

The Learning Experience

Address: TBD

*Lot 1, Block 1, Horseshoe Ridge Subdivision, 1st Amendment
A Parcel of Land Located in the SE ¼ of Section 28, Township 6 South, Range
66 West of the 6th Principal Meridian
Town of Parker, County of Douglas, State of Colorado*

Final Drainage Report

Prepared by: Brad Anderson

Reviewed by: Mike Beach, P.E.

Date: October 29, 2019



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Project Location

Project Name: The Learning Experience

Location: Southwest corner of Triple Crown Drive and Pardee Street

Address: T.B.D.

Parcels/Tax Lots: 2233-284-23-004

Zoning: PD Commercial (Horseshoe Ridge)

Site Area: Total = ±1.111 Acres

City, County, State: Town of Parker, Douglas County, Colorado

Governing Agency: Town of Parker

Design Criteria: "Storm Drainage and Environmental Criteria Manual", Town of Parker, Colorado, Revised and Adopted February 2014

Engineer's Certification

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

Signature

Colorado P.E. License No.

Seal and Date

Section 1 – Project Overview

This report accompanies The Learning Experience plans to construct a new commercial area within the Town of Parker.

The subject site (Lot 1, Block 1, as shown on the predeveloped basin drainage map, Appendix G) contains native grasses and is surrounded by public roads on the east and north, existing vacant lot to the south, and existing residential to the west. The property is +\1.111-acres and has two access points to the public right of way. The property is located in the Southwest corner of corner of the intersection of Triple Crown Drive and Pardee Street.

The proposed onsite improvements include rough grading to provide a building pad, construction of a new building along with a playground. Other improvements include asphalt parking, concrete sidewalks, landscaping, water and sewer connections, storm drainage improvements, and temporary & permanent erosion control facilities. The existing regional stormwater detention pond will be regraded and resized to contain the new amount of runoff from the subject site.

Section 2 – Pre-Developed Conditions

The site is located on FEMA MAP 08035C0182G and does not contain any mapped floodplain areas. (See Appendix A – FIRM Flood Plain Panel).

The subject lot was included in the original Horseshoe Subdivisions Stormwater Report prepared by Tetra Tech, dated Sept. 2005, revised January 17, 2006, for calculation purposes only, however it does not appear to have been included in the detention pond sizing calculations for the regional facility located along Motsenbocker Road.

The existing stormwater pond currently collects runoff from the Triple Crown Drive along north portion of the lot as well as portions of the residential subdivision just north of the site. Majority of the site slopes towards the east at roughly 1% to 3%. Current stormwater runoff would flow over the curb into the right of way of Triple Crown or Pardee. There is an existing Type R structure located in the Northeast corner of the property. Based on drainage flow arrows from previous stormwater reports, it appears the intention of this Type R was to connect this sites stormwater runoff to that Type R. The runoff from the Type R is conveyed to the existing Regional Detention Pond. The conveyance pipe is primarily located along the north side of Triple Crown Drive.

The NRCS classifies soils on all of Lot 1 as hydrologic group “B”. See Appendix C for more NRCS information.

Existing conditions for the site show an overall percent imperviousness of 2.4%, an existing Conditions Basin Map is included in the Appendix. See Appendix E for the calculations.

Section 3 – Post-Developed Conditions

Site improvements will include, but are not limited to, constructing a new commercial building, asphalt parking lot, concrete sidewalks, outdoor playground area, landscaping, water and sewer connections, storm drainage improvements, and temporary & permanent erosion control facilities. The existing regional stormwater detention pond will also be regraded and resized to contain the new amount of runoff on the site.

The post-developed drainage area for this site is roughly 1.111 acres. There is an existing regional stormwater detention pond located at the southwest corner of the intersection of Triple Crown Drive and Motsenbocker Road. This pond will be reconstructed to hold runoff from the proposed developments. More runoff will be directed to this area than existing conditions.

The proposed basins have been analyzed and divided into 2 subbasins. Subbasin descriptions are as follows: (See Appendix G for the Existing and Proposed Basin Maps).

Subbasin 1 – The 1.100-acre subbasin is primarily proposed asphalt parking, some landscaping and sidewalk areas. Runoff from this subbasin is collected via curb & gutter, then deposited into a new Type R catch basin that will convey the stormwater to the existing regional detention pond. The calculated detention volume (including WQ) is described in Appendix E – Calculations. The proposed percent imperviousness for this basin is 61.4%.

Subbasin OS1 – This 0.160-acre subbasin contributes due to the proposed grading on the site. Since the existing site is fairly steep across it, it is necessary to keep the shared driveway included into this conveyance system. This subbasin contains asphaltic concrete and sidewalk areas. Runoff from this subbasin will be directed towards the northeast into a Type R Inlet. Flows will then travel into the conveyance piping and eventually to the existing regional detention pond. The percent imperviousness for this basin is 83.4%.

Flow Rates/Conveyance Table:

Subbasin	Area (acres)	5-year Coeff.	5-year Developed Flow	10-year Coeff.	10-year Developed Flow	100-year Coeff.	100-year Developed Flow
1	1.100	0.51	2.1	0.55	2.7	0.71	5.5
OS1	0.160	0.71	0.4	0.73	0.6	0.82	1.2

Pipe Flow Analysis:

All pipes on site will be constructed as 18” reinforced concrete pipe. All pipes have been designed at a 0.5% slope. This pipe will be able to carry stormwater up to 7.92 cfs. The total site will contribute about 6.7 cfs.

Precipitation data is obtained from the Storm Drainage and Environmental Criteria Manual from the Town of Parker.

**TABLE 5.1
ONE-HOUR POINT RAINFALL**

Frequency of Design Event (yr)	One-hour Point Rainfall, P ₁ (in)
2	0.99
5	1.39
10	1.64
25	1.98
50	2.31
100	2.60

Peak discharge flow rates from this project are included in the Appendix. All conveyance for the project is provided via overland flow, new storm pipes, and detention ponds.

Section 4 - Hydrologic Calculations

Water Quality & Detention Design:

Within the original storm report, Horseshoe Ridge Subdivision Drainage Report by Tetra Tech, Dated Sept. 2005, Revised January 17, 2006, Stormwater quality treatment was provided within the original Detention Pond III, located at the SE corner of Triple Crown Dr. and N. Motsenbocker Rd. There is currently an existing outlet structure built today that treats the existing Water Quality for Pond III. The additional flows from Lot 1 will be calculated into the total detention of the pond III. Please see Appendix D and E for Calculations.

Detention Pond III Design:

Modifications will need to be done with this project to the existing Detention Pond III within the Horseshoe Ridge Subdivision at the SE corner of Triple Crown Dr. and N. Motsenbocker Rd. Using UDFCD Detention Basin Design Workbook, Lot 1 (1.111 acres) is required to detain a total of 0.147 ac/ft, this includes water quality. The existing Pond III, as it sits today, has a total volume of 4.9 ac/ft. A portion of the pond will be dug out to increase the volume to 5.047 ac/ft to help accommodate the additional detention needed. Retaining walls will be put in place at the 100-yr mark to help diminish the amount of dirt work needed in this area.

All calculations can be found in the Appendix section.

Conveyance Analysis:

In review of the Tetra Tech Report we understand the existing storm drainage infrastructure located along Triple Crown Drive was analyzed for the 2-year and 100-year event. The HGL's per that report is included in the appendix of this report. We have analyzed this existing storm line with the 10-year event and the 100-year event included flows from this project and the previous project. The 10-year event HGL is contained within the pipe, however the 100-year event as shown within this report has one structure where the HGL is at the rim of the structure. Based on a site visit, this specific structure is located whereas any structure flooding would overflow and would be directed into the street and be conveyed via curb and gutter to the next Type R located within Triple Crown, where it would then make its way to the detention facility.

Section 5 – Design and Placement of Construction BMP's

Temporary Erosion and Sediment Control:

All erosion and sediment control measures shall be governed by the requirements of the Town of Parker. A combination of silt fence, temporary conveyance swales, slope protection, rock socks, constructions fences, and temporary sediment pond will be implemented to prevent offsite discharge of sediment. An engineered temporary erosion and sedimentation control plan was prepared to direct the contractor in complying with these requirements.

Temporary swales will be installed along the property lines at certain locations to prevent sediment laden storm water from discharging offsite. Temporary slope protection will be installed along permanent slopes equal to 3:1 horizontal to vertical. Slope protection may include surface roughening, temporary erosion control blankets or other approved equivalent.

A construction entrance will be installed at the proposed entrance. This construction entrance will be relocated as necessary to accommodate the proposed site improvements.

Permanent Erosion and Sediment Control:

Permanent erosion and sediment control will be provided onsite to minimize long term erosion impacts and minimize the amount of sediment that discharges offsite. All areas of the natural ground surface which are not covered in impervious surfaces will be resurfaced with landscaping or native vegetation. The owner will maintain the grounds to ensure there are no areas of erosion.

References

- *Town of Parker, "Storm Drainage and Environmental Criteria Manual", Revised February 2014.*
- *Urban Drainage & Flood Control District Drainage Criteria Manual*
- *FEMA Flood Insurance Rate Map, Community Panel #08035C0182G; March 16, 2016.*
- *USDA Natural Resources Conservation Service Web Soil Survey (WSS) aka NRCS Soils Map*
- *Survey prepared by PLS Group., dated 1/15/2019*
- *Horseshoe Ridge Subdivision Drainage Report by Tetra Tech, Dated Sept. 2005, Revised January 17, 2006*

Appendix

Appendix A – FIRM Floodplain Panel

Appendix B – Vicinity Map

Appendix C – NRCS Soils Data

Appendix D – Criteria

Appendix E – Calculations

Appendix F – Detention Pond Volumes

Appendix G – Basin Map/Grading & Drainage Plan

Appendix H – Existing Pond

Appendix A – FIRM Floodplain Panel

Site Location

NOTES TO USERS

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

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

Boundaries of the **Floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway width and other pertinent floodway data are provided in the Floodway Data table shown on this FIRM.

The projection used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The horizontal datum was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight position differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NOG Information Services
NOAA, NNGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

Base map information shown on this FIRM was provided by the Douglas County GIS Department and the Town of Castle Rock GIS Department. Additional input was provided by the City of Lone Tree and Town of Parker. These data are current as of 2010.

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

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

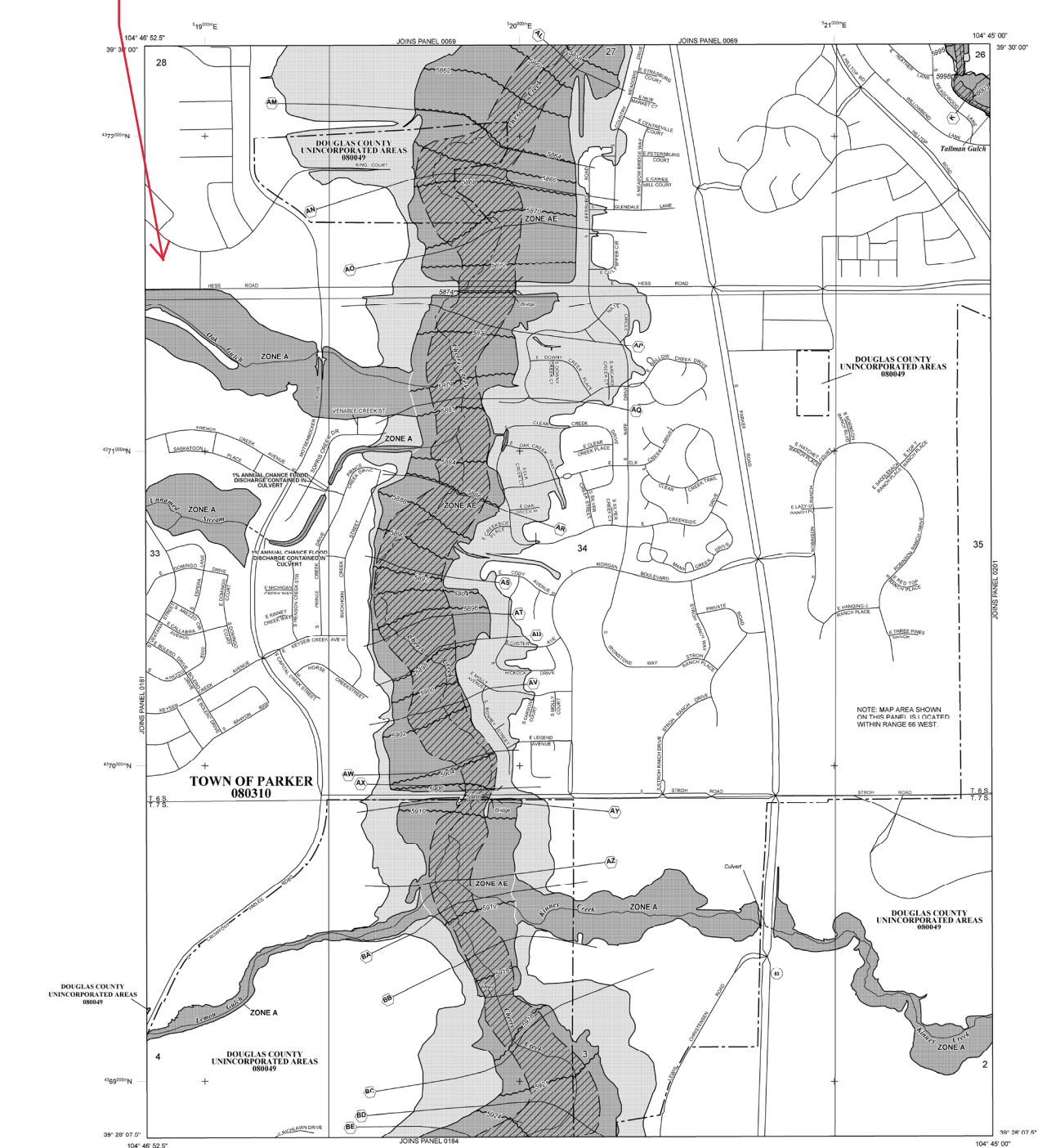
Based on updated topographic information, this map reflects more detailed and up-to-date stream channel configurations and floodplain delineations than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance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

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

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

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have questions about this map, how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/>.



LEGEND

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

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The base flood elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A
No Base Flood Elevations determined.

ZONE AE
Base Flood Elevations determined.

ZONE AO
Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

ZONE AO
Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined; areas of elevated flow flooding; velocities also determined.

ZONE AR
Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decreased. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE AR
Areas to be protected from the 1% annual chance flood by a Federal flood protection system under construction; no base flood elevations determined.

ZONE AV
Coastal flood zone with velocity hazard (wave action); no base flood elevations determined.

ZONE V
Coastal flood zone with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

ZONE X
Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D
Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary

Floodway boundary

Zone D boundary

Zone D and OPA boundary

Boundary during Special Flood Hazard Area Zone D and boundary during Special Flood Hazard Area of different Special Flood Hazard zones, or flood velocities.

Base Flood Elevation (see notes to users section of this FIRM) (EL 987)

Base Flood Elevation value where uniform within zone; elevation in feet

*Referenced to the North American Vertical Datum of 1988

(A) (A) Cross section line

(B) --- (B) --- Transect line

45° 02' 00" 92° 02' 00" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) datum hemisphere

1000-meter horizontal Transverse Mercator grid values, zone 13

DSM510 X Bench mark (see explanation in Notes to Users section of this FIRM)

*M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTY WIDE FLOOD INSURANCE RATE MAP
SEPTEMBER 30, 2020

EFFECTIVE DATES OF REVISIONS TO THIS PANEL
MARCH 16, 2018: To update corporate limits, to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to update map format, to add roads and road names, to reflect updated topographic information, to incorporate previously issued letters of map revision.

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

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-435-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
100 0 100 200 METERS

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0182G

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

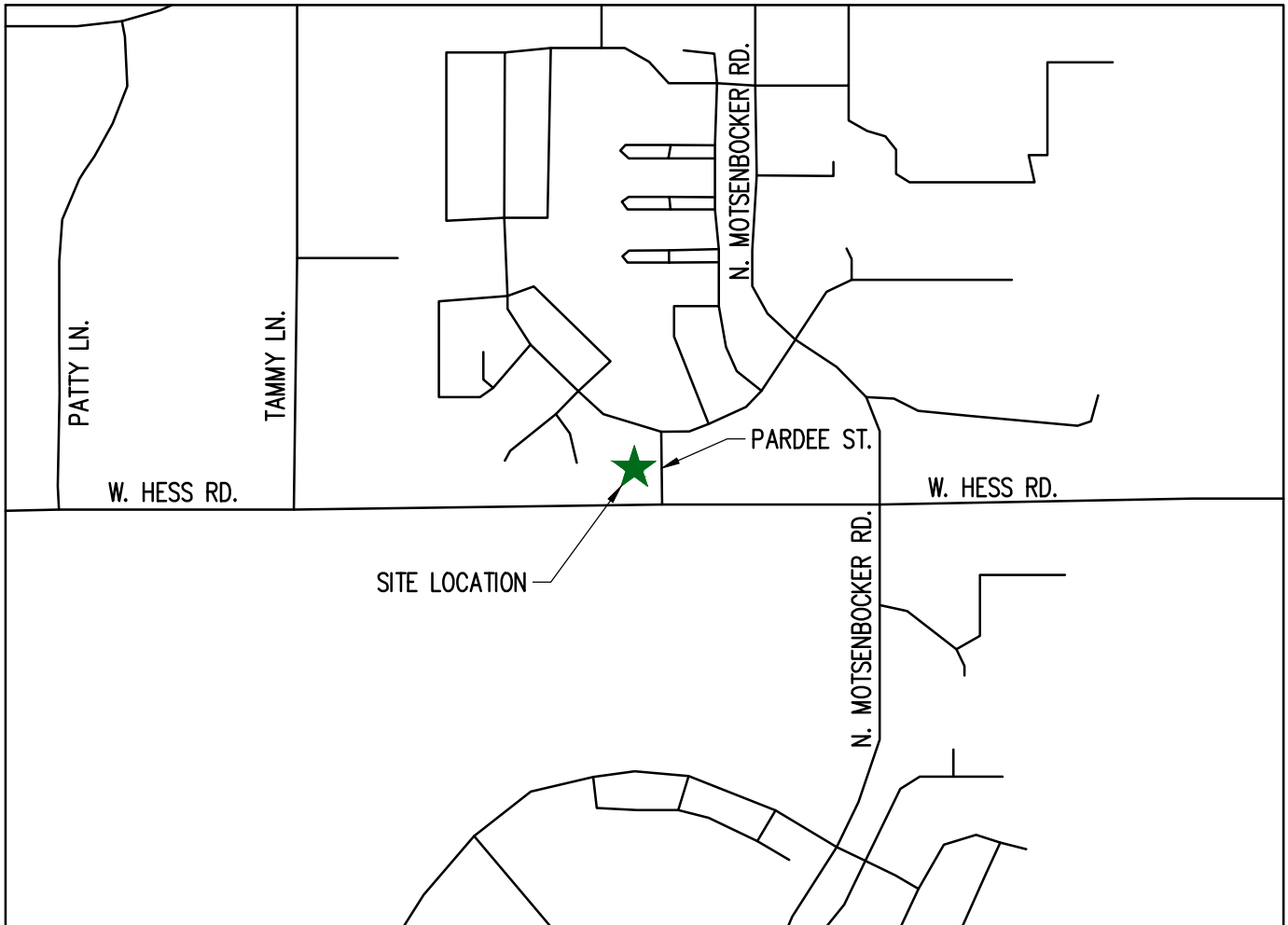
PANEL 182 OF 495
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:	COMMUNITY	NUMBER	PANEL	SUFFIX
	DOUGLAS COUNTY	080049	0182G	G
	PARKER, TOWN OF	080310	0182G	G

