Drainage Report
Sundara Ridge Lots 1 through 91
Portion of Section 15, T12S, R13E
Pima County Tax Code 224-39-0020
Oro Valley, Pima County, Arizona
TOV Application 2100731
FINAL SITE PLAN CASE #2201777
GRADING PERMIT #2500131

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7th Submittal
December 2024

ARROYO ENGINEERING, LLC
Water Resources & Civil Engineering Consultants

PLANS REVIEWED AND ACCEPTED FOR CODE COMPLIANCE

Stormwater: droberts 04/10/2025

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

TABLE OF CONTENTS

I. Introduction 1
II. Existing Conditions 2
A. Offsite Watersheds 2
B. Onsite Drainage 2
III. Proposed Conditions 3
IV. Special Conditions 4
A. Rezoning Requirements 4
B. FEMA Conditional Letter of Map Revision 5
C. Maintenance Requirements for Proposed Regional Detention Basin 5
V. Hydrologic and Hydraulic Analysis 6
A. Hydrology 6
1. Existing Conditions 6
2. Developed Conditions 8
A. Onsite Hydrology 8
B. Lomas de Oro Wash 9
C. Canyon Shadows Wash 9
B. Hydraulics 10
1. Existing Conditions Floodplain Analysis 10
2. Lomas de Oro Wash Floodplain Analysis - Developed Conditions 11
3. Canyon Shadows Wash Floodplain Analysis - Developed Conditions 11
4. Proposed Drainage Structures 11
A. Streets 12
B. Grate Inlets 12
C. Scuppers 13
D. Storm Drains 13
E. Cross-Drainage Culverts 16
F. Channels 16
G. Concept Design for Bank Protection along Lomas de Oro Wash 17
H. Concept Design for Bank Protection along Canyon Shadows Wash 19
I. Benefits to Offsite Properties from Bank Protection along Canyon Shadows Wash 19
C. Stormwater Detention 20
1. Basin Sedimentation 21
2. Stormwater Harvesting 21
3. Basin Drain Times 21
4. Basin Maintenance Requirements 21
D. Erosion Control 23
1. Erosion Hazard Setbacks 23
2. Scuppers 23
3. Total Scour for Bank Protection 24
4. Total Scour for Sanitary Sewer Crossing 24
5. Riprap Aprons 24
E. Stormwater Pollution Plan Requirements 25

F. First Flush 25
G. Maintenance of Drainage Structures 26
VI. Conclusion 27
VII. References 28

Tables

Existing Conditions Offsite Hydrology 6
Existing Conditions Onsite Hydrology 7
Developed Conditions Onsite Hydrology 8
Lomas de Oro Wash – Flow Reduction 9
Benefits of Regional Detention Basin along Lomas de Oro Wash 9
Canyon Shadows Wash – Flow Reduction 10
Hydraulic Capacity for Cross-Slope Roadway 12
Onsite Hydraulic Structures – Grate Inlets 12
Onsite Hydraulic Structures – Scuppers 13
Onsite Hydraulic Structures – Storm Drains (1 of 3) 13
Onsite Hydraulic Structures – Storm Drains (2 of 3) 14
Onsite Hydraulic Structures – Storm Drains (3 of 3) 15
Onsite Hydraulic Structures – Cross-Drainage Culvert for Lomas de Oro Wash 16
Onsite Hydraulic Structures - Local Collector Channels 16
Onsite Hydraulic Structures - Local Channels 17
Lomas de Oro Wash – Bank Protection Concept Design 18
Canyon Shadows Wash – Change in WSEL and Velocity at Property Line 19
Proposed Outflows from Detention Basins 20
Concept Designs for Detention Basins 20
Erosion Hazard Setbacks 23
Concept Design[1] for Erosion Control Aprons 25

Appendix A. Exhibits
Appendix B. Hydrology
Appendix C. Hydraulics
Appendix CS. Canyon Shadows Wash - Developed Floodplain and Erosion Mitigation (prepared separately by LJA Engineering, Inc.)
Appendix D. Scour and Erosion Mitigation
Appendix E. Detention Routing
Appendix F. Oro Valley Checklist
Appendix G. LJA Final Site Plan

(HEC-RAS and FLO-2D models provided separately)

I. INTRODUCTION

This Drainage Report has been prepared for LJA Engineering (LJA), in conjunction with a Final Site Plan for the proposed subdivision named "Sundara Ridge Lots 1 through 91," located within the Town of Oro Valley, Pima County, Arizona. The project is located within a portion of Section 15, Township 12 South, Range 13 East. The proposed project is located on parcel 224-39-0020. A Location Map and an aerial photograph are provided in Appendix A (WLB, 2016).

Legal description

NW4 EXC N75' 155.31 AC SEC 15-12-13

More specially, the property situates on the southeast corner of the intersection of La Cholla Boulevard and Lambert Lane. The project is bounded on the east by the Rancho Feliz subdivision and on the south by the Lomas de Oro subdivision. The proposed project is a development of 91 single family residential homes, single-story and two-story homes, on 145.203 gross acres (141.7 acres net acres after ROW dedications). There are 73 lots which have a minimum lot size of 1/2 acre, and 18 lots which have a minimum lot size of 10,000 square feet. The site is currently undeveloped, and currently zoned R1-144 (Single-Family Residential District). The Town of Oro Valley General Plan designates the property as Low Density Residential (LDR-1).

A Rezoning Site Analysis (WLB, 2016) (OV914-009) was approved by the Town Council on May 4, 2016. The Town Council voted to conditionally approve the above rezoning request, subject to the modified conditions of approval. This Drainage Report has been prepared in compliance with the drainage-related conditions, as discussed in Section IV of this report.

Three onsite watercourses convey regulatory flows from cross-drainage culverts at Lambert Lane across the property. According to the FEMA Flood Insurance Rate Map (FIRM) Panel 04019C1070L (June 16, 2011), the 100-year floodplains for Lomas de Oro Wash, Canyon Shadows Wash, and Canada Hills Wash are designated as Zone "A." A Conditional Letter of Map Revision (CLOMR) and subsequent LOMR will be submitted to FEMA for Lomas de Oro Wash and Canyon Shadows Wash.

This drainage analysis was prepared in accordance with the Oro Valley Drainage Criteria Manual (DCM) (**2010 Edition**), using additional technical criteria and computer modeling from the City of Tucson Drainage Standards Manual (DSM) (1989, 1998), the Pima County Drainage and Channel Design Standards Manual (1984), the HEC-RAS River Analysis Systems software package (v6.5, 2024), the FLO-2D model (Pro Model, 2019), and web-based PC-Hydro (Pima County Regional Flood Control District, 2019).

The purpose of the engineering analysis consists of (1) a hydrologic analysis to determine 100-year discharges; (2) floodplain delineations for the regulatory watercourses; (3) detention basin routing for 2-year, 10-year, and 100-year discharges; and (4) a hydraulic analysis for the proposed onsite stormwater conveyance measures, including erosion control.

II. EXISTING CONDITIONS

A. Offsite Watersheds

Three onsite watercourses convey regulatory flows from cross-drainage culverts at Lambert Lane across the property. According to the FEMA Flood Insurance Rate Map (FIRM) Panel 04019C1070L (June 16, 2011), the 100-year floodplains for Lomas de Oro Wash, Canyon Shadows Wash, and Canada Hills Wash are designated as Zone "A." A Conditional Letter of Map Revision (CLOMR) and subsequent LOMR will be submitted to FEMA for Lomas de Oro Wash and Canyon Shadows Wash.

To the south of the site, stormwater flowing within the Lomas de Oro Wash is captured and conveyed in gabion-lined channel. Lomas de Oro Wash eventually drains to the Cañada del Oro Wash, located approximately one half mile south of the subject property.

Onsite stormwater runoff within the Canyon Shadows Wash is discharged near the southeast property corner where it flows through offsite properties to the Rancho Feliz Wash, located further southeast of the project site. The Rancho Feliz Wash eventually drains to the Cañada del Oro Wash.

B. Onsite Drainage

Lomas de Oro Wash, Canyon Shadows Wash, and Canada Hills Wash flow across the project site from cross-drainage structures at Lambert Lane. The washes course through and exit the subject property in a natural condition and manner. There are no man-made features onsite nor are there constructed facilities to convey these offsite flows.

Onsite stormwater runoff flows into one of these three watercourses, with the exception of some local runoff along the southern property line.

III. PROPOSED CONDITIONS

The site layout will impact hydrologic characteristics such as impervious cover and floodplain encroachment. As a result of the increased impervious cover, detention basins will be constructed to detain the increased onsite flows with basin outflows less than existing conditions.

A cross-drainage culvert is proposed at the single roadway crossing. The culvert will have a height of 6 feet to facilitate wildlife crossings in accordance with Town requirements.

In accordance with rezoning requirements, a regional basin has been provided to reduce the Lomas de Oro Wash 100-year peak flow by 10% for the purpose of improving the downstream flooding conditions that currently impact residential parcels south of the subject property. The 10%, reduction was requested by the Town Engineer, and the basin will be dedicated to the Town. The Town Engineer has authorized the basin to have a maximum ponding depth of approximately five feet and will receive relief from the Code limitations on maximum cut depth. A Conditional Letter of Map Revision (CLOMR) and subsequent LOMR will be submitted to FEMA for the Lomas de Oro Wash.

In accordance with rezoning requirements, the project shall include drainage improvements to improve the existing drainage conditions within the area downstream of the project along the Canyon Shadows Wash. At the southeastern property corner where the Canyon Shadows Wash exits the property, the existing conditions shallow sheet flows that will be contained within the proposed channel improvements will be discharged in a manner to improve downstream offsite drainage conditions. The proposed improvements will facilitate efforts to remove three offsite residences from the FEMA Zone A floodplain as part of the CLOMR and LOMR applications.

Adjoining properties will not be protected from erosion due to potential lateral channel migration because they are outside of the project 100-year floodplains and erosion hazard setbacks.

The propose culvert at the crossing of the Lomas de Oro Wash has been designed to convey incoming bed-sediment load. Both the proposed culvert and proposed bank protection have been designed to take into account local geomorphology and long-term aggradation or degradation.

Maintenance of all drainage improvements proposed as part of this development will be the responsibility of the HOA, except for the regional offline basin, which will be the responsibility of the Town of Oro Valley.

A proposed Concept Drainage Plan map is included in Appendix A. The map shows the developed hydrology, proposed hydraulic structures, bank protection, and detention basins.

IV. SPECIAL CONDITIONS

A. Rezoning Requirements

A Rezoning Site Analysis (WLB, 2016) (OV914-009) was approved by the Town Council on May 4, 2016. The Town Council voted to conditionally approve the rezoning request, subject to the modified conditions of approval. This Drainage Report has been prepared in compliance with drainage-related conditions 6a and 6b, reproduced as follows:

Engineering

6. In accordance with Section 11.3.11 of the Town of Oro Valley Drainage Criteria Manual, the applicant shall reduce the post-development outflow of drainage from the Lomas de Oro and Canyon Shadows Washes, or provide other means as approved by the Town Engineer, to improve the existing drainage within the downstream area. The reduction shall be to an amount that has the effect of making existing residential structures located on immediately adjacent downstream properties, as shown on the Tentative Development Plan, eligible to be removed from the Town and FEMA floodplain.

    a. The regional on-site detention depicted on the Tentative Development Plan and discussed in the Site Analysis shall be designed and constructed so that the existing 100-year Lomas de Oro Wash peak flow is reduced by 10% where it exits the project's southern boundary. Furthermore, the basin shall be dedicated by the developer to the Town of Oro Valley upon successful inspection and acceptance by the Town Engineer and prior to the release of building permits.

    b. If the applicant is unable to construct the proposed off-site improvements depicted on the Tentative Development Plan and discussed in the Site Analysis, an on-site solution must be established and approved by the Town Engineer.

In accordance with rezoning requirements, a regional basin has been provided to reduce the Lomas de Oro Wash 100-year peak flow by 10% for the purpose of improving the downstream flooding conditions that currently impact residential parcels south of the subject property. The 10%, reduction was requested by the Town Engineer, and the basin will be dedicated to the Town. The Town Engineer has authorized the basin to have a maximum ponding depth of approximately five feet and will receive relief from the Code limitations on maximum cut depth. A Conditional Letter of Map Revision (CLOMR) and subsequent LOMR will be submitted to FEMA for the Lomas de Oro Wash.

In accordance with rezoning requirements, the project shall include drainage improvements to improve the existing drainage conditions within the area downstream of the project along the Canyon Shadows Wash. The effect of these improvements shall be to make the existing residential structures eligible to be removed from the FEMA floodplain.

At the southeastern property corner where the Canyon Shadows Wash exits the property, the existing conditions shallow sheet flows that will be contained within the proposed channel improvements will be discharged in a manner to improve downstream offsite drainage conditions. The proposed improvements will facilitate efforts to remove three offsite residences from the FEMA Zone A floodplain as part of the CLOMR and LOMR applications. The proposed drainage improvements are discussed in Section V.B.4.I of this report.

B. FEMA Conditional Letter of Map Revision

Three onsite watercourses convey regulatory flows from cross-drainage culverts at Lambert Lane across the property. According to the FEMA Flood Insurance Rate Map (FIRM) Panel 04019C1070L (June 16, 2011), the 100-year floodplains for Lomas de Oro Wash, Canyon Shadows Wash, and Canada Hills Wash are designated as Zone "A." A Conditional Letter of Map Revision (CLOMR) and subsequent LOMR will be submitted to FEMA for Lomas de Oro Wash and Canyon Shadows Wash.

The 100-year discharge from an existing Letter of Map Revision (LOMR) was used for the LdO Wash (Psomas, 2014). This LOMR regulatory discharge is the current FEMA-adopted value for use at this time.

However, an ongoing FEMA study (Oro Valley Cholla Wash Study, Pima County Regional Flood Control District), is likely to produce a new, larger regulatory FEMA discharge along the Lomas de Oro Wash. It is anticipated that this discharge will be adopted before a final LOMR can be processed for this project. Consequently, the preliminary discharge from the FEMA study was provided by the Town and used to insure that adequate channel depth would be available for the proposed concept design for the bank protection along the Lomas de Oro Wash. Results are presented in Section V.B.4.G of this report.

C. Maintenance Requirements for Proposed Regional Detention Basin

Maintenance of all drainage improvements proposed as part of this development will be the responsibility of the HOA, except for the regional offline basin, which will be the responsibility of the Town of Oro Valley.

All of the other proposed onsite detention basins will be maintained in accordance with Section 11.6 of the 2010 DCM. Details are provided within Section V.C.4 of this report.

V. HYDROLOGIC AND HYDRAULIC ANALYSIS

A. Hydrology

Hydrologic calculations were performed using the web-based PC-Hydro, in accordance with guidelines from the PC-Hydro User Guide (Pima County Regional Flood Control District, 2019; Arroyo Engineering, 2007). Hydrologic data sheets are included in Appendix B, which provide all of the input variables. Watersheds and concentration points are shown on the project maps in Appendix A.

Existing and developed onsite 2-year, 10-year, and 100-year discharges were calculated for use in performing detention basin routing. For the watercourses that originate offsite (Lomas de Oro Wash and Canada Hills Wash), 100-year flow values were obtained from existing reports. For these two main watercourses, and Canyon Shadows Wash, that outfall from the property, hydrologic analyses were limited to the 100-year flow and the effect of proposed detention basins at the downstream property lines.

1. Existing Conditions

The 100-year peak discharge values for Lomas de Oro (LdO) Wash and Canada Hills Wash (CHW) were obtained from existing sources.

An existing FEMA Letter of Map Revision (LOMR) was used for the LdO Wash (Psomas, 2014). Excerpts from the LOMR are provided in Appendix B. The 100-year discharges were obtained from the HEC-HMS summary output. The discharges reported in the Psomas report do not match the HEC-HMS model. The larger values reported in the HEC-HMS model were used.

The Drainage Report for La Cholla Boulevard (LCB) was used for the Canada Hills Wash (SCE Engineering, 2018). Excerpts are provided in Appendix B. The 100-year discharges are shown on Figure 2b from that report.

Existing Conditions Offsite Hydrology

Location	Conc. Pt.	Source	Q_{100} (cfs)	Area (ac)
CHW north of Lambert Ln	LC-11c	SCE Engineering, 2018	533	397.8
CHW at La Cholla Blvd.	LC-11d	SCE Engineering, 2018	622	453.6
LdO at Lambert Ln	LDO-4	Psomas 2014 HEC-HMS (CP4)	1619	1480.0
LdO at south property line	LDO-2	Psomas, 2014 HEC- HMS (CP2)	1642	1567.0

Existing Conditions Onsite Hydrology		
Conc. Pt.	Q_{100} (cfs)	Area (ac)
1.5	18	2.7
1	36	5.4
2.5	16	3.1
2	49	10.3
3.5	108	27.3
3	124	32.8
4.5 (CSW[1] at Lambert Ln)	95	24.3
4 (CSW[1] south of Lambert Ln)	106	28.4
5 (CSW[1] at south property line)	265	101.1
5a	2	0.5
5b	6	1.3
5c	27	5.8
5d	38	8.5
6	14	2.7
7	5	0.9
8	29	5.6
9	51	12.8
10	73	22.0
[1] CSW = Canyon Shadows Wash		

2. Developed Conditions

A. Onsite Hydrology

Concentration points were identified for use in the concept design of the proposed hydraulic structures. The Developed Conditions Watershed Map shows the concentration points and watersheds; the Concept Drainage Plan references these concentration points to the proposed hydraulic structures. The maps are included in Appendix A.

Developed Conditions Onsite Hydrology		
Conc. Pt.	Q_{100} (cfs)	Area (ac)
N1	33	6.2
N2	24	4.5
N3	21	4.2
D2	36	4.6
D2.1	46	5.9
N2.4	2	0.3
N2.5	20	3.8
D2.5	19	2.3
D2.6	34	5.8
D2.65	8	1.0
D2.7	3	0.6
D3	47	5.8
D3.3	3.6	0.7
D3.5	10	1.2
D4	45	5.9
D4.1	6	1.1
N4.1	13	2.5
N4a	5	0.9
N4b	26	5.0
N5	26	5.4
N5.1	24	4.6
D5	35	6.6
D6	26	3.2
D7	29	3.6
D12	34	6.3
D13	1.3	0.2
CP-5	262	88.4 plus Basin SE outflow
CP-5b	5	1.1
CP-5c	6	1.4

B. Lomas de Oro Wash

In accordance with rezoning requirement 6a, a regional detention basin has been provided to reduce the Lomas de Oro Wash 100-year peak flow by 10%, with the intent to improve the downstream flooding conditions that currently impact residential parcels south of the subject property. A 155-foot side weir has been provided to divert flows from the LdO Wash to the regional detention basin. Hydraulic calculations using HEC-RAS were used to determine the side-weir discharges, and a hydrograph constructed to determine the inflow volume to the basin. HEC-RAS files have been provided separately. Hydrograph calculations are provided in Appendix D. A summary table is provided below.

Lomas de Oro Wash – Flow Reduction	
Existing 100-year Discharge (cfs) [CP-LDO-2]	1642
Target discharge (10% less)	1478
Computed discharge with side weir outflows (cfs)	**1474**
Peak side-weir discharge to basin (cfs)	168
Volume to Basin (cf)	306028
Volume to Basin (af)	7.025

The 10% reduction in the 100-year discharge of LdO Wash has been provided to comply with rezoning requirements as requested by the Town Engineer. Due to the proposed construction of a 155-foot weir and a 7-acre-feet detention basin, the following benefits will be accrued, as summarized in the following table.

Benefits of Regional Detention Basin along Lomas de Oro Wash	
Existing 100-year Discharge (cfs)	1642
Proposed 100-year discharge (cfs)	1474
(Reduction in discharge) (cfs)	**168**
Existing 100-year water surface elevation near south property line (ft)	2518.7
Proposed 100-year water surface elevation near south property line (ft)	2518.4
(Reduction in 100-year water surface elevation) (ft)	**0.3**
Existing floodplain width near south property line (ft)	388
Proposed floodplain width near south property line (ft)	376
(Reduction in floodplain width) (ft)	**12**

C. Canyon Shadows Wash

In accordance with rezoning requirement 6, flows within the Canyon Shadows Wash have been reduced at the southern property line as the result of proposed onsite detention at Basin SE. Hydrograph summation was used to combine the developed flow from the wash with

the developed flow from Basin SE. Results are summarized in the following table, with calculations provided in Appendix B.

Canyon Shadows Wash – Flow Reduction	
Existing 100-year Discharge at CP-5 (cfs)	265
Developed 100-year discharge from wash (cfs)	231
Developed 100-year outflow from basin SE (cfs)	34
Combined developed 100-year discharge at CP-5 (cfs)	262

B. Hydraulics

Project topographic mapping was provided by Bowman Consulting in 2021. From their Final Site Plan:

BASIS OF ELEVATION

NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

BENCHMARK

BENCHMARK #1: DESCRIPTION
NORTHWEST CORNER OF SECTION 15
BRASS CAP IN HANDHOLE RLS 42285
ELEVATION = 2607.67 FEET

BENCHMARK #2: DESCRIPTION
NORTH QUARTER CORNER OF SECTION 15
BRASS CAP IN HANDHOLE RLS 85235
ELEVATION = 2600.64 FEET

1. Existing Conditions Floodplain Analysis

The existing conditions FLO-2D model (Pro Model, 2019), prepared as part of the rezoning application (JE Fuller 2015), was modified for use in modeling the existing conditions onsite floodplains for Lomas de Oro Wash, Canyon Shadows Wash, and Canada Hills Wash. The modified FLO-2D model was restricted to hydraulic modeling only, with hydrology based on steady-state 100-year discharges as presented in Section V.A.1 of this report. An Existing Conditions Floodplain Map is included in Appendix A.

FLO-2D Modeling Parameters (per JE Fuller, 2015)

1) The model was compiled for 20-foot grid and utilizes PAG elevation data.
2) The Manning's Roughness values were defined spatially with a shape file by identifying areas with similar characteristics as follows:
- Streets. N=0.020.
- Bare desert and/or undeveloped land. N=0.045.
- Drainage ways through development. N=0.045.
- Golf courses. N=0.030.
- Residential development. N=0.085.

2. Lomas de Oro Wash Floodplain Analysis - Developed Conditions

The RiverCAD software program was used to compile a HEC-RAS input file for the portion of the LdO Wash with proposed improvements. Developed conditions hydraulic modeling with HEC-RAS was determined to be more appropriate and reliable than FLO-2D for evaluating a side weir, a cross-drainage culvert, and providing hydraulic parameters for scour calculations. Upstream and downstream of the HEC-RAS reach, the floodplain limits tie into the FLO-2D floodplain limits.

As a concept design for use by LJA to develop engineering plans for the proposed side weir, a summary table of discharges, water surface elevations, and weir elevations is provided in Appendix C.

The floodplain modeling was performed for subcritical conditions. Manning's roughness coefficients and expansion/contraction coefficients were selected based on engineering judgment for observed conditions. The downstream boundary condition was based on normal depth. The HEC-RAS input/output files are provided separately. A Developed Conditions Floodplain Map is included in Appendix A.

HEC-RAS Modeling Parameters	
Roughness coefficients	0.025, 0.030, 0.035, 0.040, 0.045
Expansion and contraction coefficients	0.1 exp, 0.3 cont – all reaches; 0.3 exp, 0.5 cont – vicinity of culverts
Flow regime	subcritical

A subcritical flow regime was modeled because supercritical flow depths are unlikely to be maintained within a sand-bed channel as the channel adjusts bed forms in order to minimize the specific energy and attain critical depth. **Competent, high-gradient sand-bed washes typically achieve an equilibrium adjustment between the flow, sediment transport, and channel morphology at or near critical flow (Grant, 1997).**

3. Canyon Shadows Wash Floodplain Analysis - Developed Conditions

For developed conditions, a HEC-RAS model was prepared by LJA to be used as part of the CLOMR application (LJA, 2024). The floodplain modeling incorporates the proposed encroachment from bank protection and the proposed improvements at the southeast corner of the property. A Developed Conditions Floodplain Map is included in Appendix A. LJA HEC-RAS summary output tables and proposed finished-floor elevations are provided in Appendix CS.

4. Proposed Drainage Structures

All calculations, with referenced equations, are included in Appendix C as concept designs. LJA's engineering designs have been shown on their Site Plan (see Appendix G).

A. Streets

For street flows, hydraulic calculations were performed to establish the minimum slope that would convey the maximum 100-year discharge of 50 cfs within the curbs of the proposed public roadway section (50-foot right-of-way). The typical street section is based on 28 feet of pavement, a 2% crown, 6-inch curbs, and sidewalks on both sides. Manning's roughness coefficients were varied across the 50-foot right-of-way, with a value of 0.013 used for concrete portions, a value of 0.016 used for asphalt portions, and a value of 0.022 used for unpaved portions. The calculations are based on the 100-year flow contained within the curbs. For the design street section, with the maximum discharge of 50 cfs, the minimum street slope is 0.94%.

For certain roadway locations, a 2% cross-slope roadway will be necessary. Hydraulic calculations, contained in Appendix C, provide the hydraulic capacity for a range of expected street slopes. Results are summarized in the following table.

Hydraulic Capacity for Cross-Slope Roadway	
Street slope (%)	Capacity (cfs)
4	57
3	49
2.5	45
2	40
1.6	36
0.64	23

B. Grate Inlets

Street runoff will be collected by grate inlets for downstream conveyance. The bypass flow along the curbs at each location was determined. All calculations, with referenced equations, are included in Appendix C as a concept design. LJA's engineering design has been shown on their Final Site Plan (see Appendix G).

Onsite Hydraulic Structures – Grate Inlets				
Conc. Pt.	Q_{100} (cfs)	Grate width (lf)	Grate inlet (max slope [sL] for 100% interception)	Bypass flow at curbs (cfs)
D2.1	46	28	7.4%	1.9
D2.5	19	28	6.3%	0.8
D3	47	28	6.6%	1.9
D3.5	10	28	8.8%	0.4
D4	45	28	6.6%	1.8
D5	35	28	7.7%	1.4

C. Scuppers

Hydraulic calculations were performed to determine the scupper sizes needed to convey the street runoff. The design discharge at each scupper includes bypass flow from the upstream grate inlet, where applicable. The scupper widths were determined as a concept design minimum width at each location. All calculations, with referenced equations, are included in Appendix C as a concept design. LJA's engineering design has been shown on their Final Site Plan (see Appendix G).

Onsite Hydraulic Structures – Scuppers								
Scupper Conc. Pt.	Q_{100} (cfs)	Bypass flow from from upstream vane grate		Design Q_{100} (cfs)	Opening height (h) (ft)	Scupper thickness (t) (ft)	Yi (ft)	Minimum width (L) (ft)
		CP	Q (cfs)					
D2	36	D2.1+D2.5	2.7	38.7	0.67	0.33	1	13
D2.65	8	n/a		8	0.67	0.33	1	3
D6	26	D4+D5	3.2	29.2	0.67	0.33	1	10
D7	29	D3	1.9	30.9	0.67	0.33	1	11
N2.4	2	reverse scupper		2	0.67	0.33	1	1
N5	26	reverse scupper		26	0.67	0.33	1	9
D2.7	3	reverse scupper		3	0.67	0.33	1	1
D3.3	3.6	reverse scupper		3.6	0.67	0.33	1	1
D4.1	6	reverse scupper		6	0.67	0.33	1	2

D. Storm Drains

Storm drains will be used to convey runoff from grate inlets to downstream outfalls. Hydraulic grade line calculations indicated that none of the storm drains are flowing under pressure (included in Appendix C). Normal depth calculations were completed to determine the flow depths in the pipes for each segment (included in Appendix C). Storm drain profiles are shown on the LJA Final Site Plan.

Onsite Hydraulic Structures – Storm Drains (1 of 3)							
Storm Drain Outfall at SW Basin = D4+D5							
RUN D4							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
306.80	2518.08	1	36	80	3.00	0.0	
length	*102.5*						5.02%
409.34	2523.23	1	36	80	1.56	21.5	
Manhole and D5 lateral inflow							
409.34	2523.33	1	36	45	1.22	16.6	
length	*304.8*						3.75%
714.13	2534.77	1	36	45	1.22	16.6	
Manhole							
714.13	2534.87	1	36	45	0.80	29.7	

length	*29.6*						18.65%
743.68	2540.38	1	36	45	0.80	29.7	
Storm Drain Lateral from D5 to D4							
RUN D5							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
221.22	2523.63	1	36	35	1.21	13.1	
length	*184.7*						2.34%
405.89	2527.95	1	36	35	1.21	13.1	
Manhole and D13 lateral inflow							
405.89	2528.05	1	36	35	1.22	12.9	
length	*45.7*						2.25%
451.64	2529.08	1	36	35	1.22	12.9	
Storm Drain Lateral from D13 to D5							
RUN SD-D13							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
1003.04	2529.95	1	12	1.3	0.51	3.2	
length	18.2						0.50%
1021.20	2530.04	1	12	1.3	0.51	3.2	

Onsite Hydraulic Structures – Storm Drains (2 of 3)							
Storm Drain Outfall at SW Basin = D3							
RUN D3							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
408.49	2518.08	1	36	47	3.00	0.0	
length	113.7						4.33%
522.18	2523.00	1	36	47	1.20	17.7	
Manhole							
522.18	2523.10	1	36	47	1.22	17.4	
length	446.2						4.13%
968.38	2541.54	1	36	47	1.22	17.4	
968.38	2541.54	1	36	47	1.22	17.4	
Manhole							
968.38	2541.64	1	36	47	0.76	33.3	
length	15.3						25.02%
983.65	2545.46	1	36	47	0.76	33.3	
Storm Drain Outfall at SE Basin = D2.1+N2							
RUN SD-D2.1							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
997.10	2494.95	1	48	70	3.0	0.0	
length	-150.5						1.99%
846.61	2497.94	1	48	70	1.62	14.6	
Manhole							
846.86	2498.34	1	48	70	1.44	17.2	

length	-364.93						3.11%
481.93	2509.68	1	48	70	1.44	17.2	
Manhole							
481.93	2509.78	1	48	70	1.47	16.7	
length	-310.6						2.86%
171.33	2518.65	1	48	70	1.47	16.7	
Manhole and N2 lateral inflow							
171.33	2519.65	1	36	46	1.22	17.0	
length	-113.20						3.89%
58.13	2524.05	1	36	46	1.22	17.0	
Manhole							
58.13	2524.15	1	36	46	0.95	24.0	
length	-19.13						10.14%
39.00	2526.09	1	36	46	0.95	24.0	

Onsite Hydraulic Structures – Storm Drains (3 of 3)							
Storm Drain Lateral from N2 to D2.1							
RUN N2							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
1110.31	2520.27	1	30	24	0.98	13.5	
length	-75.3						3.28%
1035.01	2522.74	1	30	24	0.98	13.5	
Storm Drain from D2.5 to Basin N							
RUN SD-D2.5							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
1041.09	2570.00	1	36	38	0.60	0	
length	41.7						21.45%
1082.82	2578.95	1	36	38	0.71	29.7	
Storm Drain from D3.5 to Basin C							
RUN SD-D3.5							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
1074.00	2564.00	1	18	10	1.30	0.0	
length	-54.0						-0.81%
1020.00	2564.44	1	18	10	1.33	6.0	
Storm Drain at D12							
RUN SD-D12							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
1205.09	2548.10	1	30	34	1.91	8.4	
length	-109.5						0.79%
1095.62	2548.96	1	30	34	1.91	8.4	
Manhole							
1097.52	2549.36	1	30	34	1.64	10.0	
length	-71.5						1.18%
1026.04	2550.20	1	30	34	1.64	10.0	

E. Cross-Drainage Culverts

Hydraulic calculations were performed to determine the concept design for the proposed cross-drainage culvert for the Lomas de Oro Wash. Sediment transport ratios were calculated according to Equation 11.9 of the DSM (COT, 1998) to insure the culverts will maintain sediment transport rates. In addition, an acceptable "openness ratio" for wildlife accessibility was determined for the proposed arch culverts in accordance to the Arizona Game and Fish methodology. All calculations, with referenced equations, are included in Appendix C and Appendix D.

Onsite Hydraulic Structures – Cross-Drainage Culvert for Lomas de Oro Wash					
Concentration Point	Q_{100} (cfs)	Structure	Headwater/ Diameter (rise)	Headwater Depth	Calculations per
Lomas de Oro Wash	1474	2 24'x6' ConSpan arches	0.75	4.5'	HEC-RAS

F. Channels

Local collector channels will be used around the edge of the proposed lots to collect runoff from undisturbed areas and convey the runoff downstream. The concept designs for the channels, as shown in the following table, are based on Figure 8.15, Typical Collector-Channel Cross Section, from the City of Tucson Drainage Manual (1998), where the design depth is twice the calculated flow depth. All calculations, with referenced equations, are included in Appendix C as a concept design. LJA's engineering design has been shown on their Final Site Plan (see Appendix G).

Onsite Hydraulic Structures - Local Collector Channels										
Location	Q100 (cfs)	Flow Depth (ft)	Design Depth (ft)	Bottom width (ft)	Design Topwidth (ft)	Left sideslope (xH:1V)	Left lining	Right sideslope (xH:1V)	Right lining	min slope %
N1	33	1.5	3.0	4	16	1	grouted riprap	2	grouted riprap	0.5
N2	24	1.3	2.6	4	12	2	grouted riprap	1	grouted riprap	0.5
N3	21	1.1	2.2	4	15	2	grouted riprap	1	grouted riprap	0.5
N4.1	13	0.9	1.8	4	13	2	dumped riprap	3	earthen	0.5
N4b	26	1.2	2.4	4	15	2	dumped riprap	3	earthen	0.51
N5	26	1.4	2.9	4	12	1	grouted riprap	2	grouted riprap	0.5
N5.1	24	1.2	2.4	4	16	3	earthen	2	dumped riprap	0.5
D3.3	3.6	0.4	0.9	4	8	2	dumped riprap	2	dumped riprap	0.54
D13	1.3	0.2	0.4	4	5	2	grouted riprap	1	grouted riprap	1.0
d_{50} = 6 inches										

Local grouted riprap channels will be used between lots to convey runoff to downstream storm drains. The concept designs for the channels, as shown in the following table, are based on normal depth for the minimum slope shown on the LJA Final Site Plan. The design depth includes freeboard. All calculations are included in Appendix C as a concept design. LJA's engineering design has been shown on their Final Site Plan (see Appendix G).

