PHASE III DRAINAGE REPORT

FOR

LAGAE RANCH FILING 1, LOT 236-B

Prepared:
February 06, 2020

Prepared for:

CENTURY COMMUNITIES

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Harris Kocher Smith Project #190920

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A. Certification Statement

This report and plan for the Phase III drainage design of Lagae Ranch Filing 1, Lot 236-B was prepared by me (or under my direct supervision) in accordance with the provisions of Douglas County Drainage Design and Technical Criteria for the owners thereof. I understand that Douglas County does not and will not assume liability for drainage facilities designed by others.

_____ _____

Kevin P. Kennedy, P.E. Date
Registered Professional Engineer
State of Colorado No. 38561
On Behalf of Harris Kocher Smith

Century Communities hereby certifies that the drainage facilities for Lagae Ranch Filing 1, Lot 236-B shall be constructed according to the design presented in this report. I understand that Douglas County does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that Douglas County reviews drainage plans pursuant to Colorado Revised Statues, Title 30, Article 28; but cannot, on behalf of Lot 1, Filing 10, Castle Pines Village, guarantee that final drainage design review will absolve Brookfield Homes and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

_____

Name of Developer

_____

Authorized Signature

B. INTRODUCTION

I. Location

The Lagae Ranch development consists of a parcel described by an administrative replat of lot 236-A and tract T-1, Lagae Ranch filing 1, 1st Amendment (hereinafter referred to as "Site"). The Site is located in the South ½ of Section 3 and the North ½ of Section 10, both of Township 7 South, Range 67 West of the 6th Meridian, city of Castle Pines, county of Douglas, state of Colorado. The Site is bounded by Colorado State Highway 87 to the east and Lagae Road to the west. To the north and south of the Site there is undeveloped land zoned as city-incorporated areas.

A Vicinity Map follows, in Figure 1.

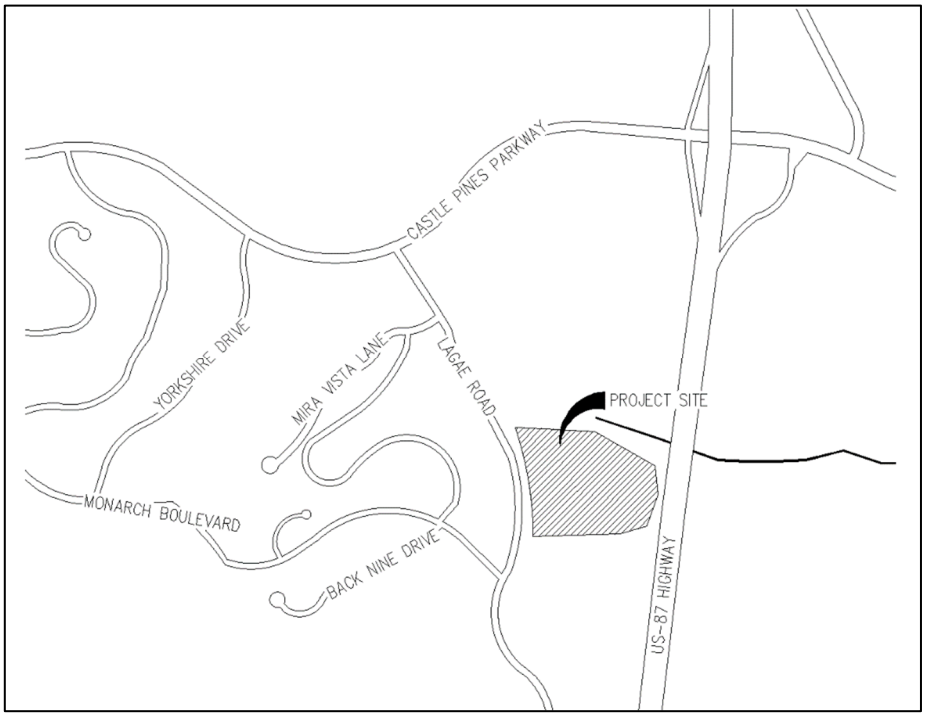


Figure 1: Vicinity Map
Not to Scale

II. Description of Property and Proposed Development

The Site is approximately 18.75-acres of vacant, undeveloped land. The Site generally slopes from southwest to northeast with approximately 89' of fall. The majority of this fall is made up in an approximately 3:1 slope on the northern side of the property, sloping down to Newline Gulch Spring Tributary and a regional stormwater detention facility.

The site soils generally consist of Fondis clay loam (FoD) and Fondis-Kutch Association (Fu) which are categorized as belonging to Hydrologic Soil Groups C and D as seen in Appendix B.

At the time of this report, the proposed Site Plan consists of thirty-four single-family structures containing 187 townhouse units. Attached garages will be located on Site for each townhouse. Other Site improvements will include paved drives/walks, surface parking, curb & gutter, utilities, and landscaping. There will be two access points to the development, both on Lagae Road.

C. HISTORIC DRAINAGE

I. Overall Basin Description

The Project Site is tributary to the Newline Gulch Spring Tributary which runs west to east adjacent to the site. The Newline Gulch Spring Tributary is tributary to a regional full spectrum detention facility, located northeast of the Site. Based upon the Douglas County Flood Insurance Rate Maps (FIRM) Panel Number 08035C0160F Douglas County, Colorado, effective September 30, 2005, the site is shown to be in a Zone X (unshaded) Flood Area. Therefore, it is determined that this Site is not within a 100-year flood designated area. The FIRM Map can be found in Appendix A of this report. Drainage Patterns through Property

The existing undeveloped Site conveys flows overland towards the Newline Gulch Spring Tributary. There are no sources of off-site drainage entering the Site. The Site generally slopes towards the Newline Gulch Spring Tributary which runs from the west to the east and is located north of the Site. The elevation difference between the highest point on the existing Site to the lowest point on the existing site is approximately 89 feet.

D. DESIGN CRITERIA

I. Regulations

The principal design criteria used for this study was the Douglas County Storm Drainage Design and Technical Criteria Manual ("Criteria Manual").

In addition, the Urban Storm Drainage Criteria Manual, Volumes 1, 2 and 3, for Mile High Flood District (MHFD) (MHFD Criteria Manual) was also consulted.

II. References

The Site area is included as part of the Phase III Drainage Study for Lagae Ranch ("Drainage Study") by Lund Partnership. The proposed Site is in compliance with drainage requirements set forth in the Drainage Study. The Drainage Study was amended in November 2018 by Rick Engineering to expand the land use of the Site to include Single Family Attached, or Multifamily Residential Units. All references can be found in Appendix C.

The design was performed according to a survey of existing conditions and topography performed by Harris Kocher Smith in October of 2019.

III. Hydrologic Criteria

The Criteria Manual was followed without variation or deviation. Per Douglas County "Zone 1" criteria, the 1-hour point rainfall for the 5-year storm is P1=1.43 inches and for the 100-year storm, P1=2.60 inches.

Per Criteria Manual Section 6.3.4, the dominant land use and hydrologic soil type should be chosen and used for all hydrologic analysis. The Site is comprised of Hydrologic Soil Type C/D, which was used for hydrologic analysis. 54% imperviousness was calculated for the entire Site based on land usage and recommended imperviousness from Table 6-3 of Volume 1 of the UDFCD Criteria Manual.

The Rational Method was used to analyze the minor 5-year storm and the major 100-year storm for design of storm sewer and inlets. The Rational Method Calculation for the Site can be found in Appendix A.

Composite runoff coefficients were calculated for each of the major basins. The minimum time of concentration used for urbanized basins was 5 minutes.

III. Hydraulic Criteria

Inlet capacity was based on utilizing the UDFCD spreadsheet "UD-Inlet_v4.05.xlsm", released March 2017. The calculations are shown in Appendix B.

Proposed storm sewer pipes are sized to convey the 100-year event.

The Criteria Manual was followed, with some variation and deviation to the StormCAD analysis as outlined in UDFCD's publishing of: Modeling Hydraulic and Energy Gradients in Storm Sewers: A Comparison of Computational Methods. The following design charts and supplemental models were used to assist with the analysis:

- StormCAD computer model for hydraulic grade line analysis
- FlowMaster computer model for hydraulic analysis

E. DRAINAGE PLAN

I. General Concept

The Site and disturbed areas have been divided into 11 drainage basins. Runoff from most of the Site will be routed via the proposed curb and gutter, valley pans, and on-site private storm sewer to the Site outfall into the Newline Gulch Spring Tributary. The Newline Gulch Spring Tributary is tributary to a regional full spectrum detention facility, located northeast of the Site. The Tributary and the detention facility were designed as part of the Drainage Study to accommodate expected flows from the Site.

The Drainage Study refers to the Site as Basin A-32, tributary to Design Point 66. At Design Point 66, the Drainage Study planned for developed flows of 57.04 CFS in the minor storm, and 121.25 CFS in the major storm. The proposed improvements to the Site result in developed flows of 20.8 CFS in the minor storm, and 76.6 CFS in the major storm.

II. Specific Details

Basin A1 (2.40-acre) consists of portions of roofs, alleys, parking, sidewalks, landscaping. Runoff from this basin will surface-drain to proposed alley, be conveyed via inverted crown to a proposed 5' Type R curb inlet in sump tributary to Design Point 3, and ultimately be conveyed through proposed on-site storm sewer to the Site outfall into the Newline Gulch Spring Tributary. The inlet captures 100% of the runoff in the major storm event. Peak runoff rate from Basin A1 is calculated to be 9.1 CFS for the major storm event.

Basin A7 (2.36-acre) consists of portions of roofs, alleys, drives, parking, sidewalks, landscaping. Runoff from this basin will surface-drain to proposed private road, be

conveyed via curb and gutter to a proposed 10' Type R curb inlet in sump at Design Point 5, and ultimately be conveyed through proposed on-site storm sewer to the Site outfall into the Newline Gulch Spring Tributary. The inlet captures 100% of the runoff in the major storm event. Peak runoff rate from Basin A7 is calculated to be 9.7 CFS for the major storm event.

Basin A8 (1.21-acre) consists of portions of roofs, alleys, drives, parking, sidewalks, landscaping. Runoff from this basin will surface-drain to proposed private road, be conveyed via curb and gutter to a proposed 5' Type R curb inlet in sump at Design Point 6, and ultimately be conveyed through proposed on-site storm sewer to the Site outfall into the Newline Gulch Spring Tributary. The inlet captures 100% of the runoff in the major storm event. Peak runoff rate from Basin A8 is calculated to be 6.9 CFS for the major storm event.

Basin B1 (1.71-acre) consists of portions of roofs, alleys, drives, parking, sidewalks, landscaping. Runoff from this basin will surface-drain to proposed private road, be conveyed via curb and gutter to a proposed 5' Type R curb inlet tributary to Design Point 3, and ultimately be conveyed through proposed on-site storm sewer to the Site outfall into the Newline Gulch Spring Tributary. The inlet captures 49% of the runoff in the major storm event. The remaining flow (3.1 CFS) will be bypassed and conveyed via curb and gutter to Design Point 6. Peak runoff rate from Basin B1 is calculated to be 6.1 CFS for the major storm event.

Basin B2 (1.14-acre) consists of portions of roofs, drives, parking, sidewalks, landscaping. Runoff from this basin will surface-drain to proposed private road, be conveyed via curb and gutter to a proposed 5' Type R curb inlet tributary to Design Point 3, and ultimately be conveyed through proposed on-site storm sewer to the Site outfall into the Newline Gulch Spring Tributary. The inlet captures 52% of the runoff in the major storm event. The remaining flow (2.6 CFS) will be bypassed and conveyed via curb and gutter to Design Point 5. Peak runoff rate from Basin B2 is calculated to be 5.5 CFS for the major storm event.

Basin C1 (2.01-acre) consists of portions of roofs, alleys, parking, sidewalks, landscaping. Runoff from this basin will surface-drain to proposed alley, be conveyed via inverted crown to a proposed 5' Type R curb inlet in sump tributary to Design Point 4, and ultimately be conveyed through proposed on-site storm sewer to the Site outfall

into the Newline Gulch Spring Tributary. The inlet captures 100% of the runoff in the major storm event. Peak runoff rate from Basin C1 is calculated to be 8.4 CFS for the major storm event.

Basin D1 (1.36-acre) consists of portions of roofs, alleys, drives, parking, sidewalks, landscaping. Runoff from this basin will surface-drain to proposed private road, be conveyed via curb and gutter to a proposed 5' Type R curb inlet tributary to Design Point 1, and ultimately be conveyed through proposed on-site storm sewer to the Site outfall into the Newline Gulch Spring Tributary. The inlet captures 52% of the runoff in the major storm event. The remaining flow (2.7 CFS) will be bypassed and conveyed via curb and gutter to Inlet E1. Peak runoff rate from Basin D1 is calculated to be 5.6 CFS for the major storm event.

Basin D2 (0.56-acre) consists of portions of roofs, alleys, drives, parking, sidewalks, landscaping. Runoff from this basin will surface-drain to proposed private road, be conveyed via curb and gutter to a proposed 5' Type R curb inlet at Design Point 1, and ultimately be conveyed through proposed on-site storm sewer to the Site outfall into the Newline Gulch Spring Tributary. The inlet captures 71% of the runoff in the major storm event. The remaining flow (0.9 CFS) will be bypassed and conveyed via curb and gutter to Design Point 2. Peak runoff rate from Basin D2 is calculated to be 3.0 CFS for the major storm event.

Basin D3 (0.59-acre) consists of portions of roofs, alleys, drives, parking, sidewalks, landscaping. Runoff from this basin will surface-drain to proposed private road, be conveyed via curb and gutter to a proposed 5' Type R curb inlet at Design Point 2, and ultimately be conveyed through proposed on-site storm sewer to the Site outfall into the Newline Gulch Spring Tributary. The inlet captures 60% of the runoff in the major storm event. The remaining flow (1.7 CFS) will be bypassed and conveyed via curb and gutter to Design Point 6. Peak runoff rate from Basin D3 is calculated to be 3.4 CFS for the major storm event.

