

**FINAL DRAINAGE REPORT**

FOR

**LINCOLN & DRANSFELDT**

July 30, 2021

Prepared for:

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## TABLE OF CONTENTS

TABLE OF CONTENTS.....	ii
ENGINEER CERTIFICATION.....	iii
1. GENERAL LOCATION AND DESCRIPTION .....	1
A. Location.....	1
B. Description of Property.....	1
2. MAJOR DRAINAGE BASINS AND SUB-BASINS .....	1
A. Major Basin Description.....	1
B. Sub-basin Description .....	1
3. DRAINAGE DESIGN CRITERIA .....	2
A. Regulations .....	2
B. Town of Parker Stream Protection Standards .....	2
C. Development Criteria References and Constraints .....	2
D. Hydrologic Criteria .....	2
E. Hydraulic Criteria .....	3
F. Variance from Criteria.....	3
4. DRAINAGE FACILITY DESIGN .....	3
A. General Concept .....	3
B. Specific Details .....	3
C. Outlet Works.....	4
D. Storm Sewer System .....	4
5. Environmental Protection Criteria.....	5
A. General.....	5
B. Construction BMP Plan .....	5
C. Permanent BMP Plan.....	5
6. CONCLUSIONS .....	5
A. Compliance with Standards .....	5
B. Drainage Concept.....	5
C. Sediment and Erosion Control Concept.....	5
7. LIST OF REFERENCES.....	7
APPENDIX A – Vicinity Map, FIRM, Geotechnical Report .....	1
APPENDIX B – Hydrologic Computations .....	2
APPENDIX C – Hydraulic Computations .....	3
APPENDIX D – Final Drainage Plan.....	4

## **ENGINEER CERTIFICATION**

This report for the final design of Lincoln & Dransfeldt was prepared by me or under my direct supervision in accordance with the provisions of the Town of Parker Storm Drainage and Environmental Criteria Manual. I understand that the Town of Parker and its designated town authority do not and will not assume liability for drainage facilities designed by others.

By: Rachel C. Patton  
Licensed Professional Engineer  
State of Colorado  
No. 54450  
On behalf of Harris Kocher Smith

## **1. GENERAL LOCATION AND DESCRIPTION**

### **A. Location**

The Lincoln & Dransfeldt development (herein referred to as "Site") lies within the Town of Parker and County of Douglas. The Site is bounded by existing commercial development to the east and south and Lincoln Avenue to the north and Dransfeldt Road to the west.

The Site is more particularly situated in the Southwest  $\frac{1}{4}$  of Section 15, Township 6 South, Range 66 West of the 6<sup>th</sup> Principal Meridian, County of Douglas, State of Colorado.

A Vicinity Map is included in Appendix A.

### **B. Description of Property**

The planned Lincoln & Dransfeldt development will contain a gas station, restaurants and retail.

The Site is approximately 7.27 acres. The entire Site will be disturbed by demolition, excavation, grading, utility installation and other construction activities.

Currently, the Site is an empty lot with an existing drainage ditch that runs east to west along the northern property line. The existing grades on Site slope generally from east to west, at approximately 2.5%.

There is an existing drainage ditch that runs along the northern property line that will be rerouted via proposed storm infrastructure. There are no existing major irrigation facilities such as ditches or canals located on the Site.

There is no known contamination on site. The contractor will be responsible for monitoring for contamination throughout the construction and any required remediation will occur immediately.

The hydrologic soil group for the Site consists of Natural Resources Conservation Service (NRCS) Type B and C soil. Type C/D was used for conservative design purposes.

## **2. MAJOR DRAINAGE BASINS AND SUB-BASINS**

### **A. Major Basin Description**

The Site is shown to be in a Zone X (unshaded) Flood Area according to FIRM Map 08035C0067G County of Douglas, Colorado March 16, 2016 (See FIRM map in Appendix A). Zone X (unshaded), as depicted on the aforementioned Map, is described by FEMA as "Areas determined to be outside the 0.2% annual change floodplain". A copy of the FIRM Map is included in Appendix A for reference.

### **B. Sub-basin Description**

Existing runoff from the Site flows overland to an existing storm culvert at the northwest corner of the property. The culvert ties into an existing storm sewer infrastructure and conveys flows to the west.

### 3. DRAINAGE DESIGN CRITERIA

#### A. Regulations

The principal design criteria used for this Study was the Town of Parker Storm Drainage and Environmental Criteria Manual revised February 2014.

In addition, the Urban Storm Drainage Criteria Manual, Volumes 1-3 for Mile High Flood District (MHFD) was also consulted.

#### B. Town of Parker Stream Protection Standards

Compliance with the Town of Parker's Stream Protection Standards is not applicable because there are no "natural drainage systems", as defined by the Parker Criteria.

#### C. Development Criteria References and Constraints

The principal design guidelines that will be sourced for this Site development are the Town of Parker Storm Drainage and Environmental Criteria Manual (hereinafter referred to as "Parker Criteria") and the Urban Storm Drainage Criteria Manual, January 2016 (Volume 1&2) and November 2010 (Volume 3) (hereinafter referred to as "District Manual").

The drainage design will be affected by the proposed grading, building outline and legal boundaries of the Site. In order to conform to existing grades at property boundaries, the 2009 International Building Code, and Geotechnical Report recommendations, areas of the Site consisting of small swaths of walks and landscaping are to drain away from the building and off-site to the existing right-of-way, undetained and untreated.

#### D. Hydrologic Criteria

The following formula, from the District Manual, was used to determine rainfall intensities:

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

One-hour rainfall  $P_1$  values were taken from Table 5.1 in Parker Criteria. The  $P_1$  values for the 2-year and 100-year storms are 0.99 inches and 2.60 inches, respectively.

As previously mentioned, the hydrologic soil group of the Site is assumed to be comprised of NRCS Type C and D soil for conservative design purposes.

The Rational Method, as presented in the District Manual, was used to calculate the maximum rate of runoff for the minor and major storm events. "C" coefficients were taken from Table 6-4 of the District Manual. Rational Method calculation results, including composite C-values, time of concentration, and flow rates can be found in Appendix C.

For the Final Drainage Report, the 2-year and 100-year storm events have been analyzed, from Table 3-1 of the District Manual. The 2-year storm is considered the minor event and the 100-year storm is considered the major event.

The maximum allowable unit flow release rates (cfs/acre) for on-site detention facilities were obtained from Equation 12-5 from Volume 2 Chapter 12 of the District Manual. The maximum allowable unit release rate is equal to 90 percent of the predevelopment discharge for the upstream watershed. The WQCV will be released using a cap with an orifice designed to release the storm using a 12-hour drain time. Calculations are in Appendix D.

Other criteria or calculation methods outside of Parker Criteria were not used in the hydrologic design for the Site.

#### **E. Hydraulic Criteria**

Hydraulic capacity for proposed storm sewer system was designed in accordance with the Parker Criteria and the Streets/Inlets/Storm Sewers chapter of the District Manual.

The routing method for the proposed storm sewer system was designed in accordance with the Parker Criteria and the Streets/Inlets/Storm Sewers chapter of the District Manual. StormCAD software will be used for design calculations.