Onsite Hydraulic Structures - Local Channels

Location	Q100 (cfs)	Flow Depth (ft)	Design Depth[a] (ft)	Bottom width (ft)	Design Topwidth (ft)	Left sideslope (xH:1V)	Left lining	Right sideslope (xH:1V)	Right lining	min slope %
D12	34	1.4	1.7	4	7	1	grouted riprap	1	grouted riprap	0.97
N2	24	1.7	2.0	4	8	1	grouted riprap	1	grouted riprap	0.25
N3	21	1.1	1.3	4	7	1	grouted riprap	1	grouted riprap	0.85

[a] = includes freeboard, d_{50} = 6 inches for grouted riprap

G. Concept Design for Bank Protection along Lomas de Oro Wash

Bank protection is proposed along the Lomas de Oro Wash at locations where proposed lots, roadways, and detention basins encroach into either the 100-year floodplain or the erosion hazard setback. Locations are generally identified on the Concept Drainage Plan (Appendix A), with engineering details in plan, profile, and section provided on the LJA Final Site Plan (Appendix G). The following table, referenced to the HEC-RAS station numbers (hydraulic cross sections), provide the computed 100-year water surface elevation (WSEL), minimum freeboard, minimum design WSEL, and minimum toe-down depths. Freeboard calculations are included in Appendix C. Scour and toedown calculations are included in Appendix D.

An ongoing FEMA study (Oro Valley Cholla Wash Study, Pima County Regional Flood Control District), is likely to produce a new, larger regulatory FEMA discharge along the Lomas de Oro Wash. It is anticipated that this discharge will be adopted before a final LOMR can be processed for this project. Consequently, the preliminary discharge from the FEMA study was provided by the Town and used to insure that adequate channel depth would be available for the proposed concept design for the bank protection along the Lomas de Oro Wash.

The current FEMA design discharge used for this project is 1642 cfs. The preliminary 100-year discharge for the pending FEMA study, provided by the Town, is 2272 cfs. A HEC-RAS plan was created for the preliminary discharge, with computed water surface elevations compiled in the following table. All project design WSELs (including freeboard) exceed the computed WSELs for the preliminary FEMA study, with the exception of Station 29. At this location, the design WSEL was increased by 0.1 feet. Results are presented in the following table.

Lomas de Oro Wash – Bank Protection Concept Design						
HEC-RAS Sta	Q Total (cfs)	Computed WSEL (ft)	Minimum freeboard (ft)	Minimum Design WSEL (ft)	WSEL with pending FEMA Q100 (2272 cfs) (ft)	Minimum Toe-down (ft)
35	1642	2581.9	1.0	2582.9	2582.3	n/a
34	1642	2580.1	1.0	2581.1	2580.4	6.6
33	1642	2578	1.0	2579.0	2578.3	4.4
32	1544	2575.6	1.0	2576.6	2576.0	4.2
31	1474	2573.9	1.0	2574.9	2574.2	4.2
30	1474	2572	1.0	2573.0	2572.3	4.2
29	1474	2570.2	1.0	2571.3*	2571.3	4.2
28.5	1474	2570.1	1.0	2571.1	2571.0	4.2
28.3	Culvert					
28	1474	2567.6	1.0	2568.6	2567.3	4.5
27	1474	2566.6	1.0	2567.6	2566.9	4.5
26.5	1474	2564.3	1.0	2565.3	2564.6	4.5
26	1474	2562.1	0.5	2562.6	2562.4	4.1
25	1474	2559.5	0.4	2559.9	2559.8	4.1
24	1474	2557.3	0.5	2557.8	2557.6	4.1
23	1474	2555.2	0.5	2555.7	2555.5	4.1
22	1474	2552.7	0.5	2553.2	2553.1	4.1
21	1474	2550	0.5	2550.5	2550.3	4.1
20	1474	2547.6	0.4	2548.0	2547.9	4.1
19	1474	2544.8	0.4	2545.2	2545.1	4.1
18	1474	2541.7	0.5	2542.2	2542.0	4.1
17	1474	2538.8	0.5	2539.3	2539.1	4.1
16	1474	2536	0.5	2536.5	2536.3	4.1
15	1474	2533	0.4	2533.4	2533.2	4.1
14	1474	2529.9	0.4	2530.3	2530.2	4.1
13	1474	2526.9	1.0	2527.9	2527.2	4.3
12	1474	2524.5	1.0	2525.5	2524.8	4.3
11	1474	2521.3	0.5	2521.8	2521.7	4.3
10	1474	2518.4	0.5	2518.9	2518.8	n/a
* Design WSEL increased from 2571.2 to 2571.3 to accommodate pending FEMA Q_{100}						

H. Concept Design for Bank Protection along Canyon Shadows Wash

Bank protection is proposed along the Canyon Shadows Wash at locations where proposed lots, roadways, and detention basins encroach into either the 100-year floodplain or the erosion hazard setback. In addition, channel improvements are proposed at the southeast property corner to protect offsite structures. Locations are generally identified on the Concept Drainage Plan (Appendix A). Engineering details in plan, profile, and section are provided as excerpts in Appendix CS and provided on the LJA Final Site Plan (Appendix G).

I. Benefits to Offsite Properties from Bank Protection along Canyon Shadows Wash

In accordance with rezoning requirements (see Section IV of this report), the project shall include drainage improvements to improve the existing drainage conditions within the area downstream of the project along the Canyon Shadows Wash. The effect of these improvements shall be to make the existing residential structures eligible to be removed from the FEMA floodplain.

At the southeastern property corner where the Canyon Shadows Wash exits the property, the existing conditions flows that will be contained within the proposed channel improvements will be discharged in a manner to improve downstream offsite drainage conditions. This is demonstrated by comparing the existing FEMA floodplain boundaries to the proposed offsite floodplain boundaries as shown on the Developed Conditions Floodplain Map included in Appendix A.

The offsite floodplain for design conditions was determined by LJA with hydraulic modeling using HEC-RAS (LJA, 2024). The modeling will be used as part of the CLOMR and LOMR applications for the purpose of removing three offsite residences from the FEMA Zone A floodplain. LJA HEC-RAS summary output tables and proposed finished-floor elevations are provided in Appendix CS. LJA HEC-RAS digital files have been provided separately.

In addition, an assessment of pre-and post-development flood depths and velocities was completed to show that there are no adverse impacts to offsite properties. As shown in the following table, the project is in compliance with Section 17-5-8A.b of the TOV floodplain ordinance.

Canyon Shadows Wash – Change in WSEL and Velocity at Property Line			
Cross Section 292.29	Q_{100} (cfs)	100-Year WSEL (ft)	Channel velocity (ft/s)
Existing conditions	265	2474.43	3.77
Developed conditions	262	2474.42	3.73
Change	-3	-0.01	-0.04

C. Stormwater Detention

In accordance with Town requirements, developed discharges are required to be reduced 10% below existing values. The Concept Drainage Plan (Appendix A) shows the location of the proposed detention basins. Results are summarized in the following tables, with calculations in Appendix E.

Proposed Outflows from Detention Basins			
	Q_{100} (cfs)	Q_{10} (cfs)	Q_2 (cfs)
Basin SW -existing conditions	174	72	24
Basin SW –developed outflow	116	17	3.1
Basin SE -existing conditions	83	33	9.8
Basin SE –developed outflow	34	4	1.5
Basin N -existing conditions	44	18	6.0
Basin N –developed outflow	0.2	0	0
Basin C -existing conditions	6.5	2.7	0.9
Basin C –developed outflow	2.1	0.9	0.2

Concept Designs for Detention Basins				
Location	Basin SW	Basin SE	Basin N	Basin C
Inflows (CP)	D3-D7, N4b	N2, N3, D2.1, D2	D2.5, D2.6	D3.5
100-yr inflow (cfs)	224	125	52	10
100-yr outflow (cfs)	116	34	0.2	2.1
100-yr ponding depth (ft)	3.0	3.0	0.6	1.3
Basin depth (ft)	3.5	3.5	3.25	3.0
Freeboard (ft)	0.5	0.5	2.65	1.7
100-year ponding volume (cf)	135531	92947	53047	7736
Basin volume provided (cf)	162592	110366	307982	20242
Outflow weir and invert elevation (0.0 is bottom)	80-ft weir invert = 2.4’	9-ft weir invert = 2.0’	n/a	n/a
Outflow orifice pipe and invert elevation (0.0 is bottom)	12-inch RCP invert =0.33’	12-inch RCP invert =0.33’	12-inch RCP invert =0.33’	12-inch RCP invert =0.33’
Sediment volume (cf)	5474	2016	2414	180
Sediment depth (ft)	0.14	0.07	0.03 (nominal)	0.03 (nominal)

1. Basin Sedimentation

Basins have been designed to accommodate the sediment inflow volumes tabulated above (calculations in Appendix E). Sediment measurement devices are required by the Town.

2. Stormwater Harvesting

Stormwater harvesting has been provided by LJA by elevating the invert of each outlet pipe by 4 inches.

3. Basin Drain Times

The basins will drain in less than 24 hours. Routing calculations are included in Appendix E.

4. Basin Maintenance Requirements

Detention basins will be maintained in accordance with Section 11.6 of the DCM.

11.6 Basin Access and Maintenance Requirements

Thorough, routine maintenance is required to ensure adequate performance for the life of proposed detention basins. The drainage report and landscape plan shall address the following:

1. Access is to be provided to all detention basins and appurtenant structures and facilities. Access is to be clearly delineated on the grading and landscape plans. For basins three feet in depth and greater a vehicle access ramp shall be provided which is suitable in width and construction to safely accommodate heavy equipment. The slope of the access ramp shall not exceed 6:1 (horizontal to vertical) and extend from the top of the basin to the bottom. Vegetation shall not be permitted on the ramp's surface.
2. A graduated marker or story poll, in 0.1 foot increments, is to be provided in all detention basins. Basins are to be cleaned when the marker indicates a sediment depth of 0.5 feet, or once every 24 months, whichever occurs first.
3. Inlet and outlet structures are to be kept free of vegetation and debris at all times.
4. Vegetation irrigation and maintenance schedules shall be provided as an appendix to the drainage report and in tabular or note form on the landscape plan.
5. The maintenance schedule and requirements shall be detailed in private Covenants, Conditions and Restrictions (CC&Rs). The Homeowner's Association (HOA) or responsible party shall be clearly identified within the CC&Rs and shall be responsible for maintenance of basins and basin appurtenances, and maintenance record keeping. Maintenance records shall indicate:
   a. Date of maintenance activities;
   b. Description of maintenance activities;
   c. Depth of sediment as noted on the graduated marker;
   d. Photographs of the basin and appurtenances before and following maintenance activities;
   e. Signature of responsible individual (i.e. HOA President) certifying that the noted maintenance was completed according to the approved schedule and requirements, and that the basin(s) and appurtenances substantially comply with the approved improvement plans; and
   f. Maintenance records shall be retained by responsible party for three years following the most recent maintenance activity. The maintenance records shall be provided to the Town of Oro Valley on a yearly basis.

g. Inspection of the basin and of maintenance records will occur on an annual basis by Town of Oro Valley Stormwater Utility inspector(s) as part of the State ADEQ Permit requirements.

6. Subject to the Town Engineer's written approval, basin maintenance schedules and requirements may be modified following a three-year period of operation. Supporting documentation for such a request is to include, at a minimum:
   a. Past maintenance records and photographs spanning the previous three years (if applicable);
   b. Current photographs of the basin and basin appurtenances;
   c. A written explanation for the request to modify the maintenance requirements.

D. Erosion Control

1. Erosion Hazard Setbacks

Erosion hazard setbacks for the three regulatory watercourses were calculated according to Equations 7.8a, 7.8b, and 7.8c from the City of Tucson Standards Manual (COT, 1989, rev. 1998). Calculations are included in Appendix E.

Existing channel banks were delineated using project topography and 2011 PAG aerial photographs. "Base' setbacks, with no modification for channel curvature, were calculated as a function of discharge and delineated as offsets from the channel banks. For those areas where channel curvature might affect the setback, radii of curvature were measured and tabulated along with channel topwidths. Setbacks were then calculated and revised at the areas of curvature, and finally adjusted to remove the setback lines were erosion mitigation is proposed. Final erosion hazard setback lines are shown on the Developed Conditions Floodplain Map in Appendix A.

Erosion Hazard Setbacks

Watercourse	Location	Q (cfs)	$r_{c\ (ft)}$	$T_{w\ (ft)}$	r_c/T_w =	Setback (ft)
Canada Hills	base	622			≥10	25
local	1		137	16	8.6	42
Lomas de Oro	base	1642			≥10	41
local	0.3		162	7	23.1	41
local	0.5		191	34	5.6	69
local	1		73	30	2.4	101
local	2	not used*	114	32	3.6	101
local	3		117	39	3.0	101
Canyon Shadows	base	300			≥10	17
local	1		191	14	13.6	17
local	2	not used*	567	81	7	29
* setback line behind erosion mitigation						

2. Scuppers

Curb openings or scuppers shall be fitted with outlet aprons in accordance with Pima County regulations (2016 Pima County Subdivision and Development Street Standards). Outlet aprons are shown on the LJA Engineering Final Site Plan.

3. Total Scour for Bank Protection

Total scour has been calculated according to the City of Tucson methodology (*Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona*, 1989). Summary tables, with all calculations, are provided in Appendix D.

An abutment scour component has been added at the northwest corner of the proposed regional detention basin. A long-term degradation component of 2 feet has been added to the Lomas de Oro Wash as requested by the Town. No long-term degradation was identified for the Canyon Shadows Wash. All calculations are provided in Appendix D.

Toedowns along the Canyon Shadow Wash were determined separately by LJA and are included in Appendix CS.

4. Total Scour for Sanitary Sewer Crossing

Total scour has been calculated according to the City of Tucson methodology (*Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona*, 1989). Summary tables, with all calculations, are provided in Appendix D. No long-term degradation was identified for the Canyon Shadows Wash. All calculations are provided in Appendix D

5. Riprap Aprons

Riprap aprons are proposed as erosion mitigation at inlets and the outlets of flows for the proposed detention basins and other hydraulic structures where appropriate. The concept designs for the aprons are based on Pima County geometric parameters (*Drainage and Channel Design Standards for Local Drainage*, June, 1984). Concept design parameters are provided in the following table, with a schematic in Appendix D. **Final designs by LJA may vary depending on site grading constraints.**

Concept Design[1] for Erosion Control Aprons				
Location	Pipe size	Apron upstream width[B] (ft)	Length of Apron[A] (L_{SB}) (ft)	Riprap (d_{50})
LdO Wash	2 24'x6' ConSpan	48'+(2*4.5') = 57'	36	Grouted 6 inch
D12	1 30-inch	2.5'+(2*2.5') = 7.5'	20	Grouted 6 inch
N2.5	2 18-inch	3'+(2*1.5') = 6'	12	Grouted 6 inch
D2.65	3' scupper	3'+1.3' = 4.3'	5	Grouted 6 inch
Basin outlets				
Basin SW	1 12-inch	3	8	Grouted 6 inch
	80-ft weir, d= 0.6'	80'+(2*0.6') = 81.2'	5	Grouted 6 inch
Basin SE	1 12-inch	3	8	Grouted 6 inch
	19-ft weir, d= 1.0	19'+(2*1.0') = 21'	8	Grouted 6 inch
Basin N	1 12-inch	3	8	Grouted 6 inch
Basin C	1 12-inch	3	8	Grouted 6 inch
Basin inlets				
D2.1	1 48-inch	4'+(2*1.6') = 7.2'	32	Grouted 6 inch
D2	13' scupper	13'+1.3' = 14.3'	5	Grouted 6 inch
D2.5	1 36-inch	3'+(2*0.7') = 4.4'	24	Grouted 6 inch
D2.6	2 24-inch	4'+(2*2') = 8'	16	Grouted 6 inch
D3	1 36-inch	3'+(2*1.2') = 5.4'	24	Grouted 6 inch
D3.5	1 18-inch	1.5'+(2*1.5') = 4.5'	12	Grouted 6 inch
D4+5	1 36-inch	3'+(2*1.6') = 6.2'	24	Grouted 6 inch
D6	10' scupper	10'+1.3' = 11.3'	5	Grouted 6 inch
D7	11' scupper	11'+1.3' = 12.3'	5	Grouted 6 inch
N3	2 24-inch	4'+(2*2.0') = 8'	16	Grouted 6 inch
N4b	2 24-inch	4'+(2*2.0') = 8'	16	Grouted 6 inch

[1] **Concept design may vary on LJA Final Site Plan depending on site grading constraints**
[A] L_{SB} = (8 * pipe diameter or flow depth),
[B] apron upstream width = culvert spread + 1D or 1Dc on each side
For dumped riprap. apron thickness = 2 * d_{50}

E. Stormwater Pollution Plan Requirements

Stormwater Pollution Plan requirements will be addressed by LJA in conjunction with the preparation of a grading plan for this project.

F. First Flush

First-flush requirements are not applicable per DCN 11.7.2.

G. Maintenance of Drainage Structures

The following notes are included in the Drainage Report, Final Plat, Final Site Plan, and Covenants, Conditions, and Restrictions (CC&Rs).

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

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

VI. CONCLUSION

This Drainage Report was prepared in accordance with the Town of Oro Valley Drainage Criteria Manual. The primary focus of the technical analysis consisted of (1) a hydrologic analysis to determine offsite 100-year discharges; (2) floodplain delineations for the existing regulatory watercourses; (3) calculating existing and developed onsite 2-year, 10-year, and 100-year discharges for use in performing detention basin routing; and (4) a hydraulic analysis for the proposed onsite stormwater conveyance measures, including erosion control.

This drainage analysis was prepared in accordance with the Oro Valley Drainage Criteria Manual (DCM) (**2010 Edition**), using additional technical criteria and computer modeling from the City of Tucson Drainage Standards Manual (DSM) (1989, 1998), the Pima County Drainage and Channel Design Standards Manual (1984), the HEC-RAS River Analysis Systems software package (v6.5, 2024), the FLO-2D model (Pro Model, 2019), and the web-based PC-Hydro (Pima County Regional Flood Control District, 2019).

According to the FEMA Flood Insurance Rate Map (FIRM) Panel 04019C1070L (June 16, 2011), the 100-year floodplains for Lomas de Oro Wash, Canyon Shadows Wash, and Canada Hills Wash are designated as Zone "A." A Conditional Letter of Map Revision (CLOMR) and subsequent LOMR will be submitted to FEMA for Lomas de Oro Wash and Canyon Shadows Wash.

In accordance with rezoning requirements, a regional basin has been provided to reduce the Lomas de Oro Wash 100-year peak flow by 10% for the purpose of improving the downstream flooding conditions that currently impact residential parcels south of the subject property. The 10%, reduction was requested by the Town Engineer, and the basin will be dedicated to the Town. The Town Engineer has authorized the basin to have a maximum ponding depth of approximately five feet and will receive relief from the Code limitations on maximum cut depth.

In accordance with rezoning requirements, the project shall include drainage improvements to improve the existing drainage conditions within the area downstream of the project along the Canyon Shadows Wash. At the southeastern property corner where the Canyon Shadows Wash exits the property, the existing conditions shallow sheet flows that will be contained within the proposed channel improvements will be discharged in a manner to improve downstream offsite drainage conditions. The proposed improvements will facilitate efforts to remove three offsite residences from the FEMA Zone A floodplain as part of the CLOMR and LOMR applications.

Maintenance of all drainage improvements proposed as part of this development will be the responsibility of the HOA, except for the regional offline basin, which will be the responsibility of the Town of Oro Valley.

VII. REFERENCES

Federal Emergency Management Agency, *Flood Insurance Study for Pima County and Incorporated Areas, Arizona,* June 16, 2011.

FLO-2D Software, Inc., *FLO-2D Pro Model, 2019.*

JE Fuller Hydrology and Geomorphology Inc., *Offsite Drainage Analysis for La Cholla and Lambert SEC*, May, 2015.

Kimley-Horn and Associates, *Oro Valley Drainage Criteria Manual,* 2002, updated 2010 (dma Engineering, LLC).

LJA Engineering, Inc., *SEC Lambert and La Cholla, Conditional Letter of Map Revision (CLOMR)*, June, 2024.

Pima County Regional Flood Control District, *Design Standards for Stormwater Detention and Retention*, November, 2015.

Pima County Regional Flood Control District, *PC-Hydro User Guide,* 2019; (Pima County Regional Flood Control District, 2019; Arroyo Engineering, 2007).

Pima County Department of Transportation and Flood Control District, *Drainage and Channel Design Standards for Local Drainage*, June, 1984.

Pima County Department of Transportation and Flood Control District, *Oro Valley Cholla Wash Study,* (FEMA Contract # HSFE60-15-D-0003), in process.

Psomas, *Letter of Map Revision Request for Lomas de Oro Wash Channel Improvements*, June 2014.

SCE Engineering, *La Cholla Boulevard: Overton Road to Tangerine Road, Final Drainage Report,* January 2018.

Simons, Li & Associates, Inc., *Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona*, 1989, updated 1998.

Water Resources Res., Vol. 33, No. 3, "*Critical flow constraints in mobile-bed streams: A new hypothesis*," Grant, 1997.

The WLB Group, *Rezoning Site Analysis (OV914-009) Lambert and La Cholla, Southeast Corner*, 2016.

U.S. Army Corps of Engineers, *HEC-RAS River Analysis Systems*, Version 6.5, 2024.

Appendix A. Exhibits

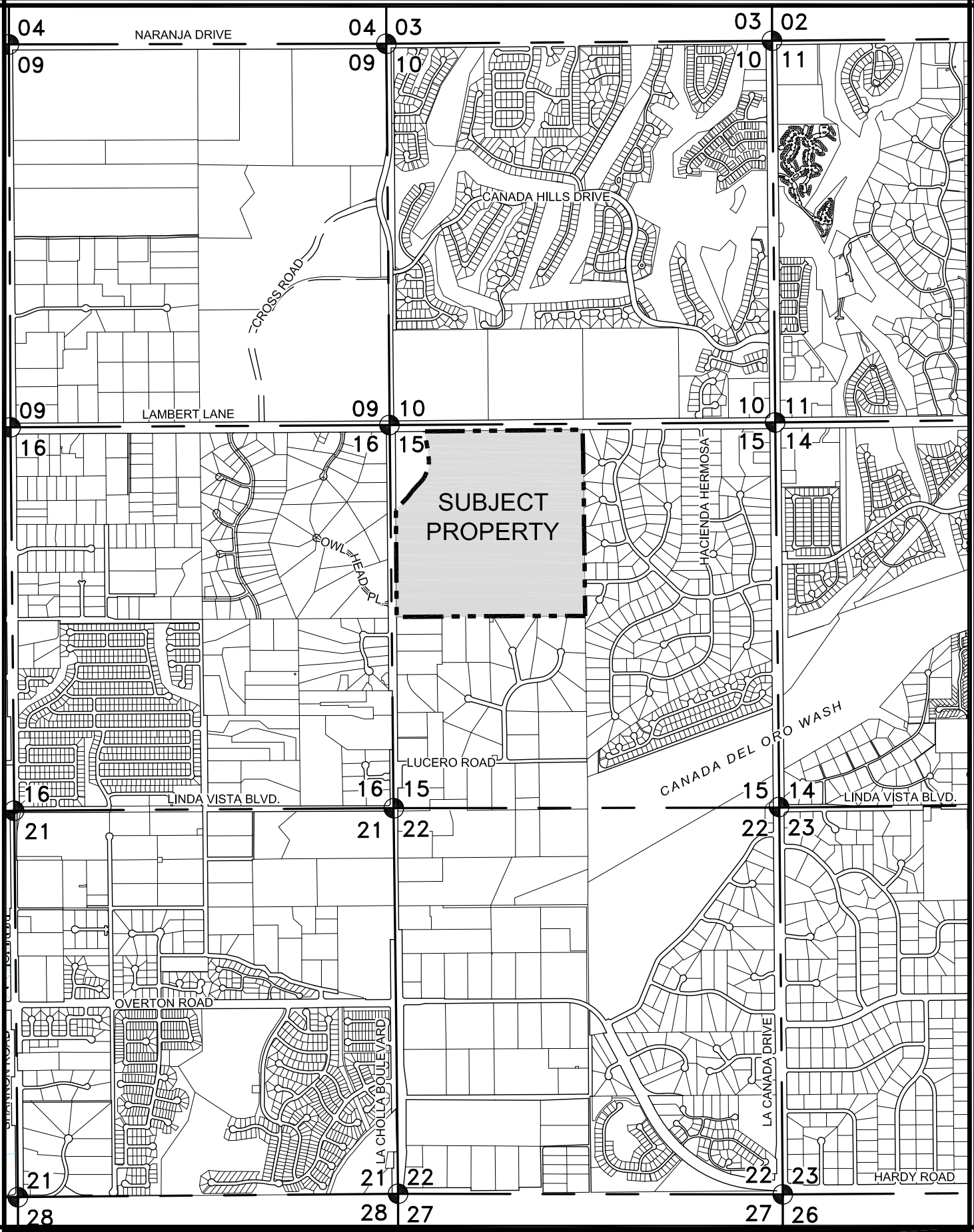


EXHIBIT A
SITE LOCATION MAP

The WLB Group WLB

2014.10.06
WLB No. 114012-A-001

1/3 MILE

L:\114012\A-001 Rezoning\Exhibits\A - Site Location Map.dwg Plotted: Oct. 06, 2014



The WLB Group WLB

EXHIBIT B
AERIAL PHOTOGRAPH

2015.03.02
WLB No. 114012-A-001

0' 500'

L:\114012\A-001 Rezoning\Exhibits\B - Aerial Photograph.dwg Plotted: Mar. 03, 2015

NOTES TO USERS

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

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

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

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

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

The **projection** used in the preparation of this map was Arizona Central State Plane zone (FIPSZONE 0202). International Feet. The **horizontal datum** was NAD 83, HPGN/HARN GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

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

Base map information shown on this FIRM was derived from multiple sources. Base map imagery for eastern Pima County was provided in digital format by the Pima Association of Governments. These data were developed at 1-foot Ground Sample Distance (GSD) from color aerial photography flown in 2002. Base map imagery for western Pima County was derived from USGS Imagery available for the State of Arizona and produced at a scale of 1:12,000 from photography dated 2006 and 2007.

This map may reflect more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

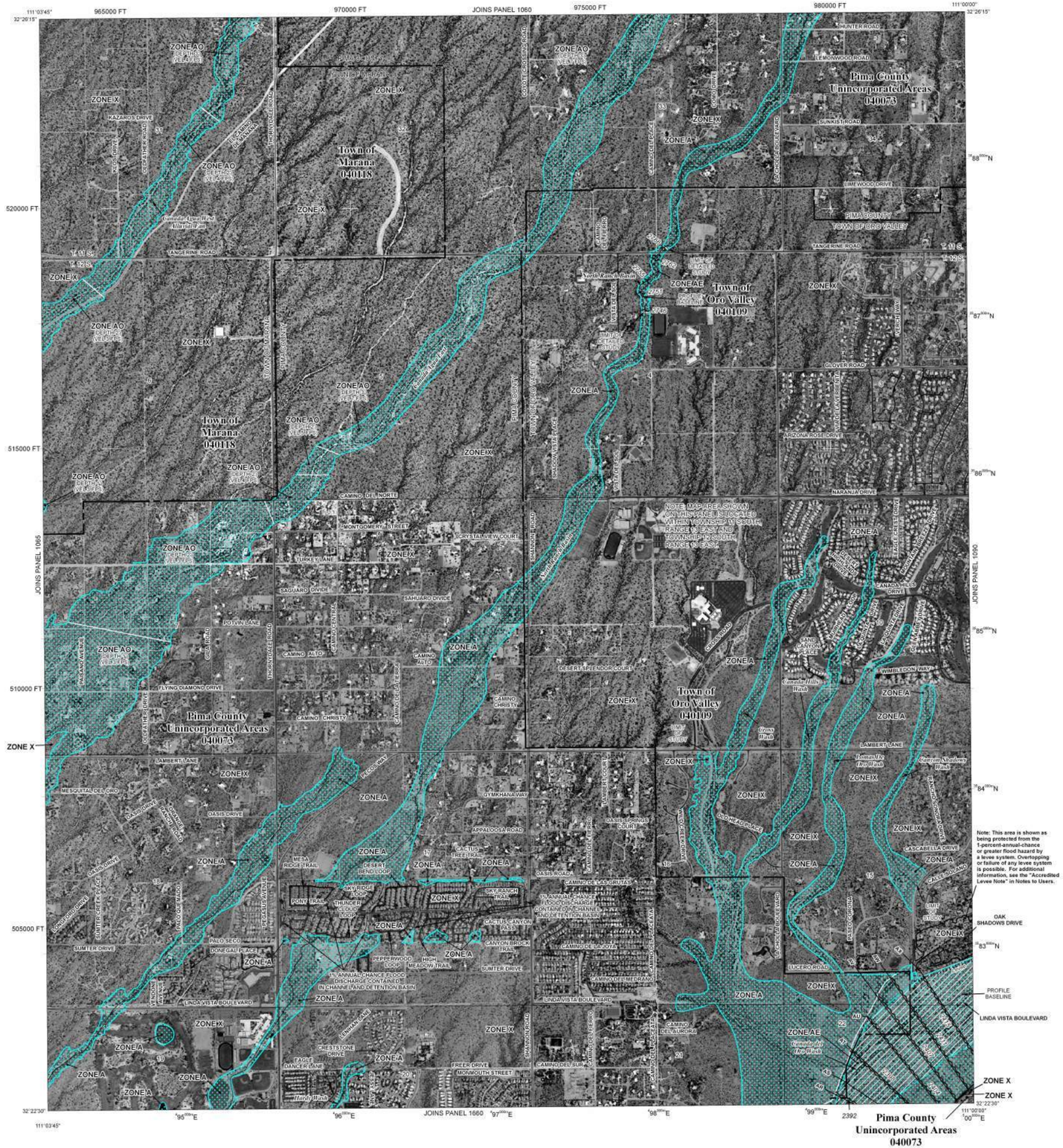
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

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

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

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

Accredited Levee Notes to Users: Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance-level) and Emergency Action Plan, on the levee system(s) shown as providing protection for areas on this panel. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.



LEGEND

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

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

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- Limit of Moderate Wave Action
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL. 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 4276000mN — 1000-meter Universal Transverse Mercator grid values, zone 12
- 600000 FT — 5000-foot grid values: Arizona State Plane coordinate system, Central zone (FIPSZONE 0202), Transverse Mercator projection
- DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
February 8, 1999

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
June 16, 2011 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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

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

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NATIONAL FLOOD INSURANCE PROGRAM

NFIP

PANEL 1070L

FIRM

FLOOD INSURANCE RATE MAP

PIMA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 1070 OF 4750

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARANA, TOWN OF	040118	1070	L
ORO VALLEY, TOWN OF	040109	1070	L
PIMA COUNTY	040073	1070	L

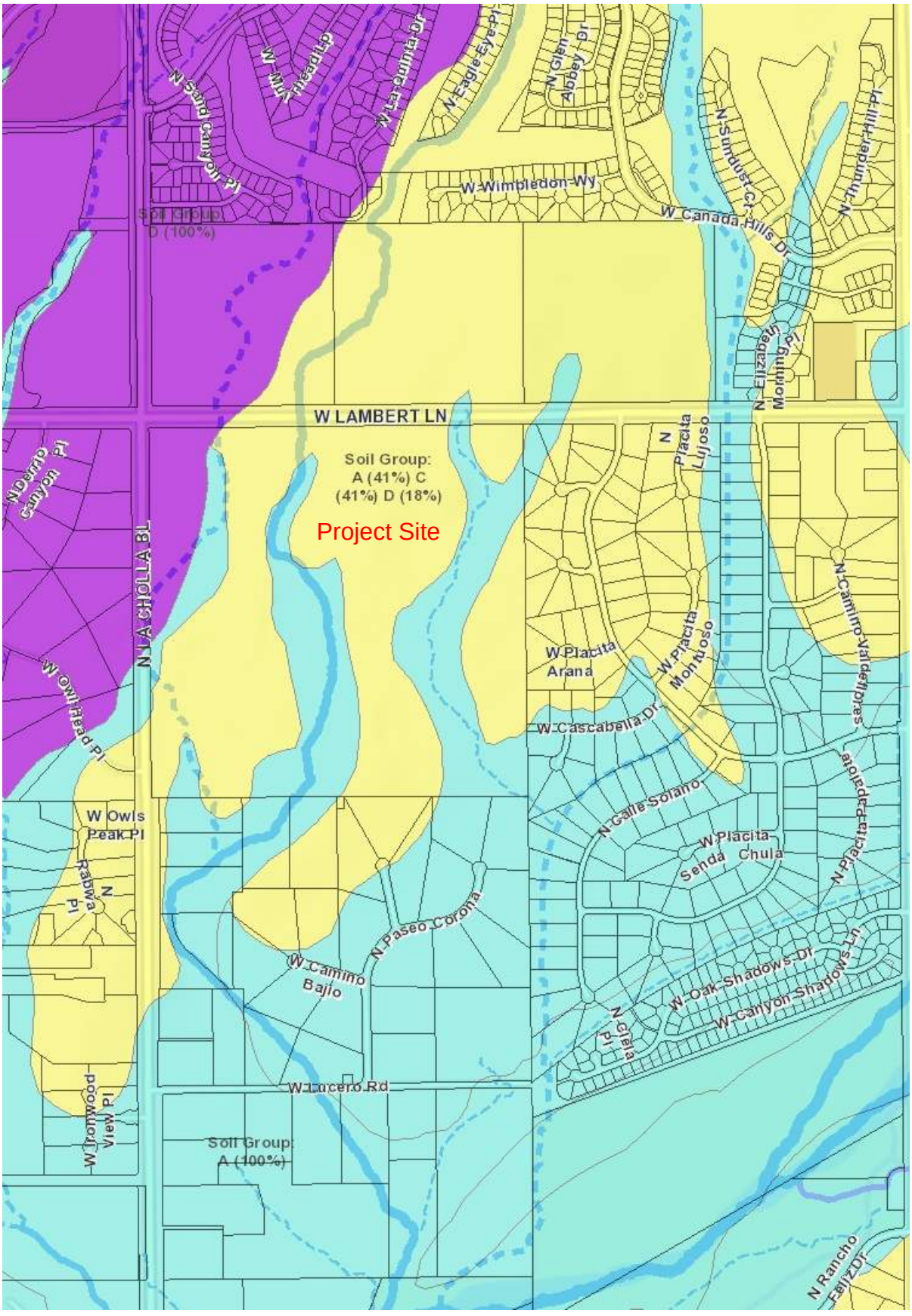
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 04019C1070L

MAP REVISED JUNE 16, 2011

Federal Emergency Management Agency

Hydrologic Soil Groups



Legend

- Parcels

Hydrologic Soils Group

- Soil Group: A 100%
- Soil Group: B 100%
- Soil Group: C 100%
- Soil Group: D 100%
- Soil Group: Mixed

Washes - All

- Unknown Discharge
- 100-500 CFS
- 500-1000 CFS
- 1000-2000 CFS
- 2000-5000 CFS
- 5000-10000 CFS
- Over 10000 CFS



Notes:

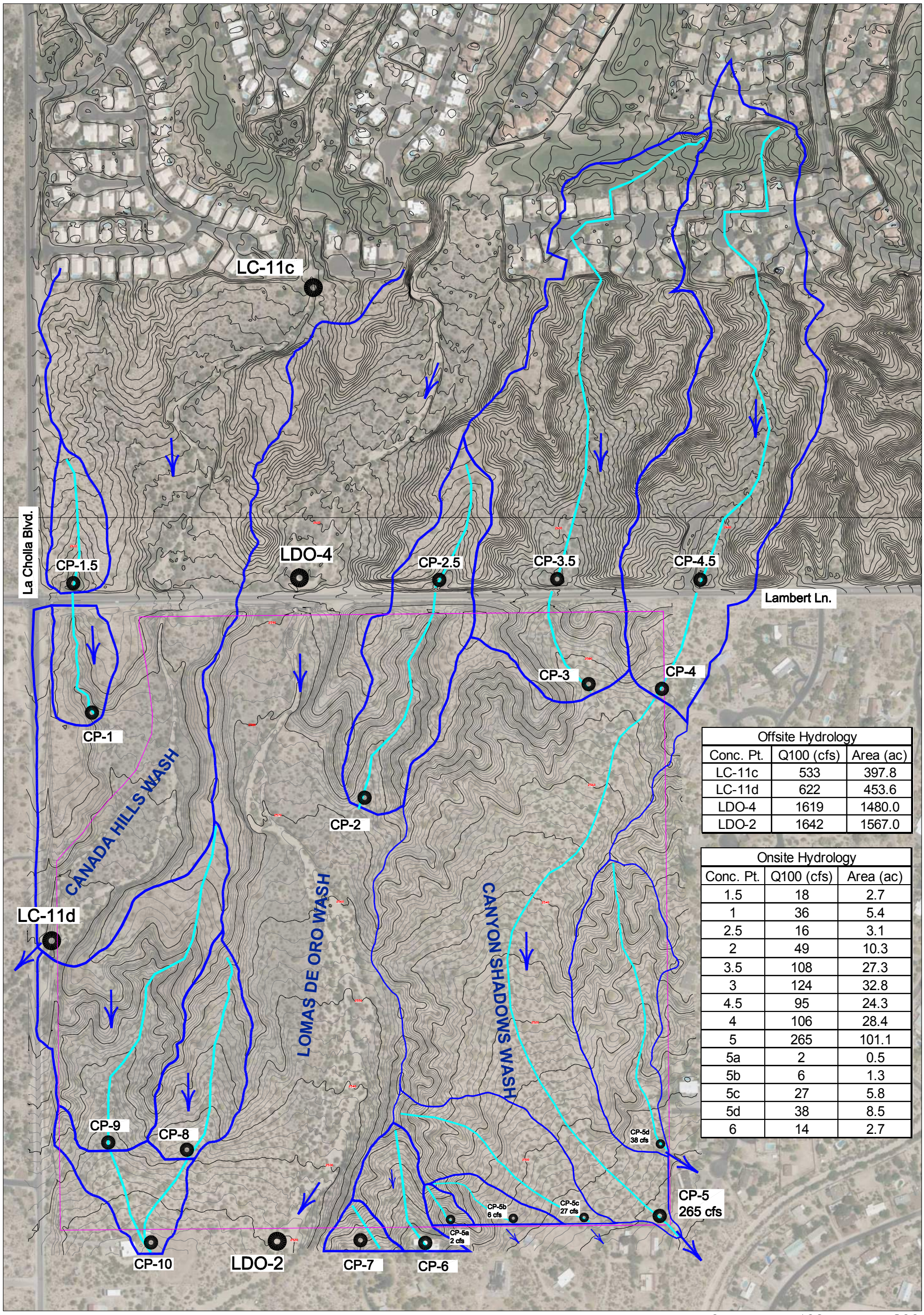
8/20/2021

2,000.0 0 1,000.00

Feet

Pima County GIS

This map is static output from an internet mapping site and no warranty is expressed or implied as to the accuracy, reliability, currency or completeness of the data, and is for reference only



Offsite Hydrology		
Conc. Pt.	Q100 (cfs)	Area (ac)
LC-11c	533	397.8
LC-11d	622	453.6
LDO-4	1619	1480.0
LDO-2	1642	1567.0

Onsite Hydrology		
Conc. Pt.	Q100 (cfs)	Area (ac)
1.5	18	2.7
1	36	5.4
2.5	16	3.1
2	49	10.3
3.5	108	27.3
3	124	32.8
4.5	95	24.3
4	106	28.4
5	265	101.1
5a	2	0.5
5b	6	1.3
5c	27	5.8
5d	38	8.5
6	14	2.7

CI=2'
NAVD88

LEGEND

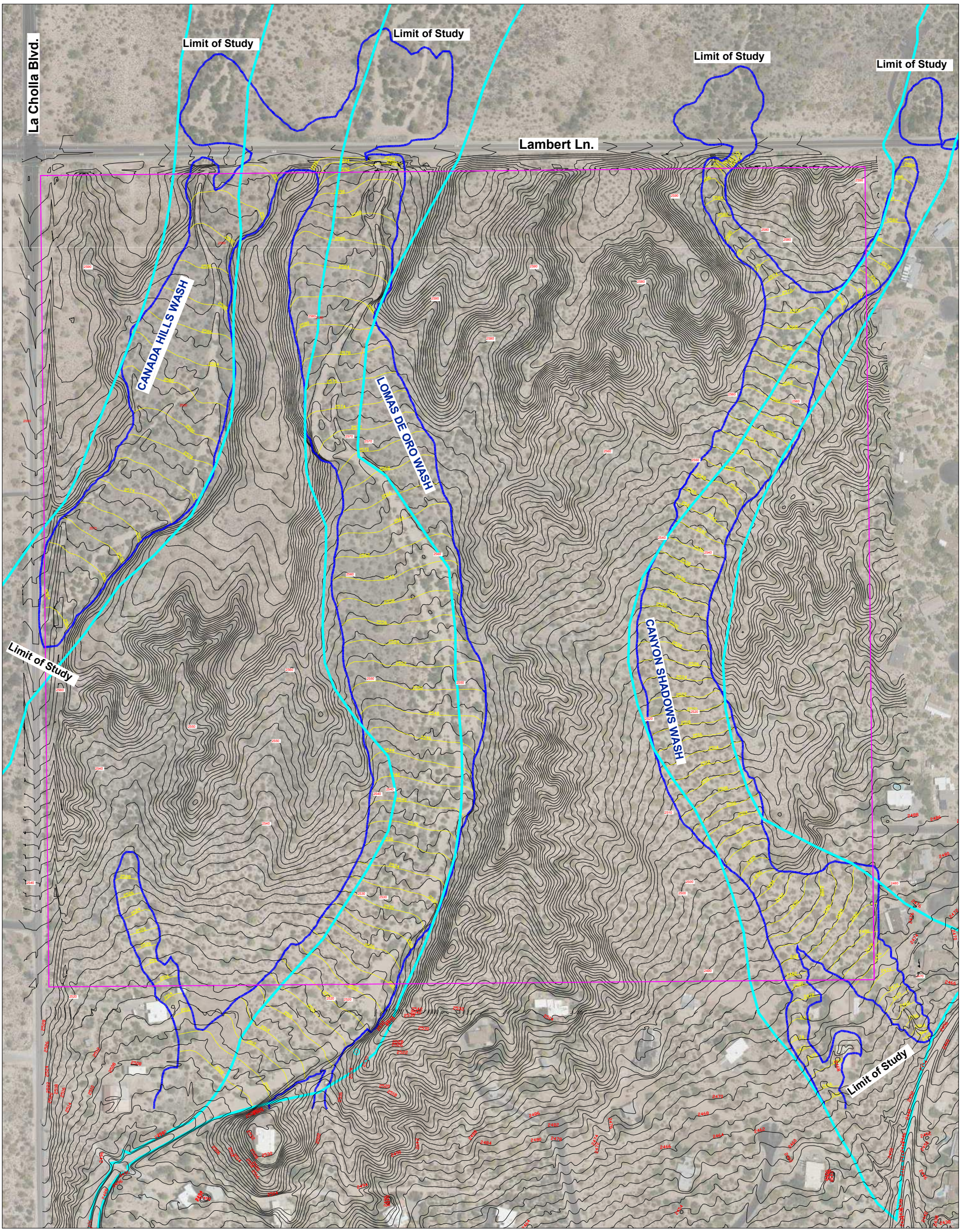
- Watershed boundary
- PC-Hydro Lc
- Property line
- Concentration point
- Flow arrow

0 400 800

SCALE

R R O Y O ENGINEERING, LLC
Water Resources & Civil Engineering Consultants

EXISTING CONDITIONS HYDROLOGY



0 300 600

SCALE

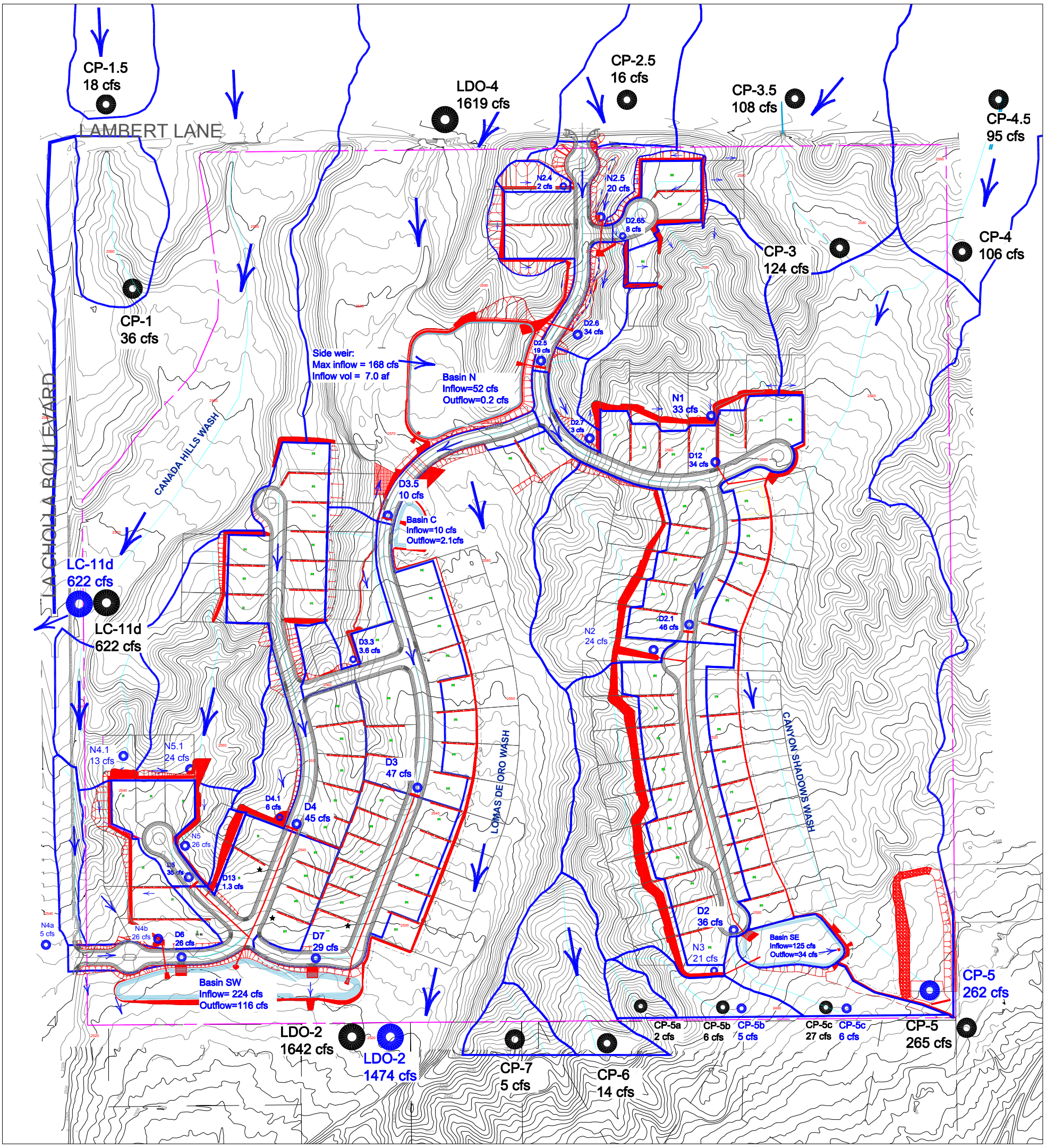
CI=2'
NAVD88

LEGEND

- 100-year floodplain (FLO-2D), with Limits of Study
- 100-year (base flood) elevations (FLO-2D)
- FEMA Zone A floodplain (approximate)
- Property boundary

ARROYO ENGINEERING, LLC
Water Resources & Civil Engineering Consultants

EXISTING CONDITIONS FLOODPLAIN MAP



(map optimized for pdf review)

0 300 600

SCALE

CI=2'
NAVD88

LEGEND

104 cfs — Proposed concentration point, with 100-year discharge

14 cfs — Existing concentration point, with 100-year discharge

Flow path

Flow arrow

Proposed drainage improvements

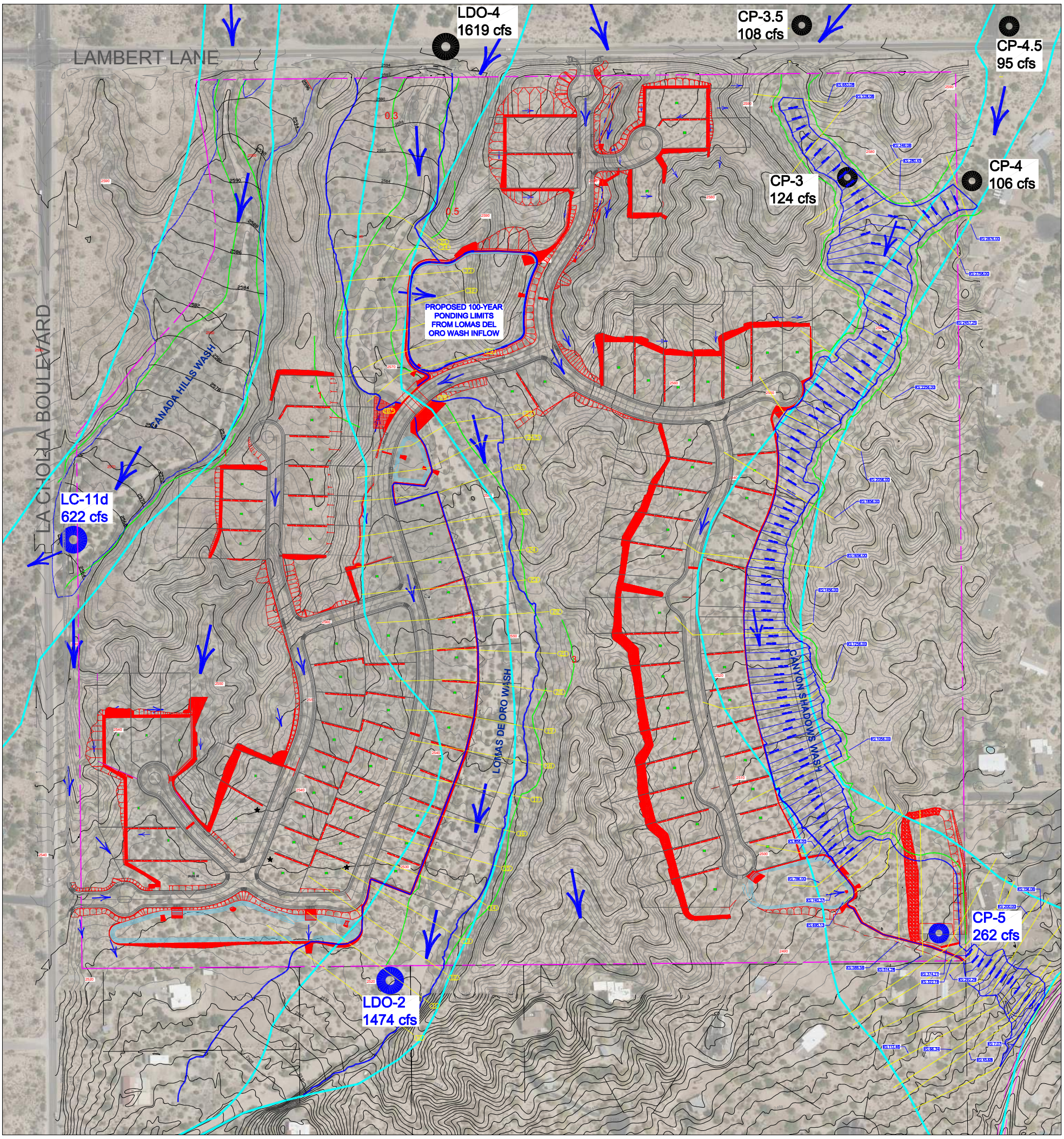
Property boundary

Limit of grading

This is a watershed map and not to be used for construction. The purpose of this map is to show watershed boundaries and 100-year flow rates. Proposed hydraulic structures and any other applicable information are shown on the map titled "Concept Drainage Plan."

ARROYO ENGINEERING, LLC
Water Resources & Civil Engineering Consultants

DEVELOPED CONDITIONS WATERSHED MAP



0 300 600

SCALE

CI=2'
NAVD88

(map optimized for pdf review)

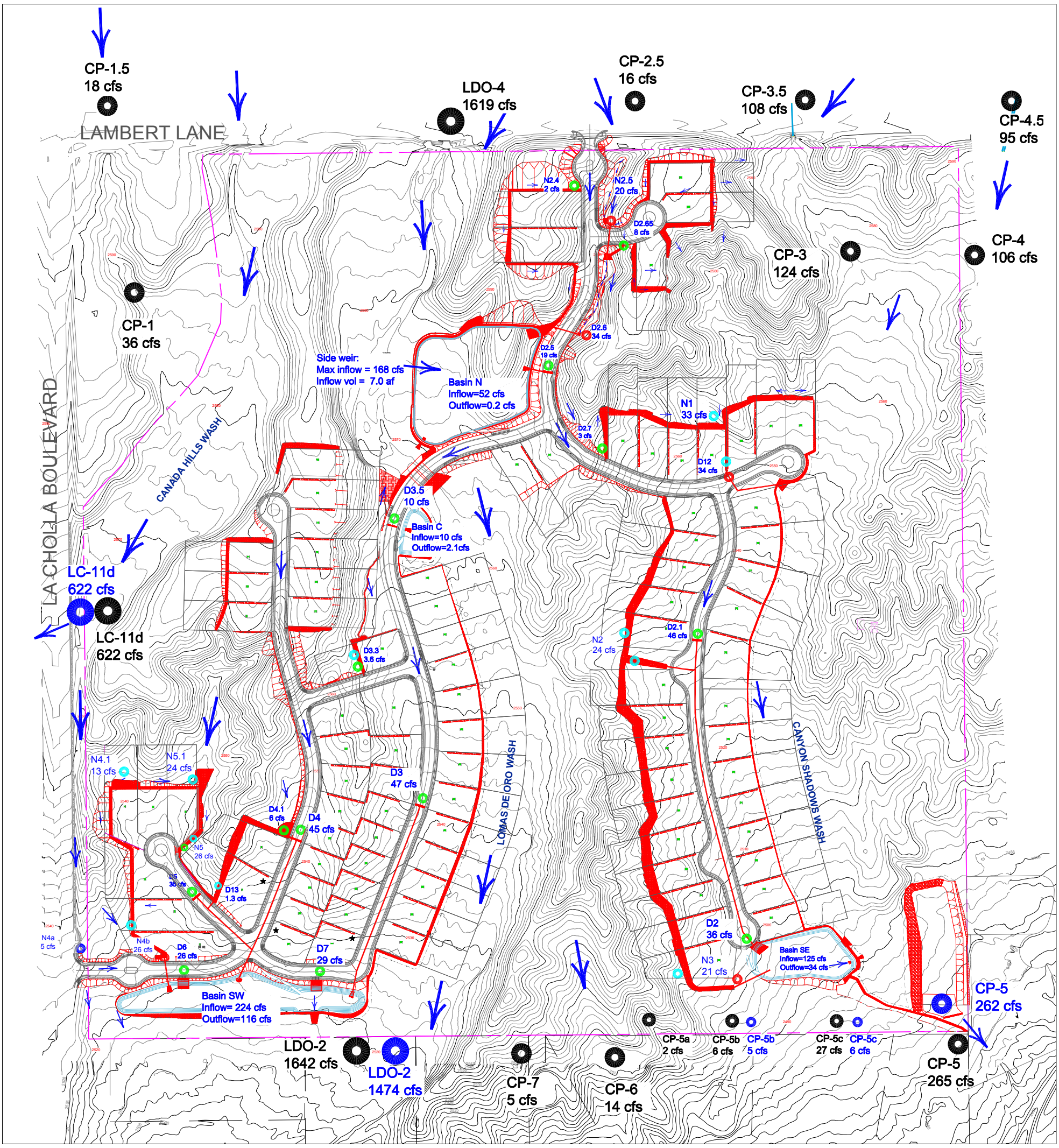
LEGEND

- Developed 100-year floodplain
- HEC-RAS cross section, with I.D. number (WSELs in Appendix C)
- LJA HEC-RAS cross section, with I.D. number
- Base flood elevation for FLO-2D 100-year floodplain
- FEMA Zone A
- 1474 cfs — Proposed concentration point, with 100-year discharge
- 104 cfs — Existing concentration point, with 100-year discharge
- Flow arrow
- 2 — Erosion hazard setback, with ID number for calculations
- Property boundary

This is a floodplain map and not to be used for construction. For proposed contour and pad elevations, see the LJA Site Plan.

ARROYO ENGINEERING, LLC
Water Resources & Civil Engineering Consultants

DEVELOPED CONDITIONS FLOODPLAIN MAP



(map optimized for pdf review)

0 300 600

SCALE

CI=2'
NAVD88

LEGEND

- 104 cfs — Proposed concentration point, with 100-year discharge
- 124 cfs — Existing concentration point, with 100-year discharge
- Concentration point at proposed culvert
- Concentration point at proposed grate inlet or scupper
- Concentration point at proposed local channel
- Flow arrow
- Proposed storm drain or cross-drainage culvert
- Proposed grouted riprap
- Limit of grading
- Property boundary

This map is conceptual and not for construction. Concept design parameters are provided in the report text. Final designs are provided on the LJA engineering plans.

ARROYO ENGINEERING, LLC
Water Resources & Civil Engineering Consultants

CONCEPT DRAINAGE PLAN

Appendix B. Hydrology

LETTER OF MAP REVISION REQUEST FOR LOMAS DE ORO WASH CHANNEL IMPROVEMENTS

June 04, 2014

Prepared for:

Town of Oro Valley
11000 N. La Canada Drive
Oro Valley, Arizona 85737

Prepared by:

PSOMAS
333 East Wetmore Road, Suite 450
Tucson, AZ 85705
Project No. 7TOV067805

Project: Lomas de Oro Simulation Run: 100YR

Start of Run:	01Jan2000, 00:00	Basin Model:	Basin 2
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100YR
Compute Time:	16Oct2008, 15:30:22	Control Specifications:	Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak
CP1	2.509204	1644.5	01Jan2000, 02:5
CP2	2.448329	1642.3	01Jan2000, 02:4
CP3	2.379376	1635.8	01Jan2000, 02:4
CP4	2.312907	1619.3	01Jan2000, 02:4
CP5	2.266360	1612.6	01Jan2000, 02:4
CP6	2.135672	1598.0	01Jan2000, 02:3
CP7	2.060625	1592.6	01Jan2000, 02:3
CP8	1.906547	1485.3	01Jan2000, 02:3
CP9	1.518703	1189.5	01Jan2000, 02:2
CP10	0.680078	642.1	01Jan2000, 02:0
CP11	0.150609	258.8	01Jan2000, 01:5
CP12	0.169672	197.0	01Jan2000, 02:0
CP13	0.032094	38.6	01Jan2000, 02:0
WS1	0.060875	168.2	01Jan2000, 01:4
WS2	0.068953	182.0	01Jan2000, 01:4
WS3	0.066469	134.5	01Jan2000, 01:5

Table 4-2
Summary of Hydrologic Results

Watershed/Concentration Point	Drainage Area (sq.mi.)	Q100 (cfs)
CP1	2.5092	1387.9
CP2	2.4483	1386.4
CP3	2.3794	1381.5
CP4	2.3129	1367.8
CP5	2.2664	1363.4
CP6	2.1357	1352.5
CP7	2.0606	1348.5
CP8	1.9065	1255.7
CP9	1.5187	997
CP10	0.6801	493.8
CP11	0.1506	224.2
CP12	0.1697	174.3
CP13	0.0321	34.7
WS1	0.0609	146
WS2	0.0690	159.3
WS3	0.0665	118.3
WS4	0.0465	116.3
WS5	0.1307	382.2
WS6	0.0750	276.8
WS7	0.1220	191.3
WS8	0.2182	177.6
WS9	0.8386	552.3
WS10	0.5295	271.4
WS11	0.1506	224.2
WS12	0.1697	174.3
WS13	0.0321	34.7

4.6.1 Verification of Results

No data is available to verify results. However, since construction, a storm event with a total precipitation depth and intensity close to the 100-year design storm occurred and the channel function as expected.

MATCH LINE SEE SHEET 2

LA CANADA DRIVE

GLOVER ROAD

NARANJA DRIVE

CANADA HILLS DRIVE

LAMBERT LANE

LA CHOLLA BLVD.

MATCH LINE SEE BELOW LEFT

MATCH LINE SEE ABOVE RIGHT

LA CHOLLA BLVD.

WS1 WS2 WS3 WS4 WS5 WS6 WS7

CP1 CP2 CP3 CP4 CP5 CP6 CP7

400 0 200 400 600 1000

SCALE 1"=400 FEET
CONTOUR INTERVAL=10'-0"

LEGEND

- WATERSHED BOUNDARY
- CP4 — CONCENTRATION POINT
- WS4 — WATERSHED DESIGNATION

FIGURE 3-1
WATERSHED MAP
FOR
LOMAS DE ORO
LOMR REQUEST

PSOMAS
333 E. Wetmore Road, Suite 450
Tucson, AZ 85705
(520) 292-2300
(520) 292-1290 fax
www.psomas.com

SHEET 3 OF 3

	NAME	DATE
DESIGN	J OLIVER	06/14
DRAWN	D DICKINSON	06/14
CHECKED	M DALY	06/14

La Cholla Boulevard: Overton Road to Tangerine Road

Final Drainage Report

Prepared for





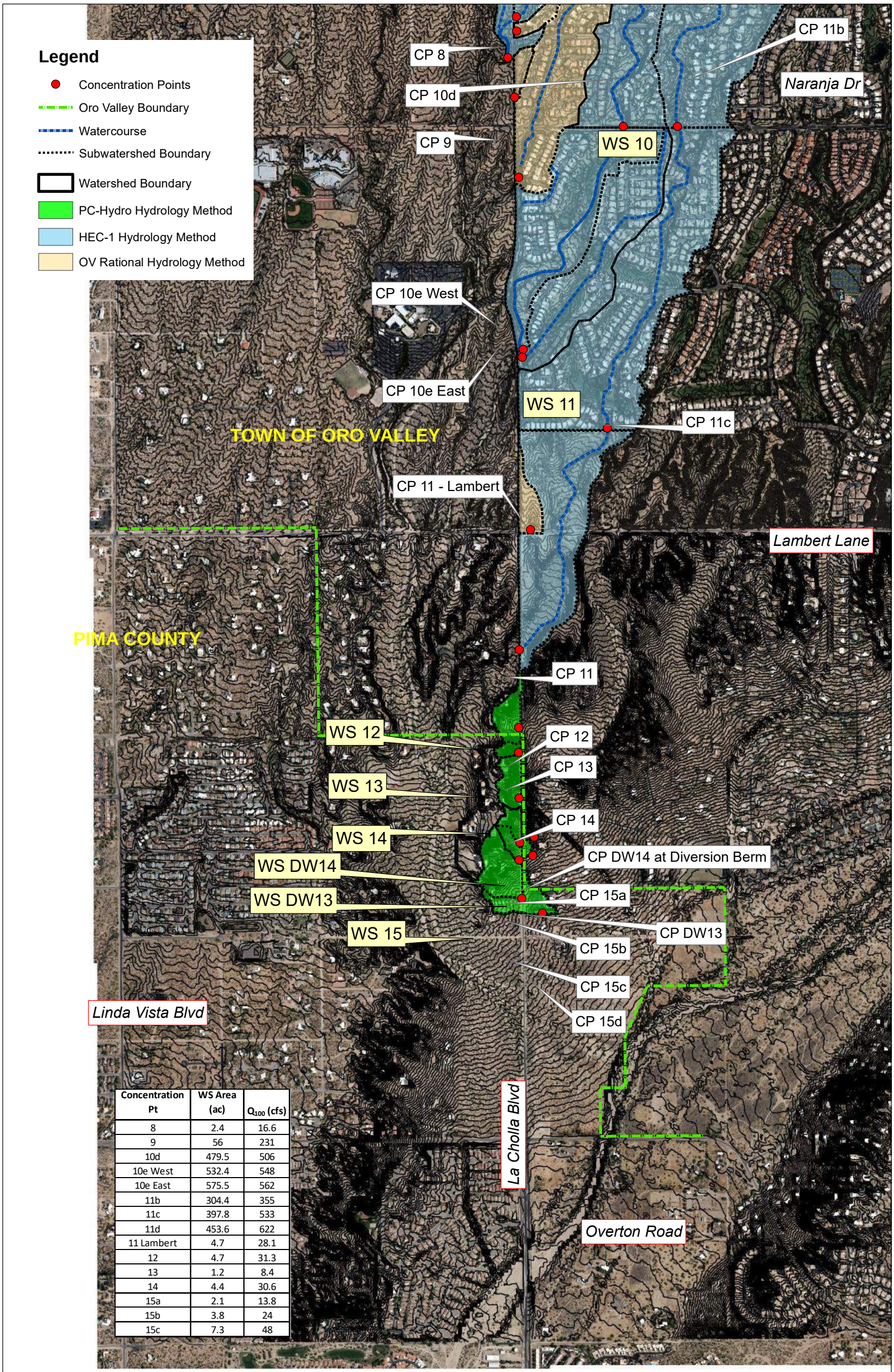


Prepared by



510 E 4th Street
Tucson, AZ. 85705

January 2018



Concentration Pt	WS Area (ac)	Q_{100} (cfs)
8	2.4	16.6
9	56	231
10d	479.5	506
10e West	532.4	548
10e East	575.5	562
11b	304.4	355
11c	397.8	533
11d	453.6	622
11 Lambert	4.7	28.1
12	4.7	31.3
13	1.2	8.4
14	4.4	30.6
15a	2.1	13.8
15b	3.8	24
15c	7.3	48

La Cholla Boulevard, Overton Road to Tangerine Road
Final Drainage Report

Figure 2b - Watershed Map Watershed 1 - 15 (South)

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP1.5	Date:	04/01/2021
Concentration Point:	CP1.5	Job #	
Watershed Area:	2.7 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	16	546	0.0293	0.035

Length of Watercourse (Lc):	546 feet	Mean Slope:	0.0293
Length to Cen. of Gravity (Lca):	273 feet	Weighted Basin Fac:	0.035
Veg. Cover Type(s):	Desert Brush	Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA data user generated

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.02	3.17	3.46	3.72	4.53

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	-	-	-
C	-	-	-
D	100	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.63	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	6.55	in/hr
PEAK DISCHARGE:	17.8	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP1	Date:	04/01/2021
Concentration Point:	CP1	Job #	
Watershed Area:	5.4 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	16	546	0.0293	0.035
2	20	562	0.0356	0.035

Length of Watercourse (Lc):	1108	feet	Mean Slope:	0.0323	
Length to Cen. of Gravity (Lca):	554	feet	Weighted Basin Fac:	0.035	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA data user generated

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.02	3.17	3.46	3.72	4.53

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	-	-	-
C	-	-	-
D	100	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.63	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	6.55	in/hr
PEAK DISCHARGE:	35.6	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP2.5	Date:	04/01/2021
Concentration Point:	CP2.5	Job #	
Watershed Area:	3.1 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	24	552	0.0435	0.035

Length of Watercourse (Lc):	552 feet	Mean Slope:	0.0435
Length to Cen. of Gravity (Lca):	276 feet	Weighted Basin Fac:	0.035
Veg. Cover Type(s):	Desert Brush	Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA data user generated

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.02	3.17	3.46	3.72	4.53

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.51	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	5.21	in/hr
PEAK DISCHARGE:	16.3	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP2	Date:	04/01/2021
Concentration Point:	CP2	Job #	
Watershed Area:	10.3 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	24	552	0.0435	0.04
2	38	1000	0.038	0.04

Length of Watercourse (Lc):	1552	feet	Mean Slope:	0.0398	
Length to Cen. of Gravity (Lca):	776	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA data user generated

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.02	3.17	3.46	3.72	4.53

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.51	
Time of Concentration:	6.3	min
Rainfall Intensity (i) @ Tc:	9.33	in/hr
Runoff Supply Rate (q) @ Tc:	4.71	in/hr
PEAK DISCHARGE:	48.9	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP3.5	Date:	04/01/2021
Concentration Point:	CP3.5	Job #	
Watershed Area:	27.3 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	14	462	0.0303	0.06
2	3	538	0.0056	0.025
3	34	1280	0.0266	0.04

Length of Watercourse (Lc):	2280	feet	Mean Slope:	0.0166	
Length to Cen. of Gravity (Lca):	1140	feet	Weighted Basin Fac:	0.041	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA data user generated

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.02	3.17	3.46	3.72	4.53

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	10	99	0.957

Weighted Runoff Coef. (Cw):	0.55	
Time of Concentration:	12.2	min
Rainfall Intensity (i) @ Tc:	7.14	in/hr
Runoff Supply Rate (q) @ Tc:	3.93	in/hr
PEAK DISCHARGE:	108.1	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP3	Date:	04/01/2021
Concentration Point:	CP3	Job #	
Watershed Area:	32.8 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	14	462	0.0303	0.06
2	3	538	0.0056	0.025
3	34	1280	0.0266	0.04
4	34	476	0.0714	0.04

Length of Watercourse (Lc):	2756	feet	Mean Slope:	0.02	
Length to Cen. of Gravity (Lca):	1378	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA data user generated

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.02	3.17	3.46	3.72	4.53

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	46	81.9	0.404
C	38	87.3	0.549
D	16	90.3	0.635
Imp.	9	99	0.957

Weighted Runoff Coef. (Cw):	0.54	
Time of Concentration:	12.9	min
Rainfall Intensity (i) @ Tc:	6.96	in/hr
Runoff Supply Rate (q) @ Tc:	3.74	in/hr
PEAK DISCHARGE:	123.7	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP4.5	Date:	04/01/2021
Concentration Point:	CP4.5	Job #	
Watershed Area:	24.3 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10	245	0.0408	0.06
2	2	633	0.0032	0.025
3	36	1402	0.0257	0.04

Length of Watercourse (Lc):	2280	feet	Mean Slope:	0.0115	
Length to Cen. of Gravity (Lca):	1140	feet	Weighted Basin Fac:	0.038	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA data user generated

