BULLDOG ENGINEERING

December 31st, 2025

Aaron Monks
Castle Rock Engineering Manager
100 N. Wilcox St.
Castle Rock, CO 80104

RE: Drainage Report for Berkenkotter Holdings LLC Parking Addition
Lot 1, Re-Subdivision of Lot 1 Kolacny's Addition to Castle Rock

To Whom it May Concern,

Attached is the Drainage Report and Plan for the Parking Lot Improvements at 1212 Caprice Drive in Castle Rock, Colorado (Lot 1, Re-Subdivision of Lot 1 Kolacny's Addition to Castle Rock). This report addresses both the on-site and off-site hydrology that affects or is affected by the proposed development.

If you have any further questions or comments regarding this matter, please contact this office.

Sincerely,

Mark Harris

Mark Harris P.E.
Owner/Principal

info@bulldogeng.com PO Box 114 - 1540 Main Street - Suite 218, Windsor, CO 80550 970-460-0089

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INTRODUCTION

General Location and Description:

The subject site is comprised of the vacant land at the northeast corner of Caprice Drive & a Private Drive in Castle Rock, CO (Parcel 2505-023-14-009). The site is also considered as the 1212 Caprice Drive. The site is located within the southwest quarter of Section 2, Township 8 North, Range 67 West of the 6th Principal Meridian. The site is bordered on the north by commercial developments. The south side of the property is next to a private drive. The western side of the site is adjacent to the Caprice Drive ROW, and the Eastern side is adjacent to another commercial development. Please refer to the Vicinity Map.

The existing site is undeveloped currently with a mostly gravel surface. The soil on the site is a classified as Bresser Sandy Laom 0 to 3 percent slopes. All the soil on the site is a Hydrologic group "B".

The proposed improvements associated with this project site include constructing 27,668 square feet of pavement & sidewalk for parking and pedestrian access.

The original basin's imperviousness was compared to the imperviousness of the proposed to determine if further analysis would be required. The existing site consists of mostly gravel surface, and all drainage is directed to one existing low point at the northwest corner of the site. The original design's overall composite percent imperviousness was determined to be 32% for the entire site.

The overall composite percent imperviousness of the proposed site is calculated to be 74%. Based on the calculations, an increase of the developed runoff would be anticipated. Considering that the proposed development does increase the imperviousness of the site, a water quality area will be required. Additionally, the site is required to meet the intended drainage patterns will remain the same, so detailed analysis of the changes will not be required. Reference to the grading & drainage plan.

Runoff from the proposed improvements will be collected in grass swales ways and conveyed towards the proposed water quality area along the North side of the site. The water quality area will be released into the existing Caprice Drive ROW at the northwest corner of the site, matching the existing drainage pattern. The adjacent ROW has an asphalt paved surface and concrete curb & gutter where the water quality area will discharge.

DRAINAGE BASINS AND SUB-BASINS

Major Basin Description

According to the Castle Rock Basin Master Plans this site is included in the Plum Creek Basin. This parcel is included on FEMA panel 08035C0188G. The site is within Zone X and is outside any area of flood risk.

Existing Drainage Basin Conditions

The area of improvements, which is a total area of 0.86-acres (37,492 square feet) will be developed and treated. The developed area historically slopes from south to northwest. The natural grade and development along the northern side of the site will prevent offsite flow from entering the developed area. Any offsite flow from the East will be captured and treated. The adjacent private drive to the South, the ROW to the West, and commercial property to the North are all lower than the site, thus not contributing any flow to the site.

Proposed Drainage Basin Conditions

The site will be designed to gather as much of the 0.86-acre developed area as possible and direct it to the proposed water quality area at the North side of the site. Additionally, any runoff from the West will be captured and treated to further improve the existing condition. The entire captured area is 74% impervious, and the water quality provided will meet the Town of Castle Rock MS4 requirements by providing the WQCV Standard for 100% of the developed area. Per the MS4 criteria, this development requires a water quality area, sized for all storm events and released within 40 hours, for flood control purposes. As such, the proposed Water quality area is designed to meet the WQCV Standard.

DRAINAGE DESIGN CRITERIA

According to the Town of Castle Rock Basin Master Plans this site is included in the Plumb Creek Drainage Basin.

The Rational Method was used to calculate runoff and release rates. The water quality area was sized using the Mile High Flood District (MHFD) Detention Basin Design Workbook. An extended detention basin is designed to release the water quality capture volume within a 40-hour period to maintain water quality. The proposed on-site drainage conveyances were sized to convey the 100-year event to the proposed water quality area.

The runoff was calculated by inputting the area, imperviousness, soil type, one-hour precipitation values, slope, length of travel and conveyance into the peak runoff spreadsheet provided by the Mile High Flood District (MHFD).

DRAINAGE FACILITY DESIGN

Per Town of Castle Rock criteria, only a water quality area will be provided for the MS4 requirement, but detention is not required. The minimum WQCV required for the site is 0.021 ac-ft. The invert of the pond is 6155.23, with the top of the water quality pond set at 6156.20. The water quality area will have a 6” HDPE outlet pipe with a orifice cap. The orifice cap will have one (1) 9/16” diameter hole to release the water quality capture volume runoff as detailed on the Utility Plan.

An emergency spillway is designed to allow on-site flows to leave the water quality area in the event that the pond outlet is clogged or overwhelmed in larger storm events. The emergency overflow is provided at elevation 6156.20. The spillway shall be a minimum of 12 feet wide total with a crest width of 8 feet and will limit the flow depth for the study area to approximately 0.19 feet while conveying the 100-YR storm event peak flow. The top of berm elevation is 6156.50 which allows for 0.11-feet of freeboard in the spillway while conveying the 100-year peak runoff in a plugged condition.

The proposed water quality area has been designed to treat the runoff from the entire developed area.

See Tables 1 below for the parameters for the water quality area and the associated development.

Table 1: Water Quality Area Parameters

Parameter Description	Parameter Value	Unit
Invert Elevation	6,155.23	feet
Top of Pond Elevation	6,156.50	feet
Spillway Elevation	6,156.20	feet
Required WQ Volume	915	cubic-feet
Designed WQ Volume	1,341	cubic-feet
WQ-Surface Elevation	6,156.02	feet
Developed 100-Year Runoff Through Spillway (Elevation)	6,156.39	feet

The spreadsheets included in the report detail the physical requirements to provide adequate drainage conveyance. Please refer to the spreadsheets for the specific design.

Care should be taken to keep trash and debris out of conveyance elements to prevent excess water from building up on the site. If a complete blockage would occur in the water quality area outlet the water would release through the emergency spillway. If blockages occur the blocked element should be immediately cleaned. All storm drainage pipes shall be kept clean to maintain full capacity.

Storm Water Quality Considerations

The entire captured area will meet the Weld County MS4 requirements by providing the WQCV Standard for 100% of the developed area. Per the MS4 criteria, this development requires a water quality area, sized for all storm events and releasing within 40 hours, for flood control purposes. The proposed pond meets this criteria and therefore the proposed Water quality area is designed to meet the MS4 WQCV Standard.

CONCLUSION

Developed storm water flows from the subject site will be controlled through an on- site water quality area. The allowable release rates from the water quality area include a water quality release rate that allows minor storm flows to release within a 40- hour time period. Off-site flows that drain toward the site are directed through the property and the water quality area.

This report and design will meet the Town of Castle Rock Code without any variances. This design should be more than adequate to prevent either on-site or off-site runoff flows from creating damage. Please see the reference sheet for a complete list of references used for this design and report.

SITE MAINTENANCE

Drainage/ Site Maintenance Plan

1. At all times any erosion that may occur shall be corrected as soon as possible to mitigate the chance of erosion leaving the site.
2. All drainage facilities, including culverts and swales, shall be inspected regularly, and cleaned if necessary.
3. All swales shall be maintained and regraded, if necessary, to maintain the design depth and function of the swale.
4. Any disturbed areas that are seeded, and vegetation does not grow, shall be re-seeded and irrigated as necessary to establish permanent vegetation.
5. Snow is not to be piled in swales or near water quality area outlet.