Other criteria or calculation methods outside of Parker Criteria was not used in the drainage facility design for the Site.

The Water Quality Control Volume (WQCV) treatment system and release rate was designed in accordance with Volume 3 of the District Manual. WQCV calculations for the Site can be found in Appendix D.

#### **F. Variance from Criteria**

There are no requested variances from Criteria.

### **4. DRAINAGE FACILITY DESIGN**

#### **A. General Concept**

The general drainage concept for the Site is to capture runoff and route the runoff through proposed curb and gutter and storm sewer infrastructure to an extended detention basin where runoff will be treated and detained. The Extended Detention will have an overflow to the public roadway.

#### **B. Specific Details**

There is an existing 36"x24" HERCP storm sewer conveyance system underneath Dransfeldt Road that flows from east to west. The system includes street drainage, inlets, and manholes. There are no existing stormwater storage facilities located on the Site.

Once captured, runoff will be routed to an extended detention basin. Runoff captured from Basins A-F will be routed into the detention basin. Runoff will then be treated, detained and released to the public storm infrastructure. See Appendix D for calculations.

An assumed imperviousness of 95% for commercial areas was used in the design of the drainage infrastructure based on Table 6-3 in Volume 1 Chapter 6 of the District Criteria. The total required volume is provided based on the UD-Detention Design Spreadsheet.

Additional volume was provided to allow for construction tolerance in the field.

<b>EXTENDED DETENTION BASIN SUMMARY TABLE</b>		
<b>STAGE – STORAGE DESCRIPTION</b>	<b>VOLUME REQUIRED</b>	<b>VOLUME PROVIDED</b>
	<b>[AC-FT]</b>	<b>[AC-FT]</b>
WQCV	0.271	0.271
EURV	0.417	0.417
100-YEAR	0.285	0.285
<b>TOTAL</b>	<b>0.973</b>	<b>1.699</b>

Details and information regarding the Extended Detention Basin can be found in the Appendices.

**C. Outlet Works**

Inspection of the outlet structure and extended detention basin shall occur annually following precipitation events to determine if the sand filter is providing acceptable infiltration. Typical periodic maintenance tasks include: Checking for erosion and repairing as necessary. Remove debris and litter from trash rack to minimize clogging of the outlet structure. Remove debris and litter from the overflow structure. Maintenance shall be performed on an as-needed basis. Repair basin inlets, outlets, and storm pipes required for the BMP to operate as intended. Repair and vegetate any eroded side slopes as needed following inspection.

**D. Storm Sewer System**

The following section describes in detail the on-site drainage basins.

Basin EX-1 (0.44 acres) consists of an existing private drive and an existing pond for the neighboring property. The drainage patterns for this basin will not be affected.

Basin A (0.87 acres) consists of commercial area, with an assumed impervious of 95%. Runoff from Basin A will runoff to the proposed curb and gutter and will be routed to the proposed detention basin via the proposed storm infrastructure.

Basin B (4.29 acres) consists of commercial area, with an assumed impervious of 95%. Runoff from Basin B will runoff to the proposed curb and gutter and will be routed to the proposed detention basin via the proposed storm infrastructure.

Basin C (1.36 acres) consists of commercial area, with an assumed impervious of 95%. Runoff from Basin C will runoff to the proposed curb and gutter and will be routed to the proposed detention basin via the proposed storm infrastructure.

Basin D (0.75 acres) consists of commercial area, with an assumed impervious of 95%. Runoff from Basin D will runoff to the proposed curb and gutter and will be routed to the proposed detention basin via the proposed storm infrastructure.

## **5. Environmental Protection Criteria**

### **A. General**

There are no wetland areas or waters of the U.S. situated within the Site. There are no anticipated impacts on threatened and endangered species or presence of Habitat Protection Areas and Stream Restoration Areas.

A Stormwater discharge permit will be acquired through the Colorado Discharge Permit System (CDPS) in addition to a grading permit granted by the Town of Parker.

### **B. Construction BMP Plan**

CBMPs are required to be constructed for use before, during and immediately after the phases of construction. All initial phase CBMPs must be approved and installed prior to the issuance of a grading permit from the Town of Parker. The primary purpose of the CBMPs to be implemented is erosion and sediment control and to contain land disturbing activities onsite. Example of some of the CBMPs to be utilized are silt fencing, sediment basins, vehicle tracking control, seeding and mulching, etc. CBMP Plans will be submitted and approved by the Town of Parker prior to land disturbance.

### **C. Permanent BMP Plan**

A permanent BMP Plan will be required for the Site since there is an on-site detention basin.

## **6. CONCLUSIONS**

### **A. Compliance with Standards**

Drainage design for the Site was performed in accordance with Parker Criteria, except for when instructed to by said Standard.

Major Drainageway Planning Studies did not implicate specific design requirements to the Site.

The District Manual was used for the design of the Site only when instructed to by Parker Criteria.

### **B. Drainage Concept**

The proposed development will have no negative drainage impacts on upstream and downstream properties.

The proposed development will not influence any master drainage plan recommendations.

### **C. Sediment and Erosion Control Concept**

As designed, the proposed CBMP plan satisfies all requirements to obtain a stormwater discharge permit from the CDPS. The CBMP plan also satisfies, at a minimum, all requirements set forth by the

Town of Parker and MHFD. All stormwater runoff generated by the Site during construction will be treated by CBMPs. The effect of land disturbing activities on adjacent development and right-of-ways is minimized through the use of various CBMPs.

## 7. LIST OF REFERENCES

1. Storm Drainage and Environmental Criteria Manual, Town of Parker, Colorado; revised February 2014.
2. Urban Storm Drainage Criteria Manual, Vol. 1 & 2, Urban Drainage and Flood Control District, January 2016.
3. Urban Storm Drainage Criteria Manual, Vol. 3, Urban Drainage and Flood Control District, November 2010.
4. Flood Insurance Rate Map, City and County of Denver, Colorado, Map #0800460201G, FEMA, revised November 17<sup>th</sup>, 2005.

**APPENDIX A – Vicinity Map, FIRM, Geotechnical Report**





United States  
Department of  
Agriculture

**NRCS**

Natural  
Resources  
Conservation  
Service

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

# Custom Soil Resource Report for Castle Rock Area, Colorado



# Preface

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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](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.

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# Contents

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<b>Preface</b> .....	2
<b>How Soil Surveys Are Made</b> .....	5
<b>Soil Map</b> .....	8
Soil Map.....	9
Legend.....	10
Map Unit Legend.....	11
Map Unit Descriptions.....	11
Castle Rock Area, Colorado.....	13
BrB—Bresser sandy loam, cool, 1 to 3 percent slopes.....	13
Lo—Loamy alluvial land.....	14
Sa—Sampson loam.....	15
<b>Soil Information for All Uses</b> .....	18
Soil Properties and Qualities.....	18
Soil Erosion Factors.....	18
Wind Erodibility Index.....	18
Soil Qualities and Features.....	21
Hydrologic Soil Group.....	21
<b>References</b> .....	26

# How Soil Surveys Are Made

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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

## Custom Soil Resource Report

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

## Custom Soil Resource Report

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

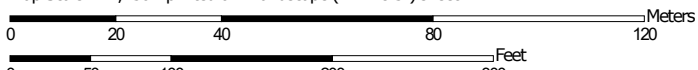
---

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.

