MVE, INC.
ENGINEERS SURVEYORS
1903 lelaray street, suite 200
colorado springs, co 80909
719.635.5736

Final Drainage Report

Crowe Subdivision Filing No. 1

Project No. 61138

May 12, 2021

PCD File No.

MS215

Final Drainage Report

for

Crowe Subdivision Filing No. 1

Project No. 61138

May 12, 2021

prepared for

Michael B. Crowe
15980 Roller Coaster Road
Colorado Springs, CO 80921

prepared by

MVE, Inc.
1903 Lelaray Street, Suite 200
Colorado Springs, CO 80909
719.635.5736

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Statements and Acknowledgments

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.

_____ _____

David R. Gorman, P.E. Colorado No. 31672 Date
For and on Behalf of MVE, Inc.

Developer's Statement

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

_____ _____

Michael B. Crowe Date
Owner
15980 Roller Coaster Road
Colorado Springs, CO 80921

El Paso County

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

_____ _____

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

Contents

Final Drainage Report

The purpose of this Final Drainage Report is to identify drainage patterns and quantities within and affecting the proposed Crowe Subdivision Filing No. 1 site. The development project is a residential subdivision with 5.0± acre lots. The report will identify specific solutions to drainage concerns on-site and off-site resulting from the proposed project. The report and included maps present results of hydrologic and drainage facilities analyses. The report will discuss the recommended drainage improvements to the site and identify drainage requirements relative to the proposed project. This report has been prepared and submitted in accordance with the requirements of the El Paso County development approval process. An Appendix is included with this report with pertinent calculations and graphs used in the drainage analyses and design.

1 General Location and Description

1.1 Location

The proposed Crowe Subdivision Filing No. 1 site is located within the northeast one-quarter of the southwest one-quarter of Section 28, Township 11 South, Range 66 west of the 6th principal meridian in El Paso County, Colorado. The 20.052± acre site is situated on the west side of Roller Coaster Road, north of Stella Drive, south of Baptist Drive. Roller Coaster Road, a public asphalt road with 100 ft right-of-way, is adjacent to the eastern edge of the site. Lots 1, 2, and 3 Andrene Subdivision (Zone RR-5) with existing single-family residential development is south of the site on the same side of Roller Coaster Road. An unplatted parcel zoned RR-5 with existing single family residential development is located on the north side and west side of the site. Lots 1 through 4 Aspen Woods (zone RR5) with existing single-family residential development is east of the site on the other side of Roller Coaster Road. The El Paso County Assessor's Schedule Number for the site is 6128000001. The proposed site has never been platted. A **Vicinity Map** is included in the **Appendix**. The site is located in El Paso County's Smith Creek Drainage Basin.

1.2 Description of Property

The Crowe Subdivision Filing No. 1 site 20.052± acres and is zoned RR-5 (Residential Rural (5 Acres)). The property is the location of a single-family residence with an existing gravel driveway. The proposed Crowe Subdivision Filing No. 1 includes 3 rural residential lots, and about 1,845 feet of gravel driveways.

The ground cover, which is in fair to good condition, consists of native grasses, sparse brush and mature coniferous trees. The tree coverage is dense throughout the site.

The existing site topography slopes to the south with grades that range from 7% to 19%.

There are no major drainage ways in the Crowe Subdivision Filing No. 1 site. All storm runoff flows drain south. There is no storm drain system in the surrounding area. The site is located within the smith creek major drain basin. The flows from the site flow south and eventually enter smith creek which is a tributary to Monument creek.

According to the National Resource Conservation Service, there are two (2) soil types in the Crowe Subdivision Filing No. 1 site. Kettle gravelly loamy sand (map unit 41) makes up about 93% of the

soil on the site. The soil is deep and somewhat excessively drained. Permeability is moderately rapid, surface runoff is slow, and the hazard of erosion is slight to moderate. Kettle gravelly loamy sand is classified as being part of Hydrologic Soil Group B.

The other soil type located on the site is Pring Coarse Sandy Loam (map unit 71) which makes up the remaining 7% of the soil on the site. The soil is deep and well drained. Permeability is moderately rapid, surface runoff is slow, and the hazard of erosion is slight to moderate. Pring Coarse Sandy Loam is classified as being part of Hydrologic Soil Group B.

A portion of the Soil Map and data tables from the National Cooperative Soil Survey and relevant Official Soil Series Descriptions (OSD) are included in the **Appendix**.[1] [2]

2 Drainage Basins and Sub-Basins

2.1 Major Basin Descriptions

The Crowe Subdivision Filing No. 1 site is located in the Smith Creek Drainage Basin (FOMO4000) of the Monument Creek Major Drainage Basin. The Smith Creek Drainage Basin Covers an area of approximately 5.48 square miles and drains to Monument Creek. The Smith *Creek Drainage Basin Planning Study* (DBPS) provides development recommendations and requirements for drainage development in the Smith Creek Drainage Basin.[3] The Smith Creek Drainage Basin encompasses a small portion of the City of Colorado Springs and extends to the north and east in El Paso County. The drainage basin and Smith Creek drain south into Monument Creek. The Crowe Subdivision Filing No. 1 site is located north of Smith Creek as it flows offsite towards Monument Creek . The site is located in sub-basins 209, 211, 2015, and 219 upstream of Design Point 215 of the Drainage Basin Planning Study. No improvements are recommended on or near the project site. The proposed Crowe Subdivision Filing No. 1 project is in conformance with the DBPS.

The current Flood Insurance Study of the region includes Flood Insurance Rate Maps (FIRM), effective on December 7, 2018.[4] The proposed subdivision is included in the Community Panel Numbered 08041C0285 G of the Flood Insurance Rate Maps for the El Paso County. No part of the site is shown to be included in a 100-year flood hazard area as determined by FEMA. A portion of the current FEMA Flood Insurance Rate Maps with the site delineated is included in the **Appendix**.

2.2 Sub-Basin Description

The existing drainage patterns of the Crowe Subdivision Filing No. 1 project are described by three (3) on-site drainage basins and four (4) offsite basins. All of these basins are previously undisturbed or developed to a degree as described below. All existing basin delineations and data are depicted on the attached **Existing Drainage Map**.

2.2.1 Existing Drainage Patterns (Off-Site)

Existing off-site sub-basin OS-B1 is located north of the site, containing pasture/meadow areas, drains south onto the site. This flow enters the onsite sub-basin B2 and continues through the site.

Existing off-site sub-basin OS-D1 is located north of the site just east of sub-basin OS-B1, containing pasture/meadow areas, drains southeast away from the site into a ditch that runs along Roller Coaster Road where it combines with flows from off site sub-basin OS-D2.

Existing off-site sub-basin OS-C1 is located north of the site just south of OS-D1, containing pasture/meadow areas, drains south into the site. The flow enters the onsite sub-basin C1 and continues through the site.

Existing off-site sub-basin OS-D2, located east of the site and south of sub-basin OS-D1, contains pasture/meadow areas, the west half of Roller Coaster Road and the west roadside ditch. The sub-

flow enters C2 per the existing drainage map. Please revise.

1 WSS
2 OSD
3 DBPS
4 FIRM

EX-B2 per the existing conditions drainage plan. Please revise accordingly.

EX-A1

basin accepts the storm runoff from off-site sub-basin OS-D1. The combined flows of OS-D1 and OS-D2 flow south and away from the site in the Roller Coaster Road west ditch.

2.2.2 Existing Drainage Patterns (On-Site)

The site generally drains to the south. Existing sub-basin EX-A1 is located in the southwestern portion of the site, containing pasture/meadow, drains south into the adjacent site. These flows continue south through the adjacent properties.

Existing sub-basin EX-B1 is located in the central portion of the site, just east of sub-basin B1. The sub-basin contains an existing single-family residence, and pasture/meadow areas. This sub-basin accepts the flows from off-site sub-basin OS-B1 from the north. The combined flows of sub-basin OS-B1 and sub-basin B1 continue to the south and exit to the adjacent property. These flows continue south through adjacent properties toward smith creek.

Existing sub-basin EX-C2 is located on the east side of the site and contains pasture/meadow areas. The sub-basin accepts flows from off-site sub-basin OS-C1. The combined flows of sub-basin OS-C1 and EX-C2 drains to the south and exits the site into the adjacent property. These flows continue south through the adjacent properties to Smith Creek. All flows from the site eventually enter Monument Creek.

3 Drainage Design Criteria

3.1 Development Criteria Reference

This Final Drainage Report for Crowe Subdivision Filing No. 1 has been prepared according to the report guidelines presented in the latest edition of *El Paso County Drainage Criteria Manual* (DCM)[5]. The County has also adopted portions of the City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2, especially concerning the calculation of rainfall runoff flow rates.[6] [7] The hydrologic analysis is based on a collection of data from the DCM, the NRCS Web Soil Survey[8], and existing topographic data by Polaris.

3.2 Previous Drainage Studies

No drainage reports were found for any of the surrounding developments including either Aspen Woods or Andrene Subdivision.

3.3 Hydrologic Criteria

For this Final Drainage Report, the Rational Method as described in the D*rainage Criteria Manual* has been used for all Storm Runoff calculations, as the development and all sub-basins are less than 130 acres in area. "Colorado Springs Rainfall Intensity Duration Frequency" curves, Figure 6-5 in the DCM, was used to obtain the design rainfall values; a copy is included in the **Appendix**. The "Overland (Initial) Flow Equation" (Eq. 6-8) in the DCM, and Manning's equation with estimated depths were used in time of concentration calculations. "Runoff Coefficients for Rational Method", Table 6-6 in the DCM, was utilized as a guide in estimating runoff coefficient and Percent Impervious values; a copy is included in the **Appendix**. Peak runoff discharges were calculated for each drainage sub-basin for both the 5-year storm event and the 100-year storm event with the Rational Method formula, (Eq. 6-5) in the DCM.[9]

In the case of any required stormwater quality treatment and/or stormwater detention requirements, the "Water Quality Control Volume procedure, Section 3.2.3 of the *Urban Drainage and Flood Control District Drainage Criteria Manual, Volume 3* (UDFCD)[10] [11]method was used for water quality volume calculations with the aid of the "UD-BMP_v3.06" spreadsheet developed by the Urban

5 DCM Section 4.3 and Section 4.4
6 CS DCM Vol 1
7 CS DCM Vol 2
8 WSS
9 DCM
10 UDFCD V.2
11 UDFCDV.3

Please revise the highlighted section as this discusses water quality and detention calculations yet the subsequent section indicates that water quality is not needed.

Drainage and Flood Control District. Storm routing calculation through the proposed water quality basin was performed using triangular hydrographs based on the rational method peak discharges and times of concentrations with the aid of the detention design spreadsheet, "UD-Detention_v3.07", developed by the Urban Drainage and Flood Control District.[12]

4 Drainage Facility Design

4.1 General Concept

The intent of the drainage concept presented in this Final Drainage Report is to allow for the development of the two five (5) acres lots and one one nine (9) acre lot while maintaining the existing drainage patterns on the site. The site will be in compliance with the County's Stormwater Management regulations without the need for permanent water quality treatment facilities. Major and minor storm flows will continue to be safely conveyed through the site and downstream.

The existing and proposed drainage hydrologic conditions are described in more detail below. Input data and results for all calculations are included in the **Appendix**. Drainage maps for the hydrology are also included in the **Appendix**.

4.2 Specific Details

4.2.1 Existing Hydrologic Conditions

The Crowe Subdivision Filing No. 1 site includes seven (7) sub-basins, three (3) on site and four (4) off site. The site generally drains south toward smith creek which is a tributary to monument creek. The sub-basins are described in more detail below.

Existing sub-basin EX-A1, located on the west side of the site, is 2.85± acres in area. Sub-basin A1 contains a meadow/pasture area. Peak storm runoff rates are Q_5 = 0.8 cfs and Q_{100} = 6.1 cfs (existing flows) which drain off-site to the south. These flows continue south through the adjacent properties to Smith creek.

The off-site drainage area north of the site, sub-basin OS-B1, is an undeveloped property containing pasture/meadow. The sub-basin is 64.09± acres in area and drains south into sub-basin B2. Sub-basin OS-B1 generates peak storm runoff discharges of Q_5 = 13.4 cfs and Q_{100} = 96.1 cfs (existing flows) which enters sub-basin B2. Once on the site, these flows continue to drain to the south to design point 1 (DP1).