Basin E1 (1.65-acre) consists of portions of roofs, alleys, drives, parking, sidewalks, landscaping. Runoff from this basin will surface-drain to proposed private road, be conveyed via curb and gutter to a proposed 5' Type R curb inlet tributary to Design Point 2, and ultimately be conveyed through proposed on-site storm sewer to the Site outfall into the Newline Gulch Spring Tributary. The inlet captures 33% of the runoff in

the major storm event. The remaining flow (7.9 CFS) will be bypassed and conveyed via curb and gutter to Design Point 5. Peak runoff rate from Basin E1 is calculated to be 9.1 CFS for the major storm event.

Basin P (3.78-acre) consists of portions of landscaping on the northern perimeter of the Site. Runoff from this basin will drain overland and discharge off Site to the north to the Newline Gulch Spring Tributary, following existing drainage patterns. Peak runoff rate from Basin P is calculated to be 18.9 CFS for the major storm event.

F. CONCLUSIONS

The drainage design is prepared in compliance with the MHFD & Douglas County Criteria Manuals.

Additionally, all improvements proposed with this development are designed in accordance with prescriptions described in the Phase III Drainage Report for Lagae Ranch.

The proposed project will not adversely affect drainage patterns on the Site, or negatively affect adjacent, upstream, or downstream property.

G. LIST OF REFERENCES

Storm Drainage Design and Technical Criteria Manual, Douglas County, June 2019.

Urban Storm Drainage Criteria Manual, Volumes 1, Mile High Flood District, Revised August 2018.

Urban Storm Drainage Criteria Manual, Volumes 2, Mile High Flood District, Revised September 2017.

Urban Storm Drainage Criteria Manual, Volumes 3, Mile High Flood District, Revised October 2019.

National Flood Hazard Layer FIRMette, United States Department of Homeland Security, Federal Emergency Management Agency, Accessed October 30, 2019.

Custom Soil Resource Report, Natural Resources Conservation Service, United States Department of Agriculture.

Phase III Drainage Report for Lagae Ranch, Lund Partnership, Revised July 31, 2013.

Amendment No. 2 to the Phase III Drainage Report for Lagae Ranch, Rick Engineering Company, Dated November 1, 2018.

Modeling Hydraulic and Energy Gradients in Storm Sewers: A Comparison of Computational Methods; Urban Drainage and Flood Control District, Denver, CO 2009.

Appendix A

Hydrologic Computations

National Flood Hazard Layer FIRMette

FEMA

39°27'59.49"N

104°52'55.93"W

104°52'18.48"W

39°27'31.71"N

Feet 1:6,000

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

Legend

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

SPECIAL FLOOD HAZARD AREAS

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

OTHER AREAS OF FLOOD HAZARD

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

OTHER AREAS

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

GENERAL STRUCTURES

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

OTHER FEATURES

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

MAP PANELS

- Digital Data Available
- No Digital Data Available
- Unmapped

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/30/2019 at 11:00:52 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.

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 13. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988 (NAVD 88). These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. An average offset between NAVD 88 and the National Geodetic Vertical Datum of 1929 (NGVD 29) has been computed for each Douglas County flooding source. This offset was then applied to the NGVD 29 flood elevations that were not revised during the creation of this countywide format FIRM. The offsets for each flooding source shown on this FIRM are shown in the Douglas County Vertical Datum Offset Table below. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

Spatial Reference System Division
National Geodetic Survey, NOAA
Silver Spring Metro Center
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov. For information about additional control points maintained by Douglas County, please visit http://www.publicstaging.douglas.co.us/website/control/viewer.htm.

Base map information shown on this FIRM was provided by the Douglas County GIS Department and the Town of Castle Rock GIS Department. Additional input was provided by the City of Lone Tree and Town of Parker. These data are current as of 2003.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov.

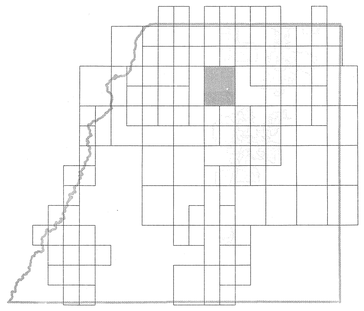
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.

Douglas County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)	Flooding Source	Vertical Datum Offset (ft)
Baldwin Gulch	3.10	Newlin Gulch	3.14
Bayou Gulch	3.22	Plum Creek, Cross Section A to D	3.12
Big Dry Creek Tributary C	3.15	Section 34 Tributary	3.62
Carpenter Creek	3.93	Sellers Gulch	3.43
Cherry Creek, Cross Section BZ to CU	3.23	Sellers Gulch, Unnamed Tributary	3.39
East Plum Creek, Cross Section W to AY	3.26	Sulphur Gulch	3.13
East Plum Creek, Cross Section AZ to CZ	3.49	Tallman Gulch	3.16
East Plum Creek, Cross Section DA to EM	3.71	West Plum Creek, Cross Section W to AM	3.88
Glade Gulch	3.65		
Happy Canyon Creek	3.12		

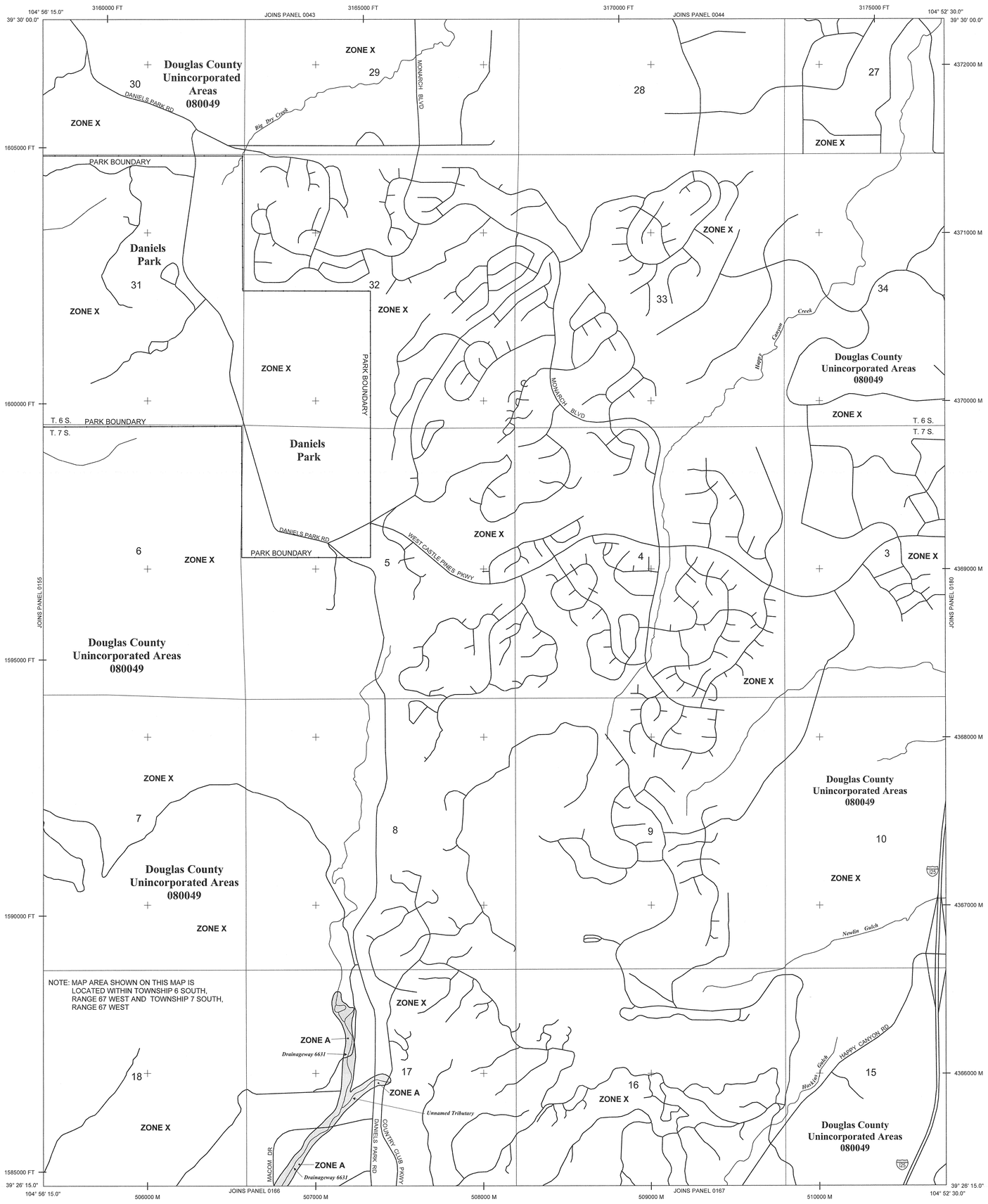
Example: To convert Baldwin Gulch elevations to NAVD 88, 3.10 feet were added to the NGVD 29 elevations.

Panel Location Map



This digital Flood Insurance Rate Map (FIRM) was produced through a cooperative partnership between the State of Colorado Water Conservation Board, the Urban Drainage and Flood Control District, and the Federal Emergency Management Agency (FEMA). The State of Colorado Water Conservation Board and the Urban Drainage and Flood Control District have implemented a long-term approach of floodplain management to reduce the costs associated with flooding. As part of this effort, both the State of Colorado and the Urban Drainage and Flood Control District have joined in Cooperating Technical Partner agreements with FEMA to produce this digital FIRM.

Additional flood hazard information and resources are available from local communities, the Colorado Water Conservation Board, and the Urban Drainage and Flood Control District.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

	Floodplain boundary
	Floodway boundary
	Zone D boundary
	Boundary dividing Special Flood Hazard Area zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
104° 50' 37.5", 39° 30' 00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4276000 M	1000-meter Universal Transverse Mercator grid ticks, zone 13
3180000 FT	5000-foot ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 502), Lambert Conformal Conic projection
× KK6400	National Geodetic Survey bench mark (see explanation in Notes to Users section of this FIRM panel

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
SEPTEMBER 30, 2005

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0160F

FIRM
FLOOD INSURANCE RATE MAP
DOUGLAS COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 160 OF 495
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
DOUGLAS COUNTY	080049	0160	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08035C0160F

EFFECTIVE DATE
SEPTEMBER 30, 2005

Federal Emergency Management Agency

United States Department of Agriculture

Natural Resources Conservation Service

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

Custom Soil Resource Report for

Castle Rock Area, Colorado

October 30, 2019

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.

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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: 1:2,460 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

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 12, Sep 13, 2019

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

Date(s) aerial images were photographed: Jul 24, 2018—Nov 19, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
FoD	Fondis clay loam, 3 to 9 percent slopes	7.2	32.7%
Fu	Fondis-Kutch association	14.8	67.3%
Totals for Area of Interest		**22.1**	**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

FoD—Fondis clay loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: jqyp
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

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

Description of Fondis

Setting

Landform: Mesas, buttes, ridges
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits over coarse-silty outwash derived from arkose

Typical profile

H1 - 0 to 7 inches: clay loam
H2 - 7 to 24 inches: clay
H3 - 24 to 60 inches: sandy clay loam

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural 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 in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: Clayey Foothill (R049BY208CO)
Hydric soil rating: No

Minor Components

Kutch

Percent of map unit: 5 percent

Hydric soil rating: No

Englewood

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

Denver

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

Aquic haplustolls

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

Fu—Fondis-Kutch association

Map Unit Setting

National map unit symbol: jqyq
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

Fondis and similar soils: 50 percent
Kutch and similar soils: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fondis

Setting

Landform: Valley sides, draws
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits over coarse-silty outwash derived from arkose

Typical profile

H1 - 0 to 7 inches: loam
H2 - 7 to 24 inches: clay
H3 - 24 to 60 inches: sandy clay loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural 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 in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Clayey Foothill (R049BY208CO)
Hydric soil rating: No

Description of Kutch

Setting

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Fine-textured residuum weathered from calcareous 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 40 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Very 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 in profile: 15 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Bresser

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

Newlin

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

Hilly gravelly land

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

Aquic haplustolls

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

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Project Name:	Lagae Ranch
	Composite C-Value Computations
	Post-Development
Project No:	190920
Date:	02/05/20
Revised:	02/05/20
Design by:	TAN
Checked by:	KPK

BASIN	TOTAL AREA (ACRES)	ROOFS (100%)	STREETS (100%)	WALKS (90%)	LANDSCAPE AREA (2%)	PERCENT IMPERVIOUS	C_5=	C_{100}=
A1	2.40	0.60	0.45	0.15	1.20	38%	0.34	0.64
A7	2.36	0.70	0.59	0.24	0.83	42%	0.38	0.66
A8	1.21	0.37	0.40	0.15	0.29	40%	0.36	0.65
B1	1.71	0.23	0.33	0.13	1.02	28%	0.26	0.60
B2	1.14	0.25	0.25	0.17	0.47	34%	0.31	0.62
C1	2.01	0.53	0.47	0.13	0.88	38%	0.35	0.64
D1	1.36	0.33	0.28	0.10	0.65	36%	0.33	0.63
D2	0.56	0.12	0.19	0.04	0.21	30%	0.28	0.61
D3	0.59	0.21	0.16	0.05	0.17	43%	0.38	0.66
E1	1.65	0.65	0.50	0.11	0.39	47%	0.42	0.68
P	3.78	0.00	0.00	0.00	3.78	20%	0.20	0.57
TOTAL	18.77	3.99	3.62	1.27	9.89	54%		

