Galloway
Planning. Architecture. Engineering.

Final Drainage Report
for
SEC of Marksheffel Rd. & Constitution Ave.

Located in the N ½ of the NW ¼ of Section 4, Township 14 South, Range 65 West, of the 6th Principal Meridian, El Paso County, State of Colorado

Date: July 20, 2015
Revised: September 14, 2015

Prepared for:

Evergreen Devco, Inc..
2390 East Camelback Road, Suite 410
Phoenix, Arizona 85016

Prepared by:

Galloway & Company, Inc.
6162 S. Willow Drive, Suite 320
Greenwood Village, CO 80111
Phone (303) 770-8884
Fax (303) 770-3636
Attn: Gary Iwata, P.E.

•Per DCM section 4.5, a "Letter Type" drainage report is required for a replat of property for which a complete drainage report has previously been approved by the County Engineer and significant changes from such report is not proposed.
•Add "PCD File No. VR-18-011" to new drainage letter

ENGINEER'S STATEMENT

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

_____ _____

Gary Iwata, P.E. #37642 Date

Galloway & Company

DEVELOPER'S STATEMENT

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

Evergreen Devco, Inc.

Business Name

By: _____

Tite: _____

Address: 2390 East Camelback Road, Suite 410

Phoenix, Arizona 85016

EL PASO COUNTY

Filed in accordance with Section 51.1 of the El Paso Land Development Code, as amended.

_____ _____

County Engineer/Director Date

Conditions:

Table of Contents

I. General Location and Description

This Final Drainage Report has been prepared by Galloway & Company, Inc. for Evergreen Devco, Inc., the developer of the site, to fulfill the drainage requirements of El Paso County, Colorado. The purpose of the report is to analyze and quantify expected development runoff from the proposed development, and to exhibit conformance with the proposed development of previous studies.

Location

The site is located in El Paso County, Colorado. The site is at the Southeast corner of Marksheffel Road and Constitution Avenue. The site lies within the North 1/2 of the Northwest ¼ of Section 4, Township 14 South, Range 65 West, of the 6th Principal Meridian.

The property is vacant and roughly rectangular in shape and is located at the southeast corner of Marksheffel Rd. and Constitution Ave. The north side of the site fronts Constitution Avenue, the east side of the side is bound by an existing drainage channel (East Fork Sub Tributary of Sand Creek), south side of the site is bound by Claremont Ranch Filing No. 8 single-family subdivision, and the west side of the site is bound by Marksheffel Rd..

Description of Property

The project site consists of 23.5 acres that is generally covered in native grasses. The site slopes generally 2-3% from the north to the south.

According to the NRCA National Cooperative Soil Survey – Web Soil Survey the development area consists mostly of Blendon Sandy Loam with some Ellicott Loamy coarse Sand which are hydrologic soil group B and A respectively. Since the site is mostly comprised of Group B soils the hydrologic calculations will be based upon Group

B. Group B soils are defined as having moderate infiltration rates when thoroughly wet and having a moderate rate of water transmission.

Improvements on the site include existing waterlines within a 50 easement on the western portion of the site paralleling Marksheffel Road, and dry utilities fronting Constitution Ave. In the eastern portion of the site a 15" sanitary sewer runs north and south within a 30' Cherokee Water and Sanitation District Easement. There are no known existing irrigation facility encumbrances on the project site.

II. Drainage Basins and Sub-Basins

Major Basin Descriptions

Existing Basins

The site falls within the East Fork of Sand Creek drainage basin and is adjacent to the East Fork Sub Tributary of Sand Creek. The site currently drains from the north to the south and then to the west along the property line, ultimately discharging into a 36" RCP stub provided by Claremont Ranch Filing No. 8.. The existing 36" RCP is routed through Claremont and ultimately discharges into the East Fork of Sand Creek.

The project resides within Basins M1, K-1 and L-1 of the approved *Final Master Development Drainage Plan (MDDP) for the Claremont Ranch (East) and Claremont Ranch West* (ref 5). Based upon the MDDP the proposed project meets the planned commercial/industrial land use. Although the MDDP states that developments are not required to provide onsite detention, El Paso County is requiring onsite water quality treatment via EURV detention ponds.

Proposed Major Basins

The site will consist of four major basins (Basin A, B, C, D) that drains to two proposed on-site private EURV Detention Ponds. All four major basins are comprised mostly of

parking, curb and gutter, landscaping, and the building roof. The proposed private storm sewer systems will capture flows within onsite inlets and convey runoff for the 100-year storm event. Developed flows are routed to the onsite private EURV water quality ponds / detention ponds. One pond is located in the southeast corner of the site adjacent to East Fork Sub Tributary of Sand Creek and the second pond is located at the southwest portion of the site. Flows from the southeast pond are released into East Fork Sub Tributary of Sand Creek. Flows from the southwest pond are released into the 36" RCP stub provided by Claremont Filing 8. There are some flows (described in the sub-basin section below) that sheet flow offsite into Marksheffel Rd. but are less than the designed flows. Per the approved MDDP, Marksheffel Road was designed to accommodate undetained developed flows from the site. Developed flows of 5.3 cfs and 9.7 cfs in the 5-year and 100-year storm event, respectfully, can be discharged into Marksheffel Road.

FEMA FIRM Information

The Federal Emergency Management Agency's Flood Insurance Rate Map (FIRM) for El Paso County, Colorado and Incorporated Areas, Map Number 08041C0756 F, dated March 17, 1997 Revised to Reflect LOMAR dated December 29, 2004 indicates the project site to be in Zone X – "Areas determined to be outside 500-year floodplain."

Sub-basin Description

Major Basin A is broken into seven smaller sub-basins (sub-basins A-1 to A-3), each draining to a specific inlet or design point.

Basin A-1 is approximately 1.73 acres that is located just north of the proposed King Soopers grocer. The majority of the basin is comprised of parking and landscaping. Drainage from Basin A-1 sheet flows to a Type-C area inlet located in a sump condition (Inlet 1A; Design Point 1). Flows collected in the inlet will be conveyed to the proposed

southeast detention pond via proposed storm sewer system. Basin A-1 contributes approximately 7.2 cfs and 13.4 cfs in the 5-year and 100-year storm event, respectfully.

Basin A-2 is approximately 2.39 acres that is located just north of the proposed King Soopers grocer. The majority of the basin is comprised of parking, and landscaping. Drainage from Basin A-2 sheet flows to a Type-C area inlet located in a sump condition (Inlet 1B; Design Point 2). Flows collected in the inlet will be conveyed to the proposed southeast detention pond via proposed storm sewer system. Basin A-2 contributes approximately 9.8 cfs and 18.2 cfs in the 5-year and 100-year storm event, respectfully.

Basin A-3 is approximately 2.16 acres that is located just north of the proposed King Soopers grocer. The majority of the basin is comprised of parking but also includes the northeast entrance drive, landscaping, and a portion of the fueling station. Drainage from Basin A-3 sheet flows to a Type-C area inlet located in a sump condition (Inlet A3; Design Point 3). Flows collected in the inlet will be conveyed to the proposed southeast detention pond via proposed storm sewer system. Basin A-3 contributes approximately 8.7 cfs and 16.3 cfs in the 5-year and 100-year storm event, respectfully.

Major Basin B is broken into four smaller sub-basins (sub-basins B-1 to B-4), each draining to a specific inlet or design point

Basin B-1 is approximately 0.11 acres that is located on the south side of the site, just behind King Soopers. It is comprised of the west loading dock area. Basin B-1 conveys developed flows via sheet flow and curb and gutter to an area inlet (Inlet 2A1; Design Point 5). Peak flows from Basin B-1 are approximately 0.5 cfs and 0.9 cfs in the 5-year and 100-year storm event, respectfully, that ultimately drain to the southeast detention pond.

Basin B-2 is approximately 0.97 acres that comprises the central portion of the King Soopers' roof. Basin B-2 conveys developed flows via roof drain system to the

proposed storm sewer system south of the building (Design Point 6). Peak flows from Basin B-2 are approximately 3.58 cfs and 6.66 cfs in the 5-year and 100-year storm event, respectfully, that ultimately drain to the southeast detention pond.

Basin B-3 is approximately 0.88 acres that comprises the eastern portion of the King Soopers' roof. Basin B-3 conveys developed flows via roof drain system to the proposed storm sewer system south of the building (Design Point 7). Peak flows from Basin B-3 are approximately 3.2 cfs and 6.0 cfs in the 5-year and 100-year storm event, respectfully, that ultimately drain to the southeast detention pond.

Basin B-4 is approximately 0.11 acres that is located on the south side of the site, just behind King Soopers. It is comprised of the east loading dock area. Basin B-4 conveys developed flows via sheet flow and curb and gutter to an area inlet (Inlet 2B1; Design Point 8). Peak flows from Basin B-4 are approximately 0.5 cfs and 0.9 cfs in the 5-year and 100-year storm event, respectfully, that ultimately drain to the southeast detention pond.

Major Basin C is broken into three smaller sub-basins (sub-basins C-1 to C-3), each draining to a specific inlet or design point.

Basin C-1 is approximately 2.1 acres that is located in the northeastern portion of the site. It consists of a future commercial pad site, which consists of a building, parking, drive lanes and landscaping. Basin C-1 conveys developed flows via curb and gutter to a future inlet (Design Point 9). The inlet discharges flows directly to the southeast detention pond. Peak flows from Basin C-1 are approximately 7.1 cfs and 12.9 cfs in the 5-year and 100-year storm event, respectfully.

Basin C-2 is approximately 2.09 acres that is located just east of the King Soopers grocer. It is mostly comprised of parking, and drive lanes. Basin C-2 conveys developed flows via curb and gutter to a Type-R inlet (Inlet 7A; Design Point 10). The

inlet discharges flows directly to the detention pond. Peak flows from Basin C-2 are approximately 6.7 cfs and 12.5 cfs in the 5-year and 100-year storm event, respectfully.

Basin C-3 is approximately 1.6 acres that is located in the northeastern portion of the site. It consists of the southeast detention pond and landscaping. Basin C-3 conveys developed flows via trickle channels to a modified Type-C outlet structure (Design Point 11). Peak flows from Basin C-3 are approximately 7.5 cfs and 13.4 cfs in the 5-year and 100-year storm event, respectfully.

Major Basin D is broken into three smaller sub-basins (sub-basins D-1 to D-8), each draining to a specific inlet or design point.

Basin D-1 is approximately 1.03 acres that is located at the northwest corner of the site. It consists of a future commercial pad site, which consists of a building, parking, drive lanes and landscaping. Drainage from Basin D-1 will be conveyed to the storm sewer stub (Design Point 12). Peak flows from Basin D-1 are approximately 4.2 cfs and 7.7 cfs in the 5-year and 100-year storm event, respectfully, that ultimately drain to the southeast detention pond.

Basin D-2 is approximately 0.87 acres that is located at the northwest corner of the site. It consists of a future commercial pad site, which consists of a building, parking, drive lanes and landscaping. Drainage from Basin D-2 will be conveyed to the storm sewer stub (Design Point 13). Peak flows from Basin D-2 are approximately 3.6 cfs and 6.6 cfs in the 5-year and 100-year storm event, respectfully, that ultimately drain to the southeast detention pond.

Basin D-3 is approximately 0.49 acres that is located in the northwestern portion of the site. It is comprised mostly of the northwestern entrance drive with some landscaping. Drainage from Basin D-3 conveys developed flows via curb and gutter to an on-grade Type R curb inlet (Inlet 3B1; Design Point 14). All flow from a 5-year storm event is

captured, while only 0.3 cfs will not be caught in a 10-year storm event. Peak flows from Basin D-3 are approximately 1.6 cfs and 3.3 cfs in the 5-year and 100-year storm event, respectfully, that ultimately drain to the southeast detention pond.

Basin D-4 is approximately 0.97 acres that is located just north of the proposed King Soopers grocer. The majority of the basin is comprised of parking and landscaping. Drainage from Basin D-4 sheet flows to a Type-C area inlet located in a sump condition (Inlet 3B; Design Point 15). Flows collected in the inlet will be conveyed to the proposed southeast detention pond via proposed storm sewer system. Basin D-4 contributes approximately 4.1 cfs and 7.6 cfs in the 5-year and 100-year storm event, respectfully, that ultimately drain to the southeast detention pond

Basin D-5 is approximately 0.86 acres that is located in the west portion of the site. It consists of a future commercial pad site, which consists of a building, parking, drive lanes and landscaping. Drainage from Basin D-5 will be conveyed to the storm sewer stub (Design Point 16). Peak flows from Basin D-5 are approximately 3.6 cfs and 6.6 cfs in the 5-year and 100-year storm event, respectfully, that ultimately drain to the southwest detention pond.

Basin D-6 is approximately 0.63 acres that is located just west of the King Soopers grocer. It is mostly comprised of parking. Basin D-6 conveys developed flows via sheet flow to a Type R inlet (Inlet 3C; Design Point 17) located in a sump. Peak flows from Basin D-6 are approximately 2.1 cfs and 4.2 cfs in the 5-year and 100-year storm event, respectfully, that ultimately drain to the southwest detention pond.

Basin D-7 is approximately 0.55 acres that is located in southwest portion of the site. It consists of a future commercial pad site, which consists of a building, parking, drive lanes and landscaping. Drainage from Basin D-7 will be conveyed to the southwest detention pond (Design Point 18). Peak flows from Basin D-7 are approximately 2.3 cfs and 4.2 cfs in the 5-year and 100-year storm event, respectfully.

Basin D-8 is approximately 0.67 acres that is located just west of the King Soopers grocer. It is mostly comprised of drive lanes, and landscaping. Basin D-8 conveys developed flows via curb and gutter to two on-grade Type-R inlets (Inlet 4A; Design Point 19). The inlets discharge flows directly to the southwest detention pond. Peak flows from Basin D-8 are approximately 2.4 cfs and 4.6 cfs in the 5-year and 100-year storm event, respectfully. The on-grade inlets intercept 100% of the minor storm and bypass 0.3 cfs in the major storm. Bypass flows are discharged into basin OS-2.

Basin D-9 is approximately 0.89 acres that comprises the western portion of the King Soopers' roof. Basin D-9 conveys developed flows via roof drains (Design Point 4) directly to the southwest water quality pond. Peak flows from Basin D-9 are approximately 3.3 cfs and 6.1 cfs in the 5-year and 100-year storm event, respectfully.

Off-site Basins - There are four off-site basins, which are basins that discharge offsite without being detained. These basins are described below in more detail.

Basin OS-1 is approximately 0.4 acres that is located in the southern portion of the site adjacent to Claremont Ranch Filing No. 8. It is comprised mostly of landscaping and a retaining wall. The majority of the developed flows from Basin OS-1 will be intercepted by a french-drain that parallels the retaining wall and the lot line and discharges in the 36" RCP stub provided by Claremont Filing No. 8. Peak flows from Basin OS-1 are approximately 0.1 cfs and 0.8 cfs in the 5-year and 100-year storm event, respectfully.

Basin OS-2 is approximately 1.7 acres that is located in the western portion of the site. It is comprised mostly of the southwestern and western entrances drive and landscaping. Drainage from Basin OS-2 conveys flows via curb and gutter to Marksheffel Rd. Peak flows from Basin OS-2 are approximately 4.0 cfs and 9.0 cfs in the 5-year and 100-year storm event, respectfully. There is an additional 0.3 cfs of bypass flows from Basin D-8 for a total of 9.3 cfs in the 100-year storm that discharges

into Marksheffel Road. Per the MDDP, Marksheffel Road was designed to accommodate undetained developed flows from the site. As stated in the MDDP, developed flows of 5.3 cfs and 9.7 cfs in the 5-year and 100-year storm event, respectfully, can be discharged into Marksheffel Road.

Basin OS-3 is approximately 0.4 acres that is located in the northeastern portion of the site. It is comprised mostly of landscaping. Drainage from Basin OS-3 conveys flows via sheet flow to East Fork Sub Tributary of Sand Creek. Peak flows from Basin OS-3 are approximately 0.2 cfs and 1.2 cfs in the 5-year and 100-year storm event, respectfully.

Basin OS-4 is approximately 0.1 acres that is located in the southeastern portion of the site. It is comprised mostly of landscaping. Drainage from Basin OS-4 is conveyed via sheet flow directly to East Fork Sub Tributary of Sand Creek. Peak flows from Basin OS-3 are approximately 0.1 cfs and 0.2 cfs in the 5-year and 100-year storm event, respectfully.

Basin OS-5 is approximately 0.1 acres that is located in the southeastern portion of the site adjacent to Claremont Ranch Filing No. 8. It is comprised mostly of landscaping. The majority of the developed flows from Basin OS-5 will sheet flow into existing Norte Way within Claremont Rand Filing No. 8. Peak flows from Basin OS-5 are approximately 0.05 cfs and 0.39 cfs in the 5-year and 100-year storm event, respectfully. Per the approved MDDP, Notre Way is a 35’ back-of-curb to back-of-curb street section with a street capacity of Q_5=9.0 cfs and Q_{100}=34.3 cfs. Existing Basin flows tributary to Norte Way (Q_5=5.4 cfs and Q_{100}=11.9) and the addition of Basin OS-1 do not exceed street capacity nor do they exceed the capacity of the existing 10’ Type-R inlet at the intersection of Norte Way and Bucolo Avenue. The inlet located in a sump with a capacity of 13 cfs.

Drainage Facilities/Proposed Cost Estimate

The on-site drainage facilities required for the Claremont Ranch Filing #8 site are listed below.

These on-site facilities are Private, non-reimbursable drainage facilities:

ITEM	QUANTITY	UNIT PRICE	EXT. COST
5" CDOT/Denver 13 Valley Grate	1 EA	$3,000	$3,000
10" CDOT/Denver 13 Valley Grate	2 EA	$4,500	$9,000
15" CDOT/Denver 13 Valley Grate	1 EA	$6,000	$6,000
5" CDOT Type R Curb Opening	2 EA	$3,791.00	$7,582.00
10" CDOT Type R Curb Opening	3 EA	$5,528.00	$16,584.00
Grated Inlet (Type C)	1 EA	$3,270.00	$3,270.00
Grated Inlet (Type D)	2 EA	$3,908.00	$7,816.00
Flared End Section RCP	4 EA	$750.00	$3,000.00
6" PVC	375 LF	$34.00	$12,750.00
12" PVC	85 LF	$43.00	$3,655.00
12" RCP	125 LF	$55.00	$6,875.00
18" RCP	830 LF	$69.00	$57,270.00
24" RCP	810 LF	$84.00	$68,040.00
30' RCP	235 LF	$94.00	$22,090.00
36" RCP	495 LF	$124.00	$61,380.00
5' Dia Manhole	6 EA	$4,575.00	$27,450.00
Insert-a-Tee	5 EA	$750.00	$3,750.00
		Sub-total:	$319,512.00
		15% Engineering and Consistency:	$47,927.00
		Total:	**$367,439.00**

Drainage and Bridge Fees

The site is located entirely within the Sand Creek Drainage Basin. The 2014 Drainage and Bridge Fees per El Paso County for this site are listed below.

Drainage Fee: $15,000/Impervious acre

Bridge Fee: $4,544/Impervious acre

The impervious area for the site was calculated from the site plan.

The total platted acreage for the site is 23.54 acres with a calculated 84% impervious value. Therefore, the calculated impervious area is 19.74 acres (84%).

Drainage Fee: $15,000/Impervious acre x 84% Impervious = $12,600/ac.

Bridge Fee: $4,544/Impervious acre x 84% Impervious = $3,817/ac.

Total fees due per platted acreage = $16,417/ac.

The total fee obligation for the site is summarized as follows:

Drainage fees for subdivision: $12,600/ac x 23.54 ac =	**$296,604**
Bridge fees for subdivision: $3,817/ac x 23.54 ac =	**$ 89,852**
Total fees for subdivision: $16,417/ac x 23.54 ac =	**$386,456**

III. Drainage Design Criteria

Development Criteria Reference

Where not otherwise specifically discussed, all storm water runoff, conveyance, and management facilities are designed using the guidance of the updated City of Colorado Springs, "Drainage Criteria Manual", Volumes 1 and 2. The proposed water quality/ detention pond are designed in accordance with the Urban Drainage and Flood Control District's (UDFCD), Urban Storm Drainage Criteria Manual, Volume III (USDCM).

Hydrologic Criteria

The drainage calculations were based on the City of Colorado Springs drainage criteria manual Figure 6-5 and IDF equations to determine the intensity.

Table 1 – Precipitation Data

Return Period	One Hour Depth (in.)	Intensity
5-year	1.44	5.17
100-year	2.42	8.68

Calculations for time of concentration (t_c) was calculated and due to the small basin sizes for the site, produced a 5 minute minimum t_c for most basins.

The rational method was used to calculate peak flows as the tributary areas are less than 100 acres. The rational method has been proven to be accurate for basins of this size and is based on the following formula:

$$Q = CIA$$

Where:

Q = Peak Discharge (cfs)

C = Runoff Coefficient

I = Runoff intensity (inches/hour)

A = Drainage area (acres)

The runoff coefficients are calculated based on land use, percent imperviousness, and design storm for each basin, as shown in the Colorado Springs/El Paso County drainage criteria manual. The runoff coefficient for commercial impervious basins was 0.88 (100-year) and 0.81 (5-year) per Colorado Springs drainage criteria. The appendix contains runoff coefficient calculations for basins that were not 100% impervious.

The 100-year event was used as the major storm event for pipes and inlets. The 5-year event was used as the minor event and hydraulic results are shown in the appendix.

Inlet calculations and street capacity for the sump and on-grade inlets was performed by the UDFCD Street Capacity and Inlet Sizing spreadsheets (UD-Inlet v3.14). Results are included in the appendix. The 100-year event was used as the major storm event for pipes and inlets which will be a private storm sewer system.

Standard SF-1 and SF-2 forms were created to determine the t_c and intensities and input into StormCAD software to calculate pipe hydraulics and HGL's. The resultant flows from StormCAD were used for the design of the outlet structures and pipe sizing. Losses and loss coefficients are provided in the appendix and are determined from StormCAD using Colorado Springs and UDFCD criteria. Total head losses are due to friction, changes in velocities, changes in direction of flow, and the shape of the structure. See the appendix for more information.

Detention and water quality is required for the project site. The detention and water quality ponds and outlet structures were designed using UDFCD software, specifically the UD-Detention_v2.35 spreadsheet. These spreadsheets can be found in the appendix.

IV. Drainage Facility Design

General Concept

As discussed, the site will consist of four major basins (Basin A, B, C, D) that drain to the proposed on-site private EURV Detention Pond and a private water quality pond. The private detention\water quality ponds will discharge into the East Fork Sub Tributary of Sand Creek. Each private pond has two feet of freeboard. Generally, the site grades follow the existing drainage pattern. The detention volume of the southeast pond is 2.5

acre-feet while the water quality volume of the southwest pond is 1.0 acre-foot. The existing topography slopes from the north to the south at approximately 2-3% grade.

Proposed drainage patterns will generally follow existing conditions. Due to the building footprint location and the four entrance drives the site becomes a fill site to allow for a 3% maximum grade in the parking lot area to ensure ADA conformance. Due to the aforementioned site constraints we are not able to design the site to be "self-contained"; meaning to keep all drainage on site and run it through the water quality pond prior to discharging into the East Fork Sub Tributary of Sand Creek. Coordination is on-going with the overall developer to provide a design that benefits all of the final users within the development.

The existing site is undeveloped. Due to the proposed improvements the developed impervious area and runoff are increased from historic levels.

The on-site private detention and water quality pond will be used for treatment of the project site. It is not anticipated to be used to treat any offsite basins or drainage from Constitution Ave. The private water quality pond will be maintained by Evergreen Development Co. The outlet structure is designed to discharge at the allowable 100-year release rate. An emergency overflow weir is designed to discharge into the East Fork Sub Tributary of Sand Creek in the event the outlet structure is clogged.

Specific Details

The proposed development depicted on the associated drainage plan and described above will generate 5-year and 100-year onsite runoff to be captured and conveyed in the proposed storm sewer systems. The majority of on-site developed flows will be captured in the proposed storm sewer system and conveyed to the proposed detention and water quality ponds. The southeast pond will discharge directly into the East Fork Sub Tributary of Sand Creek. While the southwest pond will discharge into the 36" storm sewer stub provided by Claremont Ranch Filing 8.

Southeast Pond – The private EURV detention and water quality pond is located on the southeast corner of the site. The shape of the detention and water quality pond is rectangular in shape with 3:1 side slopes and a retaining wall. The outfall of the pond will be from the south end of the pond and directed to the East Fork Sub Tributary of Sand Creek. A 10' maintenance access is provided at the northwest side of the pond.

The pond has been designed as a EURV detention pond. The average width of the pond is 150 feet and the length is 315 feet. The depth is approximately 4.5 feet from the bottom of the pond to the water quality water surface elevation (WSEL), providing a WQCV of 2.1 acre-feet. The outlet structure is designed to allow the pond to fill up using a 72 hour drain time and to allow flows over the WQCV to spill over the top of the outlet structure through a trash rack. The 100-year WSEL is approximately 6436. Two feet of freeboard is provided above the 100-year WSEL. The southeast pond will release the EURV at 1.1 cfs and the 100-year release at 8.2 cfs into the East Fork Sub Tributary of Sand Creek. The MDDP anticipated that the eastern portion of the site, (MDDP basin K-1), will discharge 27.7 cfs and 44.5 cfs into the East Fork Sub Tributary of Sand Creek in the 10-year and 100-year storms, respectively. The proposed southeast pond's discharge is considerably less; therefore there are no negative impacts to the East Fork Sub Tributary of Sand Creek. In the event the outlet structure becomes clogged, flows in excess of the 100-year WSEL will overtop the detention pond through the emergency overflow weir and outfall into the East Fork Sub Tributary of Sand Creek.

During construction the southeast pond will be used as a sedimentation pond for the entire site. Flows will be routed to the pond via diversion ditch.

Southwest Pond - The private water quality only pond is located in the southwest portion of the site. The shape of the water quality pond is rectangular in shape with 3:1 side slopes and a retaining wall. The outfall of the pond will be from the southwest end of the pond and will be piped to the existing 36" RCP stub provided by Claremont Ranch

Filing No. 8. Per the MDDP the 36" RCP was designed to convey 48.6 cfs and 88.3 cfs in the 5-year and 100-year developed flows respectively. The southwest pond will release EURV 1.1 cfs and 50.6 cfs in the 100-year storm which are less than the anticipated MDDP flows.

The pond has been designed as a EURV water quality pond. The average width of the pond is 95 feet and the length is 115 feet. The depth is approximately 8 feet from the bottom of the pond to the water quality water surface elevation (WSEL), providing a WQCV of 1.0 acre-feet. The outlet structure is designed to allow the pond to fill up using a 72 hour drain time and to allow flows over the WQCV to spill over the top of the outlet structure through a trash rack. The 100-year WSEL is approximately 6439. Two foot of freeboard is provided above the 100-year WSEL. In the event the outlet structure becomes clogged, flows in excess of the 100-year WSEL will overtop the detention pond through the emergency overflow weir and outfall into adjacent drive.

