DRAINAGE REPORT

Wal-Mart Fuel Station #984-543
133 Sam Walton Lane
Castle Rock CO, 80104

Lot 1, Milestone Filing No. 4, Walmart Center
A portion of the East ½ of Section 2
Township 20 South, Range 66 West, of the 6th P.M.

CEI Project No. 32644

February 12, 2024
Revision Number: Rev-0

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Engineer's Certification Statement:

I affirm that this report and plan for the Phase II drainage design of Wal-Mart Fuel Station #984-543 was prepared by me (or under my direct supervision) in accordance with the provisions of the Town of Castle Rock Drainage Design and Technical Criteria for the owners thereof. I understand that the Town of Castle Rock does not and will not assume liability for drainage facilities designed by others.



Tom Burry, P.E.
Registered Professional Engineer
State of Colorado No. 47294

Intent of Report:

It is the intent of this report to show that the stormwater management facilities for the proposed Wal-Mart Fuel Station meet the requirements of the Town of Castle Rock, Douglas County, and general engineering practices for safe conveyance of stormwater within and/or from the site without damage to downstream property and life as well as establishing compliance with previous drainage studies. Previous drainage reports that studied the area include "Final Drainage Study for Wal-Mart Store No. 98401 Lot 1, Milestone Filing No. 4" prepared by CLC Associates as well as the "Metzler Ranch Master Drainage Study" prepared by Inter-Mountain Engineering.

Modifications for this project will be contained in a 1.71-acre portion of the 21.7-acre Wal-Mart parcel denoted Lot 1 of the Milestone Filing No. 4. The project is classified as a redevelopment and majority of the site area will be altered to accommodate the proposed structures. This report will show that the post-development conditions are at or below that of the pre-development conditions for each of the following: water quality capture volume and the safe conveyance of storm water within and/or from the site so to ensure that there will not be a negative impact to any of the downstream areas.

Project Description:

The project is platted as Lot 1 Milestone Filing No. 4 and is a portion of the East ½ of section 2, Township 20 South, Range 66 West, of the 6th P.M. County of Douglas, Colorado. The approximately 0.77-acre site currently serves as the southwestern portion of the existing Wal-Mart Supercenter's parking, with an additional 0.94 acres included in this analysis due to the proposed accessibility updates within and adjacent to the site. The area consists of asphalt, parking stalls, and landscape islands. The site is bordered by Front Street and Interstate 28 to the east, Sam Walton Lane to the south, Trail Boss Drive to the west, and other existing private developments to the north (see *Vicinity Map* in Exhibit 1).

No portions of the Wal-Mart Fuel station proposed development are located within the 100-year floodplain, Zone A (see Exhibit 2 for *Flood Insurance Rate Map Panel #08035C0186G, March 16, 2016*). Zone X is defined as areas determined to be outside the 0.2% annual chance floodplain.

Soils Description:

Based on the Geotechnical Report that studied the site "Geotechnical Engineering Report Walmart Fuel Station - Store #984" prepared by ECS Southwest, LLP., as well as the soils report (see Exhibit 3) the site consists of asphalt and fill materials with native sand with carrying amounts of silt, clay and gravel. Ground water seepage was not observed during drilling and at the completion of drilling. The NRCS report classifies the native soil as Kutch Sandy Loams: falling into Hydraulic Soil Group (HSG) D. The soil is denoted to have moderately low to moderately high infiltration capacity (0.06 to 0.20 in/hr.). Additionally, the site has Bresser sandy loams, cool: falling into Hydraulic Soil Group (HSG) B. The soil is denoted to have moderately high to high infiltration capacity (0.06 to 6.00 in/hr.)

Existing Conditions:

The proposed redevelopment is located within a portion of the area studied by the "Metzler Ranch Master Drainage Study" and more recently by CLC Associates in the "Final Drainage Study for Wal-Mart Store No. 98401 Lot 1, Milestone Filing No. 4." Existing runoff for the site is controlled via the implementation of regional and sub-regional ponds which have been designed to provide both detention and water quality functionality. The larger of the two structures is located on the School/Park site to the South and treats Lot 2 and varying portions of Lots 1 and 3, while the smaller pond is located North of the Wal-Mart lot and treats the majority of Lot 3 and a portion of Lot 1. The stormwater that accumulates in the existing parking lot is routed overland to a series of inlets that convey the runoff to either of the two ponds (See Exhibit 6).

As stated earlier, the entirety of the redevelopment/disturbance will be contained within a 1.92-acre portion of the existing Wal-Mart store parking lot. There is also additional drainage considered from run-on from areas outside the proposed limits of disturbance ("Off-Site"). Existing conditions within the future limits of disturbance are approximately 79.6% impervious with the 20.2% pervious area being contained in landscaping areas.

The entirety of the redevelopment/disturbance is contained within portions of drainage basins Pre-A, Pre-B, and Pre-E, Pre-J, and Pre-K denoted in this report. Runoff from these basins was routed via overland flow to area inlets to the south, west, east, and southeast of the site. Existing area conditions are approximately 1.53 acres of asphalt and concrete impervious area and 0.39 acres of pervious landscape islands. The site generally slopes from north to south at approximately 1-3%. Existing total runoff values for the disturbed area include a Q_5= 6.31 cfs (minor storm event) and Q_{100}= 13.58 cfs (major storm event) (See Exhibit 4). The project site has run-on flows from small areas of the existing Walmart parking and landscaped areas. The site includes landscape islands and light poles.

From the site, stormwater is conveyed through underground pipes to the two existing Water Quality and Detention facilities, with Wal-Mart's subregional facility being located to the north of the parking lot and the regional facility being located to the south across Sam Walton Lane. The water quality treatment and detention facilities to the south and north of the site have both been designed to adequately treat the site in its existing and proposed condition.

CEI Engineering Associates, Inc. is not aware of nor has been made aware of flooding concerns in the vicinity of the site.

Pre-Development Runoff Summary				
Minor-Drain Basin Name	PCM Type	Area (acres)	Q_5 (cfs)	Q_{100} (cfs)
Pre-A	Existing Stormwater Quality and Detention Facilities	1.22	4.53	9.15
Pre-B		0.19	0.72	1.44
Pre-E		0.29	1.02	2.11
Pre-J		0.14	0.02	0.56
Pre-K		0.08	0.02	0.32
Offsite "F"		0.36	1.47	2.82
Offsite "G"		1.26	5.19	9.92
Offsite "H"		0.18	0.72	1.39
Offsite "I"		0.12	0.47	0.93
Total		3.84	14.16	28.64

Proposed Conditions:

Given the existing imperviousness of the site and previous drainage design under the Wal-Mart development under the "Final Drainage Study" performed by CLC Associates Inc. (Project #97.211), published May 6, 1999, and the "Metzler Pond Retrofit Project" performed by Kiowa Engineering Corporation (Project #19005), published October 31, 2019, the site would fall under the category of a "Constrained Redevelopment" site and does not require additional detention or water quality treatment.
The redevelopment project will include the construction of an approximately 1,621 square foot fuel station convenience store with 8 fuel islands, and other related site features such as a canopy for the fuel islands, paved parking and drive aisles, utilities, site access sidewalks, and landscape improvements as required by the Town of Castle Rock.

This redevelopment will add approximately 6,534 square feet (0.15 acres) of new impervious area. The total impervious area will be approximately 1.68 acres (87.5%) and 0.24 acres (12.5%) of pervious area for the total drainage area. All post-development site runoffs will be contained within seven Drainage Management Areas (DMA): Post-A, Post-B, Post-C, Post-D, Post-E, Post-J, and Post-K (See Exhibit 6). Post-A through Post-D make up the bulk of the site, while Post-E includes an adjacent portion of the parking lot that will includes the addition of new sidewalks within the existing landscape islands for access from the site to Sam Walton Lane. Post-J and Post-K include additional parking areas proposed towards the southeast corner of the existing Walmart Supercenter site.

Stormwater runoff from Post-A enters the water quality and detention facilities via an existing inlet, Inlet 3, that has been analyzed for proposed site capacity using the MHFD-Inlet spreadsheet calculator. With the on-site and off-site contributing flows to existing Inlet 3, the

MHFD-Inlet spreadsheet shows that this inlet is over capacity when modeled as shown in the original Wal-Mart report, but the development causes a decrease in flow contributing to this inlet from pre- to post-development. Runoff from Post-B will flow overland to an existing off-site inlet to the north. Its impervious cover does not increase from pre- to post-development conditions, so the inlet will not be pushed beyond its originally designed capabilities. Runoff from Post-C and Post-D will enter the existing underground infrastructure via 2 proposed curb inlets on-site, Inlets 1 and 2, which have both been sized for capacity using the MHFD-Inlet spreadsheet calculator. Inlet 2 has been analyzed to also include off-site contributing flows and will have sufficient capacity to accept its on-site and off-site flows. Runoff from Post-E will maintain the existing drainage pattern of flowing overland to the south toward Sam Walton Lane. Runoff from Post-J and Post-K will flow to an existing grate inlet towards the SE corner of the existing WM supercenter site. All of these areas will continue to be directed to and treated in the existing stormwater water quality and detention facilities without causing an adverse impact to the existing system (See Exhibit 5).

Post-Development Runoff Summary				
Minor-Drainage Basin Name	PCM Type	Area (acres)	Q_5 (cfs)	Q_{100} (cfs)
Post-A	Existing Storwmwater Quality and Detention Facilities	1.07	4.00	8.05
Post-B		0.08	0.33	0.63
Post-C		0.06	0.25	0.47
Post-D		0.25	0.87	1.82
Post-E		0.24	0.93	1.83
Post-J		0.14	0.37	0.91
Post-K		0.08	0.17	0.48
Offsite "F"		0.36	1.47	2.82
Offsite "G"		1.26	5.19	9.92
Offsite "H"		0.18	0.74	1.42
Offsite "I"		0.12	0.47	0.93
Total		3.84	14.79	29.28

Development Runoff Comparison Summary (Includes Offsite)				
Major-Drain Basin Name	PCM Type	Area (acres)	Q_5 (cfs)	Q_{100} (cfs)

Pre-Total	Existing Storwmwater Quality and Detention Facilities	3.84	14.16	28.64
Post-Total		3.84	14.79	29.28
Difference			0.63	0.64

The proposed development is within the Walmart parking lot that was previously designed for the Major and Minor storms. The proposed fuel station, additional parking, and additional off-site site access improvements will increase the existing impervious area in within the proposed limits of disturbance by 7.9%. This will cause a negligible impact on the existing infrastructure and is within the design parameters of the existing treatment facilities. Therefore, the major and minor storm infrastructure existing on site are sufficient for the proposed development.

LID/Water Quality:

Because this site is classified as being a "Constrained Development" due to its being within the boundaries of an existing development that has appropriately designed water quality facilities, this site is exempt from providing any additional BMP's. Please refer to the "Final Drainage Study for Walmart Store No. 98401" by CLC Associates, Inc. (CLC Project #97.211), dated May 6, 1999 and "Metzler Ranch Pont Retrofit Project" by Kiowa Engineering Corporation (Project #19005), dated October 31, 2019 for additional design information on the existing facilities.

The proposed development is not required to implement additional LID (Low impact development) strategies.

Drainage Methodology:

This drainage report was prepared in accordance with the criteria established in the Town of Castle Rock Storm Drainage Design and Technical Criteria Manual (SDDTCM), as revised June 2019. The rational method was used as a hydrology analysis method within the UD-Rational spreadsheet. Inlet capacities were calculated for the Minor (5-year reoccurrence) and Major Storm Events (100-year reoccurrence) using the MHFD-Inlet spreadsheet. Hydrologic Soil group was determined from a report generated for the site from the NRCS. Rainfall depths were taken from the SDDTCM. A minimum time of concentration of 5 minutes was assumed for each subcatchment in the pre- and post-developed condition (See Exhibit 4). Hydraflow Storm Sewers was used to model the proposed pipes from the new inlets. Starting HGLs were assigned by calculating the difference between the HGL elevation and the corresponding structure inverts for the Major and Minor storm events shown in the original Wal-Mart Report and adding that difference to the surveyed inverts of the existing system at the point of connection (See Exhibit 5).

4-Step Process:

The Four-Step process is a method ensures a minimization of adverse impacts of urbanization relating to stormwater runoff. The Four-Step process pertains to management of smaller, more frequently occurring storms as opposed to larger storms for which the infrastructure is sized. This process is detailed in SDDTCM and is required to satisfy corresponding permits.

1. Reduce Runoff Volume to the Maximum Extent Practicable:

The proposed design of the site will add approximately 6,534 square feet of additional impervious area. This increase remains within the constraints of the existing stormwater facilities and previous drainage studies, so no additional runoff reduction measures are required/anticipated.

2. Provide Water Quality Capture Volume and Flood Control Detention Via Full-Spectrum Detention:

A total of seven (7) post-development drainage areas will be routed to separate design points, where the flows will be conveyed into and treated by the two existing regional and sub-regional water quality and detention facilities that have been designed to accept these site flows and treat them sufficiently per previous drainage studies.

3. Utilize Stream Channel Stabilization Techniques:

The parcel outfalls in accordance with the plan developed for the existing Super Walmart parcel compared to the initial development. The proposed stormwater conveyance system has been sized appropriately to convey the necessary runoff volume from a 100-year storm event abiding by the major storm requirements set forth in SDDTCM before tying into existing stormwater system.

4. Undertake Source Control:

Implementation of BMP's (Best Management Practices) will be required during the construction operations, and spill prevention and control measures shall be followed to mitigate any potential for fuels and oils to make there way into the downstream storm drain system.

Conclusion:

The proposed development of the Wal-Mart Fuel Station #984-543 in the Wal-Mart Shopping Center parking lot at 133 Sam Walton Lane meets the general provisions of the Town of Castle Rock or general engineering practices with regard to the management of stormwater runoff and water quality. This report has been prepared in general accordance with the current requirements of the applicable storm water jurisdictions and approving agencies. In addition, storm events/frequencies, runoff calculations, discharge criteria, evaluation methods (including computer software applications), etc., have been based on the guidelines/requirements of these permitting entities and reflect the application of generally accepted standard of engineering practice. Redevelopment will not cause adverse impact to downstream developments. This design is based on, and limited by, the weather data, the analysis and their applicability as presented herein.

References:

Town of Castle Rock – Storm Drainage Design and Technical Criteria Manual (SDDTCM), published June 2019.

Urban Drainage and Flood Control District (UDFCD) – Urban Storm Drainage Criteria Manual, Volume 1, Updated January 2016.

