Final Drainage Report

Tract A, Wilsons Widefield Addition No. 6
El Paso County, Colorado

Prepared for:
Widefield School District 3
445 Jersey Ln
Colorado Springs, CO 80911
Contact: Dave Gish

Prepared by:
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Project #: 096958001

Prepared: January 14, 2022

PCD File Number: TBD PPR-22-009

Kimley»Horn

CERTIFICATION

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 County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparation of this report.

SIGNATURE (Affix Seal): _____

Colorado P.E. No. 49487 Date

OWNER/DEVELOPER'S STATEMENT

I, the developer, have read and will comply with all of the requirements specified in this Drainage Report and Plan.

Widefield School District 3
Name of Developer

_____
Authorized Signature Date

_____
Printed Name

_____
Title

_____
Address:

EL PASO COUNTY

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

_____ _____
Jennifer Irvine, P.E. Date
County Engineer/ ECM Administrator

Conditions:

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INTRODUCTION

PURPOSE AND SCOPE OF STUDY

The purpose of this Final Drainage Report (FDR) is to provide the hydrologic and hydraulic calculations and to document and finalize the drainage design methodology in support of the proposed Tract A of Wilsons Widefield Addition No. 6 ("the Project") for LKA Partners. The Project is located within the jurisdictional limits of El Paso County ("the County"). Thus, the guidelines for the hydrologic and hydraulic design components were based on the criteria for the County and City of Colorado Springs, described below.

LOCATION

The 7.93-acre parcel (TSN: 55193-13-001) is located at the southeast corner of the Syracuse St. and Jersey Ln. intersections. A vicinity map has been provided in the **Appendix A** of this report.

DESCRIPTION OF PROPERTY

The Project is located on approximately 7.93 acres of land consisting of an existing elementary school with associated playground, parking lot, ballfield and hardscape. The Project consists of a building addition to the existing elementary school with associated sidewalk and hardscape extensions, new playground equipment, and a proposed onsite full spectrum detention basin. The Site does not currently provide water quality or detention for the Project area. The existing land use is for an elementary school.

The existing topography consists of slopes ranging from 1% to 25% and generally slopes from Northeast to Southwest.

NRCS soil data is available for this Site and it has been noted that soils onsite are generally USCS Type B/C. The NRCS soil data can be found in **Appendix B**. There are no major drainage ways or irrigation facilities within the Site.

Improvements will consist of mowing, clearing and grubbing, weed control, paved access road construction, building pad grading, one detention pond, culverts, drainage swales, and native seeding.

An updated Topographic field survey was completed for the Project by Drexel, Barrell & CO, dated July 26, 2021 and is the basis for design for the drainage improvements.

DRAINAGE BASINS

MAJOR BASIN DESCRIPTIONS

The Site improvements are located in Zone X, as determined by the Flood Insurance Rate Map (FIRM) number 08041C0952G effective date, December 7, 2018 (see **Appendix A**).

The Project is located within El Paso County's East Big Johnson Drainage Basin.

EXISTING SUB-BASIN DESCRIPTIONS

Site runoff flows from north to south via sheet and concentrated flows over developed land to Constitution Ave. Below is a description of the existing onsite sub-basins.

Sub-Basin EX-1

Sub-Basin EX-1 consists of the majority of the school property. Drainage flows overland from Northeast to Southwest and conveys through an existing swale to the Southwest corner at Design Point EX1. Runoff during the 5-year and 100-year events are 8.19 cfs and 21.73 cfs, respectively. Runoff from this basin is currently directed to design point EX1 where it will drain into an existing culvert that runs underneath an existing access to the South. This sub-basin has an area of 6.89 acres. The impervious value for this basin is 34%. Refer to **Appendix D** for the Existing Conditions Drainage Map.

Include Size of existing culvert

Sub-Basin EX-2

Sub-Basin EX-2 consists of a portion of the Northwest corner of the Property. Drainage flows overland from East to West and conveys to the curb and gutter that runs north-south along the eastern side of Syracuse Street at Design Point EX2. Direct runoff during the 5-year and 100-year events are 3.38 cfs and 6.62 cfs, respectively. Runoff from this basin is currently directed to design point EX2 where it will drain into the existing Syracuse Street curb and gutter and run to the South, which collects in an existing 10- Type R Inlet. This sub-basin has an area of 1.11 acres. The impervious value for this basin is 71%. Refer to **Appendix D** for the Existing Conditions Drainage Map.

foot

PROPOSED RATIONAL SUB-BASIN DESCRIPTIONS

Map and spreadsheet shows 6.51 acres & 47% imperviousness. Please update accordingly to correct values.

Sub-Basin A1 consists of a portion of the east half of the site. Runoff from this basin will be directed to design point 1 where it will drain into the full spectrum detention South Pond, which will outfall through the proposed outlet structure to the existing drainage swale. This sub-basin has an area of 6.31 acres. The impervious value for this basin is 45 runoff of 6.17 cfs and 21.76 cfs in the minor and major storm event.

Update flow rates to match hydrology spreadsheet in appendix

Sub-Basin A2 consists of a portion of landscaping, parking, and building unit in the west side of the site. Runoff from this basin will be directed to Design Point 2 which will outfall to the existing curb and gutter in Jersey Ln. This sub-basin has an area of 1.69 acres. The impervious value for Sub-Basin B2 is 69%. The basin will generate runoff of 2.36 cfs and 6.41 cfs in the minor and major storm event.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

The proposed storm facilities are designed to be in compliance with the City of Colorado Springs and El Paso County “Drainage Criteria Manual (DCM)” dated October 2018 (”the MANUAL”), El Paso County “Engineering Criteria Manual” (“the Engineering Manual”), Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs Drainage Criteria Manual dated May 2014 (“the Colorado Springs MANUAL”).

There are no known master plans or studies for the site.

HYDROLOGIC CRITERIA

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the existing and proposed drainage analysis per the MANUAL. The rainfall depths for site were determined from equation 6-1, equation 6-2 utilizing Figures 6-6, 6-11, 6-12, and 6 -17 from the DCM. Refer to **Table 1** below for the rainfall depths utilized for the site and **Appendix B** for the hydrologic calculations for the site.

Table 1: *Rainfall Depths*

	Duration (HRS)
Storm Event	**1 HR**
5 Year	1.52
100 Year	2.55

Calculations for the runoff coefficients and percent impervious are included in the **Appendix B**. Rational method was used to determine the peak flows for the project. These flows were used to determine the size of the proposed inlets, culvert, storm drain system and on-site swales.

The proposed impervious values in Table 6-6 of the DCM were utilized in this report for the final design. Refer to **Appendix B** of this report for Table 6-6.

The Site is providing one full spectrum detention pond. The Site is maintaining the historic drainage patterns as much as possible.

There are no additional provisions selected or deviations from the criteria in both the MANUAL and Colorado Springs MANUAL.

HYDRAULIC CRITERIA

Applicable design methods were utilized to size the proposed pond, which includes the use of the UD-Detention spreadsheet and rational calculations spreadsheet.

Proposed drainage features on-site have been analyzed and sized for the following design storm events:

- Major Storm: 100-year Storm Event

One full spectrum detention pond is proposed in order to maintain historic flows and water quality. The detention pond known as the South Pond. The South Pond is in the southwest corner of the Site with a proposed volume of 0.96 ac-ft and designed for the 100-year storm event. The pond has a discharge rate of 8.1 cfs in the 100-year condition. Water from the South Pond is discharged into an existing culvert at the southwest corner of the site and ultimately out falling to Fountain Creek. Pond calculations are provided in the **Appendix C**.

Include discussion on the drainage criteria used on the storm system and swale.

Calculations for storm pipe were not included in Appendix C. Please provide on next submittal.

Curb and gutter, inlets, grass lined swales, and storm drain pipes are designed to carry flows to the South Pond. The storm drain pipe calculations are provided in the **Appendix C** and the design points are provided in the Proposed Drainage Map located in **Appendix D**. designed to release the 100-year flow rates below the pre-development flow rate.

Include what pre-develo rates are, as well as WQ EURV rates

Emergency overflows will be routed over the southwest corner of the pond. It will fo drainage conditions and enter the existing swale that conveys south from the Property.

Include discussion o compare to previous existing culvert and i function properly with the existing Type R i to Mesa Ridge Self S Project MS144, for d & culvert information

THE FOUR STEP PROCESS

The Project was designed in accordance with the four-step process to minimize adverse impacts of urbanization, as outlined in the County's "Four-Step Process" for selecting str BMPs (ECM Section I.7.2 BMP Selection).

Step 1. **Employ Runoff Reduction Practices**- The project is proposing an expa an existing school building that will be designed to minimize the impact to the cu existing terrain. The Site's proposed paved roadways and building footprint will increase the Site's impervious area; however, drainage swales will be constructed to slow down the runoff velocity and reduce runoff peaks. A full spectrum detention pond will be used to capture stormwater and maintain flows discharging off site at or below historic levels.

Step 2. Stabilize Drainageways– Stabilizing proposed drainage swales by designing them with slopes that control the flow rates. Placement of riprap upstream and downstream of culverts to help reduce erosion of the drainage swales. Rock chutes will be constructed to reduce the velocities of runoff entering the ponds at the channel locations. We anticipate this will minimize erosion.

Step 3. Provide Water Quality Capture Volume (WQCV) –Permanent water quality measures and detention facilities will be provided with the Project. More specifically, this project proposes the construction of an Extended Detention Basin to provide for the required water quality capture volume.

Step 4. Consider Need for Industrial and Commercial BMPs – The proposed project is proposing a school addition; therefore, covering of storage/handling areas and spill containment and control will not need to be provided.

DRAINAGE FACILITY DESIGN

GENERAL CONCEPT

The proposed drainage patterns will match the historic patterns. To maintain historic flows, a full spectrum detention pond is being proposed and will capture and control the flows from the proposed development to convey flows with a series of swales, parking lot sheet flow, and a storm drain system.

Provided in the **Appendix B** are hydrologic calculations utilizing the Rational method for the existing and proposed conditions. Provided in **Appendix C** are the hydraulic calculations for the proposed conditions, including the proposed detention basin sizing. As previously mentioned, the existing drainage map and proposed drainage map can be found in **Appendix D.**

SPECIFIC DETAILS

The existing conditions of the Site have flows conveying from the northeast to the southwest corner and spill into the existing culvert that conveys South underneath the adjacent property's drive access. Runoff conditions for the Site were developed utilizing the Rational Method described in the Hydrologic Criteria section of this report.

Sub-basins A1 and A2 consist of a school expansion and detention pond. Flows are conveyed from the north side of the Site to the southwest corner of the Site. On site flows enter South Pond which then spill into the existing culvert that conveys South underneath the adjacent property's drive access.

Include disc and access will be main public/privat

The hydrologic calculations, hydraulic calculations, and Drainage Maps are included in the **Appendix B, Appendix C,** and **Appendix D** of this report for reference.

O&M Manua for pond.

The Site will disturb more than 1 acre and will require a Colorado Discharge Permit System (CDPS) General Permit for Stormwater Discharge Associated with Construction Activities from the Colorado Department of Public Health and Environment (CDPHE).

Since the Site was previously platted, there are no associated drainage and bridge fees due at this time.

include cost estimate

SUMMARY

The proposed drainage design is to maintain the historic drainage patterns, the overall imperviousness and release rates for the Site. Runoff from the Site will flow through an existing storm drain system to an existing El Paso County drainage basin: The East Big Johnson Basin. The basin ultimately discharges to Fountain Creek. The drainage design presented within this report conforms to the criteria presented in both the MANUAL and the Colorado Springs MANUAL. Additionally, the Site runoff and storm drain facilities will not adversely affect the downstream and surrounding developments, including Fountain Creek.