V. Summary

The proposed construction of the Southeast Corner of Marksheffel Rd. and Constitution Ave. will not adversely affect the downstream and surrounding developments. It is in general conformance with the drainage design and analysis in the approved Master Development Drainage Plan for Claremont Ranch (East & West). The site is following the design standards and guidelines as set forth by the City of Colorado Springs Drainage Criteria Manual, Volumes 1 and 2, as well as Urban Drainage Flood Control District Volumes 1, 2, and 3.

VI. References

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

2. Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, March 2006 (with current revisions).

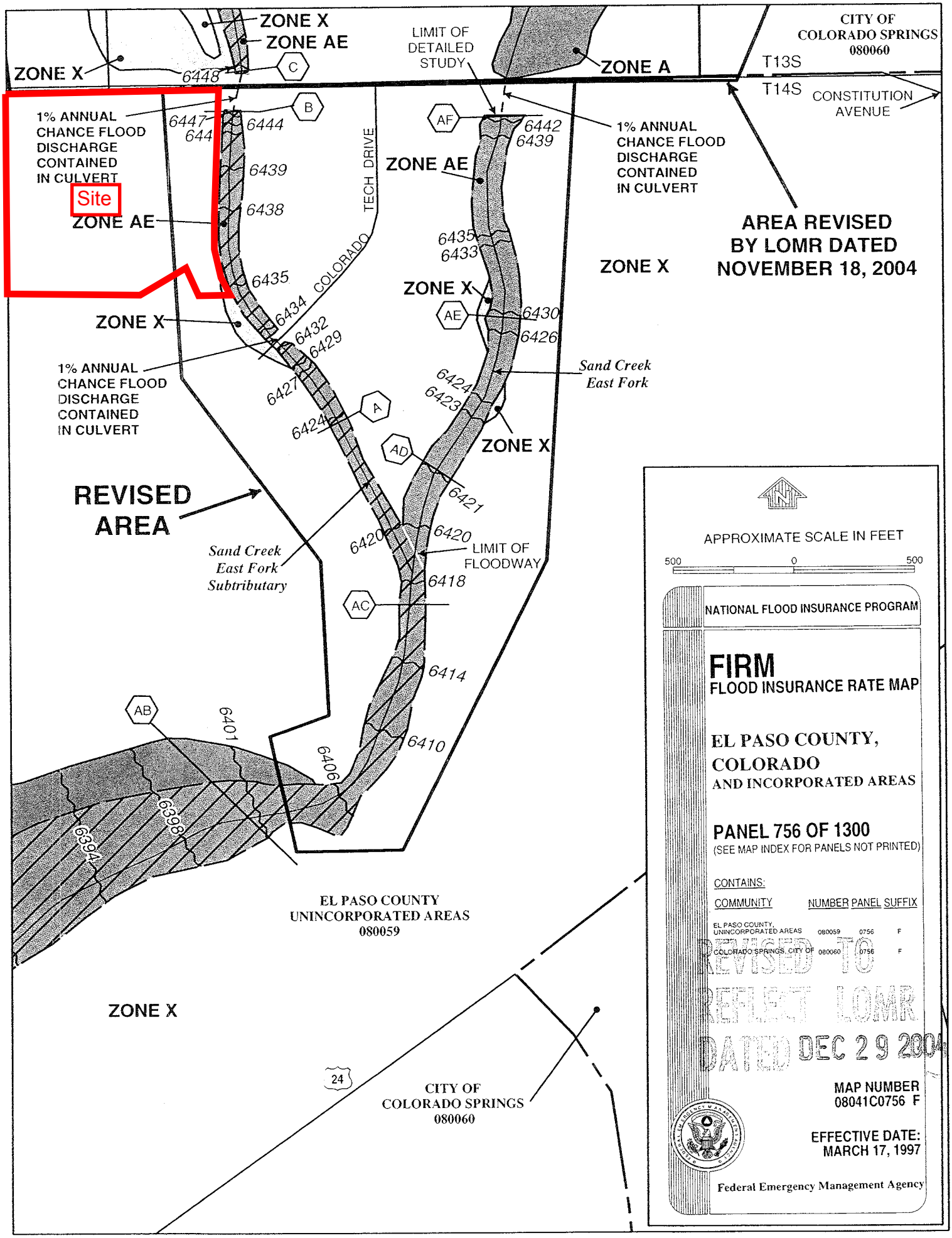
3. Flood Insurance Rate Map – El Paso County, Colorado and Incorporated Areas Community Panel No. 08041C0756 F, Effective March 17, 1997.

4. Soil Map – El Paso County Area, Colorado as available through the Natural Resources Conservation Service National Cooperative Soil Survey web site via Web Soil Survey 2.0.

5. Final Master Development Drainage Plan (MDDP) for the "Claremont Ranch (East)" & "Claremont Ranch West", by Matrix Design Group, Inc., Revised February 6, 2001.

Appendix A

Vicinity Map, FEMA, and Soils Information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LIMIT OF DETAILED STUDY
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CONSTITUTION AVENUE
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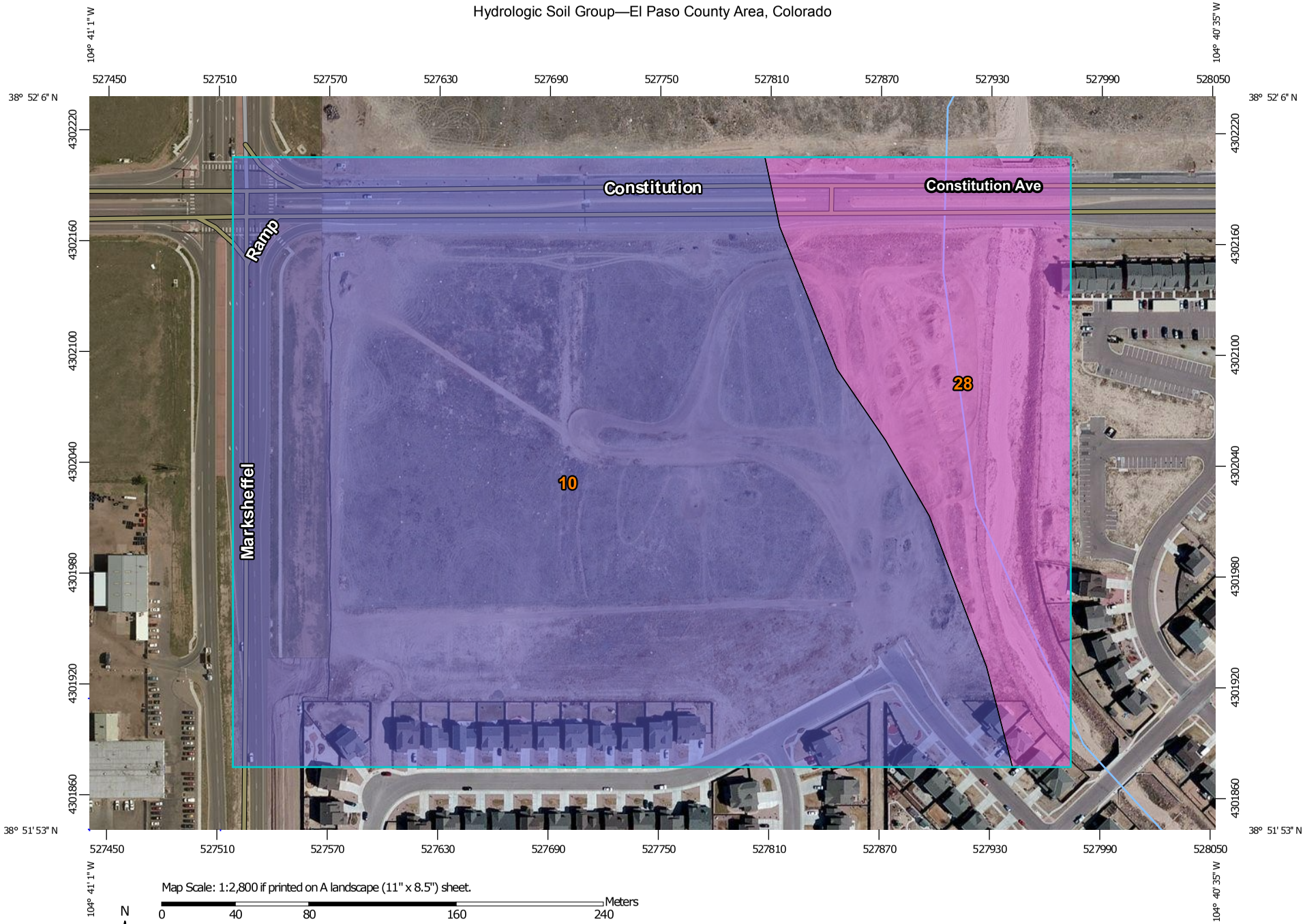
ZONE X
AF
6442
6439
ZONE AE
1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN CULVERT
AREA REVISED BY LOMR DATED NOVEMBER 18, 2004
ZONE X
6435
6433
ZONE X
AE
6430
6426
Sand Creek East Fork
6424
6423
AD
ZONE X
6421
6420
6420
LIMIT OF FLOODWAY
6418
AC
REVISED AREA
Sand Creek East Fork Subtributary
6414
AB
6401
6406
6410
6398
6394
EL PASO COUNTY UNINCORPORATED AREAS 080059
ZONE X
24
CITY OF COLORADO SPRINGS 080060
APPROXIMATE SCALE IN FEET
500
0
500
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS
PANEL 756 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY
NUMBER
PANEL
SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS 080059 0756 F
COLORADO SPRINGS, CITY OF 080060 0756 F
REVISED TO REFLECT LOMR DATED DEC 29 2004
MAP NUMBER
08041C0756 F
EFFECTIVE DATE:
MARCH 17, 1997
Federal Emergency Management Agency


104° 41' 1" W
104° 40' 35" W
527450
527510
527570
527630
527690
527750
527810
527870
527930
527990
528050
38° 52' 6" N
38° 51' 53" N
4302220
4302160
4302100
4302040
4301980
4301920
4301860
Constitution
Constitution Ave
Ramp
Marksheffel
10
28
Map Scale: 1:2,800 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0
40
80
160
240
Feet
0
100
200
400
600
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

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: http://websoilsurvey.nrcs.usda.gov
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 12, Sep 29, 2014

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

Date(s) aerial images were photographed: Apr 15, 2011—Jun 17, 2014

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

Hydrologic Soil Group— Summary by Map Unit — El Paso County Area, Colorado (CO625)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10	Blendon sandy loam, 0 to 3 percent slopes	B	29.3	78.6%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A	8.0	21.4%
Totals for Area of Interest			**37.3**	**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

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Appendix B

City IDF & Runoff Coefficients

PROJECT: Marksheffel/Constitution Project Site
LOCATION: Marksheffel Rd. and Constitution Ave
Colorado Springs, El Paso County

Project No.: EDI8.01
Date: September 14, 2015
Engineer: Gary Iwata

*PERCENT IMPERVIOUS VALUES	
LANDSCAPE	0
PAVING	100
ROOFING	90
COMMERCIAL	95

* RUNOFF COEFFICIENTS USED				
	2-Year	5-Year	10-year	100-Year
LANDSCAPE	0.02	0.08	0.15	0.35
PAVING	0.89	0.90	0.92	0.96
ROOFING	0.71	0.73	0.75	0.81
COMMERCIAL	0.79	0.81	0.83	0.88

* Table 6-6 in CO Springs, Drainage Criteria Manual Revised May 2014

Composite Runoff Coefficients and Percent Imperviousness for Developed Drainage Basins

BASIN DESIG.	OVERALL AREA (sf)	LANDSCAPE AREA (sf)	PAVED AREA (sf)	ROOF AREA (sf)	COMMERCIAL AREA (sf)	2-YEAR COEFF.	5-YEAR COEFF.	10-YEAR COEFF.	100-YEAR COEFF.	PERCENT IMPERVIOUS
A-1	75,466	8,652	66,814	0	0	0.79	0.81	0.83	0.89	89%
A-2	103,978	13,055	87,265	3,658	0	0.77	0.79	0.82	0.88	87%
A-3	94,063	12,348	76,537	5,178	0	0.77	0.78	0.81	0.87	86%
TOTAL A	**273,507**	**34,055**	**230,616**	**8,836**	**0**					87%
B-1	4,733	0	4,733	0	0	0.89	0.90	0.92	0.96	100%
B-2	42,137	0	0	42,137	0	0.71	0.73	0.75	0.81	90%
B-3	38,183	0	0	38,183	0	0.71	0.73	0.75	0.81	90%
B-4	4,598	0	4,598	0	0	0.89	0.90	0.92	0.96	100%
TOTAL B	**89,651**	**0**	**9,331**	**80,320**	**0**					91%
C-1	89,136	0	0	0	89,136	0.79	0.81	0.83	0.88	95%
C-2	91,159	14,517	76,642	0		0.75	0.77	0.80	0.86	84%
C-3	70,175	0	70,175	0	0	0.89	0.90	0.92	0.96	100%
TOTAL C	**250,470**	**14,517**	**146,817**	**0**	**89,136**					92%
TOTAL TO SE POND	**613,628**	**48,572**	**386,764**	**89,156**	**89,136**	0.78	0.80	0.82	0.88	90%
D-1	45,062	0	0	0	45,062	0.79	0.81	0.83	0.88	95%
D-2	37,698	0	0	0	37,698	0.79	0.81	0.83	0.88	95%
D-3	21,420	6,628	14,792	0	0	0.62	0.65	0.68	0.77	69%
D-4	42,468	4,291	38,177	0		0.80	0.82	0.84	0.90	90%
D-5	37,423	0	0	0	37,423	0.79	0.81	0.83	0.88	95%
D-6	27,611	7,191	20,421	0	0	0.62	0.65	0.68	0.75	70%
D-7	23,746	0	0	0	23,746	0.79	0.81	0.83	0.88	95%
D-8	29322	5,222	24,100	0	0	0.74	0.75	0.78	0.85	82%
D-9	38,829	0	0	38,829	0	0.71	0.73	0.75	0.81	90%
TOTAL D	**303,579**	**23,332**	**97,489**	**38,829**	**143,930**					89%
TOTAL TO SW POND	**303,579**	**23,332**	**97,489**	**38,829**	**143,930**					89%
OS										
OS-1	16,526	16,526	0	0	0	0.02	0.08	0.15	0.35	0%
OS-2	72,934	36,375	36,559	0	0	0.46	0.49	0.54	0.66	50%
OS-3	18,678	18,678	0	0	0	0.02	0.08	0.15	0.35	0%
OS-4	3,028	3,028	0	0	0	0.02	0.08	0.15	0.35	0%
OS-5	5,590	5,590	0	0	0	0.02	0.08	0.15	0.35	0%
TOTAL OS	**116,756**	**80,197**	**36,559**	**0**	**0**					31%
TOTAL SITE	**1,026,035**	**144,173**	**520,813**	**127,985**	**233,065**	1	0.74	0.77	0.84	84%
H-1	58,806	58,806	0	0	0	0.02	0.08	0.15	0.35	0%
H-2	964,857	964,857	0	0	0	0.02	0.08	0.15	0.35	0%
Total Historic	**1,023,663**	**1,023,663**	**0**	**0**	**0**	**0.02**	**0.08**	**0.15**	**0.35**	**0%**

Appendix C

Rational Method Spreadsheets

PROJECT: Marksheffel/Constitution Project Site
LOCATION: Marksheffel Rd. and Constitution Ave
Colorado Springs, El Paso County

Project No.: EDI8.01
Date: September 14, 2015
Engineer: Gary Iwata

Time of Concentration, 5 Year Coefficient

Basin Desig	Overall Area (ac)	5-Year Coeff C5	Initial / Overland Time, ti			Travel Time, tt				ti +tt	Tc Check (Urbanized Basins)		Result	
			Length (ft)	Slope (%)	ti (min)	Length (ft)	SLOPE (%)	Velocity (fps)	tt (min)	tc (min)	Total Length (ft)	tc = (L/180+10) (min)	tc (min)	Notes
A-1	1.73	0.81	53	18.00%	1.47	340	1.65%	2.57	2.2	3.7	393	12.2	5.0	Use minimum value
A-2	2.39	0.81	53	18.00%	1.47	340	1.50%	2.45	2.3	3.8	393	12.2	5.0	Use minimum value
A-3	2.16	0.79	74	16.00%	1.90	340	1.34%	2.32	2.4	4.3	414	12.3	5.0	Use minimum value
TOTAL A	6.28													
B-1	0.11	0.90	1	1.00%	0.36	91	4.80%	4.38	0.3	0.7	92	10.5	5.0	Use minimum value
B-2	0.97	0.73	60	2.00%	4.09	215	2.00%	2.83	1.3	5.4	275	11.5	5.4	
B-3	0.88	0.73	60	2.00%	4.09	215	2.00%	2.83	1.3	5.4	275	11.5	5.4	
B-4	0.11	0.73	1	1.00%	0.67	91	4.80%	4.38	0.3	1.0	92	10.5	5.0	Use minimum value
TOTAL B	2.06													
C-1	2.05	0.81	61	10.00%	1.89	575	0.50%	1.41	6.8	8.7	636	13.5	8.7	
C-2	2.09	0.77	40	1.50%	3.29	630	0.62%	1.57	6.7	10.0	670	13.7	10.0	
C-3	1.61	0.90	23	2.00%	1.37	405	2.00%	2.83	2.4	3.8	428	12.4	5.0	Use minimum value
TOTAL C	5.75													
D-1	1.03	0.81	80	2.50%	3.44	240	1.00%	2.00	2.0	5.4	320	11.8	5.4	
D-2	0.87	0.81	25	4.00%	1.64	300	1.00%	2.00	2.5	4.1	325	11.8	5.0	Use minimum value
D-3	0.49	0.65	8	2.00%	1.83	360	1.00%	2.00	3.0	4.8	368	12.0	5.0	Use minimum value
D-4	0.97	0.82	53	2.50%	2.73	340	1.90%	2.76	2.1	4.8	393	12.2	5.0	Use minimum value
D-5	0.86	0.81	20	10.00%	1.08	225	1.00%	2.00	1.9	3.0	245	11.4	5.0	Use minimum value
D-6	0.63	0.65	25	2.00%	3.24	110	1.50%	2.45	0.7	4.0	135	10.8	5.0	Use minimum value
D-7	0.55	0.81	10	2.00%	1.31	240	1.00%	2.00	2.0	3.3	250	11.4	5.0	Use minimum value
D-8	0.67	0.75	28	2.00%	2.62	490	1.00%	2.00	4.1	6.7	518	12.9	6.7	
D-9	0.89	0.73	60	2.00%	4.09	215	2.00%	2.83	1.3	5.4	275	11.5	5.4	
TOTAL D	6.97													
OS														
OS-1	0.38	0.08	44	4.00%	7.67	920	0.50%	0.49	31.0	38.7	964	15.4	15.4	
OS-2	1.67	0.49	30	2.00%	4.77	150	1.00%	2.00	1.3	6.0	180	11.0	6.0	
OS-3	0.43	0.08	48	10.00%	5.90	65	1.50%	0.86	1.3	7.2	113	10.6	7.2	
OS-4	0.07	0.08	6	0.50%	5.67	8	25.00%	3.50	0.0	5.7	14	10.1	5.7	
OS-5	0.13	0.08	10	2.00%	4.61	13	25.00%	3.50	0.1	4.7	23	10.1	5.0	Use minimum value
TOTAL OS	2.68													
H-1	1.35	0.08	20	2.00%	6.52	555	2.00%	1.41	6.5	13.1	575	13.2	7.9	
H-2	22.15	0.08	50	8.00%	6.49	1570	1.00%	1.00	26.2	32.7	1,620	19.0	19.0	
Total Historic	23.50													

PROJECT: Marksheffel/Constitution Project Site
LOCATION: Marksheffel Rd. and Constitution Ave

Project No.: EDI8.01
Date: September 14, 2015
Engineer: Gary Iwata

5-YR RUNOFF COMPUTATIONS (RATIONAL METHOD)

BASIN INFORMATION				DIRECT RUNOFF				TOTAL RUNOFF				PIPE			TRAVEL TIME			REMARKS
DESIGN PT.	BASIN	AREA (acres)	RUNOFF COEFF.	Tc (min)	C x A (acres)	I (in/hr)	Q (cfs)	Tc (min)	∑C x A (acres)	I (in/hr)	Q (cfs)	DESIGN FLOW (cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (ft/s)	t_t (min)	
1	A-1	1.73	0.81	5.00	1.40	5.17	7.22					7.22	0.50%	24	193	4.96	0.65	
2	A-2	2.39	0.79	5.00	1.89	5.17	9.76	5.65	3.28	4.99	16.38	16.38	0.50%	36	193	6.13	0.52	
3	A-3	2.16	0.78	5.00	1.69	5.17	8.74	5.52	4.98	5.02	24.97	24.97	0.50%	36	261	6.13	0.71	
5	B-1	0.11	0.90	5.00	0.10	5.17	0.51					0.51	0.50%	18	48.00	4.25	0.19	
6	B-2	0.97	0.73	5.36	0.71	5.06	3.58	5.36	0.80	5.06	4.07	4.07	0.50%	24	120.00	5.00	0.40	
7	B-3	0.88	0.73	5.36	0.64	5.06	3.24	5.76	1.44	4.96	7.16	7.16	0.50%	24	37.80	5.45	0.12	
8	B-4	0.11	0.90	5.00	0.10	5.17	0.49	5.48	1.54	5.03	7.74	7.74	0.50%	24	337.00	5.52	1.02	
9	C-1	2.05	0.81	9.96	1.66	4.14	6.86					6.86						
10	C-2	2.09	0.77	9.96	1.61	4.14	6.66	9.96	3.27	4.14	13.51	13.51	0.40%	24	53.10	3.68	0.24	
11	C-3	1.61	0.90	5.00	1.45	5.17	7.49	10.20	4.72	4.10	19.34	19.34						
A		**14.09**									**52.06**	**52.06**						**TOTAL TO SE POND**
12	D-1	1.03	0.81	5.44	0.84	5.04	4.23					4.23	1.50%	18	257	6.52	0.66	
13	D-2	0.87	0.81	5.00	0.70	5.17	3.62					3.62	0.70%	18	13.2	4.79	0.05	
14	D-3	0.49	0.65	5.00	0.32	5.17	1.64	5.05	1.02	5.16	5.25	5.25	1.90%	18	62	7.61	0.14	
15	D-4	0.97	0.82	5.00	0.80	5.17	4.12	5.14	2.65	5.13	13.61	13.61	1.50%	24	198	1.68	1.96	
16	D-5	0.86	0.81	5.00	0.70	5.17	3.60				-	3.60	2.00%	18	71.00	7.76	0.15	
17	D-6	0.63	0.65	5.00	0.41	5.17	2.12	5.06	3.76	5.15	19.37	19.37	1.50%	30	32.00	3.96	0.13	
18	D-7	0.55	0.81	5.00	0.44	5.17	2.28				-	2.28	2.00%	18	8.00	2.35	0.06	
19	D-8	0.67	0.75	6.70	0.51	4.73	2.40	6.70	0.95	4.73	4.49	4.49	2.00%	18	60.00	2.54	0.39	
4	D-9	0.89	0.73	5.36	0.65	5.06	3.30					3.30	2.00%	12	24.00	8.36	0.05	
B		**6.97**									**27.15**	**27.16**						**TOTAL TO SW POND**
20	OS-1	0.38	0.08	15.36	0.03	3.49	0.11											
21	OS-2	1.67	0.49	6.02	0.82	4.89	4.02											
22	OS-3	0.43	0.08	7.17	0.03	4.63	0.16											
23	OS-4	0.07	0.08	5.70	0.01	4.97	0.03											
26	OS-5	0.13	0.08	5.00	0.01	5.17	0.05											
24	H-1	1.35	0.08	7.93	0.11	4.48	0.48											Per MDDP
25	H-2	22.15	0.08	19.00	1.77	3.17	5.61											

PROJECT: Marksheffel/Constitution Project Site
LOCATION: Marksheffel Rd. and Constitution Ave

Project No.: EDI8.01
Date: September 14, 2015
Engineer: Gary Iwata

100-YR RUNOFF COMPUTATIONS (RATIONAL METHOD)

BASIN INFORMATION				DIRECT RUNOFF				TOTAL RUNOFF				PIPE			TRAVEL TIME			REMARKS
DESIGN PT.	BASIN	AREA (acres)	RUNOFF COEFF.	Tc (min)	C x A (acres)	I (in/hr)	Q (cfs)	Tc (min)	∑C x A (acres)	I (in/hr)	Q (cfs)	DESIGN FLOW (cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (ft/s)	t_t (min)	
1	A-1	1.73	0.89	5.00	1.54	8.68	13.38					13.38	0.50%	24	193	4.26	0.76	
2	A-2	2.39	0.88	5.00	2.10	8.68	18.19	5.00	3.64	8.68	31.58	31.58	0.50%	36	193	7.15	0.45	
3	A-3	2.16	0.87	5.00	1.88	8.68	16.34	5.45	5.52	8.46	46.71	46.71	0.50%	36	261	7.60	0.57	
5	B-1	0.11	0.96	5.00	0.10	8.68	0.91					0.91	0.40%	18	48.00	0.51	1.57	
6	B-2	0.97	0.81	5.36	0.78	8.50	6.66	6.57	0.89	7.99	7.10	7.10	0.40%	24	120.00	1.35	1.48	
7	B-3	0.88	0.81	5.36	0.71	8.50	6.04	6.84	1.60	7.89	12.60	12.60	0.40%	24	37.80	2.69	0.23	
8	B-4	0.11	0.96	5.00	0.10	8.68	0.88	5.60	1.70	8.40	14.27	14.27	0.40%	24	336.00	4.61	1.21	
9	C-1	2.05	0.88	9.96	1.80	6.94	12.50					12.50						
10	C-2	2.09	0.86	9.96	1.81	6.94	12.54	9.96	3.61	6.94	25.04	25.04	0.40%	24	53.10	2.02	0.44	
11	C-3	1.61	0.96	5.00	1.55	8.68	13.42	10.39	5.15	6.84	35.22	35.22						
A		**14.09**									**96.20**	96.20						**TOTAL TO SE POND**
12	D-1	1.03	0.88	5.44	0.91	8.47	7.71					7.71	1.50%	18	257	4.36	0.98	
13	D-2	0.87	0.88	5.00	0.76	8.68	6.61					6.61	0.70%	18	13.2	3.74	0.06	
14	D-3	0.49	0.77	5.00	0.38	8.68	3.29	5.00	1.14	8.68	9.90	9.90	1.90%	18	61.9	5.60	0.18	
15	D-4	0.97	0.90	5.00	0.88	8.68	7.60	5.18	2.93	8.59	25.14	25.14	1.50%	24	198	8.09	0.41	
16	D-5	0.86	0.88	5.00	0.76	8.68	6.56				-	6.56	2.00%	18	71.00	3.71	0.32	
17	D-6	0.63	0.75	5.00	0.48	8.68	4.15	5.00	4.16	8.68	36.12	36.12	1.50%	30	31.80	7.36	0.07	
18	D-7	0.55	0.88	5.00	0.48	8.68	4.16				-	4.16	2.00%	18	8.00	2.35	0.06	
19	D-8	0.67	0.85	6.70	0.57	7.94	4.55	6.70	1.05	7.94	8.36	8.36	2.00%	18	60.00	4.73	0.21	
	D-9	0.89	0.81	5.36	0.72	8.50	6.14					6.14	2.00%	12	24.00	9.48	0.04	
B		**6.97**									**50.62**	50.62						**TOTAL TO SW POND**
20	OS-1	0.38	0.35	15.36	0.13	5.85	0.78											
21	OS-2	1.67	0.66	6.02	1.10	8.21	9.02											
22	OS-3	0.43	0.35	7.17	0.15	7.77	1.17											
23	OS-4	0.07	0.35	5.70	0.02	8.35	0.20											
26	OS-5	0.13	0.35	5.00	0.04	8.68	0.39											
24	H-1	1.35	0.35	7.93	0.47	7.52	3.55											
25	H-2	22.15	0.35	19.00	7.75	5.32	41.20											

Use minimum Time of Concentration = 5 minutes
Use composite coefficients

Appendix D

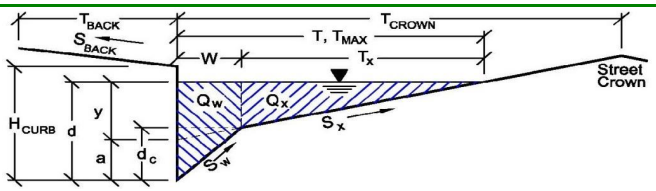
Hydraulic Calculations

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: SEC Marksheffel & Constitution

Inlet ID: Inlet-1A



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	1.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	60.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.020	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	60.0	60.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	12.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

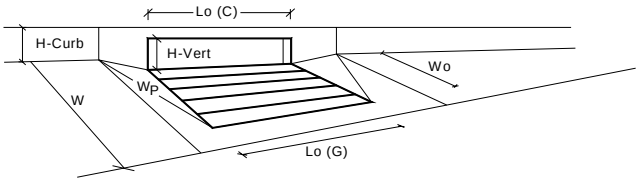
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

Warning 02: Max Allowable Depth for Minor Storm is greater than the Curb Height.