TYPE C/D HYDRAULIC SOIL	
5 YR - $C_{C/D}$ =	0.82i+0.035
100 YR - $C_{C/D}$ =	0.41i+0.484

< Table 6-4; 2018 USDCM Vol. 1

Project Name: Lagae Ranch
Project No: 190920
Date: 02/05/20
Revised: 02/05/20

STANDARD FORM SF-2
TIME OF CONCENTRATION

Designed By: TAN
Checked By: KPK

SUB-BASIN DATA			INITIAL/OVERLAND TIME (T_i)			TRAVEL TIME (T_t)					Tc CHECK (URBANIZED BASINS)			FINAL	REMARKS
BASIN	AREA (AC)	C_5	LENGTH (FT)	SLOPE %	Ti (MIN)	LENGTH (FT)	SLOPE %	C_v k	VELOCITY (FPS)	Tt (MIN)	COMPOS. Tc (MIN)	TOTAL LENGTH	Tc = (L/180) + 10 (MIN)	Tc (MIN)	
A1	2.40	0.34	273	7.24	11.86	581	1.72	20	2.62	3.69	15.55	854	14.74	14.74	
A7	2.36	0.26	170	3.68	12.98	433	1.50	20	2.45	2.95	15.93	603	13.35	13.35	
A8	1.21	0.31	17.5	12.79	2.59	265	1.13	20	2.13	2.08	5.00	283	11.57	5.00	
B1	1.71	0.35	289	6.28	12.75	555	2.30	20	3.03	3.05	15.80	844	14.69	14.69	
B2	1.14	0.38	17	1.77	4.50	639	2.86	20	3.38	3.15	7.65	656	13.64	7.65	
C1	2.01	0.36	64	1.80	8.90	518	1.91	20	2.76	3.12	12.03	582	13.23	12.03	
D1	1.36	0.33	168	5.86	10.18	346	2.40	20	3.10	1.86	12.04	514	12.86	12.04	
D2	0.56	0.28	25	5.79	4.17	123	2.33	20	3.05	0.67	5.00	148	10.82	5.00	
D3	0.59	0.42	18	9.11	2.53	135	2.00	20	2.83	0.80	5.00	153	10.85	5.00	
E1	1.65	0.38	36	11.16	3.52	552	2.19	20	2.96	3.11	6.63	588	13.27	6.63	
P	3.78	0.20			0.00				0.00	0.00	0.00	-	0.00	5.00	

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*https://udfcd.org/wp-content/uploads/uploads/vol1%20criteria%20manual/06_Runoff.pdf

Project Name: Lagae Ranch
Project No: 190920
Date: 02/05/20
Revised: 02/05/20

STANDARD FORM SF-2
Post-Development
Rational Method Procedure

Designed By: TAN
Checked By: KPK
Design Storm: 5 YR

		DIRECT RUNOFF						TOTAL RUNOFF				INLET					CARRYOVER FLOWS					
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	Tc (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	Tc (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS)	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	BYPASS RUNOFF, Q (CFS)	LENGTH (FT)	SLOPE (%)	VELOCITY (FPS)	Tt (min)	REMARKS
D1		1.36	0.33	12.04	0.45	3.58	1.6					2.00	1.6	1.5	1.5	0.1	0.1					Carryover flow is conveyed to Inlet E1
D2		0.56	0.28	5.00	0.16	4.85	0.8					2.00	0.8	0.8	0.8	0.0	0.0					Carryover flow is conveyed to Inlet D3
	1							12.04	0.58	3.58	2.1											
E1		1.65	0.42	6.63	0.70	4.47	3.1					2.00	3.2	2.2	2.2	1.0	1.0					Carryover flow is conveyed to Inlet A7
D3		0.59	0.38	5.00	0.23	4.85	1.1					2.00	1.1	1.1	1.1	0.0	0.0					Carryover flow is conveyed to Inlet A8
	2							12.04	1.30	3.58	4.6											
A1		2.40	0.34	14.74	0.82	3.27	2.7					SUMP	2.7	5.4	2.7	0.0						
B1		1.71	0.26	14.69	0.45	3.28	1.5					2.00	1.5	1.4	1.4	0.1	0.1					Carryover flow is conveyed to Inlet A8
B2		1.14	0.31	7.65	0.35	4.27	1.5					2.00	1.5	1.4	1.4	0.1	0.1					Carryover flow is conveyed to Inlet A7
	3							14.74	1.58	3.27	5.2											
C1		2.01	0.35	12.03	0.69	3.59	2.5					SUMP	2.5	5.4	2.5	0.0						
	4							14.74	2.27	3.27	7.4											
A7		2.36	0.38	13.35	0.90	3.43	3.1					SUMP	4.2	10.5	4.2	0.0						Accepts carryover flow from inlets B2 & E1
	5							14.74	3.49	3.27	11.4											
A8		1.21	0.36	5.00	0.44	4.85	2.1					SUMP	2.2	5.4	2.2	0.0						Accepts carryover flow from inlets B1 & D3
	6							14.74	3.95	3.27	12.9											
	7							14.74	5.24	3.27	17.2											Discharged off-site to Newline Tributary
P	8	3.78	0.20	5.00	0.75	4.85	3.6															Discharged off-site overland
SITE TOTAL											20.8											

Project Name: Lagae Ranch
Project No: 190920
Date: 02/05/20
Revised: 02/05/20

STANDARD FORM SF-2
Post-Development
Rational Method Procedure

Designed By: TAN
Checked By: KPK
Design Storm: 100 YR

		DIRECT RUNOFF						TOTAL RUNOFF				INLET					CARRYOVER FLOWS					
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	Tc (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	Tc (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS)	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	BYPASS RUNOFF, Q (CFS)	LENGTH (FT)	SLOPE (%)	VELOCITY (FPS)	Tt (min)	REMARKS
D1		1.36	0.63	12.04	0.86	6.52	5.6					2.00	5.6	2.9	2.9	2.7	2.7					Carryover flow is conveyed to Inlet E1
D2		0.56	0.61	5.00	0.34	8.82	3.0					2.00	3.0	2.1	2.1	0.9	0.9					Carryover flow is conveyed to Inlet D3
	1							12.04	0.68	6.52	4.5											
E1		1.65	0.68	6.63	1.12	8.13	9.1					2.00	11.8	4.0	4.0	7.8	7.8					Carryover flow is conveyed to Inlet A7
D3		0.59	0.66	5.00	0.39	8.82	3.4					2.00	4.3	2.5	2.5	1.8	1.8					Carryover flow is conveyed to Inlet A8
	2							12.04	1.46	6.52	9.5											
A1		2.40	0.64	14.74	1.53	5.95	9.1					SUMP	9.1	12.3	9.1	0.0						
B1		1.71	0.60	14.69	1.02	5.96	6.1					2.00	6.1	3.0	3.0	3.1	3.1					Carryover flow is conveyed to Inlet A8
B2		1.14	0.62	7.65	0.71	7.76	5.5					2.00	5.5	2.9	2.9	2.6	2.6					Carryover flow is conveyed to Inlet A7
	3							14.74	2.41	5.95	14.3											
C1		2.01	0.64	12.03	1.28	6.52	8.4					SUMP	8.4	12.3	8.4	0.0						
	4							14.74	3.69	5.95	22.0											
A7		2.36	0.66	13.35	1.55	6.23	9.7					SUMP	20.0	25.5	20.0	0.0						Accepts carryover flow from inlets B2 & E1
	5							14.74	6.91	5.95	41.1											
A8		1.21	0.65	5.00	0.78	8.82	6.9					SUMP	11.8	12.3	11.8	0.0						Accepts carryover flow from inlets B1 & D3
	6							14.74	8.25	5.95	49.1											
	7							14.74	9.71	5.95	57.8											Discharged off-site to Newline Tributary
P	8	3.78	0.57	5.00	2.14	8.82	18.9															Discharged off-site overland
SITE TOTAL											76.6											

Appendix B

Hydraulic Computations

Version 4.05 Released March 2017

INLET MANAGEMENT

Worksheet Protected

INLET NAME	A1	B1	B2	C1	A7	A8
Site Type (Urban or Rural)						
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	In Sump	On Grade	On Grade	In Sump	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	2.7	1.5	1.5	2.5	3.1	2.1
Major Q_{Known} (cfs)	9.1	6.1	5.5	8.4	9.7	6.9

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	User-Defined	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	1.1	0.1
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	10.5	4.8

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)	**2.7**	**1.5**	**1.5**	**2.5**	**4.2**	**2.2**
Major Total Design Peak Flow, Q (cfs)	**9.1**	**6.1**	**5.5**	**8.4**	**20.2**	**11.7**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	0.1	0.1	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	3.1	2.6	N/A	N/A	N/A

Minor Storm (Calculated) Analysis of Flow Time

C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

Major Storm (Calculated) Analysis of Flow Time

C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

Version 4.05 Released March 2017

INLET MANAGEMENT

Worksheet Protected

INLET NAME	D1	D2	E1	D3
Site Type (Urban or Rural)				
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.6	0.8	3.1	1.1
Major Q_{Known} (cfs)	5.6	3.0	9.1	3.4

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	D1	D2
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.1	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	2.7	0.9

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)	**1.6**	**0.8**	**3.2**	**1.1**
Major Total Design Peak Flow, Q (cfs)	**5.6**	**3.0**	**11.8**	**4.3**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.1	0.0	1.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	2.7	0.9	7.9	1.7

Minor Storm (Calculated) Analysis of Flow T

C	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A

Major Storm (Calculated) Analysis of Flow T

C	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A

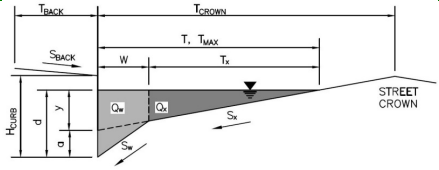
Version 4.05 Released March 2017

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

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

Project: **Enter Your Project Name Here**

Inlet ID: **A1**



Gutter Geometry (Enter data in the blue cells)

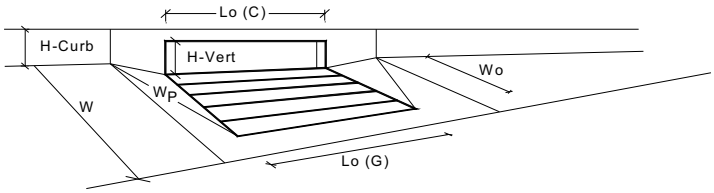
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	19.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.203	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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} =	0.012	

		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	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		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	12.0	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
Area Opening 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) =	5.00	5.00	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 =	2.00	2.00	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} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.7	9.1	cfs

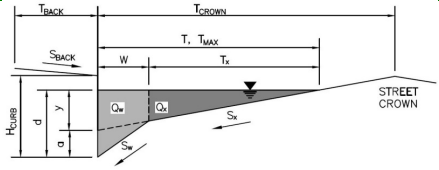
Version 4.05 Released March 2017

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

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

Project: **Enter Your Project Name Here**

Inlet ID: **A7**



Gutter Geometry (Enter data in the blue cells)

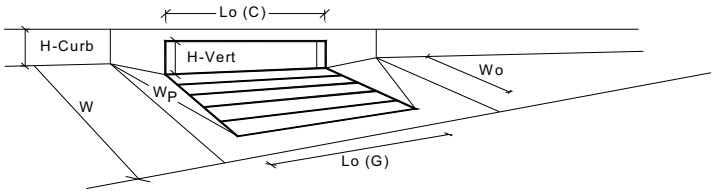
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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} =	0.014	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		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 =	2	2	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0	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
Area Opening 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) =	5.00	5.00	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 =	2.00	2.00	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} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.93	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**10.5**	**25.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	4.2	20.2	cfs

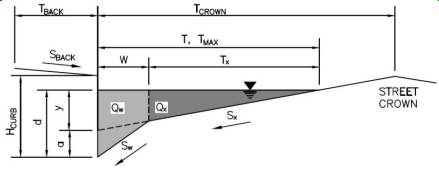
Version 4.05 Released March 2017

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

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

Project: **Enter Your Project Name Here**

Inlet ID: **A8**



Gutter Geometry (Enter data in the blue cells)

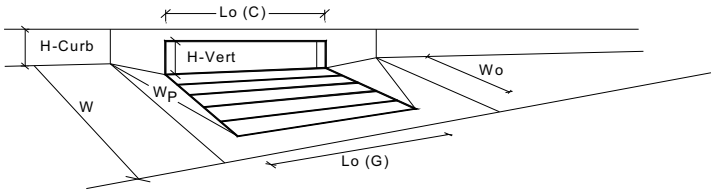
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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} =	0.014	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		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	12.0	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
Area Opening 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) =	5.00	5.00	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 =	2.00	2.00	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} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.2	11.7	cfs

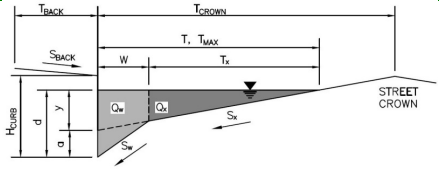
Version 4.05 Released March 2017

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

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

Project: **Enter Your Project Name Here**

Inlet ID: **B1**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	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} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.014	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

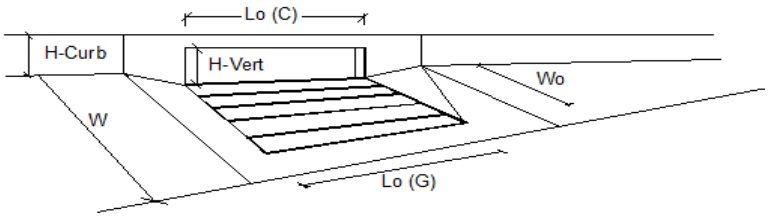
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**17.6**	**136.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.4**	**3.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**3.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**93**	**49**	**%**

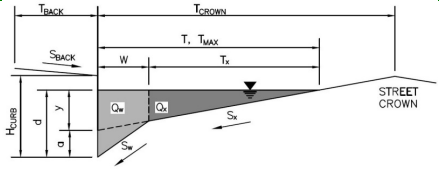
Version 4.05 Released March 2017

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

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

Project: **Enter Your Project Name Here**

Inlet ID: **B2**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	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} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.014	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

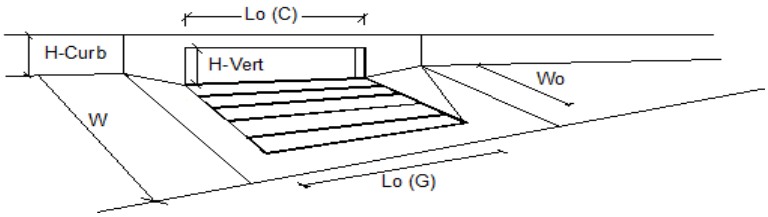
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**17.6**	**136.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.4**	**2.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**2.6**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**93**	**52**	**%**

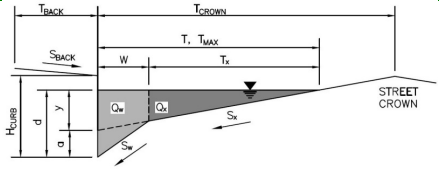
Version 4.05 Released March 2017

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

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

Project: **Enter Your Project Name Here**

Inlet ID: **C1**



Gutter Geometry (Enter data in the blue cells)

