FINAL DRAINAGE REPORT
FOR
ORO VALLEY ASSISTED LIVING COMMUNITY
BLOCK 4 LOT 1 OF INNOVATION CORPORATE CENTER
A PORTION OF NEIGHBORHOOD 3
IN RANCHO VISTOSO

LOCATED WITHIN SECTION'S 31 & 32, T11S, R14E, G&SRM
TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
TOWN OF ORO VALLEY PROJECT NUMBER: OV 2300981
PIMA COUNTY TAX CODE: PARCEL 219-20-939A
12380 N. Vistoso Park Road

NGVD 1929

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1 Introduction

1.1 Project Description

This drainage report has been prepared in support of the Development Plan for Oro Valley Assisted Living Community located in Block 4 - Lot 1 of Innovation Corporate Center, a portion of Rancho Vistoso Neighborhood 3, part of an Industrial/Commercial development within Rancho Vistoso. The proposed Oro Valley Assisted Living Community development contains a gross area of approximately 8.03 acres and is currently zoned for Rancho Vistoso P.A.D., Campus Park Industrial Land Use. This site has been recently analyzed in the "*Final Drainage Report for Securaplane & Block 4 Pads (Lots 1 & 2) at Innovation Park*" prepared by The WLB Group, Inc., dated March 26th, 2013 (see reference 10). It should be noted within this analysis, that for each sub-basin within the watershed the Proposed Conditions discharges have been prepared with maximum development density. This report addresses offsite and onsite hydrologic and hydraulic conditions, stormwater detention/retention and conformance with applicable Town of Oro Valley drainage criteria per *Town of Oro Valley Drainage Criteria, 2020 DRAFT (Ref. 4).*

1.1.1 Project Name and Address

The project name is Oro Valley Assisted Living Community and consists of Tax Assessor Parcel Number 219-20-939A.

1.1.2 Location and Topography

This site is more specifically described as being a portion of Sections 31 & 32, Township 11 South, Range 14 East, Gila and Salt River Meridian, Town of Oro Valley, Pima County, Arizona. The site is bounded on the southwest by Vistoso Park Drive, and on the northwest by the Greenway Channel (Vistoso Community Association Bk. 63 Pg. 16 & Seq. No. 20071980025-Common Area "A"). The site is bound on the east by VWI Vistoso Investment LLC (Parcel 219-20-919A), currently undeveloped vacant desert (Vistoso Community Association Bk. 63 Pg. 17 & Seq. No. 20071980026-Common Area "B"), and Lot 1; Block 4 of Innovation Corporate Center (VWI/Vistoso Development- Seq. No. 20131300053), which is currently undeveloped vacant desert and constructed drainage channel. (see Exhibit 1).

The elevations on the site range from 2730 feet on the north side of the site to 2692 on the south side of the site (Existing Securaplane stormdrain). The existing ground slopes

generally from the northeast to southwest at an average slope greater than 2.0 percent (see Figure 3).

1.1.3 Purpose

The purpose of this report is to present the existing hydrologic and hydraulic characteristics of the area and to provide analysis, supporting information and calculations for the proposed drainage design. The site drainage has been designed in accordance with the *Town of Oro Valley Drainage Criteria, 2020 DRAFT (Ref. 4)* and has been evaluated for storm durations and frequencies of the 1-hour; 2-year, 10-year, 50-year, and 100-year storm events. A drainage strategy that will safely and efficiently convey runoff through the site and maintain the existing drainage patterns of the adjacent land has been provided.

Objectives of this report include evaluation of the hydrologic conditions given the existing and proposed site characteristics, provide sufficient sizing of hydraulic structures used in the conveyance of stormwater runoff, and design channels to convey discharge in a safe and non-erosive manner. This report will address the provisions that have been incorporated into the proposed drainage design to accommodate the existing undeveloped and future developed conditions for the site.

1.1.4 Existing Reports

This project is located immediately downstream from the Securaplane commercial development. The Block 4 Pads (Lots 1 & 2) have been previously analyzed in "*Final Drainage Report for Securaplane & Block 4 Pads (Lots 1 & 2) at Innovation Park"* OV1212-20 prepared by The WLB Group, dated March 2013. The prior report outlines the Hydrologic results for offsite discharges and watershed boundaries as well as the detention requirements for this area. Furthermore, the detention basins for Securaplane have been designed for future development runoff from the Block 4 lots. The existing floodplain adjacent to the northwest property boundary was previously analyzed "*Drainage Report for a portion of Neighborhood 3 in Rancho Vistoso (A.K.A. Innovation Corporate-East)"* prepared by The WLB Group, dated February 2007. This drainage analysis will update the previous results utilizing the updated drainage standards per the *Oro Valley Drainage Criteria, 2020 DRAFT (Ref. 4).*

1.1.5 Regional Drainage Plan/Characteristics

Careful consideration was given to ensure that the development of the Oro Valley Assisted Living Community will convey flows at or below the existing discharge outlet elevations. On-site storm water flow drains from the northwest to the southeast predominately by natural runoff from the currently undeveloped Tortolita Mountain foothills. The average slope of the site is greater than 3 percent. Existing site vegetation consists primarily of native desert grass and brush, cactus, Mesquite and Palo Verde trees. An existing collector channel (CP OS4-Collector Channel; see reference 10) located within Common Area "B" (Seq. No. 20071980026) collects and directs all offsite flows along the northeastern property line of the site (see Figure 3). In addition to the channel, a regional detention basin has been constructed for this commercial development of Block 4, Lots 1 & 2 (see reference 10). This basin is located in the southern boundary of site, and is the natural detention area immediately upstream of E. Tangerine Road immediately upstream of the existing 2 – 8' x 8' – 282 LF reinforced concrete box culvert (RCBC) discharging under E. Tangerine Road and to the south, ultimately being intercepted by Big Wash located approximately 0.4 miles to the southwest. Please note: the detention/retention requirements have been satisfied with a regional Detention Basin A located in Meggit (formerly Securaplane) commercial, adjacent to Tangerine Road Right-of-Way. The detention requirements for this portion of the Block 4 Pads (Lots 1 & 2) site have been provided by this regional basin.

1.1.6 Site Location Relative to Known FEMA Flood Hazard Zones

The effective FIRM indicates that the majority of the project site lies within the flood hazard area Zone X, as defined by FIRM Panels 04019C1090L, effective date June 16, 2011 (see Figure 2). The remaining portion is located with a Shaded Zone X.

Zone X is defined by the Federal Emergency Management Agency (FEMA) as:

Areas determined to be outside of the 1% annual chance flood. Flood insurance is optional at the discretion of the owner or lending institution.

Shaded Zone X is defined by the Federal Emergency Management Agency (FEMA) as:

Areas determined to be within of the 0.2% annual chance flood. This area is identified as being protected from the 1% chance or greater by a levee system. Flood insurance is optional at the discretion of the owner or lending institution.

2 HYDROLOGIC ANALYSIS

2.1 Off-Site Hydrology

The site is located within the Big Wash watershed. The offsite flows from the immediate hillside sheet floods across the graded area and onto the site. The Pre-Developed onsite flows drain from the north to the south, through sheet flow and natural swales, to existing culverts beneath parking lot at the Meggit (formerly Securaplane) commercial development. Using recent topography, the offsite watersheds have been re-analyzed and calculated using the new topography (October 12, 2022) and NOAA 14 precipitation values and are provided within this report.

2.1.1 Impact(s) to Proposed Project Site

The proposed development will not have any impacts from any regional (large scale) offsite watershed. Post developed conditions will closely mimic the current conditions of the site per existing conditions (see attached Figure 4). Flow will continue south in the existing stormdrain into the regional detention basin, which is ultimately intercepted by Big Wash, located approximately 0.25 miles south.

2.1.2 Existing Land Use

The site is currently vacant desert/suburban valley landscape with some natural vegetation, and two large graded super pads for Block 4 - Lot 1 (see Figure 3).

2.2 On-Site Hydrology

The design storm flow rates for pre- and post-development peak stormwater discharges were estimated using the Automated Calculation Sheet for Category 1 Flood Hydrology Procedure version 1 (C1FHP) from Town of Oro Valley, Public Works, Stormwater Utility (Reference 4). Computer results are included in Appendix A of this report. Runoff coefficients were based on the draft Drainage Design Manual from TOV-Stormwater Utility (Ref. 4). A typical runoff C-Value of 0.96 is used for areas associated with Pavement and Rooftops, and a C-value of 0.5 for Undeveloped Desert Rangeland. A weighted basin runoff factor (N_{bw}) range of 0.020 to 0.05, an impervious cover estimated to be between 20% and 50% for a residential development and a vegetative cover density approximately 25 percent of grass, brush, and trees were utilized. Hydrologic soil types located at the site have been classified as Sasabe Caralampi Complex and Comoro Sandy Loam. According to the U.S. National Resources Conservation Service (NRCS), the Sasabe

Caralampi Complex is 100% Soil Group C and Comoro Sandy Loam is 100% Soil Group A.

The site has been divided into major drainage areas in order to evaluate the conveyance of onsite runoff associated with the development of this site. Any required hydraulics (i.e. culverts, scuppers, water harvesting basins, etc.) are discussed in greater detail in the proposed drainage infrastructure section of this report.

2.2.1 Methodology and Criteria

The site is designed in accordance with the Town of Oro Valley, Stormwater Utility department *Town of Oro Valley Drainage Criteria*, *2020 DRAFT* (Ref. 4). Additionally, the following standards are referenced where applicable: City of Tucson Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona (Ref. 1) and *Hydrology Manual for Engineering Design and Floodplain Management within Pima County* (Ref. 2). The actual procedure is more specifically described as follows:

- Offsite watersheds are delineated using 1"= 120' PAG topography NGVD 29 with 1' contour intervals. Onsite watersheds are delineated using 1" = 50' topography NAVD 88 with 1' contour intervals. Drainage areas were determined through the use of AutoDesk/AutoCAD 2021. Runoff coefficients were based on the *Drainage Town of Oro Valley Drainage Criteria, DRAFT* (Ref. 2).
- The pre and post-development peak stormwater discharges affecting this project were determined in accordance with the Automated Calculation Sheet for Category 1 Flood Hydrology Procedure version 1 (C1FHP). Computer printouts of the results have been included in Appendix A of this report.

  The C1FHP Flood Peak Estimator Procedure was used to calculate the peak discharges in accordance with the *Town of Oro Valley Drainage Criteria, DRAFT (Ref. 4)* as shown below.

  $$Q_{p100\ (1\%\ AEP\ Peak)} = 1.008(C_{w1\%AEP})(i_{1\%AEP})(F_{Acw})A$$

  Where: $Q_{p100\ (1\%\ AEP\ Peak)}$= the peak discharge, in cfs, from a given area

  $C_{w1\%AEP}$ = a coefficient relating the runoff to rainfall

  $i_{1\%AEP}$= average rainfall intensity (table 4.1), in inches/hour, lasting for a T_{c100}

  $T_{c1\%AEP}$ = the time of concentration, in minutes

A = drainage area, in acres

Runoff Coefficients ("$C_{w1\%AEP}$" Values) were determined using parameters as found within Table 3-3 the *Town of Oro Valley Drainage Criteria, 2020 DRAFT (Ref. 4)* and were weighted based on natural and proposed conditions.

The rainfall intensity ($i_{1\%AEP}$) for a drainage area depends on the time of concentration (Tc), with a minimum of 5 minutes. The Tc is calculated with the following equation from the *Hydrology Manual for Engineering Design and Floodplain Management within Pima County* (Ref. 2):

$$T_{c1\%AEP} = (0.23\ n_{bw1\%AEP}(L_c L_{cs})^{0.3}/(S_c P_{1,1\%AEP} C_{w1\%AEP})^{0.4} + 1.31)^{1.61}$$

[When $5 < T_{c100} < 180$]

Where: $T_{c1\%AEP}$ = the time of concentration, in minutes;

$n_{bw1\%AEP}$ = Weighted basin factor for the 100-yr flood

L_c = length of the longest flow path, in feet

L_{ca} = length from the watershed outlet to geographical center of the watershed are, measured along the long of the longest flow path, ft

$C_{w1\%AEP}$ = weighted runoff coefficient for the 100-year flood

S_c = watercourse slope, in feet/mile

$P_{1,1\%AEP}$ = Aerial reduced one-hour, 100-year rainfall depth, in inches/hour

The drainage area, longest flow path, high and low elevations, and slopes for each watershed are based on the proposed grading design for the site. All drainage area IDs and locations are shown on Figure 4. The 2-, 10-, 50-, and the 100-year storm events are included in Appendix A.

2.2.2 Existing Condition Discharge

The site is currently mostly native desert landscape, with erosion protection improvements, fill dirt spoil piles along with clearing and grading in the area of the pads for Lots 1 & 2. Stormwater runoff will sheet flood south and collected in an existing stormwater management basin and discharged south through an existing regional detention basin, which ultimately is intercepted by Big Wash, located approximately 0.25 miles south.

Under existing conditions the site has a vegetative cover of approximately 20 percent of grass and brush. The impervious cover has been estimated to be 0% to 10% for the existing landscape rock outcrops and compacted dirt. The soils for the project site consist of Sasabe Caralampi Complex and Comoro Sandy Loam. According to the U.S. National Resources Conservation Service (NRCS), the Sasabe Caralampi Complex is 100% Soil Group C and Comoro Sandy Loam is 100% Soil Group A.

The Assisted Living Community site has been divided into 3 major watersheds in order to evaluate the natural trend, collection points of runoff, and calculate discharges in the existing condition. These concentration points are depicted on Figure 3, the Pre-Developed Watershed Map, and includes both the off- and on-site sub-basins, providing a cumulative estimation of the discharges at key points affecting the property, and its future design. The numbering scheme is built in such a fashion as to designate sub-basins (CP 2.1E is a sub-basin of CP 2.0E, etc.). All upstream sub-watersheds that contribute to the downstream sub-watershed concentration point have been calculated using the combined total area of the sub-watersheds including the remaining areas (see Figure 3B). These watersheds have been determined to have areas ranging from 0.6 to 11.4 acres, with 100-year peak discharges of 4 to 65 cfs, respectively. The Category 1 Flood Hydrology Procedure, as directed by the Town, was used to model the hydrologic conditions of these watersheds. The estimated watershed areas, with corresponding 2-, 10-, 50- and 100-year peak discharge rates, for each proposed concentration point are provided in the following table:

Table of Off-site/On-site Pre Developed 2-, 10-, 50-, and 100-Year Discharges

Concentration Point	Drainage Area (ac)	2-Year (cfs)	10-Year (cfs)	50-Year (cfs)	100-Year (cfs)
1E	11.4	12	30	55	65
1.1E	9.7	10	25	45	53
1.2E	2.4	2	6	12	14
2E	0.7	1	2	3	4
OS1a	1.4	2	4	8	9
OS1b	0.6	1	2	3	4

2.2.3 Proposed Condition Discharge

Under post-development conditions, the site has been divided into three major watersheds in order to evaluate the conveyance of onsite runoff associated with the grading of the proposed development (see Figure 4). These concentration points define onsite watersheds, and are numbered in such a fashion as to designate sub-basins (CP 1.1 is a sub-basin of CP 1.0, etc.). All upstream sub-watersheds that contribute to the downstream sub-watershed concentration point have been calculated using the combined total area of the subwatersheds including the remaining areas (see Figure 4) There are a total of 10 sub-watersheds defined by these concentration points and range in size from 0.13 acres to 11.4 acres with corresponding 100-year peak discharges of 1 cfs to 70 cfs. Runoff coefficient ranges of 0.54 to 0.91, impervious factors ranging from 0 to 10 percent, and a vegetative cover density of 20 percent were used to model developed conditions. The minor watersheds quantify drainage areas within courtyards and common areas in need of stormdrain 12-inches or bigger. The post-developed watershed areas, with corresponding 2-, 10-, 50- and 100-year peak discharge rates for each corresponding watershed, are shown in the table on the next page; see the Category 1 Flood Hydrology Procedure Worksheets in Appendix A.

Table of On-site Post Developed 2-, 10-, 50-, and 100-Year Discharges

Concentration Point	Drainage Area (ac)	2-Year (cfs)	10-Year (cfs)	50-Year (cfs)	100-Year (cfs)
1.0	11.8	15	33	62	73
1.1	0.16	0.1	1	1	1
1.1a	0.26	0.1	1	2	2
1.2	1.3	2	4	8	10
1.3	0.77	1	2	4	5
1.4	1.29	2	4	7	8
1.4a	0.1	0.1	0.1	1	1
1.5	0.4	1	1	2	3
1.6	2.57	3	7	13	16
1.7	0.19	0.1	1	1	1
1.8	0.15	0.1	0.1	1	1
1.9	1.42	2	4	8	10
2.0	0.41	0.1	1	1	2

3.0	0.77	1	2	3	4
A	0.27	0.1	1	1	2
B	0.31	0.1	1	1	2
F	0.10	0.1	0.1	1	1
G	0.26	0.1	1	2	2
H	0.08	0.1	0.1	0.1	1
I	0.14	0.1	0.1	1	1
K	0.16	0.1	0.1	1	1
L	0.16	0.1	0.1	1	1

3 DEVELOPMENT STANDARDS

3.1 Conveyance of Runoff through Project Site

This section describes the proposed drainage structures consisting of culverts, channels, scuppers, catch basins, and basins and their related outflow structures to safely convey the 100- year storm peak discharge. The following table summarizes and further explains the drainage structures for this development. Refer to Appendix B of this report for details and supporting calculations of hydraulic structures.

TABLE OF HYDRAULIC STRUCTURES		
CP	**Q100 (cfs)**	**STRUCTURE**
1.0	73	2-36” Existing SRP’s w/Headwalls; 106.5 LF @ 1.26% Slope
1.1	1	Type 5 Catch Basin w/ 1 EF-1 grate; 24” SRP, 113.48LF @ 2.2% Slope
1.2	10	Type 5 Catch Basin w/ 1 EF-1 grate; 30” SRP, 242.13LF @ 1.86% Slope
1.3	5	Type 4 Catch Basin w/2 EF-1 grate;18” SRP, 129.17LF @ 3.10% Slope
1.4	8	1-18” SRP w/Headwalls; 30 LF @ 8.0% Slope
1.4a	1	Type 4 Catch Basin w/1 EF-1 grate;18” SRP, 93.82LF @ 4.9% Slope

TABLE OF HYDRAULIC STRUCTURES		
1.5	3	Type 4 Catch Basin w/1 EF-1 grate;18" SRP, 30.0LF @ 0.5% Slope
1.6	16	1-24" CMP w/Headwalls; 10 LF @ 8.0% Slope
1.7	1	Type 5 Catch Basin w/ 1 EF-1 grate; 18" SRP, 69.34LF @ 1.01% Slope
1.8	1	Type 5 Catch Basin w/ 1 EF-1 grate; 18" SRP, 37.53LF @ 1.06% Slope
1.9	10	Type 4 Catch Basin w/4 EF-1 grate;24" SRP, 144.87LF @ 2.07% Slope

REGIONAL DETENTION BASIN A
(From Final Drainage Report Securaplane & Block 4 Pads)

This project is required to comply with drainage requirements set forth by the Town, and all new development shall conform to the Pima County Stormwater Detention/Retention Manual volumetric capturing requirements. The calculated required storage for the on-site detention is 107,618 ft^3. The Regional Detention Basin A has been designed to collect 54.93 acres of the 76.26 acres determined to be within the watershed. The remaining 21.33 acres from Block 6 (Seq. 20071980026) will bypass Basin A. The 'Pre-Dev' and 'Post-Dev' categories denote the calculated values for the 76.26 acres, while the 'Post-Actual' considers the total discharges that will be collected by Basin A. 'Bypass' verifies the discharge to go around Basin A, leaving the site directly through the Existing ADOT RCBC's. 'Det. Discharge' accounts for the Maximum discharge from Basin A to not exceed the 'Pre-Dev' discharge value. The bypass flows from concentrated point CP 1.1a (PAAL Driveway Entrance) will be ultimately intercepted and detained in Securaplane basins adjacent to Tangerine Road ROW as part of the overall drainage design for this regional basin (see reference 11).

Detention Basin Maintenance:

Regional Detention Basin A is required to have routine maintenance and inspection to ensure adequate performance for the life of the basin. The basin will be inspected after every major storm event and cleared of all organic and inorganic debris. The basin shall be cleaned after 6" of sediment has accumulated on the bottom of the basin, or once every 24 months, whichever occurs first. Finally, inspection of the basin and maintenance records is to occur on an annual basis.

First Flush

First flush is being addressed in the storm drain systems with the installation of the Triton Catch Basin Filter inserts produced by Revel Environmental Manufacturing Inc. The filter inserts are inserted into a catch basin to remove sediment, oil, and debris from urban runoff. Each major concentration point that discharges directly off the pavement surfaces will require this filter or a similar one to minimize non-point source pollutants that enter into the drainage ways and ultimately into the Town's natural watercourses. These filters will capture and eliminate pollutants that adhere to the pavement surface like hydrocarbons and other contaminants such as metals, sand, silt and litter from stormwater runoff. This filter insert resembles a treatment system or structure within a channel like a check dam fabricated of porous material (gravel, rock, sand or burlap) such that storm water can pass through yet oils and contaminants are filtered. The filter is a non-reactive High Impact Polystrene plastic construction with U.V. inhibitors. The exterior side of the filter is constructed with a Type 304 Stainless Steel and can be easily removed for ease of maintenance. The media is nonhazardous, per EPA and OSHA standards, and is easily installed into new and existing catch basins, trench drains, and sidewalk scuppers. These filters also meet Best Available Technology (BAT) for use in stormwater Best Management Practices (BMP). More detailed information on the Triton Filter Inserts is provided in Appendix B.

First Flush basin filter inserts are intended to reduce the amount of pavement surface contaminants discharged from the project site during the first half-inch depth of the 5-year storm event. Regular Maintenance inspection and/or replacement will be required for any storm event exceeding the 10-year event. These first flush devices shall be inspected and maintained according to manufacturer's recommendations by the owner.

4 INTERIM CONDITION DRAINAGE CONCEPT

There are no interim drainage concepts for this project.

5 SPECIAL ISSUES OR CONSIDERATIONS

5.1 401/404 Permit

Applicable Army Corps of Engineers (ACOE) 401/404 permitting may be necessary for the unnamed wash channelization and culvert crossings. A Nationwide Permit will be appropriate depending on the current status of the overall USACOE pursuant to Section

404 of the Federal Water Pollution Control Act amendments of 1972, 33 USC 1334. All activities associated with this project meet with the conditions of the current Nationwide Permit Number 14. WLB will coordinate with the client as to these requirements. A 404 Compliance Statement is included as Exhibit 5 of this report.

5.1.1 SWPPP

A Storm Water Pollution Prevention Plan (SWPPP) will be required for this site. Projects authorized under the Construction General Permit (CGP) will be required to supply a Notice of Intent (NOI) letter and a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP required under the Construction General Permit (CGP) will be submitted (under separate cover) for this project with the final construction plans. A Storm Water Pollution Prevention Plan (SWPPP) will be provided and will include Best Management Practices (BMPs) for the project, a revegetation and/or soil stabilization plan, an implementation and maintenance plan for the SWPPP, and the location of the BMPs or sediment control devices. The SWPPP guidelines adhere to the EPA National Pollutant Discharge Elimination System (NPDES) and the Arizona Department of Environmental Quality (ADEQ) guidelines and criteria.

Projects authorized under the Multi-Sector General Permit (MSGP) will be required to supply portions of the Notice of Intent (NOI) letter and a Storm Water Pollution Prevention Plan (SWPPP) under the Construction General Permit (CGP). Furthermore, documentation of industrial activities Standard Industrial Classification (SIC) Codes will need to be included within the MSGP, if necessary.

5.2 Downstream Impacts of Proposed Improvements

The proposed improvements will not adversely impact downstream areas. The downstream areas have been designed to account for the proposed improvements of Block 4 – Lot 1 per Final Drainage Report for Securaplane & Block 4 Pads (Lots 1 & 2) at Innovation Park (Ref 11).

5.3 Upstream Impacts of Proposed Improvements

The proposed improvements will not adversely impact upstream areas as this development is located at the top of the watershed for Block 4, Lots 1 & 2. The adjacent existing detention basin, culverts, and channel is located within a separate watershed per Innovation Corporate Center-East drainage study (Ref 10).

