



JEWELL URBAN COTTAGES SUBDIVISION FILING NO. 1

PRELIMINARY DRAINAGE REPORT

**REPLAT OF PLOT 4 AND A PORTION OF PLOT 5, MALONE SUBDIVISION
CITY OF AURORA, COLORADO**

**FEBRURAY 2021
REVISED APRIL 2025**

Prepared For:
Urban Cottages, LLC
10657 East Ida Avenue
Englewood, CO 80111

Approved For One Year From This Date _____	
_____ Aurora Water - Drainage Division	_____ Date

By:
CAGE Civil Engineering
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ENGINEER'S CERTIFICATION:

I affirm that this report and plan for Jewell Urban Cottages Subdivision Filing No. 1 was prepared by me (or under my direct supervision) in accordance with the City of Aurora Storm Drainage Design and Technical Criteria Manual. I understand that the City of Aurora does not and will not assume liability for drainage facilities designed by others.

Eric Pearson, PE	Date
State of Colorado No. 45415	
For and on behalf of CAGE Civil Engineering	



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SCOPE

The purpose of this report is to present the preliminary drainage plan for the proposed Jewell Urban Cottages Subdivision Filing No. 1 development. The following report includes analysis and design information for the proposed storm systems in general conformance with the standards and specifications for the City of Aurora and the Mile High Flood District (MHFD). Note, the Preliminary Drainage Report (PDR) must be approved prior to Civil Plan approval.

A. INTRODUCTION

1. Location

- a. Jewell Urban Cottages Subdivision Filing No. 1 is located on Plot 4 and a portion of Plot 4 of the Malone Subdivision, in the northwest quarter of Section 15, Township 4 South, Range 67 West of the 6th Principal Meridian in the City of Aurora, County of Adams, Colorado.
- b. Vicinity Map:



VICINITY MAP



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- c. Surrounding Developments:
 - o The project is bordered to the north by East Jewell Avenue; to the east by a portion of Plot 5 of the Malone Subdivision; to the west by Plot 3 of the Malone Subdivision; and to the south by Plot 12 of the Malone Subdivision and Malone Subdivision 2nd Filing.
- 2. Proposed Development
 - a. General Project Description:
 - o The proposed development includes the construction of 15 buildings with 30 duplex units and associated infrastructure. The proposed land use is residential and has a density of 7.5 DU/acre.
 - o Vehicular access will be provided at two locations along the south side of E Jewell Ave.
 - o Composite % Imperviousness: ~ 67%
- 3. Changes to MDR
 - a. Changes to Approved MDR: N/A
 - b. Conditionally Approved Comments: N/A
- 4. Variances
 - a. Variance Request:
 - o A variance is requested for the slope of the grass swale along the east side of the site to be at 1.5% instead of the recommended 2% according to Section 7.5 of the Aurora SDDTC. The reason for this request is to allow the swale to follow the existing slope of the eastern property line because this swale's purpose is to intercept on-site flows and keep them from flowing into the off-site pond to the east. The swale will have more than sufficient capacity for the area tributary to it in the 100-year storm at 1.5%. See Appendix C for swale capacity calculation. Where grades in the swale are less than 2%, a slotted underdrain leading to the Type C inlet is proposed to minimize prolonged standing water and ensure vegetation in this area is not stressed due to excessive moisture.
 - o A variance is requested for the side slopes of the grass swale along the east side of the site to be at 4:1 instead of 5:1 according to Section 7.5 of the Aurora SDDTC. The reason for this request is to match the slope of the existing pond to the east of the site, which is at 4:1.
 - o A variance is requested for the side slopes of the grass swale at the top of the retaining wall along the south side of the site to be at a maximum of 3:1 matching the existing slopes. The required 5:1 side slopes according to Section 7.5 of the Aurora SDDTC are not achievable at this location because the proposed grade ties into the existing ground along the south property line. 5:1 side slopes would require significant offsite grading on private property to the south.



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- A variance is requested for the freeboard between the 100yr WSEL and the flowline elevation at the low point in Jewell Avenue. 0.5' of freeboard is being requested instead of the 1' of freeboard required between the HGL and inlet invert according to Section 6.4.6 of the Aurora SDDTC. This is due to the constrained nature of the outfall elevation and inlet elevation at the existing low point in Jewell Avenue. It is important to note that in the emergency condition this reduction of freeboard doesn't put any structures at risk. If the pond were to overflow, water would simply overtop the pond and into Jewell Ave. Eventually then overtopping the Jewell Ave crown and flowing down the street to its ultimate receiving waters

B. HISTORICAL DRAINAGE

1. Description of Property and Drainage Basin

a. Existing Conditions:

- The project site is a parcel of approximately 3.99 acres consisting of opens space with native grasses, fencing, a residence with paved driveways/patios, various wood shelters/barns and a small concrete pad.
- The site generally slopes from south to north with an average slope of 6%.
- The entire property ultimately drains north to East Jewell Avenue where runoff is intercepted by the Havana Heights storm sewer system.
- Soil types on site as identified by the Natural Resources Conservation Service (NRCS) are as follows:

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
TrC	Truckton loamy sand, 0 to 3 percent slopes	A	1.6	41.6%
TrE	Truckton loamy sand, 5 to 20 percent slopes	A	2.2	58.4%
Totals for Area of Interest			3.8	100.0%

- See Appendix A for soils map.
- The project site is located within the Havana Heights Drainage Basin.

b. Major Drainageways:

- The project site is located within the Havana Heights Drainage Basin and is within the Westerly Creek watershed.
- The site is in FEMA Floodplain Zone X (Area of Minimal Flood Hazard) per FIRMette in Appendix A, FIRM Panel 08005C0186K, published 12/17/2010, this FIRM Panel has not been printed per FEMA.

c. Existing Irrigation Facilities: N/A

d. Offsite Basins:



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- In the existing condition, offsite basins from the south flow onto the property and ultimately drain to Jewell Ave.
- e. Outfalls Downstream from Property:
 - Runoff from the project site is captured and conveyed via the Havana Heights storm sewer system and ultimately discharges into the Parker/Mexico Outfall System.
- f. Relevant Major Drainageway Planning Studies: N/A

C. DESIGN CRITERIA

1. Hydrologic Criteria

- a. Minor and Major Design Storm Frequencies:
 - 2-year and 100-year storms.
- b. One Hour Point Precipitation Depths:
 - The project design rainfall intensities were determined using the NOAA Atlas 14 Point Precipitation Frequency Estimates for the site location. These values can be found in Appendix A.
- c. Calculation Method: Rational Formula:
 - $Q=CIA$ (Eq 5.1)
- d. Detention Volume Computation Method:
 - Water Quality and 100-year detention volume is provided by an on-site detention basin. This basin is sized per the latest Mile High Flood District (MHFD) Detention Basin Design Workbook "UD-Detention, Version 4.06 (July 2022)".
- e. Design Criteria References
 - The City of Aurora Storm Drainage Design and Technical Criteria (SDDTC) [Ref. 1]
 - The Urban Storm Drainage Criteria Manual (USDCM), Volumes 1, 2, and 3, from the Mile High Flood District [Ref. 2].
 - Havana Heights Drainage Improvements – Hydrologic Summary Report, Sellards & Grigg, Inc, dated June 1985, Aurora EDN: 850177 [Ref. 3]

2. Hydraulic Criteria

- a. Design Storm Frequencies:
 - Design storm recurrence intervals being evaluated are the 2-year storm for the minor event and the 100-year storm for the major event. The 100-year storm is being used for the design of pipes, inlets, swales, curb and gutter.
 - In the minor storm the water is not allowed to overtop the curb, while in the major storm the maximum depth of water over the flowline cannot exceed 12 inches. For alley loaded product areas, flows cannot cross the sidewalk.
- b. Criteria for Sizing Detention Facilities:



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- The extended detention basin (EDB) for this site was designed per the latest Mile High Flood District (MHFD) Detention Basin Design Workbook “UD-Detention, Version 4.06 (July 2022)”.
- The EDB was designed to achieve the required drain times for the WQCV (40 Hours), EURV (12 to 32 hours), and a maximum release rate of 90% of the predevelopment 100-year flow.
- c. Criteria for Sizing Drainage Corridor Widths: N/A
- d. FEMA or FHAD Floodplains: N/A
- e. Public and Private Infrastructure:
 - All infrastructure is private other than the Type R Inlet, the RCP pipes to and from the pond, and STMH-1.
- f. Temporary Stormwater Infrastructure: N/A
- g. Calculation Methods and Software Used in Hydraulic Analysis:
 - MHFD-Detention workbook, HY-8.

D. DRAINAGE PLAN

1. General Concept

- a. Proposed Drainage Concept & Proposed Downstream Outfall:
 - The drainage design of Jewell Urban Cottages Subdivision Filing No. 1 will follow existing drainage patterns to convey flows northwest to the existing storm sewer in Jewell Ave which outfalls into the Havana Heights Drainage System (EDN: 850177)
 - The previous report (Havana Heights Drainage System EDN: 850177) states that “Infiltration rates, perviousness, imperviousness, and on-site detention maximum release rates are all derived directly from information and data provided in the COA reference report and the COA most recent zoning map.” Therefore, it is determined that the existing storm sewer system within Jewel is sized for this development, in its existing condition.
 - The outfall for this project is an existing 36” RCP flowing east to the west below E. Jewell Ave. Per information in the previous drainage report (Havana Heights Drainage System EDN: 850177) this pipe conveys an existing 100 yr flow of 46.2 cfs in the 100-yr storm. Per the previous point, it has been determined that the existing site currently enters this 36” pipe. In the proposed condition, the extended detention basin (EDB) will have a 100-yr release rate of 1.1 cfs which is less than the historic (existing) peak flow rate from the site. Therefore, there should be a net decrease in the flows entering the existing 36” pipe for the proposed condition, when compared to the existing. However, as a conservative approach, if existing on-site flows were not accounted for in the analysis of the existing 36” RCP pipe, an analysis has been performed assuming the EDB outflow will be in addition to the existing flow, resulting in a total flow of 47.3 cfs at the tie in location. The existing 36” RCP has capacity for this additional flow, see calculations in Appendix C.



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- It is important to note that the historical objective of the Havana Heights Outfall system was to limit flows into the Parker / Mexico drainage facility to 46 cfs. This was achieved by constructing a 27-inch diameter orifice that restricts flows to 46 cfs. Per the previous drainage report (EDN: 850177), the peak 100 yr flow reaching the intersection of Havana Street and Jewell Ave is 150 cfs. Flows exceeding 46 cfs are diverted to a bubble up structure on Havana St., north of Jewell Ave. See excerpts of the previous drainage report in Appendix D.
- Offsite drainage to the south of the property, in basin OS1 & OS2, will be conveyed in a proposed swale in basin UD1 along the south and east sides of the property. This swale leads to a proposed Type C inlet and pipe that connects to the existing storm sewer in Jewell Ave. The additional runoff entering the storm sewer at this location, between MH-6 and MH-7 (EDN: 850177), is 2.77 cfs in the 100-yr storm. This additional flow will result in a 0.13' HGL rise, when compared to the existing HGL. However, based on hydraulic calculations in Appendix C, the flow is shown to be contained within the pipe and in our opinion, does not signal any negative impacts to upstream infrastructure.
- Conveying runoff from basins OS1, OS2, & UD1 to the existing storm in Jewell Ave matches historical drainage patterns and stops any drainage from entering the existing detention pond (EDN 850177) to the east of the property.

b. Coordination with Surrounding Development:

- The Havana Heights Pond (in emergency overflow condition) will flow west along Jewell, and enter this development's pond, be treated again and outfall into the Jewell Street storm sewer system.
- The existing Havana Heights Pond overflow is at 5560.90 (per EDN: 850177), and all buildings in this development will be higher than this elevation plus flow depth plus freeboard. The Havana Heights Pond overflow is not being modified by this plan.

c. Detention Ponding / Water Quality BMP Plan

- An Extended Detention Basin (EDB) is proposed on the north side of the site adjacent to Jewell Ave. The proposed EDB's required volumes and release rates were derived from the MHFD Urban Storm Drainage Criteria Manual, Volume 2, Chapter 12. These have been calculated using the MHFD Detention Basin Design Workbook (MHFD-Detention, Version 4.06, July 2022)

2. Specific Details

a. Proposed Basins:

- Basin D1 consists of rooftops, pavement, curb, gutter, sidewalk, retaining walls, and landscaping. Runoff is conveyed downslope to design point 1 via 1' curb and gutter where it flows to the north and east and is collected by a proposed Type R inlet in sump. This inlet discharges into the proposed extended detention basin at the northwest corner of the site. This basin accepts upstream flow from basin D2, D4, D5 and basin OS3.
- Basin D2 consists of rooftops, pavement, curb, gutter, sidewalk, and landscaping. Runoff is conveyed downslope to design point 2, via 1' curb and gutter where it



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enters E. Jewell Ave. and discharges into basin D1 via 2' curb & gutter and flows to the west. This basin accepts upstream flows from basin D5.

- Basin D3 consists of rooftops, sidewalk, gravel, landscaping, retaining wall, and the proposed extended detention basin. Runoff is conveyed to design point 3 via overland flow and a trickle channel where it is collected by a modified Type C outlet structure and discharges into the existing Havana Heights storm sewer system at the northwest corner of the site. Basin D3 accepts flows from all upstream D basins and OS3.
- Basin D4 consists of rooftops, pavement, sidewalk, retaining wall and landscaping. Runoff is conveyed via overland flow and private alley to design point 4 where it discharges into basin D1.
- Basin D5 consists of rooftops, pavement, sidewalk, retaining wall and landscaping. Runoff is conveyed via overland flow and private alley to design point 5 where it discharges into basin D2.
- Basin UD1 consists of concrete trickle channel, riprap, and landscaping. Runoff will be conveyed in a proposed swale along the south and east sides of the property that leads to a proposed Type C inlet at design point 6. Basin UD1 accepts offsite drainage from basin OS1 & OS2 to the south and passes runoff through the site to the existing storm sewer in Jewell Ave, matching historic drainage patterns. The swale will have more than sufficient capacity for the area tributary to it in the 100-year storm at 1.5%. See Appendix C for swale capacity calculation. Where grades in the swale are less than 2%, a slotted underdrain leading to the Type C inlet is proposed to minimize prolonged standing water and ensure vegetation in this area is not stressed due to excessive moisture.
- Basin OS1 is an offsite basin to the south of the site and consists of rooftops, pavement, and landscaping. Runoff sheets flows into the site along the south property line at design point 7 and enters basin UD1. All runoff from basin OS1 will pass through the site to the existing storm sewer in Jewell Ave, matching historic drainage patterns.
- Basin OS2 is an offsite basin to the south of the site and consists of rooftops, pavement, and landscaping. Runoff sheets flows into the site along the south property line at design point 8 and enters basin UD1. All runoff from basin OS2 will pass through the site to the existing storm sewer in Jewell Ave, matching historic drainage patterns.
- Basin OS3 is a small offsite basin bordering the western edge of the property and consists of landscaping. Runoff from this basin sheet flows onto the property at design point 9 and enters Basin D2. All runoff from basin OS3 will pass through the EDB into the existing storm sewer in Jewell Ave, matching historical drainage patterns.



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b. Basin Summary Table

BASIN SUMMARY TABLE					
Basin Designation	Design Point	Area (ac)	% Impervious	Q ₂ (cfs)	Q ₁₀₀ (cfs)
D1	1	1.74	72.62	2.22	7.44
D2	2	0.93	74.65	1.28	4.23
D3	3	1.17	59.02	1.29	4.77
D4	4	0.21	53.04	0.22	0.86
D5	5	0.14	63.36	0.18	0.65
UD1	6	0.28	24.21	0.09	0.58
OS1	7	1.42	13.21	0.17	1.63
OS2	8	0.27	18.67	0.07	0.56
OS3	9	0.04	5.00	0.002	0.04

Figure 1. Basin Summary Table

c. Street, Drive, and Alley Capacity Table

- In the below Figure 2, the table shows the capacity of the private drives and private alleys for the two most conservative situations onsite. The table also shows that the maximum depths do not exceed curb capacity in the minor storm or 1 foot in the major storm, which is consistent with table 6-2 in the SDDTC.
- The first is for the private drive on the west side of the site, where flows from upstream basins (D1+D4+OS3) combine in the east curb line, at section G. This location is more conservative than the private drive on the east side of the site because the flow rate is greater, even though the slope is less on the east side. See Appendix C calculation.
- The second is for the private alley within basin D5, at section D. This location is more conservative than section C because the shallower slope at this location causes greater depth and spread. See Appendix C for calculation.
- Capacity calculations for Jewell Avenue can be found in Appendix C.

STREET, DRIVE, AND ALLEY CAPACITY TABLE						
Type	Minor Storm			Minor Storm		
	Q ₂ (cfs)	Depth (ft)	Spread (ft)	Q ₁₀₀ (cfs)	Depth (ft)	Spread (ft)
Private Drive (D1+D4+OS3) Section G	2.44	0.20	6.95	8.35	0.29	11.40
Private Alley (D5) Section D	0.18	0.06	6.00	0.65	0.10	10.00

Figure 2. Street, Drive, and Alley Capacity Table



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d. Detention Pond Location and Outfall:

- The site proposes a full spectrum Extended Detention Basin (EDB) on the north side of the site to provide detention and water quality for the WQCV, EURV, and 100-yr storm.
- Onsite runoff enters the EDB via the Type R sump inlet within Jewell Avenue. Runoff is discharged into the EDB forebay, where flow velocity and energy are reduced. A trickle channel at the bottom of the EDB will then convey flows to a modified Type-C outlet structure.
- The outlet structure releases runoff into the existing Havana Heights Drainage System (EDN: 850177) at controlled rates that adhere to MHFD criteria for EDB's. See Appendix C for outlet structure calculations using MHFD Detention Basin Design Workbook (MHFD-Detention, Version 4.06, July 2022).
- A Plasti-Fab Flap Gate Backflow Preventer was required due to the shallowness of the onsite detention system in comparison to the existing storm system in Jewell Ave. In major storms the Havana Heights Drainage System EDN: 850117 does have the potential to back up into the extended detention basin. Therefore, this backflow preventer will protect the onsite system from flooding. The Plasti-Fab Flap Gate was chosen for its ability to be mounted on the outside face of the restrictor plate on the downstream side of the outlet structure. See Appendix C for Plasti-Fab detail sheets.
- Due to grading constraints, runoff from basin UD1 will exit the property without detention. The 100-year runoff for this basin has been added to the pond release rate when calculating the peak outflow vs. predevelopment flow to compensate for the undetained flow from this basin. See Figure 3 below.
- A summary table comparing the proposed release rates vs the predeveloped peak flows are shown below in Figure 3 below. The ratio of proposed peak outflows Q to the predeveloped peak Q for the site 89%, which is less than the maximum 90% release rate per MHFD.

100 YR RELEASE RATE SUMMARY TABLE		
Basin Designation	Q ₁₀₀ (cfs)	Notes
Pond Outflow (D1, D2, D3, D4, D5)	1.09	Routed through EDB
UD1	0.58	Undetained flows
OS1	1.63	Undetained offsite flows
OS2	0.56	Undetained offsite flows
OS3	0.04	Offsite flows, routed though EDB
Total 100 Yr Outflow (Pond Outflow + UD1)	1.67	
100 Yr Predevelopment Peak Q	1.87	
Peak Outflow to Predevelopment Q %	89%	

Figure 3. 100 Yr Release Rate Summary Table



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e. Emergency Overflow Paths:

- The first emergency overflow location is a shared overflow between the proposed Type R sump inlet in Jewell Avenue and the emergency overflow for the pond. If the Type R sump inlet were to clog, water would overtop the back of the sidewalk and go south back into the EDB. If the outlet structure for the EDB is clogged, flows will overtop the pond and flow north into Jewell Ave. An analysis for this emergency overflow has been included in Appendix C. If both the Type R inlet and the outlet structure are clogged, water will pool until it overtops the crown of Jewell Avenue and flows to the existing inlet on the north side of Jewell Ave, as it does in the existing condition. If this existing inlet is also clogged, flows will overtop to the north to the private Joliet Street as in the existing condition. See Appendix C for overflow calculations these three emergency conditions: overtop into pond via inlet clogged, overtop in Jewell Ave via outlet structure clogged, overtopping street crown via outlet structure clogged.
- The second emergency overflow location is for the proposed Type C inlet on the east side of the site. If this inlet were to clog, water would pool up and overflow to the existing pond (EDN: 850177). An analysis for this emergency overflow has been included in Appendix C. If the outlet structure for the existing pond is clogged, water would overtop into the proposed site. However, these flows would be contained within the proposed swale on the east side of the site until water pools up and crests the northwest corner of the existing pond toward Jewell Ave, which is the historical emergency overflow point.

f. Problems Encountered: N/A

g. Permanent BMPs: See section d above.

h. Phasing: N/A

i. Open Channel:

- A grass lined swale is utilized in this development to convey offsite flows from the south away from retaining walls and to proposed storm sewer. Hydraulic calculations for the swales are shown in Appendix C. The Manning's "n" value used for grass swales is 0.025.
- Two situations are analyzed in this report to confirm specifications of the swales with the SDDTC. The first is the portion of the swale with the flattest slope to confirm capacity, and the second is the portion of the swale with the steepest slope, to confirm velocity. See section E in Appendix C
- All swales adhere to the specifications of Table 7-2 in the SDDTC.

j. Roadside Ditches: N/A

k. Outfall System Plan: N/A

l. Other Info: N/A



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E. CONCLUSIONS

1. Compliance with Standards
 - The drainage design for the Jewell Urban Cottages Subdivision Filing No. 1 site detailed within this report is in general compliance with the *City of Aurora Storm Drainage Design and Technical Criteria Manual*, and the *Mile High Flood District Urban Storm Drainage Criteria Manual*.
2. Summary of Concept
 - The drainage design of the Jewell Urban Cottages Subdivision Filing No. 1 will match historic drainage patterns as closely as possible.
 - The majority of the site's runoff will drain to a proposed Extended Detention Basin (EDB) located on the north side of the site via curb and gutter and storm sewer. Release rates from the EDB have been adjusted to compensate for all undetained runoff exiting the site.
 - In summary, it is our opinion that the proposed development will have no negative impact to downstream flows, channel depths, velocities, erosion rates and existing infrastructure.

F. REFERENCES

1. *Storm Drainage Design and Technical Criteria*, City of Aurora, Revised November 2023
2. *Urban Storm Drainage Criteria Manual, Volumes 1, 2, and 3*, Mile High Flood District, latest edition.
3. *Havana Heights Drainage Improvements – Hydrologic Summary Report*, Sellards & Grigg, Inc, dated June 1985, Aurora EDN: 850177



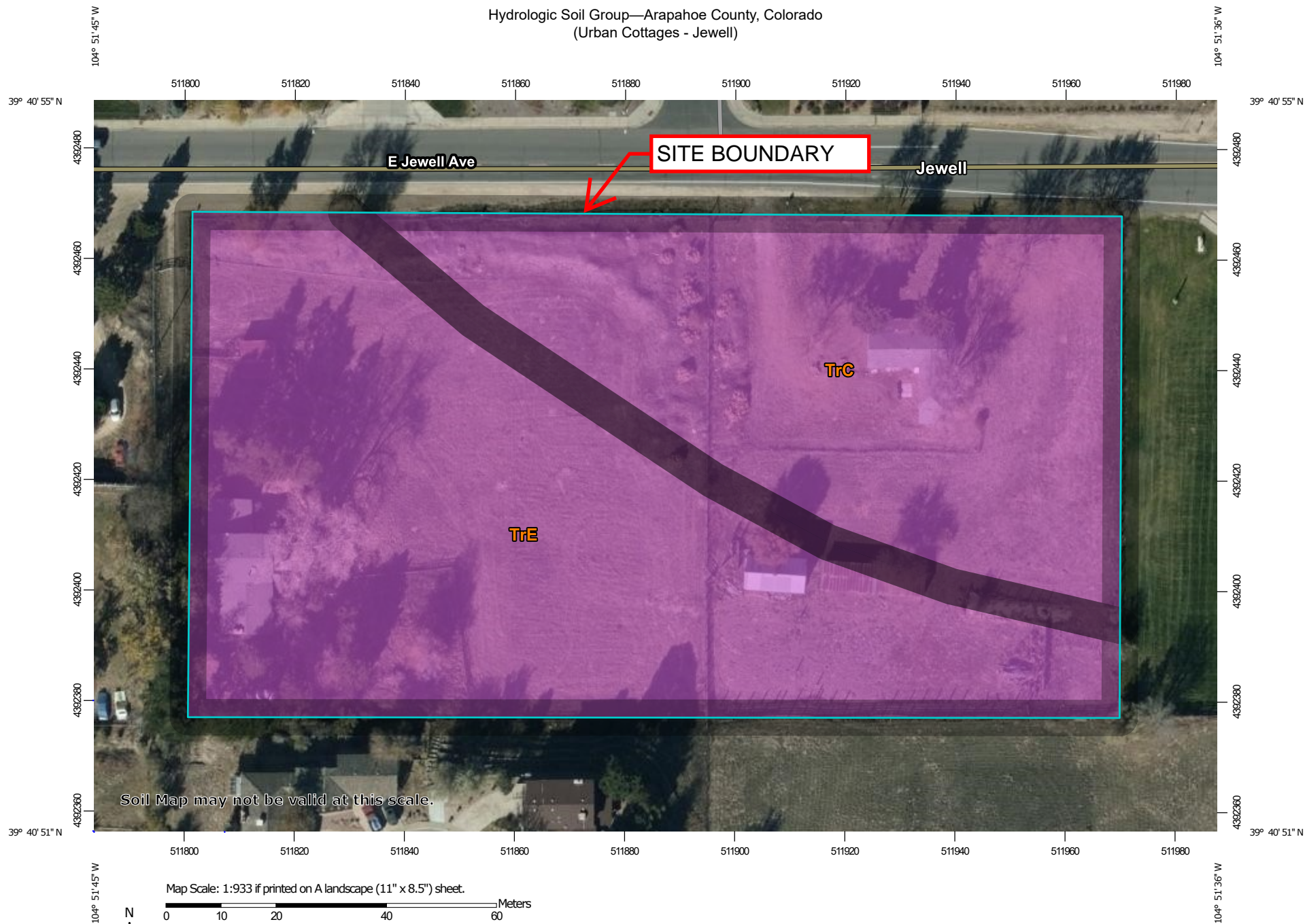
APPENDIX A

Soils Map & Geotech Report Excerpts

1 Hour Rainfall Values

FEMA FIRMette

Hydrologic Soil Group—Arapahoe County, Colorado
(Urban Cottages - Jewell)



Soil Map may not be valid at this scale.

Map Scale: 1:933 if printed on A landscape (11" x 8.5") sheet.

