Hydraulics and Hydrology Memorandum

Date:	June 2, 2023
Project:	Monument Academy Recirculation Project
To:	Monument Academy
Cc:	Alissa Werre, PE, El Paso County; Cory Beasley, PE, HDR
From:	Elizabeth Staten, PE, HDR
Subject:	**Hydrologic Analysis and Hydraulic Assessment**

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 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.

Elizabeth Staten, P.E. #38974 — Date: 6/28/2023

COLORADO LICENSED
ELIZABETH STATEN
38974
06/28/2023
PROFESSIONAL ENGINEER

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.

_____ _____

Name, Title Date

Business Name:

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.

_____ _____

County Engineer / ECM Administrator Date

Conditions:

1 Introduction

The purpose of this technical memorandum is to present a hydrologic analysis and hydraulic assessment for the Monument Academy Recirculation Project (Project) in El Paso County, Colorado. The Project aims to redirect or capture stormwater runoff flows from new impervious surfaces with minimal changes in hydraulic conditions.

The Project will add two, paved, private, internal roads to improve circulation of traffic on Monument Academy's property in El Paso County, CO. It also includes modular block walls, private storm system additions, and landscaping modifications.

Figure 1: Vicinity Map

1.1 Location

The Project is at the Monument Academy West Campus located just outside the limits of the Town of Monument, El Paso County CO. The Project is in the NW ¼, Section 13, Township 11S, Range 67W. The project site is located north of Highway 105, and east of Knollwood Drive, and is accessed from Knollwood Drive by turning east on Village Ridge Point. The subject property is in Knollwood Village Filing No. 2, and neighboring properties are either in the same development, or in Harmon Hills Filing No. 1 to the north.

1.2 Description of Property

The project site on Monument Academy private property (MA Property) is in a mixed-use suburban area northeast of Monument, Colorado. The MA Property is bounded by Highway 105

on the south and encompasses a segment of Dirty Woman Creek on the north. The property includes 15.4 acres, though approximately seven acres is considered a “No-Build” Area for habitat conservation and floodplain preservation.

The developed area of the site includes the school building, private internal roads, parking areas, a playground, and an athletic field. Undeveloped areas include upland hills forested with deciduous and evergreen trees, and lowland plains near the creek with grassland and wetland vegetation. An NRCS Soil Report shows two types of soils in the vicinity. Loams and clay loams (with 1-3% slopes) are found along Dirty Woman Creek and its floodplain. Upland areas are expected to be loamy sands or coarse sands (with 3-8% slopes). See Appendix C.

The MA Property generally drains from the southeast to northwest with stormwater runoff flowing overland to Dirty Woman Creek. Dirty Woman Creek runs through the northern part of the property and remains north of the project site area. No other major drainageways cross through the MA Property.

1.3 Basin Descriptions

The MA Property is in the Dirty Woman Creek Drainage Basin. The 1993 Drainage Basin Planning Study for Dirty Woman Creek provides recommendations for the basin including upsizing culverts both upstream and downstream of the MA Property. The recommendations do not affect the project site, as it does not contain the creek.

Dirty Woman Creek includes FEMA mapped special flood hazard areas. The 100-year floodplain is outside the project perimeter as shown in Flood Insurance Rate Map (FIRM) Map Number 08041C0276G, December 7, 2018, and Map Number 08041C0278G, December 7, 2018. This project does not cause impacts to the neighboring floodplain.

Tributary basin areas consist primarily of the project site itself and the undeveloped hillside to the east. A one-third acre portion of the neighboring property to the east represents the only offsite flow. Highway 105 located along the southern edge of the project intercepts stormwater runoff flow from the south before it reaches the project. Stormwater runoff from the developed areas is collected along the existing internal road curb and gutter, and at several low point inlets around the property. The runoff is then routed through the Monument Academy private stormwater network prior to outfalling on the northwest side of the developed area and flowing to Dirty Woman Creek. Runoff from the northern and western portions of the property sheet flows directly to Dirty Woman Creek.

2 Design Criteria

The Monument Academy project has elected to obtain construction permitting through the Colorado Department of Public Safety. Design standards for the project are not specific with respect to hydrology and hydraulics criteria since El Paso County is not the permitting body. El Paso County’s Engineering Criteria and Drainage Criteria Manuals were referenced for guidelines as well as design criteria published by Colorado Department of Transportation (CDOT), and Mile High Flood District (MHFD).

2.1 Four Step Process

Considerations were taken to reduce the impacts of the additional impervious area associated with the project.

1. Runoff reduction practices were incorporated by limiting the additions to the existing private stormwater network. The proposed internal road at the back of school drains to swales and sheet flows to the existing open field rather than to a network of inlets and pipes.
2. Stabilization of drainageways is achieved through soil riprap outlet protection near the wetlands area, and riprap lined channels on steeper slopes.
3. Permanent Water Quality requirements are achieved through runoff reduction. Calculations are evidenced in Appendix F. Receiving pervious areas for infiltration are in the existing No-Build easement on the MA Property.
4. Industrial and commercial source control BMPs are not required for this project.

2.2 Hydrology

A hydrologic analysis using the rational method was performed to determine the 10-year and 100-year peak flow rates for sizing the stormwater system for the Project.

Precipitation data is developed in accordance with Colorado Dept. of Transportation (CDOT) and Mile High Flood District (MHFD) criteria and uses NOAA Atlas 14 guidance. An Intensity Duration Frequency (IDF) curve (Figure 2) was developed for Monument to define the rainfall intensity.

Sub-basins are typically less than one acre in size. The minimum time of concentration of five minutes was used for all basins for a conservative approach. The project area comprises multiple land uses with impervious surface areas, constructed outdoor spaces, undeveloped areas, and combinations thereof.

Drainage Basin maps, NRCS soil maps, and rational method calculations are located in the Appendices. A summary is provided in the table below.

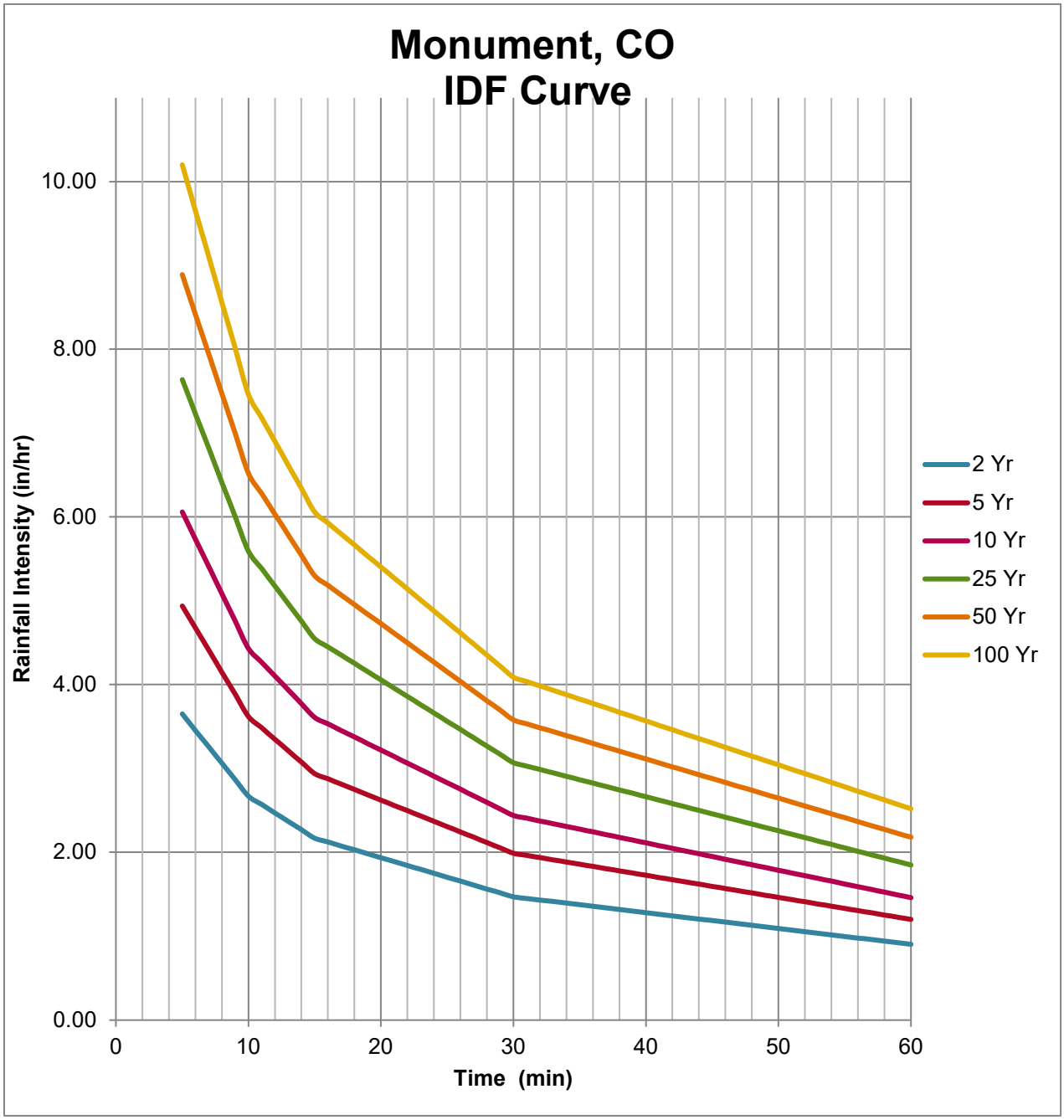


Figure 2: IDF curve

Table 1. Proposed Basins Hydrology

Basin ID	**Area (ac)**	**C10**	**Q10 (cfs)**	**C100**	**Q100 (cfs)**
A-0	0.31	0.62	1.2	0.75	2.4
A-1	0.75	0.81	3.7	0.88	6.8
A-EX-2	0.35	0.74	1.6	0.81	2.9
A- EX-3	0.32	0.92	1.8	0.96	3.1
A-4	0.52	0.58	1.9	0.70	3.7
A-5	1.59	0.61	5.9	0.74	12.0
A-6	0.42	0.86	2.2	0.90	3.9
A- EX-7	0.57	0.92	3.2	0.96	5.6
A-8	0.25	0.38	0.6	0.58	1.5
A-9	1.05	0.41	2.6	0.60	6.4
A-10	0.34	0.39	0.8	0.58	2.0
A-11	1.09	0.72	4.8	0.81	9.0

2.3 Related Projects

Improvement projects continue to evolve localized drainage patterns in and around the project area. Recent changes include a project to widen Highway 105 south of the MA Property. The Highway 105 project will incorporate a new retaining wall between the MA Property and Highway 105 reducing the total tributary area draining north to the school's stormwater network. The changed area instead sends the runoff flow to the Highway 105 stormwater network, which outfalls to Dirty Woman Creek approximately 2000 feet downstream of the MA Property.

2.4 Environmental Features

Most of the project site is located near the banks of Dirty Woman Creek, which flows through the northern portion of this 15-acre property. The project site limits are approximately 100-feet from Dirty Woman Creek, and approximately 50-feet outside the limits of the FEMA 100-year floodplain boundary. Riparian vegetation blankets the land between the developed areas of the property and the creek. The area along this portion of Dirty Woman Creek has been designated as non-critical habitat area for the Preble's Meadow Jumping Mouse. Wetland areas are also located in the vicinity of the project. These features are notated on the project's plan sheets.

3 Drainage Design

The existing stormwater system was analyzed to verify that changes in flow to this system do not result in an adverse impact. It is expected that the existing stormwater network will remain in place unless shown otherwise in the plan documents.

3.1 Existing Conditions

The Monument Academy existing drainage network captures stormwater runoff in the existing internal roads' curb inlets and in local grate inlets along the front of the school. Flow is then conveyed north and west to the 24-inch pipe outfall location behind the school. The stormwater system is a private network and is not connected to other stormwater systems. Analysis of the

existing system includes 0.3 acres of tributary area that will be allotted to the Highway 105 storm system when the neighboring project constructs a new retaining wall.

Stormwater runoff from the school building is collected in a series of downspouts from the roof and piped to the open field areas northwest of the building. Stormwater runoff from the hills, offsite area, and play areas north of the building flows overland or collects in shallow ditches then discharges to the same open field which is tributary to Dirty Woman Creek.

An outfall for an 18-inch pipe is located onsite west of the playground area. The source of flow for the pipe was unable to be confirmed with the site survey or a field visit. Conversations with Monument Academy were also unable to confirm the source. It is assumed the outfall pipe drains groundwater from underneath the playground and should be protected or extended.

3.2 Proposed Conditions

Replacement or protection of existing storm systems is as directed by Monument Academy. The proposed system additions serve to collect stormwater flows from the proposed internal roadways, extend the existing pipe outfalls due to proposed internal roadway reconfiguration, and to convey concentrated runoff to inlets or ditches.

Basin A-0 to LINE 100 – A new inlet upstream of the pedestrian crossing will collect stormwater runoff from the proposed internal road in front of the school, then pipe flows to the existing private stormwater network.

Basins A-1, A-5, and A-6 to Existing – The basin areas are reduced from existing condition as some of the stormwater runoff is now intercepted upstream in Basin A-0 with the new proposed internal road in front of the school. Inlets along the existing internal road will be protected in place.

Basin A-EX-2 to LINE 102 – Inlets in front of the school will be protected in place. The 24-inch outfall pipe for the school's private storm network will be extended to accommodate for the proposed internal road behind the school. Total flows through the existing storm network are decreased in proposed condition due to the reduction in total area from the adjacent Highway 105 project. An outfall stilling basin is proposed to dissipate energy, reduce flow velocities, and reduce erosion potential.

Figure 3: Looking West

Basin A-4 to Underdrain –
In existing condition, the playground and sand play area north of the building drain from east to west overland or through the sandy subgrade below the sidewalk. In proposed condition, the flow path is impeded by the proposed internal road behind the school, which is several inches higher than the sand area. An underdrain is proposed along the western edge of the basin to promote infiltration of stormwater. The underdrain will outfall west of the proposed internal road behind the school.

LINE 104 – The 18-inch outfall pipe near the playground area will be extended to route flows under the proposed internal road behind the school.

Basin A-EX-3 and A-EX-7 to Existing – Downspouts and existing outfalls from the building roofs to the front and back of school will be protected in place.

Basin A-8 to LINE 108 – A new crossing culvert is proposed to drain the infield area between the playground and athletic field. The culvert will outfall west of the proposed internal road behind the school.

Basin A-9 to V-DITCH 2 – Stormwater runoff from the upland hill areas east of the athletic field will be intercepted by the proposed internal road behind the school and routed north along the curb and gutter flow line. This flow will outfall to a riprap-lined channel which routes the stormwater away from the roadway and west toward the existing open field between the school and Dirty Woman Creek. Riprap calculations are included with Appendix F.

Basin A-10 to V-DITCH 1 – A new grass-lined channel is proposed between the athletic field and modular block retaining wall to route stormwater runoff west. Flows then cross over the proposed internal road behind the school in a gutter pan before continuing west. Runoff flows to an existing grass buffer prior to infiltrating or flowing toward the creek.

Basin A-11 to Existing – Runoff flows from the back of school internal road sheet flow to an existing grass buffer within the no-build area.

A comparison of the existing and proposed tributary flow rates is reflected in Table 2. Increased imperviousness from the internal roads contributes to marginally higher runoff rates, but the effects are mitigated on-site.

- Subtotal A for the stormwater network reflects flows are slightly increased in proposed condition. This is attributable to both the reduction in total area from the adjacent Highway 105 project, and the increased impervious area.
- Subtotal B reflects a reduction in flows consistent with a slight reduction in tributary area in basin A-4.
- Subtotal C reflects an increase in tributary flow in part due to additional tributary area. For the back of school basins, A-8 to A-11, stormwater runoff flows are redistributed within the MA Property between existing and proposed conditions. The remaining increase in flow is associated with imperviousness from the new back of school internal road. Higher flow rates are attenuated by existing grass buffer Receiving Pervious Area (RPA) between the school and the Dirty Woman Creek floodplain. Calculations support the buffer RPA provides sufficient space and time to infiltrate the flow.

