



MCC RETAIL SUBDIVISION FILING NO. 4

ECHO SUITES HOTEL

PRELIMINARY DRAINAGE REPORT

CITY OF AURORA, COLORADO

NOVEMBER 2023

Prepared For:
GCHD Aurora, LLC
17950 Preston Road, Suite 780
Dallas, Texas 75252

Approved For One Year From This Date	
03/20/2024	
<i>Janet A Bender</i>	03/20/2024
Aurora Water - Drainage Division	Date

CRH

By:
CAGE Civil Engineering
405 Urban Street, Suite 404
Denver, CO 80228

Contact: Kyle Swaving
Phone: 719.439.5888

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ENGINEER'S CERTIFICATION:

I affirm that this report and plan for Echo Suites Hotel (MCC Retail Subdivision Filing No. 4) 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.

FACSIMILE

This electronic plan is a facsimile of the signed and sealed pdf set



Kyle Swaving, PE

State of Colorado No. 53376

For and on behalf of CAGE Civil Engineering

Date

Kyle J. Swaving

03/14/2024

Date



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SCOPE

The purpose of this report is to present the preliminary drainage plan for the proposed Echo Suites Hotel 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

- The Echo Suites Hotel development is located on located in the SW ¼ of section 27, T.3S., R.66W., of the 6th PM City of Aurora, County of Adams, State of Colorado.
- See Appendix A for Vicinity Map.
- The project is bordered:
 - North: East 32nd Parkway
 - East: East Branch Highline Canal
 - West: Tower Road
 - South: Interstate 70

2. Proposed Development

- The project site is a parcel of approximately 2.74 acres consisting of vacant land with a few trees and native grasses.
- The proposed Echo Suites Hotel development includes the construction of one 4-story, 12,767 square foot building, parking lot, and associated utility infrastructure.
- All flows discharging offsite will drain to the following tributaries:
 - All Basins flow into the Sand Creek Drainage.
- Vehicular access to the development will be provided at two locations, the northeast and the northwest ends of the site to private drives internal to the Tower Crossing Development.
- The site generally slopes from North to South. The proposed site slopes toward existing Detention Pond C2 (EDN: 222104). Slopes vary from 2% to 5%.
- 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
PIB	Platner loam, 0 to 3 percent slopes	C	2.6	100.0%
Totals for Area of Interest			2.6	100.0%



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- See Appendix A for soils map.
- There is no pollution or any known contamination existing at the site. Should any pollution or contamination be introduced to the site during construction the contractor will be responsible for remediation.
- There are no floodplains delineated by the City of Aurora or FEMA on the site. Refer to the FIRM map in Appendix A.
- There are no known irrigation canals, ditches, or geologic features within the project boundary. The Highline Canal is located directly to the east of the proposed site. According to HighlineCanalColorado.com there are no flows that will overtop the canal in the 100yr storm. There is approximately 1.4' of freeboard where the canal is next to the Site. Additionally, any flows overtopping the canal to the north would bypass the site. See email with John Costello in Appendix C.
- Requested variances:
 - a. No variances are being requested.

B. HISTORICAL DRAINAGE

1. Overall Basin Description

- In the existing condition, the site drains south directly into Detention Pond C2 (EDN: 222104). Please reference Appendix C, MCC Retail Subdivision Filing No. 3 Drainage Map (RSN: 1765709) for existing drainage basins.
 - The proposed Site lies within Basins D13 and C2 of the MCC Retail Subdivision Filing No. 1 Drainage Map (EDN: 222104). Additionally offsite Basin OS-5 drains onto the proposed site.
 - Basin D13 is comprised of pavement, landscaping, and undeveloped land. Storm flows are conveyed via overland flow south directly to the existing detention pond. Flows from this pond eventually outfall to the Sand Creek Drainage.
 - Basin C2 is within Tract C which contains Detention Pond C2 (EDN: 222104). However, this Detention Pond's required volume doesn't use a portion of Tract C on the southeast end. Therefore, some of the unused area has been purchased and reallocated to Lot 2 of MCC Retail Subdivision Filing No. 4. With this plat the new tract area has been renamed to Tract A
 - Basin C2 has an existing imperviousness of 68% according to MCC Retail Subdivision Filing No. 1 (EDN: 222104). This basin's percent imperviousness can be recalculated and lowered since the pond area consists mostly of native grasses, trickle channels, and WQCV water surface elevation. This reanalysis accounts for the change in impervious from the portion of Tract C that is reallocated to this site and is discussed further in this report in Section D.1.
 - Basin OS-5 is an off site basin that consists of undeveloped area. This basin's flows discharge onto the proposed Site via overland flow.



BASIN SUMMARY TABLE - EXISTING							
Basin Designation	Basin Design Point	Area (ac)	% Impervious	C ₂	Q ₂ (cfs)	C ₁₀₀	Q ₁₀₀ (cfs)
D13	-	3.57	80%	0.71	4.39	0.82	14.6
C2	-	1.74	68%	0.62	2.7	0.67	8.5
OS-5	-	0.61	22%	0.27	0.5	0.31	1.6

Figure 1: Existing Basin Summary Table

MCC Retail Subdivision Filing No.1 - Final Drainage Report (EDN: 222104)
MCC Retail Subdivision Filing No. 3 - Final Drainage Report (RSN: 1765709)

- Sand Creek Drainage is the major drainageway for this site. According to FIRM 08005C0044K dated 12/17/2010, the site is within Zone X which is located outside of all floodplain limits. The FIRM Map is included in Appendix A.

2. Drainage Patterns Through Property

- Runoff throughout the Site slopes to the south toward Detention Pond C2 (EDN: 222104). Currently all flows discharge to the pond via overland flow.

3. Outfalls Downstream from Property

- The entire site will drain into Detention Pond C2 (EDN: 222104). This detention pond drains through a series of inline ponds that eventually outfall into the Sand Creek Drainage.

C. DESIGN CRITERIA

1. References

- The City of Aurora Storm Drainage Design and Technical Criteria [Ref. 1],
- Urban Storm Drainage Criteria Manual, Volumes 1, 2, and 3, from the Mile High Flood District [Ref. 2].
- MCC Retail Filing No 1 - Construction Documents and Final Drainage Report, by Ware Malcomb (EDN: 222104) [Ref. 3].
- MCC Retail Subdivision Filing No. 3 – Final Drainage Report, by CAGE Civil Engineering (RSN: 1765709) [Ref. 4].



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2. Hydrologic Criteria

- Peak storm runoff was determined using the Rational Formula: $Q=CIA$ [Ref. 1].
- Design storm recurrence intervals are the 2-year storm for the minor event and the 100-year storm for the major event.
- The 1-hour point rainfall depth for the 2-year storm was determined to be 0.86 inches and for the 100-year storm to be 2.46 inches. The values were determined using NOAA Atlas 14 Table in Appendix A.
- See Appendix B for all hydrologic and swale calculations.

3. Hydraulic Criteria

- Both the USDCM and the SDDTCM were used for the drainage design for this site.
- 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 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 parking lots, the maximum depth allowed is 1.5' for a driving lane and 1.0' for a parking space.
- Water surface profile method: N/A.
- Major Drainageways: N/A.

D. DRAINAGE PLAN

1. General Concept

- In the current condition the Site lies within Basin D13 and Basin C2. However, as previously mentioned above Basin C2 has two issues:
 - The grading limits of Pond C2 in Basin C2 is as under-utilized.
 - Basin C2 has an inaccurate Percent Imperviousness of 68%.

Therefore, to reduce the amount of unmaintained pond area and provide more development flexibility, a portion of Tract C (EDN: 222104) has been purchased and reallocated to be used for the proposed development. Basin C2 has been redelineated to Basin C2a. This new basin and tract delineation follows the 100yr WSEL line more accurately. Accompanied with this delineation the Pond imperviousness has been recalculated to reflect a more accurate percent impervious.

It is important to note that the required volume of Detention Pond C2 (EDN: 222104) will not change. Only the excess tract area will be repurposed for the development of Echo Suites Hotel.



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See table below with Existing conditions and Proposed conditions.

	Contributing Basins	Total Area	% Impervious	Req. Detention Volume
Existing Pond Conditions (EDN 222104)	C2, P3-c, OS-4, OS-5	7.25 AC	56.10%	0.682 ACFT
Proposed Pond Conditions (RSN 1770665)	H1, H2, R1,R2, C2a, D13a, D13b, OS4, OS5, ROW1	7.57 AC	47.50%	0.635 ACFT

- The changes to Tract C (EDN: 222104) and the delineation of Basin C2 to C2a benefits this development in several ways
 - It provides more developable area to achieve parking and landscape requirements.
 - It provides excess percent impervious which allows for more impervious area in the proposed site and the developments to the North without overburdening the pond.
 - It provides better maintenance for the unused portion of the Detention Pond's tract.
 - It provides a more aesthetic landscapable area versus empty tract area.
 - It provides for the unaccounted impervious area from Basin ROW1
- According to MCC Retail Subdivision Filing No. 1 – Final Drainage Report (EDN: 222104) the contributing basins C2, P3-c, OS-4, and OS-5 account for a total area of 7.25 AC at a 56.1% imperviousness. This results in a required detention volume of 0.682 AC FT according to the Mile High Detention spread sheet. See Appendix B.
- In the proposed condition the contributing basins H1, H2, R1, R2, C2a, D13a, D13b, OS4, OS5, ROW1 have an increased area of 7.57 AC going to pond C2 with a decrease in % imperviousness to 47.5%. This results in a required detention volume of 0.635 AC FT according to the Mile High Detention spread sheet. See Appendix B.
- In the proposed condition the required volume is less than the existing volume required/provided from pond C2. Therefore the increase in area does not negatively affect Pond C2 or the downstream stormwater infrastructure. The Drainage design of the Echo Suites Hotel will be in general conformance with the historical drainage patterns currently on Site.
- See Basin Summary Table below.



BASIN SUMMARY TABLE							
Basin Designation	Basin Design Point	Area (ac)	% Impervious	C ₂	Q ₂ (cfs)	C ₁₀₀	Q ₁₀₀ (cfs)
H1	H1	0.90	70.63%	0.58	1.34	0.77	5.11
H2	H2	1.55	67.39%	0.55	1.86	0.76	7.34
R1	R1	0.06	95.00%	0.79	0.14	0.87	0.43
R2	R2	0.23	95.00%	0.79	0.54	0.87	1.69
D13a*	D13a	0.96	80.00%	0.71	1.88	0.82	6.20
D13b*	D13b	0.33	80.00%	0.71	0.64	0.82	2.13
OS-5**	OS5	0.61	20.00%	0.27	0.50	0.31	1.60
ROW1	ROW1	0.13	64.45%	0.53	0.20	0.75	0.80
C2a	-	1.24	28.76%	0.22	0.64	0.61	5.08
Sum Total (Excluding C2a)					7.09		25.30

*See MCC Retail Subdivision Filing No. 3 - *Final Drainage Report* (RSN:1765709)

**See Approved MCC Retail Subdivision Filing No. 1 - *Final Drainage Report* (EDN:222104)

Figure 2. Basin Summary Table

2. Specific Details

- H Basins and R Basins make up all onsite basins.
 - **Basin H1 (70.63% Impervious):** This basin is comprised of pavement, sidewalk, landscaping. Runoff from throughout the basin is conveyed via internal flowlines to a curb cut at Design Point H1. From H1 flows drain into Detention Pond C2 (EDN: 222104) within Basin C2a. Flows are then eventually routed through a series of inline ponds to their outfall at Sand Creek Drainage.
 - **Basin H2 (67.39% Impervious):** This basin is comprised of pavement, sidewalk, landscaping. Runoff from throughout the basin is conveyed via internal flowlines to a curb cut at Design Point H2. From Design Point H2 flows drain into Detention Pond C2 (EDN: 222104) within Basin C2a. Flows are then eventually routed through a series of inline ponds to their outfall at Sand Creek Drainage.
 - **Basin R1 (90.00% Impervious):** This basin is comprised of building roof. Runoff from this basin is conveyed via roof drain scuppers into Basin H1 at Design Point R1. Then water flows into Detention Pond C2 (EDN: 222104) within Basin C2a. Flows are then eventually routed through a series of inline ponds to their outfall at Sand Creek Drainage.



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- **Basin R2 (90.00% Impervious):** This basin is comprised of building roof. Runoff from this basin is conveyed via roof drain scuppers into Basin H2 at Design Point R2. Then water flows into Detention Pond C2 (EDN: 222104) within Basin C2a. Flows are then eventually routed through a series of inline ponds to their outfall at Sand Creek Drainage.
- All other basins are offsite basins that either run onto the site or need to be analyzed due to redelination of the basin boundary.
 - **Basin D13a (80.00% Impervious):** This basin is currently comprised of roadway, sidewalk, undeveloped land, and landscaping. However, in the final condition the basin's impervious value will be 80% or less. Runoff from this basin is conveyed via overland flow and roadway flowlines into Basin H1 at Design Point D13a. Then water flows into Detention Pond C2 (EDN: 222104) within Basin C2a. Flows are then eventually routed through a series of inline ponds to their outfall at Sand Creek Drainage.
 - **Basin D13b (80.00% Impervious):** This basin is currently comprised of roadway, sidewalk, undeveloped land, and landscaping. However, in the final condition the basin's impervious value will be 80% or less. Runoff from this basin is conveyed via overland flow and roadway flowlines into Basin H2 at Design Point D13b. Then water flows into Detention Pond C2 (EDN: 222104) within Basin C2a. Flows are then eventually routed through a series of inline ponds to their outfall at Sand Creek Drainage.
 - **Basin OS-5 (20.00% Impervious):** This basin is an offsite basin defined in the MCC Retail Subdivision Filing No. 1 – Final Drainage Report (EDN: 222104) by Ware Malcomb. This basin consists mostly of undeveloped land. Runoff from this basin sheet flows to the west into Basin H2 at Design Point OS5. Then water flows into Detention Pond C2 (EDN: 222104) within Basin C2a. Flows are then eventually routed through a series of inline ponds to their outfall at Sand Creek Drainage.
 - **Basin ROW1 (64.45% Impervious):** This offsite basin was unaccounted for in the MCC Retail Subdivision Filing No. 1 – Final Drainage Report (EDN: 222104) by Ware Malcomb. This basin consists of undeveloped land and pavement from Himalaya Rd. Runoff from this basin sheet flows to the northwest into Basin H2 at Design Point ROW1. Then water flows into Detention Pond C2 (EDN: 222104) within Basin C2a. Flows are then eventually routed through a series of inline ponds to their outfall at Sand Creek Drainage.
 - **Basin C2a (28.76% Impervious):** This offsite basin does not contribute any stormwater onto the proposed Site. However, it must be described due to the new delineation of its basin. Basin C2a is a replacement basin for Basin C2 outlined in the MCC Retail Subdivision Filing No. 1 – Final Drainage Report (EDN: 222104) by Ware Malcomb. Basin C2a is comprised primarily of Detention Pond C2 which includes imperviousness from the WQCV per attached email from Richard Ommert (see Appendix C) and the pavement included in the pond. Flows generated within this basin are detained in Pond C2 (EDN: 222104). Flows are then eventually routed through a series of inline ponds to their outfall at Sand Creek Drainage.
- TOD and Urban Center Developments: N/A
- Detention Pond location/outfall:



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The proposed site utilizes the adjacent Detention Pond C2 within Tract C outlined in the MCC Retail Subdivision Filing No. 1 – Final Drainage Report (EDN: 222104). This pond is located at the southwest corner of the site. All of the onsite drainage will outfall directly into the pond via curb cuts and trickle channels. Flows from this pond are routed through a series of inline ponds to their outfall into Sand Creek Drainage.

Although a portion of Tract C will be reallocated for the proposed site, it is important to note that the required volume of Detention Pond C2 (EDN: 222104) will not change.

Only the excess tract area will be repurposed for the development of Echo Suites Hotel.

- Emergency overflow paths for sump inlets and detention ponds: N/A
- Solutions for problems encountered: Due to Detention Pond Tract C (EDN: 222104) being underutilized and an inaccurate impervious value for Basin C2 the tract and basin were redelineated to allow for further development of the unused area. Calculations have been provided to demonstrate that the reduction in Pond Imperviousness accounts for the extra impervious created from the proposed hotel and unaccounted offsite impervious area.
- Permanent BMPs: N/A
- Phasing: No site phasing is proposed.
- Open channel concepts: N/A
- Roadside Ditch Stabilization: N/A
- Outfall Systems Requirements: N/A

E. CONCLUSIONS

1. Compliance with Standards

- The drainage design for the Echo Suites Hotel site detailed within this report is in general conformance with the *City of Aurora Storm Drainage Design and Technical Criteria Manual*, and the *Mile High Flood District Urban Storm Drainage Criteria Manual*.
- The drainage design for the Echo Suites Hotel site detailed within this report is in general conformance with the approved design of the MCC Retail Filing No. 1 - Final Drainage Report (EDN: 222104) and MCC Retail Subdivision Filing No. 3 - Phase II Final Drainage Report (RSN: 1765709).

