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Final Drainage Report

Arvidson Subdivision

Project No. 61049

January 18, 2018

PCD File No. MS-17-006
P-17-016
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Comments 2/20/18, EN

Final Drainage Report

for

Arvidson Subdivision

Project No. 61049

January 18, 2018

prepared for

Matthew and Jenna Arvidson
2310 Wakonda Way
Monument, CO 80132
970.381.

prepared by

MVE, Inc.
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719.635.5736

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.

_____ _____

Matthew Arvidson Date
Owner
2310 Wakonda Way
Monument, CO 80132

Jenna Arvidson Date
Owner
2310 Wakonda Way
Monument, CO 80132

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 Arvidson Subdivision. This plat is the subdivision of a 5.45± Acre parcel into two lots. The report will "identify specific solutions to problems on-site and off-site resulting from the proposed project.[1] 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 Final Plat 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 Arvidson Subdivision site is located within the southeast one-quarter of Section 3, Township 11 South, Range 67 west of the 6th principal meridian in El Paso County, Colorado. The 5.45± acre site is situated on the north side of Wakonda Way, west of Beacon Lite Rd and east of Aries Dr. The proposed site has never been platted. A **Vicinity Map** is included in the **Appendix**.

The properties to the south of the site are platted as Tracts 1, 32, and 33, Wakonda Hills, Subdivision No. 1, zoned RR-0.5 (Rural Residential), and used as single family residencies and vacant residential lots. The property north and northwest of the site is Lot 1, A and B's Yard Subdivision, containing one singe-family residence with RR-5 zoning (Rural Residential). The property to the west is not platted, contains one single-family residence and is zoned RR-5. Lot 1, Shattuck Subdivision, located to the southeast of the site, is zoned I-2 (Limited Industrial) and is used as a warehouse/storage facility. The property to the east is zoned RR-2.5 (Rural Residential) and is used as a single family residence.

1.2 Description of Property

Arvidson Subdivision contains 5.45± acres and is zoned RR-5 (Rural Residential). The property contains one existing residence, gravel drive, and auxiliary structures. The property is planned to be rezoned RR-2.5 (Rural Residential).

The southeast portion of the site is grass meadow and the northwest portion is wooded hillside. The ground cover, which is in good condition, consists of native grasses and trees. The existing site topography slopes to the southwest with grades that range from 2% to 10% towards of Wakonda Way.

According to the National Resource Conservation Service, the dominant soil in the immediate area of the Arvidson Subdivision site is Kettle gravelly loam (map unit 41). The Kettle gravelly loam is typically deep and well drained. Permeability is rapid, surface runoff is medium, and the hazard of erosion is moderate. Kettle gravelly loam is classified as being part of Hydrologic Soil Group B. A

1 DCM, 4-6.

portion of the **Soil Map** and data tables from the National Cooperative Soil Survey are included in the **Appendix.**[2]

There are no major drainageways in the Arvidson Subdivision site. The majority of the flows of the site flow south and under Wakonda Way via corrugated metal pipe (CMP) and then continue to flow south and west into the east side of an unnamed sub-tributary. The other portion of the site flows south and west and meets with the same sub-tributary at a more northern point. The unnamed sub-tributary eventually flows into Monument Lake.

The current Flood Insurance Study of the region includes Flood Insurance Rate Maps (FIRMs), effective March 17, 1997. [3] [4] The project site is included in Community Panel Number 08041C0276 F of the FIRMs for El Paso County, Colorado. No portion of the site lies within FEMA designated Special Flood Hazard Areas (SFHAs). An excerpt of the current FEMA Flood Insurance Rate Maps with the site delineated is included in the Appendix.

2 Drainage Basins and Sub-Basins

2.1 Major Basin Descriptions

Arvidson Subdivision site is located in the Palmer Lake Major Drainage Basin (FOFO5400) on the north side of El Paso County. The basin is an unstudied basin and has no operative Drainage Basin Planning Study (DBPS). The Basin stretches for approximately 2.5 miles on the north side of El Paso County and drains from northeast to southwest into Monument Lake. The site is located in the southeastern portion of the Palmer Lake Major Drainage Basin. A copy of a portion of the **"*Drainage Area Identification Study*"[5] map**, showing the site location within the Basin is included in the **Appendix**.

2.2 Sub-Basin Description

2.2.1 Existing Drainage Patterns (On-Site) Off-Site Drainage Flow Patterns

Off-site drainage flows enter Arvidson Subdivision from the northeast and east. The hydrologic analyses used in the drainage design of the proposed subdivision considered the existing Land Use Conditions of the offsite sub-basin.

Existing off site sub-basin OSA1 is located north and east of the site, containing an off-site residence and undeveloped land as well as the east side of Beacon Lite Road. The basin runoff flows west toward Beacon Lite Road and then travels south in the roadside ditch, exiting the site in the roadside ditch and continuing south past the Wakonda Way intersection.

2.2.2 Existing Drainage Patterns (On-Site)

The site contains a ridge on the western portion which drains offsite towards the west on one side and east towards the center of the site of the other. The existing drainage patterns for the site are described by three on-site basins that drain towards the south of the site and the North edge of Wakonda Way. The drainage sub-basins are shown on the included **Existing Drainage Map**.

Existing sub-basin A2 is located on the eastern portion of the site, containing the west side of Beacon Lite Rd. The sub-basin drains south towards Wakonda Way in the roadside ditch. Flows from this basin turn west at Wakonda Way, combining with the flows from sub-basin A3.

Existing sub-basin A3 contains the middle portion of the property and combines with the flows from sub-basin A2. The combined flows drain to Point of Interest 1 located at a low point at the northern portion of Wakonda Way at the location of an exiting 24" CMP. The existing culvert conveys the runoff flows under Wakonda Way and then the runoff continues offsite to the southeast in the adjacent property south of the site.

2 WSS
3 FIS
4 FIRM, Map No. 08041C0756 F
5 Drain. Area Ident. Study

Existing sub-basin B1 contains the western portion of the property and drains westerly and southerly by sheet flow to the adjacent property to the west. Once offsite, the storm runoff drains toward the northern side of Wakonda Way. All flows from the site flows westerly, eventually into an unnamed tributary that drains to Monument Lake.

The Soil, Geology, Geologic Hazard and Wastewater Study for the site was prepared by Entech Engineering, Inc.[6] The study notes isolated areas of Seasonal Shallow Ground Water and Potentially Unstable Slopes. Mitigation is to avoid areas of ponded water and steep slopes. Foundation drains are also suggested for any new structures, depending on building location. The areas of concern are noted on the Drainage Maps.

Please describe the OS1 basin flows description and how it enters and leave this site.

3 Drainage Design Criteria

3.1 Development Criteria Reference

This Final Drainage Report for Arvidson Subdivision has been prepared according to the report guidelines presented in the latest edition of *El Paso County Drainage Criteria Manual* (DCM)[7]. The hydrologic analysis is based on a collection of data from the DCM, the NCSS Web Soil Survey[8], and proposed lot layout by M.V.E., Inc.

3.2 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]

No other drainage reports for any of the adjacent properties are available for review during the course of preparing this drainage report .

4 Drainage Facility Design

4.1 General Concept

The intent of the drainage concept presented in this Final Drainage Report is to maintain the existing drainage patterns & quantities on the site. 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 off-site drainage area north and east of the site, Basin OSA 1, contains 10.11 acres draining to the east edge of the site along the east edge of Beacon Lite Road. Discharges of Q_5 = 3.0 cfs and Q_{100} = 19.0 cfs (existing flows) continue to drain offsite to the south in the eastern roadside ditch.

6 Soils & Geology
7 DCM Section 4.3 and Section 4.4
8 WSS
9 DCM

Existing sub-basin A2 (0.29 acres) is comprised of the west side of Beacon Lite Road and drains south towards Wakonda Way. The discharges generated by A2 are Q_5 = 0.6 cfs and Q_{100} = 1.4 cfs (existing flow), which drains southerly along Beacon Lite Rd via roadside ditch and the flow enters sub-basin A3 at the southeast corner of the site.