REFERENCES

1. City of Colorado Springs "Drainage Criteria Manual (DCM) Volume 1", dated May, 2014
2. El Paso County "Drainage Criteria Manual", dated October 31, 2018
3. El Paso County "Engineering Criteria Manual" Revision 6, dated December 13, 2016
4. Chapter 6 and Section 3.2.1. of Chapter 13-City of Colorado Springs Drainage Criteria Manual, May 2014.
5. Urban Drainage and Flood Control District Drainage Criteria Manual (UDFCDCM), Vol. 1, prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.
6. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C0756G, Effective Date December 7, 2018, prepared by the Federal Emergency Management Agency (FEMA).

APPENDIX

APPENDIX A: FIGURES

Webster Elementary

Vicinity Map

National Flood Hazard Layer FIRMette

FEMA

104°43'9"W 38°43'45"N

104°42'31"W 38°43'17"N

0 250 500 1,000 1,500 2,000 Feet 1:6,000

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

Legend

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

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

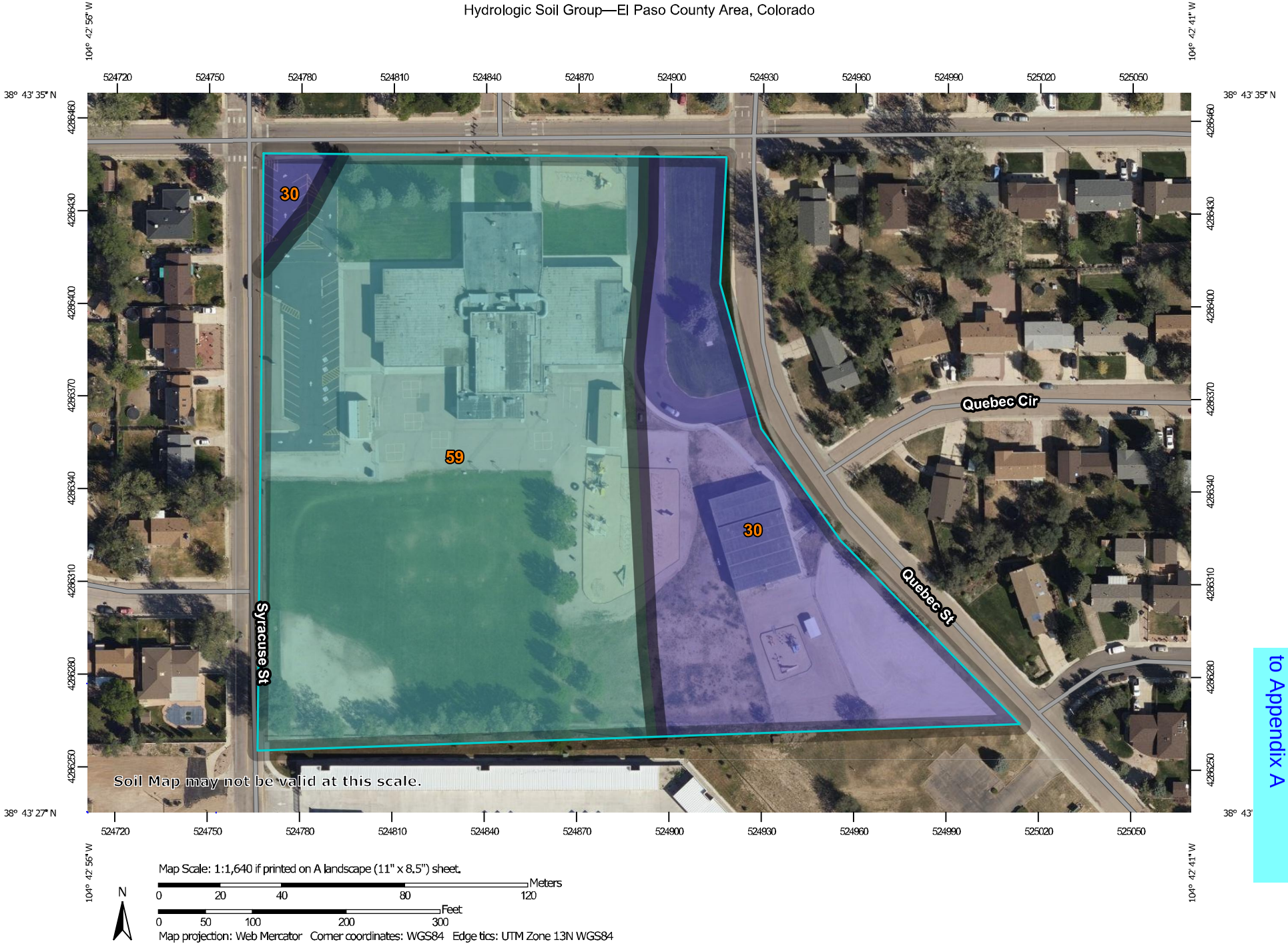
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/16/2021 at 9:46 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

APPENDIX B: HYDROLOGY



Map Scale: 1:1,640 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

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

Move soils information to Appendix A

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: 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 14, 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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
30	Fort Collins loam, 0 to 3 percent slopes	B	2.7	31.5%
59	Nunn clay loam, 0 to 3 percent slopes	C	5.8	68.5%
Totals for Area of Interest			**8.4**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

The methods described in this Manual require only that the 1-hour, 6-hour and 24-hours depths be used as input. The storm return periods required for the application of methods in this Manual are the 2-, 5-, 10-, 25-, 50- and 100-year events. The 6-hour and 24-hour depths for these return periods can be read directly from Figures 6-6 through 6-17 at the end of this chapter. The1-hour depth for return periods can be calculated for all design return periods following this procedure:

Step 1: Calculate 2-year, 1-hour rainfall based on 2-year, 6-hour and 24-hour values.

$$Y_2 = 0.218 + 0.709 \cdot (X_1 \cdot X_1 / X_2) \quad \text{(Eq. 6-1)}$$

Where:

Y_2 = 2-year, 1-hour rainfall (in)

X_1 = 2-year, 6-hour rainfall (in) from Figure 6-6

X_2 = 2-year, 24-hour rainfall (in) from Figure 6-12

Step 2: Calculate 100-year, 1-hour rainfall based on 2-year 6-hour and 24-hour values

$$Y_{100} = 1.897 + 0.439 \cdot (X_3 \cdot X_3 / X_4) - 0.008\ Z \quad \text{(Eq. 6-2)}$$

Where

Y_{100} = 100-year, 1-hour rainfall (in)

X_3 = 100-year, 6-hour rainfall (in) from Figure 6-11

X_4 = 100-year, 24-hour rainfall (in) from Figure 6-17

Z = Elevation in hundreds of feet above sea level

Step 3: Plot the 2-year and 100-year, 1-hour values on the diagram provided in Figure 6-18 and connect the points with a straight line. The 1-hour point rainfall values for other recurrence intervals can be read directly from the straight line drawn on Figure 6-18.

Example: Determine the 10-year, 1-hour rainfall depth for downtown Colorado Springs.

Step 1*:* Calculate 2-year, 1-hour rainfall (Y_2) based on 2-year, 6-hour and 24-hour values. From Figure 6-6, the 2-year, 6-hour rainfall depth for downtown Colorado Springs is approximately 1.7 inches (X_1), and from Figure 6-12, the 2-year 24-hour depth is approximately 2.1 inches (X_2). The 2-year, 1-hour rainfall is calculated as follows:

$$Y_2 = 0.218 + 0.709 \cdot (1.7 \cdot 1.7 / 2.1) = 1.19 \text{ in} \quad \text{(Eq. 6-3)}$$

Step 2*:* Calculate 100-year, 1-hour rainfall (Y_{100}) based on 100-year, 6-hour and 24-hour values. From Figure 6-11, the 100-year, 6-hour rainfall depth for downtown Colorado Springs is approximately 3.5 inches (X_3), and from Figure 6-17, the 100-year 24-hour depth is approximately 4.5 inches (X_4). Assume an elevation of 6,840 feet for Colorado Springs. The 100-year, 1-hour rainfall is calculated as follows:

$$Y_{100} = 1.897 + 0.439 \cdot (3.5 \cdot 3.5 / 4.6) - 0.008 \cdot (6{,}840/100) = 2.52 \text{ in} \quad \text{(Eq. 6-4)}$$

Step 3*:* Plot 2-year and 100-year, 1-hour rainfall depths on Figure 6-18 and read 10-year value from straight line. This example is illustrated on Figure 6-18, with a 1-hour, 10-year rainfall depth of approximately 1.75 inches. Figure 6-18a provides the example, and Figure 6-18b provides a blank chart.

Figure 6-6. 2-Year, 6-Hour Precipitation Tenths of an Inch (NOAA Atlas 2)

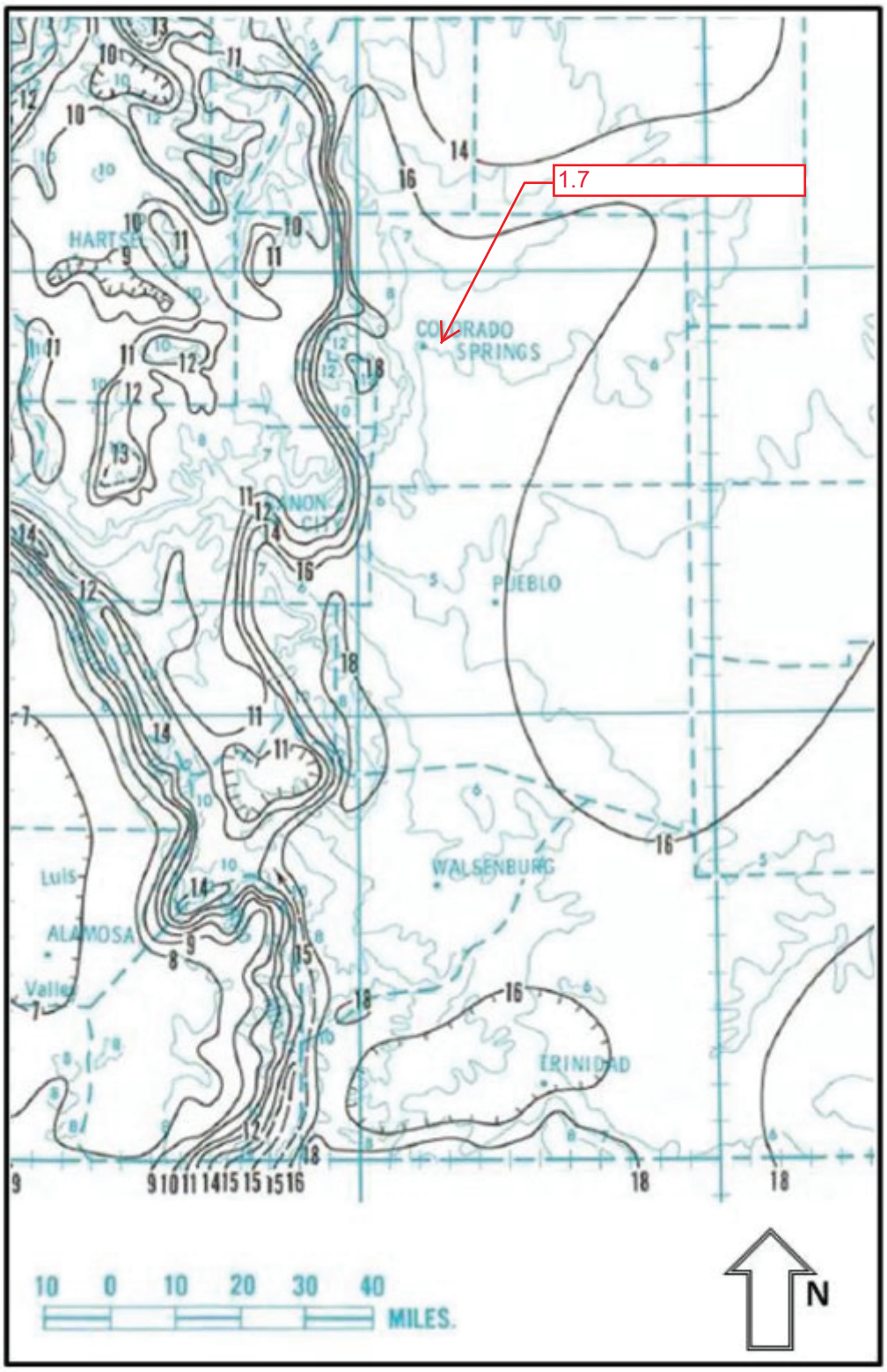


Figure 6-12. 2-Year, 24-Hour Precipitation Tenths of an Inch (NOAA Atlas 2)

