MASTER DEVELOPMENT DRAINAGE PLAN & FINAL DRAINAGE REPORT

FOR

HIGHLANDS AT BRIARGATE

NORTHEAST CORNER OF REASEARCH PARKWAY AND CHAPEL HILLS DRIVE
COLORADO SPRINGS, EL PASO COUNTY, COLORADO

Prepared: April 20th, 2022
Revised: ____________

Prepared for:
Davis Development

7375 W. 52nd, Ste 200
Arvada, CO 80002
Phone: 303-302-2502

Prepared by:

HARRIS KOCHER SMITH

Mark A West, P.E., C.F.M.
1120 Lincoln Street, Suite 1000
Denver, CO 80203
Ph.: 303-623-6300, Fax: 303-623-6311

Harris Kocher Smith Project No.: 210639

TABLE OF CONTENTS

CONTACT INFORMATION

Applicant:	Lance Chernow
Company Name:	Davis Development
Email:	lance.chernow@davisdevelopment.com
Mailing Address:	7375 W. 52nd Ave, Ste. 200
	Arvada, CO 80003
Telephone #:	(770)-474-4345

Plan Preparation Consultant:

Company Name:	Harris Kocher Smith
Professional Engineer:	Mark A. West, P.E., C.F.M
Email:	mwest@hkseng.com
Mailing Address:	1120 Lincoln Street, Suite 1000
	Denver, CO 80203
Telephone #	(303) 623-6300
Fax #	(303) 623-6311

I. Certifications

Engineer's Statement:

This report and plan for the drainage design of Highlands at Briargate was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability cause by any negligent acts, error, or omissions on my party in preparing this report.

______________________________ ________________

Mark A. West, P.E., C.F.M. Date
State of Colorado Registration No. 38561
On Behalf of Harris Kocher Smith

Developer's Statement

Davis Development hereby certifies that the drainage facilities for Highlands at Briargate shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of Highlands of Briargate, guarantee that final drainage design review will absolve Davis Development and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

Davis Development
Name of Developer

________________________________ ________________
By: Lance Chernow Date
Title: General Counsel
Address: 7375 W. 52nd Ave, Ste. 200
Arvada, CO

City of Colorado Springs Only:
Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

________________________________ ________________
For City Engineer Date
Conditions:

II. Purpose

The purpose of this Master Development Drainage Plan is to identify on-Site and off-Site drainage patterns and to design the proposed storm sewer, inlet interception locations, and water quality facilities for the Highlands at Briargate development.

III. General Location and Description

A. Site Location

The entire property, including the Highlands at Briargate development, is located at the northwest corner of Research Parkway and Chapel Hill Drive, which is situated in the West half of Section 33, Township 12 South, Range 66 West of the 6th Principal Meridian, City of Colorado Springs (City), County of El Paso, State of Colorado.

The property is bound by Research Parkway along the north, with a Medical Center facility across the street; Chapel Hills Drive along the east, with a gasoline station and business buildings across the street; Highland Ridge Heights along the North, with an undeveloped tract of land to the across; A religious community of buildings to the West with large asphalt parking areas.

A Vicinity Map is included in Appendix A, for reference.

B. Description of Property

The entire property being subdivided in the Highland at Briargate Filling No. 1 is 13.425 acres. The Highlands at Briargate site, hereby referring to the multifamily development and referred to as “Site” for this report, will be developed within the property and consists of Lot 2 of Highlands at Briargate Filing No. 4.

The Site will be developed as an apartment complex with onsite facilities and amenities. The Site is approximately 13.425 acres. The Site will be disturbed by demolition, excavation, grading, utility installation and other construction activities.

The Site appears to be mostly covered with short grasses and weeds, assumed to be a mix of native and non-native. A few trees and shrubs are scattered around the property. The Site generally drains East to West, overland, with slopes ranging approximately between 3% and 25% within the area to be developed.

According to the Natural Resources Conservation Service (NRCS) Web Soil Survey (WSS), the underlying soil within the limits of the Site was entirely Blakeland loamy sand, 1 to 9 percent slopes. The associated Hydrologic Soil Groups are classified as A. For runoff computations, Hydrologic Soil Group A was used, which assumes more conservative results (slightly higher flows). Pages from the NRCS WSS report are included in Appendix B; a summary table follows.

Map Unit Symbol	Map Unit Name	Area of Interest (AOI)	Hydrologic Soil Group	Hydrologic Soil Ground	
		Acres	Percent		Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	35.3	100%	A	100%
	Minor Components			N/A	0%

IV. Drainage Design Criteria

A. Regulations

This study was prepared in accordance with the City of Colorado Springs “Drainage Criteria Manual” (DCM) Volumes 1 and 2 (last revised May 2014) and the Mile High Flood Control District’s (MHFCD) “Urban Storm Drainage Criteria Manual” (USDCM) Volumes 1 (2018), 2 (2017) and 3 (2019). The Colorado Department of Transportation (CDOT) Drainage Design Manual (2019) was used with reference to the Type R inlets proposed with this development.

B. Hydrologic Criteria

The total area of the property, whose runoff is being directed to the proposed detention pond, is approximately 13.425 acres which consists of the Site and the proposed apartment complex. The Rational Method is appropriate and was used to calculate peak rates of stormwater runoff. The design storms analyzed for this Site include the 5-year and 100-year for the minor and major storms, respectively, per the CCS DCM.

Rainfall intensities were determined using the following Rainfall Intensity Duration (IDF) equations, as applicable, excerpted from Vol. 1, Ch. 6 of the CCS DCM can be found in Table 1 below:

TABLE 1: RAINFALL INTENSITY DURATION
IDF Equations
$I_{100} = -2.52\ln(D) + 12.735$
$I_{50} = -2.25\ln(D) + 11.375$
$I_{25} = -2.00\ln(D) + 10.111$
$I_{10} = -1.75\ln(D) + 8.847$
$I_{5} = -1.50\ln(D) + 7.583$
$I_{2} = -1.19\ln(D) + 6.035$

The runoff coefficients from Table 6-6 of Vol. 1 of the CCS DCM were used to the extent practical. Deviations from the CCS DCM methodology, for the purpose of this Final Drainage Report, are as follows:

- 75% imperviousness was used for apartment developments as a preliminary value to represent the Site.

Water Quality treatment and detention will be required for the proposed development. Required water quality and detention storage were calculated using DCM Volume 2 and MHFCD UD Detention worksheet. Ponds will release at or below historic rates.