Mile High Flood District – Peak Runoff Prediction by the Rational Method – UD-Rational 2.00, published May 2017.

Mile High Flood District – Street Capacity and Inlet Sizing – MHFD-Inlet v5.02, published September 2022.

Hydraflow Storm Sewers Extension for Autodesk Civil 3D

"Final Drainage Study for Wal-Mart Store No. 98401", prepared by CLC Associates, Inc. (Project #97.211), dated May 6, 1999.

"Metzler Ranch Pond Retrofit Project", prepared by Kiowa Engineering Corporation (Project #19005), dated October 31, 2019.

"Geotechnical Engineering Report – Walmart Fuel Station – Store #984", prepared by ECS Southwest, LLP (Project #19:8744), dated August 30, 2022.

Custom Soil Resource Report for – Castle Rock Area, Colorado, product of the National Cooperative Soil Survey, generated September 29, 2023.

National Flood Hazard Layer FIRMette, Map No. 08035C0188G, effective March 16, 2016.

EXHIBIT 1

Vicinity Map

Vicinity Map

133 Sam Walton Lane, Castle Rock, Colorado 80104

Legend

Castle Rock, CO - Wal-Mart Refuel

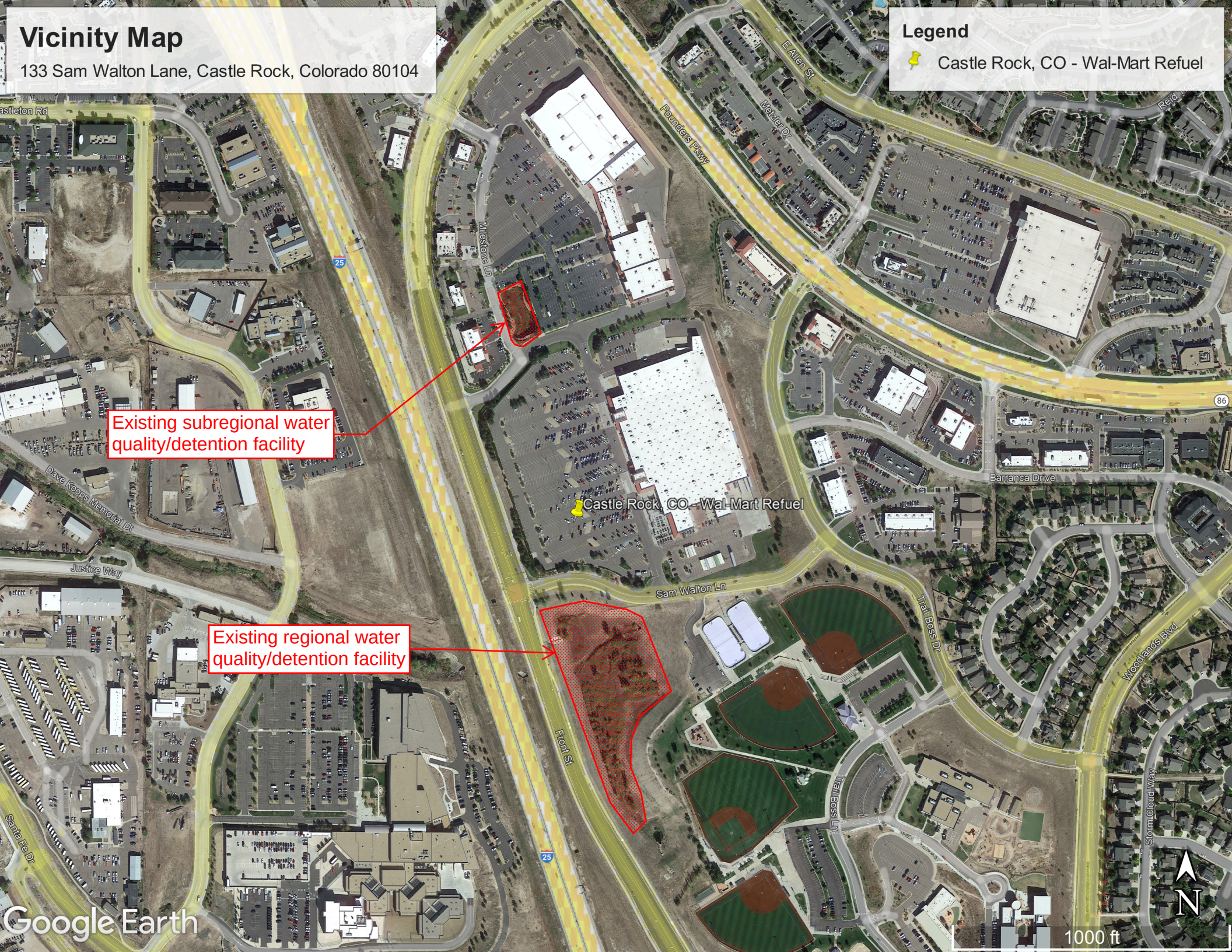


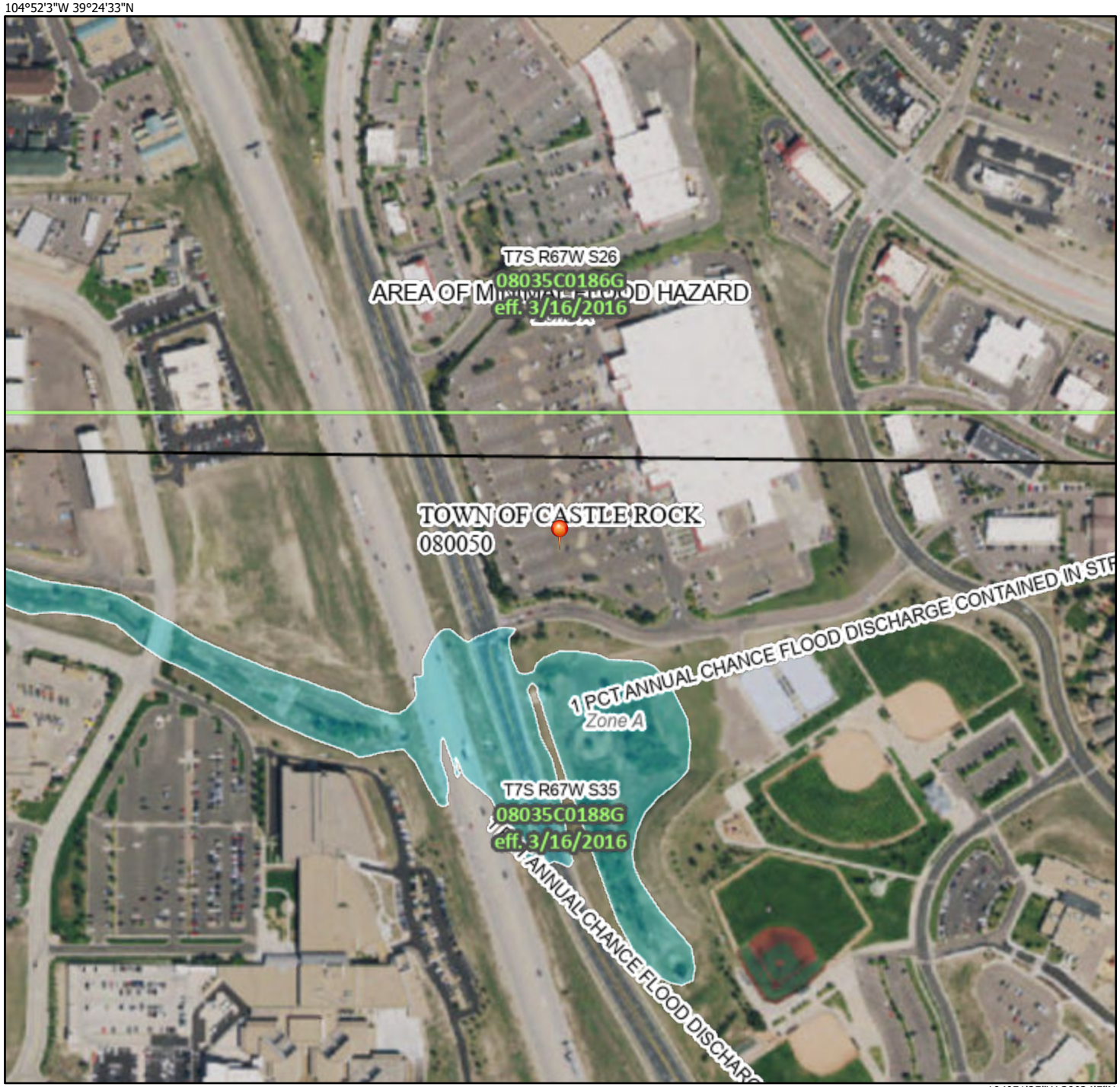
EXHIBIT 2

FIRM Map

National Flood Hazard Layer FIRMette

FEMA

104°52'3"W 39°24'33"N



104°51'25"W 39°24'5"N

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

1:6,000

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 Cross Sections with 1% Annual Chance
- 17.5 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 9/29/2023 at 10:48 AM 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.

EXHIBIT 3

NRCS Soils Report

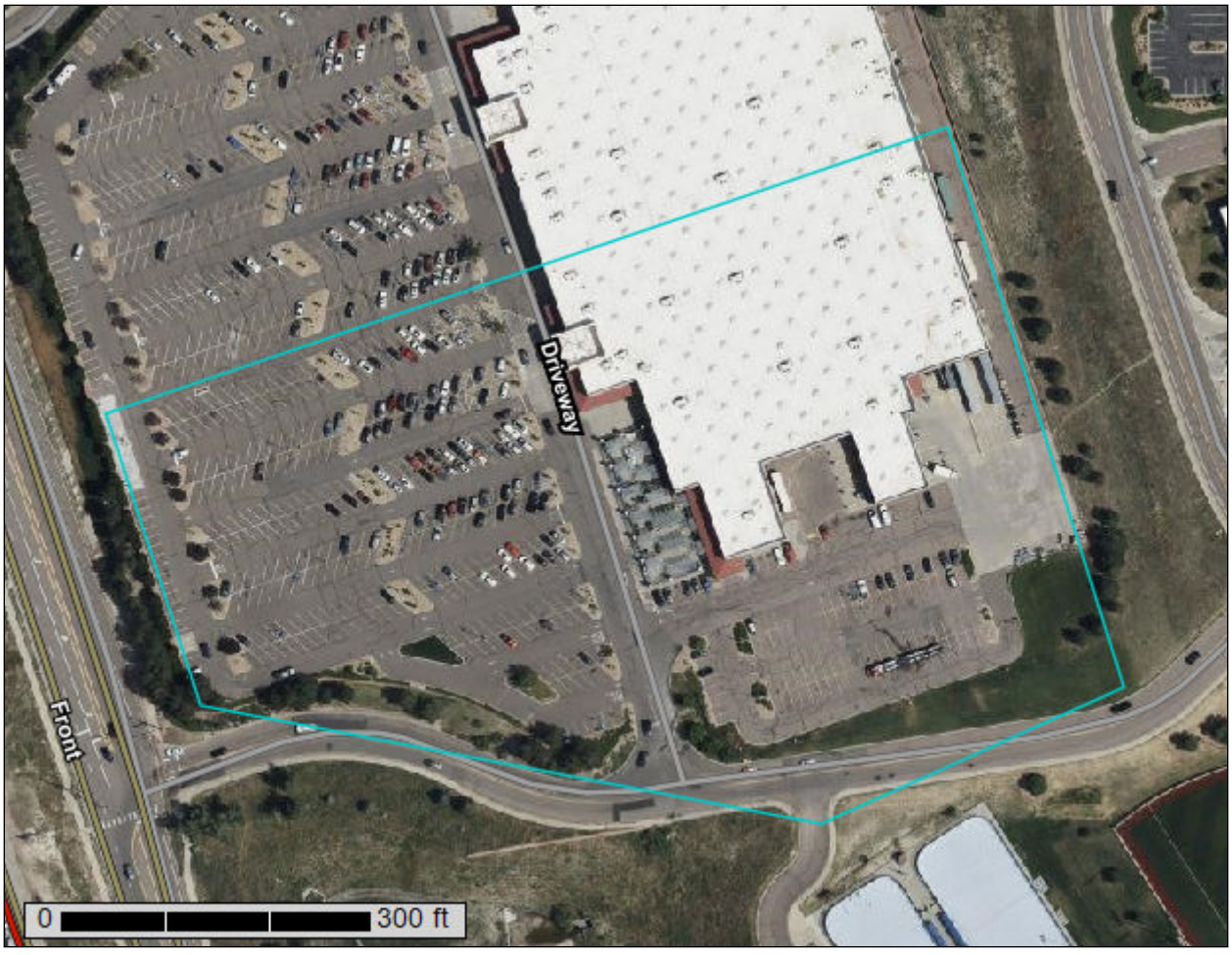
United States Department of Agriculture

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



February 9, 2024

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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KtE—Kutch sandy loam, 5 to 20 percent slopes.....14
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How Soil Surveys Are Made

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

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

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

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

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

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

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

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

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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Custom Soil Resource Report
Soil Map



Map Scale: 1:1,730 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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 16, Aug 24, 2023

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	3.4	34.7%
KtE	Kutch sandy loam, 5 to 20 percent slopes	6.4	65.3%
Totals for Area of Interest		**9.8**	**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: 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 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 14-19 PZ
Hydric soil rating: No

KtE—Kutch sandy loam, 5 to 20 percent slopes

Map Unit Setting

National map unit symbol: jqz5
Elevation: 5,500 to 6,800 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 120 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Kutch

Setting

Landform: Valley sides, alluvial fans, drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous fine-loamy clayey shale

Typical profile

H1 - 0 to 6 inches: sandy loam
H2 - 6 to 32 inches: clay
H3 - 32 to 36 inches: weathered bedrock

Properties and qualities

Slope: 5 to 20 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Bresser

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

Newlin

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

Aquic haplustolls

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

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EXHIBIT 4

Hydrologic Computations

Calculation of Peak Runoff using Rational Method

Designer: Eric Lawrence, P.E.
Company: CEI Engineering Associates, Inc.
Date: 2/9/2024
Project: Wal-Mart Fuel Station #984
Location: 133 Sam Walton Lane, Castle Rock, CO

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

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

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

Computed $t_c = t_i + t_t$

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

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

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) =	1.06	1.43	1.66		2.26	2.60	