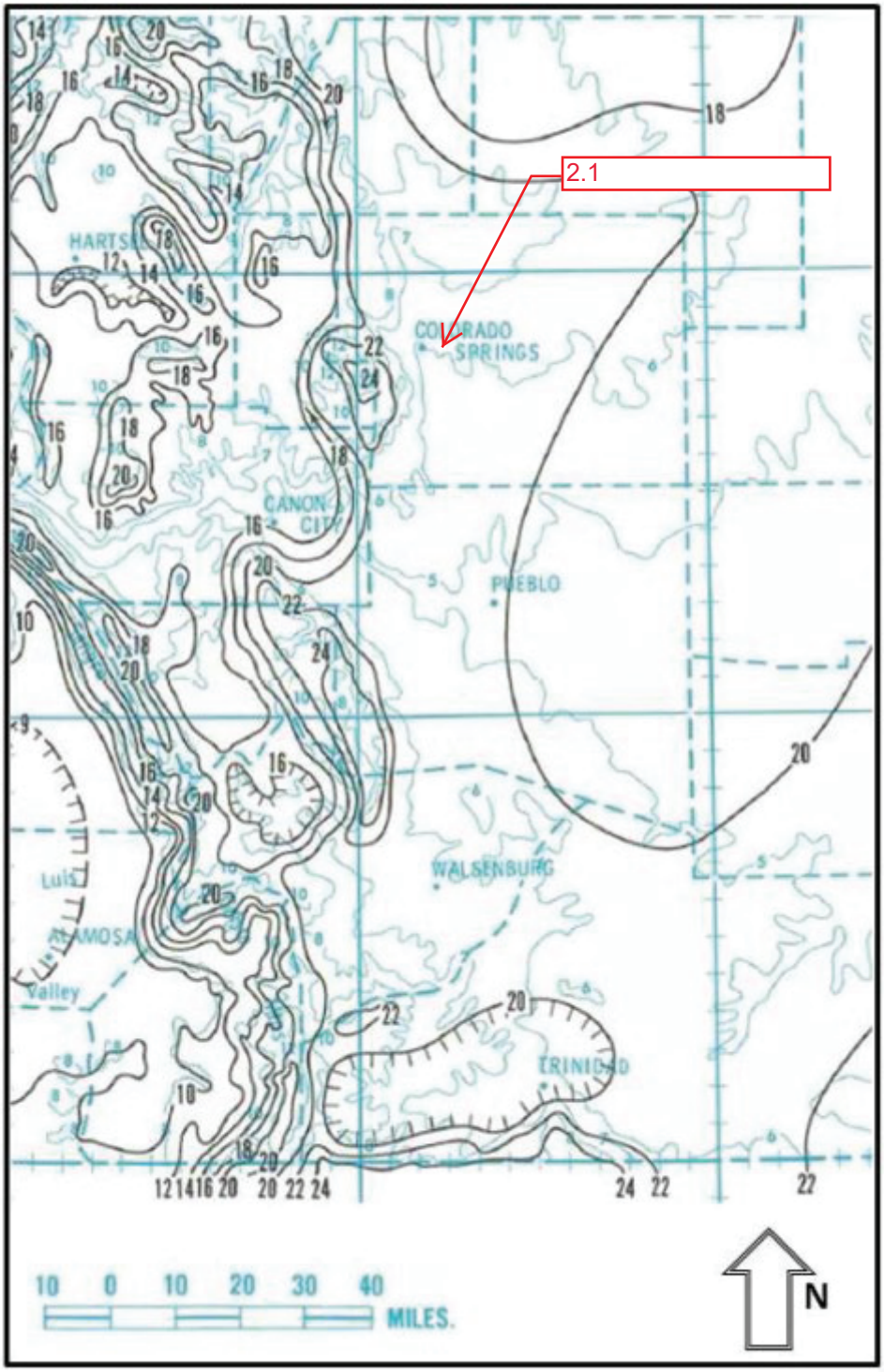


Figure 6-11. 100-Year, 6-Hour Precipitation Tenths of an Inch (NOAA Atlas 2)

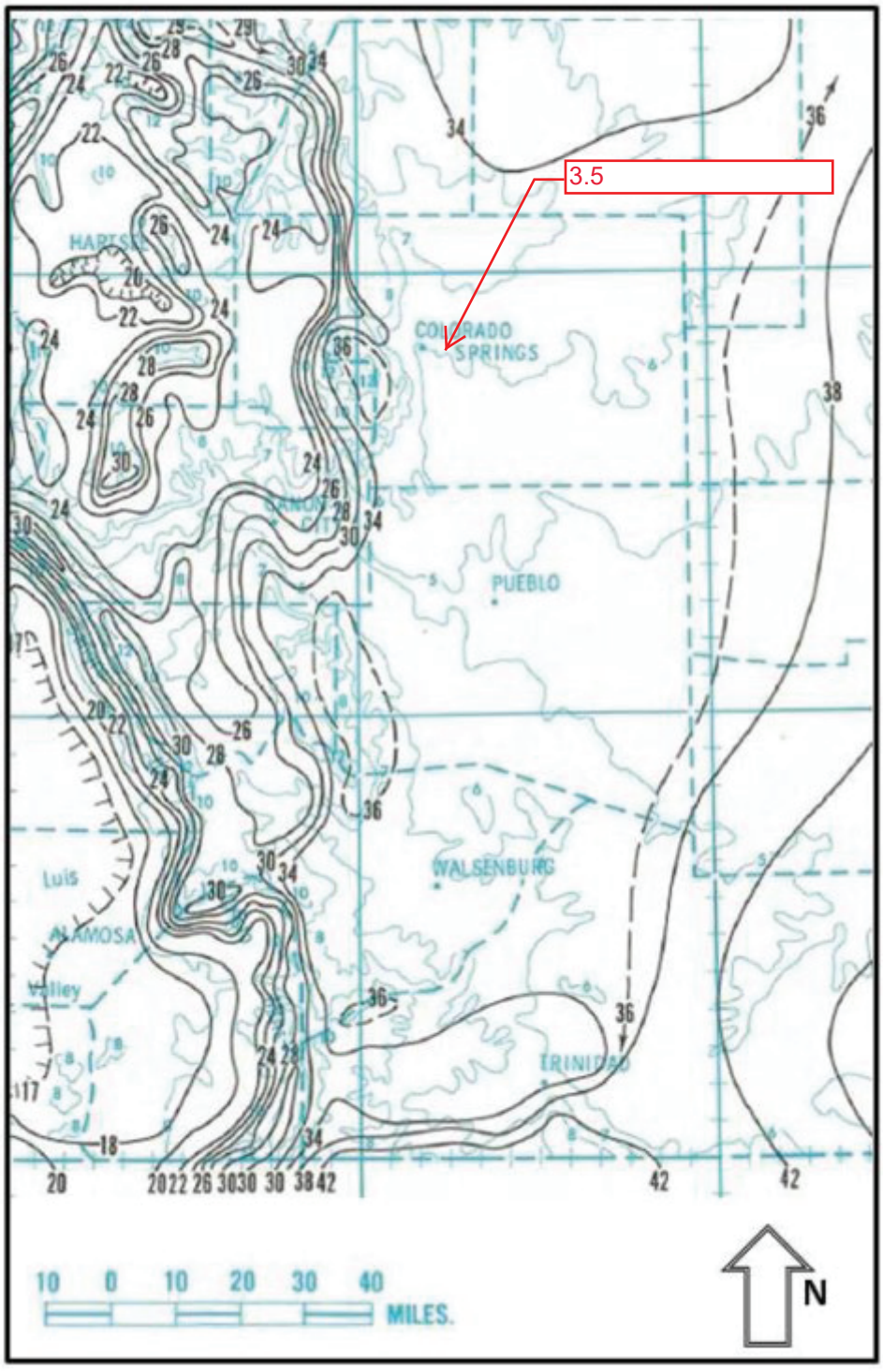
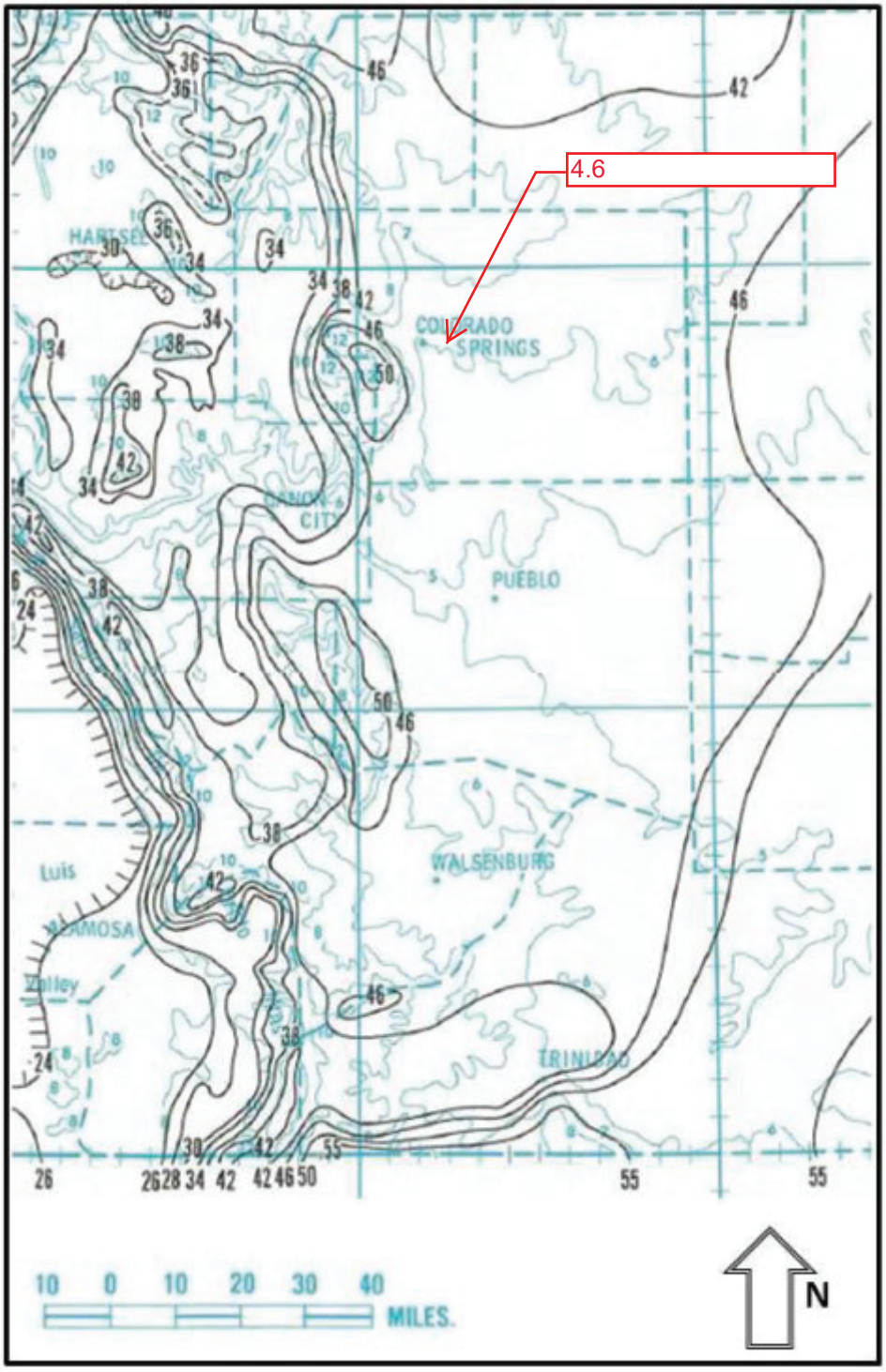
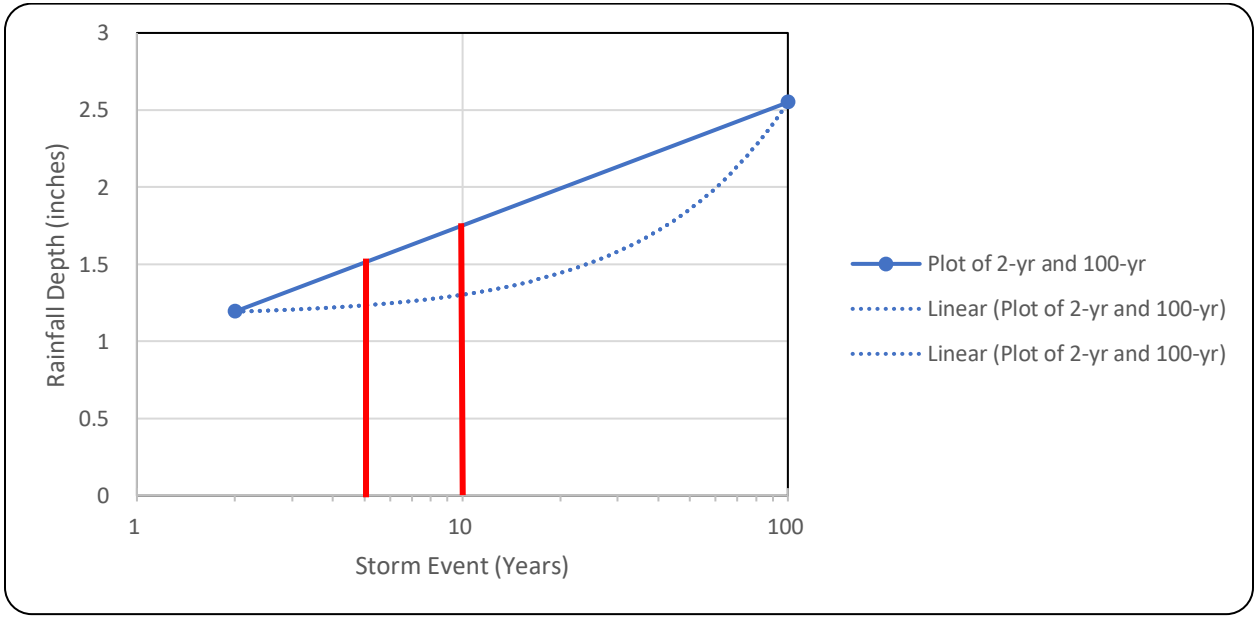


