DRAINAGE REPORT

EXTRA SPACE – ORO VALLEY

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1 INTRODUCTION

1.1 PROJECT DESCRIPTION

The drainage report consists of the hydrologic and hydraulic documentation for the on-site analysis of the proposed expansion of the Extra Space located at 8710 N Oracle Rd, Tucson, Arizona. The expansion property is currently a vacant lot. The site is bounded by Oracle Road to the west and Hardy Road to the north. There are currently private residential developments to the east, a multi-family residential property to the northeast, and two commercial developments to the northwest and south of the property.

The overall area of the property is approximately 4.7 acres and predominantly pervious. The proposed improvements of the site includes one storage facility building, recreational vehicle spaces, and a roadway connecting the new site to the existing site.

1.2 LOCATION

The site is located in northeast quarter of Section 25, Township 12 South, Range 13 East, G&SRM, Tucson, Arizona. The property is identified with the Accessor Parcel Numbers 125-14-166D and 225-14-166E and is located near the southeast corner of Oracle Road and Hardy Road. The project is located approximately at 32º21’55” Latitude and -110º58’06” Longitude. Refer to Figure 1 of the project location map.

1.3 HYDROLOGY

The Town of Oro Valley computation procedure, as presented in Chapter 3 of the Town of Oro Valley Drainage Criteria Manual (“Manual”), was used to compute the 100-, 10-, and 2-year discharges for the property. The Hydrologic Data Sheet provided in Chapter 3 of the Manual was used in the analysis and the determination for each watershed is described in this report. Specific watershed parameters were estimated per the Town of Oro Valley Hydrologic Procedures and based on the local topography (2015 Lidar per Pima County GIS and ALTA survey), recent aerial photography and field verification.

Hydrologic soil groups (HSG) for the existing and proposed condition watershed areas were determined from the Pima County MapGuide Map, which is a GIS system that includes various digital mapping layers for Pima County, Arizona. Soil information for this report is based on the NRCS (Natural Resources Conservation Services) line work within Pima County MapGuide Map, effective October 1, 2016.

The computations from the spreadsheets are similar to the Rational Method where it is assumed that rainfall is uniformly distributed over the watershed, uniform rainfall intensity occurs with a duration of at least the time of concentration, the peak runoff is proportional to the rainfall intensity, and the rainfall depth averaged over the time period is equal to the time of concentration, the return period of the runoff event is the same as the return period of the precipitation event.

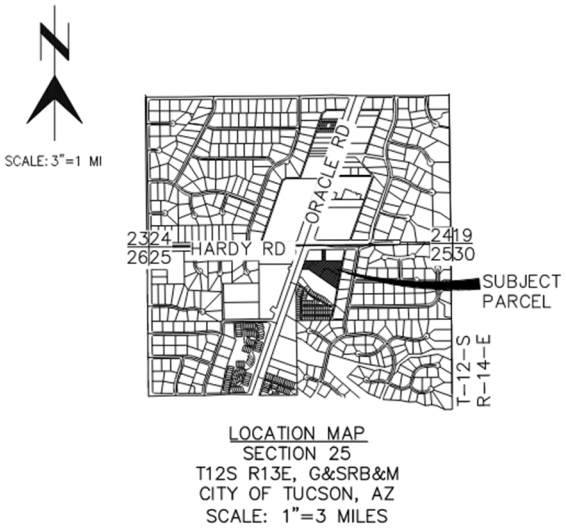


Figure 1 – Vicinity and Location Map.

2 EXISTING CONDITIONS

2.1 OVERVIEW

The property is currently an undeveloped vacant lot that is bounded by development on every side. The property experiences sheet flow conditions throughout the site that convey stormwater to the west and south of the property. The runoff that conveys to the south enters the existing private 38' drainage easement located on the property. It is conveyed towards the southwest corner of the property which and is discharged into the existing basin and 2-24" storm pipes located at the Oracle Road right-of-way. The detention basin outlets to the southern Oracle Road right-of-way and off of the site. Onsite soils are comprised of Palo Verdes and Sahuarita Complex soils, 2 to 9 percent slopes, and are classified as 50% HSG C and 50% HSG D.

2.2 FEMA FIRM

The site is within FEMA FIRM Panel 04019C1680L, effective June 2011. Refer to **Appendix A** for the FEMA FIRMette with the approximate project boundary shown. The site is found in an unshaded Zone X which is defined by FEMA as an area that is outside of the 0.2% Annual Chance Flood Hazard.

2.3 EXISTING OFFSITE HYDROLOGY

Offsite runoff contributing to the project site is primarily generated from single-family residential neighborhoods located to the east. Based on current land use patterns, no significant changes are anticipated in these areas, and consequently, the contributing offsite drainage is expected to remain consistent in the future.

Offsite runoff generally flows from east to west, entering the site through a combination of sheet flow and natural channels. Upon reaching the site, runoff becomes concentrated within an existing constructed channel located along the southern boundary. This channel directs flow westward and off the site, where it then concentrates into an 8-foot by 5-foot reinforced concrete box culvert (RCBC), which conveys flow under Oracle Road.

A locally mapped regulatory floodplain is present on site and a floodplain study was conducted to analyze potential impacts to the existing floodplain. See the section titled "Floodplain Study" for more detail. Additionally, historical imagery from Pima Maps indicates minimal geomorphological change in the natural onsite channels, with offsite sheet flow consistently concentrating at the same locations over time.

The Oro Valley Category 1 Flood Hydrology Procedure (C1FHP) was utilized as the primary hydrologic method for analyzing offsite flows. This procedure was chosen for its applicability to the local conditions and regulatory compliance.

Local precipitation data was sourced from NOAA Atlas 14, Volume 1, Version 5, which provided the 100-year (1% Annual Exceedance Probability) 1-hour rainfall depth at the upper 90% confidence interval. This data ensures the hydrologic analysis reflects extreme storm events with appropriate margins of safety.

Existing hydrologic soil data was obtained primarily from the NRCS Web Soil Survey, supplemented with data from Pima Maps where NRCS information was unavailable. This data was used to establish hydrologic soil properties of the contributing watersheds. Input parameters and peak flows for the hydrologic analysis are summarized in Table 1 below:

Table 1: Offsite Hydrologic Analysis Summary

Watershed	Area (ac)	Land Use Category	Basin Factor	1% AEP 1-Hour Rainfall Depth (in.)	Weighted Runoff Coefficient ($C_{w1\%AEP}$)	1% AEP Peak Flow (cfs)
OFF-1	0.18	Suburban	0.075	2.86	0.889	2
OFF-2	1.33	Suburban	0.045	2.86	0.748	10
OFF-3	6.94	Suburban	0.045	2.86	0.756	49
OFF-4	0.73	Suburban	0.075	2.86	0.819	6
OFF-5	3.43	Suburban	0.045	2.86	0.776	26
OFF-6	13.62	Suburban	0.045	2.86	0.705	80
OFF-7	0.46	Suburban	0.075	2.86	0.763	3
OFF-8	1.88	Suburban	0.075	2.86	0.763	13
OFF-9	130.75	Natural/Rural	0.075	2.86	0.678	496
OFF-10	8.26	Suburban	0.05	2.86	0.721	59

This offsite hydrologic analysis was compared to a previous study performed by Atwell on the same project. The average unit discharges of the offsite watersheds are listed in Table 2 below:

Table 2: Hydrology Comparison

Engineer	Average Unit Discharge (cfs)
Kimley-Horn	7.6
Atwell	7.8

Predicted future conditions of upstream offsite land use are expected to remain consistent with current conditions. The contributing watershed was modeled as suburban, characterized by impervious surfaces including roads, roofs, and other paved areas typically associated with single-family residential developments. For a map of the offsite hydrology, see Appendix G – Offsite Hydrology Exhibit.

2.4 EXISTING ONSITE HYDROLOGY

The existing site is currently undeveloped and comprised of desert vegetation. There are natural forming channels within the site, the largest occurring at the south of the property in the private drainage easement. The onsite runoff follows a sheet flow pattern that is sloped from east to west.

The existing site was broken into two (2) watersheds. The first onsite watershed (EON-1) comprises of the area that is conveyed to the southwest and converges with the existing development (watershed EON-3). The second onsite watershed (EON-2) is the remainder of the onsite flow that conveys to the west directly into the Oracle Road right-of-way following the grade of the road. All contour information was provided via survey and supplemented with Pima County 2015 LiDAR data.

In addition, there is an existing development located south of the proposed site, where there is an existing office building, paved roadways, and storage units. This was broken down to one watershed (EON-3) where its flow converges west to an existing basin. During heavy storm events, the flow then outlets to the Oracle Road right-of-way following the grade of the road.

Each watershed was analyzed with the Town of Oro Valley Hydrologic Data Sheets, which are provided in Appendix B of this report. Utilizing the tables 3-2 through 3-5 provided in Chapter 3 of the manual, the following factors are used in each watershed analysis. The rainfall depth for the 100-year storm event for one hour was determined using the NOAA Atlas 14. The rainfall depth used was 2.86 inches.

Two onsite watersheds (EON-1 and EON-2) were determined to have the “Natural/Rural” watershed classification due to the area having 5% impervious cover. The third watershed (EON-3) was determined to be “Commercial” because the site has approximately 95% impervious cover. For all watersheds, the runoff follows sheet flow conditions with no channels occurring within the watershed. This condition is designated as dispersed flow per Table 3-3 and results in the 100-yr basin factor “n” as 0.05 for “Natural/Rural” and “Commercial.” The weighted coefficient “Cw” was calculated using

the values provided in Table 3-4 using 50% Soil C and 50% Soil D along with the impervious cover, the factors used were 0.60, 0.68, and 0.96 respectively. The weighted runoff coefficient was determined to be 0.65 (EON-1),0.61 (EON-2), and 0.94 (EON-3). The contributing area factors for the site were determined by Table 3-2 of the manual, the "Natural/Rural" watershed has a factor of 1.0 and 0.90 for "Commercial" all which were applied. The final values used in the calculation are provided in Table 3-5, which provides the weighted ratios for the 2- and 10-year storm event. Refer to Tables 3 and 4 for the summary of the results of the existing hydrology and Figure A-1 in Appendix A for information of the existing onsite conditions.

Table 3: Onsite 100-year Hydrology Results

Figure #	Drainage Area ID	Watershed Area (acres)	C_W	Tc (min)	i (in/hr)	Area Factor	Q_{100} (CFS)
A.1	EON-1	3.4	0.65	5	10.9	1.0	**24**
A.1	EON-2	1.3	0.65	5	10.9	1.0	**9**
A.1	EON-3	4.4	0.94	6	8.88	0.9	**33**

Table 4: Existing Onsite Hydrology Results

Figure #	Drainage Area ID	Watershed Area (acres)	T_c(2) (min)	Q_2 (CFS)	T_c(10) (min)	Q_{10} (CFS)	T_c(100) (min)	Q_{100} (CFS)
A.1	EON-1	3.38	13.0	2.0	8.0	9.0	**5.0**	**24.0**
A.1	EON-2	1.3	13.0	1.0	8.0	3.0	**5.0**	**9.0**
A.1	EON-3	4.4	13.0	5.0	8.0	14.0	**6.0**	**33.0**

2.5 EXISTING CONDITIONS SUMMARY

The site currently an undeveloped natural lot, which results in mostly pervious cover and an existing commercial site south of the proposed site which is mainly impervious. The site is in FEMA Zone "X". The onsite topography conveys all on-site runoff to the south and west, all flow generally conveys offsite where it discharges into the right-of-way for Oracle Road to the southwest.

3 PROPOSED CONDITIONS

3.1 IMPROVEMENT SUMMARY

The proposed development of the site includes a new storage building, additional recreational vehicle spaces, and roadway connecting the existing site to the proposed site. There will be landscaped areas, water harvesting areas, and a detention/retention basin. In addition, there will be a re-design for the existing onsite basin for the existing development runoff. The proposed development will increase the overall impervious cover onsite and will follow the commercial usage onsite.

To abandon the existing 38' drainage easement, a new conveyance system is proposed for the offsite runoff. Most of the offsite flow will be intercepted by catch basins located at the site's eastern boundary. This flow will be conveyed through the site via a proposed storm drain system along the southern portion of the site. The storm drain will direct flow to an existing roadside ditch to the east of the site along Oracle Road for final discharge.

In addition, two driveway culverts will be installed beneath the proposed connection to Hardy Road. These culverts will convey offsite flow at two specific locations through the site, ultimately discharging into the same roadside ditch along Oracle Road.

3.2 PROPOSED OFFSITE HYDRAULICS

The hydraulic design for offsite conveyance was modeled using StormCAD for all closed conduit storm drains and culverts, and FlowMaster for open channels. These software tools provided accurate simulations of flow capacity and hydraulic performance.

All storm drains and culverts were sized in accordance with the Oro Valley Drainage Criteria Manual. Specifically, storm drains were designed to ensure the hydraulic grade line (HGL) remains below the ground surface throughout the entire length of the pipe network until discharge, preventing potential surface flooding.

The StormCAD model accounts for both friction losses and bend losses to accurately represent the total head loss within the storm drain system. This ensures reliable hydraulic performance under design storm conditions.

Inlet structures were sized following the guidelines outlined in the City of Tucson's Standards Manual for Drainage Design and Floodplain Management to ensure efficient capture and conveyance of stormwater into the drainage system. HGL and EGL calculation results are shown in Appendix E – HGL and EGL Analysis. Summary tables for design of offsite conveyance structures are listed below:

Table 5: Offsite Inlet Design Summary

Inlet	Type	Standard Detail No.	Grate Type	Grate Quantity	Inflow (cfs)	Clogging Factor	Max. Ponding Depth (ft)
CB-1	PAG Type 4 (Area Inlet)	309	EF-1	2	32	1.5	0.95
CB-2	PAG Type 4 (Area Inlet)	309	EF-1	6	83	1.5	0.96
CB-3	PAG Type 4 (Area Inlet)	309	EF-1	1	13	1.5	0.72

Table 6: Culvert Design Summary							
Culvert	**Type**	**Barrels**	**Diameter (in)**	**Length (ft)**	**Design Flow (cfs)**	**Headwater Depth (ft)**	**Outlet Velocity (ft/s)**
SD-1	RCP	1	24.0	84	10	0.78	8.88
SD-2	RCP	1	30.0	63	49	1.94	11.98

Table 7: Storm Drain Design Summary							
Pipe	**Type**	**Barrels**	**Diameter (in)**	**Length (ft)**	**Design Flow (cfs)**	**Headwater Depth (ft)**	**Outlet Velocity (ft/s)**
SD-3	HDPE	1	24.0	73	32	6.47	10.19
SD-4	HDPE	1	36.0	114	32	6.95	4.53
SD-5	HDPE	1	36.0	74	83	5.55	11.74
SD-6	HDPE	1	42.0	88	115	7.22	11.95
SD-7	HDPE	1	24.0	98	13	1.30	14.72
SD-8	HDPE	1	42.0	300	128	5.34	13.3
SD-9	HDPE	1	42.0	56	128	3.99	13.3
SD-10	HDPE	2	36.0	171	128	3.60	9.05

Table 8: Channel Design Summary									
Channel	**Channel Depth (ft)**	**Side Slopes (H:V)**	**Bottom Width (ft)**	**Mannings n**	**Transverse Slopes (ft/ft)**	**Design Flow (cfs)**	**Design Velocity (ft/s)**	**Flow Depth (ft)**	**Freeboard (ft)**
CH-1	2.0	3.0	0.0	0.025	0.05	51	9.74	1.3	0.7
CH-2	2.0	3.0	0.0	0.025	0.02	2	3.07	0.5	1.5
CH-3	2.0	3.0	0.0	0.025	0.02	2	3.07	0.5	1.5
CH-4	2.0	3.0	0.0	0.025	0.05	49	9.64	1.3	0.7
CH-5	2.0	3.0	0.0	0.025	0.03	6	4.71	0.7	1.3
CH-6	2.0	3.0	0.0	0.025	0.02	3	3.40	0.5	1.5
CH-7	4.0	2.0	4.0	0.035	0.02	128.0	6.66	2.3	1.7

2.3.1 FREEBOARD VARIANCE REQUEST

Due to the nature of existing offsite flow patterns, which tend to be mostly braided sheet flow that ponds along the boundary of the project (see Appendix G – Proposed 100-yr Floodplain Limits), the freeboard requirement of the Oro Valley Drainage Criteria is impractical for the proposed channels to comply with. Therefore, a variance is respectfully requested from the freeboard requirement of Equation 4.2 in the Oro Valley Drainage Criteria. In lieu of this requirement, a proposed 0.5-foot minimum freeboard will be provided at all channels along with mitigation of adverse flooding impacts due to the proposed development.

