FINAL

Drainage Study and Stormwater Quality Plan

Amble Site Improvements

Original Date: October 5, 2022
Final: December 15, 2023

Prepared by: Matthew Eggen, P.E.

NOTE

City of Steamboat Springs plan review and approval is only for general conformance with City design criteria and the City code. The City is not responsible for the accuracy and adequacy of the design, dimensions, and elevations that shall be confirmed and correlated at the job site. The City of Steamboat Springs assumes no responsibility for the completeness or accuracy of this document

LANDMARK CONSULTANTS, INC.
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CERTIFICATION

I hereby affirm that this Drainage Study and Stormwater Quality Plan for Amble Site Improvements was prepared by me (or under my direct supervision) for the owners thereof and is, to the best of my knowledge, in accordance with the provisions of the City of Steamboat Springs Storm Drainage Criteria and approved variances. I understand that the City of Steamboat Springs does not and will not assume liability for drainage facilities designed by others.

MATTHEW CARL EGGEN
50740
12/15/23

NOT VALID WITHOUT ORIGINAL
SIGNATURE AND DATE

Matthew Eggen, P.E.
State of Colorado No. 50740

INTRODUCTION AND LOCATION

The purpose of this drainage study and stormwater quality plan is to develop an analysis of stormwater runoff and drainage structures required for Amble Site Improvements. Included in this study are all the base data, methods, assumptions, and calculations for the stormwater management system for the development of the property.

The facts and opinions expressed in this report are based on Landmark Consultants, Inc.'s (Landmark's) understanding of the project and data gathered from:

- Site visit (spring 2023)
- Steamboat Springs GIS data
- NRCS soil maps
- FEMA FIRM Community Panel Numbers 08107-CO883-D (February 4, 2005)
- Detailed field survey by Landmark Consultants, Inc.
- Citywide Stormwater Master Plan, March 2013.
- References listed at the end of this report

The subject property is approximately 4.31 acres in size. It is in the Northeast ¼ of Section 28, Township 6 North, Range 84 West of the 6th Principal Meridian, City of Steamboat Springs, Routt County, Colorado.

Specifically, the site is located in the center of Mount Werner Circle, south of the Steamboat Grand and north of the West Condominiums. The proposed construction will be limited to a disturbance area of approximately 5.94-acres below 7000-feet in elevation.

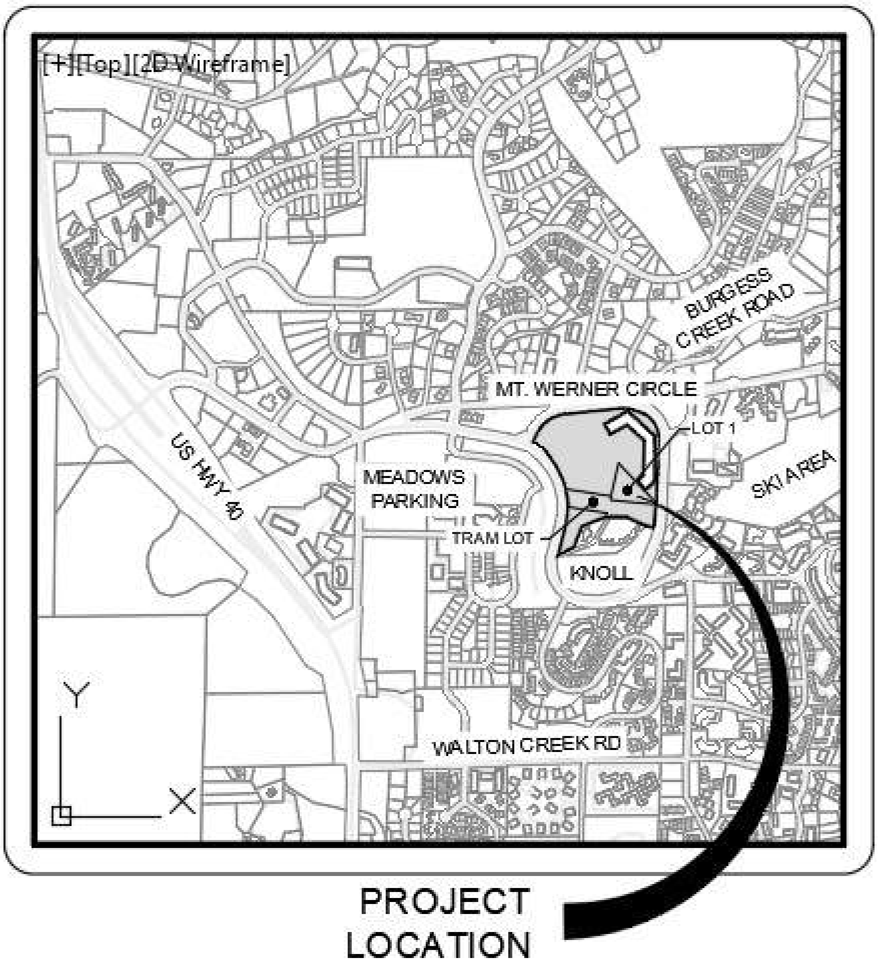


Figure 1- Vicinity Map

The existing site sits atop a knoll of native vegetation grasses. Cutting through the site are three (3) asphalt trails/accesses running generally north to south. The two on the east are pedestrian trails and the western asphalt access is an emergency access road for the Steamboat Grand. There also exists a gondola tram line with five (5) tram towers that runs east to west.

The project proposes the construction of a paved internal private access roadway to access lot 1, a paved emergency access to the Steamboat Grand, and over lot grading of Lot 1. One proposed water quality/detention facility will receive the runoff from the impervious and snowstorage surfaces.

DRAINAGE CRITERIA AND METHODOLOGY

Landmark prepared this report in accordance with *City of Steamboat Springs Engineering Standards, Section 5.0, Drainage Criteria* effective September 2007 and updated July 2019. The methods used by Landmark are described below and the actual calculations are presented in the Appendices. The scope of this report is limited to flow determinations related to the described hydrological storm event. This report does not attempt to model subsurface flows nor is it intended to be used in the design of structure features including foundation drains and roof drains.

Design Rainfall and Runoff Frequency

Landmark used the 5-year, 24-hour storm to analyze the minor storm event and the 100-year, 24-hour storm for the major storm event. Landmark used the Rational Method to determine peak runoff of small basins to design the on-site storm water runoff infrastructure associated with this project. The minimum time of concentration (t_c) used for this analysis is 5 minutes, based on the recommendations for urbanized watersheds found in Section 5.2.6.1 of the *Drainage Criteria*.

Storm Sewer Design

Storm sewers were designed and evaluated using Autodesk’s Storm and Sanitary Sewer Analysis, which uses hydrodynamic routing. Storm sewers were sized to convey the minor storm event so that the HGL does not exceed the ground elevation however, the storm sewers convey the major storm event as well. In general, channels and roadside ditches are designed so that the Froude number during the major storm does not exceed 0.8.

Stormwater Quality

The project uses the WQCV design standard to provide stormwater quality treatment in the form of a sand filter designed per the parameters recommended in Volume 3 of the Mile High Flood District’s Criteria Manual. This standard was chosen due to the expected low pollutant load and its widespread applicability.

EXISTING SITE CONDITIONS

The historic condition of the site is an undeveloped lot (4.35 acres) that is vacant and covered with native grasses. In this report the term “historic condition” refers to the conditions of the site prior to any construction activity and may also be referred to as the “pre-development condition” or “existing condition”.

Figure 2: Existing Conditions shows the features of the site prior to development.

Currently the site is vacant (except for the three (3) asphalt surfaced trails/accesses) and covered by well-established native grasses, shrubs, and trees. The site slopes to the east and to the west from a large knoll which delineates the drainage.

The existing site is evaluated as two drainage basins. Basin H1 contains the west draining slopes of Lot 1 and the Tram Lot, as well as the westerly portion of the West Condominiums development. Basin H1 drainage is collected in a roadside ditch on the east side of Mt Werner Circle and routed into an existing 24” CMP culvert under Mt Werner Circle and outfalls into the Wildhorse Meadows subdivision, which ultimately outfalls to a storm sewer system under Ski Town Park and into the Yampa River.

Basin H2 contains the east draining slopes of Lot 1, and a portion of the grand building, Mt Werner Circle, and the West Condominiums. Basin H2 drainage is collected in a series of roadside ditches and culverts, which ultimately outfalls into Burgess Creek and from there into the Yampa River.

A review of the NRCS soil data for the area indicates the site is dominated by NRCS HSG C soils which are soils having a slow infiltration rate when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.

FEMA FLOODPLAIN

Landmark reviewed FEMA FIRM Community Panel Numbers 08107-CO883-D (February 4, 2005) and no portions of the property are within the 100yr and 500yr floodplains.

PROPOSED SITE CONDITIONS

This project proposes the construction of a paved internal private access roadway to access lot 1, a paved emergency access to the Steamboat Grand, and over lot grading of Lot 1. Lot 1 is expected to be developed for multifamily condominium and the Tram Lot is expected to be developed for an aerial tramway and related facilities. Table 6-3 from Urban Drainage for recommended percentage imperviousness values was used to estimate future development imperviousness. Lot 1 was assumed at 70% impervious (slightly less than the 75% recommended for “Apartments” as there will be small portions of the lot not developed due to steep slopes). The Tram Lot was assumed at 20% impervious (Conservative estimate for impervious improvements to include tram towers, access paths, and covered tram turn station). The total disturbed area (including all of Lot 1 and the Tram Lot) is expected to be about 5.94-acres. The proposed development is shown in Figure 3: Proposed Conditions.

The site is divided into subbasins, D1.a-D1.f & D2. Basins D1.a-D1.f drain to the west and outfall to the culvert under Mt Werner Circle to the Wildhorse Meadows Subdivision. Basin D1.a consists of mainly existing, undisturbed areas, and a small portion of the proposed internal private access roadway. The proposed portion of basin D1.a will be routed into a proposed roadside ditch, which will outfall directly into the existing culvert under Mt Werner Circle. Basin D1.b-D1.f consists of the remainder of the west draining developed areas which include the internal private access, emergency access, Lot 1 and the Tram Lot. Basin D1.b-D1.f will be routed through swales and culverts to the proposed water quality/detention facility on the western side of the Tram Lot. The proposed facility will outfall into the existing culvert under Mt Werner Circle.

Basin D2 consists of east draining portions of Lot 1 and the Tram Lot. Drainage from these areas will remain historical as there is no proposed increase run-off.

Table 1 summarizes and compares the hydrological characteristics of the developed site and the existing site:

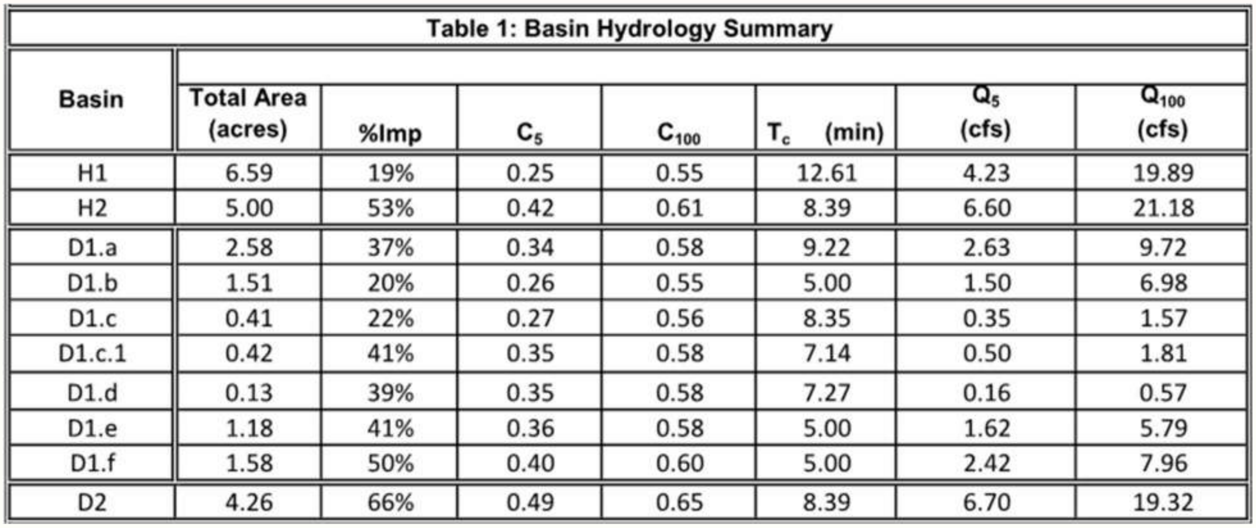


Table 1: Basin Hydrology Summary							
Basin	Total Area (acres)	%Imp	C_5	C_{100}	T_c (min)	Q_5 (cfs)	Q_{100} (cfs)
H1	6.59	19%	0.25	0.55	12.61	4.23	19.89
H2	5.00	53%	0.42	0.61	8.39	6.60	21.18
D1.a	2.58	37%	0.34	0.58	9.22	2.63	9.72
D1.b	1.51	20%	0.26	0.55	5.00	1.50	6.98
D1.c	0.41	22%	0.27	0.56	8.35	0.35	1.57
D1.c.1	0.42	41%	0.35	0.58	7.14	0.50	1.81
D1.d	0.13	39%	0.35	0.58	7.27	0.16	0.57
D1.e	1.18	41%	0.36	0.58	5.00	1.62	5.79
D1.f	1.58	50%	0.40	0.60	5.00	2.42	7.96
D2	4.26	66%	0.49	0.65	8.39	6.70	19.32

Table 2 summarizes the design points for the developed site:

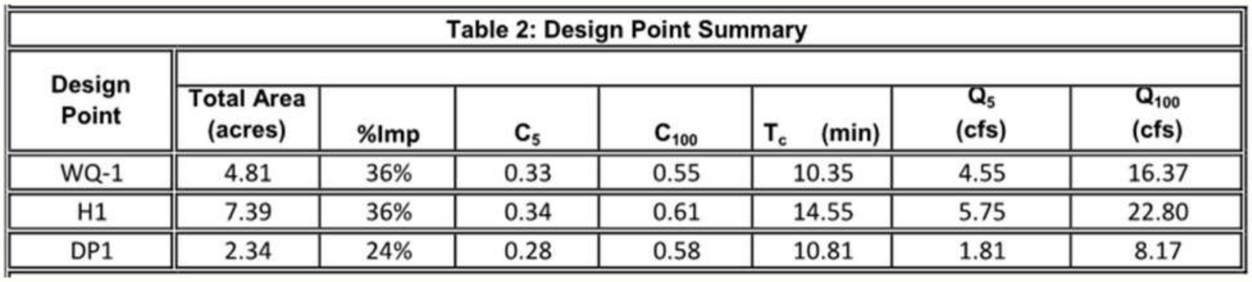


Table 2: Design Point Summary							
Design Point	Total Area (acres)	%Imp	C_5	C_{100}	T_c (min)	Q_5 (cfs)	Q_{100} (cfs)
WQ-1	4.81	36%	0.33	0.55	10.35	4.55	16.37
H1	7.39	36%	0.34	0.61	14.55	5.75	22.80
DP1	2.34	24%	0.28	0.58	10.81	1.81	8.17

Detention

The proposed development will increase the imperviousness of the site to 36% in at the design point H1 (basins D1.a - D1.f), resulting in an increase in estimated peak runoff for both the minor and major storm. A decrease in estimated peak runoff for both the minor and major storm in basin D2 as compared to basin H2 as the size of the basin has been decreased (see Table 1). The pond (pond WQ-1) will provide detention to restrict flows to historic values at H1. Table 3 summarized the detention release rates:

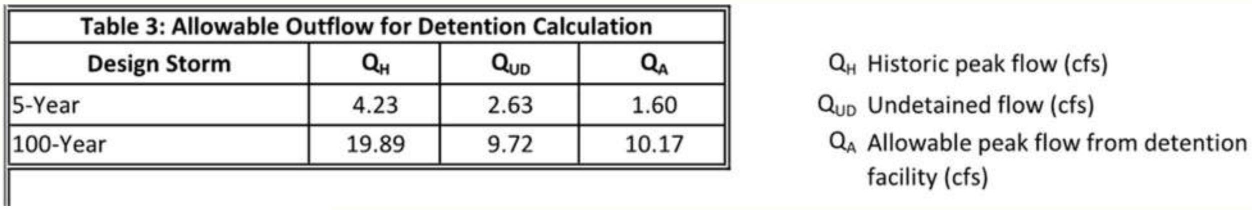


Table 3: Allowable Outflow for Detention Calculation			
Design Storm	Q_H	Q_{UD}	Q_A
5-Year	4.23	2.63	1.60
100-Year	19.89	9.72	10.17

Q_H Historic peak flow (cfs)
Q_{UD} Undetained flow (cfs)
Q_A Allowable peak flow from detention facility (cfs)

The required volume estimates for the design storms are V_5=1,835-ft^3 and V_{100}=3,854-ft^3.

Table 4 in the next section summarizes the pond volumes and other parameters.

Storm System

Storm sewer systems in general will be made up of ADS drain basins and corrugated HDPE pipe in sizes from 12" to 24". The underdrains in the ponds will be 4" HDPE perforated pipe and the outlet structure's will be CDOT type C inlets. All basin, storm-system, swale, and water quality calculations are included in the appendices.

STORMWATER QUALITY

Water quality in the Yampa River is degraded by the washing-off of accumulated deposits on the urban landscape of Steamboat Springs. Metals, salts, sand, gravel, trash, debris, and organics (including oil and gasoline) all accumulate on the streets and in parking lots of Steamboat Springs over the course of time. During a rainstorm event, these pollutants are washed into the Yampa River and its tributaries. Water quality problems caused by these pollutants include turbid water, nutrient enrichment, bacterial contamination, reduction in dissolved oxygen, and increased stress on aquatic life. The most prevalent pollutant in Steamboat Springs is sediment. BMP's included in this project are designed to minimize the amount of sediment leaving the site and entering the waterways.

Potential Pollutant Sources: The following are anticipated pollutant sources for this project:

1. Routine maintenance involving fertilizers, pesticides, detergents, fuels, solvents, oils, etc.
2. On site waste management practices (waste piles, dumpsters, etc.)

BMP Selection:

From the Mile High Flood District's (MHFD) *Urban Storm Drainage Criteria Manual* (USDCM), Volume 3, BMP selection involves many factors such as physical site characteristics, treatment objectives, aesthetics, safety, maintenance requirements, and costs. As each site is unique, there is not a standard BMP that can be implemented for every application and therefore there may be multiple solutions including stand-alone BMPs or 'treatment trains' that combine multiple BMPs to achieve the water quality objectives.

Water Quality Capture Volume:

The water quality capture volume (WQCV) is calculated following Section 5.12.7.1 of the *Design Criteria*. A drain time coefficient of 0.8 is used, based on the MHFD's recommended minimum drain time of 12 hours for SF's.

Table 4 summarizes the requirements and designs of the Water Quality Ponds:

Table 4: Water Quality Pond Summary

Basin	Sand Filter Flat Area (ft^2)		Bioretention Flat Area (ft^2)		WQCV¹ (ft^3)	Detention² V_5 (ft^3)	Detention² V_{100} (ft^3)	V_{100} + WQCV (ft^3)	Total Volume (ft^3)
	Required	Provided	Required	Provided	Required				Provided
WQ-1	935	1,574	1495	1,574	2,229	1,835	3,854	6,082	6,624
					Total Treated Area (acres)				4.24
					Total Disturbed area (acres)				5.04
					Percent Treated (%)				84%

These facilities treat approximately 84% of the site leaving 0.80-acres, or 16% of the site area untreated. A separate water quality facility for a portion of basin D2 is not feasible as it would require locating the treatment pond on a steep slope or within the right-of-way near the Gondola Transit Center that is currently looking to redevelop.

The calculations for the WQCV and BMP sizing have been included in the appendices.

Site operation can significantly manage stormwater quality and care should be exercised to monitor and maintain the BMPs described. An Operation and Maintenance Plan is included in Appendix D.

CONCLUSIONS

The improvements for the proposed development include the construction of a paved internal private access roadway to access lot 1, a paved emergency access to the Steamboat Grand, and over lot grading of Lot 1, and one water quality (sand filter)/ detention pond.

Runoff from the project will maintain historical drainage patterns with all flow discharging to the existing culvert under Mt Werner Circle to the west and to the existing roadside ditch to the east.

The runoff from developed areas will be treated in the sand filter. Although the proposed development will increase the estimated peak flows from the site, the sand filter pond will also provide detention for the project by restricting flows to historic values.

In order to operate as intended, on-going maintenance and inspection of storm systems, swales and the sand filters will be required.

LIMITATIONS

This study is intended to estimate and analyze peak stormwater runoff volumes generated by hydrologic events in order to evaluate existing drainage infrastructure and design new infrastructure needed to manage these flows. It does not account for groundwater, springs, or seeps and is not intended to be used for the evaluation or design of foundation drains or roof drains.

Basin delineations, areas, and soil characteristics are based on those described in the Report. Actual conditions may vary. Landmark's assumptions, recommendations and opinions are based on this information and the proposed site plan. If any of the data is found to be inaccurate or the proposed site plan is changed, Landmark should be contacted to review this report and make any necessary revisions.

The data, opinions, and recommendations of this report are applicable to the specific design elements and location that is the subject of this report. This report is not applicable to any other design elements or to any other locations. Any and subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendation without the prior written consent of Landmark Consultants, Inc.

Landmark Consultants, Inc. has no responsibility for construction means, methods, techniques, sequences, or procedures, or for safety precautions or programs in connection with the construction, for the acts or omissions of the contractor, or any other person performing any of the construction, or for the failure of any of them to carry out the construction in accordance with the Final Construction Drawings and Specifications.

The only warranty or guarantee made by Landmark Consultants, Inc. in connection with the services performed for this project is that such services are performed with the care and skill ordinarily exercised by members of the profession practicing under similar conditions, at the same time, and in the same or similar locality. No other warranty, expressed or implied, is made or intended by rendering such services or by furnishing written reports of the findings.

REFERENCES

1. Section 5.0 Drainage Criteria, City of Steamboat Springs Department of Public Works, July 2019.
2. Drainage Criteria Manual (Volumes 1 – 3), Mile High Flood District's (MHFD), 2019
3. Hydraulic Design of Energy Dissipators for Culverts and Channels (HEC 14), Federal Highway Administration, September 1983
4. Hydraulic Design of Highway Culverts (HDS-5), Federal Highway Administration, September 2001
5. Procedures for Determining Peak Flows in Colorado, Natural Resource Conservation Service, 1984
6. Urban Hydrology for Small Watersheds (TR-55), Natural Resource Conservation Service, June 1986
7. Citywide Stormwater Master Plan, City of Steamboat Springs, Colorado, SEH, March 2013.