Wakonda Way is a 22 ft wide, paved street with no curb on either side and a low point approaching the intersection with Beacon Lite Rd. Beacon Lite Rd is a 20 ft wide, paved street from the intersection with Wakonda Way northbound for approximately 80 ft. After the initial 80 ft, Beacon Lite Rd becomes a dirt and gravel road with a roadside ditch on the each side of the road. The road slants towards the ditches and flows from OSA1 and A2 collect on the sides and travel southerly and westerly via the ditch.

Existing sub-basin A3 (3.48 acres) contains the existing residence, gravel driveway, and part of Wakonda Way. The sub-basin generates flows of Q_5 = 1.5 cfs and Q_{100} = 7.5 cfs (existing flow), which drains southerly towards Wakonda Way. The flows of sub-basin A2 and sub-basin A3 combine at a low point on the north side of Wakonda Way designated Point of Interest 1, featuring the existing 24" CMP culvert allowing flows to cross to the south side of Wakonda Way. The combined flows at Point of Interest 1 are Q_5 = 1.9 cfs and Q_{100} = 8.5 cfs (existing flows). Flows continue towards through the adjacent property to the south, via CMP, as described in Section 2.2.

Existing sub-basin B1 (1.32 acres) is comprised of the undeveloped western portion of the site. The discharges generated by sub-basin B1 are Q_5 = 0.4 cfs and Q_{100} = 3.0 cfs (existing flow), which drains offsite in a mainly southwesterly direction towards the north edge of Wakonda Way. These flows continue offsite to the unnamed tributary as described in Section 2.2 above.

The **Existing Drainage Map** depicts the existing topographic mapping, drainage basin delineations, drainage patterns, existing streets, drainage facilities, and runoff quantities with a data table including drainage areas and flow rates.

4.2.2 Proposed Hydrologic Conditions

The off-site drainage basin, OSA1 (10.11 acres), will continue to drain toward the site as in existing conditions. The discharge is Q_5 = 3.0 cfs and Q_{100} = 19.0 cfs (proposed flow) to the east side of Beacon Lite Road and then offsite to the south as in existing conditions.

Proposed sub-basin A2 (0.29 acres) will remain the same as in the existing conditions. The discharges generated by A2 are Q_5 = 0.6 cfs and Q_{100} = 1.4 cfs (proposed flow), which drains southerly along the west side of Beacon Lite Rd until flows reach the northern edge of Wakonda Way where flows enter sub-basin A3 and continue to travel to Point of Interest 1.

Proposed sub-basin A3 (3.48 acres) is comprised of the middle section of the site. The sub-basin contains the existing residence, as well as a portion of the proposed development, which includes an extension of the gravel road, a house, and a concrete parking area. The discharges from the sub-basin are Q_5 = 1.8 cfs and Q_{100} = 7.9 cfs (proposed flows). The proposed discharges are very slightly higher than the existing discharges for sub-basin A3. Sub-basin A3 flows south to Point of Interest 1 and are combined with flows from sub-basin A2. The combined peak flows at Point of Interest 1 for A2 and A3 are Q_5 = 2.2 cfs and Q_{100} = 8.8 cfs (proposed flows). The existing 24" CMP convey thje flows under Wakonda Way and into the property to the south. Once offsite, the flows will flow to an unnamed tributary which will eventually flow into Monument Lake.

Developed sub-basin B1 (1.32 acres) is the western section of the site that is well treed and vegetated. The sub-basin will contain a portion of the proposed new residential lot including an extension of the gravel road, a house, and a concrete parking parking area. The sub-basin generates storm runoff peak discharges of Q_5 = 0.6 cfs and Q_{100} = 3.2 cfs (proposed flows). The proposed flows are a very slight increase from the existing conditions. Sub-basin B1 flows westerly towards an unnamed tributary and southerly towards Wakonda Way.

Please add a description of OS1.

4.3 Downstream Facilities

The existing 24" Corrugated Metal Pipe (CMP) pipe culvert located at the low point on the north side of Wakonda Way will continue to be utilized for draining the flows from sub-basins A2 and A3 from

the north side of Wakonda Way to the property to the south as in the existing conditions. The proposed subdivision has negligible effects on stormwater flows from the property.

There is no existing driveway culvert at the driveway and no driveway culvert is proposed. Storm drainage flows, existing grades and topography do not warrant a driveway culvert at this location. The existing driveway will continue to function as in existing conditions and no new driveway improvements are proposed at Wakonda Way.

The existing and proposed site is Low Density (Rural) Housing, 2.5 acres and larger. Also, there are no roadways or other improvements planned for the site. No water quality facilities are required. Any residential construction that involves land disturbance will require a BESQCP to be obtained from El Paso County.

5 Drainage and Bridge Fees

The site is located in the Palmer Lake Major Drainage Basin. Development in this basin carries Drainage Fees of $11,919.00 per impervious acre. The impervious area does not consider the Right of Way from Wakonda Way or from Beacon Lite Rd. The Drainage Fees for the subdivision are calculated below:

Arvidson Subdivision

Drainage Fees:

Drainage Fees = Platted Area x %imperviousness x $11,919.00

Drainage Fees = 4.47 Ac x 0.065 x $11,919.00 = **$3,463.07**

These Drainage Fees will be paid by the Developer at the filing of the plat.

The Palmer Lake Drainage Basin has Bridge Fees of $0 and no Bridge Fees are due for this project.

6 Conclusion

This Final Drainage Report presents existing and proposed drainage conditions for the proposed subdivision. The subdivision 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.

References

City of Colorado Springs/El Paso County Drainage Criteria Manual. City of Colorado Springs, Department of Public Works, Engineering Division; HDR Infrastructure, Inc.; El Paso County, Department of Public Works, Engineering Division (Colorado Springs: City of Colorado Springs, Revised November 1991).

NCSS Web Soil Survey. United States Department of Agriculture, Natural Resources Conservation Service ("http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx", accessed May, 2017).

Flood Insurance Rate Map. Federal Emergency Management Agency, National Flood Insurance Program (Washington D.C.: FEMA, March 17, 1997).

Flood Insurance Study for El Paso County, Colorado and incorporated Areas. Federal Emergency Management Agency (Washington D.C.: FEMA, March 17, 1997).

Drainage Area Identification Study. Muller Engineering Company, Inc. (Lakewood, CO: , 1986).