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
Pre-A	1.22	D	89.6	0.74	0.77	0.79	0.82	0.84	0.85	0.87															5.00	3.60	4.85	5.63		7.67	8.82		3.23	4.53	5.43		7.81	9.15	
Pre-B	0.19	D	92.1	0.76	0.79	0.81	0.83	0.85	0.86	0.88															5.00	3.60	4.85	5.63		7.67	8.82		0.52	0.72	0.87		1.24	1.44	
Pre-E	0.29	B	85.4	0.69	0.72	0.75	0.79	0.80	0.82	0.85															5.00	3.60	4.85	5.63		7.67	8.82		0.72	1.02	1.22		1.79	2.11	
Pre-J	0.14	B	5.5	0.03	0.04	0.10	0.28	0.36	0.45	0.56															5.00	3.60	4.85	5.63		7.67	8.82		0.01	0.02	0.08		0.38	0.56	
Pre-K	0.08	B	6.5	0.03	0.04	0.11	0.29	0.36	0.46	0.56															5.00	3.60	4.85	5.63		7.67	8.82		0.01	0.02	0.05		0.22	0.32	
Post-A	1.07	D	90.3	0.74	0.77	0.80	0.82	0.84	0.85	0.87															5.00	3.60	4.85	5.63		7.67	8.82		2.86	4.00	4.79		6.88	8.05	
Post-B	0.08	D	100.0	0.83	0.85	0.87	0.88	0.89	0.89	0.90															5.00	3.60	4.85	5.63		7.67	8.82		0.24	0.33	0.39		0.54	0.63	
Post-C (To Inlet 1)	0.06	D	100.0	0.83	0.85	0.87	0.88	0.89	0.89	0.90															5.00	3.60	4.85	5.63		7.67	8.82		0.18	0.25	0.29		0.41	0.47	
Post-D	0.25	D	83.5	0.68	0.72	0.75	0.79	0.81	0.83	0.85															5.00	3.60	4.85	5.63		7.67	8.82		0.61	0.87	1.05		1.54	1.82	
Post-E	0.24	B	94.2	0.78	0.80	0.82	0.84	0.85	0.86	0.88															5.00	3.60	4.85	5.63		7.67	8.82		0.67	0.93	1.10		1.57	1.83	
Post-J	0.14	B	66.4	0.52	0.55	0.59	0.67	0.70	0.73	0.78															5.00	3.60	4.85	5.63		7.67	8.82		0.26	0.37	0.47		0.75	0.91	
Post-K	0.08	B	54.1	0.41	0.44	0.49	0.59	0.63	0.68	0.73															5.00	3.60	4.85	5.63		7.67	8.82		0.12	0.17	0.22		0.39	0.48	
Off-Site "F"	0.36	D	98.8	0.82	0.84	0.86	0.87	0.88	0.89	0.90															5.00	3.60	4.85	5.63		7.67	8.82		1.06	1.47	1.74		2.43	2.82	
Post-D + Off-Site "F" (To Inlet 2)	0.61	D	92.5	0.76	0.79	0.81	0.84	0.85	0.86	0.88															5.00	3.60	4.85	5.63		7.67	8.82		1.68	2.33	2.79		3.98	4.64	
Off-Site "G"	1.26	D	100.0	0.83	0.85	0.87	0.88	0.89	0.89	0.90															5.00	3.60	4.85	5.63		7.67	8.82		3.78	5.19	6.15		8.57	9.92	
Off-Site "I"	0.12	D	95.8	0.79	0.82	0.84	0.86	0.87	0.88	0.89															5.00	3.60	4.85	5.63		7.67	8.82		0.34	0.47	0.56		0.80	0.93	
Post-A + Off-Site "G" + Off-site "I" (To Inlet 3)	2.45	D	95.6	0.79	0.81	0.83	0.85	0.87	0.87	0.89															5.00	3.60	4.85	5.63		7.67	8.82		6.98	9.67	11.51		16.25	18.90	
Off-Site "H"	0.18	B	96.9	0.80	0.83	0.84	0.86	0.87	0.88	0.89															5.00	3.60	4.85	5.63		7.67	8.82		0.52	0.72	0.85		1.20	1.39	
Post-E + Off-Site "H" (To Sam Walton Lane)	0.42	B	95.4	0.79	0.81	0.83	0.85	0.86	0.87	0.89															5.00	3.60	4.85	5.63		7.67	8.82		1.19	1.66	1.95		2.77	3.22	

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Inlet 1	Inlet 2	Inlet 3
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT/Denver 13 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.3	2.3	9.7
Major Q_{Known} (cfs)	0.5	4.6	18.9

Bypass (Carry-Over) Flow from Upstream Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.3**	**2.3**	**9.7**
Major Total Design Peak Flow, Q (cfs)	**0.5**	**4.6**	**18.9**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A

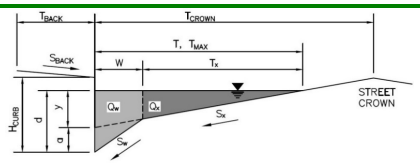
MHFD-Inlet, Version 5.02 (August 2022)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Wal-Mart Fuel Station #984 - 133 Sam Walton Lane, Castle Rock, CO**

Inlet ID: **Inlet 1**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.330	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	28.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.024	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

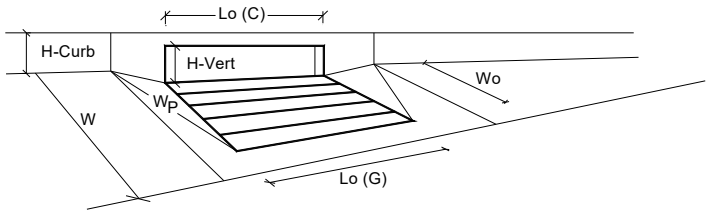
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.0	5.0	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	4.00	4.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.34	0.34	ft
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**3.6**	**3.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)		$Q_{PEAK\ REQUIRED}$ =	0.3	0.5	cfs

Warning 1

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

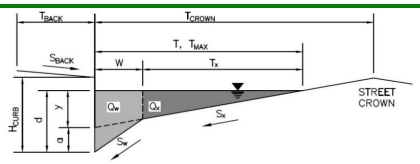
MHFD-Inlet, Version 5.02 (August 2022)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Wal-Mart Fuel Station #984 - 133 Sam Walton Lane, Castle Rock, CO**

Inlet ID: **Inlet 2**



Gutter Geometry:

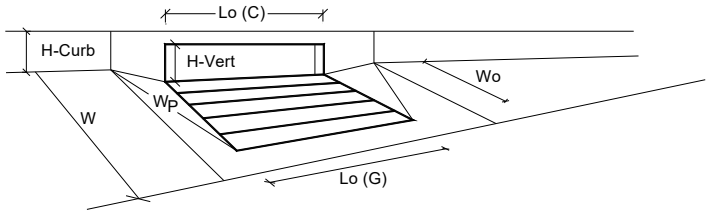
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	30.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.091	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	40.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.018	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	40.0	40.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)			MINOR	MAJOR		
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches	
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1		
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.0	inches	
Grate Information			MINOR	MAJOR		Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet	
Width of a Unit Grate		W_o =	N/A	N/A	feet	
Open Area Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A		
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A		
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A		
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A		
Curb Opening Information			MINOR	MAJOR		
Warning 1 Length of a Unit Curb Opening		L_o (C) =	4.00	4.00	feet	
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches	
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches	
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees	
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	1.00	1.00	feet	
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10		
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60		
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67		
Low Head Performance Reduction (Calculated)			MINOR	MAJOR		
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft	
Depth for Curb Opening Weir Equation		d_{Curb} =	0.42	0.42	ft	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A		
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00		
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	N/A	N/A		
			MINOR	MAJOR		
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**4.9**	**4.9**	**cfs**	
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)		$Q_{PEAK\ REQUIRED}$ =	2.3	4.6	cfs	

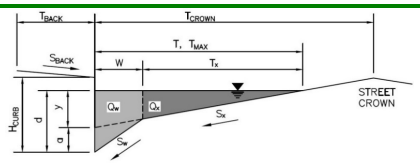
Warning 1: Dimension entered is not a typical dimension for inlet type specified.

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Wal-Mart Fuel Station #984 - 133 Sam Walton Lane, Castle Rock, CO**

Inlet ID: **Inlet 3**



Gutter Geometry:

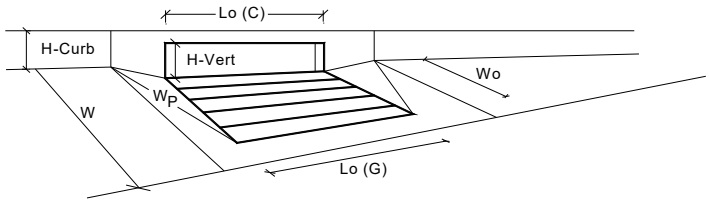
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.000	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.73	ft
Street Transverse Slope	S_X =	0.033	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches

Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	

Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	1.73	1.73	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	

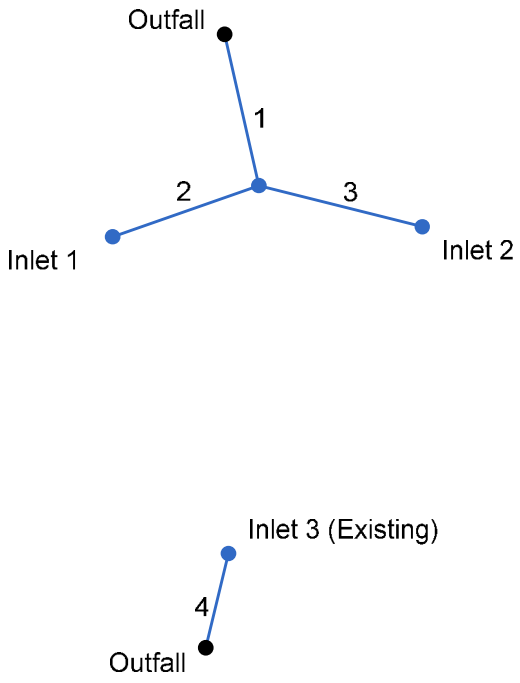
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.51	0.51	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.36	0.36	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.71	0.71	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.71	0.71	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**6.7**	**6.7**	**cfs**
WARNING: Inlet Capacity < Q Peak for Minor and Major Storms	$Q_{PEAK\ REQUIRED}$ =	9.7	18.9	cfs

EXHIBIT 5

Storm Sewer Hydraulics Profiles

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Castle Rock - Storm Sewers.stm	Number of lines: 4	Date: 10/2/2023

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	56.000	78.817	MH	0.00	0.00	0.00	0.0	6203.93	0.46	6204.19	24	Cir	0.013	0.99	6209.96	
2	1	50.000	79.355	Curb	0.25	0.00	0.00	0.0	6204.19	2.78	6205.58	18	Cir	0.013	1.00	6210.08	Post-C
3	1	54.000	-62.761	Curb	2.33	0.00	0.00	0.0	6204.19	0.48	6204.45	18	Cir	0.013	1.00	6208.92	Post-D + Offsite
4	End	35.000	-78.149	Comb	9.67	0.00	0.00	0.0	6176.32	29.43	6186.62	30	Cir	0.013	1.00	6205.77	Post-A + Offsite

Project File: Castle Rock - Minor Storm Event.stm

Number of lines: 4

Date: 10/5/2023

Structure Report

Struct No.	Structure ID	Junction Type	Rim Elev (ft)	Structure			Line Out			Line In		
				Shape	Length (ft)	Width (ft)	Size (in)	Shape	Invert (ft)	Size (in)	Shape	Invert (ft)
1		Manhole	6209.96	Cir	4.00	4.00	24	Cir	6204.19	18 18	Cir Cir	6204.19 6204.19
2	Inlet 1	Curb-Horiz	6210.08	Cir	4.00	4.00	18	Cir	6205.58			
3	Inlet 2	Curb-Horiz	6208.92	Cir	4.00	4.00	18	Cir	6204.45			
4	Inlet 3 (Existing)	Combination	6205.77	Cir	4.00	4.00	30	Cir	6186.62			

Project File: Castle Rock - Minor Storm Event.stm | Number of Structures: 4 | Run Date: 10/5/2023

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1		2.58	24	Cir	56.000	6203.93	6204.19	0.464	6204.87	6204.75	0.20	6204.75	End	Manhole
2	Post-C	0.25	18	Cir	50.000	6204.19	6205.58	2.780	6204.75	6205.76	n/a	6205.76 j	1	Curb-Horiz
3	Post-D + Offsite	2.33	18	Cir	54.000	6204.19	6204.45	0.482	6204.77	6205.04	0.21	6205.24	1	Curb-Horiz
4	Post-A + Offsite	9.67	30	Cir	35.000	6176.32	6186.62	29.429	6178.78	6187.66	n/a	6187.66 j	End	Combination

Project File: Castle Rock - Minor Storm Event.stm | Number of lines: 4 | Run Date: 10/5/2023

NOTES: Known Qs only ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	56.000	0.00	0.00	0.00	0.00	0.00	0.0	5.9	0.0	2.58	15.40	2.68	24	0.46	6203.93	6204.19	6204.87	6204.75	6208.43	6209.96	
2	1	50.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.25	17.51	1.22	18	2.78	6204.19	6205.58	6204.75	6205.76	6209.96	6210.08	Post-C
3	1	54.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.33	7.29	3.66	18	0.48	6204.19	6204.45	6204.77	6205.04	6209.96	6208.92	Post-D + Offsite
4	End	35.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	9.67	222.5	3.50	30	29.43	6176.32	6186.62	6178.78	6187.66	6180.22	6205.77	Post-A + Offsite

Project File: Castle Rock - Minor Storm Event.stm

Number of lines: 4

Run Date: 10/5/2023

NOTES:Known Qs only ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1		0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.00	0.00	0.00	0.00	0.0	Off
2	Inlet 1	0.25*	0.00	0.25	0.00	Curb	4.0	4.00	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.12	2.94	0.12	2.94	0.0	1
3	Inlet 2	2.33*	0.00	2.33	0.00	Curb	4.0	4.00	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.32	13.04	0.32	13.04	0.0	1
4	Inlet 3 (Existing)	9.67*	0.00	9.67	0.00	Comb	4.0	4.00	2.00	2.00	2.00	Sag	2.00	0.050	0.020	0.013	0.58	26.23	0.58	26.23	0.0	Off

Project File: Castle Rock - Minor Storm Event.stm | Number of lines: 4 | Run Date: 10/5/2023

NOTES: Inlet N-Values = 0.016; Known Qs only; * Indicates Known Q added. All curb inlets are Horiz throat.

