mutual Irrigation Canal. The 2018 Flood Insurance Rate Maps (FIRM) for the District's property, produced by Federal Emergency Management Agency (FEMA), are shown in the following figure. These FIRM maps indicate that the District's entire property lies outside of the 100-year floodplains of Fountain Creek located approximately 1.5 miles west of the WTP and the Peterson Field Drainageway located approximately 1.0 miles north of the WTP.



FLOOD HAZARD INFORMATION

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

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

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at https://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates, refer to 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 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **8/7/2025 3:27 PM** and does not reflect changes or amendments to subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418.

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. 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.

SCALE

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map, please see the Flood Insurance Study (FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

N

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

0 50 100 200 300 400 Meters

FEMA FLOODPLAIN MAP NUMBERS:

08041C0763G
08041C0744G
08041C0761G
08041C0742G

FIGURE III-2.DWG

FIGURE III-2
FEMA FLOODPLAIN MAP
SECURITY WATER DISTRICT

GMS, INC.

CONSULTING ENGINEERS
611 N. WEBER, SUITE 300
COLORADO SPRINGS, COLORADO 80903

MAY 2026

G:\SECURITY\2023-053\130\Drainage Report\Figure III-2.dwg, 8.5x11, 5/8/2026 12:05:58 PM, jms, DWG To PDF.pc3, 1:1

SECTION IV
HYDROLOGY

A. HYDROLOGIC CRITERIA

This drainage analysis has been prepared in accordance with the current El Paso County Drainage Criteria Manual (DCM) and the City of Colorado Springs DCM Volume 1 dated May 2014 and revised in January 2021 and Volume 2 revised in December 2020. The Urban Storm Drainage Criteria Manual is referenced when applicable. Hydrologic calculations were performed to determine runoff quantities for the 5-year and 100-year frequency storms for existing and developed conditions using the Rational Method as required for basins having areas less than 130 acres according to Chapter 6 of the El Paso County DCM Volume 1 Update.

A variance from the Full Spectrum Detention (FSD) is requested. Full spectrum detention facilities are required in accordance with Section 3.2.1. of Chapter 13 of the City/County DCM Volume 1, dated May 2014, effective January 31, 2015. However, an existing downstream regional detention facility on the District's larger 70-acre property provides detention, or retention in this case, for minor and major storm events. The 2014 City of Colorado Springs DCM Volume 1 - "On-Site Detention Requirements When Regional Detention is Provided" Policy Verification dated August 2017 and revised September 2017 states if the downstream regional detention provides detention for the minor (5-year) and major (100-year) storm events, then only the water quality capture volume (WQCV) is required on-site. The pond on the District's property is sized for minor and major storm events; thus, only the WQCV is designed for the proposed improvements.

B. PRECIPITATION DATA

Precipitation data for the Security-Widefield area was taken from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Precipitation Frequency Server to calculate rainfall intensity. The table below contains the 1-hour point precipitation values in inches for the average recurrence intervals in years. See Appendix A for NOAA Atlas 14 data.

TABLE IV-1

PRECIPITATION DATA

SECURITY WATER DISTRICT

Point Precipitation Frequency (in inches)							
Duration	Average Recurrence Interval (years)						
	2	5	10	25	50	100	500
60-min	1	1.28	1.55	1.96	2.32	2.72	3.78

C. RATIONAL METHOD

A runoff coefficient was established for each of the sub-basins that make up the 1.7-acre WTP site and drain to their respective basins. This component of the hydrologic calculation has been developed utilizing the existing land uses and the land surface conditions.

Since all the basins are less than 130 acres, the rational method is used to calculate runoff from all the on-site basins. The rational formula is as follows:

$$Q = C \cdot i \cdot A$$

Where,

Q = Peak runoff rate, in cubic feet per second (cfs)

C = Runoff coefficient representing a ratio of peak runoff rate to average rainfall intensity for a duration equal to the runoff time of concentration

i = average rainfall intensity, in inches per hour (in/hr)

A = Area of basin, in acres (ac)

D. FOUR STEP PROCESS

The proposed improvements consist of a 51-foot by 40-foot building addition with new asphalt travel ways replacing the existing gravel drives. These improvements will follow the Urban Drainage Flood Control District “Four Step Process” to reduce runoff volumes, stabilize drainage ways, treat the WQCV, and implement long-term source controls.

1. Proposed Runoff Management

The improvements include new asphalt around the perimeter of the existing building and the building addition, which will increase the peak stormwater flows for downstream users. These flows will be retained on District property with the addition of grass lined swales along the perimeter of the WTP property to redirect the increased flow back to the District's larger 70-acre property. Newly developed grass swales along the west and south sides will direct flow to a culvert, that traverses under the paved road, and discharges to the southwest of the property. A swale to the north and along the east will flow into a temporary detention pond, where an overflow concrete crosspan will cross the asphalt drive to the south swale. At the discharge of the swales and culverts, a newly constructed bioretention pond, denoted as SWD Pond No. 1, will be placed to the southwest of the site to convey the increased flow to the center of the District's property to be captured by the basins low point, which is currently a pond. SWD Pond No. 1 will be sized for the WQCV, and be installed with appropriate medias to infiltrate and discharge the WQCV at reduced flows. The area outside the WTP property consists primarily of pervious surfaces such as grass, trees, and shrubs and will retain the District's increased onsite drainage from downstream developments. SWD Pond No. 1 will include a spillway for larger storm events to control and direct flows towards the District's 70-acre property.

2. Stabilization of Drainageways

New grass lined swales will redirect runoff from entering any adjacent properties to the south. A newly constructed bioretention pond at the WTP's main discharge point will prevent stormwater runoff from flowing downstream onto adjacent properties. This pond also be utilized as a WQCV to dissipate flows exiting the culvert and slowly release onto the District's larger property.

3. Proposed Water Quality Capture Volume (WQCV)

A new WQCV is proposed through SWD Pond No. 1 designed for partial infiltration. The captured runoff is temporarily stored within the ponded surface storage area and allowed to infiltrate vertically through the engineered bioretention media, where filtration,

adsorption, and biological uptake provide pollutant removal. The system will include a subsurface underdrain to safely convey excess runoff at a controlled, reduced discharge rate, while the majority of captured WQCV is intended to infiltrate into the underlying soils. This approach provides stormwater quality treatment through filtration, soil contact, and infiltration processes, supporting pollutant removal and reducing runoff volumes in accordance with applicable design criteria.

4. Industrial and Commercial Best Management Practices (BMPs)

This report provides a final grading and erosion control plans with BMPs in place. The proposed project will use silt fences, swales, mulching and reseeding to mitigate the potential for erosion across the site.

E. EXISTING MINOR SUB-BASIN DRAINAGE CONDITIONS

The focus of this Drainage Report is on the District's 1.7-acre fenced in property. The District's WTP is located approximately 400 feet west of the Fountain Mutual Irrigation Canal. The, "Security PFOS / PFOAS Drinking Water Mitigation System Drainage Letter," was prepared for El Paso County in May 2019 by URS Group, Inc. for the original construction of the District's existing water treatment plant. The report stated that existing drainage patterns would be maintained as part of the improvements. Existing facilities were not analyzed as part of the project, and no new drainage infrastructure was constructed as part of the treatment plant project.

For the purposes of this analysis, the minor drainage basins were further delineated using on-site survey using modern methods with 1- and 5- contours. The WTP site resides on a topographical high point; thus, off-site runoff is not a consideration for this report. The WTP site drains to three primary sub-basins as previously denoted. The sub-basin delineations in the WTP site were subdivided to Sub-Basins 1A, 2A, and 3A with Sub-Basin 1A contributing to Sub-Basin 1, -2A contributing -2, and -3A contributing to -3. A description and the peak runoff for the 5-year and 100-year storm events are included in the following table. Imperviousness was determined using surveyed data. The peak runoff calculations for the existing site are attached in Appendix B along with the tributary area, weighted C coefficients, impervious areas, and rain intensity. Rainfall intensities differ between Sub-Basins 1A and

3A compared to Sub-Basin 2A, primarily due to the variations in time of concentration. Per the Mile High Flood District "Calculation of Peak Runoff using Rational Method" worksheet in Appendix B and C, rainfall intensity is a factor of 1-hour precipitation depths and time of concentrations. A smaller time of concentration equals a larger rainfall intensity and vice versa. Sub-Basin 1A is significantly smaller than the other sub-basins, resulting in a much shorter flow path and a greater rainfall intensity. The following figure delineates the existing sub-basins through the District's WTP site along with the relevant hydraulic data.

SUB–BASIN 2

3A	2.38
1.19	5.07
0.16	0.46
0.32	1.94

3A

DISTRICT'S 1.7–ACRE FENCED IN WTP SITE

EXISTING STORAGE TANK

EXISTING WTP BUILDING

2A	2.45
0.50	5.20
0.17	0.20
0.33	0.84

5850

5855

5855

5855

5855

5855

DISTRICT 70–ACRE PROPERTY BOUNDARY

SUB–BASIN 3

12" CSP CULVERT

18" CSP CULVERT

2A

1A

1A	4.34
0.01	9.23
0.53	0.02
0.65	0.04

SUB–BASIN 1

BASIN #
ACREAGE
5–yr C–FACTOR
100–yr C–FACTOR

1A	1.49
26.45	3.24
0.04	1.65
0.45	39.02

5–YR INTENSITY (in/hr)
100–YR INTENSITY (in/hr)
5–YR FLOWS (CFS)
100–YR FLOWS (CFS)

PATH FOR TIME OF CONCENTRATION

SUB–BASIN BOUNDARY

FLOW ARROW

1A DESIGN POINT

N

0' 50' 100'

SCALE: 1" = 50'

FIGURE IV–1.DWG

FIGURE IV–1
EXISTING MINOR DRAINAGE BASIN
SECURITY WATER DISTRICT

GMS, INC.

CONSULTING ENGINEERS
611 N. WEBER, SUITE 300
COLORADO SPRINGS, COLORADO 80903

MAY 2026

TABLE IV-2

EXISTING MINOR DRAINAGE BASIN CHARACTERISTICS

SECURITY WATER DISTRICT

Basin ID	Area (AC)	Slopes (%)	5-Year Flow (Minor Storm) (cfs)	100-Year Flow (Major Storm) (cfs)	Description
SUB 1A	0.003	1 to 3%	0.02	0.04	SUB 1A is a small portion of land in the southwest corner by the entrance to thes site. Runoff is conveyed south along the gravel road onto Lincoln Plaza Drive. Primary ground cover is the gravel road.
SUB 2A	0.50	1 to 6%	0.20	0.84	SUB 2 is the area to the west of the WTP building. Flow is conveyed to the southwest, through two existing culverts and off the secured WTP site. The primary ground cover consists of the metal roofing from the storage tank, native grasses, concrete walkways, bare soil and gravel drives.
SUB 3A	1.19	5 to 9%	0.46	1.94	SUB 3 is the land to the north, east, and south of the WTP area. Runoff flows to the south and east. The primary ground cover is native grasses and gravel drives. Runoff was historically conveyed to adjacent properties.

F. PROPOSED MINOR SUB-BASIN DRAINAGE CONDITIONS

The proposed improvements to the District's WTP site include a new 51-feet by 40-feet building addition, with hot mix bituminous pavement to replace the existing gravel travel ways around the treatment complex. New swales will be included around the perimeter of the District's site to better control and convey stormwater runoff. A map of the proposed improvements is included in the back of this report, denoted Figure IV-2.

The proposed swales will increase the number of sub-basins to seven (7). Of these seven sub-basins, two of the sub-basins will continue to flow onto adjacent properties the same as has historically occurred with "undeveloped" hydrologic conditions.. The peak runoff calculations for the proposed site are attached in Appendix C along with the tributary area, weighted C coefficients, impervious areas, and rain intensity. The following Figure IV-3

delineates the proposed sub-basins through the District's WTP site along with the relevant hydraulic data. The sub-basins are identified as Design Points (DP), which is the location of flow before a hydraulic structure conveys the runoff to other sub-basins.

These improvements aim to redirect flow from draining to adjacent properties and to retain the runoff generated within the secured site on District owned property. Because both parcels are under District ownership, directing runoff between them does not constitute an offsite discharge concern. Refer to Figure IV-4 for the flow path of the generated runoff from the 1.7-acre water treatment plant to the low point of the District's larger 70-acre property. The terminal destination of runoff is a 0.5-acre pond located at the low point on the District's downstream property. This pond is designed to retain runoff from the entire contributing area, with water dissipating through infiltration and evaporation. Runoff will not be pumped or discharged offsite under the analyzed storm events.

The proposed improvements retain and manage stormwater runoff generated solely from on-site precipitation and do not intercept, divert, or diminish flows from any natural waterway. The Colorado Division of Water Resources (DWR) was contacted to evaluate potential impacts to downstream water rights resulting from the proposed improvements. Existing runoff from Basins 1 and 3 currently combine and convey flows along the roadside ditch adjacent to Bradley Road, beneath Bradley Road, and toward a low point within a buffalo grass area. This grass area appears to be a topographical low point, where flows appear to be detained and infiltrate into the ground. These basins do not discharge to natural waterways. The proposed bioretention system will provide similar infiltration-based stormwater management on District property, consistent with existing site hydrology. As such, no injury to existing water rights is anticipated. At the time of this report, formal confirmation from DWR has not yet been received.

SUB–BASIN 2

2A	3.31
0.20	7.04
0.18	0.12
0.34	0.47

2E	3.39
0.49	7.21
0.47	0.78
0.59	2.09

EXISTING STORAGE TANK

EXISTING WTP BUILDING

PROPOSED BUILDING ADDITION

WQCV

DISTRICT 70–ACRE PROPERTY BOUNDARY

NEW CONCRETE PAN

2B	3.58
0.26	7.61
0.63	0.58
0.72	1.42

2C	3.20
0.35	6.79
0.42	0.47
0.55	1.32

SUB–BASIN 3

SUB–BASIN 3

12" CSP CULVERT

18" CSP CULVERT

2D	3.51
0.39	7.45
0.50	0.68
0.62	1.79

NEW SWD POND NO. 1

1A	3.46
0.01	7.36
0.01	0.00
0.13	0.01

3A	4.34
0.01	9.23
0.16	0.01
0.32	0.03

SUB–BASIN 1

BASIN #
ACREAGE
5–yr C–FACTOR
100–yr C–FACTOR
5–YR INTENSITY (in/hr)
100–YR INTENSITY (in/hr)
5–YR FLOWS (CFS)
100–YR FLOWS (CFS)

1A	1.49
26.45	3.24
0.04	1.65
0.45	39.02

PATH FOR TIME OF CONCENTRATION

SUB–BASIN BOUNDARY

FLOW ARROW

DESIGN POINT

N

0' 50' 100'

SCALE: 1" = 50'

FIGURE IV–3.DWG

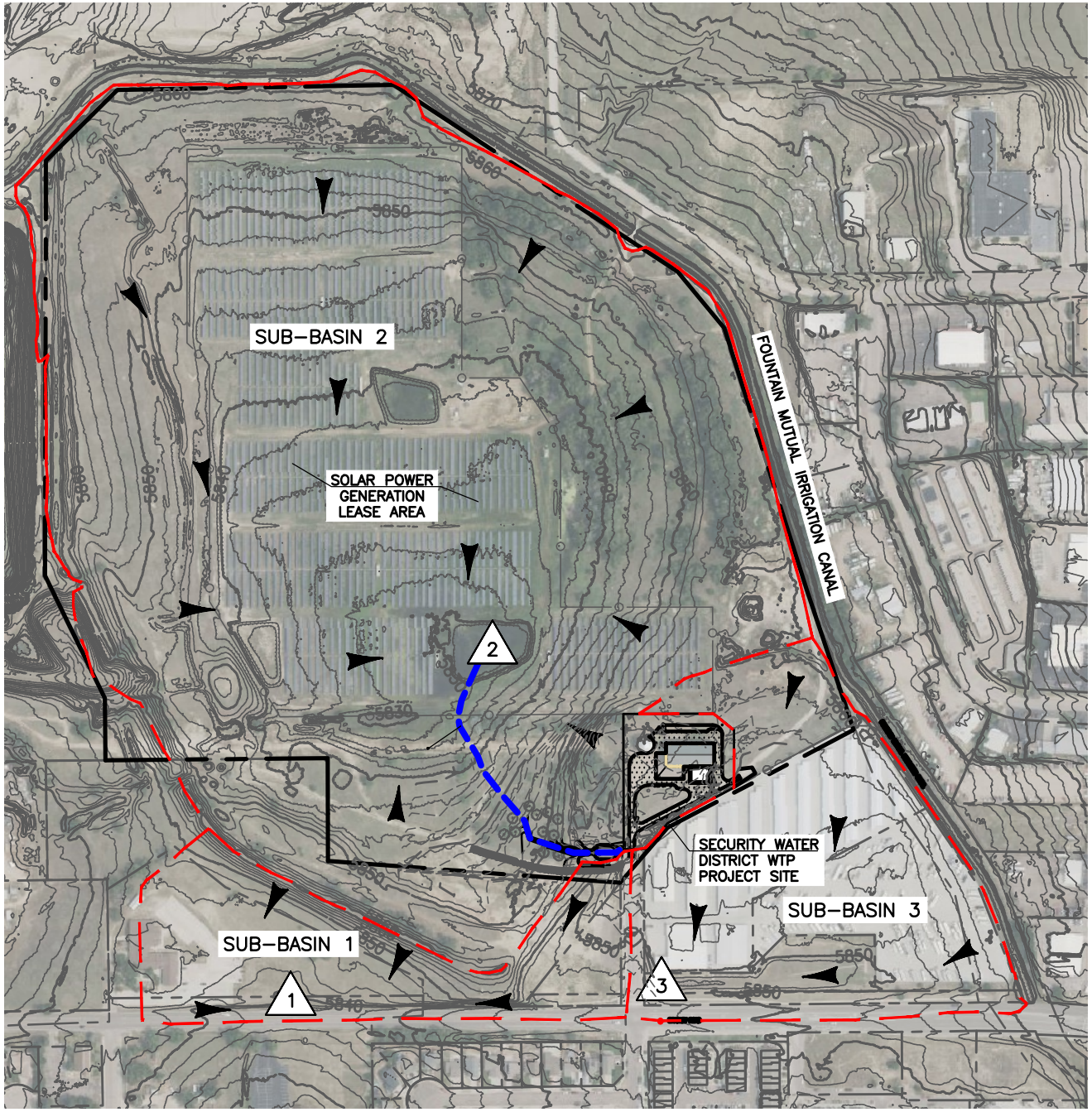
FIGURE IV–3
PROPOSED MINOR DRAINAGE BASIN
SECURITY WATER DISTRICT

GMS, INC.

CONSULTING ENGINEERS
611 N. WEBER, SUITE 300
COLORADO SPRINGS, COLORADO 80903

MAY 2026

G:\SECURITY\2023-053\130\Drainage Report\Figure IV-4.dwg, 8.5x11 (2), 5/8/2026 2:15:34 PM, jms



SCALE: 1" = 400'

N

DRAINAGE BOUNDARY

DISTRICT PROPERTY LINE

TIME OF CONCENTRATION

1 DESIGN POINT

FLOW ARROW

SOURCE: CONTOUR MAPPING FROM LIDAR DATA FROM THE COLORADO HAZARD MAPPING AND RISK MAP PORTAL BY THE COLORADO WATER CONSERVATION BOARD. DATED 2018. THE SITE WATERSHED BOUNDARY IS BASED ON PROPOSED GRADING FROM FIGURE IV-2.

FIGURE IV-4.DWG

FIGURE IV-4
PROPOSED MAJOR DRAINAGE BASIN
SECURITY WATER DISTRICT

GMS, INC.

CONSULTING ENGINEERS
611 N. WEBER, SUITE 300
COLORADO SPRINGS, COLORADO 80903

MAY 2026

TABLE IV-3

PROPOSED MINOR DRAINAGE BASIN CHARACTERISTICS

SECURITY WATER DISTRICT

Proposed Design Point (DP)	Tributary Area (AC)	Slopes (%)	5-Year Flow (Minor Storm) (cfs)	100-Year Flow (Major Storm) (cfs)	Description
DP 1A	0.01	2 to 8%	0.00	0.01	SUB 1A is the area of improvement just to the south of the District's property, outside of the fenced property line. These improvements include the new asphalt drive. Runoff sheet flows to the southwest and off the District's property. The primary ground cover consists of native grasses, bare soil and an asphalt drive.
DP 2A	0.20	2 to 4%	0.12	0.47	SUB 2A is the northwest corner of the WTP site. Runoff is conveyed to an existing swale that discharges into riprap, and onto the District's larger property. The primary ground cover is native grass and the existing storage tank.
DP 2B	0.26	1 to 3%	0.58	1.42	SUB 2B primarily consists of the asphalt drive to the east of the WTP building. Runoff flows to the south and west The primary ground cover is asphalt. Runoff sheet flows to an enhanced swale along the western boundary of the secured site, and discharges into the District's new WQCV.
DP 2C	0.35	1 to 4%	0.47	1.32	SUB 2C consists of the center of the District's site. Runoff sheet flows to the south, where a newly developed swale conveys the flow to the District's existing 12-inch culvert. The primary ground cover is native grass, asphalt pavement, and the existing metal building.
DP 2D	0.39	2 to 7%	0.68	1.79	SUB 2D consists of the southern areas of the WTP site. Runoff sheet flows to the south, and channelizes along the proposed southern swale and discharges at the District's existing 18-inch culvert. The primary ground cover is the proposed asphalt drives, proposed building addition, and vegetated swale.

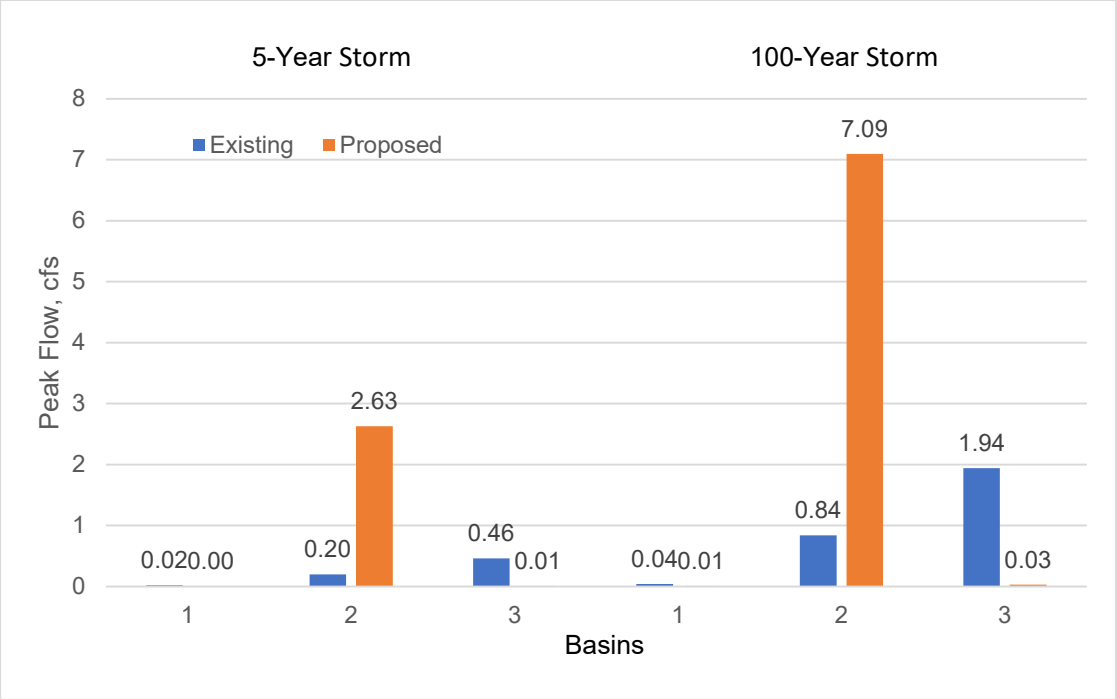
TABLE IV-3, Cont'd

Proposed Design Point (DP)	Tributary Area (AC)	Slopes (%)	5-Year Flow (Minor Storm) (cfs)	100-Year Flow (Major Storm) (cfs)	Description
DP 2E	0.49	1 to 3%	0.78	2.09	SUB 2E consists of the northern and eastern areas of the WTP building. Runoff sheet flows off the asphalt drives into the newly developed swale. The swale ends at the District's WQCV along the east of the WTP building. Overflow discharges across the asphalt drive and into the southern swale.
DP 3A	0.01	8%	0.01	0.03	SUB 3A is the area of improvement just to the south of the District's property, outside of the fenced property line. These improvements include the new asphalt paved drive. Runoff sheet flows to the southeast and off the District's property. The primary ground cover consists of native grasses and asphalt drives.

G. EXISTING AND PROPOSED WTP SUB-BASIN COMPARISONS

The existing and proposed improvements have been compared side by side to compare the existing versus the proposed discharges to their respective major basins. The following graph displays the minor sub-basin runoffs for both the 5- and 100-year storm events.

FIGURE IV-5
5- AND 100-YEAR RUNOFF COMPARISONS
SECURITY WATER DISTRICT



The figure above shows that the proposed improvements reduce on-site runoff from Sub-Basins 1 and 3 for both the 5-year and 100-year storm events. These improvements redirect flow toward the District's larger 70-acre property (Sub-Basin 2). As a result, the proposed improvements do not affect downstream properties, and any increase in runoff due to the improvements will be retained on District property.