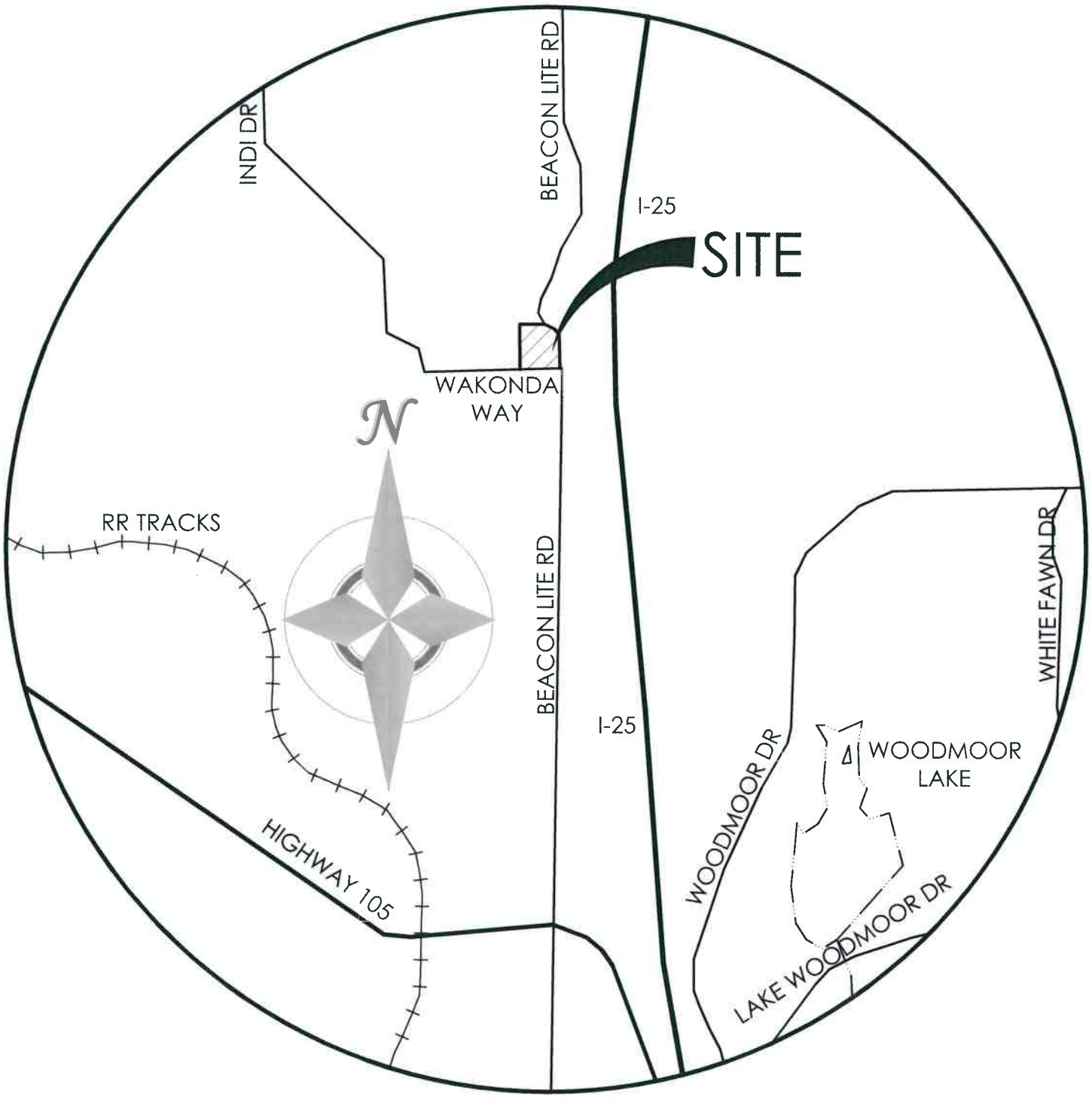
Soil, Geology, Geologic Hazard, and Wastewater Study, Arvidson Subdivision, 2310 Wakonda Way, Monument, Colorado. Entech Engineers, Inc. (El Paso County, Colorado: , January 10, 2018).

City of Colorado Springs Drainage Criteria Manual Volume 1. City of Colorado Springs Engineering Division with Matrix Design Group and Wright Water Engineers (Colorado Springs, Colorado: , May 2014).

Appendices

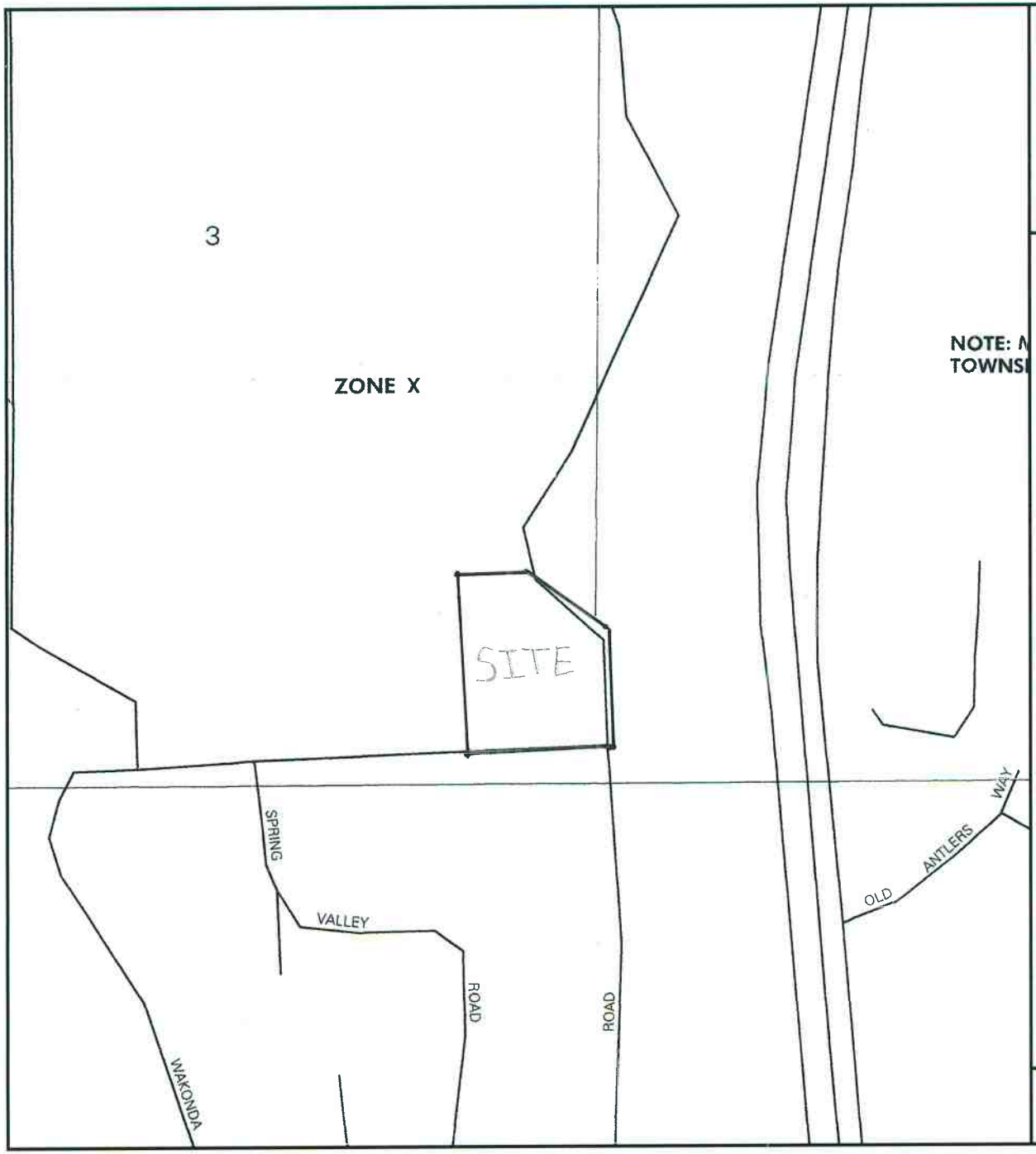
7 General Maps and Supporting Data

Vicinity Map
Portions of Flood Insurance Rate Map
Portion of Drainage Area Identification Study Map
NRCS Soil Map and Tables
SCS Soil Type Descriptions
Hydrologic Soil Group Map and Tables