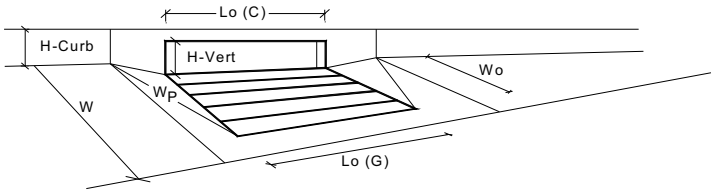
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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} =	0.012	

		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	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		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	12.0	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
Area Opening 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) =	5.00	5.00	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 =	2.00	2.00	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} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.5	8.4	cfs

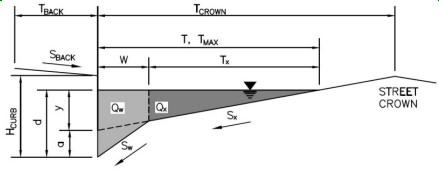
Version 4.05 Released March 2017

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

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

Project: **Enter Your Project Name Here**

Inlet ID: **D1**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	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} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.014	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

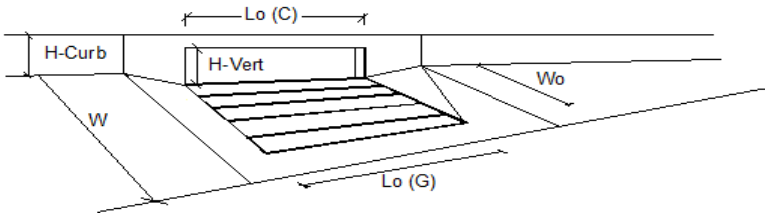
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**17.6**	**136.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.5**	**2.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**2.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**92**	**52**	**%**

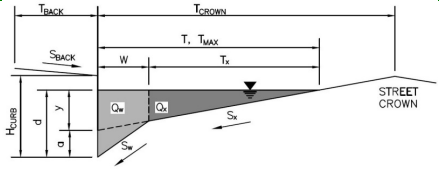
Version 4.05 Released March 2017

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

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

Project: **Enter Your Project Name Here**

Inlet ID: **D2**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	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} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.014	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

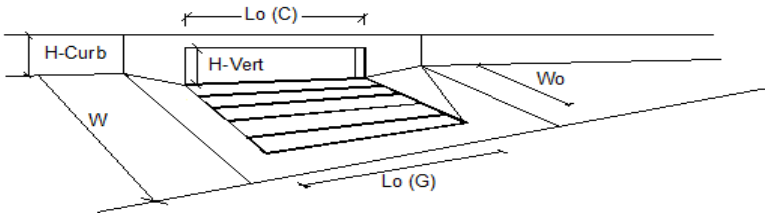
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**17.6**	**136.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.8**	**2.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.9**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**71**	**%**

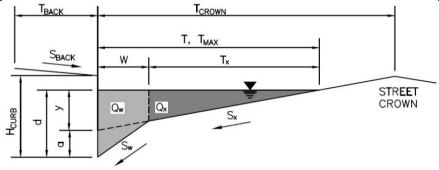
Version 4.05 Released March 2017

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

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

Project: **Enter Your Project Name Here**

Inlet ID: **D3**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	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} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.014	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

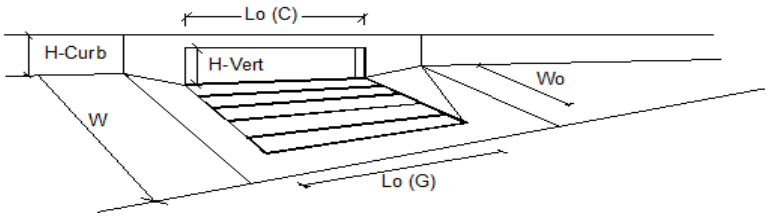
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**17.6**	**136.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.1**	**2.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**99**	**60**	**%**

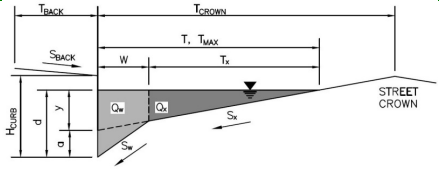
Version 4.05 Released March 2017

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

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

Project: **Enter Your Project Name Here**

Inlet ID: **E1**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	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} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.014	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

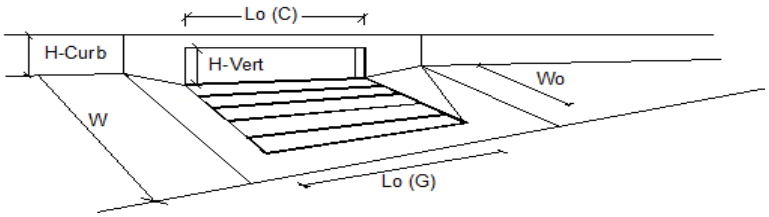
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**17.6**	**136.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

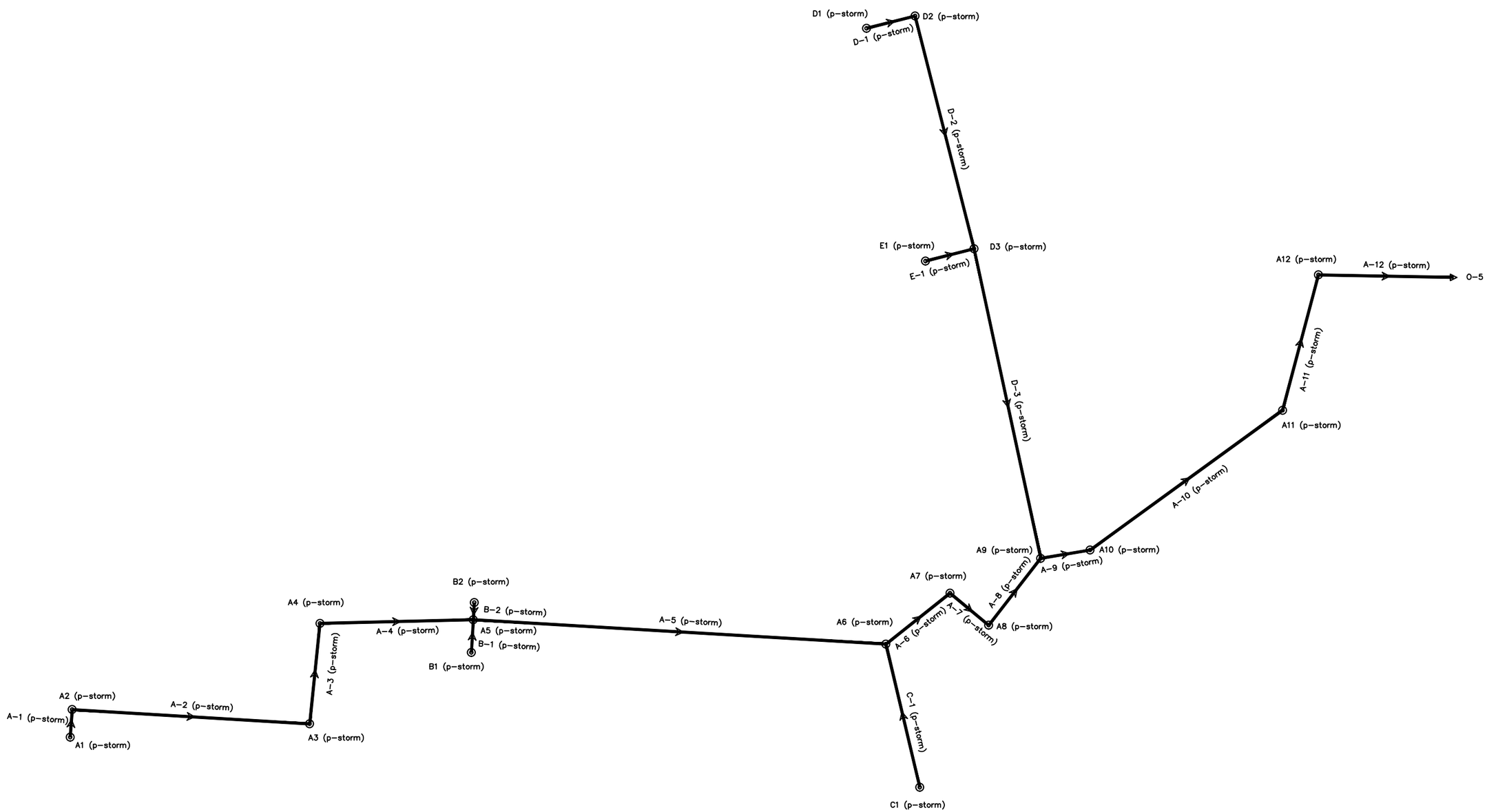
INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.2**	**4.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.0**	**7.9**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**69**	**33**	**%**

Filepath: P:\190920\ENGINEERING\EXHIBIT\STORMCAD LAYOUT.DWG Layout: LAYOUT2
NO CHANGES ARE TO BE MADE TO THIS DRAWING WITHOUT WRITTEN PERMISSION OF HARRIS KOCHER SMITH.
Plotted: WED 02/05/20 4:56:28P By: Tom Nichols



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

STORMCAD LAYOUT

SCALE: 1" = 80'

80 0 80 160

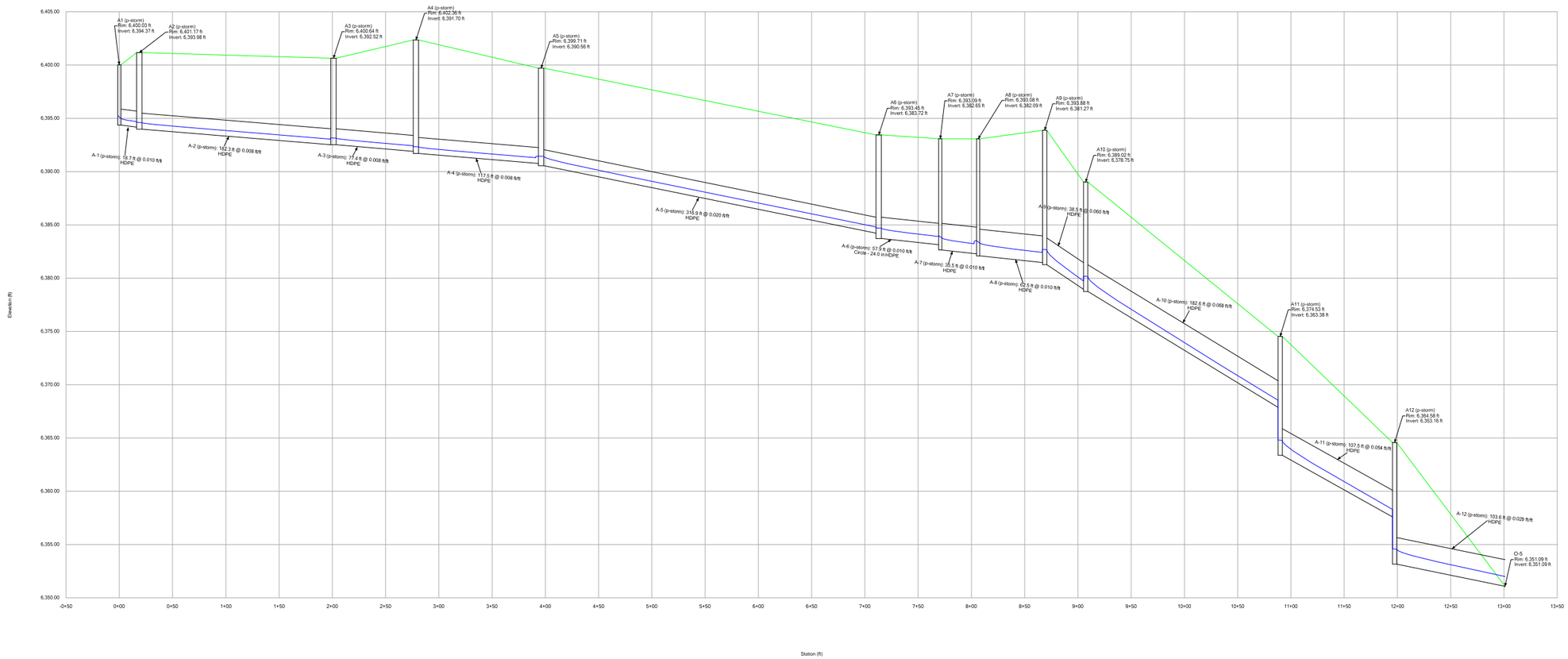
SCALE: 1" = 80'

