BANNER SCOTTSDALE CAMPUS

Scottsdale, AZ

Conceptual Drainage Report

Project No. 1121151

August 2022

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ARIZONA, U.S.A.

5-ZN-2022
9/20/2022

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LIST OF ABBREVIATIONS

1D	one-dimensional
2D	two-dimensional
ADOT	Arizona Department of Transportation
C	runoff coefficient
CAP	Central Arizona Project
cb	catch basin
cfs	cubic feet per second
CMP	corrugated metal pipe
DDMSW	Drainage Design Management System for Windows
FCDMC	Flood Control District of Maricopa County
elev	Elevation
EOPCC	engineer's opinion of probable construction cost
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FF	Finished Floor
fps	feet per second
ft	feet
GIS	geographical information system
HDPE	high density polyethylene
HEC-HMS	Hydrologic Engineering Center Hydrological Modeling System
HEC-RAS	Hydrologic Engineering Center River Analysis System
hr	hour
in.	inch
inv	invert
MAG	Maricopa Association of Governments
MCDOT	Maricopa County Department of Transportation
MH	manhole
min	minute
NAD83	Northern American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Services

PAG	Pima Association of Governments
PCFCD	Pinal County Flood Control District
RCBC	reinforced concrete box culvert
RCP	reinforced concrete pipe
SRP	Salt River Project
sq ft	square feet
sq mi	square mile
SY	square yard
USACE	United States Army Corp of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
XKSAT	hydraulic conductivity
yr	year

1. INTRODUCTION

1.1 Project Description

This Conceptual Drainage Report presents the basic drainage conditions and possible stormwater management solutions that apply to the Banner Scottdale Campus (BSC) project site. This report is intentionally preliminary in scope and is submitted in support of rezoning and conditional use permit applications for the project. This report will provide the basis for future design level reports as the project progresses. The Banner Scottdale Campus development includes the design of a new hospital building, cancer center, medical office building, parking structure, and associated hardscape improvements. Development within the Banner Scottsdale Campus will be classified with office, parking, and hospital land uses. Additionally, properties north of the Banner Scottsdale Campus, in Planning Unit 9, are anticipated to become industrial land use developments. As a part of the Master Plan of Planning Unit 9, a new public road will be designed to extend Cavasson Road to the edge of the site. A connecting roadway will also be designed between Legacy Blvd and Cavasson Road. There has been no previous development of this site.

The conceptual drainage design of the BSC property is occurring concurrently with a master drainage planning effort for Unit 9. Several alternatives are being considered for how the BSC parcel, the remainder of Unit 9, and Unit 8 will manage runoff as part of an integrated plan. The preferred alternative of the Master Drainage Plan is not yet known; however, alternatives that have thus far been considered are provided within the memorandum provided in **Appendix A**. Arizona State Land Department (ASLD) and Banner have eliminated Alternative 2 from consideration at this point in time, and ASLD has requested that additional refinement be made to the remaining alternatives. As all of the master drainage plan alternatives consist of diversion of runoff generated north of the BSC parcel eastward and away from the site, drainage concepts presented herein focus on on-site stormwater management within the BSC site and an off-site collection system in Cavasson Boulevard that has been sized to accommodate either master plan alternative currently being considered. As the preferred master plan solution is developed, any modifications necessary to the Cavasson Boulevard collection system will be determined and documented in future drainage reports.

1.2 Project Location

The BSC is located within the Crossroads East Planning Unit 9. Planning Unit 9 is approximately 98 acres in size and is located at the intersection of Hayden Road and Loop 101 in Scottsdale, Arizona. It is in the southwest quadrant of Township 4 North, Range 4 East, Section 25 and the northwest quadrant of Township 4 North, Range 4 East, Section 36. The site is bounded by the City of Scottsdale Water Campus to the East, Arizona State Route 101 to the South, Hayden Road to the West, and Hualapai Drive to the North. The BSC site represents approximately 45 Acres and is the southern portion of Unity 9. See **Figure 1** below for a Vicinity Map.

2. BACKGROUND

2.1 Previous Studies

Planning Unit 9 is within the Crossroads East planning area. Crossroads East has been the subject of considerable drainage planning and infrastructure construction in the last ten years, including construction of the Powerline Channel and Basin 53R. These facilities are designed to collect and store the 100-year design storm event, and they divert runoff from a significant off-site area that previously reached the project site. Planning documents for Crossroads East prescribed that Planning Units 8 and 9 should divert remaining on-site generated runoff, for up to and including the 100-year design storm event, to Basin 53R. Additional information can be found in the following reports:

- *Crossroads East Drainage Infrastructure Design Concept Report*, 2015 (**Reference 1**)

- *Crossroads East Drainage Infrastructure Phase I*, 2020 (**Reference 2**)

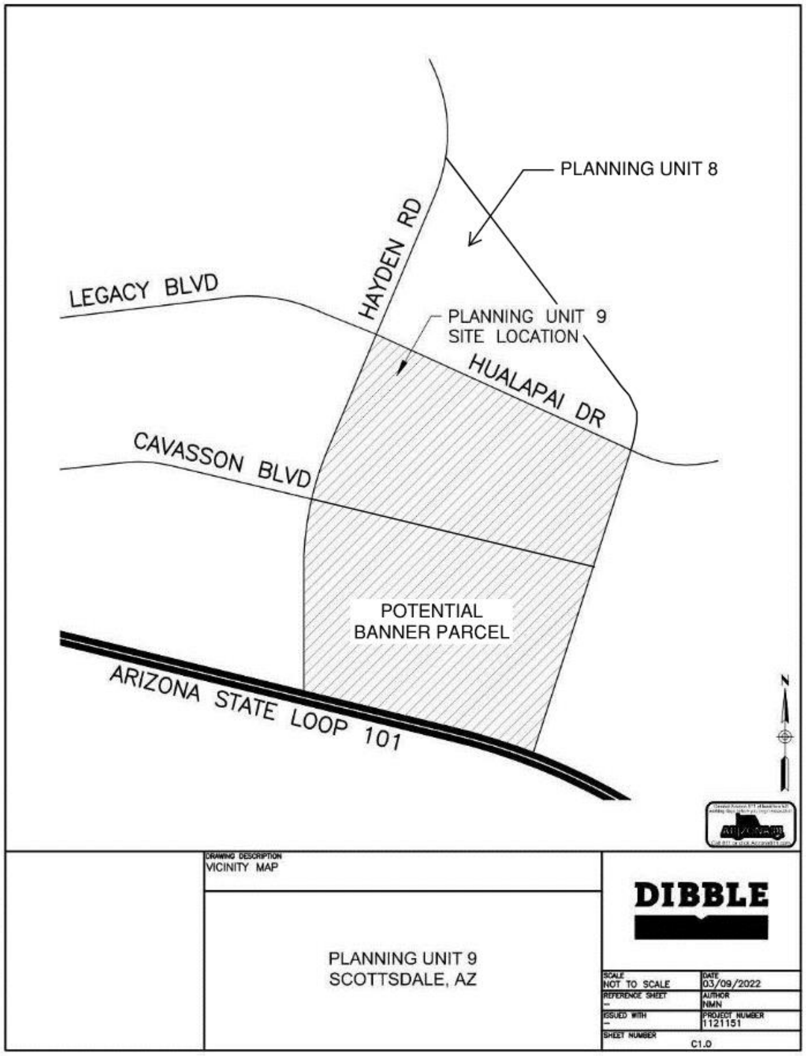

Figure 1 - Vicinity Map

2.2 Existing Conditions

The BSC site and Planning Units 8 and 9 are composed of undeveloped desert rangeland drainage from northeast to southwest at an average slope of 1.7%. The Powerline Channel diverts runoff from north of the area for up to and including the 100-year 24-hour design storm event. Diverted runoff is released to Basin 53R, a regional detention basin designed and constructed as part of the Crossroads East project. An exhibit with existing condition elevation contour lines is provided in **Appendix B**. Today, runoff from the planning area travels southwesterly until being intercepted by concrete collection channels within the ADOT State Route Loop 101 right-of-way. These channels lead to three culvert crossings that deliver runoff to south of the freeway.

Pavement drainage for Hayden Road is provided by a catch basin and storm drain system. The system has an outlet to an engineered channel on the east side of Hayden Road, beginning approximately 800 feet north of the ADOT right-of-way limit. This channel leads the western most ADOT culvert crossing the freeway.

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2.3 FEMA Floodplains

Planning Unit 9 lies within a FEMA Zone AO (Alluvial Fan) Special Flood Hazard Area. An AO Zone is defined as "Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between one and three feet." Average flood depths are derived from detailed hydraulic analysis are shown in this zone. Mandatory flood insurance requirements for federally backed loans apply. At the site, the FEMA defined average depth is 1-foot. A current-effective FEMA flood hazard map is provided in **Appendix B**.

The delineation of this flood zone pre-dates the Powerline Channel diversion and is no longer based on detailed analysis. However, National Flood Insurance Program requirements dictate that construction provide provisions consistent with currently effective delineation until such time that an official flood map revision is accepted by FEMA.

3. DESIGN CRITERIA

Drainage concepts presented herein have been developed consistent with drainage design standards provided in the publication *City of Scottsdale Design Standards and Policies Manual*, 2018 (**Reference 3**) with additional stipulations provided by inclusion in the Crossroads East planning area. These additional stipulations are as follows:

1. 100-year 2-hour storage is not required; sites shall provide storage or treatment for the first flush runoff volume.
2. Facilities shall be sized to convey the 100-year design storm to Basin 53R.
3. Freeboard is required for detention and conveyance facilities; 1 foot of freeboard shall be provided above the 100-year hydraulic grade line elevation of channels, detention facilities, and pipes used to convey runoff to Basin 53R.
4. Hayden Road currently conveys right-of-way runoff in a storm drain to an open channel at the northeast corner of Hayden Road and the Loop 101 freeway; from here, runoff travels beneath Loop 101 in an ADOT culvert. This situation shall remain as directed by the City.

Specific requirements relative to construction within a FEMA Zone AO floodplain are as follows:

1. Building finish floor elevations must be elevated 2 feet above the highest pre-construction adjacent ground surface (HAG) at the building permitter, this is the regulatory flood elevation (RFE).
2. Buildings classified as "critical facilities" by FEMA or "essential" by ASCE (**Reference 5**) must be elevated an additional foot or be above the 500-year water surface elevation – whichever is greater; hospitals fall into this category. A 500-year analysis is currently underway, the current design meets the condition of HAG plus 3 feet.
3. Finished floors specifically for parking may be below the RFE provided that dry floodproofing of the area is provided up to the RFE elevation and stormwater has means to pass through the parking area by way of wall openings.

4. METHODOLOGY & APPROACH

Conceptual level drainage solutions have been determined using *HEC-HMS* rainfall-runoff software, *Storm and Sanitary Analysis* unsteady hydraulic routing software, *Hydraflow Storm Sewers* hydraulic routing software, and spreadsheets. Calculations developed thus far are limited to those items wherein feasibility in meeting the design criteria must be demonstrated.

4.1 Rainfall Runoff Calculations

One-dimensional hydrology was performed using the *HEC-HMS* (Hydrologic Modeling System), and the Flood Control District of Maricopa County's (FCDMC) *Drainage Design Management System for*

Windows (DDMSW) version 5.6 was used to pre-process the subbasin modeling parameters. The proposed condition model domain, subbasins, and time of concentration flow paths are shown as **Exhibit C1**, included in **Appendix C**. This exhibit includes the subbasins associated with Unit 8, Unit 9, Basin 53R, and the downstream subbasin north of Union Hills Drive. The *HEC-HMS* design model developed for the *Crossroads East Drainage Infrastructure Phase I* project provided the starting point for the current project modeling. The original subbasin encompassing all of combined Unit 8 and Unit 9 areas was subdivided based on the locations of Hualapai Drive and Cavasson Boulevard, the preliminary site grading for the BSC, and primary natural topographic boundaries. *HEC-HMS* schematics are provided for master drainage plan Alternative 1 and 3 in **Appendix D**. Alternative 2 has been eliminated from contention. The modeling of the Banner Scottsdale Campus is identical in each alternative model.

4.1.1 Rainfall

Precipitation data used in rainfall runoff calculations was obtained from the NOAA Atlas 14 Precipitation Frequency Data Server. Both 100-year, 24-hour and 100-year, 6-hour storms were modeled.

4.1.2 Inflow Hydrographs

The model makes use of inflow hydrographs produced as part of the *Crossroads East Drainage Infrastructure Phase I* project. These hydrographs were developed through 2-dimensional flow modeling of the watershed contributing to the Crossroads East system. Inflow hydrographs for the 100-year, 24-hour and 100-year, 6-hour storms were retained from the original modeling without modification.

4.1.3 Rainfall Losses

The Green & Ampt Method was selected for this project. The rainfall loss parameters were developed using guidance provided in the *Drainage Design Manual for Maricopa County, Volume I Hydrology* (**Reference 4**) (Hydrology Manual). The Green & Ampt infiltration equation parameters were based on logarithmic area-averaging of the map unit hydraulic conductivities (XKSAT) for mapped soils in each basin. The selection of capillary suction (PSIF) and soil moisture deficit (DTHETA) were based on the calculated sub-basin value of XKSAT. The bare ground XKSAT values for each sub-basin were then adjusted for vegetation cover. The calculation of these parameters was accomplished within DDMSW.

4.1.4 Land Use

Land use data for the Green & Ampt Method computations were selected based on future condition land use expectations. For Unit 8 and Unit 9, parameters corresponding to Institutional (hospital) and General Office land use designations were selected. A hydrologic modeling land use exhibit is provided as **Exhibit C2** in **Appendix C**. Detailed data associated with each land use code are provided in the DDMSW output in **Appendix C.**

4.1.5 Soil Parameters

Soils information for the Green & Ampt method were obtained from soil surveys performed by the Soil Conservation Service (SCS). A soils map is provided as **Exhibit C3** in **Appendix C**.

4.1.6 Unit Hydrographs

The Clark Unit Hydrograph Method was used for this project. The longest flow paths for each subbasin were selected using topographic mapping. DDMSW uses the Papadakis and Kazan equation to calculate times of concentration. Watershed roughness coefficients (K_b) were calculated by DDMSW using equation parameters taken from Table 3.1 of the Hydrology Manual.

4.1.7 Depth-Area Reduction Factors

Depth area reduction factors were not used in this model.

4.1.8 Flow Routing

Normal depth routing was used for surface flow in this model.

4.2 First Flush Calculations

The 'first flush' volume is considered a minimum level of control for new development at which stormwater pollution prevention practices must be put in place. First flush is intended to retain and/or treat runoff to remove pollution elements such as hydrocarbons and fine sediment. The City of Scottsdale provides the following equation for the calculation of the first flush.

V = CPA, where:

V = the required first flush storage volume, in cubic feet;
C = the weighted average runoff coefficient for the disturbed area of the proposed development;
P = the required precipitation depth of 0.5 inches, converted to feet; and
A = the disturbed area of the proposed development, in square feet.

At this preliminary stage, the calculations for first flush excluded the runoff coefficient, C, as a conservative measure. The first flush volumes were accounted for in *HEC-HMS* computations by a volume divert out of each subbasin hydrograph.

4.3 Hydraulic Routing Computations

The proposed drainage plan for the BSC includes detention routing through a number of storage basins combined with underground storm drain. In addition, the tailwater condition of the site—Basin 53R—varies with time as it fills and releases over the course of the design storm event. For these reasons, an unsteady hydraulic routing software was used design and analysis critical components of the system. Autodesk *Storm and Sanitary Analysis* was used to model these components. Inflow hydrographs from the *HEC-HMS* analysis were input into storage elements in the model with overflow weir and bleed-off pipe outlets. Dynamic storage routing within the storage areas and in connecting storm drain was provided by the software. The downstream tailwater condition at Basin 53R was input as a time-stage table, also obtained from the *HEC-HMS* model.

The proposed storm in Cavasson Boulevard has been modeled using steady-state hydraulic routing software, *Hydraflow Storm Sewers* using the peak discharge results from *HEC-HMS* computations.

4.4 Cavasson Boulevard Sediment Management

With the initial construction of the Cavasson Boulevard, prior to development in existing parcels north of the Banner site, the potential for sediment accumulation at the Cavasson Boulevard storm drain exists. Therefore, sediment collection basins have been sized using Flood Control District of Maricopa County methodology. The sediment loads for each basin were computed for a 2-year maintenance interval and are the sum of the 100-year event sediment yield and 2 x the annual sediment yield. Totals include both bed load and wash load components. Sediment data for the bed load analysis were obtained from site bulk soil samples obtained for the project. These samples were taken outside of the wash beds and are therefore conservative in regards to sediment yield. Bed material is generally courser than overbank surface material, and we expect that updated samples from the beds themselves will yield lower sediment loads at each basin. This will be verified in final design. Basin configuration consists of a 1-foot deep sediment collection area.

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Flow out of the basin will be controlled by the sill elevation of a drop inlet (MAG 501-5). A foot of freeboard above the 100-year headwater elevation of the inlet will be provided at locations where overflow would not otherwise reach Basin 53R.

5. PRELIMINARY GRADING AND DRAINAGE PLAN

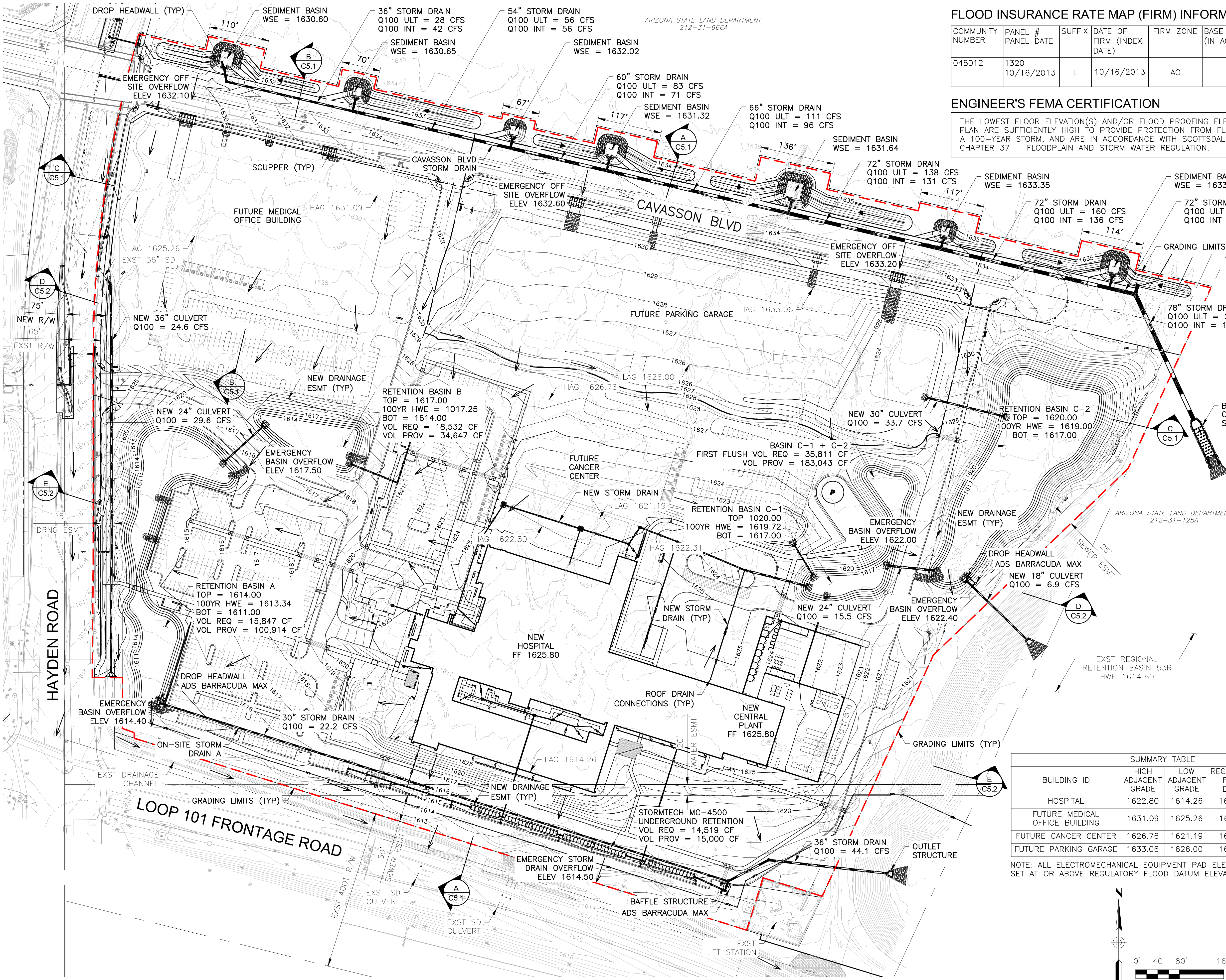
The Preliminary Grading and Drainage Plan for the BSC is provided as **Figure 2**. Relevant peak discharge and storage values are shown. The drainage plan provides first flush treatment for all surfaces. Preliminary grading divides the site into five primary drainage areas. Northeast and Central area runoff will be directed to the large basin at the northeast corner of the site. The basin will have a drain pipe to Basin 53R. Extreme events, beyond the 100-year design storm, will overtop the on-site basin and enter Basin 53R. Southwest and Northwest portions of the site have been designed to convey the 100-year event in a detention basin and pipe system. Runoff will be directed to first flush basins that also provide flow attenuation of the 100-year peak discharge. In these basins, an overtopping weir has been designed at the first flush storage elevation, such that any runoff greater than the first flush volume will overtop the weir and enter a pipe system. The pipe will contain the 100-year runoff, picking up additional 100-year runoff from the southeast area as it travels easterly to Basin 53R. A flap gate at the Basin 53R outlet will ensure no backflow onto the Banner site.

The off-site collection system in Cavasson Boulvard ranges in size from 36 inches at the most upstream reach to 78 inches at the outfall. Hydraulic grade line calculations have been performed for (1) the case in which the parcels north of the Banner site are undeveloped and (2) the future developed scenario. In the case of the future developed scenario, the peak discharges used accommodate the more stringent of the master plan alternatives currently being considered.

For systems that, if overwhelmed by storms larger than the 100-year event, would result in bypass flow leaving the site to the south, rather than Basin 53R, a minimum of 1 foot of freeboard has been provided between the design hydraulic grade lines and southern and western site outfall elevations. Peak stage and discharge from Basin 53R are not increased as compared to the proposed conditions documented in the Basin 53R design report, *Crossroads East Drainage Infrastructure Phase I*, 2020 (**Reference 2**). These values are shown in **Table 1 – Basin 53R Hydraulic Summary**.

Table 1 – Basin 53R Hydraulic Summary

Condition	Max Stage (ft)	Max Discharge (cfs)
Basin 53R Design Report	1614.8	400
Alternative 1	1614.4	395
Alternative 2	1614.4	395
Alternative 3	1614.4	395



FLOOD INSURANCE RATE MAP (FIRM) INFORMATION

COMMUNITY NUMBER	PANEL # PANEL DATE	SUFFIX	DATE OF FIRM (INDEX DATE)	FIRM ZONE	BASE FLOOD ELEVATION (IN AO ZONE USE DEPTH)
045012	1320 10/16/2013	L	10/16/2013	AO	DEPTH 1

ENGINEER'S FEMA CERTIFICATION

THE LOWEST FLOOR ELEVATION(S) AND/OR FLOOD PROOFING ELEVATION(S) ON THIS PLAN ARE SUFFICIENTLY HIGH TO PROVIDE PROTECTION FROM FLOODING CAUSED BY A 100-YEAR STORM, AND ARE IN ACCORDANCE WITH SCOTTSDALE REVISED CODE, CHAPTER 37 – FLOODPLAIN AND STORM WATER REGULATION.

SUMMARY TABLE

BUILDING ID	HIGH ADJACENT GRADE	LOW ADJACENT GRADE	REGULATORY FLOOD DATUM	FINISHED FLOOR ELEVATION
HOSPITAL	1622.80	1614.26	1623.34	1625.80
FUTURE MEDICAL OFFICE BUILDING	1631.09	1625.26	1632.09	1633.60
FUTURE CANCER CENTER	1626.76	1621.19	1627.76	1629.90
FUTURE PARKING GARAGE	1633.06	1626.00	1634.06	1635.10

NOTE: ALL ELECTROMECHANICAL EQUIPMENT PAD ELEVATIONS SHALL BE SET AT OR ABOVE REGULATORY FLOOD DATUM ELEVATION.

Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA 811
Call 811 or click Arizona811.com

Banner Project C Medical Center

SCOTTSDALE CAMPUS HOSPITAL
18611 North Hayden Road
Scottsdale, Arizona 85255

SMITHGROUP
455 NORTH THIRD STREET
SUITE 250
PHOENIX, AZ 85004
602.265.2200
smithgroup.com

DIBBLE
DIBBLE
CIVIL
1626 N LITCHFIELD ROAD
SUITE 150
GOODYEAR, AZ 85395
623.935.2258
dibblecorp.com

ISSUED FOR	REV	DATE
CITY COMMENTS		31AUG22
ENTITLEMENT REVIEW		15APR22

SEALS AND SIGNATURES

Registered Professional Engineer (Civil) CERTIFICATE No. 43320 CHRISTINA SHANNON MAUCK Date Signed 08/31/22 ARIZONA U.S.A.

SHEET TITLE
PRELIMINARY GRADING & DRAINAGE PLAN

PROJECT NUMBER 13178.000

SHEET NUMBER
FIGURE 2

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Plot Date: 8/31/2022 4:43:09 PM J:\2021\1121151 Banner Scottsdale Campus\CAD\1121151-C2.X-PRELIM G&D.dwg

HEC-HMS hydrologic computation results are provided in **Appendix D**. The modeling of the Banner Scottsdale Campus is identical in each alternative model. Detention and storm drain routing calculations are provided in **Appendix E**. The 100-year 6-hour storm event generally provided higher peak discharges within Unit 9; however, due to the much higher depth in Basin 53R during the 24-hour storm event, the 24-hour event produces the highest stage in the detention and pipe system at the southern limit of the site.

Finished floor elevations and highest adjacent natural grade elevations are provided in **Table 2 – Finished Floor Elevations**. A 500-year analysis is currently underway. The current design meets the condition of HAG plus 3 feet; the results of the 500-year analysis will be incorporated into the selection of finished floor when completed.

Table 2 – Finished Floor Elevations

Location	FF Elevation (ft)	Highest Adjacent Natural Ground Elevation (ft)
Hospital	1625.8	1622.8
Medical Office Building	1633.6	1631.1
Cancer Center	1629.9	1626.8
Parking Structure	1635.1	1633.1

The sediment loads (yields) at each sediment collection basin are shown below. A minimum yield of 0.01 Acre-Feet was applied. Sediment yield calculations can be found in **Appendix G**.

Table 3 – Cavasson Blvd Sediment Yield Results

Sediment Basin	Sediment Yield 2-YR Maintenance Interval (AC-FT)	Bottom Area Req'd @ 1' Deep (SF)
1	0.019	590
2	0.010	260
3	0.010	260
4	0.011	290
5	0.019	590
6	0.010	260
7	0.010	260

Sediment basin footprints have been determined based on 4H:1V sideslopes, the existing surface grade, and the preliminary Cavasson Road profile. Maintenance access ramps are a part of the design, most likely to be constructed of compacted aggregate base course material. Access roads and ramps are 10’ wide and have a maximum slope of 10H:1V. Riprap is provided at inflow locations. Earthen ditches have been sized to collect sheet flow traveling outside of the main wash section of each contributing area. These are labeled D1 through D10 and are summarized in the table below. A minimum discharge of 5 CFS was applied for preliminary design.

Table 4 – Cavasson Blvd Collection Ditch Results

Basin ID	Area (Acres)	Q (CFS)	Area (Acres)	Ditch ID	Q100 (CFS)	Bottom Width (ft)	Sideslope	Flow Depth (FT)	Velocity (FT/S)
SEDY1	19.2	42	14.9	D1	33	8	4H:1V	0.9	3.0
			3.21	D2	7	0	4H:1V	0.9	2.2
SEDY2	6.7	15	1.08	D3	5	0	4H:1V	0.8	2.0
SEDY4	13.7	32	0.44	D4	5	0	4H:1V	0.8	2.0
			0.34	D5	5	0	4H:1V	0.8	2.0
SEDY5	19.8	51	0.72	D6	5	0	4H:1V	0.8	2.0
			1.22	D7	5	0	4H:1V	0.8	2.0
SEDY6	4.5	12	0.18	D8	5	0	4H:1V	0.8	2.0
SEDY7	10.9	29	0.9	D9	5	0	4H:1V	0.8	2.0
			1.23	D10	5	0	4H:1V	0.8	2.0

Inlet pipes at each sediment collection basin convey off-site runoff to the trunk line after sediment removal. Preliminary sizing calculations are based on a worst case HGL slope of 0.5% and a maximum headwater depth/diameter ratio of 1.5. Pipe sizes will be confirmed during the final design when final sediment basin and roadway grades are known.

Table 5 – Cavasson Blvd Storm Drain Inlet Pipe Results

Inlet Location	Q100 Exst (CFS)	Q100 Ult (CFS)	Inlet Diameter
Sediment Basin 1	42	28	42"
Sediment Basin 2	15	28	36"
Sediment Basin 3	19	29	36"
Sediment Basin 4	32	29	36"
Sediment Basin 5	51	29	42"
Sediment Basin 6	12	24	36"
Sediment Basin 7	29	24	36"

6. CONCLUSION

The preliminary grading and drainage conceptual provided herein will support the development of the Banner Scottsdale Campus and is consistent with in-progress planning for the future development of Planning Unit 9, while maintaining City of Scottsdale design standards. The proposed plan is consistent with previous master planning efforts for this area, and calculations support that the proposed facility will be reasonably safe from flooding and result in no adverse impact to adjacent properties for up to and including the 100-year design storm event. As the preferred master plan solution is developed, the specific treatment of runoff reaching Cavasson Boulevard, to be constructed with the BSC project, will be determined and documented in future drainage reports.