SECTION V
STORMWATER MANAGEMENT FACILITY DESIGN

A. CULVERTS

The proposed improvements will leverage existing facilities to optimize construction and maintenance costs. The existing facilities include a 12-inch and 18-inch culverts that traverse underneath the gravel drives at the southwest corner of the WTP secured site. These culverts are constructed of corrugated steel pipe (CSP).

The 12-inch CSP culvert is approximately 30 feet in length with a longitudinal slope of 2.0%. This culvert traverses underneath the east/west gravel drive that passes through the WTP site and onto the larger 70-acre property. With the newly paved drives, an added 10-feet of the 12-inch culvert will be added to the north of the existing culvert to maintain adequate slopes and discharges with the new pavement grading. The 18-inch CSP is approximately 50 feet in length with a longitudinal slope of 1.1%. This culvert underlies the north/south gravel drive providing primary access to the entrance of the WTP building. No modifications will be made to this culvert.

According to Chapter 9 of the El Paso County DCM Volume 1, culverts will be chosen which will not cause damage to adjacent properties for the 100-year storm. The Urban Drainage Criteria Manual (UDCM) Volume 2 Chapter 11 was used to verify the capacity of the existing culvert. The UDCM also recommends that the headwater depth to culvert diameter ratio (HW/D) should not exceed 1.5 for the 100-year event peak flow, a minimum pipe diameter of 15 inches for culverts, and that the culvert must be sloped to provide a minimum outlet pipe velocity of 3 feet per second (fps). The Federal Highway Administration HY-8 Culvert Analysis Program was used to analyze the performance of the existing 12-inch and 18-inch CSP culverts with the increase in flow rates from the proposed improvements. Design calculations for each culvert can be found in Appendix D.

The results indicate that the existing culverts are adequate to handle the increased flows from the impervious areas. The 12-inch CSP culvert had a HW/D ratio of 0.8 and the 18-inch CSP culvert has a HW/D ratio of 1.0. Outlet velocities were 3.5 fps and 4.8 fps, respectively.

Based on the modeling, the flows will not cause overtopping of the roadways. Thus, these culverts are adequate for the increase flows from the improvements.

It is noted that the existing 12-inch culvert is below the recommended size; however, the culvert is adequate to convey the required flows from the minor basin. If the culvert needs to be replaced in the future, it can be upsized to the recommended minimum size.

B. SWALES

Swales provide a cost-effective solution to convey stormwater while preventing flooding and erosion, and providing some level of water quality control or maintenance. The UDCM Volume 1 Chapter 8 provides some design criteria for determining channel lining, geometry, and depth based on flow rate and channel slope. Where possible, it is recommended that channels be designed to provide a minimum of one-foot of freeboard, referring to the distance from the top of the water surface to the top of the ditch, for the minor storm event. However, the City/County Swale Freeboard Policy Clarification, dated March 9, 2023 states that no freeboard is required for swales less than 18-inches deep.

The proposed minor drainage channels have been sized utilizing Manning's equation for open channel flow, assuming a friction factor ("n") of 0.030 for grass vegetated channels. The proposed channel improvements have generally been designed as grass-lined channels designed to convey 100-year flows, with a trapezoidal cross-section, 4:1 maximum side slope, freeboard of 1-foot and a minimum slope of 0.5%. Maximum allowable velocities have been evaluated based on the City/County drainage criteria, typically allowing for a maximum 100-year velocity of 5 feet per second for native grass channels. The proposed channel segments will generally be seeded with native grasses for erosion control. All the swale flows will be conveyed to the WQCV near the southwest extent of the District's secured WTP site.

For this analysis, the swales were divided and named for the basin it conveys flow from. The proposed improvements have four proposed channels and one existing channel. The analysis also includes the concrete cross pan overflow for the WQCV on the east side of the secured site. Hydraulic calculations were conducted with Federal Highway Administration Hydraulic Toolbox. The hydraulic calculations can be seen in Appendix E, along with the

modeling inputs and results. These calculations show the longitudinal and side slopes, velocity, water depth, and freeboard depth for the 5- and 100-year storm events.

All channels meet the 4:1 side slope requirement, except for the swale serving sub-basin 2D that has a side slope of 2.5:1 on the pavement side of the swale. A variance is requested to increase the channel's side slopes serving this basin. The required side slopes cannot be attained due to property ownership constraints. An erosion control blanket will be provided on the portions of the swale that are steeper than 3:1. Swales serving Sub-Basins 2A, 2B, 2C and the concrete crosspan overflow are less than 18 inches deep, thus a 1-foot freeboard is not required. Sub-Basins 2D and 2E have freeboard depths of at least two feet. All other criteria satisfy the drainage regulations.

The proposed swales provide more than enough capacity to handle runoff from a 100-year storm event. The WQCV basin at the southwest corner of the District's WTP property will aid in dissipating the higher velocity flows and limit or mitigate downstream erosion on the District's owned property.

C. STORMWATER STORAGE FACILITIES

The 2014 City/County DCM Volume 1 - "On-Site Detention Requirements When Regional Detention is Provided" Policy Verification, dated August 2017 and revised September 2017, states if the downstream regional detention provides detention for the minor (5-year) and major (100-year) storm events, then only the WQCV is required on-site. The pond on the District's 70-acre property has a surface area of 0.5-acres, providing adequate storage for minor and major storm events. Therefore, only the WQCV is designed for the proposed improvements to enhance water quality benefits.

D. WATER QUALITY ENHANCEMENT BEST MANAGEMENT PRACTICES

SWD Pond No. 1 is proposed to provide permanent water quality treatment for runoff generated by the proposed site improvements. The facility has been designed in accordance with the criteria outlined in the Mile High Flood District Urban Storm Drainage Criteria Manual (USDCM), Volume 3, utilizing the SCM Design Workbook for preliminary sizing and configuration. Detailed SCM design calculations are provided in Appendix F, and supporting

detention routing calculations demonstrating compliance with required drain time criteria are included in Appendix G. The proposed SWD Pond No. 1 is sized to capture and treat the required Water Quality Capture Volume (WQCV) through a partial infiltration system that promotes filtration and infiltration while safely conveying excess treated runoff through an underdrain system. Because increased flows are directed to the District's downstream drainage system, an outlet structure limiting discharge to historic rates is not required. The bioretention facility is therefore designed solely to capture and treat the WQCV. The total required WQCV for the proposed facility is 0.027 acre-feet.

The SWD Pond No. 1 consists of an 18-inch engineered bioretention media layer underlain by a 6-inch sand transition layer and washed aggregate drainage layer containing a 4-inch factory-slotted Schedule 40 PVC underdrain. The engineered bioretention media shall conform to the gradation and composition requirements of Table BR-3, Chapter 4 of the MHFD Urban Storm Drainage Criteria Manual. The media surface will be seeded with native, drought-tolerant grasses adapted to both periodic inundation and dry conditions. Full vegetative cover will promote filtration, prevent erosion, and promote long term treatment performances.

The surface media has a proposed elevation at 5851.50. The underdrain will have an invert elevation of 5849.17 feet. The underdrain outlet is fitted with a single 3/4-inch diameter terminal orifice plate to regulate discharge and achieve the required extended detention drawdown period. This underdrain extends approximately 48 feet along the length of the pond before transitioning to a solid PVC pipe for daylight discharge. Detention routing confirm that the WQCV fully drains in approximately 13 hours, satisfying MHFD criteria requiring a minimum 12-hour drawdown period to provide adequate water quality residence time. Cleanout risers are provided at the upstream underdrain endpoint for inspection and maintenance. The PVC cap at the terminal will be a threaded cap to allow for proper flushing of the underdrain.

Overflow from storm events exceeding the WQCV will be safely conveyed over the proposed overflow spillway, preventing overtopping of the berms and directing the runoff towards the District's larger property. Riprap protection, consiting of 6-inch D50 Type M riprap, will be installed at the ponds inlet and outlets to prevent scouring and localized erosion. The spillway crest elevation is proposed at 5852.50, which is above the WQCV ponding depth. The top

of the berms adjacent to each side of the spillway will be set at 5853.50 feet to provide a minimum of 1 foot of freeboard.

The Contractor will be required to implement Best Management Practices (BMPs) for erosion control throughout the construction project. Silt fences will provide sediment control at the toe of disturbed slopes and downgradient from areas disturbed by construction. Cut slopes will be stabilized during excavation and vegetation will be established on disturbed soils as soon as possible.

The proposed SWD Pond No. 1 shall be routinely inspected and maintained to preserve long-term treatment performance and hydraulic function. Maintenance activities shall include semi-annual inspections and additional inspections following major storm events to evaluate sediment accumulation, erosion, standing water, vegetation health, and underdrain performance. Accumulated sediment, trash, and debris shall be removed as necessary to maintain design storage capacity and proper flow distribution. The facility shall be maintained with full vegetative cover using native drought-tolerant grasses, with bare areas reseeded and invasive vegetation removed as needed. The underdrain assembly shall be periodically inspected and flushed to ensure the required 12-hour drawdown time is maintained. Temporary irrigation shall be provided during vegetation establishment and removed once vegetation is fully established.

E. COST ESTIMATE AND DRAINAGE FEES

The portion of total project construction costs pertinent to temporary and permanent stormwater management infrastructure are presented on the El Paso County 2026 Financial Assurance Form (FAE). A preliminary construction cost estimate for SWD Pond No. 1 is provided in the following table.

TABLE V-1

SWD POND NO. 1 COST ESTIMATE

SECURITY WATER DISTRICT

Item	Description	Quantity	Unit Cost	Total Cost
1.	4-inch Schedule 40 PVC Factory-Slotted Underdrain Pipe	48 LF	$ 80	$ 3,840
2.	4-inch Schedule 40 solid PVC pipe	52 LF	$ 60	$ 3,120
3.	Engineered Bioretention Media for SWD Pond No. 1	50 CY	$ 120	$ 6,000
4.	Non-woven Geotextile Synthetic Membrane	55 SY	$ 10	$ 550
5.	6-inch Filter Sand Transition Layer	6 CY	$ 140	$ 840
6.	No. 8 Aggregate Drainage Layer	5 CY	$ 120	$ 600
7.	Concrete Spillway Overflow Structure	2 CY	$ 1,500	$ 3,000
8.	Type M Riprap (6-inch d50)	6 CY	$ 250	$ 1,500
9.	Reclaimed Concrete Access Road	58 SY	$ 35	$ 2,030
	Subtotal Preliminary Cost Estimate			$ 21,480
	Project Contingencies (at 15%)			$ 3,520
	Total Preliminary Cost Estimate			$ 25,000

The total financial assurance amount prepared in accordance with El Paso County requirements is $121,625, as documented in the FAE. This estimate includes all site grading and earthwork activities, vehicle travel surfaces and shoulders, erosion and sediment control measures, and construction of SWD Pond No. 1, including the underdrain system, bioretention media, aggregate drainage layer, and associated appurtenances.

Earthwork quantities included in the FAE are based on the calculations presented in Section 1, Grading and Erosion Control, of the Financial Assurance Estimate. A copy of the completed 2026 Financial Assurance Estimate is provided in Appendix H.

No drainage basin fees or bridge fees are applicable to this Site Development Plan.

SECTION VI

CONCLUSIONS AND RECOMMENDATIONS FOR IMPLEMENTATION

The proposed improvements to the Security Water District's WTP will increase the impervious areas on the property, thus increasing the on-site runoff volume. Modifications to the on-site drainage patterns will reduce the runoff impact on downstream land. New drainage facilities, designed and constructed in accordance with El Paso County standards, will safely convey increased flows to outfalls located on the District's property. The proposed stormwater swales and water quality facilities have been designed to mitigate the effects of added impervious surfaces on flow rates and to meet the County's stormwater quality requirements. These flows will be directed to the District's 70-acre site, where a 0.5-acre surface area pond has sufficient capacity to retain both the 5-year and 100-year storm events. Proper maintenance of these facilities by the District will ensure their long-term functionality and prevent impacts to downstream or adjacent properties.

SECTION VII
REFERENCES

El Paso County. *Drainage Criteria Manual.* 31 Oct 2018. Municode Library, https://library.municode.com/co/el_paso_county/codes/drainage_criteria_manual?nodeId=DRCRMACOELPACO. Accessed 28 Aug. 2025.

Federal Highway Administration. *Hydraulic Toolbox.* Built 21 July 2023.

City of Colorado Springs. *Drainage Criteria Manual. Volumes 1 and 2.* May 2014.

Mile High Flood District (MHFD). *Urban Storm Drainage Criteria Manual. Volumes I, II, III.*

National Oceanic and Atmospheric Administration (NOAA). *ATLAS 14, Volume 8: Precipitation Frequency Data Server (PFDS).* Online at https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=pa. Accessed 28 Aug. 2025.

United States Department of Agriculture (USDA) Natural Resources Conservation Service. *Web Soil Survey 2014/2015.* Online at https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx. Accessed 28 Aug. 2025.

EXISTING RAW WATER TANK
T.O.C. = 5859.10
TANK DRAIN
EXISTING BUILDING
F.F. EL. = 5858.70
PROPOSED BUILDING ADDITION
F.F. EL. = 5858.70
EXISTING SANITARY SEWER MANHOLE
RIM EL = 5857.78
FINISHED SURFACE EL = 5857.79
SILT FENCING AT OWNER'S DISCRETION – TYP.
AIR/VAC VAULT
RELOCATED FIRE HYDRANT
EXISTING TRANSFORMER
EXISTING ELECTRICAL GEAR
CONC. BOLLARD – TYP.
EXISTING GENERATOR
C 6A 6'–0" WIDE CONCRETE CROSSPAN
INLET PROTECTION – TYP.
WATTLE ALONG PERIMETER OF SOUTHERN CHAIN FENCE A 6
B 6A EMERGENCY SPILLWAY CREST EL. = 5852.50
INSTALL RIP–RAP, TYPE M, 6" d50 RIPRAP PLACED ON FILTER FABRIC 5' EACH SIDE OF CHANNEL FLOW LINE 10' WIDE, 15' LONG AND 1' DEEP CENTERED ON CULVERT CENTERLINE. KEY TOP AND BOTTOM TERMINATIONS 2' INTO SOIL.
EXISTING 12" CSP CULVERT
EXISTING 18" CSP CULVERT
INSTALL RIP–RAP, TYPE M, 6" d50 RIPRAP PLACED ON FILTER FABRIC 5' EACH SIDE OF CHANNEL FLOW LINE 10' WIDE, 15' LONG CENTERED ON CULVERT CENTERLINE. KEY TOP AND BOTTOM TERMINATIONS 2' INTO SOIL.
END OF 4–INCH PVC UNDERDRAIN PIPE. INSTALL 4–INCH PVC THREADED CAP. DRILL 3/4–INCH ORIFICE HOLE ON END. I.E. = 5848.67
REMOVE TREES AS NECESSARY
TRANSITION FROM 4–INCH ø FACTORY SLOTTED PIPE TO SOLID PVC. INSTALL 52 FEET OF SOLID PVC PIPE TO DAYLIGHT.
MATCH EXISTING ELEVATIONS TO MAINTAIN SECURITY GATE OPERATIONS. CONFIRM WITH ENGINEER.
INSTALL NEW 4" CLEANOUT D 6A
NEW 12' WIDE MAINTENANCE ACCESS ROAD E 6A
SWD POND NO. 1
MEDIA SURFACE EL. = 5851.50
MEDIA BASE EL. = 5850.00
TOP OF BERM EL. = 5853.50
A 6A
EL. = 5854.00
EL. = 5853.78
STRAW WATTLES 30' FROM TOE OF SLOPE
INSTALL 48 FEET OF 4–INCH ø SCHED 40 UNDERDRAIN FACTORY SLOTTED PIPE COMPLYING WITH MHFD TABLE 4–6 OPEN AREA REQUIREMENTS. INSTALL UNDERDRAIN AT 0.5% MINIMUM SLOPE.

N

0' 20' 40'
SCALE: HORIZ. 1" = 20'

NOTES:

1. ALL AREAS WITHIN THE SECURITY FENCE WHICH ARE NOT SURFACED WITH HOT MIX ASPHALT PAVEMENT, CONCRETE FLATWORK OR RECLAIMED CONCRETE AGGREGATE SHALL BE LANDSCAPED WITH NON–IRRIGATED GRASSES IN ACCORDANCE WITH SPECIFICATION SECTION 02900. IN ADDITION, AREAS DISTURBED BY CONSTRUCTION AND MANAGEMENT (STOCKPILING) OF EXCESS SOIL MATERIALS FROM THE SECURED SITE SHALL BE LIKEWISE LANDSCAPED.
2. THE SCOPE OF WORK IN LANDSCAPING WITH NON–IRRIGATED GRASSES SHALL INCLUDE SOIL PREPARATION WITH GRADING TO FINAL ELEVATIONS AS DIRECTED BY THE ENGINEER AND OWNER, TILLING, ADDITION OF FERTILIZERS, SEEDING OF GRASSES BY DRILLING, MULCHING AND TEMPORARY MANAGEMENT OF RUNOFF TO MINIMIZE OR ELIMINATE EROSION AND SEDIMENT GENERATION.
3. INSTALLATION OF NON–IRRIGATED GRASSES SHALL BE PLANNED FOR THE WINTER SEASON, 2025–2026, GENERALLY AFTER DECEMBER 1, 2025.
4. THE OWNER MAY INITIATE AN EXTENDED TEMPORARY EROSION AND SEDIMENT CONTROL PLAN (TESCP) AFTER INSTALLATION OF THE NON–IRRIGATED LANDSCAPING SHOULD IT BE DEEMED NECESSARY TO BEST GUARANTEE SUCCESSFUL ESTABLISHMENT OF GROUND COVER.
5. PER ADDENDUM NO. 1 EXCESS SOIL FROM CONSTRUCTION SHALL BE STOCKPILED AND GRADED TO ACCOMMODATE OWNER'S TESCP AT APPROX 150 FT NORTHEAST OF NORTHEAST SECURED FENCE NOTED WITH 3
6. CAUTION: EXISTING SECURITY GATE HAS DETECTOR LOOP BELOW EXISTING FINISHED ABC SURFACING WITHIN APPROX 30–FEET OF GATE. DO NOT DISTURB WITH SUBGRADE PREPARATION AND SURFACING OPERATIONS. SUBGRADE SCARIFICATION WITHIN 20–30 FEET OF GATE AT DETECTOR LOOP LOCATION IS NOT REQUIRED PROVIDED PROOF ROLLING OF EXISTING ABC SURFACING PROVES SATISFACTORY.

LEGEND

- EXISTING HMA PAVEMENT
- NEW HMA PAVEMENT 6" FULL DEPTH ON PREPARED SUBGRADE
- RECLAIMED CONCRETE SHOULDER COMPACTED MATERIAL, 6" DEPTH
- 5857 EXISTING ELEVATION CONTOUR LINE
- 5858
- 5857 FINISHED SURFACE ELEVATION CONTOUR LINE
- 5858
- NEW CONVEY WATER DITCH
- EXISTING EDGE OF ABC SURFACING

SCALE VERIFICATION
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY

REVISIONS

NO.	DATE	DESCRIPTION
1	01/13/2025	UPDATED WITH ADDENDA 1 FOR BIDDING
2	06/30/2025	UPDATED WITH REMS FOR PPRBD PLAN REVIEW SUBMITTAL

FIGURE IV–2
SITE GRADING, DRAINAGE, AND LANDSCAPING PLAN
SECURITY WATER DISTRICT

GMS INC CONSULTING ENGINEERS
611 N. WEBER, SUITE 300
COLORADO SPRINGS, COLORADO 80903
719–475–2935

DRAWN	SKC	PROJECT NO.	2023–053.116
DESIGNED	XX	GMS FILE NO.	3803
CHECKED	RJS		
DATE	OCTOBER 2024		

SHEET 1 OF 1

G:\SECURITY\2023-053\130 - SDP\Drainage Report\Figure IV-2.dwg, Site Grad Drng and Lscape Plan (2), 6/22/2026 9:33:11 AM, jms, DWG To PDF pc3, 1:1