INLET IN A SUMP OR SAG LOCATION

Project = SEC Marksheffel & Constitution

Inlet ID = Inlet-1A



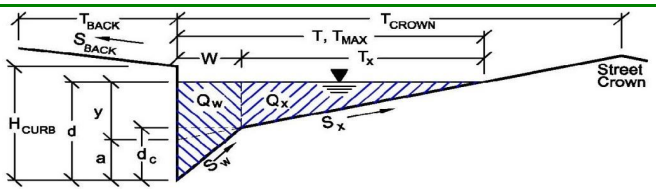
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	12.0	12.0	inches
				☐ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**13.6**	**13.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	7.2	13.4	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: SEC Marksheffel & Constitution

Inlet ID: Inlet-1B



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	1.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	60.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.020	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	60.0	60.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	12.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

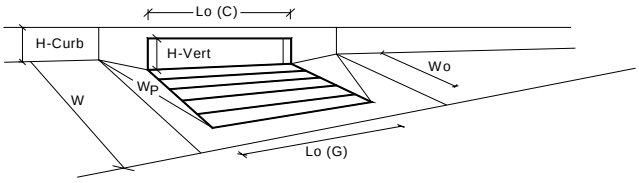
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

Warning 02: Max Allowable Depth for Minor Storm is greater than the Curb Height.

INLET IN A SUMP OR SAG LOCATION

Project = SEC Marksheffel & Constitution

Inlet ID = Inlet-1B



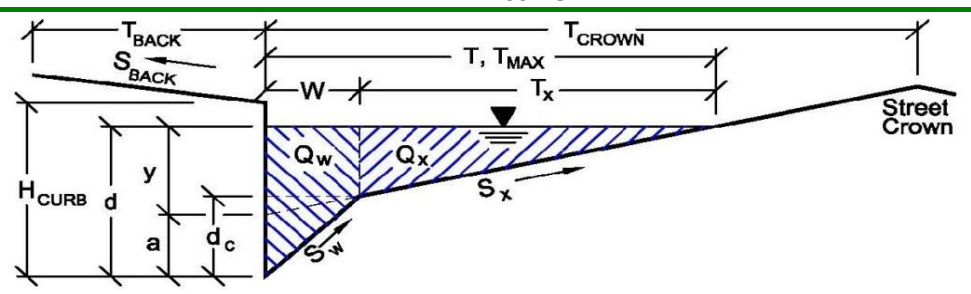
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	12.0	12.0	inches
				☐ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**21.6**	**21.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	9.8	18.2	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: SEC Marksheffel & Constitution

Inlet ID: Inlet-1C



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	1.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	60.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.020	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	60.0	60.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	12.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	SUMP	SUMP	cfs

Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

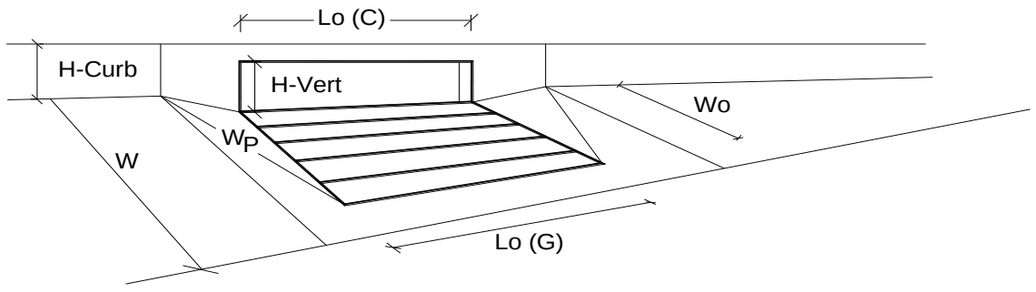
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

Warning 02: Max Allowable Depth for Minor Storm is greater than the Curb Height.

INLET IN A SUMP OR SAG LOCATION

Project = SEC Marksheffel & Constitution

Inlet ID = Inlet-1C



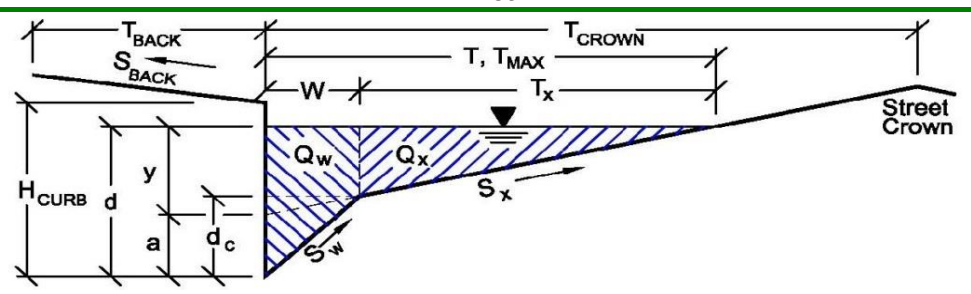
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	12.0	12.0	inches
				☐ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**21.6**	**21.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	8.7	16.3	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: SEC Marksheffel & Constitution

Inlet ID: Inlet-2A-1



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	50.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.080	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	58.32	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	60.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.017	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.017	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	60.0	60.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	12.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

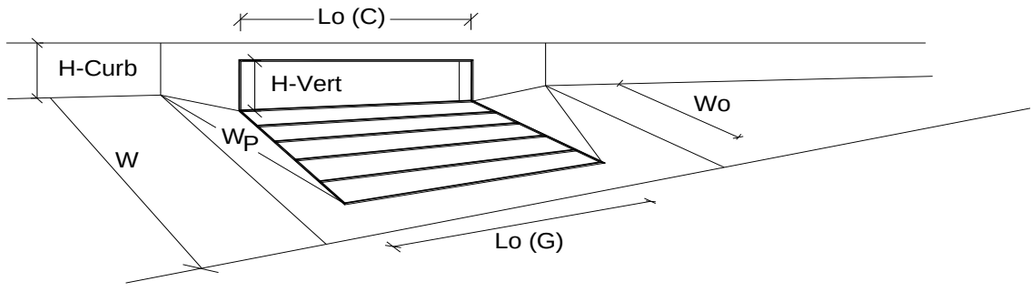
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

INLET IN A SUMP OR SAG LOCATION

Project = SEC Marksheffel & Constitution

Inlet ID = Inlet-2A-1



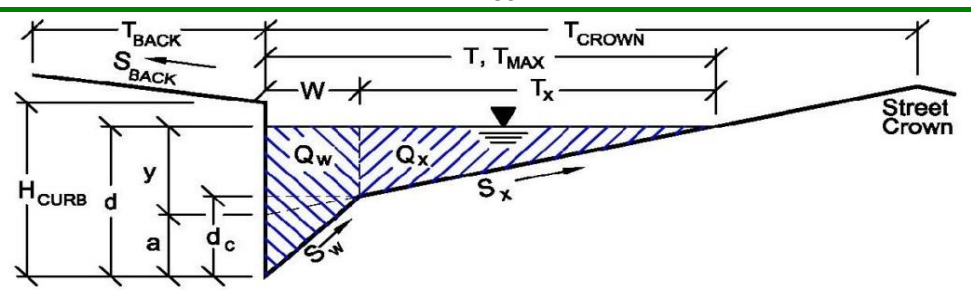
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	12.0	12.0	inches
				☐ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.6**	**5.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.5	0.9	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: SEC Marksheffel & Constitution

Inlet ID: Inlet-2B-1



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	50.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.080	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	58.32	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	60.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.017	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.017	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	60.0	60.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	12.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

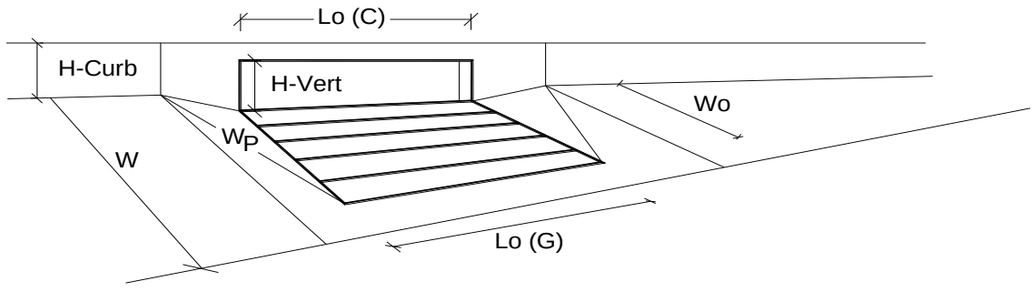
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

INLET IN A SUMP OR SAG LOCATION

Project = SEC Marksheffel & Constitution

Inlet ID = Inlet-2B-1



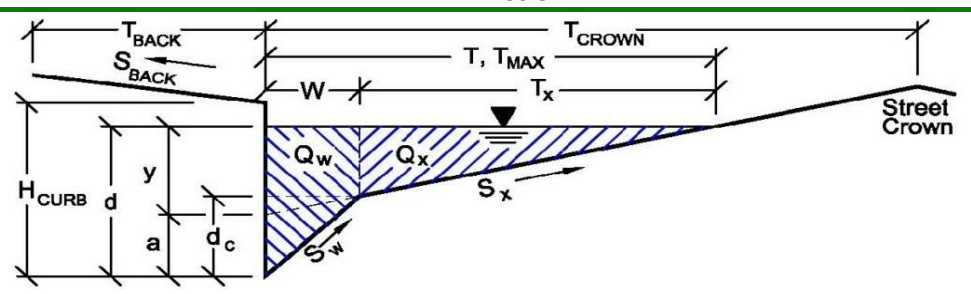
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	12.0	12.0	inches
				☐ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.6**	**5.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.5	0.9	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: SEC Marksheffel & Constitution

Inlet ID: Inlet-3B



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	1.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	60.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.020	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	60.0	60.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	12.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	SUMP	SUMP	cfs

Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

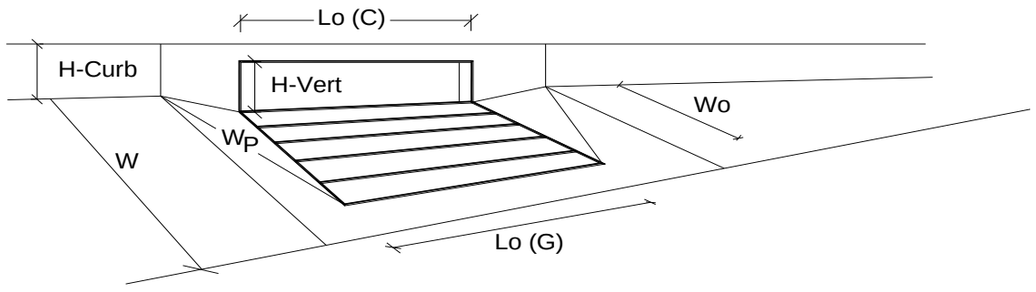
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

Warning 02: Max Allowable Depth for Minor Storm is greater than the Curb Height.

INLET IN A SUMP OR SAG LOCATION

Project = SEC Marksheffel & Constitution

Inlet ID = Inlet-3B

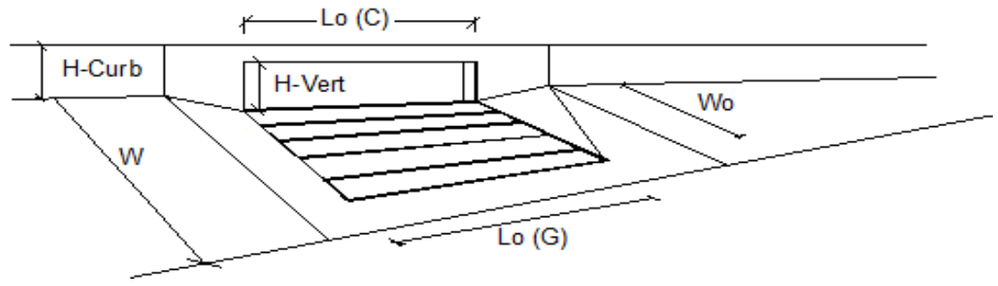


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	12.0	12.0	inches
				☐ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.6**	**5.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.5	0.9	cfs

INLET ON A CONTINUOUS GRADE

Project: SEC Marksheffel & Constitution

Inlet ID: Inlet-3B-1



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

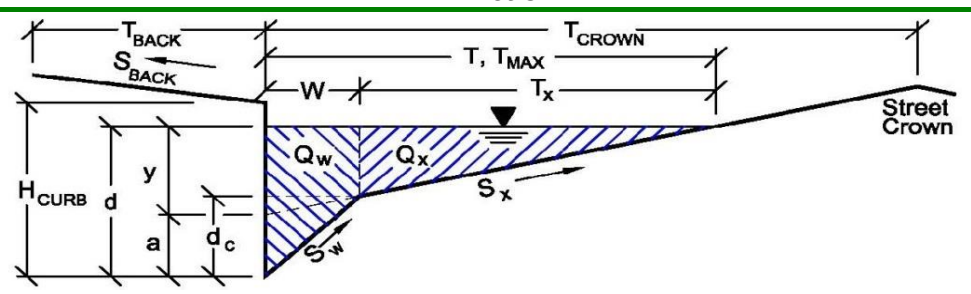
Street Hydraulics: OK - Q < maximum allowable from sheet 'Q-Allow'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.64**	**3.29**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: SEC Marksheffel & Constitution

Inlet ID: Inlet-3B-1



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	2.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	30.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	30.0	30.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**17.0**	**17.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

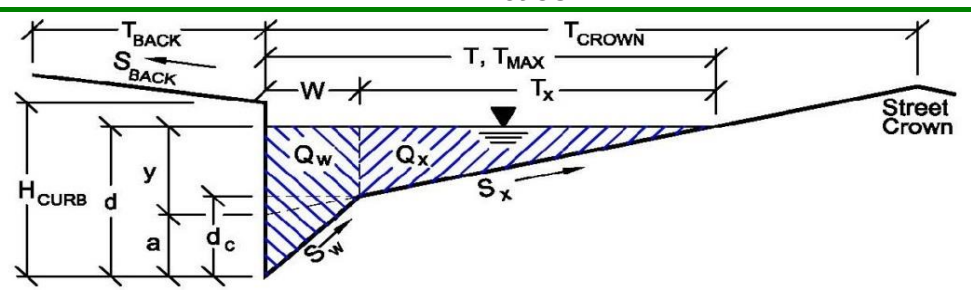
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: SEC Marksheffel & Constitution

Inlet ID: Inlet-3C



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	1.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	114.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.014	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	30.0	30.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

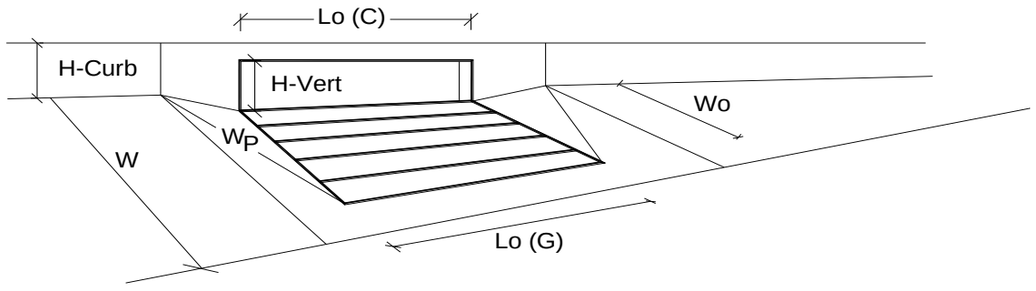
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

INLET IN A SUMP OR SAG LOCATION

Project = SEC Marksheffel & Constitution

Inlet ID = Inlet-3C

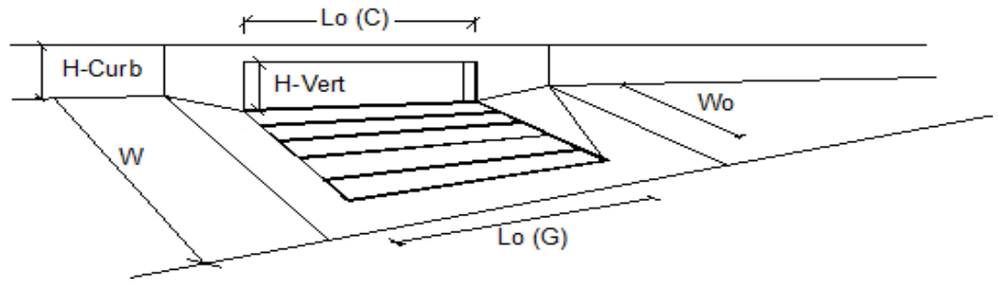


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.7	inches
				☐ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**6.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.1	4.2	cfs

INLET ON A CONTINUOUS GRADE

Project: SEC Marksheffel & Constitution

Inlet ID: Inlet-4A



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

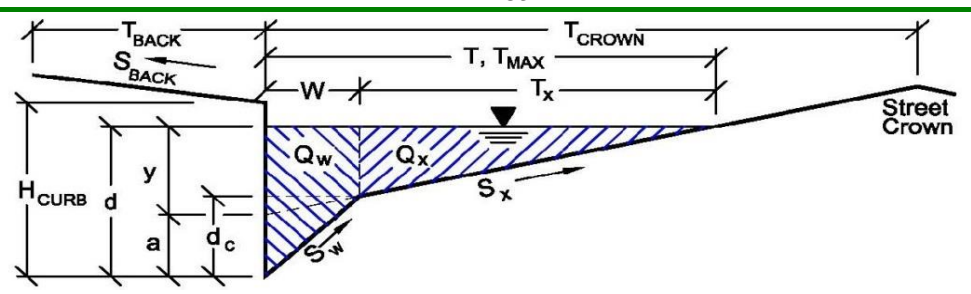
Street Hydraulics: OK - Q < maximum allowable from sheet 'Q-Allow'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.40**	**4.28**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**94**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: SEC Marksheffel & Constitution

Inlet ID: Inlet-4A



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	2.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	30.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	30.0	30.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**17.0**	**17.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

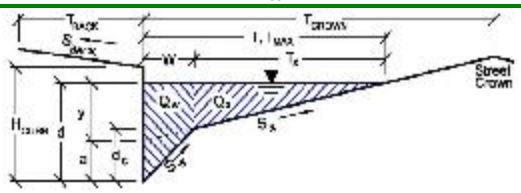
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: SEC Marksheffel & Constitution

Inlet ID: Inlet-7A



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	30.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	30.0	30.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		■	■	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

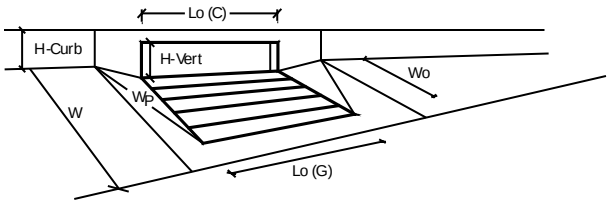
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

INLET IN A SUMP OR SAG LOCATION

Project = SEC Marksheffel & Constitution

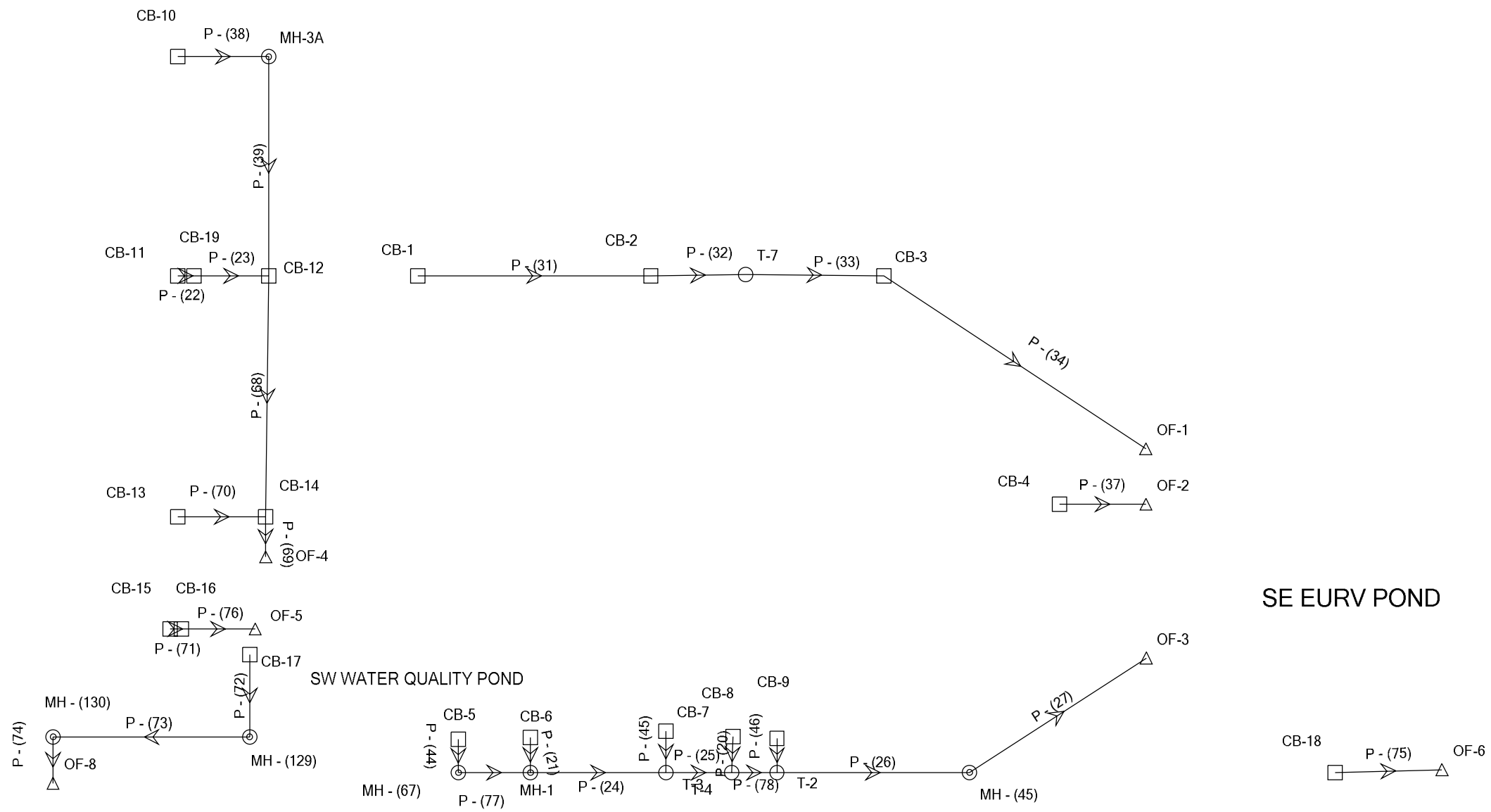
Inlet ID = Inlet-7A



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	8.7	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condi	Q_a =	**10.5**	**21.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	6.6	12.5	cfs