7. REFERENCES

1. TY Lin International, *Crossroads East Drainage Infrastructure Design Concept Report*, 2015

2. Michael Baker Jr., Inc., *Crossroads East Drainage Infrastructure Phase I*, 2020

3. City of Scottsdale, *Design Standards and Policies Manual*, 2018.

4. Flood Control District of Maricopa County, *Drainage Design Manual for Maricopa County, Volume I Hydrology*, 2018

5. American Society of Civil Engineers, *ASCE 24-14 Flood Resistant Design and Construction*, 2015.

Appendix A Unit 9 Master Drainage Plan Alternatives (Preliminary)

Memorandum

To:	Mark Edelman (ASLD) Manny Patel (ASLD)	**Date:**	4/27/2022
Copy:	Cody Edam (Banner) Aaron Zeligman (Banner)		
From:	Josh Papworth (Dibble)	**Project No.:**	1121151
	Shannon Mauck (Dibble)		
Subject:	**Unit 9 Master Drainage Plan Alternatives**		

1. Introduction

Master drainage plan alternatives for Crossroads East Planning Unit 9 are presented herein in support of development of the Banner Scottsdale Campus project. The purpose of this memorandum is to provide conceptual alternatives for consideration by Arizona State Land Department (ASLD), the current owner of the properties, so that a preferred alternative may be selected. The selected alternative will become the Master Drainage Plan and will be submitted to the City of Scottsdale for approval. These master drainage planning efforts are occurring concurrently with conceptual design of the Banner Scottsdale Campus site, that is planned to occupy the southernmost parcel in Unit 9. At the time of the writing of this document, this land is owned by ASLD, and it will be referred to herein as the 'future Banner parcel'. The Master Drainage Plan will provide the basis for constructing major common drainage improvements and any unique drainage requirements for future developments. Additionally, once the selected Master Drainage Plan is known, the interim treatment of runoff reaching Cavasson Road can be addressed for the future Banner parcel.

Currently, no information is available regarding site planning for future sites to be within the remainder of Unit 9 or the next northern planning unit, Unit 8. Therefore, it is possible that the future site usage will warrant some modifications to this plan. Modifications are possible provided the permit applicant and landowner request a revision to the plan from the City of Scottsdale.

The Planning Unit 9 site is approximately 98 acres in size and is located at the intersection of Hayden Road and Loop 101 in Scottsdale, Arizona. It is in the southwest quadrant of Township 4 North, Range 4 East, Section 25 and the northwest quadrant of Township 4 North, Range 4 East, Section 36. The site is bounded by the City of Scottsdale Water Campus to the East, Arizona State Route 101 to the South, Hayden Road to the West, and Hualapai Drive to the North. The existing site is undeveloped desert rangeland. See **Figure 1** for a **Vicinity Map**.

2. Background and Previous Studies

Planning Unit 8 is within the Crossroads East planning area. Crossroads East has been the subject of considerable drainage planning and infrastructure construction in the last ten years, including construction of the Powerline Channel and Basin 53R. These facilities are designed to collect and store the 100-year design storm event, and they divert runoff from a significant off-site area that previously reached the project site. Planning documents for Crossroads East prescribed that Planning Units 8 and 9 should divert remaining on-site generated runoff to Basin 53R. Additional information can be found in the following reports:

- *Crossroads East Drainage Infrastructure Design Concept Report*, 2015
- *Crossroads East Drainage Infrastructure Phase I*, 2020

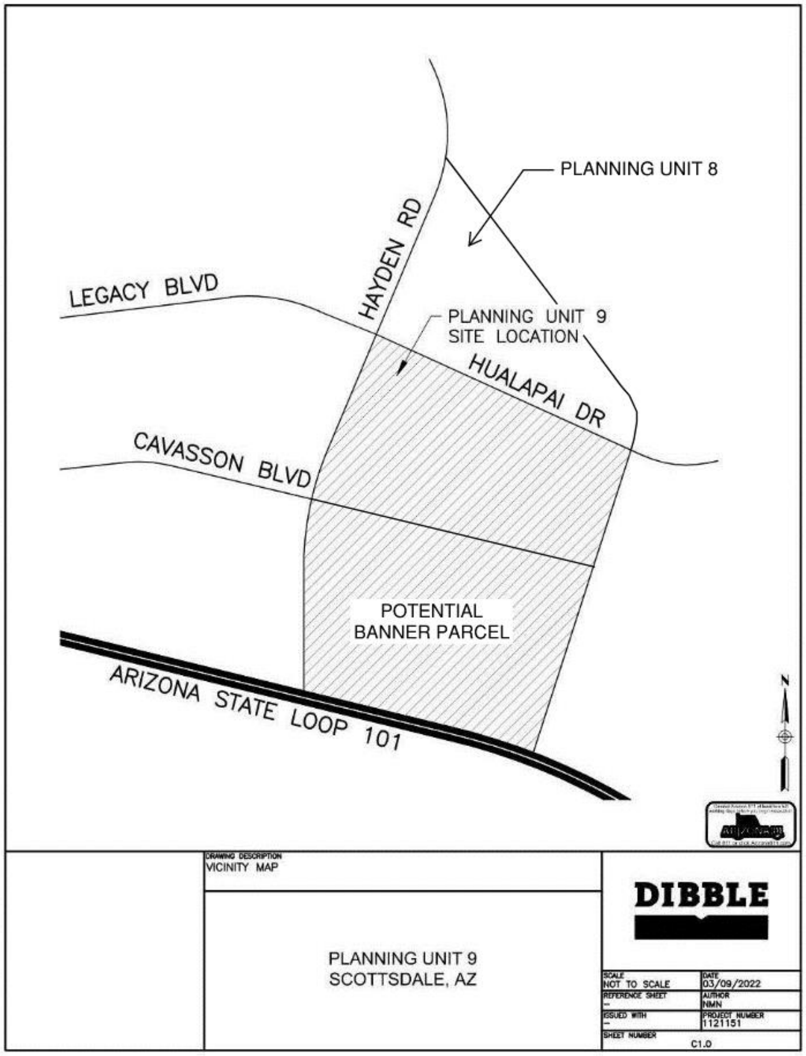


Figure 1: Project Site

3. Approach to Alternatives Development

Alternatives presented herein have been developed consistent with drainage design standards provided in the publication *City of Scottsdale Design Standards and Policies Manual*, 2018 with additional stipulations provided by inclusion in the Crossroads East planning area. These additional stipulations are as follows:

1. 100-year 2-hour storage is not required; sites shall provide storage or treatment for the first flush runoff volume.
2. Facilities shall be sized to convey the 100-year design storm to Basin 53R.
3. Freeboard is required for detention and conveyance facilities; 1 foot of freeboard shall be provided above the 100-year hydraulic grade line elevation of channels, detention facilities, and pipes used to convey runoff to Basin 53R.
4. Hayden Road currently conveys right-of-way runoff in a storm drain to an open channel at the northeast corner of Hayden Road and the Loop 101 freeway; from here, runoff travels beneath Loop 101 in an ADOT culvert. This situation shall remain.

Alignment alternatives have been developed based on dominant surface grades, the planned locations of Hualapai Road and Cavasson Road, and potential tie in points with the existing Powerline Channel and Basin 53R infrastructure. In most cases, open channel facilities provide the most economical option for stormwater conveyance. Various channel linings are possible, and selection varies based on conveyance capacity, the materials' ability to resist erosion, and cost. Conveyance options were selected for the alternatives according to the following decision criteria.

- Open channels were selected unless the required channel depth exceeded 10 feet, in which case an underground a storm drain was selected
- Desert landscaping was selected as the preferred lining material unless (1) velocity or (2) channel width required an alternative material; a maximum channel top width of 75 feet was selected; once exceeded, a smoother surface material (concrete) was selected

Peak discharges for use in alternative sizing were developed using HEC-HMS computer software and input parameters were chose consistent with Flood Control District of Maricopa County methodology. All planning unit areas were assigned a developed land use type consistent with Institutional (hospital) and General Office zoning. Preliminary profiles of all proposed facilities were developed, and channel and pipe sizes were determined within a spreadsheet. Culverts were sized using Federal Highway Administration HY-8 computer software.

Planning level cost data has been compiled for comparison between alternatives. Costs are limited to master drainage plan infrastructure and estimated land value north of Cavasson Road. A land unit value of $20 per square foot has been used in the estimates. Cost breakdowns by feature are provided as **Attachment B**.

4. Alternatives

4.1. Common Elements

As mentioned in the introduction, the future Banner parcel conceptual design is being developed concurrently with this master drainage plan. The future Banner drainage plan has been developed to a conceptual stage, and there are no competing alternatives within the site that require selection. Therefore, the current plan for the Banner parcel can be considered common to all three Unit 9 alternatives. The current conceptual drainage plan for the Banner parcel is provided as **Attachment A**, and the primary elements are described below.

The drainage plan for the Banner parcel provides first flush treatment for all surfaces. Preliminary grading divides the site into four primary drainage areas. Northeast area runoff will be directed to the large basin at the northeast corner of the site. The basin will have a drain pipe to Basin 53R. Extreme events, beyond the 100-year design storm, will overtop the on-site basin and enter Basin 53R. South and west portions of the site have been designed to convey the 100-year event in a detention basin and pipe system. Runoff will be directed to first flush basins that also provide flow attenuation of the 100-year peak discharge. In these basins, an overtopping weir has been designed at the first flush storage elevation, such that any runoff greater than the first flush volume will overtop the weir and enter a pipe system. The pipe will contain the 100-year runoff, picking up additional 100-year runoff as it travels easterly to Basin 53R. A flap gate at the Basin 53R outlet will ensure no backflow onto the Banner site. The systems described above include a minimum of 1 foot of freeboard between the design hydraulic grade lines and southern and western site outfall elevations.

4.2. Alternative 1

Alternative 1 is shown schematically as **Figure 2**. Feature sizes and details can be seen in the table that follows the figure. Parcel areas are labeled as 'Future Banner Parcel', 'Future B-1 Parcel' for the area between Hualapai Drive and Cavasson Road, and 'Future C-1 Parcel' for the area north of Hualapai Drive. The alternative consists of two conveyance routes along the north side of both Hualapai Drive and Cavasson Road.

Channels CH1 through CH3 were forced to be relatively shallow due to the existing depth of the receiving water, the Powerline Channel. Proposed channels are designed at the minimum slope required to meet minimum flushing velocity requirements. Therefore, in order to meet the maximum top width criteria of 75 feet, these channels were required to be concrete lined. Maximum channel top widths in this reach vary from 23 feet to 44 feet, with an estimated land requirement of approximately 2.3 acres. There are no anticipated utility conflicts in this reach. The 100-year water surface elevation in the Powerline Channel additionally constrains the reach design, and additional fill of the roadway section of up to a foot will likely be required to provide a roadway overtopping elevation matching the Powerline Channel's top of bank elevation. This will, in turn, require that developments making connection to Hualapai Road will also need to be elevated accordingly.

The Cavasson Road reach begins at it's western limit as a landscaped channel before transitioning to a segment of concrete lined channel. The final segment is an underground storm drain. Maximum channel top widths in this reach vary from 43 feet to 57 feet, with an estimated land requirement of approximately 1.6 acres. The anticipated pipe diameter is 66 inches. The use of a storm drain was necessary due to the significant depth required to travel beneath planned sewer stubs for future development and existing utilities in the Basin 53R bank. To maintain pipe velocities below city-stipulated maximum values, the outlet must be roughly 19 feet above the bottom of Basin 53R. A concrete baffle chute spillway will provide energy dissipation from the pipe outlet to the basin bottom.

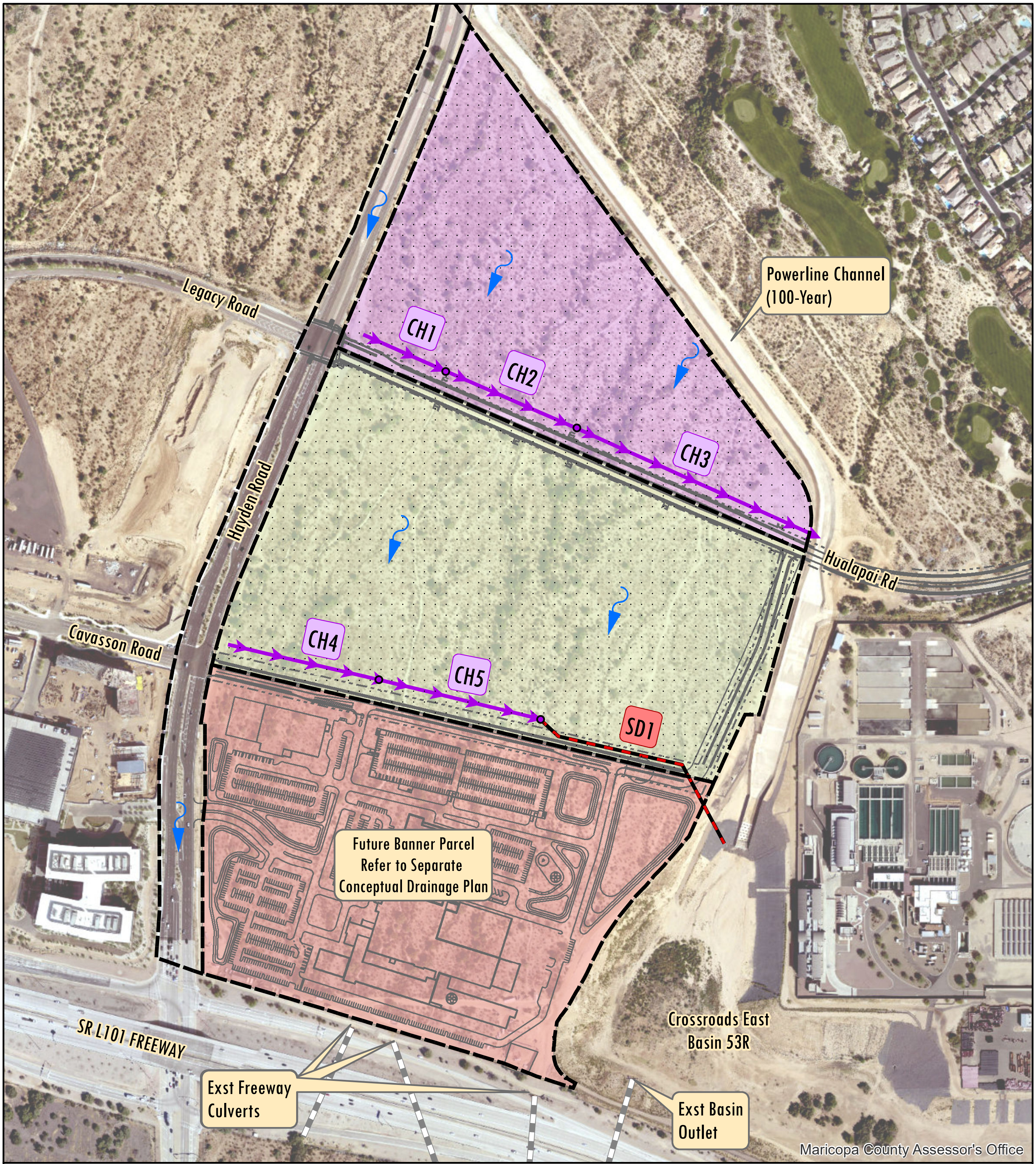
The planning level estimated infrastructure cost for this alternative, including an estimate of land value, is $ 7.0M.

Advantages of Alternative 1 include:

- Least land requirement of any alternative
- Cavasson Road may be constructed at or near existing grade
- Minimized utility crossings
- Parcels are not subdivided

Disadvantages of Alternative 1 include:

- Shallow, inefficient conveyance along Hualapai Drive, requiring more expensive channel lining
- Additional fill for roadway construction will be required to maintain the top of bank elevation at the connection to the Powerline Channel.



UNIT 9 MASTER DRAINAGE PLAN
FIGURE 2 - ALTERNATIVE 1

DIBBLE

Study Area & Major Drng Boundaries	Conveyance Channel
Future Banner Parcel	Storm Drain
Future B-1 Parcel	First Flush Storage Requirement
Future C-1 Parcel	

0 250 500 Feet

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Planning Unit 9 Master Drainage Plan
Alternative 1 Infrastructure Data Sheet

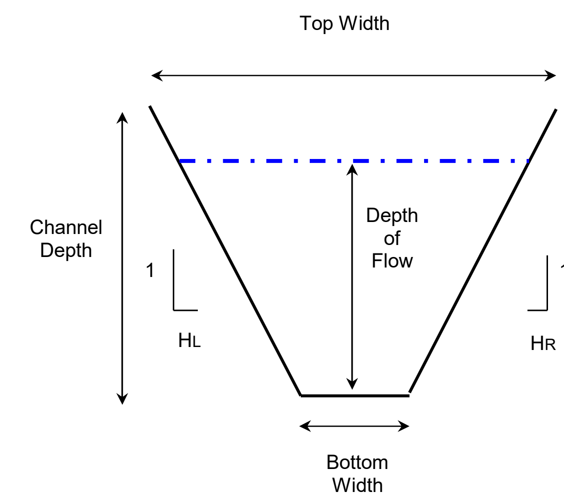
Channel Properties

Plan ID	Design Q100 (cfs)	Downstream Invert Elevation (ft)	Upstream Invert Elevation (ft)	Length (ft.)	Design Invert Slope (ft./ft.)	Material Type	Manning's "n" Value	Bottom Width, W (ft.)	Depth of Flow(ft.)	Sideslope (H:1) Left (HL)	Sideslope (H:1) Right (HR)	Left Access Road Width (ft)	Right Access Road Width (ft)	Number of Drop Structures	Drop Structure Height (ft)	Fence Length (ft)	Area (sf.)	Wetted Perimeter (ft.)	Froude Number	Type of Flow	Velocity (fps)	Freeboard (ft.)	Design Depth (ft)	Channel Topwidth (ft)	Total ROW Width Required (ft)
A1_CH1	44	51.3	51.89	393	0.0015	S	0.022	6	1.7	2	2	14	4679	0	0.0	n/a	15.3	13.4	0.46	Sub	2.9	1.0	2.7	23	37
A1_CH2	119	50.4	51.3	600	0.0015	S	0.022	18	1.7	2	2	14	7140	0	0.0	n/a	36.1	25.4	0.48	Sub	3.3	1.0	2.7	35	49
A1_CH3	123	48.93	50.4	977	0.0015	S	0.022	18	1.7	2	2	14	11631	0	0.0	n/a	36.9	25.7	0.48	Sub	3.3	1.0	2.7	44	58
A1_CH4	59	27.77	28.58	540	0.0015	LLE	0.035	5	2.2	4	4	14	6426	0	0.0	n/a	30.1	23.1	0.30	Sub	2.0	1.0	3.2	57	71
A1_CH5	140	26.9	27.77	580	0.0015	S	0.022	9	2.6	2	2	14	6902	0	0.0	n/a	36.4	20.5	0.49	Sub	3.8	1.0	3.6	43	57

Channel Material Type: NV = Natural Vegetation, C = Concrete, R = Riprap, GR = Grass, E = Natural or Earth, LE = Landscaped Earth, LLE = Light Landscaped Earth

Utility Crossings

Plan ID	Water	Sewer	Fiber Optic
A1_CH1	0	0	0
A1_CH2	0	0	0
A1_CH3	0	0	0
A1_CH4	0	0	0
A1_CH5	0	0	0
SD1	0	0	0



Typical Channel Section

Storm Drain Properties

Alternative Element ID	Length (ft)	Number of Pipes	Diameter (in)	Manning's N Value	Design Storm	QDesign (cfs)	QFull (cfs)	Velocity (ft/s)	Friction Slope (ft/ft)	Trunkline Manholes	Length of Lateral Pipe (ft)	No. of Catch Basins	No. of Junction Structures	No. of Outfall Headwalls
SD1	900	1	66	0.015	100YR	186	184	7.8	0.0040	3	36	4	0	1

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4.3. Alternative 2

Alternative 2 is shown schematically as **Figure 3**. Feature sizes and details can be seen in the table that follows the figure. Alternative 2 differs from Alternative 1 in the collection of runoff at Hualapai Drive.

Channels north of Hualapai Drive convey runoff to the topographic low point between Hayden Road and the Powerline Channel where a 3-barrel, 36-inch diameter culvert delivers the concentrated flow beneath the roadway. Normal channel landscaping has been chosen for this reach. Channel top widths in this reach vary from 46 feet to 60 feet, with an estimated land requirement of approximately 2.9 acres.

Once south of Hualapai Drive, Channel CH4 conveys runoff to Cavasson Road at roughly the midline of Future Parcel B1. This channel consists of a landscaped channel with seven 2-foot-tall drop structures to mitigate excessive velocity. The anticipated maximum top width for this reach is 64 feet, and the estimated land requirement is 2.0 acres.

At Cavasson Road, Channel CH4 is merged with Channel CH6, and both are conveyed in an underground storm drain to Basin 53R. Maximum channel top widths in this reach vary from 46 feet to 57 feet, with an estimated land requirement of approximately 1.7 acres. The anticipated pipe diameter is 78 inches. The use of a storm drain was necessary due to the significant depth required to travel beneath planned sewer stubs for future development and existing utilities in the Basin 53R bank. To maintain pipe velocities below city-stipulated maximum values, the outlet must be roughly 19 feet above the bottom of Basin 53R. A concrete baffle chute spillway will provide energy dissipation from the pipe outlet to the basin bottom.

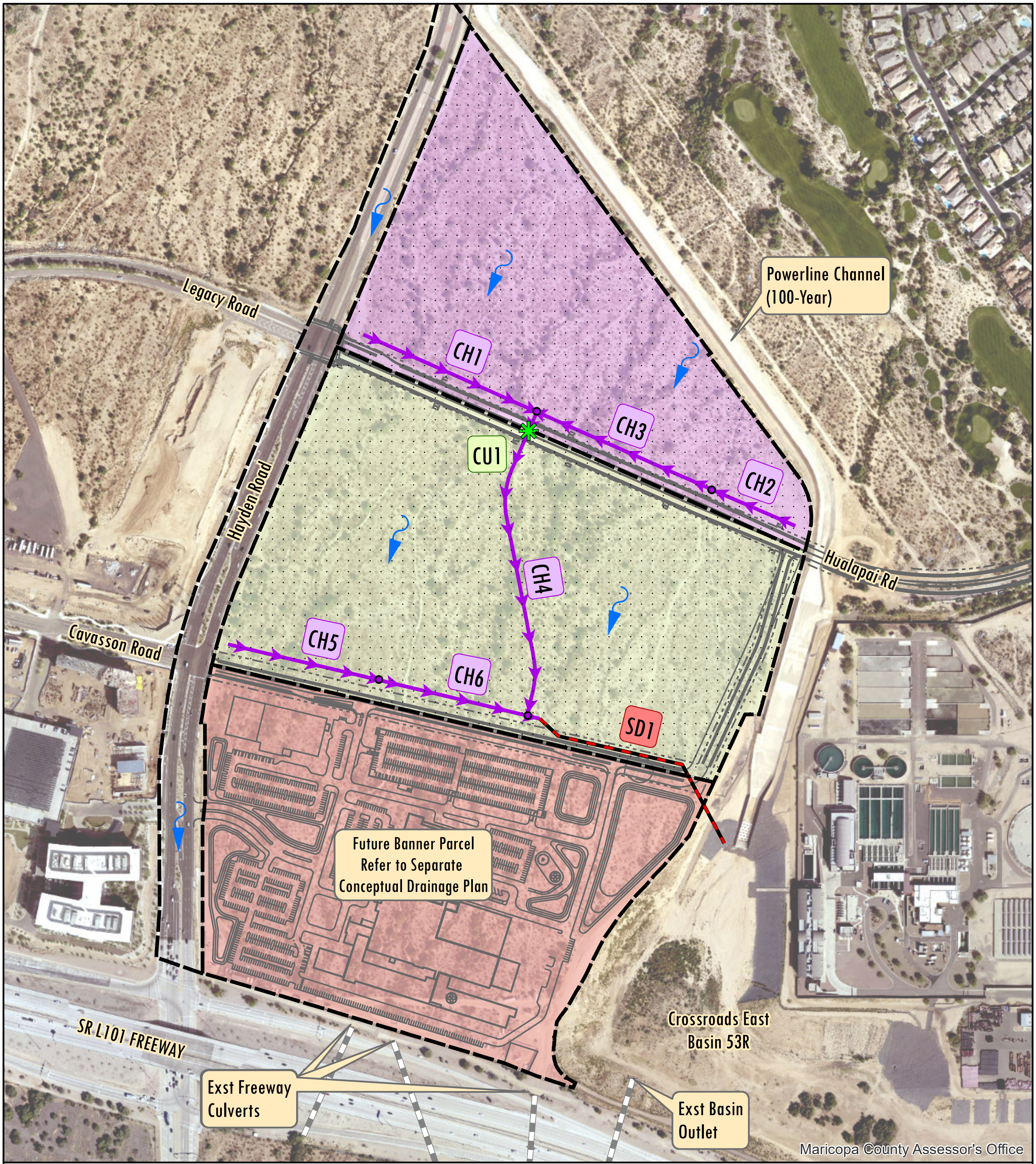
The planning level estimated infrastructure cost for this alternative, excluding land value, is $8.6M.

Advantages of Alternative 2 include:

- Efficient use of existing topographic grades for the area north of Hualapai Drive
- Hualapai Drive and Cavasson Road may be constructed at or near existing grade

Disadvantages of Alternative 1 include:

- Future Parcel B-1 is subdivided
- Most land requirement of any alternative
- Highest relative cost
- More utility crossings than Alternative 1



UNIT 9 MASTER DRAINAGE PLAN
FIGURE 3 - ALTERNATIVE 2

DIBBLE

Study Area & Major Drng Boundaries
Future Banner Parcel
Future B-1 Parcel
Future C-1 Parcel
Conveyance Channel
Storm Drain
Culvert Crossing Location
First Flush Storage Requirement

0 250 500 Feet

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Planning Unit 9 Master Drainage Plan
Alternative 2 Infrastructure Data Sheet

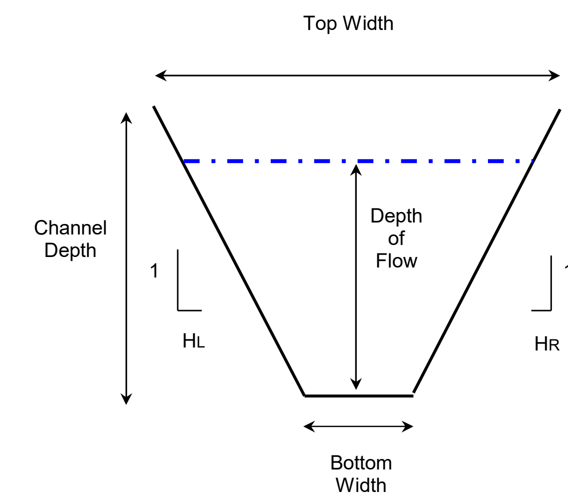
Channel Properties

Plan ID	Design Q100 (cfs)	Downstream Invert Elevation (ft)	Upstream Invert Elevation (ft)	Length (ft.)	Design Invert Slope (ft./ft.)	Material Type	Manning's "n" Value	Bottom Width, W (ft.)	Depth of Flow(ft.)	Sideslope (H:1) Left (HL)	Sideslope (H:1) Right (HR)	Left Access Road Width (ft)	Right Access Road Width (ft)	Number of Drop Structures	Drop Structure Height (ft)	Fence Length (ft)	Area (sf.)	Wetted Perimeter (ft.)	Froude Number	Type of Flow	Velocity (fps)	Freeboard (ft.)	Design Depth (ft)	Channel Topwidth (ft)	Total ROW Width Required (ft)
A2_CH1	44	48.5	51.77	777	0.0042	LLE	0.035	4	1.6	4	4	14	9252	0	0.0	n/a	16.4	17.0	0.48	Sub	2.7	1.0	2.6	49	63
A2_CH2	15	50.08	51.67	380	0.0042	LLE	0.035	2	1.2	4	4	14	4522	0	0.0	n/a	7.3	11.2	0.45	Sub	2.1	1.0	2.2	37	51
A2_CH3	92	48.5	50.08	716	0.0022	LLE	0.035	7	2.5	4	4	14	8516	0	0.0	n/a	42.1	27.6	0.31	Sub	2.2	1.0	3.5	67	81
A2_CH4	130	29.57	47.49	1078	0.0166	LE	0.045	11	2.3	4	4	14	12833	7	1.9	n/a	46.5	30.0	0.39	Sub	2.8	1.0	3.3	66	80
A2_CH5	59	27.8	28.58	520	0.0015	LLE	0.035	5	2.2	4	4	14	6188	0	0.0	n/a	30.1	23.1	0.30	Sub	2.0	1.0	3.2	57	71
A2_CH6	139	25.9	26.77	580	0.0015	S	0.022	9	2.6	2	2	14	6902	0	0.0	n/a	36.2	20.4	0.49	Sub	3.8	1.0	3.6	46	60

Channel Material Type: NV = Natural Vegetation, C = Concrete, R = Riprap, GR = Grass, E = Natural or Earth, LE = Landscaped Earth, LLE = Light Landscaped Earth

Culvert Properties

I.D.	Design Q100 (cfs)	Length (ft.)	Inlet Inv. (ft.)	Outlet Inv. (ft.)	Slope (ft./ft.)	Number of Barrels	Culvert Span (ft.)	Culvert Dia./ Height (ft.)	Barrel/ Material	Manning's "n" Value	Entrance (Wingwall, Headwall or Project)	Tailwater Depth (ft.)	Computed Headwater	Computed HW/D
ALT2_CU1	130	102	1647.80	1647.49	0.0040	3	-	3	CONC	0.045	Headwall	2.30	3.42	1.14



Typical Channel Section

Utility Crossings

Plan ID	Water	Sewer	Fiber Optic
A2_CH1	0	0	0
A2_CH2	0	0	0
A2_CH3	2	2	0
A2_CH4	0	0	0
A2_CH5	0	0	0
A2_CH6	0	0	0
SD1	0	0	0

Storm Drain Properties

Alternative Element ID	Length (ft)	Number of Pipes	Diameter (in)	Manning's N Value	Design Storm	QDesign (cfs)	QFull (cfs)	Velocity (ft/s)	Friction Slope (ft/ft)	Trunkline Manholes	Length of Lateral Pipe (ft)	No. of Catch Basins	No. of Junction Structures	No. of Outfall Headwalls
SD1	900	1	78	0.015	100YR	299	287	9.0	0.0040	3	36	4	0	1

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4.4. Alternative 3

Alternative 3 is shown schematically as **Figure 4**. Feature sizes and details can be seen in the table that follows the figure. This alternative seeks to combine the advantages of the previous two alternatives.

