PRELIMINARY DRAINAGE REPORT
FOR
CHAMBERS AND HESS FILING NO. 1

Job Number: D-1173

January 24, 2020
Revised: May 5, 2020

PRELIMINARY DRAINAGE REPORT
FOR
CHAMBERS AND HESS FILING NO. 1
PARKER, COLORADO

Job Number: D-1173

Owner:
FIRST GUARDIAN GROUP, INC.
2025 Gateway Place, Suite 485
San Jose, CA 95110

Applicant/Developer:
REPUBLIC INVESTMENT GROUP
5750 DTC Parkway, Suite 160
Greenwood Village, CO 80111

Engineer:
RICK ENGINEERING COMPANY
9801 East Easter Avenue
Centennial, CO 80112
(303) 537-8020

January 24, 2020
Revised May 5, 2020

Certification

Professional Engineer:

This report for the preliminary design of Chambers and Hess Filing No. 1 was prepared by me or under my direct supervision in accordance with the provisions of the Town of Parker Storm Drainage and Environmental Criteria Manual. I understand that the Town of Parker and its designated town authority do no and will not assume liability for the drainage facilities designed by others.

____

Troy Bales
Registered Professional Engineer
State of Colorado No. 50961

TABLE OF CONTENTS

APPENDICES

I. GENERAL LOCATION AND DESCRIPTION

A. Location

The Chambers and Hess Filing No. 1 development is in the Town of Parker, Douglas County, Colorado. More specifically, the development is located in the southeast one-quarter of Section 29, Township 6 South, Range 66 West of the Sixth Principal Meridian.

The subject site is also known as Block 10, Lot 1 of Douglas 234 Filing No. 1. The site is 13.803 acres in area. Chambers and Hess Filing No. 1 is located entirely within the Douglas 234 Filing No. 1 subdivision.

Bordering the Chambers and Hess Filing No. 1 development to the north is South Red Sky Drive, a residential collector street that transitions to a residential local street east of the existing traffic roundabout. To the south, Chambers and Hess Filing No. 1 development is bordered by existing Hess Road, an arterial roadway. South of Hess Road is the Stroh Ranch Development. West of Chambers and Hess Filing No. 1 development is existing Chambers Road, arterial roadway. East of Chambers and Hess Filing No. 1 development is Block 12, Lots7-23, of Douglas 234 Filing No. 1, 1st Amendment.

Chambers and Hess Filing No. 1 is within the Cherry Creek watershed. Cherry Creek is located about 1.75 miles east of Chambers and Hess Filing No. 1.

A National Resources Conservation Service (NRCS) soils map is in the Appendix. Four distinct soil types are encountered within Chamber and Hess Filing No. 1. Newlin-Satanta (NsE) complex, Hydrologic Soil Group B, described as gravelly sandy clay loam. Kutch clay loam (KuE), Hydrologic Soil Group D, described as clay loam. Manzanola clay loam (Ma), Hydrologic Soil Group C, described as clay loam. Renohill-Buick (RmE) complex, Hydrologic Soil Group D, described as clay loam.

In the existing condition, Chambers and Hess Filing No. 1 is vacant ground composed of native grasses and only a few trees. The site generally slopes from west to east with grades varying between 1% and 28%. Along the western boundary, the land slopes to the west to Chambers Road. Along the southern boundary, land slopes to the south to Hess Road.

Chambers and Hess Filing No. 1 is proposed to be developed for commercial/retail development.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Description

Chambers and Hess Filing No. 1 is located within two major drainage basins, Cherry Creek and Oak Gulch. Oak Gulch is tributary to Cherry Creek.

Chambers and Hess Filing No. 1 is approximately 2 miles upstream of Cherry Creek. The most recent Flood Hazard Area Delineation for Cherry Creek in 2003 by URS did not include Chambers and Hess Filing No. 1 in the report.

Oak Gulch was studied as part of the "Oak Gulch and Lemon Gulch Flood Hazard Area Delineation" (Reference 4). Chambers and Hess Filing No. 1 is part of sub-basin 109.

Chambers and Hess Filing No.1 is in FEMA Zone X, an area of minimal flood hazard. A FEMA LOMR will not be required.

The Chambers and Hess Filing No. 1 site was originally studied as part of the Parker 234 Subdivision Final Drainage Report (Reference 3). The report identified that the site is part of the Cherry Creek watershed and Oak Gulch watershed. The report assigned historic drainage basin C-3 (area tributary to Cherry Creek) and historic drainage basin D-3 (area tributary to Oak Gulch).

B. Site Sub-Basin Description

Referring to the Historic Drainage Map in Appendix C, the basin designations were adopted from the Parker 234 Final Drainage Report to maintain clarity and continuity.

Historic Basins C1, C2, C3 and C4, tributary to Cherry Creek, drain from west to east. Basin C1 drains to an existing area inlet that was constructed as part of the Parker 234 subdivision improvements. The runoff then travels north and east via storm sewer to existing detention Pond "A". Basin C2 drains from west to east, ultimately through the residential lots on Block 2 of Douglas 234 Filing No. 1, eventually to the existing Red Sky Drive, then to existing pond "A". Basin C3 drains from west to east through the residential lots on Block 2 of Douglas 234 Filing No. 1, eventually to existing Detention Pond "A". Detained runoff from Pond "A" is conveyed under Jordan Road to the east, to an unnamed drainage way that ultimately connects to Cherry Creek. Basin C4 drains to the north to Red Sky Drive, then to the east and ultimately captured by existing storm sewer and routed to Pond "A".

Historic Basins D1 and D2, tributary to Oak Gulch, drain to the west and south to existing South Chambers Road and Hess Road. Runoff from Historic Basins D1 and D2 travels south on Chambers Road, then east on Hess Road, to Pond F (Reference 5). Runoff from Pond F is conveyed south, under Hess Road to Oak Gulch.

There is no offsite runoff that flows onto Chambers and Hess Filing No. 1.

III. DRAINAGE DESIGN CRITERIA

A. Regulations

Chambers and Hess Filing No. 1 is not located within a regulated flood plain, therefore, Chambers and Hess Filing No. 1 is in compliance with the Town of Parker's floodplain ordinance.

B. Discussion of compliance with the Town's Stream Preservation Standards

Chambers and Hess Filing No. 1 is not located within the Town of Parker Stream Preservation Area. Nonetheless, Chambers and Filing No. 1 will implement BMP measures to ensure that no adverse impact to water quality due to land disturbances. There are no Minor or Major Modifications requested. There are no planned improvements that would be eligible for Mile High Flood District's maintenance eligibility.

C. Development Criteria and Constraints

Chambers and Hess Filing No. 1 will comply with the drainage improvements outlined in the Final Drainage Report for the Parker 234 Subdivision. The report assigned the area of Chambers and Hess Filing No. 1 as future commercial development, 95% impervious. Chambers and Hess Filing No. 1 is using 75% impervious for the commercial lots, according to Mile High Flood District Table 6-3 (see Appendix) Business: Suburban Area. The proposed impervious is 73%. By reducing the impervious area, there will be no adverse impact to the downstream drainage conveyance elements, including the existing storm sewer and existing detention Pond “A”.

D. Hydrology Criteria

The minor storm is the 2 year recurrence interval. The major storm is the 100 year recurrence interval.

The site is 13.80 acres. The Rational Method is the method used to determine runoff rates for the minor and major storm. Rational Method runoff coefficients are based on the NRCS Hydrologic Soil Ratings. The predominant soil type (10 acres), Newlin-Satanta, has Hydrologic Soil Group Rating as Type “B”. There are also 5 acres of Type “C/D” rated soils. After consulting the Mile High Flood District about how to calculate Rational Method Runoff Coefficients when there are differing types of soils from a Hydrologic Soil Group Rating standpoint, they recommended to evaluate each basin based on where the basin is located with respect to the Hydrologic Soil Group Rating. The Rational Method Runoff Coefficients were calculated assuming the entire site is Type “C/D” soils for simplicity, yielding a more conservative estimate of developed runoff.

There are no detention facilities proposed for Chambers and Hess Filing No. 1. Existing detention pond “A” will receive developed runoff from Chambers and Hess Filing No. 1, as designated in the Final Drainage Report for the Parker 234 Subdivision.

E. Hydraulic Criteria

Private Drive A is a normal crowned roadways, 26’ flowline to flowline. Street capacities for Drive A are calculated using UD-Inlet Version 4.05. The minor storm flow depth is limited to no curb overtopping. Minor storm runoff can spread to the crown of the street. The major storm flow depth cannot exceed 12 inches. Appendix B contains street capacity calculations. UD-Inlet was also utilized to calculate proposed storm sewer inlet capture rates.

Hydraulic grade lines are calculated using Mile High Flood District’s UD Sewer software. The hydraulic grade line for the minor storm must be located below the crown of the pipe. The hydraulic grade line for the major storm must be located at least 12” below finished grade as a maximum condition.

F. Variance from Criteria

There are no variances from criteria being sought.

IV. DRAINAGE FACILITY DESIGN

A. General Concept

Chambers and Hess Filing No. 1 eleven proposed commercial lots. The specific developments within the commercial lots are unknown currently. This report will quantify the runoff tributary from each commercial lot in sizing the storm drainage infrastructure. The proposed storm sewer system will provide a stub to each lot so that when the lot is developed, they can utilize the connection to the storm sewer system to convey runoff from each commercial lot. The commercial lots are designated to be a maximum of 75% impervious.

The drive and commercial lots will convey runoff to proposed storm inlets and ultimately to the existing storm sewer stub constructed in Tract B of Parker 234 subdivision. There is no offsite runoff draining on the Chambers and Hess Filing No. 1. Runoff from Chambers and Hess Filing No. 1 is designated to be collected and conveyed by the proposed storm sewer system. Existing Pond “A” will ultimately receive the developed runoff from Chambers and Hess Filing No. 1.

The appendix contains design charts utilized to quantify developed runoff.

B. Specific Details

The site is 13.80 acres and subdivided into 15 sub-basins to quantify developed storm runoff at various design points. Each sub-basin is evaluated for the proposed impervious improvements. Areas within the sub-basins are assigned land uses, Concrete or Asphalt Pavement, Drives and Walks, Landscape or lawns and Commercial areas. The Proposed Impervious calculation in the Appendix summarizes the percent impervious of each sub basin. Times of Concentrations are either calculated or assumed to be the minimum of 5 minutes. Design points are located to calculate runoff to determine if the drive has the capacity to convey runoff. Design points are also located at proposed inlets and manholes to calculate the cumulative effect of runoff as the runoff conveys downstream.

As previously discussed, each commercial lot will capture developed runoff that is conveyed to the storm sewer system constructed by this proposal. The proposed storm system will convey the major storm from each commercial lot to the existing storm sewer connection.

Referring to the proposed drainage map, sump inlets are located in Sliceroo Drive, near Hess Road at Design Points 9 and 10. The sump inlets are designed to provide 100% capture of the major storm. At no point does runoff ever exceed available street capacities for the minor or major storm.

C. Discussion of Detention Storage Required for Full-Spectrum Detention

As previously discussed, Chambers and Hess Filing No. 1 is not required to have on site detention because the property was included in the tributary area to the existing detention Pond “A”, about 1200 feet east of Chambers and Hess Filing No. 1. The appendices contain original design calculations for Pond “A”. When Pond “A” was designed, the Chambers and Hess Filing No. 1 property was assigned a percent impervious of 95%. The proposed site impervious for Chambers and Hess Filing No. 1 is 69%. There is no additional drainage area tributary to Pond “A”. Therefore, the detention volume requirements for Pond “A” are not adversely impacted by a developed Chambers and Hess Filing No. 1 property because the pond will receive more pervious drainage area than originally designed.

D. Discussion of Outlet Requirements

The outlet structure for existing Pond "A" will require no further improvements due to the construction of Chambers and Hess Filing No. 1 as discussed in the previous section.

E. Discussion of Storm Sewer Configuration

The proposed storm sewer main is located within the commercial lots and Sliceroo Drive. The storm sewer main will have storm sewer inlets in the commercial lots to convey major storm runoff to the existing storm sewer stub in Tract B of Parker 234 Subdivision. The storm sewer main is routed through the site to convey developed runoff to the existing stub. The Final Drainage Report for Parker 234 Subdivision calculated the total developed storm runoff from the Chambers and Hess Filing No. 1 property to be in the minor storm, 34.7 cfs and 88.6 cfs in the major storm. By reducing the amount of impervious area, the total developed storm runoff from Chambers and Hess Filing No. 1 property in the minor and major storm respectively is: 19.0 cfs and 73.0 cfs.

UDSewer was utilized to calculate the Hydraulic Grade Line for the major and minor storm sewer. The major storm model used a tailwater elevation that corresponds to the tailwater elevation of existing manhole SDMH-2 in the Final Drainage Report for Parker 234 Subdivision. The minor storm tailwater elevation was calculated as normal depth pipe flow at Parker 234 SDMH-2. The Hydraulic Grade Line calculations are located in Appendix B.

F. Discussion on Channel Design and Soil Erodibility Within Channel

There are only minor drainage grass lined swales proposed for Chambers and Hess Filing No. 1. The calculations for these minor drainage grass lined swales are in the appendix. The relatively low developed runoff conveyed by these swales yield velocities less than 5 feet per second, resulting in stable grass swales that do not require grade drops or armoring.

G. Stormwater Utility Eligible Facilities

V. ENVIRONMENTAL PROTECTION CRITERIA

A. General

There are no wetlands located in Chambers and Hess Filing No. 1. There are no "Waters of the U.S." located in Chambers and Hess Filing No. 1.

B. Construction BMP Plan

Construction BMP's will be implemented in a three phase schedule, initial, interim and final stabilization.

The initial phase will install construction fencing, perimeter construction BMP's like Silt Fencing and Sediment Control Logs. Vehicle tracking control to reduce the tracking of soils into the surrounding public streets and subdivision. At existing storm drain inlets on Hess Road and

Red Sky Drive will have Inlet Protections installed to prevent sediments from entering existing storm drain systems.

The interim phase will have the erosion and sediment controls associated with ongoing construction and grading operations. As grading operations bring the ground to finished grade elevations, trenching for proposed utilities, and rough street cuts prior to paving, BMP's like Check Dams, Diversion Ditches are installed to reduce stormwater runoff to non erosive velocities.

The final phase is where the site is to be stabilized by revegetating disturbed areas, installing erosion control blankets or similar on steeper grades.

C. Permanent BMP Plan

Chambers and Hess Filing No. 1 will utilize a regional Permanent BMP by discharging developed runoff to existing Pond "A". Pond "A" acts as the Water Quality Enhancement BMP for Chambers and Hess Filing No. 1.

VI. CONCLUSIONS

A. Compliance with Standards

The drainage plan for Chambers and Hess Filing No. 1 is compliant with Town of Parker's stormwater ordinances. Chambers and Hess Filing No. 1 is compliant with the Town of Parker's Storm Drainage and Environmental Criterial Manual by utilizing the design methods and requirements outlined in the SDECM.

B. Drainage Concept

The drainage design for Chambers and Hess Filing No. 1 effectively controls developed runoff by constructing storm sewer and storm drain inlets that convey developed runoff to the existing storm sewer stub constructed in anticipation of commercial development. By reducing the impervious area from the original drainage concept ensures that there are no adverse downstream impacts to the existing storm drainage infrastructure within the Parker 234 subdivision.

VII. REFERENCES

1. "Urban Storm Drainage Criteria Manual Volumes 1, 2 and 3". Urban Drainage and Flood Control District, 2016.
2. "Storm Drainage and Environmental Criteria Manual". Town of Parker, Colorado. February 2014.
3. "Final Drainage Report for the Parker 234 Subdivision Parker Colorado". CVL Consultants of Colorado, Inc. 2003.
4. "Oak Gulch and Lemon Gulch Flood Hazard Area Delineation". CH2M Hill. 2000.
5. "Addendum #2 to the Final Drainage Report for Douglas 234 Parker Colorado". CVL Consultants of Colorado, Inc. 2004.

Appendix A

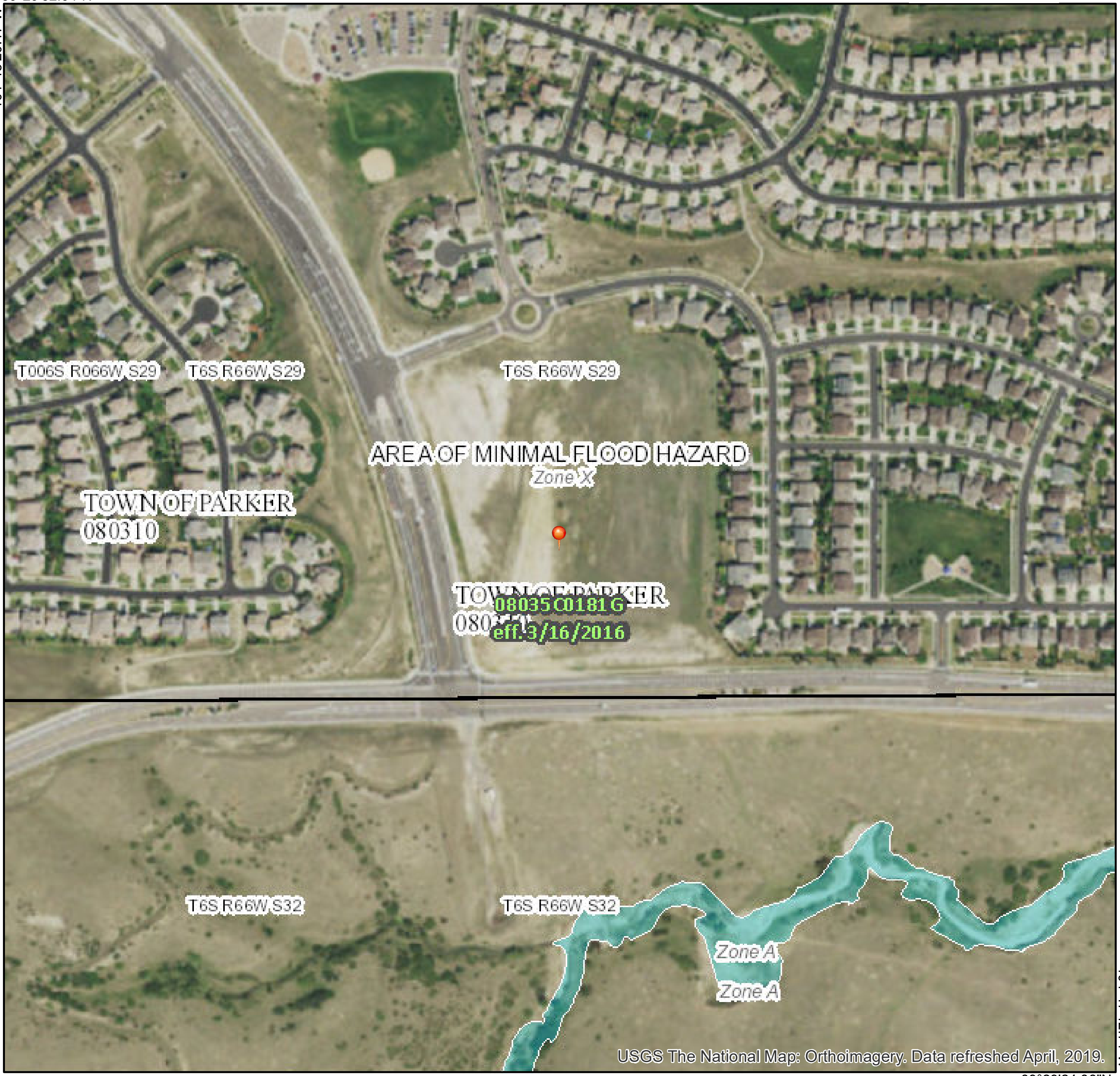
Hydrologic Computations

National Flood Hazard Layer FIRMette

FEMA

39°29'52.64"N

104°48'20.17"W



104°47'42.71"W

39°29'24.88"N

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

1:6,000

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 11/25/2019 at 3:59:17 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Hydrologic Soil Group—Castle Rock Area, Colorado