3.3 FLOODPLAIN STUDY

3.3.1 PURPOSE

The purpose of this floodplain analysis is to evaluate potential impacts to the existing local floodplain resulting from the proposed site improvements. This study assesses both existing and proposed conditions to confirm compliance with applicable floodplain management criteria and to mitigate adverse flooding impacts due to the proposed development.

3.3.2 METHODOLOGY

A two-dimensional hydraulic model was developed using HEC-RAS to simulate both existing and proposed floodplain conditions. A watercourse is considered a regulatory floodplain if the peak flow exceeds 100 cubic feet per second (cfs) during the 1% Annual Exceedance Probability (AEP) storm event. Hydrology for the 100-year storm was developed as part of this drainage report and used to generate inflow hydrographs.

Assuming this project complies with pre- vs. post-development peak discharge criteria, all model inflows were held constant between existing and proposed conditions. Terrain modeling for the existing condition utilized Pima Association of Governments (PAG) LiDAR data, while proposed conditions incorporated both PAG LiDAR and the site's finished grade design surface.

Surface roughness (Manning's n) values were assigned using Pima County Land Cover data for the existing condition and a modified version of the data reflecting site improvements for the proposed condition. Hydraulic structures such as existing and proposed culverts were incorporated into the model using field survey data and design documents. Proposed storm drain inlets were represented using rating curves corresponding to their respective design inflows.

3.3.3 MODEL RESULTS COMPARISON

A comparison of model results was performed using results from the Carmack Wash Floodplain Study (2020), completed by Arroyo Engineering, LLC. The main point of reference to be compared was the peak discharge at the model's downstream outlet—an existing 8-foot by 5-foot reinforced concrete box culvert (RCBC) located beneath Oracle Road, just south of Hardy Road.

As shown in Table 9, the modeled peak flows at this location differ by approximately 4% from the referenced study. This relatively small difference in results demonstrates consistency and supports the reliability of the hydraulic model for this study. Additionally, the modeled existing floodplain extents are generally consistent with those shown in the Carmack Wash study.

Table 9: Floodplain Study Flow Comparison	
Engineer	**100-yr Discharge from Point of Reference (cfs)**
Kimley-Horn	364
Arroyo, LLC	351

3.3.4 RESULTS SUMMARY

The floodplain analysis indicates no adverse impacts to the extent of the floodplain as a result of the proposed site improvements. The only observable floodplain impact is a reduction in onsite floodplain area due to the conveyance of a portion of the offsite flow through the proposed storm drain system. Existing and proposed floodplain limits are illustrated in Appendix F and Appendix G, respectively.

3.4 PROPOSED ONSITE HYDROLOGY

The proposed development will consist of a new multistory storage facility with vehicular access, RV storage, water harvesting areas and a detention/retention basin. The site will consolidate into one (1) watershed area (DON-1). The runoff will generally flow away from the buildings via surface flow along the adjacent vehicle use areas to the west of the site. All of the runoff will be conveyed to a low point to the west of the site into the proposed detention/retention basin. Noncontributing water harvesting areas have been placed in the landscaped areas just west of the building and at the southwest corner of the property, east of the access road. These areas will be depressed 6 inches and landscaped with desert plants. The detention/retention basin will outlet on the west end of the basin to match existing conditions. Refer to Figure A-2 in Appendix A for information on the proposed conditions.

Watershed DON-1 was classified to be “Commercial” due to the proposed use of the site, this classification was used to determine the factors required for the hydrologic analysis. The watershed was calculated to have an impervious area of 95%. The onsite runoff follows a sheet flow condition and does not follow a channel on-site, therefore the 100-yr basin factor was determined to be 0.05 per Table 3-3. The weighted runoff coefficient was determined using the values provided in Table 3-4. DON-1 had 50% Soil C and 50% Soil D, therefore the runoff coefficient used was 0.943 for DON-1. The contributing area factor for a commercial area, per Table 3-2, is 0.90. Finally, the ratios used to determine the additional storm events from Table 3-5 were used in this calculation. The values for the commercial watershed type were used for the analysis. Refer to Tables 10 and 11 for a summary of the results.

Table 10: Developed Onsite 100-year Hydrology Results							
Figure #	**Drainage Area ID**	**Watershed Area (acres)**	**Cw**	**Tc (min)**	**i (in/hr)**	**Area Factor**	**Q_{100} (CFS)**
A.2	DON-1	3.69	0.94	5	10.94	0.90	**35**

Table 11: Developed Onsite Hydrology Results								
Figure #	Drainage Area ID	Watershed Area (acres)	T_c(2)	Q_2 (CFS)	T_c(10)	Q_{10} (CFS)	T_c(100)	Q_{100} (CFS)
A.2	DON-1	3.69	11	5	7	14	**5**	**35**

The existing development will remain in the same state for the proposed development. The watershed, EON-1, will remain the same and the runoff will not increase due to the existing commercial development and no increase in impervious cover. Refer to Table 4, EON-3, for the proposed hydrology conditions at the existing development.

3.5 ONSITE HYDRAULICS

5.3.1 ONSITE CONVEYANCE STRUCTURES

The runoff generated by the onsite watershed will be conveyed throughout the site via surface flow. The site grading will ensure that runoff is conveyed to either the water harvesting area or proposed basin. Curb openings are proposed at the low point where the stormwater will discharge into the basin onsite. The curb openings were calculated using equation 10.14 in the Tucson's Standards Manual for Drainage Design and Floodplain Management ($Q=2.3*L*Y_i^{1.5}$) for the 10-yr storm event for DON-1.

The same methodology was used to determine the number of scuppers required for the existing onsite runoff. The surface flow from the existing development will follow the same drainage patterns, which utilizes existing weep holes located within the wall. Upon a site visit, it was determined that there was four (4) 1-ft wide weep holes that outlet into the wall. With the removal of this wall and equation 10.14 in the Tucson's Standards Manual for Drainage Design and Floodplain Management ($Q=2.3*L*Y_i^{1.5}$). the curb openings were determined for the 10-yr storm event for EON-3.

The proposed curb for the property will be designed to PAG Standard Detail 209 – Vertical Curb for a 6" reveal. It is the intent of the curb openings to capture 100% of the runoff and for the flow depth to not exceed the top of the curb. The minimum flow depth of 0.5' was used to match the reveal of the curb. The minimum curb opening (L) was calculated for the one concentration point for the basin, and the proposed opening was determined from those results.

Table 12: Curb Openings				
Drainage Area ID	Q_{10} (cfs)	Yi max (ft)	L min (ft)	Proposed Opening Width (ft)
DON-1	14	0.5	17.2	17.5
EON-3	14	0.5	17.2	17.5

In the event of a 100-yr storm event, the water from the northeast end of the site will split, going either north of the building or south of the building. The runoff running north of the building will follow the curb line and run along the pavement. The pavement slopes to the low point, which includes the 17.5' curb opening which inlets into the new basin. The runoff that runs south of the

building will follow the curb line. This will run within the proposed pavement and go into the same low point mentioned previously, which then inlets into the basin.

At the east end of the basin and at the EON-3 concentration points, there are seven (7) sidewalk scuppers provided to direct flow from the road to the proposed and existing basins. The openings will be 2.5 feet wide and will accommodate the opening requirement for DON-1 and EON-3 as shown in Table 12. The sidewalk scuppers will be PAG Standard Detail 205, type 3.

5.3.2 First Flush Requirements

The first flush is the total volume for the first 0.5 inches of rainfall discharging on the site. The site is a new development on existing vacant land; therefore, the proposed design shall take into account the First Flush requirement per section 2.1.3 of the Design Standards for Stormwater Detention and Retention. The first flush is calculated by determining the amount of impervious area and the additional disturbed area that will be developed. Then, using the values from Table 2.1, the volume is determined. For this site, the amount of impervious area was determined to be 131,915 cf (3.03 ac), and the pervious cover was 4,324 cf. Using a factor of 1,440 cf/ac (Table 2.1) for the impervious cover and 140 cf/ac for the additional disturbed area, the total volume required was determined to be 4,375 cf.

The volume provided will be split up into two parts of the site: Basin 1 and water harvesting area southwest of the proposed building. Both will be 4” deep in retention volume. Basin 1 is expected to hold 3,964 cf and the water harvesting area has a volume capacity of 1,094 cf. Once the water harvesting area volume is filled, it is expected to overflow to Basin 1. The first flush volume is met with both the basin and water harvesting area.

Refer to Table 13 for the first flush volume requirements for DON-1.

Table 13: First Flush Volumes

Drainage Area ID	Volume Required (CF)	Volume Provided (CF)
DON-1	4,375	5,058

5.3.3 Detention/Retention Requirements

The proposed development is located within a critical basin which requires the developed conditions to reduce its discharges to 85 percent of the existing site conditions. In order to achieve this reduction, a detention/retention basin is proposed to reduce the developed peak discharge rates for the 2-, 10-, and 100-year storm events. The basin captures the runoff generated from watershed area DON-1. The basin will have access on the north end for maintenance purposes only, via a 14 ft wide path. In addition, the basin was designed to meet the first-flush requirement for the watershed that conveys its runoff into the basin. The basin was analyzed using the Pima County Routing spreadsheet and has been included in Appendix C of this report.

The basin will be 3.0 feet in depth and consist of a bottom area of 0.12 ac (5,126 sf) at an elevation of 2626.25 and top area of 0.15 ac (6,451 sf) at an elevation of 2629.25. The sidewalls of the basin

will consist of 1:1 concrete side slopes on all sides. Due to the 3-ft depth and 1:1 side slopes, a security fence is required to be placed on all sides of the basin.

The basin is proposed to have a concrete weir structure at the southwest corner of the basin for its outlet. The weir will be 6.4 feet long and placed 0.75' above the basin bottom at an elevation of 2627.0. The weir results of the basin having a retention volume of 3,964 ft^3 and a 100-year water surface elevation of 2628.25 with a 12" freeboard. Refer to table 14 for a result of the basin area and table 15 for a result of total site discharge.

Table 14: Retention/Detention Basin Results

Basin ID	Bottom Elev.	Basin Top Elev.	Basin Weir Elev.	Ret. Vol. (ft^3)	Q_2 In (CFS)	Q_2 Out (CFS)	Q_{10} In (CFS)	Q_{10} Out (CFS)	Q_{100} In (CFS)	Q_{100} Out (CFS)
1	2626.25	2629.25	2627.0	3964	5	1.5	14	9.3	**35**	**26.9**

Table 15: Site Discharge Results West

Storm event	Exist. Conditions Discharge Rate EON-1 and EON-2 (cfs)	Max Discharge Rate Allowed (cfs)	Dev. Conditions Discharge Rate DON-1 (cfs)
Q2	3	2.6	**1.5**
Q10	12	10.2	**9.3**
Q100	33	28.1	**27**

The existing basin onsite will be cut into by the proposed sidewalk of the new development. Therefore, a reconfiguration of the existing basin is required. Using the provided ALTA survey, it was determined that the existing basin is approximately 1' deep, with side slopes ranging from 2:1 to 5:1. The existing retention volume was determined to be 2,394 ft^3. The basin will increased to the north, so there is no decrease in retention volumes. The basin sides will remain the same, but the north end will now be 3:1 side slopes, and the eastern end (sidewalk end) will have 2:1 side slopes. The bottom of the basin is at an elevation of 2625.0 with a bottom area of 0.05 ac (2,191 SF), and top elevation is 2626.0 with a top area of 0.06 ac (2,609 SF). The new volume for the existing basin will be 2,397 ft^3, the intention being that the retention volume match the pre-development hydrology.

An additional geotechnical study was conducted to determine the percolation rates of the existing soils on-site to ensure positive infiltration is occurring at the basin and water harvesting areas. Per the geotechnical addendum (dated 05/15/2025), the average infiltration rate is 9 inches/hour for the existing soil. This high infiltration rate allows for the stormwater harvesting areas to maintain adequate infiltration for the maximum six inches of stormwater in each harvesting area to drain within 12 hours per Town of Oro Valley code. Refer to Geotech Addendum #1 for more information.

4 SUMMARY AND CONCLUSIONS

The Extra Space expansion is a proposed expansion to an existing extra space facility, the site will include a new storage facility, recreational vehicle spaces, a new paved roadway, and landscaped areas throughout the site. The proposed improvements will increase the overall impervious cover that currently exists. Onsite runoff will drain to the west, like existing conditions, to a proposed 3' deep basin. There will be new concentration points established within the proposed development, but there will be an overall reduction in the discharge rates for the 2-, 10-, and 100-year storm events.

In addition, the proposed drainage improvements are designed to intercept and convey offsite runoff efficiently through the site using a system of catch basins, storm drains, and driveway culverts, which shall discharge from the site without altering offsite flow patterns. The hydrologic and hydraulic analyses, conducted using recognized methods and software tools, confirm that the proposed system will manage runoff in compliance with local standards. Storm drains, inlets, and culverts have been sized to handle design flows, maintain safe hydraulic conditions, and prevent surface flooding, ensuring that the site's drainage infrastructure is equipped to manage both current and future conditions effectively.

5 REFERENCES

Town of Oro Valley Drainage Criteria Manual, Town of Oro Valley, 2020.

Standards Manual For Drainage Design And Floodplain Management In Tucson, Arizona. City of Tucson, July 1998.

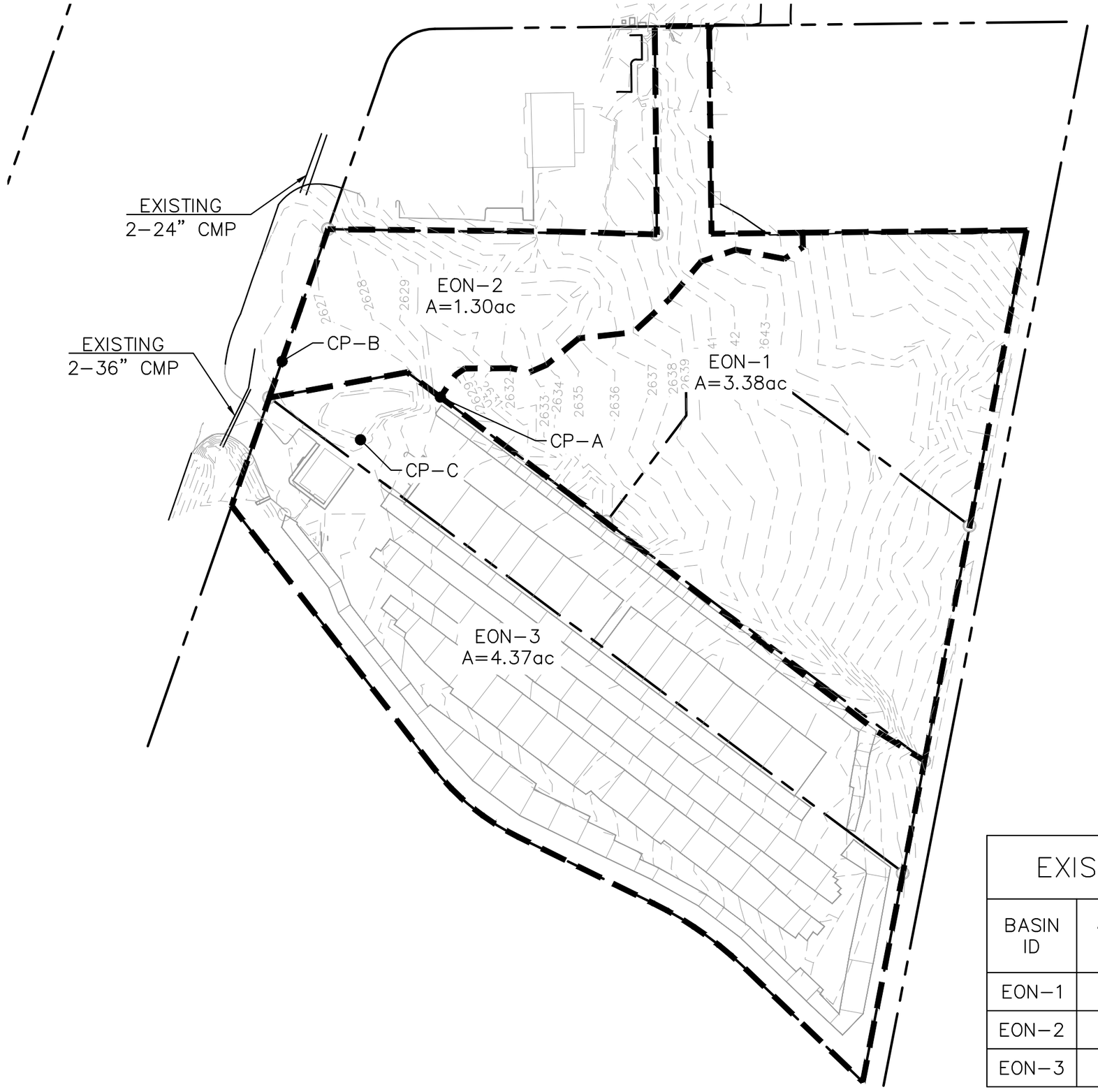
Design Standards for Stormwater Detention and Retention. Pima County Regional Flood Control District, June 2014.