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.02	3.17	3.46	3.72	4.53

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	13	99	0.957

Weighted Runoff Coef. (Cw):	0.56	
Time of Concentration:	13.3	min
Rainfall Intensity (i) @ Tc:	6.87	in/hr
Runoff Supply Rate (q) @ Tc:	3.87	in/hr
PEAK DISCHARGE:	94.8	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP4	Date:	04/01/2021
Concentration Point:	CP4	Job #	
Watershed Area:	28.4 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10	245	0.0408	0.06
2	2	633	0.0032	0.025
3	36	1402	0.0257	0.04
4	20	464	0.0431	0.04

Length of Watercourse (Lc):	2744	feet	Mean Slope:	0.0137	
Length to Cen. of Gravity (Lca):	1372	feet	Weighted Basin Fac:	0.038	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA data user generated

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.02	3.17	3.46	3.72	4.53

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	11	99	0.957

Weighted Runoff Coef. (Cw):	0.55	
Time of Concentration:	14.3	min
Rainfall Intensity (i) @ Tc:	6.66	in/hr
Runoff Supply Rate (q) @ Tc:	3.69	in/hr
PEAK DISCHARGE:	105.8	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP5 existing rev	Date:	11/27/2024
Concentration Point:	CP5 existing rev	Job #	
Watershed Area:	101.1 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10	245	0.0408	0.06
2	2	633	0.0032	0.025
3	36	1402	0.0257	0.04
4	20	464	0.0431	0.04
5	84	2704	0.0311	0.04

Length of Watercourse (Lc):	5448 feet	Mean Slope:	0.0197
Length to Cen. of Gravity (Lca):	2724 feet	Weighted Basin Fac:	0.039

RETURN PERIOD: 100-years NOAA Data Obtained: 2024-11-27 02:51:58 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.62	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Default Vegetation Percentages Not Used

Soil Type	Percent	Veg %	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	68	30	82	Desert Brush	0.426
C	22	30	87	Desert Brush	0.549
D	10	30	90	Desert Brush	0.635
Imp.	6	-	99	-	0.957

Weighted Runoff Coef. (Cw):	0.5	
Time of Concentration:	21.9	min
Rainfall Intensity (i) @ Tc:	5.16	in/hr
Runoff Supply Rate (q) @ Tc:	2.6	in/hr
PEAK DISCHARGE:	264.5	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP5a	Date:	01/29/2024
Concentration Point:	CP5a	Job #	
Watershed Area:	0.5 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	36	192	0.1875	0.11

Length of Watercourse (Lc):	192 feet	Mean Slope:	0.1875
Length to Cen. of Gravity (Lca):	81 feet	Weighted Basin Fac:	0.11
		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA Data Obtained: 2024-01-29 12:56:24 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.62	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	100	82	Desert Brush	0.426
Imp.	0	99	-	0.957

Weighted Runoff Coef. (Cw):	0.43	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	4.4	in/hr
PEAK DISCHARGE:	2.2	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP5b	Date:	01/29/2024
Concentration Point:	CP5b	Job #	
Watershed Area:	1.3 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	48	402	0.1194	0.095

Length of Watercourse (Lc):	402 feet	Mean Slope:	0.1194
Length to Cen. of Gravity (Lca):	201 feet	Weighted Basin Fac:	0.095
		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA Data Obtained: 2024-01-29 12:56:24 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.62	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	100	82	Desert Brush	0.426
Imp.	0	99	-	0.957

Weighted Runoff Coef. (Cw):	0.43	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	4.4	in/hr
PEAK DISCHARGE:	5.8	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP5c existing	Date:	11/27/2024
Concentration Point:	CP5c existing	Job #	
Watershed Area:	5.8 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	80	942	0.0849	0.076

Length of Watercourse (Lc):	942 feet	Mean Slope:	0.0849
Length to Cen. of Gravity (Lca):	471 feet	Weighted Basin Fac:	0.076

RETURN PERIOD: 100-years NOAA Data Obtained: 2024-01-29 12:56:24 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.62	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Default Vegetation Percentages Not Used

Soil Type	Percent	Veg %	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	47	30	82	Desert Brush	0.426
C	37	30	87	Desert Brush	0.549
D	16	30	90	Desert Brush	0.635
Imp.	0	-	99	-	0.957

Weighted Runoff Coef. (Cw):	0.51	
Time of Concentration:	6.6	min
Rainfall Intensity (i) @ Tc:	9.15	in/hr
Runoff Supply Rate (q) @ Tc:	4.62	in/hr
PEAK DISCHARGE:	27	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP5d existing	Date:	11/27/2024
Concentration Point:	CP5d existing	Job #	
Watershed Area:	8.5 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	79	1264	0.0625	0.066

Length of Watercourse (Lc):	1264 feet	Mean Slope:	0.0625
Length to Cen. of Gravity (Lca):	640 feet	Weighted Basin Fac:	0.066

RETURN PERIOD: 100-years NOAA Data Obtained: 2024-01-29 12:56:24 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.62	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Default Vegetation Percentages Not Used

Soil Type	Percent	Veg %	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	41	30	82	Desert Brush	0.426
C	41	30	87	Desert Brush	0.549
D	18	30	90	Desert Brush	0.635
Imp.	0	-	99	-	0.957

Weighted Runoff Coef. (Cw):	0.51	
Time of Concentration:	7.9	min
Rainfall Intensity (i) @ Tc:	8.52	in/hr
Runoff Supply Rate (q) @ Tc:	4.38	in/hr
PEAK DISCHARGE:	37.5	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP6	Date:	04/01/2021
Concentration Point:	CP6	Job #	
Watershed Area:	2.7 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	42	532	0.0789	0.074

Length of Watercourse (Lc):	532 feet	Mean Slope:	0.0789
Length to Cen. of Gravity (Lca):	266 feet	Weighted Basin Fac:	0.074
Veg. Cover Type(s):	Desert Brush	Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA data user generated

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.02	3.17	3.46	3.72	4.53

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.51	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	5.21	in/hr
PEAK DISCHARGE:	14.2	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP7	Date:	04/01/2021
Concentration Point:	CP7	Job #	
Watershed Area:	0.9 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	32	214	0.1495	0.101

Length of Watercourse (Lc):	214 feet	Mean Slope:	0.1495
Length to Cen. of Gravity (Lca):	107 feet	Weighted Basin Fac:	0.101
Veg. Cover Type(s):	Desert Brush	Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA data user generated

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.02	3.17	3.46	3.72	4.53

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.51	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	5.21	in/hr
PEAK DISCHARGE:	4.7	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP8	Date:	04/01/2021
Concentration Point:	CP8	Job #	
Watershed Area:	5.6 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	44	884	0.0498	0.05

Length of Watercourse (Lc):	884 feet	Mean Slope:	0.0498
Length to Cen. of Gravity (Lca):	442 feet	Weighted Basin Fac:	0.05
Veg. Cover Type(s):	Desert Brush	Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA data user generated

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.02	3.17	3.46	3.72	4.53

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.51	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	5.21	in/hr
PEAK DISCHARGE:	29.4	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP9	Date:	04/01/2021
Concentration Point:	CP9	Job #	
Watershed Area:	12.8 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	16	400	0.04	0.055
2	42	652	0.0644	0.066
3	16	544	0.0294	0.05

Length of Watercourse (Lc):	1596 feet		Mean Slope:	0.0425
Length to Cen. of Gravity (Lca):	798 feet		Weighted Basin Fac:	0.058
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA data user generated

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3957 Longitude: -111.0096

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.02	3.17	3.46	3.72	4.53

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	44	81.9	0.404
C	39	87.3	0.549
D	17	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.5	
Time of Concentration:	9.6	min
Rainfall Intensity (i) @ Tc:	7.97	in/hr
Runoff Supply Rate (q) @ Tc:	3.98	in/hr
PEAK DISCHARGE:	51.4	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP10	Date:	04/01/2021
Concentration Point:	CP10	Job #	
Watershed Area:	22 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	16	400	0.04	0.055
2	42	652	0.0644	0.066
3	16	544	0.0294	0.05
4	12	388	0.0309	0.05

Length of Watercourse (Lc):	1984	feet	Mean Slope:	0.0398	
Length to Cen. of Gravity (Lca):	992	feet	Weighted Basin Fac:	0.056	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA data user generated

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3957 Longitude: -111.0096

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.02	3.17	3.46	3.72	4.53

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	71	81.9	0.404
C	21	87.3	0.549
D	8	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.45	
Time of Concentration:	11.8	min
Rainfall Intensity (i) @ Tc:	7.25	in/hr
Runoff Supply Rate (q) @ Tc:	3.28	in/hr
PEAK DISCHARGE:	72.8	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	N1	Date:	09/05/2023
Concentration Point:	N1	Job #	
Watershed Area:	6.2 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	52	628	0.0828	0.075

Length of Watercourse (Lc):	628 feet	Mean Slope:	0.0828
Length to Cen. of Gravity (Lca):	314 feet	Weighted Basin Fac:	0.075
		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 12:19:20 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	41	82	Desert Brush	0.426
C	41	87	Desert Brush	0.549
D	18	90.3	Desert Brush	0.644
Imp.	0	99	-	0.957

Weighted Runoff Coef. (Cw):	0.52	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.31	in/hr
Runoff Supply Rate (q) @ Tc:	5.32	in/hr
PEAK DISCHARGE:	33.2	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	N2	Date:	04/27/2021
Concentration Point:	N2	Job #	
Watershed Area:	4.5 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	42	716	0.0587	0.059

Length of Watercourse (Lc):	716	feet	Mean Slope:	0.0587	
Length to Cen. of Gravity (Lca):	358	feet	Weighted Basin Fac:	0.059	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 12:19:20 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.51	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.31	in/hr
Runoff Supply Rate (q) @ Tc:	5.21	in/hr
PEAK DISCHARGE:	23.6	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	N2.4	Date:	09/06/2022
Concentration Point:	N2.4	Job #	
Watershed Area:	0.3 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	1	196	0.0051	0.034

Length of Watercourse (Lc):	196 feet	Mean Slope:	0.0051
Length to Cen. of Gravity (Lca):	98 feet	Weighted Basin Fac:	0.034
		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 11:52:50 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	41	82	Desert Brush	0.426
C	41	87	Desert Brush	0.549
D	18	90.3	Desert Brush	0.644
Imp.	0	99	-	0.957

Weighted Runoff Coef. (Cw):	0.52	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	5.32	in/hr
PEAK DISCHARGE:	1.6	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	N3	Date:	04/27/2021
Concentration Point:	N3	Job #	
Watershed Area:	4.2 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	58	900	0.0644	0.064

Length of Watercourse (Lc):	900	feet	Mean Slope:	0.0644	
Length to Cen. of Gravity (Lca):	450	feet	Weighted Basin Fac:	0.064	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 12:19:20 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.51	
Time of Concentration:	5.9	min
Rainfall Intensity (i) @ Tc:	9.57	in/hr
Runoff Supply Rate (q) @ Tc:	4.84	in/hr
PEAK DISCHARGE:	20.5	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	N4.1 2nd sub	Date:	08/03/2021
Concentration Point:	N4.1 2nd sub	Job #	
Watershed Area:	2.5 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	34	396	0.0859	0.077

Length of Watercourse (Lc):	396	feet	Mean Slope:	0.0859	
Length to Cen. of Gravity (Lca):	198	feet	Weighted Basin Fac:	0.077	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-08-03 11:24:25 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.51	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	5.21	in/hr
PEAK DISCHARGE:	13.1	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	N4a 2nd sub	Date:	08/05/2021
Concentration Point:	N4a 2nd sub	Job #	
Watershed Area:	0.9 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	18	528	0.0341	0.04

Length of Watercourse (Lc):	528	feet	Mean Slope:	0.0341	
Length to Cen. of Gravity (Lca):	264	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-08-05 03:15:59 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.51	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	5.21	in/hr
PEAK DISCHARGE:	4.7	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	N4b	Date:	09/06/2023
Concentration Point:	N4b	Job #	
Watershed Area:	5 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	34	396	0.0859	0.077
2	26	506	0.0514	0.05

Length of Watercourse (Lc):	902 feet	Mean Slope:	0.0634
Length to Cen. of Gravity (Lca):	451 feet	Weighted Basin Fac:	0.062
		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 12:08:36 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	41	82	Desert Brush	0.426
C	41	87	Desert Brush	0.549
D	18	90	Desert Brush	0.635
Imp.	2	99	-	0.957

Weighted Runoff Coef. (Cw):	0.52	
Time of Concentration:	5.6	min
Rainfall Intensity (i) @ Tc:	9.78	in/hr
Runoff Supply Rate (q) @ Tc:	5.12	in/hr
PEAK DISCHARGE:	25.8	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	N5.1 2nd sub	Date:	08/03/2021
Concentration Point:	N5.1 2nd sub	Job #	
Watershed Area:	4.6 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	46	702	0.0655	0.067

Length of Watercourse (Lc):	702	feet	Mean Slope:	0.0655	
Length to Cen. of Gravity (Lca):	351	feet	Weighted Basin Fac:	0.067	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-08-03 11:51:29 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.51	
Time of Concentration:	5.2	min
Rainfall Intensity (i) @ Tc:	10.17	in/hr
Runoff Supply Rate (q) @ Tc:	5.14	in/hr
PEAK DISCHARGE:	23.8	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	N5 2nd sub	Date:	08/03/2021
Concentration Point:	N5 2nd sub	Job #	
Watershed Area:	5.4 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	46	702	0.0655	0.067
2	4	198	0.0202	0.03

Length of Watercourse (Lc):	900	feet	Mean Slope:	0.0474	
Length to Cen. of Gravity (Lca):	450	feet	Weighted Basin Fac:	0.059	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 12:03:31 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.51	
Time of Concentration:	6.2	min
Rainfall Intensity (i) @ Tc:	9.38	in/hr
Runoff Supply Rate (q) @ Tc:	4.74	in/hr
PEAK DISCHARGE:	25.8	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D2	Date:	07/08/2022
Concentration Point:	D2	Job #	
Watershed Area:	4.6 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	27	842	0.0321	0.025

Length of Watercourse (Lc):	842	feet	Mean Slope:	0.0321
Length to Cen. of Gravity (Lca):	421	feet	Weighted Basin Fac:	0.025
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 11:46:14 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	71	81.9	0.424
C	21	87.3	0.557
D	8	90.3	0.644
Imp.	60	99	0.957

Weighted Runoff Coef. (Cw):	0.76	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	7.86	in/hr
PEAK DISCHARGE:	36.4	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D2.1	Date:	09/05/2023
Concentration Point:	D2.1	Job #	
Watershed Area:	5.9 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	28	1155	0.0242	0.025

Length of Watercourse (Lc):	1155 feet	Mean Slope:	0.0242
Length to Cen. of Gravity (Lca):	578 feet	Weighted Basin Fac:	0.025
		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 12:19:20 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	56	82	Desert Brush	0.426
C	30	87	Desert Brush	0.549
D	14	90	Desert Brush	0.635
Imp.	54	99	-	0.957

Weighted Runoff Coef. (Cw):	0.74	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	7.67	in/hr
PEAK DISCHARGE:	45.6	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	N2.5	Date:	04/27/2021
Concentration Point:	N2.5	Job #	
Watershed Area:	3.8 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	24	552	0.0435	0.04
2	12	190	0.0632	0.04

Length of Watercourse (Lc):	742	feet	Mean Slope:	0.0475	
Length to Cen. of Gravity (Lca):	371	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 11:52:50 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.51	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	5.21	in/hr
PEAK DISCHARGE:	20	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D2.5	Date:	09/06/2022
Concentration Point:	D2.5	Job #	
Watershed Area:	2.3 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	22	680	0.0324	0.025

Length of Watercourse (Lc):	680 feet	Mean Slope:	0.0324
Length to Cen. of Gravity (Lca):	340 feet	Weighted Basin Fac:	0.025
		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 11:52:50 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	41	82	Desert Brush	0.426
C	41	87	Desert Brush	0.549
D	18	90.3	Desert Brush	0.644
Imp.	60	99	-	0.957

Weighted Runoff Coef. (Cw):	0.78	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	8.05	in/hr
PEAK DISCHARGE:	18.7	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D2.6	Date:	09/06/2022
Concentration Point:	D2.6	Job #	
Watershed Area:	5.8 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	24	552	0.0435	0.035
2	12	190	0.0632	0.04
3	22	316	0.0696	0.069

Length of Watercourse (Lc):	1058 feet	Mean Slope:	0.0529
Length to Cen. of Gravity (Lca):	529 feet	Weighted Basin Fac:	0.046
		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 11:52:50 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	41	82	Desert Brush	0.426
C	41	87	Desert Brush	0.549
D	18	90.3	Desert Brush	0.644
Imp.	10	99	-	0.957

Weighted Runoff Coef. (Cw):	0.56	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	5.77	in/hr
PEAK DISCHARGE:	33.8	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D2.65	Date:	09/06/2022
Concentration Point:	D2.65	Job #	
Watershed Area:	1.0 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	1	320	0.0031	0.025

Length of Watercourse (Lc):	320 feet	Mean Slope:	0.0031
Length to Cen. of Gravity (Lca):	160 feet	Weighted Basin Fac:	0.025
		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 11:52:50 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	41	82	Desert Brush	0.426
C	41	87	Desert Brush	0.549
D	18	90.3	Desert Brush	0.644
Imp.	60	99	-	0.957

Weighted Runoff Coef. (Cw):	0.78	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	8.05	in/hr
PEAK DISCHARGE:	8.1	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D2.7	Date:	09/22/2023
Concentration Point:	D2.7	Job #	
Watershed Area:	0.6 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	26	290	0.0897	0.078

Length of Watercourse (Lc):	290 feet	Mean Slope:	0.0897
Length to Cen. of Gravity (Lca):	145 feet	Weighted Basin Fac:	0.078
		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 11:52:50 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	41	82	Desert Brush	0.426
C	41	87	Desert Brush	0.549
D	18	90.3	Desert Brush	0.644
Imp.	0	99	-	0.957

Weighted Runoff Coef. (Cw):	0.52	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	5.32	in/hr
PEAK DISCHARGE:	3.2	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D3.3	Date:	07/15/2022
Concentration Point:	D3.3	Job #	
Watershed Area:	0.74 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	28	243	0.1152	0.089
2	1.3	207	0.0063	0.035

Length of Watercourse (Lc):	450	feet	Mean Slope:	0.0183	
Length to Cen. of Gravity (Lca):	200	feet	Weighted Basin Fac:	0.064	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-08-05 12:31:14 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.424
C	41	87.3	0.557
D	18	90.3	0.644
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.52	
Time of Concentration:	6.2	min
Rainfall Intensity (i) @ Tc:	9.35	in/hr
Runoff Supply Rate (q) @ Tc:	4.85	in/hr
PEAK DISCHARGE:	3.6	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D3.5	Date:	04/27/2021
Concentration Point:	D3.5	Job #	
Watershed Area:	1.2 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	6	554	0.0108	0.025

Length of Watercourse (Lc):	554	feet	Mean Slope:	0.0108	
Length to Cen. of Gravity (Lca):	277	feet	Weighted Basin Fac:	0.025	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 11:58:38 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.404
C	41	87.3	0.549
D	18	90.3	0.635
Imp.	70	99	0.957

Weighted Runoff Coef. (Cw):	0.82	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	8.47	in/hr
PEAK DISCHARGE:	10.2	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D3 rev	Date:	07/09/2021
Concentration Point:	D3 rev	Job #	
Watershed Area:	5.8 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	28	817	0.0343	0.025

Length of Watercourse (Lc):	817	feet	Mean Slope:	0.0343	
Length to Cen. of Gravity (Lca):	409	feet	Weighted Basin Fac:	0.025	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 11:58:38 AM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.424
C	41	87.3	0.557
D	18	90.3	0.644
Imp.	60	99	0.957

Weighted Runoff Coef. (Cw):	0.78	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	8.06	in/hr
PEAK DISCHARGE:	47.1	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D4 rev	Date:	07/09/2021
Concentration Point:	D4 rev	Job #	
Watershed Area:	5.9 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	46	1014	0.0454	0.025

Length of Watercourse (Lc):	1014	feet	Mean Slope:	0.0454	
Length to Cen. of Gravity (Lca):	507	feet	Weighted Basin Fac:	0.025	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 12:03:31 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.424
C	41	87.3	0.557
D	18	90.3	0.644
Imp.	50	99	0.957

Weighted Runoff Coef. (Cw):	0.74	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	7.61	in/hr
PEAK DISCHARGE:	45.2	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D4.1	Date:	08/05/2022
Concentration Point:	D4.1	Job #	
Watershed Area:	1.1 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	32	524	0.0611	0.065

Length of Watercourse (Lc):	524	feet	Mean Slope:	0.0611	
Length to Cen. of Gravity (Lca):	262	feet	Weighted Basin Fac:	0.065	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 12:03:31 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.424
C	41	87.3	0.557
D	18	90.3	0.644
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.52	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	5.35	in/hr
PEAK DISCHARGE:	5.9	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D5	Date:	09/05/2023
Concentration Point:	D5	Job #	
Watershed Area:	6.6 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	46	702	0.0655	0.067
2	4	198	0.0202	0.03
3	1.8	90	0.02	0.025

Length of Watercourse (Lc):	990 feet	Mean Slope:	0.043
Length to Cen. of Gravity (Lca):	495 feet	Weighted Basin Fac:	0.056
		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 12:03:31 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	41	82	Desert Brush	0.426
C	41	87	Desert Brush	0.549
D	18	90.3	Desert Brush	0.644
Imp.	11	99	-	0.957

Weighted Runoff Coef. (Cw):	0.56	
Time of Concentration:	6.2	min
Rainfall Intensity (i) @ Tc:	9.39	in/hr
Runoff Supply Rate (q) @ Tc:	5.3	in/hr
PEAK DISCHARGE:	35.3	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D6	Date:	09/05/2023
Concentration Point:	D6	Job #	
Watershed Area:	3.2 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	20	542	0.0369	0.025

Length of Watercourse (Lc):	542 feet	Mean Slope:	0.0369
Length to Cen. of Gravity (Lca):	271 feet	Weighted Basin Fac:	0.025
		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-08-05 12:31:14 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	41	82	Desert Brush	0.426
C	41	87	Desert Brush	0.549
D	18	90.3	Desert Brush	0.644
Imp.	60	99	-	0.957

Weighted Runoff Coef. (Cw):	0.78	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	8.05	in/hr
PEAK DISCHARGE:	26	cfs

PIMA COUNTY
FLOOD CONTROL

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D7 rev	Date:	07/08/2022
Concentration Point:	D7 rev	Job #	
Watershed Area:	3.6 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	18	612	0.0294	0.025

Length of Watercourse (Lc):	612	feet	Mean Slope:	0.0294	
Length to Cen. of Gravity (Lca):	306	feet	Weighted Basin Fac:	0.025	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 02:40:36 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.424
C	41	87.3	0.557
D	18	90.3	0.644
Imp.	60	99	0.957

Weighted Runoff Coef. (Cw):	0.78	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	8.06	in/hr
PEAK DISCHARGE:	29.2	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D12	Date:	09/05/2023
Concentration Point:	D12	Job #	
Watershed Area:	6.3 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	52	628	0.0828	0.075
2	12	122	0.0984	0.035

Length of Watercourse (Lc):	750 feet	Mean Slope:	0.0851
Length to Cen. of Gravity (Lca):	375 feet	Weighted Basin Fac:	0.068
		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-04-27 12:19:20 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	41	82	Desert Brush	0.426
C	41	87	Desert Brush	0.549
D	18	90.3	Desert Brush	0.644
Imp.	0	99	-	0.957

Weighted Runoff Coef. (Cw):	0.52	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	5.32	in/hr
PEAK DISCHARGE:	33.8	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	D13	Date:	07/08/2022
Concentration Point:	D13	Job #	
Watershed Area:	0.24 Acres	Watershed Type	Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10	242	0.0413	0.04

Length of Watercourse (Lc):	242	feet	Mean Slope:	0.0413	
Length to Cen. of Gravity (Lca):	10	feet	Weighted Basin Fac:	0.04	
Veg. Cover Type(s):	Desert Brush		Veg. Cover Density:	30	

RETURN PERIOD: 100-years NOAA Data Obtained: 2021-08-05 12:31:14 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.63	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Runoff Coef. (C)
B	41	81.9	0.424
C	41	87.3	0.557
D	18	90.3	0.644
Imp.	0	99	0.957

Weighted Runoff Coef. (Cw):	0.52	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	5.35	in/hr
PEAK DISCHARGE:	1.3	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP5 dev rev	Date:	11/27/2024
Concentration Point:	CP5 dev rev	Job #	
Watershed Area:	88.4 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10	245	0.0408	0.06
2	2	633	0.0032	0.025
3	36	1402	0.0257	0.04
4	20	464	0.0431	0.04
5	84	2704	0.0311	0.04

Length of Watercourse (Lc):	5448 feet	Mean Slope:	0.0197
Length to Cen. of Gravity (Lca):	2724 feet	Weighted Basin Fac:	0.039

RETURN PERIOD: 2-years NOAA Data Obtained: 2024-11-27 02:51:58 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.36	0.54	0.67	0.91	1.12	1.27	1.34	1.52	1.7	2.02

Default Vegetation Percentages Not Used

Soil Type	Percent	Veg %	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	68	30	82	Desert Brush	0.144
C	22	30	87	Desert Brush	0.26
D	10	30	90	Desert Brush	0.358
Imp.	6	-	99	-	0.899

Weighted Runoff Coef. (Cw):	0.23	
Time of Concentration:	53.1	min
Rainfall Intensity (i) @ Tc:	1.21	in/hr
Runoff Supply Rate (q) @ Tc:	0.28	in/hr
PEAK DISCHARGE:	25.2	cfs

Notes:

use for hydrograph summation, add to Basim SE for CP-5 developed at SE property corner

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP5 dev rev	Date:	11/27/2024
Concentration Point:	CP5 dev rev	Job #	
Watershed Area:	88.4 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10	245	0.0408	0.06
2	2	633	0.0032	0.025
3	36	1402	0.0257	0.04
4	20	464	0.0431	0.04
5	84	2704	0.0311	0.04

Length of Watercourse (Lc):	5448 feet	Mean Slope:	0.0197
Length to Cen. of Gravity (Lca):	2724 feet	Weighted Basin Fac:	0.039

RETURN PERIOD: 10-years NOAA Data Obtained: 2024-11-27 02:51:58 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.56	0.85	1.05	1.42	1.75	1.95	2.03	2.24	2.46	2.96

Default Vegetation Percentages Not Used

Soil Type	Percent	Veg %	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	68	30	82	Desert Brush	0.28
C	22	30	87	Desert Brush	0.409
D	10	30	90	Desert Brush	0.505
Imp.	6	-	99	-	0.934

Weighted Runoff Coef. (Cw):	0.37	
Time of Concentration:	32.2	min
Rainfall Intensity (i) @ Tc:	2.69	in/hr
Runoff Supply Rate (q) @ Tc:	0.99	in/hr
PEAK DISCHARGE:	88.1	cfs

Notes:

use for hydrograph summation, add to Basim SE for CP-5 developed at SE property corner

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP5 dev rev	Date:	11/27/2024
Concentration Point:	CP5 dev rev	Job #	
Watershed Area:	88.4 Acres	Watershed Type	Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10	245	0.0408	0.06
2	2	633	0.0032	0.025
3	36	1402	0.0257	0.04
4	20	464	0.0431	0.04
5	84	2704	0.0311	0.04

Length of Watercourse (Lc):	5448 feet	Mean Slope:	0.0197
Length to Cen. of Gravity (Lca):	2724 feet	Weighted Basin Fac:	0.039

RETURN PERIOD: 100-years NOAA Data Obtained: 2024-11-27 02:51:58 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.62	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Default Vegetation Percentages Not Used

Soil Type	Percent	Veg %	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	68	30	82	Desert Brush	0.426
C	22	30	87	Desert Brush	0.549
D	10	30	90	Desert Brush	0.635
Imp.	6	-	99	-	0.957

Weighted Runoff Coef. (Cw):	0.5	
Time of Concentration:	21.9	min
Rainfall Intensity (i) @ Tc:	5.16	in/hr
Runoff Supply Rate (q) @ Tc:	2.6	in/hr
PEAK DISCHARGE:	231.3	cfs

Notes:

use for hydrograph summation, add to Basim SE for CP-5 developed at SE property corner

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP5b dev	Date:	01/29/2024
Concentration Point:	CP5b dev	Job #	
Watershed Area:	1.1 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	48	402	0.1194	0.095

Length of Watercourse (Lc):	402 feet	Mean Slope:	0.1194
Length to Cen. of Gravity (Lca):	201 feet	Weighted Basin Fac:	0.095
		Veg. Cover Density:	30

RETURN PERIOD: 100-years NOAA Data Obtained: 2024-01-29 12:56:24 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.62	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Soil Type	Percent	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	100	82	Desert Brush	0.426
Imp.	0	99	-	0.957

Weighted Runoff Coef. (Cw):	0.43	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	4.4	in/hr
PEAK DISCHARGE:	4.9	cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Generated using methonds provided by Pima County Regional Flood Control District

Client:	Bowman	Prepared by:	LKR
Project Name:	CP5c developed	Date:	11/27/2024
Concentration Point:	CP5c developed	Job #	
Watershed Area:	1.4 Acres	Watershed Type	Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	18	358	0.0503	0.055

Length of Watercourse (Lc):	358 feet	Mean Slope:	0.0503
Length to Cen. of Gravity (Lca):	179 feet	Weighted Basin Fac:	0.055

RETURN PERIOD: 100-years NOAA Data Obtained: 2024-01-29 12:56:24 PM

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3942 Longitude: -111.0102

Duration:	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in):	0.86	1.31	1.62	2.19	2.71	3.01	3.16	3.44	3.71	4.52

Default Vegetation Percentages Not Used

Soil Type	Percent	Veg %	Curve # (CN)	Veg. Cover Type(s):	Runoff Coef. (C)
B	100	30	82	Desert Brush	0.426
Imp.	0	-	99	-	0.957

Weighted Runoff Coef. (Cw):	0.43	
Time of Concentration:	5	min
Rainfall Intensity (i) @ Tc:	10.32	in/hr
Runoff Supply Rate (q) @ Tc:	4.4	in/hr
PEAK DISCHARGE:	6.2	cfs

Canyon Shadows Wash at CP-5 (Developed)
Hydrograph summation

100-year	Cyn Shadows Wash developed	Basin SE Basin outflow	CP-5 Combined
Peak discharge (cfs)	231	34	262
Time (min)	Discharge (cfs)	Discharge (cfs)	Discharge (cfs)
0	0	0	0
1	2	0	2
2	5	0	5
3	9	0	9
4	14	0	14
5	20	0	20
6	27	0	27
7	34	0	34
8	41	0	41
9	49	0	49
10	56	0	57
11	66	1	67
12	76	1	77
13	85	2	87
14	95	3	98
15	105	4	109
16	116	4	121
17	128	6	134
18	141	10	151
19	156	14	170
20	171	18	189
21	185	21	206
22	199	24	224
23	211	27	238
24	221	30	251
25	231	31	262
26	224	33	256
27	217	34	250
28	209	34	243
29	201	34	236
30	193	34	228
31	186	34	220
32	178	33	211
33	171	32	203
34	163	32	195
35	156	31	187
36	149	30	179
37	142	29	171
38	136	28	164
39	131	27	158
40	125	26	151
41	120	25	144
42	114	24	137
43	108	23	131
44	103	22	125
45	98	21	118
46	93	20	113
47	88	19	107
48	83	18	101
49	79	18	96
50	74	17	91
51	70	16	86
52	67	15	82
53	63	15	78
54	59	14	73
55	55	14	69
56	52	13	65
57	50	12	62
58	47	12	59
59	44	12	55
60	41	11	52

Appendix C. Hydraulics

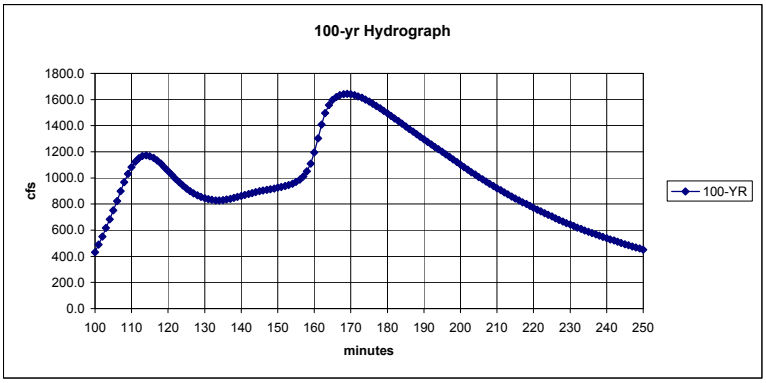
Lomas de Oro Wash
HEC-HMS hydrology

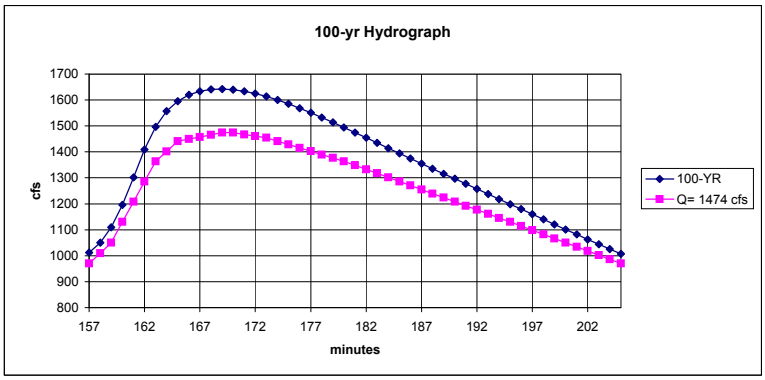
Concentration Point	CP-2	
Return Period	100-Yr	1642 cfs
100-yr discharge (cfs)	1642	
Rise Time =	169	(min)

0

Target discharge (10% less)	1478
Computed discharge (cfs)	1474
Discharge to basin (cfs)	168
Volume to Basin (cf)	306028
Volume to Basin (af)	7.025

Time (min)	Channel Discharge (cfs)	Side discharge to basin (cfs)	Incremental Volume (cf)	Cumulative Volume (cf)
157	1012	42	0	0
158	1050	51	2790	2790
159	1110	60	3315	6105
160	1196	66	3759	9864
161	1302	94	4803	14667
162	1409	123	6519	21186
163	1496	132	7656	28842
164	1557	144	8286	37128
165	1596	155	8964	46092
166	1620	158	9389	55481
167	1634	162	9592	65073
168	1641	165	9794	74867
169	1642	168	9997	84864
170	1640	166	10020	94884
171	1634	164	9886	104770
172	1625	162	9773	114542
173	1613	160	9660	124202
174	1600	159	9569	133771
175	1585	154	9390	143161
176	1568	149	9101	152261
177	1551	144	8812	161073
178	1532	140	8523	169595
179	1513	135	8234	177829
180	1494	130	7945	185773
181	1474	126	7671	193444
182	1454	121	7413	200857
183	1434	117	7155	208012
184	1415	113	6897	214909
185	1395	109	6639	221548
186	1375	104	6389	227937
187	1355	100	6146	234083
188	1335	96	5904	239987
189	1316	92	5662	245649
190	1296	88	5419	251068
191	1277	84	5181	256249
192	1257	80	4947	261196
193	1238	77	4713	265909
194	1218	73	4479	270388
195	1199	69	4245	274633
196	1179	65	4024	278657
197	1160	62	3815	282472
198	1140	58	3606	286078
199	1121	55	3397	289475
200	1101	51	3188	292663
201	1082	49	3002	295665
202	1063	46	2837	298502
203	1044	43	2673	301175
204	1026	40	2509	303684
205	1008	38	2344	306028





OFFSITE DRAINAGE ANALYSIS FOR:
LA CHOLLA AND LAMBERT SEC

A PROPOSED SUBDIVISION LOCATED IN THE NORTHWEST 1/4 OF SECTION 15, T-12-S, R-13-E, G.&S.R.M., ORO VALLEY, ARIZONA

Prepared for:

Future Arizona Inc.
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May 2015



Expires 3/31/2018

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

2 Existing Conditions FLO-2D Models

2.1 Overview

The existing conditions model prepared for this project has a 20-foot grid and utilizes PAG elevation data provided by the WLB Group. The 100-year 3-hour and 24-hour storms were modeled, however only the 3-hour storm is provided with this report.