Existing sub-basin EX-B2, located in the central and western portions of the site, is 11.38± acres in area and accepts the flows from off-site sub-basin OS-B1. Sub-basin EX-B2 contains an existing single-family residence, a gravel driveway, and meadow/pasture area. Peak storm runoff rates are Q_5 = 3.5 cfs and Q_{100} = 23.3 cfs (existing flows) which drain south to DP1. These flows continue to drain south through adjacent properties. The combined peak storm runoff rates flowing to DP1 are Q_5 = 15.3 cfs and Q_{100} = 111.0 cfs (existing flows) which flow south through adjacent properties to smith creek.

Existing off-site sub-basin OS-C1 is 3.48± acres in area, located north of the site, contains pasture/meadow area. Sub-basin OS-C1 produces peak discharges of Q_5 = 1.0 cfs and Q_{100} = 7.2 cfs (existing flows) which drain south and into sub-basin EX-C2. Once on the site, these flows continue to drain to the south to design point 2 (DP2).

Existing sub-basin EX-C2, located on the east side of the site, is 4.80± acres in area and accepts the flows from off-site sub-basin OS-C1 . Sub-basin EX-C2 contains a meadow/pasture area and an existing gravel driveway. Peak storm runoff rates are Q_5 = 1.5 cfs and Q_{100} = 10.1 cfs (existing flows) which drain south to design point 2 (DP2). The combined peak storm runoff rates flowing to DP2 are

12 UDFCD

Q_5 = 2.4 cfs and Q_{100} = 16.5 cfs (existing flows) which flow south through adjacent properties to smith creek.

Existing off-site sub-basin OS-D1, also located north of the site, is 37.09± acres in area. Sub-basin OS-D1 contains the west side of Roller Coaster Road and meadow/pasture area. Peak storm runoff rates are Q_5 = 10.9 cfs and Q_{100} = 60.7 cfs (existing flows) which drain southeast into offsite sub-basin OS-D2 at design point 3 (DP3). These flows continue to drain to the south along Roller Coaster Road in the roadside ditch to design point 4 (DP4).

Existing off-site sub-basin OS-D2, located east of the site, is 0.82± acres in area and accepts the flows from off-site sub-basin OS-D1 . Sub-basin OS-D2 contains the west side of Roller Coaster Road and meadow/pasture area. The sub-basin generates flows of Q_5 = 0.9 cfs and Q_{100} = 2.6 cfs (existing flow), which drains south along the west side of Roller Coaster Road in the roadside ditch. These flows, along with the flows from existing sub-basin OS-D1, continue to drain to the south to design point 4 (DP4).

4.2.2 Proposed Hydrologic Conditions

The proposed drainage basins for Crowe Subdivision Filing No. 1 mirror the existing basins as there are no changes being made to the site that will affect drainage basin boundaries or drainage patterns. Seven (7) sub-basins, three (3) on-site and four (4) off-site, have been identified in the Crowe Subdivision Filing No. 1 project site for analysis and design of the developed drainage system. The sub-basins are described in more detail below.

Proposed sub-basin A1 (2.85 acres) will continue to drain off of the site to the as in existing conditions. Sub-basin A1, located on the western side of the site, will be developed with a portion of the new single-family residence and gravel driveway for Lot 3. Proposed Basin A1 will generate peak storm runoff discharges of Q_5 = 1.4 cfs and Q_{100} = 6.9 cfs (proposed flows) which exits the site at to the south. This represents negligible increases in peak discharges of 0.6 cfs in the 5-year rainfall event and 0.8 cfs in the 100-year event. The developed flows will continue to drain to the south through adjacent properties toward smith creek.

Off-site sub-basin OS-B1 (64.09 acres) will continue to drain into the site as in existing conditions. Sub-basin OS-B1 generates peak storm runoff discharges of Q_5 = 13.4 cfs and Q_{100} = 96.1 cfs which enter sub-basin B2. Once in the site, these flows continue to drain to the south to design point 1 (DP1).

Proposed sub-basin B2 (11.39 acres) will continue to accept the flows from off-site sub-basin OS-B1 as in existing conditions. The proposed sub-basin B2 will not be further developed in the proposed condition, except for the relocation and extension of the gravel driveway from Roller Coaster Road. The existing two (2) single-family residences and other existing improvements will remain in place. Sub-basin B2 will generate peak storm runoff discharges of Q_5 = 4.1 cfs and Q_{100} = 24.0 cfs (proposed flow) which drain south to design point 1 (DP1). The combined flows of sub-basins OS-B1 and B2 at DP1 generate peak storm runoff discharges of Q_5 = 15.8 cfs and Q_{100} = 111.5 cfs (proposed flow). This represents negligible increases in peak discharges of 0.3 cfs in the 5-year rainfall event and 0.5 cfs in the 100-year event.

Off-site sub-basin OS-C1 (3.48 acres) will continue to drain into the site as in existing conditions. Sub-basin OS-C1 generates peak storm runoff discharges of Q_5 = 1.0 cfs and Q_{100} = 7.2 cfs which enters sub-basin C2. Once in the site, these flows continue to drain to the south to design point 2 (DP2).

Proposed sub-basin C2 (4.80 acres) will continue to accept the flows from off-site sub-basin OS-C1 as in existing conditions. The proposed sub-basin C2 will contain one (1) single family residence and gravel driveway for proposed Lot 1 on the east side of the site. Sub-basin C2 will generate peak storm runoff discharges of Q_5 = 1.9 cfs and Q_{100} = 10.5 cfs (proposed flow) which flows south to design point 2 (DP2). The combined flows of OS-C1 and C2 at DP2 are Q_5 = 2.8 cfs and Q_{100} = 16.9 cfs (proposed flow) which flow south onto the adjacent property. The negligible flow increases in the developed condition at DP2 are 0.4 cfs in the 5-year rainfall event and 0.4 cfs in the 100-year event.

a driveway would be on the south side within the joint access easement. Addition driveways from the main southerly driveway may be provided and should be accounted for in your design but i suggest to just indicate that a driveway for lot 1 will be proposed without specifically identifying where.

Off-site sub-basin OS-D1 (37.09 acres) will continue to drain south to the Roller Coaster Road roadside ditch to the east of the site as in existing conditions. Basin OS-D1 generates peak storm runoff discharges of Q_5 = 10.9 cfs and Q_{100} = 60.7 cfs which enters off-site sub-basin OS-D2 at design point 3 (DP3). These flows continue to drain to the south to existing design point 4 (DP4).

Off-site sub-basin OS-D2 (0.82 acres) will continue to accept the runoff from sub-basin OS-D1 and drain south along the west side of Roller Coaster Road as in existing conditions. Sub-basin OS-D2 contains a paved road, and meadow/pasture area. The sub-basin generates flows of Q_5 = 0.9 cfs and Q_{100} = 2.6 cfs. The combined flows of Q_5 = 11.4 cfs and Q_{100} = 61.3 cfs at DP4 remain the same as in existing conditions.

4.3 Erosion Control

There is no public infrastructure construction or overlot grading associated with this subdivision. Any required best management practices (BMP's) for the individual lot home construction will be handled on the BESQCP for each lot at time of building permit.

4.4 Four Step Process

The El Paso County Engineering Criteria Manual (Appendix I, Section I.7.2) requires the consideration of a “Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long term source controls”. The Four Step Process is incorporated in this project and the elements are discussed below.

The entire site is consists of 5-acre single family residential lots which are excluded from Post Construction Stormwater Management requirements by ECM 1.7.1.B.5 due to the low development density as 5-acre lots. There is no public roadway being dedicated or constructed as part of this project. The site is not subject to Post Construction Stormwater Treatment requirements.

1) Runoff Reduction Practices are employed in this project. Impervious surfaces have been reduced as much as practically possible. There is only minimal concrete or other hard surfaces proposed. Minimized Directly Connected Impervious Areas (MDCIA) is employed on the project because runoff passes through an open space meadow area before leaving the site.

2) There are no drainage paths on the site that are required to be stabilized as they are well vegetated with no visual erosion.

3) The project contains no potentially hazardous uses. The site is exempted from the use of WQCV BMPs by ECM 1.7.1.B.5 by virtue of the large lot rural residential nature of the site having percent imperiousness of less than 10%.

4) The rural residential lot is not anticipated to contain storage of potentially harmful substances or use of potentially harmful substances. No site specific or other source control BMPs are required.

5 Drainage and Bridge Fees

The site is located within the Smith Creek Drainage Basin of Monument Creek, El Paso Basin Number FOMO4000, which was last studied in 2002. Fees associated with this basin are Drainage Fees of $8,052 per impervious acre and Bridge Fees of $1,080 per impervious acre. The percent Imperiousness of the 5-acre Rural Residential site is 7% in accordance with El Paso County Engineering Criteria Manual Appendix L Table 3-1. Also, reductions in the per acre Drainage Fee are allowed pursuant to El Paso County Resolution 99-383. A fee reduction in the of 25% for lots 2.5 acres or larger is utilized for this project. The Crowe Subdivision Filing No. 1 site contains 20.052 acres. Drainage and Bridge Fees for the site are calculated below:

FEE CALCULATION (Smith Creek 2021 Drainage and Bridge Fees)

Drainage Fee	=	20.052 x $8,052/Imp. Ac x 0.07 Imp.	= $11,302.11
Bridge Fee	=	20.052 x $1,080/Imp. Ac x 0.07 Imp.	= $ 1,515.93
		Subtotal	= $12,818.04
		25% Fee Reduction	= ($3,204.51)
		Grand Total Fees	**= $ 9,613.53**

the fee reduction only applies to the drainage fee not the bridge fee. Please revise accordingly.

6 Conclusion

This Final Drainage Report presents existing and proposed drainage conditions for the proposed Crowe Subdivision Filing No. 1 project. The development will have negligible and inconsequential effects on the existing site drainage and drainage conditions downstream. The proposed project will not, with respect to stormwater runoff, negatively impact the adjacent properties and downstream properties.

Please discuss detention and why it was not provided.

References

NRCS Web Soil Survey. United States Department of Agriculture, Natural Resources Conservation Service ("http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx", accessed March, 2018).

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Detention Design Spreadsheet. Urban Drainage and Flood Control District ("http://www.udfcd.org/downloads/software/UD-Detention_v2.2.xls", accessed January 2010).

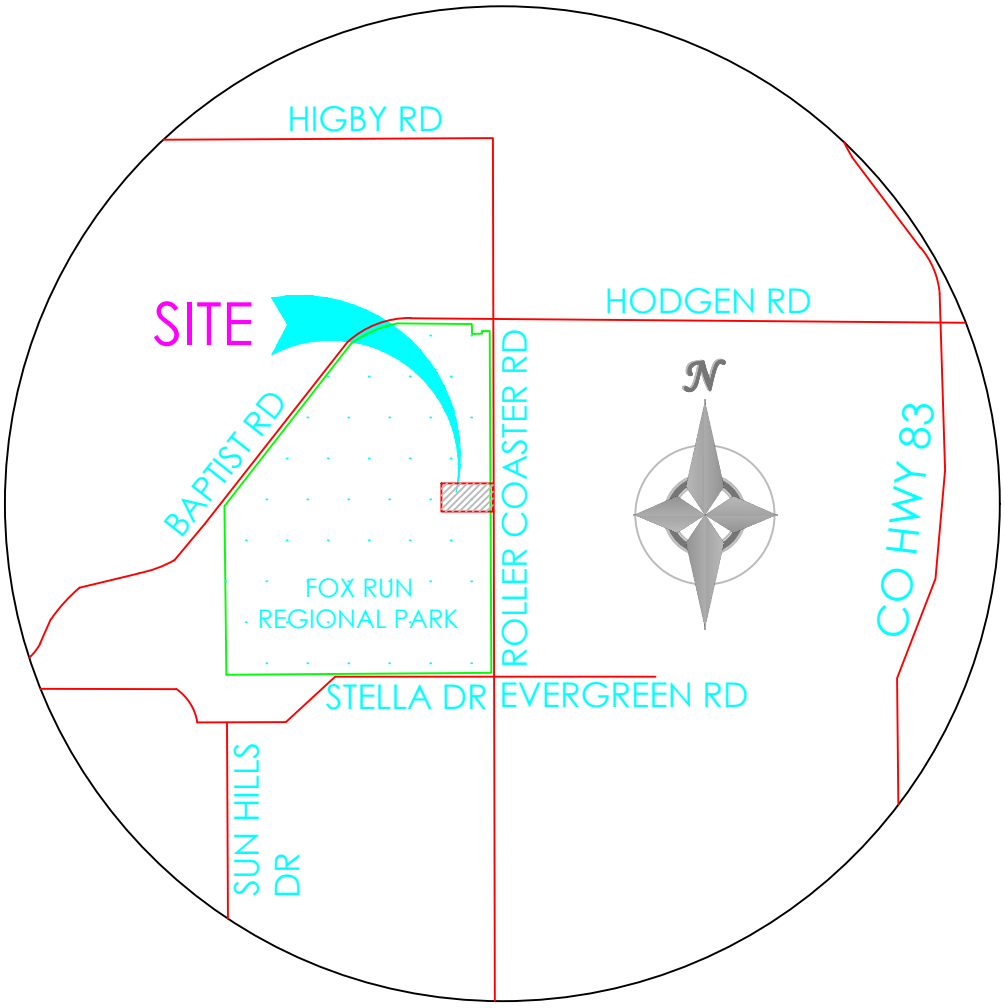
Urban Storm Drainage Criteria Manual Volume 3. Urban Drainage and Flood Control District (Denver, Colorado: , August, 2011).