2. Summary of Concept

- With Tract C being underutilized and Basin C2 having an inaccurate impervious value, a portion of Tract C was able to be reallocated for use in the proposed site without affecting the Pond volume. With the reallocation and the adjustments to Basin C2's imperviousness the proposed Site is able to stay within the allowed imperviousness provided by previous reports. Therefore, the Site will have no adverse effects on the existing stormwater system in the area.



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F. REFERENCES

1. *Storm Drainage Design and Technical Criteria*, City of Aurora, Revised September 2010 [Ref. 1]
2. *Urban Storm Drainage Criteria Manual, Volumes 1, 2, and 3*, Mile High Flood District, Revised January 2021. [Ref. 2]
3. MCC Retail Subdivision Filing No. 1 Construction Documents and Final Drainage Report, by Ware Malcomb (EDN: 222104) [Ref. 3].
4. MCC Retail Subdivision Filing No. 3 – Final Drainage Report, by CAGE Civil Engineering (RSN: 1765709) [Ref. 4].



APPENDIX A

Vicinity Map

FEMA FIRMette

Web Soil Survey - Hydrologic Soil Group

NOAA Atlas 14



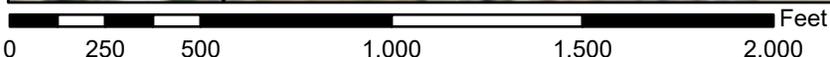
VICINITY MAP



National Flood Hazard Layer FIRMMette



104°46'26"W 39°45'47"N



1:6,000

104°45'48"W 39°45'20"N

Basemap Imagery Source: USGS National Map 2023

Legend

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

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

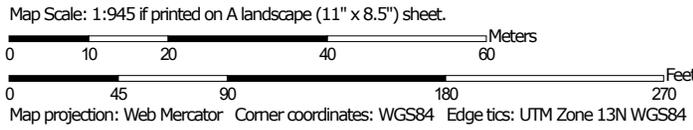
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **9/22/2023 at 2:01 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded 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.

Hydrologic Soil Group—Adams County Area, Parts of Adams and Denver Counties, Colorado
(Tower Crossings - Echo)



Soil Map may not be valid at this scale.



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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: Adams County Area, Parts of Adams and Denver Counties, Colorado
 Survey Area Data: Version 19, Sep 1, 2022

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

Date(s) aerial images were photographed: Jun 9, 2021—Jun 12, 2021

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
PIB	Platner loam, 0 to 3 percent slopes	C	2.6	100.0%
Totals for Area of Interest			2.6	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: 39.7593°, Longitude: -104.7692°
Elevation: 5423 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aeriels](#)

PF tabular

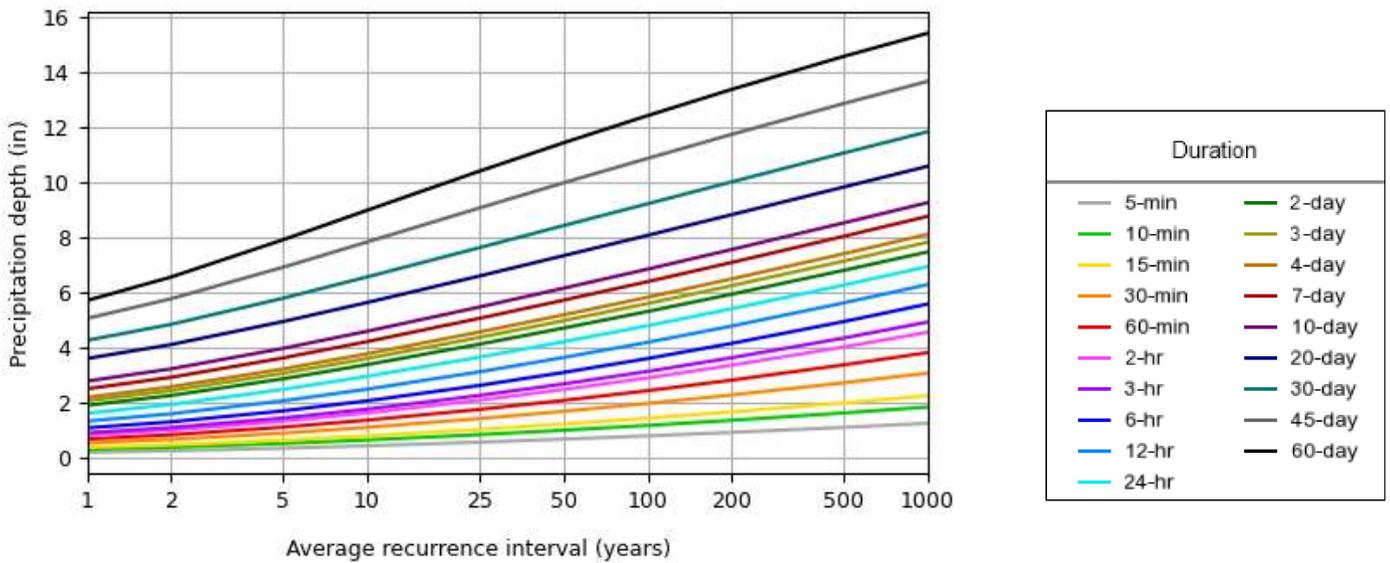
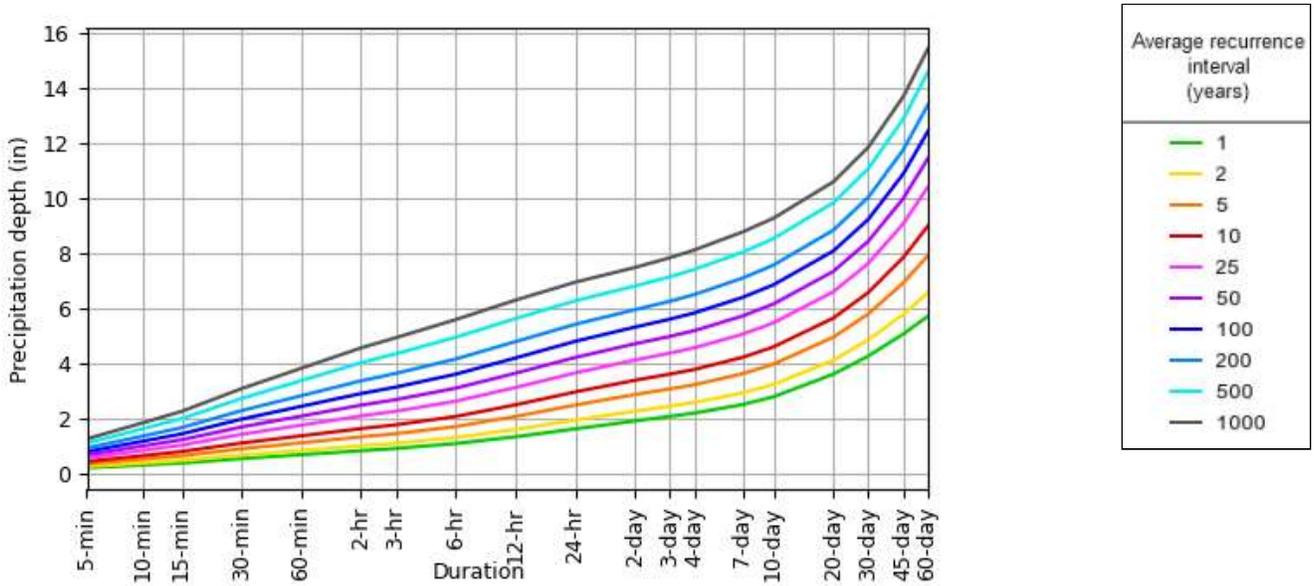
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.224 (0.180-0.281)	0.277 (0.221-0.347)	0.371 (0.296-0.467)	0.457 (0.362-0.578)	0.588 (0.455-0.781)	0.698 (0.525-0.935)	0.816 (0.593-1.12)	0.944 (0.657-1.33)	1.13 (0.753-1.62)	1.27 (0.826-1.85)
10-min	0.328 (0.263-0.412)	0.405 (0.324-0.509)	0.543 (0.433-0.684)	0.669 (0.531-0.846)	0.861 (0.666-1.14)	1.02 (0.769-1.37)	1.19 (0.868-1.64)	1.38 (0.962-1.94)	1.65 (1.10-2.38)	1.86 (1.21-2.70)
15-min	0.400 (0.321-0.502)	0.494 (0.395-0.620)	0.663 (0.528-0.834)	0.816 (0.647-1.03)	1.05 (0.813-1.40)	1.25 (0.938-1.67)	1.46 (1.06-2.00)	1.68 (1.17-2.37)	2.01 (1.34-2.90)	2.27 (1.48-3.30)
30-min	0.561 (0.449-0.703)	0.688 (0.550-0.863)	0.916 (0.730-1.15)	1.12 (0.891-1.42)	1.44 (1.12-1.91)	1.71 (1.28-2.29)	1.99 (1.45-2.73)	2.30 (1.60-3.23)	2.74 (1.83-3.95)	3.10 (2.01-4.49)
60-min	0.703 (0.563-0.882)	0.856 (0.685-1.07)	1.13 (0.902-1.42)	1.39 (1.10-1.75)	1.77 (1.38-2.36)	2.10 (1.58-2.82)	2.46 (1.78-3.37)	2.84 (1.98-4.00)	3.39 (2.27-4.89)	3.84 (2.49-5.56)
2-hr	0.846 (0.682-1.05)	1.02 (0.825-1.28)	1.35 (1.08-1.68)	1.65 (1.32-2.07)	2.11 (1.64-2.78)	2.50 (1.90-3.32)	2.92 (2.14-3.97)	3.38 (2.37-4.71)	4.04 (2.72-5.77)	4.57 (2.99-6.57)
3-hr	0.928 (0.751-1.15)	1.12 (0.903-1.38)	1.46 (1.18-1.82)	1.78 (1.43-2.23)	2.28 (1.79-2.99)	2.70 (2.06-3.57)	3.15 (2.32-4.27)	3.65 (2.58-5.06)	4.36 (2.96-6.20)	4.94 (3.25-7.06)
6-hr	1.11 (0.901-1.36)	1.32 (1.08-1.63)	1.72 (1.40-2.12)	2.09 (1.68-2.58)	2.64 (2.08-3.44)	3.11 (2.39-4.08)	3.62 (2.68-4.85)	4.17 (2.97-5.73)	4.96 (3.39-6.98)	5.60 (3.71-7.92)
12-hr	1.35 (1.11-1.65)	1.62 (1.33-1.97)	2.09 (1.70-2.55)	2.51 (2.04-3.08)	3.14 (2.48-4.02)	3.66 (2.82-4.73)	4.21 (3.14-5.57)	4.80 (3.44-6.51)	5.64 (3.88-7.84)	6.30 (4.21-8.84)
24-hr	1.64 (1.35-1.98)	1.96 (1.61-2.37)	2.50 (2.06-3.03)	2.98 (2.43-3.63)	3.67 (2.91-4.64)	4.23 (3.28-5.40)	4.81 (3.61-6.29)	5.43 (3.91-7.27)	6.28 (4.35-8.63)	6.95 (4.69-9.65)
2-day	1.92 (1.60-2.31)	2.28 (1.90-2.74)	2.88 (2.39-3.47)	3.40 (2.80-4.11)	4.13 (3.30-5.17)	4.72 (3.68-5.97)	5.32 (4.02-6.88)	5.96 (4.32-7.89)	6.82 (4.76-9.26)	7.49 (5.09-10.3)
3-day	2.09 (1.74-2.49)	2.46 (2.05-2.94)	3.08 (2.56-3.70)	3.62 (2.99-4.35)	4.38 (3.52-5.44)	4.99 (3.91-6.27)	5.61 (4.26-7.21)	6.26 (4.56-8.24)	7.15 (5.02-9.65)	7.84 (5.36-10.7)
4-day	2.21 (1.85-2.63)	2.60 (2.17-3.09)	3.24 (2.70-3.87)	3.79 (3.14-4.54)	4.58 (3.68-5.66)	5.20 (4.09-6.51)	5.84 (4.44-7.48)	6.51 (4.76-8.53)	7.42 (5.22-9.97)	8.12 (5.58-11.1)
7-day	2.52 (2.12-2.98)	2.94 (2.47-3.48)	3.64 (3.05-4.32)	4.23 (3.53-5.04)	5.07 (4.10-6.22)	5.73 (4.53-7.12)	6.41 (4.90-8.13)	7.10 (5.23-9.23)	8.05 (5.70-10.7)	8.78 (6.07-11.8)
10-day	2.80 (2.37-3.30)	3.25 (2.74-3.82)	3.99 (3.35-4.71)	4.61 (3.86-5.46)	5.48 (4.45-6.69)	6.17 (4.89-7.61)	6.86 (5.27-8.65)	7.58 (5.59-9.79)	8.54 (6.08-11.3)	9.27 (6.44-12.4)
20-day	3.62 (3.08-4.23)	4.13 (3.51-4.82)	4.96 (4.20-5.81)	5.65 (4.76-6.64)	6.61 (5.39-7.97)	7.34 (5.87-8.97)	8.08 (6.26-10.1)	8.84 (6.58-11.3)	9.83 (7.06-12.9)	10.6 (7.42-14.1)
30-day	4.28 (3.66-4.97)	4.86 (4.15-5.65)	5.80 (4.94-6.76)	6.58 (5.57-7.69)	7.63 (6.25-9.14)	8.44 (6.76-10.2)	9.23 (7.17-11.4)	10.0 (7.49-12.7)	11.1 (7.98-14.4)	11.8 (8.34-15.6)
45-day	5.07 (4.35-5.86)	5.79 (4.96-6.69)	6.93 (5.92-8.03)	7.84 (6.67-9.13)	9.07 (7.45-10.8)	9.99 (8.03-12.0)	10.9 (8.48-13.4)	11.7 (8.81-14.8)	12.9 (9.31-16.6)	13.7 (9.68-17.9)
60-day	5.72 (4.92-6.59)	6.58 (5.65-7.58)	7.92 (6.79-9.15)	8.99 (7.67-10.4)	10.4 (8.55-12.3)	11.4 (9.22-13.7)	12.4 (9.71-15.2)	13.4 (10.1-16.7)	14.6 (10.6-18.7)	15.4 (11.0-20.1)

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: 39.7593°, Longitude: -104.7692°



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Maps & aerials

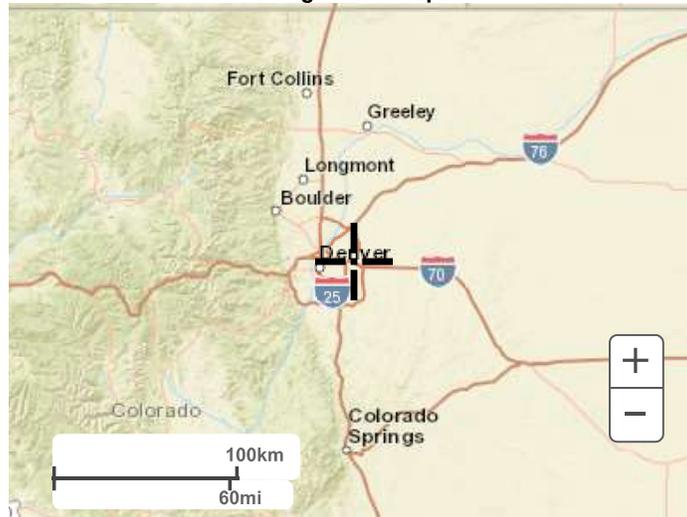
Small scale terrain



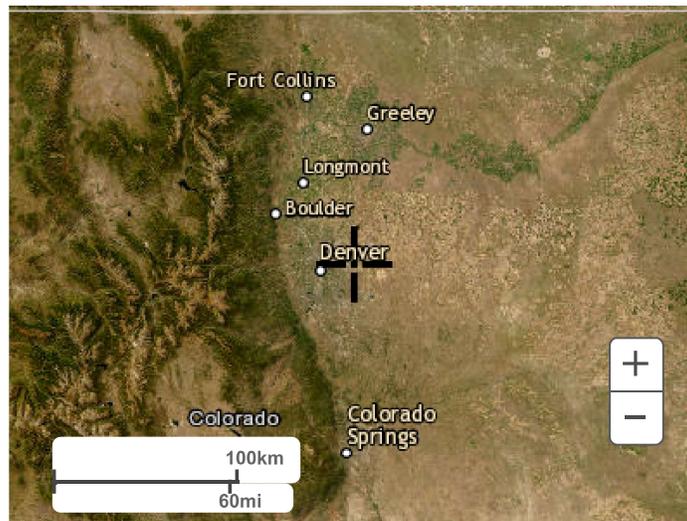
Large scale terrain



Large scale map



Large scale aerial



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1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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APPENDIX B

Rational Calculations
Hydraflow Sections & Calcs



Project: Echo Suites - Aurora
 Location: Aurora, CO
 Designer: KJS/JLE
 Date: 10/24/2023
 Latest Revision: 2/9/2024