5.4 Floodplain use permits

The site is located outside of FEMA SFHAs, but does reside within a local regulatory 100-year floodplain. The proposed development is designed/protected outside of any local regulatory floodplains. A floodplain use permit from the Town of Oro Valley may be required for the development of this project.

6 Conclusions

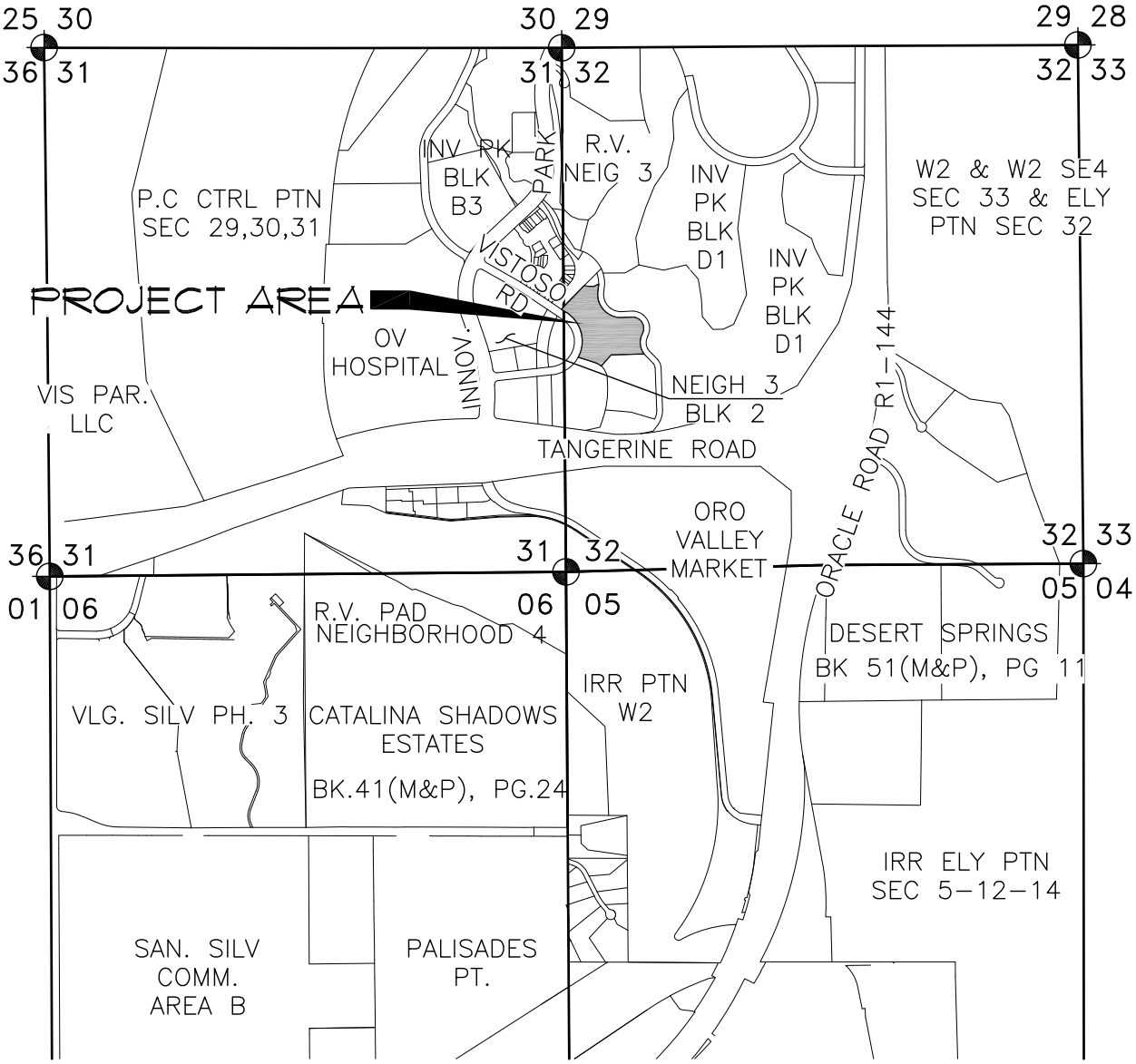
1. The project is a proposed commercial development. The site is surrounded by existing commercial developments and vacant desert landscape.
2. The onsite runoff is designed to flow away from the proposed buildings into the PAAL's and/or it will be directed around the buildings into the parking stalls, ultimately discharging into Stormdrain Run A.
3. No ephemeral stream channels or other preferential flow paths direct storm water to the project; therefore, 401/404 permitting will not be necessary.
4. The proposed minimum finished floors have been set a minimum of 1-foot above the 100-year water surface elevation adjacent to existing greenway channel adjacent to the north property boundary.
5. The effective FIRM indicates that the majority of the project site lies within the flood hazard area Zone X, as defined by FIRM Panels 04019C1090L, effective date June 16, 2011 (see Figure 2). The remaining portion is located with a Shaded Zone X.

The Oro Valley Assisted Living Community development plan has been analyzed within this report and a workable drainage design has been developed. This design will provide for the safe and efficient collection and conveyance of all onsite and offsite generated runoff. Development of this project, in accordance with the drainage design, will not produce adverse effects for adjacent or downstream property owners. However, deviation in construction from the Improvement Plans, which have been based upon this drainage report, may nullify the conclusions of this report, as may variations in climatic conditions, vegetation and erosion/deposition.

7 References

1. *City of Tucson Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona,* 201 North Stone Avenue, Tucson, AZ 85701, dated February 12, 1990
2. *Hydrology Manual for Engineering Design and Floodplain Management within Pima County, Arizona*, September 1979
3. *Highway Drainage Design Manual, Hydrology, FHW A-A293-281, March, 1993, prepared by Arizona Department of Transportation*
4. *Town of Oro Valley Drainage Criteria, Department of Public Works, Town of Oro Valley, Arizona 2020 DCM DRAFT*
5. Federal Emergency Management Agency, *Flood Insurance Rate Maps for Pima County, Arizona, and Incorporated Areas*, *Map Number 04019C1090L,* dated June 16, 2011, LOMR Effective November 19, 2020.
6. Bentley Systems, incorporated, *Bentley FlowMaster V8i.* 27 Siemons Company Drive, Watertown, Ct. 06795
7. *AutoCAD*, v2021 Land, by AutoDesk, 111 McInnis Parkway, San Rafael, CA 94903
8. *FHWA Culvert Analysis, Hy8, Version 6.1*, Department of Transportation, 400 Seventh Street, S. W., Washington, D.C. 20590.
9. *FHWA Hydraulic Toolbox, Version 4.4*, Department of Transportation, 400 Seventh Street, S. W., Washington, D.C. 20590.
10. *"Drainage Report for a Portion of Neighborhood 3 in Rancho Vistos (A.K.A. Innovation Corporate Center-East)" prepared by The WLB Group, Inc. February 2007*
11. *"Final Drainage Report for Securaplane & Block 4 Pads (Lots 1 & 2) at Innovation Park" prepared by The WLB Group, Inc. March 2013*

Exhibit 1 Vicinity Map



3" = 1 MILE

VICINITY MAP

A PORTION OF SECTION 31 & 32
T11S, R14E, G & S.R.M., TOWN OF ORO VALLEY,
PIMA COUNTY, ARIZONA

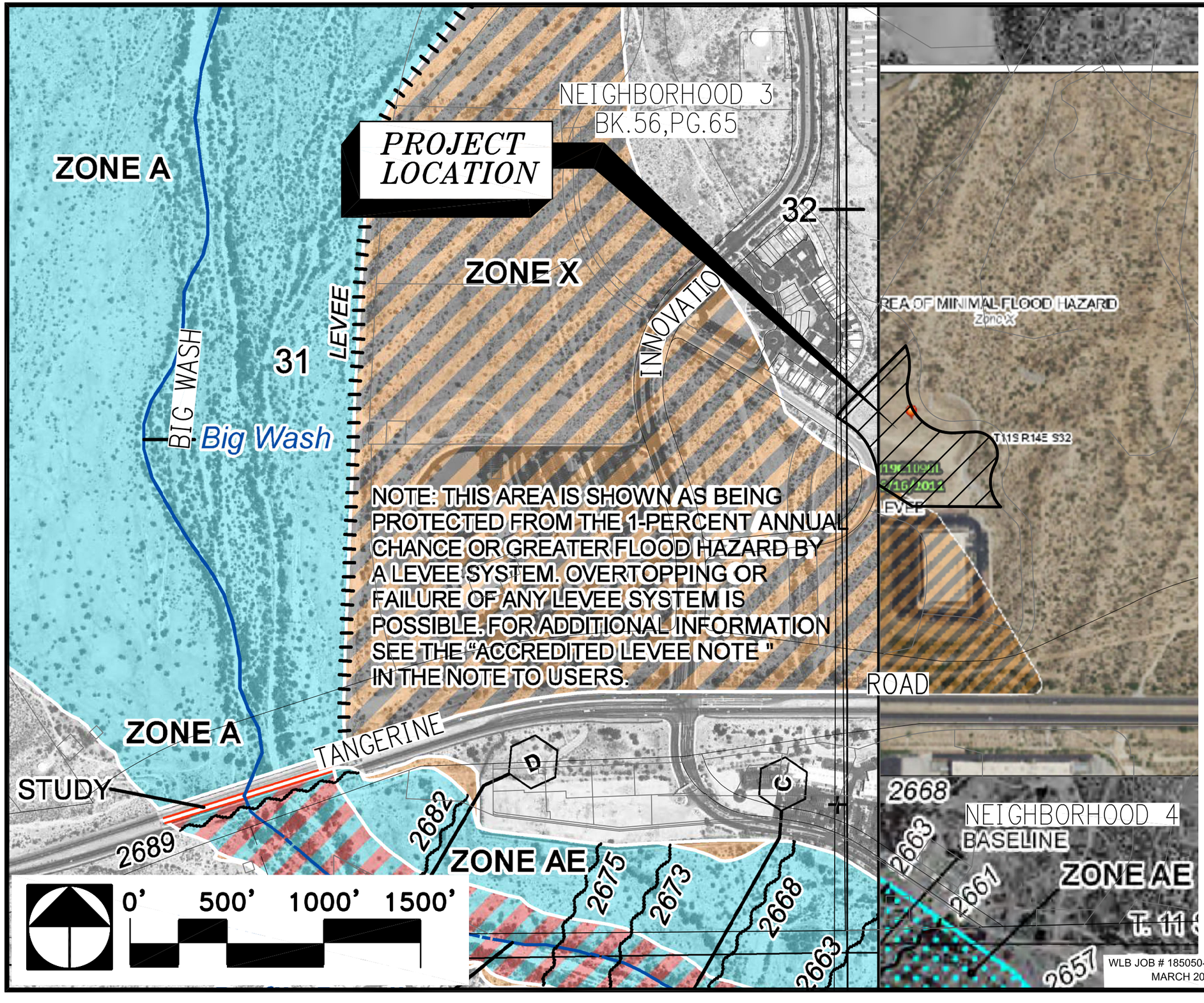
The WLB Group INC.
WLB
Offices located in Tucson, Phoenix and Las Vegas, NV
4444 East Broadway
Tucson, Arizona 85711 (520) 881-7480

FIGURE 1

Q:\185050\HN-02 RV N 3 Inn Corp Ctr Lot 1\03 Hydro\Exhibits\FIG1_LOC.dwg Plotted: Nov 07, 2023

WLB JOB# 185050-HP02-0400

Exhibit 2 FIRM (Flood Insurance Rate Map)



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

OTHER AREAS
- Area of Undetermined Flood Hazard Zone D

SCALE

Map Projection:
NAD 1983 HARN StatePlane Arizona Central FIPS 0202 Feet Intl
Western Hemisphere; Vertical Datum: NAVD 88

1 inch = 1,000 feet 1:12,000

0 500 1,000 2,000 Feet
0 150 300 600 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP
PIMA COUNTY, ARIZONA
and Incorporated Areas
PANEL 1090 OF 4750

Panel Contains:

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

REVISED TO
REFLECT LOMR
EFFECTIVE: November 19, 2020

VERSION NUMBER
2.1.3.0
MAP NUMBER
04019C1090L
MAP REVISED
JUNE 16, 2011

FIRM MAP
ORO VALLEY ASSISTED LIVING COMMUNITY LOT 1
INNOVATION PARK DRIVE
TOWN OF ORO VALLEY,
PIMA COUNTY, ARIZONA
FIGURE 2

WLB JOB # 185050-HN02-0400
MARCH 2024

Q:\185050\HN-02 RV N 3 Inn Corp Ctr Lot 1\03 Hydrol\Exhibits\FIG2-FEMA.dwg Plotted: Feb 29, 2024

Exhibit 3 Pre Developed Watershed (Figure 3)

TABLE OF PRE-DEVELOPED PEAK DISCHARGES					
CONC. PT	DRAINAGE AREA (ac)	Q_2 (cfs)	Q_{10} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
1E	11.4	12	30	55	65
1.1E	9.7	10	25	45	53
1.2E	2.4	2	6	12	14
2E	0.7	1	2	3	4
OS1a	1.4	2	4	8	9
OS1b	0.6	1	2	3	4

*EXISTING EMERGENCY OVERFLOW WEIR

*EX. TYPE 4 CATCH BASIN W/6 EF-1 GRATES RIM=2745.73' INVERT=2732.11'

*EXISTING DETENTION BASIN BASIN VOLUME=149,883 CU. FT. 100-YR WSEL=2740 WEIR CREST ELEVTION=2741

*100-YEAR PONDING LIMITS PER PLANS AND REPORT

*Q=511.5cfs

*EX. 2-60" CMP'S; 212LF @ 1.0% SLOPE; V=13.43 FPS

*EXISTING 100-YEAR FLOODPLAIN LIMIT

SOIL BOUNDARY

SASABE - CARALAMPI COMPLEX
C - 100%

COMORO SANDY LOAM
A - 100%

PROJECT BOUNDARY

**EX. EROSION PROTECTION

**EX. CONSTRUCTED CHANNEL

**EX. STORMDRAIN CATCH BASIN

**2-36" EX. SRP'S
106.5 LF @ 1.26% SLOPE
DESIGN ?=96 CFS

**2-48" EX. SRP'S
270 LF @ 132% SLOPE
DESIGN ?=196 CFS

**STORMDRAIN JUNCTION
RIM=2694.50
INV.=2690.76

**2-36" EX. SRP'S
322 LF @ 3.58% SLOPE
DESIGN ?=96 CFS

**SECURAPLANE

FEMA SHADED ZONE X FLOODPLAIN BOUNDARY

VISTOSO PARK ROAD

OS1b | OS1a | 1.2E | 2E | 1.1E | 1E

CS 186 WSEL=2726.75' | CS 179 WSEL=2725.73' | CS 172 WSEL=2723.23' | CS 171 WSEL=2722.81' | CS 169 WSEL=2721.43' | CS 168 WSEL=2720.63' | CS 167 WSEL=2720.15' | CS 163 WSEL=2719.26' | CS 162 WSEL=2719.64' | CS 161 WSEL=2716.75' | CS 159 WSEL=2716.72' | CS 158 WSEL=2714.32' | CS 157 WSEL=2716.05' | CS 153 WSEL=2714.30' | CS 151 WSEL=2713.67' | CS 150 WSEL=2713.65' | CS 144 WSEL=2713.64' | CS 139 *Qwse=479.8 CFS WSEL=2713.63' | CS 137 WSEL=2713.53'

35 2705.59

LEGEND

- WATERSHED BOUNDARY
- 2350 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- *100-YEAR FLOODPLAIN LIMIT
- *HEC-RAS CROSS SECTION
- SOILS BOUNDARY
- FEMA SHADED ZONE X BOUNDARY
- PROPERTY BOUNDARY
- EROSION HAZARD SETBACK
- 1E CONCENTRATION POINT
- FLOW DIRECTION

0' 40' 80' 120'

CONTOUR INTERVAL = 1'

REFERENCES:

*"DRAINAGE REPORT FOR A PORTION OF NEIGHBORHOOD 3 IN RANCHO VISTOSO (A.K.A. INNOVATION CORPORATE CENTER-EAST)" PREPARED BY THE WLB GROUP, INC. FEBRUARY 2007

**"FINAL DRAINAGE REPORT FOR SECURAPLANE & BLOCK 4 PADS (LOTS 1 & 2) AT INNOVATION PARK" PREPARED BY THE WLB GROUP, INC. MARCH 2013

The WLB Group INC. WLB
Engineering Planning Surveying Landscape Architecture Urban Design
Offices located in Tucson, Phoenix, and Flagstaff, Arizona, and Las Vegas, Nevada
4444 East Broadway Boulevard, Tucson, Arizona 85711 (520) 881-7480

PRE DEVELOPED WATERSHED AND FLOODPLAIN MAP

ORO VALLEY ASSISTED LIVING COMMUNITY

BLOCK 4-LOT 1, INNOVATION CORPORATE CENTER;
RANCHO VISTOSO NEIGH 3, TOWN OF ORO VALLEY, ARIZONA

FIGURE 3

WLB JOB # 185050-HN02-0400
MARCH 2024

Q:\185050\HN-02 RV N 3 Inn Corp Ctr Lot 1\03 Hydro\Exhibits\FIG3_EX.dwg Plotted: Mar 05, 2024

Exhibit 4 Post Developed Watershed Map (Figure 4)

TABLE OF POST-DEVELOPED PEAK DISCHARGES					
CONC. PT	DRAINAGE AREA (ac)	Q_2 (cfs)	Q_{10} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
1.0	11.8 (SD RUN A)	15	33	62	73
1.1	0.16	0.1	1	1	1
1.1a	0.26	0.1	1	2	2
1.2	1.3	2	4	8	10
1.3	0.77	1	2	4	5
1.4	1.29	2	4	7	8
1.4a	0.1	0.1	0.1	1	1
1.5	0.4	1	1	2	3
1.6	2.57	3	7	13	16
1.7	0.19	0.1	1	1	1
1.8	0.15	0.1	0.1	1	1
1.9	1.42	2	4	8	10
2.0	0.41	0.1	1	1	2
3.0	0.77	1	2	3	4
A	0.27	0.1	1	1	2
B	0.31	0.1	1	1	2
F	0.1	0.1	0.1	1	1
G	0.26	0.1	1	2	2
H	0.08	0.1	0.1	0.1	1
I	0.14	0.1	0.1	1	1
K	0.16	0.1	0.1	1	1
L	0.16	0.1	0.1	1	1

*EXISTING EMERGENCY OVERFLOW WEIR

*EX. TYPE 4 CATCH BASIN W/6 EF-1 GRATES RIM=2745.73' INVERT=2732.11'

*EXISTING DETENTION BASIN BASIN VOLUME=149,883 CU. FT. 100-YR WSEL=2740 WEIR CREST ELEVTION=2741

*Q_{100}=511.5cfs

*100-YEAR PONDING LIMITS PER PLANS AND REPORT

CS 186 WSEL=2726.75'

CS 179 WSEL=2725.73'

CS 172 WSEL=2723.23'

CS 171 WSEL=2722.81'

CS 168 WSEL=2720.63'

CS 169 WSEL=2721.43'

CS 167 WSEL=2720.15'

CS 163 WSEL=2719.26'

CS 164 WSEL=2719.64'

CS 159 WSEL=2716.72'

CS 162 WSEL=2716.75'

CS 156 WSEL=2714.32'

CS 157 WSEL=2716.05'

CS 151 WSEL=2713.67'

CS 153 WSEL=2714.30'

CS 150 WSEL=2713.65'

CS 144 WSEL=2713.64'

CS 139 *Q_{100}=479.8 CFS WSEL=2713.63'

CS 137 WSEL=2713.53'

*EX. 2-60" CMP'S; 212LF @ 1.0% SLOPE; V=13.43 FPS

*EXISTING 100-YEAR FLOODPLAIN LIMIT

PROJECT BOUNDARY

SOIL BOUNDARY

LOAM

SASABE - CARALAMPI COMPLEX C - 100%

COMORO SANDY LOAM A - 100%

CP 1.7 TYPE 5 CATCH BASIN W/ 1 EF-1 GRATE RIM=2714.10 INV.=2708.10

CP 1.6 HW=1.4'

RUN A 1-24" CMP; 10 LF @ 8.0% SLOPE

CP 1.5 TYPE 4 CATCH BASIN W/ 1 EF-1 GRATE RIM=2711.50 INV.=2704.90

CP 1.4a TYPE 4 CATCH BASIN W/ 1 EF-1 GRATE RIM=2711.50 INV.=2707.75

RIM=2712.50 INV.=2704.25

RUN A 1-18" SRP; 28.4 LF @ 0.9% SLOPE

X1.6

X1.4

CP 1.4 HW=1.1'

**EX. EROSION PROTECTION

RUN A 1-18" SRP; 124 LF @ 3.63% SLOPE

RUN A 1-30" SRP; 199.9 LF @ 0.50% SLOPE

RUN A 1-18" SRP; 69.3 LF @ 1.01% SLOPE

VISTOSO PARK ROAD

CP 1.8 TYPE 5 CATCH BASIN W/ 1 EF-1 GRATE RIM=2713.65 INV.=2707.30

RUN A 1-18" SRP; 37.5 LF @ 1.07% SLOPE

RIM=2713.15 INV.=2706.80

RUN A 1-18" SRP; 93.8 LF @ 4.05% SLOPE

RIM=2711.75 INV.=2703.25

RUN A 1-30" SRP; 172.3 LF @ 1.02% SLOPE

FEMA SHADED ZONE X FLOODPLAIN BOUNDARY

PROJECT BOUNDARY

CP 1.9 TYPE 4 CATCH BASIN W/ 4 EF-1 GRATES RIM=2711.00 INV.=2702.50

RUN A 1-24" SRP; 144.9 LF @1.52% SLOPE

CP 1.1 TYPE 5 CATCH BASIN W/ 1 EF-1 GRATE RIM=2707.05 INV.=2700.20

RUN A 1-24" SRP; 113.5 LF @ 1.50% SLOPE

RIM=2710.85 INV.=2697.00

RUN A 1-30" SRP; 242.1 LF @ 1.40% SLOPE

RUN A 1-18" SRP; 129.2 LF @ 2.32% SLOPE

CP 1.3 TYPE 4 CATCH BASIN W/ 2 EF-1 GRATE RIM=2710.50 INV.=2705.50

**EX. CONSTRUCTED CHANNEL

**EX. STORMDRAIN CATCH BASIN

PROJECT BOUNDARY

CP 1.2 TYPE 5 CATCH BASIN W/ 1 EF-1 GRATE RIM=2710.00 INV.=2701.40

RUN A 1-42" CMP; 62.1 LF @ 4.83% SLOPE

VISTOSO PARK ROAD CIRCLE

**2-36" EX. SRP'S 106.5 LF @ 1.26% SLOPE DESIGN Q_{100}=96 CFS

**2-48" EX. SRP'S 270 LF @ 132% SLOPE DESIGN Q_{100}=196 CFS

**STORMDRAIN JUNCTION RIM=2694.50 INV.=2690.76

**2-36" EX. SRP'S 322 LF @ 3.58% SLOPE DESIGN Q_{100}=96 CFS

**SECURAPLANE

LEGEND

- WATERSHED BOUNDARY
- SUBWATERSHED BOUNDARY
- 2350 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- *100-YEAR FLOODPLAIN LIMIT
- CS 164 / WSEL *HEC-RAS CROSS SECTION
- FEMA SHADED ZONE X
- SOILS BOUNDARY
- PROPERTY BOUNDARY
- 1.1 MAJOR CONCENTRATION POINT
- A MINOR CONCENTRATION POINT
- FLOW DIRECTION

1 PROPOSED CONSTRUCTED CHANNEL DETAIL N.T.S.

TABLE OF CONSTRUCTED CHANNELS									
X-SEC	Q_{100}(cfs)	V_{100}(fps)	fb	d	D	SLOPE(%)	Bw	SS	n
X1.4	9.0	2.89	0.16'	0.82'	0.98'	1.0 (MIN)	3'	1	0.036
X1.6	16.0	4.74	0.15'	0.52'	0.67'	3.8 (MIN)	6'	1	0.036

- SEE CALCULATION SHEETS IN HYDRO REPORT-APPENDIX B FOR MORE INFORMATION
- SIDE SLOPES STEEPER THAN 3:1 SHALL BE RIP-RAP IN ACCORDANCE TO SLOPE STABILIZATION DETAILS

0' 40' 80' 120'

CONTOUR INTERVAL = 1'

REFERENCES:

* "DRAINAGE REPORT FOR A PORTION OF NEIGHBORHOOD 3 IN RANCHO VISTOSO (A.K.A. INNOVATION CORPORATE CENTER-EAST)" PREPARED BY THE WLB GROUP, INC. FEBRUARY 2007

** "FINAL DRAINAGE REPORT FOR SECURAPLANE & BLOCK 4 PADS (LOTS 1 & 2) AT INNOVATION PARK" PREPARED BY THE WLB GROUP, INC. MARCH 2013

The WLB Group INC. WLB

Engineering Planning Surveying Landscape Architecture Urban Design Offices located in Tucson, Phoenix, and Flagstaff, Arizona, and Las Vegas, Nevada 4444 East Broadway Boulevard, Tucson, Arizona 85711 (520) 881-7480

POST DEVELOPED WATERSHED AND FLOODPLAIN MAP

ORO VALLEY ASSISTED LIVING COMMUNITY

BLOCK 4-LOT 1, INNOVATION CORPORATE CENTER;

RANCHO VISTOSO NEIGH 3, TOWN OF ORO VALLEY, ARIZONA

FIGURE 4

WLB JOB # 185050-HN02-0400

MAY 2024

Exhibit 5 404 Compliance

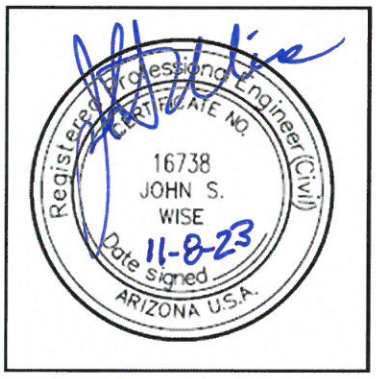
404 COMPLIANCE STATEMENT

This development, Oro Valley Assisted Living Community, contains a gross area of approximately 8.03 acres. The site is located within a portion of Sections 31 & 32, Township 11 South, Range 14 East, Gila and Salt River Meridian, Pima County, Arizona.