APPENDIX A – PRECIPITATION FREQUENCY DATA SERVER

NOAA Atlas 14, Volume 8, Version 2
Location name: Colorado Springs, Colorado, USA*
Latitude: 38.772°, Longitude: -104.743°
Elevation: 5858 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.244** (0.202-0.298)	**0.294** (0.243-0.360)	**0.381** (0.314-0.468)	**0.460** (0.376-0.567)	**0.577** (0.458-0.749)	**0.674** (0.519-0.886)	**0.777** (0.576-1.05)	**0.888** (0.628-1.24)	**1.04** (0.707-1.50)	**1.17** (0.767-1.69)
10-min	**0.357** (0.295-0.437)	**0.430** (0.355-0.526)	**0.558** (0.459-0.686)	**0.673** (0.551-0.831)	**0.845** (0.670-1.10)	**0.987** (0.761-1.30)	**1.14** (0.844-1.54)	**1.30** (0.920-1.81)	**1.53** (1.04-2.19)	**1.71** (1.12-2.48)
15-min	**0.436** (0.360-0.533)	**0.524** (0.433-0.642)	**0.681** (0.560-0.836)	**0.821** (0.672-1.01)	**1.03** (0.817-1.34)	**1.20** (0.928-1.58)	**1.39** (1.03-1.87)	**1.58** (1.12-2.20)	**1.86** (1.26-2.67)	**2.09** (1.37-3.02)
30-min	**0.651** (0.539-0.797)	**0.783** (0.647-0.958)	**1.02** (0.836-1.25)	**1.22** (1.00-1.51)	**1.54** (1.22-1.99)	**1.80** (1.38-2.36)	**2.07** (1.54-2.80)	**2.37** (1.68-3.29)	**2.78** (1.89-3.99)	**3.12** (2.05-4.52)
60-min	**0.853** (0.706-1.04)	**1.00** (0.828-1.23)	**1.28** (1.06-1.57)	**1.55** (1.26-1.91)	**1.96** (1.57-2.57)	**2.32** (1.80-3.07)	**2.72** (2.02-3.69)	**3.15** (2.24-4.41)	**3.78** (2.57-5.44)	**4.30** (2.82-6.22)
2-hr	**1.06** (0.879-1.28)	**1.22** (1.02-1.49)	**1.55** (1.28-1.89)	**1.87** (1.54-2.29)	**2.39** (1.93-3.13)	**2.85** (2.23-3.76)	**3.36** (2.53-4.56)	**3.93** (2.82-5.49)	**4.77** (3.27-6.84)	**5.47** (3.62-7.87)
3-hr	**1.16** (0.967-1.40)	**1.32** (1.10-1.60)	**1.65** (1.38-2.01)	**2.00** (1.65-2.44)	**2.58** (2.10-3.39)	**3.10** (2.44-4.10)	**3.69** (2.80-5.01)	**4.36** (3.15-6.09)	**5.36** (3.70-7.68)	**6.20** (4.12-8.89)
6-hr	**1.32** (1.11-1.58)	**1.48** (1.25-1.79)	**1.85** (1.55-2.24)	**2.24** (1.86-2.72)	**2.90** (2.40-3.81)	**3.52** (2.80-4.64)	**4.22** (3.22-5.70)	**5.02** (3.66-6.97)	**6.22** (4.33-8.86)	**7.23** (4.84-10.3)
12-hr	**1.47** (1.24-1.75)	**1.68** (1.42-2.00)	**2.11** (1.78-2.53)	**2.55** (2.14-3.07)	**3.28** (2.72-4.26)	**3.95** (3.15-5.15)	**4.70** (3.61-6.29)	**5.55** (4.06-7.63)	**6.80** (4.77-9.62)	**7.86** (5.30-11.1)
24-hr	**1.64** (1.40-1.94)	**1.90** (1.62-2.26)	**2.42** (2.05-2.88)	**2.91** (2.46-3.49)	**3.70** (3.07-4.73)	**4.40** (3.52-5.66)	**5.16** (3.98-6.83)	**6.02** (4.43-8.19)	**7.26** (5.12-10.2)	**8.29** (5.64-11.7)
2-day	**1.87** (1.61-2.20)	**2.19** (1.88-2.58)	**2.78** (2.37-3.29)	**3.33** (2.83-3.96)	**4.18** (3.47-5.26)	**4.90** (3.95-6.24)	**5.70** (4.42-7.45)	**6.56** (4.86-8.84)	**7.81** (5.55-10.8)	**8.83** (6.06-12.3)
3-day	**2.04** (1.76-2.40)	**2.40** (2.06-2.82)	**3.04** (2.61-3.58)	**3.63** (3.10-4.30)	**4.53** (3.77-5.66)	**5.29** (4.27-6.69)	**6.11** (4.75-7.94)	**7.00** (5.21-9.37)	**8.27** (5.90-11.4)	**9.30** (6.42-12.9)
4-day	**2.19** (1.89-2.56)	**2.56** (2.22-3.01)	**3.24** (2.79-3.81)	**3.86** (3.30-4.56)	**4.79** (4.00-5.97)	**5.58** (4.52-7.03)	**6.42** (5.01-8.31)	**7.33** (5.47-9.78)	**8.63** (6.17-11.9)	**9.68** (6.70-13.4)
7-day	**2.56** (2.23-2.99)	**2.97** (2.58-3.46)	**3.70** (3.20-4.32)	**4.35** (3.75-5.12)	**5.34** (4.48-6.60)	**6.17** (5.03-7.72)	**7.06** (5.54-9.07)	**8.01** (6.01-10.6)	**9.37** (6.74-12.8)	**10.5** (7.29-14.4)
10-day	**2.89** (2.52-3.35)	**3.32** (2.90-3.86)	**4.09** (3.56-4.76)	**4.78** (4.13-5.60)	**5.81** (4.88-7.14)	**6.67** (5.45-8.30)	**7.58** (5.97-9.70)	**8.56** (6.45-11.3)	**9.95** (7.19-13.5)	**11.1** (7.75-15.2)
20-day	**3.77** (3.32-4.35)	**4.32** (3.80-4.99)	**5.26** (4.61-6.09)	**6.08** (5.29-7.07)	**7.26** (6.12-8.79)	**8.20** (6.74-10.1)	**9.18** (7.27-11.6)	**10.2** (7.74-13.3)	**11.6** (8.46-15.7)	**12.8** (9.01-17.4)
30-day	**4.50** (3.98-5.17)	**5.18** (4.57-5.95)	**6.29** (5.53-7.25)	**7.22** (6.31-8.37)	**8.52** (7.20-10.2)	**9.55** (7.86-11.7)	**10.6** (8.40-13.3)	**11.6** (8.85-15.1)	**13.1** (9.54-17.5)	**14.2** (10.1-19.3)
45-day	**5.45** (4.84-6.24)	**6.28** (5.57-7.19)	**7.61** (6.72-8.74)	**8.70** (7.64-10.0)	**10.2** (8.60-12.1)	**11.3** (9.32-13.7)	**12.4** (9.87-15.4)	**13.5** (10.3-17.3)	**14.9** (10.9-19.8)	**16.0** (11.4-21.7)
60-day	**6.28** (5.59-7.16)	**7.24** (6.44-8.26)	**8.76** (7.76-10.0)	**9.98** (8.80-11.5)	**11.6** (9.82-13.7)	**12.8** (10.6-15.4)	**14.0** (11.1-17.3)	**15.1** (11.5-19.3)	**16.5** (12.1-21.8)	**17.6** (12.6-23.7)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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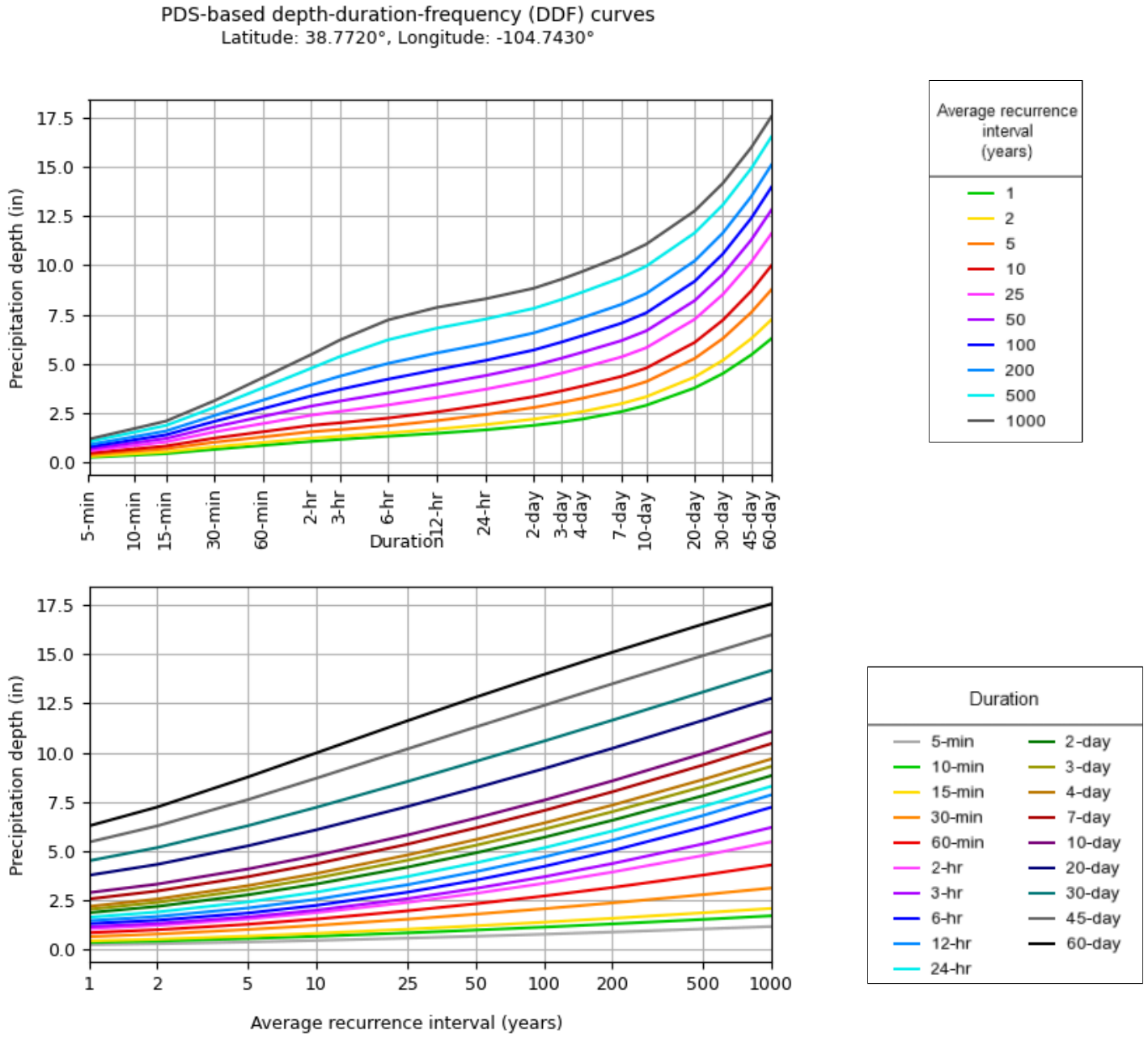
PF graphical



NOAA Atlas 14, Volume 8, Version 2

Created (GMT): Wed Aug 27 15:58:39 2025

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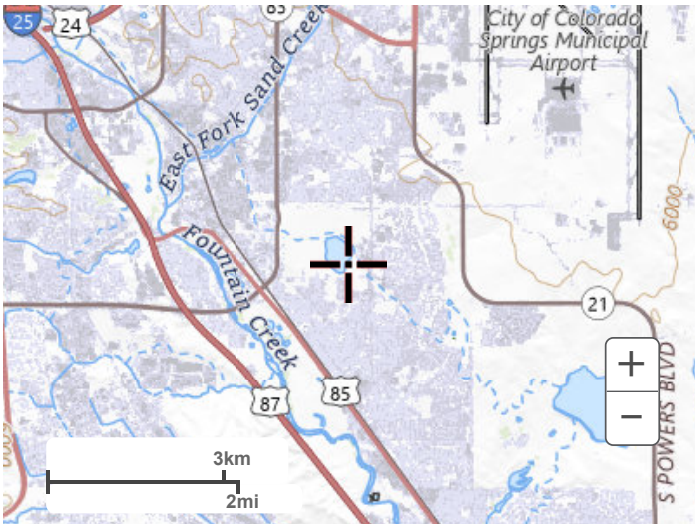
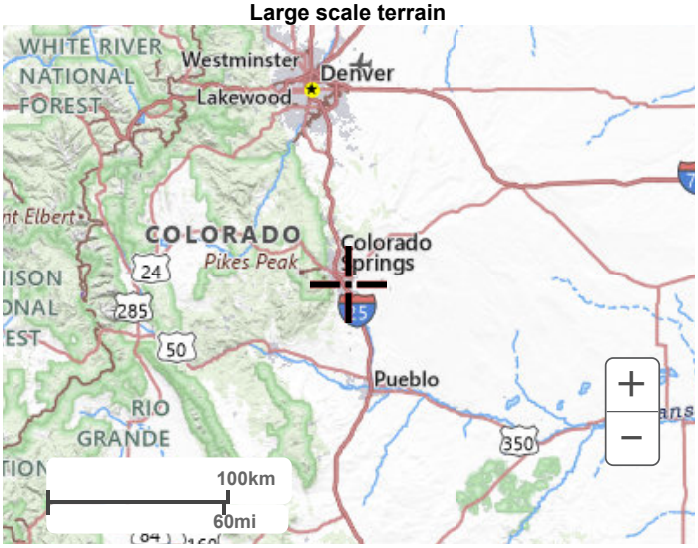
Maps & aerials

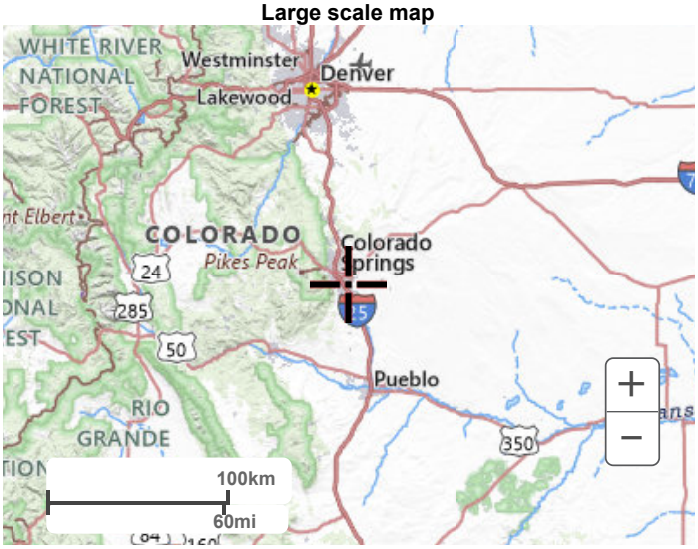
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX B – EXISTING SITE HYDRAULIC CALCULATIONS

Calculation of Peak Runoff using Rational Method

Designer: JMS
Company: GMS Consulting Engineers
Date: 5/8/2026
Project: Security Water District
Location: Security-Widefield, CO

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

Computed $t_c = t_i + t_t$

Regional $t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$

$t_{minimum}$= 5 (urban)
$t_{minimum}$= 10 (non-urban)

Selected $t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	1.00	1.28	1.55	1.96	2.32	2.72	3.78
	a	b	c				
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786				

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time							Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1A	0.01	A	68.8	0.52	0.53	0.55	0.58	0.61	0.65	0.70	30.00	5859.40	5855.35	0.135	2.37	10.00	5855.35	5855.15	0.020	10	1.41	0.12	2.49	14.37	5.00	3.39	4.34	5.26	6.65	7.87	9.23	12.82	0.01	0.02	0.02	0.03	0.03	0.04	0.06
2A	0.50	A	27.6	0.16	0.17	0.18	0.21	0.26	0.33	0.43	203.95	5858.52	5855.03	0.017	20.16	93.74	5855.03	5852.60	0.026	10	1.61	0.97	21.13	22.06	21.13	1.91	2.45	2.96	3.75	4.43	5.20	7.22	0.15	0.20	0.26	0.39	0.58	0.84	1.56
3A	1.19	A	27.2	0.15	0.16	0.18	0.20	0.26	0.32	0.43	105.53	5858.48	5858.00	0.005	22.53	89.07	5858.00	5856.06	0.022	10	1.48	1.01	23.53	22.16	22.16	1.86	2.38	2.89	3.65	4.32	5.07	7.04	0.34	0.46	0.60	0.89	1.32	1.94	3.60

APPENDIX C – PROPOSED SITE HYDRAULIC CALCULATIONS

Calculation of Peak Runoff using Rational Method

Designer: JMS
Company: GMS Consulting Engineers
Date: 5/8/2026
Project: Security Water District
Location: Security-Widefield, CO

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

Computed $t_c = t_i + t_t$

Regional $t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$

$t_{minimum}$= 5 (urban)
$t_{minimum}$= 10 (non-urban)

Selected $t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	1.00	1.28	1.55	1.96	2.32	2.72	3.78
	a	b	c				
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786				

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time							Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
Sub-Basin 1A	0.01	A	2.0	0.01	0.01	0.01	0.01	0.04	0.13	0.27	26.38	5855.26	5854.05	0.046	6.14	1.00	5854.05	5854.00	0.050	20	4.47	0.00	6.14	25.67	10.00	2.71	3.46	4.19	5.30	6.28	7.36	10.23	0.00	0.00	0.00	0.00	0.00	0.01	0.03
Sub-Basin 2A	0.20	A	29.0	0.17	0.18	0.19	0.22	0.27	0.34	0.44	40.39	5858.46	5857.91	0.014	9.56	138.75	5857.91	5857.19	0.005	20	1.44	1.61	11.16	23.53	11.16	2.59	3.31	4.01	5.07	6.00	7.04	9.78	0.09	0.12	0.15	0.22	0.33	0.47	0.86
Sub-Basin 2B	0.26	A	78.0	0.61	0.63	0.64	0.67	0.69	0.72	0.76	138.27	5858.36	5855.37	0.022	7.78	134.33	5855.37	5854.50	0.006	20	1.61	1.39	9.18	14.14	9.18	2.80	3.58	4.33	5.48	6.49	7.61	10.57	0.44	0.58	0.72	0.95	1.17	1.42	2.08
Sub-Basin 2C	0.35	A	57.0	0.40	0.42	0.44	0.47	0.51	0.55	0.62	133.93	5858.46	5855.90	0.019	11.47	79.91	5855.90	5855.10	0.010	20	2.00	0.67	12.13	17.09	12.13	2.50	3.20	3.87	4.90	5.80	6.79	9.44	0.35	0.47	0.59	0.81	1.04	1.32	2.05
Sub-Basin 2D	0.39	A	65.0	0.48	0.50	0.51	0.54	0.58	0.62	0.67	103.84	5858.50	5854.22	0.041	6.95	224.38	5854.22	5853.17	0.005	20	1.37	2.73	9.69	17.97	9.69	2.74	3.51	4.25	5.37	6.36	7.45	10.35	0.51	0.68	0.85	1.14	1.44	1.79	2.72
Sub-Basin 2E	0.49	A	62.0	0.45	0.47	0.48	0.52	0.55	0.59	0.65	89.01	5858.50	5856.80	0.019	8.70	265.12	5856.80	5853.00	0.014	20	2.39	1.85	10.54	17.55	10.54	2.65	3.39	4.11	5.19	6.15	7.21	10.01	0.59	0.78	0.97	1.31	1.67	2.09	3.21
Sub-Basin 3A	0.01	A	27.0	0.15	0.16	0.17	0.20	0.26	0.32	0.43	18.14	5855.26	5854.05	0.067	3.86	1.00	5854.05	5854.00	0.050	20	4.47	0.00	3.86	21.42	5.00	3.39	4.34	5.26	6.65	7.87	9.23	12.82	0.01	0.01	0.01	0.01	0.02	0.03	0.05

APPENDIX D – CULVERT HYDRAULIC ANALYSIS

HYDRAULIC ANALYSIS - HY-8 CULVERTS RESULTS
SECURITY WATER DISTRICT

Culvert ID	Slope (ft/ft)	Pipe Size	Pipe Material	Manning's Roughness Coefficient (n)	Flow Received From Sub-Basin	100-Year Storm Runoff (cfs)	Analyzed with the Federal Highway Administration's HY-8 Culvert Hydraulic Analysis Program		
							Overtopping Flow Rate (cfs)	Outlet Velocty, V100 (fps)	Headwater to Diameter Ratio for Q100
12" CSP	0.019	12	CSP	0.024	2B	1.3	1.6	3.5	0.8
18" CSP	0.011	18	CSP	0.024	2B, 2C and 2D	5.2	6.7	4.8	1.0

HY-8 Culvert Analysis Report

Table 1 - Project Headwater Table

Crossing Name	Culvert Name	Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Outlet Velocity (ft/s)
12" CSP	12" CSP	100 year	1.32	1.32	5855.94	0.75	0.837	0.84	0.50	0.49	0.49	3.49
18" CSP	18" CSP	100 year	5.20	5.20	5854.68	1.43	1.509	1.01	1.07	0.88	0.88	4.84

Crossing Notes

Crossing Input: 12" CSP

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Recurrence	
Discharge List	Define...	
TAILWATER DATA		
Channel Type	Triangular Channel	
Side Slope (H:V)	2.000	_:1
Channel Slope	0.1180	ft/ft
Manning's n (channel)	0.030	
Channel Invert Elevation	5854.330	ft
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Irregular	
Irregular Shape	Define...	
Roadway Surface	Paved	
Top Width	30.000	ft

Culvert Input: 12" CSP

Parameter	Value	Units
CULVERT DATA		
Name	12" CSP	
Shape	Circular	
Material	Corrugated Steel	
Diameter	1.000	ft
Embedment Depth	0.000	in
Manning's n	0.024	
Culvert Type	Straight	
Inlet Configuration	Thin Edge Projecting (Ke=0.9)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	ft
Inlet Elevation	5855.100	ft
Outlet Station	40.120	ft
Outlet Elevation	5854.330	ft
Number of Barrels	1	
Computed Culvert Slope	0.019192	ft/ft

Crossing Discharge Data

Discharge Selection Method: Recurrence

Table 2 - Summary of Culvert Flows at crossing: 12" CSP

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	12" CSP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5855.51	5 year	0.47	0.47	0.00	1
5855.94	100 year	1.32	1.32	0.00	1
5856.02	Overtopping	1.57	1.57	0.00	Overtopping

Table 3 - Culvert Summary Table: 12" CSP

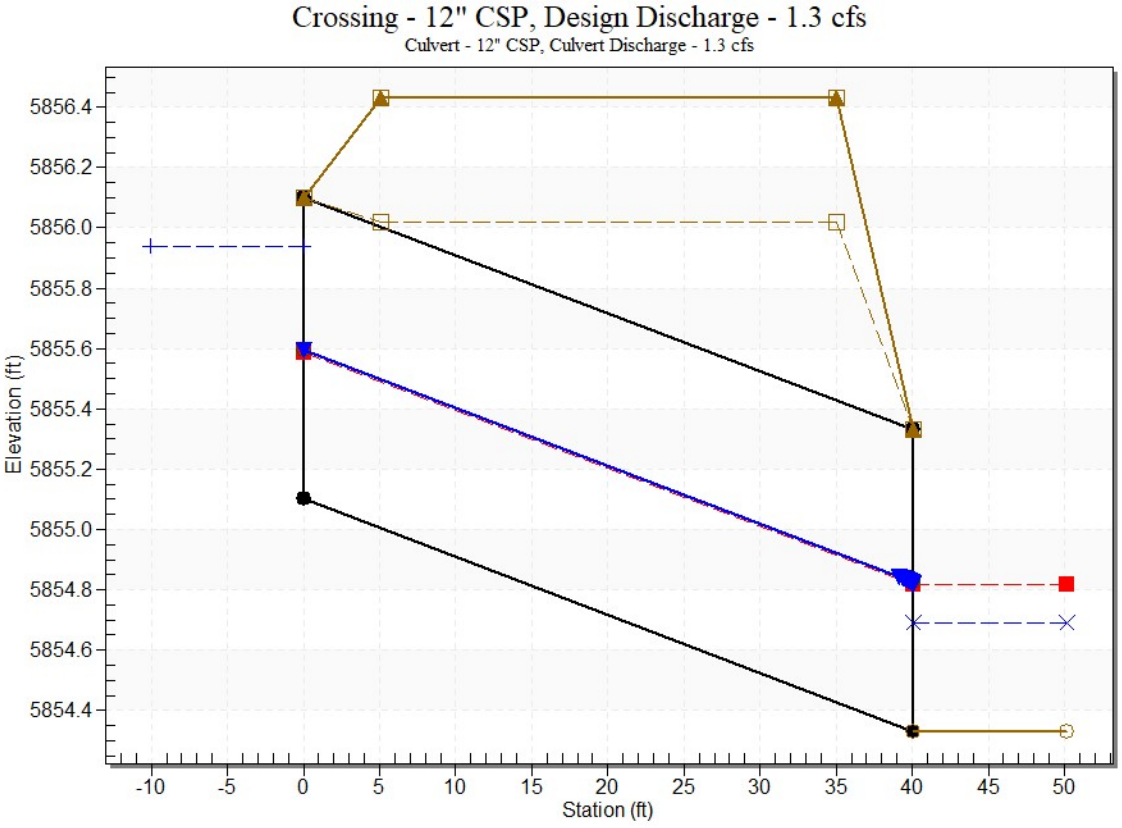
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 year	0.47	0.47	5855.51	0.41	0.0*	0.41	1-S2n	0.28	0.28	0.28	0.25	2.57	3.90
100 year	1.32	1.32	5855.94	0.75	0.837	0.84	2-M2c	0.50	0.49	0.49	0.36	3.49	5.05
Overtopping	2.64	2.06	5856.17	1.01	1.075	1.07	7-M2c	0.66	0.61	0.61	0.47	4.08	6.01

* Full Flow Headwater elevation is below inlet invert.

Culvert Barrel Data

Culvert Barrel Type: Straight Culvert
Inlet Elevation(invert): 5855.10 ft
Outlet Elevation (invert): 5854.33 ft
Culvert Length: 40.13 ft
Culvert Slope: 0.02 ft/ft

Water Surface Profile Plot for Culvert: 12" CSP



Site Data - 12" CSP

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 ft
Inlet Elevation: 5855.10 ft
Outlet Station: 40.12 ft
Outlet Elevation: 5854.33 ft
Number of Barrels: 1

Culvert Data Summary - 12" CSP

Barrel Shape: Circular
Barrel Diameter: 1.00 ft
Barrel Material: Corrugated Steel
Embedment: 0.00 in
Barrel Manning's n: 0.0240
Culvert Type: Straight
Inlet Configuration: Thin Edge Projecting (Ke=0.9)

Inlet Depression: None

Tailwater Channel Data for Crossing: 12" CSP

Tailwater Channel Option: Triangular Channel
a_side Slope (H:V): 2.00 (_:1)
Channel Slope: 0.12 ft/ft
Channel Manning's n: 0.0300
Channel Invert Elevation: 5854.33 ft

Table 4 - Downstream Channel Rating Curve (crossing: 12" CSP)

Roadway Data for crossing: 12" CSP

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section

Coord No.	Station (ft)	Elevation (ft)
0	0.00	5856.43
1	15.00	5856.27
2	30.00	5856.02

Roadway Surface: Paved
Roadway Top Width: 30.00 ft

Crossing Notes

Crossing Input: 18" CSP

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Recurrence	
Discharge List	Define...	
TAILWATER DATA		
Channel Type	Triangular Channel	
Side Slope (H:V)	2.500	_:1
Channel Slope	0.0286	ft/ft
Manning's n (channel)	0.030	
Channel Invert Elevation	5852.600	ft
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Irregular	
Irregular Shape	Define...	
Roadway Surface	Paved	
Top Width	25.000	ft

Culvert Input: 18" CSP

Parameter	Value	Units
CULVERT DATA		
Name	18" CSP	
Shape	Circular	

Material	Corrugated Steel	
Diameter	1.500	ft
Embedment Depth	0.000	in
Manning's n	0.024	
Culvert Type	Straight	
Inlet Configuration	Thin Edge Projecting (Ke=0.9)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	ft
Inlet Elevation	5853.170	ft
Outlet Station	50.430	ft
Outlet Elevation	5852.600	ft
Number of Barrels	1	
Computed Culvert Slope	0.011303	ft/ft

Crossing Discharge Data

Discharge Selection Method: Recurrence

Table 5 - Summary of Culvert Flows at crossing: 18" CSP

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	18" CSP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5853.91	5 year	1.46	1.46	0.00	1
5854.68	100 year	5.20	5.20	0.00	1
5854.98	Overtopping	6.71	6.71	0.00	Overtopping

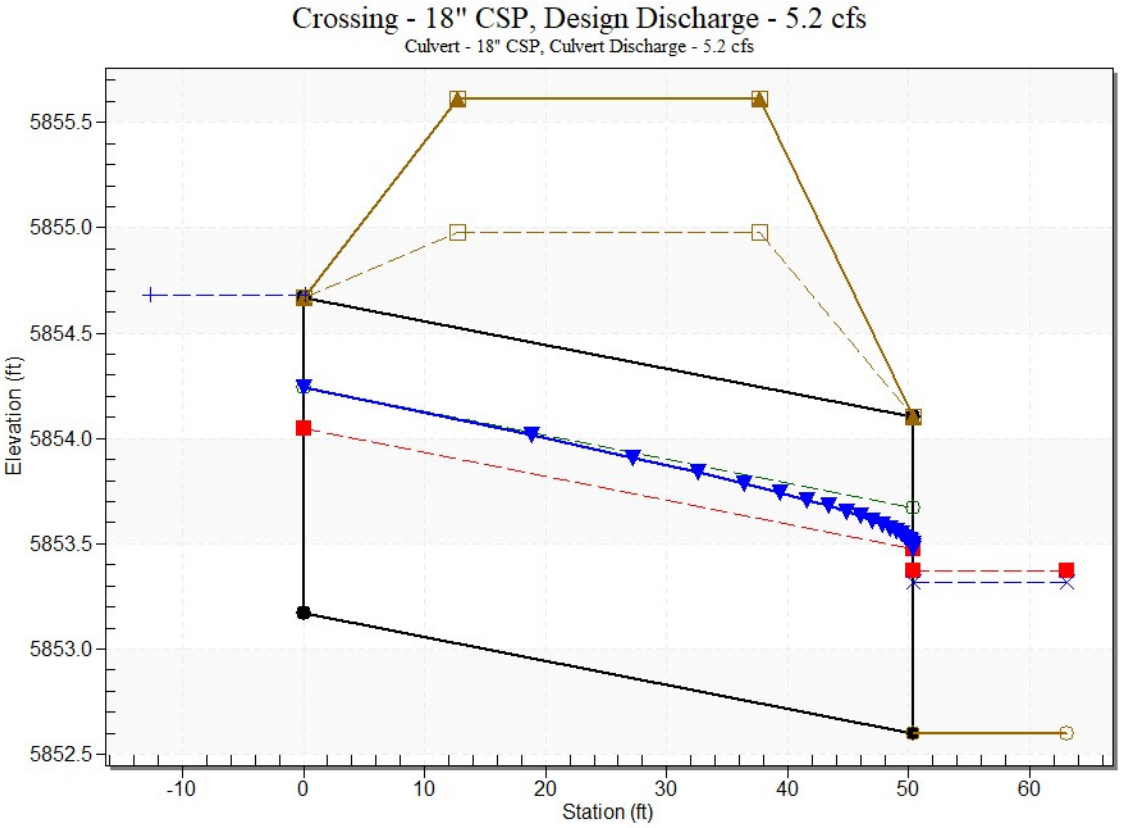
Table 6 - Culvert Summary Table: 18" CSP