0 10 20 40 60 Meters

0 45 90 180 270 Feet

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



Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

10/8/2021
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Hydrologic Soil Group—Arapahoe County, Colorado
(Urban Cottages - Jewell)

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 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Arapahoe County, Colorado
 Survey Area Data: Version 17, Aug 31, 2021

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

Date(s) aerial images were photographed: Oct 3, 2018—Dec 4, 2018

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
TrC	Truckton loamy sand, 0 to 3 percent slopes	A	1.6	41.6%
TrE	Truckton loamy sand, 5 to 20 percent slopes	A	2.2	58.4%
Totals for Area of Interest			3.8	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



NOAA Atlas 14, Volume 8, Version 2
Location name: Aurora, Colorado, USA*
Latitude: 39.6816°, Longitude: -104.8613°
Elevation: 5562 ft**

* source: ESRI Maps

** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.223 (0.178-0.281)	0.274 (0.218-0.345)	0.364 (0.289-0.460)	0.446 (0.351-0.566)	0.567 (0.436-0.757)	0.669 (0.501-0.902)	0.777 (0.562-1.07)	0.894 (0.620-1.27)	1.06 (0.705-1.54)	1.19 (0.770-1.75)
10-min	0.326 (0.260-0.411)	0.401 (0.319-0.506)	0.533 (0.423-0.674)	0.653 (0.514-0.829)	0.831 (0.639-1.11)	0.980 (0.733-1.32)	1.14 (0.823-1.57)	1.31 (0.907-1.86)	1.55 (1.03-2.26)	1.74 (1.13-2.56)
15-min	0.398 (0.317-0.502)	0.489 (0.389-0.617)	0.650 (0.516-0.822)	0.796 (0.627-1.01)	1.01 (0.779-1.35)	1.20 (0.894-1.61)	1.39 (1.00-1.92)	1.60 (1.11-2.26)	1.89 (1.26-2.76)	2.13 (1.38-3.13)
30-min	0.560 (0.446-0.706)	0.687 (0.547-0.867)	0.911 (0.722-1.15)	1.11 (0.875-1.41)	1.41 (1.08-1.88)	1.65 (1.24-2.23)	1.92 (1.38-2.64)	2.20 (1.52-3.11)	2.59 (1.72-3.77)	2.90 (1.88-4.27)
60-min	0.714 (0.569-0.899)	0.862 (0.686-1.09)	1.13 (0.894-1.42)	1.37 (1.08-1.74)	1.73 (1.33-2.32)	2.04 (1.53-2.75)	2.37 (1.71-3.27)	2.72 (1.89-3.87)	3.23 (2.15-4.71)	3.64 (2.35-5.35)
2-hr	0.868 (0.696-1.08)	1.04 (0.831-1.30)	1.34 (1.07-1.68)	1.63 (1.29-2.05)	2.06 (1.60-2.73)	2.43 (1.83-3.25)	2.82 (2.06-3.87)	3.25 (2.28-4.58)	3.87 (2.60-5.59)	4.37 (2.85-6.35)
3-hr	0.959 (0.773-1.19)	1.14 (0.914-1.41)	1.46 (1.17-1.82)	1.76 (1.40-2.21)	2.23 (1.74-2.94)	2.63 (2.00-3.50)	3.06 (2.25-4.18)	3.54 (2.49-4.95)	4.22 (2.85-6.06)	4.78 (3.13-6.90)
6-hr	1.14 (0.928-1.41)	1.35 (1.10-1.67)	1.74 (1.40-2.15)	2.09 (1.68-2.59)	2.63 (2.07-3.43)	3.08 (2.36-4.07)	3.58 (2.64-4.83)	4.12 (2.92-5.70)	4.89 (3.33-6.94)	5.51 (3.64-7.87)
12-hr	1.38 (1.12-1.68)	1.66 (1.35-2.02)	2.14 (1.74-2.62)	2.57 (2.08-3.16)	3.20 (2.52-4.11)	3.72 (2.86-4.82)	4.26 (3.17-5.66)	4.84 (3.45-6.60)	5.66 (3.88-7.91)	6.30 (4.20-8.90)
24-hr	1.67 (1.38-2.02)	2.00 (1.64-2.42)	2.56 (2.10-3.11)	3.05 (2.48-3.72)	3.75 (2.97-4.74)	4.31 (3.33-5.52)	4.89 (3.66-6.42)	5.51 (3.96-7.41)	6.36 (4.39-8.77)	7.02 (4.72-9.80)
2-day	1.98 (1.65-2.38)	2.33 (1.93-2.80)	2.92 (2.41-3.51)	3.43 (2.82-4.14)	4.16 (3.32-5.22)	4.76 (3.71-6.03)	5.37 (4.05-6.97)	6.02 (4.36-8.01)	6.91 (4.82-9.44)	7.62 (5.17-10.5)
3-day	2.12 (1.77-2.53)	2.51 (2.09-3.00)	3.15 (2.62-3.78)	3.70 (3.06-4.46)	4.49 (3.60-5.59)	5.12 (4.00-6.44)	5.76 (4.36-7.42)	6.43 (4.68-8.49)	7.35 (5.15-9.95)	8.06 (5.50-11.1)
4-day	2.23 (1.86-2.65)	2.64 (2.21-3.15)	3.34 (2.78-3.99)	3.93 (3.25-4.71)	4.76 (3.82-5.88)	5.41 (4.24-6.78)	6.08 (4.62-7.78)	6.77 (4.94-8.88)	7.70 (5.41-10.4)	8.42 (5.77-11.5)
7-day	2.55 (2.15-3.02)	3.01 (2.53-3.56)	3.76 (3.15-4.46)	4.40 (3.66-5.23)	5.29 (4.27-6.48)	5.99 (4.73-7.43)	6.70 (5.12-8.50)	7.42 (5.46-9.65)	8.41 (5.95-11.2)	9.16 (6.33-12.4)
10-day	2.87 (2.42-3.37)	3.33 (2.81-3.92)	4.10 (3.45-4.84)	4.75 (3.98-5.63)	5.66 (4.60-6.91)	6.38 (5.06-7.88)	7.11 (5.46-8.97)	7.86 (5.81-10.2)	8.88 (6.32-11.8)	9.66 (6.70-13.0)
20-day	3.76 (3.20-4.38)	4.25 (3.62-4.96)	5.07 (4.29-5.92)	5.75 (4.85-6.75)	6.71 (5.49-8.09)	7.46 (5.97-9.11)	8.22 (6.37-10.3)	9.00 (6.71-11.5)	10.1 (7.22-13.2)	10.9 (7.61-14.4)
30-day	4.46 (3.81-5.17)	5.03 (4.29-5.83)	5.95 (5.07-6.92)	6.72 (5.69-7.84)	7.77 (6.37-9.29)	8.58 (6.89-10.4)	9.38 (7.30-11.6)	10.2 (7.64-12.9)	11.3 (8.14-14.7)	12.1 (8.53-16.0)
45-day	5.29 (4.54-6.10)	6.02 (5.16-6.94)	7.18 (6.14-8.30)	8.12 (6.91-9.42)	9.36 (7.70-11.1)	10.3 (8.29-12.4)	11.2 (8.74-13.7)	12.1 (9.08-15.2)	13.2 (9.58-17.0)	14.1 (9.96-18.4)
60-day	5.96 (5.14-6.85)	6.88 (5.92-7.90)	8.31 (7.13-9.57)	9.44 (8.06-10.9)	10.9 (8.98-12.8)	12.0 (9.67-14.3)	13.0 (10.2-15.8)	14.0 (10.5-17.4)	15.2 (11.0-19.4)	16.0 (11.4-20.9)

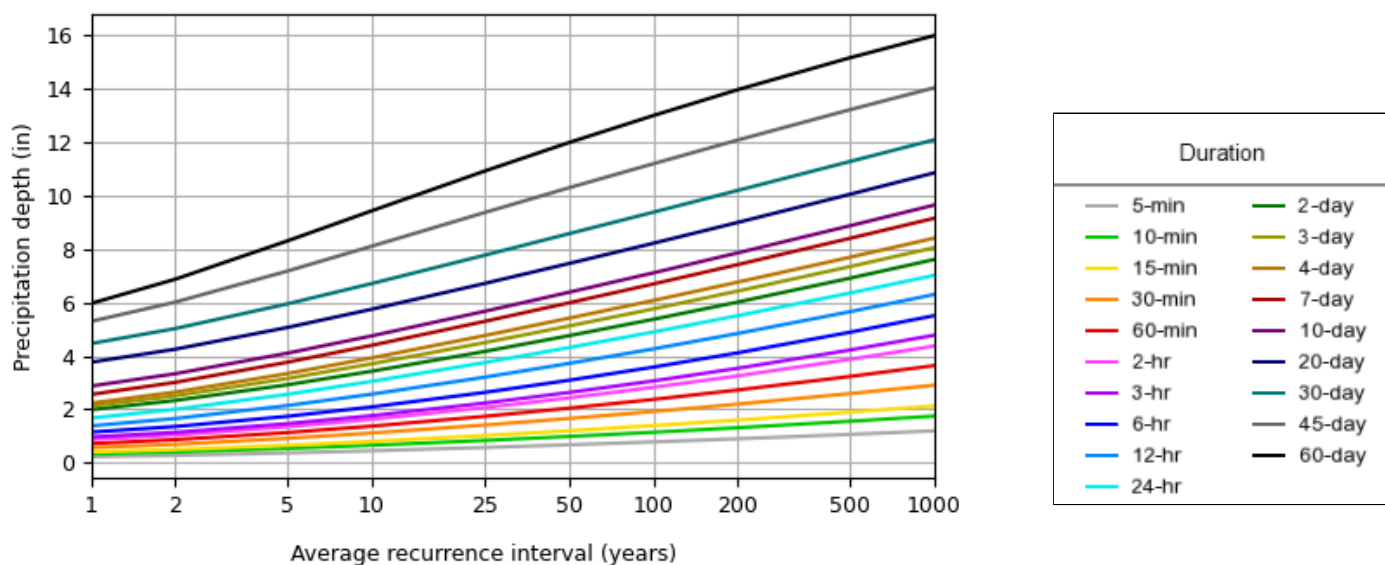
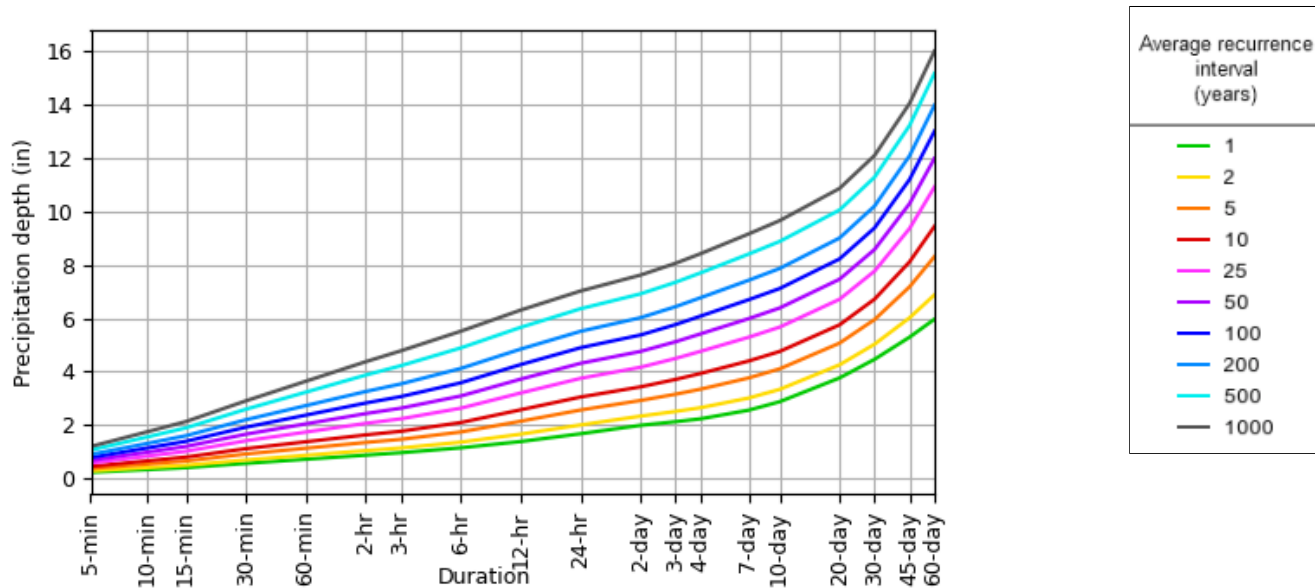
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical

PDS-based depth-duration-frequency (DDF) curves

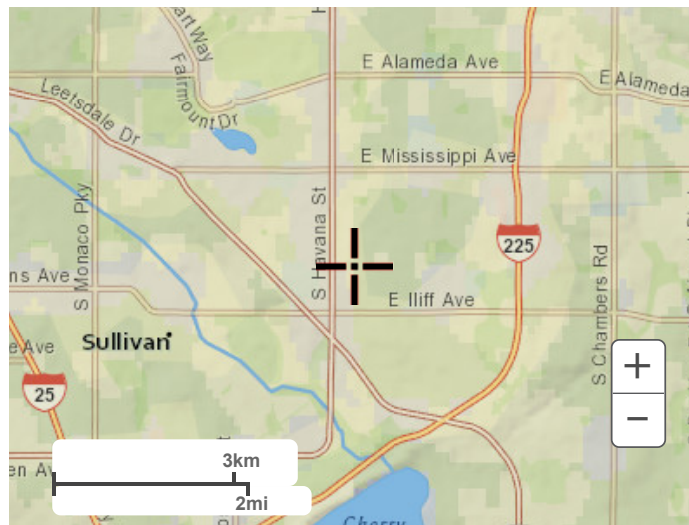
Latitude: 39.6816°, Longitude: -104.8613°



NOAA Atlas 14, Volume 8, Version 2

Created (GMT): Fri May 17 14:33:57 2024

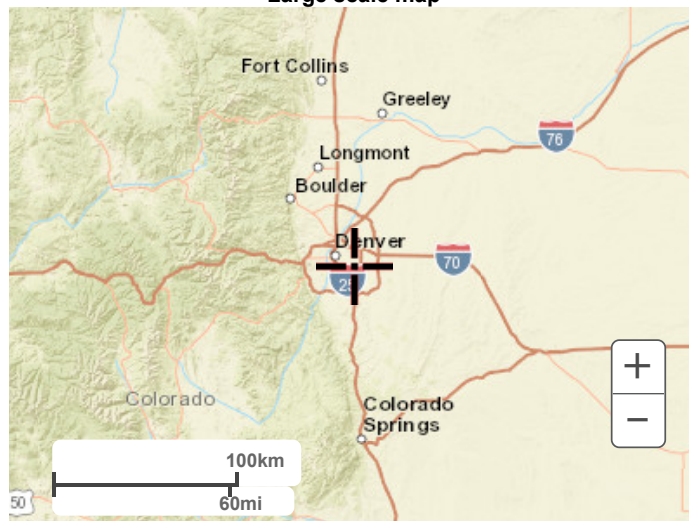
[Back to Top](#)**Maps & aerals****Small scale terrain**



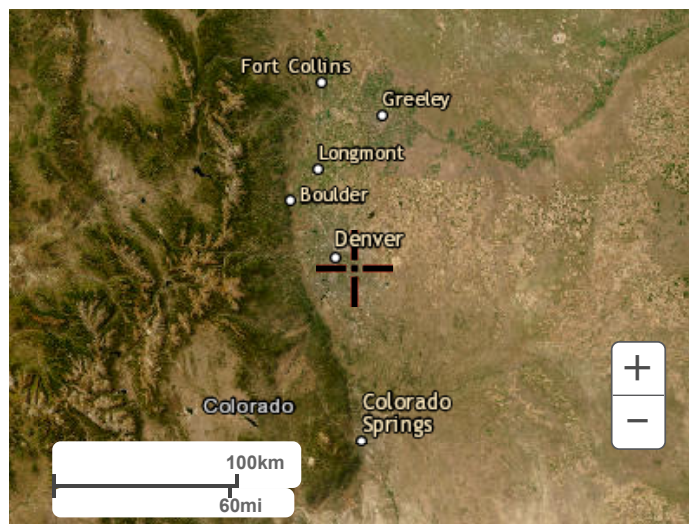
Large scale terrain



Large scale map



Large scale aerial



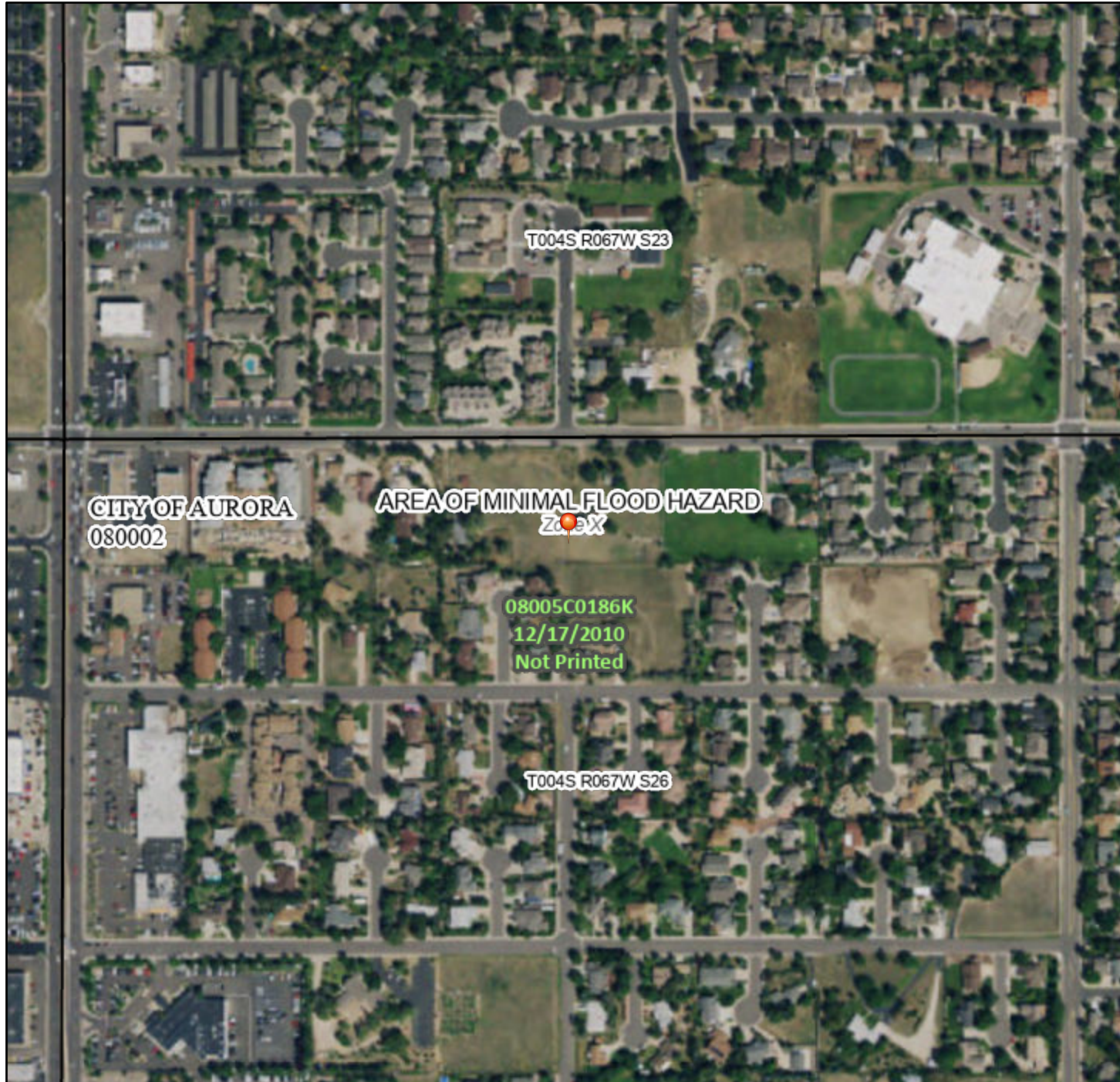
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1325 East West Highway
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Questions?: HDSC.Questions@noaa.gov
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National Flood Hazard Layer FIRMette



104°51'59"W 39°41'6"N



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

1:6,000

104°51'22"W 39°40'39"N

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

Legend

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

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
MAP PANELS		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped
		The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.



This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/7/2022 at 4:10 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX B

Rational Calculations
COA Imperviousness and C-Values



Project: Urban Cottages Jewell
Location: Aurora, CO
Designer: IJL
Date: 12/27/2021
Latest Revision: 4/7/2025

BASIN SUMMARY TABLE					
Basin Designation	Design Point	Area (ac)	% Impervious	Q ₂ (cfs)	Q ₁₀₀ (cfs)
D1	1	1.74	72.62	2.22	7.44
D2	2	0.93	74.65	1.28	4.23
D3	3	1.17	59.02	1.29	4.77
D4	4	0.21	53.04	0.22	0.86
D5	5	0.14	63.36	0.18	0.65
UD1	6	0.28	24.21	0.09	0.58
OS1	7	1.42	13.21	0.17	1.63
OS2	8	0.27	18.67	0.07	0.56
OS3	9	0.04	5.00	0.002	0.04



Project: Urban Cottages Jewell
 Location: Aurora, CO
 Designer: JIL
 Date: 12/27/2021
 Latest Revision: 4/7/2025

¹From Table 5-6 Impervious Values for Urban Surfaces for Site and Small Watershed Analysis
²From Table 5-7 Runoff Coefficient Equations Based on NRCS Soil Group and Storm Return Period

IMPERVIOUSNESS AND RUNOFF COEFFICIENT CALCULATIONS

				Roofs	Native Grass	Landscaping	Pavement	Sidewalk	Gravel	WQCV						
				Impervious % ¹	95%	5%	20%	95%	95%	60%	100%					
Basin Designation	NRCS Hydrologic Soil Group	Total Area (ac)	Total Area (sf)	Roofs (sf)	Native Grass (sf)	Landscaping (sf)	Pavement (sf)	Sidewalk (sf)	Gravel (sf)	WQCV (sf)	Percent Impervious	Runoff Coefficients, C ²				
												C ₂	C ₃	C ₁₀	C ₁₀₀	
D1	A	1.74	75,946	15,790	0	22,666	29,058	8,432	0	0	72.62%	0.55	0.57	0.59	0.68	
D2	A	0.93	40,365	10,030	0	10,953	15,273	4,109	0	0	74.65%	0.57	0.59	0.61	0.69	
D3	A	1.17	51,161	15,414	0	24,712	0	5,880	326	4,830	59.02%	0.42	0.44	0.45	0.57	
D4	A	0.21	8,967	1,373	0	5,017	1,790	788	0	0	53.04%	0.37	0.38	0.40	0.52	
D5	A	0.14	6,123	1,347	0	2,583	1,790	403	0	0	63.36%	0.46	0.48	0.50	0.60	
Tributary To Pond (D1, D2, D3, D4, D5)	A	4.19	182,562	43,954	0	58,330	47,910	19,611	326	4,830	67.15%	0.50	0.52	0.53	0.63	
UD1	A	0.28	12,064	0	0	11,376	0	667	20	0	24.21%	0.13	0.14	0.15	0.30	
Total On-Site	A	4.47	194,625	43,954	0	69,707	47,910	20,279	346	4,830	64.49%	0.47	0.49	0.51	0.61	
OS1	A	1.42	61,830	5,639	56,192	0	0	0	0	0	13.21%	0.06	0.06	0.07	0.21	
OS2	A	0.27	11,874	1,804	10,070	0	0	0	0	0	18.67%	0.09	0.10	0.11	0.26	
OS3	A	0.04	1,620	0	1,620	0	0	0	0	0	5.00%	0.02	0.02	0.02	0.15	
Overall	A	6.20	269,950	51,396	67,882	69,707	47,910	20,279	346	4,830	50.37%	0.34	0.36	0.37	0.50	

Project: Urban Cottages Jewell

Location: Aurora, CO

Designer: IJL

Date: 12/27/2021

Latest Revision: 4/7/2025

NRCS Conveyance Factors, K ²	
Type of Land Surface	K
Heavy Meadow	2.5
Tillage/Field	5
Short Pasture/Lawns	7
Nearly Bare Ground	10
Grassed Waterway	15
Paved Areas	20

¹Max 300 ft in Urban areas and 500 ft in rural areas

²From Table 6-2 in UDFCD Volume 1

Minimum T_c = 5

TIME OF CONCENTRATION CALCULATIONS

Basin Designation	Imperviousness (%)	C _s	Initial/Overland Flow Time, T _i			Channelized Flow/Travel Time, T _t					Time of Concentration, T _c (Check)			
			Length (ft) ¹	Slope (%)	T _i (min)	Land Surface	Length (ft)	Slope (%)	Velocity (ft/sec)	T _t (min)	Computed T _c (min)	First Design Point T _c (min)	Minimum T _c (min)	Selected T _c (min)
D1	72.62%	0.57	138	3.04	7.9	Paved Areas	448	2.17	2.94	2.5	10.4	16.3	5.0	10.4
D2	74.65%	0.59	140	3.29	7.4	Paved Areas	308	1.94	2.79	1.8	9.3	15.2	5.0	9.3
D3	59.02%	0.44	52	14.69	3.6	Paved Areas	385	0.66	1.62	4.0	7.5	20.5	5.0	7.5
D4	53.04%	0.38	79	13.03	5.0	Paved Areas	52	6.88	5.24	0.2	5.1	17.2	5.0	5.1
D5	63.36%	0.48	58	5.01	5.1	Paved Areas	86	0.77	1.76	0.8	5.9	16.1	5.0	5.9
UD1	24.21%	0.14	10	12.64	2.4	Grassed Waterway	828	2.83	2.52	5.5	7.9	28.5	5.0	7.9
OS1	13.21%	0.06	272	9.22	14.9	Short Pasture/Lawns	1	9.22	2.13	0.0	14.9	N/A	5.0	14.9
OS2	18.67%	0.10	58	20.12	5.1	Short Pasture/Lawns	1	22.00	3.28	0.0	5.1	N/A	5.0	5.1
OS3	5.00%	0.02	10	22.30	2.2	Short Pasture/Lawns	1	22.30	3.31	0.0	2.2	N/A	5.0	5.0

$$t_c = t_i + t_t \quad (5.2)$$

where t_c = time of concentration (minutes)
 t_i = initial, inlet, or overland flow time (minutes)
 t_t = travel time in the ditch, channel, gutter, storm sewer, etc. (minutes)

$$t_i = \frac{0.395(1.1 - C_s)^5 \sqrt{L}}{\sqrt{S}} \quad (5.3)$$

where t_i = initial or overland flow time (minutes)
 C_s = runoff coefficient for 5-year frequency
 L = length of overland flow, (ft., 500 ft. max.)
 S = average basin slope (ft/ft)

2.4.3 First Design Point Time of Concentration in Urban Catchments

Equation 6-4 was solely determined by the waterway characteristics and using a set of empirical formulas. A calibration study between the Rational Method and the Colorado Urban Hydrograph Procedure (CUHP) suggests that the time of concentration shall be the lesser of the values calculated by Equation 6-2 and Equation 6-5 (Guo and Urbanas 2013).

$$t_c = (26 - 17i) + \frac{L_i}{60(14i + 9)\sqrt{S_i}} \quad \text{Equation 6-5}$$

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
 L_i = length of channelized flow path (ft)
 i = imperviousness (expressed as a decimal)
 S_i = slope of the channelized flow path (ft/ft).

2.4.4 Minimum Time of Concentration

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.