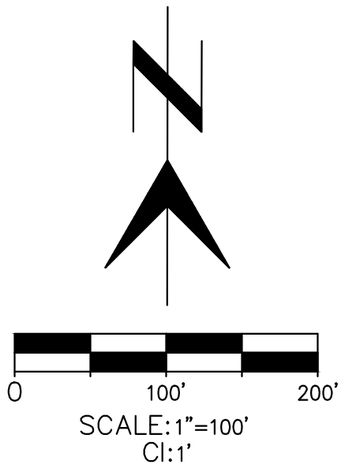
Appendix A – Figures and Exhibits

Figure A-1 – Existing Hydrology Exhibit

Figure A-2 – Proposed Hydrology Exhibit

FEMA FIRMette





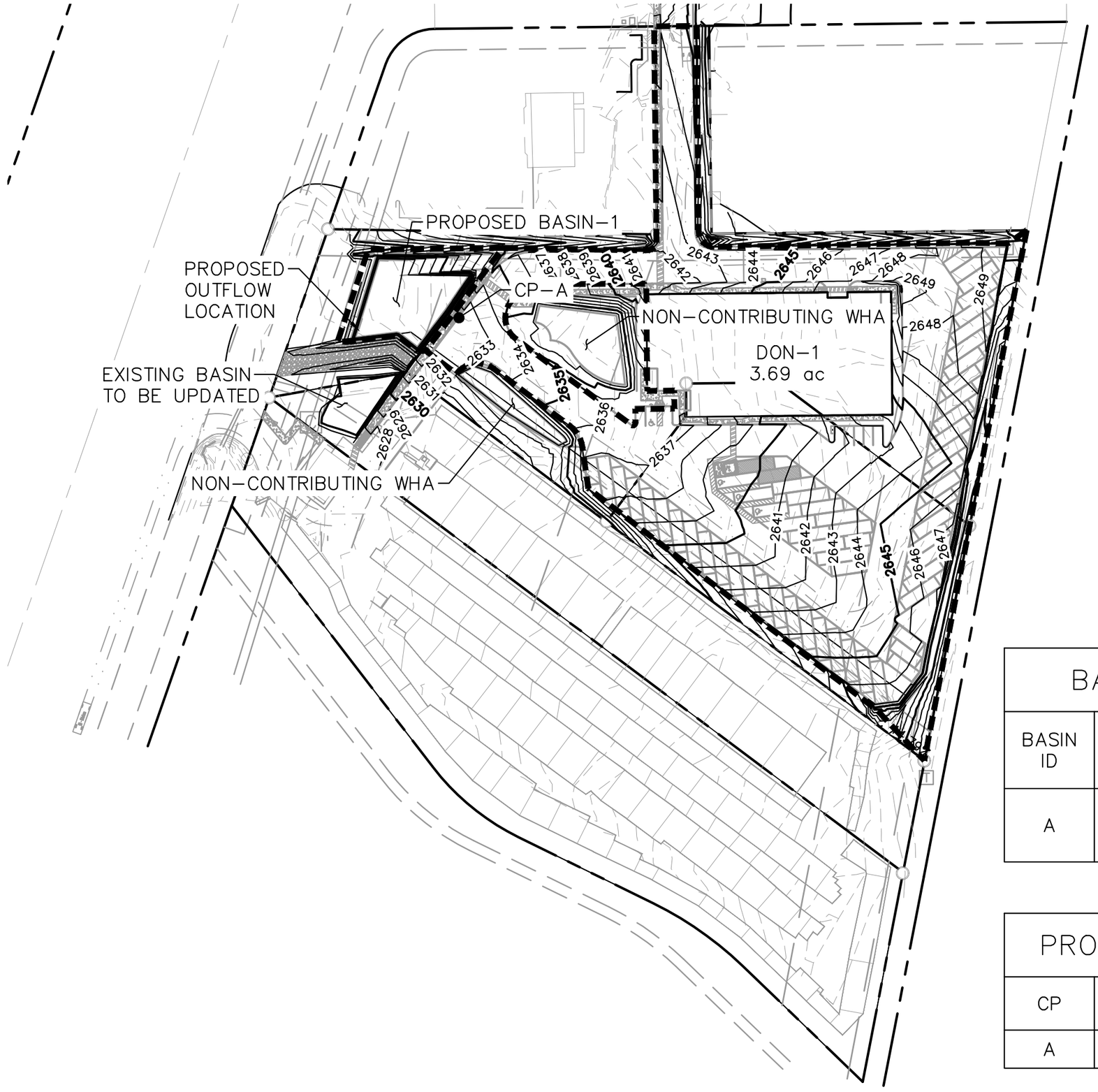
EXISTING DESIGN FLOWS				
BASIN ID	AREA (AC)	Q2 (CFS)	Q10 (CFS)	Q100 (CFS)
EON–1	3.38	2	9	24
EON–2	1.30	1	3	9
EON–3	4.37	5	14	33

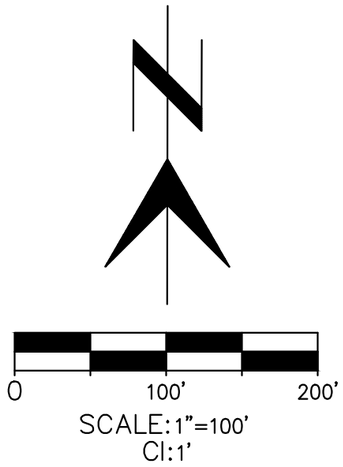
Kimley»Horn

3300 East Sunrise Drive, Suite 130
Tucson, Arizona 85718

EXISTING CONDITIONS EXHIBIT

FIGURE A–1





BASIN RESULTS			
BASIN ID	Q2 (CFS) IN/OUT	Q10 (CFS) IN/OUT	Q100 (CFS) IN/OUT
A	5/2	14/9	35/17

PROPOSED DESIGN FLOWS				
CP	AREA (AC)	Q2 (CFS)	Q10 (CFS)	Q100 (CFS)
A	3.69	5	14	35

Kimley»Horn

3300 East Sunrise Drive, Suite 130
Tucson, Arizona 85718

PROPOSED
CONDITIONS EXHIBIT

FIGURE A–2

National Flood Hazard Layer FIRMette

FEMA

110°58'24"W 32°22'5"N

110°57'47"W 32°21'35"N

Feet

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

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

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

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

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

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

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

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

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/26/2024 at 8:54 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Appendix B – Hydrologic Calculations

Existing Onsite Hydrologic Calculations

Proposed Onsite Hydrologic Calculations

Automated Calculation Sheet for Category 1 Flood Hydrology Procedure (C1FHP)

Town of Oro Valley, Public Works, Stormwater Utility

OV-Hydro, Version 1.0

Flood-Recurrence Interval: **1%** AEP (Annual Exceedance Probability (100-Year Return Period)

Project Name and Location: Extra Space Oro Valley 8760 N Oracle Rd

Drainage Concentration Point: EON-1

Watershed Centroid: Lat.: 32.3650 Long.: -110.9680

Watershed Area (A) at Drainage Concentration Point: 3.38 acres

Length of Hydraulically Longest Watercourse (L): 761 feet

Length from Center of Watershed Area (L_{ca}), along L_c : 380 feet

For (check one): Exst. Conditions: X; Future Conditions:

Segment	Change in Length Factors			Change in Elevation Factors			Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1:	761	feet	H_1:	26	feet	S_1:	**0.0342**	feet/foot	0.050
2	L_2:		feet	H_2:		feet	S_2:	**1**	feet/foot	
3	L_3:		feet	H_3:		feet	S_3:	**1**	feet/foot	
4	L_4:		feet	H_4:		feet	S_4:	**1**	feet/foot	
5	L_5:		feet	H_5:		feet	S_5:	**1**	feet/foot	

(The Sum of L_1 Through L_5 Must = Total Length, L)

(The Value "1" Represents a Place Holder)

$G = [(L_1)^3/H_1]^{1/2} + [(L_2)^3/H_2]^{1/2} + [(L_3)^3/H_3]^{1/2} + [(L_4)^3/H_4]^{1/2} + [(L_5)^3/H_5]^{1/2}$ G = 4,117

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0342** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P_{1\%\ AEP}^{1-hr}$ = **2.86** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Natural/Rural					
Percentage of Total Area:	100					% Area = **100**

(Note: Sum of Subareas Must = 100% of A)

Hydrologic Parameters

Weighted Basin Factor: Note: Along Inremental Alluvial Channel Segments with Natural Streambeds, $n_{bi\ AEP}$ Must Not Be Less than $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.050**

Hydrologic Soil Group (HSG):	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D
Percentage of HSG:		50	50												
Runoff Coeff., Pervious (C):		0.636			0.000			0.000			0.000			0.000	
% Imp. in each Subarea:	5														
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96	
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.652			0.000			0.000			0.000			0.000	

Contrib. Area Factor (F_{Ac}):	1.00	0.00				F_{Acw} = **1.00**

Time of Concentration ($T_{c1\%\ AEP}$): **5 minutes**

Determined from:

$T_{c1\%\ AEP} = 0.87(K_{1\%\ AEP})^{[0.641+0.221(\text{Log } K_{1\%\ AEP})]}$ (DCM Equation 3.7)

$T_{c1\%\ AEP}$ = 5 (to nearset whole minute)

$K_{1\%\ AEP} = 1.2\ nb_{1\%\ AEP}(L\ L_{ca})^{0.3}/(S P_{c\ 1\%\ AEP}^{1-hr}\ C_{w1\%\ AEP})^{0.4}$ (DCM Equation 3.8)

$K_{1\%\ AEP}$ = 8 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ ($P_{1\%\ AEP}^{1-hr}$ **$i_{1\%\ AEP}$ = 10.94 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 24 cfs**

Prepared by: Mia Perla

Date:

Checked by:

Date:

Watershed Types

Natural/Rural

Suburban
Moderately Urban

Highly Urban
Commerical/Industrial

NOTES: (1) Drainage area may not exceed 640 acres (1 square mile) in size.

(2) $T_{c1\%\ AEP}$ may not exceed 180 minutes. If $T_{c1\%\ AEP} < 5$, set $T_{c1\%\ AEP}$ = 5 minutes.

(3) Auto-calculated runoff coefficents correspond (±) to those listed in Table 3.4 of the DCM.

(4) If HSG Type A is encountered in a watershed, substitute with HSG Type B.

For other return periods:	50% AEP	10% AEP	4% AEP	2% AEP	0.2% AEP
Ratio to 1% AEP Peak:	0.09	0.35	0.56	0.77	1.7
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	13	8	6	6	4
$Q_{n\%\ AEP}$ (cfs):	2	9	14	19	41

Automated Calculation Sheet for Category 1 Flood Hydrology Procedure (C1FHP)

Town of Oro Valley, Public Works, Stormwater Utility

OV-Hydro, Version 1.0

Flood-Recurrence Interval: **1%** AEP (Annual Exceedance Probability (100-Year Return Period)

Project Name and Location: Extra Space Oro Valley 8760 N Oracle Rd

Drainage Concentration Point: EON-2

Watershed Centroid: Lat.: 32.3650 Long.: -110.9680

Watershed Area (A) at Drainage Concentration Point: 1.3 acres

Length of Hydraulically Longest Watercourse (L): 761 feet

Length from Center of Watershed Area (L_{ca}), along L_c : 380 feet

For (check one): Exst. Conditions: X; Future Conditions:

Segment	Change in Length Factors		Change in Elevation Factors		Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1: 467	feet	H_1: 17	feet	S_1:	**0.0364**	feet/foot	0.050
2	L_2:	feet	H_2:	feet	S_2:	**1**	feet/foot	
3	L_3:	feet	H_3:	feet	S_3:	**1**	feet/foot	
4	L_4:	feet	H_4:	feet	S_4:	**1**	feet/foot	
5	L_5:	feet	H_5:	feet	S_5:	**1**	feet/foot	

(The Sum of L_1 Through L_5 Must = Total Length, L)

(The Value "1" Represents a Place Holder)

$G = [(L_1)^3/H_1]^{1/2} + [(L_2)^3/H_2]^{1/2} + [(L_3)^3/H_3]^{1/2} + [(L_4)^3/H_4]^{1/2} + [(L_5)^3/H_5]^{1/2}$ G = 2,448

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0967** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P_{1\%\ AEP}^{1-hr}$ = **2.86** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Natural/Rural					
Percentage of Total Area:	100					% Area = **100**

(Note: Sum of Subareas Must = 100% of A)

Hydrologic Parameters

Weighted Basin Factor: Note: Along Inremental Alluvial Channel Segments with Natural Streambeds, $n_{bi\ AEP}$ Must Not Be Less than $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.050**

Hydrologic Soil Group (HSG):	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D
Percentage of HSG:		50	50												
Runoff Coeff., Pervious (C):		0.636			0.000			0.000			0.000			0.000	
% Imp. in each Subarea:	5														
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96	
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.652			0.000			0.000			0.000			0.000	

Contrib. Area Factor (F_{Ac}):	1.00					F_{Acw} = **1.00**

Time of Concentration ($T_{c1\%\ AEP}$): **5 minutes**

Determined from:

$T_{c1\%\ AEP} = 0.87(K_{1\%\ AEP})^{[0.641+0.221(\text{Log } K_{1\%\ AEP})]}$ (DCM Equation 3.7)

$T_{c1\%\ AEP}$ = 3 (to nearset whole minute)

$K_{1\%\ AEP} = 1.2\ nb_{1\%\ AEP}(L\ L_{ca})^{0.3}/(S_c P_{1\%\ AEP}^{1-hr}\ C_{w1\%\ AEP})^{0.4}$ (DCM Equation 3.8)

$K_{1\%\ AEP}$ = 5 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ ($P_{1\%\ AEP}^{1-hr}$ **$i_{1\%\ AEP}$ = 10.94 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 9 cfs**

Prepared by: Mia Perla

Date:

Checked by:

Date:

Watershed Types

Natural/Rural

Suburban
Moderately Urban

Highly Urban
Commerical/Industrial

NOTES: (1) Drainage area may not exceed 640 acres (1 square mile) in size.

(2) $T_{c1\%\ AEP}$ may not exceed 180 minutes. If $T_{c1\%\ AEP} < 5$, set $T_{c1\%\ AEP} = 5$ minutes.

(3) Auto-calculated runoff coefficents correspond (±) to those listed in Table 3.4 of the DCM.

(4) If HSG Type A is encountered in a watershed, substitute with HSG Type B.