Table 2. Tributary Flow Comparison

Outfall	Tributary Existing Basins	Tributary Existing Area (ac)	Tributary Existing Q10 (cfs)	Outfall	Tributary Proposed Basins	Tributary Proposed Area (ac)	Tributary Proposed Q10 (cfs)
Existing Storm Network	--	0.00	0.0	Line 102	A-0	0.31	1.2
	A-EX-1	1.08	4.2		A-1	0.75	3.7
	A-EX-2	0.35	1.6		A-EX-2	0.35	1.6
	A-EX-5	1.79	6.4		A-5	1.59	5.9
	A-EX-6	0.43	2.2		A-6	0.42	2.2
	Subtotal A	**3.65**	**14.34**		**Subtotal A**	**3.43**	**14.48**
Ex. Roof Drains	A-EX-3	0.32	1.8	Ex. Roof Drains	A-EX-3	0.32	1.8
Wetlands	A-EX-4	0.60	2.1	Wetlands	A-4	0.52	1.9
Ex. Roof Drains	A-EX-7	0.57	3.2	Ex. Roof Drains	A-EX-7	0.57	3.2
	Subtotal B	**1.50**	**7.04**		**Subtotal B**	**1.42**	**6.83**
Existing Channel	A-EX-8	0.81	1.5	Line 108 to RPA	A-8	0.25	0.6
Ex. Grass buffer	A-EX-10	0.98	3.9	V-Ditch 1 to RPA	A-10	0.34	0.8
				Ex. Grass buffer (RPA)	A-11	1.09	4.8
Ex. Grass buffer	A-EX-9	0.77	1.6	V-Ditch 2 to RPA	A-9	1.05	2.6
	Subtotal C	**2.56**	**6.95**		**Subtotal C**	**2.74**	**8.75**
Existing	**total**	**7.70**	**28.33**	**Proposed**	**total**	**7.58**	**30.06**

Calculations for flow routing through the proposed stormwater network were performed in Bentley InRoads and are presented in summary form in the tables below. Four pipes are shown with zero flow reported. The source of flow for Line 104, which includes P-EX-19 and P-104 was undetermined as previously discussed. Pipes P-EX-11 and P-EX-17 are within basin A-EX-2 which includes four inlet points. Flow for the entire basin was routed through other points in the storm network. Additional information is shown in a detailed report in Appendix F. Calculations support that the private stormwater system is not adversely affected by the changes associated with this project.

Table 3. InRoads Pipe Data

						10 – year		
Pipe ID	Material	Dia. (in)	Length (ft)	Slope (%)	Capacity (cfs)	Total Flow (cfs)	Velocity (ft/s)	Flow Depth (ft)
P-101	RCP	18	39.4	4.5	22.3	0.9	6.2	0.21
P-102	RCP	24	20.5	1.0	22.6	13.1	7.5	1.09
P-104	RCP	18	20.8	5.7	25.1	0.0	0.0	0.0
P-108	RCP	18	61.5	4.8	23.1	0.6	5.5	0.16

						10 – year		
Pipe ID	Material	Dia. (in)	Length (ft)	Slope (%)	Capacity (cfs)	Total Flow (cfs)	Velocity (ft/s)	Flow Depth (ft)
P-EX-1	RCP	24	45.9	0.5	16.0	4.8	4.5	0.75
P-EX-2	RCP	12	18.7	3.0	6.2	0.7	5.2	0.23
P-EX-3	RCP	24	113.1	0.5	16.0	5.4	4.6	0.80
P-EX-4	RCP	24	14.5	0.5	16.0	5.3	4.6	0.79
P-EX-5	RCP	24	20.4	0.5	16.0	5.3	4.6	0.79
P-EX-6	RCP	24	34.8	0.5	16.0	5.3	4.6	0.79
P-EX-7	RCP	12	37.5	16.3	14.4	1.0	10.6	0.18
P-EX-8	RCP	24	45.4	0.5	16.0	6.2	4.8	0.87
P-EX-9	RCP	24	41.1	0.5	16.0	6.2	4.8	0.86
P-EX-10	RCP	24	97.4	0.5	16.0	6.1	4.8	0.86
P-EX-11	RCP	12	29.4	3.8	6.9	0.0	0.0	0.0
P-EX-12	RCP	18	12.8	10.6	34.2	6.4	3.6	1.50
P-EX-13	RCP	24	41.8	0.5	16.0	11.9	5.6	1.29
P-EX-14	RCP	18	64.8	14.8	40.4	1.6	11.1	0.21
P-EX-15	RCP	18	67.8	15.0	40.7	1.6	11.2	0.20
P-EX-16	RCP	24	61.1	1.4	26.8	13.4	8.5	1.00
P-EX-17	RCP	12	30.8	10.0	11.3	0.0	0.0	0.0
P-EX-18	RCP	24	129.8	2.0	32.0	13.3	9.7	0.90
P-EX-19	RCP	18	60.3	2.0	14.9	0.0	0.0	0.0

4 Conclusion

The Monument Academy project will include extensions to the existing drainage system and creation of new drainage swales. Existing flow patterns are maintained and relocated outfalls will be protected with riprap to reduce erosion. The project should not adversely impact downstream facilities or surrounding development.

5 References

A. Colorado Department of Public Health and Environment, MS4 General Permits, https://cdphe.colorado.gov/wq-municipal-ms4-general-permits

B. Colorado Department of Transportation, 2019 Drainage Design Manual, https://www.codot.gov/business/hydraulics/drainage-design-manual

C. Colorado Springs, Drainage Basin Planning Studies, Dirty Woman and Crystal Creek DBPS, https://coloradosprings.gov/dbps

D. El Paso County, Drainage Criteria Manual, Version: Oct. 31, 2018 (Current), https://publicworks.elpasoco.com/stormwater/

E. El Paso County, Engineering Criteria Manual, Version: Oct. 14, 2020 (Current), https://publicworks.elpasoco.com/stormwater/

F. Mile High Flood District, Detention Design – MHFD-Detention v4.04, Feb. 2021, https://mhfd.org/resources/software

G. US Department of Agriculture, NRCS (2021). Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

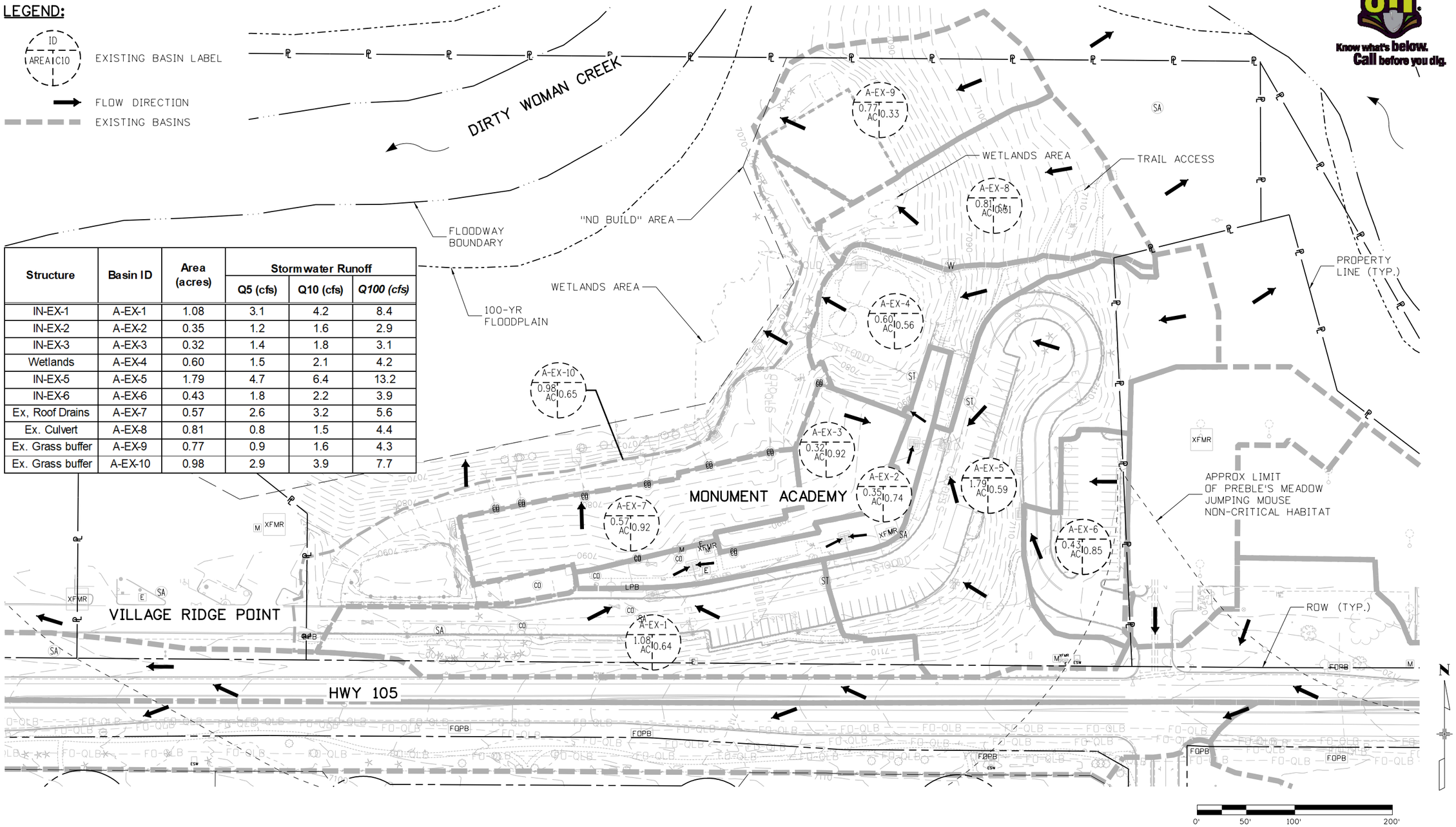
H. US Department of Commerce, NOAA (2021). NOAA Atlas 14: Precipitation-Frequency Atlas of the United States, Volume 8, Version 2. https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

6 Appendices

A. Drainage Basin Maps
B. Historic Plans (2007)
C. Soils Report
D. Floodplain Map
E. Precipitation Data
F. Calculations

Appendix A

Drainage Basin Maps



Structure	Basin ID	Area (acres)	Stormwater Runoff		
			Q5 (cfs)	Q10 (cfs)	*Q100 (cfs)*
IN-EX-1	A-EX-1	1.08	3.1	4.2	8.4
IN-EX-2	A-EX-2	0.35	1.2	1.6	2.9
IN-EX-3	A-EX-3	0.32	1.4	1.8	3.1
Wetlands	A-EX-4	0.60	1.5	2.1	4.2
IN-EX-5	A-EX-5	1.79	4.7	6.4	13.2
IN-EX-6	A-EX-6	0.43	1.8	2.2	3.9
Ex, Roof Drains	A-EX-7	0.57	2.6	3.2	5.6
Ex. Culvert	A-EX-8	0.81	0.8	1.5	4.4
Ex. Grass buffer	A-EX-9	0.77	0.9	1.6	4.3
Ex. Grass buffer	A-EX-10	0.98	2.9	3.9	7.7

Know what's below. Call before you dig.

AVANCE 4:21:58 PM p:\\PWAPPDMA001:NorthCentral_Omaha\Documents\200716\00000000026051\6.0_CAD_BIM\6.2_Work_In_Progress\Hydraulics\Drawings Monument Academy\Basin Sheets\School Access HYDR_BasinMap_EX.dgn

Print Date: 6/3/2022
File Name: School Access HYDR_BasinMap_EX.dgn
Horiz. Scale: 1:100 Vert. Scale: None

HDR
5555 TECH CENTER DRIVE, SUITE 310
COLORADO SPRINGS, CO 80919 PHONE: 719-272-8800

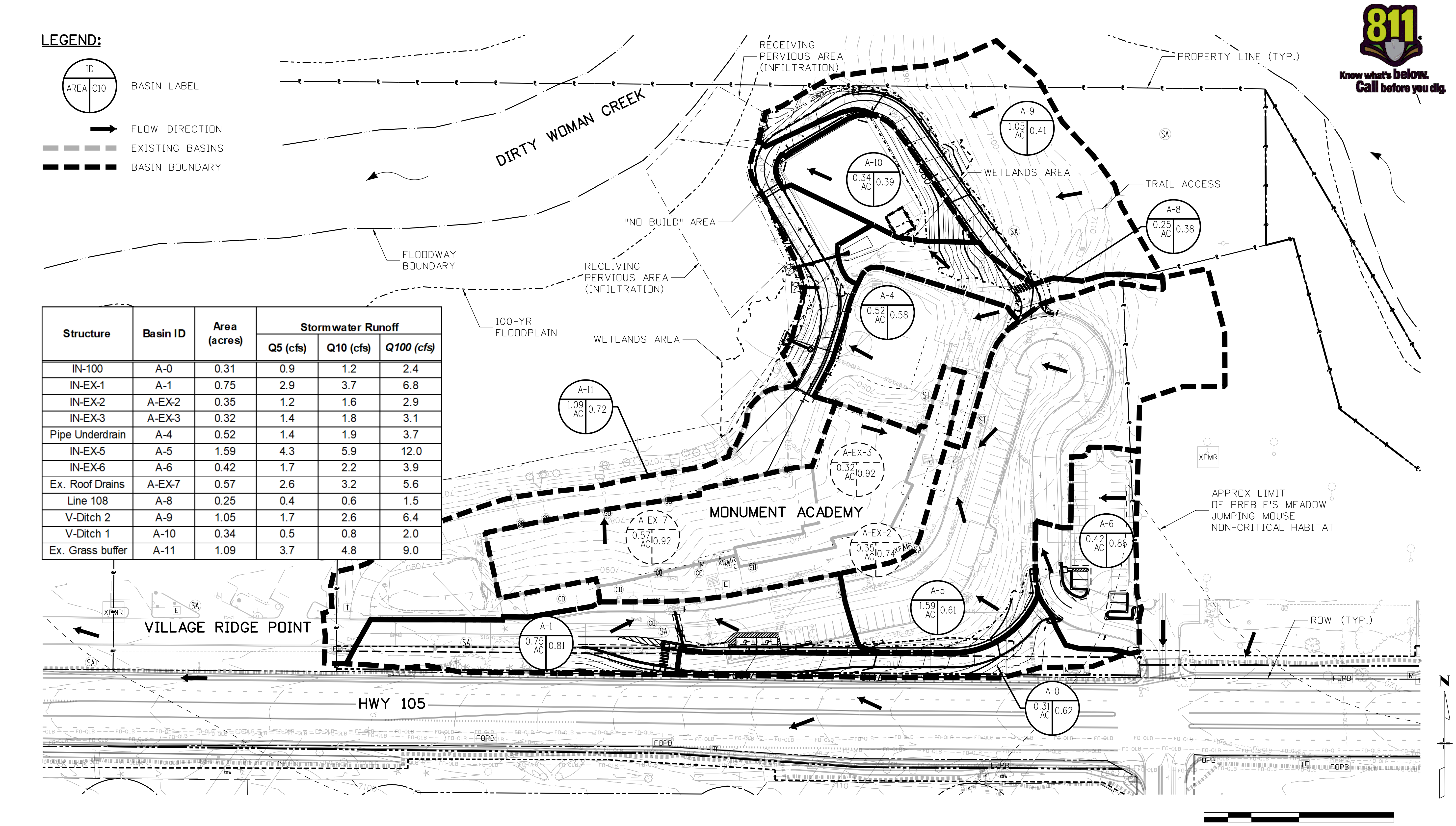
Sheet Revisions		
Date:	Comments	Init.

As Constructed
No Revisions:
Revised:
Void:

MONUMENT ACADEMY
DRAINAGE MAPS
EXISTING BASINS

Designer: A.VANCE
Detailer: A.VANCE
Sheet Subset: DR-MAP
Structure Numbers:
Subset Sheets: 1 of 2

Project No./Code: 19734
STA 105A-014
Sheet Number MAP-01



Structure	Basin ID	Area (acres)	Stormwater Runoff		
			Q5 (cfs)	Q10 (cfs)	Q100 (cfs)
IN-100	A-0	0.31	0.9	1.2	2.4
IN-EX-1	A-1	0.75	2.9	3.7	6.8
IN-EX-2	A-EX-2	0.35	1.2	1.6	2.9
IN-EX-3	A-EX-3	0.32	1.4	1.8	3.1
Pipe Underdrain	A-4	0.52	1.4	1.9	3.7
IN-EX-5	A-5	1.59	4.3	5.9	12.0
IN-EX-6	A-6	0.42	1.7	2.2	3.9
Ex. Roof Drains	A-EX-7	0.57	2.6	3.2	5.6
Line 108	A-8	0.25	0.4	0.6	1.5
V-Ditch 2	A-9	1.05	1.7	2.6	6.4
V-Ditch 1	A-10	0.34	0.5	0.8	2.0
Ex. Grass buffer	A-11	1.09	3.7	4.8	9.0

Print Date: 6/3/2022
File Name: School Access HYDR_BasinMap_PR.dgn
Horiz. Scale: 1:100 Vert. Scale: None

HDR
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Sheet Revisions

Date:	Comments	Init.