2.2 Model Methodology

The procedure followed to develop the project FLO-2D model has been utilized by JE Fuller in a number of similar projects. The project FLO-2D model domain was developed to account for the incoming watershed, the project itself, and a short distance downstream of the project. A total of 238,199 grid elements were modeled, covering 3.4 square miles.

2.2.1 Elevations

Elevations for the project model were obtained from PAG elevation data provided by the WLB Group.

2.2.2 Rainfall

Rainfall was modeled using upper 90% NOAA [1] data. The rainfall depths are spatially distributed over the study area by sampling from NOAA provided rainfall raster data. The 100-year, 3-hour depth varies from 3.18 to 3.40 inches over the watershed. A uniform depth of 4.6 inches was identified for the 24-hour storm.

The 3-hour rainfall distribution is a SCS Type II distribution described in Pima County Tech Policy TECH-018, Acceptable Model Parameterization for Determining Peak Discharges. The 24-hour distribution is a SCS Type I distribution.

2.2.3 Infiltration

Infiltration was modeled using the Pima County SCS methodology within the FLO-2D model. This procedure requires three shape file layers to compute the Curve Number:

- Impervious cover, with values in the range of 0<IMP<1.0. Impervious cover was defined within a shape file with these parameters:
    - Bare Earth: Imp=0.10.
    - Residential Areas: Imp=0.30 (assuming an average of 2 houses per acre).
    - Streets: Imp=0.95.
- Land cover with cover density in the range of 0<CD<1.0. Land cover was defined within a shape file with these parameters:
    - Golf Courses: Urban Lawn with 60% cover density.
    - All other areas: Desert Brush with 20 % cover density.
- Soils type. Soils data was obtained from Pima County via their shape file "

Curve numbers are computed for each grid element based upon soil type, vegetation type, vegetation cover density, and impervious cover percentage. Curve numbers vary from less than 78 in golf course areas to nearly 98 along road surfaces. These parameters are summarized within Figure 3.

2.2.4 Roughness

The Floodplain Manning's Roughness values were defined spatially with a shape file by identifying areas with similar characteristics as follows:

- Streets. N=0.020.
- Bare desert and/or undeveloped land. N=0.045.
- Drainage ways through development. N=0.045.
- Golf courses. N=0.030.
- Residential development. N=0.085.
- Upper slopes (steep slopes in upper watershed, north of Tortolita Mountain Ci. N=0.065.

By default, FLO-2D will address the roughness of the watershed using multiple parameters. The first is the floodplain roughness value (described above) which is applied to flow depths of 3.0 feet or more. The second parameter is the shallow roughness value, which is applied to depths of 0.5 feet or less. Roughness values in-between 0.5 and 3.0 feet are adjusted up from the roughness value with depths of 0.5 feet having a roughness value of approximately 1.4 times the defined value. This last parameter is called the Depth Varied Roughness. These parameters can be turned off and the model will apply the Floodplain Roughness Value to all flow depths.

It has been found in recent models that turning off the Depth Varied Roughness and the Shallow Roughness parameters leads to an increase in flow velocities, short times to peak, and ultimately higher discharges. Both approaches were followed for this project and it was found that turning off these two parameters generated the most conservative discharges, increasing them 15-20 percent versus using the standard procedures. The model provided with this report has the Shallow and Depth Varied Roughness Parameters turned off.

2.3 Special Considerations

The upstream watershed contains a number of culvert crossings. Unless culverts are placed into the model, water artificially ponds behind road crossings and excess attenuation occurs. The purpose of this study was to identify peak discharges at the project boundary, therefore it is not feasible to accurately define each of these crossings. Two methods exist to account for this issue. The first is to simply redefine the grid elevations so that flow crosses the road. The second is to define an assumed culvert crossing at these locations. This latter method was used and two generic rating tables were constructed in HY-8. One is a 10 foot wide by 6 foot high box, the other is a 20 foot wide by 6 foot high box. These sizes are typically larger than the actual culvert that is in the ground and therefore this is a conservative approach in regards to underestimating attenuation.

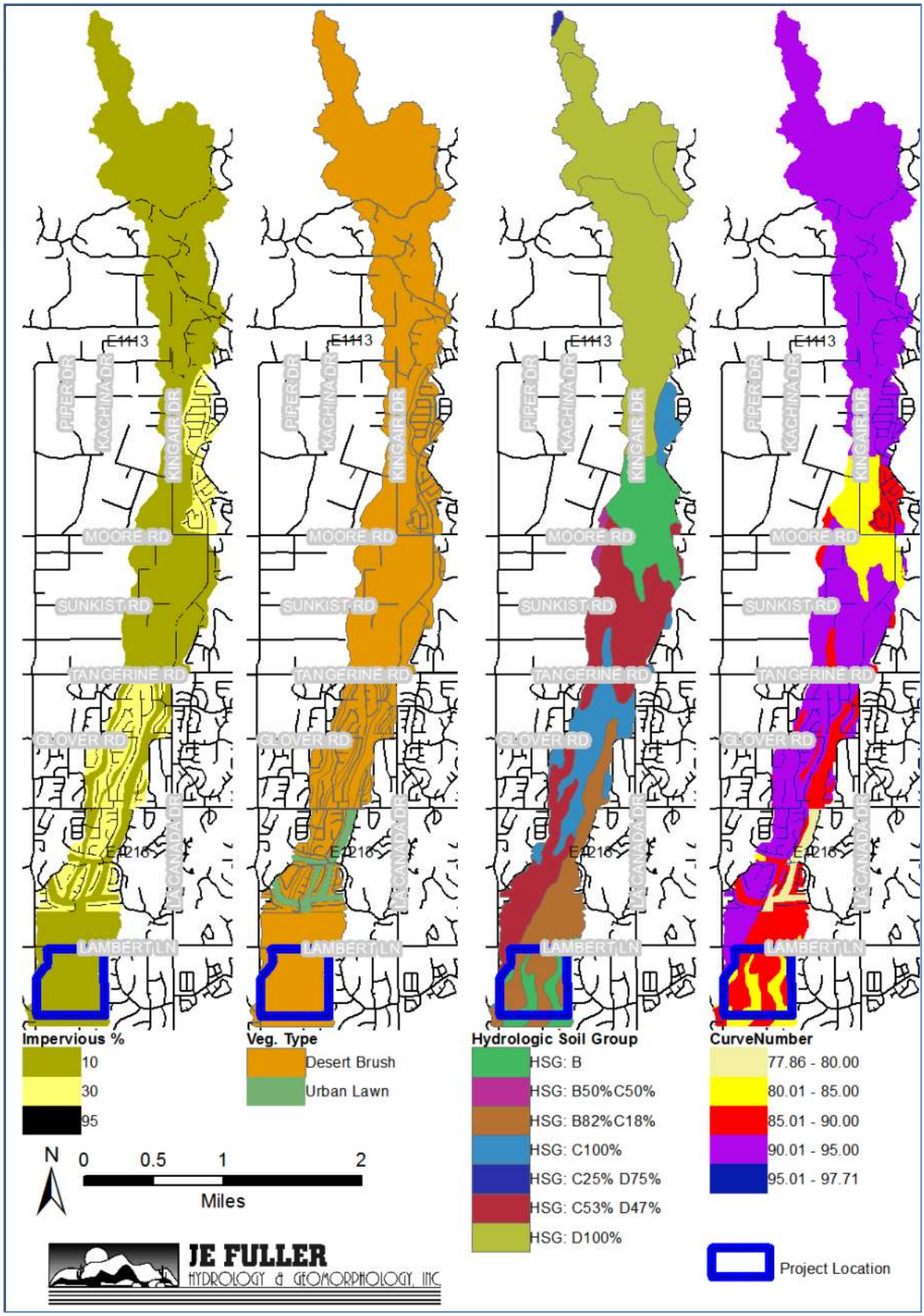


Figure 3. Landuse and Curve Number Overview.

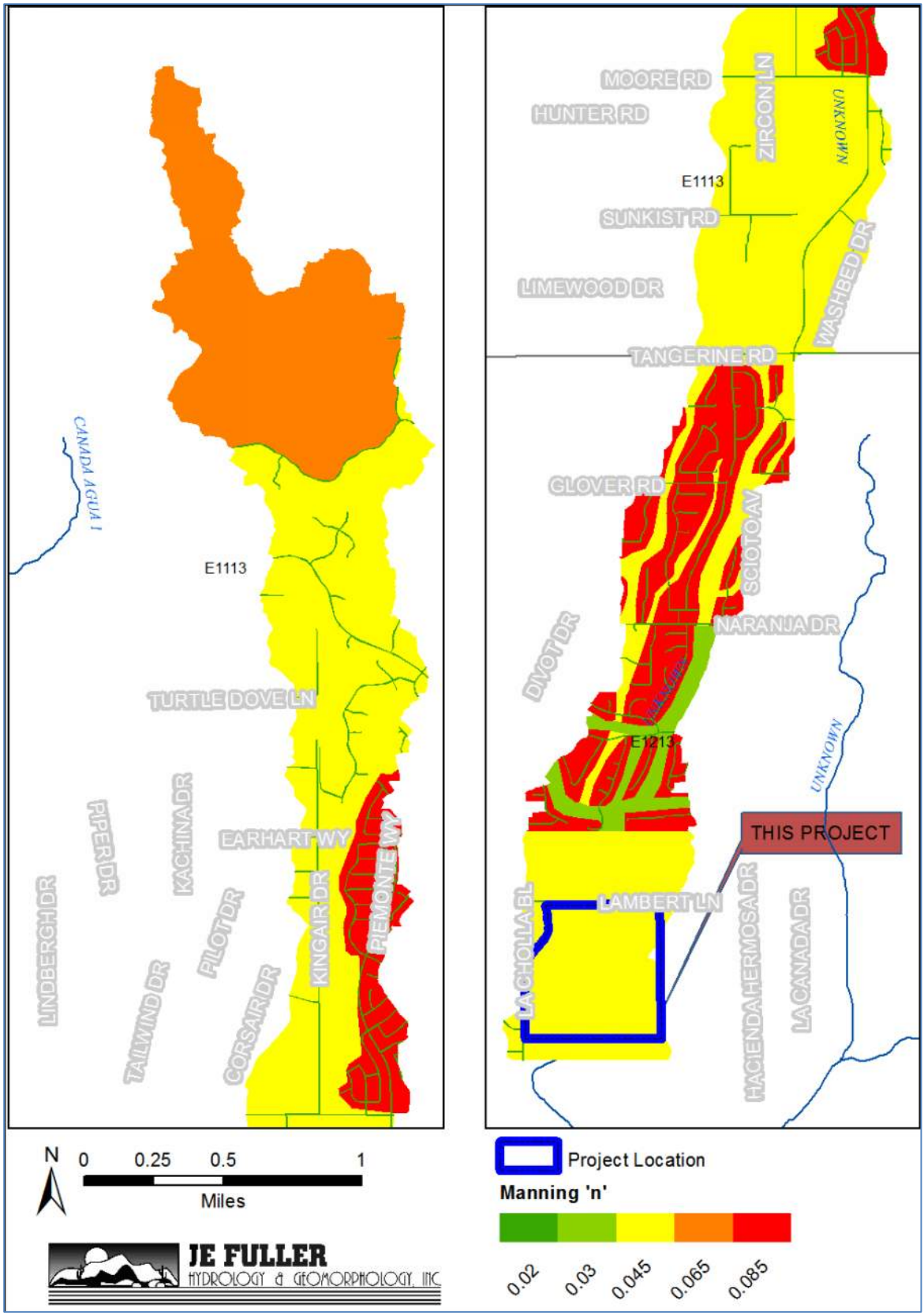


Figure 4. Manning's roughness.

PROJECT NAME: Fasseas
PROJECT DETAIL: 50-ft ROW roadway

Q100: 50
Minimum slope = 0.94% Minimum slope for maximum discharge

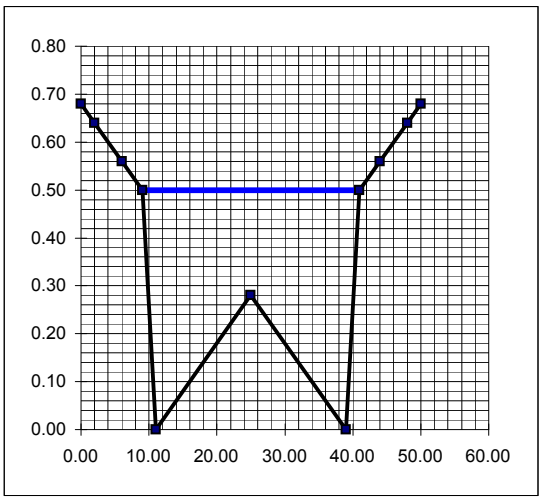
MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient



SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.

NUMBER OF POINTS IN SECTION = 11.00
ASSUMED WSEL= 0.50
BED OR ENERGY SLOPE (FT/FT) = 0.0094

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.00	0.68	0.0
2	2.00	0.64	0.0
3	6.00	0.56	0.0
4	9.00	0.50	0.0
5	11.00	0.00	0.5
6	25.00	0.28	0.2
7	39.00	0.00	0.5
8	41.00	0.50	0.0
9	44.00	0.56	0.0
10	48.00	0.64	0.0
11	50.00	0.68	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0250	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	2.00	0.50	2.06	0.24	4.31	2.2
0.0160	14.00	5.04	14.00	0.36	4.56	23.0
0.0160	14.00	5.04	14.00	0.36	4.56	23.0
0.0130	2.00	0.50	2.06	0.24	4.31	2.2
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.1300	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0

VALUES FOR TOTAL SECTION =	32	11	32	0.3	4.5	50

F = 1.4

PROJECT NAME: Fasseas
PROJECT DETAIL: 50-ft ROW roadway
Cross-slope section

Q100: 57 Maximum discharge for specified slope
4.00% slope

MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

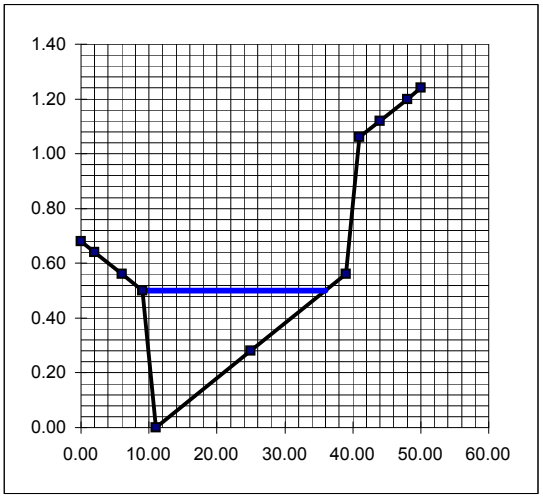
Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient

SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.



NUMBER OF POINTS IN SECTION = 11.00
ASSUMED WSEL= 0.50
BED OR ENERGY SLOPE (FT/FT) = 0.0400

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.00	0.68	0.0
2	2.00	0.64	0.0
3	6.00	0.56	0.0
4	9.00	0.50	0.0
5	11.00	0.00	0.5
6	25.00	0.28	0.2
7	39.00	0.56	0.0
8	41.00	1.06	0.0
9	44.00	1.12	0.0
10	48.00	1.20	0.0
11	50.00	1.24	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0250	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	2.00	0.50	2.06	0.24	8.89	4.4
0.0160	14.00	5.04	14.00	0.36	9.40	47.4
0.0160	11.00	1.21	11.00	0.11	4.26	5.2
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.1300	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0

VALUES FOR TOTAL SECTION =	27	7	27	0.2	8.4	57

F = 3.0

PROJECT NAME: Fasseas
PROJECT DETAIL: 50-ft ROW roadway
Cross-slope section

Q100:	49	Maximum discharge for specified slope
	3.00%	slope

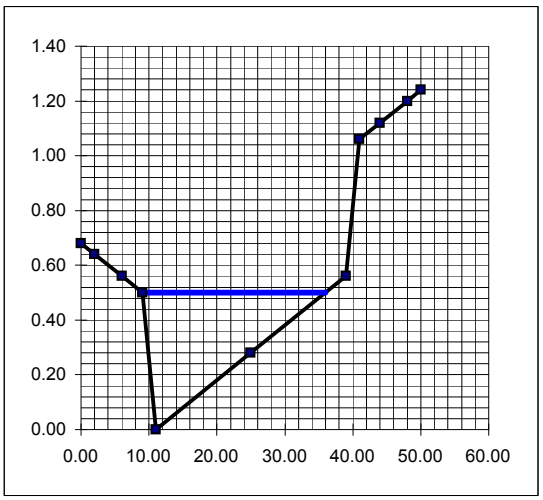
MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient



SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.

NUMBER OF POINTS IN SECTION =	11.00
ASSUMED WSEL=	0.50
BED OR ENERGY SLOPE (FT/FT) =	0.0300

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.00	0.68	0.0
2	2.00	0.64	0.0
3	6.00	0.56	0.0
4	9.00	0.50	0.0
5	11.00	0.00	0.5
6	25.00	0.28	0.2
7	39.00	0.56	0.0
8	41.00	1.06	0.0
9	44.00	1.12	0.0
10	48.00	1.20	0.0
11	50.00	1.24	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0250	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	2.00	0.50	2.06	0.24	7.70	3.8
0.0160	14.00	5.04	14.00	0.36	8.14	41.0
0.0160	11.00	1.21	11.00	0.11	3.69	4.5
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.1300	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0

VALUES FOR TOTAL SECTION =	27	7	27	0.2	7.3	49

F = 2.6

PROJECT NAME: Fasseas
PROJECT DETAIL: 50-ft ROW roadway
Cross-slope section

Q100: 45 Maximum discharge for specified slope
2.50% slope

MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

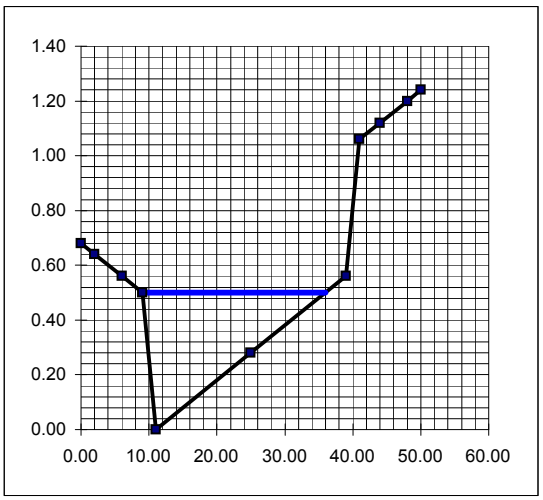
Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient

SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.



NUMBER OF POINTS IN SECTION = 11.00
ASSUMED WSEL= 0.50
BED OR ENERGY SLOPE (FT/FT) = 0.0250

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.00	0.68	0.0
2	2.00	0.64	0.0
3	6.00	0.56	0.0
4	9.00	0.50	0.0
5	11.00	0.00	0.5
6	25.00	0.28	0.2
7	39.00	0.56	0.0
8	41.00	1.06	0.0
9	44.00	1.12	0.0
10	48.00	1.20	0.0
11	50.00	1.24	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0250	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	2.00	0.50	2.06	0.24	7.03	3.5
0.0160	14.00	5.04	14.00	0.36	7.43	37.4
0.0160	11.00	1.21	11.00	0.11	3.37	4.1
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.1300	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0

VALUES FOR TOTAL SECTION =	27	7	27	0.2	6.7	45

F = 2.4

PROJECT NAME: Fasseas
PROJECT DETAIL: 50-ft ROW roadway
Cross-slope section

Q100: 40 Maximum discharge for specified slope
2.00% slope

MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

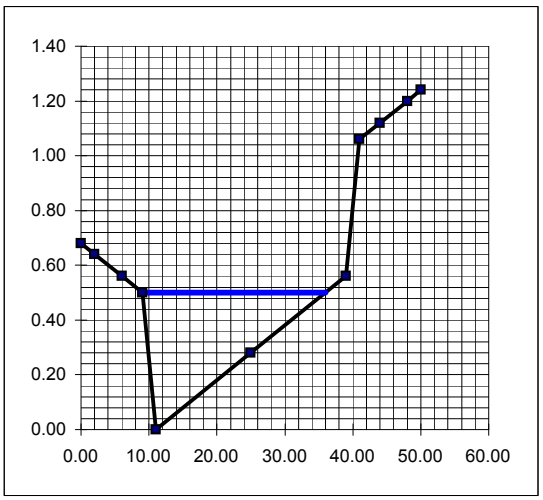
Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient

SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.



NUMBER OF POINTS IN SECTION = 11.00
ASSUMED WSEL= 0.50
BED OR ENERGY SLOPE (FT/FT) = 0.0200

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.00	0.68	0.0
2	2.00	0.64	0.0
3	6.00	0.56	0.0
4	9.00	0.50	0.0
5	11.00	0.00	0.5
6	25.00	0.28	0.2
7	39.00	0.56	0.0
8	41.00	1.06	0.0
9	44.00	1.12	0.0
10	48.00	1.20	0.0
11	50.00	1.24	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0250	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	2.00	0.50	2.06	0.24	6.29	3.1
0.0160	14.00	5.04	14.00	0.36	6.65	33.5
0.0160	11.00	1.21	11.00	0.11	3.01	3.6
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.1300	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0

VALUES FOR TOTAL SECTION =	27	7	27	0.2	6.0	40

F = 2.1

PROJECT NAME: Fasseas
PROJECT DETAIL: 50-ft ROW roadway
Cross-slope section

Q100:	36	Maximum discharge for specified slope
	1.60%	slope

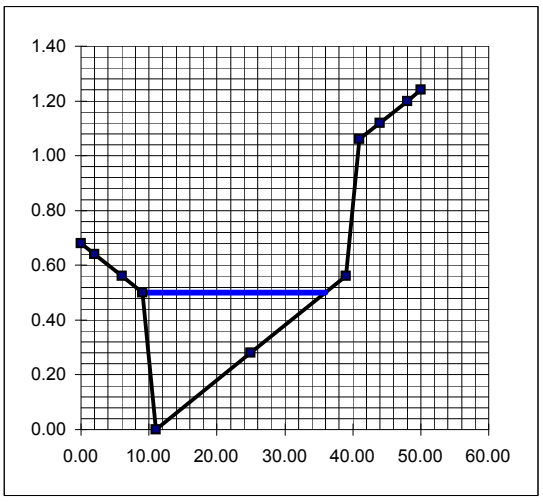
MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient



SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.

NUMBER OF POINTS IN SECTION =	11.00
ASSUMED WSEL=	0.50
BED OR ENERGY SLOPE (FT/FT) =	0.0160

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.00	0.68	0.0
2	2.00	0.64	0.0
3	6.00	0.56	0.0
4	9.00	0.50	0.0
5	11.00	0.00	0.5
6	25.00	0.28	0.2
7	39.00	0.56	0.0
8	41.00	1.06	0.0
9	44.00	1.12	0.0
10	48.00	1.20	0.0
11	50.00	1.24	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0250	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	2.00	0.50	2.06	0.24	5.62	2.8
0.0160	14.00	5.04	14.00	0.36	5.94	30.0
0.0160	11.00	1.21	11.00	0.11	2.70	3.3
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.1300	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0

VALUES FOR TOTAL SECTION =	27	7	27	0.2	5.3	36

F = 1.9

PROJECT NAME: Fasseas
PROJECT DETAIL: 50-ft ROW roadway
Cross-slope section

Q100: 23 Maximum discharge for specified slope
0.64% slope

MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

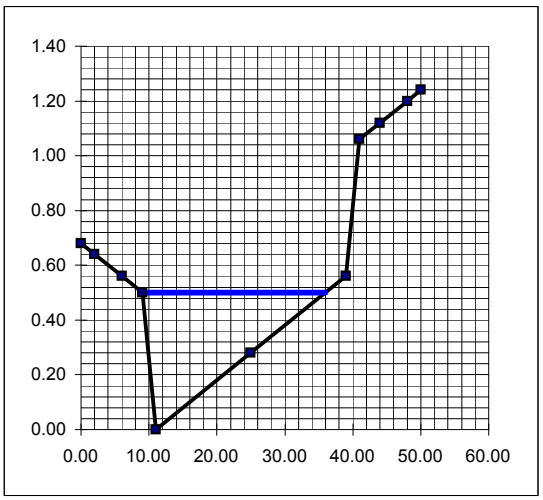
Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient

SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.



NUMBER OF POINTS IN SECTION = 11.00
ASSUMED WSEL= 0.50
BED OR ENERGY SLOPE (FT/FT) = 0.0064

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.00	0.68	0.0
2	2.00	0.64	0.0
3	6.00	0.56	0.0
4	9.00	0.50	0.0
5	11.00	0.00	0.5
6	25.00	0.28	0.2
7	39.00	0.56	0.0
8	41.00	1.06	0.0
9	44.00	1.12	0.0
10	48.00	1.20	0.0
11	50.00	1.24	0.0

SEGMENT DATA

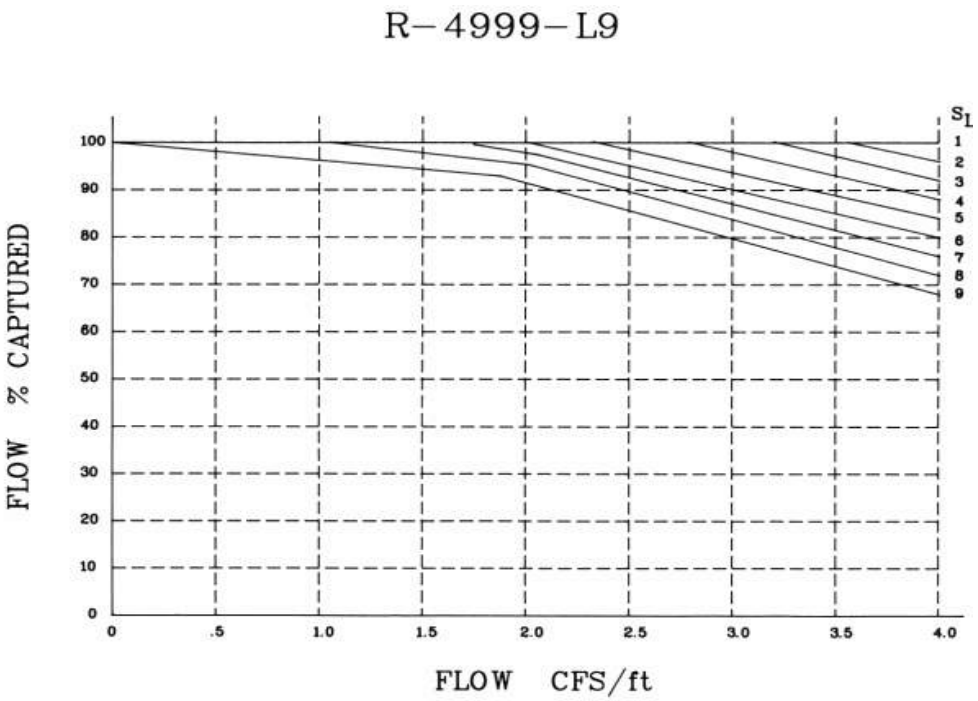
Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0250	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	2.00	0.50	2.06	0.24	3.56	1.8
0.0160	14.00	5.04	14.00	0.36	3.76	18.9
0.0160	11.00	1.21	11.00	0.11	1.71	2.1
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.1300	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0

VALUES FOR TOTAL SECTION =	27	7	27	0.2	3.4	23

F = 1.2

Grate Inlet Capacity for Neenah Grate

Project: Sundara



Location	Q100 (cfs)	Linear feet provided (ft)	Required capacity (cfs/ft)	For 100% interception Maximum slope (%)	Curb bypass flow Q100 (cfs)
D2.1	46	28	1.6	7.4%	1.9
D2.5	19	28	0.7	6.3%	0.8
D3	47	28	1.7	6.6%	1.9
D3.5	10	28	0.4	8.8%	0.4
D4	45	28	1.6	6.6%	1.8
D5	35	28	1.3	7.7%	1.4

PROJECT NAME: Sundara
PROJECT DETAIL: 50-ft ROW roadway
1% cross-slope section at grate

D2.1 Q100: 46 Maximum discharge for specified slope
3.46% slope
1.9 bypass flow at grate

MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

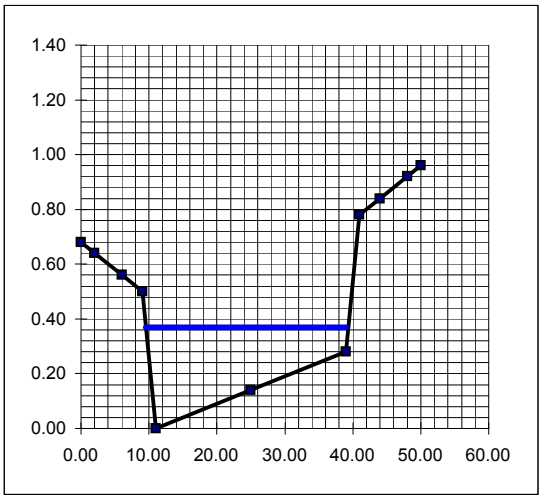
Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient

SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.



NUMBER OF POINTS IN SECTION = 11.00
ASSUMED WSEL= 0.37
BED OR ENERGY SLOPE (FT/FT) = 0.0346

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.00	0.68	0.0
2	2.00	0.64	0.0
3	6.00	0.56	0.0
4	9.00	0.50	0.0
5	11.00	0.00	0.4
6	25.00	0.14	0.2
7	39.00	0.28	0.1
8	41.00	0.78	0.0
9	44.00	0.84	0.0
10	48.00	0.92	0.0
11	50.00	0.96	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0250	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	1.48	0.27	1.53	0.18	6.77	1.9
0.0160	14.00	4.20	14.00	0.30	7.74	32.5
0.0160	14.00	2.24	14.00	0.16	5.09	11.4
0.0130	0.36	0.02	0.37	0.04	2.64	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.1300	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0

VALUES FOR TOTAL SECTION =	30	7	30	0.2	6.8	46

F = 2.5

PROJECT NAME: Sundara
PROJECT DETAIL: 50-ft ROW roadway
1% cross-slope section at grate

D2.5	**Q100:**	**19**	Maximum discharge for specified slope
		2.22%	slope
		0.8	bypass flow at grate

MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

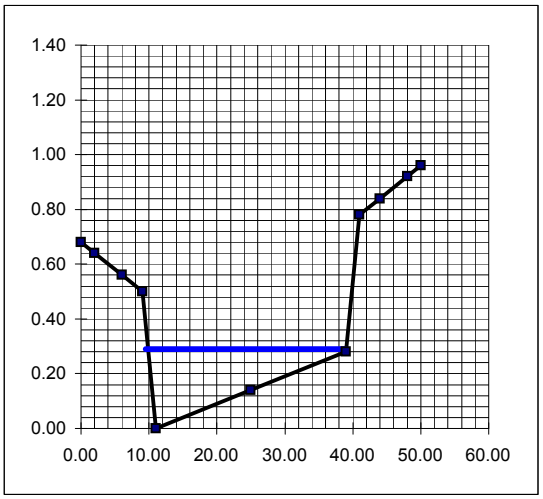
Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient

SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.



NUMBER OF POINTS IN SECTION =	11.00
ASSUMED WSEL=	0.29
BED OR ENERGY SLOPE (FT/FT) =	0.0222

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.00	0.68	0.0
2	2.00	0.64	0.0
3	6.00	0.56	0.0
4	9.00	0.50	0.0
5	11.00	0.00	0.3
6	25.00	0.14	0.2
7	39.00	0.28	0.0
8	41.00	0.78	0.0
9	44.00	0.84	0.0
10	48.00	0.92	0.0
11	50.00	0.96	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0250	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	1.16	0.17	1.20	0.14	4.61	0.8
0.0160	14.00	3.08	14.00	0.22	5.04	15.5
0.0160	14.00	1.12	14.00	0.08	2.57	2.9
0.0130	0.04	0.00	0.04	0.00	0.49	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.1300	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0

VALUES FOR TOTAL SECTION =	29	4	29	0.1	4.4	19

F = 2.0

PROJECT NAME: Sundara
PROJECT DETAIL: 50-ft ROW roadway
1% cross-slope section at grate

D3	**Q100:**	**47**	Maximum discharge for specified slope
		4.12%	slope
		1.9	bypass flow at grate

MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

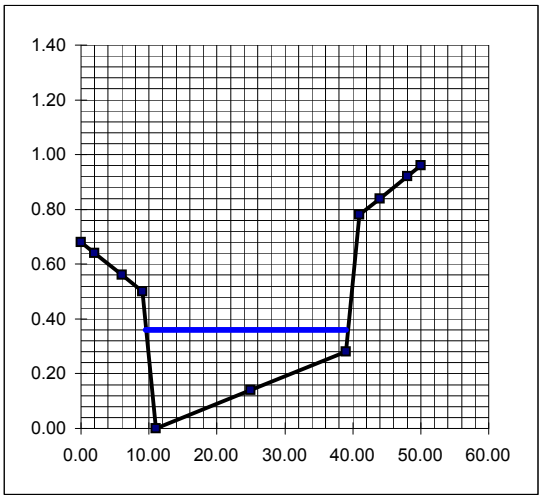
Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient

SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.