FlexTable: Conduit Table

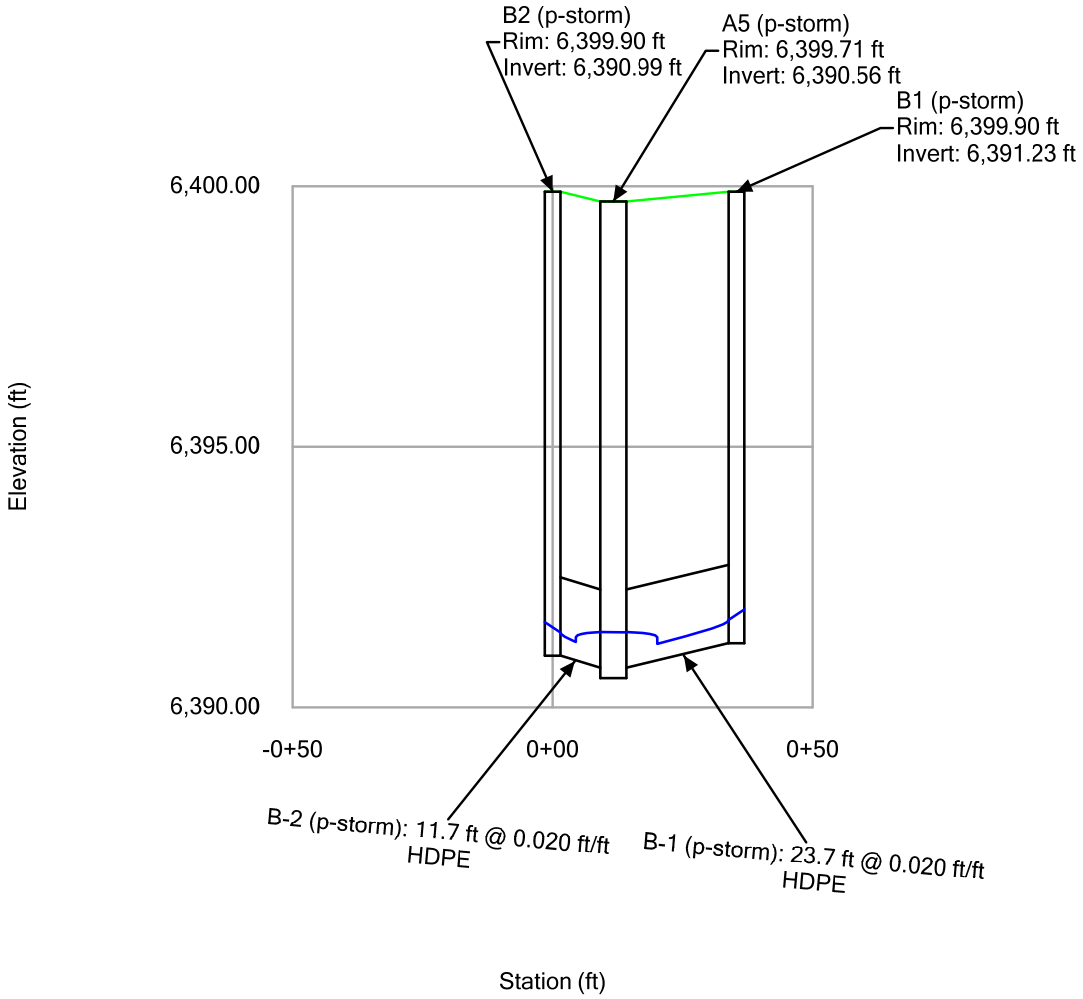
Active Scenario: 5 YR

Label	Notes	Diameter (in)	Manning's n	Start Node	Stop Node	Length (Unified) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Flow (cfs)	Capacity (Full Flow) (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
A-1 (p-storm)	18" HDPE	18.0	0.012	A1 (p-storm)	A2 (p-storm)	18.7	6,394.37	6,394.18	0.010	2.70	11.38	5.28	6,394.99	6,394.69	6,395.22	6,395.09
A-2 (p-storm)	18" HDPE	18.0	0.012	A2 (p-storm)	A3 (p-storm)	182.3	6,393.98	6,392.52	0.008	2.70	10.18	4.87	6,394.60	6,393.16	6,394.84	6,393.38
A-3 (p-storm)	18" HDPE	18.0	0.012	A3 (p-storm)	A4 (p-storm)	77.4	6,392.52	6,391.90	0.008	2.70	10.18	4.87	6,393.14	6,392.43	6,393.38	6,392.80
A-4 (p-storm)	18" HDPE	18.0	0.012	A4 (p-storm)	A5 (p-storm)	117.5	6,391.70	6,390.76	0.008	2.70	10.18	4.87	6,392.32	6,391.45	6,392.56	6,391.63
A-5 (p-storm)	18" HDPE	18.0	0.012	A5 (p-storm)	A6 (p-storm)	316.9	6,390.56	6,384.22	0.020	5.20	16.09	8.12	6,391.44	6,384.81	6,391.80	6,385.84
A-6 (p-storm)	24" HDPE	24.0	0.012	A6 (p-storm)	A7 (p-storm)	57.9	6,383.72	6,383.15	0.010	7.40	24.51	6.83	6,384.69	6,383.91	6,385.07	6,384.61
A-7 (p-storm)	30" HDPE	30.0	0.012	A7 (p-storm)	A8 (p-storm)	35.5	6,382.65	6,382.29	0.010	11.40	44.43	7.58	6,383.78	6,383.53	6,384.21	6,383.87
A-8 (p-storm)	30" HDPE	30.0	0.012	A8 (p-storm)	A9 (p-storm)	62.5	6,382.09	6,381.47	0.010	12.90	44.43	7.84	6,383.30	6,382.70	6,383.77	6,383.15
A-9 (p-storm)	30" HDPE	30.0	0.012	A9 (p-storm)	A10 (p-storm)	38.5	6,381.27	6,378.96	0.060	17.20	108.88	16.19	6,382.67	6,379.74	6,383.24	6,382.43
A-10 (p-storm)	30" HDPE	30.0	0.012	A10 (p-storm)	A11 (p-storm)	182.6	6,378.76	6,367.88	0.060	17.20	108.48	16.15	6,380.16	6,368.55	6,380.73	6,372.60
A-11 (p-storm)	30" HDPE	30.0	0.012	A11 (p-storm)	A12 (p-storm)	107.5	6,363.38	6,357.60	0.054	17.20	103.03	15.57	6,364.78	6,358.30	6,365.35	6,361.89
A-12 (p-storm)	30" HDPE	30.0	0.012	A12 (p-storm)	O-5	103.6	6,353.16	6,351.09	0.020	17.20	62.83	10.91	6,354.56	6,352.00	6,355.13	6,353.73
B-1 (p-storm)	18" HDPE	18.0	0.012	B1 (p-storm)	A5 (p-storm)	23.7	6,391.23	6,390.76	0.020	1.40	16.09	5.59	6,391.68	6,391.45	6,391.84	6,391.50
B-2 (p-storm)	18" HDPE	18.0	0.012	B2 (p-storm)	A5 (p-storm)	11.7	6,390.99	6,390.76	0.020	1.40	16.09	5.59	6,391.44	6,391.45	6,391.60	6,391.50
C-1 (p-storm)	18" HDPE	18.0	0.012	C1 (p-storm)	A6 (p-storm)	110.3	6,385.53	6,384.42	0.010	2.50	11.38	5.16	6,386.13	6,384.90	6,386.35	6,385.32
D-1 (p-storm)	18" HDPE	18.0	0.012	D1 (p-storm)	D2 (p-storm)	35.3	6,396.13	6,395.43	0.020	1.50	16.09	5.70	6,396.59	6,395.74	6,396.76	6,396.24
D-2 (p-storm)	18" HDPE	18.0	0.012	D2 (p-storm)	D3 (p-storm)	179.0	6,395.23	6,391.65	0.020	2.10	16.09	6.29	6,395.77	6,392.33	6,395.97	6,392.44
D-3 (p-storm)	18" HDPE	18.0	0.012	D3 (p-storm)	A9 (p-storm)	240.4	6,391.45	6,382.47	0.037	4.60	21.99	9.84	6,392.27	6,382.93	6,392.60	6,384.44
E-1 (p-storm)	18" HDPE	18.0	0.012	E1 (p-storm)	D3 (p-storm)	35.3	6,392.35	6,391.65	0.020	2.20	16.09	6.38	6,392.91	6,392.34	6,393.12	6,392.46

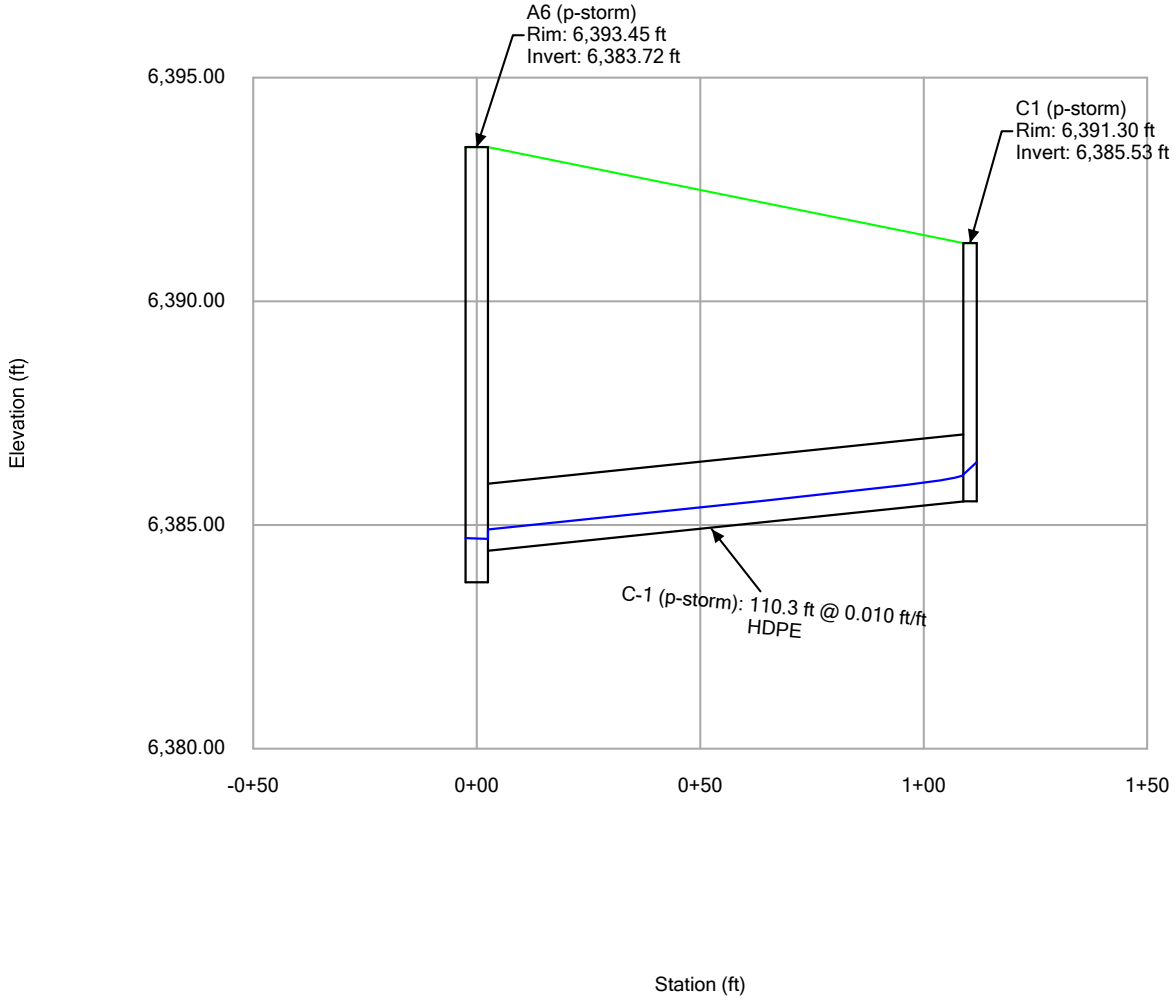
Profile Report
Engineering Profile - Line A (190920.stsw)
Active Scenario: 5 YR



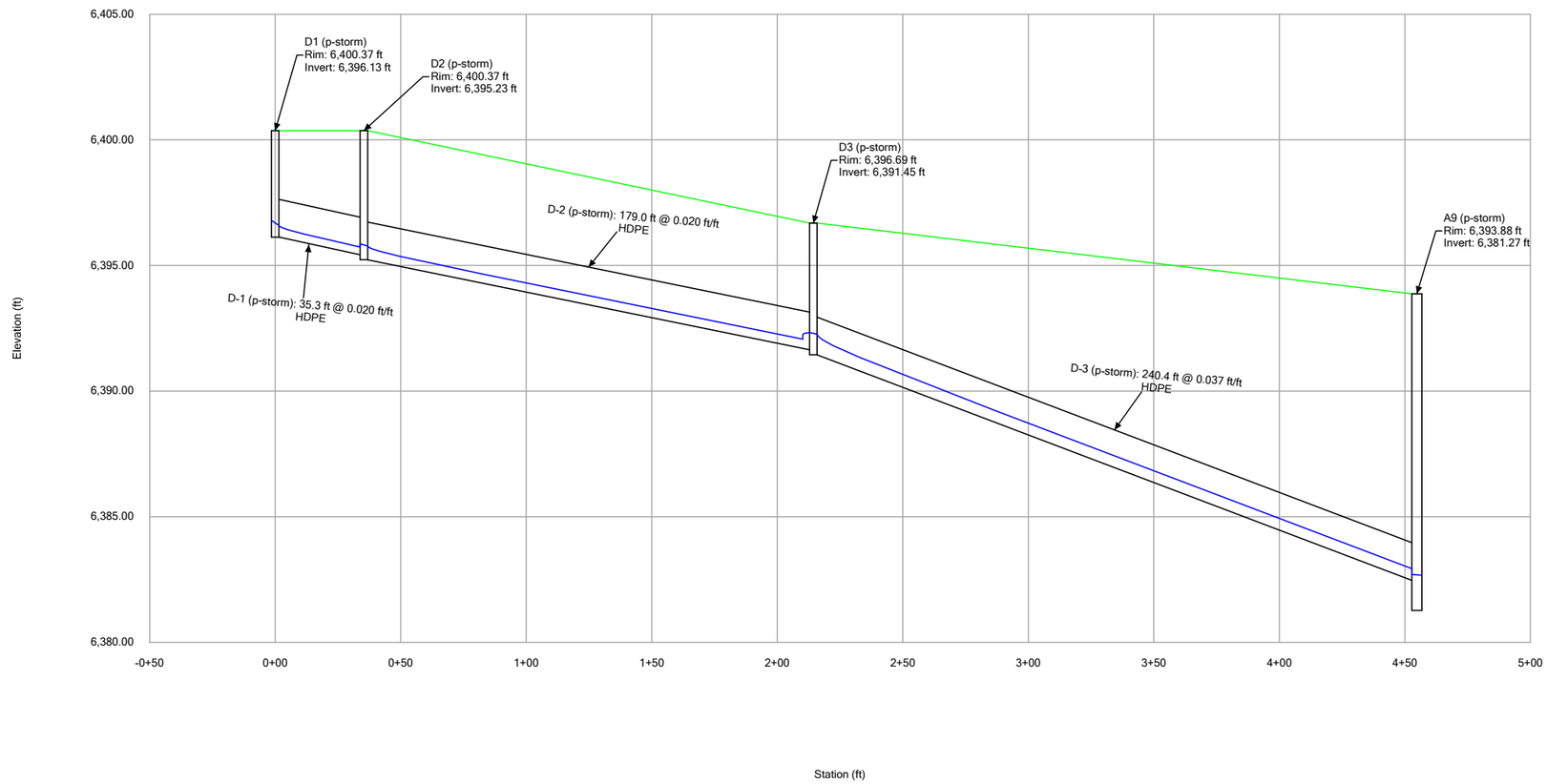
Profile Report
Engineering Profile - Line B (190920.stsw)
Active Scenario: 5 YR