MyReport

Line No.	Area Dn (sqft)	Area Up (sqft)	Byp Ln No	Coeff C1 (C)	Coeff C2 (C)	Coeff C3 (C)	Capac Full (cfs)	Crit Depth (ft)	Cross Sl, Sw (ft/ft)	Cross Sl, Sx (ft/ft)	Curb Len (ft)	Defl Ang (Deg)	Depth Dn (ft)	Depth Up (ft)	DnStm Ln No	Drng Area (ac)	Easting X (ft)	EGL Dn (ft)	EGL Up (ft)	Energy Loss (ft)
1	0.72	0.72	n/a	0.20	0.50	0.90	15.40	0.56	....	....	....	78.817	0.94	0.56**	Outfall	0.00	282.51	6205.07	6204.95	0.000
2	0.12	0.12	1	0.20	0.50	0.90	17.51	0.18	0.050	0.020	4.00	79.355	0.56	0.18**	1	0.00	236.09	6204.81	6205.83	0.000
3	0.63	0.64	1	0.20	0.50	0.90	7.29	0.58	0.050	0.020	4.00	-62.761	0.58	0.58**	1	0.00	334.40	6204.98	6205.24	0.259
4	1.93	1.93	Sag	0.20	0.50	0.90	222.48	1.04	0.050	0.020	4.00	-78.149	2.46	1.04**	Outfall	0.00	272.86	6179.17	6188.05	0.000

Project File: Castle Rock - Minor Storm Event.stm | Number of lines: 4 | Date: 10/5/2023

NOTES: ** Critical depth

MyReport

Flow Rate (cfs)	Sf Ave (ft/ft)	Sf Dn (ft/ft)	Grate Area (sqft)	Grate Len (ft)	Grate Width (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Gutter Depth (ft)	Gutter Slope (ft/ft)	Gutter Spread (ft)	Gutter Width (ft)	HGL Dn (ft)	HGL Up (ft)	HGL Jnct (ft)	HGL Jmp Dn (ft)	HGL Jmp Up (ft)	Incr CxA	Incr Q (cfs)	Inlet Depth (ft)	Inlet Eff (%)
2.58	0.000	0.000	....	....	....	6208.43	6209.96	....	....	....	....	6204.87	6204.75	6204.75	....	....	0.00	0.00	....	....
0.25	0.000	0.000	....	....	....	6209.96	6210.08	0.12	Sag	2.94	2.00	6204.75	6205.76 j	6205.76	6204.73	6204.63	0.00	0.25	0.12	100
2.33	0.480	0.482	....	....	....	6209.96	6208.92	0.32	Sag	13.04	2.00	6204.77	6205.04	6205.24	....	....	0.00	2.33	0.32	100
9.67	0.000	0.000	2.00	2.00	2.00	6180.22	6205.77	0.58	Sag	26.23	2.00	6178.78	6187.66 j	6187.66	6179.42	6180.42	0.00	9.67	0.58	100

Project File: Castle Rock - Minor Storm Event.stm | Number of lines: 4 | Date: 10/5/2023

NOTES: ** Critical depth

MyReport

Inlet ID	Inlet Loc	(ft)	Inlet Time (min)	i Sys (in/hr)	i Inlet (in/hr)	Invert Dn (ft)	Invert Up (ft)	Jump Loc (ft)	Jump Len (ft)	Vel Hd Jmp Dn (ft)	Vel Hd Jmp Up (ft)	J-Loss Coeff	Junct Type	Known Q (cfs)	Cost RCP	Cost CMP	Cost PVC	
	Sag		0.0	0.00	0.00	6203.93	6204.19	....	....	0.00	0.00	0.99 z	MH	0.00	2,584	2,326	2,196	
Inlet 1	Sag		0.0	0.00	0.00	6204.19	6205.58	10.00	1.33	0.02	0.20	1.00 z	Curb	0.25	2,120	1,908	1,802	
Inlet 2	Sag		0.0	0.00	0.00	6204.19	6204.45	....	....	0.00	0.00	1.00	Curb	2.33	2,280	2,052	1,938	
Inlet 3 (Existing)	Sag		0.0	0.00	0.00	6176.32	6186.62	7.00	5.19	0.39	2.77	1.00 z	Comb.	9.67	2,745	2,470	2,333	

Project File: Castle Rock - Minor Storm Event.stm | Number of lines: 4 | Date: 10/5/2023

NOTES: Known Qs only. ; ** Critical depth

MyReport

Line ID	Line Length (ft)	Line Size (in)	Line Slope (%)	Line Type	Local Depr (in)	n-val Gutter	n-val Pipe	Minor Loss (ft)	Northing Y (ft)	Pipe Travel (min)	Q Byp (cfs)	Q Capt (cfs)	Q Carry (cfs)	Line Rise (in)	Runoff Coeff (C)	Line Span (in)	Area A1 (ac)	Area A2 (ac)	Area A3 (ac)	Tc (min)	
	56.000	24	0.46	Cir	....	....	0.013	0.20	178.73	1.14	....	....	....	24	0.00	24	0.00	0.00	0.00	5.9	
Post-C	50.000	18	2.78	Cir	0.0	....	0.013	n/a	160.13	5.89	0.00	0.25	0.00	18	0.00	18	0.00	0.00	0.00	0.0	
Post-D + Offsite	54.000	18	0.48	Cir	0.0	....	0.013	0.21	163.79	0.68	0.00	2.33	0.00	18	0.00	18	0.00	0.00	0.00	0.0	
Post-A + Offsite	35.000	30	29.43	Cir	0.0	....	0.013	n/a	45.10	0.30	0.00	9.67	0.00	30	0.00	30	0.00	0.00	0.00	0.0	

Project File: Castle Rock - Minor Storm Event.stm | Number of lines: 4 | Date: 10/5/2023

NOTES: ** Critical depth

MyReport

Throat Ht (in)	Total Area (ac)	Total CxA	Total Runoff (cfs)	Vel Ave (ft/s)	Vel Dn (ft/s)	Vel Hd Dn (ft)	Vel Hd Up (ft)	Vel Up (ft/s)	Cover Dn (ft)	Cover Up (ft)	Storage (cft)	
....	0.00	0.00	0.00	2.68	1.78	0.20	0.20	3.59	2.50	3.77	60.38	
4.0	0.00	0.00	0.00	1.22	0.42	0.06	0.06	2.01	4.27	3.00	17.43	
4.0	0.00	0.00	0.00	3.66	3.67	0.21	0.21	3.66	4.27	2.97	34.34	
4.0	0.00	0.00	0.00	3.50	1.98	0.39	0.39	5.02	1.40	16.65	125.35	

Project File: Castle Rock - Minor Storm Event.stm | Number of lines: 4 | Date: 10/5/2023

NOTES: ** Critical depth

Storm Sewer Inlet Time Tabulation

Line No.	Line ID	Tc Method	Sheet Flow					Shallow Concentrated Flow					Channel Flow							Total Travel Time (min)
			n-Value	flow Length (ft)	2-yr 24h P (in)	Land Slope (%)	Travel Time (min)	flow Length (ft)	Water Slope (%)	Surf Descr	Ave Vel (ft/s)	Travel Time (min)	X-sec Area (sqft)	Wetted Perim (ft)	Chan Slope (%)	n-Value	Vel	flow Length (ft)	Travel Time (min)	
1		User																		0.00
2	Post-C	User																		0.00
3	Post-D + Offsite	User																		0.00
4	Post-A + Offsite	User																		0.00

Project File: Castle Rock - Minor Storm Event.stm | Min. Tc used for intensity calculations = 5 min | Number of lines: 4 | Date: 10/5/2023

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)		
(1)	(in) (2)	(cfs) (3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(ft) (12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(K) (23)	(ft) (24)
1	24	2.58	6203.93	6204.87	0.94	0.72	1.78	0.20	6205.07	0.000	56.000	6204.19	6204.75	0.56**	0.72	3.59	0.20	6204.95	0.000	0.000	n/a	0.99	0.20
2	18	0.25	6204.19	6204.75	0.56	0.12	0.42	0.06	6204.81	0.000	50.000	6205.58	6205.76 j	0.18**	0.12	2.01	0.06	6205.83	0.000	0.000	n/a	1.00	0.06
3	18	2.33	6204.19	6204.77	0.58*	0.63	3.67	0.21	6204.98	0.482	54.000	6204.45	6205.04	0.58**	0.64	3.66	0.21	6205.24	0.478	0.480	0.259	1.00	0.21
4	30	9.67	6176.32	6178.78	2.46	1.93	1.98	0.39	6179.17	0.000	35.000	6186.62	6187.66 j	1.04**	1.93	5.02	0.39	6188.05	0.000	0.000	n/a	1.00	0.39

Project File: Castle Rock - Minor Storm Event.stm | Number of lines: 4 | Run Date: 10/5/2023

Notes: * Normal depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraflow HGL Computation Procedure

General Procedure:

Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles.

Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.

Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.

Col. 3 Total flow rate in the line.

Col. 4 The elevation of the downstream invert.

Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.

Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).

Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

Col. 12 The line length.

Col. 13 The elevation of the upstream invert.

Col. 14 Elevation of the hydraulic grade line at the upstream end.

Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 16 Cross-sectional area of the flow at the upstream end.

Col. 17 The velocity of the flow at the upstream end, (Col. 3 / Col. 16).

Col. 18 Velocity head (Velocity squared / 2g).

Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18) .

Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).

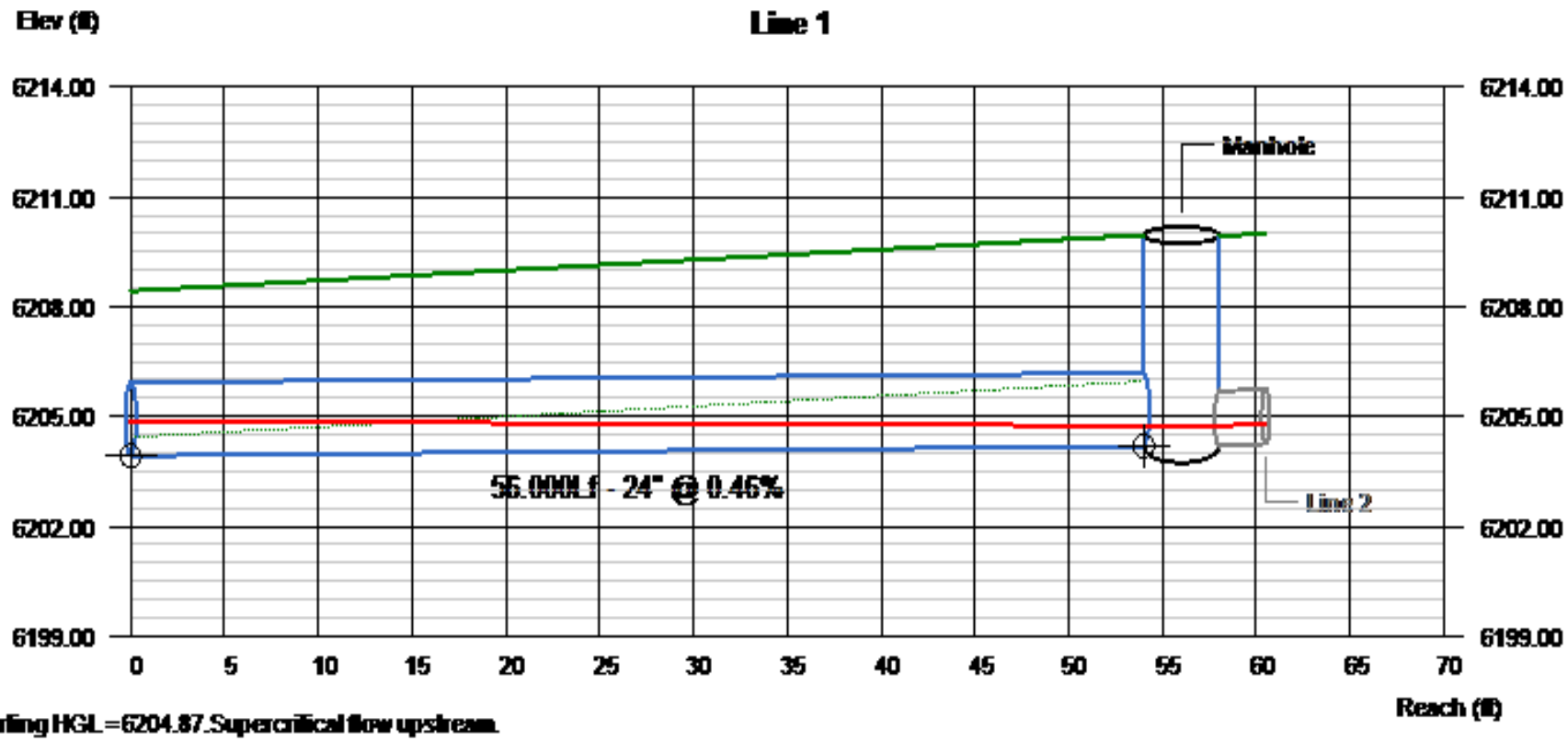
Col. 21 The average of the downstream and upstream friction slopes.

Col. 22 Energy loss. Average Sf/100 x Line Length (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.

Col. 23 The junction loss coefficient (K).