Map Scale: 1:2,100 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 30, 60, 120, 180

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 Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Castle Rock Area, Colorado
Survey Area Data: Version 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: Jun 10, 2014—Aug 21, 2014

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
KuE	Kutch clay loam, 8 to 20 percent slopes	D	0.6	3.8%
Ma	Manzanola clay loam	C	3.5	23.1%
NsE	Newlin-Satanta complex, 5 to 20 percent slopes	B	9.9	64.6%
RmE	Renohill-Buick complex, 5 to 25 percent slopes	D	1.3	8.5%
Totals for Area of Interest			**15.3**	**100.0%**

Description

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

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

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

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Table 6-4. Runoff coefficient equations based on NRCS soil group and storm return period

NRCS Soil Group	Storm Return Period						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	$C_A = 0.84i^{1.302}$	$C_A = 0.86i^{1.276}$	$C_A = 0.87i^{1.232}$	$C_A = 0.84i^{1.124}$	$C_A = 0.85i+0.025$	$C_A = 0.78i+0.110$	$C_A = 0.65i+0.254$
B	$C_B = 0.84i^{1.169}$	$C_B = 0.86i^{1.088}$	$C_B = 0.81i+0.057$	$C_B = 0.63i+0.249$	$C_B = 0.56i+0.328$	$C_B = 0.47i+0.426$	$C_B = 0.37i+0.536$
C/D	$C_{C/D} = 0.83i^{1.122}$	$C_{C/D} = 0.82i+0.035$	$C_{C/D} = 0.74i+0.132$	$C_{C/D} = 0.56i+0.319$	$C_{C/D} = 0.49i+0.393$	$C_{C/D} = 0.41i+0.484$	$C_{C/D} = 0.32i+0.588$

Where:

i = % imperviousness (expressed as a decimal)

C_A = Runoff coefficient for Natural Resources Conservation Service (NRCS) HSG A soils

C_B = Runoff coefficient for NRCS HSG B soils

$C_{C/D}$ = Runoff coefficient for NRCS HSG C and D soils.

The values for various catchment imperviousness and storm return periods are presented graphically in Figures 6-1 through 6-3, and are tabulated in Table 6-5. These coefficients were developed for the Denver region to work in conjunction with the time of concentration recommendations in Section 2.4. Use of these coefficients and this procedure outside of the semi-arid climate found in the Denver region may not be valid. The UD-Rational Excel workbook performs all the needed calculations to find the runoff coefficient given the soil type and imperviousness and the reader may want to take advantage of this macro-enabled Excel workbook that is available for download from the UDFCD's website www.udfcd.org.

See Examples 7.1 and 7.2 that illustrate the Rational Method.

Table 6-3. Recommended percentage imperviousness values

Land Use or Surface Characteristics	Percentage Imperviousness (%)
Business:	
Downtown Areas	95
Suburban Areas	75
Residential lots (lot area only)**:**	
Single-family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	2
Lawns, clayey soil	2

PROJECT: **CHAMBERS AND HESS FILING NO. 1**
SUBJECT: HISTORIC IMPERVIOUSNESS

JOB #: **D01173**
DATE: **12/13/2019**
BY: **BHE**

Basin Name	Square Footage	Acres	Native Ground (sf)	Native Ground (Acres)	Gravel (sf)	Gravel (Acres)	Roofs (sf)	Roofs (Acres)	Soil Type "C/D" Composite Runoff Factors			
									C_2	C_5	C_{100}	I %
C1	417,552	9.59	417,552	9.59	0	0.00	0	0.00	0.01	0.05	0.49	2.0
C2	28,133	0.65	28,133	0.65	0	0.00	0	0.00	0.01	0.05	0.49	2.0
C3	8,776	0.20	8,776	0.20	0	0.00	0	0.00	0.01	0.05	0.49	2.0
C4	2,644	0.06	2,644	0.06	0	0.00	0	0.00	0.01	0.05	0.49	2.0
D1	75,297	1.73	75,297	1.73	0	0.00	0	0.00	0.01	0.05	0.49	2.0
D2	68,188	1.57	68,188	1.57	0	0.00	0	0.00	0.01	0.05	0.49	2.0

Land Use	Imp., I %
Native Ground	2%
Gravel	40%
Roofs	90%

PROJECT: CHAMBERS AND HESS FILING NO. 1
SUBJECT: TIME OF CONCENTRATION

JOB #: D01173
DATE: 12/13/2019
BY: BHE

TIME OF CONCENTRATION

			TIME (Ti) *[Max. 300']*					TRAVEL TIME (Tt)							Tc CHECK		FINAL Tc	Time to Peak** Flow	Remarks
Basin No.	Area (acres)	5Yr. co-eff.	Elevations Upstream	Elevations Downstream	Dist. (ft)	Slope (%)	Ti (min)	Elevations Upstream	Elevations Downstream	Dist. (ft)	Slope (%)	*	Vel. (fps)	Tt (min)	Tc	Tc (min)	(min)		
C1	9.59	0.05	6085.1	6074.0	196	5.7	14.9	6074.0	6054.0	408	4.9	3	1.8	3.7	18.6	29.0	18.6	**29.0**	NON URBANIZED
C2	0.65	0.05																**5.0**	ASSUME MIN TC
C3	0.20	0.05	6070.0	6064.0	143	4.2	14.1	6064.0	6059.0	172	2.9	3	1.2	2.3	16.4	27.5	16.4	**27.5**	NON URBANIZED
C4	0.06	0.05																**5.0**	ASSUME MIN TC
D1	1.73	0.05	6085.4	6084.0	76	1.8	13.6	6084.0	6082.0	64	3.1	3	1.3	0.8	14.4	26.3	14.4	**26.3**	NON URBANIZED
D2	1.57	0.05	6086.0	6083.1	84	3.5	11.5	6083.1	6054.7	512	5.5	3	2.0	4.4	15.8	29.6	15.8	**29.6**	NON URBANIZED

<u>* Type of Land Surface for Overland Travel Time</u>

1 = Heavy Meadow
2 = Tillage / Field
3 = Short pasture & lawns
4 = Nearly bare ground
5 = Grassed waterway
6 = Paved areas and shallow paved swales

<u>VELOCITY COEFFICIENTS</u>

1	2.5
2	5
3	7
4	10
5	15
6	20

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

CALCULATED BY: BHE
DATE: 12/13/19 **P1=** 0.99
CHECKED BY:

JOB NO: D01173
PROJECT: CHAMBERS AND HESS FILING NO. 1
DESIGN STORM: 2 Year

BASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		AREA DESIG.	AREA (Acres)	RUNOFF COEFF	Tc (min)	C A (Acres)	I (in/hour)	Q (cfs)	Tc (min)	(C A) (Acres)	I (in/hour)	Q (cfs)	SLOPE (%)	STREET FLOW (cfs)	DESIGN FLOW (cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	Tt (min)	
C1	**1**	**C1**	9.59	0.01	29.0	0.10	1.59	**0.2**													
C2			0.65	0.01	5.0	0.01	3.36	**0.0**													
C3			0.20	0.01	27.5	0.00	1.64	**0.0**													
C4			0.06	0.01	5.0	0.00	3.36	**0.0**													
D1			1.73	0.01	26.3	0.02	1.68	**0.0**													
D2			1.57	0.01	29.6	0.02	1.57	**0.0**													

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

CALCULATED BY: BHE
DATE: 12/13/19 **P1=** 2.60
CHECKED BY:

JOB NO: D01173
PROJECT: CHAMBERS AND HESS FILING NO. 1
DESIGN STORM: 100 YEAR

BASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		AREA DESIG.	AREA (Acres)	RUNOFF COEFF	Tc (min)	C A (Acres)	I (in/hour)	Q (cfs)	Tc (min)	(C A) (Acres)	I (in/hour)	Q (cfs)	SLOPE (%)	STREET FLOW (cfs)	DESIGN FLOW (cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	Tt (min)	
C1	**1**	**C1**	9.59	0.49	29.0	4.72	4.16	**19.6**													
C2			0.65	0.49	5.0	0.32	8.82	**2.8**													
C3			0.20	0.49	27.5	0.10	4.29	**0.4**													
C4			0.06	0.49	5.0	0.03	8.82	**0.3**													
D1			1.73	0.49	26.3	0.85	4.40	**3.7**													
D2			1.57	0.49	29.6	0.77	4.11	**3.2**													

PROJECT: CHAMBERS AND HESS FILING NO. 1
SUBJECT: Proposed Impervious

JOB #: D01173
DATE: 5/4/2020
BY: BHE

Basin Name	Square Footage	Acres	Lawns/ Native Area (sf)	Lawns/ Native Area (Acres)	Asphalt/ Concrete (sf)	Asphalt/ Concrete (Acres)	Drives and Walks (sf)	Drives and Walks (Acres)	Surburban Commercial (sf)	Surburban Commercial (Acres)	Soil Type "C/D" Composite Runoff Factors			
											C_2	C_5	C_{100}	I %
A1	40,782	0.94	0	0.00	0	0.00	0	0.00	40,782	0.94	0.60	0.65	0.79	75.0
A2	43,166	0.99	0	0.00	0	0.00	0	0.00	43,166	0.99	0.60	0.65	0.79	75.0
A3	41,151	0.94	0	0.00	0	0.00	0	0.00	41,151	0.94	0.60	0.65	0.79	75.0
A4	42,254	0.97	0	0.00	0	0.00	0	0.00	42,254	0.97	0.60	0.65	0.79	75.0
A5	35,369	0.81	0	0.00	0	0.00	0	0.00	35,369	0.81	0.60	0.65	0.79	75.0
A6	66,879	1.54	0	0.00	0	0.00	0	0.00	66,879	1.54	0.60	0.65	0.79	75.0
A7	34,360	0.79	0	0.00	0	0.00	0	0.00	34,360	0.79	0.60	0.65	0.79	75.0
A8	26,401	0.61	0	0.00	0	0.00	0	0.00	26,401	0.61	0.60	0.65	0.79	75.0
A9	40,435	0.93	19,323	0.44	15,574	0.36	5,538	0.13	0	0.00	0.40	0.46	0.70	51.8
A10	36,273	0.83	14,964	0.34	15,602	0.36	5,707	0.13	0	0.00	0.45	0.51	0.72	58.0
A11	31,512	0.72	0	0.00	0	0.00	0	0.00	31,512	0.72	0.60	0.65	0.79	75.0
A12	56,235	1.29	0	0.00	0	0.00	0	0.00	56,235	1.29	0.60	0.65	0.79	75.0
A13	73,525	1.69	0	0.00	0	0.00	0	0.00	73,525	1.69	0.60	0.65	0.79	75.0
A14	17,850	0.41	17,850	0.41	0	0.00	0	0.00	0	0.00	0.01	0.05	0.49	2.0
OS1	14,396	0.33	14,396	0.33	0	0.00	0	0.00	0	0.00	0.01	0.05	0.49	2.0
HESS1	56,658	1.30	12,553	0.29	39,461	0.91	4,644	0.11	0	0.00	0.62	0.67	0.80	77.5
HESS2	2,683	0.06	363	0.01	2,014	0.05	306	0.01	0	0.00	0.70	0.74	0.83	85.6
Totals:	**600,588**	**13.79**	**66,533**	**1.53**	**31,176**	**0.72**	**11,245**	**0.26**	**491,634**	**11.29**	**0.54**	**0.60**	**0.76**	**68.5**

Land Use	Imp., I %
Lawns/Native Area	2%
Asphalt/Concrete	100%
Drives and Walks	90%
Surburban Commercial	75%

PROJECT: CHAMBERS AND HESS FILING NO. 1
SUBJECT: TIME OF CONCENTRATION

JOB #: D01173
DATE: 5/4/2020
BY: BHE

TIME OF CONCENTRATION

			TIME (Ti) *[Max. 300']*					TRAVEL TIME (Tt)							Tc CHECK		FINAL Tc	Time to Peak** Flow	Remarks
Basin No.	Area (acres)	5Yr. co-eff.	Elevations Upstream	Elevations Downstream	Dist. (ft)	Slope (%)	Ti (min)	Elevations Upstream	Elevations Downstream	Dist. (ft)	Slope (%)	*	Vel. (fps)	Tt (min)	Tc	Tc (min)	(min)		
A1	0.94	0.65																**5.0**	Assume Min Tc
A2	0.99	0.65																**5.0**	Assume Min Tc
A3	0.94	0.65																**5.0**	Assume Min Tc
A4	0.97	0.65																**5.0**	Assume Min Tc
A5	0.81	0.65																**5.0**	Assume Min Tc
A6	1.54	0.65																**5.0**	Assume Min Tc
A7	0.79	0.65																**5.0**	Assume Min Tc
A8	0.61	0.65																**5.0**	Assume Min Tc
A9	0.93	0.46	6077.8	6076.8	19	5.3	2.9	6076.8	6053.1	1072	2.2	6	2.9	6.2	9.1	24.6	9.1	**9.1**	
A10	0.83	0.51	6077.4	6076.8	20	2.9	3.4	6076.8	6053.1	1101	2.2	6	2.9	6.4	9.8	23.4	9.8	**9.8**	
A11	0.72	0.65																**5.0**	Assume Min Tc
A12	1.29	0.65																**5.0**	Assume Min Tc
A13	1.69	0.65																**5.0**	Assume Min Tc
A14	0.41	0.05																**5.0**	Assume Min Tc
OS1	0.33	0.05																**5.0**	Assume Min Tc
HESS1	1.30	0.67	6074.1	6072.7	67	2.1	5.0	6072.7	6055.2	644	2.7	6	3.2	3.4	8.4	16.1	8.4	**8.4**	Assume Min Tc
HESS2	0.06	0.74																**5.0**	Assume Min Tc

* Type of Land Surface for Overland Travel Time	VELOCITY COEFFICIENTS	
1 = Heavy Meadow	1	2.5
2 = Tillage / Field	2	5
3 = Short pasture & lawns	3	7
4 = Nearly bare ground	4	10
5 = Grassed waterway	5	15
6 = Paved areas and shallow paved swales	6	20

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

CALCULATED BY:	**BHE**			**JOB NO:**	**D01173**
DATE:	**5/4/20**	**P1=**	**0.99**	**PROJECT:**	**CHAMBERS AND HESS FILING NO. 1**
CHECKED BY:				**DESIGN STORM:**	**2 Year**

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
BASIN	DESIGN POINT	AREA DESIG.	AREA (Acres)	RUNOFF COEFF	Tc (min)	C A (Acres)	I (in/hour)	Q (cfs)	Tc (min)	(C A) (Acres)	I (in/hour)	Q (cfs)	SLOPE (%)	STREET FLOW (cfs)	DESIGN FLOW (cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	Tt (min)	REMARKS
A1	1	A1	0.94	0.60	5.0	0.56	3.36	**1.9**							1.9	1.2	18	147	4.8	0.5	INL-09 TO INL-08
A2	2	A2	0.99	0.60	5.0	0.60	3.36	**2.0**													
	2	A1+A2							5.5	1.16	3.27	**3.8**			3.8	1.8	18	141	6.6	0.4	INL-08 TO INL-07
A3	3	A3	0.94	0.60	5.0	0.57	3.36	**1.9**													
	3	A1-A3							5.9	1.73	3.21	**5.5**			5.5	3.2	24	137	8.9	0.3	INL-07 TO INL-06
A4	4	A4	0.97	0.60	5.0	0.58	3.36	**2.0**													
	4	A1-A4							6.1	2.31	3.17	**7.3**			7.3	1.8	24	218	7.7	0.5	INL-06 TO INL-05
A5			0.81	0.60	5.0	0.49	3.36	**1.6**													
	5	A1-A5							6.6	2.80	3.10	**8.7**			8.7	10.5	24	136	15.4	0.1	INL-05 TO SDMH-01
A6	6	A6	1.54	0.60	5.0	0.92	3.36	**3.1**							3.1	3.0	18	146	7.6	0.3	INL-14 TO INL-13
A7	7	A6-A7	0.79	0.60	5.0	0.47	3.36	**1.6**	5.3	1.40	3.30	**4.6**			4.6	6.3	24	115	10.7	0.2	INL-13 TO INL-12
A8	8	A6-A8	0.61	0.60	5.0	0.36	3.36	**1.2**	5.5	1.76	3.27	**5.8**			5.8	5.0	24	76	10.5	0.1	INL-12 TO INL-11
HESS2	9		0.06	0.70	5.0	0.04	3.36	**0.1**													
A9	9	A9+HESS2	0.93	0.40	9.1	0.37	2.77	**1.0**	9.1	0.41	2.77	**1.1**									INL-11 DESIGN Q
	9	A6-A9+HESS2							9.1	2.17	2.77	**6.0**			6.0	0.5	24	11	4.7	0.0	DP9: RUNOFF LEAVING INL-11
A10	10	A10	0.83	0.45	9.8	0.38	2.70	**1.0**							1.0	0.5	18	21	2.8	0.1	INL-10 TO SDMH-02
	11	A6-A10+HESS2							9.9	2.55	2.69	**6.9**			6.9	0.5	24	294	4.9	1.0	SDMH-02 TO SDMH-01
	12	A1-A10+HESS2							10.9	5.34	2.59	**13.8**			13.8	0.5	36	199	5.8	0.6	SDMH-01 TO INL-04
A11	13	A1-A11+HESS2	0.72	0.60	5.0	0.43	3.36	**1.5**	11.5	5.78	2.53	**14.6**			14.6	0.5	36	88	5.8	0.3	INL-04 TO INL-02
A12	14	A12	1.29	0.60	5.0	0.78	3.36	**2.6**							2.6	8.1	18	179	10.3	0.3	INL-03 TO INL-02
A13	15	A13	1.69	0.60	5.0	1.01	3.36	**3.4**													
	15	A1-A13+HESS2							11.7	7.57	2.51	**19.0**			19.0	10.5	36	38	18.7	0.0	INL-02 TO INL-01
A14	16		0.41	0.01	5.0	0.00	3.36	**0.0**													