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 year	1.46	1.46	5853.91	0.67	0.736	0.49	2-M2c	0.50	0.45	0.45	0.45	3.24	2.93
100 year	5.20	5.20	5854.68	1.43	1.509	1.01	7-M2c	1.07	0.88	0.88	0.72	4.84	4.03
Overtopping	10.40	7.90	5855.41	2.04	2.243	1.50	7-M2c	1.50	1.09	1.09	0.93	5.75	4.79

Culvert Barrel Data

Culvert Barrel Type: Straight Culvert
Inlet Elevation(invert): 5853.17 ft
Outlet Elevation (invert): 5852.60 ft
Culvert Length: 50.43 ft
Culvert Slope: 0.01 ft/ft

Water Surface Profile Plot for Culvert: 18" CSP



Site Data - 18" CSP

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 ft
Inlet Elevation: 5853.17 ft
Outlet Station: 50.43 ft
Outlet Elevation: 5852.60 ft
Number of Barrels: 1

Culvert Data Summary - 18" CSP

Barrel Shape: Circular
Barrel Diameter: 1.50 ft
Barrel Material: Corrugated Steel
Embedment: 0.00 in
Barrel Manning's n: 0.0240
Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting (Ke=0.9)
Inlet Depression: None

Tailwater Channel Data for Crossing: 18" CSP

Tailwater Channel Option: Triangular Channel
a_side Slope (H:V): 2.50 (_:1)
Channel Slope: 0.03 ft/ft
Channel Manning's n: 0.0300
Channel Invert Elevation: 5852.60 ft

Table 7 - Downstream Channel Rating Curve (crossing: 18" CSP)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
1.46	5853.05	0.45	2.93	0.80	1.09
5.20	5853.32	0.72	4.03	1.28	1.18

Roadway Data for crossing: 18" CSP

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section

Coord No.	Station (ft)	Elevation (ft)
0	0.00	5855.61
1	15.00	5855.50
2	25.00	5854.98

Roadway Surface: Paved
Roadway Top Width: 25.00 ft

APPENDIX E – SWALES HYDRAULIC ANALYSIS

HYDRAULIC ANALYSIS - HYDRAULIC TOOLBOX SWALES RESULTS
SECURITY WATER DISTRICT

Swale Design Point	Proposed Slope, S (ft/ft)	Left Side Slope (H:1V)	Right Side Slope (H:1V)	Minor Event (5-YR)			Major Event Capacity (100-YR)			Depth of Swale (in)	Freeboard Required?	Freeboard Depth (ft)	Does Ditch have 100-YR Capacity?	Remarks
				Flow, Q (cfs)	Velocity, V (fps)	Water Depth, D (ft)	Flow, Q (cfs)	Velocity, V (fps)	Water Depth, D (ft)					
2A	0.005	5	4	0.12	0.60	0.08	0.47	0.92	0.18	8.0	No	0.49	Yes	Grass
2B	0.001	4	4	0.58	0.53	0.29	1.42	0.68	0.45	13.6	No	0.68	Yes	Grass
2C	0.010	5	7	0.47	1.15	0.15	1.32	1.55	0.25	9.8	No	0.57	Yes	Grass
2D	0.005	2.5	20	1.46	1.06	0.39	3.88	1.46	0.45	32.6	Yes	2.27	Yes	Grass
2E	0.006	5	20	0.78	1.06	0.21	2.09	1.39	0.34	38.4	Yes	2.86	Yes	Grass
2E	0.006	12	15	0.78	2.25	0.16	2.09	2.89	0.23	9.7	No	0.58	Yes	Concrete

Hydraulic Analysis Report

Project Data

Project Title: Security Water District – Water Treatment Plant Addition

Designer: JMS

Project Date: Thursday, August 21, 2025

Project Units: U.S. Customary Units

Notes:

Channel Analysis: DP 2A Swale - 100 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft	Elevation (ft)	Manning's n
0.00	5858.00	0.0300
3.30	5857.33	0.0300
5.30	5857.33	0.0300
10.90	5858.42	-----

Longitudinal Slope: 0.0050 ft/ft

Flow 0.4700 cfs

Result Parameters

Depth 0.1771 ft

Area of Flow 0.5121 ft^2

Wetted Perimeter 3.8172 ft

Hydraulic Radius 0.1341 ft

Average Velocity 0.9178 ft/s

Top Width 3.7823 ft

Froude Number: 0.4396

Critical Depth 0.1087 ft

Critical Velocity 1.6976 ft/s

Critical Slope: 0.0296 ft/ft

Critical Top Width 3.09 ft

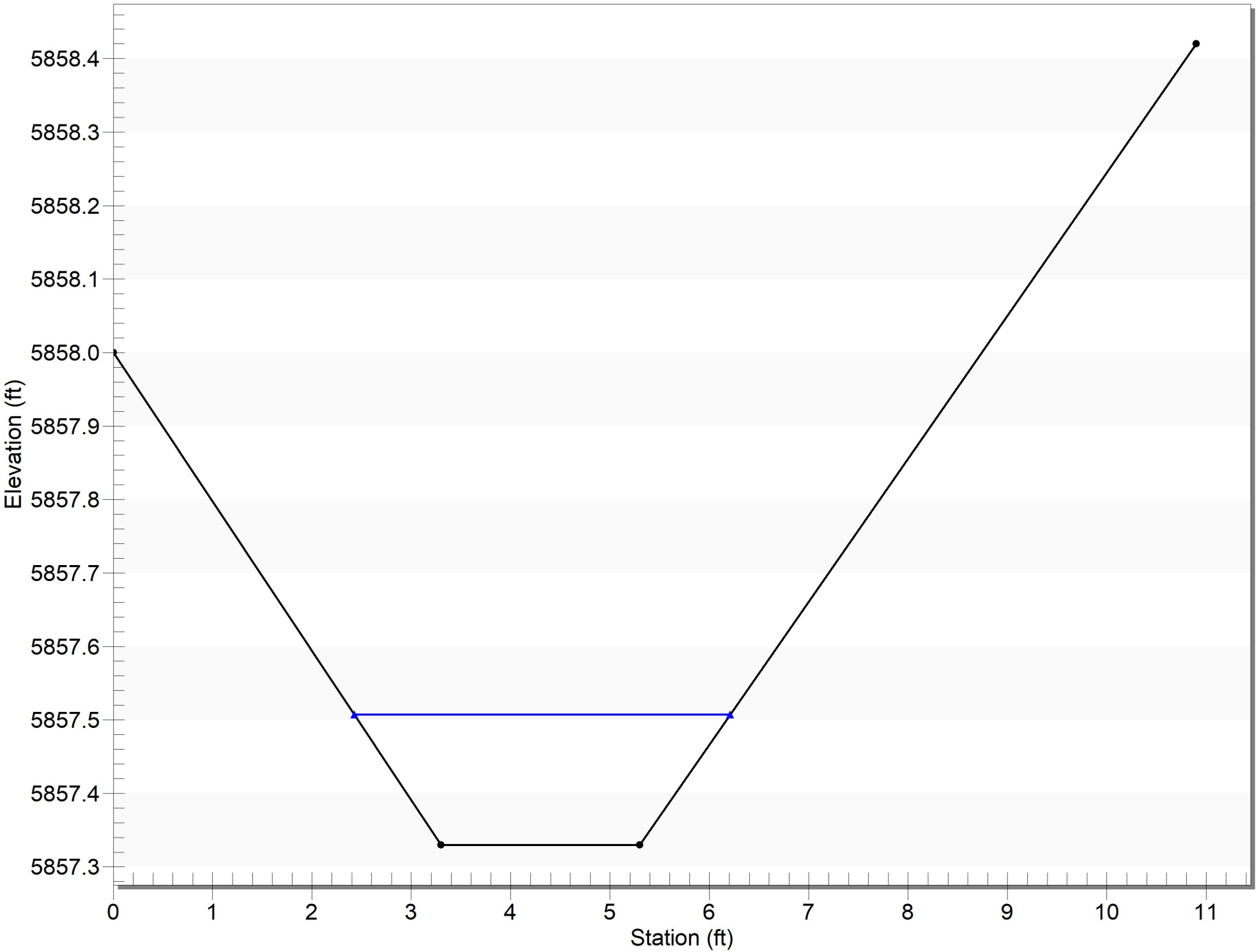
Calculated Max Shear Stress 0.0553 lb/ft^2

Calculated Avg Shear Stress 0.0419 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2A Swale - 100 Year Storm



Channel Analysis: DP 2B Swale - 100 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft	Elevation (ft)	Manning's n
0.00	5854.97	0.0300
3.88	5854.27	0.0300
5.88	5854.27	0.0300
12.80	5855.40	-----

Longitudinal Slope: 0.0010 ft/ft

Flow 1.4200 cfs

Result Parameters

Depth 0.4517 ft

Area of Flow 2.0935 ft^2

Wetted Perimeter 7.3468 ft

Hydraulic Radius 0.2850 ft

Average Velocity 0.6783 ft/s

Top Width 7.2697 ft

Froude Number: 0.2227

Critical Depth 0.2037 ft

Critical Velocity 2.1861 ft/s

Critical Slope: 0.0251 ft/ft

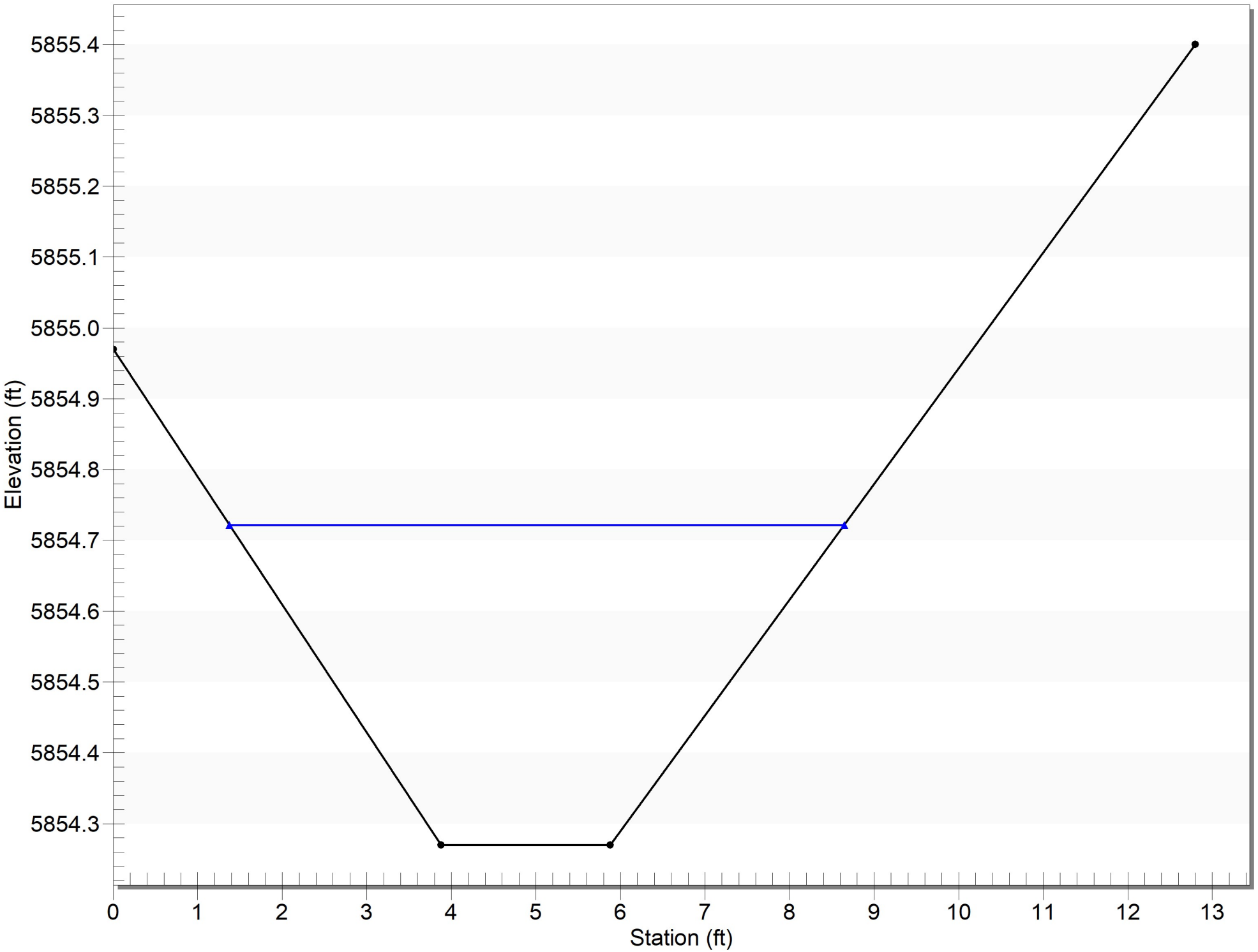
Critical Top Width 4.38 ft

Calculated Max Shear Stress 0.0282 lb/ft^2

Calculated Avg Shear Stress 0.0178 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300


DP 2B Swale - 100 Year Storm
5855.4
5855.3
5855.2
5855.1
5855.0
5854.9
5854.8
5854.7
5854.6
5854.5
5854.4
5854.3
Elevation (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Station (ft)

Channel Analysis: DP 2C Swale - 100 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft	Elevation (ft)	Manning's n
0.00	5856.01	0.0300
4.03	5855.26	0.0300
6.03	5855.26	0.0300
13.19	5856.47	-----

Longitudinal Slope: 0.0100 ft/ft

Flow 1.3200 cfs

Result Parameters

Depth 0.2497 ft

Area of Flow 0.8515 ft^2

Wetted Perimeter 4.8636 ft

Hydraulic Radius 0.1751 ft

Average Velocity 1.5502 ft/s

Top Width 4.8196 ft

Froude Number: 0.6499

Critical Depth 0.1965 ft

Critical Velocity 2.1598 ft/s

Critical Slope: 0.0253 ft/ft

Critical Top Width 4.22 ft

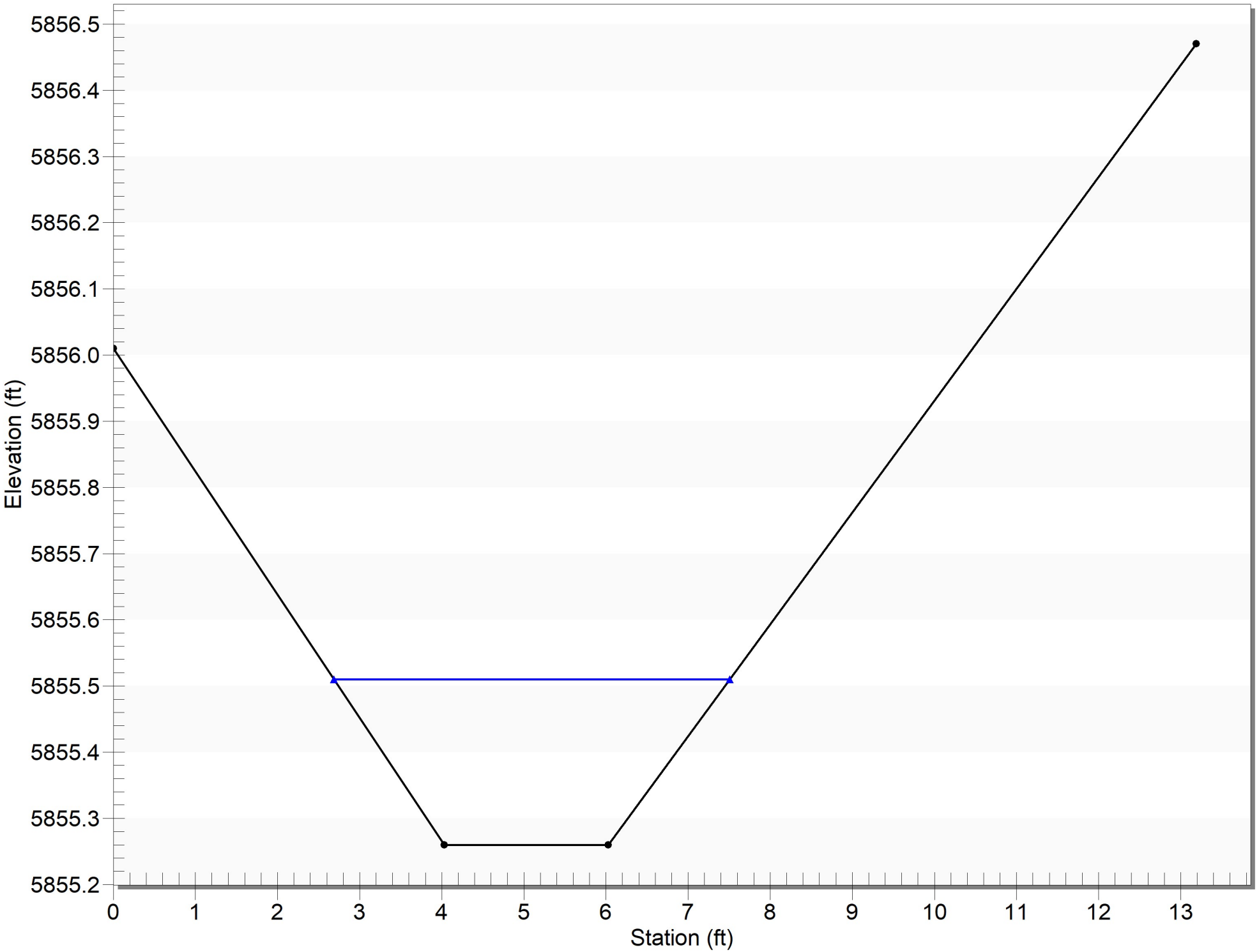
Calculated Max Shear Stress 0.1558 lb/ft^2

Calculated Avg Shear Stress 0.1092 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2C Swale - 100 Year



Channel Analysis: DP 2D Swale - 100 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft	Elevation (ft)	Manning's n
0.00	5856.00	0.0300
7.17	5853.28	0.0300
9.17	5853.28	0.0300
29.36	5854.65	-----

Longitudinal Slope: 0.0050 ft/ft

Flow 3.8800 cfs

Result Parameters

Depth 0.4504 ft

Area of Flow 2.6626 ft^2

Wetted Perimeter 9.9221 ft

Hydraulic Radius 0.2684 ft

Average Velocity 1.4572 ft/s

Top Width 9.8243 ft

Froude Number: 0.4933

Critical Depth 0.3190 ft

Critical Velocity 2.5492 ft/s

Critical Slope: 0.0226 ft/ft

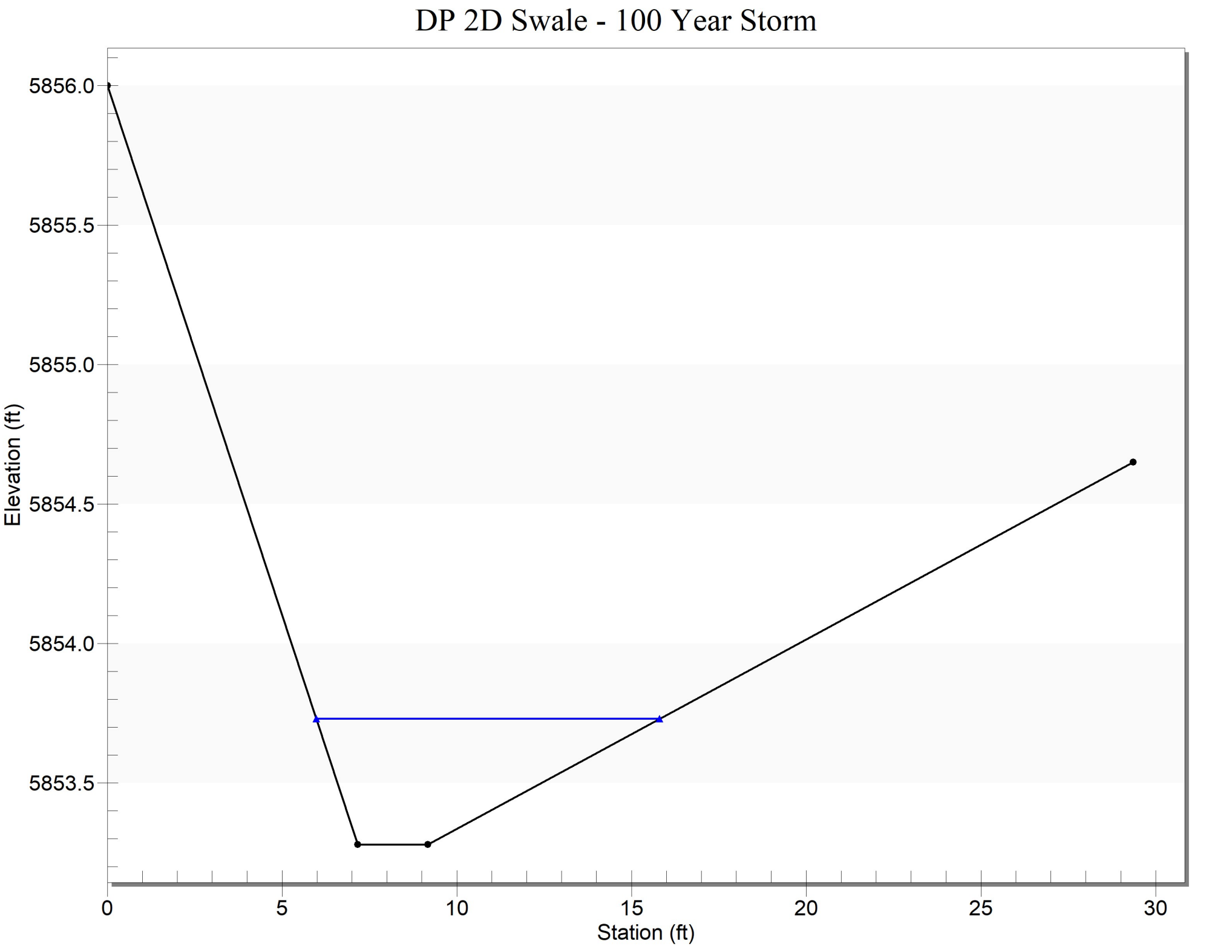
Critical Top Width 7.54 ft

Calculated Max Shear Stress 0.1405 lb/ft^2

Calculated Avg Shear Stress 0.0837 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300


DP 2D Swale - 100 Year Storm
5856.0
5855.5
5855.0
5854.5
5854.0
5853.5
Elevation (ft)
0
5
10
15
20
25
30
Station (ft)

Channel Analysis: DP 2E Swale - 100 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft	Elevation (ft)	Manning's n
0.00	5857.85	0.0300
11.00	5854.65	0.0300
13.00	5854.65	0.0300
25.82	5855.84	-----