Drainage Criteria Manual (Volume 2). Urban Drainage and Flood Control District (Denver, Colorado: Urban Drainage and Flood Control District, Rev. April, 2008).

Appendices

1 General Maps and Supporting Data

Vicinity Map
Portions of Flood Insurance Rate Map
NRCS Soil Map and Tables
SCS Soil Type Descriptions
Hydrologic Soil Group Map and Tables



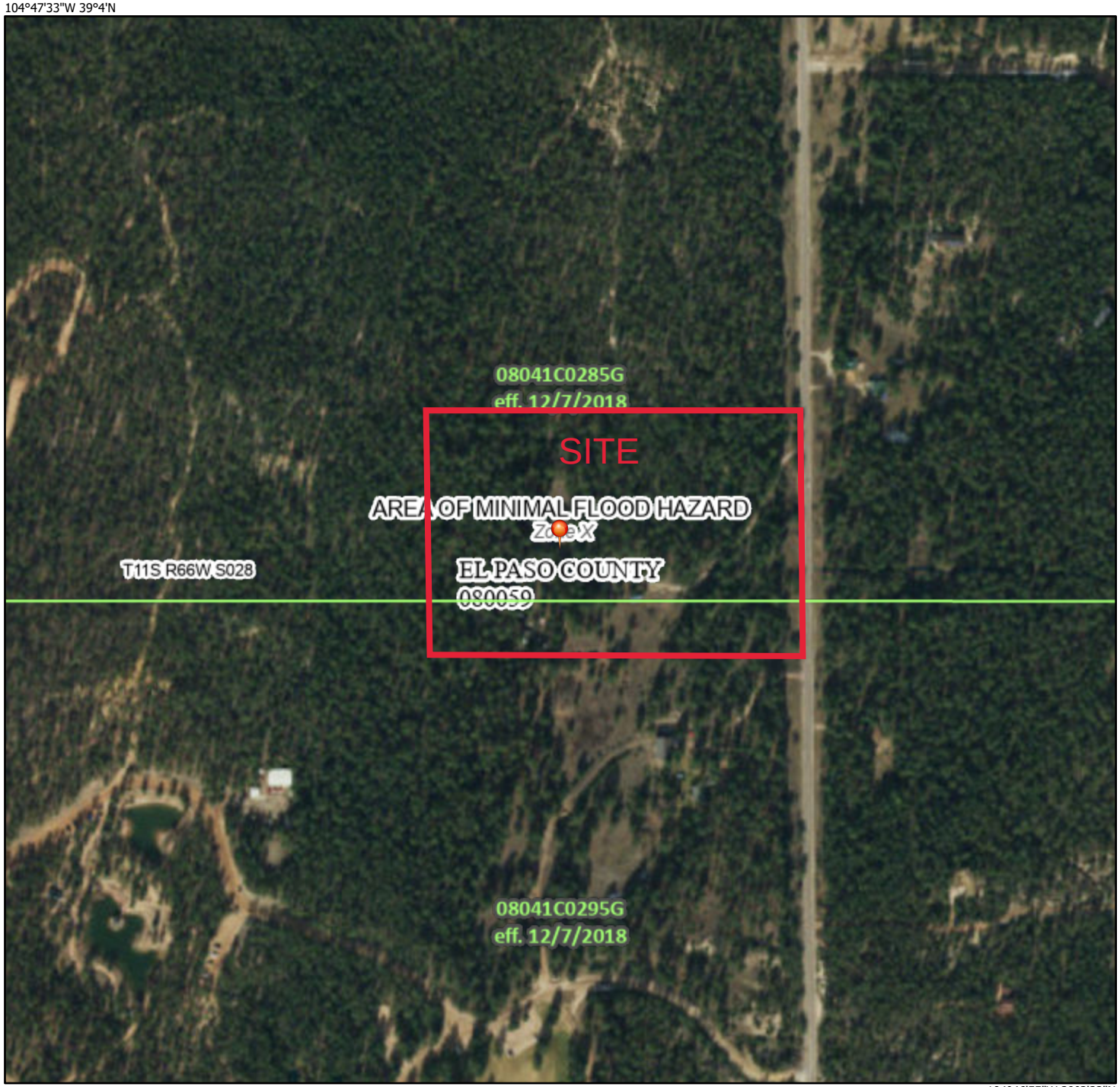
VICINITY MAP

NOT TO SCALE

National Flood Hazard Layer FIRMette

FEMA

104°47'33"W 39°4'N



104°46'55"W 39°3'32"N

Feet 1:6,000

0 250 500 1,000 1,500 2,000

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

Legend

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

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

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

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

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

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

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

N

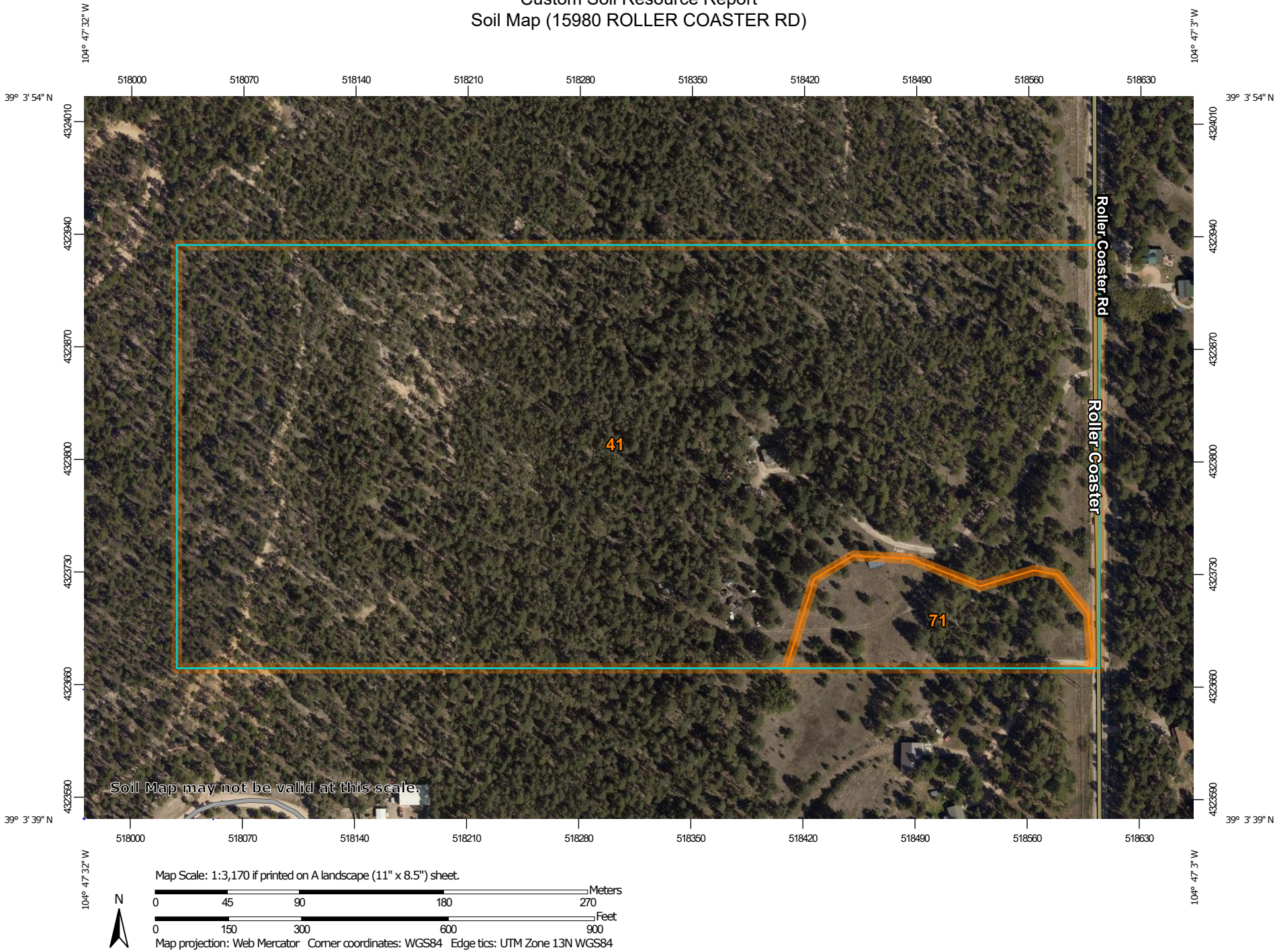
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 1/20/2021 at 6:14 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.

Custom Soil Resource Report
Soil Map (15980 ROLLER COASTER RD)



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 17, Sep 13, 2019

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.

pricklypear occur. Ample amounts of litter and forage should be left on the soil because of the high hazard of soil blowing.

Windbreaks and environmental plantings are generally well suited to this soil. Summer fallow a year prior to planting and continued cultivation for weed control are needed to insure establishment and survival of plantings. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Depending on land use, this soil can produce habitat that is suitable for either rangeland wildlife, such as antelope, or for openland wildlife, such as pheasant, cottontail, and mourning dove. Availability of irrigation water largely determines the land use. Where no irrigation water is available, this soil is mainly used as rangeland, a use that favors rangeland wildlife. If this soil is used as rangeland, fences, livestock water developments, and proper livestock grazing use are practices that enhance habitat for rangeland wildlife. Production of crops such as wheat, corn, and alfalfa provides suitable habitat for openland wildlife, especially pheasant. Among the practices that increase openland wildlife populations are planting trees and shrubs and providing undisturbed nesting cover.

The main limitation of this soil for urban use is shrink-swell potential. Buildings and roads need to be designed to overcome this limitation. Roads need to be designed to minimize frost-heave damage. Capability subclasses IVe, nonirrigated, and IIe, irrigated.

40—Kettle gravelly loamy sand, 3 to 8 percent slopes. This deep, well drained soil formed in sandy arkosic deposits on uplands. Elevation ranges from 7,000 to 7,700 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is gray gravelly loamy sand about 3 inches thick. The subsurface layer is light gray gravelly loamy sand about 13 inches thick. The subsoil is very pale brown gravelly sandy loam about 24 inches thick. It consists of a matrix of loamy coarse sand that has thin bands of coarse sandy loam or sandy clay loam. The substratum to a depth of 60 inches or more is light yellowish brown extremely gravelly loamy sand.

Included with this soil in mapping are small areas of Alamosa loam, 1 to 3 percent slopes; Elbeth sandy loam, 3 to 8 percent slopes; Pring coarse sandy loam, 3 to 8 percent slopes; Tomah-Crowfoot loamy sands, 3 to 8 percent slopes; and a few rock outcrops.