Figure 6-17. 100-Year, 24-Hour Precipitation Tenths of an Inch (NOAA Atlas 2)



Rainfall Depths			
			Notes
2 yr, 6 hr rainfall (in)	X_1 =	1.7	From Figure 6-6
2 yr, 24 hr rainfall (in)	X_2 =	2.1	From Figure 6-12
100 yr, 6 hr rainfall (in)	X_3 =	3.5	From Figure 6-11
100 yr, 24 hr rainfall (in)	X_4 =	4.6	From Figure 6-17
Elevation (hundreds of feet)]	Z =	64.5	
2 yr, 1 hr rainfall (in)	Y_2 =	1.193719	Equation 6-1
100 yr, 1 hr rainfall (in)	Y_{100} =	2.550076	Equation 6-2
Graph			
X-axis		Y-axis	
2	Y2	1.193719	Calculated from Eq 6-1
100	Y100	2.550076	Calculated from Eq 6-2
	Y5	1.52	Determined From Graph below
	Y10	1.75	Determined From Graph below



$$I = \frac{28.5\ P_1}{(10+T_D)^{0.786}}$$

Where:

I = rainfall intensity (inches per hour)

P_1 = one-hour rainfall depth (inches) from Table 6-2 One-hour Point Rainfall D
City of Colorado Springs Drainage Design

T_C = storm duration (minutes)

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.19	1.52	1.75	2.55

Time Intensity Frequency Tabulation

TIME	2 YR	5 YR	10 YR	100 YR
5	4.05	5.16	5.94	8.65
10	3.23	4.11	4.73	6.90
15	2.71	3.45	3.97	5.79
30	1.87	2.38	2.75	4.00
60	1.21	1.54	1.77	2.58
120	0.74	0.94	1.09	1.58

Weighted Imperviousness Calculations

SUB-BASIN	AREA (SF)	AREA (Acres)	ROOF AREA	ROOF IMPERVIOUSNESS	ROOF C2	ROOF C5	ROOF C10	ROOF C100	LANDSCAPE AREA	LANDSCAPE IMPERVIOUSNESS	LANDSCAPE C2	LANDSCAPE C5	LANDSCAPE C10	LANDSCAPE C100	PAVEMENT AREA	PAVEMENT IMPERVIOUSNESS	PAVEMENT C2	PAVEMENT C5	PAVEMENT C10	PAVEMENT C100	WEIGHTED IMPERVIOUSNESS	WEIGHTED COEFFICIENTS C2	WEIGHTED COEFFICIENTS C5	WEIGHTED COEFFICIENTS C10	WEIGHTED COEFFICIENTS C100
EX-1	300314	6.89	0.787	90%	0.71	0.73	0.75	0.81	4.557261	2%	0.03	0.09	0.17	0.36	1.55	100%	0.89	0.90	0.92	0.96	34%	0.30	0.35	0.40	0.55
EX-2	48423.57	1.11	0	90%	0.71	0.73	0.75	0.81	0.331652	2%	0.03	0.09	0.17	0.36	0.78	100%	0.89	0.90	0.92	0.96	71%	0.63	0.66	0.70	0.78
TOTAL	348,738	8.01	0.79	90%	0.71	0.73	0.75	0.81	4.89	2%	0.03	0.09	0.17	0.36	2.33	100%	0.89	0.90	0.92	0.96	39%	0.35	0.39	0.45	0.58

Webster Elementary

Akers Road - Drainage Report
Proposed Runoff Calculations
Time of Concentration

Watercourse Coefficient

					Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00			Grassed Waterway	15.00				
					Fallow or Cultivation	5.00	Nearly Bare Ground	10.00			Paved Area & Shallow Gutter	20.00				
	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
1	EX-1	300,314	6.89	0.35	100	1.5%	12.1	820	1.5%	10.00	1.2	11.2	23.3	920	15.1	15.1
2	EX-2	48,424	1.11	0.66	100	1.7%	6.8	180	1.7%	20.00	2.6	1.2	8.0	280	11.6	8.0

Webster Elementary

Akers Road - Drainage Report
Proposed Runoff Calculations ***Design Storm 5 Year***
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
1	EX-1	6.89	0.35	15.1	2.38	3.44	8.19				8.19	
2	EX-2	1.11	0.66	8.0	0.73	4.48	3.38				3.38	

Webster Elementary

Akers Road - Drainage Report
Proposed Runoff Calculations ***Design Storm 100 Year***
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
1	EX-1	6.89	0.55	15.1	3.77	5.77	21.73				21.73	
2	EX-2	1.11	0.78	8.0	0.87	7.51	6.62				6.62	

SUMMARY - EXISTING RUNOFF TABLE						
DESIGN POINT	**BASIN DESIGNATION**	**BASIN AREA (ACRES)**	**DIRECT 5-YR RUNOFF (CFS)**	**DIRECT 100-YR RUNOFF (CFS)**	**CUMULATIVE 5-YR RUNOFF (CFS)**	**CUMULATIVE 100-YR RUNOFF (CFS)**
1	EX-1	6.89	8.19	21.73	8.19	21.73
2	EX-2	1.11	3.38	6.62	3.38	6.62

BASIN IMPERVIOUSNESS

		Runoff Coefficient		
Landuse	**I**	**2-YR**	**5-YR**	**100-YR**
Landscape	0%	0.02	0.08	0.35
Roof	90%	0.71	0.73	0.81
Drives&Walks	100%	0.89	0.90	0.96

Basin Designation	A_{TOTAL} **(AC)**	A_{TOTAL} **(SF)**	$A_{LANDSCAPE}$ **(SF)**	A_{ROOF} **(SF)**	$A_{DRIVES\ \&\ WALKS}$ **(SF)**	$I_{WEIGHTED}$
1	6.51	283,496	144,948	60,602	77,946	47%
Into Swale	1.34	58,489	27,385	7,975	23,129	52%
Total On-Site	6.51	283496.00	144948.00	60602.00	77946.00	
Basins that Flow Off-site						
O1	1.49	64,852	20,422	0	44,430	69%
Total	**8.00**	**348,348.00**	**165,370.00**	**60,602.00**	**122,376.00**	**51%**

Calculation of Peak Runoff using Rational Method

Designer: Jared Roberts
Company: Kimley-Horn
Date: 1/7/2022
Project: Webster Elementary School
Location: Widefield, Colorado

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

Computed $t_c = t_i + t_t$

Regional $t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$

$t_{minimum}$ = 5 (urban)
$t_{minimum}$ = 10 (non-urban)

Selected $t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

1-hour rainfall depth, P1 (in) =	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
	0.83	1.09	1.33	1.69	1.99	2.31	3.14

Rainfall Intensity Equation Coefficients =	a	b	c
	28.50	10.00	0.786

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

$Q(cfs) = CIA$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time							Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
A1	6.51	C	47.0	0.36	0.42	0.48	0.58	0.63	0.68	0.74	77.00	5668.67	5664.55	0.054	6.21	850.00	5664.55	5655.50	0.011	15	1.55	9.15	15.36	26.82	15.36	1.85	2.45	2.99	3.79	4.47	5.18	7.05	4.31	6.66	9.28	14.38	18.18	22.82	33.77
A2	1.49	C	69.0	0.55	0.60	0.64	0.71	0.73	0.77	0.81	212.00			0.020	10.51	625.00	5660.33	5656.17	0.007	20	1.63	6.38	16.90	21.11	16.90	1.77	2.34	2.85	3.62	4.27	4.95	6.73	1.45	2.08	2.71	3.81	4.66	5.65	8.08

