OV Case #2002761
Grading Permit #2202968

PLANS REVIEWED AND ACCEPTED FOR CODE COMPLIANCE

Stormwater: droberts 07/03/2024

The issuance of a permit shall not be construed to be a permit or approval of any violation of the codes or ordinances of the Town of Oro Valley

NARANJA TRAILS

Final Drainage Report

Town of Oro Valley, AZ

Job No: 20000103

NWQ S12, T12S, R13E

TOV Permit(s): 2000939, 2002761, 2202968, 2202968, 2301593

Pima County Tax ID(s): 22428156G, 22428156H, 22428156F

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May 23, 2024

ATWELL

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1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

Naranja Trails (Project) is an approximately 58-acre, 61-Lot residential development located within a portion of Section 12, Township 12 South, Range 13 East, of the Gila and Salt River Base and Meridian, Town of Oro Valley, Pima County, Arizona.

1.2 LOCATION AND TOPOGRAPHY

The Project site is bounded to the north by Naranja Drive, to the east by Pusch Ridge Vistas, to the south by the Highlands mobile home park and by Naranja Ridge Estates to the west. The Highlands Wash enters the site via a culvert under Naranja Drive and exists the site to the south into the Highlands. See *Exhibit 1 – Vicinity Map* for the location of this project.

The Project site slopes generally southerly at an average slope of 2.7%. The majority of the site is typical of a river bottom, with bunches of grasses, bushes and shrubs. Offsite flows enter the site via a culvert under Naranja Drive. Just south of the culvert there is a well incised thalweg that gives way to a braided wash formation about 1,000-feet south of Naranja Drive. Along the southern property line existing levees are built up to funnel these spread flows into a channel through the Highlands.

As previously stated, to the east lies the Pusch Ridge Vistas subdivision. This subdivision drains into an existing wash located in the southeastern portion of the Project that discharges into a detention basin that attenuates the flows before discharging into Highlands Wash. Upon completion of the Naranja Trails project, this existing detention basin will be abandoned and filled. Flows generated from the Pusch Ridge Vistas development will maintain its existing flow path and will be conveyed into a proposed culvert that crosses N. Shore Cliff Drive and discharged upstream of the existing southern levee. Ultimately, these flows will converge into the proposed sediment basin and exit the Site via the Highlands channel.

1.3 PURPOSE OF THE REPORT

The purpose of this Final Drainage Report is to verify that the proposed development will have sufficient drainage infrastructure to accommodate the 100-year, 2-hour storm event and provide the required storm water detention for the Site. Additionally, this report will assess the flood limits of Highlands Wash as they convey through the site within the proposed improvements. The report will compare the proposed water surface elevations to the existing conditions and outline measures to address increased runoff resulting from the development

within the drainage basin. Furthermore, it will propose the removal of the Pusch Ridge Vista Detention basin to accommodate the proposed development. Wherever feasible, the design concepts utilized in the Highlands Wash Project should also be integrated to help mitigate regional peak flows and facilitate the provision of a sediment basin.

The analyses detailed in this report have been prepared in accordance with the *2022 Town of Oro Valley Drainage Criteria Manual (DCM)*, *Pima County Regional Flood Control District's Technical Policy Tech-033*, *Drainage and Channel Design Standards for Local Drainage in Pima County* and general standard engineering practices.

1.4 PURPOSE OF IMPROVEMENTS

The proposed improvements have many purposes and benefits to multiple stake holders. The primary benefit and goal of these improvements is to create a safe, habitable development that will provide housing that is protected from flood waters. Secondary benefits include flood control, sediment management, wash access (for continued maintenance), higher level of stormwater quality and a source for fill dirt.

These improvements will elevate and protect adjacent residential lots so that floodwater will not pose a risk to the proposed structures. These improvements include an inline detention/sediment basin that will allow floodwater to drop a portion of the suspended sediment load prior to entering the Highland subdivision. It is understood that in the current conditions there are significant amount of sediment deposits in the Highlands Wash. Sediment deposition has the potential to reduce the conveyance capacity of any conveyance corridor. By providing a basin, the sediment load will reduce and therefore protect downstream structures and conveyances corridors from sediment deposition. The current inline basin design attenuates the peak flows only slightly, enough to offset any increases due to the development. However, as discussed later in this report, this is only a small portion of a regional solution to the flooding issues in this area. A regional plan has been prepared to construct a levee that will further increase the attenuation and reduce the peak flow. Upon completion of the proposed levee and channel system through the Highlands, the stormwater quality will increase because the suspended sediment load will be dramatically reduced.

These improvements also provide access for maintenance crews to get to the downstream side of the culvert under Naranja Drive and the detention/sediment basin. Having reliable access is critical to a proper maintenance program.

Lastly, typically, a private development would not realize the return on investment

in creating such a large detention basin. In the case of this development, the return on this investment is realized in the readily available fill dirt that is required to elevate the proposed lots above the adjacent flood waters.

In summary, the community will benefit by increased storm water quality and reduced sediment loads, the Town of Oro Valley will benefit by gaining reliable access to their storm water facilities and reduced sediment loads in downstream conveyance corridors and the owner/developer will benefit by gaining developable property and access to needed fill dirt.

1.5 PREVIOUS AND ON-GOING STUDIES

1.5.a Drainage Report for Highlands Wash Design Concept Memorandum and Improvement Plans

This reach of Highlands Wash was specifically studied in the *Drainage Report for Highlands Wash Design Concept Memorandum and Improvement Plans*, prepared by Arroyo Engineering LLC, dated December 30, 2019, (Highland Wash Study). The purpose of the Highlands Wash Study was to:

1) Evaluate and confirm the use of the 2013 District hydrologic analysis
2) Perform an updated existing conditions hydraulic analysis of the Highland Wash using new 2018 topographic data provided by the Town of Oro Valley
3) Develop a final concept design for the proposed channel and levee improvements at The Highlands
4) Complete a Design Concept Memorandum and Improvement Plans for the proposed flood-control improvements

Due to the previously mentioned braided wash system, this report analyzed Highlands Wash using the FLO-2D program from Naranja Drive downstream to the Canada del Oro (CDO) Wash. The focus of the Highlands Wash Study was to evaluate and propose a plan to mitigate flooding within The Highlands. As a recommendation, a sediment basin was proposed on the southern portion of this Project's site, just prior to entering The Highlands. At the time of this report, no construction has started on or permits issued for this sediment basin. This basin will not be included in the existing conditions model presented in this report.

1.5.b Highland Wash Basin Management Study

The Highland Wash Basin Management Study, Phase III Final Report (Camp Dresser & McKee, Inc. (CDM), 1990) was prepared to address flooding issues within The Highlands, a residential subdivision located just north of Lambert Lane

near the downstream confluence with the Canada Del Oro Wash. The Highland Wash is conveyed through the subdivision within an undersized constructed channel that is prone to overtopping. The report offered several alternatives designed to address overbank flooding within The Highlands. The recommended alternative included:

1) New in channel detention facilities located behind existing culverts at Moore, Tangerine, and Naranja Roads,
2) Reconstruction of the existing training levee located north of The Highlands
3) A new concrete trapezoid channel through The Highlands capable of conveying the reduced flood peak.

The CDM-recommended in-channel detention facilities have been constructed at Moore, Tangerine, and Naranja Roads.

1.5.c Technical Data Notebook for Highland Wash and its Tributaries

More recent hydrologic modeling and floodplain mapping for the Highland Wash and tributaries have been completed as part of the *Technical Data Notebook for Hydrologic and Hydraulic Mapping of the Highland Wash and its Tributaries* (Pima County Regional Flood Control District, [preliminary] 2013). (Known herein as the TDN) Floodplain mapping was completed for the wash and tributaries between W. Tortolita Mountain Circle on the north and Lambert Lane on the south. The study incorporated hydrologic modeling with HEC-HMS and floodplain mapping with HEC-RAS. The District created a baseline hydrologic model for the Highland Wash for comparison with the results presented in the Highland Wash Basin Management Study (CDM, 1990). A refined hydrologic model was also produced which included areal reduction and new in-channel detention basins located upstream of Moore Road, Tangerine Road, and Naranja Road. The refined model produced a discharge of 2,160 cfs at Lambert Lane. The three basins have reduced the 100-yr peak discharge at The Highlands by approximately 30%.

1.5.d Drainage Report of Pusch Ridge Vistas

Baker & Associates Engineering, Inc. prepared improvement plans and a drainage report, dated March 6, 2002. For the development of the Pusch Ridge Vistas subdivision.

2.0 FEMA FIRM

The Site is located on Federal Emergency Management Agency (FEMA), Flood Insurance

Rate Map (FIRM) No. 04019C1090L. The Project is located in the Flood Hazard Zone “X”. Zone “X” is defined as:

> “Areas of Minimal Flood Hazard”

While this Project is located within FEMA Flood Hazard Zone “X”, Highlands Wash is a locally regulated wash by Pima County Flood Control and the Town of Oro Valley. Refer to *Exhibit 2- FEMA FIRM* for a copy of the map.

3.0 OFFSITE HYDROLOGY

Flows within Highlands Wash have been studied in detail in the previous studies. The previously prepared HEC-HMS files were updated, as discussed below, and were used as hydrograph inputs for the 2-dimensional modeling of Highlands Wash and the wash from Pusch Ridge Vistas. In summary of the previous efforts, the floodplain mapping used for this modeling required the obtaining of the 100-year discharge. The U.S. Army Corps of Engineers Computer Hydrologic Modeling System, (HEC-HMS) version 4.3 was used to estimate the required discharge. The HEC-HMS model requires parameters regarding rainfall, topography, soil, and vegetation characteristics to estimate the volume and peak discharges. Those parameters were determined according to the *Pima County Regional Flood Control District Technical Policy 018* (Tech-018). The purpose of the hydrologic study contained herein is to compare the proposed hydrology to the existing conditions to show that the proposed improvements will not increase the peak flow in the downstream properties and to prepare the hydrologic inputs for the hydraulic modeling of the Highland Wash.

3.1 Parameter Estimation

The methods used to determine discharge in the Pusch Ridge Vistas subdivision and the revised areas due to subdivision of drainage boundaries and the proposed development are summarized in Table 3.1.1 below. For the most part, data inputs were taken from the *Drainage Report for Pusch Ridge Vistas*, or the TDN due to slight differences in calculation methods, Pusch Ridge Vistas flow were calculated separately from the regional flows.

Table 3.1.1 – Methods used for HEC-HMS analysis

	Selected Method
Rainfall	NOAA 14, upper 90% Confidence Interval
Rainfall Distribution	3-hr SCS Type II Storm
Rainfall Loss	SCS Curve Number
Time of Concentration	SCS Segmental Method
Transform	SCS Unit Hydrograph

3.1.a Drainage Boundaries

In general, drainage boundaries were taken as presented in the Technical Data Notebook for Highland Wash and its Tributaries (TDN). Sub-Basin HW-01 was sub-divided further to introduce more refined view of the subject parcel and neighboring properties. One of the neighboring properties is located to the east of the subject site, namely Pusch Ridge Vistas. Pusch Ridge Vistas drainage boundaries were estimated from the aerial topographic survey and the previously mentioned Pusch Ridge Vistas Drainage Report. The majority of the Pusch Ridge Vistas subdivision drains away from the proposed improvements. The southern portion of Pusch Ridge Vistas drains through the southern portion of our proposed improvements. Regional drainage boundaries were subdivided using topographic data. Overall subbasin boundaries were accepted as presented in the TDN.

The proposed drainage boundaries were based on the proposed grading plan. Separating out the residential improvements from the original drainage boundary and Pusch Ridge Vistas.

3.1.b Watershed Work Maps

The drainage boundary of the contributing watershed was determined using the 2020 Version of AutoCAD Civil 3D, aerial topography and the original construction paving plans for Pusch Ridge Vistas. The delineated drainage boundaries are shown on *Exhibit 3 – Existing HEC-HMS Schematic* and *Exhibit 4 – Proposed HEC-HMS* Schematic.

3.1.c Precipitation

NOAA Atlas 14 was used to obtain the upper 90% rainfall depth for the 100-year, 3-hour storm event. A depth of 3.23 inches was used for this offsite drainage boundary. The original Areal Reduction factors were incorporated into the model as described in the TDN. The original model, provided by the Flood Control District for Pima County, contained multiple precipitation gages to accommodate different Areal Reduction Factor for different locations throughout the study area. This project utilized the “3-hr Type II AR 3” precipitation gage with a total rainfall of 2.99-inches.

3.1.d Physical Parameters

The SCS Curve Number (CN) method was utilized as a rainfall loss method in the HEC-HMS model. the CN was determined using the Curve Number tables in the Hydrologic Soils Group maps associated with the PC Hydro User Guide (Arroyo Engineering 2007). Vegetation and the impervious fraction of the watershed were estimated using the aerial photography.

3.1.e Model Preparation

Two HEC-HMS models were prepared for this project; an Existing Conditions; Proposed Conditions. For the existing and proposed models, sub-basin HW01 was divided into sub-boundaries relative to the study areas. The existing conditions model increased focus on the existing detention basin graded with the Pusch Ridge Vistas improvements and the peak flow at the upstream end of the Highlands model home development. The proposed conditions accounts for the developed portions of the proposed Naranja Trails subdivision and the proposed regional detention basin just upstream of the Highlands. Table 3.2 summarizes the Sub-basin characteristics for the separate models.

The Lag Time was calculated using methods described in Chapter 15 – Time of Concentration of Part 630 National Engineering Handbook, prepared by the Natural Resources Conservation Services (NRCS), formerly SCS, equations 15-4a, shown below. No additional channel routing or shallow sheet flow was considered for these drainage basins. HEC-HMS reports are included in the *Appendix B* of this Report. A copy of the HEC-HMS model files can be provided upon request.

$$L = \frac{\ell^{0.8}(S+1)^{0.7}}{1{,}900Y^{0.5}} \qquad \text{(eq. 15–4a)}$$

Applying equation 15–3, $L=0.6T_c$, yields:

$$T_c = \frac{\ell^{0.8}(S+1)^{0.7}}{1{,}140Y^{0.5}} \qquad \text{(eq. 15–4b)}$$

where:

L = lag, h
T_c = time of concentration, h
ℓ = flow length, ft
Y = average watershed land slope, %
S = maximum potential retention, in

$$= \frac{1{,}000}{cn'} - 10$$

where:

cn' = the retardance factor

Table 3.1.2 Sub-Basin Characteristics – HEC-HMS

Drainage Basin	Area (sq.mi.)	CN	Impervious Area (%)	Vegetation Cover (%)	Lag Time (min.)
Existing Conditions					
HW01A	0.0403	91.53	30	15	13.3
HW01B	0.1084	84.34	0	15	24.9
HW01C	0.0301	88.98	30	15	13.4
Proposed Conditions					
HW01A	0.0403	91.53	30	15	13.3
HW01B	0.0760	84.23	0	15	24.9
HW01C	0.0270	88.66	30	15	13.4
HW01D	0.0355	88.66	30	15	11.9

3.1.f Detention Basins

Currently, there is an existing detention basin within the development area of Naranja Trails. This basin was incorporated into the improvements of Pusch Ridge Vistas development in order to mitigate the hydrologic impacts of that subdivision. The existing conditions model evaluates this basin in the modeling considerations. The proposed improvements include a larger detention basin upstream of the Highlands, to offset some of the impacts associated with the development of Naranja Trails and the existing impact of Pusch Ridge Vistas. Information on these basins is summarized in the below table. The proposed channel will have two points of access, one from the north, one from the south. Each access path will be approximately 16-feet wide and will have a maximum longitudinal slope of approximately 10%.

The design of the proposed basin is based on incising the wash and terminating the incision with a long daylight cut. This will provide sufficient attenuation for the proposed improvements so as to not increase flows downstream and return the flows to near existing conditions so there will be no adverse impact to the downstream properties. This incisement will be drained with small ditches that will tie-in downstream and drain the detained stormwaters.

Table 3.1.3 Detention Basin Characteristics

HEC-HMS Detention Basin ID	Bottom Elevation	Overflow Crest Elevation	Overflow Crest Length (ft)	Volume @ Crest (ac-ft)
PRV	2575.5	2579.5	100	3.0
RETNAR	2566.59	2570.0	~600ft	10.0

3.2 HYDROLOGIC RESULTS

The 100-year peak discharges at the concentration points along Highlands Wash were determined using the HEC-HMS program.

Table 3.2.1 below summarizes the drainage sub-basins analysis results that were modified within this updated study. See screenshots from HEC-HMS in the Appendix of this report for further detail and the digital model for complete model result details.

Table 3.2.1 Summary of the Sub-Basin Hydrologic Analysis Results

Drainage Sub-Basin	Area (sq.mi.)	100-yr Peak Discharge (cfs)	Runoff Volume (Acre-feet)
Existing Conditions			
HW01A	0.0403	93.6	4.5
HW01B	0.1084	164.9	8.9
HW01C	0.0301	72.4	3.0
Proposed Conditions			
HW01A	0.0403	93.6	4.5
HW01B	0.0812	85.4	6.2
HW01C	0.0322	55.8	2.7
HW01D	0.0252	77.8	3.5

The proposed in-line basin (RETNAR) will experience a maximum stage of 2573.9 (7.3 feet), temporarily storing a volume of 34.3 acre-feet, during the peak event. See Table 3.2.2. It should be noted that per the existing conditions FLO-2D model, discussed later in this report, offsite flows enter the Pusch Ridge Vista detention basin, causing the basin to overtop back into the Highland Wash. This flow

diversion is not included in the HEC-HMS model, nor is it reflected in the results presented in this section.

Table 3.2.2 Detention Basin Results

HEC-HMS Detention Basin ID	Peak Inflow (cfs)	Peak Outflow (cfs)	Inflow Volume (ac-ft)	Outflow Volume (ac-ft)	Max Water Surface Elevation	Volume @ Max Elev. (ac-ft)
Existing Basin (to be removed)						
PRV	63.0	1.0	3.0	1.9	2579.1	2.8
Proposed Basin (with Sediment Storage)						
RETNAR	2162.6	2159.4	299.4	296.2	2573.9	34.3

There are three critical points of interest to this project; J03, located at the upstream portion of Highlands Wash entering the project area (Naranja Road), J01A, located at the downstream portion of Highlands Wash as it exits the project area just upstream of the Highlands, and J02, located at Lambert Lane. These points were used to compare the existing conditions to the proposed conditions. It can be seen in Table 3.2.3 that the proposed detention basin attenuates the flows sufficiently to not increase the flow to downstream properties.

Table 3.2.3 Summary of Hydrologic Analysis Results

Concentration Point	Location	Contributing Area (sq.mi.)	100-yr Peak Discharge (cfs)	Time to Peak (hr:mm)
Existing Conditions				
J03	At Naranja Dr	2.45	2138.7	02:49
J01A	At Highlands	2.59	2159.5	02:54
J02	At Lambert Ln	2.67	2169.7	03:00
Proposed Conditions				
J03	At Naranja Dr	2.45	2138.7	02:49
J01A	At Highlands	2.59	2159.4	02:56
J02	At Lambert Ln	2.67	2169.0	03:03

4.0 OFFSITE HYDRAULIC MODELING

As previously stated, the WLB Group, Inc. started an initial analysis of the Highland Wash through this site. In their memo they reference coordination and verification steps that were taken prior to when the project came to a halt. (WLB Group Memo is included in the Appendix C for reference). This study is based off the information and coordination that WLB Group previously prepared, addresses the outstanding comments from the Town of Oro Valley.

This analysis utilizes the FLO-2D program to perform the 2-dimensional modeling. All model criterion presented in the WLB Group model will be carried and used in the model presented with this report. In general, these model inputs are listed below. For the digital terrain model, the QGIS program was used with the FLO-2D extension to assign the grid elevation from a DEM exported from AutoCAD Civil3D. The DEM (in geotif format) is provided in the digital data. It is noted that some model instability was observed during the proposed conditions calculations. The Courant number was reduced from the default 0.6 to 0.5 and the model instability appears to be acceptable. This could be explained due to the large flat bottomed sediment basin in the analysis area. Also, there are two inflow canyons where flows enter from Pusch Ridge Vista. The HEC-HMS model only modeled the total flows entering the basin. As a study of the division of these is irrelevant to the purposes of this study and the flows converge in the same location, the flows were divided proportional to their estimated size, approximately 1/3 of the flows were assumed to enter the northern canyon and the remaining 2/3 entering the southern canyon. To model this, the peak flows were divided between three cells; one cell was located in the northern canyon and the other two cells in the southern canyon.

Global FLO-2D Variables:

Model Version:	Pro Model Build No. 19.07.21
Model Grid:	5ft x 5ft Cartesian grid
Inflow:	2,135cfs 100yr, @ Naranja Drive (10 cells)
	63 cfs 100yr, @ Pusch Ridge Vistas (3 cells)
Model Runtime:	5 Hours
AMANN	-99
TOUT	0.10
FROUDL	0.95
SHALLOWN	Unused (See AMANN above)
TOLGLOBAL	0.010
DEPTOL	0.0
COURANT	0.5

Existing Conditions Model

Project File: FLO-2D-Existing.zip
DTM Point File: 20000103-EG.tif
Manning's N: Mannings_N_Existing.shp

Proposed Conditions Model

Project File: FLO-2D-Proposed.zip
DTM Point File: 20000103-FG.tif
Manning's N: Mannings_N_Proposed.shp

Pusch Ridge Vistas subdivision drains from two natural washes into a natural channel that runs into a detention basin located on our site. This detention basin has an outlet structure located near the southwest corner that allows the basin to drain into Highland Wash. This outlet structure, according to available as-builts and field verification, has a steel plate with a 6-inch orifice on the upstream side. This basin outfall was not included in the 2D model as the flows through this structure are estimated to be less than one cfs and deemed insignificant to the results of the modeling. Upon completion of the Naranja Trails project, this existing detention basin will be abandoned and filled. Flows generated from the Pusch Ridge Vistas development will maintain its existing flow path. A roadway crossing with culvert will capture these flows and convey them to the proposed detention basin and exit the Site via the Highlands channel.

With the development of the Naranja Trails project, a detention basin at the south property boundary has been designed to attenuate the peak flows prior to entering the Highlands subdivision, while offsetting the impacts of the proposed development. This new basin will collect sheet flow generated within the development and concentrated flows within the Highlands Wash. These onsite flows are intended to be conveyed into the proposed detention basin before spreading out and exiting the site in a condition similar to existing conditions. *Exhibits 5 and 6* illustrate the Existing and Proposed Conditions.

5.0 RESULTS ANALYSIS

The FLO-2D Mapper Pro program was used to extract the Maximum Water Surface Elevation at Cell, Flow Depth at Cell and the Maximum Velocity at Cell data for both the Existing and Proposed Conditions. Exhibits 7 and 8 show the Maximum Flow Depth at Cell for the existing and proposed conditions, respectively. Maximum Velocity at Cell for the Existing and Proposed Conditions can be found in Exhibit 9 and 10, respectively.

The QGIS open-source geographic information system application was used to convert

the Water Surface Elevation at Cell data and the Maximum Velocity at Cell data into raster data. The raster data for both existing and proposed conditions was then compared to illustrate the differences between the two models. For this report, the existing water surface elevation was subtracted from the proposed water surface elevation. Resultant values greater than zero are considered to be increases in the proposed conditions values, while resultant values less than zero are considered to be decreases. Exhibits 11 and 12 illustrate the differences between the existing and proposed conditions for Max Water Surface Elevation and velocity. In accordance with Oro Valley and Pima County floodplain policies, water surface elevations increase less than 0.10 feet are considered to not increase. For clarity, values where proposed water surface elevation increases are less than 0.10 feet or lower than existing have been faded back.

In Exhibit 11 shows that any increase in water surface elevation is located completely within the property line or returns to existing conditions near the property line and therefore maintain a no-rise situation for the surrounding properties.

Exhibit 12 shows the percent increase in the maximum velocity when compared to the existing conditions. Areas where the proposed velocities are lower than 2.5 feet per second were excluded from the analysis as velocities below 2.5 feet per second are considered non-erosive and therefore any changes in velocities are insignificant. Areas less than 5% increase are excluded for clarity. It can be seen that the areas that the velocity increase is small and located within or near the property line. In review of exhibit 11 & 12, it can be concluded that the proposed improvements will not adversely impact any surrounding properties.

It can be seen in Exhibits 3, 7 & 9 that in the existing conditions there are some floodwaters that overtop the existing levee and enter the western half of the Highlands. It should be noted that Pima County Regional Flood Control District in junction with the Town of Oro Valley have completed a drainage study, design concept memo and 65% improvement plan for the Highland Wash. In this study, a sediment basin, levee outfall chute and downstream channel improvements have been proposed to channelize the flows and convey them through the Highlands and remove this overtopping. Every effort was expanded to include a portion of these improvements in the proposed plan. However, this project does not have the accessibly, scope or financial ability to improve the channel through the Highlands. It was found that, without the downstream channelization, concentrating the flows with a levee and chute would increase the flood depths through the Highlands, particularly for the properties adjacent to the wash. This was found to increase the risk of flooding for those properties and therefore not included in the proposed improvements. These improvements will allow the floodwater to convey in the historical pattern, namely, overtopping the existing levee and entering the west half of the highlands.

It can be seen that the areas of depth and or velocity increases are located near the centralized channel and away from the residential units. Every effort was expended to reduce the amount of water overtopping the levee while still maintaining floodplain management regulations.

6.0 PROPOSED-CONDITIONS DRAINAGE DESIGN

6.1 Proposed Drainage Infrastructure

Drainage within the Naranja Trails subdivision is proposed to be conveyed via several onsite storm drain systems. Offsite drainage will be accepted at various locations along the east property boundary line and conveyed via channels to the proposed storm drain systems. These systems will efficiently transport the drainage to the Highlands Wash, ensuring effective management of the stormwater runoff. Within the subdivision, the lots will be designed to drain towards the proposed Shore Cliffs Drive, which will feature a standard crown roadway section with curb and gutter. The roadway typically drains to the south and it is proposed to include several on-grade catch basins that will intercept onsite runoff. Refer to *Exhibit 13 - Proposed Onsite Drainage Map* for a depiction of the proposed drainage.

6.2 Proposed Stormwater Detention Facilities

The proposed development includes a detention/sediment basin. This basin will detain flows below the downstream flow line. The inline detention basin is designed to provide storage to offset the increased runoff from the site. The provided detention will offset any adverse impacts of the development during the 2-year, 10-year, and 100-year events. After a comprehensive evaluation of various drainage approaches, it has been determined that direct percolation method will be employed to effectively drain these stormwater flows. A daylight channel was found to be too deep and require a significant length downstream to daylight. A bleed off pipe would be susceptible to blockage due to the anticipated sediment deposition. Soil percolation testing has been conducted on three locations across the bottom of the wash. These results were evaluated to derive an average percolation rate. It is estimated that there will be approximate 6.3 acre-feet of retained stormwater that will need to be bleed off. Patterson Engineering prepared infiltration test for the site. Tests were performed using a 12-inch single-ring diameter infiltrometers. (Full percolation tests results are provided in the *Appendix E* of this report). The average percolation rate was found to be 3 minutes per inch, or 20 inches per hour or 1.6 cf/sf/hr. With a safety factor of 0.50, the anticipated percolation rate of the basin bottom is 0.8cf/sf/hr. The approximate basin bottom is 1.26 acres. Therefore, the anticipated basin percolation rate is 1.0 acre-feet per hour, for a drain time of approximately 6.3 hours.

6.3 Hydrologic Analyses

Peak flows at critical concentration points throughout the Site were calculated using the PCHydro V7.2 program. Watershed data was estimated from the topographic survey and aerial photos. Watershed types were categorized according to the those listed in Tables 4.1-4.3 of the PCHydro User's Guide. Normal values were assumed when the Basin Factors were selected. For drainage basins with multiple watershed types, Basin Factors were weighted according to area. Vegetative Cover for the area is generally considered to be "Desert Brush" with densities ranging from 0-20%. According to the Pima County Regional Flood Control District (PCRFCD) GIS soil map database, the project is comprised of Soil Types A and C soils. Refer to *Appendix A – Onsite Hydrology* for the PC-Hydro outputs and the following summary table for the areas and peak discharges for the 2-, 10-, and 100-year storm events.

Table 6.3.1 Summary of Hydrologic Analysis Results

Drainage Area ID	Concentration Point	Area (ac)	2-Yr Flow (cfs)	10-Yr Flow (cfs)	100-Yr Flow (cfs)
OFF-1	CP-1	0.68	1	2.2	4.2
OFF-2	CP-2	2.12	3	6.7	13
OFF-3	CP-3	1.51	2.4	5.1	9.6
OFF-4	CP-4	1.28	2	4.3	8.2
OFF-5	CP-5	0.98	1.5	3.3	6.2
OFF-6	CP-6	0.53	0.8	1.8	3.4
DON-1	CP-7	0.34	1.3	2.1	3.3
DON-2	CP-8	0.84	2.6	4.5	7.3
DON-3	CP-9	1.22	3.4	6	10
DON-4	CP-10	1.27	3.6	6.3	10.4
DON-5	CP-11	1.17	3.3	5.8	9.6
DON-6	CP-12	1.14	3.4	5.9	9.7
DON-7	CP-13	1.15	3.2	5.7	9.4
DON-8	CP-14	1.11	3.1	5.5	9.1
DON-9	CP-15	5.6	13.3	24.5	42.2
DON-9 & DON-10	CP-16	24	35	75	150.5

6.4 Hydraulic Design

Seven (7) storm drain crossings are proposed beneath the Shore Cliffs roadway to convey offsite/onsite drainage from east to west to the Highlands Wash. Catch basins and storm drains were sized such that the streets will convey the 10-year storm within the curbs, and the 100-year flows within the right of way. Bentely StormCAD hydraulic modeling was used to model each of the drainage crossings. The model includes elements such as pipes,

catch basins, manholes, and outlets designed to accommodate catchment inflows that align with the PC-Hydro peak discharge rates. To ensure adherence to the 2020 Town of Oro Valley Design Criteria Manual (TOVDCM), the culvert hydraulics and open channel hydraulics were evaluated using Bentley Systems Inc.'s CulvertMaster and FlowMaster software, respectively.

Proposed catch basins will be constructed in accordance with Pima County Association of Governments (PAG) Standard Details 308 & 310. Catch basins were analyzed using StormCAD and following methodology outlined in the Chapter 10 of the Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona (COT Drainage Manual). StormCAD program utilizes inlet computations as per the HEC-22 drainage manual. As integrated into the StormCAD programming, gutter depths were calculated for both the structure functioning as an orifice and a weir and the equation yielding the higher of the two values was used for the design ponding depth. It should be noted that gutter depths shown for the sag inlets include gutter depression.

Storm drain systems were analyzed following methodology outlined in Chapter 10 of the COT Drainage Manual and the 2022 DCM. Drainage structures were sized to convey the 100-year peak flow, with the hydraulic grade line maintaining a minimum of 12-inches of freeboard to the flowline of the street. Catch basins located onsite are designed to intercept drainage runoff at several concentration points. Laterals and storm drains are designed onsite to convey drainage runoff from the onsite and offsite contributing areas below grade to the Highlands Wash. Refer to *Appendix A- Onsite Hydraulics* for a summary of the results.

6.5 Erosion Control

6.5.a Channels

Engineered channels have been designed to capture offsite/onsite flows originating from the east. These channels will convey the flow along the rear of the eastern lots towards the proposed storm drain crossings. The hydraulic calculations for these channels were conducted using FlowMaster, a software developed by Bentley, Inc. To ensure the stability and protection of the channel banks, the sizing of the rock riprap was determined using HEC-11 methods. Please refer to *Appendix A- Erosion Protection Calculations* for a summary of the results.

6.5.b Storm Drain/Culvert

Erosion stabilization will be provided at any location where drainage is constricted, dissipated, or abruptly changed in flow direction. Culvert and storm drain outlets to earthen ground will be protected from erosion by riprap pads consisting of lengths

and widths per the 2022 DCM design standards. Riprap underlain with filter fabric will be placed at each outlets bottoms to help prevent erosion and undermining of the structures. Refer to *Appendix A - Erosion Protection Calculations* for the calculations performed to determine the culvert outlet erosion protection designed at each of the outlets.

Through extensive option review, pro and con evaluation, cost benefit analysis and multiple discussions with the Town of Oro Valley, it was concluded that the best course of action regarding the existing culvert at Naranja Drive is to maintain the existing headwall and outlet structure on the south side of the road. Multiple design alternatives were reviewed in attempts to extend the existing culvert to open up a wider cross section for the street improvements. However, a retaining wall was found to have the least amount of impact to the existing wash characteristics and provide sufficient width for the desired street improvements. As extensive erosion can be observed around the outlet, loose riprap will be placed at the outlet at existing grade to mitigate the potential for future erosion. To size the riprap, a HEC-RAS 2D analysis was prepared specifically at the outlet, to evaluate the estimated shear stresses. The results were used along with the HEC-15 documentation to find a suitable riprap size. A riprap apron is proposed with three stages of riprap sizes, progressively reducing the median riprap size as the flow progress downstream. An initial size of D_{50} = 24-inches will be used at the headwall, extending out approximately 25-feet, where it will transition to D_{50} = 12-inches and extend another approximate 25-feet. See Appendix A for results maps from the HEC-RAS model and HEC-15 riprap calculations.

6.5.c Highlands Wash Scour Analysis

The erosion-hazard setbacks were calculated in accordance with Section 5.5 of the TOVDCM. Results from the analysis are included in Appendix A of this report. Lots or engineered embankments located within the Erosion-Hazard Setback will be protected from scour and subsequent lateral migration of the wash. The proposed mitigation plan is to place riprap at the toe of the embankment with a toe down that will protect from lateral migration of the wash. As this riprap is to protect against scour and lateral migration, the riprap will be carried up the embankment a few feet to provide sufficient freeboard protection and may not extend all the way to the top of embankment.

Scour for Highlands Wash was analyzed using methods described in the 2020 TOVDCM. More specifically, 4 types of scour components were considered: Long Term, General, Bedform and Local. Three representative cross section locations were analyzed along the wash. Long Term scour was calculated using the ADWR

Level 1 Analysis. General scour was calculated using the Zeller equation (1981). Bend scour was not considered for this reach of the wash as it is considered to be relatively straight. Bedform scour was assumed to be half the height of the dune or antidune height. Simons and Senturk (1992) provide the dune and antidune height. Local scour was only calculated for the area just downstream of the drop. Local scour for this area was calculated using the Zimmerman and Maniak Equation. Drop height was determined to not be a determining factor for this scour location as the drop was designed in accordance with the NRCS Rock Chute. The Rock Chute and scour calculations are included in *Appendix A-Erosion Protection*.

Particle grain sizes used for the calculations are based on the soil gradation results provided in the Geotechnical Analysis for Naranja Trails Supplemental No. 1 by Pattison Engineering, LLC under Project No. 20-098 dated March 26, 2021. Hydraulic results for each of the cross-sections were determined using Bentley FlowMaster under Manning's normal depth flow conditions. A Factor of Safety of 1.3 was used for the total scour equation. Section 3A scour computation includes the local condition of the chute drop. Refer to the *Exhibit 13 - Proposed Onsite Drainage Map* for a depiction of the scour areas and *Appendix A – Erosion Protection* for the flow and scour depth computation worksheets. Summary results are shown in the table below.

Table 6.5.1: Channel Scour Depth

Cross-Section ID	Q100 (CFS)	Depth (ft)	Channel Slope (%)	Avg. Velocity (ft/s)	Total Scour Depth (ft)
1	2,139	6.19	1.90	4.82	3.96
2	2,139	3.70	2.30	5.03	4.34
3	2,139	2.85	1.50	6.36	4.61
3A*	2,139	2.85	1.50	6.36	6.37

* - Includes local scour for bottom of chute

7.0 SPECIAL PERMITS

7.1 WATERS OF THE UNITED STATES (404)

A preliminary jurisdictional delineation was submitted to the United States Army Corps of Engineers, and, as a result, it has been determined, preliminarily, that waters of the U.S. may be present on the project site. As such, the developer has contracted with SWCA Environmental Consultants to prepare Section 404 permit for the disturbance. The calculated disturbed area is less than 0.50 acres, and

therefore should fall under the Nationwide Permit 29. It is understood that this permit process will need to be complete before any disturbance in the are determined to be waters of the US.

7.2 FEMA FLOODPLAIN

This site does not have any FEMA regulated floodplain. No coordination with FEMA is anticipated to be required with this project.

8.0 MAINTENANCE & INSPECTION PLAN

8.1 Preventive Measures

The most effective way to maintain the storm-water quality facility is to prevent the pollutants from entering the facility in the first place. Common pollutants include sediment, trash and debris, chemicals, pet wastes, runoff from stored materials, illicit discharges into the storm drainage system and many others. A thorough maintenance program will include measures to address these potential contaminants and will save money and time in the long run. Key points to consider in the maintenance program include:

- Educate property owners/residents/employees to be aware of how their actions impact water quality, and how they can help reduce maintenance costs.
- Keep properties, streets, and curb & gutters free of trash, debris, and lawn clippings.
- Ensure the proper disposal of hazardous wastes and chemicals.
- Plan lawn care to minimize the use of chemicals and pesticides.
- Sweep paved surfaces and put the sweepings in a compost pile or back on the lawn.
- Be aware of automobiles leaking fluids. Use drip pans or granular absorbents, such as cat litter, to contain drippings – dispose of properly.
- Re-vegetate disturbed and bare areas to maintain vegetative stabilization.
- Clean out the upstream components of the storm drainage system, including inlets, storm sewers and outfalls.
- Do not store materials outdoors (including landscaping materials) unless they are properly protected from rain and from storm-water runoff.

8.2 Inspection Procedures

All stormwater facilities within the Site shall be inspected by an HOA representative, or qualified consultant. Highlands wash however, will be dedicated to the Town of Oro Valley

(TOV) and inspected/maintained by the town. Per the Town of Oro Valley (TOV):

"All *drainage structures shall be inspected, and a summary report prepared a minimum of once each year in accordance with the procedures in the approved Drainage Report. Copies of the annual inspection reports shall be made available to the Town upon request.*

All drainage structures shall be inspected, and a summary report prepared by an Arizona Registered Professional Civil Engineer a minimum of once every five years in accordance with the procedures presented in the approved Drainage Report. Copies of the 5-year-interval inspection reports shall be made available to the Town upon request. The report shall identify the maintenance needs for the next 5-year period, including the anticipated annual cost of maintenance and repair."

Inspection should follow the inspection guidance found in the SOP located in Section 7.4 of this report. The person(s) conducting the inspection activities shall complete an appropriate inspection report. A separate form shall be filled out in the field for all storm-water management facilities inspected. If a storm-water management facility cannot be inspected, the inspector shall record an explanation of the circumstances on the form. The inspection report should describe any maintenance activities that are recommended. In order to ensure the optimal functioning and longevity of storm drain facilities and natural regulatory watercourses, it is essential to implement thorough inspection and maintenance procedures.

8.3 Maintenance Procedures

All drainage facilities within the Site shall be maintained and operated by the HOA to promote performance. Physical and legal access has been dedicated to all drainage channels, roadway culverts, and stormwater facilities primarily for the operation and maintenance of these infrastructures (Refer to the Final Plat for all dedicated drainage easements within the Site). These dedicated drainage easements ensure that necessary inspection, cleaning, repair, and other maintenance activities can be carried out effectively and efficiently. Storm-water Management Facility Maintenance consists of two categories: scheduled and unscheduled. A description of each category follows.