APPENDIX A

HYDROLOGIC CALCULATIONS

Table 6-3. Recommended percentage imperviousness values

Land Use or Surface Characteristics	Percentage Imperviousness (%)
Business:	
Downtown Areas	95
Suburban Areas	75
Residential lots (lot area only)**:**	
Single-family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	2
Lawns, clayey soil	2

Table 6-5. Runoff coefficients, *c*

Total or Effective % Impervious	NRCS Hydrologic Soil Group A						
	2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**	**500-Year**
2%	0.01	0.01	0.01	0.01	0.04	0.13	0.27
5%	0.02	0.02	0.02	0.03	0.07	0.15	0.29
10%	0.04	0.05	0.05	0.07	0.11	0.19	0.32
15%	0.07	0.08	0.08	0.1	0.15	0.23	0.35
20%	0.1	0.11	0.12	0.14	0.2	0.27	0.38
25%	0.14	0.15	0.16	0.19	0.24	0.3	0.42
30%	0.18	0.19	0.2	0.23	0.28	0.34	0.45
35%	0.21	0.23	0.24	0.27	0.32	0.38	0.48
40%	0.25	0.27	0.28	0.32	0.37	0.42	0.51
45%	0.3	0.31	0.33	0.36	0.41	0.46	0.54
50%	0.34	0.36	0.37	0.41	0.45	0.5	0.58
55%	0.39	0.4	0.42	0.45	0.49	0.54	0.61
60%	0.43	0.45	0.47	0.5	0.54	0.58	0.64
65%	0.48	0.5	0.51	0.54	0.58	0.62	0.67
70%	0.53	0.55	0.56	0.59	0.62	0.65	0.71
75%	0.58	0.6	0.61	0.64	0.66	0.69	0.74
80%	0.63	0.65	0.66	0.69	0.71	0.73	0.77
85%	0.68	0.7	0.71	0.74	0.75	0.77	0.8
90%	0.73	0.75	0.77	0.79	0.79	0.81	0.84
95%	0.79	0.81	0.82	0.83	0.84	0.85	0.87
100%	0.84	0.86	0.87	0.88	0.88	0.89	0.9
Total or Effective % Impervious	**NRCS Hydrologic Soil Group B**						
	2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**	**500-Year**
2%	0.01	0.01	0.07	0.26	0.34	0.44	0.54
5%	0.03	0.03	0.1	0.28	0.36	0.45	0.55
10%	0.06	0.07	0.14	0.31	0.38	0.47	0.57
15%	0.09	0.11	0.18	0.34	0.41	0.5	0.59
20%	0.13	0.15	0.22	0.38	0.44	0.52	0.61
25%	0.17	0.19	0.26	0.41	0.47	0.54	0.63
30%	0.2	0.23	0.3	0.44	0.49	0.57	0.65
35%	0.24	0.27	0.34	0.47	0.52	0.59	0.66
40%	0.29	0.32	0.38	0.5	0.55	0.61	0.68
45%	0.33	0.36	0.42	0.53	0.58	0.64	0.7
50%	0.37	0.4	0.46	0.56	0.61	0.66	0.72
55%	0.42	0.45	0.5	0.6	0.63	0.68	0.74
60%	0.46	0.49	0.54	0.63	0.66	0.71	0.76
65%	0.5	0.54	0.58	0.66	0.69	0.73	0.77
70%	0.55	0.58	0.62	0.69	0.72	0.75	0.79
75%	0.6	0.63	0.66	0.72	0.75	0.78	0.81
80%	0.64	0.67	0.7	0.75	0.77	0.8	0.83
85%	0.69	0.72	0.74	0.78	0.8	0.82	0.85
90%	0.74	0.76	0.78	0.81	0.83	0.84	0.87
95%	0.79	0.81	0.82	0.85	0.86	0.87	0.88
100%	0.84	0.86	0.86	0.88	0.89	0.89	0.9

Table 6-5. Runoff coefficients, *c* (continued)

Total or Effective % Impervious	NRCS Hydrologic Soil Group C						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
2%	0.01	0.05	0.15	0.33	0.40	0.49	0.59
5%	0.03	0.08	0.17	0.35	0.42	0.5	0.6
10%	0.06	0.12	0.21	0.37	0.44	0.52	0.62
15%	0.1	0.16	0.24	0.4	0.47	0.55	0.64
20%	0.14	0.2	0.28	0.43	0.49	0.57	0.65
25%	0.18	0.24	0.32	0.46	0.52	0.59	0.67
30%	0.22	0.28	0.35	0.49	0.54	0.61	0.68
35%	0.26	0.32	0.39	0.51	0.57	0.63	0.7
40%	0.3	0.36	0.43	0.54	0.59	0.65	0.71
45%	0.34	0.4	0.46	0.57	0.62	0.67	0.73
50%	0.38	0.44	0.5	0.6	0.64	0.69	0.75
55%	0.43	0.48	0.54	0.63	0.66	0.71	0.76
60%	0.47	0.52	0.57	0.65	0.69	0.73	0.78
65%	0.51	0.56	0.61	0.68	0.71	0.75	0.79
70%	0.56	0.61	0.65	0.71	0.74	0.77	0.81
75%	0.6	0.65	0.68	0.74	0.76	0.79	0.82
80%	0.65	0.69	0.72	0.77	0.79	0.81	0.84
85%	0.7	0.73	0.76	0.79	0.81	0.83	0.86
90%	0.74	0.77	0.79	0.82	0.84	0.85	0.87
95%	0.79	0.81	0.83	0.85	0.86	0.87	0.89
100%	0.83	0.85	0.87	0.88	0.89	0.89	0.9

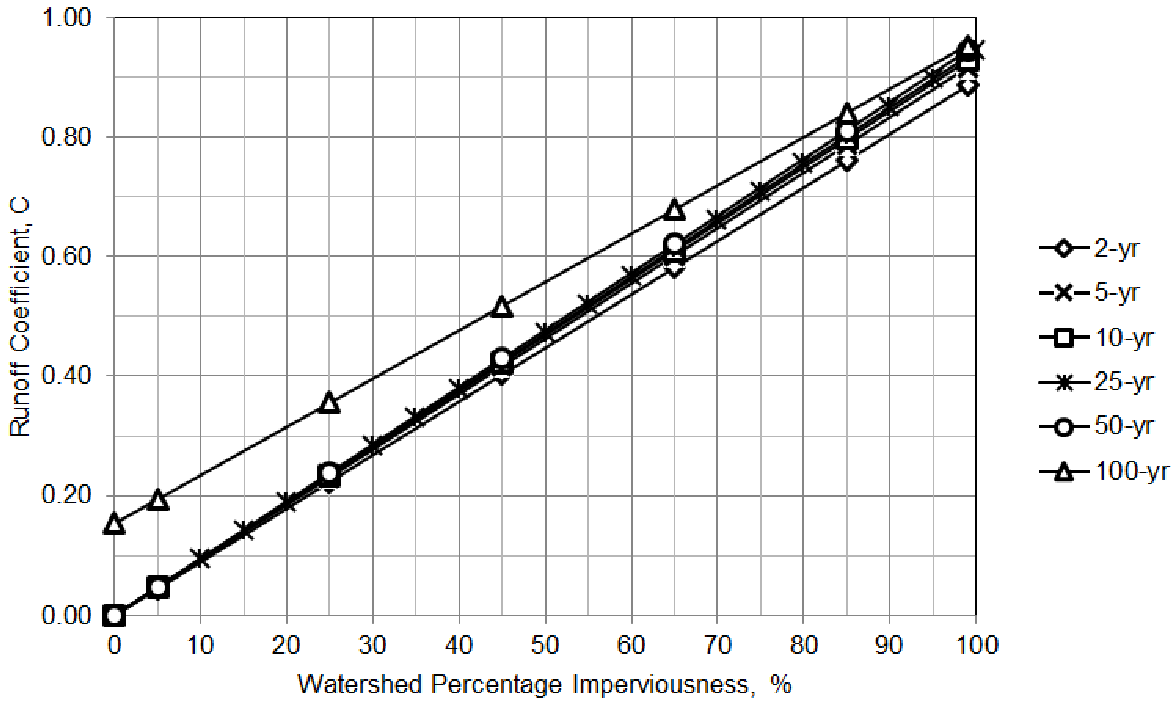


Figure 6-1. Runoff coefficient vs. watershed imperviousness NRCS HSG A

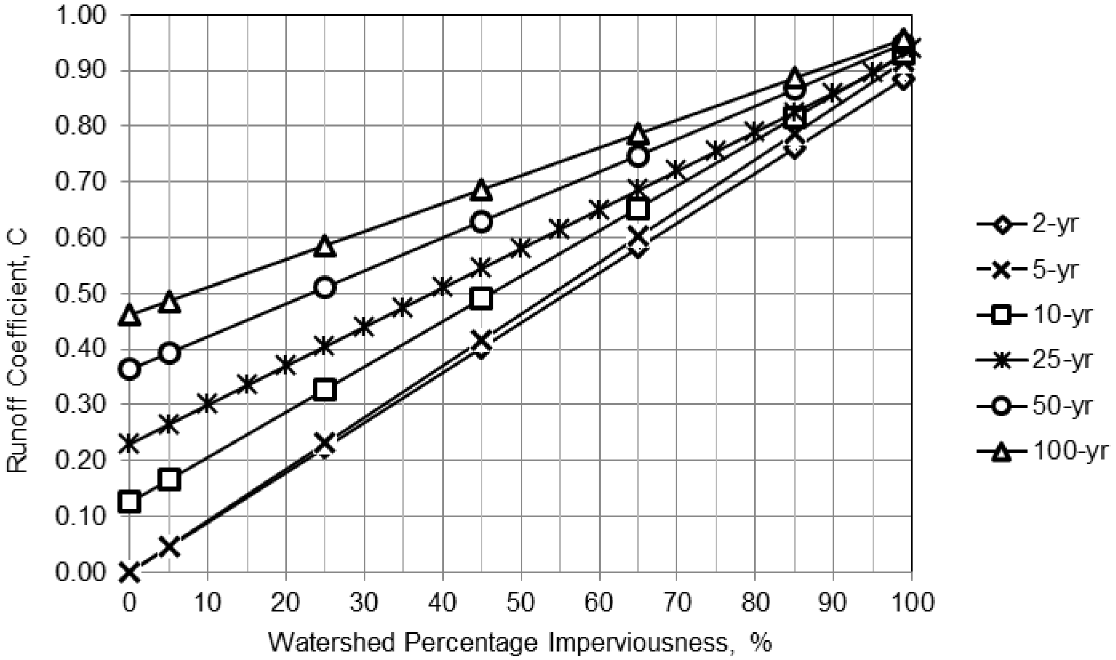


Figure 6-2. Runoff coefficient vs. watershed imperviousness NRCS HSG B

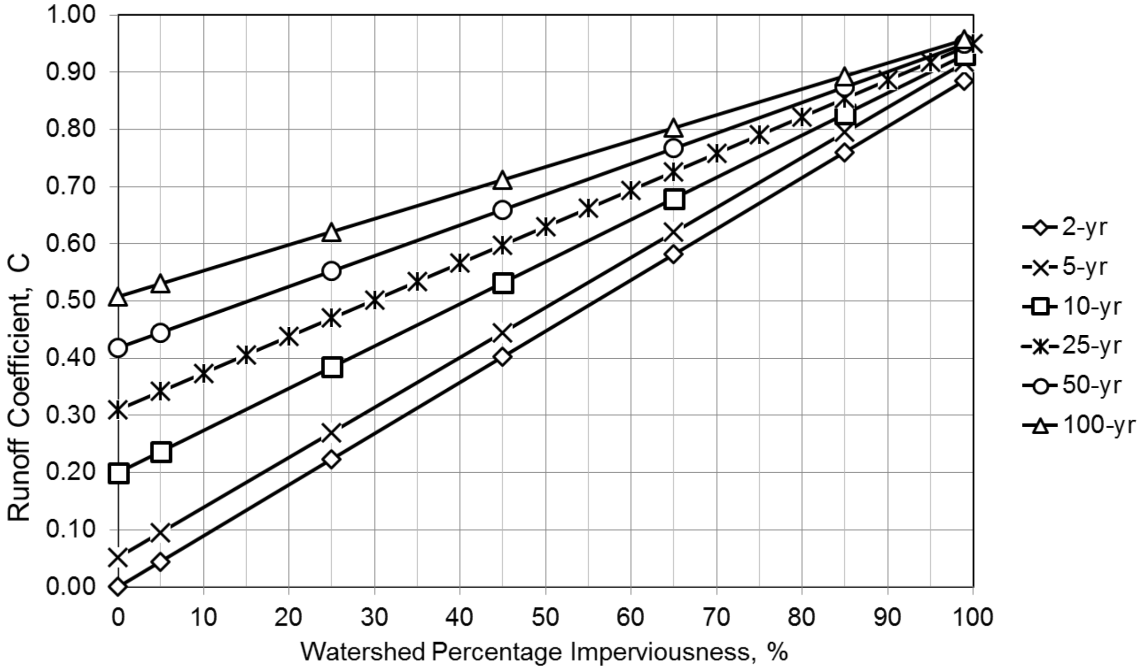
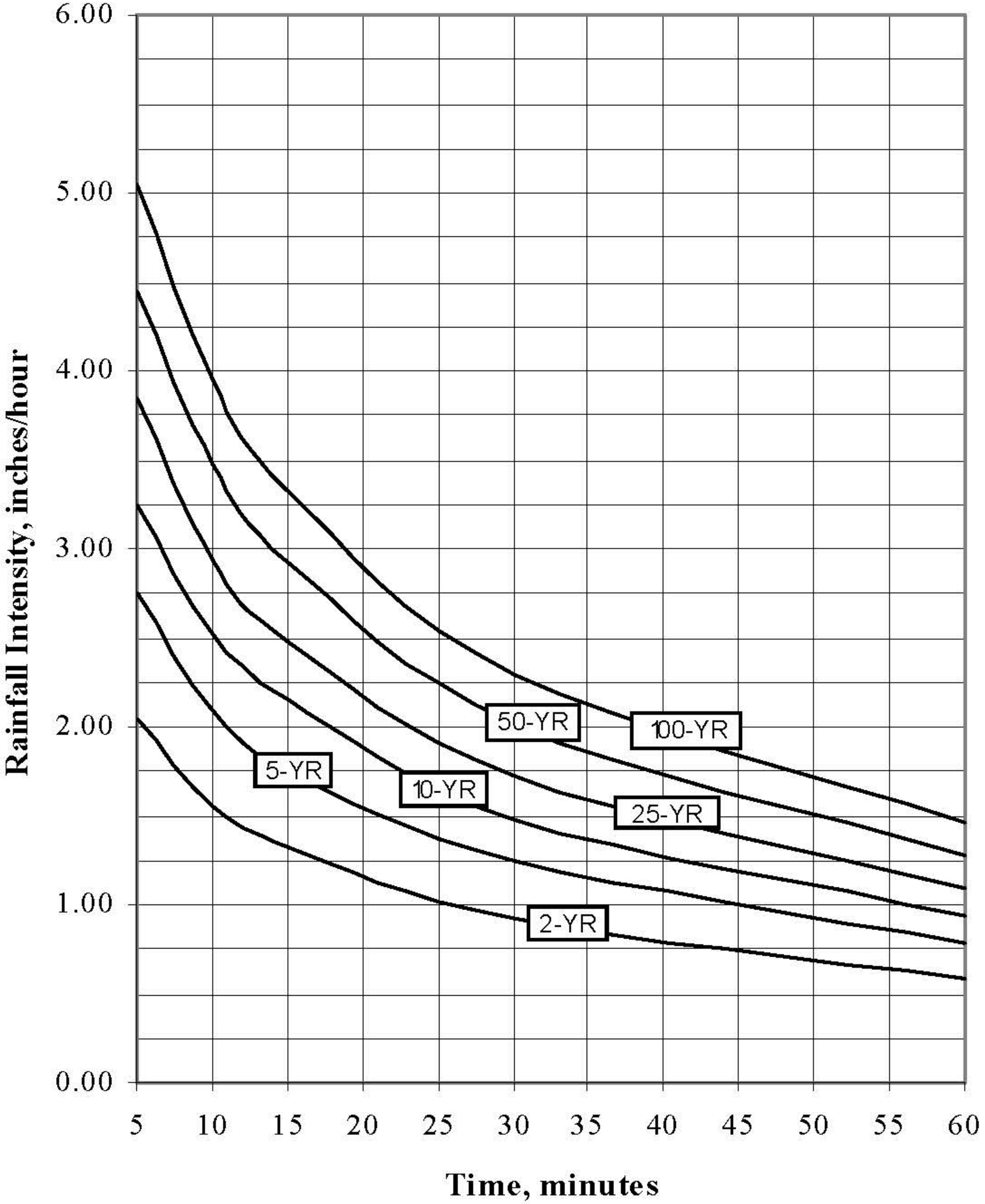


Figure 6-3. Runoff coefficient vs. watershed imperviousness NRCS HSG C and D

Figure 5.5.1 Intensity – Duration – Frequency Curves



Hydrologic Soil Group—Routt Area, Colorado, Parts of Rio Blanco and Routt Counties
(Gondola Transit Center)

Map Scale: 1:4,110 if printed on A portrait (8.5" x 11") sheet.

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

MAP LEGEND

Area of Interest (AOI)

- ▭ Area of Interest (AOI)

Soils

Soil Rating Polygons

- 🟪 A
- 🟩 A/D
- 🟦 B
- 🟫 B/D
- 🟦 C
- 🟨 C/D
- 🟥 D
- ⬜ Not rated or not available

Soil Rating Lines

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

Soil Rating Points

- ■ A
- ■ A/D
- ■ B
- ■ B/D
- ■ C
- ■ C/D
- ■ D
- □ Not rated or not available

Water Features

- 〰 Streams and Canals

Transportation

- ┼┼┼ Rails
- 〰 Interstate Highways
- 〰 US Routes
- 〰 Major Roads
- 〰 Local Roads

Background

- ▨ Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
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: Routt Area, Colorado, Parts of Rio Blanco and Routt Counties
Survey Area Data: Version 11, Sep 2, 2021

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

Date(s) aerial images were photographed: May 8, 2012—Oct 5, 2017

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
50F	Routt loam, 25 to 65 percent slopes, very stony	C	53.8	70.3%
52A	Slocum loam, 0 to 3 percent slopes	C/D	6.3	8.2%
133	Lintim loam, 3 to 25 percent slopes	C	16.4	21.4%
Totals for Area of Interest			**76.5**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX B

HYDRAULIC CALCULATIONS

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DATE: 12/15/2023
POND ID:

BASIN RUNOFF COEFFICIENT CALCULATIONS

Character of Surface	Percent Impervious
Asphalt Parking and Walkways	100%
Gravel	40%
Roof	90%
Lawns and Landscaping	2%
Assumed Imperviousness (Lot 1)	70%
Assumed Imperviousness (Tram Lot)	20%

IDF	Soil Type
Steamboat Springs NOAA	C

Basin ID	Basin Area (sq.ft.)	Basin Area (acres)	Area of Asphalt Parking and Walkways (sq.ft.)	Area of Asphalt Parking and Walkways (acres)	Area of Gravel Surfaces (sq.ft)	Area of Gravel Surfaces (acres)	Area of Roof (sq.ft.)	Area of Roof (acres)	Area of Lawns and Landscaping (sq.ft.)	Area of Lawns and Landscaping (acres)	Assumed Imperviousness (sq.ft.)	Assumed Imperviousness (acres)	Assumed Imperviousness (sq.ft.)	Assumed Imperviousness (acres)	Percent Impervious	5-year Composite Runoff Coefficient	100-year Composite Runoff Coefficient
H1	287133.00	6.59	43666.00	1.00	0.00	0.00	6017.00	0.14	237450.00	5.45	0.00	0.00	0.00	0.00	19%	0.25	0.55
H2	217961.00	5.00	78961.00	1.81	0.00	0.00	37954.00	0.87	101046.00	2.32	0.00	0.00	0.00	0.00	53%	0.42	0.61
D1.a	112208.00	2.58	38970.00	0.89	0.00	0.00	0.00	0.00	65109.00	1.49	0.00	0.00	8129.00	0.19	37%	0.34	0.58
D1.b	65830.00	1.51	6672.00	0.15	0.00	0.00	0.00	0.00	30267.00	0.69	0.00	0.00	28891.00	0.66	20%	0.26	0.55
D1.c	17771.00	0.41	3643.00	0.08	0.00	0.00	0.00	0.00	14128.00	0.32	0.00	0.00	0.00	0.00	22%	0.27	0.56
D1.c.1	18402.00	0.42	1239.00	0.03	0.00	0.00	6749.00	0.15	10414.00	0.24	0.00	0.00	0.00	0.00	41%	0.35	0.58
D1.d	5845.00	0.13	2212.00	0.05	0.00	0.00	0.00	0.00	3633.00	0.08	0.00	0.00	0.00	0.00	39%	0.35	0.58
D1.e	51353.00	1.18	1465.00	0.03	0.00	0.00	0.00	0.00	3188.00	0.07	20801.00	0.48	25899.00	0.59	41%	0.36	0.58
D1.f	68763.00	1.58	7297.00	0.17	12308.00	0.28	0.00	0.00	18238.00	0.42	30920.00	0.71	0.00	0.00	50%	0.40	0.60
D2	185693.00	4.26	74420.00	1.71	0.00	0.00	37954.00	0.87	28485.00	0.65	7081.00	0.16	37753.00	0.87	66%	0.49	0.65

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BASIN TIME OF CONCENTRATION CALCULATIONS

Overland Flow, Time of Concentration:

$$T_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{1/3}}$$ (Equation RO-3)

Gutter/Swale Flow, Time of Concentration:

T_t = L / 60V

T_c = T_i + T_t (Equation RO-2)

Intensity, i From Figures 3.3.1-2 (Area II)

Velocity (Gutter Flow), V = 20·$S^{1/2}$

Velocity (Swale Flow), V = 15·$S^{1/2}$

Rational Equation: Q = CiA (Equation RO-1)

	Overland Flow 1				Conveyance		Swale Flow 1				Conveyance		Swale Flow 2				Time of Concentration		
Basin(s)	C_5*	Length, L (ft)	Slope, S (%)	T_i (min)		K	Length, L (ft)	Slope, S (%)	Velocity, V (ft/s)	T_t (min)		K	Length, L (ft)	Slope, S (%)	Velocity, V (ft/s)	T_t (min)	Comp. T_c (min)	$\frac{L}{180}+10$	Actual T_c (min)
H1	**0.25**	100	35.70	4.71	**Short Pasture and Lawns**	**7**	515	4.30	4.15	5.91	**Short Pasture and Lawns**	**7**	**355**	18.20	8.53	1.98	12.61	15.39	12.61
H2	**0.42**		N/A	N/A	**Shallow Paved Swales**	**20**	726	4.00	4.00	3.03	**Short Pasture and Lawns**	**7**	**451**	4.00	4.00	5.37	8.39	16.54	8.39
D1.a	**0.90**	100	7.30	1.89	**Shallow Paved Swales**	**20**	140	4.10	4.05	0.58	**Grassed Waterway**	**15**	**1200**	3.90	3.95	6.75	9.22	18.00	9.22
D1.b	**0.26**		NA	N/A	**Grassed Waterway**	**15**	331	1.60	2.53	2.91	**Shallow Paved Swales**	**20**			N/A	N/A	2.91	11.84	5.00
D1.c	**0.27**	100	10.00	7.06	**Shallow Paved Swales**	**20**	169	1.20	2.19	1.29	**Shallow Paved Swales**	**20**			N/A	N/A	8.35	11.49	8.35
D1.c.1	**0.35**	100	10.10	6.34	**Shallow Paved Swales**	**20**	253	7.00	5.29	0.80	**Shallow Paved Swales**	**20**			N/A	N/A	7.14	11.96	7.14
D1.d	**0.35**	100	7.50	7.04	**Shallow Paved Swales**	**20**	73	7.00	5.29	0.23	**Short Pasture and Lawns**	**7**			N/A	N/A	7.27	10.96	7.27
D1.e	**0.36**		NA	N/A	**Shallow Paved Swales**	**20**	330	3.50	3.74	1.47	**Grassed Waterway**	**15**	**85**	6.00	4.90	0.39	1.86	12.31	5.00
D1.f	**0.40**		NA	N/A	**Shallow Paved Swales**	**20**	500	1.00	2.00	4.17	**Shallow Paved Swales**	**20**			N/A	N/A	4.17	12.78	5.00
D2	**0.49**		N/A	N/A	**Shallow Paved Swales**	**20**	726	4.00	4.00	3.03	**Short Pasture and Lawns**	**7**	**451**	4.00	4.00	5.37	8.39	16.54	8.39

Note: C_5 for overland flow is C value for that segment of flow, not overall basin C_5

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DIRECT RUNOFF COMPUTATIONS

Overland Flow, Time of Concentration:

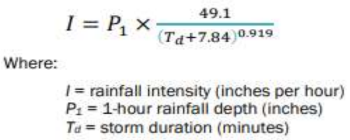
$$T_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{1/3}}$$ (Equation RO-3)

Gutter/Swale Flow, Time of Concentration:

$T_t = L / 60V$

$T_c = T_i + T_t$ (Equation RO-2)

Intensity, I from Equation 1



$$I = P_1 \times \frac{49.1}{(T_d + 7.84)^{0.919}}$$

Where:

I = rainfall intensity (inches per hour)
P_1 = 1-hour rainfall depth (inches)
T_d = storm duration (minutes)

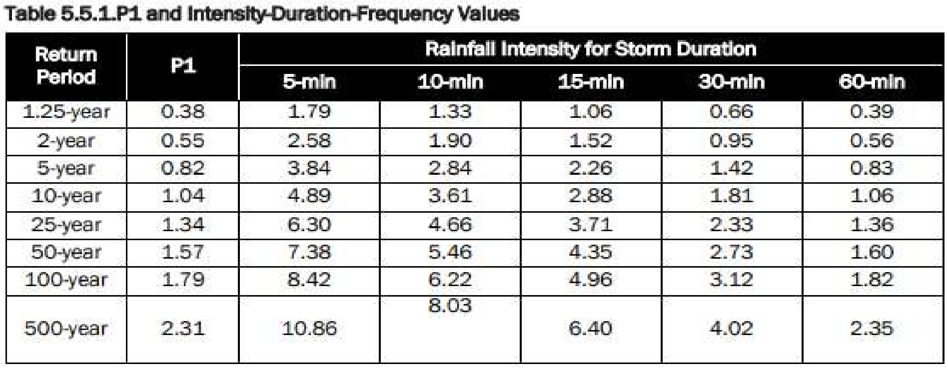


Table 5.5.1.P1 and Intensity-Duration-Frequency Values

Return Period	P1	Rainfall Intensity for Storm Duration				
		5-min	10-min	15-min	30-min	60-min
1.25-year	0.38	1.79	1.33	1.06	0.66	0.39
2-year	0.55	2.58	1.90	1.52	0.95	0.56
5-year	0.82	3.84	2.84	2.26	1.42	0.83
10-year	1.04	4.89	3.61	2.88	1.81	1.06
25-year	1.34	6.30	4.66	3.71	2.33	1.36
50-year	1.57	7.38	5.46	4.35	2.73	1.60
100-year	1.79	8.42	6.22	4.96	3.12	1.82
500-year	2.31	10.86	8.03	6.40	4.02	2.35

Velocity (Gutter Flow), $V = 20 \cdot S^{1/2}$

Velocity (Swale Flow), $V = 15 \cdot S^{1/2}$

Rational Equation: $Q = CiA$ (Equation RO-1)

Basin(s)	Area, A (acres)	T_c (min)	C_5	C_{100}	Intensity, I_5 (in/hr)	Intensity, I_{100} (in/hr)	Flow, Q_5 (cfs)	Q_5 per Acre (cfs/ac)	Flow, Q_{100} (cfs)	Q_{100} per Acre (cfs/ac)
H1	6.59	12.61	0.25	0.55	2.53	5.52	4.23	0.64	19.89	3.02
H2	5.00	8.39	0.42	0.61	3.18	6.94	6.60	1.32	21.18	4.23
D1.a	2.58	9.22	0.34	0.58	3.01	6.56	2.63	1.02	9.72	3.77
D1.b	1.51	5.00	0.26	0.55	3.86	8.42	1.50	0.99	6.98	4.62
D1.c	0.41	8.35	0.27	0.56	3.18	6.94	0.35	0.86	1.57	3.85
D1.c.1	0.42	7.14	0.35	0.58	3.38	7.37	0.50	1.19	1.81	4.28
D1.d	0.13	7.27	0.35	0.58	3.38	7.37	0.16	1.17	0.57	4.27
D1.e	1.18	5.00	0.36	0.58	3.86	8.42	1.62	1.37	5.79	4.91
D1.f	1.58	5.00	0.40	0.60	3.86	8.42	2.42	1.53	7.96	5.04
D2	4.26	8.39	0.49	0.65	3.18	6.94	6.70	1.57	19.32	4.53

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COMBINED RUNOFF COEFFICIENT CALCULATIONS

Character of Surface	Percent Impervious
Asphalt Parking and Walkways	100%
Gravel	40%
Roof	90%
Lawns and Landscaping	2%
Assumed Imperviousness	70%
Assumed Imperviousness (Tram Lot)	20%

