

**FINAL DRAINAGE REPORT FOR
BRADLEY POINT FILING NO. 1
EL PASO COUNTY, COLORADO**

SEPTEMBER 2023

Prepared for:

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Prepared by:



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Project #70-074
PCD Project # MS-21-002

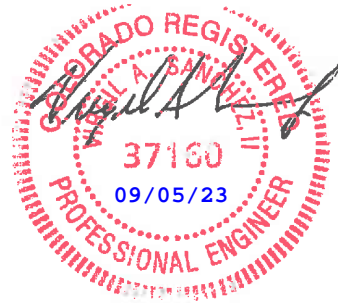
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DRAINAGE PLAN STATEMENTS

ENGINEERS STATEMENT

The attached drainage plan and report was prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the master plan of the drainage basin.

Virgil A. Sanchez, P.E. #37160
For and on Behalf of M&S Civil Consultants, Inc



DEVELOPER'S STATEMENT

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

BY: Steve J Schnurr
Stephen J. Schnurr

TITLE: OWNER/DEVELOPER
DATE: 09/05/23

ADDRESS: Stephen J. Schnurr
2010 Fox Mountain Point
Colorado Springs, CO 80906

EL PASO COUNTY'S STATEMENT

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

BY: _____ DATE: _____
Joshua Palmer, P.E.
County Engineer / ECM Administrator

**FINAL DRAINAGE REPORT FOR
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FINAL DRAINAGE REPORT FOR BRADLEY POINT FILING NO. 1

PURPOSE

This document is the Final Drainage Report for Bradley Point Filing No. 1. The purpose of this document is to identify and analyze the on and offsite drainage patterns and to ensure that post development runoff is routed through the site safely and in a manner that satisfies the requirements set forth by the El Paso County Drainage Criteria Manual.

GENERAL LOCATION AND DESCRIPTION

“Bradley Point Filing No. 1” refers to the subdivision of two parcels, 6503-40-0038 and 6503-40-0040. Bradley Point Filing No. 1 is located within the southeast and northwest quarters of the southeast quarter of Section 3, Township 15 south, Range 66 West, of the 6th Principal Meridian, El Paso County, Colorado. The site boundary is defined by Highway 85/87 on the southwestern boundary, Parcel 1 of the Rocky Mountain Materials and Asphalt Exemption Plat Map – Rec. No. 211713132 on the northwestern boundary, A.T. & S.F. Railroad Right of Way on the northeastern boundary, and unplatted land – Book 2780, Page 119, Schedule No. 65112-00-001 on the southeastern boundary. Bradley Point Filing No. 1 lies within the Little Johnson Drainage Basin. Flows from this site are tributary the US 85-87 corridor and ultimately tributary to Fountain Creek.

Bradley Point Filing No. 1 consists of 9.736 acres and is presently undeveloped. Vegetation is sparse, consisting of native grasses. Approximately 23.5% of the site is covered in an aggregate base coarse material. Existing site terrain generally slopes from northwest to southeast at grade rates that vary between 0.7% and 10.4%. An existing dirt access road runs along the southwestern edge of the railroad. One end terminates at the fence along the northwestern boundary of the project site, while the other end terminates as it meets the asphalt road of the project site.

Bradley Point Filing No. 1 is currently zoned M for industrial use. The purpose of development is to provide secure materials storage and parking. The development is to be secured via a perimeter fence and controlled access gate. Additional improvements proposed for the site include paving for an internal access entrance and storm drainage improvements for both lots.

SOILS

Soils for this project are delineated by the Soils Map in the appendix as Blakeland Loamy Sand (8) and Nunn Clay Loam (59). Blakeland Loamy Sand is characterized as Hydrologic Soil Type "A", and comprises approximately 99.3% of the site. The remaining 0.7% on the southern corner of the site consists of the Nunn Clay Loam, which is characterized as Hydrologic Soil Group C. Soils in the study area are shown as mapped by S.C.S. in the "Soils Survey of El Paso County Area". Natural vegetation is sparse, consisting of native grasses and weeds over a majority of the site. Approximately one quarter of the site is covered with an aggregate base material.

HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual and where applicable the Urban Storm Drainage Criteria Manual. The Rational Method was used to estimate stormwater runoff anticipated from design storms with 5-year and 100-year recurrence intervals.

HYDRAULIC CALCULATIONS

Hydraulic calculations were estimated using the Manning's Formula and the methods described in the El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual. The relevant data sheets are included in the appendix of this report.

FLOODPLAIN STATEMENT

No portion of this site is within a designated F.E.M.A. floodplain as determined by the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 08041C0744 G, effective date December 7th, 2018. A copy of this panel can be found in the appendix.

DRAINAGE CRITERIA

This drainage analysis has been prepared in accordance with the current City of Colorado Springs/El Paso County Drainage Criteria Manual, Volumes I & II, dated November 1991, including subsequent updates. El Paso County has also adopted Chapter 6 and Section 3.2.1 of Chapter 13 in the City of Colorado Springs & El Paso County Drainage Criteria Manual Volumes I and II, dated May 2014. (Appendix I of the El Paso County's Engineering Criteria Manual (ECM), 2008). In addition to the ECM, the Urban Storm Drainage Criteria Manuals, Volumes 1-3, published by the Urban Drainage and Flood Control District (Volumes 1 & 2 dated January 2016, Volume 3 dated November 2010 and updates). Calculations were performed to determine runoff quantities for the 5-year and 100-year frequency storms for developed conditions using the Rational Method.

EXISTING DRAINAGE CONDITIONS

The Bradley Point Filing No. 1 site consists of 9.736 acres Drainage Basin. This area was previously studied in the "Little Johnson/Security Creek Drainage Basin Planning Study" (DBPS), dated April 1988, and prepared by Simons, LLI & Associates, Inc., in cooperation with Kiowa Engineering Corporation. In the existing condition runoff from the northern parcel drains to a existing low point located above existing Bradley Road where it is retained onsite behind the existing roadway and property line embankments. A portion of the western fringe of the upper parcel drains to the existing Rights of Way of Highway 85-87 where it continues southeasterly within the existing roadway burrow ditch. Runoff from a portion of the southern parcel drains to the aforementioned borrow ditch and continues south along the eastern edge of the roadway. The remaining runoff produced within the southern parcel drains to a localized depression found adjacent to southern property line and the South Academy overpass where it ponds and remains.

Design Point 1

Basin A consists of 4.65 undeveloped acres of moderately sparse natural grasses and vegetation, and is comprised of the northwestern half of the overall site. Runoff produced within **Basin A** is anticipated to reach peak runoff rates of Q5=4.6 cfs and Q100=11.8 cfs, and will flow east towards the **DP1**, where it collects in a localized depression.

Design Point 2

Basin B consists of 1.27 undeveloped acres of extremely sparse vegetation growing through a semi-compacted base material, located near the center of the site. Runoff produced within **Basin B** is anticipated to reach peak runoff rates of Q5=1.7 cfs and Q100=3.9 cfs. This flow naturally continues south towards the design point, where it collects in the roadside ditch and is redirected southeast towards downstream infrastructure.

Design Point 3

Basin C consists of 1.39 undeveloped acres, approximately 60% of which is extremely sparse vegetation growing through an aggregate base material, while the rest of the basin consists of moderately sparse natural grasses and vegetation. This basin is situated near the center of the site. Runoff produced within **Basin C** is anticipated to reach peak runoff rates of Q5=1.6 cfs and Q100=4.0 cfs, and will flow south towards the **DP3**, where it will be redirected south east via the roadside ditch.

Design Point 4

Basin D consists of 1.82 undeveloped acres, approximately 30% of which is extremely sparse vegetation growing through an aggregate base material, while the rest of the basin consists of sparse natural grasses and vegetation. This basin is situated on the southeastern side of the site. Runoff produced within **Basin D** (Q5=1.9 cfs and Q100=5.0 cfs) flows from north to south, collecting in a localized depression at the design point.

Design Point 5

Offsite **Basin E** consists of 5.53 acres, which is located to the northwest of the site, consisting of a portion of sparse natural grasses and vegetation within the borrow ditch and northern half of the existing asphalt paved US Highway 85/87. Peak runoff rates from **Basin E** reach Q5=4.1 cfs and Q100=10.3 cfs. **Basin E2** consists of approximately 1.08 acres of the northern half of existing Highway 85/87, located immediately adjacent to the southwest of the site. Approximately half of **Basin E2** consists of an asphalt paved roadway surface, and the other half consists of sparse natural grasses and vegetation, reaching peak runoff rates of Q5=1.4 cfs and Q100=3.3 cfs. Runoff produced within **Basin E** and **Basin E2** will combine and flow east towards **Design Point 5**. Runoff at **DP5** is anticipated to reach peak runoff rates of Q5=4.4 cfs and Q100=10.8 cfs.

Design Point 6

Basin F consists of approximately 0.45 acres of the northern half of existing Highway 85/87, and is located on the south end of the site. A majority of this basin consists of an asphalt paved roadway surface, while a small portion consists of sparse natural grasses and vegetation. Runoff produced within **Basin F** is anticipated to reach peak runoff rates of Q5=1.4 cfs and Q100=2.6 cfs. Runoff from **DP2** and **DP5** combine with runoff from **Basin F** at **DP6**. This cumulative flow is expected to reach peak flow rates of Q5=5.9 and Q100=13.9 Cfs.

Design Point 7

Basin G consists of approximately 0.65 acres of the northern half of existing Highway 85/87, located along the southwest of the site. Approximately half of this basin consists of an asphalt paved roadway surface, and the other half consists of sparse natural grasses and vegetation. Runoff produced within **Basin G** is anticipated to reach peak runoff rates of $Q_5=1.7$ cfs and $Q_{100}=3.4$ cfs. This runoff will discharge into the existing roadside ditch. At **DP7**, runoff from **Basin G** will combine with flows from **Design Point 3** and **Design Point 6**, and shall continue within the existing roadside ditch. The cumulative flow is expected to reach rates of $Q_5=7.4$ and $Q_{100}=17.5$ cfs. A cross section of the existing ditch with 100 year event flows can be viewed on the Existing Drainage Map.

FOUR STEP PROCESS

Step 1 Reduce runoff by disconnecting impervious area, eliminating "unnecessary" impervious area and encouraging infiltration into soils that are suitable. An aggregate base material is proposed as the ground cover to minimize directly connected impervious areas from the proposed paved road. This material also serves the purpose of eliminating unnecessary impervious area (pavement) and encouraging infiltration.

Step 2 Treat and Slowly Release the WQCV. – Two infiltration detention facilities are planned collect and slowly discharge runoff by infiltration. The water quality capture volume is intended to slowly drain in approximately 12 hours via infiltration thru the in-situ material.

Step 3 Stabilize Stream Channels. – With implementation of the two infiltration detention facilities, the runoff from the proposed industrial development to downstream facilities will be equivalent to predevelopment conditions. As the developed discharge leaving the site is equivalent to the existing conditions, is site is not anticipated to have negative effects on downstream drainageways.

Step 4 Implement Source Controls. – The proposed project will use silt fences, vehicle tracking control pads, straw bale barriers, outlet protection, temporary sediment basins, erosion control blankets, and reseeded to mitigate the potential for erosion across the site and protect downstream waters.

PROPOSED DRAINAGE CHARACTERISTICS

General Concept Drainage Discussion

The following is a description of the onsite basins, offsite flows and the overall drainage characteristics for the development of Bradley Point Filing No. 1. The development of Bradley Point Filing No. 1 consists converting the two existing undeveloped lots into two distinct storage parking areas, one with a paved entrance. A shared access easement will be provided from the primary access, within Lot 1 to the southern second lot. At the request of the developer, the internal surface runoff from each lot will be routed its own onsite infiltration pond. This type of treatment has proved a suitable solution for the parcel located upstream from this subject site and functions to mimic the existing site drainage conditions where runoff is retained onsite.

Surface runoff produced within the site will sheet flow across the parcels where it will be collected and conveyed by swales located along the perimeter of the parcels and ponds. Flows conveyed by the swales

will direct runoff to low points and proposed 24" RCP culverts which will convey runoff to the bottom of the ponds. Riprap and forebays will be provided for the infiltration detention facilities. These facilities are detailed and designed within this drainage report. All proposed facilities are private and are to be privately maintained.

The following detailed drainage discussion provides an overview of the proposed development. Surface flow is designated as Design Points (DP). Captured flow within the storm sewer system is designated as Pipe Runs (PR).

Detailed Drainage Discussion

Design Point 1

Basin A is comprised of the northeastern half of this subject site, which consists of 4.47 acres of gravel parking lot/storage area and a portion of a proposed paved road. Runoff produced within **Basin A** (Q5=9.9 cfs and Q100=19.7 cfs), will flow from north to south as sheet flow prior to being collected by a pair of proposed earthen triangular shaped swales. The proposed swales will convey the intercepted runoff to a proposed 3'x 3' CDOT Type 'C' area sump inlet. It is estimated that approximately 2/3 of the runoff will be collected by the eastern swale or approximately 13.0 cfs (F-F). The remaining 6.7cfs will be collected by the southern leg (G-G). A proposed 24" RCP storm pipe conveys the collected runoff a proposed concrete forebay at the southern corner of a proposed infiltration **Pond 1**. Riprap placed along the forebay will function to dissipates energy and prevent erosion prior to runoff existing the structure and entering the infiltration pond.

Design Point 2

Basin B consists of 4.17 acres of gravel parking lot/storage area. This basin is located within the southeastern half of the site. Runoff produced within **Basin B** (Q5=9.0 cfs and Q100=18.0 cfs), will flow from north to south as sheet flow prior to being collected by a pair of proposed earthen triangular shaped swales. The proposed swales will convey the intercepted runoff to a proposed 3'x 3' CDOT Type 'C' area sump inlet. It is estimated that approximately 1/3 of the runoff will be collected by the eastern swale or approximately 6.0 cfs (H-H). The remaining 12.0 cfs will be collected by the southern leg (I-I). A proposed 24" RCP storm pipe conveys the collected runoff a proposed concrete forebay at the southern corner of a proposed infiltration **Pond 2**. Riprap placed along the forebay will function to dissipates energy and prevent erosion prior to runoff existing the structure and entering the infiltration pond.

Design Point 3

Basin E consists of 5.53 acres which is located to the northwest of the site, consisting of a portion of sparse natural grasses and vegetation within the borrow ditch and northern half of the existing asphalt paved US Highway 85/87. Runoff produced within **Basin E** is anticipated to reach peak runoff rates of Q5=6.5 cfs and Q100=16.2 cfs, and will combine with flows from **Basin F**. **Basin F** consists of 0.72 acres of the northern half of existing Highway 85/87, located to the southwest of the site. Approximately half of this basin consists of roadway surfaces (proposed concrete entrance and existing paved US Highway 85/87), and the other half consists of sparse natural grasses and vegetation. Runoff produced within **Basin F** is anticipated to reach peak runoff rates of Q5=1.4 and Q100=3.0 cfs, and will flow east from the crown of the road where it discharges into the existing roadside ditch and combines with runoff from **Basin E**.

The combined flows are redirected southeast towards the design point at peak runoff rates of $Q_5=6.6$ and $Q_{100}=16.0$ cfs. From here, the runoff will continue southeast into **Basin G**.

Design Point 4

Basin G consists of approximately 2.28 acres of the northern half of existing Highway 85/87, located to the southwest of the site. Approximately half of this basin consists of an asphalt paved roadway surface, and the other half consists of sparse natural grasses and vegetation. Runoff produced within **Basin G** is anticipated to reach peak runoff rates of $Q_5=4.0$ cfs and $Q_{100}=8.8$ cfs. Runoff from **Basin G** will combine with flows from **Design Point 3** and will continue southeast within the newly regarded borrow ditch. A cross section of the roadside ditch at this point can be viewed on the Proposed Drainage Map, depicting what is experienced during the 100-year event. This cumulative flow is expected to reach peak flow rates of $Q_5=7.4$ and $Q_{100}=17.5$ cfs. Flows to the ditch are equal to those of the existing condition ($Q_5=7.4$ and $Q_{100}=17.5$ cfs). Runoff leaving the site shall continue within the existing roadside ditch.

WATER QUALITY AND DETENTION

Two Private Infiltration Ponds are proposed for this site in order to reduce the fully developed flows from the site to pre-development levels and address water quality. The ponds have been sized utilizing the StormShed 4G program with the outlet being infiltration only. The ponds have been sized to store the WQCV, EURV, and the flood control volumes for the 2, 5, 10, 25, 50, and 100 year storm events. Based upon contributing area of 4.47 acres and watershed imperviousness is 82% for **Pond 1** and a contributing area of 4.17 acres and 80% imperviousness for **Pond 2**. The WQCV for both ponds will be slowly released over approximately 12-12.5 hours. The 100-year storm events collected by both ponds will drain fully in less than 120 hours. The maximum 100-Yr storage volume is 0.626 acre-feet (27,287.79 cf) for **Pond 1** and 0.578 acre-feet (25,163.86 cf) for **Pond 2**, resulting in maximum ponding depths of 4.88 feet and 4.62 feet respectively. The ponds have a minimum of 1.2'-1.5' of freeboard (in the 100 year events) and are capable of storing the 500-year storms based upon the anticipated infiltration rates for the ponds, of 8.0 inches/hour. The full soils infiltration report prepared by Entech Engineering has been included in the appendix of this report. It is important to note that the parcel to the northwest is currently utilizing a similarly constructed facility to detain onsite runoff.

EROSION CONTROL

It is the policy of the El Paso County that M&S Civil Consultants, Inc submits an erosion control plan with the drainage report. Proposed straw wattles, silt fence, vehicle traffic control, a temporary sediment basin, permanent erosion control fabric, and reseeding are proposed as erosion control measures. The proposed total area of land disturbance is 9.52 acres. The proposed development will not adversely impact the existing surrounding industrial infrastructure. An ESQCP permit is required for site construction in order to ensure compliance with the SWMP report and permits. Infiltration Basin and Swale inspections are required to ensure all storm structures are functioning as designed.

CONSTRUCTION COST OPINION – BRADLEY POINT FILING NO. 1

Private Drainage Facilities:

Item	Description	Quantity	Unit Cost	Cost
1.	24" RCP	70 LF	\$125 /LF	\$8,750
2.	Infiltration Pond	2 EA	\$8,000 /EA	\$16,000
3.	Forebay	2 EA	\$5,000 /EA	\$10,000
4.	3' CDOT Type C Inlet	2 EA	\$5,000 /EA	\$10,000
Total \$				\$44,750

M & S Civil Consultants, Inc. (M & S) cannot and does not guarantee the construction cost will not vary from these opinions of probable costs. These opinions represent our best judgment as design professionals familiar with the construction industry and this development in particular. The above is only an estimate of the facility cost and drainage basin fee amounts in 2021.

DRAINAGE & BRIDGE FEES – BRADLEY POINT FILING NO. 1

This site is within the Little Johnson Drainage Basin. The 2021 Drainage and Bridge Fees per El Paso County for the Bradley Point Filing No. 1 site are as follows:

Per Bradley Point Filing No. 1 Site Boundary – **Total Area** **9.74 Acres**

BRADLEY POINT FILING NO. 1 FEES:

Drainage Fees:	9.736	x	81.0%	x	\$12,048	=	\$	<u>95,012.46</u>
							Total \$	95,012.46

It should be noted that these fees are provided in this Final Drainage Report have been paid at the time of the plat recording and are included in this report for informational purposes only.

M & S Civil Consultants, Inc. (M & S) cannot and does not guarantee the construction cost will not vary from these opinions of probable costs. These opinions represent our best judgment as design professionals familiar with the construction industry and this development in particular. The above is only an estimate of the facility cost and drainage basin fee amounts in 2021.

SUMMARY

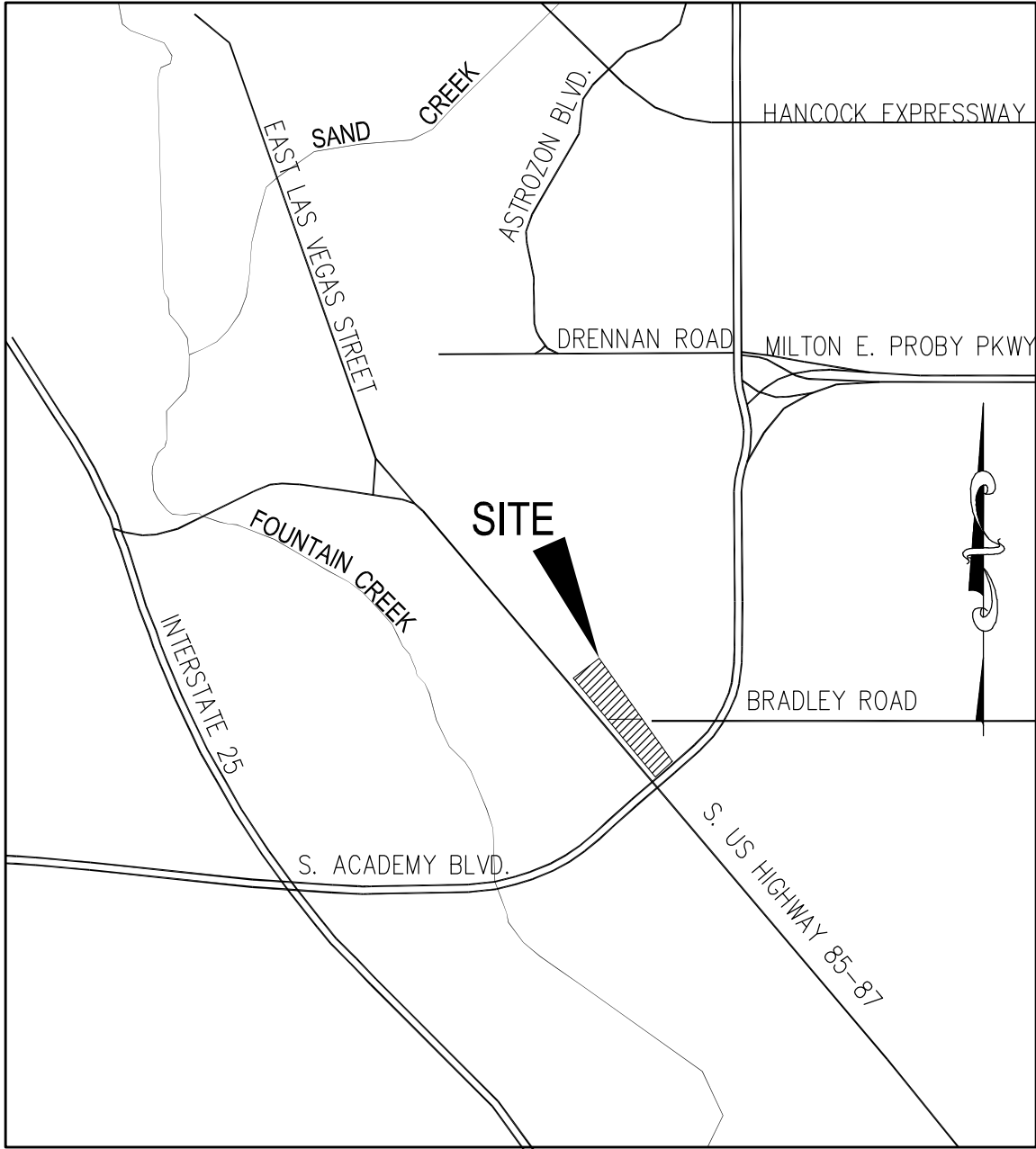
Development of this site will not adversely affect the surrounding developments per this final drainage report. Two infiltration ponds will be used to treat and detain runoff from the developed site. The proposed discharge rates exiting the site are the same as existing conditions. Care will be taken during construction to accommodate overland flow routes onsite and temporary drainage conditions. Overall, the development of the Bradley Point Filing No. 1 project shall not adversely affect adjacent or downstream property.

REFERENCES

- 1.) "City of Colorado Springs Drainage Criteria Manual", Volumes 1 & 2, City of Colorado May 2014.
- 2.) Mile High Flood District (2021). Criteria Manual. "Urban Storm Drainage Criteria Manuals, Volumes 1-3". Retrieved from <https://mhfd.org/resources/criteria-manual/>
- 3.) NRSC Web Soil Survey Map for El Paso County. <http://websoilsurvey.nrcs.usda.gov>
- 4.) Flood Insurance Rate Map (FIRM), Federal Emergency Management Agency, Effective date December 7th, 2018.
- 5.) Simons, LLI & Associates, Inc., in cooperation with Kiowa Engineering Corporation (April 1988). "Little Johnson/Security Creek Drainage Basin Planning Study". Retrieved from <https://coloradosprings.gov/dbps>
- 6.) Colorado Aggregate Recycling (2021). Colorado Springs: Products. Retrieved From <https://www.coloradoaggregaterecycling.com/colorado-springs/>
- 7.) "El Paso County Drainage Criteria Manual", Volumes 1 & 2, Municode 2021.

