NATIVE SUN CONSTRUCTION

MONUMENT, CO
FINAL DRAINAGE REPORT

Submittal Dates:
Issued for Review September 2, 2021
Revised December 15, 2021

OWNER/APPLICANT

Native Sun Construction
16050 Old Denver Road
Monument, CO 80132
Phone (719) 593-5874
Email: info@nativesun.construction

CONSULTANT

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Monument, CO 80132
Phone 719-271-1175
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CDX2 Project No. 21002
TOM File No.

TABLE OF CONTENTS

CERTIFICATIONS

Design Engineer's Statement:

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

_____ _____

Name Date

Owner/Developer's Statement:

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

_____ _____

By Date

Title

Address

Town of Monument:

Filed in accordance with the requirements of the City of Colorado Springs/El Paso County Drainage Criteria Manual Volume 2, dated November 1, as amended.

_____ _____

Name: Date

_____

Town of Monument

Conditions:

FLOODPLAIN STATEMENT

To the best of my knowledge and belief, no portion of the this property is located within a designated 100 year floodplain as shown on FIRM map numbers 08041C0286G (effective date December 7, 2018). A copy of the FIRM map and FIRMETTE are included as attachments to this report.

_____

Christian L. Day, PE Colorado 35037

INTRODUCTION

The purpose of the following Final Drainage Report (FDR) is to present and analyze final drainage improvements for the Native Sun Construction site improvements. The format of this report follows the requirements in the Drainage Criteria Manual, Volume I, page 4-10, section 4.4, "Final Drainage Report (FDR)", with the exception of this Introductory section. Per the DCM the FDR shall contain all components of the PDR (Preliminary Drainage Report) plus the required components of the FDR.

Native Sun Construction is proposing site improvements to a portion of their 7.36 acre property (Parcel B) adjacent to Woodcarver Road. As such, the Town of Monument (TOM) is requesting that the drainage characteristics of the property be studied as part of the work and hence this FDR produced.

GENERAL PROPERTY DESCRIPTION

Native Sun Construction is located in El Paso County Colorado, but the property will be annexed by the TOM in the near future. The property is adjacent to the southwest edge of Woodcarver Road. The area of study is generally confined to disturbed and developed areas of the property itself, that is the 7.36 acres of Parcel B. See "Improvement Survey Plat" by Barron Land for additional information. There are minor offsite runoff contributions to which flow onto and across the site however. The site is zoned Planned Development (PD). The surrounding areas are zoned Agricultural (A-35) in unincorporated El Paso County.

The site is located in the northeast 1/4 of the Section 35, Township 11 South, Range 67 West of the 6th Prime Meridian, El Paso County.

There are no major drainageways or drainage facilities on the site. Monument Creek meanders approximately 1000' to the south of the property. Beaver Creek is approximately 1/2 mile to the west.

The surrounding developments include the Navsys Corporation and other small businesses to the south, mostly vacant land to the west and the Santa Fe Trail to the north and east. It is noted that the Falcon Commerce Center and UPS distribution facility are being constructed in the vacant land to the north and east, beyond the Santa Fe Trail.

Parcel B site encompasses 7.36 acres in total. The existing conditions contain gravel areas, native grasses, several mature trees, and wetlands. In the proposed condition, the land use will include road base-surfaced construction yard, parking and driveways, an office building, a maintenance shop, an extended detention stormwater pond, and open space & landscaped areas.

The topography of the site is moderately sloped, with grades generally around 3%, but going to about 30% in one area. The northwest part of the property is the high point, and slopes in each direction from there, with the majority of the site sloping south and east where it flows to and existing low point and wetland. Two swales form in the middle of the property, and drain south to the low point.

Soil Conservation Service soil survey records indicate the project area is covered by soils classified in the Kettle-Rock outcrop complex, which is categorized in the Hydrological Group "B", the Peyton-Pring complex, 8 to 15 percent slopes, which is categorized in the Hydrological Group "B", and the Pring coarse sandy loam, 3 to 8 percent slopes, also in Hydrological Group "B". See the attached soil report in the appendix for further details on the soils.

There are no major drainageways to describe on the property. This property does not have any irrigation facilities in either the existing or proposed conditions.

The Native Sun site is located in the Monument Creek drainage basin. This basin has been studied by CH2M Hill in the undated report entitled "Monument Creek Drainage Basin Planning Study, Volume I Report". The site is within the study area shown on Figure 2-1, though nothing within the report specifically applies to the development of this property.

The Flood Insurance Rate Maps FIRM map number 08041C0286G (effective date December 7, 2018) does not indicate that there is a floodplain on the site.

There are no known irrigation facilities which will influence local drainage.

EXISTING DRAINAGE CHARACTERISTICS

The topography of the site is moderately sloped, with grades generally around 3%, but going to about 30% in one area. The northwest part of the property is the high point, and slopes in each direction from there, with the majority of the site sloping south and east where it flows to and existing low point and wetland. Two swales form in the middle of the property, and drain south to the low point. See "Existing Drainage Plan" in the Appendices for a visual and to correlate the following sub-basin descriptions.

Basin E1 contains the west portion of the Parcel B and the land cover includes the moderate tree coverage, native grassed sloped areas, and a gravel and dirt access. Basin E1 is a contributing drainage area to an existing culvert which crosses the rail tracks.

Basin E2 contains the southwest area of the parcel and contains the existing native grassed sloped areas and a gravel and dirt access/construction storage area, and drains to Point 2. Basin E2 drains in a sheet-like manner across the south and west property lines, ultimately accumulating to Point E2. Point E2 is a low point along the railroad tracks.

Basin E3 contains the central portion of the site and includes moderate tree coverage, wetlands, native grassed sloped areas, and a gravel and dirt access. Basin E3 discharges to a low point along the south property line, which outlets through a 24" metal culvert under a gravel road to Point 3.

Currently a portion of Woodcarver Road runoff enters the site along the north property line. Additionally, runoff from the 25+/-' undeveloped from the Falcon Commerce Center and UPS

distribution facility land is conveyed through a 12" CMP and discharged in the existing drainage across the site, to Point E3. Runoff from the 25' +/- acre Falcon Commerce Center and UPS distribution facility will eventually be intercepted by a storm main and conveyed to a regional detention facility constructed with the site. Hence the 25 acres will no longer drain across Parcel B.

Peak existing flows are derived from the Rational Method as described on page 5-5 of the Drainage Criteria Manual, Volume I, utilizing Hydrology Studio software. See the Appendices for these calculations for each basin.

See the attached: "Existing Drainage Plan" later in this report for more information including existing basin areas and grading.

PROPOSED DRAINAGE CHARACTERISTICS

For the proposed condition, the area of the drainage basins will generally remain consistent to the existing, with some minor offsite contributions entering from the north. Additionally, in the proposed condition Points 2 and 3 are combined and labeled Point 3. The change in land use will be adding two buildings (shop and office), gravel drive and material storage areas, and landscaping. Additionally a large full spectrum extended detention basin (FSEDB) is proposed . Hydrologically, the land use will experience an increase in Rational "C" values due to the new roads, parking and buildings. Based on this, there will be a relative increase in runoff values.

Basin P1 contains the west portion of the Parcel B and the land cover includes the moderate tree coverage, native grassed sloped areas, and a gravel and dirt access road. This area is collected by the proposed ditch to the north of the access drive, and drains though a proposed 18" RCP (structure C1). Basin P1 is a contributing area drainage to an existing culvert which crosses the rail tracks. Basin P1 runoff will not be captured by a BMP.

Basin P3 contains the central portion of the Parcel B and is the largest basin in the proposed condition. The land cover includes the office and shop buildings, gravel drives and parking, landscaping, gravel storage areas, and moderate tree coverage, native grassed sloped areas, and the FSEDB. Most of the area drains to a central concrete gutter (proposed), which then drains to the pond. Along both the west/southwest and east/south east edges of the yard are intercepted by two grass lined ditches, which both drain into the FSEDB. Basin P3 will have the FSEDB constructed to capture most of the WQCV from the basin. The criteria used for design is from the Mile High Flood Control District. Specifically, MHFD-Detention_v4 03.xlsm is used to design the pond. See "BMP Calculations" in the Appendix for more information.

There are two small subareas along the north property line (designated as A1 and B1). These small areas are generally unimproved and are piped by proposed RCP culverts under the main entrance, then yard, outfalling to the wetland area then to Point P3. The land cover includes the native grassed sloped areas, proposed gravel accesses and asphalt from Woodcarver Road. Runoff from the 25' +/- acre Falcon Commerce Center and UPS distribution facility will be intercepted by a storm main and conveyed to a regional detention facility constructed with the site. Hence the 25 acres will no longer drain across Parcel B. Stormwater generated in these two small subareas will not be treated for water quality.

It is noted that while the proposed basin hydrology is computed with the Rational Method, the design of the extended detention pond utilizes the Colorado Unit Hydrograph procedure. For comparison purposes, each procedure will yield different results.

See the attached "Proposed Drainage Plan" later in this report for more information including proposed basin areas, pond location, culvert layout, and grading.

WATER QUALITY

An extended detention pond will be added to the property as part of the improvements. This pond is designed using MHFD-Detention_v4 03.xlsm. The pond will be designed to settle pollutants over a period of 40 hours, and allow filtered water to drain through the proposed outlet structure. The excess runoff will leave the release structure through the upper stages, design for larger storms. Additionally, an emergency spillway will be provided to give events larger than the 100-year an outlet, and incase the outlet structure were to clog. The flow will then resume its historical pattern.

The pond will be privately owned and maintained by Native Sun Construction. However, easements will be provided per TOM Regulations.

Step 1 of the Four Step Process to Minimize Adverse Impacts of Urbanization (Employ Runoff Reduction Practices) includes "minimizing directly connected impervious areas" (MDCIA). The principal behind MDCIA is twofold: to reduce impervious areas and to route runoff from impervious surfaces over grassy areas to slow down runoff and promote infiltration. The use of grass swales instead of storm sewers, like grass buffers, slows down runoff and promotes infiltration, also reducing effective imperviousness. It also may reduce the size and cost of downstream storm sewers and detention. For Basin P3, the proposed drainage patterns on site will remain somewhat consistent with those of the historic condition. Sheet flow will runoff from the north and west to the to the south and east. Approximately 1.92 acres of the 5.66 acres draining in Basin P3 will be directed though grass lined swales and provide filtration prior to settling the in the WQCV of the FSEDB.

Step 2 of the Four Step Process to Minimize Adverse Impacts of Urbanization is to Implement BMPs that provide a water quality capture volume with slow release. The majority of the Parcel B developed area will be directed into the FSEDB. The pond will fulfill Step 2 of the four step process, which is to provide water quality capture volume (WQCV). Details for the pond will be shown in the construction documents for the project, but will be similar to those shown in the Mile High Flood Control District

documentation. Also included in this FDR's Appendices are the calculations for the WQCV and FSEDB. The pond will capture at least 80% of the total site WQCV (see calculation in Appendices).

Step 3 of the Four Step Process to Minimize Adverse Impacts of Urbanization will be to stabilize drainage ways. Within drainage ways, natural and manmade, erosion can be a major source of sediment and associated constituents, such as phosphorus. Natural drainage ways are often subject to bed and bank erosion when urbanizing areas increase the frequency, rate, and volume of runoff. There are no drainageways proposed as part of this plan.

Step 4 of the Four Step Process to Minimize Adverse Impacts of Urbanization considers the need for industrial and commercial BMPs. If a new development or significant redevelopment activity is planned for an industrial or commercial site, the need for specialized BMPs must be considered. Per the Early Assistance meeting with the TOM, the site will need meet the criteria for water quality capture volume. No other BMP's are required.

There are easements proposed for the pond and culverts. The purpose of these easements are to preserve the BMP's and allow for periodic, routine maintenance. No other storage, development or changes will be allowed within these easements.

A cost estimate of the proposed FSEDB is included in the Appendices of this FDR.

In the Appendices, the supporting content includes: vicinity map, Rational Method calculations, culvert and ditch calculations, FSEDB calculations, soils report and map, floodplain map, drainage plans, and FSEDB cost estimate.

EROSION CONTROL

During construction, best management practices for erosion control will be employed based on the El Paso County criteria and the erosion control plans. Since the proposed improvements encompass more than 1 acre (roughly 5 acres), construction BMP's will be employed on the project. Erosion controls plans will be included with the construction documents, to be developed later.

Silt fencing and vehicle-tracking controls will be in place to minimize erosion from the site. Silt fencing will be placed along the downsloping portions of the site. This will prevent suspended sediment from leaving the site during construction. Silt fencing is to remain in place until vegetation is reestablished after completion of construction. Inlet protection shall be provided at the entrances to the culverts until the site is stabilized.

Best erosion control practices will be utilized as deemed necessary by the Contractor or Engineer and are not limited to the measures described above.

DRAINAGE FEES

The TOM defaults to El Paso County for drainage fees. The site sits within the Jackson Creek basin (FOMO4400). There are basin fees listed on the El Paso County Drainage Basin Fees, Resolution No. 20-424 for 2021 for the this drainage basin. This amount is $7,818 per impervious acre. There are no bridge fees associated with this basin. It is noted that fifty percent (50%) of the cost of a small on-site pond may be reimbursed to the developer if specific criteria are met. These criteria are presented in the "Monument, Colorado Code of Ordinances, 3.28.070 - Imposition of stormwater drainage system impact fee". This pond fits all of the criteria listed for reimbursement.