For other return periods:	50% AEP	10% AEP	4% AEP	2% AEP	0.2% AEP
Ratio to 1% AEP Peak:	0.09	0.35	0.56	0.77	1.7
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	13	8	6	6	4
$Q_{n\%\ AEP}$ (cfs):	1	3	5	7	16

Automated Calculation Sheet for Category 1 Flood Hydrology Procedure (C1FHP)

Town of Oro Valley, Public Works, Stormwater Utility

OV-Hydro, Version 1.0

Flood-Recurrence Interval: **1%** AEP (Annual Exceedance Probability (100-Year Return Period)

Project Name and Location: Extra Space Oro Valley 8760 N Oracle Rd

Drainage Concentration Point: EON-3

Watershed Centroid: Lat.: 32.3650 Long.: -110.9680

Watershed Area (A) at Drainage Concentration Point:	4.37	acres	For (check one):
Length of Hydraulically Longest Watercourse (L):	832	feet	Exst. Conditions: X
Length from Center of Watershed Area (L_{ca}), along L_c :	416	feet	Future Conditions:

Segment	Change in Length Factors			Change in Elevation Factors			Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1:	832	feet	H_1:	20	feet	S_1:	**0.0240**	feet/foot	0.050
2	L_2:		feet	H_2:		feet	S_2:	**1**	feet/foot	
3	L_3:		feet	H_3:		feet	S_3:	**1**	feet/foot	
4	L_4:		feet	H_4:		feet	S_4:	**1**	feet/foot	
5	L_5:		feet	H_5:		feet	S_5:	**1**	feet/foot	

(The Sum of L_1 Through L_5 Must = Total Length, L)

(The Value "1" Represents a Place Holder)

$G = [(L_1)^3/H_1]^{1/2} + [(L_2)^3/H_2]^{1/2} + [(L_3)^3/H_3]^{1/2} + [(L_4)^3/H_4]^{1/2} + [(L_5)^3/H_5]^{1/2}$ G = 5,366

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0240** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P_{1\%\ AEP}^{1-hr}$ = **2.47** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Commercial					
Percentage of Total Area:	100					% Area = **100**

(Note: Sum of Subareas Must = 100% of A)

Hydrologic Parameters

Weighted Basin Factor: Note: Along Inremental Alluvial Channel Segments with Natural Streambeds, $n_{bi\ AEP}$ Must Not Be Less than $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.050**

Hydrologic Soil Group (HSG):	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D
Percentage of HSG:		50	50												
Runoff Coeff., Pervious (C):		0.595			0.000			0.000			0.000			0.000	
% Imp. in each Subarea:	95														
Runoff Coeff., Imp. (C):		0.95			0.95			0.95			0.95			0.95	
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.935			0.000			0.000			0.000			0.000	

Contrib. Area Factor (F_{Ac}): 0.90 — F_{Acw} = **0.90**

Time of Concentration ($T_{c1\%\ AEP}$): **6 minutes**

Determined from:

$T_{c1\%\ AEP} = 0.87(K_{1\%\ AEP})^{[0.641+0.221(\text{Log } K_{1\%\ AEP})]}$ (DCM Equation 3.7)

$T_{c1\%\ AEP}$ = 6 (to nearset whole minute)

$K_{1\%\ AEP} = 1.2\ nb_{1\%\ AEP}(L\ L_{ca})^{0.3}/(S P_{c\ 1\%\ AEP}^{1-hr}\ C_{w1\%\ AEP})^{0.4}$ (DCM Equation 3.8)

$K_{1\%\ AEP}$ = 9 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ ($P_{1\%\ AEP}^{1-hr}$ **$i_{1\%\ AEP}$ = 8.88 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 33 cfs**

Prepared by: Mia Perla

Date:

Checked by:

Date:

Watershed Types

Natural/Rural

Suburban

Moderately Urban

Highly Urban

Commerical/Industrial

NOTES: (1) Drainage area may not exceed 640 acres (1 square mile) in size.

(2) $T_{c1\%\ AEP}$ may not exceed 180 minutes. If $T_{c1\%\ AEP} < 5$, set $T_{c1\%\ AEP} = 5$ minutes.

(3) Auto-calculated runoff coefficents correspond (±) to those listed in Table 3.4 of the DCM.

(4) If HSG Type A is encountered in a watershed, substitute with HSG Type B.

For other return periods:	50% AEP	10% AEP	4% AEP	2% AEP	0.2% AEP
Ratio to 1% AEP Peak:	0.14	0.42	0.61	0.79	1.57
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	13	8	7	7	5
$Q_{n\%\ AEP}$ (cfs):	5	14	20	26	52

Automated Calculation Sheet for Category 1 Flood Hydrology Procedure (C1FHP)

Town of Oro Valley, Public Works, Stormwater Utility

OV-Hydro, Version 1.0

Flood-Recurrence Interval: **1%** AEP (Annual Exceedance Probability (100-Year Return Period)

Project Name and Location: Extra Space Oro Valley 8760 N Oracle Rd

Drainage Concentration Point: DON-1

Watershed Centroid: Lat.: 32.3650 Long.: -110.9680

Watershed Area (A) at Drainage Concentration Point:	3.69	acres	For (check one):
Length of Hydraulically Longest Watercourse (L):	698	feet	Exst. Conditions:
Length from Center of Watershed Area (L_{ca}), along L_c :	350	feet	Future Conditions: X

Segment	Change in Length Factors			Change in Elevation Factors			Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1:	698	feet	H_1:	23	feet	S_1:	**0.0330**	feet/foot	0.050
2	L_2:		feet	H_2:		feet	S_2:	**1**	feet/foot	
3	L_3:		feet	H_3:		feet	S_3:	**1**	feet/foot	
4	L_4:		feet	H_4:		feet	S_4:	**1**	feet/foot	
5	L_5:		feet	H_5:		feet	S_5:	**1**	feet/foot	

(The Sum of L_1 Through L_5 Must = Total Length, L)

(The Value "1" Represents a Place Holder)

$G = [(L_1)^3/H_1]^{1/2} + [(L_2)^3/H_2]^{1/2} + [(L_3)^3/H_3]^{1/2} + [(L_4)^3/H_4]^{1/2} + [(L_5)^3/H_5]^{1/2}$ G = 3,845

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0330** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P_{1\%\ AEP}^{1-hr}$ = **2.86** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Commercial					
Percentage of Total Area:	100					% Area = **100**

(Note: Sum of Subareas Must = 100% of A)

Hydrologic Parameters

Weighted Basin Factor: Note: Along Inremental Alluvial Channel Segments with Natural Streambeds, $n_{bi\ AEP}$ Must Not Be Less than $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.050**

Hydrologic Soil Group (HSG):	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D
Percentage of HSG:		50	50												
Runoff Coeff., Pervious (C):		0.636			0.000			0.000			0.000			0.000	
% Imp. in each Subarea:	95														
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96	
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.943			0.000			0.000			0.000			0.000	

Contrib. Area Factor (F_{Ac}):	0.90					F_{Acw} = **0.90**

Time of Concentration ($T_{c1\%\ AEP}$): **5 minutes**

Determined from:

$T_{c1\%\ AEP} = 0.87(K_{1\%\ AEP})^{[0.641+0.221(\text{Log } K_{1\%\ AEP})]}$ (DCM Equation 3.7)

$T_{c1\%\ AEP}$ = 4 (to nearset whole minute)

$K_{1\%\ AEP} = 1.2\ nb_{1\%\ AEP}(L\ L_{ca})^{0.3}/(S P_{c\,1\%\ AEP}^{1-hr}\ C_{w1\%\ AEP})^{0.4}$ (DCM Equation 3.8)

$K_{1\%\ AEP}$ = 7 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity $(i_{1\%\ AEP}) = 5.1\ (T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}\ (P_{1\%\ AEP}^{1-hr})$ **$i_{1\%\ AEP}$ = 10.94 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 35 cfs**

Prepared by: Mia Perla

Date:

Checked by:

Date:

Watershed Types

Natural/Rural

Suburban
Moderately Urban

Highly Urban
Commerical/Industrial

NOTES: (1) Drainage area may not exceed 640 acres (1 square mile) in size.

(2) $T_{c1\%\ AEP}$ may not exceed 180 minutes. If $T_{c1\%\ AEP} < 5$, set $T_{c1\%\ AEP} = 5$ minutes.

(3) Auto-calculated runoff coefficents correspond (±) to those listed in Table 3.4 of the DCM.

(4) If HSG Type A is encountered in a watershed, substitute with HSG Type B.

For other return periods:	50% AEP	10% AEP	4% AEP	2% AEP	0.2% AEP
Ratio to 1% AEP Peak:	0.14	0.42	0.61	0.79	1.57
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	11	7	6	5	4
$Q_{n\%\ AEP}$ (cfs):	5	14	21	27	54

Appendix C – Basin Calculations and Models

Pima County Basin Routing Spreadsheet

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

ROUTING OF A FLOOD HYDROGRAPH THROUGH A STORMWATER DETENTION / RETENTION FACILITY

Worksheet to Input the Inflow Hydrograph, & Automatically Perform the Routing Calculations using the Stage-Volume data, Volume-Outflow data, & SO Working Curve

8770 N Oracle Rd	**Project Address**
Mia Perla	**Designer**
Monday, May 12, 2025	**Run Date**
PC-ROUTE v. 8.0 (XLS).xls	**Program File Name**

Rev. 10/20

GOVERNING EQUATION: ***Ref: Applied Hydrology (Ven Te Chow, Editor 1964)***

Mass Conservation: $0.5 * (I_1 + I_2) * \Delta t - 0.5 * (O_1 + O_2) * \Delta t = S_2 - S_1$

Isolate, divide by Δt: $0.5 * (I_1 + I_2) + S_1 / \Delta t - 0.5 * O_1 = S_2 / \Delta t + 0.5 * O_2$

VARIABLES:

Δt	time interval between hydrograph discharges.
I_1, I_2	inflow rate into facility at start and end of time interval from inflow hydrograph
O_1, O_2	facility outflow rate at start & end of time interval
S_1, S_2	stormwater in storage in the facility at start and end of time interval

Note: Input Δt, target discharges & inflow hydrographs for 3 storm frequencies into blue cells. Outflow hydrographs (yellow) are calculated from specified outlet configuration (**vol-outflow** tab) and facility geometry (**Stage-Vol** tab). To add rows to this worksheet, add them in roughly the center of the range, then unhide all columns and copy hidden equations into the new rows. Zero discharge within and beyond the end of the hydrograph will not affect the routing. **All blue cells in this spreadsheet must either be blank (highlight, right-click, Clear Contents) or must contain a number. In addition, the Stage - Volume data must be entered in numerically ascending order. This spreadsheet does not have a "clear" button to clear all input data in one action; to accomplish this, restart Excel using a blank copy of the spreadsheet.**

RESULTS:

	max inflow		max outflow		total inflow volume				max stage (H) *				target ** discharge	
100-Year	34.5	cfs	27.5	cfs	36644	ft^3	0.841	af	2.00	ft	17	min	28.1	cfs
10-Year	14.8	cfs	9.7	cfs	16984	ft^3	0.390	af	1.37	ft	22	min	10.2	csf
2-Year	4.9	cfs	1.7	cfs	6830	ft^3	0.157	af	0.94	ft	36	min	2.6	cfs

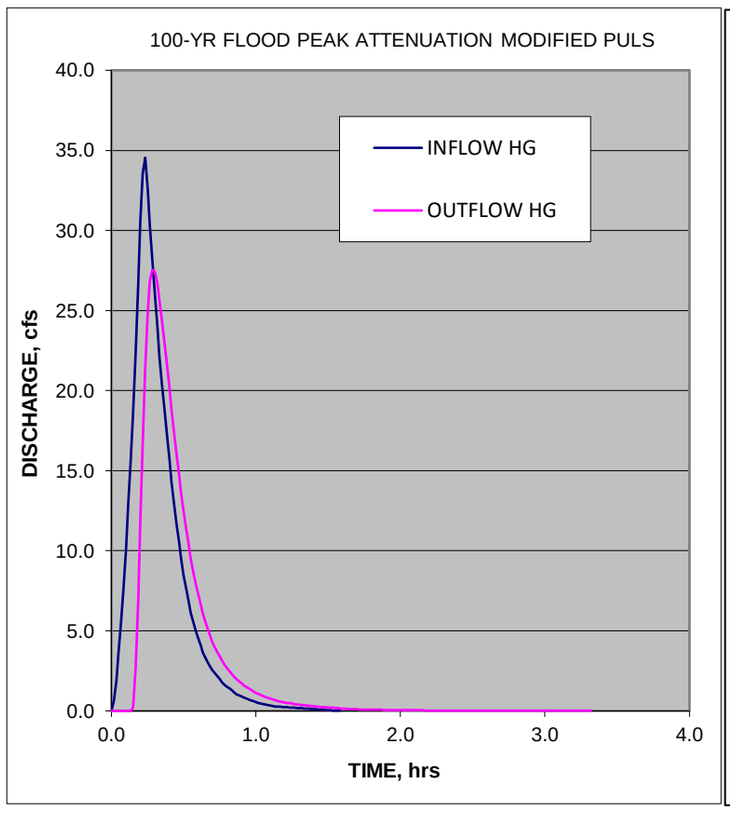
Δt = 1.00 min 0.0167 hr inflow hydrograph time interval