Longitudinal Slope: 0.0060 ft/ft

Flow 2.0900 cfs

Result Parameters

Depth 0.3404 ft

Area of Flow 1.5041 ft^2

Wetted Perimeter 6.9016 ft

Hydraulic Radius 0.2179 ft

Average Velocity 1.3895 ft/s

Top Width 6.8373 ft

Froude Number: 0.5221

Critical Depth 0.2427 ft

Critical Velocity 2.3115 ft/s

Critical Slope: 0.0242 ft/ft

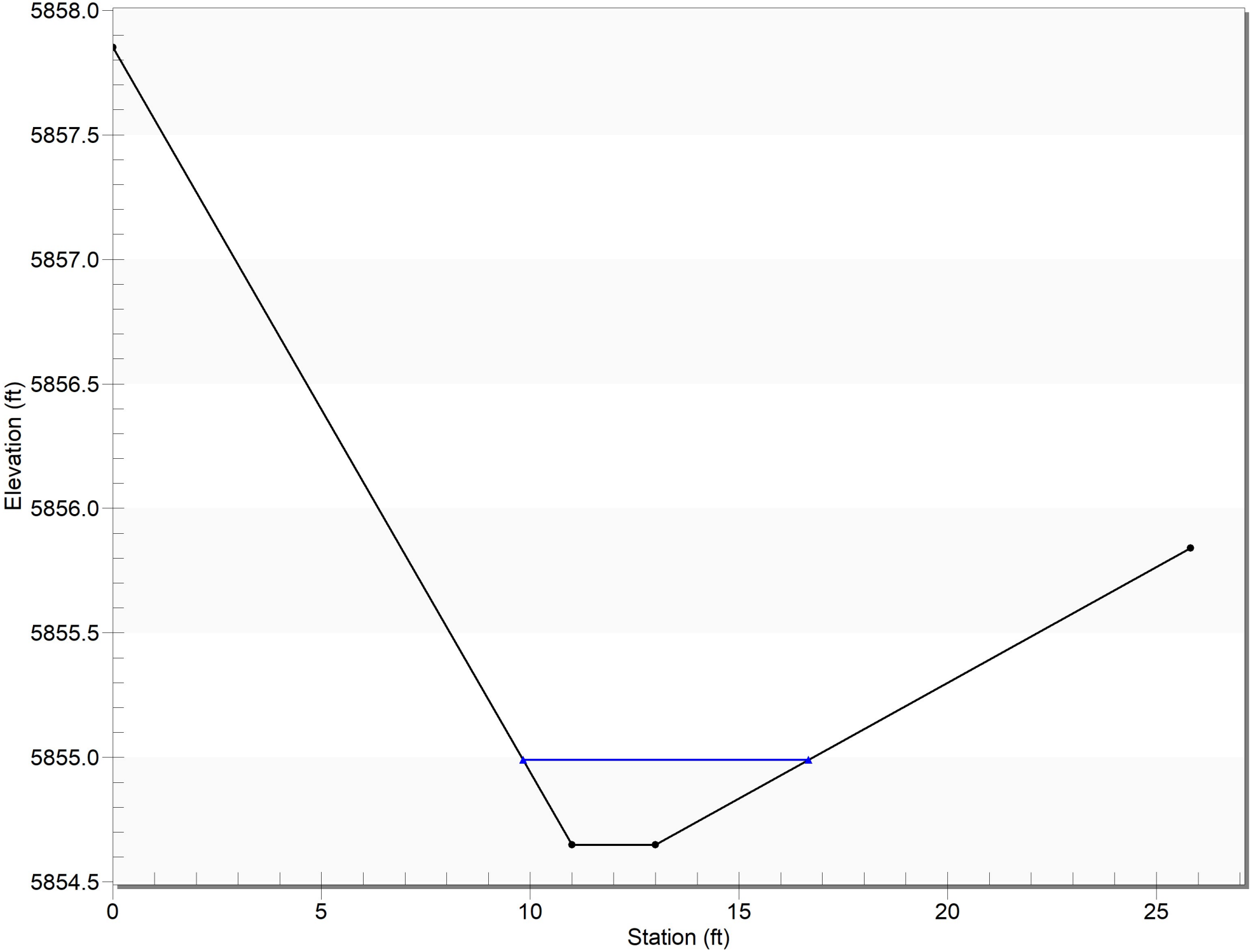
Critical Top Width 5.45 ft

Calculated Max Shear Stress 0.1274 lb/ft^2

Calculated Avg Shear Stress 0.0816 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300


DP 2E Swale - 100 Year Storm
5858.0
5857.5
5857.0
5856.5
5856.0
5855.5
5855.0
5854.5
Elevation (ft)
0
5
10
15
20
25
Station (ft)

Channel Analysis: DP 2E Concrete Cross Pan - 100 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft	Elevation (ft)	Manning's n
0.00	5855.79	0.0120
10.00	5854.98	0.0120
20.00	5855.60	-----

Longitudinal Slope: 0.0100 ft/ft

Flow 2.0900 cfs

Result Parameters

Depth 0.2255 ft

Area of Flow 0.7243 ft^2

Wetted Perimeter 6.4384 ft

Hydraulic Radius 0.1125 ft

Average Velocity 2.8857 ft/s

Top Width 6.4223 ft

Froude Number: 1.5143

Critical Depth 0.2663 ft

Critical Velocity 2.0705 ft/s

Critical Slope: 0.0041 ft/ft

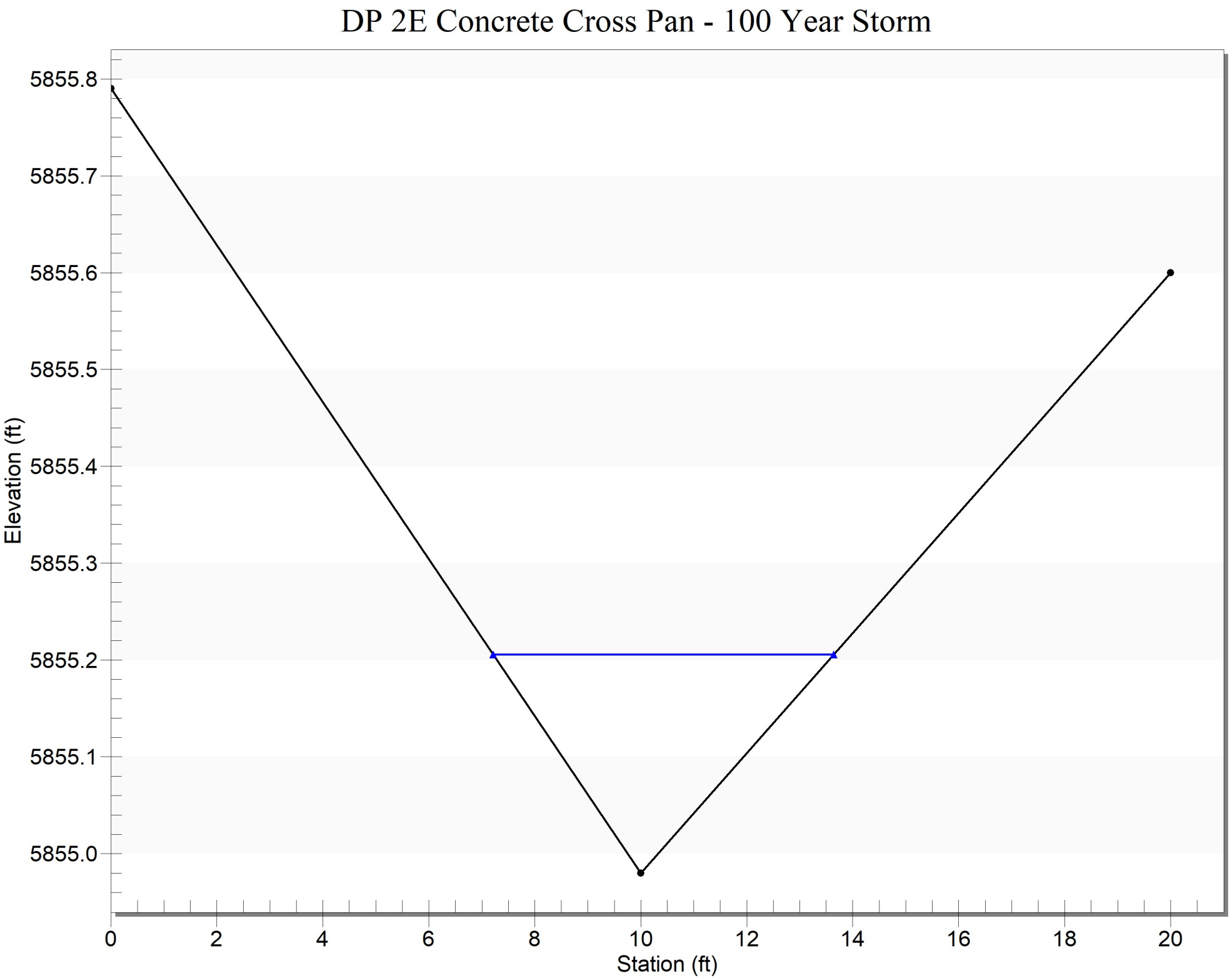
Critical Top Width 7.58 ft

Calculated Max Shear Stress 0.1407 lb/ft^2

Calculated Avg Shear Stress 0.0702 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0120


DP 2E Concrete Cross Pan - 100 Year Storm
5855.8
5855.7
5855.6
5855.5
5855.4
5855.3
5855.2
5855.1
5855.0
Elevation (ft)
0
2
4
6
8
10
12
14
16
18
20
Station (ft)

Channel Analysis: DP 2A Swale - 5 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft	Elevation (ft)	Manning's n
0.00	5858.00	0.0300
3.30	5857.33	0.0300
5.30	5857.33	0.0300
10.90	5858.42	-----

Longitudinal Slope: 0.0050 ft/ft

Flow 0.1200 cfs

Result Parameters

Depth 0.0831 ft

Area of Flow 0.2009 ft^2

Wetted Perimeter 2.8524 ft

Hydraulic Radius 0.0704 ft

Average Velocity 0.5973 ft/s

Top Width 2.8360 ft

Froude Number: 0.3955

Critical Depth 0.0463 ft

Critical Velocity 1.1616 ft/s

Critical Slope: 0.0380 ft/ft

Critical Top Width 2.47 ft

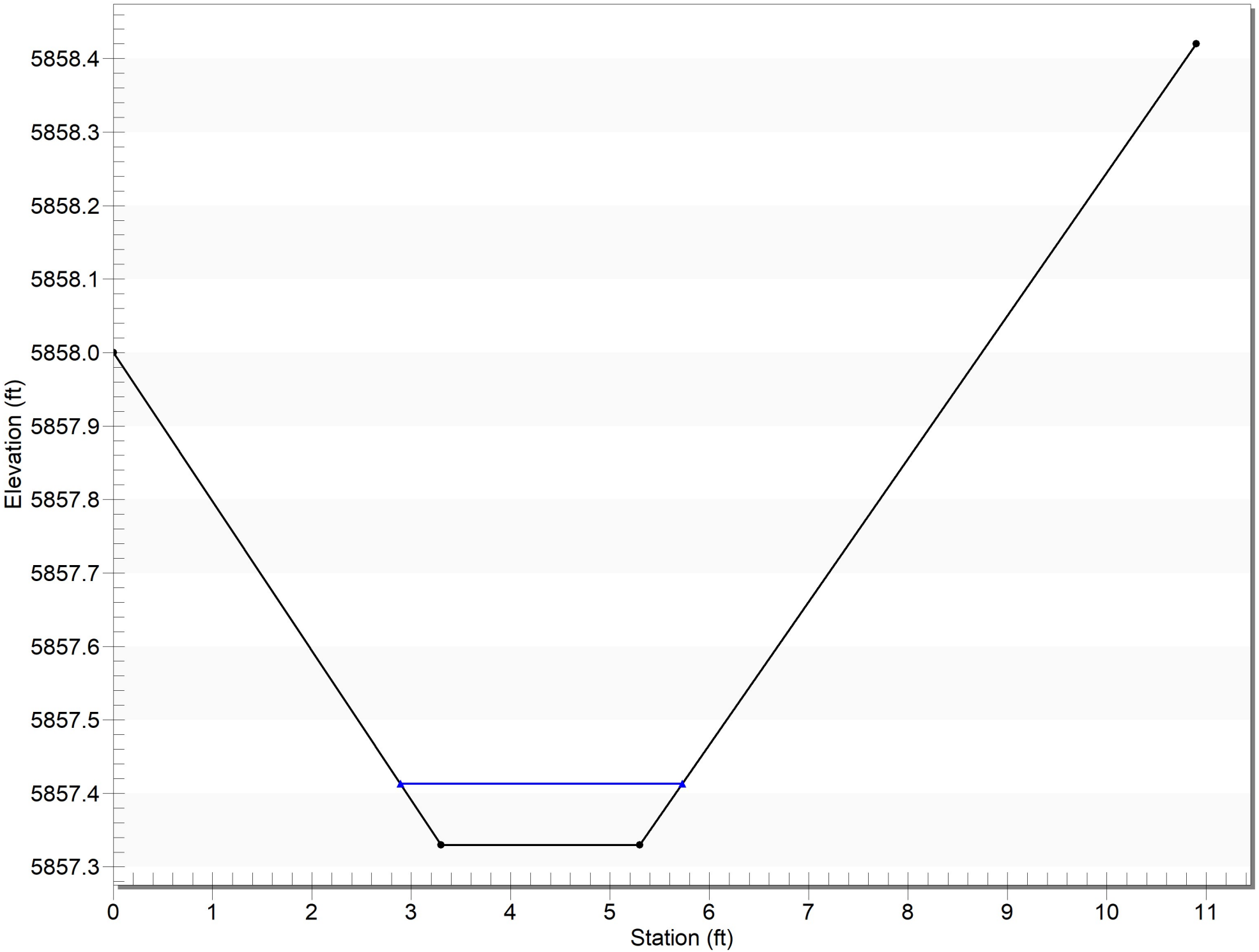
Calculated Max Shear Stress 0.0259 lb/ft^2

Calculated Avg Shear Stress 0.0220 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2A Swale - 5 Year Storm



Channel Analysis: DP 2B Swale - 5 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft	Elevation (ft)	Manning's n
0.00	5854.97	0.0300
3.88	5854.27	0.0300
5.88	5854.27	0.0300
12.80	5855.40	-----

Longitudinal Slope: 0.0010 ft/ft

Flow 0.5800 cfs

Result Parameters

Depth 0.2931 ft

Area of Flow 1.0871 ft^2

Wetted Perimeter 5.4691 ft

Hydraulic Radius 0.1988 ft

Average Velocity 0.5335 ft/s

Top Width 5.4191 ft

Froude Number: 0.2099

Critical Depth 0.1216 ft

Critical Velocity 1.7613 ft/s

Critical Slope: 0.0289 ft/ft

Critical Top Width 3.42 ft

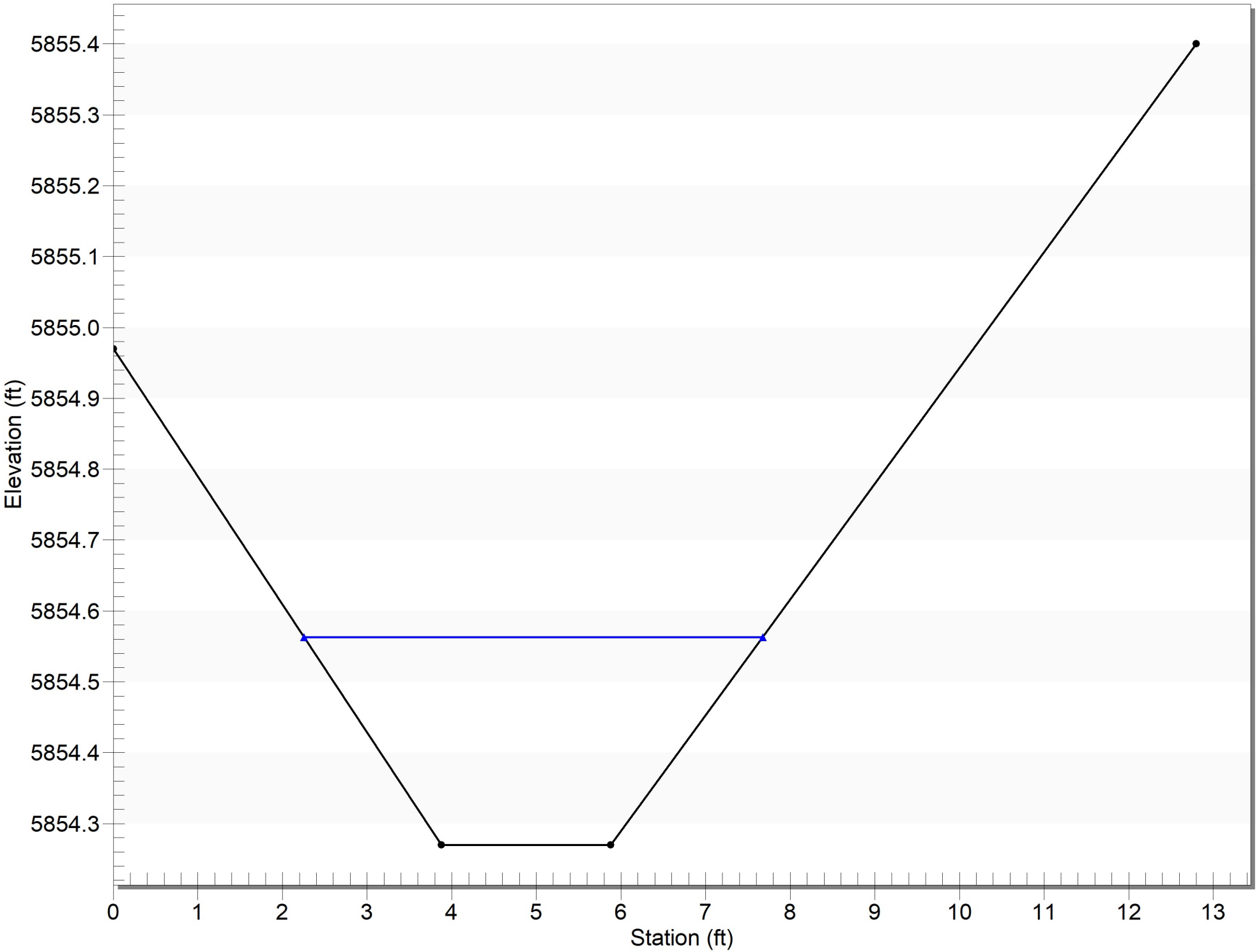
Calculated Max Shear Stress 0.0183 lb/ft^2

Calculated Avg Shear Stress 0.0124 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2B Swale - 5 Year



Channel Analysis: DP 2C Swale - 5 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft	Elevation (ft)	Manning's n
0.00	5856.01	0.0300
4.03	5855.26	0.0300
6.03	5855.26	0.0300
13.19	5856.47	-----

Longitudinal Slope: 0.0100 ft/ft

Flow 0.4700 cfs

Result Parameters

Depth 0.1451 ft

Area of Flow 0.4092 ft^2

Wetted Perimeter 3.6642 ft

Hydraulic Radius 0.1117 ft

Average Velocity 1.1486 ft/s

Top Width 3.6387 ft

Froude Number: 0.6036

Critical Depth 0.1076 ft

Critical Velocity 1.6761 ft/s

Critical Slope: 0.0298 ft/ft

Critical Top Width 3.21 ft

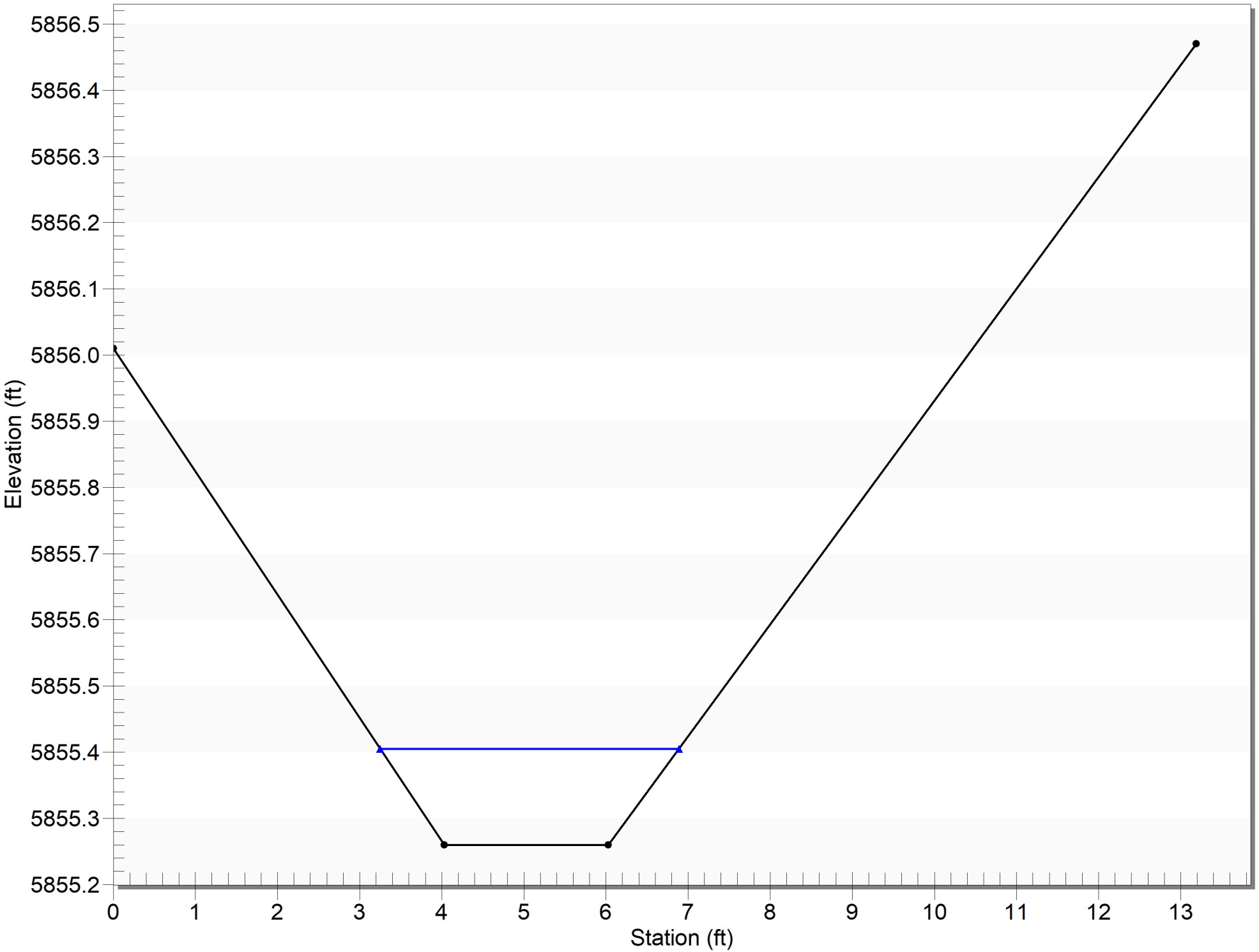
Calculated Max Shear Stress 0.0906 lb/ft^2

Calculated Avg Shear Stress 0.0697 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2C Swale - 5 Year Storm



Channel Analysis: DP 2D Swale - 5 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft	Elevation (ft)	Manning's n
0.00	5856.00	0.0300
7.17	5853.28	0.0300
9.17	5853.28	0.0300
29.36	5854.65	-----

Longitudinal Slope: 0.0050 ft/ft

Flow 1.4600 cfs

Result Parameters

Depth 0.2874 ft

Area of Flow 1.2924 ft^2

Wetted Perimeter 7.0558 ft

Hydraulic Radius 0.1832 ft

Average Velocity 1.1297 ft/s

Top Width 6.9933 ft

Froude Number: 0.4631

Critical Depth 0.1926 ft

Critical Velocity 2.0642 ft/s

Critical Slope: 0.0260 ft/ft

Critical Top Width 5.35 ft

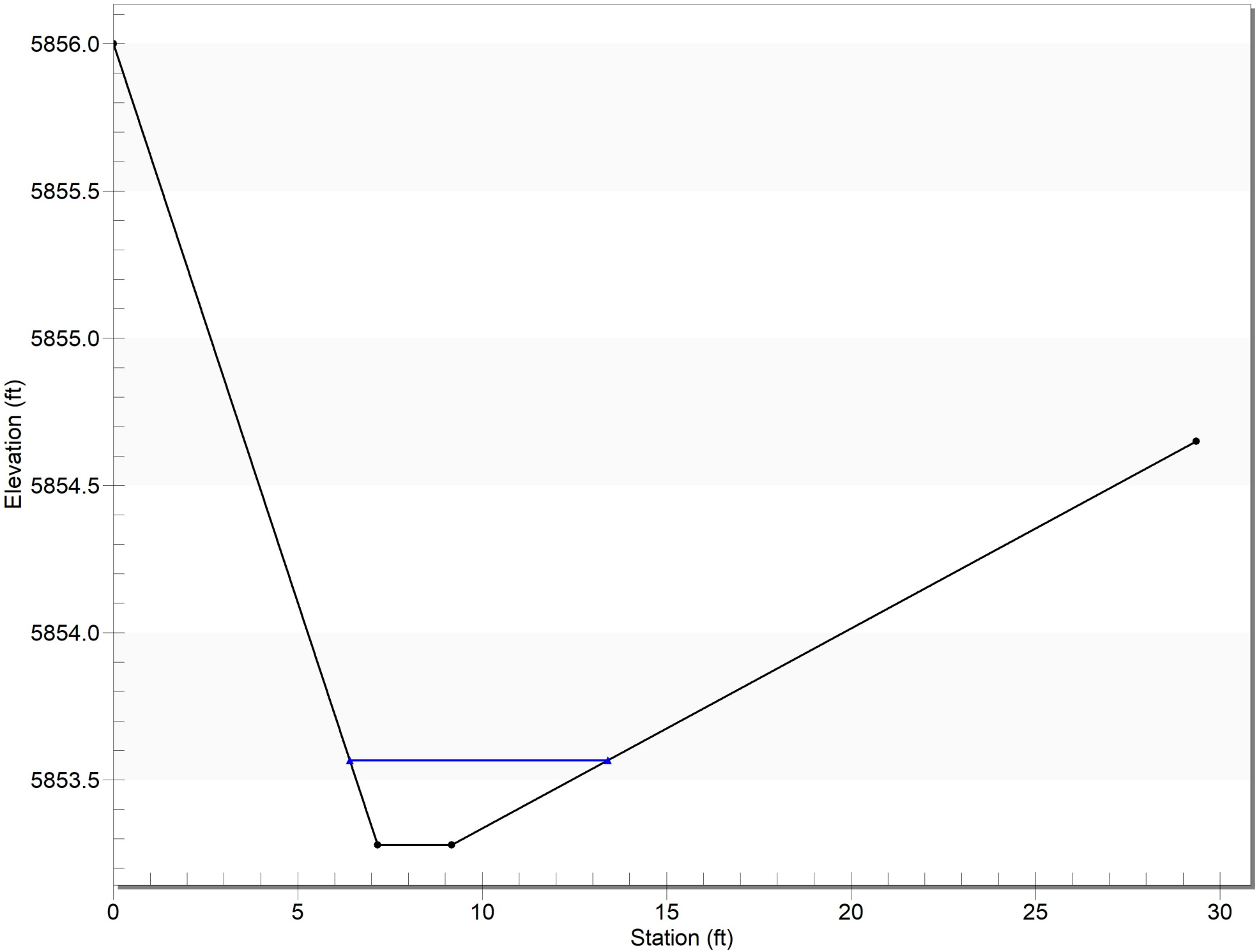
Calculated Max Shear Stress 0.0897 lb/ft^2