REFERENCES

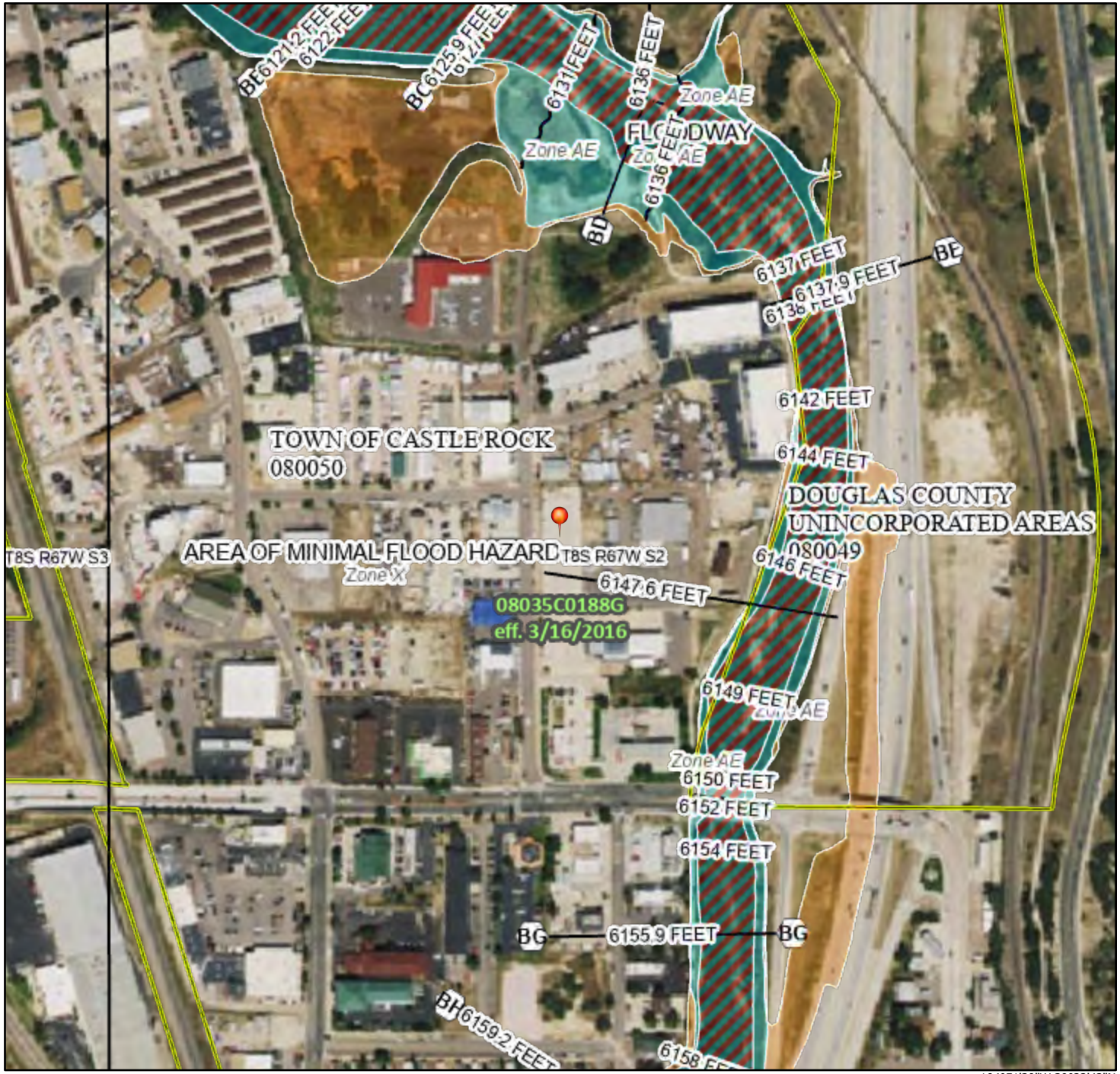
1. Urban Storm Drainage Criteria Manual, Volumes 1 (August 2018), 2 (September 2017) and 3 (November 2010/October 2019), Urban Drainage and Flood Control District, Denver, Colorado.
2. National Resources Conservation Service, Web Soil Survey, Weld County, Colorado, Southern Part, May 20, 2020.
3. msc.fema.gov website, FEMA Map 08035C0199G effective 03/16/2016, Firmette dated May 20, 2020.
4. Detention Basin Volume Estimating Workbook, Version 2.35, Released January 2015 by the Urban Drainage and Flood Control District, Denver, Colorado.
5. Peak Runoff Prediction by the Rational Method, Version 2.00, Released May 2017 by the Urban Drainage and Flood Control District, Denver, Colorado.
6. Hydraflow Express Extension, Autodesk Civil 3D Version 2020, May 22, 2020.

Berkenkotter Parking	Vicinity Map	BULLDOG ENGINEERING 970-502-6444

National Flood Hazard Layer FIRMette

FEMA

104°52'8"W 39°23'10"N



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

1:6,000

104°51'30"W 39°22'42"N

Basemap Imagery Source: USGS National Map 2023

Legend

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

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

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

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

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

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 1/6/2026 at 1:10 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.

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

October 23, 2025

Custom Soil Resource Report
Soil Map

Map Scale: 1:727 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 35 70 140 210

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 18, Aug 29, 2025

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

Date(s) aerial images were photographed: Mar 1, 2023—Sep 1, 2023

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	2.2	90.4%
NeE	Newlin gravelly sandy loam, 8 to 30 percent slopes	0.2	9.6%
Totals for Area of Interest		**2.4**	**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.

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: Prime farmland if irrigated

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 supply, 0 to 60 inches: 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

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

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 Palmer Divide
Hydric soil rating: No

NeE—Newlin gravelly sandy loam, 8 to 30 percent slopes

Map Unit Setting

National map unit symbol: jqzg
Elevation: 5,500 to 6,600 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 49 to 51 degrees F
Frost-free period: 120 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Newlin and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Newlin

Setting

Landform: Terraces, mesas, plateaus
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Unconformable sandy and gravelly and/or mixed source alluvium

Typical profile

H1 - 0 to 8 inches: gravelly sandy loam
H2 - 8 to 17 inches: gravelly sandy clay loam
H3 - 17 to 22 inches: gravelly sandy loam

H4 - 22 to 60 inches: very gravelly sand

Properties and qualities

Slope: 8 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R049XY214CO - Gravelly Foothill
Hydric soil rating: No

Minor Components

Bresser

Percent of map unit: 5 percent
Hydric soil rating: No

Stapleton

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

Satanta

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

Aquic haplustolls

Percent of map unit: 2 percent
Landform: Swales
Hydric soil rating: Yes

References

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NOAA Atlas 14, Volume 8, Version 2
Location name: Castle Rock, Colorado, USA*
Latitude: 39.3814°, Longitude: -104.8634°
Elevation: 6159 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.229** (0.193-0.276)	**0.292** (0.246-0.352)	**0.397** (0.333-0.480)	**0.486** (0.404-0.590)	**0.610** (0.488-0.770)	**0.709** (0.551-0.906)	**0.809** (0.604-1.06)	**0.912** (0.649-1.23)	**1.05** (0.716-1.46)	**1.16** (0.766-1.63)
10-min	**0.336** (0.283-0.405)	**0.428** (0.360-0.516)	**0.581** (0.487-0.703)	**0.711** (0.592-0.864)	**0.894** (0.714-1.13)	**1.04** (0.807-1.33)	**1.18** (0.885-1.55)	**1.34** (0.951-1.80)	**1.54** (1.05-2.14)	**1.70** (1.12-2.39)
15-min	**0.409** (0.345-0.493)	**0.522** (0.439-0.629)	**0.709** (0.594-0.857)	**0.867** (0.722-1.05)	**1.09** (0.871-1.38)	**1.26** (0.984-1.62)	**1.44** (1.08-1.90)	**1.63** (1.16-2.20)	**1.88** (1.28-2.61)	**2.07** (1.37-2.92)
30-min	**0.537** (0.452-0.647)	**0.686** (0.577-0.827)	**0.933** (0.782-1.13)	**1.14** (0.950-1.39)	**1.43** (1.15-1.81)	**1.66** (1.29-2.13)	**1.90** (1.42-2.49)	**2.14** (1.52-2.88)	**2.46** (1.67-3.41)	**2.71** (1.79-3.81)
60-min	**0.685** (0.577-0.825)	**0.851** (0.716-1.03)	**1.14** (0.952-1.37)	**1.38** (1.15-1.68)	**1.74** (1.40-2.21)	**2.03** (1.58-2.60)	**2.33** (1.74-3.06)	**2.64** (1.88-3.57)	**3.08** (2.10-4.28)	**3.42** (2.26-4.82)
2-hr	**0.832** (0.705-0.997)	**1.02** (0.860-1.22)	**1.34** (1.13-1.61)	**1.62** (1.36-1.96)	**2.04** (1.66-2.59)	**2.39** (1.88-3.06)	**2.76** (2.08-3.62)	**3.15** (2.26-4.24)	**3.69** (2.54-5.12)	**4.13** (2.74-5.78)
3-hr	**0.943** (0.801-1.12)	**1.13** (0.957-1.35)	**1.46** (1.23-1.75)	**1.76** (1.48-2.12)	**2.22** (1.81-2.81)	**2.61** (2.06-3.33)	**3.02** (2.29-3.96)	**3.47** (2.50-4.67)	**4.10** (2.83-5.67)	**4.62** (3.08-6.44)
6-hr	**1.15** (0.983-1.36)	**1.36** (1.16-1.61)	**1.73** (1.47-2.06)	**2.08** (1.75-2.48)	**2.61** (2.14-3.29)	**3.06** (2.44-3.89)	**3.55** (2.71-4.63)	**4.08** (2.97-5.47)	**4.85** (3.37-6.67)	**5.47** (3.68-7.57)
12-hr	**1.39** (1.19-1.63)	**1.65** (1.41-1.94)	**2.11** (1.80-2.49)	**2.52** (2.14-2.99)	**3.14** (2.58-3.91)	**3.66** (2.92-4.60)	**4.20** (3.22-5.42)	**4.80** (3.51-6.36)	**5.63** (3.94-7.68)	**6.30** (4.26-8.67)
24-hr	**1.66** (1.43-1.94)	**1.97** (1.70-2.31)	**2.52** (2.16-2.95)	**3.00** (2.55-3.53)	**3.69** (3.04-4.54)	**4.25** (3.41-5.29)	**4.84** (3.73-6.18)	**5.47** (4.02-7.18)	**6.33** (4.45-8.55)	**7.02** (4.78-9.59)
2-day	**1.96** (1.70-2.27)	**2.31** (2.00-2.69)	**2.92** (2.51-3.40)	**3.44** (2.94-4.02)	**4.18** (3.45-5.08)	**4.77** (3.84-5.88)	**5.39** (4.17-6.81)	**6.03** (4.45-7.84)	**6.91** (4.88-9.25)	**7.60** (5.21-10.3)
3-day	**2.13** (1.85-2.46)	**2.52** (2.18-2.91)	**3.17** (2.74-3.67)	**3.72** (3.20-4.34)	**4.50** (3.73-5.45)	**5.12** (4.13-6.28)	**5.76** (4.47-7.25)	**6.42** (4.76-8.31)	**7.32** (5.19-9.75)	**8.02** (5.52-10.8)
4-day	**2.26** (1.97-2.61)	**2.67** (2.32-3.08)	**3.35** (2.90-3.88)	**3.93** (3.38-4.57)	**4.75** (3.94-5.72)	**5.39** (4.36-6.59)	**6.05** (4.70-7.58)	**6.73** (5.00-8.68)	**7.65** (5.44-10.2)	**8.37** (5.78-11.3)
7-day	**2.60** (2.28-2.99)	**3.04** (2.65-3.48)	**3.76** (3.27-4.33)	**4.38** (3.78-5.06)	**5.25** (4.38-6.29)	**5.94** (4.83-7.23)	**6.66** (5.20-8.30)	**7.40** (5.52-9.49)	**8.40** (6.01-11.1)	**9.18** (6.38-12.3)
10-day	**2.91** (2.55-3.33)	**3.36** (2.94-3.85)	**4.12** (3.59-4.72)	**4.76** (4.13-5.49)	**5.68** (4.75-6.78)	**6.41** (5.22-7.76)	**7.15** (5.61-8.89)	**7.93** (5.94-10.1)	**8.99** (6.45-11.8)	**9.82** (6.84-13.1)
20-day	**3.80** (3.35-4.32)	**4.34** (3.82-4.93)	**5.22** (4.58-5.95)	**5.96** (5.20-6.82)	**7.00** (5.88-8.28)	**7.81** (6.40-9.37)	**8.64** (6.81-10.6)	**9.48** (7.14-12.0)	**10.6** (7.66-13.8)	**11.5** (8.06-15.2)
30-day	**4.54** (4.01-5.13)	**5.17** (4.56-5.84)	**6.19** (5.44-7.02)	**7.03** (6.15-8.02)	**8.19** (6.89-9.61)	**9.08** (7.45-10.8)	**9.96** (7.87-12.2)	**10.8** (8.19-13.7)	**12.0** (8.70-15.6)	**12.9** (9.09-17.0)
45-day	**5.46** (4.84-6.14)	**6.22** (5.51-7.01)	**7.45** (6.57-8.42)	**8.44** (7.40-9.58)	**9.77** (8.22-11.4)	**10.8** (8.85-12.7)	**11.7** (9.29-14.2)	**12.7** (9.60-15.9)	**13.9** (10.1-17.9)	**14.8** (10.5-19.5)
60-day	**6.23** (5.54-7.00)	**7.13** (6.32-8.01)	**8.54** (7.55-9.62)	**9.67** (8.50-10.9)	**11.2** (9.40-12.9)	**12.3** (10.1-14.4)	**13.3** (10.6-16.1)	**14.3** (10.9-17.8)	**15.6** (11.3-20.0)	**16.5** (11.7-21.6)