# Custom Soil Resource Report Soil Map




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



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 1:20,000.

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: Castle Rock Area, Colorado  
 Survey Area Data: Version 13, Jun 5, 2020

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

Date(s) aerial images were photographed: Jun 10, 2014—Dec 4, 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
BrB	Bresser sandy loam, cool, 1 to 3 percent slopes	7.8	89.4%
Lo	Loamy alluvial land	0.4	5.0%
Sa	Sampson loam	0.5	5.6%
<b>Totals for Area of Interest</b>		<b>8.8</b>	<b>100.0%</b>

## 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

## Custom Soil Resource Report

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.

## Castle Rock Area, Colorado

### BrB—Bresser sandy loam, cool, 1 to 3 percent slopes

#### Map Unit Setting

*National map unit symbol:* 2tlpj  
*Elevation:* 5,500 to 6,500 feet  
*Mean annual precipitation:* 15 to 19 inches  
*Mean annual air temperature:* 48 to 52 degrees F  
*Frost-free period:* 100 to 130 days  
*Farmland classification:* Farmland of statewide importance

#### Map Unit Composition

*Bresser, cool, and similar soils:* 90 percent  
*Minor components:* 10 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Bresser, Cool

##### Setting

*Landform:* Hillslopes, terraces  
*Landform position (two-dimensional):* Footslope  
*Landform position (three-dimensional):* Base slope, tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Tertiary aged alluvium derived from arkose

##### Typical profile

*Ap - 0 to 5 inches:* sandy loam  
*Bt1 - 5 to 8 inches:* sandy loam  
*Bt2 - 8 to 27 inches:* sandy clay loam  
*Bt3 - 27 to 36 inches:* sandy loam  
*C - 36 to 80 inches:* loamy coarse sand

##### Properties and qualities

*Slope:* 1 to 3 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high  
(0.60 to 6.00 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Calcium carbonate, maximum content:* 5 percent  
*Maximum salinity:* Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)  
*Available water capacity:* Low (about 5.4 inches)

##### Interpretive groups

*Land capability classification (irrigated):* 2e  
*Land capability classification (nonirrigated):* 4s  
*Hydrologic Soil Group:* B  
*Ecological site:* R049XB210CO - Sandy Foothill  
*Hydric soil rating:* No

## Minor Components

### Sampson

*Percent of map unit:* 5 percent  
*Landform:* Terraces, alluvial fans  
*Landform position (two-dimensional):* Toeslope  
*Landform position (three-dimensional):* Base slope, tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Ecological site:* R049XC202CO - Loamy Foothill 14-19 P.Z.  
*Hydric soil rating:* No

### Truckton

*Percent of map unit:* 5 percent  
*Landform:* Hillslopes, terraces  
*Landform position (two-dimensional):* Footslope  
*Landform position (three-dimensional):* Base slope, tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Ecological site:* R049XB210CO - Sandy Foothill  
*Hydric soil rating:* No

## Lo—Loamy alluvial land

### Map Unit Setting

*National map unit symbol:* jqzb  
*Elevation:* 7,000 to 8,000 feet  
*Mean annual precipitation:* 17 to 19 inches  
*Mean annual air temperature:* 44 to 46 degrees F  
*Frost-free period:* 115 to 120 days  
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Loamy alluvial land:* 80 percent  
*Minor components:* 20 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Loamy Alluvial Land

#### Setting

*Landform:* Flood plains, swales  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

#### Typical profile

*H1 - 0 to 20 inches:* sandy loam  
*H2 - 20 to 40 inches:* stratified loamy sand to clay loam  
*H3 - 40 to 60 inches:* sand and gravel

**Properties and qualities**

*Slope:* 1 to 5 percent  
*Drainage class:* Well drained  
*Runoff class:* Very low  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high  
(0.20 to 6.00 in/hr)  
*Depth to water table:* About 48 to 72 inches  
*Frequency of flooding:* FrequentNone  
*Calcium carbonate, maximum content:* 5 percent  
*Maximum salinity:* Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)  
*Available water capacity:* Moderate (about 6.0 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 4w  
*Hydrologic Soil Group:* C  
*Ecological site:* R049XY036CO - Overflow  
*Hydric soil rating:* No

**Minor Components**

**Bresser**

*Percent of map unit:* 7 percent  
*Hydric soil rating:* No

**Sampson**

*Percent of map unit:* 7 percent  
*Hydric soil rating:* No

**Sandy alluvial land**

*Percent of map unit:* 5 percent

**Fluvaquentic haplustolls**

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

**Sa—Sampson loam**

**Map Unit Setting**

*National map unit symbol:* jr02  
*Elevation:* 5,500 to 6,600 feet  
*Mean annual precipitation:* 15 to 19 inches  
*Mean annual air temperature:* 48 to 50 degrees F  
*Frost-free period:* 120 to 135 days  
*Farmland classification:* Farmland of statewide importance

**Map Unit Composition**

*Sampson and similar soils:* 80 percent  
*Minor components:* 20 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

## Description of Sampson

### Setting

*Landform:* Stream terraces on drainageways  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Weathered alluvium derived from arkose

### Typical profile

*H1 - 0 to 9 inches:* loam  
*H2 - 9 to 28 inches:* clay loam  
*H3 - 28 to 38 inches:* loam  
*H4 - 38 to 60 inches:* silt loam

### Properties and qualities

*Slope:* 1 to 4 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high  
(0.60 to 2.00 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Calcium carbonate, maximum content:* 15 percent  
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)  
*Available water capacity:* High (about 9.5 inches)

### Interpretive groups

*Land capability classification (irrigated):* 3e  
*Land capability classification (nonirrigated):* 3c  
*Hydrologic Soil Group:* B  
*Ecological site:* R049XC202CO - Loamy Foothill 14-19 P.Z.  
*Hydric soil rating:* No

## Minor Components

### Englewood

*Percent of map unit:* 8 percent  
*Hydric soil rating:* No

### Bresser

*Percent of map unit:* 7 percent  
*Hydric soil rating:* No

### Loamy alluvial land

*Percent of map unit:* 4 percent  
*Hydric soil rating:* No

### Aquic haplustolls

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

## Custom Soil Resource Report

# **Soil Information for All Uses**

---

## **Soil Properties and Qualities**

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

## **Soil Erosion Factors**

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

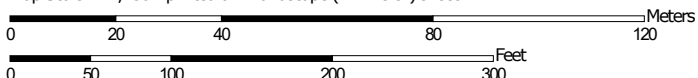
## **Wind Erodiability Index**

The 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.

# Custom Soil Resource Report Map—Wind Erodibility Index




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



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**













-  0
-  38
-  48
-  56
-  86
-  134
-  160
-  180
-  220
-  250
-  310
-  Not rated or not available

**Soil Rating Lines**


-  0
-  38
-  48
-  56
-  86
-  134
-  160
-  180
-  220

-  250
-  310
-  Not rated or not available






**Soil Rating Points**

-  0
-  38
-  48
-  56
-  86
-  134
-  160
-  180
-  220
-  250
-  310
-  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 1:20,000.