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

MAP NUMBER 08035C0182G
MAP REVISED MARCH 16, 2016
Federal Emergency Management Agency

Appendix B – Vicinity Map



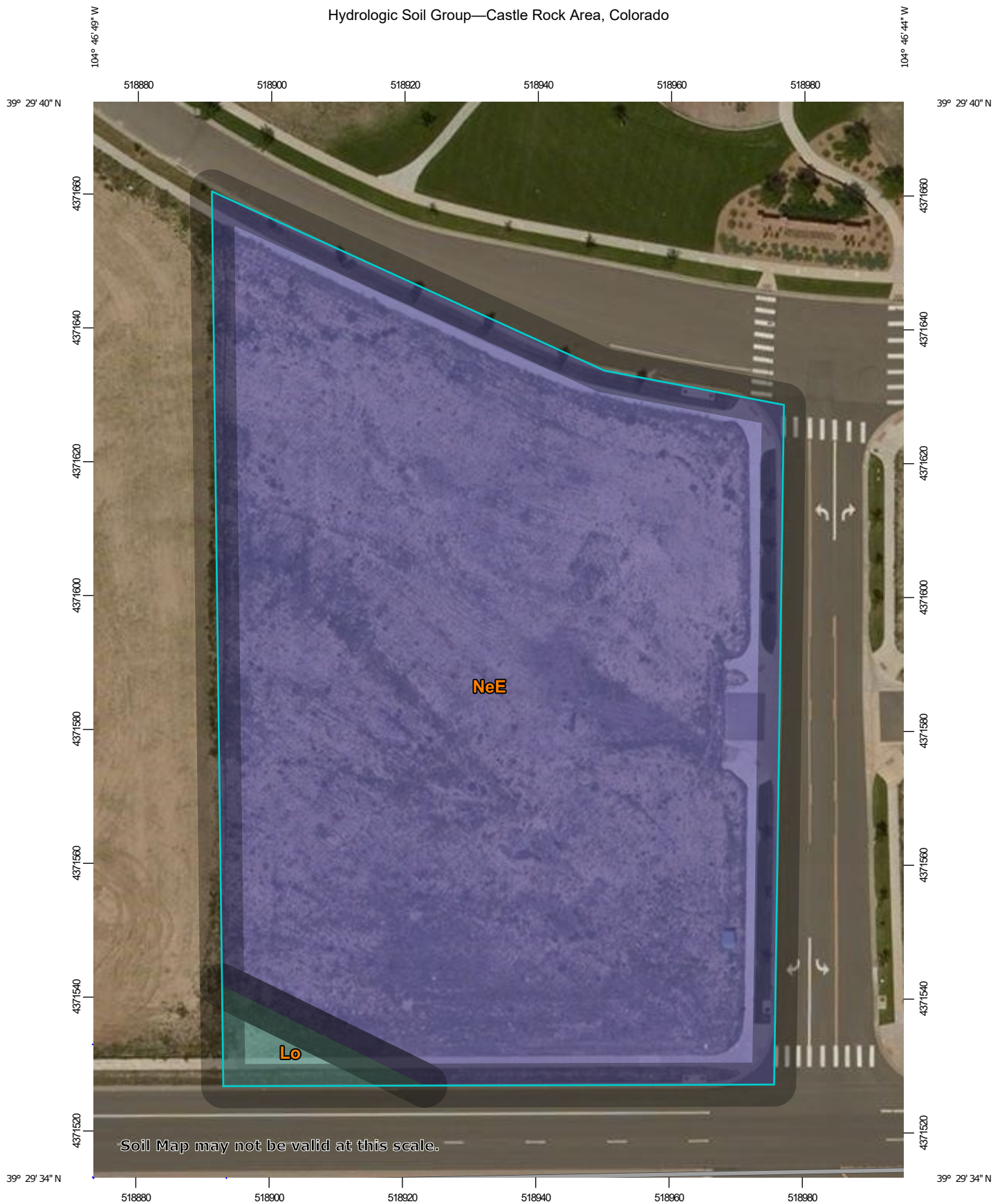
SCALE 1:1000

VICINITY MAP



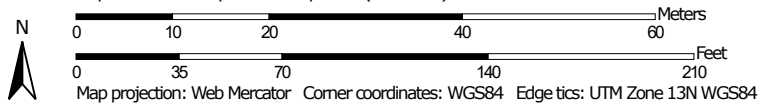
Appendix C – NRCS Soils Data

Hydrologic Soil Group—Castle Rock Area, Colorado



Soil Map may not be valid at this scale.

Map Scale: 1:783 if printed on A portrait (8.5" x 11") sheet.



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 11, Sep 10, 2018

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
Lo	Loamy alluvial land	C	0.1	2.3%
NeE	Newlin gravelly sandy loam, 8 to 30 percent slopes	B	2.3	97.7%
Totals for Area of Interest			2.4	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

Appendix D – Criteria

UDFCD Intensity-Duration Calculations:

Equation 5-1

$$I = (28.5 * P1) / ((10 + Tc)^{0.786})$$

Where: I = rainfall intensity (inches per hour)
P1 = 1-hour point rainfall depth (inches)
Tc = Time of Concentration (minutes)

Duration	P1	5	10	15	20	25	30	Tc	Rainfall
2-year	0.99	3.36	2.68	2.25	1.95	1.73	1.55		Enter Td
5-year	1.39	4.71	3.76	3.16	2.73	2.42	2.18		Enter Td
10-year	1.64	5.56	4.44	3.72	3.23	2.86	2.57		Enter Td
100-year	2.6	8.82	7.03	5.90	5.11	4.53	4.08		Enter Td

Notes:

Visit NOAA Atlas 14 to obtain 1-hour point rainfall depths (P1)

https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

5. HYDROLOGIC CRITERIA

5.1 INTRODUCTION

This section presents the criteria and methodology for determining storm runoff design peaks and volumes to be used in the Town of Parker for preparation of storm drainage plans and facility design. In general, hydrologic analysis of the initial and major storm events for both the historic and fully developed site conditions is required. In addition to the hydrologic analysis for a site, a hydrologic analysis should be performed for all off site basins that impact the proposed site. The Town of Parker adopts procedures prescribed by the Urban Drainage and Flood Control District (UDFCD) for performing hydrologic analysis. These procedures may be found in the Rainfall and Runoff sections of the MANUAL. Standards and technical criteria found in the MANUAL should be followed except where superseded by specific requirements of this manual.

5.2 DESIGN RAINFALL

For any storm runoff technique, design rainfall must first be established. The design rainfall data to be used for the Town of Parker were obtained from NOAA Atlas 2, Precipitation– Frequency Atlas of the Western United States, Volume III– Colorado. The design storm events developed and utilized are the same as those used by UDFCD.

The one-hour point rainfall depths for different frequency events are shown in Table 5.1 herein. Rainfall intensity as a function of the one-hour point rainfall and the time of concentration can be approximated by the following equation which appears in the MANUAL as Equation RA-5.

$$I = (28.5P_1)/(10+t_c)^{0.786}$$

Where, I = rainfall intensity (in/hr)
 P_1 = one-hour point rainfall depth (in)
 t_c = time of concentration (min)

Graphical presentation of the equation is shown as the Time-Intensity-Frequency curves in Figure 5.1 herein. Rainfall intensity for use in the Rational Method may be taken from Figure 5.1 or calculated using the equation.

TABLE 5.1
ONE-HOUR POINT RAINFALL

Frequency of Design Event (yr)	One-hour Point Rainfall, P_1 (in)
2	0.99
5	1.39
10	1.64
25	1.98
50	2.31
100	2.60

5.3 FLOOD HYDROLOGY OVERVIEW

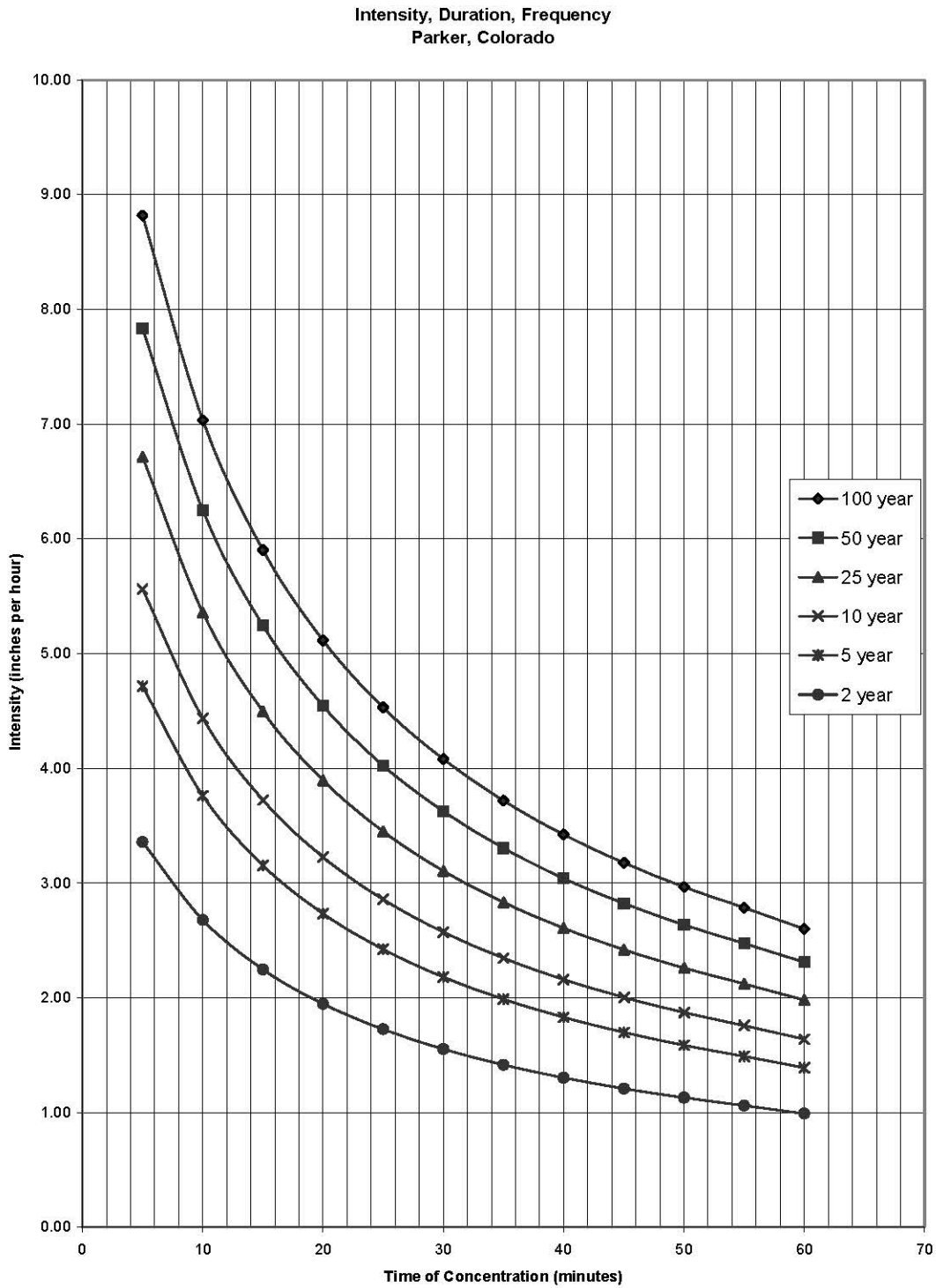
Various methods exist to determine appropriate flood peaks or hydrographs for storm drainage planning and design. Methods for determining flood peaks or hydrographs are the Rational Method, the Colorado Urban Hydrograph Procedure (CUHP), and Urban Drainage Stormwater Management (UDSWM) model. The Town of Parker discourages the use of computer models other than CUHP and UDSWM since these programs are preferred, if not required, by UDFCD for studies involving major drainageways where UDFCD approval is sought or where maintenance eligibility is requested.

The three methods are briefly described in this section, and a discussion of their applicability to the Town of Parker is discussed. UDSWM is mostly used to combine and route the hydrographs generated using CUHP.

In general, the Rational Method is the most widely used and accepted technique for determining peak flows in urban areas for small basins. Within the constraints outlined in the MANUAL, use of the Rational Method provides a relatively simple but effective way to analyze storm runoff.

CUHP is somewhat more complicated than the Rational Method. It allows a manual computation of a runoff hydrograph which may be used for further hydraulic routing through channels and/or detention ponds. Historically, CUHP is best used in urban areas for which runoff coefficients have been derived. However, recent improvements by UDFCD include consideration for different soil types, thus CUHP is now more applicable to rural areas. The reader is referred to UDFCD for the latest version of CUHP.

UDSWM is a computer model that generates runoff hydrographs and routes and combines these hydrographs. UDSWM is a modified version of the Runoff Block of the Environmental Protection Agency's Storm Water Management Model (SWMM). It has been modified to be used in conjunction with CUHP. Table 5.2 herein provides guidance on selecting the appropriate method for a given project.



**FIGURE 5.1
RAINFALL INTENSITY VERSUS DURATION CURVES FOR PARKER, COLORADO**

Appendix E – Calculations

CALCULATED BY : BSA
 DATE: 10/29/2019 REV:
 CHECKED BY: MRB

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

JOB NO: 18-066-001
 PROJECT: LOT 1 - TLE
 DESIGN STORM: 5-YEAR

TOTAL BASIN

SUBBASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS	
		AREA DESIGN	AREA (AC)	RUNOFF COEFF	t _c (MIN)	C*A (AC)	I IN/HR	Q (CFS)	t _c (MIN)	Σ(C*A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t _c (MIN)		
(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)		
1.00		1.10	0.51	10.0	0.56	3.76	2.1															
OS1		0.16	0.71	5.0	0.11	3.36	0.4															

CALCULATED BY : BSA
 DATE: 10/29/2019 REV:
 CHECKED BY: MRB

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

JOB NO: 18-066-001
 PROJECT: LOT 1 - TLE
 DESIGN STORM: 10-YEAR

TOTAL BASIN

SUBBASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF					STREET		PIPE			TRAVEL TIME			REMARKS
		AREA DESIGN	AREA (AC)	RUNOFF COEFF	t _c (MIN)	C*A (AC)	I (IN/HR)	Q (CFS)	t (MIN)	Σ(C*A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t (MIN)		
(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)		
1.00			1.10	0.55	10.0	0.61	4.44	2.7														
OS1			0.16	0.73	5.0	0.12	4.71	0.6														

CALCULATED BY : BSA
 DATE: 10/29/2019 REV:
 CHECKED BY: MRB

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

JOB NO: 18-066-001
 PROJECT: LOT 1 - TLE
 DESIGN STORM: 100-YEAR

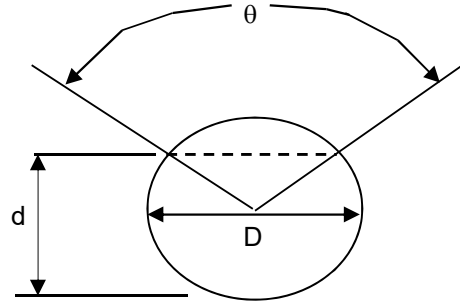
TOTAL BASIN

SUBBASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		AREA DESIGN	AREA (AC)	RUNOFF COEFF	t _c (MIN)	C * A (AC)	I IN/HR	Q (CFS)	t _c (MIN)	Σ(C * A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t _t (MIN)	
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1.00			1.10	0.71	10.0	0.79	7.03	5.5													
OS1			0.16	0.82	5.0	0.13	8.82	1.2													

MANNING'S EQUATION FOR PIPE FLOW

Project: TLE - PARKER Location: All Pipes
 By: BSA Date: #####
 Chk. By: Date: mdo version 12.8.00

Clear Data
Entry Cells



INPUT

D= 18 inches
 d= 16.2 inches
 n= 0.013 manning's coeff
 θ= 73.7 degrees
 S= 0.005 slope in/in

Mannings Formula

$$Q = (1.486/n) A R_h^{2/3} S^{1/2}$$

R=A/P
 A=cross sectional area
 P=wetted perimeter
 S=slope of channel
 n=Manning's roughness coefficient

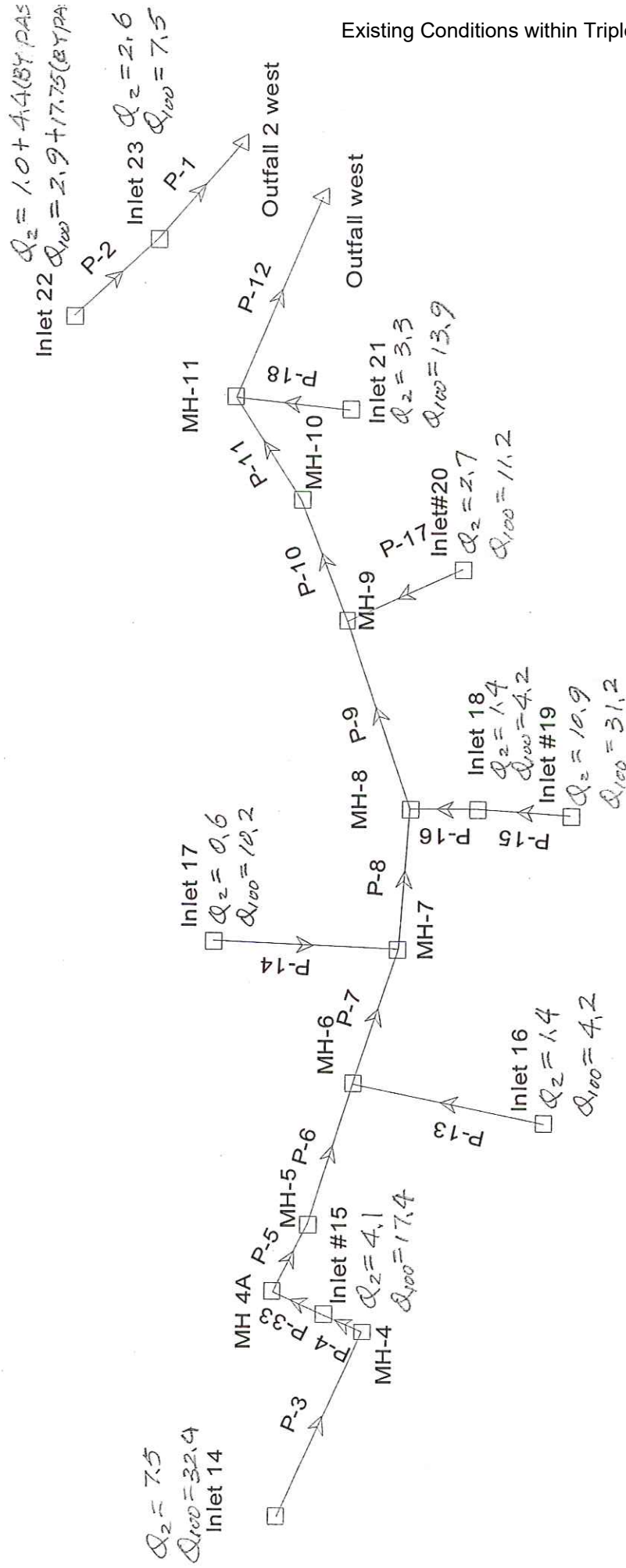
$$V = (1.49/n) R_h^{2/3} S^{1/2}$$

$$Q = V \times A$$

			Solution to Mannings Equation		Manning's n-values	
Area, ft ²	Wetted Perimeter, ft	Hydraulic Radius, ft	velocity ft/s	flow, cfs		
1.68	3.75	0.45	4.73	7.92	PVC	0.01
					PE (<9"dia)	0.015
					PE (>12"dia)	0.02
					PE(9-12"dia)	0.017
					CMP	0.025
					ADS N12	0.012
					HCMP	0.023
					Conc	0.013