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

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

Please refer to NOAA Atlas 14 document for more information.

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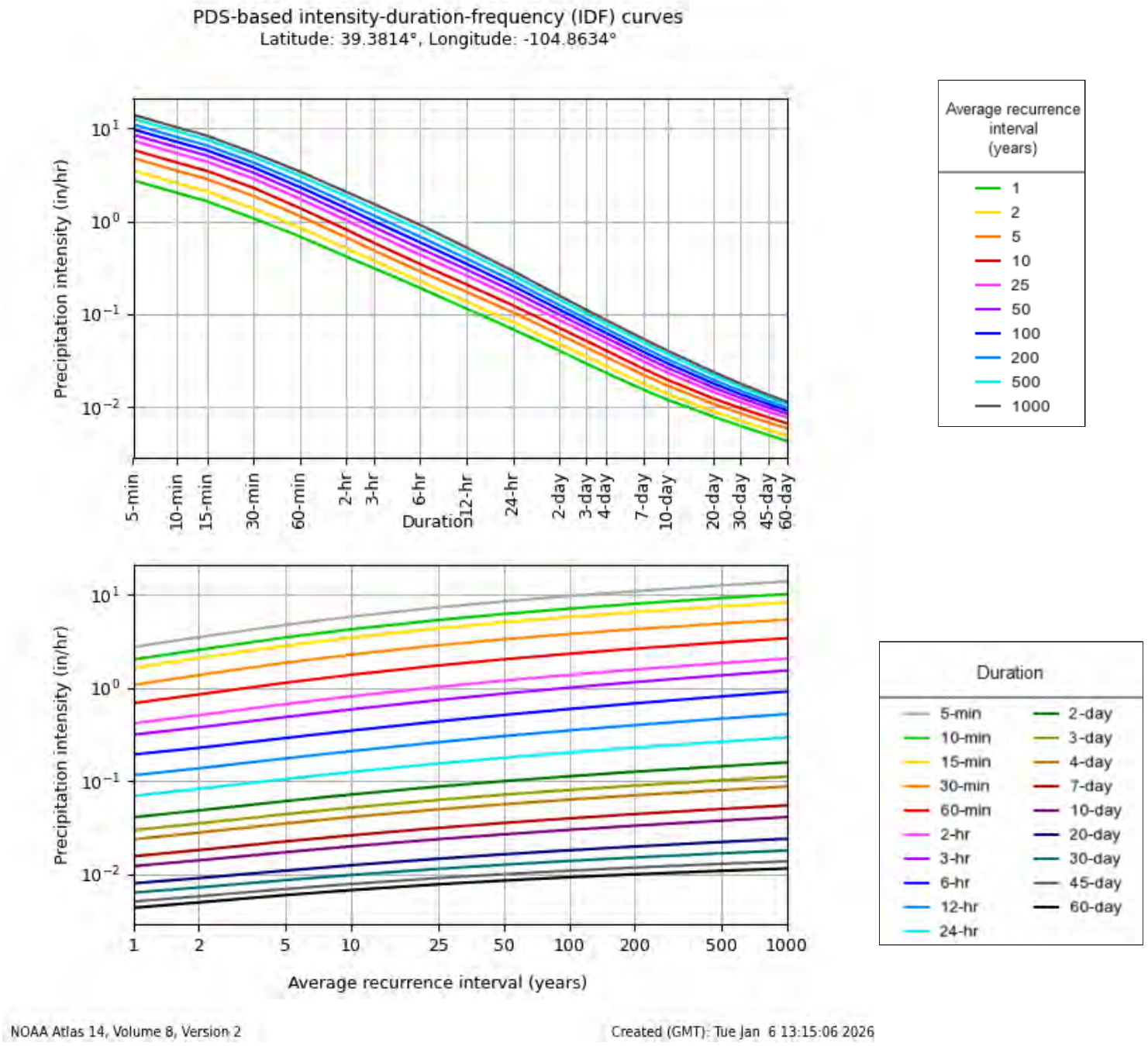
PF graphical