APPENDIX

VICINITY MAP

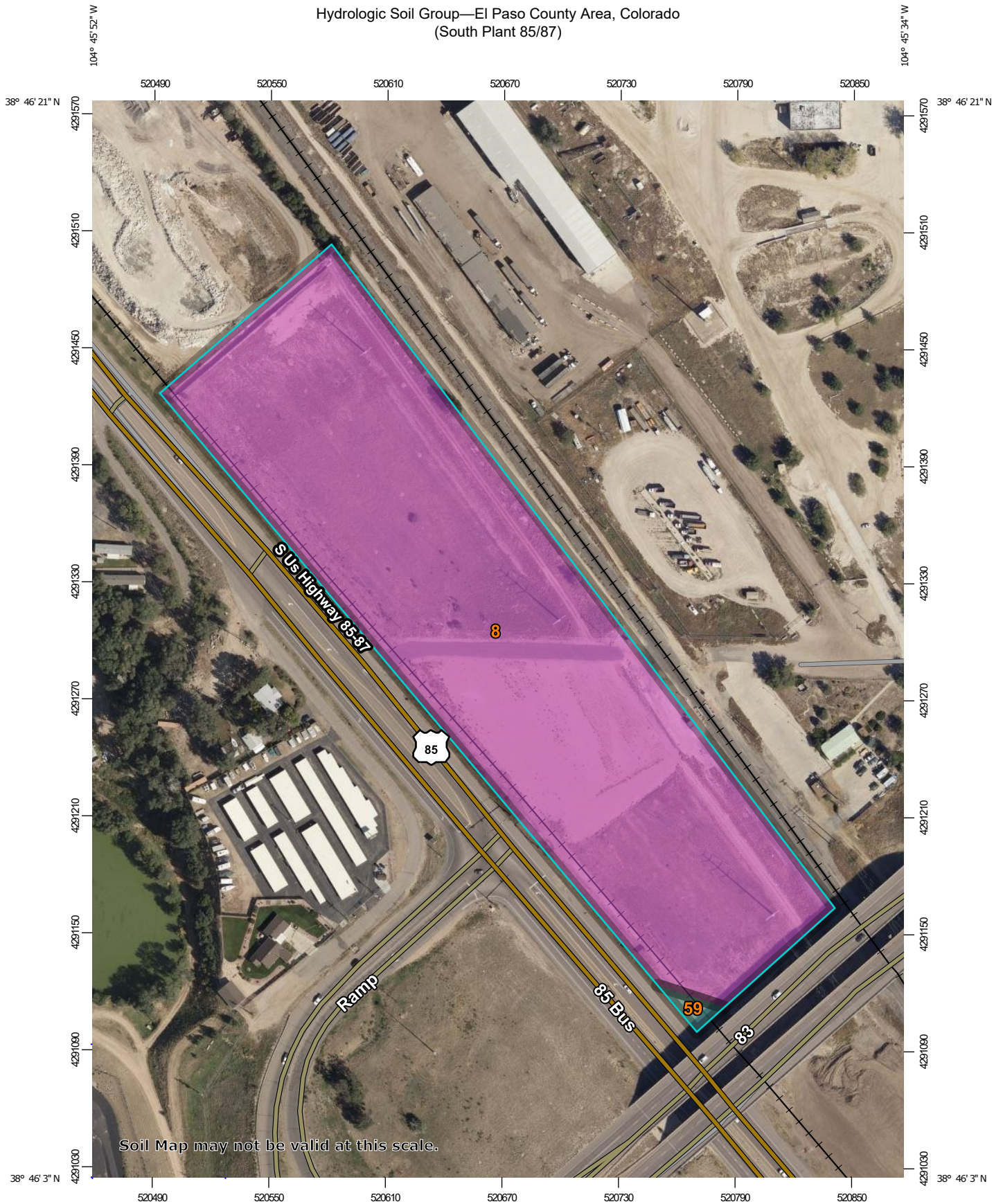


VICINITY MAP

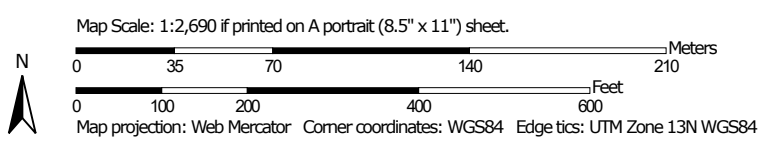
N.T.S.

SOILS MAP

Hydrologic Soil Group—El Paso County Area, Colorado
(South Plant 85/87)




Soil Map may not be valid at this scale.



MAP LEGEND

Area of Interest (AOI)









 Area of Interest (AOI)

Soils

Soil Rating Polygons





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

Soil Rating Lines

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

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available


Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
 Survey Area Data: Version 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	11.2	99.3%
59	Nunn clay loam, 0 to 3 percent slopes	C	0.1	0.7%
Totals for Area of Interest			11.3	100.0%

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

FIRM PANEL

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not constitute a guarantee, warranty, or endorsement of any product or service, nor does it constitute an offer of insurance. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where Base Flood Elevations (BFEs) are shown, please refer to the National Flood Insurance Program's Flood Insurance Study Profile and Elevation Data and/or Summary of Shaded Areas which contain BFEs and other information. The profile and elevation data should be used to determine the flood hazard in areas where BFEs are shown. These BFEs are intended for flood insurance rating purposes only and are not to be used for any other purpose. The profile and elevation data presented in the FIS report should be used in conjunction with the FEMA Flood Elevation Data for Flood Hazard Analysis and Mapping.

Causeway Flood Elevations shown on this map apply only to individual 0.07 North American Vertical Datum of 1988 (NAVD88) datum. The National Geospatial Survey available at the American Vertical Datum of 1988, visit the National Geospatial Survey website at <http://www.ngs.noaa.gov> to obtain the National Geospatial Survey of the following address:

NGS Information Services
 7700 Lottsburg Road
 Silver Spring, MD 20910-0382

To obtain current elevation, description, and/or location information for bench marks shown on this map, please contact the Information Services Branch of the National Geospatial Survey at (301) 741-6326. For more information, please visit the website at <http://www.ngs.noaa.gov>.

Please refer to the following information for more details regarding the National Geospatial Survey, City of Pueblo, Colorado, City of Pueblo, Colorado, Bureau of Land Management, and other organizations. For more information, please visit the website at <http://www.ngs.noaa.gov>.

This map reflects cross-sectional and other data stream channel characteristics and floodplain delineations from those shown on the previous FIS for the jurisdiction. As a result, the Flood Profile and Floodway Data tables in the Flood Insurance Study Report may differ from what is shown on this map. The profile boundaries depicted on this map are not to be used for flood insurance rating purposes. As a result, the profile boundaries may differ significantly from the new base map channel representation shown on this map.

Causeway Flood Elevations shown on this map are based on the best data available at the time of publication. Because change due to alterations or re-measurements may have occurred since this map was published, map users should contact appropriate authorities for the most current data.

This map is for use in administering the National Flood Insurance Program. It does not constitute a guarantee, warranty, or endorsement of any product or service, nor does it constitute an offer of insurance. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where Base Flood Elevations (BFEs) are shown, please refer to the National Flood Insurance Program's Flood Insurance Study Profile and Elevation Data and/or Summary of Shaded Areas which contain BFEs and other information. The profile and elevation data should be used to determine the flood hazard in areas where BFEs are shown. These BFEs are intended for flood insurance rating purposes only and are not to be used for any other purpose. The profile and elevation data presented in the FIS report should be used in conjunction with the FEMA Flood Elevation Data for Flood Hazard Analysis and Mapping.

Causeway Flood Elevations shown on this map apply only to individual 0.07 North American Vertical Datum of 1988 (NAVD88) datum. The National Geospatial Survey available at the American Vertical Datum of 1988, visit the National Geospatial Survey website at <http://www.ngs.noaa.gov> to obtain the National Geospatial Survey of the following address:

NGS Information Services
 7700 Lottsburg Road
 Silver Spring, MD 20910-0382

To obtain current elevation, description, and/or location information for bench marks shown on this map, please contact the Information Services Branch of the National Geospatial Survey at (301) 741-6326. For more information, please visit the website at <http://www.ngs.noaa.gov>.

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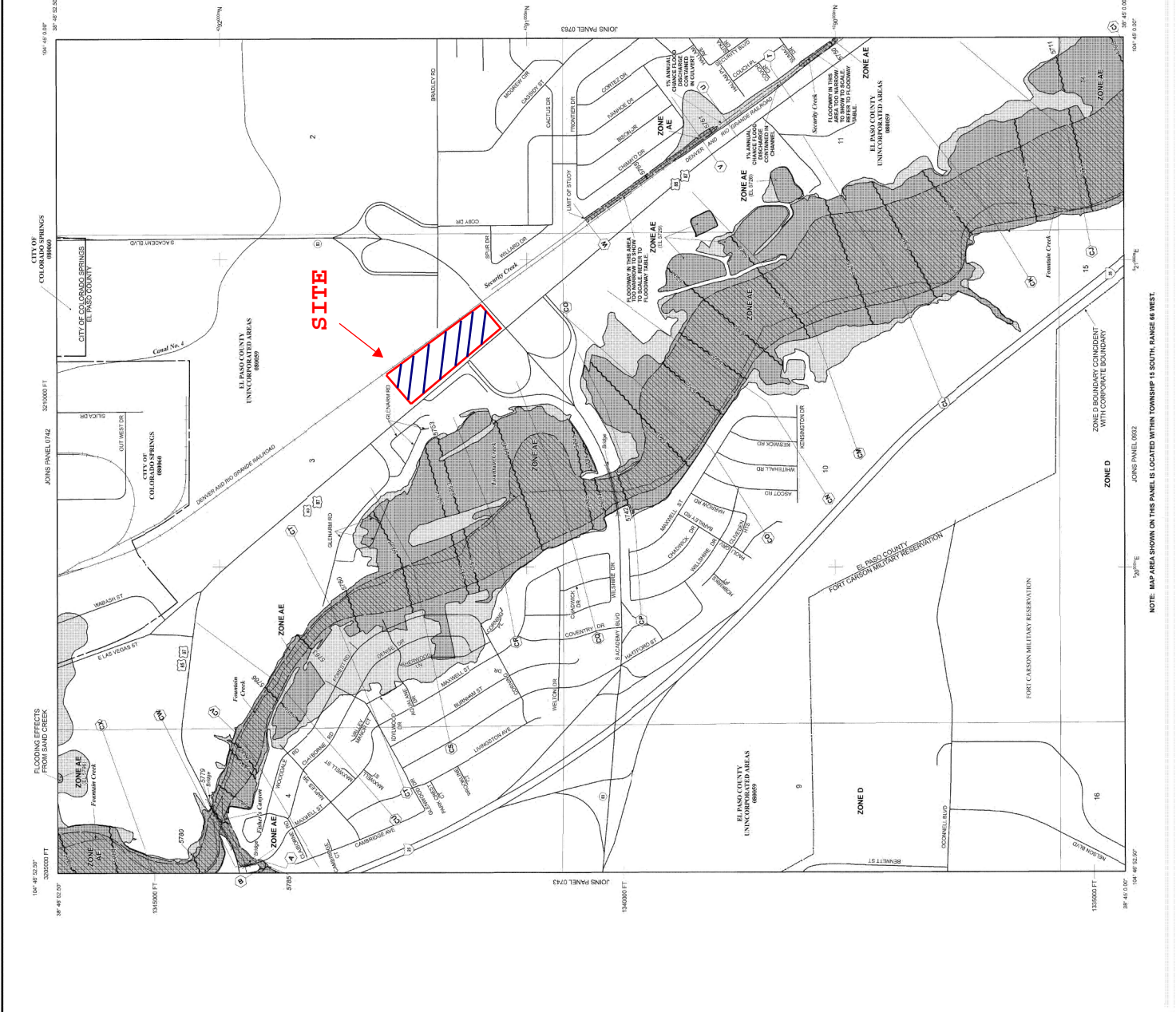
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NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 15 SOUTH, RANGE 66 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO IMPAIRMENT BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood hazard used to determine flood insurance rates. Flood insurance rates are based on the risk of a building being damaged or destroyed by the 1% annual chance flood. Areas of the community that are subject to the 1% annual chance flood are shown on this map. The 1% annual chance flood is defined as the flood that has a 1% chance of being equaled or exceeded in any given year.

ZONE AE
 Special Flood Hazard Area (SFHA) subject to impairment by the 1% annual chance flood. Areas of the community that are subject to the 1% annual chance flood are shown on this map. The 1% annual chance flood is defined as the flood that has a 1% chance of being equaled or exceeded in any given year.

ZONE AH
 Areas of the community that are subject to the 1% annual chance flood. Areas of the community that are subject to the 1% annual chance flood are shown on this map. The 1% annual chance flood is defined as the flood that has a 1% chance of being equaled or exceeded in any given year.

ZONE AR
 Areas of the community that are subject to the 1% annual chance flood. Areas of the community that are subject to the 1% annual chance flood are shown on this map. The 1% annual chance flood is defined as the flood that has a 1% chance of being equaled or exceeded in any given year.

ZONE AV
 Areas of the community that are subject to the 1% annual chance flood. Areas of the community that are subject to the 1% annual chance flood are shown on this map. The 1% annual chance flood is defined as the flood that has a 1% chance of being equaled or exceeded in any given year.

ZONE VE
 Areas of the community that are subject to the 1% annual chance flood. Areas of the community that are subject to the 1% annual chance flood are shown on this map. The 1% annual chance flood is defined as the flood that has a 1% chance of being equaled or exceeded in any given year.

ZONE V
 Areas of the community that are subject to the 1% annual chance flood. Areas of the community that are subject to the 1% annual chance flood are shown on this map. The 1% annual chance flood is defined as the flood that has a 1% chance of being equaled or exceeded in any given year.

ZONE X
 Areas of the community that are subject to the 1% annual chance flood. Areas of the community that are subject to the 1% annual chance flood are shown on this map. The 1% annual chance flood is defined as the flood that has a 1% chance of being equaled or exceeded in any given year.

ZONE D
 Areas of the community that are subject to the 1% annual chance flood. Areas of the community that are subject to the 1% annual chance flood are shown on this map. The 1% annual chance flood is defined as the flood that has a 1% chance of being equaled or exceeded in any given year.

OTHER AREAS
 Areas of the community that are subject to the 1% annual chance flood. Areas of the community that are subject to the 1% annual chance flood are shown on this map. The 1% annual chance flood is defined as the flood that has a 1% chance of being equaled or exceeded in any given year.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
 Areas of the community that are subject to the 1% annual chance flood. Areas of the community that are subject to the 1% annual chance flood are shown on this map. The 1% annual chance flood is defined as the flood that has a 1% chance of being equaled or exceeded in any given year.

OTHERWISE PROTECTED AREAS (OPAs)
 Areas of the community that are subject to the 1% annual chance flood. Areas of the community that are subject to the 1% annual chance flood are shown on this map. The 1% annual chance flood is defined as the flood that has a 1% chance of being equaled or exceeded in any given year.

FIRM
 FLOOD INSURANCE RATE MAP
 EL PASO COUNTY,
 COLORADO
 AND INCORPORATED AREAS

PANEL 0744G

PANEL 744 OF 1300
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

DATE: 07/2018
 NUMBER: 0744G
 SHEETS: 1300

MAP NUMBER
 0804101744G

MAP REVISED
 DECEMBER 7, 2018

Federal Emergency Management Agency

HYDROLOGIC CALCULATIONS

BRADLEY POINT FILING NO. 1
EXISTING CONDITIONS DRAINAGE CALCULATIONS
(Area Runoff Coefficient Summary)

BASIN	TOTAL AREA (SF)	TOTAL AREA (Acres)	STREETS/DEVELOPED			AGGREGATE BASE MATERIAL			UNDEVELOPED/LANDSCAPE			RUNOFF COEFFICIENT	
			AREA (Acres)	C ₅	C ₁₀₀	AREA (Acres)	C ₅	C ₁₀₀	AREA (Acres)	C ₅	C ₁₀₀	C ₅	C ₁₀₀
<i>A</i>	202348.4143	4.65	0.07	0.90	0.96	4.58	0.35	0.54	0.00	0.08	0.35	0.36	0.55
<i>B</i>	55366.9622	1.27	0.20	0.90	0.96	1.07	0.35	0.54	0.00	0.08	0.35	0.44	0.61
<i>C</i>	60455.3113	1.39	0.00	0.90	0.96	1.39	0.35	0.54	0.00	0.08	0.35	0.35	0.54
<i>D</i>	79161.6725	1.82	0.00	0.90	0.96	1.82	0.35	0.54	0.00	0.08	0.35	0.35	0.54
<i>E</i>	240799.7172	5.53	2.12	0.90	0.96	0.00	0.35	0.54	3.41	0.08	0.35	0.39	0.58
<i>E2</i>	46914.4055	1.08	0.50	0.90	0.96	0.00	0.35	0.54	0.58	0.08	0.35	0.46	0.63
<i>F</i>	19702.8045	0.45	0.35	0.90	0.96	0.00	0.35	0.54	0.10	0.08	0.35	0.71	0.82
<i>G</i>	28387.025	0.65	0.49	0.90	0.96	0.00	0.35	0.54	0.16	0.08	0.35	0.70	0.81

Calculated by: CVW
Date: 3/29/2023
Checked by: DLM

BRADLEY POINT FILING NO. 1
EXISTING CONDITIONS DRAINAGE CALCULATIONS
(Area Drainage Summary)

From Area Runoff Coefficient Summary				OVERLAND				STREET / CHANNEL FLOW				Time of Travel (T_t)		INTENSITY *		TOTAL FLOWS	
BASIN	AREA TOTAL (Acres)	C_5	C_{100}	C_5	Length (ft)	Height (ft)	T_c (min)	Length (ft)	Slope (%)	Velocity (fps)	T_t (min)	TOTAL (min)	CHECK (min)	I_5 (in/hr)	I_{100} (in/hr)	Q_5 (c.f.s.)	Q_{100} (c.f.s.)
		From DCM Table 5-1															
A	4.65	0.36	0.55	0.36	100	2.75	9.6	613	0.9%	0.7	15.1	24.7	14.0	2.8	4.7	4.6	11.8
B	1.27	0.44	0.61	0.44	100	1.6	10.3	316	0.9%	1.0	5.5	15.8	12.3	3.4	5.8	1.9	4.5
C	1.39	0.35	0.54	0.35	100	1.4	12.1	417	1.1%	1.1	6.6	18.7	12.9	3.2	5.4	1.6	4.0
D	1.82	0.35	0.54	0.35	100	1.98	10.8	470	1.3%	0.8	9.7	20.5	13.2	3.1	5.1	1.9	5.0
E	5.53	0.39	0.58	0.39	30	0.6	5.6	2000	1.5%	0.9	38.7	44.2	21.3	1.9	3.2	4.1	10.3
E2	1.08	0.46	0.63	0.46	100	0.96	11.7	525	0.3%	0.8	10.8	22.5	13.5	2.9	4.9	1.4	3.3
F	0.45	0.71	0.82	0.71	75	1.06	5.4	298	0.7%	1.3	4.0	9.3	12.1	4.2	7.1	1.4	2.6
G	0.65	0.70	0.81	0.70	100	1.34	6.6	406	0.6%	1.1	5.9	12.5	12.8	3.8	6.4	1.7	3.4

* Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: CVW _____
Date: 3/29/2023 _____
Checked by: DLM _____

BRADLEY POINT FILING NO. 1
EXISTING CONDITIONS DRAINAGE CALCULATIONS
(Basin Routing Summary)

<i>From Area Runoff Coefficient Summary</i>				OVERLAND				PIPE / CHANNEL FLOW				Time of Travel (T_t)	INTENSITY *		TOTAL FLOWS		COMMENTS	
DESIGN POINT	CONTRIBUTING BASINS/PIPES	CA₅	CA₁₀₀	C_s	Length	Height	T_c	Length	Slope	Velocity	T_t	TOTAL	I₅	I₁₀₀	Q₅	Q₁₀₀		
					(ft)	(ft)												(min)
1	Basin A	1.66	2.54				24.7					24.7	2.8	4.7	4.6	11.8	<i>LOCALIZED DEPRESSION</i>	
					Basin A Tc was used													
2	Basin B	0.55	0.77				15.8	406	0.7%	1.3	5.2	21.0	3.0	5.1	1.7	3.9	<i>EXITS SITE TO ROADSIDE DITCH</i>	
		0.55	0.77		Design Pt 1 Tc was used													
3	Basin C	0.49	0.75				18.7					18.7	3.2	5.4	1.6	4.0	<i>EXITS SITE TO ROADSIDE DITCH</i>	
					Basin C Tc was used													
4	Basin D	0.64	0.98				20.5					20.5	3.1	5.1	1.9	5.0	<i>LOCALIZED DEPRESSION</i>	
					Basin D Tc was used													
5	Basin E2 Basin E	0.50	0.68				44.2	525	0.3%	1.1	8.1	52.3	1.6	2.8	4.4	10.8	<i>EXISTING ROADSIDE DITCH</i>	
		2.18	3.23		Basin E Tc was used													
		2.67	3.91		Basin E Tc was used													
6	Basin F Design Point 5 Design Point 2	0.32	0.37				52.3					52.3	1.6	2.8	5.9	13.9	<i>EXISTING ROADSIDE DITCH</i>	
		2.67	3.91		Design Point 5 Tc was used													
		0.55	0.77		Design Point 5 Tc was used													
		3.55	5.05		Design Point 5 Tc was used													
7	Basin G Design Point 6 Design Point 3	0.45	0.53				52.3					52.3	1.6	2.8	7.4	17.5	<i>EXISTING ROADSIDE DITCH</i>	
		3.55	5.05		Design Pt 6 Tc was used													
		0.49	0.75		Design Pt 6 Tc was used													
		4.49	6.33		Design Pt 6 Tc was used													

BRADLEY POINT FILING NO. 1
PROPOSED CONDITIONS DRAINAGE CALCULATIONS
(Area Runoff Coefficient Summary)

BASIN	TOTAL AREA (SF)	TOTAL AREA (Acres)	STREETS/DEVELOPED			AGGREGATE BASE MATERIAL			UNDEVELOPED/LANDSCAPE			RUNOFF COEFFICIENT	
			AREA (Acres)	C ₅	C ₁₀₀	AREA (Acres)	C ₅	C ₁₀₀	AREA (Acres)	C ₅	C ₁₀₀	C ₅	C ₁₀₀
<i>A</i>	194500.7466	4.47	0.12	0.90	0.96	4.34	0.59	0.70	0.00	0.08	0.35	0.60	0.71
<i>B</i>	181766.1572	4.17	0.00	0.90	0.96	4.17	0.59	0.70	0.00	0.08	0.35	0.59	0.70
<i>E</i>	240799.7172	5.53	2.12	0.90	0.96	0.00	0.35	0.54	3.41	0.08	0.35	0.39	0.58
<i>F</i>	31224.2092	0.72	0.38	0.90	0.96	0.00	0.35	0.54	0.33	0.08	0.35	0.52	0.68
<i>G</i>	99495.0053	2.28	1.19	0.90	0.96	0.00	0.35	0.54	1.09	0.08	0.35	0.51	0.67

Calculated by: CVW
Date: 12/7/2022
Checked by: DLM

BRADLEY POINT FILING NO. 1
PROPOSED CONDITIONS DRAINAGE CALCULATIONS
(Area Drainage Summary)