CONCLUSION

The proposed drainage design for the Native Sun Construction Development will be effective to provide water quality capture volume (WQCV) for at least 89% of area within the project limits. Most of the untreated area is from Basin P1, which is a 0.69 acre largely undeveloped basin. This basin remains mostly the same, except for the regrading of the access road. The other areas that are not treated include fill slopes along the yard. These areas are not physically possible to route runoff from and into the FSEDP. Hence the project will request a deviation for treating the water quality from these areas.

In terms of stormwater quantity, the proposed/developed condition discharge will be less at all three points, than in the existing condition. It is understood that there is wildlife habitat degradation in Monument Creek from other upstream developments increasing the amount of impermeable surfaces. This project will effectively control discharge to levels less than existing and there will be no adverse effects to downstream properties.

This final drainage report for the site is in accordance with Section 4.4 of the Drainage Criteria manual. The following pages include calculations and drainage maps in support of the design.

Section I.7.2 of the Engineering Criteria Manual discusses BMP selections. The selection of appropriate BMPs is based on the characteristics of the site and potential pollutants. The Four-Step Process provides a method of going through the selection process. The four step process states *All sites defined as "New Development and Significant Redevelopment" and all stormwater quality detention, as listed above in Section I.7.1.B shall address stormwater quality by providing the WQCV*. Most of the developed Parcel B will drain to the full spectrum extended detention basin. The FSEDB is mentioned in Step 3 of the selection process, which is to provide water quality capture volume (WQCV). Details of the FSEDB will be shown on the construction drawings, to be developed later.

There will be small areas of the site from which stormwater is not treated, although these will encompass equal to or less than 11% of the project area. This is because it is physically impossible to treat these areas in the selected BMP's. As such, a deviation to the El Paso County Engineering Criteria Manual of requiring all areas to be treated is being submitted concurrently with this report. MS 4 Permit (Modification 4) Part 1 section E.4.a.iv.(A).1 defines the situation where this deviation is appropriate.

REFERENCES

"Drainage Basins", map published by El Paso County, 2005.

"Drainage Criteria Manual, Volume I", by El Paso County, October 14, 1994.

"Custom Soil Resource Report for El Paso County Area, Colorado", NRCS, 2021.

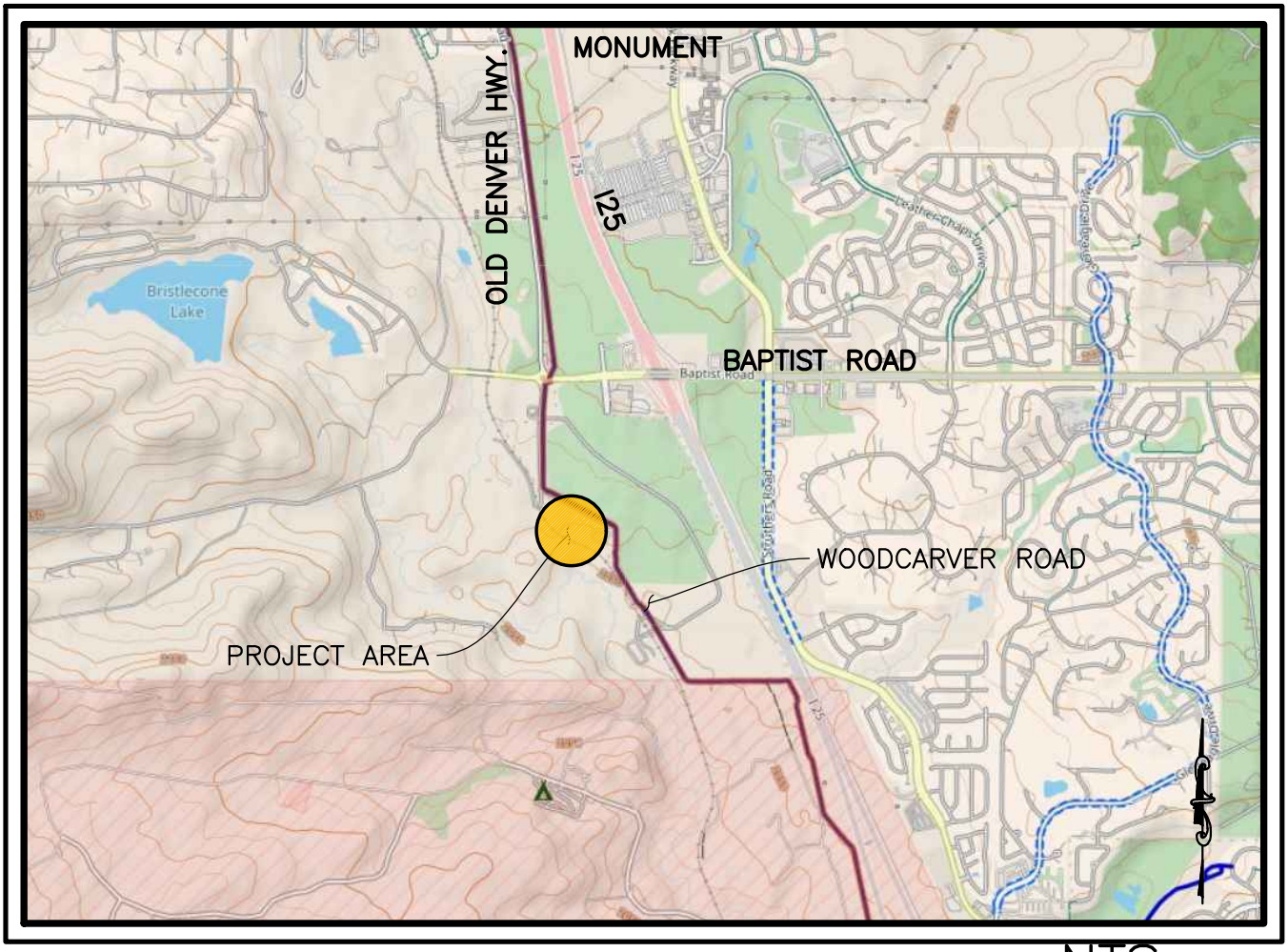
"Flood Insurance Rate Map", Map Number 08041C0286G, Panel 286, FEMA, December 7, 2018.

APPENDICES

VICINITY MAP

NATIVE SUN CONSTRUCTION
SITE IMPROVEMENTS
MONUMENT, COLORADO

VICINITY MAP



NTS

CIVIL

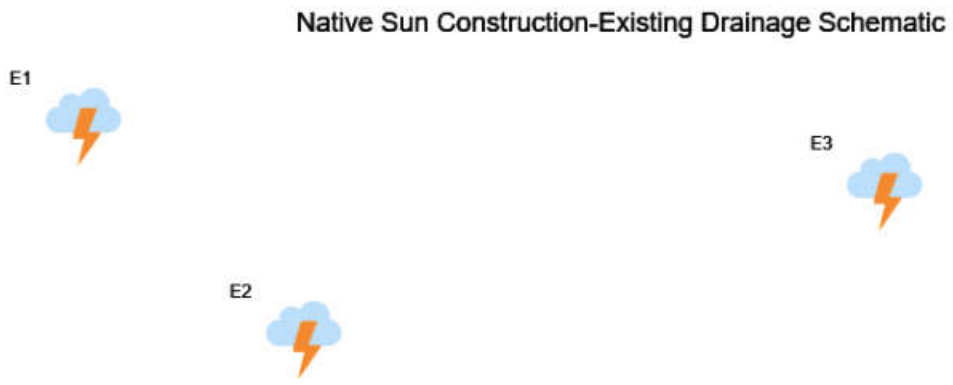
HYDROLOGIC CALCULATIONS

Basin Model

Hydrology Studio v 3.0.0.20

Project Name: Native Sun Construction, Exisitng Drainage Plan, CD Civil Design

12-06-2021



Hydrograph by Return Period

Project Name: Native Sun Construction, Exisitng Drainage Plan, CD Civil Design

Hydrology Studio v 3.0.0.20

12-06-2021

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Outflow (cfs)							
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1	Rational	E1	0.951	1.151		1.495	1.801	2.251	2.619	3.008
2	Rational	E2	1.397	1.690		2.195	2.645	3.304	3.844	4.416
3	Rational	E3	2.283	2.763		3.589	4.323	5.402	6.285	7.220

Hydrograph 2-yr Summary

Project Name: Native Sun Construction, Exisitng Drainage Plan, CD Civil Design

Hydrology Studio v 3.0.0.20

12-06-2021

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	Rational	E1	1.151	0.17	691	----		
2	Rational	E2	1.690	0.17	1,014	----		
3	Rational	E3	2.763	0.17	1,658	----		

Hydrograph 5-yr Summary

Project Name: Native Sun Construction, Exisitng Drainage Plan, CD Civil Design

Hydrology Studio v 3.0.0.20

12-06-2021

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	Rational	E1	1.495	0.17	897	----		
2	Rational	E2	2.195	0.17	1,317	----		
3	Rational	E3	3.589	0.17	2,153	----		

Hydrograph 10-yr Summary

Project Name: Native Sun Construction, Exisitng Drainage Plan, CD Civil Design

Hydrology Studio v 3.0.0.20

12-06-2021

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	Rational	E1	1.801	0.17	1,081	----		
2	Rational	E2	2.645	0.17	1,587	----		
3	Rational	E3	4.323	0.17	2,594	----		

Hydrograph 100-yr Summary

Project Name: Native Sun Construction, Exisitng Drainage Plan, CD Civil Design

Hydrology Studio v 3.0.0.20

12-06-2021

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	Rational	E1	3.008	0.17	1,805	----		
2	Rational	E2	4.416	0.17	2,650	----		
3	Rational	E3	7.220	0.17	4,332	----		

IDF Report

IDF filename: ColoradoSpringsCO.idf

Hydrology Studio v 3.0.0.20

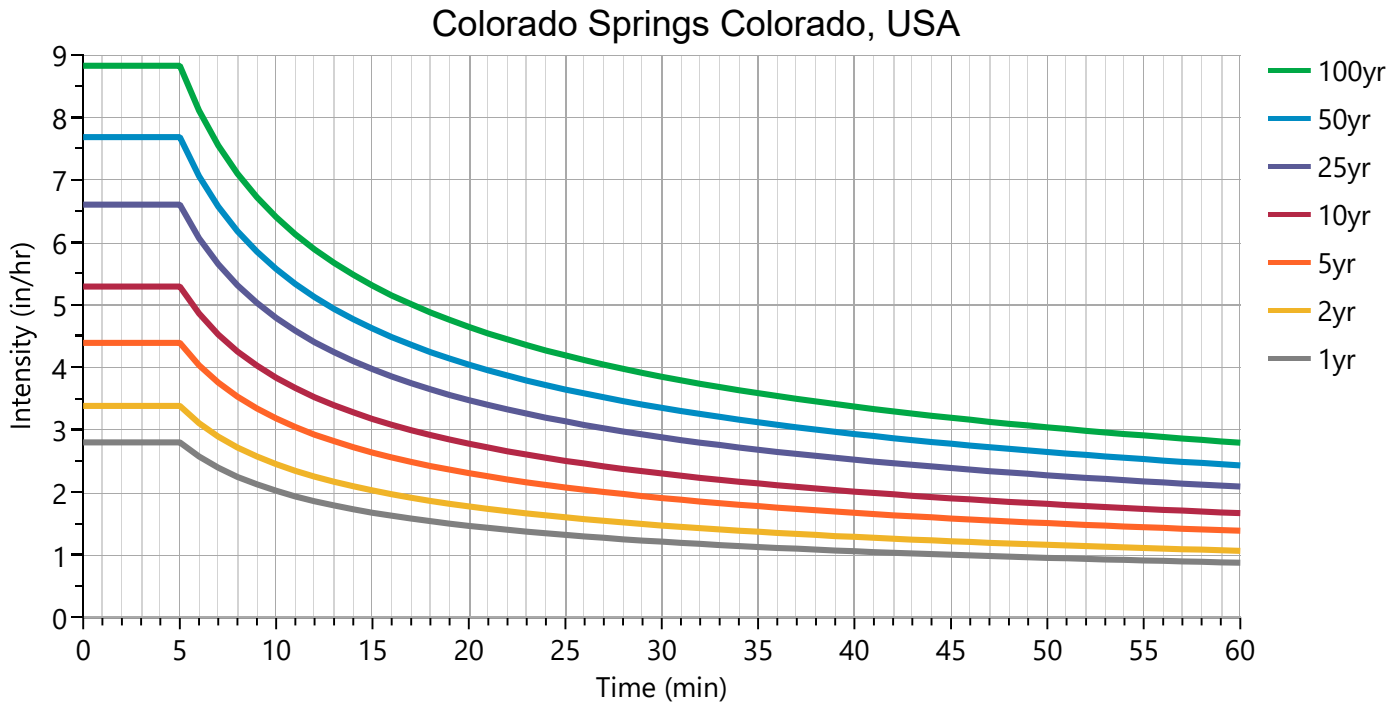
12-04-2021

Equation Coefficients	Intensity = B / (Tc + D)^E (in/hr)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
B	5.9491	7.1404	0.0000	9.2708	11.1783	13.9011	16.1813	18.5714	
D	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
E	0.4683	0.4647	0.0000	0.4645	0.4649	0.4628	0.4630	0.4626	

Minimum Tc = 5 minutes

Tc (min)	Intensity Values (in/hr)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
Cf	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
5	2.80	3.38	0	4.39	5.29	6.60	7.68	8.82	
10	2.02	2.45	0	3.18	3.83	4.79	5.57	6.40	
15	1.67	2.03	0	2.64	3.17	3.97	4.62	5.31	
20	1.46	1.77	0	2.31	2.78	3.47	4.04	4.64	
25	1.32	1.60	0	2.08	2.50	3.13	3.65	4.19	
30	1.21	1.47	0	1.91	2.30	2.88	3.35	3.85	
35	1.13	1.37	0	1.78	2.14	2.68	3.12	3.58	
40	1.06	1.29	0	1.67	2.01	2.52	2.93	3.37	
45	1.00	1.22	0	1.58	1.90	2.39	2.78	3.19	
50	0.95	1.16	0	1.51	1.81	2.27	2.64	3.04	
55	0.91	1.11	0	1.44	1.74	2.18	2.53	2.91	
60	0.87	1.07	0	1.38	1.67	2.09	2.43	2.79	

Cf = Correction Factor applied to Rational Method runoff coefficient.