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Maps & aerials

Small scale terrain

NOAA Atlas 14, Volume 8, Version 2
Location name: Castle Rock, Colorado, USA*
Latitude: 39.3814°, Longitude: -104.8634°
Elevation: 6159 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**2.75** (2.32-3.31)	**3.50** (2.95-4.22)	**4.76** (4.00-5.76)	**5.83** (4.85-7.08)	**7.32** (5.86-9.24)	**8.51** (6.61-10.9)	**9.71** (7.25-12.7)	**10.9** (7.79-14.8)	**12.6** (8.59-17.5)	**13.9** (9.19-19.6)
10-min	**2.02** (1.70-2.43)	**2.57** (2.16-3.10)	**3.49** (2.92-4.22)	**4.27** (3.55-5.18)	**5.36** (4.28-6.77)	**6.23** (4.84-7.96)	**7.10** (5.31-9.32)	**8.02** (5.71-10.8)	**9.25** (6.29-12.8)	**10.2** (6.73-14.4)
15-min	**1.64** (1.38-1.97)	**2.09** (1.76-2.52)	**2.84** (2.38-3.43)	**3.47** (2.89-4.22)	**4.36** (3.48-5.50)	**5.06** (3.94-6.47)	**5.78** (4.32-7.58)	**6.52** (4.64-8.79)	**7.52** (5.11-10.4)	**8.29** (5.47-11.7)
30-min	**1.07** (0.904-1.29)	**1.37** (1.15-1.65)	**1.87** (1.56-2.26)	**2.28** (1.90-2.77)	**2.87** (2.29-3.62)	**3.33** (2.59-4.25)	**3.79** (2.83-4.97)	**4.27** (3.04-5.76)	**4.92** (3.34-6.82)	**5.41** (3.58-7.63)
60-min	**0.685** (0.577-0.825)	**0.851** (0.716-1.03)	**1.14** (0.952-1.37)	**1.38** (1.15-1.68)	**1.74** (1.40-2.21)	**2.03** (1.58-2.60)	**2.33** (1.74-3.06)	**2.64** (1.88-3.57)	**3.08** (2.10-4.28)	**3.42** (2.26-4.82)
2-hr	**0.416** (0.352-0.498)	**0.508** (0.430-0.609)	**0.669** (0.564-0.804)	**0.812** (0.679-0.980)	**1.02** (0.827-1.29)	**1.20** (0.939-1.53)	**1.38** (1.04-1.81)	**1.57** (1.13-2.12)	**1.85** (1.27-2.56)	**2.06** (1.37-2.89)
3-hr	**0.314** (0.266-0.374)	**0.375** (0.318-0.448)	**0.486** (0.410-0.582)	**0.587** (0.492-0.706)	**0.739** (0.602-0.936)	**0.868** (0.685-1.11)	**1.00** (0.762-1.32)	**1.15** (0.834-1.55)	**1.36** (0.943-1.89)	**1.54** (1.02-2.14)
6-hr	**0.192** (0.164-0.227)	**0.226** (0.193-0.268)	**0.289** (0.245-0.344)	**0.347** (0.292-0.414)	**0.436** (0.357-0.548)	**0.511** (0.406-0.650)	**0.593** (0.453-0.772)	**0.682** (0.496-0.913)	**0.809** (0.563-1.11)	**0.913** (0.613-1.26)
12-hr	**0.115** (0.098-0.135)	**0.136** (0.117-0.160)	**0.174** (0.149-0.206)	**0.209** (0.177-0.248)	**0.260** (0.214-0.324)	**0.303** (0.242-0.381)	**0.349** (0.267-0.450)	**0.398** (0.291-0.527)	**0.467** (0.326-0.637)	**0.523** (0.353-0.719)
24-hr	**0.069** (0.059-0.080)	**0.082** (0.070-0.096)	**0.104** (0.089-0.123)	**0.124** (0.106-0.147)	**0.153** (0.126-0.188)	**0.177** (0.141-0.220)	**0.201** (0.155-0.257)	**0.227** (0.167-0.298)	**0.263** (0.185-0.356)	**0.292** (0.199-0.399)
2-day	**0.040** (0.035-0.047)	**0.048** (0.041-0.055)	**0.060** (0.052-0.070)	**0.071** (0.061-0.083)	**0.087** (0.071-0.105)	**0.099** (0.079-0.122)	**0.112** (0.086-0.141)	**0.125** (0.092-0.163)	**0.143** (0.101-0.192)	**0.158** (0.108-0.214)
3-day	**0.029** (0.025-0.034)	**0.034** (0.030-0.040)	**0.043** (0.038-0.051)	**0.051** (0.044-0.060)	**0.062** (0.051-0.075)	**0.071** (0.057-0.087)	**0.080** (0.062-0.100)	**0.089** (0.066-0.115)	**0.101** (0.072-0.135)	**0.111** (0.076-0.150)
4-day	**0.023** (0.020-0.027)	**0.027** (0.024-0.032)	**0.034** (0.030-0.040)	**0.040** (0.035-0.047)	**0.049** (0.041-0.059)	**0.056** (0.045-0.068)	**0.063** (0.049-0.079)	**0.070** (0.052-0.090)	**0.079** (0.056-0.105)	**0.087** (0.060-0.117)
7-day	**0.015** (0.013-0.017)	**0.018** (0.015-0.020)	**0.022** (0.019-0.025)	**0.026** (0.022-0.030)	**0.031** (0.026-0.037)	**0.035** (0.028-0.043)	**0.039** (0.030-0.049)	**0.044** (0.032-0.056)	**0.050** (0.035-0.066)	**0.054** (0.037-0.073)
10-day	**0.012** (0.010-0.013)	**0.014** (0.012-0.016)	**0.017** (0.014-0.019)	**0.019** (0.017-0.022)	**0.023** (0.019-0.028)	**0.026** (0.021-0.032)	**0.029** (0.023-0.037)	**0.033** (0.024-0.042)	**0.037** (0.026-0.049)	**0.040** (0.028-0.054)
20-day	**0.007** (0.006-0.008)	**0.009** (0.007-0.010)	**0.010** (0.009-0.012)	**0.012** (0.010-0.014)	**0.014** (0.012-0.017)	**0.016** (0.013-0.019)	**0.017** (0.014-0.022)	**0.019** (0.014-0.025)	**0.022** (0.015-0.028)	**0.023** (0.016-0.031)
30-day	**0.006** (0.005-0.007)	**0.007** (0.006-0.008)	**0.008** (0.007-0.009)	**0.009** (0.008-0.011)	**0.011** (0.009-0.013)	**0.012** (0.010-0.015)	**0.013** (0.010-0.016)	**0.015** (0.011-0.018)	**0.016** (0.012-0.021)	**0.017** (0.012-0.023)
45-day	**0.005** (0.004-0.005)	**0.005** (0.005-0.006)	**0.006** (0.006-0.007)	**0.007** (0.006-0.008)	**0.009** (0.007-0.010)	**0.009** (0.008-0.011)	**0.010** (0.008-0.013)	**0.011** (0.008-0.014)	**0.012** (0.009-0.016)	**0.013** (0.009-0.018)
60-day	**0.004** (0.003-0.004)	**0.004** (0.004-0.005)	**0.005** (0.005-0.006)	**0.006** (0.005-0.007)	**0.007** (0.006-0.008)	**0.008** (0.007-0.010)	**0.009** (0.007-0.011)	**0.009** (0.007-0.012)	**0.010** (0.007-0.013)	**0.011** (0.008-0.015)

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

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

Please refer to NOAA Atlas 14 document for more information.

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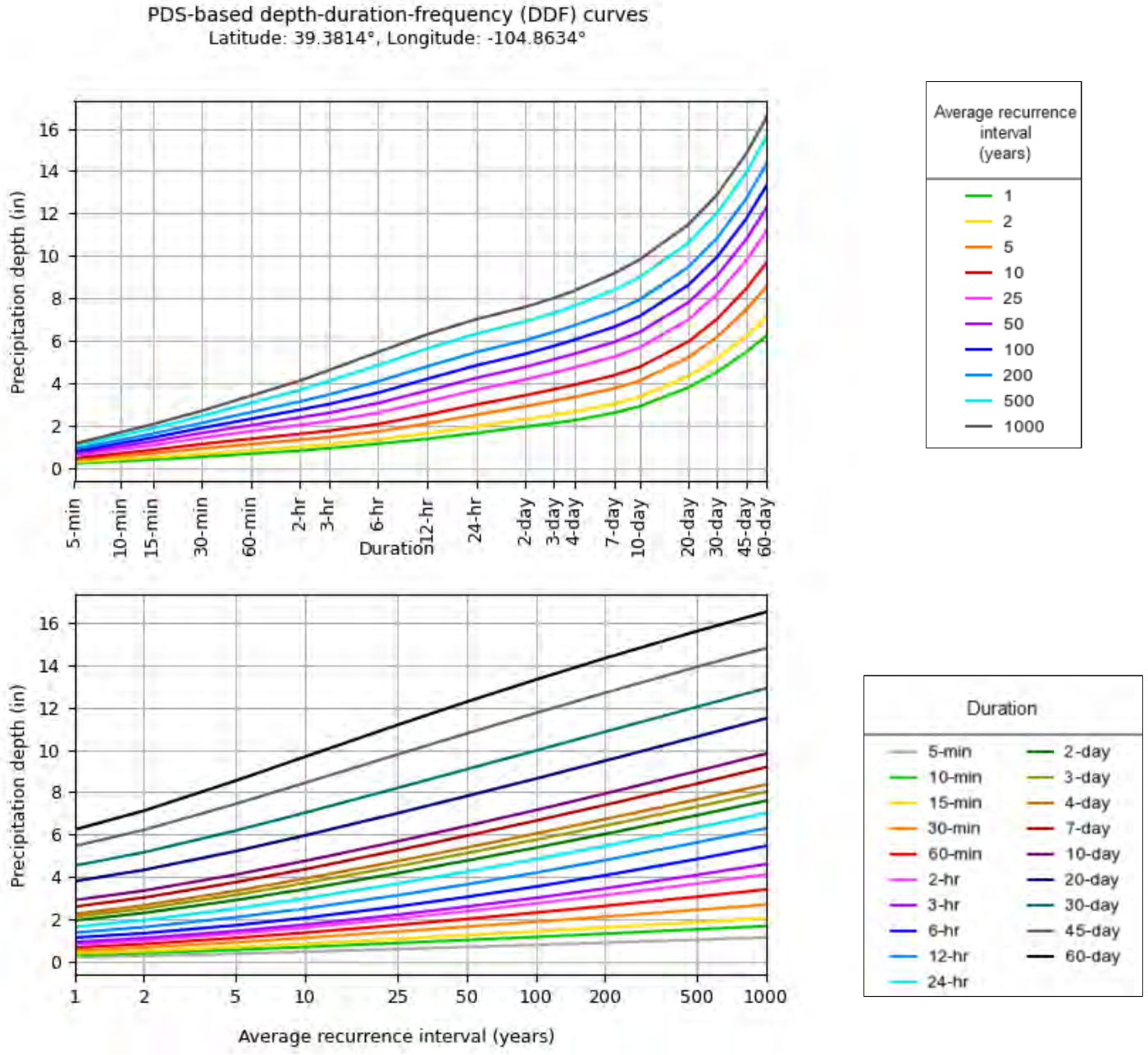
PF graphical



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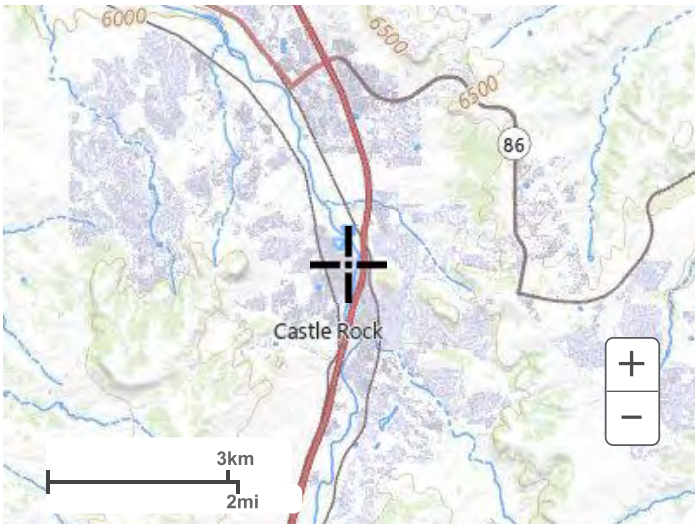
Maps & aerials

Small scale terrain



Large scale terrain

Large scale map

Large scale aerial

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

Percent Imperviousness w/ Areas in Square Feet						
Basin	Buildings (90% Imp.)	Recycled Asphalt / Road Base (40%)	Paved (100% Imp.)	Open Space (2% Imp.)	Total Area	Percent Imperviousness.
Existing Site	0	30,052	0	7,440	37,492	32%
Proposed Site	0	0	27,668	9,824	37,492	74%