Project: Urban Cottages Jewell
Location: Aurora, CO
Designer: IJL
Date: 12/27/2021
Latest Revision: 4/7/2025

Design Storm:	2-Yr
1-hr Design Point Rainfall (in):	0.86

2-YEAR PEAK RUNOFF CALCULATIONS

Basin Designation	Design Point	Area (ac)	C ₂	C X A	T _c (min)	Intensity (in/hr)	Peak Flow, Q (cfs)
D1	1	1.74	0.55	0.97	10.4	2.30	2.22
D2	2	0.93	0.57	0.53	9.3	2.40	1.28
D3	3	1.17	0.42	0.50	7.5	2.59	1.29
D4	4	0.21	0.37	0.08	5.1	2.91	0.22
D5	5	0.14	0.46	0.07	5.9	2.79	0.18
UD1	6	0.28	0.13	0.04	7.9	2.54	0.09
OS1	7	1.42	0.06	0.09	14.9	1.96	0.17
OS2	8	0.27	0.09	0.026	5.1	2.91	0.07
OS3	9	0.04	0.02	0.001	5.0	2.92	0.002

$$I = \frac{28.5 P_1}{(10 + T_c)^{0.786}} \quad (5.5)$$

Where:

I = rainfall intensity (inches per hour)
 P₁ = one-hour rainfall depth (inches) from Figures RA-1 through RA-6 in USDCM, Volume 1
 T_c = time of concentration (minutes).

$$Q = CIA \quad (5.1)$$

where Q = Peak discharge (cfs)
 C = Runoff coefficient from Table 1
 I = Rainfall intensity (inches/hour)
 A = Drainage area (acres)



Project: Urban Cottages Jewell
Location: Aurora, CO
Designer: IJL
Date: 12/27/2021
Latest Revision: 4/7/2025

Design Storm:	100-Yr
1-hr Design Point Rainfall (in):	2.37

100-YEAR PEAK RUNOFF CALCULATIONS

Basin Designation	Design Point	Area (ac)	C ₁₀₀	C X A	T _c (min)	Intensity (in/hr)	Peak Flow, Q (cfs)
D1	1	1.74	0.68	1.18	10.4	6.31	7.44
D2	2	0.93	0.69	0.64	9.3	6.59	4.23
D3	3	1.17	0.57	0.67	7.5	7.12	4.77
D4	4	0.21	0.52	0.11	5.1	8.00	0.86
D5	5	0.14	0.60	0.08	5.9	7.68	0.65
UD1	6	0.28	0.30	0.08	7.9	7.00	0.58
OS1	7	1.42	0.21	0.30	14.9	5.40	1.63
OS2	8	0.27	0.26	0.07	5.1	8.00	0.56
OS3	9	0.04	0.15	0.01	5.0	8.04	0.04

$$I = \frac{28.5 P_1}{(10 + T_c)^{0.786}} \quad (5.5)$$

Where:

I = rainfall intensity (inches per hour)
 P₁ = one-hour rainfall depth (inches) from Figures RA-1 through RA-6 in USDCM, Volume 1
 T_c = time of concentration (minutes).

$$Q = CIA \quad (5.1)$$

where Q = Peak discharge (cfs)
 C = Runoff coefficient from Table 1
 I = Rainfall intensity (inches/hour)
 A = Drainage area (acres)

Table 5-6. Imperviousness Values for Urban Surfaces for Site and Small Watershed Analysis

Surface Type		Imperviousness
Paved Streets		95%
Concrete Drive and Walks		95%
Roofs		95%
Gravel	No Traffic Areas (pedestrian use)	40%
	Low Traffic Areas (maintenance paths and substations)	60%
	High Traffic Areas (roadways and parking)	80%
Landscaping (including water-wise vegetation, active turf, uncompacted gravel, planting beds, residential artificial turf, etc.)		20%
Artificial Turf (non-residential)	Landscape applications (with subgrade drainage layer)	45% [†]
	Sport fields with underdrain pipe system	65%
Open Water Areas, including footprint of WQCV		100%
Solar Panels, Gravel Cover, Rows Parallel to Contours*		50%
Solar Panels, Gravel Cover, Rows Diagonal to Contours*		60%
Solar Panels, Gravel Cover, Rows Perpendicular to Contours*		75%
Solar Panels, Grass Cover, Rows Parallel to Contours*		10%
Solar Panels, Grass Cover, Rows Diagonal to Contours*		20%
Solar Panels, Grass Cover, Rows Perpendicular to Contours*		45%
Historic Flow Analysis, Undisturbed Native Grasses, Agricultural, Open Space		5%
Newly Graded Areas, prior to full vegetation establishment		65%
Restored open space with decompacted soils and full vegetation establishment**		10%

[†] Lower imperviousness values will be considered as a variance, when supported by manufacturer's specifications and/or other data.

* Assumes a 1:1 ratio of panels to aisles. See the technical memorandum entitled *Determination of Solar Panel Field Runoff Coefficients and Imperviousness Values* (Earles, Olson, & Howard, 2023) for additional information on procedures to reflect other impervious areas (such as roads and pads that may be part of a solar field) and layouts with wider inter-panel spacing.

** Full vegetation establishment is defined in *City of Aurora Rules and Regulations Regarding Stormwater Discharges Associated with Construction Activities* as [having] established uniform density matching at least 70% of pre-disturbance vegetative density coverage, [with] no bare spots, etc. If a site's SWMP permit has been closed out, then full vegetation establishment can be assumed.

5.3.2 Runoff Coefficients for Rational Method

Rational Method runoff coefficients shall be determined using the methodology described in Volume 1, Chapter 6: Runoff of the MHFD Manual. The MHFD methodology uses the imperviousness of a drainage area in conjunction with the hydrologic soil group (HSG) to calculate the runoff coefficient. The imperviousness of the land use/surface type draining to the point of interest should be derived from Table 5-5 or Table 5-6 above (depending on the stage of the design). The HSG may be determined using the Natural Resources Conservation Service's (NRCS's) [Web Soil Survey](#) (Natural Resources Conservation Service). These data may be used alongside the tables, charts, and equations in Volume 1, Chapter 6: Runoff of the MHFD Manual to determine runoff coefficients for the Rational Method.

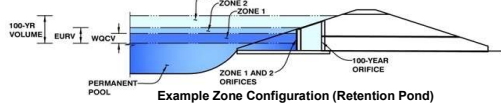
APPENDIX C

MHFD Detention Basin Calculations

Plasti-Fab Flap Gate Details

Hydraulic Calculations & Sections

MHFD-Detention, Version 4.06 (July 2022)

Basin ID: EDB

Example Zone Configuration (Retention Pond)

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

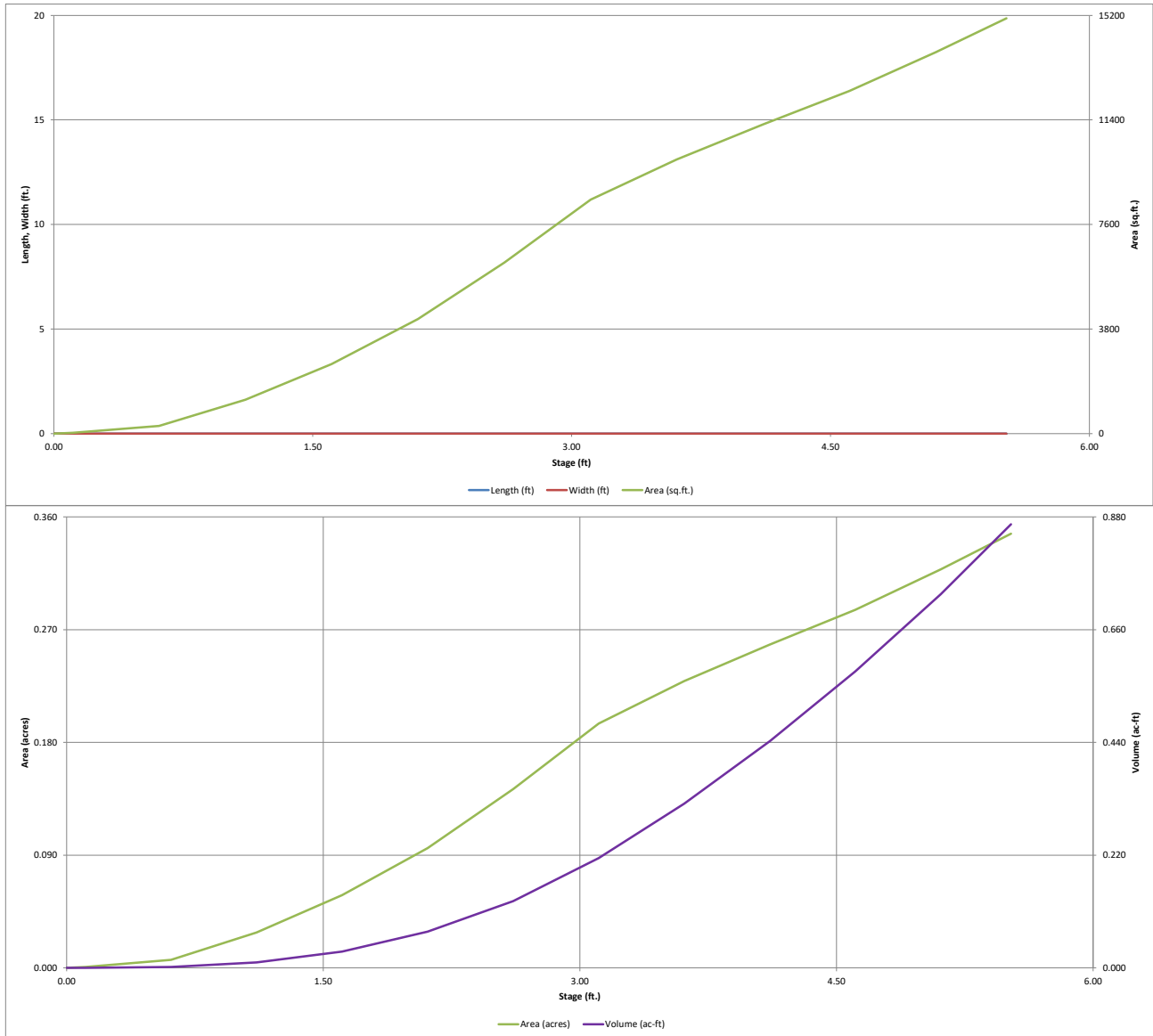
Optional User Overrides	
	acre-feet
	acre-feet
0.86	inches
1.13	inches
1.37	inches
1.73	inches
2.04	inches
2.37	inches
3.23	inches

Initial Surge Area (A_{ISV}) =	user	ft ²
Surge Volume Length (L_{ISV}) =	user	ft
Surge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{BLOOR}) =	user	ft
Length of Basin Floor (L_{BLOOR}) =	user	ft
Width of Basin Floor (W_{BLOOR}) =	user	ft
Area of Basin Floor (A_{BLOOR}) =	user	ft ²
Volume of Basin Floor (V_{BLOOR}) =	user	ft ³
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft ²
Volume of Main Basin (V_{MAIN}) =	user	ft ³
Calculated Total Basin Volume (V_{TOTAL}) =	user	acre-feet

[illegible]

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

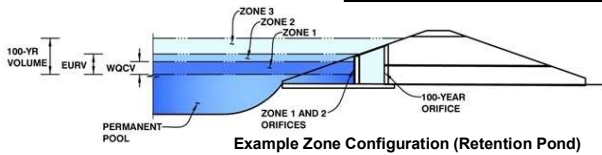


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Urban Cottages - Jewell**

Basin ID: **EDB**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.32	0.092	Orifice Plate
Zone 2 (EURV)	3.76	0.262	Rectangular Orifice
Zone 3 (100-year)	4.30	0.138	Weir&Pipe (Circular)
Total (all zones)		0.492	

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

Underdrain Orifice Invert Depth = ft (distance below the filtration media surface)
Underdrain Orifice Diameter = inches

Calculated Parameters for Underdrain
Underdrain Orifice Area = ft²
Underdrain Orifice Centroid = feet

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

Centroid of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = inches
Orifice Plate: Orifice Area per Row = sq. inches (diameter = 3/4 inch)

Calculated Parameters for Plate
WQ Orifice Area per Row = ft²
Elliptical Half-Width = feet
Elliptical Slot Centroid = feet
Elliptical Slot Area = ft²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.25	2.50					
Orifice Area (sq. inches)	0.46	0.46	0.46					

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

User Input: Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height = inches
Vertical Orifice Width = inches

Calculated Parameters for Vertical Orifice
Zone 2 Rectangular Not Selected
Vertical Orifice Area = ft²
Vertical Orifice Centroid = feet

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

Overflow Weir Front Edge Height, H_o = ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = feet
Overflow Weir Grate Slope = H:V
Horiz. Length of Weir Sides = feet
Overflow Grate Type =
Debris Clogging % = %

Calculated Parameters for Overflow Weir
Zone 3 Weir Not Selected
Height of Grate Upper Edge, H_u = feet
Overflow Weir Slope Length = feet
Grate Open Area / 100-yr Orifice Area =
Overflow Grate Open Area w/o Debris = ft²
Overflow Grate Open Area w/ Debris = ft²

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

Depth to Invert of Outlet Pipe = ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter = inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate
Zone 3 Circular Not Selected
Outlet Orifice Area = ft²
Outlet Orifice Centroid = feet
Half-Central Angle of Restrictor Plate on Pipe = radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage = ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length = feet
Spillway End Slopes = H:V
Freeboard above Max Water Surface = feet

Calculated Parameters for Spillway
Spillway Design Flow Depth = feet
Stage at Top of Freeboard = feet
Basin Area at Top of Freeboard = acres
Basin Volume at Top of Freeboard = acre-ft

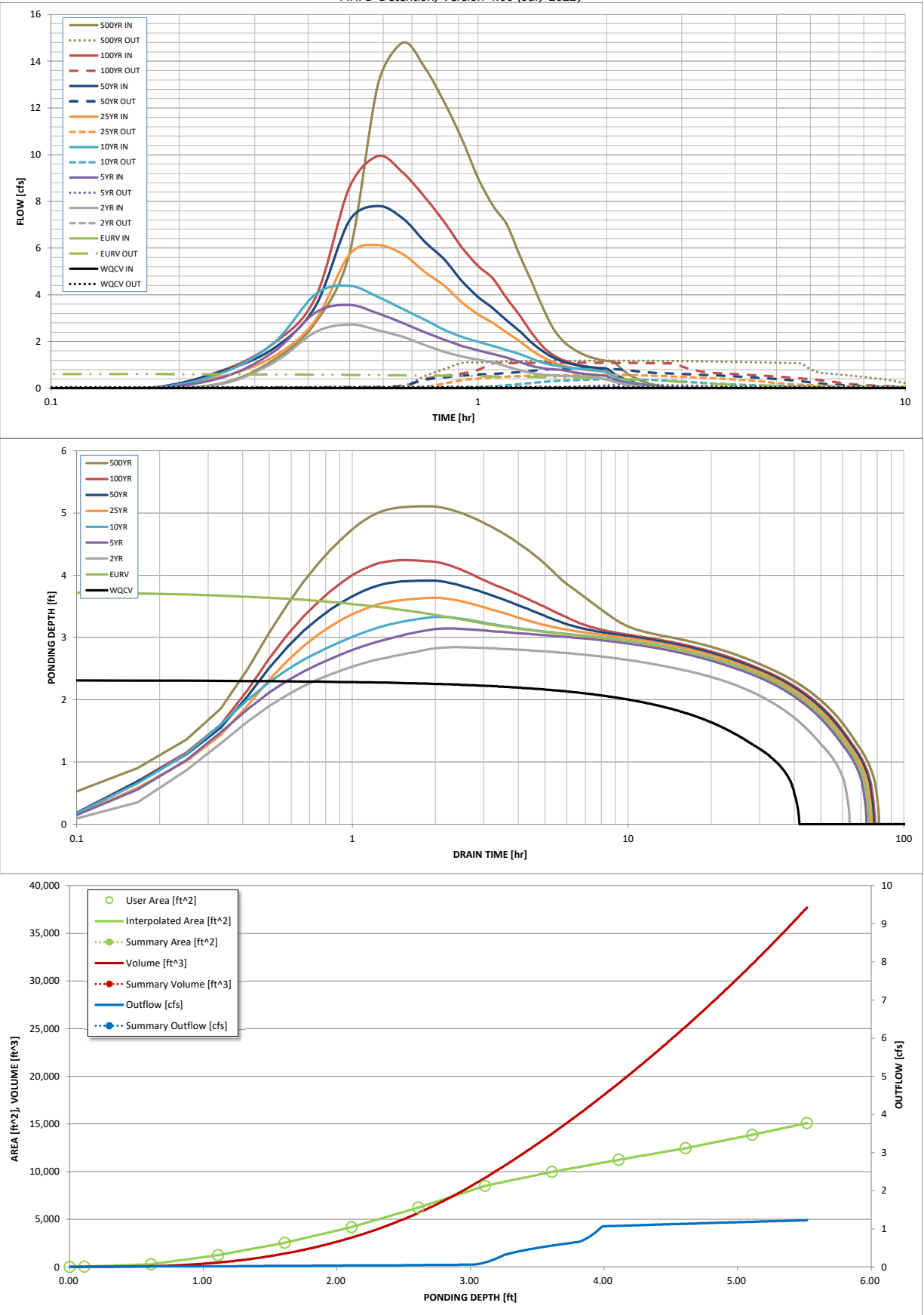
Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	0.86	1.13	1.37	1.73	2.04	2.37	3.23
One-Hour Rainfall Depth (in) =	0.092	0.354	0.175	0.236	0.294	0.389	0.482	0.593	0.878
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.175	0.236	0.294	0.389	0.482	0.593	0.878
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.0	0.0	0.0	0.1	0.8	1.9	4.4
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A							
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.00	0.01	0.02	0.19	0.45	1.05
Peak Inflow Q (cfs) =	N/A	N/A	2.7	3.6	4.4	6.1	7.8	9.9	14.8
Peak Outflow Q (cfs) =	0.0	0.6	0.1	0.2	0.4	0.6	0.9	1.1	1.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	8.4	9.9	6.2	1.0	0.6	0.3
Structure Controlling Flow =	Plate	Vertical Orifice 1	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	0.0	0.0	0.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	65	58	67	67	66	65	64	63
Time to Drain 99% of Inflow Volume (hours) =	40	71	61	71	72	72	73	73	73
Maximum Ponding Depth (ft) =	2.32	3.76	2.84	3.14	3.33	3.64	3.92	4.24	5.11
Area at Maximum Ponding Depth (acres) =	0.12	0.24	0.17	0.20	0.21	0.23	0.25	0.27	0.32
Maximum Volume Stored (acre-ft) =	0.093	0.356	0.166	0.221	0.259	0.325	0.392	0.476	0.726

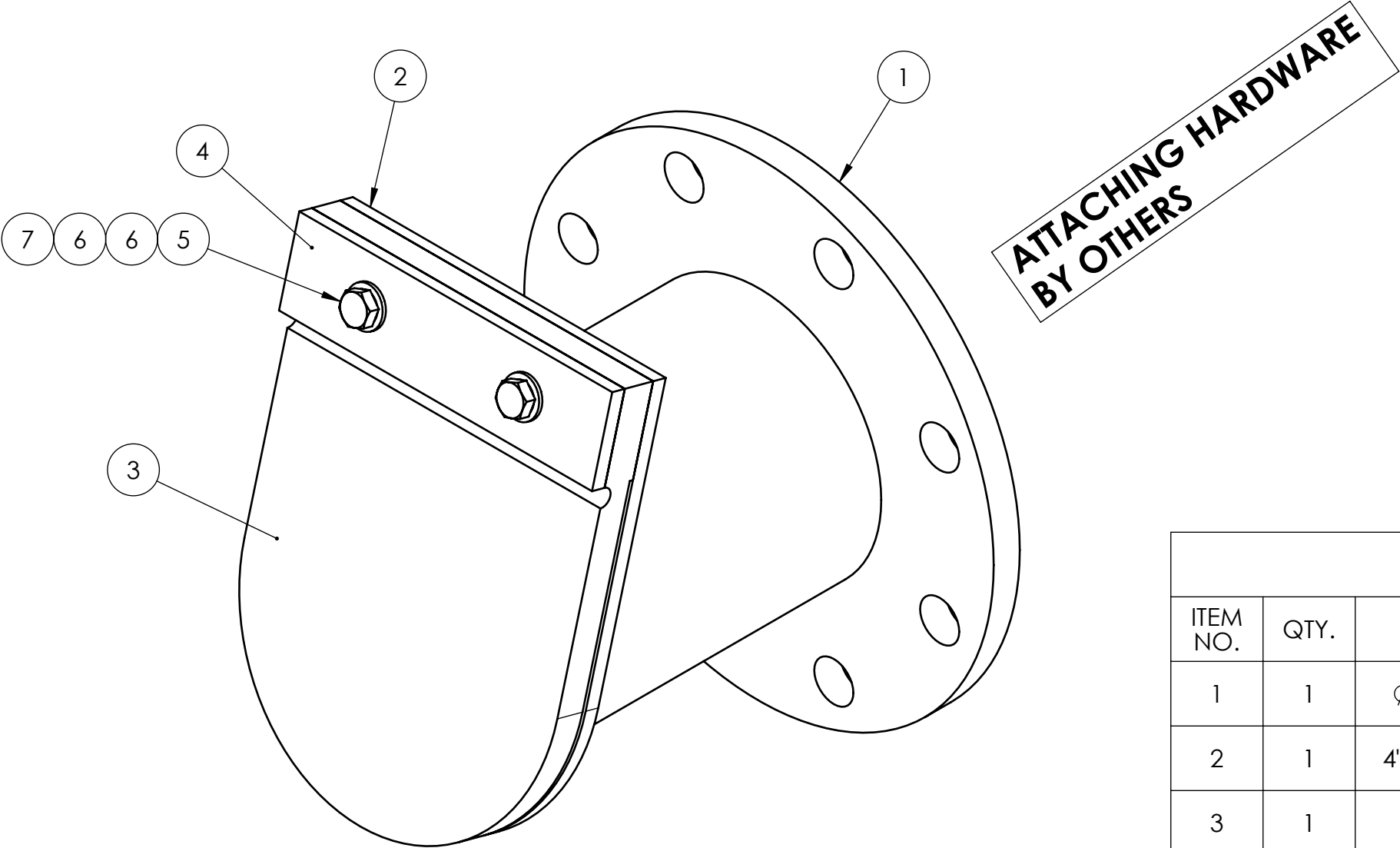
DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)



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

REVISIONS				
REV.	DESCRIPTION	NCR/ECO NO.	REVISED BY	DATE
A	INITIAL RELEASE		Z.MENLE	04/27/2018



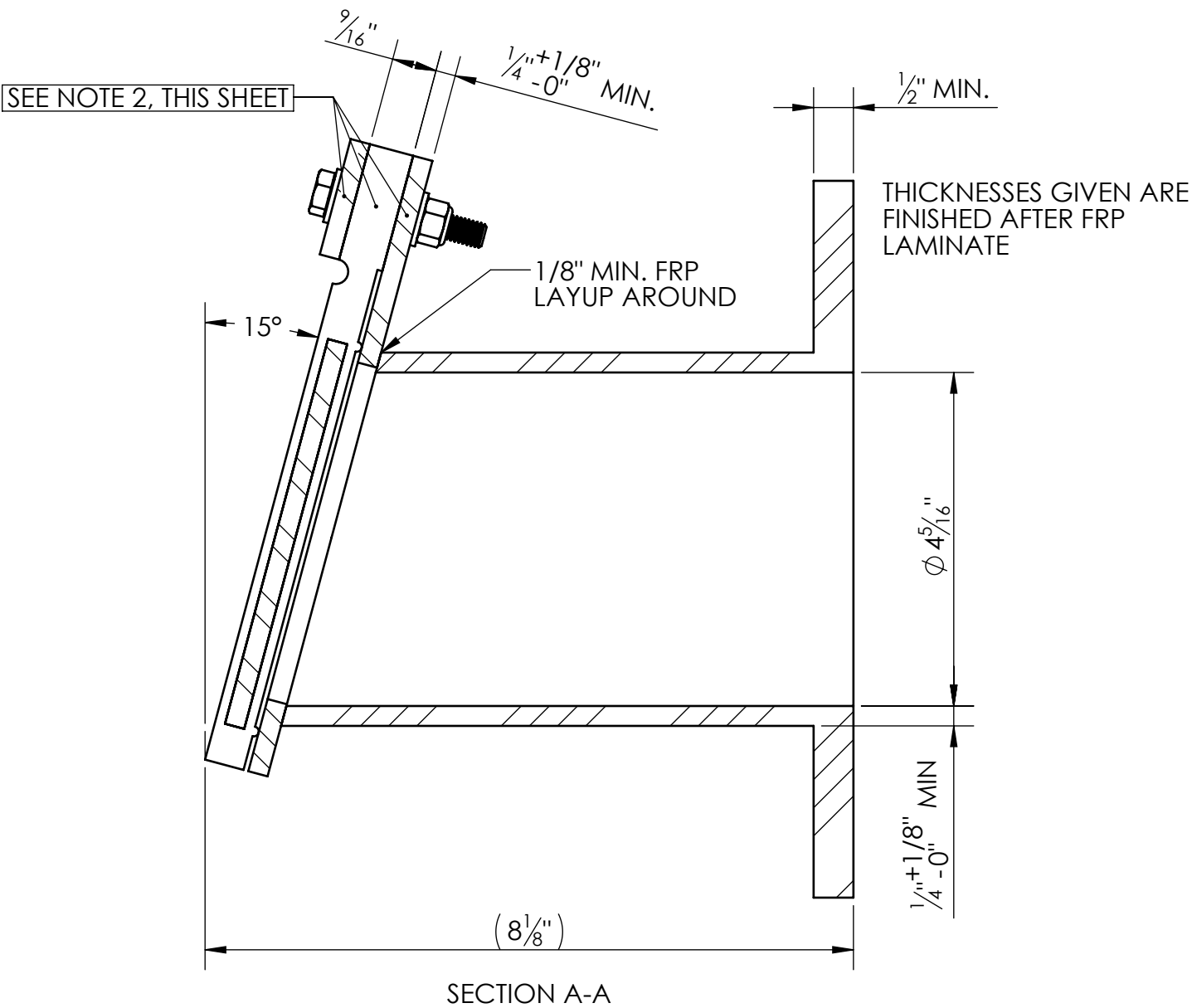
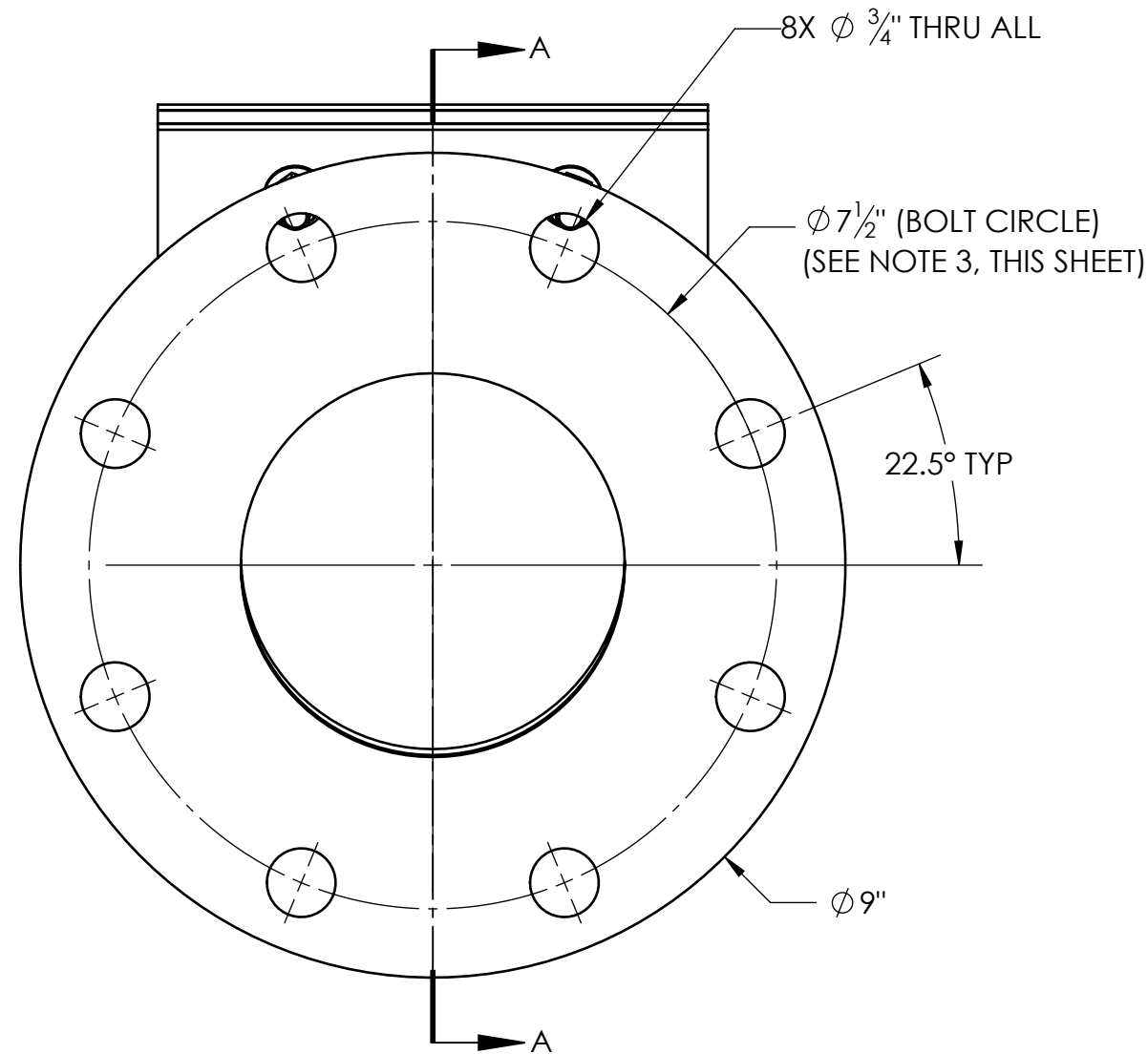
BOM TABLE					
ITEM NO.	QTY.	DESCRIPTION	AREA	MATERIAL	PART NUMBER
1	1	Ø 4" PIPE STUB W/ MOUNTING FLANGE		ASHLAND 411-350M, VINYL ESTER	512-0065
2	1	4" FG SEAL FLANGE PLATE, 1/4" X 6" X 8"	44.125	FRP (FLAT STOCK, POLYESTER)	318-0002
3	1	4" FLAP SEAL W/ INT. STEEL PLATE			512-0026
4	1	4" FG CLAMPING BAR, 1/4" X 1 1/2" X 6"	9	FRP (FLAT STOCK, POLYESTER)	318-0002
5	2	HHCS, 5/16-18UNC X 2"		T-316 S/S	661-0020
6	4	FLAT WASHER, 5/16"		T-316 S/S	664-0006
7	2	NYLON-INSERT HEX LOCK NUT 5/16-18UNC (MCMaster-CARR 90715A135)		T-316 S/S	663-0052

NOTES:


- RESIN FOR HAND LAYUPS: ASHLAND AROPOL L 80505 T-20 OR EQUAL.
- JOIN FLAP SEAL FLANGE TO PIPE W/ PLEXUS MA-300 THEN OVERLAY WITH HLU (M,M,M,CV) TO ACHIEVE REQUIRED MIN. FINISHED THICKNESS. HLU SHALL EXTEND MINIMUM 3" ONTO EACH PART. WHERE PART DIMENSION IS LESS THAN 3" HLU SHALL EXTEND TO THE EDGE.
- GEL COAT EXTERIOR OF FINISHED ASSEMBLY GRAY. DO NOT GEL COAT SEATING SURFACES OR INTERIOR.
- STUB FLANGE BOLT HOLES TO STRADDLE CENTERLINE.
- ALL HARDWARE IS T-316 S/S.