■ Override Depths

Scenario: 5-year

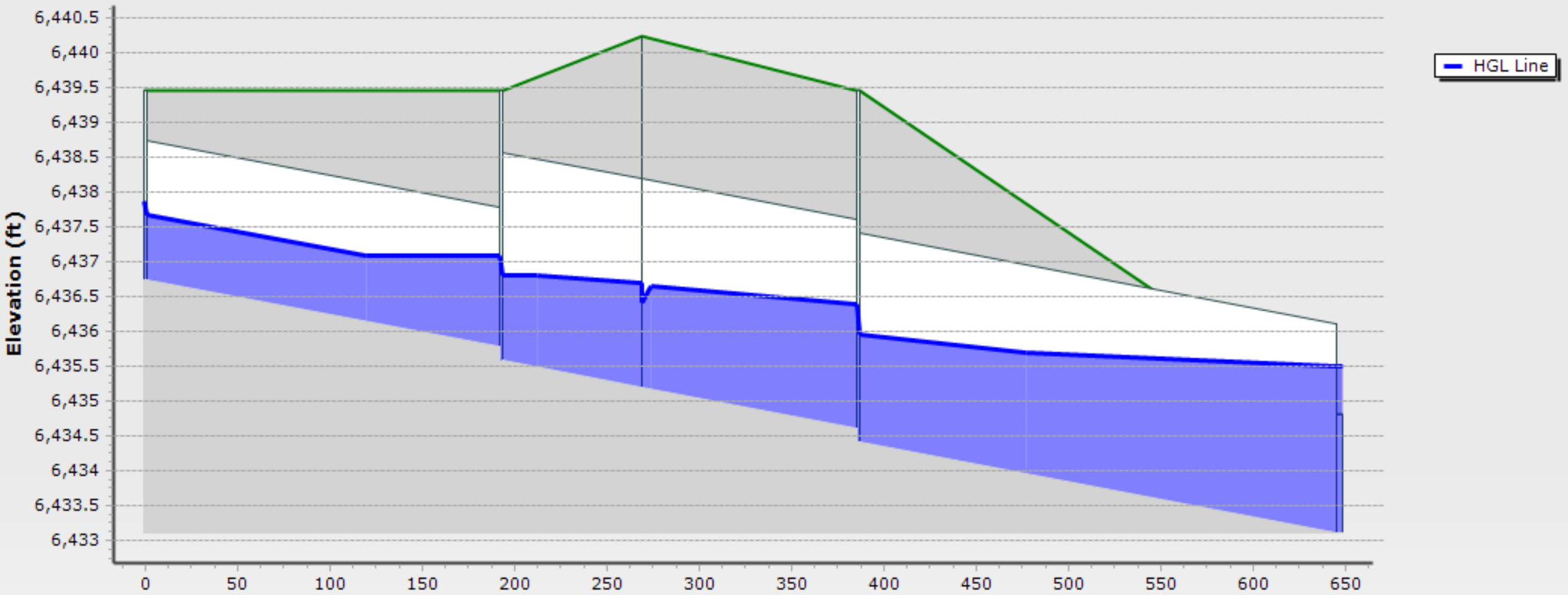


Scenario: 5-year
Current Time Step: 0.000Hr
Conduit FlexTable: Combined Pipe/Node Report

Label	Start Node	Stop Node	Diameter (in)	Length (Unified) (ft)	Capacity (Full Flow) (ft³/s)	Velocity (Average) (ft/s)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Slope (ft/ft)	Manning's n	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
P - (20)	CB-8	T-4	12.0	42.0	5.93	4.13	6,436.13	6,434.96	0.028	0.013	6,437.47	6,437.12
P - (21)	CB-6	MH-1	12.0	26.2	10.08	6.71	6,437.80	6,435.70	0.080	0.013	6,437.95	6,437.28
P - (22)	CB-11	CB-19	18.0	8.0	14.85	2.05	6,436.92	6,436.76	0.020	0.013	6,438.68	6,438.67
P - (23)	CB-19	CB-12	18.0	70.4	14.87	2.97	6,436.56	6,435.15	0.020	0.013	6,438.60	6,438.43
P - (24)	MH-1	T-3	24.0	172.0	14.33	3.87	6,435.35	6,434.66	0.004	0.013	6,437.27	6,437.22
P - (25)	T-3	T-4	24.0	50.4	14.25	2.37	6,434.66	6,434.46	0.004	0.013	6,437.18	6,437.12
P - (26)	T-2	MH - (45)	24.0	94.5	14.34	3.56	6,434.18	6,433.80	0.004	0.013	6,436.78	6,436.55
P - (27)	MH - (45)	OF-3	24.0	175.6	14.28	3.56	6,433.70	6,433.00	0.004	0.013	6,436.43	6,436.00
P - (31)	CB-1	CB-2	24.0	193.0	14.29	4.56	6,435.89	6,435.12	0.004	0.013	6,436.90	6,436.61
P - (32)	CB-2	T-7	36.0	76.2	42.19	5.59	6,435.02	6,434.72	0.004	0.013	6,436.40	6,436.40
P - (33)	T-7	CB-3	36.0	116.8	42.54	5.63	6,434.72	6,434.24	0.004	0.013	6,436.24	6,436.24
P - (34)	CB-3	OF-1	36.0	261.3	40.00	5.97	6,434.04	6,433.10	0.004	0.013	6,436.00	6,436.00
P - (37)	CB-4	OF-2	24.0	53.1	14.23	2.12	6,433.25	6,433.04	0.004	0.013	6,435.32	6,435.27
P - (38)	CB-10	MH-3A	18.0	75.8	12.88	6.53	6,439.20	6,438.06	0.015	0.013	6,439.79	6,438.90
P - (39)	MH-3A	CB-12	18.0	181.0	12.85	6.52	6,437.86	6,435.15	0.015	0.013	6,438.64	6,438.43
P - (44)	CB-5	MH - (67)	12.0	42.3	2.26	4.28	6,435.88	6,435.71	0.004	0.013	6,437.75	6,437.37
P - (45)	CB-7	T-3	12.0	21.7	10.08	11.74	6,436.90	6,435.16	0.080	0.013	6,437.37	6,437.22
P - (46)	CB-9	T-2	12.0	74.0	2.52	0.62	6,435.05	6,434.68	0.005	0.013	6,436.89	6,436.88
P - (68)	CB-12	CB-14	36.0	197.9	81.71	1.93	6,434.95	6,431.98	0.015	0.013	6,438.39	6,438.31
P - (69)	CB-14	OF-4	36.0	31.8	81.89	2.74	6,430.48	6,430.00	0.015	0.013	6,438.23	6,438.20
P - (70)	CB-13	CB-14	18.0	70.7	14.83	2.04	6,433.39	6,431.98	0.020	0.013	6,438.39	6,438.31
P - (71)	CB-15	CB-16	18.0	8.0	14.85	1.29	6,432.86	6,432.70	0.020	0.013	6,438.36	6,438.36
P - (72)	CB-17	MH - (129)	30.0	69.0	53.41	4.31	6,429.42	6,428.25	0.017	0.013	6,429.67	6,428.50
P - (73)	MH - (129)	MH - (130)	30.0	164.2	53.28	4.30	6,428.05	6,425.28	0.017	0.013	6,428.30	6,425.59
P - (74)	MH - (130)	OF-8	36.0	38.6	140.30	5.87	6,425.08	6,423.37	0.044	0.013	6,425.27	6,423.56
P - (75)	CB-18	OF-6	18.0	86.5	7.80	0.61	6,431.15	6,430.67	0.006	0.013	6,435.01	6,435.00
P - (76)	CB-16	OF-5	18.0	60.2	14.85	2.54	6,431.20	6,430.00	0.020	0.013	6,438.31	6,438.20
P - (77)	MH - (67)	MH-1	18.0	39.6	6.68	1.90	6,435.61	6,435.45	0.004	0.013	6,437.32	6,437.28
P - (78)	T-4	T-2	24.0	70.2	14.29	3.40	6,434.46	6,434.18	0.004	0.013	6,437.03	6,436.88

H:\Evergreen Development\CO, Colorado Springs EDI000008.01 - Constitution Ave. & Marksheffl Road\3. Permit Const Docs\3.04 Grading-Drainage Studies\3.04.2 Proposed Drainage Reports-Info\StormCAD\EDI08.1.stc

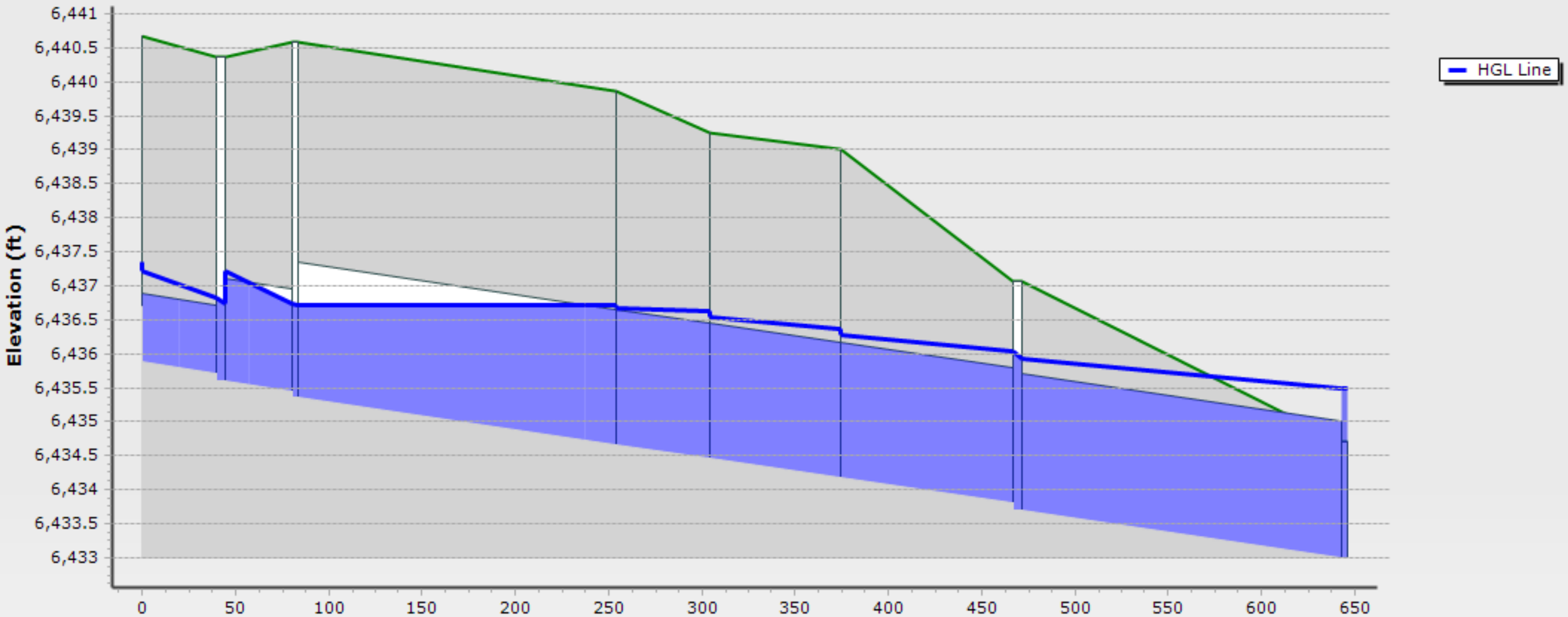
Basin A - 5-year



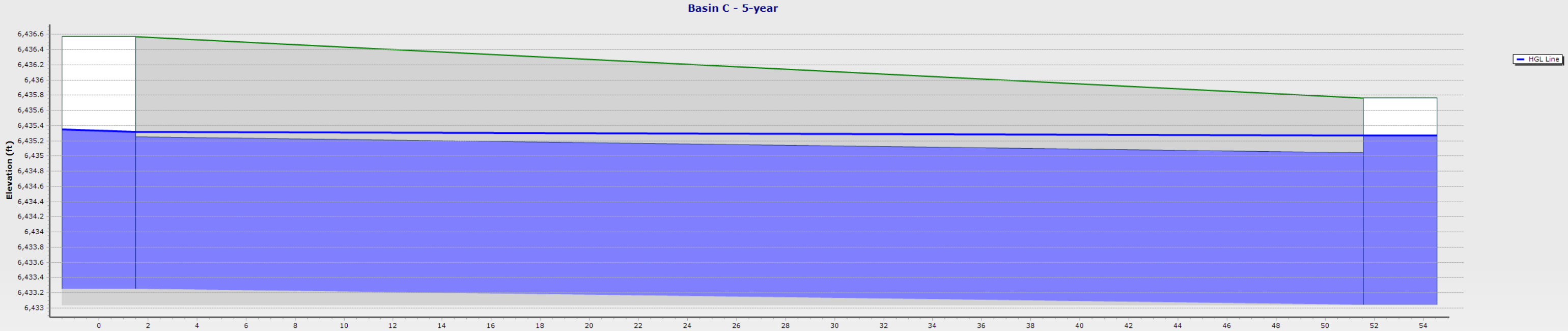
ID\Label	69 \ P - (31)	70 \ P - (32)	71 \ P - (33)	72 \ P - (34)
Link Length (ft)	191.4	75.4	115.9	258.9
Rise (in)\Material	24.0 \	36.0 \	36.0 \	36.0 \
Flow (ft³/s)	7.22	16.38	16.38	24.97
Slope (ft/ft)	0.005	0.005	0.005	0.005

ID\Label	85 \ CB-1	86 \ CB-2	124 \ T-7	87 \ CB-3	88 \ OF-1
Ground (ft)	6439.46	6439.46	6440.24	6439.46	6434.81
Invert (ft)	6436.74	6435.57	6435.19	6434.41	6433.10
Station (ft)	0.0	193.0	269.2	385.9	647.2

Basin B - 5-year

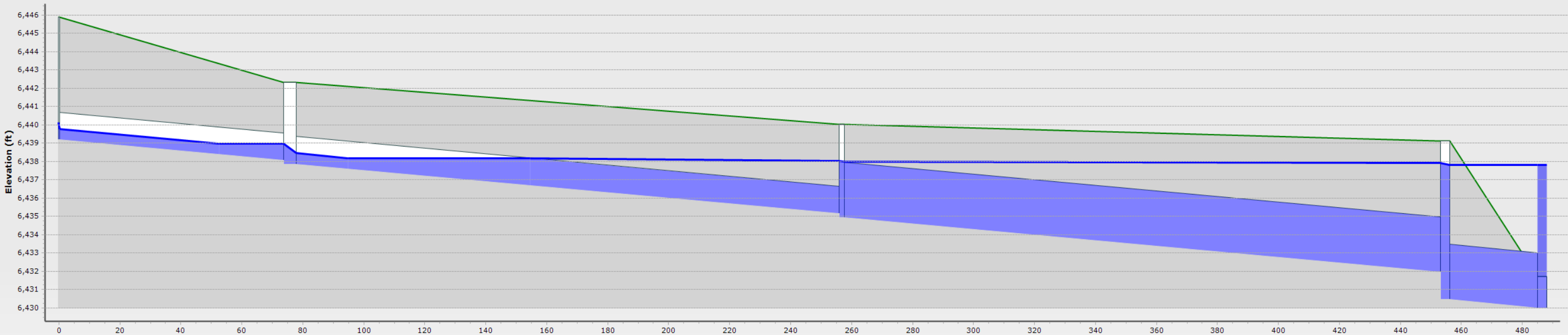


ID\Label	63 \ P - (44)	65 \ P - (77)	76 \ P - (24)	78 \ P - (25)	81 \ P - (78)	79 \ P - (26)	80 \ P - (27)	
Link Length (ft)	39.6	35.6	170.5	50.4	70.1	92.0	171.6	
Rise (in)\Material	12.0 \	18.0 \	24.0 \	24.0 \	24.0 \	24.0 \	24.0 \	
Flow (ft³/s)	3.36	3.36	3.87	7.45	10.69	11.18	11.18	
Slope (ft/ft)	0.004	0.004	0.004	0.004	0.004	0.004	0.004	
ID\Label	91 \ CB-5	23 \ MH - (67)	37 \ MH-1	111 \ T-3	112 \ T-4	110 \ T-2	38 \ MH - (45)	96 \ OF-3
Ground (ft)	6440.67	6440.37	6440.58	6439.87	6439.25	6439.00	6437.06	6434.70
Invert (ft)	6436.70	6435.61	6435.35	6434.66	6434.46	6434.18	6433.70	6433.00
Station (ft)	0.0	42.3	81.9	253.9	304.3	374.5	469.0	644.5



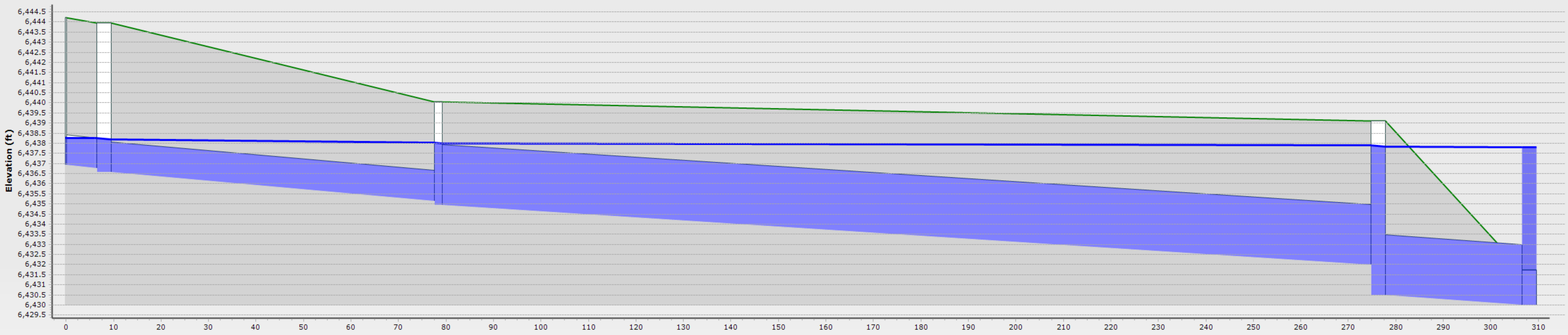
ID\Label		83 \ P - (37)	
Link Length (ft)		50.1	
Rise (in)\Material		24.0 \	
Flow (ft³/s)		6.66	
Slope (ft/ft)		0.004	
ID\Label	90 \ CB-4		89 \ OF-2
Ground (ft)	6436.57		6435.76
Invert (ft)	6433.25		6433.04
Station (ft)	0.0		53.1

Basin D - 5-year



ID\Label		58 \ P - (38)	59 \ P - (39)		68 \ P - (68)	73 \ P - (69)	
Link Length (ft)		73.6	178.2		195.6	28.8	
Rise (in)\Material		18.0 \	18.0 \		36.0 \	36.0 \	
Flow (ft³/s)		4.23	4.23		13.61	19.37	
Slope (ft/ft)		0.015	0.015		0.015	0.015	
ID\Label	99 \ CB-10	17 \ MH-3A		101 \ CB-12		103 \ CB-14	97 \ OF-4
Ground (ft)	6445.88	6442.31		6440.03		6439.10	6431.71
Invert (ft)	6439.20	6437.86		6434.95		6430.48	6430.00
Station (ft)	0.0	75.8		256.8		454.7	486.5

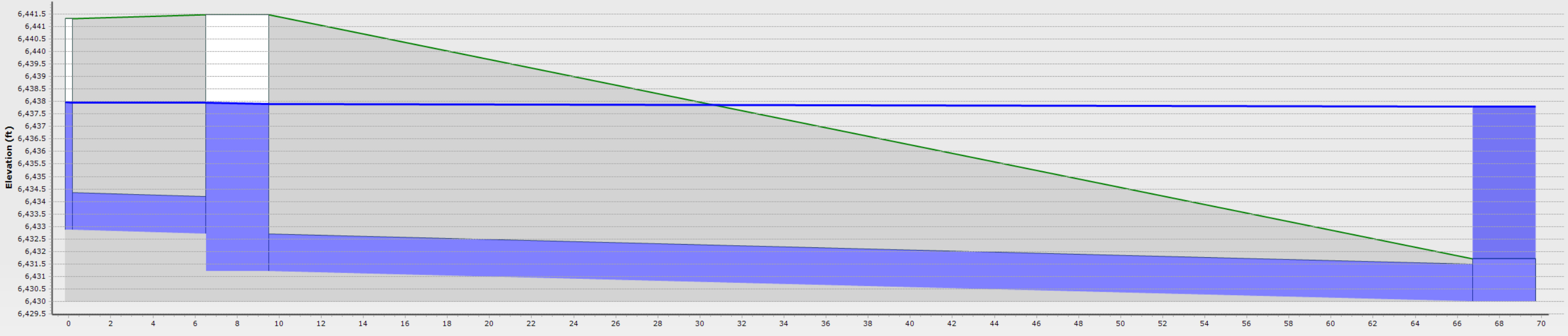
Basin D Mid Lateral - 5-year



131 \ P - (22)	132 \ P - (23)	68 \ P - (68)	73 \ P - (69)
6.3	68.1	195.6	28.8
18.0 \	18.0 \	36.0 \	36.0 \
3.62	5.25	13.61	19.37
0.020	0.020	0.015	0.015

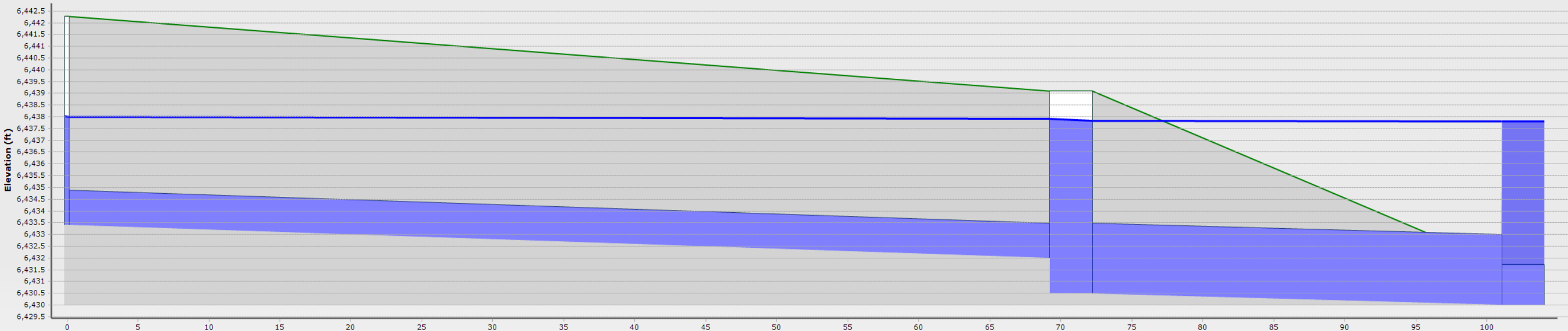
100 \ CB-11	130 \ CB-19	101 \ CB-12	103 \ CB-14	97 \ OF-4
6444.21	6443.96	6440.03	6439.10	6431.71
6436.92	6436.56	6434.95	6430.48	6430.00
0.0	8.0	78.4	276.3	308.1

Basin D South - 5-year

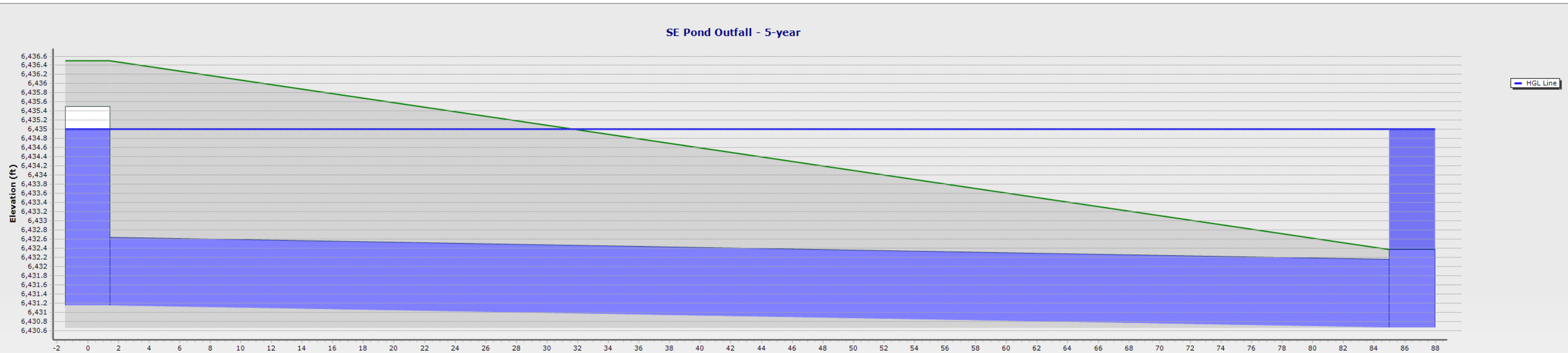


ID\Label	61 \ P - (71)		62 \ P - (76)		
Link Length (ft)	6.3		57.2		
Rise (in)\Material	18.0 \		18.0 \		
Flow (ft³/s)	2.28		4.49		
Slope (ft/ft)	0.020		0.020		
ID\Label	104 \ CB-15	105 \ CB-16			98 \ OF-5
Ground (ft)	6441.31	6441.47			6431.71
Invert (ft)	6432.86	6431.20			6430.00
Station (ft)	0.0	8.0			68.2

Basin D Lateral South - 5-year

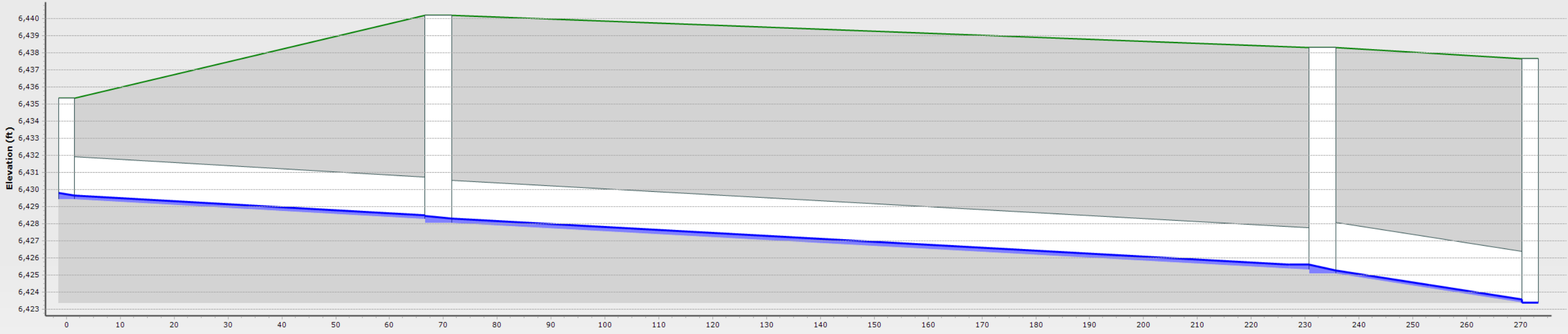


		60 \ P - (70)				73 \ P - (69)		
		69.0				28.8		
		18.0 \				36.0 \		
		3.60				19.37		
		0.020				0.015		
102 \ CB-13				103 \ CB-14				97 \ OF-4
6442.27				6439.10				6431.71
6433.39				6430.48				6430.00
0.0				70.7				102.5