I, John Wise, am a Registered Professional Civil Engineer in the State of Arizona and am responsible for the preparation of the report for the above-referenced project. I attest to the following statement:

This project has been determined to be covered by the Nationwide Permit program issued by the USACOE pursuant to Section 404 of the Federal Water Pollution Control Act amendments of 1972, 33 USC 1334. All activities associated with this project meet with the conditions of the Nationwide Permit program.

ATTESTED TO THIS 8th DAY OF November 2023



Place Engineer's Seal and Signature in the space above.

COUNTY OF PIMA)

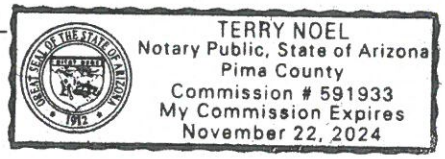
) SS

STATE OF ARIZONA)

THIS STATEMENT WAS ACKNOWLEDGED BEFORE ME THIS 8th DAY OF November 2023

NOTARY PUBLIC Terry Noel

MY COMMISSION EXPIRES November 22, 2024



Appendix A: Hydrologic Analysis

A.1 C1FHP Offsite Worksheets

A.2 C1FHP Pre Developed Worksheets

A.3 C1FHP Post Developed Worksheets

NOAA Atlas 14, Volume 1, Version 5
Location name: Tucson, Arizona, USA*
Latitude: 32.4312°, Longitude: -110.9427°
Elevation: m/ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.246** (0.218-0.282)	**0.318** (0.281-0.364)	**0.421** (0.370-0.480)	**0.499** (0.436-0.568)	**0.605** (0.522-0.686)	**0.685** (0.584-0.780)	**0.768** (0.646-0.877)	**0.851** (0.705-0.977)	**0.963** (0.778-1.11)	**1.05** (0.831-1.22)
10-min	**0.375** (0.331-0.429)	**0.484** (0.428-0.555)	**0.641** (0.563-0.731)	**0.759** (0.664-0.864)	**0.921** (0.795-1.04)	**1.04** (0.890-1.19)	**1.17** (0.983-1.33)	**1.30** (1.07-1.49)	**1.47** (1.18-1.69)	**1.60** (1.26-1.86)
15-min	**0.464** (0.410-0.532)	**0.600** (0.531-0.688)	**0.794** (0.698-0.906)	**0.941** (0.823-1.07)	**1.14** (0.985-1.30)	**1.29** (1.10-1.47)	**1.45** (1.22-1.65)	**1.61** (1.33-1.84)	**1.82** (1.47-2.10)	**1.98** (1.57-2.30)
30-min	**0.625** (0.553-0.716)	**0.808** (0.715-0.926)	**1.07** (0.939-1.22)	**1.27** (1.11-1.44)	**1.54** (1.33-1.74)	**1.74** (1.48-1.98)	**1.95** (1.64-2.23)	**2.16** (1.79-2.48)	**2.44** (1.98-2.83)	**2.66** (2.11-3.10)
60-min	**0.774** (0.684-0.886)	**1.00** (0.885-1.15)	**1.32** (1.16-1.51)	**1.57** (1.37-1.79)	**1.90** (1.64-2.16)	**2.15** (1.84-2.45)	**2.41** (2.03-2.76)	**2.68** (2.22-3.07)	**3.03** (2.45-3.50)	**3.30** (2.61-3.84)
2-hr	**0.895** (0.794-1.01)	**1.14** (1.02-1.30)	**1.49** (1.32-1.69)	**1.76** (1.54-1.99)	**2.13** (1.85-2.40)	**2.42** (2.08-2.73)	**2.72** (2.31-3.08)	**3.03** (2.52-3.43)	**3.45** (2.80-3.94)	**3.78** (3.00-4.36)
3-hr	**0.951** (0.849-1.08)	**1.20** (1.07-1.37)	**1.55** (1.38-1.76)	**1.83** (1.61-2.07)	**2.22** (1.94-2.51)	**2.53** (2.17-2.86)	**2.85** (2.41-3.24)	**3.19** (2.65-3.64)	**3.67** (2.96-4.22)	**4.05** (3.19-4.70)
6-hr	**1.10** (0.985-1.25)	**1.38** (1.24-1.56)	**1.75** (1.56-1.98)	**2.05** (1.81-2.31)	**2.47** (2.16-2.77)	**2.80** (2.42-3.15)	**3.16** (2.68-3.56)	**3.53** (2.94-3.99)	**4.05** (3.28-4.61)	**4.46** (3.54-5.13)
12-hr	**1.26** (1.14-1.41)	**1.58** (1.42-1.77)	**1.98** (1.77-2.21)	**2.30** (2.05-2.56)	**2.75** (2.42-3.06)	**3.10** (2.71-3.45)	**3.47** (2.98-3.87)	**3.84** (3.25-4.32)	**4.37** (3.61-4.96)	**4.78** (3.88-5.48)
24-hr	**1.48** (1.35-1.63)	**1.85** (1.69-2.04)	**2.32** (2.11-2.56)	**2.70** (2.45-2.98)	**3.23** (2.91-3.58)	**3.65** (3.27-4.05)	**4.10** (3.62-4.56)	**4.55** (3.98-5.10)	**5.18** (4.45-5.87)	**5.68** (4.81-6.49)
2-day	**1.65** (1.51-1.81)	**2.07** (1.89-2.27)	**2.61** (2.38-2.86)	**3.05** (2.77-3.34)	**3.65** (3.30-4.02)	**4.14** (3.70-4.57)	**4.64** (4.11-5.16)	**5.17** (4.51-5.78)	**5.89** (5.05-6.67)	**6.46** (5.46-7.40)
3-day	**1.75** (1.61-1.93)	**2.20** (2.01-2.42)	**2.79** (2.54-3.07)	**3.28** (2.98-3.60)	**3.97** (3.57-4.37)	**4.53** (4.03-5.00)	**5.13** (4.51-5.70)	**5.76** (4.99-6.45)	**6.65** (5.63-7.55)	**7.38** (6.14-8.47)
4-day	**1.86** (1.70-2.05)	**2.34** (2.13-2.57)	**2.97** (2.70-3.27)	**3.51** (3.18-3.86)	**4.28** (3.84-4.72)	**4.92** (4.36-5.44)	**5.61** (4.90-6.24)	**6.35** (5.46-7.12)	**7.41** (6.21-8.43)	**8.29** (6.81-9.54)
7-day	**2.15** (1.95-2.37)	**2.69** (2.45-2.98)	**3.43** (3.11-3.79)	**4.07** (3.67-4.50)	**5.01** (4.47-5.55)	**5.79** (5.10-6.45)	**6.65** (5.78-7.46)	**7.58** (6.49-8.58)	**8.95** (7.47-10.3)	**10.1** (8.25-11.7)
10-day	**2.40** (2.19-2.65)	**3.01** (2.73-3.32)	**3.82** (3.46-4.21)	**4.51** (4.07-4.97)	**5.51** (4.92-6.09)	**6.35** (5.61-7.04)	**7.26** (6.33-8.11)	**8.24** (7.08-9.29)	**9.66** (8.09-11.0)	**10.8** (8.89-12.5)
20-day	**3.13** (2.86-3.44)	**3.93** (3.58-4.32)	**4.98** (4.53-5.48)	**5.85** (5.30-6.43)	**7.08** (6.35-7.80)	**8.07** (7.17-8.93)	**9.13** (8.02-10.2)	**10.2** (8.89-11.5)	**11.8** (10.0-13.4)	**13.1** (10.9-15.1)
30-day	**3.81** (3.51-4.16)	**4.78** (4.38-5.20)	**5.96** (5.46-6.50)	**6.92** (6.32-7.54)	**8.24** (7.47-9.00)	**9.28** (8.35-10.2)	**10.4** (9.23-11.4)	**11.5** (10.1-12.7)	**13.0** (11.3-14.6)	**14.2** (12.1-16.1)
45-day	**4.64** (4.27-5.03)	**5.80** (5.34-6.31)	**7.17** (6.60-7.80)	**8.23** (7.57-8.96)	**9.63** (8.80-10.5)	**10.7** (9.70-11.7)	**11.7** (10.6-12.9)	**12.8** (11.4-14.1)	**14.1** (12.5-15.8)	**15.2** (13.3-17.1)
60-day	**5.23** (4.82-5.69)	**6.55** (6.02-7.12)	**8.11** (7.45-8.81)	**9.30** (8.54-10.1)	**10.9** (9.94-11.9)	**12.1** (11.0-13.2)	**13.3** (12.0-14.6)	**14.4** (12.9-15.9)	**16.0** (14.1-17.8)	**17.1** (15.0-19.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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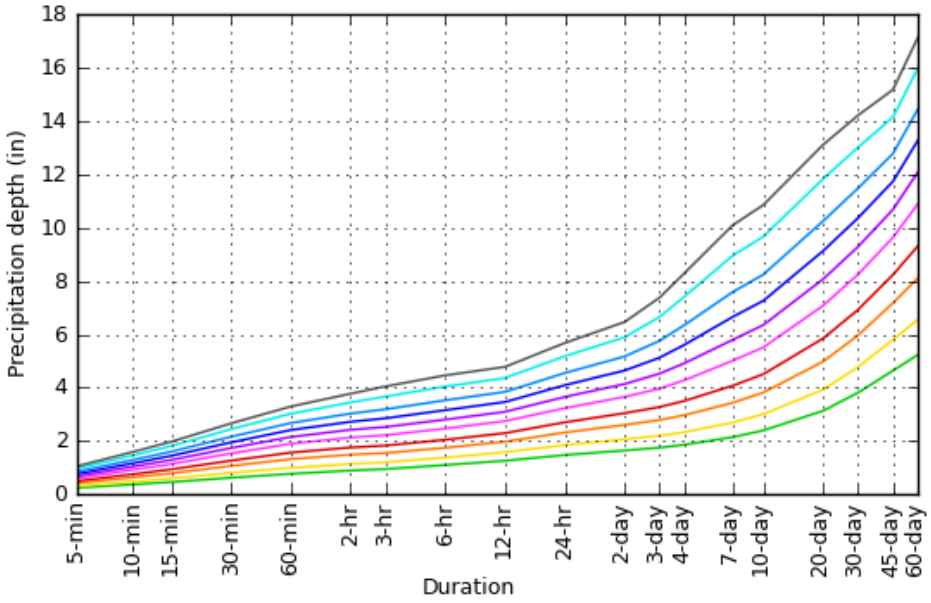
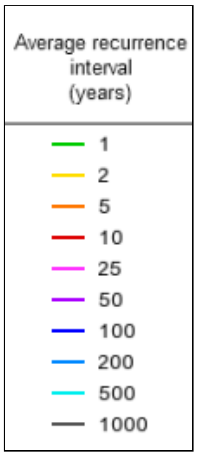
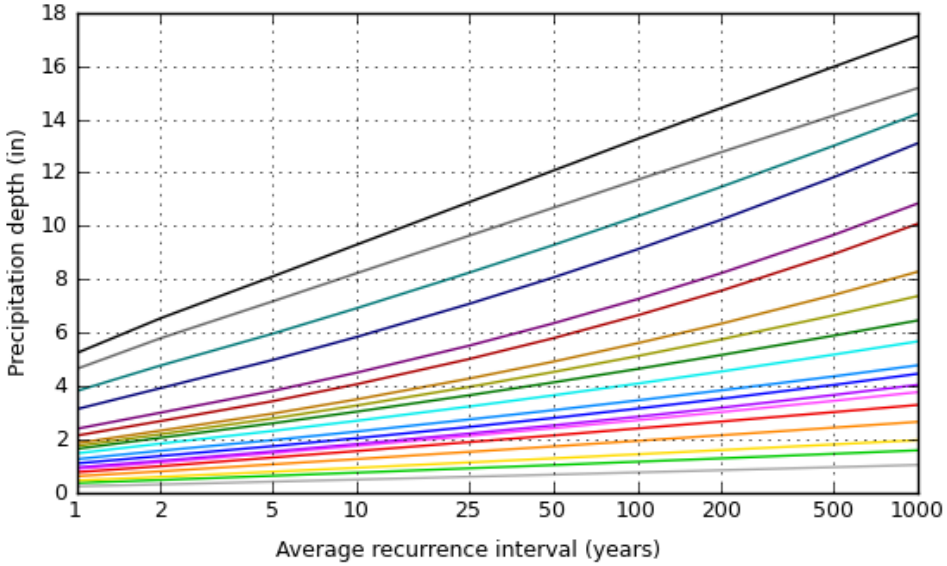
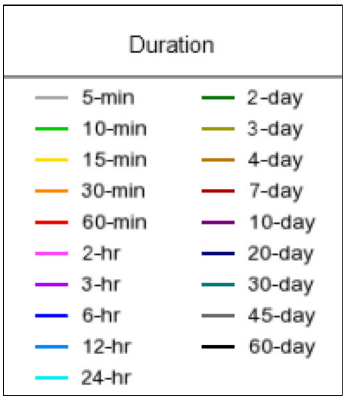
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 32.4312°, Longitude: -110.9427°









NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Wed Apr 19 23:40:57 2023

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Maps & aerials

Small scale terrain

A.1 C1FHP Offsite Worksheets

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: RV N3 Assisted Living
Drainage Concentration Point: OS1a

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 1.41 acres
Length of Hydraulically Longest Watercourse (L): 590 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 295 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: 520	feet	H_1: 66	feet	S_1:	**0.1269**	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 = 1,460

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.1634** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Natural					
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:		100														
Runoff Coeff., Pervious (C):		0.582			0.000			0.000			0.000			0.000		
% Imp. in each Subarea:		5														$IMP_{w\%}$ = **5.00**
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96		
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.601			0.000			0.000			0.000			0.000		$C_{w1\%\ AEP}$ = **0.601**

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 nearest whole minute)

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

$K_{1\%\ AEP}$ = 4 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity $(i_{1\%\ AEP}) = 5.1\ (T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}\ (P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 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: EJB
Date: 3/15/23
Checked by: JSW
Date: 3/15/23

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:	0.18	0.46	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	2	4	6	8	0

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: RV N3 Assisted Living
Drainage Concentration Point: OS1b

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.57 acres
Length of Hydraulically Longest Watercourse (L): 364 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 182 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: 364	feet	H_1: 30	feet	S_1:	**0.0824**	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 = 1,268

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0824** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Natural					
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:		100														
Runoff Coeff., Pervious (C):		0.582			0.000			0.000			0.000			0.000		
% Imp. in each Subarea:		5														$IMP_{w\%}$ = **5.00**
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96		
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.601			0.000			0.000			0.000			0.000		$C_{w1\%\ AEP}$ = **0.601**
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 nearest whole minute)

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

$K_{1\%\ AEP}$ = 4 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 4 cfs**

Prepared by: EJB
Date: 3/15/23
Checked by: JSW
Date: 3/15/23

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:	0.18	0.46	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	1	2	2	3	0

A.2 C1FHP Pre Developed Worksheets

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: RV N3 Assisted Living
Drainage Concentration Point: 1E

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 11.35 acres
Length of Hydraulically Longest Watercourse (L): 1,220 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 610 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:	1,220 feet	H_1:	88 feet	S_1:	**0.0721**	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 = 4,543

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0721** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Natural					
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:	70	30														
Runoff Coeff., Pervious (C):		0.493			0.000			0.000			0.000			0.000		
% Imp. in each Subarea:		10														$IMP_{w\%}$ = **10.00**
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96		
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.540			0.000			0.000			0.000			0.000		$C_{w1\%\ AEP}$ = **0.540**
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)

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

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

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

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 65 cfs**

Prepared by: EJB
Date: 4/20/23
Checked by: JSW
Date: 4/20/23

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:	0.18	0.46	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	12	30	42	55	0

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: RV N3 Assisted Living
Drainage Concentration Point: 1.1E

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 9.73 acres
Length of Hydraulically Longest Watercourse (L): 1,050 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 525 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: 1,050	feet	H_1: 68	feet	S_1:	**0.0648**	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 = 4,126

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0648** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Natural					
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:	70	30														
Runoff Coeff., Pervious (C):	0.493			0.000			0.000			0.000			0.000			
% Imp. in each Subarea:	5															$IMP_{w\%}$ = **5.00**
Runoff Coeff., Imp. (C):	0.96			0.96			0.96			0.96			0.96			
Wtd. Runoff C ($C_{wi\%\ AEP}$):	0.516			0.000			0.000			0.000			0.000			$C_{w1\%\ AEP}$ = **0.516**
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)

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

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

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

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 53 cfs**

Prepared by: EJB
Date: 4/20/23
Checked by: JSW
Date: 4/20/23

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:	0.18	0.46	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	10	25	35	45	0

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: RV N3 Assisted Living
Drainage Concentration Point: 1.2E

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 2.41 acres
Length of Hydraulically Longest Watercourse (L): 654 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 327 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: 654	feet	H_1: 60	feet	S_1:	**0.0917**	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 = 2,159

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0917** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Natural					
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**

	Subarea 1			Subarea 2			Subarea 3			Subarea 4			Subarea 5			
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):		0.519			0.000			0.000			0.000			0.000		
% Imp. in each Subarea:	5															$IMP_{w\%}$ = **5.00**
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96		
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.541			0.000			0.000			0.000			0.000		$C_{w1\%\ AEP}$ = **0.541**
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 nearest whole minute)

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

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

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 14 cfs**

Prepared by: EJB
Date: 3/15/23
Checked by: JSW
Date: 3/15/23

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:	0.18	0.46	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	2	6	9	12	0

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: RV N3 Assisted Living
Drainage Concentration Point: 2E

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.7 acres
Length of Hydraulically Longest Watercourse (L): 362 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 181 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: 362	feet	H_1: 12	feet	S_1:	**0.0331**	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 = 1,988

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0331** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Natural					
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:	100															
Runoff Coeff., Pervious (C):	0.455			0.000			0.000			0.000			0.000			
% Imp. in each Subarea:	10															$IMP_{w\%}$ = **10.00**
Runoff Coeff., Imp. (C):	0.96			0.96			0.96			0.96			0.96			
Wtd. Runoff C ($C_{wi\%\ AEP}$):	0.505			0.000			0.000			0.000			0.000			$C_{w1\%\ AEP}$ = **0.505**
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)

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

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

$K_{1\%\ AEP}$ = 6 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 4 cfs**

Prepared by: EJB
Date: 4/20/23
Checked by: JSW
Date: 4/20/23

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:	0.18	0.46	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	1	2	2	3	0

A.3 C1FHP Post Developed Worksheets

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: RV N3 Assisted Living
Drainage Concentration Point: 1.0 (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 11.8 acres
Length of Hydraulically Longest Watercourse (L): 1,220 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 610 feet

For (check one): Exst. Conditions [ ] Future Conditions [X]

Segment	Change in Length Factors			Change in Elevation Factors			Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1:	1,220	feet	H_1:	88	feet	S_1:	**0.0721**	feet/foot	0.028
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 = 4,543

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0721** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban/Natural					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.028**

	Subarea 1			Subarea 2			Subarea 3			Subarea 4			Subarea 5			
Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	70	30			30											
Runoff Coeff., Pervious (C):		0.493			0.175			0.000			0.000			0.000		
% Imp. in each Subarea:		50														$IMP_{w\%}$ = **50.00**
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96		
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.725			0.175			0.000			0.000			0.000		$C_{w1\%\ AEP}$ = **0.725**
Contrib. Area Factor (F_{Ac}):		0.80														F_{Acw} = **0.80**

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 nearest whole minute)

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

$K_{1\%\ AEP}$ = 4 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity $(i_{1\%\ AEP}) = 5.1\ (T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}\ (P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 73 cfs**

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	15	33	47	62	0

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: RV N3 Assisted Living
Drainage Concentration Point: 1.1 (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.16 acres
Length of Hydraulically Longest Watercourse (L): 102 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 51 feet

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

Segment	Change in Length Factors		Change in Elevation Factors		Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1: 102	feet	H_1: 2	feet	S_1:	**0.0196**	feet/foot	0.022
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 = 728

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0196** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

	Subarea 1			Subarea 2			Subarea 3			Subarea 4			Subarea 5			
Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	100															
Runoff Coeff., Pervious (C):	0.455			0.000			0.000			0.000			0.000			
% Imp. in each Subarea:	80															$IMP_{w\%}$ = **80.00**
Runoff Coeff., Imp. (C):	0.96			0.96			0.96			0.96			0.96			
Wtd. Runoff C ($C_{wi\%\ AEP}$):	0.857			0.000			0.000			0.000			0.000			$C_{w1\%\ AEP}$ = **0.857**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 1 (to nearest whole minute)

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

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

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

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

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	0	1	1	1	0

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: RV N3 Assisted Living
Drainage Concentration Point: 1.1a (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.26 acres
Length of Hydraulically Longest Watercourse (L): 200 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 100 feet

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

Segment	Change in Length Factors			Change in Elevation Factors			Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1:	200	feet	H_1:	8	feet	S_1:	**0.0400**	feet/foot	0.022
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 = 1,000

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0400** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

	Subarea 1			Subarea 2			Subarea 3			Subarea 4			Subarea 5			
Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	100															
Runoff Coeff., Pervious (C):	0.455			0.000			0.000			0.000			0.000			
% Imp. in each Subarea:	80															$IMP_{w\%}$ = **80.00**
Runoff Coeff., Imp. (C):	0.96			0.96			0.96			0.96			0.96			
Wtd. Runoff C ($C_{wi\%\ AEP}$):	0.857			0.000			0.000			0.000			0.000			$C_{w1\%\ AEP}$ = **0.857**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 1 (to nearest whole minute)

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

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

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,}$ = 1.008 $(C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})$ A **$Q_{p1\%\ AEP}$ = 2 cfs**

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	0	1	1	2	0

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: RV N3 Assisted Living
Drainage Concentration Point: 1.2 (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 1.3 acres
Length of Hydraulically Longest Watercourse (L): 288 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 144 feet

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

Segment	Change in Length Factors			Change in Elevation Factors			Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1:	288	feet	H_1:	3	feet	S_1:	**0.0087**	feet/foot	0.022
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 = 3,091

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0087** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	90	10														
Runoff Coeff., Pervious (C):	0.468			0.000			0.000			0.000			0.000			
% Imp. in each Subarea:	80															$IMP_{w\%}$ = **80.00**
Runoff Coeff., Imp. (C):	0.96			0.96			0.96			0.96			0.96			
Wtd. Runoff C ($C_{wi\%\ AEP}$):	0.859			0.000			0.000			0.000			0.000			$C_{w1\%\ AEP}$ = **0.859**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 2 (to nearest whole minute)