APPENDIX C: HYDRAULICS

Include design of drainage swale

Include design of storm system

Include analysis of existing culvert & ditch (off-site)

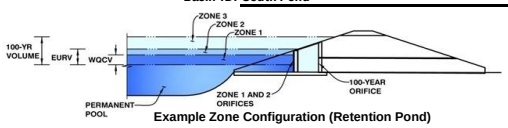
Include design for pond forebays

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Webster Elementary

Basin ID: South Pond



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	6.51	acres
Watershed Length =	1,160	ft
Watershed Length to Centroid =	350	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	51.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	31.5%	percent
Percentage Hydrologic Soil Groups C/D =	68.5%	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) =	0.113	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.327	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.349	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.508	acre-feet	1.52 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.628	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	0.784	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.921	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.55 in.) =	1.106	acre-feet	2.55 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.438	acre-feet	inches
Approximate 2-yr Detention Volume =	0.275	acre-feet	
Approximate 5-yr Detention Volume =	0.404	acre-feet	
Approximate 10-yr Detention Volume =	0.475	acre-feet	
Approximate 25-yr Detention Volume =	0.515	acre-feet	
Approximate 50-yr Detention Volume =	0.535	acre-feet	
Approximate 100-yr Detention Volume =	0.611	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.113	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.214	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.283	acre-feet
Total Detention Basin Volume =	0.611	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

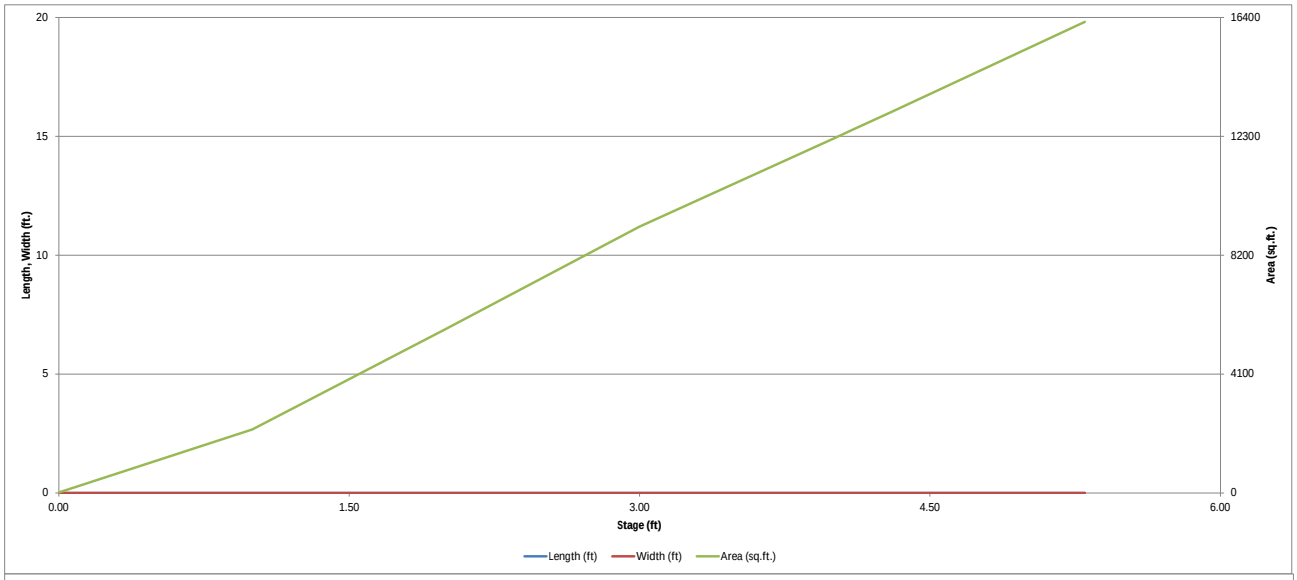
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

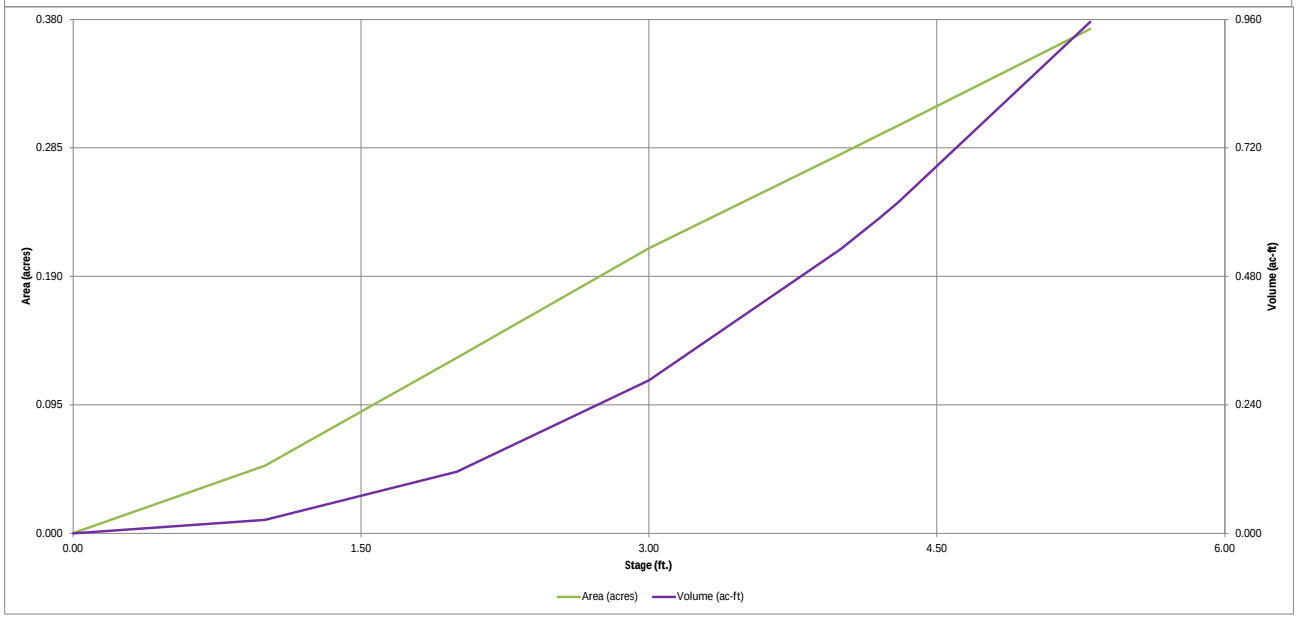
Depth Increment = ft

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	--	--	--	16	0.000		
5,655.00	--	1.00	--	--	--	2,184	0.050	1,100	0.025
5,656.00	--	2.00	--	--	--	5,658	0.130	5,021	0.115
5,657.00	--	3.00	--	--	--	9,183	0.211	12,441	0.286
5,658.00	--	4.00	--	--	--	12,216	0.280	23,141	0.531
5,658.10	--	4.10	--	--	--	12,523	0.287	24,378	0.560
5,658.20	--	4.20	--	--	--	12,831	0.295	25,646	0.589
5,658.30	--	4.30	--	--	--	13,139	0.302	26,944	0.619
5,659.30	--	5.30	--	--	--	16,251	0.373	41,639	0.956

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



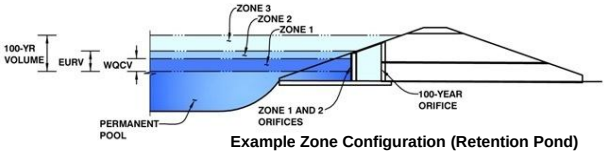


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Webster Elementary**

Basin ID: **South Pond**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.99	0.113	Orifice Plate
Zone 2 (EURV)	3.20	0.214	Orifice Plate
Zone 3 (100-year)	4.28	0.283	Weir&Pipe (Restrict)
Total (all zones)		0.611	

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 =	3.20	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	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	0.80	1.60	2.40				
Orifice Area (sq. inches)	0.44	0.79	0.79	0.79				

	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			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

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			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.20	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.20	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	2.92	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	9.20	N/A	
Horiz. Length of Weir Sides =	2.92	N/A	feet	Overflow Grate Open Area w/o Debris =	8.13	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	4.06	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			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 Orifice Area =	0.88	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.43	N/A	feet
Restrictor Plate Height Above Pipe Invert =	9.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.57	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.30	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.80	feet
Spillway Crest Length =	5.00	feet	Stage at Top of Freeboard =	6.10	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.37	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.96	acre-ft