Design Point	Combined Basin IDs	Basin Area (sq.ft.)	Basin Area (acres)	Area of Asphalt Parking and Walkways (sq.ft.)	Area of Asphalt Parking and Walkways (acres)	Area of Gravel Surfaces (sq.ft)	Area of Gravel Surfaces (acres)	Area of Roof (sq.ft.)	Area of Roof (acres)	Area of Lawns and Landscaping (sq.ft.)	Area of Lawns and Landscaping (acres)	Assumed Imperviousness (sq.ft.)	Assumed Imperviousness (acres)	Assumed Imperviousness (sq.ft.)	Assumed Imperviousness (acres)	Percent Impervious	5-year Composite Runoff Coefficient	100-year Composite Runoff Coefficient
WQ-1	D1.b + D1.c+D1.d+D1.e+D1.f	227964.00	4.81	21289.00	0.49	12308.00	0.28	0.00	0.00	69454.00	1.59	51721.00	1.19	54790.00	1.26	36%	0.33	0.55
H1	D1.a+D1.b+D1.c+D1.d+D1.e+D1.f	340172.00	7.39	60259.00	1.38	12308.00	0.28	0.00	0.00	134563.00	3.09	51721.00	1.19	62919.00	1.44	36%	0.34	0.61
DP1	D1.b+D1.c+D1.c.1	102003.00	2.34	11554.00	0.27	0.00	0.00	6749.00	0.15	54809.00	1.26	0.00	0.00	28891.00	0.66	24%	0.28	0.58

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COMBINED TIME OF CONCENTRATION COMPUTATIONS

Overland Flow, Time of Concentration:

$$T_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{1/3}}$$ (Equation RO-3)

Gutter/Swale Flow, Time of Concentration:

T_t = L / 60V
T_c = T_i + T_t (Equation RO-2)
Intensity, i From Figures 3.3.1-2 (Area II)
Velocity (Gutter Flow), V = $20 \cdot S^{1/2}$
Velocity (Swale Flow), V = $15 \cdot S^{1/2}$
Rational Equation: Q = CiA (Equation RO-1)

		Overland Flow 1				Conveyance		Swale Flow 1				Conveyance		Swale Flow 2				Time of Concentration		
Design Point	Basin(s)	C_5	Length, L (ft)	Slope, S (%)	T_i (min)		K	Length, L (ft)	Slope, S (%)	Velocity, V (ft/s)	T_t (min)		K	Length, L (ft)	Slope, S (%)	Velocity, V (ft/s)	T_t (min)	Comp. T_c (min)	$\frac{L}{180}+10$	Actual T_c (min)
WQ-1	D1.b + D1.c+D1.d+D1.e+D1.f	**0.33**	100	10.00	6.54	**Shallow Paved Swales**	**20**	301	8	5.51	0.91	**Grassed Waterway**	**15**	**331**	1.60	2.53	2.91	10.35	14.07	10.35
H1	D1.a+D1.b+D1.c+D1.d+D1.e+D1.f	**0.34**	100	7	7.22	Shallow Paved Swales	20	140	4	4.05	0.58	Grassed Waterway	15	1200	4	3.95	6.75	14.55	18.00	14.55
DP1	D1.b+D1.c+D1.c.1	**0.28**	100	10.00	7.00	**Shallow Paved Swales**	**20**	301	8	5.51	0.91	**Grassed Waterway**	**15**	**331**	1.60	2.53	2.91	10.81	14.07	10.81

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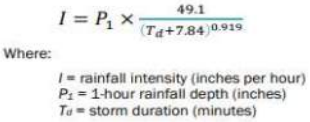
COMBINED DIRECT RUNOFF COMPUTATIONS

Overland Flow, Time of Concentration:

$$T_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{1/3}}$$

Gutter/Swale Flow, Time of Concentration:

T_t = L / 60V
$T_c = T_i + T_t$ (Equation RO-2)
Intensity, I from Equation 1

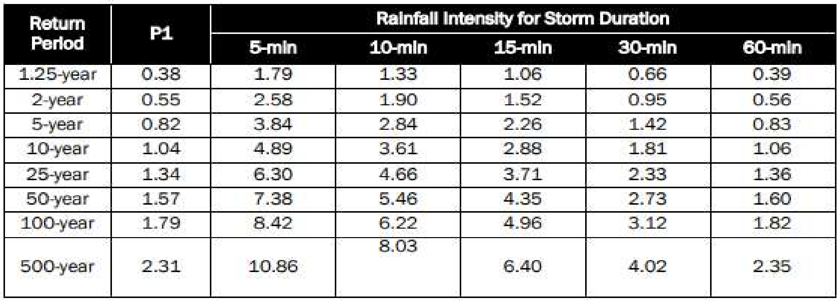


$$I = P_1 \times \frac{49.1}{(T_d + 7.84)^{0.919}}$$

Where:

I = rainfall intensity (inches per hour)
P_1 = 1-hour rainfall depth (inches)
T_d = storm duration (minutes)

Table 5.5.1.P1 and Intensity-Duration-Frequency Values



Return Period	P1	Rainfall Intensity for Storm Duration				
		5-min	10-min	15-min	30-min	60-min
1.25-year	0.38	1.79	1.33	1.06	0.66	0.39
2-year	0.55	2.58	1.90	1.52	0.95	0.56
5-year	0.82	3.84	2.84	2.26	1.42	0.83
10-year	1.04	4.89	3.61	2.88	1.81	1.06
25-year	1.34	6.30	4.66	3.71	2.33	1.36
50-year	1.57	7.38	5.46	4.35	2.73	1.60
100-year	1.79	8.42	6.22	4.96	3.12	1.82
500-year	2.31	10.86	8.03	6.40	4.02	2.35

Velocity (Gutter Flow), V = 20·$S^{½}$
Velocity (Swale Flow), V = 15·$S^{½}$
Rational Equation: Q = CiA (Equation RO-1)

Design Point	Basin(s)	Area, A (acres)	T_c (min)	C_5	C_{100}	Intensity, I_5 (in/hr)	Intensity, I_{100} (in/hr)	Flow, Q_5 (cfs)	Q_5 per Acre (cfs/ac)	Flow, Q_{100} (cfs)	Q_{100} per Acre (cfs/ac)
WQ-1	D1.b + D1.c+D1.d+D1.e+D1.f	4.81	10.35	0.33	0.55	2.85	6.22	4.55	0.95	16.37	3.40
H1	D1.a+D1.b+D1.c+D1.d+D1.e+D1.f	7.39	14.55	0.34	0.61	2.32	5.06	5.75	0.78	22.80	3.09
DP1	D1.b+D1.c+D1.c.1	2.34	10.81	0.28	0.58	2.78	6.07	1.81	0.77	8.17	3.49

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TABLES

Table 1: Basin Hydrology Summary

Basin	Total Area (acres)	%Imp	C_5	C_{100}	T_c (min)	Q_5 (cfs)	Q_{100} (cfs)
H1	6.59	19%	0.25	0.55	12.61	4.23	19.89
H2	5.00	53%	0.42	0.61	8.39	6.60	21.18
D1.a	2.58	37%	0.34	0.58	9.22	2.63	9.72
D1.b	1.51	20%	0.26	0.55	5.00	1.50	6.98
D1.c	0.41	22%	0.27	0.56	8.35	0.35	1.57
D1.c.1	0.42	41%	0.35	0.58	7.14	0.50	1.81
D1.d	0.13	39%	0.35	0.58	7.27	0.16	0.57
D1.e	1.18	41%	0.36	0.58	5.00	1.62	5.79
D1.f	1.58	50%	0.40	0.60	5.00	2.42	7.96
D2	4.26	66%	0.49	0.65	8.39	6.70	19.32

Table 2: Design Point Summary

Design Point	Total Area (acres)	%Imp	C_5	C_{100}	T_c (min)	Q_5 (cfs)	Q_{100} (cfs)
WQ-1	4.81	36%	0.33	0.55	10.35	4.55	16.37
H1	7.39	36%	0.34	0.61	14.55	5.75	22.80
DP1	2.34	24%	0.28	0.58	10.81	1.81	8.17

Table 3: Allowable Outflow for Detention Calculation

Design Storm	Q_H	Q_{UD}	Q_A
5-Year	4.23	2.63	1.60
100-Year	19.89	9.72	10.17

Q_H Historic peak flow (cfs)
Q_{UD} Undetained flow (cfs)
Q_A Allowable peak flow from detention facility (cfs)

Table 4: Water Quality Pond Summary

Basin	Sand Filter Flat Area (ft^2)		Bioretention Flat Area (ft^2)		WQCV[1] (ft^3)	Detention[2] V_5 (ft^3)	Detention[2] V_{100} (ft^3)	V_{100} + WQCV (ft^3)	Total Volume (ft^3)
	Required	Provided	Required	Provided	Required				Provided
WQ-1	935	1,574	1495	1,574	2,229	1,835	3,854	6,082	6,624
					Total Treated Area (acres)				4.24
					Total Disturbed area (acres)				5.04
					Percent Treated (%)				84%

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PROJECT: 2571-001
DESIGNER: Matthew Eggen
DATE: 12/15/2023
POND ID:

CRITICAL FLOW COMPUTATION

$$Fr = \frac{v}{\sqrt{gD_h}} \tag{5.7.2}$$

Where:

Fr = Froude number (dimensionless)
v = velocity (ft/s)
g = gravitational acceleration (32.2 ft/s^2)
A = channel flow area (ft^2)
T = top width of flow area (ft)
D_h = hydraulic depth, D_h=A/T (ft)

	FR	V	G	a	t	Dh	DESIGN %	Check Dam Slope
DP-1	**0.78**	2.86	32.2	3.18	7.56	0.42	1.50%	1.50%
D1.e	**0.76**	3.04	32.2	2.00	4.00	0.50	5.20%	1.50%
D1.a	**0.78**	3.43	32.2	2.88	4.80	0.60	4.20%	1.50%

Channel Report

D1.a - Top of Ditch Check

Trapezoidal

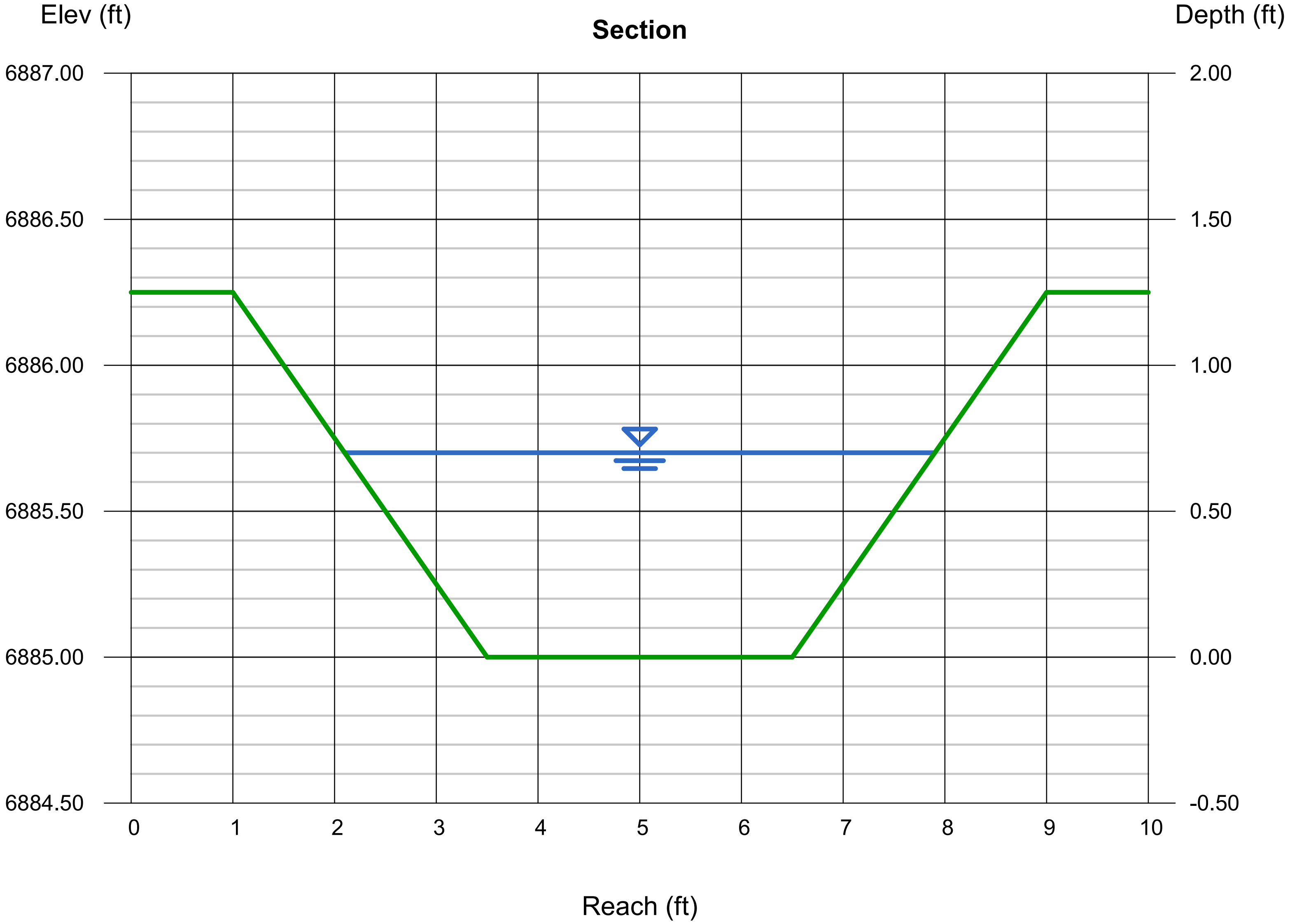
Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 1.25
Invert Elev (ft)	= 6885.00
Slope (%)	= 1.50
N-Value	= 0.035

Calculations

Compute by:	Q vs Depth
No. Increments	= 50

Highlighted

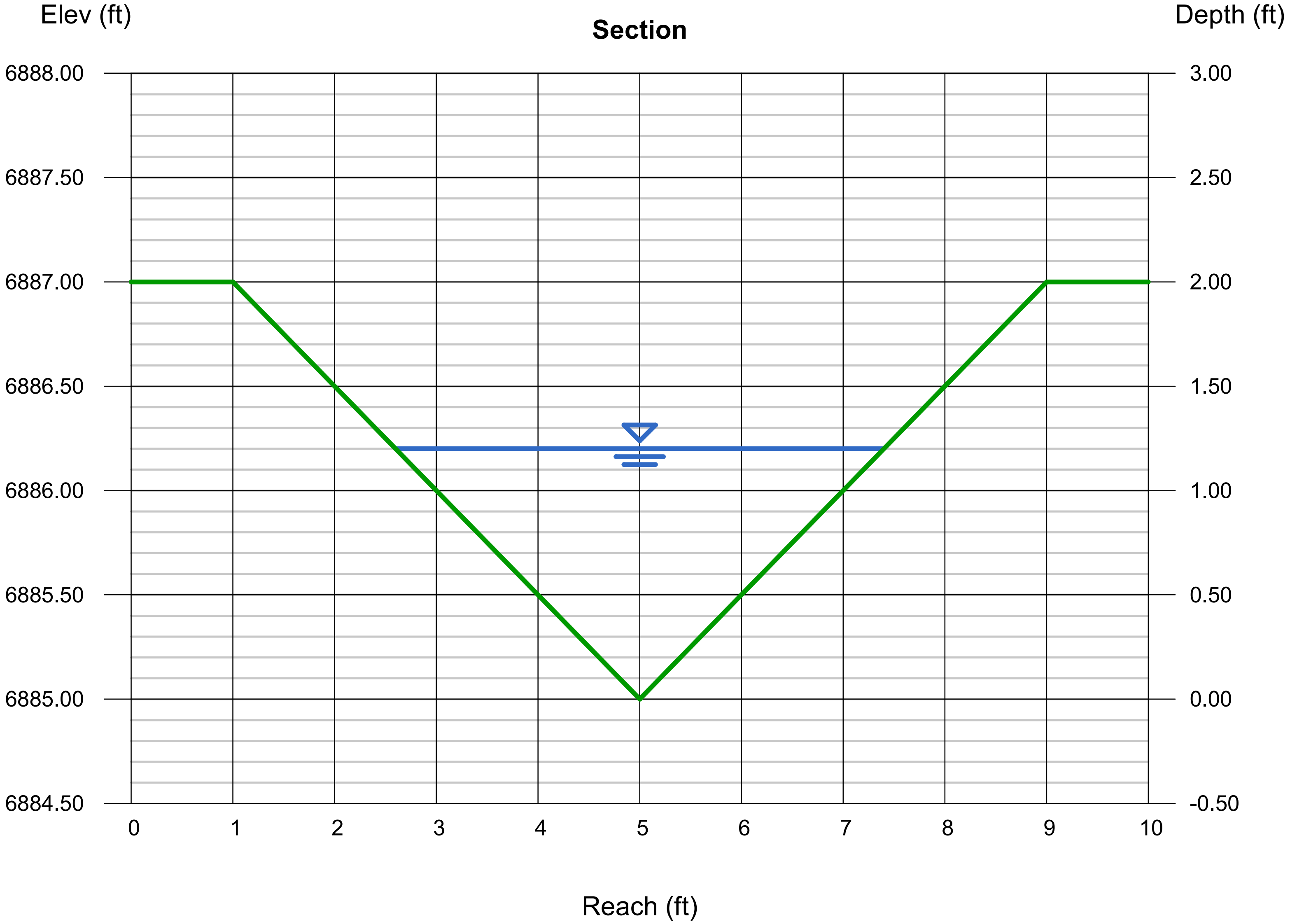
Depth (ft)	= 0.70
Q (cfs)	= 10.12
Area (sqft)	= 3.08
Velocity (ft/s)	= 3.29
Wetted Perim (ft)	= 6.13
Crit Depth, Yc (ft)	= 0.62
Top Width (ft)	= 5.80
EGL (ft)	= 0.87



Channel Report

D1.a - Bottom of Ditch Check

Triangular		**Highlighted**	
Side Slopes (z:1)	= 2.00, 2.00	Depth (ft)	= 1.20
Total Depth (ft)	= 2.00	Q (cfs)	= 9.888
		Area (sqft)	= 2.88
Invert Elev (ft)	= 6885.00	Velocity (ft/s)	= 3.43
Slope (%)	= 1.50	Wetted Perim (ft)	= 5.37
N-Value	= 0.035	Crit Depth, Yc (ft)	= 1.09
		Top Width (ft)	= 4.80
Calculations		EGL (ft)	= 1.38
Compute by:	Q vs Depth		
No. Increments	= 50		



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 13 2023

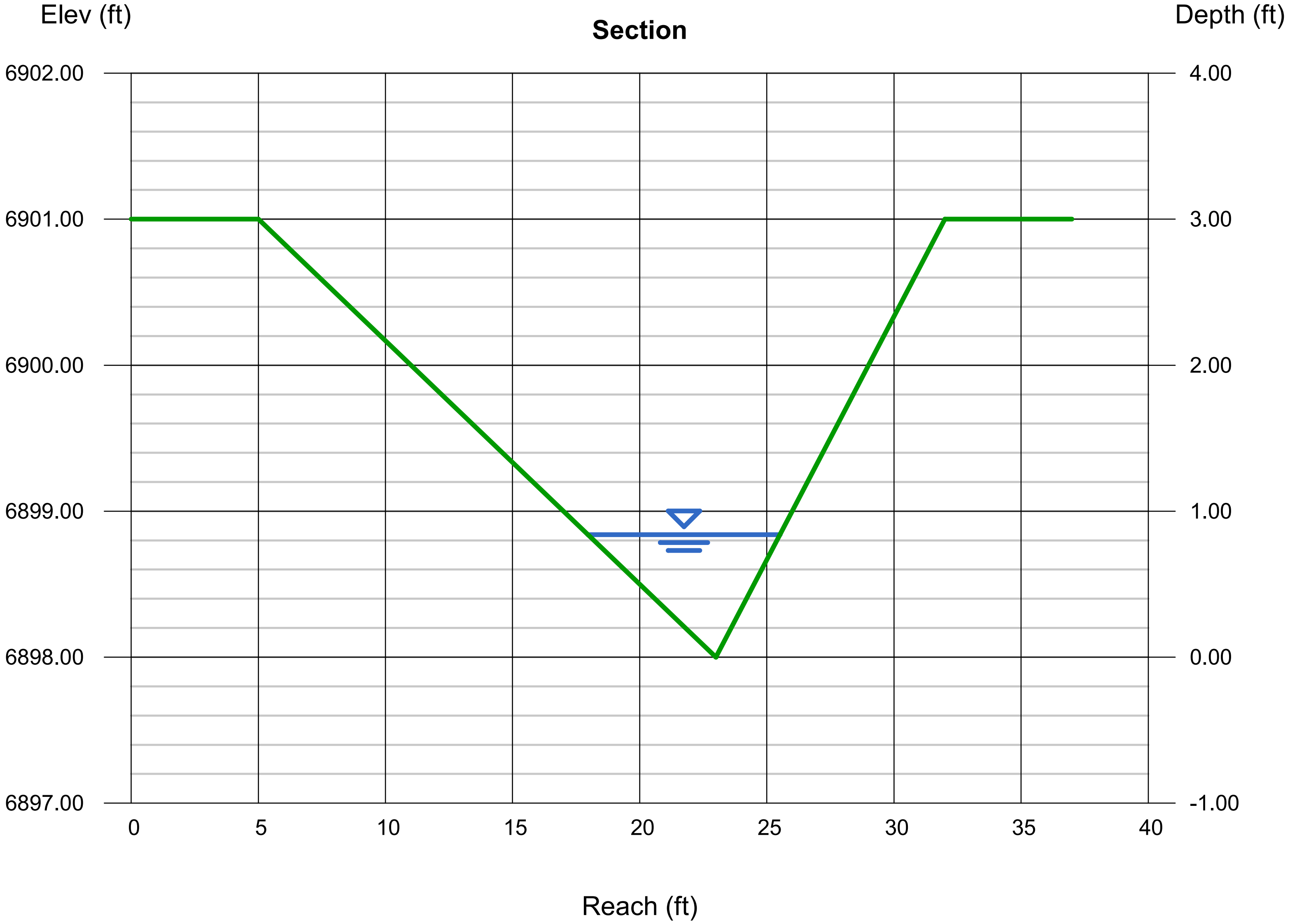
DP1 100 YEAR CHANNEL FLOW

Triangular
Side Slopes (z:1) = 6.00, 3.00
Total Depth (ft) = 3.00

Invert Elev (ft) = 6898.00
Slope (%) = 1.50
N-Value = 0.035

Calculations
Compute by: Q vs Depth
No. Increments = 50

Highlighted
Depth (ft) = 0.84
Q (cfs) = 9.093
Area (sqft) = 3.18
Velocity (ft/s) = 2.86
Wetted Perim (ft) = 7.77
Crit Depth, Yc (ft) = 0.77
Top Width (ft) = 7.56
EGL (ft) = 0.97