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

$K_{1\%\ AEP}$ = 3 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 10 cfs**

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	2	4	6	8	0

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: RV N3 Assisted Living
Drainage Concentration Point: 1.3 (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.77 acres
Length of Hydraulically Longest Watercourse (L): 352 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 176 feet

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

Segment	Change in Length Factors		Change in Elevation Factors		Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1: 352	feet	H_1: 22	feet	S_1:	**0.0625**	feet/foot	0.045
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 = 1,408

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0625** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Natural/Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.045**

Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	20	80														
Runoff Coeff., Pervious (C):		0.557			0.000			0.000			0.000			0.000		
% Imp. in each Subarea:	20															$IMP_{w\%}$ = **20.00**
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96		
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.637			0.000			0.000			0.000			0.000		$C_{w1\%\ AEP}$ = **0.637**
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 nearest whole minute)

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

$K_{1\%\ AEP}$ = 4 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,}$ = 1.008 $(C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})$ A **$Q_{p1\%\ AEP}$ = 5 cfs**

Prepared by: EJB
Date: 4/24/23
Checked by: JSW
Date: 4/24/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	1	2	3	4	0

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: RV N3 Assisted Living
Drainage Concentration Point: 1.4 (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 1.29 acres
Length of Hydraulically Longest Watercourse (L): 352 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 176 feet

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

Segment	Change in Length Factors			Change in Elevation Factors			Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1:	352	feet	H_1:	25	feet	S_1:	**0.0710**	feet/foot	0.045
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 = 1,321

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0710** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Natural/Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.045**

Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	20	80														
Runoff Coeff., Pervious (C):		0.557			0.000			0.000			0.000			0.000		
% Imp. in each Subarea:	5															$IMP_{w\%}$ = **5.00**
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96		
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.577			0.000			0.000			0.000			0.000		$C_{w1\%\ AEP}$ = **0.577**

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 nearest whole minute)

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

$K_{1\%\ AEP}$ = 4 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity $(i_{1\%\ AEP}) = 5.1\ (T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}\ (P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 8 cfs**

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	2	4	5	7	0

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: RV N3 Assisted Living
Drainage Concentration Point: 1.4a (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.1 acres
Length of Hydraulically Longest Watercourse (L): 70 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 35 feet

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

Segment	Change in Length Factors		Change in Elevation Factors		Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1: 70	feet	H_1: 1	feet	S_1:	**0.0143**	feet/foot	0.045
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 = 586

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0143** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Natural/Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.045**

	Subarea 1			Subarea 2			Subarea 3			Subarea 4			Subarea 5			
Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	20	80														
Runoff Coeff., Pervious (C):		0.557			0.000			0.000			0.000			0.000		
% Imp. in each Subarea:	5															$IMP_{w\%}$ = **5.00**
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96		
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.577			0.000			0.000			0.000			0.000		$C_{w1\%\ AEP}$ = **0.577**
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)

$T_{c1\%\ AEP}$ = 2 (to nearest whole minute)

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

$K_{1\%\ AEP}$ = 3 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

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

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	0	0	0	1	0

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: RV N3 Assisted Living
Drainage Concentration Point: 1.5 (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.4 acres
Length of Hydraulically Longest Watercourse (L): 320 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 160 feet

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

Segment	Change in Length Factors			Change in Elevation Factors			Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1:	320	feet	H_1:	12	feet	S_1:	**0.0375**	feet/foot	0.022
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 = 1,652

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0375** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	90	10														
Runoff Coeff., Pervious (C):	0.468			0.000			0.000			0.000			0.000			
% Imp. in each Subarea:	80															$IMP_{w\%}$ = **80.00**
Runoff Coeff., Imp. (C):	0.96			0.96			0.96			0.96			0.96			
Wtd. Runoff C ($C_{wi\%\ AEP}$):	0.859			0.000			0.000			0.000			0.000			$C_{w1\%\ AEP}$ = **0.859**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 1 (to nearest whole minute)

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

$K_{1\%\ AEP}$ = 2 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 3 cfs**

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	1	1	2	2	0

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: RV N3 Assisted Living
Drainage Concentration Point: 1.6 (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 2.57 acres
Length of Hydraulically Longest Watercourse (L): 730 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 365 feet

For (check one): Exst. Conditions [ ] Future Conditions [X]

Segment	Change in Length Factors		Change in Elevation Factors		Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1: 730	feet	H_1: 82	feet	S_1:	**0.1123**	feet/foot	0.045
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 = 2,178

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.1123** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Natural/Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.045**

	Subarea 1			Subarea 2			Subarea 3			Subarea 4			Subarea 5			
Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	20	80														
Runoff Coeff., Pervious (C):		0.557			0.000			0.000			0.000			0.000		
% Imp. in each Subarea:	5															$IMP_{w\%}$ = **5.00**
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96		
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.577			0.000			0.000			0.000			0.000		$C_{w1\%\ AEP}$ = **0.577**
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 nearest whole minute)

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

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

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 16 cfs**

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	3	7	10	13	0

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: RV N3 Assisted Living
Drainage Concentration Point: 1.7 (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.19 acres
Length of Hydraulically Longest Watercourse (L): 140 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 70 feet

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

Segment	Change in Length Factors			Change in Elevation Factors			Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1:	140	feet	H_1:	2	feet	S_1:	**0.0143**	feet/foot	0.022
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 = 1,171

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0143** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	100															
Runoff Coeff., Pervious (C):		0.455			0.000			0.000			0.000			0.000		
% Imp. in each Subarea:	80															$IMP_{w\%}$ = **80.00**
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96		
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.857			0.000			0.000			0.000			0.000		$C_{w1\%\ AEP}$ = **0.857**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 1 (to nearest whole minute)

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

$K_{1\%\ AEP}$ = 2 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

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

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	0	1	1	1	0

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: RV N3 Assisted Living
Drainage Concentration Point: 1.8 (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.15 acres
Length of Hydraulically Longest Watercourse (L): 146 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 73 feet

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

Segment	Change in Length Factors			Change in Elevation Factors			Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1:	146	feet	H_1:	2	feet	S_1:	**0.0137**	feet/foot	0.022
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 = 1,247

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0137** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

	Subarea 1			Subarea 2			Subarea 3			Subarea 4			Subarea 5			
Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	100															
Runoff Coeff., Pervious (C):	0.455			0.000			0.000			0.000			0.000			
% Imp. in each Subarea:	80															$IMP_{w\%}$ = **80.00**
Runoff Coeff., Imp. (C):	0.96			0.96			0.96			0.96			0.96			
Wtd. Runoff C ($C_{wi\%\ AEP}$):	0.857			0.000			0.000			0.000			0.000			$C_{w1\%\ AEP}$ = **0.857**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 1 (to nearest whole minute)

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

$K_{1\%\ AEP}$ = 2 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = $5.1\ (T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}\ (P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

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

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	0	0	1	1	0

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: RV N3 Assisted Living
Drainage Concentration Point: 1.9 (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 1.42 acres
Length of Hydraulically Longest Watercourse (L): 640 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 320 feet

For (check one): Exst. Conditions [ ] Future Conditions [X]

Segment	Change in Length Factors		Change in Elevation Factors		Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1: 640	feet	H_1: 30	feet	S_1:	**0.0469**	feet/foot	0.022
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 = 2,956

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0469** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	100															
Runoff Coeff., Pervious (C):		0.455			0.000			0.000			0.000			0.000		
% Imp. in each Subarea:	70															$IMP_{w\%}$ = **70.00**
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96		
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.807			0.000			0.000			0.000			0.000		$C_{w1\%\ AEP}$ = **0.807**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 2 (to nearest whole minute)

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

$K_{1\%\ AEP}$ = 3 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 10 cfs**

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	2	4	6	8	0

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: RV N3 Assisted Living
Drainage Concentration Point: 2.0 (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.41 acres
Length of Hydraulically Longest Watercourse (L): 272 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 136 feet

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

Segment	Change in Length Factors			Change in Elevation Factors			Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1:	272	feet	H_1:	8	feet	S_1:	**0.0294**	feet/foot	0.022
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 = 1,586

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0294** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

	Subarea 1			Subarea 2			Subarea 3			Subarea 4			Subarea 5			
Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	100															
Runoff Coeff., Pervious (C):		0.455			0.000			0.000			0.000			0.000		
% Imp. in each Subarea:	40															$IMP_{w\%}$ = **40.00**
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96		
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.656			0.000			0.000			0.000			0.000		$C_{w1\%\ AEP}$ = **0.656**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 1 (to nearest whole minute)

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

$K_{1\%\ AEP}$ = 2 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 2 cfs**

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	0	1	1	2	0

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: RV N3 Assisted Living
Drainage Concentration Point: 3.0 (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.77 acres
Length of Hydraulically Longest Watercourse (L): 330 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 165 feet

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

Segment	Change in Length Factors		Change in Elevation Factors		Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1: 330	feet	H_1: 23	feet	S_1:	**0.0697**	feet/foot	0.022
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 = 1,250

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0697** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	100															
Runoff Coeff., Pervious (C):	0.455			0.000			0.000			0.000			0.000			
% Imp. in each Subarea:	30															$IMP_{w\%}$ = **30.00**
Runoff Coeff., Imp. (C):	0.96			0.96			0.96			0.96			0.96			
Wtd. Runoff C ($C_{wi\%\ AEP}$):	0.606			0.000			0.000			0.000			0.000			$C_{w1\%\ AEP}$ = **0.606**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 1 (to nearest whole minute)

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

$K_{1\%\ AEP}$ = 2 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 4 cfs**

Prepared by: EJB
Date: 11/6/23
Checked by: JSW
Date: 11/6/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	1	2	3	3	0

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: RV N3 Assisted Living
Drainage Concentration Point: A (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.27 acres
Length of Hydraulically Longest Watercourse (L): 180 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 90 feet

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

Segment	Change in Length Factors			Change in Elevation Factors			Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1:	180	feet	H_1:	2	feet	S_1:	**0.0111**	feet/foot	0.022
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 = 1,708

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0111** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	100															
Runoff Coeff., Pervious (C):	0.455			0.000			0.000			0.000			0.000			
% Imp. in each Subarea:	40															$IMP_{w\%}$ = **40.00**
Runoff Coeff., Imp. (C):	0.96			0.96			0.96			0.96			0.96			
Wtd. Runoff C ($C_{wi\%\ AEP}$):	0.656			0.000			0.000			0.000			0.000			$C_{w1\%\ AEP}$ = **0.656**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 1 (to nearest whole minute)

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

$K_{1\%\ AEP}$ = 2 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 2 cfs**

Prepared by: EJB
Date: 11/2/23
Checked by: JSW
Date: 11/2/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	0	1	1	1	0

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: RV N3 Assisted Living
Drainage Concentration Point: B (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.31 acres
Length of Hydraulically Longest Watercourse (L): 200 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 100 feet

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

Segment	Change in Length Factors		Change in Elevation Factors		Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1: 200	feet	H_1: 2	feet	S_1:	**0.0100**	feet/foot	0.022
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 = 2,000

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0100** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

	Subarea 1			Subarea 2			Subarea 3			Subarea 4			Subarea 5			
Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	100															
Runoff Coeff., Pervious (C):	0.455			0.000			0.000			0.000			0.000			
% Imp. in each Subarea:	40															$IMP_{w\%}$ = **40.00**
Runoff Coeff., Imp. (C):	0.96			0.96			0.96			0.96			0.96			
Wtd. Runoff C ($C_{wi\%\ AEP}$):	0.656			0.000			0.000			0.000			0.000			$C_{w1\%\ AEP}$ = **0.656**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 2 (to nearest whole minute)

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

$K_{1\%\ AEP}$ = 3 (to nearest whole value)

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,}$ = 1.008 $(C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})$ A **$Q_{p1\%\ AEP}$ = 2 cfs**

Prepared by: EJB
Date: 11/2/23
Checked by: JSW
Date: 11/2/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	0	1	1	1	0

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: RV N3 Assisted Living
Drainage Concentration Point: F (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.1 acres
Length of Hydraulically Longest Watercourse (L): 80 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 40 feet

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

Segment	Change in Length Factors		Change in Elevation Factors		Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1: 80	feet	H_1: 2	feet	S_1:	**0.0250**	feet/foot	0.022
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 = 506

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0250** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

	Subarea 1			Subarea 2			Subarea 3			Subarea 4			Subarea 5			
Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	100															
Runoff Coeff., Pervious (C):	0.455			0.000			0.000			0.000			0.000			
% Imp. in each Subarea:	70															$IMP_{w\%}$ = **70.00**
Runoff Coeff., Imp. (C):	0.96			0.96			0.96			0.96			0.96			
Wtd. Runoff C ($C_{wi\%\ AEP}$):	0.807			0.000			0.000			0.000			0.000			$C_{w1\%\ AEP}$ = **0.807**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 1 (to nearest whole minute)

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

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

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

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

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	0	0	0	1	0

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: RV N3 Assisted Living
Drainage Concentration Point: G (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.26 acres
Length of Hydraulically Longest Watercourse (L): 50 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 25 feet

For (check one): Exst. Conditions [ ] Future Conditions [X]

Segment	Change in Length Factors		Change in Elevation Factors		Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1: 50	feet	H_1: 2	feet	S_1:	**0.0400**	feet/foot	0.022
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 = 250

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0400** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	100															
Runoff Coeff., Pervious (C):	0.455			0.000			0.000			0.000			0.000			
% Imp. in each Subarea:	70															$IMP_{w\%}$ = **70.00**
Runoff Coeff., Imp. (C):	0.96			0.96			0.96			0.96			0.96			
Wtd. Runoff C ($C_{wi\%\ AEP}$):	0.807			0.000			0.000			0.000			0.000			$C_{w1\%\ AEP}$ = **0.807**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 1 (to nearest whole minute)

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

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

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

1% AEP Peak, $Q_{p1\%\ AEP,} = 1.008\ (C_{w1\%\ AEP})(i_{1\%\ AEP})(F_{Acw})\ A$ **$Q_{p1\%\ AEP}$ = 2 cfs**

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	0	1	1	2	0

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: RV N3 Assisted Living
Drainage Concentration Point: H (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.08 acres
Length of Hydraulically Longest Watercourse (L): 50 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 25 feet

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

Segment	Change in Length Factors			Change in Elevation Factors			Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1:	50	feet	H_1:	2	feet	S_1:	**0.0400**	feet/foot	0.022
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 = 250

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0400** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

	Subarea 1			Subarea 2			Subarea 3			Subarea 4			Subarea 5			
Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	100															
Runoff Coeff., Pervious (C):	0.455			0.000			0.000			0.000			0.000			
% Imp. in each Subarea:	70															$IMP_{w\%}$ = **70.00**
Runoff Coeff., Imp. (C):	0.96			0.96			0.96			0.96			0.96			
Wtd. Runoff C ($C_{wi\%\ AEP}$):	0.807			0.000			0.000			0.000			0.000			$C_{w1\%\ AEP}$ = **0.807**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 1 (to nearest whole minute)

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

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

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

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

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	0	0	0	0	0

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: RV N3 Assisted Living
Drainage Concentration Point: I (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.14 acres
Length of Hydraulically Longest Watercourse (L): 50 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 25 feet

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

Segment	Change in Length Factors		Change in Elevation Factors		Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1: 50	feet	H_1: 2	feet	S_1:	**0.0400**	feet/foot	0.022
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 = 250

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0400** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	100															
Runoff Coeff., Pervious (C):	0.455			0.000			0.000			0.000			0.000			
% Imp. in each Subarea:	70															$IMP_{w\%}$ = **70.00**
Runoff Coeff., Imp. (C):	0.96			0.96			0.96			0.96			0.96			
Wtd. Runoff C ($C_{wi\%\ AEP}$):	0.807			0.000			0.000			0.000			0.000			$C_{w1\%\ AEP}$ = **0.807**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 1 (to nearest whole minute)

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

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

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

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

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	0	0	1	1	0

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: RV N3 Assisted Living
Drainage Concentration Point: K (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.16 acres
Length of Hydraulically Longest Watercourse (L): 80 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 40 feet

For (check one): Exst. Conditions [ ] Future Conditions [X]

Segment	Change in Length Factors		Change in Elevation Factors		Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1: 80	feet	H_1: 2	feet	S_1:	**0.0250**	feet/foot	0.022
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 = 506

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0250** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

	Subarea 1			Subarea 2			Subarea 3			Subarea 4			Subarea 5			
Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	100															
Runoff Coeff., Pervious (C):	0.455			0.000			0.000			0.000			0.000			
% Imp. in each Subarea:	60															$IMP_{w\%}$ = **60.00**
Runoff Coeff., Imp. (C):	0.96			0.96			0.96			0.96			0.96			
Wtd. Runoff C ($C_{wi\%\ AEP}$):	0.756			0.000			0.000			0.000			0.000			$C_{w1\%\ AEP}$ = **0.756**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 1 (to nearest whole minute)

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

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

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

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

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	0	0	1	1	0

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: RV N3 Assisted Living
Drainage Concentration Point: L (Dev)

Watershed Centroid: Lat.: 32.4304 Long.: -110.9427

Watershed Area (A) at Drainage Concentration Point: 0.16 acres
Length of Hydraulically Longest Watercourse (L): 80 feet
Length from Center of Watershed Area (L_{ca}), along L_c : 40 feet

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

Segment	Change in Length Factors		Change in Elevation Factors		Segment	Calculated Slope		$n_{bi\ AEP}$
1	L_1: 80	feet	H_1: 1	feet	S_1:	**0.0125**	feet/foot	0.022
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 = 716

Mean Slope, $S_c = (L_c/G)^2$ S_c = **0.0125** feet/foot

NOAA 14 1% AEP 1-Hour Rainfall Depth (**at Upper 90% Confidence Interval**): $P^{1-hr}_{1\%\ AEP}$ = **2.76** inches

	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Weighted Watershed Parameters
Watershed Type(s)	Highly Urban					
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 $0.2169(S_i)^{0.5}$ $n_{bw1\%\ AEP}$ = **0.022**

	Subarea 1			Subarea 2			Subarea 3			Subarea 4			Subarea 5			
Hydrologic Soil Group (HSG)	B	C	D	B	C	D	B	C	D	B	C	D	B	C	D	
Percentage of HSG:	100															
Runoff Coeff., Pervious (C):		0.455			0.000			0.000			0.000			0.000		
% Imp. in each Subarea:	50															$IMP_{w\%}$ = **50.00**
Runoff Coeff., Imp. (C):		0.96			0.96			0.96			0.96			0.96		
Wtd. Runoff C ($C_{wi\%\ AEP}$):		0.706			0.000			0.000			0.000			0.000		$C_{w1\%\ AEP}$ = **0.706**
Contrib. Area Factor (F_{Ac}):	0.80															F_{Acw} = **0.80**

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)

$T_{c1\%\ AEP}$ = 1 (to nearest whole minute)

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

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

At $T_{c1\%\ AEP}$, the Rainfall Intensity ($i_{1\%\ AEP}$) = 5.1 $(T_{c1\%\ AEP})^{-[0.0369+0.2030(\text{Log } T_{c1\%\ AEP})]}$ $(P^{1-hr}_{1\%\ AEP})$ **$i_{1\%\ AEP}$ = 10.56 in./hr.**

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

Prepared by: EJB
Date: 11/1/23
Checked by: JSW
Date: 11/1/23

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:	0.2	0.45	0.65	0.85	
$T_{Cn\%\ AEP}$ (min., per Eqn. 3.12)	10	7	6	5	#DIV/0!
$Q_{n\%\ AEP}$ (cfs):	0	0	1	1	0