IMPERVIOUSNESS AND RUNOFF COEFFICIENT CALCULATIONS

	Roofs	Lawn	Pavement	Sidewalk	WQCV
Impervious % ¹	95%	20%	95%	95%	100%
C2	0.79	0.14	0.79	0.79	0.87
C5	0.81	0.20	0.81	0.81	0.88
C10	0.83	0.28	0.83	0.83	0.90
C100	0.87	0.57	0.87	0.87	0.93

Basin Designation	NRCS Hydrologic Soil Group	Total Area (ac)	Total Area (sf)	Roofs (sf)	Lawn (sf)	Pavement (sf)	Sidewalk (sf)	WQCV (sf)	Percent Impervious	Runoff Coefficients, C ²			
										C ₂	C ₅	C ₁₀	C ₁₀₀
H1	C/D	0.90	39,336		12,780	23,313	3,243		70.63%	0.58	0.61	0.65	0.77
H2	C/D	1.55	67,314		24,778	38,481	4,055		67.39%	0.55	0.59	0.63	0.76
R1	C/D	0.06	2,600	2,600					95.00%	0.79	0.81	0.83	0.87
R2	C/D	0.23	10,168	10,168					95.00%	0.79	0.81	0.83	0.87
Onsite Total		2.74	119,418	12,768	37,558	61,794	7,298		71.41%	0.59	0.62	0.66	0.78
D13a*	C/D	0.96	41,840	See Note Below					80.00%	0.71	0.72	0.76	0.82
D13b*	C/D	0.33	14,245	See Note Below					80.00%	0.71	0.72	0.76	0.82
OS-5**	C/D	0.61	26,572	See Note Below					20.00%	0.27	0.28	0.29	0.31
ROW1	C/D	0.13	5,732		2,335	3,397			64.45%	0.53	0.56	0.61	0.75
C2a	C/D	1.24	53,813		47,605	5,056		1,152	28.76%	0.22	0.27	0.34	0.61

*See MCC Retail Subdivision Filing No. 3 - Final Drainage Report By CAGE Civil Engineering (RSN: 1765709)

**See Approved MCC Retail Subdivision Filing No. 1 - Final Drainage Report (EDN:222104) by Ware Malcomb



Project: Echo Suites - Aurora

Location: Aurora, CO

Designer: KJS/JLE

Date: 10/24/2023

Latest Revision: 2/9/2024

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

² From COA SDDTC Manual equations 5.2, 5.3, & 5.4

Minimum T_c

5

TIME OF CONCENTRATION CALCULATIONS

Basin Designation	Imperviousness (%)	C ₅	Initial/Overland Flow Time, T _i			Channelized Flow/Travel Time, T _t				Time of Concentration, T _c (Check)		Selected T _c (min)	
			Length (ft) ¹	Slope (%)	T _i (min)	Land Surface	Length (ft)	Slope (%)	Velocity (ft/sec)	T _t (min)	Computed T _c (min)		Minimum T _c (min)
H1	70.63%	0.61	74	1.80	6.33	Paved Areas	246	2.20	2.97	1.38	7.71	2.00	7.71
H2	67.39%	0.59	59	2.83	5.12	Paved Areas	555	0.50	1.41	6.54	11.66	3.00	11.66
R1	95.00%	0.81	5.0 minutes assumed due to roof basin										5.00
R2	95.00%	0.81	5.0 minutes assumed due to roof basin										5.00
D13a*	80.00%	0.72	135	2.30	6.13	Paved Areas	1	0.50	1.41	0.01	6.14	3.00	6.14
D13b*	80.00%	0.72	136	2.50	5.99	Paved Areas	1	0.50	1.41	0.01	6.00	3.00	6.00
OS-5**	20.00%		See Note Below										5.00
ROW1	64.45%	0.56	50	2.00	5.54	Paved Areas	1	0.50	1.41	0.01	5.55	5.00	5.55
C2a	28.76%	0.27	65	6.32	6.62	Paved Areas	245	0.50	1.41	2.89	9.51	3.00	9.51

*See MCC Retail Subdivision Filing No. 3 - Final Drainage Report By CAGE Civil Engineering (RSN: 1765709)

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

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)

$$t_t = \frac{0.395(1.1 - C)^{\frac{1}{5}} \sqrt{L}}{\sqrt[3]{S}} \quad (5.3)$$

where t_i = initial or overland flow time (minutes)
 C₅ = runoff coefficient for 5-year frequency
 L = length of overland flow, (ft., 500 ft. max.)
 S = average basin slope (ft/ft)

$$t_c = \frac{L'}{180} + 10 \quad (5.4)$$

Where t_c = time of concentration (minutes)
 L' = length of flow to first design point from the most remote point (feet)



Project: Echo Suites - Aurora
Location: Aurora, CO
Designer: KJS/JLE
Date: 10/24/2023
Latest Revision: 2/9/2024

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)
H1	H1	0.90	0.58	0.52	7.71	2.56	1.34
H2	H2	1.55	0.55	0.85	11.66	2.19	1.86
R1	R1	0.06	0.79	0.05	5.00	2.92	0.14
R2	R2	0.23	0.79	0.18	5.00	2.92	0.54
D13a*	D13a	0.96	0.71	0.68	6.14	2.75	1.88
D13b*	D13b	0.33	0.71	0.23	6.00	2.77	0.64
OS-5**	OS5	0.61	0.27	0.16	5.00	2.92	0.50
ROW1	ROW1	0.13	0.53	0.07	5.55	2.84	0.20
C2a	-	1.24	0.22	0.27	9.51	2.37	0.64

*See MCC Retail Subdivision Filing No. 3 - Final Drainage Report By CAGE Civil Engineering (RSN: 1765709)

**See Approved MCC Retail Subdivision Filing No. 1 - Final Drainage Report (EDN:222104) by Ware Malcomb

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

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: Echo Suites - Aurora
Location: Aurora, CO
Designer: KJS/JLE
Date: 10/24/2023
Latest Revision: 2/9/2024

Design Storm:	100-Yr
1-hr Design Point Rainfall (in):	2.46

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)
H1	H1	0.90	0.77	0.70	7.71	7.32	5.11
H2	H2	1.55	0.76	1.17	11.66	6.25	7.34
R1	R1	0.06	0.87	0.05	5.00	8.34	0.43
R2	R2	0.23	0.87	0.20	5.00	8.34	1.69
D13a*	D13a	0.96	0.82	0.79	6.14	7.88	6.20
D13b*	D13b	0.33	0.82	0.27	6.00	7.93	2.13
OS-5**	OS5	0.61	0.31	0.19	5.00	8.34	1.60
ROW1	ROW1	0.13	0.75	0.10	5.55	8.11	0.80
C2a	-	1.24	0.61	0.75	9.51	6.79	5.08

*See MCC Retail Subdivision Filing No. 3 - Final Drainage Report By CAGE Civil Engineering (RSN: 1765709)

**See Approved MCC Retail Subdivision Filing No. 1 - Final Drainage Report (EDN:222104) by Ware Malcomb

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

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)

Channel Report

100 YR

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Dec 14 2023

Basin H1 - Section 1

User-defined

Invert Elev (ft) = 27.23
Slope (%) = 0.50
N-Value = 0.016

Highlighted

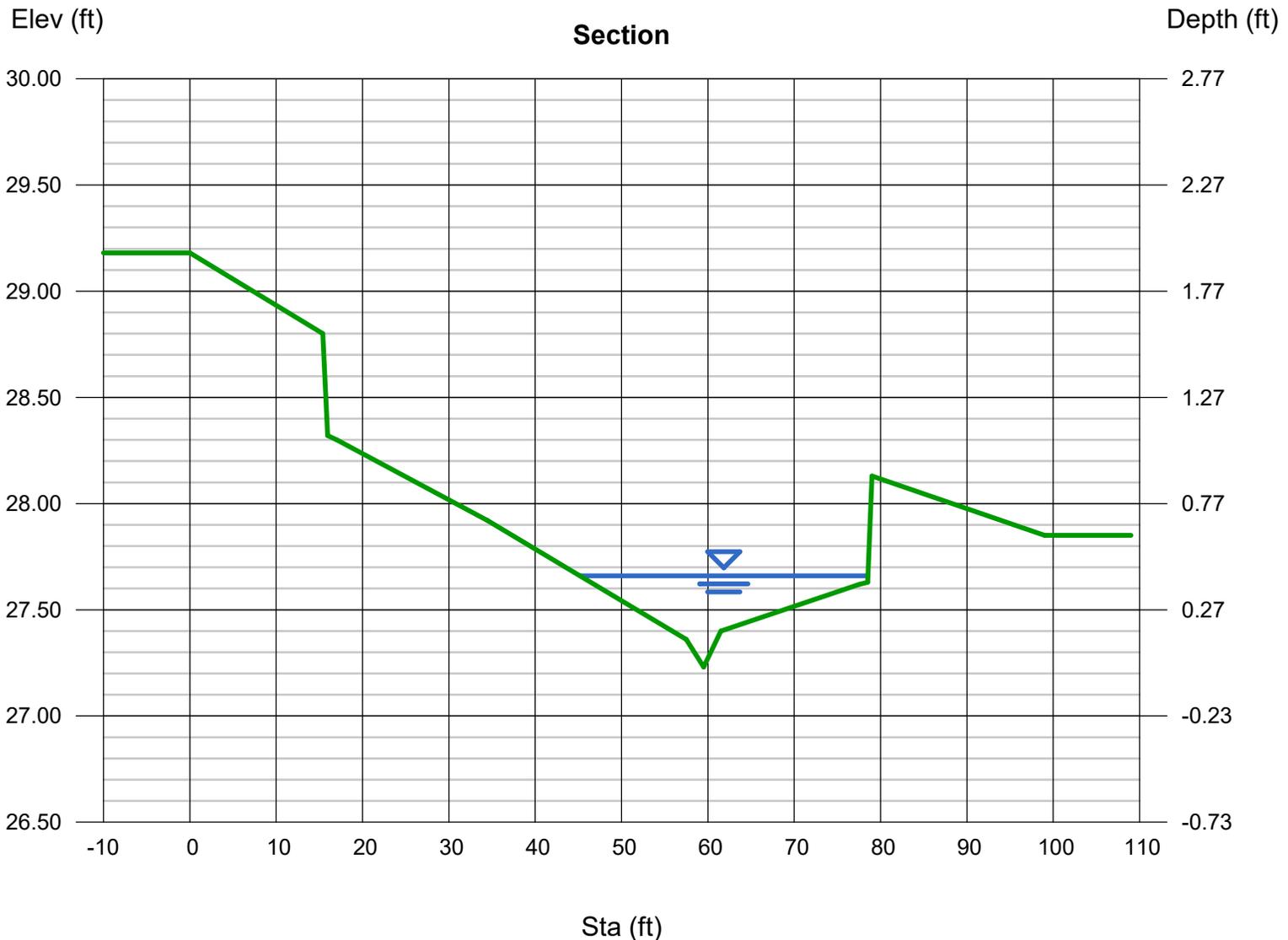
Depth (ft) = 0.43
Q (cfs) = 11.32
Area (sqft) = 5.70
Velocity (ft/s) = 1.98
Wetted Perim (ft) = 33.38
Crit Depth, Yc (ft) = 0.42
Top Width (ft) = 33.35
EGL (ft) = 0.49

Calculations

Compute by: Known Q
Known Q (cfs) = 11.32

(Sta, El, n)-(Sta, El, n)...

(0.00, 29.18)-(15.41, 28.80, 0.030)-(15.95, 28.32, 0.013)-(17.03, 28.30, 0.013)-(34.50, 27.92, 0.016)-(57.50, 27.36, 0.016)-(59.50, 27.23, 0.013)
-(61.50, 27.40, 0.013)-(77.50, 27.62, 0.016)-(78.50, 27.63, 0.013)-(79.00, 28.13, 0.013)-(99.00, 27.85, 0.030)



Channel Report

100 YR

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Dec 14 2023

Basin H2 - Section 2

User-defined

Invert Elev (ft) = 24.87
Slope (%) = 0.50
N-Value = 0.015

Highlighted

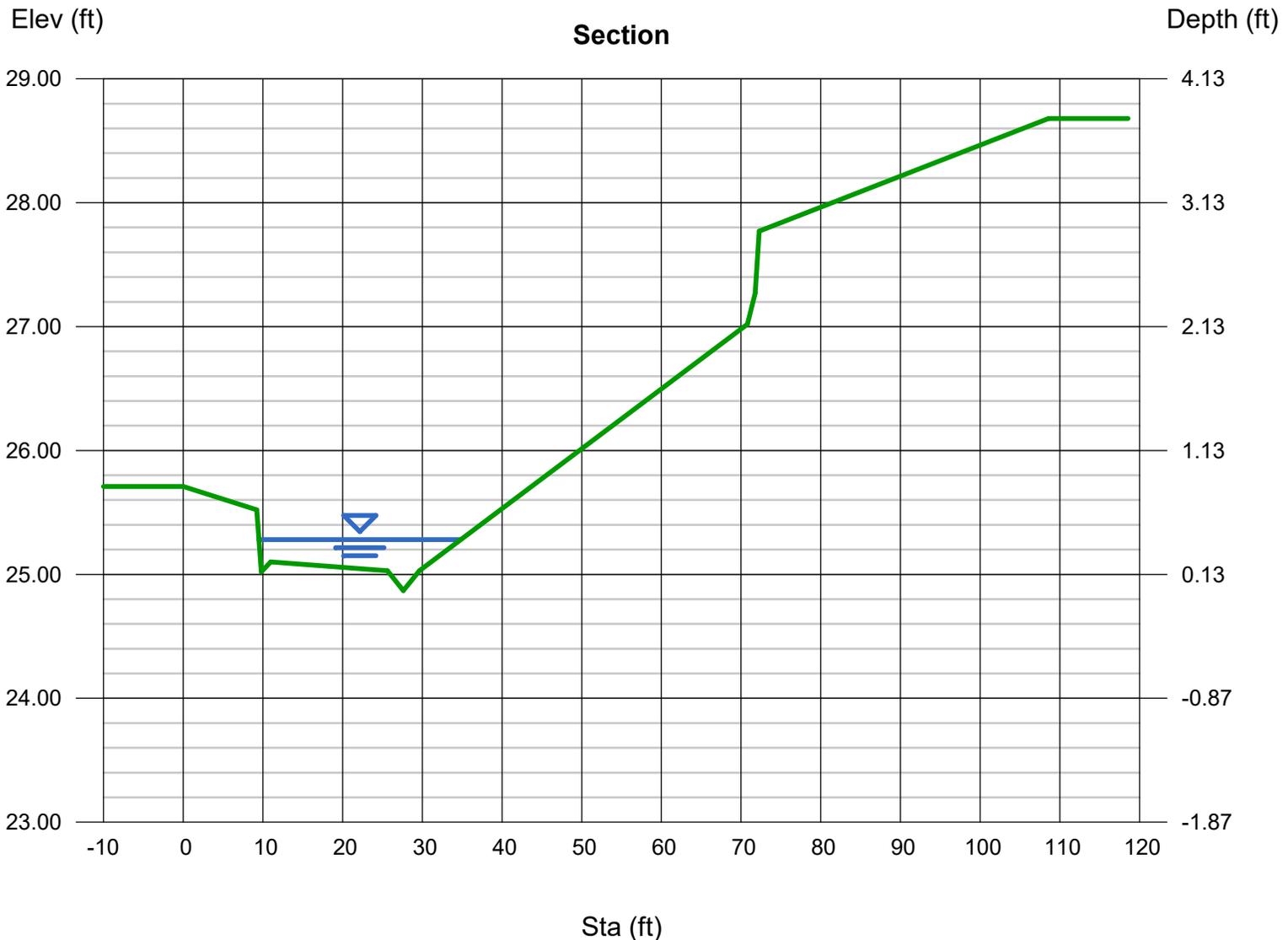
Depth (ft) = 0.41
Q (cfs) = 13.12
Area (sqft) = 5.41
Velocity (ft/s) = 2.42
Wetted Perim (ft) = 25.41
Crit Depth, Yc (ft) = 0.40
Top Width (ft) = 25.30
EGL (ft) = 0.50

Calculations

Compute by: Known Q
Known Q (cfs) = 13.12

(Sta, El, n)-(Sta, El, n)...