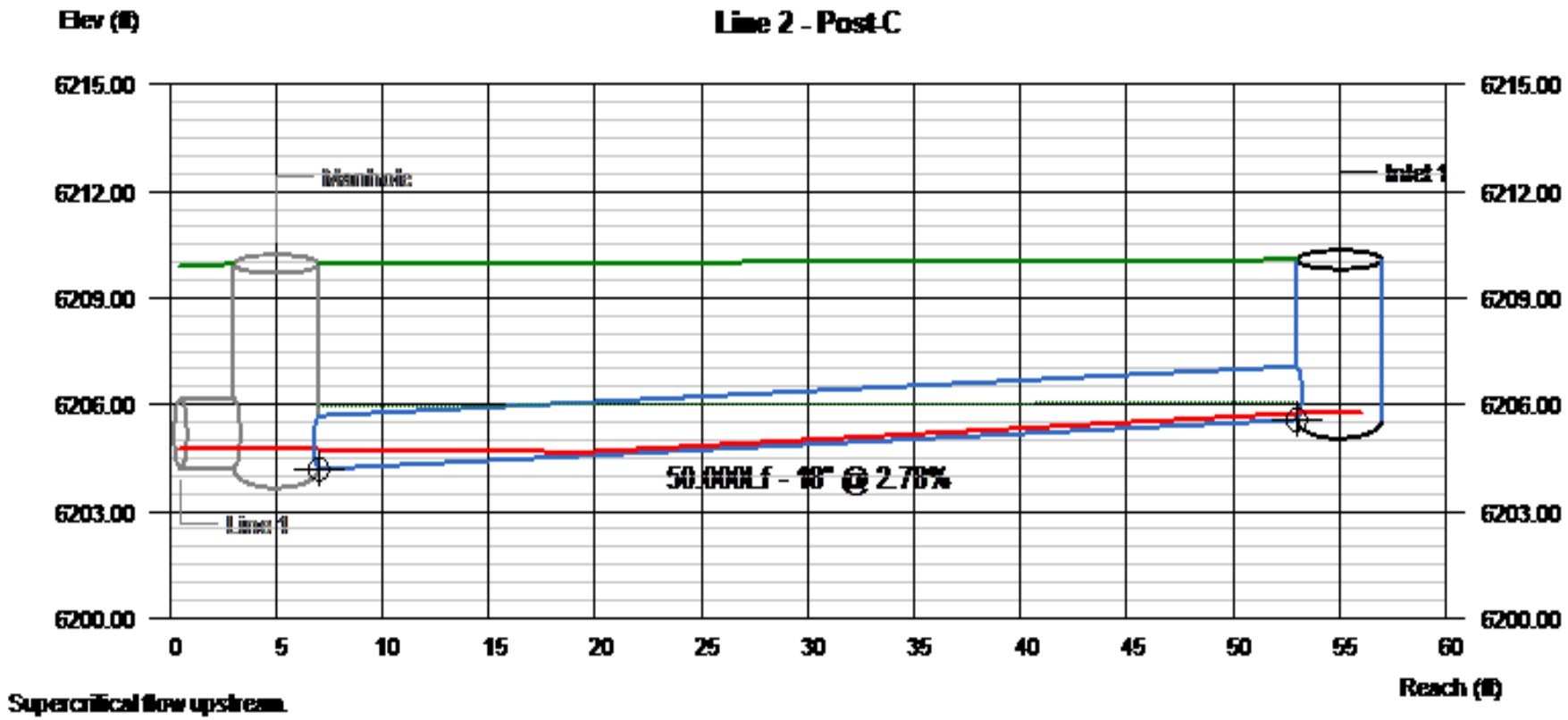
Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

MINOR STORM EVENT (5-YEAR EVENT)

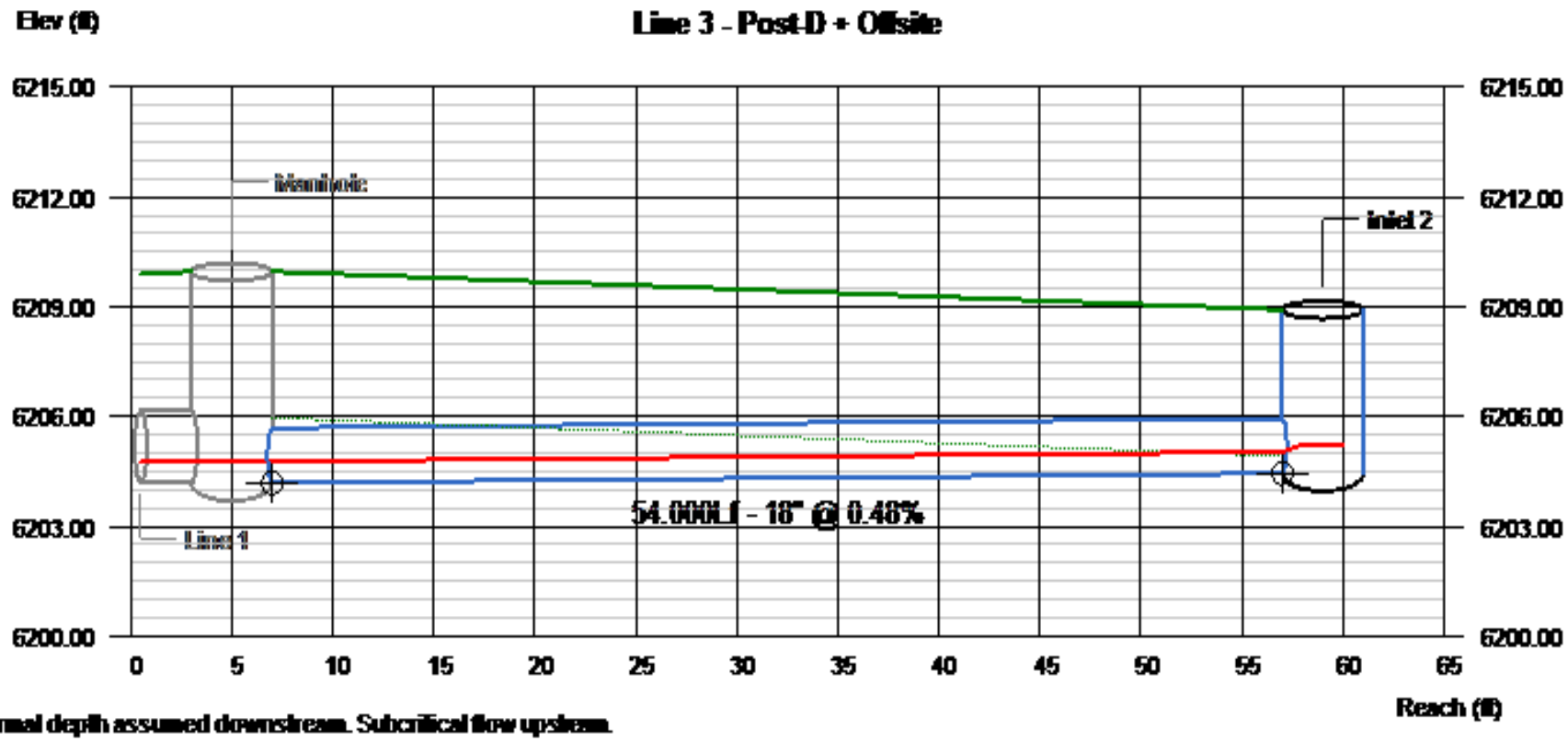


Starting HGL = 6204.87 Supercritical flow upstream.

MINOR STORM EVENT (5-YEAR EVENT)

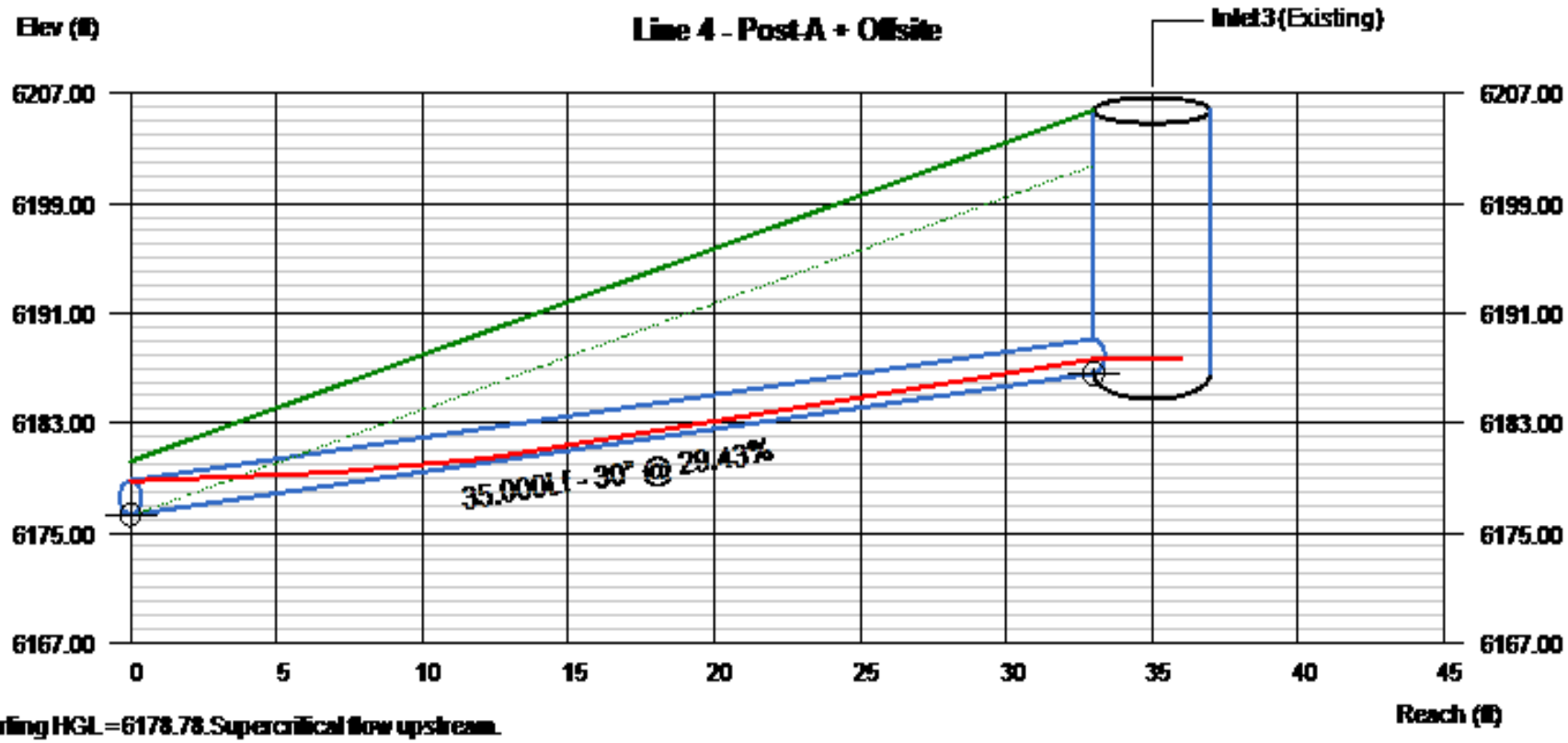


MINOR STORM EVENT (5-YEAR EVENT)



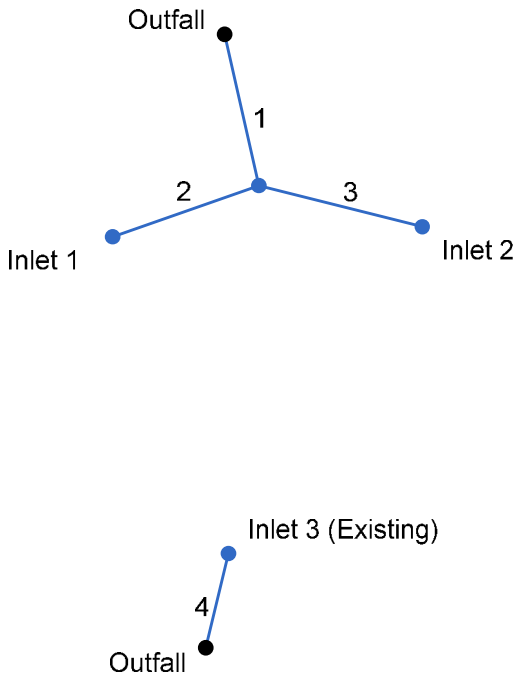
Normal depth assumed downstream. Subcritical flow upstream.

MINOR STORM EVENT (5-YEAR EVENT)



Starting HGL = 6178.78. Supercritical flow upstream.

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Castle Rock - Storm Sewers.stm	Number of lines: 4	Date: 10/2/2023

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	56.000	78.817	MH	0.00	0.00	0.00	0.0	6203.93	0.46	6204.19	24	Cir	0.013	0.99	6209.96	
2	1	50.000	79.355	Curb	0.47	0.00	0.00	0.0	6204.19	2.78	6205.58	18	Cir	0.013	1.00	6210.08	Post-C
3	1	54.000	-62.761	Curb	4.64	0.00	0.00	0.0	6204.19	0.48	6204.45	18	Cir	0.013	1.00	6208.92	Post-D + Offsite
4	End	35.000	-78.149	Comb	18.90	0.00	0.00	0.0	6176.32	29.43	6186.62	30	Cir	0.013	1.00	6205.77	Post-A + Offsite

Project File: Castle Rock - Major Storm Event.stm

Number of lines: 4

Date: 10/5/2023

Structure Report

Struct No.	Structure ID	Junction Type	Rim Elev (ft)	Structure			Line Out			Line In		
				Shape	Length (ft)	Width (ft)	Size (in)	Shape	Invert (ft)	Size (in)	Shape	Invert (ft)
1		Manhole	6209.96	Cir	4.00	4.00	24	Cir	6204.19	18 18	Cir Cir	6204.19 6204.19
2	Inlet 1	Curb-Horiz	6210.08	Cir	4.00	4.00	18	Cir	6205.58			
3	Inlet 2	Curb-Horiz	6208.92	Cir	4.00	4.00	18	Cir	6204.45			
4	Inlet 3 (Existing)	Combination	6205.77	Cir	4.00	4.00	30	Cir	6186.62			

Project File: Castle Rock - Major Storm Event.stm | Number of Structures: 4 | Run Date: 10/5/2023

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1		5.11	24	Cir	56.000	6203.93	6204.19	0.464	6207.03*	6207.06*	0.04	6207.10	End	Manhole
2	Post-C	0.47	18	Cir	50.000	6204.19	6205.58	2.780	6207.10*	6207.10*	0.00	6207.10	1	Curb-Horiz
3	Post-D + Offsite	4.64	18	Cir	54.000	6204.19	6204.45	0.482	6207.10*	6207.21*	0.11	6207.31	1	Curb-Horiz
4	Post-A + Offsite	18.90	30	Cir	35.000	6176.32	6186.62	29.429	6181.32	6188.09	n/a	6188.09 j	End	Combination

Project File: Castle Rock - Major Storm Event.stm | Number of lines: 4 | Run Date: 10/5/2023

NOTES: Known Qs only ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	56.000	0.00	0.00	0.00	0.00	0.00	0.0	3.1	0.0	5.11	15.40	1.63	24	0.46	6203.93	6204.19	6207.03	6207.06	6208.43	6209.96	
2	1	50.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.47	17.51	0.27	18	2.78	6204.19	6205.58	6207.10	6207.10	6209.96	6210.08	Post-C
3	1	54.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	4.64	7.29	2.63	18	0.48	6204.19	6204.45	6207.10	6207.21	6209.96	6208.92	Post-D + Offsite
4	End	35.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	18.90	222.5	5.07	30	29.43	6176.32	6186.62	6181.32	6188.09	6180.22	6205.77	Post-A + Offsite

Project File: Castle Rock - Major Storm Event.stm

Number of lines: 4

Run Date: 10/5/2023

NOTES:Known Qs only ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1		0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.00	0.00	0.00	0.00	0.0	Off
2	Inlet 1	0.47*	0.00	0.47	0.00	Curb	4.0	4.00	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.15	4.48	0.15	4.48	0.0	1
3	Inlet 2	4.64*	0.00	4.64	0.00	Curb	4.0	4.00	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.50	21.89	0.50	21.89	0.0	1
4	Inlet 3 (Existing)	18.90*	0.00	18.90	0.00	Comb	4.0	4.00	2.00	2.00	2.00	Sag	2.00	0.050	0.020	0.013	1.08	51.25	1.08	51.25	0.0	Off

Project File: Castle Rock - Major Storm Event.stm | Number of lines: 4 | Run Date: 10/5/2023

NOTES: Inlet N-Values = 0.016; Known Qs only; * Indicates Known Q added. All curb inlets are Horiz throat.