8.3.a Scheduled Maintenance

Most of this work consists of regularly scheduled mowing, trimming and trash and debris pickups for storm-water management facilities. This work also includes items such cleaning and the removal of debris/material that may be clogging inlet grates and trash racks. It may also include activities such as weed control, mosquito treatment, and algae treatment. These activities normally will be performed numerous times during the year.

8.3.b Unscheduled Maintenance

Unscheduled maintenance will involve the repair of facilities after storms and flooding. The frequency and scope of this type of maintenance cannot be predicted. Some examples of unscheduled maintenance are:

- Embankment repair to keep erosion or rock riprap or earth fill sloughing.
- Debris removal during and following storms.
- Inlet and outlet channel repairs to halt erosion and maintain hydraulic capacity.
- Inlet and outlet structure repair so that the facility will function as intended.

It is important that adequate funding be provided for unscheduled maintenance such that repairs can be made immediately after flood or inundation damage occurs.

8.4 Standard Operating Procedures (SOP)

8.4.a Streets

Storm water runoff is most often collected and channeled along paved streets and conveyed towards and into storm-water system components such as catch basins, scuppers, and spillways. Stormwater collects sediment, trash, debris, oil, and any other pollutant that may be deposited along paved areas. This potential polluted runoff is then discharged untreated into retention basins, parks, and channels. Maintaining paved areas free sediment, trash, debris, oil, etc. will assist in minimizing pollutants entering the system. The following healthy habits can make a big difference.

- Picking up and properly dispose of trash and debris
- Picking up and properly dispose of pet waste
- Sweep up sediments, debris, and yard waste instead of washing driveways and sidewalks
- Properly dispose of household hazardous waste
- Use pesticides and fertilizers as directed by the manufacturer
- Cover and properly store hazardous materials to prevent spills
- Clean up spills using a dry absorbent and dispose of properly
- Park Vehicles that leak fluids on private property, encourage methods to prevent leaks and spills from entering the public streets

- Encourage use of a commercial car wash for heavily soiled vehicles
- Maintain pool drainage on private property

8.4.b Retention Basins and Channels

Channels are storm water conveyance structures design to allow storm water to pass though or around the project while protecting the nearby properties from the storm water inundation. Retention basins are depressed areas that are often utilized as greenbelts, landscaped open areas, common areas, parks, and even community lakes. Stormwater is discharged into such basins or channels via a variety of storm-water system components and is allowed to percolate into the soil. Retention/detention basin and channels may require maintenance including but not limited to the following:

- Maintenance to mitigate standing water that persists for periods exceeding 12 hours.
- Silt removal should occur when the accumulated depth exceeds 6 inches on average in basins and channels without sediment traps. In basins and channels with sediment traps, silt removal should occur when accumulation exceeds 4 inches.
- Maintain spillways, culverts, and storm drains to discharge into retention basins or channels at least 2” above the bottom of the basin with a sediment trap.
- Remove sediment, trash and debris captured by trash racks at outfall points.
- Ensure trash racks are secured at storm drain outfalls where they were originally required on grading and drainage plans.
- Ensure that guardrails are maintained and secured on head walls, retaining walls, etc., where a fall hazard of 30 inches or greater is present.
- Weed Control: Weed growth can adversely affect the use, appearance, and hydraulic characteristics of a basin and channel. Therefore, weed growth shall be controlled. Extensive use of herbicides in basins or channels where the primary or secondary purpose is groundwater recharge is not acceptable.
- Repair of Eroded Slopes: Immediate repair of eroded slopes can minimize the ultimate cost for this activity. Small areas can be repaired by hand with on-site materials. Large, eroded areas are much more difficult and

expensive to correct because they may require larger equipment and placement of imported material.

- Eroded areas should be repaired as soon and reasonably possible. Should areas be found to have repeated erosions issues, contact a qualified consultant to determine the best management practice to prevent future degradation.

8.4.c Catch Basins

Catch basins are storm drain inlets installed along the street curb and gutter, street shoulders, paved areas, and landscaped areas. Catch basins located in landscaped areas and paved areas without curb and gutter consist of a concrete box structure with an inlet grate covering the structure. Catch basins along curb and gutter locations consist of an inlet opening within the curb and may also have an inlet grate incorporated within the gutter. Catch basins may or may not have a depressed bottom to allow for deposition of sediment and/or debris prior to discharging runoff via a pipe to a retention/detention basin, underground retention system, drywell or bubbler box. Catch basins that are not properly maintained may cause or contribute to street flooding or standing water issues.

Maintenance of catch basins may include, but are not limited to:

- Removal of sediment, trash, and debris from the catch basin and lateral sections of pipe.
- Ensure that inlet grate is properly secured within support frame.

8.4.d Culverts and Equalizer Pipes

Culverts are concrete structures that allow for vehicle access over an open channel. Such structures are typically found near entrances to communities or businesses.

Equalizer pipes are linear sections of pipe that allow for drainage from one retention area to another. These pipes are subsurface with pipe openings into each retention area. Equalizer pipes may also be connected to headwalls. Maintenance of culverts and equalizer pipes may include, but are not limited to:

- Removal of sediment, trash, and debris from culverts and pipes to prevent standing water issues.
- Maintain turf or landscaped areas at culvert and pipe openings to ensure

positive flow towards the center of retention areas.

8.4.e Headwalls

Headwalls are concrete structures that are installed at subsurface, pipe discharge points. Headwalls may be utilized at equalizer pipe openings or at outfalls leading from a catch basin from the street. Headwalls generally have guardrails attached to the top and sides or wings. Grates or trash racks are installed across the pipe openings to prevent children and animals from entering the pipe and to catch trash and debris. Splash pads or riprap aprons are required at outfall points and are intended to decrease the velocity of stormwater flows into turf or landscaped areas, and to trap sediment and debris.

Maintenance of headwalls may include, but is not limited to:

- Removal of sediment, trash, and debris from inside pipe openings and lateral sections of pipe.
- Removal of sediment, trash, and debris from trash racks and splash pads.
- Removal of vegetative matter that may hinder the flow of stormwater into the retention area.
- Ensure structural integrity of headwalls, guardrails, and trash racks.
- Ensure positive flow line towards the center of the retention area. Maintain transition from spillway to turf or landscaped area to promote positive drainage and prevent standing water.
- Inspect riprap for undermining, the process of the hydraulic removal of the soil beneath the riprap.

9.0 SUMMARY AND CONCLUSIONS

This report meets the requirements depicted in the *Pima County Drainage Standards and Practices*, the *2022 Town of Oro Valley Drainage Criteria Manual* and standard engineering practices. The following items are noted:

- The Site is within the FEMA Special Flood Hazard Areas for the Site (Zone X)
- Proposed improvements will not increase the 100-year, 3-hour peak flows downstream
- Proposed condition has been found to not adversely impact surrounding residential properties
- Onsite drainage will be directed through seven (7) proposed storm drain crossings to the adjacent wash and sized to convey the 100-year, 2-hour storm event.
- Storm water detention will be provided in an inline detention basin
- Retained storm water will percolate directly into the ground in approximately 6.3 hours.

10.0 REFERENCES

1. Drainage Report for Highlands Wash Design Concept Memorandum and Improvement Plans, Arroyo Engineering LLC, December 30, 2019

2. The Highland Wash Basin Management Study, Phase III Final Report, Camp Dresser & McKee, Inc., 1990

3. Technical Data Notebook for Hydrologic and Hydraulic Mapping of the Highland Wash and its Tributaries, Pima County Regional Flood Control District, [preliminary] 2013.

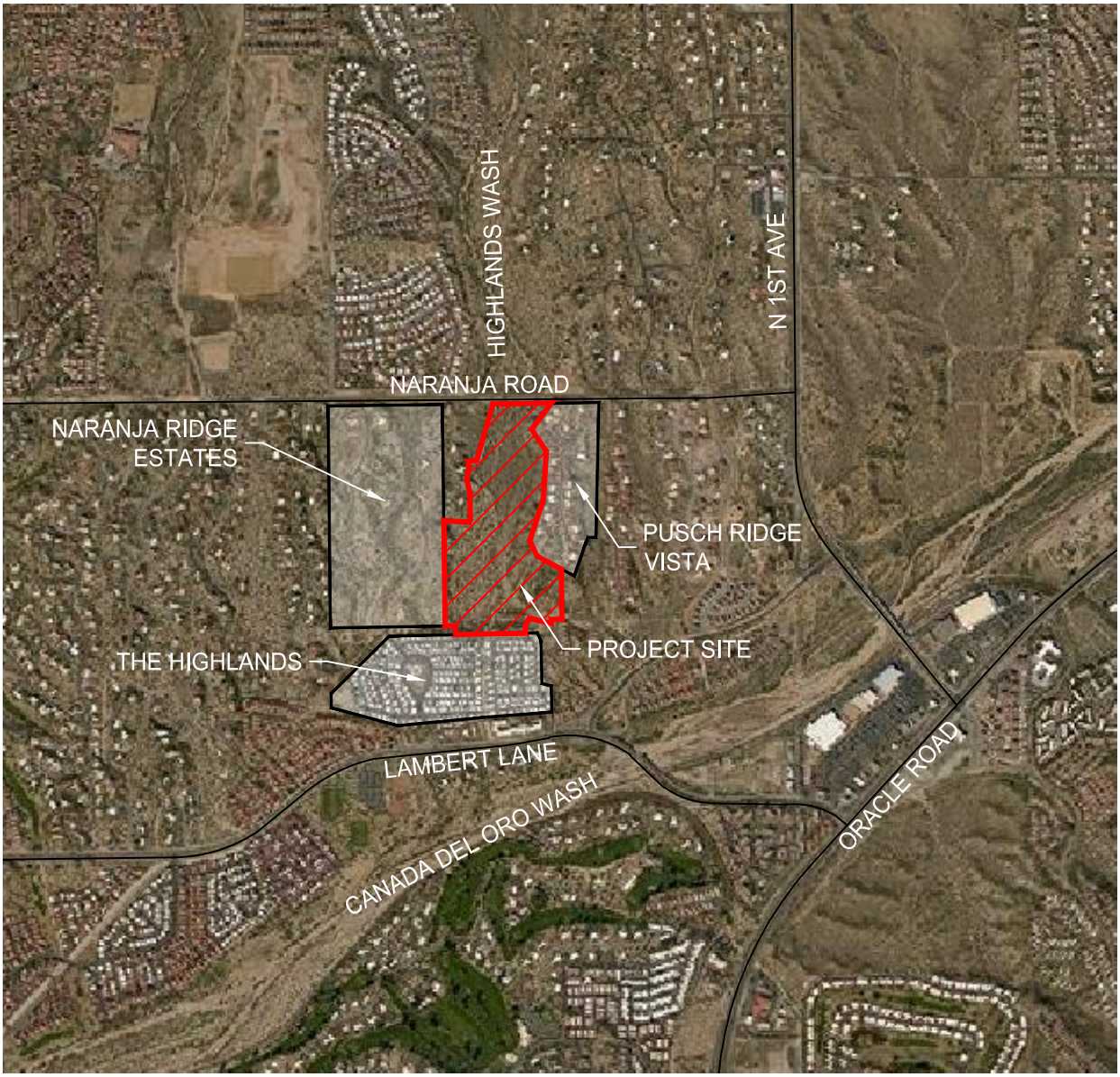
4. Drainage Criteria Manual, Town of Oro Valley, 2020 (Draft)

5. Pima County Regional Flood Control Districts Technical Policy TECH-033, Pima County Flood Control District, 2021

6. Drainage and Channel Design Standards for Local Drainage, Pima County Flood Control District, 1984

EXHIBITS

EXHIBIT 1 – VICINITY MAP
EXHIBIT 2 – FEMA FIRM MAP
EXHIBIT 3 – EXISTING HEC-HMS SCHEMATIC
EXHIBIT 4 – PROPOSED HEC-HMS SCHEMATIC
EXHIBIT 5 – PRE-DEVELOPMENT DRAINAGE MAP
EXHIBIT 6 – POST-DEVELOPMENT DRAINAGE MAP
EXHIBIT 13 – PROPOSED ONSITE DRAINAGE MAP



N.T.S.

PROJECT LOCATION

ATWELL
866.850.4200 www.atwell-group.com
4700 E. SOUTHERN AVENUE
MESA, AZ 85206
480.218.8831

EXHIBIT 1 - VICINITY MAP

NARANJA TRAILS
DRAINAGE REPORT
ORO VALLEY, AZ

PROJECT LOCATION

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1090L

FIRM

FLOOD INSURANCE RATE MAP

PIMA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 1090 OF 4750

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ORO VALLEY, TOWN OF	040109	1090	L
PIMA COUNTY	040073	1090	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
04019C1090L

MAP REVISED
JUNE 16, 2011

Federal Emergency Management Agency

ATWELL
866.850.4200 www.atwell-group.com
4700 E. SOUTHERN AVENUE
MESA, AZ 85206
480.218.8831

EXHIBIT 2 - FEMA FIRM

NARANJA TRAILS
DRAINAGE REPORT
ORO VALLEY, AZ

J02
R01B
J01
HW01A
J01A
HW01B
R01A
HIGHLAND WASH
RETPRV
J03
HW01C
HW02
NARANJA DRIVE

LEGEND
DRAINAGE BOUNDARY
ROUTING PATH

0 300 600 Feet

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE:
CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR; NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK, OF PERSONS ENGAGED IN THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

ATWELL
866.850.4200 www.atwell-group.com
4700 E. SOUTHERN AVENUE
MESA, AZ 85206
480.218.8831

NARANJA TRAILS

DRAINAGE REPORT
EXISTING HEC-HMS SCHEMATIC
NARANJA TRAILS
ORO VALLEY

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

REVISIONS:

PM.
DR.
JOB NO. 20000103
FILE NO.

SHEET NO.
EXH 3

J02
R01B
J01
HW01A
HW02
RETNAR
J01A
PROPOSED BASIN AREA
HW01B
DRAINAGE AREA BOUNDARY
PROPERTY LINE
R01A
HIGHLAND WASH
J03
HW01D
PROPOSED IMPROVMENTS
HW01C
NARANJA DRIVE

LEGEND
DRAINAGE BOUDNARY
ROUTING PATH

0 300 600 Feet

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ATWELL
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MESA, AZ 85206
480.218.8831

NARANJA TRAILS

PROJECT: PROPOSED HEC-HMS SCHEMATIC
DRAINAGE REPORT
NARANJA TRAILS
ORO VALLEY

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

REVISIONS:

PM.
DR.
JOB NO. 20000103
FILE NO.

SHEET NO.
EXH 4

PUSCH RIDGE VISTAS
(NOT-A-PART)

HW01C

42cfs

21cfs

J03

2,139cfs

PROPOSED
IMPROVEMENTS

PROPOSED
LOTS (TYP.)

EXISTING
DETENTION BASIN
BASIN DRAIN
STRUCTURE

2,159cfs

THE HIGHLANDS
(NOT-A-PART)

STUDY AREA BOUNDARY

PROJECT BOUNDARY

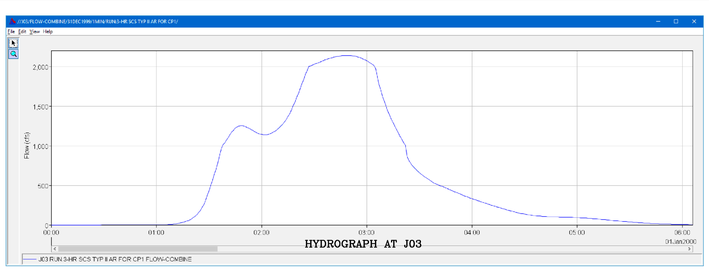
DIRECTION OF FLOW

2,160cfs — 100-YR, 3-HOUR PEAK FLOW

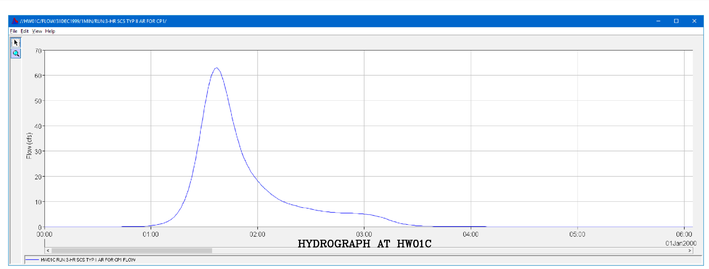
MANNINGS N = 0.020
STREETS, CONCRETE CHANNELS

MANNINGS N = 0.055
NATURAL VEGETATED CHANNELS

100-YR, 3-HR INUNDATION ZONE



HYDROGRAPH AT J03



HYDROGRAPH AT HW01C

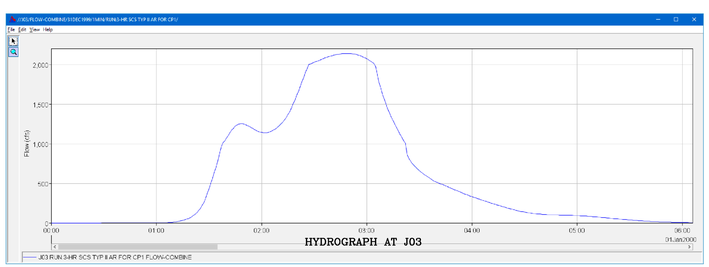
NARANJA TRAILS
EXHIBIT 5 - PRE-DEVELOPMENT DRAINAGE MAP
ORO VALLEY, AZ

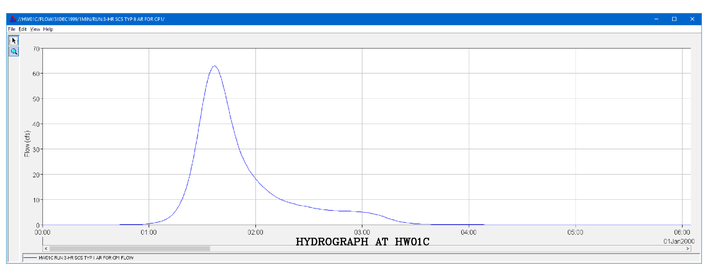
ATWELL

N MANDARIN LN
N PUSCH RIDGE VIEW PL
E DESERT LEDGE PL
E LAMBERT LN
E BREARLEY DR
E SHORE CLIFF DR
N HEWITT PL
N WHELAN PL
E MORNING RIDGE PL
N PUSCH RIDGE VISTAS DR
W DESERT KNOLL PL
HW01C
42cfs
21cfs
N CHAPIN CT
W NARANJA DR
DRAINAGE CORRIDORS (TYP.)
PROPOSED IMPROVEMENTS
PROPOSED LOTS (TYP.)
PROPOSED CULVERT
J03
2,139cfs
FLOODPLAIN CROSS SECTION #2
PROPOSED SEDIMENT BASIN
FLOODPLAIN CROSS SECTION #1
CALCULATED WEIR LOCATION
N MONT BLANC AV
N RAINIER AV
N KITTATINNY AV
N KILIMANJARO AV
W VESUVIUS ST
W OLYMPUS ST
W APPALACHIAN ST
W MATTERHORN ST
W LAMBERT LN
N SAWTOOTH RD
W STEAMBOAT DR
W AMY TEAM RD
W STEAMBOAT RD
N SLUICE DR
W WINDOWMAKER RD
W PLATTE DR
N FALLING RAIN RD
N CLOUD DANCER CT
W DREAM WEAVER DR
N DESERT MINISPERI WY
W ANDES ST
W ADIRONDACK ST
W WEISSHORN ST
W SHENANDOAH ST
N HIGHLANDS DR
N EVEREST AV
N STROMBOLI AV
N PYRENEES AV

LEGEND

- STUDY AREA BOUNDARY
- PROJECT BOUNDARY
- DIRECTION OF FLOW
- 2,160cfs — 100-YR, 3-HOUR PEAK FLOW
- MANNINGS N = 0.020 STREETS, CONCRETE CHANNELS
- MANNINGS N = 0.035 EARTH CHANNELS
- MANNINGS N = 0.055 NATURAL VEGETATED CHANNELS
- MANNINGS N = 0.059 RIPRAP
- MANNINGS N = 0.065 RESIDENTIAL
- MANNINGS N = 0.100 DETENTION BASIN
- 100-YR, 3-HR INUNDATION ZONE





NARANJA TRAILS
EXHIBIT 6 - POST-DEVELOPMENT OFFSTIE DRAINAGE MAP
ORO VALLEY, AZ

ATWELL

PUSCH RIDGE VISTAS (NOT-A-PART)

CH1-OFF1
OFF-1
FE #1 (CP-1)
OFF-2
CH1-S1
CH1-S2
CULVERT-1
DON-1
FE #3 (CP-2)
CB #1 (CP-7)
SD 1
FE #2
DON-2
CB #2 (CP-8)
MH #1
FF=46.50
CB NAR1
2,139cfs
FF=39.40
FF=40.30
DON-4
FF=34.80
CH2-S1
CH2-S2
CH2-S3
OFF-3
FE #5 (CP-3)
DON-3
CB #3 (CP-9)
MH #3
SD 2
CB #4 (CP-10)
MH #2
FF=31.90
FF=28.60
DON-5
CB #5 (CP-11)
CB #6 (CP-12)
SD 3
DON-6
FF=25.20
FF=22.60
FE #6
FE #4
CH2-S4
FE #8
CH3-S4
PROPOSED LOTS (TYP.)
FF=16.00
DON-7
CB #7 (CP-13)
CB #8 (CP-14)
SD 4
DON-8
FF=12.40
CH3-S1
CH3-S2
CH3-S3
OFF-4
FE #7 (CP-4)
CH4-S1
CH4-S2
CH4-S3
FE #9 (CP-5)
OFF-5
CH5-S1
CH5-S2
CH5-S3
OFF-6
FE #11 (CP-6)
FF=10.00
FF=5.50
DON-9
SD 5
MH #4
FF=2.20
FF=1.10
FE #10
FE #12
DON-10
63 cfs
CP-15
CP-16 (DON-9 + DON-10)
HW #1
CULVERT-2
FF=85.10
FF=85.20
FF=89.10
FF=89.20
FF=91.20
FF=96.00
HW #2
CULV-2 CHAN
SCOUR SECTION 1
REFER TO ATTACHMENT 4 OF THIS REPORT FOR THE SCOUR ANALYSIS COMPUTATIONS
FLOODPLAIN CROSS SECTION #2
MAIN DROP
SCOUR SECTION 2
WEST DROP
SCOUR SECTION 3
CPW01
CPW02
PROPOSED SEDIMENT BASIN
FLOODPLAIN CROSS SECTION #1
CALCULATED WEIR LOCATION
2,159cfs
THE HIGHLANDS (NOT-A-PART)

LEGEND

DRAINAGE BOUNDARIES

PROPOSED STORM DRAIN

DIRECTION FLOW

HIGHLANDS WASH
100 -YR, 3-HR PEAK FLOW

2,139cfs

NARANJA TRAILS

EXHIBIT 13: POST-DEVELOPMENT DRAINAGE MAP
TOWN OF ORO VALLEY, ARIZONA

ATWELL
866.850.4200 www.atwell-group.com
4700 E. SOUTHERN AVENUE
MESA, AZ 85206
480.218.8831

APPENDIX A

ONSITE HYDROLOGY:
PC-HYDRO RESULTS

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP01 (OFF-1)	Job #	20000103
Watershed Area:	0.68 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	24	438	0.0548	0.04

Length of Watercourse (Lc):	438	feet	Mean Slope:	0.0548	
Length to Cen. of Gravity (Lca):	168	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 2-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.168
C	41	88.7	0.296
D	18	91.7	0.403
Imp.	10	99	0.901

Weighted Runoff Coef. (Cw):	0.33	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	1.41	in/hr
PEAK DISCHARGE:	1	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP01 (OFF-1)	Job #	20000103
Watershed Area:	0.68 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	24	438	0.0548	0.04

Length of Watercourse (Lc):	438	feet	Mean Slope:	0.0548	
Length to Cen. of Gravity (Lca):	168	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 10-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.309
C	41	88.7	0.445
D	18	91.7	0.547
Imp.	10	99	0.935

Weighted Runoff Coef. (Cw):	0.46	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	3.15	in/hr
PEAK DISCHARGE:	2.2	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP01 (OFF-1)	Job #	20000103
Watershed Area:	0.68 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	24	438	0.0548	0.04

Length of Watercourse (Lc):	438	feet	Mean Slope:	0.0548	
Length to Cen. of Gravity (Lca):	168	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.81	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.453
C	41	88.7	0.58
D	18	91.7	0.668
Imp.	10	99	0.957

Weighted Runoff Coef. (Cw):	0.58	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	6.1	in/hr
PEAK DISCHARGE:	4.2	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP02 (OFF-2)	Job #	20000103
Watershed Area:	2.12 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	56	629	0.089	0.04

Length of Watercourse (Lc):	629	feet	Mean Slope:	0.089	
Length to Cen. of Gravity (Lca):	239	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 2-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.168
C	41	88.7	0.296
D	18	91.7	0.403
Imp.	10	99	0.901

Weighted Runoff Coef. (Cw):	0.33	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	1.41	in/hr
PEAK DISCHARGE:	3	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP02 (OFF-2)	Job #	20000103
Watershed Area:	2.12 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	56	629	0.089	0.04

Length of Watercourse (Lc):	629	feet	Mean Slope:	0.089	
Length to Cen. of Gravity (Lca):	239	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 10-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.309
C	41	88.7	0.445
D	18	91.7	0.547
Imp.	10	99	0.935

Weighted Runoff Coef. (Cw):	0.46	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	3.15	in/hr
PEAK DISCHARGE:	6.7	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP02 (OFF-2)	Job #	20000103
Watershed Area:	2.12 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	56	629	0.089	0.04

Length of Watercourse (Lc):	629	feet	Mean Slope:	0.089	
Length to Cen. of Gravity (Lca):	239	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.81	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.453
C	41	88.7	0.58
D	18	91.7	0.668
Imp.	10	99	0.957

Weighted Runoff Coef. (Cw):	0.58	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	6.1	in/hr
PEAK DISCHARGE:	13	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP03 (OFF-3)	Job #	20000103
Watershed Area:	1.51 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	53	615	0.0862	0.04

Length of Watercourse (Lc):	615	feet	Mean Slope:	0.0862	
Length to Cen. of Gravity (Lca):	208	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 2-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.168
C	41	88.7	0.296
D	18	91.7	0.403
Imp.	15	99	0.901

Weighted Runoff Coef. (Cw):	0.36	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	1.55	in/hr
PEAK DISCHARGE:	2.4	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP03 (OFF-3)	Job #	20000103
Watershed Area:	1.51 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	53	615	0.0862	0.04

Length of Watercourse (Lc):	615	feet	Mean Slope:	0.0862	
Length to Cen. of Gravity (Lca):	208	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 10-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.309
C	41	88.7	0.445
D	18	91.7	0.547
Imp.	15	99	0.935

Weighted Runoff Coef. (Cw):	0.49	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	3.33	in/hr
PEAK DISCHARGE:	5.1	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP03 (OFF-3)	Job #	20000103
Watershed Area:	1.51 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	53	615	0.0862	0.04

Length of Watercourse (Lc):	615	feet	Mean Slope:	0.0862	
Length to Cen. of Gravity (Lca):	208	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.81	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.453
C	41	88.7	0.58
D	18	91.7	0.668
Imp.	15	99	0.957

Weighted Runoff Coef. (Cw):	0.61	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	6.32	in/hr
PEAK DISCHARGE:	9.6	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP04 (OFF-4)	Job #	20000103
Watershed Area:	1.28 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	47	546	0.0861	0.04

Length of Watercourse (Lc):	546	feet	Mean Slope:	0.0861	
Length to Cen. of Gravity (Lca):	195	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 2-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.168
C	41	88.7	0.296
D	18	91.7	0.403
Imp.	15	99	0.901

Weighted Runoff Coef. (Cw):	0.36	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	1.55	in/hr
PEAK DISCHARGE:	2	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP04 (OFF-4)	Job #	20000103
Watershed Area:	1.28 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	47	546	0.0861	0.04

Length of Watercourse (Lc):	546	feet	Mean Slope:	0.0861	
Length to Cen. of Gravity (Lca):	195	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 10-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.309
C	41	88.7	0.445
D	18	91.7	0.547
Imp.	15	99	0.935

Weighted Runoff Coef. (Cw):	0.49	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	3.33	in/hr
PEAK DISCHARGE:	4.3	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP04 (OFF-4)	Job #	20000103
Watershed Area:	1.28 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	47	546	0.0861	0.04

Length of Watercourse (Lc):	546	feet	Mean Slope:	0.0861	
Length to Cen. of Gravity (Lca):	195	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.81	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.453
C	41	88.7	0.58
D	18	91.7	0.668
Imp.	15	99	0.957

Weighted Runoff Coef. (Cw):	0.61	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	6.32	in/hr
PEAK DISCHARGE:	8.2	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP05 (OFF-5)	Job #	20000103
Watershed Area:	0.98 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	56	524	0.1069	0.04

Length of Watercourse (Lc):	524	feet	Mean Slope:	0.1069	
Length to Cen. of Gravity (Lca):	191	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 2-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.168
C	41	88.7	0.296
D	18	91.7	0.403
Imp.	15	99	0.901

Weighted Runoff Coef. (Cw):	0.36	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	1.55	in/hr
PEAK DISCHARGE:	1.5	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP05 (OFF-5)	Job #	20000103
Watershed Area:	0.98 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	56	524	0.1069	0.04

Length of Watercourse (Lc):	524	feet	Mean Slope:	0.1069	
Length to Cen. of Gravity (Lca):	191	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 10-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.309
C	41	88.7	0.445
D	18	91.7	0.547
Imp.	15	99	0.935

Weighted Runoff Coef. (Cw):	0.49	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	3.33	in/hr
PEAK DISCHARGE:	3.3	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP05 (OFF-5)	Job #	20000103
Watershed Area:	0.98 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	56	524	0.1069	0.04

Length of Watercourse (Lc):	524	feet	Mean Slope:	0.1069	
Length to Cen. of Gravity (Lca):	191	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.81	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.453
C	41	88.7	0.58
D	18	91.7	0.668
Imp.	15	99	0.957

Weighted Runoff Coef. (Cw):	0.61	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	6.32	in/hr
PEAK DISCHARGE:	6.2	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP06 (OFF-6)	Job #	20000103
Watershed Area:	0.53 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	50	377	0.1326	0.04

Length of Watercourse (Lc):	377	feet	Mean Slope:	0.1326	
Length to Cen. of Gravity (Lca):	120	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 2-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.168
C	41	88.7	0.296
D	18	91.7	0.403
Imp.	15	99	0.901

Weighted Runoff Coef. (Cw):	0.36	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	1.55	in/hr
PEAK DISCHARGE:	0.8	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP06 (OFF-6)	Job #	20000103
Watershed Area:	0.53 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	50	377	0.1326	0.04

Length of Watercourse (Lc):	377	feet	Mean Slope:	0.1326	
Length to Cen. of Gravity (Lca):	120	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 10-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.309
C	41	88.7	0.445
D	18	91.7	0.547
Imp.	15	99	0.935

Weighted Runoff Coef. (Cw):	0.49	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	3.33	in/hr
PEAK DISCHARGE:	1.8	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	10/19/2021
Concentration Point:	CP06 (OFF-6)	Job #	20000103
Watershed Area:	0.53 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	50	377	0.1326	0.04

Length of Watercourse (Lc):	377	feet	Mean Slope:	0.1326	
Length to Cen. of Gravity (Lca):	120	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-10-19 03:16:32 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4061 Longitude: -110.972

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.81	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	83	0.453
C	41	88.7	0.58
D	18	91.7	0.668
Imp.	15	99	0.957

Weighted Runoff Coef. (Cw):	0.61	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	6.32	in/hr
PEAK DISCHARGE:	3.4	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP07 (DON-1)	Job #	20000103
Watershed Area:	0.34 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	23	490	0.0469	0.022

Length of Watercourse (Lc):	490	feet	Mean Slope:	0.0469	
Length to Cen. of Gravity (Lca):	273	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	0	

RETURN PERIOD: 2-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	84	0.19
C	-	-	-
D	-	-	-
Imp.	95	99	0.901

Weighted Runoff Coef. (Cw):	0.87	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	3.74	in/hr
PEAK DISCHARGE:	1.3	cfs

Notes:

DON-1

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP07 (DON-1)	Job #	20000103
Watershed Area:	0.34 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	23	490	0.0469	0.022

Length of Watercourse (Lc):	490	feet	Mean Slope:	0.0469	
Length to Cen. of Gravity (Lca):	273	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	0	

RETURN PERIOD: 10-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	84	0.333
C	-	-	-
D	-	-	-
Imp.	95	99	0.935

Weighted Runoff Coef. (Cw):	0.9	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	6.19	in/hr
PEAK DISCHARGE:	2.1	cfs

Notes:

DON-1

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP07 (DON-1)	Job #	20000103
Watershed Area:	0.34 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	23	490	0.0469	0.022

Length of Watercourse (Lc):	490	feet	Mean Slope:	0.0469	
Length to Cen. of Gravity (Lca):	273	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	0	

RETURN PERIOD: 100-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.81	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	84	0.476
C	-	-	-
D	-	-	-
Imp.	95	99	0.957

Weighted Runoff Coef. (Cw):	0.93	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	9.74	in/hr
PEAK DISCHARGE:	3.3	cfs

Notes:

DON-1

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP08 (DON-2)	Job #	20000103
Watershed Area:	0.84 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	23	502	0.0458	0.022

Length of Watercourse (Lc):	502	feet	Mean Slope:	0.0458	
Length to Cen. of Gravity (Lca):	173	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	10	

RETURN PERIOD: 2-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83.3	0.168
C	-	-	-
D	-	-	-
Imp.	75	99	0.901

Weighted Runoff Coef. (Cw):	0.72	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	3.1	in/hr
PEAK DISCHARGE:	2.6	cfs

Notes:

DON-2

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP08 (DON-2)	Job #	20000103
Watershed Area:	0.84 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	23	502	0.0458	0.022

Length of Watercourse (Lc):	502	feet	Mean Slope:	0.0458	
Length to Cen. of Gravity (Lca):	173	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	10	

RETURN PERIOD: 10-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83.3	0.309
C	-	-	-
D	-	-	-
Imp.	75	99	0.935

Weighted Runoff Coef. (Cw):	0.78	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	5.32	in/hr
PEAK DISCHARGE:	4.5	cfs

Notes:

DON-2

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP08 (DON-2)	Job #	20000103
Watershed Area:	0.84 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	23	502	0.0458	0.022

Length of Watercourse (Lc):	502	feet	Mean Slope:	0.0458	
Length to Cen. of Gravity (Lca):	173	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	10	

RETURN PERIOD: 100-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.81	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83.3	0.453
C	-	-	-
D	-	-	-
Imp.	75	99	0.957

Weighted Runoff Coef. (Cw):	0.83	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	8.67	in/hr
PEAK DISCHARGE:	7.3	cfs

Notes:

DON-2

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP09 (DON-3)	Job #	20000103
Watershed Area:	1.22 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	13.6	486	0.028	0.022

Length of Watercourse (Lc):	486	feet	Mean Slope:	0.028	
Length to Cen. of Gravity (Lca):	186	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 2-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.168
C	-	-	-
D	-	-	-
Imp.	65	99	0.901

Weighted Runoff Coef. (Cw):	0.64	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	2.78	in/hr
PEAK DISCHARGE:	3.4	cfs

Notes:

DON-3

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP09 (DON-3)	Job #	20000103
Watershed Area:	1.22 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	13.6	486	0.028	0.022

Length of Watercourse (Lc):	486	feet	Mean Slope:	0.028	
Length to Cen. of Gravity (Lca):	186	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 10-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.309
C	-	-	-
D	-	-	-
Imp.	65	99	0.935

Weighted Runoff Coef. (Cw):	0.72	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	4.89	in/hr
PEAK DISCHARGE:	6	cfs

Notes:

DON-3

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP09 (DON-3)	Job #	20000103
Watershed Area:	1.22 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	13.6	486	0.028	0.022

Length of Watercourse (Lc):	486	feet	Mean Slope:	0.028	
Length to Cen. of Gravity (Lca):	186	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 100-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.81	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.453
C	-	-	-
D	-	-	-
Imp.	65	99	0.957

Weighted Runoff Coef. (Cw):	0.78	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	8.15	in/hr
PEAK DISCHARGE:	10	cfs

Notes:

DON-3

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP10 (DON-4)	Job #	20000103
Watershed Area:	1.27 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	12.6	486	0.0259	0.022

Length of Watercourse (Lc):	486	feet	Mean Slope:	0.0259	
Length to Cen. of Gravity (Lca):	212	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 2-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.168
C	-	-	-
D	-	-	-
Imp.	65	99	0.901

Weighted Runoff Coef. (Cw):	0.64	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	2.78	in/hr
PEAK DISCHARGE:	3.6	cfs

Notes:

DON-4

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP10 (DON-4)	Job #	20000103
Watershed Area:	1.27 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	12.6	486	0.0259	0.022

Length of Watercourse (Lc):	486	feet	Mean Slope:	0.0259	
Length to Cen. of Gravity (Lca):	212	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 10-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.309
C	-	-	-
D	-	-	-
Imp.	65	99	0.935

Weighted Runoff Coef. (Cw):	0.72	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	4.89	in/hr
PEAK DISCHARGE:	6.3	cfs

Notes:

DON-4

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP10 (DON-4)	Job #	20000103
Watershed Area:	1.27 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	12.6	486	0.0259	0.022

Length of Watercourse (Lc):	486	feet	Mean Slope:	0.0259	
Length to Cen. of Gravity (Lca):	212	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 100-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.81	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.453
C	-	-	-
D	-	-	-
Imp.	65	99	0.957

Weighted Runoff Coef. (Cw):	0.78	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	8.15	in/hr
PEAK DISCHARGE:	10.4	cfs

Notes:

DON-4

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP11 (DON-5)	Job #	20000103
Watershed Area:	1.17 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10.2	452	0.0226	0.022

Length of Watercourse (Lc):	452	feet	Mean Slope:	0.0226	
Length to Cen. of Gravity (Lca):	212	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 2-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.168
C	-	-	-
D	-	-	-
Imp.	65	99	0.901

Weighted Runoff Coef. (Cw):	0.64	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	2.78	in/hr
PEAK DISCHARGE:	3.3	cfs

Notes:

DON-5

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP11 (DON-5)	Job #	20000103
Watershed Area:	1.17 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10.2	452	0.0226	0.022

Length of Watercourse (Lc):	452	feet	Mean Slope:	0.0226	
Length to Cen. of Gravity (Lca):	212	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 10-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.309
C	-	-	-
D	-	-	-
Imp.	65	99	0.935

Weighted Runoff Coef. (Cw):	0.72	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	4.89	in/hr
PEAK DISCHARGE:	5.8	cfs

Notes:

DON-5

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP11 (DON-5)	Job #	20000103
Watershed Area:	1.17 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10.2	452	0.0226	0.022

Length of Watercourse (Lc):	452	feet	Mean Slope:	0.0226	
Length to Cen. of Gravity (Lca):	212	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 100-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.81	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.453
C	-	-	-
D	-	-	-
Imp.	65	99	0.957

Weighted Runoff Coef. (Cw):	0.78	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	8.15	in/hr
PEAK DISCHARGE:	9.6	cfs

Notes:

DON-5

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP12 (DON-6)	Job #	20000103
Watershed Area:	1.14 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	9.7	445	0.0218	0.022

Length of Watercourse (Lc):	445	feet	Mean Slope:	0.0218	
Length to Cen. of Gravity (Lca):	181	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 2-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.168
C	-	-	-
D	-	-	-
Imp.	70	99	0.901

Weighted Runoff Coef. (Cw):	0.68	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	2.94	in/hr
PEAK DISCHARGE:	3.4	cfs

Notes:

DON-6

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP12 (DON-6)	Job #	20000103
Watershed Area:	1.14 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	9.7	445	0.0218	0.022

Length of Watercourse (Lc):	445	feet	Mean Slope:	0.0218	
Length to Cen. of Gravity (Lca):	181	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 10-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.309
C	-	-	-
D	-	-	-
Imp.	70	99	0.935

Weighted Runoff Coef. (Cw):	0.75	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	5.11	in/hr
PEAK DISCHARGE:	5.9	cfs

Notes:

DON-6

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP12 (DON-6)	Job #	20000103
Watershed Area:	1.14 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	9.7	445	0.0218	0.022

Length of Watercourse (Lc):	445	feet	Mean Slope:	0.0218	
Length to Cen. of Gravity (Lca):	181	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 100-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.81	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.453
C	-	-	-
D	-	-	-
Imp.	70	99	0.957

Weighted Runoff Coef. (Cw):	0.81	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	8.41	in/hr
PEAK DISCHARGE:	9.7	cfs

Notes:

DON-6

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP13 (DON-7)	Job #	20000103
Watershed Area:	1.15 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	13.1	445	0.0294	0.022

Length of Watercourse (Lc):	445	feet	Mean Slope:	0.0294	
Length to Cen. of Gravity (Lca):	177	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 2-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.168
C	-	-	-
D	-	-	-
Imp.	65	99	0.901

Weighted Runoff Coef. (Cw):	0.64	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	2.78	in/hr
PEAK DISCHARGE:	3.2	cfs

Notes:

DON-7

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP13 (DON-7)	Job #	20000103
Watershed Area:	1.15 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	13.1	445	0.0294	0.022

Length of Watercourse (Lc):	445	feet	Mean Slope:	0.0294	
Length to Cen. of Gravity (Lca):	177	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 10-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.309
C	-	-	-
D	-	-	-
Imp.	65	99	0.935

Weighted Runoff Coef. (Cw):	0.72	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	4.89	in/hr
PEAK DISCHARGE:	5.7	cfs

Notes:

DON-7

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP13 (DON-7)	Job #	20000103
Watershed Area:	1.15 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	13.1	445	0.0294	0.022

Length of Watercourse (Lc):	445	feet	Mean Slope:	0.0294	
Length to Cen. of Gravity (Lca):	177	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 100-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.81	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.453
C	-	-	-
D	-	-	-
Imp.	65	99	0.957

Weighted Runoff Coef. (Cw):	0.78	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	8.15	in/hr
PEAK DISCHARGE:	9.4	cfs

Notes:

DON-7

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP14 (DON-8)	Job #	20000103
Watershed Area:	1.11 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	14.1	486	0.029	0.022

Length of Watercourse (Lc):	486	feet	Mean Slope:	0.029	
Length to Cen. of Gravity (Lca):	199	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 2-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.168
C	-	-	-
D	-	-	-
Imp.	65	99	0.901

Weighted Runoff Coef. (Cw):	0.64	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	2.78	in/hr
PEAK DISCHARGE:	3.1	cfs

Notes:

DON-8

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP14 (DON-8)	Job #	20000103
Watershed Area:	1.11 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	14.1	486	0.029	0.022

Length of Watercourse (Lc):	486	feet	Mean Slope:	0.029	
Length to Cen. of Gravity (Lca):	199	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 10-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.309
C	-	-	-
D	-	-	-
Imp.	65	99	0.935

Weighted Runoff Coef. (Cw):	0.72	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	4.89	in/hr
PEAK DISCHARGE:	5.5	cfs

Notes:

DON-8

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	03/24/2022
Concentration Point:	CP14 (DON-8)	Job #	20000103
Watershed Area:	1.11 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	14.1	486	0.029	0.022

Length of Watercourse (Lc):	486	feet	Mean Slope:	0.029	
Length to Cen. of Gravity (Lca):	199	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 100-years NOAA Data Obtained: 2022-03-24 01:13:19 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4056 Longitude: -110.9719

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.81	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.453
C	-	-	-
D	-	-	-
Imp.	65	99	0.957

Weighted Runoff Coef. (Cw):	0.78	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	8.15	in/hr
PEAK DISCHARGE:	9.1	cfs

Notes:

DON-8

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell LLC
Project Name:	Naranja Trails	Date:	07/13/2023
Concentration Point:	CP 15	Job #	20000103
Watershed Area:	5.6 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	28.9	1059	0.0273	0.022

Length of Watercourse (Lc):	1059	feet	Mean Slope:	0.0273	
Length to Cen. of Gravity (Lca):	530	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 2-years NOAA Data Obtained: 2023-07-13 02:17:31 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4086 Longitude: -110.9714

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	84	0.19
C	-	-	-
D	-	-	-
Imp.	50	99	0.901

Weighted Runoff Coef. (Cw):	0.55	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	2.36	in/hr
PEAK DISCHARGE:	13.3	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell LLC
Project Name:	Naranja Trails	Date:	07/13/2023
Concentration Point:	CP 15	Job #	20000103
Watershed Area:	5.6 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	28.9	1059	0.0273	0.022

Length of Watercourse (Lc):	1059	feet	Mean Slope:	0.0273	
Length to Cen. of Gravity (Lca):	530	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 10-years NOAA Data Obtained: 2023-07-13 02:17:31 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4086 Longitude: -110.9714

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	84	0.333
C	-	-	-
D	-	-	-
Imp.	50	99	0.935

Weighted Runoff Coef. (Cw):	0.63	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	4.33	in/hr
PEAK DISCHARGE:	24.5	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell LLC
Project Name:	Naranja Trails	Date:	07/13/2023
Concentration Point:	CP 15	Job #	20000103
Watershed Area:	5.6 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	28.9	1059	0.0273	0.022

Length of Watercourse (Lc):	1059	feet	Mean Slope:	0.0273	
Length to Cen. of Gravity (Lca):	530	feet	Weighted Basin Fac:	0.022	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 100-years NOAA Data Obtained: 2023-07-13 02:17:31 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4086 Longitude: -110.9714

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.8	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	84	0.476
C	-	-	-
D	-	-	-
Imp.	50	99	0.957

Weighted Runoff Coef. (Cw):	0.72	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	7.48	in/hr
PEAK DISCHARGE:	42.2	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell LLC
Project Name:	Naranja Trails	Date:	07/14/2023
Concentration Point:	CP16	Job #	20000103
Watershed Area:	24 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	7	549	0.0128	0.032
2	14	290	0.0483	0.035
3	17	60	0.2833	0.035
4	45	1024	0.0439	0.035

Length of Watercourse (Lc):	1923	feet	Mean Slope:	0.0296	
Length to Cen. of Gravity (Lca):	986	feet	Weighted Basin Fac:	0.034	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	20	

RETURN PERIOD: 2-years NOAA Data Obtained: 2023-07-14 10:22:05 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4086 Longitude: -110.9714

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.168
C	-	-	-
D	-	-	-
Imp.	40	99	0.901

Weighted Runoff Coef. (Cw):	0.46	
Time of Concentration:	11	min
Rainfall Intensity (i) @ Tc:	3.13	in/hr
Runoff Supply Rate (q) @ Tc:	1.45	in/hr
PEAK DISCHARGE:	35	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell LLC
Project Name:	Naranja Trails	Date:	07/14/2023
Concentration Point:	CP16	Job #	20000103
Watershed Area:	24 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	7	549	0.0128	0.032
2	14	290	0.0483	0.035
3	17	60	0.2833	0.035
4	45	1024	0.0439	0.035

Length of Watercourse (Lc):	1923	feet	Mean Slope:	0.0296
Length to Cen. of Gravity (Lca):	986	feet	Weighted Basin Fac:	0.034
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	20

RETURN PERIOD: 10-years NOAA Data Obtained: 2023-07-14 10:22:05 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4086 Longitude: -110.9714

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.309
C	-	-	-
D	-	-	-
Imp.	40	99	0.935

Weighted Runoff Coef. (Cw):	0.56	
Time of Concentration:	8.1	min
Rainfall Intensity (i) @ Tc:	5.54	in/hr
Runoff Supply Rate (q) @ Tc:	3.1	in/hr
PEAK DISCHARGE:	75	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell LLC
Project Name:	Naranja Trails	Date:	07/14/2023
Concentration Point:	CP16	Job #	20000103
Watershed Area:	24 Acres	Watershed Type	Undeveloped-Mountain

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	7	549	0.0128	0.032
2	14	290	0.0483	0.035
3	17	60	0.2833	0.035
4	45	1024	0.0439	0.035

Length of Watercourse (Lc):	1923	feet	Mean Slope:	0.0296	
Length to Cen. of Gravity (Lca):	986	feet	Weighted Basin Fac:	0.034	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	20	

RETURN PERIOD: 100-years NOAA Data Obtained: 2023-07-14 10:22:05 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4086 Longitude: -110.9714

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.8	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	100	83	0.453
C	-	-	-
D	-	-	-
Imp.	40	99	0.957

Weighted Runoff Coef. (Cw):	0.65	
Time of Concentration:	6.2	min
Rainfall Intensity (i) @ Tc:	9.51	in/hr
Runoff Supply Rate (q) @ Tc:	6.22	in/hr
PEAK DISCHARGE:	150.5	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	07/19/2023
Concentration Point:	CPW01	Job #	20000103
Watershed Area:	7.58 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	51	456	0.1118	0.032
2	19	506	0.0375	0.032

Length of Watercourse (Lc):	962	feet	Mean Slope:	0.0586	
Length to Cen. of Gravity (Lca):	403	feet	Weighted Basin Fac:	0.032	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	00	

RETURN PERIOD: 2-years NOAA Data Obtained: 2023-07-19 09:45:08 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4071 Longitude: -110.973

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	87	0.266
C	41	90	0.364
D	18	93	0.493
Imp.	0	99	0.901

Weighted Runoff Coef. (Cw):	0.35	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	1.5	in/hr
PEAK DISCHARGE:	11.4	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	07/19/2023
Concentration Point:	CPW01	Job #	20000103
Watershed Area:	7.58 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	51	456	0.1118	0.032
2	19	506	0.0375	0.032

Length of Watercourse (Lc):	962	feet	Mean Slope:	0.0586	
Length to Cen. of Gravity (Lca):	403	feet	Weighted Basin Fac:	0.032	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	00	

RETURN PERIOD: 10-years NOAA Data Obtained: 2023-07-19 09:45:08 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4071 Longitude: -110.973

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	87	0.414
C	41	90	0.511
D	18	93	0.626
Imp.	0	99	0.935

Weighted Runoff Coef. (Cw):	0.49	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	3.36	in/hr
PEAK DISCHARGE:	25.7	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	07/19/2023
Concentration Point:	CPW01	Job #	20000103
Watershed Area:	7.58 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	51	456	0.1118	0.032
2	19	506	0.0375	0.032

Length of Watercourse (Lc):	962	feet	Mean Slope:	0.0586	
Length to Cen. of Gravity (Lca):	403	feet	Weighted Basin Fac:	0.032	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	00	

RETURN PERIOD: 100-years NOAA Data Obtained: 2023-07-19 09:45:08 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4071 Longitude: -110.973

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.8	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	87	0.553
C	41	90	0.638
D	18	93	0.732
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.62	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	6.47	in/hr
PEAK DISCHARGE:	49.4	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	07/20/2023
Concentration Point:	CPW02	Job #	20000103
Watershed Area:	1.28 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	3	93	0.0323	0.032
2	60.2	310	0.1942	0.032

Length of Watercourse (Lc):	403	feet	Mean Slope:	0.1089
Length to Cen. of Gravity (Lca):	202	feet	Weighted Basin Fac:	0.032
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15

RETURN PERIOD: 2-years NOAA Data Obtained: 2023-07-19 09:45:08 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4071 Longitude: -110.973

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	84	0.19
C	41	88.5	0.312
D	18	91.5	0.424
Imp.	0	99	0.901

Weighted Runoff Coef. (Cw):	0.28	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	1.22	in/hr
PEAK DISCHARGE:	1.6	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	07/20/2023
Concentration Point:	CPW02	Job #	20000103
Watershed Area:	1.28 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	3	93	0.0323	0.032
2	60.2	310	0.1942	0.032

Length of Watercourse (Lc):	403	feet	Mean Slope:	0.1089	
Length to Cen. of Gravity (Lca):	202	feet	Weighted Basin Fac:	0.032	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15	

RETURN PERIOD: 10-years NOAA Data Obtained: 2023-07-19 09:45:08 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4071 Longitude: -110.973

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	84	0.333
C	41	88.5	0.46
D	18	91.5	0.566
Imp.	0	99	0.935

Weighted Runoff Coef. (Cw):	0.43	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	2.92	in/hr
PEAK DISCHARGE:	3.8	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	07/20/2023
Concentration Point:	CPW02	Job #	20000103
Watershed Area:	1.28 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	3	93	0.0323	0.032
2	60.2	310	0.1942	0.032

Length of Watercourse (Lc):	403	feet	Mean Slope:	0.1089
Length to Cen. of Gravity (Lca):	202	feet	Weighted Basin Fac:	0.032
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	15

RETURN PERIOD: 100-years NOAA Data Obtained: 2023-07-19 09:45:08 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4071 Longitude: -110.973

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.8	4.54

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	84	0.476
C	41	88.5	0.594
D	18	91.5	0.684
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.56	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	5.86	in/hr
PEAK DISCHARGE:	7.6	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	07/19/2023
Concentration Point:	NAR1	Job #	20000103
Watershed Area:	0.36 Acres	Watershed Type	Shallow Streetflow-Paved

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	6.4	427	0.015	0.02

Length of Watercourse (Lc):	427 feet	Mean Slope:	0.015
Length to Cen. of Gravity (Lca):	59 feet	Weighted Basin Fac:	0.02

RETURN PERIOD: 2-years NOAA Data Obtained: 2023-07-19 09:45:08 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4098 Longitude: -110.9726

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.55	0.68	0.92	1.14	1.29	1.36	1.55	1.74	2.03

Default Vegetation Percentages Not Used

Soil Type	Percent	Veg %	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
D	100	-	87	Urban Lawns	0.266
Imp.	100	-	99	-	0.901

Weighted Runoff Coef. (Cw):	0.9	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	4.32	in/hr
Runoff Supply Rate (q) @ Tc:	3.89	in/hr
PEAK DISCHARGE:	1.4	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	07/19/2023
Concentration Point:	NAR1	Job #	20000103
Watershed Area:	0.36 Acres	Watershed Type	Shallow Streetflow-Paved

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	6.4	427	0.015	0.02

Length of Watercourse (Lc):	427 feet	Mean Slope:	0.015
Length to Cen. of Gravity (Lca):	59 feet	Weighted Basin Fac:	0.02

RETURN PERIOD: 10-years NOAA Data Obtained: 2023-07-19 09:45:08 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4098 Longitude: -110.9726

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.28	2.52	2.97

Default Vegetation Percentages Not Used

Soil Type	Percent	Veg %	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
D	100	-	87	Urban Lawns	0.414
Imp.	100	-	99	-	0.935

Weighted Runoff Coef. (Cw):	0.93	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	6.84	in/hr
Runoff Supply Rate (q) @ Tc:	6.39	in/hr
PEAK DISCHARGE:	2.3	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Meritage Homes	Prepared by:	Atwell
Project Name:	Naranja Trails	Date:	07/19/2023
Concentration Point:	NAR1	Job #	20000103
Watershed Area:	0.36 Acres	Watershed Type	Shallow Streetflow-Paved

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	6.4	427	0.015	0.02

Length of Watercourse (Lc):	427 feet	Mean Slope:	0.015
Length to Cen. of Gravity (Lca):	59 feet	Weighted Basin Fac:	0.02

RETURN PERIOD: 100-years NOAA Data Obtained: 2023-07-19 09:45:08 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.4098 Longitude: -110.9726

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.87	1.33	1.65	2.22	2.74	3.06	3.22	3.52	3.8	4.54

Default Vegetation Percentages Not Used

Soil Type	Percent	Veg %	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
D	100	-	87	Urban Lawns	0.553
Imp.	100	-	99	-	0.957

Weighted Runoff Coef. (Cw):	0.96	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.44	in/hr
Runoff Supply Rate (q) @ Tc:	9.99	in/hr
PEAK DISCHARGE:	3.6	cfs

ONSITE HYDRAULICS

CHANNEL HYDRAULICS

Worksheet for Ch1-OFF1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	2.500 %
Left Side Slope	1.500 H:V
Right Side Slope	6.000 H:V
Bottom Width	0.00 ft
Discharge	4.20 cfs

Results	
Normal Depth	0.62 ft
Flow Area	1.4 ft²
Wetted Perimeter	4.9 ft
Hydraulic Radius	0.29 ft
Top Width	4.61 ft
Critical Depth	0.60 ft
Critical Slope	2.850 %
Velocity	2.96 ft/s
Velocity Head	0.14 ft
Specific Energy	0.75 ft
Froude Number	0.940
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.62 ft
Critical Depth	0.60 ft
Channel Slope	2.500 %
Critical Slope	2.850 %

CH1-Section 1 -OFF2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.035	
Channel Slope	1.200	%
Left Side Slope	3.000	H:V
Right Side Slope	1.000	H:V
Bottom Width	5.00	ft
Discharge	13.00	cfs

Results		
Normal Depth	0.67	ft
Flow Area	4.3	ft²
Wetted Perimeter	8.1	ft
Hydraulic Radius	0.53	ft
Top Width	7.69	ft
Critical Depth	0.55	ft
Critical Slope	2.438	%
Velocity	3.04	ft/s
Velocity Head	0.14	ft
Specific Energy	0.82	ft
Froude Number	0.719	
Flow Type	Subcritical	

GVF Input Data		
Downstream Depth	0.00	ft
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.00	ft
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.67	ft
Critical Depth	0.55	ft
Channel Slope	1.200	%
Critical Slope	2.438	%

CH1-Section 2 -OFF2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	5.300 %
Left Side Slope	3.000 H:V
Right Side Slope	1.000 H:V
Bottom Width	5.00 ft
Discharge	13.00 cfs

Results	
Normal Depth	0.44 ft
Flow Area	2.6 ft²
Wetted Perimeter	7.0 ft
Hydraulic Radius	0.37 ft
Top Width	6.76 ft
Critical Depth	0.55 ft
Critical Slope	2.439 %
Velocity	5.02 ft/s
Velocity Head	0.39 ft
Specific Energy	0.83 ft
Froude Number	1.432
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.44 ft
Critical Depth	0.55 ft
Channel Slope	5.300 %
Critical Slope	2.439 %

CH2-Section 1-OFF3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.035	
Channel Slope	15.200	%
Left Side Slope	3.000	H:V
Right Side Slope	1.000	H:V
Bottom Width	5.00	ft
Discharge	9.60	cfs

Results		
Normal Depth	0.27	ft
Flow Area	1.5	ft²
Wetted Perimeter	6.2	ft
Hydraulic Radius	0.24	ft
Top Width	6.08	ft
Critical Depth	0.46	ft
Critical Slope	2.559	%
Velocity	6.40	ft/s
Velocity Head	0.64	ft
Specific Energy	0.91	ft
Froude Number	2.272	
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.00	ft
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.00	ft
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.27	ft
Critical Depth	0.46	ft
Channel Slope	15.200	%
Critical Slope	2.559	%

CH2-Section 2 -OFF3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	5.700 %
Left Side Slope	3.000 H:V
Right Side Slope	1.000 H:V
Bottom Width	5.00 ft
Discharge	9.60 cfs

Results	
Normal Depth	0.36 ft
Flow Area	2.1 ft²
Wetted Perimeter	6.7 ft
Hydraulic Radius	0.31 ft
Top Width	6.44 ft
Critical Depth	0.46 ft
Critical Slope	2.559 %
Velocity	4.65 ft/s
Velocity Head	0.34 ft
Specific Energy	0.70 ft
Froude Number	1.447
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.36 ft
Critical Depth	0.46 ft
Channel Slope	5.700 %
Critical Slope	2.559 %

CH2-Section 3 -OFF3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	1.400 %
Left Side Slope	3.000 H:V
Right Side Slope	1.000 H:V
Bottom Width	5.00 ft
Discharge	9.60 cfs

Results	
Normal Depth	0.54 ft
Flow Area	3.3 ft²
Wetted Perimeter	7.5 ft
Hydraulic Radius	0.44 ft
Top Width	7.17 ft
Critical Depth	0.46 ft
Critical Slope	2.559 %
Velocity	2.91 ft/s
Velocity Head	0.13 ft
Specific Energy	0.67 ft
Froude Number	0.757
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.54 ft
Critical Depth	0.46 ft
Channel Slope	1.400 %
Critical Slope	2.559 %

Worksheet for CH2-Section 4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.005 ft/ft (V:H)
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	5.00 ft
Discharge	25.80 cfs

Results	
Normal Depth	1.17 ft
Flow Area	10.0 ft²
Wetted Perimeter	12.4 ft
Hydraulic Radius	0.80 ft
Top Width	12.02 ft
Critical Depth	0.79 ft
Critical Slope	0.022 ft/ft (V:H)
Velocity	2.59 ft/s
Velocity Head	0.10 ft
Specific Energy	1.27 ft
Froude Number	0.502
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.17 ft
Critical Depth	0.79 ft
Channel Slope	0.005 ft/ft (V:H)
Critical Slope	0.022 ft/ft (V:H)

CH3-Section 1-OFF4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	4.700 %
Left Side Slope	3.000 H:V
Right Side Slope	1.000 H:V
Bottom Width	5.00 ft
Discharge	8.20 cfs

Results	
Normal Depth	0.35 ft
Flow Area	2.0 ft²
Wetted Perimeter	6.6 ft
Hydraulic Radius	0.30 ft
Top Width	6.39 ft
Critical Depth	0.41 ft
Critical Slope	2.626 %
Velocity	4.13 ft/s
Velocity Head	0.27 ft
Specific Energy	0.61 ft
Froude Number	1.308
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.35 ft
Critical Depth	0.41 ft
Channel Slope	4.700 %
Critical Slope	2.626 %

CH3-Section 2-OFF4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	1.000 %
Left Side Slope	3.000 H:V
Right Side Slope	1.000 H:V
Bottom Width	5.00 ft
Discharge	8.20 cfs

Results	
Normal Depth	0.55 ft
Flow Area	3.3 ft²
Wetted Perimeter	7.5 ft
Hydraulic Radius	0.44 ft
Top Width	7.18 ft
Critical Depth	0.41 ft
Critical Slope	2.626 %
Velocity	2.47 ft/s
Velocity Head	0.09 ft
Specific Energy	0.64 ft
Froude Number	0.640
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.55 ft
Critical Depth	0.41 ft
Channel Slope	1.000 %
Critical Slope	2.626 %

CH3-Section 3-OFF4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	7.500 %
Left Side Slope	3.000 H:V
Right Side Slope	1.000 H:V
Bottom Width	5.00 ft
Discharge	8.20 cfs

Results	
Normal Depth	0.30 ft
Flow Area	1.7 ft²
Wetted Perimeter	6.4 ft
Hydraulic Radius	0.27 ft
Top Width	6.21 ft
Critical Depth	0.41 ft
Critical Slope	2.626 %
Velocity	4.82 ft/s
Velocity Head	0.36 ft
Specific Energy	0.66 ft
Froude Number	1.623
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.30 ft
Critical Depth	0.41 ft
Channel Slope	7.500 %
Critical Slope	2.626 %

Worksheet for CH3-Section 4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.005 ft/ft (V:H)
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	5.00 ft
Discharge	26.70 cfs

Results	
Normal Depth	1.19 ft
Flow Area	10.2 ft²
Wetted Perimeter	12.5 ft
Hydraulic Radius	0.81 ft
Top Width	12.14 ft
Critical Depth	0.81 ft
Critical Slope	0.022 ft/ft (V:H)
Velocity	2.62 ft/s
Velocity Head	0.11 ft
Specific Energy	1.30 ft
Froude Number	0.503
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.19 ft
Critical Depth	0.81 ft
Channel Slope	0.005 ft/ft (V:H)
Critical Slope	0.022 ft/ft (V:H)

CH4-Section 1-OFF5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	3.000 %
Left Side Slope	3.000 H:V
Right Side Slope	1.000 H:V
Bottom Width	5.00 ft
Discharge	6.20 cfs

Results	
Normal Depth	0.34 ft
Flow Area	1.9 ft²
Wetted Perimeter	6.5 ft
Hydraulic Radius	0.29 ft
Top Width	6.35 ft
Critical Depth	0.35 ft
Critical Slope	2.753 %
Velocity	3.24 ft/s
Velocity Head	0.16 ft
Specific Energy	0.50 ft
Froude Number	1.040
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.34 ft
Critical Depth	0.35 ft
Channel Slope	3.000 %
Critical Slope	2.753 %

CH4-Section 2-OFF5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	10.100 %
Left Side Slope	3.000 H:V
Right Side Slope	1.000 H:V
Bottom Width	5.00 ft
Discharge	6.20 cfs

Results	
Normal Depth	0.24 ft
Flow Area	1.3 ft²
Wetted Perimeter	6.1 ft
Hydraulic Radius	0.21 ft
Top Width	5.94 ft
Critical Depth	0.35 ft
Critical Slope	2.753 %
Velocity	4.80 ft/s
Velocity Head	0.36 ft
Specific Energy	0.59 ft
Froude Number	1.817
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.24 ft
Critical Depth	0.35 ft
Channel Slope	10.100 %
Critical Slope	2.753 %

CH4-Section 3-OFF5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	2.000 %
Left Side Slope	3.000 H:V
Right Side Slope	1.000 H:V
Bottom Width	5.00 ft
Discharge	6.20 cfs

Results	
Normal Depth	0.38 ft
Flow Area	2.2 ft²
Wetted Perimeter	6.7 ft
Hydraulic Radius	0.32 ft
Top Width	6.52 ft
Critical Depth	0.35 ft
Critical Slope	2.753 %
Velocity	2.84 ft/s
Velocity Head	0.12 ft
Specific Energy	0.50 ft
Froude Number	0.863
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.38 ft
Critical Depth	0.35 ft
Channel Slope	2.000 %
Critical Slope	2.753 %

CH5-Section 1-OFF6

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	1.300 %
Left Side Slope	3.000 H:V
Right Side Slope	1.000 H:V
Bottom Width	5.00 ft
Discharge	3.40 cfs

Results	
Normal Depth	0.30 ft
Flow Area	1.7 ft²
Wetted Perimeter	6.4 ft
Hydraulic Radius	0.27 ft
Top Width	6.21 ft
Critical Depth	0.24 ft
Critical Slope	3.063 %
Velocity	2.00 ft/s
Velocity Head	0.06 ft
Specific Energy	0.37 ft
Froude Number	0.675
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.30 ft
Critical Depth	0.24 ft
Channel Slope	1.300 %
Critical Slope	3.063 %

CH5-Section 2-OFF6

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.500 %
Left Side Slope	3.000 H:V
Right Side Slope	1.000 H:V
Bottom Width	5.00 ft
Discharge	3.40 cfs

Results	
Normal Depth	0.40 ft
Flow Area	2.3 ft²
Wetted Perimeter	6.8 ft
Hydraulic Radius	0.34 ft
Top Width	6.60 ft
Critical Depth	0.24 ft
Critical Slope	3.062 %
Velocity	1.46 ft/s
Velocity Head	0.03 ft
Specific Energy	0.43 ft
Froude Number	0.435
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.40 ft
Critical Depth	0.24 ft
Channel Slope	0.500 %
Critical Slope	3.062 %

CH5-Section 3-OFF6

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.035	
Channel Slope	0.500	%
Left Side Slope	3.000	H:V
Right Side Slope	1.000	H:V
Bottom Width	2.00	ft
Discharge	3.40	cfs

Results		
Normal Depth	0.62	ft
Flow Area	2.0	ft²
Wetted Perimeter	4.9	ft
Hydraulic Radius	0.42	ft
Top Width	4.50	ft
Critical Depth	0.39	ft
Critical Slope	2.878	%
Velocity	1.68	ft/s
Velocity Head	0.04	ft
Specific Energy	0.67	ft
Froude Number	0.440	
Flow Type	Subcritical	

GVF Input Data		
Downstream Depth	0.00	ft
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.00	ft
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.39	ft
Channel Slope	0.500	%
Critical Slope	2.878	%

Worksheet for Culv-2 Chan

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.055
Channel Slope	4.000 %
Left Side Slope	2.000 H:V
Right Side Slope	2.000 H:V
Bottom Width	16.00 ft
Discharge	150.50 cfs

Results	
Normal Depth	1.36 ft
Flow Area	25.4 ft²
Wetted Perimeter	22.1 ft
Hydraulic Radius	1.15 ft
Top Width	21.42 ft
Critical Depth	1.32 ft
Critical Slope	4.362 %
Velocity	5.93 ft/s
Velocity Head	0.55 ft
Specific Energy	1.90 ft
Froude Number	0.961
Flow Type	Subcritical

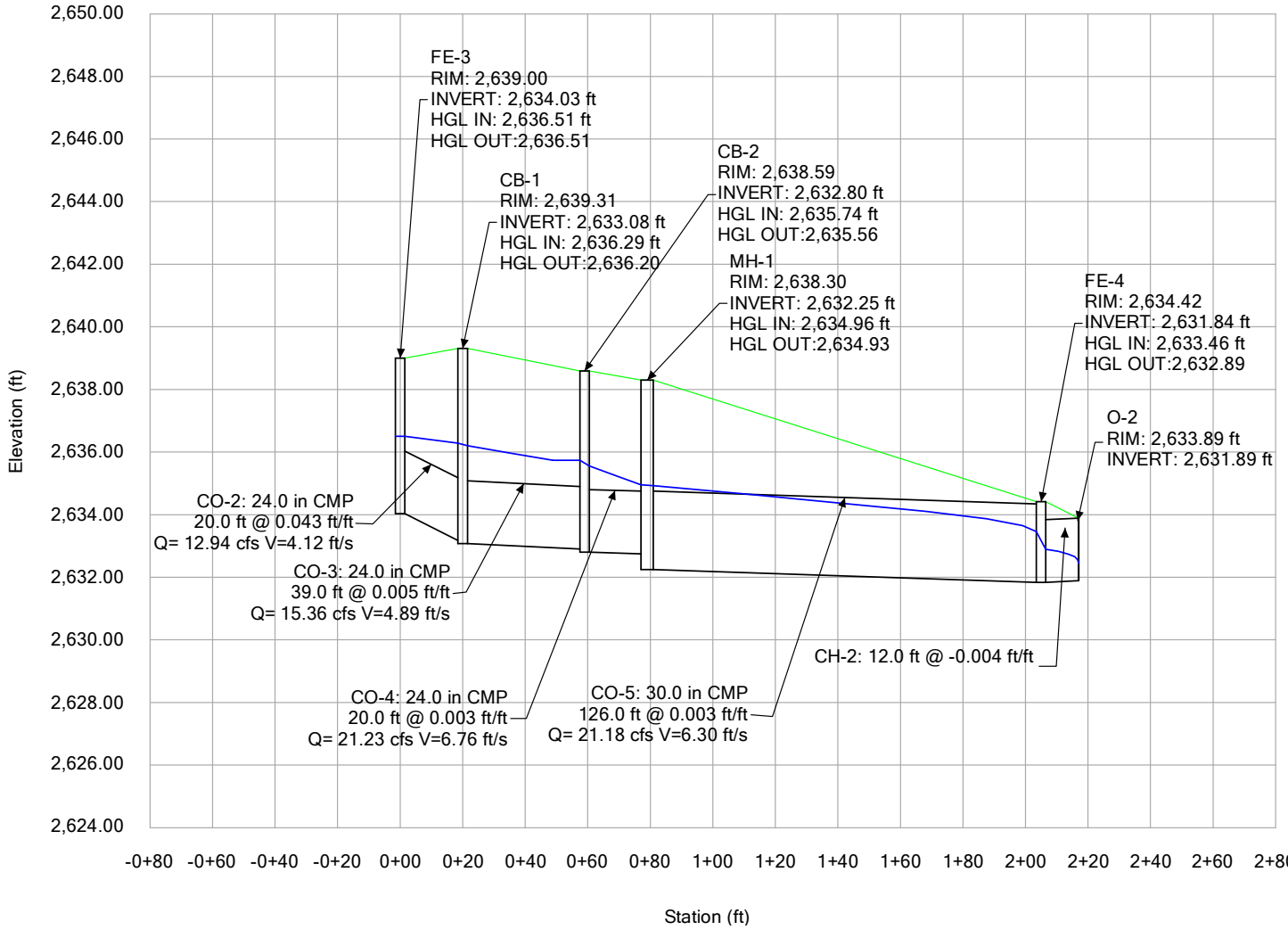
GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.36 ft
Critical Depth	1.32 ft
Channel Slope	4.000 %
Critical Slope	4.362 %

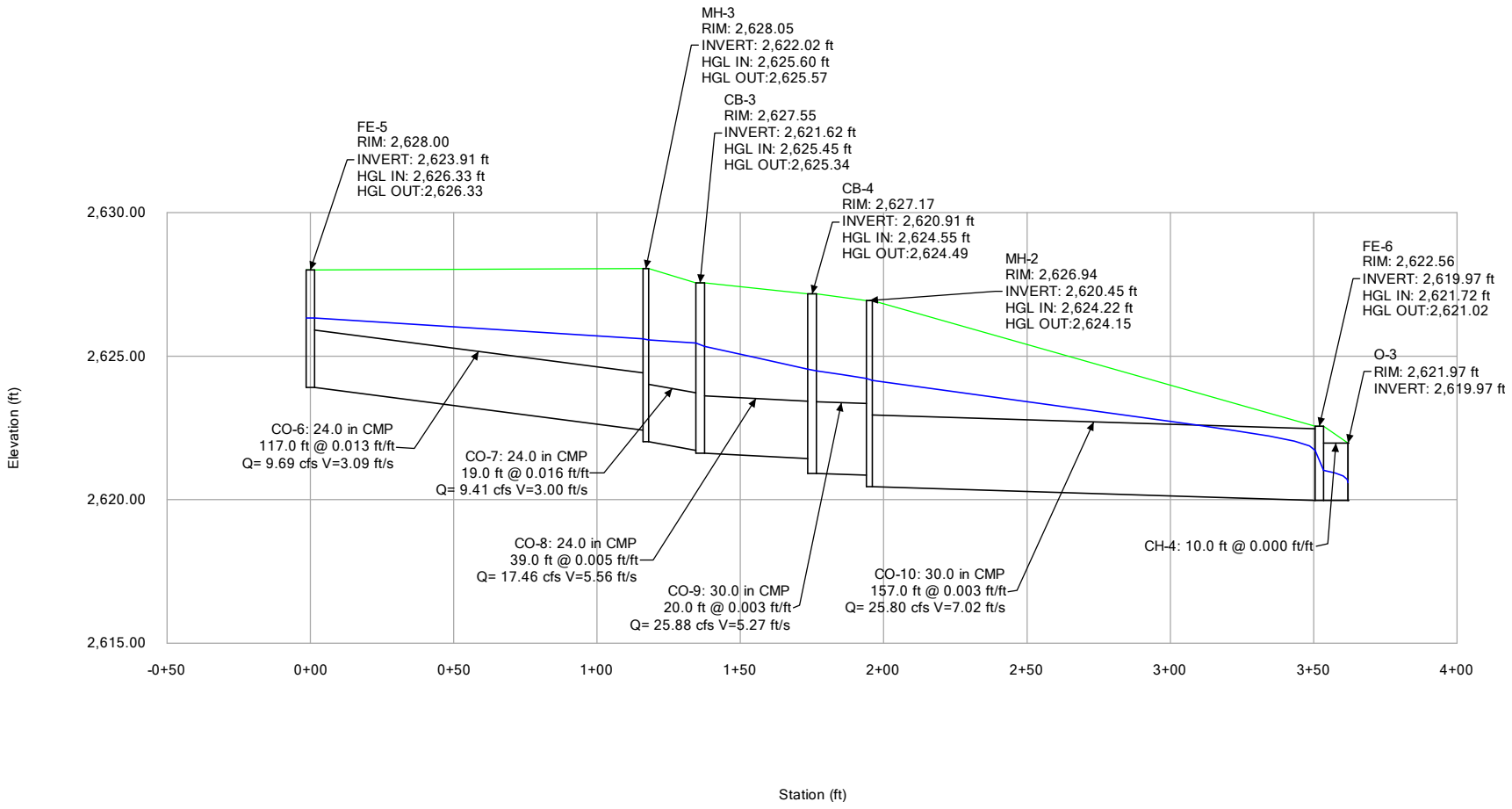
STORMCAD RESULTS

Profile Report

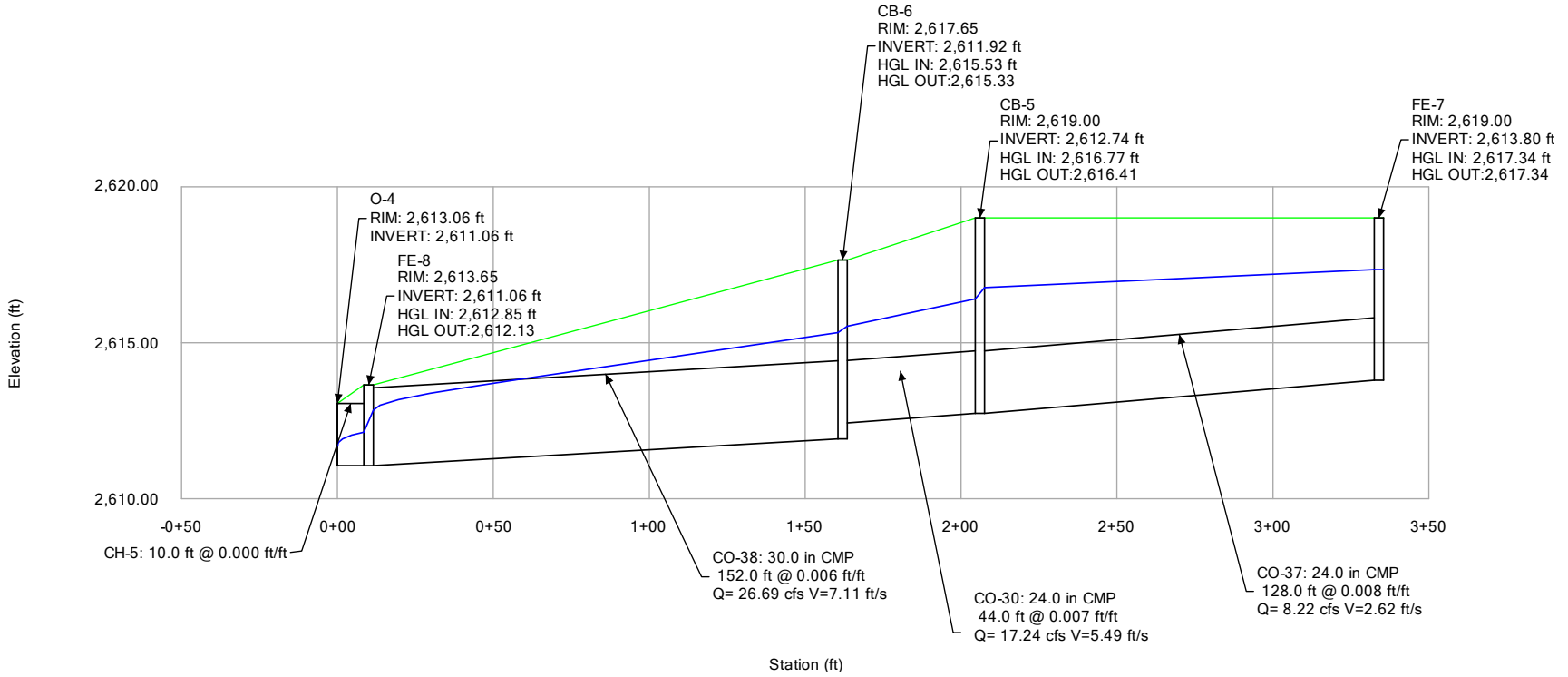
Engineering Profile - SD1 (Naranja Trails Onsite SD_07.17.23.stsw)