Created by: Mike O'Shea

Scenario: Southern System-100-year



Scenario: Southern System-100-year

Combined Pipe\Node Report

Label	Upstream Node	Downstream Node	Length (ft)	Section Size	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Total System Flow (cfs)	Full Capacity (cfs)	Depth In (ft)	Depth Out (ft)	Velocity Out (ft/s)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
P-1	Inlet 23	Outfall 2 we	48.20	30 inch	5,880.46	5,880.00	0.009544	28.15	40.07	4.77	5.00	5.73	5,885.23	5,885.00
P-2	Inlet 22	Inlet 23	57.30	24 inch	5,881.50	5,880.96	0.009424	20.65	21.96	4.20	4.27	6.57	5,885.70	5,885.23
P-3	Inlet 14	MH-4	382.30	24 inch	5,938.00	5,928.00	0.026157	32.40	36.59	1.89	2.11	10.31	5,939.89	5,930.11
P-4	MH-4	Inlet #15	32.30	24 inch	5,927.80	5,926.90	0.027864	32.40	37.76	2.31	2.55	10.31	5,930.11	5,929.45
P-5	MH 4A	MH-5	151.10	30 inch	5,925.50	5,921.83	0.024289	49.80	63.92	2.30	1.70	14.04	5,927.80	5,923.53
P-6	MH-5	MH-6	213.77	30 inch	5,921.63	5,917.42	0.019694	49.80	57.56	2.30	1.80	13.17	5,923.93	5,919.22
P-7	MH-6	MH-7	148.00	30 inch	5,917.22	5,911.50	0.038649	54.00	80.63	2.34	2.97	11.00	5,919.56	5,914.47
P-8	MH-7	MH-8	83.86	30 inch	5,910.00	5,906.05	0.047102	64.20	89.01	4.47	6.37	13.08	5,914.47	5,912.42
P-9	MH-8	MH-9	145.70	30 inch	5,905.85	5,901.33	0.031023	99.60	72.24	6.57	2.49	20.31	5,912.42	5,903.82
P-10	MH-9	MH-10	102.70	30 inch	5,901.13	5,891.76	0.091237	110.80	123.89	2.49	2.01	26.24	5,903.62	5,893.77
P-11	MH-10	MH-11	208.60	36 inch	5,889.61	5,882.78	0.032742	110.80	120.68	4.25	5.32	15.67	5,893.86	5,888.10
P-12	MH-11	Outfall west	201.91	42 inch	5,882.28	5,880.00	0.011292	124.70	106.91	5.82	5.00	12.96	5,888.10	5,885.00
P-13	Inlet 16	MH-6	78.60	18 inch	5,920.30	5,918.42	0.023919	4.20	16.24	0.79	1.14	2.90	5,921.09	5,919.56
P-14	Inlet 17	MH-7	34.20	18 inch	5,912.00	5,911.00	0.029240	10.20	17.96	2.79	3.47	5.77	5,914.79	5,914.47
P-15	Inlet #19	Inlet 18	88.70	24 inch	5,907.58	5,906.70	0.009921	31.20	22.53	6.92	6.12	9.93	5,914.50	5,912.82
P-16	Inlet 18	MH-8	16.30	24 inch	5,906.50	5,906.35	0.009202	35.40	21.70	6.32	6.07	11.27	5,912.82	5,912.42
P-17	Inlet#20	MH-9	44.00	18 inch	5,902.60	5,902.13	0.010682	11.20	10.86	1.48	1.49	6.34	5,904.08	5,903.62
P-18	Inlet 21	MH-11	40.00	18 inch	5,885.00	5,884.28	0.018000	13.90	14.09	3.80	3.82	7.87	5,888.80	5,888.10
P-33	Inlet #15	MH 4A	30.10	24 inch	5,926.90	5,926.00	0.029900	49.80	39.12	2.55	1.98	15.88	5,929.45	5,927.98

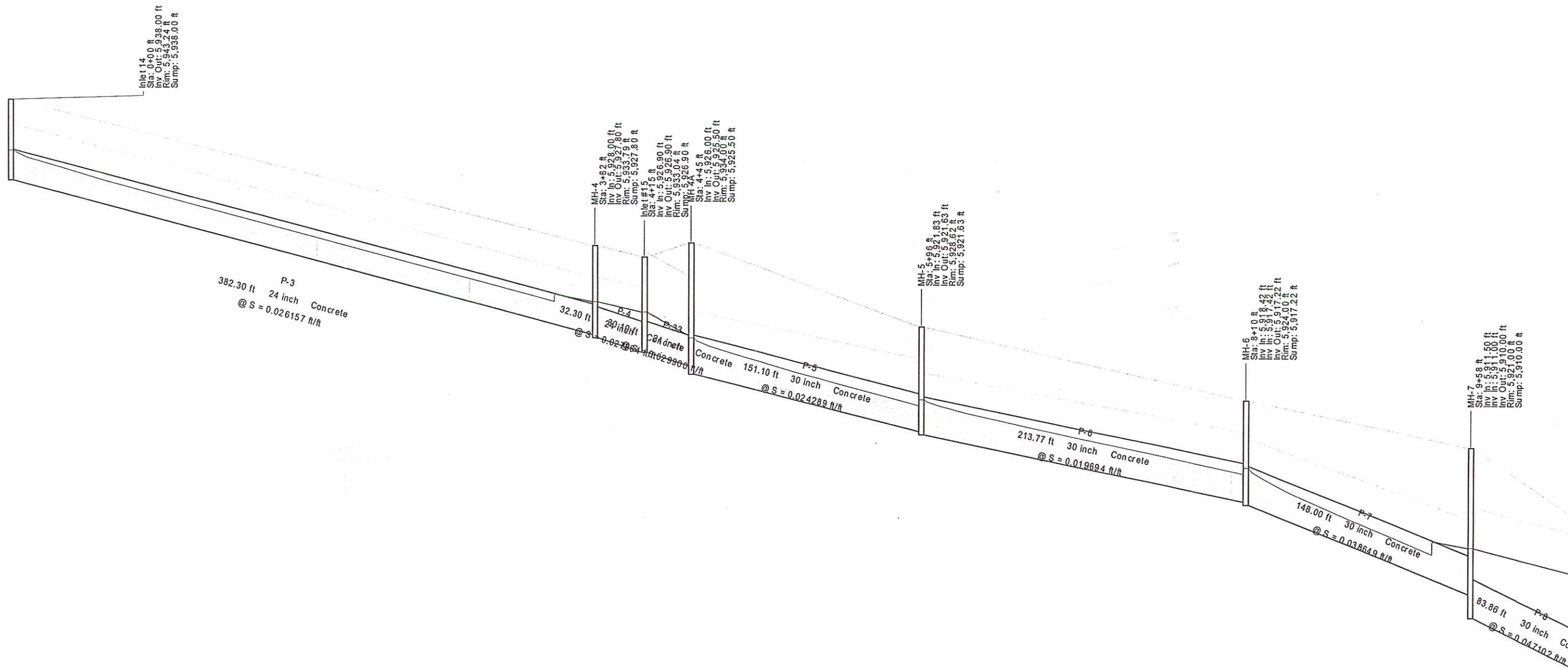
Scenario: Southern System-2-year

Combined PipeNode Report

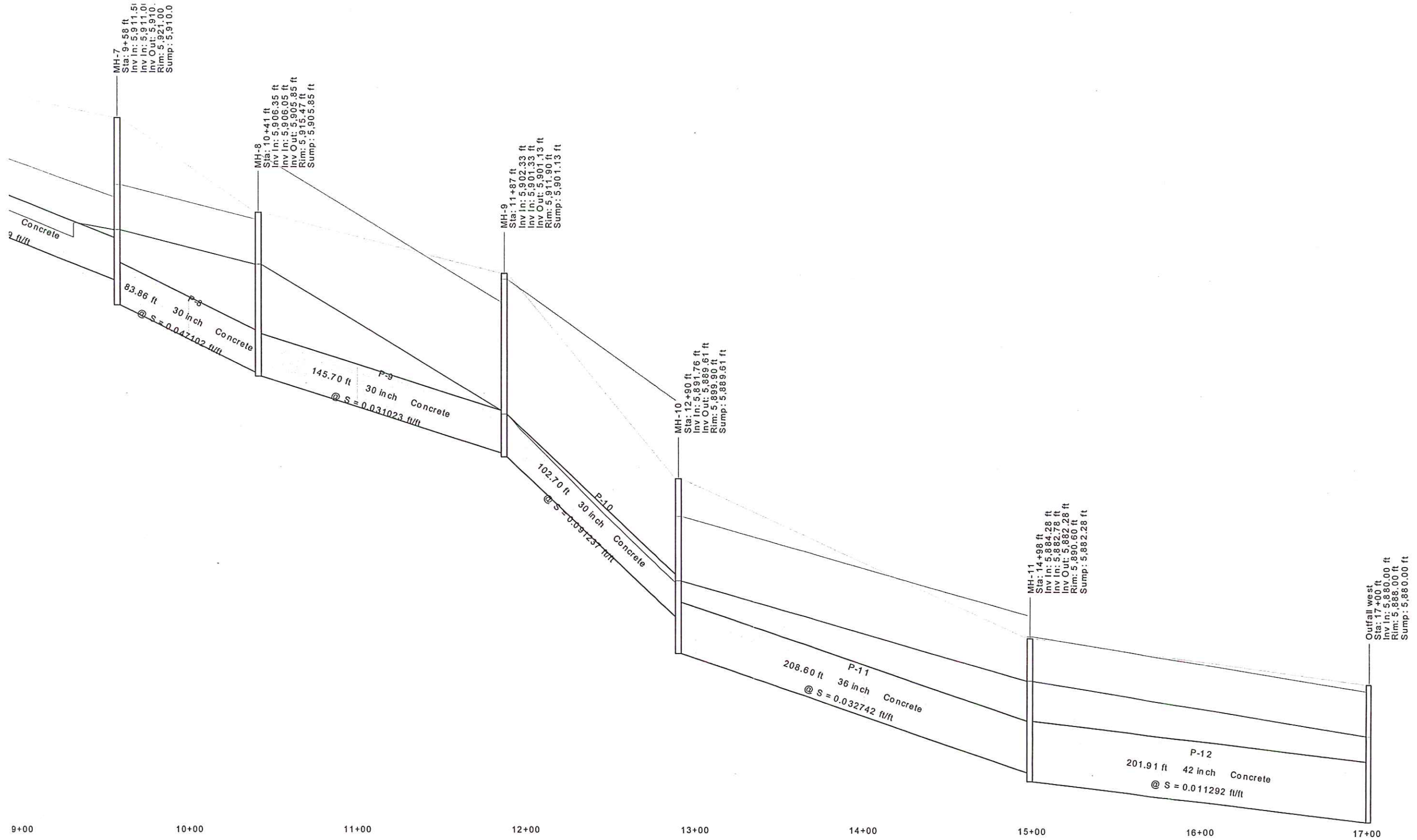
Label	Upstream Node	Downstream Node	Length (ft)	Section Size	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Total System Flow (cfs)	Full Capacity (cfs)	Depth In (ft)	Depth Out (ft)	Velocity Out (ft/s)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
P-1	Inlet 23	Outfall 2 we	48.20	30 inch	5,880.46	5,880.00	0.009544	8.00	40.07	0.94	0.77	6.26	5,881.40	5,880.77
P-2	Inlet 22	Inlet 23	57.30	24 inch	5,881.50	5,880.96	0.009424	5.40	21.96	0.82	0.68	5.78	5,882.32	5,881.64
P-3	Inlet 14	MH-4	382.30	24 inch	5,938.00	5,928.00	0.026157	7.50	36.59	0.97	1.02	4.64	5,938.97	5,929.02
P-4	MH-4	Inlet #15	32.30	24 inch	5,927.80	5,926.90	0.027864	11.60	37.76	1.22	1.43	4.83	5,929.02	5,928.33
P-5	MH 4A	MH-5	151.10	30 inch	5,925.50	5,921.83	0.024289	15.70	63.92	1.34	0.84	10.77	5,926.84	5,922.67
P-6	MH-5	MH-6	213.77	30 inch	5,921.63	5,917.42	0.019694	15.70	57.56	1.34	0.89	9.99	5,922.97	5,918.31
P-7	MH-6	MH-7	148.00	30 inch	5,917.22	5,911.50	0.038649	17.10	80.63	1.40	0.78	13.04	5,918.62	5,912.28
P-8	MH-7	MH-8	83.86	30 inch	5,910.00	5,906.05	0.047102	17.70	89.01	1.42	1.65	5.17	5,911.42	5,907.70
P-9	MH-8	MH-9	145.70	30 inch	5,905.85	5,901.33	0.031023	29.30	72.24	1.85	1.12	13.75	5,907.70	5,902.45
P-10	MH-9	MH-10	102.70	30 inch	5,901.13	5,891.76	0.091237	31.50	123.89	1.91	0.89	20.05	5,903.04	5,892.65
P-11	MH-10	MH-11	208.60	36 inch	5,889.61	5,882.78	0.032742	31.50	120.68	1.82	1.05	14.36	5,891.43	5,883.83
P-12	MH-11	Outfall west	201.91	42 inch	5,882.28	5,880.00	0.011292	36.00	106.91	1.86	1.40	10.02	5,884.14	5,881.40
P-13	Inlet 16	MH-6	78.60	18 inch	5,920.30	5,918.42	0.023919	1.40	16.24	0.44	0.30	5.63	5,920.74	5,918.72
P-14	Inlet 17	MH-7	34.20	18 inch	5,912.00	5,911.00	0.029240	0.60	17.96	0.29	0.42	1.46	5,912.29	5,911.42
P-15	Inlet #19	Inlet 18	88.70	24 inch	5,907.58	5,906.70	0.009921	10.90	22.53	1.18	0.98	7.11	5,908.76	5,907.68
P-16	Inlet 18	MH-8	16.30	24 inch	5,906.50	5,906.35	0.009202	12.30	21.70	1.26	1.35	5.47	5,907.76	5,907.70
P-17	Inlet#20	MH-9	44.00	18 inch	5,902.60	5,902.13	0.010682	2.70	10.86	0.62	0.91	2.40	5,903.22	5,903.04
P-18	Inlet 21	MH-11	40.00	18 inch	5,885.00	5,884.28	0.018000	3.30	14.09	0.69	0.50	6.40	5,885.69	5,884.78
P-33	Inlet #15	MH 4A	30.10	24 inch	5,926.90	5,926.00	0.029900	15.70	39.12	1.43	1.00	10.02	5,928.33	5,927.00

Profile
Scenario: Southern System-100-year

Profile: Triple Crown Drive
Scenario: Southern System-100-year



Profile
Scenario: Southern System-100-year



9+00

10+00

11+00

12+00

13+00

14+00

15+00

16+00

17+00

Station (ft)

Title: Horseshoe Ridge
I:\...08 reports\final drainage\pond3-rev.stm
01/05/06 10:53:26 AM

Tetra Tech RMC
© Haestad Methods, Inc. 37 Brookside Road Waterbury, CT 06708 USA +1-203-755-1666

Project Engineer: Vera Stepanek
StormCAD v5.5 [5.5003]
Page 1 of 1

Lot 1 - 10-year Event added to existing Storm Flows in Triple Crown Rd.

Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)

Project Description

File Name 10-yr SSA.SPF

Analysis Options

Flow Units cfs
Link Routing Method Kinematic Wave
Storage Node Exfiltration.. None
Starting Date MAY-28-2019 00:00:00
Ending Date MAY-28-2019 01:00:00
Report Time Step 00:05:00

Element Count

Number of subbasins 0
Number of nodes 18
Number of links 17

Node Summary

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft ²	External Inflow
INLET 19	JUNCTION	5907.58	5911.00	0.00	Yes
INLET14	JUNCTION	5938.00	5943.24	0.00	Yes
INLET15	JUNCTION	5926.90	5933.04	0.00	Yes
INLET16	JUNCTION	5920.30	5924.93	0.00	Yes
INLET17	JUNCTION	5912.00	5915.00	0.00	Yes
INLET18	JUNCTION	5906.50	5915.47	0.00	Yes
INLET20	JUNCTION	5902.60	5912.00	0.00	Yes
INTLET21	JUNCTION	5885.00	5890.00	0.00	Yes
MH-10	JUNCTION	5889.61	5899.90	0.00	
MH-11	JUNCTION	5882.28	5890.60	0.00	
MH-4	JUNCTION	5927.80	5933.79	0.00	
MH-4A	JUNCTION	5925.50	5934.00	0.00	
MH-5	JUNCTION	5921.63	5928.62	0.00	
MH-6	JUNCTION	5917.22	5924.00	0.00	
MH-7	JUNCTION	5910.00	5921.00	0.00	
MH-8	JUNCTION	5905.85	5915.47	0.00	
MH-9	JUNCTION	5901.13	5911.90	0.00	
OUTFALLWEST	OUTFALL	5880.00	5883.50	0.00	

Link Summary

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
P-10	MH-9	MH-10	CONDUIT	102.7	9.1237	0.0130
P-11	MH-10	MH-11	CONDUIT	208.6	3.2742	0.0130
P-12	MH-11	OUTFALLWEST	CONDUIT	201.9	1.1292	0.0130
P-13	INLET16	MH-6	CONDUIT	78.6	2.3919	0.0130
P-14	INLET17	MH-7	CONDUIT	34.2	2.9240	0.0130
P-15	INLET 19	INLET18	CONDUIT	88.7	0.9921	0.0130
P-16	INLET18	MH-8	CONDUIT	16.3	0.9202	0.0130
P-17	INLET20	MH-9	CONDUIT	44.0	1.0682	0.0130
P-18	INTLET21	MH-11	CONDUIT	40.0	1.8000	0.0130
P-3	INLET14	MH-4	CONDUIT	382.3	2.6157	0.0130
P-33	INLET15	MH-4A	CONDUIT	30.1	2.9900	0.0130
P-4	MH-4	INLET15	CONDUIT	32.3	2.7864	0.0130
P-5	MH-4A	MH-5	CONDUIT	151.1	2.4289	0.0130
P-6	MH-5	MH-6	CONDUIT	213.8	1.9694	0.0130
P-7	MH-6	MH-7	CONDUIT	148.0	3.8649	0.0130
P-8	MH-7	MH-8	CONDUIT	83.9	4.7102	0.0130
P-9	MH-8	MH-9	CONDUIT	145.7	3.1023	0.0130