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 13 2023

BASIN D1.e 100 YEAR CHANNEL FLOW

Triangular

Side Slopes (z:1) = 2.00, 2.00

Total Depth (ft) = 2.00

Invert Elev (ft) = 6932.42

Slope (%) = 1.50

N-Value = 0.035

Calculations

Compute by: Q vs Depth

No. Increments = 50

Highlighted

Depth (ft) = 1.00

Q (cfs) = 6.080

Area (sqft) = 2.00

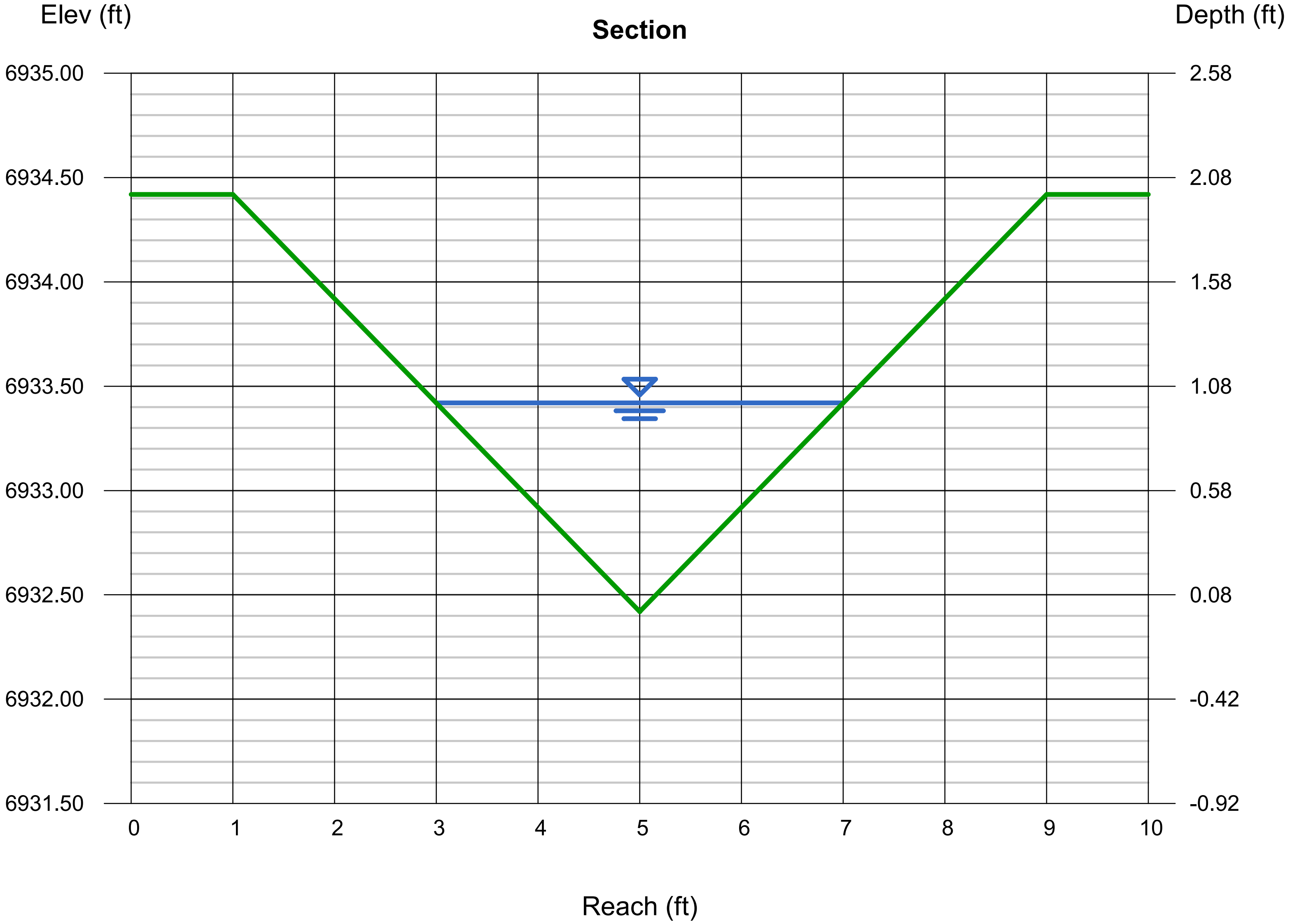
Velocity (ft/s) = 3.04

Wetted Perim (ft) = 4.47

Crit Depth, Yc (ft) = 0.90

Top Width (ft) = 4.00

EGL (ft) = 1.14



Channel Report

BASIN D1.e - Top of Ditch Check

Trapezoidal

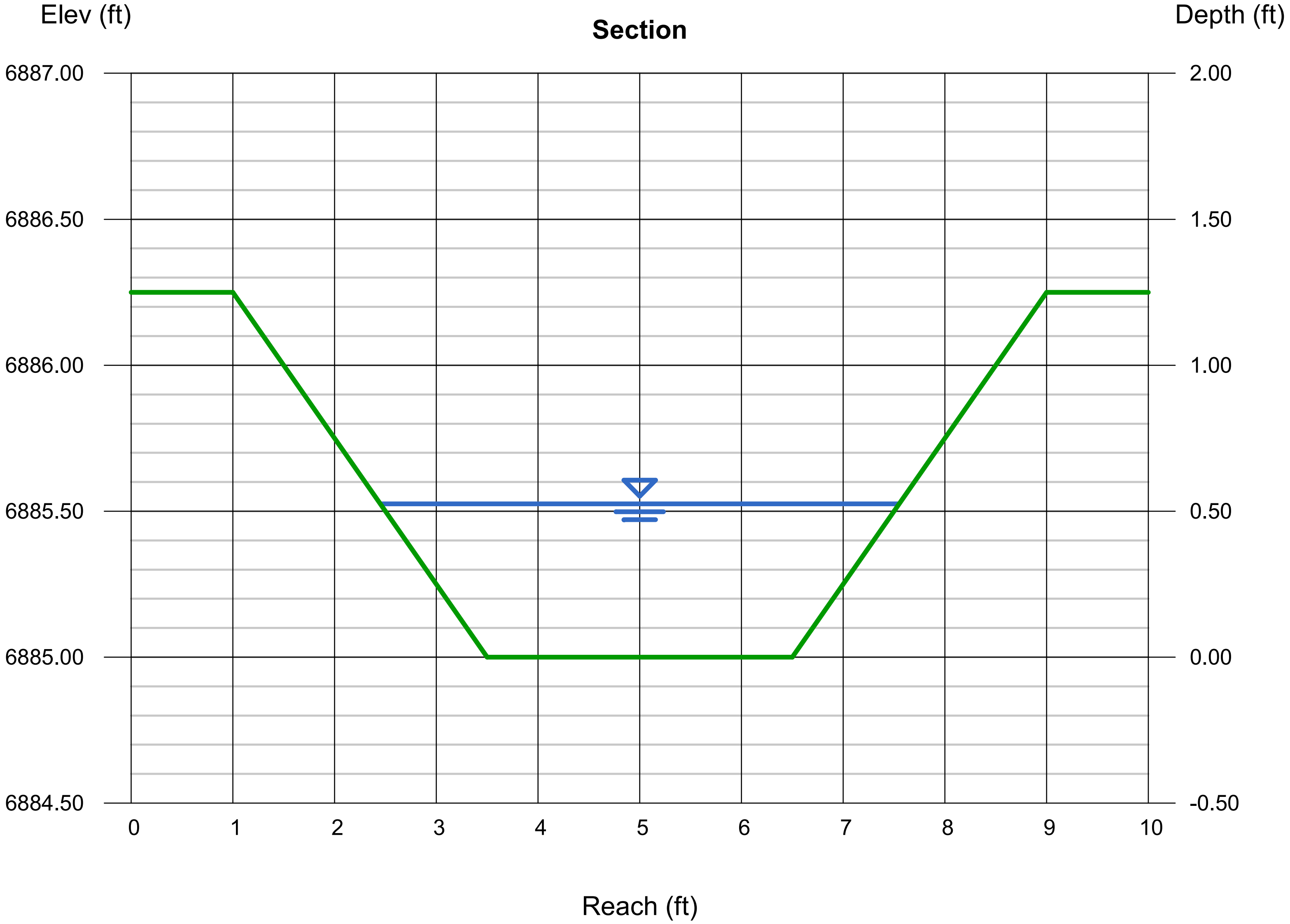
Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 1.25
Invert Elev (ft)	= 6885.00
Slope (%)	= 1.50
N-Value	= 0.035

Calculations

Compute by:	Q vs Depth
No. Increments	= 50

Highlighted

Depth (ft)	= 0.53
Q (cfs)	= 5.976
Area (sqft)	= 2.13
Velocity (ft/s)	= 2.81
Wetted Perim (ft)	= 5.35
Crit Depth, Yc (ft)	= 0.45
Top Width (ft)	= 5.10
EGL (ft)	= 0.65



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 13 2023

BASIN D1.c 100 YEAR GUTTER FLOW

Gutter

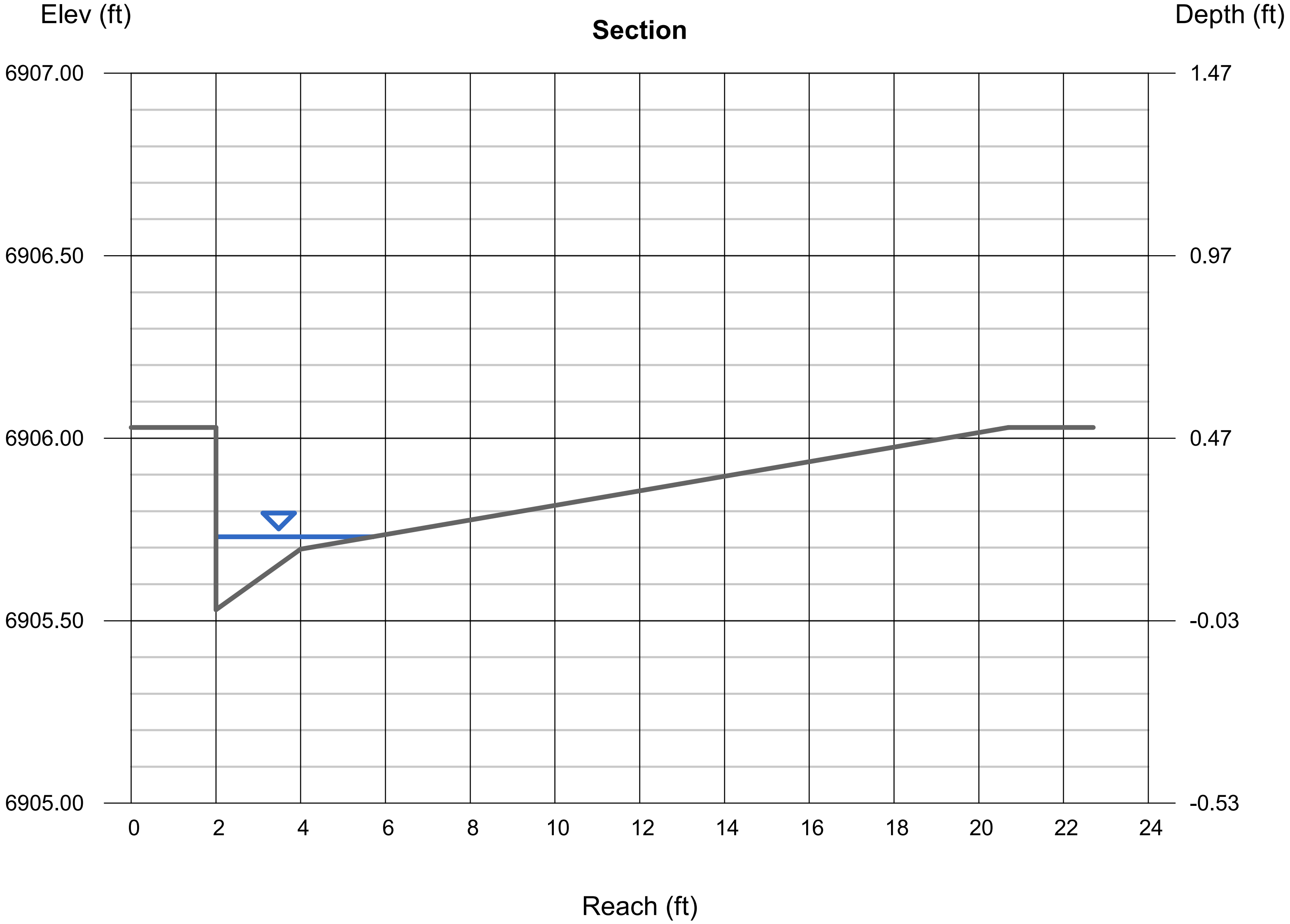
Cross Sl, Sx (ft/ft)	= 0.020
Cross Sl, Sw (ft/ft)	= 0.083
Gutter Width (ft)	= 2.00
Invert Elev (ft)	= 6905.53
Slope (%)	= 7.00
N-Value	= 0.015

Calculations

Compute by:	Q vs Depth
No. Increments	= 50

Highlighted

Depth (ft)	= 0.20
Q (cfs)	= 1.664
Area (sqft)	= 0.26
Velocity (ft/s)	= 6.33
Wetted Perim (ft)	= 3.91
Crit Depth, Yc (ft)	= 0.31
Spread Width (ft)	= 3.70
EGL (ft)	= 0.82

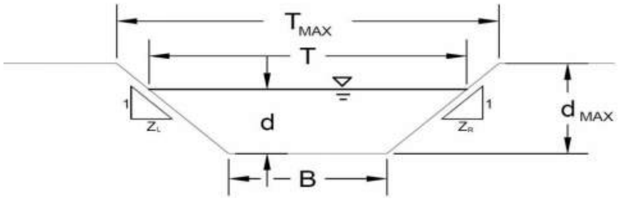


MHFD-Inlet, Version 5.01 (April 2021)

AREA INLET IN A SWALE

Amble Site Improvements

Inlet 01



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =	C	
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below	
Channel Invert Slope	S_O =	0.0400	ft/ft
Bottom Width	B =	1.25	ft
Left Side Slope	Z1 =	0.33	ft/ft
Right Side Sloe	Z2 =	0.33	ft/ft

Check one of the following soil types:

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

Choose One:

● **Non-Cohesive**
○ **Cohesive**
○ **Paved**

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	**T_{MAX} =**	**16.00**	**16.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	**d_{MAX} =**	**1.50**	**1.50**	**ft**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.0**	**11.0**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	**d_{allow} =**	**1.50**	**1.50**	**ft**

Water Depth in Channel Based On Design Peak Flow

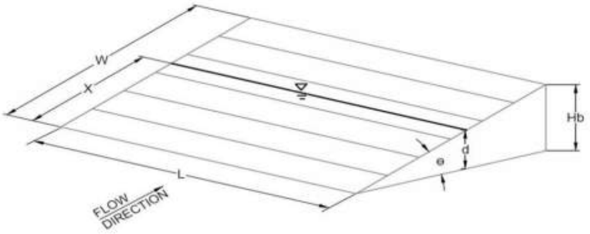
Design Peak Flow	**Q_o =**	**2.6**	**9.7**	**cfs**
Water Depth	**d =**	**0.91**	**1.44**	**ft**

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

Inlet Design Information (Input)

Type of Inlet	User-Defined ▾	Inlet Type =	User-Defined

Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	2.33	ft
Length of Grate	L =	2.33	ft
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	ft
Clogging Factor	C_f =	0.50	
Grate Discharge Coefficient	C_d =	N/A	
Orifice Coefficient	C_o =	0.64	
Weir Coefficient	C_w =	2.05	



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.91	1.44	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**9.3**	**11.7**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

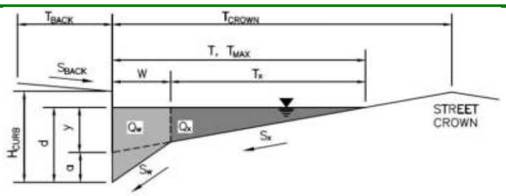
MHFD-Inlet, Version 5.01 (April 2021)

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

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

Amble Site Improvements

Inlet 05



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.070	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

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

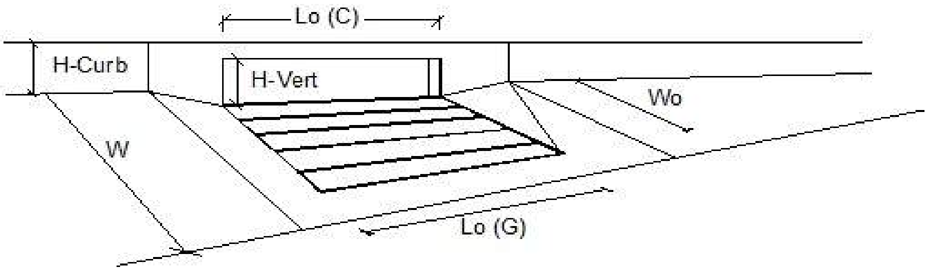
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**10.0**	**10.0**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input) Denver No. 16 Combination ▼

		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

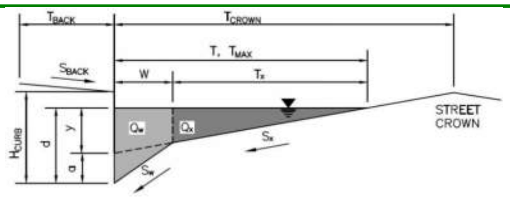
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.1**	**0.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**85**	**81**	**%**

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

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

Amble Site Improvements

CurbInlet03



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.070	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

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

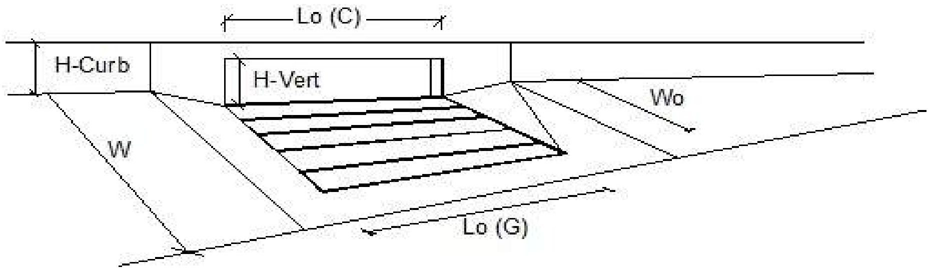
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**10.0**	**10.0**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

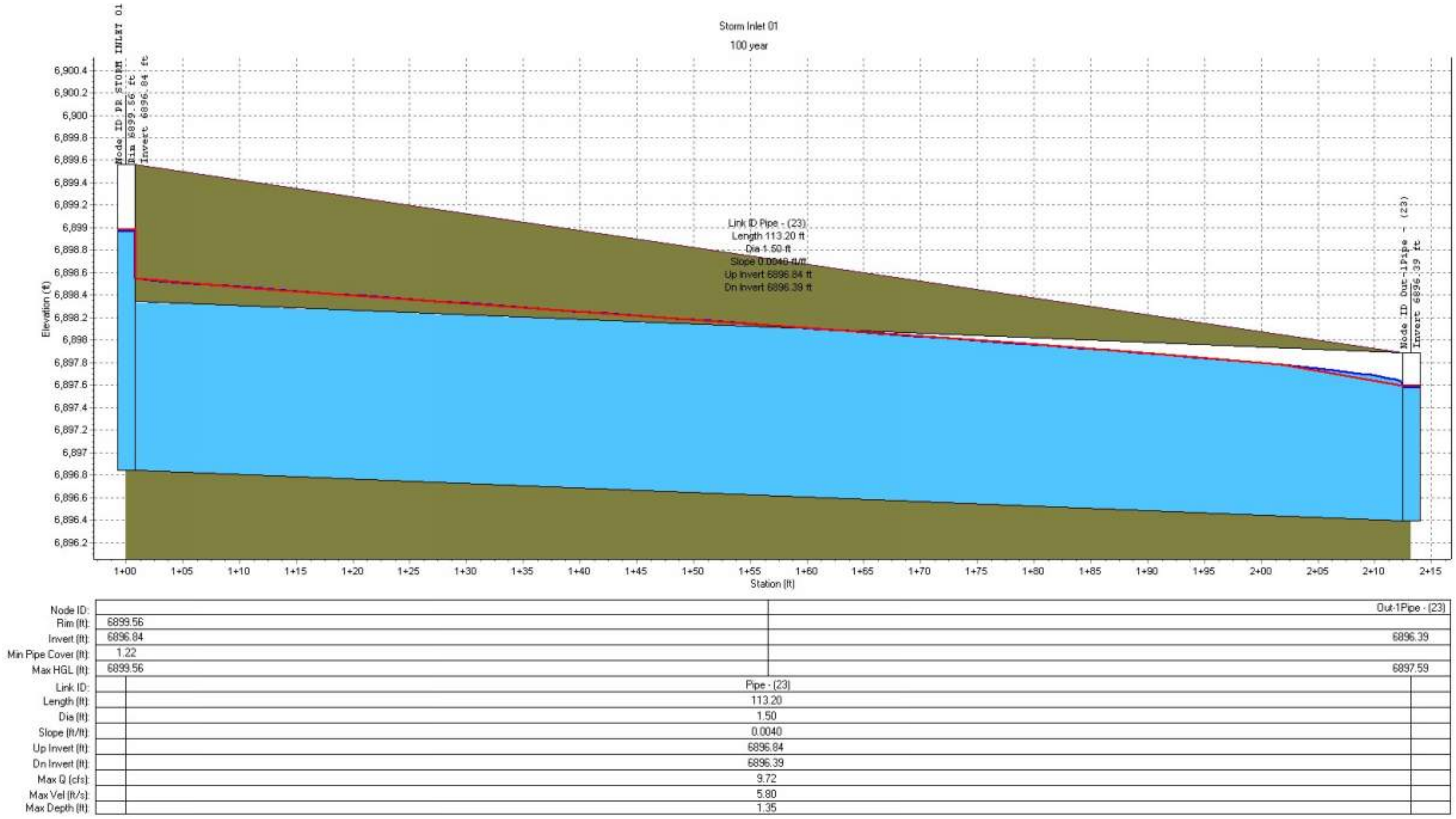


Design Information (Input)

Denver No. 16 Combination

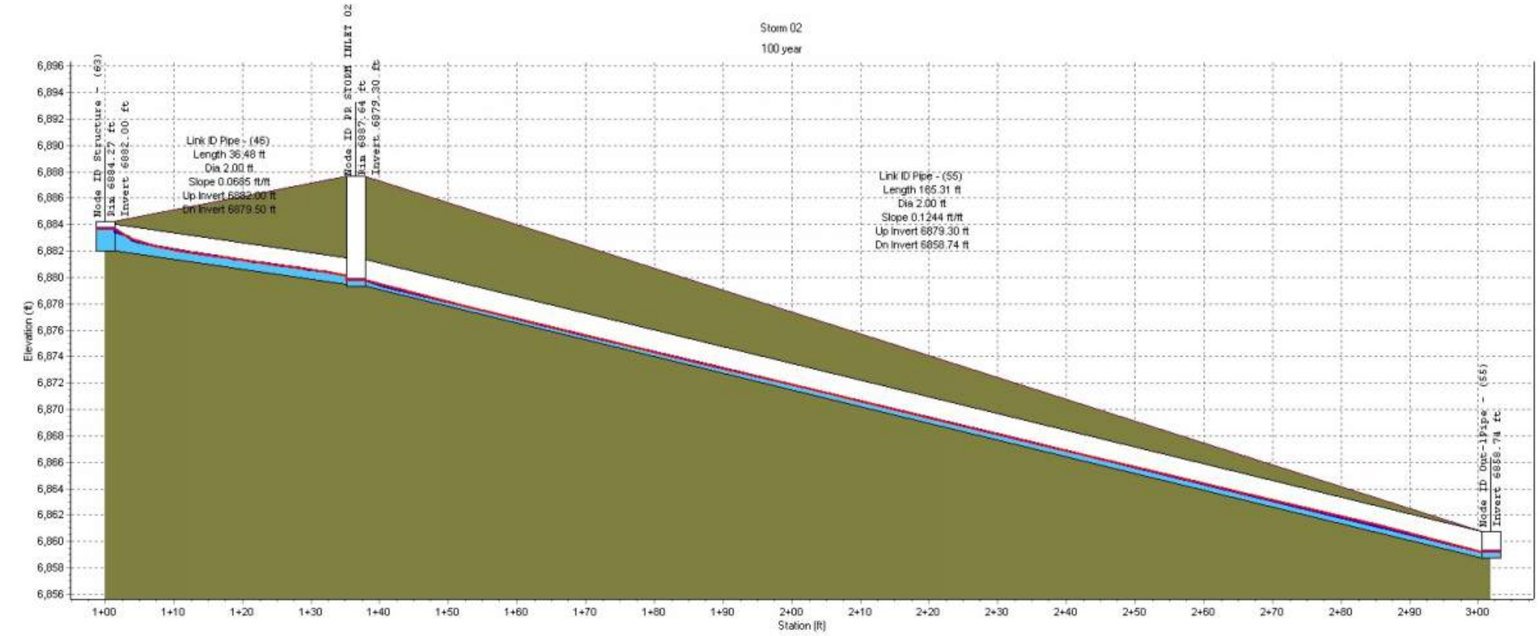
		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.3**	**1.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**0.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**80**	**68**	**%**



Node ID:		Out-1Pipe - (23)
Rim (ft):	6899.56	
Invert (ft):	6896.84	6896.39
Min Pipe Cover (ft):	1.22	
Max HGL (ft):	6899.56	6897.59
Link ID:	Pipe - (23)	
Length (ft):	113.20	
Dia (ft):	1.50	
Slope (ft/ft):	0.0040	
Up Invert (ft):	6896.84	
Dn Invert (ft):	6896.39	
Max Q (cfs):	9.72	
Max Vel (ft/s):	5.80	
Max Depth (ft):	1.35	

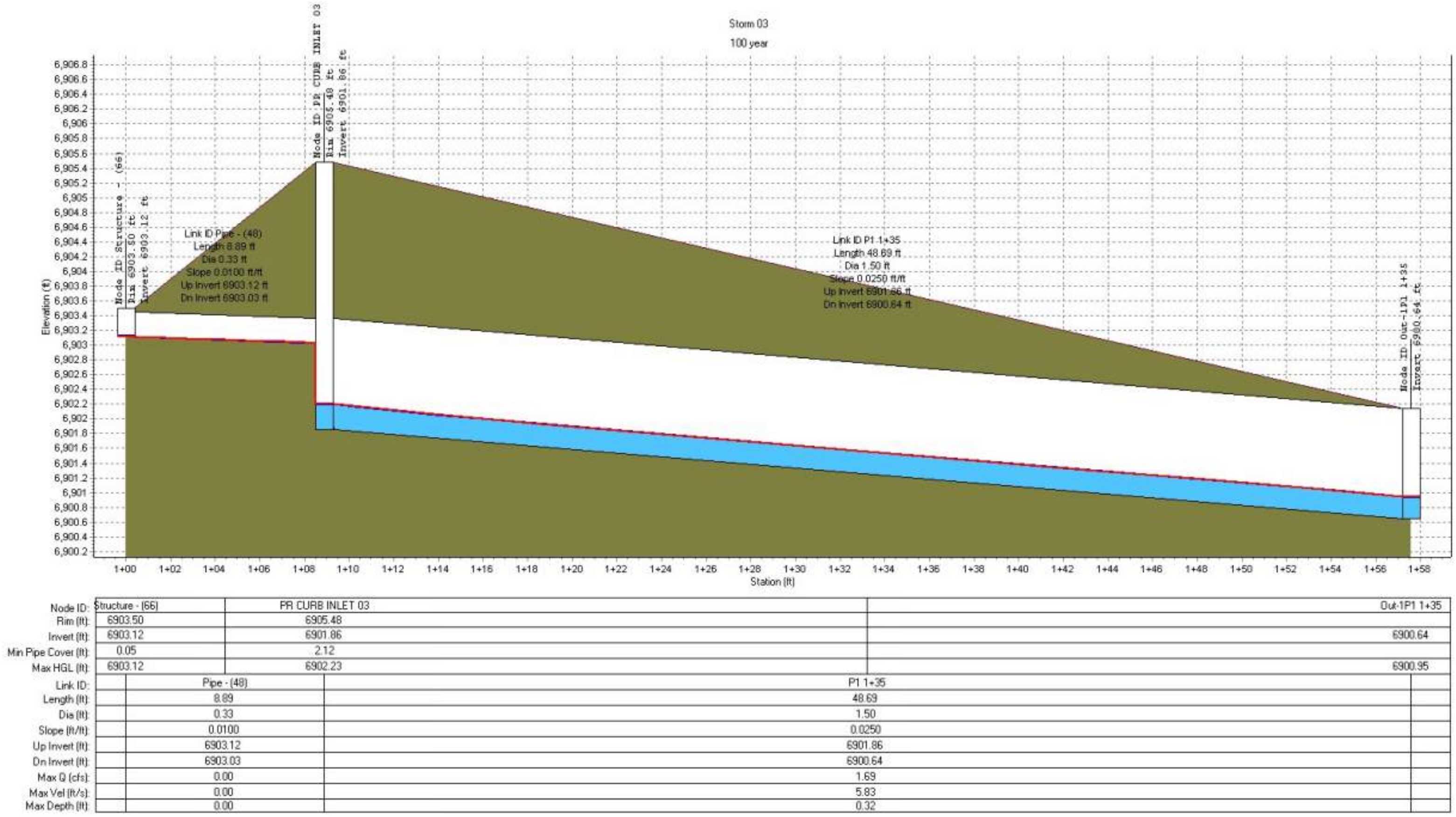
Autodesk Storm and Sanitary Analysis



Node ID:	Structure - (63)	PR STORM INLET 02	Out-1Pipe - (55)
Rim (ft):	6884.27	6887.64	
Invert (ft):	6882.00	6879.30	6858.74
Min Pipe Cover (ft):	0.27	6.14	
Max HGL (ft):	6883.66	6879.80	6859.20