Collection channels CH1 through CH2, north of Hualapai Drive, convey runoff to culvert CU1. CU1 consists of 3-barrels of 36-inch-diameter-pipe. The crossing location is roughly 500 feet west of the future Powerline Channel bridge, west of the point where the roadway grade is expected to rise to meet the bridge structure. Maximum channel top widths in this reach vary from 46 feet to 60 feet, with an estimated land requirement of approximately 2.1 acres.

Once south of Hualapai Drive, Channels CH3 and CH4 convey runoff to Cavasson Road starting at roughly the middle of Future Parcel B1 and then southerly along the eastern boundary of Future Parcel B1. Channel CH4 consists of a landscaped channel with six 2-foot-tall drop structures to mitigate excessive velocity. Maximum channel top widths in this reach vary from 42 feet to 57 feet, with an estimated land requirement of approximately 2.1 acres. A second culvert CU2, conveys the northeast corner of Future Parcel C-1 to Channel CH4. Its size is 1-barrel, 24-inches in diameter.

Identical to Alternative 1, the Cavasson Road reach begins at the western limit as a landscaped channel before transitioning to a segment of concrete-lined channel. The final segment is an underground storm drain. Maximum channel top widths in this reach vary from 43 feet to 57 feet, with an estimated land requirement of approximately 1.6 acres. The anticipated pipe diameter of Storm Drain SD1 is 66 inches until the connection with Channel CH4, where it is increased to 78 inches in diameter. The use of a storm drain was necessary due to the significant depth required to travel beneath planned sewer stubs for future development and existing utilities in the Basin 53R bank. To maintain pipe velocities below city-stipulated maximum values, the outlet must be roughly 19 feet above the bottom of Basin 53R. A concrete baffle chute spillway will provide energy dissipation from the pipe outlet to the basin bottom.

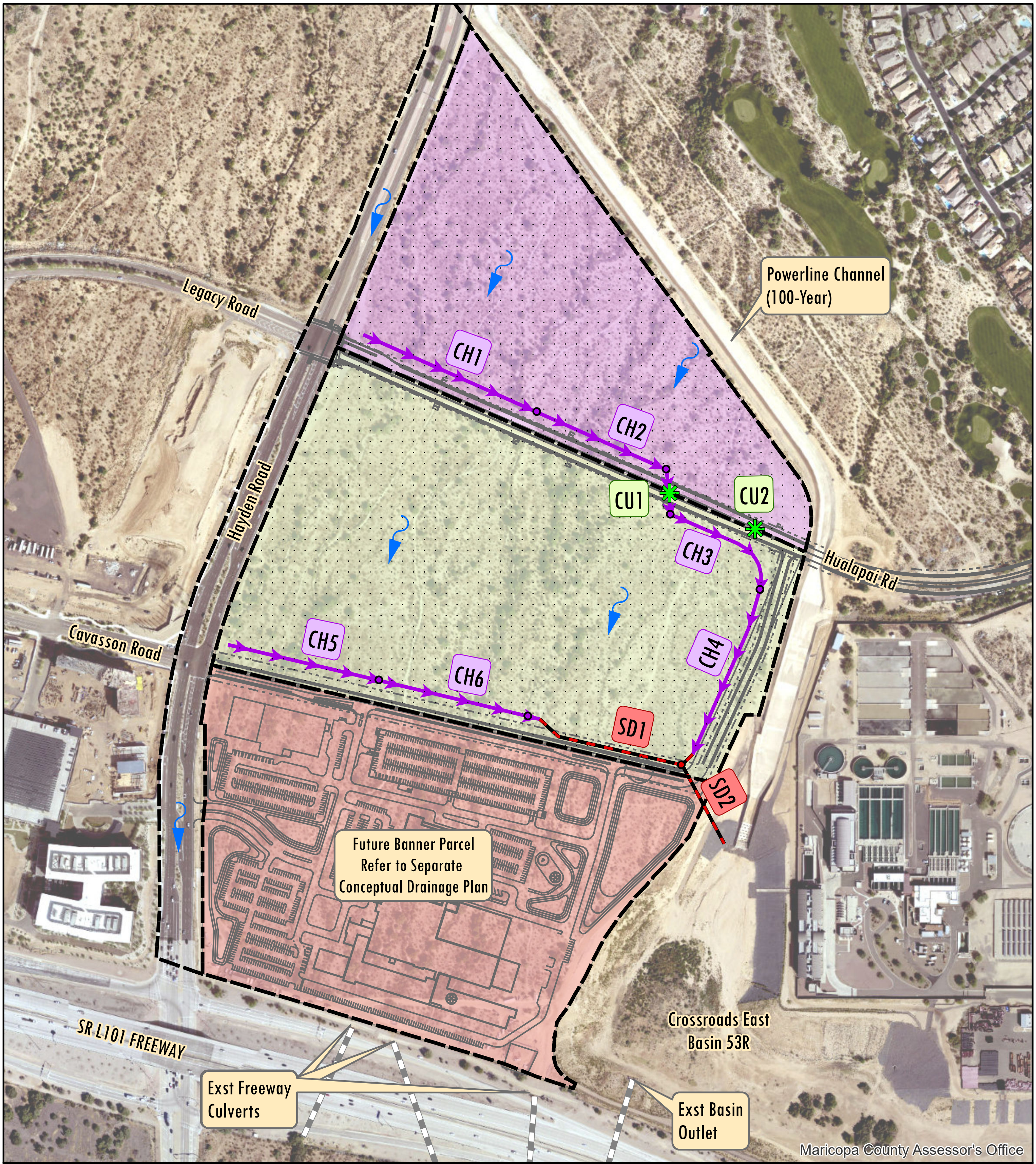
The planning level estimated infrastructure cost for this alternative, including an estimate of land value, is $7.9M.

Advantages of Alternative 3 include:

- Efficient use of existing topographic grades for the area north of Hualapai Drive
- Hualapai Drive and Cavasson Road may be constructed at or near existing grade
- Future Parcel B-1 is not subdivided

Disadvantages of Alternative 3 include:

- Higher land requirement than Alternative 1
- More utility crossings than Alternative 1



UNIT 9 MASTER DRAINAGE PLAN
FIGURE 4 - ALTERNATIVE 3

DIBBLE

- Study Area & Major Drng Boundaries
- Future Banner Parcel
- Future B-1 Parcel
- Future C-1 Parcel
- Conveyance Channel
- Storm Drain
- Culvert Crossing Location
- First Flush Storage Requirement

0 250 500 Feet

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Table 3

Planning Unit 9 Master Drainage Plan
Alternative 3 Infrastructure Data Sheet

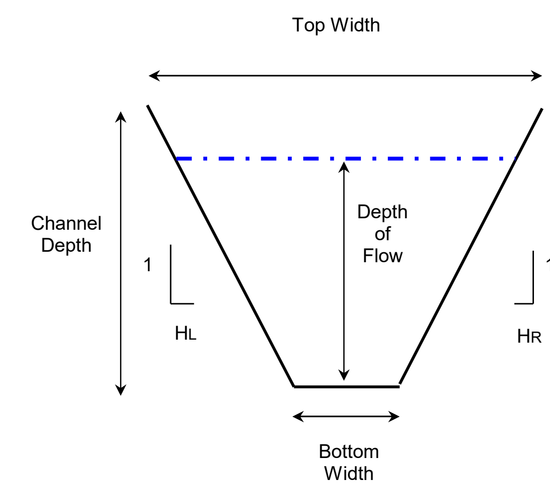
Channel Properties

Plan ID	Design Q100 (cfs)	Downstream Invert Elevation (ft)	Upstream Invert Elevation (ft)	Length (ft.)	Design Invert Slope (ft./ft.)	Material Type	Manning's "n" Value	Bottom Width, W (ft.)	Depth of Flow(ft.)	Sideslope (H:1) Left (HL)	Sideslope (H:1) Right (HR)	Left Access Road Width (ft)	Right Access Road Width (ft)	Number of Drop Structures	Drop Structure Height (ft)	Fence Length (ft)	Area (sf.)	Wetted Perimeter (ft.)	Froude Number	Type of Flow	Velocity (fps)	Freeboard (ft.)	Design Depth (ft)	Channel Topwidth (ft)	Total ROW Width Required (ft)
A3_CH1	44	49.75	51	419	0.0030	LLE	0.035	4	1.7	4	4	14	4985	0	0.0	n/a	18.6	18.1	0.41	Sub	2.4	1.0	2.7	46	60
A3_CH2	113	47.5	49.75	926	0.0024	LLE	0.035	10	2.2	4	4	14	11014	0	0.0	n/a	41.8	28.3	0.39	Sub	2.7	1.0	3.2	60	74
A3_CH3	113	46.31	47.15	420	0.0020	LLE	0.035	10	2.3	4	4	14	4996	0	0.0	n/a	44.7	29.1	0.36	Sub	2.5	1.0	3.3	57	71
A3_CH4	119	32.32	46.31	807	0.0173	LE	0.045	10	2.3	4	4	14	9601	6	1.8	n/a	43.3	28.7	0.39	Sub	2.7	1.0	3.3	64	78
A3_CH5	59	27.77	28.58	540	0.0015	LLE	0.035	5	2.2	4	4	14	6426	0	0.0	n/a	30.1	23.1	0.30	Sub	2.0	1.0	3.2	57	71
A3_CH6	139	26.9	27.77	580	0.0015	S	0.022	9	2.6	2	2	14	6902	0	0.0	n/a	36.2	20.4	0.49	Sub	3.8	1.0	3.6	42	56

Channel Material Type: NV = Natural Vegetation, C = Concrete, R = Riprap, GR = Grass, E = Natural or Earth, LE = Landscaped Earth, LLE = Light Landscaped Earth

Culvert Properties

I.D.	Design Q100 (cfs)	Length (ft.)	Inlet Inv. (ft.)	Outlet Inv. (ft.)	Slope (ft./ft.)	Number of Barrels	Culvert Span (ft.)	Culvert Dia./ Height (ft.)	Barrel/ Material	Manning's "n" Value	Entrance (Wingwall, Headwall or Project)	Tailwater Depth (ft.)	Computed Headwater	Computed HW/D
ALT3_CU1	119	118	1647.50	1647.15	0.0030	3	-	3	CONC	0.013	Headwall	2.27	3.23	1.08
ALT3_CU2	15.3	123	1649.09	1647.46	0.0130	1	-	2	CONC	0.013	Headwall	2.30	1.09	0.55



Typical Channel Section

Utility Crossings

Plan ID	Water	Sewer	Fiber Optic
A3_CH1	0	0	0
A3_CH2	2	2	0
A3_CH3	0	0	0
A3_CH4	0	0	0
A3_CH5	0	0	0
A3_CH6	0	0	0
SD1	0	0	0
SD2	0	0	0

Storm Drain Properties

Alternative Element ID	Length (ft)	Number of Pipes	Diameter (in)	Manning's N Value	Design Storm	QDesign (cfs)	QFull (cfs)	Velocity (ft/s)	Friction Slope (ft/ft)	Trunkline Manholes	Length of Lateral Pipe (ft)	No. of Catch Basins	No. of Junction Structures	No. of Outfall Headwalls
SD1	287	1	78	0.015	100YR	298	287	9.0	0.0040	2	36	4	0	1
SD2	613	1	66	0.015	100YR	187	184	7.9	0.0040	2	0	0	0	1

5. Summary & Next Steps

Land requirements and preliminary costs of each alternative are summarized in the following table. As noted in Section 4.1, Alternative 1 will likely require the elevating of Hualapai Road to provide an elevation at or about the existing bank of the Powerline Channel. This will, in turn, require that the adjacent development provide fill to meet the new roadway elevation. This is likely to be a significant cost that is not captured in estimates here and should be considered in selecting an alternative.

Once Arizona State Land Department has reviewed this information and selected a preferred alternative, a Master Drainage Report will be prepared for Planning Unit 9 and submitted to the City of Scottsdale as part of the requirements for design board review of the Banner Scottsdale Campus project. Additionally, the interim treatment of runoff reaching Cavasson Road can be addressed for the future Banner parcel with knowledge of the Master Drainage Plan.

Table 4 – Alternatives Summary

Alternative	Infrastructure Cost	Required Land Area	Estimated Land Value	Total Cost
1	$3.6M	4.0 Acres	$3.4M	$7.0M
2	$2.9M	6.5 Acres	$5.7M	$8.6M
3	$2.8M	5.9 Acres	$5.1M	$7.9M

Appendix B FEMA Flood Insurance Rate Map

NOTES TO USERS

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

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

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

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

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

The **projection** used in the preparation of this map was Arizona State Plane Central zone (FIPSZONE 0202). The **horizontal datum** was NAD 83 HARN, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988 (NAVD 88). These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. Map users wishing to obtain flood elevations referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29) may use the following Maricopa County website application: http://www.fcd.maricopa.gov/Maps/gismaps/apps/gdacs/application/index.cfm

This web tool allows users to obtain point-specific datum conversion values by zooming in and hovering over a VERTCON checkbox on the layers menu on the left side of the screen. The VERTCON grid referenced in this web application was also used to convert existing flood elevations from NGVD 29 to NAVD 88.

To obtain current elevation, description, and/or location information for National Geodetic Survey 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. To obtain information about Geodetic Densification and Cadastral Survey bench marks produced by the Maricopa County Department of Transportation, please visit the Flood Control District of Maricopa County website at:
http://www.fcd.maricopa.gov/Maps/gismaps/apps/gdacs/application/index.cfm.

Base map information shown on this FIRM was derived from multiple sources. Aerial imagery was provided in digital format by the Maricopa County Department of Public Works, Flood Control District. The imagery is dated October 2009 to November 2009. Additional National Agricultural Imagery Program (NAIP) imagery was provided by the Arizona State Land Department (ALRIS) and is dated 2007. The coordinate system used for the production of the digital FIRM is State Plane Arizona Central NAD83 HARN, International Feet.

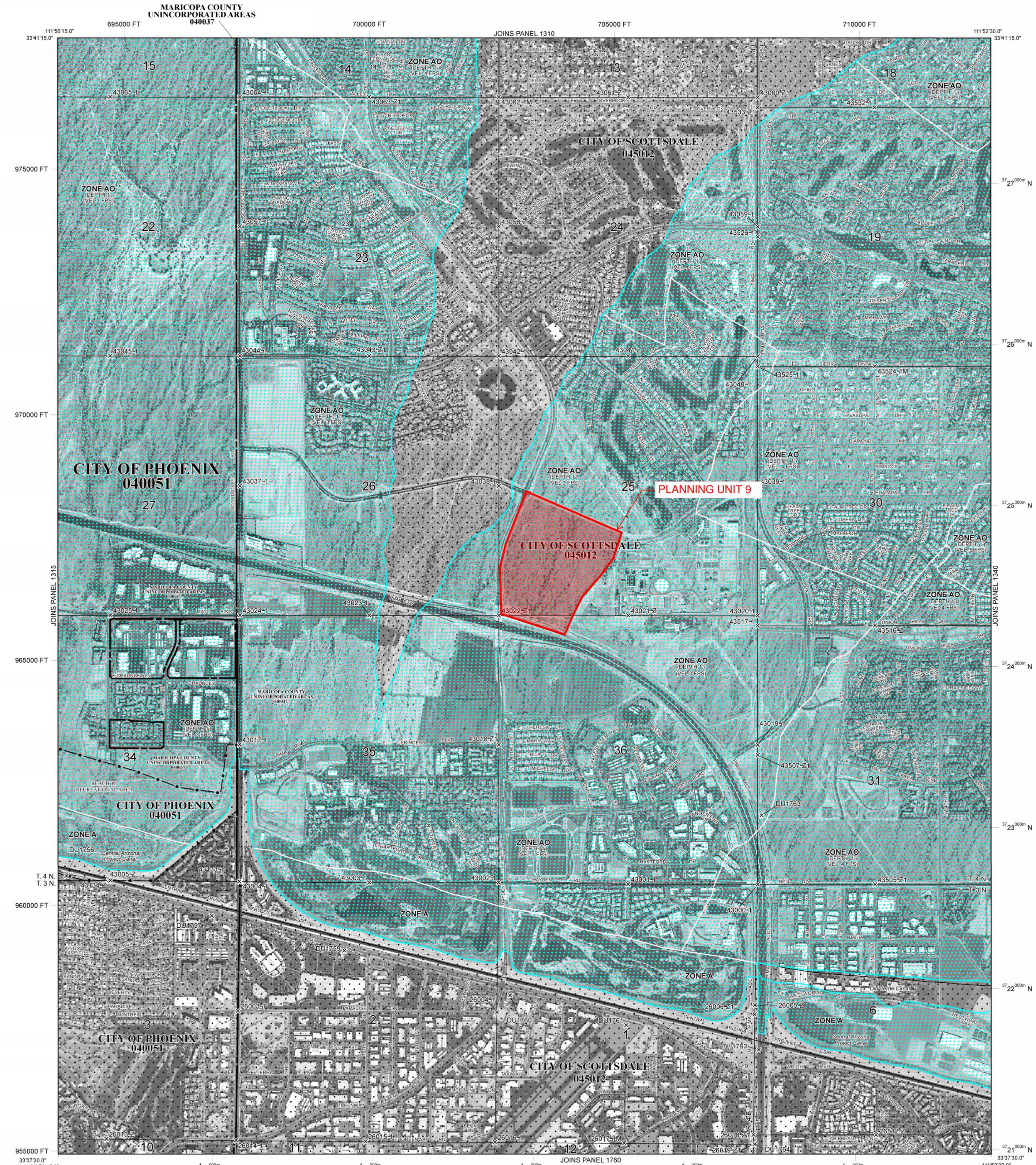
The **profile base line** depicted on this map represents the hydraulic modeling baselines that match flood profiles in the FIS report. As a result of improved topographic data, the profile base line, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

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

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

For Information on available products associated with this FIRM, visit the **FEMA 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, 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/.



LEGEND

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

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

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	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 encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

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

OTHER AREAS

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

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
0.2% annual chance floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 - - - 23	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
$^{42}75^{000m}$N	1000-meter Universal Transverse Mercator grid ticks, zone 12
6000000 M	5000-foot grid ticks: Arizona State Plane coordinate system, central zone (FIPSZONE 0202), Transverse Mercator
DX5510	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
April 15, 1988

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
December 3, 1993 September 30, 1995 July 19, 2001 September 30, 2005
October 16, 2013 –to add base flood elevation, to add special flood hazard areas, to incorporate previously issued letters of map revision, to add roads and road names, to update corporate limits, to change floodway, to advance suffix, to change base flood elevations, and to add floodway.

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

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

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

PANEL 1320L

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 1320 OF 4425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	1320	L
PHOENIX, CITY OF	040051	1320	L
SCOTTSDALE, CITY OF	045012	1320	L

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
04013C1320L

MAP REVISED
OCTOBER 16, 2013

Federal Emergency Management Agency

5-ZN-2022
9/20/2022

PLANNING UNIT 9 MASTER DRAINAGE PLAN
EXISTING CONDITION

DIBBLE

Study Area Boundary
Powerline Channel
Topographic Index Contour (5 ft Interval)
Topographic Contour (1 ft Interval)

0 150 300
Feet

5-ZN-2022
9/20/2022

Appendix C Subbasin Parameter Calculations

BANNER SCOTTSDALE CAMPUS
EXHIBIT C-1 - SUBBASIN MAP

DIBBLE

Subbasins

Time of Concentration Flow Path

1-Foot Topographic Contours

0 350 700 Feet

5-ZN-2022
9/20/2022

BANNER SCOTTSDALE CAMPUS
EXHIBIT C-3 - LAND USE

DIBBLE

Subbasins
2001 - Desert Landscaping / Graded Natural
2002 - Pavement
300 - General Industrial
400 - Institutional / General Office

0 350 700 Feet

5-ZN-2022
9/20/2022

BANNER SCOTTSDALE CAMPUS
EXHIBIT C-4 - SOILS

DIBBLE

Subbasins
64555 - Gilman Loams
64590 - Momoli Gravelly Sandy Loam, 1 to 5 pcf Slopes

0 350 700 Feet

5-ZN-2022
9/20/2022

RAINFALL DATA
Project Reference: BANNER SCOTTS MP 6HR

ID	Method	Duration	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
DEFAULT	CUSTOM	5 MIN	0.262	0.354	0.424	0.517	0.589	0.662
	CUSTOM	10 MIN	0.399	0.538	0.645	0.787	0.896	1.010
	CUSTOM	15 MIN	0.494	0.666	0.799	0.976	1.110	1.250
	CUSTOM	30 MIN	0.665	0.897	1.080	1.310	1.500	1.680
	CUSTOM	1 HOUR	0.823	1.110	1.330	1.630	1.850	2.080
	CUSTOM	2 HOUR	0.953	1.270	1.510	1.840	2.090	2.340
	CUSTOM	3 HOUR	1.040	1.350	1.610	1.960	2.230	2.520
	CUSTOM	6 HOUR	1.230	1.570	1.840	2.200	2.490	2.790
	CUSTOM	12 HOUR	1.400	1.760	2.050	2.440	2.740	3.050
	CUSTOM	24 HOUR	1.660	2.150	2.530	3.080	3.510	3.960

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetation Cover (%)	DTHETA	Kb	Description
Major Basin ID: 01									
B1-C	400	0.0335	100.0	0.10	80	75.0	NORMAL	0.032	Office General (Office where no detail available)
		0.0335	**100.0**						
B1-E	400	0.0204	100.0	0.10	80	75.0	NORMAL	0.033	Office General (Office where no detail available)
		0.0204	**100.0**						
B1-W	400	0.0233	100.0	0.10	80	75.0	NORMAL	0.033	Office General (Office where no detail available)
		0.0233	**100.0**						
BAN-CE	400	0.0138	100.0	0.10	80	75.0	NORMAL	0.034	Office General (Office where no detail available)
		0.0138	**100.0**						
BAN-NE	400	0.0197	100.0	0.10	80	75.0	NORMAL	0.033	Office General (Office where no detail available)
		0.0197	**100.0**						
BAN-NW	2002	0.0002	1.2	0.05	95	0.0	DRY	0.034	Pavement and Rooftops
	400	0.0171	98.8	0.10	80	75.0	NORMAL	0.034	Office General (Office where no detail available)
		0.0173	**100.0**						
BAN-SE	400	0.0120	100.0	0.10	80	75.0	NORMAL	0.034	Office General (Office where no detail available)
		0.0120	**100.0**						
BAN-SW	2002	0.0005	4.1	0.05	95	0.0	DRY	0.034	Pavement and Rooftops
	400	0.0116	95.9	0.10	80	75.0	NORMAL	0.034	Office General (Office where no detail available)
		0.0121	**100.0**						
C1-C	400	0.0290	100.0	0.10	80	75.0	NORMAL	0.032	Office General (Office where no detail available)
		0.0290	**100.0**						
C1-E	400	0.0046	100.0	0.10	80	75.0	NORMAL	0.037	Office General (Office where no detail available)

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetation Cover (%)	DTHETA	Kb	Description

Major Basin ID: 01

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetation Cover (%)	DTHETA	Kb	Description
		0.0046	**100.0**						
C1-W	400	0.0194	100.0	0.10	80	75.0	NORMAL	0.033	Office General (Office where no detail available)
		0.0194	**100.0**						
HAYDEN	2002	0.0191	100.0	0.05	95	0.0	DRY	0.033	Pavement and Rooftops
		0.0191	**100.0**						
SB02	300	0.0721	100.0	0.15	55	60.0	NORMAL	0.030	General Industrial (Industrial where no detail available)
		0.0721	**100.0**						
SB03	300	0.1114	100.0	0.15	55	60.0	NORMAL	0.028	General Industrial (Industrial where no detail available)
		0.1114	**100.0**						
SB04	2001	0.0790	97.9	0.20	0	30.0	NORMAL	0.029	Landscaping w/o impervious under treatment
	400	0.0017	2.1	0.10	80	75.0	NORMAL	0.029	Office General (Office where no detail available)
		0.0807	**100.0**						

Area ID	Book Number	Map Unit	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)	Comments

Major Basin ID: 01

Area ID	Book Number	Map Unit	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)	Comments
B1-C	645	90	64590	0.034	100.00	0.390	-	100	
B1-E	645	90	64590	0.020	100.00	0.390	-	100	
B1-W	645	90	64590	0.023	100.00	0.390	-	100	
BAN-CE	645	90	64590	0.014	100.00	0.390	-	100	
BAN-NE	645	90	64590	0.020	100.00	0.390	-	100	
BAN-NW	645	90	64590	0.017	100.00	0.390	-	100	
BAN-SE	645	90	64590	0.012	100.00	0.390	-	100	
BAN-SW	645	55	64555	0.004	35.50	0.270	-	100	
	645	90	64590	0.008	64.50	0.390	-	100	
C1-C	645	90	64590	0.029	100.00	0.390	-	100	
C1-E	645	90	64590	0.005	100.00	0.390	-	100	
C1-W	645	90	64590	0.019	100.00	0.390	-	100	
HAYDEN	645	55	64555	0.002	9.40	0.270	-	100	
	645	90	64590	0.017	90.60	0.390	-	100	
SB02	645	90	64590	0.072	100.00	0.390	-	100	
SB03	645	55	64555	0.024	21.70	0.270	-	100	
	645	90	64590	0.087	78.30	0.390	-	100	
SB04	645	90	64590	0.081	100.00	0.390	-	100	

Major Basin ID: 01

Area ID	Sub Basin Parameters						Rainfall Losses						Return Period Parameters					
	Area (sq mi)	Length (mi)	Slope (ft/mi)	Adj Slope	Time-Area	Kb	IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)		2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
B1-C	0.034	0.28	73.9	73.9	Urban	0.032	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.279	0.251	0.235	0.218	0.207	0.198
												Vel (f/s)	1.47	1.64	1.75	1.88	1.98	2.07
												R (Hrs)	0.223	0.198	0.184	0.169	0.160	0.152
SB02	0.072	0.40	73.4	73.4	Urban	0.030	0.15	0.25	4.03	0.608	55	**Tc (Hrs)**	0.362	0.317	0.293	0.270	0.255	0.242
												Vel (f/s)	1.62	1.85	2.00	2.17	2.30	2.42
												R (Hrs)	0.258	0.223	0.204	0.186	0.175	0.165
BAN-CE	0.014	0.13	61.1	61.1	Urban	0.034	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.208	0.187	0.175	0.163*	0.154*	0.147 *
												Vel (f/s)	0.92	1.02	1.09	1.17	1.24	1.30
												R (Hrs)	0.144	0.128	0.119	0.110	0.104	0.098
B1-E	0.020	0.26	77.5	77.5	Urban	0.033	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.269	0.242	0.226	0.210	0.200	0.191
												Vel (f/s)	1.42	1.58	1.69	1.82	1.91	2.00
												R (Hrs)	0.273	0.242	0.225	0.207	0.196	0.186
SB03	0.111	0.54	37.0	37.0	Urban	0.028	0.15	0.25	4.17	0.563	55	**Tc (Hrs)**	0.499	0.438	0.405	0.373	0.352	0.334
												Vel (f/s)	1.59	1.81	1.96	2.12	2.25	2.37
												R (Hrs)	0.366	0.317	0.290	0.265	0.248	0.234
B1-W	0.023	0.27	82.4	82.4	Urban	0.033	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.269	0.242	0.226	0.210	0.200	0.191
												Vel (f/s)	1.47	1.64	1.75	1.89	1.98	2.07
												R (Hrs)	0.260	0.231	0.214	0.197	0.187	0.177
SB04	0.081	0.43	73.7	73.7	Urban	0.029	0.20	0.25	4.03	0.480	2	**Tc (Hrs)**	0.554	0.417	0.367	0.324	0.299	0.277
												Vel (f/s)	1.14	1.51	1.72	1.95	2.11	2.28
												R (Hrs)	0.410	0.299	0.260	0.226	0.207	0.190
BAN-NE	0.020	0.22	63.1	63.1	Urban	0.033	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.264	0.237	0.222	0.206	0.196	0.187
												Vel (f/s)	1.22	1.36	1.45	1.57	1.65	1.73
												R (Hrs)	0.233	0.207	0.193	0.178	0.168	0.159
BAN-N W	0.017	0.17	87.2	87.2	Urban	0.034	0.10	0.25	4.03	0.667	80	**Tc (Hrs)**	0.213	0.192	0.179	0.166*	0.158*	0.151 *
												Vel (f/s)	1.17	1.30	1.39	1.50	1.58	1.65
												R (Hrs)	0.164	0.146	0.136	0.125	0.118	0.112