VICINITY MAP

NOT TO SCALE



APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 276 OF 1300

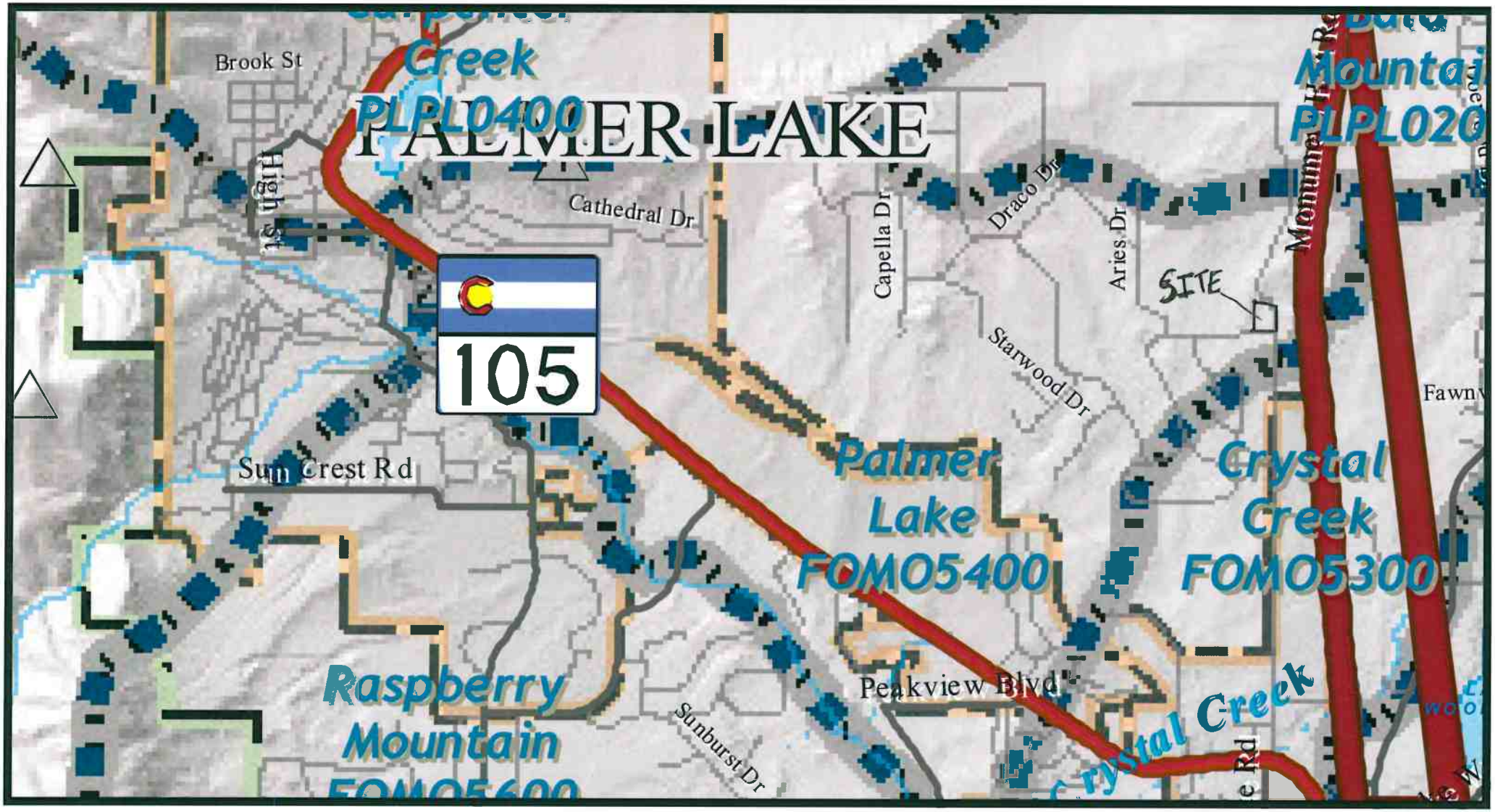
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0276	F
MONUMENT, TOWN OF	080064	0276	F
PALMER LAKE, TOWN OF	080065	0276	F

MAP NUMBER 08041C0276 F

EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency


PALMER LAKE
Brook St
High St
Cathedral Dr
Capella Dr
Draco Dr
Aries Dr
Starwood Dr
SITE
105
Sun Crest Rd
Peakview Blvd
Sunburst Dr
Monument
Fawn
Creek
PLPL0400
Mountai
PLPL020
Palmer
Lake
FOMO5400
Crystal
Creek
FOMO5300
Raspberry
Mountain
Crystal Creek

Soil Map—El Paso County Area, Colorado
(Arvidson Minor Subdivision Plat)

Map Scale: 1:1,430 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

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

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 14, Sep 23, 2016

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

Date(s) aerial images were photographed: Apr 15, 2011—Sep 22, 2011

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

Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
1	Alamosa loam, 1 to 3 percent slopes	0.1	0.8%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	7.6	98.5%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	0.1	0.7%
Totals for Area of Interest		**7.7**	**100.0%**

cludes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Elbeth-Pring complex, 5 to 30 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because there is little value in separating them. The pattern and proportion of the soils are not uniform. An area shown on the map has at least one of the dominant (named) soils or may have all of them. Olney and Vona soils, eroded, is an undifferentiated group in this survey area.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Pits, gravel is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

The military impact area described in some map units consists of a large area on the Fort Carson Military Reservation. It is used as an artillery and bombing target area. This area has not been surveyed, but most of the soils mapped adjacent to the area are in the Heldt, Kim, Midway, Razor, and Wiley series. It is estimated that most of the impact area is Razor-Midway complex.

The acreage and proportionate extent of each map unit are given in table 4, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

Soil descriptions

1—Alamosa loam, 1 to 3 percent slopes. This deep, poorly drained soil formed in alluvium on flood plains and fans. Elevation ranges from 7,200 to 7,700 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 42 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is dark gray loam about 6 inches thick. The subsoil is clay loam about 27 inches thick; it is very dark gray in the upper part and gray in the lower part. The substratum is dark greenish gray and light gray sandy clay loam and sandy loam. Mottles are common in the subsoil and substratum.

Included with this soil in mapping are small areas of Ellicott loamy coarse sand, 0 to 5 percent slopes; Cruckton sandy loam, 1 to 9 percent slopes; Peyton sandy loam, 1 to 5 percent slopes; and Pring coarse sandy loam, 3 to 8 percent slopes.

Permeability of this Alamosa soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Organic matter content of the surface layer is high. This soil has a high water table, usually between May and October. Surface runoff is slow, and the hazard of erosion is slight.

This soil is used mostly for native hay or pasture.

The potential plant community is mainly slender wheatgrass, Baltic rush, Nebraska sedge, timothy, and reedgrassses. Willows are a part of the plant community.

If the range has deteriorated, it consists mostly of Kentucky bluegrass and willows. If overgrazing is severe, denuding of the soil and gullying are possible and reestablishment of a good plant cover is very difficult. Where seeding is practical, smooth brome, orchardgrass, Garrison creeping foxtail, or reed canarygrass should be used.

Wet areas of this soil are well suited to shallow water developments, which encourage wetland wildlife such as waterfowl and a number of shore birds. Because of the availability of moisture, this soil provides excellent waterfowl nesting cover. Rangeland wildlife, such as deer and cottontail, use the areas where excellent cover is provided by willows, rushes, and other wetland vegetation. Wildlife on this soil can best be aided by using proper livestock grazing practices and allowing natural vegetation, such as willows and cattails, to grow.

This soil has poor potential for homesites. The main limitations for this use are a high water table and the hazard of flooding. Capability subclass Vw.

2—Ascalon sandy loam, 1 to 3 percent slopes. This deep, well drained soil formed in mixed alluvium and wind-laid material on uplands. Elevation ranges from 5,500 to 6,500 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 140 days.

Typically, the surface layer is brown sandy loam about 8 inches thick. The subsoil is brown, yellowish brown, and pale brown sandy clay loam about 22 inches thick. The substratum is calcareous, very pale brown sandy loam and loamy sand.

Included with this soil in mapping are small areas of Bresser sandy loam, 0 to 3 percent slopes; Olney sandy loam, 0 to 3 percent slopes; Vona sandy loam, 1 to 3 percent slopes; and Fort Collins loam, 0 to 3 percent slopes.

Permeability of this Ascalon soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Organic matter content of the surface layer is medium. Surface runoff is slow, and the hazards of erosion and soil blowing are moderate.

This soil is used mainly as cropland.

A typical rotation is wheat and summer fallow. Summer fallow is necessary because rainfall is insufficient for yearly cropping. Feed grains such as millet are used as a

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.

strength. Special designs for buildings and roads are required to offset these limitations. Methods of sewage disposal other than septic tank absorption fields are needed because of the limited depth to bedrock. Capability subclass VIe.