PROJECT: MASTERS HAPPY VALLEY, OR, USA		<div>Plasti-Fab®</div> HAPPY VALLEY, OR		PLASTI-FAB PART NUMBER: FGFM004-01			TITLE: 4" FLAP GATE ASSEMBLY, FLANGE MOUNT TYPE		
CUSTOMER: PLASTI-FAB, A DIVISION OF ERSHIGS				MATERIAL INFORMATION:					
REP:				SPECIAL FINISH REQUIREMENT:					
P.O. NO:									
PROPRIETARY AND CONFIDENTIAL INFORMATION, DESIGNS, CONCEPTS & IDEAS CONTAINED HEREIN ARE THE SOLE PROPERTY OF PLASTI-FAB, A DIVISION OF ERSHIGS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION IS PROHIBITED.		TOLERANCES UNLESS OTHERWISE SPECIFIED.							
		≤ 6'-0"	± 1/16"		NAME:	DATE:	SIZE B	DRAWING NO.: FGFM004-01	REV. A
		> 6'-0" AND ≤ 25'-0"	± 1/8"	DRAWN BY:	Z.MENLE	04/27/2018			
		> 25'-0"	± 1/2"	CHECKED BY:	CRL		WEIGHT: 5	SCALE: 1:2	SHEET: 1 OF 5

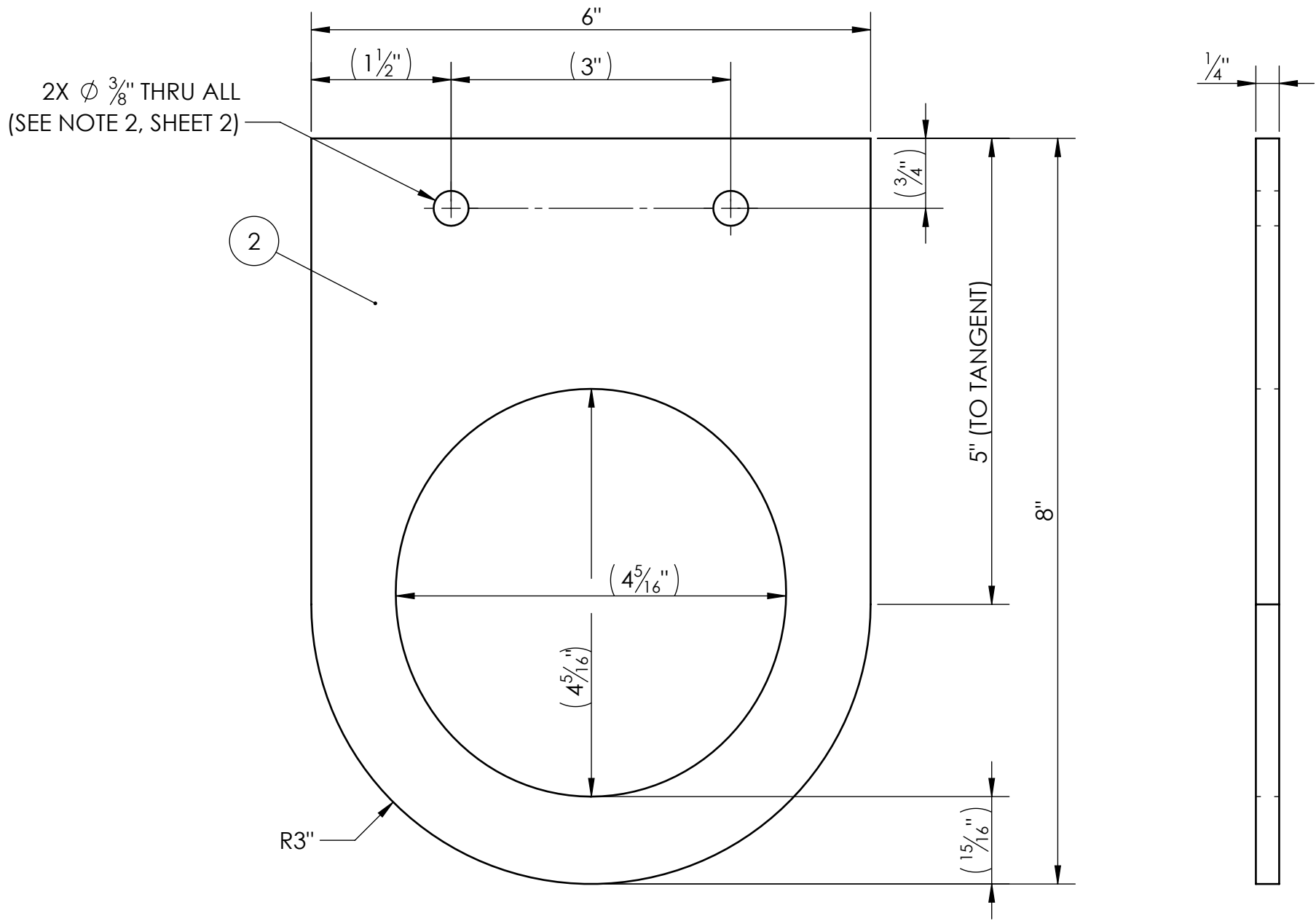
REVISIONS				
REV.	DESCRIPTION	NCR/ECO NO.	REVISED BY	DATE
A	INITIAL RELEASE		Z.MENLE	04/30/2018



- NOTES:**
- GRIND INTERIOR TRANSITION BETWEEN PIPE & FG SEAL FLANGE FLAT TO ELIMINATE FLOW INTERFERENCE. FILL GAPS AS REQUIRED WITH PLEXUS MA 300. GRIND SMOOTH.
 - MATCH DRILL CLAMPING BAR, FLAP SEAL & SEAL FLANGE AT FINAL ASSEMBLY.
 - DRILL PATTERN CORRESPONDS TO ASME/ANSI CLASS 125 FLANGES.


PROJECT: MASTERS HAPPY VALLEY, OR, USA		 HAPPY VALLEY, OR		PLASTI-FAB PART NUMBER: FGFM004-01			TITLE: 4" FLAP GATE ASSEMBLY, FLANGE MOUNT TYPE		
CUSTOMER: PLASTI-FAB, A DIVISION OF ERSHIGS				MATERIAL INFORMATION:					
REP:		SPECIAL FINISH REQUIREMENT:							
P.O. NO:									
PROPRIETARY AND CONFIDENTIAL INFORMATION, DESIGNS, CONCEPTS & IDEAS CONTAINED HEREIN ARE THE SOLE PROPERTY OF PLASTI-FAB, A DIVISION OF ERSHIGS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION IS PROHIBITED.		UNLESS OTHERWISE SPECIFIED. DIMENSIONS ARE IN INCHES							
		TOLERANCES UNLESS OTHERWISE SPECIFIED.							
		≤ 6'-0"	± 1/16"		NAME:	DATE:	SIZE B	DRAWING NO.: FGFM004-01	REV. A
		> 6'-0" AND ≤ 25'-0"	± 1/8"	DRAWN BY:	Z.MENLE	04/27/2018			
		> 25'-0"	± 1/2"	CHECKED BY:	CRL		WEIGHT: 5	SCALE: 1:2	SHEET: 2 OF 5

REVISIONS				
REV.	DESCRIPTION	NCR/ECO NO.	REVISED BY	DATE
A	INITIAL RELEASE		Z.MENLE	04/30/2018

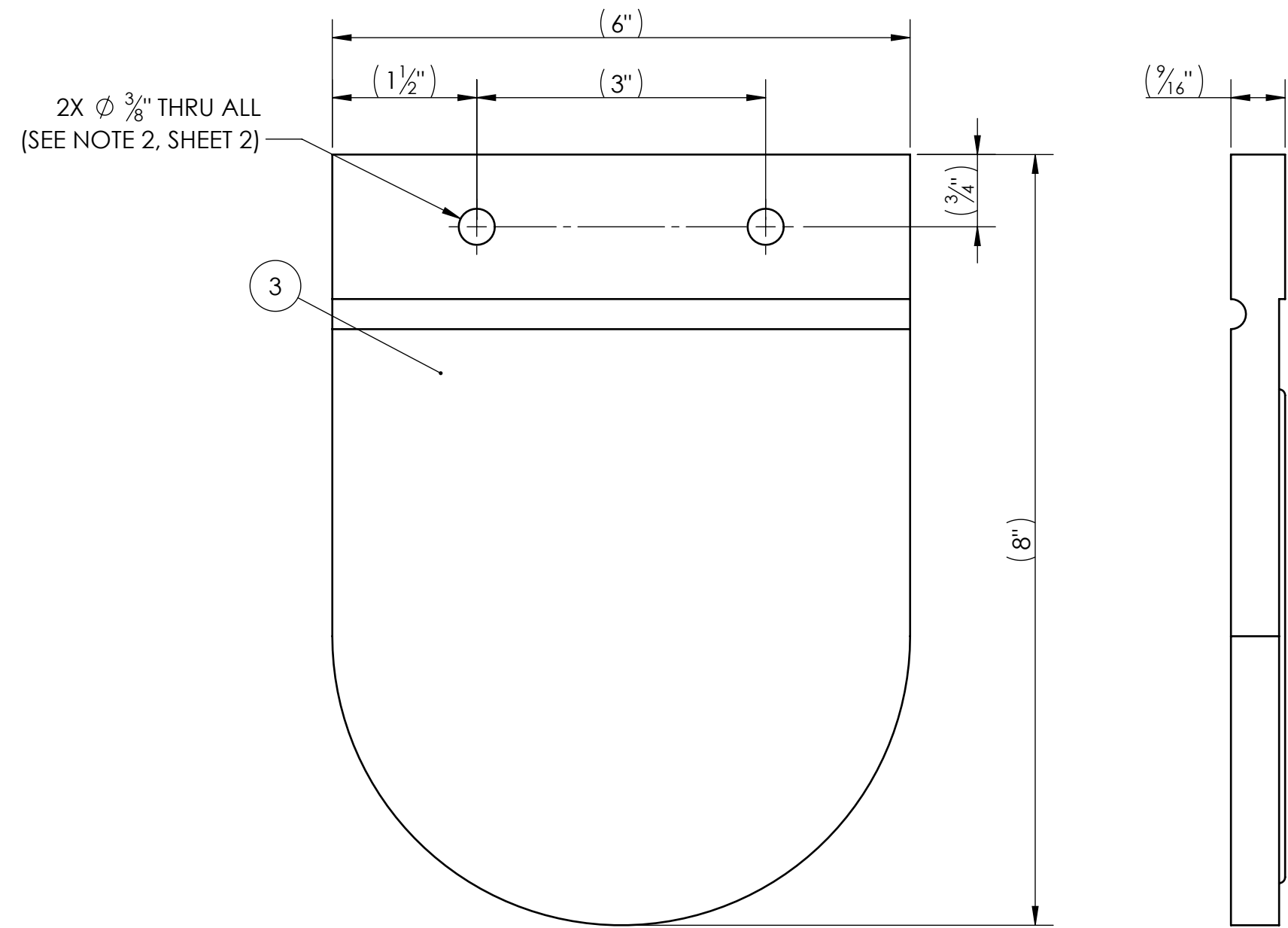


NOTES:


- SEE SHEET#1 FOR BALLOON BILL OF MATERIALS INFORMATION.
- GRIND OPENING AS REQUIRED AT FINAL ASSEMBLY TO MATCH FLANGED PIPE ID.

PROJECT: MASTERS HAPPY VALLEY, OR, USA		 HAPPY VALLEY, OR		PLASTI-FAB PART NUMBER: 318-0002			TITLE: 4" FG SEAL FLANGE PLATE			
CUSTOMER: PLASTI-FAB, A DIVISION OF ERSHIGS				MATERIAL INFORMATION: FRP (FLAT STOCK, POLYESTER)						
REP:		SPECIAL FINISH REQUIREMENT:								
P.O. NO:										
PROPRIETARY AND CONFIDENTIAL INFORMATION, DESIGNS, CONCEPTS & IDEAS CONTAINED HEREIN ARE THE SOLE PROPERTY OF PLASTI-FAB, A DIVISION OF ERSHIGS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION IS PROHIBITED.		UNLESS OTHERWISE SPECIFIED. DIMENSIONS ARE IN INCHES								
		TOLERANCES UNLESS OTHERWISE SPECIFIED.								
		≤ 6'-0"		± 1/16"				SIZE B	DRAWING NO.: FGFM004-01	REV. A
		> 6'-0" AND ≤ 25'-0"		± 1/8"		DRAWN BY: Z.MENLE 04/27/2018				
> 25'-0"		± 1/2"		CHECKED BY: CRL		WEIGHT: 0	SCALE: 1:1.5			

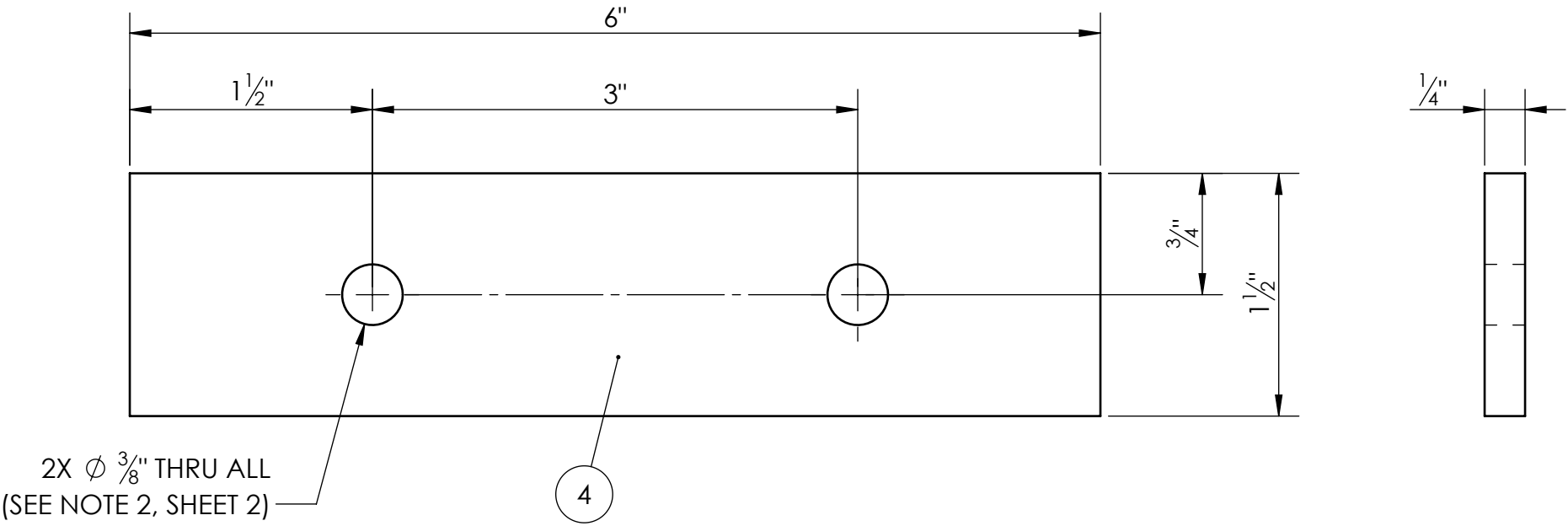
REVISIONS				
REV.	DESCRIPTION	NCR/ECO NO.	REVISED BY	DATE
A	INITIAL RELEASE		Z.MENLE	04/30/2018




- NOTES:**
- SEE SHEET#1 FOR BALLOON BILL OF MATERIALS INFORMATION.

PROJECT: MASTERS HAPPY VALLEY, OR, USA		 HAPPY VALLEY, OR		PLASTI-FAB PART NUMBER: 512-0026			TITLE: 4" FLAP SEAL W/ INT. STEEL PLATE		
CUSTOMER: PLASTI-FAB, A DIVISION OF ERSHIGS				MATERIAL INFORMATION:					
REP:		SPECIAL FINISH REQUIREMENT:							
P.O. NO:									
PROPRIETARY AND CONFIDENTIAL INFORMATION, DESIGNS, CONCEPTS & IDEAS CONTAINED HEREIN ARE THE SOLE PROPERTY OF PLASTI-FAB, A DIVISION OF ERSHIGS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION IS PROHIBITED.		UNLESS OTHERWISE SPECIFIED. DIMENSIONS ARE IN INCHES							
		TOLERANCES UNLESS OTHERWISE SPECIFIED.							
		≤ 6'-0"	± 1/16"		NAME:	DATE:	SIZE	DRAWING NO.:	REV.
		> 6'-0" AND ≤ 25'-0"	± 1/8"	DRAWN BY:	Z.MENLE	04/27/2018	B	FGFM004-01	A
		> 25'-0"	± 1/2"	CHECKED BY:	CRL		WEIGHT: 2	SCALE: 1:1.5	SHEET: 4 OF 5

REVISIONS				
REV.	DESCRIPTION	NCR/ECO NO.	REVISED BY	DATE
A	INITIAL RELEASE		Z.MENLE	04/30/2018



NOTES:
1. SEE SHEET#1 FOR BALLOON BILL OF MATERIALS INFORMATION.

PROJECT: MASTERS HAPPY VALLEY, OR, USA		 HAPPY VALLEY, OR		PLASTI-FAB PART NUMBER:			TITLE: 4" FG CLAMPING BAR		
CUSTOMER: PLASTI-FAB, A DIVISION OF ERSHIGS				MATERIAL INFORMATION: FRP (FLAT STOCK, POLYESTER)					
REP:		SPECIAL FINISH REQUIREMENT:							
P.O. NO:									
PROPRIETARY AND CONFIDENTIAL INFORMATION, DESIGNS, CONCEPTS & IDEAS CONTAINED HEREIN ARE THE SOLE PROPERTY OF PLASTI-FAB, A DIVISION OF ERSHIGS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION IS PROHIBITED.		UNLESS OTHERWISE SPECIFIED. DIMENSIONS ARE IN INCHES							
		TOLERANCES UNLESS OTHERWISE SPECIFIED.							
		≤ 6'-0"	± 1/16"		NAME:	DATE:	SIZE B	DRAWING NO.: FGFM004-01	REV. A
		> 6'-0" AND ≤ 25'-0"	± 1/8"	DRAWN BY:	Z.MENLE	04/27/2018			
		> 25'-0"	± 1/2"	CHECKED BY:	CRL		WEIGHT: 0	SCALE: 1:1	SHEET: 5 OF 5

Channel Report

Existing 36in RCP From MH-6 to MH-5

Circular

Diameter (ft) = 3.00

Invert Elev (ft) = 100.00

Slope (%) = 0.45

N-Value = 0.013

Calculations

Compute by:

Known Q (cfs)

Known Q

= 46.20

From Havana Heights
Drainage Report
(EDN 850177)

EX HGL Depth

Highlighted

Depth (ft)

= 2.56

Q (cfs)

= 46.20

Area (sqft)

= 6.43

Velocity (ft/s)

= 7.18

Wetted Perim (ft)

= 7.08

Crit Depth, Yc (ft)

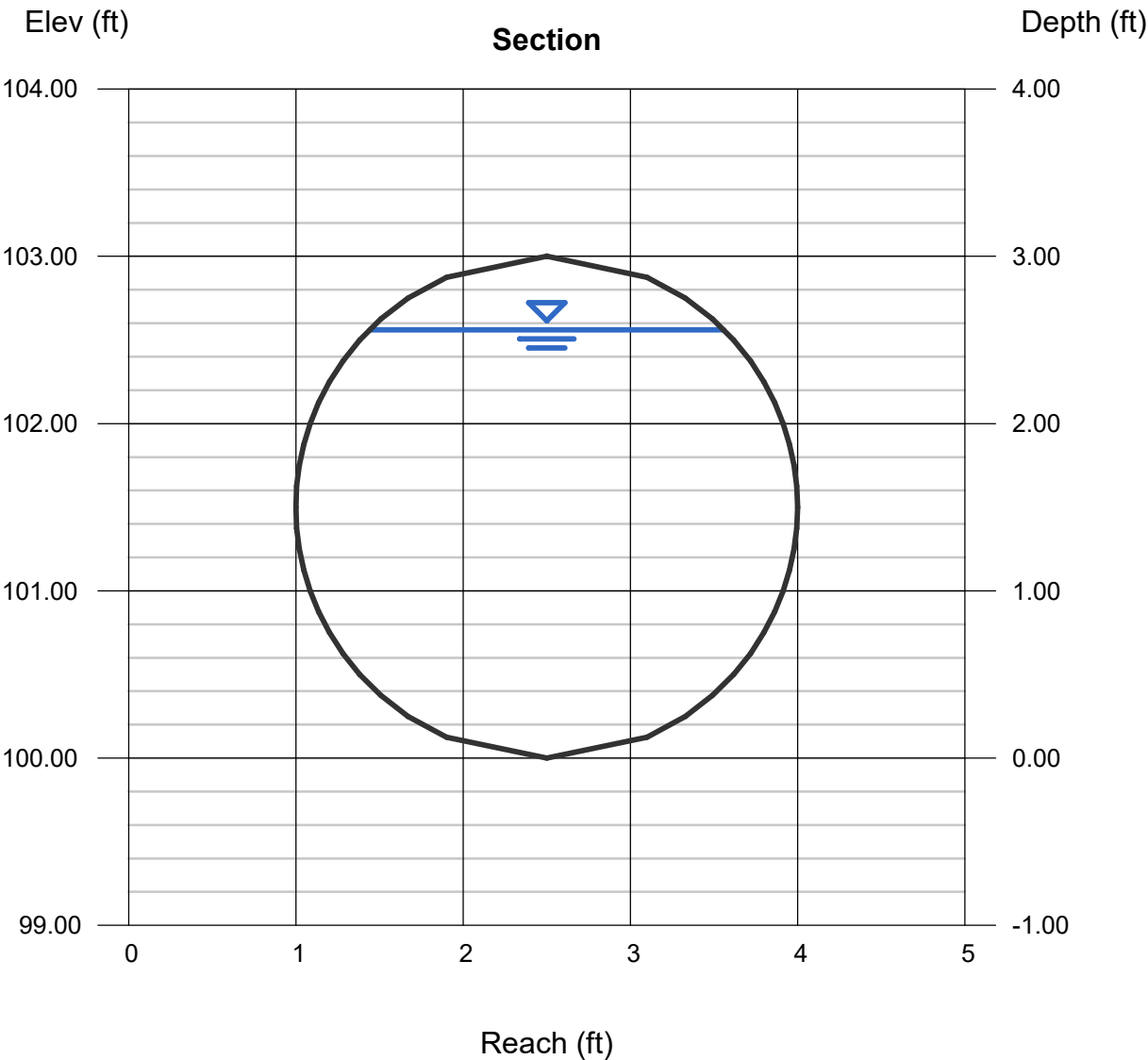
= 2.22

Top Width (ft)

= 2.11

EGL (ft)