Calculated Avg Shear Stress 0.0571 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2D Swale - 5 Year Storm



Channel Analysis: DP 2E Swale - 5 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft	Elevation (ft)	Manning's n
0.00	5857.85	0.0300
11.00	5854.65	0.0300
13.00	5854.65	0.0300
25.82	5855.84	-----

Longitudinal Slope: 0.0060 ft/ft

Flow 0.7800 cfs

Result Parameters

Depth 0.2100 ft

Area of Flow 0.7333 ft^2

Wetted Perimeter 5.0238 ft

Hydraulic Radius 0.1460 ft

Average Velocity 1.0637 ft/s

Top Width 4.9841 ft

Froude Number: 0.4887

Critical Depth 0.1409 ft

Critical Velocity 1.8446 ft/s

Critical Slope: 0.0280 ft/ft

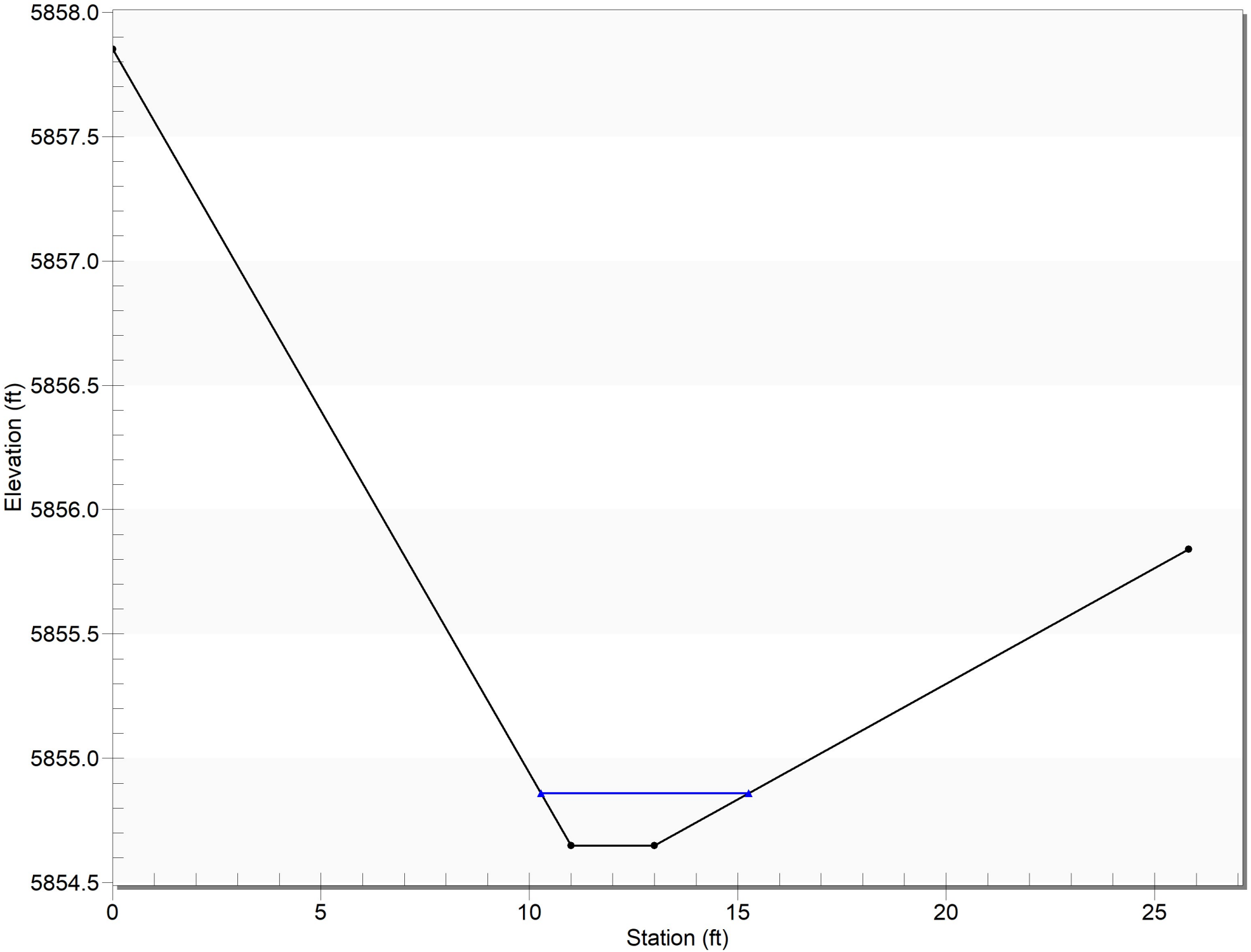
Critical Top Width 4.00 ft

Calculated Max Shear Stress 0.0786 lb/ft^2

Calculated Avg Shear Stress 0.0547 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300


DP 2E Swale - 5 Year Storm
5858.0
5857.5
5857.0
5856.5
5856.0
5855.5
5855.0
5854.5
Elevation (ft)
0
5
10
15
20
25
Station (ft)

Channel Analysis: DP 2E Concrete Cross Pan - 5 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft	Elevation (ft)	Manning's n
0.00	5855.79	0.0120
10.00	5854.98	0.0120
20.00	5855.60	-----

Longitudinal Slope: 0.0100 ft/ft

Flow 0.7800 cfs

Result Parameters

Depth 0.1559 ft

Area of Flow 0.3458 ft^2

Wetted Perimeter 4.4490 ft

Hydraulic Radius 0.0777 ft

Average Velocity 2.2555 ft/s

Top Width 4.4379 ft

Froude Number: 1.4239

Critical Depth 0.1795 ft

Critical Velocity 1.7001 ft/s

Critical Slope: 0.0047 ft/ft

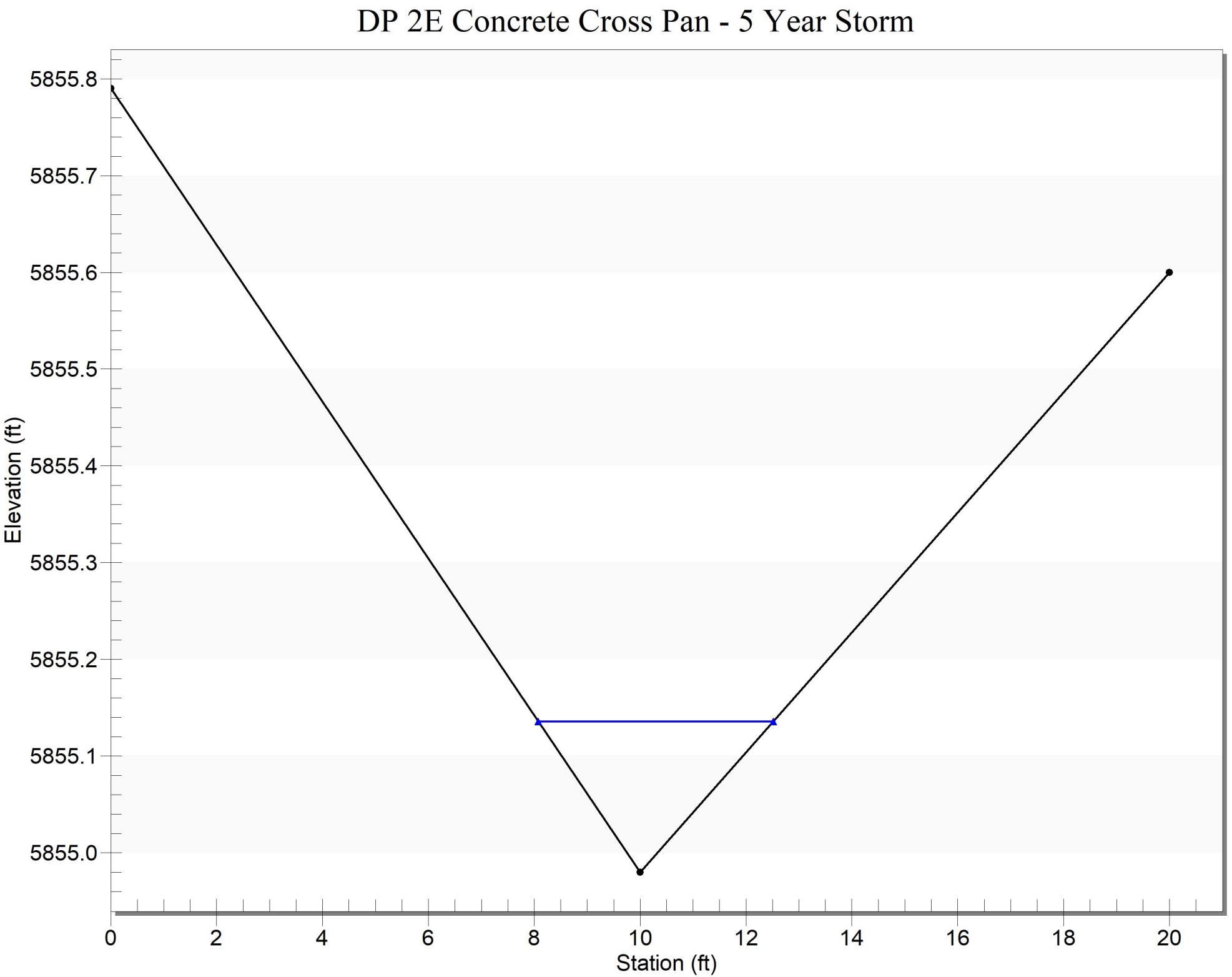
Critical Top Width 5.11 ft

Calculated Max Shear Stress 0.0973 lb/ft^2

Calculated Avg Shear Stress 0.0485 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0120


DP 2E Concrete Cross Pan - 5 Year Storm
5855.8
5855.7
5855.6
5855.5
5855.4
5855.3
5855.2
5855.1
5855.0
Elevation (ft)
0
2
4
6
8
10
12
14
16
18
20
Station (ft)

Selected Profile: FHWA Profile (read-only)

Culvert Assessment Profiles

Culvert Assessment Profile Name: Standard (read-only)

Maximum Excavation Depth: 20.00 ft

Maximum Shallow Cover: 4.00 ft

Maximum Small Pipe Size: 36.00 ft

Minimum Manned Entry Size: 48.00 in

Riprap Classes

Riprap Class Name:CLASS I

Riprap Class Order:1

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 304.80 mm

D85: 228.60 mm

D50: 165.10 mm

D15: 114.30 mm

Riprap Class Name:CLASS II

Riprap Class Order:2

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 457.20 mm

D85: 330.20 mm

D50: 241.30 mm

D15: 177.80 mm

Riprap Class Name:CLASS III

Riprap Class Order:3

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 609.60 mm

D85: 431.80 mm

D50: 317.50 mm

D15: 228.60 mm

Riprap Class Name:CLASS IV

Riprap Class Order:4

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 762.00 mm

D85: 533.40 mm

D50: 393.70 mm

D15: 266.70 mm

Riprap Class Name:CLASS V

Riprap Class Order:5

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 914.40 mm

D85: 647.70 mm

D50: 469.90 mm

D15: 330.20 mm

Riprap Class Name:CLASS VI

Riprap Class Order:6

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 1066.80 mm

D85: 762.00 mm

D50: 546.10 mm

D15: 381.00 mm

Riprap Class Name:CLASS VII

Riprap Class Order:7

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 1257.30 mm

D85: 889.00 mm

D50: 647.70 mm

D15: 444.50 mm

Riprap Class Name:CLASS VIII

Riprap Class Order:8

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 1524.00 mm

D85: 1079.50 mm

D50: 800.10 mm

D15: 558.80 mm

Riprap Class Name:CLASS IX

Riprap Class Order:9

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 1828.80 mm

D85: 1295.40 mm

D50: 965.20 mm

D15: 660.40 mm

Riprap Class Name:CLASS X

Riprap Class Order:10

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 2133.60 mm

D85: 1511.30 mm

D50: 1130.30 mm

D15: 787.40 mm

APPENDIX F – SCM BIORETENTION ANALYSIS

MILE HIGH FLOOD DISTRICT

STORMWATER CONTROL MEASURE (SCM) DESIGN WORKBOOK

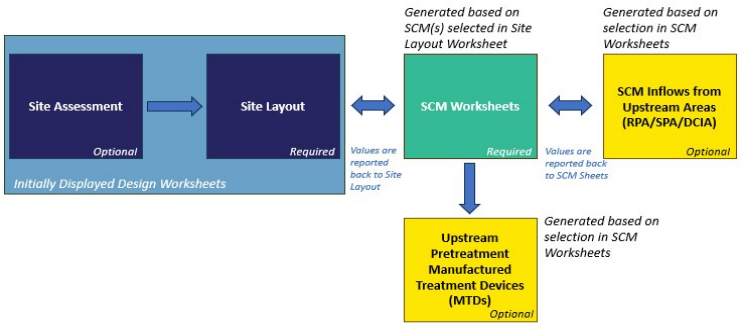
SCM Design, Version 4.02 (June 2025)
Mile High Flood District
Denver, Colorado
www.mhfd.org

Purpose: This workbook is used as a preliminary SCM site design aid and a tool to demonstrate the proper use of MHFD critiera and the achievement of specific treatment thresholds as laid out in the design standards of the MS4 permit. This workbook is not intended to determine compliance with MS4 design standards and exclusions, that is the responsiblity of the Engineer and Reviewing Permittee.

Function: This workbook provides the designer with tools to incorporate MHFD Volume 3 Chapter 4 SCM criteria and sizing into the site assessment, site layout, and preliminary design; and to calculate the downstream benefits of runoff reduction on WQCV requirements.

Compatibility: This SCM Design workbook is intended to be compatible with MHFD-Detention, which allows the user to develop SCM basin geometries (depth, area, and volume), calculate orifice opening dimensions and other outlet structure components for the WQCV event and larger storms, and route storm hydrographs through SCMs. User input cells are provided in this workbook for areas, volumes, and outlet dimensions when incorporation of MHFD-Detention results is appropriate.

Content: **The workbook consists of the following worksheets (see flow chart below which describes worksheet interaction):**



Site Assessment The Site Assessment worksheet (optional) evaluates an entire site with respect to physical characteristics, opportunities for runoff reduction,and suitability for infiltration-based SCMs.

Site Layout The Site Layout worksheet (required) is the primary hub for evaluating a site and serves as the gateway to all other SCM worksheets listed below. The user can define multiple outfalls from the site and then evaluate different MS4 Standards and SCM Types for each outfall. When a user selects an SCM type, a new worksheet of that type will be created with the corresponding Outfall ID (***ID#***). Water quality results from the SCM worksheet will then be carried back to the Site Layout worksheet for that Outfall ID column. At the bottom of the Site Layout worksheet, all outfalls will be summed to provide water quality results for the entire site.

SCM Worksheets New SCM worksheets (**SCM_ID#**), generated from the Site Layout worksheet, allow the user to develop a preliminary design in accordance with MHFD criteria provided in Chapter 4 of the USDCM. Two additional worksheets can be generated from within most SCM worksheets to design and account for runoff reduction through RPA treatment upstream of the SCM and/or a pretreatment Sedimentation MTD.

Example Site The Example Site worksheet includes a demonstration of how the Site Layout worksheet can be applied to a project site. The example includes 10 different outfalls with various paired SCM worksheets including RPA, Rooftop Systems, BR, SF, and EDB. The example further demonstrates how the RPA worksheet can be paired with an EDB worksheet to define upstream runoff reduction for inflows to the EDB.

Worksheet Naming Convention	SCM Worksheet Title	Fact Sheet
Upstream Treatment SCMs		
SCM ID# **Inflows**	SCM Inflows from Upstream Receiving Pervious Areas (RPA) Including Grass Buffers and Grass Swales	T-1
SCM ID# **HDS** ***Inflow#***	Sedimentation Manufactured Treatment Device (Sedimentation MTD) - Hydrodynamic Separator (HDS)	T-8
SCMs		
RPA ***ID#***	Receiving Pervious Areas (RPA) Including Grass Buffers and Grass Swales	T-1
GreenRoof ***ID#***	Green Roof Systems (GreenRoof)	T-2
BlueRoof ***ID#***	Blue Roof Systems (BlueRoof)	T-2
BR ***ID#***	Bioretention Systems (BR)	T-3
SF ***ID#***	Sand Filters (SF)	T-4
PPS ***ID#***	Permeable Pavement Systems (PPS)	T-5
EDB ***ID#***	Extended Detention Basins (EDB)	T-6
RP ***ID#***	Retention Ponds (RP)	T-7
CWP **ID#**	Constructed Wetland Ponds (CWP)	T-7
HRMF ***ID#***	Filtration Manufactured Treatment Device (Filtration MTD) - High Rate Media Filtration (HRMF)	T-8
HRBF ***ID#***	Filtration Manufactured Treatment Device (Filtration MTD) - High Rate Biofiltration (HRBF)	T-8

Acknowledgements: ***Spreadsheet Development Team:***
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Cerulean Consulting, LLC

Holly Piza, P.E. and Brik Zivkovich, P.E.
Mile High Flood District

Comments? Direct all comments regarding this spreadsheet workbook to: MHFD email
Revisions? Check for revised versions of this or any other workbook at: Downloads

Site Assessment

SCM Design, Version 4.02 (June 2025)

Designer: JMS
Company: GMS Consulting Engineers
Date: June 22, 2026
Project: Security Water District WTP Building Addition
Location: Security, Colorado

1. Physical Site Characteristics

A) Total Site Area

Area = 1.69 acres 73,616 ft^2

B) Describe any upstream offsite areas that drain onto site and downstream conveyance systems or overland flow paths.

The treatment plant resides at a topographical high point. No upstream, offsite flows travel onsite.

C) Describe any floodplain/floodway mapping, fluvial hazard zones, or geomorphic/geotechnical instabilites that may impact the site.

The site is not located in a designated floodplain.

D) Is the watershed anticipated to be in a phased development state for a number of years moving forward or are highly erosive soils present? Explain.

NO

E) List any vegetation assessments that have been conducted including wetland and aquatic resources delineations.

There are no delineated wetlands around the WTP site. The only wetland associated with the larger District's property is the Fountain Mutual Irrigation Canal, which flows southeasterly through the majority of the District's service area and just esat of the property. Water is not proposed to runoff to this location.

F) List any assessments of habitat for threatened or endangered species and other regulated species.

None.

G) Describe any existing and/or proposed utility mapping for subsurface and/or above-ground utilities that may impact SCMs.

The owner is a water utility provider with water mains, sewer, gas, fiber and electrical utility mains. No utilities are located in the proposed location of the bioretention pond.

H) Are there receiving water quality concerns such as TMDLs, 303(d) listings, or other pollutant reduction targets? Explain.

NO

I) Describe how community values including context, scale, materials, and user experience will be incorporated on site. See Chapter 4 for additional gudance.

The proposed bioretention pond aligns with MHFD community values by combining stormwater treatment with an attractive landscaped feature using native grasses. This design promotes sustainability through low-maintenance vegetation, local climate resilience, and improved water quality treatment.

J) Will attenuation of the EURV and/or flood storage (e.g. FSD) be provided onsite?

NO

Since runoff will be retained on the District's larger property, the bioretention will only be sized for the WQCV. A spillway will be included to direct larger storm-water events to the District's downstream property.

Site Assessment

SCM Design, Version 4.02 (June 2025)

Designer: JMS
Company: GMS Consulting Engineers
Date: June 22, 2026
Project: Security Water District WTP Building Addition
Location: Security, Colorado

2. Opportunities for Step 1: Runoff Reduction

A) Describe opportunities for runoff reduction measures that can be used on this site to potentially reduce WQCV requirements?

Conserve Existing Amenities: Identify portions of site that should be protected including mature trees, stream corridors, wetlands, and Type A/B soils with high infiltration potential.

The entire site is located on Type A soil with high infiltration potential. Mature trees are located on the west side of the property, outside the fenced operations area. Runoff is directed to the bioretention pond via grass swales.

Minimize Impacts: Creative site layout and constructing to minimum widths can reduce the extent of paved areas. Concentrate new impervious areas over Type C/D soils. Maintain natural drainage patterns and promote sheet flow.

Drainage will continue to flow onto the District's larger property to the west and north. Impacts of the new impervious areas will be minimized to adjacent, downstream properties.

Minimize Directly Connected Impervious Areas (MDCIA): Allow runoff from impervious areas to sheet flow through vegetation which slows runoff, promotes infiltration, reduces pollutant loads and helps mimic predevelopment hydrology.

The runoff from the improved pavement areas will flow through grass swales prior to the bioretention system.

3. Suitability for Infiltration-Based SCMs

A) What are the dominant Hydrologic Soil Groups (HSG) for the site?

Type A and B Soils — ***Soils suitable for full infiltration***

B) Provide a description of topsoil texture, agronomic properties, and geotechnical soil characterizations.

The NRCS indicates this soil as 8 - Blakeland loam sand. Infiltration rates range from 5.95 to 19.98 inches per hour.

C) Identify Site Constraints

i) Is subgrade depth to bedrock < 3 feet?	NO
ii) Is subgrade depth to seasonal high groundwater table < 3 feet?	NO

D) Identify Site Risks

i) Are expansive/collapsible soils present?	NO
ii) Are highly concentrated pollutant sources present (hotspot)?	NO
iii) Is site located above contaminated soils or groundwater?	NO
iv) Are steep slopes present in proposed SCM locations? (> 3H:1V)	NO
v) Are there other concerns that indicate high risk for infiltration?	NO

E) Describe Exploratory Borings/Pits and Laboratory Tests (Sec. 4.2)

i) How many borings/pits were drilled/excavated?	$N_{Borings/Pits}$ =	3
ii) Depth of borings/pits below SCM (or proposed grade) surface?	$D_{Borings/Pits}$ =	30.00 ft

iii) Describe laboratory tests performed on soil samples:

Soils testing was conducted around the site for the proposed WTP improvements.

F) Preliminary Infiltration System Recommendation

Full Infiltration — **Suitable Soils and Low Risk, must verify adequate subgrade infiltration rates.**

This is a preliminary recommendation. Consult with a qualified geotechnical engineer when planning an infiltration-based SCM.

Site Layout

SCM Design, Version 4.02 (June 2025)

Designer: JMS
Company: GMS Consulting Engineers
Date: June 22, 2026
Project: Security Water District Building Addition
Location: Security, Colorado

SITE LAYOUT INFO (User Input in Blue Cells)

Water Quality Event (WQE): 0.60 inches

Outfall ID	2A											
Total Tributary Area (ft^2)	73,616											
Total Tributary Area (ac)	1.69											
Imperviousness (%)	60.2%											
MS4 Design Standard	WQCV											
SCM Type	BR											

Notes:

OUTFALL RESULTS

SCM Worksheet Name	BR_2A											
Untreated Area (ft^3)	0											
Default WQCV (ft^3)	1,162											
Optional Override WQCV (ft^3)	1,176											
WQCV Reduction (ft^3)	0											
Remaining WQCV (ft^3)	1,176											
WQCV Reduction (%)	0%											
Design WQCV of SCM (ft^3)	1,192											
Pollutant Removal (ft^3)	0											
Untreated WQCV (ft^3)	0											

TOTAL SITE RESULTS (Sums results from all Outfalls)

Total Site Area	73,616	ft^2	1.69	acres
Treated Area	73,616	ft^2	1.69	acres
Untreated Area	0	ft^2	0.00	acres
Total Site Imperviousness	60.2%	%		
Default (or Override) WQCV	1,176	ft^3	0.027	acre-feet
Remaining WQCV	1,176	ft^3	0.027	acre-feet
WQCV Reduction	0%	%		
Design WQCV	1,192	ft^3	0.027	acre-feet
Untreated WQCV	0	ft^3	0.000	acre-feet

Bioretention System (BR)

SCM Design, Version 4.02 (June 2025)

Designer: JMS
Company: GMS Consulting Engineers
Date: June 22, 2026
Project: Security Water District Building Addition
Location: Security, Colorado
Outfall ID: 2A

1. Subsurface Exploration and Infiltration System Selection

A) Identify Site Constraints
- i) Is subgrade depth to bedrock < 3 feet? — NO
- ii) Is subgrade depth to seasonal high groundwater table < 3 feet? — NO

B) Identify Site Risks
- i) Are expansive/collapsible soils present? — NO
- ii) Are highly concentrated pollutant sources present (hotspot)? — NO
- iii) Is site located above contaminated soils or groundwater? — NO
- iv) Is SCM located at top of steep slope? (> 3H:1V) — NO
- v) Is SCM located adjacent to building, hardscape, or pavement? — NO
- vi) Is SCM located above building foundation wall backfill? — NO
- vii) Are there other concerns that indicate high risk for infiltration? — NO

C) Preliminary Infiltration/Percolation Tests of underlying soils
- i) Were preliminary infiltration/percolation tests conducted? — YES *Please describe below*
- ii) Preliminary estimate of infiltration rate — F_{prelim} = 5.95 in/hr

The National Resources Conservation Service indicates a type A soil in the area. The permeability rate ranges from 5.95 to 19.98 in/hr. A more conservative value is used.