As Constructed
No Revisions:
Revised:
Void:

MONUMENT ACADEMY
DRAINAGE MAPS
PROPOSED BASINS

Designer: A.VANCE
Detailer: A.VANCE
Sheet Subset: DR-MAP
Structure Numbers
Subset Sheets: 2 of 2

Project No./Code
19734
STA 105A-014
Sheet Number MAP-02

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Appendix B

Historic Plans (2007)

MONUMENT ACADEMY (TRACT A, KNOLLWOOD VILLAGE FILING NO. 2)

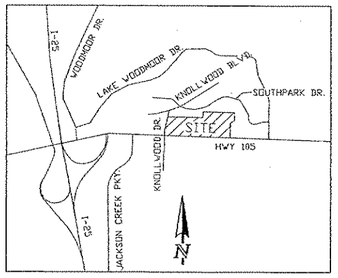
TOWN OF MONUMENT, COUNTY OF EL PASO, STATE OF COLORADO

PRIVATE STORM SEWER PLANS

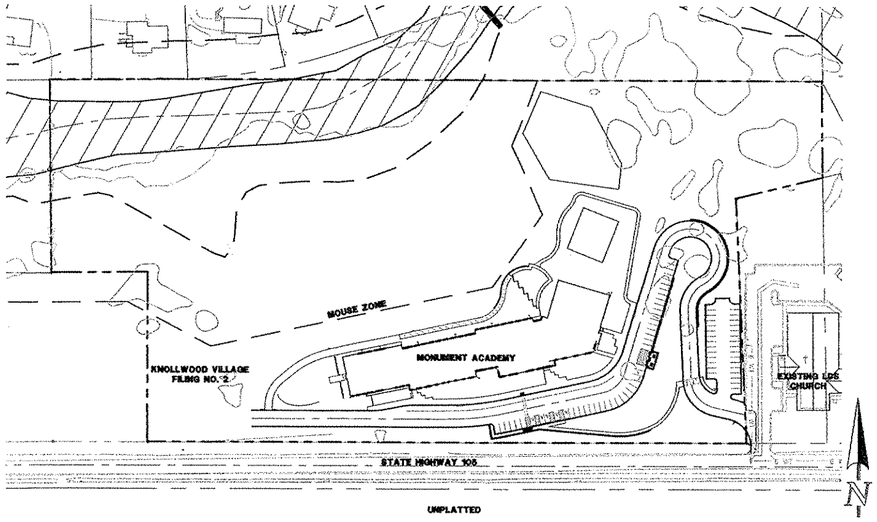
AUGUST 2007

GENERAL NOTES

1. ALL MATERIALS AND INSTALLATION PROCEDURES SHALL BE IN COMPLIANCE WITH EL PASO COUNTY STANDARD SPECIFICATIONS.
2. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE EXISTENCE AND LOCATION OF ALL UNDERGROUND UTILITIES ALONG THE ROUTE OF THE WORK. THE OMISSION FROM OR THE INCLUSION OF UTILITY LOCATIONS ON THE PLANS IS NOT TO BE CONSIDERED AS THE NONEXISTENCE OF OR A DEFINITE LOCATION OF EXISTING UNDERGROUND UTILITIES.
3. THE CONTRACTOR WILL TAKE THE NECESSARY PRECAUTIONS TO PROTECT EXISTING UTILITIES FROM DAMAGE DUE TO THIS OPERATION. ANY DAMAGE TO THE UTILITIES WILL BE REPAIRED AT THE CONTRACTOR'S EXPENSE, AND ANY SERVICE DISRUPTION WILL BE SETTLED BY THE CONTRACTOR.
4. UNLESS OTHERWISE NOTED, STORM SEWER PIPE SHALL BE CLASS II REINFORCED CONCRETE PIPE WITH 6000 PSI CONCRETE AND CLASS-C BEDDING. UNLESS OTHERWISE NOTED, ALL STORM SEWER BENDS, WYES AND TEES SHOWN ON PLANS SHALL BE PREFABRICATED.
5. ALL BACKFILL, SUB-BASE, AND/OR BASE COURSE (CLASS 6) MATERIAL SHALL BE COMPACTED PER EL PASO COUNTY SPECIFICATIONS.
6. ALL STATIONING IS CENTERLINE OF STORM SEWER UNLESS OTHERWISE INDICATED. ALL ELEVATIONS ARE AT FLOW LINE OF PIPE UNLESS OTHERWISE INDICATED.
7. IF A DISCREPANCY OCCURS BETWEEN THE CONSTRUCTION DOCUMENTS AND EL PASO COUNTY SPECIFICATIONS, THE ENGINEER WILL BE NOTIFIED IMMEDIATELY FOR RESOLUTION.
8. THE CONTRACTOR SHALL SECURE ALL APPLICABLE LICENSES AND PERMITS TO COMPLETE THE CONSTRUCTION IN COMPLIANCE WITH ALL LOCAL, STATE, AND FEDERAL REGULATIONS.
9. CONTRACTOR TO OBTAIN COPIES OF THE SOILS REPORT FROM THE GEOTECHNICAL ENGINEER AND TO BE KEPT ON-SITE DURING ALL EARTHWORK OPERATIONS.
10. BENCHMARKS:



VICINITY MAP
N.T.S.



KEY MAP
1"=100'

LEGEND

- EXISTING WATER LINE
- EXISTING FIRE HYDRANT
- EXISTING GATE VALVE
- EXISTING SANITARY SEWER
- EXISTING SAN. MANHOLE
- EXISTING GAS MAIN
- PROPOSED GATE VALVE
- PROPOSED WATER MAIN
- PROPOSED FIRE HYDRANT
- PROPOSED STORM SEWER
- PROPOSED STORM INLET

SHEET INDEX:

AGENCIES:

DEVELOPER:	MONUMENT ACADEMY 1824 WOODMOOR DRIVE MONUMENT, CO 80132 BOB HUGHES (719) 487-8695
CIVIL ENGINEER:	CLASSIC CONSULTING ENGINEERS & SURVEYORS 6385 CORPORATE DRIVE COLORADO SPRINGS, COLORADO 80919 MR. KYLE R. CAMPBELL, P.E., (719) 785-2800
FIRE DISTRICT:	WOODMOOR-MONUMENT FIRE DISTRICT 1855 WOODMOOR DR. MONUMENT, CO 80132
GAS COMPANY:	PEOPLES NATURAL GAS COMPANY 37 WIDEFIELD BOULEVARD WIDEFIELD, COLORADO 80911 MR. GEORGE M. PETERSON, (719) 392-3481
ELECTRIC COMPANY:	MOUNTAIN VIEW ELECTRIC ASSOC., INC. 11140 EAST WOODMEN ROAD FALCON, COLORADO 80831 MS. AMY CALLAGHAN (719) 495-2283
TELEPHONE COMPANY:	QWEST COMMUNICATIONS (719) 278-4655
WATER & WASTEWATER:	WOODMOOR WATER AND SANITATION DISTRICT 1845 WOODMOOR DRIVE P.O. BOX 1407 MONUMENT, CO 80132 MR. RANDY OLLETTE (719) 488-2525

APPROVALS:

DETAILED IMPROVEMENT PLANS AND SPECIFICATIONS ENGINEER'S STATEMENT:

THESE DETAILED PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION. SAID DETAILED PLANS AND SPECIFICATIONS HAVE BEEN PREPARED ACCORDING TO THE CRITERIA ESTABLISHED BY THE COUNTY 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 IS DESIGNED. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY DIRECTLY CAUSED BY THE NEGLIGENT ACTS, ERRORS, OR OMISSIONS ON MY PART IN PREPARATION OF THE DETAILED IMPROVEMENT PLANS AND SPECIFICATIONS.

KYLE R. CAMPBELL, COLORADO P.E. #29794
FOR AND ON THE BEHALF OF CLASSIC CONSULTING ENGINEERS & SURVEYORS

10.30.07
DATE

48 HOURS BEFORE YOU DIG, CALL UTILITY LOCATORS
1-800-922-1987
CITY OF COLORADO SPRINGS DEPT. OF UTILITIES GAS, ELECTRIC, WATER AND WASTEWATER

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE CAUSED BY HIS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NO.	REVISION	DATE
1	100% DD SET - NOT FOR CONSTRUCTION	08/17/07
2	FINAL PLAT REVISIONS	11/21/07

REVIEW:
PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF CLASSIC CONSULTING ENGINEERS AND SURVEYORS, LLC

KYLE R. CAMPBELL, COLORADO P.E. #29794 — 10.30.07 DATE

CLASSIC CONSULTING ENGINEERS & SURVEYORS
6385 Corporate Drive, Suite 101 (719)785-0790
Colorado Springs, Colorado 80919 (719)785-0799(Fax)

MONUMENT ACADEMY
CIVIL CONSTRUCTION PLANS
PRIVATE STORM SEWER PLANS

DESIGNED BY	JWW	SCALE		DATE	08/16/07
DRAWN BY	JWW	(H) 1"=VARIES		SHEET	1 OF 3
CHECKED BY		(V) 1"= N/A		JOB NO.	2218.00

HUTTON ARCHITECTURE STUDIO
70 BROADWAY
Suite 300, Denver
Colorado 80203
303.861.1600 tel
303.861.1602 fax
www.huttonford.com

PROJECT:
MONUMENT ACADEMY CHARTER SCHOOL

Project #:
2007-01

OWNER:
Monument Academy Charter School

CONSULTANTS:

Structural:
Shelton Group, Inc.
6638 W. Ottoway Ave.
Littleton, CO 80128
303.973.07.57
f-303.973.3250

Mech./Elec.:
Shaffer Boucom Eng
7333 W. Jefferson Ave.
Ste. 230
Lakewood, CO 80235
303.986.8200
f-303.986.8222

Civil:
Classic Consultants
6385 Corporate Dr.
Ste 101
Co Sprgs, CO 80919
719.785.0790
f-719.785.0799

Landscape:
KWS design, LLC
70 Broadway, Ste 330
Denver, CO 80203
303.744.0966

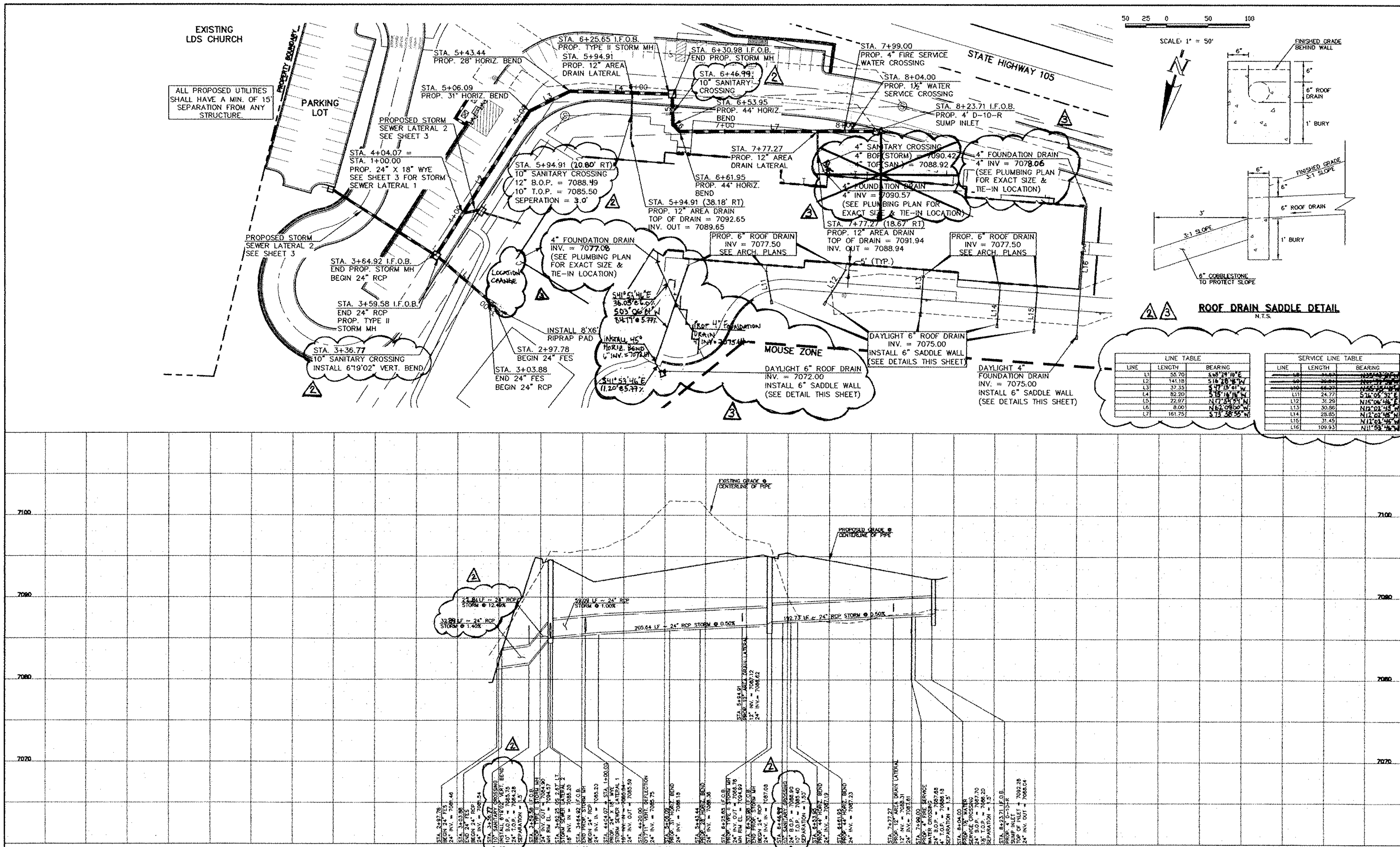
ISSUE DATE:
Bid Package 2
100% CD

10/23/07

REVISION DATES:

SHEET TITLE:
STORM SEWER PLAN

C-13



LINE TABLE		
LINE	LENGTH	BEARING
L1	55.70	S65°29'10"E
L2	141.18	S16°28'46"W
L3	37.35	S47°13'01"W
L4	82.20	S15°16'16"W
L5	22.97	N17°54'54"W
L6	8.00	N62°08'00"W
L7	161.75	S73°38'55"W

SERVICE LINE TABLE		
LINE	LENGTH	BEARING
~~L8~~	~~34.62~~	~~N35°43'37"E~~
~~L9~~	~~30.04~~	~~N09°37'54"W~~
~~L10~~	~~66.37~~	[illegible]
L11	24.77	S74°05'32"E
L12	31.29	N15°06'46"E
L13	30.86	N12°02'45"W
L14	28.85	N12°02'45"W
L15	31.45	N12°02'45"W
L16	109.93	N11°53'46"W

NOTE:

1. CONTRACTOR TO VERIFY HORIZONTAL & VERTICAL LOCATIONS OF EX. UTILITIES PRIOR TO CONSTRUCTION & REPORT CONFLICTS TO ENGINEER.