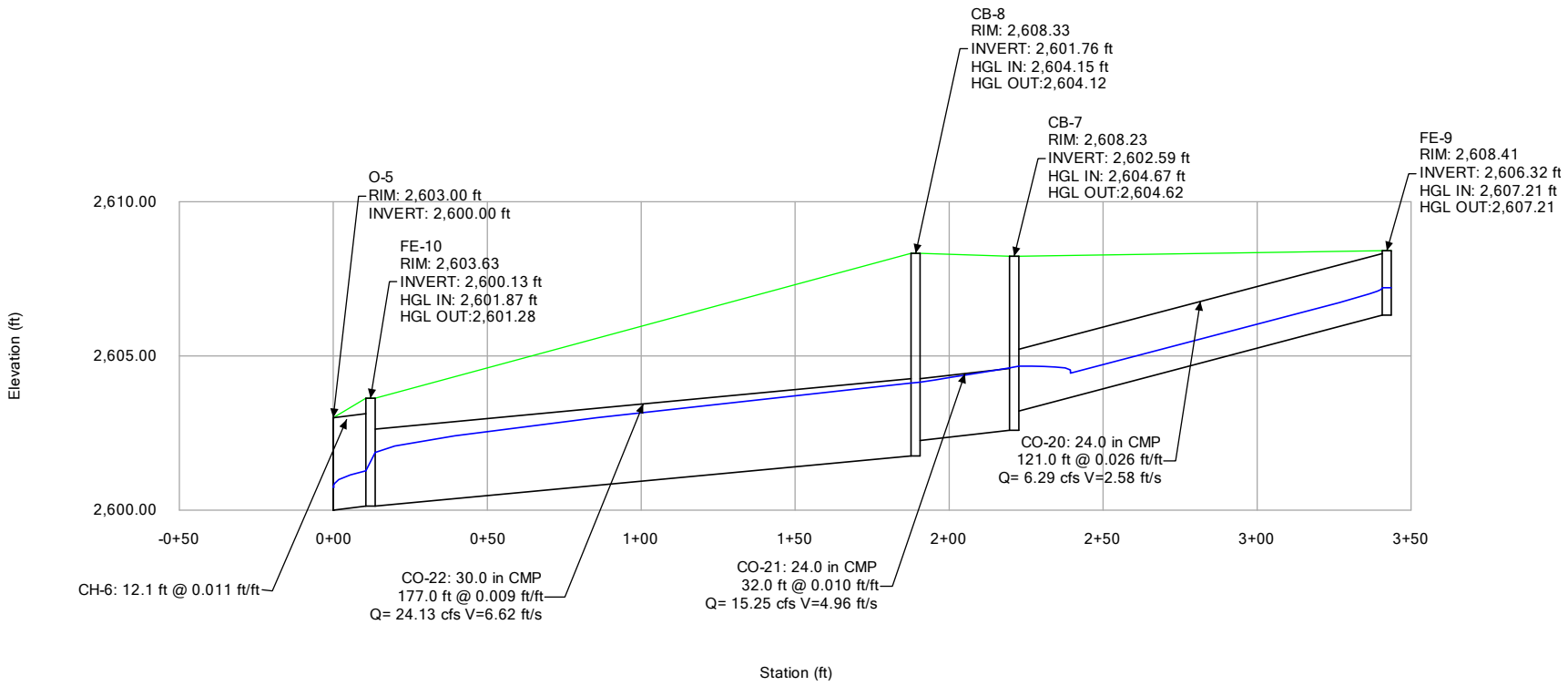
Profile Report
Engineering Profile - SD2 (Naranja Trails Onsite SD_New.stsw)



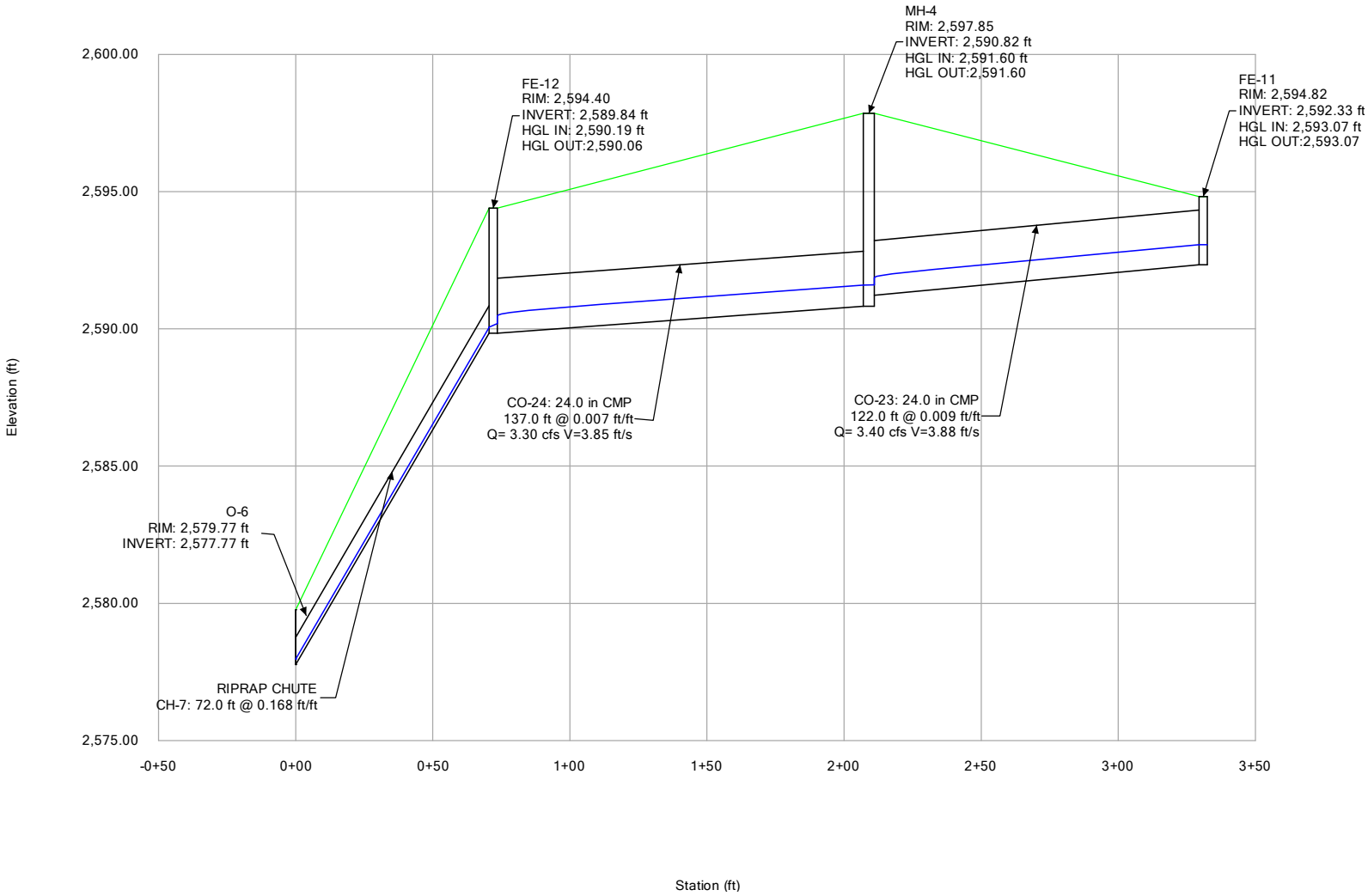
Profile Report
Engineering Profile - SD3 (Naranja Trails Onsite SD_New.stsw)



Profile Report
Engineering Profile - SD4 (Naranja Trails Onsite SD_New.stsw)



Profile Report
Engineering Profile - SD5 (Naranja Trails Onsite SD_New.stsw)



FlexTable: Conduit Table

Label	Start Node	Elevation Ground (Start) (ft)	Invert (Start) (ft)	Stop Node	Elevation Ground (Stop) (ft)	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
CO-2	FE-3	2,639.00	2,634.03	CB-1	2,639.31	2,633.18	20.0	0.043	24.0	0.024	12.94	4.12	2,636.51	2,636.29
CO-3	CB-1	2,639.31	2,633.08	CB-2	2,638.59	2,632.90	39.0	0.005	24.0	0.024	15.36	4.89	2,636.20	2,635.74
CO-4	CB-2	2,638.59	2,632.80	MH-1	2,638.30	2,632.75	20.0	0.003	24.0	0.024	21.23	6.76	2,635.56	2,634.96
CO-5	MH-1	2,638.30	2,632.25	FE-4	2,634.42	2,631.84	126.0	0.003	30.0	0.024	21.18	4.31	2,634.93	2,633.46
CO-6	FE-5	2,628.00	2,623.91	MH-3	2,628.05	2,622.42	117.0	0.013	24.0	0.024	9.69	3.09	2,626.33	2,625.60
CO-7	MH-3	2,628.05	2,622.02	CB-3	2,627.55	2,621.72	19.0	0.016	24.0	0.024	9.41	3.00	2,625.57	2,625.45
CO-8	CB-3	2,627.55	2,621.62	CB-4	2,627.17	2,621.43	39.0	0.005	24.0	0.024	17.46	5.56	2,625.34	2,624.55
CO-9	CB-4	2,627.17	2,620.91	MH-2	2,626.94	2,620.85	20.0	0.003	30.0	0.024	25.88	5.27	2,624.49	2,624.22
CO-10	MH-2	2,626.94	2,620.45	FE-6	2,622.56	2,619.97	157.0	0.003	30.0	0.024	25.80	5.26	2,624.15	2,621.72
CO-20	FE-9	2,608.41	2,606.32	CB-7	2,608.23	2,603.22	121.0	0.026	24.0	0.024	6.29	5.56	2,607.21	2,604.67
CO-21	CB-7	2,608.23	2,602.59	CB-8	2,608.33	2,602.26	32.0	0.010	24.0	0.024	15.25	4.85	2,604.62	2,604.15
CO-22	CB-8	2,608.33	2,601.76	FE-10	2,603.63	2,600.13	177.0	0.009	30.0	0.024	24.13	4.92	2,604.12	2,601.87
CO-23	FE-11	2,594.82	2,592.33	MH-4	2,597.85	2,591.22	122.0	0.009	24.0	0.024	3.40	3.22	2,593.07	2,591.87
CO-24	MH-4	2,597.85	2,590.82	FE-12	2,594.40	2,589.84	137.0	0.007	24.0	0.024	3.30	2.93	2,591.60	2,590.48
CO-30	CB-5	2,619.00	2,612.74	CB-6	2,617.65	2,612.43	44.0	0.007	24.0	0.024	17.24	5.49	2,616.41	2,615.53
CO-37	FE-7	2,619.00	2,613.80	CB-5	2,619.00	2,612.74	128.0	0.008	24.0	0.024	8.22	2.62	2,617.34	2,616.77
CO-38	CB-6	2,617.65	2,611.92	FE-8	2,613.65	2,611.06	152.0	0.006	30.0	0.024	26.69	5.44	2,615.33	2,612.85

FlexTable: Catch Basin Table

Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Length (ft)	Width (ft)	Inlet Type	Inlet	Flow (Captured) (cfs)	Depth (Gutter) (in)	Flow (Total Bypassed) (cfs)
CB-1	2,639.31	2,639.31	2,633.08	3.08	2.75	Catalog Inlet	PAG 308 (Type 3); L=8'	2.47	2.1	0.86
CB-2	2,638.59	2,638.59	2,632.80	2.98	3.75	Catalog Inlet	PAG 310 (Type 5); L=12'	5.98	2.8	1.35
CB-3	2,627.55	2,627.55	2,621.62	2.98	3.75	Catalog Inlet	PAG 310 (Type 5); L=12'	8.38	3.7	2.49
CB-4	2,627.17	2,627.17	2,620.91	2.98	3.75	Catalog Inlet	PAG 310 (Type 5); L=12'	8.87	3.8	2.91
CB-5	2,619.00	2,619.00	2,612.74	2.98	3.75	Catalog Inlet	PAG 310 (Type 5); L=8' Dbl	9.70	3.5	2.40
CB-6	2,617.65	2,617.65	2,611.92	2.98	3.75	Catalog Inlet	PAG 310 (Type 5); L=8' Dbl	10.00	3.5	2.63
CB-7	2,608.23	2,608.23	2,602.59	2.98	3.75	Catalog Inlet	PAG 310 (Type 5); L=12'	9.21	4.1	2.63
CB-8	2,608.33	2,608.33	2,601.76	2.98	3.75	Catalog Inlet	PAG 310 (Type 5); L=12'	9.15	4.1	2.59

FlexTable: Catchment Table

Label	Outflow Element	Area (User Defined) (acres)	Runoff Coefficient (Rational)	Time of Concentration (hours)	Flow (Total Out) (cfs)
OFF-2 (CP02)	FE-3	2.120	0.580	0.083	12.94
DON-1 (CP07)	CB-1	0.340	0.930	0.083	3.33
DON-2 (CP08)	CB-2	0.840	0.830	0.083	7.34
OFF-3 (CP03)	FE-5	1.510	0.610	0.083	9.69
DON-3 (CP09)	CB-3	1.220	0.780	0.083	10.01
DON-4 CP10)	CB-4	1.270	0.780	0.083	10.42
OFF-4 (CP04)	FE-7	1.280	0.610	0.083	8.22
DON-5 (CP11)	CB-5	1.170	0.780	0.083	9.60
DON-6 (CP12)	CB-6	1.140	0.810	0.083	9.72
OFF-5 (CP05)	FE-9	0.980	0.610	0.083	6.29
DON-7 (CP13)	CB-7	1.150	0.780	0.083	9.44
DON-8 (CP14)	CB-8	1.110	0.780	0.083	9.11
OFF-6 (CP 6)	FE-11	0.530	0.610	0.083	3.40

FlexTable: Manhole Table

Label	Elevation (Rim) (ft)	Flow (Total Out) (cfs)	Elevation (Invert in 1) (ft)	Elevation (Invert Out) (ft)	Depth (Out) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	HEC-22 Benching Method	Headloss (ft)	Hydraulic Grade Line (In) (ft)
MH-1	2,638.30	21.18	2,632.75	2,632.25	2.68	2,634.93	HEC-22 Energy (Second Edition)	Half	0.03	2,634.96
MH-2	2,626.94	25.80	2,620.85	2,620.45	3.70	2,624.15	HEC-22 Energy (Second Edition)	Half	0.07	2,624.22
MH-4	2,597.85	3.30	2,591.22	2,590.82	0.78	2,591.60	HEC-22 Energy (Second Edition)	Half	0.00	2,591.60
MH-3	2,628.05	9.41	2,622.42	2,622.02	3.55	2,625.57	HEC-22 Energy (Second Edition)	Half	0.03	2,625.60

Worksheet for CB-NAR1 Outlet

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data	
Roughness Coefficient	0.015
Channel Slope	0.010 ft/ft (V:H)
Normal Depth	2.00 ft
Diameter	24.0 in
Discharge	19.61 cfs

Results	
Discharge	19.61 cfs
Normal Depth	2.00 ft
Flow Area	3.1 ft²
Wetted Perimeter	6.3 ft
Hydraulic Radius	0.50 ft
Top Width	0.00 ft
Critical Depth	1.59 ft
Percent Full	100.0 %
Critical Slope	0.011 ft/ft (V:H)
Velocity	6.24 ft/s
Velocity Head	0.61 ft
Specific Energy	2.61 ft
Froude Number	(N/A)
Maximum Discharge	21.09 cfs
Discharge Full	19.61 cfs
Slope Full	0.010 ft/ft (V:H)
Flow Type	Undefined

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	0.0 %
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	2.00 ft
Critical Depth	1.59 ft
Channel Slope	0.010 ft/ft (V:H)
Critical Slope	0.011 ft/ft (V:H)

SCUPPER CAPACITY CALCULATIONS

CATCH BASIN / SCUPPER CAPACITY

SUMP CONDITION - 10 YEAR STORM EVENT

Naranja Trails

Final Drainage Report
5/24/2024

Objective: Calculation of Inlet Capacity for catch basins and scuppers in Sump Condition
Location: Town of Oro Valley
Reference: COTDSM, Chapter 10: Storm Drains

Equations:

Curb Opening Capacity (Weir Calculation), Q_{CO} = Cw x (L + 1.8W) x d^1.5*Fs

Where: d = Depth of Flow at Curb (Ft) = SEE BELOW
C_W = Weir Coefficient = SEE BELOW
L = Curb Opening Length (Ft) = SEE BELOW
W = Gutter Width at Inlet (Ft) = SEE BELOW
F_S = Clogging factor of Safety = 0.67

INLET STRUCTURE PARAMETERS

Structure	P (Ft)	L (Ft)	W (Ft)	$C_{W\ (Grate)}$	$C_{W\ (Curb)}$
PAG 205.5 Scupper		Per Structure	2.00		2.3
PAG 309, Catch Basin, Type 4, EF-2	10.21			3.0	

INLET STRUCTURE CAPACITY - 10 YEAR STORM

Contributing Sub-Basin	Inlet ID	Full/Half Sub-Basin	Flow Per Inlet (CFS)	Catch Basin/Scupper Type and Length (ft)	Depth of Flow, d (Ft)	Capacity Per Inlet (CFS)
DON-9 (CP-15)	S-1	Full	42.2	PAG 205.5 Scupper, L = 80	0.5	45.5
NAR1	CB-NAR1	Full	2.3	PAG 309, Catch Basin, Type 4, EF-2	0.5	5.4

CULVERT HYDRAULICS

Culvert Designer/Analyzer Report
Culvert 1

Analysis Component			
Storm Event	Design	Discharge	4.15 cfs

Peak Discharge Method: User-Specified			
Design Discharge	4.15 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	4.15 cfs	Bottom Elevation	2,644.03 ft
Depth	0.11 ft	Velocity	1.44 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	4.15 cfs	2,654.28 ft	6.57 ft/s
Weir	Roadway (Constant Elevation)	0.00 cfs	2,654.28 ft	N/A
Total	----------	4.15 cfs	2,654.28 ft	N/A

Culvert Designer/Analyzer Report
Culvert 1

Component:Culvert-1

Culvert Summary					
Computed Headwater Elev	2,654.28	ft	Discharge	4.15	cfs
Inlet Control HW Elev.	2,654.17	ft	Tailwater Elevation	2,644.14	ft
Outlet Control HW Elev.	2,654.28	ft	Control Type	Entrance Control	
Headwater Depth/Height	0.52				

Grades					
Upstream Invert	2,653.25	ft	Downstream Invert	2,644.03	ft
Length	163.00	ft	Constructed Slope	0.056564	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.51	ft
Slope Type	Steep		Normal Depth	0.51	ft
Flow Regime	Supercritical		Critical Depth	0.72	ft
Velocity Downstream	6.57	ft/s	Critical Slope	0.015319	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,654.28	ft	Upstream Velocity Head	0.26	ft
Ke	0.20		Entrance Loss	0.05	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,654.17	ft	Flow Control	Unsubmerged	
Inlet Type	Beveled ring, 33.7° (1.5:1) bevels		Area Full	3.1	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Designer/Analyzer Report
Culvert 1

Component:Weir

Hydraulic Component(s): Roadway (Constant Elevation)					
Discharge	0.00	cfs	Allowable HW Elevation	2,654.28	ft
Roadway Width	86.00	ft	Overtopping Coefficient	2.90	US
Length	100.00	ft	Crest Elevation	2,659.50	ft
Headwater Elevation	N/A	ft	Discharge Coefficient (Cr)	2.90	
Submergence Factor (Kt)	1.00				

Sta (ft)	Elev. (ft)
0.00	2,659.50
100.00	2,659.50

Culvert Designer/Analyzer Report
Culvert 2

Analysis Component			
Storm Event	Design	Discharge	150.50 cfs

Peak Discharge Method: User-Specified			
Design Discharge	150.50 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	150.50 cfs	Bottom Elevation	2,573.69 ft
Depth	1.04 ft	Velocity	7.98 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	4-48 inch Circular	150.55 cfs	2,578.13 ft	6.72 ft/s
Weir	Roadway (Constant Elevation)	0.00 cfs	2,578.13 ft	N/A
Total	----------	150.55 cfs	2,578.13 ft	N/A

Culvert Designer/Analyzer Report
Culvert 2

Component:Culvert-1

Culvert Summary					
Computed Headwater Eleva	2,578.13	ft	Discharge	150.55	cfs
Inlet Control HW Elev.	2,577.98	ft	Tailwater Elevation	2,574.73	ft
Outlet Control HW Elev.	2,578.13	ft	Control Type	Outlet Control	
Headwater Depth/Height	0.67				

Grades					
Upstream Invert	2,575.45	ft	Downstream Invert	2,573.69	ft
Length	200.00	ft	Constructed Slope	0.008800	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	1.83	ft
Slope Type	Mild		Normal Depth	2.04	ft
Flow Regime	Subcritical		Critical Depth	1.83	ft
Velocity Downstream	6.72	ft/s	Critical Slope	0.012754	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	4.00	ft
Section Size	48 inch		Rise	4.00	ft
Number Sections	4				

Outlet Control Properties					
Outlet Control HW Elev.	2,578.13	ft	Upstream Velocity Head	0.53	ft
Ke	0.20		Entrance Loss	0.11	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,577.98	ft	Flow Control	N/A	
Inlet TypeBeveled ring, 45° (1:1) bevels			Area Full	50.3	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	A	
C	0.03000		Equation Form	1	
Y	0.74000				

Culvert Designer/Analyzer Report
Culvert 2

Component:Weir

Hydraulic Component(s): Roadway (Constant Elevation)					
Discharge	0.00	cfs	Allowable HW Elevation	2,578.13	ft
Roadway Width	28.00	ft	Overtopping Coefficient	2.90	US
Length	100.00	ft	Crest Elevation	2,581.49	ft
Headwater Elevation	N/A	ft	Discharge Coefficient (Cr)	2.90	
Submergence Factor (Kt)	1.00				

Sta (ft)	Elev. (ft)
0.00	2,581.49
100.00	2,581.49

EROSION PROTECTION CALCULATIONS

RIPRAP SIZING AND BANK TOE PROTECTION

Location: **Highlands Wash**
Objective: Compute Channel Bank Protection and Bank Toe Protection
Municipality: Oro Valley
Reference: HEC-11

Riprap Sizing

For the HEC-11 method the d_{50} (ft) is determined by:

$$d_{50} = \frac{0.001 V_a^{\,3}}{d_{avg}^{\,0.5} K_1^{\,1.5}} \qquad (6.15)$$

Where V_a (ft/sec) is the average velocity in the main channel, d_{avg} (ft) is the average flow depth in the main channel, and K_1 is the bank angle correction factor. The bank angle correction factor is determined using Equation (6.16).

$$K_1 = \left[1 - \frac{\sin^2\theta}{\sin^2\phi}\right]^{0.5} \qquad (6.16)$$

Where θ is the bank angle with the horizontal, Φ is the riprap material's angle of repose. The bank angle correction factor can also be determined using Figure 6.10. The riprap material's angle of repose can be determined using Figure 6.11.

X-Section	V_a (fps)	Depth, d_{avg} Area/Top Width (ft)	Bank Slope	Bank Angle (Θ)	Riprap Angle of Repose (Ø)	K1	D_{50} Calculated (ft)	D_{50} Used (in)
Section 1	4.82	1.52	3:1	19.84	41	0.64	0.18	**6**
Section 2	5.03	1.36	3:1	19.84	41	0.64	0.21	**6**
Section 3	6.36	1.36	3:1	19.84	41	0.64	0.43	**6**
Section 3A	6.36	1.36	3.00	19.84	41	0.64	0.43	**6**

Bank Toe Protection - Launchable Riprap

$$L = 1.5H + \left(1 + \frac{C_{VI}}{100}\right) T\sqrt{5}\frac{H_v}{H} \qquad (6.43)$$

where H is the toe thickness $2T < H \leq 3T$, C_{VI} is the volume increase in percent from Table 6.8, T is the riprap layer thickness $T = 1.5d_{50}$, and H_V is the vertical launch distance = EL_{TOP} - H - EL_{TG} + Z_T where EL_{TOP} is the top elevation for toe protection, EL_{TG} is the thalweg elevation, and Z_T is the total scour depth. The total scour depth estimation procedure can be found in Chapter 11.

X-Section	D_{50} (ft)	Zt (ft)	Hv (ft)	EL_{TOP} (ft)	EL_{TG} (ft)	C_{VI} (%)	T(ft)	H (ft)	L (ft)
Section 1	0.50	3.96	1.71	100.00	100.00	25	0.75	2.25	**4.97**
Section 2	0.50	4.34	2.09	100.00	100.00	25	0.75	2.25	**5.32**
Section 3	0.50	4.61	2.36	100.00	100.00	25	0.75	2.25	**5.57**
Section 3A	0.50	6.37	2.12	98.00	100.00	25	0.75	2.25	**5.35**

* Note: Section 3A will utilize a 2-foot cutoff wall at the downstream edge of the energy dissipating structure, thereby reducing the amount of launch needed.

LATERAL EROSION SETBACK

ATWELL

Naranja Trails

Final Drainage Report
September 20, 2023

Location: **Highlands Wash**
Objective: Compute estimated Lateral Erosion Setback
Municipality: Oro Valley
Reference: Drainage Criteria Manual for Oro Valley 2020-Draft

For $\frac{R_c}{T} \geq 10$ $SB \geq 1.0(Q_{P1\%})^{0.5}$ *(Equation 5.37)*

For $5 < \frac{R_c}{T} < 10$ $SB \geq 1.7(Q_{P1\%})^{0.5}$ *(Equation 5.38)*

For $\frac{R_c}{T} \leq 5$ $SB \geq 2.5(Q_{P1\%})^{0.5}$ *(Equation 5.39)*

Where,

SB	=	Erosion-hazard setback limit, in feet.
$Q_{P1\%}$	=	The 1% AEP flood, in cfs.
R_c	=	Radius of curvature of channel centerline, in feet.
T	=	Top width of the main channel, in feet.

ESTIMATED LATERAL EROSION SETBACK

Channel	$Q_{p1\%}$	R_c	T	R_c/T	Factor	SB
Section 1	2136.0	1800	275	6.5	1.7	79
Section 2	2136.0	800	230	3.5	2.5	116
Section 3	2136.0	1200	258	4.7	2.5	116
Culv-2 Chan	150.5	n/a	21	10+	1.0	12*

* Erosion-Hazard Setback shall not be less than 25-feet.

OUTLET RIP-RAP DESIGN

Naranja Trails

Objective: Calculation of rip-rap size of storm drain outlets to minimize erosion
Location: Town of Oro Valley
Reference: Town of Oro Valley Drainage Criteria Manual (Draft)

Equations:

Riprap Minimum D50 particle size Equation 8.1 Town of Oro Valley Drainage Criteria Manual (Draft)

$$D_{50} = 0.15V^2$$

Length of Scour Hole, Equation 5.16 Town of Oro Valley Drainage Criteria Manual (Draft)

$$L_{SCUL} = 2.2884\left(\frac{Q_{p1\%}^{0.62}}{A^{0.275}}\right)$$

Riprap Apron Width, Equation 5.17 Town of Oro Valley Drainage Criteria Manual (Draft)

$$W_{SCUL} = 0.6820\left(\frac{Q_{p1\%}^{0.89}}{A^{0.6125}}\right)$$

Riprap Apron Thickness

T = 2*D_{50} , Min. 12"

OUTLET FLOW PARAMETERS

Storm Drain System Identification	Outlet ID	Pipe Diameter [Dc] (ft)	Average Flow, (Q) (ft^3/s)	Outlet Flow Depth, (y) (ft)	Average Velocity, [V] (ft/s)	Average Area, Q/V (A) (ft^2)	Minimum Riprap Size, d_{50} (Eqn 8.1) (in)	Design Riprap Size, D_{50} (in)	Length of Scour Basin (Eqn 5.16) (ft)	Riprap Apron Width (Eqn 5.17) (ft)	Design Apron Thickness, (T) (ft)
CULVERT 1	FE2	2.00	4.20	0.51	6.57	0.6	6.5	9.0	6.3	3.2	1.5
SD 1	FE4	2.50	23.60	1.62	4.31	5.5	2.8	6.0	10.2	4.0	1.0
SD 2	FE6	2.50	30.00	1.75	5.26	5.7	4.2	6.0	11.7	4.8	1.0
SD 3	FE8	2.50	27.50	1.79	5.44	5.1	4.4	6.0	11.4	4.8	1.0
SD 4	FE10	2.50	24.70	1.74	4.92	5.0	3.6	6.0	10.7	4.4	1.0
SD 5	FE12	2.00	3.40	0.64	2.93	1.2	1.3	6.0	4.7	1.9	1.0
CULVERT 2	HW2	4.00	150.50	1.83	5.85	25.7	5.1	6.0	21.0	8.1	1.0

RIPRAP SIZING AND BANK TOE PROTECTION

Name: **East Rear Lot Channel**
Objective: Compute Channel Bank Protection and Bank Toe Protection
Municipality: Oro Valley
Reference: FlowMaster

Riprap Sizing

For the HEC-11 method the d_{50} (ft) is determined by:

$$d_{50} = \frac{0.001 V_a^{\ 3}}{d_{avg}^{\ 0.5} K_1^{\ 1.5}} \qquad (6.15)$$

Where V_a (ft/sec) is the average velocity in the main channel, d_{avg} (ft) is the average flow depth in the main channel, and K_1 is the bank angle correction factor. The bank angle correction factor is determined using Equation (6.16).

$$K_1 = \left[1 - \frac{\sin^2\theta}{\sin^2\phi}\right]^{0.5} \qquad (6.16)$$

Where θ is the bank angle with the horizontal, Φ is the riprap material's angle of repose. The bank angle correction factor can also be determined using Figure 6.10. The riprap material's angle of repose can be determined using Figure 6.11.

Channel	X-Section	V_a (fps)	Depth, d_{avg} Area/Top Width (ft)	Bank Slope	Bank Angle (Θ)	Riprap Angle of Repose (Ø)	K1	D_{50} Calculated (ft)	D_{50} Used (in)
1	Section 1	3.04	0.56	3:1	19.84	41	0.64	0.07	**6**
1	Section 2	5.02	0.39	3:1	19.84	41	0.64	0.39	**6**
2	Section 1	6.40	0.25	3:1	19.84	41	0.64	1.02	**9**
2	Section 2	4.65	0.33	3:1	19.84	41	0.64	0.34	**6**
2	Section 3	2.91	0.46	3:1	19.84	41	0.64	0.07	**6**
2	Section 4	2.59	0.83	3:1	19.84	41	0.64	0.04	**6**
3	Section 1	4.13	0.31	3:1	19.84	41	0.64	0.25	**6**
3	Section 2	2.47	0.46	3:1	19.84	41	0.64	0.04	**6**
3	Section 3	4.82	0.27	3:1	19.84	41	0.64	0.42	**6**
3	Sectrion 4	2.62	0.84	3:1	19.84	41	0.64	0.04	**6**
4	Section 1	3.24	0.30	3:1	19.84	41	0.64	0.12	**6**
4	Section 2	4.80	0.22	3:1	19.84	41	0.64	0.46	**6**
4	Section 3	2.84	0.40	3:1	19.84	41	0.64	0.07	**6**
5	Section 1	2.00	0.27	3:1	19.84	41	0.64	0.03	**6**
5	Section 2	1.46	0.35	3:1	19.84	41	0.64	0.01	**6**
5	Section 3	1.68	0.45	3:1	19.84	41	0.64	0.01	**6**

Rock Chute Design - Plan Sheet

(Version WI-July-2010, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Naranja Trails - Main Drop
Designer: Atwell
Date: 7/12/2023

County: Pima
Checked by:
Date:

ROCKFACED CONCRETE WILL BE USED IN LIEU OF LOOSE RIPRAP. FACE WILL USE D50=6"

Minimum Design Values		Enter Plan Values
24.0 in.	D_{50} dia. =	24.00 in.
48.0 in.	$Rock_{chute}$ thickness =	48.00 in.
18 ft.	Inlet apron length =	18.00 ft.
30 ft.	Outlet apron length =	30.00 ft.
53 ft.	Radius =	67 ft.

Will bedding be used? No

Rock Gradation Envelope

% Passing	Diameter, in. (weight, lbs.)
D_{100}	36 - 48 (3302 - 7827)
D_{85}	31 - 43 (2150 - 5706)
D_{50}	24 - 36 (978 - 3302)
D_{10}	19 - 31 (501 - 2150)

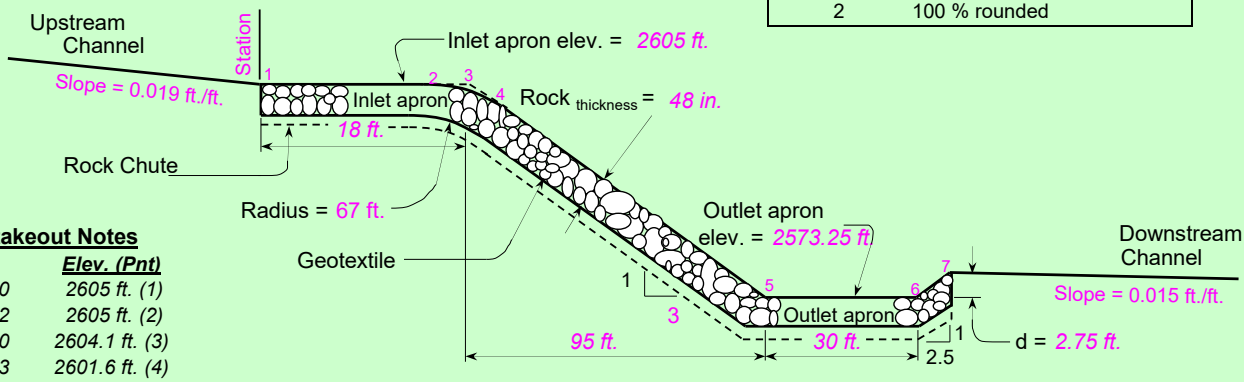
Quantities [a]

Rock =	4213	yd^3
Geotextile (WCS-13)[b] =	3389	yd^2
Bedding =	0	yd^3
Excavation =	0	yd^3
Earthfill =	0	yd^3
Seeding =	0.0	acres

Notes: [a] Rock, bedding, and geotextile quantities are determined from the x-section below (neglect radius).
[b] Geotextile Class I (non-woven) shall be overlapped and anchored (18-in. min. along sides and 24-in. min. on the ends).

Degree of angularity = 1

1	50% angular, 50% rounded
2	100 % rounded



Profile Along Centerline of Rock Chute

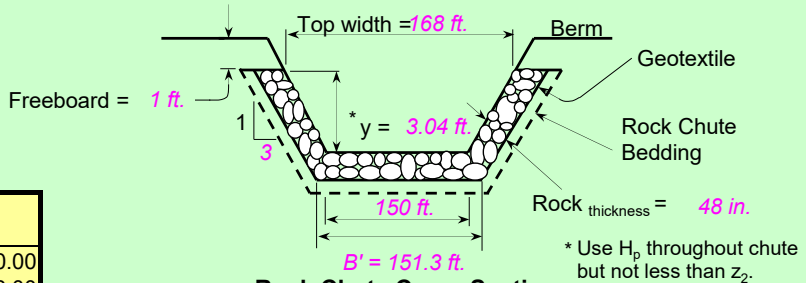
****Note: The outlet will function adequately**

Stakeout Notes

Sta.	Elev. (Pnt)
0+00.0	2605 ft. (1)
0+07.2	2605 ft. (2)
0+18.0	2604.1 ft. (3)
0+28.3	2601.6 ft. (4)
1+13.3	2573.25 ft. (5)
1+43.3	2573.25 ft. (6)
1+50.1	2576 ft. (7)

Class I non-woven

Rock gradation envelope can be met with Gradation printed



* Use H_o throughout chute but not less than z_2.