Results of hydrologic analyses, in addition to pertinent charts, figures, and tables, are included in Appendix C of this report.

C. Hydraulic Criteria

Inlet capacity will be based on utilizing the UDFCD spreadsheet “UD Inlet v4.06.xls”, released August 2018. Utilizing this spreadsheet, all inlets will be analyzed for proposed conditions. At the moment, inlet capacity has not been determined, however, as the project moves forward we will meet the City of Colorado standards.

V. Existing Drainage Conditions

A. Major Basin Descriptions

The Site is within the Pine Creek drainage basin and was included in the previous study listed below.

- *Pine Creek Drainage Basin, prepared in June 1988 by Obering, Wurth, & Associates Consulting Civil Engineers.*

The Site is a part of the area described in the Pine Creek Drainage Basin, prepared in June 1988 by Obering, Wurth, & Associates Consulting Civil Engineers. The Site occupies portions of the southwest area of the Pine Creek drainage basin. Pine Creek flows west at roughly at varying slopes. At the time the Pine Creek Drainage Basin was written, the Pine Creek basin was determined to contain approximately 3,200 acres. Excerpts from the Pine Creek can be found in Appendix A.

The Site does not lie within a FEMA designated floodplain. Flood Insurance Rate Map (FIRMette) Map Number 08041C0508G (effective 12/7/2018) indicates that the Site is in an area designated as Zone X, area determined to be outside the 0.2% annual chance floodplain. FIRMette excerpts are included in Appendix A, for reference.

B. Existing Facilities

There are no known major drainageways on, adjacent to, or otherwise impacting the Site. A 48-inch diameter pipe extends across the southern portion of the site from east to west.

There are no known irrigation facilities on, adjacent to, or otherwise impacting the Site.

Utilities and other encumbrances considered can be found in the existing conditions drainage plan in Appendix E and include:

- A storm sewer line that runs through the Site from east to west. It is located inside a 10' Storm Sewer Easement (Book 6155 Page 1143) and also within 50' Public Improvement and Utility Easement (Book 3805 Page 822)

- A gas and water line that runs through the Site from east to west. It is located within a 50' Public Improvement and Utility Easement (Book 3805 Page 822)

Existing Conditions Sub-basin Descriptions

The entire project site is presently undeveloped land. Runoff from all subbasins will generally flow east to west. The stormwater flow pattern for all subbasins generally sheet flow across the existing open land.

VI. Proposed Drainage Conditions

A. General Concept

Runoff from the Site will be captured in proposed inlets, conveyed in proposed pipes, detained in the proposed extended detention basin (Pond), and released at or below historic rates. Drainage patterns will remain relatively unchanged from current conditions, except that the flows captured and detained will be discharged through a proposed storm sewer pipe to an existing 48" pipe on the west boundary of the Site.

B. Sub-basin Descriptions

As previously noted, the Site currently drains overland generally East to West. Development of the Site will not change the general drainage patterns. All design storm runoff from the Site is planned to be captured via proposed private inlets, conveyed in pipes to a proposed private on-Site water quality and detention facility, detained, and released at or below historic rates. A Final Drainage Plan is included in Appendix E, for reference.

The Site has been generally subdivided into twenty (20) subbasins, described in more detail below. All of the "A" basins are flowing into the norther pond while all of the "B" basins are flowing into the southern pond, both through a proposed storm system. These areas may be adjusted periodically as the project moves forward and calculations will be adjusted as needed. The locations of these subbasins can be seen on the Final Drainage Plan located in Appendix E.

Subbasin A1 (0.41 acres) is comprised of a portion of a building, walks, drive, and parking. Runoff from this subbasin will be captured in a private Type R inlet (Sump) at inlet A1. and conveyed through proposed storm sewer to the Pond. Inlet A1 flows to design point 1 at Curb Inlet A2. The stormwater flow pattern for this subbasin will generally be initial sheet flow across parking to said Type R inlet, eventually being routed in private proposed storm sewer to the Pond. The minor and major developed peak flows for this subbasin are 1.00 cfs and 2.47 cfs, respectively.

Subbasin A2 (0.42 acres) is comprised of walks, a drive and parking. Runoff from this subbasin will be captured in a private Type R 10' inlet (at grade) at inlet A2 and conveyed through private proposed storm sewer to the Pond. Inlet A1 flows to design point 1 at Inlet A2. The stormwater flow pattern for this subbasin will generally be initial sheet flow across parking areas, to curb and gutter, to said private Type R 10' Inlet, eventually being routed in private proposed storm sewer to the Pond. Overflow from this subbasin will flow into subbasin A3 and be collected in inlet A3. The minor and major developed peak flows for this subbasin are 1.01 cfs and 2.51 cfs, respectively.

Subbasin A3 (0.27 acres) is comprised of a portion of a building, walks, drive, and parking. Runoff from this subbasin will be captured in a private Type R inlet (at grade) at inlet A3 and conveyed through private proposed storm sewer to the Pond. Inlet A3 flows to design point 3 at Inlet A4. The stormwater flow pattern for this subbasin will generally be initial sheet flow across parking areas to curb and gutter, to said private Type R inlet, eventually being routed in private proposed storm sewer to the Pond. The minor and major developed peak flows for this subbasin are 0.64 cfs and 1.60 cfs, respectively.

Subbasin A4 (0.78 acres) is comprised of a portion of a building, walks, drive, and parking. Runoff from this subbasin will be captured in a private Type R inlet (at grade) at inlet A4. Inlet A4 flows to design point 9 at Inlet A5. The stormwater flow pattern for this subbasin will generally be initial sheet flow across landscape/parking areas to curb and gutter, to said private Type R inlet (at grade) inlet, eventually being routed in private proposed storm sewer to the Pond. The minor and major developed peak flows for this subbasin are 1.87 cfs and 4.64 cfs, respectively.

Subbasin A5 (0.69 acres) is comprised of a portion a building, walks, drive, and parking. Runoff from this subbasin will be captured in a private 10' Type R inlet (Sump) at inlet A5 and conveyed through private proposed storm sewer to the Pond. Inlet A5 is in design point 9 and into flows to design point 10. The stormwater flow pattern for this subbasin will generally be initial sheet flow across landscape/parking areas to curb and gutter, to said private Type R inlet, eventually being routed in private proposed storm sewer to the Pond. The minor and major developed peak flows for this subbasin are 1.66 cfs and 4.11 cfs, respectively.