= 3.36

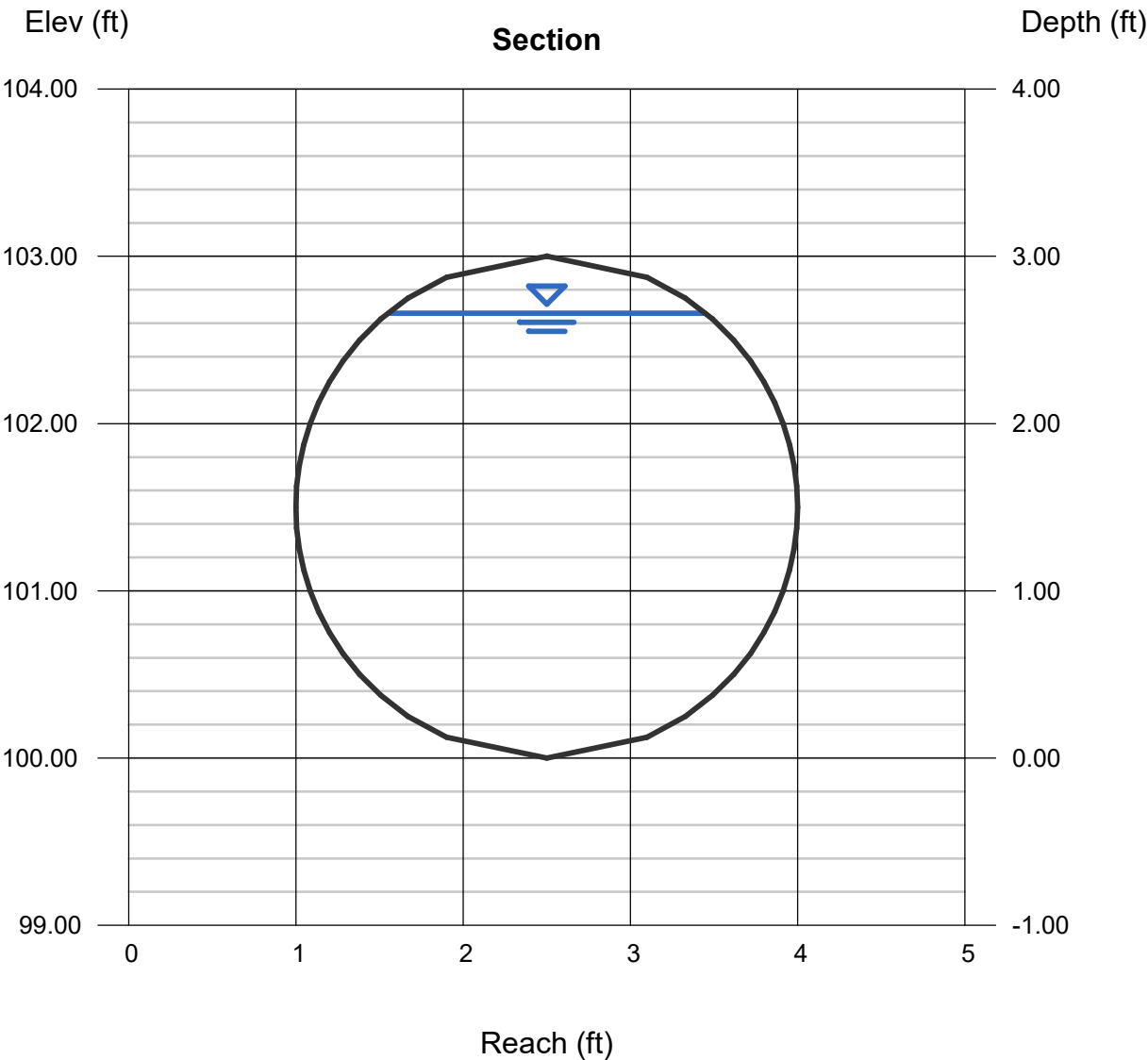


Channel Report

100 Yr EDB Release + Ex. 100 Yr Flow in Ex. 36in RCP at Connection

Circular		Highlighted	
Diameter (ft)	= 3.00	Depth (ft)	= 2.66
		Q (cfs)	= 47.30
		Area (sqft)	= 6.63
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 7.14
Slope (%)	= 0.45	Wetted Perim (ft)	= 7.37
N-Value	= 0.013	Crit Depth, Yc (ft)	= 2.24
		Top Width (ft)	= 1.90
		EGL (ft)	= 3.45
Calculations			
Compute by:			
Known Q (cfs)		Known Q	
		= 47.30	

Pond Release of 1.1 cfs +
46.2 cfs from Havana Heights
Drainage Report (EDN
850177)



Channel Report

Existing Flow 36in RCP From MH-6 to MH-7

Circular

Diameter (ft) = 3.00

Invert Elev (ft) = 100.00
Slope (%) = 0.51
N-Value = 0.013

Calculations

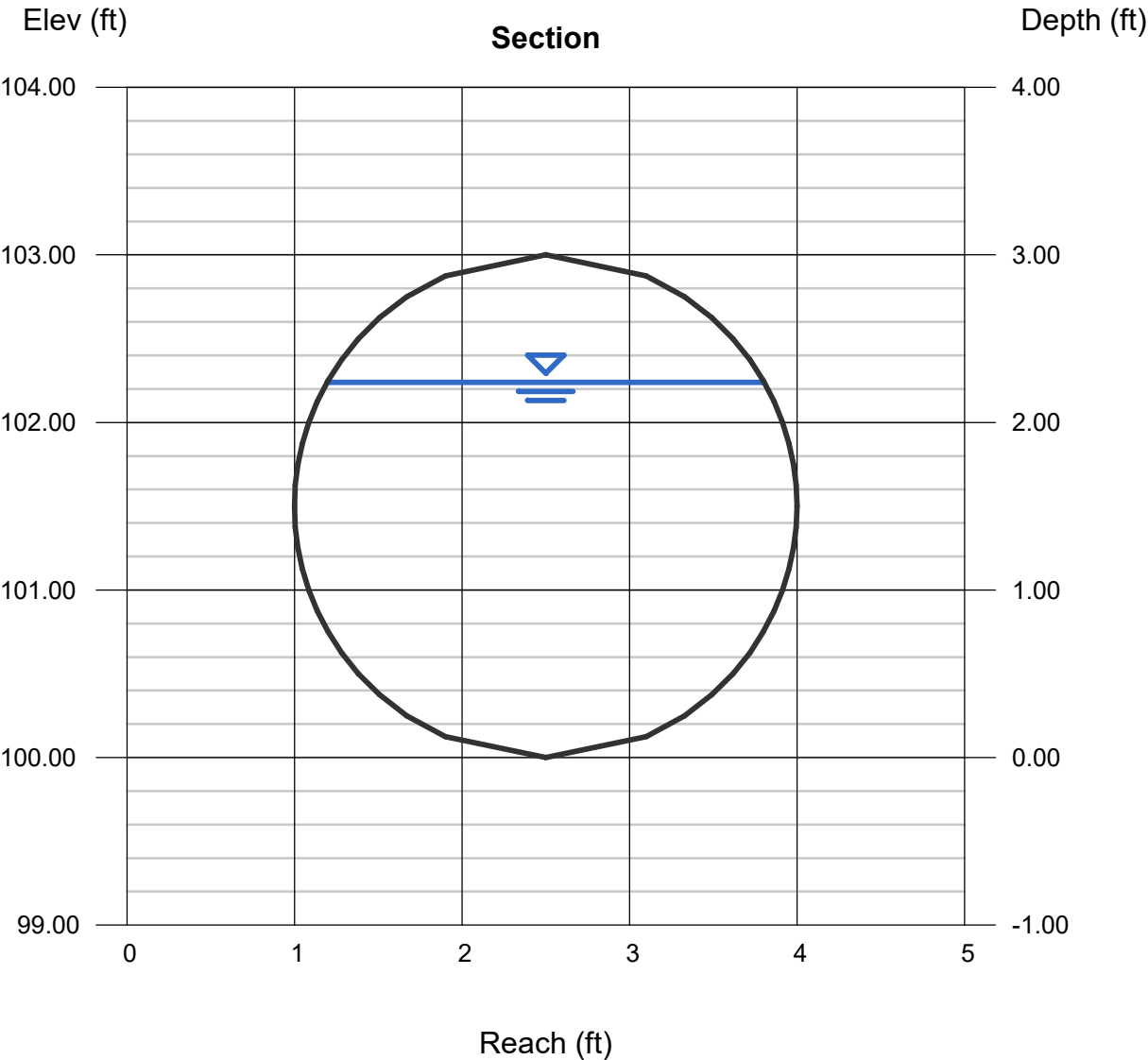
Compute by:
Known Q (cfs) = 43.20

EX HGL Depth

Highlighted

Depth (ft) = 2.24
Q (cfs) = 43.20
Area (sqft) = 5.67
Velocity (ft/s) = 7.62
Wetted Perim (ft) = 6.27
Crit Depth, Yc (ft) = 2.14
Top Width (ft) = 2.60
EGL (ft) = 3.14

From Havana Heights
Drainage Report
(EDN 850177)



Channel Report

Proposed Flow 36in RCP From MH-6 to MH-7

Circular

Diameter (ft) = 3.00

Invert Elev (ft) = 100.00

Slope (%) = 0.51

N-Value = 0.013

Calculations

Compute by:
Known Q (cfs) = 45.97

Pr. HGL Depth
0.13' higher than Ex.

Highlighted

Depth (ft) = 2.37

Q (cfs) = 45.97

Area (sqft) = 5.99

Velocity (ft/s) = 7.67

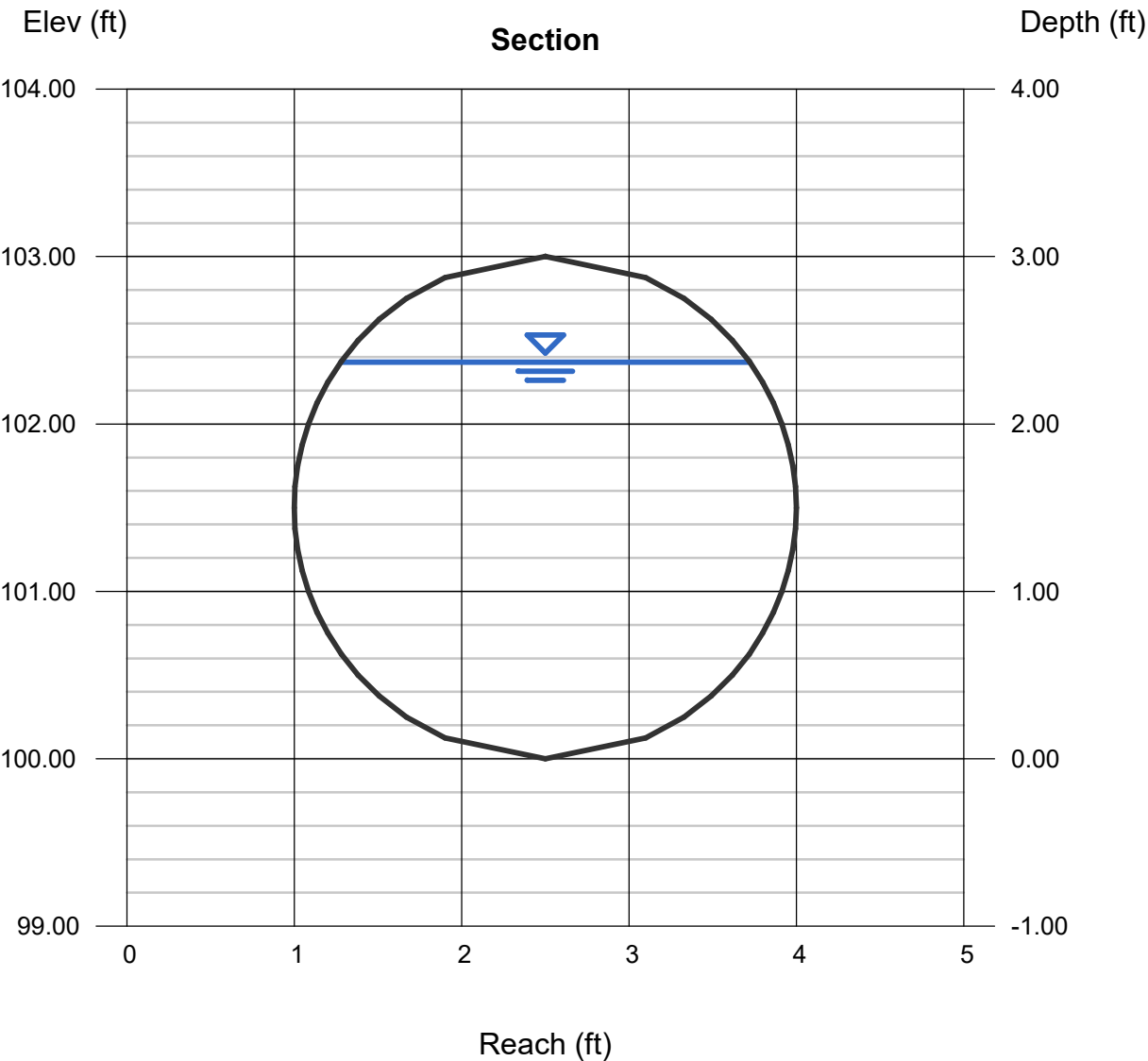
Wetted Perim (ft) = 6.57

Crit Depth, Yc (ft) = 2.21

Top Width (ft) = 2.44

EGL (ft) = 3.29

EX. 100 yr Q + (OS1+OS2+UD1) =
43.2 cfs + 2.77 cfs = 45.97 cfs.

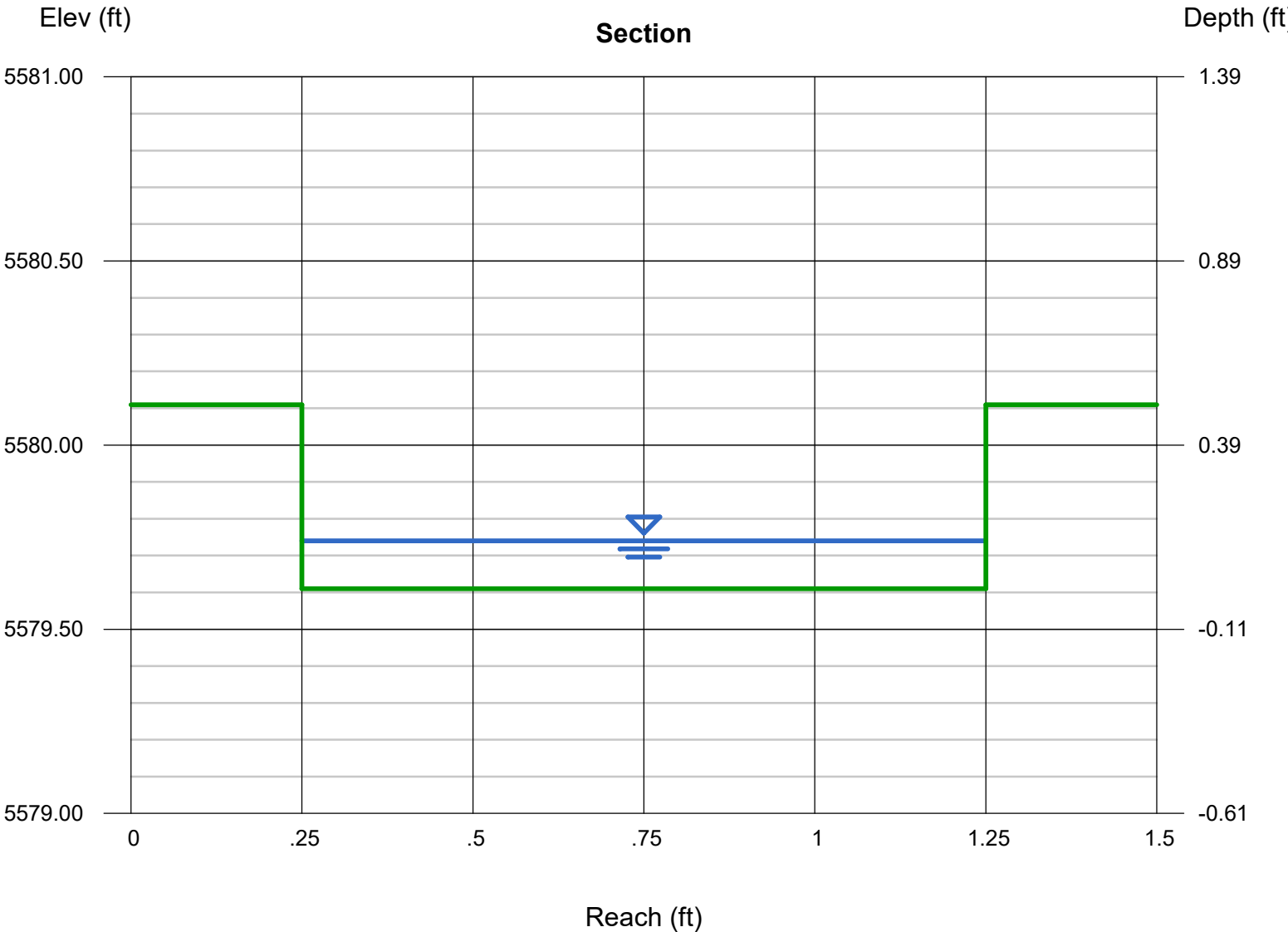


Channel Report

South Swale at Top of Retaining Wall (OS2) - Section B

Rectangular		Highlighted	
Bottom Width (ft)	= 1.00	Depth (ft)	= 0.13
Total Depth (ft)	= 0.50	Q (cfs)	= 0.560
		Area (sqft)	= 0.13
Invert Elev (ft)	= 5579.61	Velocity (ft/s)	= 4.31
Slope (%)	= 3.00	Wetted Perim (ft)	= 1.26
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.22
		Top Width (ft)	= 1.00
		EGL (ft)	= 0.42
Calculations			
Compute by:			
Known Q (cfs)		Known Q	
		= 0.56	

OS2 100 YR storm



Channel Report

18 ft Wide Alley (Basin D4) - Section C (2-yr)

Triangular

Side Slopes (z:1) = 50.00, 50.00
Total Depth (ft) = 0.18

Invert Elev (ft) = 100.00
Slope (%) = 6.90
N-Value = 0.013

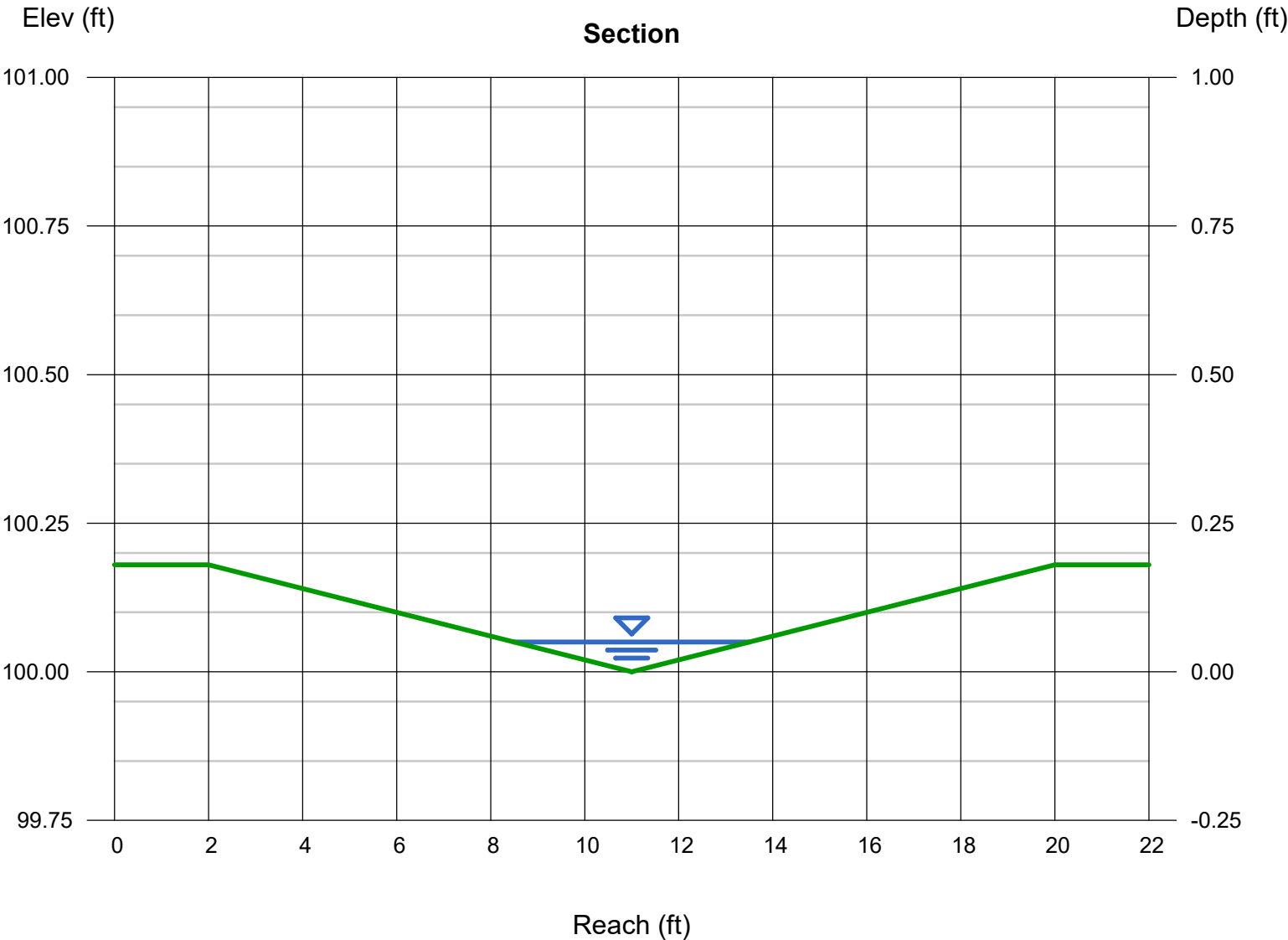
Calculations

Compute by:
Known Q (cfs) = 0.22

Highlighted

Depth (ft) = 0.05
Q (cfs) = 0.220
Area (sqft) = 0.13
Velocity (ft/s) = 1.76
Wetted Perim (ft) = 5.00
Crit Depth, Yc (ft) = 0.07
Top Width (ft) = 5.00
EGL (ft) = 0.10

Basin D4 2 yr Q

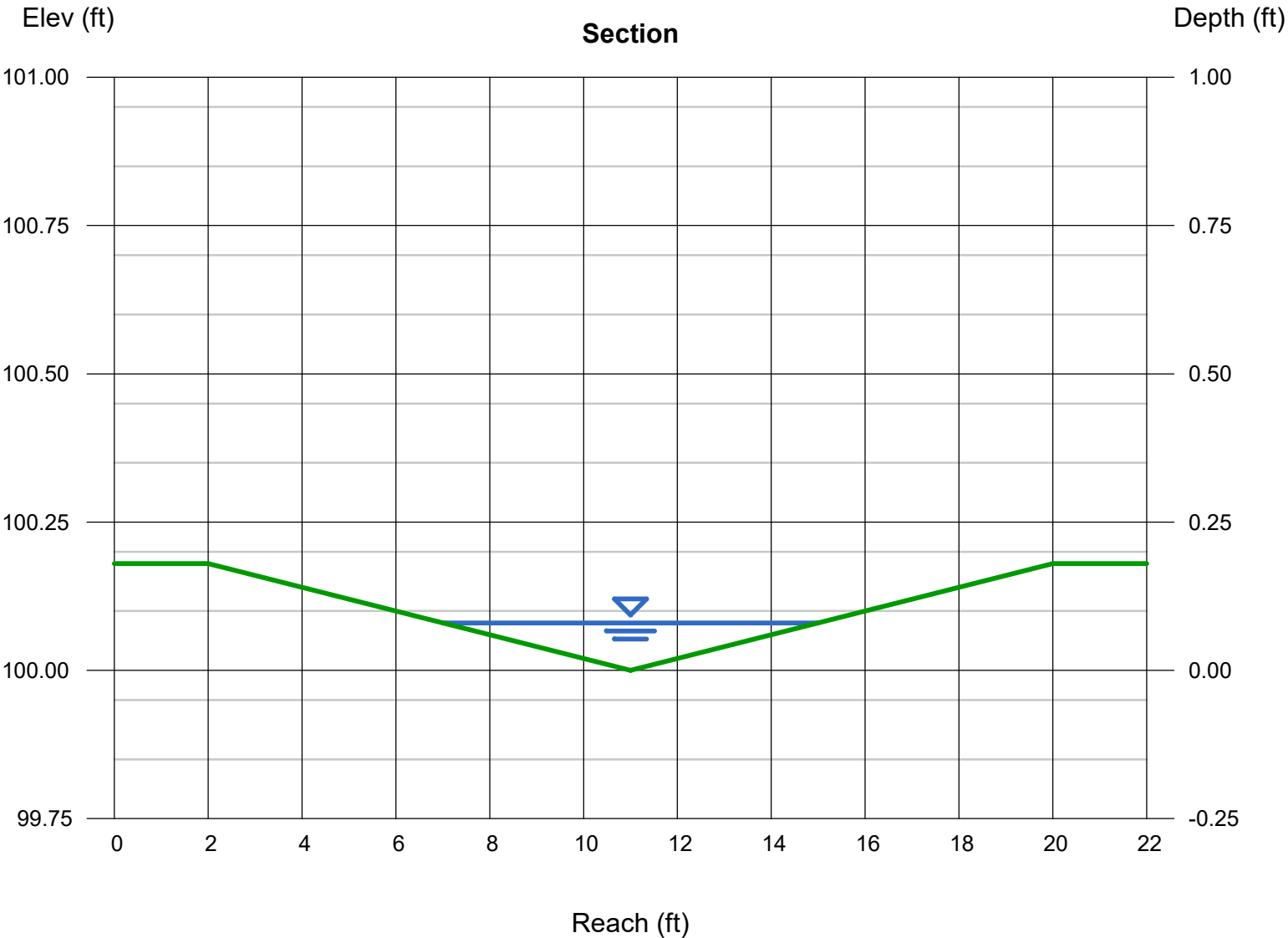


Channel Report

18 ft Wide Alley (Basin D4) - Section C (100-yr)

Triangular		Highlighted	
Side Slopes (z:1)	= 50.00, 50.00	Depth (ft)	= 0.08
Total Depth (ft)	= 0.18	Q (cfs)	= 0.860
		Area (sqft)	= 0.32
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 2.69
Slope (%)	= 6.90	Wetted Perim (ft)	= 8.00
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.12
		Top Width (ft)	= 8.00
		EGL (ft)	= 0.19
Calculations			
Compute by:			
Known Q (cfs)		Known Q	
		= 0.86	

Basin D4 100 yr Q



Channel Report

18 ft Wide Alley (Basin D5) - Section D (2-yr)