Calculated Parameters for Spillway

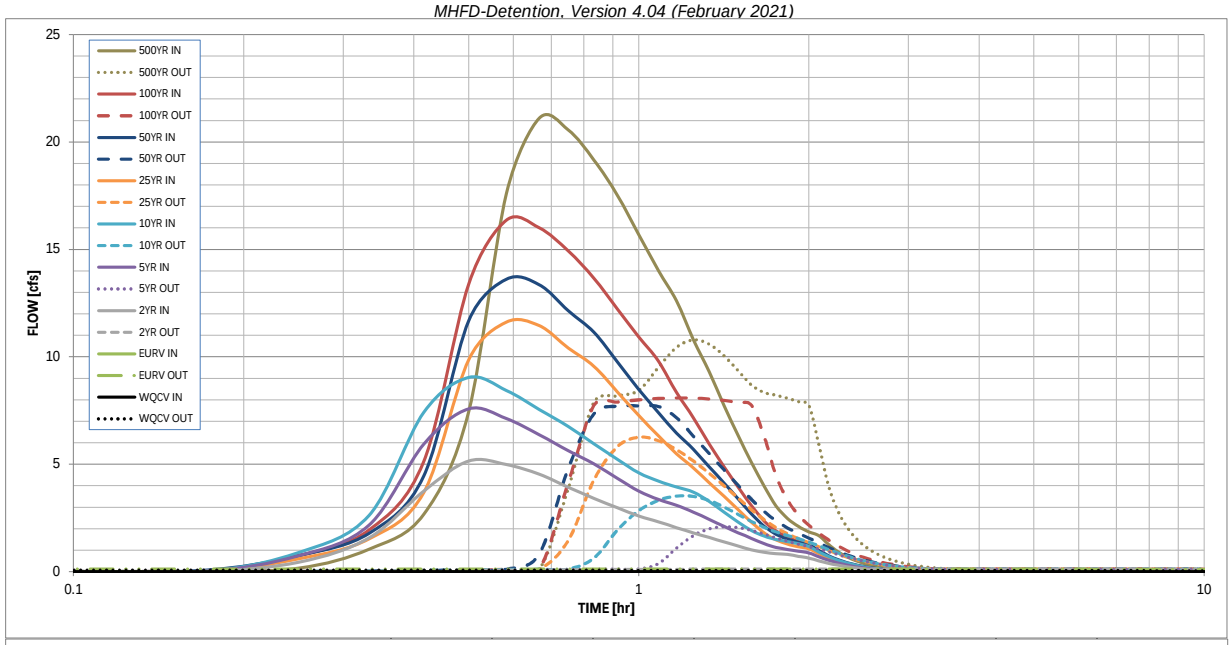
Routed Hydrograph Results

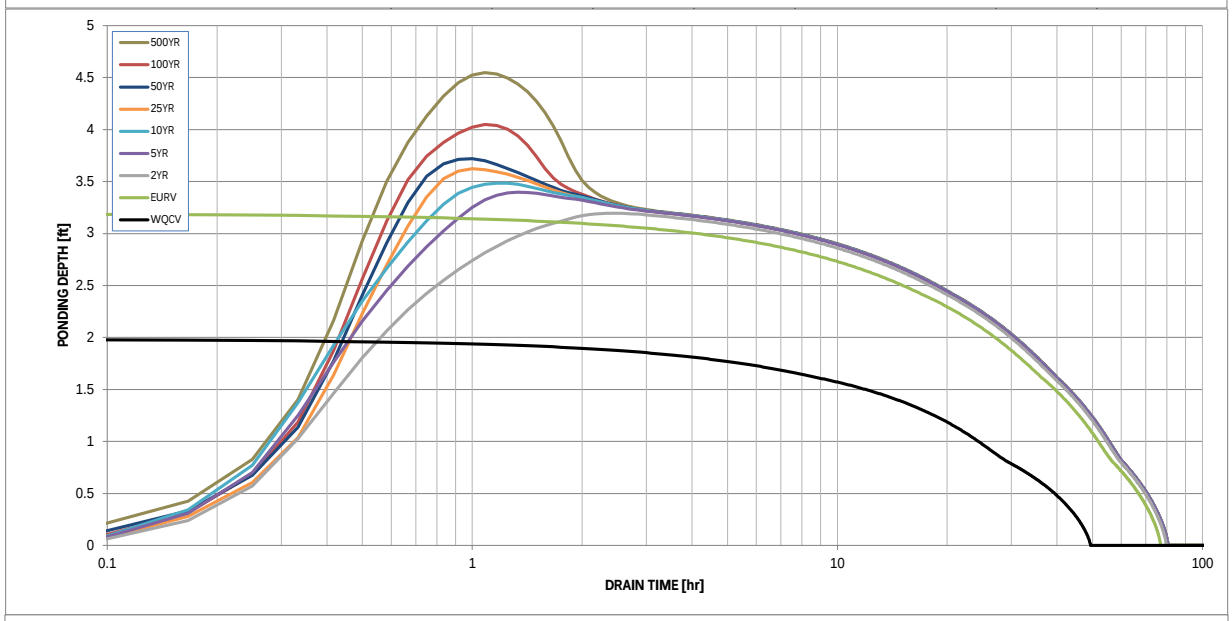
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

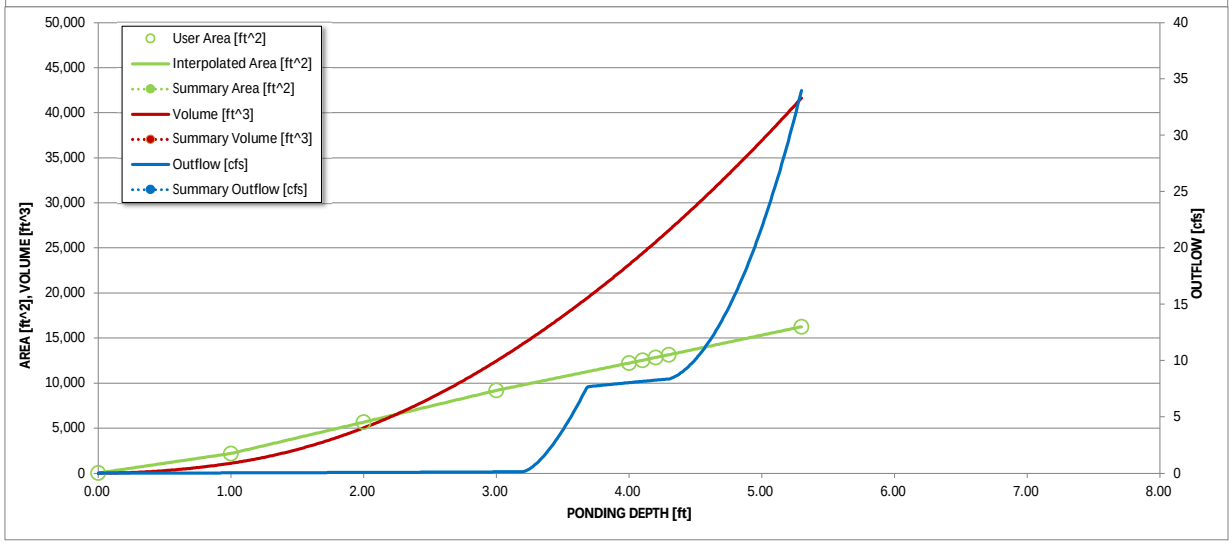
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.55	3.14
CUHP Runoff Volume (acre-ft) =	0.113	0.327	0.349	0.508	0.628	0.784	0.921	1.106	1.438
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.349	0.508	0.628	0.784	0.921	1.106	1.438
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.0	2.3	3.2	5.1	6.3	8.2	11.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.16	0.35	0.48	0.79	0.97	1.26	1.71
Peak Inflow Q (cfs) =	N/A	N/A	5.2	7.6	9.0	11.6	13.6	16.4	21.1
Peak Outflow Q (cfs) =	0.1	0.1	0.1	2.1	3.5	6.3	7.7	8.1	10.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.9	1.1	1.2	1.2	1.0	1.0
Structure Controlling Flow =	Plate	Overflow Weir 1	Overflow Weir 1	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	0.2	0.4	0.7	0.9	1.0	1.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	43	63	65	61	59	56	55	52	49
Time to Drain 99% of Inflow Volume (hours) =	**47**	71	73	72	71	69	68	66	62
Maximum Ponding Depth (ft) =	1.99	3.20	3.20	3.40	3.48	3.62	3.72	4.05	4.55
Area at Maximum Ponding Depth (acres) =	0.13	0.22	0.22	0.24	0.24	0.25	0.26	0.28	0.32
Maximum Volume Stored (acre-ft) =	0.114	0.329	0.327	0.373	0.395	0.430	0.453	0.543	0.693

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.16
	0:15:00	0.00	0.00	0.44	0.74	0.89	0.60	0.75	0.75	1.05
	0:20:00	0.00	0.00	1.58	2.17	2.63	1.54	1.79	1.95	2.67
	0:25:00	0.00	0.00	3.76	5.94	7.42	3.69	4.46	5.14	7.45
	0:30:00	0.00	0.00	5.16	7.58	9.04	9.87	11.69	13.39	17.59
	0:35:00	0.00	0.00	4.98	7.13	8.44	11.62	13.61	16.36	21.11
	0:40:00	0.00	0.00	4.54	6.37	7.55	11.45	13.36	16.00	20.57
	0:45:00	0.00	0.00	3.93	5.63	6.76	10.42	12.14	14.93	19.16
	0:50:00	0.00	0.00	3.41	5.01	5.95	9.56	11.14	13.66	17.52
	0:55:00	0.00	0.00	2.97	4.34	5.23	8.37	9.76	12.23	15.69
	1:00:00	0.00	0.00	2.59	3.75	4.60	7.26	8.49	10.92	14.01
	1:05:00	0.00	0.00	2.32	3.36	4.21	6.32	7.40	9.80	12.61
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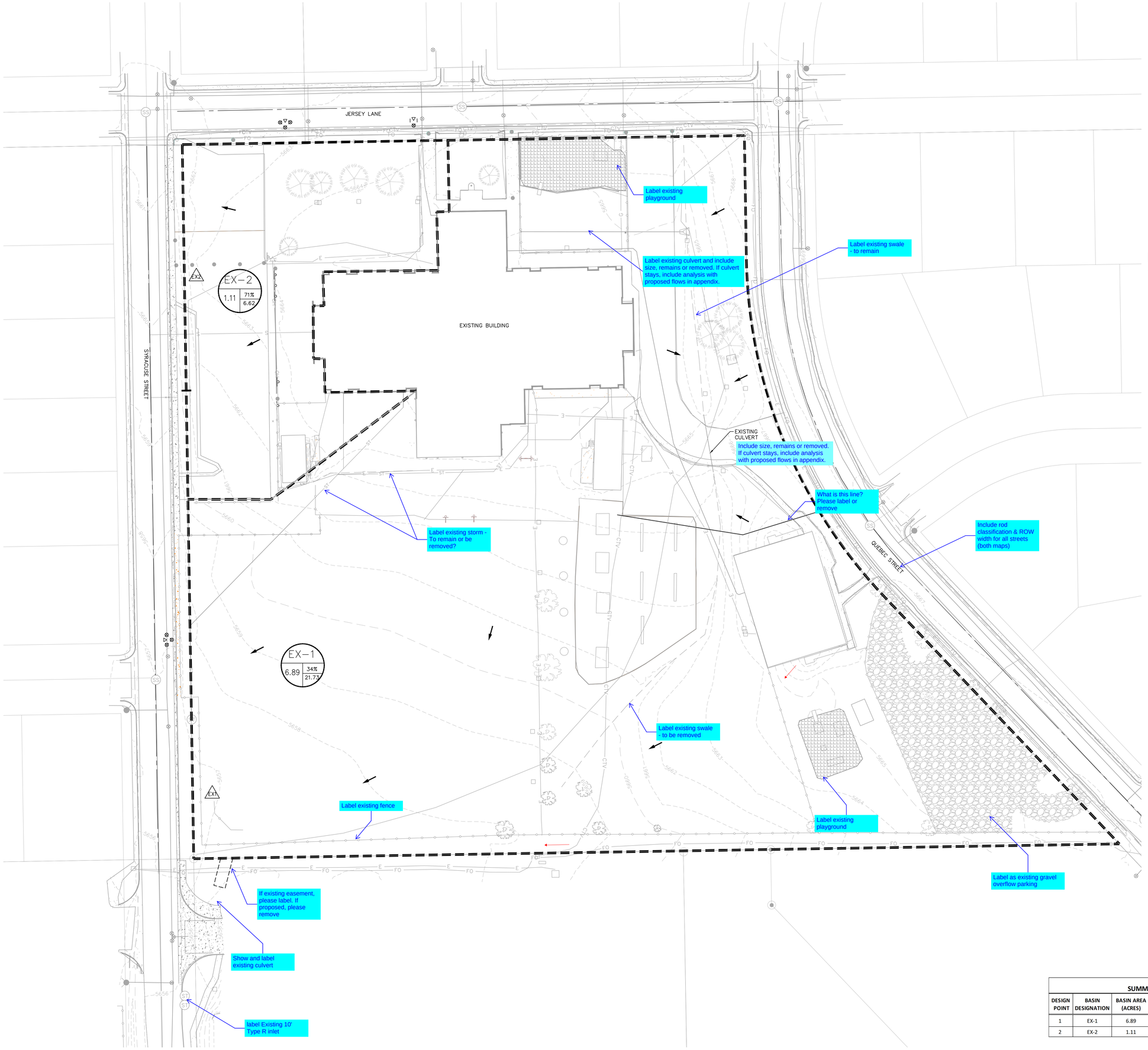
APPENDIX D: DRAINAGE MAPS



LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = 100-YR COMPOSITE RUNOFF COEFFICIENT
D = 100-YR DESIGN STORM RUNOFF (CFS)

DESIGN POINT
FLOW DIRECTION
DRAINAGE BASIN BOUNDARY
PROPERTY LINE
PROPOSED MAJOR CONTOUR
PROPOSED MINOR CONTOUR
EXISTING MAJOR CONTOUR
EXISTING MAJOR CONTOUR