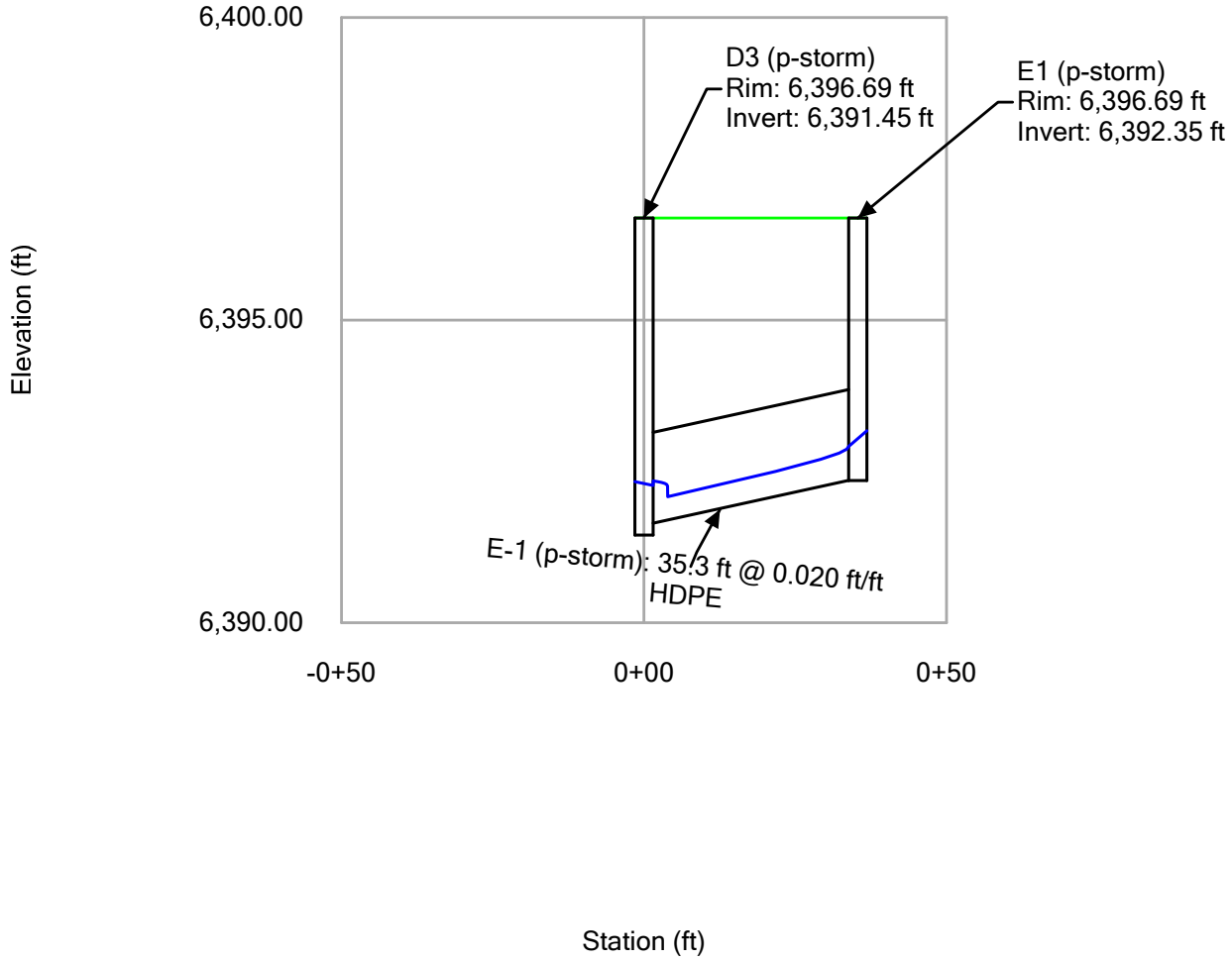
Profile Report
Engineering Profile - Line C (190920.stsw)
Active Scenario: 5 YR



Profile Report
Engineering Profile - Line D (190920.stsw)
Active Scenario: 5 YR



Profile Report
Engineering Profile - Line E (190920.stsw)
Active Scenario: 5 YR

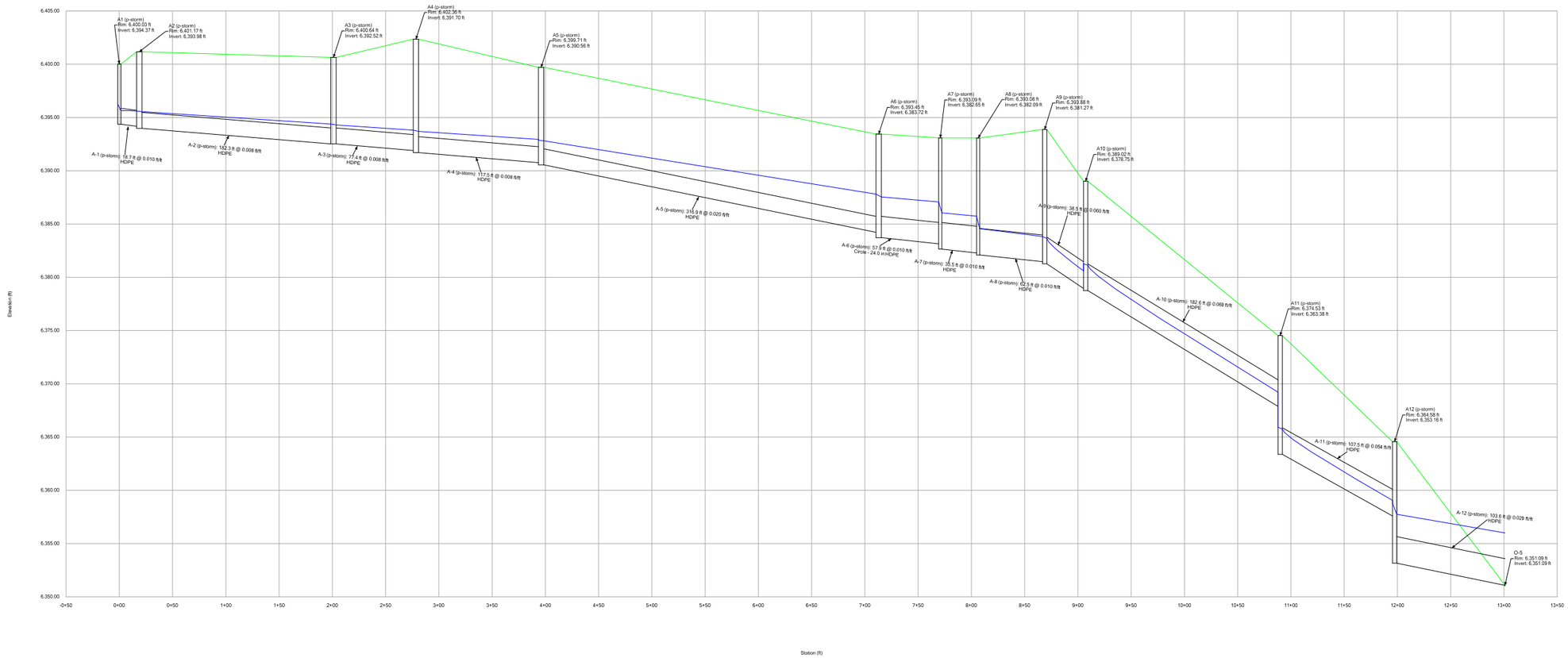


FlexTable: Conduit Table

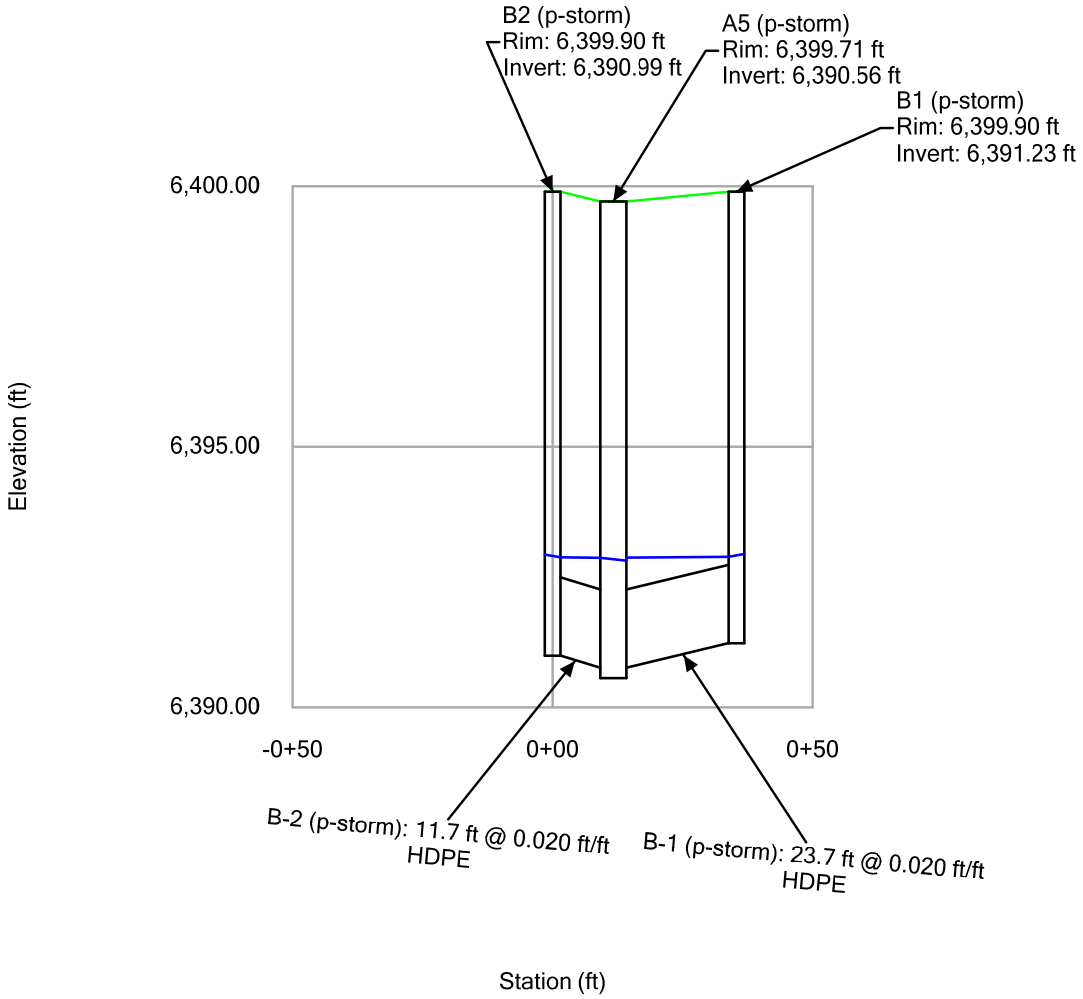
Active Scenario: 100 YR

Label	Notes	Diameter (in)	Manning's n	Start Node	Stop Node	Length (Unified) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Flow (cfs)	Capacity (Full Flow) (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
A-1 (p-storm)	18" HDPE	18.0	0.012	A1 (p-storm)	A2 (p-storm)	18.7	6,394.37	6,394.18	0.010	9.10	11.38	7.15	6,395.65	6,395.61	6,396.15	6,396.04
A-2 (p-storm)	18" HDPE	18.0	0.012	A2 (p-storm)	A3 (p-storm)	182.3	6,393.98	6,392.52	0.008	9.10	10.18	5.15	6,395.55	6,394.39	6,395.97	6,394.80
A-3 (p-storm)	18" HDPE	18.0	0.012	A3 (p-storm)	A4 (p-storm)	77.4	6,392.52	6,391.90	0.008	9.10	10.18	5.15	6,394.30	6,393.81	6,394.72	6,394.22
A-4 (p-storm)	18" HDPE	18.0	0.012	A4 (p-storm)	A5 (p-storm)	117.5	6,391.70	6,390.76	0.008	9.10	10.18	5.15	6,393.70	6,392.95	6,394.11	6,393.36
A-5 (p-storm)	18" HDPE	18.0	0.012	A5 (p-storm)	A6 (p-storm)	316.9	6,390.56	6,384.22	0.020	14.30	16.09	8.09	6,392.81	6,387.81	6,393.83	6,388.83
A-6 (p-storm)	24" HDPE	24.0	0.012	A6 (p-storm)	A7 (p-storm)	57.9	6,383.72	6,383.15	0.010	22.00	24.51	7.00	6,387.54	6,387.08	6,388.31	6,387.84
A-7 (p-storm)	30" HDPE	30.0	0.012	A7 (p-storm)	A8 (p-storm)	35.5	6,382.65	6,382.29	0.010	41.10	44.43	8.37	6,386.05	6,385.74	6,387.14	6,386.83
A-8 (p-storm)	30" HDPE	30.0	0.012	A8 (p-storm)	A9 (p-storm)	62.5	6,382.09	6,381.47	0.010	49.10	44.43	10.00	6,384.56	6,383.82	6,386.12	6,385.45
A-9 (p-storm)	30" HDPE	30.0	0.012	A9 (p-storm)	A10 (p-storm)	38.5	6,381.27	6,378.96	0.060	57.80	108.88	22.51	6,383.65	6,380.60	6,385.88	6,385.03
A-10 (p-storm)	30" HDPE	30.0	0.012	A10 (p-storm)	A11 (p-storm)	182.6	6,378.76	6,367.88	0.060	57.80	108.48	22.45	6,381.14	6,369.22	6,383.37	6,376.43
A-11 (p-storm)	30" HDPE	30.0	0.012	A11 (p-storm)	A12 (p-storm)	107.5	6,363.38	6,357.60	0.054	57.80	103.03	21.59	6,365.75	6,359.07	6,367.99	6,364.85
A-12 (p-storm)	30" HDPE	30.0	0.012	A12 (p-storm)	O-5	103.6	6,353.16	6,351.09	0.020	57.80	62.83	11.77	6,357.75	6,356.00	6,359.91	6,358.15
B-1 (p-storm)	18" HDPE	18.0	0.012	B1 (p-storm)	A5 (p-storm)	23.7	6,391.23	6,390.76	0.020	3.00	16.09	1.70	6,392.89	6,392.87	6,392.93	6,392.92
B-2 (p-storm)	18" HDPE	18.0	0.012	B2 (p-storm)	A5 (p-storm)	11.7	6,390.99	6,390.76	0.020	2.90	16.09	1.64	6,392.88	6,392.87	6,392.92	6,392.91
C-1 (p-storm)	18" HDPE	18.0	0.012	C1 (p-storm)	A6 (p-storm)	110.3	6,385.53	6,384.42	0.010	8.40	11.38	4.75	6,388.54	6,387.94	6,388.90	6,388.29
D-1 (p-storm)	18" HDPE	18.0	0.012	D1 (p-storm)	D2 (p-storm)	35.3	6,396.13	6,395.43	0.020	2.90	16.09	6.90	6,396.78	6,396.23	6,397.02	6,396.37
D-2 (p-storm)	18" HDPE	18.0	0.012	D2 (p-storm)	D3 (p-storm)	179.0	6,395.23	6,391.65	0.020	4.50	16.09	7.81	6,396.04	6,392.78	6,396.37	6,392.93
D-3 (p-storm)	18" HDPE	18.0	0.012	D3 (p-storm)	A9 (p-storm)	240.4	6,391.45	6,382.47	0.037	9.50	21.99	11.98	6,392.64	6,383.89	6,393.26	6,384.36
E-1 (p-storm)	18" HDPE	18.0	0.012	E1 (p-storm)	D3 (p-storm)	35.3	6,392.35	6,391.65	0.020	4.00	16.09	7.56	6,393.12	6,392.79	6,393.42	6,392.91