MyReport

Line No.	Area Dn (sqft)	Area Up (sqft)	Byp Ln No	Coeff C1 (C)	Coeff C2 (C)	Coeff C3 (C)	Capac Full (cfs)	Crit Depth (ft)	Cross Sl, Sw (ft/ft)	Cross Sl, Sx (ft/ft)	Curb Len (ft)	Defl Ang (Deg)	Depth Dn (ft)	Depth Up (ft)	DnStm Ln No	Drng Area (ac)	Easting X (ft)	EGL Dn (ft)	EGL Up (ft)	Energy Loss (ft)
1	3.14	3.14	n/a	0.20	0.50	0.90	15.40	0.80	....	....	....	78.817	2.00	2.00	Outfall	0.00	282.51	6207.07	6207.10	0.029
2	1.77	1.77	1	0.20	0.50	0.90	17.51	0.25	0.050	0.020	4.00	79.355	1.50	1.50	1	0.00	236.09	6207.10	6207.10	0.001
3	1.77	1.77	1	0.20	0.50	0.90	7.29	0.83	0.050	0.020	4.00	-62.761	1.50	1.50	1	0.00	334.40	6207.21	6207.31	0.105
4	3.01	3.01	Sag	0.20	0.50	0.90	222.48	1.47	0.050	0.020	4.00	-78.149	2.50	1.47**	Outfall	0.00	272.86	6181.55	6188.71	0.124

Project File: Castle Rock - Major Storm Event.stm | Number of lines: 4 | Date: 10/5/2023

NOTES: ** Critical depth

MyReport

Flow Rate (cfs)	Sf Ave (ft/ft)	Sf Dn (ft/ft)	Grate Area (sqft)	Grate Len (ft)	Grate Width (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Gutter Depth (ft)	Gutter Slope (ft/ft)	Gutter Spread (ft)	Gutter Width (ft)	HGL Dn (ft)	HGL Up (ft)	HGL Jnct (ft)	HGL Jmp Dn (ft)	HGL Jmp Up (ft)	Incr CxA	Incr Q (cfs)	Inlet Depth (ft)	Inlet Eff (%)
5.11	0.051	0.051	....	....	....	6208.43	6209.96	....	....	....	....	6207.03	6207.06	6207.10	....	....	0.00	0.00	....	....
0.47	0.002	0.002	....	....	....	6209.96	6210.08	0.15	Sag	4.48	2.00	6207.10	6207.10	6207.10	....	....	0.00	0.47	0.15	100
4.64	0.195	0.195	....	....	....	6209.96	6208.92	0.50	Sag	21.89	2.00	6207.10	6207.21	6207.31	....	....	0.00	4.64	0.50	100
18.90	0.355	0.212	2.00	2.00	2.00	6180.22	6205.77	1.08	Sag	51.25	2.00	6181.32	6188.09 j	6188.09	6180.88	6182.63	0.00	18.90	1.08	100

Project File: Castle Rock - Major Storm Event.stm | Number of lines: 4 | Date: 10/5/2023

NOTES: ** Critical depth

MyReport

Inlet ID	Inlet Loc	(ft)	Inlet Time (min)	i Sys (in/hr)	i Inlet (in/hr)	Invert Dn (ft)	Invert Up (ft)	Jump Loc (ft)	Jump Len (ft)	Vel Hd Jmp Dn (ft)	Vel Hd Jmp Up (ft)	J-Loss Coeff	Junct Type	Known Q (cfs)	Cost RCP	Cost CMP	Cost PVC	
	Sag		0.0	0.00	0.00	6203.93	6204.19	....	....	0.00	0.00	0.99	MH	0.00	2,584	2,326	2,196	
Inlet 1	Sag		0.0	0.00	0.00	6204.19	6205.58	....	....	0.00	0.00	1.00	Curb	0.47	2,120	1,908	1,802	
Inlet 2	Sag		0.0	0.00	0.00	6204.19	6204.45	....	....	0.00	0.00	1.00	Curb	4.64	2,280	2,052	1,938	
Inlet 3 (Existing)	Sag		0.0	0.00	0.00	6176.32	6186.62	7.00	12.50	0.23	7.65	1.00 z	Comb.	18.90	2,745	2,470	2,333	

Project File: Castle Rock - Major Storm Event.stm | Number of lines: 4 | Date: 10/5/2023

NOTES: Known Qs only. ; ** Critical depth

MyReport

Line ID	Line Length (ft)	Line Size (in)	Line Slope (%)	Line Type	Local Depr (in)	n-val Gutter	n-val Pipe	Minor Loss (ft)	Northing Y (ft)	Pipe Travel (min)	Q Byp (cfs)	Q Capt (cfs)	Q Carry (cfs)	Line Rise (in)	Runoff Coeff (C)	Line Span (in)	Area A1 (ac)	Area A2 (ac)	Area A3 (ac)	Tc (min)	
	56.000	24	0.46	Cir	....	....	0.013	0.04	178.73	0.57	....	....	....	24	0.00	24	0.00	0.00	0.00	3.1	
Post-C	50.000	18	2.78	Cir	0.0	....	0.013	0.00	160.13	3.13	0.00	0.47	0.00	18	0.00	18	0.00	0.00	0.00	0.0	
Post-D + Offsite	54.000	18	0.48	Cir	0.0	....	0.013	0.11	163.79	0.34	0.00	4.64	0.00	18	0.00	18	0.00	0.00	0.00	0.0	
Post-A + Offsite	35.000	30	29.43	Cir	0.0	....	0.013	n/a	45.10	0.15	0.00	18.90	0.00	30	0.00	30	0.00	0.00	0.00	0.0	

Project File: Castle Rock - Major Storm Event.stm | Number of lines: 4 | Date: 10/5/2023

NOTES: ** Critical depth

MyReport

Throat Ht (in)	Total Area (ac)	Total CxA	Total Runoff (cfs)	Vel Ave (ft/s)	Vel Dn (ft/s)	Vel Hd Dn (ft)	Vel Hd Up (ft)	Vel Up (ft/s)	Cover Dn (ft)	Cover Up (ft)	Storage (cft)	
....	0.00	0.00	0.00	1.63	1.63	0.04	0.04	1.63	2.50	3.77	175.89	
4.0	0.00	0.00	0.00	0.27	0.27	0.00	0.00	0.27	4.27	3.00	88.34	
4.0	0.00	0.00	0.00	2.63	2.63	0.11	0.11	2.63	4.27	2.97	95.41	
4.0	0.00	0.00	0.00	5.07	3.85	0.23	0.61	6.28	1.40	16.65	160.69	

Project File: Castle Rock - Major Storm Event.stm | Number of lines: 4 | Date: 10/5/2023

NOTES: ** Critical depth

Storm Sewer Inlet Time Tabulation

Line No.	Line ID	Tc Method	Sheet Flow					Shallow Concentrated Flow					Channel Flow							Total Travel Time (min)
			n-Value	flow Length (ft)	2-yr 24h P (in)	Land Slope (%)	Travel Time (min)	flow Length (ft)	Water Slope (%)	Surf Descr	Ave Vel (ft/s)	Travel Time (min)	X-sec Area (sqft)	Wetted Perim (ft)	Chan Slope (%)	n-Value	Vel	flow Length (ft)	Travel Time (min)	
1		User																		0.00
2	Post-C	User																		0.00
3	Post-D + Offsite	User																		0.00
4	Post-A + Offsite	User																		0.00

Project File: Castle Rock - Major Storm Event.stm | Min. Tc used for intensity calculations = 5 min | Number of lines: 4 | Date: 10/5/2023

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)		
(1)	(in) (2)	(cfs) (3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(ft) (12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(K) (23)	(ft) (24)
1	24	5.11	6203.93	6207.03	2.00	3.14	1.63	0.04	6207.07	0.051	56.000	6204.19	6207.06	2.00	3.14	1.63	0.04	6207.10	0.051	0.051	0.029	0.99	0.04
2	18	0.47	6204.19	6207.10	1.50	1.77	0.27	0.00	6207.10	0.002	50.000	6205.58	6207.10	1.50	1.77	0.27	0.00	6207.10	0.002	0.002	0.001	1.00	0.00
3	18	4.64	6204.19	6207.10	1.50	1.77	2.63	0.11	6207.21	0.195	54.000	6204.45	6207.21	1.50	1.77	2.63	0.11	6207.31	0.195	0.195	0.105	1.00	0.11
4	30	18.90	6176.32	6181.32	2.50	3.01	3.85	0.23	6181.55	0.212	35.000	6186.62	6188.09 j	1.47**	3.01	6.28	0.61	6188.71	0.498	0.355	n/a	1.00	n/a

Project File: Castle Rock - Major Storm Event.stm | Number of lines: 4 | Run Date: 10/5/2023

Notes: ; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraflow HGL Computation Procedure

General Procedure:

Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles.

Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.

Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.

Col. 3 Total flow rate in the line.

Col. 4 The elevation of the downstream invert.

Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.

Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).

Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

Col. 12 The line length.

Col. 13 The elevation of the upstream invert.

Col. 14 Elevation of the hydraulic grade line at the upstream end.

Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 16 Cross-sectional area of the flow at the upstream end.

Col. 17 The velocity of the flow at the upstream end, (Col. 3 / Col. 16).

Col. 18 Velocity head (Velocity squared / 2g).

Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18) .

Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).

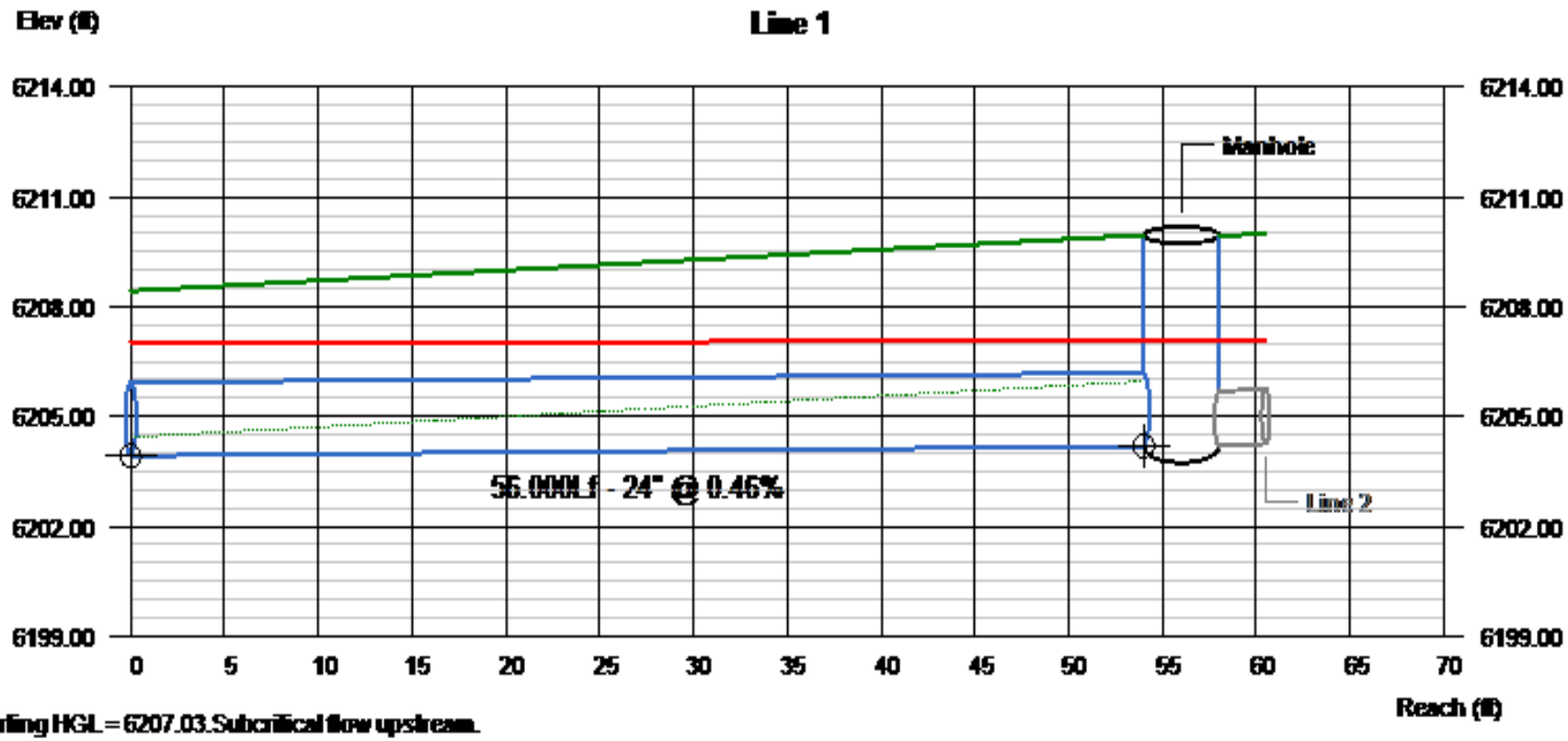
Col. 21 The average of the downstream and upstream friction slopes.

Col. 22 Energy loss. Average Sf/100 x Line Length (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.

Col. 23 The junction loss coefficient (K).