Appendix B: Hydraulic Analysis

B.1 Storm drain Run A StormCAD worksheets and profiles

B.2 Grate Inlet Worksheets

B.3 Constructed Channel Worksheets

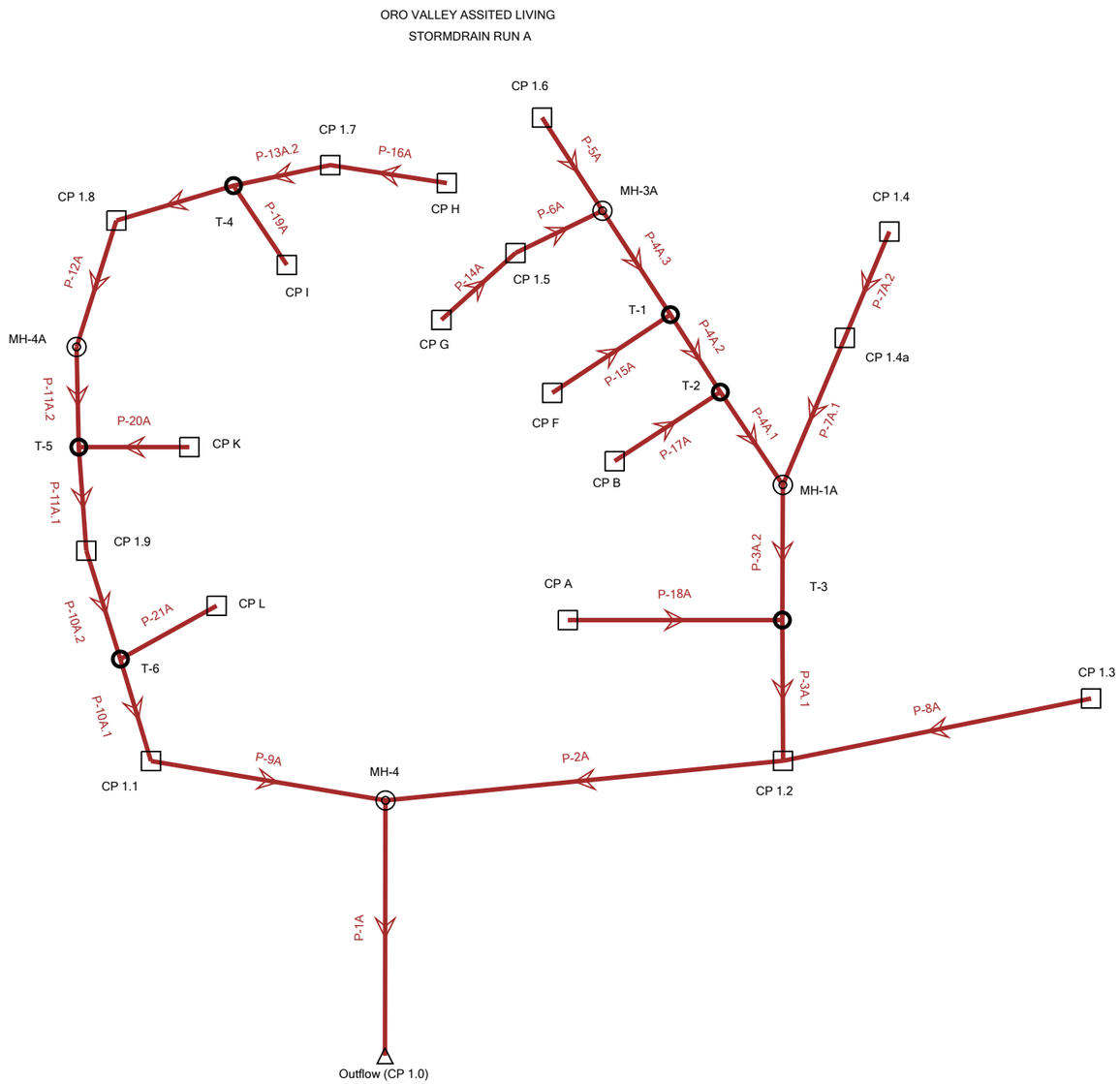
B.4 Rip Rap and Splash Pad Worksheets

B.5 Pipe Culvert Sediment-Transport Worksheets

B.6 PAAL Conveyance Worksheets

B.1 Storm drain Run A StormCAD worksheets and profiles

Scenario: Base



Conduit FlexTable: WLB Group Table

Label	Upstream Structure	Flow (cfs)	Length (User Defined) (ft)	Diameter (in)	Material	Number of Barrels	Velocity (ft/s)	Elevation Ground (Start) (ft)	Hydraulic Grade Line (In) (ft)	Energy Grade Line (In) (ft)	Invert (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (Out) (ft)	Invert (Stop) (ft)	Energy Grade Line (Out) (ft)
P-5A	CP 1.6	16.00	10.0	24.0	CMP	1	10.81	2,712.50	2,710.24	2,710.92	2,708.80	2,712.50	2,709.05	2,708.00	2,710.47
P-2A	CP 1.2	46.00	242.1	30.0	Steel	1	9.37	2,710.00	2,704.15	2,705.51	2,701.40	2,710.85	2,701.10	2,698.00	2,702.47
P-1A	MH-4	60.00	62.1	42.0	CMP	1	12.45	2,710.85	2,699.43	2,700.53	2,697.00	2,698.00	2,695.76	2,694.00	2,698.13
P-12A	CP 1.8	4.00	37.5	18.0	Steel	1	5.67	2,713.65	2,708.07	2,708.37	2,707.30	2,713.15	2,707.77	2,706.90	2,707.99
P-9A	CP 1.1	14.00	113.5	24.0	Steel	1	8.84	2,707.05	2,701.55	2,702.15	2,700.20	2,710.85	2,701.10	2,698.50	2,701.41
P-8A	CP 1.3	5.00	129.2	18.0	Steel	1	8.00	2,710.50	2,706.36	2,706.71	2,705.50	2,710.00	2,705.53	2,702.50	2,705.66
P-6A	CP 1.5	3.00	30.0	18.0	Steel	1	1.70	2,711.50	2,709.04	2,709.09	2,704.90	2,712.50	2,709.02	2,704.75	2,709.06
P-14A	CP G	2.00	49.2	12.0	Steel	1	2.55	2,710.75	2,709.28	2,709.39	2,705.75	2,711.50	2,709.13	2,704.90	2,709.23
P-4A.3	MH-3A	19.00	94.1	30.0	Steel	1	3.87	2,712.50	2,708.39	2,708.62	2,704.25	2,712.18	2,708.19	2,703.78	2,708.42
P-15A	CP F	1.00	25.0	12.0	Steel	1	1.27	2,711.90	2,708.21	2,708.23	2,705.90	2,712.18	2,708.19	2,704.53	2,708.21
P-4A.2	T-1	20.00	40.7	30.0	Steel	1	4.07	2,712.18	2,708.03	2,708.28	2,703.78	2,711.99	2,707.93	2,703.58	2,708.19
P-4A.1	T-2	22.00	66.0	30.0	Steel	1	4.48	2,711.99	2,707.69	2,708.00	2,703.58	2,711.75	2,707.50	2,703.25	2,707.81
P-17A	CP B	2.00	43.4	12.0	Steel	1	2.55	2,711.50	2,708.07	2,708.17	2,705.00	2,711.99	2,707.93	2,704.33	2,708.03
P-3A.2	MH-1A	31.00	77.1	30.0	Steel	1	6.32	2,711.75	2,707.12	2,707.74	2,703.25	2,710.89	2,706.68	2,702.51	2,707.30
P-3A.1	T-3	33.00	105.2	30.0	Steel	1	6.72	2,710.89	2,706.21	2,706.92	2,702.51	2,710.00	2,705.53	2,701.50	2,706.23
P-18A	CP A	2.00	79.6	12.0	Steel	1	2.55	2,712.35	2,706.93	2,707.03	2,704.35	2,710.89	2,706.68	2,703.26	2,706.78
P-7A.2	CP 1.4	8.00	30.0	18.0	Steel	1	14.27	2,713.25	2,711.35	2,711.87	2,710.25	2,711.50	2,709.25	2,707.85	2,709.59
P-7A.1	CP 1.4a	9.00	93.8	18.0	Steel	1	11.14	2,711.50	2,708.91	2,709.50	2,707.75	2,711.75	2,707.50	2,704.25	2,707.90
P-16A	CP H	1.00	94.2	12.0	Steel	1	3.90	2,711.90	2,709.47	2,709.63	2,709.05	2,714.10	2,708.74	2,708.10	2,708.80
P-13A.2	CP 1.7	2.00	15.0	18.0	Steel	1	4.58	2,714.10	2,708.63	2,708.83	2,708.10	2,713.89	2,708.58	2,707.95	2,708.71
P-13A.1	T-4	2.00	53.3	18.0	Steel	1	4.63	2,713.89	2,708.48	2,708.68	2,707.95	2,713.65	2,708.23	2,707.40	2,708.30
P-19A	CP I	0.00	21.1	12.0	Steel	1	0.00	2,711.00	2,708.58	2,708.58	2,708.45	2,713.89	2,708.58	2,708.20	2,708.58
P-11A.2	MH-4A	4.00	69.1	18.0	Steel	1	9.20	2,713.15	2,707.57	2,707.87	2,706.80	2,712.11	2,705.03	2,704.00	2,705.18
P-11A.1	T-5	5.00	24.7	18.0	Steel	1	9.80	2,712.11	2,704.86	2,705.21	2,704.00	2,711.00	2,704.11	2,703.00	2,704.31
P-20A	CP K	1.00	65.5	12.0	Steel	1	6.91	2,711.50	2,707.92	2,708.08	2,707.50	2,712.11	2,705.03	2,704.25	2,705.06
P-10A.2	CP 1.9	13.00	31.6	24.0	Steel	1	8.73	2,711.00	2,703.80	2,704.36	2,702.50	2,708.60	2,703.04	2,702.02	2,704.05
P-10A.1	T-6	13.00	113.2	24.0	Steel	1	8.72	2,708.60	2,703.32	2,703.88	2,702.02	2,707.05	2,702.00	2,700.30	2,702.32
P-21A	CP L	0.00	59.4	12.0	Steel	1	0.00	2,711.70	2,707.70	2,707.70	2,707.70	2,708.60	2,703.32	2,702.52	2,703.32

Conduit FlexTable: Culvert Table

Label	Start Node	Stop Node	Length (User Defined) (ft)	Diameter (in)	Slope (Calculated) (ft/ft)	Material	Flow (cfs)	Flow / Capacity (Design) (%)	Velocity (ft/s)	Velocity (In) (ft/s)	Velocity (Out) (ft/s)	Depth (Normal) (ft)	Specific Energy (In) (in)	Specific Energy (Out) (in)	Manning's n	Upstream Structure Headloss (ft)	Headloss (ft)
P-5A	CP 1.6	MH-3A	10.0	24.0	0.080	CMP	16.00	46.2	10.81	6.60	9.56	0.95	25.4	29.7	0.024	0.22	1.19
P-2A	CP 1.2	MH-4	242.1	30.0	0.014	Steel	46.00	94.6	9.37	9.37	9.37	1.94	49.4	53.6	0.013	1.38	3.05
P-1A	MH-4	Outflow (CP 1.0)	62.1	42.0	0.048	CMP	60.00	50.1	12.45	8.43	12.34	1.75	42.4	49.6	0.024	1.68	3.66
P-12A	CP 1.8	MH-4A	37.5	18.0	0.011	Steel	4.00	36.9	5.67	4.41	3.77	0.63	12.8	13.1	0.013	0.17	0.30
P-9A	CP 1.1	MH-4	113.5	24.0	0.015	Steel	14.00	50.6	8.84	6.22	4.46	1.01	23.4	35.0	0.013	0.45	0.44
P-8A	CP 1.3	CP 1.2	129.2	18.0	0.023	Steel	5.00	31.2	8.00	4.77	2.83	0.58	14.6	37.9	0.013	0.11	0.83
P-6A	CP 1.5	MH-3A	30.0	18.0	0.005	Steel	3.00	40.4	1.70	1.70	1.70	0.66	50.3	51.8	0.013	0.09	0.02
P-14A	CP G	CP 1.5	49.2	12.0	0.017	Steel	2.00	42.7	2.55	2.55	2.55	0.46	43.6	52.0	0.013	0.03	0.16
P-4A.3	MH-3A	T-1	94.1	30.0	0.005	Steel	19.00	65.5	3.87	3.87	3.87	1.48	52.5	55.7	0.013	0.63	0.20
P-15A	CP F	T-1	25.0	12.0	0.055	Steel	1.00	12.0	1.27	1.27	1.27	0.23	28.0	44.2	0.013	0.01	0.02
P-4A.2	T-1	T-2	40.7	30.0	0.005	Steel	20.00	69.6	4.07	4.07	4.07	1.54	54.0	55.3	0.013	0.16	0.10
P-4A.1	T-2	MH-1A	66.0	30.0	0.005	Steel	22.00	75.9	4.48	4.48	4.48	1.63	53.1	54.8	0.013	0.24	0.19
P-17A	CP B	T-2	43.4	12.0	0.015	Steel	2.00	45.2	2.55	2.55	2.55	0.47	38.0	44.4	0.013	0.03	0.14
P-3A.2	MH-1A	T-3	77.1	30.0	0.010	Steel	31.00	77.1	6.32	6.32	6.32	1.65	53.8	57.4	0.013	0.38	0.44
P-3A.1	T-3	CP 1.2	105.2	30.0	0.010	Steel	33.00	82.1	6.72	6.72	6.72	1.72	52.9	56.8	0.013	0.46	0.68
P-18A	CP A	T-3	79.6	12.0	0.014	Steel	2.00	48.0	2.55	2.55	2.55	0.49	32.1	42.2	0.013	0.03	0.25
P-7A.2	CP 1.4	CP 1.4a	30.0	18.0	0.080	Steel	8.00	26.9	14.27	5.78	4.65	0.53	19.4	20.9	0.013	0.17	2.09
P-7A.1	CP 1.4a	MH-1A	93.8	18.0	0.037	Steel	9.00	44.4	11.14	6.13	5.09	0.70	20.9	43.8	0.013	0.34	1.41
P-16A	CP H	CP 1.7	94.2	12.0	0.010	Steel	1.00	28.0	3.90	3.20	1.88	0.36	6.9	8.3	0.013	0.05	0.73
P-13A.2	CP 1.7	T-4	15.0	18.0	0.010	Steel	2.00	19.0	4.58	3.55	2.82	0.44	8.8	9.1	0.013	0.11	0.05
P-13A.1	T-4	CP 1.8	53.3	18.0	0.010	Steel	2.00	18.7	4.63	3.55	1.98	0.44	8.8	10.7	0.013	0.10	0.25
P-19A	CP I	T-4	21.1	12.0	0.012	Steel	0.00	0.0	0.00	0.00	0.00	(N/A)	1.6	4.6	0.013	0.00	0.00
P-11A.2	MH-4A	T-5	69.1	18.0	0.041	Steel	4.00	18.9	9.20	4.41	3.10	0.44	12.8	14.1	0.013	0.20	2.54
P-11A.1	T-5	CP 1.9	24.7	18.0	0.041	Steel	5.00	23.7	9.80	4.77	3.55	0.50	14.6	15.7	0.013	0.17	0.75
P-20A	CP K	T-5	65.5	12.0	0.050	Steel	1.00	12.6	6.91	3.20	1.53	0.24	6.9	9.8	0.013	0.00	2.89
P-10A.2	CP 1.9	T-6	31.6	24.0	0.015	Steel	13.00	46.6	8.73	6.03	8.03	0.96	22.3	24.3	0.013	0.32	0.75
P-10A.1	T-6	CP 1.1	113.2	24.0	0.015	Steel	13.00	46.6	8.72	6.03	4.57	0.96	22.3	24.3	0.013	0.00	1.32
P-21A	CP L	T-6	59.4	12.0	0.087	Steel	0.00	0.0	0.00	0.00	0.00	(N/A)	0.0	9.6	0.013	0.00	4.38

Network Elements FlexTable: AASHTO Headloss Table

Label	Headloss Method	Headloss (ft)	Adjusted Headloss (AASHTO) (ft)	Unadjusted Headloss (AASHTO) (ft)	Velocity Head (In-Governing) (ft)	Velocity Head (Out) (ft)	Bend Angle (Calculated) (degrees)	Bend Loss (AASHTO) (ft)	Bend Loss Coefficient (AASHTO)	Bend Loss Conduit Flow (AASHTO) (cfs)	Bend Loss Pipe Angle (AASHTO) (degrees)	Bend Loss Pipe Velocity (AASHTO) (ft/s)	Bend Loss Pipe Velocity Head (AASHTO) (ft)	Contraction Loss (AASHTO) (ft)	Contraction Loss Coefficient (AASHTO)	Correction factor for shaping (AASHTO)	Expansion Loss (AASHTO) (ft)	Expansion Loss Coefficient (AASHTO)	Expansion Loss Pipe Flow (AASHTO) (cfs)	Expansion Loss Pipe Velocity (AASHTO) (ft/s)
MH-1A	AASHTO	0.38	0.38	0.38	1.42			0.12	0.383	22.00	34.11	4.48	0.31	0.15	0.250	1.000	0.11	0.350	22.00	4.48
MH-4A	AASHTO	0.20	0.20	0.20	1.42			0.05	0.230	4.00	18.72	3.77	0.22	0.08	0.250	1.000	0.08	0.350	4.00	3.77
MH-3A	AASHTO	0.63	0.63	0.63	1.42			0.03	0.671	3.00	82.69	1.70	0.04	0.06	0.250	1.000	0.54	0.350	16.00	9.96
MH-4	AASHTO	1.68	1.68	1.68	1.42			0.92	0.677	46.00	84.19	9.37	1.36	0.28	0.250	1.000	0.48	0.350	46.00	9.37
CP 1.7	AASHTO	0.11	0.11	0.08	1.42			0.01	0.251	1.00	20.72	1.88	0.06	0.05	0.250	1.000	0.02	0.350	1.00	1.88
CP 1.8	AASHTO	0.17	0.17	0.13	1.42			0.03	0.536	2.00	55.96	1.98	0.06	0.08	0.250	1.000	0.02	0.350	2.00	1.98
CP 1.9	AASHTO	0.32	0.32	0.24	1.42			0.03	0.169	5.00	13.32	3.56	0.20	0.14	0.250	1.000	0.07	0.350	5.00	3.56
CP 1.1	AASHTO	0.45	0.45	0.45	1.42			0.19	0.580	13.00	63.76	4.57	0.32	0.15	0.250	1.000	0.11	0.350	13.00	4.57
CP 1.2	AASHTO	1.38	1.38	1.06	1.42			0.48	0.678	33.00	84.57	6.72	0.70	0.34	0.250	1.000	0.25	0.350	33.00	6.72
CP 1.3	AASHTO	0.11	0.11	0.09	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.09	0.250	1.000	0.00	0.000	0.00	0.00
CP 1.4	AASHTO	0.17	0.17	0.13	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.13	0.250	1.000	0.00	0.000	0.00	0.00
CP 1.6	AASHTO	0.22	0.22	0.17	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.17	0.250	1.000	0.00	0.000	0.00	0.00
CP 1.5	AASHTO	0.09	0.09	0.07	1.42			0.02	0.203	2.00	16.20	2.55	0.10	0.01	0.250	1.000	0.04	0.350	2.00	2.55
CP G	AASHTO	0.03	0.03	0.03	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.03	0.250	1.000	0.00	0.000	0.00	0.00
CP F	AASHTO	0.01	0.01	0.01	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.01	0.250	1.000	0.00	0.000	0.00	0.00
CP B	AASHTO	0.03	0.03	0.03	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.03	0.250	1.000	0.00	0.000	0.00	0.00
CP A	AASHTO	0.03	0.03	0.03	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.03	0.250	1.000	0.00	0.000	0.00	0.00
CP 1.4a	AASHTO	0.34	0.34	0.26	1.42			0.00	0.001	8.00	0.11	4.65	0.34	0.15	0.250	1.000	0.12	0.350	8.00	4.65
CP H	AASHTO	0.05	0.05	0.04	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.04	0.250	1.000	0.00	0.000	0.00	0.00
CP I	AASHTO	0.00	0.00	0.00	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.00	0.00
CP K	Absolute	0.00	0.00	0.00	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.00	0.00
CP L	AASHTO	0.00	0.00	0.00	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.00	0.00
T-1	AASHTO	0.16	0.16	0.16	1.42			0.02	0.703	1.00	90.67	1.27	0.03	0.06	0.250	1.000	0.08	0.350	19.00	3.87
T-2	AASHTO	0.24	0.24	0.24	1.42			0.07	0.697	2.00	89.23	2.55	0.10	0.08	0.250	1.000	0.09	0.350	20.00	4.07
T-3	AASHTO	0.46	0.46	0.46	1.42			0.07	0.699	2.00	89.74	2.55	0.10	0.18	0.250	1.000	0.22	0.350	31.00	6.32
T-4	AASHTO	0.10	0.10	0.10	1.42			0.01	0.058	2.00	4.59	2.82	0.12	0.05	0.250	1.000	0.04	0.350	2.00	2.82
T-5	AASHTO	0.17	0.17	0.17	1.42			0.03	0.717	1.00	94.14	1.53	0.04	0.09	0.250	1.000	0.05	0.350	4.00	3.10
T-6	Absolute	0.00	0.00	0.00	1.42			0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.00	0.00
Outflow (CP 1.0)																				
P-5A		1.19				1.42	0.24													
P-2A		3.05				1.36	84.19													
P-1A		3.66				2.37	0.00													
P-12A		0.30				0.22	18.72													
P-9A		0.44				0.31	80.56													
P-8A		0.83				0.12	5.74													
P-6A		0.02				0.04	82.69													
P-14A		0.16				0.10	16.20													
P-4A.3		0.20				0.23	0.36													
P-15A		0.02				0.03	90.67													
P-4A.2		0.10				0.26	1.10													
P-4A.1		0.19				0.31	34.11													
P-17A		0.14				0.10	89.23													
P-3A.2		0.44				0.62	0.43													
P-3A.1		0.68				0.70	84.57													
P-18A		0.25				0.10	89.74													

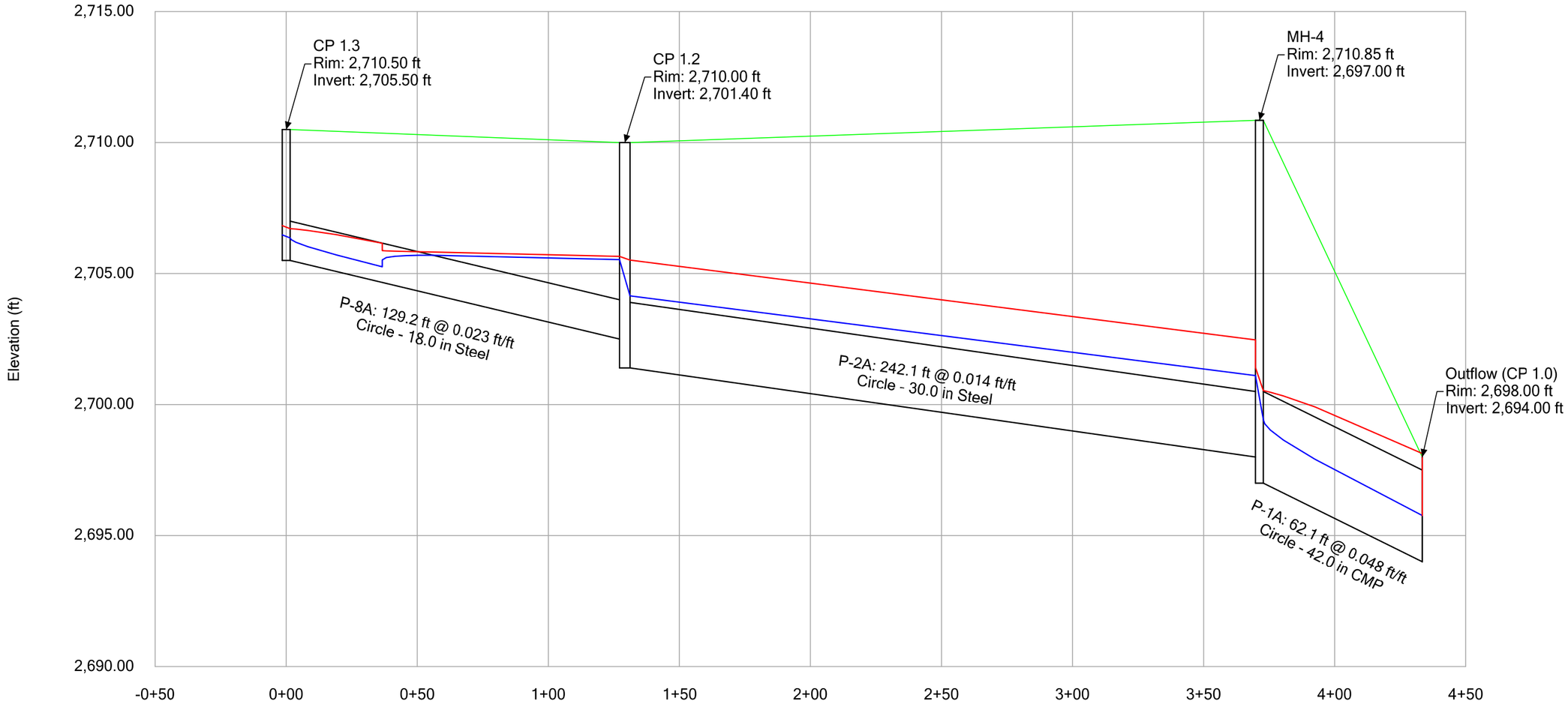
Network Elements FlexTable: AASHTO Headloss Table

Label	Headloss Method	Headloss (ft)	Adjusted Headloss (AASHTO) (ft)	Unadjusted Headloss (AASHTO) (ft)	Velocity Head (In-Governing) (ft)	Velocity Head (Out) (ft)	Bend Angle (Calculated) (degrees)	Bend Loss (AASHTO) (ft)	Bend Loss Coefficient (AASHTO)	Bend Loss Conduit Flow (AASHTO) (cfs)	Bend Loss Pipe Angle (AASHTO) (degrees)	Bend Loss Pipe Velocity (AASHTO) (ft/s)	Bend Loss Pipe Velocity Head (AASHTO) (ft)	Contraction Loss (AASHTO) (ft)	Contraction Loss Coefficient (AASHTO)	Correction factor for shaping (AASHTO)	Expansion Loss (AASHTO) (ft)	Expansion Loss Coefficient (AASHTO)	Expansion Loss Pipe Flow (AASHTO) (cfs)	Expansion Loss Pipe Velocity (AASHTO) (ft/s)	Expansion Loss Pipe Velocity Head (AASHTO) (ft)	Friction Slope (ft/ft)
P-7A.2		2.09				0.34	0.11														0.31	
P-7A.1		1.41				0.40	22.69														0.22	
P-16A		0.73				0.06	20.72														1.54	
P-13A.2		0.05				0.12	4.59														1.36	
P-13A.1		0.25				0.06	55.96														0.06	
P-19A		0.00				0.00	72.66														0.06	
P-11A.2		2.54				0.15	2.89														0.20	
P-11A.1		0.75				0.20	13.32														0.32	
P-20A		2.89				0.04	94.14														0.70	
P-10A.2		0.75				1.00	0.78														0.00	
P-10A.1		1.32				0.32	63.76														0.00	
P-21A		4.38				0.00	77.70														0.00	
																					0.10	
																					0.00	
																					0.00	
																					0.00	
																					0.00	
																					0.00	
																					0.34	
																					0.00	
																					0.00	
																					0.00	
																					0.00	
																					0.23	
																					0.26	
																					0.62	
																					0.12	
																					0.15	
																					0.00	