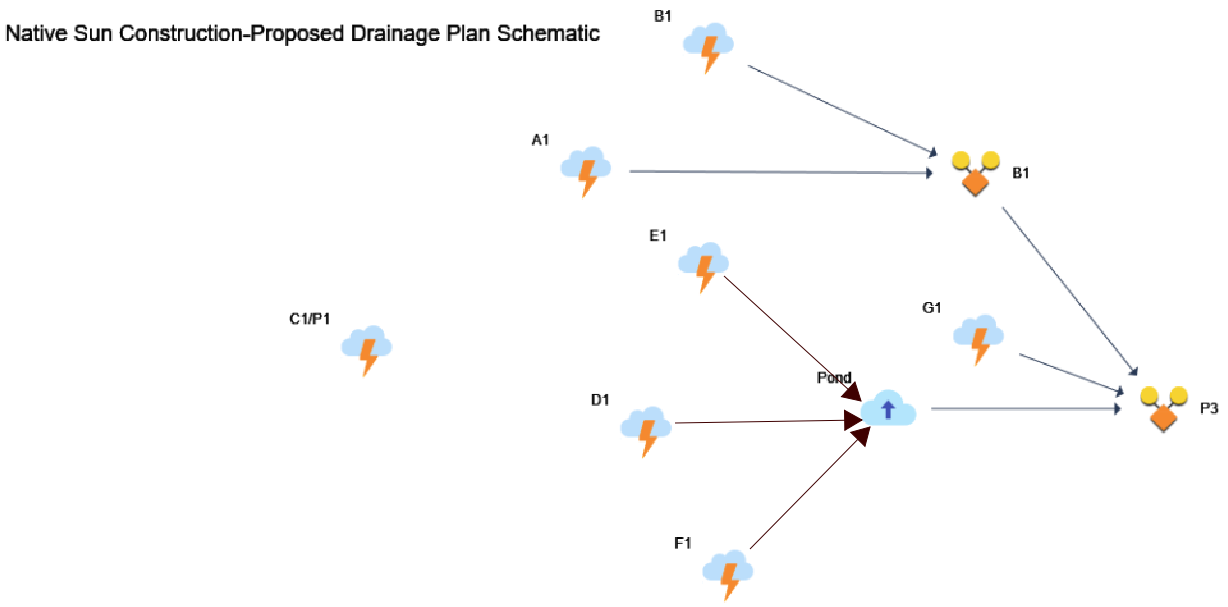


Basin Model

Hydrology Studio v 3.0.0.20

Project Name:

12-06-2021



Hydrograph by Return Period

Project Name:

Hydrology Studio v 3.0.0.20

12-06-2021

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Outflow (cfs)							
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1	Rational	A1		0.392		0.509	0.613			1.024
2	Rational	B1		0.318		0.414	0.498			0.832
3	Rational	C1/P1		0.845		1.098	1.322			2.208
4	Rational	D1		3.840		4.989	6.010			10.04
5	Rational	E1		3.738		4.855	5.849			9.767
6	Junction	B1		0.710		0.923	1.112			1.856
7	Rational	F1		1.225		1.591	1.916			3.200
8	Manual	Pond		0.140		0.520	1.430			4.020
9	Rational	G1		0.213		0.277	0.333			0.557
10	Junction	P3		0.972		1.247	1.904			6.157

Hydrograph 2-yr Summary

Project Name:

Hydrology Studio v 3.0.0.20

12-06-2021

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	Rational	A1	0.392	0.17	235	----		
2	Rational	B1	0.318	0.17	191	----		
3	Rational	C1/P1	0.845	0.17	507	----		
4	Rational	D1	3.840	0.17	2,304	----		
5	Rational	E1	3.738	0.17	2,243	----		
6	Junction	B1	0.710	0.17	426	1, 2		
7	Rational	F1	1.225	0.17	735	----		
8	Manual	Pond	0.140	0.37	2,613	----		
9	Rational	G1	0.213	0.17	128	----		
10	Junction	P3	0.972	0.17	3,124	6, 8, 9		

Hydrograph 5-yr Summary

Project Name:

Hydrology Studio v 3.0.0.20

12-06-2021

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	Rational	A1	0.509	0.17	305	----		
2	Rational	B1	0.414	0.17	248	----		
3	Rational	C1/P1	1.098	0.17	659	----		
4	Rational	D1	4.989	0.17	2,993	----		
5	Rational	E1	4.855	0.17	2,913	----		
6	Junction	B1	0.923	0.17	554	1, 2		
7	Rational	F1	1.591	0.17	954	----		
8	Manual	Pond	0.520	0.40	3,440	----		
9	Rational	G1	0.277	0.17	166	----		
10	Junction	P3	1.247	0.17	4,105	6, 8, 9		

Hydrograph 10-yr Summary

Project Name:

Hydrology Studio v 3.0.0.20

12-06-2021

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	Rational	A1	0.613	0.17	368	----		
2	Rational	B1	0.498	0.17	299	----		
3	Rational	C1/P1	1.322	0.17	793	----		
4	Rational	D1	6.010	0.17	3,606	----		
5	Rational	E1	5.849	0.17	3,509	----		
6	Junction	B1	1.112	0.17	667	1, 2		
7	Rational	F1	1.916	0.17	1,150	----		
8	Manual	Pond	1.430	0.28	4,258	----		
9	Rational	G1	0.333	0.17	200	----		
10	Junction	P3	1.904	0.27	5,058	6, 8, 9		

Hydrograph 100-yr Summary

Project Name:

Hydrology Studio v 3.0.0.20

12-06-2021

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	Rational	A1	1.024	0.17	614	----		
2	Rational	B1	0.832	0.17	499	----		
3	Rational	C1/P1	2.208	0.17	1,325	----		
4	Rational	D1	10.04	0.17	6,021	----		
5	Rational	E1	9.767	0.17	5,860	----		
6	Junction	B1	1.856	0.17	1,114	1, 2		
7	Rational	F1	3.200	0.17	1,920	----		
8	Manual	Pond	4.020	0.22	7,122	----		
9	Rational	G1	0.557	0.17	334	----		
10	Junction	P3	6.157	0.17	8,458	6, 8, 9		

IDF Report

IDF filename: ColoradoSpringsCO.idf

Hydrology Studio v 3.0.0.20

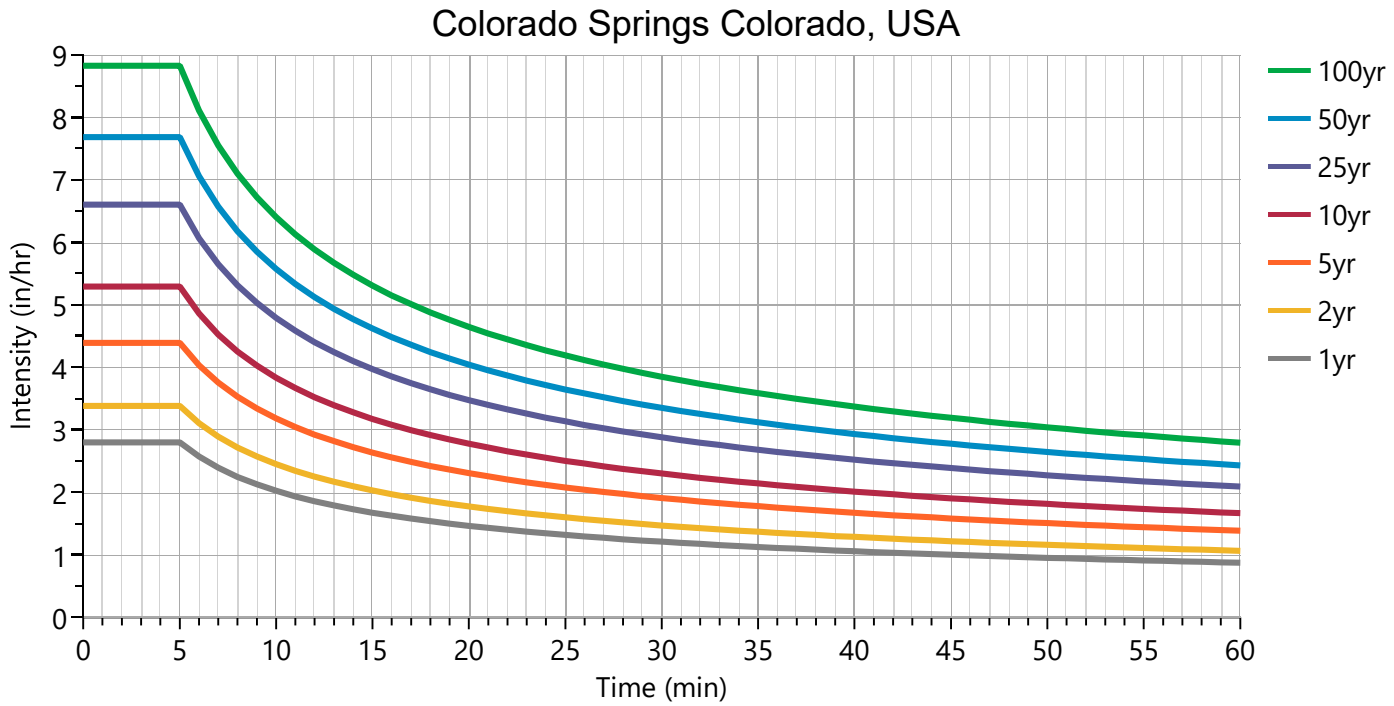
12-04-2021

Equation Coefficients	Intensity = B / (Tc + D)^E (in/hr)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
B	5.9491	7.1404	0.0000	9.2708	11.1783	13.9011	16.1813	18.5714	
D	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
E	0.4683	0.4647	0.0000	0.4645	0.4649	0.4628	0.4630	0.4626	

Minimum Tc = 5 minutes

Tc (min)	Intensity Values (in/hr)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
Cf	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
5	2.80	3.38	0	4.39	5.29	6.60	7.68	8.82	
10	2.02	2.45	0	3.18	3.83	4.79	5.57	6.40	
15	1.67	2.03	0	2.64	3.17	3.97	4.62	5.31	
20	1.46	1.77	0	2.31	2.78	3.47	4.04	4.64	
25	1.32	1.60	0	2.08	2.50	3.13	3.65	4.19	
30	1.21	1.47	0	1.91	2.30	2.88	3.35	3.85	
35	1.13	1.37	0	1.78	2.14	2.68	3.12	3.58	
40	1.06	1.29	0	1.67	2.01	2.52	2.93	3.37	
45	1.00	1.22	0	1.58	1.90	2.39	2.78	3.19	
50	0.95	1.16	0	1.51	1.81	2.27	2.64	3.04	
55	0.91	1.11	0	1.44	1.74	2.18	2.53	2.91	
60	0.87	1.07	0	1.38	1.67	2.09	2.43	2.79	

Cf = Correction Factor applied to Rational Method runoff coefficient.