* Non default value or value out of range

5-ZN-2022
9/20/2022

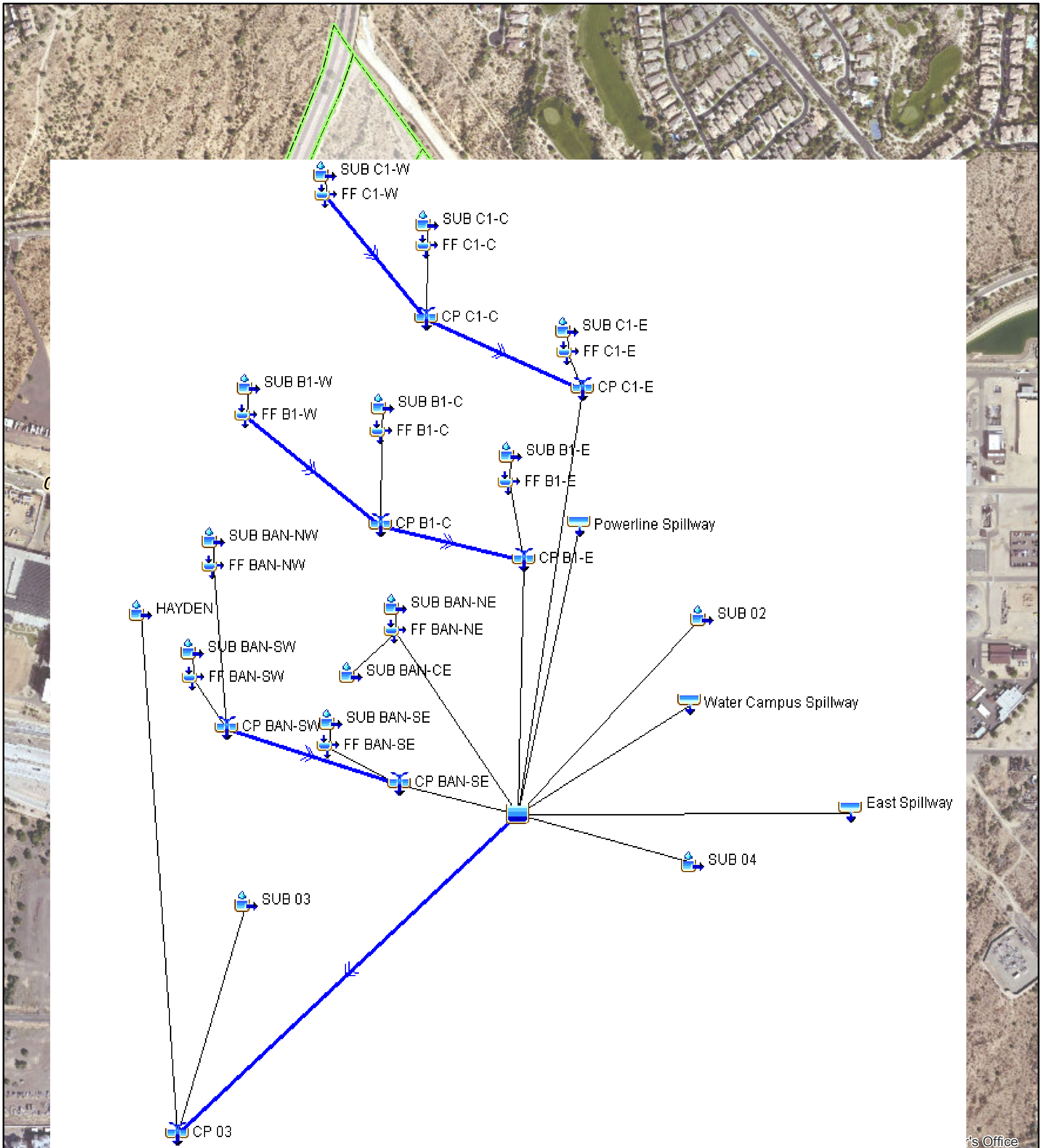
Area ID	Area (sq mi)	Length (mi)	Slope (ft/mi)	Adj Slope	Time-Area	Kb	IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)		2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
	Sub Basin Parameters						Rainfall Losses						Return Period Parameters					
Major Basin ID: 01																		
BAN-SE	0.012	0.16	61.7	61.7	Urban	0.034	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.230	0.207	0.194	0.180	0.171	0.163 *
												Vel (f/s)	1.02	1.13	1.21	1.30	1.37	1.44
												R (Hrs)	0.208	0.185	0.172	0.158	0.149	0.142
BAN-SW	0.012	0.12	108.3	108.3	Urban	0.034	0.10	0.25	4.28	0.580	81	**Tc (Hrs)**	0.166*	0.150*	0.140*	0.130*	0.124*	0.118 *
												Vel (f/s)	1.06	1.17	1.26	1.35	1.42	1.49
												R (Hrs)	0.115	0.102	0.095	0.088	0.083	0.079
C1-C	0.029	0.23	88.5	88.5	Urban	0.032	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.239	0.215	0.201	0.187	0.177	0.169
												Vel (f/s)	1.41	1.57	1.68	1.80	1.91	2.00
												R (Hrs)	0.175	0.156	0.145	0.133	0.126	0.120
C1-E	0.005	0.08	119.0	119.0	Urban	0.037	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.139*	0.125*	0.117*	0.108*	0.103*	0.098 *
												Vel (f/s)	0.84	0.94	1.00	1.09	1.14	1.20
												R (Hrs)	0.112	0.100	0.093	0.085	0.081	0.077
C1-W	0.019	0.28	90.9	90.9	Urban	0.033	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.266	0.239	0.224	0.208	0.197	0.188
												Vel (f/s)	1.54	1.72	1.83	1.97	2.08	2.18
												R (Hrs)	0.294	0.261	0.243	0.223	0.211	0.201
HAYDEN	0.019	0.75	91.2	91.2	Urban	0.033	0.05	0.35	4.08	0.377	95	**Tc (Hrs)**	0.409	0.372	0.350	0.327	0.311	0.298
												Vel (f/s)	2.69	2.96	3.14	3.36	3.54	3.69
												R (Hrs)	1.045	0.940	0.878	0.813	0.771	0.734

Area ID	Area (sq mi)	Length (mi)	Slope (ft/mi)	Adj Slope	Time-Area	Kb	IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)		2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
Sub Basin Parameters							Rainfall Losses					Return Period Parameters						
Major Basin ID: 01																		
B1-C	0.034	0.28	73.9	73.9	Urban	0.032	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.303	0.270	0.252	0.233	0.220	0.209
												Vel (f/s)	1.36	1.52	1.63	1.76	1.87	1.96
												R (Hrs)	0.244	0.215	0.199	0.182	0.171	0.162
BAN-CE	0.014	0.13	61.1	61.1	Urban	0.034	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.226	0.202	0.188	0.174	0.164*	0.156 *
												Vel (f/s)	0.84	0.94	1.01	1.10	1.16	1.22
												R (Hrs)	0.158	0.139	0.129	0.118	0.111	0.105
B1-E	0.020	0.26	77.5	77.5	Urban	0.033	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.292	0.261	0.244	0.225	0.213	0.202
												Vel (f/s)	1.31	1.46	1.56	1.69	1.79	1.89
												R (Hrs)	0.299	0.264	0.244	0.223	0.210	0.198
B1-W	0.023	0.27	82.4	82.4	Urban	0.033	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.292	0.261	0.244	0.225	0.213	0.202
												Vel (f/s)	1.36	1.52	1.62	1.76	1.86	1.96
												R (Hrs)	0.285	0.251	0.232	0.212	0.200	0.189
BAN-NE	0.020	0.22	63.1	63.1	Urban	0.033	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.287	0.256	0.239	0.220	0.208	0.198
												Vel (f/s)	1.12	1.26	1.35	1.47	1.55	1.63
												R (Hrs)	0.256	0.226	0.209	0.191	0.180	0.170
BAN-N W	0.017	0.17	87.2	87.2	Urban	0.034	0.10	0.25	4.03	0.667	80	**Tc (Hrs)**	0.232	0.207	0.193	0.178	0.168	0.160 *
												Vel (f/s)	1.07	1.20	1.29	1.40	1.48	1.56
												R (Hrs)	0.180	0.159	0.147	0.134	0.127	0.120
BAN-SE	0.012	0.16	61.7	61.7	Urban	0.034	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.250	0.223	0.208	0.192	0.182	0.173
												Vel (f/s)	0.94	1.05	1.13	1.22	1.29	1.36
												R (Hrs)	0.228	0.201	0.186	0.170	0.160	0.151
BAN-S W	0.012	0.12	108.3	108.3	Urban	0.034	0.10	0.25	4.28	0.580	81	**Tc (Hrs)**	0.180	0.161*	0.151*	0.139*	0.132*	0.125 *
												Vel (f/s)	0.98	1.09	1.17	1.27	1.33	1.41
												R (Hrs)	0.126	0.111	0.103	0.094	0.089	0.084
C1-C	0.029	0.23	88.5	88.5	Urban	0.032	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.260	0.232	0.216	0.200	0.189	0.179
												Vel (f/s)	1.30	1.45	1.56	1.69	1.78	1.88
												R (Hrs)	0.192	0.170	0.157	0.144	0.135	0.128

* Non default value or value out of range

Area ID	Sub Basin Parameters: Area (sq mi)	Length (mi)	Slope (ft/mi)	Adj Slope	Time-Area	Kb	Rainfall Losses: IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)	Return Period Parameters	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
Major Basin ID: 01																		
C1-E	0.005	0.08	119.0	119.0	Urban	0.037	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.151*	0.134*	0.126*	0.116*	0.110*	0.104 *
												Vel (f/s)	0.78	0.88	0.93	1.01	1.07	1.13
												R (Hrs)	0.123	0.108	0.100	0.092	0.086	0.082
SB02	0.072	0.40	73.4	73.4	URBAN	0.030	0.15	0.25	4.03	0.608	55	**Tc (Hrs)**	0.395	0.342	0.316	0.288	0.270	0.254
												Vel (f/s)	1.49	1.72	1.86	2.04	2.17	2.31
												R (Hrs)	0.284	0.242	0.221	0.200	0.186	0.174
C1-W	0.019	0.28	90.9	90.9	Urban	0.033	0.10	0.25	4.03	0.671	80	**Tc (Hrs)**	0.289	0.258	0.241	0.222	0.210	0.200
												Vel (f/s)	1.42	1.59	1.70	1.85	1.96	2.05
												R (Hrs)	0.322	0.284	0.263	0.241	0.226	0.214
SB03	0.111	0.54	37.0	37.0	URBAN	0.028	0.15	0.25	4.17	0.563	55	**Tc (Hrs)**	0.544	0.472	0.436	0.397	0.372	0.351
												Vel (f/s)	1.46	1.68	1.82	1.99	2.13	2.26
												R (Hrs)	0.402	0.344	0.315	0.284	0.264	0.248
HAYDEN	0.019	0.75	91.2	91.2	Urban	0.033	0.05	0.35	4.08	0.377	95	**Tc (Hrs)**	0.444	0.401	0.377	0.349	0.332	0.316
												Vel (f/s)	2.48	2.74	2.92	3.15	3.31	3.48
												R (Hrs)	1.142	1.021	0.952	0.874	0.826	0.785
SB04	0.081	0.43	73.7	73.7	URBAN	0.029	0.20	0.25	4.03	0.480	2	**Tc (Hrs)**	0.606*	0.446	0.393	0.338	0.308	0.285
												Vel (f/s)	1.04	1.41	1.60	1.87	2.05	2.21
												R (Hrs)	0.452	0.322	0.280	0.237	0.213	0.196

Appendix D HEC-HMS Calculations



BANNER SCOTTSDALE CAMPUS MASTER DRAINAGE PLAN
EXHIBIT D-1 ALTERNATIVE 1 HEC-HMS SCHEMATIC

DIBBLE

Subbasins	HEC-HMS Combine
HEC-HMS Inflow Hydrograph	HEC-HMS Divert
HEC-HMS Subbasin	HEC-HMS Route
HEC-HMS Storage Route	

N
0 350 700 Feet

5-ZN-2022
9/20/2022

Project: UNIT9_Ultimate_Alt1_100yr
Simulation Run: UNIT9_Ultimate_100yr6hr
Simulation Start: 31 December 2018, 24:00
Simulation End: 1 January 2019, 18:00

HMS Version: 4.9
Executed: 30 August 2022, 22:31

Global Parameter Summary - Subbasin

Area (MI^2)

Element Name	Area (MI^2)
SUB B1 - C	0.03
SUB B1 - W	0.02
SUB B1 - E	0.02
SUB C1 - C	0.03
SUB C1 - W	0.02
SUB C1 - E	0.01
SUB BAN - NW	0.02
SUB BAN - SW	0.01
SUB BAN - SE	0.01
SUB BAN - NE	0.02
Sub 04	0.08
Sub 02	0.07
Sub 03	0.11
Hayden	0.02
SUB BAN - CE	0.01

Downstream

Element Name	Downstream
SUB B1 - C	FF B1 - C
SUB B1 - W	FF B1 - W
SUB B1 - E	FF B1 - E
SUB C1 - C	FF C1 - C
SUB C1 - W	FF C1 - W
SUB C1 - E	FF C1 - E
SUB BAN - NW	FF BAN - NW
SUB BAN - SW	FF BAN - SW
SUB BAN - SE	FF BAN - SE
SUB BAN - NE	FF BAN - NE
Sub 04	Basin53R Route
Sub 02	Basin53R Route
Sub 03	Cp 03
Hayden	Cp 03
SUB BAN - CE	FF BAN - NE

Loss Rate: Green and Ampt

Element Name	Percent Impervious Area	Initial Variable	Moisture Deficit	Wetting Front Suction	Hydraulic Conductivity
SUB B1 - C	80	Moisture Deficit	0.25	4.03	0.39
SUB B1 - W	80	Moisture Deficit	0.25	4.03	0.39
SUB B1 - E	80	Moisture Deficit	0.25	4.03	0.39
SUB C1 - C	80	Moisture Deficit	0.25	4.03	0.39
SUB C1 - W	80	Moisture Deficit	0.25	4.03	0.39
SUB C1 - E	80	Moisture Deficit	0.25	4.03	0.39
SUB BAN - NW	80	Moisture Deficit	0.25	4.03	0.39
SUB BAN - SW	81	Moisture Deficit	0.25	4.28	0.34
SUB BAN - SE	80	Moisture Deficit	0.25	4.03	0.39
SUB BAN - NE	80	Moisture Deficit	0.25	4.03	0.39
Sub 04	2	Moisture Deficit	0.25	4.03	0.39
Sub 02	55	Moisture Deficit	0.25	4.03	0.39
Sub 03	55	Moisture Deficit	0.25	4.17	0.36
Hayden	95	Moisture Deficit	0.35	4.08	0.38
SUB BAN - CE	80	Moisture Deficit	0.25	4.03	0.39

Transform: Clark

Element Name	Clark Method	Time of Concentration	Storage Coefficient	Time Area Method	Time - Area Percentage Curve
SUB B1 - C	Specified	0.2	0.15	Paired Data	Developed
SUB B1 - W	Specified	0.19	0.18	Paired Data	Developed
SUB B1 - E	Specified	0.19	0.19	Paired Data	Developed
SUB C1 - C	Specified	0.17	0.12	Paired Data	Developed
SUB C1 - W	Specified	0.19	0.2	Paired Data	Developed
SUB C1 - E	Specified	0.1	0.08	Paired Data	Developed
SUB BAN - NW	Specified	0.15	0.11	Paired Data	Developed
SUB BAN - SW	Specified	0.12	0.08	Paired Data	Developed
SUB BAN - SE	Specified	0.16	0.14	Paired Data	Developed
SUB BAN - NE	Specified	0.19	0.16	Paired Data	Developed
Sub 04	Specified	0.28	0.19	Paired Data	Developed
Sub 02	Specified	0.24	0.17	Paired Data	Developed
Sub 03	Specified	0.33	0.23	Paired Data	Developed
Hayden	Specified	0.3	0.71	Paired Data	Developed
SUB BAN - CE	Specified	0.15	0.1	Paired Data	Developed

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
RT 53R - 03	Cp 03
RT C1C - C1E	CP C1 - E
RT C1W - C1C	CP C1 - C
RT B1W - B1C	CP B1 - C
RT SW - SE	CP BAN - SE
RT B1C - B1E	CP B1 - E

Route: Kinematic Wave

Element Name	Method	Channel	Length (FT)	Energy Slope (FT/FT)	Mannings n	Shape	Number of Subreaches	Width (FT)	Side Slope (FT/FT)	Initial Variable	Index Parameter Type	Inde Flov
RT 53R - 03	Kinematic Wave	Kinematic Wave	2918.61	0.01	0.02	Trapezoid	2	32	3	Combined Inflow	Index Flow	500

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9/20/2022

Route: Normal Depth

Element Name	Method	Channel	Length (FT)	Energy Slope (FT/FT)	Mannings n	Bottom Width (FT)	Side Slope (FT/FT)	Initial Variable	Index Flow
RT C1C - C1E	Normal Depth	Trapezoid	977	0	0.02	18	2	Combined Inflow	200
RT C1W - C1C	Normal Depth	Trapezoid	600	0	0.02	18	2	Combined Inflow	150
RT B1W - B1C	Normal Depth	Trapezoid	580	0	0.02	9	4	Combined Inflow	100
RT SW - SE	Normal Depth	Circular	1077	0	0.01	Not Specified	Not Specified	Combined Inflow	100
RT B1C - B1E	Normal Depth	Circular	900	0	0.01	Not Specified	Not Specified	Combined Inflow	300

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
SUB B1 - C	0.03	86.74	01Jan2019, 04:03	2.48
SUB B1 - W	0.02	55.95	01Jan2019, 04:03	2.48
CP B1 - C	0.06	138.43	01Jan2019, 04:03	1.96
SUB B1 - E	0.02	47.81	01Jan2019, 04:03	2.48
CP B1 - E	0.08	182.19	01Jan2019, 04:03	1.96
SUB C1 - C	0.03	78.61	01Jan2019, 04:03	2.48
SUB C1 - W	0.02	44.21	01Jan2019, 04:03	2.48
CP C1 - C	0.05	118.75	01Jan2019, 04:03	1.97
SUB C1 - E	0.01	15.31	01Jan2019, 04:00	2.48
CP C1 - E	0.05	119.01	01Jan2019, 04:06	1.98
SUB BAN - NW	0.02	46.98	01Jan2019, 04:00	2.48
SUB BAN - SW	0.01	36.5	01Jan2019, 04:00	2.5
CP BAN - SW	0.03	83.48	01Jan2019, 04:00	1.46
SUB BAN - SE	0.01	31.27	01Jan2019, 04:03	2.48
CP BAN - SE	0.04	116.9	01Jan2019, 04:00	1.61
SUB BAN - NE	0.02	50.41	01Jan2019, 04:03	2.48
Sub 04	0.08	141.24	01Jan2019, 04:06	1.15
Sub 02	0.07	163.92	01Jan2019, 04:03	2.06
East Spillway	Not specified	408.73	01Jan2019, 05:39	Not specified
Powerline Spillway	Not specified	2006.63	01Jan2019, 05:33	Not specified
Water Campus Spillway	Not specified	45.34	01Jan2019, 05:45	Not specified
Basin53R Route	Not specified	322.01	01Jan2019, 09:48	Not specified
RT 53R - 03	Not specified	322.01	01Jan2019, 09:54	Not specified
Sub 03	0.11	212.15	01Jan2019, 04:06	2.07
Hayden	0.02	24.57	01Jan2019, 04:09	2.71
Cp 03	Not specified	322.01	01Jan2019, 09:54	Not specified
RT C1C - C1E	0.05	110.5	01Jan2019, 04:06	1.97
RT C1W - C1C	0.02	42.15	01Jan2019, 04:06	1.97
RT B1W - B1C	0.02	53.43	01Jan2019, 04:06	1.95
RT SW - SE	0.03	86.41	01Jan2019, 04:00	1.46
RT B1C - B1E	0.06	135.95	01Jan2019, 04:06	1.96
SUB BAN - CE	0.01	40.12	01Jan2019, 04:00	2.48

Project: UNIT9_Ultimate_Alt1_100yr
Simulation Run: UNIT9_Ultimate_100yr24hr
Simulation Start: 31 December 2018, 24:00
Simulation End: 4 January 2019, 12:00

HMS Version: 4.9
Executed: 31 August 2022, 19:10

Global Parameter Summary - Subbasin

Area (MI^2)

Element Name	Area (MI^2)
SUB B1 - C	0.03
SUB B1 - W	0.02
SUB B1 - E	0.02
SUB C1 - C	0.03
SUB C1 - W	0.02
SUB C1 - E	0.01
SUB BAN - NW	0.02
SUB BAN - SW	0.01
SUB BAN - SE	0.01
SUB BAN - NE	0.02
Sub 04	0.08
Sub 02	0.07
Sub 03	0.11
Hayden	0.02
SUB BAN - CE	0.01

Downstream

Element Name	Downstream
SUB B1 - C	FF B1 - C
SUB B1 - W	FF B1 - W
SUB B1 - E	FF B1 - E
SUB C1 - C	FF C1 - C
SUB C1 - W	FF C1 - W
SUB C1 - E	FF C1 - E
SUB BAN - NW	FF BAN - NW
SUB BAN - SW	FF BAN - SW
SUB BAN - SE	FF BAN - SE
SUB BAN - NE	FF BAN - NE
Sub 04	Basin53R Route
Sub 02	Basin53R Route
Sub 03	Cp 03
Hayden	Cp 03
SUB BAN - CE	FF BAN - NE

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Loss Rate: Green and Ampt

Element Name	Percent Impervious Area	Initial Variable	Moisture Deficit	Wetting Front Suction	Hydraulic Conductivity
SUB B1 - C	80	Moisture Deficit	0.25	4.03	0.39
SUB B1 - W	80	Moisture Deficit	0.25	4.03	0.39
SUB B1 - E	80	Moisture Deficit	0.25	4.03	0.39
SUB C1 - C	80	Moisture Deficit	0.25	4.03	0.39
SUB C1 - W	80	Moisture Deficit	0.25	4.03	0.39
SUB C1 - E	80	Moisture Deficit	0.25	4.03	0.39
SUB BAN - NW	80	Moisture Deficit	0.25	4.03	0.39
SUB BAN - SW	81	Moisture Deficit	0.25	4.28	0.34
SUB BAN - SE	80	Moisture Deficit	0.25	4.03	0.39
SUB BAN - NE	80	Moisture Deficit	0.25	4.03	0.39
Sub 04	2	Moisture Deficit	0.25	4.03	0.39
Sub 02	55	Moisture Deficit	0.25	4.03	0.39
Sub 03	55	Moisture Deficit	0.25	4.17	0.36
Hayden	95	Moisture Deficit	0.35	4.08	0.38
SUB BAN - CE	80	Moisture Deficit	0.25	4.03	0.39

Transform: Clark

Element Name	Clark Method	Time of Concentration	Storage Coefficient	Time Area Method	Time - Area Percentage Curve
SUB B1 - C	Specified	0.21	0.16	Paired Data	Developed
SUB B1 - W	Specified	0.2	0.19	Paired Data	Developed
SUB B1 - E	Specified	0.2	0.2	Paired Data	Developed
SUB C1 - C	Specified	0.18	0.13	Paired Data	Developed
SUB C1 - W	Specified	0.2	0.21	Paired Data	Developed
SUB C1 - E	Specified	0.1	0.08	Paired Data	Developed
SUB BAN - NW	Specified	0.16	0.12	Paired Data	Developed
SUB BAN - SW	Specified	0.12	0.08	Paired Data	Developed
SUB BAN - SE	Specified	0.17	0.15	Paired Data	Developed
SUB BAN - NE	Specified	0.2	0.17	Paired Data	Developed
Sub 04	Specified	0.28	0.2	Paired Data	Developed
Sub 02	Specified	0.25	0.17	Paired Data	Developed
Sub 03	Specified	0.33	0.25	Paired Data	Developed
Hayden	Specified	0.3	0.73	Paired Data	Developed
SUB BAN - CE	Specified	0.16	0.1	Paired Data	Developed

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
RT 53R - 03	Cp 03
RT C1C - C1E	CP C1 - E
RT B1C - B1E	CP B1 - E
RT C1W - C1C	CP C1 - C
RT B1W - B1C	CP B1 - C
RT SW - SE	CP BAN - SE

Route: Kinematic Wave

Element Name	Method	Channel	Length (FT)	Energy Slope (FT/FT)	Mannings n	Shape	Number of Subreaches	Width (FT)	Side Slope (FT/FT)	Initial Variable	Index Parameter Type	Inde Flov
RT 53R - 03	Kinematic Wave	Kinematic Wave	2918.61	0.01	0.02	Trapezoid	2	32	3	Combined Inflow	Index Flow	500

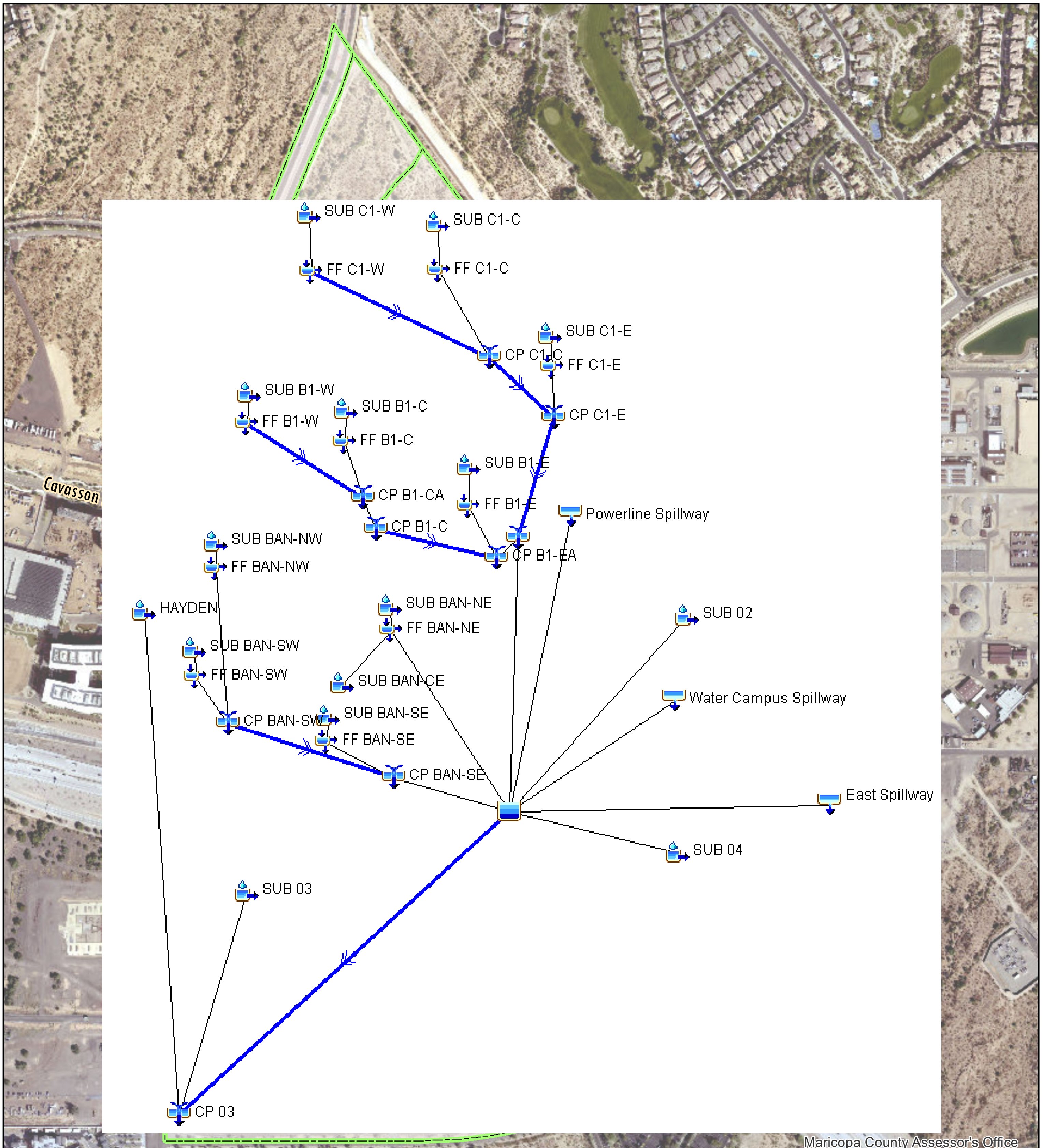
5-ZN-2022
9/20/2022

Route: Normal Depth

Element Name	Method	Channel	Length (FT)	Energy Slope (FT/FT)	Mannings n	Bottom Width (FT)	Side Slope (FT/FT)	Initial Variable	Index Flow
RT C1C - C1E	Normal Depth	Trapezoid	977	0	0.02	18	2	Combined Inflow	200
RT B1C - B1E	Normal Depth	Circular	900	0	0.01	Not Specified	Not Specified	Combined Inflow	300
RT C1W - C1C	Normal Depth	Trapezoid	600	0	0.02	18	2	Combined Inflow	150
RT B1W - B1C	Normal Depth	Trapezoid	580	0	0.04	9	4	Combined Inflow	100
RT SW - SE	Normal Depth	Circular	1085	0	0.01	Not Specified	Not Specified	Combined Inflow	100