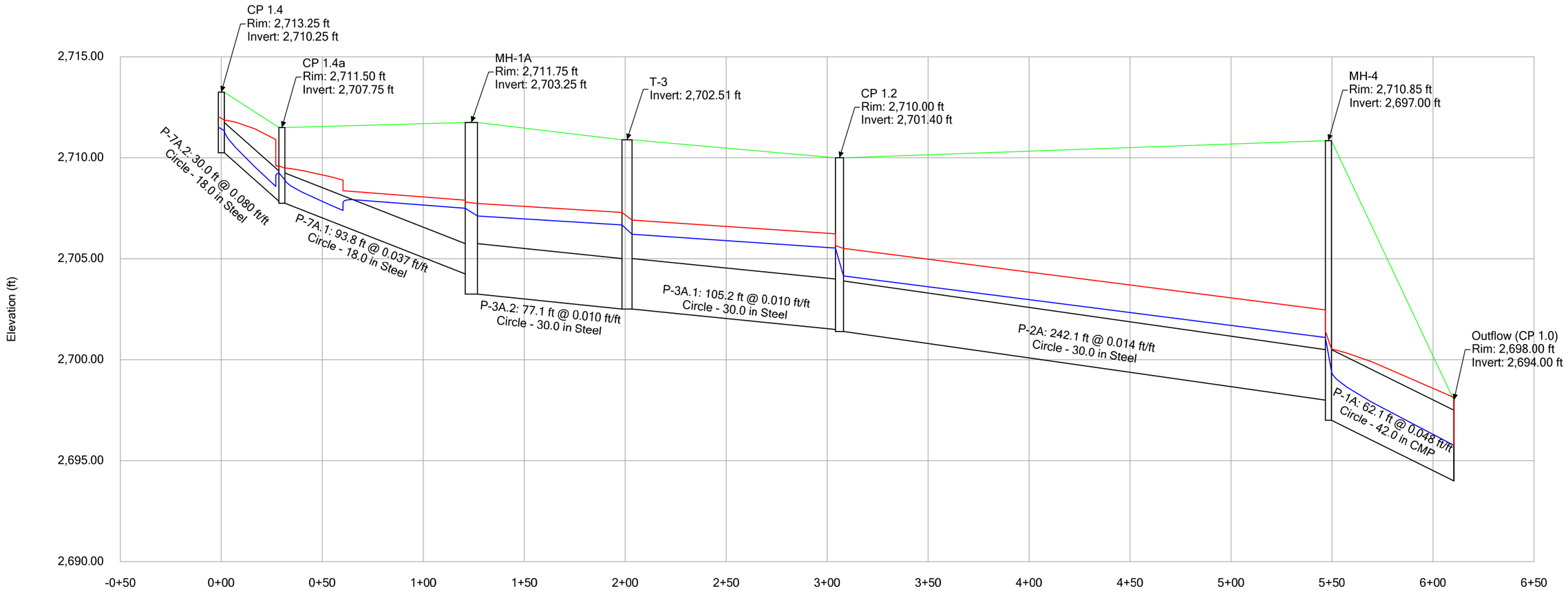
Network Elements FlexTable: AASHTO Headloss Table

Expansion Loss Pipe Velocity Head (AASHTO) (ft)	Friction Slope (ft/ft)
	0.045
	0.013
	0.039
	0.010
	0.006
	0.008
	0.001
	0.003
	0.002
	0.001
	0.002
	0.003
	0.003
	0.006
	0.006
	0.003
	0.076
	0.017
	0.009
	0.008
	0.007
	0.000
	0.039
	0.037
	0.046
	0.010
	0.014
	0.074

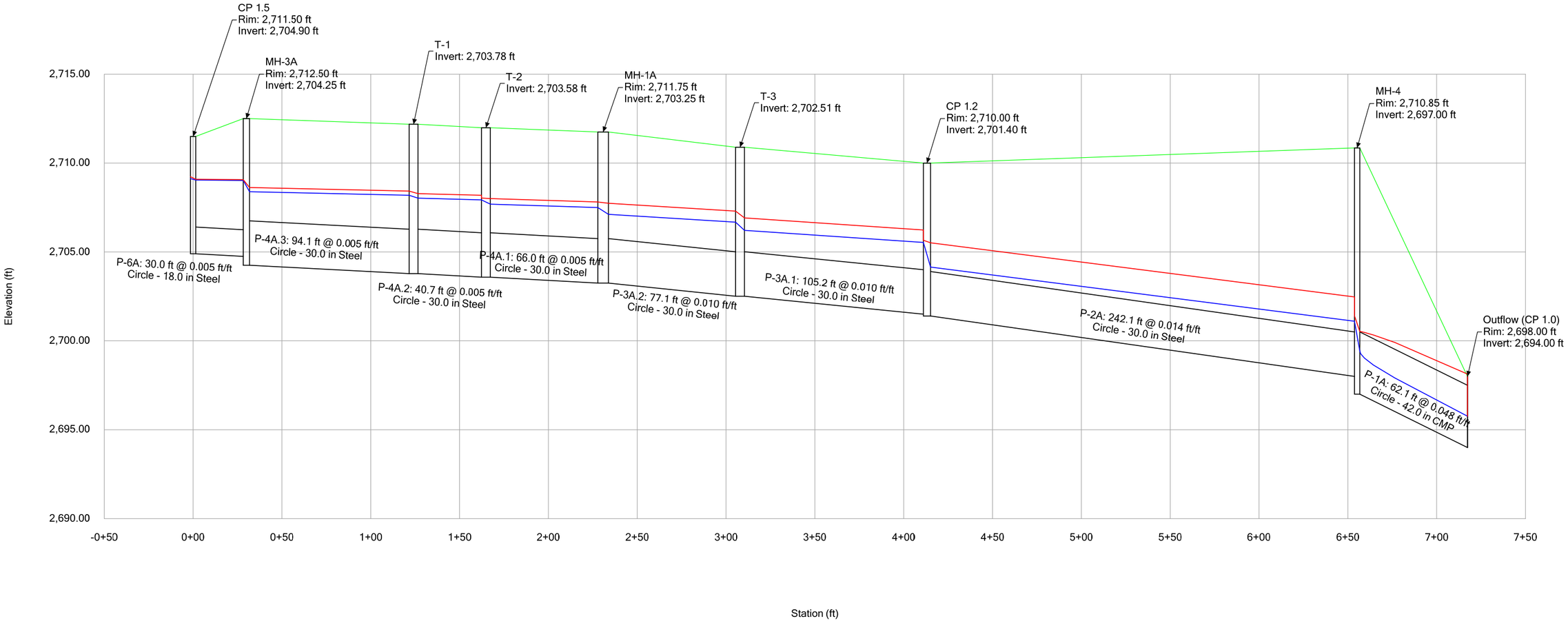
Profile Report
Engineering Profile - Profile - CP 1.3 (RUN_A.stsw)



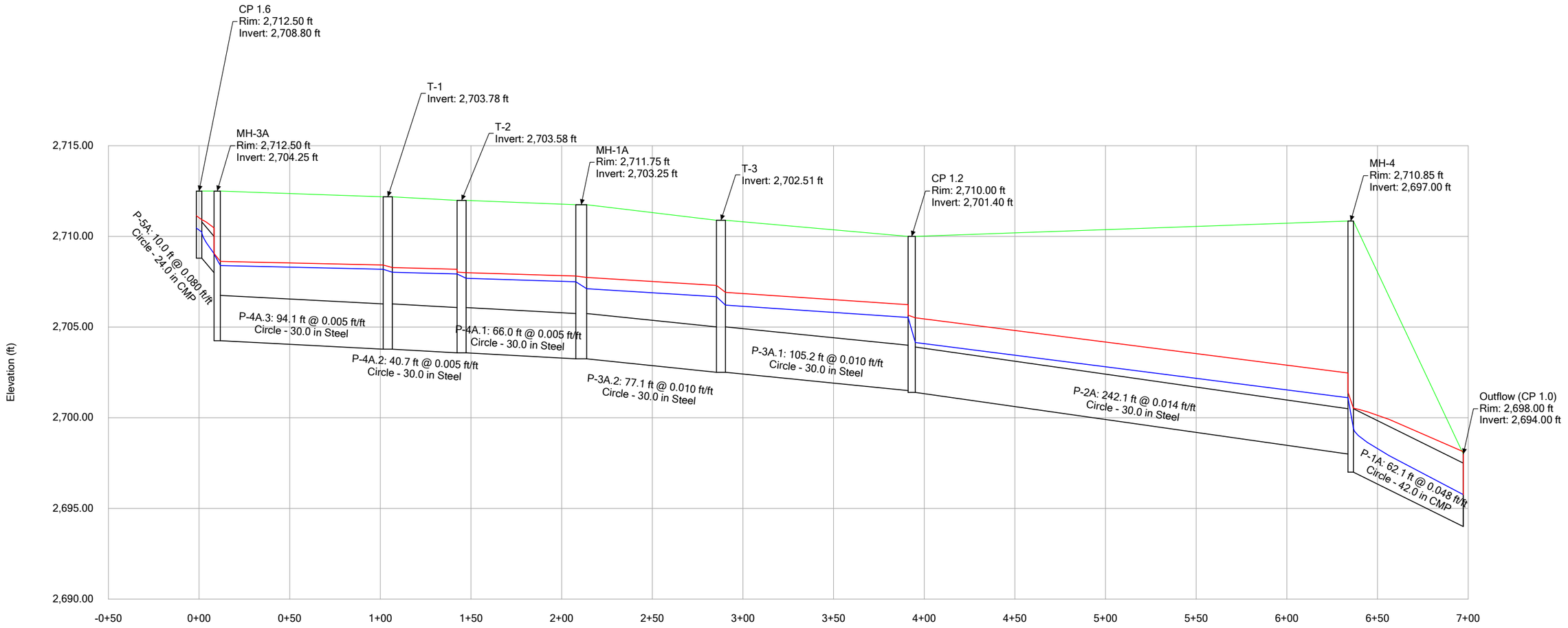
Profile Report
Engineering Profile - Profile - CP 1.4 (RUN_A.stsw)



Profile Report
Engineering Profile - Profile - CP 1.5 (RUN_A.stsw)



Profile Report
Engineering Profile - Profile - CP 1.6 (RUN_A.stsw)



Profile Report
Engineering Profile - Profile - CP 1.7 (RUN_A.stsw)

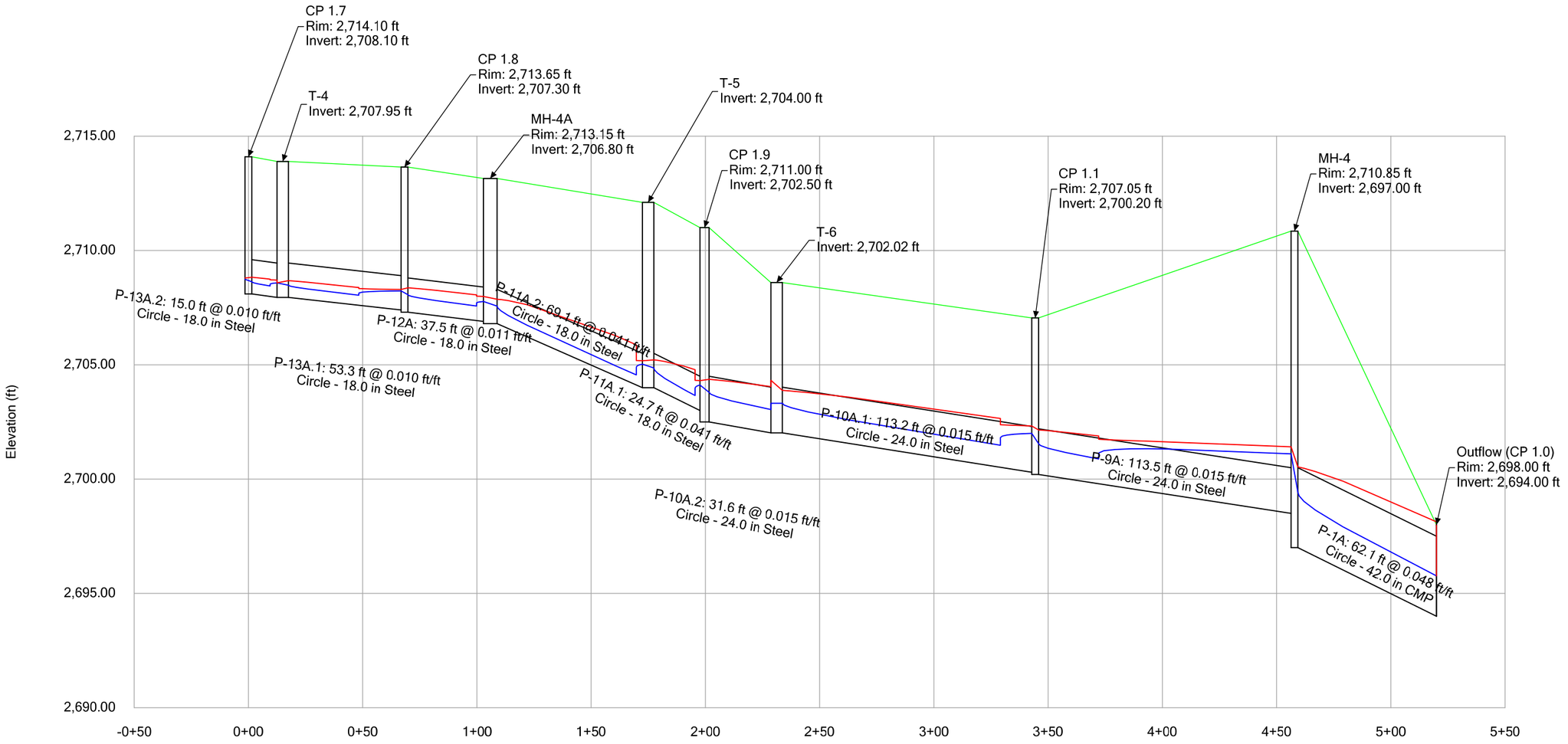


Table 1 - Summary of Culvert Flows at Crossing: CP 1.4

Headwater Elevation (ft)	Total Discharge (cfs)	1-18" SRP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
2710.25	0.00	0.00	0.00	1
2710.76	1.00	1.00	0.00	1
2710.99	2.00	2.00	0.00	1
2711.20	3.00	3.00	0.00	1
2711.39	4.00	4.00	0.00	1
2711.59	5.00	5.00	0.00	1
2711.79	6.00	6.00	0.00	1
2712.02	7.00	7.00	0.00	1
2712.26	8.00	8.00	0.00	1
2712.54	9.00	9.00	0.00	1
2712.86	10.00	10.00	0.00	1
2713.50	11.71	11.71	0.00	Overtopping

Rating Curve Plot for Crossing: CP 1.4

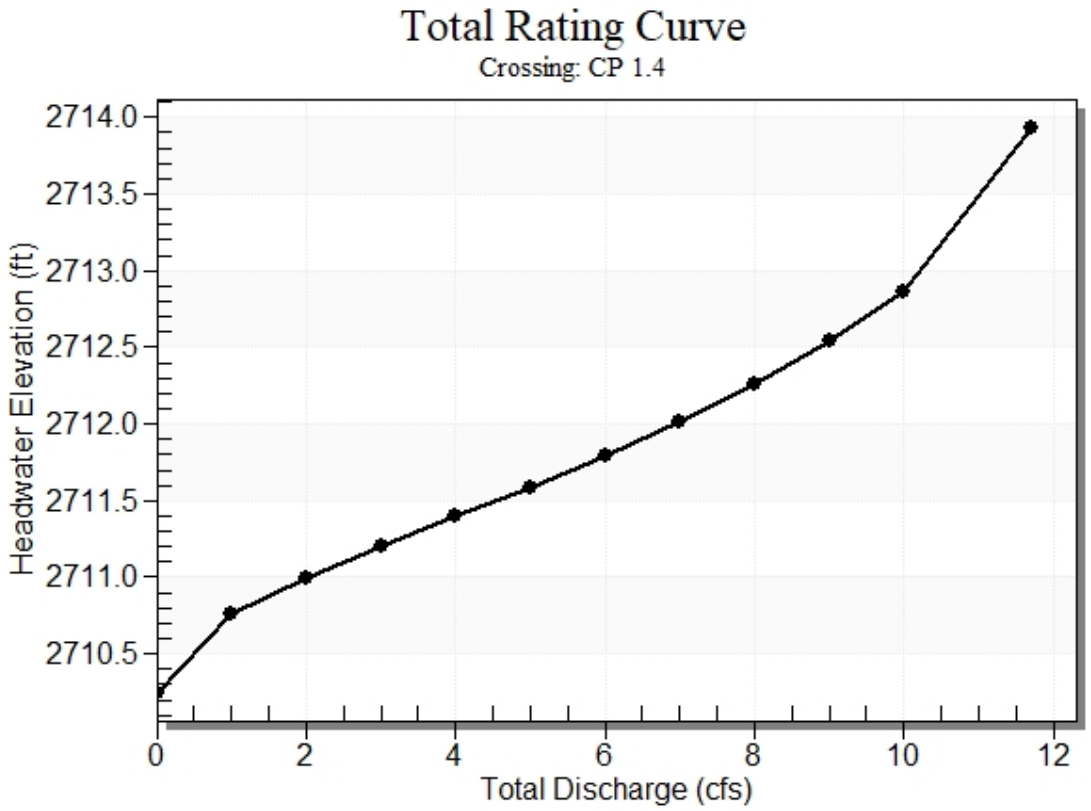


Table 2 - Culvert Summary Table: 1-18" SRP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	2710.25	0.000	0.000	0-NF	0.000	0.000	1.500	1.600	0.000	0.000
1.00	1.00	2710.76	0.511	0.0*	1-JS1f	0.244	0.369	1.500	1.600	0.566	0.000
2.00	2.00	2710.99	0.738	0.0*	1-JS1f	0.344	0.530	1.500	1.600	1.132	0.000
3.00	3.00	2711.20	0.947	0.0*	1-JS1f	0.423	0.658	1.500	1.600	1.698	0.000
4.00	4.00	2711.39	1.143	0.0*	1-S2n	0.490	0.765	0.490	1.600	7.698	0.000
5.00	5.00	2711.59	1.338	0.0*	1-S2n	0.552	0.856	0.570	1.600	7.837	0.000
6.00	6.00	2711.79	1.542	0.0*	5-S2n	0.610	0.942	0.610	1.600	8.590	0.000
7.00	7.00	2712.02	1.765	0.007	5-S2n	0.665	1.021	0.665	1.600	8.939	0.000
8.00	8.00	2712.26	2.014	0.288	5-S2n	0.719	1.092	0.719	1.600	9.250	0.000
9.00	9.00	2712.54	2.295	0.606	5-S2n	0.771	1.156	0.771	1.600	9.522	0.000
10.00	10.00	2712.86	2.612	0.961	5-S2n	0.822	1.218	0.822	1.600	9.763	0.000

* Full Flow Headwater elevation is below inlet invert.

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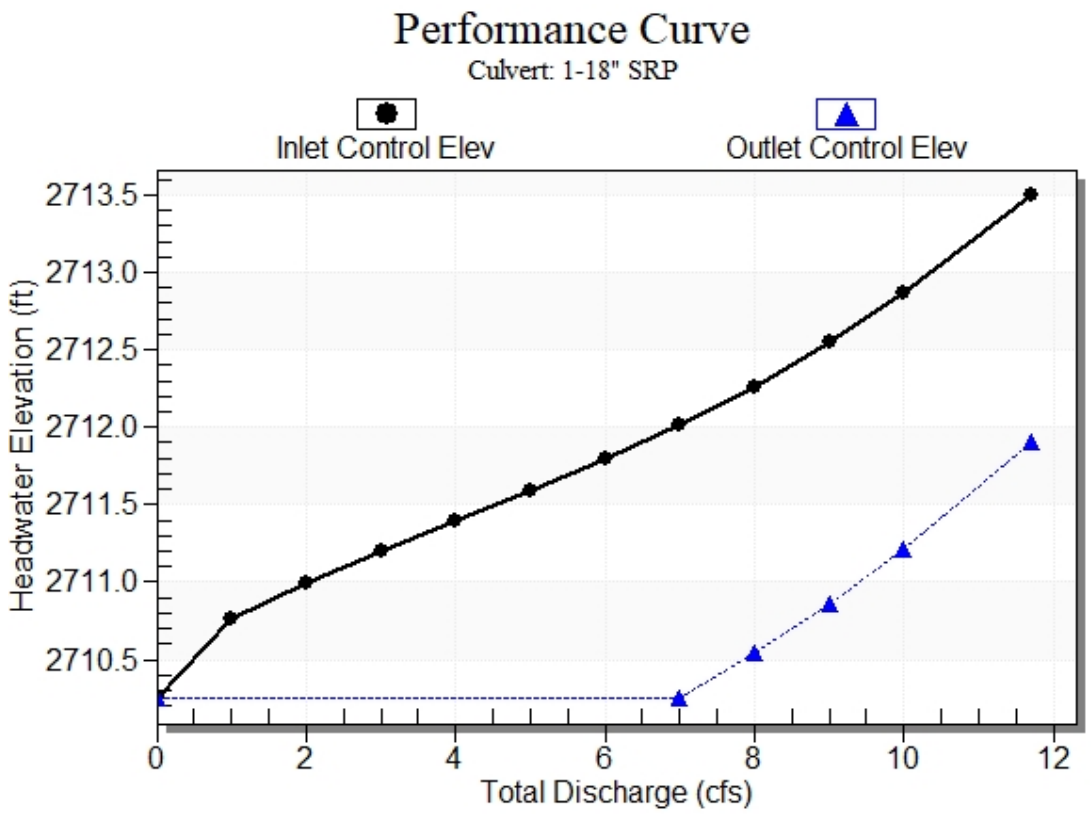
Straight Culvert

Inlet Elevation (invert): 2710.25 ft, Outlet Elevation (invert): 2707.75 ft

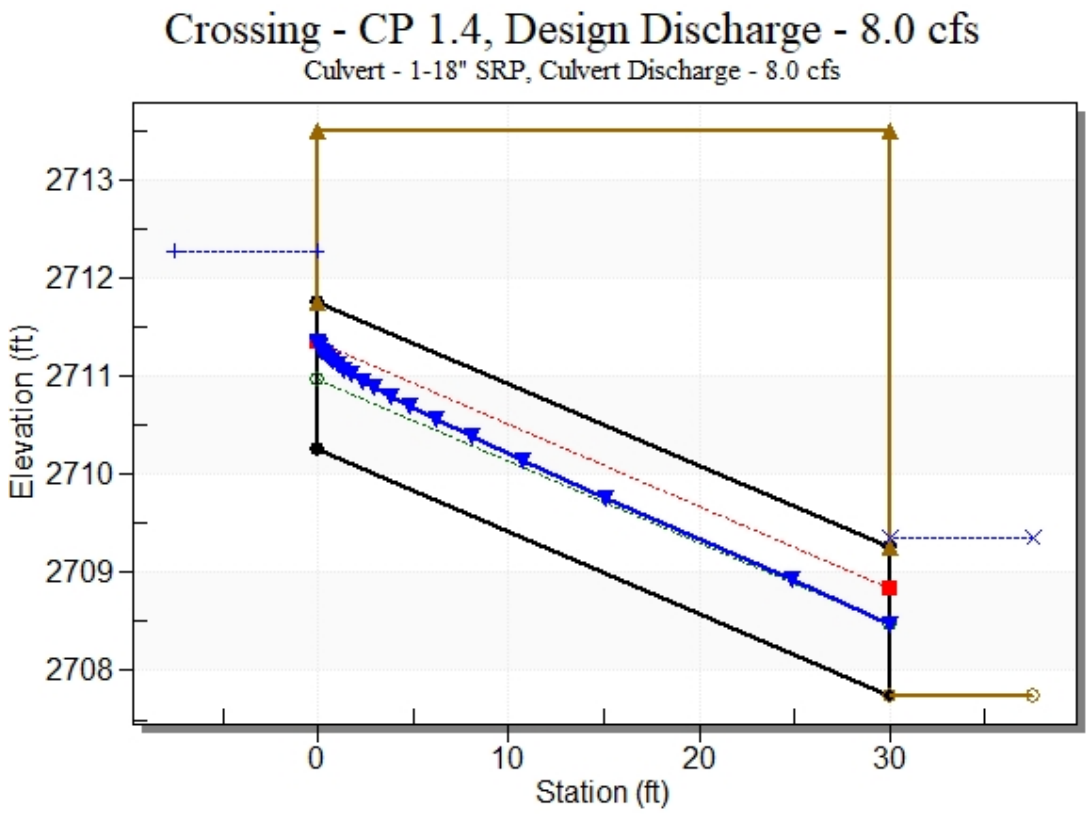
Culvert Length: 30.10 ft, Culvert Slope: 0.0833

****

Culvert Performance Curve Plot: 1-18" SRP



Water Surface Profile Plot for Culvert: 1-18" SRP



Site Data - 1-18" SRP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 2710.25 ft

Outlet Station: 30.00 ft

Outlet Elevation: 2707.75 ft

Number of Barrels: 1

Culvert Data Summary - 1-18" SRP

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: CP 1.4)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
0.00	2709.35	1.60
1.00	2709.35	1.60
2.00	2709.35	1.60
3.00	2709.35	1.60
4.00	2709.35	1.60
5.00	2709.35	1.60
6.00	2709.35	1.60
7.00	2709.35	1.60
8.00	2709.35	1.60
9.00	2709.35	1.60
10.00	2709.35	1.60