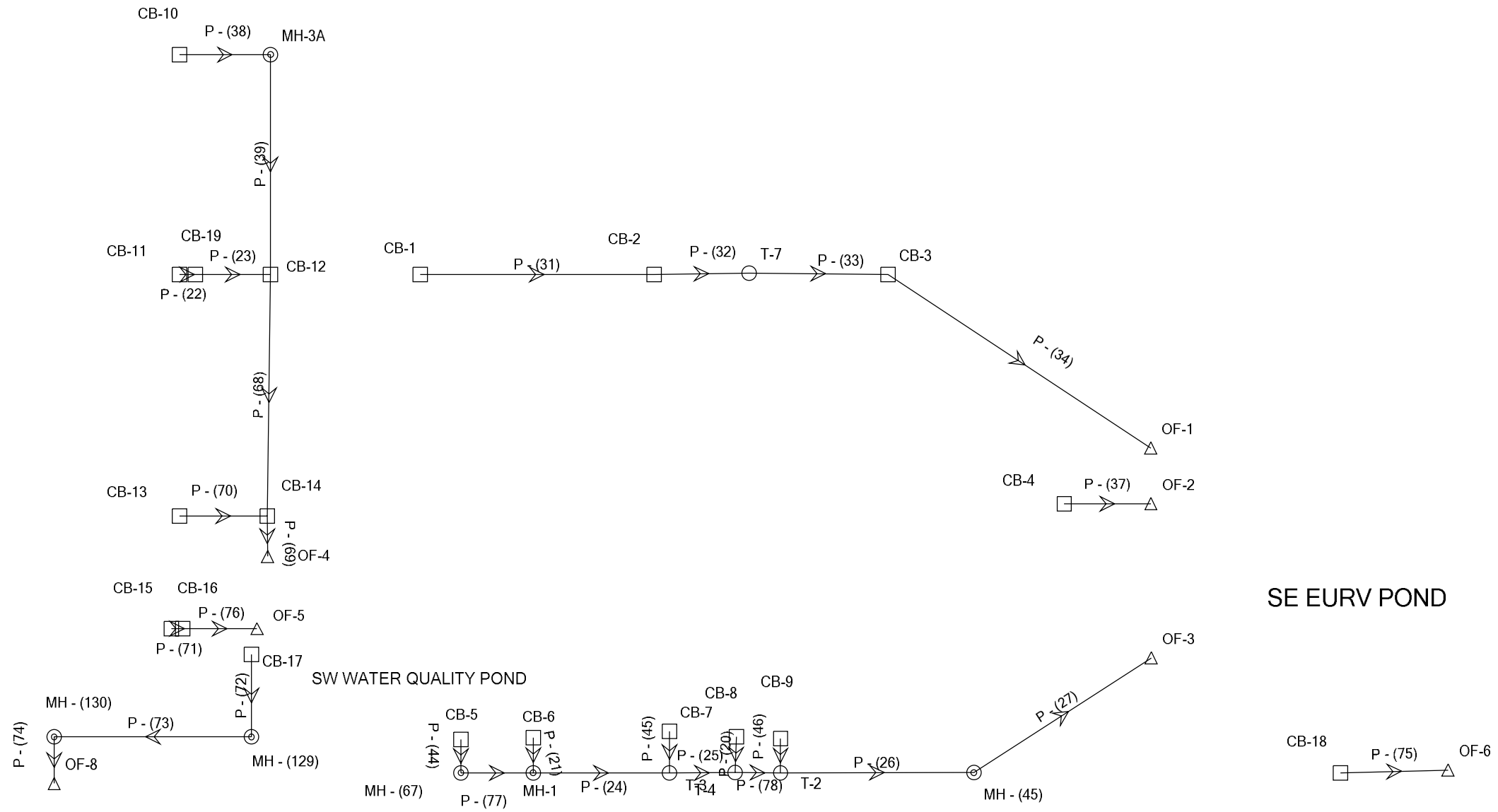
ID\Label		84 \ P - (75)	
Link Length (ft)		83.5	
Rise (in)\Material		18.0 \	
Flow (ft³/s)		1.07	
Slope (ft/ft)		0.006	
ID\Label	108 \ CB-18		107 \ OF-6
Ground (ft)	6436.50		6432.38
Invert (ft)	6431.15		6430.67
Station (ft)	0.0		86.5

SW Pond Outfall - 5-year



ID\Label		119 \ P - (72)		66 \ P - (73)	74 \ P - (74)
Link Length (ft)		65.0		159.2	34.6
Rise (in)\Material		30.0 \		30.0 \	36.0 \
Flow (ft³/s)		1.07		1.07	1.07
Slope (ft/ft)		0.017		0.017	0.044
ID\Label	106 \ CB-17		25 \ MH - (129)		33 \ MH - (130)	135 \ OF-8
Ground (ft)	6435.35		6440.21		6438.32	6437.65
Invert (ft)	6429.42		6428.05		6425.08	6423.37
Station (ft)	0.0		69.0		233.2	271.8

Scenario: 100-year

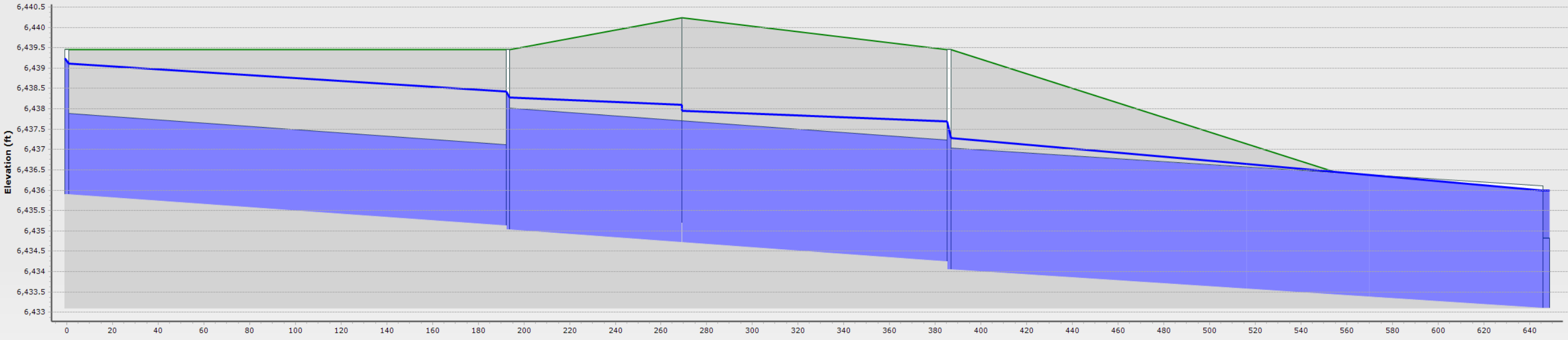


Scenario: 100-year
Current Time Step: 0.000Hr
Conduit FlexTable: Combined Pipe/Node Report

Label	Start Node	Stop Node	Diameter (in)	Length (Unified) (ft)	Capacity (Full Flow) (ft^3/s)	Velocity (Average) (ft/s)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Slope (ft/ft)	Manning's n	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
P - (20)	CB-8	T-4	12.0	42.0	5.93	1.12	6,436.13	6,434.96	0.028	0.013	6,437.65	6,437.63
P - (21)	CB-6	MH-1	12.0	26.2	10.08	11.51	6,437.80	6,435.70	0.080	0.013	6,438.20	6,437.80
P - (22)	CB-11	CB-19	18.0	8.0	14.85	3.74	6,436.92	6,436.76	0.020	0.013	6,439.88	6,439.85
P - (23)	CB-19	CB-12	18.0	70.4	14.87	5.60	6,436.56	6,435.15	0.020	0.013	6,439.60	6,438.98
P - (24)	MH-1	T-3	24.0	172.0	14.33	1.35	6,435.35	6,434.66	0.004	0.013	6,437.79	6,437.73
P - (25)	T-3	T-4	24.0	50.4	14.25	2.41	6,434.66	6,434.46	0.004	0.013	6,437.68	6,437.63
P - (26)	T-2	MH - (45)	24.0	94.5	14.34	4.61	6,434.18	6,433.80	0.004	0.013	6,437.31	6,436.92
P - (27)	MH - (45)	OF-3	24.0	175.6	14.28	4.61	6,433.70	6,433.00	0.004	0.013	6,436.72	6,436.00
P - (31)	CB-1	CB-2	24.0	193.0	14.29	4.26	6,435.89	6,435.12	0.004	0.013	6,439.11	6,438.43
P - (32)	CB-2	T-7	36.0	76.2	42.19	4.47	6,435.02	6,434.72	0.004	0.013	6,438.28	6,438.11
P - (33)	T-7	CB-3	36.0	116.8	42.54	4.47	6,434.72	6,434.24	0.004	0.013	6,437.95	6,437.69
P - (34)	CB-3	OF-1	36.0	261.3	40.00	6.61	6,434.04	6,433.10	0.004	0.013	6,437.28	6,436.00
P - (37)	CB-4	OF-2	24.0	53.1	14.23	3.99	6,433.25	6,433.04	0.004	0.013	6,436.16	6,436.00
P - (38)	CB-10	MH-3A	18.0	75.8	12.88	7.61	6,439.20	6,438.06	0.015	0.013	6,440.54	6,440.19
P - (39)	MH-3A	CB-12	18.0	181.0	12.85	4.36	6,437.86	6,435.15	0.015	0.013	6,439.95	6,438.98
P - (44)	CB-5	MH - (67)	12.0	42.3	2.26	1.16	6,435.88	6,435.71	0.004	0.013	6,437.84	6,437.81
P - (45)	CB-7	T-3	12.0	21.7	10.08	4.24	6,436.90	6,435.16	0.080	0.013	6,437.92	6,437.73
P - (46)	CB-9	T-2	12.0	74.0	2.52	7.69	6,435.05	6,434.68	0.005	0.013	6,439.60	6,437.47
P - (68)	CB-12	CB-14	36.0	197.9	81.71	3.56	6,434.95	6,431.98	0.015	0.013	6,438.86	6,438.58
P - (69)	CB-14	OF-4	36.0	31.8	81.89	5.11	6,430.48	6,430.00	0.015	0.013	6,438.29	6,438.20
P - (70)	CB-13	CB-14	18.0	70.7	14.83	3.71	6,433.39	6,431.98	0.020	0.013	6,438.85	6,438.58
P - (71)	CB-15	CB-16	18.0	8.0	14.85	2.35	6,432.86	6,432.70	0.020	0.013	6,438.77	6,438.76
P - (72)	CB-17	MH - (129)	30.0	69.0	53.41	10.31	6,429.42	6,428.25	0.017	0.013	6,433.97	6,432.92
P - (73)	MH - (129)	MH - (130)	30.0	164.2	53.28	10.31	6,428.05	6,425.28	0.017	0.013	6,431.93	6,429.43
P - (74)	MH - (130)	OF-8	36.0	38.6	140.30	18.24	6,425.08	6,423.37	0.044	0.013	6,426.33	6,424.62
P - (75)	CB-18	OF-6	18.0	86.5	7.80	4.73	6,431.15	6,430.67	0.006	0.013	6,435.55	6,435.00
P - (76)	CB-16	OF-5	18.0	60.2	14.85	4.73	6,431.20	6,430.00	0.020	0.013	6,438.58	6,438.20
P - (77)	MH - (67)	MH-1	18.0	39.6	6.68	0.51	6,435.61	6,435.45	0.004	0.013	6,437.81	6,437.80
P - (78)	T-4	T-2	24.0	70.2	14.29	2.69	6,434.46	6,434.18	0.004	0.013	6,437.57	6,437.47

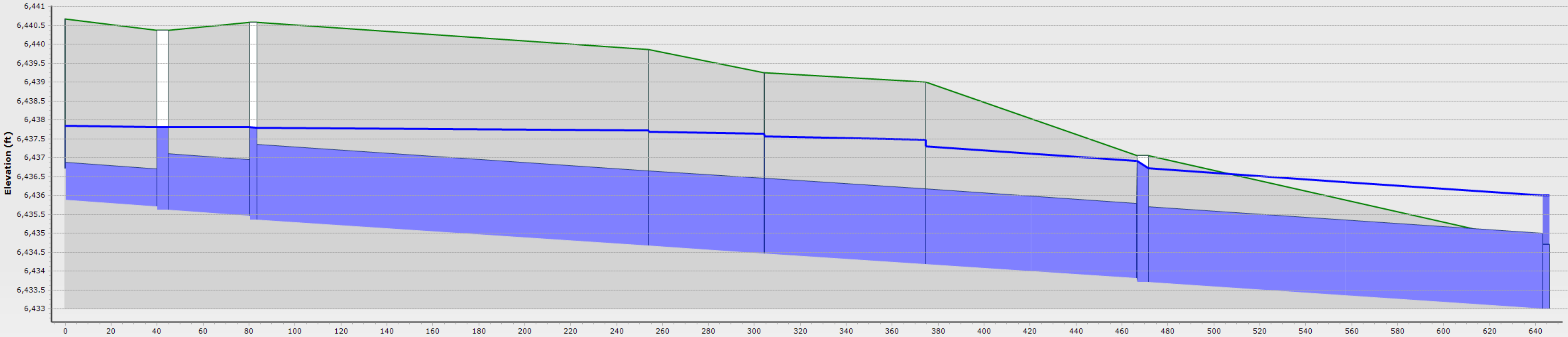
H:\Evergreen Development\CO, Colorado Springs EDI000008.01 - Constitution Ave. & Marksheffl Road\3. Permit Const Docs\3.04 Grading-Drainage Studies\3.04.2 Proposed Drainage Reports-Info\StormCAD\EDI08.1.stc

Basin A - 100-year



ID\Label		69 \ P - (31)	70 \ P - (32)	71 \ P - (33)	72 \ P - (34)	
Link Length (ft)		191.4	75.4	115.9	258.9	
Rise (in)\Material		24.0 \	36.0 \	36.0 \	36.0 \	
Flow (ft³/s)		13.38	31.58	31.58	46.71	
Slope (ft/ft)		0.004	0.004	0.004	0.004	
ID\Label	85 \ CB-1	86 \ CB-2	124 \ T-7	87 \ CB-3		88 \ OF-1
Ground (ft)	6439.46	6439.46	6440.24	6439.46		6434.81
Invert (ft)	6435.89	6435.02	6435.19	6434.04		6433.10
Station (ft)	0.0	193.0	269.2	385.9		647.2

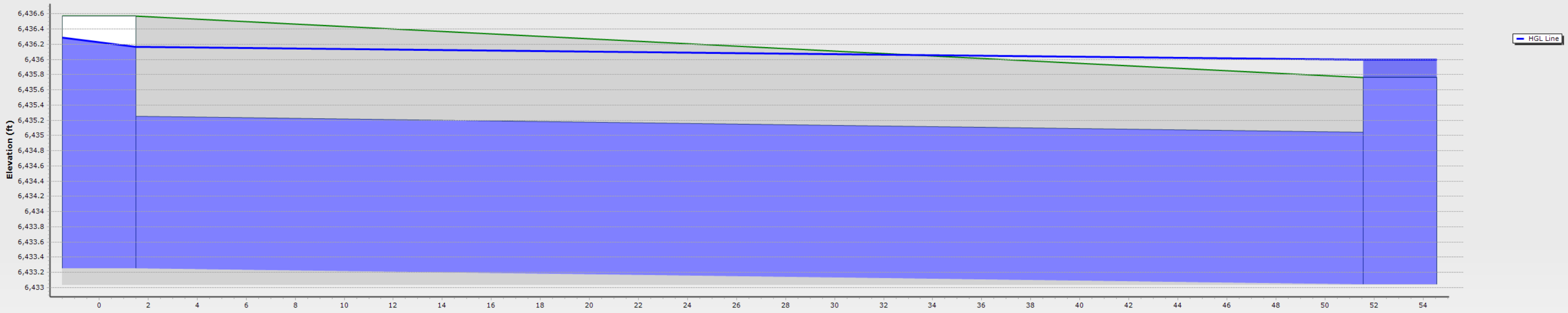
Basin B - 100-year



63 \ P - (44)	65 \ P - (77)	76 \ P - (24)	78 \ P - (25)	81 \ P - (78)	79 \ P - (26)	80 \ P - (27)
39.6	35.6	170.5	50.4	70.1	92.0	171.6
12.0 \	18.0 \	24.0 \	24.0 \	24.0 \	24.0 \	24.0 \
0.91	0.91	4.24	7.57	8.45	14.49	14.49
0.004	0.004	0.004	0.004	0.004	0.004	0.004

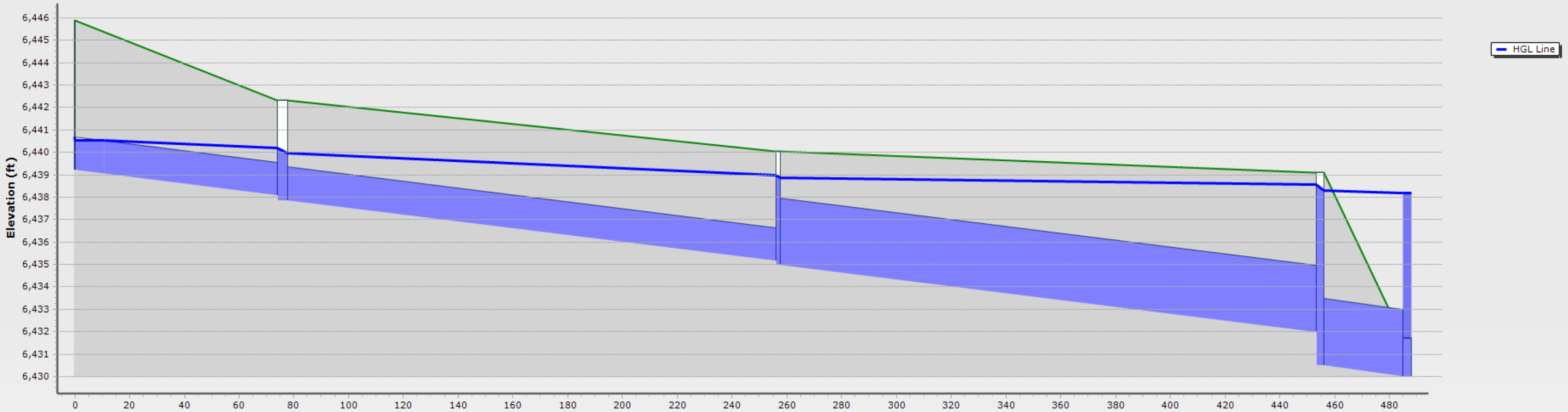
91 \ CB-5	23 \ MH - (67)	137 \ MH-1	111 \ T-3	112 \ T-4	110 \ T-2	38 \ MH - (45)	96 \ OF-3
6440.67	6440.37	6440.58	6439.87	6439.25	6439.00	6437.06	6434.70
6436.70	6435.61	6435.35	6434.66	6434.46	6434.18	6433.70	6433.00
0.0	42.3	81.9	253.9	304.3	374.5	469.0	644.5

Basin C - 100-year



ID\Label		83 \ P - (37)	
Link Length (ft)		50.1	
Rise (in)\Material		24.0 \	
Flow (ft³/s)		12.54	
Slope (ft/ft)		0.004	
ID\Label	90 \ CB-4		89 \ OF-2
Ground (ft)	6436.57		6435.76
Invert (ft)	6433.25		6433.04
Station (ft)	0.0		53.1

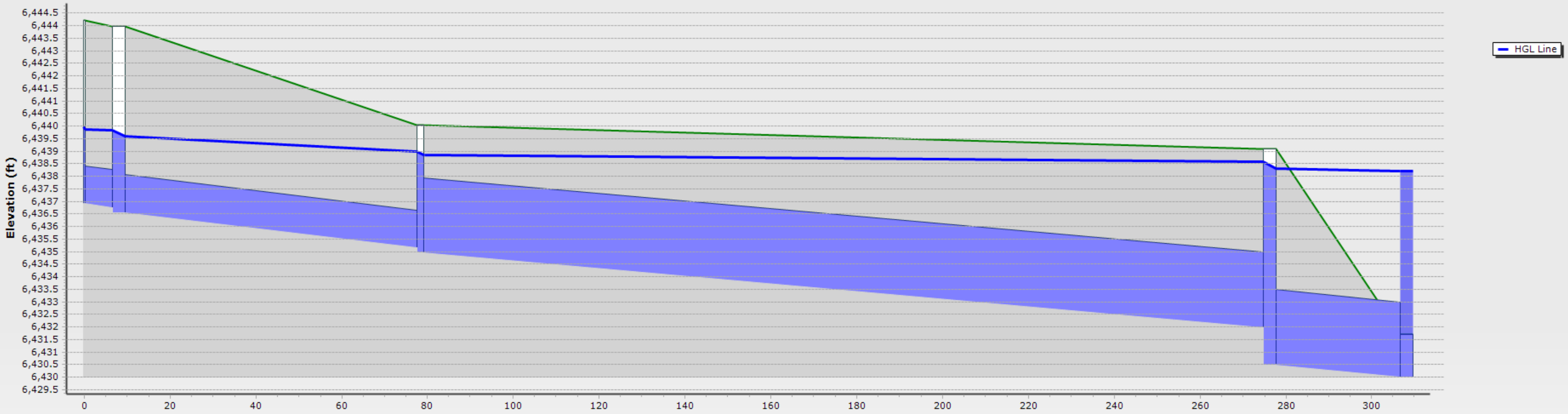
Basin D - 100-year



ID\Label	58 \ P - (38)	59 \ P - (39)	68 \ P - (68)	73 \ P - (69)
Link Length (ft)	73.6	178.2	195.6	28.8
Rise (in)\Material	18.0 \	18.0 \	36.0 \	36.0 \
Flow (ft³/s)	7.71	7.71	25.14	36.12
Slope (ft/ft)	0.015	0.015	0.015	0.015

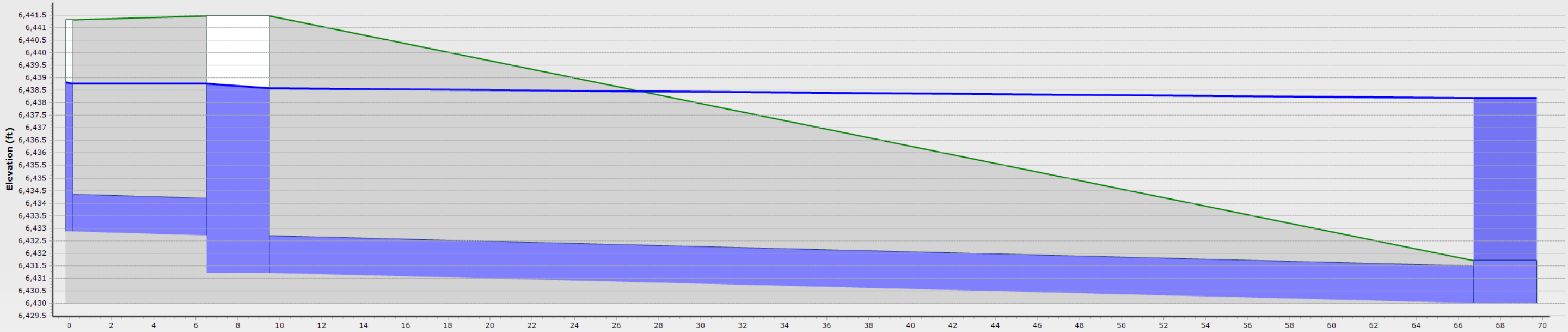
ID\Label	99 \ CB-10	17 \ MH-3A	101 \ CB-12	103 \ CB-14	97 \ OF-4
Ground (ft)	6445.88	6442.31	6440.03	6439.10	6431.71
Invert (ft)	6439.20	6437.86	6434.95	6430.48	6430.00
Station (ft)	0.0	75.8	256.8	454.7	486.5

Basin D Mid Lateral - 100-year

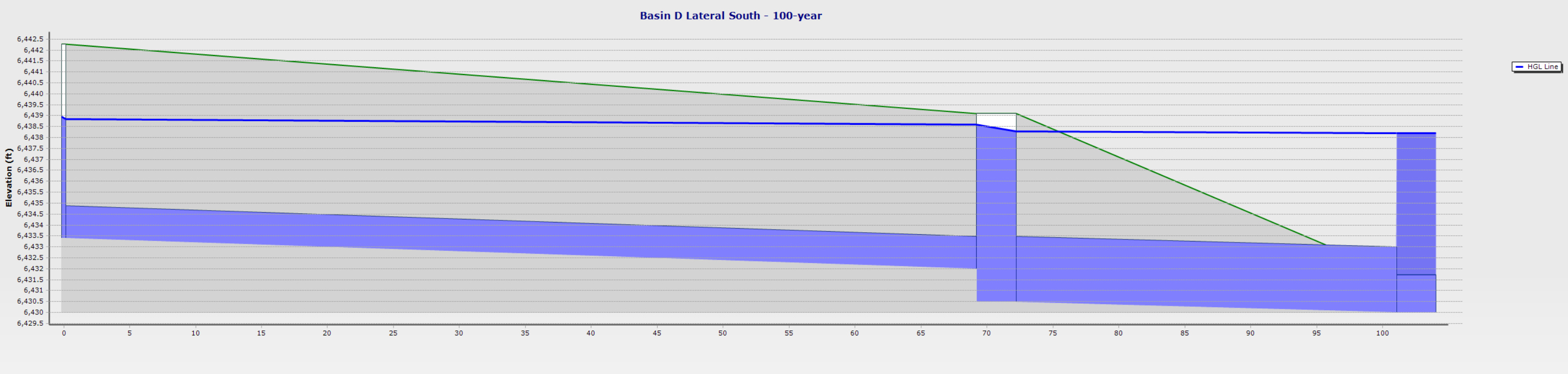


ID\Label	131 \ P - (22)	132 \ P - (23)	68 \ P - (68)	73 \ P - (69)	
Link Length (ft)	6.3	68.1	195.6	28.8	
Rise (in)\Material	18.0 \	18.0 \	36.0 \	36.0 \	
Flow (ft³/s)	6.61	9.90	25.14	36.12	
Slope (ft/ft)	0.020	0.020	0.015	0.015	
ID\Label	100 \ CB-18	110 \ CB-19	101 \ CB-12	103 \ CB-14	97 \ OF-4
Ground (ft)	6444.21	6443.96	6440.03	6439.10	6431.71
Invert (ft)	6436.92	6436.56	6434.95	6430.48	6430.00
Station (ft)	0.0	8.0	78.4	276.3	308.1