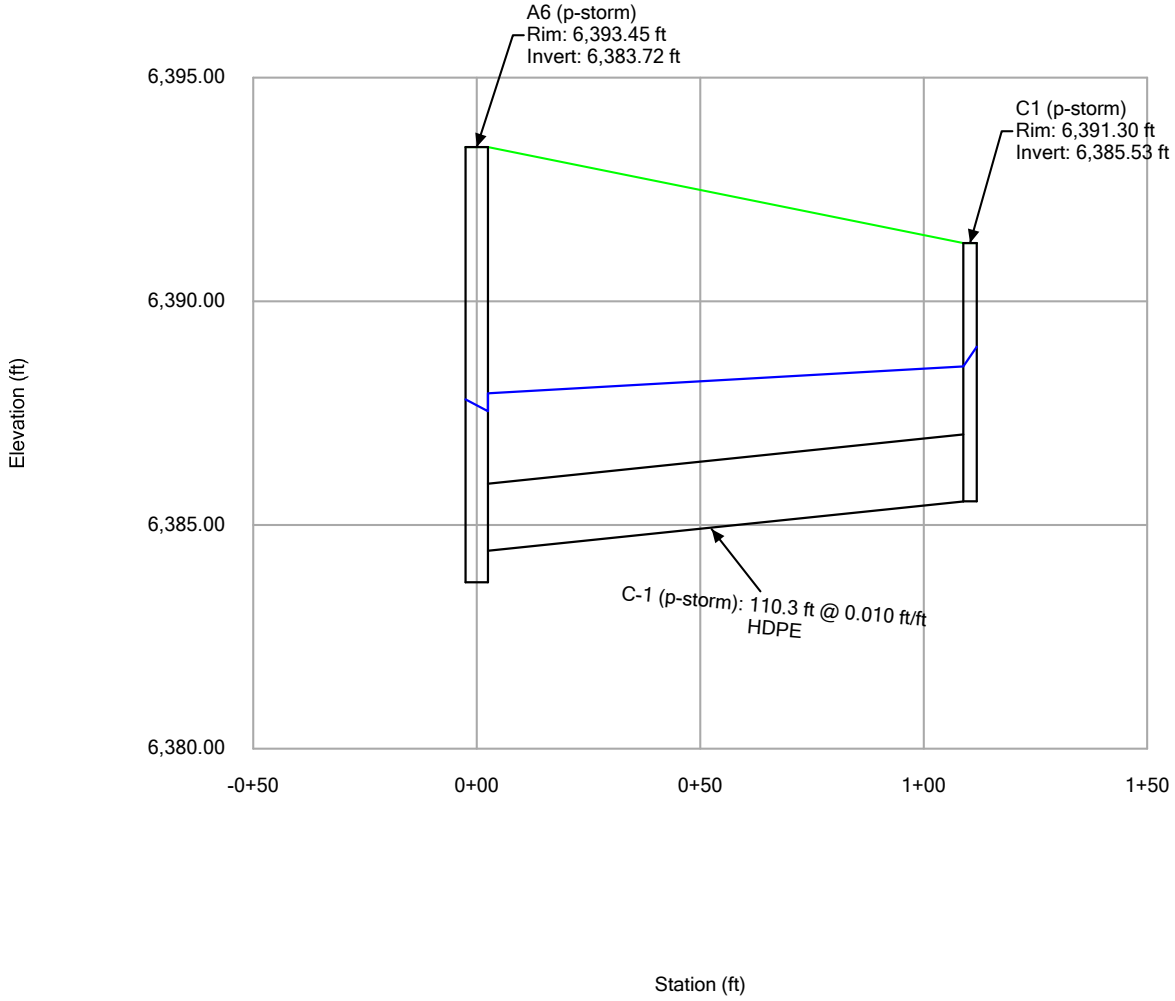
Profile Report
Engineering Profile - Line A (190920.stsw)
Active Scenario: 100 YR



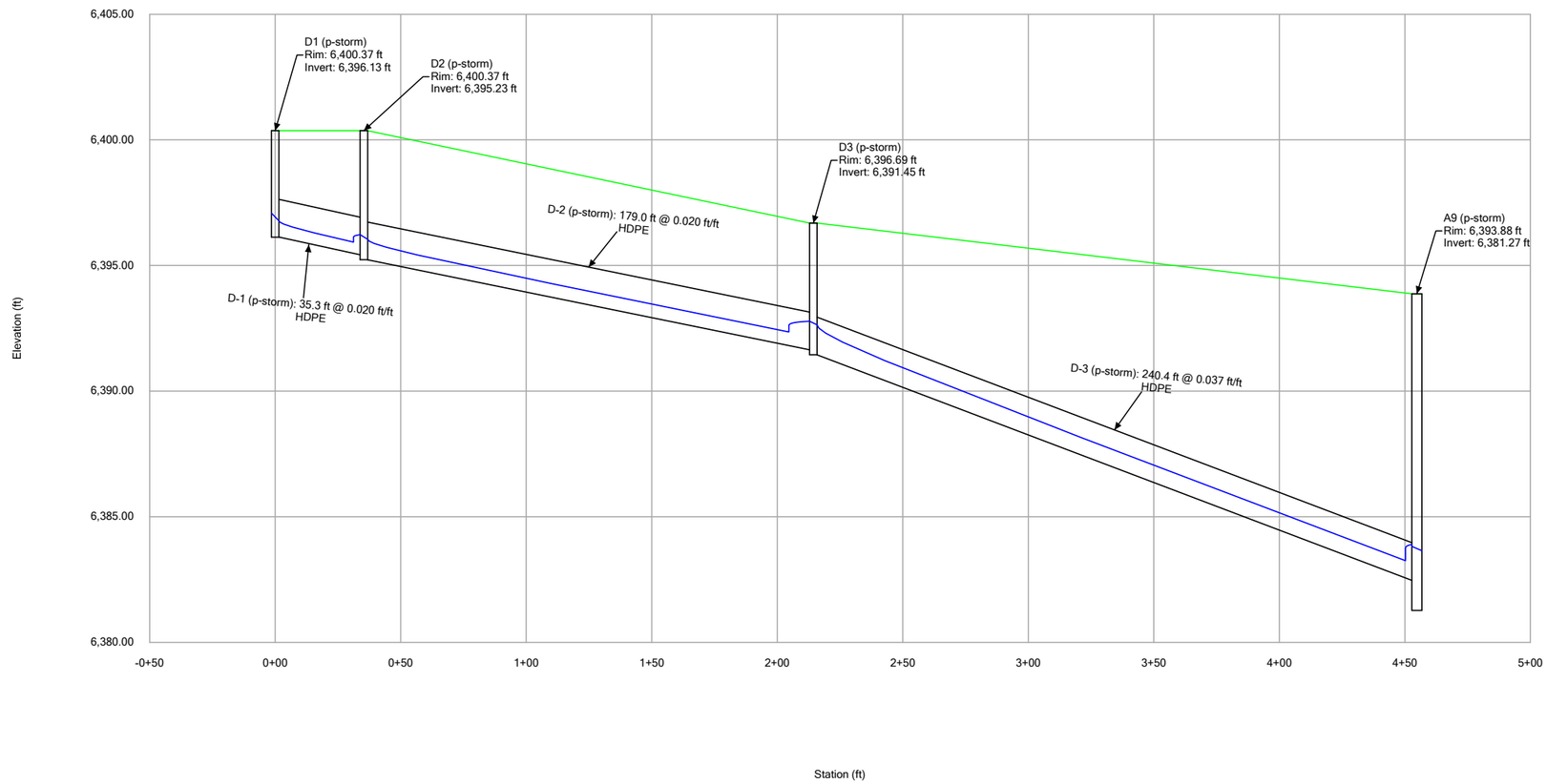
Profile Report
Engineering Profile - Line B (190920.stsw)
Active Scenario: 100 YR



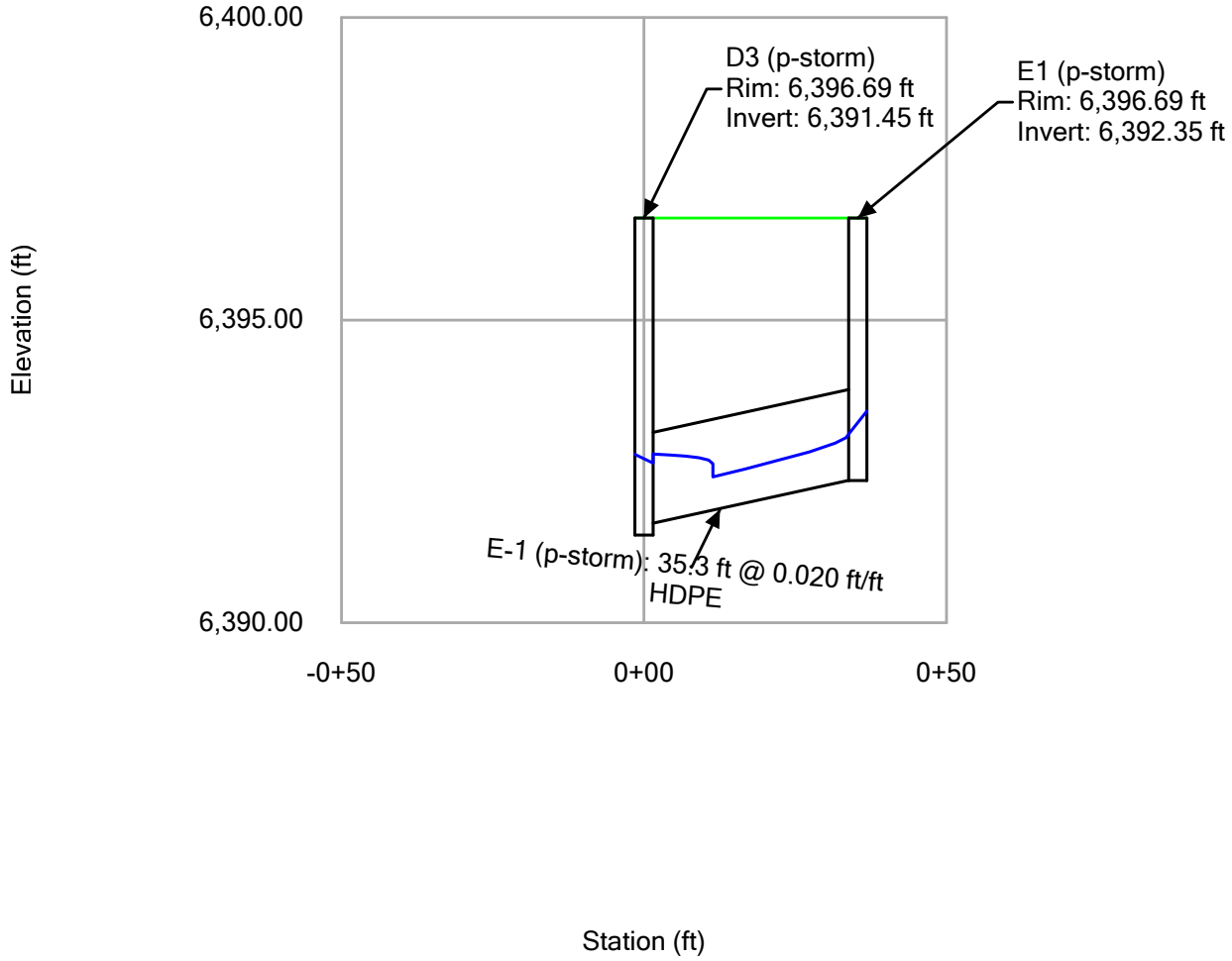
Profile Report
Engineering Profile - Line C (190920.stsw)
Active Scenario: 100 YR



Profile Report
Engineering Profile - Line D (190920.stsw)
Active Scenario: 100 YR



Profile Report
Engineering Profile - Line E (190920.stsw)
Active Scenario: 100 YR



Appendix C

Referenced Information

Excerpt from:

PHASE III DRAINAGE REPORT FOR LAGAE RANCH
LUND PARTNERSHIP, Project No. 440-0101
Dated 07/31/2013

LUND PARTNERSHIP

PHASE III
DRAINAGE REPORT

FOR

Lagae Ranch
City of Castle Pines North,
Colorado

Owner / Developer: HF Holdings, LLC
4 Inverness Ct. East, #300
Englewood, CO 80112

July 31*, 2013*

Project No. 440-0101

12265 W. Bayaud Avenue, Suite 130
Lakewood, Colorado 80228
P: 303.989.1461 • F: 303.989.4094

CIVIL ENGINEERING & SURVEYING

GRAPHIC SCALE

100 0 50 100

(IN FEET)
1 inch = 100 ft.