From Area Runoff Coefficient Summary				OVERLAND				STREET / CHANNEL FLOW				Time of Travel (T_t)		INTENSITY *		TOTAL FLOWS	
BASIN	AREA TOTAL (Acres)	C ₅	C ₁₀₀	C ₅	Length (ft)	Height (ft)	T _c (min)	Length (ft)	Slope (%)	Velocity (fps)	T _i (min)	TOTAL (min)	CHECK (min)	I ₅ (in/hr)	I ₁₀₀ (in/hr)	Q ₅ (c.f.s.)	Q ₁₀₀ (c.f.s.)
		From DCM Table 5-1															
A	4.47	0.60	0.71	0.60	100	0.6	10.7	460	0.5%	1.5	5.2	15.9	13.1	3.7	6.2	9.9	19.7
B	4.17	0.59	0.70	0.59	100	0.6	10.9	540	1.1%	1.0	8.7	19.6	13.6	3.7	6.2	9.0	18.0
E	5.53	0.39	0.58	0.39	30	0.6	5.6	2000	1.5%	1.8	18.1	23.6	21.3	3.0	5.0	6.5	16.2
F	0.72	0.52	0.68	0.52	60	0.8	7.4	525	0.3%	0.8	11.3	18.7	13.3	3.7	6.2	1.4	3.0
G	2.28	0.51	0.67	0.51	60	1	7.0	985	0.4%	0.9	17.8	24.8	15.8	3.4	5.8	4.0	8.8

* Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: CVW
Date: 12/7/2022
Checked by: DLM

BRADLEY POINT FILING NO. 1
PROPOSED CONDITIONS DRAINAGE CALCULATIONS
(Basin Routing Summary)

<i>From Area Runoff Coefficient Summary</i>				OVERLAND				PIPE / CHANNEL FLOW				Time of Travel (T_t)	INTENSITY*		TOTAL FLOWS		COMMENTS	
DESIGN POINT	CONTRIBUTING BASINS/PIPES	CA ₅	CA ₁₀₀	C _s	Length (ft)	Height (ft)	T _c (min)	Length (ft)	Slope (%)	Velocity (fps)	T _t (min)	TOTAL (min)	I ₅ (in/hr)	I ₁₀₀ (in/hr)	Q ₅ (c.f.s.)	Q ₁₀₀ (c.f.s.)		
1	Basin A	2.67	3.16				13.1					13.1	3.7	6.2	9.9	19.7		PROPOSED CULVERT
					Basin A Tc was used													
2	Basin B	2.46	2.92				13.6					13.6	3.7	6.2	9.0	18.0	PROPOSED CULVERT	
					Basin B Tc was used													
3	Basin E Basin F	2.18 0.37	3.23 0.49				21.3	525	0.4%	1.3	6.9	28.2	2.6	4.3	6.6	16.0	ROADSIDE DITCH	
		2.55	3.71		Basin E Tc was used													
4	Design Pt 3 Basin G	2.55 1.16	3.71 1.53				28.2	985	0.4%	1.2	13.3	41.5	2.0	3.3	7.4	17.5	ROADSIDE DITCH	
		3.71	5.24		Design Pt 3 Tc was used													

BRADLEY POINT FILING NO. 1
PROPOSED CONDITIONS DRAINAGE CALCULATIONS
(Storm Sewer Routing Summary)

<i>PIPE RUN</i>	<i>Contributing Pipes/Design</i>	<i>Equivalent CA₅</i>	<i>Equivalent CA₁₀₀</i>	<i>Maximum T_C</i>	<i>Intensity*</i>		<i>Flow</i>	
					<i>I₅</i>	<i>I₁₀₀</i>	<i>Q₅</i>	<i>Q₁₀₀</i>
PR 1	DESIGN POINT 1	2.67	3.16	13.1	3.7	6.2	9.9	19.7
PR 2	DESIGN POINT 2	2.46	2.92	13.6	3.7	6.2	9.0	18.0

* Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: CVW

Date: 12/7/2022

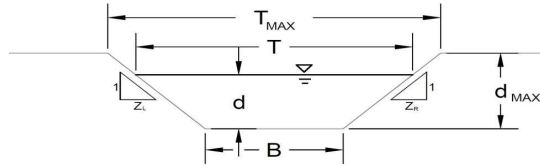
Checked by: VAS

HYDRAULIC CALCULATIONS

AREA INLET IN A SWALE

Crossroads Mixed Use

Inlet 1



This worksheet uses the NRCS vegetative retardance method to determine Manning's n.
For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)
Manning's n (Leave cell D16 blank to manually enter an n value)
Channel Invert Slope
Bottom Width
Left Side Slope
Right Side Slope

A, B, C, D or E
n = 0.035
S₀ = 0.0050 ft/ft
B = 0.00 ft
Z1 = 3.00 ft/ft
Z2 = 3.00 ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V _{MAX})	Max Froude No. (F _{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choice of n₁₆
 Non-Cohesive
 Cohesive
 Paved

Max. Allowable Top Width of Channel for Minor & Major Storm
Max. Allowable Water Depth in Channel for Minor & Major Storm

	Minor Storm	Major Storm	
T _{MAX} =	12.00	15.00	feet
d _{MAX} =	1.50	2.50	feet

Allowable Channel Capacity Based On Channel Geometry

MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q _{allow} =	16.2	63.2	cfs
d _{allow} =	1.50	2.50	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow
Water Depth

	Minor Storm	Major Storm	
Q _c =	9.9	19.7	cfs
d =	1.25	1.61	feet

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

AREA INLET IN A SWALE

Crossroads Mixed Use

Inlet 1

Inlet Design Information (Input)

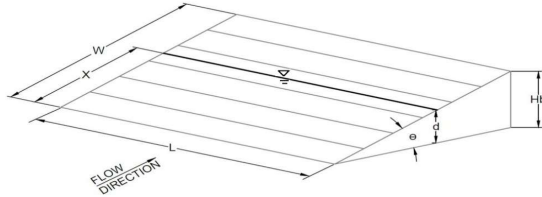
Type of Inlet

CDOT Type C

Inlet Type =

CDOT Type C

- Angle of Inclined Grate (must be <= 30 degrees)
- Width of Grate
- Length of Grate
- Open Area Ratio
- Height of Inclined Grate
- Clogging Factor
- Grate Discharge Coefficient
- Orifice Coefficient
- Weir Coefficient



θ =	0.00	degrees
W =	3.00	feet
L =	3.00	feet
A _{RATIO} =	0.70	
H _B =	0.00	feet
C _d =	0.50	
C _o =	0.96	
C _w =	0.64	
	2.05	

Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)

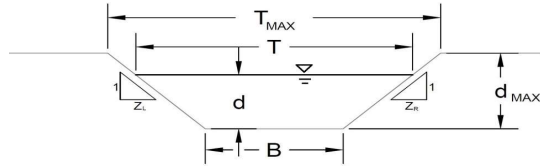
Total Inlet Interception Capacity (assumes clogged condition)

	MINOR	MAJOR	
d =	1.25	1.61	
Q _a =	18.1	20.5	cfs
Bypassed Flow, Q _b =	0.0	0.0	cfs
Capture Percentage = Q _a /Q _o = C%	100	100	%

AREA INLET IN A SWALE

Crossroads Mixed Use

Inlet 2



This worksheet uses the NRCS vegetative retardance method to determine Manning's n.
For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)

Manning's n (Leave cell D16 blank to manually enter an n value)

Channel Invert Slope

Bottom Width

Left Side Slope

Right Side Slope

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Max. Allowable Top Width of Channel for Minor & Major Storm

Max. Allowable Water Depth in Channel for Minor & Major Storm

Allowable Channel Capacity Based On Channel Geometry

MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow

Water Depth

A, B, C, D or E

n = 0.035

S_o = 0.0050 ft/ft

B = 0.00 ft

Z1 = 3.00 ft/ft

Z2 = 3.00 ft/ft

Choice of n_{pr}

Non-Cohesive

Cohesive

Paved

	Minor Storm	Major Storm	
T_{MAX} =	12.00	15.00	feet
d_{MAX} =	1.50	2.50	feet

	Minor Storm	Major Storm	
Q_{allow} =	16.2	63.2	cfs
d_{allow} =	1.50	2.50	ft

	Minor Storm	Major Storm	
Q_c =	9.0	18.0	cfs
d =	1.20	1.56	feet

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

AREA INLET IN A SWALE

Crossroads Mixed Use

Inlet 2

Inlet Design Information (Input)

Type of Inlet: Inlet Type =

Angle of Inclined Grate (must be <= 30 degrees): degrees

Width of Grate: feet

Length of Grate: feet

Open Area Ratio:

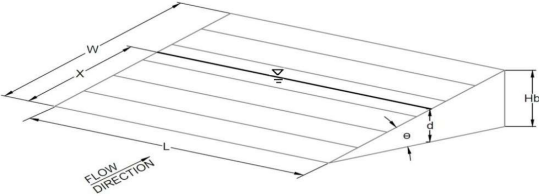
Height of Inclined Grate: feet

Clogging Factor:

Grate Discharge Coefficient:

Orifice Coefficient:

Weir Coefficient:



Water Depth at Inlet (for depressed inlets, 1 foot is added for depression):

	MINOR	MAJOR	
d =	1.20	1.56	
Q_a =	17.7	20.2	cfs
Bypassed Flow, Q _b =	0.0	0.0	cfs
Capture Percentage = Q _a /Q ₀ = C%	100	100	%

Project: BRADLEY POINT FILING NO. 1

Date: 04/19/23

FOREBAY VOLUME

MIN. FOREBAY VOLUME = 3% WQCV
 $H = 24 \text{ in} = 2 \text{ ft}$

POND 1

WQCV = 6,173 cf

$V_{\text{REQ}} = 6,173 \text{ cf} (0.03) = 185.2 \text{ cf}$

$$A = \frac{V_{\text{REQ}}}{H} = \frac{185.2 \text{ cf}}{2 \text{ ft}} = 92.6 \text{ ft}^2$$

$$A_T = 92.6 + 15 = 107.6 \text{ ft}^2 \approx 108 \text{ ft}^2$$

POND 2

WQCV = 5,551 cf

$V_{\text{REQ}} = 5,551 (0.03) = 166.5 \text{ cf}$

$$V_{\text{REQ}} = \frac{166.5 \text{ cf}}{2 \text{ ft}} = 83.3 \text{ ft}^2$$

$$A_T = 83.3 + 15 = 98.3 \text{ ft}^2 \approx 99 \text{ ft}^2$$

\therefore THE FOREBAYS AREA SHALL BE $\geq 108 \text{ ft}^2$

DIAMETER OF PIPE TO FOREBAY, $D = 24 \text{ in} = 2 \text{ ft}$

SEE CONSTRUCTION DRAWINGS FOREBAY DETAIL (13-9)
FROM CITY OF COLORADO SPRINGS DCM, VOL. 1 w/ $D = 2 \text{ ft}$

\therefore BOTH FOREBAYS HAVE A TOTAL AREA OF $\boxed{112 \text{ ft}^2}$

Project: BRADLEY POINT FILING NO. 1

Date: 04/19/23

SIZE NOTCHES FOR FOREBAYS

2% OF CONTRIBUTING 100 yr FLOW

$$\text{WEIR EQN.} \Rightarrow Q = CLH^{1.5} \Rightarrow \text{SOLVE FOR } L \Rightarrow L = \frac{Q_{\text{NOTCH}}}{CH^{1.5}}$$

$$H = 2 \text{ ft}, C = 3.1$$

POND 1

$$Q_{100} = 19.7 \text{ cfs} \Rightarrow (0.02)19.7 = \underline{0.39 \text{ cfs}}$$

$$L = \frac{0.39 \text{ cfs}}{3.1 (2 \text{ ft})^{1.5}}$$

$$L = 0.044 \left(\frac{12 \text{ in}}{1 \text{ ft}} \right) = \underline{0.53 \text{ in}}$$

∴ USE 0.75" WIDE NOTCH
OR IT MAY CLOG

POND 2

$$Q_{100} = 18.0 \text{ cfs} \Rightarrow 0.02(18) = \underline{0.36 \text{ cfs}}$$

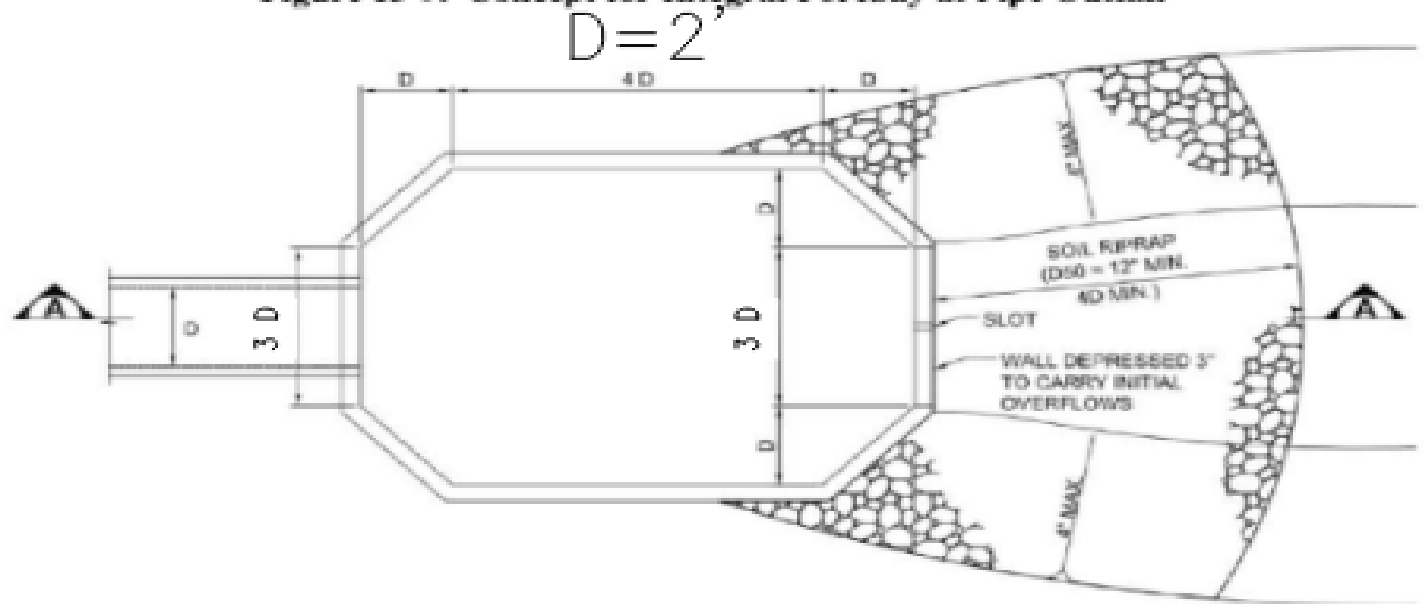
$$L = \frac{0.36 \text{ cfs}}{3.1 (2 \text{ ft})^{1.5}}$$

$$L = 0.041 \left(\frac{12 \text{ in}}{1 \text{ ft}} \right) = \underline{0.49 \text{ in}}$$

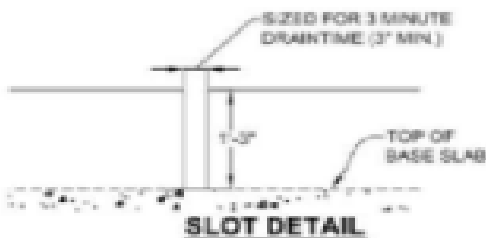
∴ USE 0.50" WIDE NOTCH
OR IT MAY CLOG

FOREBAY RIPRAP SIZING

Figure 13-9. Concept for Integral Forebay at Pipe Outfall

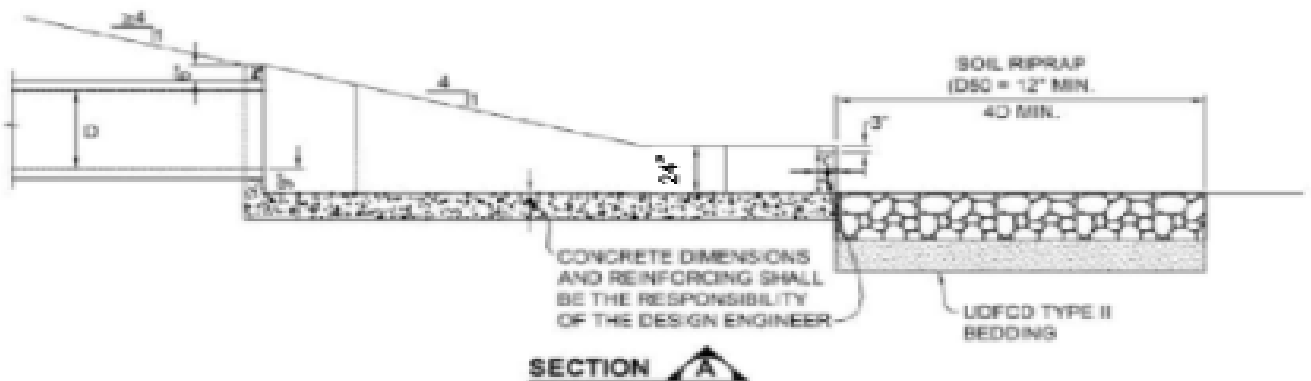


PLAN



NOTES:

1. DIMENSIONS SHOWN ARE MINIMUMS AND APPLY TO FOREBAYS WITHIN MODIFIED EXTENDED DETENTION BASINS. FOREBAYS IN STANDARD EXTENDED DETENTION BASINS SHALL BE SIZED BASED ON UDFCD CRITERIA.
2. FOR DEPTH \geq 2.5- FEET, FORESBAY REQUIRES RAMP INTO BOTTOM AND ACCESS ROAD LEADING TO STREET.



<i>Weighted Percent Imperviousness of Site to Pond 1</i>				
<i>Contributing Basins</i>	<i>Area (Acres)</i>	<i>C_s</i>	<i>*Impervious % (I)</i>	<i>(Acres)*(I)</i>
<i>A</i>	<i>4.47</i>	<i>0.60</i>	<i>82</i>	<i>366.14</i>
<i>Totals</i>	<i>4.47</i>			<i>366.14</i>
<i>Imperviousness to Infiltration Pond 1</i>	<i>82.0</i>			

***BRADLEY POINT FILING NO. 1
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)***

POND 1

Elevation	SF	CF	Storage	
			AF	Sum
5777.00	3,863.00			0
5778.00	4,846.00	4,354.50	0.10	0.10
5779.00	5,885.00	5,365.50	0.12	0.22
5780.00	6,980.00	6,432.50	0.15	0.37
5781.00	8,133.00	7,556.50	0.17	0.54
5782.00	9,343.00	8,738.00	0.20	0.74
5783.00	10,650.00	9,996.50	0.23	0.97
5784.00	55,435.00	33,042.50	0.76	1.73
Total =		<u>75,486</u> CF		
			Total =	<u>1.733</u> Ac-ft

Calculated by: DLM
Date: 5/3/2022
Checked by: _____

Weighted Percent Imperviousness of Stie to Pond 2				
Contributing Basins	Area (Acres)	C_s	*Impervious % (I)	(Acres)*(I)
B	4.17	0.59	80	333.82
Totals	4.17			333.82
Imperviousness to Infiltration Pond 2	80.0			

	1	2	1*2
Total Site Imperviousness	Ac	Imp	
Area 1	4.47	0.82	3.67 A
Area 2	4.17	0.8	3.34 B
Area 3			
Total	8.64		7.00 A+B
Site Imperviousness		7.00 / 8.64	0.81

***BRADLEY POINT FILING NO. 1
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)***

POND 2

Elevation	SF	CF	Storage	
			AF	Sum
5772.00	3,316.00			0
5773.00	4,278.00	3,797.00	0.09	0.09
5774.00	5,299.00	4,788.50	0.11	0.20
5775.00	6,373.00	5,836.00	0.13	0.33
5776.00	7,505.00	6,939.00	0.16	0.49
5777.00	8,692.00	8,098.50	0.19	0.68
5778.00	9,954.00	9,323.00	0.21	0.89
5779.00	24,989.00	17,471.50	0.40	1.29
		Total =	<u>56,254</u> CF	
			Total =	<u>1.3</u> Ac-ft
#NUM!				
#NUM!				

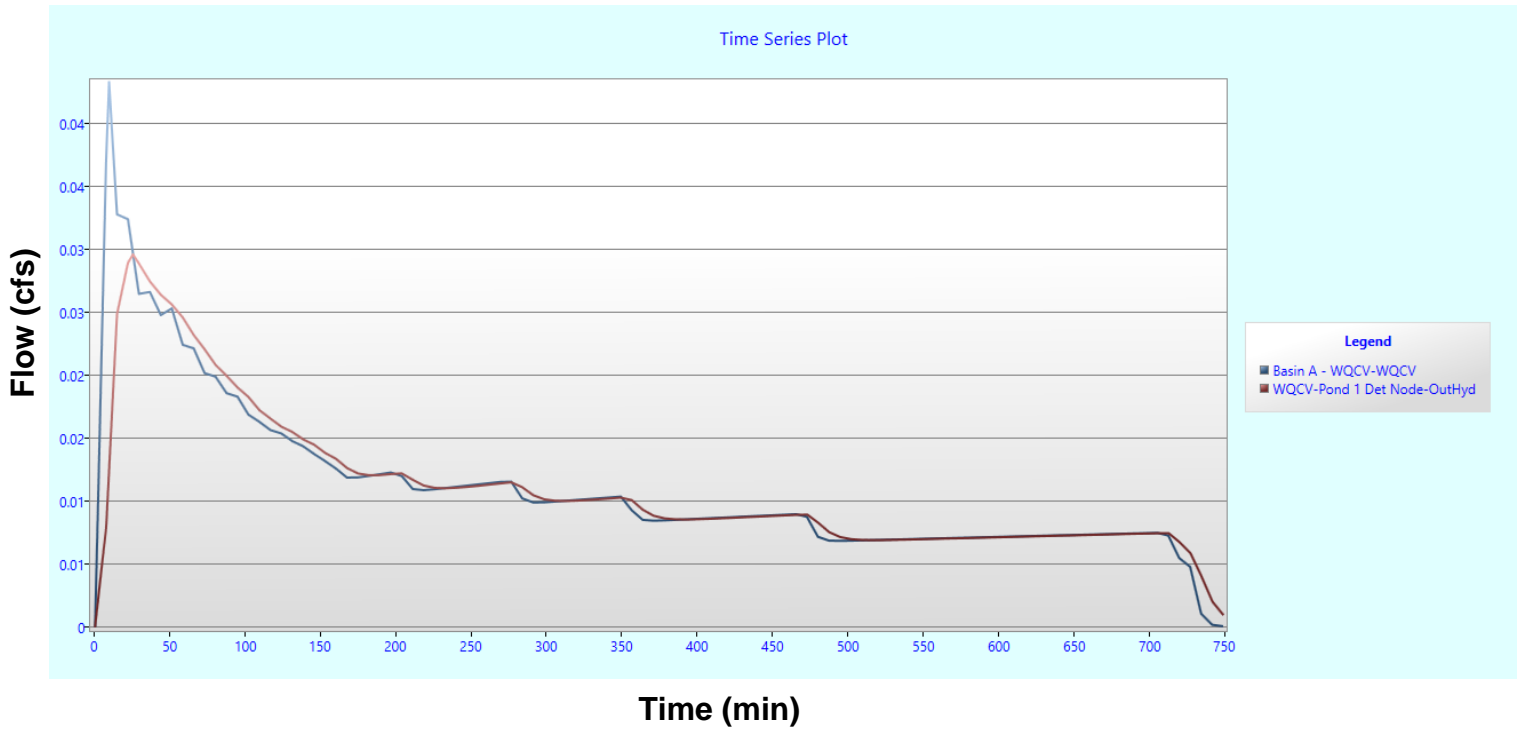
Calculated by: GT
Date: 9/15/2020
Checked by: _____