BULLDOG ENGINEERING
970-460-0089 INFO@BULLDOGENG.COM

Calculation of Peak Runoff using Rational Method

Designer: Mark Harris
Company: Bulldog Engineering
Date: 1/6/2026
Project: Berkenkotter Parking
Location: Castle Rock

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

$$\text{Computed } t_c = t_i + t_t$$

$$\text{Regional } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

$t_{minimum}$ = 5 (urban)
$t_{minimum}$ = 10 (non-urban)

$$\text{Selected } t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	0.85	1.14	1.38	1.74	2.03	2.33	3.08

Rainfall Intensity Equation Coefficients =	a	b	c
	28.50	10.00	0.786

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time							Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
Lot 1	0.86	B	74.0	0.59	0.62	0.65	0.71	0.74	0.77	0.81	71.00			0.021	5.75	366.00			0.010	15	1.50	4.07	9.81	16.57	9.81	2.32	3.11	3.76	4.74	5.53	6.35	8.39	1.17	1.65	2.12	2.91	3.53	4.21	5.83

BULLDOG ENGINEERING
970-460-0089
INFO@BULLDOGENG.COM

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jan 6 2026

Grass Swale - 1/2 100 Pear Peak Runoff from Entire Lot

Triangular

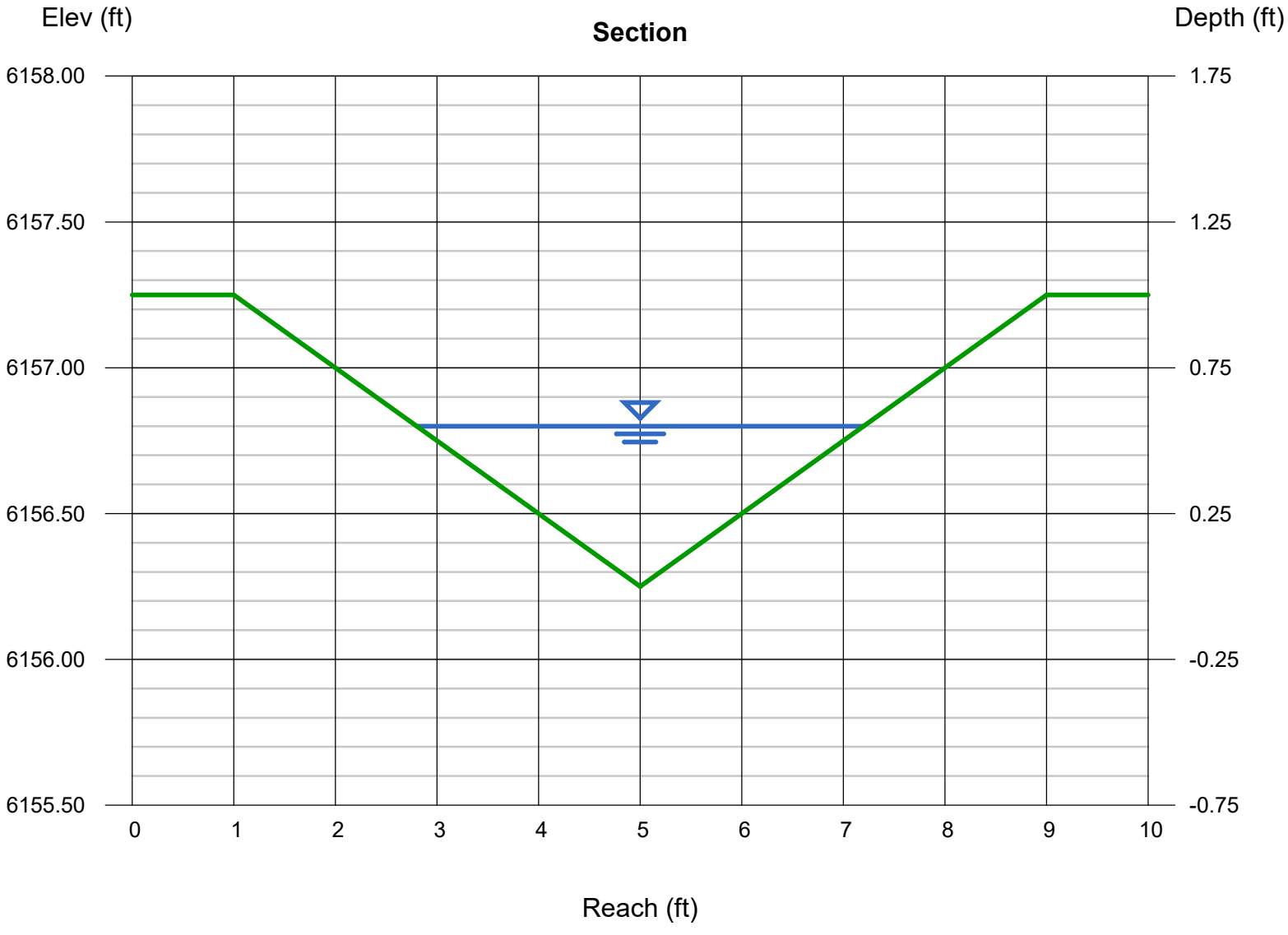
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 6156.25
Slope (%)	= 1.00
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.11

Highlighted

Depth (ft)	= 0.55
Q (cfs)	= 2.110
Area (sqft)	= 1.21
Velocity (ft/s)	= 1.74
Wetted Perim (ft)	= 4.54
Crit Depth, Yc (ft)	= 0.45
Top Width (ft)	= 4.40
EGL (ft)	= 0.60

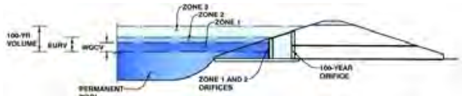


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)

Project: **Berkenkotter Parking**

Basin ID: **Water Qaulity Pond**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected SCM Type =	**EDB**	
Watershed Area =	0.86	acres
Watershed Length =	320	ft
Watershed Length to Centroid =	155	ft
Watershed Slope =	0.011	ft/ft
Watershed Imperviousness =	74.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.021	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.070	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.85 in.) =	0.040	acre-feet	0.85	inches
5-yr Runoff Volume (P1 = 1.14 in.) =	0.057	acre-feet	1.14	inches
10-yr Runoff Volume (P1 = 1.38 in.) =	0.073	acre-feet	1.38	inches
25-yr Runoff Volume (P1 = 1.74 in.) =	0.100	acre-feet	1.74	inches
50-yr Runoff Volume (P1 = 2.03 in.) =	0.120	acre-feet	2.03	inches
100-yr Runoff Volume (P1 = 2.33 in.) =	0.143	acre-feet	2.33	inches
500-yr Runoff Volume (P1 = 3.08 in.) =	0.198	acre-feet	3.08	inches
Approximate 2-yr Detention Volume =	0.039	acre-feet		
Approximate 5-yr Detention Volume =	0.056	acre-feet		
Approximate 10-yr Detention Volume =	0.072	acre-feet		
Approximate 25-yr Detention Volume =	0.086	acre-feet		
Approximate 50-yr Detention Volume =	0.092	acre-feet		
Approximate 100-yr Detention Volume =	0.101	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.021	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.021	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Total detention volume is less than 100-year volume.