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
SUB B1 - C	0.03	76.68	01Jan2019, 12:03	3.38
SUB B1 - W	0.02	49.33	01Jan2019, 12:03	3.38
CP B1 - C	0.06	121.42	01Jan2019, 12:03	2.87
SUB B1 - E	0.02	42.15	01Jan2019, 12:03	3.38
CP B1 - E	0.08	161	01Jan2019, 12:03	2.87
SUB C1 - C	0.03	71.8	01Jan2019, 12:00	3.38
SUB C1 - W	0.02	38.86	01Jan2019, 12:03	3.38
CP C1 - C	0.05	105.13	01Jan2019, 12:03	2.88
SUB C1 - E	0.01	14.35	01Jan2019, 11:57	3.38
CP C1 - E	0.05	105.21	01Jan2019, 12:06	2.88
SUB BAN - NW	0.02	43.38	01Jan2019, 12:00	3.38
SUB BAN - SW	0.01	33.76	01Jan2019, 11:57	3.42
CP BAN - SW	0.03	76.42	01Jan2019, 12:00	2.37
SUB BAN - SE	0.01	28.11	01Jan2019, 12:00	3.38
CP BAN - SE	0.04	116.8	01Jan2019, 12:00	2.52
SUB BAN - NE	0.02	44.53	01Jan2019, 12:03	3.38
Sub 04	0.08	124.52	01Jan2019, 12:06	1.04
Sub 02	0.07	145.59	01Jan2019, 12:03	2.64
East Spillway	Not specified	517.34	01Jan2019, 13:27	Not specified
Powerline Spillway	Not specified	2928.37	01Jan2019, 13:21	Not specified
Water Campus Spillway	Not specified	98.45	01Jan2019, 13:30	Not specified
Basin53R Route	Not specified	396.31	01Jan2019, 20:06	Not specified
RT 53R - 03	Not specified	396.31	01Jan2019, 20:12	Not specified
Sub 03	0.11	186.67	01Jan2019, 12:06	2.65
Hayden	0.02	21.26	01Jan2019, 12:09	3.82
Cp 03	Not specified	399.19	01Jan2019, 20:00	Not specified
RT C1C - C1E	0.05	97.93	01Jan2019, 12:06	2.88
RT B1C - B1E	0.06	118.85	01Jan2019, 12:03	2.87
RT C1W - C1C	0.02	36.93	01Jan2019, 12:06	2.87
RT B1W - B1C	0.02	46.31	01Jan2019, 12:06	2.86
RT SW - SE	0.03	88.69	01Jan2019, 12:00	2.37
SUB BAN - CE	0.01	37.14	01Jan2019, 12:00	3.38



BANNER SCOTTSDALE CAMPUS MASTER DRAINAGE PLAN
EXHIBIT D- 2 ALTERNATIVE 3 HEC-HMS SCHEMATIC

DIBBLE

Subbasins
HEC-HMS Inflow Hydrograph
HEC-HMS Subbasin
HEC-HMS Storage Route
HEC-HMS Combine
HEC-HMS Divert
HEC-HMS Route

0 350 700 Feet

5-ZN-2022
9/20/2022

Project: UNIT9_Ultimate_Alt3_100yr
Simulation Run: UNIT9_Ultimate_100yr6hr
Simulation Start: 31 December 2018, 24:00
Simulation End: 1 January 2019, 18:00

HMS Version: 4.9
Executed: 31 August 2022, 19:35

Global Parameter Summary - Subbasin

Area (MI^2)

Element Name	Area (MI^2)
SUB B1 - C	0.03
SUB B1 - W	0.02
SUB C1 - C	0.03
SUB C1 - E	0.01
SUB C1 - W	0.02
SUB B1 - E	0.02
SUB BAN - NW	0.02
SUB BAN - SW	0.01
SUB BAN - SE	0.01
SUB BAN - NE	0.02
Sub 04	0.08
Sub 02	0.07
Sub 03	0.11
Hayden	0.02
SUB BAN - CE	0.01

Downstream

Element Name	Downstream
SUB B1 - C	FF B1 - C
SUB B1 - W	FF B1 - W
SUB C1 - C	FF C1 - C
SUB C1 - E	FF C1 - E
SUB C1 - W	FF C1 - W
SUB B1 - E	FF B1 - E
SUB BAN - NW	FF BAN - NW
SUB BAN - SW	FF BAN - SW
SUB BAN - SE	FF BAN - SE
SUB BAN - NE	FF BAN - NE
Sub 04	Basin53R Route
Sub 02	Basin53R Route
Sub 03	Cp 03
Hayden	Cp 03
SUB BAN - CE	FF BAN - NE

Loss Rate: Green and Ampt

Element Name	Percent Impervious Area	Initial Variable	Moisture Deficit	Wetting Front Suction	Hydraulic Conductivity
SUB B1 - C	80	Moisture Deficit	0.25	4.03	0.39
SUB B1 - W	80	Moisture Deficit	0.25	4.03	0.39
SUB C1 - C	80	Moisture Deficit	0.25	4.03	0.39
SUB C1 - E	80	Moisture Deficit	0.25	4.03	0.39
SUB C1 - W	80	Moisture Deficit	0.25	4.03	0.39
SUB B1 - E	80	Moisture Deficit	0.25	4.03	0.39
SUB BAN - NW	80	Moisture Deficit	0.25	4.03	0.39
SUB BAN - SW	81	Moisture Deficit	0.25	4.28	0.34
SUB BAN - SE	80	Moisture Deficit	0.25	4.03	0.39
SUB BAN - NE	80	Moisture Deficit	0.25	4.03	0.39
Sub 04	0	Moisture Deficit	0.25	4.03	0.39
Sub 02	55	Moisture Deficit	0.25	4.03	0.39
Sub 03	55	Moisture Deficit	0.25	4.17	0.36
Hayden	95	Moisture Deficit	0.35	4.08	0.38
SUB BAN - CE	80	Moisture Deficit	0.25	4.03	0.39

Transform: Clark

Element Name	Clark Method	Time of Concentration	Storage Coefficient	Time Area Method	Time - Area Percentage Curve
SUB B1 - C	Specified	0.2	0.15	Paired Data	Developed
SUB B1 - W	Specified	0.19	0.18	Paired Data	Developed
SUB C1 - C	Specified	0.17	0.12	Paired Data	Developed
SUB C1 - E	Specified	0.1	0.08	Paired Data	Developed
SUB C1 - W	Specified	0.19	0.2	Paired Data	Developed
SUB B1 - E	Specified	0.19	0.19	Paired Data	Developed
SUB BAN - NW	Specified	0.15	0.11	Paired Data	Developed
SUB BAN - SW	Specified	0.12	0.08	Paired Data	Developed
SUB BAN - SE	Specified	0.16	0.14	Paired Data	Developed
SUB BAN - NE	Specified	0.19	0.16	Paired Data	Developed
Sub 04	Specified	0.28	0.19	Paired Data	Developed
Sub 02	Specified	0.24	0.17	Paired Data	Developed
Sub 03	Specified	0.33	0.23	Paired Data	Developed
Hayden	Specified	0.3	0.71	Paired Data	Developed
SUB BAN - CE	Specified	0.15	0.1	Paired Data	Developed

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
RT B1W - B1C	CP B1 - CA
RT C1E - B1E	CP B1 - E
RT C1W - C1C	CP C1 - C
RT C1C - C1E	CP C1 - E
RT B1C - B1E	CP B1 - EA
RT SW - SE	CP BAN - SE
RT 53R - 03	Cp 03

Route: Normal Depth

Element Name	Method	Channel	Length (FT)	Energy Slope (FT/FT)	Mannings n	Bottom Width (FT)	Side Slope (FT/FT)	Initial Variable	Index Flow
RT B1W - B1C	Normal Depth	Trapezoid	580	0	0.04	9	2	Combined Inflow	100
RT C1E - B1E	Normal Depth	Trapezoid	807	0	0.04	10	4	Combined Inflow	200
RT C1W - C1C	Normal Depth	Trapezoid	926	0	0.04	10	4	Combined Inflow	150
RT C1C - C1E	Normal Depth	Trapezoid	420	0	0.04	10	4	Combined Inflow	200
RT B1C - B1E	Normal Depth	Circular	614	0	0.01	Not Specified	Not Specified	Combined Inflow	300
RT SW - SE	Normal Depth	Circular	1077	0	0.01	Not Specified	Not Specified	Combined Inflow	100

Route: Kinematic Wave

Element Name	Method	Channel	Length (FT)	Energy Slope (FT/FT)	Mannings n	Shape	Number of Subreaches	Width (FT)	Side Slope (FT/FT)	Initial Variable	Index Parameter Type	Inde Flow
RT 53R - 03	Kinematic Wave	Kinematic Wave	2918.61	0.01	0.02	Trapezoid	2	32	3	Combined Inflow	Index Flow	500

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
SUB B1 - C	0.03	86.74	01Jan2019, 04:03	2.48
SUB B1 - W	0.02	55.95	01Jan2019, 04:03	2.48
RT B1W - B1C	0.02	53.19	01Jan2019, 04:06	1.95
CP B1 - CA	0.06	137.89	01Jan2019, 04:03	1.96
SUB C1 - C	0.03	78.61	01Jan2019, 04:03	2.48
SUB C1 - E	0.01	15.31	01Jan2019, 04:00	2.48
CP C1 - E	0.05	118.89	01Jan2019, 04:03	1.98
RT C1E - B1E	0.05	115.12	01Jan2019, 04:09	1.98
SUB C1 - W	0.02	44.21	01Jan2019, 04:03	2.48
RT C1W - C1C	0.02	40.62	01Jan2019, 04:09	1.97
CP C1 - C	0.05	113.07	01Jan2019, 04:03	1.97
RT C1C - C1E	0.05	109.56	01Jan2019, 04:06	1.97
CP B1 - C	0.06	137.89	01Jan2019, 04:03	1.96
RT B1C - B1E	0.06	135.45	01Jan2019, 04:03	1.96
SUB B1 - E	0.02	47.81	01Jan2019, 04:03	2.48
CP B1 - E	0.13	293	01Jan2019, 04:06	1.97
SUB BAN - NW	0.02	46.98	01Jan2019, 04:00	2.48
SUB BAN - SW	0.01	36.5	01Jan2019, 04:00	2.5
CP BAN - SW	0.03	83.48	01Jan2019, 04:00	1.46
RT SW - SE	0.03	86.41	01Jan2019, 04:00	1.46
SUB BAN - SE	0.01	26.06	01Jan2019, 04:03	2.48
CP BAN - SE	0.04	111.82	01Jan2019, 04:00	1.56
SUB BAN - NE	0.02	50.41	01Jan2019, 04:03	2.48
Sub 04	0.08	140.21	01Jan2019, 04:06	1.12

Sub 02	0.07	163.92	01Jan2019, 04:03	2.06
East Spillway	Not specified	408.73	01Jan2019, 05:39	Not specified
Powerline Spillway	Not specified	2006.63	01Jan2019, 05:33	Not specified
Water Campus Spillway	Not specified	45.34	01Jan2019, 05:45	Not specified
Basin53R Route	Not specified	321.92	01Jan2019, 09:48	Not specified
RT 53R - 03	Not specified	321.92	01Jan2019, 09:54	Not specified
Sub 03	0.11	212.15	01Jan2019, 04:06	2.07
Hayden	0.02	24.57	01Jan2019, 04:09	2.71
Cp 03	Not specified	321.92	01Jan2019, 09:54	Not specified
CP B1 - EA	0.08	183.26	01Jan2019, 04:03	1.96
SUB BAN - CE	0.01	40.12	01Jan2019, 04:00	2.48

Project: UNIT9_Ultimate_Alt3_100yr
Simulation Run: UNIT9_Ultimate_100yr24hr
Simulation Start: 31 December 2018, 24:00
Simulation End: 4 January 2019, 12:00

HMS Version: 4.9
Executed: 31 August 2022, 19:31

Global Parameter Summary - Subbasin

Area (MI²)

Element Name	Area (MI²)
SUB B1 - C	0.03
SUB B1 - W	0.02
SUB C1 - C	0.03
SUB C1 - W	0.02
SUB C1 - E	0.01
SUB B1 - E	0.02
SUB BAN - NW	0.02
SUB BAN - SW	0.01
SUB BAN - SE	0.01
SUB BAN - NE	0.02
Sub 04	0.08
Sub 02	0.07
Sub 03	0.11
Hayden	0.02
SUB BAN - CE	0.01

Downstream

Element Name	Downstream
SUB B1 - C	FF B1 - C
SUB B1 - W	FF B1 - W
SUB C1 - C	FF C1 - C
SUB C1 - W	FF C1 - W
SUB C1 - E	FF C1 - E
SUB B1 - E	FF B1 - E
SUB BAN - NW	FF BAN - NW
SUB BAN - SW	FF BAN - SW
SUB BAN - SE	FF BAN - SE
SUB BAN - NE	FF BAN - NE
Sub 04	Basin53R Route
Sub 02	Basin53R Route
Sub 03	Cp 03
Hayden	Cp 03
SUB BAN - CE	FF BAN - NE

Loss Rate: Green and Ampt

Element Name	Percent Impervious Area	Initial Variable	Moisture Deficit	Wetting Front Suction	Hydraulic Conductivity
SUB B1 - C	80	Moisture Deficit	0.25	4.03	0.39
SUB B1 - W	80	Moisture Deficit	0.25	4.03	0.39
SUB C1 - C	80	Moisture Deficit	0.25	4.03	0.39
SUB C1 - W	80	Moisture Deficit	0.25	4.03	0.39
SUB C1 - E	80	Moisture Deficit	0.25	4.03	0.39
SUB B1 - E	80	Moisture Deficit	0.25	4.03	0.39
SUB BAN - NW	80	Moisture Deficit	0.25	4.03	0.39
SUB BAN - SW	81	Moisture Deficit	0.25	4.28	0.34
SUB BAN - SE	80	Moisture Deficit	0.25	4.03	0.39
SUB BAN - NE	80	Moisture Deficit	0.25	4.03	0.39
Sub 04	2	Moisture Deficit	0.25	4.03	0.39
Sub 02	55	Moisture Deficit	0.25	4.03	0.39
Sub 03	55	Moisture Deficit	0.25	4.17	0.36
Hayden	95	Moisture Deficit	0.35	4.08	0.38
SUB BAN - CE	80	Moisture Deficit	0.25	4.03	0.39

Transform: Clark

Element Name	Clark Method	Time of Concentration	Storage Coefficient	Time Area Method	Time - Area Percentage Curve
SUB B1 - C	Specified	0.21	0.16	Paired Data	Developed
SUB B1 - W	Specified	0.2	0.19	Paired Data	Developed
SUB C1 - C	Specified	0.18	0.13	Paired Data	Developed
SUB C1 - W	Specified	0.2	0.21	Paired Data	Developed
SUB C1 - E	Specified	0.1	0.08	Paired Data	Developed
SUB B1 - E	Specified	0.2	0.2	Paired Data	Developed
SUB BAN - NW	Specified	0.16	0.12	Paired Data	Developed
SUB BAN - SW	Specified	0.12	0.08	Paired Data	Developed
SUB BAN - SE	Specified	0.17	0.15	Paired Data	Developed
SUB BAN - NE	Specified	0.2	0.17	Paired Data	Developed
Sub 04	Specified	0.28	0.2	Paired Data	Developed
Sub 02	Specified	0.25	0.17	Paired Data	Developed
Sub 03	Specified	0.35	0.25	Paired Data	Developed
Hayden	Specified	0.3	0.73	Paired Data	Developed
SUB BAN - CE	Specified	0.16	0.1	Paired Data	Developed

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
RT B1W - B1C	CP B1 - CA
RT C1W - C1C	CP C1 - C
RT C1E - C1C	CP B1 - E
RT C1C - BIC	CP C1 - E
RT B1C - B1E	CP B1 - EA
RT SW - SE	CP BAN - SE
RT 53R - 03	Cp 03

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Route: Normal Depth

Element Name	Method	Channel	Length (FT)	Energy Slope (FT/FT)	Mannings n	Bottom Width (FT)	Side Slope (FT/FT)	Initial Variable	Index Flow
RT B1W - B1C	Normal Depth	Trapezoid	580	0	0.04	9	2	Combined Inflow	100
RT C1W - C1C	Normal Depth	Trapezoid	926	0	0.04	10	4	Combined Inflow	150
RT C1E - C1C	Normal Depth	Trapezoid	807	0	0.04	10	4	Combined Inflow	200
RT C1C - BIC	Normal Depth	Trapezoid	420	0	0.04	10	4	Combined Inflow	200
RT B1C - B1E	Normal Depth	Circular	614	0	0.01	Not Specified	Not Specified	Combined Inflow	300
RT SW - SE	Normal Depth	Circular	1077	0	0.01	Not Specified	Not Specified	Combined Inflow	100

Route: Kinematic Wave

Element Name	Method	Channel	Length (FT)	Energy Slope (FT/FT)	Mannings n	Shape	Number of Subreaches	Width (FT)	Side Slope (FT/FT)	Initial Variable	Index Parameter Type	Inde Flov
RT 53R - 03	Kinematic Wave	Kinematic Wave	2918.61	0.01	0.02	Trapezoid	2	32	3	Combined Inflow	Index Flow	500

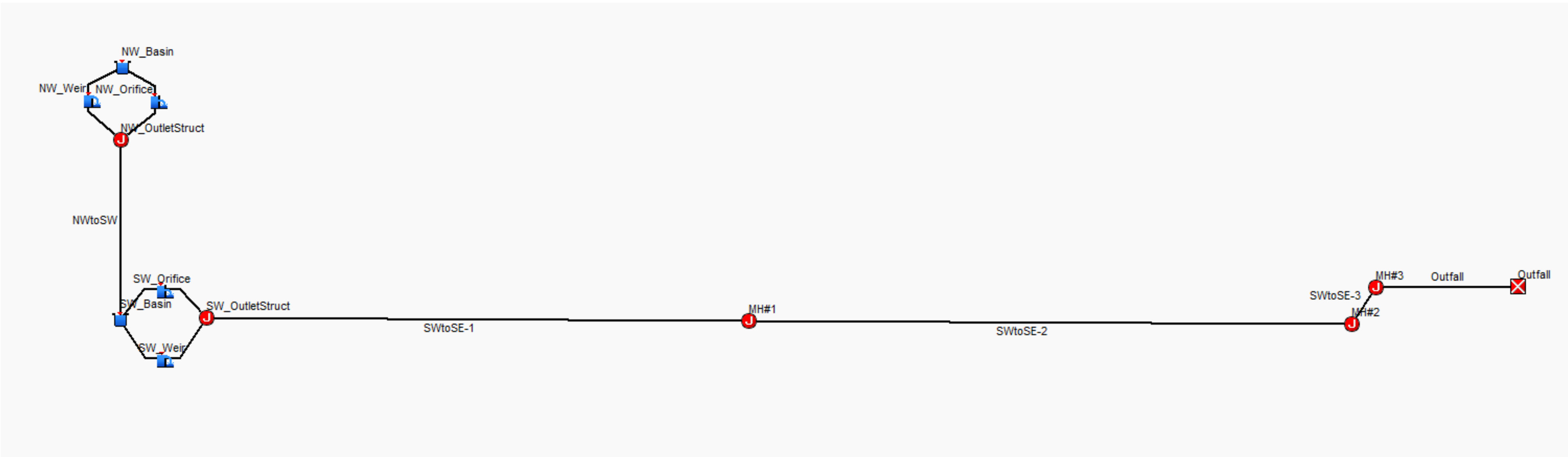
Global Results Summary

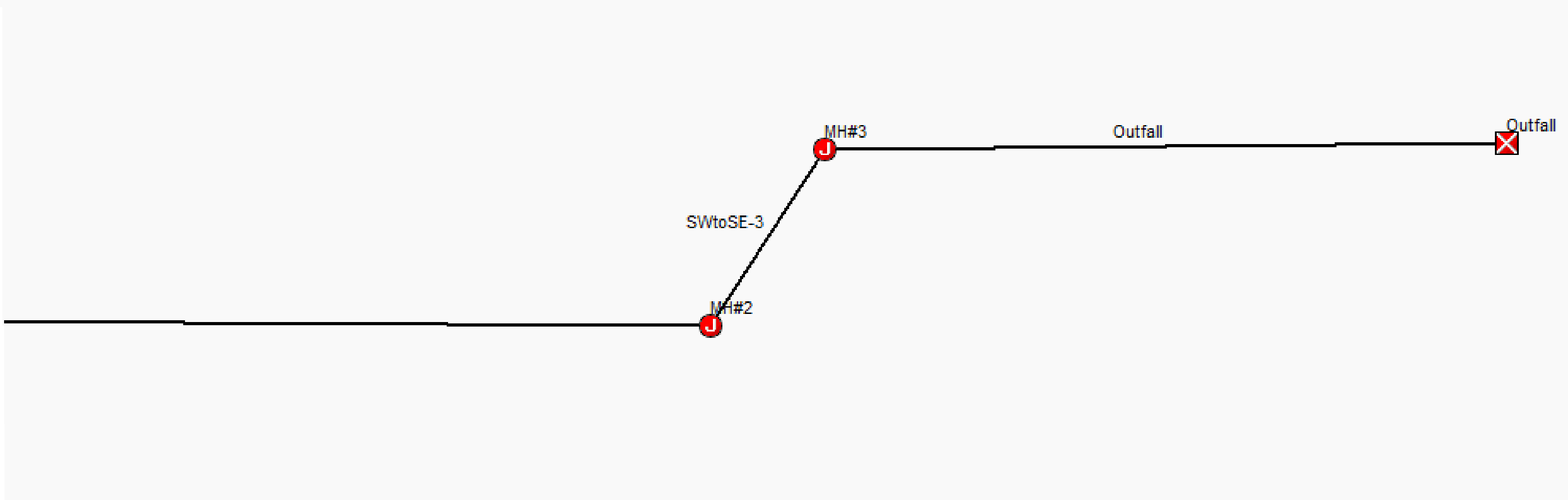
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
SUB B1 - C	0.03	76.68	01Jan2019, 12:03	3.38
SUB B1 - W	0.02	49.33	01Jan2019, 12:03	3.38
RT B1W - B1C	0.02	46.81	01Jan2019, 12:06	2.86
CP B1 - CA	0.06	122.47	01Jan2019, 12:03	2.87
SUB C1 - C	0.03	71.8	01Jan2019, 12:00	3.38
SUB C1 - W	0.02	38.86	01Jan2019, 12:03	3.38
RT C1W - C1C	0.02	35.57	01Jan2019, 12:09	2.87
SUB C1 - E	0.01	14.35	01Jan2019, 11:57	3.38
CP C1 - E	0.05	106.61	01Jan2019, 12:03	2.88
RT C1E - C1C	0.05	101.94	01Jan2019, 12:09	2.88
CP B1 - EA	0.08	163.49	01Jan2019, 12:03	2.87
CP C1 - C	0.05	100.07	01Jan2019, 12:03	2.88
RT C1C - BIC	0.05	96.62	01Jan2019, 12:06	2.88
CP B1 - C	0.06	122.47	01Jan2019, 12:03	2.87
RT B1C - B1E	0.06	121.33	01Jan2019, 12:03	2.87
SUB B1 - E	0.02	42.15	01Jan2019, 12:03	3.38
CP B1 - E	0.13	259	01Jan2019, 12:06	2.88
SUB BAN - NW	0.02	43.38	01Jan2019, 12:00	3.38
SUB BAN - SW	0.01	33.76	01Jan2019, 11:57	3.42
CP BAN - SW	0.03	76.42	01Jan2019, 12:00	2.37
RT SW - SE	0.03	88.68	01Jan2019, 12:00	2.37
SUB BAN - SE	0.01	28.11	01Jan2019, 12:00	3.38
CP BAN - SE	0.04	116.79	01Jan2019, 12:00	2.52
SUB BAN - NE	0.02	44.53	01Jan2019, 12:03	3.38

Sub 04	0.08	124.52	01Jan2019, 12:06	1.04
Sub 02	0.07	145.59	01Jan2019, 12:03	2.64
East Spillway	Not specified	517.34	01Jan2019, 13:27	Not specified
Powerline Spillway	Not specified	2928.37	01Jan2019, 13:21	Not specified
Water Campus Spillway	Not specified	98.45	01Jan2019, 13:30	Not specified
Basin53R Route	Not specified	396.31	01Jan2019, 20:06	Not specified
RT 53R - 03	Not specified	396.31	01Jan2019, 20:12	Not specified
Sub 03	0.11	184.84	01Jan2019, 12:06	2.65
Hayden	0.02	21.26	01Jan2019, 12:09	3.82
Cp 03	Not specified	399.19	01Jan2019, 20:00	Not specified
SUB BAN - CE	0.01	37.14	01Jan2019, 12:00	3.38

Appendix E Storm and Sanitary Analysis Calculations

SOUTHWEST BASIN SYSTEM





Autodesk Storm and Sanitary Analysis

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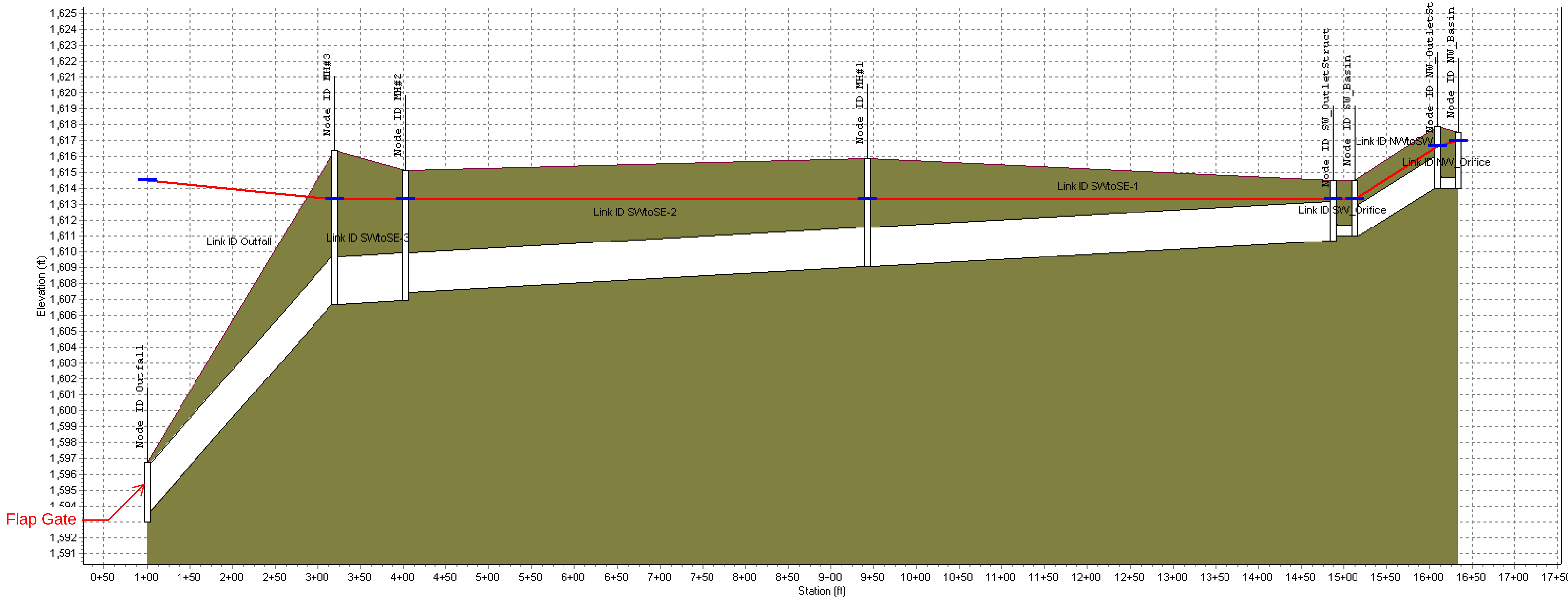
Profile Plot - 100 Year 24 Hour Storm

Banner Scottsdale Campus Conceptual Drainage Report



Node ID:	Outfall	MH#3	MH#2	MH#1	SW_OutletStruct	SW_Basin	NW_OutletStruct	NW_Basin
Rim (ft):		1616.37	1615.11	1615.89	[illegible]	1614.50	[illegible]	1617.50
Invert (ft):	1593.00	1606.72	1606.97	1609.09	[illegible]	[illegible]	[illegible]	1614.00
Min Pipe Cover (ft):		6.65	5.14	4.30	0.00		0.00	
Max HGL (ft):	1614.50	1613.32	1613.32	1613.32	[illegible]	1613.31	[illegible]	1616.97

Link ID:	Outfall	SWtoSE-3	SWtoSE-2	SWtoSE-1	SW_Orifice	NWtoSW	NW_Orifice
Length (ft):	219.40	83.21	540.08	544.74		96.60	
Dia (ft):	3.00	3.00	2.50	2.50	0.67	2.00	0.67
Slope (ft/ft):	0.0592	0.0030	0.0030	0.0030		0.0311	
Up Invert (ft):	1606.72	1606.97	1609.09	1610.70	1611.00	1614.00	1614.00
Dn Invert (ft):	1593.74	1606.72	1607.47	1609.09	1611.00	1611.00	1614.00
Max Q (cfs):	43.86	44.10	22.20	22.24	1.37	29.56	2.08
Max Vel (ft/s):	11.08	7.41	5.24	4.78	0.00	9.44	0.00
Max Depth (ft):	3.00	3.00	2.50	2.50	0.00	2.00	0.00

Autodesk Storm and Sanitary Analysis

100-Year 24-Hour Run

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

****
Project Description
****

File Name .... SouthwestSystem.SPF

****
Analysis Options
****

Flow Units .... cfs
Link Routing Method .... Hydrodynamic
Storage Node Exfiltration.. None
Starting Date JAN-01-2021 00:00:00
Ending Date JAN-03-2021 12:00:00
Report Time Step 00:00:10