HYDRAULIC CALCULATIONS

Channel Report

Project filename: curb and gutter.stx

Studio Express by Hydrology Studio v 1.0.0.9

12-04-2021

Gutter and Pavement-Access to Office

Channel 4

USER-DEFINED

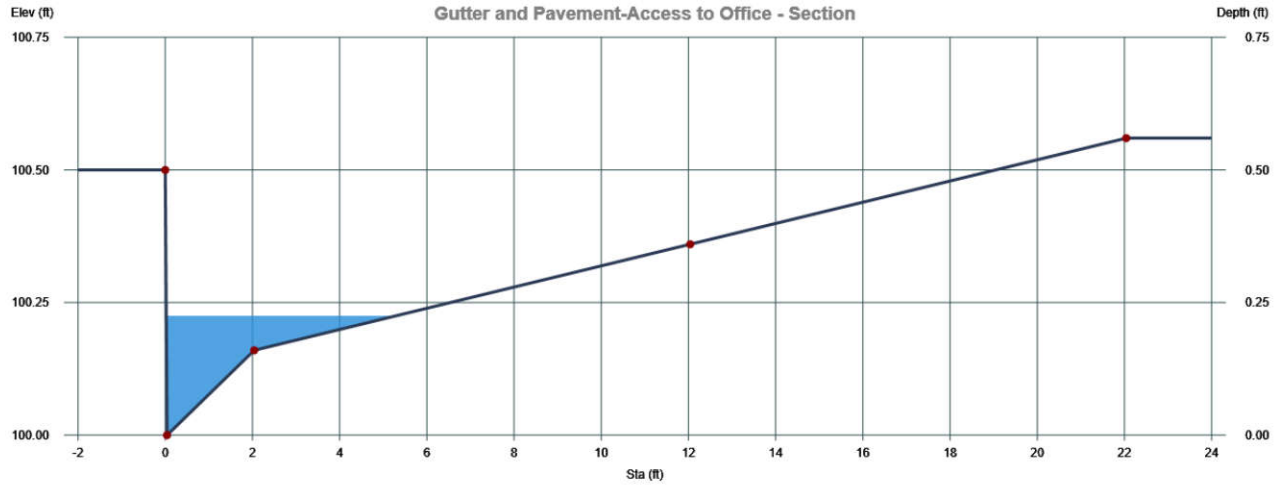
Total Depth	= 0.56 ft
Invert Elevation	= 100.00 ft
Channel Slope	= 8.000 %
Manning's n	= Composite

DISCHARGE

Method	= Q vs Depth
Q Min	= 0.06 cfs
Q Max	= 58.84 cfs
Increments	= 10

CALCULATION SAMPLE

Flow	Depth	Area	Velocity	WP	n-value	Crit Depth	HGL	EGL	Max Shear	Top Width
(cfs)	(ft)	(sqft)	(ft/s)	(ft)	Composite	(ft)	(ft)	(ft)	(lb/sqft)	(ft)
2.20	0.22	0.39	5.62	5.43	0.013	0.33	100.22	100.71	1.12	5.22



Channel Report

Project filename: curb and gutter.stx

Studio Express by Hydrology Studio v 1.0.0.9

12-04-2021

Gutter and Pavement-Along South Yard

Channel 5

USER-DEFINED

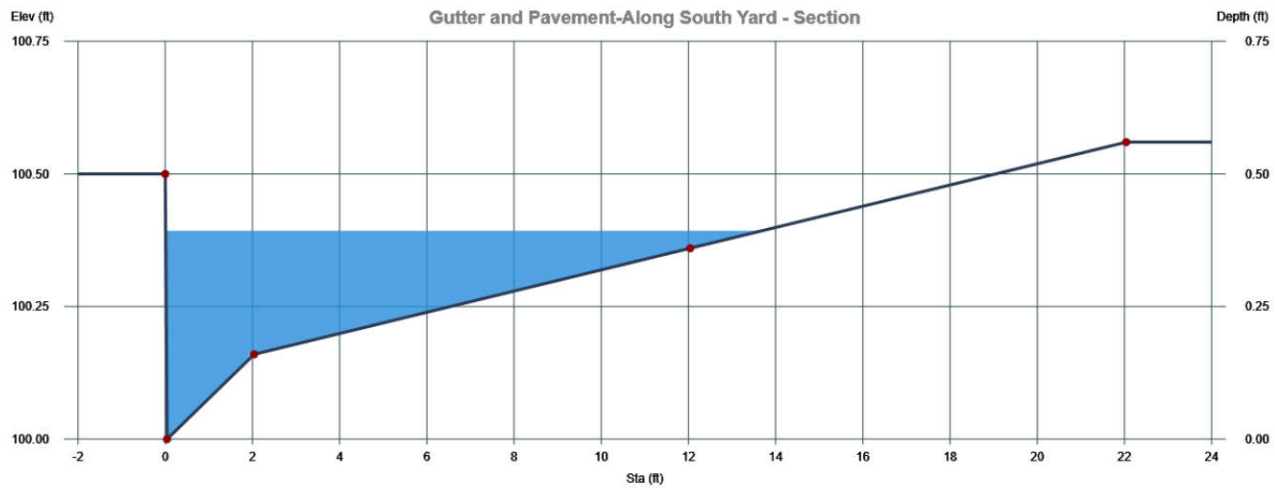
Total Depth	= 0.56 ft
Invert Elevation	= 100.00 ft
Channel Slope	= 2.000 %
Manning's n	= Composite

DISCHARGE

Method	= Q vs Depth
Q Min	= 0.03 cfs
Q Max	= 29.42 cfs
Increments	= 10

CALCULATION SAMPLE

Flow	Depth	Area	Velocity	WP	n-value	Crit Depth	HGL	EGL	Max Shear	Top Width
(cfs)	(ft)	(sqft)	(ft/s)	(ft)	Composite	(ft)	(ft)	(ft)	(lb/sqft)	(ft)
8.67	0.39	1.98	4.39	14.00	0.013	0.49	100.39	100.69	0.49	13.63



Channel Report

Project filename: curb and gutter.stx

Studio Express by Hydrology Studio v 1.0.0.9

12-04-2021

Gutter and Pavement-Along Southeast Yard

Channel 6

USER-DEFINED

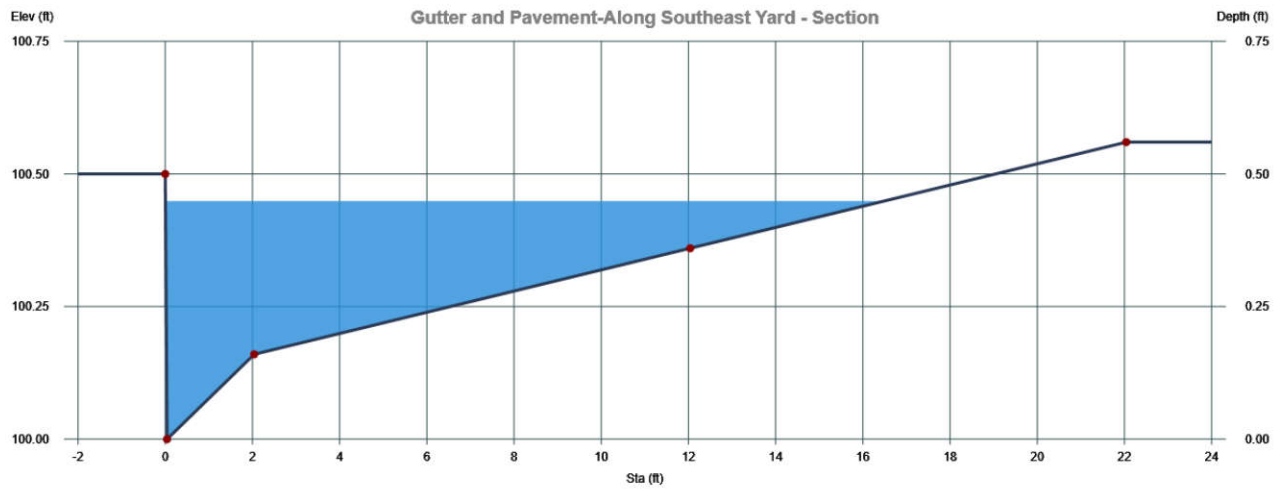
Total Depth	= 0.56 ft
Invert Elevation	= 100.00 ft
Channel Slope	= 1.000 %
Manning's n	= Composite

DISCHARGE

Method	= Q vs Depth
Q Min	= 0.02 cfs
Q Max	= 20.80 cfs
Increments	= 10

CALCULATION SAMPLE

Flow	Depth	Area	Velocity	WP	n-value	Crit Depth	HGL	EGL	Max Shear	Top Width
(cfs)	(ft)	(sqft)	(ft/s)	(ft)	Composite	(ft)	(ft)	(ft)	(lb/sqft)	(ft)
9.79	0.45	2.82	3.47	16.86	0.013	0.51	100.45	100.64	0.28	16.44



Channel Report

Project filename: native sun.cst

Culvert Studio v 2.0.0.26

12-04-2021

Channel 1

Channel 1

TRIANGULAR

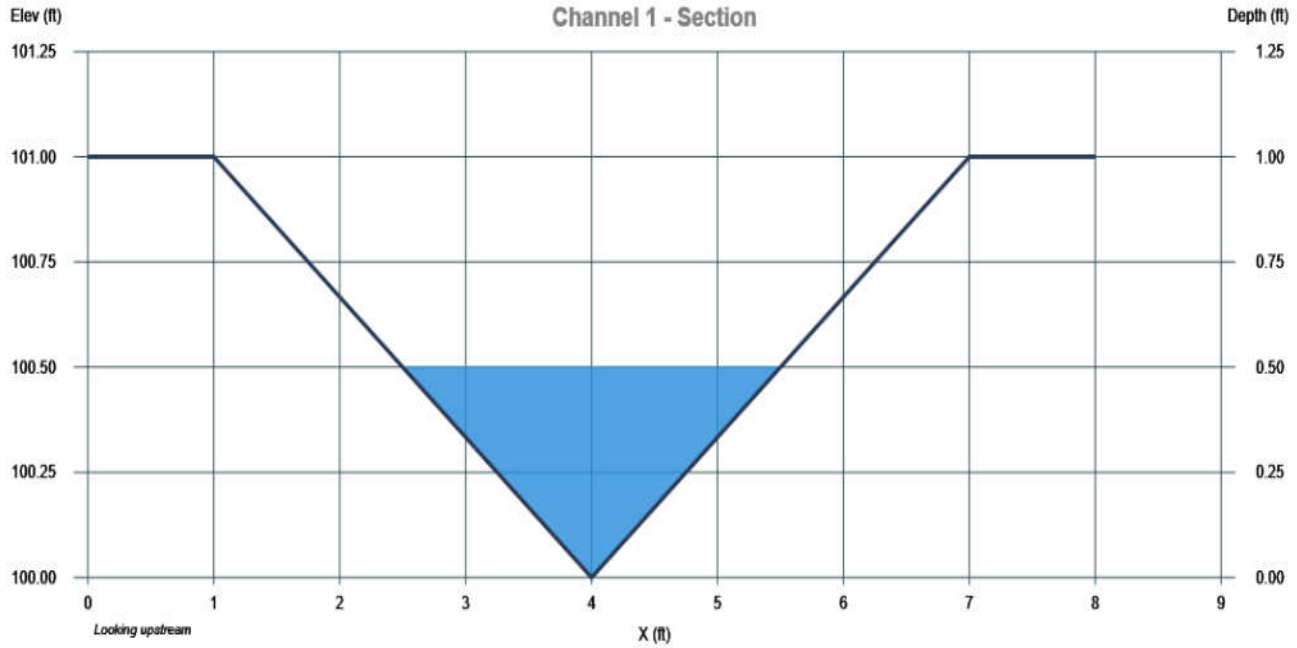
Bottom Width	= 0.00 (ft)
Side Slope Left, z:1	= 3.00
Side Slope Right, z:1	= 3.00
Total Depth	= 1.00 (ft)
Invert Elevation	= 100.00 (ft)
Channel Slope	= 0.040 (ft/ft)
Manning's n	= 0.027

DISCHARGE

Method	= Q vs Depth
Q Min	= 0.04 cfs
Q Max	= 20.08 cfs
Increments	= 10

CALCULATION SAMPLE

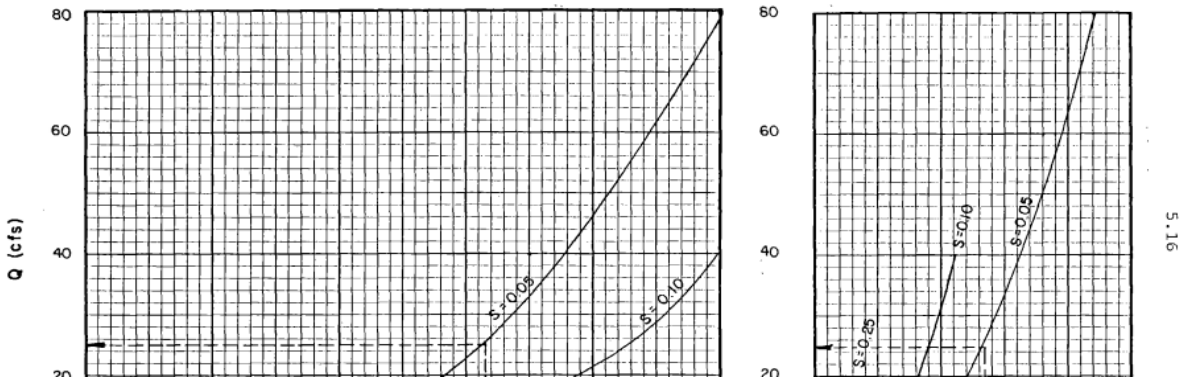
Flow	Depth	Area	Velocity	WP	n-value	Top Width	Crit Depth	HGL	EGL
(cfs)	(ft)	(sqft)	(ft/s)	(ft)		(ft)	(ft)	(ft)	(ft)
3.16	0.50	0.75	4.22	3.16	0.027	3.00	0.47	100.50	100.78



Native Sun

Lined RipRap Calculation

Location	Discharge	Velocity	Cross Sectional Area	Top Width	Hydraulic Depth	Froude No.	Reference	Flow Type	D50	Depth
	CFS	FPS	SF	FT	FT				IN	IN
Steep Slope to C1	0.6	2.7	0.22	1.62	0.14	1.29	https://library.municode.com/co/el_pa	SuperCritical	6	6



5.16

Culvert Report

Project filename: native sun.cst

Culvert Studio v 2.0.0.26

12-06-2021

A1

Culvert 1

CULVERT

Shape	= Circular
Inlet Edge	= Projecting
Material	= Concrete
Manning's n	= 0.012
Rise	= 18 in
Span	= 18 in
Invert Elev. Down	= 6758.76 ft
Length	= 62.0 ft
Slope	= 0.020 ft/ft
Invert Elev. Up	= 6760.00 ft
No. Barrels	= 1
Plan Skew Angle	= 0 degrees

EMBANKMENT

Top Width	= 50.00 ft
Top Elevation	= 6762.00 ft
Crest Length	= 53.00 ft

DISCHARGE

Method	= Rational Method
Drainage Area	= 0.30 ac
Runoff Coefficient	= 0.50
Time of Concentration	= 10 min