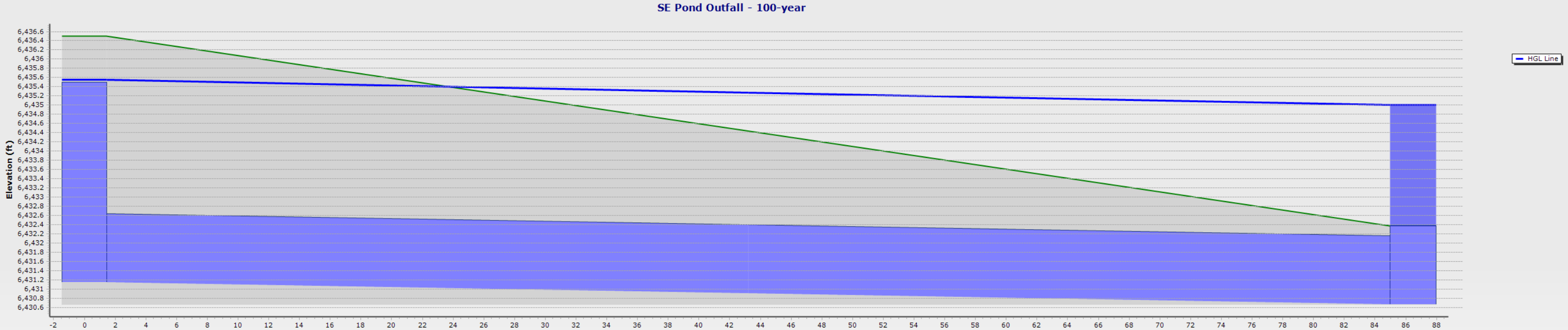
Basin D South - 100-year



ID\Label	61 \ P - (71)		62 \ P - (76)	
Link Length (ft)	6.3		57.2	
Rise (in)\Material	18.0 \		18.0 \	
Flow (ft³/s)	4.16		8.36	
Slope (ft/ft)	0.020		0.020	
ID\Label	104 \ CB-15	105 \ CB-16		98 \ OF-5
Ground (ft)	6441.31	6441.47		6431.71
Invert (ft)	6432.86	6431.20		6430.00
Station (ft)	0.0	8.0		68.2

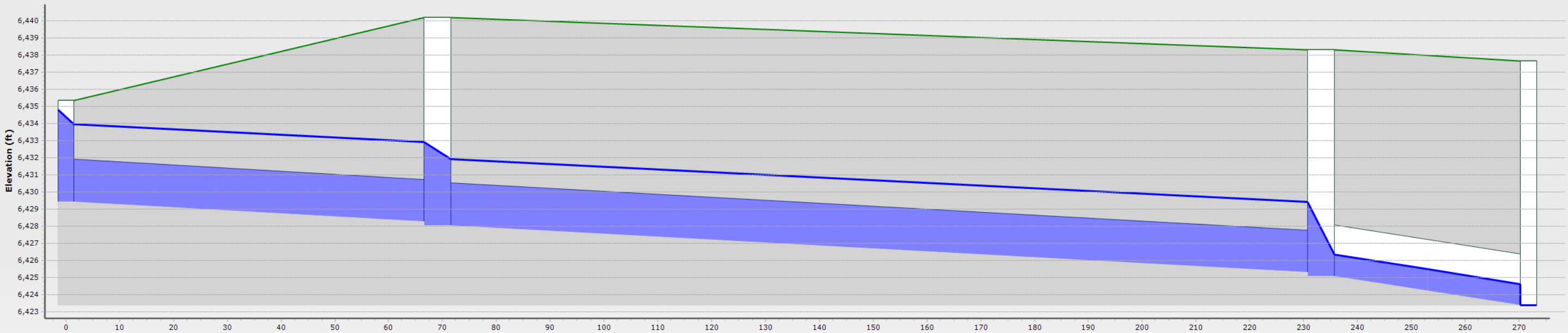


	60 \ P - (70)		73 \ P - (69)	
	69.0		28.8	
	18.0 \		36.0 \	
	6.56		36.12	
	0.020		0.015	
102 \ CB-13		103 \ CB-14		97 \ OF-4
6442.27		6439.10		6431.71
6433.39		6430.48		6430.00
0.0		70.7		102.5



ID\Label		84 \ P - (75)	
Link Length (ft)		83.5	
Rise (in)\Material		18.0 \	
Flow (ft³/s)		8.36	
Slope (ft/ft)		0.006	
ID\Label	108 \ CB-18		107 \ OF-6
Ground (ft)	6436.50		6432.38
Invert (ft)	6431.15		6430.67
Station (ft)	0.0		86.5

SW Pond Outfall - 100-year



ID\Label		119 \ P - (72)		66 \ P - (73)		74 \ P - (74)	
Link Length (ft)		65.0		159.2		34.6	
Rise (in)\Material		30.0 \		30.0 \		36.0 \	
Flow (ft³/s)		50.62		50.62		50.62	
Slope (ft/ft)		0.017		0.017		0.044	
ID\Label	106 \ CB-17		25 \ MH - (129)		33 \ MH - (130)		135 \ OF-8
Ground (ft)	6435.35		6440.21		6438.32		6437.65
Invert (ft)	6429.42		6428.05		6425.08		6423.37
Station (ft)	0.0		69.0		233.2		271.8

Project: **SEC Marksheffel/Constitution**
Conveyence Location: **SE EURV Pond Outfall**
Conveyence Description: **18" RCP**
Storm Event Periodicity: **100-year**

Design Parameters

Pipe Diameter (D)	18	Tailwater Depth (Y_t)=	4.33	
Discharge (Q_d)=	8.8	Slope (S)=	0.60%	
Pipe Velocity (v)=	7.80	Mannings (n)=	0.013	
Normal Depth (D_n)=	1.50	Q_{full}=	8.15	cfs
Actual Depth (d)=	1.50	Froude Number (Fr)=	1.12	*SUPERCRITICAL*

Rip-Rap Size

For supercritical flow Fr > 1

D_a= 1/2*($D+D_n$)

D_a= 1.50 Substitute D_a for D in all equations.

For subcritical flow Fr < 1

D= 1.50 Use Da = 1.50 for calculation purposes

Design Parameters

$Q/D^{1.5}$= 4.77
$Q/D^{2.5}$ = 3.18
Yt/D= 1.00

Rip Rap Size

-From Figure MD-21 (Urban Drainage Design Criteria Manual)

Use Type M RipRap

-From Table MD-7 (5-1) d_{50} = **12**

RipRap Depth = 2*d_{50}= **24** in.

Length and Width of Protection

-From Figure MD-23 (Urban Drainage Design Criteria Manual)

expansion factor 1/(2 tan Θ) = 6.6

-Solve for At, where At = Q/Va

Q= 8.77 cfs
V= 5.50 fps (assumed maximum for erosive velocities)
At= 1.59 sq ft

-Check length adjustment factor (D/4 for each whole number $Q/D^{2.5}$ > 6)

Adjustment Factor 0 *No Length Adjustment Required*

If $Q/D^{2.5}$ < 6			**If $Q/D^{2.5}$ > 6**	
Minimum length (ft)=	4.5	L = 3 D		
Calculated length (ft)=	-7.0	L= (1/(2 TAN Θ))(A_t/Y_t -W)	adjusted length=	n/a
Maximum length (ft)=	15.0	L = 10 D		
Width (ft)=	4.5	W=3D		

Required Rip Rap Length = 4.5 ft
Required Rip Rap Width = 4.5 ft

Project: **SEC Marksheffel/Constitution**
Conveyence Location: **Basin C-2**
Conveyence Description: **30" RCP**
Storm Event Periodicity: **100-year**

Design Parameters

Pipe Diameter (D)	24	Tailwater Depth (Y_t)=	2.74	
Discharge (Q_d)=	11.6	Slope (S)=	0.30%	
Pipe Velocity (v)=	6.61	Mannings (n)=	0.013	
Normal Depth (D_n)=	2.00	Q_{full}=	12.42	cfs
Actual Depth (d)=	2.00	Froude Number (Fr)=	0.82	*SUBCRITICAL*

Rip-Rap Size

For supercritical flow Fr > 1

D_a= 1/2*(D+D_n)

D_a= 2.00 Substitute D_a for D in all equations.

For subcritical flow Fr < 1

D= 2.00 Use D = 2.00 for calculation purposes

Design Parameters

$Q/D^{1.5}$= 4.09
$Q/D^{2.5}$ = 2.05
Yt/D= 1.00

Rip Rap Size

-From Figure MD-21 (Urban Drainage Design Criteria Manual)

Use Type L RipRap

-From Table MD-7 (5-1) d_{50} = **9**

RipRap Depth = 2*d_{50}= **18** in.

Length and Width of Protection

-From Figure MD-23 (Urban Drainage Design Criteria Manual)

expansion factor 1/(2 tan Θ) = 6.6

-Solve for At, where At = Q/Va

Q= 11.57 cfs
V= 5.50 fps (assumed maximum for erosive velocities)
At= 2.10 sq ft

-Check length adjustment factor (D/4 for each whole number $Q/D^{2.5}$ > 6)

Adjustment Factor 0 *No Length Adjustment Required*

If $Q/D^{2.5}$ < 6			**If $Q/D^{2.5}$ > 6**	
Minimum length (ft)=	6.0	L = 3 D		
Calculated length (ft)=	-8.0	L= (1/(2 TAN Θ))(A_t/Y_t -W)	adjusted length=	n/a
Maximum length (ft)=	20.0	L = 10 D		
Width (ft)=	6.0	W=3D		

Required Rip Rap Length = 6.0 ft
Required Rip Rap Width = 6.0 ft

Project: **SEC Marksheffel/Constitution**
Conveyence Location: **Basin D-6**
Conveyence Description: **36" RCP**
Storm Event Periodicity: **100-year**

Design Parameters

Pipe Diameter (D)	36	Tailwater Depth (Y_t)=	8.53	
Discharge (Q_d)=	36.1	Slope (S)=	1.50%	
Pipe Velocity (v)=	7.36	Mannings (n)=	0.013	
Normal Depth (D_n)=	1.40	Q_{full}=	81.87	cfs
Actual Depth (d)=	3.00	Froude Number (Fr)=	0.75	*SUBCRITICAL*

Rip-Rap Size

For supercritical flow Fr > 1

$D_a = 1/2*(D+D_n)$

D_a= 2.20 Substitute D_a for D in all equations.

For subcritical flow Fr < 1

D= 3.00 Use D = 3.00 for calculation purposes

Design Parameters

$Q/D^{1.5}$= 6.95
$Q/D^{2.5}$ = 2.32
Yt/D= 1.00

Rip Rap Size

-From Figure MD-21 (Urban Drainage Design Criteria Manual)

Use Type L RipRap

-From Table MD-7 (5-1) d_{50} = **9**

RipRap Depth = $2*d_{50}$= **18** in.

Length and Width of Protection

-From Figure MD-23 (Urban Drainage Design Criteria Manual)

expansion factor $1/(2 \tan \Theta)$ = 6.6

-Solve for At, where At = Q/Va

Q= 36.12 cfs
V= 5.50 fps (assumed maximum for erosive velocities)
At= 6.57 sq ft

-Check length adjustment factor (D/4 for each whole number $Q/D^{2.5} > 6$)

Adjustment Factor 0 *No Length Adjustment Required*

If $Q/D^{2.5} < 6$			**If $Q/D^{2.5} > 6$**	
Minimum length (ft)=	9.0	L = 3 D		
Calculated length (ft)=	-14.0	L= $(1/(2 \text{ TAN } \Theta))(A_t/Y_t - W)$	adjusted length=	n/a
Maximum length (ft)=	30.0	L = 10 D		
Width (ft)=	9.0	W=3D		

Required Rip Rap Length = 9.0 ft
Required Rip Rap Width = 9.0 ft

Project: **SEC Marksheffel/Constitution**
Conveyence Location: **Basin D-8**
Conveyence Description: **18" RCP**
Storm Event Periodicity: **100-year**

Design Parameters

Pipe Diameter (D)	18	Tailwater Depth (Y_t)=	5.35	
Discharge (Q_d)=	8.4	Slope (S)=	1.50%	
Pipe Velocity (v)=	4.73	Mannings (n)=	0.013	
Normal Depth (D_n)=	1.50	Q_{full}=	12.89	cfs
Actual Depth (d)=	1.50	Froude Number (Fr)=	0.68	*SUBCRITICAL*

Rip-Rap Size

For supercritical flow Fr > 1

D_a= 1/2*(D+D_n)

D_a= 1.50 Substitute D_a for D in all equations.

For subcritical flow Fr < 1

D= 1.50 Use D = 1.50 for calculation purposes

Design Parameters

$Q/D^{1.5}$= 4.55
$Q/D^{2.5}$ = 3.03
Yt/D= 1.00

Rip Rap Size

-From Figure MD-21 (Urban Drainage Design Criteria Manual)

Use Type L RipRap

-From Table MD-7 (5-1) d_{50} = **9**

RipRap Depth = 2*d_{50}= **18** in.

Length and Width of Protection

-From Figure MD-23 (Urban Drainage Design Criteria Manual)

expansion factor 1/(2 tan Θ) = 6.6

-Solve for At, where At = Q/Va

Q= 8.36 cfs
V= 5.50 fps (assumed maximum for erosive velocities)
At= 1.52 sq ft

-Check length adjustment factor (D/4 for each whole number $Q/D^{2.5}$ > 6)

Adjustment Factor 0 *No Length Adjustment Required*

If $Q/D^{2.5}$ < 6			**If $Q/D^{2.5}$ > 6**	
Minimum length (ft)=	4.5	L = 3 D		
Calculated length (ft)=	-8.0	L= (1/(2 TAN Θ))(A_t/Y_t -W)	adjusted length=	n/a
Maximum length (ft)=	15.0	L = 10 D		
Width (ft)=	4.5	W=3D		

Required Rip Rap Length = 4.5 ft
Required Rip Rap Width = 4.5 ft

Project: **SEC Marksheffel/Constitution**
Conveyence Location: **Basin A**
Conveyence Description: **36" RCP**
Storm Event Periodicity: **100-year**

Design Parameters

Pipe Diameter (D)	36	Tailwater Depth (Y_t)=	2.90	
Discharge (Q_d)=	46.7	Slope (S)=	0.50%	
Pipe Velocity (v)=	7.61	Mannings (n)=	0.013	
Normal Depth (D_n)=	2.90	Q_{full}=	47.27	cfs
Actual Depth (d)=	2.90	Froude Number (Fr)=	0.79	*SUBCRITICAL*

Rip-Rap Size

For supercritical flow Fr > 1

D_a= 1/2*(D+D_n)

D_a= 2.95 Substitute D_a for D in all equations.

For subcritical flow Fr < 1

D= 3.00 Use D = 3.00 for calculation purposes

Design Parameters

$Q/D^{1.5}$= 8.99
$Q/D^{2.5}$ = 3.00
Yt/D= 0.97

Rip Rap Size

-From Figure MD-21 (Urban Drainage Design Criteria Manual)

Use Type L RipRap

-From Table MD-7 (5-1) d_{50} = **9**

RipRap Depth = 2*d_{50}= **18** in.

Length and Width of Protection

-From Figure MD-23 (Urban Drainage Design Criteria Manual)

expansion factor 1/(2 tan Θ) = 6.6

-Solve for At, where At = Q/Va

Q= 46.71 cfs
V= 5.50 fps (assumed maximum for erosive velocities)
At= 8.49 sq ft

-Check length adjustment factor (D/4 for each whole number $Q/D^{2.5}$ > 6)

Adjustment Factor 0 *No Length Adjustment Required*

If $Q/D^{2.5}$ < 6			**If $Q/D^{2.5}$ > 6**	
Minimum length (ft)=	9.0	L = 3 D		
Calculated length (ft)=	0.0	L= (1/(2 TAN Θ))(A_t/Y_t -W)	adjusted length=	n/a
Maximum length (ft)=	30.0	L = 10 D		
Width (ft)=	9.0	W=3D		

Required Rip Rap Length = 9.0 ft
Required Rip Rap Width = 9.0 ft

Project: **SEC Marksheffel/Constitution**
Conveyence Location: **Basin B**
Conveyence Description: **24" RCP**
Storm Event Periodicity: **100-year**

Design Parameters

Pipe Diameter (D)	24	Tailwater Depth (Y_t)=	2.00	
Discharge (Q_d)=	14.3	Slope (S)=	0.40%	
Pipe Velocity (v)=	7.61	Mannings (n)=	0.013	
Normal Depth (D_n)=	1.66	Q_{full}=	14.34	cfs
Actual Depth (d)=	2.00	Froude Number (Fr)=	0.95	*SUBCRITICAL*

Rip-Rap Size

For supercritical flow Fr > 1

$D_a = 1/2*(D+D_n)$

D_a= 1.83 Substitute D_a for D in all equations.

For subcritical flow Fr < 1

D= 2.00 Use D = 2.00 for calculation purposes

Design Parameters

$Q/D^{1.5}$= 5.05
$Q/D^{2.5}$ = 2.52
Yt/D= 1.00

Rip Rap Size

-From Figure MD-21 (Urban Drainage Design Criteria Manual)

Use Type L RipRap

-From Table MD-7 (5-1) d_{50} = **9**

RipRap Depth = $2*d_{50}$= **18** in.

Length and Width of Protection

-From Figure MD-23 (Urban Drainage Design Criteria Manual)

expansion factor $1/(2 \tan \Theta)$ = 6.6

-Solve for At, where At = Q/Va

Q= 14.27 cfs
V= 5.50 fps (assumed maximum for erosive velocities)
At= 2.59 sq ft

-Check length adjustment factor (D/4 for each whole number $Q/D^{2.5} > 6$)

Adjustment Factor 0 *No Length Adjustment Required*

If $Q/D^{2.5} < 6$			**If $Q/D^{2.5} > 6$**	
Minimum length (ft)=	6.0	L = 3 D		
Calculated length (ft)=	-4.0	L= $(1/(2 \text{ TAN } \Theta))(A_t/Y_t - W)$	adjusted length=	n/a
Maximum length (ft)=	20.0	L = 10 D		
Width (ft)=	6.0	W=3D		

Required Rip Rap Length = 6.0 ft
Required Rip Rap Width = 6.0 ft

Appendix E

Water Quality Pond Calculations

SE POND CALCULATIONS

Tributary Area, A (acres) = 14.09
Excess Urban Runoff Volume (acre-ft) = 2.01
100 year Volume (acre-ft) = 2.42

Prismoidal Method				
Elevation	**Area (ft^2)**	**Volume (ft^3)**	**$Volume_{sum}$ (ft^3)**	**$Volume_{sum}$ (Ac-ft)**
6431.6	0	0	0	0.00
6432.0	1,586	233	233	0.01
6433.0	17,974	8,300	8,532	0.20
6434.0	35,641	26,308	34,841	0.80
6435.0	43,869	39,684	74,525	1.71
6436.0	47,444	45,645	120,170	2.76
6437.0	50,972	49,198	169,367	3.89
6438.0	78,097	64,054	233,422	5.36

Excess Urban Runoff Volume Elevation (ft) = 6435.29
Excess Urban Runoff Depth (ft) = 3.73
100 year Elevation (ft) = 6435.70
100 year Depth (ft) = 4.14
Emergency Overflow Elevation (ft) = 6436.20

DETENTION VOLUME BY THE FULL SPECTRUM METHOD

Project: Marksheffel / Constitution

Basin ID: SE Pond

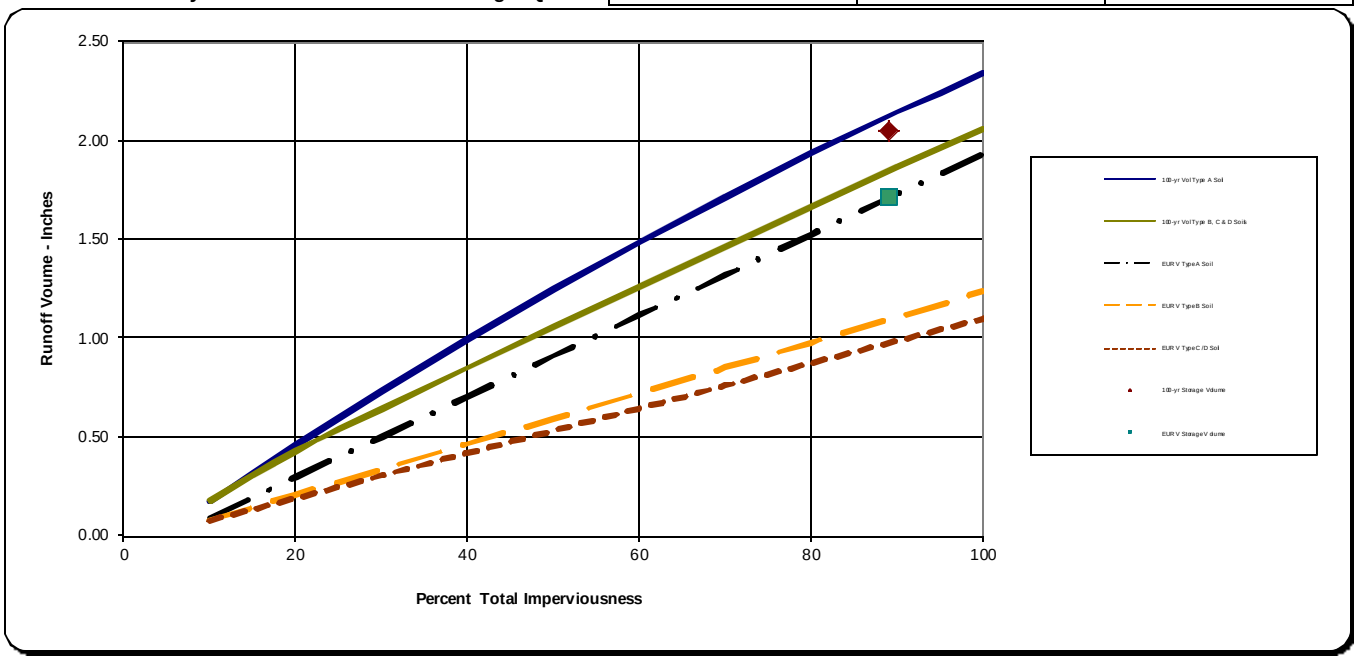
* User input data shown in blue.

Area of Watershed (acres)	14.09	
Subwatershed Imperviousness	89.0%	
Level of Minimizing Directly Connected Impervious Area (MDCIA)	0	0
Effective Imperviousness[1]	89.0%	

Hydrologic Soil Type	Percentage of Area	Area (acres)
Type A	75.0%	10.6
Type B	25.0%	3.5
Type C or D		0.0

Recommended Horton's Equation Parameters for CUHP		
Infiltration (inches per hour)		Decay Coefficient--α
Initial--f_i	Final--f_0	
4.875	0.9	0.0010

	Detention Volumes [2,5]		
	(watershed inches)	(acre-feet)	Maximum Allowable Release Rate, cfs[3]
Excess Urban Runoff Volume[4]	1.71	2.01	Design Oulet to Empty EURV in 72 Hours
100-year Detention Volume Including WQCV [5]	2.06	2.42	8.28



Notes:

1) Effective imperviousness is based on Figure ND-1 of the Urban Storm Drainage Criteria Manual (USDCM).

2) Results shown reflect runoff reduction from Level 1 or 2 MDCIA and are plotted at the watershed's total imperviousness value; the impact of MDCIA is reflected by the results being below the curves.

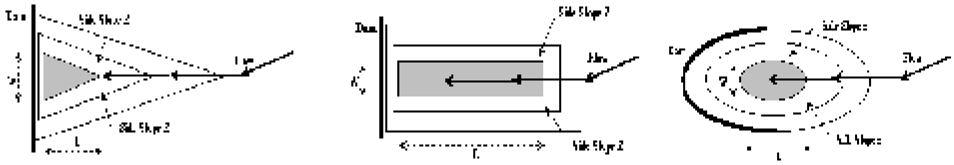
3) Maximum allowable release rates for 100-year event are based on Table SO-1. Outlet for the Excess Urban Runoff Volume (EURV) to be designed to empty out the EURV in 72 hours. Outlet design is similar to one for the WQCV outlet of an extended detention basin (i.e., perforated plate with a micro-pool) and extends to top of EURV water surface elevation.

4) EURV approximates the difference between developed and pre-developed runoff volume.

5) 100-yr detention volume includes EURV. No need to add more volume for WQCV or EURV

STAGE-STORAGE SIZING FOR DETENTION BASINS

Project: **Marksheffel / Constitution**
Basin ID: **SE Pond**



Design Information (Input):

Width of Basin Bottom, W =	215.00	ft
Length of Basin Bottom, L =	320.00	ft
Dam Side-slope (H:V), Z_d =	4.00	ft/ft

Check Basin Shape

Right Triangle		OR…
Isosceles Triangle		OR…
Rectangle		OR…
Circle / Ellipse		OR…
Irregular	X	(Use Overide values in cells G32:G52)

Stage-Storage Relationship:

	MINOR	MAJOR	
Storage Requirement from Sheet 'Modified FAA':			acre-ft.
Storage Requirement from Sheet 'Hydrograph':			acre-ft.
Storage Requirement from Sheet 'Full-Spectrum':	2.01	2.42	acre-ft.