Triangular

Side Slopes (z:1) = 50.00, 50.00
Total Depth (ft) = 0.18

Invert Elev (ft) = 100.00
Slope (%) = 1.00
N-Value = 0.013

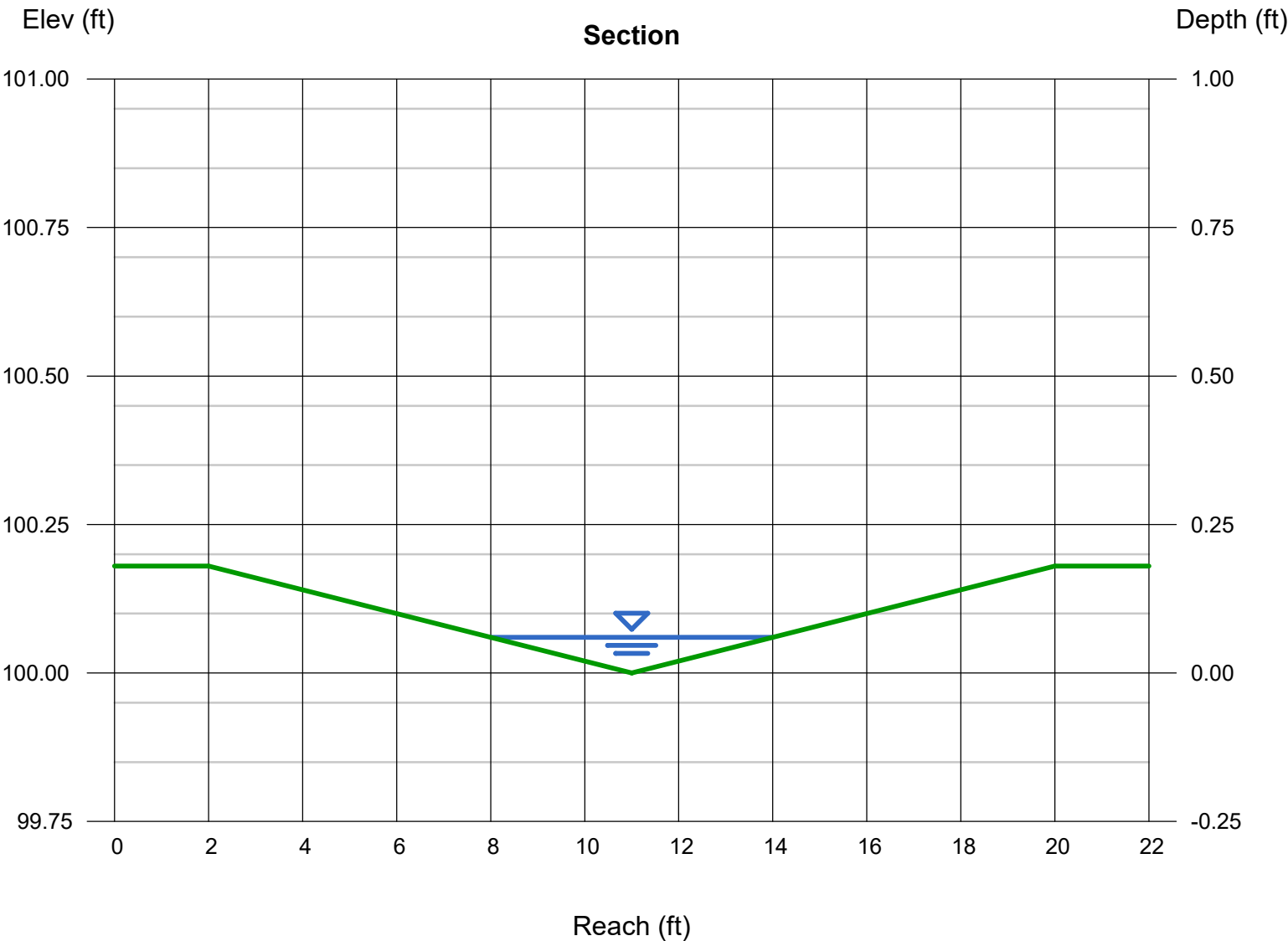
Calculations

Compute by:
Known Q (cfs) = 0.18

Highlighted

Depth (ft) = 0.06
Q (cfs) = 0.180
Area (sqft) = 0.18
Velocity (ft/s) = 1.00
Wetted Perim (ft) = 6.00
Crit Depth, Yc (ft) = 0.07
Top Width (ft) = 6.00
EGL (ft) = 0.08

Basin D5 2 yr Q



Channel Report

18 ft Wide Alley (Basin D5) - Section D (100-yr)

Triangular

Side Slopes (z:1) = 50.00, 50.00
Total Depth (ft) = 0.18

Invert Elev (ft) = 100.00
Slope (%) = 1.00
N-Value = 0.013

Calculations

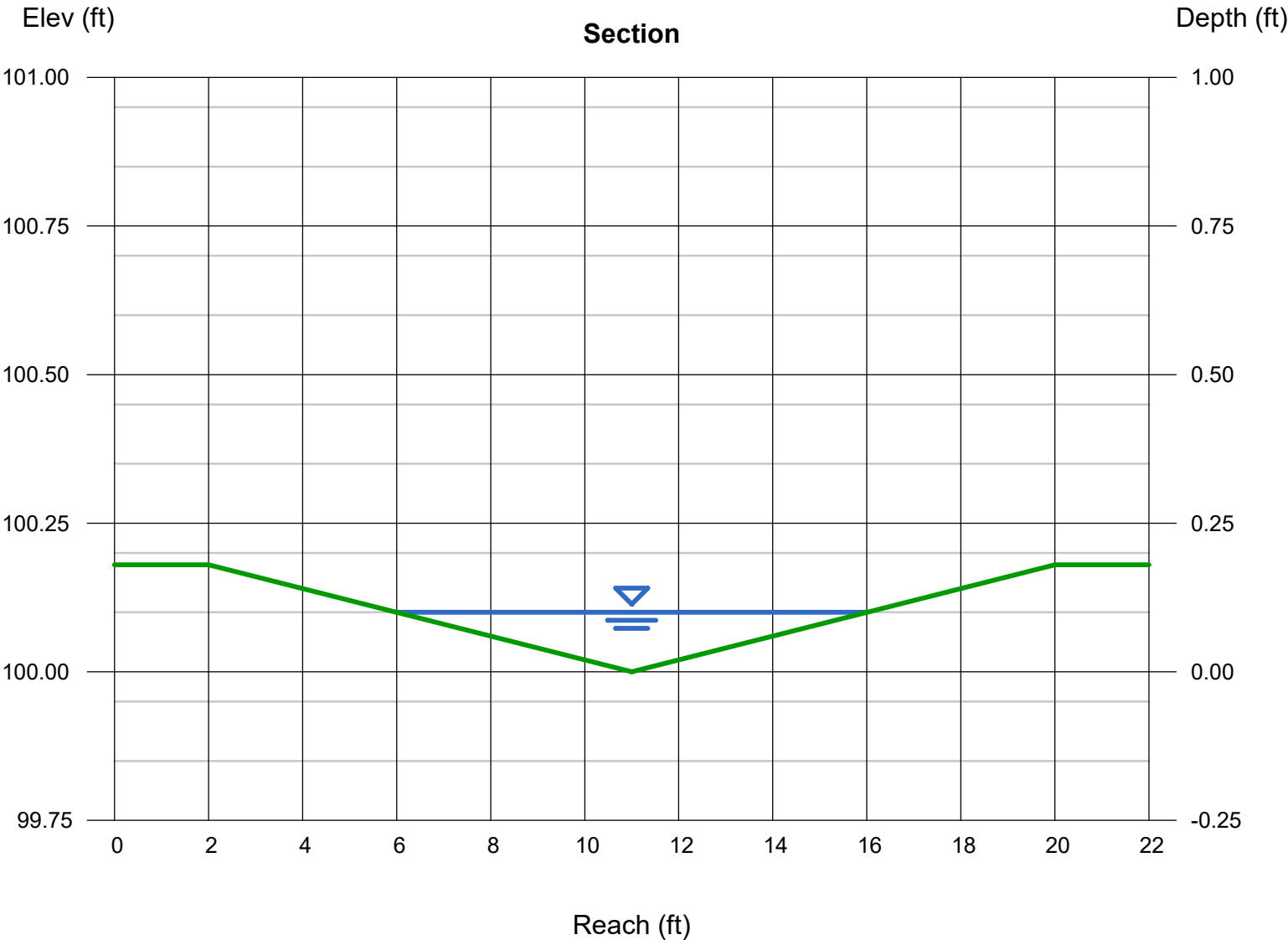
Compute by:
Known Q (cfs)

Known Q
= 0.65

Highlighted

Depth (ft) = 0.10
Q (cfs) = 0.650
Area (sqft) = 0.50
Velocity (ft/s) = 1.30
Wetted Perim (ft) = 10.00
Crit Depth, Yc (ft) = 0.11
Top Width (ft) = 10.00
EGL (ft) = 0.13

Basin D5 100 yr Q



Channel Report

SWALE IN BASIN UD1 (Min Slope) - Section E

User-defined

Invert Elev (ft) = 5560.28
Slope (%) = 1.50
N-Value = 0.025

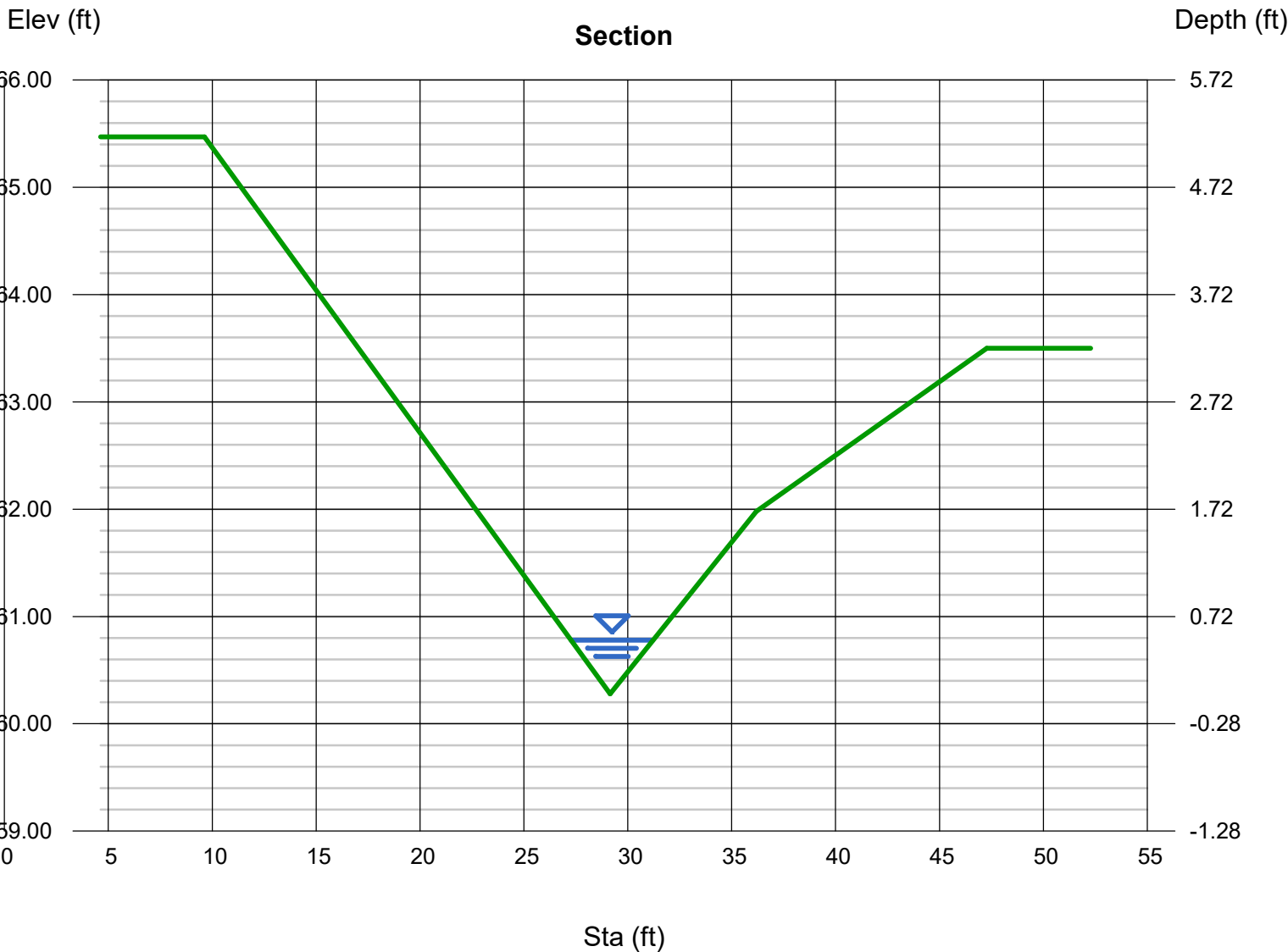
Calculations

Compute by:
Known Q (cfs) = 2.77

Highlighted

Depth (ft) = 0.50
Q (cfs) = 2.770
Area (sqft) = 0.99
Velocity (ft/s) = 2.81
Wetted Perim (ft) = 4.07
Crit Depth, Yc (ft) = 0.50
Top Width (ft) = 3.95
EGL (ft) = 0.62

(Sta, El, n)-(Sta, El, n)...
(9.63, 5565.47)-(29.15, 5560.28, 0.025)-(36.18, 5561.98, 0.025)-(47.27, 5563.50, 0.025)



Channel Report

SWALE IN BASIN UD1 (Max Slope) - Section E

Triangular

Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 1.00

Invert Elev (ft) = 100.00
Slope (%) = 7.00
N-Value = 0.025

Calculations

Compute by:
Known Q (cfs)

Known Q
= 2.77

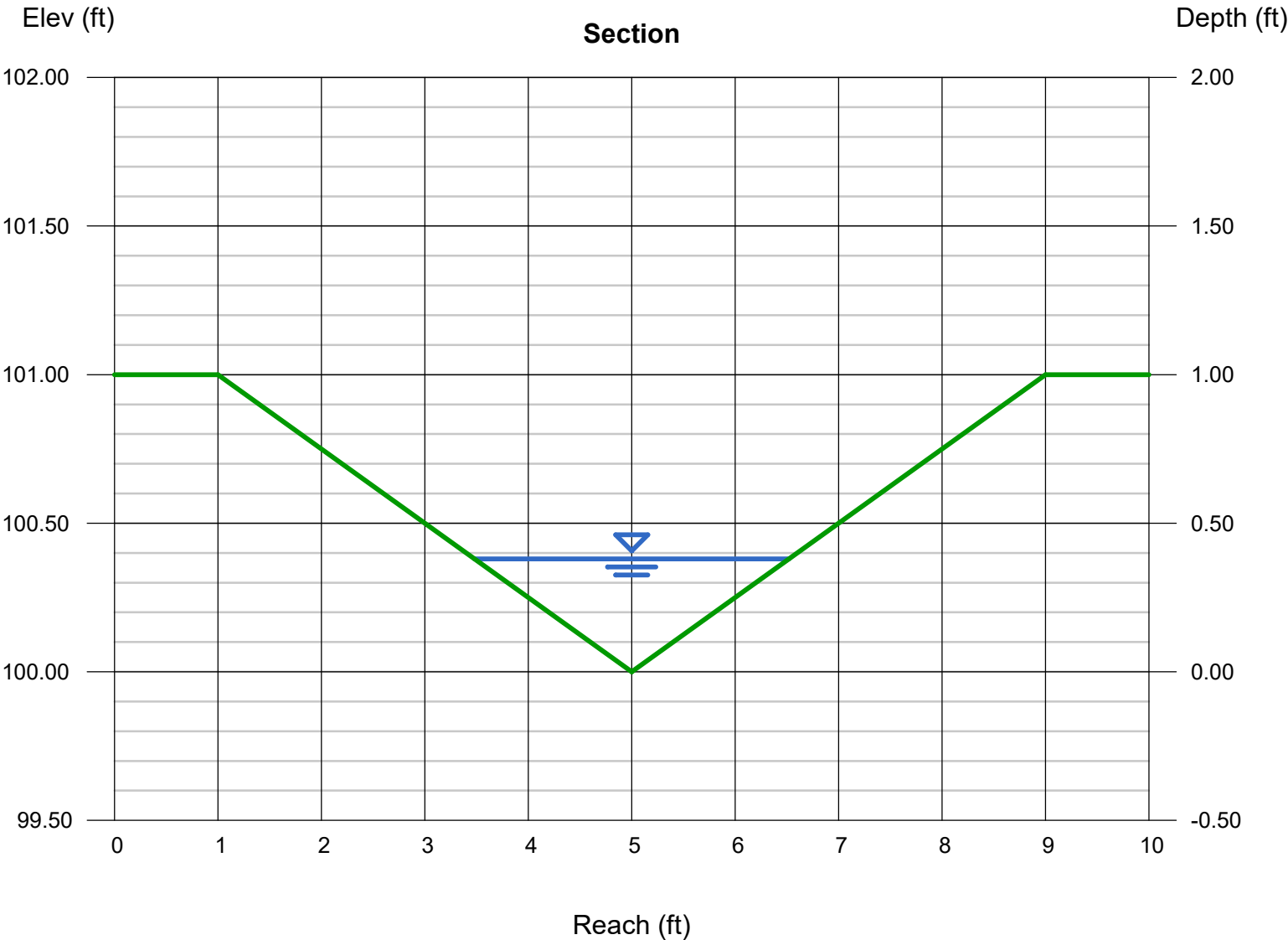
max slope

Highlighted

Depth (ft) = 0.38
Q (cfs) = 2.770
Area (sqft) = 0.58
Velocity (ft/s) = 4.80
Wetted Perim (ft) = 3.13
Crit Depth, Yc (ft) = 0.50
Top Width (ft) = 3.04
EGL (ft) = 0.74

max velocity is
less than 5 ft/s
limit in table 7-2

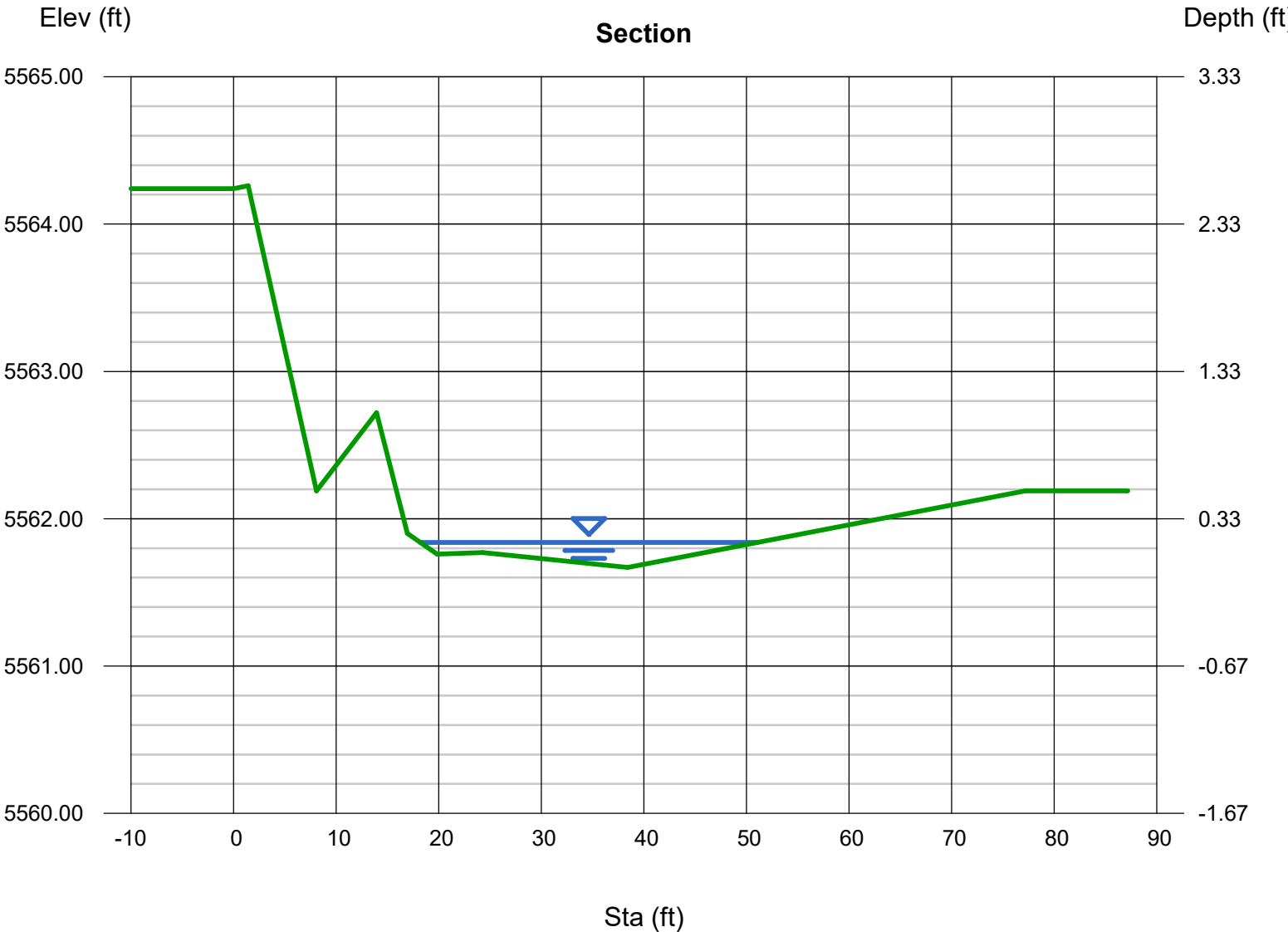
Basin UD1+OS1+OS2 100 yr Q



Channel Report

Emergency Spill Way Basin UD1 - Section F

User-defined		Highlighted	
Invert Elev (ft)	= 5561.67	Depth (ft)	= 0.17
Slope (%)	= 0.50	Q (cfs)	= 2.770
N-Value	= 0.025	Area (sqft)	= 3.17
		Velocity (ft/s)	= 0.87
Calculations		Wetted Perim (ft)	= 32.89
Compute by:	Known Q	Crit Depth, Yc (ft)	= 0.13
Known Q (cfs)	<div><div>= 2.77</div></div>	Top Width (ft)	= 32.89
		EGL (ft)	= 0.18
(Sta, El, n)-(Sta, El, n)...			
(0.00, 5564.24)-(1.42, 5564.26, 0.025)-(8.09, 5562.19, 0.025)-(13.95, 5562.72, 0.025)-(16.95, 5561.90, 0.025)-(19.85, 5561.76, 0.025)-(24.28, 5561.77, 0.025)-			
-(38.42, 5561.67, 0.025)-(77.17, 5562.19, 0.025)			
Basin UD1+OS1+OS2 100 yr Q			



Channel Report

Private Road Section G - (100-year)

Gutter

Cross Sl, Sx (ft/ft)	= 0.020
Cross Sl, Sw (ft/ft)	= 0.083
Gutter Width (ft)	= 1.00
Invert Elev (ft)	= 100.00
Slope (%)	= 3.65
N-Value	= 0.013

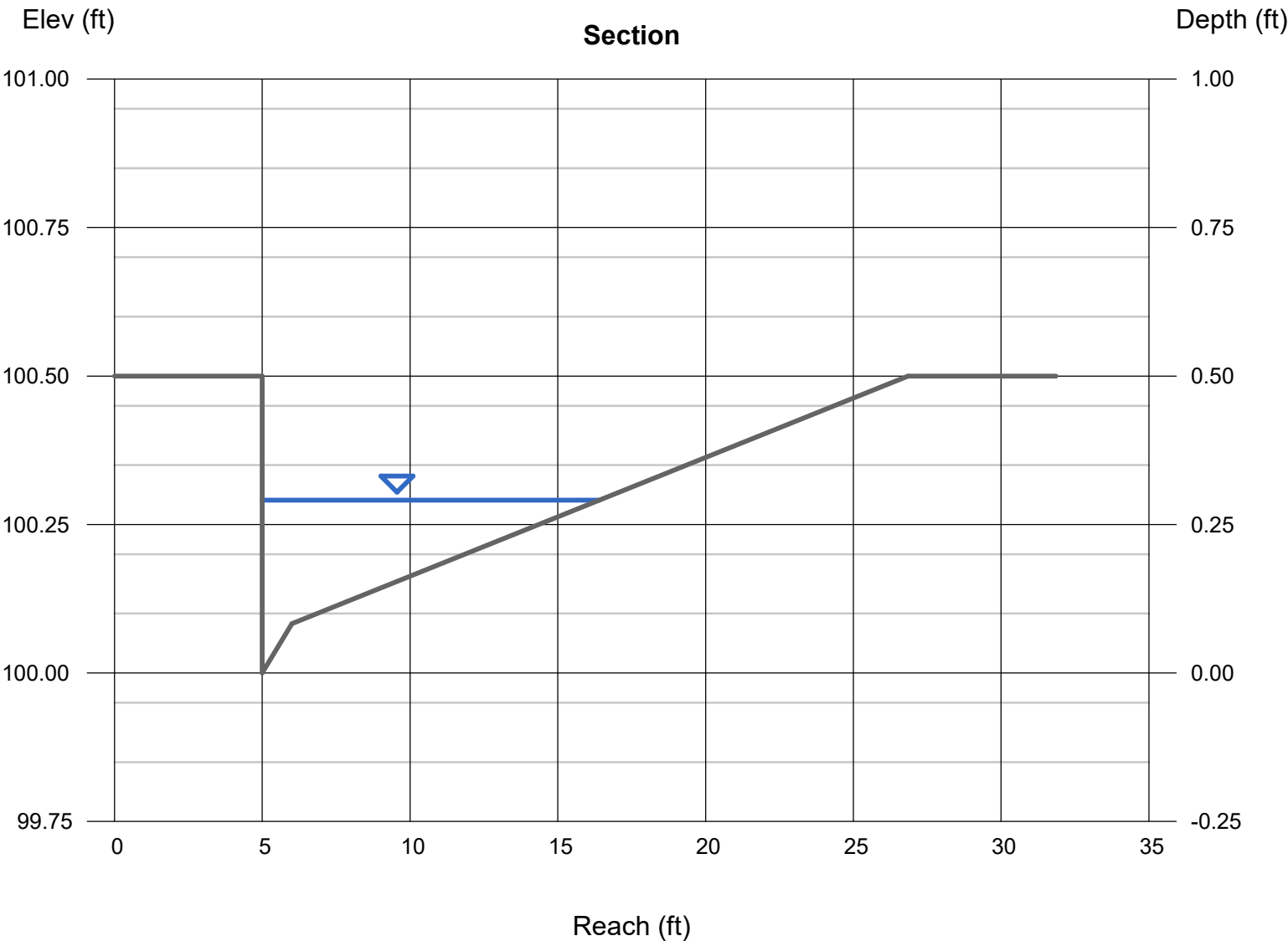
Highlighted

Depth (ft)	= 0.29
Q (cfs)	= 8.350
Area (sqft)	= 1.33
Velocity (ft/s)	= 6.27
Wetted Perim (ft)	= 11.70
Crit Depth, Yc (ft)	= 0.44
Spread Width (ft)	= 11.40
EGL (ft)	= 0.90

Calculations

Compute by:	Known Q
Known Q (cfs)	= 8.35

Basin D1+D4+OS3 100 yr Q



Channel Report

Private Road Section G - (2-year)

Gutter

Cross Sl, Sx (ft/ft)	= 0.020
Cross Sl, Sw (ft/ft)	= 0.083
Gutter Width (ft)	= 1.00
Invert Elev (ft)	= 100.00
Slope (%)	= 3.65
N-Value	= 0.013