Tailwater Channel Data - CP 1.4

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 2709.35 ft

Roadway Data for Crossing: CP 1.4

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 30.00 ft

Crest Elevation: 2713.50 ft

Roadway Surface: Paved

Roadway Top Width: 30.00 ft

Table 1 - Summary of Culvert Flows at Crossing: CP 1.6

Headwater Elevation (ft)	Total Discharge (cfs)	1-24" CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
2708.80	0.00	0.00	0.00	1
2709.47	2.00	2.00	0.00	1
2709.77	4.00	4.00	0.00	1
2710.04	6.00	6.00	0.00	1
2710.30	8.00	8.00	0.00	1
2710.55	10.00	10.00	0.00	1
2710.82	12.00	12.00	0.00	1
2711.10	14.00	14.00	0.00	1
2711.42	16.00	16.00	0.00	1
2711.77	18.00	18.00	0.00	1
2712.17	20.00	20.00	0.00	1
2712.50	21.48	21.48	0.00	Overtopping

Rating Curve Plot for Crossing: CP 1.6

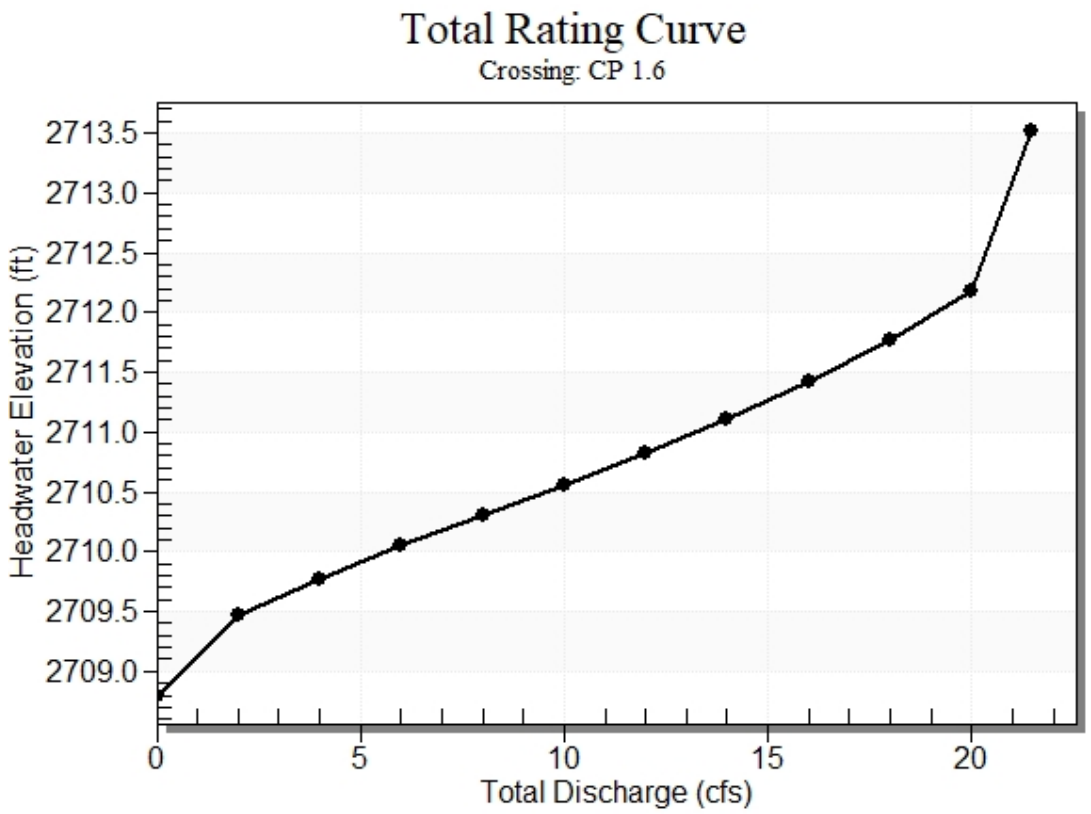


Table 2 - Culvert Summary Table: 1-24" CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	2708.80	0.000	0.000	0-NF	0.000	0.000	0.330	0.330	0.000	0.000
2.00	2.00	2709.47	0.674	0.0*	1-S2n	0.317	0.485	0.331	0.330	5.688	0.000
4.00	4.00	2709.77	0.973	0.0*	1-S2n	0.446	0.697	0.476	0.330	6.743	0.000
6.00	6.00	2710.04	1.245	0.197	1-S2n	0.548	0.865	0.594	0.330	7.408	0.000
8.00	8.00	2710.30	1.501	0.440	1-S2n	0.636	1.006	0.700	0.330	7.895	0.000
10.00	10.00	2710.55	1.753	0.692	1-S2n	0.716	1.126	0.796	0.330	8.294	0.000
12.00	12.00	2710.82	2.016	0.965	5-S2n	0.790	1.239	0.886	0.330	8.634	0.000
14.00	14.00	2711.10	2.301	1.260	5-S2n	0.861	1.344	0.972	0.330	8.947	0.000
16.00	16.00	2711.42	2.617	1.573	5-S2n	0.929	1.437	1.053	0.330	9.232	0.000
18.00	18.00	2711.77	2.972	2.147	5-S2n	0.995	1.526	1.133	0.330	9.503	0.000
20.00	20.00	2712.17	3.372	2.464	5-S2n	1.061	1.604	1.209	0.330	9.763	0.000

* Full Flow Headwater elevation is below inlet invert.

****

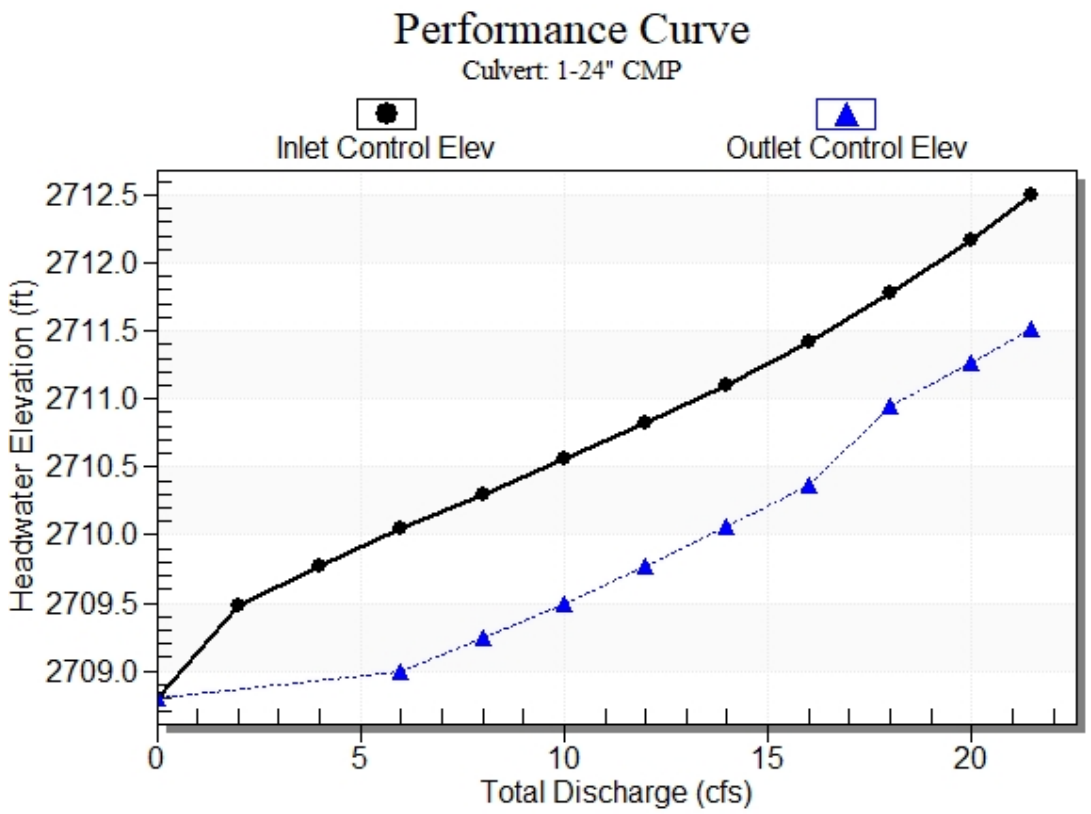
Straight Culvert

Inlet Elevation (invert): 2708.80 ft, Outlet Elevation (invert): 2708.00 ft

Culvert Length: 10.03 ft, Culvert Slope: 0.0800

****

Culvert Performance Curve Plot: 1-24" CMP



Water Surface Profile Plot for Culvert: 1-24" CMP

Site Data - 1-24" CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 2708.80 ft

Outlet Station: 10.00 ft

Outlet Elevation: 2708.00 ft

Number of Barrels: 1

Culvert Data Summary - 1-24" CMP

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: CP 1.6)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
0.00	2708.33	0.33
2.00	2708.33	0.33
4.00	2708.33	0.33
6.00	2708.33	0.33
8.00	2708.33	0.33
10.00	2708.33	0.33
12.00	2708.33	0.33
14.00	2708.33	0.33
16.00	2708.33	0.33
18.00	2708.33	0.33
20.00	2708.33	0.33

Tailwater Channel Data - CP 1.6

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 2708.33 ft

Roadway Data for Crossing: CP 1.6

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 ft

Crest Elevation: 2712.50 ft

Roadway Surface: Paved

Roadway Top Width: 10.00 ft

B.2 Grate Inlet Worksheets

PROJECT: Oro Valley Assited Living Community
WLB NO: 185050-HN02-0400
DESCRIPTION: CP 1.1 **Q100= 1.00**
DATE: 11/6/2023

Type of Grate	**EF-1**	**Width, ft**	**1.97**
Number of Grates	**1**	**Length, ft**	**3.33**
Area, ft^2	**6.56**	**Wing, ft**	
Perimeter, ft	**7.27**		

GRATE INLET

DEPTH (FT)	PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)	
0.05	7.27	6.56	0.24	7.85	0.24
0.10	7.27	6.56	0.69	11.10	0.69
0.15	7.27	6.56	1.27	13.59	1.27
0.20	7.27	6.56	1.95	15.70	1.95
0.25	7.27	6.56	2.73	17.55	2.73
0.30	7.27	6.56	3.58	19.22	3.58
0.35	7.27	6.56	4.52	20.76	4.52
0.40	7.27	6.56	5.52	22.20	5.52
0.45	7.27	6.56	6.58	23.54	6.58
0.50	**7.27**	**6.56**	**7.71**	**24.82**	**7.71**
0.55	7.27	6.56	8.90	26.03	8.90
0.60	7.27	6.56	10.14	27.19	10.14
0.65	7.27	6.56	11.43	28.30	11.43
0.67	7.27	6.56	11.96	28.73	11.96
0.68	7.27	6.56	12.23	28.94	12.23
0.70	7.27	6.56	12.77	29.36	12.77
0.75	7.27	6.56	14.17	30.39	14.17

Type 5 Catch Basin PC/COT Std. Dtl. 307:

Length of Sump = Total Length of Grates
Length of Wing = 0.00 *(Wing Lengths are 4', 8', 12' or 16')*
Total Length = 3.33 (Effective Opening)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	TOTAL COMBINED CAPACITY (CFS)
				[3] WEIR EQ.	[4] ORIFICE EQ.		
0.05	3.33	0.50	60.00	0.09	N/A	0.09	0.33
0.10	3.33	0.50	60.00	0.24	N/A	0.24	0.93
0.15	3.33	0.50	60.00	0.44	N/A	0.44	1.71
0.20	3.33	0.50	60.00	0.69	N/A	0.69	2.64
0.25	3.33	0.50	60.00	0.96	1.63	0.96	3.68
0.30	3.33	0.50	60.00	1.26	2.57	1.26	4.84
0.35	3.33	0.50	60.00	1.59	3.25	1.59	6.10
0.40	3.33	0.50	60.00	1.94	3.82	1.94	7.46
0.45	3.33	0.50	60.00	2.31	4.30	2.31	8.90
0.50	**3.33**	**0.50**	**60.00**	**2.71**	**4.74**	**2.71**	**10.42**
0.55	3.33	0.50	60.00	3.12	5.14	3.12	12.02
0.60	3.33	0.50	60.00	3.56	5.52	3.56	13.70
0.65	3.33	0.50	60.00	4.01	5.86	4.01	15.44
0.67	3.33	0.50	60.00	4.20	6.00	4.20	16.16
0.68	3.33	0.50	60.00	4.29	6.06	4.29	17.07
0.70	3.33	0.50	60.00	4.49	6.19	4.49	16.72
0.75	3.33	0.50	60.00	4.97	6.51	4.97	17.75

Q100 =1 cfs

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$
3. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$
4. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$

* Calculated length of curb opening equals length of scupper/Safety Factor to account for clogging 10/1.25= 8'

PROJECT: Oro Valley Assited Living Community
WLB NO: 185050-HN02-0400
DESCRIPTION: CP 1.2 **Q100= 10.00**
DATE: 11/6/2023

Type of Grate	**EF-1**	**Width, ft**	**1.97**
Number of Grates	**1**	**Length, ft**	**3.33**
Area, ft^2	**6.56**	**Wing, ft**	
Perimeter, ft	**7.27**		

GRATE INLET

DEPTH (FT)	PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)	
0.05	7.27	6.56	0.24	7.85	0.24
0.10	7.27	6.56	0.69	11.10	0.69
0.15	7.27	6.56	1.27	13.59	1.27
0.20	7.27	6.56	1.95	15.70	1.95
0.25	7.27	6.56	2.73	17.55	2.73
0.30	7.27	6.56	3.58	19.22	3.58
0.35	7.27	6.56	4.52	20.76	4.52
0.40	7.27	6.56	5.52	22.20	5.52
0.45	7.27	6.56	6.58	23.54	6.58
0.50	**7.27**	**6.56**	**7.71**	**24.82**	**7.71**
0.55	7.27	6.56	8.90	26.03	8.90
0.60	7.27	6.56	10.14	27.19	10.14
0.65	7.27	6.56	11.43	28.30	11.43
0.67	7.27	6.56	11.96	28.73	11.96
0.68	7.27	6.56	12.23	28.94	12.23
0.70	7.27	6.56	12.77	29.36	12.77
0.75	7.27	6.56	14.17	30.39	14.17

Type 5 Catch Basin PC/COT Std. Dtl. 307:

Length of Sump = Total Length of Grates
Length of Wing = 0.00 *(Wing Lengths are 4', 8', 12' or 16')*
Total Length = 3.33 (Effective Opening)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	TOTAL COMBINED CAPACITY (CFS)
				[3] WEIR EQ.	[4] ORIFICE EQ.		
0.05	3.33	0.50	60.00	0.09	N/A	0.09	0.33
0.10	3.33	0.50	60.00	0.24	N/A	0.24	0.93
0.15	3.33	0.50	60.00	0.44	N/A	0.44	1.71
0.20	3.33	0.50	60.00	0.69	N/A	0.69	2.64
0.25	3.33	0.50	60.00	0.96	1.63	0.96	3.68
0.30	3.33	0.50	60.00	1.26	2.57	1.26	4.84
0.35	3.33	0.50	60.00	1.59	3.25	1.59	6.10
0.40	3.33	0.50	60.00	1.94	3.82	1.94	7.46
0.45	3.33	0.50	60.00	2.31	4.30	2.31	8.90
0.50	**3.33**	**0.50**	**60.00**	**2.71**	**4.74**	**2.71**	**10.42**
0.55	3.33	0.50	60.00	3.12	5.14	3.12	12.02
0.60	3.33	0.50	60.00	3.56	5.52	3.56	13.70
0.65	3.33	0.50	60.00	4.01	5.86	4.01	15.44
0.67	3.33	0.50	60.00	4.20	6.00	4.20	16.16
0.68	3.33	0.50	60.00	4.29	6.06	4.29	17.07
0.70	3.33	0.50	60.00	4.49	6.19	4.49	16.72
0.75	3.33	0.50	60.00	4.97	6.51	4.97	17.75

Q100 =10 cfs

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$
3. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$
4. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$

* Calculated length of curb opening equals length of scupper/Safety Factor to account for clogging 10/1.25= 8'

PROJECT: Oro Valley Assited Living Community
WLB NO: 185050-HN02-0400
DESCRIPTION: CP 1.3 **Q100=** 3.00
DATE: 11/6/2023 **Grate Layou**

Type of Grate	**EF-1**	**Width, ft**	**1.97**		**#1**
Number of Grates	**2**	**Length, ft**	**3.33**		**#2**
Area, ft^2	**9.33**	**Wing, ft**			
Perimeter, ft	**14.54**	**Y, ft**	**0.50**		
			Required Perimeter,ft (Clogging)	**5.66**	
GRATE INLET			**Required Area,ft (Clogging)**	**1.59**	

DEPTH (FT)	* PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)	DESIGN (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)		
0.05	14.54	9.33	0.49	11.17	0.49	0.24
0.10	14.54	9.33	1.38	15.79	1.38	0.69
0.15	14.54	9.33	2.53	19.34	2.53	1.27
0.20	14.54	9.33	3.90	22.33	3.90	1.95
0.25	14.54	9.33	5.45	24.97	5.45	2.73
0.30	**14.54**	**9.33**	**7.17**	**27.35**	**7.17**	**3.58**
0.35	14.54	9.33	9.03	29.54	9.03	4.52
0.39	14.54	9.33	10.79	31.34	10.79	5.39
0.40	14.54	9.33	11.04	31.58	11.04	5.52
0.45	14.54	9.33	13.17	33.50	13.17	6.58
0.50	**14.54**	**9.33**	**15.42**	**35.31**	**15.42**	**7.71**
0.60	14.54	9.33	20.27	38.68	20.27	10.14
0.70	14.54	9.33	25.55	41.78	25.55	12.77
0.80	14.54	9.33	31.21	44.66	31.21	15.61
0.90	14.54	9.33	37.24	47.37	37.24	18.62
1.00	14.54	9.33	43.62	49.93	43.62	21.81
1.10	14.54	9.33	50.32	52.37	50.32	25.16
1.20	14.54	9.33	57.34	54.70	54.70	27.35
1.30	14.54	9.33	64.65	56.93	56.93	28.47
1.40	14.54	9.33	72.26	59.08	59.08	29.54
1.50	14.54	9.33	80.14	61.16	61.16	30.58

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$

* Calculated clogging for orfice flow is 200% times the required perimeter.
The required perimeter is one half of a EF-1 grate STD. DTL. 311
Thus, as per the clogging requirements, the grate inlet has been rated for 1 EF-1 grate,
but the ponding depth has been rated for double the discharge

PROJECT: Oro Valley Assited Living Community
WLB NO: 185050-HN02-0400
DESCRIPTION: CP 1.4a **Q100=** 1.00
DATE: 11/6/2023 **Grate Layou**

Type of Grate	**EF-1**	**Width, ft**	**1.97**	**#1**
Number of Grates	**1**	**Length, ft**	**3.33**	
Area, ft^2	**4.67**	**Wing, ft**		
Perimeter, ft	**14.54**	**Y, ft**	**0.50**	

Required Perimeter,ft (Clogging) **1.89**
Required Area,ft (Clogging) **0.53**

GRATE INLET

DEPTH (FT)	* PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)	DESIGN (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)		
0.05	14.54	4.67	0.49	5.58	0.49	0.24
0.10	14.54	4.67	1.38	7.90	1.38	0.69
0.15	**14.54**	**4.67**	**2.53**	**9.67**	**2.53**	**1.27**
0.20	14.54	4.67	3.90	11.17	3.90	1.95
0.25	14.54	4.67	5.45	12.48	5.45	2.73
0.30	14.54	4.67	7.17	13.67	7.17	3.58
0.35	14.54	4.67	9.03	14.77	9.03	4.52
0.39	14.54	4.67	10.79	15.67	10.79	5.39
0.40	14.54	4.67	11.04	15.79	11.04	5.52
0.45	14.54	4.67	13.17	16.75	13.17	6.58
0.50	**14.54**	**4.67**	**15.42**	**17.65**	**15.42**	**7.71**
0.60	14.54	4.67	20.27	19.34	19.34	9.67
0.70	14.54	4.67	25.55	20.89	20.89	10.44
0.80	14.54	4.67	31.21	22.33	22.33	11.17
0.90	14.54	4.67	37.24	23.69	23.69	11.84
1.00	14.54	4.67	43.62	24.97	24.97	12.48
1.10	14.54	4.67	50.32	26.19	26.19	13.09
1.20	14.54	4.67	57.34	27.35	27.35	13.67
1.30	14.54	4.67	64.65	28.47	28.47	14.23
1.40	14.54	4.67	72.26	29.54	29.54	14.77
1.50	14.54	4.67	80.14	30.58	30.58	15.29

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$

* Calculated clogging for orfice flow is 200% times the required perimeter.
The required perimeter is one half of a EF-1 grate STD. DTL. 311
Thus, as per the clogging requirements, the grate inlet has been rated for 1 EF-1 grate,
but the ponding depth has been rated for double the discharge

PROJECT: Oro Valley Assited Living Community
WLB NO: 185050-HN02-0400
DESCRIPTION: CP 1.5 **Q100=** 3.00
DATE: 11/6/2023 **Grate Layou**

#1

Type of Grate	**EF-1**	**Width, ft**	**1.97**
Number of Grates	**1**	**Length, ft**	**3.33**
Area, ft^2	**4.67**	**Wing, ft**	
Perimeter, ft	**10.60**	**Y, ft**	**0.50**

Required Perimeter,ft (Clogging) **5.66**
Required Area,ft (Clogging) **1.59**

GRATE INLET

DEPTH (FT)	* PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)	DESIGN (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)		
0.05	10.60	4.67	0.36	5.58	0.36	0.18
0.10	10.60	4.67	1.01	7.90	1.01	0.50
0.15	10.60	4.67	1.85	9.67	1.85	0.92
0.20	10.60	4.67	2.84	11.17	2.84	1.42
0.25	10.60	4.67	3.98	12.48	3.98	1.99
0.30	10.60	4.67	5.23	13.67	5.23	2.61
0.35	**10.60**	**4.67**	**6.58**	**14.77**	**6.58**	**3.29**
0.40	10.60	4.67	8.04	15.79	8.04	4.02
0.45	10.60	4.67	9.60	16.75	9.60	4.80
0.50	**10.60**	**4.67**	**11.24**	**17.65**	**11.24**	**5.62**
0.60	10.60	4.67	14.78	19.34	14.78	7.39
0.70	10.60	4.67	18.62	20.89	18.62	9.31
0.80	10.60	4.67	22.75	22.33	22.33	11.17
0.90	10.60	4.67	27.15	23.69	23.69	11.84
1.00	10.60	4.67	31.80	24.97	24.97	12.48
1.10	10.60	4.67	36.69	26.19	26.19	13.09
1.20	10.60	4.67	41.80	27.35	27.35	13.67
1.30	10.60	4.67	47.13	28.47	28.47	14.23
1.40	10.60	4.67	52.68	29.54	29.54	14.77
1.50	10.60	4.67	58.42	30.58	30.58	15.29

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$

* Calculated clogging for orfice flow is 200% times the required perimeter.
The required perimeter is one half of a EF-1 grate STD. DTL. 311
Thus, as per the clogging requirements, the grate inlet has been rated for 1 EF-1 grate,
but the ponding depth has been rated for double the discharge

PROJECT: Oro Valley Assited Living Community
WLB NO: 185050-HN02-0400
DESCRIPTION: CP 1.7 **Q100= 1.00**
DATE: 11/6/2023

Type of Grate	**EF-1**	**Width, ft**	**1.97**
Number of Grates	**1**	**Length, ft**	**3.33**
Area, ft^2	**6.56**	**Wing, ft**	
Perimeter, ft	**7.27**		

GRATE INLET

DEPTH (FT)	PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)	
0.05	7.27	6.56	0.24	7.85	0.24
0.10	7.27	6.56	0.69	11.10	0.69
0.15	7.27	6.56	1.27	13.59	1.27
0.20	7.27	6.56	1.95	15.70	1.95
0.25	7.27	6.56	2.73	17.55	2.73
0.30	7.27	6.56	3.58	19.22	3.58
0.35	7.27	6.56	4.52	20.76	4.52
0.40	7.27	6.56	5.52	22.20	5.52
0.45	7.27	6.56	6.58	23.54	6.58
0.50	**7.27**	**6.56**	**7.71**	**24.82**	**7.71**
0.55	7.27	6.56	8.90	26.03	8.90
0.60	7.27	6.56	10.14	27.19	10.14
0.65	7.27	6.56	11.43	28.30	11.43
0.67	7.27	6.56	11.96	28.73	11.96
0.68	7.27	6.56	12.23	28.94	12.23
0.70	7.27	6.56	12.77	29.36	12.77
0.75	7.27	6.56	14.17	30.39	14.17