(0.00, 25.71)-(9.22, 25.52, 0.030)-(9.81, 25.02, 0.013)-(10.98, 25.10, 0.013)-(25.63, 25.03, 0.016)-(27.63, 24.87, 0.013)-(29.63, 25.03, 0.013)
-(70.79, 27.02, 0.016)-(71.79, 27.27, 0.013)-(72.29, 27.77, 0.013)-(108.57, 28.68, 0.013)



Channel Report

100 YR

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Dec 14 2023

Basin H2 - Section 3

User-defined

Invert Elev (ft) = 5425.18
 Slope (%) = 0.50
 N-Value = 0.016

Highlighted

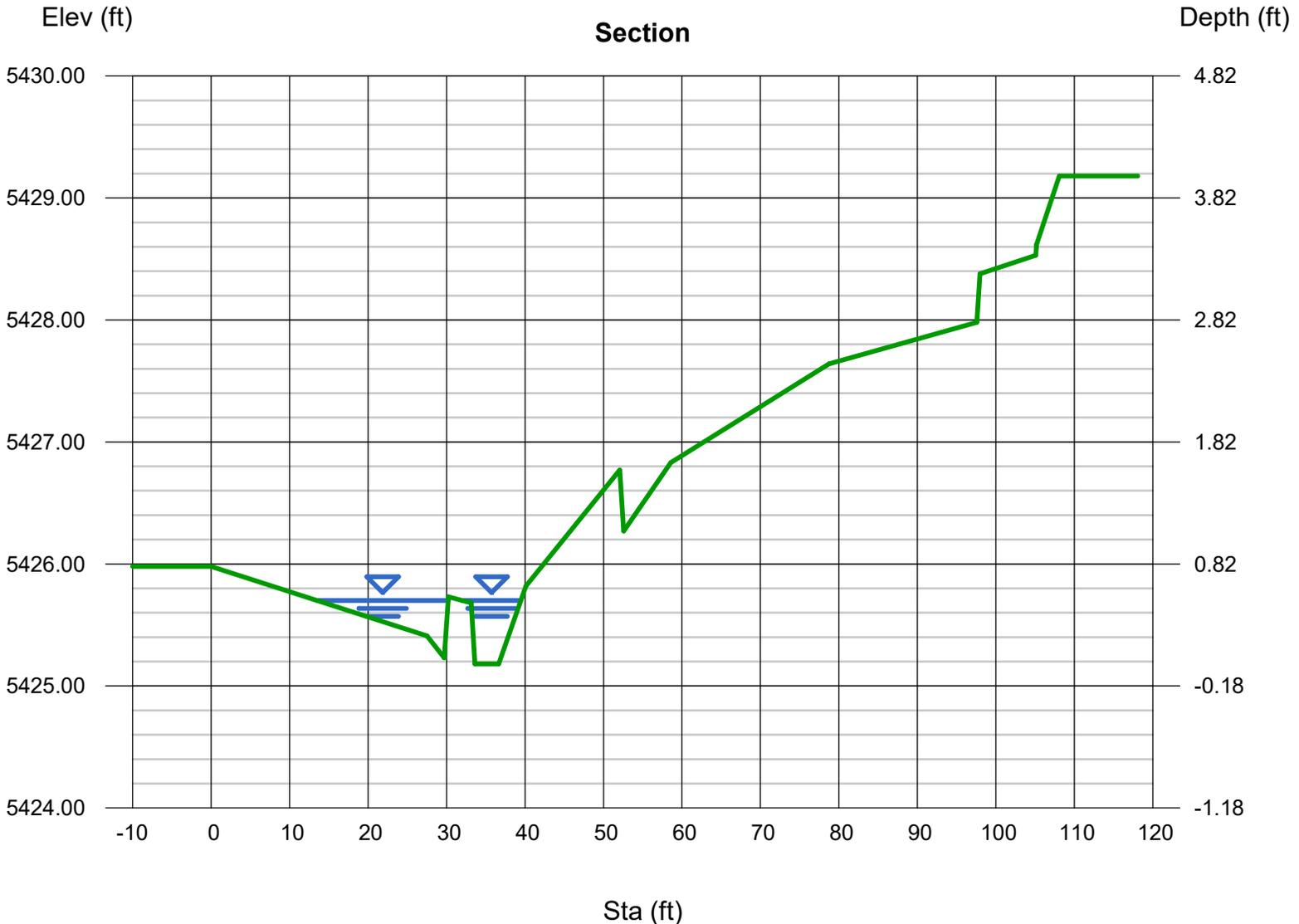
Depth (ft) = 0.52
 Q (cfs) = 13.12
 Area (sqft) = 5.43
 Velocity (ft/s) = 2.42
 Wetted Perim (ft) = 24.65
 Crit Depth, Yc (ft) = 0.50
 Top Width (ft) = 24.21
 EGL (ft) = 0.61

Calculations

Compute by: Known Q
 Known Q (cfs) = 13.12

(Sta, El, n)-(Sta, El, n)...

(0.00, 5425.98)-(27.52, 5425.41, 0.016)-(29.70, 5425.23, 0.013)-(30.25, 5425.73, 0.013)-(33.13, 5425.68, 0.030)-(33.63, 5425.18, 0.013)-(36.63, 5425.18, 0.013)
 -(40.13, 5425.82, 0.013)-(52.08, 5426.77, 0.030)-(52.57, 5426.27, 0.013)-(58.58, 5426.83, 0.013)-(78.76, 5427.64, 0.016)-(97.58, 5427.98, 0.016)-(97.98, 5428.38, 0.016)
 -(105.08, 5428.53, 0.013)-(105.18, 5428.62, 0.013)-(108.08, 5429.18, 0.013)



Channel Report

100 YR

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Dec 14 2023

Basin H2 - Section 4

User-defined

Invert Elev (ft) = 5426.19
Slope (%) = 0.50
N-Value = 0.017

Highlighted

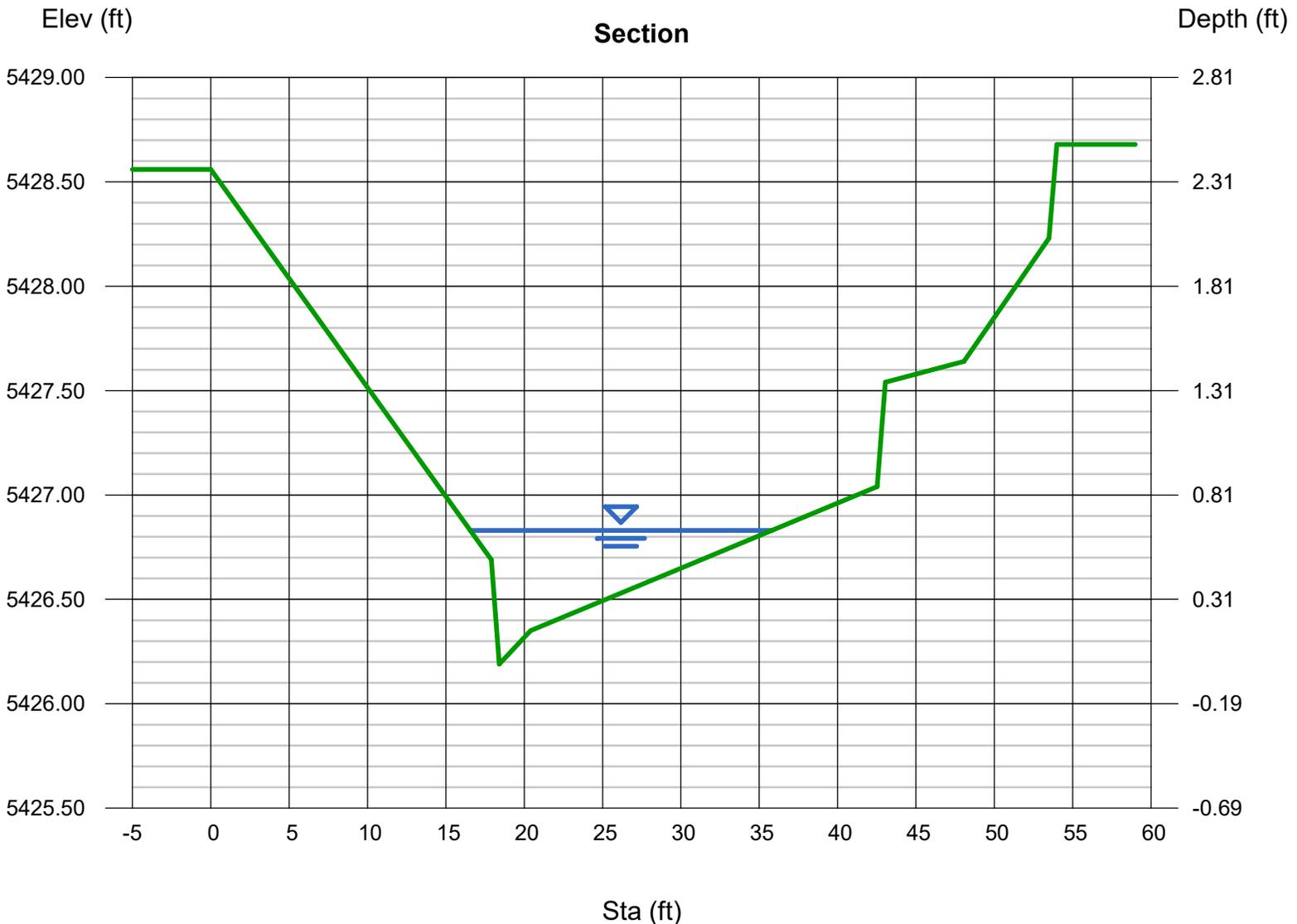
Depth (ft) = 0.64
Q (cfs) = 13.12
Area (sqft) = 5.11
Velocity (ft/s) = 2.57
Wetted Perim (ft) = 19.47
Crit Depth, Yc (ft) = 0.62
Top Width (ft) = 19.24
EGL (ft) = 0.74

Calculations

Compute by: Known Q
Known Q (cfs) = 13.12

(Sta, El, n)-(Sta, El, n)...

(0.00, 5428.56)-(17.90, 5426.69, 0.030)-(18.40, 5426.19, 0.013)-(20.41, 5426.35, 0.013)-(42.53, 5427.04, 0.016)-(43.04, 5427.54, 0.013)-(48.06, 5427.64, 0.013)
-(53.48, 5428.23, 0.030)-(53.99, 5428.68, 0.013)



Channel Report

100 YR

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Dec 14 2023

Basin H1 - 8' Curb Cut 1

Rectangular

Bottom Width (ft) = 8.00
Total Depth (ft) = 0.50

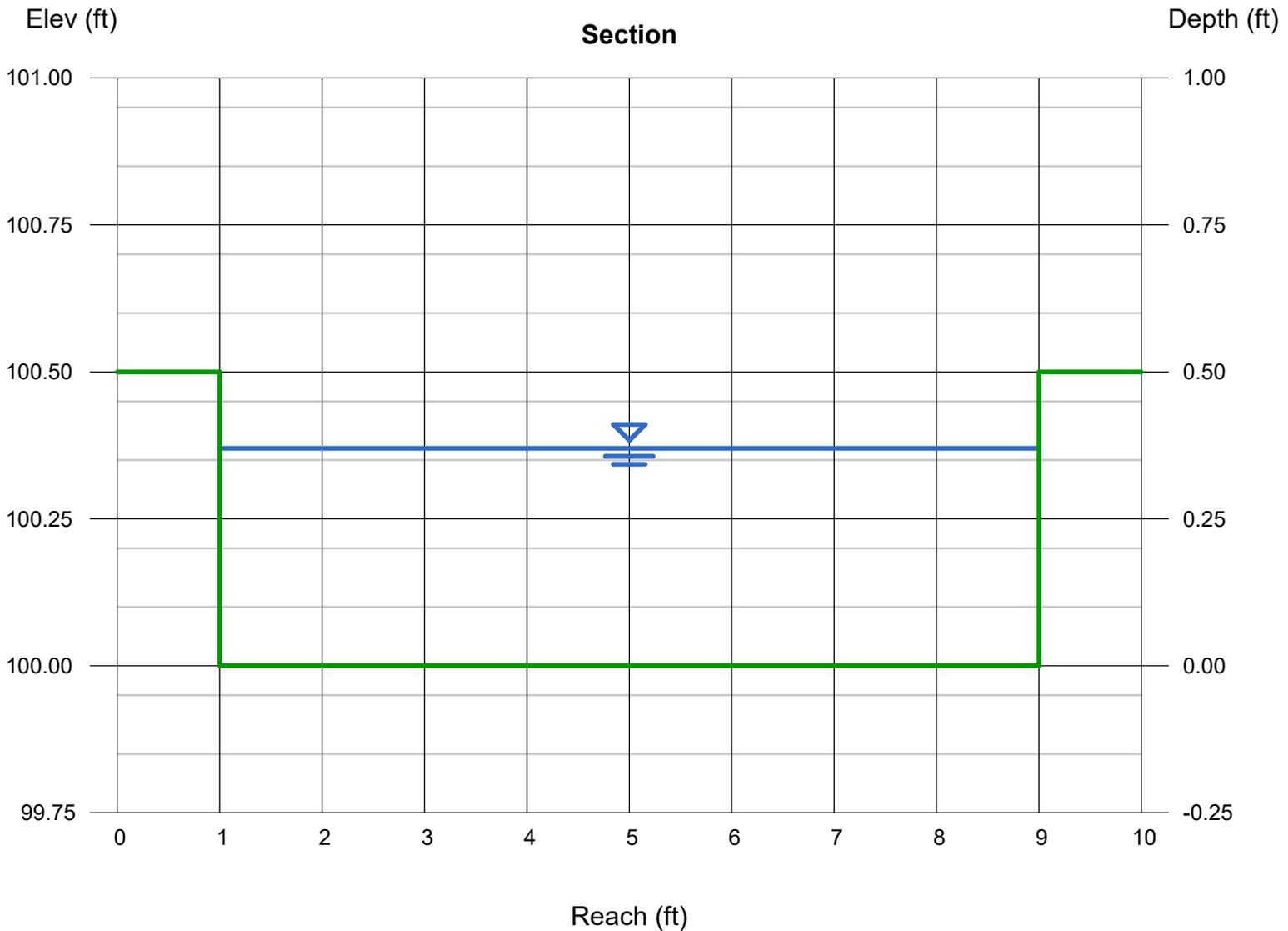
Invert Elev (ft) = 100.00
Slope (%) = 0.50
N-Value = 0.013

Calculations

Compute by: Known Q
Known Q (cfs) = 11.32

Highlighted

Depth (ft) = 0.37
Q (cfs) = 11.32
Area (sqft) = 2.96
Velocity (ft/s) = 3.82
Wetted Perim (ft) = 8.74
Crit Depth, Yc (ft) = 0.40
Top Width (ft) = 8.00
EGL (ft) = 0.60



Channel Report

100 YR

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Dec 14 2023

Basin H2 - 8' Curb Cut 2

Rectangular

Bottom Width (ft) = 8.00
Total Depth (ft) = 0.50

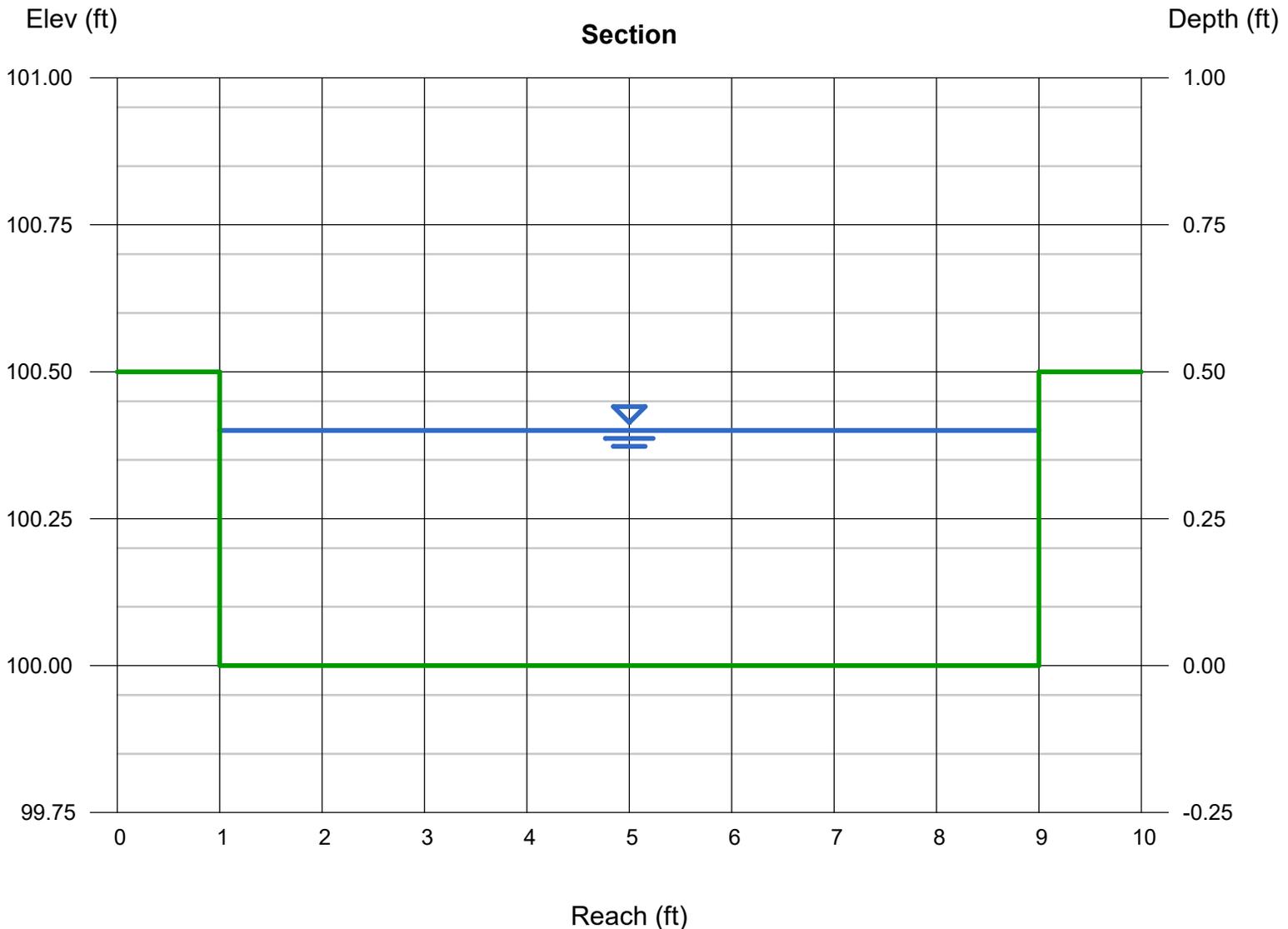
Invert Elev (ft) = 100.00
Slope (%) = 0.50
N-Value = 0.013