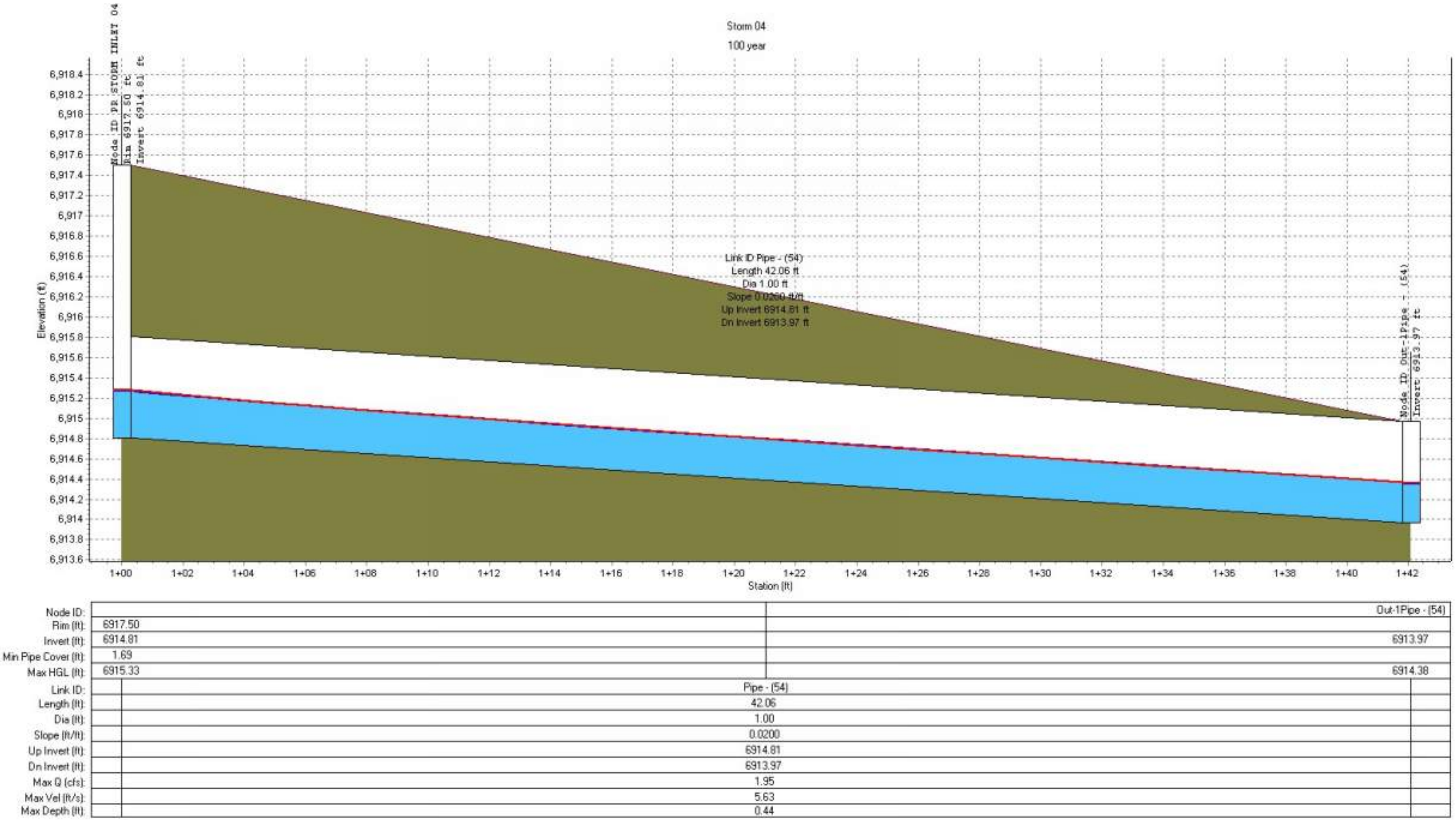
Link ID:	Pipe - (46)	Pipe - (55)
Length (ft):	36.48	165.31
Dia (ft):	2.00	2.00
Slope (ft/ft):	0.0685	0.1244
Up Invert (ft):	6882.00	6879.30
Dn Invert (ft):	6879.50	6858.74
Max Q (cfs):	10.17	10.17
Max Vel (ft/s):	5.76	17.46
Max Depth (ft):	1.10	0.48

Autodesk Storm and Sanitary Analysis



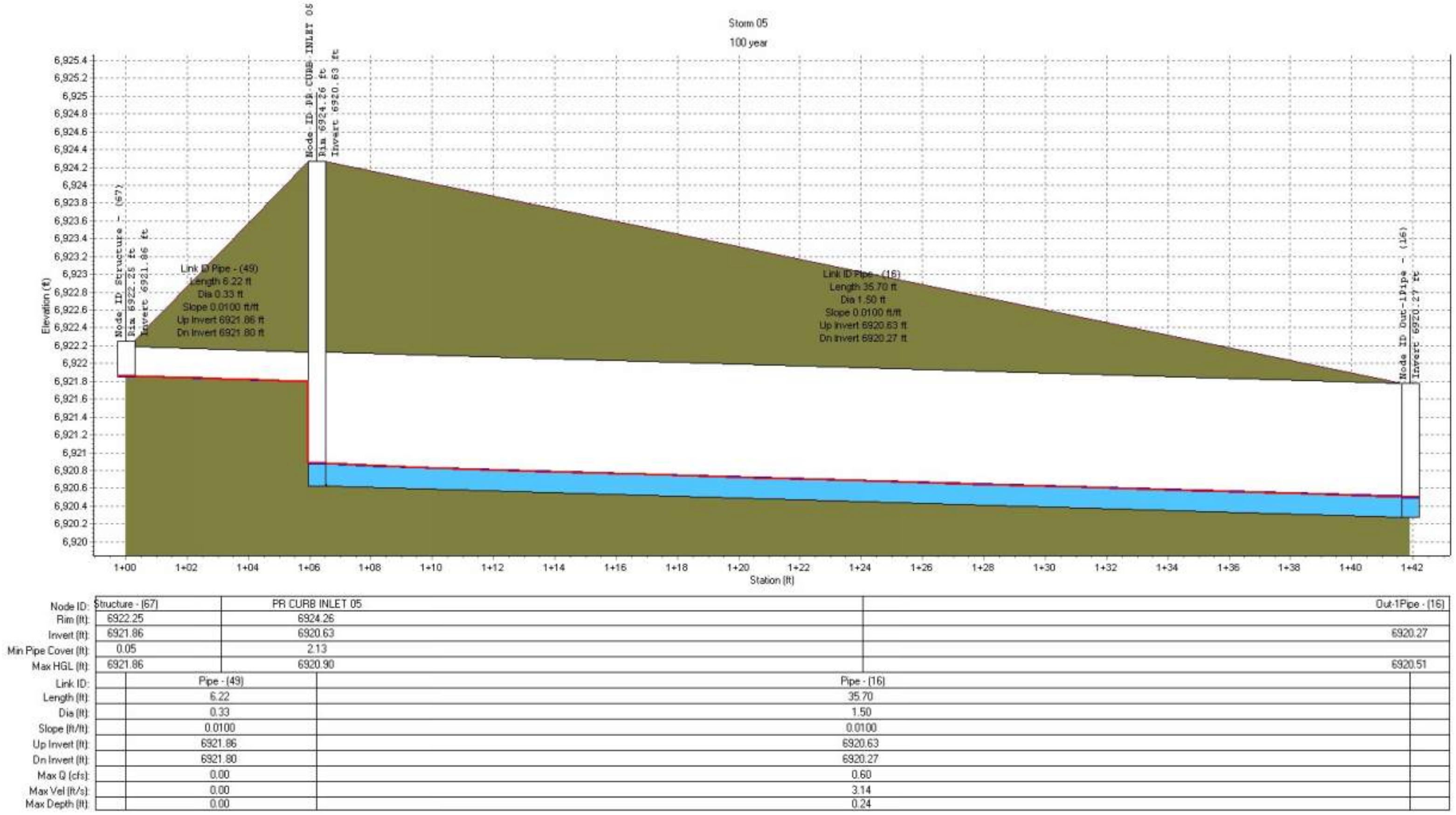
Node ID:	Structure - (66)		PR CURB INLET 03		Out-1P1 1+35
Rim (ft):	6903.50		6905.48		
Invert (ft):	6903.12		6901.86		6900.64
Min Pipe Cover (ft):	0.05		2.12		
Max HGL (ft):	6903.12		6902.23		6900.95
Link ID:		Pipe - (48)		P1 1+35	
Length (ft):		8.89		48.69	
Dia (ft):		0.33		1.50	
Slope (ft/ft):		0.0100		0.0250	
Up Invert (ft):		6903.12		6901.86	
Dn Invert (ft):		6903.03		6900.64	
Max Q (cfs):		0.00		1.69	
Max Vel (ft/s):		0.00		5.83	
Max Depth (ft):		0.00		0.32	

Autodesk Storm and Sanitary Analysis



Node ID:		Out-1Pipe - (54)
Rim (ft):	6917.50	
Invert (ft):	6914.81	6913.97
Min Pipe Cover (ft):	1.69	
Max HGL (ft):	6915.33	6914.38

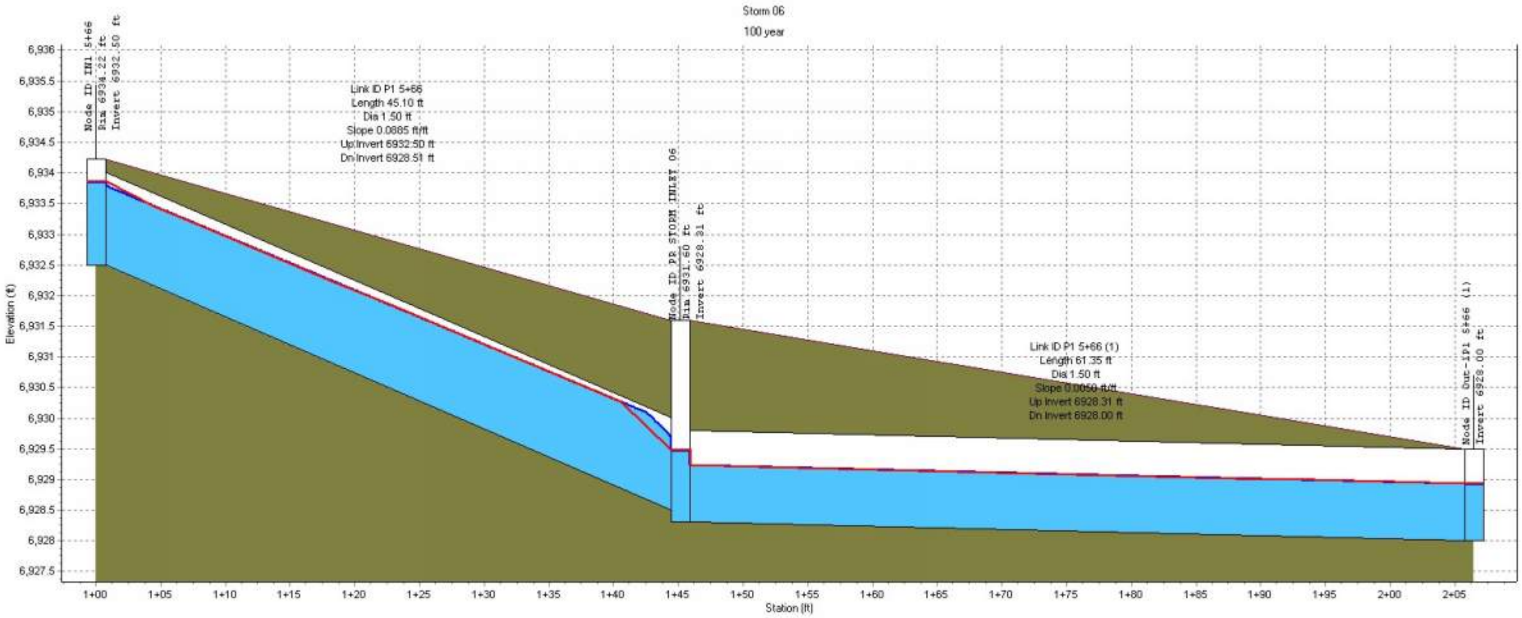
Link ID:	Pipe - (54)
Length (ft):	42.06
Dia (ft):	1.00
Slope (ft/ft):	0.0200
Up Invert (ft):	6914.81
Dn Invert (ft):	6913.97
Max Q (cfs):	1.95
Max Vel (ft/s):	5.63
Max Depth (ft):	0.44



Node ID:	Structure - (67)	PR CURB INLET 05	Out-1Pipe - (16)
Rim (ft):	6922.25	6924.26	
Invert (ft):	6921.86	6920.63	6920.27
Min Pipe Cover (ft):	0.05	2.13	
Max HGL (ft):	6921.86	6920.90	6920.51

Link ID:	Pipe - (49)	Pipe - (16)
Length (ft):	6.22	35.70
Dia (ft):	0.33	1.50
Slope (ft/ft):	0.0100	0.0100
Up Invert (ft):	6921.86	6920.63
Dn Invert (ft):	6921.80	6920.27
Max Q (cfs):	0.00	0.60
Max Vel (ft/s):	0.00	3.14
Max Depth (ft):	0.00	0.24

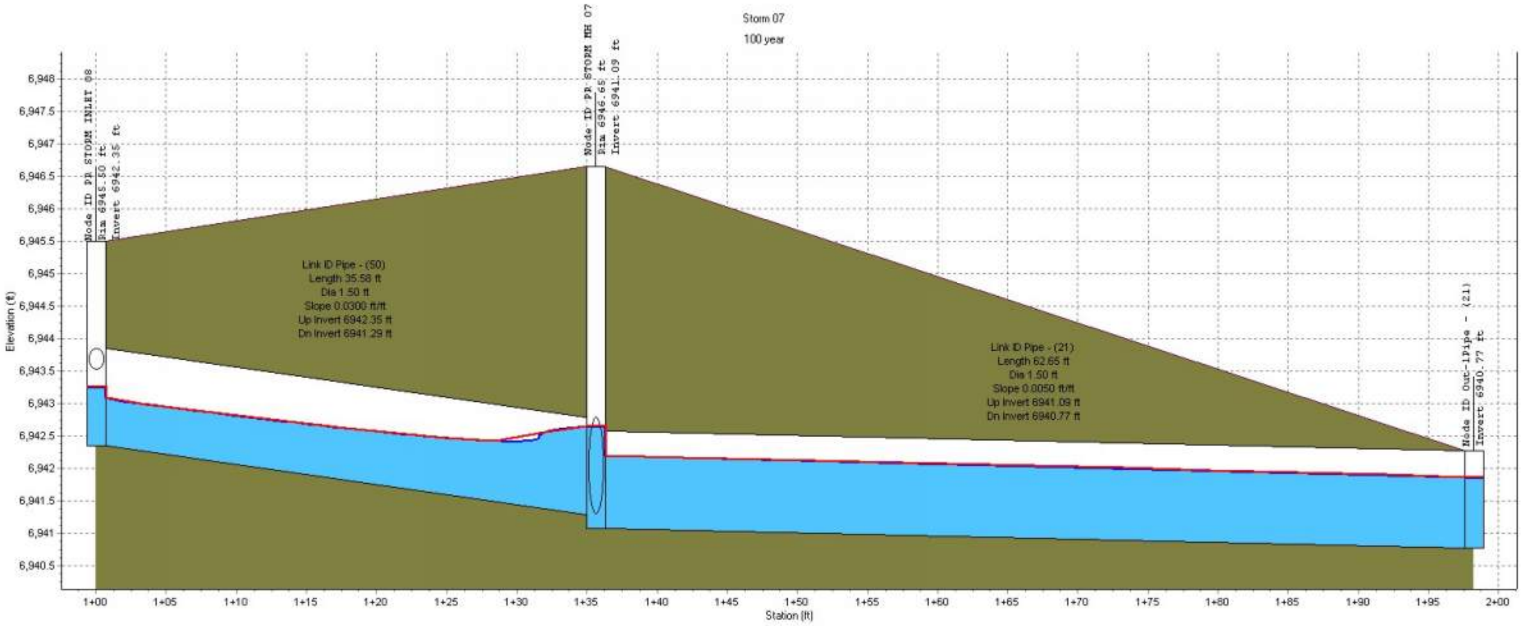
Autodesk Storm and Sanitary Analysis



Node ID:	IN1 5+66	PR STORM INLET 06	Out-1P1 5+66 (1)
Rim (ft):	6934.22	6931.60	
Invert (ft):	6932.50	6928.31	6928.00
Min Pipe Cover (ft):	0.22	1.59	
Max HGL (ft):	6933.86	6929.50	6928.94

Link ID:	P1 5+66	P1 5+66 (1)
Length (ft):	45.10	61.35
Dia (ft):	1.50	1.50
Slope (ft/ft):	0.0885	0.0050
Up Invert (ft):	6932.50	6928.31
Dn Invert (ft):	6928.51	6928.00
Max Q (cfs):	5.81	5.88
Max Vel (ft/s):	4.78	4.40
Max Depth (ft):	1.17	1.05

Autodesk Storm and Sanitary Analysis



Node ID:		PR STORM MH 07	Out-1Pipe - (21)
Rim (ft):	6945.50	6946.65	
Invert (ft):	6942.35	6941.09	6940.77
Min Pipe Cover (ft):	1.65	3.87	
Max HGL (ft):	6943.28	6942.65	6941.87

Link ID:	Pipe - (50)	Pipe - (21)
Length (ft):	35.58	62.65
Dia (ft):	1.50	1.50
Slope (ft/ft):	0.0300	0.0050
Up Invert (ft):	6942.35	6941.09
Dn Invert (ft):	6941.29	6940.77
Max Q (cfs):	8.74	7.97
Max Vel (ft/s):	8.74	4.91
Max Depth (ft):	1.14	1.30

Autodesk Storm and Sanitary Analysis

Weir Report

Outlet Structure - 5-year Weir + 100-year Inlet Overflow Weir

Compound Weir

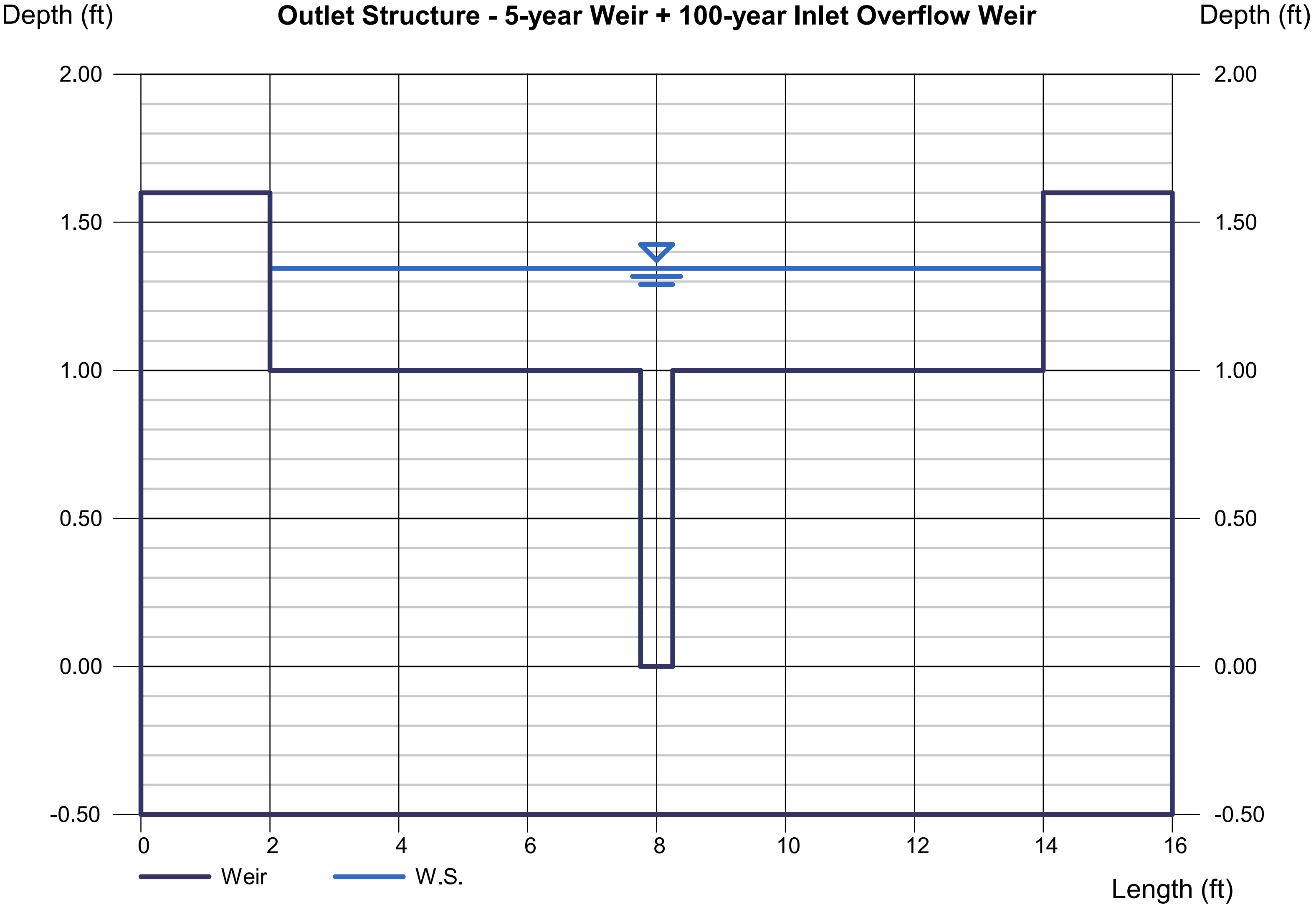
Crest = Sharp
Bottom Length (ft) = 12.00
Total Depth (ft) = 1.60
Length, x (ft) = 0.50
Depth, a (ft) = 1.00

Calculations

Weir Coeff. Cw = 3.33
Compute by: Q vs Depth
No. Increments = 50

Highlighted

Depth (ft) = 1.34
Q (cfs) = 10.32
Area (sqft) = 4.63
Velocity (ft/s) = 2.23
Top Width (ft) = 12.00



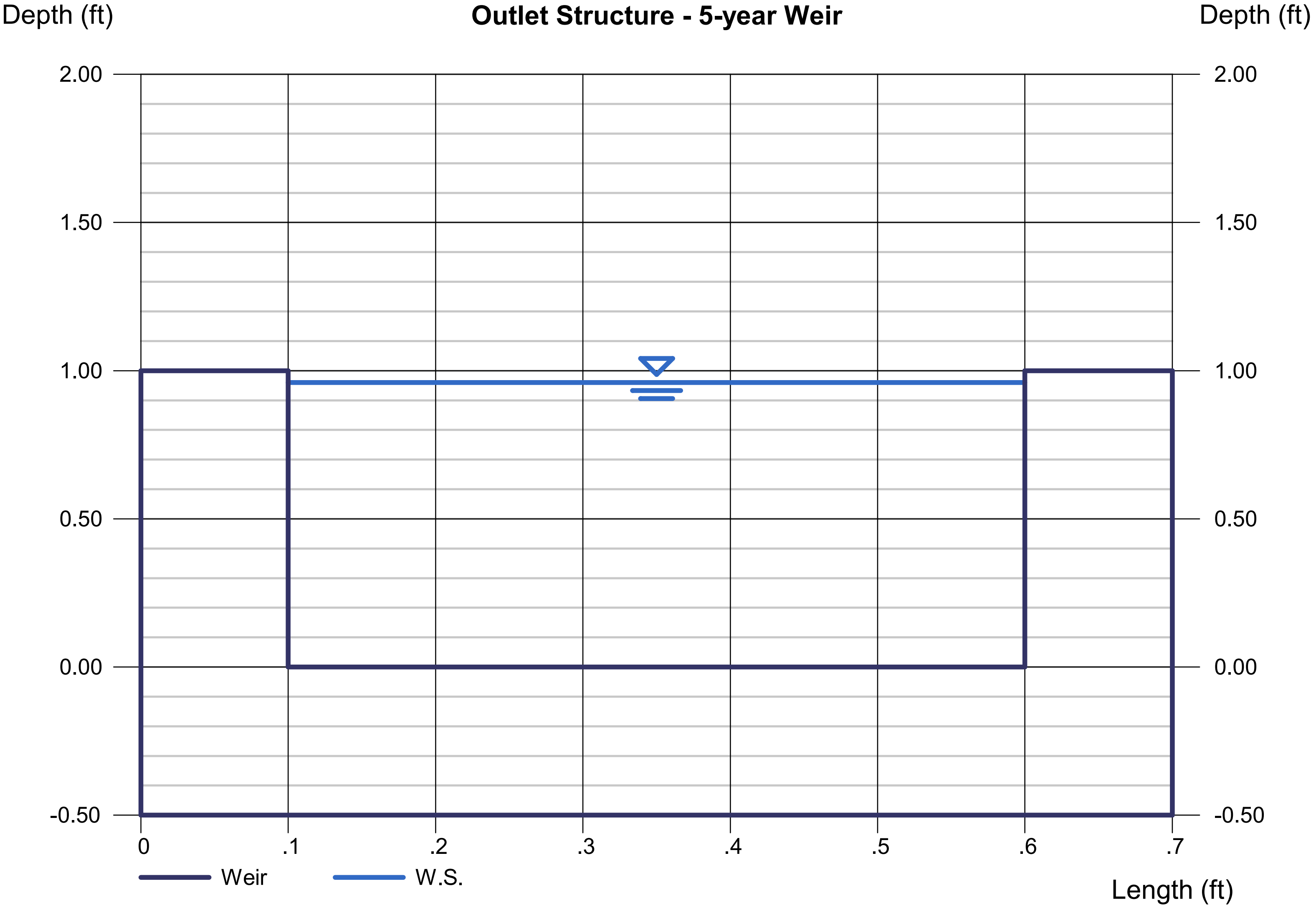
Weir Report

Outlet Structure - 5-year Weir

Rectangular Weir
Crest = Sharp
Bottom Length (ft) = 0.50
Total Depth (ft) = 1.00

Calculations
Weir Coeff. Cw = 3.33
Compute by: Q vs Depth
No. Increments = 50

Highlighted
Depth (ft) = 0.96
Q (cfs) = 1.566
Area (sqft) = 0.48
Velocity (ft/s) = 3.26
Top Width (ft) = 0.50



APPENDIX C

WATER QUALITY CALCULATIONS

LANDMARK
CONSULTANTS, INC.
CIVIL ENGINEERS | SURVEYORS
141 9th Street ~ P.O. Box 774943
Steamboat Springs, Colorado 80477
(970) 871-9494
www.LANDMARK-CO.com

PROJECT: 2571-001
DESIGNER: Matthew Eggen
DATE: 12/15/2023
POND ID:

FAA Method Detention Estimate

Per section 5.11.7.2 of the City of Steamboat Springs Drainage Criteria

$$V_i = (CiA)(T_c)(60\,\mathrm{sec/min}) \qquad (5.11.1)$$

Where:

V_i = inflow volume (ft^3)
C = Rational Method runoff coefficient for the major or minor storm
A = watershed area draining to the detention pond (acres)
T_c = Rational Method time of concentration (min)
i = design rainfall intensity (in/hr)

$$V_o = (Allowable\,ReleaseRate)(T_c)(60\,\mathrm{sec/min}) \qquad (5.11.2)$$

Where:

V_o = outflow volume (ft^3)
T_c = Rational Method time of concentration (min)
Allowable release rate shall be determined per this Section (cfs).