Include all hatchings & linetypes in legend

NOTES

1. THESE DETAILED PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION. SAID DETAILED PLANS AND SPECIFICATIONS HAVE BEEN PREPARED ACCORDING TO THE ESTABLISHED CRITERIA FOR DETAILED DRAINAGE PLANS AND SPECIFICATIONS, AND SAID DETAILED PLANS AND SPECIFICATIONS ARE IN CONFORMITY WITH THE MASTER PLAN OF THE DRAINAGE BASIN. SAID DETAILED DRAINAGE PLANS AND SPECIFICATIONS MEET THE PURPOSES FOR WHICH THE PARTICULAR DRAINAGE FACILITY(S) IS DESIGNED. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY ANY NEGLIGENT ACTS, ERRORS OR COMMISSIONS ON MY PART IN PREPARATION OF THE DETAILED DRAINAGE PLANS AND SPECIFICATIONS.
2. PLAN REVIEW BY EL PASO COUNTY IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH DESIGN CRITERIA. EL PASO COUNTY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. EL PASO COUNTY, THROUGH APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

Label all adjacent property owners (both maps)

Label all high and low points

Label all existing buildings

Include hatching for concrete and asphalt on-site areas

Label all sidewalks, c&g (ramp or vertical), cross pans, etc

SUMMARY - EXISTING RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)
1	EX-1	6.89	8.19	21.73	8.19	21.73
2	EX-2	1.11	3.38	6.62	3.38	6.62

LKA PARTNERS INCORPORATED
A Professional Corporation for Architecture and Planning
430 North Tejon Street Suite 208
Colorado Springs Colorado 80903
tele: 719.473.8446 fax: 719.473.8448
web: www.lkapartners.com

Kimley»Horn
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4582 SOUTH ULSTER STREET, SUITE 1500
COLORADO SPRINGS, COLORADO 80903 (719) 453-0180

Webster Elementary School Addition and Alterations

445 Jersey Lane, Colorado Springs, CO 80911

Widefield School District 3
1820 Main Street
Colorado Springs, CO. 80911

WIDEFIELD SCHOOL DISTRICT 3
PRIDE. TRADITION. INNOVATION.

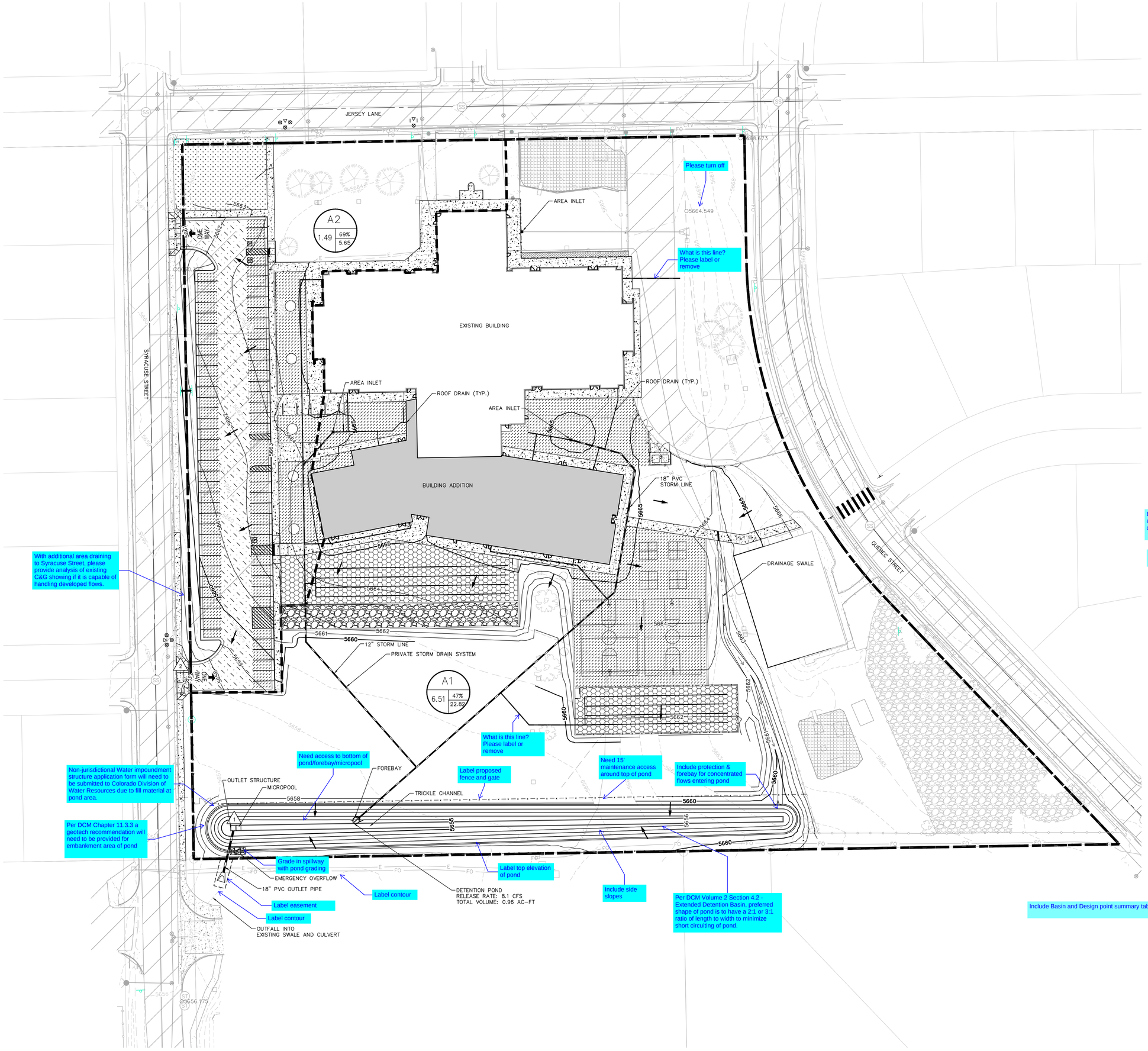
Construction Documents

Drawn:	JAR
Checked:	EJG
Issued:	11 January 2022
Revised:	

Area Key Plan

Existing Drainage Map

Project No. 21-003
The LKA Partners Incorporated



LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = 100-YR COMPOSITE RUNOFF COEFFICIENT
D = 100-YR DESIGN STORM RUNOFF (CFS)

DESIGN POINT
FLOW DIRECTION
DRAINAGE BASIN BOUNDARY
PROPERTY LINE
PROPOSED MAJOR CONTOUR
PROPOSED MINOR CONTOUR
EXISTING MAJOR CONTOUR
EXISTING MAJOR CONTOUR

Include all hatchings & linetypes in legend

NOTES

1. THESE DETAILED PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION. SAID DETAILED PLANS AND SPECIFICATIONS HAVE BEEN PREPARED ACCORDING TO THE ESTABLISHED CRITERIA FOR DETAILED DRAINAGE PLANS AND SPECIFICATIONS, AND SAID DETAILED PLANS AND SPECIFICATIONS ARE IN CONFORMITY WITH THE MASTER PLAN OF THE DRAINAGE BASIN. SAID DETAILED DRAINAGE PLANS AND SPECIFICATIONS MEET THE PURPOSES FOR WHICH THE PARTICULAR DRAINAGE FACILITY(S) IS DESIGNED. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY ANY NEGLIGENT ACTS, ERRORS OR COMMISSIONS ON MY PART IN PREPARATION OF THE DETAILED DRAINAGE PLANS AND SPECIFICATIONS.
2. PLAN REVIEW BY EL PASO COUNTY IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH DESIGN CRITERIA. EL PASO COUNTY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. EL PASO COUNTY, THROUGH APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.
3. PLEASE SEE THE FINAL DRAINAGE REPORT FOR THIS WEBSTER ELEMENTARY FOR PROPOSED 5 AND 100 YEAR FLOW VALUES.

Label all existing facilities (C&G, culverts, inlets, cross pans, etc)

Each location of accepted flow (culvert, inlet, etc) should be an individual basin with a design point. Please add additional basins.

Include size and material of all inlets, pipes, etc

Include Basin and Design point summary tables

NORTH

GRAPHIC SCALE IN FEET
0 15 30 60

LKA PARTNERS INCORPORATED
A Professional Corporation for Architecture and Planning
430 North Tejon Street Suite 208
Colorado Springs Colorado 80903
tele: 719.473.8446 fax: 719.473.8448
web: www.lkapartners.com

Kimley»Horn
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2 NORTH NEVADA AVENUE, SUITE 900
COLORADO SPRINGS, COLORADO 80903 (719) 453-0180

Webster Elementary School Addition and Alterations

445 Jersey Lane, Colorado Springs, CO 80911

Widefield School District 3
1820 Main Street
Colorado Springs, CO. 80911

WIDEFIELD SCHOOL DISTRICT 3
PRIDE. TRADITION. INNOVATION.

Construction Documents

Drawn:	JAR
Checked:	EJG
Issued:	11 January 2022
Revised:	

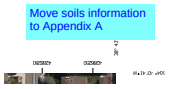
Area Key Plan

Proposed Drainage Map

Project No. 21-003
The LKA Partners Incorporated

ENG-PPR22009-R1_Drainage Report.pdf Markup Summary

CDurham (66)



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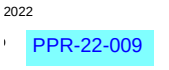
Move soils information to Appendix A



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PPR-22-009

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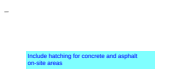
Include all hatchings & linetypes in legend



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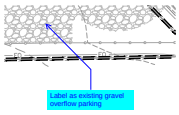
Include hatching for concrete and asphalt on-site areas



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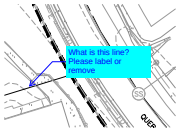
Label as existing gravel overflow parking



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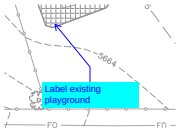
Label all sidewalks, c&g (ramp or vertical), cross pans, etc



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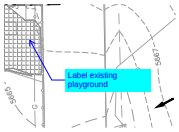
Label existing playground



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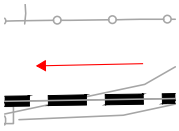
Label existing playground



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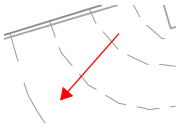

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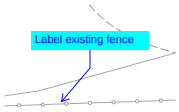

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Label existing fence

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Author: CDurham
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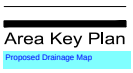
Existing Drainage Map



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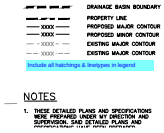
Proposed Drainage Map



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Include all hatchings & linetypes in legend

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Author: CDurham
Date: 3/14/2022 10:09:00 AM
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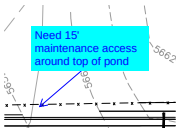
Include Basin and Design point summary tables



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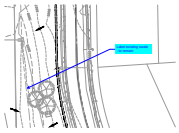
Need 15' maintenance access around top of pond



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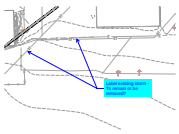
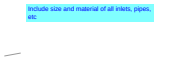
Page Label: [1] Existing Drainage Map
Author: CDurham
Date: 3/14/2022 10:13:28 AM
Status:
Color:
Layer:
Space:

Label existing swale - to remain



Subject: Callout
Page Label: [1] Existing Drainage Map
Author: CDurham
Date: 3/14/2022 10:14:30 AM
Status:
Color:
Layer:
Space:

Label existing storm - To remain or be removed?