Permeability of this Kettle soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is low to moderate. Surface runoff is slow, and the hazard of erosion is slight to moderate. A few gullies have formed in drainageways.

This soil is used for woodland, livestock grazing, wildlife habitat, recreation, and homesites.

This soil is suited to the production of ponderosa pine. It is capable of producing about 2,240 cubic feet or 4,900 board feet (International rule), of merchantable timber per acre from a fully stocked, even-aged stand of 80-year-old trees. The main limitation for the production or harvesting of timber is the low available water capacity. The low available water capacity also influences seedling survival, especially in areas where understory plants are plentiful. Erosion must be kept to a minimum when harvesting timber.

This soil has good potential for mule deer, tree squirrels, cottontail rabbit, and wild turkey. These animals obtain their food and shelter from pine trees, shrubs, and ground cover, which provide browse, forbs, fruit, and seeds. The presence of ponderosa pine and Gambel oak should encourage wild turkey populations; however, where water is not naturally present, wildlife watering facilities must be provided to attract and maintain wild turkey and other wildlife species. Livestock grazing management is vital on this soil if wildlife populations are to be maintained.

This soil has good potential for use as homesites. Plans for homesite development on this soil should provide for the preservation of as many trees as possible in order to maintain the esthetic value of the sites. During seasons of low precipitation, fire may become a hazard to homesites. This hazard can be minimized by installing firebreaks and reducing the amount of litter on the forest floor. Capability subclass VIe.

41—Kettle gravelly loamy sand, 8 to 40 percent slopes. This deep, well drained soil formed in sandy arkosic deposits on uplands. Elevation ranges from 7,000 to 7,700 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is gray gravelly loamy sand about 3 inches thick. The subsurface layer is light gray gravelly loamy sand about 13 inches thick. The subsoil is very pale brown gravelly sandy loam about 24 inches thick. It consists of a matrix of loamy coarse sand that has thin bands of coarse sandy loam or sandy clay loam. The substratum to a depth of 60 inches or more is light yellowish brown extremely gravelly loamy sand.

Included with this soil in mapping are small areas of Elbeth sandy loam, 8 to 15 percent slopes; Pring coarse sandy loam, 8 to 15 percent slopes; Tomah-Crowfoot loamy sands, 8 to 15 percent slopes; and a few rock outcrops.

Permeability of this Kettle soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is low to moderate. Surface runoff is medium, and the hazard of erosion is moderate. Some gullies have formed in drainageways.

The soil is used for woodland, livestock grazing, wildlife habitat, recreation, and homesites.

This soil is suited to the production of ponderosa pine. It is capable of producing 2,240 cubic feet, or 4,900 board

feet (International rule), of merchantable timber per acre from a fully stocked, even-aged stand of 80-year-old trees. The main limitation for this use is the moderate hazard of erosion. Measures must be taken to reduce erosion when harvesting timber, especially on the steeper slopes. The low to moderate available water capacity also influences seedling survival, especially in areas where understory plants are plentiful.

This soil has good potential for mule deer, tree squirrel, cottontail, and wild turkey. These animals obtain their food and shelter from pine trees, shrubs, and ground cover, which provide browse, forbs, fruit, and seeds. The presence of ponderosa pine and Gambel oak should encourage wild turkey populations; however, where water is not naturally present, wildlife watering facilities must be provided to attract and maintain wild turkey and other wildlife species. Livestock grazing management is vital on this soil if wildlife populations are to be maintained.

The moderately sloping to steep slopes limit the suitability of this soil for homesites. Special practices must be provided to minimize surface runoff and thus keep erosion to a minimum. This soil requires special site or building designs because of the slope. Deep cuts, to provide essentially level building sites, may expose bedrock. Access roads must be designed to provide adequate cut-slope grade, and drains must be used to control surface runoff and keep soil losses to a minimum. During seasons of low precipitation, fire may become a hazard to homesites. This hazard can be minimized by installing firebreaks and reducing the amount of litter on the forest floor. Capability subclass VIe.

42—Kettle-Rock outcrop complex. This gently rolling to very steep complex, is mostly on the side slopes of uplands. Slopes range from 8 to 60 percent. Elevation ranges from 6,800 to 7,700 feet. The average annual precipitation is about 18 inches, and average annual air temperature is about 43 degrees F.

The Kettle soil makes up about 60 percent of the complex, Rock outcrop about 20 percent, and other soils about 20 percent.

Included with this complex in mapping are areas of Peyton-Pring complex, 8 to 15 percent slopes; Elbeth sandy loam, 8 to 15 percent slopes; and Elbeth-Pring complex, 5 to 50 percent slopes.

The Kettle soil is deep and well drained. It formed in sandy arkosic deposits, mostly on the lower slopes of the complex. Slope is commonly less than 20 percent. Typically, the surface layer is gray, medium acid or slightly acid gravelly loamy sand about 3 inches thick. The subsurface layer is light gray, medium acid gravelly loamy sand about 13 inches thick. The subsoil is very pale brown, medium acid or slightly acid gravelly sandy loam about 24 inches thick. It consists of loamy coarse sand that has thin bands of coarse sandy loam or sandy clay loam. The substratum to a depth of 60 inches or more is light yellowish brown extremely gravelly loamy sand.

Permeability of the Kettle soil is rapid. Effective rooting depth is more than 60 inches. Available water capacity is low to moderate. Surface runoff is medium to rapid, and the hazard of erosion is slight to high. Soil slippage and deep gullies are common.

Rock outcrop is mostly in the form of vertical cliffs. Large stones are common on the lower slopes of this complex.

This complex is suited to the production of ponderosa pine. It is capable of producing 2,240 cubic feet, or 4,900 board feet (International rule), of merchantable timber per acre from a fully stocked, even-aged stand of 80-year-old trees. The main limitation of this complex for this use is the presence of Rock outcrop and the moderate hazard of erosion on the Kettle soil. Measures must be taken to minimize erosion when harvesting timber, especially on the steeper slopes. The low to moderate available water capacity also influences seedling survival, especially where understory plants are plentiful.

This complex has good potential for producing habitat for mule deer, tree squirrels, cottontail, and wild turkey. These animals obtain their food and shelter from pine trees, shrubs, and ground cover, which provide browse, forbs, fruit, and seeds. The presence of ponderosa pine and Gambel oak should encourage wild turkey populations; however, where water is not naturally present, wildlife watering facilities must be provided to attract and maintain wild turkey and other wildlife species. Livestock grazing management is vital on this soil if wildlife populations are to be maintained.

The moderate to very steep slopes limit the potential of this complex for homesites. Special practices must be provided to minimize surface runoff and thus keep erosion to a minimum. Special site or building designs are required because of the slope. Deep cuts, to provide essentially level building sites, can expose bedrock. The limitation of large stones on the soil surface can be overcome through the use of heavy equipment when preparing building sites. Access roads must be designed to provide adequate cut-slope grade, and drains must be used to control surface runoff and thus keep soil losses to a minimum. Deep cuts along the uphill side of the roads can expose the bedrock. Capability subclass VIIe.

43—Kim loam, 1 to 8 percent slopes. This deep, well drained soil formed in calcareous loamy sediment on fans and uplands. Elevation ranges from 5,300 to 5,600. The average annual precipitation is about 13 inches, the average annual temperature is about 49 degrees F, and the average frost-free period is about 145 days.

Typically, the surface layer is brown loam about 4 inches thick. The substratum is very pale brown loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Fort Collins loam, 3 to 8 percent slopes; Midway clay loam, 3 to 25 percent slopes, and Wiley silt loam, 3 to 9 percent slopes.

Permeability of this Kim soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is medium, and the hazard of erosion is moderate.

Almost all areas of this soil are used as rangeland.

survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

These soils are suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

These soils have a good potential for homesites. The main limitations, especially on the Peyton soil, are low bearing strength and frost-action potential. Buildings and roads can be designed to overcome these limitations. Access roads should have adequate cut-slope grade and be provided with drains to control surface runoff and keep soil losses to a minimum. Capability subclass VIe.

69—Peyton-Pring complex, 8 to 15 percent slopes. These gently to moderately sloping soils are on valley side slopes and on uplands. Elevation ranges from 6,800 to 7,600 feet. The average annual precipitation is about 17 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 120 days.

The Peyton soil makes up about 40 percent of the complex, the Pring soil about 30 percent, and other soils about 30 percent.

Included with these soils in mapping are areas of Holderness loam, 8 to 15 percent slopes; Tomah-Crowfoot loamy sands, 8 to 15 percent slopes; Kettle gravelly loamy sand, 8 to 40 percent slopes; and a few areas of Rock outcrop.

The Peyton soil is commonly on the less sloping part of the landscape. It is deep, noncalcareous, and well drained. It formed in alluvium and residuum derived from weathered, arkosic, sedimentary rock. Typically, the surface layer is grayish brown sandy loam about 12 inches thick. The subsoil, about 23 inches thick, is pale brown sandy clay loam in the upper 13 inches and pale brown sandy loam in the lower 10 inches. The substratum is pale brown sandy loam to a depth of 60 inches or more.

Permeability of the Peyton soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is medium to rapid, and the hazard of erosion is moderate to high. Some gullies have developed along drainageways and livestock trails.

The Pring soil is deep, noncalcareous, and well drained. It formed in sandy sediment derived from weathered, arkosic, sedimentary rock. Typically, the surface layer is dark grayish brown coarse sandy loam about 4 inches thick. The substratum is dark grayish brown coarse sandy loam about 10 inches thick over pale brown gravelly sandy loam that extends to a depth of 60 inches or more.

Permeability of the Pring soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is medium to rapid, and the hazard of erosion is moderate to high. Some gullies have developed along drainageways and livestock trails.

The soils in this complex are used as rangeland, for wildlife habitat, and for homesites.

These soils are well suited to the production of native vegetation suitable for grazing. The dominant native species are mountain muhly, bluestem grasses, needleandthread, and blue grama. These soils are subject to invasion of Kentucky bluegrass and Gambel oak. Common forbs are hairy goldenrod, geranium, milkvetch, low larkspur, fringed sage, and buckwheat.

Properly locating livestock watering facilities helps to control grazing. Timely deferment of grazing is needed to protect the plant cover.

Windbreaks and environmental plantings generally are suited to these soils. Soil blowing is the main limitation to the establishment of trees and shrubs. This limitation can be overcome by cultivating only in the tree rows and leaving a strip of vegetation between the rows. Supplemental irrigation may be needed when planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

These soils are well suited to wildlife habitat. They are best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

These soils have good potential for use as homesites. The main limitations are steepness of slope, limited ability to support a load, and frost-action potential. Buildings and roads can be designed to overcome these limitations. These soils also require special site or building designs because of the slope. Access roads should have adequate cut-slope grade, and drains should be provided to control surface runoff and keep soil losses to a minimum. Capability subclass VIe.

70—Pits, gravel. Gravel pits are in nearly level to rolling areas. They are open excavations several feet deep and commonly 5 acres or less in size.

Gravel pits are very low in natural fertility and are highly susceptible to soil blowing. A cover of weeds or straw helps to control erosion.

Windbreaks and environmental plantings generally are not suited to these areas. Onsite investigation is needed to determine if plantings are feasible. Capability subclass VIIIs.

71—Pring coarse sandy loam, 3 to 8 percent slopes. This deep, noncalcareous, well drained soil formed in sandy sediment derived from arkosic sedimentary rock on valley side slopes and on uplands. Elevation ranges from 6,800 to 7,600 feet. The average annual precipitation is about 17 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is dark grayish brown coarse sandy loam about 4 inches thick. The substratum is dark grayish brown coarse sandy loam about 10 inches thick over pale brown gravelly sandy loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Alamosa loam, 1 to 3 percent slopes, along drainageways; Cruckton sandy loam, 1 to 9 percent slopes; Peyton sandy loam, 1 to 5 percent slopes; Peyton sandy loam, 5 to 9 percent slopes; and Tomah-Crowfoot loamy sands, 3 to 8 percent slopes. In some places arkose beds of sandstone and shale are at a depth of 0 to 40 inches.

Permeability of this Pring soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is medium, and the hazard of erosion is moderate.

Almost all areas of this soil are used as rangeland. Some areas previously cultivated have been reseeded to grass. This soil is also used for wildlife habitat and homesites.