A (acres) =	4.81	<-- INPUT from impervious calcs
Tc (min) =	10.35	<-- INPUT from Tc calcs

Minor Storm (5-Year) Use Minor Storm for Detention only pond (No WQ)

C_5 =	0.33	<-- INPUT from impervious calcs
i (in/hr) =	2.85	<-- INPUT from runoff calcs
V_i (ft^3) =	2828	
Q_{A5} =	1.60	<-- INPUT from historic runoff calcs
V_o (ft^3) =	993	
V_{req} (ft^3) =	1835	

Major Storm (100-Year)

C_{100}	0.55	<-- INPUT from impervious calcs
i (in/hr)	6.22	<-- INPUT from runoff calcs
V_i (ft^3)	10,170	
Q_{A100}	10.17	<-- INPUT from historic runoff calcs
V_o (ft^3)	6,317	
V_{req} (ft^3)	3854	

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www.LANDMARK-CO.com

PROJECT: 2571-001
DESIGNER: Matthew Eggen
DATE: 12/15/2023
POND ID:

WQCV DESIGN CALCULATION - 12 HOUR DRAIN TIME

Sand Filter or Bioretention (Rain Garden)

REQUIRED STORAGE & SAND FILTER SIZE:

BASIN AREA (AC) = 4.81 <-- INPUT from impervious calcs

BASIN IMPERVIOUSNESS PERCENT = 36% <-- INPUT from impervious calcs

BASIN IMPERVIOUSNESS RATIO = 0.3568 <-- CALCULATED

d6 (in) = 0.34 <-- INPUT depth of average runoff producing storm

WQCV (watershed inches) = 0.11 <-- CALCULATED from MHFD Vol.3, Equation 3-1

V (ft^3) = 2,229 <-- CALCULATED from MHFD Vol.3, Equation 3-2
SAND FILTER **A_f, Minimum Flat Filter Area (ft^2) =** 935 <-- CALCULATED from USCDM Vol.3, Equation SF-2
BIORETENTION **A_f, Minimum Flat Filter Area (ft^2) =** 1,495 <-- CALCULATED from USCDM Vol.3, Equation B-2

4" UNDERDRAIN ORIFICE:

Pond Bottom Elev (ft) = 6895.30 <-- INPUT per grading plan

Underdrain invert at outlet (ft) = 6893.03 <-- INPUT per plan

Distance to center of orifice (ft) = 2.31 <-- CALCULATED

3/8" MIN. TO PREVENT CLOGGING

Orifice Diameter (in) = 1.06 <-- CALCULATED

OUTLET PIPE*:

Q_{100} (cfs) = 10.17 <-- INPUT from runoff calcs

120% * Q100 12.2 <-- CALCULATED

n 0.02 <-- INPUT based on pipe material

S_0 0.01 ft/ ft <-- INPUT per plan

d_{100} (in) 22.38 in

Typical Manning's n Values

Material	n
CMP	0.024
HDPE	0.020
RCP	0.012

* Calculate only if a stand alone waterquality pond (no detention)

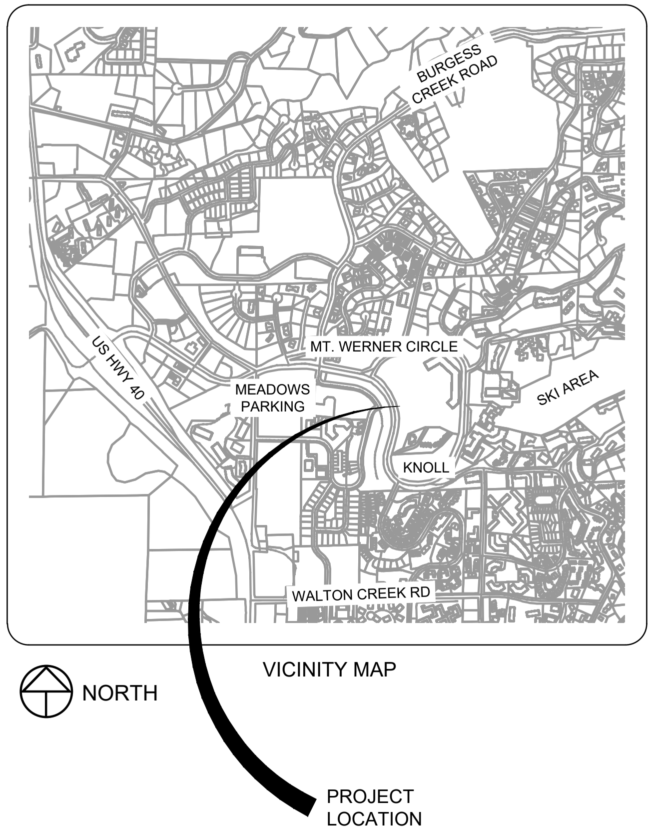
APPENDIX D

OWNERSHIP AND MAINTENANCE PLAN

AMBLE SITE IMPROVEMENTS

WQ-1 SAND FILTER OWNERSHIP AND MAINTENANCE PLAN

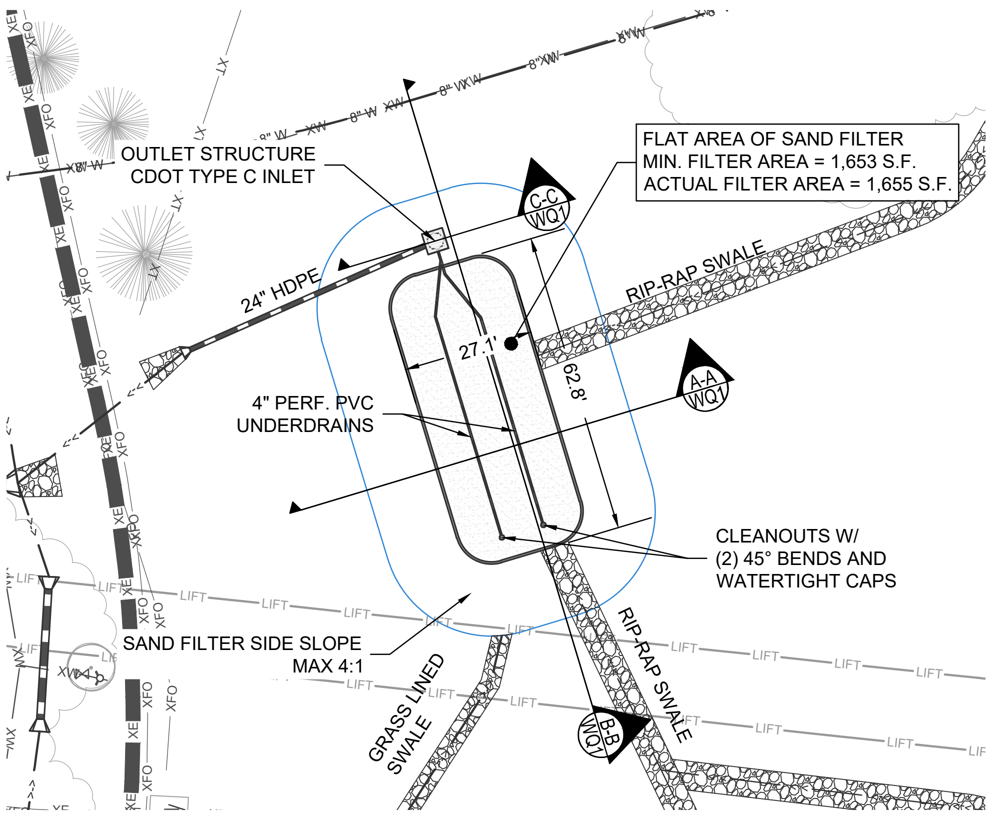
CONSTRUCTED IN [MONTH, YEAR], MAINTENANCE TO BE PERFORMED BY AMBLE



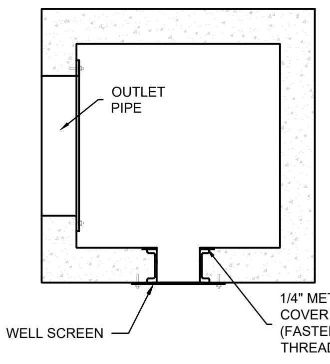
VICINITY MAP

NOTES:

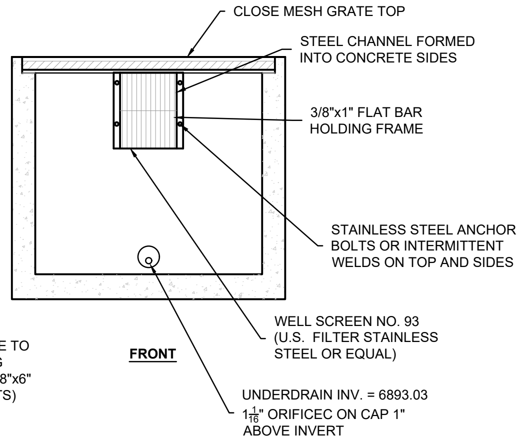
1. FOR ADDITIONAL DESIGN INFORMATION REFER TO THE CONSTRUCTION DRAWINGS FOR THIS PROJECT.
2. SEE DETAILED NOTES ON THE SECOND SHEET OF THIS PLAN FOR ALL MAINTENANCE REQUIREMENTS.



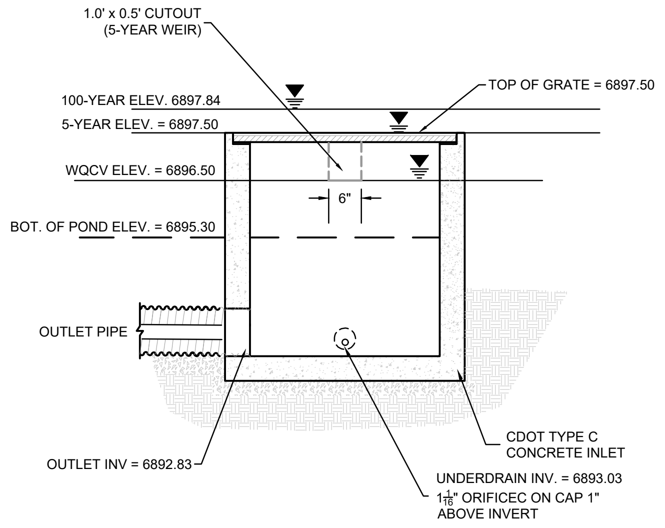
NOTE: DIMENSIONS ARE TO LIMITS OF SAND FILTER



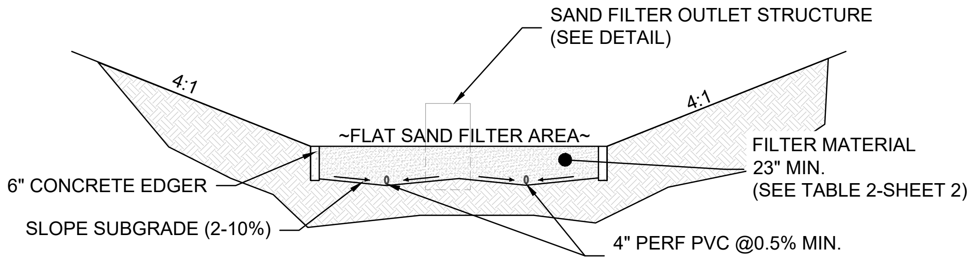
TOP



FRONT



SECTION C-C



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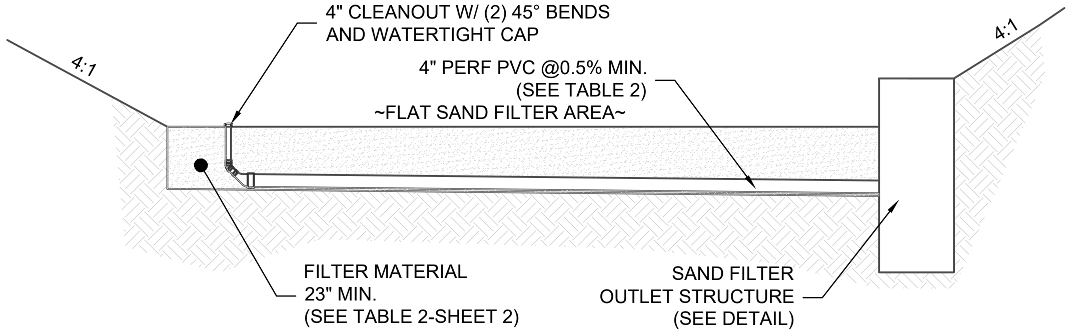

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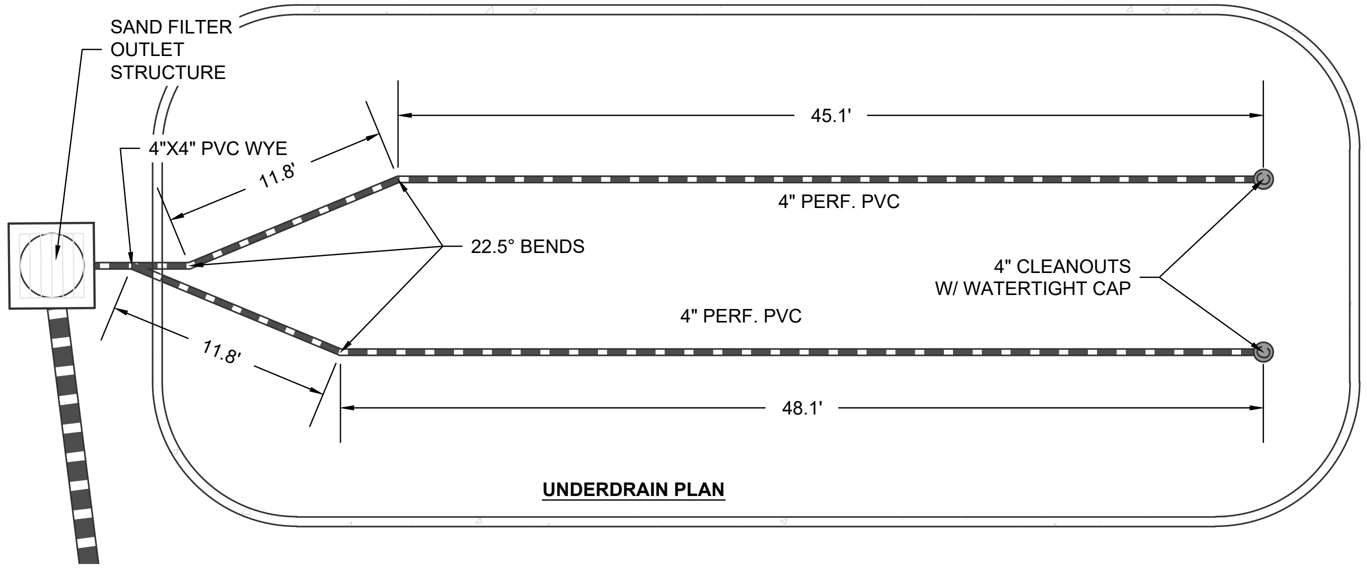

UNDERDRAIN PLAN

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Amble Site Improvements
WQ-1 Sand Filter and Detention Pond
OWNERSHIP AND MAINTENENCE PLAN

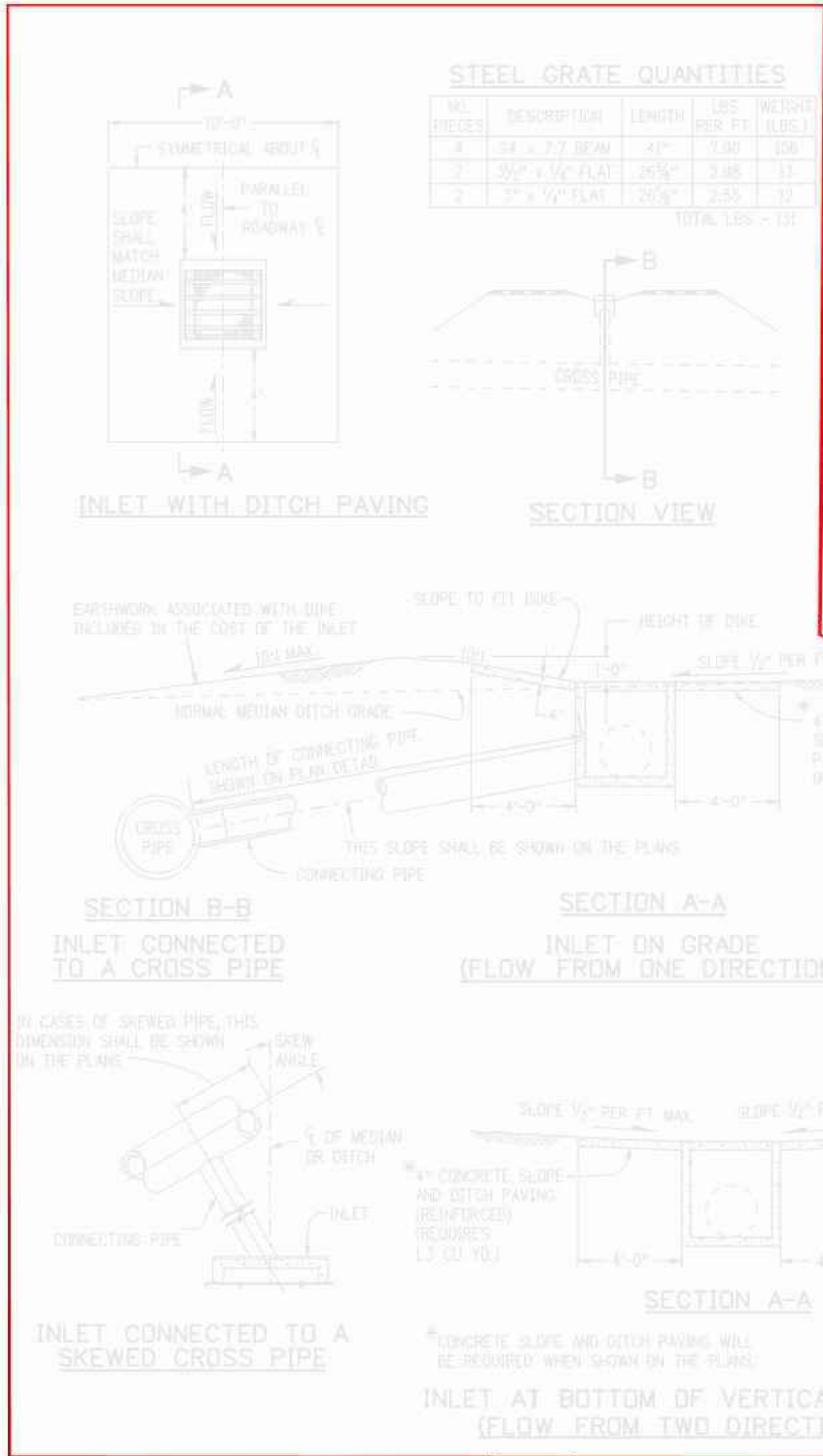
PROJECT: 2571-001
DATE: 12/15/2023
DRAWN BY: MCE
CHECKED BY: LCI

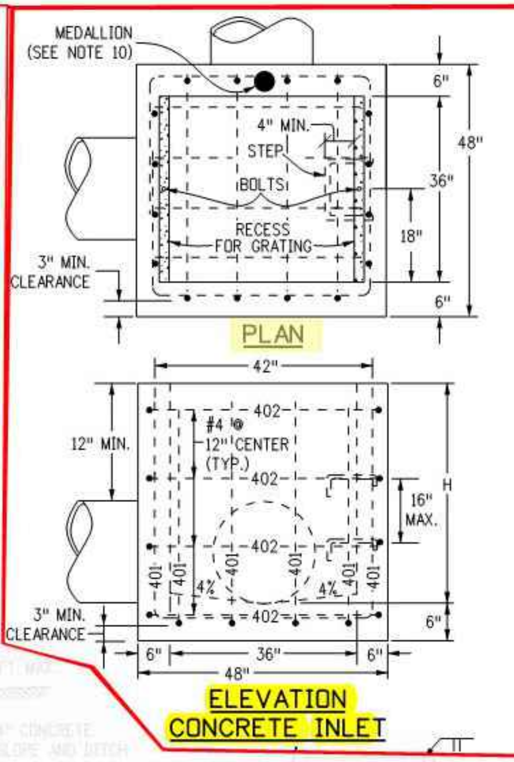
SHEET
1
Of 3 Sheets

AMBLE SITE IMPROVEMENTS

WQ-1 SAND FILTER OWNERSHIP AND MAINTENANCE PLAN

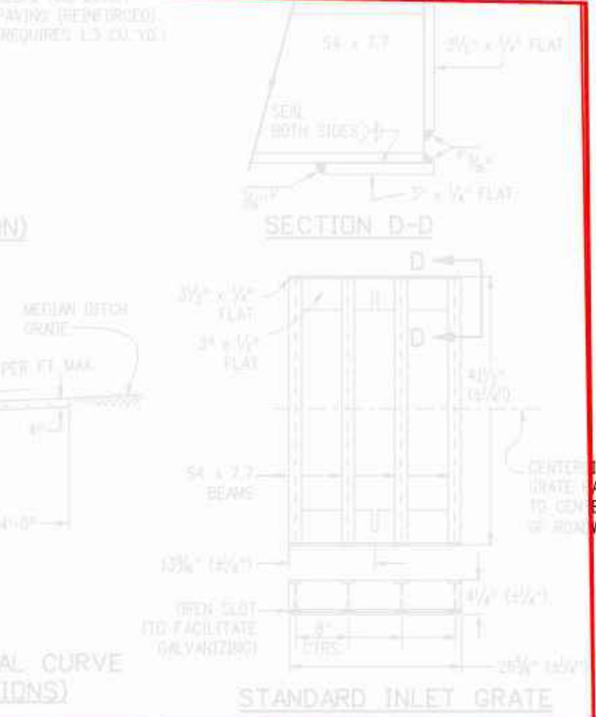
CONSTRUCTED IN [MONTH, YEAR], MAINTENANCE TO BE PERFORMED BY AMBLE

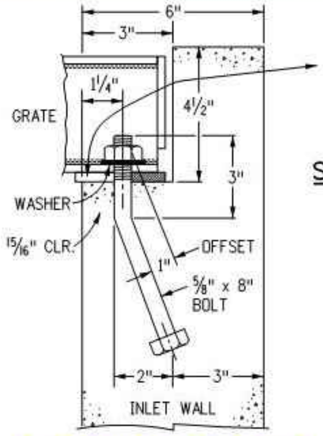




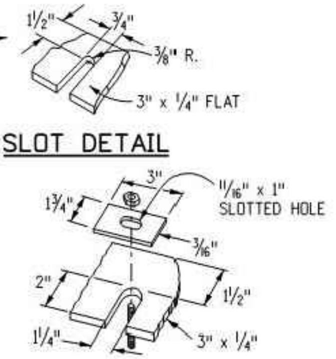
PLAN

ELEVATION
CONCRETE INLET





GRATE INSTALLATION DETAIL



ALTERNATE SLOT
AND HOLD DOWN
PLATE DETAIL

QUANTITIES FOR ONE INLET

H	CONCRETE ▼ (CU. YDS.)	STEEL ▼ (LBS.)	NO. STEPS REQ'D.
2'-6"	1.0	76	0
3'-0"	1.1	81	0
3'-6"	1.2	97	0
4'-0"	1.3	102	1
4'-6"	1.5	117	2
5'-0"	1.6	123	2
5'-6"	1.7	138	2
6'-0"	1.9	143	3
6'-6"	2.0	159	3
7'-0"	2.1	164	3
7'-6"	2.2	180	4
8'-0"	2.4	185	4
8'-6"	2.5	200	4
9'-0"	2.6	206	5
9'-6"	2.8	221	5
10'-0"	2.9	236	6
11'-6"	3.3	252	6

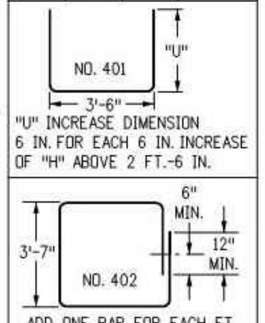
▼ PIPE INSIDE DIAMETER SHALL BE 30 IN. OR LESS. CONCRETE AND STEEL QUANTITIES ARE FOR ONE ENTIRE INLET BEFORE DEDUCTION FOR VOLUME OCCUPIED BY PIPE. WEIGHT OF STEEL INCLUDES A RING FOR THE MAXIMUM PIPE DIAMETER.