Cross Section Summary

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft ²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
P-10	CIRCULAR	2.50	2.50	1	4.91	0.63	123.89
P-11	CIRCULAR	3.00	3.00	1	7.07	0.75	120.69
P-12	CIRCULAR	3.50	3.50	1	9.62	0.88	106.91
P-13	CIRCULAR	1.50	1.50	1	1.77	0.38	16.25
P-14	CIRCULAR	1.50	1.50	1	1.77	0.38	17.96
P-15	CIRCULAR	2.00	2.00	1	3.14	0.50	22.53
P-16	CIRCULAR	2.00	2.00	1	3.14	0.50	21.70
P-17	CIRCULAR	1.50	1.50	1	1.77	0.38	10.86
P-18	CIRCULAR	1.50	1.50	1	1.77	0.38	14.09

P-3	CIRCULAR	2.00	2.00	1	3.14	0.50	36.59
P-33	CIRCULAR	2.00	2.00	1	3.14	0.50	39.12
P-4	CIRCULAR	2.00	2.00	1	3.14	0.50	37.76
P-5	CIRCULAR	2.50	2.50	1	4.91	0.63	63.92
P-6	CIRCULAR	2.50	2.50	1	4.91	0.63	57.56
P-7	CIRCULAR	2.50	2.50	1	4.91	0.63	80.64
P-8	CIRCULAR	2.50	2.50	1	4.91	0.63	89.02
P-9	CIRCULAR	2.50	2.50	1	4.91	0.63	72.24

```

*****
Flow Routing Continuity
*****
                Volume      Volume
                acre-ft     M gallons
-----
External Inflow ..... 5.983      1.950
External Outflow ..... 5.862      1.910
Initial Stored Volume .... 0.000      0.000
Final Stored Volume ..... 0.121      0.039
Continuity Error (%) ..... 0.000

```

Node Depth Summary

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
INLET 19	1.36	1.36	5908.94	0 00:00	0	0	0:00:00
INLET14	1.02	1.02	5939.02	0 00:00	0	0	0:00:00
INLET15	1.27	1.29	5928.19	0 00:01	0	0	0:00:00
INLET16	0.63	0.63	5920.93	0 00:00	0	0	0:00:00
INLET17	0.35	0.35	5912.35	0 00:00	0	0	0:00:00
INLET18	1.68	8.97	5915.47	0 00:01	0.01	1	0:00:00
INLET20	0.84	0.84	5903.44	0 00:00	0	0	0:00:00
INTLET21	0.81	0.81	5885.81	0 00:00	0	0	0:00:00
MH-10	3.41	3.44	5893.05	0 00:02	0	0	0:00:00
MH-11	2.81	2.87	5885.15	0 00:01	0	0	0:00:00
MH-4	1.21	1.22	5929.02	0 00:08	0	0	0:00:00
MH-4A	1.77	1.78	5927.28	0 00:01	0	0	0:00:00
MH-5	1.37	1.38	5923.01	0 00:02	0	0	0:00:00
MH-6	1.82	1.87	5919.09	0 00:01	0	0	0:00:00
MH-7	2.63	2.65	5912.65	0 00:02	0	0	0:00:00
MH-8	2.05	2.45	5908.30	0 00:01	0	0	0:00:00
MH-9	1.89	1.91	5903.04	0 00:02	0	0	0:00:00
OUTFALLWEST	2.07	2.12	5882.12	0 00:03	0	0	0:00:00

Node Flow Summary

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days hh:mm
INLET 19	JUNCTION	18.10	18.10	0 00:00	0.00	
INLET14	JUNCTION	18.80	18.80	0 00:00	0.00	
INLET15	JUNCTION	10.10	29.26	0 00:01	0.00	
INLET16	JUNCTION	5.90	5.90	0 00:00	0.00	
INLET17	JUNCTION	2.20	2.20	0 00:00	0.00	
INLET18	JUNCTION	2.50	22.94	0 00:01	0.62	0 00:01
INLET20	JUNCTION	6.50	6.50	0 00:00	0.00	
INTLET21	JUNCTION	8.00	8.00	0 00:00	0.00	
MH-10	JUNCTION	0.00	65.12	0 00:02	0.00	
MH-11	JUNCTION	0.00	72.87	0 00:03	0.00	
MH-4	JUNCTION	0.00	18.80	0 00:08	0.00	
MH-4A	JUNCTION	0.00	28.99	0 00:01	0.00	
MH-5	JUNCTION	0.00	28.97	0 00:02	0.00	
MH-6	JUNCTION	0.00	35.28	0 00:02	0.00	
MH-7	JUNCTION	0.00	37.23	0 00:02	0.00	
MH-8	JUNCTION	0.00	58.09	0 00:02	0.00	
MH-9	JUNCTION	0.00	65.11	0 00:02	0.00	
OUTFALLWEST	OUTFALL	0.00	72.68	0 00:03	0.00	

Outfall Loading Summary

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
OUTFALLWEST	100.00	70.64	72.68
System	100.00	70.64	72.68

Link Flow Summary

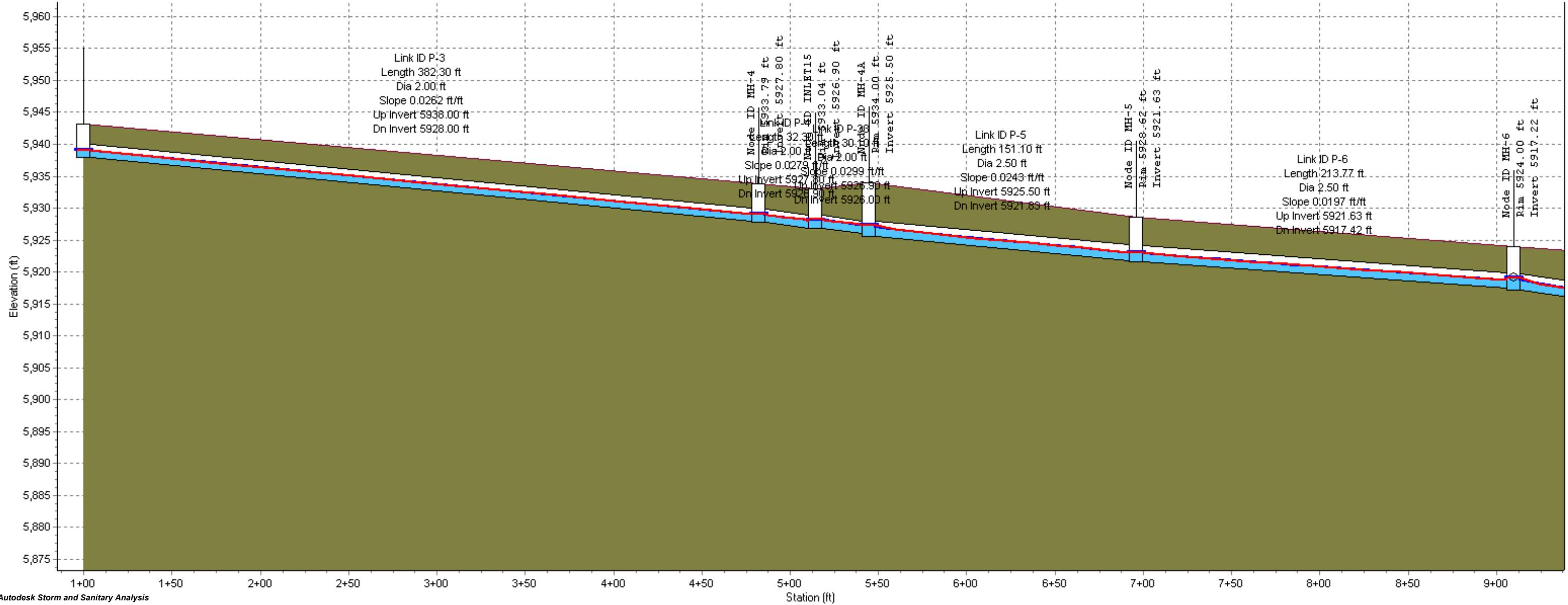
Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis cfs	Design Flow Capacity cfs	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes	Reported Condition
P-10	CONDUIT	0 00:02	25.55	1.00	65.12	123.89	0.53	0.52	0	Calculated
P-11	CONDUIT	0 00:03	17.45	1.00	64.81	120.69	0.54	0.52	0	Calculated
P-12	CONDUIT	0 00:03	11.96	1.00	72.68	106.91	0.68	0.61	0	Calculated
P-13	CONDUIT	0 00:01	9.20	1.00	6.76	16.25	0.42	0.43	0	Calculated
P-14	CONDUIT	0 00:01	7.41	1.00	2.46	17.96	0.14	0.24	0	Calculated
P-15	CONDUIT	0 00:01	8.53	1.00	20.44	22.53	0.91	0.71	0	Calculated
P-16	CONDUIT	0 00:01	7.87	1.00	22.48	21.70	1.04	0.99	0	> CAPACITY
P-17	CONDUIT	0 00:01	6.91	1.00	7.36	10.86	0.68	0.58	0	Calculated
P-18	CONDUIT	0 00:01	8.79	1.00	8.92	14.09	0.63	0.56	0	Calculated
P-3	CONDUIT	0 00:08	11.72	1.00	18.80	36.59	0.51	0.51	0	Calculated
P-33	CONDUIT	0 00:01	13.65	1.00	28.99	39.12	0.74	0.64	0	Calculated
P-4	CONDUIT	0 00:01	12.21	1.00	19.16	37.76	0.51	0.50	0	Calculated
P-5	CONDUIT	0 00:02	12.75	1.00	28.97	63.92	0.45	0.47	0	Calculated
P-6	CONDUIT	0 00:02	11.82	1.00	29.27	57.56	0.51	0.50	0	Calculated
P-7	CONDUIT	0 00:02	15.92	1.00	35.06	80.64	0.43	0.46	0	Calculated
P-8	CONDUIT	0 00:02	17.40	1.00	37.48	89.02	0.42	0.45	0	Calculated
P-9	CONDUIT	0 00:02	16.46	1.00	58.67	72.24	0.81	0.68	0	Calculated

Highest Flow Instability Indexes

- Link P-33 (16)
- Link P-5 (15)
- Link P-4 (13)
- Link P-6 (13)
- Link P-16 (11)

Analysis began on: Tue May 28 16:30:13 2019
Analysis ended on: Tue May 28 16:30:13 2019
Total elapsed time: < 1 sec

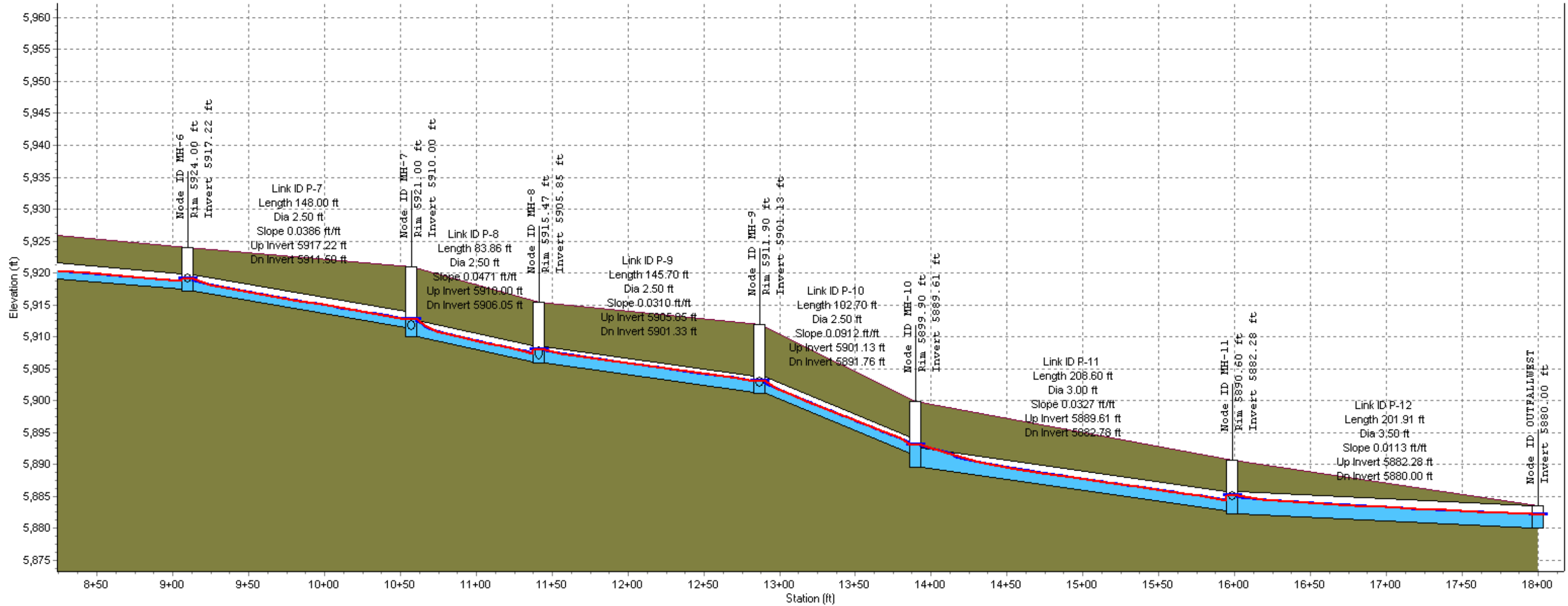
Profile Plot
Main Street Storm Sewer



Autodesk Storm and Sanitary Analysis

	INLET14	MH-4	INLET15	MH-4A	MH-5	MH-6
Node ID:	INLET14	MH-4	INLET15	MH-4A	MH-5	MH-6
Rim (ft):	5943.24	5933.79	5933.04	5934.00	5928.62	5924.00
Invert (ft):	5938.00	5927.80	5926.90	5925.50	5921.63	5917.22
Min Pipe Cover (ft):	3.24	3.79	4.14	6.00	4.29	4.08
Max HGL (ft):	5939.02	5929.02	5928.19	5927.28	5923.01	5919.09
Link ID:	P-3	P-4	P-33	P-5	P-6	
Length (ft):	382.30	32.30	30.10	151.10	213.77	
Dia (ft):	2.00	2.00	2.00	2.50	2.50	
Slope (ft/ft):	0.0262	0.0279	0.0299	0.0243	0.0197	
Up Invert (ft):	5938.00	5927.80	5926.90	5925.50	5921.63	
Dn Invert (ft):	5928.00	5926.90	5926.00	5921.83	5917.42	
Max Q (cfs):	18.80	19.16	28.99	28.97	29.27	
Max Vel (ft/s):	11.72	12.21	13.65	12.75	11.82	
Max Depth (ft):	1.02	1.00	1.28	1.18	1.25	

Profile Plot
Main Street Storm Sewer



Node ID:	MH-6	MH-7	MH-8	MH-9	MH-10	MH-11	
Rim (ft):	5924.00	5921.00	5915.47	5911.90	5899.90	5890.60	
Invert (ft):	5917.22	5910.00	5905.85	5901.13	5889.61	5882.28	5880.00
Min Pipe Cover (ft):	4.08	7.00	6.92	8.07	5.64	4.82	
Max HGL (ft):	5919.09	5912.65	5908.30	5903.04	5893.05	5885.15	5882.12
Link ID:	P-7	P-8	P-9	P-10	P-11	P-12	
Length (ft):	148.00	83.86	145.70	102.70	208.60	201.91	
Dia (ft):	2.50	2.50	2.50	2.50	3.00	3.50	
Slope (ft/ft):	0.0386	0.0471	0.0310	0.0912	0.0327	0.0113	
Up Invert (ft):	5917.22	5910.00	5905.85	5901.13	5889.61	5882.28	
Dn Invert (ft):	5911.50	5906.05	5901.33	5891.76	5882.78	5880.00	
Max Q (cfs):	35.06	37.48	58.67	65.12	64.81	72.68	
Max Vel (ft/s):	15.92	17.40	16.46	25.55	17.45	11.96	
Max Depth (ft):	1.15	1.12	1.69	1.28	1.56	2.11	

Lot 1 - 100-yr Event added to Existing Storm Flows in Triple Crown Drive

Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)

 Project Description

 File Name 100-yr SSA.SPF

 Analysis Options

 Flow Units cfs
 Link Routing Method Kinematic Wave
 Storage Node Exfiltration.. None
 Starting Date MAY-28-2019 00:00:00
 Ending Date MAY-28-2019 01:00:00
 Report Time Step 00:05:00

 Element Count

 Number of subbasins 0
 Number of nodes 18
 Number of links 17

 Node Summary

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft ²	External Inflow
INLET 19	JUNCTION	5907.58	5911.00	0.00	Yes
INLET14	JUNCTION	5938.00	5943.24	0.00	Yes
INLET15	JUNCTION	5926.90	5933.04	0.00	Yes
INLET16	JUNCTION	5920.30	5924.93	0.00	Yes
INLET17	JUNCTION	5912.00	5915.00	0.00	Yes
INLET18	JUNCTION	5906.50	5915.47	0.00	Yes
INLET20	JUNCTION	5902.60	5912.00	0.00	Yes
INTLET21	JUNCTION	5885.00	5890.00	0.00	Yes
MH-10	JUNCTION	5889.61	5899.90	0.00	
MH-11	JUNCTION	5882.28	5890.60	0.00	
MH-4	JUNCTION	5927.80	5933.79	0.00	
MH-4A	JUNCTION	5925.50	5934.00	0.00	
MH-5	JUNCTION	5921.63	5928.62	0.00	
MH-6	JUNCTION	5917.22	5924.00	0.00	
MH-7	JUNCTION	5910.00	5921.00	0.00	
MH-8	JUNCTION	5905.85	5915.47	0.00	
MH-9	JUNCTION	5901.13	5911.90	0.00	
OUTFALLWEST	OUTFALL	5880.00	5883.50	0.00	

 Link Summary

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
P-10	MH-9	MH-10	CONDUIT	102.7	9.1237	0.0130
P-11	MH-10	MH-11	CONDUIT	208.6	3.2742	0.0130
P-12	MH-11	OUTFALLWEST	CONDUIT	201.9	1.1292	0.0130
P-13	INLET16	MH-6	CONDUIT	78.6	2.3919	0.0130
P-14	INLET17	MH-7	CONDUIT	34.2	2.9240	0.0130
P-15	INLET 19	INLET18	CONDUIT	88.7	0.9921	0.0130
P-16	INLET18	MH-8	CONDUIT	16.3	0.9202	0.0130
P-17	INLET20	MH-9	CONDUIT	44.0	1.0682	0.0130
P-18	INTLET21	MH-11	CONDUIT	40.0	1.8000	0.0130
P-3	INLET14	MH-4	CONDUIT	382.3	2.6157	0.0130
P-33	INLET15	MH-4A	CONDUIT	30.1	2.9900	0.0130
P-4	MH-4	INLET15	CONDUIT	32.3	2.7864	0.0130
P-5	MH-4A	MH-5	CONDUIT	151.1	2.4289	0.0130
P-6	MH-5	MH-6	CONDUIT	213.8	1.9694	0.0130
P-7	MH-6	MH-7	CONDUIT	148.0	3.8649	0.0130
P-8	MH-7	MH-8	CONDUIT	83.9	4.7102	0.0130
P-9	MH-8	MH-9	CONDUIT	145.7	3.1023	0.0130

 Cross Section Summary

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft ²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
P-10	CIRCULAR	2.50	2.50	1	4.91	0.63	123.89
P-11	CIRCULAR	3.00	3.00	1	7.07	0.75	120.69
P-12	CIRCULAR	3.50	3.50	1	9.62	0.88	106.91
P-13	CIRCULAR	1.50	1.50	1	1.77	0.38	16.25
P-14	CIRCULAR	1.50	1.50	1	1.77	0.38	17.96
P-15	CIRCULAR	2.00	2.00	1	3.14	0.50	22.53
P-16	CIRCULAR	2.00	2.00	1	3.14	0.50	21.70
P-17	CIRCULAR	1.50	1.50	1	1.77	0.38	10.86
P-18	CIRCULAR	1.50	1.50	1	1.77	0.38	14.09