Subbasin A6 (0.92 acres) is comprised of a portion of a building, walks, drive, and parking. Runoff from this subbasin will be captured in a private Type R inlet (at grade) at inlet A6 and conveyed through private proposed storm sewer to the Pond. The stormwater flow pattern for this subbasin will generally be initial sheet flow across landscape/parking areas to curb and gutter, to said private Type R inlet, eventually being routed in private proposed storm sewer to the Pond. The minor and major developed peak flows for this subbasin are 2.20 cfs and 5.47 cfs, respectively.

Subbasin A7 (0.26 acres) is comprised of portions of a building, walks, drive, and parking. Runoff from this subbasin will be captured in a private Type R inlet (Sump) at inlet A7 and conveyed through private proposed storm sewer to the Pond. Inlet A7 is at design point 4 and flows to Inlet A5 at design point 9. The stormwater flow pattern for this subbasin will generally be initial sheet flow across landscape/parking areas, to the curb and gutter, and to said private Type R inlet, eventually being routed in private proposed storm sewer to the Pond. The minor and major developed peak flows for this subbasin are 0.61 cfs and 1.52 cfs, respectively.

Subbasin A8 (0.79 acres) is comprised of portions a building, walks, drive, landscaping, and parking. Runoff from this subbasin will be captured in a private Type R inlet (at grade) at inlet A8 and conveyed through private proposed storm sewer to the Pond. Inlet A8 flows to Inlet A9 at design point 5. The stormwater flow pattern for this subbasin will generally be initial sheet flow across roofs and landscaping areas, to said private Type C inlet, eventually being routed in private proposed storm sewer to the Pond. The minor and major developed peak flows for this subbasin are 1.89 cfs and 4.69 cfs, respectively.

Subbasin A9 (0.50 acres) is comprised of a portion of walks, drives, and landscaping. Runoff for this subbasin will be captured in a private Type R inlet (at grade) at inlet A9 and conveyed through private proposed storm sewer to the Pond. Inlet A9 flows toward design point 5 at inlet. The stormwater flow pattern for this subbasin will generally be initial sheet flow across a drives, walks, and landscaping, to said Type C inlet, eventually being routed in private proposed storm sewer to the Pond. The minor and major developed peak flows for this subbasin are 1.19 cfs and 2.96 cfs, respectively.

Subbasin A10 (0.58 acres) is comprised of portions a building, walks, drive, landscaping, and parking. Runoff for this subbasin will be captured in a private Type R inlet (Sump) at inlet A10 and conveyed through private proposed storm sewer to the Pond. The stormwater flow pattern for this subbasin will generally be initial sheet flow across landscape/parking areas, to the curb and gutter, to said private Type R inlet, eventually being routed in private proposed storm sewer to the Pond. The minor and major developed peak flows for this subbasin are 1.39 cfs and 3.45 cfs, respectively.

Subbasin A11 (1.69 acres) is comprised of portions a building, walks, drive, landscaping, and parking. Runoff for this subbasin will be captured in a private Type R inlet (Sump) at inlet A11 and conveyed through private proposed storm sewer to the Pond. The stormwater flow pattern for this subbasin will generally be initial sheet flow across the street, to the curb and gutter, to said private Type R inlet, eventually being routed in private proposed storm sewer to the Pond. The minor and major developed peak flows for this subbasin are 4.07 cfs and 10.10 cfs, respectively.

Subbasin A12 (0.69 acres) is comprised of a building, walks, drive, landscaping, and parking. Runoff for this subbasin will be captured in a private Type R inlet (Sump) at inlet A5 and conveyed through private proposed storm sewer to the Pond. Inlet A5 flows to design point 10. The stormwater flow pattern for this subbasin will generally be initial sheet flow across landscape/parking areas, to the curb and gutter, to said private Type R inlet, eventually being routed in private proposed storm sewer to the Pond. The minor and major developed peak flows for this subbasin are 1.65 cfs and 4.09 cfs, respectively.

Subbasin A13 (0.90 acres) is comprised a building, walks, drive, landscaping, and parking. Runoff for this subbasin will be captured in a private Type R inlet (Sump) at inlet A13 and conveyed through private proposed storm sewer to the Pond. Inlet A13 is at design point 10 and flows to into the proposed Pond. The stormwater flow pattern for this subbasin will generally be initial sheet flow across landscape/parking areas, to the curb and gutter, to said private Type R inlet, eventually being routed in private proposed storm sewer to the Pond. The minor and major developed peak flows for this subbasin are 2.17 cfs and 5.39 cfs, respectively.

Subbasin A14 (0.54 acres) is compromised of the entire pond area.

Subbasin B1 (1.00 acres) is comprised of a portion of building, walks, drive, landscaping, and parking. Runoff for this subbasin will be captured in a private Type C inlet (on grade) at inlet B1 and conveyed through private proposed storm sewer to the Pond. Inlet B1 flows to design point 11 at inlet B2. The stormwater flow pattern for this subbasin will generally be initial sheet flow across drives and landscaping, to said private Type C inlet, eventually being routed through the private proposed storm sewer to the Pond. The minor and major developed peak flows for this subbasin are 2.40 cfs and 5.95 cfs, respectively.

Subbasin B2 (1.44 acres) of building, walks, drive, landscaping, and parking. Runoff for this subbasin will be captured in a private Type R inlet (Sump) at inlet B2 and conveyed through private proposed storm sewer to the Pond. Inlet B2 is at design point 11 and flows to the pond at B3.. The stormwater flow pattern for this subbasin will generally be initial sheet flow across landscape/parking areas, to the curb and gutter, to said private Type R inlet, eventually being routed in private proposed storm sewer to the Pond. The minor and major developed peak flows for this subbasin are 3.47 cfs and 8.60 cfs, respectively.

Subbasin B3 (0.34 acres) is compromised of the entire pond area.

Subbasin X1 (0.45 acres) is comprised entirely of landscaping area. Runoff for this subbasin will sheet flow offsite. The minor and major developed peak flows for this subbasin are 1.07 cfs and 2.66 cfs, respectively.

Subbasin X2 (0.26 acres) is comprised entirely of landscaping area. Runoff for this subbasin will sheet flow offsite.. The minor and major developed peak flows for this subbasin are 0.62 cfs and 1.54 cfs, respectively.