****
Element Count
****

Number of subbasins 0
Number of nodes 8
Number of links 9

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft^2	External Inflow
MH#1	JUNCTION	1609.09	1615.89	0.00	
MH#2	JUNCTION	1606.97	1615.11	0.00	Yes
MH#3	JUNCTION	1606.72	1616.37	0.00	
NW_OutletStruct	JUNCTION	1614.00	1617.90	0.00	
SW_OutletStruct	JUNCTION	1610.70	1614.50	0.01	
Outfall	OUTFALL	1593.00	1596.74	0.00	
NW_Basin	STORAGE	1614.00	1617.50	0.00	Yes
SW_Basin	STORAGE	1611.00	1614.50	0.00	Yes

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
NWtoSW	NW_OutletStruct	SW_Basin	CONDUIT	96.6	3.1056	0.0130
Outfall	MH#3	Outfall	CONDUIT	219.4	5.9161	0.0260
SWtoSE-1	SW_OutletStruct	MH#1	CONDUIT	544.7	0.2956	0.0130
SWtoSE-2	MH#1	MH#2	CONDUIT	540.1	0.3000	0.0130
SWtoSE-3	MH#2	MH#3	CONDUIT	83.2	0.3005	0.0130
NW_Orifice	NW_Basin	NW_OutletStruct	ORIFICE			
SW_Orifice	SW_Basin	SW_OutletStruct	ORIFICE			
NW_Weir	NW_Basin	NW_OutletStruct	WEIR			
SW_Weir	SW_Basin	SW_OutletStruct	WEIR			

****
Cross Section Summary
****

Link	Shape	Depth/	Width	No. of	Cross	Full Flow

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Design ID		Diameter ft	ft	Barrels	Sectional Area ft²	Hydraulic Radius ft	Flow Capacity cfs
NWtoSW	CIRCULAR	2.00	2.00	1	3.14	0.50	39.87
Outfall	CIRCULAR	3.00	3.00	1	7.07	0.75	81.12
SWtoSE-1	CIRCULAR	2.50	2.50	1	4.91	0.63	22.30
SWtoSE-2	CIRCULAR	2.50	2.50	1	4.91	0.63	22.46
SWtoSE-3	CIRCULAR	3.00	3.00	1	7.07	0.75	36.56

```
**************************        Volume         Volume
Flow Routing Continuity           acre-ft       Mgallons
**************************       ---------     ---------
External Inflow ..........          7.085          2.309
External Outflow .........          7.078          2.307
Initial Stored Volume ....          0.000          0.000
Final Stored Volume ......          0.012          0.004
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
MH#1	1.06	4.23	1613.32	1	01:10	0	0	0:00:00
MH#2	1.71	6.35	1613.32	1	01:20	0	0	0:00:00
MH#3	1.73	6.60	1613.32	1	01:22	0	0	0:00:00
NW_OutletStruct	0.11	2.65	1616.65	0	12:07	0	0	0:00:00
SW_OutletStruct	0.65	2.62	1613.32	1	01:28	0	0	0:00:00
Outfall	9.30	21.50	1614.50	0	19:15	0	0	0:00:00
NW_Basin	0.30	2.97	1616.97	0	12:07	0	0	0:00:00
SW_Basin	0.57	2.31	1613.31	0	12:21	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
MH#1	JUNCTION	0.00	22.24	0	12:19	0.00		
MH#2	JUNCTION	28.09	43.95	0	12:05	0.00		
MH#3	JUNCTION	0.00	44.10	0	12:05	0.00		
NW_OutletStruct	JUNCTION	0.00	29.60	0	12:05	0.00		
SW_OutletStruct	JUNCTION	0.00	22.27	0	12:19	0.00		

Outfall	OUTFALL	0.00	43.86	0	12:05	0.00
NW_Basin	STORAGE	43.37	43.37	0	11:59	0.00
SW_Basin	STORAGE	33.80	60.45	0	11:59	0.00

****
Storage Node Summary
****

Storage Node ID	Maximum Ponded Volume 1000 ft³	Maximum Ponded Volume (%)	Time of Max Ponded Volume days hh:mm	Average Ponded Volume 1000 ft³	Average Ponded Volume (%)	Maximum Storage Node Outflow cfs	Maximum Exfiltration Rate cfm	Time of Max. Exfiltration Rate hh:mm:ss	Total Exfiltrated Volume 1000 ft³
NW_Basin	34.044	81	0 12:07	2.958	7	29.60	0.00	0:00:00	0.000
SW_Basin	73.310	61	0 12:21	17.063	14	22.27	0.00	0:00:00	0.000

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Outfall	83.14	1.84	43.86
System	83.14	1.84	43.86

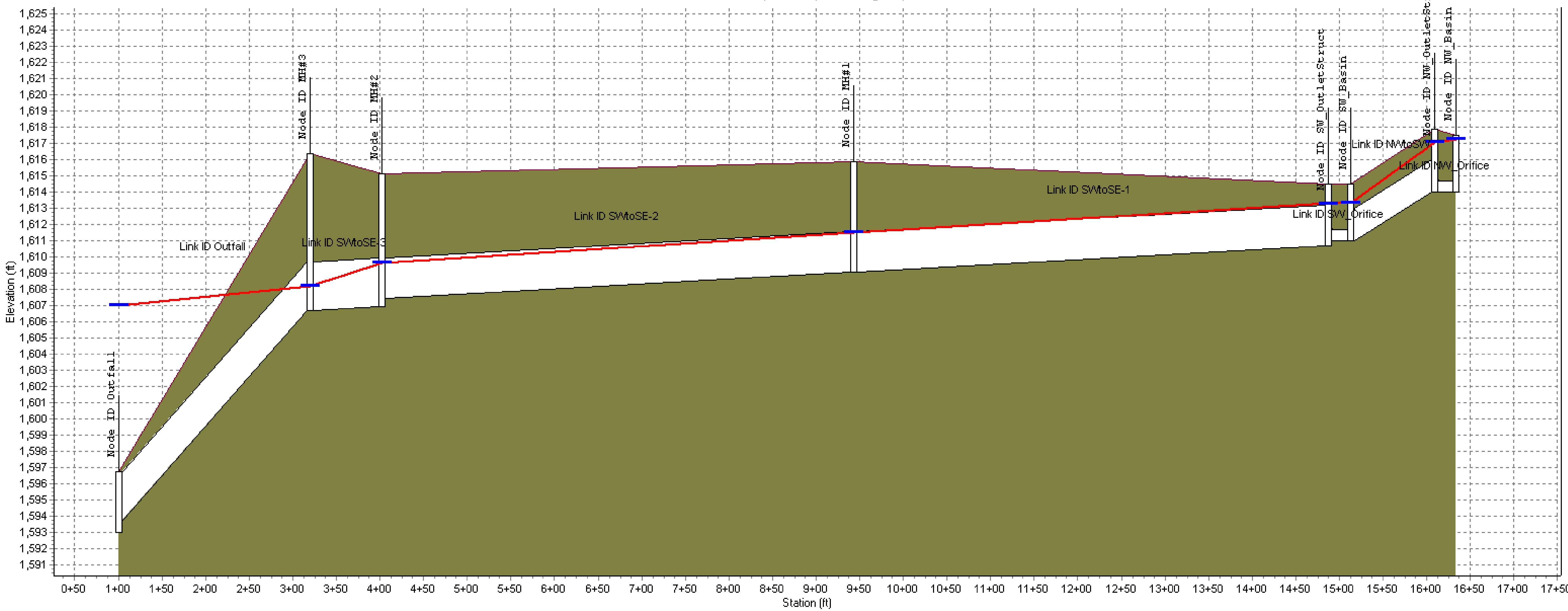
****
Link Flow Summary
****

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
NWtoSW	CONDUIT	0 12:05	9.44	1.07	29.56	39.87	0.74	1.00	10	SURCHARGED
Outfall	CONDUIT	0 12:05	11.08	1.00	43.86	81.12	0.54	1.00	975	SURCHARGED
SWtoSE-1	CONDUIT	0 12:19	4.78	1.00	22.24	22.30	1.00	1.00	117	SURCHARGED

```
  SWtoSE-2             CONDUIT      0  12:20      5.24     1.00        22.20       22.46       0.99
1.00        780  SURCHARGED
  SWtoSE-3             CONDUIT      0  12:05      7.41     1.00        44.10       36.56       1.21
1.00        955  SURCHARGED
  NW_Orifice           ORIFICE      0  11:51                            2.08
  SW_Orifice           ORIFICE      0  11:34                            1.37
  NW_Weir              WEIR         0  12:05                           28.58
0.70
  SW_Weir              WEIR         0  12:19                           22.24
0.59


  ********************************
  Highest Flow Instability Indexes
  ********************************
  Link SWtoSE-3 (20)
  Link SWtoSE-2 (18)
  Link SWtoSE-1 (17)
  Link SW_Weir (10)
  Link SW_Orifice (6)



  WARNING 107 : Initial water surface elevation defined for Junction SW_OutletStruct is below
junction invert elevation.
                Assumed initial water surface elevation equal to invert elevation.
  WARNING 110 : Initial water surface elevation defined for Storage Node NW_Basin is below
storage node invert elevation.
                Assumed initial water surface elevation equal to invert elevation.
  WARNING 110 : Initial water surface elevation defined for Storage Node SW_Basin is below
storage node invert elevation.
                Assumed initial water surface elevation equal to invert elevation.

  Analysis began on:  Tue Aug 30 19:22:59 2022
  Analysis ended on:  Tue Aug 30 19:23:02 2022
  Total elapsed time: 00:00:03
```

Profile Plot - 100 Year 6 Hour Storm

Banner Scottsdale Campus Conceptual Drainage Report



Node ID:	Outfall	MH#3	MH#2	MH#1	SW_OutletStruct / SW_Basin	NW_OutletStruct / NW_Basin
Rim (ft):		1616.37	1615.11	1615.89	1614150 4.50	1617160 7.50
Invert (ft):	1593.00	1606.72	1606.97	1609.09	1610160 1.00	1614100 4.00
Min Pipe Cover (ft):		6.65	5.14	4.30	0.00	0.00
Max HGL (ft):	1607.00	1608.22	1609.65	1611.50	1613123 3.34	1617164 7.25

Link ID:	Outfall	SWtoSE-3	SWtoSE-2	SWtoSE-1	SW_Orifice	NWtoSW	NW_Orifice
Length (ft):	219.40	83.21	540.08	544.74		96.60	
Dia (ft):	3.00	3.00	2.50	2.50	0.67	2.00	0.67
Slope (ft/ft):	0.0592	0.0030	0.0030	0.0030		0.0311	
Up Invert (ft):	1606.72	1606.97	1609.09	1610.70	1611.00	1614.00	1614.00
Dn Invert (ft):	1593.74	1606.72	1607.47	1609.09	1611.00	1611.00	1614.00
Max Q (cfs):	35.79	35.79	22.31	22.32	1.41	31.26	2.07
Max Vel (ft/s):	10.59	6.87	5.24	4.80	0.00	10.55	0.00
Max Depth (ft):	1.95	2.09	2.25	2.46	0.00	2.00	0.00

Autodesk Storm and Sanitary Analysis

5-ZN-2022
9/20/2022

100-Year 6-Hour Run

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

****
Project Description
****

File Name .... SouthwestSystem.SPF

****
Analysis Options
****

Flow Units .... cfs
Link Routing Method .... Hydrodynamic
Storage Node Exfiltration.. None
Starting Date JAN-01-2021 00:00:00
Ending Date JAN-03-2021 12:00:00
Report Time Step 00:00:10

****
Element Count
****

Number of subbasins 0
Number of nodes 8
Number of links 9

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
MH#1	JUNCTION	1609.09	1615.89	0.00	
MH#2	JUNCTION	1606.97	1615.11	0.00	Yes
MH#3	JUNCTION	1606.72	1616.37	0.00	
NW_OutletStruct	JUNCTION	1614.00	1617.90	0.00	
SW_OutletStruct	JUNCTION	1610.70	1614.50	0.01	
Outfall	OUTFALL	1593.00	1596.74	0.00	
NW_Basin	STORAGE	1614.00	1617.50	0.00	Yes
SW_Basin	STORAGE	1611.00	1614.50	0.00	Yes

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
NWtoSW	NW_OutletStruct	SW_Basin	CONDUIT	96.6	3.1056	0.0130
Outfall	MH#3	Outfall	CONDUIT	219.4	5.9161	0.0260
SWtoSE-1	SW_OutletStruct	MH#1	CONDUIT	544.7	0.2956	0.0130
SWtoSE-2	MH#1	MH#2	CONDUIT	540.1	0.3000	0.0130
SWtoSE-3	MH#2	MH#3	CONDUIT	83.2	0.3005	0.0130
NW_Orifice	NW_Basin	NW_OutletStruct	ORIFICE			
SW_Orifice	SW_Basin	SW_OutletStruct	ORIFICE			
NW_Weir	NW_Basin	NW_OutletStruct	WEIR			
SW_Weir	SW_Basin	SW_OutletStruct	WEIR			

****
Cross Section Summary
****

Link	Shape	Depth/	Width	No. of	Cross	Full Flow

5-ZN-2022
9/20/2022

ID		Diameter ft	ft	Barrels	Sectional Area ft²	Hydraulic Radius ft	Design Flow Capacity cfs
NWtoSW	CIRCULAR	2.00	2.00	1	3.14	0.50	39.87
Outfall	CIRCULAR	3.00	3.00	1	7.07	0.75	81.12
SWtoSE-1	CIRCULAR	2.50	2.50	1	4.91	0.63	22.30
SWtoSE-2	CIRCULAR	2.50	2.50	1	4.91	0.63	22.46
SWtoSE-3	CIRCULAR	3.00	3.00	1	7.07	0.75	36.56

Flow Routing Continuity

Flow Routing Continuity	Volume acre-ft	Volume Mgallons
External Inflow	4.529	1.476
External Outflow	4.527	1.475
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.020	0.007
Continuity Error (%)	-0.004	

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
MH#1	0.17	2.41	1611.50	0	04:26	0	0	0:00:00
MH#2	0.17	2.68	1609.65	0	04:13	0	0	0:00:00
MH#3	0.10	1.50	1608.22	0	04:13	0	0	0:00:00
NW_OutletStruct	0.08	3.04	1617.04	0	04:08	0	0	0:00:00
SW_OutletStruct	0.16	2.59	1613.29	0	04:25	0	0	0:00:00
Outfall	9.37	14.00	1607.00	0	09:09	0	0	0:00:00
NW_Basin	0.17	3.25	1617.25	0	04:08	0	0	0:00:00
SW_Basin	0.15	2.34	1613.34	0	04:25	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
MH#1	JUNCTION	0.00	22.32	0	04:25	0.00		
MH#2	JUNCTION	17.70	35.82	0	04:12	0.00		
MH#3	JUNCTION	0.00	35.79	0	04:13	0.00		
NW_OutletStruct	JUNCTION	0.00	31.24	0	04:08	0.00		
SW_OutletStruct	JUNCTION	0.00	22.35	0	04:23	0.00		

Outfall	OUTFALL	0.00	35.79	0	04:13	0.00
NW_Basin	STORAGE	47.00	47.00	0	04:00	0.00
SW_Basin	STORAGE	31.29	61.18	0	04:03	0.00

****
Storage Node Summary
****

Storage Node ID	Maximum Ponded Volume 1000 ft³	Maximum Ponded Volume (%)	Time of Max Ponded Volume days hh:mm	Average Ponded Volume 1000 ft³	Average Ponded Volume (%)	Maximum Storage Node Outflow cfs	Maximum Exfiltration Rate cfm	Time of Max. Exfiltration Rate hh:mm:ss	Total Exfiltrated Volume 1000 ft³
NW_Basin	38.108	91	0 04:08	1.744	4	31.24	0.00	0:00:00	0.000
SW_Basin	74.483	62	0 04:25	4.273	4	22.35	0.00	0:00:00	0.000

****
Outfall Loading Summary
****

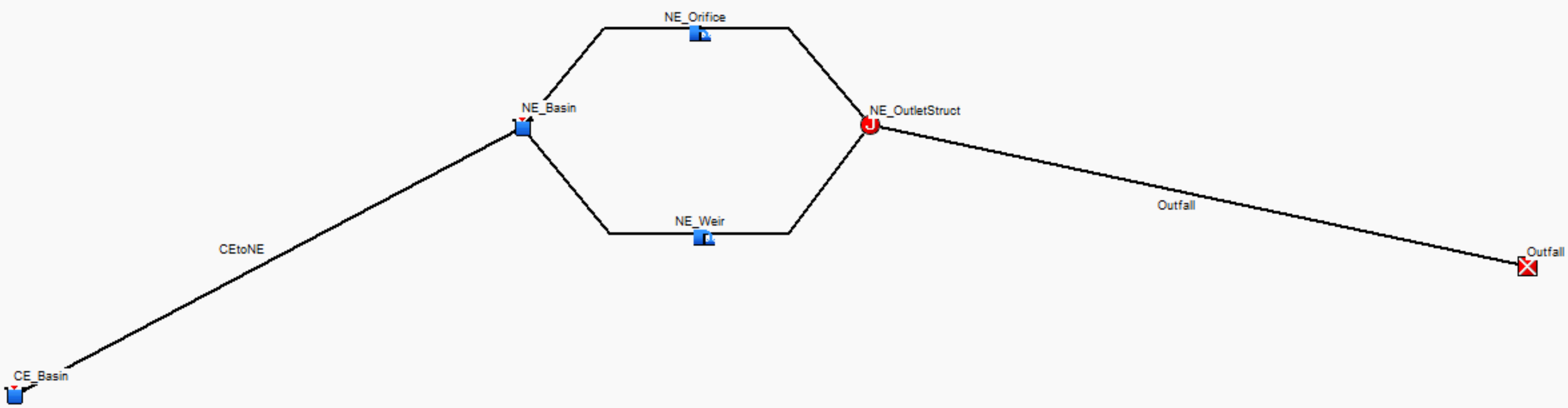
Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Outfall	97.83	1.02	35.79
System	97.83	1.02	35.79

****
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
NWtoSW	CONDUIT	0 04:09	10.55	1.07	31.26	39.87	0.78	1.00	10	SURCHARGED
Outfall	CONDUIT	0 04:13	10.59	1.00	35.79	81.12	0.44	0.65	0	Calculated
SWtoSE-1	CONDUIT	0 04:25	4.80	1.00	22.32	22.30	1.00	0.98	0	> CAPACITY

```
  SWtoSE-2             CONDUIT      0  04:25      5.24     1.00        22.31       22.46       0.99
0.90          0  Calculated
  SWtoSE-3             CONDUIT      0  04:13      6.87     1.00        35.79       36.56       0.98
0.70          0  Calculated
  NW_Orifice           ORIFICE      0  04:31                              2.07
  SW_Orifice           ORIFICE      0  03:56                              1.41
  NW_Weir              WEIR         0  04:08                             30.98
0.86
  SW_Weir              WEIR         0  04:23                             22.33
0.60


  ********************************
  Highest Flow Instability Indexes
  ********************************
  All links are stable.



  WARNING 107 : Initial water surface elevation defined for Junction SW_OutletStruct is below
junction invert elevation.
                Assumed initial water surface elevation equal to invert elevation.
  WARNING 110 : Initial water surface elevation defined for Storage Node NW_Basin is below
storage node invert elevation.
                Assumed initial water surface elevation equal to invert elevation.
  WARNING 110 : Initial water surface elevation defined for Storage Node SW_Basin is below
storage node invert elevation.
                Assumed initial water surface elevation equal to invert elevation.