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

CALCULATED BY: BHE
DATE: 5/4/20 **P1=** 0.99
CHECKED BY:

JOB NO: D01173
PROJECT: CHAMBERS AND HESS FILING NO. 1
DESIGN STORM: 2 Year

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
BASIN	DESIGN POINT	AREA DESIG.	AREA (Acres)	RUNOFF COEFF	Tc (min)	C A (Acres)	I (in/hour)	Q (cfs)	Tc (min)	(C A) (Acres)	I (in/hour)	Q (cfs)	SLOPE (%)	STREET FLOW (cfs)	DESIGN FLOW (cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	Tt (min)	REMARKS
	16								11.8	7.57	2.51	**19.0**			19.0	10.5	36	45	18.7	0.0	TOTAL RUNOFF INTO EXISTING DOUGLAS 234 STORM SYSTEM
OS1			0.33	0.01	5.0	0.00	3.36	**0.0**													
HESS1	17	HESS1	1.30	0.62	8.4	0.81	2.87	**2.3**	8.4	0.81	2.87	**2.3**									

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

CALCULATED BY: BHE
DATE: 5/4/20 **P1=** 2.60
CHECKED BY:

JOB NO: D01173
PROJECT: CHAMBERS AND HESS FILING NO. 1
DESIGN STORM: 100 YEAR

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
BASIN	DESIGN POINT	AREA DESIG.	AREA (Acres)	RUNOFF COEFF	Tc (min)	C A (Acres)	I (in/hour)	Q (cfs)	Tc (min)	(C A) (Acres)	I (in/hour)	Q (cfs)	SLOPE (%)	STREET FLOW (cfs)	DESIGN FLOW (cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	Tt (min)	REMARKS
A1	1	A1	0.94	0.79	5.0	0.74	8.82	**6.5**							6.5	1.2	18	147	6.7	0.4	INL-09 TO INL-08
A2	2		0.99	0.79	5.0	0.78	8.82	**6.9**													
	2	A1+A2							5.4	1.53	8.65	**13.2**			13.2	1.8	18	141	9.0	0.3	INL-08 TO INL-07
A3	3		0.94	0.79	5.0	0.75	8.82	**6.6**													
	3	A1-A3							5.6	2.27	8.54	**19.4**			19.4	3.2	24	137	12.6	0.2	INL-07 TO INL-06
A4	4		0.97	0.79	5.0	0.77	8.82	**6.8**													
	4	A1-A4							5.8	3.04	8.46	**25.7**			25.7	1.8	24	218	10.8	0.3	INL-06 TO INL-05
A5	5		0.81	0.79	5.0	0.64	8.82	**5.7**													
	5	A1-A5							6.1	3.68	8.32	**30.7**			30.7	10.5	24	136	22.3	0.1	INL-05 TO SDMH-01
A6	6	A6	1.54	0.79	5.0	1.22	8.82	**10.7**							10.7	3.0	18	146	10.6	0.2	INL-14 TO INL-13
A7	7	A6-A7	0.79	0.79	5.0	0.62	8.82	**5.5**	5.2	1.84	8.71	**16.0**			16.0	6.3	24	115	15.4	0.1	INL-13 TO INL-12
A8	8	A6-A8	0.61	0.79	5.0	0.48	8.82	**4.2**	5.4	2.32	8.66	**20.1**			20.1	5.0	24	76	15.0	0.1	INL-12 TO INL-11
OS1			0.33	0.49	5.0	0.16	8.82	**1.4**													
HESS1	17	HESS1	1.30	0.80	8.4	1.04	7.52	**7.8**	8.4	1.21	7.52	**9.1**									
									8.4 8.4	0.84 0.37	7.52 7.52	**6.3** **2.8**									CAPTURED BY INLET INL-15 BYPASSED INLET 15 TO INLET A11
HESS2			0.06	0.83	5.0	0.05	8.82	**0.5**													
A9	9	A9+HESS1+HESS2	0.93	0.70	9.1	0.65	7.29	**4.7**	9.1	1.07	7.29	**7.8**									INL-11 INLET DESIGN
		A6-A9+HESS1+ HESS2							9.1	3.39	7.29	**24.7**			24.7	0.5	24	11	7.9	0.0	DP9: RUNOFF LEAVING INL-11
A10	10	A10	0.83	0.72	9.8	0.60	7.10	**4.3**							4.3	0.5	18	21	4.4	0.1	INL-10 TO SDMH-02
	11	A6-A10							9.9	3.99	7.07	**28.2**			28.2	0.5	24	294	9.0	0.5	SDMH-02 TO SDMH-01
	12	A1-A10							10.4	7.67	6.92	**53.1**			53.1	0.5	36	199	7.5	0.4	SDMH-01 TO INL-04
A11	13	A1-A11	0.72	0.79	5.0	0.57	8.82	**5.0**	10.8	8.24	6.81	**56.1**			56.1	0.5	36	88	7.9	0.2	INL-04 TO INL-02
A12	14	A12	1.29	0.79	5.0	1.02	8.82	**9.0**							9.0	8.1	18	179	14.6	0.2	INL-03 TO INL-02

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

CALCULATED BY: BHE | **JOB NO:** D01173
DATE: 5/4/20 | **P1=** 2.60 | **PROJECT:** CHAMBERS AND HESS FILING NO. 1
CHECKED BY: | **DESIGN STORM:** 100 YEAR

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
BASIN	DESIGN POINT	AREA DESIG.	AREA (Acres)	RUNOFF COEFF	Tc (min)	C A (Acres)	I (in/hour)	Q (cfs)	Tc (min)	(C A) (Acres)	I (in/hour)	Q (cfs)	SLOPE (%)	STREET FLOW (cfs)	DESIGN FLOW (cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	Tt (min)	REMARKS
A13	15	A13	1.69	0.79	5.0	1.34	8.82	**11.8**													
	15	A1-A13							11.0	10.60	6.76	**71.7**			71.7	10.5	36	38	27.4	0.0	INL-02 TO INL-01
A14	16		0.41	0.49	5.0	0.20	8.82	**1.8**	11.0	10.80	6.76	**73.0**			73.0	10.5	36	45	18.7	0.0	TOTAL RUNOFF INTO EXISTING DOUGLAS 234 STORM SYSTEM

Appendix B

Hydraulic Computations

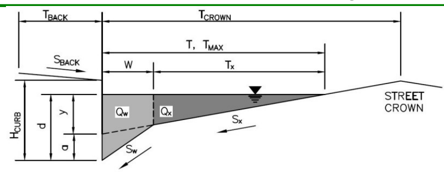
Version 4.05 Released March 2017

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

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

Project: CHAMBERS AND HESS

Inlet ID: DRIVE A STREET CAPACITY



THE DRIVE A STREET CAPACITIES ARE SUMMARIZED IN A RATING CURVE AT VARIOUS STREET LONGITUDINAL SLOPES

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	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} =	13.0	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 =	0.005	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	13.0	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

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	3.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	4.63	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.456	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	2.2	2.2	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.8	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**4.0**	**4.0**	**cfs**
Flow Velocity within the Gutter Section	V =	3.0	3.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	1.2	1.2	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.130	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	6.6	76.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	6.3	42.6	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.1	11.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	7.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	9.4	61.0	cfs
Average Flow Velocity Within the Gutter Section	V =	3.7	6.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.9	6.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**9.4**	**61.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	12.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	1.37	7.37	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**4.0**	**61.0**	**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'

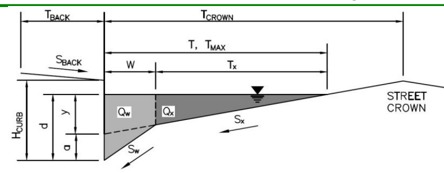
Version 4.05 Released March 2017

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

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

Project: CHAMBERS AND HESS

Inlet ID: DRIVE A STREET CAPACITY



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	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} =	13.0	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 =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	13.0	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

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	3.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	4.63	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.456	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	3.1	3.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.6	2.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**5.7**	**5.7**	**cfs**
Flow Velocity within the Gutter Section	V =	4.3	4.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	1.6	1.6	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.130	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	9.4	107.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	8.9	60.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	4.4	16.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	9.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	13.2	86.3	cfs
Average Flow Velocity Within the Gutter Section	V =	5.2	8.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.6	8.8	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**13.2**	**86.3**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	12.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	1.37	7.37	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**5.7**	**86.3**	**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'

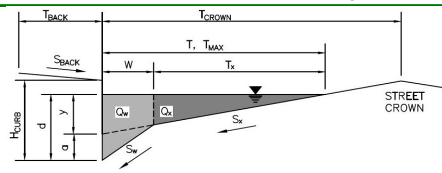
Version 4.05 Released March 2017

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

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

Project: CHAMBERS AND HESS

Inlet ID: DRIVE A STREET CAPACITY



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	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} =	13.0	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	13.0	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

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	3.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	4.63	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.456	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	4.4	4.4	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.7	3.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**8.0**	**8.0**	**cfs**
Flow Velocity within the Gutter Section	V =	6.0	6.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.3	2.3	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.130	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	13.3	152.5	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	12.5	85.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	6.2	22.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	14.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	18.7	122.0	cfs
Average Flow Velocity Within the Gutter Section	V =	7.4	12.5	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.7	12.5	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.83	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**18.7**	**101.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	11.13	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	1.37	6.50	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**8.0**	**101.8**	**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'

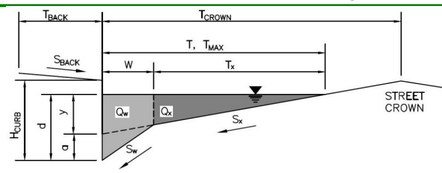
Version 4.05 Released March 2017

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

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

Project: CHAMBERS AND HESS

Inlet ID: DRIVE A STREET CAPACITY



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	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} =	13.0	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 =	0.030	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	13.0	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

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	3.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	4.63	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.456	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	5.3	5.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.5	4.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**9.8**	**9.8**	**cfs**
Flow Velocity within the Gutter Section	V =	7.4	7.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.9	2.9	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.130	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	16.3	186.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	15.4	104.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	7.6	28.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	17.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	22.9	149.4	cfs
Average Flow Velocity Within the Gutter Section	V =	9.1	15.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	4.5	15.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	0.74	0.60	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**17.1**	**90.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.46	9.77	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.83	5.14	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**9.8**	**90.1**	**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'

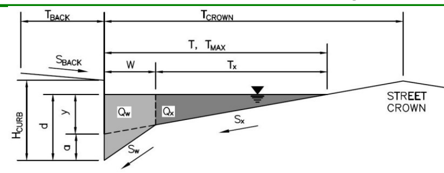
Version 4.05 Released March 2017

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

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

Project: CHAMBERS AND HESS

Inlet ID: DRIVE A STREET CAPACITY



Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0		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} =	13.0		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 =	0.040		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	13.0	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

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	3.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	4.63	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.456	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	6.2	6.2	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	5.2	5.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**11.3**	**11.3**	**cfs**
Flow Velocity within the Gutter Section	V =	8.5	8.5	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.3	3.3	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.130	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	18.8	215.7	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	17.7	120.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	8.8	32.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	19.8	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	26.5	172.5	cfs
Average Flow Velocity Within the Gutter Section	V =	10.5	17.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	5.2	17.6	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	0.59	0.48	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**15.7**	**82.7**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.09	8.95	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.46	4.32	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.3**	**82.7**	**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'

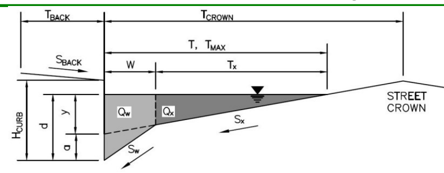
Version 4.05 Released March 2017

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

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

Project: CHAMBERS AND HESS

Inlet ID: DRIVE A STREET CAPACITY



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	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} =	13.0	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 =	0.050	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	13.0	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

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	3.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	4.63	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.456	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	6.9	6.9	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	5.8	5.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**12.7**	**12.7**	**cfs**
Flow Velocity within the Gutter Section	V =	9.5	9.5	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.7	3.7	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.130	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	21.0	241.2	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	19.8	134.6	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	9.8	36.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	22.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	29.6	192.9	cfs
Average Flow Velocity Within the Gutter Section	V =	11.7	19.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	5.9	19.7	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	0.49	0.40	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**14.6**	**77.3**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.83	8.38	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.20	3.75	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**12.7**	**77.3**	**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'

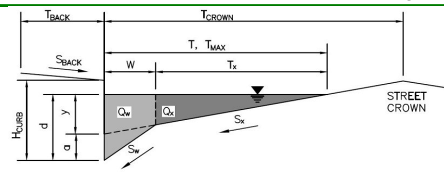
Version 4.05 Released March 2017

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

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

Project: **CHAMBERS AND HESS**

Inlet ID: **DRIVE A AND ALLEY A STREET CAPACITY**



Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0		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} =	14.0		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 =	0.060		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	14.0	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

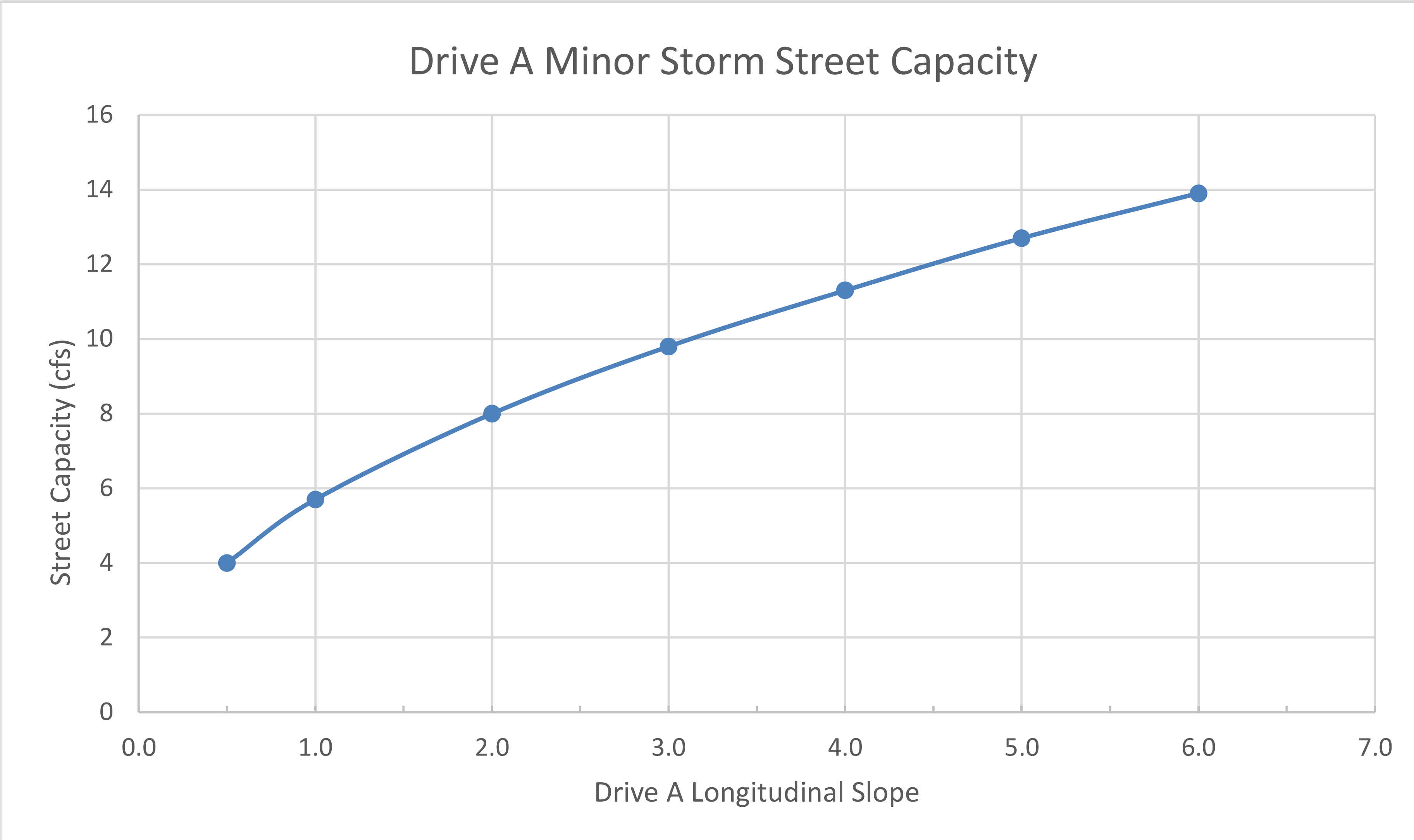
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.36	3.36	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.87	4.87	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	12.0	12.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.425	0.425	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	9.5	9.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	7.0	7.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**16.6**	**16.6**	**cfs**
Flow Velocity within the Gutter Section	V =	10.9	10.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.4	4.4	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.130	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	23.0	264.2	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	22.2	157.3	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	10.7	39.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	24.2	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	33.0	221.2	cfs
Average Flow Velocity Within the Gutter Section	V =	12.9	21.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	6.4	21.6	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	0.43	0.35	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.1**	**76.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.65	7.98	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	3.11	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**14.1**	**76.6**	**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'



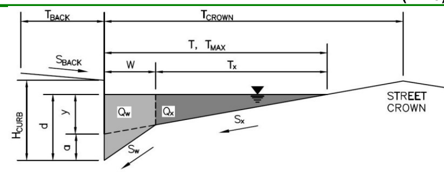
SEE THE PREVIOUS PAGES FOR THE STREET CAPACITY CALCULATIONS AT VARIOUS LONGITUDINAL SLOPES

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

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

Project: CHAMBERS AND HESS

Inlet ID: INLET 11 (DP 9)



Gutter Geometry (Enter data in the blue cells)

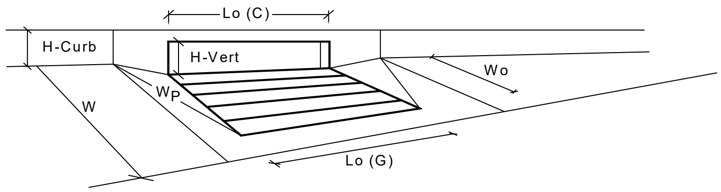
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	13.0	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	13.0	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



		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening				
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 =	4.6	6.9	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} =	0.22	0.41	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.59	0.88	
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 =	**2.9**	**7.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.1	7.2	cfs