P-3	CIRCULAR	2.00	2.00	1	3.14	0.50	36.59
P-33	CIRCULAR	2.00	2.00	1	3.14	0.50	39.12
P-4	CIRCULAR	2.00	2.00	1	3.14	0.50	37.76
P-5	CIRCULAR	2.50	2.50	1	4.91	0.63	63.92
P-6	CIRCULAR	2.50	2.50	1	4.91	0.63	57.56
P-7	CIRCULAR	2.50	2.50	1	4.91	0.63	80.64
P-8	CIRCULAR	2.50	2.50	1	4.91	0.63	89.02
P-9	CIRCULAR	2.50	2.50	1	4.91	0.63	72.24

```

*****
Flow Routing Continuity
*****
Volume      Volume
acre-ft     Mgallons
-----
External Inflow ..... 10.904 3.553
External Outflow ..... 7.940 2.588
Initial Stored Volume .... 0.000 0.000
Final Stored Volume ..... 0.161 0.053
Continuity Error (%) ..... -0.001

```

Node Depth Summary

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
INLET 19	3.42	3.42	5911.00	0 00:00	8.63	61	0:00:00
INLET14	1.46	1.46	5939.46	0 00:00	0	0	0:00:00
INLET15	6.10	6.14	5933.04	0 00:01	10.51	60	0:00:00
INLET16	0.90	0.90	5921.20	0 00:00	0	0	0:00:00
INLET17	0.81	0.81	5912.81	0 00:00	0	0	0:00:00
INLET18	8.97	8.97	5915.47	0 00:00	4.98	61	0:00:00
INLET20	9.40	9.40	5912.00	0 00:00	0.34	61	0:00:00
INTLET21	1.21	1.21	5886.21	0 00:00	0	0	0:00:00
MH-10	3.64	3.65	5893.26	0 00:02	0	0	0:00:00
MH-11	3.21	3.50	5885.78	0 00:01	0	0	0:00:00
MH-4	1.66	1.66	5929.46	0 00:08	0	0	0:00:00
MH-4A	2.49	2.50	5928.00	0 00:01	0	0	0:00:00
MH-5	1.61	1.65	5923.28	0 00:01	0	0	0:00:00
MH-6	2.10	2.18	5919.40	0 00:01	0	0	0:00:00
MH-7	2.91	2.96	5912.96	0 00:02	0	0	0:00:00
MH-8	9.50	9.62	5915.47	0 00:01	9.44	60	0:00:00
MH-9	2.69	2.70	5903.83	0 00:02	0	0	0:00:00
OUTFALLWEST	2.59	2.62	5882.62	0 00:03	0	0	0:00:00

Node Flow Summary

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days hh:mm
INLET 19	JUNCTION	31.20	31.20	0 00:00	8.67	0 00:01
INLET14	JUNCTION	32.40	32.40	0 00:00	0.00	
INLET15	JUNCTION	17.40	50.55	0 00:01	10.75	0 00:03
INLET16	JUNCTION	10.90	10.90	0 00:00	0.00	
INLET17	JUNCTION	10.20	10.20	0 00:00	0.00	
INLET18	JUNCTION	4.20	26.73	0 00:01	5.03	0 00:01
INLET20	JUNCTION	11.20	11.20	0 00:00	0.34	0 00:01
INTLET21	JUNCTION	13.90	13.90	0 00:00	0.00	
MH-10	JUNCTION	0.00	83.36	0 00:02	0.00	
MH-11	JUNCTION	0.00	97.43	0 00:02	0.00	
MH-4	JUNCTION	0.00	32.40	0 00:08	0.00	
MH-4A	JUNCTION	0.00	39.12	0 00:01	0.00	
MH-5	JUNCTION	0.00	40.79	0 00:01	0.00	
MH-6	JUNCTION	0.00	51.11	0 00:02	0.00	
MH-7	JUNCTION	0.00	62.21	0 00:02	0.00	
MH-8	JUNCTION	0.00	83.94	0 00:02	10.68	0 00:02
MH-9	JUNCTION	0.00	83.41	0 00:02	0.00	
OUTFALLWEST	OUTFALL	0.00	97.31	0 00:03	0.00	

Outfall Loading Summary

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
OUTFALLWEST	100.00	95.69	97.31
System	100.00	95.69	97.31

Link Flow Summary

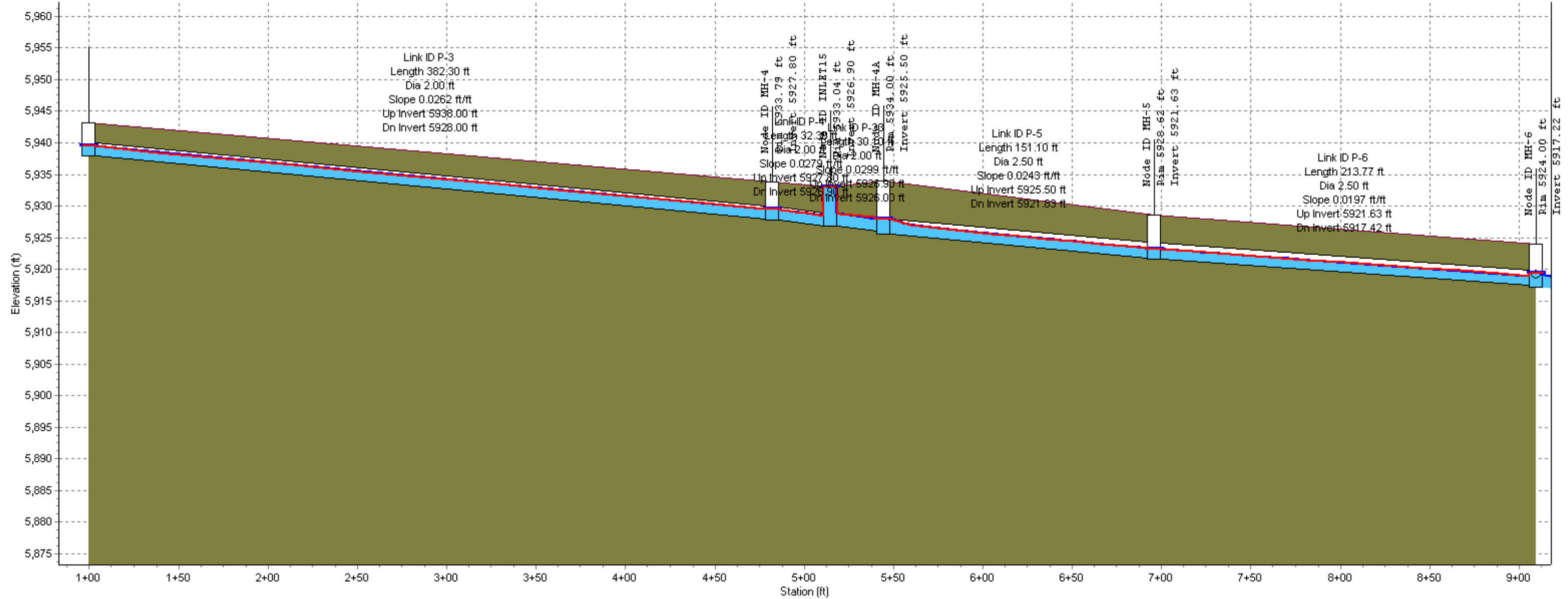
Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis cfs	Design Flow Capacity cfs	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes	Reported Condition
P-10	CONDUIT	0 00:02	27.08	1.00	83.36	123.89	0.67	0.60	0	Calculated
P-11	CONDUIT	0 00:02	18.44	1.00	83.50	120.69	0.69	0.61	0	Calculated
P-12	CONDUIT	0 00:03	12.60	1.00	97.31	106.91	0.91	0.75	0	Calculated
P-13	CONDUIT	0 00:01	10.63	1.00	12.40	16.25	0.76	0.63	0	Calculated
P-14	CONDUIT	0 00:01	11.04	1.00	11.10	17.96	0.62	0.55	0	Calculated
P-15	CONDUIT	0 00:01	7.17	1.00	22.53	22.53	1.00	1.00	60	SURCHARGED
P-16	CONDUIT	0 00:01	6.91	1.00	21.70	21.70	1.00	1.00	60	SURCHARGED
P-17	CONDUIT	0 00:01	6.35	1.00	11.20	10.86	1.03	1.00	1	SURCHARGED
P-18	CONDUIT	0 00:01	9.14	1.00	14.09	14.09	1.00	0.90	0	> CAPACITY
P-3	CONDUIT	0 00:08	13.14	1.00	32.40	36.59	0.89	0.73	0	Calculated
P-33	CONDUIT	0 00:01	12.45	1.00	39.12	39.12	1.00	1.00	60	SURCHARGED
P-4	CONDUIT	0 00:01	13.73	1.00	33.15	37.76	0.88	0.72	0	Calculated
P-5	CONDUIT	0 00:01	14.02	1.00	40.79	63.92	0.64	0.57	0	Calculated
P-6	CONDUIT	0 00:02	12.83	1.00	40.00	57.56	0.69	0.61	0	Calculated
P-7	CONDUIT	0 00:02	17.51	1.00	51.74	80.64	0.64	0.58	0	Calculated
P-8	CONDUIT	0 00:02	19.61	1.00	62.24	89.02	0.70	0.62	0	Calculated
P-9	CONDUIT	0 00:02	15.32	1.00	72.24	72.24	1.00	1.00	59	SURCHARGED

Highest Flow Instability Indexes

Link P-17 (26)
Link P-4 (18)
Link P-14 (15)
Link P-10 (11)
Link P-11 (11)

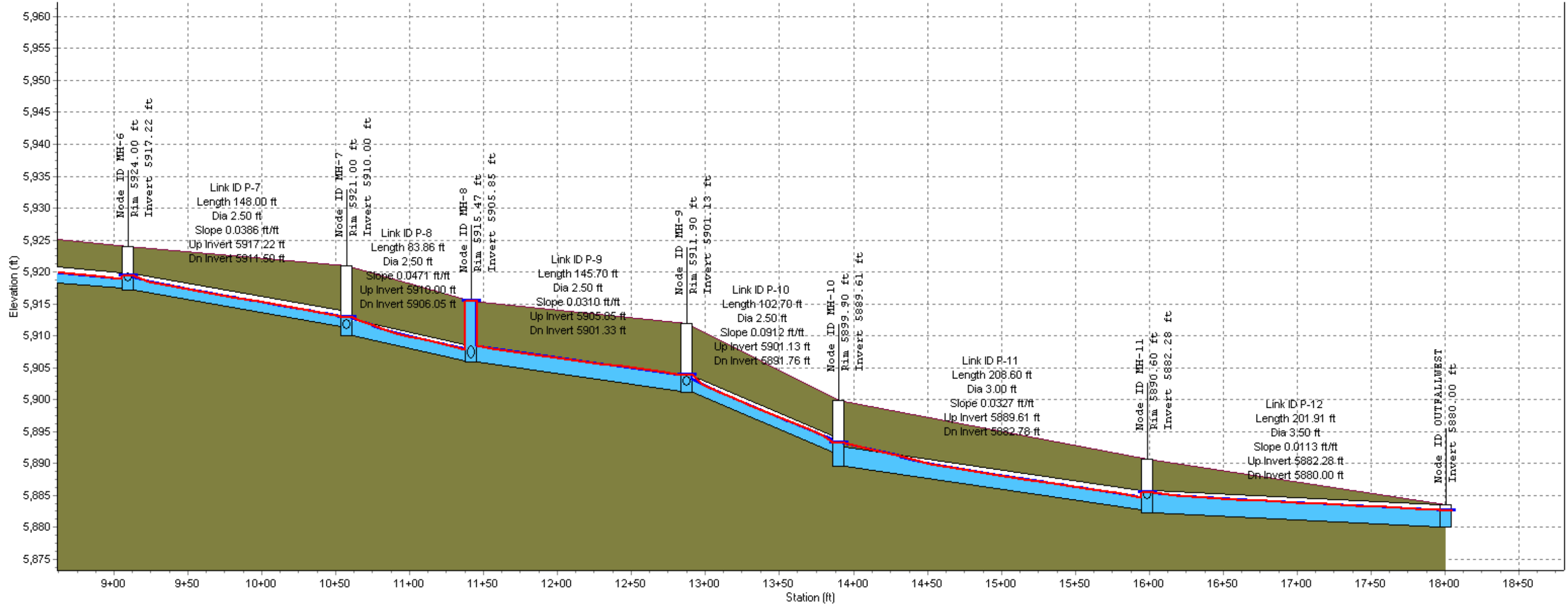
Analysis began on: Tue May 28 16:32:01 2019
Analysis ended on: Tue May 28 16:32:01 2019
Total elapsed time: < 1 sec

Profile Plot
Main Street Storm Sewer



Node ID:	INLET14		MH-4	INLET15	MH-4A		MH-5		MH-6
Rim (ft):	5943.24		5933.79	5933.04	5934.00		5928.62		
Invert (ft):	5938.00		5927.80	5926.90	5925.50		5921.63		
Min Pipe Cover (ft):	3.24		3.79	4.14	6.00		4.29		4.08
Max HGL (ft):	5939.46		5929.46	5933.04	5928.00		5923.28		
Link ID:		P-3		P-4	P-33		P-5		P-6
Length (ft):		382.30		32.30	30.10		151.10		213.77
Dia (ft):		2.00		2.00	2.00		2.50		2.50
Slope (ft/ft):		0.0262		0.0279	0.0299		0.0243		0.0197
Up Invert (ft):		5938.00		5927.80	5926.90		5925.50		5921.63
Dn Invert (ft):		5928.00		5926.90	5926.00		5921.83		5917.42
Max Q (cfs):		32.40		33.15	39.12		40.79		40.00
Max Vel (ft/s):		13.14		13.73	12.45		14.02		12.83
Max Depth (ft):		1.46		1.43	2.00		1.41		1.51

Profile Plot
Main Street Storm Sewer



Node ID:	MH-6	MH-7	MH-8	MH-9	MH-10	MH-11	OUTFALLWEST
Rim (ft):	5924.00	5921.00	5915.47	5911.90	5899.90	5890.60	
Invert (ft):	5917.22	5910.00	5905.85	5901.13	5889.61	5882.28	5880.00
Min Pipe Cover (ft):	4.08	7.00	6.92	8.07	5.64	4.82	
Max HGL (ft):	5919.40	5912.96	5915.47	5903.83	5893.26	5885.78	5882.62
Link ID:	P-7	P-8	P-9	P-10	P-11	P-12	
Length (ft):	148.00	83.86	145.70	102.70	208.60	201.91	
Dia (ft):	2.50	2.50	2.50	2.50	3.00	3.50	
Slope (ft/ft):	0.0386	0.0471	0.0310	0.0912	0.0327	0.0113	
Up Invert (ft):	5917.22	5910.00	5905.85	5901.13	5889.61	5882.28	
Dn Invert (ft):	5911.50	5906.05	5901.33	5891.76	5882.78	5880.00	
Max Q (cfs):	51.74	62.24	72.24	83.36	83.50	97.31	
Max Vel (ft/s):	17.51	19.61	15.32	27.08	18.44	12.60	
Max Depth (ft):	1.43	1.51	2.50	1.50	1.83	2.62	

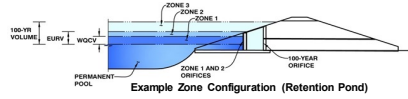
Appendix F – Detention Pond Volumes

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: TLE Parker

Basin ID: Volume Required at Existing Pond



Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	1.26	acres
Watershed Length =	484	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	64.16%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQC Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Parker - Town Hall	
Water Quality Capture Volume (WQCV) =	0.026	acre-feet
Excess Urban Runoff Volume (EURV) =	0.088	acre-feet
2-yr Runoff Volume (P1 = 0.99 in.) =	0.061	acre-feet
5-yr Runoff Volume (P1 = 1.39 in.) =	0.090	acre-feet
10-yr Runoff Volume (P1 = 1.64 in.) =	0.118	acre-feet
25-yr Runoff Volume (P1 = 1.98 in.) =	0.161	acre-feet
50-yr Runoff Volume (P1 = 2.31 in.) =	0.194	acre-feet
100-yr Runoff Volume (P1 = 2.6 in.) =	0.231	acre-feet
500-yr Runoff Volume (P1 = 3.08 in.) =	0.291	acre-feet
Approximate 2-yr Detention Volume =	0.057	acre-feet
Approximate 5-yr Detention Volume =	0.085	acre-feet
Approximate 10-yr Detention Volume =	0.110	acre-feet
Approximate 25-yr Detention Volume =	0.125	acre-feet
Approximate 50-yr Detention Volume =	0.135	acre-feet
Approximate 100-yr Detention Volume =	0.147	acre-feet

Optional User Override 1-hr Precipitation	
0.99	inches
1.39	inches
1.64	inches
1.98	inches
2.31	inches
2.60	inches
	inches