D) Final Design Infiltrometer Test
- i) Were infiltrometer tests conducted? — NO
- ii) Select type of infiltrometer test performed:
- iii) How many locations were tested? — N_{Tests} =
- iv) Describe test locations relative to borings/pits
- v) What was the maximum infiltration rate tested? — F_{Max} = in/hr
- vi) What was the minimum infiltration rate tested? — F_{Min} = in/hr
- vii) Design Infiltration Rate — F_{Design} = 6.00 in/hr

E) Recommended Infiltration System — Full Infiltration **Suitable Soils and Low Risk, must verify adequate subgrade infiltration rates.**

F) Select Infiltration System to use for Design — Partial Infiltration

Bioretention System (BR)

SCM Design, Version 4.02 (June 2025)

Designer:	**JMS**
Company:	**GMS Consulting Engineers**
Date:	**June 22, 2026**
Project:	**Security Water District Building Addition**
Location:	**Security, Colorado**
Outfall ID:	**2A**

2. Inlet Design and Pretreatment

A) Is RPA (GB/GS) used for Runoff Reduction upstream of SCM? NO

Define inflow points for all areas tributary to the SCM below.

B) Inflow Points contributing to SCM (max 8)

Inflow Design Point ID	2A							
Tributary Area to Inflow Point (ft^2)	73,616							
Imperviousness above Inflow Point (%)	60.2%							
Default WQCV for Inflow Point (ft^3)	1,162							
Optional Override WQCV for Inflow Point (ft^3)	1,176							
WQCV Reduction above Inflow Point (ft^3)	0							
Remaining WQCV at Inflow Point (ft^3)	1,176							
Will pretreatment be provided with a Sedimentation MTD (HDS)	NO							
Paired Pretreatment HDS Worksheet Name								
Sheet or Concentrated Flow	Conc							

C) Sheet Flow

Select sheet flow inflow feature	--							
Is Concrete Edger used?	--							
Spacing between slots, recommend ≤ 2 ft on center (ft)	--							
Slot Opening Length, recommend 1.5 (in)	--							
Select type of blind swale used to distribute flow	--							
Select energy dissipation method for level spreader	--							
Height of drop, recommend 2 to 3 (in)	--							
Is concrete mowing strip provided to facilitate maintenance?	--							

D) Concentrated Flow

Select concentrated flow inflow feature	Pipe							
Is downspout extension needed to bridge backfill zone?	--							
Depth of gutter flow line depression for curb opening, recommend 3 (in)	--							
Curb opening inlet width (ft)	--							
Height of drop to sediment pad/forebay, recommend ≥ 1 (in)	--							
Select energy dissipation method for downspouts and/or curb openings.	--							
Select energy dissipation method for swales, channels, and piped outfalls	Riprap							

v) Forebay

Impervious area tributary to concentrated inflow location (ft^2)	44,317							
Forebay Type (Concrete Sediment Pad sufficient for Imp Area ≤ 2 acre)	Pad							
Minimum Forebay Volume (ft^3)	--							
Design Forebay Volume (ft^3)	--							
Maximum Forebay Depth (in)	--							
Design Forebay Depth (in)	--							
Rectangular Weir Notch Width to Empty Forebay in 5-minutes (in)	--							
Design Notch Width (in)	--							
Forebay Drain Time (minutes)	--							

Provide pretreatment to remove coarse sediment, trash and debris. This is especially critical for roadway runoff to bioretention systems.

Bioretention System (BR)

SCM Design, Version 4.02 (June 2025)

Designer: JMS
Company: GMS Consulting Engineers
Date: June 22, 2026
Project: Security Water District Building Addition
Location: Security, Colorado
Outfall ID: 2A

3. Design Storage Volume

Inflow Points above should be fully defined before proceeding below

A) Contributing Watershed Area (including bioretention area)
Area = 73,616 ft²
Area = 1.69 ac
Total Tributary Inflow Area (ft²) = 73,616
BR Footprint Area (ft²) = 0

B) Imperviousness of Tributary Area
i = 60.2% %

C) Default WQCV (or optional Override WQCV)
$V_{WQCV\ Default}$ = 1,162 ft³
$V_{WQCV\ Override}$ = 1,176 ft³

D) WQCV Reduction resulting from Upstream RPA (GB/GS)
WQCV Reduction = 0 ft³

E) Remaining WQCV
$V_{WQCV\ Remaining}$ = 1,176 ft³

4. Bioretention System Basin Geometry

A) Mimimum Filter Media Surface Area
$A_{F\ Min}$ = 886 ft²

B) Design Filter Media Surface Area
$A_{F\ Design}$ = 1,331 ft²

C) WQCV Ponding Depth (recommend max. 12-inch)
D_{WQCV} = 11.00 in

D) Media Surface Slope (typically flat or mild slope < 0.01 ft/ft)
$S_{Surface}$ = 0.010 ft / ft

E) Max. Side Slope (Z = 4:1 or flatter, horiz. dist per unit vertical)
(Use "0" if bioretention has vertical walls)
Z = 4.00 ft / ft

F) Media Surface Length-to-Width Ratio
$R_{L/W}$ = 2

G) Calculated WQCV (based on $A_{F\ Design}$, D_{WQCV}, and Z)
$V_{WQCV\ Calculated}$ = 1,505 ft³

H) Design WQCV (based on actual design geometry)
$V_{WQCV\ Design}$ = 1,192 ft³
Explain difference from Calculated WQCV

I) If basin geometry is irregular, design volume differs, or media pore space is being utilized, please provide description.
Calculations based on a MHFD Detention Basin Workbook. Media surface dimensions are 48'L x 24'W with a 1' ponding height.

Bioretention System (BR)

SCM Design, Version 4.02 (June 2025)

Designer: JMS
Company: GMS Consulting Engineers
Date: June 22, 2026
Project: Security Water District Building Addition
Location: Security, Colorado
Outfall ID: 2A

5. Underdrain System, Impermeable Liner, and Geotextile

A) Are underdrains provided? — YES

B) Is a Drain Trench provided consistent with Figure 4-2? — YES
- Trench Bottom Width ≥ 12 inches, Trench Depth ≥ 15 inches
- Drain gravel satisfies gradation specifications for AASHTO M 43 No. 8 coarse aggregate
- Filter sand above drain gravel satisfies gradation specifications for AASHTO M 43 fine aggregate
- Filter sand depth above drain trench ≥ 6 inches
- Filter sand extends ≥ 12 inches beyond trench top width

Yes. See attached drawings.

C) Select Factory-Slotted Pipe Size and Material — 4-inch (ID), Sch 40 PVC

D) Does the specified pipe material meet the specifications for slot configurations shown in Table 4-6 and Figure 4-3. — YES

E) Are cleanouts provided for inspection and maintenance? — YES

F) Is an impermeable geomembrane liner provided? — NO

G) Are details provided regarding sealing at underdrain penetrations similar to Figure 4-6?

H) Are geomembrane connections to vertical concrete surfaces consistent with Figure 4-7?

I) Do the plans specify thermal welding and air lance testing of joints?

6. Bioretention Media

A) Depth of Media (18-inch minimum, 36-inch when trees planted) — D_{Media} = 18.00 in

B) Do construction documents specify media testing requirements? — YES

Analyze gradation and nutrient content of media after delivery to the site and preferably, prior to placement.

The media will conform to Table BR-3 in Chapter 4 of the Mile High Flood District Urband Storm Drainage Criteria Manual Volume 3.

Bioretention System (BR)

SCM Design, Version 4.02 (June 2025)

Designer: JMS
Company: GMS Consulting Engineers
Date: June 22, 2026
Project: Security Water District Building Addition
Location: Security, Colorado
Outfall ID: 2A

7. Vegetation

A) Select the method of vegetation planting (pulldown list). Consult with vegetation specialist to consider shade, heat island effects, application of deicers in the watershed, and other site-specific factors.

Table BR-4 provides suggested Native Seed Mix

Sod-forming native grasses from seed

Typically costs less than container grown plants but more susceptible to being washed away during establishment.

The native seed mix will be in accordance with Table BR-4 in Chapter 4 of the Mile High Flood District Urband Storm Drainage Criteria Manual Volume 3.

B) Has a landscape/vegetation management plan been developed?

YES

C) Describe vegetation/landscaping considerations:
- Stability issues (steep slopes, high erosion potential)?
- Topsoil management (assessment, stockpiling, and placement)?
- Community benefits with place-making approach?
- Biodiversity of the site including pollinator species?
- Environmental stewardship through conservation?
- Inundation frequency and depth impacts on vegetation?
- Required maintenance activities and intervals?

Bioretention area shall be planted with native, drought-tolerant grasses adapted to periodic inundation and dry conditions. Maintain full vegetative cover to promote filtration, prevent erosion, and support long-term treatment performance.

8. Irrigation

A) How will irrigation be provided for vegetation establishment?

Place temporary irrigation on top of the bioretention media surface. Remove irrigation pipes once vegetation is established to avoid it being buried over time.

Temporary

Irrigation will be provided for the establishment of the grass.

9. Outlet

A) Underdrain Orifice Diameter for 12-hour drain time

i) Underdrain Orifice Invert Depth (distance from filter media surface to orifice invert)

y = 28.0 in

ii) Calculated Underdrain Orifice Diameter
Simplified Equation (when not using MHFD-Detention)
MHFD-Detention Calculation (if used)

Dia. $_{Simplified}$ = 0.77 in
Dia. $_{MHFD\text{-}Detention}$ = 0.75 in

iii) Underdrain Orifice Diameter specified on construction plans

Orifice Dia. $_{Design}$ = 0.75 in

B) Describe Underdrain Orifice Outlet Configuration.
Consider adding Internal Water Storage (IWS) zone as described in the upfront section of Chapter 4. This can reduce nutrient loading from outflows.

4-inch Sched 40 PVC factory slotted underdrain placed within washed aggregate drainage layer, located beneath 6-inch sand transition layer and 18-inch bioretention media. A 3/4-inch orifice will be drilled into a PVC cap where the underdrain daylights.

C) Describe Outlet Structure(s) for events larger than WQCV. (full-spectrum detention, overflow spillway, etc.)

An overflow spillway located above the WQCV ponding depth of 12-inches is proposed.

10. Maintenance

A) Has a maintenance plan that includes the following been developed?
- access for restorative and routine maintenance
- access to forebay/concrete sediment pads
- types of equipment required
- plant debris removal
- do not use for snow storage

YES

Inspect semi-annually and after major storm events. Remove sediment and debris, maintain native grass cover, reseed bare areas ,remove weeds, inspect for clogging or erosion, and clean underdrain/orifice as needed to maintain design drainage.

Notes:

APPENDIX G –BIORETENTION POND SIZING

MILE HIGH FLOOD DISTRICT

DETENTION BASIN DESIGN WORKBOOK

MHFD-Detention, Version 4.07 (June 2025)
Mile High Flood District
Denver, Colorado
www.mhfd.org

Purpose:

This workbook aids in the estimation of stormwater detention basin sizing and outlet routing based on the modified puls routing method for urban watersheds. Several different SCM types and various outlet configurations can be sized.

Function:

1. Approximates the stage-area-volume relationship for a detention basin based on watershed parameters and basin geometry parameters. Also evaluates existing user-defined basin stage-area relationships.

2. Sizes filtration media orifice, outlet orifices, elliptical slots, weirs, trash racks, and develops stage-discharge relationships. Uses the Modified Puls method to route a series of hydrographs (i.e., 2-, 5-, 10-, 25-, 50-, 100- and 500-year) and calibrates the peak discharge out of the basin to match the pre-development peak discharges for the watershed.

Content: **This workbook consists of the following sheets:**

Basin	Tabulates stage-area-volume relationship estimates based on watershed parameters
Outlet Structure	Tabulates a stage-discharge relationship for the user-defined outlet structure (inlet control).
Reference	Provides reference equations and figures.
User Tips and Tools	Provides instructions and video links to assist in using this workbook. Includes a stage-area calculator.
SCM Zone Images	Provides images of typical SCM zone confirgurations corresponding with Zone pulldown selections.

Acknowledgements: ***Spreadsheet Development Team:***
Ken MacKenzie, P.E., Holly Piza, P.E.
Mile High Flood District

Derek N. Rapp, P.E.
Peak Stormwater Engineering, LLC

Dr. James C.Y. Guo, Ph.D., P.E.
Professor, Department of Civil Engineering, University of Colorado at Denver

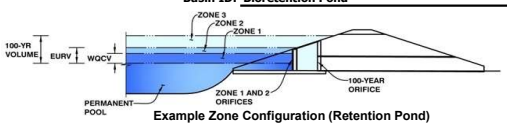
Comments? Direct all comments regarding this spreadsheet workbook to: **MHFD E-Mail**
Revisions? Check for revised versions of this or any other workbook at: **Downloads**

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)

Project: Security Water District

Basin ID: Bioretention Pond



Example Zone Configuration (Retention Pond)

Watershed Information

Selected SCM Type =	**BR**	
Watershed Area =	1.69	acres
Watershed Length =	716	ft
Watershed Length to Centroid =	300	ft
Watershed Slope =	0.008	ft/ft
Watershed Imperviousness =	60.20%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.027	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.124	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1 in.) =	0.075	acre-feet	1.00	inches
5-yr Runoff Volume (P1 = 1.28 in.) =	0.099	acre-feet	1.28	inches
10-yr Runoff Volume (P1 = 1.55 in.) =	0.124	acre-feet	1.55	inches
25-yr Runoff Volume (P1 = 1.96 in.) =	0.169	acre-feet	1.96	inches
50-yr Runoff Volume (P1 = 2.32 in.) =	0.214	acre-feet	2.32	inches
100-yr Runoff Volume (P1 = 2.72 in.) =	0.270	acre-feet	2.72	inches
500-yr Runoff Volume (P1 = 3.78 in.) =	0.417	acre-feet	3.78	inches
Approximate 2-yr Detention Volume =	0.067	acre-feet		
Approximate 5-yr Detention Volume =	0.090	acre-feet		
Approximate 10-yr Detention Volume =	0.112	acre-feet		
Approximate 25-yr Detention Volume =	0.150	acre-feet		
Approximate 50-yr Detention Volume =	0.175	acre-feet		
Approximate 100-yr Detention Volume =	0.202	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.027	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.027	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Total detention volume is less than 100-year volume.

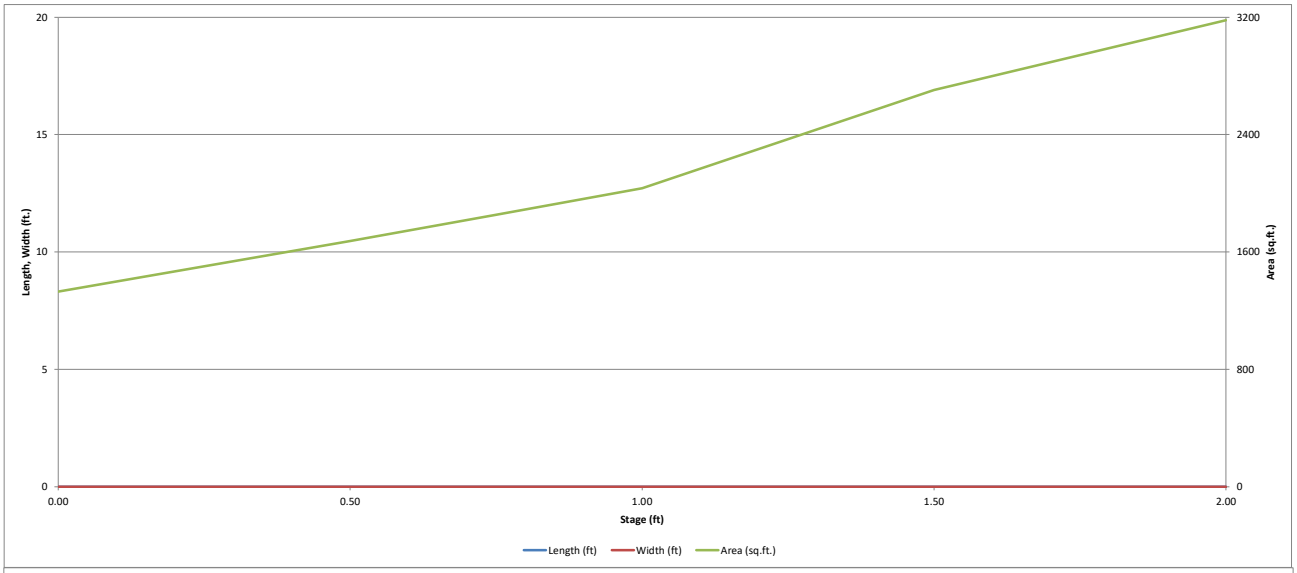
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

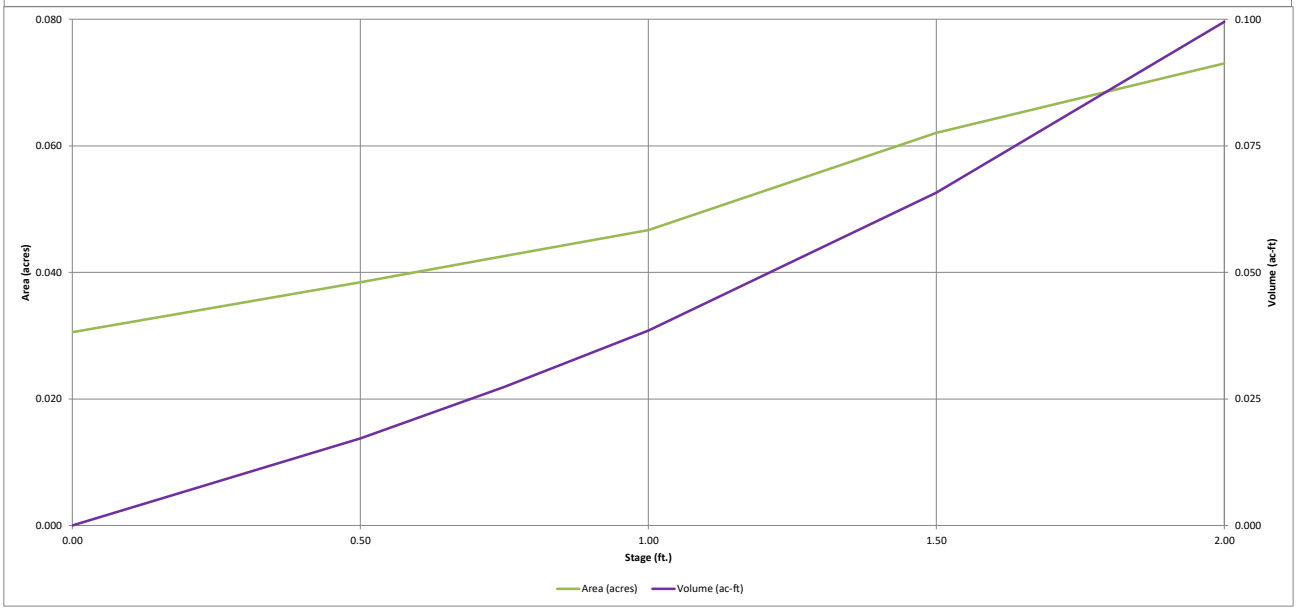
Depth Increment = 0.50 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Media Surface	--	0.00	--	--	--	1,331	0.031		
	--	0.50	--	--	--	1,674	0.038	751	0.017
Top of WQCV	--	0.75	--	--	--	1,855	0.043	1,192	0.027
Spillway	--	1.00	--	--	--	2,035	0.047	1,679	0.039
	--	1.50	--	--	--	2,705	0.062	2,864	0.066
Top of Berm	--	2.00	--	--	--	3,181	0.073	4,335	0.100

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)



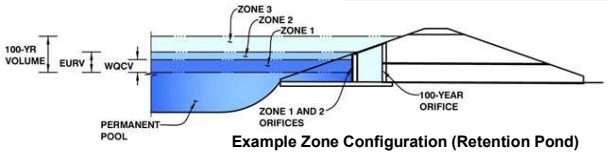


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Project: **Security Water District**

Basin ID: **Bioretention Pond**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.74	0.027	Filtration Media
Zone 2			
Zone 3			
Total (all zones)		0.027	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration SCM)

Underdrain Orifice Invert Depth =	2.33	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.75	inches	Underdrain Orifice Centroid =	0.03	feet

Calculated Parameters for Underdrain

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation SCM)

Centroid of Lowest Orifice =		ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =		ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =		inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =		sq. inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (optional)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =			ft^2
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =			feet
Vertical Orifice Diameter =			inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft^2
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft^2
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft^2
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	1.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.33	feet
Spillway Crest Length =	4.00	feet	Stage at Top of Freeboard =	2.40	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.07	acres
Freeboard above Max Water Surface =	1.07	feet	Basin Volume at Top of Freeboard =	0.10	acre-ft

Calculated Parameters for Spillway

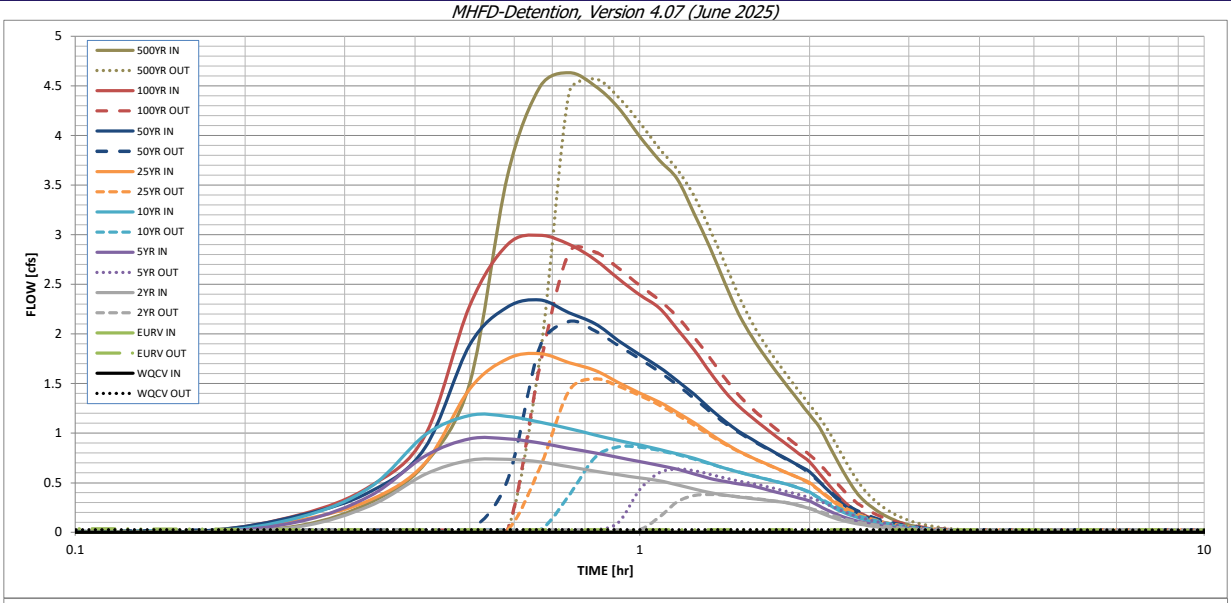
Routed Hydrograph Results

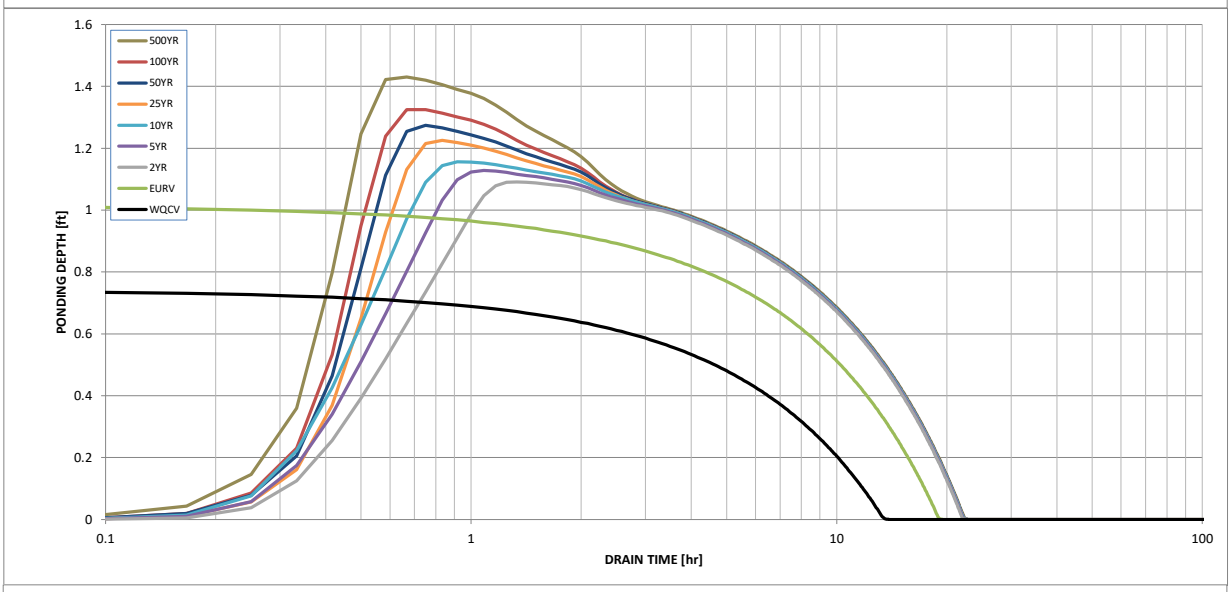
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