Calculations

Compute by: Known Q
Known Q (cfs) = 13.12

Highlighted

Depth (ft) = 0.40
Q (cfs) = 13.12
Area (sqft) = 3.20
Velocity (ft/s) = 4.10
Wetted Perim (ft) = 8.80
Crit Depth, Yc (ft) = 0.44
Top Width (ft) = 8.00
EGL (ft) = 0.66



Channel Report

2 YR

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Dec 14 2023

Basin H2 - 3' Curb Chase

Rectangular

Bottom Width (ft) = 3.00
Total Depth (ft) = 0.50

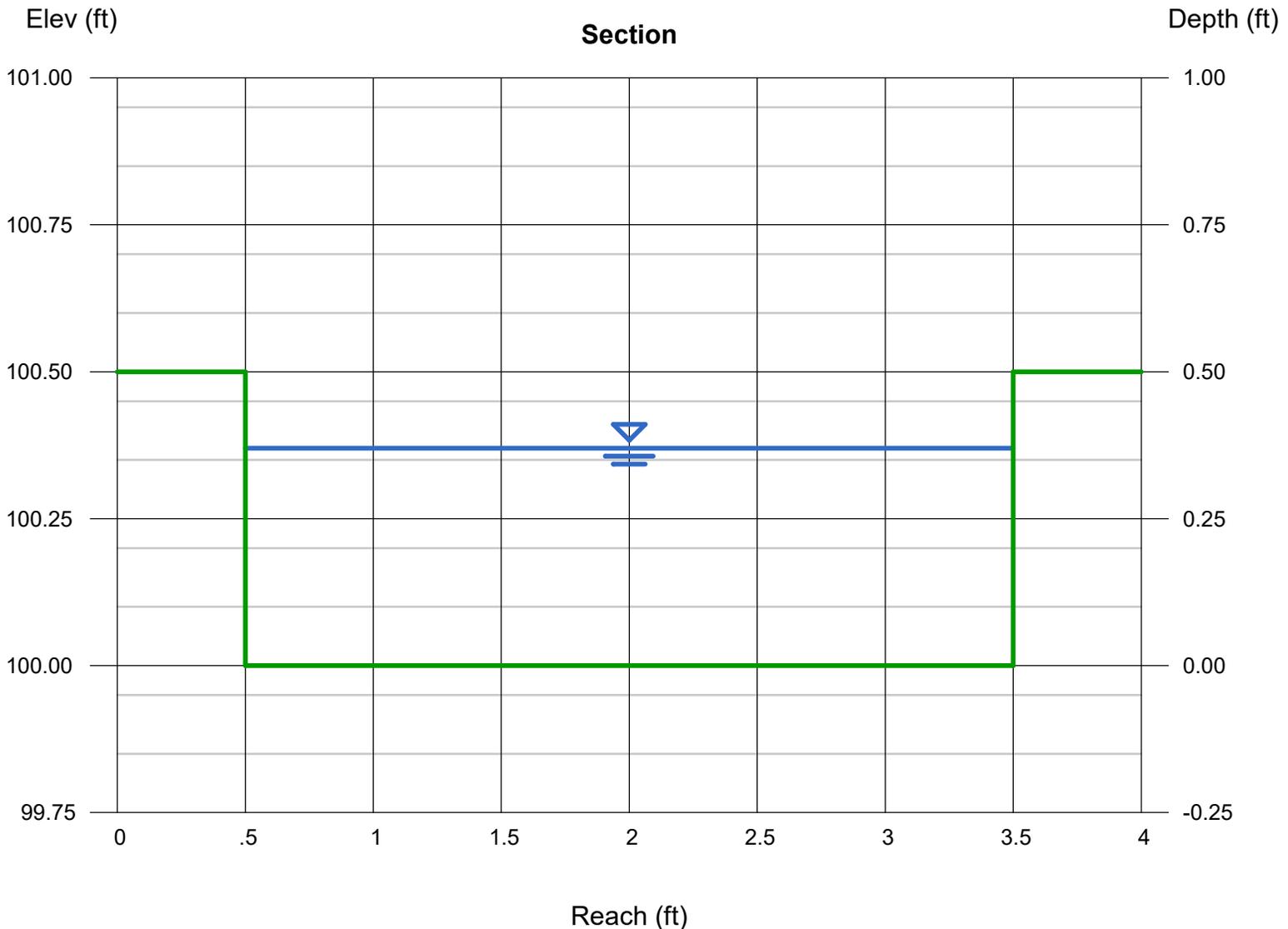
Invert Elev (ft) = 100.00
Slope (%) = 0.50
N-Value = 0.013

Calculations

Compute by: Known Q
Known Q (cfs) = 3.92

Highlighted

Depth (ft) = 0.37
Q (cfs) = 3.920
Area (sqft) = 1.11
Velocity (ft/s) = 3.53
Wetted Perim (ft) = 3.74
Crit Depth, Yc (ft) = 0.38
Top Width (ft) = 3.00
EGL (ft) = 0.56



Channel Report

2 YR

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Friday, Nov 17 2023

Basin H2 - 2' Curb Chase 2 & 3

Rectangular

Bottom Width (ft) = 2.00
Total Depth (ft) = 0.50

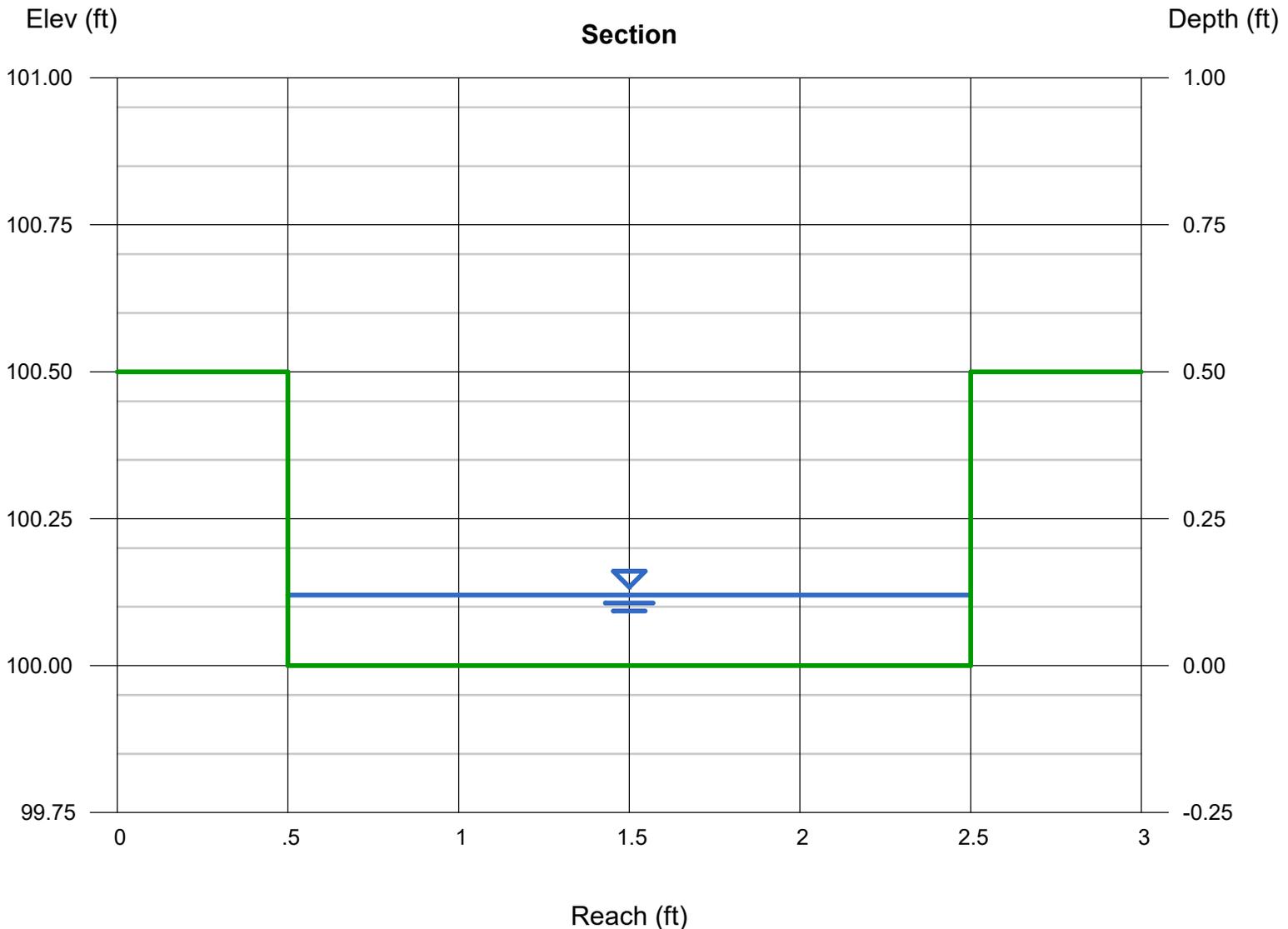
Invert Elev (ft) = 100.00
Slope (%) = 2.60
N-Value = 0.013

Calculations

Compute by: Known Q
Known Q (cfs) = 0.98

Highlighted

Depth (ft) = 0.12
Q (cfs) = 0.980
Area (sqft) = 0.24
Velocity (ft/s) = 4.08
Wetted Perim (ft) = 2.24
Crit Depth, Yc (ft) = 0.20
Top Width (ft) = 2.00
EGL (ft) = 0.38



Channel Report

100 YR

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Dec 14 2023

Roof Basins - Sidewalk Chase

Rectangular

Bottom Width (ft) = 1.00
Total Depth (ft) = 0.36

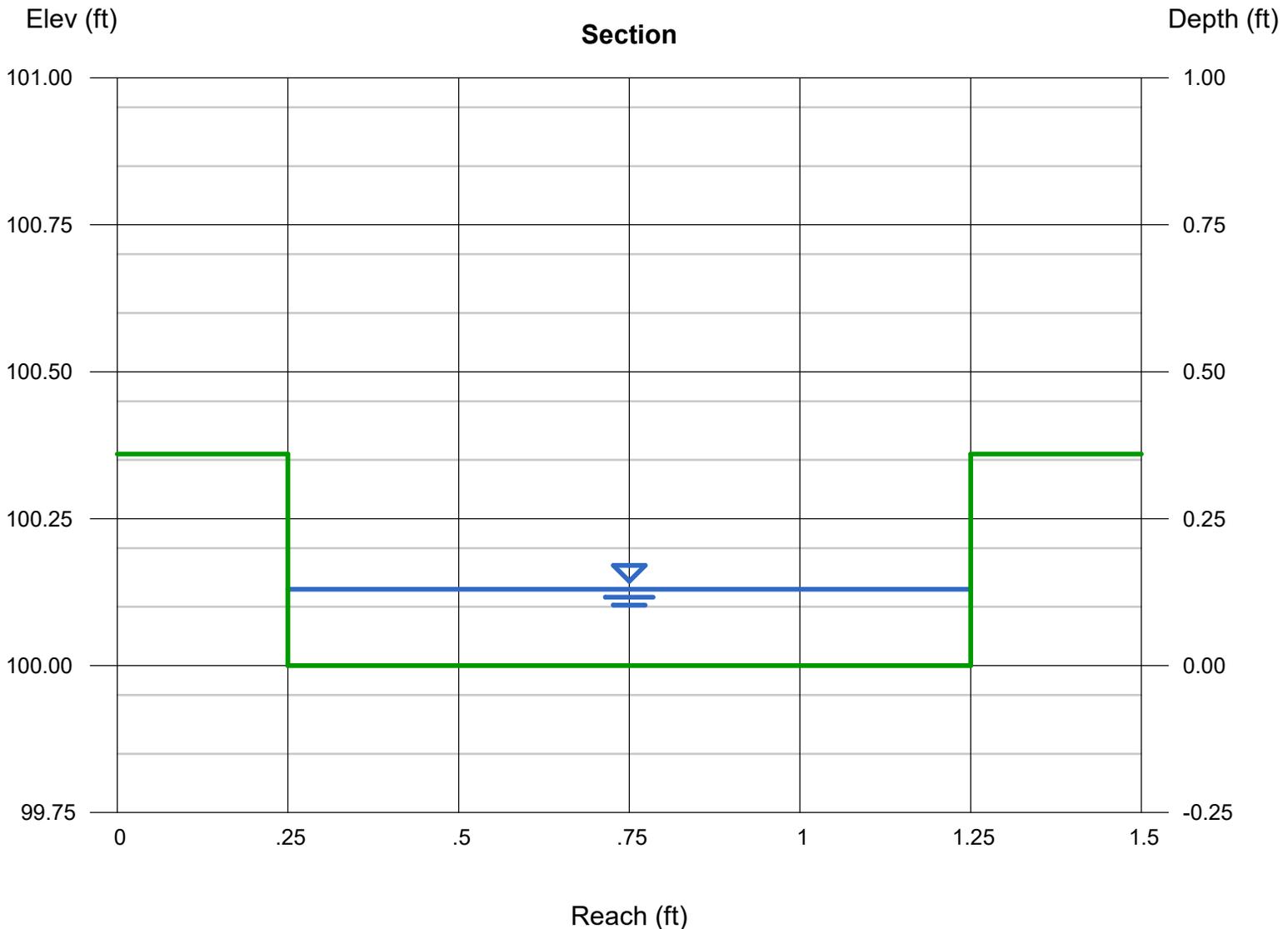
Invert Elev (ft) = 100.00
Slope (%) = 2.00
N-Value = 0.013

Calculations

Compute by: Known Q
Known Q (cfs) = 0.42

Highlighted

Depth (ft) = 0.13
Q (cfs) = 0.420
Area (sqft) = 0.13
Velocity (ft/s) = 3.23
Wetted Perim (ft) = 1.26
Crit Depth, Yc (ft) = 0.18
Top Width (ft) = 1.00
EGL (ft) = 0.29



Channel Report

2 YR

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Dec 14 2023

Basin H2 - 6in Curb w/ 2ft Gutter

User-defined

Invert Elev (ft) = 5426.19
Slope (%) = 0.50
N-Value = 0.015

Highlighted

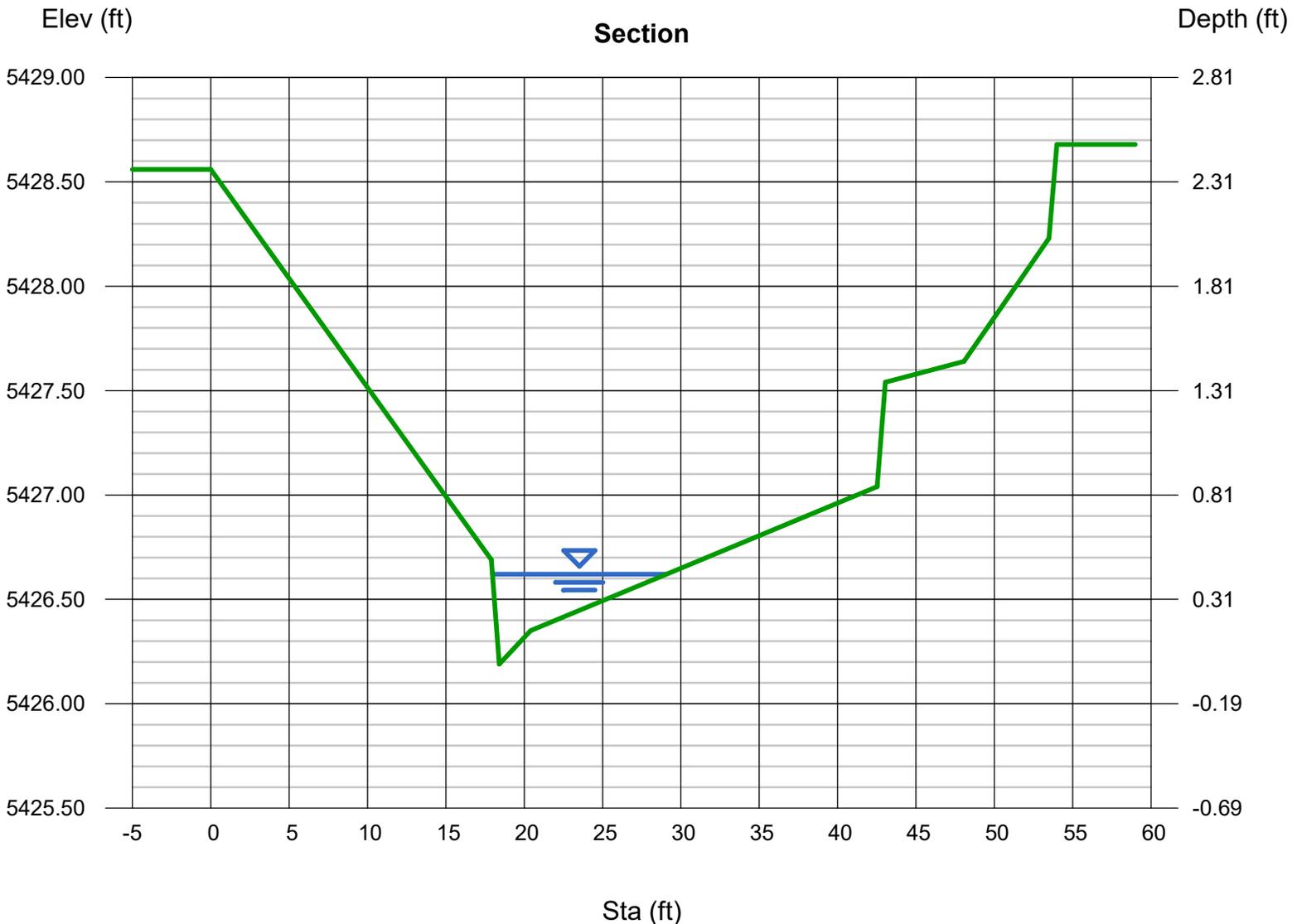
Depth (ft) = 0.43
Q (cfs) = 3.920
Area (sqft) = 1.97
Velocity (ft/s) = 1.99
Wetted Perim (ft) = 11.29
Crit Depth, Yc (ft) = 0.41
Top Width (ft) = 11.10
EGL (ft) = 0.49

Calculations

Compute by: Known Q
Known Q (cfs) = 3.92

(Sta, El, n)-(Sta, El, n)...