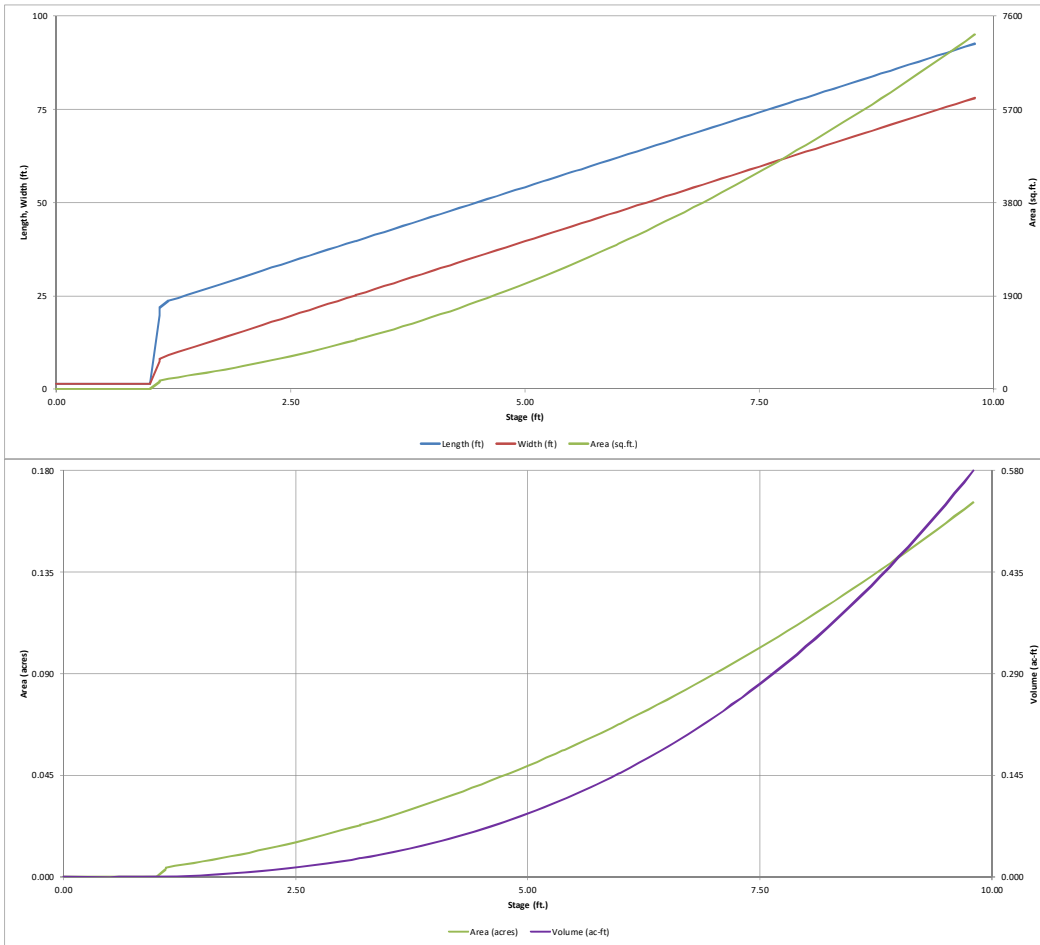
Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.026	acre-feet
Zone 2 Volume (10-year - Zone 1) =	0.083	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.037	acre-feet
Total Detention Basin Volume =	0.147	acre-feet
Initial Surcharge Volume (SV) =	1	ft³
Initial Surcharge Depth (SD) =	0.50	ft
Total Available Detention Depth (H _{total}) =	6.00	ft
Depth of Trickle Channel (H _{TC}) =	0.50	ft
Slope of Trickle Channel (S _{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S _{main}) =	4	H:V
Basin Length-to-Width Ratio (R _{l/w}) =	3	
Initial Surcharge Area (A _{sv}) =	2	ft²
Surcharge Volume Length (L _{sv}) =	1.4	ft
Surcharge Volume Width (W _{sv}) =	1.4	ft
Depth of Basin Floor (H _{floor}) =	0.11	ft
Length of Basin Floor (L _{floor}) =	23.0	ft
Width of Basin Floor (W _{floor}) =	8.5	ft
Area of Basin Floor (A _{floor}) =	195	ft²
Volume of Basin Floor (V _{floor}) =	8	ft³
Depth of Main Basin (H _{main}) =	4.89	ft
Length of Main Basin (L _{main}) =	62.2	ft
Width of Main Basin (W _{main}) =	47.6	ft
Area of Main Basin (A _{main}) =	2,960	ft²
Volume of Main Basin (V _{main}) =	6,385	ft³
Calculated Total Basin Volume (V _{total}) =	0.147	acre-feet

Depth Increment = 0.1 ft									
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft²)	Optional Override Area (ft²)	Area (acre)	Volume (ft³)	Volume (ac-ft)
Top of Micropool									
ISV	0.50		1.4	1.4	2		0.000	1	0.000
	0.60		1.4	1.4	2		0.000	1	0.000
	0.70		1.4	1.4	2		0.000	1	0.000
	0.80		1.4	1.4	2		0.000	2	0.000
	0.90		1.4	1.4	2		0.000	2	0.000
	1.00		1.4	1.4	2		0.000	2	0.000
	1.10		19.8	7.4	147		0.003	7	0.000
Floor	1.11		21.8	8.1	176		0.004	9	0.000
	1.20		23.7	9.1	216		0.005	27	0.001
	1.30		24.5	9.9	243		0.006	50	0.001
	1.40		25.3	10.7	271		0.006	76	0.002
	1.50		26.1	11.5	301		0.007	104	0.002
	1.60		26.9	12.3	332		0.008	136	0.003
	1.70		27.7	13.1	364		0.008	171	0.004
	1.80		28.5	13.9	397		0.009	209	0.005
	1.90		29.3	14.7	431		0.010	250	0.006
	2.00		30.1	15.5	467		0.011	295	0.007
	2.10		31.0	16.4	508		0.012	349	0.008
	2.20		31.8	17.2	547		0.013	401	0.009
	2.30		32.6	18.0	587		0.013	458	0.011
	2.40		33.4	18.8	628		0.014	519	0.012
	2.50		34.2	19.6	670		0.015	584	0.013
	2.60		35.0	20.4	714		0.016	653	0.015
	2.70		35.8	21.2	759		0.017	726	0.017
	2.80		36.6	22.0	805		0.018	805	0.018
	2.90		37.4	22.8	852		0.020	887	0.020
	3.00		38.2	23.6	901		0.021	975	0.022
	3.10		39.0	24.4	951		0.022	1,068	0.025
Zone 1 (WQCV)	3.19		39.7	25.1	997		0.023	1,155	0.027
	3.20		39.8	25.2	1,003		0.023	1,165	0.027
	3.30		40.6	26.0	1,055		0.024	1,268	0.029
	3.40		41.4	26.8	1,109		0.025	1,376	0.032
	3.50		42.2	27.6	1,164		0.027	1,490	0.034
	3.60		43.0	28.4	1,221		0.028	1,609	0.037
	3.70		43.8	29.2	1,278		0.029	1,734	0.040
	3.80		44.6	30.0	1,337		0.031	1,865	0.043
	3.90		45.4	30.8	1,398		0.032	2,002	0.046
	4.00		46.2	31.6	1,459		0.034	2,145	0.049
	4.10		47.0	32.4	1,522		0.035	2,294	0.053
	4.20		47.8	33.2	1,586		0.036	2,449	0.056
	4.30		48.6	34.0	1,652		0.038	2,611	0.060
	4.40		49.4	34.8	1,718		0.039	2,780	0.064
	4.50		50.2	35.6	1,786		0.041	2,955	0.068
	4.60		51.0	36.4	1,856		0.043	3,137	0.072
	4.70		51.8	37.2	1,926		0.044	3,326	0.076
	4.80		52.6	38.0	1,998		0.046	3,522	0.081
	4.90		53.4	38.8	2,071		0.048	3,726	0.086
	5.00		54.2	39.6	2,146		0.049	3,936	0.090
	5.10		55.0	40.4	2,221		0.051	4,155	0.095
	5.20		55.8	41.2	2,298		0.053	4,381	0.101
	5.30		56.6	42.0	2,376		0.055	4,614	0.106
Zone 2 (10-year)	5.37		57.1	42.6	2,432		0.056	4,783	0.110
	5.40		57.4	42.8	2,456		0.056	4,856	0.111
	5.50		58.2	43.6	2,537		0.058	5,106	0.117
	5.60		59.0	44.4	2,619		0.060	5,363	0.123
	5.70		59.8	45.2	2,702		0.062	5,629	0.129
	5.80		60.6	46.0	2,787		0.064	5,904	0.136
Zone 3 (100-year)	5.90		61.4	46.8	2,873		0.066	6,187	0.142
	5.98		62.0	47.5	2,942		0.068	6,419	0.147
	6.00		62.2	47.6	2,960		0.068	6,478	0.149
	6.10		63.0	48.4	3,048		0.070	6,779	0.156
	6.20		63.8	49.2	3,138		0.072	7,088	0.163
	6.30		64.6	50.0	3,229		0.074	7,406	0.170
	6.40		65.4	50.8	3,321		0.076	7,734	0.178
	6.50		66.2	51.6	3,415		0.078	8,071	0.185
	6.60		67.0	52.4	3,510		0.081	8,417	0.193
	6.70		67.8	53.2	3,606		0.083	8,773	0.201
	6.80		68.6	54.0	3,703		0.085	9,138	0.210
	6.90		69.4	54.8	3,802		0.087	9,513	0.218
	7.00		70.2	55.6	3,902		0.090	9,899	0.227
	7.10		71.0	56.4	4,003		0.092	10,294	0.236
	7.20		71.8	57.2	4,106		0.094	10,699	0.246
	7.30		72.6	58.0	4,209		0.097	11,115	0.255
	7.40		73.4	58.8	4,315		0.099	11,541	0.265
	7.50		74.2	59.6	4,421		0.101	11,978	0.275
	7.60		75.0	60.4	4,529		0.104	12,425	0.285
	7.70		75.8	61.2	4,638		0.106	12,884	0.296
	7.80		76.6	62.0	4,748		0.109	13,353	0.307
	7.90		77.4	62.8	4,859		0.112	13,833	0.318
	8.00		78.2	63.6	4,972		0.114	14,325	0.329
	8.10		79.0	64.4	5,086		0.117	14,828	0.340
	8.20		79.8	65.2	5,201		0.119	15,342	0.352
	8.30		80.6	66.0	5,318		0.122	15,868	0.364
	8.40		81.4	66.8	5,436		0.125	16,406	0.377
	8.50		82.2	67.6	5,555		0.128	16,955	0.389
	8.60		83.0	68.4	5,676		0.130	17,517	0.402
	8.70		83.8	69.2	5,797		0.133	18,090	0.415
	8.80		84.6	70.0	5,920		0.136	18,676	0.429
	8.90		85.4	70.8	6,045		0.139	19,275	0.442
	9.00		86.2	71.6	6,170		0.142	19,885	0.457
	9.10		87.0	72.4	6,297		0.145	20,509	0.471
	9.20		87.8	73.2	6,425		0.148	21,145	0.485
	9.30		88.6	74.0	6,555		0.150	21,794	0.500
	9.40		89.4	74.8	6,685		0.153	22,456	0.516
	9.50		90.2	75.6	6,817		0.157	23,131	0.531
	9.60		91.0	76.4	6,951		0.160	23,819	0.547
	9.70		91.8	77.2	7,085		0.163	24,521	0.563
	9.80		92.6	78.0	7,221		0.166	25,236	0.579

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



Appendix G – Basin Map/Grading and Drainage Plan

HORSESHOE RIDGE SUBDIVISION 1ST AMENDMENT

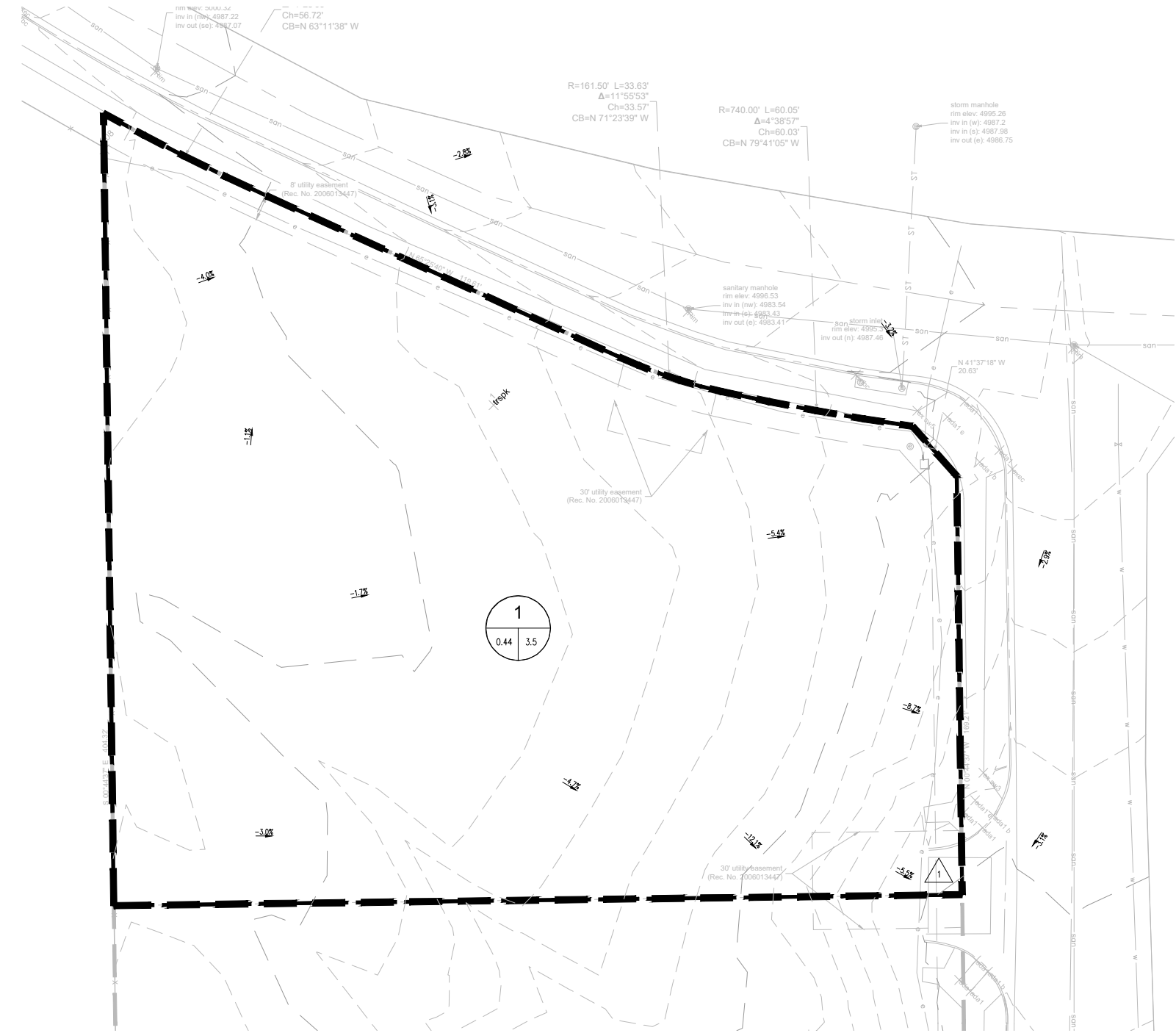
LOT 1, BLOCK 1, HORSESHOE RIDGE SUBDIVISION 1ST AMENDMENT

A PARCEL OF LAND LOCATED IN THE SE 1/4 OF SECTION 28, TOWNSHIP 6 SOUTH, RANGE 66 WEST OF THE 6TH PRINCIPAL MERIDIAN

CONSTRUCTION DOCUMENTS

LEGEND

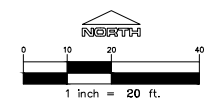
- 3156 EXISTING CONTOUR
- PROPERTY LINE
- BASIN LIMITS
- BASIN
- 100-YR COEF
- 100-YR CFS
- DESIGN POINT



SUBBASIN # / DESIGN POINT	CONTRIBUTING AREA (ACRES)	RUNOFF 10YR (CFS)	PEAK 100YR (CFS)
1	1.111	0.4	3.5



SEE LOT 2 BLOCK 1 HORSESHOE RIDGE SUBDIVISION 1ST AMENDMENT PLANS FOR ADDITIONAL GRADING INFORMATION; IF LOT 2 IS UNABLE TO BE CONSTRUCTED, CONTRACTOR IS TO GRADE FROM EDGE OF PAVEMENT SHOWN ON THESE PLANS BACK TO EXISTING AT NO LESS THAN 3:1 SLOPE.



The Town of Parker review constitutes general compliance with the Town's Standards and approved variances, subject to these plans being stamped, signed, and dated by the professional engineer of record. Review by the Town does not constitute approval of the plan design or accuracy and correctness of engineering calculations. Errors in the design or calculations remain the responsibility of the registered professional engineer whose stamp and signature are affixed to this document.

This review does not constitute approval of any private on-site improvements which may be shown. Construction cannot commence until all required drainage/traffic report(s), final development plan(s), special review(s), grading permit, and/or other permits are complete, approved and on file with the Town of Parker.

Town of Parker, Director of Engineering Date



PROJECT TITLE
THE LEARNING EXPERIENCE

LOT 1, BLOCK 1
 HORSESHOE RIDGE
 PARKER, CO 80134

PREPARED FOR
BRYTAR COMPANIES

8117 PRESTON RD. #300
 DALLAS, TX 75225

SUBMITTAL
CONSTRUCTION DOCS.

DRAWN BY: BSA
 CHECKED BY: MRB
 PROJECT NO.: 18-075-001

REVISIONS	DATE

DATE
5/28/2019

SHEET TITLE
**EXISTING CONDITIONS
 BASIN MAP**

SHEET INFORMATION
BM-2.0

Of 15

HORSESHOE RIDGE SUBDIVISION 1ST AMENDMENT

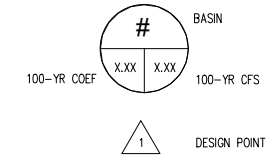
LOT 1, BLOCK 1, HORSESHOE RIDGE SUBDIVISION 1ST AMENDMENT

A PARCEL OF LAND LOCATED IN THE SE 1/4 OF SECTION 28, TOWNSHIP 6 SOUTH, RANGE 66 WEST OF THE 6TH PRINCIPAL MERIDIAN

CONSTRUCTION DOCUMENTS

LEGEND

- 3155 — PROPOSED MAJOR CONTOUR
- 3156 — PROPOSED MINOR CONTOUR
- - - 3156 - - - EXISTING CONTOUR
- — — — — PROPERTY LINE
- — — — — BASIN LIMITS



SUMMARY RUNOFF TABLE

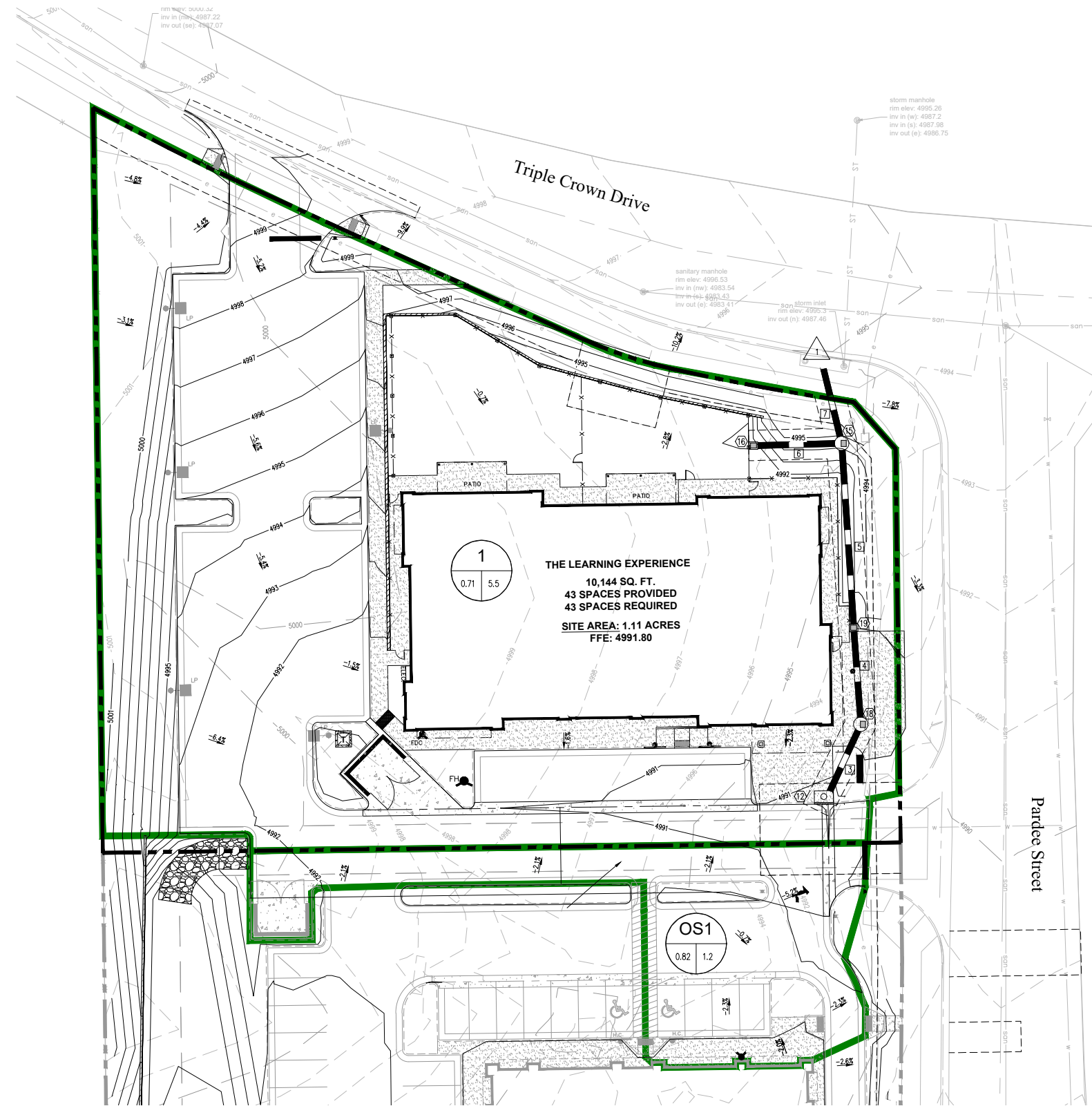
SUBBASIN # / DESIGN POINT	CONTRIBUTING AREA (ACRES)	RUNOFF 10YR (CFS)	PEAK 100YR (CFS)
1	1.100	2.7	5.5
OS1	0.169	0.6	1.2

STRUCTURE TABLE

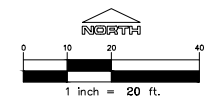
#	TYPE	RIM	INVERT
12	RT TYPE R	RIM = 4990.30	IE OUT: 4988.59 18" NE
15	RT SDMH	RIM = 4994.42	IE IN: 4987.79 18" S IE IN: 4987.79 18" W IE OUT: 4987.69 18" N
16	RT TYPE 13 INLET	RIM = 4991.53	IE OUT: 4987.95 18" E
18	RT SDMH	RIM = 4991.45	IE IN: 4988.45 18" SW IE OUT: 4988.35 18" N
19	RT TYPE 13 INLET	RIM = 4992.03	IE IN: 4988.19 18" S IE OUT: 4988.09 18" N

PIPE TABLE

#	SIZE	LENGTH	MATERIAL	SLOPE
3	18"	29'	Concrete Pipe	0.50%
4	18"	32'	Concrete Pipe	0.50%
5	18"	60'	Concrete Pipe	0.50%
6	18"	29'	Concrete Pipe	0.55%
7	18"	25'	Concrete Pipe	0.50%



SEE LOT 2 BLOCK 1 HORSESHOE RIDGE SUBDIVISION 1ST AMENDMENT PLANS FOR ADDITIONAL GRADING INFORMATION; IF LOT 2 IS UNABLE TO BE CONSTRUCTED, CONTRACTOR IS TO GRADE FROM EDGE OF PAVEMENT SHOWN ON THESE PLANS BACK TO EXISTING AT NO LESS THAN 3:1 SLOPE.