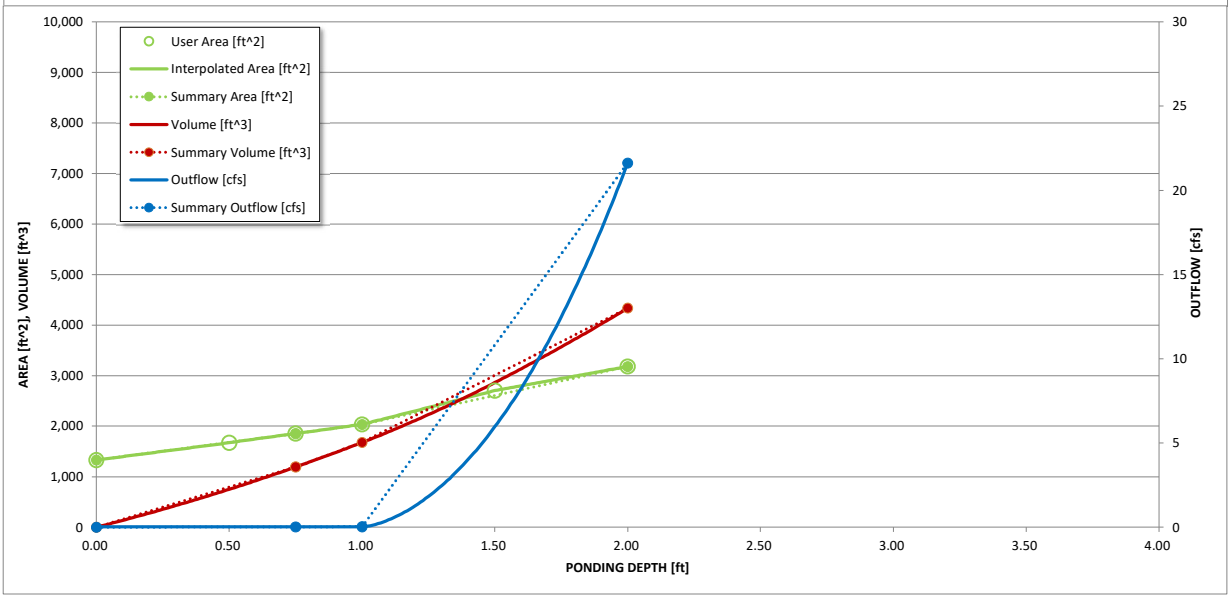
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.00	1.28	1.55	1.96	2.32	2.72	3.78
CUHP Runoff Volume (acre-ft) =	0.027	0.124	0.075	0.099	0.124	0.169	0.214	0.270	0.417
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.075	0.099	0.124	0.169	0.214	0.270	0.417
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.2	0.4	0.7	1.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.3	0.4	0.6	1.1	1.8	4.0
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.12	0.17	0.23	0.36	0.63	1.09	2.34
Peak Inflow Q (cfs) =	N/A	N/A	0.7	0.9	1.2	1.8	2.3	3.0	4.6
Peak Outflow Q (cfs) =	0.0	12.3	0.4	0.6	0.9	1.5	2.1	2.8	4.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.2	2.2	2.5	2.0	1.5	1.2
Structure Controlling Flow =	Filtration Media	Spillway	Spillway	Spillway	Spillway	Spillway	Spillway	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	13	18	21	21	20	20	19	18	16
Time to Drain 99% of Inflow Volume (hours) =	**13**	19	22	22	22	21	21	21	20
Maximum Ponding Depth (ft) =	0.75	1.01	1.09	1.13	1.16	1.23	1.27	1.32	1.43
Area at Maximum Ponding Depth (acres) =	0.04	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06
Maximum Volume Stored (acre-ft) =	0.027	0.039	0.043	0.044	0.046	0.050	0.052	0.055	0.061

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
\	0:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.07
	0:15:00	0	0.00	0.06	0.11	0.15	0.12	0.17	0.18	0.30
	0:20:00	0	0.00	0.27	0.37	0.46	0.33	0.41	0.46	0.69
	0:25:00	0	0.00	0.59	0.77	0.98	0.70	0.85	0.97	1.50
	0:30:00	0	0.00	0.73	0.94	1.18	1.45	1.89	2.28	3.59
	0:35:00	0	0.00	0.73	0.94	1.17	1.75	2.27	2.90	4.49
	0:40:00	0	0.00	0.71	0.90	1.11	1.80	2.34	2.99	4.63
	0:45:00	0	0.00	0.66	0.85	1.05	1.71	2.21	2.90	4.50
	0:50:00	0	0.00	0.62	0.80	0.98	1.63	2.10	2.75	4.28
	0:55:00	0	0.00	0.58	0.75	0.93	1.51	1.93	2.56	3.99
	1:00:00	0	0.00	0.55	0.71	0.88	1.41	1.79	2.39	3.75
	1:05:00	0	0.00	0.52	0.68	0.84	1.31	1.67	2.26	3.56
	1:10:00	0	0.00	0.48	0.64	0.79	1.21	1.53	2.04	3.21
	1:15:00	0	0.00	0.44	0.59	0.75	1.11	1.39	1.84	2.87
	1:20:00	0	0.00	0.40	0.54	0.69	0.99	1.25	1.61	2.51
	1:25:00	0	0.00	0.38	0.51	0.65	0.90	1.12	1.42	2.20
	1:30:00	0	0.00	0.36	0.49	0.61	0.82	1.02	1.27	1.96
	1:35:00	0	0.00	0.34	0.47	0.57	0.75	0.94	1.16	1.78
	1:40:00	0	0.00	0.33	0.43	0.54	0.70	0.86	1.05	1.61
	1:45:00	0	0.00	0.31	0.40	0.51	0.64	0.80	0.96	1.46
	1:50:00	0	0.00	0.30	0.37	0.48	0.60	0.73	0.88	1.32
	1:55:00	0	0.00	0.27	0.35	0.45	0.55	0.67	0.79	1.19
	2:00:00	0	0.00	0.24	0.32	0.41	0.50	0.61	0.71	1.06
	2:05:00	0	0.00	0.20	0.26	0.34	0.42	0.51	0.59	0.88
	2:10:00	0	0.00	0.16	0.22	0.28	0.34	0.41	0.48	0.70
	2:15:00	0	0.00	0.13	0.17	0.22	0.27	0.32	0.37	0.54
	2:20:00	0	0.00	0.11	0.14	0.19	0.21	0.25	0.28	0.41
	2:25:00	0	0.00	0.09	0.12	0.15	0.17	0.20	0.22	0.32
	2:30:00	0	0.00	0.07	0.10	0.13	0.14	0.16	0.17	0.25
	2:35:00	0	0.00	0.06	0.08	0.11	0.11	0.13	0.14	0.20
	2:40:00	0	0.00	0.05	0.07	0.09	0.09	0.11	0.11	0.16
	2:45:00	0	0.00	0.04	0.06	0.07	0.07	0.09	0.09	0.12
	2:50:00	0	0.00	0.03	0.05	0.06	0.06	0.07	0.07	0.09
	2:55:00	0	0.00	0.03	0.04	0.05	0.05	0.06	0.05	0.07
	3:00:00	0	0.00	0.02	0.03	0.04	0.04	0.05	0.04	0.06
	3:05:00	0	0.00	0.02	0.02	0.03	0.03	0.04	0.04	0.05
	3:10:00	0	0.00	0.01	0.02	0.02	0.02	0.03	0.03	0.04
	3:15:00	0	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03
	3:20:00	0	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02
	3:25:00	0	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	3:30:00	0	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	3:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Elevation [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
Media Surface	0.00	5851.50	1331	0.031	0	0.000	0.00
Top of WQCV	0.75	5852.25	1855	0.043	1192	0.027	0.03
Spillway	1.00	5852.50	2035	0.047	1679	0.039	0.03
Top of Berm	2.00	5853.50	3181	0.073	4335	0.100	21.63

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

APPENDIX H – 2026 FINANCIAL ASSURANCE ESTIMATE FORM

2026 Financial Assurance Estimate Form
(with pre-plat construction)

Updated: 2/2026

PROJECT INFORMATION

Project Name: Security Water District IXWTP	Date: 6/18/2026	PCD File No. PPR262

Description	Quantity	Units	Unit Cost		Total	(with Pre-Plat Construction) % Complete	Remaining	
SECTION 1 - GRADING AND EROSION CONTROL (Construction and Permanent BMPs)								
Earthwork								*
less than 5,000; $8,000 min	398.	CY	$ 7.50	=	$ 8,000.00		$ 8,000.00	*
5,001-20,000; $30,000 min		CY	$ 6.50	=	$ -		$ -	*
20,001-50,000; $100,000 min		CY	$ 4.50	=	$ -		$ -	*
50,001-200,000; $175,000 min		CY	$ 3.00	=	$ -		$ -	*
greater than 200,000; $500,000 min		CY	$ 2.50	=	$ -		$ -	*
Erosion Control Blanket		SY	$ 6.00	=	$ -		$ -	*
Seeding (inc. noxious weed mgmnt.) & Mulching		AC	$ 2,037.00	=	$ -		$ -	*
Permanent Pond/PCM (provide engineer's estimate)	1.	EA	$ 25,000.00	=	$ 25,000.00		$ 25,000.00	*
					$ -		$ -	*
					$ -		$ -	*
[insert items not listed but part of construction plans]					$ -		$ -	*
Safety Fence		LF	$ 5.00	=	$ -		$ -	
Inlet Protection	2.	EA	$ 322.00	=	$ 644.00		$ 644.00	
Rock Check Dam		EA	$ 908.00	=	$ -		$ -	
Concrete Washout Basin	1.	EA	$ 1,790.00	=	$ 1,790.00		$ 1,790.00	
Sediment Basin	1.	EA	$ 3,483.00	=	$ 3,483.00		$ 3,483.00	
Sediment Trap		EA	$ 877.00	=	$ -		$ -	
Silt Fence	702.	LF	$ 3.00	=	$ 2,106.00		$ 2,106.00	
Slope Drain		LF	$ 30.00	=	$ -		$ -	
Straw Bale		EA	$ 56.00	=	$ -		$ -	
Straw Wattle/Rock Sock	756.	LF	$ 11.00	=	$ 8,316.00		$ 8,316.00	
Surface Roughening		AC	$ 507.00	=	$ -		$ -	
Vehicle Tracking Control	1.	EA	$ 3,840.00	=	$ 3,840.00		$ 3,840.00	
				=	$ -		$ -	
				=	$ -		$ -	
				=	$ -		$ -	
[insert items not listed but part of construction plans]				=	$ -		$ -	
MAINTENANCE (35% of Construction BMPs)				=	$ 7,062.65		$ 7,062.65	
* - Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)		**Section 1 Subtotal**		=	**$ 60,241.65**		**$ 60,241.65**	
SECTION 2 - PUBLIC IMPROVEMENTS *								
ROADWAY IMPROVEMENTS								*
Construction Traffic Control		LS		=	$ -		$ -	*
Aggregate Base Course (135 lbs/cf)		Tons	$ 42.00	=	$ -		$ -	*
Aggregate Base Course (135 lbs/cf)		CY	$ 81.00	=	$ -		$ -	*
Asphalt Pavement (3" thick)		SY	$ 22.00	=	$ -		$ -	*
Asphalt Pavement (4" thick)		SY	$ 31.00	=	$ -		$ -	*
Asphalt Pavement (6" thick)		SY	$ 47.00	=	$ -		$ -	*
Asphalt Pavement (147 lbs/cf) __" thick		Tons	$ 140.00	=	$ -		$ -	*
Raised Median, Paved		SF	$ 15.00	=	$ -		$ -	*
Signs (regulatory/advisory/guide/street)		EA	$ 293.00	=	$ -		$ -	*
Epoxy Pavement Marking		SF	$ 19.00	=	$ -		$ -	*
Thermoplastic Pavement Marking		SF	$ 29.00	=	$ -		$ -	*
Barricade - Type 3		EA	$ 380.00	=	$ -		$ -	*
Delineator - Type I		EA	$ 38.00	=	$ -		$ -	*
Curb and Gutter, Type A (6" Vertical)		LF	$ 49.00	=	$ -		$ -	*
Curb and Gutter, Type B (Median)		LF	$ 50.00	=	$ -		$ -	*
Curb and Gutter, Type C (Ramp)		LF	$ 51.00	=	$ -		$ -	*
4" Sidewalk (common areas only)		SY	$ 69.00	=	$ -		$ -	*
5" Sidewalk		SY	$ 85.00	=	$ -		$ -	*
6" Sidewalk		SY	$ 113.00	=	$ -		$ -	*
8" Sidewalk		SY	$ 141.00	=	$ -		$ -	*
Pedestrian Ramp		EA	$ 1,961.00	=	$ -		$ -	*
Cross Pan, local (8" thick, 6' wide to include return)		LF	$ 87.00	=	$ -		$ -	*
Cross Pan, collector (9" thick, 8' wide to include return)		LF	$ 131.00	=	$ -		$ -	*
Curb Opening with Drainage Chase		EA	$ 2,341.00	=	$ -		$ -	*
Guardrail Type 3 (W-Beam)		LF	$ 87.00	=	$ -		$ -	*
Guardrail Type 7 (Concrete)		LF	$ 104.00	=	$ -		$ -	*
Guardrail End Anchorage		EA	$ 2,485.00	=	$ -		$ -	*
Guardrail Impact Attenuator		EA	$ 22,568.00	=	$ -		$ -	*
Sound Barrier Fence (CMU block, 6' high)		LF	$ 113.00	=	$ -		$ -	*
Sound Barrier Fence (panels, 6' high)		LF	$ 115.00	=	$ -		$ -	*
Electrical Conduit, Size =		LF	$ 33.00	=	$ -		$ -	*
Traffic Signal, (provide engineer's estimate)		EA		=	$ -		$ -	*
Survey Monumentation		EA	$ 638.00	=	$ -		$ -	*
				=	$ -		$ -	*

PROJECT INFORMATION

Project Name: Security Water District IXWTP | **Date: 6/18/2026** | **PCD File No. PPR262**

Description	Quantity	Units	Unit Cost		Total	(with Pre-Plat Construction) % Complete	Remaining	
				=	$ -		$ -	*
				=	$ -		$ -	*
[insert items not listed but part of construction plans]				=	$ -		$ -	*
STORM DRAIN IMPROVEMENTS								*
Concrete Box Culvert (M Standard), Size (W x H)		LF		=	$ -		$ -	*
18" Reinforced Concrete Pipe		LF	$ 111.00	=	$ -		$ -	*
24" Reinforced Concrete Pipe		LF	$ 161.00	=	$ -		$ -	*
30" Reinforced Concrete Pipe		LF	$ 167.00	=	$ -		$ -	*
36" Reinforced Concrete Pipe		LF	$ 191.00	=	$ -		$ -	*
42" Reinforced Concrete Pipe		LF	$ 275.00	=	$ -		$ -	*
48" Reinforced Concrete Pipe		LF	$ 349.00	=	$ -		$ -	*
54" Reinforced Concrete Pipe		LF	$ 465.00	=	$ -		$ -	*
60" Reinforced Concrete Pipe		LF	$ 476.00	=	$ -		$ -	*
66" Reinforced Concrete Pipe		LF	$ 550.00	=	$ -		$ -	*
72" Reinforced Concrete Pipe		LF	$ 616.00	=	$ -		$ -	*
18" Corrugated Steel Pipe		LF	$ 136.00	=	$ -		$ -	*
24" Corrugated Steel Pipe		LF	$ 229.00	=	$ -		$ -	*
30" Corrugated Steel Pipe		LF	$ 244.00	=	$ -		$ -	*
36" Corrugated Steel Pipe		LF	$ 244.00	=	$ -		$ -	*
42" Corrugated Steel Pipe		LF	$ 226.00	=	$ -		$ -	*
48" Corrugated Steel Pipe		LF	$ 465.00	=	$ -		$ -	*
54" Corrugated Steel Pipe		LF	$ 459.00	=	$ -		$ -	*
60" Corrugated Steel Pipe		LF	$ 501.00	=	$ -		$ -	*
66" Corrugated Steel Pipe		LF	$ 580.00	=	$ -		$ -	*
72" Corrugated Steel Pipe		LF	$ 654.00	=	$ -		$ -	*
78" Corrugated Steel Pipe		LF	$ 728.00	=	$ -		$ -	*
84" Corrugated Steel Pipe		LF	$ 901.00	=	$ -		$ -	*
Flared End Section (FES) RCP Size = (unit cost = 6x pipe unit cost)		EA		=	$ -		$ -	*
Flared End Section (FES) CSP Size = (unit cost = 6x pipe unit cost)		EA		=	$ -		$ -	*
				=	$ -		$ -	*
[insert items not listed but part of construction plans]				=	$ -		$ -	*
End Treatment- Headwall		EA		=	$ -		$ -	*
End Treatment- Wingwall		EA		=	$ -		$ -	*
End Treatment - Cutoff Wall		EA		=	$ -		$ -	*
Curb Inlet (Type R) L=5', Depth < 5'		EA	$ 8,814.00	=	$ -		$ -	*
Curb Inlet (Type R) L=5', 5' ≤ Depth < 10'		EA	$ 10,835.00	=	$ -		$ -	*
Curb Inlet (Type R) L =5', 10' ≤ Depth < 15'		EA	$ 12,206.00	=	$ -		$ -	*
Curb Inlet (Type R) L =10', Depth < 5'		EA	$ 11,438.00	=	$ -		$ -	*
Curb Inlet (Type R) L =10', 5' ≤ Depth < 10'		EA	$ 12,689.00	=	$ -		$ -	*
Curb Inlet (Type R) L =10', 10' ≤ Depth < 15'		EA	$ 16,174.00	=	$ -		$ -	*
Curb Inlet (Type R) L =15', Depth < 5'		EA	$ 14,452.00	=	$ -		$ -	*
Curb Inlet (Type R) L =15', 5' ≤ Depth < 10'		EA	$ 17,237.00	=	$ -		$ -	*
Curb Inlet (Type R) L =15', 10' ≤ Depth < 15'		EA	$ 21,610.00	=	$ -		$ -	*
Curb Inlet (Type R) L =20', Depth < 5'		EA	$ 16,499.00	=	$ -		$ -	*
Curb Inlet (Type R) L =20', 5' ≤ Depth < 10'		EA	$ 20,012.00	=	$ -		$ -	*
Grated Inlet (Type C), Depth < 5'		EA	$ 8,156.00	=	$ -		$ -	*
Grated Inlet (Type D), Depth < 5'		EA	$ 11,435.00	=	$ -		$ -	*
Storm Sewer Manhole, Box Base		EA	$ 18,950.00	=	$ -		$ -	*
Storm Sewer Manhole, Slab Base		EA	$ 9,314.00	=	$ -		$ -	*
Geotextile (Erosion Control)		SY	$ 6.00	=	$ -		$ -	*
Rip Rap, d50 size from 6" to 24"		Tons	$ 102.00	=	$ -		$ -	*
Rip Rap, Grouted		Tons	$ 136.00	=	$ -		$ -	*
Drainage Channel Construction, Size (W x H)		LF		=	$ -		$ -	*
Drainage Channel Lining, Concrete		CY	$ 815.00	=	$ -		$ -	*
Drainage Channel Lining, Rip Rap		CY	$ 234.00	=	$ -		$ -	*
Drainage Channel Lining, Grass		AC	$ 2,100.00	=	$ -		$ -	*
Permanent Drainage Channel Lining or Roadside Ditch TRM		SY	$ 13.00	=	$ -		$ -	*
				=	$ -		$ -	*
				=	$ -		$ -	*
				=	$ -		$ -	*
[insert items not listed but part of construction plans]				=	$ -		$ -	*
* - Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)		**Section 2 Subtotal**		=	$ -		$ -	*

PROJECT INFORMATION		
Project Name: Security Water District IXWTP	**Date: 6/18/2026**	**PCD File No. PPR262**

Description	Quantity	Units	Unit Cost		Total	% Complete	(with Pre-Plat Construction) Remaining
SECTION 3 - COMMON DEVELOPMENT IMPROVEMENTS (Private or District and NOT Maintained by EPC)**							
ROADWAY IMPROVEMENTS							
Asphalt Pavement (6" thick)	916.	SY	$ 41.00	=	$ 37,556.00		$ 37,556.00
Class 6 Aggregate Compacted Shoulder (3' wide)	1314.	LF	$ 5.00	=	$ 6,570.00		$ 6,570.00
				=	$ -		$ -
				=	$ -		$ -
				=	$ -		$ -
				=	$ -		$ -
STORM DRAIN IMPROVEMENTS (Exception: Permanent Pond/BMP shall be itemized under Section 1)							
Cross Pan, Local (8" thick, 6' wide to include return)	15.	LF	$ 85.00	=	$ 1,275.00		$ 1,275.00
12" Corrugated Steel Pipe	10.	LF	$ 75.00	=	$ 750.00		$ 750.00
Rip Rap, d50 size from 6" to 24"	36.	Tons	$ 112.00	=	$ 4,032.00		$ 4,032.00
				=	$ -		$ -
				=	$ -		$ -
				=	$ -		$ -
WATER SYSTEM IMPROVEMENTS							
Water Main Pipe (PVC), Size 8"		LF	$ 90.00	=	$ -		$ -
Water Main Pipe (Ductile Iron), Size 8"		LF	$ 105.00	=	$ -		$ -
Gate Valves, 8"		EA	$ 2,599.00	=	$ -		$ -
Fire Hydrant Assembly, w/ all valves		EA	$ 9,228.00	=	$ -		$ -
Water Service Line Installation, inc. tap and valves		EA	$ 1,852.00	=	$ -		$ -
Fire Cistern Installation, complete		EA		=	$ -		$ -
				=	$ -		$ -
[insert items not listed but part of construction plans]				=	$ -		$ -
SANITARY SEWER IMPROVEMENTS							
Sewer Main Pipe (PVC), Size 8"		LF	$ 90.00	=	$ -		$ -
Sanitary Sewer Manhole, Depth < 15 feet		EA	$ 6,136.00	=	$ -		$ -
Sanitary Service Line Installation, complete		EA	$ 1,962.00	=	$ -		$ -
Sanitary Sewer Lift Station, complete		EA		=	$ -		$ -
				=	$ -		$ -
[insert items not listed but part of construction plans]				=	$ -		$ -
LANDSCAPING IMPROVEMENTS (For subdivision specific condition of approval, or PUD)							
		EA		=	$ -		$ -
		EA		=	$ -		$ -
		EA		=	$ -		$ -
		EA		=	$ -		$ -
		EA		=	$ -		$ -
** - Section 3 is not subject to defect warranty requirements		**Section 3 Subtotal**		=	**$ 50,183.00**		**$ 50,183.00**
AS-BUILT PLANS (Public Improvements inc. Permanent WQCV BMPs)		LS	$ 9,700.00	=	$ 9,700.00		$ 9,700.00
POND/BMP CERTIFICATION (inc. elevations and volume calculations)		LS	$ 1,500.00	=	$ 1,500.00		$ 1,500.00

Total Construction Financial Assurance $ **121,624.65**
(Sum of all section subtotals plus as-builts and pond/BMP certification)

Total Remaining Construction Financial Assurance (with Pre-Plat Construction) $ **121,624.65**
(Sum of all section totals less credit for items complete plus as-builts and pond/BMP certification)

Total Defect Warranty Financial Assurance $ **6,600.00**
(20% of all items identified as (*). To be collateralized at time of preliminary acceptance)

Approvals

I hereby certify that this is an accurate and complete estimate of costs for the work as shown on the Grading and Erosion Control Plan and Construction Drawings associated with the Project.

ROGER J. SAMS REGISTERED 11884 PROFESSIONAL ENGINEER STATE OF COLORADO 06-19-2026

Roger J. Sams
Engineer (P.E. Seal Required)

Roy E. Heald, General Manager — 06/19/2026
Approved by Owner / Applicant — Date

Approved by El Paso County Engineer / ECM Administrator — Date