48 HOURS BEFORE YOU DIG, CALL UTILITY LOCATORS
1-800-922-1987
CITY OF COLORADO SPRINGS DEPT. OF UTILITIES GAS, ELECTRIC, WATER AND WASTEWATER

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NO.	REVISION	DATE
1	100% DD SET – NOT FOR CONSTRUCTION	08/17/07
2	FINAL PLAT REVISIONS	11/21/07
3	FOUNDATION AND STORM DRAIN REALIGNMENT	02/06/08

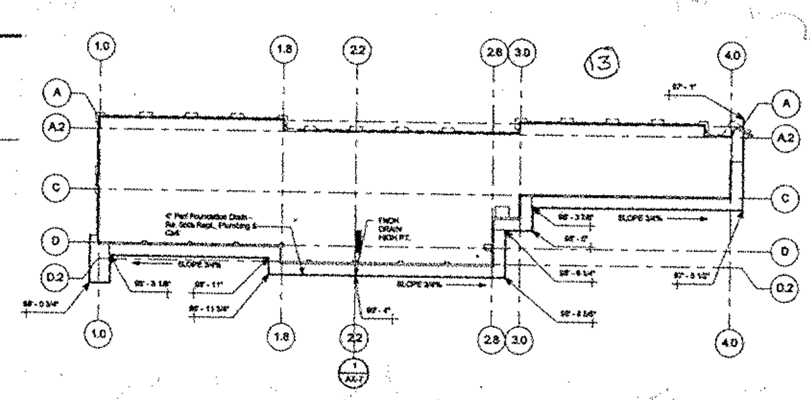
REVIEW:
PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF CLASSIC CONSULTING ENGINEERS AND SURVEYORS, LLC

KYLE R. CAMPBELL, COLORADO P.E. #29794 — DATE 10300

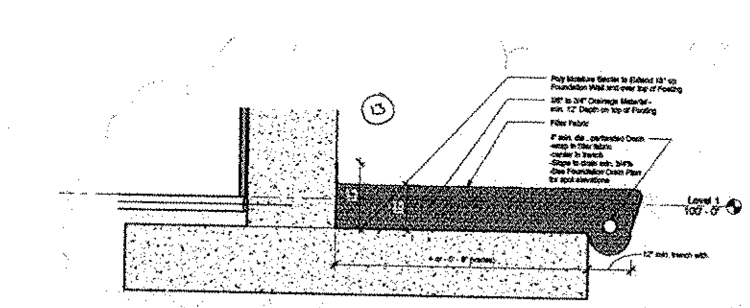
CLASSIC CONSULTING ENGINEERS & SURVEYORS
6385 Corporate Drive, Suite 101 (719)785-0790
Colorado Springs, Colorado 80919 (719)785-0799(Fax)

MONUMENT ACADEMY
CIVIL CONSTRUCTION PLANS
STORM SEWER SYSTEM PLAN

DESIGNED BY	JWW	SCALE	DATE 06/2...
DRAWN BY	JWW	(H) 1"= 50'	SHEET
CHECKED BY		(V) 1"= 5'	



Foundation Drain Location Plan
1/32" = 1'-0"



Foundation Drain Detail
3/4" = 1'-0"

HUTTON ARCHITECTURE STUDIO
70 BROADWAY
Suite 300, Denver
Colorado 80203
303.861.1600 tel
303.861.1602 fax
www.huttonford.com

PROJECT: MONUMENT ACADEMY CHARTER SCHOOL
(13) RFI 13 - 1/10/08

Project #: 2007-01

OWNER: Monument Academy Charter School

CONSULTANTS:
Structural: Sheflin Group, Inc. 6638 W. Ottawa Ave. Littleton, CO 80128 303.973.0757 f-303.973.3250
Mech./Elec.: Shaffer Baucom Eng. 7333 W. Jefferson Ave. Ste. 230 Lakewood, CO 80235 303.986.8200 f-303.986.8222
Civil: Classic Consultants 6385 Corporate Dr. Ste 101 Co Sprgs, CO 80919 719.785.0790 f-719.785.0799
Landscape: KWS design, LLC 70 Broadway, Ste 350 Denver, CO 80203 303.744.0966

ISSUE DATE: Bid Package 2 100% CD 10/25/07

REVISION DATES: 02/07/08

SHEET TITLE: STORM SEWER PLAN

C-14

HUTTON ARCHITECTURE STUDIO
70 BROADWAY
Suite 300, Denver
Colorado 80203
303.861.1600 tel
303.861.1602 fax
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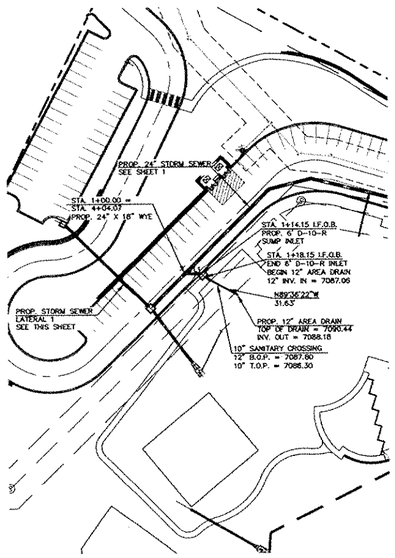

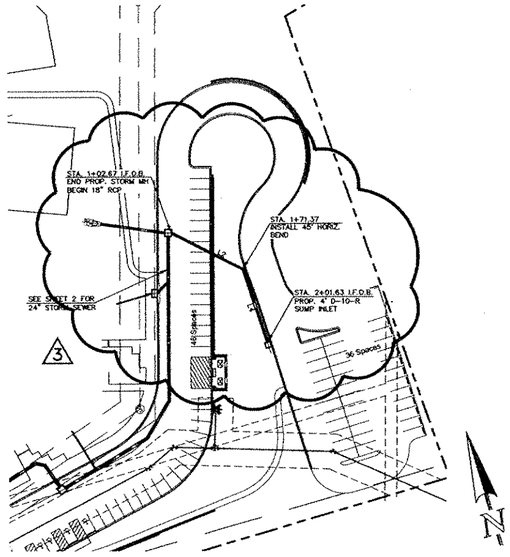

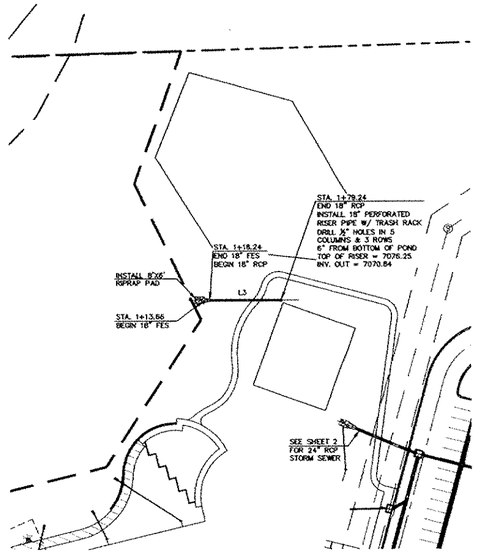

NOTE:

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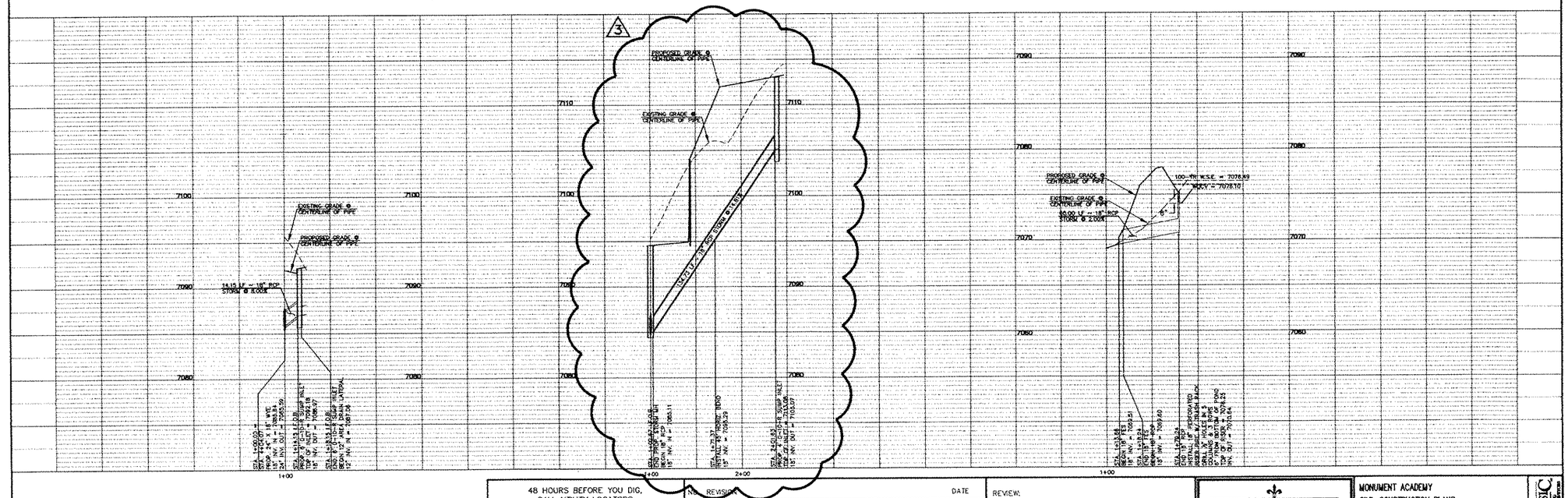
LINE TABLE		
LINE	LENGTH	BEARING
L1	14.15	S61°27'17"W
L2	68.71	S46°16'09"E
L3	60.34	N88°23'46"W
L4	66.03	S01°16'09"E

2 3

N

50 25 0 50 100

SCALE: 1" = 50'



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1-800-922-1987
CITY OF COLORADO SPRINGS DEPT. OF UTILITIES
GAS, ELECTRIC, WATER AND WASTEWATER

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NO.	REVISION	DATE
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2	FINAL PLAT REVISIONS	11/21/07
3	FOUNDATION AND STORM DRAIN REALIGNMENT	02/06/08

REVIEW:
PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF CLASSIC CONSULTING ENGINEERS AND SURVEYORS, LLC

KYLE M. CAMPBELL, COLORADO P.E. #29794 — 2.8.08 DATE

CLASSIC SM
CONSULTING ENGINEERS & SURVEYORS
6385 Corporate Drive, Suite 101 (719)785-0790
Colorado Springs, Colorado 80919 (719)785-0799(Fax)

MONUMENT ACADEMY
CIVIL CONSTRUCTION PLANS
LATERALS 1, 2 & OUTFALL
PLAN & PROFILE

DESIGNED BY	JWW	SCALE	DATE 08/17/07
DRAWN BY	JWW	(H) 1"= 50'	SHEET 15 OF 18
CHECKED BY		(V) 1"= 5'	ISSUE 3

PROJECT:
MONUMENT ACADEMY CHARTER SCHOOL

Project #:
2007.01

OWNER:
Monument Academy Charter School

CONSULTANTS:

Structural:
Sheffer Group, Inc
6438 W. Ottawa Ave.
Littleton, CO 80128
303.973.0757
f-303.973.3250

Mech./Elec.:
Sheffer Baucom Eng.
7333 W. Jefferson Ave.
Ste. 230
Lakewood, CO 80235
303.986.8200
f-303.986.8222

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6385 Corporate Dr.
Ste 101
Co. Spgs, CO 80919
719.785.0790
f-719.785.0799

Landscape:
KWS design, LLC
70 Broadway, Ste 350
Denver, CO 80203
303.744.0966

ISSUE DATE:
Bid Package 2
100% CD
10/25/07

REVISION DATES:
02/07/08

SHEET TITLE:
STORM SEWER PLAN

C-15

Appendix C

Soils Report

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

Monument Academy

April 6, 2022

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

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Contents

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: 1:4,300 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

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 19, Aug 31, 2021

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

Date(s) aerial images were photographed: 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
1	Alamosa loam, 1 to 3 percent slopes	25.0	42.7%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	33.5	57.3%
Totals for Area of Interest		**58.5**	**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

1—Alamosa loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3670
Elevation: 7,200 to 7,700 feet
Farmland classification: Prime farmland if irrigated and reclaimed of excess salts and sodium

Map Unit Composition

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

Description of Alamosa

Setting

Landform: Flood plains, fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 6 inches: loam
Bt - 6 to 14 inches: clay loam
Btk - 14 to 33 inches: clay loam
Cg1 - 33 to 53 inches: sandy clay loam
Cg2 - 53 to 60 inches: sandy loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 12 to 18 inches
Frequency of flooding: FrequentNone
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Very slightly saline to strongly saline (2.0 to 16.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: D
Ecological site: R048AY241CO - Mountain Meadow
Hydric soil rating: Yes

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

92—Tomah-Crowfoot loamy sands, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 36b9
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Tomah and similar soils: 50 percent
Crowfoot and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tomah

Setting

Landform: Hills, alluvial fans
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose and/or residuum weathered from arkose

Typical profile

A - 0 to 10 inches: loamy sand
E - 10 to 22 inches: coarse sand
Bt - 22 to 48 inches: stratified coarse sand to sandy clay loam
C - 48 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 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 to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Description of Crowfoot

Setting

Landform: Alluvial fans, hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 12 inches: loamy sand
E - 12 to 23 inches: sand
Bt - 23 to 36 inches: sandy clay loam
C - 36 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 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 to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

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

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Erosion Factors

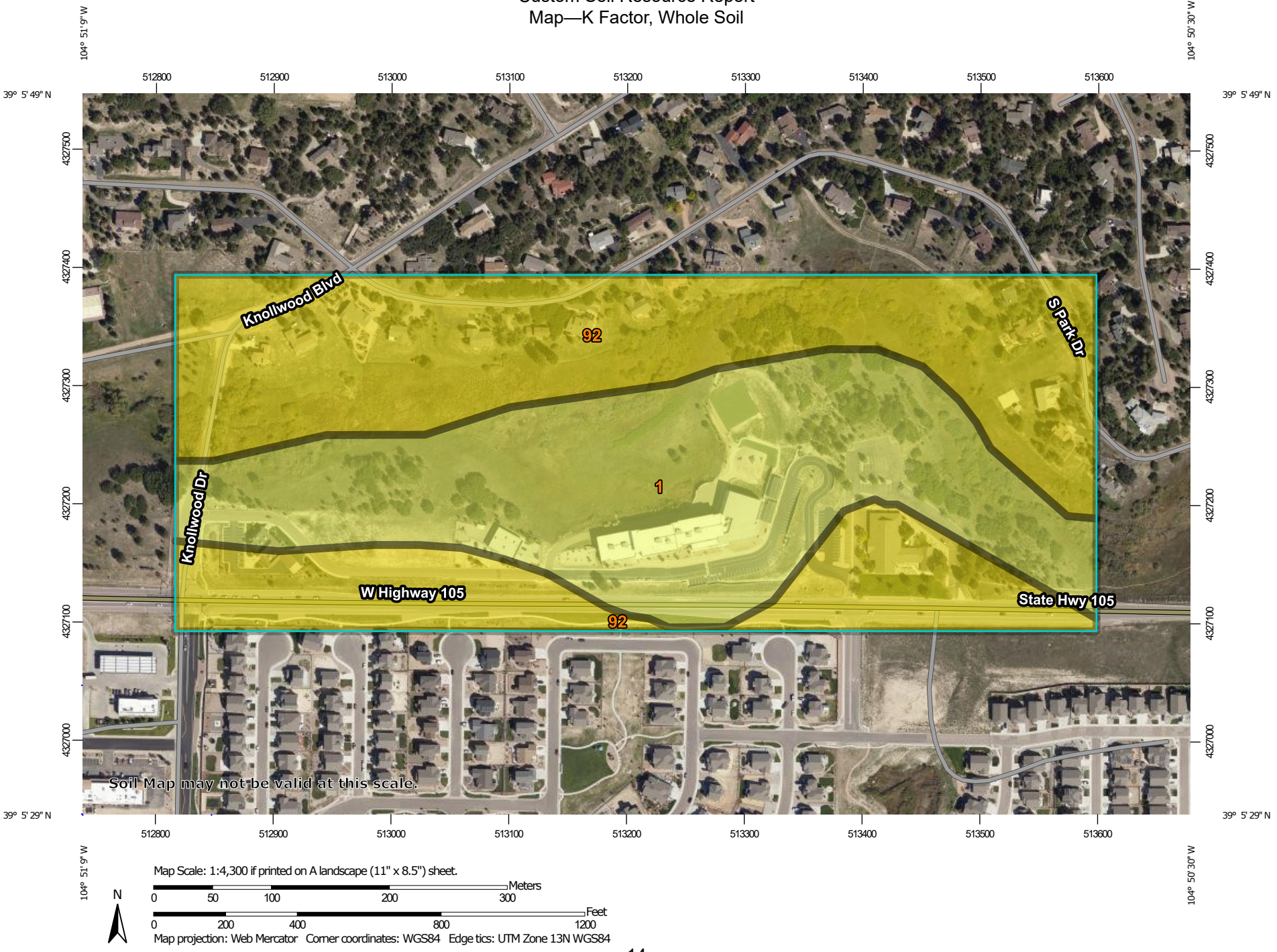
Soil Erosion Factors are soil properties and interpretations used in evaluating the soil for potential erosion. Example soil erosion factors can include K factor for the whole soil or on a rock free basis, T factor, wind erodibility group and wind erodibility index.

K Factor, Whole Soil

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Factor K does not apply to organic horizons and is not reported for those layers.



Map Scale: 1:4,300 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Lines

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Points

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
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 19, Aug 31, 2021

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

Date(s) aerial images were photographed: 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.