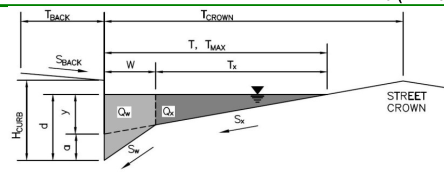
Version 4.05 Released March 2017

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

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

Project: CHAMBERS AND HESS

Inlet ID: INLET 10 (DP 10)



Gutter Geometry (Enter data in the blue cells)

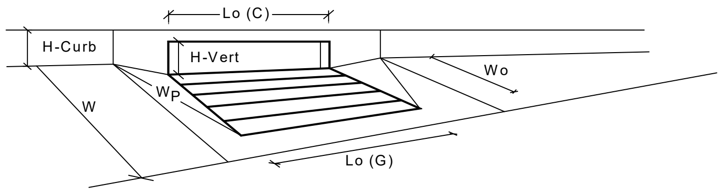
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	13.0	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	13.0	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



		MINOR	MAJOR	
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 =	4.6	6.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
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} =	0.22	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.59	0.77	
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 =	**2.9**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.0	4.3	cfs

PROJECT:	**CHAMBERS AND HESS FILING NO. 1**	**JOB #:**	**D01173**
SUBJECT:	**INLET DESIGNS**	**DATE:**	**5/4/2020**
		BY:	**BHE**

Commercial Lot Inlet Designs

CDOT Type D inlet design parameters

Area= 3'x6'= 18.00 ft^2
Open area =70% of total area (source: UD Inlet, MHFD)
Total Open area= 12.60 ft^2
Open area with 50% clogging factor= 6.30 ft^2
Perimeter: 18 ft
Perimeter with 50% clogging factor= 9 ft

CDOT Type C inlet design parameters

Area= 3'X3'= 9.00 ft^2
Open area =70% of total area (source: UD Inlet, MHFD)
Total Open area= 6.30 ft^2
Open area with 50% clogging factor= 3.15 ft^2
Perimeter: 12 ft
Perimeter with 50% clogging factor= 6 ft

Orifice Equation: Q=CdA(2gh)^.5 (Eq 1) h= (Q/CdA)^2/(2G) (Eq 2) Cd= 0.60
G= 32.2

Weir Equation: Q=CwLh^1.5 (Eq 3) h= (Q/CwL)^.6667 (Eq 4) Cw= 3.00
L=Perimeter

	Basin	Q100 (cfs)	Proposed Inlet Type
Commercial Lot 1	A1	6.5	CDOT Type C
Commercial Lot 2	A2	6.9	CDOT Type C
Commercial Lot 3	A3	6.6	CDOT Type C
Commercial Lot 4	A4	6.8	CDOT Type C
Commercial Lot 5	A6	10.7	CDOT Type C
Commercial Lot 6	A7	5.5	CDOT Type C
Commercial Lot 7	A8	4.2	CDOT Type C
Commercial Lot 8	A11	5.0	CDOT Type D
Commercial Lot 9	A5	5.7	CDOT Type C
Commercial Lot 10	A13	11.8	CDOT Type D
Commercial Lot 11	A12	9.0	CDOT Type C
Basin A14	A14	1.8	CDOT Type D

All inlets are located in Sumps

PROJECT: CHAMBERS AND HESS FILING NO. 1 **JOB #: D01173**
SUBJECT: INLET DESIGNS **DATE: 5/4/2020**
BY: BHE

Determine Head Required to capture the runoff

Commercial Lot 1
Design Q= 6.5 cfs
CDOT Type C
Area= 3.15 ft^2
Perimeter= 6 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.19

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.51

Larger h Controls: 0.51 ft of Head required to capture 100% of runoff

---

Commercial Lot 2
Design Q= 6.9 cfs
CDOT Type C
Area= 3.15 ft^2
Perimeter= 6 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.21

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.53

Larger h Controls: 0.53 ft of Head required to capture 100% of runoff

---

Commercial Lot 3
Design Q= 6.6 cfs
CDOT Type C
Area= 3.15 ft^2
Perimeter= 6 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.19

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.51

Larger h Controls: 0.51 ft of Head required to capture 100% of runoff

---

Commercial Lot 4
Design Q= 6.8 cfs
CDOT Type C
Area= 3.15 ft^2
Perimeter= 6 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.20

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.52

Larger h Controls: 0.52 ft of Head required to capture 100% of runoff

---

PROJECT:	**CHAMBERS AND HESS FILING NO. 1**	**JOB #:**	**D01173**
SUBJECT:	**INLET DESIGNS**	**DATE:**	**5/4/2020**
		BY:	**BHE**

Commercial Lot 5
Design Q= 10.7 cfs
CDOT Type C
Area= 3.15 ft^2
Perimeter= 6 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.50

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.71

Larger h Controls: 0.71 ft of Head required to capture 100% of runoff

---

Commercial Lot 6
Design Q= 5.5 cfs
CDOT Type C
Area= 3.15 ft^2
Perimeter= 6 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.13

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.45

Larger h Controls: 0.45 ft of Head required to capture 100% of runoff

---

Commercial Lot 7
Design Q= 4.2 cfs
CDOT Type C
Area= 3.15 ft^2
Perimeter= 6 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.08

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.38

Larger h Controls: 0.38 ft of Head required to capture 100% of runoff

---

Commercial Lot 8
Design Q= 5.0 cfs
CDOT Type D
Area= 6.30 ft^2
Perimeter= 9 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.03

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.33

Larger h Controls: 0.33 ft of Head required to capture 100% of runoff

---

PROJECT:	**CHAMBERS AND HESS FILING NO. 1**	**JOB #:**	**D01173**
SUBJECT:	**INLET DESIGNS**	**DATE:**	**5/4/2020**
		BY:	**BHE**

Commercial Lot 9
Design Q= 5.7 cfs
CDOT Type C
Area= 3.15 ft^2
Perimeter= 6 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.14

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.46

Larger h Controls: 0.46 ft of Head required to capture 100% of runoff

---

Commercial Lot 10
Design Q= 11.8 cfs
CDOT Type D
Area= 6.30 ft^2
Perimeter= 9 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.15

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.58

Larger h Controls: 0.58 ft of Head required to capture 100% of runoff

---

Commercial Lot 11
Design Q= 9.0 cfs
CDOT Type C
Area= 3.15 ft^2
Perimeter= 6 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.35

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.63

Larger h Controls: 0.63 ft of Head required to capture 100% of runoff

---

Basin A14
Design Q= 1.8 cfs
CDOT Type D
Area= 6.30 ft^2
Perimeter= 9 ft

Orifice Equation=> solve for H (Eq 2)
h (ft)= 0.00

Weir Equation=> solve for H (Eq 4)
h (ft)= 0.16

Larger h Controls: 0.16 ft of Head required to capture 100% of runoff

---

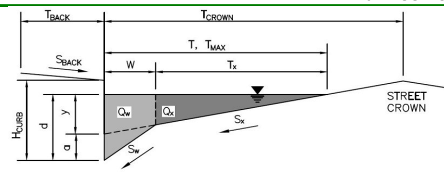
Version 4.05 Released March 2017

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

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

Project: CHAMBERS AND HESS

Inlet ID: INLET 15 HESS ROAD



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	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} =	62.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.021	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 =	0.030	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	62.0	62.0	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

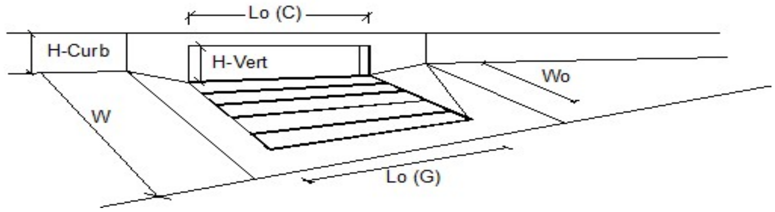
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**17.2**	**141.3**	**cfs**

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)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		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 =	2	2	
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	
Design Discharge for Half of Street (from Sheet *Inlet Management*)		Q_o =	**2.3**	**9.1**	cfs
Water Spread Width		T =	6.3	12.2	ft
Water Depth at Flowline (outside of local depression)		d =	3.1	4.6	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.793	0.478	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	0.5	4.8	cfs
Discharge within the Gutter Section W		Q_w =	1.8	4.3	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W		A_W =	0.35	0.59	sq ft
Velocity within the Gutter Section W		V_W =	5.2	7.3	fps
Water Depth for Design Condition		d_{LOCAL} =	6.1	7.6	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		Q_a =	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		Q_b =	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.169	0.110	ft/ft
Required Length L_T to Have 100% Interception		L_T =	7.20	17.66	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	7.20	10.00	ft
Interception Capacity		Q_i =	2.3	7.1	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.06	0.06	
Effective (Unclogged) Length		L_e =	9.37	9.37	ft
Actual Interception Capacity		Q_a =	**2.3**	**6.9**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		Q_b =	**0.0**	**2.2**	cfs
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**2.3**	**6.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	**0.0**	**2.2**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**76**	**%**

P-7	161.00	36 inch	65.75	6,014.39	6,008.53
P-8	54.00	36 inch	47.96	6,008.92	6,006.13
P-11	84.00	36 inch	53.22	6,003.64	6,002.39
P-12	90.00	36 inch	53.13	6,001.66	5,999.07
P-13	28.00	36 inch	62.50	5,999.73	5,998.71
P-20	77.00	36 inch	88.60	6,048.89	6,035.91
P-21	102.00	36 inch	88.34	6,035.19	6,030.38
P-22	29.00	36 inch	87.89	6,031.03	6,028.72
P-23	184.00	18 inch	5.50	6,033.31	6,029.02
P-25	141.00	36 inch	53.37	6,006.83	6,004.38
P-26	22.00	18 inch	5.87	6,008.95	6,008.92
P-27	47.00	18 inch	5.91	6,010.48	6,009.07
P-28	94.00	18 inch	5.95	6,014.07	6,010.30
P-31	226.00	18 inch	3.80	6,025.90	6,021.91
P-32	212.00	18 inch	6.04	6,021.91	6,013.90
P-35	108.00	36 inch	67.21	5,999.04	5,994.01
P-36	119.00	36 inch	67.09	5,993.03	5,986.62

		Elevations		
Label	Discharge	Ground	Upstream HGL	Downstream HGL
SDIN-1	88.60	6,062.42	6,048.89	6,048.89
SDMH-2	87.89	6,037.20	6,031.03	6,031.03
SDIN-3	66.84	6,036.51	6,029.02	6,029.02
SDMH-3	66.72	6,036.20	6,028.17	6,028.17
SDMH-4	66.05	6,030.00	6,019.72	6,018.84
SDMH-5	65.75	6,024.40	6,015.26	6,014.39
SDIN-4	47.96	6,017.37	6,008.92	6,008.92
SDIN-7	53.37	6,015.70	6,006.83	6,006.83
SDMH-9	53.22	6,012.30	6,004.38	6,003.64
SDMH-10	53.13	6,010.00	6,002.39	6,001.66
SDIN-8	62.50	6,008.42	5,999.73	5,999.73
SDIN-9	67.21	6,008.42	5,999.04	5,999.04
SDIN-2	5.50	6,041.41	6,033.31	6,033.31
SDMH-1	88.34	6,040.80	6,035.19	6,035.19
SDMH-8	5.87	6,018.30	6,009.07	6,008.95
SDMH-7	5.91	6,020.00	6,010.68	6,010.48
SDMH-6	5.95	6,023.40	6,014.27	6,014.07
SDIN-5	3.80	6,034.15	6,025.90	6,025.90
SDIN-6	6.04	6,030.16	6,021.91	6,021.91
Outlet	66.96	5,990.00	5,986.62	5,986.62

100 YEAR
TAILWATER
ELEVATION
FOR UDSEWER

		Elevations		
Label	Discharge	Ground	Upstream HGL	Downstream HGL
SDMH-11	67.09	6,006.00	5,994.01	5,993.03

Elapsed: 0 minute(s) 1 second(s)

EXCERPTED FROM PARKER 234 FINAL DRAINAGE REPORT
(REF #3)

Program:
UDSEWER Math Model Interface 2.1.1.4
Run Date:
5/6/2020 11:57:30 AM

UDSewer Results Summary

Project Title: CHAMBERS AND HESS MAJOR STORM
Project Description: Default system

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6031.03

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	**Ground Elevation (ft)**	**Total Known Flow (cfs)**	**Local Contribution (cfs)**	**Drainage Area (Ac.)**	**Runoff Coefficient**	**5yr Coefficient**	**Overland Length (ft)**	**Overland Slope (%)**	**Gutter Length (ft)**	**Gutter Velocity (fps)**
OUTFALL 1 S(99)	6053.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EXISTING	6042.24	72.50	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83

PARKER 234										
INL-01	6055.00	72.50	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-02	6060.00	71.10	0.00	1.00	0.50	0.50	100.00	2.00	200.00	2.83
INL-04	6054.11	55.60	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-01	6063.79	52.60	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-02	6053.38	27.60	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-11	6054.54	24.10	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-12	6061.71	20.10	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-13	6065.02	16.00	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-14	6068.43	10.70	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-10	6053.10	4.30	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-05	6065.83	30.70	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-06	6071.93	25.70	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-07	6074.13	19.40	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-08	6076.49	13.20	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-09	6078.04	6.50	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-03	6063.62	9.00	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	**Overland Time (min)**	**Gutter Time (min)**	**Basin Tc (min)**	**Intensity (in/hr)**	**Local Contrib (cfs)**	**Coeff. Area**	**Intensity (in/hr)**	**Manhole Tc (min)**	**Peak Flow (cfs)**	**Comment**
OUTFALL 1 S(99)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
EXISTING PARKER 234	8.62	0.59	9.21	NaN	NaN	8.50	8.53	NaN	72.50	
INL-01	8.62	0.59	9.21	NaN	NaN	8.00	9.06	NaN	72.50	
INL-02	8.62	1.18	9.80	NaN	NaN	7.50	9.48	NaN	71.10	
INL-04	8.62	0.59	9.21	NaN	NaN	6.50	8.55	NaN	55.60	
SDMH-01	8.62	0.59	9.21	NaN	NaN	6.00	8.77	NaN	52.60	
SDMH-02	8.62	0.59	9.21	NaN	NaN	3.00	9.20	NaN	27.60	
INL-11	8.62	0.59	9.21	NaN	NaN	2.00	12.05	NaN	24.10	
INL-12	8.62	0.59	9.21	NaN	NaN	1.50	13.40	NaN	20.10	
INL-13	8.62	0.59	9.21	NaN	NaN	1.00	16.00	NaN	16.00	
INL-14	8.62	0.59	9.21	NaN	NaN	0.50	21.40	NaN	10.70	
INL-10	8.62	0.59	9.21	NaN	NaN	0.50	8.60	NaN	4.30	
INL-05	8.62	0.59	9.21	NaN	NaN	2.50	12.28	NaN	30.70	
INL-06	8.62	0.59	9.21	NaN	NaN	2.00	12.85	NaN	25.70	
INL-07	8.62	0.59	9.21	NaN	NaN	1.50	12.93	NaN	19.40	
INL-08	8.62	0.59	9.21	NaN	NaN	1.00	13.20	NaN	13.20	
INL-09	8.62	0.59	9.21	NaN	NaN	0.50	13.00	NaN	6.50	
INL-03	8.62	0.59	9.21	NaN	NaN	0.50	18.00	NaN	9.00	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	**Sewer Length (ft)**	**Downstream Invert (ft)**	**Slope (%)**	**Upstream Invert (ft)**	**Mannings n**	**Bend Loss**	**Lateral Loss**	**Cross Section**	**Rise (ft or in)**	**Span (ft or in)**
EXISTING PARKER 234	104.00	6027.93	4.3	6032.40	0.013	0.29	0.00	CIRCULAR	36.00 in	36.00 in
INL-01	45.00	6034.05	11.1	6039.05	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
INL-02	37.50	6039.25	11.3	6043.48	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
INL-04	87.80	6043.68	0.5	6044.12	0.013	1.00	0.00	CIRCULAR	36.00 in	36.00 in
SDMH-01	199.39	6044.32	0.5	6045.32	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
SDMH-02	294.18	6045.82	0.5	6047.29	0.013	0.05	0.00	CIRCULAR	30.00 in	30.00 in
INL-11	10.80	6047.79	0.5	6047.84	0.013	0.81	0.00	CIRCULAR	24.00 in	24.00 in
INL-12	76.35	6048.05	4.6	6051.56	0.013	0.16	0.00	CIRCULAR	24.00 in	24.00 in
INL-13	115.24	6051.75	6.3	6059.01	0.013	0.16	0.00	CIRCULAR	24.00 in	24.00 in
INL-14	146.26	6059.51	3.0	6063.90	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
INL-10	20.67	6048.29	0.5	6048.39	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in
INL-05	136.13	6046.32	10.1	6060.09	0.013	1.00	0.00	CIRCULAR	24.00 in	24.00 in
INL-06	217.68	6060.19	1.8	6064.00	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
INL-07	137.31	6064.20	3.2	6068.53	0.013	0.75	0.00	CIRCULAR	24.00 in	24.00 in
INL-08	141.24	6069.03	1.8	6071.57	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
INL-09	147.31	6071.77	1.2	6073.54	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
INL-03	179.08	6044.98	7.8	6059.00	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	**Flow (cfs)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Froude Number**	**Flow Condition**	**Flow (cfs)**	**Surcharged Length (ft)**	**Comment**
EXISTING	138.68	19.62	32.27	10.85	18.48	19.84	3.17	Supercritical	72.50	3.26	Velocity is