  Analysis began on:  Wed Aug 31 14:44:15 2022
  Analysis ended on:  Wed Aug 31 14:44:19 2022
  Total elapsed time: 00:00:04
```

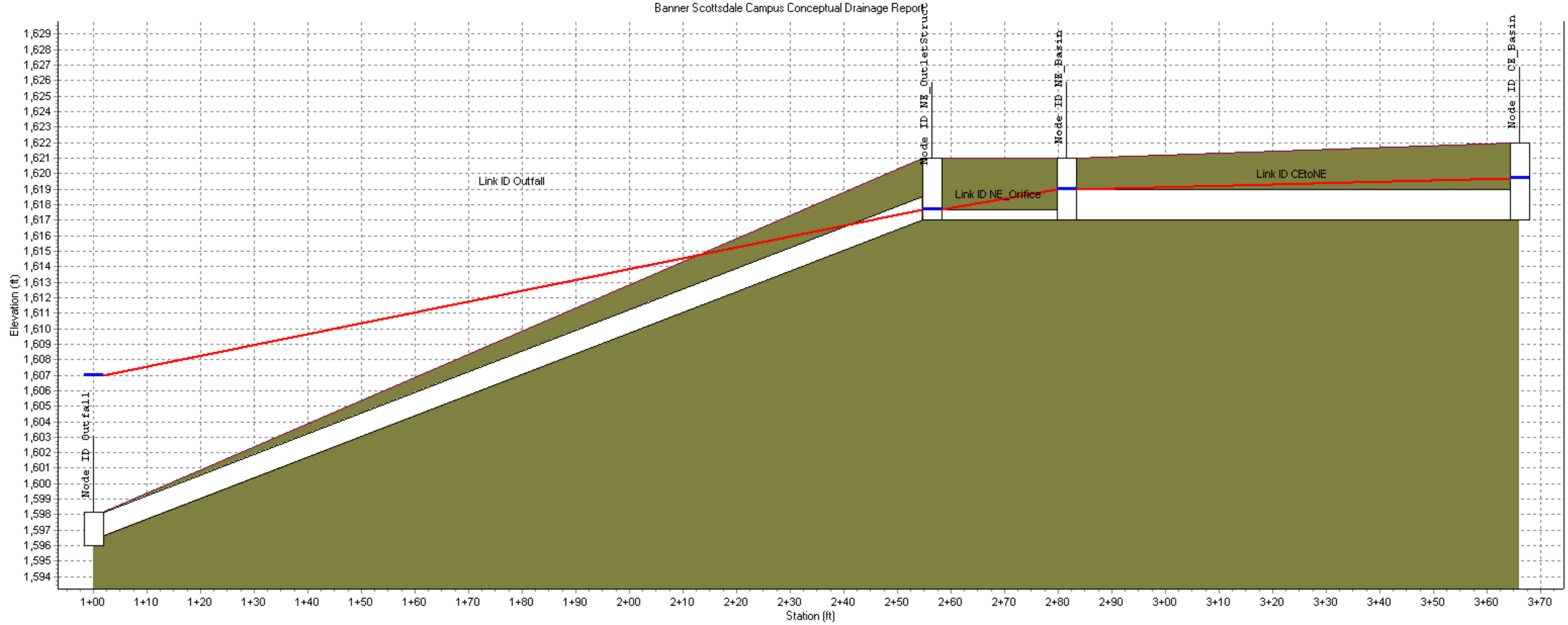
NORTHEAST BASIN SYSTEM



Autodesk Storm and Sanitary Analysis

Profile Plot - 100 Year 6 Hour Storm

Banner Scottsdale Campus Conceptual Drainage Report



Node ID:	Outfall	NE_OutletStruct	NE_Basin	CE_Basin
Rim (ft):		1621.00	1621.00	1622.00
Invert (ft):	1596.00	1617.00	1617.00	1617.00
Min Pipe Cover (ft):		0.00		
Max HGL (ft):	1607.00	1617.65	1618.99	1619.72

Link ID:	Outfall	NE_Orifice	CEtoNE
Length (ft):	156.44		84.57
Dia (ft):	1.50	0.67	2.00
Slope (ft/ft):	0.1300		0.0000
Up Invert (ft):	1617.00	1617.00	1617.00
Dn Invert (ft):	1596.67	1617.00	1617.00
Max Q (cfs):	6.85	2.00	15.47
Max Vel (ft/s):	9.61	0.00	5.26
Max Depth (ft):	1.04	0.00	1.99

5-ZN-2022
9/20/2022

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

****
Project Description
****
File Name .... NortheastSystem.SPF

****
Analysis Options
****
Flow Units .... cfs
Link Routing Method .... Hydrodynamic
Storage Node Exfiltration.. None
Starting Date JAN-01-2021 00:00:00
Ending Date JAN-03-2021 12:00:00
Report Time Step 00:00:10

****
Element Count
****
Number of subbasins 0
Number of nodes 4
Number of links 4

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
NE_OutletStruct	JUNCTION	1617.00	1621.00	0.00	
Outfall	OUTFALL	1596.00	1598.17	0.00	
CE_Basin	STORAGE	1617.00	1621.00	0.00	Yes
NE_Basin	STORAGE	1617.00	1621.00	0.00	Yes

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
CEtoNE	CE_Basin	NE_Basin	CONDUIT	84.6	0.0012	0.0130
Outfall	NE_OutletStruct	Outfall	CONDUIT	156.4	12.9954	0.0260
NE_Orifice	NE_Basin	NE_OutletStruct	ORIFICE			
NE_Weir	NE_Basin	NE_OutletStruct	WEIR			

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs

----

CEtoNE	CIRCULAR	2.00	2.00	1	3.14	0.50	0.78
Outfall	CIRCULAR	1.50	1.50	1	1.77	0.38	18.93

****
Flow Routing Continuity
****

	Volume acre-ft	Volume Mgallons
External Inflow	4.488	1.462
External Outflow	4.487	1.462
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.003	0.001
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	Time of Max Occurrence hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
NE_OutletStruct	0.17	0.65	1617.65	0	04:50	0	0	0:00:00
Outfall	6.53	11.00	1607.00	0	09:09	0	0	0:00:00
CE_Basin	0.60	2.72	1619.72	0	04:12	0	0	0:00:00
NE_Basin	0.57	1.99	1618.99	0	04:50	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	Time of Peak Inflow Occurrence hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	Time of Peak Flooding Occurrence hh:mm
NE_OutletStruct	JUNCTION	0.00	6.85	0	04:50	0.00		
Outfall	OUTFALL	0.00	6.85	0	04:50	0.00		
CE_Basin	STORAGE	40.10	40.10	0	04:00	0.00		
NE_Basin	STORAGE	50.38	63.98	0	04:02	0.00		

****
Storage Node Summary
****

Storage Node ID	Maximum Ponded Volume 1000 ft³	Maximum Ponded Volume (%)	Time of Max Ponded Volume days hh:mm	Average Ponded Volume 1000 ft³	Average Ponded Volume (%)	Maximum Storage Node Outflow cfs	Maximum Exfiltration Rate cfm	Time of Max. Exfiltration Rate hh:mm:ss	Total Exfiltrated Volume 1000 ft³

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CE_Basin	39.167	60	0	04:12	5.060	8	15.47	0.00	0:00:00	0.000
NE_Basin	136.831	41	0	04:50	27.964	8	6.85	0.00	0:00:00	0.000

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Outfall	83.83	1.16	6.85
System	83.83	1.16	6.85

****
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
CEtoNE	CONDUIT	0 04:11	5.26	1.00	15.47	0.78	19.89	1.00	0	> CAPACITY
Outfall	CONDUIT	0 04:50	9.61	1.00	6.85	18.93	0.36	0.69	0	Calculated
NE_Orifice	ORIFICE	0 05:19			2.00					
NE_Weir	WEIR	0 04:50			4.86			0.24		

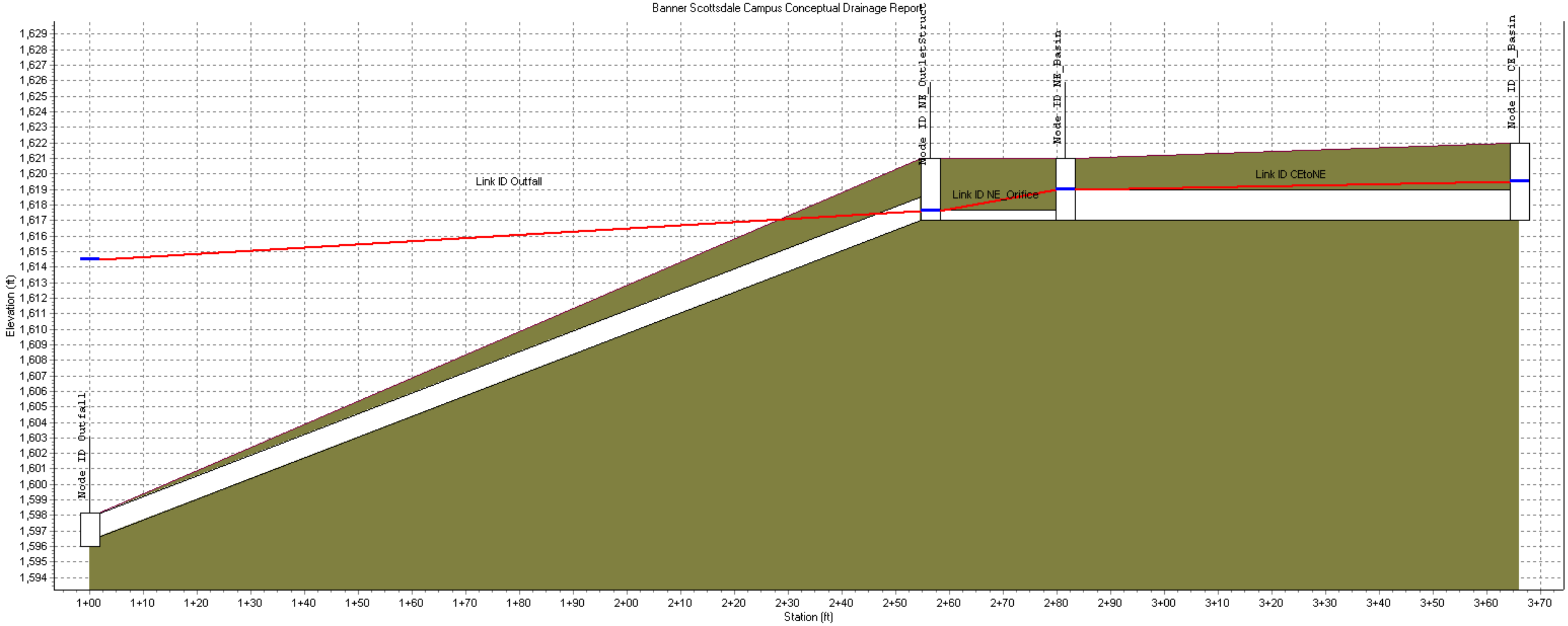
****
Highest Flow Instability Indexes
****
All links are stable.

WARNING 107 : Initial water surface elevation defined for Junction NE_OutletStruct is below junction invert elevation.
Assumed initial water surface elevation equal to invert elevation.
WARNING 110 : Initial water surface elevation defined for Storage Node NE_Basin is below storage node invert elevation.
Assumed initial water surface elevation equal to invert elevation.
WARNING 004 : Minimum elevation drop used for Conduit CEtoNE.

Analysis began on: Tue Aug 30 19:33:52 2022
Analysis ended on: Tue Aug 30 19:33:55 2022
Total elapsed time: 00:00:03

Profile Plot - 100 Year 6 Hour Storm

Banner Scottsdale Campus Conceptual Drainage Report



Node ID:	Outfall	NE_OutletStruct	NE_Basin	CE_Basin
Rim (ft):		1621.00	1621.00	1622.00
Invert (ft):	1596.00	1617.00	1617.00	1617.00
Min Pipe Cover (ft):		0.00		
Max HGL (ft):	1614.50	1617.63	1618.97	1619.51

Link ID:	Outfall	NE_Orifice	CEtoNE
Length (ft):	156.44		84.57
Dia (ft):	1.50	0.67	2.00
Slope (ft/ft):	0.1300		0.0000
Up Invert (ft):	1617.00	1617.00	1617.00
Dn Invert (ft):	1596.67	1617.00	1617.00
Max Q (cfs):	6.52	2.00	13.95
Max Vel (ft/s):	9.49	0.00	4.74
Max Depth (ft):	1.05	0.00	1.98

5-ZN-2022
9/20/2022

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

****
Project Description
****
File Name .... NortheastSystem.SPF

****
Analysis Options
****
Flow Units .... cfs
Link Routing Method .... Hydrodynamic
Storage Node Exfiltration.. None
Starting Date JAN-01-2021 00:00:00
Ending Date JAN-03-2021 12:00:00
Report Time Step 00:00:10

****
Element Count
****
Number of subbasins 0
Number of nodes 4
Number of links 4

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
NE_OutletStruct	JUNCTION	1617.00	1621.00	0.00	
Outfall	OUTFALL	1596.00	1598.17	0.00	
CE_Basin	STORAGE	1617.00	1622.00	0.00	Yes
NE_Basin	STORAGE	1617.00	1621.00	0.00	Yes

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
CEtoNE	CE_Basin	NE_Basin	CONDUIT	84.6	0.0012	0.0130
Outfall	NE_OutletStruct	Outfall	CONDUIT	156.4	12.9954	0.0260
NE_Orifice	NE_Basin	NE_OutletStruct	ORIFICE			
NE_Weir	NE_Basin	NE_OutletStruct	WEIR			

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs

5-ZN-2022
9/20/2022

CEtoNE	CIRCULAR	2.00	2.00	1	3.14	0.50
0.78						
Outfall	CIRCULAR	1.50	1.50	1	1.77	0.38
18.93						

Flow Routing Continuity

Flow Routing Continuity	Volume acre-ft	Volume Mgallons
External Inflow	6.133	1.998
External Outflow	6.131	1.998
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.001	0.000
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	Time of Max Occurrence hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
NE_OutletStruct	0.23	0.63	1617.63	0	12:55	0	0	0:00:00
Outfall	6.94	18.50	1614.50	0	19:15	0	0	0:00:00
CE_Basin	0.78	2.51	1619.51	0	12:11	0	0	0:00:00
NE_Basin	0.76	1.97	1618.97	0	12:55	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	Time of Peak Inflow Occurrence hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	Time of Peak Flooding Occurrence hh:mm
NE_OutletStruct	JUNCTION	0.00	6.52	0	12:55	0.00		
Outfall	OUTFALL	0.00	6.52	0	12:55	0.00		
CE_Basin	STORAGE	37.09	37.09	0	12:00	0.00		
NE_Basin	STORAGE	44.49	56.83	0	12:03	0.00		

Storage Node Summary

Storage Node ID	Maximum Ponded Volume 1000 ft^3	Maximum Ponded Volume (%)	Time of Max Ponded Volume days hh:mm	Average Ponded Volume 1000 ft^3	Average Ponded Volume (%)	Maximum Storage Node Outflow cfs	Maximum Exfiltration Rate cfm	Time of Max. Exfiltration Rate hh:mm:ss	Total Exfiltrated Volume 1000 ft^3

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CE_Basin	34.823	44	0	12:11	6.573	8	13.95	0.00	0:00:00	0.000
NE_Basin	134.783	40	0	12:55	37.181	11	6.52	0.00	0:00:00	0.000

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Outfall	99.83	1.27	6.52
System	99.83	1.27	6.52

****
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
CEtoNE	CONDUIT	0 12:10	4.74	1.00	13.95	0.78	17.93	0.99	0	> CAPACITY
Outfall	CONDUIT	0 12:55	9.49	1.00	6.52	18.93	0.34	0.70	0	Calculated
NE_Orifice	ORIFICE	0 13:06			2.00					
NE_Weir	WEIR	0 12:55			4.53			0.23		

****
Highest Flow Instability Indexes
****
All links are stable.

WARNING 107 : Initial water surface elevation defined for Junction NE_OutletStruct is below junction invert elevation.
Assumed initial water surface elevation equal to invert elevation.
WARNING 110 : Initial water surface elevation defined for Storage Node NE_Basin is below storage node invert elevation.
Assumed initial water surface elevation equal to invert elevation.
WARNING 004 : Minimum elevation drop used for Conduit CEtoNE.

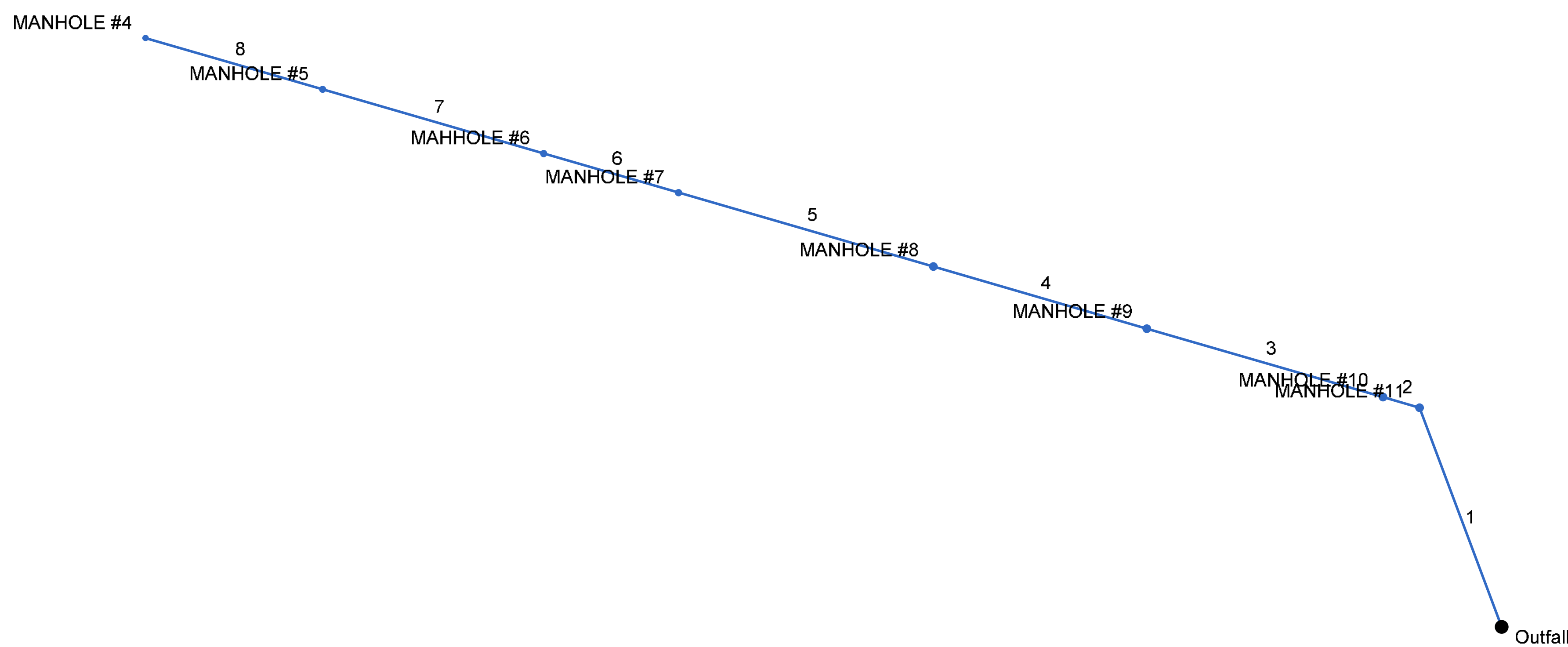
Analysis began on: Wed Aug 31 14:54:39 2022
Analysis ended on: Wed Aug 31 14:54:42 2022
Total elapsed time: 00:00:03

5-ZN-2022
9/20/2022

Appendix F Cavasson Blvd Storm Drain Calculations

5-ZN-2022
9/20/2022

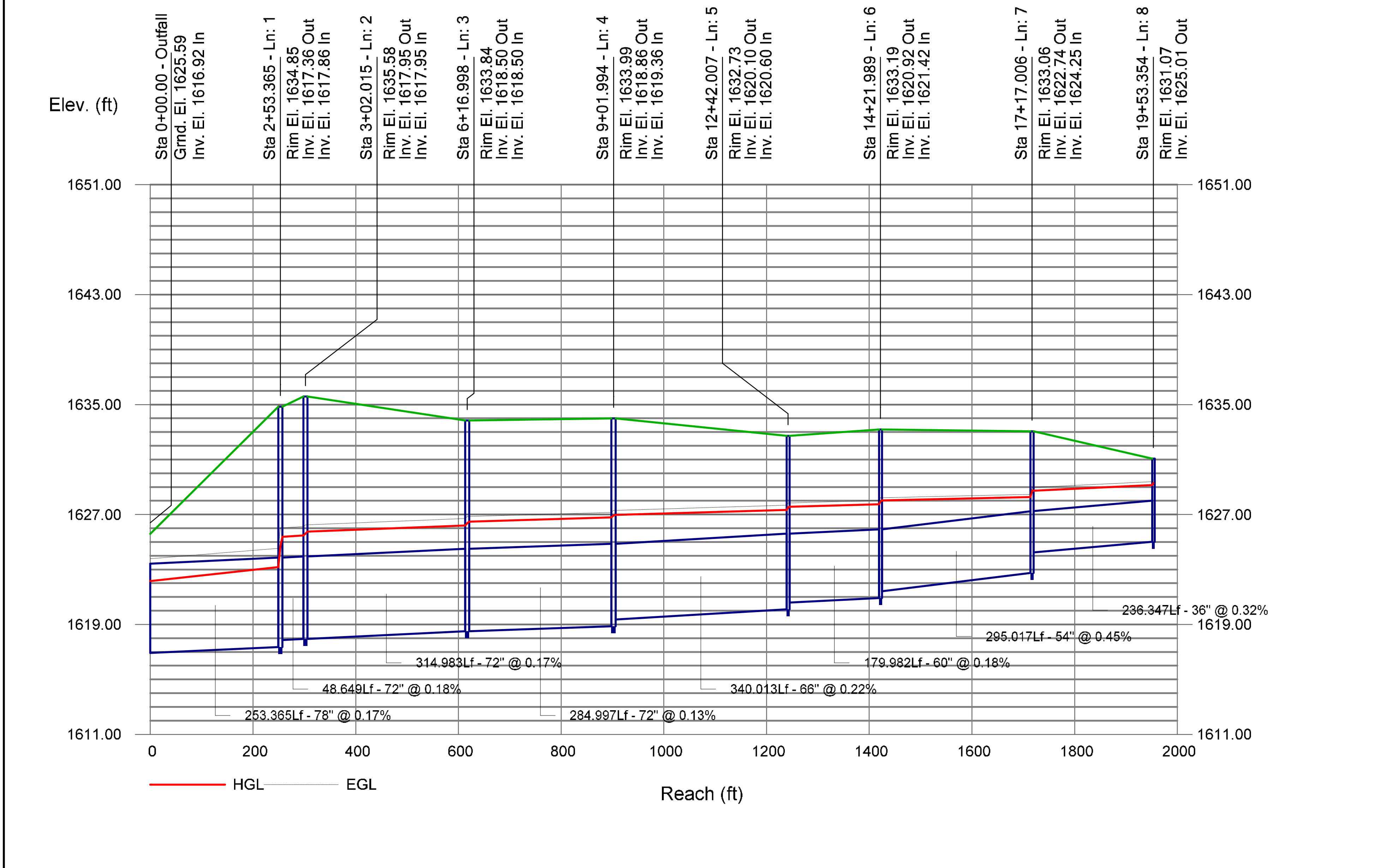
Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: CavassonSD_DD_UltimateFlows.stm	Number of lines: 8	Date: 8/31/2022

Storm Sewer Profile

Proj. file: CavassonSD_DD_UltimateFlows.stm



5-ZN-2022

Storm Sewers

9/20/2022

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	253.365	-114.934	MH	293.00	0.00	0.00	0.0	1616.92	0.17	1617.36	78	Cir	0.013	1.10	1634.85	
2	1	48.649	-51.922	MH	183.00	0.00	0.00	0.0	1617.86	0.18	1617.95	72	Cir	0.013	0.20	1635.58	
3	2	314.983	0.035	MH	160.00	0.00	0.00	0.0	1617.95	0.17	1618.50	72	Cir	0.013	0.30	1633.84	
4	3	284.997	-0.008	MH	138.00	0.00	0.00	0.0	1618.50	0.13	1618.86	72	Cir	0.013	0.40	1633.99	
5	4	340.013	0.005	MH	111.00	0.00	0.00	0.0	1619.36	0.22	1620.10	66	Cir	0.013	0.50	1632.73	
6	5	179.982	-0.008	MH	83.00	0.00	0.00	0.0	1620.60	0.18	1620.92	60	Cir	0.013	0.70	1633.19	
7	6	295.017	0.009	MH	56.00	0.00	0.00	0.0	1621.42	0.45	1622.74	54	Cir	0.013	2.40	1633.06	
8	7	236.347	0.000	MH	28.00	0.00	0.00	0.0	1624.25	0.32	1625.01	36	Cir	0.013	0.58	1631.07	

Project File: CavassonSD_DD_UltimateFlows.stm | Number of lines: 8 | Date: 8/31/2022

5-ZN-2022
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Structure Report

Struct No.	Structure ID	Junction Type	Rim Elev (ft)	Structure			Line Out			Line In		
				Shape	Length (ft)	Width (ft)	Size (in)	Shape	Invert (ft)	Size (in)	Shape	Invert (ft)
1	MANHOLE #11	Manhole	1634.85	Cir	8.00	8.00	78	Cir	1617.36	72	Cir	1617.86
2	MANHOLE #10	Manhole	1635.58	Cir	8.00	8.00	72	Cir	1617.95	72	Cir	1617.95
3	MANHOLE #9	Manhole	1633.84	Cir	8.00	8.00	72	Cir	1618.50	72	Cir	1618.50
4	MANHOLE #8	Manhole	1633.99	Cir	8.00	8.00	72	Cir	1618.86	66	Cir	1619.36
5	MANHOLE #7	Manhole	1632.73	Cir	6.00	6.00	66	Cir	1620.10	60	Cir	1620.60
6	MAHHOLE #6	Manhole	1633.19	Cir	6.00	6.00	60	Cir	1620.92	54	Cir	1621.42
7	MANHOLE #5	Manhole	1633.06	Cir	6.00	6.00	54	Cir	1622.74	36	Cir	1624.25
8	MANHOLE #4	Manhole	1631.07	Cir	5.00	5.00	36	Cir	1625.01			

Project File: CavassonSD_DD_UltimateFlows.stm	Number of Structures: 8	Run Date: 8/31/2022

5-ZN-2022

9/20/2022

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	78	293.0	1616.92	1622.15	5.23	28.61	10.24	1.63	1623.78	0.323	253.365	1617.36	1623.18	5.82	31.33	9.35	1.36	1624.54	0.276	0.300	0.759	1.10	1.50
2	72	183.0	1617.86	1625.38	6.00	28.27	6.47	0.65	1626.03	0.187	48.649	1617.95	1625.47	6.00	28.27	6.47	0.65	1626.12	0.187	0.187	0.091	0.20	0.13
3	72	160.0	1617.95	1625.76	6.00	28.27	5.66	0.50	1626.26	0.143	314.983	1618.50	1626.21	6.00	28.27	5.66	0.50	1626.70	0.143	0.143	0.450	0.30	0.15
4	72	138.0	1618.50	1626.48	6.00	28.27	4.88	0.37	1626.85	0.106	284.997	1618.86	1626.79	6.00	28.27	4.88	0.37	1627.16	0.106	0.106	0.303	0.40	0.15
5	66	111.0	1619.36	1626.97	5.50	23.75	4.67	0.34	1627.30	0.109	340.013	1620.10	1627.34	5.50	23.76	4.67	0.34	1627.68	0.109	0.109	0.371	0.50	0.17
6	60	83.00	1620.60	1627.57	5.00	19.63	4.23	0.28	1627.85	0.102	179.982	1620.92	1627.75	5.00	19.63	4.23	0.28	1628.03	0.102	0.102	0.183	0.70	0.19
7	54	56.00	1621.42	1628.03	4.50	15.90	3.52	0.19	1628.22	0.081	295.017	1622.74	1628.27	4.50	15.90	3.52	0.19	1628.46	0.081	0.081	0.239	2.40	0.46
8	36	28.00	1624.25	1628.73	3.00	7.07	3.96	0.24	1628.98	0.176	236.347	1625.01	1629.15	3.00	7.07	3.96	0.24	1629.39	0.176	0.176	0.417	0.58	0.14

Project File: CavassonSD_DD_UltimateFlows.stm	Number of lines: 8	Run Date: 8/31/2022

; c = cir e = ellip b = box

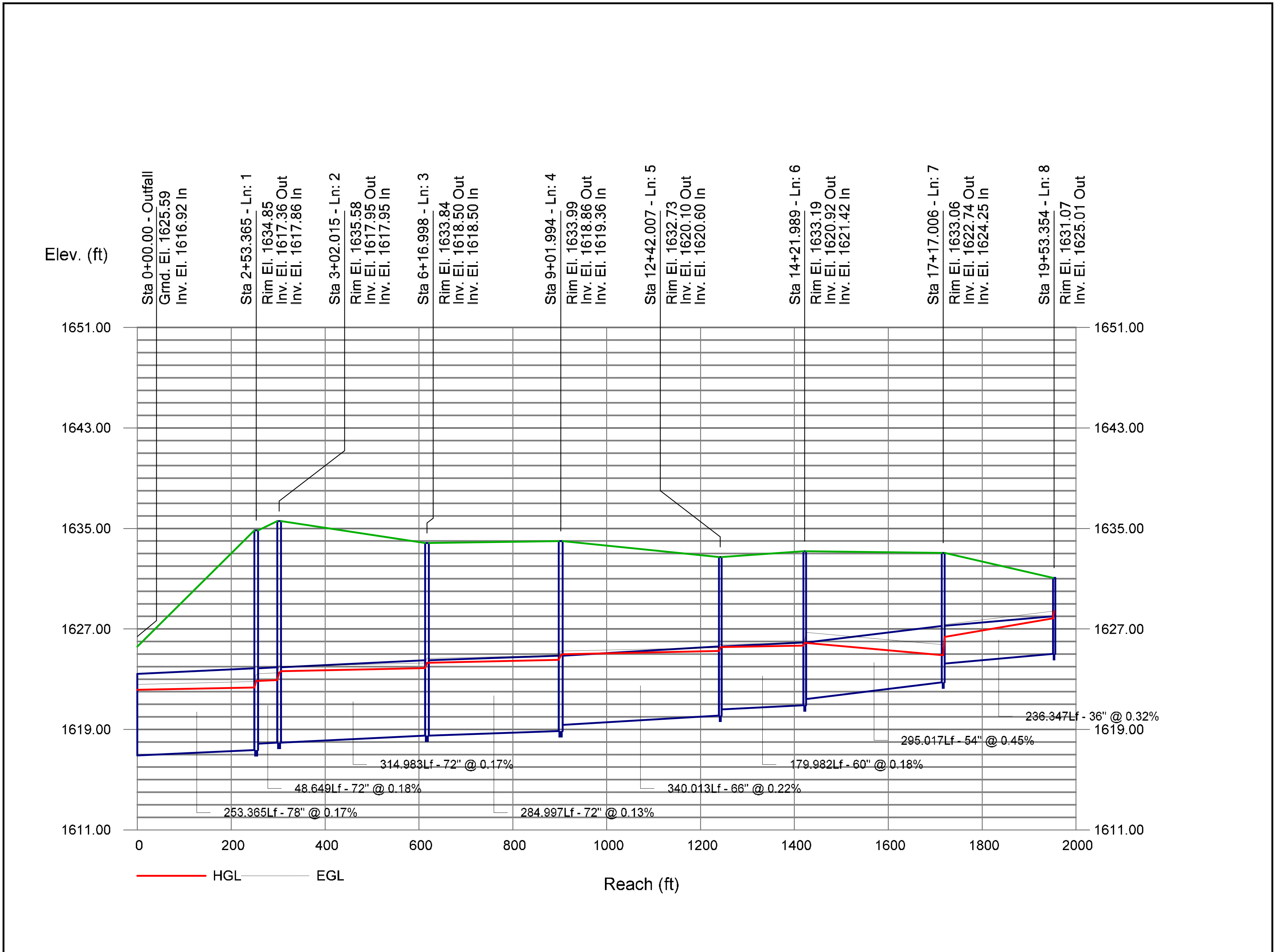
Storm Sewers v2019.20

5-ZN-2022

9/20/2022

Storm Sewer Profile

Proj. file: CavassonSD_DD_InterimFlows.stm



5-ZN-2022

Storm Sewers

9/20/2022

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	253.365	-114.934	MH	0.00	0.00	0.00	0.0	1616.92	0.17	1617.36	78	Cir	0.013	1.10	1634.85	
2	1	48.649	-51.922	MH	0.00	10.88	0.45	10.2	1617.86	0.18	1617.95	72	Cir	0.013	1.00	1635.58	
3	2	314.983	0.035	MH	0.00	4.48	0.45	11.0	1617.95	0.17	1618.50	72	Cir	0.013	1.00	1633.84	
4	3	284.997	-0.008	MH	0.00	19.84	0.45	11.5	1618.50	0.13	1618.86	72	Cir	0.013	1.00	1633.99	
5	4	340.013	0.005	MH	0.00	13.70	0.45	14.2	1619.36	0.22	1620.10	66	Cir	0.013	1.00	1632.73	
6	5	179.982	-0.008	MH	0.00	8.13	0.45	14.8	1620.60	0.18	1620.92	60	Cir	0.013	1.00	1633.19	
7	6	295.017	0.009	MH	0.00	6.72	0.45	15.0	1621.42	0.45	1622.74	54	Cir	0.013	1.00	1633.06	
8	7	236.347	0.000	MH	0.00	19.20	0.45	15.9	1624.25	0.32	1625.01	36	Cir	0.013	1.00	1631.07	

Project File: CavassonSD_DD_InterimFlows.stm | Number of lines: 8 | Date: 8/31/2022

5-ZN-2022
9/20/2022

Structure Report

Struct No.	Structure ID	Junction Type	Rim Elev (ft)	Structure			Line Out			Line In		
				Shape	Length (ft)	Width (ft)	Size (in)	Shape	Invert (ft)	Size (in)	Shape	Invert (ft)
1	MANHOLE #11	Manhole	1634.85	Cir	8.00	8.00	78	Cir	1617.36	72	Cir	1617.86
2	MANHOLE #10	Manhole	1635.58	Cir	8.00	8.00	72	Cir	1617.95	72	Cir	1617.95
3	MANHOLE #9	Manhole	1633.84	Cir	8.00	8.00	72	Cir	1618.50	72	Cir	1618.50
4	MANHOLE #8	Manhole	1633.99	Cir	8.00	8.00	72	Cir	1618.86	66	Cir	1619.36
5	MANHOLE #7	Manhole	1632.73	Cir	6.00	6.00	66	Cir	1620.10	60	Cir	1620.60
6	MAHHOLE #6	Manhole	1633.19	Cir	6.00	6.00	60	Cir	1620.92	54	Cir	1621.42
7	MANHOLE #5	Manhole	1633.06	Cir	6.00	6.00	54	Cir	1622.74	36	Cir	1624.25
8	MANHOLE #4	Manhole	1631.07	Cir	5.00	5.00	36	Cir	1625.01			

Project File: CavassonSD_DD_InterimFlows.stm	Number of Structures: 8	Run Date: 8/31/2022

5-ZN-2022
9/20/2022

Hydraulic Grade Line Computations

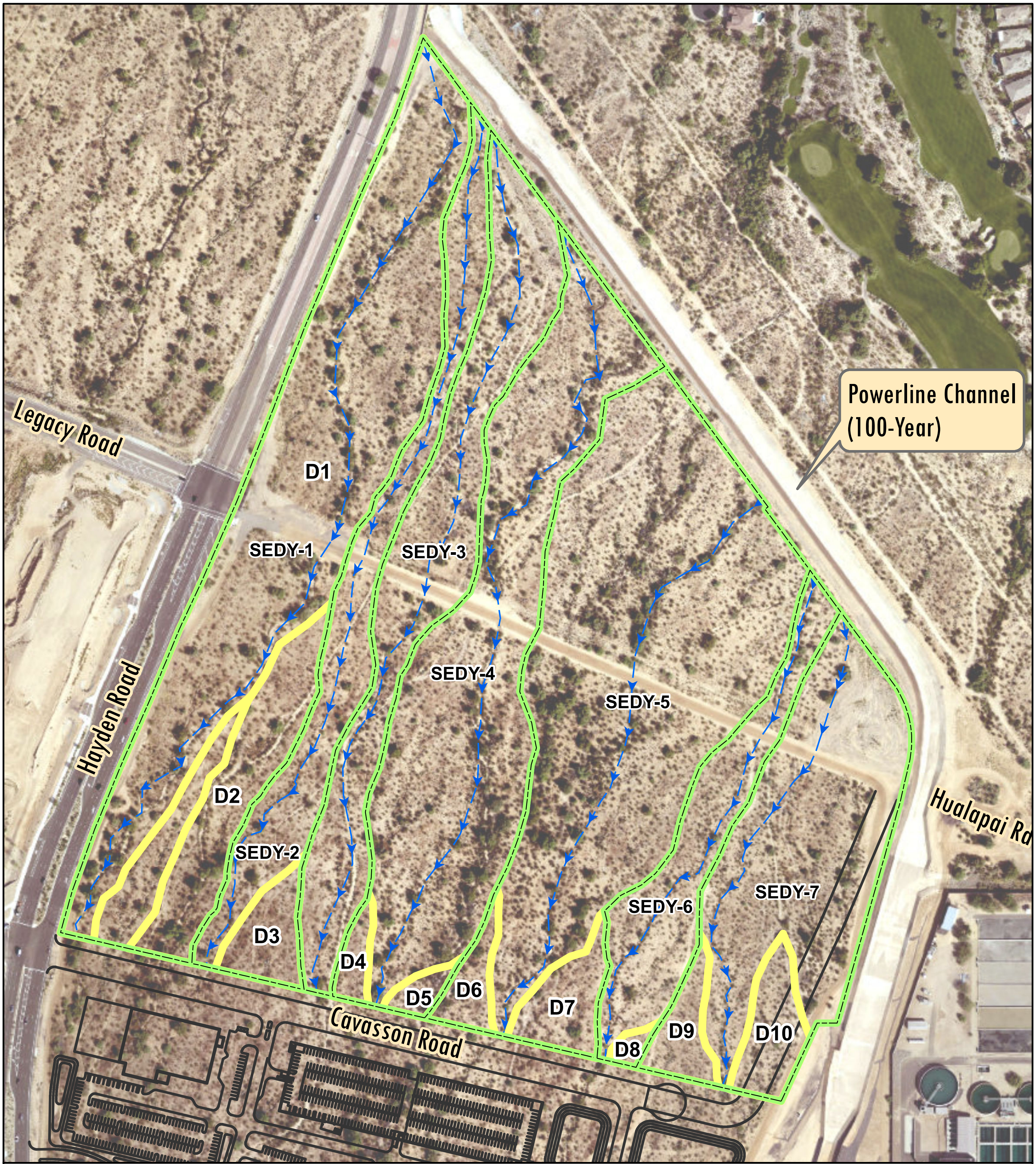
Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	78	151.8	1616.92	1622.15	5.23	28.61	5.30	0.44	1622.59	0.087	253.365	1617.36	1622.33	4.97	27.25	5.57	0.48	1622.82	0.096	0.091	0.232	1.10	0.53
2	72	152.3	1617.86	1622.87	5.00	25.20	6.05	0.57	1623.43	0.125	48.649	1617.95	1622.92	4.97	25.05	6.08	0.57	1623.50	0.127	0.126	0.061	1.00	0.57
3	72	136.2	1617.95	1623.63	5.68	27.69	4.92	0.38	1624.01	0.089	314.983	1618.50	1623.88	5.38	26.75	5.09	0.40	1624.29	0.091	0.090	0.285	1.00	0.40
4	72	131.4	1618.50	1624.32	5.82	28.02	4.69	0.34	1624.66	0.085	284.997	1618.86	1624.55	5.69	27.71	4.74	0.35	1624.90	0.083	0.084	0.239	1.00	0.35
5	66	96.69	1619.36	1624.99	5.50	23.75	4.07	0.26	1625.25	0.083	340.013	1620.10	1625.24	5.14	23.09	4.19	0.27	1625.51	0.072	0.077	0.263	1.00	0.27
6	60	70.71	1620.60	1625.56	4.96	19.61	3.61	0.20	1625.76	0.069	179.982	1620.92	1625.67	4.75	19.28	3.67	0.21	1625.88	0.064	0.066	0.119	1.00	0.21
7	54	56.03	1621.42	1625.88	4.46	7.59	3.53	0.85	1626.73	0.081	295.017	1622.74	1624.91	2.17**	7.59	7.38	0.85	1625.76	0.097	0.089	n/a	1.00	0.85
8	36	42.29	1624.25	1626.37	2.12*	5.33	7.93	0.98	1627.35	0.562	236.347	1625.01	1627.84	2.83	6.90	6.13	0.58	1628.42	0.348	0.455	1.075	1.00	0.58

Project File: CavassonSD_DD_InterimFlows.stm	Number of lines: 8	Run Date: 8/31/2022

Notes: * Critical depth assumed; ** Critical depth. ; c = cir e = ellip b = box

5-ZN-2022
9/20/2022

Appendix G Sediment Collection System Calculations



BANNER SCOTTSDALE CAMPUS
EXHIBIT G-1 - SEDIMENT YIELD HYDROLOGY

DIBBLE

Sediment Yield Subbasins
Ditch Subbasins
Time of Conc. Flowpath

N
0 175 350
Feet

5-ZN-2022
9/20/2022

BANNER SCOTTSDALE CAMPUS

DIBBLE PROJECT NO. 1121151

RATIONAL METHOD CALCULATIONS FOR SEDIMENT YIELD

SEDIMENT BASIN 1

CALC'D BY: JEP

DATE: 5/20/22

Design Data:

		Design Frequency						
		2	5	10	25	50	100	Year
Drainage Areas:	A_1	19.20	19.20	19.20	19.20	19.20	19.20	Acres
	A_2	0.00	-	-	-	-	-	Acres
	A_3	0.00	-	-	-	-	-	Acres
Total Drainage Area	A	19.20	19.20	19.20	19.20	19.20	19.20	Acres
Drainage Length		2798.40	2798.40	2798.40	2798.40	2798.40	2798.40	Feet
Elevations:								
Top of Drainage Area		1680.00	1680.00	1680.00	1680.00	1680.00	1680.00	Feet
At Structure		1632.00	1632.00	1632.00	1632.00	1632.00	1632.00	Feet
Drainage Area Slope		1.72	1.72	1.72	1.72	1.72	1.72	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

		Design Frequency						
		2	5	10	25	50	100	Year
Time of Concentration	T_c	24.54	21.19	19.44	17.76	16.76	15.91	Min
Rainfall Intensity	i	1.56	2.31	2.89	3.67	4.27	4.90	In/Hr
Runoff Coefficients:	C_1	0.37	0.37	0.37	0.37	0.42	0.45	
	C_2	-	-	-	-	-	-	
	C_3	-	-	-	-	-	-	
Weighted Runoff Coefficient	C_W	0.37	0.37	0.37	0.37	0.42	0.45	
Peak Discharge $Q_P = C_W \, I \, A$		11.1	16.4	20.5	26.1	34.4	42.3	cfs

Storage Volume Computations:	2	5	10	25	50	100	Year
Req.d Retention Vol. $V = C_W \, P_{2hr} \, A$	0.39	0.53	0.64	0.78	1.01	1.21	ac-ft

NOTES

1. Runoff coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment factors of 1.10, 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.
2. The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County.
3. Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and rights-of-way, or alleys.
4. Values based on the NDR terrain class. Values should be increased for NHS and NMT terrain classes by the difference between NHS (or NMT) and the NDR C values, up to a maximum of 0.95. Engineering judgement should be used.

5-ZN-2022
9/20/2022

BANNER SCOTTSDALE CAMPUS

DIBBLE PROJECT NO. 1121151
RATIONAL METHOD CALCULATIONS FOR SEDIMENT YIELD
SEDIMENT BASIN 2

DIBBLE

CALC'D BY: JEP
DATE: 5/20/22

Design Data:

		Design Frequency						
		2	5	10	25	50	100	Year
Drainage Areas:	A_1	6.72	6.72	6.72	6.72	6.72	6.72	Acres
	A_2	0.00	-	-	-	-	-	Acres
	A_3	0.00	-	-	-	-	-	Acres
Total Drainage Area	A	6.72	6.72	6.72	6.72	6.72	6.72	Acres
Drainage Length		2476.32	2476.32	2476.32	2476.32	2476.32	2476.32	Feet
Elevations:								
Top of Drainage Area		1680.00	1680.00	1680.00	1680.00	1680.00	1680.00	Feet
At Structure		1632.00	1632.00	1632.00	1632.00	1632.00	1632.00	Feet
Drainage Area Slope		1.94	1.94	1.94	1.94	1.94	1.94	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

		Design Frequency						
		2	5	10	25	50	100	Year
Time of Concentration	T_c	23.00	19.93	18.32	16.76	15.83	15.03	Min
Rainfall Intensity	i	1.63	2.38	2.97	3.75	4.36	5.00	In/Hr
Runoff Coefficients:	C_1	0.37	0.37	0.37	0.37	0.42	0.45	
	C_2	-	-	-	-	-	-	
	C_3	-	-	-	-	-	-	
Weighted Runoff Coefficient	C_W	0.37	0.37	0.37	0.37	0.42	0.45	
Peak Discharge $Q_P = C_W \, I \, A$		4.1	5.9	7.4	9.3	12.3	15.1	cfs