Table—K Factor, Whole Soil

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Alamosa loam, 1 to 3 percent slopes	.20	25.0	42.7%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	.17	33.5	57.3%
Totals for Area of Interest			**58.5**	**100.0%**

Rating Options—K Factor, Whole Soil

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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.

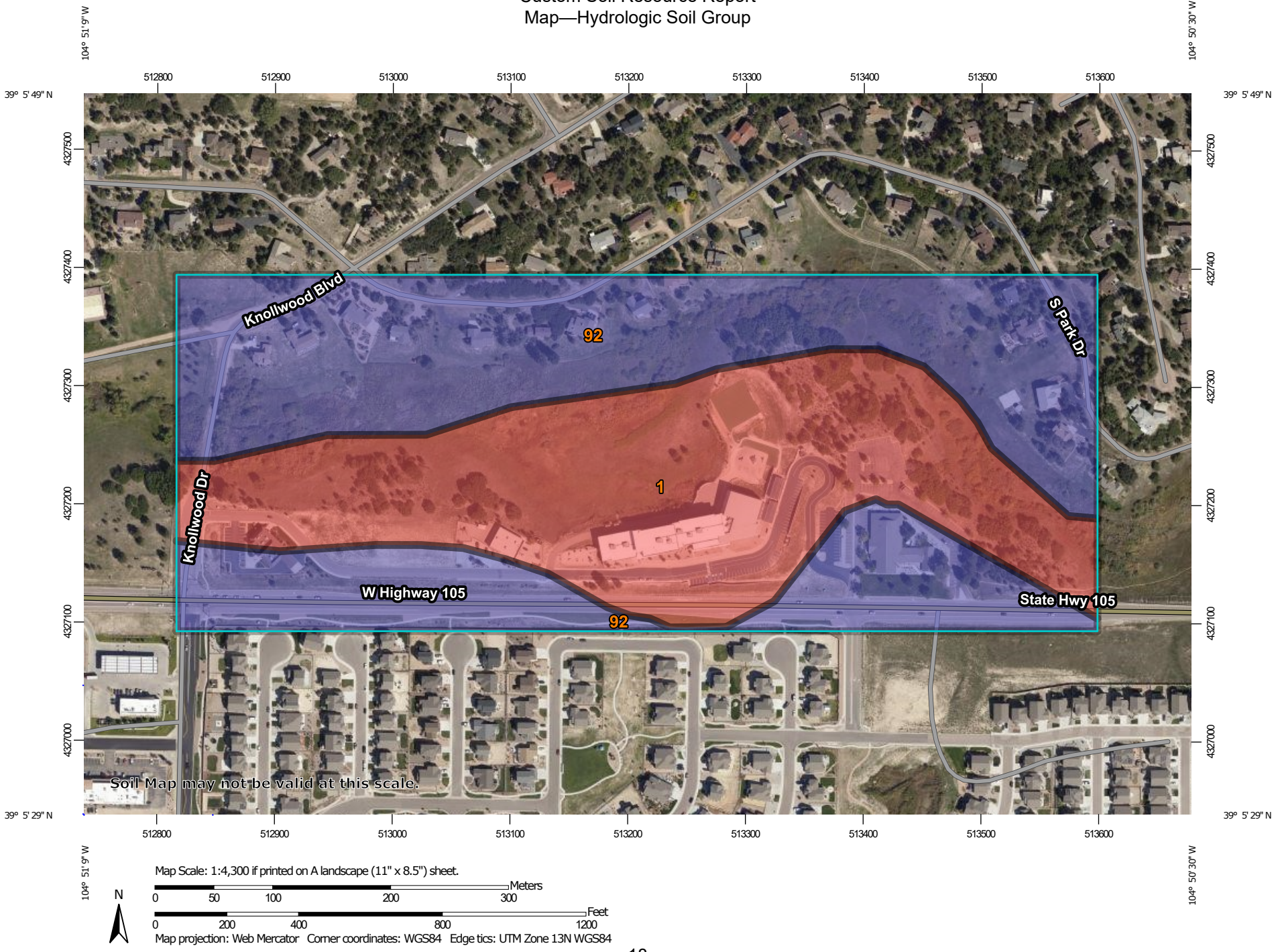
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained

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.



Map Scale: 1:4,300 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021

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

Date(s) aerial images were photographed: 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.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Alamosa loam, 1 to 3 percent slopes	D	25.0	42.7%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	33.5	57.3%
Totals for Area of Interest			**58.5**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Soil Erosion

This folder contains a collection of tabular reports that present soil erosion factors and groupings. The reports (tables) include all selected map units and components for each map unit. Soil erosion factors are soil properties and interpretations used in evaluating the soil for potential erosion. Example soil erosion factors can include K factor for the whole soil or on a rock free basis, T factor, wind erodibility group and wind erodibility index.

RUSLE2 Related Attributes

This report summarizes those soil attributes used by the Revised Universal Soil Loss Equation Version 2 (RUSLE2) for the map units in the selected area. The report includes the map unit symbol, the component name, and the percent of the component in the map unit. Soil property data for each map unit component include the hydrologic soil group, erosion factor Kf for the surface horizon, erosion factor T, and the representative percentage of sand, silt, and clay in the mineral surface horizon. Missing surface data may indicate the presence of an organic layer.

Report—RUSLE2 Related Attributes

Soil properties and interpretations for erosion runoff calculations. The surface mineral horizon properties are displayed or the first mineral horizon below an organic surface horizon. Organic horizons are not displayed.

RUSLE2 Related Attributes–El Paso County Area, Colorado

Map symbol and soil name	Pct. of map unit	Slope length (ft)	Hydrologic group	Kf	T factor	Representative value		
						% Sand	% Silt	% Clay
1—Alamosa loam, 1 to 3 percent slopes								
Alamosa	85	—	D	.20	5	43.0	38.5	18.5
92—Tomah-Crowfoot loamy sands, 3 to 8 percent slopes								
Tomah	50	—	B	.17	4	84.3	9.2	6.5
Crowfoot	30	—	B	.15	3	85.7	4.3	10.0

References

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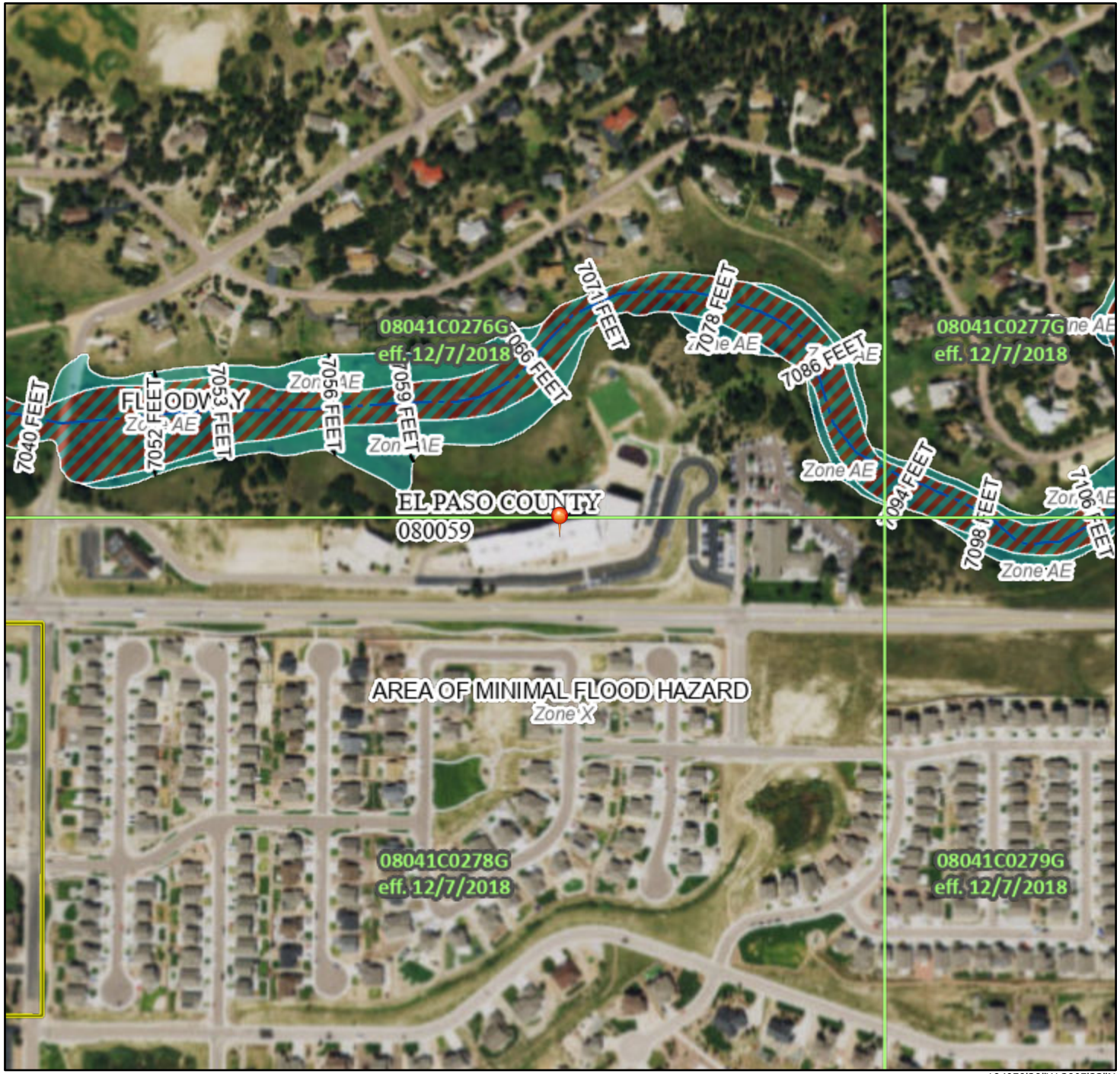
Appendix D

Floodplain Map

National Flood Hazard Layer FIRMette

FEMA

104°51'7"W 39°5'51"N



104°50'30"W 39°5'23"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
- 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 1/12/2022 at 3:38 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Appendix E

Precipitation Data

NOAA Atlas 14, Volume 8, Version 2
Location name: Monument, Colorado, USA*
Latitude: 39.0934°, Longitude: -104.8462°
Elevation: 7101.14 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**2.88** (2.36-3.49)	**3.65** (2.99-4.44)	**4.94** (4.04-6.04)	**6.06** (4.92-7.42)	**7.64** (5.99-9.66)	**8.89** (6.80-11.4)	**10.2** (7.52-13.3)	**11.5** (8.16-15.3)	**13.4** (9.07-18.2)	**14.8** (9.78-20.3)
10-min	**2.11** (1.73-2.56)	**2.67** (2.19-3.25)	**3.62** (2.96-4.42)	**4.43** (3.60-5.43)	**5.59** (4.39-7.07)	**6.52** (4.98-8.31)	**7.46** (5.51-9.71)	**8.45** (5.97-11.2)	**9.79** (6.65-13.3)	**10.8** (7.16-14.9)
15-min	**1.71** (1.40-2.08)	**2.17** (1.78-2.64)	**2.94** (2.40-3.59)	**3.61** (2.93-4.41)	**4.55** (3.57-5.75)	**5.30** (4.05-6.76)	**6.06** (4.48-7.90)	**6.87** (4.85-9.13)	**7.96** (5.40-10.8)	**8.81** (5.82-12.1)
30-min	**1.16** (0.948-1.40)	**1.47** (1.20-1.78)	**1.99** (1.62-2.43)	**2.44** (1.98-2.98)	**3.07** (2.41-3.88)	**3.58** (2.73-4.56)	**4.09** (3.02-5.33)	**4.63** (3.27-6.16)	**5.37** (3.64-7.30)	**5.94** (3.92-8.16)
60-min	**0.735** (0.602-0.893)	**0.903** (0.740-1.10)	**1.20** (0.978-1.46)	**1.46** (1.19-1.79)	**1.85** (1.46-2.36)	**2.18** (1.67-2.80)	**2.52** (1.87-3.30)	**2.89** (2.05-3.86)	**3.41** (2.32-4.65)	**3.82** (2.52-5.25)
2-hr	**0.446** (0.368-0.538)	**0.536** (0.442-0.647)	**0.701** (0.576-0.848)	**0.854** (0.696-1.04)	**1.09** (0.867-1.38)	**1.28** (0.996-1.64)	**1.50** (1.12-1.95)	**1.73** (1.24-2.31)	**2.07** (1.42-2.81)	**2.34** (1.55-3.19)
3-hr	**0.332** (0.275-0.399)	**0.390** (0.323-0.469)	**0.501** (0.413-0.603)	**0.608** (0.498-0.734)	**0.777** (0.626-0.990)	**0.925** (0.722-1.18)	**1.09** (0.819-1.42)	**1.27** (0.914-1.69)	**1.53** (1.06-2.09)	**1.75** (1.17-2.38)
6-hr	**0.201** (0.168-0.239)	**0.233** (0.194-0.277)	**0.295** (0.245-0.352)	**0.357** (0.294-0.427)	**0.456** (0.371-0.579)	**0.545** (0.429-0.694)	**0.644** (0.488-0.835)	**0.754** (0.547-0.999)	**0.916** (0.638-1.24)	**1.05** (0.706-1.42)
12-hr	**0.121** (0.101-0.142)	**0.142** (0.118-0.167)	**0.181** (0.151-0.214)	**0.218** (0.181-0.259)	**0.277** (0.225-0.347)	**0.328** (0.259-0.413)	**0.384** (0.292-0.492)	**0.445** (0.325-0.584)	**0.535** (0.374-0.716)	**0.608** (0.411-0.816)
24-hr	**0.073** (0.061-0.085)	**0.086** (0.072-0.101)	**0.110** (0.092-0.129)	**0.132** (0.110-0.155)	**0.165** (0.135-0.204)	**0.194** (0.153-0.240)	**0.224** (0.171-0.284)	**0.257** (0.188-0.333)	**0.304** (0.213-0.403)	**0.342** (0.233-0.456)
2-day	**0.043** (0.036-0.050)	**0.050** (0.043-0.058)	**0.064** (0.054-0.074)	**0.075** (0.063-0.088)	**0.093** (0.076-0.114)	**0.108** (0.086-0.133)	**0.124** (0.095-0.156)	**0.141** (0.104-0.182)	**0.166** (0.117-0.218)	**0.185** (0.127-0.245)
3-day	**0.031** (0.026-0.036)	**0.036** (0.031-0.042)	**0.046** (0.039-0.053)	**0.054** (0.046-0.063)	**0.067** (0.055-0.081)	**0.077** (0.062-0.095)	**0.088** (0.068-0.110)	**0.100** (0.074-0.128)	**0.117** (0.083-0.153)	**0.130** (0.090-0.172)
4-day	**0.025** (0.021-0.028)	**0.029** (0.025-0.033)	**0.036** (0.031-0.042)	**0.043** (0.036-0.050)	**0.053** (0.043-0.064)	**0.061** (0.049-0.074)	**0.069** (0.054-0.086)	**0.079** (0.058-0.100)	**0.091** (0.065-0.119)	**0.102** (0.070-0.134)
7-day	**0.016** (0.014-0.019)	**0.019** (0.016-0.022)	**0.023** (0.020-0.027)	**0.027** (0.023-0.032)	**0.033** (0.028-0.040)	**0.038** (0.031-0.046)	**0.044** (0.034-0.054)	**0.049** (0.037-0.062)	**0.057** (0.041-0.074)	**0.063** (0.044-0.083)
10-day	**0.013** (0.011-0.015)	**0.015** (0.013-0.017)	**0.018** (0.016-0.021)	**0.021** (0.018-0.024)	**0.026** (0.021-0.031)	**0.029** (0.024-0.035)	**0.033** (0.026-0.041)	**0.037** (0.028-0.047)	**0.043** (0.031-0.056)	**0.048** (0.033-0.062)
20-day	**0.009** (0.007-0.010)	**0.010** (0.009-0.011)	**0.012** (0.010-0.014)	**0.014** (0.012-0.016)	**0.016** (0.014-0.019)	**0.019** (0.015-0.022)	**0.021** (0.016-0.025)	**0.023** (0.017-0.029)	**0.026** (0.019-0.034)	**0.029** (0.020-0.037)
30-day	**0.007** (0.006-0.008)	**0.008** (0.007-0.009)	**0.010** (0.008-0.011)	**0.011** (0.009-0.012)	**0.013** (0.011-0.015)	**0.014** (0.012-0.017)	**0.016** (0.013-0.019)	**0.018** (0.013-0.022)	**0.020** (0.014-0.025)	**0.022** (0.015-0.028)
45-day	**0.006** (0.005-0.006)	**0.006** (0.006-0.007)	**0.008** (0.007-0.009)	**0.009** (0.008-0.010)	**0.010** (0.009-0.012)	**0.011** (0.009-0.013)	**0.012** (0.010-0.015)	**0.014** (0.010-0.017)	**0.015** (0.011-0.019)	**0.016** (0.011-0.021)
60-day	**0.005** (0.004-0.005)	**0.005** (0.005-0.006)	**0.007** (0.006-0.007)	**0.007** (0.006-0.008)	**0.009** (0.007-0.010)	**0.010** (0.008-0.011)	**0.010** (0.008-0.012)	**0.011** (0.008-0.014)	**0.012** (0.009-0.015)	**0.013** (0.009-0.017)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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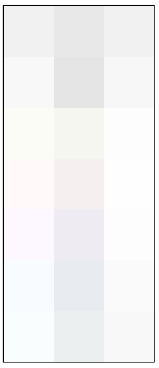
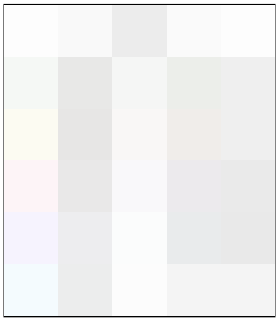
PF graphical