This soil is well suited to the production of native vegetation suitable for grazing by cattle and sheep. Rangeland vegetation is mainly mountain muhly, little bluestem, needleandthread, Parry oatgrass, and junegrass.

Deferment of grazing in spring helps to maintain vigor and production of the cool-season bunchgrasses. Fencing and properly locating livestock watering facilities help to control grazing.

Windbreaks and environmental plantings generally are suited to this soil. The hazard of soil blowing is the main limitation to the establishment of trees and shrubs. This limitation can be overcome by cultivating only in the tree rows and leaving a strip of vegetation between the rows. Supplemental irrigation may be needed when planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil is well suited for use as homesites. Erosion control practices are needed to control soil blowing and water erosion on construction sites where the ground cover has been removed. Capability subclass IVe.

72—Pring coarse sandy loam, 8 to 15 percent slopes. This deep, noncalcareous, well drained soil formed in sandy sediment derived from arkosic sedimentary rock on valley side slopes and on uplands. Elevation ranges from 6,800 to 7,600 feet. The average annual precipitation is about 17 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is dark grayish brown coarse sandy loam about 4 inches thick. The substratum is dark grayish brown coarse sandy loam about 10 inches thick over pale brown gravelly sandy loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Cruckton sandy loam, 1 to 9 percent slopes; Peyton sandy loam, 5 to 9 percent slopes; and Tomah-Crowfoot loamy sands, 8 to 15 percent slopes. Arkose beds of sandstone and shale are at a depth of 0 to 40 inches in some places.

Permeability of this Pring soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is medium, and the hazard of erosion is moderate. Some gullies have developed along drainageways.

Almost all areas of this soil are used as rangeland. Some areas previously cultivated have been reseeded to grass. This soil is also used for wildlife habitat and as homesites.

This soil is well suited to the production of native vegetation suitable for grazing by cattle and sheep. The native vegetation is mainly mountain muhly, little bluestem, needleandthread, Parry oatgrass, and junegrass.

Deferment of grazing in spring helps to maintain the vigor and production of the cool-season bunchgrasses. Fencing and properly locating livestock watering facilities help to control grazing.

Windbreaks and environmental plantings generally are suited to this soil. The hazard of soil blowing is the main limitation to the establishment of trees and shrubs. This limitation can be overcome by cultivating only in the tree rows and leaving a strip of vegetation between the rows. Supplemental irrigation may be needed when planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

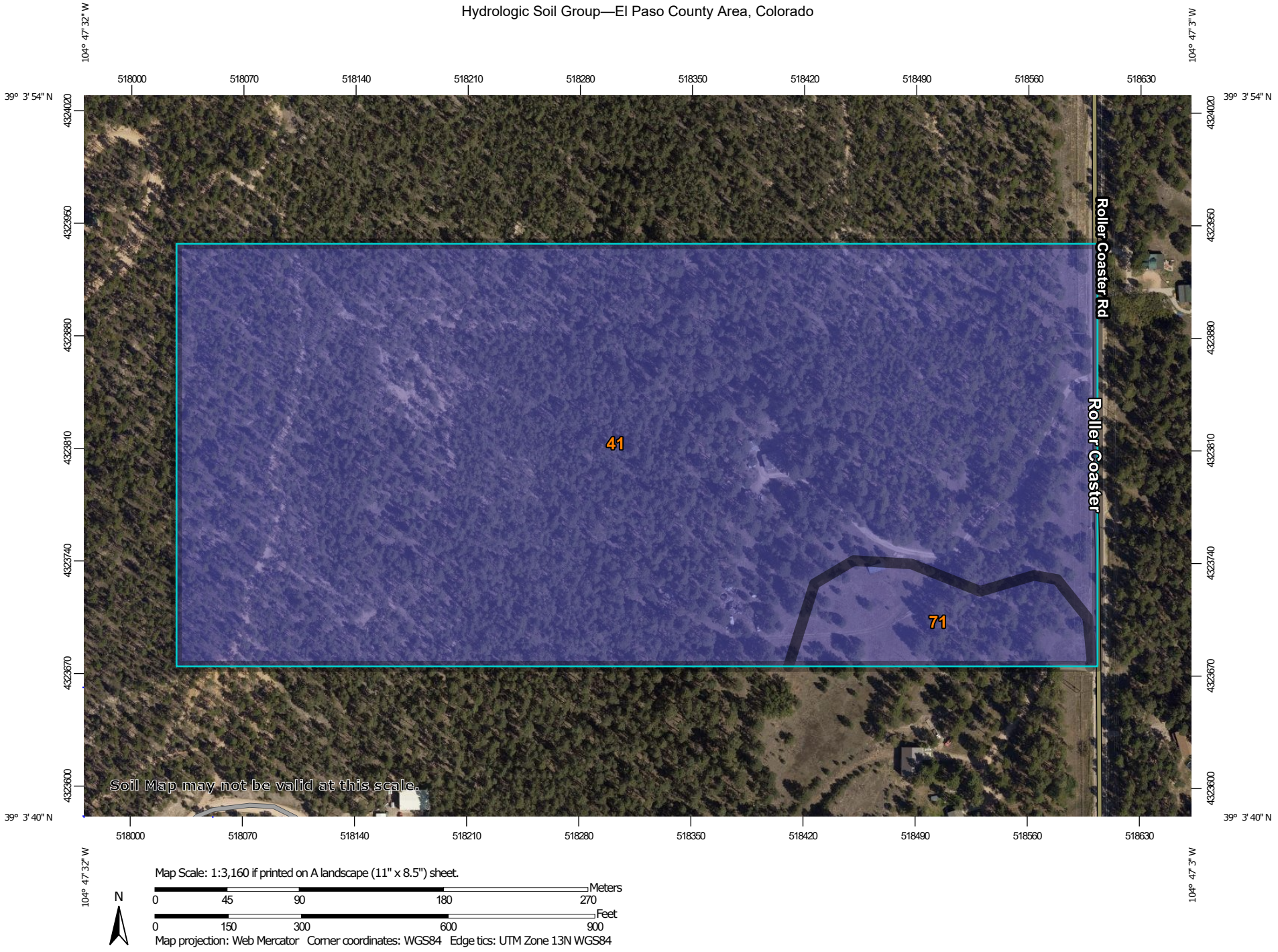
This soil is suited to habitat for openland and rangeland wildlife habitat. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil has good potential for urban uses. The main limitation is slope. Special site or building designs are needed because of the slope. Access roads must have adequate cut-slope grade and be provided with drains to control surface runoff. Capability subclass VIe.

73—Razor clay loam, 3 to 9 percent slopes. This moderately deep, well drained, clayey soil formed in residuum derived from calcareous shale on uplands. Elevation ranges from 5,300 to 6,100 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is about 145 days.

Typically, the surface layer is light brownish gray clay loam about 3 inches thick. The subsoil is grayish brown heavy clay loam or clay about 15 inches thick. The substratum is grayish brown clay that grades to calcareous shale at a depth of about 31 inches. Visible lime is in the lower part of the subsoil and in the substratum.

Included with this soil in mapping are small areas of Midway clay loam, 3 to 25 percent slopes; Heldt clay loam, 0 to 3 percent slopes; and Stoneham sandy loam, 3 to 8 percent slopes.



Map Scale: 1:3,160 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

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.

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

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

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

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

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

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

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

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	35.0	93.4%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	2.5	6.6%
Totals for Area of Interest			**37.5**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

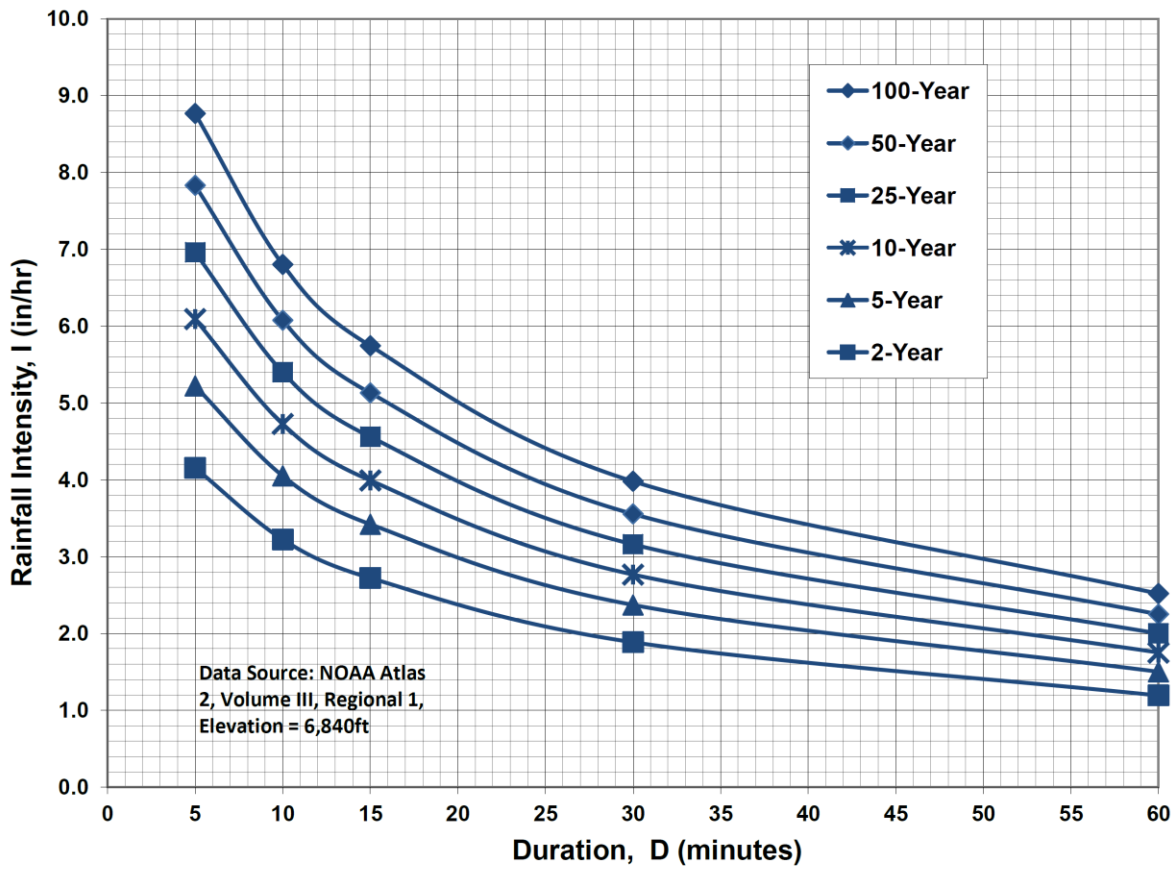
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

2 Hydrologic Calculations

Runoff Coefficients and Percent Imperviousness Table 6-6
Colorado Springs Rainfall Intensity Duration Frequency Figure 6-5
Hydrologic Calculations Summary Form SF-1 for Existing & Developed Conditions
Hydrologic Calculations Summary 5-yr Form SF-2 for Existing & Developed Conditions
Hydrologic Calculations Summary 100-yr Form SF-2 for Existing & Developed Conditions

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_{5} = -1.50 \ln(D) + 7.583$

$I_{2} = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

Table 6-6. Runoff Coefficients for Rational Method

(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis--Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

Job No.: **61138** Date: **5/18/2021 10:57**

Project: **Crowe Sub** Calcs By: **WCG**

Checked By:

Time of Concentration (Modified from Standard Form SF-1)