PARKER 234								Jump			Too High
INL-01	222.93	31.54	32.27	10.85	14.12	28.18	5.30	Supercritical	72.50	0.00	Velocity is Too High
INL-02	224.61	31.78	32.06	10.69	13.92	28.19	5.35	Pressurized	71.10	37.50	Velocity is Too High
INL-04	47.29	6.69	36.00	7.87	36.00	7.87	0.00	Pressurized	55.60	87.80	
SDMH-01	47.29	6.69	36.00	7.44	36.00	7.44	0.00	Pressurized	52.60	199.39	
SDMH-02	29.08	5.92	21.49	7.33	23.32	6.74	0.85	Pressurized	27.60	294.18	
INL-11	16.04	5.11	24.00	7.67	24.00	7.67	0.00	Pressurized	24.10	10.80	
INL-12	48.65	15.49	19.31	7.42	10.75	14.75	3.14	Pressurized	20.10	76.35	
INL-13	56.93	18.12	17.30	6.60	8.70	15.56	3.75	Supercritical	16.00	0.00	
INL-14	18.24	10.32	15.06	6.77	9.91	10.73	2.31	Supercritical	10.70	0.00	
INL-10	7.45	4.21	9.54	4.52	9.81	4.37	0.95	Pressurized	4.30	20.67	
INL-05	72.14	22.96	22.47	10.04	10.93	22.04	4.64	Supercritical Jump	30.70	38.72	Velocity is Too High
INL-06	30.01	9.55	21.35	8.71	17.10	10.74	1.65	Supercritical Jump	25.70	75.22	
INL-07	40.28	12.82	19.00	7.27	11.74	12.70	2.56	Supercritical Jump	19.40	25.07	
INL-08	14.13	8.00	16.29	7.85	13.79	9.09	1.50	Supercritical	13.20	0.00	
INL-09	11.54	6.53	11.83	5.28	9.67	6.72	1.47	Supercritical Jump	6.50	50.31	
INL-03	29.47	16.68	13.93	6.13	6.83	14.65	3.97	Supercritical Jump	9.00	22.27	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
EXISTING PARKER 234	72.50	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
INL-01	72.50	CIRCULAR	36.00 in	36.00 in	24.00 in	24.00 in	36.00 in	36.00 in	7.07	
INL-02	71.10	CIRCULAR	36.00 in	36.00 in	24.00 in	24.00 in	36.00 in	36.00 in	7.07	
INL-04	55.60	CIRCULAR	36.00 in	36.00 in	42.00 in	42.00 in	36.00 in	36.00 in	7.07	Existing height is smaller than the suggested height. Existing width is smaller than the suggested

										width. Exceeds max. Depth/Rise
SDMH-01	52.60	CIRCULAR	36.00 in	36.00 in	42.00 in	42.00 in	36.00 in	36.00 in	7.07	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise
SDMH-02	27.60	CIRCULAR	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	4.91	
INL-11	24.10	CIRCULAR	24.00 in	24.00 in	30.00 in	30.00 in	24.00 in	24.00 in	3.14	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise
INL-12	20.10	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
INL-13	16.00	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
INL-14	10.70	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-10	4.30	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-05	30.70	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
INL-06	25.70	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
INL-07	19.40	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
INL-08	13.20	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-09	6.50	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-03	9.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6031.03

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
EXISTING PARKER 234	6027.93	6032.40	0.00	0.00	6031.03	6035.09	6032.66	4.25	6036.92
INL-01	6034.05	6039.05	0.08	0.00	6035.23	6045.92	6047.56	0.00	6047.56
INL-02	6039.25	6043.48	0.08	0.00	6046.07	6046.49	6047.64	0.42	6048.06
INL-04	6043.68	6044.12	0.96	0.00	6048.06	6048.67	6049.02	0.61	6049.63
SDMH-01	6044.32	6045.32	0.04	0.00	6048.81	6050.04	6049.67	1.23	6050.90
SDMH-02	6045.82	6047.29	0.02	0.00	6050.44	6051.76	6050.93	1.32	6052.25
INL-11	6047.79	6047.84	0.74	0.00	6052.50	6052.63	6053.42	0.12	6053.54
INL-12	6048.05	6051.56	0.10	0.00	6053.01	6053.60	6053.64	0.60	6054.24
INL-13	6051.75	6059.01	0.06	0.00	6053.67	6060.45	6056.23	4.89	6061.13
INL-14	6059.51	6063.90	0.03	0.00	6060.48	6065.16	6062.13	3.74	6065.87
INL-10	6048.29	6048.39	0.09	0.00	6052.25	6052.29	6052.35	0.03	6052.38
INL-05	6046.32	6060.09	1.48	0.00	6051.53	6061.96	6053.01	10.52	6063.53
INL-06	6060.19	6064.00	0.05	0.00	6062.54	6065.78	6063.58	3.38	6066.96
INL-07	6064.20	6068.53	0.44	0.00	6066.81	6070.11	6067.40	3.53	6070.93
INL-08	6069.03	6071.57	0.04	0.00	6070.18	6072.93	6071.46	2.43	6073.88
INL-09	6071.77	6073.54	0.01	0.00	6073.68	6074.53	6073.89	1.06	6074.96
INL-03	6044.98	6059.00	0.40	0.00	6048.06	6060.16	6048.46	12.28	6060.74

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
EXISTING PARKER 234	104.00	4.00	6.00	6.67	48.76	26.22	22.05	17.68	10.67	6.51	1385.31	
INL-01	45.00	4.00	6.00	6.67	14.38	9.02	4.86	29.90	16.78	12.62	268.22	
INL-02	37.50	4.00	6.00	6.67	29.50	16.58	12.42	31.04	17.35	13.19	350.76	
INL-04	87.80	4.00	6.00	6.67	30.64	17.15	12.99	17.98	10.82	6.66	588.84	
SDMH-01	199.39	4.00	6.00	6.67	17.57	10.62	6.45	34.94	19.30	15.14	1584.33	

SDMH-02	294.18	3.50	6.00	6.08	34.44	18.76	15.18	10.68	6.88	3.30	1973.92	
INL-11	10.80	3.00	4.00	5.50	10.19	6.18	3.34	12.40	7.28	4.45	18.29	
INL-12	76.35	3.00	4.00	5.50	11.98	7.08	4.24	19.30	10.73	7.90	220.66	
INL-13	115.24	3.00	4.00	5.50	18.92	10.54	7.71	11.02	6.59	3.76	313.49	
INL-14	146.26	2.50	4.00	4.92	10.52	6.05	3.80	8.56	5.07	2.82	178.31	
INL-10	20.67	2.50	4.00	4.92	9.69	5.64	3.39	8.92	5.25	3.00	24.20	
INL-05	136.13	3.00	4.00	5.50	33.94	18.05	15.22	10.48	6.32	3.49	863.37	
INL-06	217.68	3.00	4.00	5.50	10.28	6.22	3.39	14.86	8.51	5.68	438.05	
INL-07	137.31	3.00	4.00	5.50	14.46	8.31	5.48	10.20	6.18	3.35	267.80	
INL-08	141.24	2.50	4.00	4.92	9.70	5.64	3.39	9.34	5.46	3.21	170.60	
INL-09	147.31	2.50	4.00	4.92	8.94	5.26	3.01	8.50	5.04	2.79	157.93	
INL-03	179.08	2.50	4.00	4.92	29.54	15.56	13.31	8.74	5.16	2.91	852.69	

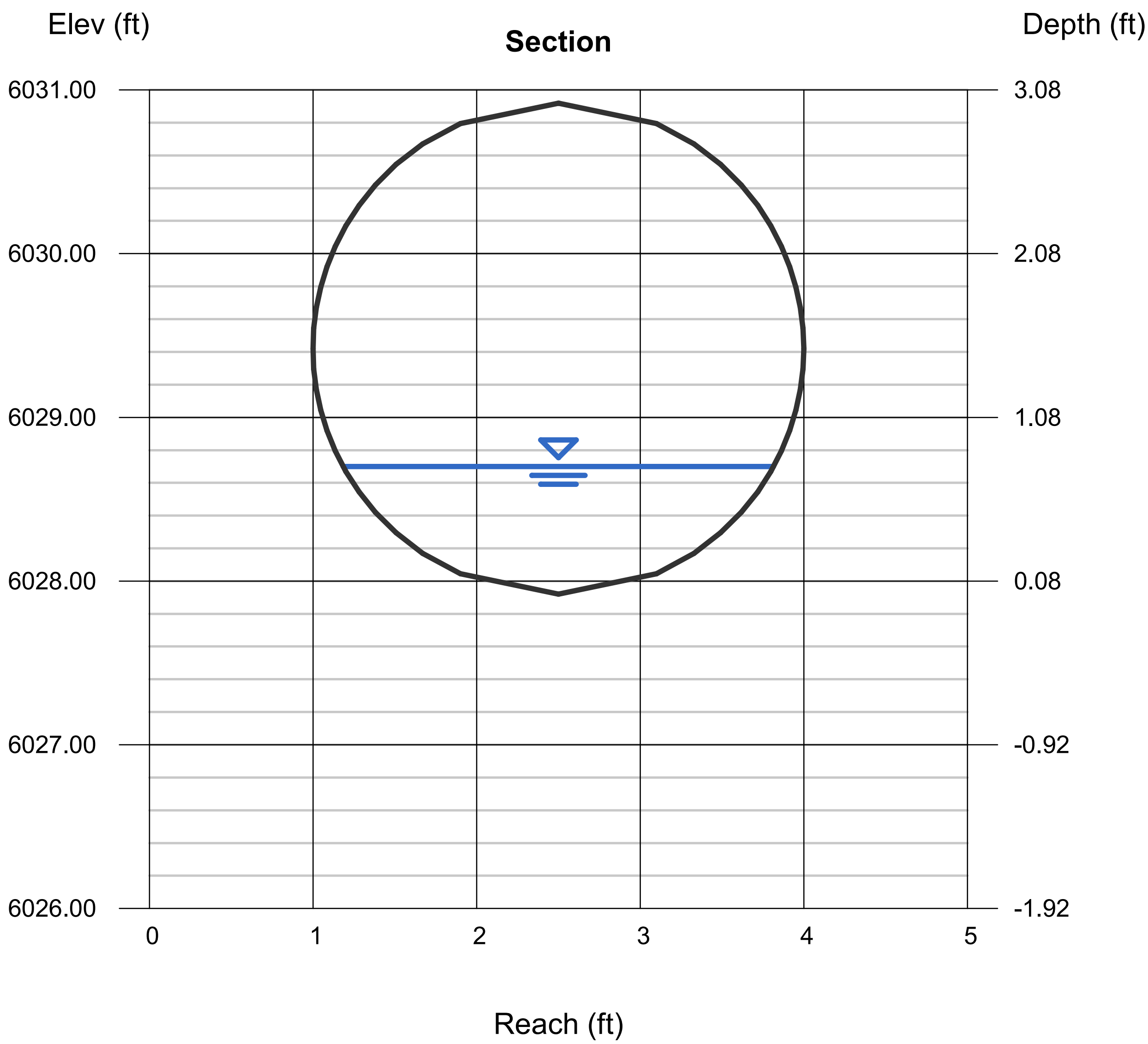
Total earth volume for sewer trenches = 9657 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

Channel Report

MINOR STORM TAIL WATER CALCULATION FOR UD SEWER

Circular		**Highlighted**	
Diameter (ft)	= 3.00	Depth (ft)	= 0.78
		Q (cfs)	= 20.40
		Area (sqft)	= 1.48
Invert Elev (ft)	= 6027.92	Velocity (ft/s)	= 13.81
Slope (%)	= 4.30	Wetted Perim (ft)	= 3.22
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.45
		Top Width (ft)	= 2.64
Calculations		EGL (ft)	= 3.74
Compute by:	Known Q		
Known Q (cfs)	= 20.40		



Program: UDSEWER Math Model Interface 2.1.1.4 **Run Date:** 5/6/2020 12:16:26 PM	# UDSewer Results Summary **Project Title:** CHAMBERS AND HESS MINOR STORM **Project Description:** Default system

System Input Summary

Rainfall Parameters

Rainfall Return Period: 2
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6028.20

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	**Ground Elevation (ft)**	**Total Known Flow (cfs)**	**Local Contribution (cfs)**	**Drainage Area (Ac.)**	**Runoff Coefficient**	**5yr Coefficient**	**Overland Length (ft)**	**Overland Slope (%)**	**Gutter Length (ft)**	**Gutter Velocity (fps)**
OUTFALL 1 S(99)	6038.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EXISTING	6042.20	19.00	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83

PARKER 234										
INL-01	6055.00	19.00	0.00	1.00	0.50	0.50	100.00	1.00	100.00	2.00
INL-02	6060.00	19.00	0.00	1.00	0.50	0.50	100.00	2.00	200.00	2.83
INL-04	6054.11	14.60	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-01	6063.79	13.80	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
SDMH-02	6053.38	6.90	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-11	6054.54	6.00	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-12	6061.71	5.80	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-13	6065.02	4.60	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-14	6068.43	3.10	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-10	6053.10	1.00	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-05	6065.83	8.70	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-06	6071.93	7.30	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-07	6074.13	5.50	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-08	6076.49	3.80	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-09	6078.04	1.90	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83
INL-03	6063.62	2.60	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	**Overland Time (min)**	**Gutter Time (min)**	**Basin Tc (min)**	**Intensity (in/hr)**	**Local Contrib (cfs)**	**Coeff. Area**	**Intensity (in/hr)**	**Manhole Tc (min)**	**Peak Flow (cfs)**	**Comment**
OUTFALL 1 S(99)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
EXISTING PARKER 234	8.62	0.59	9.21	NaN	NaN	8.50	2.24	NaN	19.00	
INL-01	10.83	0.83	11.11	NaN	NaN	8.00	2.38	NaN	19.00	Used UDFCD Tc Maximum
INL-02	8.62	1.18	9.80	NaN	NaN	7.50	2.53	NaN	19.00	
INL-04	8.62	0.59	9.21	NaN	NaN	6.50	2.25	NaN	14.60	
SDMH-01	8.62	0.59	9.21	NaN	NaN	6.00	2.30	NaN	13.80	
SDMH-02	8.62	0.59	9.21	NaN	NaN	3.00	2.30	NaN	6.90	
INL-11	8.62	0.59	9.21	NaN	NaN	2.00	3.00	NaN	6.00	
INL-12	8.62	0.59	9.21	NaN	NaN	1.50	3.87	NaN	5.80	
INL-13	8.62	0.59	9.21	NaN	NaN	1.00	4.60	NaN	4.60	
INL-14	8.62	0.59	9.21	NaN	NaN	0.50	6.20	NaN	3.10	
INL-10	8.62	0.59	9.21	NaN	NaN	0.50	2.00	NaN	1.00	
INL-05	8.62	0.59	9.21	NaN	NaN	2.50	3.48	NaN	8.70	
INL-06	8.62	0.59	9.21	NaN	NaN	2.00	3.65	NaN	7.30	
INL-07	8.62	0.59	9.21	NaN	NaN	1.50	3.67	NaN	5.50	
INL-08	8.62	0.59	9.21	NaN	NaN	1.00	3.80	NaN	3.80	
INL-09	8.62	0.59	9.21	NaN	NaN	0.50	3.80	NaN	1.90	
INL-03	8.62	0.59	9.21	NaN	NaN	0.50	5.20	NaN	2.60	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
EXISTING PARKER 234	104.00	6027.93	4.3	6032.40	0.013	0.09	0.00	CIRCULAR	36.00 in	36.00 in
INL-01	45.00	6034.05	11.1	6039.05	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
INL-02	37.50	6039.25	11.3	6043.48	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
INL-04	87.80	6043.68	0.5	6044.12	0.013	1.00	0.00	CIRCULAR	36.00 in	36.00 in
SDMH-01	199.39	6044.32	0.5	6045.32	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
SDMH-02	294.18	6045.82	0.5	6047.29	0.013	0.05	0.00	CIRCULAR	30.00 in	30.00 in
INL-11	10.80	6047.79	0.5	6047.84	0.013	0.81	0.00	CIRCULAR	24.00 in	24.00 in
INL-12	76.40	6048.05	4.6	6051.56	0.013	0.16	0.00	CIRCULAR	24.00 in	24.00 in
INL-13	115.24	6051.75	6.3	6059.01	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
INL-14	146.30	6059.51	3.0	6063.90	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
INL-10	20.67	6048.29	0.5	6048.39	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in
INL-05	136.13	6046.32	10.1	6060.09	0.013	1.00	0.00	CIRCULAR	24.00 in	24.00 in
INL-06	217.68	6060.19	1.8	6064.00	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
INL-07	137.31	6064.20	3.2	6068.53	0.013	0.68	0.00	CIRCULAR	24.00 in	24.00 in
INL-08	141.24	6069.03	1.8	6071.57	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
INL-09	147.31	6071.77	1.2	6073.54	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
INL-03	179.08	6044.98	7.8	6059.00	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length	Comment

										(ft)	
EXISTING PARKER 234	138.68	19.62	16.76	5.89	9.00	13.75	3.32	Supercritical	19.00	0.00	
INL-01	222.93	31.54	16.76	5.89	7.10	19.24	5.27	Supercritical	19.00	0.00	Velocity is Too High
INL-02	224.61	31.78	16.76	5.89	7.08	19.35	5.31	Supercritical	19.00	0.00	Velocity is Too High
INL-04	47.29	6.69	14.61	5.42	13.73	5.89	1.13	Supercritical	14.60	0.00	
SDMH-01	47.29	6.69	14.19	5.33	13.32	5.80	1.13	Supercritical	13.80	0.00	
SDMH-02	29.08	5.92	10.45	4.53	9.95	4.85	1.10	Supercritical	6.90	0.00	
INL-11	16.04	5.11	10.39	4.60	10.17	4.74	1.04	Supercritical	6.00	0.00	
INL-12	48.65	15.49	10.21	4.55	5.60	10.42	3.20	Supercritical	5.80	0.00	
INL-13	26.44	14.96	9.88	4.63	5.08	11.23	3.59	Supercritical	4.60	0.00	
INL-14	18.24	10.32	8.04	4.06	5.02	7.70	2.48	Supercritical	3.10	0.00	
INL-10	7.45	4.21	4.47	2.92	4.45	2.94	1.01	Supercritical	1.00	0.00	
INL-05	72.14	22.96	12.62	5.20	5.63	15.51	4.75	Supercritical	8.70	0.00	
INL-06	30.01	9.55	11.51	4.90	8.06	7.88	1.98	Supercritical	7.30	0.00	
INL-07	40.28	12.82	9.93	4.48	5.99	8.98	2.66	Supercritical	5.50	0.00	
INL-08	14.13	8.00	8.94	4.34	6.38	6.78	1.91	Supercritical	3.80	0.00	
INL-09	11.54	6.53	6.23	3.50	4.94	4.82	1.57	Supercritical	1.90	0.00	
INL-03	29.47	16.68	7.33	3.84	3.61	10.28	3.95	Supercritical	2.60	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
EXISTING PARKER 234	19.00	CIRCULAR	36.00 in	36.00 in	18.00 in	18.00 in	36.00 in	36.00 in	7.07	
INL-01	19.00	CIRCULAR	36.00 in	36.00 in	18.00 in	18.00 in	36.00 in	36.00 in	7.07	
INL-02	19.00	CIRCULAR	36.00 in	36.00 in	18.00 in	18.00 in	36.00 in	36.00 in	7.07	
INL-04	14.60	CIRCULAR	36.00 in	36.00 in	24.00 in	24.00 in	36.00 in	36.00 in	7.07	
SDMH-01	13.80	CIRCULAR	36.00 in	36.00 in	24.00 in	24.00 in	36.00 in	36.00 in	7.07	
SDMH-02	6.90	CIRCULAR	30.00 in	30.00 in	18.00 in	18.00 in	30.00 in	30.00 in	4.91	
INL-11	6.00	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
INL-12	5.80	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
INL-13	4.60	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-14	3.10	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-10	1.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-05	8.70	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
INL-06	7.30	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	