Highlighted

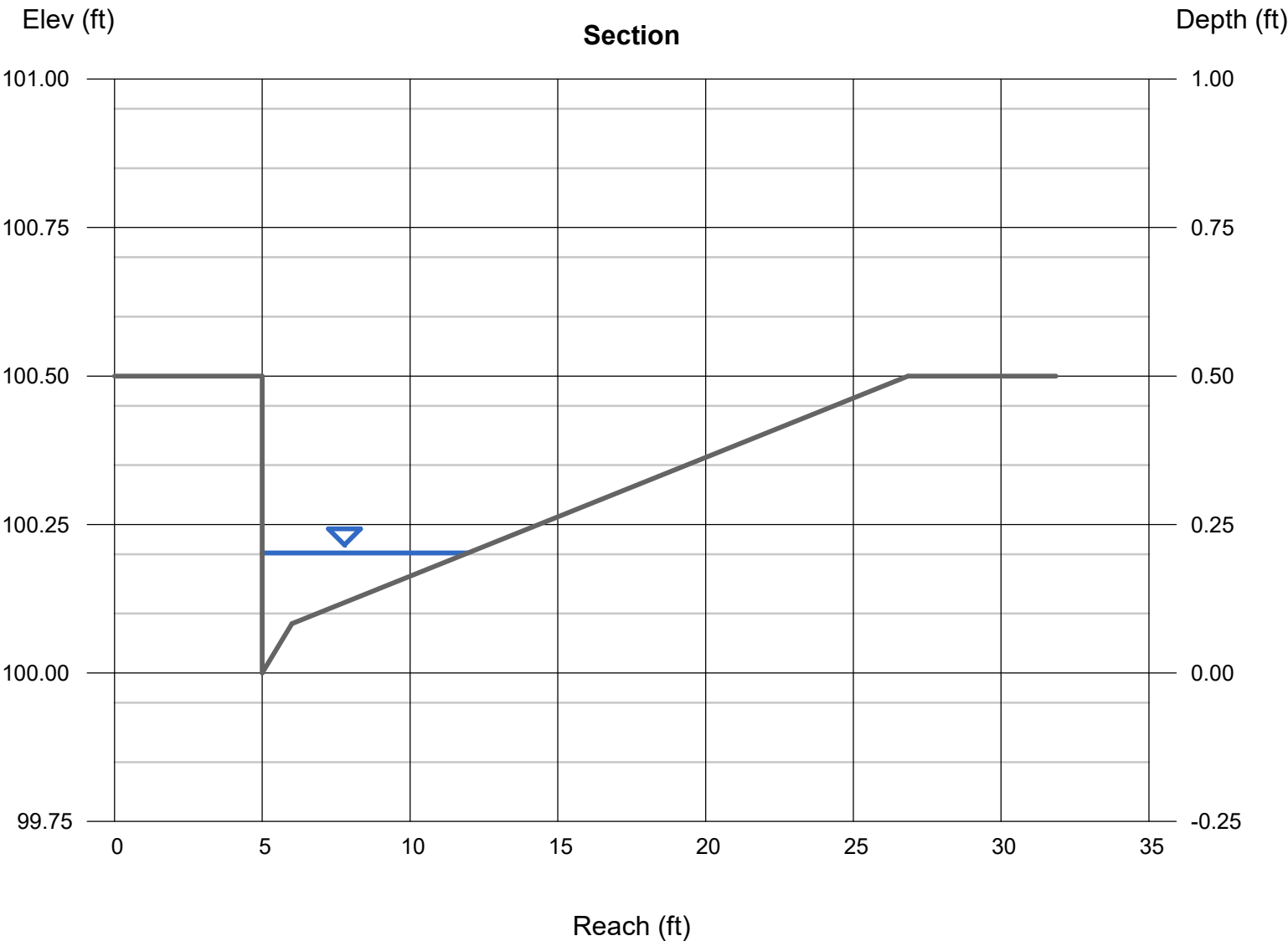
Depth (ft)	= 0.20
Q (cfs)	= 2.440
Area (sqft)	= 0.51
Velocity (ft/s)	= 4.74
Wetted Perim (ft)	= 7.16
Crit Depth, Yc (ft)	= 0.29
Spread Width (ft)	= 6.95
EGL (ft)	= 0.55

Calculations

Compute by:
Known Q (cfs)

Known Q
= 2.44

Basin D1+D4+OS3 2 yr Q

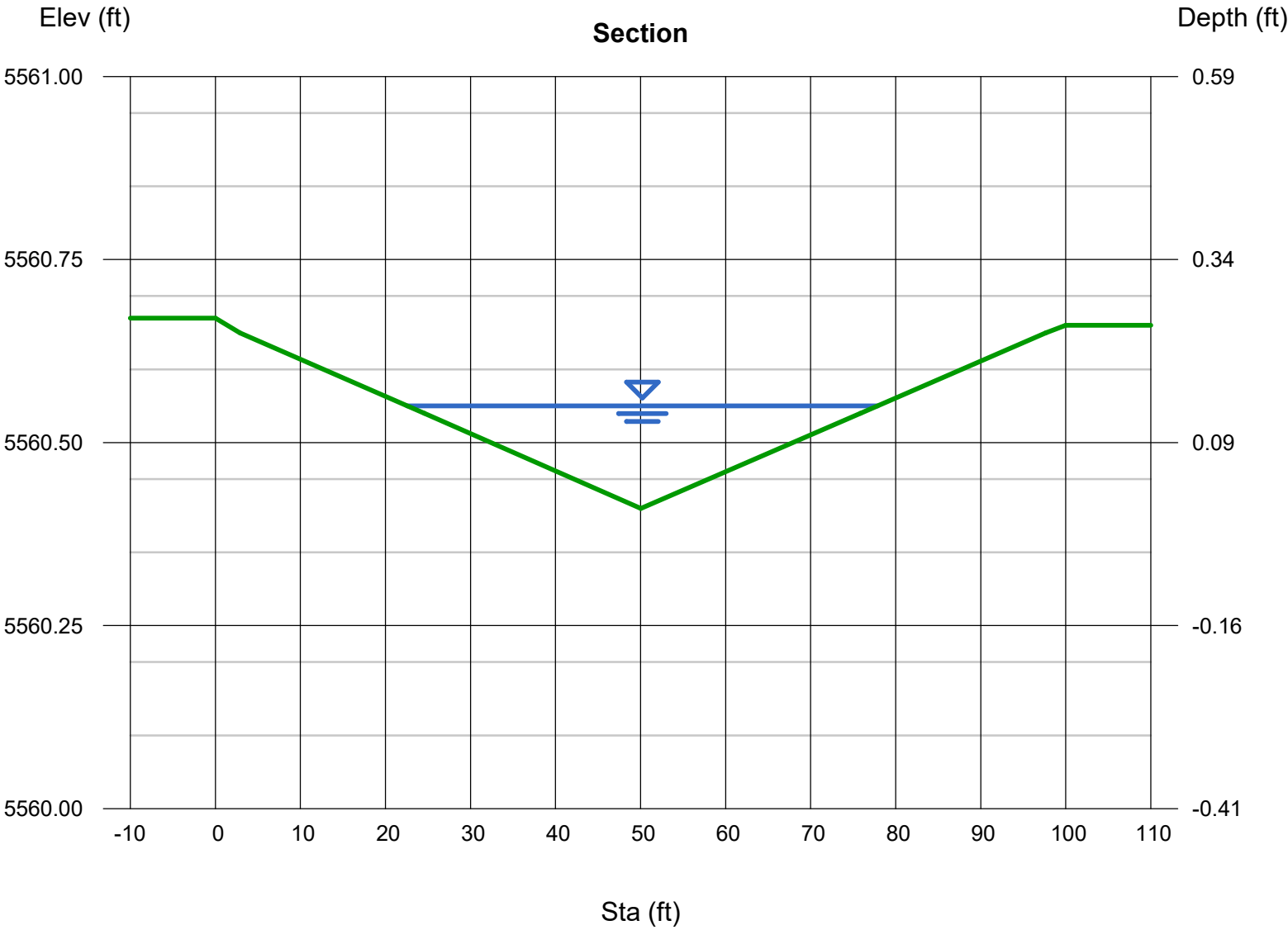


Channel Report

Pond Emergency Overflow - Section H

User-defined		Highlighted	
Invert Elev (ft)	= 5560.41	Depth (ft)	= 0.14
Slope (%)	= 2.00	Q (cfs)	= 9.900
N-Value	= 0.013	Area (sqft)	= 3.88
Calculations		Velocity (ft/s)	= 2.55
Compute by:	Known Q	Wetted Perim (ft)	= 55.36
Known Q (cfs)	= 9.90	Crit Depth, Yc (ft)	= 0.18
		Top Width (ft)	= 55.36
		EGL (ft)	= 0.24
(Sta, El, n)-(Sta, El, n)...			
(0.00, 5560.67)-(2.90, 5560.65, 0.013)-(24.56, 5560.54, 0.013)-(50.03, 5560.41, 0.013)-(75.87, 5560.54, 0.013)-(97.62, 5560.65, 0.013)-(100.00, 5560.66, 0.013)			

EDB Outlet structure
clogged. Pond inflow = 9.90

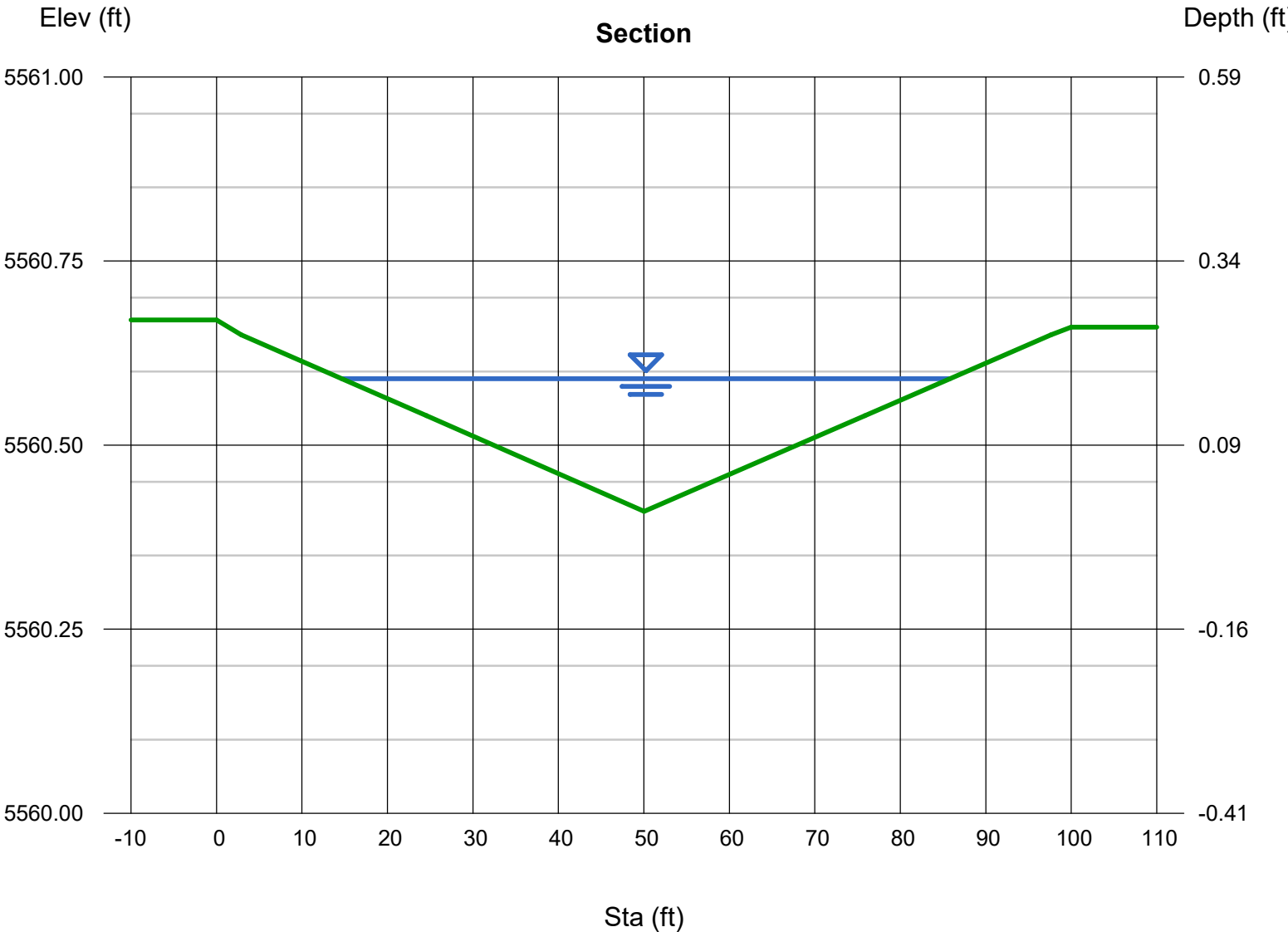


Channel Report

Jewell Inlet Emergency Overflow - Section H

<

Jewell Ave inlet clogged
Total Flows to inlet = Basins D1-D5 & OS3



Irregular Weir Flow Calculator

Jewell Avenue - Crown Emergency Overflow

17.99 CFS IN EMERGENCY CONDITION

Inputs

Headwater elevation	60.79
Weir coefficient, Cw ?	2.7

Weir points [+/-](#) (or Copy/Paste using data area)

Station (distance)	Elevation	Ponding Height	Incremental Flow	Cumulative Flow
0	61.13	0.00		
20	61.10	0.00	0.00	0.00
40	60.97	0.00	0.00	0.00
60	60.81	0.00	0.00	0.00
80	60.75	0.04	0.12	0.12
100	60.66	0.13	1.39	1.50
120	60.56	0.23	4.16	5.66
140	60.64	0.15	4.50	10.16
160	60.65	0.14	2.98	13.14
180	60.60	0.19	3.63	16.77
200	60.67	0.12	3.32	20.09
220	60.74	0.05	1.37	21.46
240	60.79	0.00	0.24	21.70
260	60.97	0.00	0.00	21.70
280	61.02	0.00	0.00	21.70
300	61.21	0.00	0.00	21.70

EDB Outlet Structure Clogged
With 0.23' of head Jewell Ave Crown will have plenty of capacity for the 17.99 cfs of overflow.

Notes

Weir Equation
q = if (length = 0) then 0 else if (slope=0) then cw*length*d₀^{1.5} else cw/(2.5*slope) * (d₀^{2.5} - d₁^{2.5}) where d₁ and d₀ are always positive or zero

Channel Report

Jewell Ave Section - West Side of Sump 2 yr

Gutter

Cross Sl, Sx (ft/ft)	= 0.020
Cross Sl, Sw (ft/ft)	= 0.083
Gutter Width (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.013

Calculations

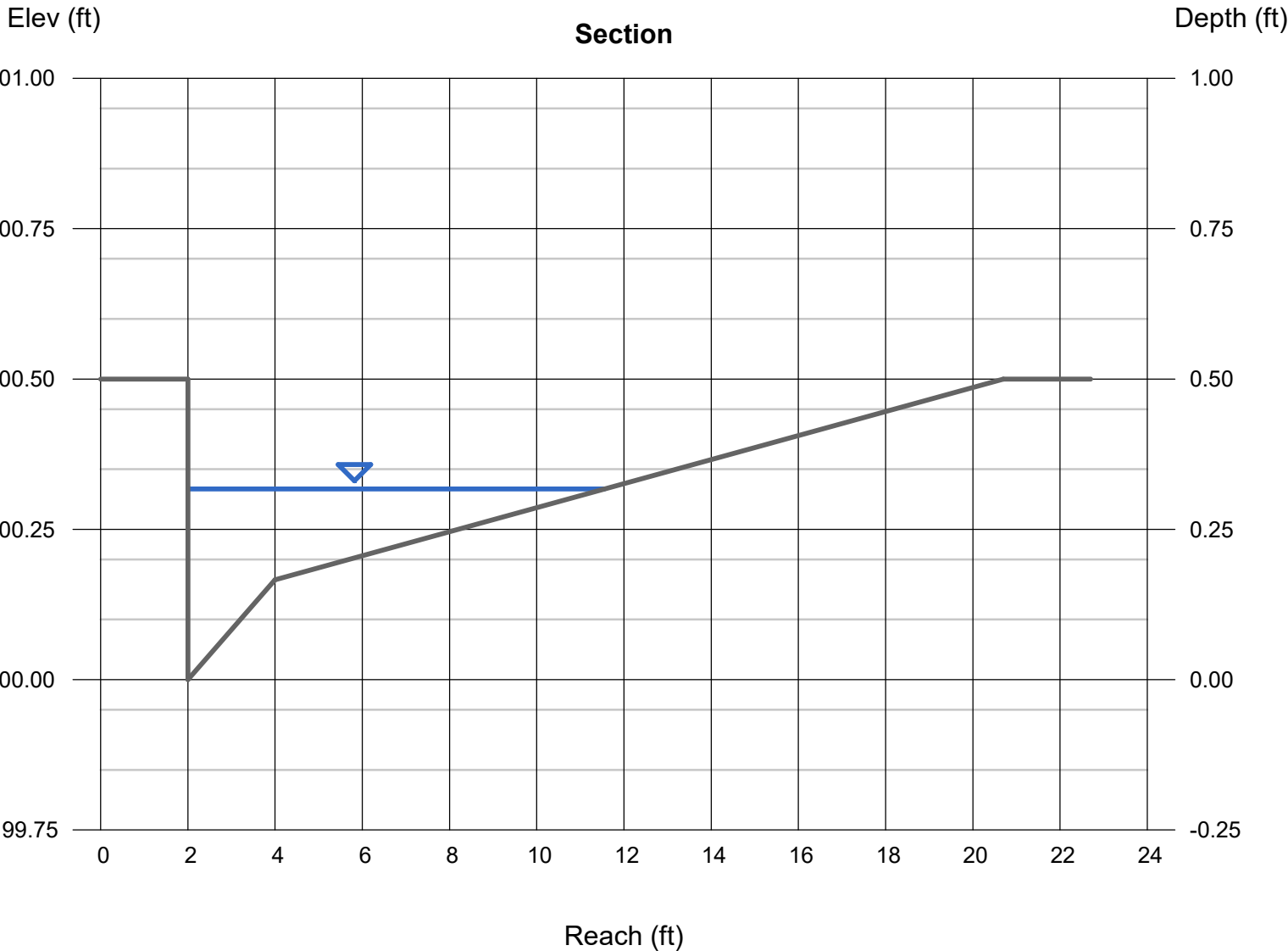
Compute by:	Known Q
Known Q (cfs)	= 2.44

Highlighted

Depth (ft)	= 0.32
Q (cfs)	= 2.440
Area (sqft)	= 1.04
Velocity (ft/s)	= 2.35
Wetted Perim (ft)	= 9.88
Crit Depth, Yc (ft)	= 0.34
Spread Width (ft)	= 9.55
EGL (ft)	= 0.40

D1+D4+OS3 2 yr

Does not overtop curb and leaves at least one 10 ft lane open. (Distance from flowline to crown is 30ft)



Channel Report

Jewell Ave Section - East Side of Sump 2 yr

Gutter

Cross Sl, Sx (ft/ft)	= 0.020
Cross Sl, Sw (ft/ft)	= 0.083
Gutter Width (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.013

Calculations

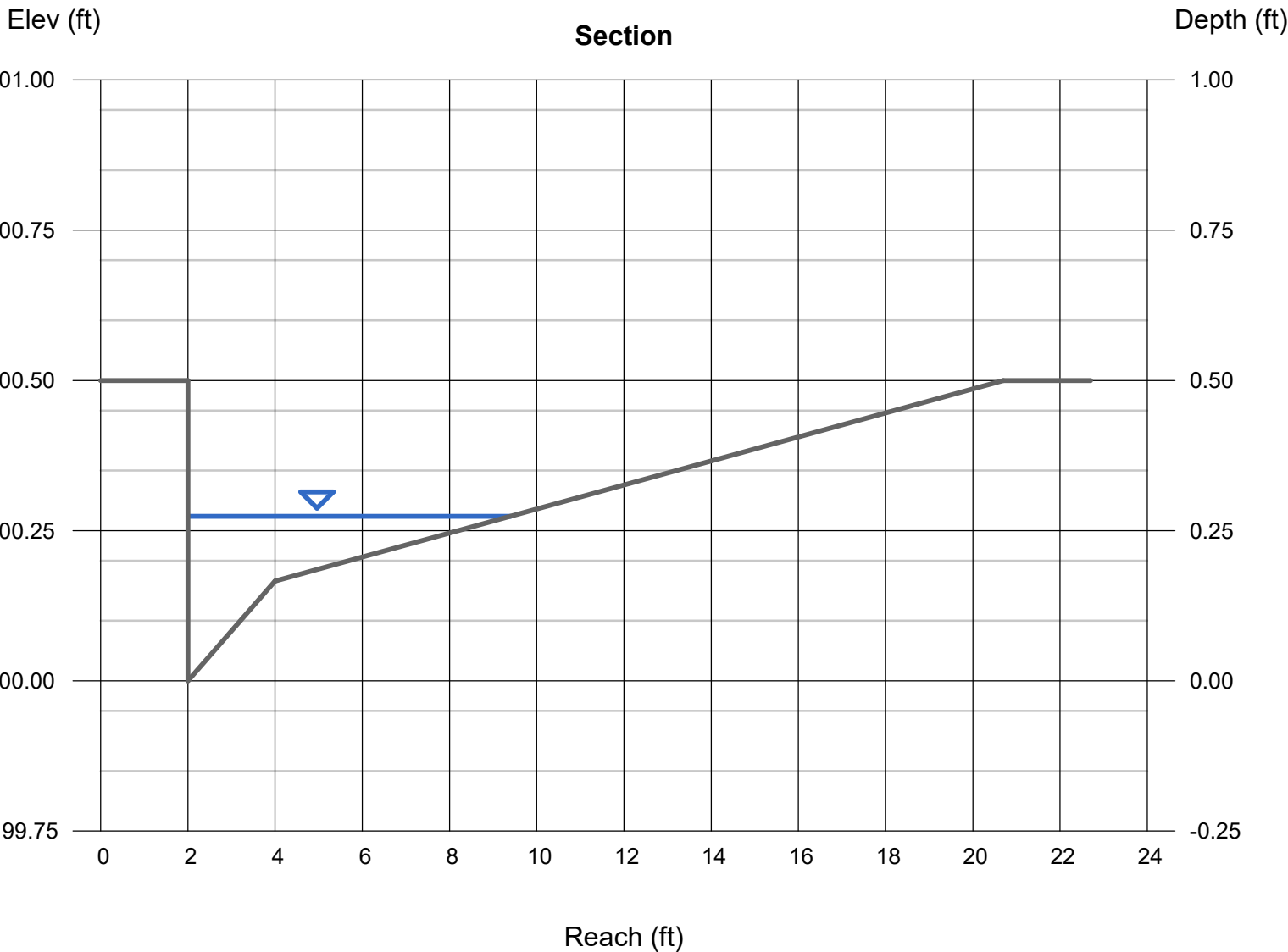
Compute by:	Known Q
Known Q (cfs)	= 1.46

Highlighted

Depth (ft)	= 0.27
Q (cfs)	= 1.460
Area (sqft)	= 0.67
Velocity (ft/s)	= 2.17
Wetted Perim (ft)	= 7.68
Crit Depth, Yc (ft)	= 0.30
Spread Width (ft)	= 7.40
EGL (ft)	= 0.35

D2+D5 2 yr

Does not overtop curb and leaves at least one 10 ft lane open. (Distance from flowline to crown is 30ft)



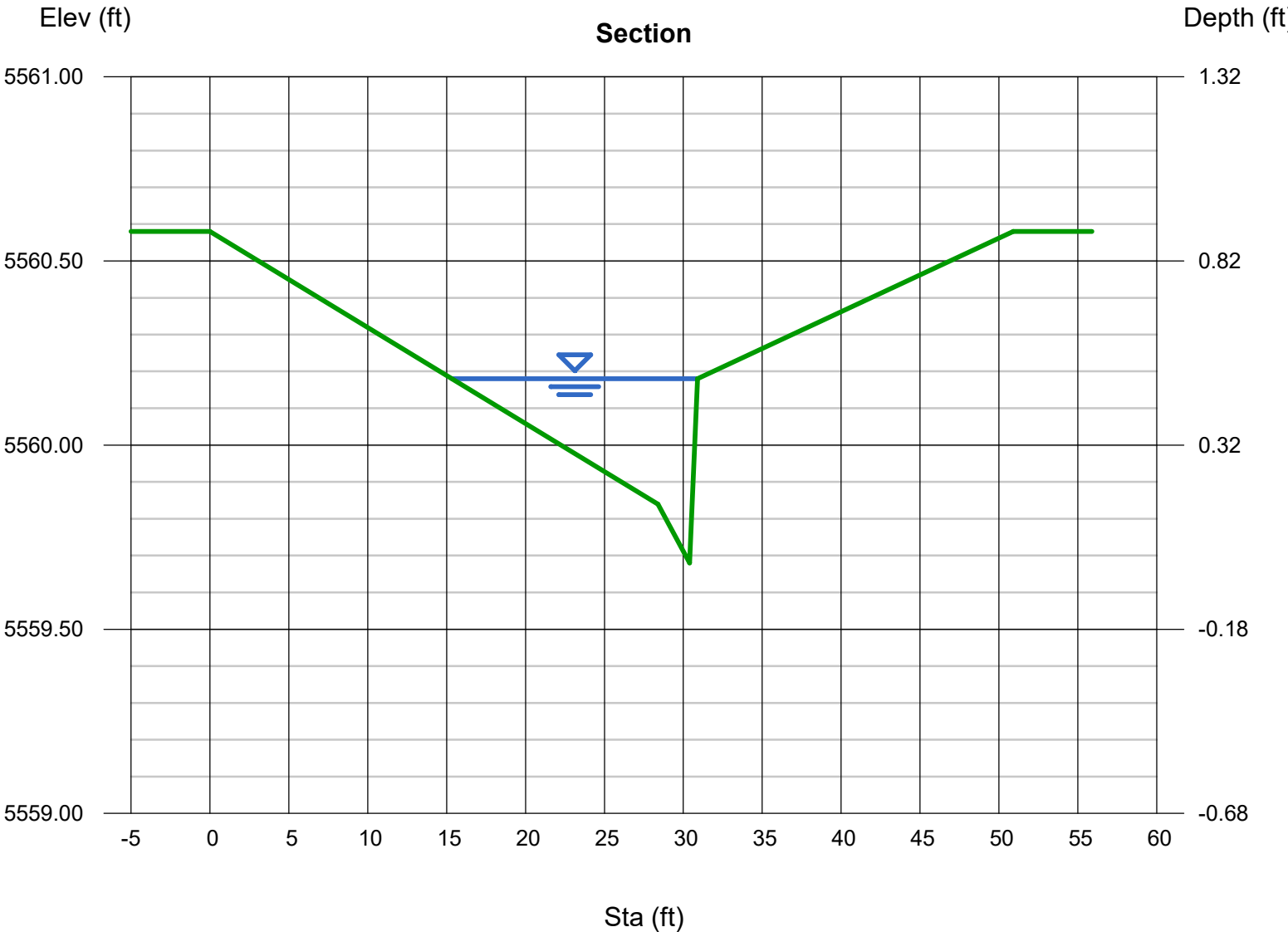
Channel Report

Jewell Ave Section - West Side of Sump 100 yr

User-defined		Highlighted	
Invert Elev (ft)	= 5559.68	Depth (ft)	= 0.50
Slope (%)	= 0.50	Q (cfs)	= 8.350
N-Value	= 0.013	Area (sqft)	= 3.19
Calculations		Velocity (ft/s)	= 2.62
Compute by:	Known Q	Wetted Perim (ft)	= 15.78
Known Q (cfs)	= 8.35	Crit Depth, Yc (ft)	= 0.51
(Sta, El, n)-(Sta, El, n)...		Top Width (ft)	= 15.56
(0.00, 5560.58)-(28.40, 5559.84, 0.013)-(30.40, 5559.68, 0.013)-(30.90, 5560.18, 0.013)-(50.90, 5560.58, 0.016)		EGL (ft)	= 0.61

D1+D4+OS3 100 yr

Does not exceed 1 foot of depth



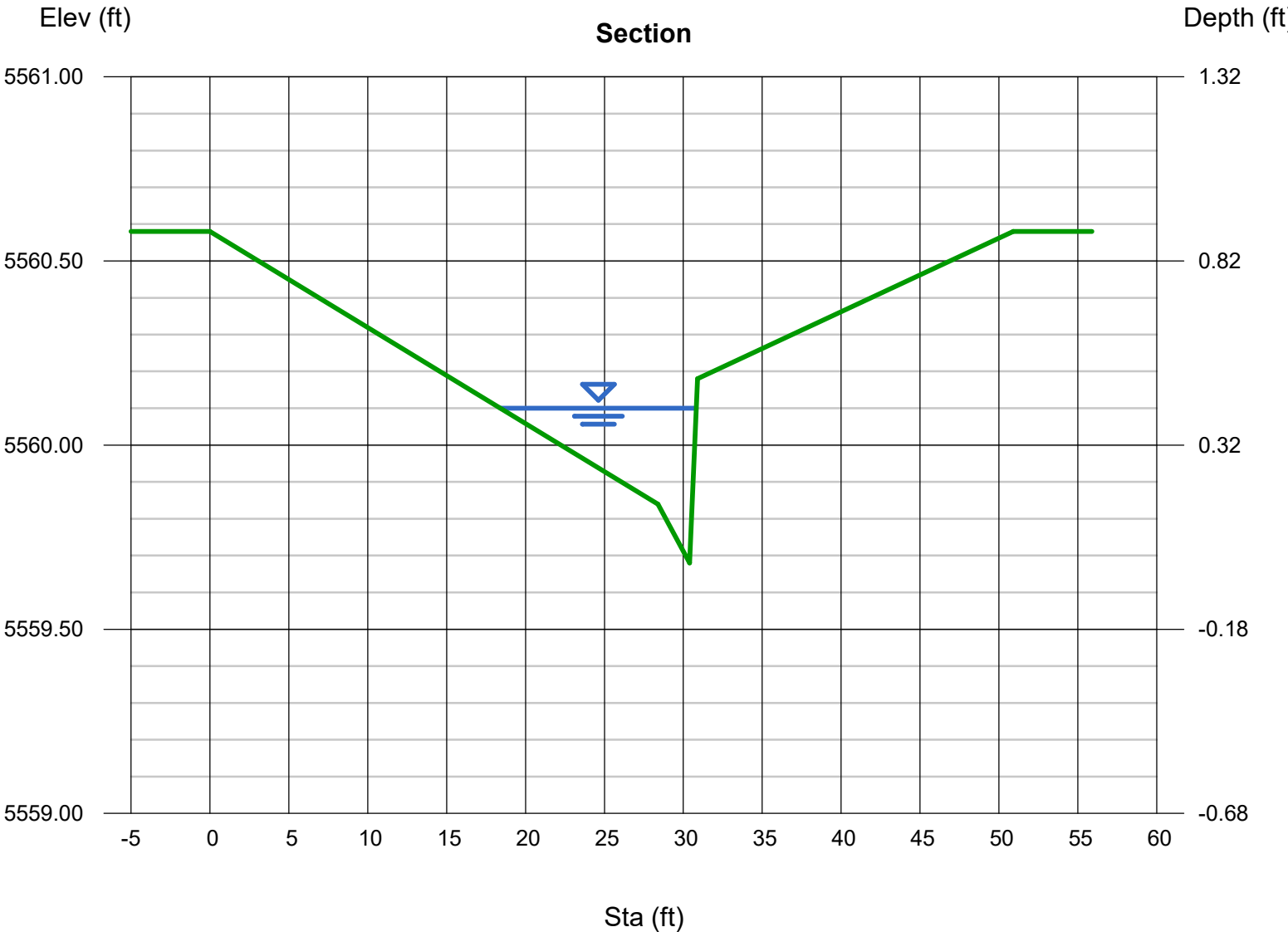
Channel Report

Jewell Ave Section - East Side of Sump 100 yr

User-defined		Highlighted	
Invert Elev (ft)	= 5559.68	Depth (ft)	= 0.42
Slope (%)	= 0.50	Q (cfs)	= 4.880
N-Value	= 0.013	Area (sqft)	= 2.07
Calculations		Velocity (ft/s)	= 2.36
Compute by:	Known Q	Wetted Perim (ft)	= 12.59
Known Q (cfs)	= 4.88	Crit Depth, Yc (ft)	= 0.43
(Sta, El, n)-(Sta, El, n)...		Top Width (ft)	= 12.40
(0.00, 5560.58)-(28.40, 5559.84, 0.013)-(30.40, 5559.68, 0.013)-(30.90, 5560.18, 0.013)-(50.90, 5560.58, 0.016)		EGL (ft)	= 0.51

D2+D5 2 yr

Does not exceed 1 foot of depth.