Know what's below.
Call before you dig.

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Town of Parker, Director of Engineering Date



PROJECT TITLE
THE LEARNING EXPERIENCE

LOT 1, BLOCK 1
 HORSESHOE RIDGE
 PARKER, CO 80134
 PREPARED FOR
BRYTAR COMPANIES

8117 PRESTON RD. #300
 DALLAS, TX 75225

SUBMITTAL
CONSTRUCTION DOCS.

DRAWN BY: BSA
 CHECKED BY: MRB
 PROJECT NO.: 18-075-001

REVISIONS

NO.	DATE	DESCRIPTION

DATE
5/28/2019

SHEET INFORMATION
PROPOSED BASIN MAP

SHEET INFORMATION
BM-1.0

of 20

Appendix H – Existing Pond

**STANDARD FORM SF-1
TIME OF CONCENTRATION**

Subdivision:

Horseshoe Ridge

Calculated by:

Vera Stepanek

Checked by:

Vera Stepanek

RMC Job No.: 22-4568-002-00

Date: January 4, 2006

Des. Pt. #	Sub-Basin Data		Overland Flow		Travel Time (Tt)			Urban Check		Remarks				
	Area	C 5 yr.		Ti (min)	L (ft)	Slope Surface Type**	Vel (fps)	Tt (min)	Comp. Tc (min.)		L (ft)	Urban Tc (min)	Final Tc (min)	
D1	2.3	0.38	50	2.0	7.4	570	3.0	3.4	2.8	10.2	620	13.4	10.2	Tc=Ti+Tt
							6							
D2	1.6	0.38	80	2.0	9.4	550	3.0	3.4	2.7	12	630	13.5	12.1	
							6							
D3	2.4	0.38	80	2.0	9.4	560	2.8	3.3	2.8	12.2	640	13.6	12.2	
							6							
D4	1.7	0.38	50	2.0	7.4	250	2.8	3.3	1.3	8.7	300	11.7	8.7	
							6							
D5	1.8	0.38	80	2.0	9.4	940	2.8	3.3	4.8	14.1	1020	15.7	14.1	
							6							
D8	1.4	0.38	50	2.0	7.4	820	1.9	2.7	5.1	12.5	870	14.8	12.5	
							6							
D6	1.7	0.38	70	2.0	8.8	650	2.6	3.2	3.4	12.2	720	14.0	12.2	
							6							
D7	1.9	0.38	50	2.0	7.4	840	1.9	2.7	5.3	12.7	890	14.9	12.7	
							6							
D9	0.6	0.73	10	2.0	1.7	780	2.6	3.2	4.1	5.8	790	14.4	5.8	
							6							
D10	4.1	0.14	150	25.0	7.4	530	2.0	1.0	9.1	16.5	680	13.8	13.8	
							3							
D11	0.6	0.73	10	2.0	1.7	660	2.0	2.7	4.0	5.7	670	13.7	5.7	
							6							
			10	2.0	5.1	500	1.2	2.2	3.8	8.9	510	12.8	8.9	
							6							

**Surface Type: 6=Paved Area (Sheet Flow) & Shallow Gutter Flow; 4=Nearly Bare Ground (From Urban Drainage Figure 2)
3=Short Grass Pasture & Lawns.

**STANDARD FORM SF-1
TIME OF CONCENTRATION**

Subdivision: Horseshoe Ridge

Calculated by: Vera Stepanek

Checked by: Vera Stepanek

RMC Job No.: 22-4568-002-00

Date: January 5, 2006

Sub-Basin Data	Overland Flow			Travel Time (Tt)			Urban Check		Final Tc (min)	Remarks		
			Ti (min)	L (ft)	Slope Surface Type**	Vel (fps)	Tt (min)	Comp. Tc (min.)			L (ft)	Urban Tc (min)
D12	2.4	0.38	7.4	530	1.1 6	2.1	4.2	12	580	13.2	11.6	Tc=Ti+Tt
D13	0.7	0.38	7.4	530	1.1 6	2.1	4.2	11.6	580	13.2	11.6	
D14	3.1	0.38	11.5	390	4.3 6	4.1	1.6	13.1	510	12.8	12.8	
D15	0.9	0.38	3.3	390	4.3 6	4.1	1.6	4.9	400	12.2	4.9	If Tc<5.0 Use 5.0 min.
D16	0.4	0.73	1.7	150	1.0 6	2.0	1.3	3.0	160	10.9	3.0	If Tc<5.0 Use 5.0 min.
D17	4.2	0.81	4.2	350	2.0 6	2.7	2.1	6.3	450	12.5	6.3	If Tc<5.0 Use 5.0 min.
D18	1.2	0.73	1.7	1120	2.1 6	2.8	6.6	8.3	1130	16.3	8.3	If Tc<5.0 Use 5.0 min.
D19	0.2	0.73	1.7	210	1.5 6	2.3	1.5	3.2	220	11.2	3.2	
D20	1.7	0.73	1.7	1120	1.5 6	2.3	8.0	9.7	1130	16.3	9.7	
D21	4.4	0.81	5.2	450	1.0 6	2.0	3.8	8.9	600	13.3	8.9	
D22	4.5	0.38	12.8	580	1.0 3	0.7	13.8	26.6	730	14.1	14.1	
D23	0.2	0.73	1.7	260	1.6 6	2.4	1.8	3.5	270	11.5	3.5	If Tc<5.0 Use 5.0 min.
	44.0											

***Surface Type: 6=Paved Area (Sheet Flow) & Shallow Gutter Flow; 4=Nearly Bare Ground (From Urban Drainage Figure 2)
3=Short Grass Pasture & Lawns.

**STANDARD FORM SF-2
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)
2 Year Storm Event BASIN D**

Subdivision: Horseshoe Ridge

Calculated by: Vera Stepanek

Checked by: Vera Stepanek

RMC Job No.: 24-0302.006.20

Date: 4-Jan-06

Structure Type	Design Pt.	Direct Runoff					Total Runoff					Street Carry Over		Pipe			Travel Time			
		Area (ac)	Runoff Coeff. (C)	T _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Area (ac)	T _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	S (%)	Q (cfs)	S (%)	Q (cfs)	Pipe Size (in)	L (ft)	V (fps)	T _t (min)
(1)	(2)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	
gutter	50	2.30	0.33	10.2	0.76	2.8	2.1													
gutter	51	1.60	0.33	12.1	0.53	2.6	1.4													
cross-pan	52	3.90							1.29	2.6	3.3									
cross-pan	53	2.40	0.33	12.2	0.79	2.6	2.0										270	4.5	1.0	
gutter	54	1.70	0.33	8.7	0.56	3.0	1.7													
cross-pan	55	8.00							13.1	2.4	6.4									
gutter	56	1.80	0.33	14.1	0.59	2.3	1.4													
Inlet #14	57	9.80								2.3	7.5						20	4.5	0.1	
gutter	58	1.70	0.33	12.2	0.56	2.6	1.4													
gutter	59	1.90	0.33	12.7	0.63	2.5	1.6													
cross-pan	60	3.60																		
gutter	61	1.40	0.33	12.5	0.46	2.5	1.2													
Inlet #15	62	5.00								2.5	4.1									
Inlet #16 Type R	63	0.60	0.71	5.8	0.43	3.3	1.4													
Inlet #17 Type C	64	4.10	0.06	13.8	0.25	2.4	0.6													
Inlet #18	66	0.60	0.71	5.7	0.43	3.3	1.4													
Inlet #19 Type D	67	4.20	0.79	6.3	3.32	3.3	10.9													
Pipe	68	D1-D11, D17							15.1	9.30	20.5						457	14.8	0.5	

**STANDARD FORM SF-2
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)
2 Year Storm Event- Basin D (cont.)**

Subdivision: Horseshoe Ridge

Calculated by: Vera Stepanek

Checked by: Vera Stepanek

RMC Job No.: 22-4568-002-00

Date: 5-Jan-06

Structure Type (Page)	Design Pt.	Direct Runoff						Total Runoff						Street Carry Over			Pipe			Travel Time		
		Area (ac)	Runoff Coeff. (C)	T _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	T _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	S (%)	Q (cfs)	Q (cfs)	S (%)	Q (cfs)	Q (cfs)	L (ft)	V (fps)	T _t (min)		
(1) gutter	(2) 69	(3) 2.40	(4) 0.33	(5) 11.6	(6) 0.79	(7) 2.6	(8) 2.1	(9) 2.6	(10) 2.1	(11) 2.6	(12) 2.6	(13) 2.1	(14) 2.6	(15) 2.6	(16) 2.1	(17) 2.6	(18) 2.6	(19) 2.1	(20) 2.6	(21) 2.1		
gutter	70	0.70	0.33	11.6	0.23	2.6	0.6															
Inlet#20	71	D12,D13																				
gutter	72	D14	3.10	0.33	12.8	1.02	2.6															
gutter	73	D15	0.90	0.33	5.0	0.30	1.0															
Inlet #21	74	D14,D15																				
Inlet#22	75	D16	0.40	0.71	5.0	0.28	1.0															
Inlet#23	76	D18	1.20	0.71	8.3	0.85	2.6															
Pipe Flow	77	D1-D15,D17																				
	78	D19	0.20	0.71	5.0	0.14	0.5															
	79	D20	1.70	0.71	9.7	1.21	3.5															
Exist. Inlet	80	D19, D20	1.90																			
Inlet#26 Type C	81	D21	4.40	0.79	8.9	3.48	10.4															
Pond area	82	D22	4.50	0.06	14.1	0.27	0.6															
Inlet #24	83	D23	0.20	0.71	5.0	0.14	0.5															
Exist. Inlet	83A	D28	0.90	0.71	5.0	0.64	2.2															
Inlet #25	84	D24	0.50	0.71	5.1	0.36	1.2															
Pipe Flows	84A	D23,D24,D25, D27,D28																				
Exist. Inlet	85	D25	1.30	0.51	5.5	0.66	2.2															
Exist. Inlet	86	D26	0.60	0.51	5.0	0.31	1.0															
Exist. Inlet	87	D27	0.60	0.57	5.0	0.34	1.2															
	88	D	47.9																			
					15.6	20.32	2.2	44.2														

**STANDARD FORM SF-2
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)
100Year Storm Event BASIN D**

Subdivision: Horseshoe Ridge

Calculated by: Vera Stepanek

Checked by: Vera Stepanek

RMC Job No.: 22-4568-002-00

Date: January 4, 2006

Structure Type	Design Pt.	Direct Runoff						Total Runoff				Street Carry Over			Pipe			Travel Time	
		Area (ac)	Runoff Coeff. (C)	T _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	T _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	S (%)	Q (cfs)	S (%)	Q (cfs)	Pipe Size (in)	L (ft)	V (fps)	T _t (min)
(1)	(2)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
gutter	50	2.30	0.54	10.2	1.24	7.0	8.7												
gutter	51	1.60	0.54	12.1	0.86	6.6	5.7												
cross-pan	52	3.90						12.1	2.11	6.6	13.8								
cross-pan	53	2.40	0.54	12.2	1.30	6.6	8.5									270	4.5		1.0
	54	1.70	0.54	8.7	0.92	7.5	6.9	12.2	2.21	6.6	14.5								
cross-pan	55	8.00						13.1	4.32	6.3	27.4								
gutter	56	1.80	0.54	14.1	0.97	6.1	5.9												
Inlet #14	57	9.80						14.2	5.29	6.1	32.4					20	4.5		0.1
	58	1.70	0.54	12.2	0.92	6.6	6.0												
	59	1.90	0.54	12.7	1.03	6.5	6.6												
cross-pan	60	3.60						12.7	1.94	6.5	12.5								
gutter	61	1.40	0.54	12.5	0.76	6.5	4.9												
Inlet #15	62	5.00						12.7	2.70	6.5	17.4								
Inlet #16 Type R	63	0.60	0.81	5.8	0.49	8.6	4.2												
Inlet #17 Type C	64	4.10	0.40	13.8	1.64	6.2	10.2									750	5.2		2.4
Inlet #18	66	0.60	0.81	5.7	0.49	8.6	4.2												
Inlet #19 Type D	67	4.20	0.88	6.3	3.70	8.4	31.2												
Pipe	68	D1-D11, D17						15.1	14.30	5.9	84.4					457	18.3		0.4

**STANDARD FORM SF-2
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)
100 Year Storm Event - Basin D (cont.)**

Subdivision: Horseshoe Ridge **RMC Job No.:** 22-4568-002-00
Calculated by: Vera Stepanek **Date:** January 5, 2006
Checked by: Vera Stepanek

Structure Type (Page)	Design Pt. (1)	Direct Runoff					Total Runoff					Street Carry Over			Pipe			Travel Time	
		Area (ac) (4)	Runoff Coeff. (C) (5)	T _c (min) (6)	C*A (ac) (7)	I (in/hr) (8)	Q (cfs) (9)	T _c (min) (10)	C*A (ac) (11)	I (in/hr) (12)	Q (cfs) (13)	S (%) (14)	Q (cfs) (15)	Q (cfs) (16)	S (%) (17)	Pipe Size (in) (18)	L (ft) (19)	V (fps) (20)	T _t (min) (21)
gutter	69	D12	2.40	0.54	11.6	1.30	6.7	8.6											
gutter	70	D13	0.70	0.54	11.6	0.38	6.7	2.5											
Inlet#20	71	D12,D13							11.6	1.67	6.7	11.2				280	5.2	0.9	
gutter	72	D14	3.10	0.54	12.8	1.67	6.5	10.8											
gutter	73	D15	0.90	0.54	5.0	0.49	8.8	4.3											
Inlet #21	74	D14,D15							12.8	2.16	6.5	13.9				420	5.2	1.3	
Inlet#22	75	D16	0.40	0.81	5.0	0.32	8.8	2.9											
Inlet#23	76	D18	1.20	0.81	8.3	0.97	7.7	7.5	8.3	1.30	7.7	10.0							
Pipe Flow	77	D1-D15,D17							15.5	18.13	5.9	107.0							
	78	D19	0.20	0.81	5.0	0.16	8.8	1.4											
	79	D20	1.70	0.81	9.7	1.38	7.2	9.9											
Exist. Inlet	80	D19, D20	1.90						9.7	1.54	7.2	11.1							
Inlet#26 Type C	81	D21	4.40	0.88	8.9	3.87	7.5	29.2											
Pond area	82	D22	4.50	0.40	14.1	1.80	6.1	11.0							120	2.0	1.0		
Inlet #24	83	D23	0.20	0.77	5.0	0.15	8.8	1.4											
Exist. Inlet	83A	D24	0.90	0.81	5.0	0.73	8.8	6.4											
Inlet #25	84	D28	0.50	0.81	5.1	0.41	8.8	3.6											
Pipe Flows	84A	D23,D24,D25, D27,D28							8.9	2.39	7.2	17.2							
Exist. Inlet	85	D25	1.30	0.58	8.9	0.75	7.5	5.7											
Exist. Inlet	86	D26	0.60	0.58	5.0	0.35	8.8	3.1											
Exist. Inlet	87	D27	0.60	0.58	5.0	0.35	8.8	3.1	9.7	2.39	7.1	17.0							
	88	D	47.90						15.5	29.38	5.9	173.3			460	2.0	3.8		

**DISCHARGE SUMMARY
DEVELOPED FLOWS - Basin D**

Subdivision: Horseshoe Ridge

Calculated by: Vera Stepanek

22-4568-002-00

Checked by: Vera Stepanek

5-Jan-06

Design Point	Contributing Basin	Area (ac)	Runoff Rate		Description
			Minor Storm 2 Year (cfs)	Major Storm 100 Year (cfs)	
50	D1	2.3	2.1	8.7	
51	D2	1.6	1.4	5.7	
52	D1,D2	3.9	3.3	13.8	
53	D3	2.4	2.0	8.5	
54	D4	1.7	1.7	6.9	
55	D1-D4	8.0	6.4	27.4	cross-pan
56	D5	1.8	1.4	5.9	
57	D1-D5	9.8	7.5	32.4	Inlet #14
58	D6	1.7	1.4	6.0	
59	D7	1.9	1.6	6.6	
60	D6,D7	3.6	3.0	12.5	cross-pan
61	D8	1.4	1.2	4.9	
62	D6,D7,D8	5.0	4.1	17.4	Inlet #15
63	D9	0.6	1.4	4.2	Inlet #16
64	D10	4.1	0.6	10.2	Inlet #17
66	D11	0.6	1.4	4.2	Inlet #18
67	D17	4.2	10.9	31.2	Inlet #19
68	D1-D11,D17	4.8	20.5	84.4	Pipe Flow
69	D12	2.4	2.1	8.6	
70	D13	0.7	0.6	2.5	
71	D12,D13	7.9	2.7	11.2	Inlet #20
72	D14	3.1	2.6	10.8	
73	D15	0.9	1.0	4.3	
74	D14,D15	4.0	3.3	13.9	Inlet #21
75	D16	0.4	1.0	2.9	Inlet #22
76	D18	1.2	2.6	7.5	Inlet #23
77	D1-D15,D17		25.3	107.0	Pipe Flow
78	D19	0.2	0.5	1.4	
79	D20	1.7	3.5	9.9	
80	D19, D20	1.9	3.9	11.1	Existing Inlet
81	D21	4.4	10.4	29.2	Inlet #26
82	D22	4.5	0.6	11.0	
83	D23	0.2	0.5	1.4	Inlet # 24
83A	D28	0.9	2.2	6.4	Exist. Inlet
84	D24	0.5	1.2	3.6	Inlet #25
84A	D23,D24,D25, D27,D28				
85	D25	1.3	14.5	17.2	Pipe Flows
86	D26	0.6	2.2	5.7	Exist. Inlet
87	D27	0.6	1.0	3.1	Exist. Inlet
88	D	0.6	1.2	3.1	Exist. Inlet
88	D	47.9	44.2	173.3	Pond III Inflow