Depth Increment = [ ] ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	1	0.000		
	--	0.07	--	--	--	99	0.002	3	0.000
	--	0.17	--	--	--	404	0.009	29	0.001
	--	0.27	--	--	--	750	0.017	86	0.002
	--	0.37	--	--	--	1,137	0.026	181	0.004
	--	0.47	--	--	--	1,563	0.036	316	0.007
	--	0.57	--	--	--	1,847	0.042	486	0.011
	--	0.67	--	--	--	1,966	0.045	677	0.016
	--	0.77	--	--	--	2,111	0.048	881	0.020
	--	0.87	--	--	--	2,289	0.053	1,101	0.025
Spillway	--	0.97	--	--	--	2,521	0.058	1,341	0.031
	--	1.07	--	--	--	2,846	0.065	1,609	0.037
	--	1.17	--	--	--	3,304	0.076	1,917	0.044
Top of WQ Area	--	1.27	--	--	--	3,648	0.084	2,265	0.052
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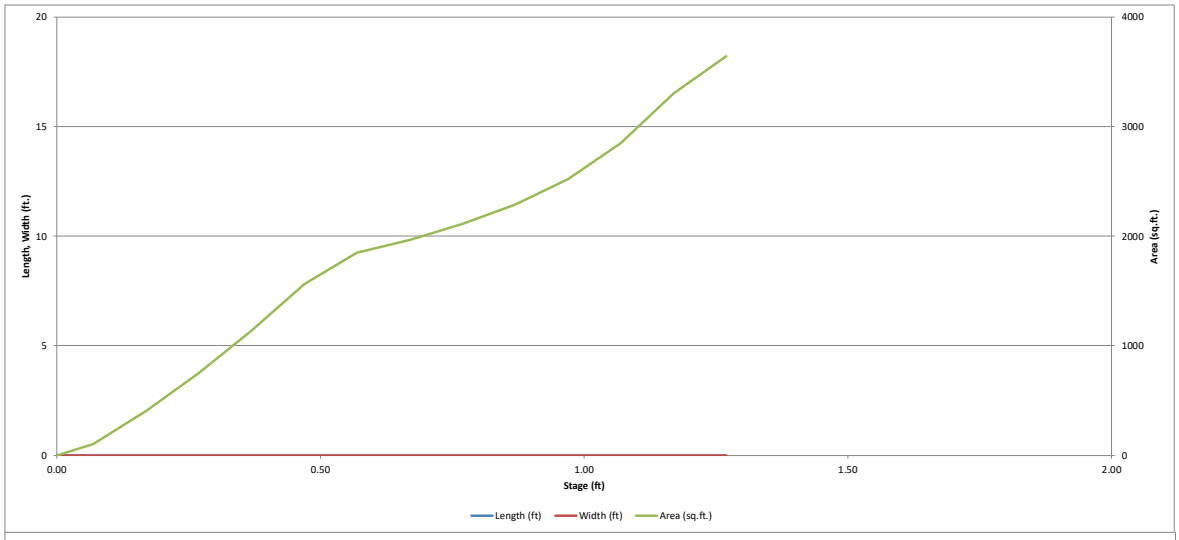
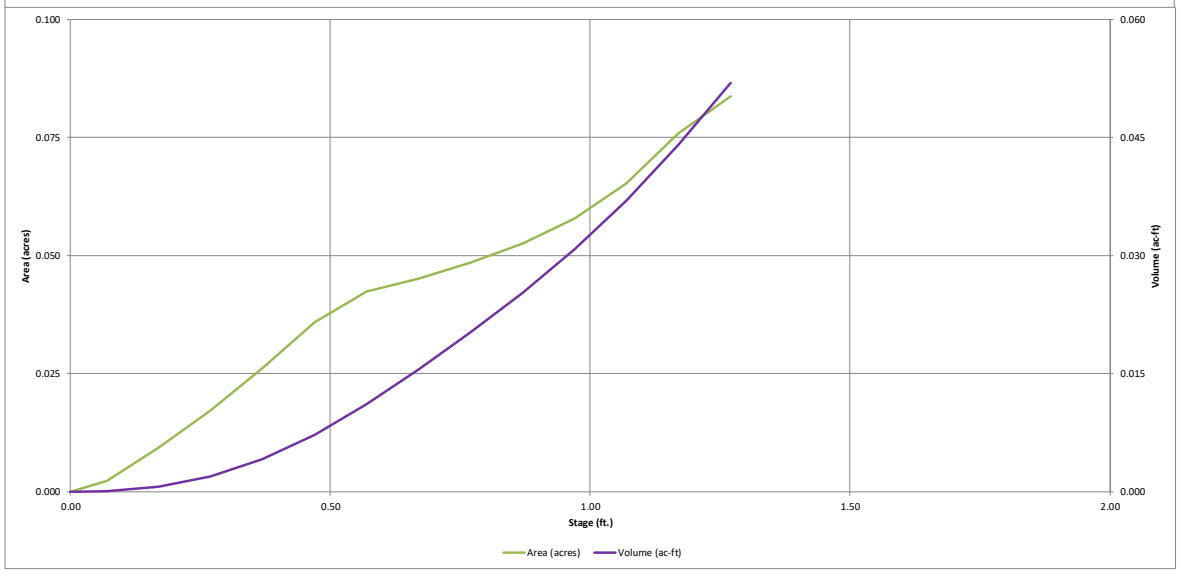
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)



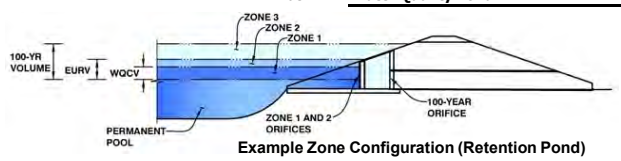


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Project: **Berkenkotter Parking**

Basin ID: **Water Qaulity Pond**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.79	0.021	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.021	

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

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^2

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 SCM)

Centroid of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)

Depth at top of Zone using Orifice Plate = 0.79 ft (relative to basin bottom at Stage = 0 ft)

Orifice Plate: Orifice Vertical Spacing = 12.00 inches

Orifice Plate: Orifice Area per Row = 0.26 sq. inches (diameter = 9/16 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row = 1.806E-03 ft^2

Elliptical Half-Width = N/A feet

Elliptical Slot Centroid = N/A feet

Elliptical Slot Area = N/A ft^2

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							
Orifice Area (sq. inches)	0.26							

	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)

	Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =			inches

Calculated Parameters for Vertical Orif

Not Selected	Not Selected

Vertical Orifice Area =

Vertical Orifice Centroid =

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

	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =			feet
Overflow Weir Grate Slope =			H:V
Horiz. Length of Weir Sides =			feet
Overflow Grate Type =			
Debris Clogging % =			%

Calculated Parameters for Overflow W

Not Selected	Not Selected

Height of Grate Upper Edge, H_t =

Overflow Weir Slope Length =

Grate Open Area / 100-yr Orifice Area =

Overflow Grate Open Area w/o Debris =

Overflow Grate Open Area w/ Debris =

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

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =	0.00		ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	6.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

Not Selected	Not Selected
0.20	
0.25	
N/A	N/A

Outlet Orifice Area =

Outlet Orifice Centroid =

Half-Central Angle of Restrictor Plate on Pipe =

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage= 0.97 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 = 0.11 feet

Calculated Parameters for Spillway

Spillway Design Flow Depth= 0.19 feet

Stage at Top of Freeboard = 1.27 feet

Basin Area at Top of Freeboard = 0.08 acres

Basin Volume at Top of Freeboard = 0.05 acre-ft

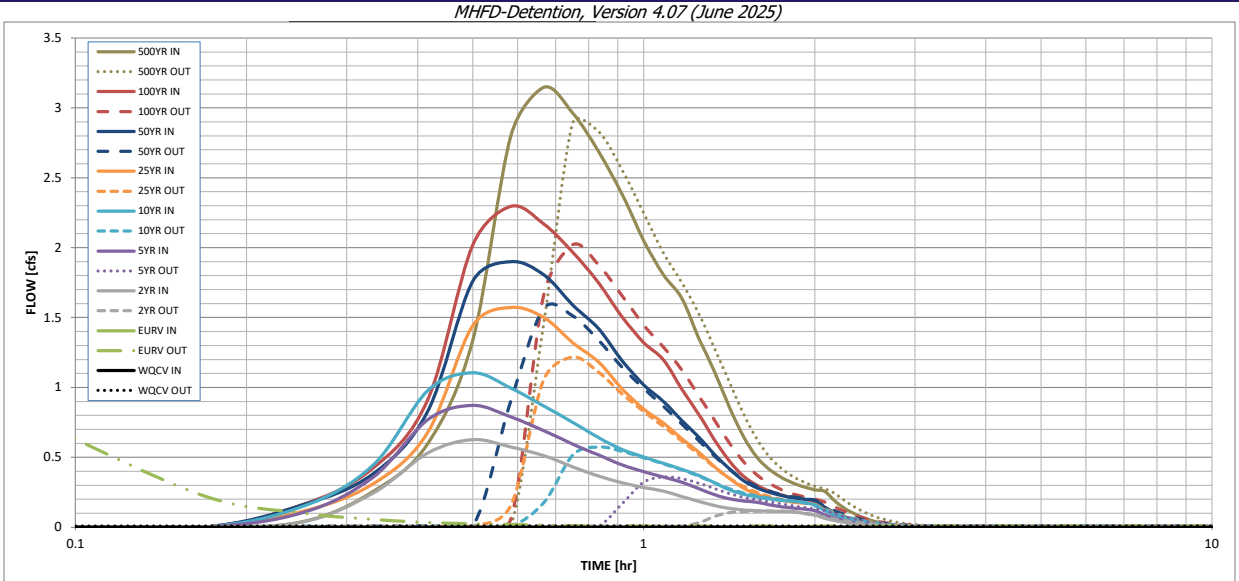
Routed Hydrograph Results

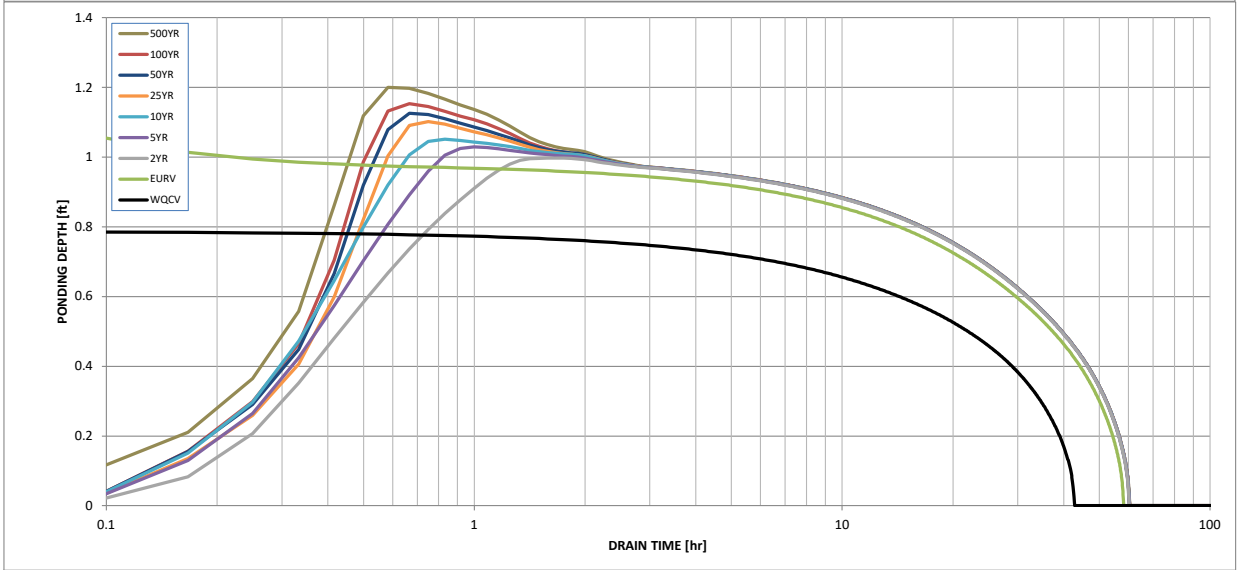
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