Labels for WQCV, Minor, & Major Storage Stages (input)	Water Surface Elevation ft (input)	Side Slope (H:V) ft/ft Below El.	Basin Width at Stage ft (output)	Basin Length at Stage ft (output)	Surface Area at Stage ft^2 (output)	Surface Area at Stage ft^2 User Overide	Volume Below Stage ft^3 (output)	Surface Area at Stage acres (output)	Volume Below Stage acre-ft (output)	Target Volumes for WQCV, Minor, & Major Storage Volumes (for goal seek)
	6431.60	(input)				0		0.000	0.000	
	6432.00		0.00	0.00		1,586	317	0.036	0.007	
	6433.00		0.00	0.00		17,974	10,097	0.413	0.232	
	6434.00		0.00	0.00		35,641	36,905	0.818	0.847	3.646
	6435.00		0.00	0.00		43,869	76,660	1.007	1.760	6,435.25
	6435.50		0.00	0.00		45,657	99,041	1.048	2.274	6,435.63
	6436.00		0.00	0.00		47,444	122,316	1.089	2.808	
	6437.00		0.00	0.00		50,972	171,524	1.170	3.938	
							#N/A		#N/A	
							#N/A		#N/A	
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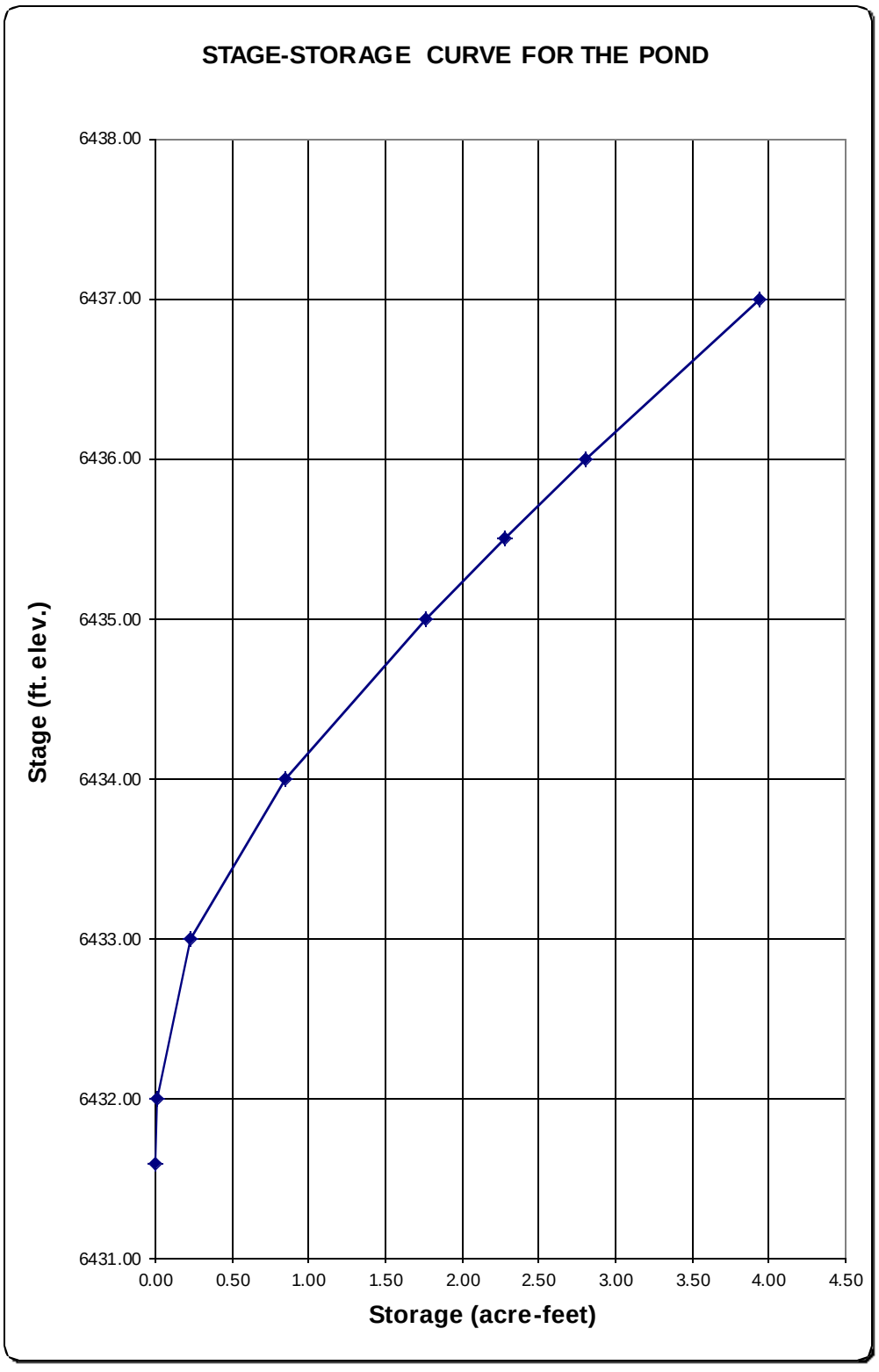
STAGE-STORAGE SIZING FOR DETENTION BASINS

Project: _____

Basin ID: _____



STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Project: **Marksheffel / Constitution**
Basin ID: **SE Pond**

WQCV Design Volume (Input):

Catchment Imperviousness, I_a = 89.0 percent
Catchment Area, A = 14.09 acres
Depth at WQCV outlet above lowest perforation, H = 3 feet
Vertical distance between rows, h = 4.00 inches
Number of rows, NL = 9.00
Orifice discharge coefficient, C_o = 0.65
Slope of Basin Trickle Channel, S = 0.005 ft / ft
Time to Drain the Pond = 72 hours

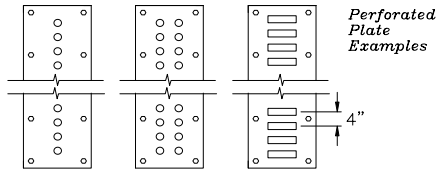
Diameter of holes, D = 1.601 inches
Number of holes per row, N = 1

OR

Height of slot, H = inches
Width of slot, W = inches

Watershed Design Information (Input):

Percent Soil Type A = 25 %
Percent Soil Type B = 75 %
Percent Soil Type C/D = 0 %



Perforated Plate Examples

Outlet Design Information (Output):

Excess Urban Runoff Volume (From 'Full-Spectrum Sheet') 1.714 watershed inches
N/A
Excess Urban Runoff Volume (From 'Full-Spectrum Sheet') 2.013 acre-feet
Outlet area per row, Ao = 2.01 square inches
Total opening area at each row based on user-input above, Ao = 2.01 square inches
Total opening area at each row based on user-input above, Ao = 0.014 square feet

3

	Central Elevations of Rows of Holes in feet																								Σ **Flow**
	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16	Row 17	Row 18	Row 19	Row 20	Row 21	Row 22	Row 23	Row 23	
	6431.50	6431.83	6432.17	6432.50	6432.83	6433.17	6433.50	6433.83	6434.17																
	Collection Capacity for Each Row of Holes in cfs																								
6431.50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000																**0.00**
6432.00	0.0516	0.0301	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000																**0.08**
6433.00	0.0894	0.0789	0.0665	0.0516	0.0301	0.0000	0.0000	0.0000	0.0000																**0.32**
6434.00	0.1154	0.1075	0.0987	0.0894	0.0789	0.0665	0.0516	0.0301	0.0000																**0.64**
6435.00	0.1365	0.1299	0.1227	0.1154	0.1075	0.0987	0.0894	0.0789	0.0665																**0.95**
6435.50	0.1459	0.1398	0.1331	0.1264	0.1192	0.1114	0.1032	0.0943	0.0841																**1.06**
6436.00	0.1548	0.1490	0.1428	0.1365	0.1299	0.1227	0.1154	0.1075	0.0987																**1.16**
6437.00	0.1711	0.1659	0.1603	0.1548	0.1490	0.1428	0.1365	0.1299	0.1227																**1.33**
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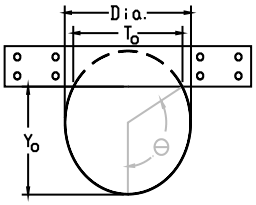
	Override Area Row 1	Override Area Row 2	Override Area Row 3	Override Area Row 4	Override Area Row 5	Override Area Row 6	Override Area Row 7	Override Area Row 8	Override Area Row 9	Override Area Row 10	Override Area Row 11	Override Area Row 12	Override Area Row 13	Override Area Row 14	Override Area Row 15	Override Area Row 16	Override Area Row 17	Override Area Row 18	Override Area Row 19	Override Area Row 20	Override Area Row 21	Override Area Row 22	Override Area Row 23	Override Area Row 24	

RESTRICTOR PLATE SIZING FOR CIRCULAR VERTICAL ORIFICES

Project: Marksheffel / Constitution

Basin ID: SE Pond

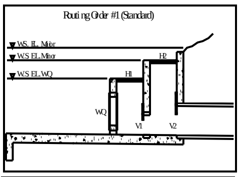
X

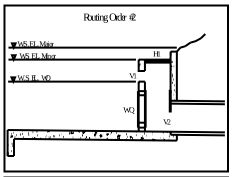


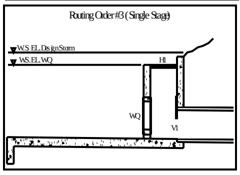
		#1 Vertical Orifice	#2 Vertical Orifice	
Sizing the Restrictor Plate for Circular Vertical Orifices or Pipes (Input)				
Water Surface Elevation at Design Depth	Elev: WS =	6,436.00		feet
Pipe/Vertical Orifice Entrance Invert Elevation	Elev: Invert =	6,431.00		feet
Required Peak Flow through Orifice at Design Depth	Q =	8.28		cfs
Pipe/Vertical Orifice Diameter (inches)	Dia =	18.0		inches
Orifice Coefficient	C_o =	0.65		
Full-flow Capacity (Calculated)				
Full-flow area	Af =	1.77		sq ft
Half Central Angle in Radians	Theta =	3.14		rad
Full-flow capacity	Qf =	19.0		cfs
	Percent of Design Flow =	229%		
Calculation of Orifice Flow Condition				
Half Central Angle (0<Theta<3.1416)	Theta =	1.44		rad
Flow area	A_o =	0.74		sq ft
Top width of Orifice (inches)	T_o =	17.84		inches
Height from Invert of Orifice to Bottom of Plate (feet)	Y_o =	0.65		feet
Elevation of Bottom of Plate	Elev Plate Bottom Edge =	6,431.65		feet
Resultant Peak Flow Through Orifice at Design Depth	Q_o =	8.3		cfs
Width of Equivalent Rectangular Vertical Orifice	**Equivalent Width =**	**1.14**		**feet**

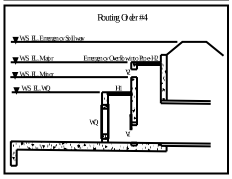
STAGE-DISCHARGE SIZING OF THE WEIRS AND ORIFICES (INLET CONTROL)

Project: Marksheffel / Constitution
Basin ID: SE Pond









Current Routing Order is #3

Design Information (Input):

			#1 Horiz.	#2 Horiz.	#1 Vert.	#2 Vert.	
Circular Opening:	Diameter in Inches	Dia. =					inches
OR							
Rectangular Opening:	Width in Feet	W =	5.67		1.14		ft.
	Length (Height for Vertical)	L or H =	2.92		0.65		ft.
	Percentage of Open Area After Trash Rack Reduction	% open =	80		100		%
	Orifice Coefficient	C_o =	0.65		0.65		
	Weir Coefficient	C_w =	3.00				
	Orifice Elevation (Bottom for Vertical)	E_o =	6435.50		6,431.00		ft.

Calculation of Collection Capacity:

Net Opening Area (after Trash Rack Reduction)	A_o =	13.22		0.74		sq. ft.
OPTIONAL: User-Overide Net Opening Area	A_o =					sq. ft.
Perimeter as Weir Length	L_w =	14.90	ft.			
OPTIONAL: User-Overide Weir Length	L_w =		ft.			

Top Elevation of Vertical Orifice Opening, Top = 6431.65 ft.
Center Elevation of Vertical Orifice Opening, Cen = 6431.33 ft.

Routing 3: Single Stage - Water flows through WQCV plate and #1 horizontal opening into #1 vertical opening. This flow will be applied to culvert sheet (#2 vertical & horizontal openings is not used).

			Horizontal Orifices				Vertical Orifices			
Labels for WQCV, Minor, & Major Storage W.S. Elevations (input)	Water Surface Elevation ft (linked)	WQCV Plate/Riser Flow cfs (User-linked)	#1 Horiz. Weir Flow cfs (output)	#1 Horiz. Orifice Flow cfs (output)	#2 Horiz. Weir Flow cfs (output)	#2 Horiz. Orifice Flow cfs (output)	#1 Vert. Collection Capacity cfs (output)	#2 Vert. Collection Capacity cfs (output)	**Total Collection Capacity cfs (output)**	Target Volumes for WQCV, Minor, & Major Storage Volumes (link for goal seek)
	6431.60	0.00	0.00	0.00	0.00	0.00	1.95	0.00	**0.00**	
	6432.00	0.08	0.00	0.00	0.00	0.00	3.17	0.00	**0.08**	
	6433.00	0.32	0.00	0.00	0.00	0.00	5.00	0.00	**0.32**	
	6434.00	0.64	0.00	0.00	0.00	0.00	6.31	0.00	**0.64**	
	6435.00	0.95	0.00	0.00	0.00	0.00	7.40	0.00	**0.95**	
	6435.50	1.06	0.00	0.00	0.00	0.00	7.89	0.00	**1.06**	
	6436.00	1.16	15.80	48.77	0.00	0.00	8.35	0.00	**8.35**	
	6437.00	1.33	82.12	84.48	0.00	0.00	9.20	0.00	**9.20**	
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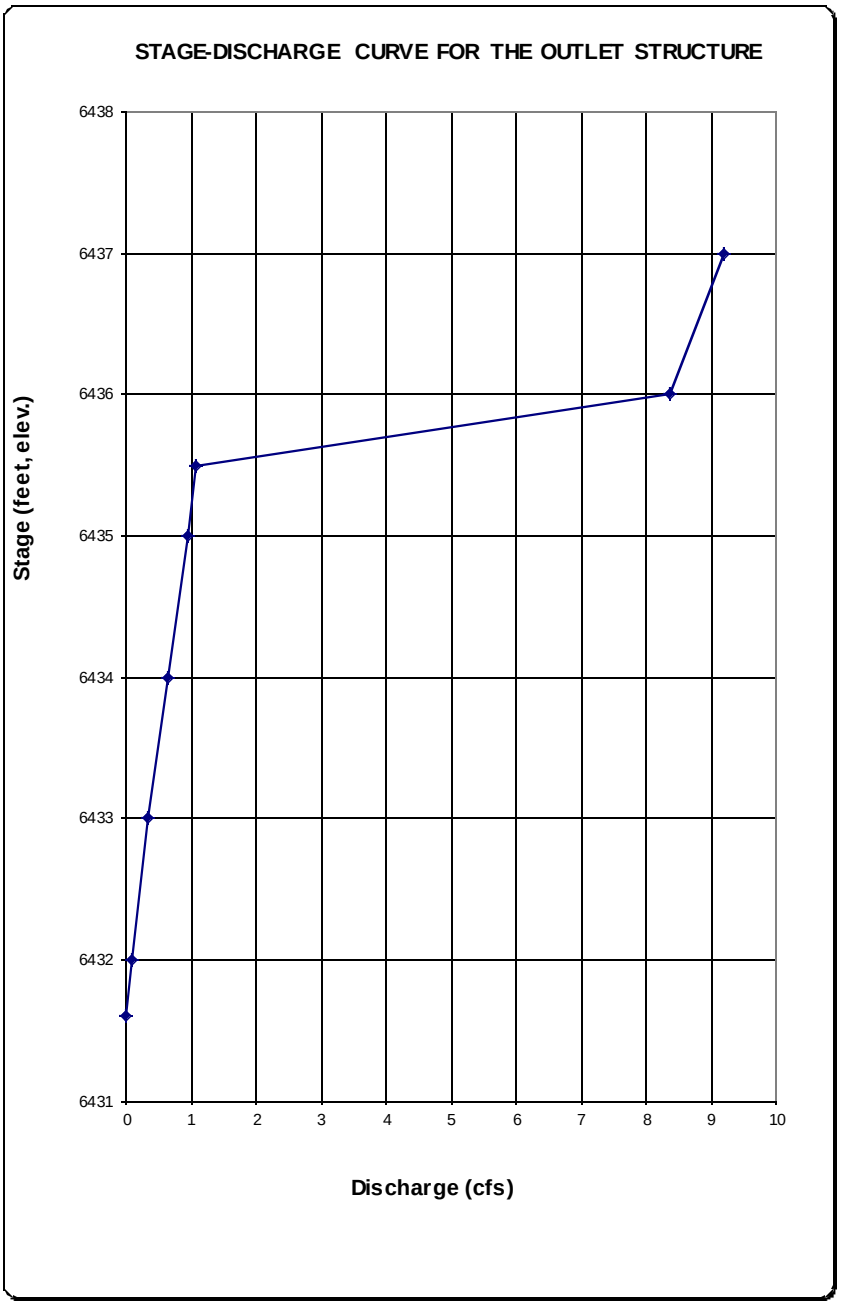
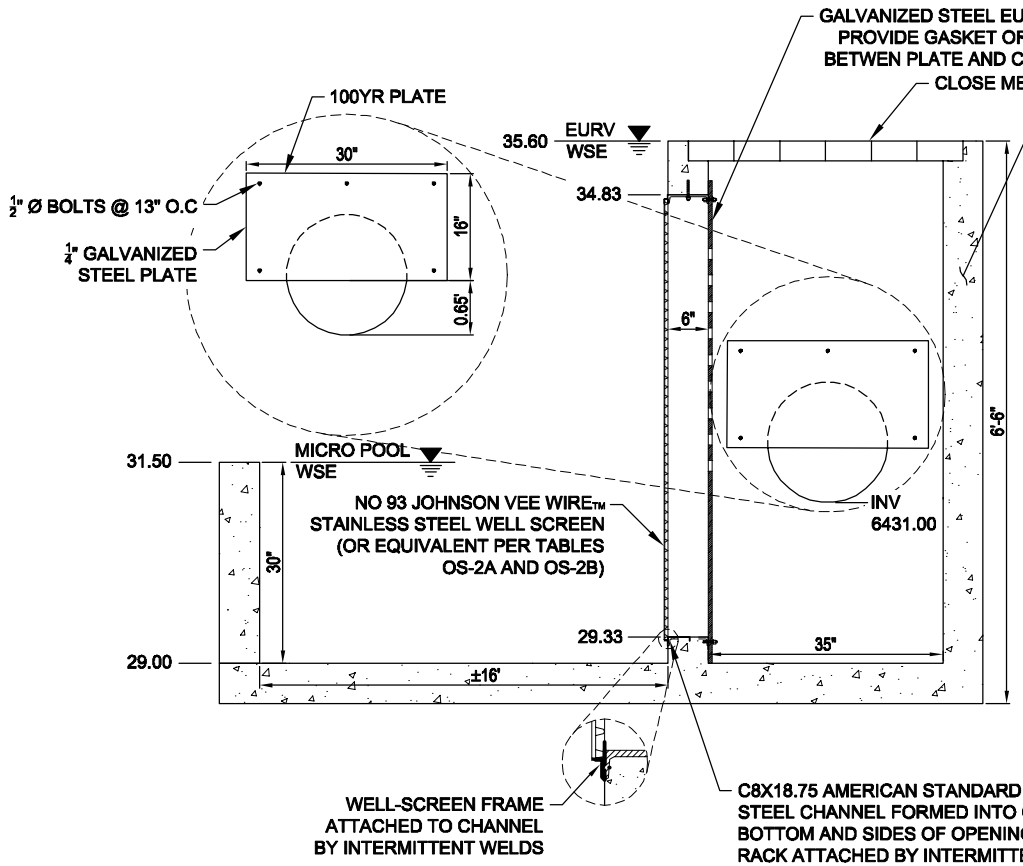
STAGE-DISCHARGE SIZING OF THE WEIRS AND ORIFICES (INLET CONTROL)

Project: Marksheffel / Constitution
Basin ID: SE Pond





SE POND OUTLET STRUCTURE

SCALE: 1"=2'

NOTE: INTERIM PLATE TO BE INSTALLED WITH EARLY GRADING AND NOT REPLACED WITH PERMANENT PLATE UNTIL SOUTHWEST POND HAS BEEN CONSTRUCTED WITH ALL ITS COMPONENTS AND ITS TRIBUTARY AREA HAS BEEN STABILIZED/PAVED.

SE SEDIMENT POND CALCULATIONS

Tributary Area, A (acres) =	**23.50**	
Required Volume per Acre (Cu Ft) =	**1,800.00**	per El Paso County Figure SB-1
Total Reqd Sed Volum (acre-ft) =	**0.97**	

Prismoidal Method				
Elevation	**Area (ft^2)**	**Volume (ft^3)**	**$Volume_{sum}$ (ft^3)**	**$Volume_{sum}$ (Ac-ft)**
6431.6	0	0	0	0.00
6432.0	1,586	233	233	0.01
6433.0	17,974	8,300	8,532	0.20
6434.0	35,641	26,308	34,841	0.80
6435.0	43,869	39,684	74,525	1.71
6436.0	47,444	45,645	120,170	2.76
6437.0	50,972	49,198	169,367	3.89
6438.0	78,097	64,054	233,422	5.36

Sediment Basin Volume Elevation (ft) =	**6434.19**
Sediment Basin Depth (ft) =	**2.63**
Emergency Overflow Elevation (ft) =	**6436.25**

Required Area per Row (Table SB-1)

1.78 sq in

Circular Perforation Sizing (Table SB-2)

Number of columns of perforations	1
(4" between perforations)	
Hole Diameter (in.)	1.5

SW POND CALCULATIONS

Tributary Area, A (acres) = 6.97

Water Quality Volume (acre-ft) = 1.00

Prismoidal Method				
Elevation	**Area (ft^2)**	**Volume (ft^3)**	**$Volume_{sum}$ (ft^3)**	**$Volume_{sum}$ (Ac-ft)**
6430.0	2,571	0	0	0.00
6431.0	3,223	2,891	2,891	0.07
6432.0	3,947	3,579	6,470	0.15
6433.0	4,743	4,339	10,808	0.25
6434.0	5,621	5,176	15,984	0.37
6435.0	6,587	6,098	22,082	0.51
6436.0	7,647	18,413	29,221	0.67
6437.0	8,093	25,376	36,184	0.83
6438.0	8,503	36,485	42,955	0.99
6439.0	9,744	42,572	53,381	1.23
6440.0	16,639	63,861	79,846	1.83

Water Quality Volume Elevation (ft) = 6438.06

Water Quality Runoff Depth (ft) = 8.06

Emergency Overflow Elevation (ft) = 6439.06

DETENTION VOLUME BY THE FULL SPECTRUM METHOD

Project: Marksheffel / Constitution
Basin ID: SW Pond

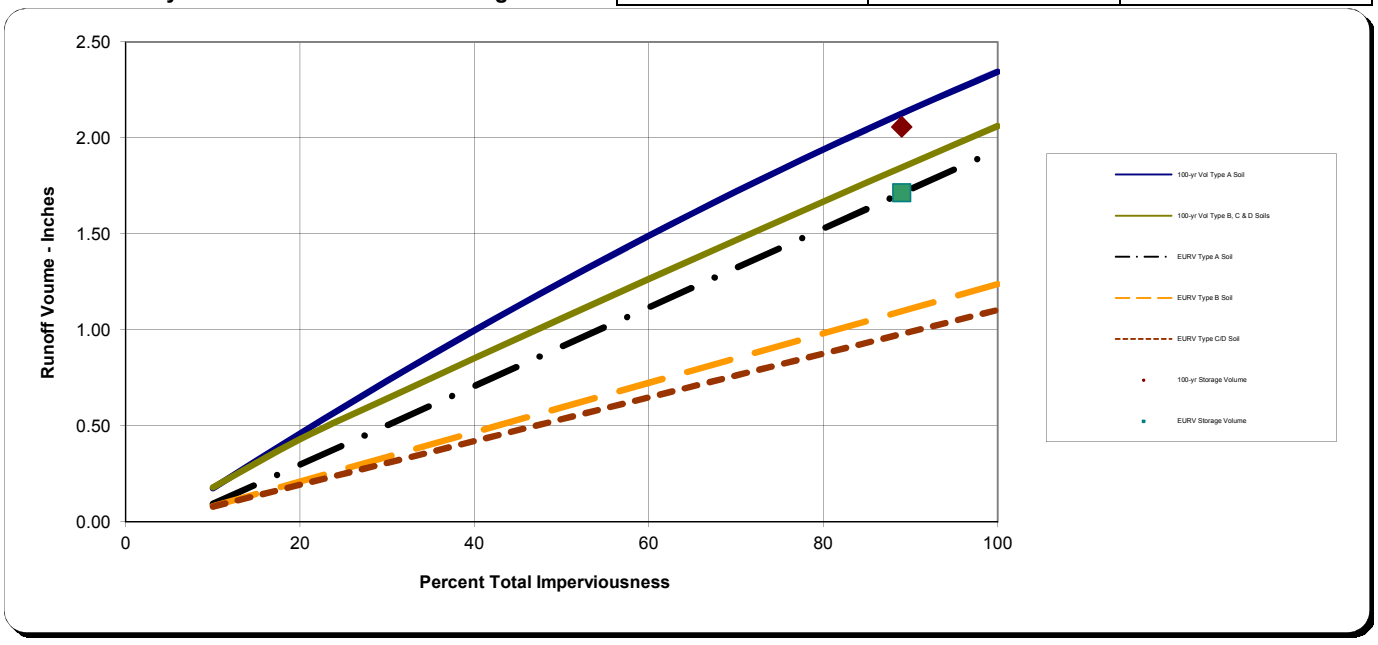
* User input data shown in blue.

Area of Watershed (acres)	6.97	
Subwatershed Imperviousness	89.0%	
Level of Minimizing Directly Connected Impervious Area (MDCIA)	0	0
Effective Imperviousness[1]	89.0%	

Hydrologic Soil Type	Percentage of Area	Area (acres)
Type A	75.0%	5.2
Type B	25.0%	1.7
Type C or D		0.0

Recommended Horton's Equation Parameters for CUHP		
Infiltration (inches per hour)		Decay Coefficient--α
Initial--f_i	Final--fo	
4.875	0.9	0.0010

	Detention Volumes [2,5]		Maximum Allowable Release Rate, cfs[3]
	(watershed inches)	(acre-feet)	
Excess Urban Runoff Volume[4]	1.71	1.00	Design Oulet to Empty EURV in 72 Hours
100-year Detention Volume Including WQCV [5]	2.06	1.19	4.09



Notes:

1) Effective imperviousness is based on Figure ND-1 of the Urban Storm Drainage Criteria Manual (USDCM).

2) Results shown reflect runoff reduction from Level 1 or 2 MDCIA and are plotted at the watershed's total imperviousness value; the impact of MDCIA is reflected by the results being below the curves.

3) Maximum allowable release rates for 100-year event are based on Table SO-1. Outlet for the Excess Urban Runoff Volume (EURV) to be designed to empty out the EURV in 72 hours. Outlet design is similar to one for the WQCV outlet of an extended detention basin (i.e., perforated plate with a micro-pool) and extends to top of EURV water surface elevation.

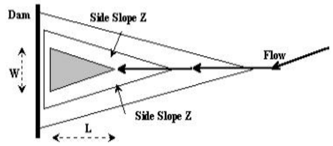
4) EURV approximates the difference between developed and pre-developed runoff volume.

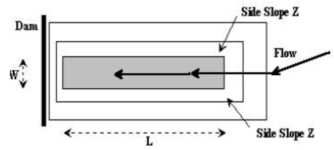
5) 100-yr detention volume includes EURV. No need to add more volume for WQCV or EURV

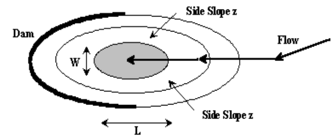
STAGE-STORAGE SIZING FOR DETENTION BASINS

Project: **Marksheffel / Constitution**

Basin ID:







Design Information (Input):

Width of Basin Bottom, W =	32.00	ft
Length of Basin Bottom, L =	26.00	ft
Dam Side-slope (H:V), Z_d =	3.00	ft/ft

Check Basin Shape

Right Triangle		OR…
Isosceles Triangle		OR…
Rectangle		OR…
Circle / Ellipse		OR…
Irregular	X	(Use Overide values in cells G32:G52)

Stage-Storage Relationship:

	MINOR	MAJOR	
Storage Requirement from Sheet 'Modified FAA':			acre-ft.
Storage Requirement from Sheet 'Hydrograph':			acre-ft.
Storage Requirement from Sheet 'Full-Spectrum':	1.00	1.19	acre-ft.