NUMBER OF POINTS IN SECTION =	11.00
ASSUMED WSEL=	0.36
BED OR ENERGY SLOPE (FT/FT) =	0.0412

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.00	0.68	0.0
2	2.00	0.64	0.0
3	6.00	0.56	0.0
4	9.00	0.50	0.0
5	11.00	0.00	0.4
6	25.00	0.14	0.2
7	39.00	0.28	0.1
8	41.00	0.78	0.0
9	44.00	0.84	0.0
10	48.00	0.92	0.0
11	50.00	0.96	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0250	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	1.44	0.26	1.48	0.17	7.25	1.9
0.0160	14.00	4.06	14.00	0.29	8.26	33.5
0.0160	14.00	2.10	14.00	0.15	5.32	11.2
0.0130	0.32	0.01	0.33	0.04	2.66	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.1300	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0

VALUES FOR TOTAL SECTION =	30	6	30	0.2	7.2	47

F = 2.7

PROJECT NAME: Sundara
PROJECT DETAIL: 50-ft ROW roadway
1% cross-slope section at grate

D3.5	**Q100:**	**10**	Maximum discharge for specified slope
		3.82%	slope
		0.4	bypass flow at grate

MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

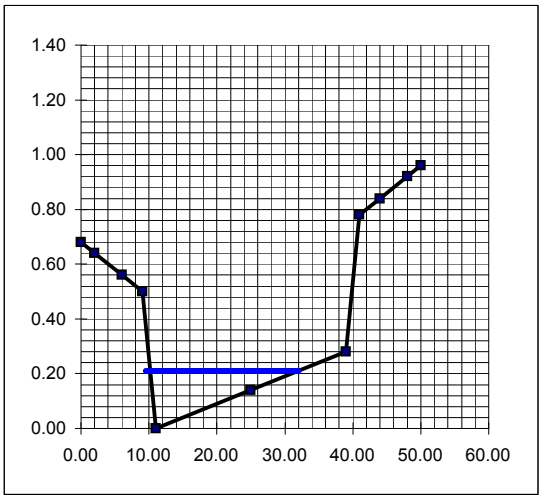
Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient

SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.



NUMBER OF POINTS IN SECTION = 11.00
ASSUMED WSEL= 0.21
BED OR ENERGY SLOPE (FT/FT) = 0.0382

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.00	0.68	0.0
2	2.00	0.64	0.0
3	6.00	0.56	0.0
4	9.00	0.50	0.0
5	11.00	0.00	0.2
6	25.00	0.14	0.1
7	39.00	0.28	0.0
8	41.00	0.78	0.0
9	44.00	0.84	0.0
10	48.00	0.92	0.0
11	50.00	0.96	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0250	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	0.84	0.09	0.87	0.10	4.87	0.4
0.0160	14.00	1.96	14.00	0.14	4.89	9.6
0.0160	7.00	0.25	7.00	0.03	1.94	0.5
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.1300	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0

VALUES FOR TOTAL SECTION =	22	2	22	0.1	4.6	10

F = 2.5

PROJECT NAME: Sundara
PROJECT DETAIL: 50-ft ROW roadway
1% cross-slope section at grate

D4	**Q100:**	**45**	Maximum discharge for specified slope
		4.25%	slope
		1.8	bypass flow at grate

MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

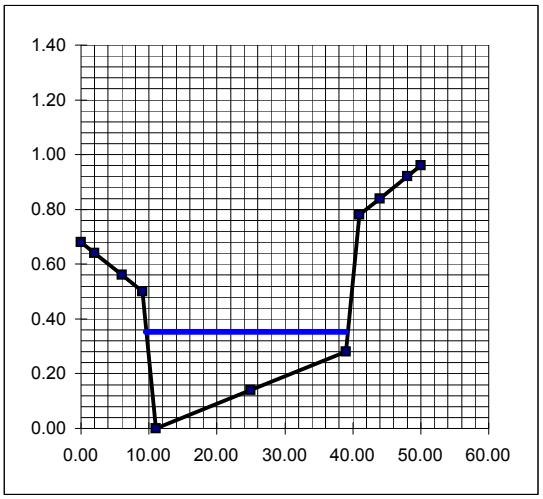
Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient

SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.



NUMBER OF POINTS IN SECTION = 11.00
ASSUMED WSEL= 0.35
BED OR ENERGY SLOPE (FT/FT) = 0.0425

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.00	0.68	0.0
2	2.00	0.64	0.0
3	6.00	0.56	0.0
4	9.00	0.50	0.0
5	11.00	0.00	0.4
6	25.00	0.14	0.2
7	39.00	0.28	0.1
8	41.00	0.78	0.0
9	44.00	0.84	0.0
10	48.00	0.92	0.0
11	50.00	0.96	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0250	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	1.41	0.25	1.45	0.17	7.25	1.8
0.0160	14.00	3.95	14.00	0.28	8.23	32.5
0.0160	14.00	1.99	14.00	0.14	5.21	10.4
0.0130	0.29	0.01	0.30	0.03	2.52	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.1300	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0

VALUES FOR TOTAL SECTION =	30	6	30	0.2	7.2	45

F = 2.8

PROJECT NAME: Sundara
PROJECT DETAIL: 50-ft ROW roadway
1% cross-slope section at grate

D5	**Q100:**	**37**	Maximum discharge for specified slope
		1.59%	slope
		1.6	bypass flow at grate

MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

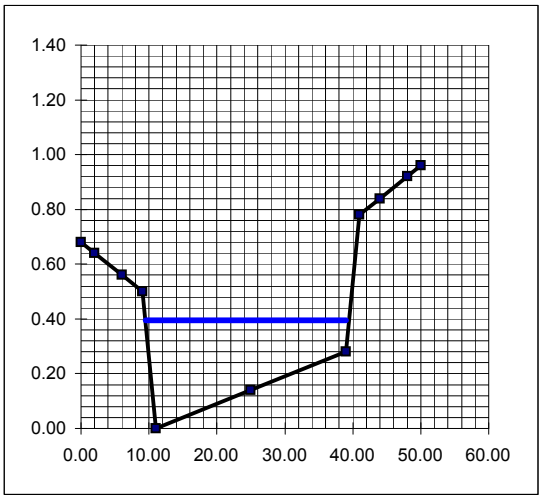
Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient

SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.



NUMBER OF POINTS IN SECTION = 11.00
ASSUMED WSEL= 0.40
BED OR ENERGY SLOPE (FT/FT) = 0.0159

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.00	0.68	0.0
2	2.00	0.64	0.0
3	6.00	0.56	0.0
4	9.00	0.50	0.0
5	11.00	0.00	0.4
6	25.00	0.14	0.3
7	39.00	0.28	0.1
8	41.00	0.78	0.0
9	44.00	0.84	0.0
10	48.00	0.92	0.0
11	50.00	0.96	0.0

SEGMENT DATA

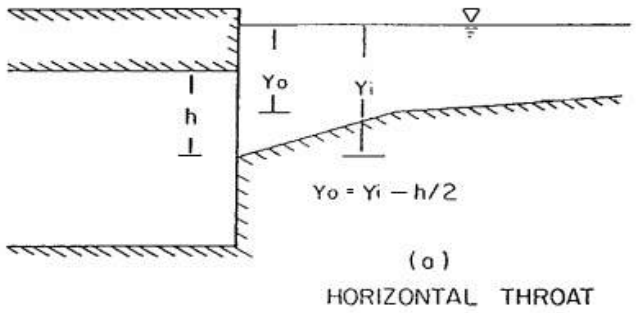
Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	0.00	0.00	0.00	0.00	0.00	0.0
0.0250	0.00	0.00	0.00	0.00	0.00	0.0
0.0130	1.58	0.31	1.63	0.19	4.79	1.5
0.0160	14.00	4.55	14.00	0.32	5.54	25.2
0.0160	14.00	2.59	14.00	0.18	3.80	9.8
0.0130	0.46	0.03	0.47	0.06	2.10	0.1
0.0220	0.00	0.00	0.00	0.00	0.00	0.0
0.1300	0.00	0.00	0.00	0.00	0.00	0.0
0.0220	0.00	0.00	0.00	0.00	0.00	0.0

VALUES FOR TOTAL SECTION =	30	7	30	0.2	4.9	37

F = 1.7

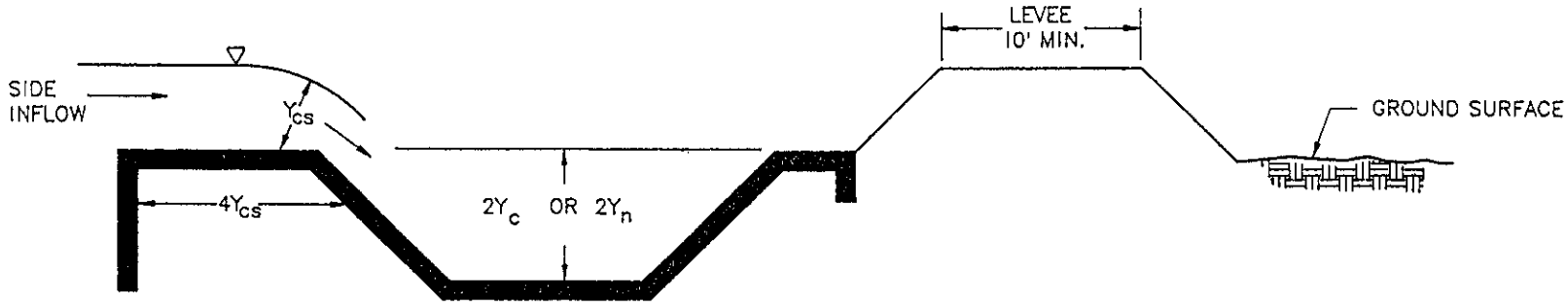
Calculations for depressed scuppers operating as an orifice
Project: Sundara

*Q = 5.35*A(Yi -h/2)^0.5* Eqn. 10.16a City of Tucson manual
Yi = height of opening + scupper thickness (t) See Figure 10.13 (a)
t= 0.33 for Type 3 scuppers



Minimum required design = 10-year with 50% clogging factor
Proposed design = 100-year with no clogging factor

Scupper Conc. Pt.	Q_{100} (cfs)	Bypass flow from from upstream vane grate		Design Q_{100} (cfs)	Opening height (h) (ft)	Scupper thickness (t) (ft)	Yi (ft)	Minimum width (L) (ft)
		CP	Q (cfs)					
D2	36	D2.1+D2.5	2.7	38.7	0.67	0.33	1	13
D2.65	8	n/a		8	0.67	0.33	1	3
D6	26	D4+D5	3.2	29.2	0.67	0.33	1	10
D7	29	D3	1.9	30.9	0.67	0.33	1	11
N2.4	2	reverse scupper		2	0.67	0.33	1	1
N5	26	reverse scupper		26	0.67	0.33	1	9
D2.7	3	reverse scupper		3	0.67	0.33	1	1
D3.3	3.6	reverse scupper		3.6	0.67	0.33	1	1
D4.1	6	reverse scupper		6	0.67	0.33	1	2



Y_{cs} = CRITICAL DEPTH OF SIDE FLOW

Y_c = CRITICAL DEPTH OF CHANNEL FLOW

Y_n = NORMAL DEPTH OF CHANNEL FLOW

NOTE:
A PROPERLY DESIGNED LEVEE OF HEIGHT Y_{cc} OR Y_{nc} CAN BE CONSTRUCTED ALONG THE BANK OPPOSITE THE SIDE INFLOW IN LIEU OF THE $2Y_{cc}$ OR $2Y_{nc}$ REQUIREMENT.

FIGURE 8.15
TYPICAL COLLECTOR–CHANNEL CROSS SECTION

PROJECT NAME: Fasseas
PROJECT DETAIL: Collector channel

Conc. Pt.: N1
Q100: 33
Minimum slope = 0.5%

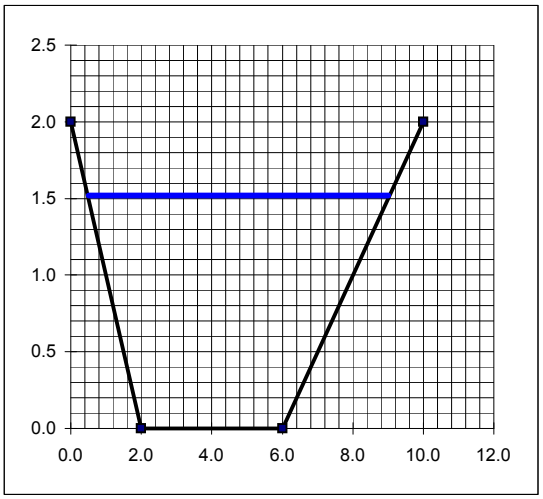
MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient



SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.

NUMBER OF POINTS IN SECTION =	4.00		
ASSUMED WSEL=	1.5		
BED OR ENERGY SLOPE (FT/FT) =	0.005	minimum	
Design Flow Depth	3.0	(ft)	
Left Side slope (H:V)	1.0	(ft)	grouted riprap
Right Side slope (H:V)	2.0	(ft)	grouted riprap
Design Channel bottom width	4.0	(ft)	grouted riprap
Design Channel Topwidth	13.1	(ft)	

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.0	2.0	0.0
2	2.0	0.0	1.5
3	6.0	0.0	1.5
4	10.0	2.0	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0360	1.52	1.16	2.15	0.54	1.93	2.2
0.0360	4.00	6.08	4.00	1.52	3.86	23.5
0.0250	3.04	2.31	3.40	0.68	3.25	7.5
VALUES FOR TOTAL SECTION =	9	10	10	1.0	3.5	33

F = 0.6

PROJECT NAME: Fasseas
PROJECT DETAIL: Collector channel

Conc. Pt.: N2
Q100: 24
Minimum slope = 0.5%

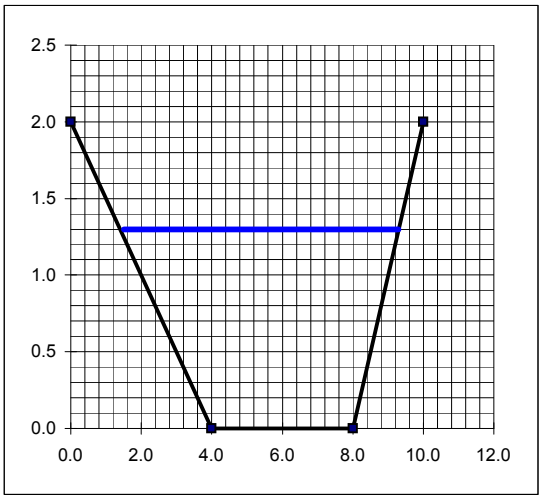
MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient



SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.

NUMBER OF POINTS IN SECTION =	4.00		
ASSUMED WSEL=	1.3		
BED OR ENERGY SLOPE (FT/FT) =	0.005	minimum	
Design Flow Depth	2.6	(ft)	
Left Side slope (H:V)	2.0	(ft)	grouted riprap
Right Side slope (H:V)	1.0	(ft)	grouted riprap
Design Channel bottom width	4.0	(ft)	grouted riprap
Design Channel Topwidth	11.8	(ft)	

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.0	2.0	0.0
2	4.0	0.0	1.3
3	8.0	0.0	1.3
4	10.0	2.0	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0360	2.60	1.69	2.91	0.58	2.03	3.4
0.0360	4.00	5.20	4.00	1.30	3.48	18.1
0.0250	1.30	0.85	1.84	0.46	2.50	2.1
VALUES FOR TOTAL SECTION =	8	8	9	0.9	3.1	24

F = 0.5

PROJECT NAME: Fasseas
PROJECT DETAIL: Collector channel

Conc. Pt.: N3
Q100: 21
Minimum slope = 0.5%

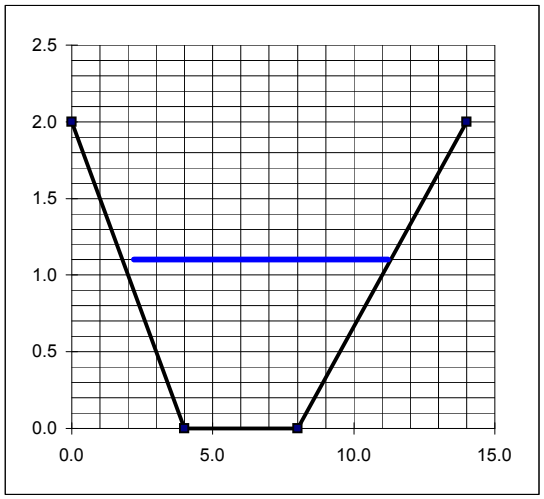
MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient



SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.

NUMBER OF POINTS IN SECTION =	4.00		
ASSUMED WSEL=	1.1		
BED OR ENERGY SLOPE (FT/FT) =	0.005	minimum	
Design Flow Depth	2.2	(ft)	
Left Side slope (H:V)	2.0	(ft)	grouted riprap
Right Side slope (H:V)	3.0	(ft)	grouted riprap
Design Channel bottom width	4.0	(ft)	grouted riprap
Design Channel Topwidth	15.0	(ft)	

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.0	2.0	0.0
2	4.0	0.0	1.1
3	8.0	0.0	1.1
4	14.0	2.0	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0360	2.20	1.21	2.46	0.49	1.82	2.2
0.0360	4.00	4.40	4.00	1.10	3.11	13.7
0.0250	3.30	1.82	3.48	0.52	2.72	4.9
VALUES FOR TOTAL SECTION =	10	7	10	0.7	2.8	21

F = 0.6

PROJECT NAME: Fasseas
PROJECT DETAIL: Collector channel

Conc. Pt.: N4.1
Q100: 13
Minimum slope = 0.5%

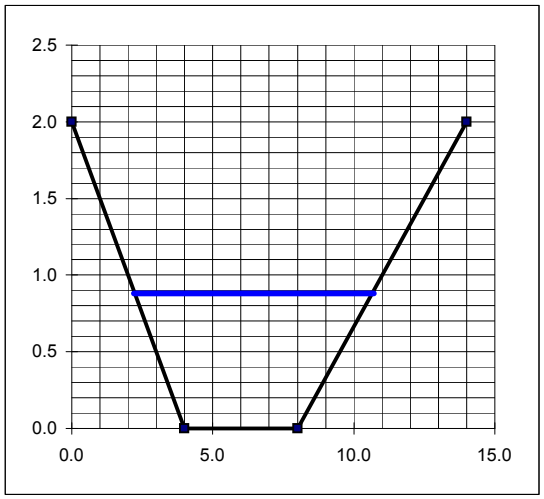
MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient



SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.

NUMBER OF POINTS IN SECTION =	4.00		
ASSUMED WSEL=	0.9		
BED OR ENERGY SLOPE (FT/FT) =	0.005	minimum	
Design Flow Depth	1.8	(ft)	
Left Side slope (H:V)	2.0	(ft)	dumped riprap
Right Side slope (H:V)	3.0	(ft)	earthen
Design Channel bottom width	4.0	(ft)	dumped riprap
Design Channel Topwidth	12.8	(ft)	

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.0	2.0	0.0
2	4.0	0.0	0.9
3	8.0	0.0	0.9
4	14.0	2.0	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0360	1.76	0.77	1.97	0.39	1.57	1.2
0.0360	4.00	3.52	4.00	0.88	2.68	9.4
0.0250	2.64	1.16	2.78	0.42	2.35	2.7
VALUES FOR TOTAL SECTION =	8	5	9	0.6	2.5	13

F = 0.5

PROJECT NAME: Fasseas
PROJECT DETAIL: Collector channel

Conc. Pt.: N4b
Q100: 26
Minimum slope = 0.5%

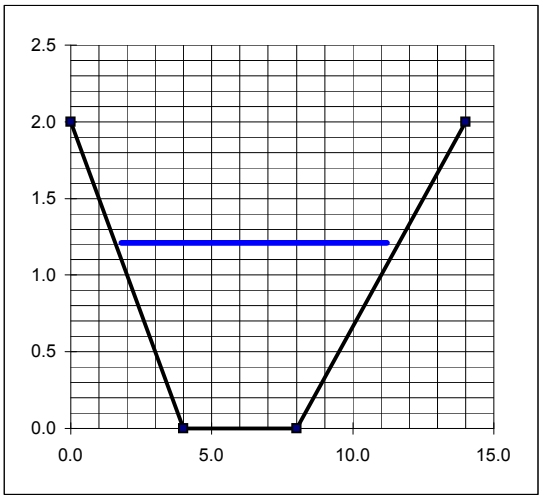
MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient



SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.

NUMBER OF POINTS IN SECTION =	4.00		
ASSUMED WSEL=	1.2		
BED OR ENERGY SLOPE (FT/FT) =	0.005	minimum	
Design Flow Depth	2.4	(ft)	
Left Side slope (H:V)	2.0	(ft)	dumped riprap
Right Side slope (H:V)	3.0	(ft)	earthen
Design Channel bottom width	4.0	(ft)	dumped riprap
Design Channel Topwidth	16.1	(ft)	

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.0	2.0	0.0
2	4.0	0.0	1.2
3	8.0	0.0	1.2
4	14.0	2.0	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0360	2.42	1.46	2.71	0.54	1.96	2.9
0.0360	4.00	4.84	4.00	1.21	3.35	16.2
0.0250	3.63	2.20	3.83	0.57	2.93	6.4
VALUES FOR TOTAL SECTION =	10	9	11	0.8	3.0	26

F = 0.6

PROJECT NAME: Fasseas
PROJECT DETAIL: Collector channel

Conc. Pt.: N5 FSP sheet 27
Q100: 26
Minimum slope = 0.5%

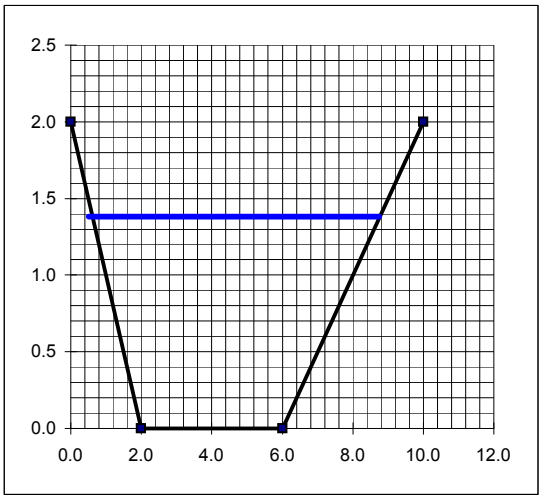
MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient



SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.

NUMBER OF POINTS IN SECTION =	4		
ASSUMED WSEL=	1.4		
BED OR ENERGY SLOPE (FT/FT) =	0.005	minimum	
Design Flow Depth	2.8	(ft)	
Left Side slope (H:V)	1.0	(ft)	grouted riprap
Right Side slope (H:V)	2.0	(ft)	grouted riprap
Design Channel bottom width	4.0	(ft)	grouted riprap
Design Channel Topwidth	12.3	(ft)	

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.0	2.0	0.0
2	2.0	0.0	1.4
3	6.0	0.0	1.4
4	10.0	2.0	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0360	1.38	0.95	1.95	0.49	1.81	1.7
0.0360	4.00	5.52	4.00	1.38	3.62	20.0
0.0360	2.76	1.90	3.09	0.62	2.12	4.0
VALUES FOR TOTAL SECTION =	8	8	9	0.9	3.1	26

F = 0.5

ARROYO ENGINEERING, LLC

PROJECT NAME: Fasseas
PROJECT DETAIL: Collector channel

Conc. Pt.: N5.1
Q100: 24
Minimum slope = 0.5%

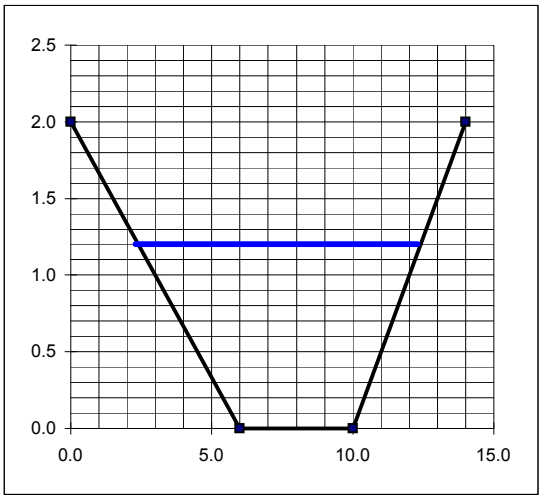
MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient



SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.

NUMBER OF POINTS IN SECTION =	4.00		
ASSUMED WSEL=	1.2		
BED OR ENERGY SLOPE (FT/FT) =	0.005	minimum	
Design Flow Depth	2.4	(ft)	
Left Side slope (H:V)	3.0	(ft)	earthen
Right Side slope (H:V)	2.0	(ft)	dumped riprap
Design Channel bottom width	4.0	(ft)	dumped riprap
Design Channel Topwidth	16.0	(ft)	

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.0	2.0	0.0
2	6.0	0.0	1.2
3	10.0	0.0	1.2
4	14.0	2.0	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0360	3.60	2.16	3.79	0.57	2.00	4.3
0.0360	4.00	4.80	4.00	1.20	3.30	15.8
0.0250	2.40	1.44	2.68	0.54	2.78	4.0
VALUES FOR TOTAL SECTION =	10	8	10	0.8	2.9	24

F = 0.6

ARROYO ENGINEERING, LLC

PROJECT NAME: Fasseas
PROJECT DETAIL: Collector channel

Conc. Pt.: D3.3
Q100: 3.6
Minimum slope = 0.54%

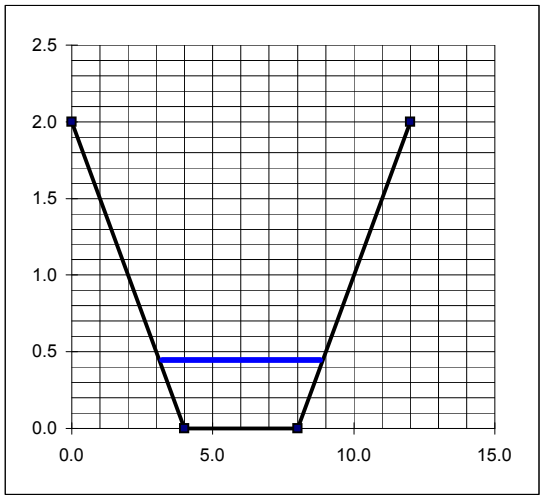
MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient



SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.

NUMBER OF POINTS IN SECTION =	4.00		
ASSUMED WSEL=	0.4		
BED OR ENERGY SLOPE (FT/FT) =	0.005	minimum	
Design Flow Depth	0.9	(ft)	
Left Side slope (H:V)	2.0	(ft)	dumped riprap
Right Side slope (H:V)	2.0	(ft)	dumped riprap
Design Channel bottom width	4.0	(ft)	dumped riprap
Design Channel Topwidth	7.6	(ft)	

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.0	2.0	0.0
2	4.0	0.0	0.4
3	8.0	0.0	0.4
4	12.0	2.0	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0360	0.90	0.20	1.00	0.20	1.04	0.2
0.0360	4.00	1.79	4.00	0.45	1.78	3.2
0.0360	0.90	0.20	1.00	0.20	1.04	0.2
VALUES FOR TOTAL SECTION =	6	2	6	0.4	1.6	3.6

F = 0.5

PROJECT NAME: Fasseas
PROJECT DETAIL: Collector channel

Conc. Pt.: D13
Q100: 1.3
Minimum slope = 1.0%

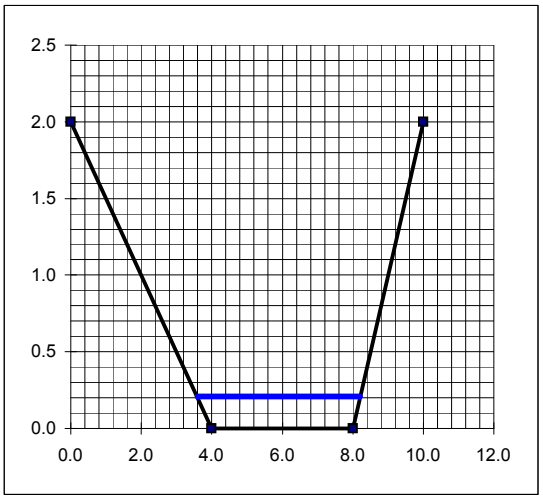
MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient



SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.

NUMBER OF POINTS IN SECTION =	4.00		
ASSUMED WSEL=	0.2		
BED OR ENERGY SLOPE (FT/FT) =	0.010	minimum	
Design Flow Depth	0.4	(ft)	
Left Side slope (H:V)	2.0	(ft)	grouted riprap
Right Side slope (H:V)	1.0	(ft)	grouted riprap
Design Channel bottom width	4.0	(ft)	grouted riprap
Design Channel Topwidth	5.3	(ft)	

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.0	2.0	0.0
2	4.0	0.0	0.2
3	8.0	0.0	0.2
4	10.0	2.0	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0360	0.42	0.04	0.47	0.09	0.85	0.0
0.0360	4.00	0.84	4.00	0.21	1.46	1.2
0.0250	0.21	0.02	0.30	0.07	1.05	0.0
VALUES FOR TOTAL SECTION =	5	1	5	0.2	1.4	1.3

F = 0.6

PROJECT NAME: Fasseas
PROJECT DETAIL: local channels

Conc. Pt.: D12
Q100: 34
Minimum slope = 0.97%

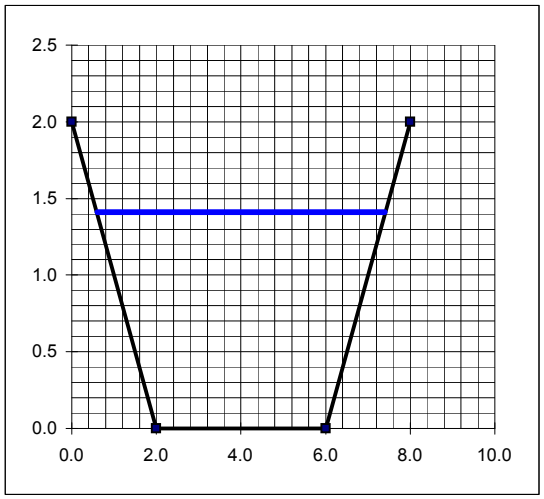
MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient



SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.

NUMBER OF POINTS IN SECTION =	4		
ASSUMED WSEL=	1.4		
BED OR ENERGY SLOPE (FT/FT) =	0.010	minimum	
Freeboard	0.3	(ft)	
Design Flow Depth	1.7	(ft)	
Left Side slope (H:V)	1.0	(ft)	grouted riprap
Right Side slope (H:V)	1.0	(ft)	grouted riprap
Design Channel bottom width	4.0	(ft)	grouted riprap
Design Channel Topwidth	7.4	(ft)	

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.0	2.0	0.0
2	2.0	0.0	1.4
3	6.0	0.0	1.4
4	8.0	2.0	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0360	1.41	0.99	1.99	0.50	2.56	2.5
0.0360	4.00	5.64	4.00	1.41	5.11	28.8
0.0360	1.41	0.99	1.99	0.50	2.56	2.5
VALUES FOR TOTAL SECTION =	7	8	8	1.0	4.4	34

F = 0.7

PROJECT NAME: Fasseas
PROJECT DETAIL: local channels

Conc. Pt.: N2
Q100: 24
Minimum slope = 0.25%

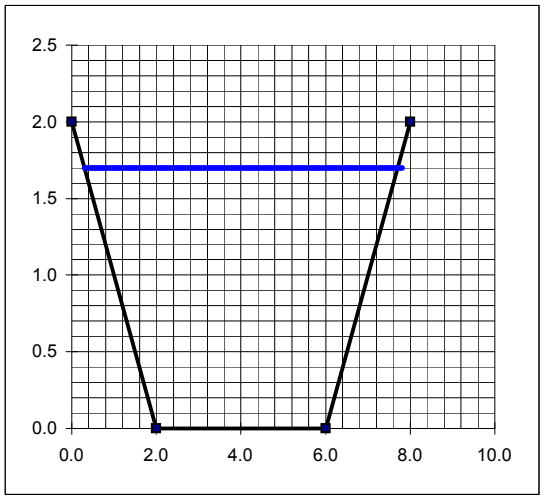
MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient



SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.

NUMBER OF POINTS IN SECTION =	4		
ASSUMED WSEL=	1.7		
BED OR ENERGY SLOPE (FT/FT) =	0.0025	minimum	
Freeboard	0.3	(ft)	
Design Flow Depth	2.0	(ft)	
Left Side slope (H:V)	1.0	(ft)	grouted riprap
Right Side slope (H:V)	1.0	(ft)	grouted riprap
Design Channel bottom width	4.0	(ft)	grouted riprap
Design Channel Topwidth	8.0	(ft)	

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.0	2.0	0.0
2	2.0	0.0	1.7
3	6.0	0.0	1.7
4	8.0	2.0	0.0

SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0360	1.70	1.45	2.40	0.60	1.47	2.1
0.0360	4.00	6.80	4.00	1.70	2.94	20.0
0.0360	1.70	1.45	2.40	0.60	1.47	2.1
VALUES FOR TOTAL SECTION =	7	10	9	1.1	2.5	24

F = 0.4

ARROYO ENGINEERING, LLC

PROJECT NAME: Fasseas
PROJECT DETAIL: local channels

Conc. Pt.: N3
Q100: 21
Minimum slope = 0.85%

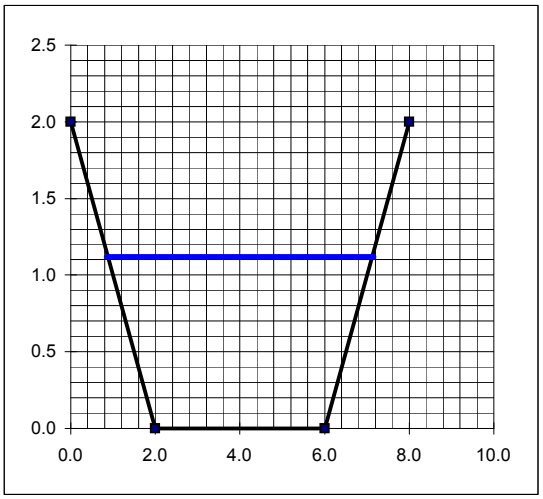
MANNING'S NORMAL DEPTH FLOW CALCULATION FOR IRREGULAR SECTIONS

THE FOLLOWING CALCULATIONS DETERMINE FLOW IN IRREGULAR SECTIONS BASED ON MANNING'S EQUATION FOR NORMAL DEPTH IN UNIFORM FLOW AS SHOWN BELOW:

Q = V * A = (1.486 * Rh ^ (2/3) * SQRT(S) / n) * A

Where:

Q = Discharge (cfs)
V = Flow Velocity (fps)
A = Cross-Sectional Flow Area (sq ft)
R = Hydraulic Radius (ft) = A / WP
WP = Wetted Perimeter (ft)
S = Bed or Energy Slope (ft/ft)
n = Manning's Roughness Coefficient



SPREADSHEET DETERMINES DISCHARGE FOR A GIVEN WATER SURFACE ELEVATION (WSEL).

ENTER REQUESTED DATA; AND THEN ENTER STATION, ELEVATION, AND MANNING "n" VALUES IN TABLE BELOW.