(0.00, 5428.56)-(17.90, 5426.69, 0.030)-(18.40, 5426.19, 0.013)-(20.41, 5426.35, 0.013)-(42.53, 5427.04, 0.016)-(43.04, 5427.54, 0.013)-(48.06, 5427.64, 0.013)
-(53.48, 5428.23, 0.030)-(53.99, 5428.68, 0.013)



Channel Report

100 YR

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Monday, Mar 11 2024

Highline Canal Trail Connection - Sidewalk Chase

Rectangular

Bottom Width (ft) = 1.00
Total Depth (ft) = 0.50

Invert Elev (ft) = 100.00
Slope (%) = 2.00
N-Value = 0.013

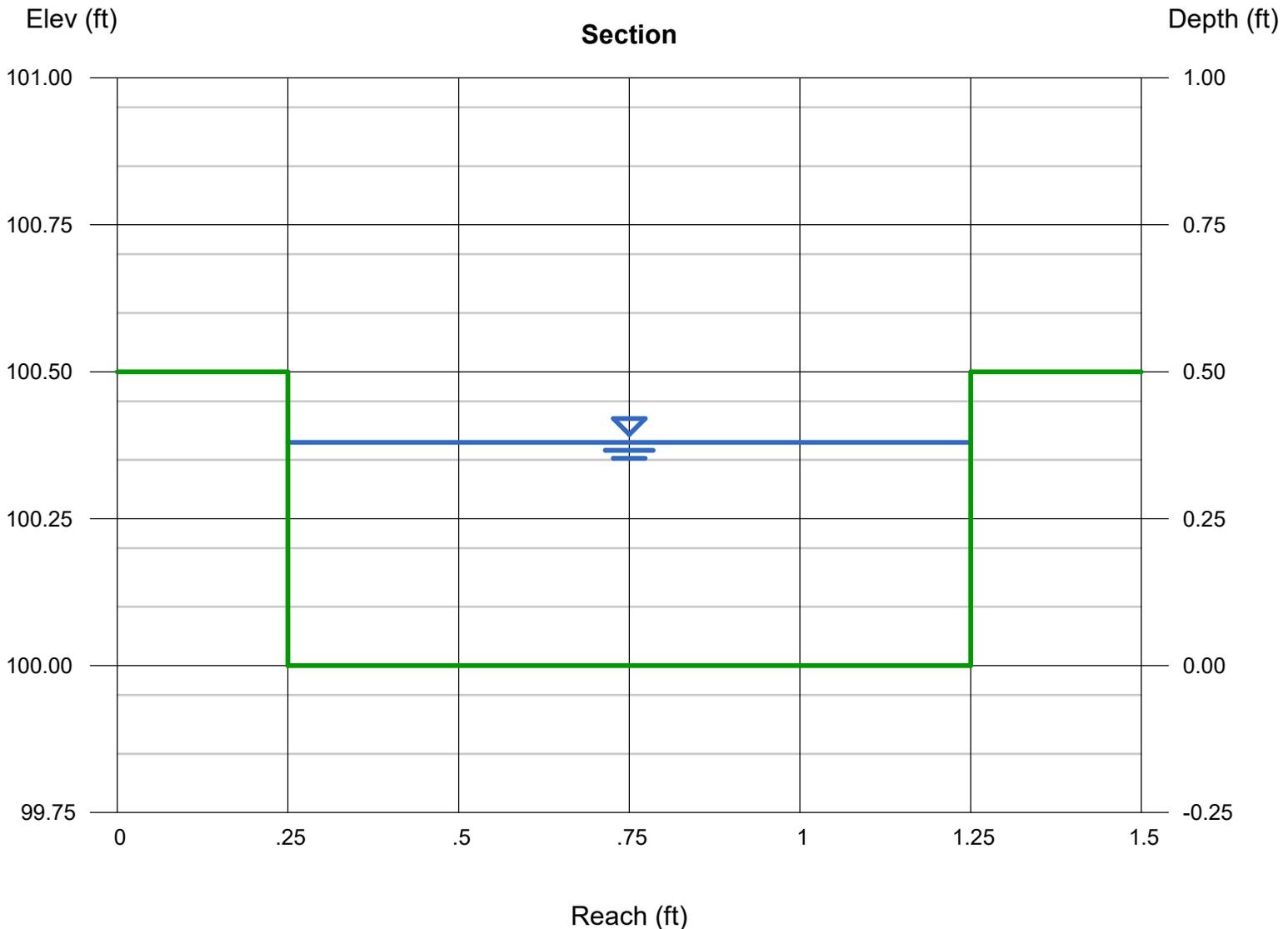
Calculations

Compute by: Known Q
Known Q (cfs) = 2.13

Flows from
Basin D13b

Highlighted

Depth (ft) = 0.38
Q (cfs) = 2.130
Area (sqft) = 0.38
Velocity (ft/s) = 5.61
Wetted Perim (ft) = 1.76
Crit Depth, Yc (ft) = 0.50
Top Width (ft) = 1.00
EGL (ft) = 0.87



APPENDIX C

MCC Retail Subdivision Filing No.1 FDR

MCC Retail Subdivision Filing No. 2 PDR

Email from Richard Ommert

WARE MALCOMB

ARCHITECTURE | PLANNING | INTERIORS
BRANDING | CIVIL ENGINEERING

FINAL DRAINAGE REPORT TOWER CROSSING MCC RETAIL RETAIL FILING NO 1

Aurora, CO

8/4/2023
JN: DCS20-4011

Prepared by:
Ware Malcomb
900 South Broadway Suite 320
Denver, CO 80209
P: 303.561.3333
F: 303.561.3339

Approved For One Year From This Date	
08/22/2023	
<hr/>	
<i>CH</i>  <hr/> Aurora Water - Drainage Division	8/10/23 <hr/> Date

Chris S. Strawn, PE No. 36328

BASIN B2:

Basin B2 is 0.51 acres and has an imperviousness of 72%. This basin consists of Detention Pond B2, as a part of Detention Ponds B2, C1, and C2, as calculated in Appendix B. This detained runoff will be released at Design Point 7 through the outlet structure described in Appendix B, and conveyed to the west under Tower Road.

BASIN P3-b:

Basin P3-b is 5.34 acres planned for future development with an assumed imperviousness of 80%. Runoff will be directed via overland flow where it will enter the proposed swale then into a storm culvert at Design Point 12, continue via grass swale through Basin P2-b, and outfall into the proposed Pond C1 at Design Point 13.

Future development of this drainage basin shall consider adjacent upstream storm event overflows and shall provide emergency relief paths downstream at the time of said development.

BASIN P2-b:

Basin P2-b is 2.55 acres planned for future development with an assumed imperviousness of 80%. Runoff will be directed via overland flow where it will enter a proposed swale and outfall into the proposed Pond C1 at Design Point 13.

Future development of this drainage basin shall consider adjacent upstream storm event overflows and shall provide emergency relief paths downstream at the time of said development.

BASIN C1:

Basin C1 is 0.67 acres and has an imperviousness of 91%. This basin consists of Detention Pond C1, as a part of Detention Ponds B2, C1, and C2, as calculated in Appendix B. The runoff from Pond C1 will be released at Design Point 14 and conveyed through an equalizer storm pipe into Pond B2. This detained runoff will be released at Design Point 7 through the outlet structure described in Appendix B, and conveyed to the west under Tower Road.

BASIN P3-c:

Basin P3-c is 3.34 acres planned for future development with an assumed imperviousness of 80%. Runoff will be directed via overland flow and into the proposed Pond C2, within Basin C2.

BASIN C2:

Basin C2 is 1.74 acres and has an imperviousness of 68%. This basin consists of Detention Pond C2, as a part of Detention Ponds B2, C1, and C2, as calculated in Appendix B. The runoff from Pond C2 will be released at Design Point 15 and conveyed through an equalizer storm pipe into Pond C1, and B2. This detained runoff will be released at Design Point 7 through the outlet structure described in Appendix B, and conveyed to the west under Tower Road.

BASIN B1:

Basin B1 is 0.53 acres and has an imperviousness of 81%. This basin consists of Detention Pond B1 as calculated in Appendix B. This detained runoff will be released at Design Point 11 through the outlet structure described in Appendix B, and conveyed to the west under Tower Road.

BASIN OS1:

Basin OS1 is 2.40 acres consisting of the south half of 32nd Avenue as shown on our Drainage Map. This basin has an imperviousness of 90%. Runoff collects at an existing inlet along the south curb of 32nd Avenue at Design Point 9 and enters the proposed storm system where the flow will be directed to Pond B1 at Design Point 10.

BASIN OS2:

Basin OS2 is 1.61 acres consisting of the east half of Tower Road as shown on our Drainage map. This basin has an imperviousness of 90%. Runoff collects at an existing inlet along the south curb of 32nd Avenue at Design Point 9 and enters the proposed storm system where the flow will be directed to Pond B1 at Design Point 10.

BASIN OS3:

Basin OS3 is 2.12 acres of mostly undeveloped land located South of Basin B2 but will not contribute to the proposed ponds. This basin has an imperviousness of 5%. Runoff from this basin will follow the historic path to the West toward Tower Road at Design Point 16, and ultimately converge at Design Point 8 with the flows from Detention ponds B1 and B2, C1, and C2.

BASIN OS4:

Basin OS4 is 1.56 acres of mostly undeveloped land from the I-70 right-of-way. This basin has an imperviousness of 5%. Runoff will be directed via overland flow and into the proposed Detention Pond C2.

BASIN OS5:

Basin OS5 is 0.61 acres and has an imperviousness of 22%. This basin consists of landscape areas and a portion of the Highline Canal Trail east of the proposed site. Runoff will be directed via overland flow through basin P3-c and into Pond C2.

BASIN OS6:

Basin OS6 is 0.50 acres and has an imperviousness of 24%. This basin consists of landscape areas and a portion of the Highline Canal Trail east of the proposed site. Runoff will be directed via overland flow through basin P3-b and into Pond C1.

BASIN OS7:

Basin OS7 is 0.37 acres and has an imperviousness of 25%. This basin consists of landscape areas and a portion of the Highline Canal Trail east of the proposed site. Runoff will be directed via overland flow through basin P3-a and into Pond B2.

See Table 1 below for the calculated design flows for the basins listed.

WARE MALCOMB

ARCHITECTURE | PLANNING | INTERIORS
BRANDING | CIVIL ENGINEERING

RUNOFF SUMMARY					
BASIN LABEL	IMPERVIOUS VALUES	AREA (AC)	LOCAL (CFS)		DESIGN POINT
			Q ₂	Q ₁₀₀	
P3-A	80%	4.25	7.8	24.3	1
A1	90%	0.40	0.9	2.8	2&3
P1	80%	0.77	1.6	4.9	
A2	90%	0.64	1.5	4.5	4&5
P2-a	80%	0.97	2.0	6.3	6
B2	72%	0.51	1.0	3.0	7
P3-B	80%	5.34	9.5	29.4	12
P2-B	80%	2.55	5.3	16.4	13
C1	91%	0.67	1.6	4.8	14
P3-c	80%	3.34	6.8	21.1	
OS4	5%	1.56	0.6	2.2	
C2	68%	1.74	2.7	8.5	15
OS1	90%	2.40	4.3	13.3	9
OS2	90%	1.61	3.7	11.4	9
B1	81%	0.53	1.1	3.4	11
OS3	5%	2.12	0.7	2.6	16
OS5	22%	0.61	0.5	1.6	
OS6	24%	0.50	0.4	1.3	
OS7	25%	0.37	0.3	1.0	

Table 1

WARE MALCOMB

ARCHITECTURE | PLANNING | INTERIORS
BRANDING | CIVIL ENGINEERING

PROJECT: TOWER CROSSING - FINAL DRAINAGE PLAN

JOB NO.: DCS20-4011

CALC. BY: MCN

DATE: 7/28/2023

Impervious Percentages - from City of Aurora Storm Drainage Design and Technical Criteria

	% Imp	C-Values Based on Frequency (yrs)			
		2	5	10	100
ROOF & ASPHALT	100%	0.87	0.88	0.90	0.93
CONCRETE	96%	0.87	0.87	0.88	0.89
ROOF	90%	0.80	0.85	0.90	0.90
LANDSCAPE	5%	0.13	0.14	0.15	0.17

Corresponds to type C or D soils

PROPOSED AND EXISTING COMPOSITE IMPERVIOUSNESS

Basin	Area (ac)	Areas (ac)				Weighted Impervious and C Values				
		ROOF & ASPHALT	CONCRETE	ROOF	LANDSCAPE	Imp.	C ₂	C ₅	C ₁₀	C ₁₀₀
P3-a	4.25	3.36			0.89	80%	0.71	0.72	0.74	0.77
A1	0.40	0.36			0.04	90%	0.79	0.80	0.82	0.85
A2	0.64	0.57			0.07	90%	0.79	0.80	0.82	0.85
P1	0.77	0.61			0.16	80%	0.71	0.72	0.74	0.77
P2-a	0.97	0.77			0.20	80%	0.71	0.72	0.74	0.77
B2	0.51	0.36			0.15	72%	0.65	0.66	0.68	0.71
P3-b	5.34	4.21			1.12	80%	0.71	0.72	0.74	0.77
P2-b	2.55	2.01			0.54	80%	0.71	0.72	0.74	0.77
C1	0.67	0.61			0.07	91%	0.80	0.81	0.83	0.86
P3-c	3.34	2.64			0.75	80%	0.72	0.73	0.74	0.77
C2	1.74	1.15			0.59	68%	0.62	0.63	0.65	0.67
B1	0.53	0.42			0.11	81%	0.72	0.73	0.75	0.78
Proposed Onsite	21.71	17.07			4.68	80%	0.71	0.72	0.74	0.77
OS1	2.40	2.136			0.26	90%	0.79	0.80	0.82	0.85
OS2	1.61	1.433			0.18	90%	0.79	0.80	0.82	0.85
OS3	2.12				2.12	5%	0.13	0.14	0.15	0.17
OS4	1.56				1.56	5%	0.13	0.14	0.15	0.17
OS5	0.61		0.115		0.50	22%	0.27	0.28	0.29	0.31
OS6	0.50		0.103		0.39	24%	0.28	0.29	0.30	0.32
OS7	0.37		0.080		0.29	25%	0.29	0.30	0.31	0.32
Offsite	9.17	3.57	0.30		5.30	45%	0.44	0.45	0.47	0.49
Pond B1	4.54	3.99			0.55	89%	0.78	0.79	0.81	0.84
Ponds B2/C1/C2	24.22	16.65	0.30		7.31	71%	0.65	0.66	0.67	0.70
Total	30.88	20.64	0.30		9.98	69%	0.63	0.64	0.66	0.69