	2	5	10	25	50	100	Year
Storage Volume Computations:							
Req.d Retention Vol. $V = C_W \, P_{2hr} \, A$	0.14	0.19	0.22	0.27	0.35	0.42	ac-ft

NOTES

1. Runoff coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment factors of 1.10, 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.
2. The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County.
3. Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and rights-of-way, or alleys.
4. Values based on the NDR terrain class. Values should be increased for NHS and NMT terrain classes by the difference between NHS (or NMT) and the NDR C values, up to a maximum of 0.95. Engineering judgement should be used.

BANNER SCOTTSDALE CAMPUS

DIBBLE PROJECT NO. 1121151

RATIONAL METHOD CALCULATIONS FOR SEDIMENT YIELD

SEDIMENT BASIN 3

DIBBLE

CALC'D BY: JEP

DATE: 5/20/22

		Design Frequency						
Design Data:		2	5	10	25	50	100	Year
Drainage Areas:	A_1	8.13	8.13	8.13	8.13	8.13	8.13	Acres
	A_2	0.00	-	-	-	-	-	Acres
	A_3	0.00	-	-	-	-	-	Acres
Total Drainage Area	A	8.13	8.13	8.13	8.13	8.13	8.13	Acres
Drainage Length		2444.64	2444.64	2444.64	2444.64	2444.64	2444.64	Feet
Elevations:								
Top of Drainage Area		1680.00	1680.00	1680.00	1680.00	1680.00	1680.00	Feet
At Structure		1633.00	1633.00	1633.00	1633.00	1633.00	1633.00	Feet
Drainage Area Slope		16.00	1.92	1.92	1.92	1.92	1.92	%
Hydrologic Soil Group		B	B	B	B	B	B	
Design Computations:		Design Frequency						
		2	5	10	25	50	100	Year
Time of Concentration	T_c	10.21	19.62	18.05	16.51	15.60	14.79	Min
Rainfall Intensity	i	2.38	2.40	2.99	3.77	4.38	5.05	In/Hr
Runoff Coefficients:	C_1	0.37	0.37	0.37	0.37	0.42	0.45	
	C_2	-	-	-	-	-	-	
	C_3	-	-	-	-	-	-	
Weighted Runoff Coefficient	C_W	0.37	0.37	0.37	0.37	0.42	0.45	
Peak Discharge $Q_P = C_W I A$		7.1	7.2	9.0	11.4	15.0	18.5	cfs
Storage Volume Computations:		2	5	10	25	50	100	Year
Req.d Retention Vol. $V = C_W P_{2hr} A$		0.17	0.22	0.27	0.33	0.43	0.51	ac-ft

NOTES

1. Runoff coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment factors of 1.10, 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.
2. The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County.
3. Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and rights-of-way, or alleys.
4. Values based on the NDR terrain class. Values should be increased for NHS and NMT terrain classes by the difference between NHS (or NMT) and the NDR C values, up to a maximum of 0.95. Engineering judgement should be used.

BANNER SCOTTSDALE CAMPUS

DIBBLE PROJECT NO. 1121151
RATIONAL METHOD CALCULATIONS FOR SEDIMENT YIELD
SEDIMENT BASIN 4

DIBBLE

CALC'D BY: JEP
DATE: 5/20/22

Design Data:

		Design Frequency						
		2	5	10	25	50	100	Year
Drainage Areas:	A_1	13.70	13.70	13.70	13.70	13.70	13.70	Acres
	A_2	0.00	-	-	-	-	-	Acres
	A_3	0.00	-	-	-	-	-	Acres
Total Drainage Area	A	13.70	13.70	13.70	13.70	13.70	13.70	Acres
Drainage Length		2328.48	2328.48	2328.48	2328.48	2328.48	2328.48	Feet
Elevations:								
Top of Drainage Area		1674.00	1674.00	1674.00	1674.00	1674.00	1674.00	Feet
At Structure		1632.00	1632.00	1632.00	1632.00	1632.00	1632.00	Feet
Drainage Area Slope		1.80	1.80	1.80	1.80	1.80	1.80	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

		Design Frequency						
		2	5	10	25	50	100	Year
Time of Concentration	T_c	21.79	18.94	17.44	15.96	15.09	14.24	Min
Rainfall Intensity	i	1.68	2.44	3.03	3.82	4.43	5.16	In/Hr
Runoff Coefficients:	C_1	0.37	0.37	0.37	0.37	0.42	0.45	
	C_2	-	-	-	-	-	-	
	C_3	-	-	-	-	-	-	
Weighted Runoff Coefficient	C_W	0.37	0.37	0.37	0.37	0.42	0.45	
Peak Discharge $Q_P = C_W I A$		8.5	12.3	15.3	19.4	25.5	31.8	cfs

	2	5	10	25	50	100	Year
Storage Volume Computations:							
Req.d Retention Vol. $V = C_W P_{2hr} A$	0.28	0.38	0.46	0.55	0.72	0.86	ac-ft

NOTES

1. Runoff coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment factors of 1.10, 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.
2. The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County.
3. Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and rights-of-way, or alleys.
4. Values based on the NDR terrain class. Values should be increased for NHS and NMT terrain classes by the difference between NHS (or NMT) and the NDR C values, up to a maximum of 0.95. Engineering judgement should be used.

BANNER SCOTTSDALE CAMPUS
DIBBLE PROJECT NO. 1121151
RATIONAL METHOD CALCULATIONS FOR SEDIMENT YIELD
SEDIMENT BASIN 5

DIBBLE

CALC'D BY: JEP
DATE: 5/20/22

Design Data:		Design Frequency						
		2	5	10	25	50	100	Year
Drainage Areas:	A_1	19.84	19.84	19.84	19.84	19.84	19.84	Acres
	A_2	0.00	-	-	-	-	-	Acres
	A_3	0.00	-	-	-	-	-	Acres
Total Drainage Area	A	19.84	19.84	19.84	19.84	19.84	19.84	Acres
Drainage Length		1689.60	1689.60	1689.60	1689.60	1689.60	1689.60	Feet
Elevations:								
Top of Drainage Area		1662.00	1662.00	1662.00	1662.00	1662.00	1662.00	Feet
At Structure		1632.00	1632.00	1632.00	1632.00	1632.00	1632.00	Feet
Drainage Area Slope		1.78	1.78	1.78	1.78	1.78	1.78	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:		Design Frequency						
		2	5	10	25	50	100	Year
Time of Concentration	T_c	17.63	15.45	14.18	12.89	12.14	11.49	Min
Rainfall Intensity	i	1.86	2.64	3.31	4.25	4.98	5.74	In/Hr
Runoff Coefficients:	C_1	0.37	0.37	0.37	0.37	0.42	0.45	
	C_2	-	-	-	-	-	-	
	C_3	-	-	-	-	-	-	
Weighted Runoff Coefficient	C_W	0.37	0.37	0.37	0.37	0.42	0.45	
Peak Discharge $Q_P = C_W \, I \, A$		13.7	19.4	24.3	31.2	41.5	51.3	cfs

	2	5	10	25	50	100	
Storage Volume Computations:	2	5	10	25	50	100	Year
Req.d Retention Vol. $V = C_W \, P_{2hr} \, A$	0.41	0.55	0.66	0.80	1.04	1.25	ac-ft

NOTES

1. Runoff coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment factors of 1.10, 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.
2. The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County.
3. Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and rights-of-way, or alleys.
4. Values based on the NDR terrain class. Values should be increased for NHS and NMT terrain classes by the difference between NHS (or NMT) and the NDR C values, up to a maximum of 0.95. Engineering judgement should be used.

BANNER SCOTTSDALE CAMPUS

DIBBLE PROJECT NO. 1121151
RATIONAL METHOD CALCULATIONS FOR SEDIMENT YIELD
SEDIMENT BASIN 6

DIBBLE

CALC'D BY: JEP
DATE: 5/20/22

Design Data:

		Design Frequency						
		2	5	10	25	50	100	Year
Drainage Areas:	A_1	4.48	4.48	4.48	4.48	4.48	4.48	Acres
	A_2	0.00	-	-	-	-	-	Acres
	A_3	0.00	-	-	-	-	-	Acres
Total Drainage Area	A	4.48	4.48	4.48	4.48	4.48	4.48	Acres
Drainage Length		1462.56	1462.56	1462.56	1462.56	1462.56	1462.56	Feet
Elevations:								
Top of Drainage Area		1662.00	1662.00	1662.00	1662.00	1662.00	1662.00	Feet
At Structure		1633.00	1633.00	1633.00	1633.00	1633.00	1633.00	Feet
Drainage Area Slope		1.98	1.98	1.98	1.98	1.98	1.98	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

		Design Frequency						
		2	5	10	25	50	100	Year
Time of Concentration	T_c	16.88	14.78	13.53	12.32	11.61	11.00	Min
Rainfall Intensity	i	1.90	2.69	3.39	4.34	5.08	5.85	In/Hr
Runoff Coefficients:	C_1	0.37	0.37	0.37	0.37	0.42	0.45	
	C_2	-	-	-	-	-	-	
	C_3	-	-	-	-	-	-	
Weighted Runoff Coefficient	C_W	0.37	0.37	0.37	0.37	0.42	0.45	
Peak Discharge $Q_P = C_W \, I \, A$		3.1	4.5	5.6	7.2	9.5	11.8	cfs

	2	5	10	25	50	100	
Storage Volume Computations:	2	5	10	25	50	100	Year
Req.d Retention Vol. $V = C_W \, P_{2hr} \, A$	0.09	0.12	0.15	0.18	0.24	0.28	ac-ft

NOTES

1. Runoff coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment factors of 1.10, 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.
2. The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County.
3. Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and rights-of-way, or alleys.
4. Values based on the NDR terrain class. Values should be increased for NHS and NMT terrain classes by the difference between NHS (or NMT) and the NDR C values, up to a maximum of 0.95. Engineering judgement should be used.

BANNER SCOTTSDALE CAMPUS

DIBBLE PROJECT NO. 1121151

RATIONAL METHOD CALCULATIONS FOR SEDIMENT YIELD

SEDIMENT BASIN 7

DIBBLE

CALC'D BY: JEP

DATE: 5/20/22

Design Data:		Design Frequency						
		2	5	10	25	50	100	Year
Drainage Areas:	A_1	10.88	10.88	10.88	10.88	10.88	10.88	Acres
	A_2	0.00	-	-	-	-	-	Acres
	A_3	0.00	-	-	-	-	-	Acres
Total Drainage Area	A	10.88	10.88	10.88	10.88	10.88	10.88	Acres
Drainage Length		1404.48	1404.48	1404.48	1404.48	1404.48	1404.48	Feet
Elevations:								
Top of Drainage Area		1662.00	1662.00	1662.00	1662.00	1662.00	1662.00	Feet
At Structure		1634.00	1634.00	1634.00	1634.00	1634.00	1634.00	Feet
Drainage Area Slope		1.99	1.99	1.99	1.99	1.99	1.99	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:		Design Frequency						
		2	5	10	25	50	100	Year
Time of Concentration	T_c	15.71	13.64	12.52	11.43	10.79	10.23	Min
Rainfall Intensity	i	1.95	2.82	3.53	4.49	5.23	6.01	In/Hr
Runoff Coefficients:	C_1	0.37	0.37	0.37	0.37	0.42	0.45	
	C_2	-	-	-	-	-	-	
	C_3	-	-	-	-	-	-	
Weighted Runoff Coefficient	C_W	0.37	0.37	0.37	0.37	0.42	0.45	
Peak Discharge $Q_P = C_W\, I\, A$		7.8	11.3	14.2	18.1	23.9	29.4	cfs

	2	5	10	25	50	100	Year
Storage Volume Computations:							
Req.d Retention Vol. $V = C_W\, P_{2hr}\, A$	0.22	0.30	0.36	0.44	0.57	0.69	ac-ft

NOTES

1. Runoff coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment factors of 1.10, 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.
2. The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County.
3. Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and rights-of-way, or alleys.
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		Q (cfs)	Volume (ac-ft)	Wash Load (ac-ft)	Bed Load (ac-ft)	Total Yield (ac-ft)
ID: SEDY-1	**2 Year:**	11	0.39	0.001	0.002	0.003
Return Periods for Analysis: All	**5 Year:**	16	0.53	0.001	0.003	0.004
	10 Year:	21	0.64	0.001	0.004	0.005
	25 Year:	26	0.78	0.002	0.005	0.007
	50 Year:	34	1.01	0.002	0.007	0.009
	100 Year:	42	1.21	0.003	0.010	0.013
	Design:	42	1.21	0.003	0.01	0.013
	Annual:			0.001	0.002	0.003
ID: SEDY-2	**2 Year:**	4	0.14	-	0.001	0.001
Return Periods for Analysis: All	**5 Year:**	6	0.19	-	0.001	0.001
	10 Year:	7	0.22	-	0.001	0.001
	25 Year:	9	0.27	0.001	0.001	0.002
	50 Year:	12	0.35	0.001	0.002	0.003
	100 Year:	15	0.42	0.001	0.003	0.004
	Design:	15	0.42	0.001	-	0.004
	Annual:			-	0.001	0.001
ID: SEDY-3	**2 Year:**	7	0.17	-	0.001	0.001
Return Periods for Analysis: All	**5 Year:**	7	0.22	-	0.001	0.001
	10 Year:	9	0.27	0.001	0.001	0.002
	25 Year:	11	0.33	0.001	0.002	0.003
	50 Year:	15	0.43	0.001	0.003	0.004
	100 Year:	19	0.51	0.001	0.004	0.005
	Design:	19	0.51	0.001	-	0.005
	Annual:			-	0.001	0.001
ID: SEDY-4	**2 Year:**	9	0.28	-	0.002	0.002
Return Periods for Analysis: All	**5 Year:**	12	0.38	0.001	0.002	0.003
	10 Year:	15	0.46	0.001	0.003	0.004
	25 Year:	19	0.55	0.001	0.004	0.005
	50 Year:	26	0.72	0.001	0.006	0.007
	100 Year:	32	0.86	0.002	0.007	0.009
	Design:	32	0.86	0.002	0.01	0.009
	Annual:			-	0.002	0.002
ID: SEDY-5	**2 Year:**	14	0.41	0.001	0.003	0.004
Return Periods for Analysis: All	**5 Year:**	19	0.55	0.001	0.004	0.005
	10 Year:	24	0.66	0.001	0.005	0.006
	25 Year:	31	0.80	0.002	0.007	0.009
	50 Year:	42	1.04	0.002	0.010	0.012
	100 Year:	51	1.25	0.003	0.013	0.016

		Q (cfs)	Volume (ac-ft)	Wash Load (ac-ft)	Bed Load (ac-ft)	Total Yield (ac-ft)
	Design:	51	1.25	0.003	0.01	0.016
	Annual:			0.001	0.003	0.004
ID: SEDY-6	**2 Year:**	3	0.09	-	-	-
Return Periods for Analysis: All	**5 Year:**	5	0.12	-	0.001	0.001
	10 Year:	6	0.15	-	0.001	0.001
	25 Year:	7	0.18	-	0.001	0.001
	50 Year:	10	0.24	-	0.002	0.002
	100 Year:	12	0.28	0.001	0.002	0.003
	Design:	12	0.28	0.001	-	0.003
	Annual:			-	-	-
ID: SEDY-7	**2 Year:**	8	0.22	-	0.001	0.001
Return Periods for Analysis: All	**5 Year:**	11	0.30	0.001	0.002	0.003
	10 Year:	14	0.36	0.001	0.003	0.004
	25 Year:	18	0.44	0.001	0.003	0.004
	50 Year:	24	0.57	0.001	0.005	0.006
	100 Year:	29	0.69	0.001	0.007	0.008
	Design:	29	0.69	0.001	0.01	0.008
	Annual:			-	0.001	0.001

Flood Control District of Maricopa County
Drainage Design Management System
RIVER MECHANICS - CROSS SECTION HYDRAULICS
Project Reference: BANNER SCOTTSDALE RM

8/31/2022

Section ID	Flow Type	Entire Section: Q (cfs)	Slope (f/f)	Man'g N Channel	Man'g N LOB	Man'g N ROB	Area (sq ft)	W.P. (ft)	Avg Width (ft)	Top Width (ft)	Hyd Depth (ft)	Max Depth (ft)	Vel (f/s)	Channel Section: Hyd Depth (ft)	Vel (ft/sec)	Froude Num
SEDY-1	Design Dominant	37	0.017500	0.030	0.045	0.045	8.41	18.24	7.46 0.00	18.02	0.47	1.13	4.40	0.47	4.40	1.13
SEDY-2	Design Dominant	12	0.019378	0.030	0.045	0.045	3.68	26.59	5.10 0.00	26.45	0.14	.72	3.26	0.14	3.26	1.54
SEDY-3	Design Dominant	16	0.019207	0.030	0.045	0.045	4.30	12.56	5.39 0.00	12.40	0.35	.80	3.72	0.35	3.72	1.11
SEDY-4	Design Dominant	26	0.018057	0.030	0.045	0.045	7.41	22.46	12.54 0.00	22.25	0.33	.59	3.51	0.33	3.51	1.08
SEDY-5	Design Dominant	42	0.017741	0.030	0.045	0.045	6.93	9.73	3.38 0.00	8.33	0.83	2.05	6.06	0.83	6.06	1.17
SEDY-6	Design Dominant	11	0.019836	0.030	0.045	0.045	2.84	6.88	3.33 0.00	6.66	0.43	.85	3.87	0.43	3.87	1.04
SEDY-7	Design Dominant	25	0.019915	0.030	0.045	0.045	4.93	7.98	3.58 0.00	7.43	0.66	1.38	5.07	0.66	5.07	1.10

Worksheet for D1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00600	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	8.00	ft
Discharge	33.00	ft³/s

Results

Normal Depth	0.93	ft
Flow Area	10.94	ft²
Wetted Perimeter	15.69	ft
Hydraulic Radius	0.70	ft
Top Width	15.46	ft
Critical Depth	0.71	ft
Critical Slope	0.01614	ft/ft
Velocity	3.02	ft/s
Velocity Head	0.14	ft
Specific Energy	1.07	ft
Froude Number	0.63	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.93	ft
Critical Depth	0.71	ft
Channel Slope	0.00600	ft/ft

5-ZN-2022
9/20/2022

Worksheet for D1

GVF Output Data

Critical Slope	0.01614	ft/ft

5-ZN-2022
9/20/2022

Worksheet for D2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00600	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Discharge	7.00	ft^3/s

Results

Normal Depth	0.89	ft
Flow Area	3.19	ft^2
Wetted Perimeter	7.36	ft
Hydraulic Radius	0.43	ft
Top Width	7.14	ft
Critical Depth	0.72	ft
Critical Slope	0.01922	ft/ft
Velocity	2.19	ft/s
Velocity Head	0.07	ft
Specific Energy	0.97	ft
Froude Number	0.58	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.89	ft
Critical Depth	0.72	ft
Channel Slope	0.00600	ft/ft
Critical Slope	0.01922	ft/ft

Worksheet for D3-D11

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02000	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Discharge	5.00	ft^3/s

Results

Normal Depth	0.63	ft
Flow Area	1.58	ft^2
Wetted Perimeter	5.18	ft
Hydraulic Radius	0.30	ft
Top Width	5.02	ft
Critical Depth	0.63	ft
Critical Slope	0.02010	ft/ft
Velocity	3.17	ft/s
Velocity Head	0.16	ft
Specific Energy	0.78	ft
Froude Number	1.00	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.63	ft
Critical Depth	0.63	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.02010	ft/ft

5-ZN-2022
9/20/2022

Worksheet for SEDY1

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	42.00	ft³/s
Crest Elevation	1629.50	ft
Tailwater Elevation	1629.50	ft
Crest Surface Type	Paved	
Crest Breadth	1.00	ft
Crest Length	12.00	ft

Results

Headwater Elevation	1630.59	ft
Headwater Height Above Crest	1.09	ft
Tailwater Height Above Crest	0.00	ft
Weir Coefficient	3.09	US
Submergence Factor	1.00	
Adjusted Weir Coefficient	3.09	US
Flow Area	13.05	ft²
Velocity	3.22	ft/s
Wetted Perimeter	14.17	ft
Top Width	12.00	ft

5-ZN-2022
9/20/2022

Worksheet for SEDY2

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	15.00	ft³/s
Crest Elevation	1629.78	ft
Tailwater Elevation	1629.78	ft
Crest Surface Type	Paved	
Crest Breadth	1.00	ft
Crest Length	6.00	ft

Results

Headwater Elevation	1630.65	ft
Headwater Height Above Crest	0.87	ft
Tailwater Height Above Crest	0.00	ft
Weir Coefficient	3.09	US
Submergence Factor	1.00	
Adjusted Weir Coefficient	3.09	US
Flow Area	5.21	ft²
Velocity	2.88	ft/s
Wetted Perimeter	7.74	ft
Top Width	6.00	ft

5-ZN-2022
9/20/2022

Worksheet for SEDY3

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	19.00	ft³/s
Crest Elevation	1631.00	ft
Tailwater Elevation	1631.00	ft
Crest Surface Type	Paved	
Crest Breadth	1.00	ft
Crest Length	6.00	ft

Results

Headwater Elevation	1632.02	ft
Headwater Height Above Crest	1.02	ft
Tailwater Height Above Crest	0.00	ft
Weir Coefficient	3.09	US
Submergence Factor	1.00	
Adjusted Weir Coefficient	3.09	US
Flow Area	6.10	ft²
Velocity	3.11	ft/s
Wetted Perimeter	8.03	ft
Top Width	6.00	ft

5-ZN-2022
9/20/2022

Worksheet for SEDY4

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	32.00	ft³/s
Crest Elevation	1630.30	ft
Tailwater Elevation	1630.30	ft
Crest Surface Type	Paved	
Crest Breadth	1.00	ft
Crest Length	10.00	ft

Results

Headwater Elevation	1631.32	ft
Headwater Height Above Crest	1.02	ft
Tailwater Height Above Crest	0.00	ft
Weir Coefficient	3.09	US
Submergence Factor	1.00	
Adjusted Weir Coefficient	3.09	US
Flow Area	10.24	ft²
Velocity	3.12	ft/s
Wetted Perimeter	12.05	ft
Top Width	10.00	ft

5-ZN-2022
9/20/2022

Worksheet for SEDY5

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	51.00	ft³/s
Crest Elevation	1630.40	ft
Tailwater Elevation	1630.40	ft
Crest Surface Type	Paved	
Crest Breadth	1.00	ft
Crest Length	12.00	ft

Results

Headwater Elevation	1631.64	ft
Headwater Height Above Crest	1.24	ft
Tailwater Height Above Crest	0.00	ft
Weir Coefficient	3.09	US
Submergence Factor	1.00	
Adjusted Weir Coefficient	3.09	US
Flow Area	14.85	ft^2
Velocity	3.43	ft/s
Wetted Perimeter	14.48	ft
Top Width	12.00	ft

5-ZN-2022
9/20/2022

Worksheet for SEDY6

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	12.00	ft³/s
Crest Elevation	1632.60	ft
Tailwater Elevation	1632.60	ft
Crest Surface Type	Paved	
Crest Breadth	1.00	ft
Crest Length	6.00	ft

Results

Headwater Elevation	1633.35	ft
Headwater Height Above Crest	0.75	ft
Tailwater Height Above Crest	0.00	ft
Weir Coefficient	3.09	US
Submergence Factor	1.00	
Adjusted Weir Coefficient	3.09	US
Flow Area	4.49	ft²
Velocity	2.67	ft/s
Wetted Perimeter	7.50	ft
Top Width	6.00	ft

5-ZN-2022
9/20/2022

Worksheet for SEDY7

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	29.00	ft³/s
Crest Elevation	1632.60	ft
Tailwater Elevation	1632.60	ft
Crest Surface Type	Paved	
Crest Breadth	1.00	ft
Crest Length	10.00	ft

Results

Headwater Elevation	1633.56	ft
Headwater Height Above Crest	0.96	ft
Tailwater Height Above Crest	0.00	ft
Weir Coefficient	3.09	US
Submergence Factor	1.00	
Adjusted Weir Coefficient	3.09	US
Flow Area	9.59	ft²
Velocity	3.02	ft/s
Wetted Perimeter	11.92	ft
Top Width	10.00	ft

5-ZN-2022
9/20/2022