DETENTION POND DESIGN PARAMETERS - Imperviousness

Ponds I and II (Basins A, B, C)

Averaged Single family Residential and open space

Basin A:	28.5 acres with 17 % imperviousness
Basin B:	13.1 acres with 55 % imperviousness
Basin C:C1-C15	26.4 acres with 52 % imperviousness
<u>Basin Off1&Off4:</u>	<u>11.2 acres with 12 % imperviousness</u>
Total:	79.2 acres

Basins A, B, C, Off1 & Off4: Imperviousness **I** = (28.5 x 17) + (13.1 x 55) + (26.4 x 52)
 +(11.2 x 12)/79.2 = **34.2**

Pond III (Basin D)

<u>Basin D</u>	
Single family Residential, Commercial, open space	
Sub-basins D17, D21 (MF)	8.6 ac @ 75%
Sub-basins D10, D22, (OS)	8.6 ac @ 50%
Sub-basins D16, D18, D19, D20, D23- D28 (Streets)	7.6 ac @ 90%
<u>Sub-basins D1-D9, D11-D15 (SF)</u>	<u>23.1 ac @ 55%</u>
Total	47.9 acres

Basin D: Imperviousness **I** = (8.6x75) + (8.6 x 5) + (7.6 x 90) + (23.1 x 55)/ 47.9= **55.2**

Basin E

Sub-basin E1:	5.8 acres open space.....	5% imperviousness
<u>Sub-basin E2:</u>	<u>9.6 acres Commercial.....</u>	<u>90% imperviousness</u>
Total:	15.4 acres	

Basin E: Imperviousness **I** = (5.8 x 5) + (9.6 x 90)/ 15.4= **58**

UDFCD Intensity-Duration Calculations:

Equation 5-1

$$I = (28.5 * P1) / ((10 + Tc)^{0.786})$$

Where: I = rainfall intensity (inches per hour)
P1 = 1-hour point rainfall depth (inches)
Tc = Time of Concentration (minutes)

Duration	P1	5	10	15	20	25	30	Tc	Rainfall
2-year	0.99	3.36	2.68	2.25	1.95	1.73	1.55	15.5	2.21
5-year	1.39	4.71	3.76	3.16	2.73	2.42	2.18	15.5	3.11
10-year	1.64	5.56	4.44	3.72	3.23	2.86	2.57	15.5	3.67
100-year	2.6	8.82	7.03	5.90	5.11	4.53	4.08	15.5	5.81

Notes:

Visit NOAA Atlas 14 to obtain 1-hour point rainfall depths (P1)

https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

CALCULATED BY : BSA
 DATE: 10/30/2019 REV:
 CHECKED BY: MRB

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

JOB NO: 18-066-001
 PROJECT: LOT 1 - TLE
 DESIGN STORM: 5-YEAR

TOTAL BASIN

SUBBASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		AREA DESIGN	AREA (AC)	RUNOFF COEFF	t _c (MIN)	C * A (AC)	I IN/HR	Q (CFS)	t _c (MIN)	Σ(C * A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t _t (MIN)	
(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	
1.00			1.10	0.51	10.0	0.56	3.76	2.1													
OS1			0.16	0.71	5.0	0.11	3.36	0.4													
Basin D			47.90	0.45	15.5	21.6	3.11	67.1													
Totals								69.6													

CALCULATED BY: BSA
 DATE: 10/30/2019 REV:
 CHECKED BY: MRB

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

JOB NO: 18-066-001
 PROJECT: LOT 1 - TLE
 DESIGN STORM: 10-YEAR

TOTAL BASIN

SUBBASIN	DESIGN POINT	DIRECT RUNOFF						TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS	
		AREA DESIGN	AREA (AC)	RUNOFF COEFF	t _c (MIN)	C * A (AC)	I IN/HR	Q (CFS)	t _c (MIN)	Σ(C * A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)		t _t (MIN)
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1.00			1.10	0.55	10.0	0.61	4.44	2.7													
OS1			0.16	0.73	5.0	0.12	4.71	0.6													
Basin D			47.90	0.50	15.5	24.1	3.67	88.6													
Totals								91.9													

CALCULATED BY : BSA
 DATE: 10/30/2019 REV:
 CHECKED BY: MRB

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

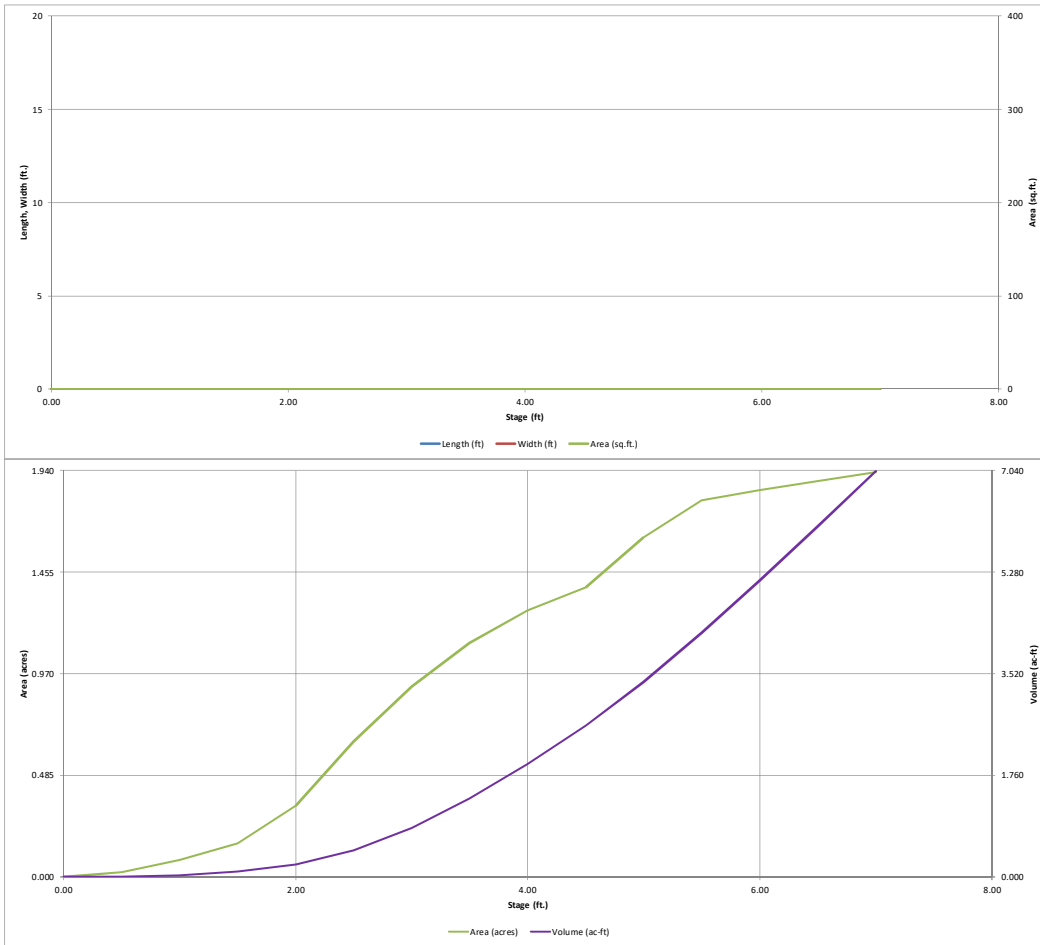
JOB NO: 18-066-001
 PROJECT: LOT 1 - TLE
 DESIGN STORM: 100-YEAR

TOTAL BASIN

SUBBASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		AREA DESIGN	AREA (AC)	RUNOFF COEFF	t _c (MIN)	C * A (AC)	I IN/HR	Q (CFS)	t _c (MIN)	Σ(C * A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t _t (MIN)	
(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	
1.00			1.10	0.71	10.0	0.79	7.03	5.5													
OS1			0.16	0.82	5.0	0.13	8.82	1.2													
Basin D			47.90	0.69	15.5	32.8	5.81	190.8													
Total								197.4													

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

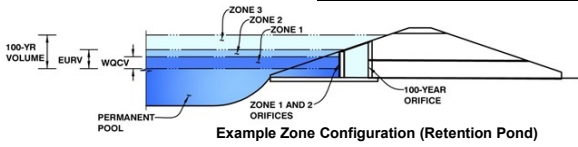


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: _____

Basin ID: _____



	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.07	0.908	Orifice Plate
Zone 2 (10-year)	5.22	2.811	Weir&Pipe (Rect.)
Zone 3 (100-year)	6.00	1.399	Weir&Pipe (Circular)
		5.119	Total

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area = ft²
 Underdrain Orifice Centroid = feet

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

Invert of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
 Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
 Orifice Plate: Orifice Vertical Spacing = inches
 Orifice Plate: Orifice Area per Row = sq. inches (diameter = 1-3/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row = ft²
 Elliptical Half-Width = feet
 Elliptical Slot Centroid = feet
 Elliptical Slot Area = ft²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.33	0.66	1.00	1.33	1.66	2.00	2.33
Orifice Area (sq. inches)	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft ²
Vertical Orifice Centroid =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 2 Weir	Zone 3 Weir	
Overflow Weir Front Edge Height, Ho =	3.10	4.90	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	6.00	feet
Overflow Weir Slope =	4.00	4.00	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	5.00	4.00	feet
Overflow Grate Open Area % =	70%	70%	%, grate open area/total area
Debris Clogging % =	50%	50%	%

Calculated Parameters for Overflow Weir

	Zone 2 Weir	Zone 3 Weir	
Height of Grate Upper Edge, H ₁ =	4.35	5.90	feet
Over Flow Weir Slope Length =	5.15	4.12	feet
Grate Open Area / 100-yr Orifice Area =	18.55	2.45	should be ≥ 4
Overflow Grate Open Area w/o Debris =	21.65	17.32	ft ²
Overflow Grate Open Area w/ Debris =	10.82	8.66	ft ²

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

	Zone 2 Rectangular	Zone 3 Circular	
Depth to Invert of Outlet Pipe =	0.00	0.00	ft (distance below basin bottom at Stage = 0 ft)
Orifice Diameter or Width =	14.00	36.00	inches
Rectangular Orifice Height =	12.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 2 Rectangular	Zone 3 Circular	
Outlet Orifice Area =	1.17	7.07	ft ²
Outlet Orifice Centroid =	0.50	1.50	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

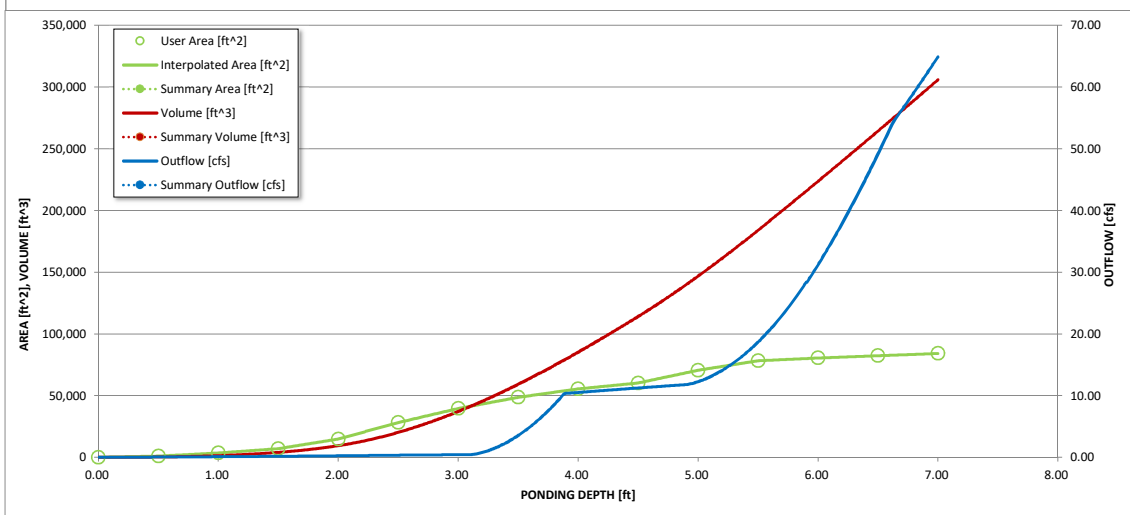
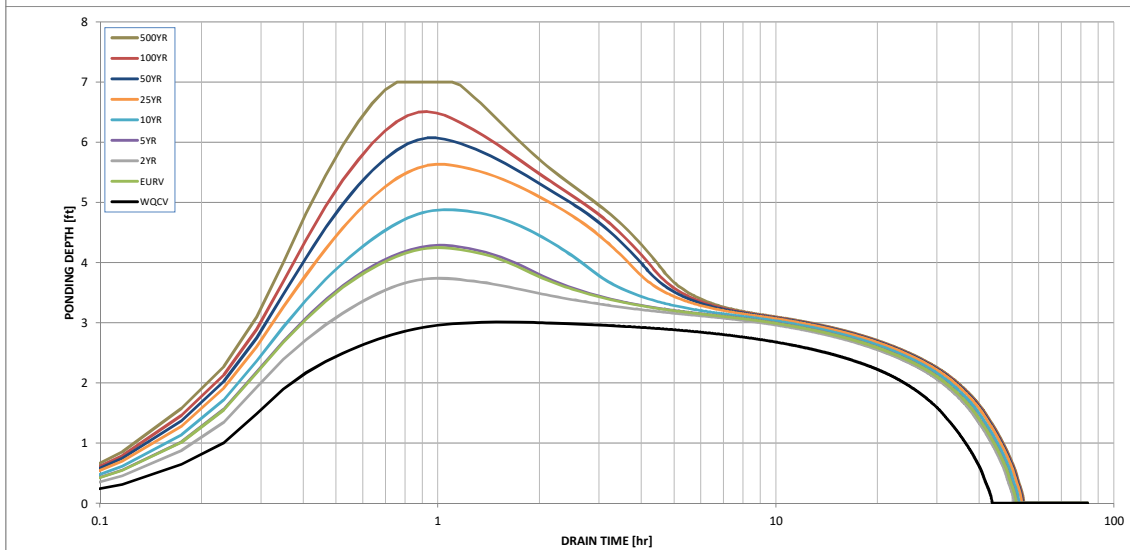
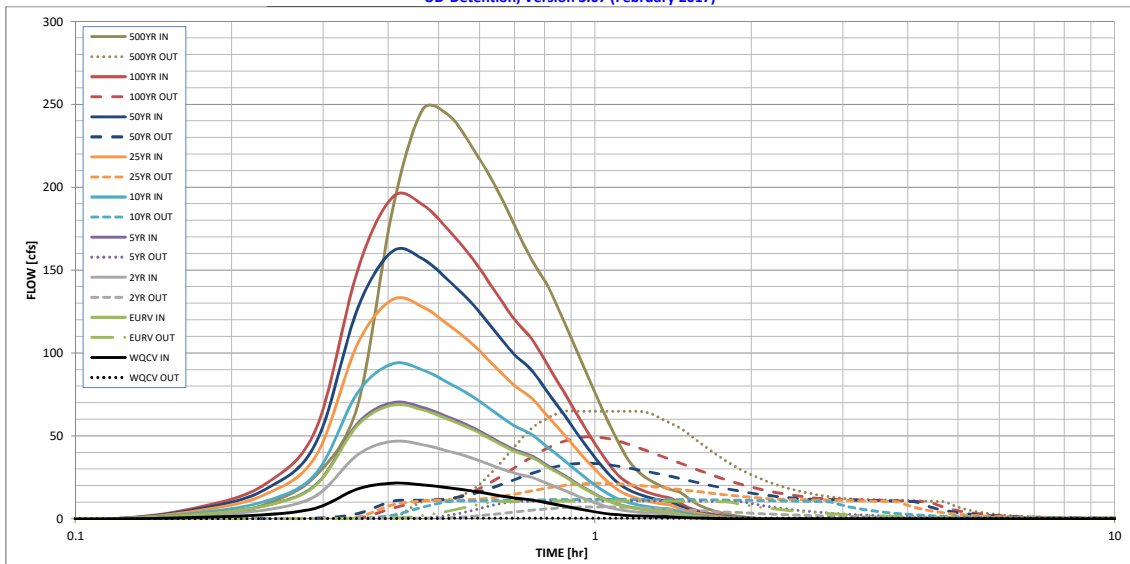
Spillway Design Flow Depth = feet
 Stage at Top of Freeboard = feet
 Basin Area at Top of Freeboard = acres

Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	0.53	1.07	0.99	1.39	1.64	1.98	2.31	2.60	3.08
Calculated Runoff Volume (acre-ft) =	0.908	2.937	1.990	3.003	4.023	5.735	7.033	8.499	10.895
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.908	2.938	1.991	3.004	4.025	5.735	7.035	8.502	10.899
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.25	0.83	1.19	1.59	2.23
Predevelopment Peak Q (cfs) =	0.0	0.0	0.6	1.2	12.2	40.9	58.6	78.4	109.7
Peak Inflow Q (cfs) =	21.5	68.6	46.7	70.1	93.5	132.2	161.3	193.9	246.7
Peak Outflow Q (cfs) =	0.4	10.9	7.3	10.9	11.8	21.4	33.5	49.5	64.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	9.0	0.96	0.5	0.6	0.6	0.6
Structure Controlling Flow =	Plate	Outlet Plate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Overflow Grate 2	Overflow Grate 2	Overflow Grate 2	N/A
Max Velocity through Grate 1 (fps) =	N/A	0.48	0.32	0.5	0.5	0.6	0.6	0.6	0.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	0.5	1.2	2.1	2.9
Time to Drain 97% of Inflow Volume (hours) =	37	39	41	39	38	36	34	33	30
Time to Drain 99% of Inflow Volume (hours) =	40	45	45	45	44	44	43	42	41
Maximum Ponding Depth (ft) =	3.01	4.25	3.74	4.29	4.88	5.63	6.07	6.51	7.00
Area at Maximum Ponding Depth (acres) =	0.91	1.33	1.19	1.33	1.56	1.81	1.85	1.89	1.93
Maximum Volume Stored (acre-ft) =	0.861	2.267	1.623	2.320	3.163	4.457	5.263	6.068	7.022

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)



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