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: Castle Rock Area, Colorado  
 Survey Area Data: Version 13, Jun 5, 2020

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

Date(s) aerial images were photographed: Jun 10, 2014—Dec 4, 2018

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

**Table—Wind Erodibility Index**

Map unit symbol	Map unit name	Rating (tons per acre per year)	Acres in AOI	Percent of AOI
BrB	Bresser sandy loam, cool, 1 to 3 percent slopes	86	7.8	89.4%
Lo	Loamy alluvial land	86	0.4	5.0%
Sa	Sampson loam	48	0.5	5.6%
<b>Totals for Area of Interest</b>			<b>8.8</b>	<b>100.0%</b>

**Rating Options—Wind Erodibility Index**

*Units of Measure:* tons per acre per year  
*Aggregation Method:* Dominant Condition  
*Component Percent Cutoff:* None Specified  
*Tie-break Rule:* Higher

**Soil Qualities and Features**

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

**Hydrologic Soil Group**

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

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

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

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

## Custom Soil Resource Report

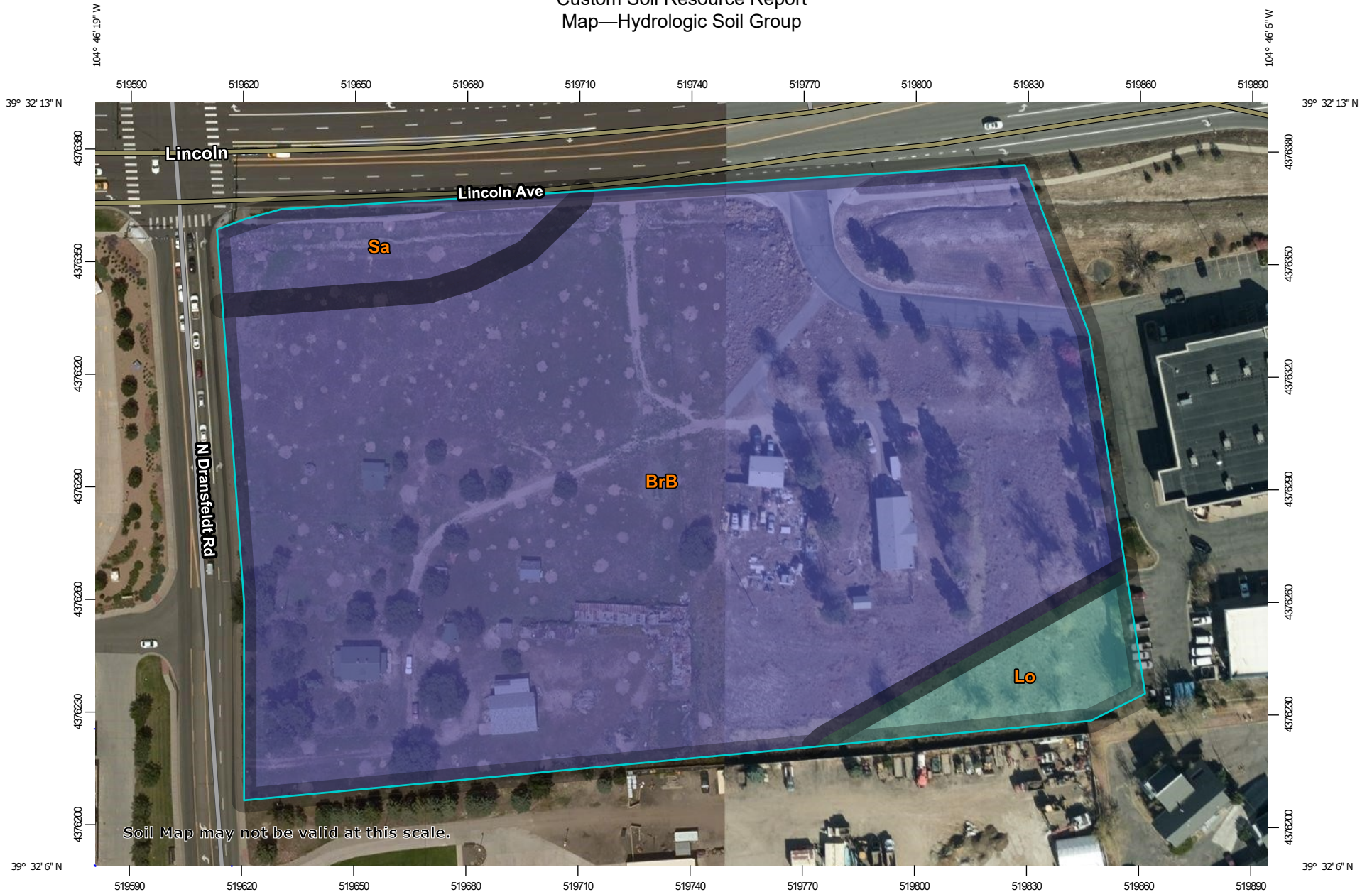
soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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.

Custom Soil Resource Report  
Map—Hydrologic Soil Group




Soil Map may not be valid at this scale.

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











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


**Water Features**

-  Streams and Canals





**Transportation**

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

**Background**

-  Aerial Photography

**Soils**

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

### MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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: Castle Rock Area, Colorado  
 Survey Area Data: Version 13, Jun 5, 2020

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

Date(s) aerial images were photographed: Jun 10, 2014—Dec 4, 2018

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

**Table—Hydrologic Soil Group**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BrB	Bresser sandy loam, cool, 1 to 3 percent slopes	B	7.8	89.4%
Lo	Loamy alluvial land	C	0.4	5.0%
Sa	Sampson loam	B	0.5	5.6%
<b>Totals for Area of Interest</b>			<b>8.8</b>	<b>100.0%</b>