Labels for WQCV, Minor, & Major Storage Stages (input)	Water Surface Elevation ft (input)	Side Slope (H:V) ft/ft Below El.	Basin Width at Stage ft (output)	Basin Length at Stage ft (output)	Surface Area at Stage ft^2 (output)	Surface Area at Stage ft^2 User Overide	Volume Below Stage ft^3 (output)	Surface Area at Stage acres (output)	Volume Below Stage acre-ft (output)	Target Volumes for WQCV, Minor, & Major Storage Volumes (for goal seek)
	6430.00	(input)				2,571	0	0.059	0.000	
	6431.00		0.00	0.00		3,222	2,897	0.074	0.066	
	6432.00		0.00	0.00		3,946	6,481	0.091	0.149	
	6433.00		0.00	0.00		4,743	10,825	0.109	0.249	
	6434.00		0.00	0.00		5,620	16,007	0.129	0.367	
	6435.00		0.00	0.00		6,587	22,110	0.151	0.508	
	6436.00		0.00	0.00		7,646	29,227	0.176	0.671	
	6437.00		0.00	0.00		8,092	37,096	0.186	0.852	6,437.776
	6437.80		0.00	0.00		8,092	43,569	0.186	1.000	6,438.822
	6438.00		0.00	0.00		8,503	45,229	0.195	1.038	
	6438.80		0.00	0.00		9,744	52,527	0.224	1.206	
	6439.00		0.00	0.00		9,744	54,476	0.224	1.251	
	6440.00		0.00	0.00			#N/A		0.000	
	6441.00		0.00	0.00			#N/A		0.000	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
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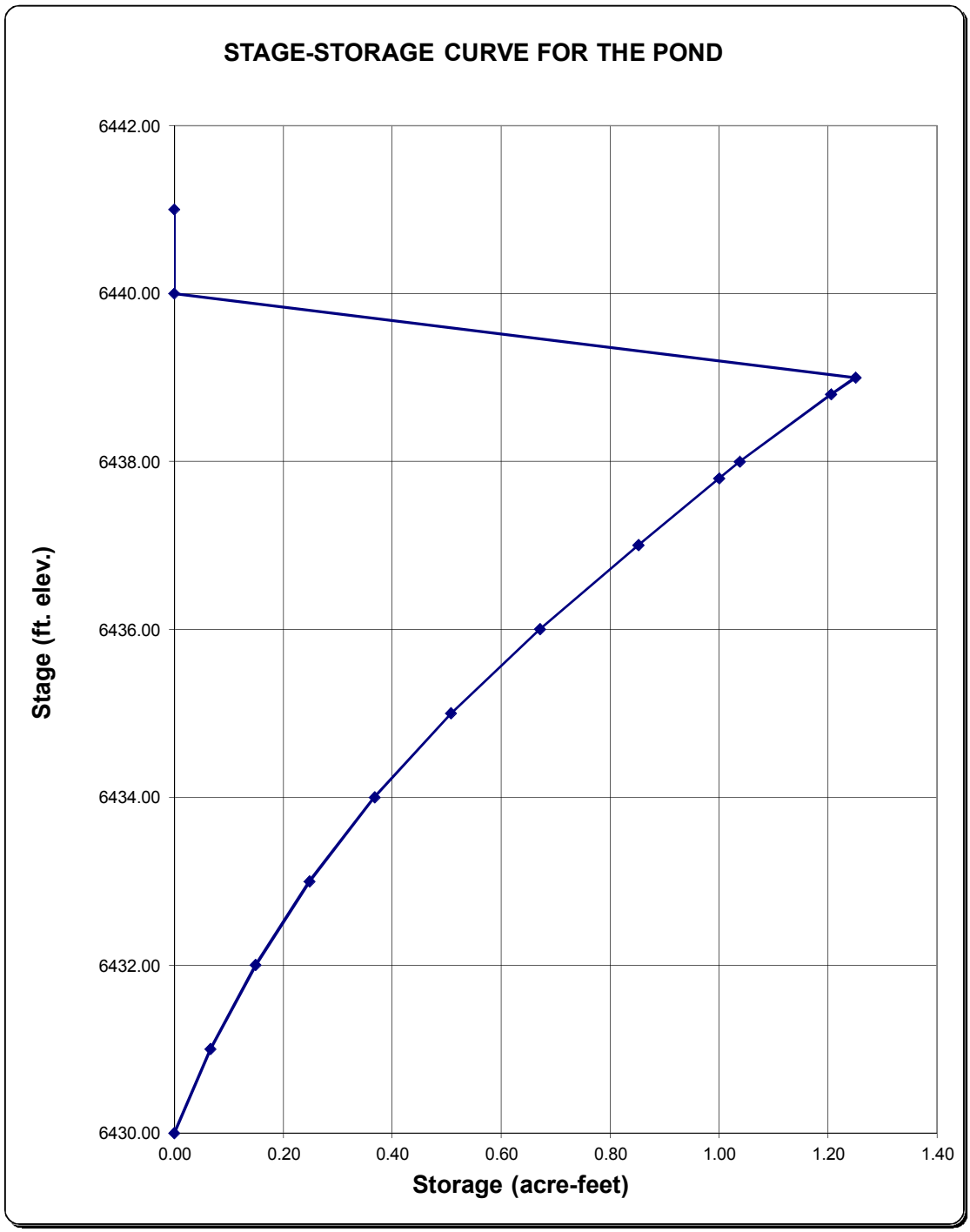
STAGE-STORAGE SIZING FOR DETENTION BASINS

Project: _____

Basin ID: _____



STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Project:

Basin ID:

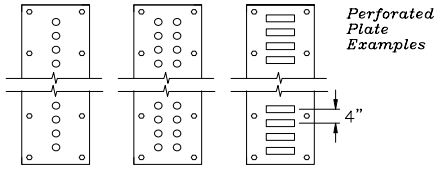
WQCV Design Volume (Input):

Catchment Imperviousness, I_a = 89.0 percent
Catchment Area, A = 6.97 acres
Depth at WQCV outlet above lowest perforation, H = 7 feet
Vertical distance between rows, h = 4.00 inches
Number of rows, NL = 21.00
Orifice discharge coefficient, C_o = 0.65
Slope of Basin Trickle Channel, S = 0.005 ft / ft
Time to Drain the Pond = 72 hours

Diameter of holes, D = 0.933 inches
Number of holes per row, N = 1

OR

Height of slot, H = inches
Width of slot, W = inches



Watershed Design Information (Input):

Percent Soil Type A = 75 %
Percent Soil Type B = 25 %
Percent Soil Type C/D = 0 %

Outlet Design Information (Output):

Excess Urban Runoff Volume (From 'Full-Spectrum Sheet') 1.714 watershed inches
N/A
Excess Urban Runoff Volume (From 'Full-Spectrum Sheet') 0.996 acre-feet
Outlet area per row, Ao = 0.68 square inches
Total opening area at each row based on user-input above, Ao = 0.68 square inches
Total opening area at each row based on user-input above, Ao = 0.005 square feet

3

	Central Elevations of Rows of Holes in feet																								**Σ Flow**
	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16	Row 17	Row 18	Row 19	Row 20	Row 21	Row 22	Row 23	Row 23	
	6430.00	6430.33	6430.67	6431.00	6431.33	6431.67	6432.00	6432.33	6432.67	6433.00	6433.33	6433.67	6434.00	6434.33	6434.67	6435.00	6435.33	6435.67	6436.00	6436.33	6436.67				
	Collection Capacity for Each Row of Holes in cfs																								
6430.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000				**0.00**
6431.00	0.0248	0.0203	0.0142	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000				**0.06**
6432.00	0.0350	0.0320	0.0286	0.0248	0.0203	0.0142	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000				**0.15**
6433.00	0.0429	0.0405	0.0378	0.0350	0.0320	0.0286	0.0248	0.0203	0.0142	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000				**0.28**
6434.00	0.0495	0.0474	0.0452	0.0429	0.0405	0.0378	0.0350	0.0320	0.0286	0.0248	0.0203	0.0142	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000				**0.42**
6435.00	0.0554	0.0535	0.0515	0.0495	0.0474	0.0452	0.0429	0.0405	0.0378	0.0350	0.0320	0.0286	0.0248	0.0203	0.0142	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000				**0.58**
6436.00	0.0607	0.0590	0.0572	0.0554	0.0535	0.0515	0.0495	0.0474	0.0452	0.0429	0.0405	0.0378	0.0350	0.0320	0.0286	0.0248	0.0203	0.0142	0.0000	0.0000	0.0000				**0.76**
6437.00	0.0655	0.0640	0.0623	0.0607	0.0590	0.0572	0.0554	0.0535	0.0515	0.0495	0.0474	0.0452	0.0429	0.0405	0.0378	0.0350	0.0320	0.0286	0.0248	0.0203	0.0142				**0.95**
6437.80	0.0692	0.0677	0.0661	0.0646	0.0630	0.0613	0.0596	0.0579	0.0561	0.0543	0.0524	0.0503	0.0483	0.0461	0.0438	0.0414	0.0389	0.0361	0.0332	0.0300	0.0263				**1.07**
6438.00	0.0700	0.0686	0.0670	0.0655	0.0640	0.0623	0.0607	0.0590	0.0572	0.0554	0.0535	0.0515	0.0495	0.0474	0.0452	0.0429	0.0405	0.0378	0.0350	0.0320	0.0286				**1.09**
6439.00	0.0743	0.0729	0.0715	0.0700	0.0686	0.0670	0.0655	0.0640	0.0623	0.0607	0.0590	0.0572	0.0554	0.0535	0.0515	0.0495	0.0474	0.0452	0.0429	0.0405	0.0378				**1.22**
	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A				**#N/A**
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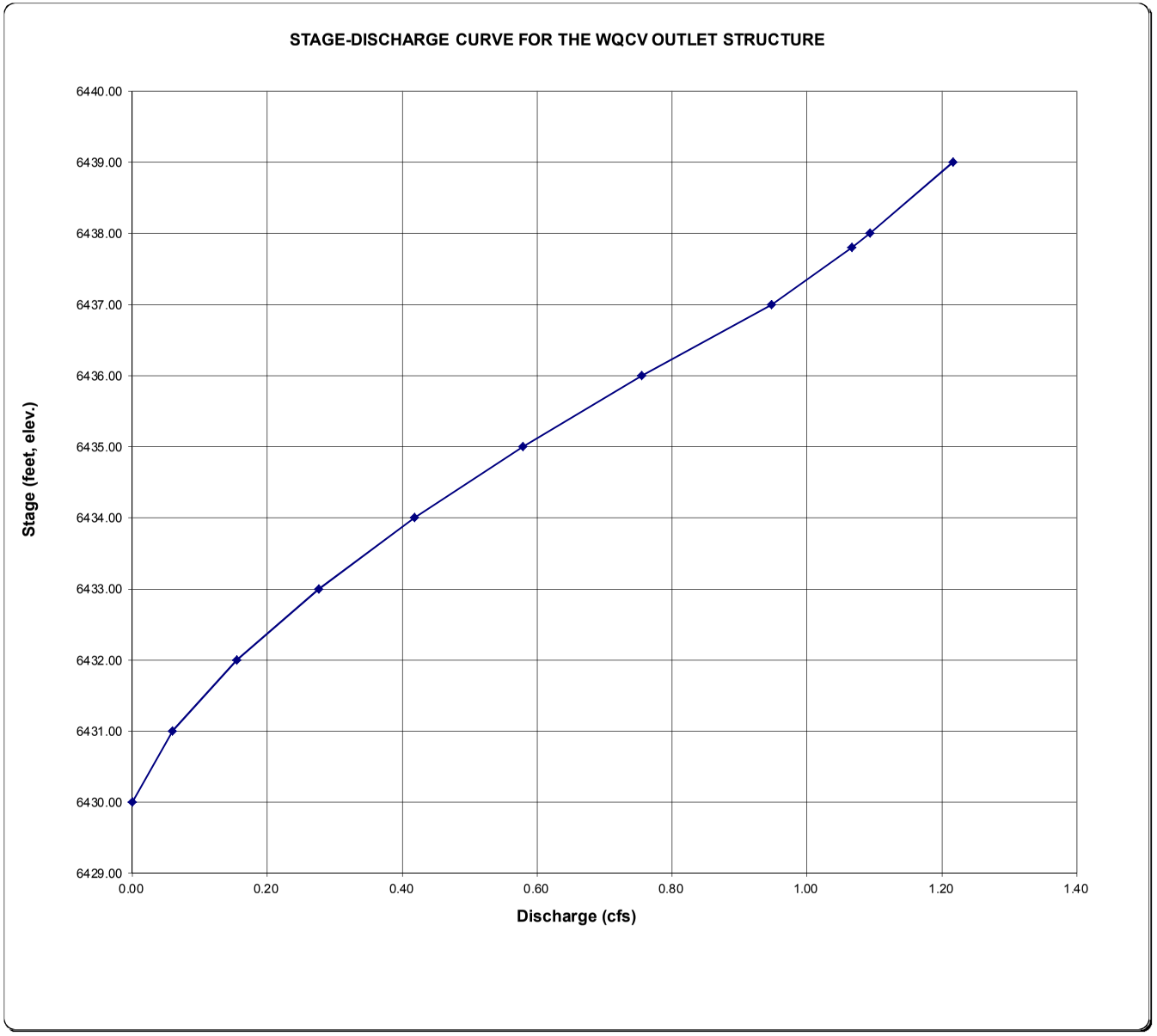
	Override Area Row 1	Override Area Row 2	Override Area Row 3	Override Area Row 4	Override Area Row 5	Override Area Row 6	Override Area Row 7	Override Area Row 8	Override Area Row 9	Override Area Row 10	Override Area Row 11	Override Area Row 12	Override Area Row 13	Override Area Row 14	Override Area Row 15	Override Area Row 16	Override Area Row 17	Override Area Row 18	Override Area Row 19	Override Area Row 20	Override Area Row 21	Override Area Row 22	Override Area Row 23	Override Area Row 24	

STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Worksheet Protected

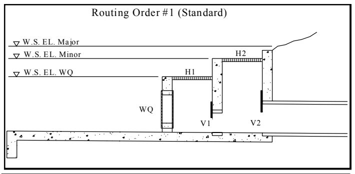
Project: _____

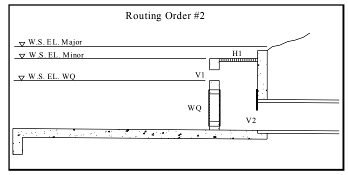
Basin ID: _____

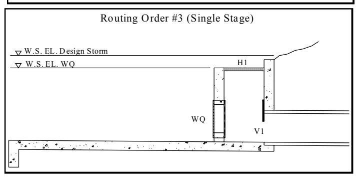


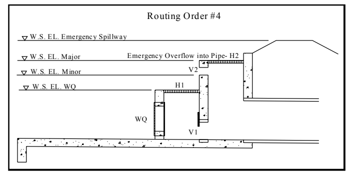
STAGE-DISCHARGE SIZING OF THE WEIRS AND ORIFICES (INLET CONTROL)

Project: **Marksheffel / Constitution**
Basin ID:









Current Routing Order is #3

Design Information (Input):

			#1 Horiz.	#2 Horiz.	#1 Vert.	#2 Vert.	
Circular Opening:	Diameter in Inches	Dia. =			30.00		inches
OR							
Rectangular Opening:	Width in Feet	W =	11.66				ft.
	Length (Height for Vertical)	L or H =	2.92				ft.
	Percentage of Open Area After Trash Rack Reduction	% open =	80		100		%
	Orifice Coefficient	C_o =	0.65		0.65		
	Weir Coefficient	C_w =	3.00				
	Orifice Elevation (Bottom for Vertical)	E_o =	6437.80		6,429.50		ft.

Calculation of Collection Capacity:

		#1 Horiz.	#2 Horiz.	#1 Vert.	#2 Vert.	
Net Opening Area (after Trash Rack Reduction)	A_o =	27.20		4.91		sq. ft.
OPTIONAL: User-Overide Net Opening Area	A_o =					sq. ft.
Perimeter as Weir Length	L_w =	24.49	ft.			
OPTIONAL: User-Overide Weir Length	L_w =		ft.			
Top Elevation of Vertical Orifice Opening, Top =				6432.00		ft.
Center Elevation of Vertical Orifice Opening, Cen =				6430.75		ft.

Routing 3: Single Stage - Water flows through WQCV plate and #1 horizontal opening into #1 vertical opening. This flow will be applied to culvert sheet (#2 vertical & horizontal openings is not used).

			Horizontal Orifices				Vertical Orifices			
Labels for WQCV, Minor, & Major Storage W.S. Elevations (input)	Water Surface Elevation ft (linked)	WQCV Plate/Riser Flow cfs (User-linked)	#1 Horiz. Weir Flow cfs (output)	#1 Horiz. Orifice Flow cfs (output)	#2 Horiz. Weir Flow cfs (output)	#2 Horiz. Orifice Flow cfs (output)	#1 Vert. Collection Capacity cfs (output)	#2 Vert. Collection Capacity cfs (output)	**Total Collection Capacity cfs (output)**	Target Volumes for WQCV, Minor, & Major Storage Volumes (link for goal seek)
	6430.00	0.00	0.00	0.00	0.00	0.00	2.56	0.00	**0.00**	
	6431.00	0.06	0.00	0.00	0.00	0.00	13.30	0.00	**0.06**	
	6432.00	0.15	0.00	0.00	0.00	0.00	28.63	0.00	**0.15**	
	6433.00	0.28	0.00	0.00	0.00	0.00	38.41	0.00	**0.28**	
	6434.00	0.42	0.00	0.00	0.00	0.00	46.16	0.00	**0.42**	
	6435.00	0.58	0.00	0.00	0.00	0.00	52.79	0.00	**0.58**	
	6436.00	0.76	0.00	0.00	0.00	0.00	58.67	0.00	**0.76**	
	6437.00	0.95	0.00	0.00	0.00	0.00	64.01	0.00	**0.95**	
	6437.80	1.07	0.00	0.00	0.00	0.00	67.99	0.00	**1.07**	
	6438.00	1.09	6.57	63.45	0.00	0.00	68.94	0.00	**7.66**	
	6438.80	1.22	73.46	141.88	0.00	0.00	72.65	0.00	**72.65**	
	6439.00		96.57	155.43	0.00	0.00	73.55	0.00	**73.55**	
	6440.00		239.72	210.45	0.00	0.00	77.87	0.00	**77.87**	
	6441.00		420.53	253.81	0.00	0.00	81.98	0.00	**81.98**	
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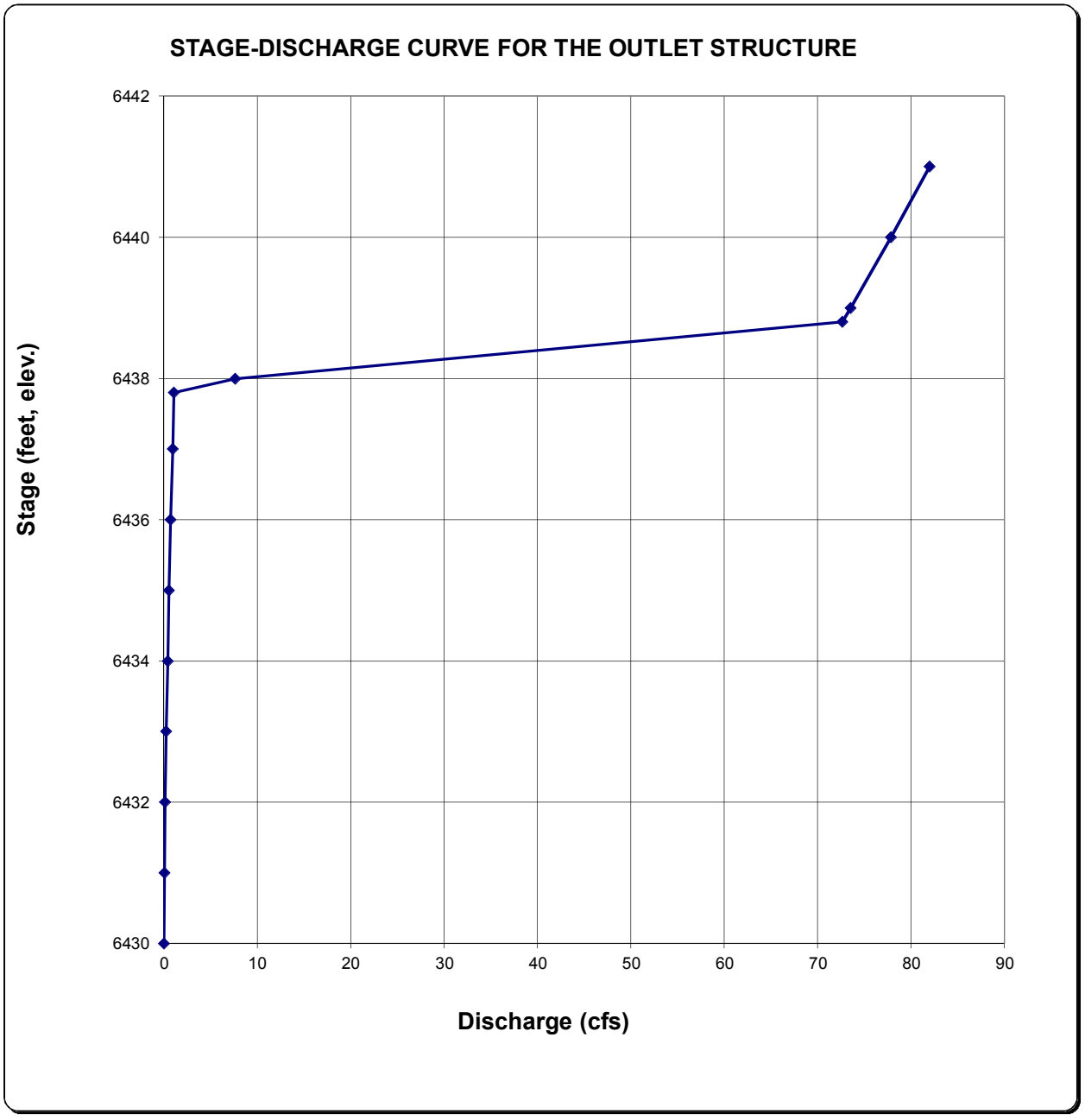
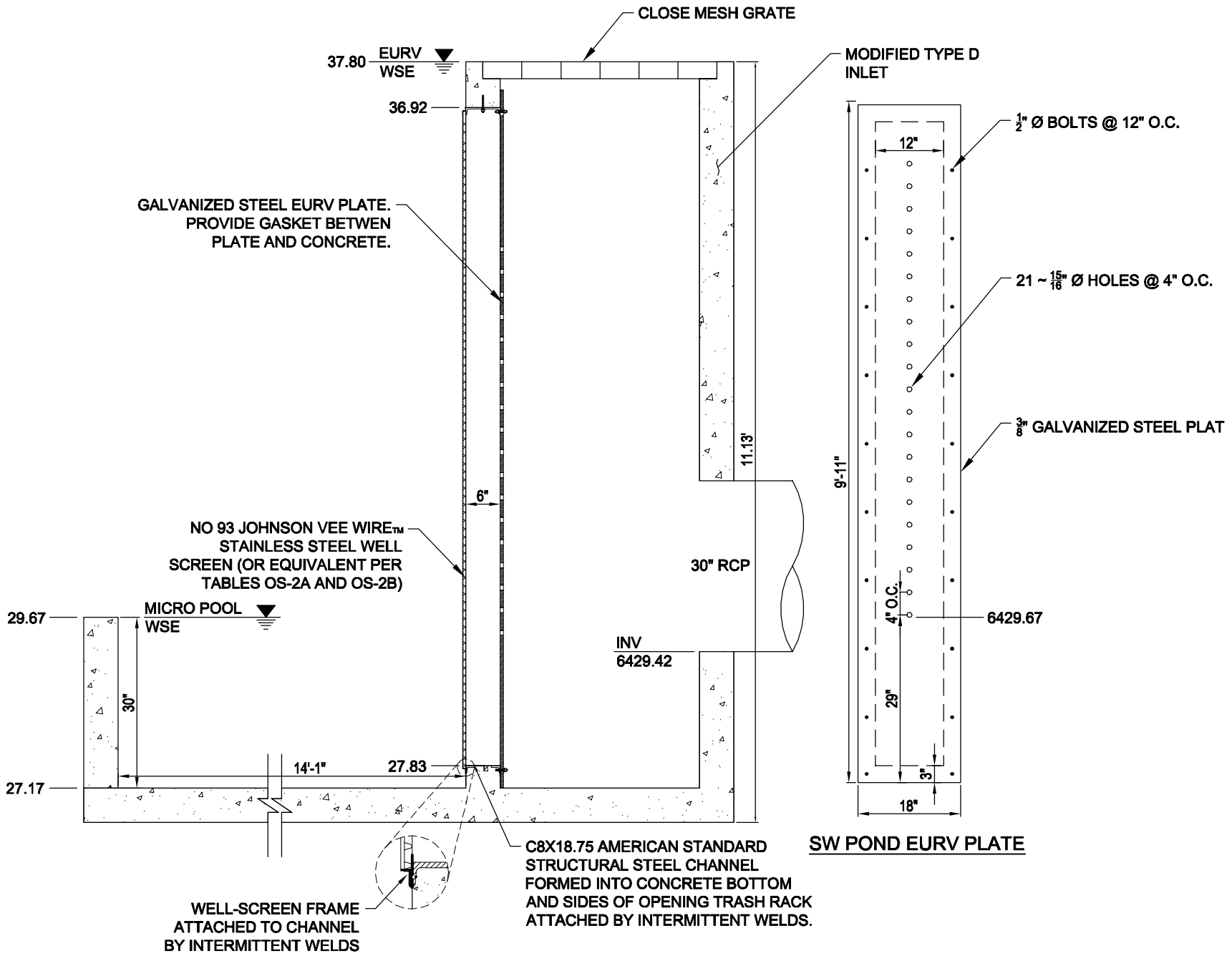
STAGE-DISCHARGE SIZING OF THE WEIRS AND ORIFICES (INLET CONTROL)

Project: Marksheffel / Constitution
Basin ID:





SW POND EURV PLATE

SW POND OUTLET STRUCTURE

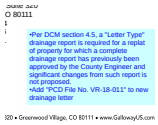
SCALE: 1"=2'

Appendix F

Map Pocket – Drainage Map

Markup Summary

•Per DCM section 4.5, a "Letter Type" drainage report is required for a replat of property for which a complete drainage report has



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Lock: Locked
Author: Daniel Torres
Date: 8/6/2018 10:36:33 AM
Color:

•Per DCM section 4.5, a "Letter Type" drainage report is required for a replat of property for which a complete drainage report has previously been approved by the County Engineer and significant changes from such report is not proposed.
•Add "PCD File No. VR-18-011" to new drainage letter