StormSHED 4G Analyses

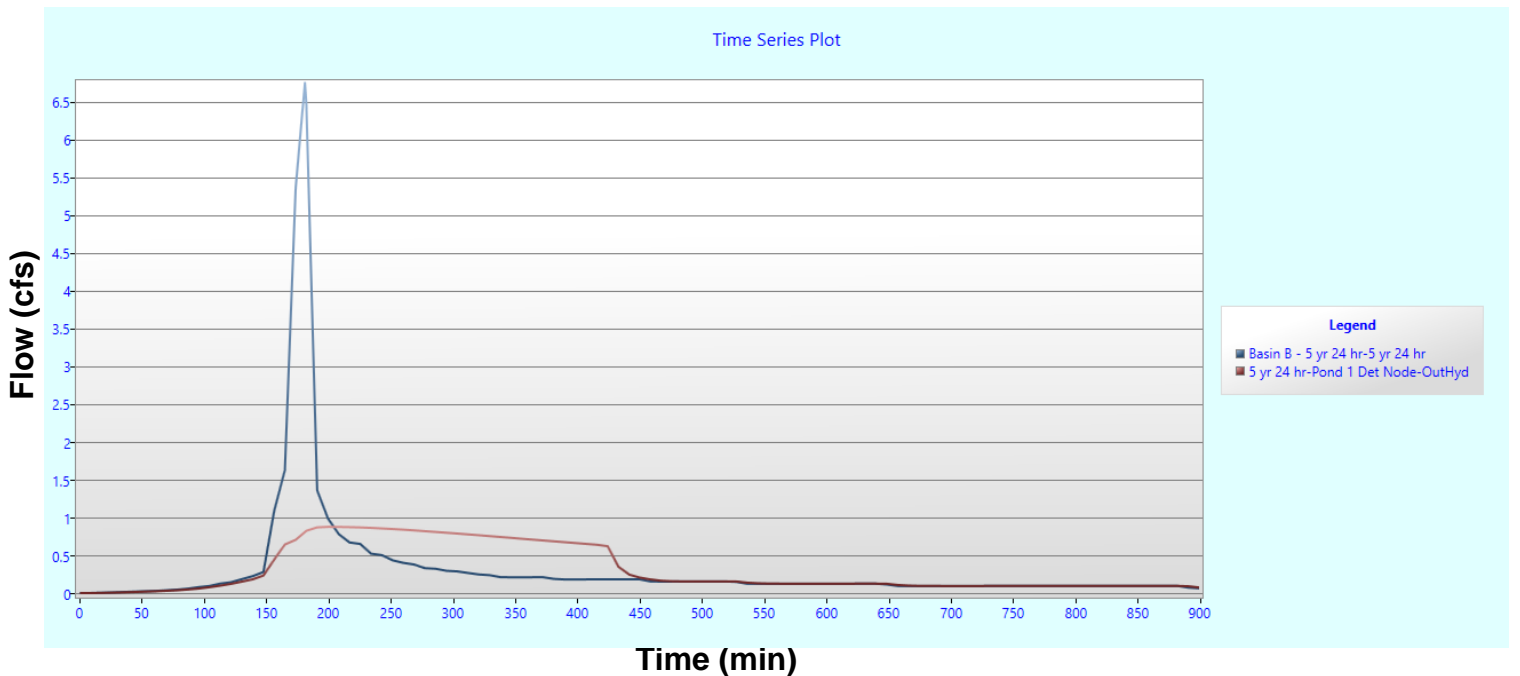
North Pond Summary Table (POND 1)

Design Event	Match Flows (cfs)	Peak Q (cfs)	Max Depth (ft)	Vol (cf)	HtoE	% Vol
WQCV	0.0432	0.0295	0.0047	15.7203	0.01	99.92
5 yr 24 hr	6.7560	0.8970	1.6587	6,668.4623	0.01	99.99
100 yr 24 hr	20.4919	1.5600	4.8800	27,287.7935	0.12	99.95

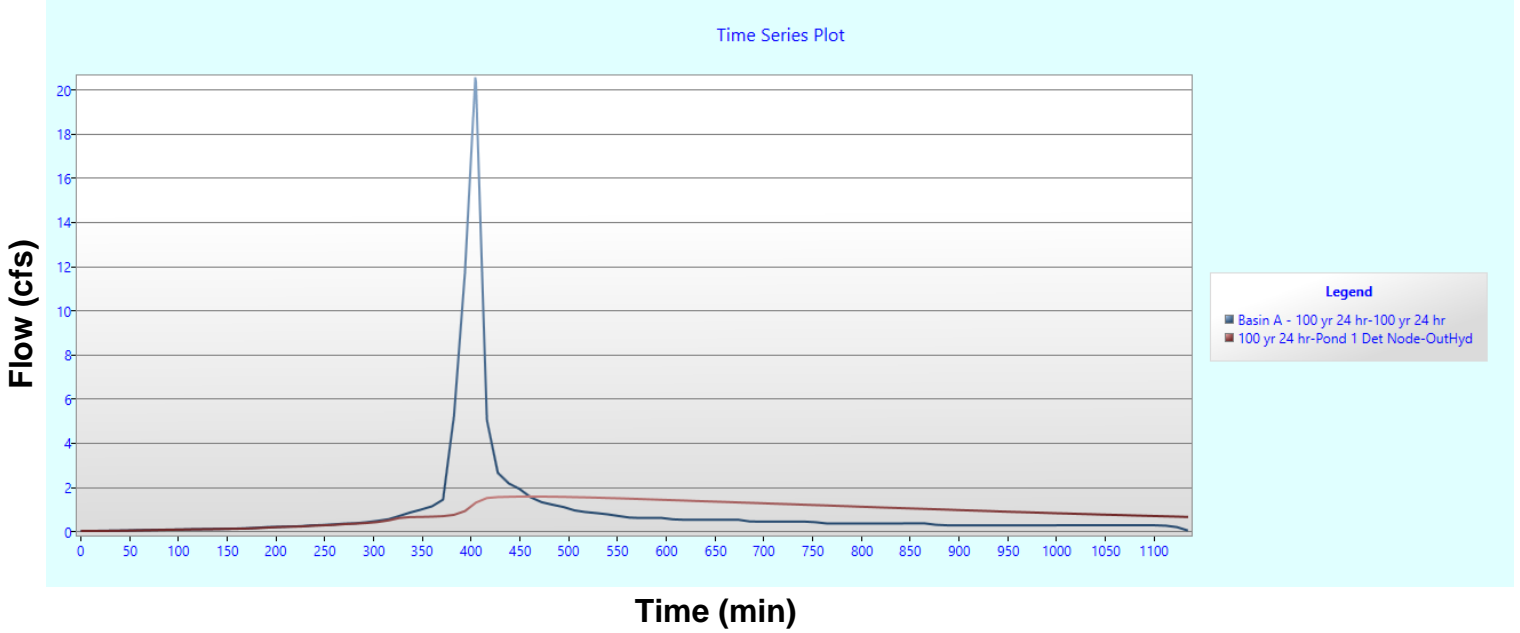
North Pond: WQCV Inflow and Outflow Hydrographs



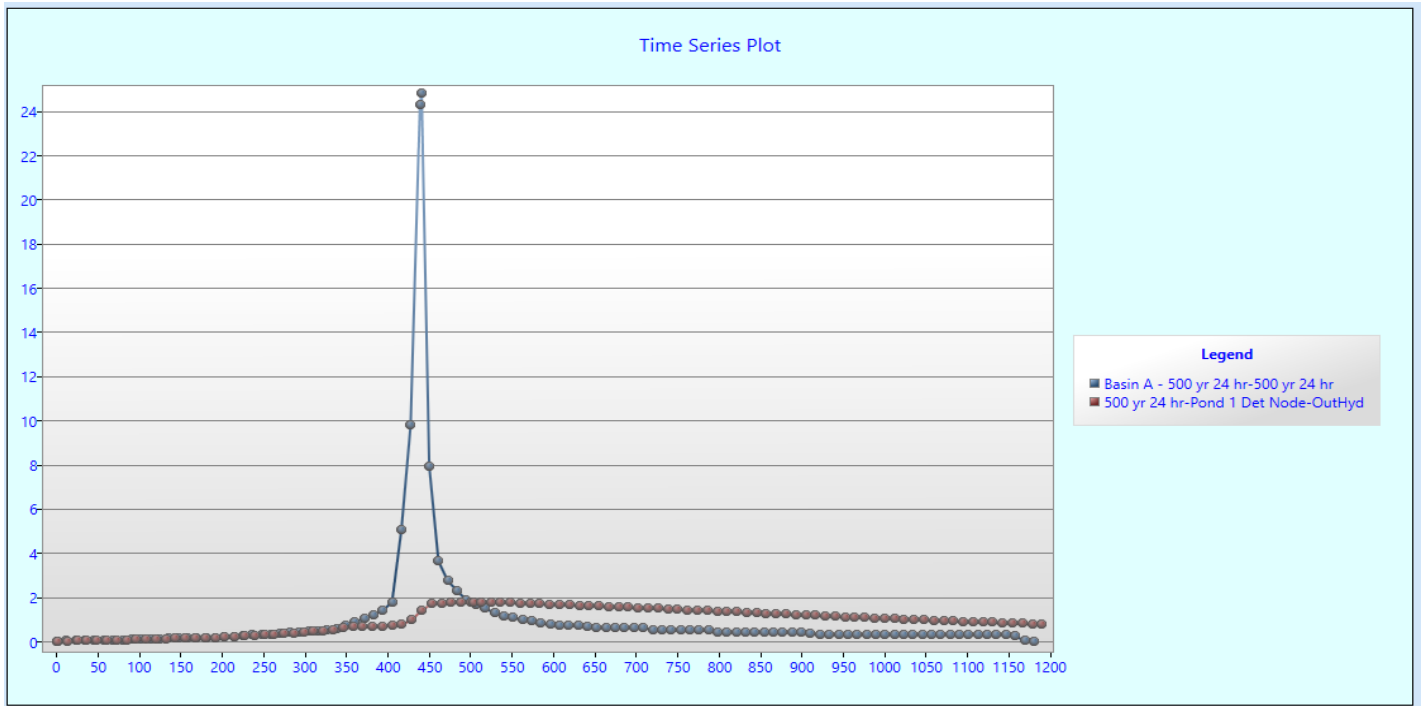
North Pond: 5 YR Inflow and Outflow Hydrographs



North Pond: 100 YR Inflow and Outflow Hydrographs



North Pond: 500 YR Inflow and Outflow Hydrograph and Summary Table

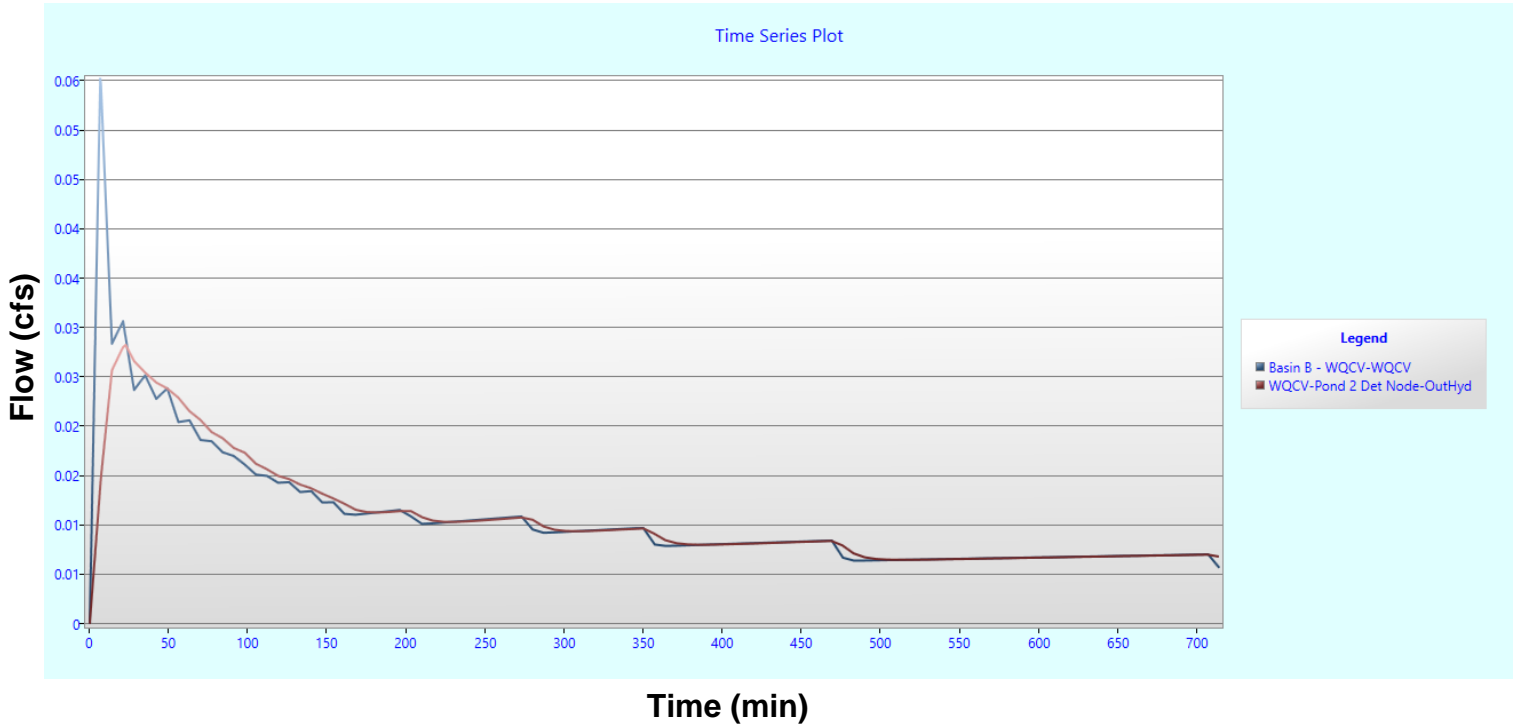


Design Event	Match Flows (cfs)	Peak Q (cfs)	Max Depth (ft)	Vol (cf)	HtoE	% Vol
500 yr 24 hr	24.7740	1.7555	5.7144	34,511.9753	1.42	99.96

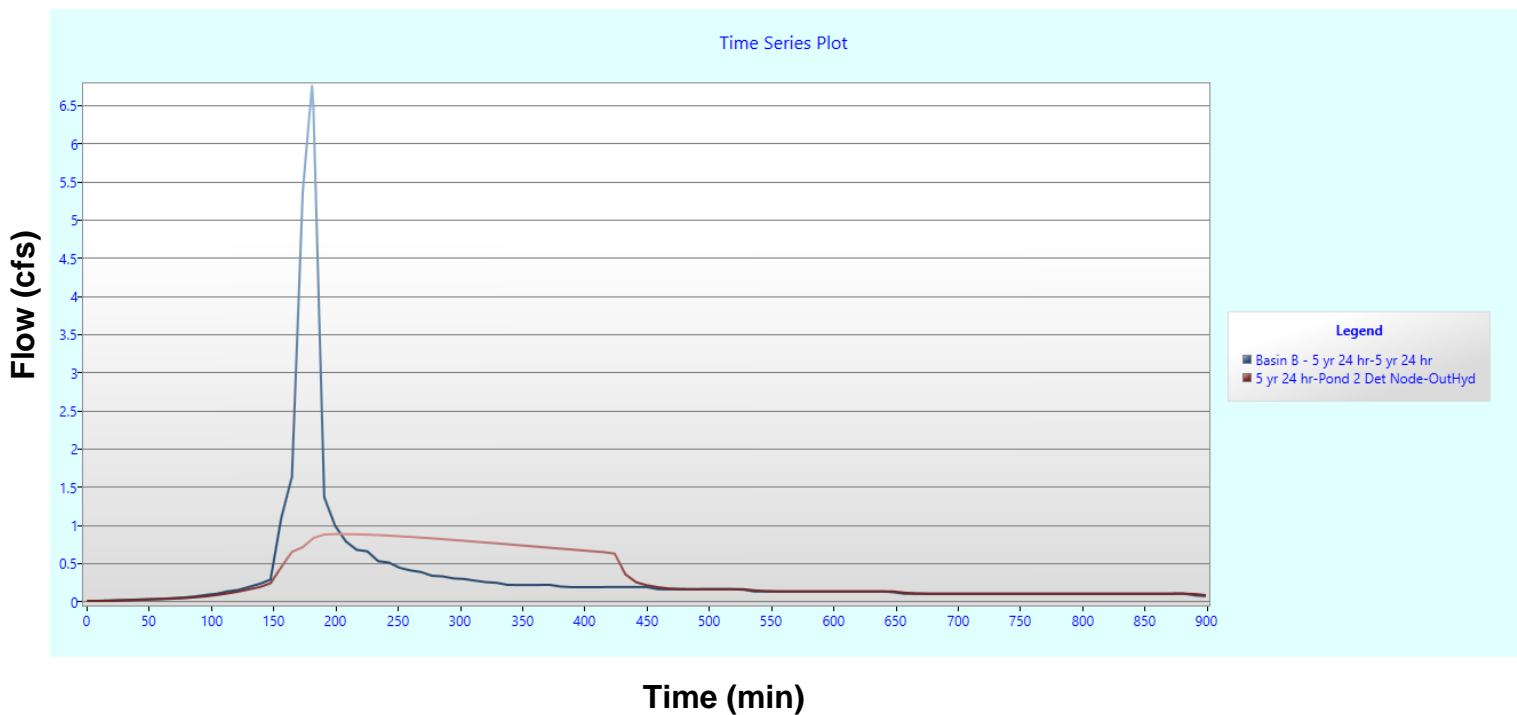
South Pond Summary Table (POND 2)

Design Event	Match Flows (cfs)	Peak Q (cfs)	Max Depth (ft)	Vol (cf)	HtoE	% Vol
WQCV	0.0551	0.0281	0.0045	14,9835	0.01	99.95
5 yr 24 hr	6.7430	0.8767	1.5473	6,143.8109	0.01	99.97
100 yr 24 hr	19.9827	1.4999	4.6147	25,163.8586	0.01	99.96

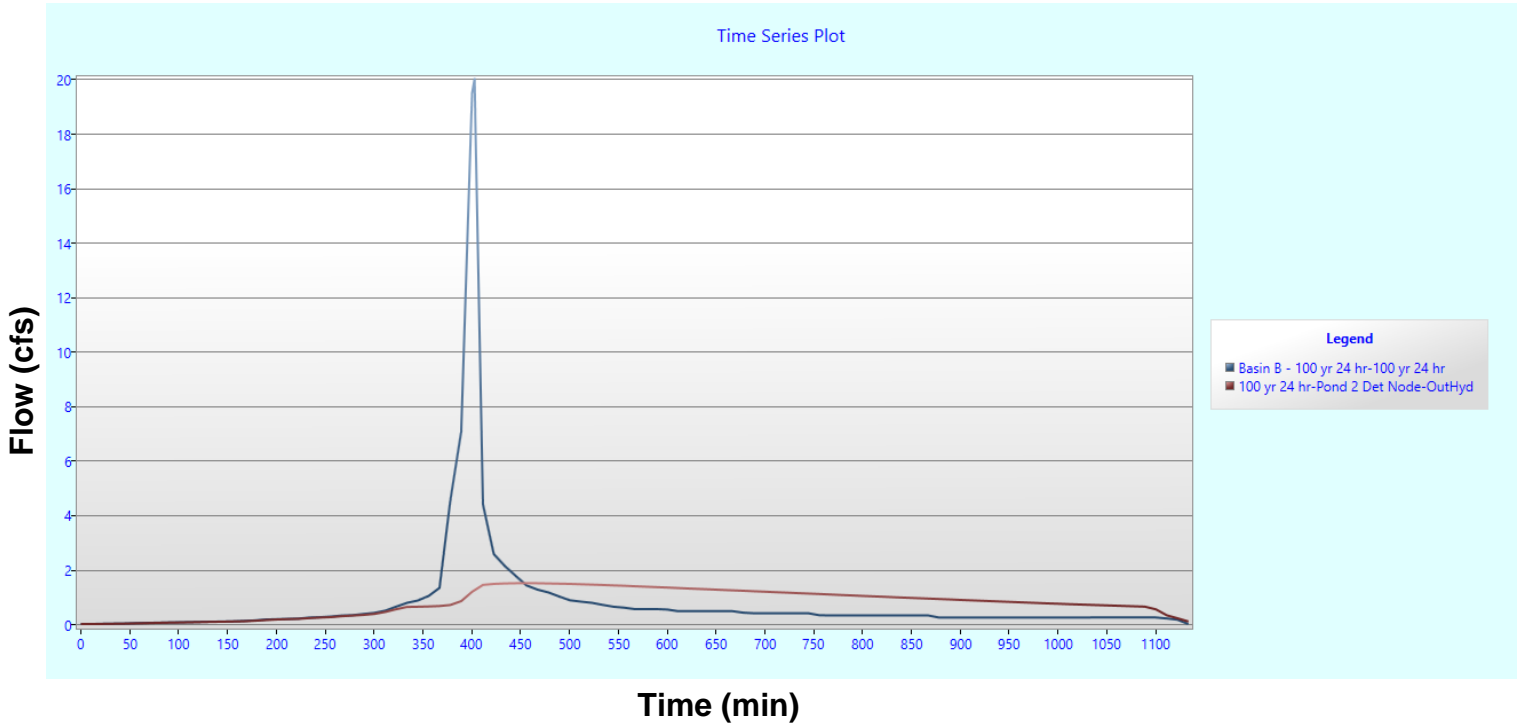
South Pond: WQCV Inflow and Outflow Hydrographs



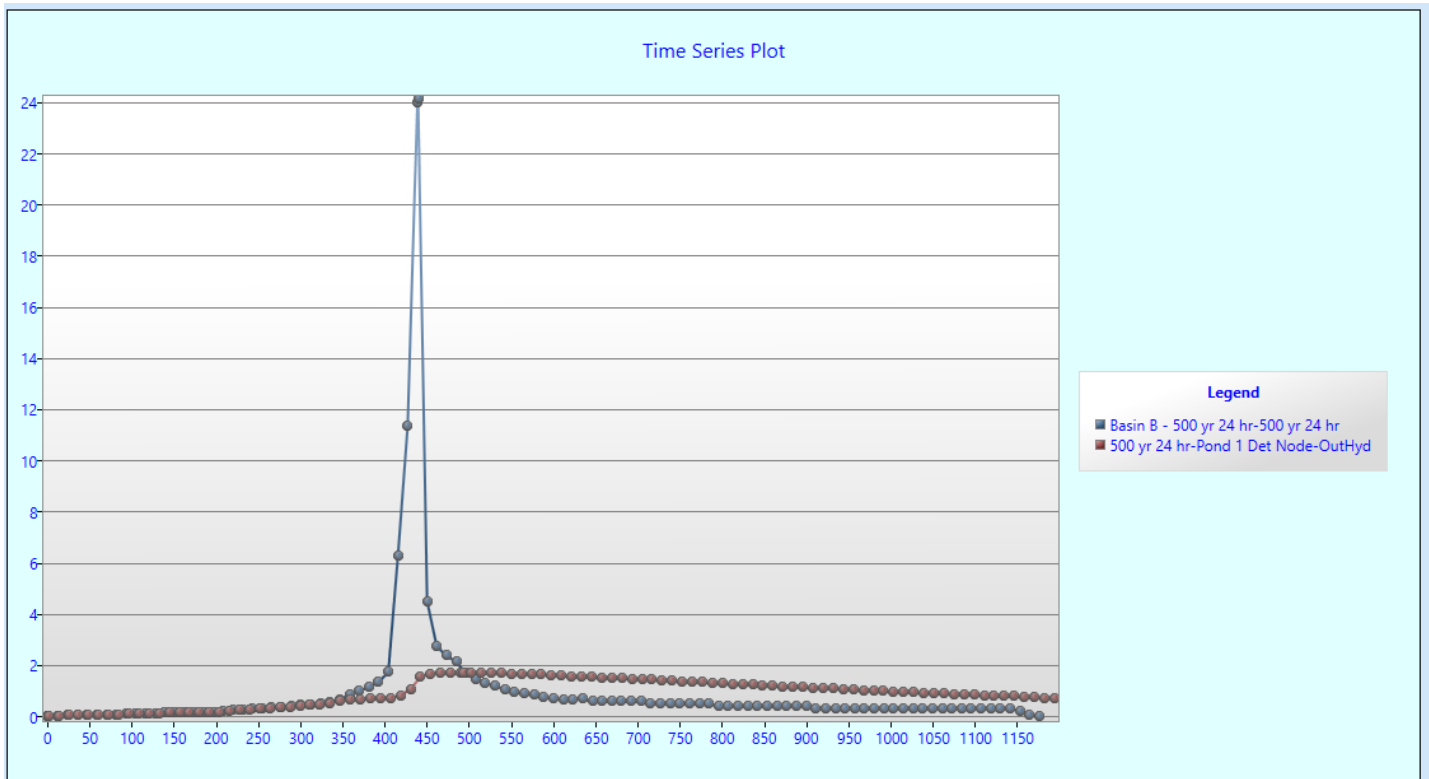
South Pond: 5 YR Inflow and Outflow Hydrographs



South Pond: 100 YR Inflow and Outflow Hydrographs



South Pond: 500 YR Inflow and Outflow Hydrograph and Summary Table



Design Event	Match Flows (cfs)	Peak Q (cfs)	Max Depth (ft)	Vol (cf)	HtoE	% Vol
500 yr 24 hr	24.0984	1.6845	5.4160	31,832.7139	1.05	99.95

Design Procedure Form: Sand Filter (SF)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 2

Designer: dlm
Company: M&S Civil Consultants
Date: April 20, 2023
Project: Bradley Point Filing No. 1
Location: US Hwy 85-87 / Bradley Road

POND 1

1. Basin Storage Volume

- A) Effective Imperviousness of Tributary Area, I_a
(100% if all paved and roofed areas upstream of sand filter)
- B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)
- C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time
 $WQCV = 0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$
- D) Contributing Watershed Area (including sand filter area)
- E) Water Quality Capture Volume (WQCV) Design Volume
 $V_{WQCV} = WQCV / 12 * Area$
- F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
- G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
- H) User Input of Water Quality Capture Volume (WQCV) Design Volume
(Only if a different WQCV Design Volume is desired)

$I_a =$ %

$i =$

WQCV = watershed inches

Area = sq ft

$V_{WQCV} =$

$d_b =$ in

$V_{WQCV \text{ OTHER}} =$ cu ft

$V_{WQCV \text{ USER}} =$ cu ft

This spreadsheet is for the design of SFBs. If no sand filter basin is proposed this should be removed.