92—Tomah-Crowfoot loamy sands, 3 to 8 percent slopes. These gently sloping to moderately sloping soils are on alluvial fans, hills, and ridges in the uplands. Elevation ranges from about 7,300 to 7,600 feet. The average annual precipitation is about 17 inches, the average annual air temperature is about 42 degrees F, and the average frost-free period is about 120 days.

The Tomah soil makes up about 50 percent of the complex, the Crowfoot soil about 30 percent, and other soils about 20 percent.

Included with these soils in mapping are areas of Elbeth sandy loam, 3 to 8 percent slopes; Kettle gravelly loamy sand, 3 to 8 percent slopes; and Pring coarse sandy loam, 3 to 8 percent slopes.

The Tomah soil is deep and well drained. It formed in alluvium or residuum derived from arkose beds. Typically, the surface layer is dark grayish brown loamy sand about 10 inches thick. The subsurface layer is very pale brown coarse sand about 12 inches thick. The subsoil, about 26 inches thick, is a matrix of very pale brown coarse sand in which are embedded many thin bands and lamellae of pale brown coarse sandy clay loam. The substratum is very pale brown coarse sand to a depth of 60 inches or more.

Permeability of the Tomah soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazard of erosion is slight to moderate.

The Crowfoot soil is deep and well drained. It formed in sediment weathered from arkosic sandstone. Typically, the surface layer is grayish brown loamy sand about 12 inches thick. The subsurface layer is very pale brown sand about 11 inches thick. The subsoil is light yellowish brown sandy clay loam about 13 inches thick. The substratum is very pale brown coarse sand to a depth of about 68 inches.

Permeability of the Crowfoot soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazard of erosion is slight to moderate.

This complex is used as rangeland, for wildlife habitat, and as homesites.

Native vegetation is mainly mountain muhly, bluestem, mountain brome, needleandthread, and blue grama. These soils are subject to invasion by Kentucky bluegrass and Gambel oak. Noticeable 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 are fairly well suited to these soils. Blowing sand and moderate available water capacity are the principal limitations for the establishment of trees and shrubs. The soils are so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

These soils are best suited to habitat for openland wildlife such as pronghorn antelope and sharp-tailed grouse. Although sharp-tailed grouse are not plentiful, they could be encouraged on these soils, especially where brush species are interspersed with grasses and forbs. If these soils are used as rangeland, wildlife production can be increased by managing livestock grazing to preclude overuse of the more desirable grass species and depletion of the various brush species.

These soils have good potential for use as homesites. The main limitation of the Crowfoot soil is frost-action potential. Roads and streets need to be designed to minimize frost-heave damage. Maintaining the existing vegetation on building sites during construction helps to control erosion. Capability subclass IVe.

93—Tomah-Crowfoot loamy sands, 8 to 15 percent slopes. These moderately sloping to strongly sloping soils are on alluvial fans, hills, and ridges in the uplands. Elevation ranges from about 7,300 to 7,600 feet. The average annual precipitation is about 17 inches, the average annual air temperature is about 42 degrees F, and the average frost-free period is about 120 days.

The Tomah soil makes up about 50 percent of the complex, the Crowfoot soil about 30 percent, and other soils about 20 percent.

Included with these soils in mapping are areas of Elbeth sandy loam, 8 to 15 percent slopes; Peyton-Pring complex, 8 to 15 percent slopes; and Kettle gravelly loamy sand, 8 to 40 percent slopes.

The Tomah soil is deep and well drained. It formed in alluvium or residuum derived from arkose beds. Typically, the surface layer is dark grayish brown loamy sand about 10 inches thick. The subsurface layer is very pale brown coarse sand about 12 inches thick. The subsoil, about 26 inches thick, consists of a matrix of very pale brown coarse sandy clay loam. The substratum is very pale brown coarse sand to a depth of 60 inches or more.

Permeability of the Tomah soil is moderately 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 are present in some drainageways and along stock trails.

The Crowfoot soil is deep and well drained. It formed in sediment weathered from arkosic sandstone. Typically, the surface layer is grayish brown loamy sand about 12 inches thick. The subsurface layer is very pale brown sand about 11 inches thick. The subsoil is light yellowish brown sandy clay loam about 13 inches thick. The substratum is very pale brown coarse sand to a depth of about 68 inches.

Hydrologic Soil Group—El Paso County Area, Colorado
(Arvidson Minor Subdivision Plat)

Map Scale: 1:1,430 if printed on A landscape (11" x 8.5") sheet.

N

0 20 40 80 120 Meters

0 50 100 200 300 Feet

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 14, Sep 23, 2016

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

Date(s) aerial images were photographed: Apr 15, 2011—Sep 22, 2011

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

Hydrologic Soil Group— Summary by Map Unit — El Paso County Area, Colorado (CO625)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Alamosa loam, 1 to 3 percent slopes	D	0.1	0.8%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	7.6	98.5%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	0.1	0.7%
Totals for Area of Interest			**7.7**	**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.

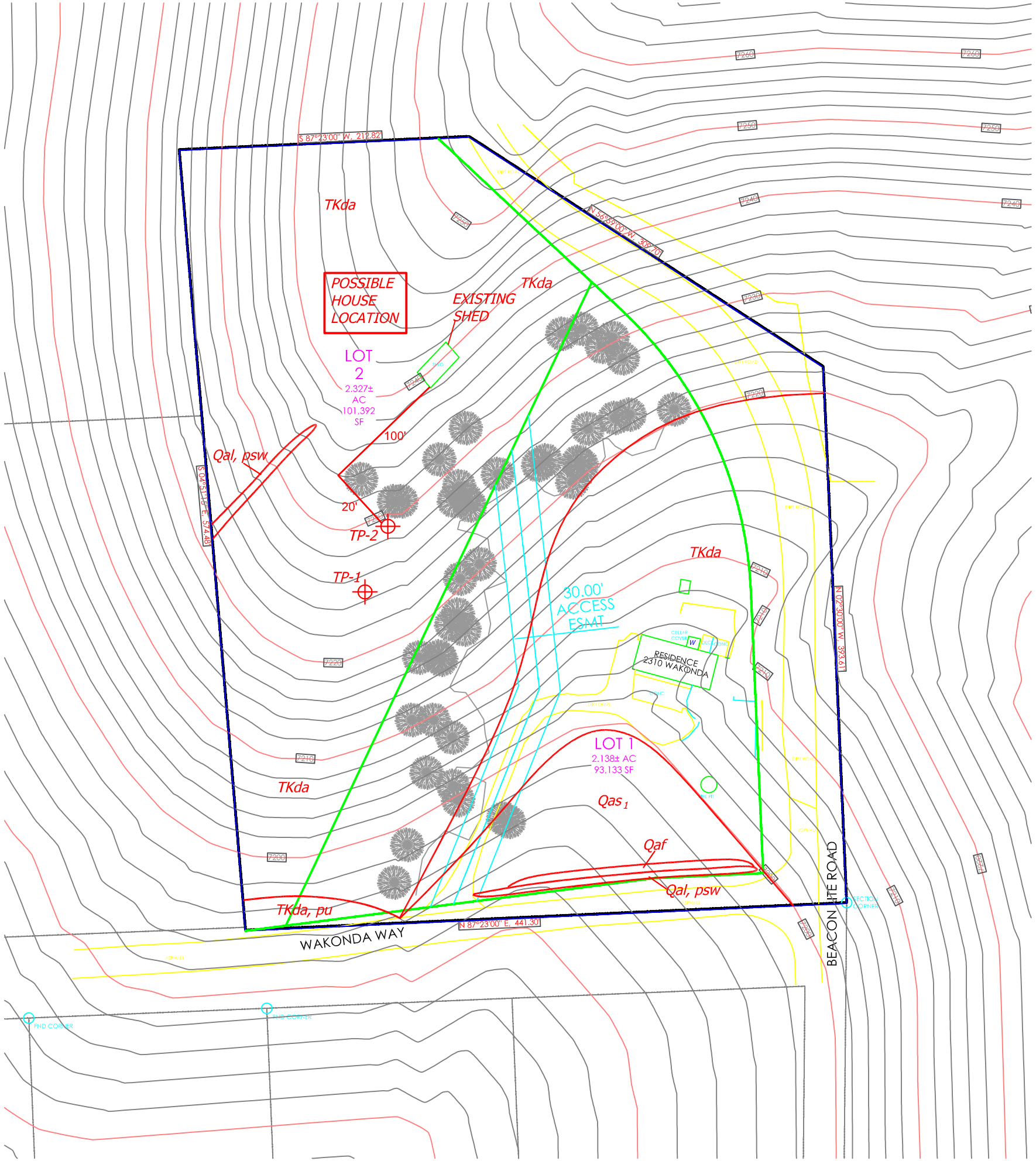
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