Subbasin X3 (0.46 acres is comprised entirely of landscaping area. Runoff for this subbasin will sheet flow offsite as current existing conditions. The minor and major developed peak flows for this subbasin are 1.10 cfs and 2.73 cfs, respectively.

C. Full Spectrum Detention Pond

Previous studies have utilized empirical equations and outdated modeling methods to determine required storage volumes. The Mile High Flood District (MHFD) continues to innovate the process of stormwater detention for attenuation of a full range of storm events. Full Spectrum Detention, using the MHFD-Detention workbook was the method chosen to determine required storage volumes and release rates for this study. This design reduces the runoff from a developed site to lower than pre-developed flowrates. The planned outfall for the Site is the existing storm sewer bisecting the Site.

Two ponds are proposed on-site with the North Pond detaining the A Basins and the South Pond detaining the B Basins. The combined ponds have been sized for the total area of 12.1 acres with 75% imperviousness which will collect and treat runoff from both A and B subbasins. The approximate footprint has been determined to be 0.54 acres for the North Pond and 0.24 acres for the South Pond.

The ponds include the water quality capture volume (WQCV), excess urban runoff volume (EURV), 100-year detention. The emergency overflow spillway crest is set at the 100-year ponding depth. The outlet structure has been designed to release the minor and major storms at reduced rates per the table below. The release rates are designed to adhere to state statute by releasing the 5-year event in under 72 hours and the 100-year event in under 120 hours.

A spillway will be included with the final design detailing 1' of freeboard. From the outlet structure, the treated and detained runoff enters the existing storm line that bisects the site.

The MHFD design spreadsheets for the Pond are included in Appendix D, for reference

Pond	Area Contribution (ac)	WQCV (ac-ft)	EURV (ac-ft)	100-yr (ac-ft)	5-year Release (cfs)	100-year Release (cfs)	Spillway Crest Length (ft)
North	9.43	0.235	0.691	1.147	2.9	13.5	11
South	2.68	0.067	0.196	0.326	0.8	2.1	5

D. Compliance with Standards and Existing Conditions

Proposed inlets are either CDOT Type R curb inlets, the Denver Type 16 valley inlets or CDOT type C area inlets per the CCS DCM. Denver Type 16 valley inlets were chosen due to increased interception capacity compared to CDOT Type 13 valley inlets. All of the proposed basins and inlets have been sized to either intercept the major 100-year storm or bypass it to follow existing conditions. Emergency overflow paths have been designed to allow runoff to flow to the existing drainage conditions without impacting the finished floor of the adjacent buildings.

E. Stormwater Quality Management Process

Both UDFCD/MHFD and CCS recommend implementation of the Four Step Process, summarized below, which helps to minimize adverse impacts of urbanization. Benefits of this process include reduced runoff, improved water quality, a decrease of the required storage volume, reduced burdens to downstream facilities, and improved site aesthetics. The Four Step Process is outlined below:

Step 1: Reduce runoff by disconnecting impervious areas, eliminating “unnecessary” impervious areas, and encouraging infiltration into soils that are suitable. This is accomplished by a combination of landscape islands and landscape areas adjacent to buildings and amenity areas on the Site.

Step 2: Treat and slowly release the WQCV. This is being accomplished through the Full Spectrum Detention Pond where runoff will slowly flow from the forebay of the pond to the outlet structure while sediment settles to the bottom of the pond. Then the runoff is slowly released out the outlet structure.

Step 3: Stabilize drainageways. A combination of seeding and mulching and riprap around the outfall will be used on Site to stabilize the land and prevent erosion. All new and re-development projects are required to construct or participate in the funding of channel stabilization measures. Drainage basin fees paid, at the time of platting, go towards channel stabilization within the drainage basin. The proposed outlet has sufficient stabilization.

Step 4: Implement source controls. A combination of source control BMP’s will be utilized including landscape maintenance, snow and ice management, and street sweeping and cleaning utilized, one can apply for reimbursement of the parts of these fees that are unused.

VII. Construction Cost Opinion

All storm sewer within the apartment complex site will be owned and maintained by Davis Development or the current property owner. Maintenance requirements for all best management practices shall be in accordance with the DCM and MHFCD Criteria Manuals.

VIII. Conclusions

A. Compliance with Standards

This drainage design was prepared in compliance with the City of Colorado Springs Drainage Criteria Manual, the Mile High Flood Control District's Criteria Manual, and major drainageway planning studies. This study and its findings are in general conformance with the MDDP and other pertinent drainage studies.

B. Summary

Currently, the Site is nearly all pervious, and flows are otherwise undetained and untreated. The proposed development associated with Highlands at Briargate Filing No. 4 includes a storm drainage system which will convey post development runoff on the Site that is to be disturbed, to an on-site water quality and detention facility. No adverse impacts to the surrounding drainage facilities are anticipated.

IX. References

1. *Drainage Criteria Manual, Volumes 1 and 2,* City of Colorado Springs, Colorado, May 2014..