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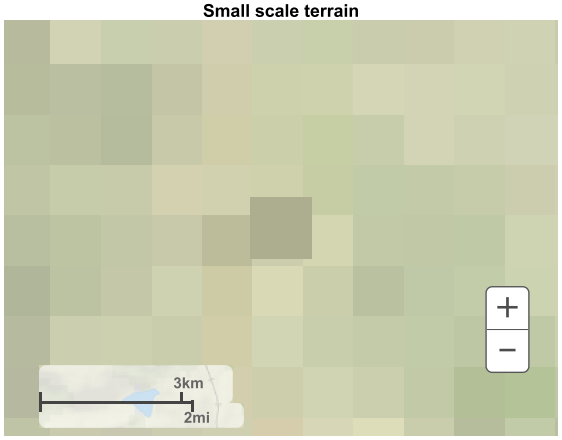
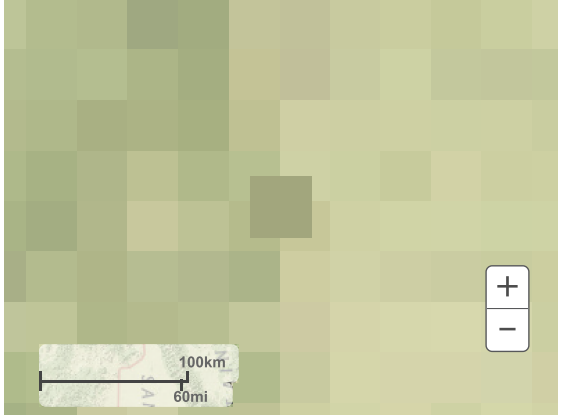
Maps & aerials

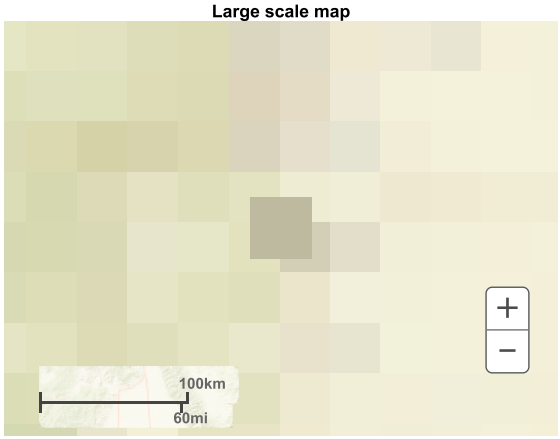
Small scale terrain



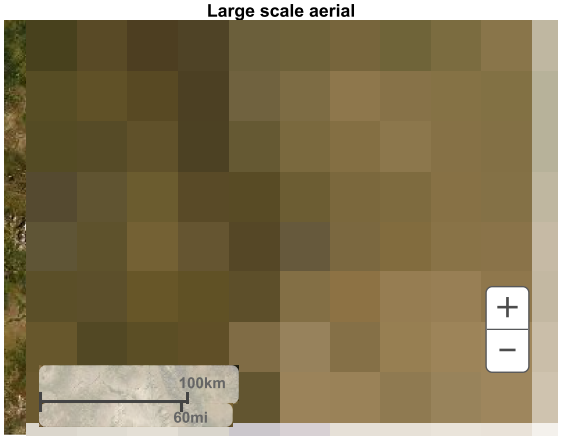
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Appendix F

Calculations

1. Rational Method
2. Bentley InRoads
3. FHWA Hydraulic Toolbox Riprap
4. Permanent Water Quality

Runoff Coefficients

Corridor / Design Package: Hwy 105 / Monument Academy
System Name: Monument Academy

Computed: AMV Date: 3/10/2022 UpDated: 6/2/2022
Checked: JLS Date: 3/23/2022 UpDated: 6/7/2022

Sub-Basin Data				Composite C			Streets (Paved) or Roofs 100%				Undeveloped Areas or Parks 7%				Business (Neighborhood Area) 70%			
Basin ID	Description	Hydr Soils Group	Total Area (ac)	C_5	C_{10}	C_{100}	C_5	C_{10}	C_{100}	Area (ac)	C_5	C_{10}	C_{100}	Area (ac)	C_5	C_{10}	C_{100}	Area (ac)
Existing																		
A-EX-1	Front Circulation Road	D	1.08	0.58	0.64	0.76	0.90	0.92	0.96	0.5939	0.19	0.29	0.52	0.487	0.53	0.57	0.68	
A-EX-2	Front of Building(s)	D	0.35	0.71	0.74	0.81	0.90	0.92	0.96	0.1656	0.19	0.29	0.52		0.53	0.57	0.68	0.182
A-EX-3	Roof drains to Front	D	0.32	0.90	0.92	0.96	0.90	0.92	0.96	0.3191	0.19	0.29	0.52		0.53	0.57	0.68	
A-EX-4	Playground	D	0.60	0.52	0.56	0.69	0.90	0.92	0.96	0.0840	0.19	0.29	0.52	0.117	0.53	0.57	0.68	0.403
A-EX-5	Front Circulation Road	B/D	1.79	0.53	0.59	0.72	0.90	0.92	0.96	0.7151	0.19	0.29	0.52	0.764	0.53	0.57	0.68	0.312
A-EX-6	Upper Parking Lot	B	0.43	0.83	0.85	0.90	0.90	0.92	0.96	0.3528	0.12	0.20	0.39		0.49	0.53	0.62	0.077
A-EX-7	Roof drains to Back	D	0.57	0.90	0.92	0.96	0.90	0.92	0.96	0.5738	0.19	0.29	0.52		0.53	0.57	0.68	
A-EX-8	Channel & undeveloped	D	0.81	0.21	0.31	0.53	0.90	0.92	0.96		0.19	0.29	0.52	0.758	0.53	0.57	0.68	0.050
A-EX-9	Athletic field & undeveloped	D	0.77	0.24	0.33	0.55	0.90	0.92	0.96	0.0111	0.19	0.29	0.52	0.657	0.53	0.57	0.68	0.097
A-EX-10	Back of School Road	D	0.98	0.60	0.65	0.76	0.90	0.92	0.96	0.4488	0.19	0.29	0.52	0.274	0.53	0.57	0.68	0.262
		subtotal	7.70							3.2642				3.06				1.38
Proposed																		
A-0	Front Circulation Road	B/D	0.31	0.56	0.62	0.75	0.90	0.92	0.96	0.1616	0.19	0.29	0.52	0.147	0.53	0.57	0.68	
A-1	Front Circulation Road	D	0.75	0.77	0.81	0.88	0.90	0.92	0.96	0.6208	0.19	0.29	0.52	0.133	0.53	0.57	0.68	
A-EX-2	Front of Building(s)	D	0.35	0.71	0.74	0.81	0.90	0.92	0.96	0.1656	0.19	0.29	0.52		0.53	0.57	0.68	0.182
A-EX-3	Roof drains to Front	D	0.32	0.90	0.92	0.96	0.90	0.92	0.96	0.3191	0.19	0.29	0.52		0.53	0.57	0.68	
A-4	Playground	D	0.52	0.54	0.58	0.70	0.90	0.92	0.96	0.0719	0.19	0.29	0.52	0.063	0.53	0.57	0.68	0.388
A-5	Front Circulation Road	B/D	1.59	0.55	0.61	0.74	0.90	0.92	0.96	0.7092	0.19	0.29	0.52	0.668	0.53	0.57	0.68	0.217
A-6	Upper Parking Lot	B	0.42	0.83	0.86	0.90	0.90	0.92	0.96	0.3545	0.12	0.20	0.39		0.49	0.53	0.62	0.070
A-EX-7	Roof drains to Back	D	0.57	0.90	0.92	0.96	0.90	0.92	0.96	0.5738	0.19	0.29	0.52		0.53	0.57	0.68	
A-8	Infield & Back Circ.Rd.	D	0.25	0.29	0.38	0.58	0.90	0.92	0.96	0.0264	0.19	0.29	0.52	0.210	0.53	0.57	0.68	0.018
A-9	Undeveloped & Back Circ.Rd.	D	1.05	0.32	0.41	0.60	0.90	0.92	0.96	0.1852	0.19	0.29	0.52	0.834	0.53	0.57	0.68	0.027
A-10	Athletic Field & Ditch	D	0.34	0.31	0.39	0.58	0.90	0.92	0.96	0.0115	0.19	0.29	0.52	0.236	0.53	0.57	0.68	0.097
A-11	Back of School & Circ. Rd.	D	1.09	0.68	0.72	0.81	0.90	0.92	0.96	0.6097	0.19	0.29	0.52	0.180	0.53	0.57	0.68	0.303
		subtotal	7.58							3.8093				2.47				1.00

Standard Form SF-2 . Storm Drainage System Design (Rational Method Procedure)

Corridor / Design Package: Hwy 105 / Monument Academy
System Name: Monument Academy

Computed: AMV Date: 3/10/2022
Checked: JLS Date: 3/23/2022

Design Storm: 5-yr

Basin Area Description		DIRECT RUNOFF							TOTAL RUNOFF				REMARKS
		AREA DESIGN (name)	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C.A. (AC)	I IN / HR	Q (CFS)	t_c (MIN)	SUM (C*A) (AC)	I (IN / HR)	Q (CFS)	
(1)		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	
Front Circulation Road		A-EX-1	1.081	0.58	5.00	0.63	4.94	**3.10**	SEE INROADS CALCULATIONS FOR FLOW ROUTING				
Front of Building(s)		A-EX-2	0.347	0.71	5.00	0.25	4.94	**1.21**					
Roof drains to Front		A-EX-3	0.319	0.90	5.00	0.29	4.94	**1.42**					
Playground		A-EX-4	0.604	0.52	5.00	0.31	4.94	**1.54**					
Front Circulation Road		A-EX-5	1.791	0.53	5.00	0.95	4.94	**4.71**					
Upper Parking Lot		A-EX-6	0.430	0.83	5.00	0.36	4.94	**1.75**					
Roof drains to Back		A-EX-7	0.574	0.90	5.00	0.52	4.94	**2.55**					
Channel & undeveloped		A-EX-8	0.808	0.21	5.00	0.17	4.94	**0.84**					
Athletic field & undeveloped		A-EX-9	0.766	0.24	5.00	0.19	4.94	**0.92**					
Back of School Road		A-EX-10	0.985	0.60	5.00	0.59	4.94	**2.94**					
Front Circulation Road		A-0	0.309	0.56	5.00	0.17	4.94	**0.86**	SEE INROADS CALCULATIONS FOR FLOW ROUTING				
Front Circulation Road		A-1	0.754	0.77	5.00	0.58	4.94	**2.88**					
Front of Building(s)		A-EX-2	0.347	0.71	5.00	0.25	4.94	**1.21**					
Roof drains to Front		A-EX-3	0.319	0.90	5.00	0.29	4.94	**1.42**					
Playground		A-4	0.523	0.54	5.00	0.28	4.94	**1.40**					
Front Circulation Road		A-5	1.594	0.55	5.00	0.88	4.94	**4.35**					
Upper Parking Lot		A-6	0.424	0.83	5.00	0.35	4.94	**1.74**					
Roof drains to Back		A-EX-7	0.574	0.90	5.00	0.52	4.94	**2.55**					
Infield & Back Circ.Rd.		A-8	0.254	0.29	5.00	0.07	4.94	**0.36**					
Undeveloped & Back Circ.Rd.		A-9	1.046	0.32	5.00	0.34	4.94	**1.68**					
Athletic Field & Ditch		A-10	0.345	0.31	5.00	0.11	4.94	**0.53**					
Back of School & Circ. Rd.		A-11	1.093	0.68	5.00	0.74	4.94	**3.67**					

(1) Basin Description linked to C-Value Sheet
(2) Basin Design Point (not designated)
(3) Enter the Basin Name from C Value Sheet
(4) Basin Area linked to C-Value Sheet
(5) Composite C linked to C-Value Sheet
(6) Time of Concentration linked to C-Value Sheet
(7) =Column 4 x Column 5
(8) =28.5*P/(10+Column 6)^0.786
(9) =Column 7 x Column 8
(10) =Column 6 + Column 21
(11) Add the Basin Areas (7) to get the combined basin AC
(12) =28.5*P/(10+Column 10)^0.786
(13) Sum of Qs
(14) Additonal Street Overland Flow
(15) Additonal Street Overland Flow
(16) Design Pipe Flow
(17) Pipe Slope
(18) Pipe Size

Standard Form SF-2 . Storm Drainage System Design (Rational Method Procedure)

Corridor / Design Package: Hwy 105 / Monument Academy
System Name: Monument Academy

Computed: AMV Date: 3/10/2022
Checked: JLS Date: 3/23/2022

Design Storm: 10-yr

Basin Area Description		DIRECT RUNOFF							TOTAL RUNOFF				REMARKS
		AREA DESIGN (name)	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C.A. (AC)	I IN / HR	Q (CFS)	t_c (MIN)	SUM (C*A) (AC)	I (IN / HR)	Q (CFS)	
(1)		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	
Front Circulation Road		A-EX-1	1.08	0.64	5.00	0.69	6.06	**4.17**	SEE INROADS CALCULATIONS FOR FLOW ROUTING				
Front of Building(s)		A-EX-2	0.35	0.74	5.00	0.26	6.06	**1.55**					
Roof drains to Front		A-EX-3	0.32	0.92	5.00	0.29	6.06	**1.78**					
Playground		A-EX-4	0.60	0.56	5.00	0.34	6.06	**2.07**					
Front Circulation Road		A-EX-5	1.79	0.59	5.00	1.06	6.06	**6.41**					
Upper Parking Lot		A-EX-6	0.43	0.85	5.00	0.37	6.06	**2.21**					
Roof drains to Back		A-EX-7	0.57	0.92	5.00	0.53	6.06	**3.20**					
Channel & undeveloped		A-EX-8	0.81	0.31	5.00	0.25	6.06	**1.50**					
Athletic field & undeveloped		A-EX-9	0.77	0.33	5.00	0.26	6.06	**1.55**					
Back of School Road		A-EX-10	0.98	0.65	5.00	0.64	6.06	**3.89**					
Front Circulation Road		A-0	0.309	0.62	5.00	0.19	6.06	**1.16**	SEE INROADS CALCULATIONS FOR FLOW ROUTING				
Front Circulation Road		A-1	0.754	0.81	5.00	0.61	6.06	**3.69**					
Front of Building(s)		A-EX-2	0.347	0.74	5.00	0.26	6.06	**1.55**					
Roof drains to Front		A-EX-3	0.319	0.92	5.00	0.29	6.06	**1.78**					
Playground		A-4	0.5229	0.58	5.00	0.31	6.06	**1.85**					
Front Circulation Road		A-5	1.5942	0.608	5.00	0.97	6.06	**5.88**					
Upper Parking Lot		A-6	0.4240	0.856	5.00	0.36	6.06	**2.20**					
Roof drains to Back		A-EX-7	0.5738	0.920	5.00	0.53	6.06	**3.20**					
Infield & Back Circ.Rd.		A-8	0.2541	0.376	5.00	0.10	6.06	**0.58**					
Undeveloped & Back Circ.Rd.		A-9	1.0460	0.409	5.00	0.43	6.06	**2.59**					
Athletic Field & Ditch		A-10	0.3447	0.390	5.00	0.13	6.06	**0.81**					
Back of School & Circ. Rd.		A-11	1.0928	0.719	5.00	0.79	6.06	**4.76**					