**Rating Options—Hydrologic Soil Group**

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

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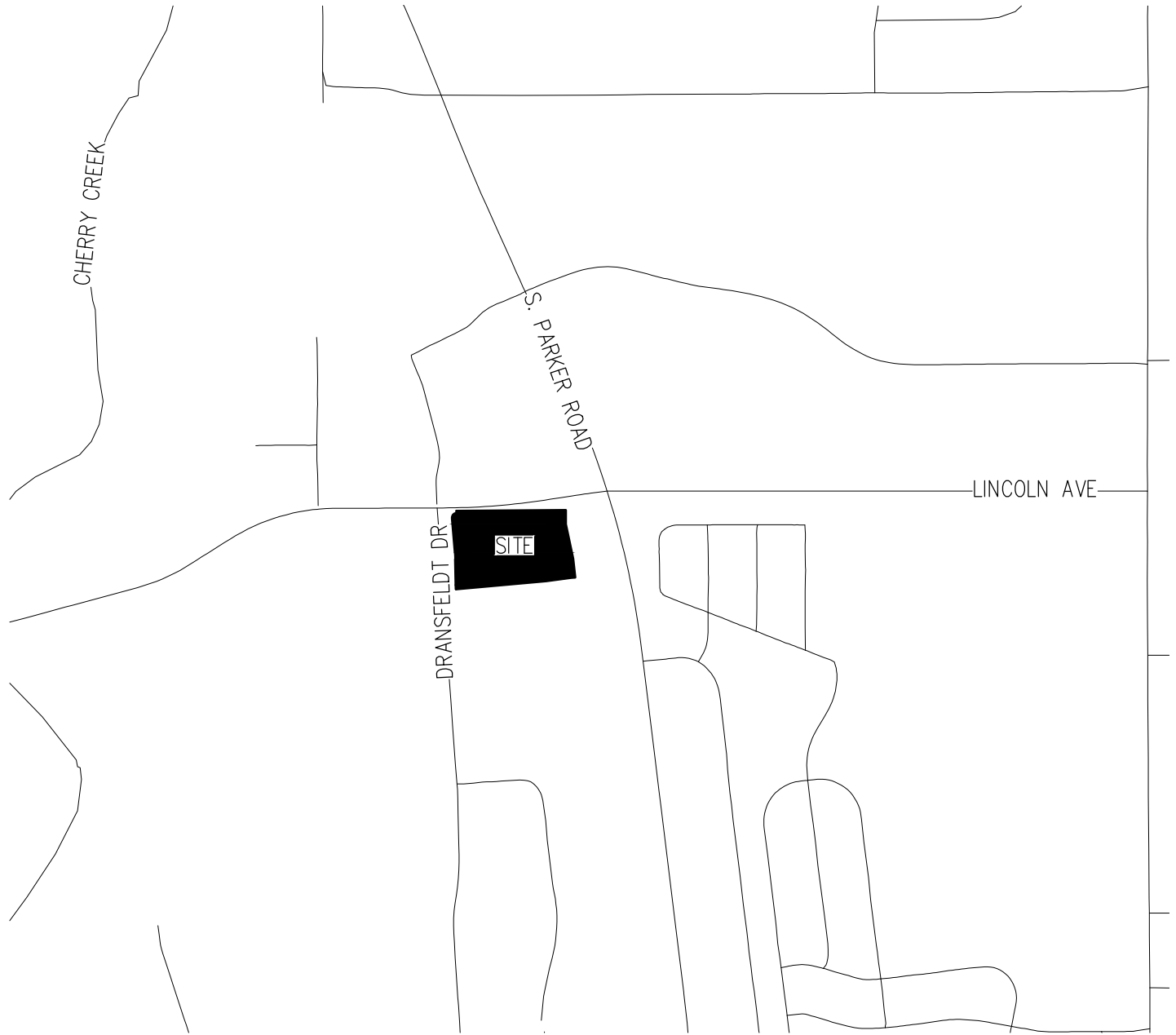
## Custom Soil Resource Report

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](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242)

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Plotted: FRI 07/30/21 4:54:02P By: Olivia McCracken Filepath: k:\200829\engineering\ref\vic map.dwg Layout: layout1



SCALE: 1" = 1000'

# LINCOLN & DRANSFELDT

## VICINITY MAP

PROJECT #: 200829  
SHEET NUMBER

# 1

1 OF 1

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

## APPENDIX B – Hydrologic Computations

### 1-HR Rainfall

<u>Return Interval (YR)</u>	<u>1-hour Rainfall</u>
2	0.97
5	1.37
10	1.55
100	2.58





Project Name: Lincoln & Dransfeldt  
 Project No: 200829  
 Date: 07/30/21  
 Revised: \_\_\_\_\_

**STANDARD FORM SF-2  
 TIME OF CONCENTRATION  
 Post-Development**

Designed By: ORM  
 Checked By: RCP

SUB-BASIN DATA			INITIAL/OVERLAND TIME (Ti)			TRAVEL TIME (Ti)					Tc CHECK (URBANIZED BASINS)			FINAL	REMARKS
BASIN	AREA (AC)	C <sub>s</sub>	LENGTH (FT)	SLOPE %	Ti (MIN)	LENGTH (FT)	SLOPE %	C <sub>v</sub>	VELOCITY (FPS)	Tt (MIN)	COMPOS. Tc (MIN)	TOTAL LENGTH	Tc = (L/180) + 10 (MIN)	Tc (MIN)	
EX-1	0.44	0.45	25.5	2.00	4.81	182.6	2.00	20	2.83	1.08	5.89	208	11.16	5.89	
A	0.87	0.81	62.5	2.00	3.29	219.9	2.00	20	2.83	1.30	5.00	282	11.57	5.00	
B	4.29	0.81	113.4	2.00	4.43	430	2.00	20	2.83	2.53	6.97	543	13.02	6.97	
C	1.36	0.81	102.6	2.00	4.22	241	2.00	20	2.83	1.42	5.64	344	11.91	5.64	
D	0.75	0.81	64.6	2.00	3.35	0	2.00	20	2.83	0.00	5.00	65	10.36	5.00	

Project Name: Lincoln & Dransfeldt  
**Composite C-Value Computations**  
*Post-Development*

Project No: 200829  
Date: 07/30/21  
Revised:  
Design by: ORM  
Checked by: RCP  
NRCS Soil Group: C/D