Rock Chute Cost Estimate

Unit	Unit Cost	Cost
Rock	$10.00 /$yd^3$	$42,130.00
Geotextile	$12.00/$yd^2$	$40,668.00
Bedding	$12.00 /$yd^3$	$0.00
Excavation	$12.00/$yd^3$	$0.00
Earthfill	$1.00 /$yd^3$	$0.00
Seeding	$2.00 /ac.	$0.00
	Total	**$82,798.00**

Rock Chute Cross Section

Profile, Cross Sections, and Quantities

NRCS Natural Resources Conservation Service, United States Department of Agriculture

Naranja Trails

Pima County

	Date
Designed	Atwell
Drawn	
Checked	
Approved	

File Name

Drawing Name

Sheet ___ of ___

Rock Chute Design - Cut/Paste Plan

(Version WI-July-2010, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Naranja Trails - Main Drop
Designer: Atwell
Date: 7/12/2023

County: Pima
Checked by:
Date:

ROCKFACED CONCRETE WILL BE USED IN LIEU OF LOOSE RIPRAP. FACE WILL USE D50=6"

Design Values

D_{50} dia. =	24.0 in.
$Rock_{chute}$ thickness =	48.0 in.
Inlet apron length =	18 ft.
Outlet apron length =	30 ft.
Radius =	67 ft.
Will bedding be used?	No

Rock Gradation Envelope

% Passing	Diameter, in. (weight, lbs.)
D_{100} ---------	36 - 48 (3302 - 7827)
D_{85} ---------	31 - 43 (2150 - 5706)
D_{50} ---------	24 - 36 (978 - 3302)
D_{10} ---------	19 - 31 (501 - 2150)

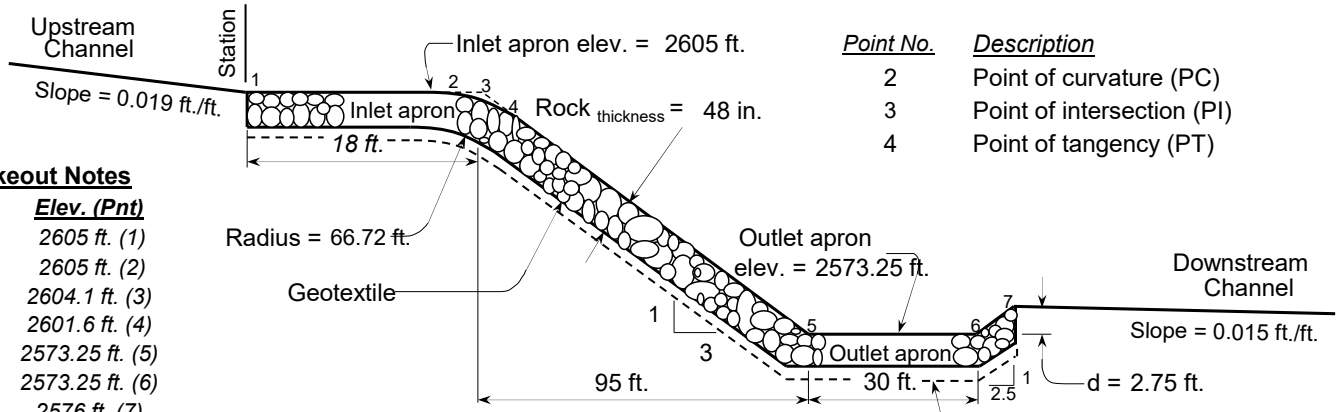
Coefficient of Uniformity, $(D_{60})/(D_{10}) < 1.7$

Quantities [a]

Rock =	4213 yd^3
Geotextile (WCS-13)[b] =	3389 yd^2
Bedding =	0 yd^3
Excavation =	0 yd^3
Earthfill =	0 yd^3
Seeding =	0.0 acres

Notes: [a] *Rock, bedding, and geotextile quantities are determined from x-section below (neglect radius).*

[b] *Geotextile Class I (Non-woven) shall be overlapped and anchored (18-in. minimum along sides and 24-in. minimum on the ends) --- quantity not included.*

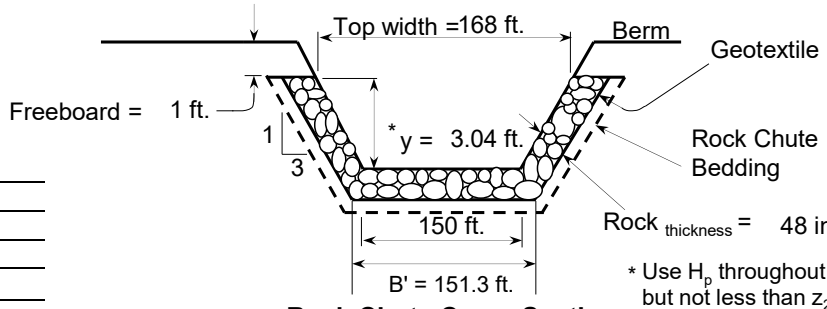


Point No.	Description
2	Point of curvature (PC)
3	Point of intersection (PI)
4	Point of tangency (PT)

Stakeout Notes

Sta.	Elev. (Pnt)
0+00.0	2605 ft. (1)
0+07.2	2605 ft. (2)
0+18.0	2604.1 ft. (3)
0+28.3	2601.6 ft. (4)
1+13.3	2573.25 ft. (5)
1+43.3	2573.25 ft. (6)
1+50.1	2576 ft. (7)

Profile Along Centerline of Rock Chute



Rock Chute Cross Section

Notes:
Rock gradation envelope can be met with Gradation printed

Profile, Cross Sections, and Quantities

NRCS Natural Resources Conservation Service, United States Department of Agriculture	Naranja Trails Pima County	Date Designed: Atwell Drawn Checked Approved	File Name Drawing Name Sheet __ of __

Rock Chute Design Calculations

(Version WI-July-2010, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Naranja Trails - Main Drop **County:** Pima
Designer: Atwell **Checked by:**
Date: 7/12/2023 **Date:**

I. Calculate the normal depth in the inlet channel

	High Flow		*Low Flow*		
y_n =	**1.47** **ft.**	**y_n =**	**0.36** **ft.**	(Normal depth)
Area =	456.4 ft^2	Area =	107.0 ft^2	(Flow area in channel)
Q_{high} =	2139.0 cfs	Q_{low} =	200.0 cfs	(Capacity in channel)
Scupstreamchannel =	0.039 ft/ft			

II. Calculate the critical depth in the chute

	High Flow		*Low Flow*		
y_c =	**1.83** **ft.**	**y_c =**	**0.38** **ft.**	(Critical depth in chute)
Area =	283.9 ft^2	Area =	57.4 ft^2	(Flow area in channel)
Q_{high} =	2139.0 cfs	Q_{low} =	200.0 cfs	(Capacity in channel)
H_{ce} =	2.71 ft.	H_{ce} =	0.57 ft.	(Total minimum specific energy head)
h_{cv} =	0.88 ft.	h_{cv} =	0.19 ft.	(Velocity head corresponding to y_c)
$10y_c$ =	**18.26** **ft.**	---	---	(Required inlet apron length)
$0.715y_c$ =	**1.31** **ft.**	**$0.715y_c$ =**	**0.27** **ft.**	(Depth of flow over the weir crest or brink)

III. Calculate the tailwater depth in the outlet channel

	High Flow		*Low Flow*	
Tw =	**1.73** **ft.**	**Tw =**	**0.42** **ft.**	(Tailwater depth)
Area =	248.6 ft^2	Area =	59.0 ft^2	(Flow area in channel)
Q_{high} =	2139.0 cfs	Q_{low} =	200.0 cfs	(Capacity in channel)
H_2 =	0.00 ft.	H_2 =	0.00 ft.	(Downstream head above weir crest, $H_2 = 0$, if $H_2 < 0.715*y_c$)

IV. Calculate the head for a trapezoidal shaped broadcrested weir

Cd = 1.00 (Coefficient of discharge for broadcrested weirs)

	High Flow			*Low Flow*		
H_p =	2.76 ft.	**2.68**	**ft.**	(Weir head)		
Area =	891.5 ft^2	862.6	ft^2	(Flow area in channel)		
V_o =	0.00 fps	**2.48**	**fps**	(Approach velocity)		
h_{pv} =	0.00 ft.	0.10	ft.	(Velocity head corresponding to H_p)		
Q_{high} =	2139.0 cfs	2139.0	cfs	(Capacity in channel)		

Trial and error procedure solving simultaneously for velocity and head

	Low Flow			
H_p =	0.57 ft.	**0.55**	**ft.**	(Weir head)
Area =	171.6 ft^2	165.6	ft^2	(Flow area in channel)
V_o =	0.00 fps	**1.21**	**fps**	(Approach velocity)
h_{pv} =	0.00 ft.	0.02	ft.	(Velocity head corresponding to H_p)
Q_{low} =	200.0 cfs	200.0	cfs	(Capacity in channel)

Trial and error procedure solving simultaneously for velocity and head

Rock Chute Design Calculations

(Version WI-July-2010, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Naranja Trails - Main Drop **County:** Pima
Designer: Atwell **Checked by:**
Date: 7/12/2023 **Date:**

V. Calculate the rock chute parameters (w/o a factor of safety applied)

	High Flow		*Low Flow*		
q_t =	1.30 cms/m		0.12 cms/m		(Equivalent unit discharge)
D_{50} (mm) =	406.17 ➔ ***(15.99 in.)***		116.83 mm		(Median ***angular*** rock size)
n =	0.060		0.050		(Manning's roughness coefficient)
z_1 =	0.99 ft.		0.22 ft.		(Normal depth in the chute)
A_1 =	151.2 ft^2		32.5 ft^2		(Area associated with normal depth)
Velocity =	14.15 fps		6.16 fps		(Velocity in chute slope)
z_{mean} =	0.97 ft.		0.21 ft.		(Mean depth)
F_1 =	2.53		2.34		(Froude number)
$L_{rock\ apron}$ =	19.99 ft.		----	----	(Length of rock outlet apron = 15*D_{50})

VI. Calculate the height of hydraulic jump height (conjugate depth)

	High Flow		*Low Flow*		
z_2 =	**3.04 ft.**		**0.61 ft.**		(Hydraulic jump height)
Q_{high} =	2139.0 cfs		200.0 cfs		(Capacity in channel)
A_2 =	483.4 ft^2		93.1 ft^2		(Flow area in channel)

VII. Calculate the energy lost through the jump (absorbed by the rock)

	High Flow		*Low Flow*		
E_1 =	4.10 ft.		0.80 ft.		(Total energy before the jump)
E_2 =	3.34 ft.		0.68 ft.		(Total energy after the jump)
R_E =	18.44 %		14.93 %		(Relative loss of energy)

Calculate Quantities for Rock Chute

-------Rock Riprap Volume-------

Area Calculations	Length @ Rock CL
h = 3.04	Inlet = 17.68
x_1 = 12.65	Outlet = 30.71
L = 9.61	Slope = 100.41
A_s = 38.45	2.5:1 Lip = 6.99
x_2 = 12.00	**Total = 155.79 ft.**
A_b = 653.19	**Rock Volume**
A_b+2*A_s = 730.10 ft^2	**4212.57 yd^3**

-------Bedding Volume-------

Area Calculations	
h = 7.04	**Bedding Thickness**
x_1 = 0.00	t_1, t_2 = ***0.00*** in.
L = 22.26	
A_s = 0.00	**Length @ Bed CL**
x_2 = 0.00	**Total = 155.76 ft.**
A_b = 0.00	**Bedding Volume**
A_b+2*A_s = 0.00 ft^2	**0.00 yd^3**

-------Geotextile Quantity-------

Width	Length @ Bot. Rock
2*Slope = 44.52	**Total = 155.76 ft.**
Bottom = 151.30	**Geotextile Area**
Total = 195.82 ft.	**3388.97 yd^2**

Note: 1) The radius is not considered when calculating quantities of riprap, bedding, or geotextile.
2) The geotextile quantity does not include over-overlapping (18-in. min.) or anchoring material (18-in. min. along sides, 24-in. min. on ends).

Rock Chute Design - Plan Sheet

(Version WI-July-2010, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Naranja Trails - West Drop
Designer: Atwell
Date: 5/15/2024

County: Pima
Checked by:
Date:

Minimum Design Values		Enter Plan Values	
5.7 in.	D_{50} dia. =	6.00 in.	
11.3 in.	$Rock_{chute}$ thickness =	12.00 in.	
4 ft.	Inlet apron length =	10.00 ft.	
7 ft.	Outlet apron length =	7.00 ft.	
16 ft.	Radius =	17 ft.	

Will bedding be used? No

Rock Gradation Envelope

% Passing		Diameter, in. (weight, lbs.)
D_{100}	---	9 - 12 (52 - 122)
D_{85}	---	8 - 11 (34 - 89)
D_{50}	---	6 - 9 (15 - 52)
D_{10}	---	5 - 8 (8 - 34)

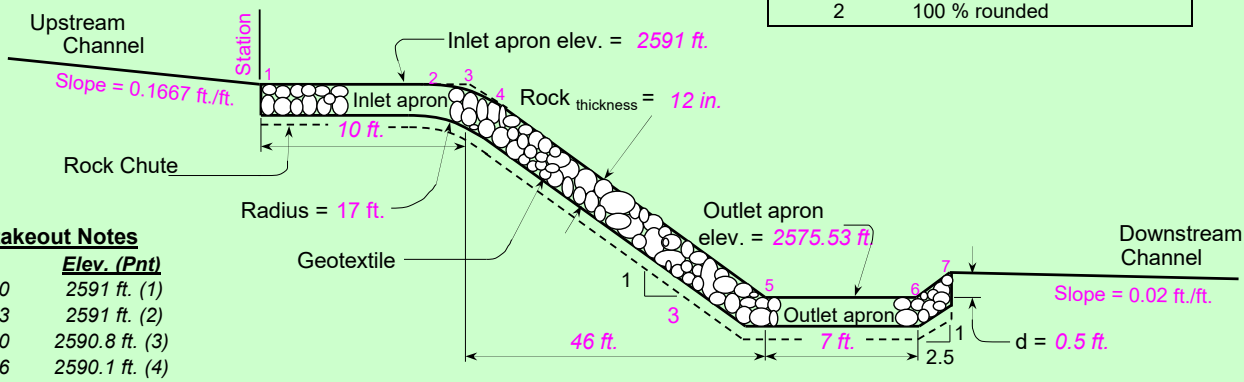
Quantities [a]

Rock =	101	yd^3
Geotextile (WCS-13)[b] =	320	yd^2
Bedding =	0	yd^3
Excavation =	0	yd^3
Earthfill =	0	yd^3
Seeding =	0.0	acres

Notes: [a] *Rock, bedding, and geotextile quantities are determined from the x-section below (neglect radius).*
[b] *Geotextile Class I (non-woven) shall be overlapped and anchored (18-in. min. along sides and 24-in. min. on the ends).*

Degree of angularity = 1

1	50% angular, 50% rounded
2	100 % rounded



Profile Along Centerline of Rock Chute

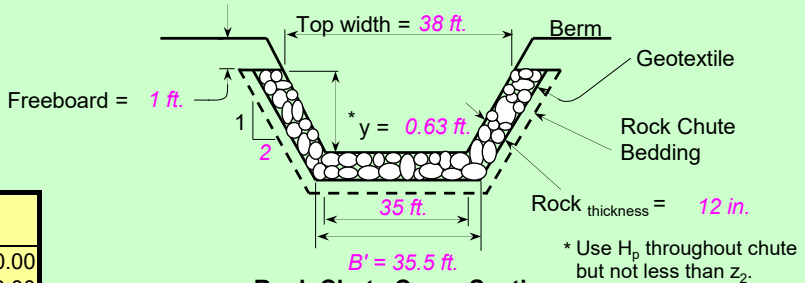
Note**: **The outlet will function adequately

Stakeout Notes

Sta.	Elev. (Pnt)
0+00.0	2591 ft. (1)
0+07.3	2591 ft. (2)
0+10.0	2590.8 ft. (3)
0+12.6	2590.1 ft. (4)
0+56.4	2575.53 ft. (5)
0+63.4	2575.53 ft. (6)
0+64.7	2576.03 ft. (7)

Class I non-woven

Rock gradation envelope can be met with DOT Light riprap Gradation



Rock Chute Cross Section

Rock Chute Cost Estimate

Unit	Unit Cost	Cost
Rock	$10.00 /$yd^3$	$1,010.00
Geotextile	$12.00/$yd^2$	$3,840.00
Bedding	$12.00 /$yd^3$	$0.00
Excavation	$12.00/$yd^3$	$0.00
Earthfill	$1.00 /$yd^3$	$0.00
Seeding	$2.00 /ac.	$0.00
	Total	**$4,850.00**

Profile, Cross Sections, and Quantities

NRCS Natural Resources Conservation Service United States Department of Agriculture

Naranja Trails - West Drop

Pima County

	Date
Designed	Atwell
Drawn	
Checked	
Approved	

File Name

Drawing Name

Sheet ___ of ___

Rock Chute Design Data

(Version WI-July-2010, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Naranja Trails - West Drop **County:** Pima
Designer: Atwell **Checked by:** Atwell
Date: May 15, 2024 **Date:** 05/15/24

Input Geometry:

→ Upstream Channel	→ Chute		→ Downstream Channel
Bw = 35.0 ft.	Bw = 35.0 ft.		Bw = 35.0 ft.
Side slopes = 3.0 (m:1)	Factor of safety = 1.20 (F_s)	1.2 Min	Side slopes = 2.0 (m:1)
Velocity n-value = 0.055	Side slopes = 2.0 (m:1)	→ 2.0:1 max.	Velocity n-value = 0.030
Bed slope = 0.1667 ft./ft.	Bed slope (3:1) = 0.333 ft./ft	→ 3.0:1 max.	Bed slope = 0.0200 ft./ft.
Note: n value = a) velocity n from waterway program	Freeboard = 1.0 ft. →		
or b) computed mannings n for channel	Outlet apron depth, d = 0.5 ft.		Base flow = 0.0 cfs

Design Storm Data (Table 2, FOTG, WI-NRCS Grade Stabilization Structure No. 410):

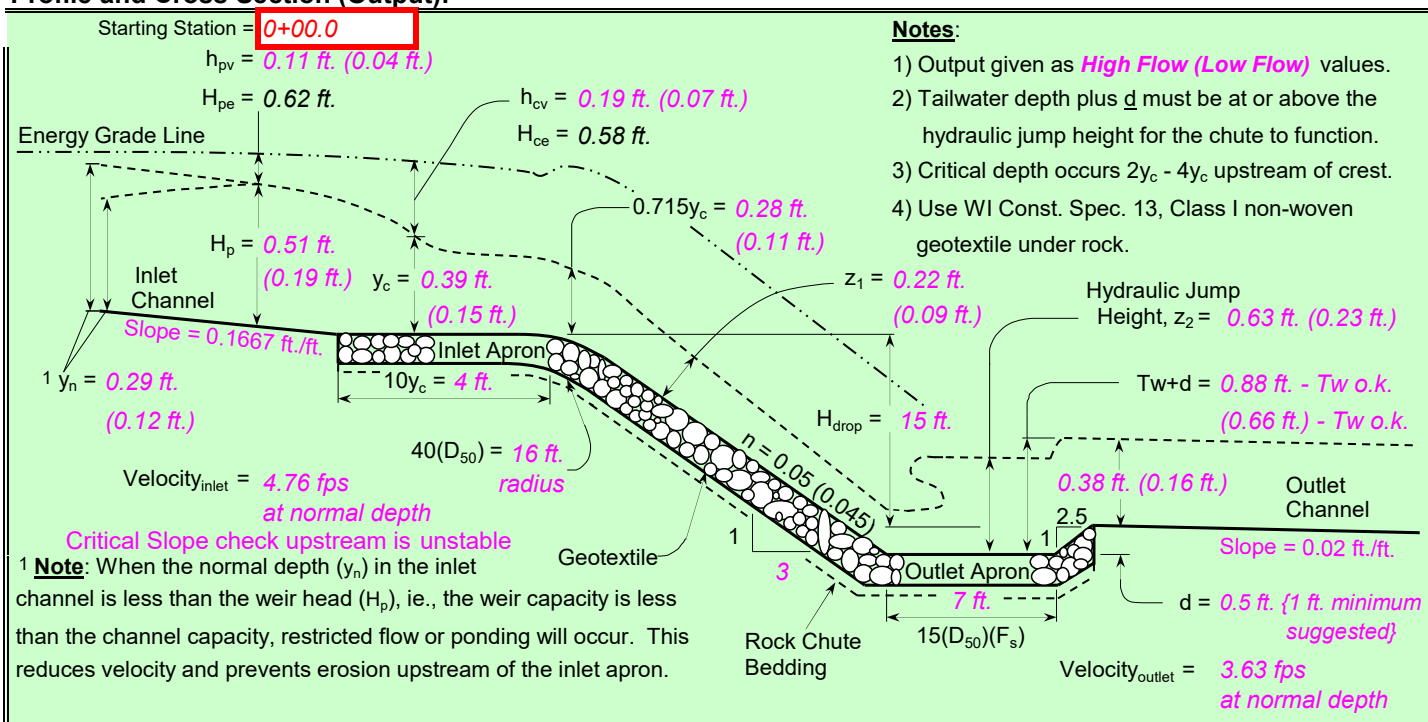
Apron elev. --- Inlet = 2591.0 ft. ------- Outlet = 2575.5 ft. --- (H_{drop} = 15 ft.)

Q_{high} = Runoff from design storm capacity from Table 2, FOTG Standard 410
Q_5 = Runofff from a 5-year,24-hour storm.

Q_{high} = 49.4 cfs High flow storm through chute → Tw (ft.) = Program
Q_5 = 11.4 cfs Low flow storm through chute → Tw (ft.) = Program

Note: The total required capacity is routed through the chute (principal spillway) or in combination with an auxiliary spillway.
Input tailwater (Tw): 0.33 1.20

Profile and Cross Section (Output):

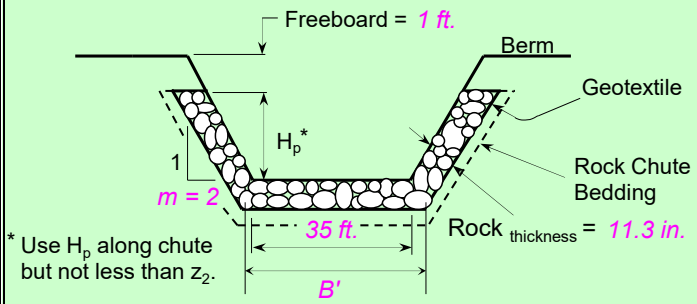


Notes:
1) Output given as ***High Flow (Low Flow)*** values.
2) Tailwater depth plus d must be at or above the hydraulic jump height for the chute to function.
3) Critical depth occurs 2y_c - 4y_c upstream of crest.
4) Use WI Const. Spec. 13, Class I non-woven geotextile under rock.

[1] **Note**: When the normal depth (y_n) in the inlet channel is less than the weir head (H_p), ie., the weir capacity is less than the channel capacity, restricted flow or ponding will occur. This reduces velocity and prevents erosion upstream of the inlet apron.

Profile Along Centerline of Chute

Typical Cross Section



* Use H_p along chute but not less than z_2.

	1.4 cfs/ft.	Equivalent unit discharge
F_S =	1.20	Factor of safety (multiplier)
z_1 =	0.22 ft.	Normal depth in chute
n-value =	0.05	Manning's roughness coefficient
$D_{50}(F_s)$ =	5.7 in.	Minimum Design D50*
$2(D_{50})(F_s)$ =	11.3 in.	Rock chute thickness
Tw + d =	0.88 ft.	Tailwater above outlet apron
z_2 =	0.63 ft.	Hydraulic jump height
*** The outlet	will	function adequately

High Flow Storm Information

Rock Chute Design Calculations

(Version WI-July-2010, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Naranja Trails - West Drop **County:** Pima
Designer: Atwell **Checked by:**
Date: 5/15/2024 **Date:**

I. Calculate the normal depth in the inlet channel

	High Flow		*Low Flow*		
y_n =	**0.29** **ft.**	**y_n =**	**0.12** **ft.**	(Normal depth)
Area =	10.4 ft^2	Area =	4.3 ft^2	(Flow area in channel)
Q_{high} =	49.4 cfs	Q_{low} =	11.4 cfs	(Capacity in channel)
Scupstreamchannel =	0.067 ft/ft			

II. Calculate the critical depth in the chute

	High Flow		*Low Flow*		
y_c =	**0.39** **ft.**	**y_c =**	**0.15** **ft.**	(Critical depth in chute)
Area =	14.0 ft^2	Area =	5.2 ft^2	(Flow area in channel)
Q_{high} =	49.4 cfs	Q_{low} =	11.4 cfs	(Capacity in channel)
H_{ce} =	0.58 ft.	H_{ce} =	0.22 ft.	(Total minimum specific energy head)
h_{cv} =	0.19 ft.	h_{cv} =	0.07 ft.	(Velocity head corresponding to y_c)
$10y_c$ =	**3.93** **ft.**	---	---	(Required inlet apron length)
$0.715y_c$ =	**0.28** **ft.**	**$0.715y_c$ =**	**0.11** **ft.**	(Depth of flow over the weir crest or brink)

III. Calculate the tailwater depth in the outlet channel

	High Flow		*Low Flow*		
Tw =	**0.38** **ft.**	**Tw =**	**0.16** **ft.**	(Tailwater depth)
Area =	13.6 ft^2	Area =	5.6 ft^2	(Flow area in channel)
Q_{high} =	49.4 cfs	Q_{low} =	11.4 cfs	(Capacity in channel)
H_2 =	0.00 ft.	H_2 =	0.00 ft.	(Downstream head above weir crest, $H_2 = 0$, if $H_2 < 0.715*y_c$)

IV. Calculate the head for a trapezoidal shaped broadcrested weir

Cd = 1.00 (Coefficient of discharge for broadcrested weirs)

	High Flow			
H_p =	0.59 ft.	**0.51** **ft.**	(Weir head)
Area =	21.7 ft^2	18.8 ft^2	(Flow area in channel)
V_o =	0.00 fps	**2.63** **fps**	(Approach velocity)
h_{pv} =	0.00 ft.	0.11 ft.	(Velocity head corresponding to H_p)
Q_{high} =	49.4 cfs	49.4 cfs	(Capacity in channel)

Trial and error procedure solving simultaneously for velocity and head

	Low Flow		
H_p =	0.22 ft.	**0.19** **ft.**	(Weir head)
Area =	7.9 ft^2	6.8 ft^2	(Flow area in channel)
V_o =	0.00 fps	**1.67** **fps**	(Approach velocity)
h_{pv} =	0.00 ft.	0.04 ft.	(Velocity head corresponding to H_p)
Q_{low} =	11.4 cfs	11.4 cfs	(Capacity in channel)

Trial and error procedure solving simultaneously for velocity and head

Rock Chute Design Calculations

(Version WI-July-2010, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Naranja Trails - West Drop **County:** Pima
Designer: Atwell **Checked by:**
Date: 5/15/2024 **Date:**

V. Calculate the rock chute parameters (w/o a factor of safety applied)

	High Flow		*Low Flow*		
q_t =	0.13	cms/m	0.03	cms/m	(Equivalent unit discharge)
D_{50} (mm) =	119.93 → ***(4.72 in.)***		55.41	mm	(Median ***angular*** rock size)
n =	0.050		0.045		(Manning's roughness coefficient)
z_1 =	0.22	ft.	0.09	ft.	(Normal depth in the chute)
A_1 =	7.9	ft^2	3.0	ft^2	(Area associated with normal depth)
Velocity =	6.26	fps	3.74	fps	(Velocity in chute slope)
z_{mean} =	0.22	ft.	0.09	ft.	(Mean depth)
F_1 =	2.36		2.25		(Froude number)
$L_{rock\ apron}$ =	5.90	ft.	----	----	(Length of rock outlet apron = 15*D_{50})

VI. Calculate the height of hydraulic jump height (conjugate depth)

	High Flow		*Low Flow*		
z_2 =	**0.63**	**ft.**	**0.23**	**ft.**	(Hydraulic jump height)
Q_{high} =	49.4	cfs	11.4	cfs	(Capacity in channel)
A_2 =	23.0	ft^2	8.3	ft^2	(Flow area in channel)

VII. Calculate the energy lost through the jump (absorbed by the rock)

	High Flow		*Low Flow*		
E_1 =	0.83	ft.	0.30	ft.	(Total energy before the jump)
E_2 =	0.70	ft.	0.26	ft.	(Total energy after the jump)
R_E =	15.25	%	13.28	%	(Relative loss of energy)

Calculate Quantities for Rock Chute

-------Rock Riprap Volume-------

Area Calculations		**Length @ Rock CL**	
h = 0.63		Inlet = 9.92	
x_1 = 2.24		Outlet = 7.18	
L = 1.41		Slope = 48.92	
A_s = 1.41		2.5:1 Lip = 1.24	
x_2 = 2.00		**Total = 67.26**	**ft.**
A_b = 37.47		**Rock Volume**	
A_b+2*A_s = 40.29	**ft^2**	**100.37**	**yd^3**

-------Bedding Volume-------

Area Calculations			
h = 1.63		**Bedding Thickness**	
x_1 = 0.00		t_1, t_2 = ***0.00***	in.
L = 3.64			
A_s = 0.00		**Length @ Bed CL**	
x_2 = 0.00		**Total = 67.26**	**ft.**
A_b = 0.00		**Bedding Volume**	
A_b+2*A_s = 0.00	**ft^2**	**0.00**	**yd^3**

-------Geotextile Quantity-------

Width		**Length @ Bot. Rock**	
2*Slope = 7.29		**Total = 67.26**	**ft.**
Bottom = 35.47		**Geotextile Area**	
Total = 42.76	**ft.**	**319.55**	**yd^2**

Note: 1) The radius is not considered when calculating quantities of riprap, bedding, or geotextile.
2) The geotextile quantity does not include over-overlapping (18-in. min.) or anchoring material (18-in. min. along sides, 24-in. min. on ends).

RIPRAP PER SHEAR STRESS HEC-15 D50 Based on permissible Shear Stress, Equation 6.7	Project: **Naranja Trails** Project #: 20000103 Date: 5/24/24 By: J Gardner

6.2 PERMISSIBLE SHEAR STRESS

Values for permissible shear stress for riprap and gravel linings are based on research conducted at laboratory facilities and in the field. The values presented here are judged to be conservative and appropriate for design use. Permissible shear stress is given by the following equation:

$$\tau_p = F_*(\gamma_s - \gamma) D_{50} \qquad (6.7)$$

where,

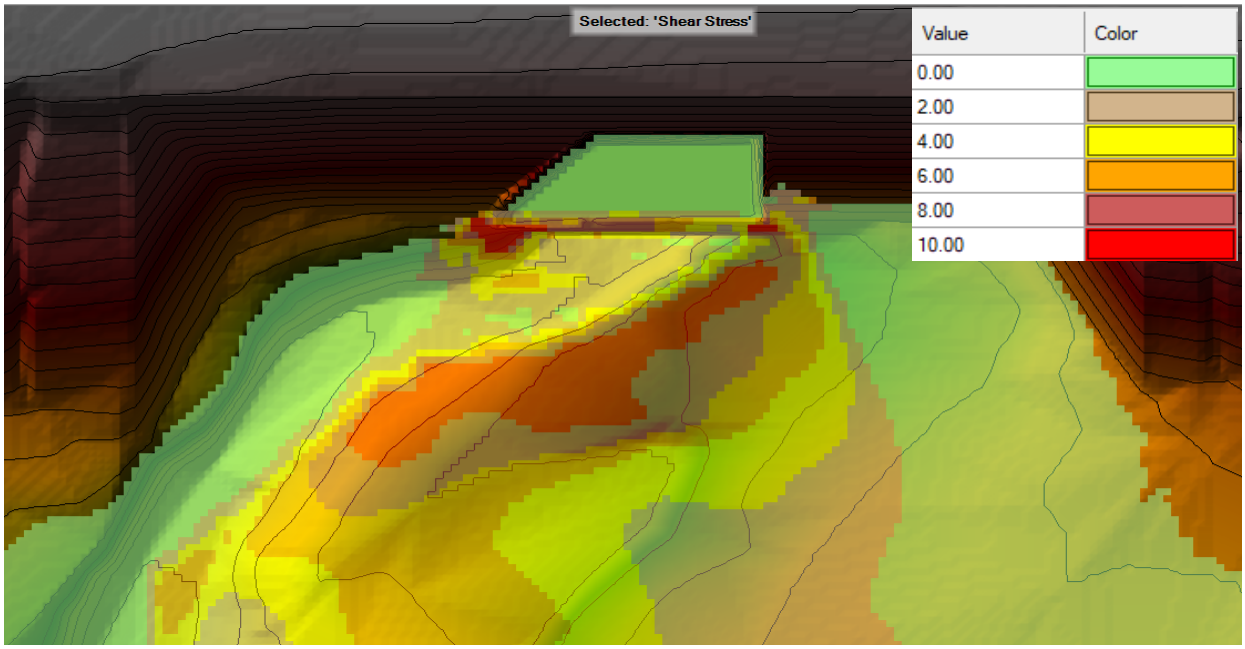
- τ_p = permissible shear stress, N/m^2 (lb/ft^2)
- F_* = Shield's parameter, dimensionless
- γ_s = specific weight of the stone, N/m^3 (lb/ft^3)
- γ = specific weight of the water, 9810 N/m^3 (62.4 lb/ft^3)
- D_{50} = mean riprap size, m (ft)

Typically, a specific weight of stone of 25,900 N/m^3 (165 lb/ft^3) is used, but if the available stone is different from this value, the site-specific value should be used.

Stone Specific Weight	165	lb/cf
Water Specific Weight	62.4	lb/cf
Shield's Parameter	0.047	

Riprap (D_{50}, in.)	**24**	**20**	**15**	**12**	**6**
Maximum Permissible Shear Stress, (lb/ft^2)	9.6	8.0	6.0	4.8	2.4

HEC-RAS 2D, Maximum Shear Stress Map, Existing Conditions



Note: A large area of high shear stress is found outside of the culvert outlet. This area is anticipated to erode in high peak flow events and follow natural stream bed formation. However, the proposed riprap will prevent further erosion and undercutting at the culvert outlet.

APPENDIX B

HEC-HMS REPORTS
EXHIBIT 7 – PRE-DEVELOPMENT MAX FLOW DEPTH MAP
EXHIBIT 8 – POST-DEVELOPMENT MAX FLOW DEPTH MAP
EXHIBIT 9 – PRE-DEVELOPMENT MAX VELOCITY MAP
EXHIBIT 10 – POST-DEVELOPMENT MAX VELOCITY MAP
EXHIBIT 11 – MAX WSE COMPARISON MAP
EXHIBIT 12 – MAX VELOCITY COMPARISON MAP
CONCEPTUAL SITE PLAN FOR NARANJA TRAILS

Weir Flow Calculations

(including irregular sections)

Reference: Techniques of Water-Resources Investigations of the United States Geological Survey, Hulsing, Larry 1968

Project: Naranja Trails
Project #: 20000103
Date: 2.25.2020
By: J Gardner

Location: Basin Southern Daylight line

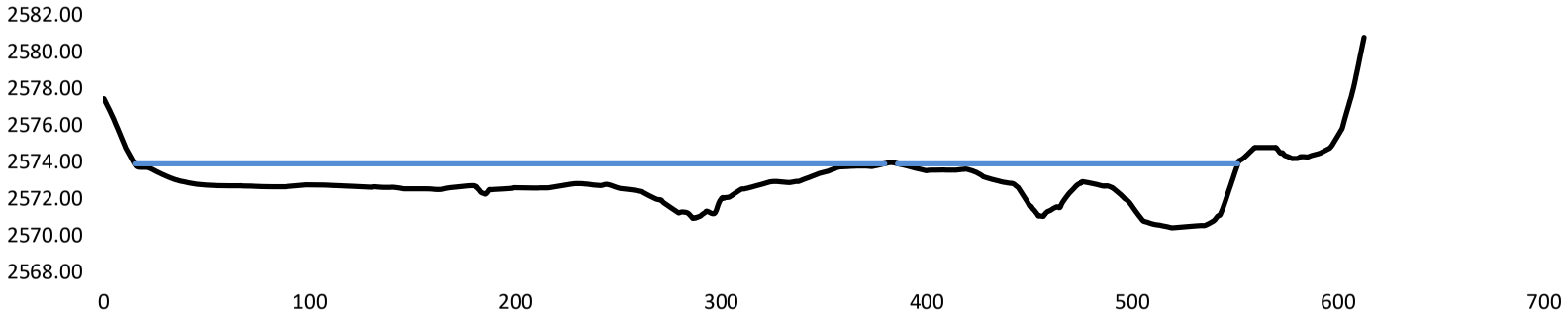
Calculations Summary

Q, Design (cfs)	Min Elev. (ft)	Water Depth (ft)	WSEL (ft)	C	Q, Calc (cfs)
	2570.69	3.231	2573.916	3.00	2158.3

Weir Flow Section and Calculations

$$Q_o = \frac{2K_t C_r L_x (HW_{rb}^{5/2} - HW_{ra}^{5/2})}{5(HW_{rb} - HW_{ra})}$$

WSE	Surface Area (ac)	Flow (cfs)
2566.59	0.00	0
2567	2.55	0
2568	3.54	0
2569	4.09	0
2570	4.63	0
2571	5.19	1.6
2572	5.96	107.2
2573	6.54	613.9
2574	7.10	2351.6



Global Summary Results for Run "3-hr SCS Typ II AR for CP1"

Project: Naranja Trails Existing Simulation Run: 3-hr SCS Typ II AR for CP1

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 16Mar2022, 10:54:49

Basin Model: Highland Wash
Meteorologic Model: 3-hr SCS Type II
Control Specifications: 3-hr Control 2

Show Elements: All Elements Volume Units: IN AC-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
HW10	0.8400	1535.1	01Jan2000, 01:47	108.4
HW09	0.2100	464.7	01Jan2000, 01:40	27.1
J09/10	1.0500	1956.6	01Jan2000, 01:45	135.5
R010	1.0500	1946.3	01Jan2000, 01:47	135.5
J_R07/R010	1.0500	1946.3	01Jan2000, 01:47	135.5
R07	1.0500	1916.4	01Jan2000, 01:56	135.5
HW07	0.1600	315.8	01Jan2000, 01:43	19.6
Reservoir-M1	1.2100	1878.7	01Jan2000, 02:03	155.1
HW08	0.2100	423.0	01Jan2000, 01:43	27.0
Reservoir-M2	0.2100	367.8	01Jan2000, 01:51	27.0
J07/08	1.4200	2178.6	01Jan2000, 02:01	182.1
R06	1.4200	2141.4	01Jan2000, 02:14	182.1
HW06	0.4400	654.6	01Jan2000, 01:48	47.1
Tangerine Road detention	1.8600	2213.7	01Jan2000, 02:23	229.2
J06	1.8600	2213.7	01Jan2000, 02:23	229.2
R04	1.8600	2204.7	01Jan2000, 02:30	229.2
HW05	0.2000	458.9	01Jan2000, 01:35	21.0
HW04	0.1600	308.8	01Jan2000, 01:38	15.2
J04/05	2.2200	2286.9	01Jan2000, 02:29	265.5
R03	2.2200	2280.2	01Jan2000, 02:35	265.5
HW03	0.2300	417.3	01Jan2000, 01:39	21.5
Naranja Road detention	2.4500	2138.7	01Jan2000, 02:49	287.0
J03	2.4500	2138.7	01Jan2000, 02:49	287.0
R01A	2.4500	2136.1	01Jan2000, 02:54	287.0
HW01C	0.0301	63.0	01Jan2000, 01:37	3.0
RETPRV	0.0301	1.0	01Jan2000, 01:22	1.9
HW01B	0.1084	122.5	01Jan2000, 01:49	8.9
J01A	2.5885	2159.5	01Jan2000, 02:54	297.7
R01B	2.5885	2157.0	01Jan2000, 02:58	297.7
HW01A	0.0403	93.6	01Jan2000, 01:36	4.5
J01	2.6288	2164.1	01Jan2000, 02:58	302.3
R02	2.6288	2163.3	01Jan2000, 03:00	302.2
HW02	0.0400	77.0	01Jan2000, 01:37	3.7
J02	2.6688	2169.7	01Jan2000, 03:00	306.0

Global Summary Results for Run "3-hr SCS Typ II AR for CP1"

Project: Naranja_Trails_Proposed Simulation Run: 3-hr SCS Typ II AR for CP1

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 16Mar2022, 11:05:01

Basin Model: Highland Wash
Meteorologic Model: 3-hr SCS Type II
Control Specifications: 3-hr Control 2