2. Basin Geometry

- A) WQCV Depth
- B) Sand Filter Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred). Use "0" if sand filter has vertical walls.
- C) Minimum Filter Area (Flat Surface Area)
- D) Actual Filter Area
- E) Volume Provided

$D_{WQCV} =$ ft

$Z =$ ft / ft

DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE

$A_{Min} =$ sq ft

$A_{Actual} =$ sq ft

$V_T =$ cu ft

3. Filter Material

Choose One

18" CDOT Class B or C Filter Material

Other (Explain):

In-situ eathern materials

4. Underdrain System

- A) Are underdrains provided?
- B) Underdrain system orifice diameter for 12 hour drain time
 - i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice
 - ii) Volume to Drain in 12 Hours
 - iii) Orifice Diameter, 3/8" Minimum

Choose One

YES

NO

$y =$ ft

$Vol_{12} =$ cu ft

$D_o =$ in

Design Procedure Form: Sand Filter (SF)

Sheet 2 of 2

Designer: dIm
Company: M&S Civil Consultants
Date: April 20, 2023
Project: Bradley Point Filing No. 1
Location: US Hwy 85-87 / Bradley Road

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric

A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?

Choose One

YES NO

6. Inlet / Outlet Works

A) Describe the type of energy dissipation at inlet points and means of conveying flows in excess of the WQCV through the outlet

Notes: _____

Design Procedure Form: Sand Filter (SF)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 2

Designer: dlm
Company: M&S Civil Consultants
Date: April 20, 2023
Project: _____
Location: _____

POND 2

1. Basin Storage Volume

- A) Effective Imperviousness of Tributary Area, I_a
(100% if all paved and roofed areas upstream of sand filter)
- B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)
- C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time
 $WQCV = 0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$
- D) Contributing Watershed Area (including sand filter area)
- E) Water Quality Capture Volume (WQCV) Design Volume
 $V_{WQCV} = WQCV / 12 * Area$
- F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
- G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
- H) User Input of Water Quality Capture Volume (WQCV) Design Volume
(Only if a different WQCV Design Volume is desired)

$I_a =$ %

$i =$

WQCV = watershed inches

Area = sq ft

$V_{WQCV} =$ cu ft

$d_b =$ in

$V_{WQCV \text{ OTHER}} =$ cu ft

$V_{WQCV \text{ USER}} =$ cu ft

This spreadsheet is for the design of SFBs. If no sand filter basin is proposed this should be removed.

2. Basin Geometry

- A) WQCV Depth
- B) Sand Filter Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred). Use "0" if sand filter has vertical walls.
- C) Minimum Filter Area (Flat Surface Area)
- D) Actual Filter Area
- E) Volume Provided

$D_{WQCV} =$ ft

$Z =$ ft / ft

DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE

$A_{Min} =$ sq ft

$A_{Actual} =$ sq ft

$V_T =$ cu ft

3. Filter Material

Choose One

18" CDOT Class B or C Filter Material
 Other (Explain):

In-situ eathern materials

4. Underdrain System

- A) Are underdrains provided?
- B) Underdrain system orifice diameter for 12 hour drain time
 - i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice
 - ii) Volume to Drain in 12 Hours
 - iii) Orifice Diameter, 3/8" Minimum

Choose One

YES
 NO

$y =$ ft

$Vol_{12} =$ cu ft

$D_o =$ in

Design Procedure Form: Sand Filter (SF)

Sheet 2 of 2

Designer: dlm
Company: M&S Civil Consultants
Date: April 20, 2023
Project:
Location:

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric

A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?

Choose One

YES NO

6. Inlet / Outlet Works

A) Describe the type of energy dissipation at inlet points and means of conveying flows in excess of the WQCV through the outlet

Notes: _____

Worksheet for West Side of Proposed Entrance - Crosspan (Concrete)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.003 ft/ft
Discharge	16.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
-0+50	85.14
-0+25	84.19
-0+15	84.20
-0+03	83.90
0+00	83.77
0+03	83.89
0+46	85.09

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+50, 85.14)	(0+46, 85.09)	0.015

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	6.0 in
Roughness Coefficient	0.015
Elevation	84.27 ft
Elevation Range	83.8 to 85.1 ft
Flow Area	8.7 ft ²
Wetted Perimeter	44.2 ft
Hydraulic Radius	2.4 in
Top Width	44.17 ft
Normal Depth	6.0 in
Critical Depth	5.5 in
Critical Slope	0.006 ft/ft
Velocity	1.84 ft/s
Velocity Head	0.05 ft
Specific Energy	0.55 ft

Worksheet for West Side of Proposed Entrance - Crossspan (Concrete)

Results

Froude Number	0.730
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	6.0 in
Critical Depth	5.5 in
Channel Slope	0.003 ft/ft
Critical Slope	0.006 ft/ft

Worksheet for East Side of Proposed Entrance - Crosspan (Concrete)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.003 ft/ft
Discharge	16.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
-0+50	85.03
-0+25	84.49
-0+03	83.78
0+00	83.66
0+03	83.78
0+46	84.98

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+50, 85.03)	(0+46, 84.98)	0.015

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	6.1 in
Roughness Coefficient	0.015
Elevation	84.16 ft
Elevation Range	83.7 to 85.0 ft
Flow Area	7.6 ft ²
Wetted Perimeter	31.9 ft
Hydraulic Radius	2.9 in
Top Width	31.89 ft
Normal Depth	6.1 in
Critical Depth	5.4 in
Critical Slope	0.005 ft/ft
Velocity	2.09 ft/s
Velocity Head	0.07 ft
Specific Energy	0.57 ft
Froude Number	0.753

Worksheet for East Side of Proposed Entrance - Crossspan (Concrete)

Results	
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	6.1 in
Critical Depth	5.4 in
Channel Slope	0.003 ft/ft
Critical Slope	0.005 ft/ft

Worksheet for Irregular Swale Section - A-A

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.004 ft/ft
Discharge	16.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	5,785.60
0+33	5,785.00
0+54	5,784.50
0+65	5,785.00
0+83	5,785.80

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5,785.60)	(0+65, 5,785.00)	0.030
(0+65, 5,785.00)	(0+83, 5,785.80)	0.016

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	7.1 in
Roughness Coefficient	0.029
Elevation	5,785.09 ft
Elevation Range	5,784.5 to 5,785.8 ft
Flow Area	11.2 ft ²
Wetted Perimeter	39.0 ft
Hydraulic Radius	3.4 in
Top Width	39.03 ft
Normal Depth	7.1 in
Critical Depth	5.2 in
Critical Slope	0.021 ft/ft
Velocity	1.43 ft/s
Velocity Head	0.03 ft
Specific Energy	0.62 ft
Froude Number	0.469

Worksheet for Irregular Swale Section - A-A

Results	
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	7.1 in
Critical Depth	5.2 in
Channel Slope	0.004 ft/ft
Critical Slope	0.021 ft/ft

Worksheet for Irregular Swale Section - B-B

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.003 ft/ft
Discharge	16.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	5,785.20
0+50	5,784.00
0+57	5,783.70
0+62	5,784.00
0+86	5,784.90

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5,785.20)	(0+62, 5,784.00)	0.030
(0+62, 5,784.00)	(0+86, 5,784.90)	0.016

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	8.2 in
Roughness Coefficient	0.027
Elevation	5,784.39 ft
Elevation Range	5,783.7 to 5,785.2 ft
Flow Area	11.6 ft ²
Wetted Perimeter	38.5 ft
Hydraulic Radius	3.6 in
Top Width	38.50 ft
Normal Depth	8.2 in
Critical Depth	6.2 in
Critical Slope	0.017 ft/ft
Velocity	1.38 ft/s
Velocity Head	0.03 ft
Specific Energy	0.71 ft
Froude Number	0.443

Worksheet for Irregular Swale Section - B-B

Results	
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	8.2 in
Critical Depth	6.2 in
Channel Slope	0.003 ft/ft
Critical Slope	0.017 ft/ft

Worksheet for Irregular Swale Section - C-C

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.004 ft/ft
Discharge	16.00 cfs

Section Definitions

	Station (ft)	Elevation (ft)
	0+00	5,784.20
	0+60	5,783.00
	0+65	5,782.80
	0+70	5,783.00
	0+96	5,784.10

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5,784.20)	(0+70, 5,783.00)	0.030
(0+70, 5,783.00)	(0+96, 5,784.10)	0.016

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	7.1 in
Roughness Coefficient	0.027
Elevation	5,783.40 ft
Elevation Range	5,782.8 to 5,784.2 ft
Flow Area	11.0 ft ²
Wetted Perimeter	39.5 ft
Hydraulic Radius	3.3 in
Top Width	39.47 ft
Normal Depth	7.1 in
Critical Depth	5.5 in
Critical Slope	0.018 ft/ft
Velocity	1.46 ft/s
Velocity Head	0.03 ft
Specific Energy	0.63 ft
Froude Number	0.489

Worksheet for Irregular Swale Section - C-C

Results	
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	7.1 in
Critical Depth	5.5 in
Channel Slope	0.004 ft/ft
Critical Slope	0.018 ft/ft

Worksheet for Irregular Swale Section - D-D

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Discharge	17.50 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	5,782.50
0+52	5,782.00
0+65	5,781.60
0+78	5,782.00
0+96	5,782.90

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5,782.50)	(0+78, 5,782.00)	0.030
(0+78, 5,782.00)	(0+96, 5,782.90)	0.016

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	7.0 in
Roughness Coefficient	0.029
Elevation	5,782.19 ft
Elevation Range	5,781.6 to 5,782.9 ft
Flow Area	12.1 ft ²
Wetted Perimeter	48.9 ft
Hydraulic Radius	3.0 in
Top Width	48.90 ft
Normal Depth	7.0 in
Critical Depth	5.5 in
Critical Slope	0.021 ft/ft
Velocity	1.45 ft/s
Velocity Head	0.03 ft
Specific Energy	0.62 ft
Froude Number	0.513

Worksheet for Irregular Swale Section - D-D

Results	
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	7.0 in
Critical Depth	5.5 in
Channel Slope	0.005 ft/ft
Critical Slope	0.021 ft/ft

Worksheet for Irregular Swale Section - E-E

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.020 ft/ft
Discharge	17.50 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	5,780.80
0+43	5,780.00
0+56	5,779.20
0+62	5,780.00
0+79	5,781.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5,780.80)	(0+62, 5,780.00)	0.030
(0+62, 5,780.00)	(0+79, 5,781.00)	0.016

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	8.0 in
Roughness Coefficient	0.030
Elevation	5,779.86 ft
Elevation Range	5,779.2 to 5,781.0 ft
Flow Area	5.2 ft ²
Wetted Perimeter	15.8 ft
Hydraulic Radius	4.0 in
Top Width	15.76 ft
Normal Depth	8.0 in
Critical Depth	8.0 in
Critical Slope	0.019 ft/ft
Velocity	3.35 ft/s
Velocity Head	0.17 ft
Specific Energy	0.84 ft
Froude Number	1.025

Worksheet for Irregular Swale Section - E-E

Results	
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	8.0 in
Critical Depth	8.0 in
Channel Slope	0.020 ft/ft
Critical Slope	0.019 ft/ft

Worksheet for Swale - F-F - 13.0 cfs

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.027
Channel Slope	0.010 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Discharge	13.00 cfs
Results	
Normal Depth	13.2 in
Flow Area	3.6 ft ²
Wetted Perimeter	7.0 ft
Hydraulic Radius	6.3 in
Top Width	6.61 ft
Critical Depth	12.4 in
Critical Slope	0.014 ft/ft
Velocity	3.57 ft/s
Velocity Head	0.20 ft
Specific Energy	1.30 ft
Froude Number	0.848
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	13.2 in
Critical Depth	12.4 in
Channel Slope	0.010 ft/ft
Critical Slope	0.014 ft/ft

Worksheet for Swale - G-G - 6.7 cfs

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.027
Channel Slope	0.012 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Discharge	6.70 cfs

Results	
Normal Depth	10.0 in
Flow Area	2.1 ft ²
Wetted Perimeter	5.3 ft
Hydraulic Radius	4.7 in
Top Width	4.98 ft
Critical Depth	9.5 in
Critical Slope	0.016 ft/ft
Velocity	3.24 ft/s
Velocity Head	0.16 ft
Specific Energy	0.99 ft
Froude Number	0.886
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	10.0 in
Critical Depth	9.5 in
Channel Slope	0.012 ft/ft
Critical Slope	0.016 ft/ft

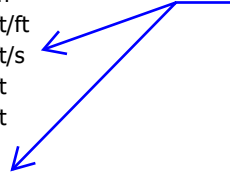
Worksheet for Swale - H-H - 6.0 cfs

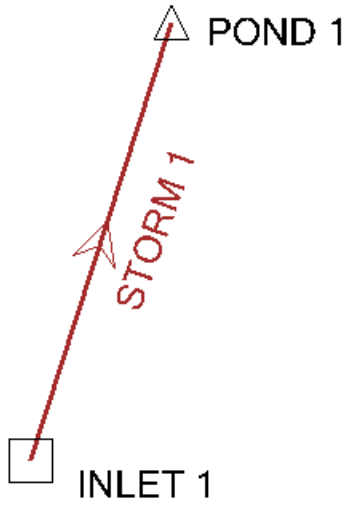
Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.027
Channel Slope	0.013 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Discharge	6.00 cfs
Results	
Normal Depth	9.4 in
Flow Area	1.8 ft ²
Wetted Perimeter	5.0 ft
Hydraulic Radius	4.5 in
Top Width	4.71 ft
Critical Depth	9.1 in
Critical Slope	0.016 ft/ft
Velocity	3.25 ft/s
Velocity Head	0.16 ft
Specific Energy	0.95 ft
Froude Number	0.914
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	9.4 in
Critical Depth	9.1 in
Channel Slope	0.013 ft/ft
Critical Slope	0.016 ft/ft

Worksheet for Swale - I-I - 12.0 cfs

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.027
Channel Slope	0.020 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Discharge	12.00 cfs
Results	
Normal Depth	11.3 in
Flow Area	2.6 ft ²
Wetted Perimeter	5.9 ft
Hydraulic Radius	5.3 in
Top Width	5.63 ft
Critical Depth	12.0 in
Critical Slope	0.014 ft/ft
Velocity	4.54 ft/s
Velocity Head	0.32 ft
Specific Energy	1.26 ft
Froude Number	1.168
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	11.3 in
Critical Depth	12.0 in
Channel Slope	0.020 ft/ft
Critical Slope	0.014 ft/ft

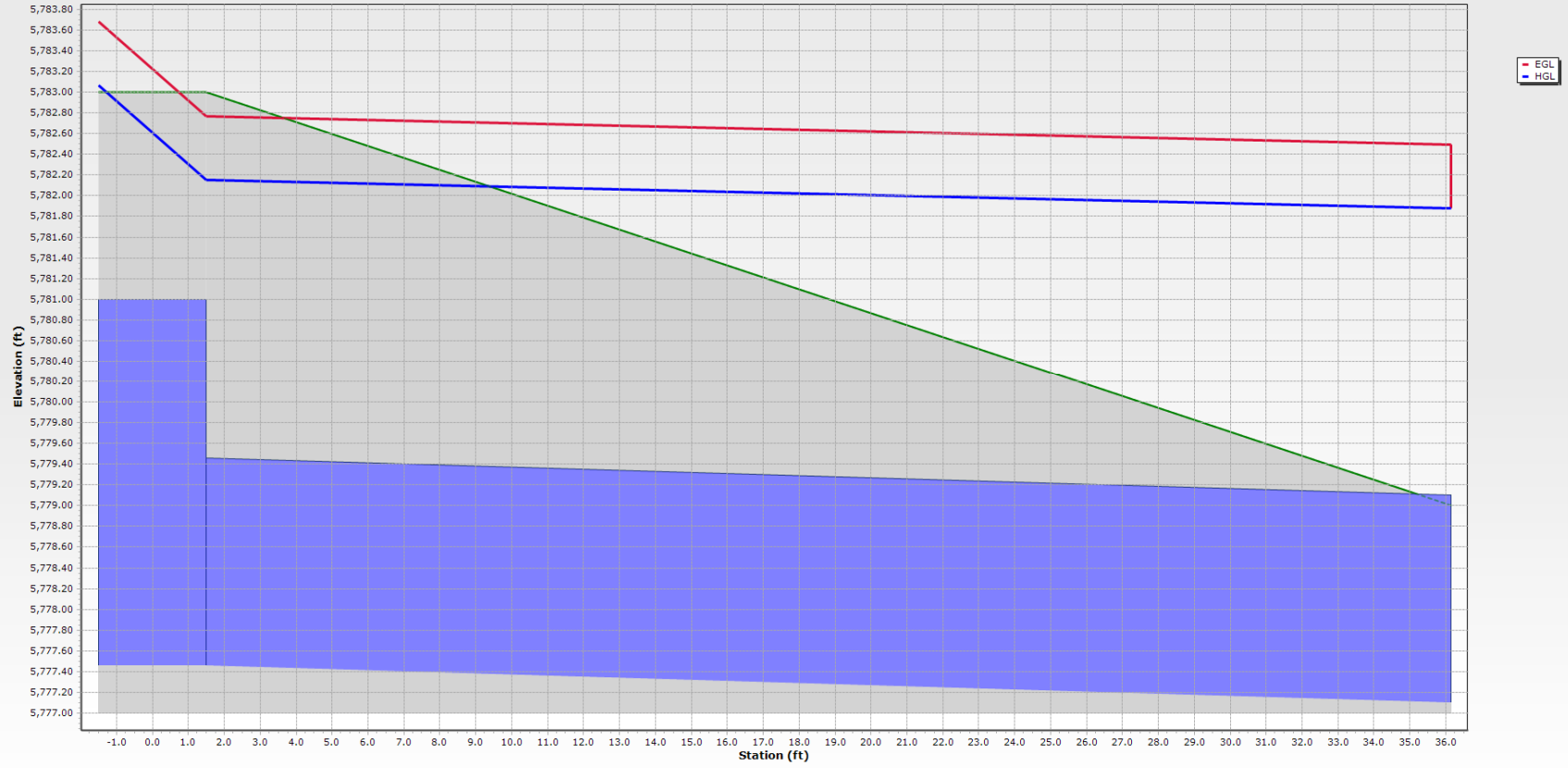
With supercritical flow and high velocity, lining appears to be required, or lowering of slope.





STORMCAD SCHEMATIC

STORM 1 - 100 yr



STORM 2 - 100 yr



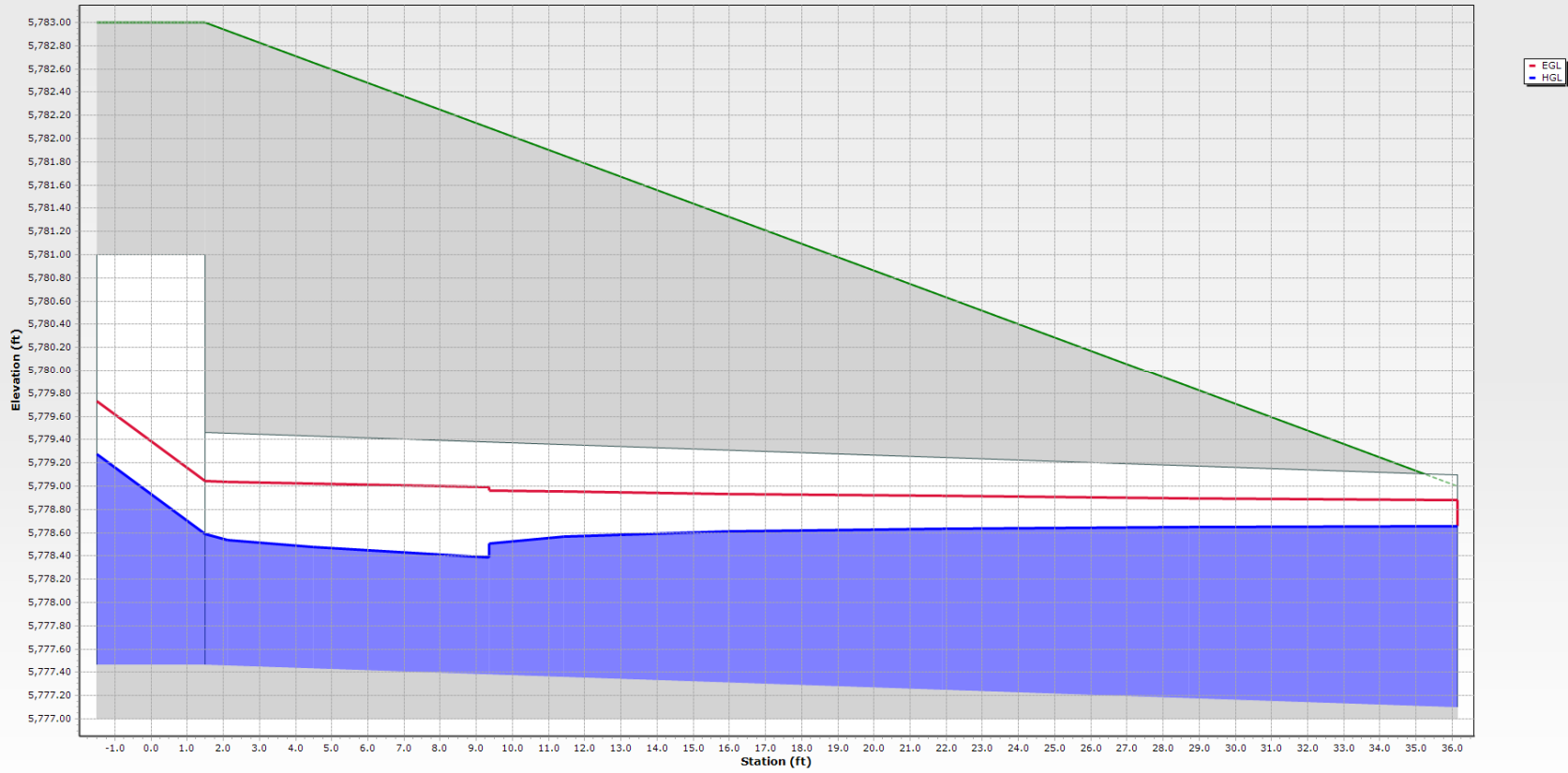
Conduit FlexTable: STRM - 100YR

Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number
STORM 1	548	INLET 1	19.70	87.3	36.1	6.27	(N/A)
STORM 2	570	INLET 2	18.00	78.3	29.1	5.73	(N/A)