GENERAL NOTES

1. INLET TYPE C IS NOT HS-20 RATED AND SHALL NOT BE PLACED IN PAVED ROADWAYS. THIS INLET SHALL BE USED ONLY OUTSIDE PAVED ROADWAYS.
2. CONCRETE SHALL BE CLASS B. INLET MAY BE CAST-IN-PLACE OR PRECAST.
3. REINFORCING BARS SHALL BE GRADE 60, EPOXY COATED, AND DEFORMED #4, AND SHALL HAVE A MIN. 2 INCH CLEARANCE. CUT OR BEND AROUND PIPES AS REQUIRED.
4. CONCRETE SLOPE AND DITCH PAVING SHALL BE IN ACCORDANCE WITH SECTION 507. REINFORCEMENT FOR CONCRETE SLOPE PAVING SHALL BE 6 X 6 - W1.4 X W1.4 OR 6 X 6 - W2.1 X W2.1.
5. STRUCTURAL STEEL FOR GRATES AND GRATE INSTALLATION HARDWARE SHALL BE GALVANIZED, AND SHALL BE IN ACCORDANCE WITH SUBSECTION 712.06.
6. THE STANDARD INLET GRATES SHALL BE USED ON ALL TYPE C INLETS UNLESS CLOSE MESH INLET GRATES ARE SPECIFIED ON THE PLANS.
7. CLOSE MESH GRATES ARE RECOMMENDED WHERE FOOT TRAFFIC OR BICYCLE ROUTES ARE IN CLOSE PROXIMITY TO GRATE. THIS GRATE IS NOT ADA COMPLIANT OR BICYCLE FRIENDLY AND SHALL NOT BE PLACED DIRECTLY IN SIDEWALKS, CROSSWALKS OR BIKE PATHS.
8. STEPS SHALL BE PROVIDED WHEN INLET DIMENSION "H" IS EQUAL TO OR GREATER THAN 3 FEET - 6 INCHES AND SHALL CONFORM TO AASHTO M 199.
9. SEE STANDARD PLAN M-604-11, FOR REINFORCEMENT AROUND THE PIPE OPENING.
10. ALL INLETS SHALL HAVE A 4 INCH DIA. METAL MEDALLION WITH A "NO DUMPING DRAINS TO STREAM" MESSAGE ON IT. THE MEDALLION SHALL HAVE A FISH SYMBOL WITH A BLUE BACKGROUND. IT SHALL BE FIRMLY ATTACHED TO THE TOP OF THE INLET WITH A PERMANENT FASTENER.

BAR LIST FOR H = 2 FT.-6 IN. AND BENDING DIAGRAM

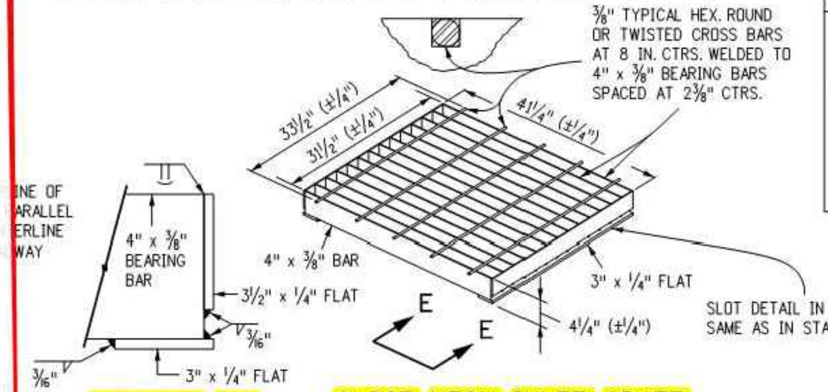
MARK	NO. REQ'D.	HEIGHT	LENGTH
401	2	2'-2½"	8'-0"
401	6	2'-7"	8'-8"
402	4	"U"	15'-4"



"U" INCREASE DIMENSION 6 IN. FOR EACH 6 IN. INCREASE OF "H" ABOVE 2 FT.-6 IN.

ADD ONE BAR FOR EACH FT. INCREASE OF "H" ABOVE 2 FT. - 6 IN.

402 BARS SHALL BE EQUALLY SPACED FROM EACH OTHER.



SECTION E-E

CLOSE MESH INLET GRATE

Computer File Information	
Creation Date: 07/31/19	(R-X)
Designer Initials: JBK	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions	
Date:	Comments

Colorado Department of Transportation
2829 West Howard Place
CDOT HQ, 3rd Floor
Denver, CO 80204
Phone: 303-757-9021 FAX: 303-757-9868
Project Development Branch JBK

INLET, TYPE C

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.
M-604-10
Standard Sheet No. 1 of 1
Project Sheet Number:

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(970) 871-9494 www.LANDMARK-CO.com
LANDMARK CONSULTANTS, INC.

Amble Site Improvements
WQ-1 Sand Filter and Detention Pond
OWNERSHIP AND MAINTENENCE PLAN

PROJECT: 2571-001
DATE: 12/15/2023
DRAWN BY: MCE
CHECKED BY: LCI

SHEET 2 Of 3 Sheets

AMBLE SITE IMPROVEMENTS

WQ-1 SAND FILTER OWNERSHIP AND MAINTENANCE PLAN

CONSTRUCTED IN [MONTH, YEAR], MAINTENANCE TO BE PERFORMED BY AMBLE

1. GENERAL PROJECT INFORMATION

ADDRESS: ACCOUNT: R8164035
LEGAL DESCRIPTION: LOT 1 & TRAM LOT, THE KNOLL SUBDIVISION

A. RECEIVING WATER: YAMPA RIVER
PROPERTY OWNER: STEAMBOAT SKI & RESORT CORPORATION
CONTACT NAME: ---
ADDRESS: 2305 MT. WERNER CIR
STEAMBOAT SPRINGS, CO 80487
PHONE NUMBER: ---_---_----
EMAIL: ______@_____.COM

D. AGENCY RESPONSIBLE
FOR MAINTENANCE: STEAMBOAT SKI & RESORT CORPORATION
CONTACT NAME: ---
ADDRESS: 2305 MT. WERNER CIR
STEAMBOAT SPRINGS, CO 80487
PHONE NUMBER: ---_---_----
EMAIL: ______@_____.COM

E. DESIGN ENGINEER: LANDMARK CONSULTANTS, INC.
CONTACT NAME: MATTHEW EGGEN, P.E.
ADDRESS: 141 9TH STREET, STEAMBOAT SPRINGS, CO
PHONE NUMBER: 970-871-9494
EMAIL: matte@landmark-co.com
PE LICENCE NUMBER: 50740

2. GENERAL FACILITY DESCRIPTION

THIS FACILITY IS A SAND FILTER DETENTION POND THAT WILL RELEASE THE WATER QUALITY CAPTURE VOLUME OVER 12-HOUR AND DETAIN RUNOFF SO THAT THE PEAK 5-YEAR AND 100-YEAR STORM EVENTS LEAVING THE WHOLE SITE ARE LESS THAN OR EQUAL TO PRE-DEVELOPMENT CONDITIONS. THE FACILITY HAS BEEN ADOPTED AND APPROVED BY STEAMBOAT RESORT DEVELOPMENT COMPANY AS PART OF THE AMBLE SITE IMPROVEMENTS PROJECT. IT WILL RECEIVE RUNOFF FROM 4.81 ACRES AND WILL OCCUPY A PARCEL OF 0.36 ACRES THAT WILL BE USED TO PROVIDE VOLUME BASED WATER QUALITY TREATMENT, MAINTENANCE, & ACCESS OPERATIONAL ACTIVITIES.

3. INSPECTION & MAINTENANCE FREQUENCY & PROCEDURE

A. THE FOLLOWING ITEMS SHOULD BE INSPECTED:

TABLE 1: MAINTENANCE ACTIVITY/FREQUENCY

ACTIVITY	REQUIRED FREQUENCY
INSPECTION TO CONFIRM INFILTRATION RATE AFTER RAINFALL; MAINTAIN AS NECESSARY. DEBRIS AND LITTER REMOVAL	TWICE ANNUALLY. ONE TIME TO OCCUR IN SPRING AFTER SNOWMELT FROM CONTRIBUTING BASIN IS COMPLETE.
MOWING, IRRIGATION	AS NEEDED TO MAINTAIN VEGETATIVE HEALTH
INSPECTION OF UNDERDRAIN VIA CLEAN-OUT; REMOVE SEDIMENT/DEBRIS IF PRESENT	WHEN PONDING LASTS LONGER THAN 24 HOURS
SCARIFY TOP 2" OF SAND WITH RAKE	WHEN PONDING LASTS LONGER THAN 24 HOURS AND UNDERDRAIN IS NOT CLOGGED
REPLENISH TOP 3" OF FILTER MEDIA WITH CLEAN COARSE SAND (AASHTO C-33 OR CDOT CLASS C FILTER MEDIA) TO THE ORIGINAL ELEVATION	AFTER SCARIFICATION 3 TIMES
SEDIMENT REMOVAL AND REPLACEMENT OF MEDIA. SEE TABLE 2 FOR MEDIA SPECIFICATIONS.	WHEN PONDING LASTS 24 HOURS, UNDERDRAIN IS NOT CLOGGED AND SCARIFICATION DOES NOT RESTORE INFILTRATION

REVISIONS TO MAINTENANCE FREQUENCY:

B. TRAFFIC CONTROL: NONE

C. THE FACILITY DOES NOT REQUIRE CONFINED SPACE ENTRY PROCEDURES

D. DEWATERING AND WATER CONTROL: NA

E. SEDIMENT, DEBRIS, & TRASH REMOVAL & DISPOSAL:

REMOVAL SHALL BE CONDUCTED IF THERE IS PRESENCE OF TRASH OR DEBRIS AT INSPECTION. SEDIMENT AND DEBRIS SHALL BE REMOVED MANUALLY USING A SHOVEL OR RAKE AND DISPOSED OF AT A LICENSED FACILITY. THE LONGEST DISTANCE BETWEEN THE EDGE OF AN ACCESS ROAD AND THE FAR CORNER OF A STRUCTURE REQUIRING SEDIMENT REMOVAL IS 25 FEET.

F. VEGETATION MANAGEMENT
SEE SECTION 4 OF THE NOTES ON THIS SHEET.

G. WETLAND AREAS ARE NOT ANTICIPATED.
SEE SECTION 8.0 OF THE NOTES ON THIS SHEET.

H. DESCRIBE ADDITIONAL REQUIRED MAINTENANCE PROCEDURES AND FREQUENCIES.-NA
SEE TABLE 1

I. MATERIALS TESTING OF SEDIMENT REMOVED FROM SITE IS NOT REQUIRED.

4. EQUIPMENT, STAFFING, AND VEGETATION MANAGEMENT

A. EQUIPMENT REQUIRED: MAY INCLUDE BUT IS NOT LIMITED TO MOWERS, PUMPS, HOSES, SHOVELS, BUCKETS, RAKES, EXCAVATORS, WEED KILLERS, GENERATORS, SPRAYERS, DATA LOG/INSPECTION REPORTS.

B. STAFFING: A MINIMUM OF 1 STAFF MEMBER IS REQUIRED TO MAINTAIN TREATMENT FACILITY.

C. SEED: SEED MIX SHALL BE PROVIDED AFTER CONSTRUCTION

D. MOWING: AS DESIRED

E. WEEDS & UNDESIRABLE VEGETATION: NOXIOUS WEEDS AND OTHER UNDESIRABLE VEGETATION SHALL BE REMOVED BY RAKING SAND FILTER.

5. SNOW AND ICE CONTROL

A. FACILITY IS NOT LOCATED WITHIN A SNOW STORAGE AREA AS DEFINED IN THE COMMUNITY DEVELOPMENT CODE.

TABLE 2: POND MATERIALS

			MASS PERCENT PASSING SQUARE MESH SIEVE	
		SIEVE SIZE	CLASS B	CLASS C
FILTER MATERIAL	CDOT FILTER MATERIAL (CLASS B OR C)	37.7mm (1.5")	100	
		19.0 mm (0.75")		100
		4.75 mm (No. 4)	20-60	60-100
		1.18 µm (No. 16)	10-30	
		300 µm (No. 50)	0-10	10-30
		150 µm (No. 100)		0-10
		75 µm (No. 200)	0-3	0-3
UNDERDRAIN PIPE	PIPE Ø AND TYPE	MAX. SLOT WIDTH (in.)	MIN. OPEN AREA (PER ft.)	
	4" SLOTTED PVC	0.032	1.90 in^2	

6. RIGHT-OF-WAY, ADJACENT OWNERSHIP, & ACCESS

A. RIGHT-OF-WAY DESCRIPTION: MT. WERNER CIRCLE, 100-FT ROW

B. ADJACENT OWNERSHIP: ADJACENT PROPERTY TO THE SOUTH IS:
OWNER: WEST CONDO HOMEOWNERS ASSOC
2120 MT WERNER CIRCLE
STEAMBOAT SPRINGS, CO 80487

C. ACCESS INFORMATION AND DETAILS: THE FACILITY IS ACCESSED VIA MT WERNER CIRCLE. A WATER QUALITY EASEMENT HAS BEEN PROVIDED FOR ACCESS AND MAINTENANCE NEEDS.

D. MAINTENANCE OPERATIONS WILL NOT IMPACT OR OBSTRUCT RIGHT-OF-WAY AND A RIGHT-OF-WAY PERMIT IS NOT REQUIRED.

7. HYDRAULIC DESIGN

A. FLOW RATES (CFS):

	INFLOW	OUTFLOW
BASE FLOW:	0	0
WQ EVENT:	NA	NA
5-YEAR:	4.55 CFS	1.57 CFS
100-YEAR:	16.37 CFS	10.32 CFS

B. VOLUMES, DEPTHS, & WSELS:

ITEM	VOLUME	WSEL	DEPTH	INVERT	AREA
SANDFILTER/ DETENTION POND	6,624 CF		3.8'	6892.83	1,574 SF
WQCV	2,448 CF	6896.50	1.2'		
5-YEAR	1,835 CF	6897.30	2.2'		
100-YEAR	4,176 CF	6758.00	2.54'		

C. WQCV DRAIN TIME = 12 HOURS

8. SENSITIVE AREAS, WETLANDS, & PERMITS

THE SITE HAS NO KNOWN WETLANDS OR WORK WITHIN THE WATERS OF THE UNITED STATES ASSOCIATED WITH THE PROJECT..

9. MISCELLANEOUS INFORMATION

A. PROJECT SURVEY:

EXISTING CONDITIONS AND TOPOGRAPHIC INFORMATION PER CITY GIS DATA AND SUPPLEMENTED WITH LANDMARK CONSULTANTS, INC. ARCHIVED SURVEY FIELD DATA .

PROJECT BENCHMARK: **3" BRASS CAP 2' BELOW GRADE**
NORTHING: 1412537.95
EASTING: 2636559.73
NAVD88 EL: 6935.31

COORDINATE SYSTEM: THE COORDINATE SYSTEM IS COLORADO COORDINATE SYSTEM, NORTH ZONE, NAD83 (2011), NAVD88, COMBINE SCALE FACTOR: (N)1415866.11(E)2636677.13, 1.000368966.

CIVIL ENGINEERS | SURVEYORS
141 9th Street ~ P.O. Box 774943
Steamboat Springs, Colorado 80477
(970) 871-9494 www.LANDMARK-CO.com
LANDMARK CONSULTANTS, INC.

Amble Site Improvements
WQ-1 Sand Filter and
Detention Pond
OWNERSHIP AND
MAINTENENCE PLAN

PROJECT: 2571-001
DATE: 12/15/2023
DRAWN BY: MCE
CHECKED BY: LCI

APPENDIX E

CITY FORMS & CHECKLISTS

Standard Form No. 3 Final Drainage Study Checklist

Instructions:

1. The applicant shall identify with a “check mark” if information is provided with letter. If applicant believes information is not required, indicate with “N/A” and attach separate sheet with explanation.
2. The reviewer will determine if information labeled “N/A” is required and whether additional information must be submitted.

I. General

___X___ A. Report typed and legible in 8½” x 11” format.
___X___ B. Report bound (comb, spiral, or staple – no notebook).
___X___ C. Drawings that are 8½ x 11 or 11 x 17 bound within report, larger drawings (up to 24 x 36) included in a pocket attached to the report. Drawings shall be at an appropriate size and scale to be legible and include project area.

II. Cover

______ A. Report Type – Final Drainage Study.
___X___ B. Project Name, Subdivision, Original Date, Revision Date.
___X___ C. Preparer’s name, firm, address, phone number.
___X___ D. “DRAFT” for 1st submittal and revisions; “FINAL” once approved.

III. Title Sheet

___X___ A. Table of Contents.
___X___ B. Certification, PE Stamp, signature, and date from licensed Colorado PE.
___X___ C. Note: City of Steamboat Springs plan review and approval is only for general conformance with City design criteria and the City code. The City is not responsible for the accuracy and adequacy of the design, dimensions, and elevations that shall be confirmed and correlated at the job site. The City of Steamboat Springs assumes no responsibility for the completeness or accuracy of this document.

IV. Introduction

___X___ A. Description of site location, size in acres, existing and proposed land use, and any pertinent background info.
___X___ B. Reference planning application type and plan set date and preparer.
___X___ C. Identify drainage reports for adjacent development.

V. Drainage Criteria and Methodology Used

___X___ A. Identify design rainfall and storm frequency.
___X___ B. Identify the runoff calculation method used.
___X___ C. Identify culvert and storm sewer design methodology.
___X___ D. Identify detention discharge and storage methodology.
___X___ E. Discuss HEC-HMS methodologies and parameters, if HEC-HMS is used.

VI. Existing Conditions (Pre-Development/Historic)

X A. Indicate ground cover, imperviousness, topography, and size of site (acres).
X B. Describe existing stormwater system (sizes, materials, etc.).
X C. Describe other notable features (canals, major utilities, etc.).
X D. Note site outfall locations and ultimate outfall location (typically Yampa River).
X E. Note capacity of existing system and identify any constraints.
X F. Identify NRCS soil type.
X G. Discuss any existing easements.
X H. Identify the FEMA Map reviewed, if site is in floodplain/way, and zone designation.

VII. Proposed Conditions

X A. Indicate ground cover, imperviousness, topography, and disturbed area (acres).
X B. Describe proposed stormwater system (sizes, materials, etc.).
X C. Describe proposed outlets and indicate historic and proposed flow for each.
X D. Include calculations for all culverts, ditches, ponds, etc. in appendix.
X E. Include a summary table for the 5- and 100-year events showing historic flow and proposed flow for total site and each basin.
X F. Discuss proposed easements.
X G. Describe off-site flows to be passed thru site.
X H. Summarize any impacts to downstream properties or indicate none. Reference CLOMR/LOMR and impacts.
I. Detention Ponds.
    x 1. Indicate pond volume and area (size and depth) requirement.
    x 2. Indicate release rates.
    X 3. Discuss outfall design, location, and overflow location.
    X 4. Discuss maintenance requirements.
J. Curb and Gutter
    X 1. Indicate gutter capacity.
    x 2. Indicate curb capacity.
    X 3. Indicate design velocity
    X 4. Indicate design depth of flow in street.
K. Culverts
    x 1. Indicate whether each culvert is under inlet or outlet control.
    X 2. Show that headwater is less than the maximum allowable.
    X 3. Indicate design velocity.
    X 4. Indicate required and provided flow rates.
    X 5. Discuss whether outlet protection is required and what will be used.
L. Inlets
    X 1. Indicate inlet capacity.
    X 2. Indicate the type of inlet(s) used.
M. Channels
    x 1. Indicate design velocity (and type of dissipation if required).
    x 2. Indicate required and provided flow capacity.
    x 3. Show critical cross-section(s) including water surface.
N. Site Discharge
    X 1. Discuss use and design of detention to ensure discharge is less than or equal to historic flow.
    X 2. Provide documentation that downstream facilities are adequate and no adverse impacts to downstream property owners (i.e. no rise certification)

VIII. Post Construction Stormwater Management

X A. Discuss in general terms which permanent BMP practices will be used to control pollutant and sediment discharge after construction is complete. Exhibit A, Storm Water Quality Plan shall be attached that will give details (see separate checklist)

IX. Conclusions

X A. Provide general summary.
X B. Note if site complies with criteria and any variances to criteria.
X C. Indicate if peak proposed flow is less than, equal to, or greater than peak historic flow for each outfall, design point, and for the total site.
X D. List proposed new stormwater system requirements.

X. References

X A. Provide a reference list of all criteria, master plans, drainage reports and technical information used.

XI. Tables

X A. Include a copy of all tables prepared for the study.

XII. Figures

X A. Vicinity Map.
X B. Site Plan (include the horizontal and vertical datum used and all benchmarks).
C. Existing conditions.
X 1. Delineate existing basin boundaries.
X 2. Delineate offsite basins impacting the site.
X 3. Show existing and proposed topography at an interval of at least 2-ft.
X 4. Show existing runoff flow arrows.
X 5. Show existing stormwater features (structures, sizes, materials, etc.).
X 6. Show floodplain limits and information.
X 7. For each basin show bubble with basin number, acreage and % impervious.
X 8. For each outlet show bubble with acreage and historic flow and proposed flow or provide information in summary table on figure.
D. Proposed Conditions
X 1. Delineate proposed basin boundaries.
X 2. Show proposed runoff flow arrows.
X 3. Show existing and proposed topography at an interval of at least 2-ft.
X 4. For each basin show bubble with basin number, acreage and percent impervious or provide a summary table or figure.
X 5. For each outlet show bubble with acreage, historic flow, and proposed flow or provide a summary table or figure.
X 6. Show floodplain limits and information.
X 7. Show proposed building footprints and FFE for commercial and multi-family
X 8. Show property lines and easements (existing and proposed).
X 9. Label public and private facilities. A general note can be placed on the plans in lieu of labeling all facilities, if applicable.

XIII. Appendices

__x__ A. Runoff Calculations.
__x__ B. Culvert Calculations.
__x__ C. Pond Calculations.
__x__ D. Other Calculations.

Acknowledgements

Standard Form No. 3 was prepared by: Matthew Eggen 12/15/2023
Date

Include Attachment A – Scope Approval Form (see Standard Form No. 5)
Include Attachment B – Storm Water Quality Plan (see Standard Form No. 4)

PROJECT SHEET – BASE DESIGN STANDARDS (Site is not constrained)

Complete a Project Sheet for each project that includes Permanent Stormwater Treatment Facilities.

SITE INFORMATION

Project Name:	The Amble		
Project Location:	Steamboat Springs, CO		
Submitted Date:	12/15/23	Submitted By:	Landmark Consultants, Inc.
Acreage Disturbed:	6.43		
Existing Impervious:	26%	New Net Impervious:	36%
Review Date:		Reviewed By:	

Preparer	City	Requirements
w/ CD's		Design Details are included for all Treatment Facilities
		List or include a description of any source controls or other non-structural practices: Select BMP based on expected pollutant type - snow storage Maintain existing drainage pattern

DESIGN STANDARDS

Multiple Design Standards may be used on a site, as necessary, to meet the requirements, but only one Design Standard may be used for each treatment facility's tributary area. Evaluation of suitability of permanent stormwater treatment facilities is based on meeting the specified Design Standard and ease of long-term maintenance. Facilities must be designed in accordance with the most current versions of the City's Engineering Standards and Volume 3 of the USDCM and meet the specific requirements for each Design Standard used.

1. Indicate below, which Design Standard(s) will be used for the project, and
2. Complete a separate, corresponding Design Standards checklist for each facility (e.g., WQCV)

Design Standard	*Quantity*	*Tributary Area*	*Location/Identifying information*
WQCV	2,448-ft3	4.81-acres	WQ-1
Pollutant Removal			
Runoff Reduction			

Standard Form No. 4 Stormwater Quality Plan Checklist

This list is not an exhaustive list of every possible item that may be required or requested in a Stormwater Quality Plan but provides a general guideline for preparation of the Stormwater Quality Plan.

Instructions:

1. The applicant shall identify with a "check mark" if information is provided within the Stormwater Quality Plan. If applicant believes information is not required, indicate with "N/A" and attach separate sheet with explanation. If information is included with the associated drainage letter or study, indicated with a "D."
2. The reviewer will determine if information labeled "N/A" is required and whether additional information must be submitted.

I. General

__X__ A. Report typed and legible in 8½" x 11" format.
__X__ B. Report bound (comb, spiral, or staple – no notebook) and in digital PDF format.
__X__ C. Drawings that are 11" x 17" bound within letter, larger drawings (up to 24" x 36") included in a pocket attached to the letter, and a digital PDF copy. Drawings shall be at an appropriate size and scale to be legible and include project area.

II. Cover

__X__ A. Report Type – Stormwater Quality Plan.
__X__ B. Project Name, Subdivision or Development, Original Date, Revision Date.
__X__ C. Preparer's name, firm, address, and phone number.
__X__ D. "DRAFT" for 1st submittal and revisions; "FINAL" once approved.

III. Title Sheet

__X__ A. Table of Contents.
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IV. Introduction and Background

__X__ A. Description of site location, study limits, size in acres, existing and proposed land use, soil data, permeability of the site, drainage patterns, and any pertinent background info.
__X__ B. State purpose and goal of Stormwater Quality Plan and report along with any special requirements of the desired outcome.
__X__ C. List any project stakeholders and/or requestors.
__X__ D. Describe the background of the flooding source and any previous studies.