LEGEND:

Qal - Alluvium of Holocene Age:
water deposited materials associated with small drainages on the property

Qaf - Artificial Fill of Holocene Age:
man-made fill deposist associeated with erosion berm

Qas_1 - Younger Piedmont-Slope Alluvium of Holocene and Late Pleistocene Age:
sheetwash and stream desposited alluvium associated with Monument Creek and its tributaries

TKda - Dawson Formation of Tertiary to Cretaceous Age:
arkosic sandstone with interbedded fine-grained sandstone, siltstone and claystone

Geologic Hazards

pu - potentially unstable slopes

psw - potentially seasonal shallow groundwater area

⌖ - test pit location and number

-tp-1 (18' w x 48' s of tp-2)

-tp-2 (100' sw x 20' se of the s corner of the existing shed)

N

REVISION	BY

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907
(719) 531-5599

GEOLOGY/ENGINEERING GEOLOGY MAP
ARVIDSON SUBDIVISION
2310 WAKONADA WAY
MONUMENT, CO.
FOR: JENNA AND MATTHEW ARVIDSON

DRAWN	LLL
CHECKED	
DATE	9/14/17
SCALE	AS SHOWN
JOB NO.	171248
FIGURE No.	6

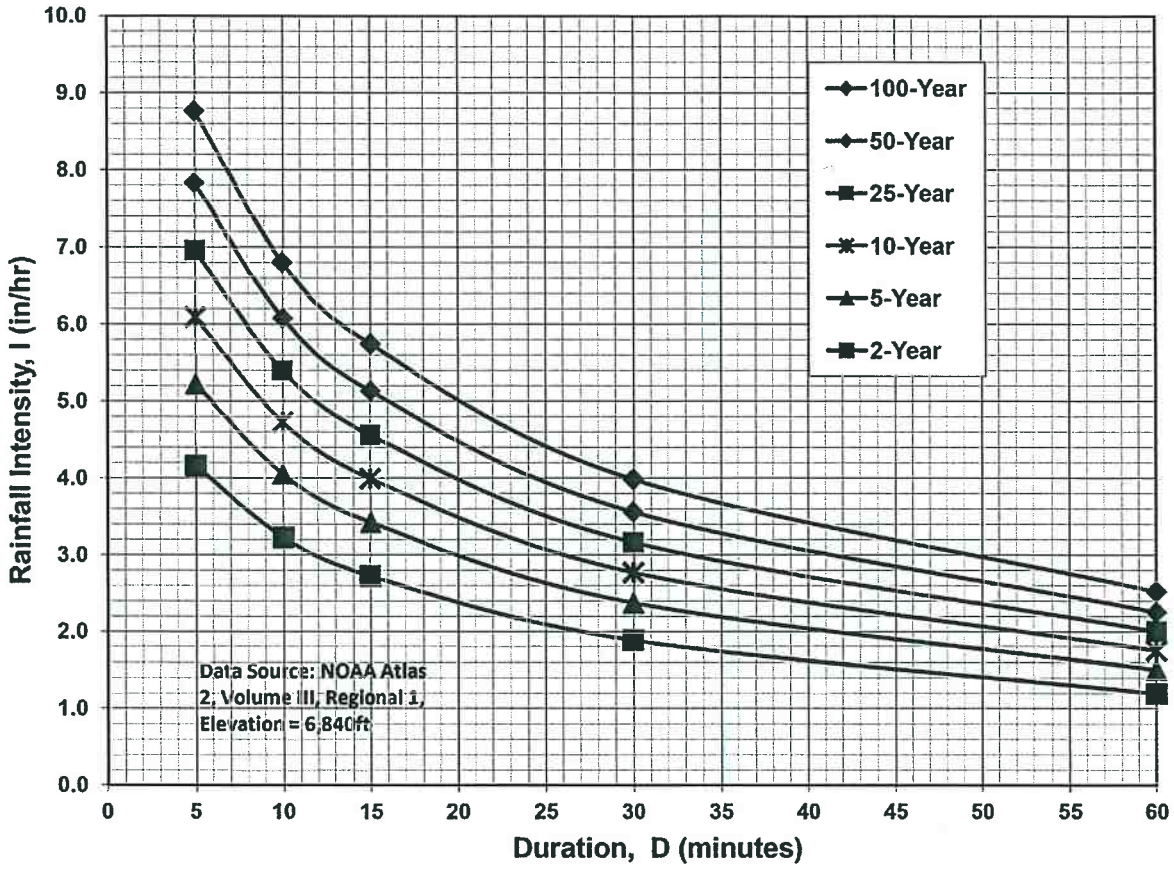
8 Hydrologic Calculations

Runoff Coefficients and Percent Imperviousness Table 6-6
Colorado Springs Rainfall Intensity Duration Frequency Table 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
Percent Imperviousness Calculation for proposed Lots 1 & 2

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

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.

Job No.: **61049**
Project: **Arvidson Minor Subdivision Plat**

Date: **1/23/18 19:49**
Calcs By: **A. Orrego**
Checked By:

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

Sub-Basin	Sub-Basin Data				Overland			Shallow Channel				Channelized				t_c Check		t_c
	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)	(min)
EX-OSA1	10.1	0.10	0.37	3%	300	17%	12.4	545	0.059	1.7	5.4	310	0.035	6.3	0.8	1155	N/A	18.6
EX-A2	0.3	0.43	0.59	55%	22	2%	4.3	0	0.000	0.0	0.0	605	0.086	4.6	2.2	627	N/A	6.5
EX-A3	3.5	0.13	0.39	7%	300	13%	12.9	314	0.070	1.9	2.8	0	0.000	0.0	0.0	614	N/A	15.7
EX-B1	1.3	0.08	0.35	0%	203	13%	11.2	0	0.000	0.0	0.0	0	0.000	0.0	0.0	203	N/A	11.2
PP-OSA1	10.1	0.10	0.37	3%	300	17%	12.4	545	0.059	1.7	5.4	310	0.035	6.3	0.8	1155	N/A	18.6
PP-A2	0.3	0.43	0.59	55%	22	2%	4.3	0	0.000	0.0	0.0	605	0.086	4.6	2.2	627	N/A	6.5
PP-A3	3.5	0.15	0.40	10%	300	13%	12.6	314	0.070	1.9	2.8	0	0.000	0.0	0.0	614	N/A	15.4
PP-B1	1.3	0.11	0.37	5%	203	13%	10.8	0	0.000	0.0	0.0	0	0.000	0.0	0.0	203	N/A	10.8

Job No.: 61049
Project: Arvidson Minor Subdivision Plat
Design Storm: 5-Year Storm *(20% Probability)*
Jurisdiction: UDFCD

Date: 1/23/18 19:49
Calcs By: A. Orrego
Checked By:

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

DP	Sub-Basin	Area (Acres)	C5	Direct Runoff t_c (min)	Direct Runoff CA (Acres)	Direct Runoff I5 (in/hr)	Direct Runoff Q5 (cfs)	Combined Runoff t_c (min)	Combined Runoff CA (Acres)	Combined Runoff I5 (in/hr)	Combined Runoff Q5 (cfs)	Streetflow Slope (%)	Streetflow Length (ft)	Streetflow Q (cfs)	Pipe Flow Q (cfs)	Pipe Flow Slope (%)	Pipe Flow Mnngs n	Pipe Flow Length (ft)	Pipe Flow D_{Pipe} (in)	Travel Time Length (ft)	Travel Time v_{Osc} (ft/s)	Travel Time t_t (min)
	EX-OSA1	10.11	0.10	18.6	0.98	3.07	3.0															
	EX-A2	0.29	0.43	6.5	0.13	4.72	0.6															
	EX-A3	3.48	0.13	15.7	0.46	3.33	1.5															
	EX-B1	1.32	0.08	11.2	0.11	3.88	0.4															
EX-POI 1	EX-A2,EX-A3	3.77	0.16					15.7	0.58	3.33	1.9											
	PP-OSA1	10.11	0.10	18.6	0.98	3.07	3.0															
	PP-A2	0.29	0.43	6.5	0.13	4.72	0.6															
	PP-A3	3.48	0.15	15.4	0.53	3.36	1.8															
	PP-B1	1.32	0.11	10.8	0.15	3.93	0.6															
PP-POI 1	PP-A2,PP-A3	3.77	0.17					15.7	0.66	3.33	2.2											

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

Job No.: 61049
Project: Arvidson Minor Subdivision Plat
Design Storm: 100-Year Storm *(1% Probability)*
Jurisdiction: UDFCD

Date: 1/23/18 19:49
Calcs By: A. Orrego
Checked By:

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

DP	Sub-Basin	Area (Acres)	C100	Direct Runoff t_c (min)	Direct Runoff CA (Acres)	Direct Runoff I100 (in/hr)	Direct Runoff Q100 (cfs)	Combined Runoff t_c (min)	Combined Runoff CA (Acres)	Combined Runoff I100 (in/hr)	Combined Runoff Q100 (cfs)	Streetflow Slope (%)	Streetflow Length (ft)	Streetflow Q (cfs)	Pipe Flow Q (cfs)	Pipe Flow Slope (%)	Pipe Flow Mnngs n	Pipe Flow Length (ft)	Pipe Flow D_{Pipe} (in)	Travel Time Length (ft)	Travel Time v_{Osc} (ft/s)	Travel Time t_t (min)
	EX-OSA1	10.11	0.37	18.6	3.69	5.15	19.0															
	EX-A2	0.29	0.59	6.5	0.17	7.93	1.4															
	EX-A3	3.48	0.39	15.7	1.35	5.60	7.5															
	EX-B1	1.32	0.35	11.2	0.46	6.52	3.0															
EX-POI 1	EX-A2,EX-A3	3.77	0.40					15.7	1.52	5.60	8.5											
	PP-OSA1	10.11	0.37	18.6	3.69	5.15	19.0															
	PP-A2	0.29	0.59	6.5	0.17	7.93	1.4															
	PP-A3	3.48	0.40	15.4	1.40	5.65	7.9															
	PP-B1	1.32	0.37	10.8	0.49	6.60	3.2															
PP-POI 1	PP-A2,PP-A3	3.77	0.42					15.7	1.57	5.60	8.8											

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

Developed Lot 1 and Lot 2 Percent Imperviousness

Job No.:	61049	Date:	1/24/18 11:46
Project:	Arvidson Minor Subdivision Plat	Calcs by:	A. Orrego
		Checked by:	
Jurisdiction	UDFCD	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	179,817	4.13	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	8,442	0.19	0.57	0.59	0.63	0.66	0.68	0.7	80%
Paved	2,000	0.05	0.89	0.9	0.92	0.94	0.95	0.96	100%
Roofs	4,266	0.10	0.71	0.73	0.75	0.78	0.8	0.81	90%
Combined	**194,525**	**4.47**	**0.07**	**0.12**	**0.19**	**0.29**	**0.33**	**0.38**	**6.5%**

194525

0

9 Hydraulic Calculations

Culvert Analysis – Existing Wakonda Way 24” CMP – Developed Flows

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jan 23 2018

Arvidson Subdivision

Invert Elev Dn (ft)	= 100.00
Pipe Length (ft)	= 40.00
Slope (%)	= 2.75
Invert Elev Up (ft)	= 101.10
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Corrugate Metal Pipe
Culvert Entrance	= Headwall
Coeff. K,M,c,Y,k	= 0.0078, 2, 0.0379, 0.69, 0.5

Embankment

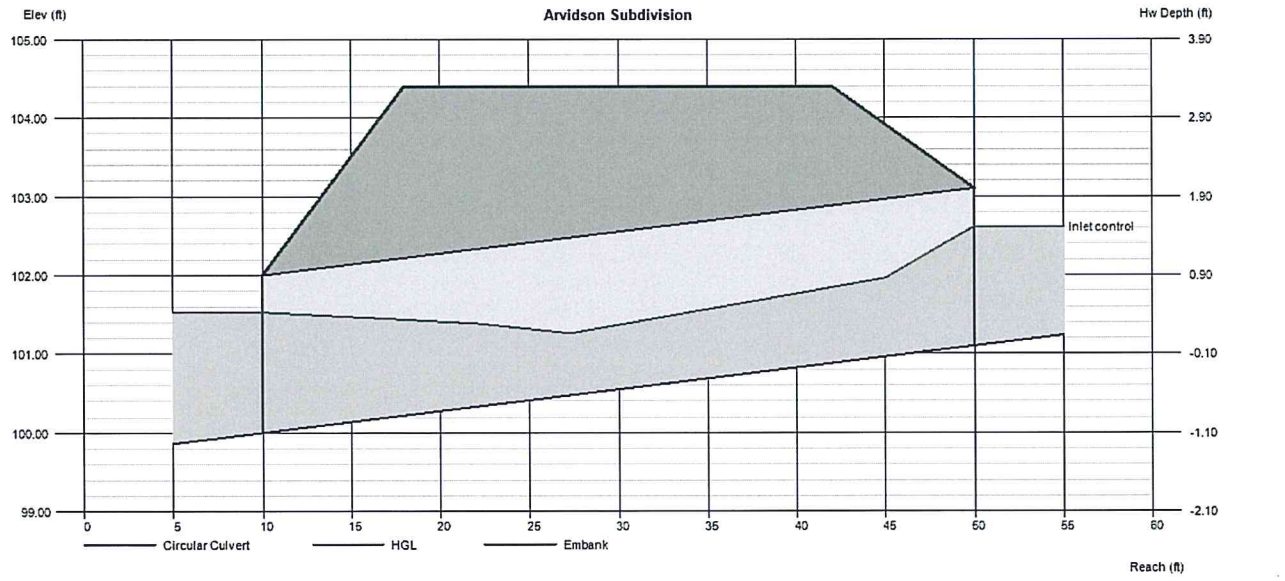
Top Elevation (ft)	= 104.40
Top Width (ft)	= 24.00
Crest Width (ft)	= 100.00