Undeveloped Basins

P1-Interim	0.77				0.77	5%	0.13	0.14	0.15	0.17
P2-a-Interim	0.97				0.97	5%	0.13	0.14	0.15	0.17
P3-a-Interim	4.25				4.25	5%	0.13	0.14	0.15	0.17
P2-b-Interim	2.55				2.55	5%	0.13	0.14	0.15	0.17
P3-b-Interim	5.34				5.34	5%	0.13	0.14	0.15	0.17
P3-c-Interim	3.34				3.34	5%	0.13	0.14	0.15	0.17

Calculated By: MCN
 Date: 7/28/2023
 Checked By:
 2-yr, 1-hour rainfall= 0.86

STANDARD FORM SF-3
 STORM DRAINAGE SYSTEM DESIGN
 (RATIONAL METHOD PROCEDURE)

Project: TOWER CROSSING - FINAL DRAINAGE PLAN
 Job No.: DCS20-4011
 Design Storm: 2-YR

BASIN	DIRECT RUNOFF								TOTAL RUNOFF			PIPE			LENGTH (FT)	VELOCITY (FPS)	t _r (MIN)	REMARKS	
	DESIGN POINT	AREA DESIGN	AREA (AC)	RUNOFF COEFF	t _c (MIN)	C * A (AC)	I (IN/HR)	Q (CFS)	t _r (MIN)	S (C * A) (CA)	I (IN/HR)	Q (CFS)	DESIGN FLOW (CFS)	SLOPE (%)					PIPE DIAM. (IN.)
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
OS7			0.37	0.29	5.0	0.11	2.90	0.3											
P3-a	1		4.25	0.71	7.5	3.04	2.57	7.8											
A1	2&3		0.40	0.79	5.0	0.32	2.90	0.9											Full flow utilized for Hydraulic Calculation at each DP
P1			0.77	0.71	5.0	0.55	2.90	1.6											
A2	4&5		0.64	0.79	5.0	0.50	2.90	1.5											Full flow utilized for Hydraulic Calculation at each DP
P2-a			0.97	0.71	5.0	0.70	2.90	2.0											
	6		1.74	0.71	5.0	1.24	2.90	3.6											Combined flows of P1 and P2-a
B2	7		0.51	0.65	5.0	0.33	2.90	1.0											
OS6			0.50	0.28	5.0	0.14	2.90	0.4											
P3-b	12		5.34	0.71	8.2	3.81	2.49	9.5											
P2-b	13		2.55	0.71	5.0	1.82	2.90	5.3											
C1	14		0.67	0.80	5.0	0.54	2.90	1.6											
OS5			0.61	0.27	5.0	0.16	2.90	0.5											
P3-c			3.34	0.72	5.4	2.39	2.84	6.8											
OS4			1.56	0.13	5.0	0.20	2.90	0.6											
C2	15		1.74	0.62	8.0	1.08	2.51	2.7											
OS1			2.40	0.79	10.4	1.89	2.28	4.3											
OS2			1.61	0.79	5.0	1.27	2.90	3.7											
	9		4.01	0.79	10.4	3.16	2.28	7.2											Combined flows of OS1 and OS2
B1	11		0.53	0.72	5.0	0.38	2.90	1.1											
OS3	16		2.12	0.13	8.5	0.28	2.46	0.7											
P1-Interim			0.77	0.13	11.6	0.10	2.18	0.2											
P2-a-Interim			0.97	0.13	5.0	0.13	2.90	0.4											
P3-a-Interim			4.25	0.13	13.4	0.55	2.04	1.1											
P2-b-Interim			2.55	0.13	9.4	0.33	2.37	0.8											
P3-b-Interim			5.34	0.13	11.3	0.69	2.20	1.5											
P3-c-Interim			3.34	0.13	12.3	0.43	2.12	0.9											

Calculated By: MCN
 Date: 7/28/2023
 Checked By:
 100-yr, 1-hour 2.46

STANDARD FORM SF-3
 STORM DRAINAGE SYSTEM DESIGN
 (RATIONAL METHOD PROCEDURE)

Project: TOWER CROSSING - FINAL DRAINAGE PLAN
 Job No.: DCS20-4011
 Design Storm: 100-YR

BASIN	DIRECT RUNOFF								TOTAL RUNOFF				PIPE			LENGTH (FT)	VELOCITY (FPS)	t (MIN)	REMARKS
	DESIGN POINT	AREA DESIGN	AREA (AC)	RUNOFF COEFF	t _c (MIN)	C * A (AC)	I (IN/HR)	Q (CFS)	t _c (MIN)	S (C * A) (CA)	I (IN/HR)	Q (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE DIAM. (IN.)				
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
OS7			0.37	0.32	5.0	0.12	8.34	1.0											
P3-A	1		4.25	0.77	7.5	3.28	7.40	24.3											
A1	2&3		0.40	0.85	5.0	0.34	8.34	2.8											Full flow utilized for Hydraulic Calculation at each DP
P1			0.77	0.77	5.0	0.59	8.34	4.9											
A2	4&5		0.64	0.85	5.0	0.54	8.34	4.5											Full flow utilized for Hydraulic Calculation at each DP
P2-a			0.97	0.77	5.0	0.75	8.34	6.3											
	6		1.74	0.77	5.0	1.34	8.34	11.2											Combined flows of P1 and P2-a
B2	7		0.51	0.71	5.0	0.36	8.34	3.0											
OS6			0.50	0.32	5.0	0.16	8.34	1.3											
P3-B	12		5.34	0.77	8.2	4.11	7.15	29.4											
P2-B	13		2.55	0.77	5.0	1.96	8.34	16.4											
C1	14		0.67	0.86	5.0	0.58	8.34	4.8											
OS5			0.61	0.31	5.0	0.19	8.34	1.6											
P3-c			3.34	0.77	5.4	2.58	8.17	21.1											
OS4			1.56	0.17	5.0	0.27	8.34	2.2											
C2	15		1.74	0.67	8.0	1.17	7.23	8.5											
OS1			2.40	0.85	10.4	2.03	6.55	13.3											
OS2			1.61	0.85	5.0	1.36	8.34	11.4											
	9		4.01	0.85	10.4	3.39	6.55	22.2											Combined flows of OS1 and OS2
B1	11		0.53	0.78	5.0	0.41	8.34	3.4											
OS3	16		2.12	0.17	8.5	0.36	7.09	2.6											
P1-Interim			0.77	0.17	11.6	0.13	6.27	0.8											
P2-a-Interim			0.97	0.17	5.0	0.16	8.34	1.4											
P3-a-Interim			4.25	0.17	13.4	0.72	5.88	4.2											
P2-b-Interim			2.55	0.17	9.4	0.43	6.81	3.0											
P3-b-Interim			5.34	0.17	11.3	0.91	6.33	5.7											
P3-c-Interim			3.34	0.17	12.3	0.57	6.10	3.5											

LEGEND:

- PROPERTY LINE
 - 5810 PROPOSED 5' CONTOUR
 - 5809 PROPOSED 1' CONTOUR
 - (5810) EXISTING 5' CONTOUR
 - (5809) EXISTING 1' CONTOUR
 - PROPOSED STORM LINE
 - EXISTING STORM LINE
 - PROPOSED STORM INLET
 - PROPOSED SIDEWALK
 - WATER QUALITY WSEL
 - EURV WSEL
 - 100-YR+1/2 EURV WSEL
 - PROPOSED CURB & GUTTER
 - EXISTING CURB & GUTTER
 - OVERLAND FLOW DIRECTION
 - EMERGENCY OVERFLOW DIRECTION
 - DRAINAGE SUB-BASINS
- DRAINAGE AREA (LABEL)**
- | | |
|------|---------------------------|
| A | 2-YR RUNOFF COEFFICIENT |
| 0.03 | 0.74 |
| AC | 0.85 |
| | 100-YR RUNOFF COEFFICIENT |
- DESIGN POINT**

The utilities shown in this drawing have been plotted from the best available survey information on 03/04/2020

NOTE TO PROPERTY OWNER: EACH PROPERTY OWNER IS RESPONSIBLE FOR MAINTAINING SURFACE OVERFLOWS FROM UPSTREAM DEVELOPMENT (SPECIFICALLY PD1 & PD12).

PROP PONDS B1, B2, C1, & C2 ARE PER THE SAND CREEK DRAINAGE AREA POND B (SC-B) EDN #980177

NOTE: THE DEVELOPER SHALL HAVE A LICENSED PROFESSIONAL ENGINEER CERTIFY EACH STORMWATER DETENTION POND AND/OR WATER QUALITY BMP IS BUILT ACCORDING TO THE APPROVED PLANS AND SPECIFICATIONS AND THE REQUIRED DETENTION VOLUME, INCLUDING THE WQCV WHEN USED, IS MET. THE CERTIFICATION SHALL ALSO VERIFY ALL PERTINENT DIMENSIONS, ELEVATIONS, REQUIRED OUTLET ORIFICE PLATES FOR DETENTION AND WQCV AND OTHER PERMANENT BMPS REQUIREMENTS ARE INSTALLED PER THE APPROVED PLANS AND SPECIFICATIONS, AND SHALL SHOW THE AS-BUILT DESIGN VOLUMES (WQCV, 10-YEAR, 100-YEAR, EURV) AND OTHER PERTINENT DIMENSIONS, ELEVATIONS AND CAPACITY REQUIREMENTS ASSOCIATED WITH THE WQ BMP USED. THE CERTIFICATION SHALL BE PROVIDED TO THE CITY OF AURORA ENGINEERING CONTROL SECTION PRINCIPAL ENGINEER. AN APPROVED POND CERTIFICATE SHALL BE REQUIRED PRIOR TO THE RETURN OF ANY FISCAL SECURITY DEPOSIT (AS WELL AS SATISFYING OTHER CONDITIONS OF THE STORMWATER PERMIT) FOR SITES THAT DO NOT REQUIRE A CERTIFICATE OF OCCUPANCY. EXAMPLES OF THESE SITES INCLUDE BUY ARE NOW LIMITED TO: SITES WITHOUT VERTICAL CONSTRUCTION, OIL AND GAS WELL PADS, OUTDOOR STORAGE, AND TOW YARDS. AN APPROVED POND CERTIFICATE SHALL BE REQUIRED PRIOR TO COMMENCEMENT OF BUSINESS OPERATIONS. IN NO CASE SHALL A CERTIFICATE OF OCCUPANCY OR TEMPORARY CERTIFICATE OF OCCUPANCY BE ISSUED WITHOUT AN APPROVED POND CERTIFICATE.

RUNOFF SUMMARY				
BASIN LABEL	IMPERVIOUS VALUES	AREA (AC)	LOCAL (CFS)	DESIGN POINT
P3-A	80%	4.25	7.8	24.3
A1	90%	0.40	0.9	2.8
P1	80%	0.77	1.6	4.9
A2	90%	0.64	1.5	4.5
P2-a	80%	0.97	2.0	6.3
B2	72%	0.51	1.0	3.0
P3-B	80%	5.34	9.5	29.4
P2-B	80%	2.55	5.3	16.4
C1	91%	0.67	1.6	4.8
P3-c	80%	3.34	6.8	21.1
OS4	5%	1.56	0.6	2.2
C2	68%	1.74	2.7	8.5
OS1	90%	2.40	4.3	13.3
OS2	90%	1.61	3.7	11.4
B1	81%	0.53	1.1	3.4
OS3	5%	2.12	0.7	2.6
OS5	22%	0.61	0.5	1.6
OS6	24%	0.50	0.4	1.3
OS7	25%	0.37	0.3	1.0

NOTES:
 1. 2.03.5.01 CITY OF AURORA PLAN REVIEW IS ONLY FOR GENERAL CONFORMANCE WITH CITY OF AURORA DESIGN CRITERIA AND THE CITY CODE. THE CITY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND ELEVATIONS WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOB SITE. THE CITY OF AURORA, THROUGH THE APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR THE COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

2. PROJECT BENCHMARK: FOUND CITY OF AURORA 3.00" BRASS CAP STAMPED COLO. DEPT. OF HIGHWAYS STATE HWY, "CDOH 1.031185, MILE POST, CONTROL MONUMENT, (COA #356628SE002)" LOCATION: BEING AT THE N.W. CORNER OF TOWER RD. & I-70, BEING THE WEST BOUND RAMP, SAID MON. BEING 10.5 FT. S.E. OF THE N.W. FLOWLINE OF THE CONC COVERED ISLAND. SD. CAP INSCRIBED COLO. DEPT. HIGHWAYS MILE POST CONTROL MON. ELEVATION IS 5439.72 FEET, (NAVD 88 DATUM).

3. ALL STORM SEWER IS PRIVATE UNLESS OTHERWISE NOTED ON PLANS.

4. STORM SYSTEM DESIGNED FOR 100YR STORM EVENT UNLESS OTHERWISE NOTED ON PLANS.

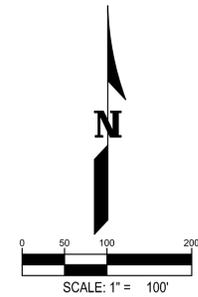
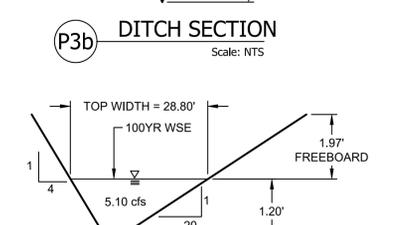
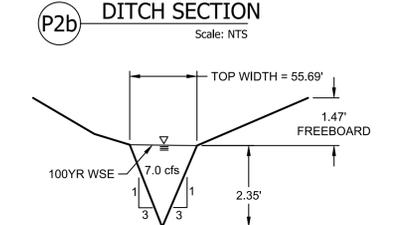
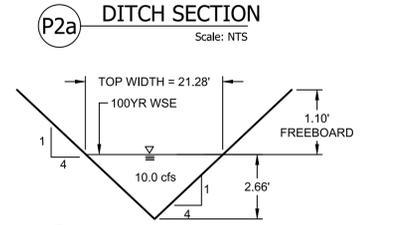
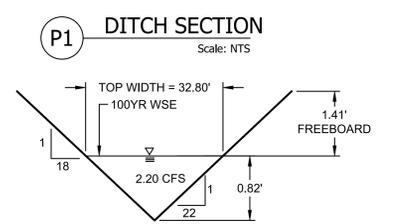
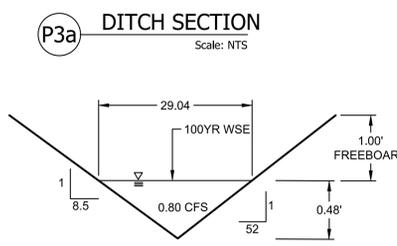
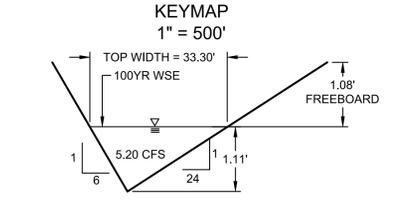
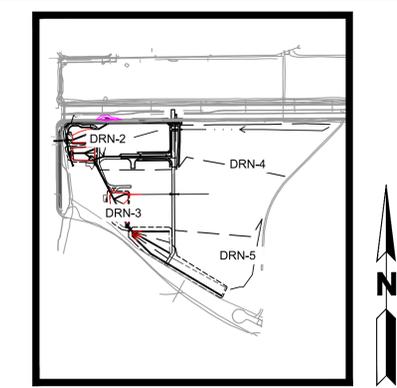
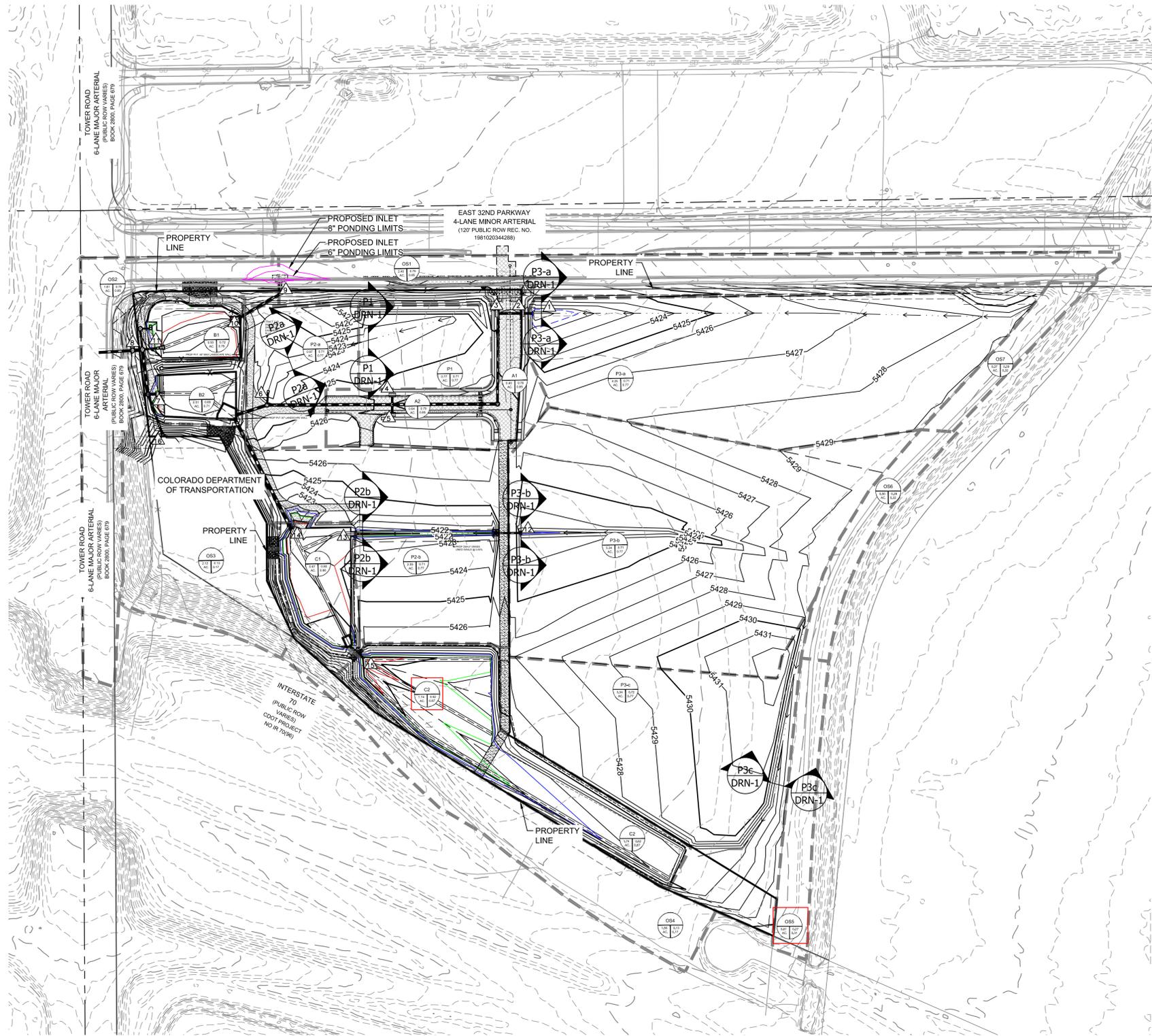
5. ALL PROPOSED STORM SEWER AND DETENTION FACILITIES WILL BE OWNED, OPERATED, AND MAINTAINED BY TOWER METRO DISTRICT.