NUMBER OF POINTS IN SECTION =	4		
ASSUMED WSEL=	1.1		
BED OR ENERGY SLOPE (FT/FT) =	0.0085	minimum	
Freeboard	0.2	(ft)	
Design Flow Depth	1.3	(ft)	
Left Side slope (H:V)	1.0	(ft)	grouted riprap
Right Side slope (H:V)	1.0	(ft)	grouted riprap
Design Channel bottom width	4.0	(ft)	grouted riprap
Design Channel Topwidth	6.7	(ft)	

POINT DATA

POINT Number	STATION (ft.)	ELEV (ft.)	h (ft.)
1	0.0	2.0	0.0
2	2.0	0.0	1.1
3	6.0	0.0	1.1
4	8.0	2.0	0.0

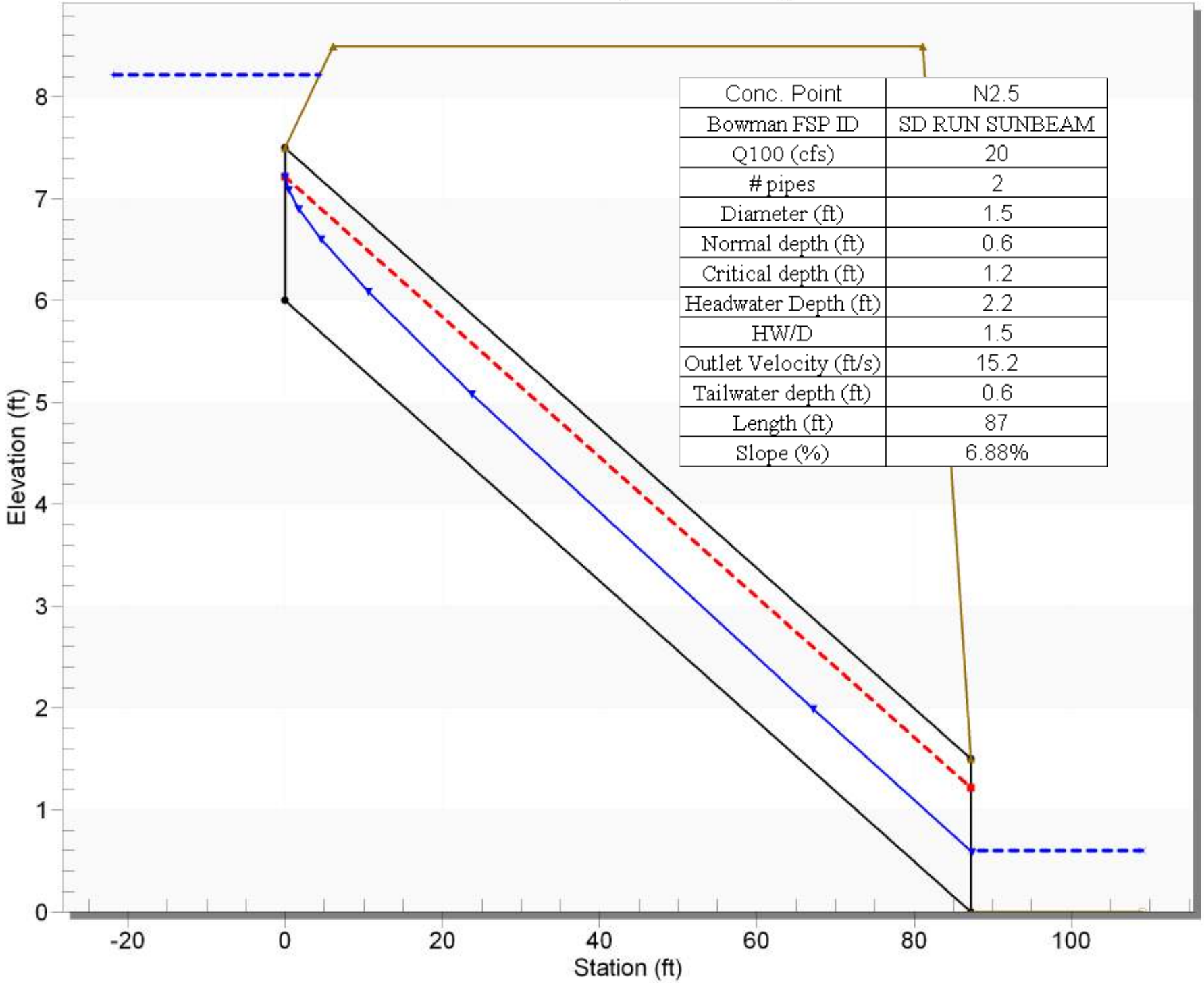
SEGMENT DATA

Manning n-value	TW (ft.)	A (sq. ft.)	WP (ft.)	Rh (ft.)	V (ft./sec.)	Q (cfs)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.0360	1.12	0.63	1.58	0.40	2.05	1.3
0.0360	4.00	4.48	4.00	1.12	4.10	18.4
0.0360	1.12	0.63	1.58	0.40	2.05	1.3
VALUES FOR TOTAL SECTION =	6	6	7	0.8	3.7	21

F = 0.7

Crossing - N2.5, Design Discharge - 20.0 cfs

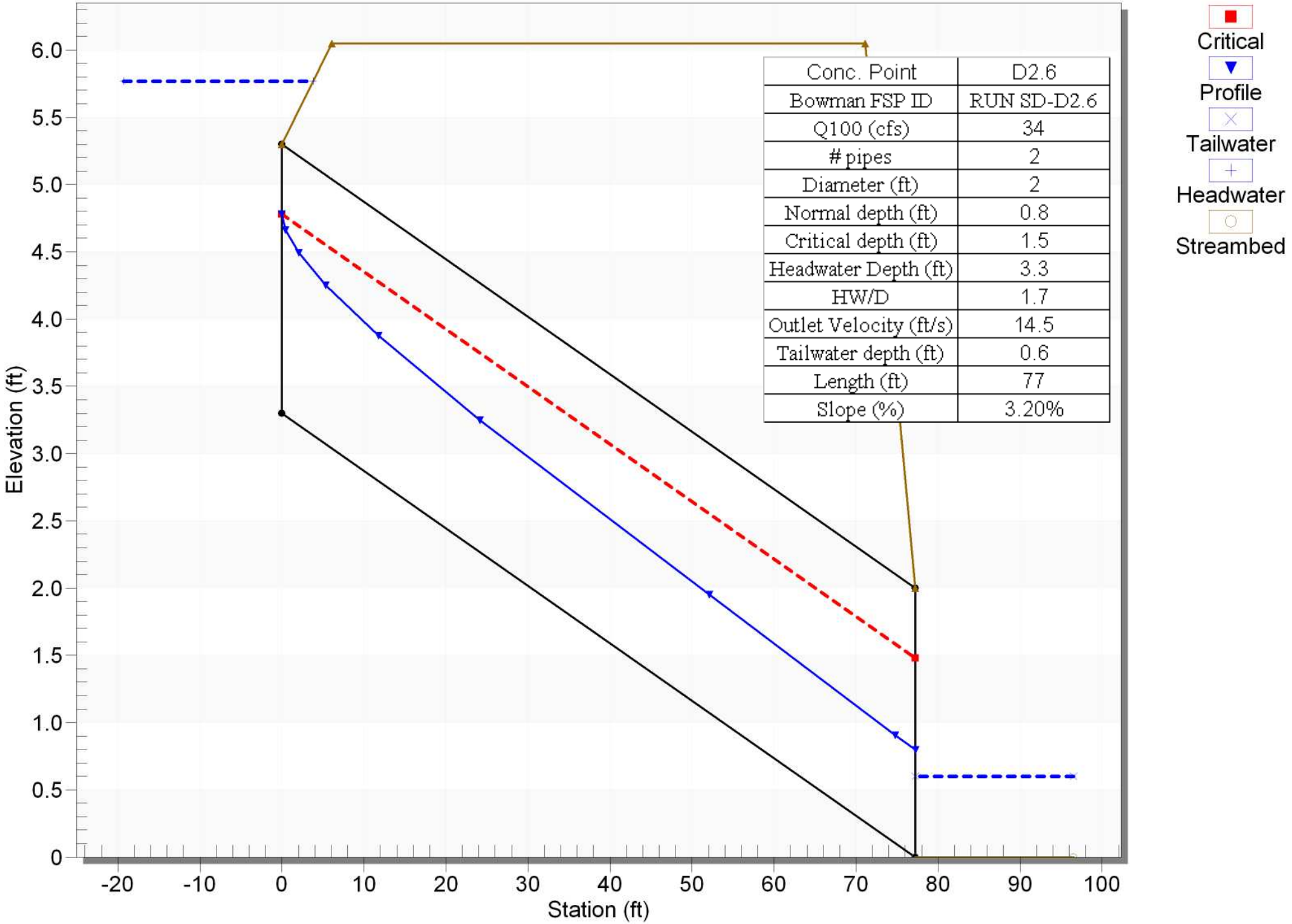
Culvert - N2.5, Culvert Discharge - 20.0 cfs



Conc. Point	N2.5
Bowman FSP ID	SD RUN SUNBEAM
Q100 (cfs)	20
# pipes	2
Diameter (ft)	1.5
Normal depth (ft)	0.6
Critical depth (ft)	1.2
Headwater Depth (ft)	2.2
HW/D	1.5
Outlet Velocity (ft/s)	15.2
Tailwater depth (ft)	0.6
Length (ft)	87
Slope (%)	6.88%

Crossing - D2.6, Design Discharge - 34.0 cfs

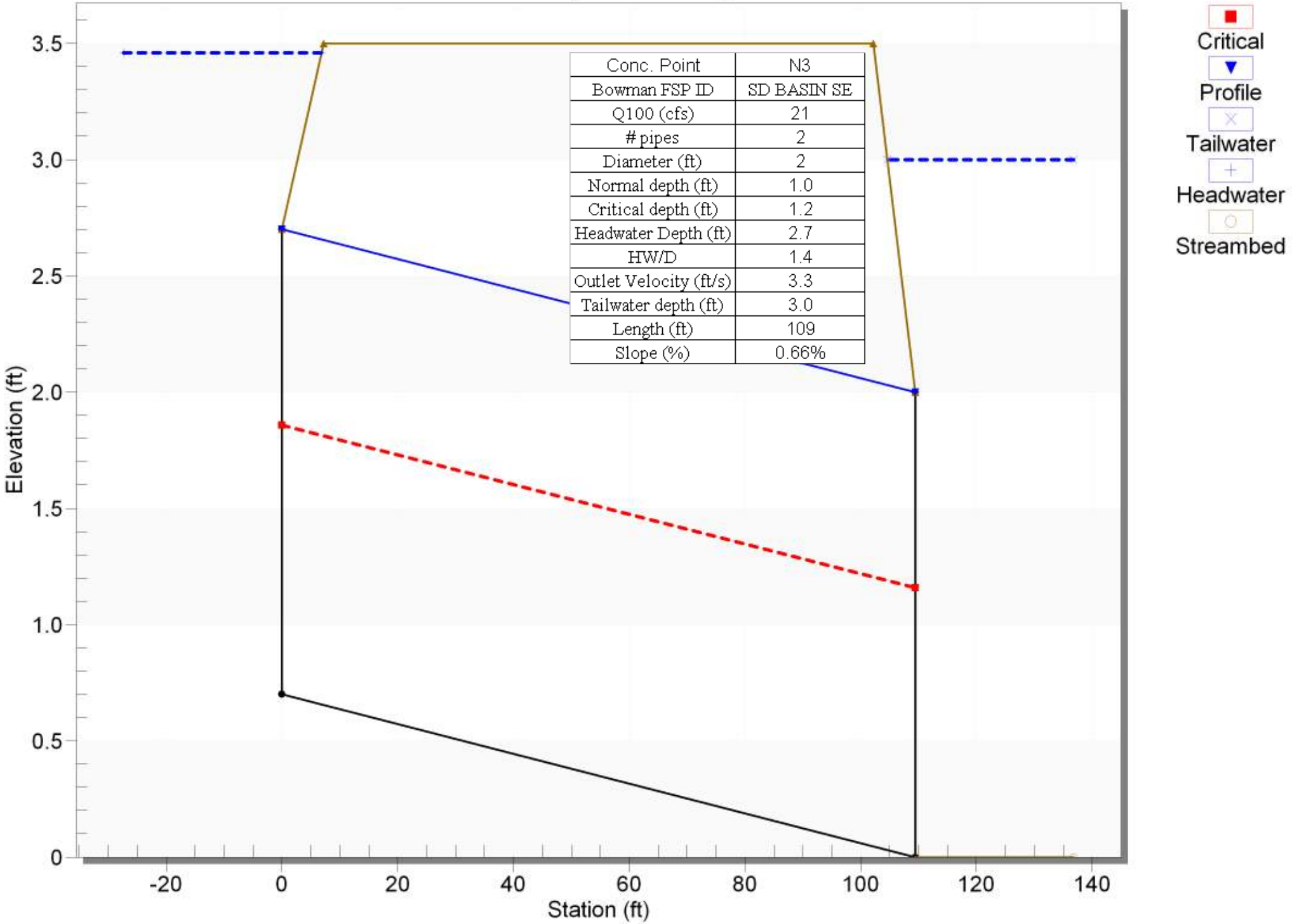
Culvert - D2.6, Culvert Discharge - 34.0 cfs



Conc. Point	D2.6
Bowman FSP ID	RUN SD-D2.6
Q100 (cfs)	34
# pipes	2
Diameter (ft)	2
Normal depth (ft)	0.8
Critical depth (ft)	1.5
Headwater Depth (ft)	3.3
HW/D	1.7
Outlet Velocity (ft/s)	14.5
Tailwater depth (ft)	0.6
Length (ft)	77
Slope (%)	3.20%

Crossing - N3, Design Discharge - 21.0 cfs

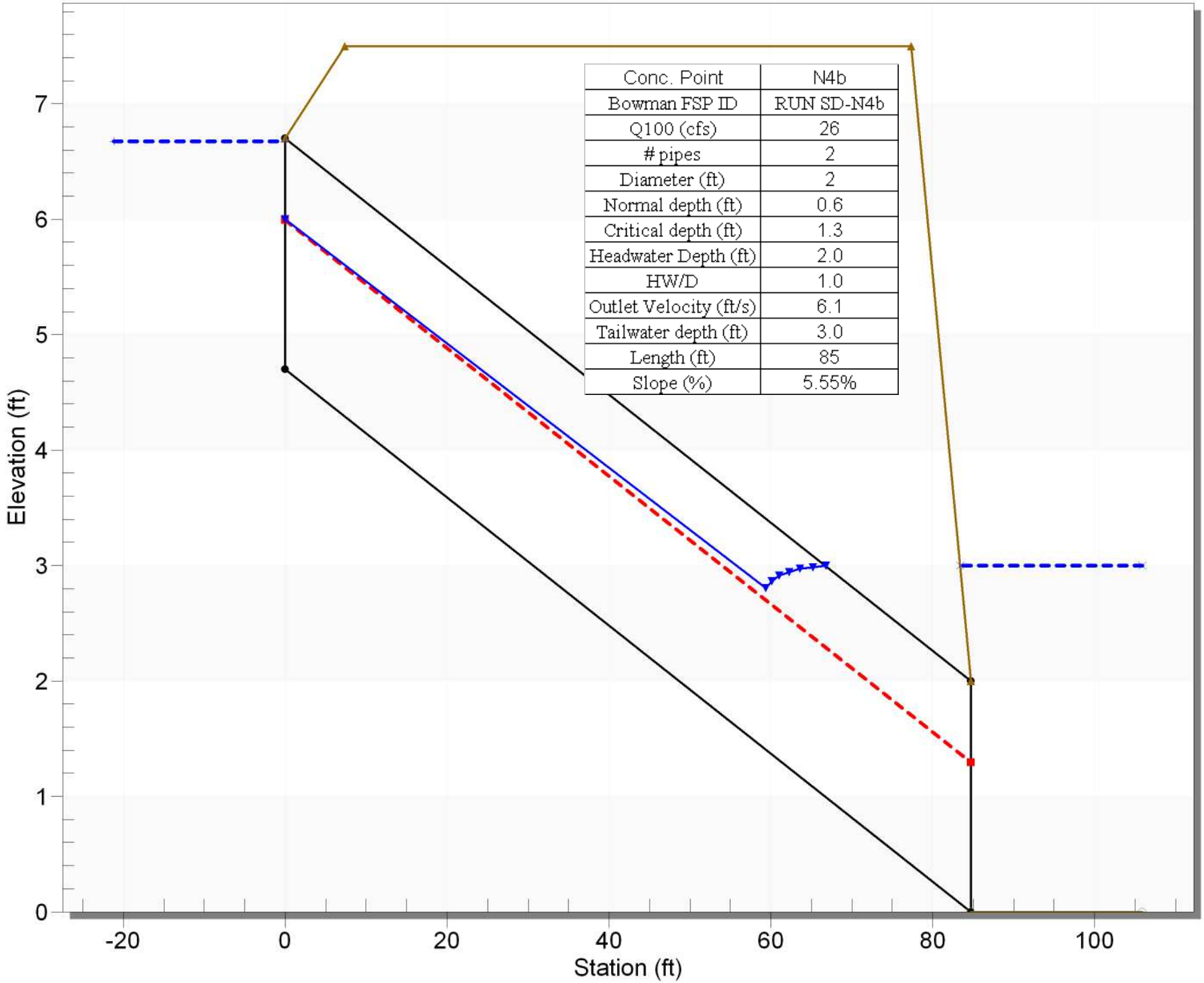
Culvert - N3, Culvert Discharge - 21.0 cfs



Conc. Point	N3
Bowman FSP ID	SD BASIN SE
Q100 (cfs)	21
# pipes	2
Diameter (ft)	2
Normal depth (ft)	1.0
Critical depth (ft)	1.2
Headwater Depth (ft)	2.7
HW/D	1.4
Outlet Velocity (ft/s)	3.3
Tailwater depth (ft)	3.0
Length (ft)	109
Slope (%)	0.66%

Crossing - N4b, Design Discharge - 26.0 cfs

Culvert - N4b, Culvert Discharge - 26.0 cfs



Conc. Point	N4b
Bowman FSP ID	RUN SD-N4b
Q100 (cfs)	26
# pipes	2
Diameter (ft)	2
Normal depth (ft)	0.6
Critical depth (ft)	1.3
Headwater Depth (ft)	2.0
HW/D	1.0
Outlet Velocity (ft/s)	6.1
Tailwater depth (ft)	3.0
Length (ft)	85
Slope (%)	5.55%

Storm drains 5th sub - Normal Depth Report

Label	Discharge (ft^3/s)	Channel Slope (ft/ft)	Normal Depth (ft)	Velocity (ft/s)
xN2 30 inch at 3.28%	24.00	0.03280	0.98	13.50
xD2.1 36 inch at 10.14%	46.00	0.10140	0.95	23.99
xD3 36 inch at 4.33%	47.00	0.04330	1.20	17.74
xD5 36 inch at 2.34%	35.00	0.02340	1.21	13.08
xD4 36 inch at 5.02%	80.00	0.05020	1.56	21.50
xD4 36 inch at 18.65%	45.00	0.18650	0.80	29.65
xD4 36 inch at 3.75%	45.00	0.03750	1.22	16.63
xD5 36 inch at 2.25%	35.00	0.02250	1.22	12.90
xD3 36 inch at 4.13%	47.00	0.04130	1.22	17.43
xD3 36 inch at 25.02%	47.00	0.25020	0.76	33.34
xD2.1 36 inch at 3.89%	46.00	0.03890	1.22	16.96
xD2.1+N2 48 inch at 2.86%	70.00	0.02860	1.47	16.71
xD2.1+N2 48 inch at 3.11%	70.00	0.03110	1.44	17.23
xD2.1+N2 48 inch at 1.99%	70.00	0.01990	1.62	14.64
xD3.5 18 inch at 0.81%	10.00	0.00810	1.33	6.04
xD13 12 inch at 0.5%	1.30	0.00500	0.51	3.23
xD12 30 inch at 1.18%	34.00	0.01180	1.64	9.99
xD12 30 inch at 0.79%	34.00	0.00790	1.91	8.44
xD2.5 36 inch at 21.45%	38.00	0.21450	0.71	29.68

Project : Sundara
Storm Drain Calculations

Results: There is no pressure flow = no Hydraulic Grade Line

				Detention Basin Ponding Elevation			
Storm Drain Outfall at SW Basin = D4+D5				**no HGL = no pressure flow**			
RUN D4				**WSEL**	free flow in pipe		
Station	Inv. Elev.	# pipes	Dia. (in)		Q (cfs)	Depth (ft)	s (%)
306.80	2518.08	1	36	2521.08	80	3.00	
length	*102.5*						5.02%
409.34	2523.23	1	36	2524.79	80	1.56	
Manhole and D5 lateral inflow							
409.34	2523.33	1	36	2524.55	45	1.22	
length	*304.8*						3.75%
714.13	2534.77	1	36	2535.99	45	1.22	
Manhole							
714.13	2534.87	1	36	2535.67	45	0.80	
length	*29.6*						18.65%
743.68	2540.38	1	36	2541.18	45	0.80	

Storm Drain Lateral from D5 to D4				**no HGL = no pressure flow**			
RUN D5				**WSEL**	free flow in pipe		
Station	Inv. Elev.	# pipes	Dia. (in)		Q (cfs)	Depth (ft)	s (%)
221.22	2523.63	1	36	2524.84	35	1.21	
							2.34%
405.89	2527.95	1	36	2529.16	35	1.21	
Manhole and D13 lateral inflow							
405.89	2528.05	1	36	2529.27	35	1.22	
							2.25%
451.64	2529.08	1	36	2530.30	35	1.22	

Storm Drain Lateral from D13 to D5				**no HGL = no pressure flow**			
RUN SD-D13				**WSEL**	free flow in pipe		
Station	Inv. Elev.	# pipes	Dia. (in)		Q (cfs)	Depth (ft)	s (%)
1003.04	2529.95	1	12	2530.46	1.3	0.51	
length	18.2						0.50%
1021.20	2530.04	1	12	2530.55	1.3	0.51	

Storm Drain Outfall at SW Basin = D3				**no HGL = no pressure flow**			
RUN D3				**WSEL**	free flow in pipe		
Station	Inv. Elev.	# pipes	Dia. (in)		Q (cfs)	Depth (ft)	s (%)
408.49	2518.08	1	36	2521.08	47	3.00	
length	113.7						4.33%
522.18	2523.00	1	36	2524.20	47	1.20	
Manhole							
522.18	2523.10	1	36	2524.32	47	1.22	
length	446.2						4.13%
968.38	2541.54	1	36	2542.76	47	1.22	
968.38	2541.54	1	36	2542.76	47	1.22	
Manhole							
968.38	2541.64	1	36	2542.40	47	0.76	
length	15.3						25.02%
983.65	2545.46	1	36	2546.22	47	0.76	

				Detention Basin Ponding Elevation			
Storm Drain Outfall at SE Basin = D2.1+N2				**no HGL = no pressure flow**			
RUN SD-D2.1				**WSEL**	free flow in pipe		
Station	Inv. Elev.	# pipes	Dia. (in)		Q (cfs)	Depth (ft)	s (%)
997.10	2494.95	1	48	2497.84	70	3.0	
length	-150.5						1.99%
846.61	2497.94	1	48	2499.56	70	1.62	
Manhole							
846.86	2498.34	1	48	2499.78	70	1.44	
length	-364.93						3.11%
481.93	2509.68	1	48	2511.12	70	1.44	
Manhole							
481.93	2509.78	1	48	2511.25	70	1.47	
	-310.60						2.86%
171.33	2518.65	1	48	2520.12	70	1.47	
Manhole and N2 lateral inflow							
171.33	2519.65	1	36	2520.87	46	1.22	
length	-113.20						3.89%
58.13	2524.05	1	36	2525.27	46	1.22	
Manhole							
58.13	2524.15	1	36	2525.10	46	0.95	
length	-19.13						10.14%
39.00	2526.09	1	36	2527.04	46	0.95	

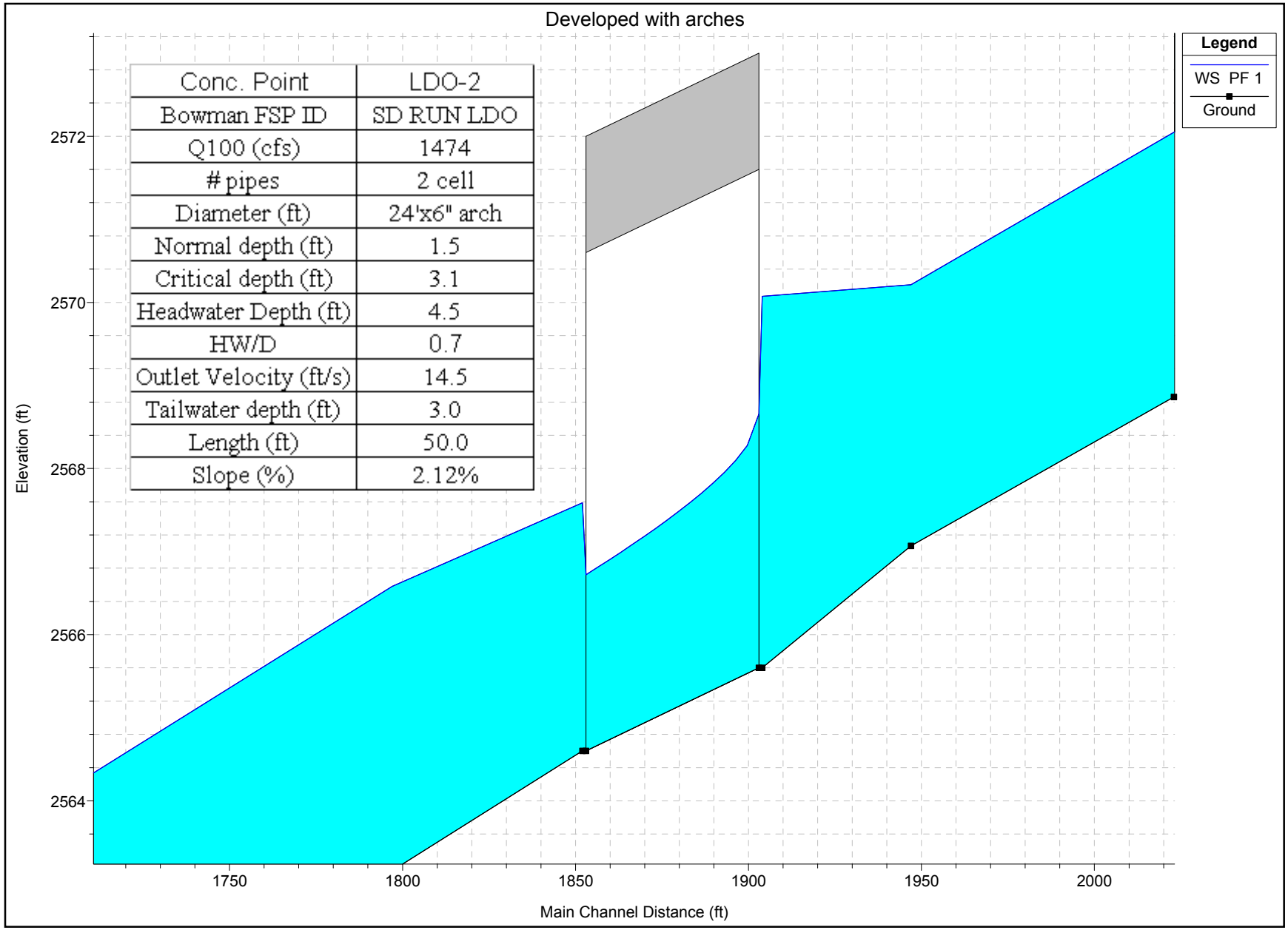
Storm Drain Lateral from N2 to D2.1				**no HGL = no pressure flow**			
RUN N2				**WSEL**	free flow in pipe		
Station	Inv. Elev.	# pipes	Dia. (in)		Q (cfs)	Depth (ft)	s (%)
1110.31	2520.27	1	30	2521.25	24	0.98	
length	-75.3						3.28%
1035.01	2522.74	1	30	2523.72	24	0.98	

Storm Drain from D2.5 to Basin N				**no HGL = no pressure flow**			
RUN SD-D2.5				**WSEL**	free flow in pipe	Depth (ft)	s (%)
Station	Inv. Elev.	# pipes	Dia. (in)		Q (cfs)	Depth	S_e
1041.09	2570.00	1	36	2570.60	38	0.60	
length	41.7						21.45%
1082.82	2578.95	1	36	2579.66	38	0.71	

Storm Drain from D3.5 to Basin C				**no HGL = no pressure flow**			
RUN SD-D3.5				**WSEL**	free flow in pipe		
Station	Inv. Elev.	# pipes	Dia. (in)		Q (cfs)	Depth (ft)	s (%)
1074.00	2564.00	1	18	2565.27	10	1.30	
length	-54.0						-0.81%
1020.00	2564.44	1	18	2565.77	10	1.33	

Storm Drain at D12				**no HGL = no pressure flow**			
RUN SD-D12				**WSEL**	free flow in pipe		
Station	Inv. Elev.	# pipes	Dia. (in)		Q (cfs)	Depth (ft)	s (%)
1205.09	2548.10	1	30	2497.84	34	1.91	
length	-109.5						0.79%
1095.62	2548.96	1	30	2550.87	34	1.91	
Manhole							
1097.52	2549.36	1	30	2551.00	34	1.64	
length	-71.5						1.18%
1026.04	2550.20	1	30	2551.84	34	1.64	

ARROYO ENGINEERING, LLC


Developed with arches
Legend
WS PF 1
Ground
Conc. Point | LDO-2
Bowman FSP ID | SD RUN LDO
Q100 (cfs) | 1474
pipes | 2 cell
Diameter (ft) | 24'x6" arch
Normal depth (ft) | 1.5
Critical depth (ft) | 3.1
Headwater Depth (ft) | 4.5
HW/D | 0.7
Outlet Velocity (ft/s) | 14.5
Tailwater depth (ft) | 3.0
Length (ft) | 50.0
Slope (%) | 2.12%
Elevation (ft)
2572
2570
2568
2566
2564
1750
1800
1850
1900
1950
2000
Main Channel Distance (ft)

Proposed Arch Culvert for Lomas de Oro Wash
Conspan 2 cell 24' SPAN X 6' RISE x 50' LONG

From HEC-RAS hydraulic analysis	
HWE (ft)	70.1
Flow depth (ft)	4.5
Upstream bed invert (ft)	65.6
Downstream bed invert (ft)	64.6
Length (ft)	50
Flow depth/rise	0.75

ok for TOV regulations

Per Arizona Game and Fish, the minimum "openness ratio" for large mammals should be between 0.75 and 0.9
The ratio is calculated per opening

Ratio = culvert height * width / length (in meters)
Ratio = 0.3048 * culvert height * width / length (in feet)

Culvert	Width (ft)	Height (ft)	Length (ft)	Ratio
Conspan 24'x6'x50'	24	6	50	0.9

HEC-RAS Plan: Dev arches River: River #1 Reach: Reach #1 Profile: PF 1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Max Chl Dpth	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft/s)	(ft)	(sq ft)	(ft)	
Reach #1	35	1642	2577.5	2581.9	7.9	4.5	352	256	0.7
Reach #1	34	1642	2575.9	2580.1	7.8	4.3	363	276	0.7
Reach #1	33	1642	2574.4	2578.0	8.0	3.6	293	184	0.8
Reach #1	32.8	Lat Struct							
Reach #1	32.6666*	1608	2573.9	2577.3	7.7	3.4	279	179	0.8
Reach #1	32.4	Lat Struct							
Reach #1	32.3333*	1572	2573.3	2576.4	7.7	3.1	256	168	0.9
Reach #1	32.2	Lat Struct							
Reach #1	32	1544	2572.8	2575.6	7.4	2.8	251	167	0.9
Reach #1	31.8	Lat Struct							
Reach #1	31.6666*	1525	2572.2	2575.1	7.4	2.9	251	168	0.9
Reach #1	31.4	Lat Struct							
Reach #1	31.3333*	1502	2571.7	2574.5	7.4	2.8	250	170	0.9
Reach #1	31.2	Lat Struct							
Reach #1	31	1474	2571.1	2573.9	7.2	2.9	252	171	0.9
Reach #1	30	1474	2568.9	2572.0	7.0	3.2	247	175	0.9
Reach #1	29	1474	2567.1	2570.2	7.0	3.1	235	133	0.8
Reach #1	28.5	1474	2565.6	2570.1	6.6	4.5	224	50	0.5
Reach #1	28.3	Culvert							
Reach #1	28	1474	2564.6	2567.6	9.9	3.0	149	50	1.0
Reach #1	27	1474	2563.2	2566.6	7.1	3.4	282	365	0.8
Reach #1	26.5	1474	2561.5	2564.3	6.7	2.8	281	228	0.8
Reach #1	26	1474	2560.0	2562.1	6.7	2.1	253	199	0.9
Reach #1	25	1474	2557.7	2559.5	6.3	1.9	238	189	1.0
Reach #1	24	1474	2555.3	2557.3	6.9	2.1	234	162	0.9
Reach #1	23	1474	2553.1	2555.2	6.7	2.1	228	166	1.0
Reach #1	22	1474	2550.3	2552.7	6.6	2.4	246	195	1.0
Reach #1	21	1474	2547.9	2550.0	6.3	2.1	235	188	1.0
Reach #1	20	1474	2545.7	2547.6	6.7	1.9	234	175	1.0
Reach #1	19	1474	2543.0	2544.8	6.7	1.8	222	157	1.0
Reach #1	18	1474	2539.7	2541.7	6.3	2.1	234	187	1.0
Reach #1	17	1474	2536.4	2538.8	6.5	2.4	230	177	1.0
Reach #1	16	1474	2533.8	2536.0	6.4	2.2	238	192	1.0
Reach #1	15	1474	2531.1	2533.0	6.2	1.9	239	199	1.0
Reach #1	14	1474	2528.0	2529.9	6.4	1.9	238	192	1.0
Reach #1	13	1474	2524.1	2526.9	6.8	2.7	237	262	0.9
Reach #1	12	1474	2521.5	2524.5	7.5	3.1	326	329	0.8
Reach #1	11	1474	2519.1	2521.3	7.1	2.2	248	312	1.1
Reach #1	10	1474	2516.6	2518.4	7.8	1.8	264	322	1.0

Lomas de Oro Wash **4th submittal**

HEC-RAS Plan: **Dev arches** changes from 2nd submittal

Locations of sections marked "*" are evenly interpolated betwen adjacent sections

Top of basin slope must be at or above 100-year WSEL

Weir elevations at sections are fixed

River Sta	Q Total (cfs)	W.S. Elev (ft)	
35	1642	2581.9	
34	1642	2580.1	Weir elev
33	1642	2578	2577.3
32.8	Lat Struct		
32.6666*	1608	2577.3	2576.5
32.4	Lat Struct		
32.3333*	1572	2576.4	2575.7
32.2	Lat Struct		
32	1544	2575.6	2575.1
31.8	Lat Struct		
31.6666*	1525	2575.1	2574.5
31.4	Lat Struct		
31.3333*	1502	2574.5	2573.8
31.2	Lat Struct		
31	1474	2573.9	2573.2
30	1474	2572	
29	1474	2570.2	
28.5	1474	2570.1	
28.3	Culvert		**2 24'x6' ConSpan**
28	1474	2567.6	
27	1474	2566.6	
26.5	1474	2564.3	
26	1474	2562.1	
25	1474	2559.5	
24	1474	2557.3	
23	1474	2555.2	
22	1474	2552.7	
21	1474	2550	
20	1474	2547.6	
19	1474	2544.8	
18	1474	2541.7	
17	1474	2538.8	
16	1474	2536	
15	1474	2533	
14	1474	2529.9	
13	1474	2526.9	
12	1474	2524.5	
11	1474	2521.3	
10	1474	2518.4	

2565.6	INLET
2564.6	OUTLET
50	LENGTH

Lomas de Oro Wash

changes for 4th sub

Minimum design water surface elevations and toedowns

From City of Tucson Drainage Standards Manual:

The freeboard requirement for channels shall be computed from Equation 8.4, with a minimum freeboard of one foot for channels with design depths of three feet or more.

$$FB = 1/6 \left(Y_{max} + \frac{V^2}{2g} \right) \qquad (8.4)$$

Where:

FB = Freeboard, in feet;
Y_{max} = Maximum depth of flow, in feet;
V = Average velocity of flow, in feet per second; and,
g = Acceleration due to gravity = 32.2 ft/sec^2.