Calculations

Qmin (cfs)	= 2.20
Qmax (cfs)	= 8.80
Tailwater Elev (ft)	= (dc+D)/2

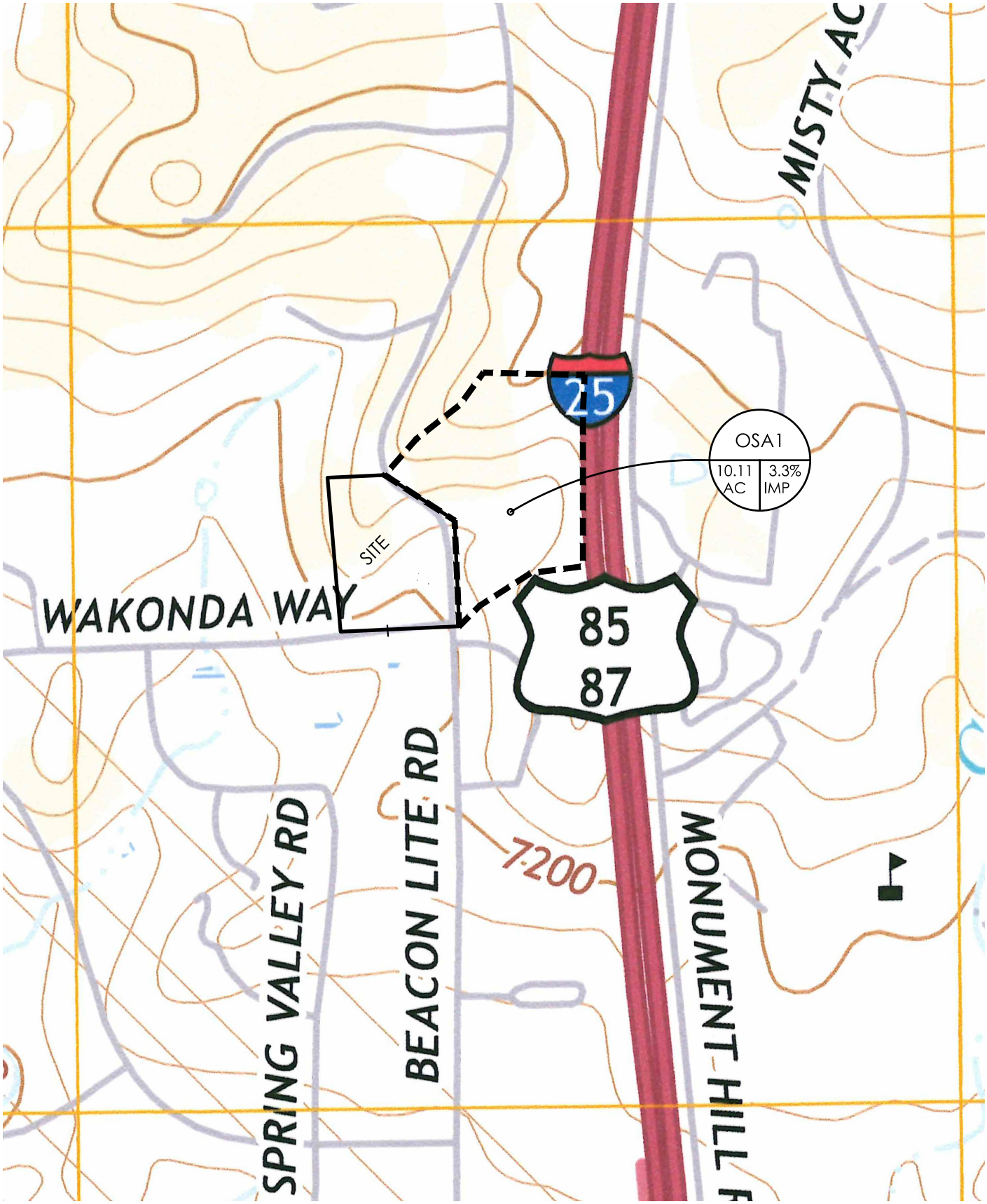
Highlighted

Qtotal (cfs)	= 8.80
Qpipe (cfs)	= 8.80
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 3.42
Veloc Up (ft/s)	= 5.22
HGL Dn (ft)	= 101.53
HGL Up (ft)	= 102.16
Hw Elev (ft)	= 102.61
Hw/D (ft)	= 0.76
Flow Regime	= Inlet Control



10 Report Maps

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



ARVIDSON MINOR SUB
OFFSITE
DRAINAGE BASIN MAP

January 18, 2018

61049-Offsite-DR-Map

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

N

SCALE:
1"=500'

LEGEND

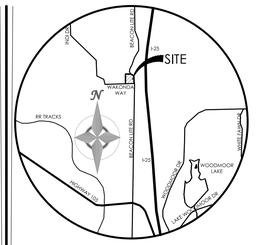
- PROPERTY LINE
- EASEMENT LINE
- LOT LINE
- BUILDING SETBACK LINE

EXISTING

- 5985 — INDEX CONTOUR
- 84 — INTERMEDIATE CONTOUR
- BARBED WIRE FENCE
- TREE (EVERGREEN/DECID.)

PROPOSED

- 5985 — INDEX CONTOUR
- 84 — INTERMEDIATE CONTOUR
- BASIN BOUNDARY
- Q_5 = 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



VICINITY MAP
NOT TO SCALE

BENCHMARK

10 0 20 50 100
1" = 50' 1:600

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 08041C0276 F, EFFECTIVE MARCH 17, 1997.

EXISTING DRAINAGE SUMMARY TABLE

POINT OF INTEREST/ BASIN(S)		AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)
	OSA1	10.11	18.6	3.0	19.0
	A2	0.29	6.5	0.6	1.4
	A3	3.48	15.7	1.5	7.5
	B1	1.32	11.2	0.4	3.0
POI 1	A2, A3	3.77	15.7	1.9	8.5

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

ARVIDSON MINOR
SUBDIVISION PLAT

EXISTING
DRAINAGE MAP

MVE PROJECT 61049
MVE DRAWING 61049-EX-DR-MAP

January 18, 2018
SHEET 1 **OF** 2

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LEGEND

- PROPERTY LINE
- EASEMENT LINE
- LOT LINE
- BUILDING SETBACK LINE

EXISTING

- 5985 INDEX CONTOUR
- 84 INTERMEDIATE CONTOUR
- BARBED WIRE FENCE
- TREE (EVERGREEN/DECID.)

PROPOSED

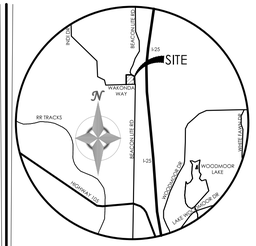
- 5985 INDEX CONTOUR
- 84 INTERMEDIATE CONTOUR
- BASIN BOUNDARY
- Q_5 = 19.0 cfs / Q_{100} = 60.0 cfs GENERAL FLOW/DIRECTION
- 1.5% SLOPE DIRECTION AND GRADE
- A1 | 1.0 AC | 50% IMP — BASIN LABEL: AREA IN ACRES, PERCENT IMPERVIOUS
- 1 POINT OF INTEREST

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 08041C0276 F, EFFECTIVE MARCH 17, 1997.

PROPOSED DRAINAGE SUMMARY TABLE

POINT OF INTEREST/ BASIN(S)		AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)
	OSA1	10.11	18.6	3.0	19.0
	A2	0.29	6.5	0.6	1.4
	A3	3.48	15.4	1.8	7.9
	B1	1.32	10.8	0.6	3.2
POI 1	A2, A3	3.77	15.4	2.2	8.8



VICINITY MAP
NOT TO SCALE

BENCHMARK

10 0 20 50 100
1" = 50' 1:600

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

ARVIDSON MINOR
SUBDIVISION PLAT

PROPOSED
DRAINAGE MAP

MVE PROJECT 61049
MVE DRAWING 61049-PP-DR-MAP

January 18, 2018
SHEET 2 **OF** 2

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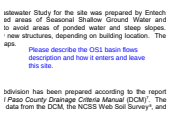
Markup Summary

dsdnijkamp (5)

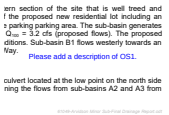
Subject: Text Box
Page Label: 1
Lock: Unlocked
Author: dsdnijkamp

Comments 2/20/18, EN



Subject: Text Box
Page Label: 8
Lock: Unlocked
Author: dsdnijkamp

Please describe the OS1 basin flows description and how it enters and leave this site.



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Page Label: 9
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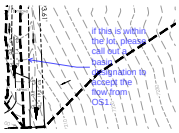
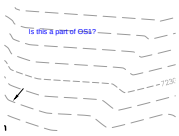
Author: dsdnijkamp

Please add a description of OS1.



Subject: Callout
Page Label: 39
Lock: Unlocked
Author: dsdnijkamp

if this is within the lot, please call out a basin designation to accept the flow from OS1.



Subject: Text Box
Page Label: 39
Lock: Unlocked
Author: dsdnijkamp

Is this a part of OS1?