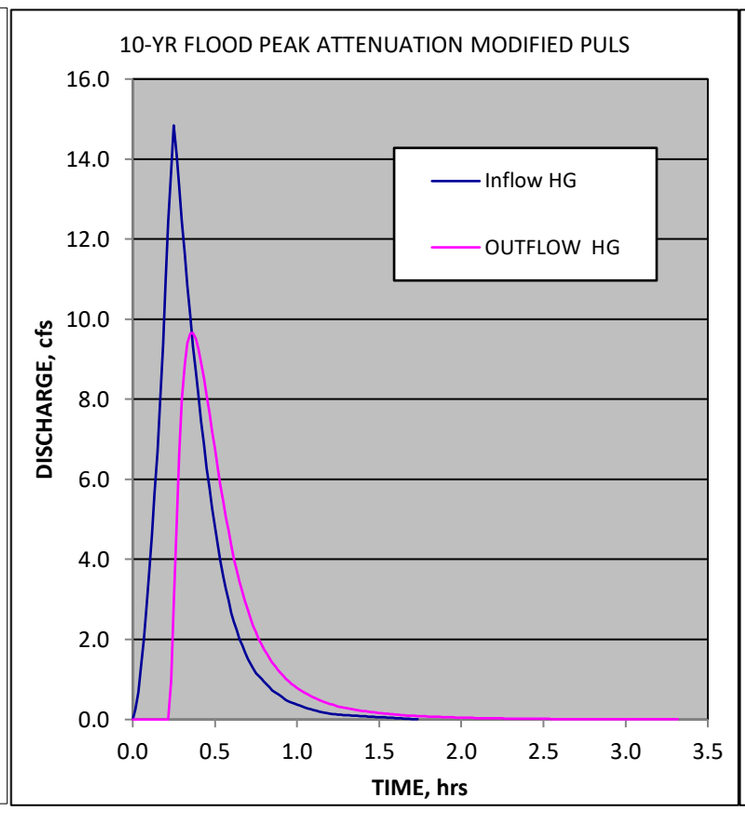
* Max Design Stage = 3.00 ft

NOTE: IF H > MAX DESIGN STAGE, EXTEND STAGE-VOL DATA TO A HIGHER STAGE

** target discharges not used in calculations; for informational use only

	100-Year			10-Year		2-Year		100-Year		10-Year		2-Year	
index count	Inflow I, cfs	time t, hr	S/Δt+O/2 cfs	Inflow I, cfs	S/Δt+O/2 cfs	Inflow I, cfs	S/Δt+O/2 cfs	outflow O, cfs	Stage H, ft	outflow O, cfs	Stage H, ft	outflow O, cfs	Stage H, ft
0	0.00	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.65	0.0167	0.32	0.25	0.12	0.07	0.03	0.00	0.00	0.00	0.00	0.00	0.00
2	1.91	0.0333	1.61	0.68	0.59	0.16	0.15	0.00	0.02	0.00	0.01	0.00	0.00
3	3.61	0.0500	4.37	1.29	1.57	0.33	0.39	0.00	0.05	0.00	0.02	0.00	0.00
4	5.50	0.0667	8.92	2.01	3.22	0.51	0.80	0.00	0.11	0.00	0.04	0.00	0.01
5	7.64	0.0833	15.49	2.79	5.62	0.71	1.41	0.00	0.19	0.00	0.07	0.00	0.02
6	10.09	0.1000	24.35	3.61	8.82	0.92	2.22	0.00	0.30	0.00	0.11	0.00	0.03
7	12.77	0.1167	35.78	4.63	12.93	1.15	3.26	0.00	0.43	0.00	0.16	0.00	0.04
8	15.50	0.1333	49.92	5.65	18.07	1.42	4.54	0.00	0.60	0.00	0.22	0.00	0.06
9	18.66	0.1500	67.00	6.69	24.25	1.70	6.09	0.21	0.80	0.00	0.30	0.00	0.07
10	22.37	0.1667	87.31	7.93	31.56	1.98	7.94	2.70	1.01	0.00	0.38	0.00	0.10
11	26.54	0.1833	109.07	9.35	40.20	2.28	10.07	6.73	1.24	0.00	0.49	0.00	0.12
12	30.41	0.2000	130.82	10.95	50.35	2.62	12.52	11.61	1.45	0.00	0.60	0.00	0.15
13	33.57	0.2167	151.21	12.43	62.04	3.00	15.33	16.74	1.64	0.00	0.74	0.00	0.19
14	34.55	0.2333	168.53	13.72	75.11	3.44	18.54	21.44	1.80	0.98	0.88	0.00	0.23
15	32.56	0.2500	180.64	14.84	88.41	3.86	22.19	24.88	1.91	2.87	1.03	0.00	0.27
16	30.35	0.2667	187.21	14.09	100.00	4.27	26.26	26.81	1.97	4.93	1.15	0.00	0.32
17	28.18	0.2833	189.68	13.29	108.77	4.61	30.70	27.53	2.00	6.67	1.23	0.00	0.37
18	26.07	0.3000	189.27	12.45	114.97	4.92	35.46	27.41	1.99	7.98	1.30	0.00	0.43
19	24.04	0.3167	186.91	11.63	119.03	4.76	40.30	26.72	1.97	8.88	1.34	0.00	0.49
20	22.11	0.3333	183.27	10.83	121.38	4.55	44.95	25.65	1.94	9.41	1.36	0.00	0.54
21	20.42	0.3500	178.88	10.06	122.42	4.32	49.39	24.38	1.90	9.64	1.37	0.00	0.59
22	18.86	0.3667	174.15	9.33	122.47	4.09	53.59	23.02	1.86	9.66	1.37	0.00	0.64
23	17.23	0.3833	169.18	8.67	121.81	3.86	57.56	21.62	1.81	9.51	1.36	0.00	0.69
24	15.71	0.4000	164.02	8.09	120.69	3.64	61.31	20.20	1.76	9.25	1.35	0.00	0.73
25	14.28	0.4167	158.82	7.46	119.21	3.43	64.84	18.77	1.72	8.92	1.34	0.08	0.77
26	12.94	0.4333	153.66	6.87	117.46	3.22	68.09	17.39	1.67	8.53	1.32	0.28	0.81
27	11.67	0.4500	148.58	6.29	115.51	3.02	70.93	16.05	1.62	8.10	1.30	0.53	0.84
28	10.56	0.4667	143.64	5.78	113.44	2.85	73.33	14.78	1.57	7.65	1.28	0.78	0.87
29	9.50	0.4833	138.88	5.28	111.31	2.69	75.32	13.58	1.53	7.20	1.26	1.01	0.89
30	8.45	0.5000	134.27	4.79	109.15	2.52	76.92	12.44	1.48	6.75	1.24	1.20	0.90
31	7.65	0.5167	129.88	4.39	106.99	2.35	78.15	11.38	1.44	6.31	1.22	1.36	0.92
32	6.84	0.5333	125.74	3.98	104.87	2.19	79.06	10.41	1.40	5.88	1.19	1.48	0.93
33	6.12	0.5500	121.82	3.58	102.77	2.04	79.70	9.51	1.36	5.46	1.17	1.56	0.93
34	5.57	0.5667	118.15	3.27	100.73	1.90	80.10	8.68	1.33	5.07	1.15	1.62	0.94
35	5.01	0.5833	114.76	2.96	98.78	1.76	80.31	7.94	1.29	4.70	1.13	1.65	0.94
36	4.52	0.6000	111.58	2.66	96.89	1.62	80.35	7.26	1.26	4.34	1.11	1.65	0.94
37	4.08	0.6167	108.63	2.44	95.10	1.51	80.27	6.64	1.23	4.02	1.10	1.64	0.94
38	3.64	0.6333	105.85	2.23	93.42	1.40	80.08	6.07	1.20	3.72	1.08	1.62	0.94
39	3.32	0.6500	103.25	2.02	91.83	1.28	79.80	5.56	1.18	3.45	1.06	1.58	0.93
40	3.01	0.6667	100.86	1.85	90.31	1.18	79.45	5.09	1.15	3.19	1.05	1.53	0.93


100-YR FLOOD PEAK ATTENUATION MODIFIED PULS
INFLOW HG
OUTFLOW HG
DISCHARGE, cfs
TIME, hrs
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
0.0
1.0
2.0
3.0
4.0


10-YR FLOOD PEAK ATTENUATION MODIFIED PULS
Inflow HG
OUTFLOW HG
DISCHARGE, cfs
TIME, hrs
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2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
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0.5
1.0
1.5
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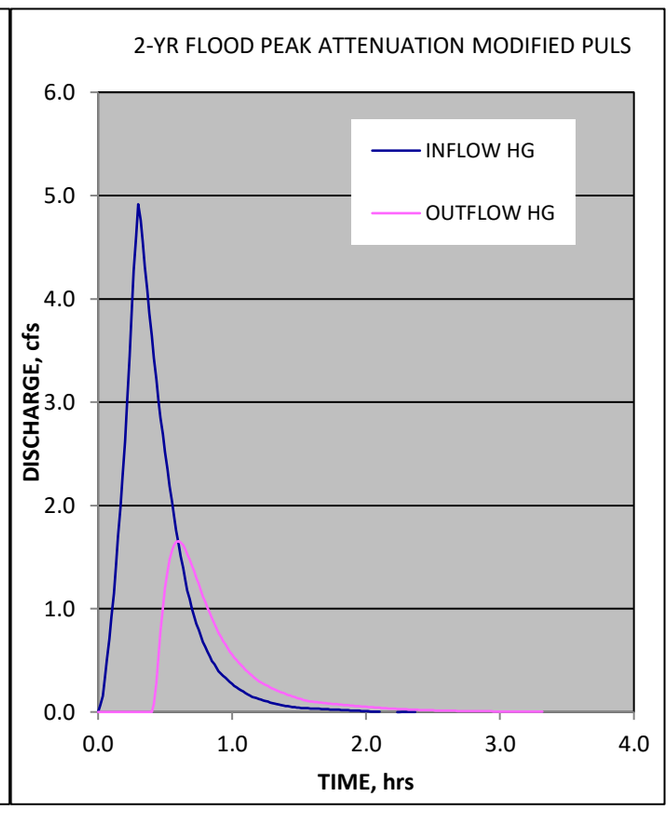
3.0
3.5


2-YR FLOOD PEAK ATTENUATION MODIFIED PULS
INFLOW HG
OUTFLOW HG
DISCHARGE, cfs
TIME, hrs
0.0
1.0
2.0
3.0
4.0
5.0
6.0
0.0
1.0
2.0
3.0
4.0

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

ROUTING OF A FLOOD HYDROGRAPH THROUGH A STORMWATER DETENTION / RETENTION FACILITY

THIS TAB CONTAINS NO INPUT DATA

Worksheet to Develop the Storage - Outflow Working Curve to be Used in the Modified Puls Method

8770 N Oracle Rd	**Project Address**
Mia Perla	**Designer**
Monday, May 12, 2025	**Run Date**
PC-ROUTE v. 8.0 (XLS).xls	**Program File Name**

GOVERNING EQUATION:

Storage - Outflow Working Curve: Function = S/Δt + O/2

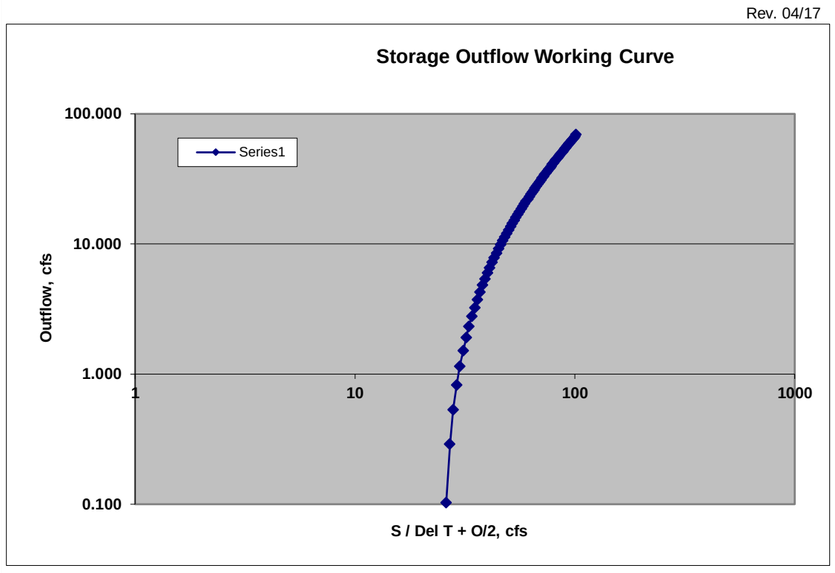
Rev. 04/17

RESULTS FROM VOLUME-OUTFLOW TAB

Stage ft	Outflow Q, cfs	Σ vol S, af	Σ vol S, cfs-hr	S/Δt cfs	O/2 cfs	Function cfs	Outflow O, cfs	index for interpolation
0.00	0.0	0.0000	0.00	0.0	0.0	0.000	0.0	1
0.03	0.0	0.0034	0.04	2.4	0.0	2.447	0.0	2
0.06	0.0	0.0067	0.08	4.9	0.0	4.894	0.0	3
0.09	0.0	0.0101	0.12	7.3	0.0	7.341	0.0	4
0.12	0.0	0.0135	0.16	9.8	0.0	9.788	0.0	5
0.15	0.0	0.0169	0.20	12.2	0.0	12.235	0.0	6
0.18	0.0	0.0203	0.25	14.7	0.0	14.708	0.0	7
0.21	0.0	0.0237	0.29	17.2	0.0	17.182	0.0	8
0.24	0.0	0.0271	0.33	19.7	0.0	19.656	0.0	9
0.27	0.0	0.0305	0.37	22.1	0.0	22.145	0.0	10
0.30	0.0	0.0339	0.41	24.6	0.0	24.641	0.0	11
0.33	0.0	0.0374	0.45	27.1	0.0	27.137	0.0	12
0.36	0.0	0.0408	0.49	29.6	0.0	29.645	0.0	13
0.39	0.0	0.0443	0.54	32.2	0.0	32.176	0.0	14
0.42	0.0	0.0478	0.58	34.7	0.0	34.706	0.0	15
0.45	0.0	0.0513	0.62	37.2	0.0	37.237	0.0	16
0.48	0.0	0.0548	0.66	39.8	0.0	39.767	0.0	17
0.51	0.0	0.0583	0.70	42.3	0.0	42.298	0.0	18
0.54	0.0	0.0617	0.75	44.8	0.0	44.829	0.0	19
0.57	0.0	0.0653	0.79	47.4	0.0	47.390	0.0	20
0.60	0.0	0.0688	0.83	50.0	0.0	49.966	0.0	21
0.63	0.0	0.0724	0.88	52.5	0.0	52.542	0.0	22
0.66	0.0	0.0759	0.92	55.1	0.0	55.118	0.0	23
0.69	0.0	0.0795	0.96	57.7	0.0	57.694	0.0	24
0.72	0.0	0.0830	1.00	60.3	0.0	60.271	0.0	25
0.75	0.0	0.0866	1.05	62.8	0.0	62.847	0.0	26
0.78	0.1	0.0902	1.09	65.5	0.1	65.520	0.1	27
0.81	0.3	0.0938	1.13	68.1	0.1	68.237	0.3	28
0.84	0.5	0.0974	1.18	70.7	0.3	70.980	0.5	29
0.87	0.8	0.1010	1.22	73.3	0.4	73.747	0.8	30
0.90	1.2	0.1046	1.27	76.0	0.6	76.532	1.2	31
0.93	1.5	0.1082	1.31	78.6	0.8	79.335	1.5	32
0.96	1.9	0.1118	1.35	81.2	1.0	82.154	1.9	33
0.99	2.3	0.1155	1.40	83.8	1.2	84.988	2.3	34
1.02	2.8	0.1191	1.44	86.4	1.4	87.835	2.8	35
1.05	3.3	0.1227	1.48	89.1	1.6	90.694	3.3	36
1.08	3.8	0.1264	1.53	91.8	1.9	93.628	3.8	37
1.11	4.3	0.1300	1.57	94.4	2.1	96.534	4.3	38
1.14	4.8	0.1337	1.62	97.0	2.4	99.452	4.8	39
1.17	5.4	0.1373	1.66	99.7	2.7	102.404	5.4	40
1.20	6.0	0.1410	1.71	102.4	3.0	105.377	6.0	41
1.23	6.6	0.1447	1.75	105.1	3.3	108.361	6.6	42
1.26	7.2	0.1484	1.80	107.8	3.6	111.361	7.2	43
1.29	7.9	0.1521	1.84	110.5	3.9	114.387	7.9	44
1.32	8.5	0.1559	1.89	113.2	4.3	117.421	8.5	45
1.35	9.2	0.1596	1.93	115.9	4.6	120.465	9.2	46
1.38	9.9	0.1634	1.98	118.6	5.0	123.552	9.9	47
1.41	10.6	0.1671	2.02	121.3	5.3	126.647	10.6	48
1.44	11.3	0.1709	2.07	124.1	5.7	129.750	11.3	49
1.47	12.1	0.1747	2.11	126.8	6.0	132.862	12.1	50
1.50	12.9	0.1784	2.16	129.6	6.4	135.981	12.9	51
1.53	13.6	0.1822	2.20	132.3	6.8	139.108	13.6	52
1.56	14.4	0.1860	2.25	135.0	7.2	142.258	14.4	53
1.59	15.2	0.1898	2.30	137.8	7.6	145.447	15.2	54
1.62	16.1	0.1937	2.34	140.6	8.0	148.642	16.1	55
1.65	16.9	0.1975	2.39	143.4	8.5	151.845	16.9	56
1.68	17.8	0.2013	2.44	146.2	8.9	155.055	17.8	57
1.71	18.6	0.2052	2.48	149.0	9.3	158.272	18.6	58
1.74	19.5	0.2090	2.53	151.7	9.8	161.496	19.5	59
1.77	20.4	0.2129	2.58	154.6	10.2	164.758	20.4	60
1.80	21.3	0.2168	2.62	157.4	10.7	168.041	21.3	61
1.83	22.2	0.2207	2.67	160.2	11.1	171.332	22.2	62
1.86	23.2	0.2246	2.72	163.1	11.6	174.628	23.2	63
1.89	24.1	0.2285	2.76	165.9	12.1	177.931	24.1	64
1.92	25.1	0.2324	2.81	168.7	12.5	181.241	25.1	65
1.95	26.0	0.2363	2.86	171.5	13.0	184.556	26.0	66
1.98	27.0	0.2402	2.91	174.4	13.5	187.913	27.0	67
2.01	28.0	0.2442	2.95	177.3	14.0	191.276	28.0	68
2.04	29.0	0.2481	3.00	180.1	14.5	194.644	29.0	69
2.07	30.0	0.2521	3.05	183.0	15.0	198.035	30.0	70
2.10	31.1	0.2561	3.10	185.9	15.5	201.438	31.1	71
2.13	32.1	0.2601	3.15	188.8	16.0	204.848	32.1	72
2.16	33.2	0.2640	3.19	191.7	16.6	208.275	33.2	73
2.19	34.2	0.2681	3.24	194.6	17.1	211.732	34.2	74
2.22	35.3	0.2721	3.29	197.5	17.6	215.194	35.3	75
2.25	36.4	0.2761	3.34	200.5	18.2	218.661	36.4	76
2.28	37.5	0.2802	3.39	203.4	18.7	222.134	37.5	77
2.31	38.6	0.2842	3.44	206.3	19.3	225.612	38.6	78
2.34	39.7	0.2882	3.49	209.2	19.8	229.096	39.7	79
2.37	40.8	0.2923	3.54	212.2	20.4	232.608	40.8	80
2.40	42.0	0.2964	3.59	215.2	21.0	236.138	42.0	81
2.43	43.1	0.3004	3.64	218.1	21.6	239.673	43.1	82
2.46	44.3	0.3045	3.68	221.1	22.1	243.221	44.3	83
2.49	45.4	0.3086	3.73	224.1	22.7	246.790	45.4	84
2.52	46.6	0.3127	3.78	227.1	23.3	250.364	46.6	85
2.55	47.8	0.3169	3.83	230.0	23.9	253.943	47.8	86
2.58	49.0	0.3210	3.88	233.0	24.5	257.550	49.0	87
2.61	50.2	0.3251	3.93	236.0	25.1	261.163	50.2	88
2.64	51.4	0.3293	3.98	239.1	25.7	264.781	51.4	89
2.67	52.7	0.3334	4.03	242.1	26.3	268.419	52.7	90
2.70	53.9	0.3376	4.09	245.1	27.0	272.070	53.9	91
2.73	55.2	0.3418	4.14	248.1	27.6	275.726	55.2	92
2.76	56.4	0.3460	4.19	251.2	28.2	279.394	56.4	93
2.79	57.7	0.3502	4.24	254.2	28.8	283.083	57.7	94
2.82	59.0	0.3544	4.29	257.3	29.5	286.777	59.0	95
2.85	60.3	0.3586	4.34	260.3	30.1	290.475	60.3	96
2.88	61.6	0.3628	4.39	263.4	30.8	294.202	61.6	97
2.91	62.9	0.3671	4.44	266.5	31.4	297.933	62.9	98
2.94	64.2	0.3713	4.49	269.6	32.1	301.669	64.2	99
2.97	65.5	0.3756	4.54	272.7	32.7	305.426	65.5	100
3.00	66.8	0.3799	4.60	275.8	33.4	309.195	66.8	101
Intermediate Calculations:								