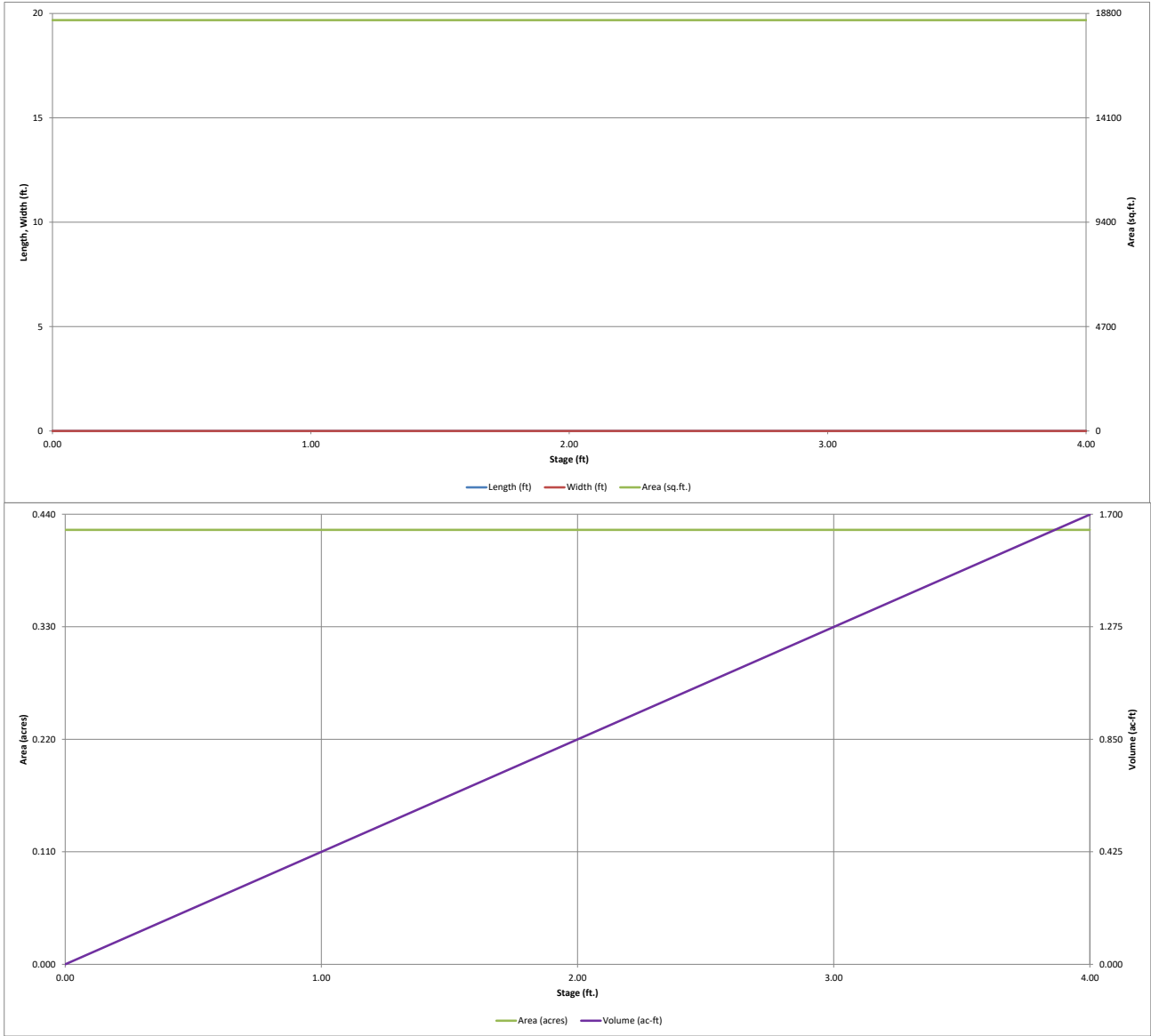
BASIN	TOTAL AREA (ACRES)	PERCENT IMPERVIOUS	C <sub>5</sub> =	C <sub>100</sub> =
EX-1	0.44	50%	0.45	0.69
A	0.87	95%	0.81	0.87
B	4.29	95%	0.81	0.87
C	1.36	95%	0.81	0.87
D	0.75	95%	0.81	0.87
<b>Total Off-Site</b>	<b>0.44</b>	<b>50%</b>	<b>0.45</b>	<b>0.69</b>
<b>Total Treated</b>	<b>7.27</b>	<b>#REF!</b>	<b>#REF!</b>	<b>#REF!</b>

## APPENDIX C – Hydraulic Computations



# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.04 (February 2021)*

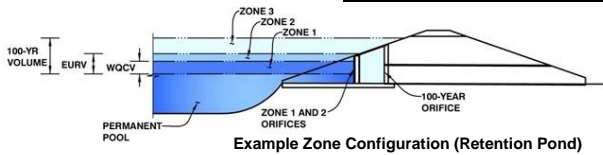


# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

**Project:** Lincoln & Dransfeldt

**Basin ID:** \_\_\_\_\_



**Example Zone Configuration (Retention Pond)**

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.64	0.271	Orifice Plate
Zone 2 (EURV)	1.62	0.417	Circular Orifice
Zone 3 (100-year)	2.30	0.285	Weir&Pipe (Restrict)
<b>Total (all zones)</b>		<b>0.973</b>	

**User Input:** Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

**Calculated Parameters for Underdrain**

Underdrain Orifice Area =	N/A	ft <sup>2</sup>
Underdrain Orifice Centroid =	N/A	feet

**User Input:** Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	0.68	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	2.70	inches
Orifice Plate: Orifice Area per Row =	4.55	sq. inches (use rectangular openings)

**Calculated Parameters for Plate**

WQ Orifice Area per Row =	3.160E-02	ft <sup>2</sup>
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft <sup>2</sup>

**User Input:** Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.23	0.45					
Orifice Area (sq. inches)	4.55	4.55	4.55					
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

**User Input:** Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	0.64	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	1.62	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	0.38	N/A	inches

**Calculated Parameters for Vertical Orifice**

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.00	N/A	ft <sup>2</sup>
Vertical Orifice Centroid =	0.02	N/A	feet

**User Input:** Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	1.72	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	9.00	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	3.92	N/A	feet
Overflow Grate Type =	Close Mesh Grate	N/A	
Debris Clogging % =	50%	N/A	%

**Calculated Parameters for Overflow Weir**

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H <sub>u</sub> =	2.70	N/A	feet
Overflow Weir Slope Length =	4.04	N/A	feet
Grate Open Area / 100-yr Orifice Area =	37.91	N/A	
Overflow Grate Open Area w/o Debris =	28.77	N/A	ft <sup>2</sup>
Overflow Grate Open Area w/ Debris =	14.38	N/A	ft <sup>2</sup>

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	8.00	N/A	inches

**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.76	N/A	ft <sup>2</sup>
Outlet Orifice Centroid =	0.39	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.46	N/A	radians

**User Input:** Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	2.40	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	8.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

**Calculated Parameters for Spillway**

Spillway Design Flow Depth =	0.82	feet
Stage at Top of Freeboard =	4.22	feet
Basin Area at Top of Freeboard =	0.42	acres
Basin Volume at Top of Freeboard =	1.70	acre-ft