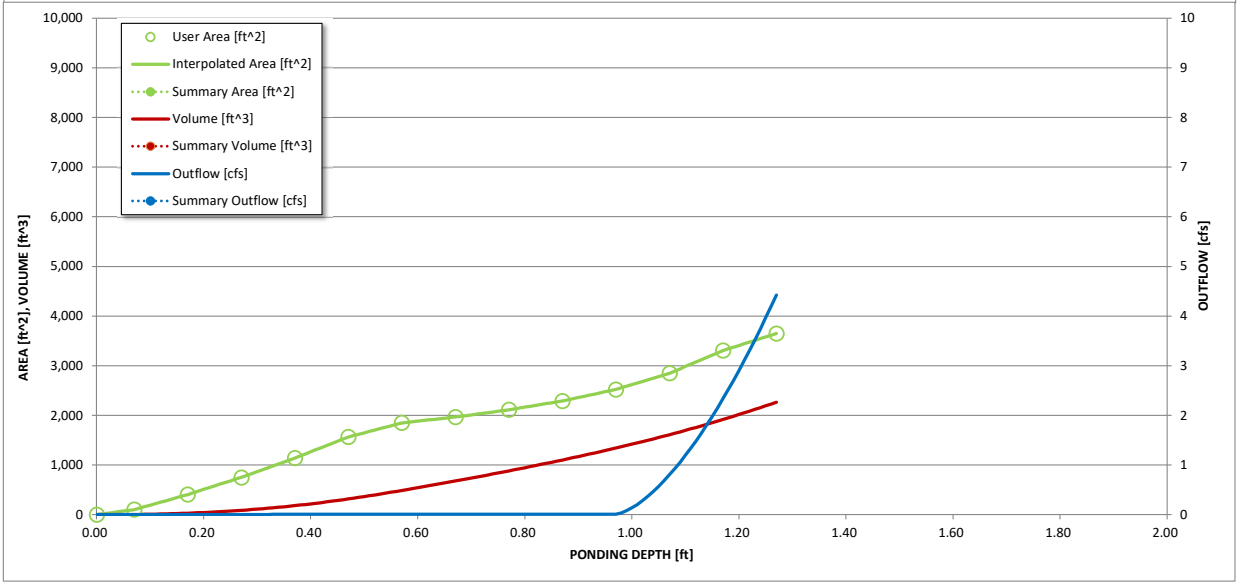
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.85	1.14	1.38	1.74	2.03	2.33
CUHP Runoff Volume (acre-ft) =	0.021	0.070	0.040	0.057	0.073	0.100	0.120	0.143
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.040	0.057	0.073	0.100	0.120	0.143
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.2	0.5	0.6	0.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.02	0.05	0.18	0.53	0.73	1.00
Peak Inflow Q (cfs) =	N/A	N/A	0.6	0.9	1.1	1.6	1.9	2.3
Peak Outflow Q (cfs) =	0.0	4.4	0.1	0.4	0.6	1.2	1.6	2.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	8.3	3.7	2.7	2.5	2.4
Structure Controlling Flow =	Plate	Spillway	Spillway	Spillway	Spillway	Spillway	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	53	56	54	53	51	50	48
Time to Drain 99% of Inflow Volume (hours) =	**42**	56	58	58	57	57	56	55
Maximum Ponding Depth (ft) =	0.79	1.07	1.00	1.03	1.05	1.10	1.12	1.15
Area at Maximum Ponding Depth (acres) =	0.05	0.06	0.06	0.06	0.06	0.07	0.07	0.07
Maximum Volume Stored (acre-ft) =	0.021	0.036	0.032	0.034	0.036	0.039	0.040	0.043

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)







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.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
	0:15:00	0	0.00	0.04	0.10	0.14	0.11	0.16	0.16	0.25
	0:20:00	0	0.00	0.24	0.35	0.44	0.31	0.38	0.42	0.60
	0:25:00	0	0.00	0.53	0.77	0.98	0.68	0.83	0.91	1.34
	0:30:00	0	0.00	0.63	0.87	1.10	1.44	1.76	2.02	2.80
	0:35:00	0	0.00	0.57	0.79	0.99	1.57	1.90	2.30	3.15
	0:40:00	0	0.00	0.51	0.69	0.87	1.50	1.81	2.17	2.96
	0:45:00	0	0.00	0.43	0.59	0.75	1.32	1.59	1.97	2.69
	0:50:00	0	0.00	0.37	0.52	0.64	1.18	1.42	1.75	2.38
	0:55:00	0	0.00	0.32	0.44	0.56	0.99	1.19	1.50	2.05
	1:00:00	0	0.00	0.28	0.40	0.50	0.85	1.02	1.32	1.81
	1:05:00	0	0.00	0.26	0.36	0.46	0.74	0.90	1.20	1.64
	1:10:00	0	0.00	0.22	0.32	0.41	0.63	0.76	0.99	1.35
	1:15:00	0	0.00	0.18	0.28	0.37	0.54	0.64	0.81	1.11
	1:20:00	0	0.00	0.15	0.23	0.32	0.43	0.52	0.62	0.85
	1:25:00	0	0.00	0.13	0.20	0.27	0.35	0.42	0.47	0.64
	1:30:00	0	0.00	0.12	0.19	0.24	0.28	0.33	0.36	0.50
	1:35:00	0	0.00	0.12	0.18	0.22	0.24	0.28	0.30	0.41
	1:40:00	0	0.00	0.12	0.16	0.20	0.21	0.25	0.26	0.35
	1:45:00	0	0.00	0.11	0.15	0.19	0.19	0.23	0.23	0.31
	1:50:00	0	0.00	0.11	0.14	0.18	0.18	0.21	0.21	0.29
	1:55:00	0	0.00	0.10	0.13	0.18	0.17	0.20	0.20	0.27
	2:00:00	0	0.00	0.09	0.12	0.16	0.16	0.19	0.19	0.25
	2:05:00	0	0.00	0.06	0.09	0.12	0.12	0.14	0.14	0.19
	2:10:00	0	0.00	0.05	0.06	0.09	0.09	0.10	0.10	0.14
	2:15:00	0	0.00	0.03	0.05	0.06	0.07	0.08	0.07	0.10
	2:20:00	0	0.00	0.02	0.03	0.04	0.05	0.05	0.05	0.07
	2:25:00	0	0.00	0.02	0.02	0.03	0.03	0.04	0.04	0.05
	2:30:00	0	0.00	0.01	0.02	0.02	0.02	0.03	0.03	0.04
	2:35:00	0	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.02
	2:40:00	0	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02
	2:45:00	0	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	2:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	4:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	5:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Maintenance Plan

Owner to maintain the Water Quality Pond per Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3.

Inspection

Inspect the Water Quality Pond at least twice annually, observing the amount of sediment in the forebay and checking for debris at the outlet structure.

Debris and Litter Removal

Remove debris and litter from the Water Quality Pond area as required to minimize clogging of the outlet.

Mowing and Plant Care

When starting from seed, mow native/drought tolerant grasses only when required to deter weeds during the first three years. Following this period, mowing of native/drought tolerant grass may stop or be reduced to maintain a height of no less than 6 inches (higher mowing heights are associated with deeper roots and greater drought tolerance). In general, mowing should be done as needed to maintain appropriate height and control weeds. Mowing of manicured grasses may vary from as frequently as weekly during the summer, to no mowing during the winter. See Section 4 of this chapter for additional recommendations from the CSU Extension.

Aeration

For Water Quality Pond with manicured grass, aeration will supply the soil and roots with air and increase infiltration. It reduces soil compaction and helps control thatch while helping water move into the root zone. Aeration is done by punching holes in the ground using an aerator with hollow punches that pull the soil cores or "plugs" from the ground. Holes should be at least 2 inches deep and no more than 4 inches apart. Aeration should be performed at least once per year when the ground is not frozen. Water the turf thoroughly prior to aeration. Mark sprinkler heads and shallow utilities such as irrigation lines and cable TV lines to ensure those lines will not be damaged. Avoid aerating in extremely hot and dry conditions. Heavy traffic areas may require aeration more frequently.

Mosquito Control

Although the design provided in this manual implements practices specifically developed to deter mosquito breeding, some level of mosquito control may be necessary if the BMP is located in close proximity to outdoor amenities. The most effective mosquito control programs include weekly inspection for signs of mosquito breeding with treatment provided when breeding is found. These inspections can be performed by a mosquito control service and typically start in midMay and extend to mid-September. Treatment should be targeted toward mosquito larvae. Mosquitoes are more difficult to control when they are adults. This typically requires neighborhood fogging with an insecticide. The use of larvicidal briquettes or "dunks" may be appropriate. These are typically effective for about one month and perform best when the basin has a hard bottom (e.g., concrete lined micropool).