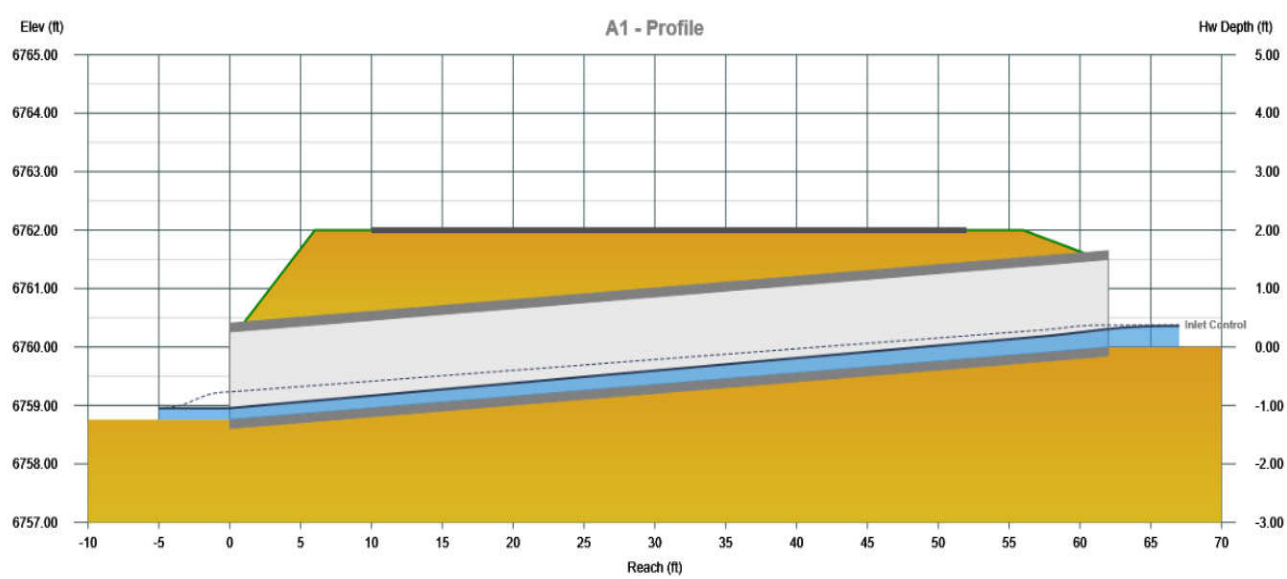
TAILWATER

Tailwater Elevation	= Normal Depth

CALCULATION SAMPLE, 10 - Year Event

Discharge			Velocity		Depth		HGL @ Hw/D = 0.24		
Total	Culvert	Over Top	Down	Up	Down	Up	Down	Up	Hw
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)	(ft)	(ft)	(ft)
0.57	0.57	0.00	4.22	2.47	2.4	3.4	6758.96	6760.28	6760.36

Notes:IDF Curves = ColoradoSpringsCO.idf;



Culvert Report

Project filename: native sun.cst

Culvert Studio v 2.0.0.26

12-06-2021

B1

Culvert 2

CULVERT

Shape	= Circular
Inlet Edge	= Projecting
Material	= Concrete
Manning's n	= 0.012
Rise	= 18 in
Span	= 18 in
Invert Elev. Down	= 6750.30 ft
Length	= 225 ft
Slope	= 0.025 ft/ft
Invert Elev. Up	= 6756.00 ft
No. Barrels	= 1
Plan Skew Angle	= 30 degrees

EMBANKMENT

Top Width	= 195.00 ft
Top Elevation	= Roadway Profile
Crest Length	= Varied

DISCHARGE

Method	= Rational Method
Drainage Area	= 0.26 ac
Runoff Coefficient	= 0.70
Time of Concentration	= 10 min

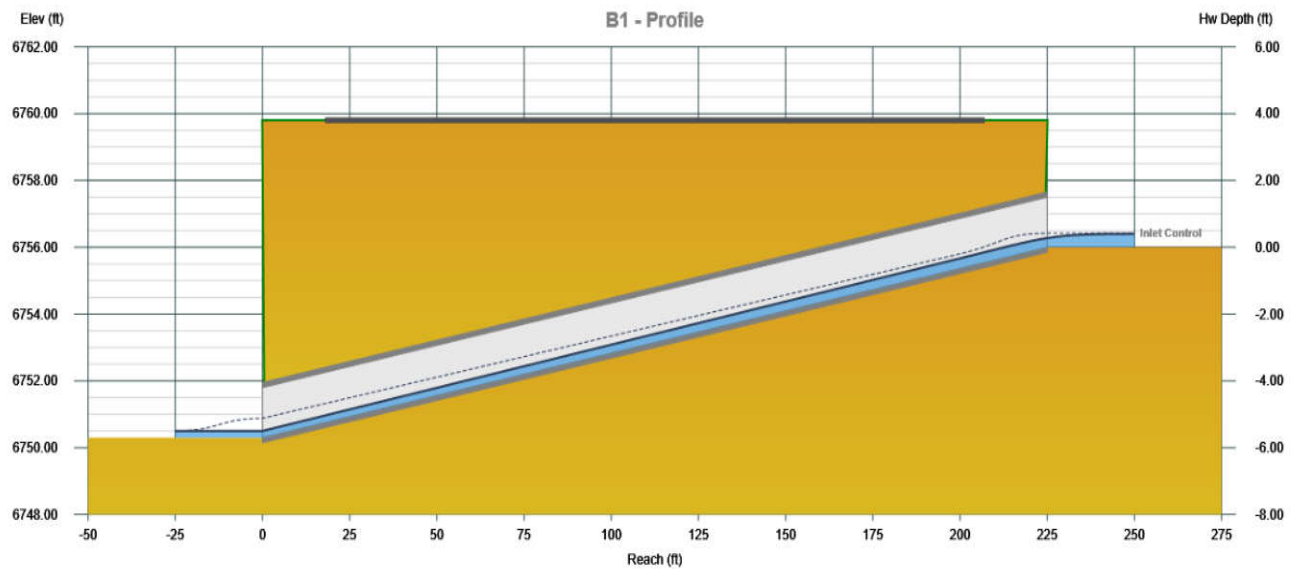
TAILWATER

Tailwater Elevation	= Normal Depth

CALCULATION SAMPLE, 10 - Year Event

Discharge			Velocity		Depth		HGL @ Hw/D = 0.27		
Total	Culvert	Over Top	Down	Up	Down	Up	Down	Up	Hw
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)	(ft)	(ft)	(ft)
0.70	0.70	0.00	4.94	2.60	2.4	3.8	6750.50	6756.31	6756.40

Notes:IDF Curves = ColoradoSpringsCO.idf;



Culvert Report

Project filename: native sun.cst

Culvert Studio v 2.0.0.26

12-08-2021

c1

Culvert 3

CULVERT

Shape	= Elliptical
Inlet Edge	= Projecting
Material	= Concrete
Manning's n	= 0.012
Rise	= 14 in
Span	= 23 in
Invert Elev. Down	= 6758.18 ft
Length	= 42.0 ft
Slope	= 0.005 ft/ft
Invert Elev. Up	= 6758.40 ft
No. Barrels	= 1
Plan Skew Angle	= 0 degrees

EMBANKMENT

Top Width	= 30.00 ft
Top Elevation	= 6762.40 ft
Crest Length	= 30.00 ft

DISCHARGE

Method	= Rational Method
Drainage Area	= 0.69 ac
Runoff Coefficient	= 0.50
Time of Concentration	= 10 min

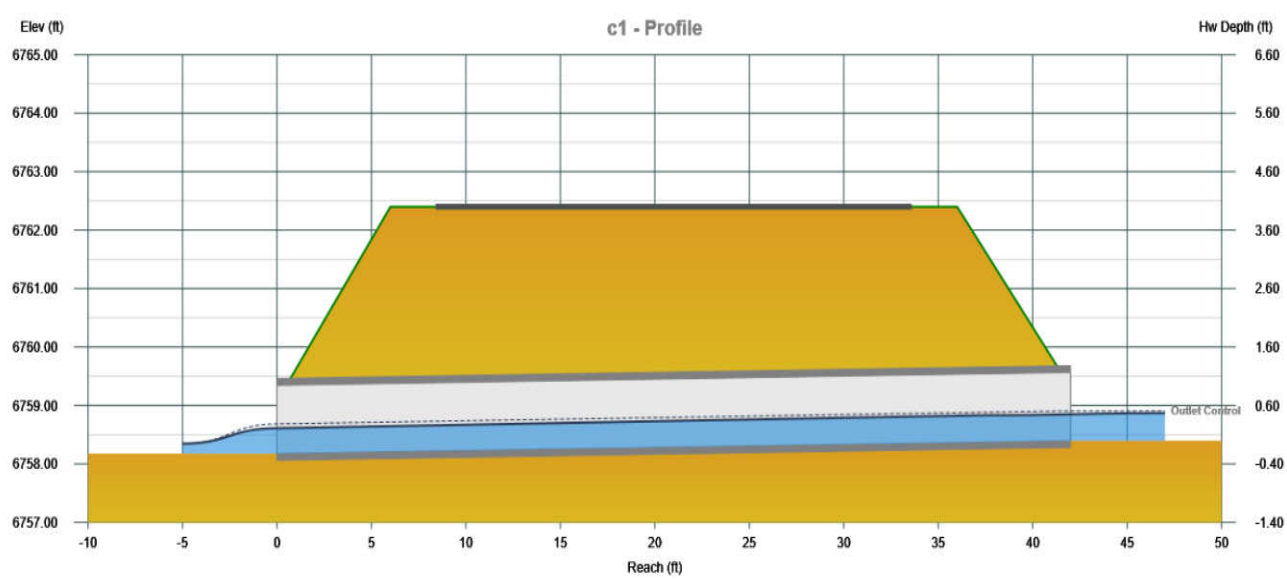
TAILWATER

Tailwater Elevation	= Normal Depth

CALCULATION SAMPLE, 10 - Year Event

Discharge			Velocity		Depth		HGL @ Hw/D = 0.40		
Total	Culvert	Over Top	Down	Up	Down	Up	Down	Up	Hw
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)	(ft)	(ft)	(ft)
1.32	1.32	0.00	2.18	2.23	5.2	5.2	6758.61	6758.83	6758.87

Notes:IDF Curves = ColoradoSpringsCO.idf;

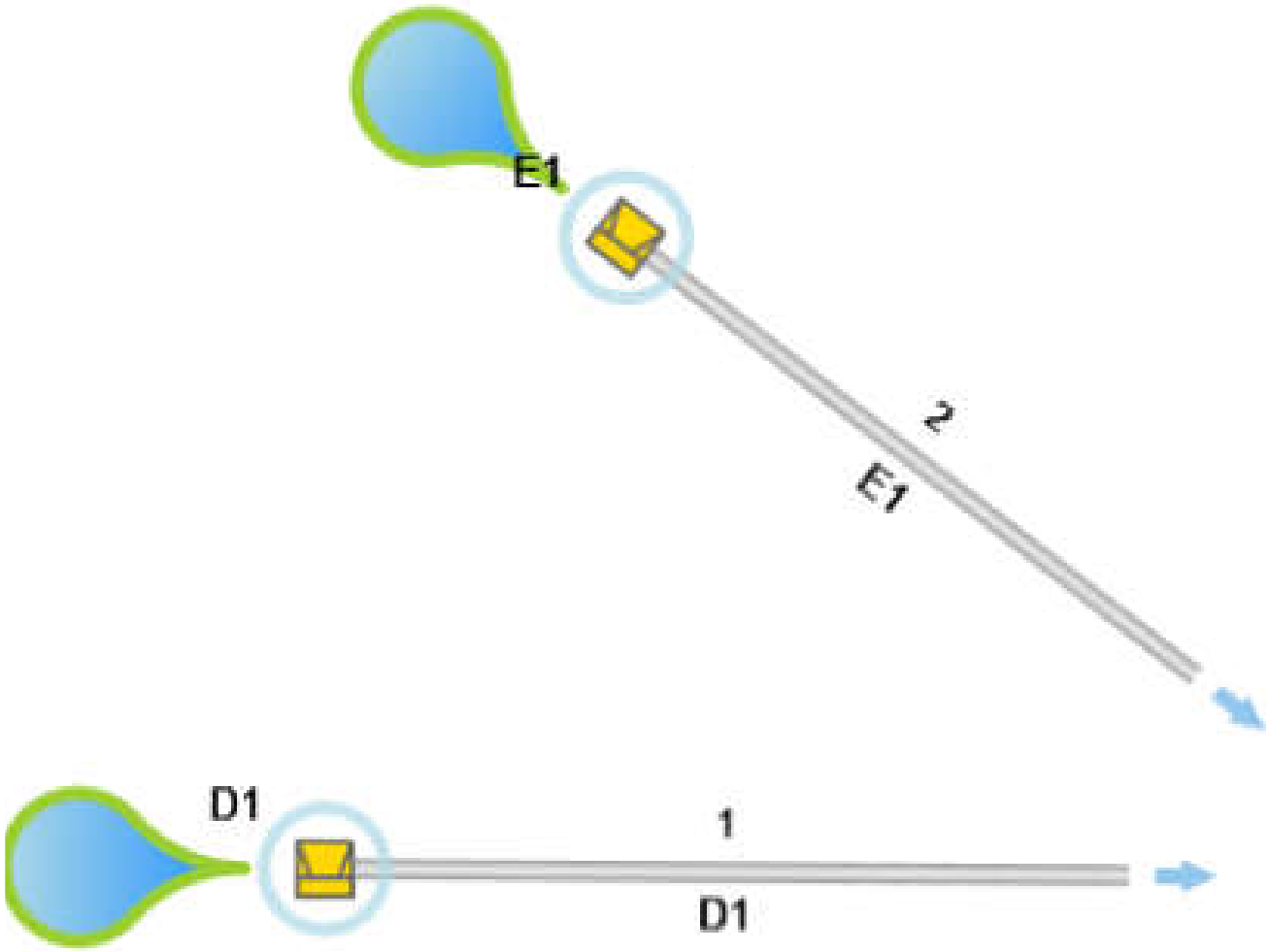


Plan View

Stormwater Studio 2021 v 3.0.0.28

Project Name: Native Sun Inlet and Pipe Design

12-05-2021



Project File: native sun.sws

Inlet Report

Stormwater Studio 2021 v 3.0.0.28

Project Name: Native Sun Inlet and Pipe Design

12-06-2021

Line No	Inlet		Q				Curb		Grate			Gutter							Inlet			Byp Line No
	Id	Type	Catch (cfs)	Carry (cfs)	Capt (cfs)	Byp (cfs)	Ht (in)	L (ft)	L (ft)	W (ft)	Area (sqft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	D1	Curb	6.01	0.00	6.01	0.00	6.0	10.00	-	-	-	Sag	2.00	0.080	0.020	0.013	0.45	16.56	0.83	16.56	6.0	0
2	E1	Curb	5.85	0.00	5.85	0.00	6.0	10.00	-	-	-	Sag	2.00	0.080	0.010	0.013	0.47	32.52	0.83	32.52	6.0	0