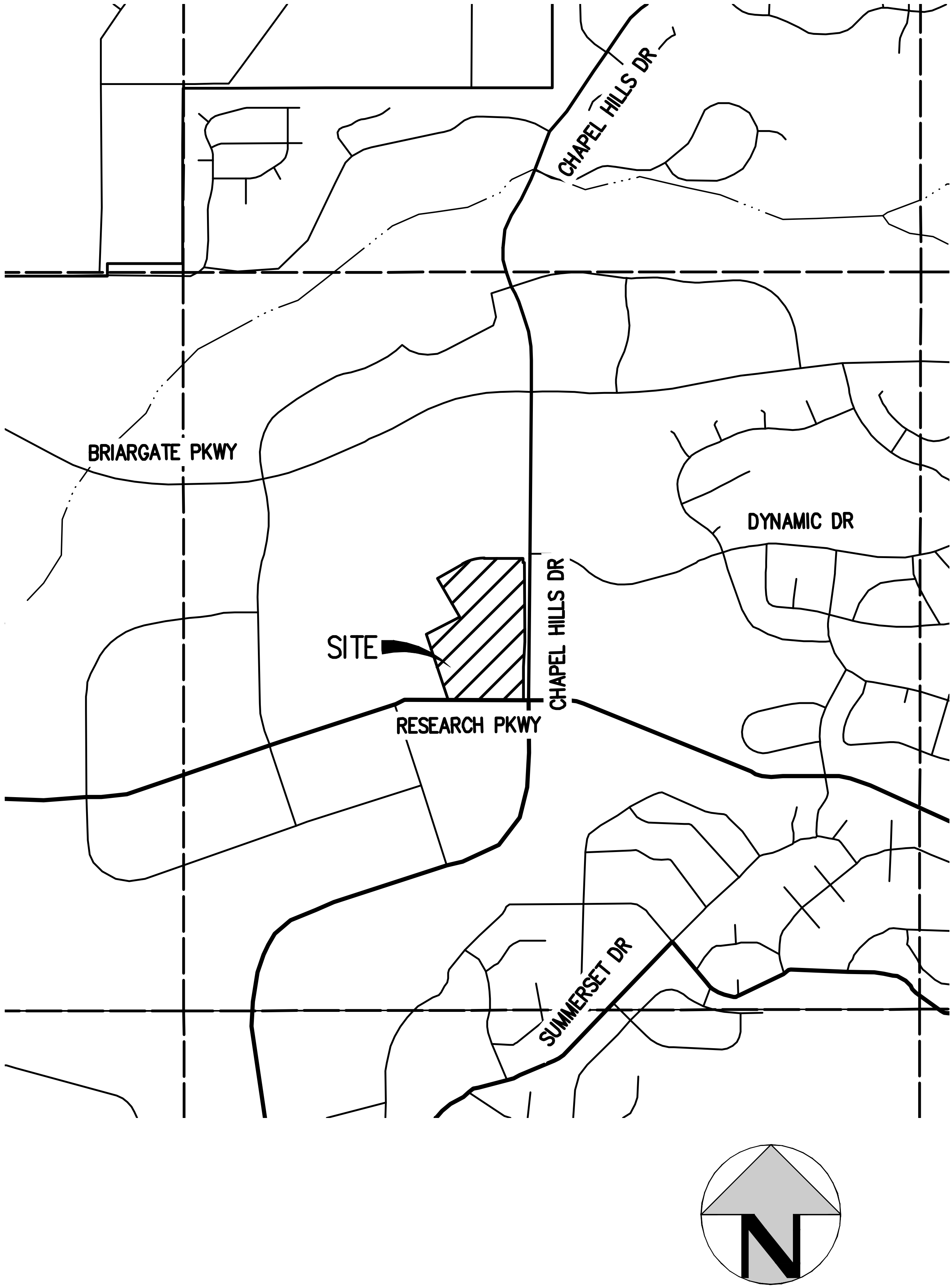
2. Pine Creek Drainage Basin, prepared in June 1988 by Obering, Wurth, & Associates Consulting Civil Engineers.

3. *Flood Insurance Rate Map*, City and County of Denver, Colorado, Map #08041C0508G, FEMA, effective December 7th, 2018.

4. *Drainage Design Manual,* Colorado Department of Transportation, 2019

5. *Urban Storm Drainage Criteria Manual* (USDCM), Mile High Flood District (MHFD, formerly known as Urban Drainage and Flood Control District, UDFCD)*:*
   Volumes 1 & 2, June 2001, Revised April 2008.
   Volume 1, Management, Hydrology and Hydraulics, Revised August 2018.
   Volume 2, Structures, Storage and Recreation, Revised September 2017.
   Volume 3, Stormwater Quality, Updated October 2019.

APPENDIX A – Vicinity Map and FIRM Map



VICINITY MAP

SCALE: 1"=1000'

National Flood Hazard Layer FIRMette

FEMA

104°47'38"W 38°58'2"N

104°47'1"W 38°57'34"N

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

1:6,000

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

Legend

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

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

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

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

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

OTHER FEATURES
- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 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 4/5/2022 at 5:28 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.