INL-07	5.50	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
INL-08	3.80	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-09	1.90	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INL-03	2.60	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6028.20

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
EXISTING PARKER 234	6027.93	6032.40	0.00	0.00	6028.68	6033.80	6031.61	2.72	6034.34
INL-01	6034.05	6039.05	0.01	0.00	6034.64	6040.45	6040.39	0.59	6040.99
INL-02	6039.25	6043.48	0.01	0.00	6040.45	6045.41	6045.65	0.00	6045.65
INL-04	6043.68	6044.12	0.07	0.00	6045.57	6045.57	6045.72	0.14	6045.86
SDMH-01	6044.32	6045.32	0.00	0.00	6045.57	6046.50	6045.96	0.99	6046.94
SDMH-02	6045.82	6047.29	0.00	0.00	6046.65	6048.16	6047.01	1.47	6048.48
INL-11	6047.79	6047.84	0.05	0.00	6048.63	6048.71	6048.98	0.05	6049.03
INL-12	6048.05	6051.56	0.01	0.00	6048.71	6052.41	6050.20	2.53	6052.73
INL-13	6051.75	6059.01	0.01	0.00	6052.42	6059.83	6054.13	6.04	6060.17
INL-14	6059.51	6063.90	0.00	0.00	6059.93	6064.57	6060.85	3.98	6064.83
INL-10	6048.29	6048.39	0.00	0.00	6048.66	6048.76	6048.79	0.10	6048.90
INL-05	6046.32	6060.09	0.12	0.00	6046.79	6061.14	6050.52	11.04	6061.56
INL-06	6060.19	6064.00	0.00	0.00	6061.15	6064.96	6061.83	3.51	6065.33
INL-07	6064.20	6068.53	0.03	0.00	6064.99	6069.36	6065.95	3.72	6069.67
INL-08	6069.03	6071.57	0.00	0.00	6069.56	6072.32	6070.27	2.33	6072.61
INL-09	6071.77	6073.54	0.00	0.00	6072.54	6074.06	6072.61	1.64	6074.25
INL-03	6044.98	6059.00	0.03	0.00	6045.44	6059.61	6046.92	12.92	6059.84

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
EXISTING PARKER 234	104.00	4.00	6.00	6.67	18.14	10.91	6.74	17.60	10.63	6.47	397.53	
INL-01	45.00	4.00	6.00	6.67	14.30	8.98	4.82	29.90	16.78	12.62	267.74	
INL-02	37.50	4.00	6.00	6.67	29.50	16.58	12.42	31.04	17.35	13.19	350.76	
INL-04	87.80	4.00	6.00	6.67	30.64	17.15	12.99	17.98	10.82	6.66	588.84	
SDMH-01	199.39	4.00	6.00	6.67	17.57	10.62	6.45	34.94	19.30	15.14	1584.33	
SDMH-02	294.18	3.50	6.00	6.08	34.44	18.76	15.18	10.68	6.88	3.30	1973.92	
INL-11	10.80	3.00	4.00	5.50	10.19	6.18	3.34	12.40	7.28	4.45	18.29	
INL-12	76.40	3.00	4.00	5.50	11.99	7.08	4.24	19.30	10.73	7.90	220.85	
INL-13	115.24	2.50	4.00	4.92	19.42	10.50	8.25	11.52	6.55	4.30	314.41	
INL-14	146.30	2.50	4.00	4.92	10.52	6.05	3.80	8.56	5.07	2.82	178.40	
INL-10	20.67	2.50	4.00	4.92	9.69	5.64	3.39	8.92	5.25	3.00	24.20	
INL-05	136.13	3.00	4.00	5.50	33.94	18.05	15.22	10.48	6.32	3.49	863.37	
INL-06	217.68	3.00	4.00	5.50	10.28	6.22	3.39	14.86	8.51	5.68	438.05	
INL-07	137.31	3.00	4.00	5.50	14.46	8.31	5.48	10.20	6.18	3.35	267.80	
INL-08	141.24	2.50	4.00	4.92	9.70	5.64	3.39	9.34	5.46	3.21	170.60	
INL-09	147.31	2.50	4.00	4.92	8.94	5.26	3.01	8.50	5.04	2.79	157.93	
INL-03	179.08	2.50	4.00	4.92	29.54	15.56	13.31	8.74	5.16	2.91	852.69	

Total earth volume for sewer trenches = 8670 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

Program: UDSEWER Math Model Interface 2.1.1.4 **Run Date:** 5/6/2020 12:31:03 PM	**UDSewer Results Summary** **Project Title:** New UDSEWER System Module **Project Description:** Default system

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6048.28

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	**Ground Elevation (ft)**	**Total Known Flow (cfs)**	**Local Contribution (cfs)**	**Drainage Area (Ac.)**	**Runoff Coefficient**	**5yr Coefficient**	**Overland Length (ft)**	**Overland Slope (%)**	**Gutter Length (ft)**	**Gutter Velocity (fps)**
OUTFALL 1	6050.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INL-15	6055.82	6.90	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
INL-15	8.62	0.59	9.21	NaN	NaN	0.50	13.80	NaN	6.90	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
INL-15	135.37	6046.78	2.4	6050.04	0.013	0.03	0.00	CIRCULAR	18.00 in	18.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
INL-15	16.35	9.25	12.20	5.41	8.16	8.86	2.16	Supercritical Jump	6.90	0.01	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
INL-15	6.90	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6048.28

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
INL-15	6046.78	6050.04	0.00	0.00	6048.28	6051.06	6048.52	2.99	6051.51

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
INL-15	135.37	2.50	4.00	4.92	7.60	4.59	2.34	11.06	6.32	4.07	162.68	

Total earth volume for sewer trenches = 163 cubic yards.

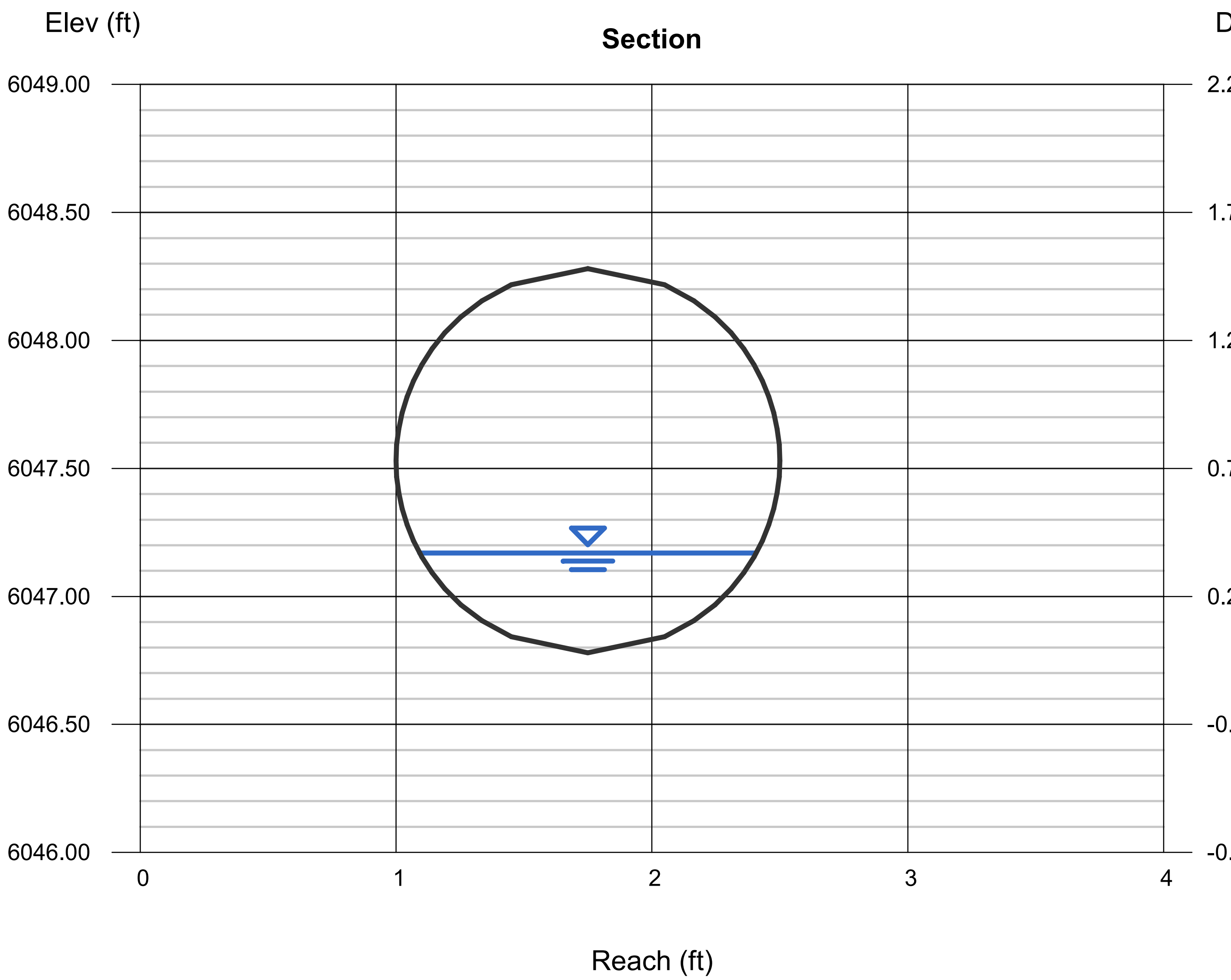
- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, May 6 2020

INLET 15 NORMAL DEPTH CALCULATION

Circular		**Highlighted**	
Diameter (ft)	= 1.50	Depth (ft)	= 0.39
		Q (cfs)	= 2.300
		Area (sqft)	= 0.37
Invert Elev (ft)	= 6046.78	Velocity (ft/s)	= 6.23
Slope (%)	= 2.41	Wetted Perim (ft)	= 1.61
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.58
		Top Width (ft)	= 1.32
Calculations		EGL (ft)	= 0.99
Compute by:	Known Q		
Known Q (cfs)	= 2.30		



Program: UDSEWER Math Model Interface 2.1.1.4 **Run Date:** 5/6/2020 12:24:54 PM	# UDSewer Results Summary **Project Title:** New UDSEWER System Module **Project Description:** Default system

System Input Summary

Rainfall Parameters

Rainfall Return Period: 2
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6047.17

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	**Ground Elevation (ft)**	**Total Known Flow (cfs)**	**Local Contribution (cfs)**	**Drainage Area (Ac.)**	**Runoff Coefficient**	**5yr Coefficient**	**Overland Length (ft)**	**Overland Slope (%)**	**Gutter Length (ft)**	**Gutter Velocity (fps)**
OUTFALL 1	6050.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INL-15	6055.82	2.30	0.00	1.00	0.50	0.50	100.00	2.00	100.00	2.83

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
INL-15	8.62	0.59	9.21	NaN	NaN	0.50	4.60	NaN	2.30	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
INL-15	135.37	6046.78	2.4	6050.04	0.013	0.03	0.00	CIRCULAR	18.00 in	18.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
INL-15	16.35	9.25	6.88	3.70	4.56	6.53	2.22	Supercritical	2.30	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
INL-15	2.30	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6047.17

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
INL-15	6046.78	6050.04	0.00	0.00	6047.17	6050.61	6047.82	3.00	6050.83

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Volume (cu. yd)	Comment
INL-15	135.37	2.50	4.00	4.92	7.60	4.59	2.34	11.06	6.32	4.07	162.68	

Total earth volume for sewer trenches = 163 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
    - Four inches for pipes less than 33 inches.
    - Six inches for pipes less than 60 inches.
    - Eight inches for all larger sizes.

Appendix C

Excerpts from Final Drainage Report for the Parker 234 Subdivision For Detention Pond "A"

The developed site can be divided into four (4) major basins, being Basins A, B, C and D. Each of these major basins contains a proposed water quality/ detention pond area.

Basin A

Basin A is comprised of most of the eastern portion of the project, including the proposed commercial site, and contributes runoff to Pond A. This facility if located in the northeasterly corner of the site, adjacent to and immediately west of the southerly extension of Jordan Rd. Pond A will discharge easterly, under Jordan Road, to the existing drainageway to Cherry Creek. Basin A is subdivided into thirteen sub-basins, and generally corresponds to historic basins C-3, C-4, C-5 and a portion of historic basin C-2. Runoff within Basin A flows overland to the internal storm drainage system, and ultimately in Pond A.

The proposed detention pond for Basin A serves only the residential portion. At such time that the commercial lot is developed, a separate detention and water quality facility will need to be provided to service that area.

Pond A is located in Tract B. Storm water will be directed to this pond via overland flow and Storm Drain Line B. The pond is sized to hold the required volume for 100-year detention and water quality per the Town of Parker and UDFCD requirements. This needed 100 year volume is 2.72. The water quality volume required is 0.68 Ac.ft. The total volume, including 100-year detention and WQCV, is accumulated by elevation 5992.1. The weir structure will have a top elevation at 5995.0 and a bottom equal to the 100-year water surface elevation, 5992.1. A 1.42' diameter orifice plate will be installed on the outlet pipe to control to pond's allowable release rate, 36.39 cfs. An outlet pipe is sized to convey 100% of the tributary developed 100-year flow, $Q_{100yr.}$ = 191.70 cfs. Storm events that exceed the volume provided in Pond A will be routed through the pond by the emergency overflow spillway. Both pond exits, the spillway and the storm drain, will be protected by riprap.

During initial and interim construction phases, Pond A will have a temporary riser pipe, rather than the permanent outlet structure to allow it to function as a sediment control pond. Also, the spillway will not be cut out of the earth berm that surrounds the pond, so that the pond can have additional volume, which may be needed during the construction operations that typically produce additional sediment. During the final stages of construction, the pond will be modified to include the earth-weir. The perforated outlet pipe will be replaced by the concrete outlet structure.

Basin B

Basin B includes the north-central portion of the project, and directs runoff to detention Pond B. This facility is located adjacent to and immediately southwesterly of the proposed alignment of Chambers Road. Discharge of the computed release rate from Pond B will travel under Chambers Road via a 42" RCP (Storm Line U), into the existing natural drainage-way at that location. The Antelope Heights project, immediately downstream from this discharge point, is coordinating engineering design to accommodate this historic runoff rate. Eventually, this pipe will be connected to the

CVL CONSULTANTS, INC.
CIVIL ENGINEERING
LAND SURVEYING
LAND PLANNING

Project Name/Number Parker 234 / 01804102
Prepared By MEF Date 2-3-08
Sheet 1 of 5

Telephone Log ☐
Meeting Record ☐
Calculations ☒
Other ☐

Divide Basin A into Commercial & Residential

Commercial Property

developed

12.56 Ac. 95% impervious

↳ detention vol_{100} = 1.852 Ac. ft

WQCV = 0.562 Ac. ft

2.414 Ac. ft.

Residential Property

30.25 Ac. 56% impervious

↳ detention vol_{100} = 2.718 Ac. ft.

WQCV = 0.676 Ac. ft.

3.394 Ac. ft. = 147,843 ft^3

Project Name/Number Parker 234 / 018041102
Date: 2-3-03
Sheet 2 of 5

CVL CONSULTANTS, INC.
CIVIL ENGINEERING
LAND SURVEYING
LAND PLANNING

- [ ] Telephone Log
- [ ] Meeting Record
- [x] Calculations
- [ ] Other

POND A

Area = 30.25 Ac.

# of homes = 130 avg. sq. footage = 1660 ft^2, 2-story

Area (park) = 1.71 Ac.

Area (lots) = 15.46 Ac.

Area (roads) = 11.19 Ac.

Area (open space) = 4.05 Ac.

130/15.46 = 8.41 dwellings/Ac. → 36% impervious per RO-5

$$\frac{1.71(5\%) + 15.46(36\%) + 11.19(100\%) + 4.05(0\%)}{30.25\text{ Ac.}} = 56\%$$

DETENTION REQUIREMENTS - ONSITE BASINS

Subdivision: Parker 234
Location: Parker

Project Name: Parker 234
Project No. 1804102
By: MEF
Checked By: KAL
Date: 01/24/03

SOIL GROUPS B/C

Q10R= 0.23
Q100R= 0.85

Note: Allowable release rates for type C soil groups is greater than type B soils, however, rates for type B soil was used for conservatism.