Notes: Return Period = 10-yrs. All curb inlets are Horiz throat.,

Project File: native sun.sws

Storm Sewer Tabulation

Stormwater Studio 2021 v 3.0.0.28

Project Name: Native Sun Inlet and Pipe Design

12-06-2021

Line ID	Length	Drng Area		Rational	C x A		Tc		Intensity	Total Q	Capacity	Velocity	Line		Invert Elev		HGL Elev		Surface Elev		Line No
		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
	(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
D1	58.50	2.240	2.240	0.70	1.57	1.57	10.0	10.00	3.83	6.01	23.50	4.29	18	5.01	6751.82	6748.89	6752.76	6750.39	6757.40	6751.10	1
E1	52.29	2.180	2.180	0.70	1.53	1.53	10.0	10.00	3.83	5.85	27.78	4.22	18	7.00	6752.80	6749.14	6753.72	6750.64	6757.98	6751.35	2

Notes: IDF File = ColoradoSpringsCO.idf, Return Period = 10-yrs.

Project File: native sun.sws

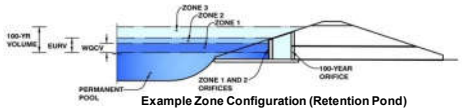
FSEDB CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Native Sun Construction

Basin ID: P2



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	4.86	acres
Watershed Length =	650	ft
Watershed Length to Centroid =	350	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	70.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

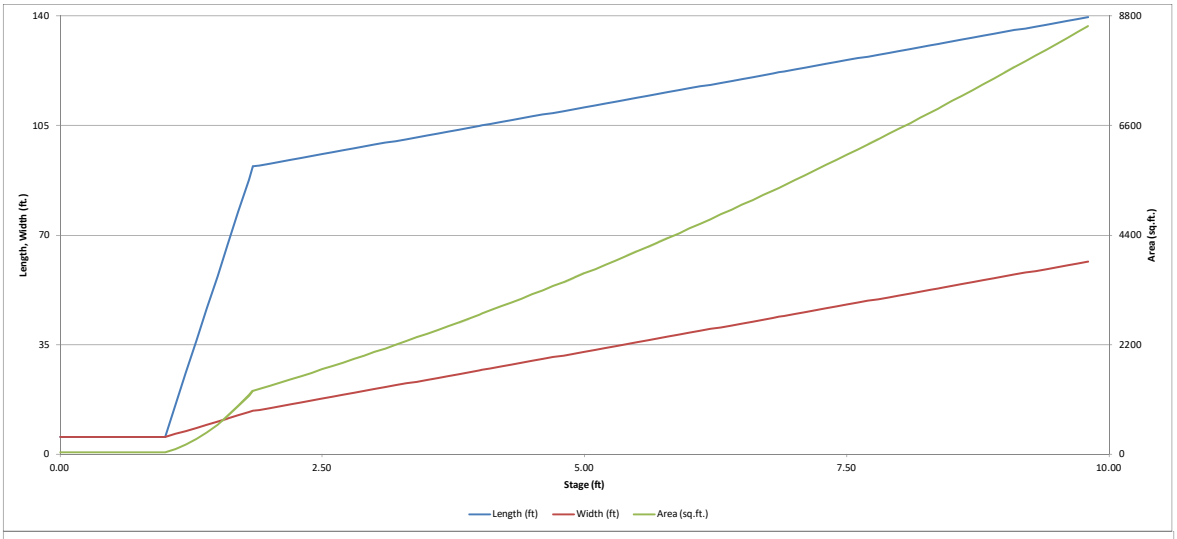
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.111	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.374	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.322	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.434	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.529	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.641	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.740	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.858	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.29 in.) =	1.171	acre-feet	3.29	inches
Approximate 2-yr Detention Volume =	0.292	acre-feet		
Approximate 5-yr Detention Volume =	0.389	acre-feet		
Approximate 10-yr Detention Volume =	0.491	acre-feet		
Approximate 25-yr Detention Volume =	0.528	acre-feet		
Approximate 50-yr Detention Volume =	0.549	acre-feet		
Approximate 100-yr Detention Volume =	0.588	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.111	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.262	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.214	acre-feet
Total Detention Basin Volume =	0.588	acre-feet
Initial Surcharge Volume (ISV) =	15	ft^3
Initial Surcharge Depth (ISD) =	0.50	ft
Total Available Detention Depth (H_{total}) =	8.50	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{main}) =	3	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	10	
Initial Surcharge Area (A_{ISV}) =	29	ft^2
Surcharge Volume Length (L_{ISV}) =	5.4	ft
Surcharge Volume Width (W_{ISV}) =	5.4	ft
Depth of Basin Floor (H_{FLOOR}) =	0.84	ft
Length of Basin Floor (L_{FLOOR}) =	91.9	ft
Width of Basin Floor (W_{FLOOR}) =	13.8	ft
Area of Basin Floor (A_{FLOOR}) =	1,268	ft^2
Volume of Basin Floor (V_{FLOOR}) =	417	ft^3
Depth of Main Basin (H_{MAIN}) =	6.66	ft
Length of Main Basin (L_{MAIN}) =	131.9	ft
Width of Main Basin (W_{MAIN}) =	53.8	ft
Area of Main Basin (A_{MAIN}) =	7,089	ft^2
Volume of Main Basin (V_{MAIN}) =	25,209	ft^3
Calculated Total Basin Volume (V_{total}) =	**0.589**	acre-feet

Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		5.4	5.4	29		0.001		
ISV	0.50		5.4	5.4	29		0.001	15	0.000
	0.60		5.4	5.4	29		0.001	17	0.000
	0.70		5.4	5.4	29		0.001	20	0.000
	0.80		5.4	5.4	29		0.001	23	0.001
	0.90		5.4	5.4	29		0.001	26	0.001
	1.00		5.4	5.4	29		0.001	29	0.001
	1.10		15.7	6.4	100		0.002	35	0.001
	1.20		26.0	7.4	192		0.004	50	0.001
	1.30		36.3	8.4	305		0.007	75	0.002
	1.40		46.6	9.4	438		0.010	112	0.003
	1.50		56.9	10.4	591		0.014	163	0.004
	1.60		67.2	11.4	766		0.018	230	0.005
	1.70		77.5	12.4	961		0.022	317	0.007
	1.80		87.8	13.4	1,176		0.027	423	0.010
Floor	1.84		91.9	13.8	1,268		0.029	472	0.011
	1.90		92.3	14.2	1,306		0.030	549	0.013
	2.00		92.9	14.8	1,370		0.031	683	0.016
	2.10		93.5	15.4	1,435		0.033	823	0.019
	2.20		94.1	16.0	1,501		0.034	970	0.022
	2.30		94.7	16.6	1,567		0.036	1,124	0.026
	2.40		95.3	17.2	1,635		0.038	1,284	0.029
	2.50		95.9	17.8	1,702		0.039	1,451	0.033
	2.60		96.5	18.4	1,771		0.041	1,624	0.037
	2.70		97.1	19.0	1,840		0.042	1,805	0.041
	2.80		97.7	19.6	1,910		0.044	1,992	0.046
	2.90		98.3	20.2	1,981		0.045	2,187	0.050
	3.00		98.9	20.8	2,052		0.047	2,389	0.055
	3.10		99.5	21.4	2,124		0.049	2,597	0.060
	3.20		100.1	22.0	2,197		0.050	2,813	0.065
	3.30		100.7	22.6	2,271		0.052	3,037	0.070
	3.40		101.3	23.2	2,345		0.054	3,268	0.075
	3.50		101.9	23.8	2,420		0.056	3,506	0.080
	3.60		102.5	24.4	2,496		0.057	3,752	0.086
	3.70		103.1	25.0	2,572		0.059	4,005	0.092
	3.80		103.7	25.6	2,649		0.061	4,266	0.098
	3.90		104.3	26.2	2,727		0.063	4,535	0.104
	4.00		104.9	26.8	2,806		0.064	4,812	0.110
Zone 1 (WQCV)	4.02		105.0	26.9	2,822		0.065	4,868	0.112
	4.10		105.5	27.4	2,885		0.066	5,096	0.117
	4.20		106.1	28.0	2,965		0.068	5,389	0.124
	4.30		106.7	28.6	3,046		0.070	5,689	0.131
	4.40		107.3	29.2	3,128		0.072	5,998	0.138
	4.50		107.9	29.8	3,210		0.074	6,315	0.145
	4.60		108.5	30.4	3,293		0.076	6,640	0.152
	4.70		109.1	31.0	3,376		0.078	6,973	0.160
	4.80		109.7	31.6	3,461		0.079	7,315	0.168
	4.90		110.3	32.2	3,546		0.081	7,666	0.176
	5.00		110.9	32.8	3,632		0.083	8,025	0.184
	5.10		111.5	33.4	3,718		0.085	8,392	0.193
	5.20		112.1	34.0	3,806		0.087	8,768	0.201
	5.30		112.7	34.6	3,894		0.089	9,153	0.210
	5.40		113.3	35.2	3,982		0.091	9,547	0.219
	5.50		113.9	35.8	4,072		0.093	9,950	0.228
	5.60		114.5	36.4	4,162		0.096	10,361	0.238
	5.70		115.1	37.0	4,253		0.098	10,782	0.248
	5.80		115.7	37.6	4,344		0.100	11,212	0.257
	5.90		116.3	38.2	4,437		0.102	11,651	0.267
	6.00		116.9	38.8	4,530		0.104	12,099	0.278
	6.10		117.5	39.4	4,623		0.106	12,557	0.288
	6.20		118.1	40.0	4,718		0.108	13,024	0.299
	6.30		118.7	40.6	4,813		0.110	13,500	0.310
	6.40		119.3	41.2	4,909		0.113	13,987	0.321
	6.50		119.9	41.8	5,005		0.115	14,482	0.332
	6.60		120.5	42.4	5,103		0.117	14,988	0.344
	6.70		121.1	43.0	5,201		0.119	15,503	0.356
	6.80		121.7	43.6	5,300		0.122	16,028	0.368
Zone 2 (EURV)	6.85		122.0	43.9	5,349		0.123	16,294	0.374
	6.90		122.3	44.2	5,399		0.124	16,563	0.380
	7.00		122.9	44.8	5,499		0.126	17,108	0.393
	7.10		123.5	45.4	5,600		0.129	17,663	0.405
	7.20		124.1	46.0	5,702		0.131	18,228	0.418
	7.30		124.7	46.6	5,804		0.133	18,803	0.432
	7.40		125.3	47.2	5,907		0.136	19,389	0.445
	7.50		125.9	47.8	6,011		0.138	19,985	0.459
	7.60		126.5	48.4	6,116		0.140	20,591	0.473
	7.70		127.1	49.0	6,221		0.143	21,208	0.487
	7.80		127.7	49.6	6,327		0.145	21,835	0.501
	7.90		128.3	50.2	6,434		0.148	22,473	0.516
	8.00		128.9	50.8	6,541		0.150	23,122	0.531
	8.10		129.5	51.4	6,649		0.153	23,781	0.546
	8.20		130.1	52.0	6,758		0.155	24,452	0.561
	8.30		130.7	52.6	6,868		0.158	25,133	0.577
Zone 3 (100-year)	8.37		131.1	53.0	6,945		0.159	25,617	0.588
	8.40		131.3	53.2	6,978		0.160	25,825	0.593
	8.50		131.9	53.8	7,089		0.163	26,529	0.609
	8.60		132.5	54.4	7,201		0.165	27,243	0.625
	8.70		133.1	55.0	7,313		0.168	27,969	0.642
	8.80		133.7	55.6	7,426		0.170	28,706	0.659
	8.90		134.3	56.2	7,540		0.173	29,454	0.676
	9.00		134.9	56.8	7,655		0.176	30,214	0.694
	9.10		135.5	57.4	7,770		0.178	30,985	0.711
	9.20		136.1	58.0	7,886		0.181	31,768	0.729
	9.30		136.7	58.6	8,003		0.184	32,563	0.748
	9.40		137.3	59.2	8,121		0.186	33,369	0.766
	9.50		137.9	59.8	8,239		0.189	34,187	0.785
	9.60		138.5	60.4	8,358		0.192	35,017	0.804
	9.70		139.1	61.0	8,477		0.195	35,858	0.823
	9.80		139.7	61.6	8,598		0.197	36,712	0.843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4400
2200
0
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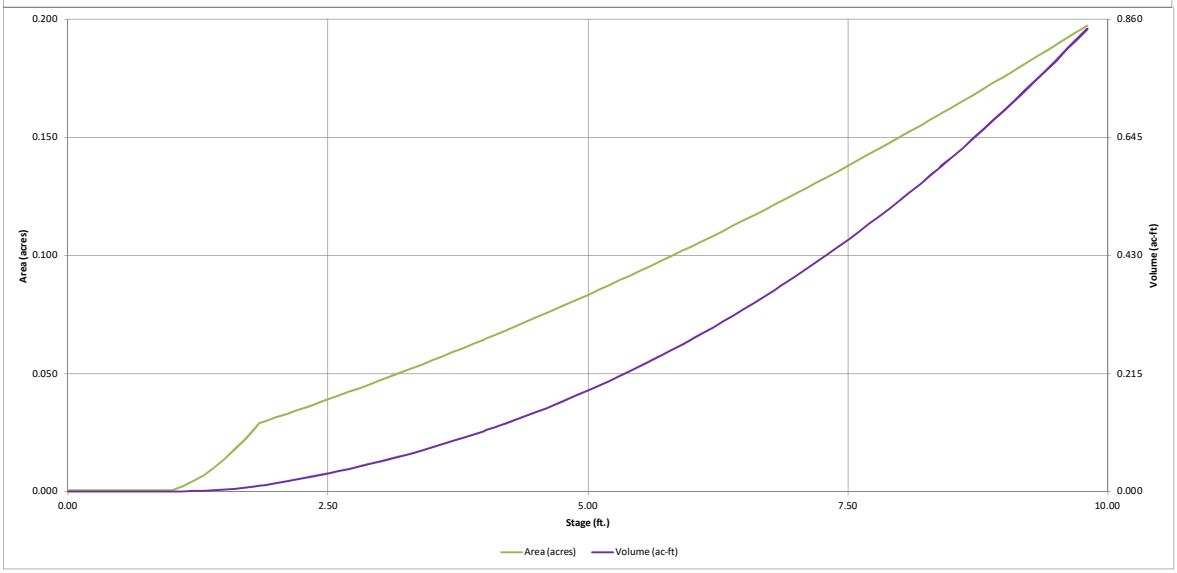
5.00
7.50
10.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)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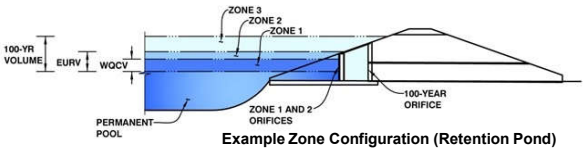
0.430
0.215
0.000
Volume (ac-ft)
0.00
2.50
5.00
7.50
10.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Native Sun Construction**