APPENDIX D

Havana Heights Drainage Improvements Excerpts (EDN 850177)

HAVANA HEIGHTS DRAINAGE IMPROVEMENTS
HYDROLOGIC SUMMARY REPORT

S&G NO. 85405-24

June, 1985

850177

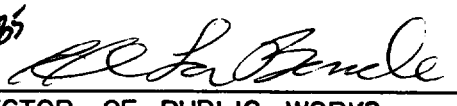

CITY OF AURORA APPROVAL	
<i>KW</i> <i>9-20-85</i> 	<i>9/24/85</i>
DIRECTOR OF PUBLIC WORKS	DATE
	<i>9/25/85</i>
DIRECTOR OF UTILITIES	DATE

Table 1
Area Modifications to C.O.A. Data

C.O.A. Sub-basin Ident.	S&G Sub-basin Ident.	C.O.A. Sub-basin Area (ac)	S&G Sub-basin Area (ac)
II	2	6.80	3.70
II/VIII	102	N/A	4.20
VIII	8	8.20	7.10
III	3	20.2	9.50
III	103	20.2	10.60
IV	4	3.10	2.30
IX	9	11.70	12.70

Figure 3, which is a modification of C.O.A. Figure 9, file number C8-4-248, illustrates sub-basin delineations for the SWMM hydrologic analysis including conveyance element identification numbers. Figure 3 is located in a pocket in the appendix of this report (under separate cover). Figure 4 represents a flow diagram of the routing order modeled with SWMM for Havana Heights.

Sub-basin and storm sewer information required for input data were determined from S&G field surveys as well as mapping and design plans provided to S&G by the C.O.A. including:

1. Kucera and Associates, Inc. topographic mapping, Scale 1"=50' at 2' contour intervals, photographed March 13, 1980.
2. Development site grading and drainage plans:
 - a. Ponderosa Heights Subdivision Filing No. 1, (approved 2-27-85)
 - b. Kester Subdivision Filing No. 1, (approved 7-13-83)
 - c. Havana Heights Filing No. 13, (approved 3-13-85)
 - d. Asbury Park Subdivision (approved 7-21-82)
3. Utility Plans and profiles:
 - a. Havana Square Filing No. 2 Storm Sewer, (approved 5-25-83)
 - b. Havana Heights Storm Sewer, (approved 2-15-84)
 - c. Peoria Park Filing No. 3 Storm Sewer, (approved 11-2-83)
 - d. Village East Unit 4 Filing No. 2 Storm Sewer, (approved 5-22-73)
 - e. Havana Heights Subdivision Filing No. 12 Sanitary Sewer, (approved 11-28-84)
 - f. Ponderosa Heights Subdivision Filing No. 1 Utility Service, (approved 2-27-85)

Infiltration rates, perviousness and imperviousness, and on-site detention maximum release rates are all derived directly from information and data provided in the C.O.A. referenced report and the C.O.A. most recent zoning

map. Design storm hyetographs are developed directly from rainfall data presented in the C.O.A. report. 2-year, 2 3/4-year and 100-year design storms are tabulated in Table 2.

V. SWMM Model Results

Once SWMM was calibrated to CUHP, the basin description data was modified to represent both existing storm drainage systems and proposed drainage improvements as outlined on C.O.A. Figure 9. SWMM model results then served to quantify the benefits of upstream ponding on reducing both the peak flow rate into the proposed detention pond as well as the peak flow at key design points within the basin.

For example, the SWMM/CUHP calibration results ignored the fact that the 100-year runoff generated from Peoria Park Filing 3 will exceed the capacity of the 2-year storm sewer designed to drain this area. Since the inlets are located in a sump, overland conveyance is not possible for excess flows in this area. Therefore, final SWMM results incorporate upstream ponding for this subdivision and other similar conditions existing in Village East Unit 4 Filing 2, at Moline Drive cul-de-sac and in proposed sump areas located at E. Evans Avenue.

Detention pond inflow and outflow design hydrographs for 2-year and 100-year storm events are tabulated in Tables 3 and 4 respectively. Approximately 10.3 cfs will overtop the pond at the overflow spillway location during the 100-year storm. This flow will spill into Jewell Avenue and will be intercepted at Joliet Street and conveyed to the north, away from the Havana Heights outfall system.

VI. Control of Discharge Into Parker/Mexico Drainage Facility

A primary objective for the Havana Heights Outfall System design is to limit the contribution of flow into the downstream Parker/Mexico drainage facilities to 46 cfs during a 100-year storm event. As a result of volume constraints on designing the detention pond, the peak 100-year flow reaching the intersection of Havana Street and Jewell Avenue is equal to almost 150 cubic feet per second (cfs). At this location, approximately 78 cfs is contained in the storm sewer and the remaining 74 cfs is overland flow in the east half of Havana Street. Consequently, it was necessary to design a special outlet structure at this intersection which will allow up to 46 cfs to enter the Parker/Mexico system and will divert the inflow exceeding 46 cfs to a bubble-up structure on Havana Street north of Jewell Avenue. The design solution for achieving this condition consists of constructing a 27-inch diameter orifice to control flows discharging into the downstream system. Assuming that a maximum 100-year hydraulic grade line elevation must be at least one-foot lower than the proposed ground elevation at the structure, a 36-inch diameter conduit is necessary to convey the excess flow of 31.6 cfs to the Havana Street bubble-up structure.

Peak flows entering the intersection of Havana Street and Jewell Ave. necessarily vary with the respective storm frequency. Similarly, the maximum hydraulic grade line elevation reached in the discharge

Narrative describing the 27-inch orifice and bubble-up structure that controls flows in the downstream system.

HAVANA HEIGHTS - AURORA STORM SEWER HYDRAULIC DESIGN TABLE 100-YR HGL CALCS

SELLARDS & GRIGG, INC.
One Union Square
143 Union Blvd, Suite 280
LAKEWOOD, COLORADO 80228
(303) 986-1444

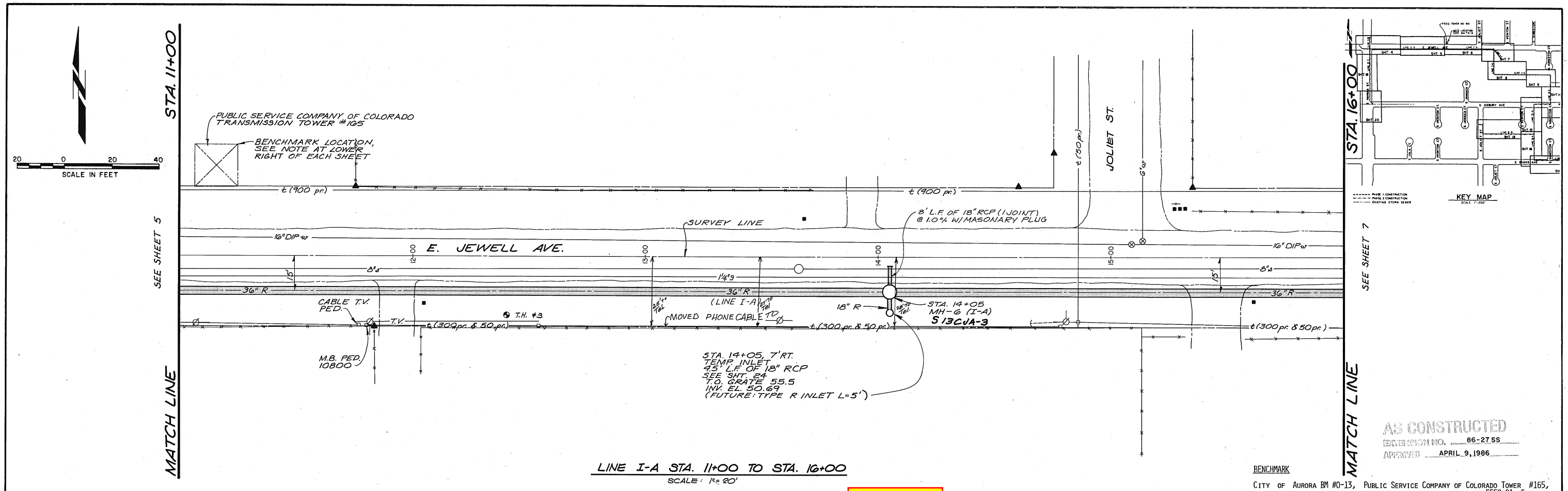
MH I.D.	PIPE DIA (Ft)	N'	S _o (ft/ft)	L (Ft)	Q ₁₀₀ (cfs)	Q _{pipe} Cap _Q (cfs) ^{S_o}	S _f (ft/ft)	DWNST HGL ELEV	UPST VEL (Ft/sec)	UPST H _v (ft)	K	Σ H _L (ft)	UPST HGL ELEV	UPST EGL ELEV
LINE I-A HAVANA ST. TO DETENTION POND ON JEWELL AVE.														
MH-1	INVT = 41.22													
	2.75	.013	.0118	43.5	46.0	59.0	.0118	1.84 = D 43.0	7.3	0.83	.05	.04	43.61	44.44
MH-2	INVT = 41.80													
	2.75	.013	.0118	74.5	46.0	59.0	.0118	1.84 = D 43.61	*OR FICE/INLET CTRL w/s				49.58	49.58
MH-3	INVT = 42.75													
	3.0	.013	.0119	334	49.6	72.0	.0053	49.58*	6.9	0.74	.05	.04	51.39	EGL = 52.13
MH-4	INVT = 46.81													
	3.0	.013	.0013	394	46.2	45.0	.0045	51.39	6.3	0.62	.05	.03	53.19	EGL = 53.81
MH-5	INVT = 48.53													
	3.0	.013	.0039	374	46.2	42.0	.0045	53.19	6.3	0.62	.05	.03	54.90	55.52
MH-6	INVT = 50.02													
	3.0	.013	.0074	452	43.2	59.0	.0041	54.90	6.0	0.56	.05	.03	56.79	57.35
MH-7	INVT = 52.92													
INLET STRUCT. HGL = 53.35 1.55' 2' L ()														

Ex. 100 yr flow in the pipe between MH-5 and MH-6 (@ pond tie in)

Ex. 100 yr flow in the pipe between MH-6 and MH-7 (@ type c inlet tie in)

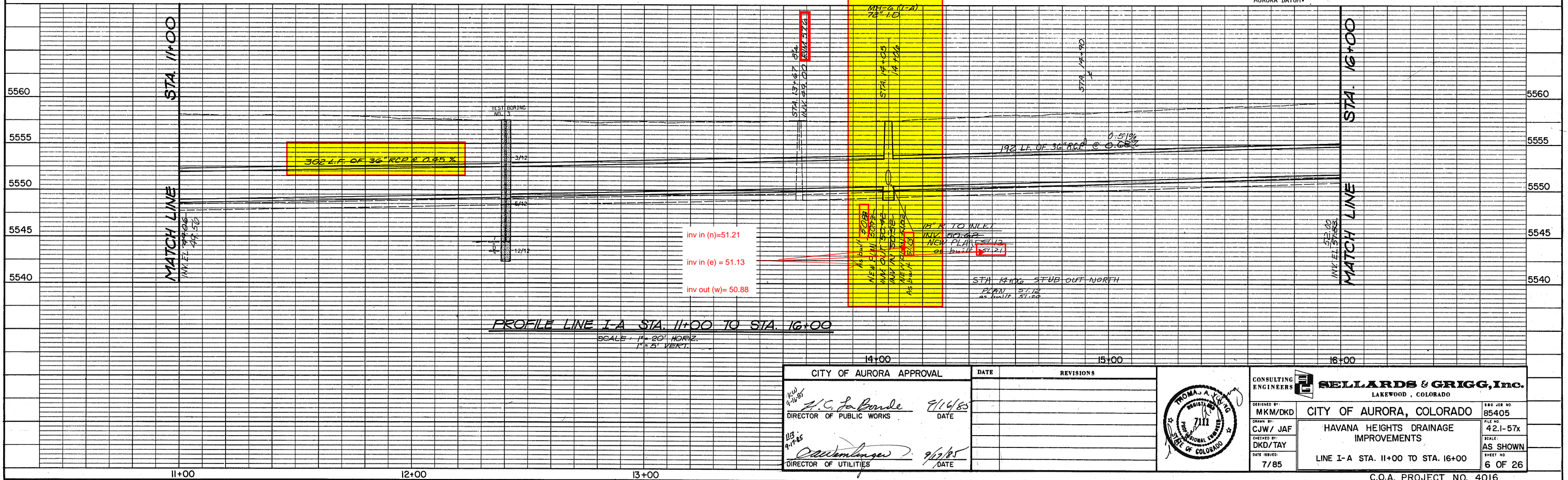
JOB 85405-24
SHEET NO. 14 OF 14
CALCULATED BY DED DATE 6/4/85
CHECKED BY DATE
SCALE

850177 6/26



LINE I-A STA. 11+00 TO STA. 16+00
SCALE: 1\"/>

BENCHMARK
CITY OF AURORA BM #0-13, PUBLIC SERVICE COMPANY OF COLORADO TOWER #165,
CHISELED SQUARE ON CONCRETE BASE, NORTHEAST LEG, ELEVATION 5558.81, CITY OF
AURORA DATUM.

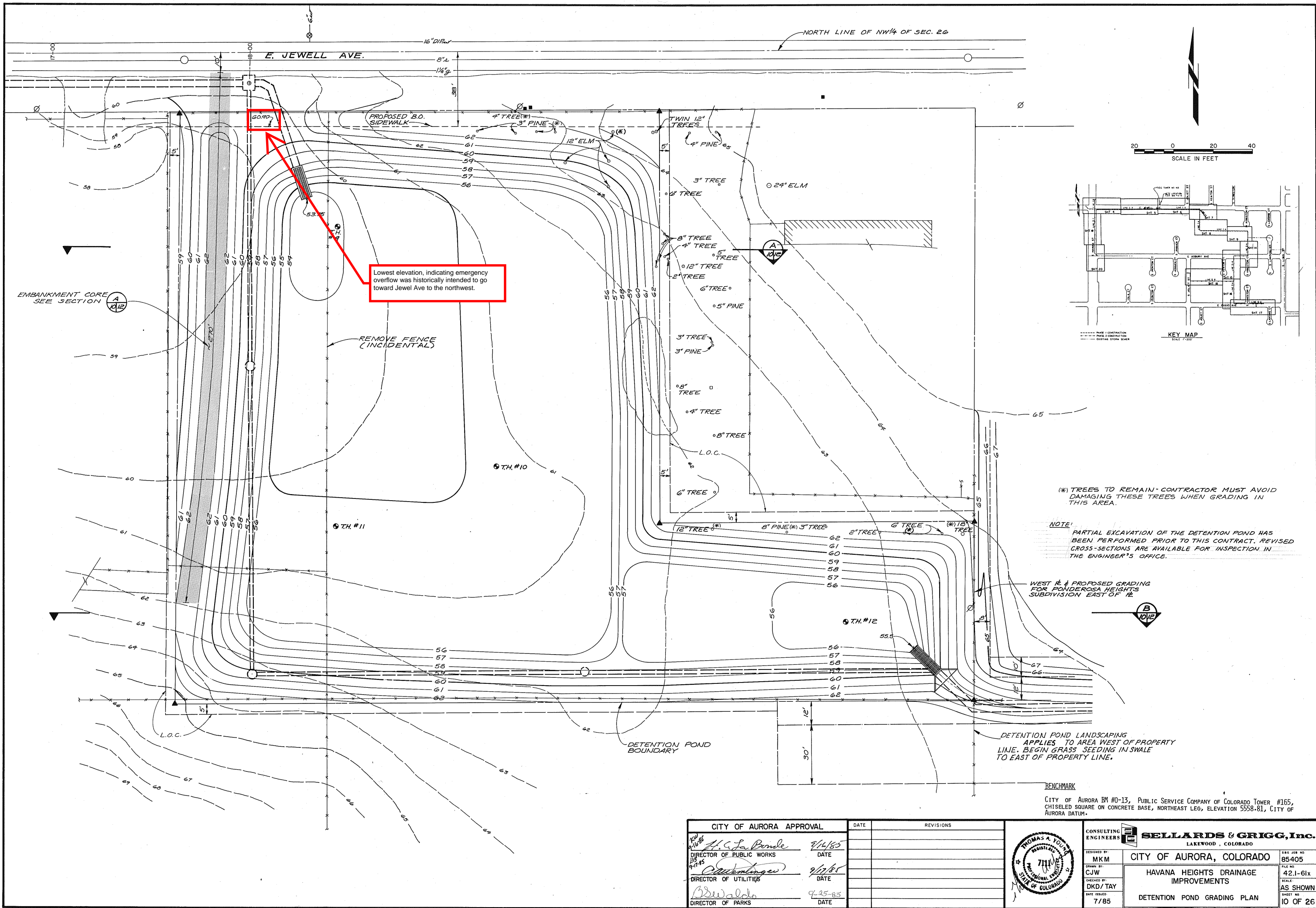


PROFILE LINE I-A STA. 11+00 TO STA. 16+00
SCALE: 1\"/>


CITY OF AURORA APPROVAL		DATE	REVISIONS
A.C. LaBonde DIRECTOR OF PUBLIC WORKS		8/14/85	
B.G. [Signature] DIRECTOR OF UTILITIES		9/2/85	
CONSULTING ENGINEERS		SELLARDS & GRIGG, Inc. LAKEWOOD, COLORADO	
DESIGNED BY: MKM/DKD		CITY OF AURORA, COLORADO	
DRAWN BY: CJW/JAF		HAVANA HEIGHTS DRAINAGE IMPROVEMENTS	
CHECKED BY: DKD/TAY		LINE I-A STA. 11+00 TO STA. 16+00	
DATE ISSUED: 7/85		SHEET NO. 6 OF 26	

850177

850177 1/26



CITY OF AURORA APPROVAL		DATE	REVISIONS
<i>H. S. La Bonte</i>	9/14/85		
DIRECTOR OF PUBLIC WORKS	DATE		
<i>C. J. W.</i>	9/17/85		
DIRECTOR OF UTILITIES	DATE		
<i>B. Swales</i>	9-25-85		
DIRECTOR OF PARKS	DATE		



CONSULTING ENGINEERS
SELLARDS & GRIGG, Inc.
LAKEWOOD, COLORADO

DESIGNED BY: MKM
CITY OF AURORA, COLORADO
FILE NO: 85405

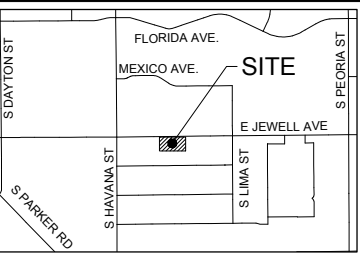
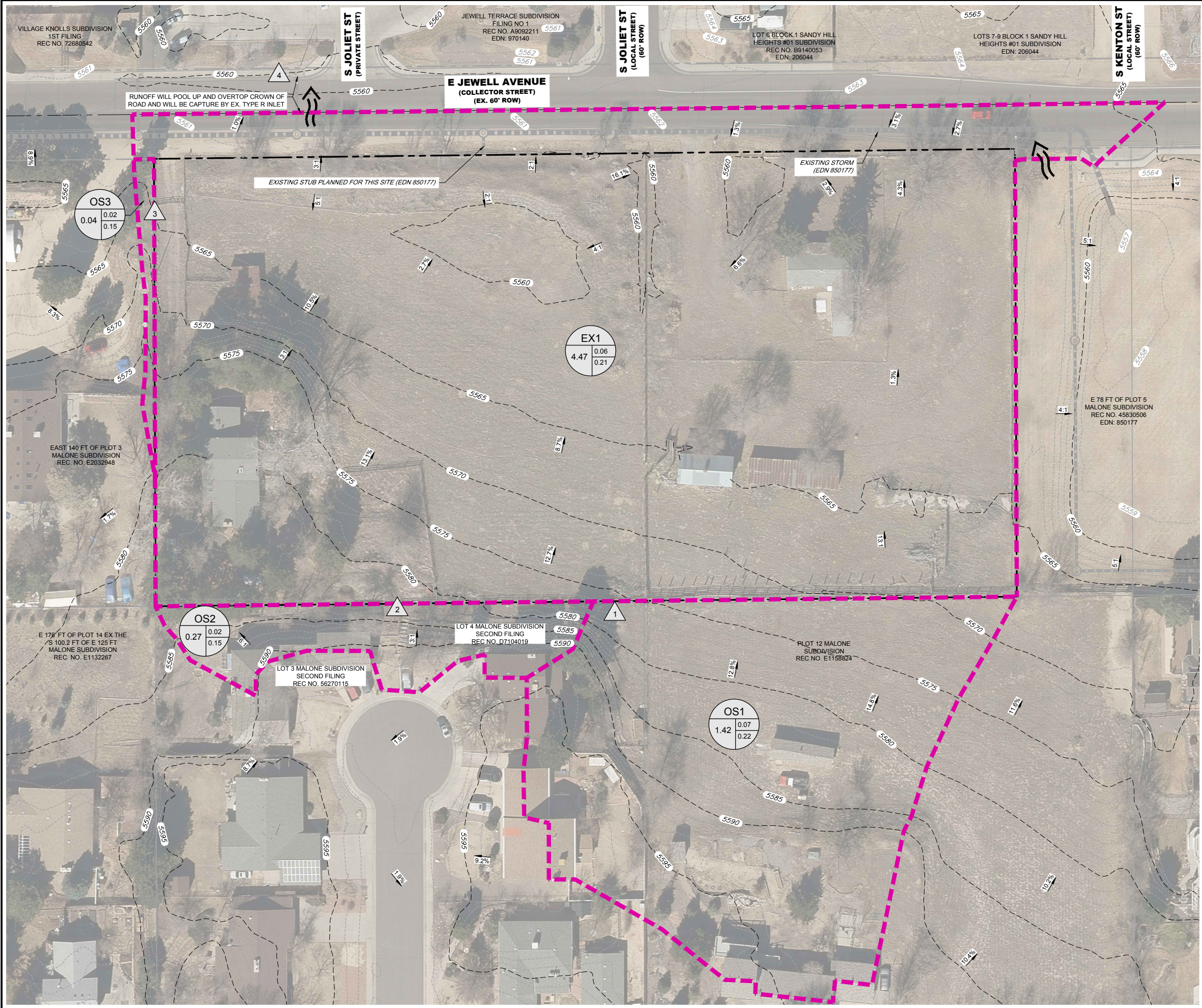
DRAWN BY: CJW
HAVANA HEIGHTS DRAINAGE IMPROVEMENTS
FILE NO: 42.1-61x

CHECKED BY: DKD/TAY
SCALE: AS SHOWN

DATE ISSUED: 7/85
DETENTION POND GRADING PLAN
SHEET NO: 10 OF 26

APPENDIX E

Existing Drainage Plan

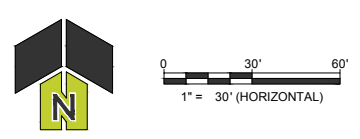


VICINITY MAP
SCALE: 1" = 2000'

LEGEND

	BASIN DESIGNATION
	BASIN AREA (ACRES)
	DESIGN POINT
	BASIN BOUNDARY
	EMERGENCY OVERFLOW
	EXISTING STORM SEWER
	EXISTING MAJOR CONTOUR
	EXISTING MINOR CONTOUR
	DRAINAGE FLOW DIRECTION

BENCHMARK:
COA ID: 4S6723SW003. DESCRIPTION: 3" BRASS CAP IN CONCRETE PAD OF THE SOUTHWEST CORNER LEFT OF POWER TRANSMISSION TOWER #164 BEING ON THE NORTH SIDE OF EAST JEWELL AVENUE ACROSS FROM THE HAVANA HEIGHTS DETENTION POND AND APPROXIMATELY 375 FT. EAST OF JOLIET STREET. ELEVATION: 5,567.417 (NAVD 88 DATUM)



REV. NO.	DESCRIPTION	DATE

URBAN COTTAGES, LLC

JEWELL URBAN COTTAGES SUBDIVISION FILING NO. 1

EXISTING DRAINAGE PLAN

E. JEWELL AVE
AURORA, CO

PRELIMINARY
THIS DRAWING HAS NOT BEEN APPROVED BY GOVERNING AGENCIES AND IS SUBJECT TO CHANGE

PROJ NO: 210204

ENG: JIL

DATE: 08/12/2024

SHEET NUMBER

EX1

1 OF 1