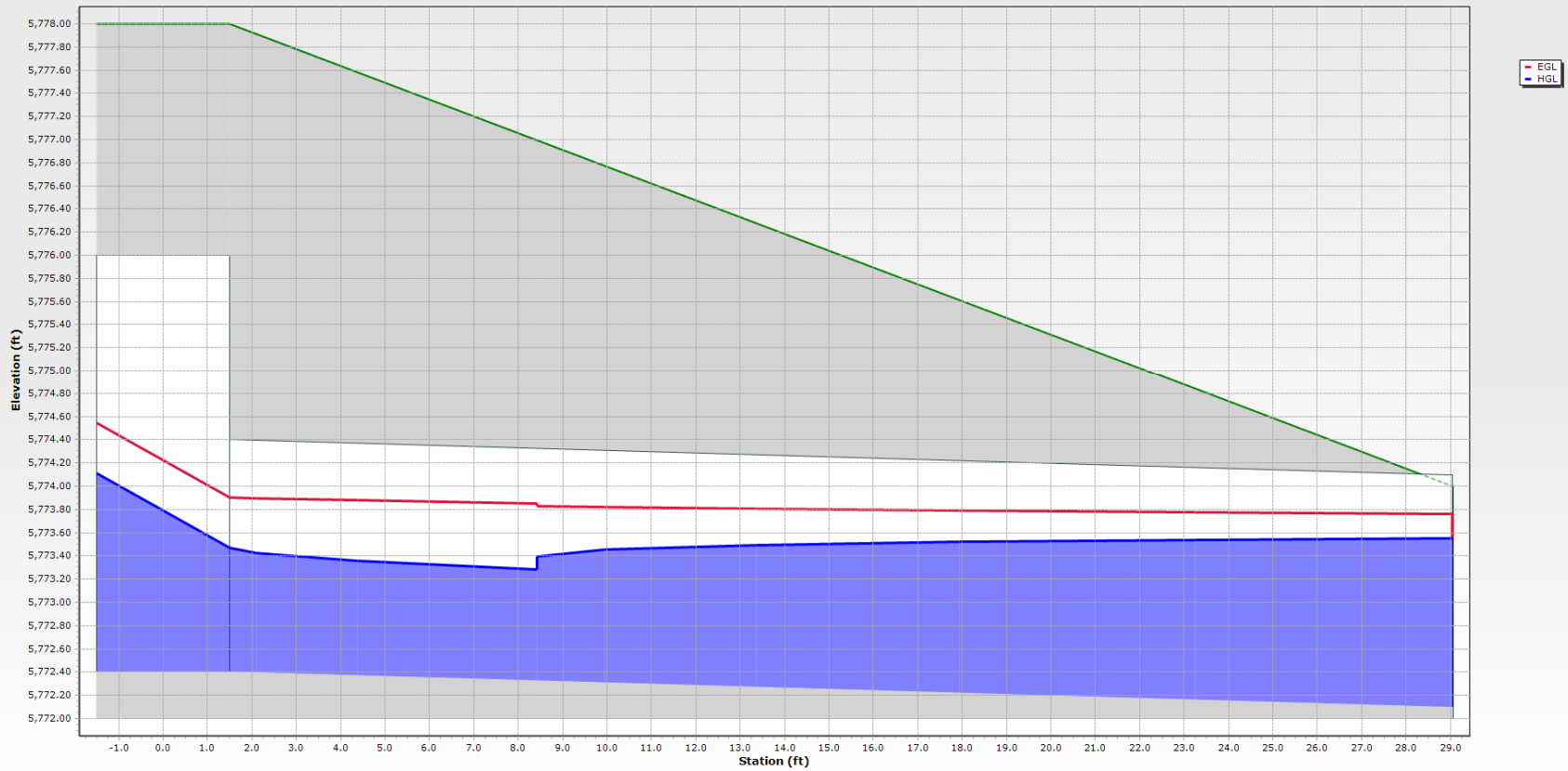
Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)	Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)
1.45	1.60	5,782.77	5,782.49	5,782.15	5,781.88	0.27	5,783.07	6.27
1.33	1.53	5,777.10	5,776.92	5,776.59	5,776.41	0.18	5,777.36	5.73

Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description
1.500	0.92	5,779.00	5,783.00	5,777.10	5,777.46	Circle - 24.0 in
1.500	0.77	5,778.00	5,774.00	5,772.40	5,772.10	Circle - 24.0 in

STORM 1 - 5 yr



STORM 2 - 5 yr



Conduit FlexTable: STRM - 5YR

Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number
STORM 1	548	INLET 1	9.90	43.8	36.1	6.95	(N/A)
STORM 2	570	INLET 2	9.00	39.2	29.1	6.87	(N/A)

Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)	Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)
0.93	1.13	5,779.04	5,778.88	5,778.59	5,778.66	-0.07	5,779.27	5.43
0.87	1.07	5,773.90	5,773.76	5,773.47	5,773.55	-0.08	5,774.11	5.26

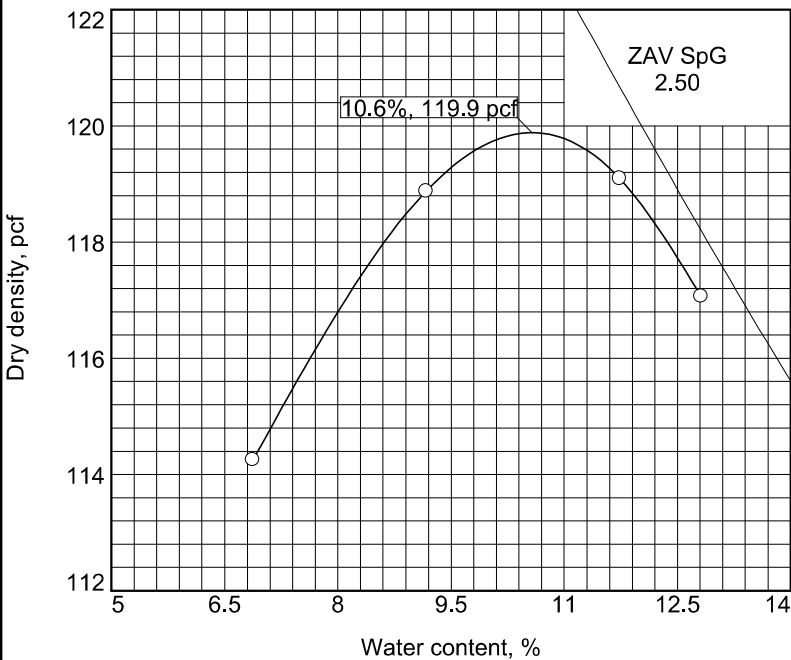
Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description
1.500	0.69	5,779.00	5,783.00	5,777.10	5,777.46	Circle - 24.0 in
1.500	0.64	5,778.00	5,774.00	5,772.40	5,772.10	Circle - 24.0 in

AGGREGATE BASE EXHIBIT

These test results apply only to the samples which were tested. the testing report shall not be reproduced, except in full, without the written approval of K & A, Inc

COMPACTION TEST REPORT

Curve No. 1217



Preparation Method _____	
Rammer: Wt. <u>10 lb.</u>	Drop <u>18 in.</u>
Type <u>Manual</u>	
Layers: No. <u>five</u>	Blows per <u>56</u>
Mold Size <u>0.075 cu. ft.</u>	
Test Performed on Material	
Passing <u>3/4 in.</u> Sieve	
%>3/4 in. <u>1</u>	%<No.200 <u>6.8</u>
Atterberg (D 4318): LL <u>NV</u>	PI <u>NP</u>
NM (D 2216) _____	Sp.G. (D 854) <u>2.5</u>
USCS (D 2487) <u>GP-GM</u>	
AASHTO (M 145) <u>A-1-a</u>	
Date: Sampled <u>3-25-2021</u>	
Received <u>3-25-2021</u>	
Tested <u>4-6-2021</u>	
Tested By <u>KP</u>	

COMPACTION TESTING DATA ASTM D 1557-12 Method C Modified

	1	2	3	4	5	6
WM + WS	10658.0	10919.0	11031.0	10997.0		
WM	6504.0	6504.0	6504.0	6504.0		
WW + T #1	730.1	718.7	669.0	786.8		
WD + T #1	692.6	670.9	615.7	723.4		
TARE #1	147.1	149.6	161.5	228.7		
WW + T #2						
WD + T #2						
TARE #2						
MOIST.	6.9	9.2	11.7	12.8		
DRY DENS.	114.3	118.9	119.1	117.1		

SIEVE TEST RESULTS ASTM D-422 ASTM D-1140

Opening Size	% Passing	Specs.
1"	100	100
3/4"	99	95 - 100
3/8"	68	
#4	48	30 - 65
#8	31	25 - 55
#16	21	
#30	16	
#50	12	
#100	9	
#200	6.8	3.0 - 12

TEST RESULTS

Maximum dry density = 119.9 pcf
Optimum moisture = 10.6 %

Project No. 21-1-235 **Client:**
Project: Colorado Aggregate Recycling

○ **Location:** Import, South Yard **Sample Number:** 1217

Kumar & Associates, Inc.

Denver, Colorado

Material Description

Recycled Concrete/ Class 6 ABC/ poorly graded gravel with silt and sand

Remarks:

Checked by: _____ DS

Title: Lab Manager

Figure

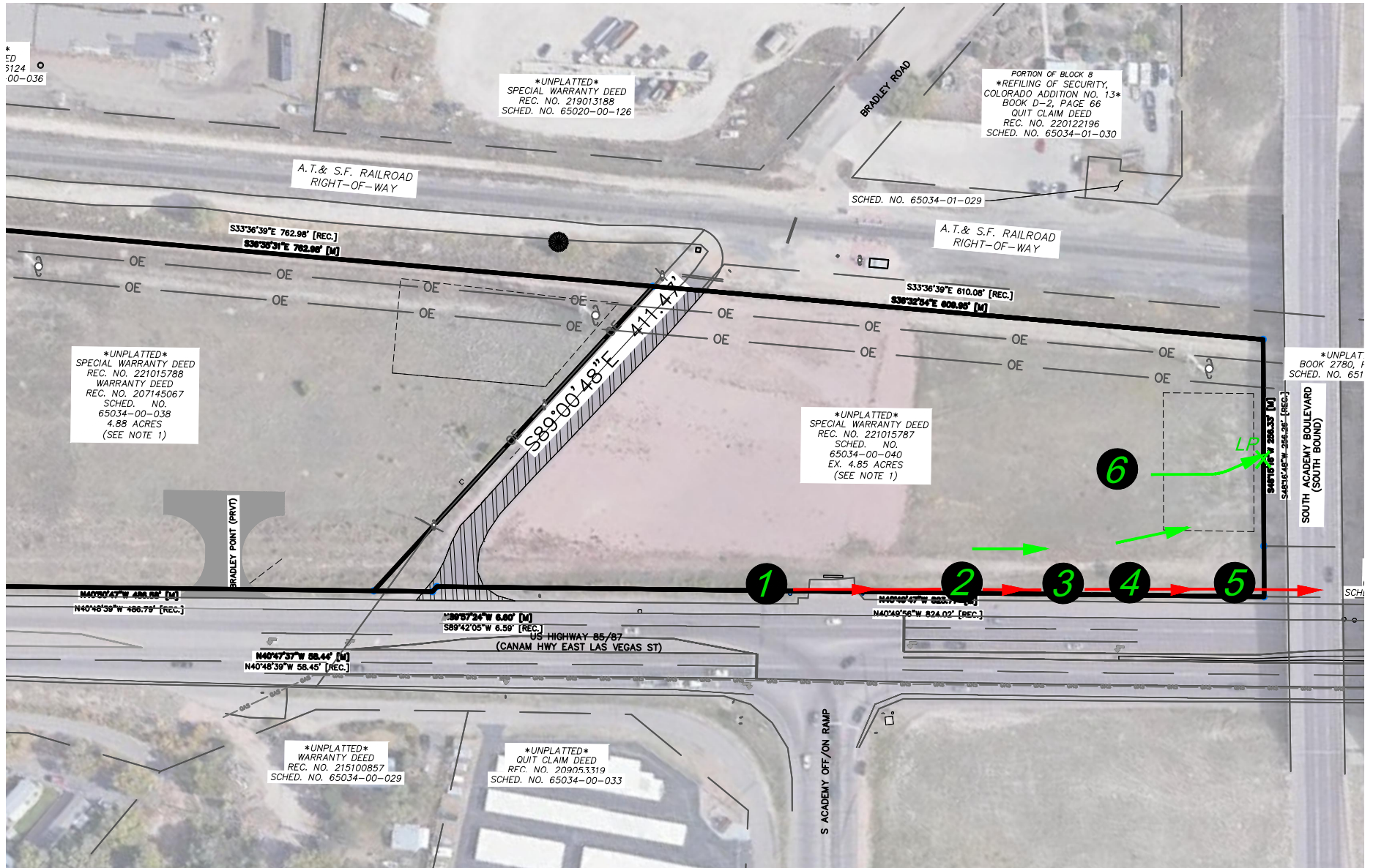
BRADLEY POINT FILING NO. 1
AGGREGATE BASE RUNOFF COEFFICIENT CALCULATION

		<i>PASSING #4 SIEVE</i>			<i>LARGER THAN #4 SIEVE</i>			<i>RUNOFF COEFFICIENT</i>	
ITEM	ITEM DESCRIPTION	PERCENT (%)	C₅	C₁₀₀	PERCENT (%)	C₅	C₁₀₀	C₅	C₁₀₀
3/4" Minus, CDOT CL6 Road Base	Recycled Concrete/ Class 6 ABC/ poorly graded gravel with silt and sand	0.48	0.09	0.36	0.52	0.59	0.70	0.35	0.54

Calculated by: CVW _____
Date: 5/5/2021



ROADSIDE DITCH CONVEYANCE EXHIBIT



ONSITE FLOWPATH



ROADSIDE DITCH FLOWPATH



PHOTO 1



PHOTO 2



PHOTO 3



PHOTO 4



PHOTO 2



PHOTO 6

SOILS INFILTRATION RATE REPORT



ENTECH
ENGINEERING, INC.

505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
PHONE (719) 531-5599
FAX (719) 531-5238

August 4, 2021
Revised October 19, 2021

Highway 85/87 Properties, LLC
2010 Fox Mountain Point
Colorado Springs, CO 80906

Attn: Steve Schnurr

Re: Infiltration Rates (Percolation Test Method)
Bradley Point, Filing No. 1
Parcel Nos. 65034-00-038 and 65034-00-040
Colorado Springs, Colorado

Dear Mr. Schnurr:

As requested, personnel of Entech Engineering, Inc. have performed percolation testing at the above referenced site to evaluate the site soils to determine the infiltration rate for the proposed detention ponds.

The testing was performed on July 22 and 26, 2021 and on August 20, 2021. The test locations are shown in Figure 1. The Test Boring Logs, Percolation Test results, Infiltration Rates, and Laboratory Test results are included with this report. Laboratory results are summarized in Table 1. Soils encountered in the profile and percolation holes consisted of clayey sand, clayey-silty sand, and silty sand. Very clean sand was encountered at 4 to 5 feet in the test pits. The percent passing the No. 200 sieve in the Test Pit Samples was 1.8 and 4.1 percent. Bedrock and groundwater were not encountered in the test borings which were drilled to 20 feet. Based on the soils encountered in the test borings, the pond locations tested will have good infiltration characteristics, if the granular soils are exposed. The test boring logs and laboratory testing (grain size) are included with this report.

Southern Pond

The percolation rates were 10 minutes/inch for P1 (TB-1A), and 3 minutes/inch for P2 (TB-1A). The percolation rates correspond to adjusted average Infiltration Rate of 1 inch/hour (TB-1A). An additional test pit (TP 2) was excavated to evaluate the sands and gravel encountered at depth. A percolation rate less than 1 min/in, which corresponds to an infiltration rate of 8.1 inches/hour was measured.

Northern Pond

The percolation rates were 8 minutes/inch for P3 (TB-2A), and 10 minutes/inch for P4 (TB-2A). The percolation rates correspond to adjusted average Infiltration Rate of 0.35 inches/hour (TB-2A). An additional test pit (TP 1) was excavated to evaluate the sands and gravel encountered at depth. A percolation rate less than 1 min/in, which corresponds to an infiltration rate of 8.1 inches/hour was measured in the field. TB 3 was drilled in the northern site. A percolation rate of 4 minutes/inch, which corresponds to an infiltration rate of 1.7 inches/hour was measured.

Results of the percolation testing/infiltration testing is included in this report. If the proposed detention ponds penetrate into the sand and gravels, infiltration rates of 8.0 inches/hour can be used. The pond excavation should be observed to verify that suitable soils are encountered. The pond surfaces will require periodic cleaning to maintain the high infiltration rates. The ponds should be installed to El Paso County standards/specifications.

Highway 85-87 Properties
Infiltration Rates (Percolation Test Method) - Revised
Bradley Point, Filing No. 1
Parcel Nos. 65034-00-038 and 65034-00-040
El Paso County, Colorado
Page 2

We trust that this has provided you with the information you required. If you have any questions or need additional information, please do not hesitate to contact us.

Respectfully Submitted,

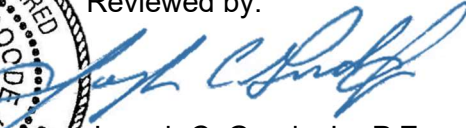
ENTECH ENGINEERING, INC.



Logan L. Langford, P.G.
Geologist



Reviewed by:



Joseph C. Goode Jr., P.E.
President

LLL

Encl.

Entech Job No. 210082

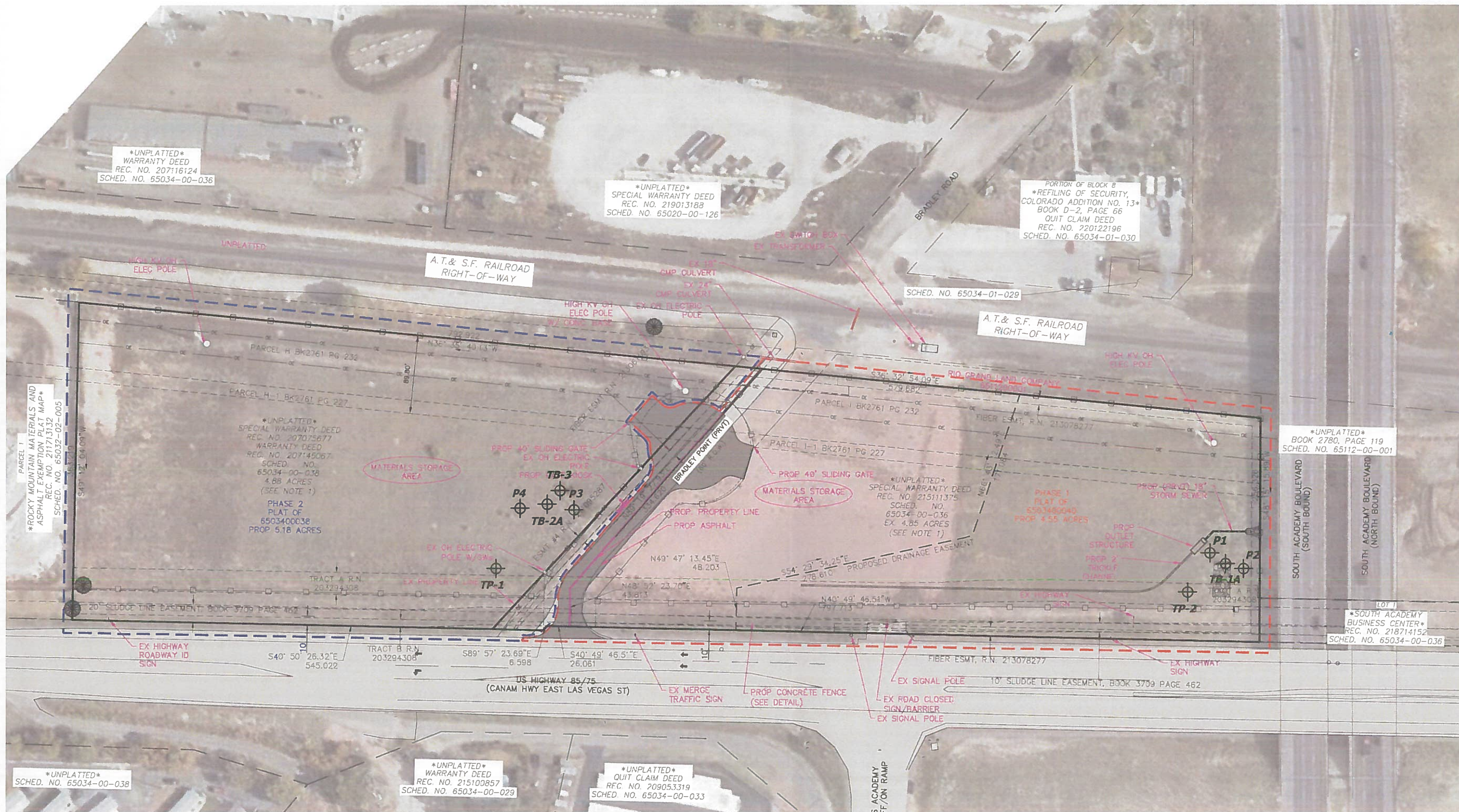
AAprojects/2021/210082 Infiltration Rate

TABLE 1

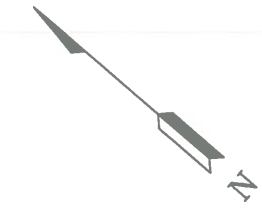
SUMMARY OF LABORATORY TEST RESULTS

CLIENT HIGHWAY 85/87 PROPERTIES
PROJECT BRADLEY POINT, FILING 1
JOB NO. 210082

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SULFATE (WT %)	FHA SWELL (PSF)	SWELL/ CONSOL (%)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION
1	1A	2-3			35.7	26	10	<0.01			SC	SAND, CLAYEY
1	2A	10			9.1						SM-SW	SAND, SLIGHTLY SILTY
1	TP-1	0-3			1.8						SW	SAND
1	TP-2	0-3			4.1						SW	SAND
1	P-1	2-3			36.4						SC	SAND, CLAYEY
1	P-2	2-3			20.2						SM	SAND, SILTY
1	P-3	2-3			9.0						SM-SW	SAND, SLIGHTLY SILTY
1	P-4	2-3			17.4						SM	SAND, SILTY



 TB- APPROXIMATE PROFILE HOLE LOCATION AND NUMBER



REVISION	BY

ENTTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907
(719) 531-5599



SITE PLAN/TEST BORING LOCATION MAP
BRADLEY POINT FILING NO. 1
COLORADO SPRINGS, CO
FOR: HIGHWAY 85/87 PROPERTIES, LLC

DRAWN LLI
CHECKED
DATE 10/19/21
SCALE AS SHOWN
JOB NO. 210082
FIGURE No. 1

INFILTRATION TESTING

Infiltration Rate (I) = Percolation Rate (P)/ Reduction Factor(RF)

I=P/RF

$R_f = [(2d_1 - \Delta d) / \text{dia}] + 1$

d_1 = initial water depth (in.)

Δd = final water level drop (in.)

dia = diameter of the percolation hole (in.)

Test No. TP-1 (21.6")

Perc Rate= 30 in/hr
dia = 8

P1

$d_1 = 21.6$
 $\Delta d = 21.6$
 $R_f = 3.7$

I = 8.108 in/hr

Test No. TP-2 (21.6")

Perc Rate= 30 in/hr
dia = 8

P2

$d_1 = 21.6$
 $\Delta d = 21.6$
 $R_f = 3.7$

I = 8.108 in/hr

Test No. TB-3 (106.8")

Perc Rate= 15 in/hr
dia = 8

P3

$d_1 = 25.2$
 $\Delta d = 8.4$
 $R_f = 6.3$

I = 2.400 in/hr

CLIENT HIGHWAY 85/87 PROPERTIES, LLC
PROJECT BRADLEY POINT FILING NO. 1
JOB NO. 210082



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COLORADO SPRINGS, COLORADO 80907

INFILTRATION TEST RESULTS

DRAWN:

DATE:

CHECKED:

DATE:

JOB NO.:

FIG NO.:

Infiltration Rate (I) = Percolation Rate (P)/ Reduction Factor(RF)

I=P/RF

$$R_f = [(2d_1 - \Delta d) / \text{dia}] + 1$$

d_1 = initial water depth (in.)

Δd = final water level drop (in.)

dia = diameter of the percolation hole (in.)