Basin ID: **P2**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.02	0.111	Orifice Plate
Zone 2 (EURV)	6.85	0.262	Orifice Plate
Zone 3 (100-year)	8.37	0.214	Weir&Pipe (Restrict)
Total (all zones)		0.588	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	6.75	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	27.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.20	4.40	6.60				
Orifice Area (sq. inches)	0.30	1.00	1.00	1.00				

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.85	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	1.00	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Type =	Close Mesh Grate	N/A	
Debris Clogging % =	0%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	7.85	N/A	feet
Overflow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	11.15	N/A	
Overflow Grate Open Area w/o Debris =	3.26	N/A	ft^2
Overflow Grate Open Area w/ Debris =	3.26	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	4.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.29	N/A	ft^2
Outlet Orifice Centroid =	0.20	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	0.98	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	6.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.75	feet
Stage at Top of Freeboard =	10.25	feet
Basin Area at Top of Freeboard =	0.21	acres
Basin Volume at Top of Freeboard =	0.93	acre-ft

Routed Hydrograph Results

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

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.29
CUHP Runoff Volume (acre-ft) =	0.111	0.374	0.322	0.434	0.529	0.641	0.740	0.858	1.171
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.322	0.434	0.529	0.641	0.740	0.858	1.171
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.6	1.7	2.5	4.5	5.6	7.0	10.5
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.13	0.35	0.52	0.92	1.16	1.45	2.16
Peak Inflow Q (cfs) =	N/A	N/A	6.3	8.5	10.0	12.3	14.2	16.8	22.6
Peak Outflow Q (cfs) =	0.1	0.2	0.1	0.5	1.4	3.6	3.9	4.0	10.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.6	0.8	0.7	0.6	1.0
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.4	1.1	1.1	1.2	1.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	61	59	63	61	58	56	54	50
Time to Drain 99% of Inflow Volume (hours) =	**42**	68	65	71	70	69	68	67	65
Maximum Ponding Depth (ft) =	4.01	6.85	6.23	7.05	7.23	7.47	7.76	8.34	8.92
Area at Maximum Ponding Depth (acres) =	0.06	0.12	0.11	0.13	0.13	0.14	0.14	0.16	0.17
Maximum Volume Stored (acre-ft) =	0.111	0.374	0.301	0.398	0.422	0.453	0.494	0.583	0.680

SOIL REPORT & MAP

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

El Paso County Area, Colorado

Native Sun Construction

May 25, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

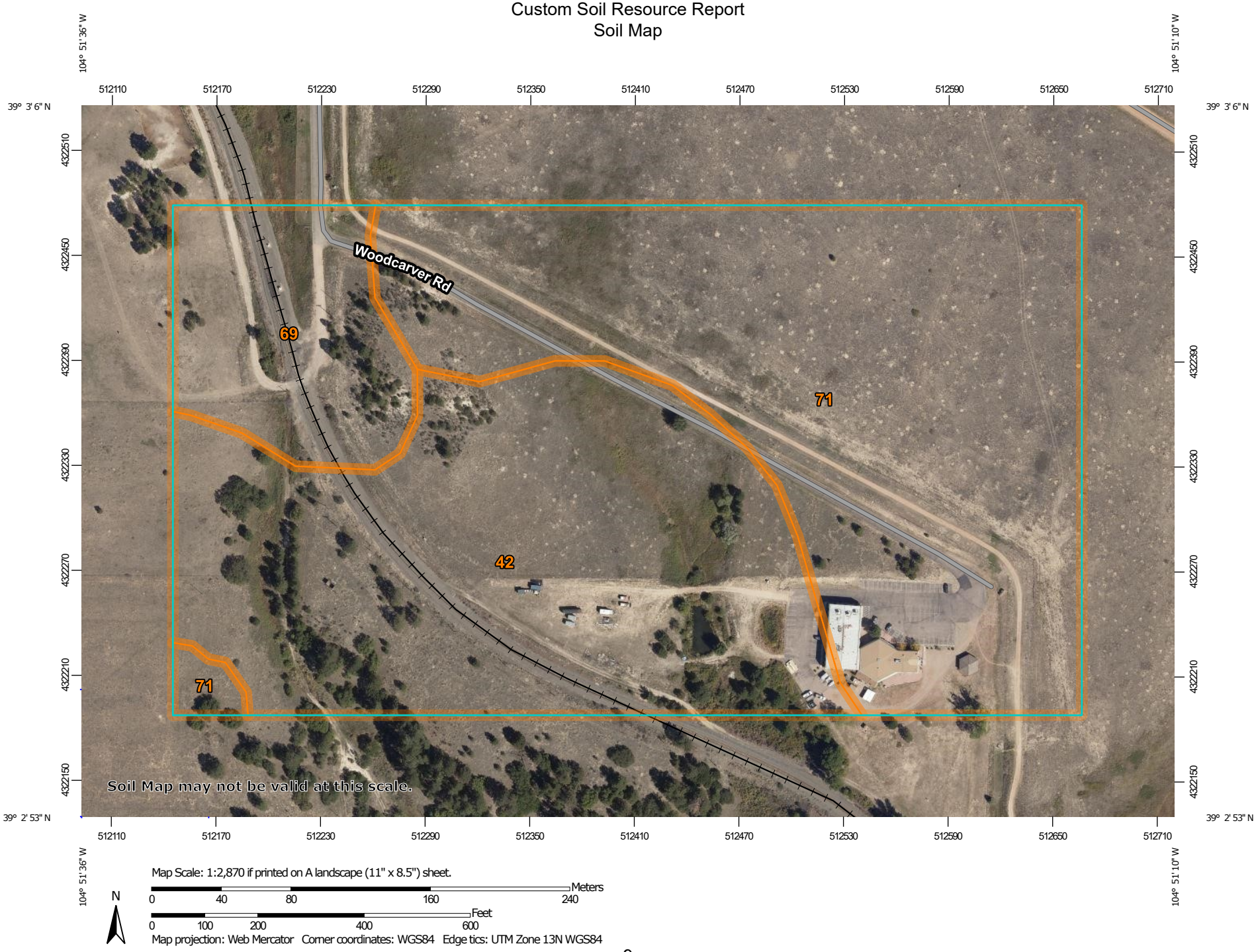
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:2,870 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 40 80 160 240

Feet: 0 100 200 400 600

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

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

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
42	Kettle-Rock outcrop complex	15.3	40.6%
69	Peyton-Pring complex, 8 to 15 percent slopes	4.4	11.6%
71	Pring coarse sandy loam, 3 to 8 percent slopes	18.0	47.9%
Totals for Area of Interest		**37.7**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The

delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

El Paso County Area, Colorado

42—Kettle-Rock outcrop complex

Map Unit Setting

National map unit symbol: 368j
Elevation: 6,800 to 7,700 feet
Frost-free period: 110 to 130 days
Farmland classification: Not prime farmland

Map Unit Composition

Kettle and similar soils: 60 percent
Rock outcrop: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kettle

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

E - 0 to 16 inches: gravelly loamy sand
Bt - 16 to 40 inches: gravelly sandy loam
C - 40 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 8 to 40 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 60 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Available water capacity: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

69—Peyton-Pring complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 369g
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Peyton and similar soils: 40 percent
Pring and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peyton

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

Typical profile

A - 0 to 12 inches: sandy loam
Bt - 12 to 25 inches: sandy clay loam
BC - 25 to 35 inches: sandy clay loam
C - 35 to 60 inches: sandy loam

Properties and qualities

Slope: 8 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Available water capacity: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R049XB216CO - Sandy Divide
Hydric soil rating: No

Description of Pring

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R049XB222CO - Loamy Park
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Other soils

Percent of map unit:
Hydric soil rating: No

71—Pring coarse sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369k
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Pring and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pring

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R048AY222CO
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Other soils

Percent of map unit:

Hydric soil rating: No

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FLOOD PLAIN MAP

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

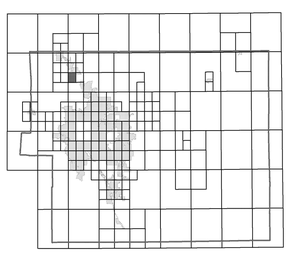
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

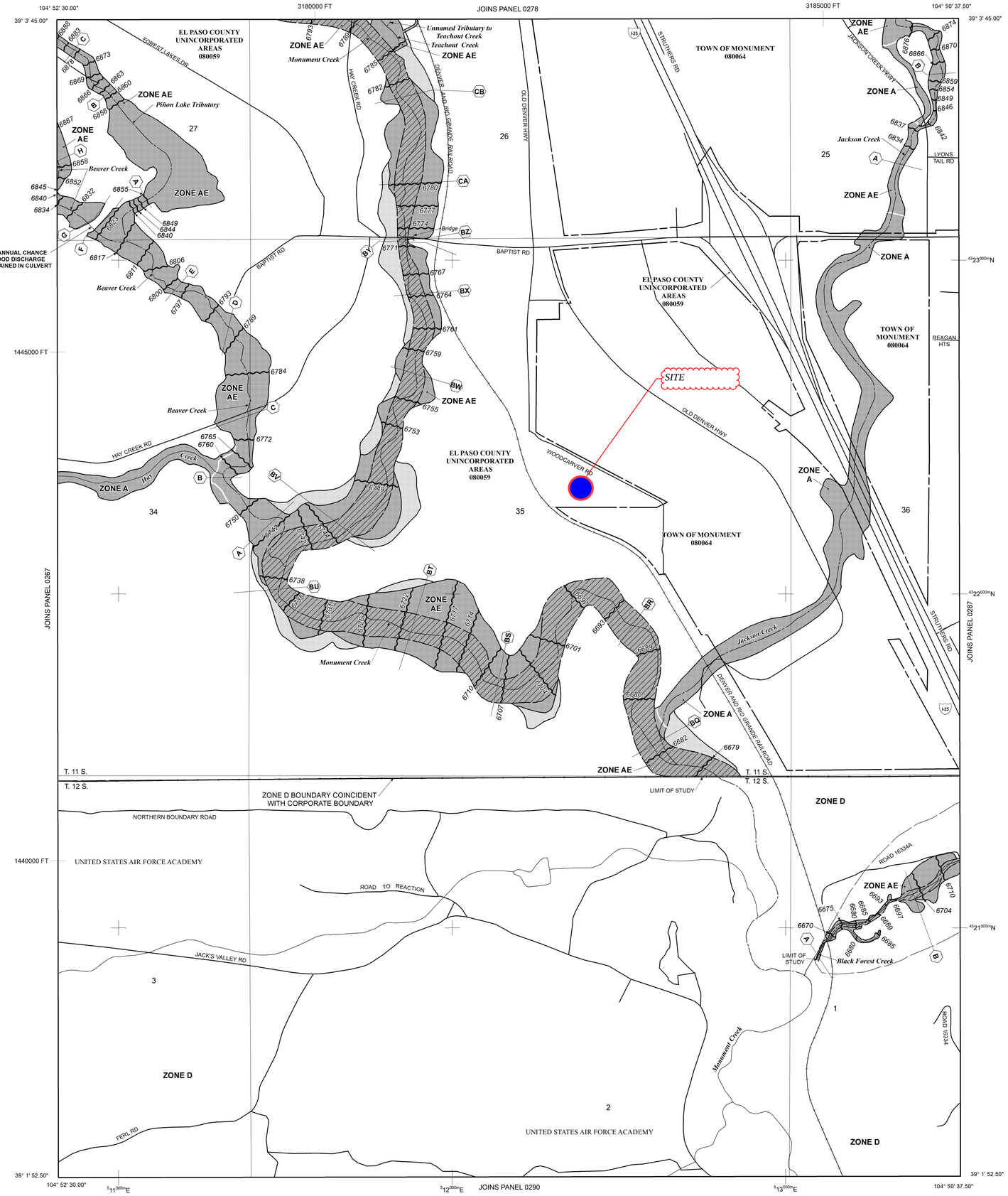
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 11 SOUTH, RANGE 67 WEST, AND TOWNSHIP 12 SOUTH, RANGE 67 WEST.