BASIN/LAND USE	DRAINAGE AREA (AC.)	% IMPERV.	V_{10} (AC. FT.)	V_{100} (AC. FT.)	Q_{10R} (CFS)	Q_{100R} (CFS)
Basin A	30.25	56	1.552	2.718	6.96	25.71
Basin B	59.88	54	2.958	5.193	13.77	50.90
Basin C	8.50	25	0.186	0.337	1.96	7.23
Basin D	34.41	26	0.785	1.423	7.91	29.25
Commerical Property	12.6	95	1.110	1.852	2.89	10.68
SUM			6.590	11.524	33.5	123.8

DETENTION PONDING FORMULAS:

$V_{100} = K_{100} \times A$ $K_{100} = (1.78I-0.002I^2-3.56)/1000$ $Q_{100R} = Q100R \times A$

$V_{10} = K_{10} \times A$ $K_{10} = (0.95I-1.90)/1000$ $Q_{10R} = Q10R \times A$

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Designer: MEF
Company: CVL Consultants
Date: January 31, 2003
Project: Parker 234
Location: Pond A

1. Basin Storage Volume	
A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	I_a = 56.00 % i = 0.56
B) Contributing Watershed Area (Area)	Area = 30.25 acres
C) Water Quality Capture Volume (WQCV) (WQCV = 1.0 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I))	WQCV = 0.22 watershed inches
D) Design Volume: Vol = (WQCV / 12) * Area * 1.2	Vol = 0.676 acre-feet
2. Outlet Works	
A) Outlet Type (Check One)	X Orifice Plate __ Perforated Riser Pipe __ Other:
B) Depth at Outlet Above Lowest Perforation (H)	H = 4.27 feet
C) Required Maximum Outlet Area per Row, (A_o)	A_o = 0.52 square inches
D) Perforation Dimensions **(enter one only)**: i) Circular Perforation Diameter **OR** ii) 2" Height Rectangular Perforation Width	D = 0.813 inches, **OR** W = __ inches
E) Number of Columns (nc, See Table 6a-1 For Maximum)	nc = 1 number
F) Actual Design Outlet Area per Row (A_o)	A_o = 0.52 square inches
G) Number of Rows (nr)	nr = 13 number
H) Total Outlet Area (A_{ot})	A_{ot} = 6.65 square inches
3. Trash Rack	
A) Needed Open Area: A_t = 0.5 * (Figure 7 Value) * A_{ot}	A_t = 231 square inches
B) Type of Outlet Opening (Check One)	X ≤ 2" Diameter **Round** __ 2" High **Rectangular** __ Other:
C) For 2", or Smaller, **Round Opening** (Ref.: Figure 6a):	
i) Width of Trash Rack and Concrete Opening (W_{conc}) from Table 6a-1	W_{conc} = 6 inches
ii) Height of Trash Rack Screen (H_{TR})	H_{TR} = 81 inches

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Designer:	**MEF**
Company:	**CVL Consultants**
Date:	**January 31, 2003**
Project:	**Parker 234**
Location:	**Pond A**

iii) Type of Screen (Based on Depth H), Describe if "Other"	x S.S. #93 VEE Wire (US Filter) Other:
iv) Screen Opening Slot Dimension, Describe if "Other"	X 0.139" (US Filter) Other:
v) Spacing of Support Rod (O.C.) Type and Size of Support Rod (Ref.: Table 6a-2)	0.75 inches **#156 VEE**
vi) Type and Size of Holding Frame (Ref.: Table 6a-2)	**3/8 in. x 1.0 in. flat bar**
D) For 2" High **Rectangular Opening** (Refer to Figure 6b):	
i) Width of Rectangular Opening (W)	W = ___ inches
ii) Width of Perforated Plate Opening (W_{conc} = W + 12")	W_{conc} = ___ inches
iii) Width of Trashrack Opening ($W_{opening}$) from Table 6b-1	$W_{opening}$ = ___ inches
iv) Height of Trash Rack Screen (H_{TR})	H_{TR} = ___ inches
v) Type of Screen (based on depth H) (Describe if "Other")	___ Klemp™ KPP Series Aluminum Other:
vi) Cross-bar Spacing (Based on Table 6b-1, Klemp™ KPP Grating). Describe if "Other"	___ inches Other:
vii) Minimum Bearing Bar Size (Klemp™ Series, Table 6b-2) (Based on depth of WQCV surcharge)	
4. Detention Basin length to width ratio	1.00 (L/W)
5 Pre-sedimentation Forebay Basin - Enter design values	
A) Volume (no less than 5% of Design Volume from 1D)	0.062 acre-feet
B) Surface Area	0.067 acres
C) Connector Pipe Diameter (Size to drain this volume in 5-minutes under inlet control)	6 inches
D) Paved/Hard Bottom and Sides	y yes/no

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Designer:	MEF
Company:	CVL Consultants
Date:	January 31, 2003
Project:	Parker 234
Location:	Pond A

6. Two-Stage Design - See Figure EDB-1	
A) Top Stage (Depth D_{WQ} = 2' Minimum)	D_{WQ} = 2.60 feet Storage= 0.645 acre-feet
B) Bottom Stage Depth (D_{BS} = 1.0' Minimum, 2.0' Maximum) Bottom Stage Storage (no less than 3% of Design Volume (0.02027596032 acre-feet.)	D_{BS} = 1.50 feet Storage= 0.031 acre-feet Surf. Area= 0.021 acres
C) Micro Pool (Minimum Depth = the Larger of 0.5 * Top Stage Depth (1.3 ') or 2.5 '	Depth= 2.50 feet Storage= 0.024 acre-feet Surf. Area= 0.010 acres
D) Total Volume: Vol_{tot} = Storage from 5A + 6A + 6B (Must be > Design Volume in 1D, or 0.675865344 acre-feet.)	Vol_{tot} = 0.738 acre-feet
7. Basin Side Slopes (Z, horizontal distance per unit vertical) Minimum Z = 4, Flatter Preferred	Z = 4.00 (horizontal/vertical)
8. Dam Embankment Side Slopes (Z, horizontal distance) per unit vertical) Minimum Z = 3, Flatter Preferred	Z = 4.00 (horizontal/vertical)
9. Vegetation (Check the method or describe "Other")	x Native Grass __ Irrigated Turf Grass __ Other:

Notes:

Pond Volume
(FAA Method)

Subdivision Parker 234
Location Parker

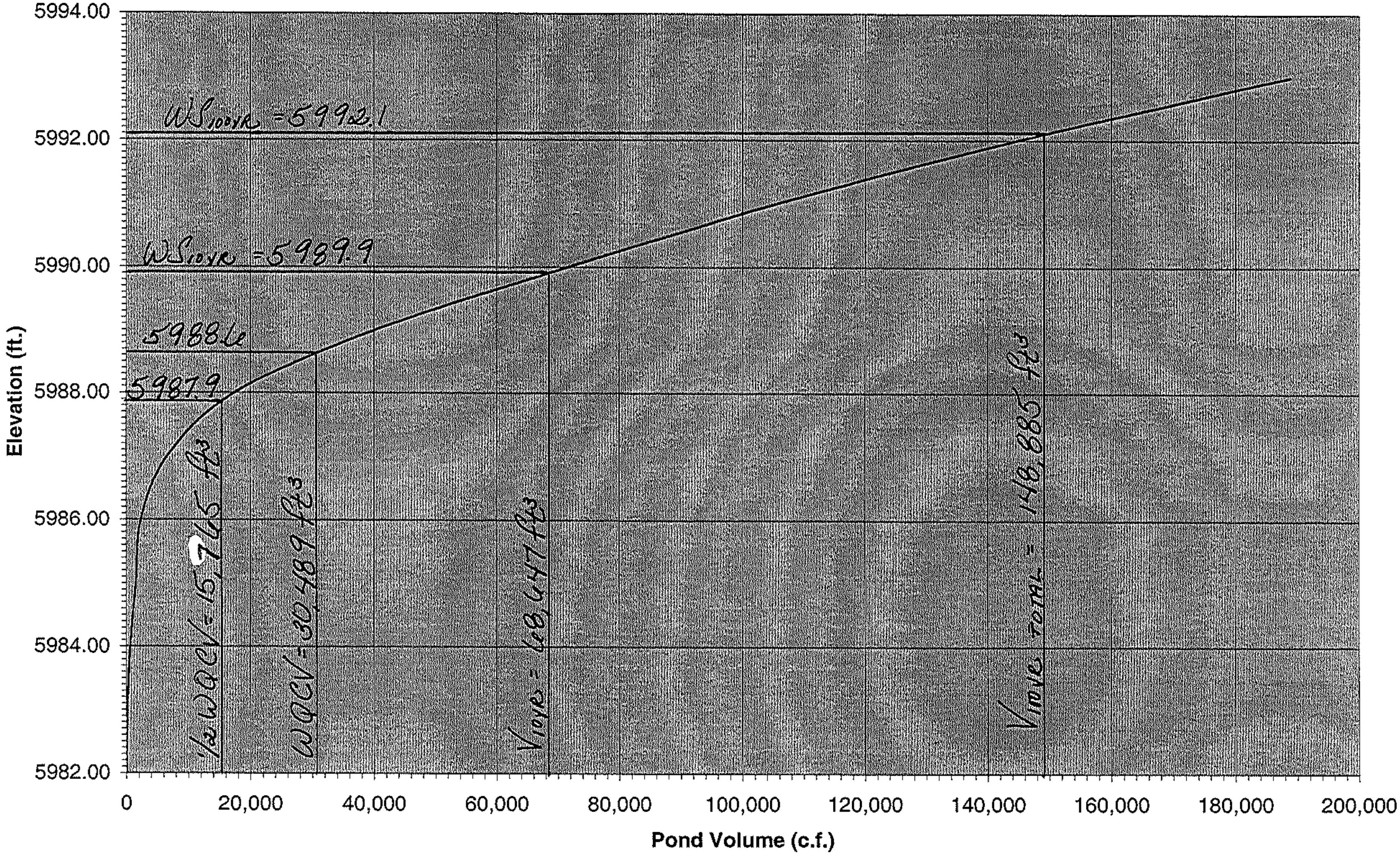
Project Name: Parker 234
Project No. 1804102
By: MEF
Checked By: KAL
Date: 1/31/03

Volume=1/3 x Depth x (A+B+(A*B)^0.5)
A - Upper Surface
B - Lower Surface

Pond A

Elevation	Surface Area (square feet)	A+B+(A*B)^0.5	1/3	Depth (feet)	Volume (cubic feet)	CumulativeVolume (cubic feet)
5982.00	0	0.0	0.0	0.00	0	0
5983.00	301	301.0	100.3	1.00	100	100
5984.00	751	1527.4	509.1	1.00	509	609
5984.50	984	2594.6	864.9	0.50	432	1,042
5985.00	1,332	3083.2	1027.7	0.50	514	1,556
5986.00	2,485	2485.0	828.3	1.00	828	2,384
5987.00	6,297	12737.8	4245.9	1.00	4,246	6,630
5988.00	16,152	32534.1	10844.7	1.00	10,845	17,475
5989.00	29,981	68138.8	22712.9	1.00	22,713	40,188
5990.00	32,693	93981.6	31327.2	1.00	31,327	71,515
5991.00	35,507	102271.0	34090.3	1.00	34,090	105,605
5992.00	42,544	116917.6	38972.5	1.00	38,973	144,578
5993.00	46,080	132900.7	44300.2	1.00	44,300	188,878

Pond A
Stage-Storage



Parker 234-Pond A
Project No. 01804102
1/31/03
Drainage.xls

Emergency Spillway Weir Calculations

Project Name:	Parker 234
Project No.	1804102
Calculated By:	MEF
Checked By:	KAL
Date:	1/31/03

Weir Equation:

$Q = C*L*(H)^{3/2}$

$C_d =$ 3.37 (trapezoidal weirs)

Note: Weirs are designed to pass 2x the 100yr. tributary flow.
(Refer to SF-3 form)

Pond A Emergency Spillway

Flow Rate ($2*Q_{100}$) =	**383.4 cfs**	
Top of Berm Elevation =	**5995.00 feet**	**Freeboard = 1.00**
Emergency Spillway Elevation =	**5994.00 feet**	
100 yr. Water Surface Elevation =	**5992.10 feet**	
Height (H)=	**1.90** feet	
Length (D) =	43.48 feet	

Pond B Emergency Spillway

Flow Rate ($2*Q_{100}$) =	**353.1 cfs**	
Top of Berm Elevation =	**6089.00 feet**	**Freeboard = 1.00**
Emergency Spillway Elevation =	**6088.00 feet**	
Bottom of Berm Elevation* =	**6086.00 feet**	**100 yr. W.S. Elevation = 6083.8 feet*
Height (H)=	**2.00** feet	
Length (D) =	37.08 feet	

Pond C Emergency Spillway

Flow Rate ($2*Q_{100}$) =	**58.1 cfs**	
Top of Berm Elevation =	**6118.00 feet**	**Freeboard = 1.00**
Emergency Spillway Elevation =	**6117.00 feet**	
100 yr. Water Surface Elevation =	**6116.20 feet**	
Height (H)=	**0.80** feet	
Length (D) =	24.13 feet	

Pond D Emergency Spillway

Flow Rate ($2*Q_{100}$) =	**160.0 cfs**	
Top of Berm Elevation =	**6050.50 feet**	**Freeboard = 1.00**
Emergency Spillway Elevation =	**6049.50 feet**	
100 yr. Water Surface Elevation =	**6048.50 feet**	
Height (H)=	**1.00** feet	
Length (D) =	47.53 feet	

Circular Orifice Sizing

Project Name:	Parker 234
Project No.	1804102
Calculated By:	MEF
Checked By:	KAL
Date:	01/31/03

Pond A

DATA:

Flow Rate (Q) =	**25.71 cfs**	
Water Surface Elevation =	**5992.10 feet**	
Invert of Orifice =	**5981.80 feet**	
Height of water surface = to invert of orifice (Y)	10.30 feet	
Diameter of Orifice (D) =	1.42 feet	
Height of water surface = to centroid of orifice (h)	10.30 feet	
C_d =	0.65	for circular orifices
g =	32.20 ft/s^2	

Orifice Equation:

$$Q = C_d*A*(2gh)^{1/2}$$

$$Q = C_d*3.1415*D^2/4*(2gh)^{1/2}$$

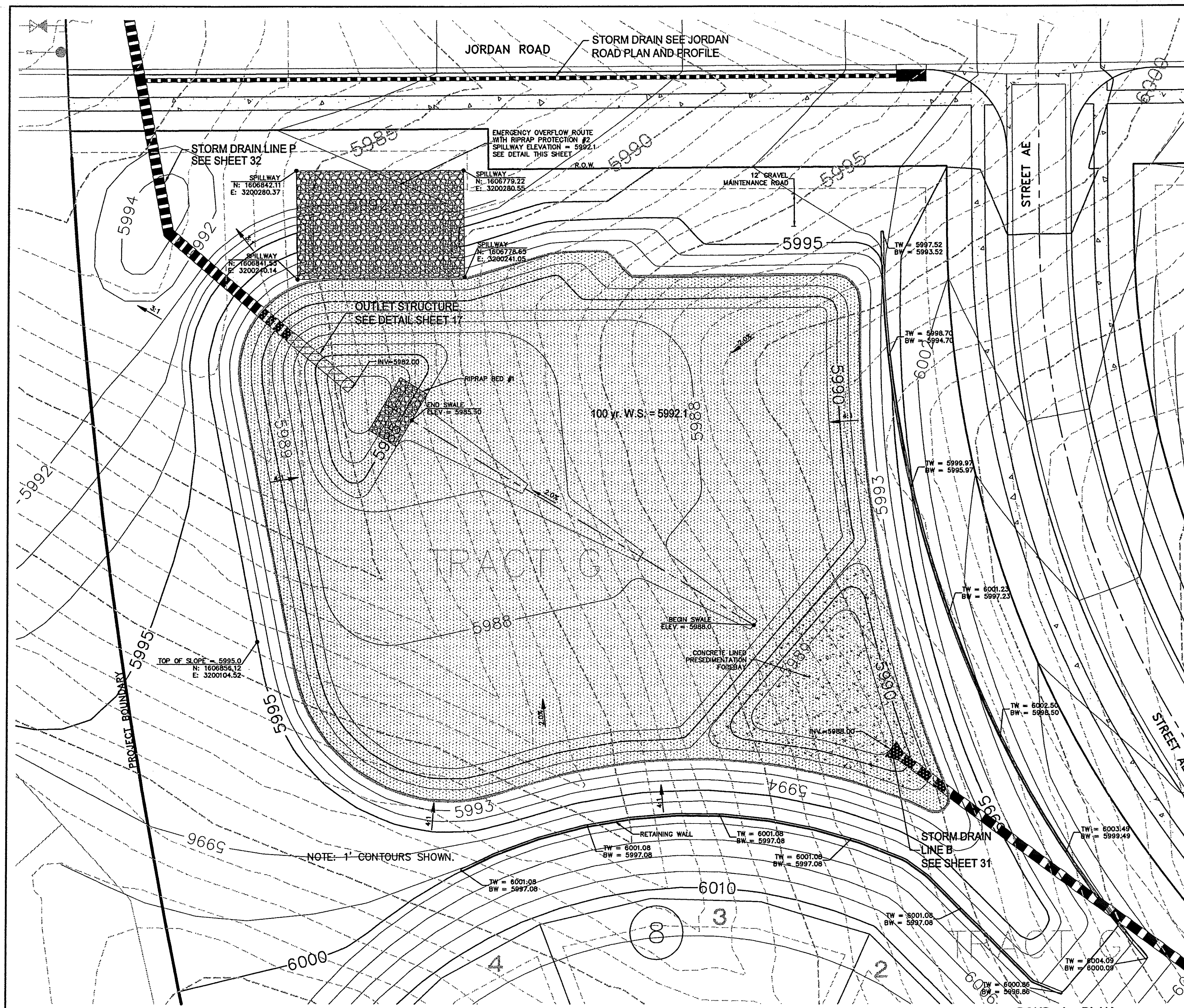
$$Q = 0.65*3.1415*D^2/4*(2*32.2*h)^{1/2}$$

$$D = (Q/(.5105*(64.4*h)^{1/2}))^{1/2}$$

Calculation Table for Orifice Size

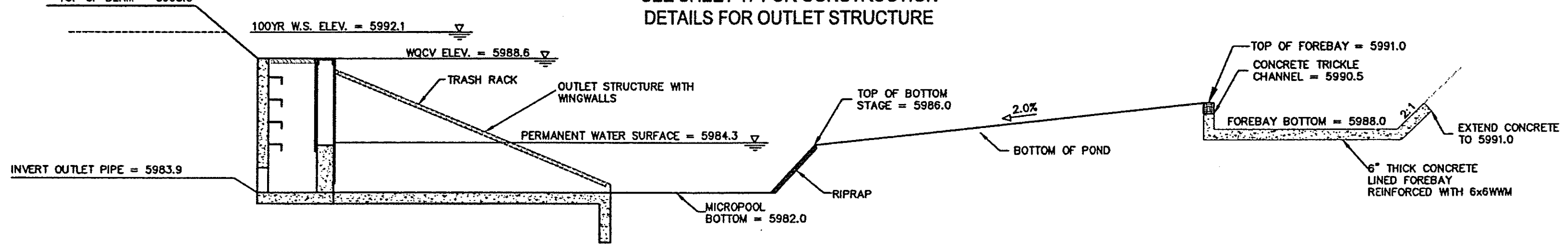
%	h = %*Y	Diam. (D)	Actual h	h/Y
98%	10.09	1.41	9.60	93%
97%	9.99	1.41	9.60	93%
96%	9.89	1.41	9.59	93%
95%	9.79	1.42	9.59	93%
94%	9.68	1.42	9.59	93%
93%	9.58	1.42	9.59	93%
92%	9.48	1.43	9.59	93%
91%	9.37	1.43	9.58	93%
90%	9.27	1.44	9.58	93%
89%	9.17	1.44	9.58	93%
88%	9.06	1.44	9.58	93%
87%	8.96	1.45	9.58	93%
86%	8.86	1.45	9.57	93%
85%	8.76	1.46	9.57	93%
84%	8.65	1.46	9.57	93%
83%	8.55	1.47	9.57	93%
82%	8.45	1.47	9.57	93%
81%	8.34	1.47	9.56	93%
80%	8.24	1.48	9.56	93%
79%	8.14	1.48	9.56	93%
78%	8.03	1.49	9.56	93%

N:\Projects\01804102\dwg\Preliminary\Filing1\Town-of-Parker\16-PondA.dwg, 02/07/2003 09:52:58 AM, \\C_VL\HP8000, JAM

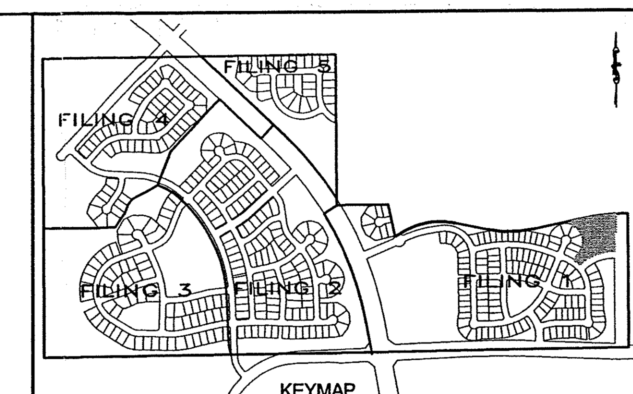


SEE SHEET 17 FOR CONSTRUCTION DETAILS FOR OUTLET STRUCTURE

POND A: PLAN
HORIZONTAL SCALE: 1" = 20'



POND A: CROSS SECTION
NOT TO SCALE



KEYMAP
N.T.S.