Test No. P1 (TB-1A) 5'4"

Perc Rate= 0.6 in/hr
dia = 8

P1

d_1 = 35.0
 Δd = 7.0
 R_f = 8.9

Test No. P2 (TB-1A) 8'3"

Perc Rate= 20 in/hr
dia = 8

P2

d_1 = 46.0
 Δd = 20.0
 R_f = 10.0

I = 0.068 in/hr

I = 2.000 in/hr

TB-1A I AVG= 1.034 in/hr

Test No. P3 (TB-2A) 8'5"

Perc Rate= 1.8182 in/hr
dia = 8

P3

d_1 = 26.0
 Δd = 18.0
 R_f = 5.3

Test No. P4 (TB-2A) 5'4"

Perc Rate= 6 in/hr
dia = 8

P3

d_1 = 73.0
 Δd = 17.0
 R_f = 17.1

I = 0.346 in/hr

I = 0.350 in/hr

TB-2A I AVG= 0.348 in/hr

CLIENT HIGHWAY 85/87 PROPERTIES, LLC
PROJECT BRADLEY POINT FILING NO. 1
JOB NO. 210082



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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

INFILTRATION TEST RESULTS

DRAWN:

DATE:

CHECKED:
LLL

DATE:
8/2/21

JOB NO.:

210082

FIG NO.:

Client: Highway 85/87 Properties
Test Location: Bradley Point, Detention Pond

Job Number: 210082

PERCOLATION HOLES

Date Holes Prepared: 7/22/2021

Date Hole Completed: 7/22/2021

Hole No. 1

Depth: 64"

<u>Trial</u>	<u>Time (min.)</u>	<u>Water Level Change (in.)</u>
1	10	1
2	10	1
3	10	1

Hole No. 2

Depth: 99"

<u>Trial</u>	<u>Time (min.)</u>	<u>Water Level Change (in.)</u>
1	10	6
2	10	2
3	10	4

Perc Rate (min./in.): 10

Perc Rate (min./in.): 3

Hole No. 3

Depth: 101"

<u>Trial</u>	<u>Time (min.)</u>	<u>Water Level Change (in.)</u>
1	10	2 1/2
2	10	1 1/5
3	10	1 1/5

Hole No. 4

Depth: 64"

<u>Trial</u>	<u>Time (min.)</u>	<u>Water Level Change (in.)</u>
1	10	1
2	10	1
3	10	1

Perc Rate (min./in.): 8

Perc Rate (min./in.): 10

Average Perc Rate (min./in.) 8



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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

PERCOLATION TEST RESULTS

DRAWN:

DATE:

CHECKED:

DATE:

JOB NO.:

FIG NO.:

Client: Highway 85/87 Propertires, LLC
Test Location: Bradley Point Filing No. 1

Job Number: 210082

PERCOLATION HOLES

Date Holes Prepared: 8/20/2021

Date Hole Completed: 8/20/2021

Hole No. TP-1
Depth: 21.6"

Hole No. TP-2
Depth: 21.6"

Hole No. TB-3
Depth: 106.8"

<u>Trial</u>	<u>Time (min.)</u>	<u>Water Level Change (in.)</u>
1	5	>5
2	5	>5
3	5	>5

<u>Trial</u>	<u>Time (min.)</u>	<u>Water Level Change (in.)</u>
1	5	>5
2	5	>5
3	5	>5

<u>Trial</u>	<u>Time (min.)</u>	<u>Water Level Change (in.)</u>
1	5	3 3/5
2	5	2 2/5
3	5	1 1/5

Perc Rate (min./in.): <1

Perc Rate (min./in.): <1

Perc Rate (min./in.): 4



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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

PERCOLATION TEST RESULTS

DRAWN:

DATE:

CHECKED:

DATE:

JOB NO.:

FIG NO.:

**TEST BORING LOGS AND
LABORATORY TESTING**

TEST BORING NO. 1 A
 DATE DRILLED 7/16/2021
 Job # 210082

TEST BORING NO. 2 A
 DATE DRILLED 7/16/2021
 CLIENT HIGHWAY 85/87 PROPERTIES
 LOCATION BRADLEY POINT, FILING 1

REMARKS

DRY TO 20', 7/16/21

SAND, CLAYEY, FINE TO MEDIUM GRAINED, TAN, MEDIUM DENSE, MOIST

SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, DRY TO MOIST

* - BULK SAMPLE TAKEN

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5			25	5.3	1
5			27	1.3	1
10			*	1.8	1
15			*	2.6	1
20			*	4.3	1

REMARKS

DRY TO 20', 7/16/21

SAND, SILTY, CLAYEY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST

SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, DRY TO MOIST

* - BULK SAMPLE TAKEN

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5			29	5.8	2
5			25	1.3	2
10			*	2.0	2
15			*	3.1	2
20			*	3.8	2



ENTECH
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505 ELKTON DRIVE
 COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:

DATE:

CHECKED: *h*

DATE:

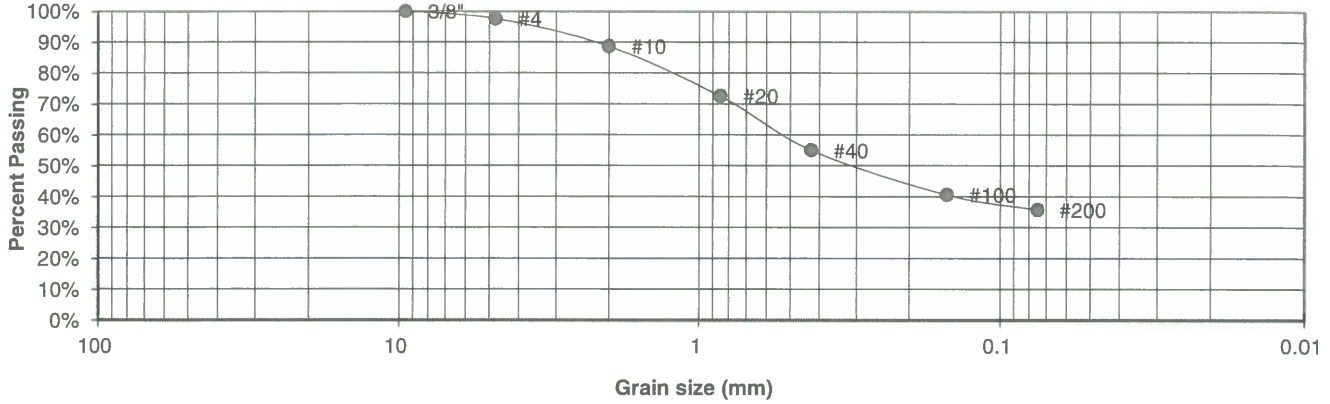
7/23/21

JOB NO.:
 210082

FIG NO.:

<u>UNIFIED CLASSIFICATION</u>	SC	<u>CLIENT</u>	HIGHWAY 85/87 PROPERTIES
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	BRADLEY POINT, FILING 1
<u>TEST BORING #</u>	1A	<u>JOB NO.</u>	210082
<u>DEPTH (FT)</u>	2-3	<u>TEST BY</u>	BL

**Sieve Analysis
Grain Size Distribution**



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	97.5%
10	88.6%
20	72.5%
40	54.9%
100	40.5%
200	35.7%

<u>Atterberg Limits</u>	
Plastic Limit	16
Liquid Limit	26
Plastic Index	10

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

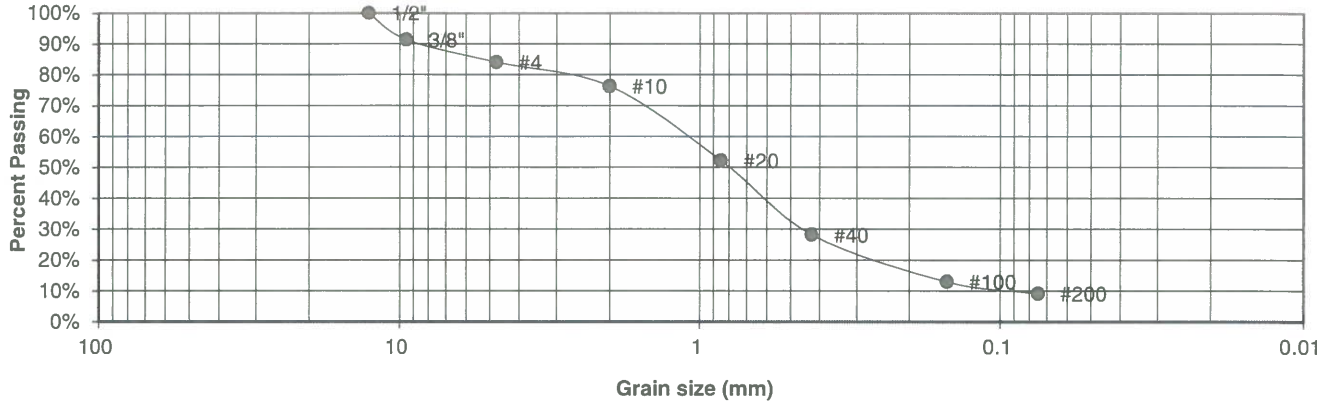
DRAWN:	DATE:	CHECKED: <i>h</i>	DATE: 7/23/21
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JOB NO.:
210082

FIG NO.:

<u>UNIFIED CLASSIFICATION</u>	SM-SW	<u>CLIENT</u>	HIGHWAY 85/87 PROPERTIES
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	BRADLEY POINT, FILING 1
<u>TEST BORING #</u>	2A	<u>JOB NO.</u>	210082
<u>DEPTH (FT)</u>	10	<u>TEST BY</u>	BL

**Sieve Analysis
Grain Size Distribution**



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	91.3%
4	84.0%
10	76.3%
20	52.2%
40	28.2%
100	12.9%
200	9.1%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

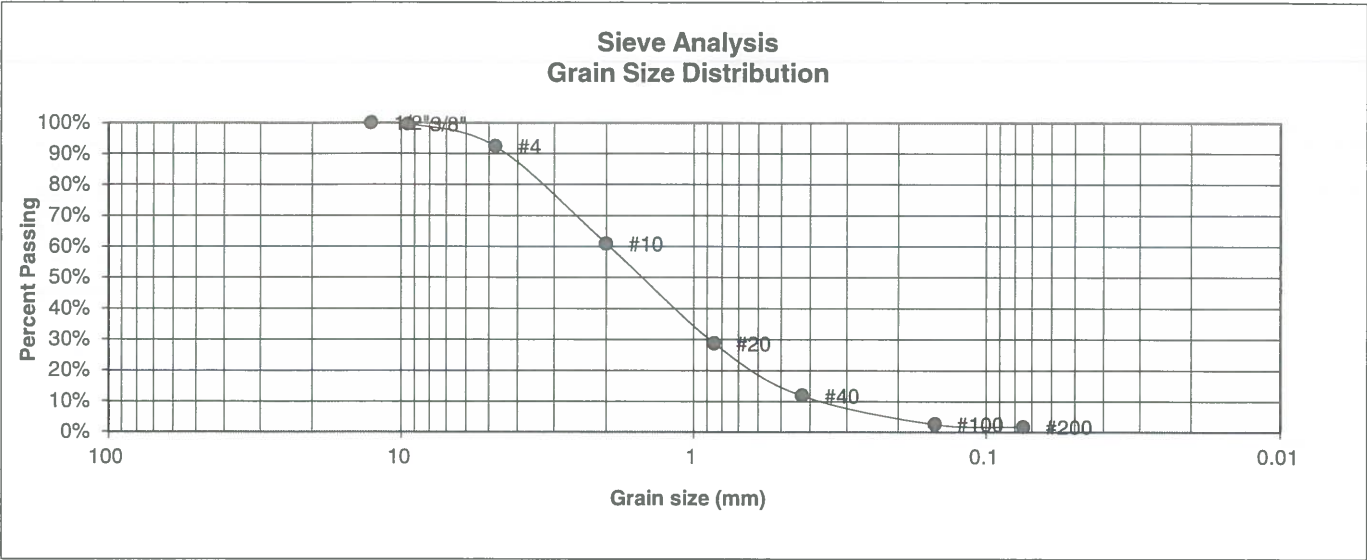
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>h</i>	DATE: 7/23/21
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JOB NO.:
210082

FIG NO.:

BORING NO.	TP-1	<u>UNIFIED CLASSIFICATION</u>	SW	<u>TEST BY</u>	BL
DEPTH(ft)	GRAB	<u>AASHTO CLASSIFICATION</u>		<u>JOB NO.</u>	210082
CLIENT	HIGHWAY 85/87 PROPERTIES				
PROJECT	BRADLEY POINT, FILING 1				



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	99.6%
4	92.3%
10	60.9%
20	28.7%
40	11.9%
100	2.6%
200	1.8%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



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COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

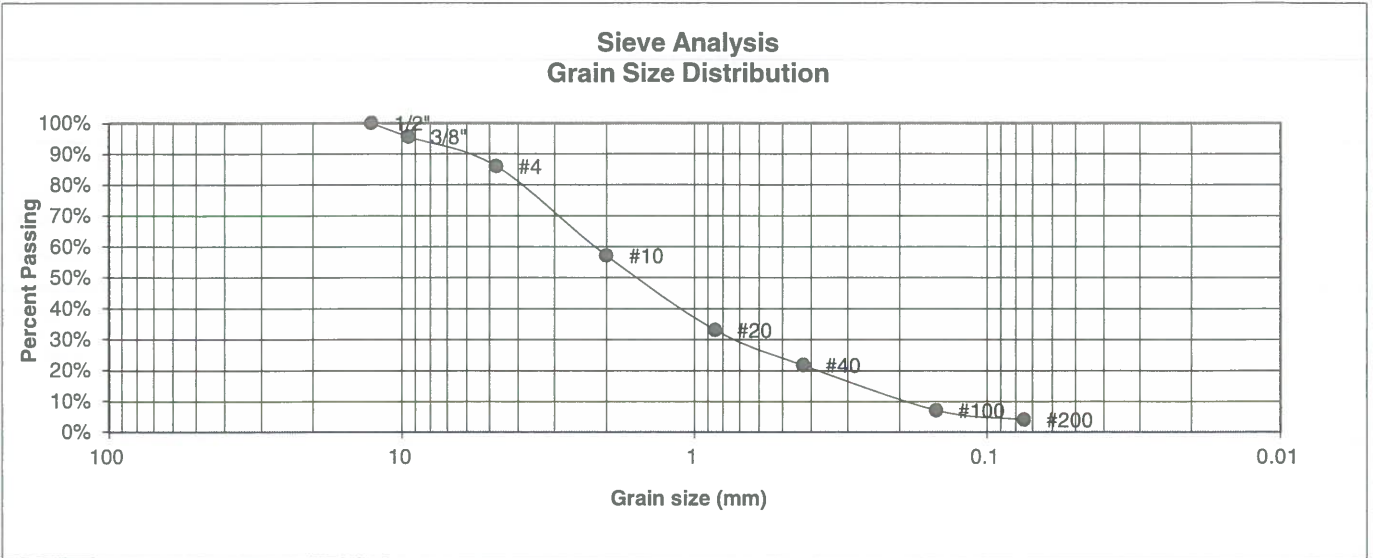
CHECKED:

DATE:

JOB NO.:
210082

FIG NO.:

BORING NO.	TP-2	UNIFIED CLASSIFICATION	SW	TEST BY	BL
DEPTH(ft)	GRAB	AASHTO CLASSIFICATION		JOB NO.	210082
CLIENT	HIGHWAY 85/87 PROPERTIES				
PROJECT	BRADLEY POINT, FILING 1				



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	95.5%
4	86.0%
10	57.1%
20	33.1%
40	21.8%
100	7.2%
200	4.1%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

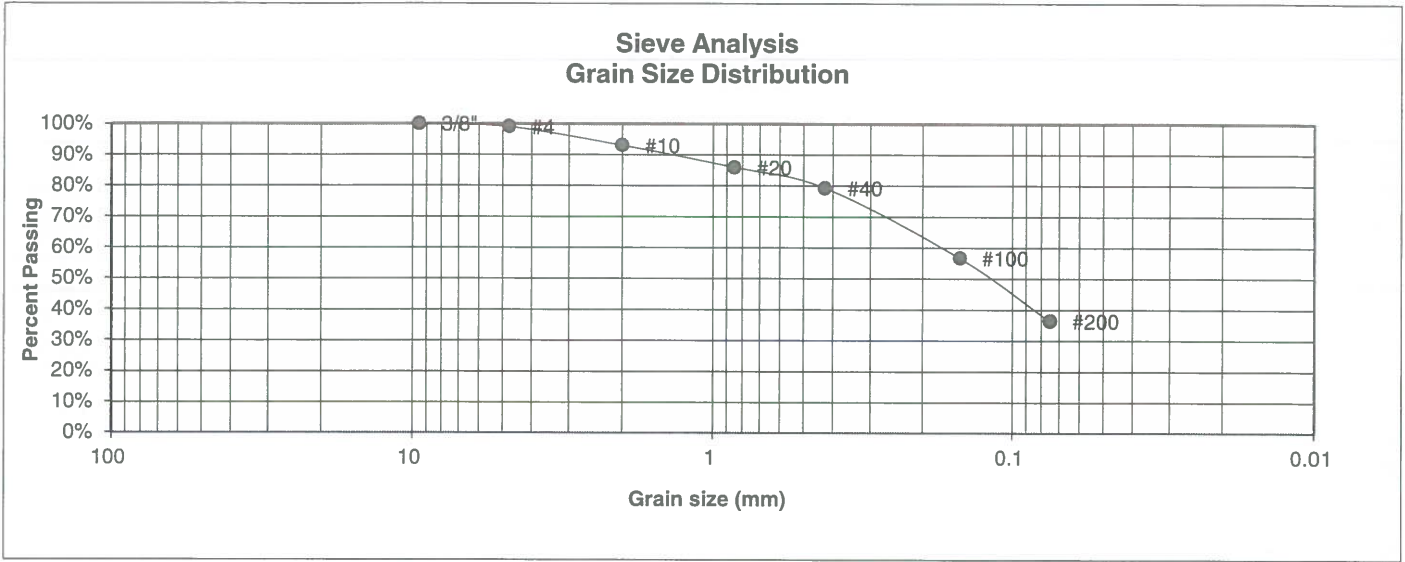
CHECKED:

DATE:

JOB NO.:
210082

FIG NO.:

<u>UNIFIED CLASSIFICATION</u>	SC	<u>CLIENT</u>	HIGHWAY 85/87 PROPERTIES
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	BRADLEY POINT, FILING 1
<u>TEST BORING #</u>	P-1	<u>JOB NO.</u>	210082
<u>DEPTH (FT)</u>	2-3	<u>TEST BY</u>	BL



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.0%
10	93.0%
20	85.9%
40	79.3%
100	56.7%
200	36.4%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



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ENGINEERING, INC.**

505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

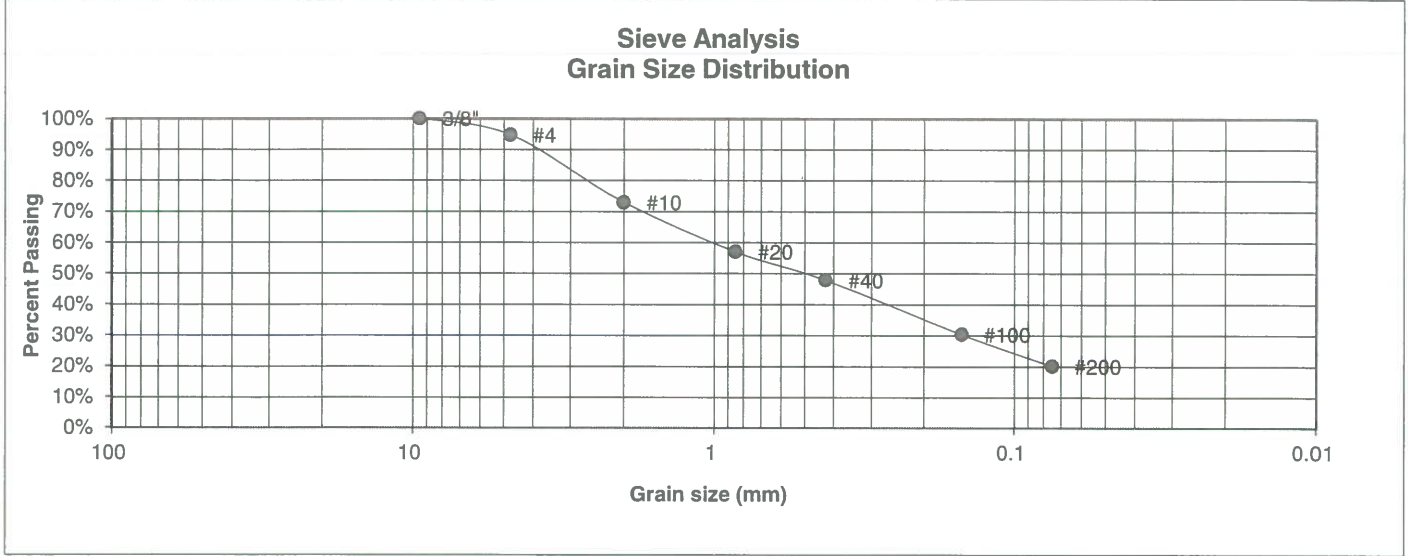
CHECKED:

DATE:

JOB NO.:
210082

FIG NO.:

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	HIGHWAY 85/87 PROPERTIES
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	BRADLEY POINT, FILING 1
<u>TEST BORING #</u>	P-2	<u>JOB NO.</u>	210082
<u>DEPTH (FT)</u>	2-3	<u>TEST BY</u>	BL



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	94.8%
10	72.9%
20	57.0%
40	47.9%
100	30.3%
200	20.2%

- Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index
- Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



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 505 ELKTON DRIVE
 COLORADO SPRINGS, COLORADO 80907

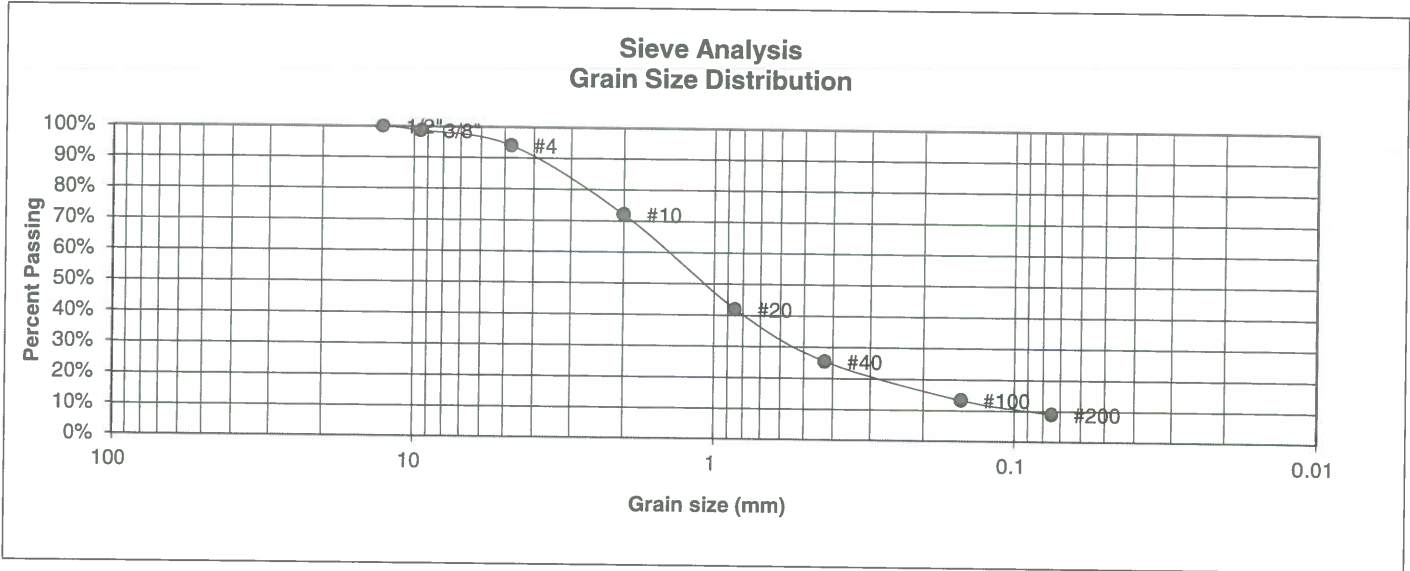
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED:	DATE:
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JOB NO.:
210082

FIG NO.:

UNIFIED CLASSIFICATION	SM-SW	CLIENT	HIGHWAY 85/87 PROPERTIES
SOIL TYPE #	1	PROJECT	BRADLEY POINT, FILING 1
TEST BORING #	P-3	JOB NO.	210082
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	98.6%
4	94.0%
10	72.1%
20	41.9%
40	25.4%
100	13.4%
200	9.0%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



**ENTECH
ENGINEERING, INC.**

505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

CHECKED:

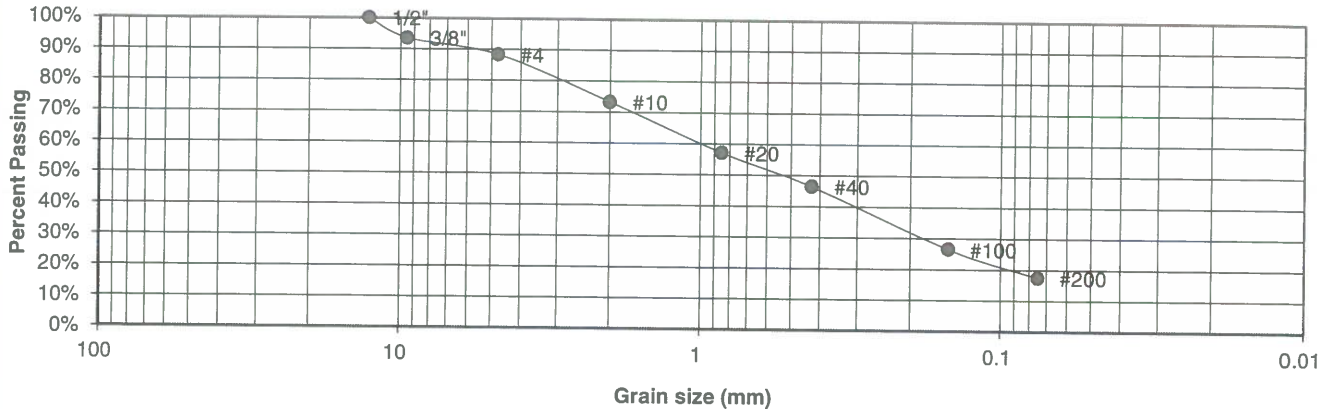
DATE:

JOB NO.:
210082

FIG NO.:

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	HIGHWAY 85/87 PROPERTIES
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	BRADLEY POINT, FILING 1
<u>TEST BORING #</u>	P-4	<u>JOB NO.</u>	210082
<u>DEPTH (FT)</u>	2-3	<u>TEST BY</u>	BL

**Sieve Analysis
Grain Size Distribution**



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	93.5%
4	88.3%
10	73.2%
20	57.1%
40	46.5%
100	26.5%
200	17.4%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



**ENTECH
ENGINEERING, INC.**

505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

CHECKED:

DATE:

JOB NO.:
210082

FIG NO.:

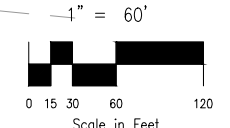
EXISTING DRAINAGE MAP

BRADLEY POINT FILING NO. 1 - EXISTING DRAINAGE MAP

AP NO. 65034-00-038 AND AP NO. 65034-00-040 ON HIGHWAY 85/87 (EAST LAS VEGAS STREET)
IN SECTION 3, T15S R66W, 6th P.M., EL PASO COUNTY, COLORADO

LEGEND

- BASIN DESIGNATION: A, C5, C100
- ACRES: 0.07, 0.90, 0.95
- 5: SURFACE DESIGN POINT
- : BASIN BOUNDARY
- - - (7070): EXIST MAJ CONT (5')
- - - (7072): EXIST MIN CONT (1')
- : EX OR EXIST
- : EXISTING
- : ADJ. PROPERTY BOUNDARY
- OE: OVERHEAD ELECTRIC
- : EXISTING FLOW DIRECTION ARROW
- ⊙: EXISTING TREE

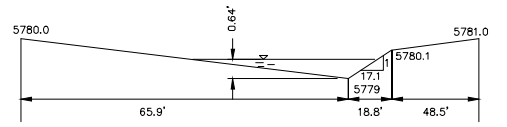
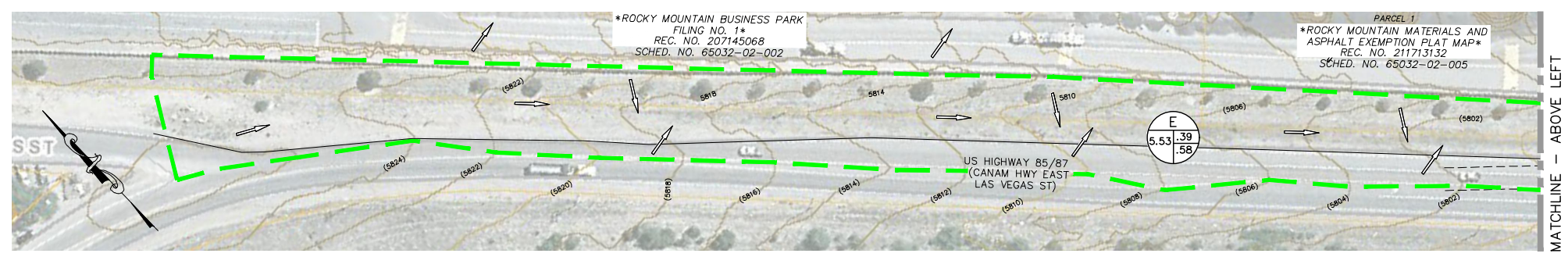
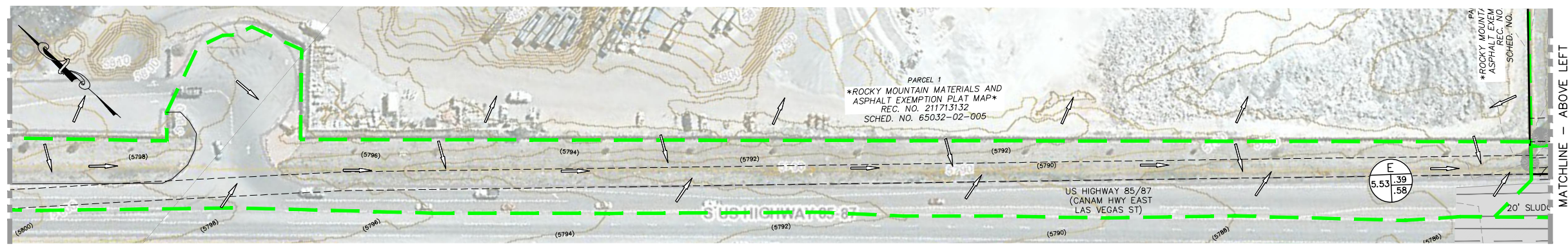
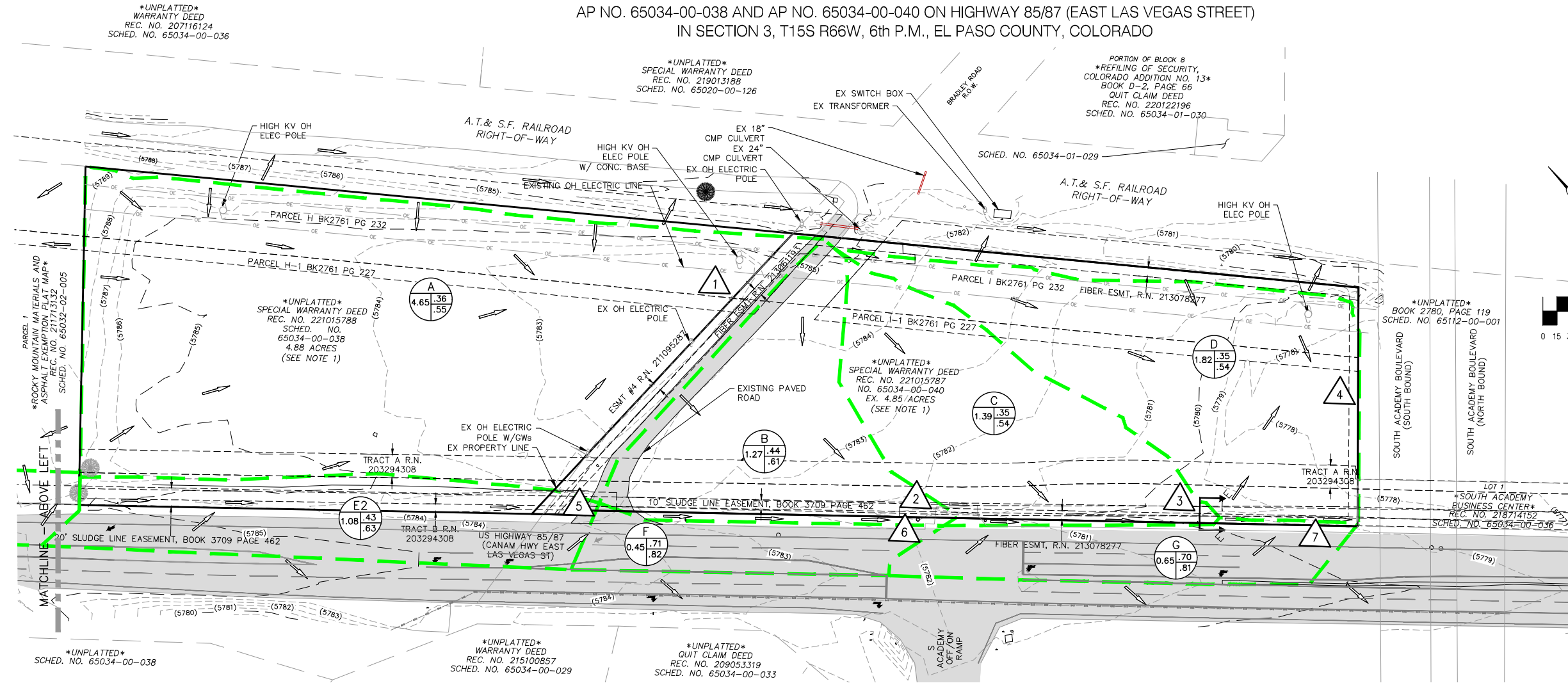


BASIN	AREA (ACRES)	Q _s	Q ₁₀₀
A	4.65	4.6	11.8
B	1.27	1.9	4.5
C	1.39	1.6	4.0
D	1.82	1.9	5.0
E	5.53	4.1	10.3
E2	1.08	1.4	3.3
F	0.45	1.4	2.6
G	0.65	1.7	3.4

DESIGN POINT	Q _s	Q ₁₀₀	CONTRIBUTING BASIN / DESIGN POINT	STRUCTURE
1	4.6	11.8	A	LOCALIZED DEPRESSION
2	1.7	3.9	B, DP 1	EXISTS TO ROADSIDE DITCH
3	1.6	4.0	C	EXISTS TO ROADSIDE DITCH
4	1.9	5.0	D	LOCALIZED DEPRESSION
5	4.4	10.8	E, E2	EXISTING ROADSIDE DITCH
6	5.9	13.9	F, DP 2, DP 5	EXISTING ROADSIDE DITCH
7	7.4	17.5	G, DP 3, DP 6	EXISTING ROADSIDE DITCH

BRADLEY POINT FILING NO. 1
EXISTING DRAINAGE MAP
DATE SUBMITTED: 08/21/23
SHEET 1 OF 1

NOTE 1:
PARCELS ARE UNDER THE SAME OWNERSHIP



CROSS SECTION E-E
N.T.S.
Q100=32.7 CFS, S=0.007 FT./FT.
V=1.91 FT/SEC, D=7.7 INCHES

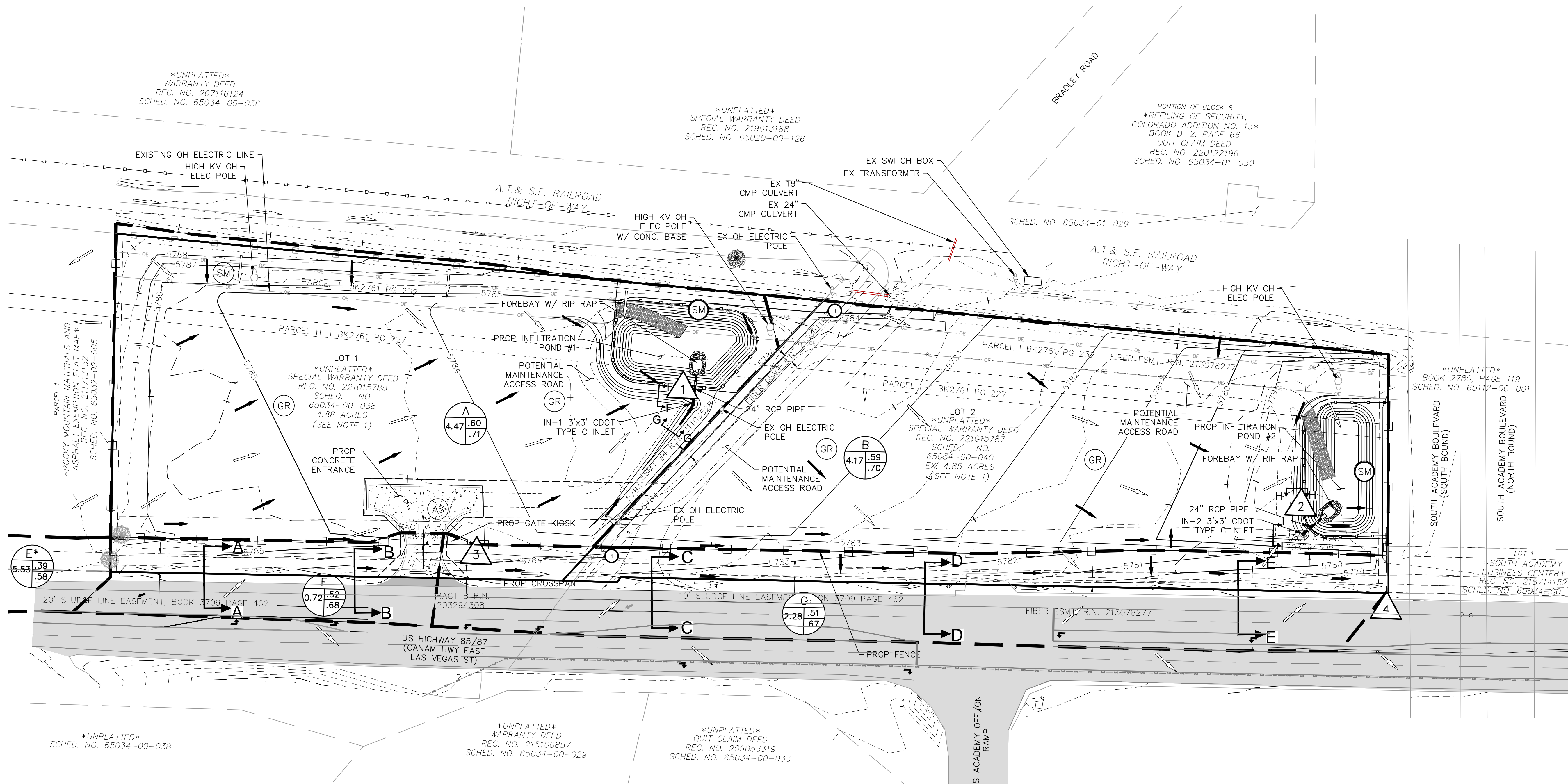


212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

PROPOSED DRAINAGE MAP

BRADLEY POINT FILING NO. 1 - PROPOSED DRAINAGE MAP

AP NO. 65034-00-038 AND AP NO. 65034-00-040 ON HIGHWAY 85/87 (EAST LAS VEGAS STREET)
IN SECTION 3, T15S R66W, 6th P.M., EL PASO COUNTY, COLORADO



LEGEND

- BASIN DESIGNATION: 661L (0.07, 90, 95) C5, C100
- ACRES: 4
- PIPE RUN REFERENCE LABEL: 5
- SURFACE DESIGN POINT
- BASIN BOUNDARY
- 100 YEAR FLOOD BOUNDARY
- PROP MAJ CONT: 7070
- PROP MIN CONT: 7072
- EXIST MAJ CONT: (7070)
- EXIST MIN CONT: (7072)
- EX OR EXIST: EXISTING
- FUT: FUTURE
- PROP: PROPOSED
- ADJ. PROPERTY BOUNDARY
- OE: OVERHEAD ELECTRIC
- PROPOSED STORM SEWER PIPE
- PROP CONCRETE FENCE
- EMERGENCY OVERFLOW DIRECTION
- PROPOSED RIPRAP
- MAINTENANCE/ACCESS ROAD (BELOW 100 YR)
- EXISTING FLOW DIRECTION ARROW
- PROPOSED FLOW DIRECTION ARROW
- ACCESS TO BE REMOVED AND NOT TO BE USED DURING CONSTRUCTION
- GR: GRAVEL
- SM: SEEDING/MULCHING
- AS: ASPHALT

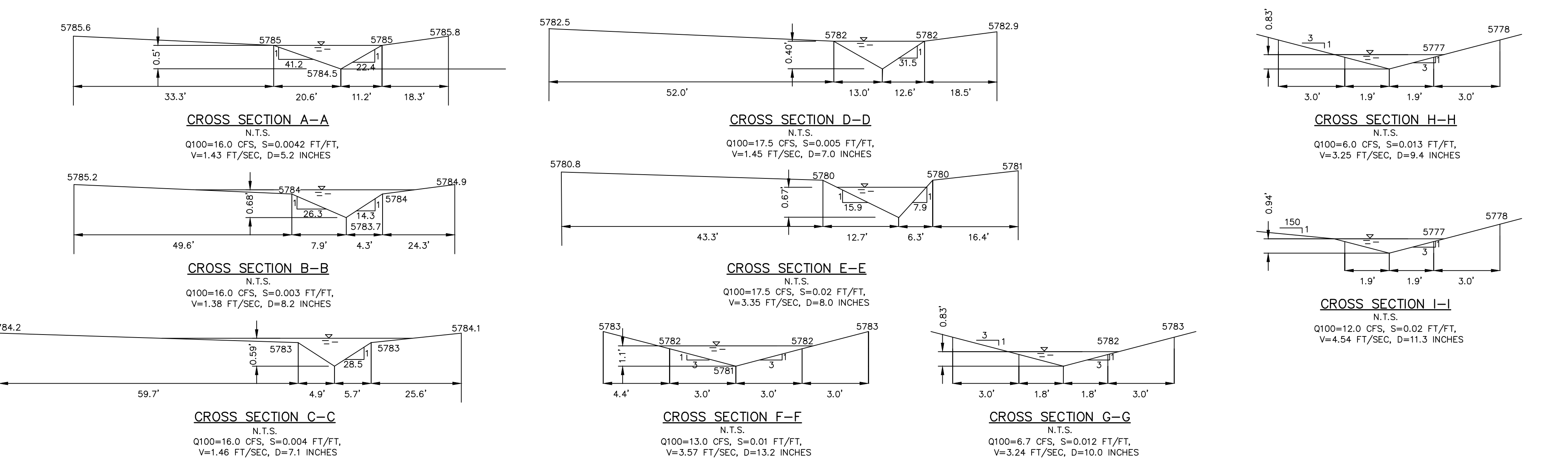
BASIN SUMMARY

BASIN	AREA (ACRES)	Q ₅	Q ₁₀₀
A	4.47	9.9	19.7
B	4.17	9.0	18.0
E	5.53	6.5	16.2
F	0.72	1.4	3.0
G	2.28	4.0	8.8

DESIGN POINT SUMMARY

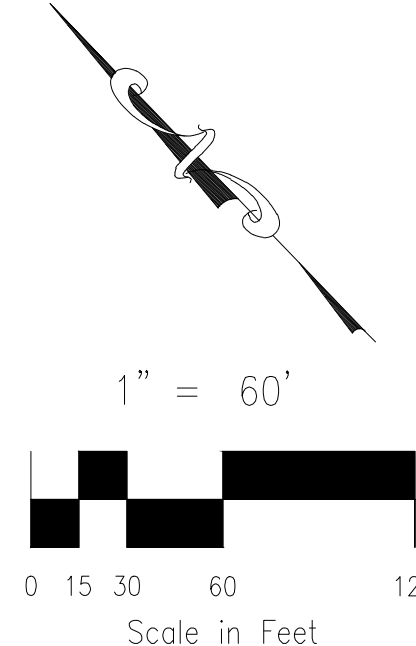
DESIGN POINT	Q ₅	Q ₁₀₀	BASIN	STRUCTURE
1	9.9	19.7	A	PROPOSED INLET 1
2	9.0	18.0	B	PROPOSED INLET 2
3	6.6	16.0	E, F	ROADSIDE DITCH
4	7.4	17.5	G, DP. 3	ROADSIDE DITCH

BRADLEY POINT FILING NO. 1
PROPOSED DRAINAGE MAP
DATE SUBMITTED: 04/20/23 SHEET 1 OF 1



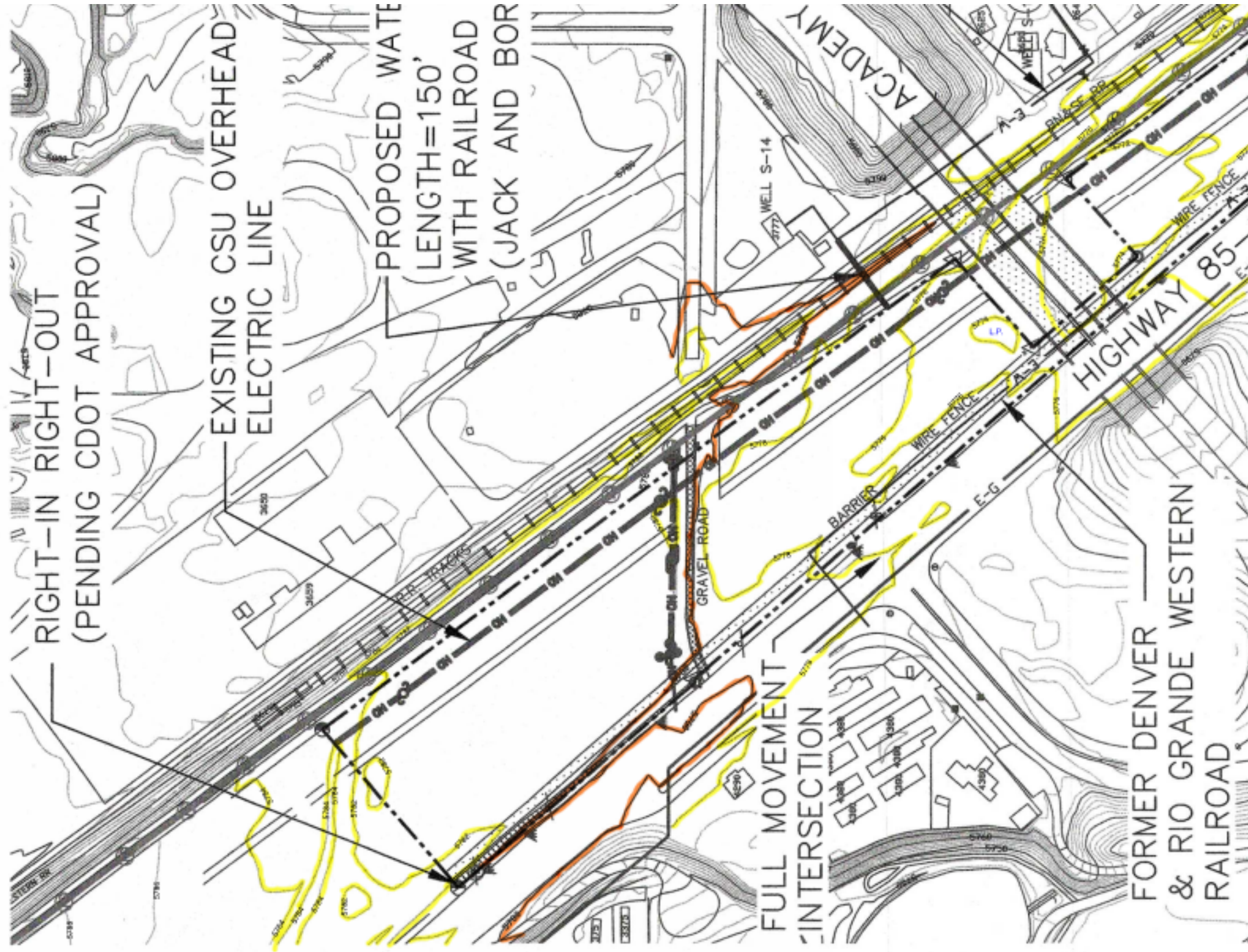
NOTES:

- PARCELS ARE UNDER THE SAME OWNERSHIP.
- * REFER TO OFFSITE BASIN E IN EXISTING CONDITIONS
- FENCES AND SIGNAGE ADDED TO PREVENT ON-SITE, STORED MATERIALS FROM ENTERING THE PONDS.
- EROSION CONTROL BLANKET SHALL BE USED ON SLOPES GREATER THAN 4:1.



File: C:\00344 SOUTH PLANT 85-87\Drainage\Proposed Drainage Map.dwg Plotstamp: 9/5/2023 6:26 PM

BACKGROUND INFORMATION



EXERPT OF US HIGHWAY 85 – SITE UTILITY MAP, BY MATRIX DESIGN GROUP, JUNE 2005