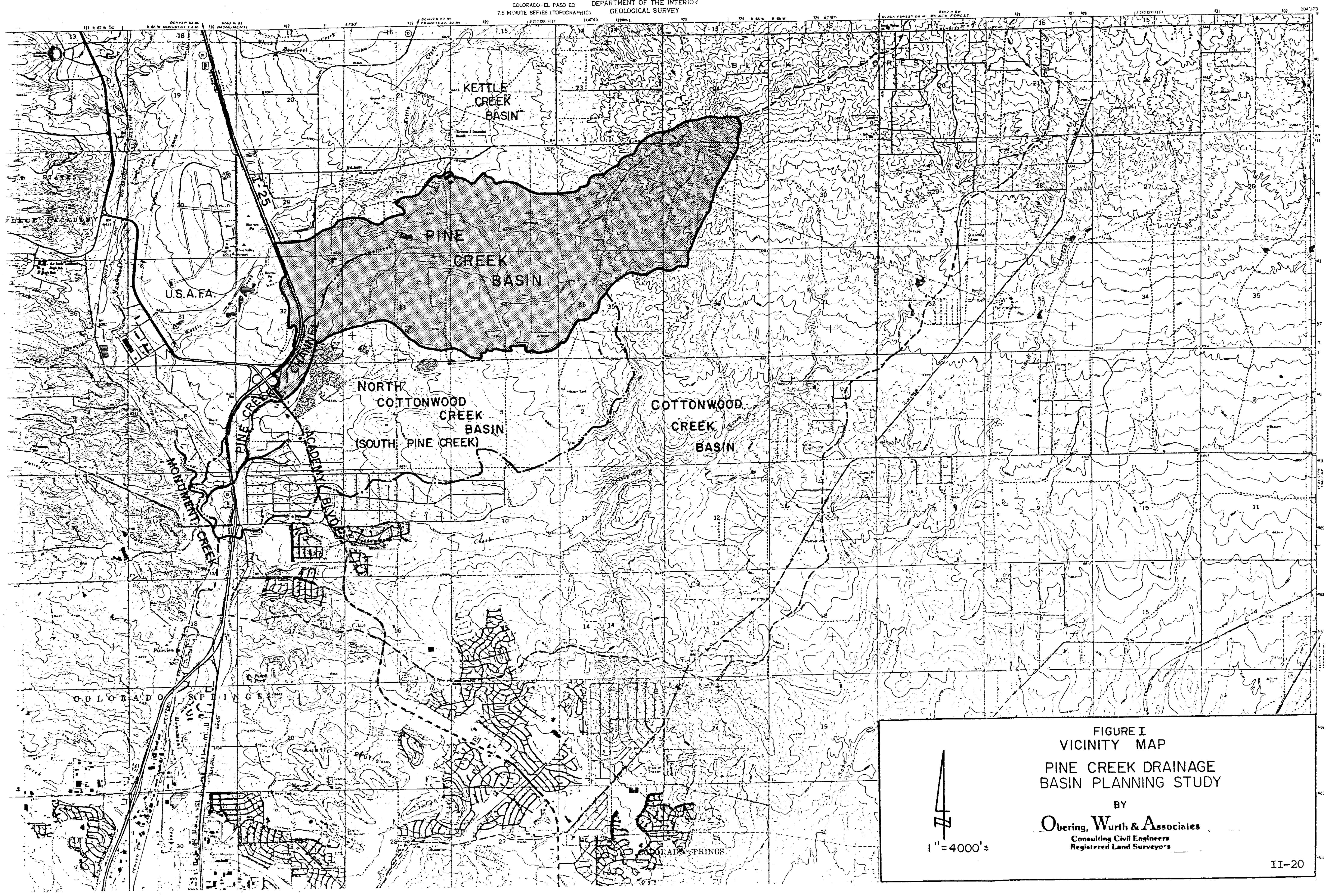


FIGURE I
VICINITY MAP
PINE CREEK DRAINAGE
BASIN PLANNING STUDY
BY
Obering, Wurth & Associates
Consulting Civil Engineers
Registered Land Surveyors

APPENDIX B – NCRS Soils Map and Geotechnical Investigation

United States Department of Agriculture

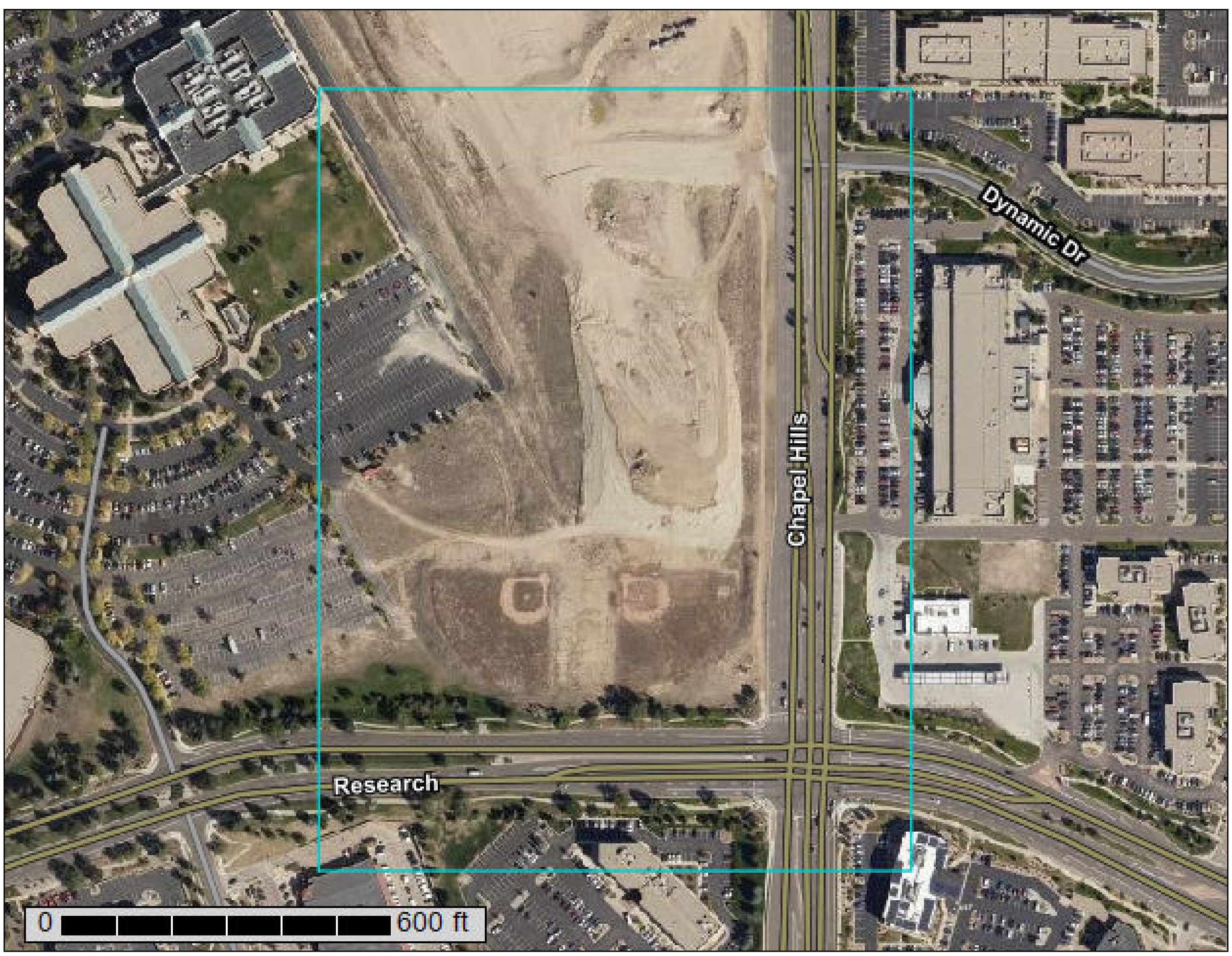
NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for

El Paso County Area, Colorado



April 14, 2022

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Soil Map


104° 47' 17" W
104° 47' 1" W
518370
518430
518490
518550
518610
518670
518730
38° 57' 51" N
38° 57' 34" N
4312820
4312760
4312700
4312640
4312580
4312520
4312460
4312400
4312340
8
Chapel Hills
Chapel Hills Dr
Research
Soil Map may not be valid at this scale.
Map Scale: 1:2,550 if printed on A portrait (8.5" x 11") sheet.
Meters
0 35 70 140 210
Feet
0 100 200 400 600
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

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

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	35.3	100.0%
Totals for Area of Interest		**35.3**	**100.0%**

Map Unit Descriptions

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

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

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

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

El Paso County Area, Colorado

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 369v
Elevation: 4,600 to 5,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Hills, flats
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 11 inches: loamy sand
AC - 11 to 27 inches: loamy sand
C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 1 percent

Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Soil Information for All Uses

Soil Reports

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

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

Soil Physical Properties

This folder contains a collection of tabular reports that present soil physical properties. The reports (tables) include all selected map units and components for each map unit. Soil physical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Physical Soil Properties

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (Ksat) is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue to the soil.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

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

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

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the "National Soil Survey Handbook."