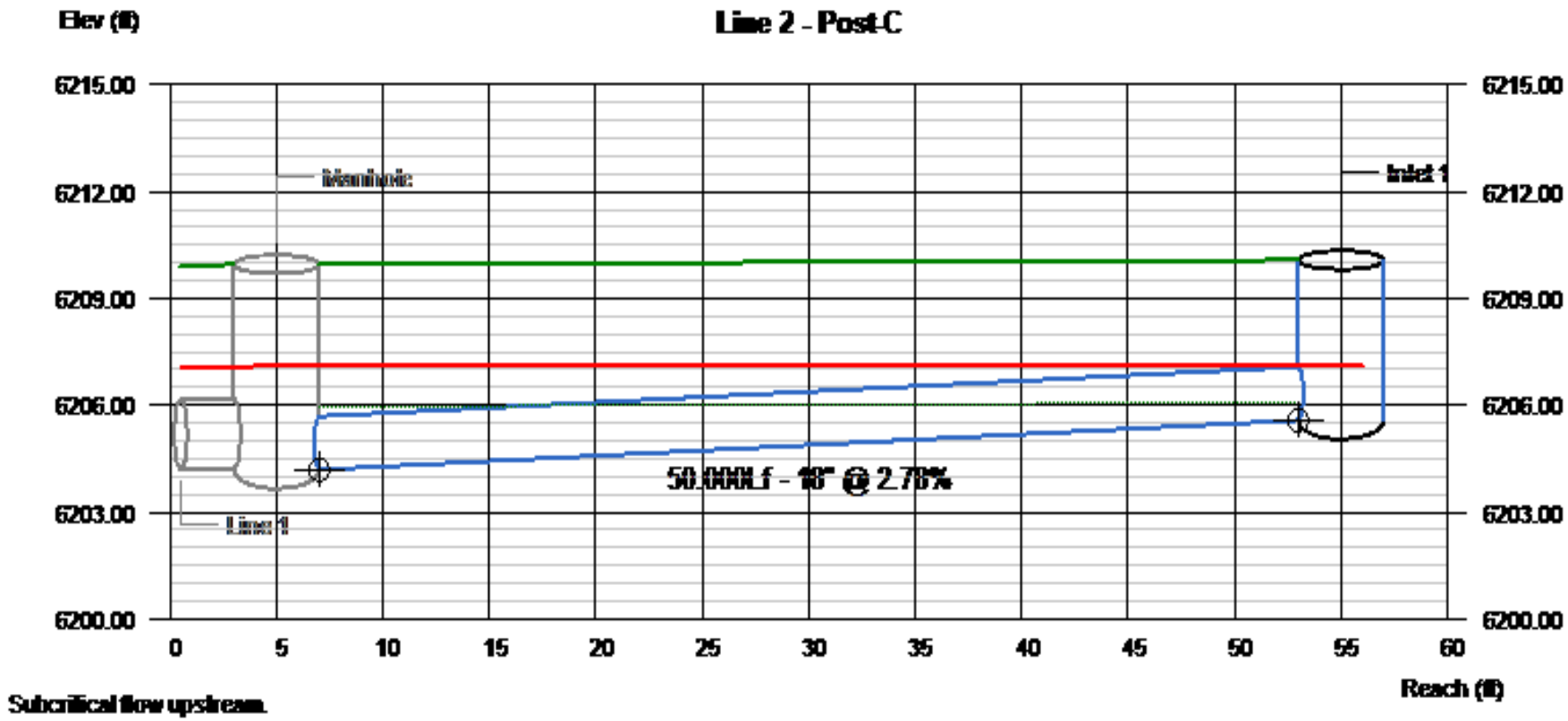
Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

MAJOR STORM EVENT (100-YEAR EVENT)

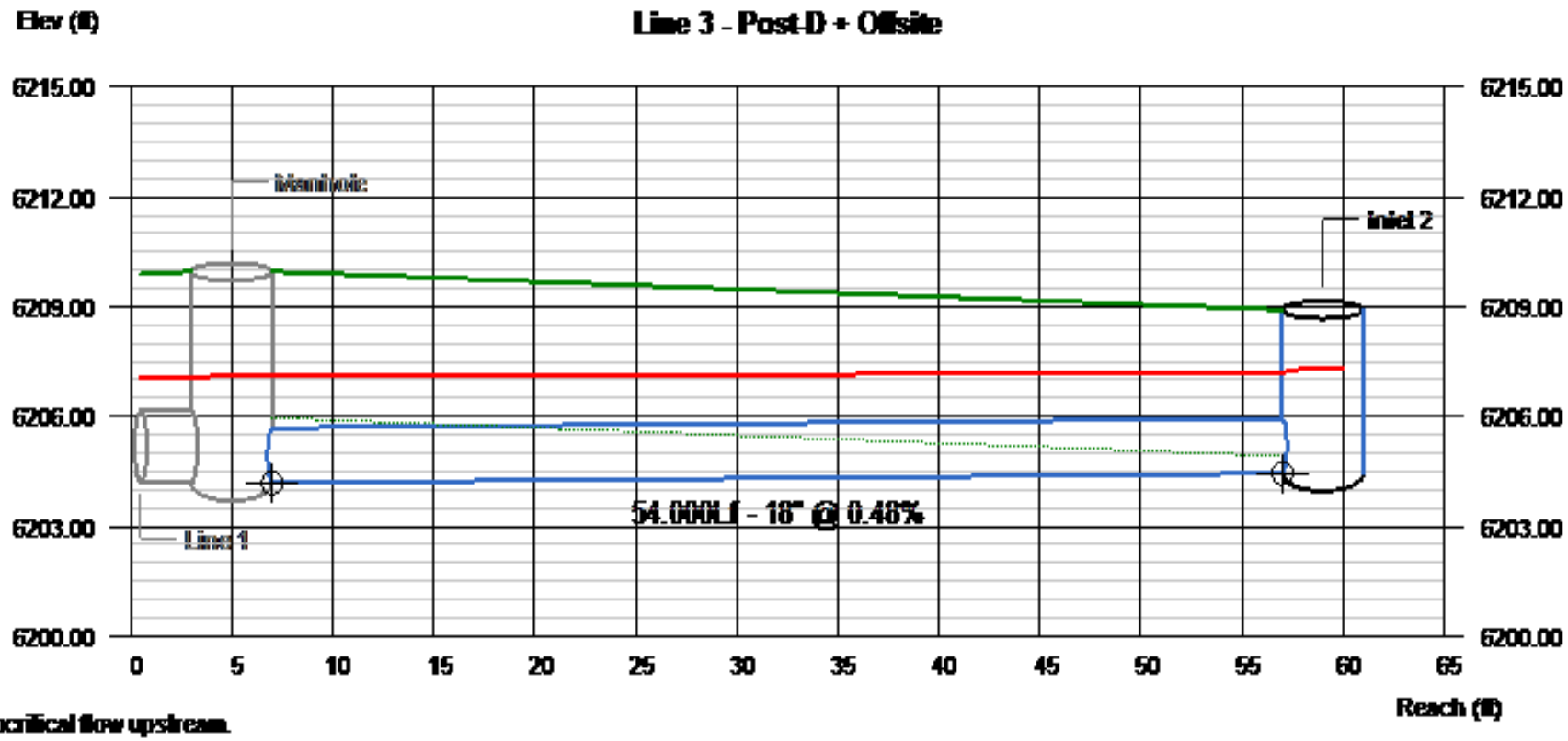


Starting HGL = 6207.03.Subcritical flow upstream.

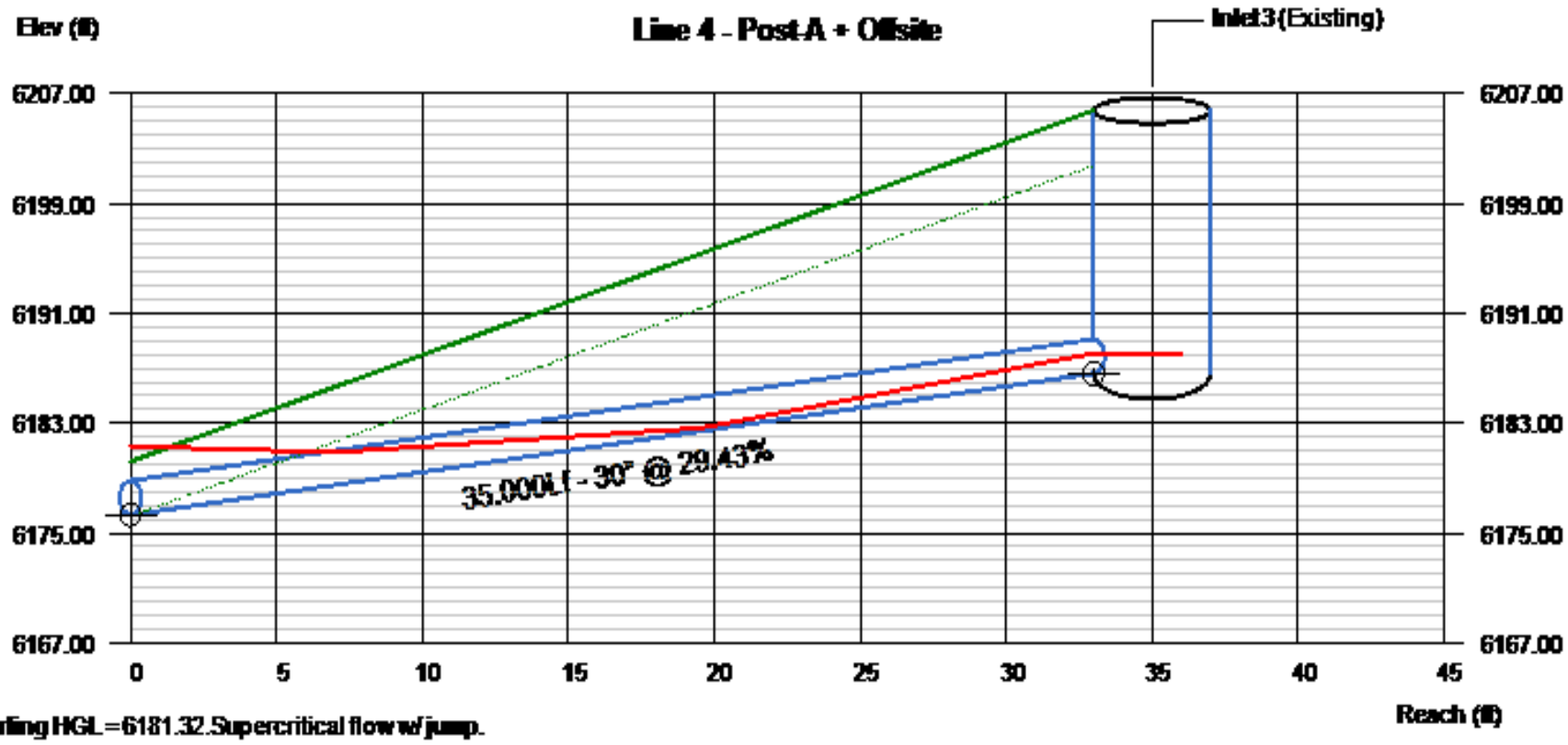
MAJOR STORM EVENT (100-YEAR EVENT)



MAJOR STORM EVENT (100-YEAR EVENT)



MAJOR STORM EVENT (100-YEAR EVENT)



Starting HGL = 6181.32. Supercritical flow w/ jump.

EXHIBIT 6

Drainage Maps

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

0 40' 60' 80'
SCALE IN FEET

Benchmark Information

Benchmark #1: 5/8" rebar with CEI cap located in an island in parking lot southeast of Wal-Mart building, approximately 48.0' west of a light pole w/3-lamps and approximately 63.6' east of a light pole w/2-lamps.
N:1573050.83'
E:3180310.61'
Elev. = 6211.44'

EXISTING LEGEND

PRE-DEVELOPMENT DRAINAGE BOUNDARY

A — BASIN ID
0.00 AC — AREA IN ACRES
0.00 — 100-YR (Q_{100}) FLOW IN CFS

EXISTING LEGEND

- Boundary Line
- Easement Line
- Easement Line (Released)
- Section Line
- Flood Hazard Line
- Break Line
- Underground Fiber Optic Line (FOC)
- Sanitary Sewer Line (SS)
- Storm Drainage Pipe ((Size))
- Underground Electric Line (UGE)
- Benchmark (BM)
- Found Monument (As Noted)
- Drainage Manhole (DMH)
- Grate Inlet (GI)
- Sewer Manhole (SMH)
- Electric Vault
- Light Pole (1 Lamp)
- Light Pole (2 Lamps)
- Light Pole (3 Lamps)
- Cart Corral
- Tree (Deciduous) (Size)
- Tree (Evergreen) (Size)
- Traffic Sign (Type of Sign)
- PVC — Polyvinyl Chloride Pipe
- RCP — Reinforced Concrete Pipe
- R/W — Right-of-Way
- (XXXX) — Record Bearing & Distance per Rec. No. DC99023457
- Flood Zone "A"
- Public R/W Dedicaation Per DC99023457

PRE-DEVELOPMENT DRAINAGE MAP



WALMART FUEL STATION #984-543
133 SAM WALTON LANE
CASTLE ROCK, COLORADO

Walmart

CEI
Solutions for Land and Life

CEI ENGINEERING ASSOC., INC.
710 W PINEDALE AVE
FRESNO, CA 93711
PHONE: (559) 447-3119
FAX: (559) 447-3129

REVISION

NO.	DESCRIPTION	DATE
	REV-X	XX/XX/XXXX

Preliminary
This document shall not be recorded for any purpose and shall not be used or viewed or relied upon as a final survey document

PROFESSIONAL OF RECORD	TAB
PROJECT MANAGER	JAP
DESIGNER	MD
CEI PROJECT NUMBER	32644
DATE	2/12/2024
REVISION	REV-0

PRE AREA MAP
SHEET TITLE
SHEET NUMBER
1

DRAWING LOCATION - P:\32000\32644.0\DRAWINGS\DESIGN\WORKING\32644 - DAM.DWG -- SAVED BY - ELAWRENCE

© 2024 CEI ENGINEERING ASSOCIATES, INC.