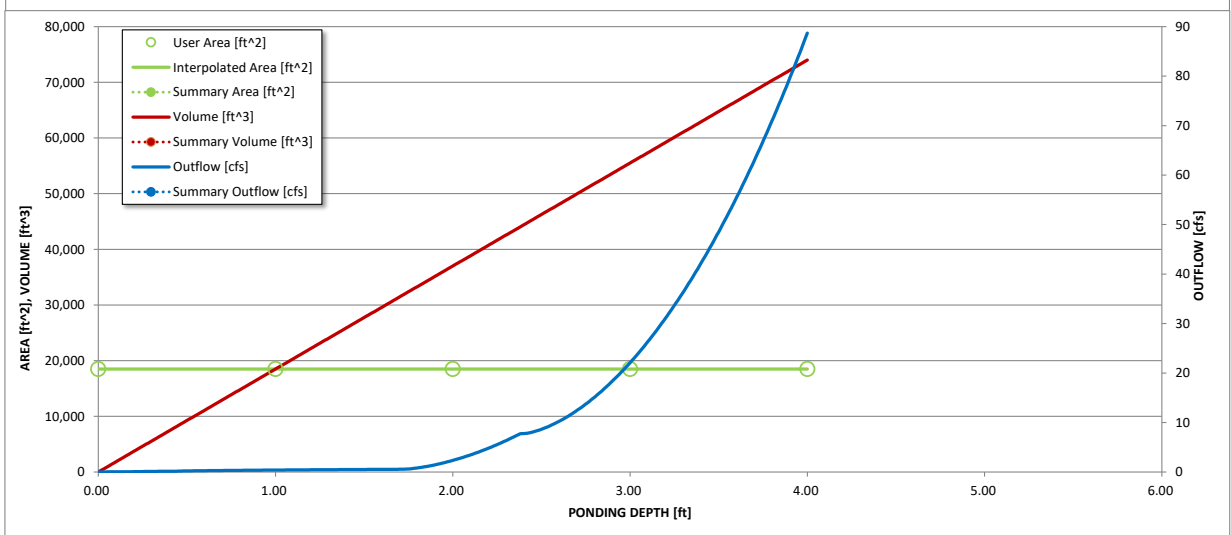
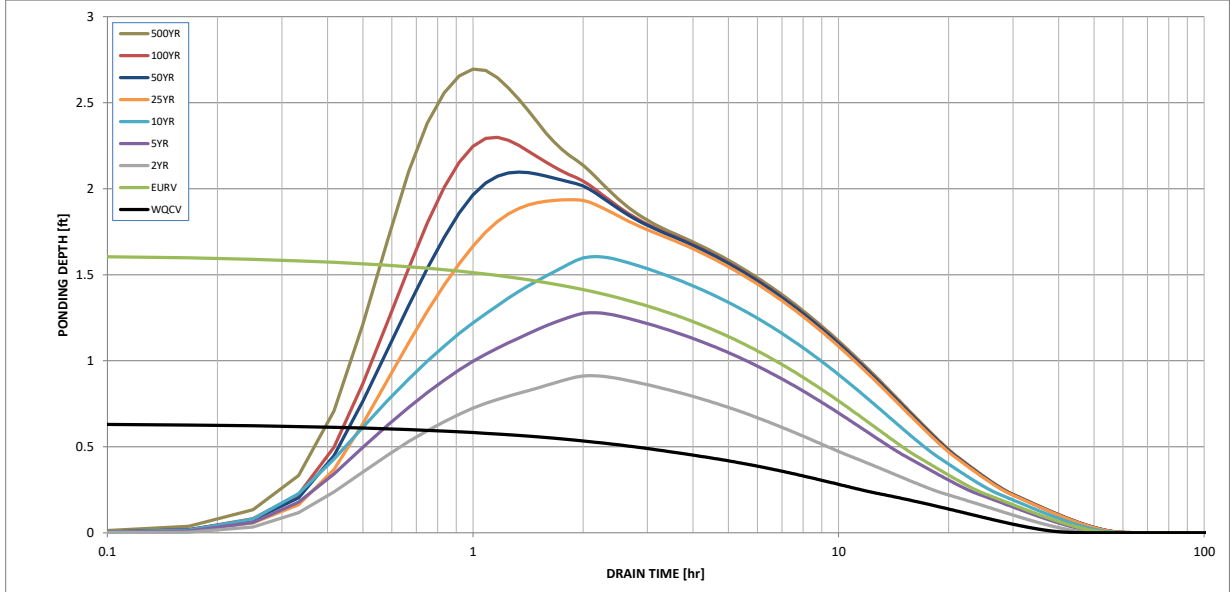
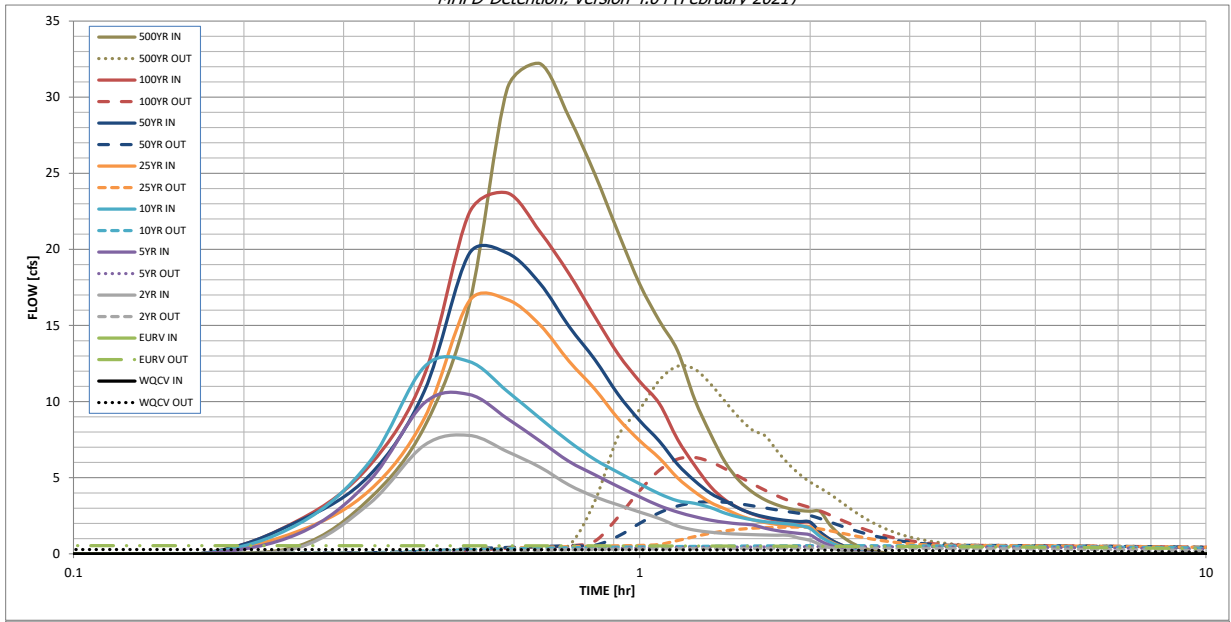
**Routed Hydrograph Results**

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	0.82	1.10	1.34	1.69	1.98	2.29	3.08
One-Hour Rainfall Depth (in) =	0.271	0.688	0.437	0.608	0.757	0.978	1.160	1.356	1.853
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.437	0.608	0.757	0.978	1.160	1.356	1.853
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.1	0.7	1.8	4.5	6.1	8.3	13.0
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A							
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.09	0.24	0.62	0.84	1.14	1.78
Peak Inflow Q (cfs) =	N/A	N/A	7.8	10.5	12.6	16.7	19.8	23.7	32.2
Peak Outflow Q (cfs) =	0.3	0.5	0.4	0.5	0.5	1.8	3.4	6.3	12.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	0.3	0.4	0.6	0.8	1.0
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.2	0.3
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	36	43	40	42	44	44	43	41	38
Time to Drain 99% of Inflow Volume (hours) =	40	49	45	48	51	51	51	50	48
Maximum Ponding Depth (ft) =	0.64	1.62	0.91	1.28	1.61	1.94	2.10	2.30	2.70
Area at Maximum Ponding Depth (acres) =	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Maximum Volume Stored (acre-ft) =	0.272	0.688	0.386	0.539	0.680	0.820	0.888	0.973	1.142