Irrigation Scheduling and Maintenance

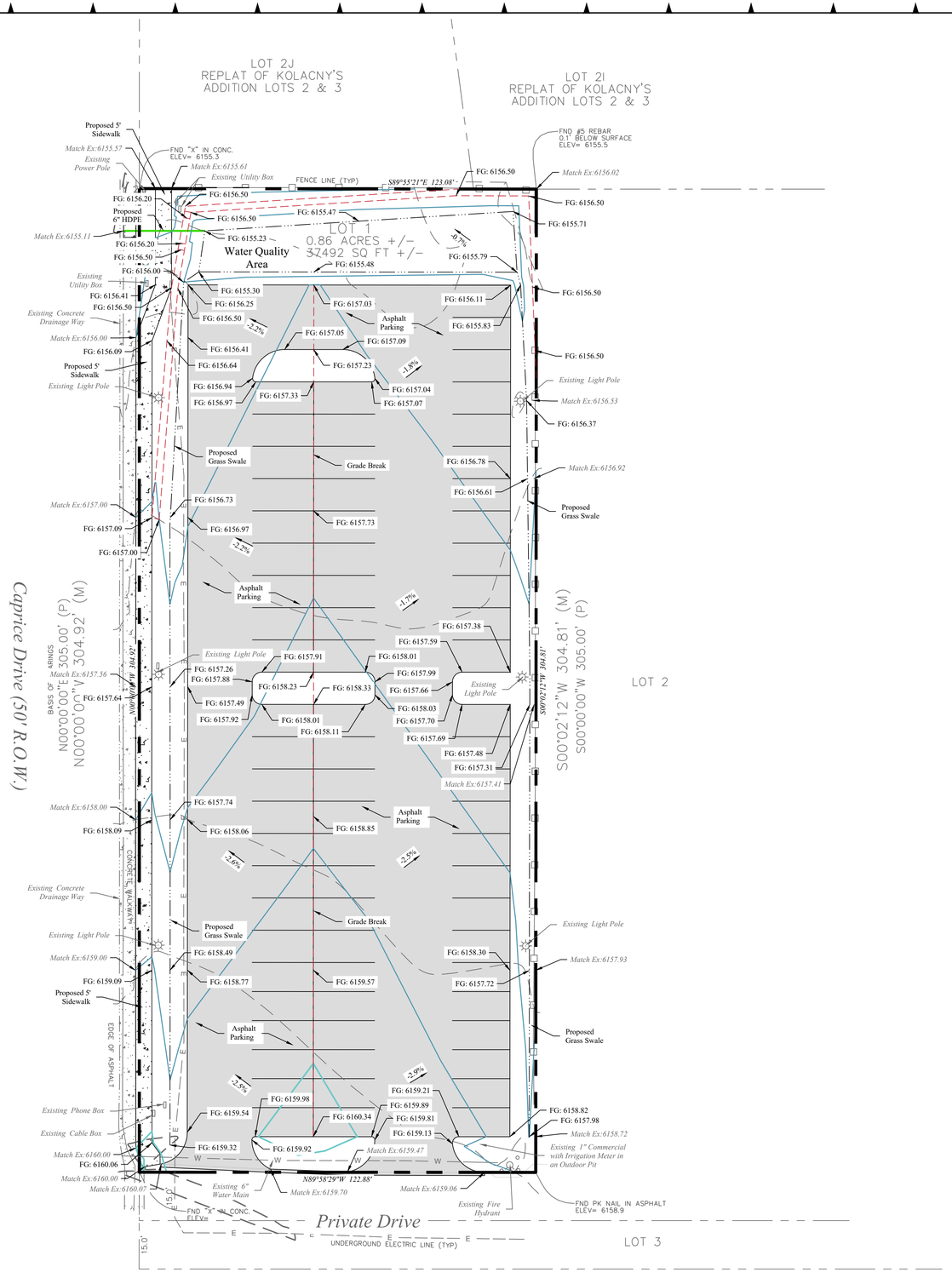
Adjust irrigation throughout the growing season to provide the proper irrigation application rate to maintain healthy vegetation. Less irrigation is typically needed in early summer and fall, with more irrigation needed during July and August. Native grass and other drought tolerant plantings should not require irrigation after establishment. Check for broken sprinkler heads and repair them, as needed. Completely drain the irrigation system before the first winter freeze each year. Upon reactivation of the irrigation system in the spring, inspect all components and replace damaged parts, as needed.

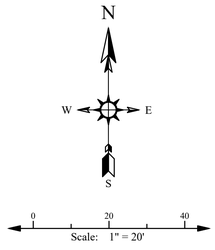
Sediment Removal from the Basin Bottom

Remove sediment from the bottom of the basin when accumulated sediment occupies about 20% of the water quality design volume or when sediment accumulation results in poor drainage within the basin. The required frequency may be every 15 to 25 years or more frequently in basins where construction activities are occurring.

Erosion and Structural Repairs

Repair basin inlets, outlets, trickle channels, and all other structural components required for the basin to operate as intended. Repair and vegetate eroded areas as needed following inspection.





Legend

Existing		Proposed
	Property Line	
	Easement	
4800	Spot Elevation	4800
4800	Major Contour	4800
4801	Minor Contour	4801
	Flowline	
	Swale Flowline	
	Grade Break	
	Curb and Gutter	
	Limits of Disturbance	LOD
	Pavement	
	Concrete	

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PRELIMINARY
NOT FOR
CONSTRUCTION

JOB NUMBER 25-008

DATE 12/31/2025

BULLDOG ENGINEERING, LLC ASSUMES NO RESPONSIBILITY FOR EXISTING UTILITY LOCATIONS (HORIZONTAL OR VERTICAL). THE EXISTING UTILITIES SHOWN ON THIS DRAWING HAVE BEEN PLOTTED FROM THE BEST AVAILABLE INFORMATION. IT IS HOWEVER THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE LOCATION OF ALL THE UTILITIES PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION ACTIVITIES.

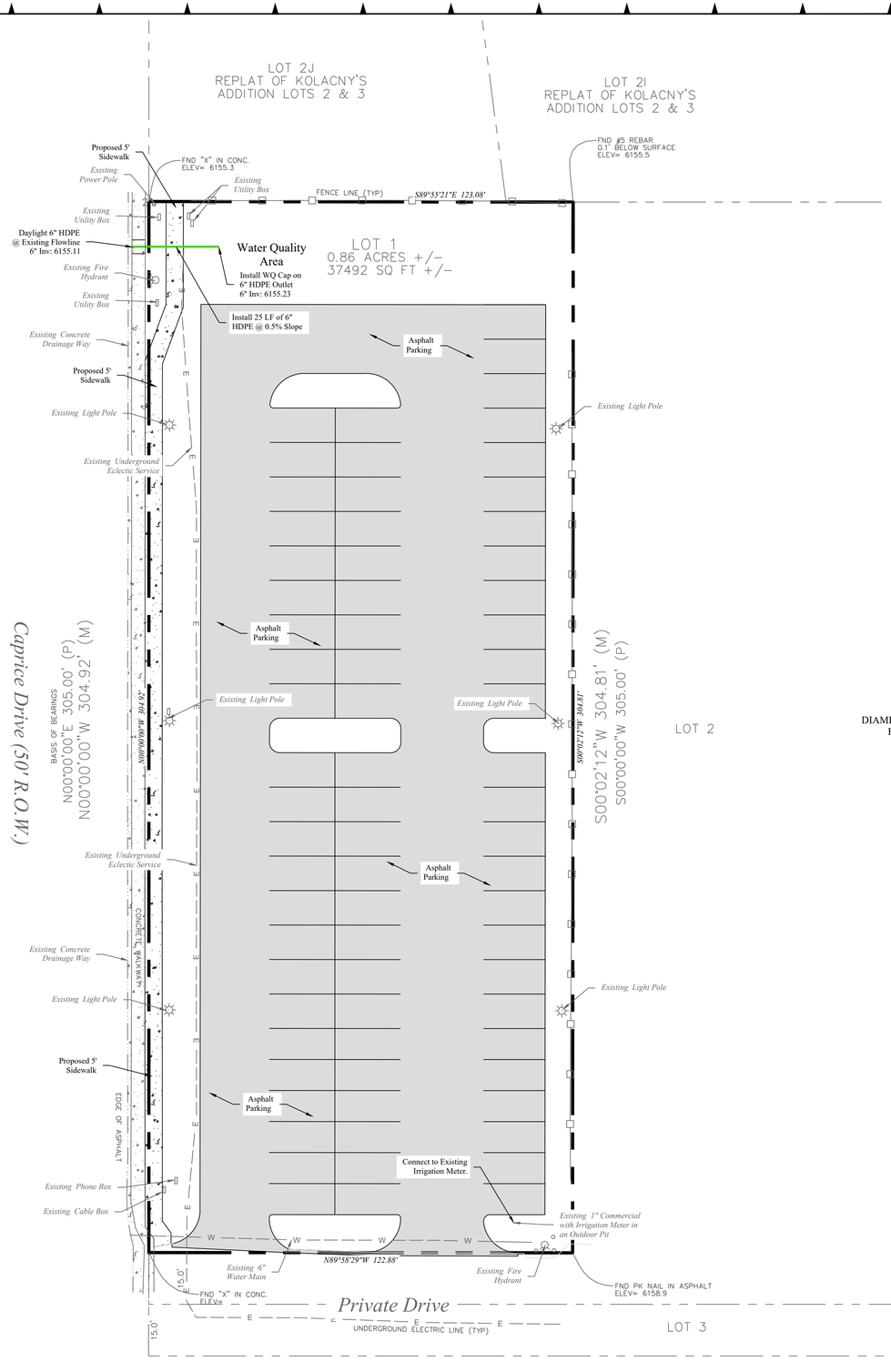
COLORADO 811 KNOW WHAT'S BELOW. CALL BEFORE YOU DIG.

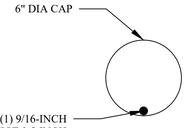
REV. NUMBER	DATE	REVISION DESCRIPTION
A	12/31/2025	For Review

Berkenkotter Parking
Construction Documents

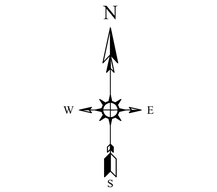
Grading & Drainage Plan
1212 Caprice Drive
Castle Rock, CO

SHEET NUMBER C4





WQ CAP DETAIL
NTS



Legend

Existing		Proposed
	Property Line	
	Easement	
	Setback	
	Flowline	
	Fence	
GAS	Gas	GAS
W	Potable Water	W
F	Fire Line	F
SS	Sanitary Sewer	SS
ST	Storm	ST
E	Electric	E
FO	Fiber Optic	FO
	Pavement	
	Concrete	

BULLDOG ENGINEERING
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REV. NUMBER	DATE	REVISION DESCRIPTION
A	12/31/2025	For Review

Berkenkotter Parking
Construction Documents

Utility Plan
1212 Caprice Drive
Castle Rock, CO

SHEET NUMBER C5