0 40' 60' 80'
SCALE IN FEET

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

Benchmark Information

Benchmark #1: 5/8" rebar with CEI cap located in an island in parking lot southeast of Wal-Mart building, approximately 48.0' west of a light pole w/3-lamps and approximately 63.6' east of a light pole w/2-lamps.
N:1570050.83'
E:3180310.61'
Elev. = 6211.44'

PROPOSED LEGEND

POST-DEVELOPMENT DRAINAGE BOUNDARY

A — BASIN ID
0.00 AC — AREA IN ACRES
0.00 — 100-YR (Q_{100}) FLOW IN CFS

EXISTING LEGEND

Boundary Line
Easement Line
Easement Line (Released)
Section Line
Flood Hazard Line
Break Line
Underground Fiber Optic Line
Sanitary Sewer Line
Storm Drainage Pipe
Underground Electric Line
Benchmark (BM)
Found Monument (As Noted)
Drainage Manhole (DMH)
Grate Inlet (GI)
Sewer Manhole (SMH)
Electric Vault
Light Pole (1 Lamp)
Light Pole (2 Lamps)
Light Pole (3 Lamps)
Cart Corral
Tree (Deciduous)
Tree (Evergreen)
Traffic Sign (Type of Sign)
Polyvinyl Chloride Pipe
Reinforced Concrete Pipe
Right-of-Way
Record Bearing & Distance per Rec. No. DC99023457
Flood Zone "A"
Public R/W Dedicoation Per DC99023457

POST-DEVELOPMENT DRAINAGE MAP



CEI ENGINEERING ASSOC., INC.
710 W PINEDALE AVE
FRESNO, CA 93711
PHONE: (559) 447-3119
FAX: (559) 447-3129

REVISION		
NO.	DESCRIPTION	DATE
	REV-X	XX/XX/XXXX

WALMART FUEL STATION #984-543
133 SAM WALTON LANE
CASTLE ROCK, COLORADO

Preliminary
This document shall not be recorded for any purpose and shall not be used or viewed or relied upon as a final survey document

PROFESSIONAL OF RECORD	TAB
PROJECT MANAGER	JAP
DESIGNER	MD
CEI PROJECT NUMBER	32644
DATE	2/12/2024
REVISION	REV-0

POST AREA MAP
SHEET TITLE
SHEET NUMBER
2

DRAWING LOCATION - P:\32000\32644.0\DRAWINGS\DESIGN\WORKING\32644 - DAM.DWG - SAVED BY - ELAWRENCE

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EXHIBIT 7

Castle Rock Phase II Drainage Report Checklist

Castle Rock Water
175 Kellogg Court, Castle Rock CO 80109
720-733-6000

Phase II Drainage Report Checklist

The Phase II Drainage Report must be in conformance with the latest Town of Castle Rock Storm Drainage Design and Technical Criteria Manual available on the Town's website.

The Phase II Drainage Report must be signed and sealed by a Professional Engineer licensed in the State of Colorado. The purpose of the Phase II Drainage Report is to identify and refine conceptual stormwater management solutions to the challenges that may be present or occur on-site and off-site.

The preparer should contact and work with the Town Stormwater Engineering Staff regarding any design, master planning and existing system questions (720-733-6000). The following outline sets forth the **required minimum** content to be provided in the Phase II Drainage Report that shall be submitted with the Planned Development Plan or Straight Zoning documents. A copy of this checklist must be submitted with the Phase II Drainage Report.

Please see Chapter 4 of the Town of Castle Rock Storm Drainage Design and Technical Criteria Manual for additional details and information. Please check off the following items to assure your report is complete. Appropriate notations shall be provided with the checklist. For example, if a specific item is not addressed or not applicable, an explanation needs to be provided.

Included	N/A	
		I. COVER SHEET
✓		A. Name of Project, including legal name of development
✓		B. Address
✓		C. Owner
✓		D. Developer
✓		E. Engineer
✓		F. Submittal date and revision dates as applicable
		II. GENERAL LOCATION AND DESCRIPTION
✓		A. Site Location
✓		B. Description of Property and Land Use
		III. DRAINAGE BASIN AND SUB-BASINS
✓		A. Major Drainage Basins
✓		B. Minor Drainage Basins
		IV. DRAINAGE DESIGN CRITERIA
✓		A. Regulations
✓		B. Drainage Studies, Master Plans, Site Constraints
✓		C. Hydrology
✓		D. Hydraulics
	✓	E. Water Quality Enhancement

Phase II Drainage Report Checklist

Included	N/A	
		V. STORMWATER MANAGEMENT FACILITY DESIGN
✓		A. Stormwater Conveyance Facilities
✓		B. Stormwater Storage Facilities
	✓	C. Water Quality Enhancement Best Management Practices
	✓	D. Floodplain Modification
	✓	E. Additional Permitting Requirements
✓		F. General
		VI. CONCLUSIONS
✓		A. Compliance with Standards
✓		B. Variances
✓		C. Drainage Concept
		VII. REFERENCES
		VIII. APPENDICES
✓		A. Hydrologic Computations
✓		B. Hydraulic Computations (If known at this time—not required)
	✓	C. Water Quality Enhancement Best Management Practices
✓		D. Referenced Information
✓		**OVERALL DRAINAGE PLAN (IN POCKET)**
✓		**DETAILED DRAINAGE PLANS (IN POCKET)**

Notes/Comments:

IV.E, V.C, and VIII.C - Water quality enhancement not required as site is within limits and design capacities of existing water quality treatment facilities.

V.D - Floodplain will not be affected with this development.

V.E - No known additional related permitting requirements at this time.

EXHIBIT 8

Water Quality Conformance Checklist

Summary of Water Quality Conformance to MS4 Permit

The purpose of this worksheet is to document conformance with the Town of Castle Rock's MS4 permit with regard to permanent water quality on land disturbance projects.

Project Name Walmart Fuel Station #984-543

Project Owner Walmart Real Estate Business Trust

Project Location 133 Sam Walton Lane

ToCR Project Number TBD

Total Site Area 1.92 (Disturbed) **acres**

Total Size of Common Plan of Development N/A **acres**

Check all that apply:

- ❒ **Project within Plum Creek Basin**
- ❒ **Project within Cherry Creek Basin**

Estimated construction completion date TBD

---

1. The water quality control measure(s) for applicable development sites shall meet one of the following base design standards as per the SDDTCM Section 14.4. Please select all design standards that were applied to meet conformance with the MS4 on this site.

   - ❒ WQCV standard
   - ❒ Pollutant removal standard
   - ❒ Runoff reduction standard
   - ☑ Applicable site draining to regional WQVC control measure (accepts drainage prior to discharging to WOTS)
   - ❒ Applicable site draining to regional WQVC control facility (with receiving pervious area control measure upstream of WOTS)
   - ❒ Constrained redevelopment sites standard
     - Imperviousness of existing site _____/_____(Imp. Ac/Site Ac) =____%
     - Variance required TCV No. _____
   - ❒ Existing control measure with WQCV per previous criteria standards
     - Reference Construction Permit No. _____
   - ❒ Cherry Creek Basin only, choose one: ☐ Tier 1 ☐ Tier 2 ☐ Tier 3
   - ❒ No control measures provided (See Permanent WQ Worksheet for applicability)

Summary of Water Quality Conformance to MS4 Permit

2. Was an exclusion to water quality applied as per SDDTCM Section 13.1.5? ☐Yes ☐No

   i. If yes, please select all that apply, provide total excluded impervious area(s) and submit variance, as applicable: TCV No. _____

   ❒ Pavement management site

   Excluded impervious area: _____ acres

   ❒ Excluded roadway redevelopment

   Excluded impervious area: _____ acres

   ❒ Excluded existing roadway areas

   Excluded impervious area: _____ acres

   ❒ Above ground and below ground utilities

   ❒ Large lot single family home

   ❒ Non-residential and non-commercial infiltration

   Excluded impervious area: _____ acres

   ❒ Land disturbance for land to remain undeveloped

   Excluded impervious area: _____ acres

   ❒ Stream Stabilization Sites

   Excluded impervious area: _____ acres

   ❒ Trails

   Excluded impervious area: _____ acres

   ❒ Oil and Gas Exploration

3. For Development and Redevelopment sites, following any exclusions claimed above, was any portion of the site excluded up to 20% of the site and not to exceed one acre? ☐Yes ☐No

   If yes, complete the following:

   Excluded area: _____ acres

   Total Site area: _____ acres, _____ % site excluded

4. For Constrained sites, was any portion of the site excluded up to 50% of the site and not to exceed 50% of the impervious area? ☐Yes ☒No

   If yes, complete the following:

   Excluded area: _____ acres

   Excluded impervious area: _____ acres

   Total Site area: _____ acres, _____ % site excluded

   Total Impervious area: _____ acres, _____ % impervious excluded

SITE DRAINS TO EXISTING REGIONAL AND SUB-REGIONAL FACILITIES WHICH PROVIDE DETENTION AND WQ

Permanent Water Quality Determination Worksheet (Taken from 2019 SDDTCM Sections 13.1.4 and 13.1.5)

Project:		**Project#**		**Applicant:**
Section	**Questions**	**Response**	**Check those that apply**	**Instructions**
1	**Non-applicable Sites**			
1.1	Will the project result in a temporary disturbance of greater than one acre?	No	☐	Proceed to section 1.2.
		Yes	☒	Proceed to section 2.
1.2	Is the project part of a larger common plan of development or sale where multiple separate and distinct construction activities may be taking place at different times on different schedules, but remain related and are within 1/4 mile of each other? (A common plan of development will generally be documented on a site development plan, master plan, or equivalent, for the property/project)	No	☐	Proceed to section 1.3.
		Yes	☐	Proceed to section 2.
1.3	Is the project within the Cherry Creek Watershed?	Yes	☐	Permanent water quality control measures may be required. Refer to Water Qualtiy Control Regulation 72.7 for details and allowable exclusions.
		No	☐	Permanent water quality control measures are not required.
2	**Applicable Site Types and Exclusions by Variance**			
2.1	Does the project have more than 35% impervious area on the existing site?	No	☐	Project is an applicable Development Site. Proceed to section 3.
		Yes	☒	Proceed to 2.2.
2.2	Does the project have greater than 75% impervious area on the existing site?	No	☐	Project is an applicable Redevelopment Site. Proceed to section 3.
		Yes	☒	Project is an applicable Constrainted Redevelopment Site. Proceed to 2.3.
2.3	Will 100% of the runoff from the existing and proposed site be captured and treated using one or more of the allowable design standards for permanent water quality?	Yes	☒	No further action required.
		No	☐	Proceed to 2.4.
2.4	Do any other water quality exclusions apply to the site?	No	☐	Portions of the project are excluded. Proceed with design in accordance with Constrained Redevelopment standards and apply for **variance** for Constrained Redevelopment Sites.
		Yes	☐	Proceed to section 3. Following approval of other exclusions, design remaining site in accordance with Constrained Redevelopment standards and apply for **variance** for Constrained Redevelopment Sites.
3	**Applicable Sites with Other Exclusions by Variance**			
3.1	**Category 1: Roadways, bridges and trails only**			
3.1.1	Is the project a bike or pedestrian trail?	Yes	☐	Proceed to next line.
		No	☐	Proceed to 3.1.2.
	Is the trail for a roadway?	Yes	☐	Proceed to 3.1.2.
		No	☐	Project is excluded. Submit **variance** for Trails Excluded from Permanent Water Quality Requirements.
3.1.2	Is the project primarily used for parking or access to parking?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to 3.1.3.
3.1.3	Does the project add impervious area?	No	☐	Project is excluded. Submit **variance** for Pavement Management Sites Excluded from Permanent Water Quality Requirements.
		Yes	☐	Proceed to 3.1.4.

Section	Questions	Response	Check those that apply	Instructions
3.1.4	Does the project add more than 8.25 feet of paved width at any location to the existing roadway?	No	☐	Project is excluded. Submit **variance** for Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements.
		Yes	☐	Proceed to next line.
	Does the project add more than one acre of paved area per mile to an existing roadway?	No	☐	Project is excluded. Submit **variance** for Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements.
		Yes	☐	Proceed to next line.
	Does the project increase the width by two times or more, on average, of the original roadway area?	No	☐	Existing areas of site are excluded only. Submit **variance** for Existing Roadway Surfaces Only Excluded from Permanent Water Quality Requirements.
		Yes	☐	This exclusion does not apply. Permanent water quality is required.
3.2	**Category 2: Non-residential and non-commercial projects only**			
3.2.1	Is the project associated with oil and gas exploration, production, processing, or treatment operations or transmission facilities, including activities necessary to prepare a site for drilling and the movement and placement of drilling equipment?	Yes	☐	Project is excluded. Submit **variance** for Oil and Gas Exploration Sites Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.2.
3.2.2	Is the project for stream stabilization?	Yes	☐	Project is excluded. Submit **variance** for Stream Stabilization Sites Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.3.
3.2.3	Is the project for installation or maintenance of aboveground or underground utilities or infrastructure that does not permanently alter the terrain, ground cover, or drainage patterns from those present prior to the construction activity including activities to install, replace or maintain utilities under roadways or other paved areas that return the surface to the same condition?	Yes	☐	Project is excluded. Submit **variance** for Aboveground and Underground Utilities Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.4.
3.2.4	Is the project on undeveloped land (land with no human-made structures such as buildings or pavement) that will remain undeveloped after the project?	Yes	☐	Project is excluded. Submit **variance** for Sites with Land Disturbances to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.5.
3.2.5	Will the post-project condition result in surface water discharge during the 80th percentile storm runoff event?	No	☐	Project is excluded. Submit **study** along with **variance** for Non-residential and Non-commercial Infiltration Conditions Excluded from Permanent Water Quality Requirements.
		Yes	☐	This exclusion does not apply. Permanent water quality is required.
3.3	**Category 3: Residential, Agricultural and Commercial projects**			
3.3.1	Is the project a single-family residential lot, or agricultural zoned lands, greater than or equal to 2.5 acres in size per dwelling unit?	Yes	☐	Proceed to next line.
		No	☐	Proceed to 3.3.2.
	Is the project site greater than 10% impervious?	No	☐	Project is excluded. Submit **variance** for Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements.
		Yes	☐	Proceed to next line.
	Is the project site greater than 20% impervious?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to next line.
	Will the post-project condition result in surface water discharge during the 80th percentile storm runoff event?	No	☐	Project is excluded. Submit **study** along with **variance** for Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements.
		Yes	☐	This exclusion does not apply. Permanent water quality is required.

Section	Questions	Response	Check those that apply	Instructions
3.3.2	Will 100% of the runoff from the residential or commercial site be captured?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to next line.
	Is all or a portion of the site undeveloped or will it remain undeveloped after construction?	Yes	☐	This portion of the project is excluded. Submit **variance** for Sites with Land Disturbance to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements. Proceed to next line.
		No	☐	Proceed to next line.
	Is the remaining untreated impervious area greater than 20% of the site?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to next line.
	Is the remaining untreated impervious area greater than one acre?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to next line.
	Is it practicable to capture runoff from portions of the site that will not drain to a control measure?	No	☐	Document justification demonstrating that it is not practicable to capture runoff from this portion of the site in the **drainage report**. No further action is needed.
		Yes	☐	This exclusion does not apply. Permanent water quality is required.