Subject: Text Box
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 10:16:35 AM
Status:
Color:
Layer:
Space:

Include size and material of all inlets, pipes, etc

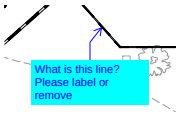
Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 10:18:43 AM
Status:
Color:
Layer:
Space:

Include protection & forebay for concentrated flows entering pond

---

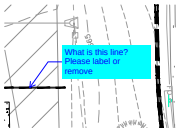
Subject: Text Box
Page Label: 32
Author: CDurham
Date: 3/14/2022 10:19:20 AM
Status:
Color:
Layer:
Space:

Include design for pond forebays



Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 10:20:53 AM
Status:
Color:
Layer:
Space:

What is this line? Please label or remove

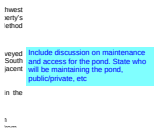


Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 10:21:23 AM
Status:
Color:
Layer:
Space:

What is this line? Please label or remove

Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 10:21:41 AM
Status:
Color:
Layer:
Space:

Please turn off



Subject: Text Box
Page Label: 8
Author: CDurham
Date: 3/14/2022 10:55:26 AM
Status:
Color:
Layer:
Space:

Include discussion on maintenance and access for the pond. State who will be maintaining the pond, public/private, etc

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Subject: Text Box
Page Label: 8
Author: CDurham
Date: 3/14/2022 10:55:49 AM
Status:
Color:
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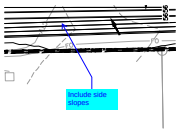
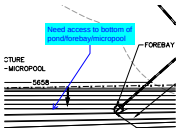
Space:

O&M Manual will need to be provided for pond.



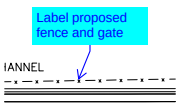
Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 2:44:09 PM
Status:
Color:
Layer:
Space:

Include side slopes



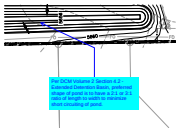
Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 2:44:22 PM
Status:
Color:
Layer:
Space:

Need access to bottom of pond/forebay/micropool



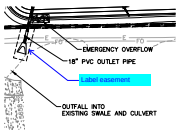
Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 2:47:11 PM
Status:
Color:
Layer:
Space:

Label proposed fence and gate



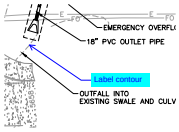
Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 2:59:58 PM
Status:
Color:
Layer:
Space:

Per DCM Volume 2 Section 4.2 - Extended Detention Basin, preferred shape of pond is to have a 2:1 or 3:1 ratio of length to width to minimize short circuiting of pond.



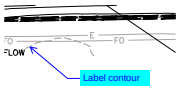
Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 3:07:46 PM
Status:
Color:
Layer:
Space:

Label easement



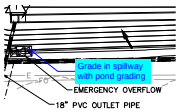
Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 3:08:15 PM
Status:
Color:
Layer:
Space:

Label contour



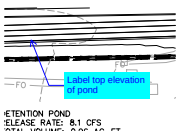
Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 3:08:27 PM
Status:
Color:
Layer:
Space:

Label contour



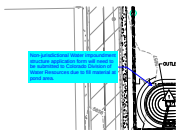
Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 3:09:13 PM
Status:
Color:
Layer:
Space:

Grade in spillway with pond grading



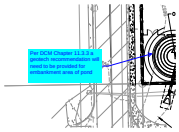
Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 3:09:44 PM
Status:
Color:
Layer:
Space:

Label top elevation of pond



Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 3:13:29 PM
Status:
Color:
Layer:
Space:

Non-jurisdictional Water impoundment structure application form will need to be submitted to Colorado Division of Water Resources due to fill material at pond area.



Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 3:13:43 PM
Status:
Color:
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Per DCM Chapter 11.3.3 a geotech recommendation will need to be provided for embankment area of pond

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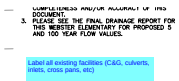
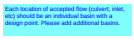


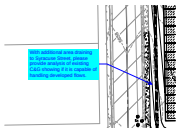
Subject: Text Box
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 3:42:01 PM
Status:
Color:
Layer:
Space:

Label all existing facilities (C&G, culverts, inlets, cross pans, etc)



Subject: Text Box
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 3:42:12 PM
Status:
Color:
Layer:
Space:

Each location of accepted flow (culvert, inlet, etc) should be an individual basin with a design point. Please add additional basins.



Subject: Callout
Page Label: [1] Proposed Drainage Map
Author: CDurham
Date: 3/14/2022 3:49:33 PM
Status:
Color:
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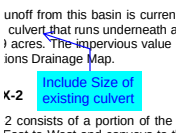
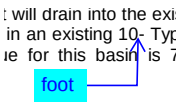
Space:

With additional area draining to Syracuse Street, please provide analysis of existing C&G showing if it is capable of handling developed flows.



Subject: Callout
Page Label: 5
Author: CDurham
Date: 3/14/2022 9:09:30 AM
Status:
Color:
Layer:
Space:

Include Size of existing culvert



Subject: Callout
Page Label: 5
Author: CDurham
Date: 3/14/2022 9:10:14 AM
Status:
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foot

Subject: Callout
Page Label: 5
Author: CDurham
Date: 3/14/2022 9:13:25 AM
Status:
Color:
Layer:
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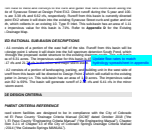
Map and spreadsheet shows 6.51 acres & 47% imperviousness. Please update accordingly to correct values.



Subject: Callout
Page Label: 5
Author: CDurham
Date: 3/14/2022 9:14:45 AM
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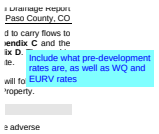
Update flow rates to match hydrology spreadsheet in appendix



Subject: Text Box
Page Label: 7
Author: CDurham
Date: 3/14/2022 9:26:19 AM
Status:
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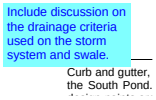
Space:

Include what pre-development rates are, as well as WQ and EURV rates

---



Subject: Text Box
Page Label: 7
Author: CDurham
Date: 3/14/2022 9:31:07 AM
Status:
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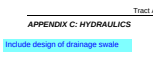
Space:

Include discussion on the drainage criteria used on the storm system and swale.



Subject: Text Box
Page Label: 32
Author: CDurham
Date: 3/14/2022 9:31:40 AM
Status:
Color:
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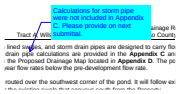
Space:

Include design of drainage swale



Subject: Callout
Page Label: 7
Author: CDurham
Date: 3/14/2022 9:33:30 AM
Status:
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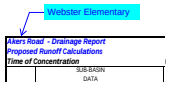
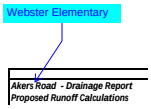
Calculations for storm pipe were not included in Appendix C. Please provide on next submittal.



Subject: Callout
Page Label: 26
Author: CDurham
Date: 3/14/2022 9:36:30 AM
Status:
Color:
Layer:
Space:

Webster Elementary



Subject: Callout
Page Label: 27
Author: CDurham
Date: 3/14/2022 9:36:44 AM
Status:
Color:
Layer:
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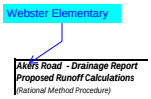
Webster Elementary



Subject: Callout
Page Label: 28
Author: CDurham
Date: 3/14/2022 9:36:58 AM
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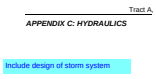
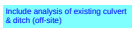
Color:
Layer:
Space:

Webster Elementary



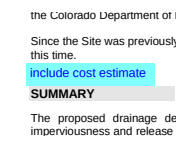
Subject: Text Box
Page Label: 32
Author: CDurham
Date: 3/14/2022 9:37:21 AM
Status:
Color:
Layer:
Space:

Include design of storm system



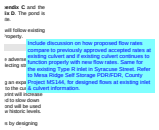
Subject: Text Box
Page Label: 32
Author: CDurham
Date: 3/14/2022 9:37:59 AM
Status:
Color:
Layer:
Space:

Include analysis of existing culvert & ditch (off-site)



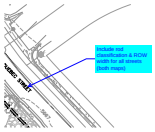
Subject: Text Box
Page Label: 8
Author: CDurham
Date: 3/14/2022 9:40:08 AM
Status:
Color:
Layer:
Space:

include cost estimate



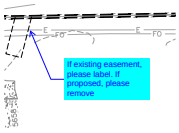
Subject: Text Box
Page Label: 7
Author: CDurham
Date: 3/14/2022 9:41:48 AM
Status:
Color:
Layer:
Space:

Include discussion on how proposed flow rates compare to previously approved accepted rates at existing culvert and if existing culvert continues to function properly with new flow rates. Same for the existing Type R inlet in Syracuse Street. Refer to Mesa Ridge Self Storage PDR/FDR, County Project MS144, for designed flows at existing inlet & culvert information.



Subject: Callout
Page Label: [1] Existing Drainage Map
Author: CDurham
Date: 3/14/2022 9:52:24 AM
Status:
Color:
Layer:
Space:

Include rod classification & ROW width for all streets (both maps)



Subject: Callout
Page Label: [1] Existing Drainage Map
Author: CDurham
Date: 3/14/2022 9:53:07 AM
Status:
Color:
Layer:
Space:

If existing easement, please label. If proposed, please remove

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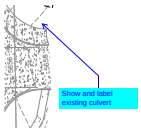
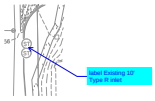


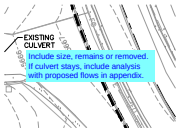
Subject: Callout
Page Label: [1] Existing Drainage Map
Author: CDurham
Date: 3/14/2022 9:54:04 AM
Status:
Color:
Layer:
Space:

Show and label existing culvert



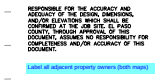
Subject: Callout
Page Label: [1] Existing Drainage Map
Author: CDurham
Date: 3/14/2022 9:54:23 AM
Status:
Color:
Layer:
Space:

label Existing 10' Type R inlet



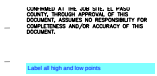
Subject: Text Box
Page Label: [1] Existing Drainage Map
Author: CDurham
Date: 3/14/2022 9:55:52 AM
Status:
Color:
Layer:
Space:

Include size, remains or removed. If culvert stays, include analysis with proposed flows in appendix.



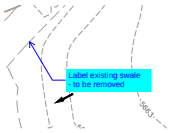
Subject: Text Box
Page Label: [1] Existing Drainage Map
Author: CDurham
Date: 3/14/2022 9:56:46 AM
Status:
Color:
Layer:
Space:

Label all adjacent property owners (both maps)



Subject: Text Box
Page Label: [1] Existing Drainage Map
Author: CDurham
Date: 3/14/2022 9:57:06 AM
Status:
Color:
Layer:
Space:

Label all high and low points

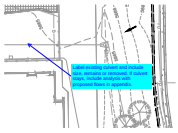


Subject: Callout
Page Label: [1] Existing Drainage Map
Author: CDurham
Date: 3/14/2022 9:57:34 AM
Status:
Color:
Layer:
Space:

Label existing swale - to be removed

Subject: Text Box
Page Label: [1] Existing Drainage Map
Author: CDurham
Date: 3/14/2022 9:57:56 AM
Status:
Color:
Layer:
Space:

Label all existing buildings



Subject: Callout
Page Label: [1] Existing Drainage Map
Author: CDurham
Date: 3/14/2022 9:59:05 AM
Status:
Color:
Layer:
Space:

Label existing culvert and include size, remains or removed. If culvert stays, include analysis with proposed flows in appendix.