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Reference:

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Physical Soil Properties–El Paso County Area, Colorado														
Map symbol and soil name	**Depth**	**Sand**	**Silt**	**Clay**	**Moist bulk density**	**Saturated hydraulic conductivity**	**Available water capacity**	**Linear extensibility**	**Organic matter**	**Erosion factors**			**Wind erodibility group**	**Wind erodibility index**
										Kw	**Kf**	**T**		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
8—Blakeland loamy sand, 1 to 9 percent slopes														
Blakeland	0-11	-85-	- 9-	3- 6- 8	1.55-1.60-1.65	42.00-92.00-141.00	0.06-0.08-0.09	0.0- 1.5- 2.9	2.0- 3.0-4.0	.10	.10	5	2	134
	11-27	-85-	- 9-	3- 6- 8	1.55-1.60-1.65	42.00-92.00-141.00	0.06-0.08-0.09	0.0- 1.5- 2.9	0.5- 0.8-1.3	.10	.10			
	27-60	-95-	- 2-	2- 4- 5	1.60-1.65-1.70	42.00-92.00-141.00	0.05-0.07-0.08	0.0- 1.5- 2.9	0.5- 0.8-1.0	.20	.20			
Other soils	—	—	—	—	—	—	—	—	—					
Pleasant	—	—	—	—	—	—	—	—	—					

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

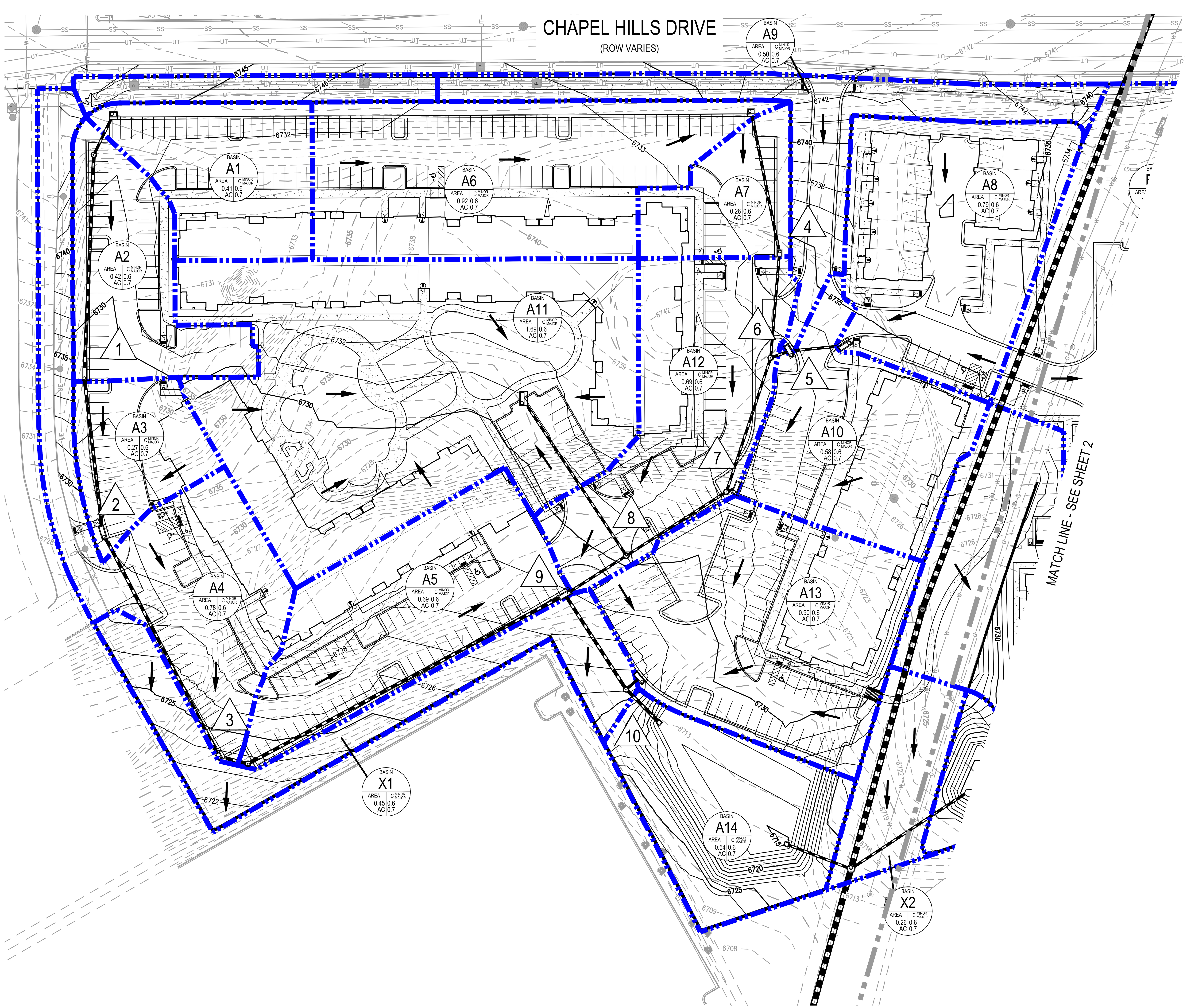
APPENDIX C – Hydrologic Computations

DIRECT RUNOFF SUMMARY TABLE			
SUB-BASIN	AREA (AC)	Q_5 (CFS)	Q_{100} (CFS)
A1	0.41	1.00	2.47
A2	0.42	1.01	2.51
A3	0.27	0.64	1.60
A4	0.78	1.87	4.64
A5	0.69	1.66	4.11
A6	0.92	2.20	5.47
A7	0.26	0.61	1.52
A8	0.79	1.89	4.69
A9	0.50	1.19	2.96
A10	0.58	1.39	3.45
A11	1.69	4.07	10.10
A12	0.69	1.65	4.09
A13	0.90	2.17	5.39
A14	0.54	1.31	3.24
B1	1.00	2.40	5.95
B2	1.44	3.47	8.60
B3	0.24	0.58	1.44
X1	0.45	1.07	2.66
X2	0.26	0.62	1.54
X3	0.46	1.10	2.73

APPENDIX D – Hydraulic and Detention Computations

Pond	Area Contribution (ac)	WQCV (ac-ft)	EURV (ac-ft)	100-yr (ac-ft)	5-year Release (cfs)	100-year Release (cfs)	Spillway Crest Length (ft)
North	9.43	0.235	0.691	1.147	2.9	13.5	11
South	2.68	0.067	0.196	0.326	0.8	2.1	5