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.04 (February 2021)*



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

# DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: \_\_\_\_\_

## Inflow Hydrographs

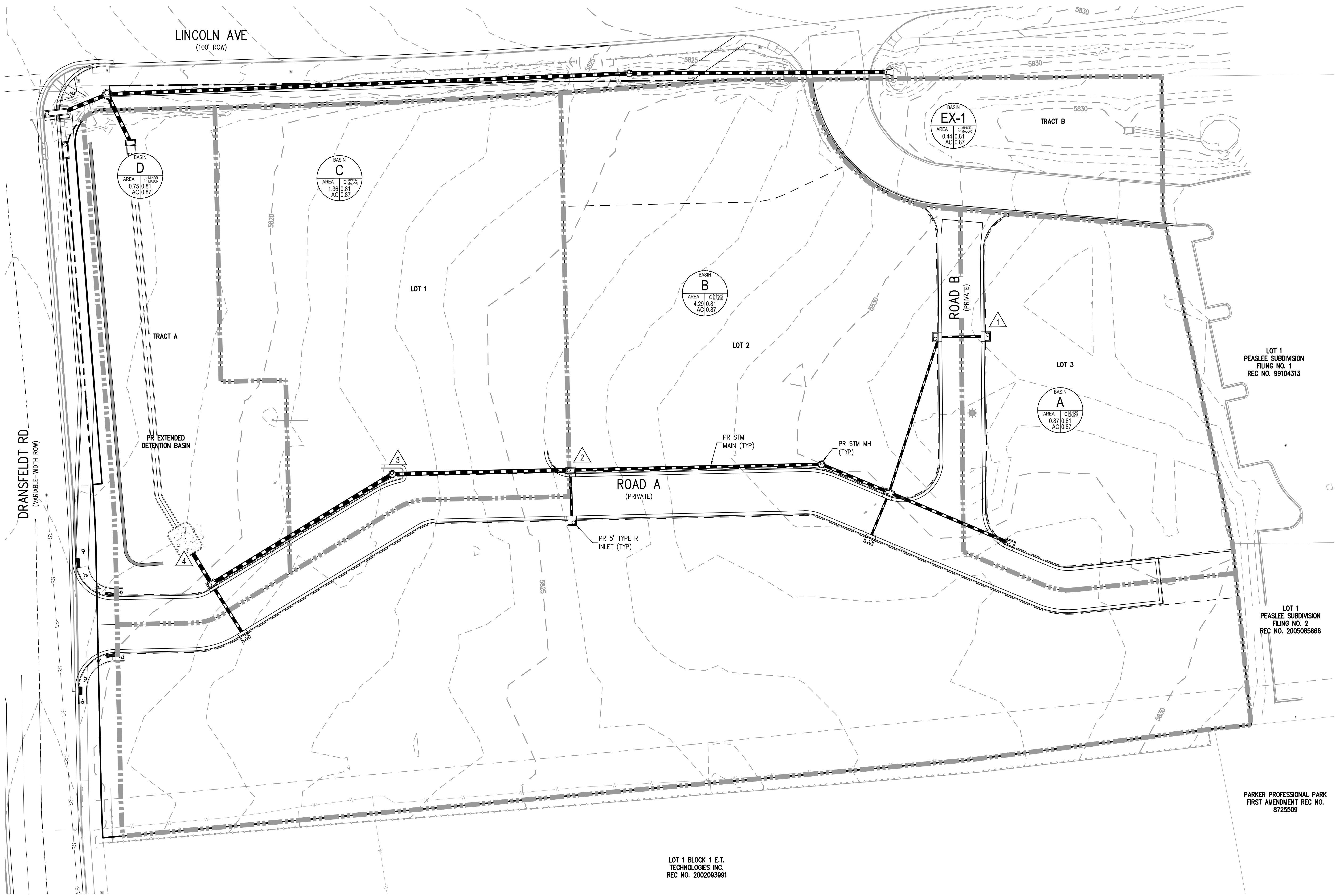
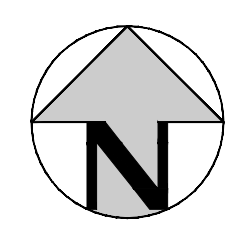
The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53
	0:15:00	0.00	0.00	0.42	1.33	1.97	1.50	2.15	2.22	3.62
	0:20:00	0.00	0.00	3.31	4.80	6.04	4.17	5.16	5.79	8.33
	0:25:00	0.00	0.00	7.14	9.91	12.29	8.91	10.69	11.74	16.35
	0:30:00	0.00	0.00	7.78	10.46	12.63	16.60	19.72	22.39	30.53
	0:35:00	0.00	0.00	6.72	8.89	10.69	16.70	19.76	23.71	32.20
	0:40:00	0.00	0.00	5.69	7.41	8.91	15.04	17.76	21.16	28.70
	0:45:00	0.00	0.00	4.53	6.07	7.38	12.66	14.95	18.41	24.94
	0:50:00	0.00	0.00	3.75	5.19	6.19	10.82	12.76	15.58	21.09
	0:55:00	0.00	0.00	3.21	4.42	5.35	8.88	10.46	13.11	17.73
	1:00:00	0.00	0.00	2.74	3.74	4.60	7.43	8.75	11.32	15.31
	1:05:00	0.00	0.00	2.32	3.16	3.95	6.29	7.40	9.87	13.34
	1:10:00	0.00	0.00	1.82	2.74	3.49	4.99	5.88	7.52	10.17
	1:15:00	0.00	0.00	1.56	2.44	3.32	4.08	4.81	5.82	7.89
	1:20:00	0.00	0.00	1.42	2.21	3.04	3.38	3.98	4.43	6.00
	1:25:00	0.00	0.00	1.34	2.06	2.66	2.94	3.47	3.54	4.80
	1:30:00	0.00	0.00	1.29	1.97	2.41	2.52	2.97	2.98	4.05
	1:35:00	0.00	0.00	1.26	1.90	2.23	2.23	2.63	2.61	3.54
	1:40:00	0.00	0.00	1.24	1.68	2.11	2.06	2.42	2.37	3.21
	1:45:00	0.00	0.00	1.22	1.52	2.03	1.93	2.27	2.20	2.98
	1:50:00	0.00	0.00	1.21	1.41	1.97	1.85	2.18	2.10	2.85
	1:55:00	0.00	0.00	1.03	1.34	1.86	1.80	2.12	2.06	2.80
	2:00:00	0.00	0.00	0.89	1.24	1.66	1.77	2.09	2.05	2.78
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	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
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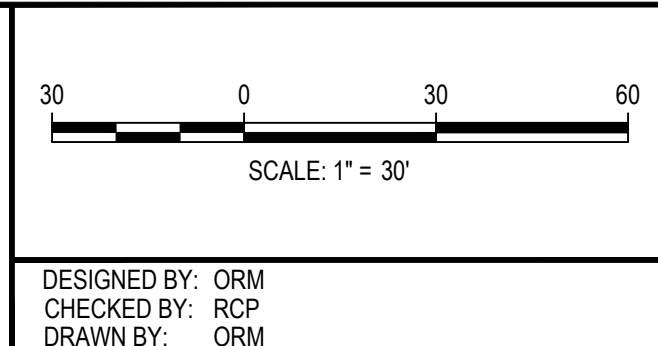


**APPENDIX D – Final Drainage Plan**

NO CHANGES ARE TO BE MADE TO THIS DRAWING WITHOUT WRITTEN PERMISSION OF HARRIS KOCHER SMITH.



FILE PATH: K:\200829\ENGINEERING\DRAINAGE\PLANNING LAYOUT LAYOUT1.dwg  
 PLOTTED: FR 07/30/21 4:40:16P BY: OLIVIA MCCracken



ISSUE DATE: 07-30-2021	
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

PLAZA STREET PARTNERS

LINCOLN & DRANSFELDT  
 DRAINAGE MAP

PROJECT #: 200829  
 SHEET NUMBER

1  
 1 OF 1