Sub-Basin	Sub-Basin Data				Overland			Shallow Channel				Channelized				t_c Check		
	Area (Acres)	C_5	C_{100}/CN	% Imp.	L_0 (ft)	S_0 (%)	t_i (min)	L_{0t} (ft)	S_{0t} (ft/ft)	v_{0sc} (ft/s)	t_t (min)	L_{0c} (ft)	S_{0c} (ft/ft)	v_{0c} (ft/s)	t_c (min)	L (min)	$t_{c,alt}$ (min)	t_c (min)
(Offsite)																		
OS-B1	64.09	0.08	0.35	0%	100	5%	10.8	1322	0.047	0.5	40.7	1516	0.046	7.1	3.5	2938	26.3	26.3
OS-C1	3.48	0.08	0.35	0%	100	7%	9.7	621	0.076	1.9	5.4	0	0.000	0.0	0.0	721	14.0	14.0
OS-D1	37.09	0.11	0.37	4%	100	6%	9.9	1645	0.047	1.5	18.0	1005	0.060	7.0	2.4	2750	25.3	25.3
OS-D2	0.82	0.32	0.53	30%	100	8%	7.1	569	0.030	1.2	7.8	0	0.000	0.0	0.0	669	13.7	13.7
(Proposed)																		
EX-A1	2.85	0.08	0.35	0%	100	7%	9.7	488	0.117	2.4	3.4	0	0.000	0.0	0.0	588	13.3	13.1
EX-B2	11.38	0.09	0.36	1%	100	11%	8.3	773	0.065	1.8	7.2	0	0.000	0.0	0.0	873	14.9	14.9
EX-C2	4.80	0.09	0.36	2%	100	8%	9.2	644	0.070	1.9	5.8	0	0.000	0.0	0.0	744	14.1	14.1
(Developed)																		
A1	2.85	0.14	0.39	8%	100	7%	9.2	488	0.117	2.4	3.4	0	0.000	0.0	0.0	588	13.3	12.6
B2	11.39	0.10	0.37	4%	100	11%	8.1	773	0.065	1.8	7.2	0	0.000	0.0	0.0	873	14.9	14.9
C2	4.80	0.11	0.37	5%	100	8%	9.0	644	0.070	1.9	5.8	0	0.000	0.0	0.0	744	14.1	14.1

Job No.: **61138**
Project: **Crowe Sub**
Design Storm: **5-Year Storm** *(20% Probability)*
Jurisdiction: **UDFCD**

Date: **5/18/2021 10:57**
Calcs By: **WCG**
Checked By:

Sub-Basin and Combined Flows (Modified from Standard Form SF-2)

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
DP	Sub-Basin	Area (Acres)	C5	t_c (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	t_c (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	Slope (%)	Length (ft)	Q (cfs)	Q (cfs)	Slope (%)	Mnngs n	Length (ft)	D_{Pipe} (in)	Length (ft)	v_{0sc} (ft/s)	t_t (min)
(Existing)																						
	EX-A1	2.85	0.08	13.1	0.23	3.62	0.8															
	OS-B1	64.09	0.08	26.3	5.27	2.54	13.4															
	EX-B2	11.38	0.09	14.9	1.02	3.42	3.5															
EX-DP1	OS-B1,EX-B2	75.48	0.08					27.2	6.15	2.49	15.3											
	OS-C1	3.48	0.08	14.0	0.28	3.52	1.0															
	EX-C2	4.80	0.09	14.1	0.44	3.50	1.5															
EX-DP2	OS-C1,EX-C2	8.27	0.09					15.6	0.72	3.35	2.4											
	OS-D1	37.09	0.11	25.3	4.20	2.60	10.9															
	OS-D2	0.82	0.32	13.7	0.27	3.55	0.9															
EX-DP4	OS-D1,OS-D2	37.92	0.12					26.2	4.46	2.54	11.4											
(Proposed)																						
	A1	2.85	0.14	12.6	0.39	3.69	1.4															
	OS-B1	64.09	0.08	26.3	5.27	2.54	13.4															
	B2	11.39	0.10	14.9	1.20	3.42	4.1															
DP1	OS-B1,B2	75.47	0.08					27.2	6.32	2.49	15.8											
	OS-C1	3.48	0.08	14.0	0.28	3.52	1.0															
	C2	4.80	0.11	14.1	0.55	3.50	1.9															
DP2	OS-C1,C2	8.28	0.10					15.6	0.82	3.35	2.8											
	OS-D1	37.09	0.11	25.3	4.20	2.60	10.9															
	OS-D2	0.82	0.32	13.7	0.27	3.55	0.9															
DP4	OS-D1,OS-D2	37.92	0.12					26.2	4.46	2.54	11.4											

Rainfall Intensity: $I = (28.5 * P1) / (10 + tc)^{0.786}$
P1: 1.5

Job No.: **61138**
Project: **Crowe Sub**
Design Storm: **100-Year Storm** *(1% Probability)*
Jurisdiction: **UDFCD**

Date: **5/18/2021 10:57**
Calcs By: **WCG**
Checked By:

Sub-Basin and Combined Flows (Modified from Standard Form SF-2)

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
DP	Sub-Basin	Area (Acres)	C100	t_c (min)	CA (Acres)	I100 (in/hr)	Q100 (cfs)	t_c (min)	CA (Acres)	I100 (in/hr)	Q100 (cfs)	Slope (%)	Length (ft)	Q (cfs)	Q (cfs)	Slope (%)	Mnngs n	Length (ft)	D_{Pipe} (in)	Length (ft)	v_{0sc} (ft/s)	t_t (min)
(Existing)																						
	EX-A1	2.85	0.35	13.1	1.00	6.09	6.1															
	OS-B1	64.09	0.35	26.3	22.54	4.27	96.1															
	EX-B2	11.38	0.36	14.9	4.06	5.75	23.3															
EX-DP1	OS-B1,EX-B2	75.48	0.35					27.2	26.49	4.19	111.0											
	OS-C1	3.48	0.35	14.0	1.22	5.91	7.2															
	EX-C2	4.80	0.36	14.1	1.72	5.88	10.1															
EX-DP2	OS-C1,EX-C2	8.27	0.35					15.6	2.94	5.62	16.5											
	OS-D1	37.09	0.37	25.3	13.90	4.36	60.7															
	OS-D2	0.82	0.53	13.7	0.44	5.96	2.6															
EX-DP4	OS-D1,OS-D2	37.92	0.38					26.2	14.33	4.27	61.3											
(Proposed)																						
	A1	2.85	0.39	12.6	1.11	6.20	6.9															
	OS-B1	64.09	0.35	26.3	22.54	4.27	96.1															
	B2	11.39	0.37	14.9	4.18	5.75	24.0															
DP1	OS-B1,B2	75.47	0.35					27.2	26.61	4.19	111.5											
	OS-C1	3.48	0.35	14.0	1.22	5.91	7.2															
	C2	4.80	0.37	14.1	1.79	5.88	10.5															
DP2	OS-C1,C2	8.28	0.36					15.6	3.01	5.62	16.9											
	OS-D1	37.09	0.37	25.3	13.90	4.36	60.7															
	OS-D2	0.82	0.53	13.7	0.44	5.96	2.6															
DP4	OS-D1,OS-D2	37.92	0.38					26.2	14.33	4.27	61.3											

Rainfall Intensity: $I = (28.5 * P1) / (10 + tc)^{0.786}$
P1: 2.52

Sub-Basin OS-B1 Runoff Calculations

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	2,791,840	64.09	0.02	0.08	0.15	0.25	0.3	0.35	0%
Paved	7,620		0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**2,799,460**	**64.09**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.3%**
	2,799,460								
	-								

Basin Travel Time

Shallow Channel Ground Cover: Heavy meadow

$L_{max,Overland}$: 300 ft C_v: 2.5

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	2,938	137	-	-	-	-	
Initial Time	100	5	0.050	-	10.8	26.3	UDFCD Formula RO-3
Shallow Channel	1,322	62	0.047	0.5	40.7	-	UDFCD Formula RO-4
Channelized	1,516	70	0.046	7.1	3.5	-	V-Ditch
				t_c	**26.3**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.01	2.54	2.96	3.39	3.81	4.27
Runoff (cfs)	2.9	**13.4**	28.9	54.6	73.7	**96.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.9	**13.4**	28.9	54.6	73.7	**96.1**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Sub-Basin OS-C1 Runoff Calculations

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	151,411	3.48	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**151,411**	**3.48**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

151,411

-

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$: 300 ft C_v: 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	721	54	-	-	-	-	
Initial Time	100	7	0.070	-	9.7	14.0	UDFCD Formula RO-3
Shallow Channel	621	47	0.076	1.9	5.4	-	UDFCD Formula RO-4
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**14.0 min.**		

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.79	3.52	4.10	4.69	5.27	5.91
Runoff (cfs)	0.2	**1.0**	2.1	4.1	5.5	**7.2**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.2	**1.0**	2.1	4.1	5.5	**7.2**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Sub-Basin OS-D1 Runoff Calculations

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	1,550,509	35.59	0.02	0.08	0.15	0.25	0.3	0.35	0%
Paved	65,320	1.50	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**1,615,829**	**37.09**	**0.06**	**0.11**	**0.18**	**0.28**	**0.33**	**0.37**	**4.0%**

1,615,829

-

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	2,750	144	-	-	-	-	
Initial Time	100	6	0.060	-	9.9	25.3	UDFCD Formula RO-3
Shallow Channel	1,645	78	0.047	1.5	18.0	-	UDFCD Formula RO-4
	1,005	60	0.060	7.0	2.4	-	V-Ditch
				t_c	**25.3**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.06	2.60	3.03	3.46	3.90	4.36
Runoff (cfs)	4.2	**10.9**	20.4	35.7	47.2	**60.7**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	4.2	**10.9**	20.4	35.7	47.2	**60.7**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Sub-Basin OS-D2 Runoff Calculations

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	25,181	0.58	0.02	0.08	0.15	0.25	0.3	0.35	0%
Paved	10,624	0.24	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**35,805**	**0.82**	**0.28**	**0.32**	**0.38**	**0.45**	**0.49**	**0.53**	**29.7%**

35,805

-

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$: 300 ft C_v: 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	669	25	-	-	-	-	
Initial Time	100	8	0.080	-	7.1	13.7	UDFCD Formula RO-3
Shallow Channel	569	17	0.030	1.2	7.8	-	UDFCD Formula RO-4
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**13.7**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.82	3.55	4.14	4.73	5.32	5.96
Runoff (cfs)	0.6	**0.9**	1.3	1.8	2.2	**2.6**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.6	**0.9**	1.3	1.8	2.2	**2.6**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Sub-Basin Ex-A1 Runoff Calculations (Existing)

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	124,087	2.85	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**124,087**	**2.85**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**
	124,087								

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$: 300 ft C_v: 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	588	64	-	-	-	-	
Initial Time	100	7	0.070	-	9.7	13.3	UDFCD Formula RO-3
Shallow Channel	488	57	0.117	2.4	3.4	-	UDFCD Formula RO-4
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**13.1**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.88	3.62	4.23	4.83	5.44	6.09
Runoff (cfs)	0.2	**0.8**	1.8	3.4	4.6	**6.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.2	**0.8**	1.8	3.4	4.6	**6.1**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Sub-Basin Ex-B2 Runoff Calculations (Existing)

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	487,458	11.19	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	5,093	0.12	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	3,360	0.08	0.71	0.73	0.75	0.78	0.8	0.81	90%
Combined	**495,911**	**11.38**	**0.03**	**0.09**	**0.16**	**0.26**	**0.31**	**0.36**	**1.4%**

495,911

-

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	873	61	-	-	-	-	
Initial Time	100	11	0.110	-	8.3	14.9	UDFCD Formula RO-3
Shallow Channel	773	50	0.065	1.8	7.2	-	UDFCD Formula RO-4
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**14.9 min.**		

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.71	3.42	3.99	4.56	5.13	5.75
Runoff (cfs)	0.9	**3.5**	7.2	13.4	18.0	**23.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.9	**3.5**	7.2	13.4	18.0	**23.3**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Sub-Basin Ex-C2 Runoff Calculations (Existing)

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	204,096	4.69	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	4,923	0.11	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**209,019**	**4.80**	**0.03**	**0.09**	**0.16**	**0.26**	**0.31**	**0.36**	**1.9%**

209,019

-

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$: 300 ft C_v: 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	744	53	-	-	-	-	
Initial Time	100	8	0.080	-	9.2	14.1	UDFCD Formula RO-3
Shallow Channel	644	45	0.070	1.9	5.8	-	UDFCD Formula RO-4
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**14.1**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.78	3.50	4.08	4.67	5.25	5.88
Runoff (cfs)	0.4	**1.5**	3.2	5.8	7.8	**10.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.4	**1.5**	3.2	5.8	7.8	**10.1**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Sub-Basin A1 Runoff Calculations (Developed)