LEGEND:

- BASIN BOUNDARY
- A-13 (1.43 / 0.20 / 0.59) — BASIN DESIGNATION; AREA IN C (5); ACRES C (100)
- DESIGN POINT
- FLOW ARROW

SUMMARY RUNOFF TABLE				
DESIGN POINT	CONTRIBUTING AREA (ACRES)	CONTRIBUTING BASINS	Q-5 (CFS)	Q-100 (CFS)
70	6.28	B-1	4.73	27.39
71	2.44	B-2	4.84	13.50
72	1.42	B-3	3.31	8.64
73	3.86	B-2 & B-3	7.99	21.79
74	0.61	B-4	2.22	4.46
75	4.47	B-2 THRU B-4	9.83	25.64
76	6.73	B-5	6.86	32.05
76 TOTAL	11.20	B-2 THRU B-5	33.91	53.37
77	15.38	B-6	12.82	61.75
41	5.67	A-16	8.89	27.92
42	1.30	A-17	2.08	6.53
42 TOTAL	6.97	A-16 & A-17	10.94	34.43
48	19.72	A-16 THRU A-22	30.04	91.18

INLET SUMMARY		
DESIGN POINT	TYPE	LENGTH
41	R	15'
42	R	5'
71	R	15'
72	R	5'
74	R	5'

LUND PARTNERSHIP
1226 [illegible] Lallaud [illegible]venue, Suite 130
La[illegible]ood, Colorado 80228
P:303.[illegible]8.[illegible]1.61 F: 303.[illegible]8.[illegible]0[illegible]
CIVIL ENGINEERING & SURVEYING

No.	Revision	Date	By

LAGAE RANCH NORTH

DRAINAGE MAP

PREPARED FOR: H.F. HOLDINGS, LLC
ADDRESS: 4 INVERNESS CT. EAST #300
ENGLEWOOD, CO 80112

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2 BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES

DATE: JULY 31, 2013
JOB NUMBER: 440-0101
SCALE: 1" = 100'

SHEET
5 OF 6

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GRAPHIC SCALE

100 0 50 100

(IN FEET)
1 inch = 100 ft.

LEGEND:

- BASIN BOUNDARY
- A-13 / 1.43 / 0.20 / 0.59 — BASIN DESIGNATION; AREA IN C (5); ACRES C (100)
- DESIGN POINT
- FLOW ARROW

SUMMARY RUNOFF TABLE

DESIGN POINT	CONTRIBUTING AREA (ACRES)	CONTRIBUTING BASINS	Q-5 (CFS)	Q-100 (CFS)
49	10.24	A-23	15.81	49.66
50	29.96	A-16 THRU A-23	42.43	133.30
51	4.61	A-24	7.34	23.05
51 TOTAL	34.57	A-16 THRU A-24	48.15	152.65
52	34.57	A-16 THRU A-24	47.55	151.20
53	1.12	A-25	1.96	6.03
54	0.10	A-26	0.36	0.73
54 TOTAL	1.22	A-25 & A-26	2.21	6.76
55	0.38	A-27	1.38	2.78
56	1.60	A-25 THRU A-27	3.47	9.14
57	1.60	A-25 THRU A-27	3.40	9.00
58	23.04	A-28	14.96	70.72
58 TOTAL	260.80	A-1 THRU A-28 & OS-1 THRU OS-13	188.53	666.44
59	3.69	A-29	9.42	22.83
60	2.73	A-30	9.88	19.88
60 TOTAL	6.42	A-29 & A-30	19.00	42.21
61	6.42	A-29 & A-30	18.85	41.93
61 TOTAL	267.22	A-1 THRU A-30 & OS-1 THRU OS-13	207.38	708.37
62	5.70	OS-14	4.06	4.06
63	13.00	OS-15	–	12.41
64	11.80	OS-16	–	11.74
65	33.73	A-31	73.70	163.03
65 TOTAL	64.23	A-31 & OS-14 THRU OS-16	77.76	191.24
66	21.66	A-32	57.04	121.25
67	11.92	A-33	7.15	41.46
67 TOTAL	365.03	A-1 THRU A-33 & OS-1 THRU OS-16	349.33	1162.03
68	365.03	A-1 THRU A-33 & OS-1 THRU OS-16	–	282.91

INLET SUMMARY

DESIGN POINT	TYPE	LENGTH
49	R	(2) – 10'
51	R	10'
53	R	5'
54	R	5'
55	R	5'
59	R	15'
60	R	10'

LUND PARTNERSHIP
1226[illegible] Calaud Avenue, Suite 130
Lakewood, Colorado 80228
P:303.[illegible]8.1161 F: 303.[illegible]8.[illegible]0[illegible]
CIVIL ENGINEERING & SURVEYING

No.	Revision	Date	By

LAGAE RANCH NORTH

DRAINAGE MAP

PREPARED FOR: H.F. HOLDINGS, LLC
ADDRESS: 4 INVERNESS CT. EAST #300
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DATE: JULY 31, 2013
JOB NUMBER: 440-0101
SCALE: 1" = 100'

SHEET
6 OF 6

P:\440\0101\dwg\Plot\Drainage\Drainage Map 440-0101.dwg, SHEET 6, 10/10/2013 9:03:56 AM, 1:1, 40

In its entirety:

LAGAE RANCH PHASE III DRAINAGE REPORT ADDENDUM FOR LAGAE RANCH – PLANNED DEVELOPMENT, 2ND AMENDMENT
RICK ENGINEERING COMPANY, JOB NO. D01037B
Dated 11/01/2018

RICK
ENGINEERING COMPANY

November 1, 2018

Sam Bishop
City of Castle Pines
Director of Community Development
7501 Village Square Drive, Suite 100
Castle Pines, CO 80108

SUBJECT: LAGAE RANCH PHASE III DRAINAGE REPORT ADDENDUM FOR LAGAE RANCH - PLANNED DEVELOPMENT, 2ND AMENDMENT (RICK ENGINEERING COMPANY, JOB NO. D01037B)

To Whom It May Concern:

The purpose of this addendum is to provide an update to the Lagae Ranch Phase III Drainage Report prepared by Lund Partnership, date November 27, 2013 (original drainage report). The original drainage report defines the drainage system requirements and provides design calculations to support the proposed development located on a portion of the Lagae Ranch Property, in the City of Castle Pines in Douglas County, Colorado. This addendum is an update to original drainage Basin A, Sub-basin A-32 only; all other basins and sub-basins within the original drainage report will remain as stated in the original drainage report.

Planned Development

To allow the additional land use of Single Family Attached, or Multifamily Residential Units to Planning Area 7, the Lagae Ranch Planned Development will need a 2nd Amendment and therefore, has warranted this addendum to the Lagae Ranch Phase III Drainage Report. The Lagae Ranch Planned Development, 2nd Amendment will be submitted in conjunction with this addendum. The changes to the planned development include the following:

Table 1: Land Use Summary

Planning Area	Currently Allowed Uses	Added Uses	Currently Allowed Density	Added Density
PA 7	Community or Commercial	Single Family Attached or Multifamily Residential Units	280,000 sq. ft., 0.34 FAR	190 Units, 12.0 du/ac

Planning Area 7 is included within the original drainage report Sub-basin A-32. The original drainage report calculated proposed hydrologic flows with a community/commercial land use site plan. A new preliminary layout was used to determine the hydrologic flows for Planning Area 7 as a residential site. The new projected flow for Planning Area 7 compared to the originally community/commercial site design is described in the drainage report below. Based on the hydrologic flow calculations, the residential site is projected to accumulate less runoff than what was originally anticipated by the original drainage report, and therefore should not impact the design of the downstream basin.

Drainage Report

Based upon a preliminary layout and the Lagae Ranch Planned Development, 2nd Amendment we have calculated a composite percent of imperviousness for Sub-basin A-32. These calculations have been included with this addendum as Table 2: Composite Percent Impervious Calculations. This reduced imperviousness is a more accurate imperviousness than the assumed value used in the original drainage report.

Also included in this addendum is a NRCS Soils Classification Maps, showing the majority of the soils located within the updated sub-basin is classified as Hydrological Soil Group C. Using this information and the reduced percent of imperviousness, the time of concentration was calculated. These computations are included in Table 3: Standard Form SF-2, Time of Concentration.

The rational method procedure was then used to calculate the minor event (5-year) flows and the major event (100-year) flows. These calculations are included in Table 4: Standard Form SF-3, Storm Drainage System Design and Table 5: Standard Form SF-3, Storm Drainage System Design.

A comparison of these flows to the original drainage report is included in the following table, Table 6: Summary of Hydrologic Flow Computations. These proposed flows are less than originally anticipated and should therefore have no significant impact to the original drainage design.

Table 6: Summary of Hydrologic Flow Computations

Design Point	Contributing Basin	Original Q5 (cfs)	Proposed Q5 (cfs)	Original Q100 (cfs)	Proposed Q100 (cfs)
66	A-32	57.04	15.57	121.25	51.78

Conclusion

This addendum has been prepared in support of the original drainage design for the Lagae Ranch proposed development, and has been provided to show that the project is consistent with what was assumed in the original drainage report for the overall project. Due to a slight decrease in imperviousness, the updated sub-basin was found to generate a reduced un-detained peak flow than what was previously assumed. If single family and multifamily residential units are proposed for Planning Area 7, there will be no adverse impacts to the downstream drainage facilities.

Please feel free to contact me directly at 303-537-8020 if you have any questions or concerns.

Sincerely,

RICK ENGINEERING COMPANY

Troy Bales, PE
Associate

Attachments

Table 2: Composite Percent Imperviousness Calculations

Subdivision: Lagae Ranch
Location: Castle Pines

Project Name: Phase III Drainage Report Addendum
Project No.: 1037B
Calculated By: SS
Date: 8/14/18

		Paved Roads			Lawns / Open Space			Roofs			Basins Total Weighted % Imp.
Basin ID	Total Area (ac)	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	
A-32	21.66	100	2.99	13.80	2	12.98	1.20	90	5.69	23.60	38.6

Table 3: STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Lagae Ranch
Location: Castle Pines

Project Name: Phase III Drainage Report Addendum
Project No.: 1037B
Calculated By: SS
Date: 8/14/18

SUB-BASIN DATA							INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					Tc CHECK (URBANIZED BASINS)			FINAL
BASIN ID	Area (ac)	Hydrologic Soils Group	Impervious (%)	C_{100}	C_2	C_5	L (FT)	S (%)	T_i (MIN)	L (FT)	S (%)	Cv	VEL. (FPS)	T_t (MIN)	COMP. T_c (MIN)	TOTAL LENGTH(FT)	Urbanized T_c (MIN)	T_c (MIN)
A-32	21.66	C	38.60	0.64	0.29	0.35	300	4.0	15.0	1200	2.0	15.0	2.1	9.4	24.4	1500.0	18.3	18.3

Table 4: STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Lagae Ranch
Location: Castle Pines

Project Name: Phase III Drainage Report Addendum
Project No.: 1037B
Calculated By: SS
Date: 8/14/18

5-YEAR STORM DESIGN																				
	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
Design Point	Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	REMARKS
66	A-32	21.66	0.35	18.33	7.58	2.05	15.57													

Table 5: STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Lagae Ranch
Location: Castle Pines

Project Name: Phase III Drainage Report Addendum
Project No.: 1037B
Calculated By: SS
Date: 8/14/18

100-YEAR STORM DESIGN																					
	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
Design Point	Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	REMARKS
66	A-32	21.66	0.64	18.33	13.86	3.74	51.78													

Appendix D

Phase III Drainage Plan

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

LEGEND

	EXISTING	PROPOSED
PROPERTY BOUNDARY		
RIGHT-OF-WAY		
UTILITY EASEMENT		
FIRE LANE EASEMENT		
CONTOURS	5173 5170	5173 5170
STORM SEWER W/ MANHOLE AND INLET	ST 72ST	
EMERGENCY OVERFLOW ARROW		

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

RUNOFF SUMMARY TABLE				
DESIGN POINT	BASIN	AREA (ACRES)	Q5 (CFS)	Q100 (CFS)
1	D1	1.36	1.6	5.6
	D2	0.56	0.8	3.0
	D1, D2	1.92	2.1	4.5
2	E1	1.65	3.1	9.1
	D3	0.59	1.1	3.4
	DP1, E1, D3	4.16	4.6	9.5
3	A1	2.40	2.7	9.1
	B1	1.71	1.5	6.1
	B2	1.14	1.5	5.5
	A1, B1, B2	5.25	5.2	14.3
4	C1	2.01	2.5	8.4
	DP3, C1	7.26	7.4	22.0
5	A7	2.36	3.1	9.7
	DP4, A7	9.62	11.4	41.1
6	A8	1.21	2.1	6.9
	DP5, A8	10.83	12.9	49.1
7	DP2, DP6	14.99	17.2	57.8
8	P	3.78	3.6	18.9

CITY OF CASTLE PINES DEVELOPMENT REVIEW ENGINEER

DATE

THESE CONSTRUCTION DRAWINGS HAVE BEEN REVIEWED BY CITY OF CASTLE PINES FOR STREET, DRAINAGE, GRADING, AND UTILITY IMPROVEMENTS ONLY.

ENGINEERING DIVISION ACCEPTANCE BLOCK

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

CALL 3 BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

SCALE: 1" = 60'

DESIGNED BY: TAN
CHECKED BY: KPK
DRAWN BY: TAN

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

CENTURY COMMUNITIES

LAGAE RANCH FILING 1, LOT 236-B
PHASE III DRAINAGE PLAN

ISSUE DATE: 02-06-2020 | PROJECT #: 190920

DATE	REVISION COMMENTS

PRELIMINARY NOT FOR CONSTRUCTION

SHEET NO. 1 OF 1

FILEPATH: P:\190920\ENGINEERING\DRAINAGE\FINAL DRAINAGE PLAN.DWG LAYOUT: LAYOUT1
7 XREFS: e-base, e-legal, e-util, p-base, p-legal, p-stamp, p-util
PLOTTED: WED 02/05/20 7:21:22P BY: TOM NICHOLS