Show Elements: All Elements Volume Units: IN AC-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
HW10	0.8400	1535.1	01Jan2000, 01:47	108.4
HW09	0.2100	464.7	01Jan2000, 01:40	27.1
J09/10	1.0500	1956.6	01Jan2000, 01:45	135.5
R010	1.0500	1946.3	01Jan2000, 01:47	135.5
J_R07/R010	1.0500	1946.3	01Jan2000, 01:47	135.5
R07	1.0500	1916.4	01Jan2000, 01:56	135.5
HW07	0.1600	315.8	01Jan2000, 01:43	19.6
Reservoir-M1	1.2100	1878.7	01Jan2000, 02:03	155.1
HW08	0.2100	423.0	01Jan2000, 01:43	27.0
Reservoir-M2	0.2100	367.8	01Jan2000, 01:51	27.0
J07/08	1.4200	2178.6	01Jan2000, 02:01	182.1
R06	1.4200	2141.4	01Jan2000, 02:14	182.1
HW06	0.4400	654.6	01Jan2000, 01:48	47.1
Tangerine Road detention	1.8600	2213.7	01Jan2000, 02:23	229.2
J06	1.8600	2213.7	01Jan2000, 02:23	229.2
R04	1.8600	2204.7	01Jan2000, 02:30	229.2
HW05	0.2000	458.9	01Jan2000, 01:35	21.0
HW04	0.1600	308.8	01Jan2000, 01:38	15.2
J04/05	2.2200	2286.9	01Jan2000, 02:29	265.5
R03	2.2200	2280.2	01Jan2000, 02:35	265.5
HW03	0.2300	417.3	01Jan2000, 01:39	21.5
Naranja Road detention	2.4500	2138.7	01Jan2000, 02:49	287.0
J03	2.4500	2138.7	01Jan2000, 02:49	287.0
R01A	2.4500	2136.1	01Jan2000, 02:54	287.0
HW01B	0.0760	85.4	01Jan2000, 01:49	6.2
HW01D	0.0355	77.8	01Jan2000, 01:35	3.5
HW01C	0.0270	55.8	01Jan2000, 01:37	2.7
RETNAR	2.5885	2159.4	01Jan2000, 02:56	296.2
J01A	2.5885	2159.4	01Jan2000, 02:56	296.2
R01B	2.5885	2156.9	01Jan2000, 03:01	296.2
HW01A	0.0403	93.6	01Jan2000, 01:36	4.5
J01	2.6288	2163.7	01Jan2000, 03:01	300.7
R02	2.6288	2162.9	01Jan2000, 03:03	300.7
HW02	0.0400	77.0	01Jan2000, 01:37	3.7
J02	2.6688	2169.0	01Jan2000, 03:03	304.4

FLO-2D Model Simulation Inflow Hydrographs

Naranja Culvert Inflow		
Spread over 10 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
0.000	0.00	0.00
0.017	0.00	0.00
0.033	0.00	0.00
0.050	0.00	0.00
0.067	0.00	0.00
0.083	0.00	0.00
0.100	0.00	0.00
0.117	0.00	0.00
0.133	0.00	0.00
0.150	0.00	0.00
0.167	0.00	0.00
0.183	0.00	0.00
0.200	0.00	0.00
0.217	0.00	0.00
0.233	0.00	0.00
0.250	0.00	0.00
0.267	0.00	0.00
0.283	0.00	0.00
0.300	0.00	0.00
0.317	0.00	0.00
0.333	0.00	0.00
0.350	0.00	0.00
0.367	0.00	0.00
0.383	0.00	0.00
0.400	0.00	0.00
0.417	0.00	0.00
0.433	0.00	0.00
0.450	0.00	0.00
0.467	0.00	0.00
0.483	0.00	0.00
0.500	0.00	0.00
0.517	0.00	0.00
0.533	0.00	0.00
0.550	0.00	0.00
0.567	0.00	0.00
0.583	0.00	0.00
0.600	0.00	0.00
0.617	0.00	0.00
0.633	0.00	0.00
0.650	0.00	0.00

PRV Canyon Inflow		
Spread over 3 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
0.000	0.00	0.00
0.017	0.00	0.00
0.033	0.00	0.00
0.050	0.00	0.00
0.067	0.00	0.00
0.083	0.00	0.00
0.100	0.00	0.00
0.117	0.00	0.00
0.133	0.00	0.00
0.150	0.00	0.00
0.167	0.00	0.00
0.183	0.00	0.00
0.200	0.00	0.00
0.217	0.00	0.00
0.233	0.00	0.00
0.250	0.00	0.00
0.267	0.00	0.00
0.283	0.00	0.00
0.300	0.00	0.00
0.317	0.00	0.00
0.333	0.00	0.00
0.350	0.00	0.00
0.367	0.00	0.00
0.383	0.00	0.00
0.400	0.00	0.00
0.417	0.00	0.00
0.433	0.00	0.00
0.450	0.00	0.00
0.467	0.00	0.00
0.483	0.00	0.00
0.500	0.00	0.00
0.517	0.00	0.00
0.533	0.00	0.00
0.550	0.00	0.00
0.567	0.00	0.00
0.583	0.00	0.00
0.600	0.00	0.00
0.617	0.00	0.00
0.633	0.00	0.00
0.650	0.00	0.00

FLO-2D Model Simulation Inflow Hydrographs

Naranja Culvert Inflow		
Spread over 10 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
0.667	0.00	0.00
0.683	0.00	0.00
0.700	0.00	0.00
0.717	0.00	0.00
0.733	0.00	0.00
0.750	0.00	0.00
0.767	0.00	0.00
0.783	0.00	0.00
0.800	0.00	0.00
0.817	0.00	0.00
0.833	0.00	0.00
0.850	0.00	0.00
0.867	0.00	0.00
0.883	0.00	0.00
0.900	0.10	0.01
0.917	0.10	0.01
0.933	0.20	0.02
0.950	0.30	0.03
0.967	0.40	0.04
0.983	0.60	0.06
1.000	0.90	0.09
1.017	1.20	0.12
1.033	1.60	0.16
1.050	2.20	0.22
1.067	2.80	0.28
1.083	3.60	0.36
1.100	4.60	0.46
1.117	5.80	0.58
1.133	7.20	0.72
1.150	9.00	0.90
1.167	11.20	1.12
1.183	13.80	1.38
1.200	17.00	1.70
1.217	20.90	2.09
1.233	25.40	2.54
1.250	30.90	3.09
1.267	37.40	3.74
1.283	45.00	4.50
1.300	54.10	5.41
1.317	64.90	6.49

PRV Canyon Inflow		
Spread over 3 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
0.667	0.00	0.00
0.683	0.00	0.00
0.700	0.00	0.00
0.717	0.00	0.00
0.733	0.00	0.00
0.750	0.00	0.00
0.767	0.00	0.00
0.783	0.00	0.00
0.800	0.00	0.00
0.817	0.01	0.00
0.833	0.02	0.01
0.850	0.02	0.01
0.867	0.04	0.01
0.883	0.06	0.02
0.900	0.08	0.03
0.917	0.12	0.04
0.933	0.16	0.05
0.950	0.20	0.07
0.967	0.26	0.09
0.983	0.33	0.11
1.000	0.40	0.13
1.017	0.48	0.16
1.033	0.58	0.19
1.050	0.69	0.23
1.067	0.82	0.27
1.083	0.96	0.32
1.100	1.13	0.38
1.117	1.33	0.44
1.133	1.59	0.53
1.150	1.90	0.63
1.167	2.27	0.76
1.183	2.71	0.90
1.200	3.25	1.08
1.217	3.90	1.30
1.233	4.66	1.55
1.250	5.54	1.85
1.267	6.56	2.19
1.283	7.75	2.58
1.300	9.14	3.05
1.317	10.75	3.58

FLO-2D Model Simulation Inflow Hydrographs

Naranja Culvert Inflow		
Spread over 10 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
1.333	77.50	7.75
1.350	92.30	9.23
1.367	109.50	10.95
1.383	129.70	12.97
1.400	153.50	15.35
1.417	181.70	18.17
1.433	215.30	21.53
1.450	255.60	25.56
1.467	306.20	30.62
1.483	366.40	36.64
1.500	430.20	43.02
1.517	495.90	49.59
1.533	565.50	56.55
1.550	635.20	63.52
1.567	706.80	70.68
1.583	782.80	78.28
1.600	867.10	86.71
1.617	961.00	96.10
1.633	1012.70	101.27
1.650	1039.20	103.92
1.667	1072.00	107.20
1.683	1106.90	110.69
1.700	1141.10	114.11
1.717	1172.40	117.24
1.733	1199.30	119.93
1.750	1221.00	122.10
1.767	1237.00	123.70
1.783	1247.30	124.73
1.800	1252.10	125.21
1.817	1251.90	125.19
1.833	1247.60	124.76
1.850	1239.90	123.99
1.867	1229.50	122.95
1.883	1217.30	121.73
1.900	1204.00	120.40
1.917	1190.40	119.04
1.933	1177.30	117.73
1.950	1165.40	116.54
1.967	1155.00	115.50
1.983	1146.60	114.66

PRV Canyon Inflow		
Spread over 3 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
1.333	12.58	4.19
1.350	14.68	4.89
1.367	17.10	5.70
1.383	19.89	6.63
1.400	23.03	7.68
1.417	26.53	8.84
1.433	30.31	10.10
1.450	34.29	11.43
1.467	38.43	12.81
1.483	42.65	14.22
1.500	46.85	15.62
1.517	50.85	16.95
1.533	54.44	18.15
1.550	57.48	19.16
1.567	59.90	19.97
1.583	61.68	20.56
1.600	62.74	20.91
1.617	63.00	21.00
1.633	62.48	20.83
1.650	61.26	20.42
1.667	59.43	19.81
1.683	57.12	19.04
1.700	54.44	18.15
1.717	51.50	17.17
1.733	48.41	16.14
1.750	45.26	15.09
1.767	42.18	14.06
1.783	39.27	13.09
1.800	36.54	12.18
1.817	34.00	11.33
1.833	31.65	10.55
1.850	29.54	9.85
1.867	27.68	9.23
1.883	26.05	8.68
1.900	24.59	8.20
1.917	23.27	7.76
1.933	22.06	7.35
1.950	20.96	6.99
1.967	19.96	6.65
1.983	19.02	6.34

FLO-2D Model Simulation Inflow Hydrographs

Naranja Culvert Inflow		
Spread over 10 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
2.000	1140.60	114.06
2.017	1137.10	113.71
2.033	1136.60	113.66
2.050	1139.20	113.92
2.067	1144.80	114.48
2.083	1152.90	115.29
2.100	1163.20	116.32
2.117	1175.40	117.54
2.133	1189.70	118.97
2.150	1206.20	120.62
2.167	1225.20	122.52
2.183	1246.90	124.69
2.200	1271.70	127.17
2.217	1300.00	130.00
2.233	1332.00	133.20
2.250	1368.00	136.80
2.267	1408.00	140.80
2.283	1452.20	145.22
2.300	1500.10	150.01
2.317	1551.50	155.15
2.333	1605.70	160.57
2.350	1662.20	166.22
2.367	1720.20	172.02
2.383	1779.00	177.90
2.400	1837.60	183.76
2.417	1895.20	189.52
2.433	1950.70	195.07
2.450	2000.50	200.05
2.467	2008.20	200.82
2.483	2016.70	201.67
2.500	2025.70	202.57
2.517	2035.00	203.50
2.533	2044.50	204.45
2.550	2053.80	205.38
2.567	2062.90	206.29
2.583	2071.80	207.18
2.600	2080.30	208.03
2.617	2088.30	208.83
2.633	2095.90	209.59
2.650	2103.00	210.30

PRV Canyon Inflow		
Spread over 3 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
2.000	18.15	6.05
2.017	17.32	5.77
2.033	16.54	5.51
2.050	15.80	5.27
2.067	15.10	5.03
2.083	14.43	4.81
2.100	13.79	4.60
2.117	13.19	4.40
2.133	12.62	4.21
2.150	12.09	4.03
2.167	11.59	3.86
2.183	11.14	3.71
2.200	10.72	3.57
2.217	10.35	3.45
2.233	10.02	3.34
2.250	9.71	3.24
2.267	9.44	3.15
2.283	9.19	3.06
2.300	8.96	2.99
2.317	8.74	2.91
2.333	8.53	2.84
2.350	8.33	2.78
2.367	8.15	2.72
2.383	7.97	2.66
2.400	7.81	2.60
2.417	7.66	2.55
2.433	7.51	2.50
2.450	7.36	2.45
2.467	7.22	2.41
2.483	7.07	2.36
2.500	6.93	2.31
2.517	6.79	2.26
2.533	6.66	2.22
2.550	6.53	2.18
2.567	6.40	2.13
2.583	6.28	2.09
2.600	6.17	2.06
2.617	6.07	2.02
2.633	5.98	1.99
2.650	5.90	1.97

FLO-2D Model Simulation Inflow Hydrographs

Naranja Culvert Inflow		
Spread over 10 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
2.667	2109.40	210.94
2.683	2115.30	211.53
2.700	2120.60	212.06
2.717	2125.20	212.52
2.733	2129.30	212.93
2.750	2132.70	213.27
2.767	2135.40	213.54
2.783	2137.30	213.73
2.800	2138.40	213.84
2.817	2138.70	213.87
2.833	2138.00	213.80
2.850	2136.40	213.64
2.867	2133.90	213.39
2.883	2130.30	213.03
2.900	2125.60	212.56
2.917	2119.70	211.97
2.933	2112.60	211.26
2.950	2104.30	210.43
2.967	2094.80	209.48
2.983	2084.00	208.40
3.000	2072.00	207.20
3.017	2058.90	205.89
3.033	2044.80	204.48
3.050	2029.60	202.96
3.067	2013.50	201.35
3.083	1977.60	197.76
3.100	1868.50	186.85
3.117	1774.00	177.40
3.133	1691.20	169.12
3.150	1617.80	161.78
3.167	1552.00	155.20
3.183	1492.00	149.20
3.200	1436.50	143.65
3.217	1384.40	138.44
3.233	1334.90	133.49
3.250	1287.40	128.74
3.267	1241.70	124.17
3.283	1197.70	119.77
3.300	1155.90	115.59
3.317	1115.80	111.58

PRV Canyon Inflow		
Spread over 3 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
2.667	5.83	1.94
2.683	5.76	1.92
2.700	5.71	1.90
2.717	5.65	1.88
2.733	5.59	1.86
2.750	5.54	1.85
2.767	5.50	1.83
2.783	5.46	1.82
2.800	5.44	1.81
2.817	5.43	1.81
2.833	5.41	1.80
2.850	5.40	1.80
2.867	5.38	1.79
2.883	5.35	1.78
2.900	5.30	1.77
2.917	5.25	1.75
2.933	5.20	1.73
2.950	5.14	1.71
2.967	5.08	1.69
2.983	5.02	1.67
3.000	4.96	1.65
3.017	4.89	1.63
3.033	4.81	1.60
3.050	4.72	1.57
3.067	4.62	1.54
3.083	4.50	1.50
3.100	4.37	1.46
3.117	4.21	1.40
3.133	4.04	1.35
3.150	3.84	1.28
3.167	3.61	1.20
3.183	3.38	1.13
3.200	3.13	1.04
3.217	2.89	0.96
3.233	2.64	0.88
3.250	2.40	0.80
3.267	2.17	0.72
3.283	1.95	0.65
3.300	1.74	0.58
3.317	1.55	0.52

FLO-2D Model Simulation Inflow Hydrographs

Naranja Culvert Inflow		
Spread over 10 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
3.333	1077.00	107.70
3.350	1039.20	103.92
3.367	1002.20	100.22
3.383	863.50	86.35
3.400	809.90	80.99
3.417	777.40	77.74
3.433	749.70	74.97
3.450	724.40	72.44
3.467	701.00	70.10
3.483	679.40	67.94
3.500	659.30	65.93
3.517	640.60	64.06
3.533	623.20	62.32
3.550	606.70	60.67
3.567	591.10	59.11
3.583	576.20	57.62
3.600	561.70	56.17
3.617	547.80	54.78
3.633	534.40	53.44
3.650	522.00	52.20
3.667	511.10	51.11
3.683	502.10	50.21
3.700	494.70	49.47
3.717	487.00	48.70
3.733	478.50	47.85
3.750	469.30	46.93
3.767	459.80	45.98
3.783	449.90	44.99
3.800	439.90	43.99
3.817	429.90	42.99
3.833	420.00	42.00
3.850	410.10	41.01
3.867	400.50	40.05
3.883	391.00	39.10
3.900	381.80	38.18
3.917	372.80	37.28
3.933	364.00	36.40
3.950	355.40	35.54
3.967	347.00	34.70
3.983	338.80	33.88

PRV Canyon Inflow		
Spread over 3 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
3.333	1.37	0.46
3.350	1.21	0.40
3.367	1.07	0.36
3.383	0.95	0.32
3.400	0.84	0.28
3.417	0.75	0.25
3.433	0.67	0.22
3.450	0.59	0.20
3.467	0.53	0.18
3.483	0.47	0.16
3.500	0.42	0.14
3.517	0.37	0.12
3.533	0.33	0.11
3.550	0.29	0.10
3.567	0.26	0.09
3.583	0.23	0.08
3.600	0.20	0.07
3.617	0.18	0.06
3.633	0.16	0.05
3.650	0.14	0.05
3.667	0.12	0.04
3.683	0.11	0.04
3.700	0.10	0.03
3.717	0.09	0.03
3.733	0.08	0.03
3.750	0.07	0.02
3.767	0.06	0.02
3.783	0.05	0.02
3.800	0.05	0.02
3.817	0.04	0.01
3.833	0.03	0.01
3.850	0.03	0.01
3.867	0.03	0.01
3.883	0.02	0.01
3.900	0.02	0.01
3.917	0.02	0.01
3.933	0.01	0.00
3.950	0.01	0.00
3.967	0.01	0.00
3.983	0.01	0.00

FLO-2D Model Simulation Inflow Hydrographs

Naranja Culvert Inflow		
Spread over 10 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
4.000	330.80	33.08
4.017	322.90	32.29
4.033	315.20	31.52
4.050	307.60	30.76
4.067	300.10	30.01
4.083	292.70	29.27
4.100	285.40	28.54
4.117	278.10	27.81
4.133	271.00	27.10
4.150	263.80	26.38
4.167	256.70	25.67
4.183	249.70	24.97
4.200	242.70	24.27
4.217	235.70	23.57
4.233	228.80	22.88
4.250	221.90	22.19
4.267	215.10	21.51
4.283	208.40	20.84
4.300	201.80	20.18
4.317	195.30	19.53
4.333	188.90	18.89
4.350	182.70	18.27
4.367	176.70	17.67
4.383	170.80	17.08
4.400	165.10	16.51
4.417	159.70	15.97
4.433	154.50	15.45
4.450	149.50	14.95
4.467	144.90	14.49
4.483	140.40	14.04
4.500	136.30	13.63
4.517	132.40	13.24
4.533	128.70	12.87
4.550	125.40	12.54
4.567	122.30	12.23
4.583	119.40	11.94
4.600	116.80	11.68
4.617	114.50	11.45
4.633	112.30	11.23
4.650	110.40	11.04

PRV Canyon Inflow		
Spread over 3 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
4.000	0.01	0.00
4.017	0.01	0.00
4.033	0.00	0.00
4.050	0.00	0.00
4.067	0.00	0.00
4.083	0.00	0.00
4.100	0.00	0.00
4.117	0.00	0.00
4.133	0.00	0.00
4.150	0.00	0.00
4.167	0.00	0.00
4.183	0.00	0.00
4.200	0.00	0.00
4.217	0.00	0.00
4.233	0.00	0.00
4.250	0.00	0.00
4.267	0.00	0.00
4.283	0.00	0.00
4.300	0.00	0.00
4.317	0.00	0.00
4.333	0.00	0.00
4.350	0.00	0.00
4.367	0.00	0.00
4.383	0.00	0.00
4.400	0.00	0.00
4.417	0.00	0.00
4.433	0.00	0.00
4.450	0.00	0.00
4.467	0.00	0.00
4.483	0.00	0.00
4.500	0.00	0.00
4.517	0.00	0.00
4.533	0.00	0.00
4.550	0.00	0.00
4.567	0.00	0.00
4.583	0.00	0.00
4.600	0.00	0.00
4.617	0.00	0.00
4.633	0.00	0.00
4.650	0.00	0.00

FLO-2D Model Simulation Inflow Hydrographs

Naranja Culvert Inflow		
Spread over 10 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
4.667	108.70	10.87
4.683	107.10	10.71
4.700	105.80	10.58
4.717	104.60	10.46
4.733	103.50	10.35
4.750	102.60	10.26
4.767	101.80	10.18
4.783	101.10	10.11
4.800	100.50	10.05
4.817	100.10	10.01
4.833	99.70	9.97
4.850	99.30	9.93
4.867	98.80	9.88
4.883	98.30	9.83
4.900	97.70	9.77
4.917	97.00	9.70
4.933	96.20	9.62
4.950	95.40	9.54
4.967	94.50	9.45
4.983	93.50	9.35
5.000	92.40	9.24
FLO-2D Model Simulation Ends		
5.017	91.20	9.12
5.033	89.90	8.99
5.050	88.60	8.86
5.067	87.10	8.71
5.083	85.60	8.56
5.100	84.00	8.40
5.117	82.40	8.24
5.133	80.60	8.06
5.150	78.90	7.89
5.167	77.00	7.70
5.183	75.10	7.51
5.200	73.20	7.32
5.217	71.20	7.12
5.233	69.20	6.92
5.250	67.20	6.72
5.267	65.10	6.51
5.283	63.00	6.30
5.300	61.00	6.10

PRV Canyon Inflow		
Spread over 3 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
4.667	0.00	0.00
4.683	0.00	0.00
4.700	0.00	0.00
4.717	0.00	0.00
4.733	0.00	0.00
4.750	0.00	0.00
4.767	0.00	0.00
4.783	0.00	0.00
4.800	0.00	0.00
4.817	0.00	0.00
4.833	0.00	0.00
4.850	0.00	0.00
4.867	0.00	0.00
4.883	0.00	0.00
4.900	0.00	0.00
4.917	0.00	0.00
4.933	0.00	0.00
4.950	0.00	0.00
4.967	0.00	0.00
4.983	0.00	0.00
5.000	0.00	0.00
5.017	0.00	0.00
5.033	0.00	0.00
5.050	0.00	0.00
5.067	0.00	0.00
5.083	0.00	0.00
5.100	0.00	0.00
5.117	0.00	0.00
5.133	0.00	0.00
5.150	0.00	0.00
5.167	0.00	0.00
5.183	0.00	0.00
5.200	0.00	0.00
5.217	0.00	0.00
5.233	0.00	0.00
5.250	0.00	0.00
5.267	0.00	0.00
5.283	0.00	0.00
5.300	0.00	0.00

FLO-2D Model Simulation Inflow Hydrographs

Naranja Culvert Inflow		
Spread over 10 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
5.317	58.90	5.89
5.333	56.80	5.68
5.350	54.70	5.47
5.367	52.70	5.27
5.383	50.60	5.06
5.400	48.60	4.86
5.417	46.70	4.67
5.433	44.70	4.47
5.450	42.80	4.28
5.467	40.90	4.09
5.483	39.10	3.91
5.500	37.30	3.73
5.517	35.50	3.55
5.533	33.90	3.39
5.550	32.20	3.22
5.567	30.60	3.06
5.583	29.10	2.91
5.600	27.60	2.76
5.617	26.20	2.62
5.633	24.80	2.48
5.650	23.50	2.35
5.667	22.20	2.22
5.683	21.00	2.10
5.700	19.80	1.98
5.717	18.70	1.87
5.733	17.70	1.77
5.750	16.60	1.66
5.767	15.70	1.57
5.783	14.80	1.48
5.800	13.90	1.39
5.817	13.10	1.31
5.833	12.30	1.23
5.850	11.50	1.15
5.867	10.80	1.08
5.883	10.20	1.02
5.900	9.50	0.95
5.917	8.90	0.89
5.933	8.40	0.84
5.950	7.80	0.78
5.967	7.40	0.74

PRV Canyon Inflow		
Spread over 3 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
5.317	0.00	0.00
5.333	0.00	0.00
5.350	0.00	0.00
5.367	0.00	0.00
5.383	0.00	0.00
5.400	0.00	0.00
5.417	0.00	0.00
5.433	0.00	0.00
5.450	0.00	0.00
5.467	0.00	0.00
5.483	0.00	0.00
5.500	0.00	0.00
5.517	0.00	0.00
5.533	0.00	0.00
5.550	0.00	0.00
5.567	0.00	0.00
5.583	0.00	0.00
5.600	0.00	0.00
5.617	0.00	0.00
5.633	0.00	0.00
5.650	0.00	0.00
5.667	0.00	0.00
5.683	0.00	0.00
5.700	0.00	0.00
5.717	0.00	0.00
5.733	0.00	0.00
5.750	0.00	0.00
5.767	0.00	0.00
5.783	0.00	0.00
5.800	0.00	0.00
5.817	0.00	0.00
5.833	0.00	0.00
5.850	0.00	0.00
5.867	0.00	0.00
5.883	0.00	0.00
5.900	0.00	0.00
5.917	0.00	0.00
5.933	0.00	0.00
5.950	0.00	0.00
5.967	0.00	0.00

FLO-2D Model Simulation Inflow Hydrographs

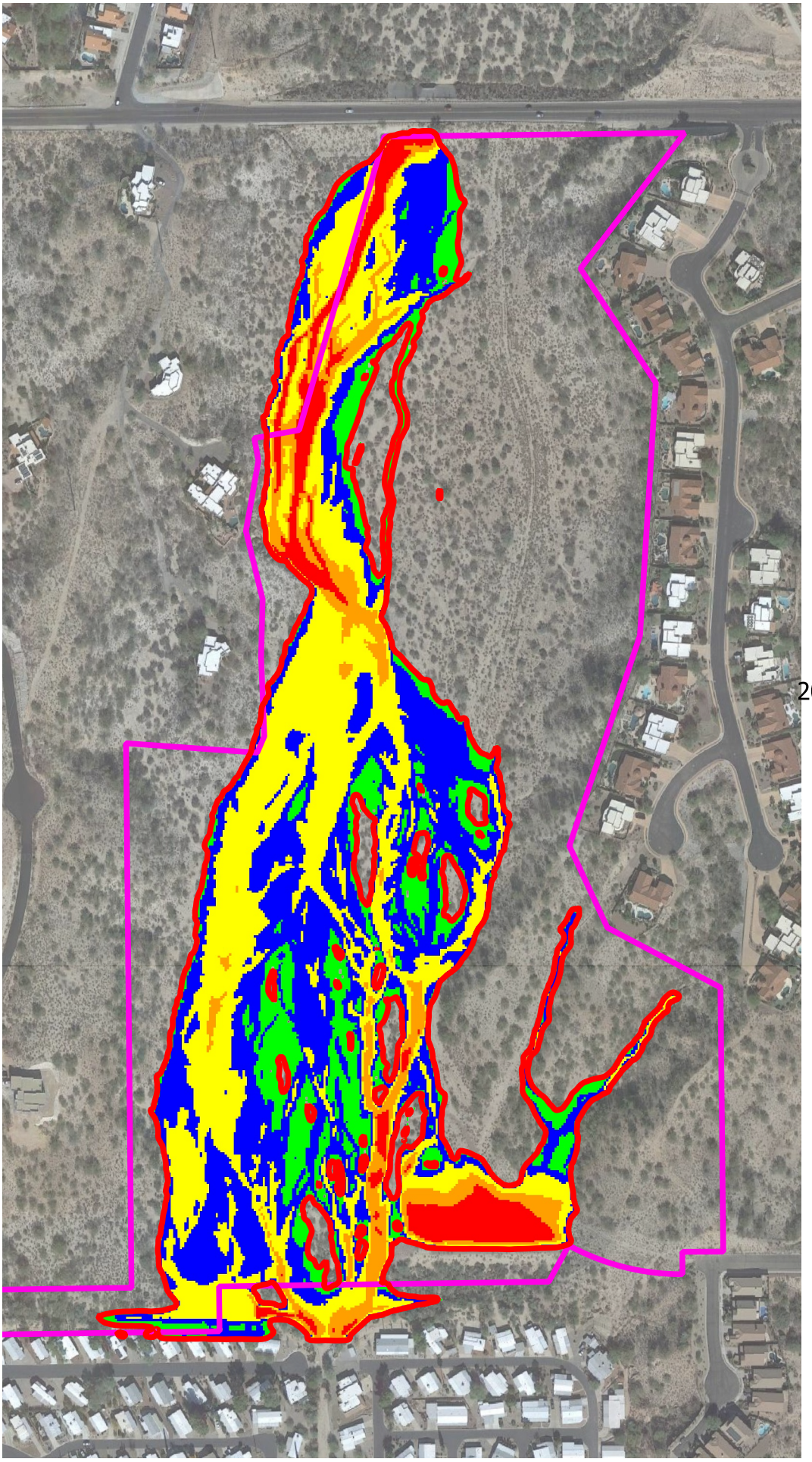
Naranja Culvert Inflow		
Spread over 10 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
5.983	6.90	0.69
6.000	6.40	0.64
6.017	6.00	0.60
6.033	5.60	0.56
6.050	5.30	0.53
6.067	4.90	0.49
6.083	4.60	0.46
6.100	4.30	0.43
6.117	4.00	0.40
6.133	3.70	0.37
6.150	3.50	0.35
6.167	3.20	0.32
6.183	3.00	0.30
6.200	2.80	0.28
6.217	2.60	0.26
6.233	2.40	0.24
6.250	2.30	0.23
6.267	2.10	0.21
6.283	2.00	0.20
6.300	1.80	0.18
6.317	1.70	0.17
6.333	1.60	0.16
6.350	1.50	0.15
6.367	1.40	0.14
6.383	1.30	0.13
6.400	1.20	0.12
6.417	1.10	0.11
6.433	1.00	0.10
6.450	0.90	0.09
6.467	0.90	0.09
6.483	0.80	0.08
6.500	0.70	0.07
6.517	0.70	0.07
6.533	0.60	0.06
6.550	0.60	0.06
6.567	0.50	0.05
6.583	0.50	0.05
6.600	0.40	0.04
6.617	0.40	0.04
6.633	0.40	0.04

PRV Canyon Inflow		
Spread over 3 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
5.983	0.00	0.00
6.000	0.00	0.00
6.017	0.00	0.00
6.033	0.00	0.00
6.050	0.00	0.00
6.067	0.00	0.00
6.083	0.00	0.00
6.100	0.00	0.00
6.117	0.00	0.00
6.133	0.00	0.00
6.150	0.00	0.00
6.167	0.00	0.00
6.183	0.00	0.00
6.200	0.00	0.00
6.217	0.00	0.00
6.233	0.00	0.00
6.250	0.00	0.00
6.267	0.00	0.00
6.283	0.00	0.00
6.300	0.00	0.00
6.317	0.00	0.00
6.333	0.00	0.00
6.350	0.00	0.00
6.367	0.00	0.00
6.383	0.00	0.00
6.400	0.00	0.00
6.417	0.00	0.00
6.433	0.00	0.00
6.450	0.00	0.00
6.467	0.00	0.00
6.483	0.00	0.00
6.500	0.00	0.00
6.517	0.00	0.00
6.533	0.00	0.00
6.550	0.00	0.00
6.567	0.00	0.00
6.583	0.00	0.00
6.600	0.00	0.00
6.617	0.00	0.00
6.633	0.00	0.00

FLO-2D Model Simulation Inflow Hydrographs

Naranja Culvert Inflow		
Spread over 10 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
6.650	0.30	0.03
6.667	0.30	0.03
6.683	0.30	0.03
6.700	0.30	0.03
6.717	0.20	0.02
6.733	0.20	0.02
6.750	0.20	0.02
6.767	0.20	0.02
6.783	0.20	0.02
6.800	0.10	0.01
6.817	0.10	0.01
6.833	0.10	0.01
6.850	0.10	0.01
6.867	0.10	0.01
6.883	0.10	0.01
6.900	0.10	0.01
6.917	0.10	0.01
6.933	0.10	0.01
6.950	0.10	0.01
6.967	0.10	0.01
6.983	0.00	0.00
7.000	0.00	0.00

PRV Canyon Inflow		
Spread over 3 Cells		
Time (hrs)	Total (cfs)	per Cell (cfs)
6.650	0.00	0.00
6.667	0.00	0.00
6.683	0.00	0.00
6.700	0.00	0.00
6.717	0.00	0.00
6.733	0.00	0.00
6.750	0.00	0.00
6.767	0.00	0.00
6.783	0.00	0.00
6.800	0.00	0.00
6.817	0.00	0.00
6.833	0.00	0.00
6.850	0.00	0.00
6.867	0.00	0.00
6.883	0.00	0.00
6.900	0.00	0.00
6.917	0.00	0.00
6.933	0.00	0.00
6.950	0.00	0.00
6.967	0.00	0.00
6.983	0.00	0.00
7.000	0.00	0.00



NARANJA TRAILS

MAXIMUM FLOW DEPTH
EXISTING CONDITIONS

LEGEND

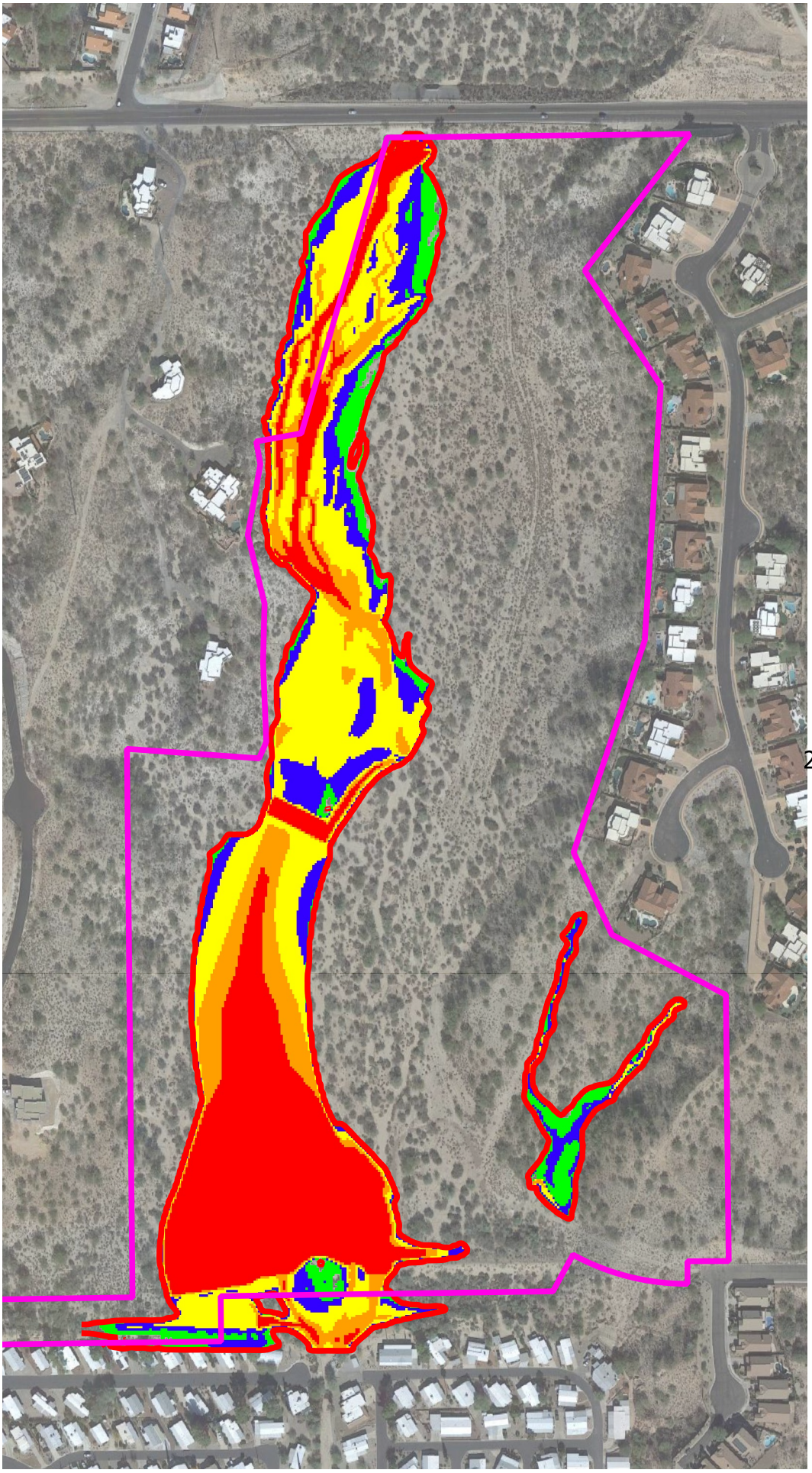
- Floodplain Limits
- Property_Boundary

Existing Max Depth

- <= 0.20
- 0.20 - 0.50
- 0.50 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

200 0 200 400 ft

EXHIBIT 7



NARANJA TRAILS

MAXIMUM FLOW DEPTH
PROPOSED CONDITIONS

LEGEND

Property_Boundary

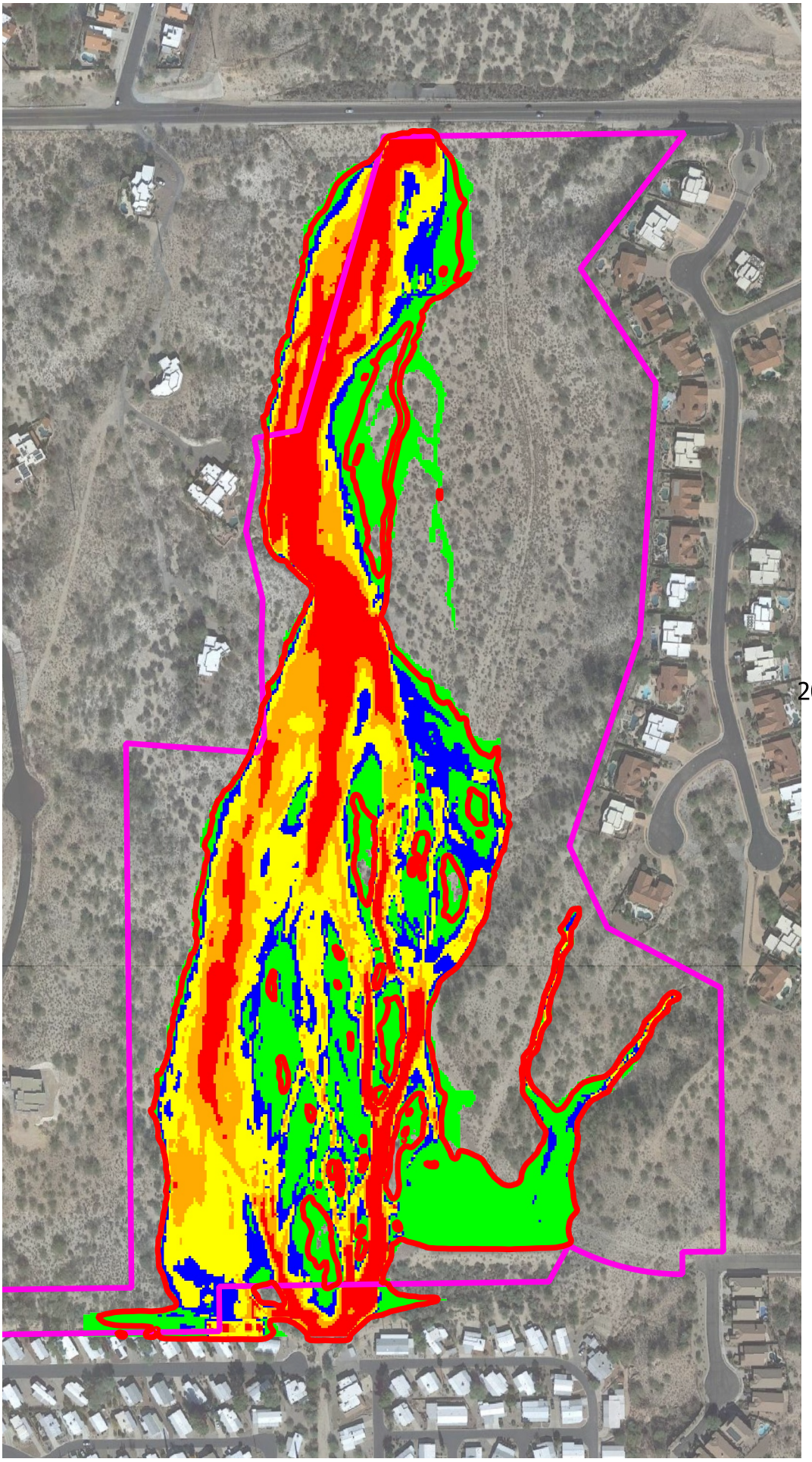
Floodplain Limits

Proposed Max Flow Depth
Band 1 (Gray)