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	111,269	2.55	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	10,368	0.24	0.57	0.59	0.63	0.66	0.68	0.7	80%
Paved	200	0.00	0.89	0.9	0.92	0.94	0.95	0.96	100%
Roofs	2,250	0.05	0.71	0.73	0.75	0.78	0.8	0.81	90%
Combined	**124,087**	**2.85**	**0.08**	**0.14**	**0.20**	**0.29**	**0.34**	**0.39**	**8.5%**

124,087

-

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	588	64	-	-	-	-	
Initial Time	100	7	0.070	-	9.2	13.3	UDFCD Formula RO-3
Shallow Channel	488	57	0.117	2.4	3.4	-	UDFCD Formula RO-4
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**12.6**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.93	3.69	4.31	4.92	5.54	6.20
Runoff (cfs)	0.7	**1.4**	2.5	4.1	5.4	**6.9**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.7	**1.4**	2.5	4.1	5.4	**6.9**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Sub-Basin B2 Runoff Calculations (Developed)

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	473,390	10.87	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	16,832	0.39	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	5,610	0.13	0.71	0.73	0.75	0.78	0.8	0.81	90%
Paved	200	0.00	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**496,032**	**11.39**	**0.05**	**0.10**	**0.17**	**0.27**	**0.32**	**0.37**	**3.8%**

496,032

-

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	873	61	-	-	-	-	
Initial Time	100	11	0.110	-	8.1	14.9	UDFCD Formula RO-3
Shallow Channel	773	50	0.065	1.8	7.2	-	UDFCD Formula RO-4
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**14.9 min.**		

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.71	3.42	3.99	4.56	5.13	5.75
Runoff (cfs)	1.4	**4.1**	7.9	14.0	18.6	**24.0**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	1.4	**4.1**	7.9	14.0	18.6	**24.0**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Sub-Basin C2 Runoff Calculations (Developed)

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	196,729	4.52	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	7,472	0.17	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	4,500	0.10	0.71	0.73	0.75	0.78	0.8	0.81	90%
Paved	400	0.01	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**209,101**	**4.80**	**0.06**	**0.11**	**0.18**	**0.28**	**0.33**	**0.37**	**5.0%**

209,101

-

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$: 300 ft C_v: 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	744	53	-	-	-	-	
Initial Time	100	8	0.080	-	9.0	14.1	UDFCD Formula RO-3
Shallow Channel	644	45	0.070	1.9	5.8	-	UDFCD Formula RO-4
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**14.1**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.78	3.50	4.08	4.67	5.25	5.88
Runoff (cfs)	0.7	**1.9**	3.6	6.2	8.2	**10.5**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.7	**1.9**	3.6	6.2	8.2	**10.5**

UDFCD: $I = (28.5 * P1) / (10 + tc)^{0.786}$

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Combined Sub-Basin Runoff Calculations (Existing)

Includes Basins OS-B1 EX-B2

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Gravel	5,093	0.12	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	3,360	0.08	0.71	0.73	0.75	0.78	0.8	0.81	90%
Pasture/Meadow	3,279,298	75.28	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**3,287,751**	**75.48**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.2%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS-B1	-	2,938	137	-	-	-	-	26.3
Channelized-1	V-Ditch		155	20	96	0	2	19.3	0.1
Channelized-2	V-Ditch		632	40	96	0	2	14.8	0.7
Channelized-3									
Total			3,725	197					
								t_c (min)	**27.2**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.98	2.49	2.91	3.32	3.74	4.19
Site Runoff (cfs)	3.22	**15.33**	33.23	63.02	84.99	**110.97**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**15.3**	-	-	-	**111.0**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Combined Sub-Basin Runoff Calculations (Existing)

Includes Basins OS-C1 EX-C2

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Gravel	4,923	0.11	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	-	0.00	0.71	0.73	0.75	0.78	0.8	0.81	90%
Pasture/Meadow	355,507	8.16	0.02	0.08	0.15	0.25	0.3	0.35	0%
Paved	-	0.00	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**360,430**	**8.27**	**0.03**	**0.09**	**0.16**	**0.26**	**0.31**	**0.35**	**1.1%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS-C1	-	400	35	-	-	-	-	14.0
Channelized-1	V-Ditch		744	50	7	0	2	7.9	1.6
Channelized-2									
Channelized-3									
Total			1,144	85					
								t_c (min)	**15.6**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.65	3.35	3.90	4.46	5.02	5.62
Site Runoff (cfs)	0.60	**2.41**	5.06	9.43	12.67	**16.50**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**2.4**	-	-	-	**16.5**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Combined Sub-Basin Runoff Calculations (Existing)

Includes Basins OS-D1

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Gravel	-	0.00	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	-	0.00	0.71	0.73	0.75	0.78	0.8	0.81	90%
Pasture/Meadow	1,550,509	35.59	0.02	0.08	0.15	0.25	0.3	0.35	0%
Paved	65,320	1.50	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**1,615,829**	**37.09**	**0.06**	**0.11**	**0.18**	**0.28**	**0.33**	**0.37**	**4.0%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS-D1	-	2,750	144	-	-	-	-	25.3
Channelized-1									
Channelized-2									
Channelized-3									
Total			2,750	144					
								t_c (min)	**25.3**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.06	2.60	3.03	3.46	3.90	4.36
Site Runoff (cfs)	4.22	**10.90**	20.36	35.70	47.16	**60.65**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**10.9**	-	-	-	**60.7**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Combined Sub-Basin Runoff Calculations (Existing)

Includes Basins OS-D1 OS-D2

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Gravel	-	0.00	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	-	0.00	0.71	0.73	0.75	0.78	0.8	0.81	90%
Pasture/Meadow	1,575,690	36.17	0.02	0.08	0.15	0.25	0.3	0.35	0%
Paved	75,944	1.74	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**1,651,634**	**37.92**	**0.06**	**0.12**	**0.19**	**0.28**	**0.33**	**0.38**	**4.6%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS-D1	-	2,750	144	-	-	-	-	25.3
Channelized-1	V-Ditch		155	20	61	0	2	17.2	0.2
Channelized-2	V-Ditch		632	40	61	0	2	13.2	0.8
Channelized-3									
Total			3,537	204					
								t_c (min)	**26.2**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.02	2.54	2.97	3.39	3.82	4.27
Site Runoff (cfs)	4.59	**11.35**	20.87	36.23	47.73	**61.27**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**11.4**	-	-	-	**61.3**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Combined Sub-Basin Runoff Calculations (Developed)

Includes Basins OS-B1 B2

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Gravel	16,832	0.39	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	5,610	0.13	0.71	0.73	0.75	0.78	0.8	0.81	90%
Pasture/Meadow	3,265,230	74.96	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**3,287,672**	**75.47**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.6%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS-B1	-	2,938	137	-	-	-	-	26.3
Channelized-1	V-Ditch		155	20	96	0	2	19.3	0.1
Channelized-2	V-Ditch		632	40	96	0	2	14.8	0.7
Channelized-3									
Total			3,725	197					
								t_c (min)	**27.2**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.98	2.49	2.91	3.32	3.74	4.19
Site Runoff (cfs)	3.58	**15.75**	33.70	63.48	85.47	**111.47**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**15.8**	-	-	-	**111.5**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Combined Sub-Basin Runoff Calculations (Developed)

Includes Basins OS-C1 C2

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Gravel	7,472	0.17	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	4,500	0.10	0.71	0.73	0.75	0.78	0.8	0.81	90%
Pasture/Meadow	348,140	7.99	0.02	0.08	0.15	0.25	0.3	0.35	0%
Paved	400	0.01	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**360,512**	**8.28**	**0.04**	**0.10**	**0.17**	**0.27**	**0.31**	**0.36**	**2.9%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS-C1	-	400	35	-	-	-	-	14.0
Channelized-1	V-Ditch		744	50	7	0	2	7.9	1.6
Channelized-2									
Channelized-3									
Total			1,144	85					
								t_c (min)	**15.6**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.65	3.35	3.90	4.46	5.02	5.62
Site Runoff (cfs)	0.90	**2.76**	5.44	9.81	13.07	**16.91**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**2.8**	-	-	-	**16.9**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Combined Sub-Basin Runoff Calculations (Developed)

Includes Basins OS-D1

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Gravel	-	0.00	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	-	0.00	0.71	0.73	0.75	0.78	0.8	0.81	90%
Pasture/Meadow	1,550,509	35.59	0.02	0.08	0.15	0.25	0.3	0.35	0%
Paved	65,320	1.50	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**1,615,829**	**37.09**	**0.06**	**0.11**	**0.18**	**0.28**	**0.33**	**0.37**	**4.0%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS-D1	-	2,750	144	-	-	-	-	25.3
Channelized-1									
Channelized-2									
Channelized-3									
Total			2,750	144					
								t_c (min)	**25.3**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.06	2.60	3.03	3.46	3.90	4.36
Site Runoff (cfs)	4.22	**10.90**	20.36	35.70	47.16	**60.65**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**10.9**	-	-	-	**60.7**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Combined Sub-Basin Runoff Calculations (Developed)

Includes Basins OS-D1 OS-D2

Job No.:	**61138**	Date:	**5/18/2021 9:31**
Project:	**Crowe Sub**	Calcs by:	**WCG**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Paved	75,944	1.74	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	1,575,690	36.17	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**1,651,634**	**37.92**	**0.06**	**0.12**	**0.19**	**0.28**	**0.33**	**0.38**	**4.6%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS-D1	-	2,750	144	-	-	-	-	25.3
Channelized-1	V-Ditch		155	20	61	0	2	17.2	0.2
Channelized-2	V-Ditch		632	40	61	0	2	13.2	0.8
Channelized-3									
Total			3,537	204					
								t_c (min)	**26.2**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.02	2.54	2.97	3.39	3.82	4.27
Site Runoff (cfs)	4.59	**11.35**	20.87	36.23	47.73	**61.27**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**11.4**	-	-	-	**61.3**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

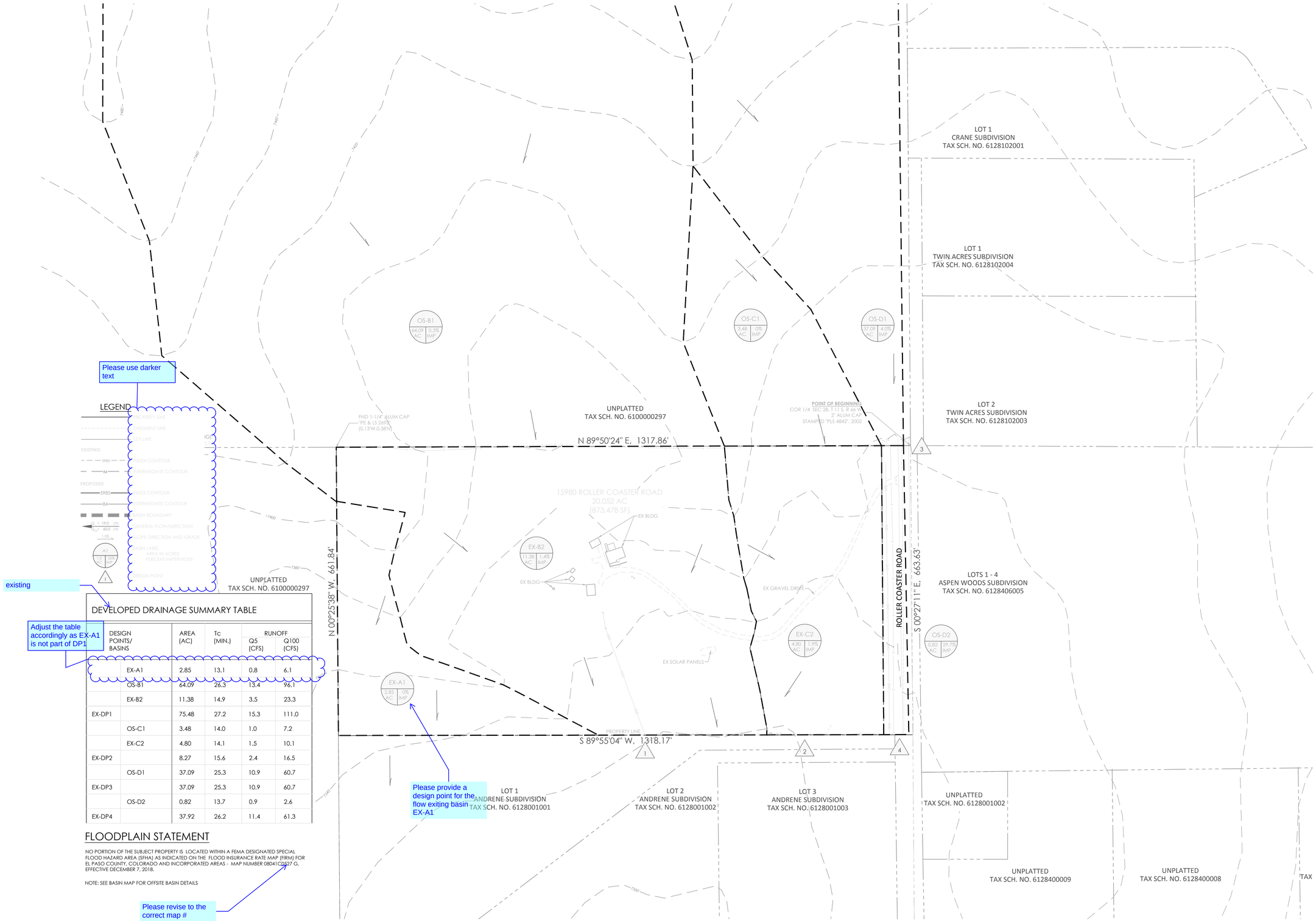
PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