LEGEND

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

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 - - - - 23	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
$^{42}75^{000m}$N	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0286G

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

PANEL 286 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0286	G
MONUMENT, TOWN OF	080064	0286	G

Notice: This map was reissued on 05/15/2020 to make a correction.This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0286G

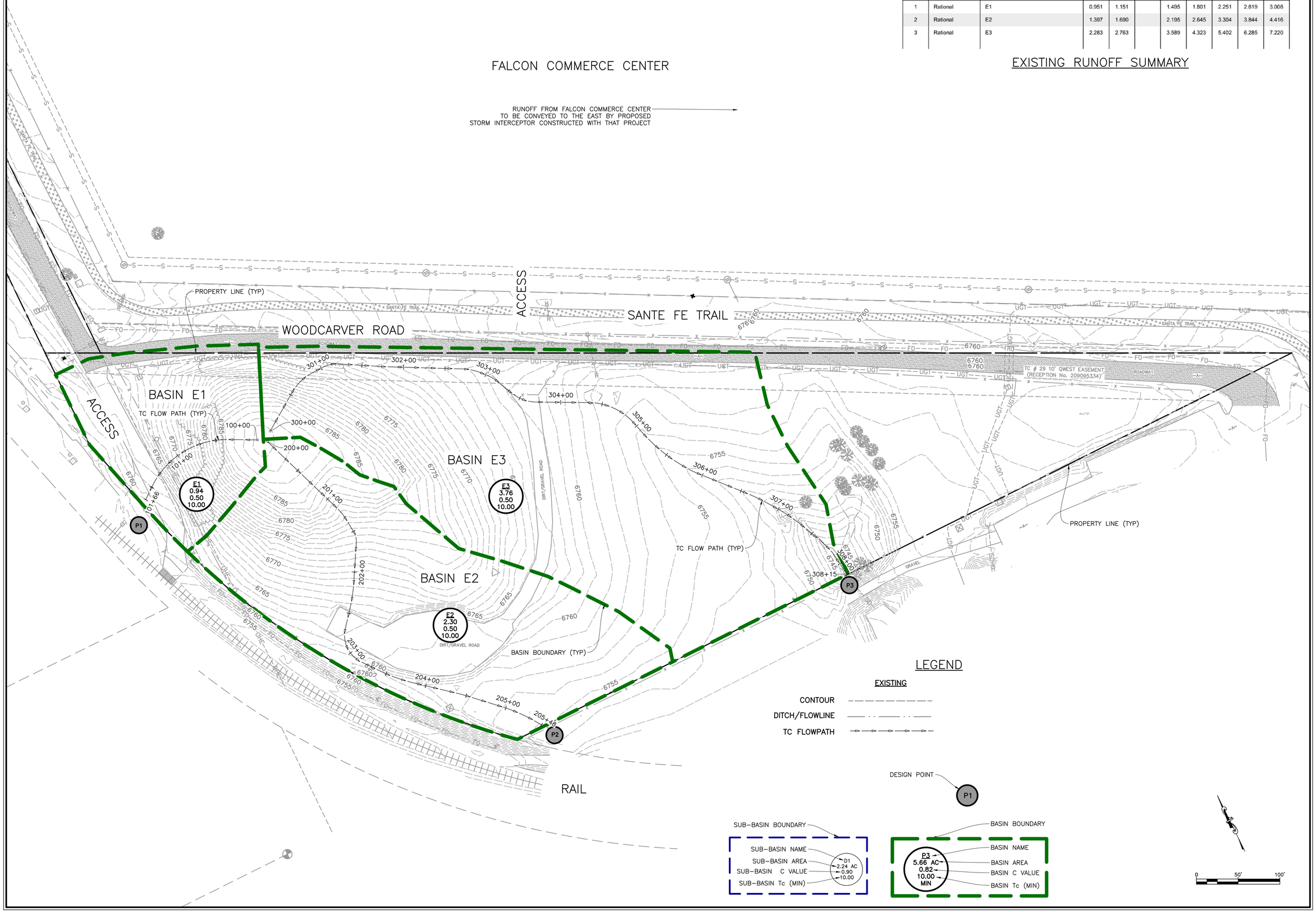
MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

DRAINAGE MAPS

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Outflow (cfs)							
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1	Rational	E1	0.951	1.151		1.495	1.801	2.251	2.619	3.008
2	Rational	E2	1.397	1.690		2.195	2.645	3.304	3.844	4.416
3	Rational	E3	2.283	2.763		3.589	4.323	5.402	6.285	7.220

EXISTING RUNOFF SUMMARY



CD CIVIL DESIGN LLC
2013 STONELEIGH TRAIL
MONUMENT, CO 80132
CDX2@GMAIL.COM 719.271.1175

NATIVE SUN CONSTRUCTION

NATIVE SUN CONSTRUCTION

PUD PLAN
EXISTING DRAINAGE MAP

REVISIONS:

SCALE:
NOTED

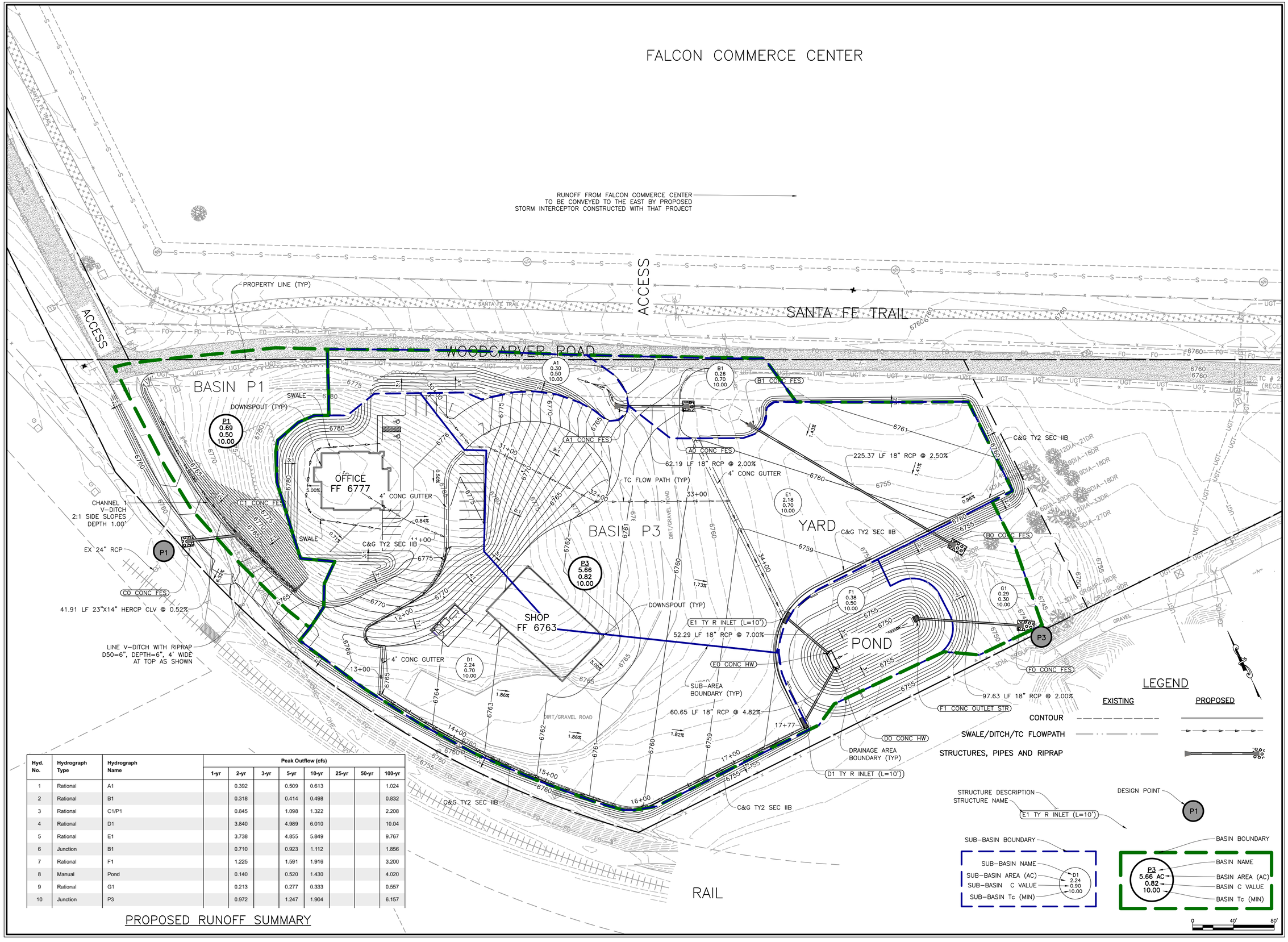
DATE:
MARCH 2021

PROJECT NO.:
21001

SHEET NO.:

EXISTING DRAINAGE MAP

FALCON COMMERCE CENTER



Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Outflow (cfs)							
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1	Rational	A1		0.392		0.509	0.613			1.024
2	Rational	B1		0.318		0.414	0.498			0.832
3	Rational	C1/P1		0.845		1.098	1.322			2.208
4	Rational	D1		3.840		4.989	6.010			10.04
5	Rational	E1		3.738		4.855	5.849			9.767
6	Junction	B1		0.710		0.923	1.112			1.856
7	Rational	F1		1.225		1.591	1.916			3.200
8	Manual	Pond		0.140		0.520	1.430			4.020
9	Rational	G1		0.213		0.277	0.333			0.557
10	Junction	P3		0.972		1.247	1.904			6.157

PROPOSED RUNOFF SUMMARY

CD CIVIL DESIGN LLC
2013 STONELEIGH TRAIL
MONUMENT, CO 80132
CDX2@GMAIL.COM 719.271.1175

NATIVE SUN CONSTRUCTION

NATIVE SUN CONSTRUCTION

PUD PLAN
PROPOSED DRAINAGE MAP

REVISIONS:

SCALE:
NOTED

DATE:
MARCH 2021

PROJECT NO.:
21001

SHEET NO.:

PROPOSED DRAINAGE MAP

FSEDB COST ESTIMATE

Native Sun Construction

Monument, Colorado

Opinion Of Probable Cost-Water Quality BMP's

12/15/2021

Reference	Description	Unit	Unit Cost	Quantity	Cost
	Major Items				
	Embankment	CY	$20.00	1,300	$26,000.00
	Topsoiling, Seeding & Mulching	SY	$4.00	2,300	$9,200.00
	Riprap 6"	CY	$100.00	10	$1,000.00
	18" Reinforced Concrete End Section	EA	$1,000.00	1	$1,000.00
	Concrete Outlet Structure	EA	$8,000.00	1	$8,000.00
	Concrete Trickle Channel	LF	$70.00	80	$5,600.00
	Concrete Class B (Headwall, Forebay And Micropool)	CY	$2,000.00	12	$24,000.00
	Type R Inlet (L=10')	EA	$3,000.00	2	$6,000.00
	18" RCP	LF	$40.00	211	$8,440.00
	Sub Total				$89,240.00
	Contingency/Minor Items	%	10	$89,240.00	$8,924.00
	Grand Total				$98,164.00

Assumptions & Notes

1	Quantities based on plans prepared by CD Civil Design LLC, and by general assumptions.
2	The cost estimate submitted herein is based on time-honored practices within the construction industry. As such the engineer does not control the cost of labor, materials, equipment, or a contractor's methods of determining prices and competitive bidding practices or market conditions. The estimate represents our best judgment as design professionals using current information available at the time of preparation. The engineer cannot guarantee that proposals, bids and/or construction costs
3	This estimate is subject to change. It generally attempts to quantify drainage construction costs. Other project related costs are not included.
4	Estimate does not include construction management and materials testing which could be a major project expense.
5	Unit costs are based on past projects, CDOT cost data from, and general assumptions.

WQCV TREATED AREAS ANALYSIS

Native Sun	
WQCV Treated Areas Analysis	
Area	WQ Treated Area
Point P1	-
Point P2	255,261.60
Point P3	-
Total	255,261.60
Total Project Area	285,318.00
Total Untreated	30,056.40
Total Treated	89%
Total Untreated	11%