- <= 0.20 ft
- 0.20 - 0.50 ft
- 0.50 - 1.0 ft
- 1.0 - 2.0 ft
- 2.0 - 3.0 ft
- > 3.0 ft

200 0 200 400 ft

EXHIBIT 8
18 Jul 2023



NARANJA TRAILS

MAXIMUM VELOCITY
EXISTING CONDITIONS

LEGEND

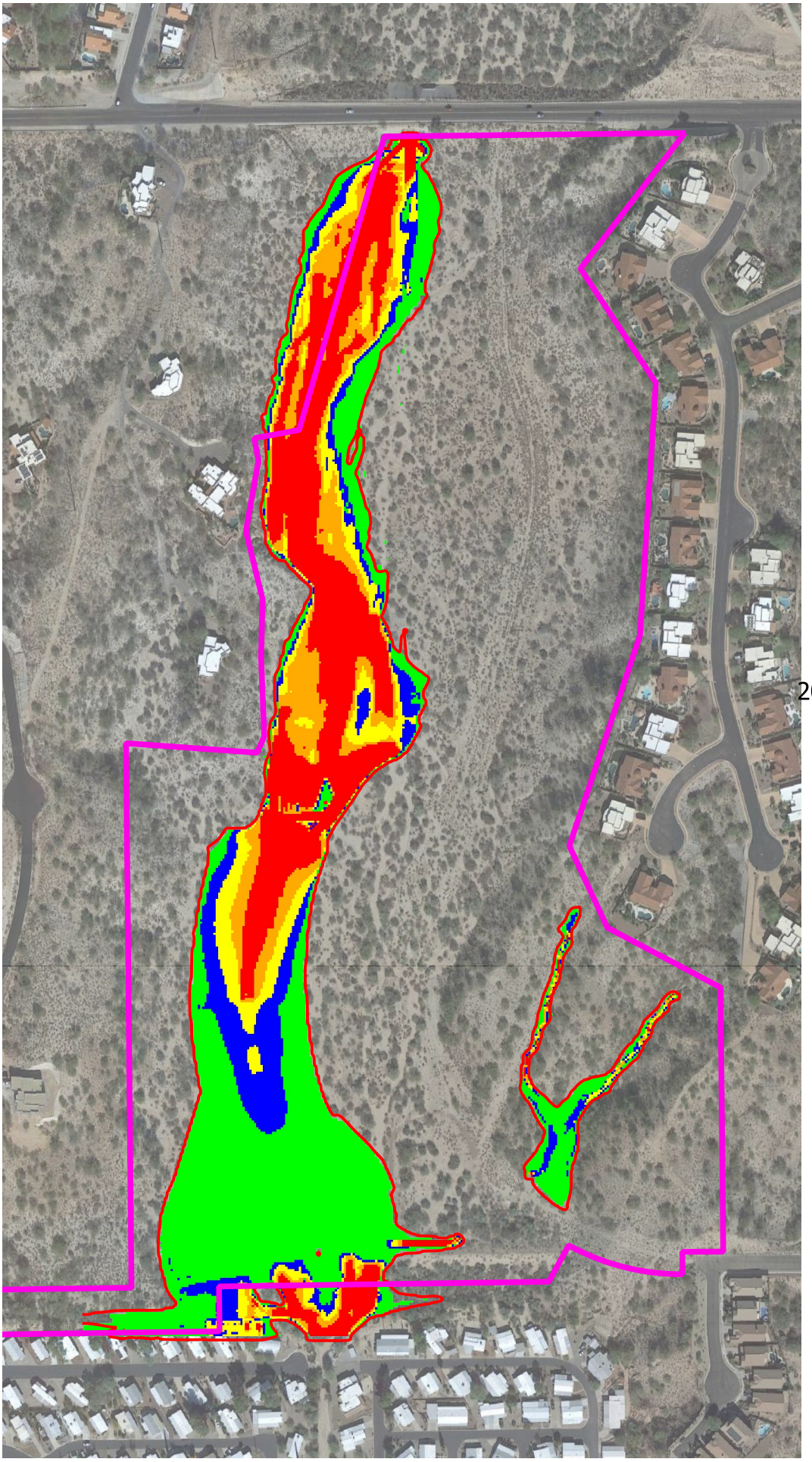
- Floodplain Limits
- Property_Boundary

Existing Max Velocity

- <= 2.50 ft/s
- 2.50 - 3.50 ft/s
- 3.50 - 4.50 ft/s
- 4.50 - 5.50 ft/s
- > 5.50 ft/s

200 0 200 400 ft

EXHIBIT 9



NARANJA TRAILS

MAXIMUM VELOCITY
PROPOSED CONDITIONS

LEGEND

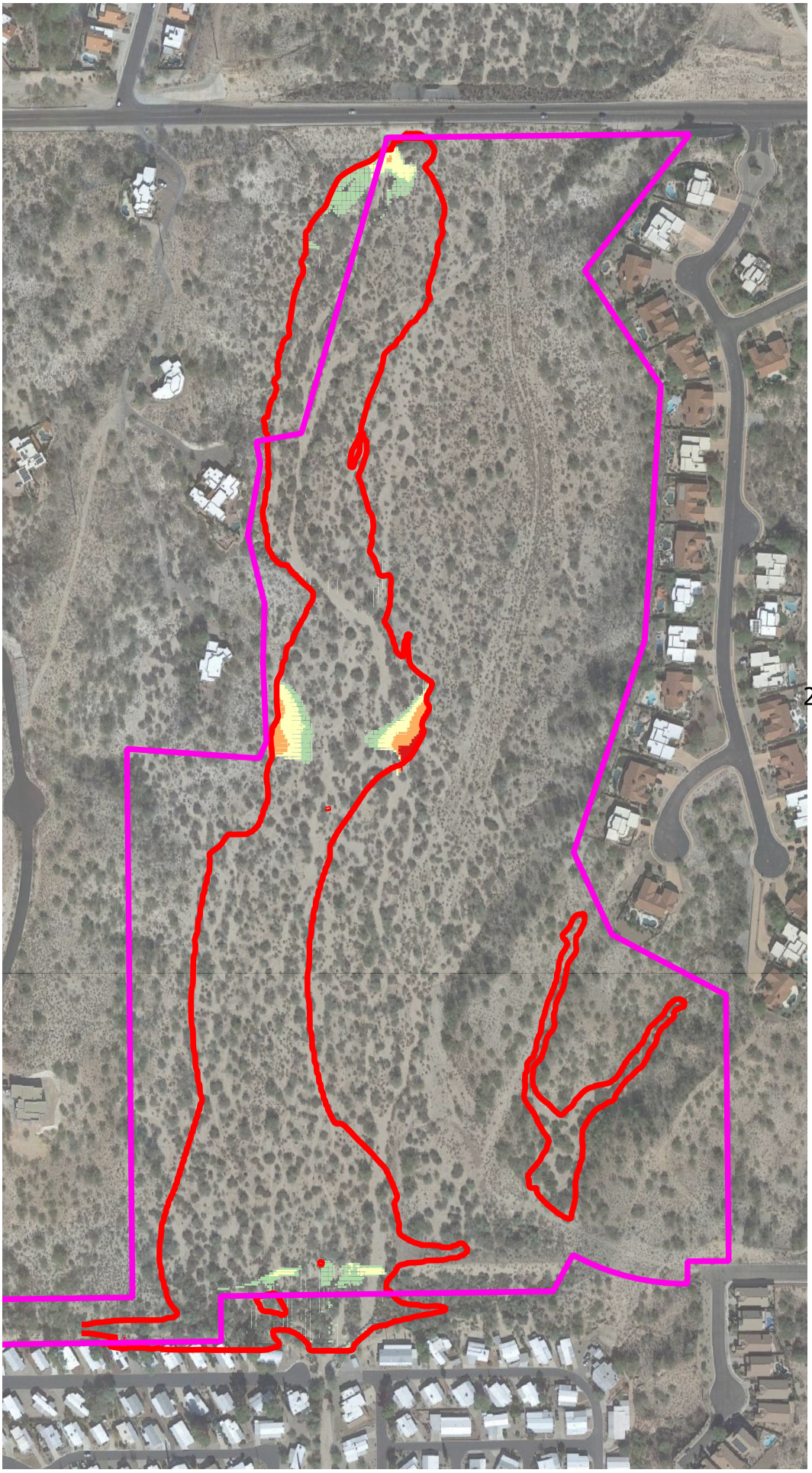
- Property_Boundary
- Floodplain Limits

Proposed Max Velocity
Band 1 (Gray)

- <= 2.50 ft/s
- 2.50 - 3.50 ft/s
- 3.50 - 4.50 ft/s
- 4.50 - 5.50 ft/s
- >5.50 ft/s

200 0 200 400 ft

EXHIBIT 10
19 Jul 2023



NARANJA TRAILS

Water Surface Elevation
Comparisons
(Proposed - Existing)

LEGEND

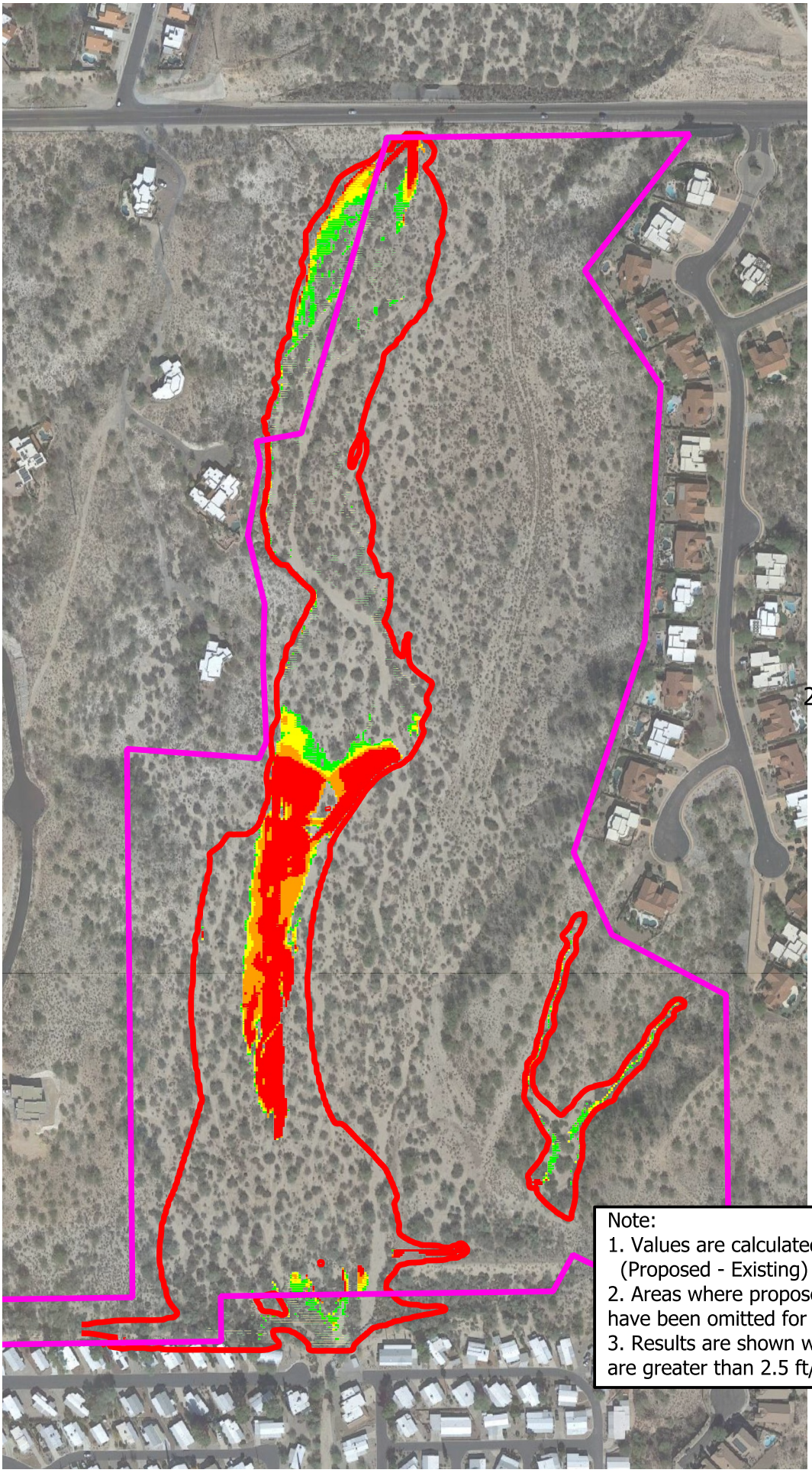
Property_Boundary

Proposed Floodplain

Delta WSE (Prop - Ex)

200 0 200 400 ft

EXHIBIT 11
19 Jul 2023



NARANJA TRAILS

Velocity
Comparisons
(Prop - Ex) / Ex

LEGEND

- Property_Boundary
- Proposed Floodplain

Velocity Increase
Band 1 (Gray)

- <= 5%
- 5% - 10%
- 10% - 20%
- 20% - 50%
- > 50%

200 0 200 400 ft

Note:
1. Values are calculated by the following equation:
(Proposed - Existing) / Existing * 100
2. Areas where proposed velocity show decreases have been omitted for clarity
3. Results are shown where the proposed velocities are greater than 2.5 ft/s.

EXHIBIT 12
19 Jul 2023

APPENDIX C

DIGITAL FILES FOR FLO-2D
DIGITAL FILES FOR HEC-HMS

APPENDIX D

WLB COORDINATION MEMO

Town of Oro Valley
Community and Economic Development Department

August 7, 2019

Rob Longaker
The WLB Group, Inc.
4444 E. Broadway Blvd
Tucson, AZ 85711
rlongaker@wlbgroup.com

Re: **Pre-application:** Proposed 42-lot residential subdivision on an approximately 58 acre property, known as Naranja Trails, located south of Naranja Drive and a ¼ mile west of 1st Avenue (Case No. 1901711).

Dear Mr. Longaker,

Thank you for submitting a pre-application for the above-referenced project. We look forward to working with you through the development review process. The purpose of this letter is to reiterate comments and issues discussed at the Development Review Committee meeting on Friday, August 2, 2019. Based on your submittal, staff offers the following comments to assist you in preparing a formal submittal. Please note that these comments are preliminary in nature and should not be considered an exhaustive code review.

Development Review Process:

1. A neighborhood meeting is required for this project. However, this meeting will not be conducted until staff has reviewed the drainage concept for the site. Please contact the Stormwater Utility staff to begin these discussions.
    a. The purpose of the neighborhood meeting is to discuss and present your proposal to neighbors (Section 22.15 of the Zoning Code). Staff will be responsible for mailing the notification letters and scheduling a meeting room. The applicant is responsible for the cost of these mailings. Please provide the following to begin the neighborhood meeting process:
        i. Public Outreach Plan
        ii. Three (3) potential meeting dates- Neighborhood meetings are held from 6-7:30 PM.

2. The proposed site plan design (i.e. number of lots, access and circulation and disturbance) is consistent with the approved Tentative Development Plan found in the Melcor Planned Area Development. As such, the following design submittals are required and must be considered by the Planning and Zoning Commission and Town Council.
    a. Conceptual Site Plan
    b. Conceptual Landscape Plan
    c. To adequately review drainage, a drainage report is also required during conceptual design review.

3. In addition to the aforementioned conceptual design plans, a Native Plant Preservation Plan, associated Site Resource Inventory and Cultural Resource Survey are required. All of which, must be submitted and reviewed by staff, prior to scheduling consideration by the Planning and Zoning Commission.

4. A Conceptual Model Home Architecture application is required and is subject to Planning and Zoning Commission approval. This may track concurrently with the other conceptual designs plans. Subsequent to a Commission approval, a Final Architecture application is required for an administrative review.

5. Upon Town Council approval of the Conceptual Design Plans, the following submittals are required and may be approved administratively.
    a. Final Site Plan (at the applicant's risk, it may be combined with the Improvement Plan)
    b. Final Landscape and Irrigation Plan
    c. Final Rainwater Harvesting Plan

6. A Final Plat is required and must be approved by Town Council. The Final Plat must dedicate the open space (common areas) to be owned and maintained by the future Homeowner's Association (per the PAD) and preserve the required open space in perpetuity. Additionally, the conservation easements must be platted and remain undisturbed no-build areas.

Conceptual Architecture

Please review the following standards, prior to your submittal.

7. The proposed development must be in compliance with the PAD Design Standards and Guidelines (Appendix C-2).
8. The proposed development is subject to the design standards outlined in Section 3.2 of Addendum "A", Design Standards, of the Zoning Code.
9. In addition to the aforementioned standards, the proposed architectural style must be compatible with the surrounding homes.

Additional staff comments:

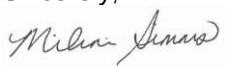
Please see additional staff comments and redlines in the attached documents.

Summary

Again, thank you for submitting a pre-application. We look forward to assisting you through the development review process. The next step is to work with staff to determine the proposed drainage scheme and schedule a neighborhood meeting.

If you have any questions, please do not hesitate to contact me.

Sincerely,



Milini Simms
Senior Planner
520.229.4836
msimms@orovalleyaz.gov

The WLB Group Inc.

January 18, 2017

Engineering • Planning
Surveying • Urban Design
Landscape Architecture

Justin Turner, P.E.
Sr. Stormwater Civil Engineer
Town of Oro Valley
Community Development & Public Works
11000 N. La Canada Dr.
Oro Valley, Arizona 85737

Re: Naranja Trails Residential Development – Existing Conditions Modeling
OV1214-34
Review Comment Responses
WLB No. 113032-A-001

Dear Justin,

In response to comments received from the Town, and dated December 14, 2016, we offer the following responses:

1. Tributary Inflow. A new hydrograph was added to the new model representing tributary inflow from the existing Pusch Ridge Vistas development. It is this watercourse that discharges into the existing stormwater detention basin. The hydrograph from CP E1 had a peak discharge of 96 cfs at a time of 0.2 hours. By comparison, the peak discharge for Highlands Wash was 2135 cfs at time 2.5 hours. This large difference in flood-peak arrival times suggests that these floods were simulated using two different storm durations (3 hour vs. 1 hour). Please verify that these two hydrographs came from the same 3-hour storm, otherwise revise the tributary inflow.

   RESPONSE: Acknowledged and reconsidered. The tributary inflow has been updated to reflect a proper 3-hour storm. The 100-year, 3-hour peak discharge of 135.8 cfs occurs at approximately 18 minutes (~0.30 hours). The large difference in flood-peak arrival times can be determined that the Highland Wash, at the point crossing Naranja Road, has an approximate total area of 2.45 sq. mi., while the discharge area from the Pusch Ridge Vista subdivision as it feeds into the detention basin is approximately 0.03 sq. mi.

2. Outflow Boundary Condition. Comment #3 from our previous letter has not been addressed.

   RESPONSE: The Downstream Boundary condition chosen was Normal Depth. It has been verified that the appropriate Friction Slope based on the channel slope would be 0.01218. A sensitivity study was performed to consider the energy slope of the channel flow of the Highlands Mobile Home Park based on initial run values. *Note: the prepared model ends within the area of the existing HMHP roadways.* A cross-sectional sample of the flow depth verifies an energy slope of approximately 5.6%. The lesser slope based on the channel

The WLB Group Inc.

longitudinal slope is the more conservative approach. It is not our intention to model further onto the HMHP site, and believe that the Existing Conditions model supplied does verify the limitations of the existing berm protection.

The Existing Conditions model is the precursor to the Proposed Conditions model which will be used for comparative purposes to define that the development of the Naranja Trails residential subdivision will not negatively impact the HMHP downstream. Also, as the undersized HMHP channel is a known condition this Existing Condition model can be used as a starting point for coordination and planning to mitigate the obvious deficiencies to the HMHP property.

3. Highland Levee. Comment #4 from our previous letter has not been addressed.

RESPONSE: Based on our conversations at a working meeting upon delivery of the Existing Conditions model v2, the comments concerning the Highland Levee were discussed in detail. Following Comment #4 to its conclusion paragraph by paragraph:

1) The Basin Management Study cited is apparently correct in its analysis that the HMHP levees are inadequate for the 100-year storm event.

2) Acknowledged.

3) Acknowledged. Further modeling iterations have identified that the Highland Park berm does verify (corrected information following) that the structure is overtopped during the 100-year event with maximum depth of approximately 0.84 ft, and a weir-top velocity of approximately 4.5 ft/sec; velocities down the aft-face berm slope are not considered, but are most certainly erosive. Again, this is the Existing Condition modeled with recent topography, and shows the obvious deficiencies of the existing berm placed to protect the HMHP.

4) The modeling is appropriate, having used breaklines to divide the berm sections and mitigate any issues of 'leaking' which is a common initial occurrence/issue with grid modeling in HEC-RAS 2D. The use of breaklines, added using the '2D Area Breaklines' function, are then impressed into the original mesh by using the 'Force Mesh Recomputation' function.

5) Acknowledged. The previous conversation and the above break-down of the comment provide adequate background as to the requested methodology. In summary, the HMHP levee/berm are inadequate, and certainly pose a threat of breach in the existing condition. Again, it is our contention that the Town consider some form of coordination, planning, and action plan in order to mitigate this threat to the downstream residents.

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Two-Dimensional Modeling. For guidelines in preparing maps for future submittal, refer to Pima County Technical Policy TECH-033, Criteria for Two-Dimensional Modeling. Include a color-indexed map of calculated differences in pre- and post-project CWSELs.

RESPONSE: Acknowledged. As you know, the Existing Conditions pre-review has gone on for quite some time, and it is our absolute intention to provide pre- and post-developed models and a map of differences at the time of FSP submittal. At this time we are requesting that the Town provide acceptance of the Existing Condition model so that Proposed Condition modeling can begin.

This addresses all the comments received to date. Again, this pre-submittal is an effort to find a satisfactory agreement that the existing conditions modeling has been met in order to begin the proposed conditions analysis in earnest. Our client is more than eager to move forward as you can well imagine.

If you have any questions or require additional information, please contact us at 881-7480.

Sincerely,

THE WLB GROUP, INC.

Christopher G. Langham, P.E., CFM
Senior Engineer

Attachments

Cc:
David Little, P.E.
David Laws, P.E.

MEMORANDUM

To: **David Laws, P.E.**
Town of Oro Valley

From: **Robert G. Longaker III, PLA, AICP**
The WLB Group, Inc.

Date: **March 21, 2016**

Subject: **Summary Discussion of Existing Conditions 2-Dimensional Model for Proposed Naranja Trails Residential Development within the Highlands Wash Oro Valley, AZ**
WLB No.: 113032-A-001

CC: **Christopher Langham, P.E., CFM**

Introduction

This memo has been prepared to address the surface hydrology of the proposed Naranja Trails residential development, which lies adjacent to the Highlands Wash. There are two primary purposes of this memo and they are as follows: (1) to discuss the methodology and results of the existing conditions 2D modeling of the Highlands Wash using HEC-RAS 5.0 Beta, and (2) to provide elementary evidence of the results of the 2D modeling completed for this site by the Pima County Regional Flood District (FCD) using FLO-2D.

Exhibits and Information Provided in this Memo

The following exhibits and supplemental information are attached to this memo:

1. Project Location Map.
2. Technical Specifications.
3. The Digital Model and an Exhibit of the Existing Floodplain Boundary.
4. Floodplain Depth Exhibit.
5. Floodplain Velocity Exhibit.
6. Floodplain Depth Comparison Exhibit: HEC-RAS 5.0 Beta vs. Flo-2D.
7. Floodplain Velocity Comparison Exhibit: HEC-RAS 5.0 Beta vs. Flo-2D.
8. Conceptual Site Plan.

Methodology and Summary of Results

Based on conversations with the Town of Oro Valley and the Pima County Flood Control District (FCD), there was a desire to model this reach of the Highlands Wash, but not with a 1D riverine modeling software such as HEC-RAS v4.0. Instead, and due to the physical nature of the Highlands Wash, it was requested by the Town of Oro Valley that the area be analyzed using a 2D analysis, using either Flo-2D or HEC-RAS 5.0 2D in order to more accurately consider the

storage, depths of flow and velocities of flow. After internal discussions concerning software pros and cons, we approached the modeling using HEC-RAS 5.0 Beta.

After completing our analysis, we sent it to FCD for review. During a meeting with FCD to discuss the analysis, representatives from FCD (Jacob Prieto, Andy Seiger and Eric Shepp) agreed with our analysis using HEC-RAS 5.0 Beta. In fact, in an effort to further verify and confirm the results of the analysis, FCD completed the same analysis using Flo-2D and the results, including depth and velocity values, were virtually identical to our results. We believe, in fact, that the minor variations in the results were likely due to the fact that our analysis used a one-foot contour interval topographic prepared specifically for the site, while the FCD used the latest PAG topography.

Conclusion

Based on our 2D analysis, we have developed an accurate representation of existing floodplain conditions within the Highlands Wash as it passes through the Naranja Trails property. The results of this analysis were reviewed and confirmed by FCD, further confirming the validity and accuracy of this modeling. We seek the approval of this existing conditions model by the Town of Oro Valley, and now wish to proceed with the preparation of a proposed conditions model that would also be reviewed and approved by FCD and the Town of Oro Valley. This proposed conditions model will allow us to demonstrate that the site can be developed in accordance with the attached conceptual site plan using appropriate measures to avoid and mitigate any negative impacts to adjacent properties to the satisfaction of the reviewing agencies.

By way of this memo, we request that you review the attached materials. Once you have reviewed them, we request to meet with you and FCD to discuss the methodology and finding of the analysis, and our methodology for the proposed conditions model. After this, we wish to continue discussions with you and with Bayer Vella to determine the path this project must take in order to position it for development as shown conceptually on the attached Conceptual Site Plan. Please note that the property owner has hired Lazarus, Silvyn & Bangs, P.C. to assist with the entitlement process.

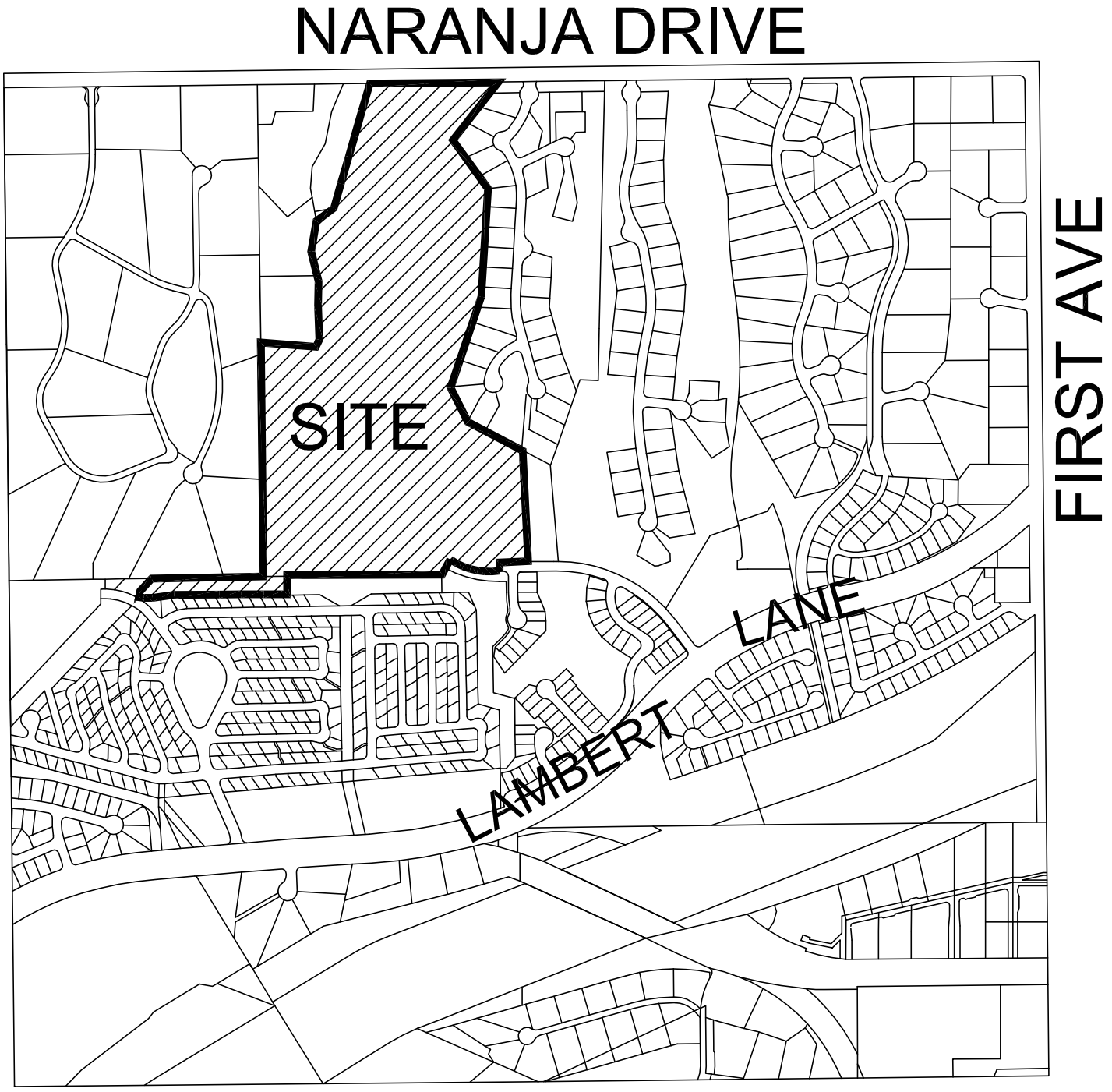
If you have any immediate questions, or require additional information, please feel free to call me at 881-7480.

Sincerely,

THE WLB GROUP, INC.

Robert G. Longaker III, PLA, AICP
Senior Project Manager

Project Location Map


NARANJA DRIVE
SITE
FIRST AVE
LANE
LAMBERT

Technical Specifications

This technical discussion will assist the reviewer as to the particulars of the model set-up, providing information as to the hydrograph data input, digital terrain surface used, particulars of the HEC RAS 5.0 grid and model calibration.

Hydrology and Hydraulic Model Setup

Care was taken to directly import the hydrologic modeling originally prepared by FCD for Highlands Wash within the HEC-HMS format. The peak discharge for the 3-hr storm was originally calculated in HMS as 2135.515 cfs with a volume of 286.12 acre feet. An initial error was to place the hydrograph data into the 'Stage Hydrograph' boundary condition which resulted in 'surging' of the flow data. Setting the hydrograph data to 'Flow Hydrograph' and calculating the 'Computation Interval' using the Diffusion Wave Equation and User Notes found within Section IV A of the User's Manual. Refining the Computational Interval provided much more expected results – with velocities closely matching those of some test Manning's cross-sections and consideration of the original HEC-RAS 4.0 modeling results.

Currently the modeling software uses a Default Manning's n Value, a block value for the entirety. Future versions of the software are slated to have a modifiable 'Land Classification', but currently we have prepared the model with a 0.055 value, which should be a quite adequate value with which to consider this vegetated yet channelized riverine environment. The determination was considered from the values provided within Table 5-2 of the ADOT Highway Drainage Design Manual – Hydrology.

The inlet is modeled to allow the incoming runoff to access the terrain mesh as it would leaving the culvert pipes entering the project site which have been determined to be 3 – 8'x6' – 100LF RCBC's. The outlet has been defined as the complete southern boundary in order to allow for the runoff to reasonably act as it would in the existing state. The topography shows berming and an inlet into the desired channel path leading into the Highlands Mobile Home Park to the south. This boundary is sufficiently beyond the property boundary of the subject property to allow for an honest assessment of the conditions within the site, ultimately allowing for a complete post-development assessment model to be prepared.

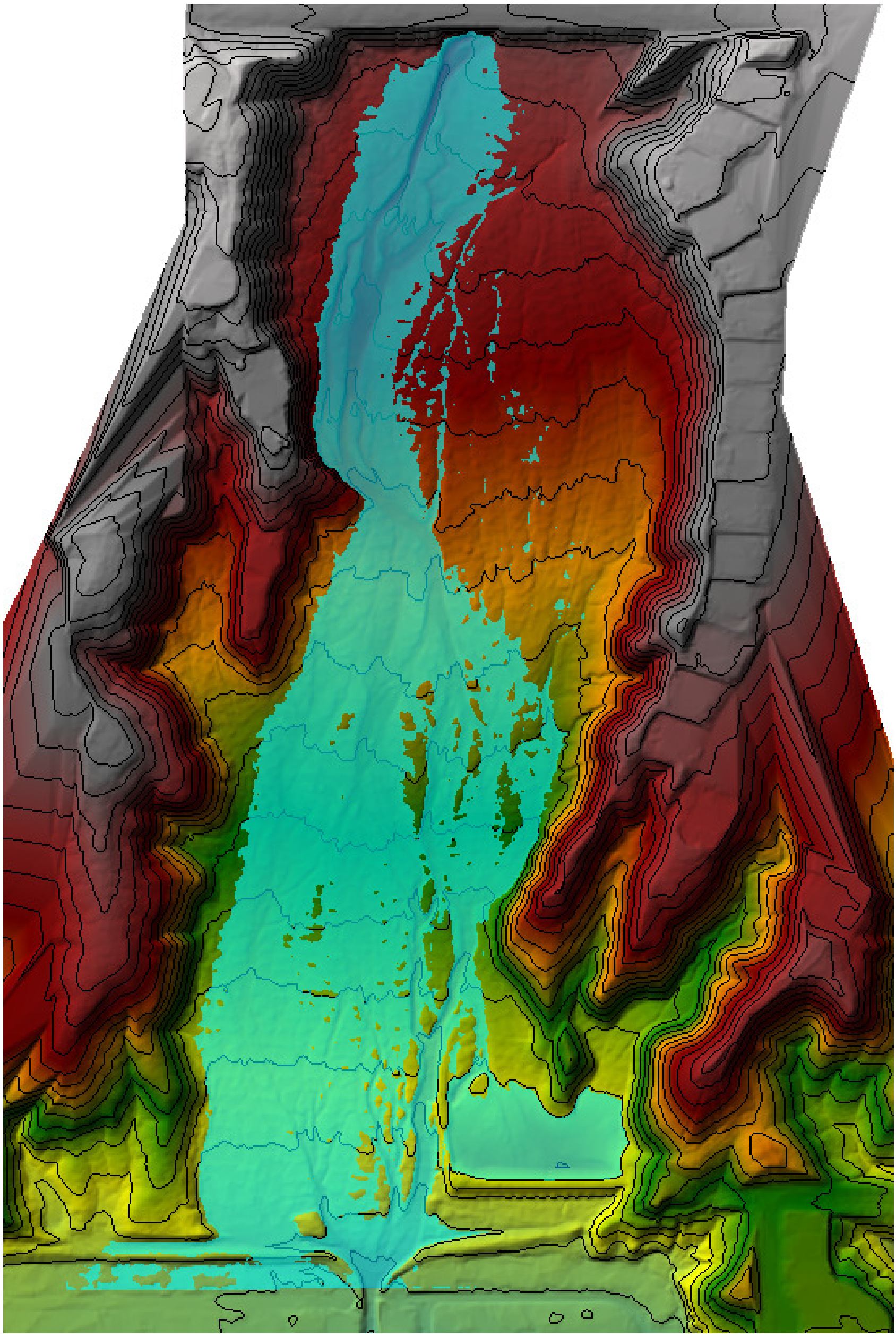
The terrain was initially modeled as a .DEM (Digital Elevation Model) as based on a 1' .DTM (Digital Terrain Model). Although this model gave the initial impression of the form of the terrain it was quickly established that the production of the .DEM negates the decimal values of the points, which translated into major 'stair-stepping' of the elevation data, and making it unacceptable for the purposes of this modeling. We analyzed several procedures for re-interpolation, but found them to produce rather fragmented results. Ultimately, using the 2015 Civil 3D function we were able to produce a much more realistic terrain through the translation of the .DTM data set into a geo-tiff file. The geo-tiff file is introduced into the 'New Terrain' function of RAS Mapper where it creates an associated .hdf and .vrt file (See Section II C of the HEC-RAS 2D User's Manual).

The mesh was originated as 20'x20' Cartesian grid on regular intervals. Initial calculations based on the general slope of the subject area showed that 35'x35' grids could maintain flow continuity without 'leaking', but with some trial-and-error and the diffusion wave calculations calibrations, it became clear that the smaller grid would be best suited. It also became apparent during initial runs that some topographic features (the Highland Park berm, and the existing detention basin remains) were not adequately considered and needed additional enhancement. The enhanced mesh, identifying feature details and allowing for the floodplain to be defined in a more fluid manner ultimately provides 8,777 cells. Filter Tolerances are set to default.