20 10 0 20 40
SCALE: 1" = 20'

100 YR. WATER SURFACE

RIRAP SUMMARY TABLE

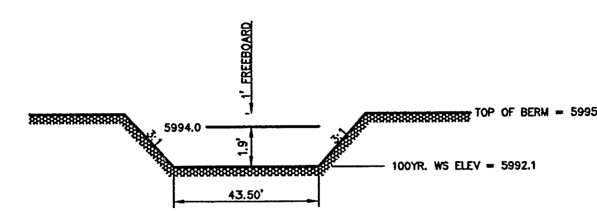
	RR#1	RR#2
LENGTH	23	61'
WIDTH	12	40'
DEPTH	2.5'	1.5'
SIZE,d50	9"	12"
TYPE	L	M

* SEE DETAIL

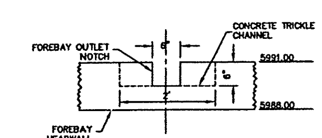
BURY TYPE L RIPRAP WITH 4" NATIVE TOPSOIL AND RESEED OR RESOD.

POND SUMMARY TABLE

	Q 10yr.	Q 100yr.
PEAK INFLOW (cfs)	127.4	191.7
PEAK OUTFLOW (cfs)	7.0	50.9
WQCV (Ac.Ft.)	0.68	
10 yr. REQUIRED VOL. (Ac.Ft.)	1.55	
100 yr. REQUIRED VOL. (Ac.Ft.)	2.72	
DETENTION CAPACITY (Ac.Ft.)	3.42	
AVAILABLE FREEBOARD (ft.)	1.0	



EMERGENCY SPILLWAY DETAIL



FOREBAY OUTLET NOTCH

CALL UNCC
TWO WORKING DAYS
BEFORE YOU DIG
1-800-922-1987
534-6700 METRO DENVER AREA
UTILITY NOTIFICATION CENTER OF COLORADO

No.	Revisions	Date	Init.	Appr.	Date
-					
-					
-					
-					

CVL CONSULTANTS OF COLORADO, INC.
CIVIL ENGINEERING · LAND SURVEYING · LAND PLANNING
7901 E. Belleview Avenue
Suite 150
Englewood, CO 80111
Tel: (720) 482-9526
Fax: (720) 482-9546

Continental Homes
7600 East Orchard Road, Ste. 165-S
Greenwood Village, CO 80111

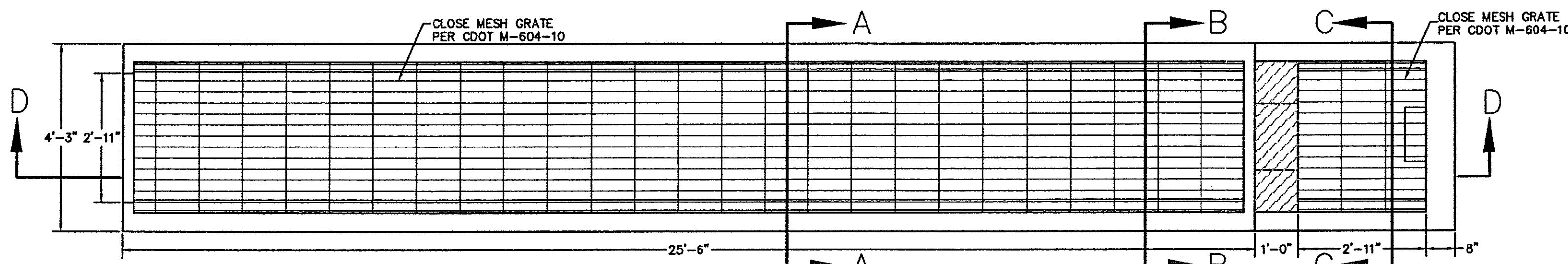
DOUGLAS 234
FILING 1
STREET AND DRAINAGE IMPROVEMENTS
POND A

SCALE: AS SHOWN
FILE NO: 01804102
DRAWN BY: JAM
CHECKED BY: KAL
DATE: FEBRUARY 2003

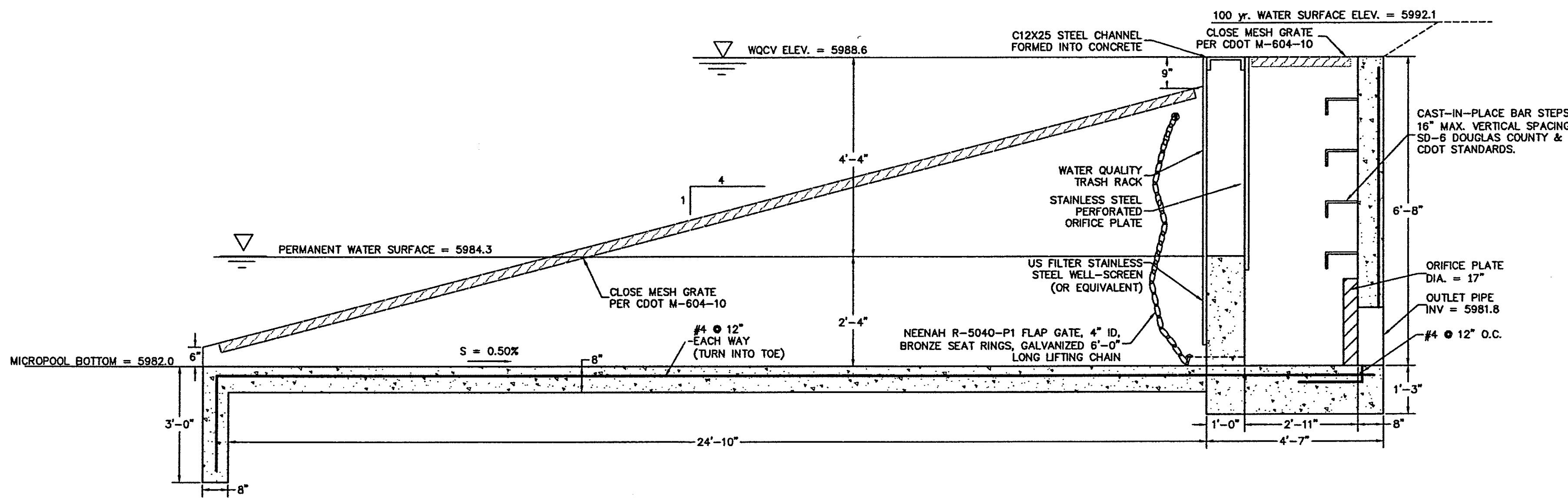
SHEET NUMBER
16

DRAWING: 16-PondA

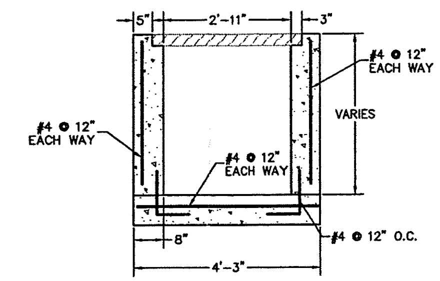
POND A DETAILS



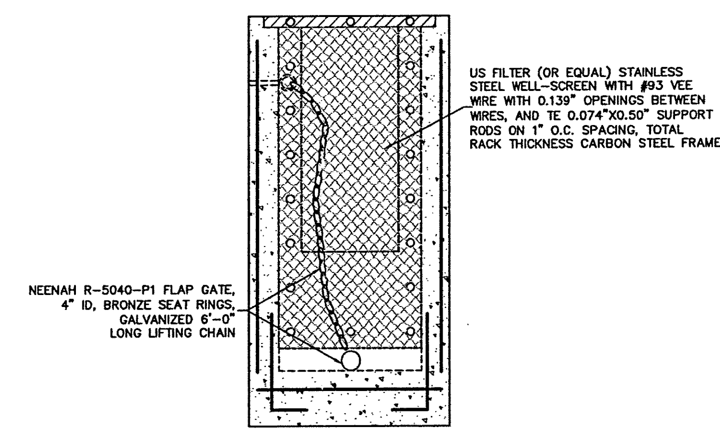
PLAN VIEW
NTS



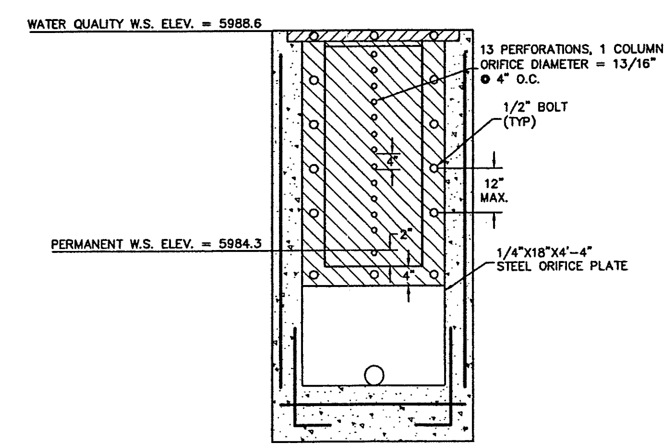
SECTION D-D
NTS



SECTION A-A
NTS



SECTION B-B
NTS



SECTION C-C
NTS

N:\Projects\01804102\dwg\Preliminary\Filing1\Town-of-Parker\17-PONDA-DET.dwg, 02/07/2003 09:53:51 AM, \\C_VLHP8000, JAM

No.	Revisions	Date	Init.	Appr.	Date
-					
-					
-					

CVL
CONSULTANTS OF COLORADO, INC.
CIVIL ENGINEERING · LAND SURVEYING · LAND PLANNING
7901 E. Belleview Avenue
Suite 150
Englewood, CO 80111
Tel: (720) 482-9526
Fax: (720) 482-9546

Continental Homes
7600 East Orchard Road, Ste. 165-S
Greenwood Village, CO 80111

DOUGLAS 234
FILING 1
STREET AND DRAINAGE IMPROVEMENTS
POND A OUTLET DETAILS

DRAWN BY: MEF
CHECKED BY: KAL
DATE: FEBRUARY 2003
SCALE: AS SHOWN
FILE NO: 01804102
SHEET NUMBER 17
DRAWING: 17-PONDA-DET

Appendix C

Drainage Plan

BASIN SUMMARY

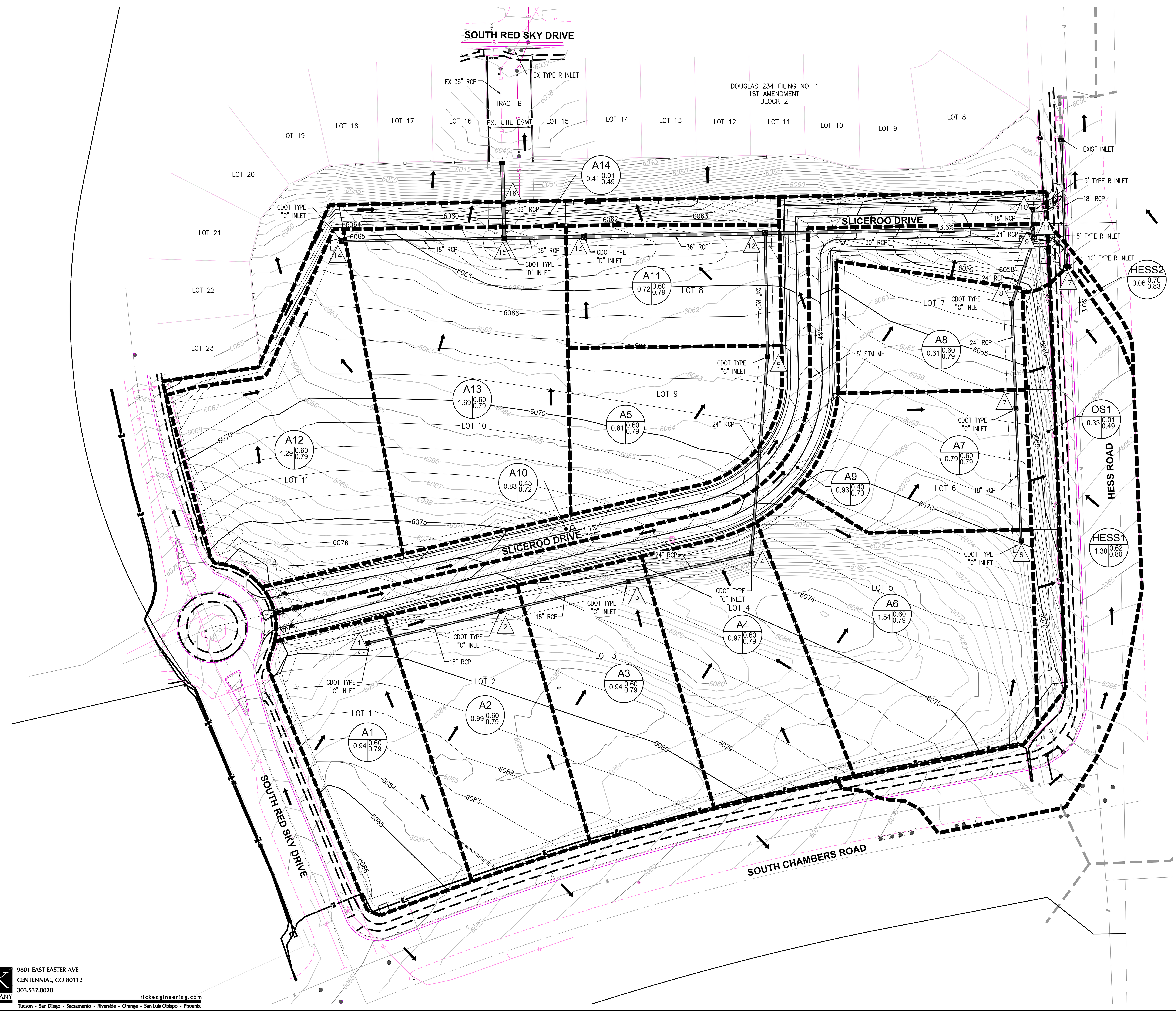
BASIN	Q5 CFS	Q100 CFS
C1	0.2	19.6
C2	0.0	2.8
C3	0.0	0.4
C4	0.0	0.3
D1	0.0	3.7
D2	0.0	3.2

PRE-DEVELOPMENT DRAINAGE MAP FOR CHAMBERS & HESS FILING NO. 1

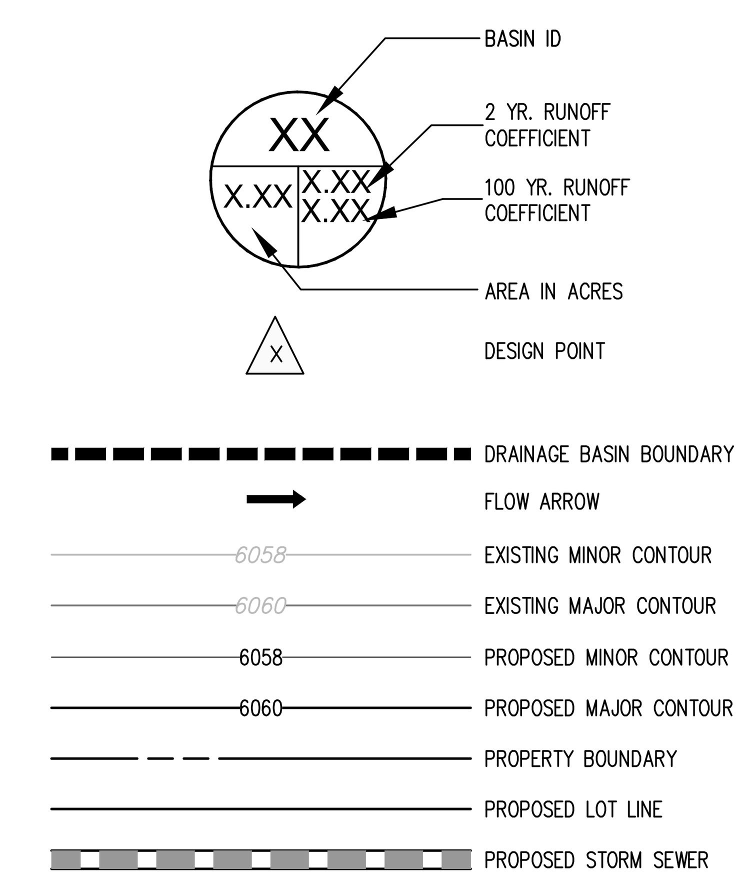
RICK ENGINEERING COMPANY
Denver
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020
rickengineering.com
Tucson - San Diego - Sacramento - Riverside - Orange - San Luis Obispo - Phoenix

D-1173
DATE: DEC 13, 2019

NOT FOR CONSTRUCTION — EXHIBIT FOR DRAINAGE STUDY REPORT ONLY



LEGEND



DESIGN POINT SUMMARY

DESIGN POINT	PEAK RUNOFF 2YR (CFS)	100YR (CFS)
1	1.9	6.5
2	3.8	13.2
3	5.5	19.4
4	7.3	25.7
5	8.7	30.7
6	3.1	10.7
7	4.6	16.0
8	5.8	20.1
9	1.1	7.2
10	1.0	4.3
11	6.9	27.6
12	13.8	52.6
13	14.6	55.6
14	2.6	9.0
15	19.0	71.1
16	19.0	72.5
17	2.3	9.1

BASIN SUMMARY

BASIN	Q2 CFS	Q100 CFS
A1	1.9	6.5
A2	2.0	6.9
A3	1.9	6.6
A4	2.0	6.8
A5	1.6	5.7
A6	3.1	10.7
A7	1.6	5.5
A8	1.2	4.2
A9	1.0	4.7
A10	1.0	4.3
A11	1.5	5.0
A12	2.6	9.0
A13	3.4	11.8
A14	0.0	1.8
HESS1	2.3	7.8
HESS2	0.1	0.5
OS1	0.0	1.4

POST-DEVELOPMENT DRAINAGE MAP FOR CHAMBERS & HESS FILING NO. 1

SHEET 2 OF 2

D-1173
DATE: MAY 5, 2020

RICK ENGINEERING COMPANY
Denver
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020
rickengineering.com
Tucson - San Diego - Sacramento - Riverside - Orange - San Luis Obispo - Phoenix

NOT FOR CONSTRUCTION – EXHIBIT FOR DRAINAGE STUDY REPORT ONLY