6. TEMPORARY GRASS LINED SWALES ARE SLOPED PER THIS FINAL DRAINAGE REPORT AT THE MINIMUM GRADE OF 0.5%. THE VARIANCE ABOVE IS BEING REQUESTED DUE TO SITE CONSTRAINTS. IN ORDER TO MAINTAIN POSITIVE DRAINAGE THROUGHOUT THE SITE, SWALES WILL BE UTILIZED TO CONVEY FLOWS TOWARD PROPOSED STORM SEWER PIPES AND PONDS. DUE TO EXISTING GRADING THROUGHOUT THE SITE AND THE CONNECTION OF THE STORM SEWER TO THE EXISTING CULVERT BENEATH TOWER ROAD, 0.5% MINIMUM SLOPES IN SWALES ARE PROPOSED. THE FOLLOWING NOTE HAS BEEN ADDED TO THE DRAINAGE AREA MAP PLANS TO ACCOMPANY THIS REPORT.

UNLINED PRIVATE TEMPORARY SWALES WITH SLOPES LESS THAN 2% (MINIMUM OF 0.5%) ARE PERMITTED FOR UP TO 36 MONTHS OR UNTIL ADJACENT DEVELOPMENT OCCURS. OTHERWISE REVISIONS SHALL BE SUBMITTED FOR CONCRETE LINED SWALES AT A MINIMUM OF 0.5%. IN ADDITION, THE CITY RESERVES THE RIGHT AT ANY POINT TO REQUIRE THE CONSTRUCTION OF THE CONCRETE LINING SHOULD THERE BE AN ISSUE WITH REDUCED CAPACITY, SEDIMENTATION, PONDING, OR OTHER ITEMS IDENTIFIED BY THE CITY ENGINEER. DUE TO THE PROXIMITY OF THE AIRPORT STANDING WATER IS NOT PERMITTED. THE OWNER SHALL TAKE IMMEDIATE ACTION IF SUCH ISSUES ARE IDENTIFIED.

DETENTION POND B1:
 WQCV = 0.150 AC-FT
 WQCV Elev = 5417.78
 EURV = 0.402 AC-FT
 EURV Elev = 5418.77
 100yr Vol = 0.562 AC-FT
 100yr Elev = 5419.29

DETENTION PONDS B2, C1, & C2:
 WQCV = 0.565 AC-FT
 WQCV Elev = 5419.65
 EURV = 1.674 AC-FT
 EURV Elev = 5420.96
 100yr Vol = 3.07 AC-FT
 100yr Elev = 5421.84



WARE MALCOMB
 CIVIL ENGINEERING & SURVEYING

900 south broadway
 suite 320
 denver, co 80209
 p 303.661.3333
 waremalcomb.com

FOR AND ON BEHALF OF WARE MALCOMB

MCC RETAIL FILING NO. 1
TOWER CROSSING
 FINAL DRAINAGE PLAN

NO.	DATE	REMARKS

JOB NO.:	DCS20-4011
PA / PM:	EM
DRAWN BY:	CS
DATE:	
PLOT DATE:	

SHEET
DRN-1
 Sheet 48



MCC RETAIL FILING NO. 2
TOWER CROSSING PHASE II
PRELIMINARY DRAINAGE REPORT
CITY OF AURORA, COLORADO
OCTOBER 2023

Prepared For:
Commerce Construction Co., L.P.
20100 East 32nd Parkway, Suite 150
Aurora, CO 80011

By:
CAGE Civil Engineering
405 Urban Street, Suite 404
Denver, CO 80228

Contact: Dan Katz
Phone: 847.826.0522

Approved For One Year From This Date	

_____	_____
Water Department	Date

TOWER CROSSING PHASE II

PRELIMINARY DRAINAGE REPORT

Page 6 of 7

- **Basin D7** is located on the east side of the site and consists of 0.57 acres of landscape area. Runoff is directed southwest to a proposed storm sewer that ultimately drains to pond C1.
 - **Basin D8** is located on the southeast half of the eastern access road, consisting of 0.20 acres of asphalt, curb & gutter, sidewalk and landscaping, Runoff is directed to an inlet at design point 8 and routed through storm sewer pipes, outletting to a swale on the west side of the road, ultimately draining to pond C1.
 - **Basin D9** is located on the southwest side of the eastern access road. This basin contains 0.25 acres of asphalt, curb & gutter, sidewalk, and landscaping. Runoff is directed to a proposed inlet at design point 9 and is routed to a swale on the west side of the road that ultimately drains to pond C1.
 - **Basin D10** is located centrally within the site, between the two proposed access drives. Runoff is directed to a swale, ultimately draining west to design point 10 and then entering proposed storm sewer that outlets to pond C1.
 - **Basin D11** is located on the west access road and consists of 0.11 acres of asphalt, curb & gutter, sidewalk, and landscaping. Runoff is directed to an inlet at design point 11 where it is routed through proposed storm sewer and outlets to pond C2.
 - **Basin D12** is located on the west access road and consists of 0.11 acres of asphalt, curb & gutter, sidewalk, and landscaping. Runoff is directed to an inlet at design point 12 where it is routed through proposed storm sewer and outlets to pond C2.
 - **Basin D13** is located on the south end of the site and consists of 3.57 acres of asphalt, gravel, sidewalk, and landscape areas. Runoff is directed southwest and directly drains to pond C2.
- **Offsite Basins:** Runoff Basins that drain within ROW and routed to pond B1.
 - **Basin OS1** is located on the north side of the site, along E 32nd Parkway. Due to adding additional pavement to this basin, it was reanalyzed to ensure that the proposed drainage is in compliance with the original drainage design. This basin consists of 2.40 acres of pavement, sidewalk and landscape areas and drains to an existing inlet at design point O1. Runoff is then collected within an existing storm sewer and routed to pond B1 before discharging Under tower Road.



Project: Tower Crossing Phase II
Location: Aurora, CO
Designer: DDK
Date: 10/2/2023
Latest Revision: 10/2/2023

BASIN SUMMARY TABLE - FINAL BUILDOUT							
Basin Designation	Basin Design Point	Impervious Values	Area (ac)	C ₂	Q ₂ (cfs)	C ₁₀₀	Q ₁₀₀ (cfs)
D1	1	80.0%	1.74	0.71	3.60	0.82	0.64
D2	2	80.0%	0.18	0.71	0.37	0.70	0.94
D3	3	80.0%	0.18	0.71	0.38	0.71	0.99
D4	4	80.0%	2.11	0.71	4.36	0.10	0.96
D5	5	90.0%	0.32	0.80	0.74	0.69	1.50
D6	6	90.0%	0.22	0.80	0.52	0.76	1.24
D7	7	80.0%	0.57	0.71	1.18	0.10	0.31
D8	8	80.0%	0.20	0.71	0.41	0.76	1.05
D9	9	80.0%	0.25	0.71	0.51	0.69	1.15
D10	10	80.0%	4.06	0.71	8.36	0.10	1.45
D11	11	80.0%	0.11	0.71	0.23	0.70	0.57
D12	12	80.0%	0.11	0.71	0.23	0.70	0.58
D13	13	80.0%	3.57	0.71	7.37	0.21	3.72
OS-1	14	90.0%	2.40	0.80	5.58	0.65	9.12

John Ebers

From: Kyle Swaving
Sent: Wednesday, October 25, 2023 9:49 AM
To: John Ebers
Subject: FW: Composite C Values for Detention Ponds

Follow Up Flag: Follow up
Flag Status: Flagged

Kyle Swaving, P.E.
Project Manager
719.439.5888



From: Ommert, Richard <rommert@auroragov.org>
Sent: Wednesday, September 27, 2023 9:41 AM
To: Eric Pearson <epearson@cagecivil.com>
Cc: Kyle Swaving <kswaving@cagecivil.com>; Chris Guyan <cguyan@cagecivil.com>; Daniel Katz <dkatz@cagecivil.com>; Bender, Janet <jbender@auroragov.org>
Subject: Re: Composite C Values for Detention Ponds

Hello Eric,

Thank you for your request for clarification. When developing impervious values for basins containing ponds, the WQCV area within the pond should assume 100% imperviousness, so option B in your email below.

Please let me know if you have any other questions.

Richard Ommert, P.E., CFM

preferred pronouns: he/him/his

Senior Engineer | City of Aurora

email rommert@auroragov.org | office 303.739.7314



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From: Eric Pearson <epearson@cagecivil.com>

Sent: Tuesday, September 26, 2023 3:59 PM

To: Bender, Janet <jbender@auroragov.org>; Ommert, Richard <rommert@auroragov.org>

Cc: Kyle Swaving <kswaving@cagecivil.com>; Chris Guyan <cguyan@cagecivil.com>; Daniel Katz <dkatz@cagecivil.com>

Subject: Composite C Values for Detention Ponds

Janet & Richard – Hope you are doing well!

We may be missing it in the code, but we wanted to get clarification of how COA determines the imperviousness for ponds... as we have been discussing among each other and can't come to an agreement.

- A. Is the pond to be considered to be 100% landscaping as the EDB is typically dry?
- B. Is the pond WQ WSEL considered to be 100% imperviousness?
- C. Is the pond ERUV WSEL considered to be 100% imperviousness?
- D. Something else...

Thanks in advance for you time and consideration -



Eric Pearson, P.E.
Director of Operations - Colorado



M: 720-206-6625
P: 630-598-0007

epearson@cagecivil.com
www.cagecivil.com

405 Urban Street, Suite 404
Lakewood, CO 80228

vCard



John Ebers

From: John Costello <john.costello@respec.com>
Sent: Friday, March 8, 2024 9:41 AM
To: Couture, Sarah
Cc: Jessica Nolle
Subject: RE: Highline Canal Model - Request for information

Sarah,

We are currently looking to update the model results published on the HighlineCanalColorado.com website to reflect the most up-to-date information. There was a spill in that location in previous version of the model. The image below has the 100-yr peak flows in the canal at each junction and the spill peak flows out of the canal (the teal lines), there are no longer spills in this area. Please let me or Jessie Nolle know if you have any further questions or concerns.



Cheers,



John J. Costello IV, PhD

Engineer III

RESPEC

720 S. Colorado Blvd., Ste. 410 S.
Denver, CO 80246

720.775.6418 // c. 612.839.6848



From: Couture, Sarah <SCouture@auroragov.org>

Sent: Wednesday, March 6, 2024 3:50 PM

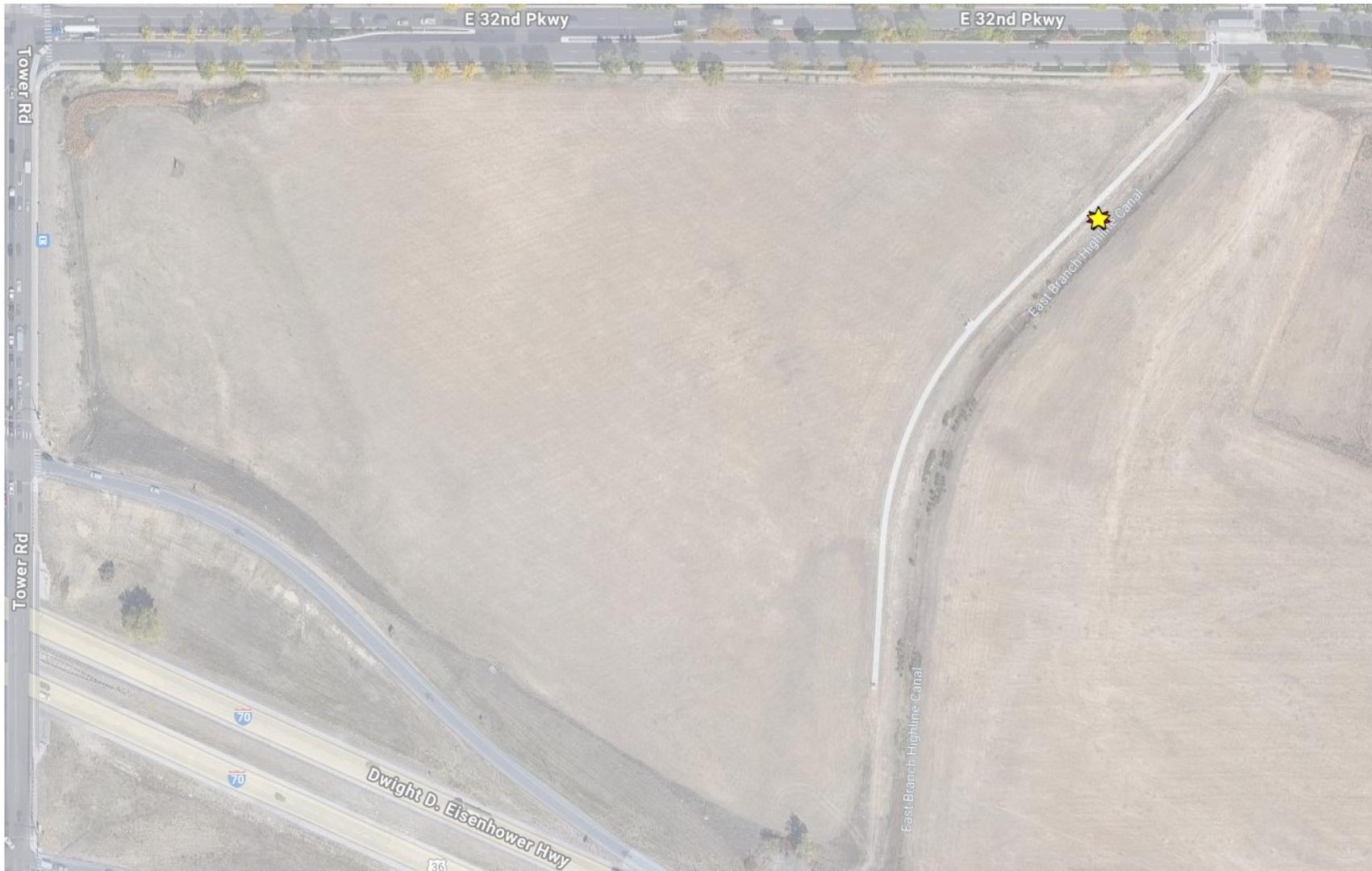
To: John Costello <john.costello@respec.com>

Subject: Highline Canal Model - Request for information

Hi John,

I have another question about the Highline Canal model.

There is a marked spill at this location near tower road and 32nd pkwy in Aurora.



There are two options, Canal Spills (irrigation flows) = 144 cfs and Canal Spills = 94.16 for this spill. Can you please clarify which flow rate is the overflow flow rate in the 100-year event? George let me know that the canal is not used for irrigation flows – and I want to confirm if we should be using the 94.16 cfs value then.

Thank you for your time,

Sarah Couture, EIT
preferred pronouns: she/her/hers

Drainage Engineer
City of Aurora | Water

Email: scouture@auroragov.org

Office: 303.739.1796



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Updated City of Aurora Storm Drainage Criteria now available. [Download here.](#)

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