(2) Basin Design Point (not designated)
(3) Enter the Basin Name from C Value Sheet
(4) Basin Area linked to C-Value Sheet
(5) Composite C linked to C-Value Sheet
(6) Time of Concentration linked to C-Value Sheet

(8) =28.5*P/(10+Column 6)^0.786
(9) =Column 7 x Column 8
(10) =Column 6 + Column 21
(11) Add the Basin Areas (7) to get the combined basin AC
(12) =28.5*P/(10+Column 10)^0.786

(14) Additonal Street Overland Flow
(15) Additonal Street Overland Flow
(16) Design Pipe Flow
(17) Pipe Slope
(18) Pipe Size

Standard Form SF-2 . Storm Drainage System Design (Rational Method Procedure)

Corridor / Design Package: Hwy 105 / Monument Academy
System Name: Monument Academy

Computed: AMV Date: 3/10/2022
Checked: JLS Date: 3/23/2022

Design Storm: 100-yr

Basin Area Description		DIRECT RUNOFF							TOTAL RUNOFF				REMARKS
		AREA DESIGN (name)	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C.A. (AC)	I IN / HR	Q (CFS)	t_c (MIN)	SUM (C*A) (AC)	I (IN / HR)	Q (CFS)	
(1)		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	
Front Circulation Road		A-EX-1	1.081	0.76	5.00	0.82	10.20	**8.40**	SEE INROADS CALCULATIONS FOR FLOW ROUTING				
Front of Building(s)		A-EX-2	0.347	0.81	5.00	0.28	10.20	**2.88**					
Roof drains to Front		A-EX-3	0.319	0.96	5.00	0.31	10.20	**3.12**					
Playground		A-EX-4	0.604	0.69	5.00	0.42	10.20	**4.24**					
Front Circulation Road		A-EX-5	1.791	0.72	5.00	1.30	10.20	**13.22**					
Upper Parking Lot		A-EX-6	0.430	0.90	5.00	0.39	10.20	**3.94**					
Roof drains to Back		A-EX-7	0.574	0.96	5.00	0.55	10.20	**5.62**					
Channel & undeveloped		A-EX-8	0.808	0.53	5.00	0.43	10.20	**4.37**					
Athletic field & undeveloped		A-EX-9	0.766	0.55	5.00	0.42	10.20	**4.27**					
Back of School Road		A-EX-10	0.985	0.76	5.00	0.75	10.20	**7.67**					
Front Circulation Road		A-0	0.309	0.75	5.00	0.23	10.20	**2.36**	SEE INROADS CALCULATIONS FOR FLOW ROUTING				
Front Circulation Road		A-1	0.754	0.88	5.00	0.67	10.20	**6.78**					
Front of Building(s)		A-EX-2	0.347	0.81	5.00	0.28	10.20	**2.88**					
Roof drains to Front		A-EX-3	0.319	0.96	5.00	0.31	10.20	**3.12**					
Playground		A-4	0.523	0.70	5.00	0.37	10.20	**3.73**					
Front Circulation Road		A-5	1.594	0.74	5.00	1.18	10.20	**11.99**					
Upper Parking Lot		A-6	0.424	0.90	5.00	0.38	10.20	**3.91**					
Roof drains to Back		A-EX-7	0.574	0.96	5.00	0.55	10.20	**5.62**					
Infield & Back Circ.Rd.		A-8	0.254	0.58	5.00	0.15	10.20	**1.50**					
Undeveloped & Back Circ.Rd.		A-9	1.046	0.60	5.00	0.63	10.20	**6.42**					
Athletic Field & Ditch		A-10	0.345	0.58	5.00	0.20	10.20	**2.04**					
Back of School & Circ. Rd.		A-11	1.093	0.81	5.00	0.88	10.20	**9.03**					

(2) Basin Design Point (not designated)
(3) Enter the Basin Name from C Value Sheet
(4) Basin Area linked to C-Value Sheet
(5) Composite C linked to C-Value Sheet
(6) Time of Concentration linked to C-Value Sheet

(8) =28.5*P/(10+Column 6)^0.786
(9) =Column 7 x Column 8
(10) =Column 6 + Column 21
(11) Add the Basin Areas (7) to get the combined basin AC
(12) =28.5*P/(10+Column 10)^0.786

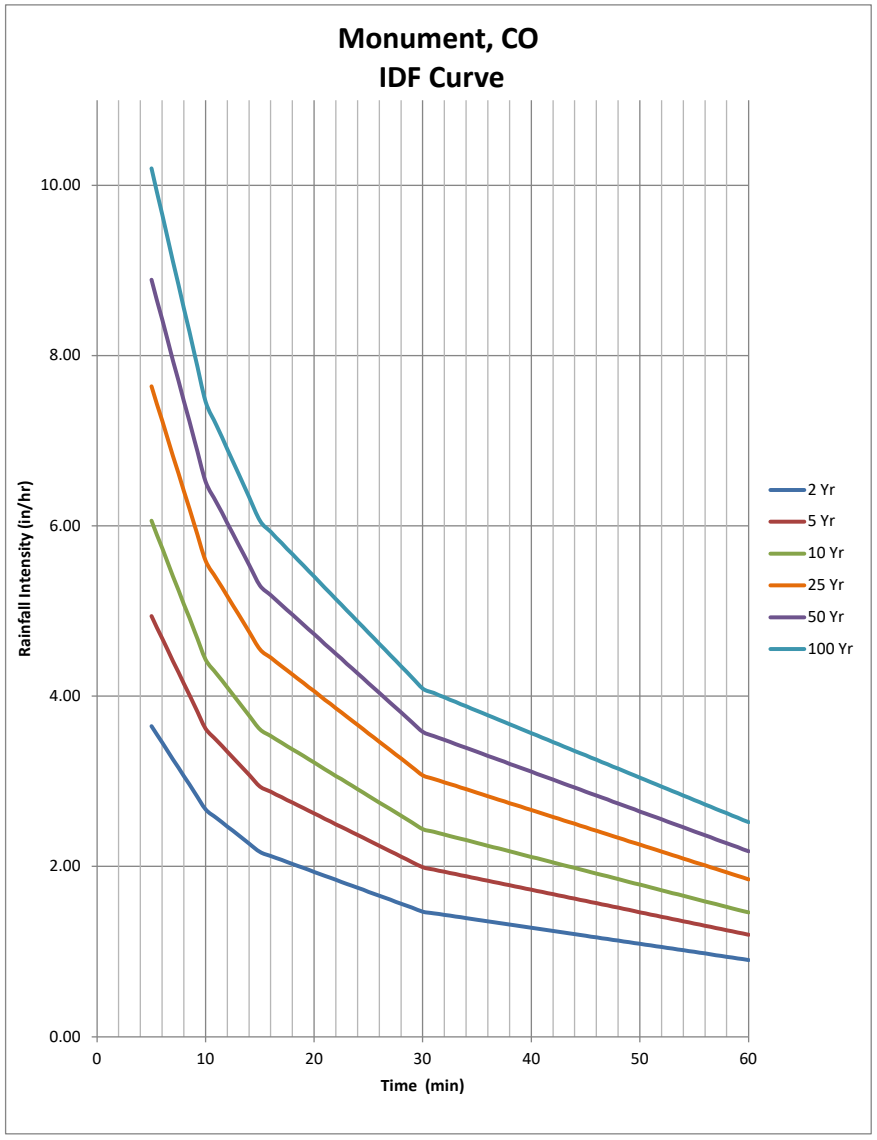
(14) Additonal Street Overland Flow
(15) Additonal Street Overland Flow
(16) Design Pipe Flow
(17) Pipe Slope
(18) Pipe Size

Monument IDF

Computed: AMV Date: 1/12/2022

Checked: JLS Date: 2/2/2022

Time (min)	(in/hr)					
	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
5	3.65	4.94	6.06	7.64	8.89	10.20
6	3.45	4.68	5.73	7.23	8.42	9.65
7	3.26	4.41	5.41	6.82	7.94	9.10
8	3.06	4.15	5.08	6.41	7.47	8.56
9	2.87	3.88	4.76	6.00	6.99	8.01
10	2.67	3.62	4.43	5.59	6.52	7.46
11	2.57	3.48	4.27	5.38	6.28	7.18
12	2.47	3.35	4.10	5.17	6.03	6.90
13	2.37	3.21	3.94	4.97	5.79	6.62
14	2.27	3.08	3.77	4.76	5.54	6.34
15	2.17	2.94	3.61	4.55	5.30	6.06
16	2.12	2.88	3.53	4.45	5.19	5.93
17	2.08	2.81	3.45	4.35	5.07	5.80
18	2.03	2.75	3.38	4.25	4.96	5.67
19	1.98	2.69	3.30	4.16	4.84	5.53
20	1.94	2.62	3.22	4.06	4.73	5.40
21	1.89	2.56	3.14	3.96	4.61	5.27
22	1.84	2.50	3.06	3.86	4.50	5.14
23	1.80	2.43	2.99	3.76	4.38	5.01
24	1.75	2.37	2.91	3.66	4.27	4.88
25	1.70	2.31	2.83	3.56	4.15	4.75
26	1.66	2.24	2.75	3.46	4.04	4.62
27	1.61	2.18	2.67	3.37	3.92	4.48
28	1.56	2.12	2.60	3.27	3.81	4.35
29	1.52	2.05	2.52	3.17	3.69	4.22
30	1.47	1.99	2.44	3.07	3.58	4.09
31	1.45	1.96	2.41	3.03	3.53	4.04
32	1.43	1.94	2.37	2.99	3.49	3.99
33	1.41	1.91	2.34	2.95	3.44	3.93
34	1.39	1.88	2.31	2.91	3.39	3.88
35	1.38	1.86	2.28	2.87	3.35	3.83
36	1.36	1.83	2.24	2.83	3.30	3.78
37	1.34	1.81	2.21	2.79	3.25	3.72
38	1.32	1.78	2.18	2.74	3.21	3.67
39	1.30	1.75	2.15	2.70	3.16	3.62
40	1.28	1.73	2.11	2.66	3.11	3.57
41	1.26	1.70	2.08	2.62	3.07	3.51
42	1.24	1.67	2.05	2.58	3.02	3.46
43	1.22	1.65	2.02	2.54	2.97	3.41
44	1.21	1.62	1.98	2.50	2.93	3.36
45	1.19	1.60	1.95	2.46	2.88	3.31
46	1.17	1.57	1.92	2.42	2.83	3.25
47	1.15	1.54	1.88	2.38	2.79	3.20
48	1.13	1.52	1.85	2.34	2.74	3.15
49	1.11	1.49	1.82	2.30	2.69	3.10
50	1.09	1.46	1.79	2.26	2.65	3.04
51	1.07	1.44	1.75	2.22	2.60	2.99
52	1.05	1.41	1.72	2.18	2.55	2.94
53	1.04	1.38	1.69	2.13	2.51	2.89
54	1.02	1.36	1.66	2.09	2.46	2.83
55	1.00	1.33	1.62	2.05	2.41	2.78
56	0.98	1.31	1.59	2.01	2.37	2.73
57	0.96	1.28	1.56	1.97	2.32	2.68
58	0.94	1.25	1.53	1.93	2.27	2.62
59	0.92	1.23	1.49	1.89	2.23	2.57
60	0.90	1.20	1.46	1.85	2.18	2.52



Calculated using NOAA Atlas 14, Volume 8, Version 2

BENTLEY INROADS REPORT - 10 YEAR PROPOSED

Areas

Drainage Reports

Element Type: Area

Date: Friday, June 3, 2022 12:56:48 PM

Drainage Data File: 10y_105_School

Basin ID	Inlet ID	Peak Flow (cfs)	Area (ac)	Runoff Coef 0	Intensity (in/h)	Time of Conc (min)
A-EX-1	-	4.17	1.08	0.64	6.06	5
A-EX-2	IN-EX-2	1.55	0.35	0.74	6.06	5
A-EX-3	IN-EX-3	1.78	0.32	0.92	6.06	5
A-EX-4	-	2.07	0.6	0.56	6.06	5
A-EX-5	-	6.41	1.79	0.59	6.06	5
A-EX-6	-	2.21	0.43	0.85	6.06	5
A-EX-7	-	3.2	0.57	0.92	6.06	5
A-EX-8	-	1.5	0.81	0.31	6.06	5
A-EX-9	-	1.55	0.77	0.33	6.06	5
A-0	IN-100	1.16	0.31	0.62	6.06	5
A-1	IN-EX-1	3.69	0.75	0.81	6.06	5
A-4	-	1.85	0.52	0.58	6.06	5
A-5	IN-EX-5	5.88	1.59	0.61	6.06	5
A-6	IN-EX-6	2.2	0.42	0.86	6.06	5
A-8	P-108	0.58	0.25	0.38	6.06	5
A-9	-	2.59	1.05	0.41	6.06	5
A-10	-	0.81	0.34	0.39	6.06	5

Number of items reported: 17

Inlets

Drainage Reports

Element Type: Inlet

Date: Friday, June 3, 2022 1:44:43 PM

Drainage Data File: 10y_105_School

ID	Type	InletClass	GrateLen (ft)	GrateWid (ft)	Location	VaultShape	Clogging (%)	Bypass To	Bypass Flow (cfs)	Inlet Depr (in)	Spread (ft)
IN-100	Curb Opening	TYPE R	5	0	On-Grade	Box	30	IN-EX-1	0.22	3	2.784
IN-EX-1	Curb Opening	TYPE R	5	0	Sump	Box	30	N/A	0	3	4.694
IN-EX-2	Grate	Grate	1.33	1.33	On-Grade	Box	30	IN-EX-3	0.85	0	5.43
IN-EX-3	Grate	Grate	1.33	1.33	On-Grade	Box	30	IN-EX-4	1.57	0	6.273
IN-EX-4	Grate	Grate	1.33	1.33	On-Grade	Box	30	IN-EX-7	0	0	0
IN-EX-5	Curb Opening	TYPE R	5	0	Sump	Box	30	N/A	0	3	6.229
IN-EX-6	Curb Opening	TYPE R	5	0	On-Grade	Box	30	IN-EX-5	0.55	3	3.092
IN-EX-7	Grate	Grate	1.33	1.33	On-Grade	Box	30	-	0	0	0

Number of items reported: 8

Manholes

Drainage Reports

Element Type: Manhole

Date: Friday, June 3, 2022 1:44:58 PM

Drainage Data File: 10y_105_School

Manhole ID	Shape	Rim (ft)	Width (ft)	Length (ft)	Type	Total Flow (cfs)	Headloss (ft)
MH-102	Circular	7077.2	4	4	13.28	0	0
MH-EX-1	Circular	7094.69	4	4	5.31	0	0
MH-EX-2	Circular	7094.17	4	4	13.36	0	0
MH-EX-3	Box	7083.93	3	6	13.36	0	0
UD-C-1	Circular	7077.19	0.5	0.5	0	0	0
UD-C-2	Circular	7078.99	0.5	0.5	0	0	0

Number of items reported: 6

Pipes

Drainage Reports

0
0
Element Type: Pipe
0
Date: Friday, June 3, 2022 1:45:27 PM
0
Drainage Data File: 10y_105_School
0