3 Report Maps

Existing Condition Hydraulic Analysis Map (Map Pocket)
Proposed Condition Hydraulic Analysis Map (Map Pocket)



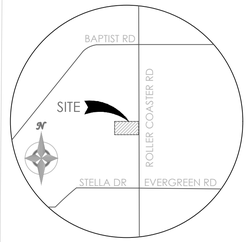
DEVELOPED DRAINAGE SUMMARY TABLE

DESIGN POINTS/ BASINS		AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)
	EX-A1	2.85	13.1	0.8	6.1
	OS-B1	64.09	26.3	13.4	96.1
	EX-B2	11.38	14.9	3.5	23.3
EX-DP1		75.48	27.2	15.3	111.0
	OS-C1	3.48	14.0	1.0	7.2
	EX-C2	4.80	14.1	1.5	10.1
EX-DP2		8.27	15.6	2.4	16.5
	OS-D1	37.09	25.3	10.9	60.7
EX-DP3		37.09	25.3	10.9	60.7
	OS-D2	0.82	13.7	0.9	2.6
EX-DP4		37.92	26.2	11.4	61.3

FLOODPLAIN STATEMENT

NO PORTION OF THE SUBJECT PROPERTY IS LOCATED WITHIN A FEMA DESIGNATED SPECIAL FLOOD HAZARD AREA (SFHA) AS INDICATED ON THE FLOOD INSURANCE RATE MAP (FIRM) FOR EL PASO COUNTY, COLORADO AND INCORPORATED AREAS - MAP NUMBER 08041C0527 G, EFFECTIVE DECEMBER 7, 2018.

NOTE: SEE BASIN MAP FOR OFFSITE BASIN DETAILS



VICINITY MAP

NOT TO SCALE

BENCHMARK

N

10 0 50 100 200

1" = 100' 1:1,200

MVE, INC.
ENGINEERS / SURVEYORS
1903 lelaray street, suite 200 colorado springs co 80909 719.635.5736

REVISIONS

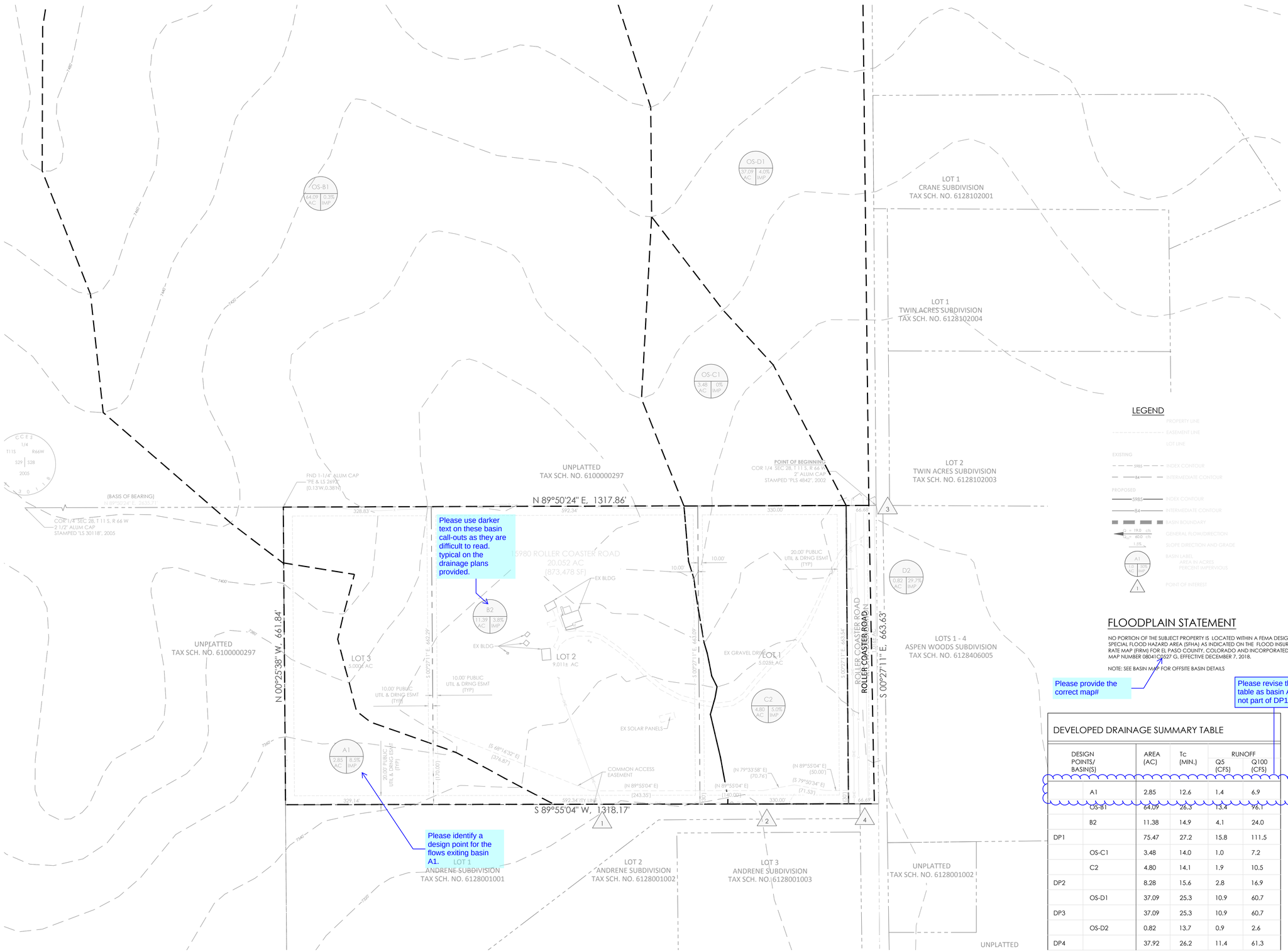
DESIGNED BY
DRAWN BY
CHECKED BY
AS-BUILTS BY
CHECKED BY

15980 ROLLERCOASTER ROAD

EXISTING DRAINAGE MAP

MVE PROJECT **61138**
MVE DRAWING **EX-DRN**

FEBRUARY 3, 2021
SHEET 1 OF 1



Please use darker text on these basin call-outs as they are difficult to read. typical on the drainage plans provided.

Please identify a design point for the flows exiting basin A1.

Please provide the correct map#

Please revise the table as basin A1 is not part of DP1

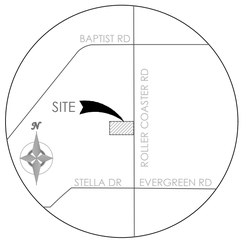
FLOODPLAIN STATEMENT

NO PORTION OF THE SUBJECT PROPERTY IS LOCATED WITHIN A FEMA DESIGNATED SPECIAL FLOOD HAZARD AREA (SFHA) AS INDICATED ON THE FLOOD INSURANCE RATE MAP (FIRM) FOR EL PASO COUNTY, COLORADO AND INCORPORATED AREAS - MAP NUMBER 08041C0527 G, EFFECTIVE DECEMBER 7, 2018.

NOTE: SEE BASIN MAP FOR OFFSITE BASIN DETAILS

DEVELOPED DRAINAGE SUMMARY TABLE

DESIGN POINTS/ BASIN(S)		AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)
	A1	2.85	12.6	1.4	6.9
	OS-B1	64.09	26.3	13.4	96.1
	B2	11.38	14.9	4.1	24.0
DP1		75.47	27.2	15.8	111.5
	OS-C1	3.48	14.0	1.0	7.2
	C2	4.80	14.1	1.9	10.5
DP2		8.28	15.6	2.8	16.9
	OS-D1	37.09	25.3	10.9	60.7
DP3		37.09	25.3	10.9	60.7
	OS-D2	0.82	13.7	0.9	2.6
DP4		37.92	26.2	11.4	61.3



VICINITY MAP

NOT TO SCALE

BENCHMARK

N

10 0 50 100 200

1" = 100' 1:1,200

MVE, INC.
ENGINEERS, SURVEYORS
1903 lelaray street, suite 200 colorado springs co 80909 719.635.5736

REVISIONS

DESIGNED BY
DRAWN BY
CHECKED BY
AS-BUILTS BY
CHECKED BY

15980 ROLLERCOASTER ROAD

PROPOSED DRAINAGE MAP

MVE PROJECT **61138**
MVE DRAWING **PP-DRN**

JANUARY 15, 2021
SHEET **1** OF **1**

LEGEND

PROPERTY LINE

EASEMENT LINE

LOT LINE

EXISTING

5985 INDEX CONTOUR

84 INTERMEDIATE CONTOUR

PROPOSED

5985 INDEX CONTOUR

84 INTERMEDIATE CONTOUR

BASIN BOUNDARY

Q = 19.0 cfs
Q_{100} = 60.0 cfs
GENERAL FLOW/DIRECTION

1.5%
SLOPE DIRECTION AND GRADE

A1
1.0 AC | 50% IMP
BASIN LABEL
AREA IN ACRES
PERCENT IMPERVIOUS

1
POINT OF INTEREST

Please use darker text

OFF-SITE DRAINAGE SUMMARY TABLE

POINT OF INTEREST/ BASIN(S)		AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)
OS-B1		64.09	26.3	13.4	96.1
OS-C1		3.48	14.0	1.0	7.2
OS-D1		37.09	25.3	10.9	60.7
OS-D2		0.82	13.7	0.9	2.6
DP4		37.92	26.2	11.4	61.3

OS-D2
0.82 AC | 29.7% IMP

OS-D1
37.09 AC | 4.0% IMP

OS-C1
3.48 AC | 0% IMP

OS-B1
64.09 AC | 0.3% IMP

ROLLER COASTER ROAD

BAPTIST ROAD

15980 ROLLER COASTER RD
20.052 AC
(873,478 SF)

7520' 7480' 7460' 7440' 7420' 7400' 7380' 7360' 7340' 7320' 7300'

N

100 0 200 400 800
1" = 400' 1:4800

FLOODPLAIN STATEMENT

NO PORTION OF THE SUBJECT PROPERTY IS LOCATED WITHIN A FEMA DESIGNATED SPECIAL FLOOD HAZARD AREA (SFHA) AS INDICATED ON THE FLOOD INSURANCE RATE MAP (FIRM) FOR EL PASO COUNTY, COLORADO AND INCORPORATED AREAS - MAP NUMBER 08041C0285 G, EFFECTIVE DECEMBER 7, 2018.

(719) 635-5736

MONUMENT VALLEY ENGINEERS INC.
*** ENGINEERS *** SURVEYORS ***
1903 LELARAY ST., COLORADO SPRINGS, COLORADO 80909

FIGURE

PAGE