for plotting

Fcn cfs	Outflow O, cfs
65.52	0.10
68.24	0.29
70.98	0.53
73.75	0.82
76.53	1.15
79.34	1.51
82.15	1.91
84.99	2.33
87.83	2.78
90.69	3.25
93.63	3.75
96.53	4.28
99.45	4.82
102.40	5.39
105.38	5.98
108.36	6.58
111.36	7.21
114.39	7.86
117.42	8.52
120.46	9.20
123.55	9.90
126.65	10.62
129.75	11.35
132.86	12.10
135.98	12.86
139.11	13.64
142.26	14.43
145.45	15.24
148.64	16.07
151.85	16.91
155.06	17.76
158.27	18.62
161.50	19.50
164.76	20.40
168.04	21.30
171.33	22.22
174.63	23.16
177.93	24.10
181.24	25.06
184.56	26.03
187.91	27.01
191.28	28.00
194.64	29.01
198.03	30.03
201.44	31.06
204.85	32.10
208.28	33.15
211.73	34.21
215.19	35.29
218.66	36.37
222.13	37.47
225.61	38.58
229.10	39.70
232.61	40.83
236.14	41.97
239.67	43.12
243.22	44.28
246.79	45.45
250.36	46.63
253.94	47.82
257.55	49.02
261.16	50.23
264.78	51.45
268.42	52.68
272.07	53.92
275.73	55.16
279.39	56.42
283.08	57.69
286.78	58.97
290.48	60.26
294.20	61.55
297.93	62.86
301.67	64.17
305.43	65.49
309.19	66.83
316.75	69.52



PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

ROUTING OF A FLOOD HYDROGRAPH THROUGH A STORMWATER DETENTION / RETENTION FACILITY

Worksheet to Input the Stage - Volume Relationship for the Facility

PIMA COUNTY FLOOD CONTROL

Rev.4/17

8770 N Oracle Rd	**Project Address**
Mia Perla	**Designer**
Monday, May 12, 2025	**Run Date**
PC-ROUTE v. 8.0 (XLS).xls	**Program File Name**

GOVERNING EQUATIONS: ***Ref: HEC-1 Flood Hydrograph Package User's Manual (USACOE September 1990)***

Conic method for reservoir volume: $\Delta V_{1\text{-}2} = 0.33 * h * (A_1 + A_2 + (A_1 * A_2)^{0.5})$ (see "**Conic Proj**" tab)

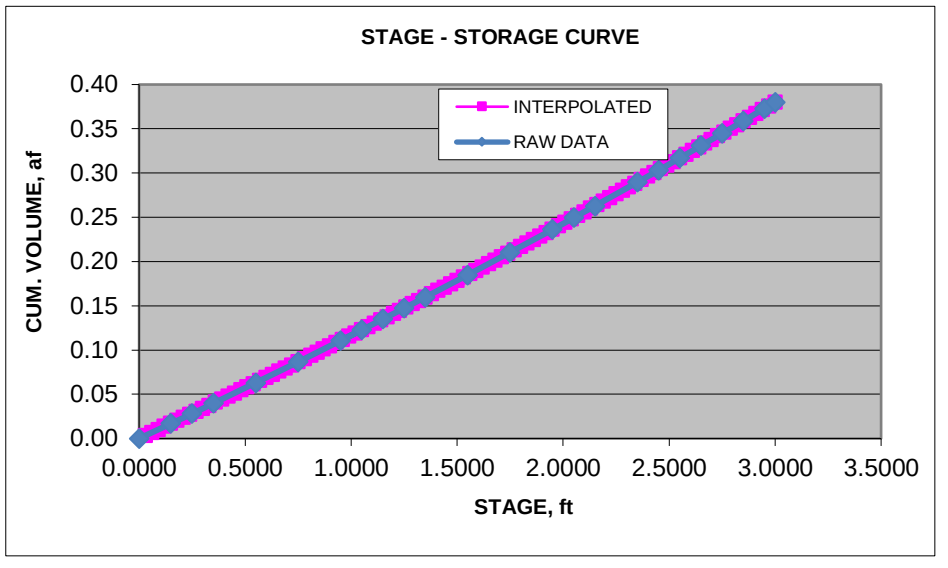
VARIABLES:

$\Delta V_{1\text{-}2}$	incremental facility storage volume between stages H_1 and H_2
h	elevation difference between A_1 and A_2
A1, A2	facility surface area at stages H_1 and H_2

3.00 = max design stage (ft)

			for information only				
stage H, ft	area A, ac	volume ΔV, af	area A, ft²	volume ΔV, ft³	Σ ΔV S, ft³	Σ ΔV S, af	index for interpolation
0.00	0.11164	0	4863	0	0	0	1
0.15	0.11306	0.017	4925	734	734	0.01685	2
0.25	0.11410	0.011	4970	495	1229	0.02821	3
0.35	0.11514	0.011	5016	499	1728	0.03967	4
0.55	0.11724	0.023	5107	1012	2740	0.06291	5
0.75	0.11934	0.024	5198	1030	3771	0.08657	6
1.05	0.12144	0.036	5290	1573	5344	0.12268	7
0.95	0.12039	-0.012	5244	-527	4817	0.11059	8
1.15	0.12250	0.024	5336	1058	5875	0.13488	9
1.25	0.12356	0.012	5382	536	6411	0.14718	10
1.35	0.12462	0.012	5429	541	6952	0.15959	11
1.55	0.12675	0.025	5521	1095	8047	0.18473	12
1.75	0.12889	0.026	5614	1114	9160	0.21029	13
1.95	0.13103	0.026	5708	1132	10293	0.23628	14
2.05	0.13211	0.013	5755	573	10866	0.24944	15
2.15	0.13319	0.013	5802	578	11444	0.26271	16
2.35	0.13536	0.027	5896	1170	12613	0.28956	17
2.45	0.13645	0.014	5944	592	13205	0.30315	18
2.55	0.13754	0.014	5991	597	13802	0.31685	19
2.65	0.13863	0.014	6039	602	14404	0.33066	20
2.75	0.13972	0.014	6086	606	15010	0.34458	21
2.85	0.14082	0.014	6134	611	15621	0.35861	22
2.95	0.14191	0.014	6182	616	16237	0.37274	23
3.00	0.14301	0.007	6230	310	16547	0.37987	24
							25
							26

Note: Develop stage-storage curve on this worksheet by either entering in the blue shaded column the planimetered basin areas (in acres) at various stages or by entering facility stages and corresponding incremental volumes (acre-feet, purple shaded column). Graph of the stage-storage curve shown to verify proper interpolation (purple points) of facility volume by **Vol Outflow** tab. **You may insert rows into the middle of this table** to accomodate the size of your data set; empty rows below the extent of your data will not cause a problem. **Stage - Volume data must begin at stage = 0 ft with a volume of 0 af. Stage - Volume data must be entered in ascending order. Blue cells below the entered data must remain empty (highlight, right-click, clear contents). All blue cells must eigther be blank or must contain a number.**



PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

ROUTING OF A FLOOD HYDROGRAPH THROUGH A STORMWATER DETENTION / RETENTION FACILITY

Worksheet to Develop the Stage - Discharge Characteristics of the Outlet Works for the Facility

PIMA COUNTY FLOOD CONTROL

Rev. 3/18

8770 N Oracle Rd	**Project Address**
Mia Perla	**Designer**
Monday, May 12, 2025	**Run Date**
PC-ROUTE v. 8.0 (XLS).xls	**Program File Name**

Note: Populate characteristics of selected outflow elements corresponding to facility outlet configuration (blue cells), or overwrite purple cells with outflows calculated outside this worksheet, as a function of the given facility stages. Storage (last column) at each stage is interpolated from stage-volume relationship (see "**Stage Vol**" tab). **Do not add rows** to this worksheet; it automatically divides maximum facility design stage into 100 increments to develop the volume-outflow curve.

GOVERNING EQUATIONS:

Orifice equation: $Q_0 = C * A * (2 * g * H)^{0.5}$ and see weir flow equation on "**Orifice**" tab

Rectangular Weir Equation: $Q_w = C * L * H^{1.5}$

Triangular Weir Equation: $Q_w = C_1 * \text{Tan}(\Theta/2) * H^{2.5}$

Box Culvert Equation: See Box Culvert equations for Inlet Control on **"RCBC"** tab

ORIFICE PLATE OUTFLOW ELEMENT

d_o (in) =		diameter	area (ft^2) =	0.000
C =		disch coefficient		
E_o (ft) =		stage @ orifice center	inv (in) =	0.00
N =		nbr identical openings	inv (ft) =	0.000

TRIANGULAR WEIR OUTFLOW ELEMENT

Z =		side slope
E_w (ft) =		stage at crest
C_1 =		disch coefficient
Θ (deg) =		notch angle

RECTANGULAR WEIR OUTFLOW ELEMENT(S)

	rect 1	rect 2	rect 3	
L (ft) =	6.6			crest length
C =	3.00			disch coefficient
E_w (ft) =	0.75			stage at crest

BOX or ROUND CULVERT OUTFLOW ELEMENT

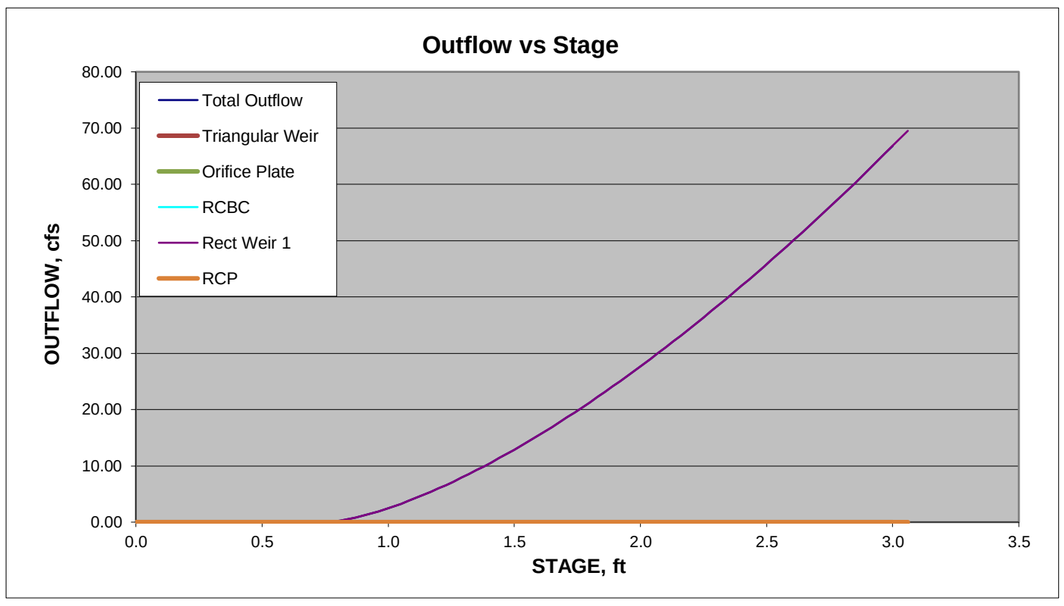
	circ pipe	RCBC	
D (ft) =			barrel rise, dia
B (ft) =			barrel span
E_b (ft) =			barrel invert
n (dim) =			Manning's coef
S (ft/ft) =			barrel slope
L (ft) =			barrel length
K_e (dim)=			ent loss coef
TW (ft) =			tailwater depth

Stage H, ft	Orifice Plate Q, cfs	Weir Element(s) Triang 1 Q, cfs	Rect 1 Q, cfs	Rect 2 Q, cfs	Rect 3 Q, cfs	RCP Q, cfs	RCBC Q, cfs	Outflow O, cfs	Σ vol S, af
0.0000								0.00	0.00000
0.0300								0.00	0.00337
0.0600								0.00	0.00674
0.0900								0.00	0.01011
0.1200								0.00	0.01348
0.1500								0.00	0.01685
0.1800								0.00	0.02026
0.2100								0.00	0.02367
0.2400								0.00	0.02707
0.2700								0.00	0.03050
0.3000								0.00	0.03394
0.3300								0.00	0.03738
0.3600								0.00	0.04083
0.3900								0.00	0.04432
0.4200								0.00	0.04780
0.4500								0.00	0.05129
0.4800								0.00	0.05478
0.5100								0.00	0.05826
0.5400								0.00	0.06175
0.5700								0.00	0.06527
0.6000								0.00	0.06882
0.6300								0.00	0.07237
0.6600								0.00	0.07592
0.6900								0.00	0.07947
0.7200								0.00	0.08302
0.7500	0.00							0.00	0.08657
0.7800	0.10							0.10	0.09018
0.8100	0.29							0.29	0.09379
0.8400	0.53							0.53	0.09740
0.8700	0.82							0.82	0.10101
0.9000	1.15							1.15	0.10462
0.9300	1.51							1.51	0.10824
0.9600	1.91							1.91	0.11185
0.9900	2.33							2.33	0.11546
1.0200	2.78							2.78	0.11907
1.0500	3.25							3.25	0.12268
1.0800	3.75							3.75	0.12638
1.1100	4.28							4.28	0.13002
1.1400	4.82							4.82	0.13367
1.1700	5.39							5.39	0.13734
1.2000	5.98							5.98	0.14103
1.2300	6.58							6.58	0.14472
1.2600	7.21							7.21	0.14842
1.2900	7.86							7.86	0.15215
1.3200	8.52							8.52	0.15587
1.3500	9.20							9.20	0.15959
1.3800	9.90							9.90	0.16336
1.4100	10.62							10.62	0.16713
1.4400	11.35							11.35	0.17090
1.4700	12.10							12.10	0.17467