V. Design Criteria and Methodology Used

X A. Identify design rainfall and storm frequency used to design permanent stormwater treatment facilities.
X B Identify the runoff calculation method used to design permanent stormwater treatment facilities.
X C. Identify the standard the design will meet and the means and methodologies by which it will use to meet the standard.
X D. Provide all details supporting the use of the selected design standard.

VI. Proposed Conditions

X A. Identify total site area, total site imperviousness, area to be treated, and impervious area to be treated. Include justification for treating less than the total site area.
X B. Describe potential site contaminant sources including sediment.
X C. Identify source and quantity of on-site and off-site stormwater flows that need to be managed and how they will be managed.
X D. For each permanent treatment facility, identify the design standard, MDCIA level (if applicable), area treated (& percentage of total), imperviousness of area treated, C values of area treated, soil types, and all pertinent data for design.
X E. Volume based facilities: Provide total storage pond volume, WQCV, drain time, release rate, sediment storage, outlet & overflow structures, area and depth of pond, micropool, forebays, etc. (include all calculations in the appendix).
X F. Flow based facilities: Provide design flow rate and all treatment calculations and how flows larger than the water quality design flow rate will be handled. If proprietary facilities are proposed, provide the justification and sizing requirements from manufacturer.
X G. If stormwater detention is provided, discuss how water quality is provided within the detention facility. No underground detention is allowed.

VII. Operation and Maintenance Plan Requirements

See template O&M plan and guidance document.

x A. Describe general project information, facility description, ROW and access information, vegetation management, hydraulic design parameters, environmental permitting, snow and ice control, and additional pertinent information in the notes.
X B. Indicate, describe, and detail the permanent stormwater treatment facilities.
X C Include section details where necessary of the permanent treatment facilities.
X D. Provide an inspection and maintenance schedule and procedure of permanent treatment facilities and who is responsible for them.
X E. Identify design specifications for construction.

Acknowledgements

Standard Form No. 4 prepared by: Matthew Eggen 12/15/2023
Date

Include appropriate Project Sheet(s) and Design Checklist(s) (See Section 5.12)
Include this form as part of the Stormwater Quality Plan.

Standard Form No. 5 Drainage and Stormwater Treatment Scope Approval Form

Prior to starting a development plan and before the first drainage submittal, a Drainage and Stormwater Treatment Scope Approval Form must be submitted for review and signed by the City Engineer. A signed form shall also be included in every drainage submittal as Attachment A. This Scope Approval Form is for City requirements only. Values may be approximate. The City encourages supporting calculations and figures to be attached.

Project Information	
Project name:	Lot 1, The Knoll Development Rights Withdrawal and Resubdivision Plat
Project location:	Steamboat Grand Resort Hotel
Developer name/contact info:	Steamboat Resort Development Company. 3501 Wazee Street, Denver CO 80215
Drainage engineer name/contact info:	Landmark Consultants, Inc. matte@landmark-co.com (970) 819-9494
Application Type:	Preliminary Plat
Proposed Land Use:	Resort Residential

Project Site Parameters	
Total parcel area (acres):	13.9
Disturbed area (acres):	4.34
Existing impervious area (acres, if applicable):	0.38
Proposed new impervious area (acres):	1.96
Proposed total impervious area (acres):	2.06
Proposed number of project outfalls:	2
Number of additional parking spaces:	0
Description and site percentage of existing cover/land use(s):	13.52 acres - Open space, pervious area 0.38 acres - Asphalt Trail, pavements, building
Description and site percentage of proposed cover/land use(s):	0.68 acres - Pavements 1.28 acres - ~70% impervious development of proposed lot 1
Expected maximum proposed conveyance gradient (%):	38%
Description of size (acres) and cover/land use(s) of offsite areas draining to the site	NA

Type of Study Required:

☐ Drainage Letter ☐ Conceptual Drainage Study
☒ Final Drainage Study ☒ Stormwater Quality Plan

Hydrologic Evaluation:

☒ Rational Method ☐ CUHP/SWMM ☐ HEC-HMS ☐ Other____________________

Project Drainage	
Number of subbasins to be evaluated:	2
Presence of pass through flow (circle):	YES [✓ NO]
Description of proposed stormwater conveyance on site:	storm water will generally be collected in swales and pipes on the west side of the parcel and conveyed to the on-site WQ/Detention basin. Storm water on the east side of the parcel will not convey additional flows and therefore be left as is.
Project includes roadway conveyance as part of design evaluation (circle):	YES [✓ NO]
Description of conveyance of site runoff downstream of site, identify any infrastructure noted in Stormwater Master Plan noted as lacking capacity for minor or major storm event:	The western site stormwater will leave the site at an existing culvert under Mount Werner Circle which outfalls into Wildhorse Meadows. The outfall pipe is not listed as a "Problem or Need" in the Citywide Stormwater Plan.
Detention expected onsite (circle):	[✓ YES] NO
Presence of Floodway or Floodplain on site (circle):	YES [✓ NO]
Anticipated modification of Floodway or Floodplain proposed (circle):	YES [✓ NO]
Describe culvert or storm sewer conveyance evaluative method:	HY-8, Autodesk Storm and Sanitary Sewer Analysis

Permanent Stormwater Treatment Facility Design Standard (check all that apply with only one standard per tributary basin):

☒ WQCV Standard ☐ TSS Standard ☐ Infiltration Standard

☐ Constrained Redevelopment WQCV Standard

☐ Constrained Redevelopment TSS Standard

☐ Constrained Redevelopment Infiltration Standard

☐ Does not Require Permanent Stormwater Treatment (attach Exclusion Tracking Form)

Project Permanent Stormwater Treatment	
Justification of choice of proposed design standard, including how the site meets the constrained redevelopment standard, infiltration test results, etc.:	Proposed improvements require detention to maintain historic discharge rates and water quality treatment due to increased impervious surface area.
Concept-level permanent stormwater treatment facility design details (type, location of facilities, proprietary structure selection, treatment train concept, etc.):	One bioretention basin will treat the WQCV and also provide adequate detention for the 5-year and 100-year storms.
Proposed LID measures to reduce runoff volume:	One bioretention basin will treat the WQCV and also provide adequate detention for the 5-year and 100-year storms.
Will treatment evaluation include off-site, pass through flow (circle):	YES [✓ NO]

Approvals

Matthew Eggen, Landmark Consultants, Inc. 9/21/22 (970)819-8893

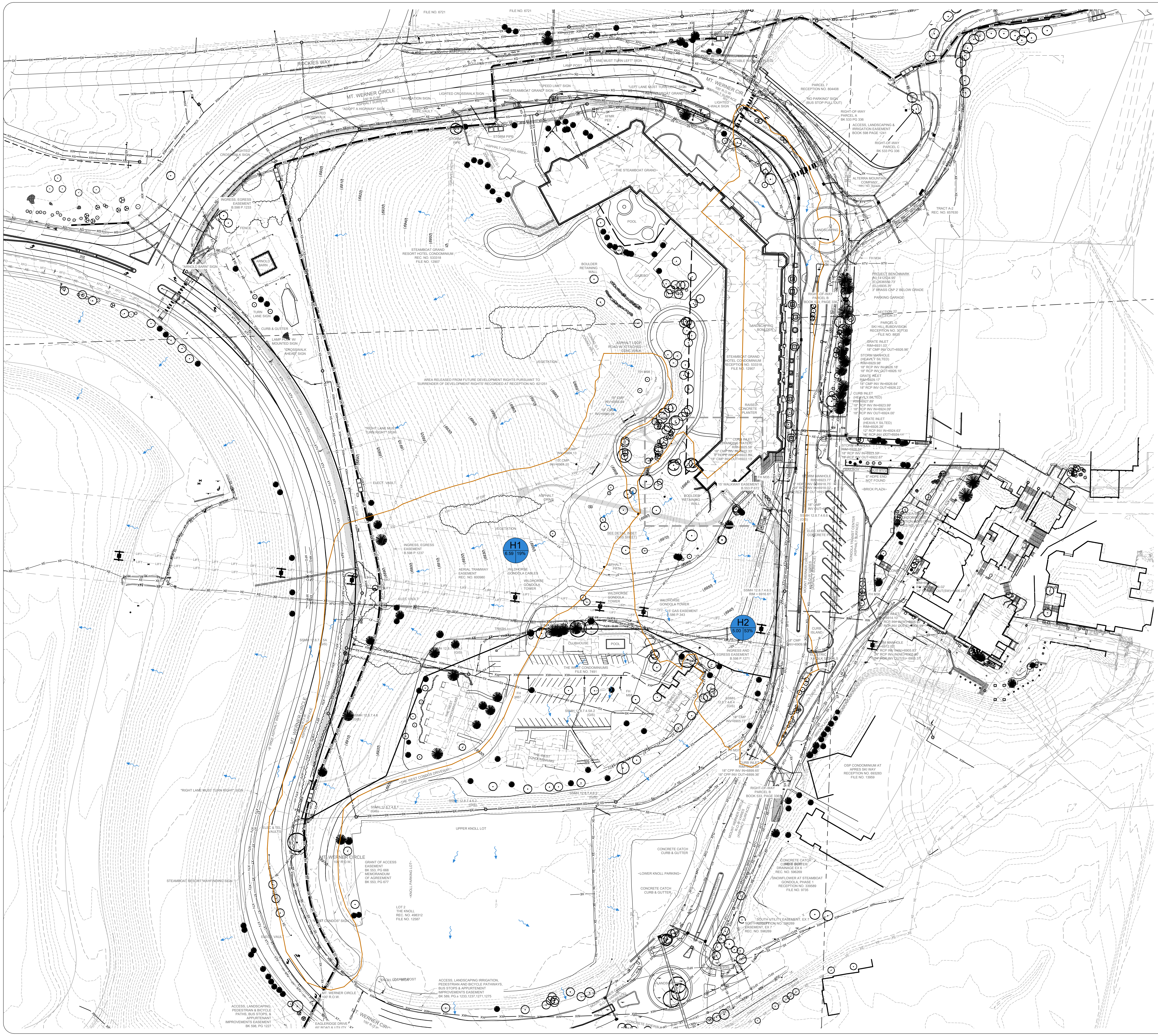
Prepared By: Date Phone number
(Insert drainage engineer name & firm)

Approved By:

Printed Name: Date
City Engineer

APPROVED
to be generally in
accordance with
CITY ENGINEERING
STANDARDS

10/04/2022



NORTH

80 0 80 160 240 Feet

(IN FEET)
1 inch = 80 ft.

LEGEND:

EXISTING STORM SEWER	
PROPOSED STORM SEWER	
PROPOSED STORM INLET (CURB & AREA)	
PROPOSED MAJOR CONTOUR	6805
PROPOSED MINOR CONTOUR	
EXISTING MAJOR CONTOUR	6805
EXISTING MINOR CONTOUR	
PROPOSED SWALE	
PROPOSED CURB & GUTTER	
PROPERTY BOUNDARY	
PROPOSED LOT LINE	
EXISTING RIGHT OF WAY	
FLOOD HAZARD LIMITS	
EXISTING BASIN	
PROPOSED BASIN	
PROPOSED SPOT ELEVATION	00.10
EXISTING SPOT ELEVATION	00.10 X
PROPOSED OVERLAND FLOW DIRECTION W/SLOPE	2.0%
PROPOSED CHANNELIZED FLOW DIRECTION W/ SLOPE	2.0%
EXISTING CHANNELIZED FLOW DIRECTION	⇐

A1
X.XX X.XX

BASIN ID

TOTAL AREA (ACRES)

PERCENT IMPERVIOUS

BASIN INFORMATION

NOTES:

1. THE SIZE, TYPE AND LOCATION OF ALL KNOWN UNDERGROUND UTILITIES ARE APPROXIMATE WHEN SHOWN ON THESE DRAWINGS. IT SHALL BE THE RESPONSIBILITY OF THE DEVELOPER TO VERIFY THE EXISTENCE OF ALL UNDERGROUND UTILITIES IN THE AREA OF THE WORK. BEFORE COMMENCING NEW CONSTRUCTION, THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING ALL UNDERGROUND UTILITIES AND SHALL BE RESPONSIBLE FOR FOR ALL UNKNOWN UNDERGROUND UTILITIES.
2. ALL PROJECT DATA IS ON VERTICAL DATUM; NAVD 88. SEE NOTES SHEET FOR BENCHMARK REFERENCES.
3. ELEVATIONS FOR IMPROVEMENTS THAT ARE CONTROLLED BY ADJACENT EXISTING FACILITIES (SUCH AS PROPOSED GUTTERS ALONG EXISTING ASPHALT) MAY REQUIRE ADJUSTMENT BASED ON ACTUAL CONDITIONS. COORDINATE WITH ENGINEER TO ENSURE A CONSISTENT SECTION WITH SMOOTH TRANSITIONS WHERE NECESSARY.
4. SEE SOILS REPORT FOR PAVEMENT, SUBGRADE AND MATERIAL PREPARATION, DESIGN AND RECOMMENDATIONS.
5. ALL CURB SPOTS SHOWN ARE FLOWLINE ELEVATIONS, UNLESS NOTED OTHERWISE. ALL OTHER SPOTS ARE FINISHED GRADE ELEVATIONS.

Table 1: Basin Hydrology Summary

Basin	Total Area (acres)	%Imp	C_5	C_{100}	T_c (min)	Q_5 (cfs)	Q_{100} (cfs)
H1	6.59	19%	0.25	0.55	12.61	4.23	19.89
H2	5.00	53%	0.42	0.61	8.39	6.60	21.18
D1.a	2.58	37%	0.34	0.58	9.22	2.63	9.72
D1.b	1.51	20%	0.26	0.55	5.00	1.50	6.98
D1.c	0.41	22%	0.27	0.56	8.35	0.35	1.57
D1.c.1	0.42	41%	0.35	0.58	7.14	0.50	1.81
D1.d	0.13	39%	0.35	0.58	7.27	0.16	0.57
D1.e	1.18	41%	0.36	0.58	5.00	1.62	5.79
D1.f	1.58	50%	0.40	0.60	5.00	2.42	7.96
D2	4.26	66%	0.49	0.65	8.39	6.70	19.32

Table 2: Design Point Summary

Design Point	Total Area (acres)	%Imp	C_5	C_{100}	T_c (min)	Q_5 (cfs)	Q_{100} (cfs)
WQ-1	4.81	36%	0.33	0.55	10.35	4.55	16.37
H1	7.39	36%	0.34	0.61	14.55	5.75	22.80
DP1	2.34	24%	0.28	0.58	10.81	1.81	8.17

Table 3: Allowable Outflow for Detention Calculation

Design Storm	Q_H	Q_{UD}	Q_A
5-Year	4.23	2.63	1.60
100-Year	19.89	9.72	10.17

Q_H Historic peak flow (cfs)
Q_{UD} Undetained flow (cfs)
Q_A Allowable peak flow from detention facility (cfs)

Table 4: Water Quality Pond Summary

Basin	Sand Filter Flat Area (ft^2)		Bioretention Flat Area (ft^2)		$WQCV^1$ (ft^3)	$Detention^2$ V_5 (ft^3)	$Detention^2$ V_{100} (ft^3)	V_{100} + WQCV (ft^3)	Total Volume (ft^3)
	Required	Provided	Required	Provided	Required				Provided
WQ-1	935	1,574	1495	1,574	2,229	1,835	3,854	6,082	6,624
					Total Treated Area (acres)				4.24
					Total Disturbed area (acres)				5.04
					Percent Treated (%)				84%

CALL UTILITY NOTIFICATION CENTER OF COLORADO

811

Know what's below.
Call before you dig.

CALL 2 BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

MATTHEW CARL EGGEN
50740
12/15/23

NOT VALID WITHOUT ORIGINAL SIGNATURE AND DATE

LANDMARK
CONSULTANTS, INC.
CIVIL ENGINEERS | SURVEYORS
141 9th Street ~ P.O. Box 774943, Steamboat Springs, CO 80477
(970) 871-9494 ~ www.LANDMARK-CO.com

These drawings are instruments of service provided by Landmark Consultants, Inc. and are not to be used for any type of construction or contracting unless signed and sealed by a Professional Engineer in the employ of Landmark Consultants, Inc.

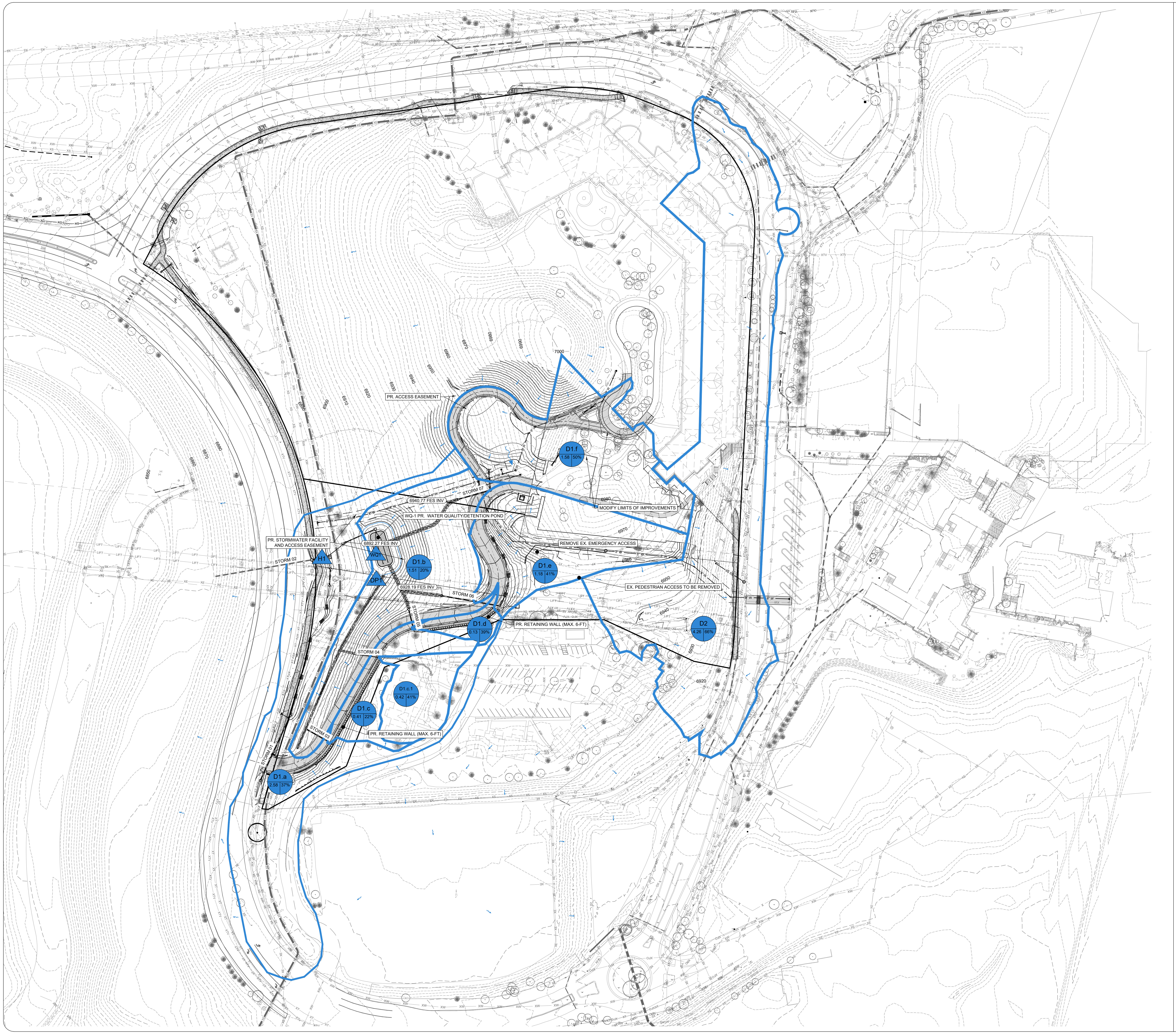
NO.	DATE:	BY:	DESCRIPTION:

PROJECT: 2571-001
DATE: 12/15/2023
CONTACT: Matthew Eggen
EMAIL: matte@landmark-co.com

The Amble - Construction Drawings

Existing Drainage Plan

SHEET
FIG 2



NORTH

80 0 80 160 240 Feet

(IN FEET)
1 inch = 80 ft.

LEGEND:

EXISTING STORM SEWER	
PROPOSED STORM SEWER	
PROPOSED STORM INLET (CURB & AREA)	
PROPOSED MAJOR CONTOUR	6805
PROPOSED MINOR CONTOUR	
EXISTING MAJOR CONTOUR	6805
EXISTING MINOR CONTOUR	
PROPOSED SWALE	
PROPOSED CURB & GUTTER	
PROPERTY BOUNDARY	
PROPOSED LOT LINE	
EXISTING RIGHT OF WAY	
FLOOD HAZARD LIMITS	
EXISTING BASIN	🟧
PROPOSED BASIN	🟦
PROPOSED SPOT ELEVATION	00.10
EXISTING SPOT ELEVATION	00.10 X
PROPOSED OVERLAND FLOW DIRECTION W/SLOPE	2.0%
PROPOSED CHANNELIZED FLOW DIRECTION W/ SLOPE	2.0%
EXISTING CHANNELIZED FLOW DIRECTION	⇐

A1
X.XX X.XX

BASIN ID
TOTAL AREA (ACRES)
PERCENT IMPERVIOUS

BASIN INFORMATION

NOTES:

1. THE SIZE, TYPE AND LOCATION OF ALL KNOWN UNDERGROUND UTILITIES ARE APPROXIMATE WHEN SHOWN ON THESE DRAWINGS. IT SHALL BE THE RESPONSIBILITY OF THE DEVELOPER TO VERIFY THE EXISTENCE OF ALL UNDERGROUND UTILITIES IN THE AREA OF THE WORK. BEFORE COMMENCING NEW CONSTRUCTION, THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING ALL UNDERGROUND UTILITIES AND SHALL BE RESPONSIBLE FOR FOR ALL UNKNOWN UNDERGROUND UTILITIES.

2. ALL PROJECT DATA IS ON VERTICAL DATUM; NAVD 88. SEE NOTES SHEET FOR BENCHMARK REFERENCES.

3. ELEVATIONS FOR IMPROVEMENTS THAT ARE CONTROLLED BY ADJACENT EXISTING FACILITIES (SUCH AS PROPOSED GUTTERS ALONG EXISTING ASPHALT) MAY REQUIRE ADJUSTMENT BASED ON ACTUAL CONDITIONS. COORDINATE WITH ENGINEER TO ENSURE A CONSISTENT SECTION WITH SMOOTH TRANSITIONS WHERE NECESSARY.

4. SEE SOILS REPORT FOR PAVEMENT, SUBGRADE AND MATERIAL PREPARATION, DESIGN AND RECOMMENDATIONS.

5. ALL CURB SPOTS SHOWN ARE FLOWLINE ELEVATIONS, UNLESS NOTED OTHERWISE. ALL OTHER SPOTS ARE FINISHED GRADE ELEVATIONS.

Table 1: Basin Hydrology Summary

Basin	Total Area (acres)	%Imp	C_5	C_{100}	T_c (min)	Q_5 (cfs)	Q_{100} (cfs)
H1	6.59	19%	0.25	0.55	12.61	4.23	19.89
H2	5.00	53%	0.42	0.61	8.39	6.60	21.18
D1.a	2.58	37%	0.34	0.58	9.22	2.63	9.72
D1.b	1.51	20%	0.26	0.55	5.00	1.50	6.98
D1.c	0.41	22%	0.27	0.56	8.35	0.35	1.57
D1.c.1	0.42	41%	0.35	0.58	7.14	0.50	1.81
D1.d	0.13	39%	0.35	0.58	7.27	0.16	0.57
D1.e	1.18	41%	0.36	0.58	5.00	1.62	5.79
D1.f	1.58	50%	0.40	0.60	5.00	2.42	7.96
D2	4.26	66%	0.49	0.65	8.39	6.70	19.32

Table 2: Design Point Summary

Design Point	Total Area (acres)	%Imp	C_5	C_{100}	T_c (min)	Q_5 (cfs)	Q_{100} (cfs)
WQ-1	4.81	36%	0.33	0.55	10.35	4.55	16.37
H1	7.39	36%	0.34	0.61	14.55	5.75	22.80
DP1	2.34	24%	0.28	0.58	10.81	1.81	8.17

Table 3: Allowable Outflow for Detention Calculation

Design Storm	Q_H	Q_{UD}	Q_A
5-Year	4.23	2.63	1.60
100-Year	19.89	9.72	10.17

Q_H Historic peak flow (cfs)
Q_{UD} Undetained flow (cfs)
Q_A Allowable peak flow from detention facility (cfs)

Table 4: Water Quality Pond Summary

Basin	Sand Filter Flat Area (ft^2)		Bioretention Flat Area (ft^2)		WQCV[1] (ft^3)	Detention[2] V_5 (ft^3)	Detention[2] V_{100} (ft^3)	V_{100} + WQCV (ft^3)	Total Volume (ft^3)
	Required	Provided	Required	Provided	Required				Provided
WQ-1	935	1,574	1495	1,574	2,229	1,835	3,854	6,082	6,624
					Total Treated Area (acres)				4.24
					Total Disturbed area (acres)				5.04
					Percent Treated (%)				84%

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MATTHEW CARL EGGEN
50740
12/15/23

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NO.	DATE:	BY:	DESCRIPTION:

PROJECT: 2571-001
DATE: 12/15/2023
CONTACT: Matthew Eggen
EMAIL: matte@landmark-co.com

The Amble - Construction Drawings

Proposed Drainage Plan

SHEET
FIG 3

DRAWING FILENAME: P:\2571-001\Engineering\Drainage\Reports\Drainage Report\2571-001-FIG 3-Proposed Drainage Plan.dwg LAYOUT NAME: FIG 3 DATE: Dec 15, 2023 - 6:16pm CAD OPERATOR: matthew
LIST OF XREFS: [2571-001-xExist] [2571-001-xExist-Utils] [2571-001-xBndy-Offsite] [2571-001-xHatch-PP] [2571-001-xSite-PP] [2571-001-xUtil-PP] [2571-001-xPlat-PP] [2571-001-xBndy] [xDRAINAGE_Leg] [xBORDER-PP CDs]