APPENDIX E – Drainage Maps



LEGEND:

EXISTING CONTOUR LINES — 5173 / 5170

PROPOSED BASIN BOUNDARY

FLOW ARROW

EXISTING STORM — ST

SITE BOUNDARY

DESIGN POINT

PROPOSED CONTOUR LINES — 5173 / 5170

PROPOSED STORM — ST

BASIN DESIGNATION — OS 1 — 5-YR RATIONAL C COEFFICIENT (0.45); BASIN SIZE IN ACRES — AREA 1.23 AC; 100-YR RATIONAL C COEFFICIENT (0.67); BASIN DESIGN POINT (1)

DIRECT RUNOFF SUMMARY TABLE			
SUB-BASIN	AREA (AC)	Q5 (CFS)	Q100 (CFS)
A1	0.41	1.00	2.47
A2	0.42	1.01	2.51
A3	0.27	0.64	1.60
A4	0.78	1.87	4.64
A5	0.69	1.66	4.11
A6	0.92	2.20	5.47
A7	0.26	0.61	1.52
A8	0.79	1.89	4.69
A9	0.50	1.19	2.96
A10	0.58	1.39	3.45
A11	1.69	4.07	10.10
A12	0.69	1.65	4.09
A13	0.90	2.17	5.39
A14	0.54	1.31	3.24
B1	1.00	2.40	5.95
B2	1.44	3.47	8.60
B3	0.24	0.58	1.44
X1	0.45	1.07	2.66
X2	0.26	0.62	1.54
X3	0.46	1.10	2.73

*NOTE: FLOW VALUES BASED ON TIME OF CONCENTRATION BASED ON ROUGH OVERLOT GRADING. TABLE VALUES SHOULD BE USED AS APPROXIMATE, BUT NOT CLOSE ENOUGH TO EXACT. BASIN DELINEATION IS NOT BASED ON ROUGH OVERLOT GRADING, RATHER ON HOW SITE WILL APPROXIMATELY END UP GRADED FOR FINAL DESIGN.

NOTES:

1. FINAL IMPROVEMENTS WILL BE DETERMINED WITH THE CONSTRUCTION DRAWINGS.

FILEPATH: K:\210639\ENGINEERING\DRAINAGE\PROPOSED DRAINAGE PLAN.DWG LAYOUT: NORTH POND
XREFS: e-base, e-legal, e-util, p-base, p-offsite(U)
PLOTTED: THU 04/21/22 3:53:50P BY: FELIPE ROCHA

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

40 0 40 80
SCALE: 1" = 40

DESIGNED BY: FR
CHECKED BY: MAW
DRAWN BY: FR

ISSUE DATE: 08-31-21

DATE	REVISION COMMENTS
####	####
####	####
####	####
####	####
####	####
####	####
####	####

HARRIS KOCHER SMITH
1120 Lincoln Street, Suite 1000
Denver, Colorado 80203
P: 303.623.6300 F: 303.623.6311
HarrisKocherSmith.com

DAVIS DEVELOPMENT

HIGHLANDS AT BRIARGATE
FINAL DRAINAGE PLAN - NORTH POND

PRELIMINARY NOT FOR CONSTRUCTION

PROJECT #: 210639
SHEET NUMBER
1
1 OF 2

BASIN DESIGNATION — BASIN OS 1 — 5-YR RATIONAL C COEFFICIENT
BASIN SIZE IN ACRES — AREA 1.23 AC — C MINOR 0.45 MAJOR 0.67 — 100-YR RATIONAL C COEFFICIENT
1 BASIN DESIGN POINT

LEGEND:

- EXISTING CONTOUR LINES (5173, 5170)
- PROPOSED BASIN BOUNDARY
- FLOW ARROW
- EXISTING STORM (ST)
- SITE BOUNDARY
- DESIGN POINT (1)
- PROPOSED CONTOUR LINES (5173, 5170)
- PROPOSED STORM (ST)

DIRECT RUNOFF SUMMARY TABLE			
SUB-BASIN	AREA (AC)	Q5 (CFS)	Q100 (CFS)
A1	0.41	1.00	2.47
A2	0.42	1.01	2.51
A3	0.27	0.64	1.60
A4	0.78	1.87	4.64
A5	0.69	1.66	4.11
A6	0.92	2.20	5.47
A7	0.26	0.61	1.52
A8	0.79	1.89	4.69
A9	0.50	1.19	2.96
A10	0.58	1.39	3.45
A11	1.69	4.07	10.10
A12	0.69	1.65	4.09
A13	0.90	2.17	5.39
A14	0.54	1.31	3.24
B1	1.00	2.40	5.95
B2	1.44	3.47	8.60
B3	0.24	0.58	1.44
X1	0.45	1.07	2.66
X2	0.26	0.62	1.54
X3	0.46	1.10	2.73

*NOTE: FLOW VALUES BASED ON TIME OF CONCENTRATION BASED ON ROUGH OVERLOT GRADING. TABLE VALUES SHOULD BE USED AS APPROXIMATE, BUT NOT CLOSE ENOUGH TO EXACT. BASIN DELINEATION IS NOT BASED ON ROUGH OVERLOT GRADING, RATHER ON HOW SITE WILL APPROXIMATELY END UP GRADED FOR FINAL DESIGN.

NOTES:

1. FINAL IMPROVEMENTS WILL BE DETERMINED WITH THE CONSTRUCTION DRAWINGS.

FILEPATH: K:\210639\ENGINEERING\DRAINAGE\PROPOSED DRAINAGE PLAN.DWG LAYOUT: SOUTH POND

40 0 40 80
SCALE: 1" = 40'

DESIGNED BY: FR
CHECKED BY: MAW
DRAWN BY: FR

ISSUE DATE: 08-31-21

DATE	REVISION COMMENTS
####	####
####	####
####	####
####	####
####	####
####	####
####	####

HKS HARRIS KOCHER SMITH
1120 Lincoln Street, Suite 1000
Denver, Colorado 80203
P: 303.623.6300 F: 303.623.6311
HarrisKocherSmith.com

DAVIS DEVELOPMENT

HIGHLANDS AT BRIARGATE
FINAL DRAINAGE PLAN - SOUTH POND

PRELIMINARY NOT FOR CONSTRUCTION

PROJECT #: 210639
SHEET NUMBER
2