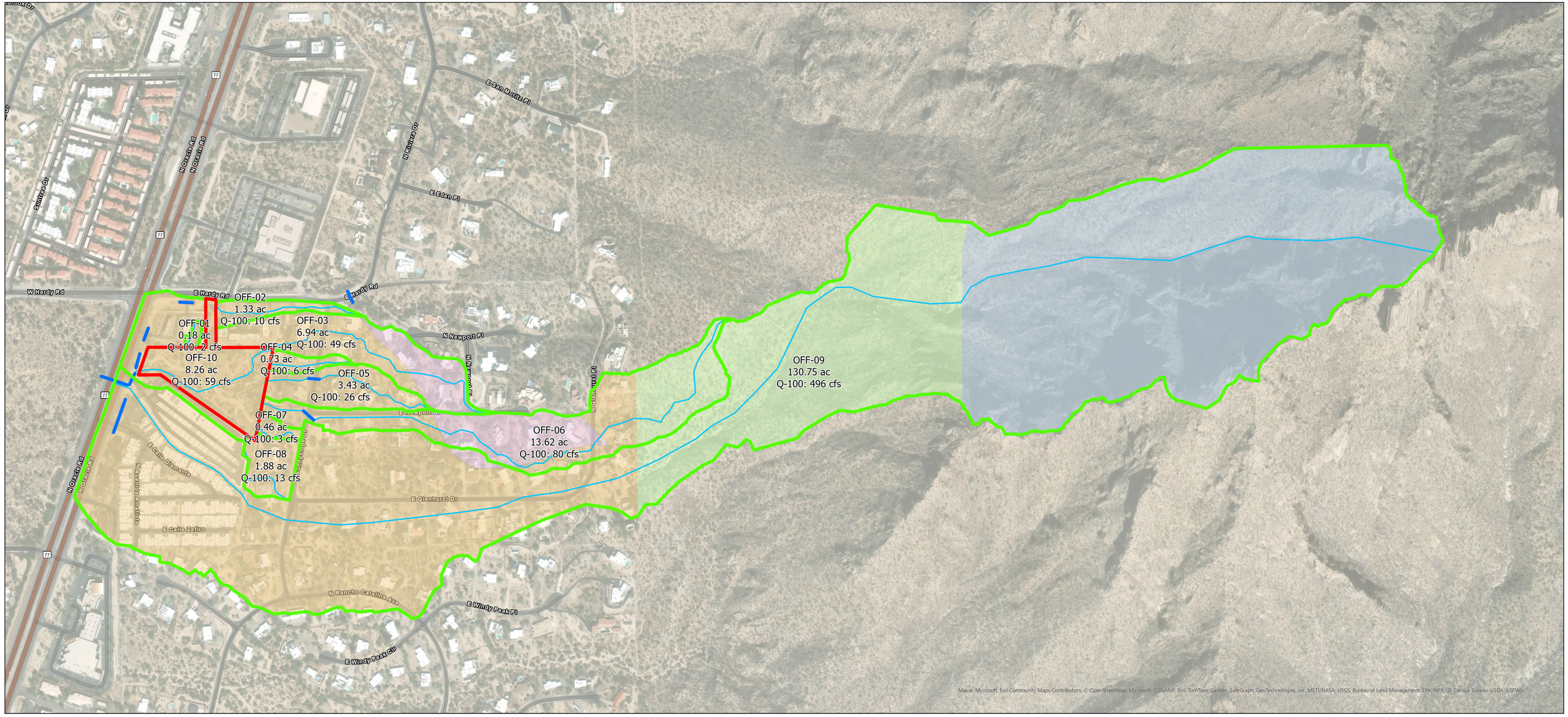
ROUTING RESULTS FOR DESIGN OF OUTLET WORKS

Max Design Stage = 3.00 ft

	Max Inflow	Max Outflow	Max Stage			target discharges
100-Yr	34.5 cfs	27.5 cfs	2.00 ft @	17 min		28.1 cfs
10-Yr	14.8 cfs	9.7 cfs	1.37 ft @	22 min		10.2 cfs
2 -yr	4.9 cfs	1.7 cfs	0.94 ft @	36 min		2.6 cfs



Appendix D – Offsite Hydrology Exhibit



Offsite Hydrology Exhibit

Legend

- Concentration Point
- Flowline
- Culvert
- Project Limits
- Watershed
- Parcels

Hydrologic Soil Group

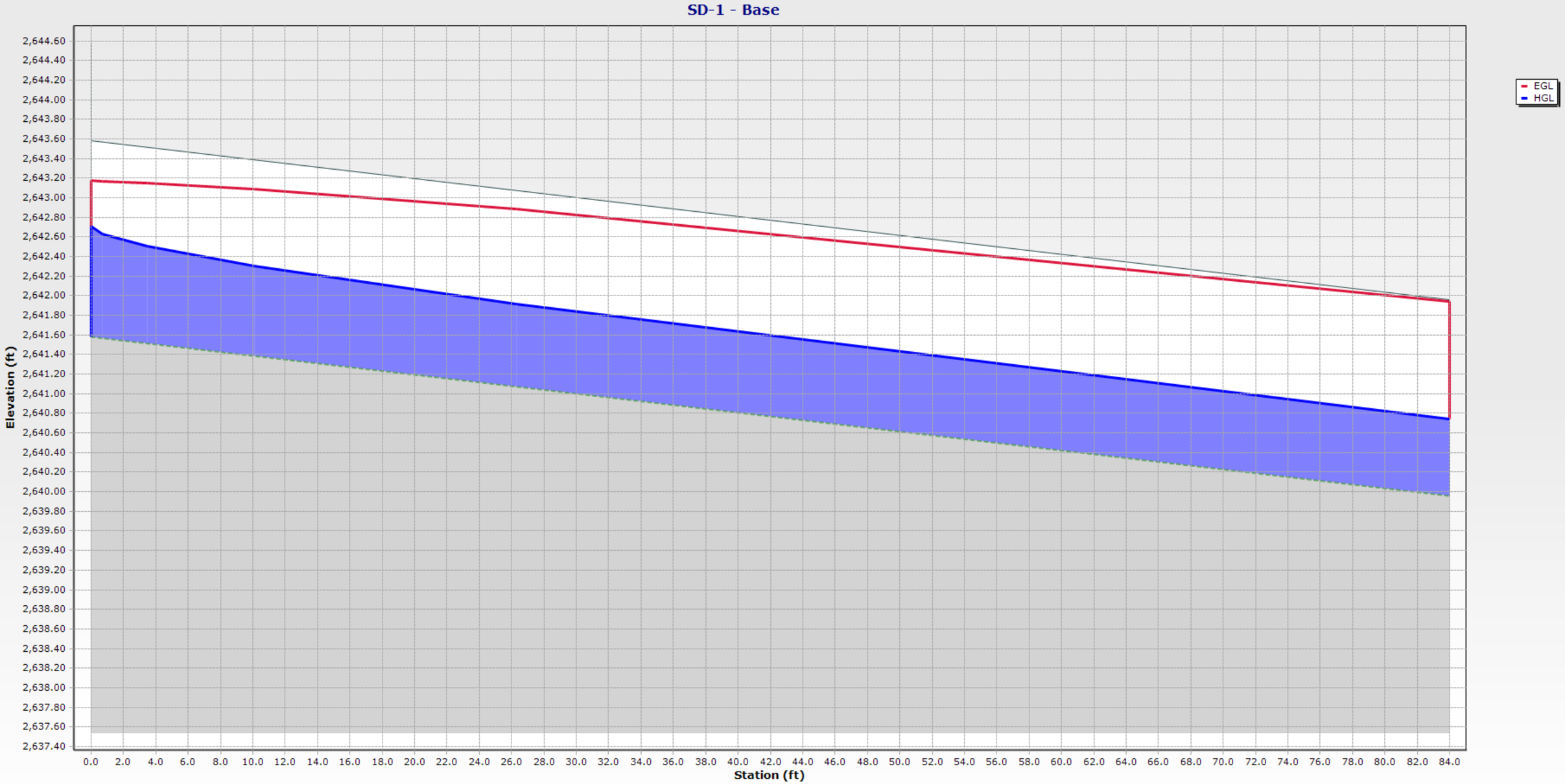
- Soil Group: B (80%) C (20%)
- Soil Group: C (100%)
- Soil Group: D (100%)
- Soil Group: C (30%) D (70%)

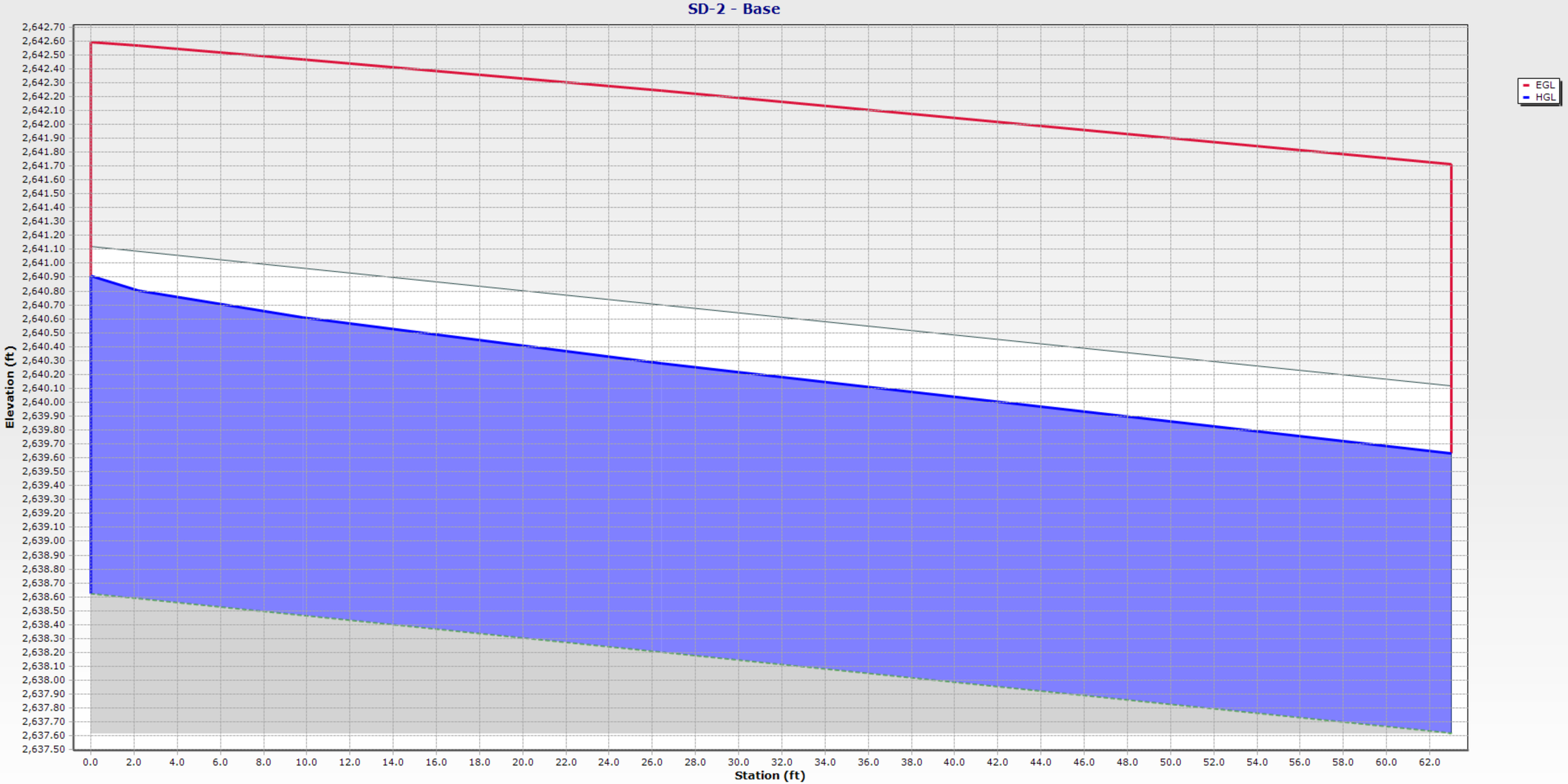
N

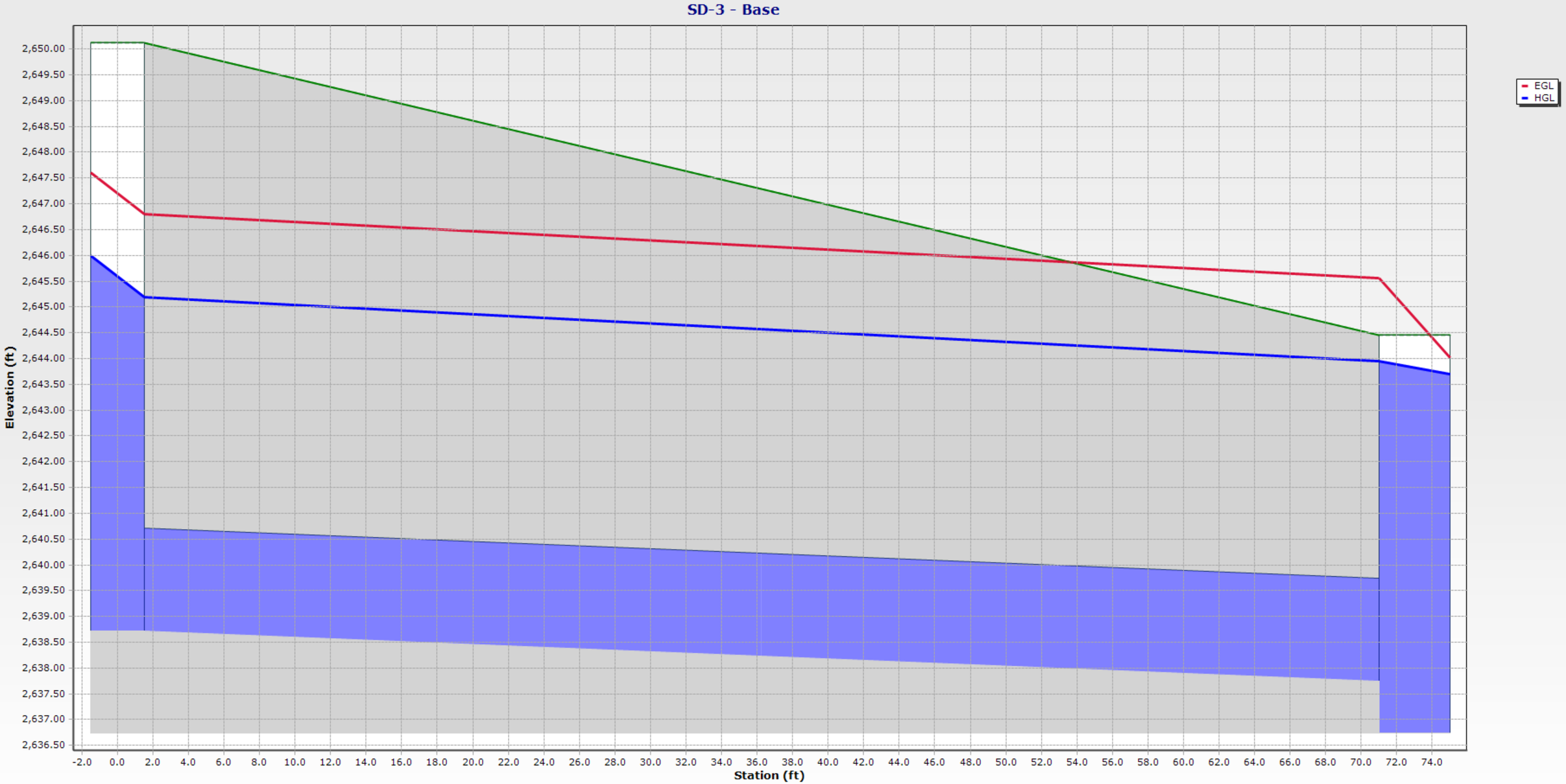
0 500 1,000 Feet

Kimley»Horn

Appendix E – HGL and EGL Analysis


SD-1 - Base
EGL
HGL
Elevation (ft)
2,644.60
2,644.40
2,644.20
2,644.00
2,643.80
2,643.60
2,643.40
2,643.20
2,643.00
2,642.80
2,642.60
2,642.40
2,642.20
2,642.00
2,641.80
2,641.60
2,641.40
2,641.20
2,641.00
2,640.80
2,640.60
2,640.40
2,640.20
2,640.00
2,639.80
2,639.60
2,639.40
2,639.20
2,639.00
2,638.80
2,638.60
2,638.40
2,638.20
2,638.00
2,637.80
2,637.60
2,637.40
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0 42.0 44.0 46.0 48.0 50.0 52.0 54.0 56.0 58.0 60.0 62.0 64.0 66.0 68.0 70.0 72.0 74.0 76.0 78.0 80.0 82.0 84.0
Station (ft)