Type 5 Catch Basin PC/COT Std. Dtl. 307:

Length of Sump = Total Length of Grates
Length of Wing = 0.00 *(Wing Lengths are 4', 8', 12' or 16')*
Total Length = 3.33 (Effective Opening)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	TOTAL COMBINED CAPACITY (CFS)
				[3] WEIR EQ.	[4] ORIFICE EQ.		
0.05	3.33	0.50	60.00	0.09	N/A	0.09	0.33
0.10	3.33	0.50	60.00	0.24	N/A	0.24	0.93
0.15	3.33	0.50	60.00	0.44	N/A	0.44	1.71
0.20	3.33	0.50	60.00	0.69	N/A	0.69	2.64
0.25	3.33	0.50	60.00	0.96	1.63	0.96	3.68
0.30	3.33	0.50	60.00	1.26	2.57	1.26	4.84
0.35	3.33	0.50	60.00	1.59	3.25	1.59	6.10
0.40	3.33	0.50	60.00	1.94	3.82	1.94	7.46
0.45	3.33	0.50	60.00	2.31	4.30	2.31	8.90
0.50	**3.33**	**0.50**	**60.00**	**2.71**	**4.74**	**2.71**	**10.42**
0.55	3.33	0.50	60.00	3.12	5.14	3.12	12.02
0.60	3.33	0.50	60.00	3.56	5.52	3.56	13.70
0.65	3.33	0.50	60.00	4.01	5.86	4.01	15.44
0.67	3.33	0.50	60.00	4.20	6.00	4.20	16.16
0.68	3.33	0.50	60.00	4.29	6.06	4.29	17.07
0.70	3.33	0.50	60.00	4.49	6.19	4.49	16.72
0.75	3.33	0.50	60.00	4.97	6.51	4.97	17.75

Q100 =1 cfs

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$
3. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$
4. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$

* Calculated length of curb opening equals length of scupper/Safety Factor to account for clogging 10/1.25= 8'

PROJECT: Oro Valley Assited Living Community
WLB NO: 185050-HN02-0400
DESCRIPTION: CP 1.8 **Q100= 1.00**
DATE: 11/6/2023

Type of Grate	**EF-1**	**Width, ft**	**1.97**
Number of Grates	**1**	**Length, ft**	**3.33**
Area, ft^2	**6.56**	**Wing, ft**	
Perimeter, ft	**7.27**		

GRATE INLET

DEPTH (FT)	PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)	
0.05	7.27	6.56	0.24	7.85	0.24
0.10	7.27	6.56	0.69	11.10	0.69
0.15	7.27	6.56	1.27	13.59	1.27
0.20	7.27	6.56	1.95	15.70	1.95
0.25	7.27	6.56	2.73	17.55	2.73
0.30	7.27	6.56	3.58	19.22	3.58
0.35	7.27	6.56	4.52	20.76	4.52
0.40	7.27	6.56	5.52	22.20	5.52
0.45	7.27	6.56	6.58	23.54	6.58
0.50	**7.27**	**6.56**	**7.71**	**24.82**	**7.71**
0.55	7.27	6.56	8.90	26.03	8.90
0.60	7.27	6.56	10.14	27.19	10.14
0.65	7.27	6.56	11.43	28.30	11.43
0.67	7.27	6.56	11.96	28.73	11.96
0.68	7.27	6.56	12.23	28.94	12.23
0.70	7.27	6.56	12.77	29.36	12.77
0.75	7.27	6.56	14.17	30.39	14.17

Type 5 Catch Basin PC/COT Std. Dtl. 307:

Length of Sump = Total Length of Grates
Length of Wing = 0.00 *(Wing Lengths are 4', 8', 12' or 16')*
Total Length = 3.33 (Effective Opening)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	TOTAL COMBINED CAPACITY (CFS)
				[3] WEIR EQ.	[4] ORIFICE EQ.		
0.05	3.33	0.50	60.00	0.09	N/A	0.09	0.33
0.10	3.33	0.50	60.00	0.24	N/A	0.24	0.93
0.15	3.33	0.50	60.00	0.44	N/A	0.44	1.71
0.20	3.33	0.50	60.00	0.69	N/A	0.69	2.64
0.25	3.33	0.50	60.00	0.96	1.63	0.96	3.68
0.30	3.33	0.50	60.00	1.26	2.57	1.26	4.84
0.35	3.33	0.50	60.00	1.59	3.25	1.59	6.10
0.40	3.33	0.50	60.00	1.94	3.82	1.94	7.46
0.45	3.33	0.50	60.00	2.31	4.30	2.31	8.90
0.50	**3.33**	**0.50**	**60.00**	**2.71**	**4.74**	**2.71**	**10.42**
0.55	3.33	0.50	60.00	3.12	5.14	3.12	12.02
0.60	3.33	0.50	60.00	3.56	5.52	3.56	13.70
0.65	3.33	0.50	60.00	4.01	5.86	4.01	15.44
0.67	3.33	0.50	60.00	4.20	6.00	4.20	16.16
0.68	3.33	0.50	60.00	4.29	6.06	4.29	17.07
0.70	3.33	0.50	60.00	4.49	6.19	4.49	16.72
0.75	3.33	0.50	60.00	4.97	6.51	4.97	17.75

Q100 =1 cfs

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$
3. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$
4. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$

* Calculated length of curb opening equals length of scupper/Safety Factor to account for clogging 10/1.25= 8'

PROJECT: Oro Valley Assited Living Community
WLB NO: 185050-HN02-0400
DESCRIPTION: CP 1.9 **Q100=** 10.00
DATE: 11/6/2023

Grate Layout

#1	#2
#3	#4

Type of Grate	**EF-1**	**Width, ft**	**1.97**		
Number of Grates	**4**	**Length, ft**	**3.33**		
Area, ft^2	**18.67**	**Wing, ft**			
Perimeter, ft	**21.20**	**Y, ft**	**0.50**		
				Required Perimeter,ft (Clogging)	**18.86**
GRATE INLET				**Required Area,ft (Clogging)**	**5.29**

DEPTH (FT)	* PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)	DESIGN (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)		
0.05	21.20	18.67	0.71	22.33	0.71	0.36
0.10	21.20	18.67	2.01	31.58	2.01	1.01
0.15	21.20	18.67	3.69	38.68	3.69	1.85
0.20	21.20	18.67	5.69	44.66	5.69	2.84
0.25	21.20	18.67	7.95	49.93	7.95	3.98
0.30	21.20	18.67	10.45	54.70	10.45	5.23
0.35	21.20	18.67	13.17	59.08	13.17	6.58
0.40	21.20	18.67	16.09	63.16	16.09	8.04
0.45	21.20	18.67	19.20	66.99	19.20	9.60
0.46	**21.20**	**18.67**	**20.10**	**68.03**	**20.10**	**10.05**
0.50	**21.20**	**18.67**	**22.49**	**70.62**	**22.49**	**11.24**
0.60	21.20	18.67	29.56	77.36	29.56	14.78
0.70	21.20	18.67	37.25	83.56	37.25	18.62
0.80	21.20	18.67	45.51	89.32	45.51	22.75
0.90	21.20	18.67	54.30	94.74	54.30	27.15
1.00	21.20	18.67	63.60	99.87	63.60	31.80
1.10	21.20	18.67	73.37	104.74	73.37	36.69
1.20	21.20	18.67	83.60	109.40	83.60	41.80
1.30	21.20	18.67	94.27	113.87	94.27	47.13
1.40	21.20	18.67	105.35	118.16	105.35	52.68
1.50	21.20	18.67	116.84	122.31	116.84	58.42

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$

* Calculated clogging for orfice flow is 200% times the required perimeter.
The required perimeter is one half of a EF-1 grate STD. DTL. 311
Thus, as per the clogging requirements, the grate inlet has been rated for 1 EF-1 grate,
but the ponding depth has been rated for double the discharge

B.3 Constructed Channel Worksheets

Worksheet for X1.4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.036	
Channel Slope	0.01000	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	9.00	ft³/s

Results

Normal Depth	0.82	ft
Flow Area	3.11	ft²
Wetted Perimeter	5.31	ft
Hydraulic Radius	0.59	ft
Top Width	4.63	ft
Critical Depth	0.61	ft
Critical Slope	0.02728	ft/ft
Velocity	2.89	ft/s
Velocity Head	0.13	ft
Specific Energy	0.95	ft
Froude Number	0.62	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.82	ft
Critical Depth	0.61	ft
Channel Slope	0.01000	ft/ft

Cross Section for X1.4

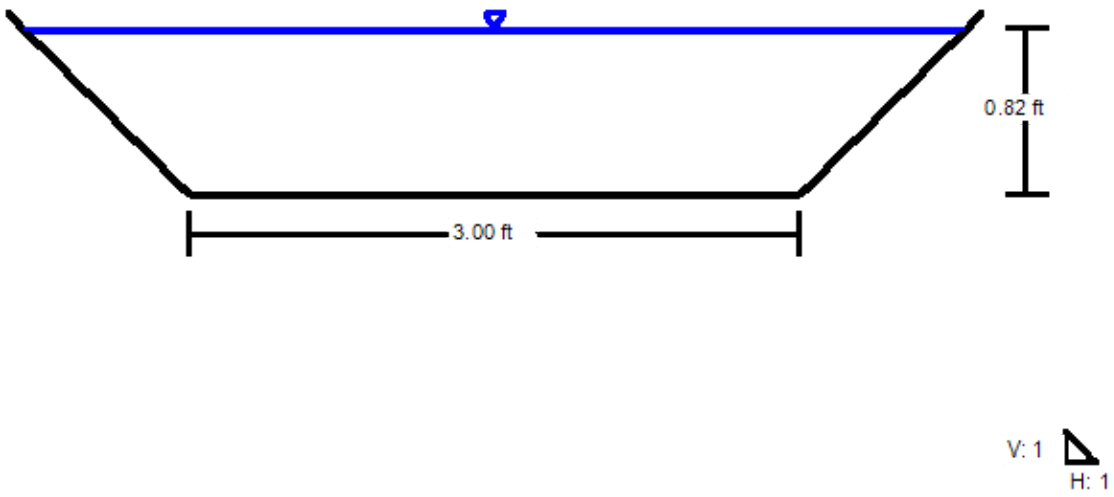
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.036	
Channel Slope	0.01000	ft/ft
Normal Depth	0.82	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	9.00	ft³/s

Cross Section Image



Worksheet for X1.6

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.036	
Channel Slope	0.03800	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	6.00	ft
Discharge	16.00	ft³/s

Results

Normal Depth	0.52	ft
Flow Area	3.38	ft²
Wetted Perimeter	7.47	ft
Hydraulic Radius	0.45	ft
Top Width	7.04	ft
Critical Depth	0.58	ft
Critical Slope	0.02535	ft/ft
Velocity	4.74	ft/s
Velocity Head	0.35	ft
Specific Energy	0.87	ft
Froude Number	1.21	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.52	ft
Critical Depth	0.58	ft
Channel Slope	0.03800	ft/ft

Cross Section for X1.6

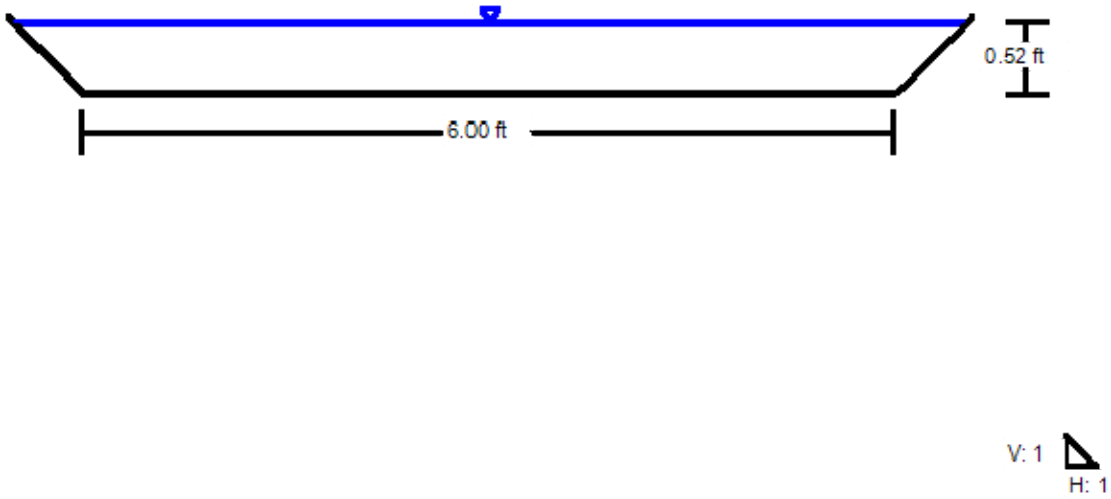
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

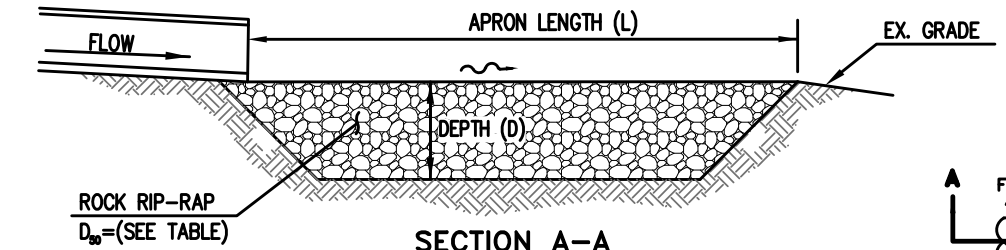
Input Data

Roughness Coefficient	0.036	
Channel Slope	0.03800	ft/ft
Normal Depth	0.52	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	6.00	ft
Discharge	16.00	ft³/s

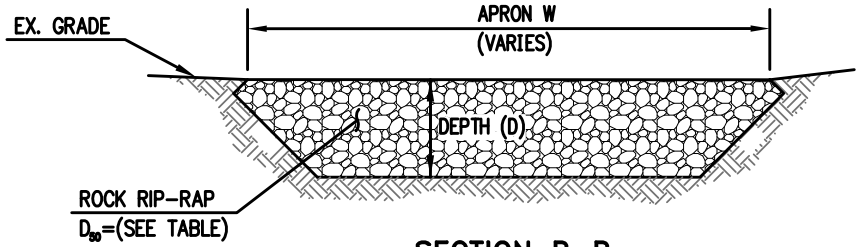
Cross Section Image



B.4 Rip Rap and Splash Pad Worksheets



SECTION A–A



SECTION B–B

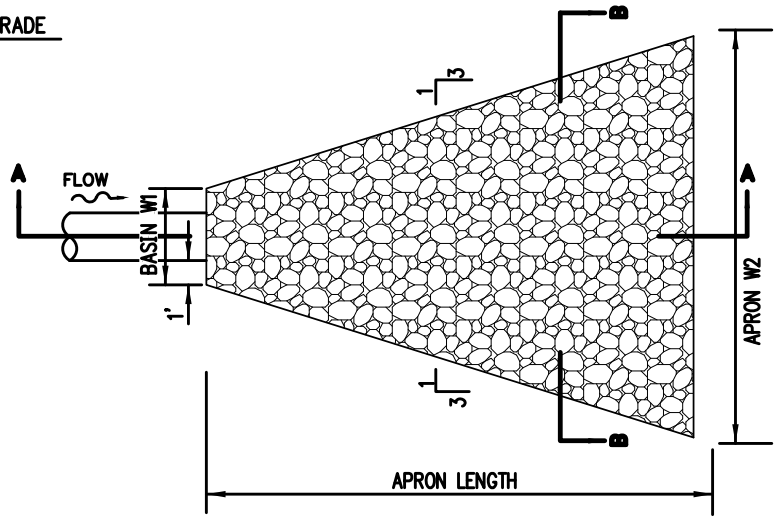


TABLE OF RIP-RAP APRON DIMENSIONS						
CP	CULVERT DESCRIPTION	APRON LENGTH(ft) L	APRON WIDTH(ft) W1	APRON WIDTH(ft) W2	APRON DEPTH(in) D	RECOMMENDED D_{50}(in)
1.1	1–42" CMP	20.0	5.5	17.5	30	15.0

RIP–RAP APRON DETAIL AT STORMDRAIN OUTLETS

N.T.S.

The WLB Group WLB	Riprap Apron Design Spreadsheet	WLB Job # 185050-HN02
	Oro Valley Assisted Living Community	

Riprap Design for Culvert

Description: Riprap Design
Date: 05/30/24
Location: CP 1.1

Designed: EJB
Checked: JSW
Date: 5/30/2024

Riprap Design Spreadsheet

References:

US DOT, FHWA, Highways in the River Environment Hydraulic and Environmental Design Considerations May 1975, pVI-24.

US DOT, FHWA, Hydraulic Design of Energy Dissipators for Culverts and Channel. Sept. 1983, pII-5-II-9.

FCDMC, Drainage Design Manual for Maricpa County Arizona, Vol. II - Hydraulics. January 1996, p5.75-5.77.

1. Riprap Size D50

Max. flow width Wo =	3	ft
Max. culvert flow depth h =	2.5	ft
Tailwater depth TW =	1.8	ft
Exit Velocity Ve =	12.65	fps
Tailwater velocity Vd =	8.855	fps
Wash bottom width =	8	ft
Computed Riprap Size D50 =	12.4	in
Design Riprap Size D50 =	**15**	in (Type 1)

2. Riprap Sizes D15 and D85

Design Riprap Size D15 =	**6**	in
Design Riprap Size D85 =	**23**	in

3. Riprap Apron Length

Riprap Apron Length =	**20**	ft

4. Rirap Apron Width

Min. Riprap Apron Width =	**8**	ft
Max. Riprap Apron Width =	**13**	ft

5. Riprap Thickness

Riprap Thickness =	**30**	in

6. Total Riprap Volume

Riprap Rock Volume =	**19.4**	CY

B.5 Pipe Culvert Sediment-Transport Worksheets

The WLB Group WLB

Pipe Culvert Sediment-transport
Sediment Analysis - Graf & Aracoglu
Rancho Vistioso Neighborhood 4 - Oro Valley Assited Living

WLB Job # 185050-HN02
Date: 11/8/2023
Prepared by: EJB
Checked by: JSW

CP 1.3

Per Pipe Cell

Qmax = (13590*(ds^-1.02)*(S^2.52)*(R^1.52)*A) Graf and Aracoglu

Q100	5	
ds =	2	mm
S =	0.031	m/m
R =	0.4572	m
A =	0.893832	m^2
Qmax =	0.287752	cms
Qmax =	10.16185	cfs
# Pipes	1	
Qmax (Total)	10.16185	

Q10	4	
ds =	2	mm
S =	0.031	m/m
R =	0.249201	m
A =	0.893832	m^2
Qmax =	0.114396	cms
Qmax =	4.039855	cfs
# Pipes	1	
Qmax (Total)	4.039855	

Q2	1	
ds =	2	mm
S =	0.031	m/m
R =	0.186619	m
A =	0.893832	m^2
Qmax =	0.073707	cms
Qmax =	2.602941	cfs
# Pipes	1	
Qmax (Total)	2.602941	

Sediment Transport Analysis	Q100	Q10	Q2
Total Culvert Sediment Flow Capacity	10.16	4.04	2.60
Channel Sediment Transport	0.07	0.03	0.01

The WLB Group WLB

Pipe Culvert Sediment-transport
Sediment Analysis - Graf & Aracoglu
Rancho Vistioso Neighborhood 4 - Oro Valley Assited Living

WLB Job # 185050-HN02
Date: 11/8/2023
Prepared by: EJB
Checked by: JSW

CP 1.4

Per Pipe Cell

Qmax = (13590*(ds^-1.02)*(S^2.52)*(R^1.52)*A) Graf and Aracoglu

Q100	8	
ds =	2	mm
S =	0.08	m/m
R =	0.4572	m
A =	0.893832	m^2
Qmax =	3.137422	cms
Qmax =	110.797	cfs
# Pipes	1	
Qmax (Total)	110.797	

Q10	4	
ds =	2	mm
S =	0.08	m/m
R =	0.249201	m
A =	0.893832	m^2
Qmax =	1.247286	cms
Qmax =	44.04748	cfs
# Pipes	1	
Qmax (Total)	44.04748	

Q2	2	
ds =	2	mm
S =	0.08	m/m
R =	0.186619	m
A =	0.893832	m^2
Qmax =	0.803645	cms
Qmax =	28.38047	cfs
# Pipes	1	
Qmax (Total)	28.38047	

Sediment Transport Analysis	Q100	Q10	Q2
Total Culvert Sediment Flow Capacity	110.80	44.05	28.38
Channel Sediment Transport	0.07	0.03	0.01

The WLB Group WLB

Pipe Culvert Sediment-transport
Sediment Analysis - Graf & Aracoglu
Rancho Vistioso Neighborhood 4 - Oro Valley Assited Living

WLB Job # 185050-HN02
Date: 11/8/2023
Prepared by: EJB
Checked by: JSW

CP 1.6

Per Pipe Cell
Qmax = (13590*(ds^-1.02)*(S^2.52)*(R^1.52)*A) Graf and Aracoglu

Q100	5	
ds =	2	mm
S =	0.08	m/m
R =	0.6096	m
A =	0.893832	m^2
Qmax =	4.85825	cms
Qmax =	171.5675	cfs
# Pipes	1	
Qmax (Total)	171.5675	

Q10	4	
ds =	2	mm
S =	0.08	m/m
R =	0.249201	m
A =	0.893832	m^2
Qmax =	1.247286	cms
Qmax =	44.04748	cfs
# Pipes	1	
Qmax (Total)	44.04748	

Q2	1	
ds =	2	mm
S =	0.08	m/m
R =	0.186619	m
A =	0.893832	m^2
Qmax =	0.803645	cms
Qmax =	28.38047	cfs
# Pipes	1	
Qmax (Total)	28.38047	

Sediment Transport Analysis	Q100	Q10	Q2
Total Culvert Sediment Flow Capacity	171.57	44.05	28.38
Channel Sediment Transport	0.07	0.03	0.01

B.6 PAAL Conveyance Worksheets

Worksheet for PAAL Conveyance (Max Flow)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00970	ft/ft
Discharge	10.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	11.15
0+01	11.15
0+01	10.65
0+14	10.39
0+27	10.65
0+27	11.15
0+28	11.15

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 11.15)	(0+28, 11.15)	0.016

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.28	ft
Elevation Range	10.39 to 11.15 ft	
Flow Area	3.88	ft²
Wetted Perimeter	26.04	ft
Hydraulic Radius	0.15	ft
Top Width	26.00	ft

Worksheet for PAAL Conveyance (Max Flow)

Results

Normal Depth		0.28	ft
Critical Depth		0.30	ft
Critical Slope		0.00681	ft/ft
Velocity		2.57	ft/s
Velocity Head		0.10	ft
Specific Energy		0.38	ft
Froude Number		1.17	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.28	ft
Critical Depth	0.30	ft
Channel Slope	0.00970	ft/ft
Critical Slope	0.00681	ft/ft

Cross Section for PAAL Conveyance (Max Flow)

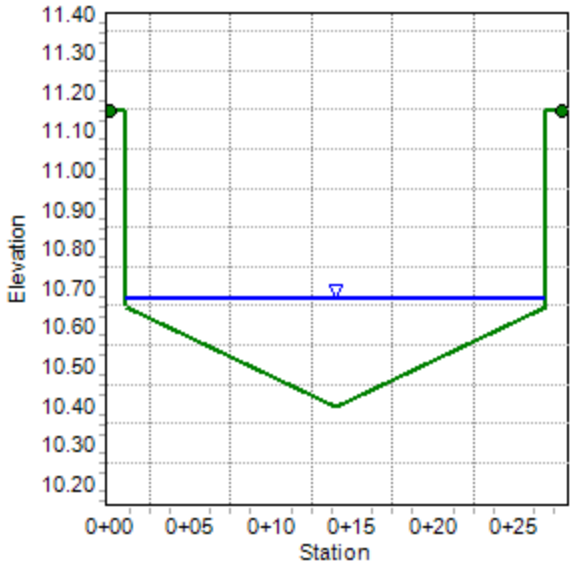
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00970	ft/ft
Normal Depth	0.28	ft
Discharge	10.00	ft³/s

Cross Section Image



LIMITATIONS

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