Digital model and an exhibit of the existing floodplain boundary.
(contained on cd included with this memo)

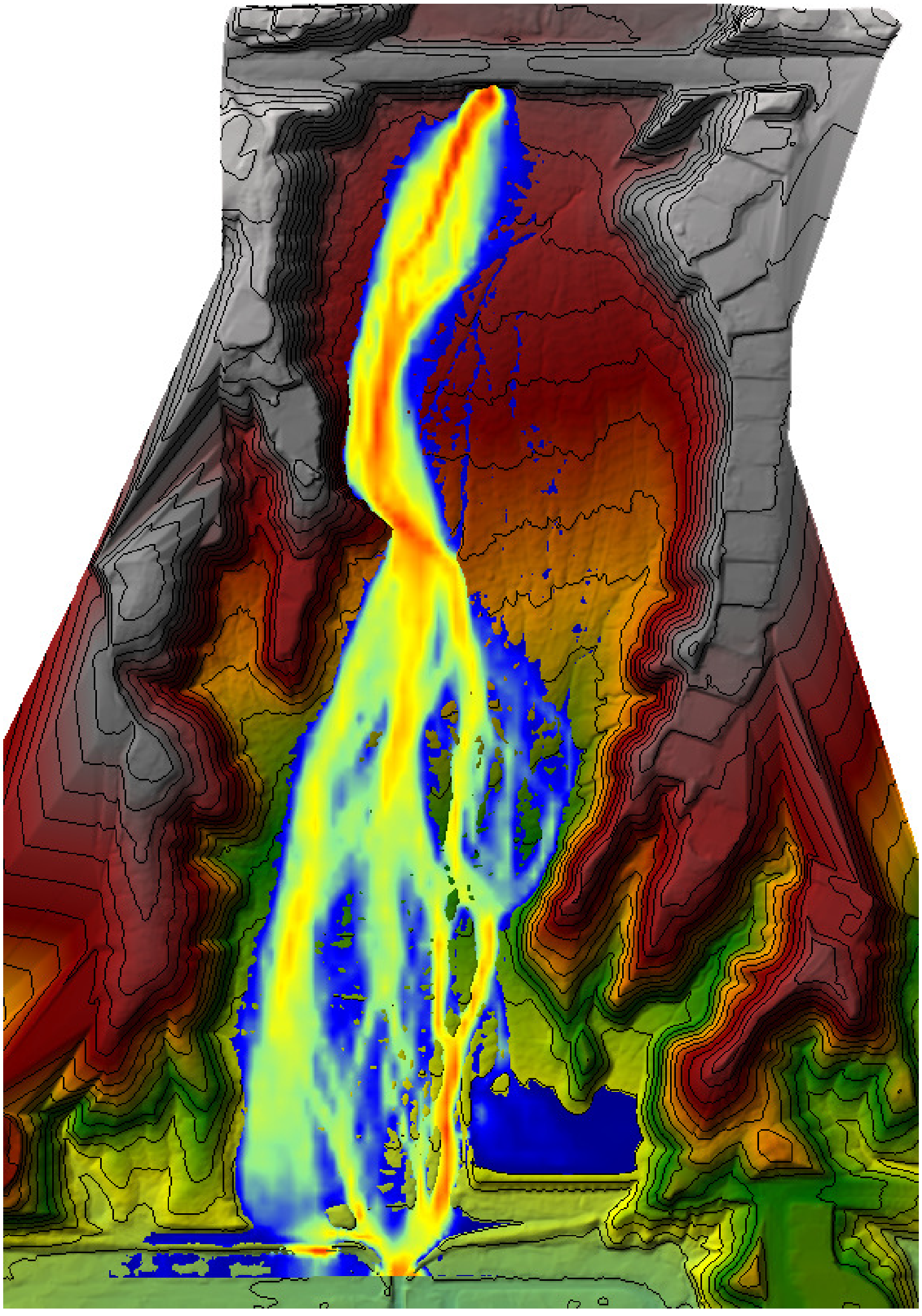
Floodplain Depth Exhibit

Floodplain – Depth

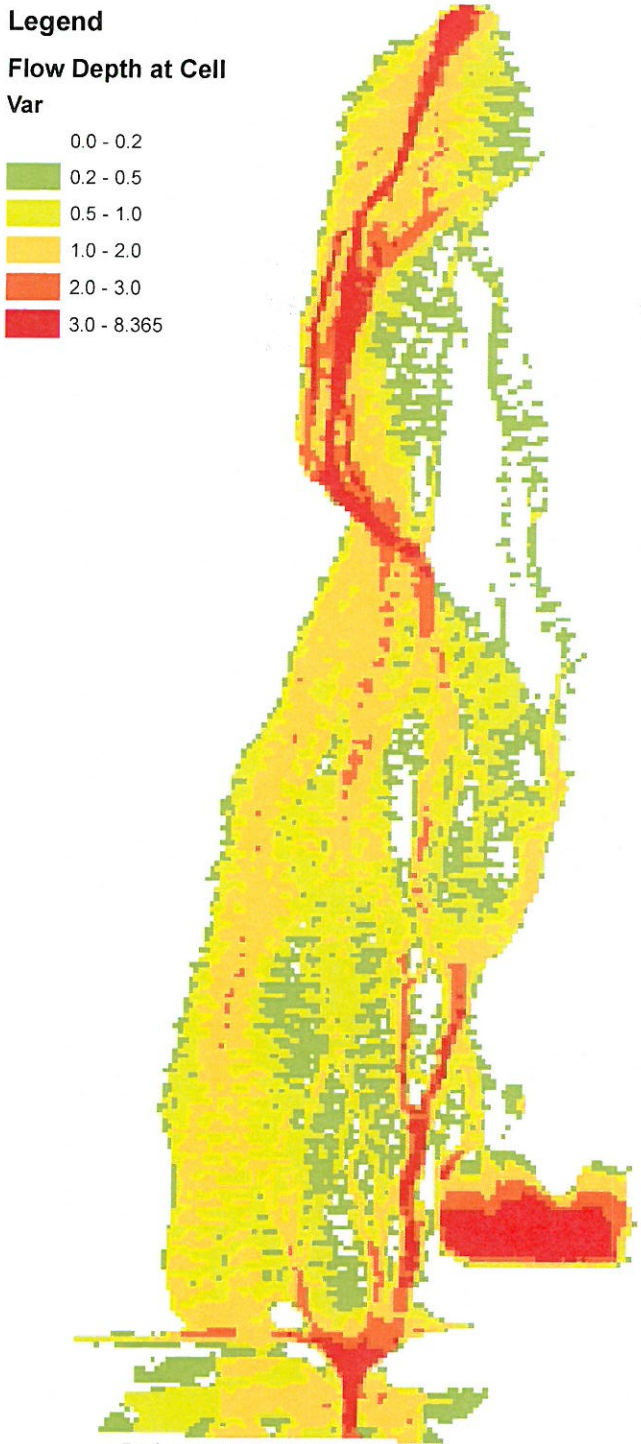


Floodplain Velocity Exhibit

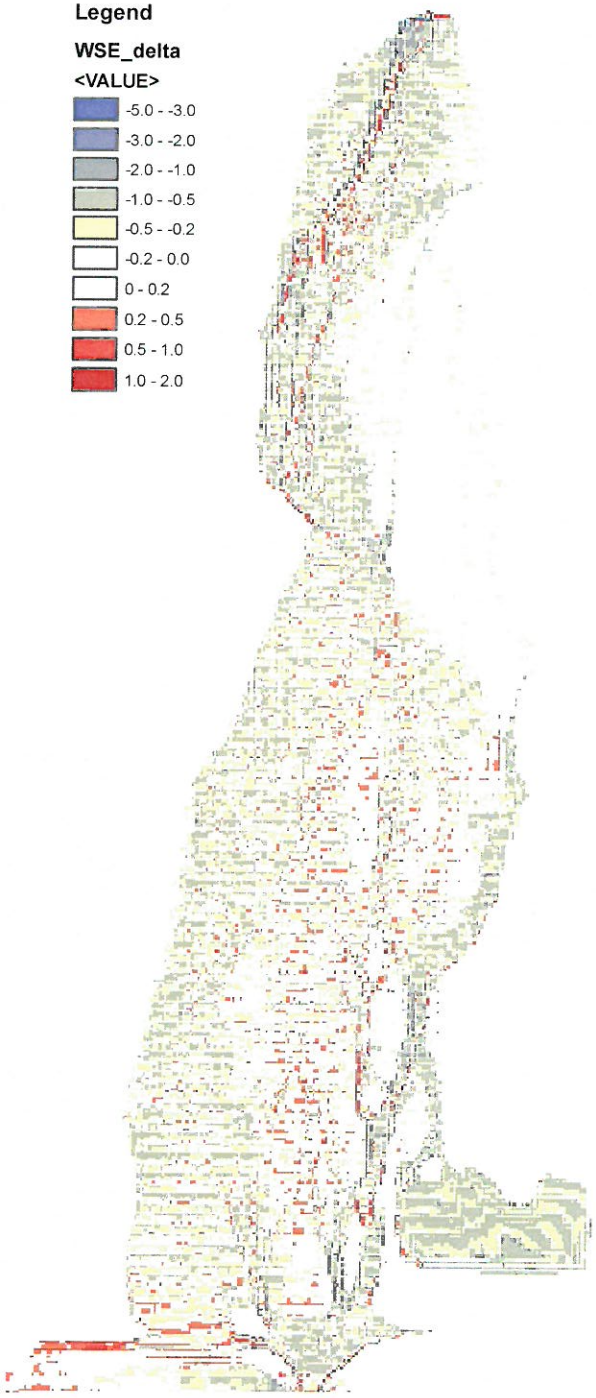
Velocity



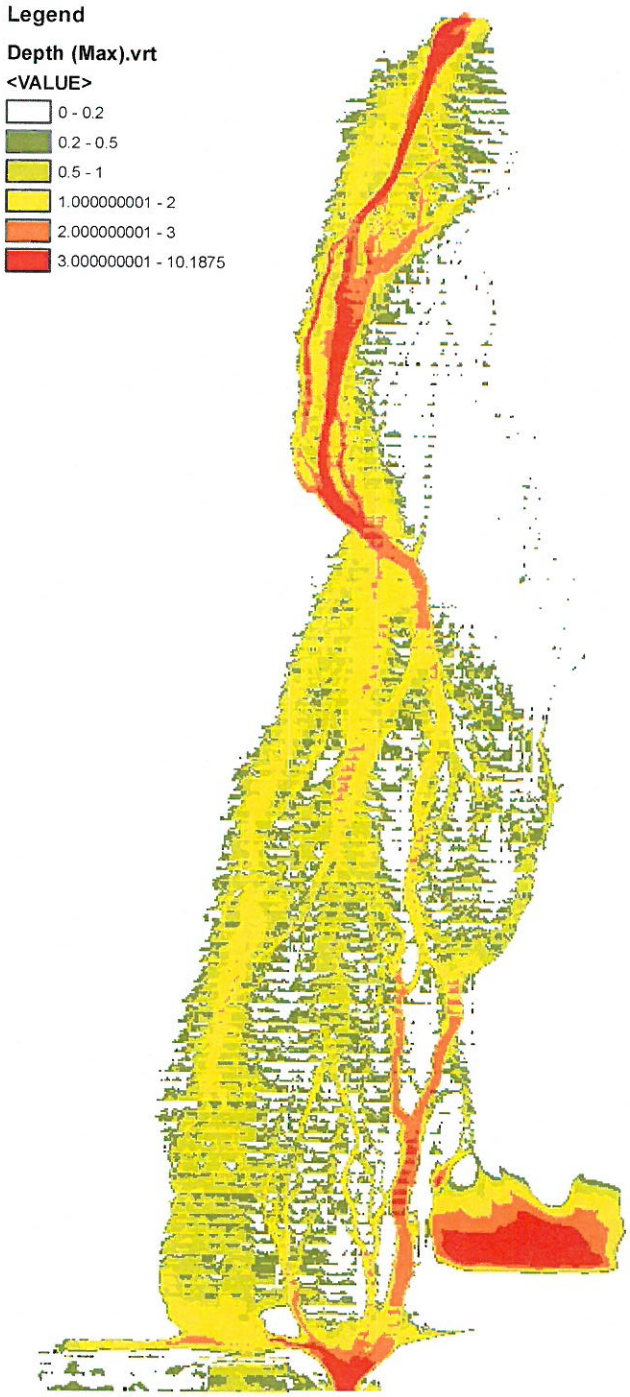
Floodplain Depth Comparison Exhibit
HEC-RAS 5.0 Beta vs. Flo-2D



FLO-2D (by J.Prietto, RFCD)

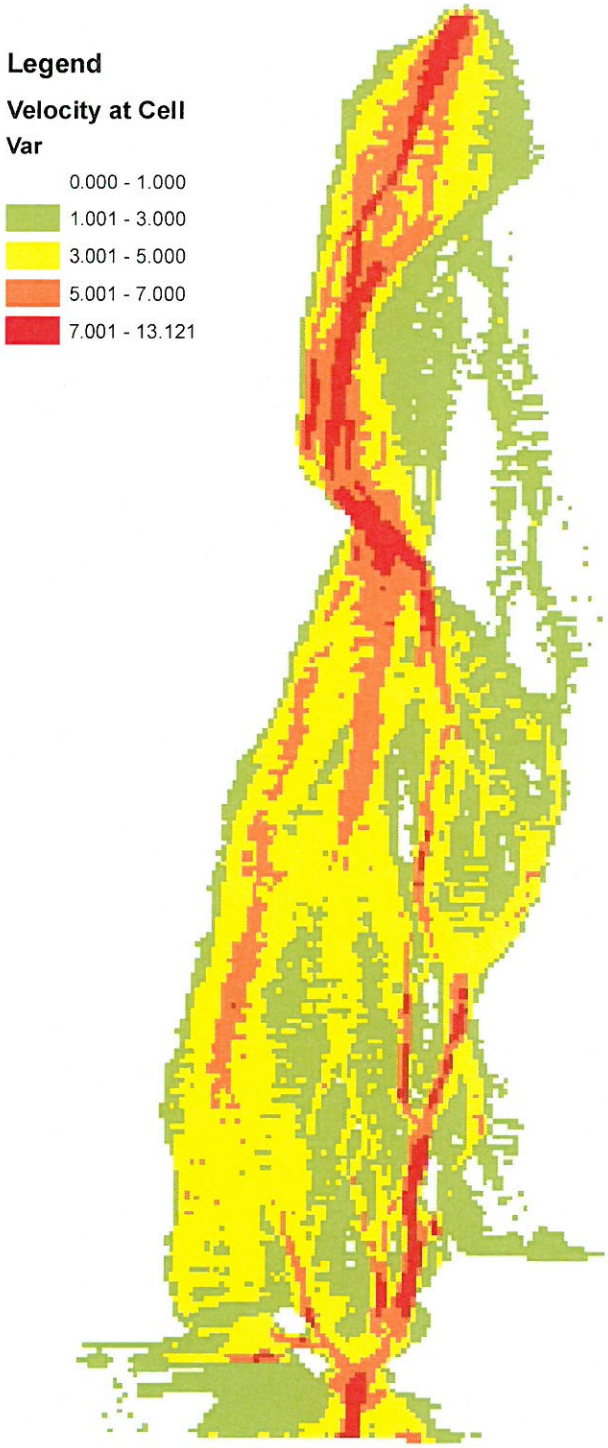


delta Flow Depth (RAS 5.0 minus FLO-2D)

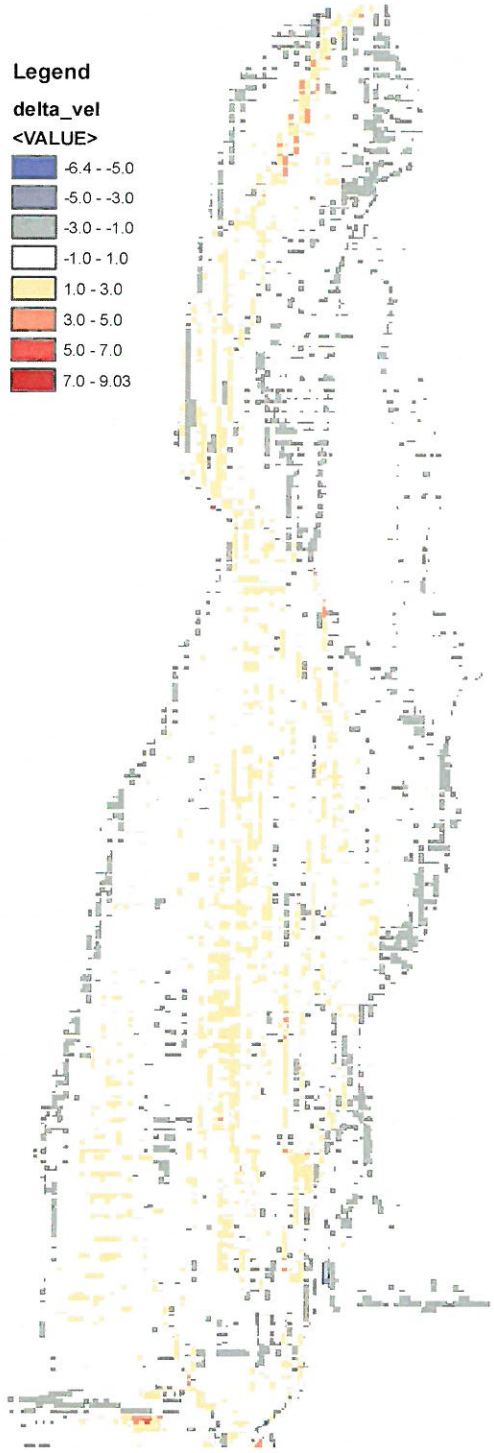


HEC-RAS 5.0 (by C. Langham, WLB Group)
Submittal #2 (09/25/2015)

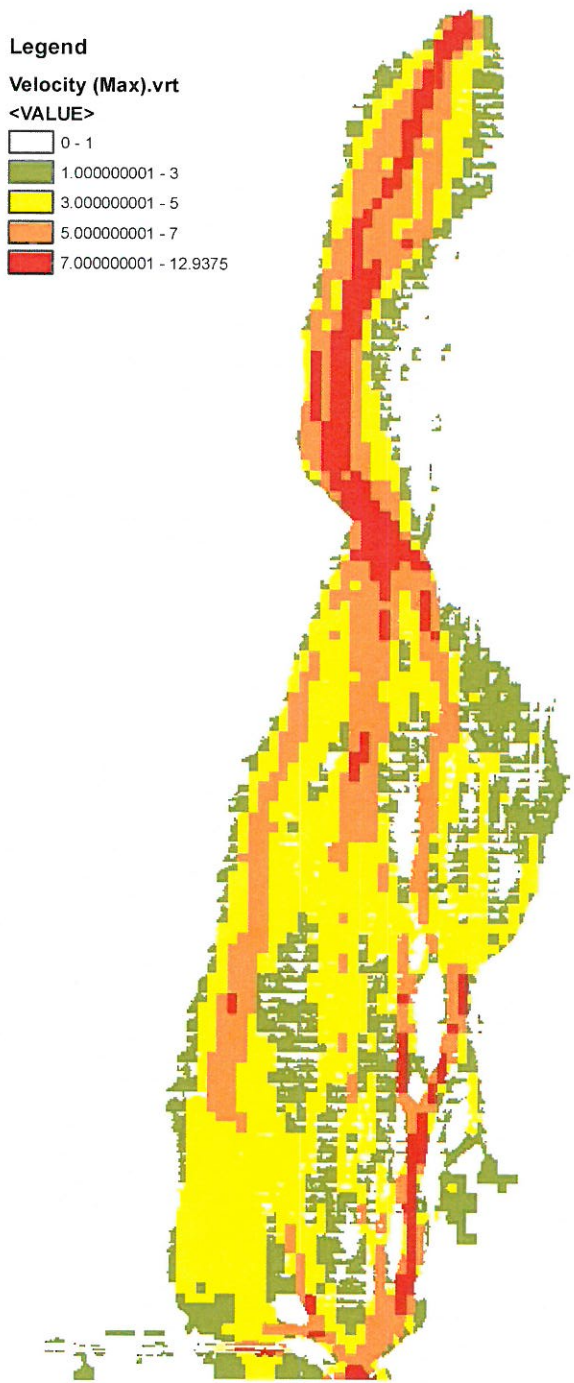
Floodplain Velocity Comparison Exhibit
HEC-RAS 5.0 Beta vs. Flo-2D



FLO-2D (by J.Prietto, RFCD)

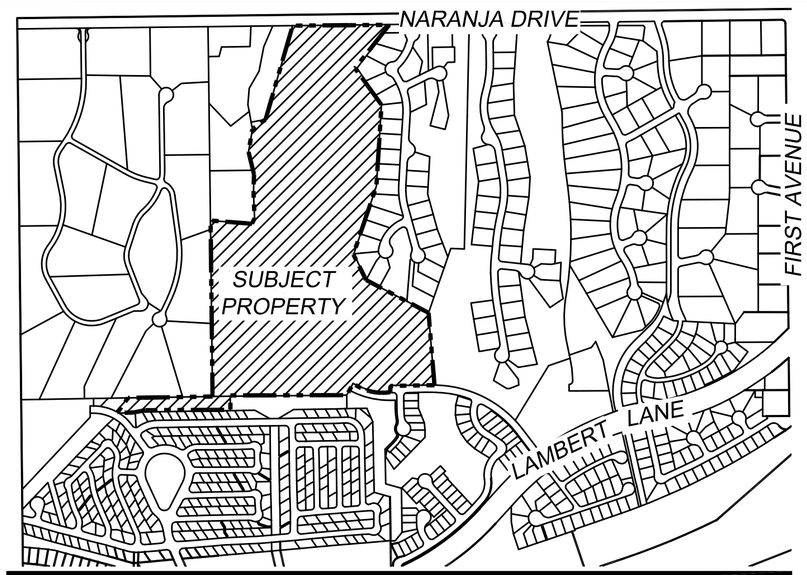


delta velocity (RAS 5.0 minus FLO-2D)



HEC-RAS 5.0 (by C. Langham, WLB Group)
Submittal #2 (09/25/2015)

Conceptual Site Plan



LOCATION MAP

N.T.S.

SITE PLAN INFORMATION

1. TOTAL SITE AREA: 58.0± ACRES
2. TOTAL NUMBER OF LOTS: 53
3. LOT SIZES:
   - LOTS 1-20: 55' X 115' TYP.
   - LOTS 21-47: 50'-55' X 125' TYP.
   - LOTS 48-53: IRREGULARY SIZED
4. TOTAL LINEAR FOOTAGE OF LOCAL STREETS: 3,270± L.F.

PAD OPEN SPACE (28± Acres)

NARANJA DRIVE

HIGHLANDS WASH

AREA OF PAD OPEN SPACE PROPOSED FOR DEVELOPMENT: 4.3± Ac.

N PUSCH RIDGE VISTAS DR.

PUSCH RIDGE VISTAS

PROPERTY BOUNDARY

TOWN OF ORO VALLEY RIPARIAN AREA

NARANJA RIDGE ESTATES

OPEN SPACE

AREA TO BE DESIGNATED AS OPEN SPACE: 5.7± Ac.

EXISTING SEWER LINE

TYPICAL PAD 100' x 100'

HIGHLANDS WASH

EXISTING BASIN TO REMAIN

N SHORE CLIFF DR

N CHAPIN CT

RIVERS EDGE II

HIGHLANDS MOBILE HOME ESTATES

The WLB Group Inc.
WLB
TUCSON - PHOENIX - LAS VEGAS - FLAGSTAFF
520.881.7480 - tucson@wlbgroup.com

NARANJA TRAILS
CONCEPTUAL SITE PLAN

2015.12.29
Contour Interval =1 Ft.
WLB No. 113032-A-001

0' 100' 200' 300'

APPENDIX E

SOIL PERCOLATION TEST RESULTS

Pattison Engineering LLC

May 3, 2022
Project No. 20-098

Meritage Homes Construction, Inc.
5326 N. La Cholla Boulevard
Tucson, AZ 85741

ENGINEERING SERVICES
Naranja Trails, Lots 1-43 Infiltration Tests
Naranja Drive
Oro Valley, Arizona

Pattison Engineering prepared a geotechnical engineering evaluation report for this project (Pattison Engineering Project No. 20-098, dated July 24, 2020). We are now providing infiltration test results for the two proposed basins that will be located within the development.

The tests were performed in 12-inch-diameter, single-ring infiltrometers with about 1 foot of head, until stabilized rates were obtained. The test results are provided in the following table.

INFILTRATION RESULTS			
Test No.	**Soil Classification**	**Depth, ft**	**Approximate Stabilized Rate of Infiltration, min./in.**
1	Sand with silt	5	4
2	Sand with silt	7	4
3	Sand with silt	7	3

The rates measured at the time of infiltration testing are based on soil conditions at the depth and locations indicated. The actual rates of constructed detention/retention basins may vary significantly because of the following factors: location and depth of basin compared to the infiltration tests conducted at the time of field exploration; type of cover in detention/retention basin bottom (grass, rock, etc.); degree of compaction of the detention/retention basin bottom; placement of fill in the detention/retention basin; and the amount and type of sediment deposited in the basin during storm events. The results do not include any factors of safety or de-rating factors.

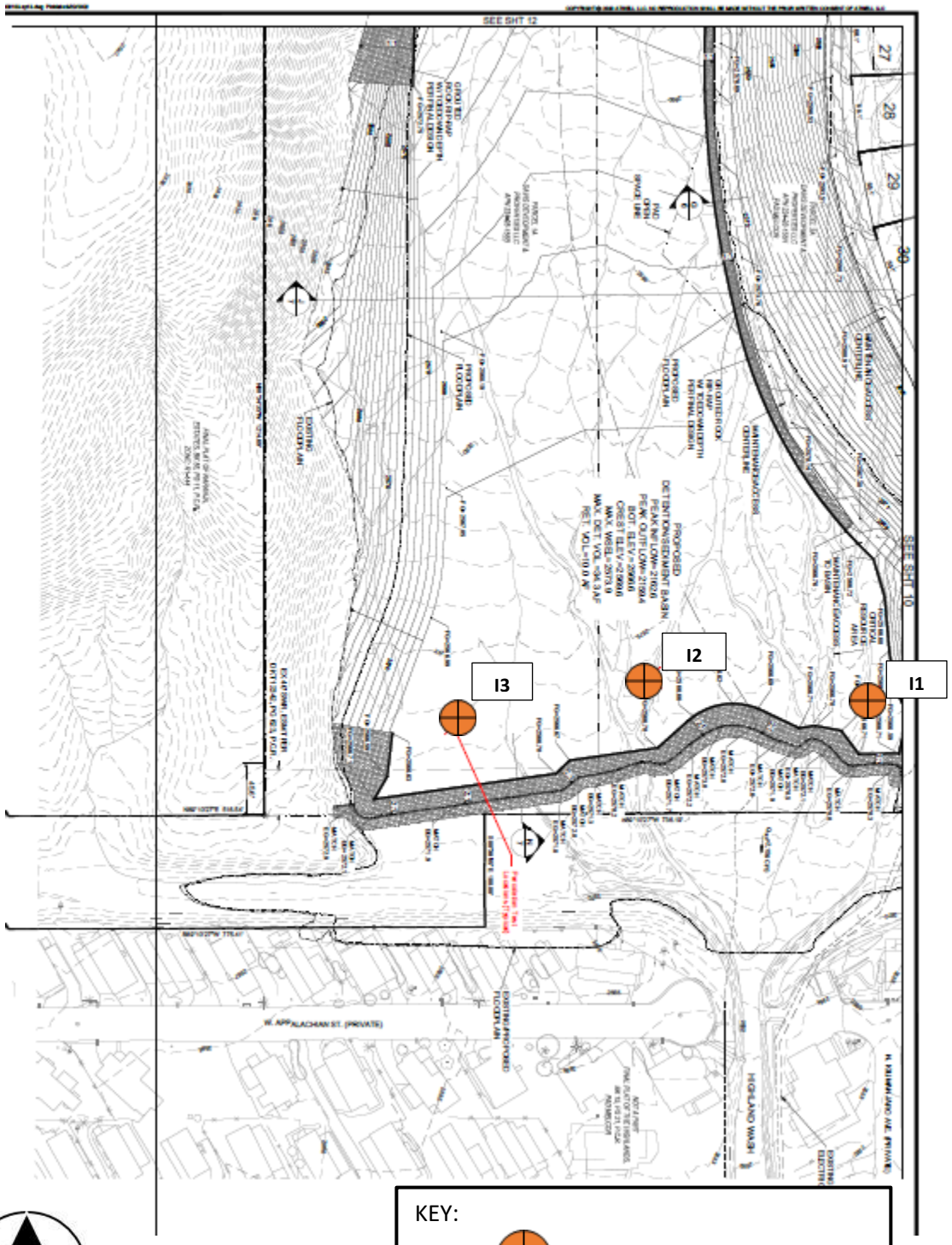
Thank you for selecting PATTISON ENGINEERING, L.L.C. We look forward to being a member of your team on the remainder of this project. If you have any questions about this letter, or require additional consultation, please call us.

Sincerely,
PATTISON ENGINEERING, L.L.C.
Geotechnical, Construction Inspection, and Materials Testing Services

Francisco J. Jacinto, P.E.
Managing Principal

Copies: Addressee (1) email

Site and Exploration Location Plan



APPENDIX F

MAITENANCE & INSPECTION MATRIX

INSPECTION CHECKLIST: PIPE SYSTEMS				
Contractor: Inspector: Date of Inspection: Conveyance Type: Conveyance Material: Structure ID:				
CRITERTIA	CONDITION CHECK	CHECK	MAINTEINANCE TASK	COMPLETED INITIAL, DATE (m/d/y)
BLOCKAGE	0%			
	1-25%			
	26-50%			
	51-75%			
	76-100%			
	UNKNOWN			
CORRECTIVE ACTION	NO ACTION			
	CLEAN PIPE OF DEBRIS/SEDIMENT			
	REMOVE AND REPLACE PIPE			
	REPAIR STRUCTURAL DEFECTS			
	RE-GRADE DITCH			
	REMOVE SEDMINET/TRASH/DEBRIS FROM DITCH			
	REINFORCE			
	INSTALL			
EROSION TYPE	NONE			
	SYPHON HOLES			
	SETTLING			
	EXPOSED PIPE			
	SCOURING/UNDERMINING			
	CREEP			
	OTHER			
CONDITION	NEW			
	GOOD			
	FAIR			
	POOR			
	INOPERABLE			
	UNKNOWN			
CONVEYANCE DEFECT	NO VISIBLE DEFECT			
	JOINT SEPARATION			
	PIPE COLLAPSE			
	PIPE CORROSION			
	ROOT INTRUSION			
	LACK OF STABILIZATION			
	LINER DAMAGE			
	SURCHARGED FLOW			
	BENT/CHIPPED			
	CRACKS			
	MODERATE EROSION			
	SEVERE EROSION			
	LEAKING			
	UNKNOWN			
NOTES:				

INSPECTION CHECKLIST: DITCHES & SWALES				
Contractor: Inspector: Date of Inspection: Conveyance Type: Conveyance Material: Conveyance ID:				
CRITERTIA	CONDITION CHECK	CHECK	MAINTEINANCE TASK	COMPLETED INITIAL, DATE (m/d/y)
BLOCKAGE	0%			
	1-25%			
	26-50%			
	51-75%			
	76-100%			
	UNKNOWN			
CORRECTIVE ACTION	NO ACTION			
	CLEAN PIPE OF DEBRIS/SEDIMENT			
	REMOVE AND REPLACE PIPE			
	REPAIR STRUCTURAL DEFECTS			
	RE-GRADE DITCH			
	REMOVE SEDMINET/TRASH/DEBRIS FROM DITCH			
	DIG-OUT DEPOSITS AROUND END SECTIONS/HWS			
	RE-INFORCE			
	INSTALL			
	UNKNOWN			
EROSION TYPE	NONE			
	SYPHON HOLES			
	SETTLING			
	EXPOSED PIPE			
	SCOURING/UNDERMINING			
	CREEP			
	OTHER			
CONDITION	NEW			
	GOOD			
	FAIR			
	POOR			
	INOPERABLE			
	UNKNOWN			
CONVEYANCE DEFECT	NO VISIBLE DEFECT			
	JOINT SEPARATION			
	PIPE COLLAPSE			
	PIPE CORROSION			
	ROOT INTRUSION			
	LACK OF STABILIZATION			
	LINER DAMAGE			
	SURCHARGED FLOW			
	BENT/CHIPPED			
	CRACKS			
	MODERATE EROSION			
	SEVERE EROSION			
	LEAKING			
	UNKNOWN			
NOTES:				

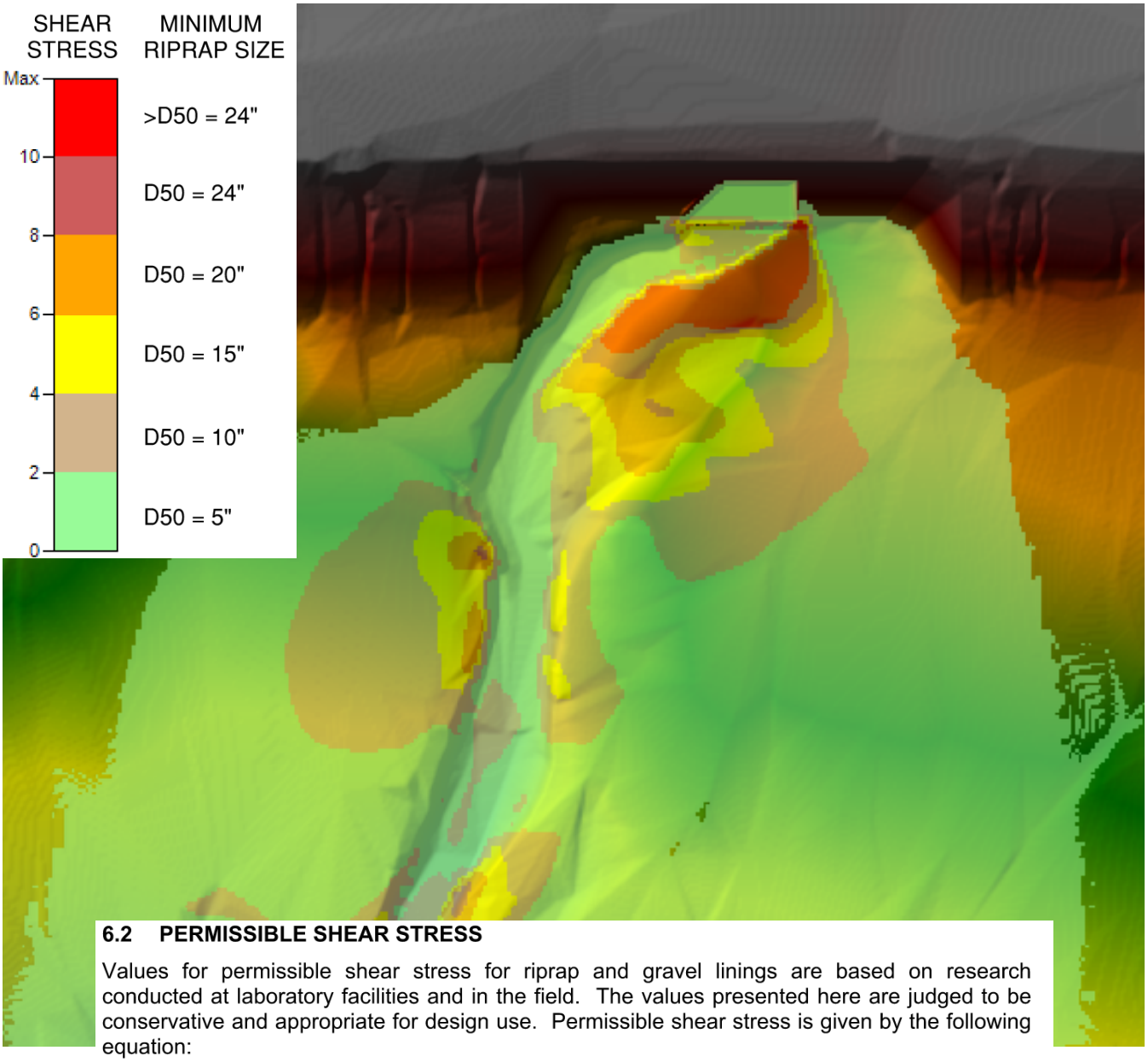
INSPECTION CHECKLIST: MANHOLES, CATCH BASINS, INLETS/OUTLETS, JUNCTION BOXES				
Contractor:				
Inspector:				
Date of Inspection:				
Structure Type:				
Structure Shape:				
Structure Material:				
Structure ID:				
CRITERTIA	CONDITION CHECK	CHECK	MAINTEINANCE TASK	COMPLETED INITIAL, DATE (m/d/y)
BLOCKAGE	0%			
	1-25%			
	26-50%			
	51-75%			
	76-100%			
	UNKNOWN			
CORRECTIVE ACTION	NO ACTION			
	REINFORCE/PLACE RIPRAP			
	REPAIR STRUCTURAL DAMAGE			
	DREMOVE DEBRIS			
	REPLACE			
	REMOVE OVERGROWN VEGETATION			
	UNKNOWN			
EROSION TYPE	NONE			
	SYPHON HOLES			
	SETTLING			
	EXPOSED PIPE			
	SCOURING/UNDERMINING			
	CREEP			
	NO INDICATION			
	OTHER			
CONDITION	NEW			
	GOOD			
	FAIR			
	POOR			
	INOPERABLE			
	UNKNOWN			
STRUCTURAL DEFECT	NO VISIBLE DEFECT			
	STRUCTURAL DAMANGE			
	CRACKS/JOINT SEPARATION			
	TOP/COVER BROKEN OR MISSING			
	LEAKING			
	ROOT INTRUSION			
	MODERATE EROSION			
	SEVERE EROSION			
	CORROSION			
	UNKNOWN			
NOTES:				

INSPECTION CHECKLIST: DETENTION BASIN					
Contractor:					
Inspector:					
Date of Inspection:					
Structure ID:					
Description of Location:					
General Dimensions:					
Stormwater within: ROW					
Easement					
TOV Facility					
Discharges to:					
Structure/Access Protection present:					
Additional Components:					
CRITERTIA	CONDITION CHECK	CHECL	*CONDITION	MAINTEINANCE TASK	COMPLETED INITIAL, DATE (m/d/y)
INLET DRAINAGE SYSTEM	TRASH, DEBRIS, AND/OR SEDIMENT PRESENT?				
	SIGNS OF EROSION?				
	DAMAGED OR PLUGGED INLET PIPES?				
OUTLET DRAINAGE SYSTEM	TRASH, DEBRIS, AND/OR SEDIMENT PRESENT?				
	SIGNS OF EROSION?				
	DAMAGED OR PLUGGED INLET PIPES?				
EROSION TYPE	NONE				
	SYPHON HOLES				
	SETTLING				
	EXPOSED PIPE				
	SCOURING/UNDERMINING				
	CREEP				
	NO INDICATION				
	OTHER				
LOW FLOW CHANNEL (IF PRESENT)	SEDIMENT ACCUMULATION GREATER THAN 3"?				
	EVIDENCE OF EROSION?				
	OVERGROWN VEGETATION PRESENT?				
BASIN	TRASH OR DEBRI PRESENT?				
	EVIDENCE OF EROSION?				
	UNDERISREABLE VGETATION THREATENING THE FUNCTION OR INTEGRITY OF BASIN?				
	SEDIMENT ACCUMULATION GREATER THAN 3"?				
EMBANKMENT AND/OR EMERGENCY SPILLWAY	SHRUBS OR TREES PRESENT				
	EVIDENCE OF EROSION?				
	EVIDENCE OF SEEPAGE ON DOWNSTREAM FACE?				
	EVIDENCE OF ANIMAL ACTIVITY?				
	EVIDENCE OF SETTLING,SCOURING, CRACHING, OR SLOUGHING?				
	TRASH,DEBRIS, OR UNDESIRABLE VEGETATION PRESENT?				
	IS CONCRETE OR RIPRAP DAMAGED?				
OUTLET CONTROL STRUCTURE	IS STANDING WATER ABOVE OUTLET/ORIFICE MORE THAN 5 DAYS AFTER STORM EVENT?				
	TRASH, DEBRIS, DAMANGE, OR CORROSION ON TRASH RACK?				
	ARE ALL MOVEABLE COMPONENTS OPERABLE THROUGH THEIR FULL RANGE OF MOTION?				
NOTES:					

*Performance Condition Criteria: Good (G), Fair (F), Poor (P), Not Applicable (N/A)


ATWELL

HEC-RAS RESULTS
SHEAR STRESS MAP
EXISTING CONDITIONS



6.2 PERMISSIBLE SHEAR STRESS

Values for permissible shear stress for riprap and gravel linings are based on research conducted at laboratory facilities and in the field. The values presented here are judged to be conservative and appropriate for design use. Permissible shear stress is given by the following equation:

$$\tau_p = F_*(\gamma_s - \gamma) D_{50} \qquad (6.7)$$

where,

τ_p = permissible shear stress, N/m^2 (lb/ft^2)
F_* = Shield's parameter, dimensionless
γ_s = specific weight of the stone, N/m^3 (lb/ft^3)
γ = specific weight of the water, 9810 N/m^3 (62.4 lb/ft^3)
D_{50} = mean riprap size, m (ft)

Typically, a specific weight of stone of 25,900 N/m^3 (165 lb/ft^3) is used, but if the available stone is different from this value, the site-specific value should be used.