SD-2 - Base
EGL
HGL
Elevation (ft)
2,642.70
2,642.60
2,642.50
2,642.40
2,642.30
2,642.20
2,642.10
2,642.00
2,641.90
2,641.80
2,641.70
2,641.60
2,641.50
2,641.40
2,641.30
2,641.20
2,641.10
2,641.00
2,640.90
2,640.80
2,640.70
2,640.60
2,640.50
2,640.40
2,640.30
2,640.20
2,640.10
2,640.00
2,639.90
2,639.80
2,639.70
2,639.60
2,639.50
2,639.40
2,639.30
2,639.20
2,639.10
2,639.00
2,638.90
2,638.80
2,638.70
2,638.60
2,638.50
2,638.40
2,638.30
2,638.20
2,638.10
2,638.00
2,637.90
2,637.80
2,637.70
2,637.60
2,637.50
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
26.0
28.0
30.0
32.0
34.0
36.0
38.0
40.0
42.0
44.0
46.0
48.0
50.0
52.0
54.0
56.0
58.0
60.0
62.0
Station (ft)


SD-3 - Base
EGL
HGL
Elevation (ft)
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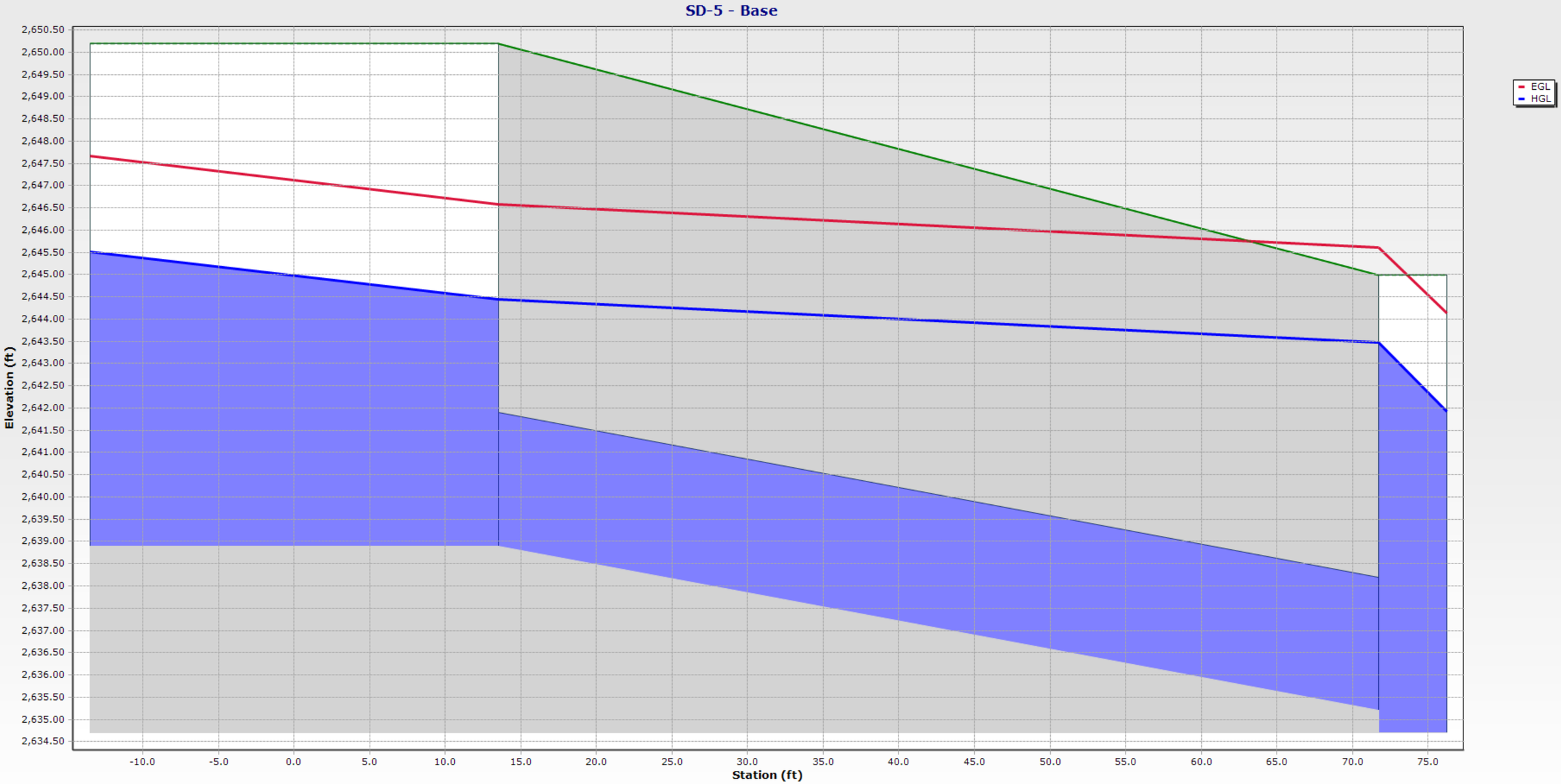
2,639.50
2,639.00
2,638.50
2,638.00
2,637.50
2,637.00
2,636.50
-2.0 0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0 42.0 44.0 46.0 48.0 50.0 52.0 54.0 56.0 58.0 60.0 62.0 64.0 66.0 68.0 70.0 72.0 74.0
Station (ft)


SD-5 - Base
EGL
HGL
Elevation (ft)
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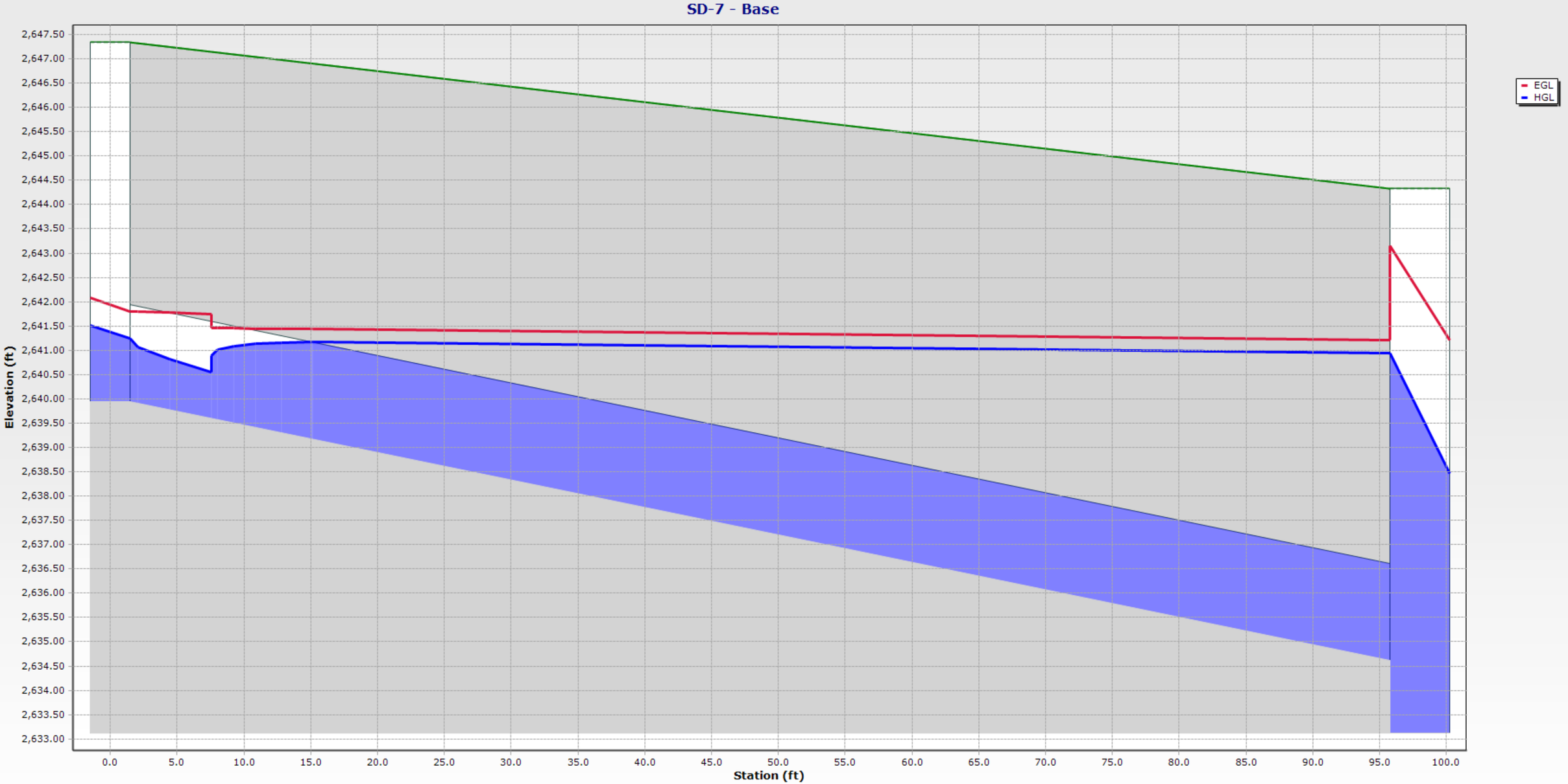
2,650.00
2,649.50
2,649.00
2,648.50
2,648.00
2,647.50
2,647.00
2,646.50
2,646.00
2,645.50
2,645.00
2,644.50
2,644.00
2,643.50
2,643.00
2,642.50
2,642.00
2,641.50
2,641.00
2,640.50
2,640.00
2,639.50
2,639.00
2,638.50
2,638.00
2,637.50
2,637.00
2,636.50
2,636.00
2,635.50
2,635.00
2,634.50
-10.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
70.0
75.0
Station (ft)


SD-7 - Base
EGL
HGL
Elevation (ft)
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2,647.00
2,646.50
2,646.00
2,645.50
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2,644.50
2,644.00
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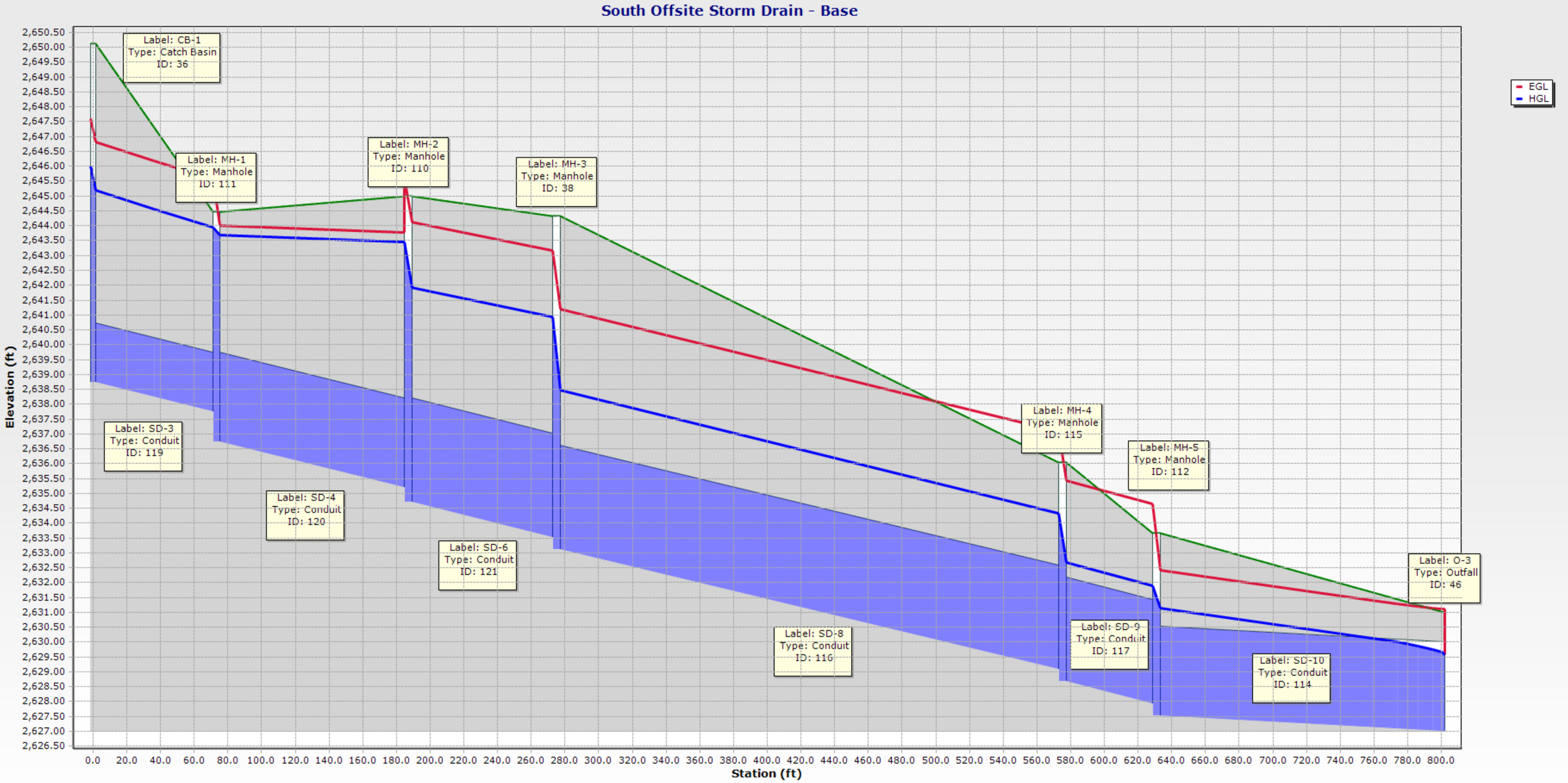
2,640.50
2,640.00
2,639.50
2,639.00
2,638.50
2,638.00
2,637.50
2,637.00
2,636.50
2,636.00
2,635.50
2,635.00
2,634.50
2,634.00
2,633.50
2,633.00
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
Station (ft)


South Offsite Storm Drain - Base
Label: CB-1
Type: Catch Basin
ID: 36
Label: MH-1
Type: Manhole
ID: 111
Label: MH-2
Type: Manhole
ID: 110
Label: MH-3
Type: Manhole
ID: 38
Label: MH-4
Type: Manhole
ID: 115
Label: MH-5
Type: Manhole
ID: 112
Label: O-3
Type: Outfall
ID: 46
Label: SD-3
Type: Conduit
ID: 119
Label: SD-4
Type: Conduit
ID: 120
Label: SD-6
Type: Conduit
ID: 121
Label: SD-8
Type: Conduit
ID: 116
Label: SD-9
Type: Conduit
ID: 117
Label: SD-10
Type: Conduit
ID: 114
EGL
HGL
Elevation (ft)
2,650.50
2,650.00
2,649.50
2,649.00
2,648.50
2,648.00
2,647.50
2,647.00
2,646.50
2,646.00
2,645.50
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Station (ft)

Appendix F – Existing 100-yr Floodplain Limits

Existing 100-yr Floodplain Limits

Kimley»Horn

Legend

- Model Boundary
- Project Limits
- Parcel Boundary
- Existing Culvert
- EG Contour (1-ft)
- Existing 100-yr Floodplain Boundary (>100 cfs)
- Existing XS

Existing 100yr Flow Depth (ft)

Value

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0

N

0 150 300 Feet

Appendix G – Proposed 100-yr Floodplain Limits

Proposed 100-yr Floodplain Limits

Legend

- Proposed 100-yr Floodplain Boundary (>100 cfs)
- Model Boundary
- Project Limits
- Parcel Boundary
- Proposed Culvert
- Existing Culvert
- FG Contour (1-ft)
- Proposed XS
- Proposed Channels

Proposed 100yr Flow Depth (ft)

Value

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0

N

0 150 300 Feet

Kimley»Horn