Pipe ID	U/S ID	D/S ID	Material	Mannings n	Height	Width	Length	Invert In	Invert Out	Slope	Total Flow	Capacity	Velocity	Flow Depth	U/S HGL	D/S HGL	U/S EGL	D/S EGL	Headloss
0	0	0	0	0	(in)	(in)	(ft)	(ft)	(ft)	(%)	(cfs)	(cfs)	(ft/s)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
P-101	IN-100	IN-EX-1	RCP	0.013	18	18	39.35	7088.85	7087.08	4.5	0.94	22.28	6.24	0.21	7089.06	7087.29	7089.66	7087.89	0
P-102	MH-102	FREE_EXT	RCP	0.013	24	24	20.54	7068.21	7068	1	13.14	22.62	7.46	1.09	7069.3	7069.09	7070.16	7069.96	0
P-104	P-EX-19	FREE_EXT	RCP	0.013	18	18	20.78	7069.58	7068.4	5.67	0	0	0	0	0	0	0	0	0
P-108	FREE_ENT	FREE_EXT	RCP	0.013	18	18	61.5	7071.33	7068.36	4.83	0.58	23.09	5.51	0.16	7071.49	7068.52	7071.96	7068.99	0
P-EX-1	IN-EX-1	P-EX-3	RCP	0.013	24	24	45.85	7085.67	7085.44	0.5	4.8	16	4.45	0.75	7086.42	7086.19	7086.72	7086.49	0
P-EX-2	IN-EX-2	P-EX-3	RCP	0.013	12	12	18.74	7086	7085.44	3	0.7	6.17	5.19	0.23	7086.23	7086.11	7086.64	7086.53	0
P-EX-3	Y_JUNCT	P-EX-4	RCP	0.013	24	24	113.1	7085.44	7084.88	0.5	5.44	16	4.6	0.8	7086.24	7085.69	7086.57	7086.02	0
P-EX-4	P-EX-3	P-EX-5	RCP	0.013	24	24	14.51	7084.88	7084.81	0.5	5.32	16	4.57	0.79	7085.68	7085.61	7086	7085.93	0
P-EX-5	P-EX-4	MH-EX-1	RCP	0.013	24	24	20.39	7084.81	7084.71	0.5	5.31	16	4.57	0.79	7085.6	7085.5	7085.93	7085.83	0
P-EX-6	MH-EX-1	P-EX-8	RCP	0.013	24	24	34.81	7083.7	7083.53	0.5	5.28	16	4.56	0.79	7084.49	7084.32	7084.81	7084.64	0
P-EX-7	IN-EX-3	P-EX-8	RCP	0.013	12	12	37.48	7089.65	7083.53	16.34	1.04	14.4	10.58	0.18	7089.83	7084.24	7091.57	7085.98	0
P-EX-8	Y_JUNCT	P-EX-9	RCP	0.013	24	24	45.39	7083.53	7083.31	0.5	6.23	16	4.77	0.87	7084.39	7084.17	7084.75	7084.53	0
P-EX-9	P-EX-8	P-EX-10	RCP	0.013	24	24	41.07	7083.31	7083.1	0.5	6.18	16	4.76	0.86	7084.17	7083.97	7084.52	7084.32	0
P-EX-10	P-EX-9	P-EX-13	RCP	0.013	24	24	97.41	7083.1	7082.62	0.5	6.14	16	4.75	0.86	7083.96	7084.25	7084.31	7084.6	0
P-EX-11	IN-EX-4	IN-EX-5	RCP	0.013	12	12	29.39	7088.18	7087.06	3.81	0	0	0	0	0	0	0	0	0
P-EX-12	IN-EX-5	P-EX-13	RCP	0.013	18	18	12.76	7083.97	7082.62	10.6	6.41	34.21	3.63	1.5	7087.14	7086.8	7087.34	7087.29	0.05
P-EX-13	Y_JUNCT	MH-EX-2	RCP	0.013	24	24	41.79	7082.62	7082.41	0.5	11.94	16	5.58	1.29	7084.25	7084.03	7084.73	7084.51	0.22
P-EX-14	IN-EX-6	P-EX-15	RCP	0.013	18	18	64.8	7105.07	7095.48	14.8	1.64	40.41	11.13	0.21	7105.28	7095.69	7107.2	7097.61	0
P-EX-15	P-EX-14	MH-EX-2	RCP	0.013	18	18	67.78	7095.48	7085.31	15	1.63	40.68	11.23	0.2	7095.68	7085.52	7097.64	7087.48	0
P-EX-16	MH-EX-2	MH-EX-3	RCP	0.013	24	24	61.12	7081.41	7080.55	1.4	13.36	26.77	8.52	1	7082.41	7081.55	7083.53	7082.68	0
P-EX-17	IN-EX-7	MH-EX-3	RCP	0.013	12	12	30.8	7081.02	7077.94	10	0	0	0	0	0	0	0	0	0
P-EX-18	MH-EX-3	P-102	RCP	0.013	24	24	127.81	7075.38	7072.83	2	13.28	31.99	9.7	0.9	7076.28	7073.73	7077.74	7075.19	0
P-EX-19	FREE_ENT	P-104	RCP	0.013	18	18	60.34	7070.79	7069.58	2	0	0	0	0	0	0	0	0	0
UD-P-2	UD-C-2	FREE_EXT	PVC	0.009	6	6	46.07	7070.41	7069.72	1.5	0	0	0	0	0	0	0	0	0
UD-P-1A	UD-C-1	UD-P-1B	PVC	0.009	6	6	5.41	7070.97	7070.89	1.5	0	0	0	0	0	0	0	0	0
UD-P-1B	UD-P-1A	UD-P-1C	PVC	0.009	6	6	27	7070.89	7070.49	1.5	0	0	0	0	0	0	0	0	0
UD-P-1C	UD-P-1B	UD-C-2	PVC	0.009	6	6	5.41	7070.49	7070.41	1.5	0	0	0	0	0	0	0	0	0

0

0
Number of items reported: 27

Hydraulic Analysis Report

Project Data

Project Title: Monument Academy

Designer:

Project Date: Friday, June 3, 2022

Project Units: U.S. Customary Units

Notes:

Channel Analysis: Channel Analysis

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 3.0000 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Longitudinal Slope: 0.1905 ft/ft

Manning's n: 0.0727

Lining Type: Rock Riprap - 300 mm (12-inch)

Flow: 2.5900 cfs

Result Parameters

Depth: 0.5018 ft

Area of Flow: 0.7555 ft^2

Wetted Perimeter: 3.1738 ft

Hydraulic Radius: 0.2380 ft

Average Velocity: 3.4283 ft/s

Top Width: 3.0109 ft

Froude Number: 1.2061

Critical Depth: 0.5409 ft

Critical Velocity: 2.9510 ft/s

Critical Slope: 0.1277 ft/ft

Critical Top Width: 3.25 ft

Calculated Max Shear Stress: 5.9653 lb/ft^2

Calculated Avg Shear Stress: 2.8296 lb/ft^2

Channel Lining Analysis: Channel Lining Design Analysis

Notes:

Lining Input Parameters

Channel Lining Type: Riprap, Cobble, or Gravel

D50: 1 ft

Riprap Specific Weight: 165 lb/ft^3

Water Specific Weight: 62.4 lb/ft^3

Riprap Shape is Angular

Safety Factor: 1

Calculated Safety Factor: 1.32551

Lining Results

Angle of Repose: 41.7 degrees

Relative Flow Depth: 0.250733 ft

Manning's n method: Bathurst

Manning's n: 0.0726643

Channel Bottom Shear Results

V*: 1.75387

Reynold's Number: 144114

Shield's Parameter: 0.114023

shear stress on channel bottom: 5.96103 lb/ft^2

Permissible shear stress for channel bottom: 8.83223 lb/ft^2

channel bottom is stable

Stable D50: 0.894612 ft

Channel Side Shear Results

K1: 0.868

K2: 1

Kb: 1.05

shear stress on side of channel: 5.96103 lb/ft^2

Permissible shear stress for side of channel: 8.83223 lb/ft^2

Stable Side D50: 0.776523 lb/ft^2

side of channel is stable

Channel Bend Shear Results

Curvature Radius: 39 ft

No further correction will occur once R/T > 10

shear stress on bottom of channel in bend: 6.25909 lb/ft^2

bottom of bend of the channel is stable

Length of Protection beyond PT: 1.54603 ft

Additional Freeboard required because of Superelevation: 0.0282626 ft

Channel Bend Side Shear Results

shear stress on side of channel in bend: 5.43289 lb/ft^2

The side of the bend of the channel is stable

Channel Lining Stability Results

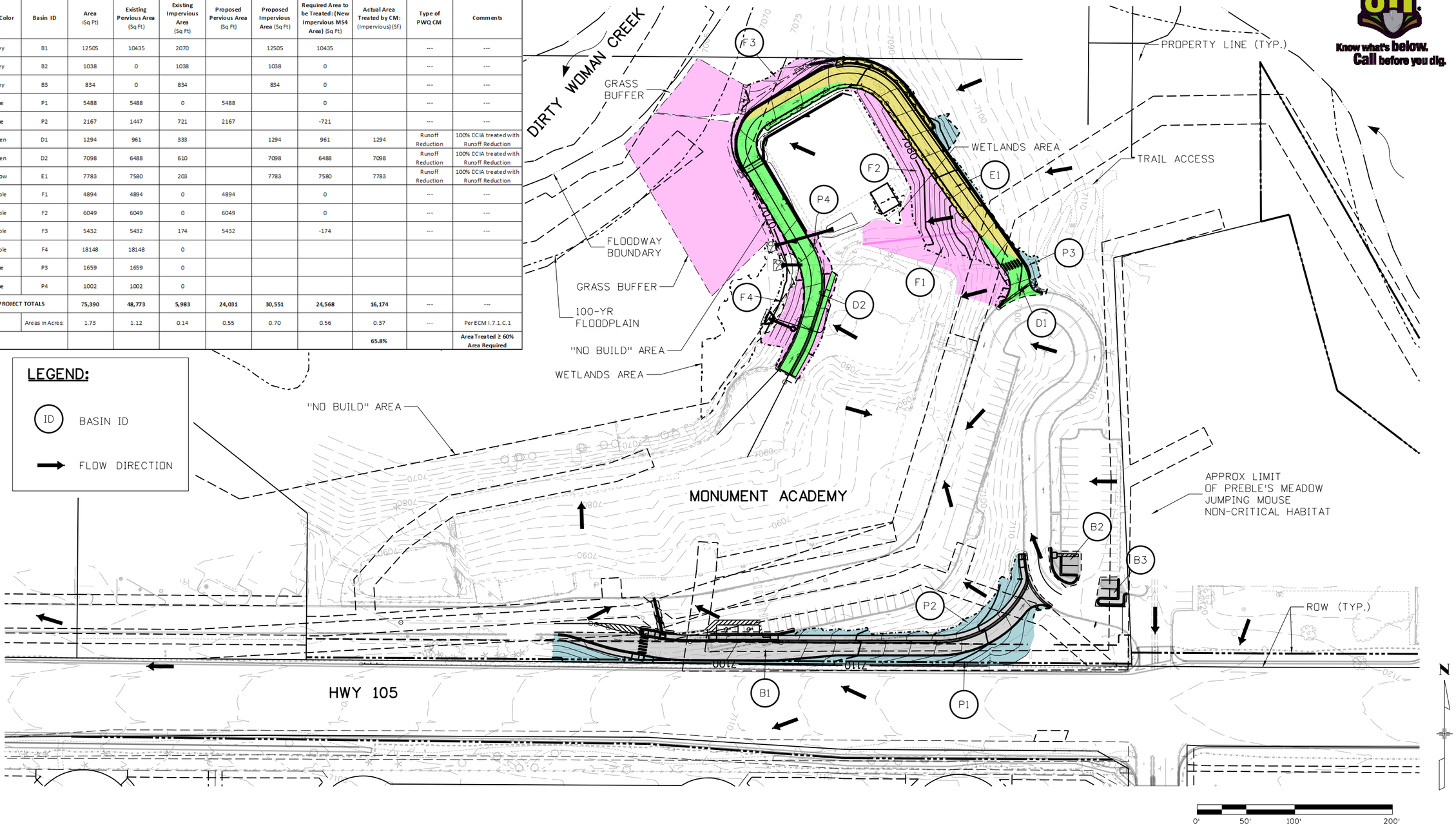
the channel is stable

Channel Summary

Name of Selected Channel: Channel Analysis

WQCV BY NEW IMPERVIOUS AREA & REDUCTION RUNOFF

Basin Color	Basin ID	Area (Sq Ft)	Existing Pervious Area (Sq Ft)	Existing Impervious Area (Sq Ft)	Proposed Pervious Area (Sq Ft)	Proposed Impervious Area (Sq Ft)	Required Area to be Treated: (New Impervious MS4 Area) (Sq Ft)	Actual Area Treated by CM: (Impervious) (Sf)	Type of PWQ CM	Comments
Grey	B1	12505	10435	2070		12505	10435		---	---
Grey	B2	1038	0	1038		1038	0		---	---
Grey	B3	834	0	834		834	0		---	---
Blue	P1	5488	5488	0	5488		0		---	---
Blue	P2	2167	1447	721	2167		-721		---	---
Green	D1	1294	961	333		1294	961	1294	Runoff Reduction	100% DCIA treated with Runoff Reduction
Green	D2	7098	6488	610		7098	6488	7098	Runoff Reduction	100% DCIA treated with Runoff Reduction
Yellow	E1	7783	7580	203		7783	7580	7783	Runoff Reduction	100% DCIA treated with Runoff Reduction
Purple	F1	4894	4894	0	4894		0		---	---
Purple	F2	6049	6049	0	6049		0		---	---
Purple	F3	5432	5432	174	5432		-174		---	---
Purple	F4	18148	18148	0						
Blue	P3	1659	1659	0						
Blue	P4	1002	1002	0						
PROJECT TOTALS		**75,390**	**48,773**	**5,983**	**24,031**	**30,551**	**24,568**	**16,174**	---	---
	Areas in Acres:	1.73	1.12	0.14	0.55	0.70	0.56	0.37	---	Per ECM I.7.1.C.1
								65.8%		**Area Treated ≥ 60% Area Required**



LEGEND:

- (ID) BASIN ID
- FLOW DIRECTION

811 Know what's below. Call before you dig.

5555 TECH CENTER DRIVE, SUITE 310
COLORADO SPRINGS, CO 80919 PHONE: 719-272-8800

Print Date: 6/28/2023
File Name: School Access HYDR_PCSM.dgn
Horiz. Scale: 1:100 Vert. Scale: None

Sheet Revisions		
Date:	Comments	Init.

As Constructed
No Revisions:
Revised:
Void:

MONUMENT ACADEMY POST CONSTRUCTION STORMWATER MANAGEMENT

Designer:	A.VANCE	Structure Numbers	
Detailer:	A.VANCE		
Sheet Subset:	WQ-MAP	Subset Sheets:	1 of 1

Project No./Code: 19734
STA 105A-014
Sheet Number MAP-WQ

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018) **Sheet 1 of 1**

Designer:	**A.Vance / EVS**
Company:	**HDR**
Date:	**June 28, 2023**
Project:	**Monument Academy**
Location:	**Monument Academy**

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth	0.43	inches
Depth of Average Runoff Producing Storm, d_6 =	0.43	inches (for Watersheds Outside of the Denver Region, Figure 3-1

Area Type	DCIA	UIA:RPA	UIA:RPA	UIA:RPA			
Area ID	Front (B,C)	D1	E1	D2			
Downstream Design Point ID	102-Out	F1	F2,F3	F4			
Downstream BMP Type	None	None	None	None			
DCIA (ft^2)	14,377	--	--	--			
UIA (ft^2)	--	1,294	7,783	7,098			
RPA (ft^2)	--	4,894	11,481	19,324			
SPA (ft^2)	--	--	--	--			
HSG A (%)	--	0%	0%	0%			
HSG B (%)	--	0%	0%	0%			
HSG C/D (%)	--	100%	100%	100%			
Average Slope of RPA (ft/ft)	--	0.100	0.100	0.100			
UIA:RPA Interface Width (ft)	--	105.00	200.00	200.00			

CALCULATED RUNOFF RESULTS

Area ID	Front (B,C)	D1	E1	D2			
UIA:RPA Area (ft^2)	--	6,188	19,264	26,422			
L / W Ratio	--	0.56	0.48	0.66			
UIA / Area	--	0.2091	0.4040	0.2686			
Runoff (in)	0.33	0.00	0.00	0.00			
Runoff (ft^3)	395	0	0	0			
Runoff Reduction (ft^3)	0	36	214	195			

CALCULATED WQCV RESULTS

Area ID	Front (B,C)	D1	E1	D2			
WQCV (ft^3)	599	54	324	296			
WQCV Reduction (ft^3)	204	54	324	296			
WQCV Reduction (%)	34%	100%	100%	100%			
Untreated WQCV (ft^3)	395	0	0	0			

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	102-Out	F1	F2,F3	F4			
DCIA (ft^2)	14,377	0	0	0			
UIA (ft^2)	0	1,294	7,783	7,098			
RPA (ft^2)	0	4,894	11,481	19,324			
SPA (ft^2)	0	0	0	0			
Total Area (ft^2)	14,377	6,188	19,264	26,422			
Total Impervious Area (ft^2)	14,377	1,294	7,783	7,098			
WQCV (ft^3)	599	54	324	296			
WQCV Reduction (ft^3)	204	54	324	296			
WQCV Reduction (%)	34%	100%	100%	100%			
Untreated WQCV (ft^3)	395	0	0	0			

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	66,251
Total Impervious Area (ft^2)	30,552
WQCV (ft^3)	1,273
WQCV Reduction (ft^3)	878
WQCV Reduction (%)	68.9%
Untreated WQCV (ft^3)	395