HEC-RAS Plan: Dev arches		100-yr			Calculated	Minimum	Minimum	Minimum
River Sta	Q Total (cfs)	W.S. Elev (ft)	Vel Chnl (ft/s)	Max Chl Dpth (ft)	freeboard (ft)	freeboard (ft)	Design WSEL (ft)	Toe-down (ft)
35	1642	2581.9	7.9	4.5	0.9	1.0	2582.9	n/a
34	1642	2580.1	7.8	4.3	0.9	1.0	2581.1	6.6
33	1642	2578	8	3.6	0.8	1.0	2579.0	4.4
32	1544	2575.6	7.4	2.8	0.6	1.0	2576.6	4.2
31	1474	2573.9	7.2	2.9	0.6	1.0	2574.9	4.2
30	1474	2572	7	3.2	0.7	1.0	2573.0	4.2
29	1474	2570.2	7	3.1	0.6	1.0	2571.2	4.2
28.5	1474	2570.1	6.6	4.5	0.9	1.0	2571.1	4.2
28.3	Culvert							
28	1474	2567.6	9.9	3	0.8	1.0	2568.6	4.5
27	1474	2566.6	7.1	3.4	0.7	1.0	2567.6	4.5
26.5	1474	2564.3	6.7	2.8	0.6	1.0	2565.3	4.5
26	1474	2562.1	6.7	2.1	0.5	0.5	2562.6	4.1
25	1474	2559.5	6.3	1.9	0.4	0.4	2559.9	4.1
24	1474	2557.3	6.9	2.1	0.5	0.5	2557.8	4.1
23	1474	2555.2	6.7	2.1	0.5	0.5	2555.7	4.1
22	1474	2552.7	6.6	2.4	0.5	0.5	2553.2	4.1
21	1474	2550	6.3	2.1	0.5	0.5	2550.5	4.1
20	1474	2547.6	6.7	1.9	0.4	0.4	2548.0	4.1
19	1474	2544.8	6.7	1.8	0.4	0.4	2545.2	4.1
18	1474	2541.7	6.3	2.1	0.5	0.5	2542.2	4.1
17	1474	2538.8	6.5	2.4	0.5	0.5	2539.3	4.1
16	1474	2536	6.4	2.2	0.5	0.5	2536.5	4.1
15	1474	2533	6.2	1.9	0.4	0.4	2533.4	4.1
14	1474	2529.9	6.4	1.9	0.4	0.4	2530.3	4.1
13	1474	2526.9	6.8	2.7	0.6	1.0	2527.9	4.3
12	1474	2524.5	7.5	3.1	0.7	1.0	2525.5	4.3
11	1474	2521.3	7.1	2.2	0.5	0.5	2521.8	4.3
10	1474	2518.4	7.8	1.8	0.5	0.5	2518.9	n/a

Comparison of Proposed Conditions vs. Pending FEMA LOMR

HEC-RAS River: River #1 Reach: Reach #1 Profile: PF 1

Reach	River Sta	Plan	Q Total	W.S. Elev
			(cfs)	(ft)
Reach #1	35	Dev Cond	1642	2581.9
Reach #1	35	Pending LOMR	2272	2582.3
Reach #1	34	Dev Cond	1642	2580.1
Reach #1	34	Pending LOMR	2272	2580.4
Reach #1	33	Dev Cond	1642	2578.0
Reach #1	33	Pending LOMR	2272	2578.3
Reach #1	32.8		Lat Struct	
Reach #1	32.6666*	Dev Cond	1608	2577.3
Reach #1	32.6666*	Pending LOMR	2210	2577.6
Reach #1	32.4		Lat Struct	
Reach #1	32.3333*	Dev Cond	1572	2576.4
Reach #1	32.3333*	Pending LOMR	2144	2576.8
Reach #1	32.2		Lat Struct	
Reach #1	32	Dev Cond	1544	2575.6
Reach #1	32	Pending LOMR	2088	2576.0
Reach #1	31.8		Lat Struct	
Reach #1	31.6666*	Dev Cond	1525	2575.1
Reach #1	31.6666*	Pending LOMR	2049	2575.4
Reach #1	31.4		Lat Struct	

HEC-RAS River: River #1 Reach: Reach #1 Profile: PF 1 (Continued)

Reach	River Sta	Plan	Q Total	W.S. Elev
			(cfs)	(ft)
Reach #1	31.3333*	Dev Cond	1502	2574.5
Reach #1	31.3333*	Pending LOMR	2006	2574.8
Reach #1	31.2		Lat Struct	
Reach #1	31	Dev Cond	1474	2573.9
Reach #1	31	Pending LOMR	1958	2574.2
Reach #1	30	Dev Cond	1474	2572.0
Reach #1	30	Pending LOMR	1958	2572.3
Reach #1	29	Dev Cond	1474	2570.2
Reach #1	29	Pending LOMR	1958	2571.3
Reach #1	28.5	Dev Cond	1474	2570.1
Reach #1	28.5	Pending LOMR	1958	2571.0
Reach #1	28.3		Culvert	
Reach #1	28	Dev Cond	1474	2567.6
Reach #1	28	Pending LOMR	1958	2567.3
Reach #1	27	Dev Cond	1474	2566.6
Reach #1	27	Pending LOMR	1958	2566.9
Reach #1	26.5	Dev Cond	1474	2564.3
Reach #1	26.5	Pending LOMR	1958	2564.6
Reach #1	26	Dev Cond	1474	2562.1

HEC-RAS River: River #1 Reach: Reach #1 Profile: PF 1 (Continued)

Reach	River Sta	Plan	Q Total	W.S. Elev
			(cfs)	(ft)
Reach #1	26	Pending LOMR	1958	2562.4
Reach #1	25	Dev Cond	1474	2559.5
Reach #1	25	Pending LOMR	1958	2559.8
Reach #1	24	Dev Cond	1474	2557.3
Reach #1	24	Pending LOMR	1958	2557.6
Reach #1	23	Dev Cond	1474	2555.2
Reach #1	23	Pending LOMR	1958	2555.5
Reach #1	22	Dev Cond	1474	2552.7
Reach #1	22	Pending LOMR	1958	2553.1
Reach #1	21	Dev Cond	1474	2550.0
Reach #1	21	Pending LOMR	1958	2550.3
Reach #1	20	Dev Cond	1474	2547.6
Reach #1	20	Pending LOMR	1958	2547.9
Reach #1	19	Dev Cond	1474	2544.8
Reach #1	19	Pending LOMR	1958	2545.1
Reach #1	18	Dev Cond	1474	2541.7
Reach #1	18	Pending LOMR	1958	2542.0
Reach #1	17	Dev Cond	1474	2538.8
Reach #1	17	Pending LOMR	1958	2539.1
Reach #1	16	Dev Cond	1474	2536.0

Comparison of Proposed Conditions vs. Pending FEMA LOMR

HEC-RAS River: River #1 Reach: Reach #1 Profile: PF 1 (Continued)

Reach	River Sta	Plan	Q Total	W.S. Elev
			(cfs)	(ft)
Reach #1	16	Pending LOMR	1958	2536.3
Reach #1	15	Dev Cond	1474	2533.0
Reach #1	15	Pending LOMR	1958	2533.2
Reach #1	14	Dev Cond	1474	2529.9
Reach #1	14	Pending LOMR	1958	2530.2
Reach #1	13	Dev Cond	1474	2526.9
Reach #1	13	Pending LOMR	1958	2527.2
Reach #1	12	Dev Cond	1474	2524.5
Reach #1	12	Pending LOMR	1958	2524.8
Reach #1	11	Dev Cond	1474	2521.3
Reach #1	11	Pending LOMR	1958	2521.7
Reach #1	10	Dev Cond	1474	2518.4
Reach #1	10	Pending LOMR	1958	2518.8

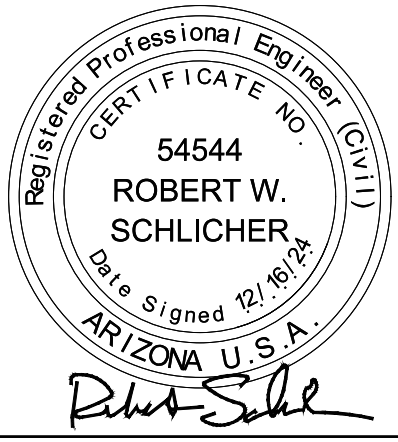
Appendix CS.
Canyon Shadows Wash - Developed Floodplain and Erosion Mitigation
(prepared separately by LJA Engineering, Inc.)

HEC-RAS Plan: Prop Cond River: Canyon Shadows G Reach: Canyon Shadows W Profile: Q100

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Canyon Shadows W	2876	Q100	262.00	2574.86	2576.12	2575.94	2576.32	0.026748	3.61	72.63	98.38	0.74
Canyon Shadows W	2758	Q100	262.00	2571.18	2572.00	2571.97	2572.24	0.046166	3.90	67.14	121.78	0.93
Canyon Shadows W	2457.25	Q100	262.00	2561.76	2562.54	2562.54	2562.81	0.022661	4.15	63.07	120.32	1.01
Canyon Shadows W	2256	Q100	262.00	2554.84	2555.72	2555.72	2555.99	0.022453	4.12	63.64	122.22	1.01
Canyon Shadows W	2056	Q100	262.00	2547.23	2548.08	2548.08	2548.33	0.023090	4.03	65.08	131.98	1.01
Canyon Shadows W	1856	Q100	262.00	2540.07	2541.02	2541.02	2541.32	0.021906	4.41	59.46	101.02	1.01
Canyon Shadows W	1656	Q100	262.00	2531.97	2532.75	2532.75	2533.01	0.022676	4.08	64.24	125.67	1.01
Canyon Shadows W	1456	Q100	262.00	2523.74	2524.54	2524.54	2524.78	0.023340	3.99	65.69	135.85	1.01
Canyon Shadows W	1256	Q100	262.00	2514.45	2515.49	2515.49	2515.67	0.023015	3.44	76.20	195.28	0.97
Canyon Shadows W	1056	Q100	262.00	2505.24	2506.11	2506.11	2506.33	0.023748	3.75	69.85	160.90	1.00
Canyon Shadows W	856	Q100	262.00	2496.83	2497.74	2497.74	2498.06	0.020798	4.55	57.58	89.86	1.00
Canyon Shadows W	785.98	Q100	262.00	2493.00	2494.13	2494.13	2494.38	0.025522	4.00	65.58	144.74	1.05
Canyon Shadows W	740.37	Q100	262.00	2490.97	2492.15	2492.15	2492.42	0.023268	4.16	62.94	122.09	1.02
Canyon Shadows W	695.13	Q100	262.00	2489.93	2490.56	2490.56	2490.75	0.025337	3.53	74.29	196.91	1.01
Canyon Shadows W	588.58	Q100	262.00	2482.83	2484.34	2484.34	2484.77	0.020093	5.27	49.71	59.03	1.01
Canyon Shadows W	514.28	Q100	262.00	2474.00	2476.13		2476.18	0.001715	1.76	148.95	147.86	0.31
Canyon Shadows W	374.27	Q100	262.00	2473.99	2475.75		2475.86	0.002877	2.73	96.01	72.51	0.42
Canyon Shadows W	322.19	Q100	262.00	2473.99	2475.29	2475.29	2475.53	0.022707	3.92	66.87	139.10	1.00
Canyon Shadows W	292.29	Q100	262.00	2473.81	2474.42	2474.42	2474.63	0.023380	3.73	70.18	160.78	1.00
Canyon Shadows W	200	Q100	262.00	2469.97	2471.21	2471.21	2471.47	0.023369	4.08	64.15	128.40	1.02
Canyon Shadows W	156.06	Q100	262.00	2466.28	2468.06	2468.06	2468.38	0.021430	4.51	58.15	93.37	1.01
Canyon Shadows W	112.46	Q100	262.00	2465.64	2466.70	2466.70	2466.96	0.023079	4.09	64.08	126.89	1.01
Canyon Shadows W	66.34	Q100	262.00	2462.00	2464.63	2464.63	2464.92	0.022662	4.33	60.47	107.54	1.02
Canyon Shadows W	45.68	Q100	262.00	2461.98	2463.16	2463.16	2463.42	0.024996	4.07	64.40	136.26	1.04
Canyon Shadows W	6	Q100	262.00	2457.98	2459.34	2459.34	2459.64	0.021834	4.46	58.77	97.96	1.01

CANYON SHADOWS WASH FLOODPLAIN

LOT#	WATER SURFACE ELEVATION (WSE)	REGULATORY FLOOD ELEVATION (RFE)	FINISHED FLOOR ELEVATION (FFE)
80	2558.60	2559.60	2561.19
79	2547.80	2548.80	2554.54
78	2544.13	2545.13	2551.43
77	2540.09	2541.09	2546.08
76	2535.80	2536.80	2540.43
75	2531.83	2532.83	2534.24
74	2526.34	2527.34	2529.02
73	2522.36	2523.36	2525.06
72	2518.24	2519.24	2521.50
71	2514.46	2515.46	2518.33
70	2511.15	2512.15	2515.07
69	2507.84	2508.84	2511.69
68	2504.75	2505.75	2508.31
67	2501.86	2502.86	2505.15



PLAN STATUS:

FOR REVIEW ☒

FOR CONSTRUCTION ☐

H: 1"=40' C.I.=2'

V:

SCALE

12/16/24

DATE

AZ4072-1004

JOB NUMBER

ML

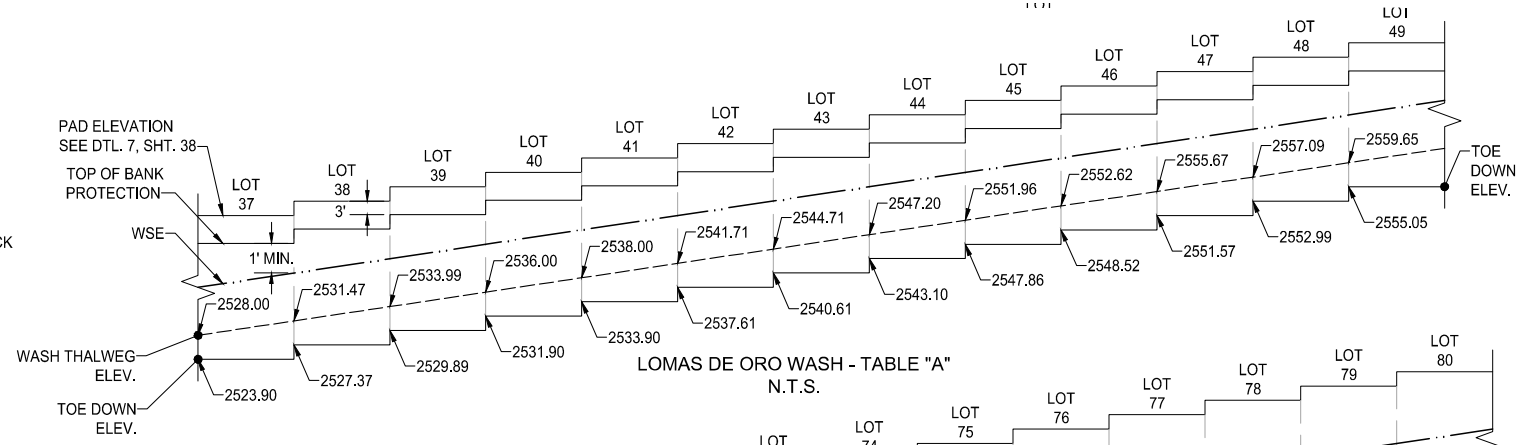
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LJA

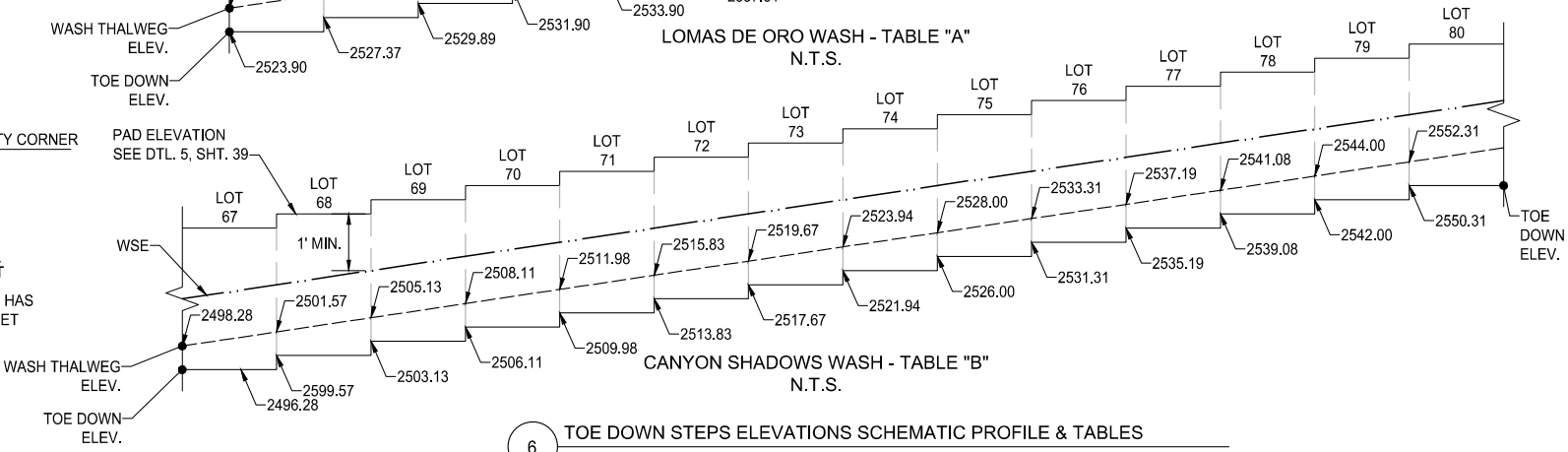
DESIGNED BY

RWS

CHECKED BY



LOMAS DE ORO WASH - TABLE "A"
N.T.S.



CANYON SHADOWS WASH - TABLE "B"
N.T.S.

6 TOE DOWN STEPS ELEVATIONS SCHEMATIC PROFILE & TABLES

N.T.S.

TABLE 'A' _ SCOUR DEPTH PROTECTION

LOMAS DE ORO WASH

LOT	WASH THALWEG ELEV.	MIN. TOE DOWN	TOE DOWN ELEV.
37	2528.00	4.1	2523.90
38	2531.47	4.1	2527.37
39	2533.99	4.1	2529.89
40	2536.00	4.1	2531.90
41	2538.00	4.1	2533.90
42	2541.71	4.1	2537.61
43	2544.71	4.1	2540.61
44	2547.20	4.1	2543.10
45	2551.96	4.1	2547.86
46	2552.62	4.1	2548.52
47	2555.67	4.1	2551.57
48	2557.09	4.1	2552.99
49	2559.65	4.6	2555.05
Basin "C"	2563.00	4.6	2558.40
Basin "N"	2573.00	4.2	2568.80
Basin "SW"	2522.00	4.2	2517.80

BASIN TOE DOWN DEPTH= TOE DOWN ELEVATION

TABLE 'B' _ SCOUR DEPTH PROTECTION

CANYON SHADOWS WASH

LOT	WASH THALWEG ELEV.	MIN. TOE DOWN	TOE DOWN ELEV.
67	2498.28	2	2496.28
68	2501.57	2	2499.57
69	2505.13	2	2503.13
70	2508.11	2	2506.11
71	2511.98	2	2509.98
72	2515.83	2	2513.83
73	2519.67	2	2517.67
74	2523.94	2	2521.94
75	2528.00	2	2526.00
76	2533.31	2	2531.31
77	2537.19	2	2535.19
78	2541.08	2	2539.08
79	2544.00	2	2542.00
80	2552.31	2	2550.31
Basin "SE"	2492.00	2	2490.00

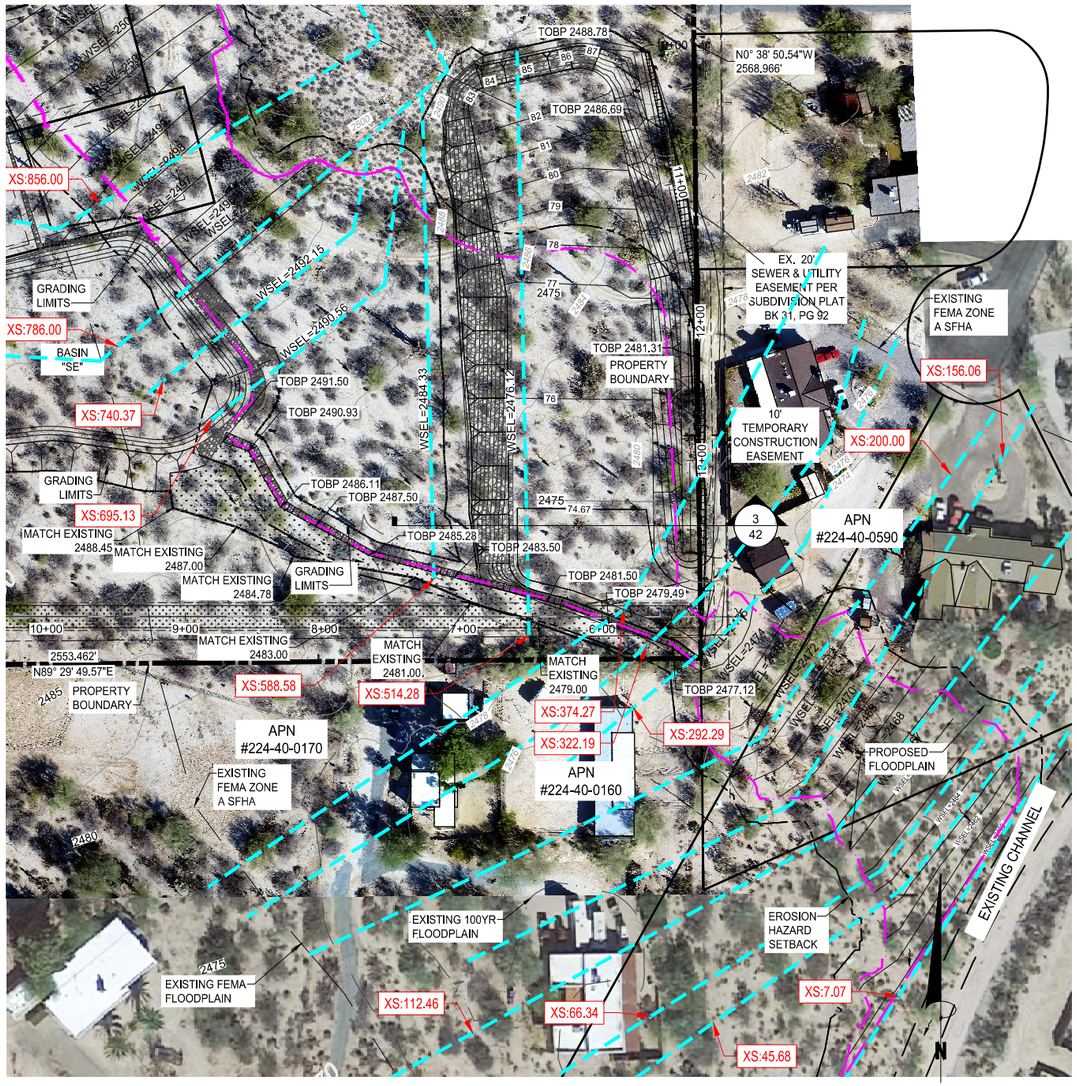
BASIN TOE DOWN DEPTH= TOE DOWN ELEVATION

REVI
DATE
NO.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W.
SCHLICHER
Date Signed 12/16/24
ARIZONA, U.S.A.

PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

H: N/A C.I.=2'
V:
SCALE
12/16/24
DATE
AZ4072-1004
JOB NUMBER
ML
DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY



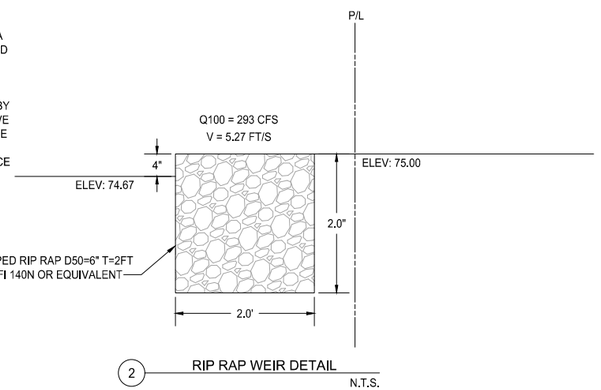
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N.T.S.

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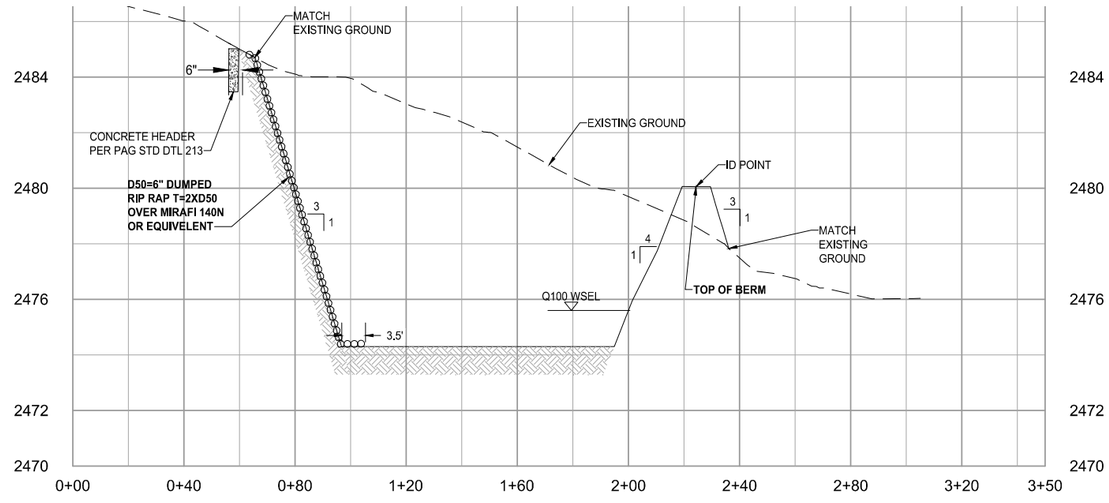
1. ALL DRAINAGE STRUCTURES SHALL BE INSPECTED AND A SUMMARY REPORT PREPARED A MINIMUM OF ONCE EACH YEAR IN ACCORDANCE WITH THE PROCEDURES IN THE APPROVED DRAINAGE REPORT. COPIES OF THE ANNUAL INSPECTION REPORTS SHALL BE MADE AVAILABLE TO THE TOWN UPON REQUEST.

2. ALL DRAINAGE STRUCTURES SHALL BE INSPECTED AND A SUMMARY REPORT PREPARED BY AN ARIZONA REGISTERED PROFESSIONAL CIVIL ENGINEER A MINIMUM OF ONCE EVERY FIVE YEARS IN ACCORDANCE WITH THE PROCEDURES PRESENTED IN THE APPROVED DRAINAGE REPORT. COPIES OF THE 5-YEAR-INTERVAL INSPECTION REPORTS SHALL BE MADE AVAILABLE TO THE TOWN UPON REQUEST. THE REPORT SHALL IDENTIFY THE MAINTENANCE NEEDS FOR THE NEXT 5-YEAR PERIOD, INCLUDING THE ANTICIPATED ANNUAL COST OF MAINTENANCE AND REPAIR.



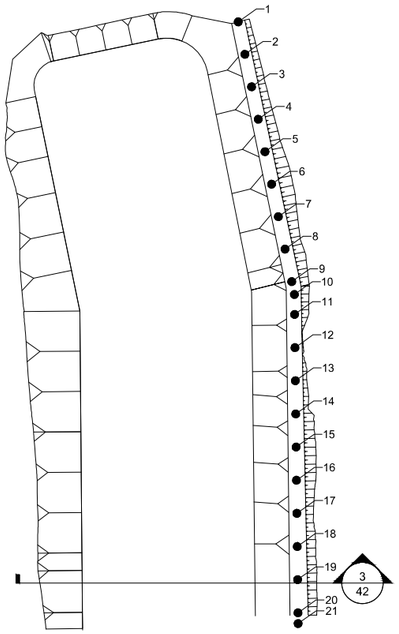
2 RIP RAP WEIR DETAIL

N.T.S.



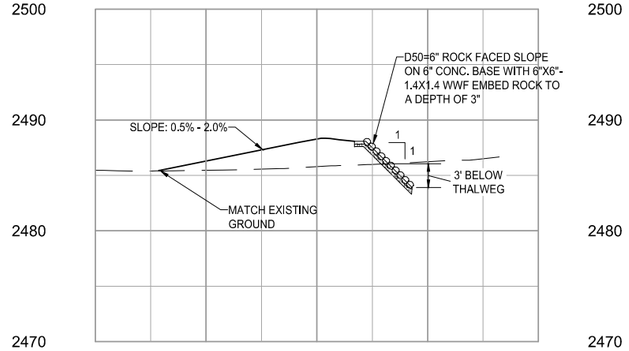
3 BERM @ SOUTHEAST CORNER

N.T.S.



3A BASIN WITH POINT ID

N.T.S.



4 BACKFILL DETAIL

N.T.S.

BERM PROTECTION TABLE

POINT ID	NORTH NG	EASTING	CANYON SHADOWS WASH BOTTOM	Q100 WSEL	TOP OF BERM	FREEBOARD	EXISTING GRADE ON PROTECTED SIDE
1	506547.02	981589.53	2486.55		2488.71		2488.02
2	506527.43	981593.57	2482.74		2488.19		2487.02
3	506507.84	981597.61	2481.90		2487.43		2486.01
4	506488.25	981601.65	2481.06		2486.67		2484.98
5	506468.66	981605.68	2480.23		2485.91		2483.95
6	506449.07	981609.72	2479.39		2485.16		2482.47
7	506429.49	981613.76	2478.55		2484.41		2481.97
8	506409.90	981617.80	2477.71		2483.65		2481.81
9	506390.31	981621.84	2476.87	2475.90	2482.90	7.00	2480.96
10	506382.51	981623.44	2476.77	2475.89	2482.60	6.71	2480.92
11	506370.47	981623.58	2476.23	2475.89	2482.33	6.44	2480.85
12	506350.47	981623.81	2475.78	2475.89	2481.88	5.99	2481
13	506330.48	981624.03	2475.33	2475.88	2481.44	5.56	2480.64
14	506330.48	981624.26	2474.88	2475.88	2480.99	5.11	2480.02
15	506290.48	981624.48	2474.43	2475.88	2480.54	4.66	2478.35
16	506270.48	981624.71	2474.00	2475.87	2480.09	4.22	2477.85
17	506250.48	981624.94	2474.00	2475.87	2479.65	3.78	2478.03
18	506230.48	981625.16	2474.00	2475.87	2479.20	3.33	2477.37
19	506210.48	981625.39	2474.00	2475.75	2478.75	3.00	2476.79
20	506190.48	981625.62	2474.00	2475.29	2478.31	3.02	2476.64
21	506183.95	981625.69	2474.00	2475.12	2478.13	3.01	2476.63

*REFER TO DETAIL 3 ON THIS PAGE, FOR GRAPHICAL REPRESENTATION.

RELATED CASE #
OV914-009
2100731
OV114-018

LJA Engineering, Inc.
7456 N. La Cholla Boulevard,
Tucson, AZ 85741
Phone 520.257.3400

BASIN DETAILS
SUNDARA RIDGE

FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

54544
ROBERT W. SCHLICHER
Date signed 12/16/24
ARIZONA U.S.A.

PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

H: 1"=50' C.I.=2'
V:
SCALE
12/16/24
DATE
AZ4072-1004
JOB NUMBER
ML
DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY

42 OF 51

P22WM00005
G-2022-007

DateTime: Mon, 16 Dec 2024 - 10:18am PathName: S:\ARIZ\Tucson\AZ4072\400\LAND_LJA MOVING FORWARD\BASE FILES\IPlv\2 DETAILS.dwg

Appendix D. Scour and Erosion

Project: Fasseas
Watercourse: Multiple

City of Tucson Erosion Hazard Setback Equations for Local Watercourses

Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona
Simons, Li & Associates, Inc, December 1989, (revised July, 1998)

Eqn 7.8a	For $r_c/T_w \geq 10$:	$SB = 1.0\ (Q_{p100})^{0.5}$
Eqn 7.8b	For $5 < r_c/T_w < 10$:	$SB = 1.7\ (Q_{p100})^{0.5}$
Eqn 7.8c	For $r_c/T_w \leq 5$:	$SB = 2.5\ (Q_{p100})^{0.5}$

Watercourse	Location	Q (cfs)	$r_{c\ (ft)}$	$T_{w\ (ft)}$	r_c/T_w =	Setback (ft)
Canada Hills	base	622			≥10	25
local	1		137	16	8.6	42
Lomas de Oro	base	1642			≥10	41
local	0.3		162	7	23.1	41
local	0.5		191	34	5.6	69
local	1		73	30	2.4	101
local	2	(not used)*	114	32	3.6	101
local	3		117	39	3.0	101
Canyon Shadows	base	300			≥10	17
local	1		191	14	13.6	17
local	2	(not used)*	567	81	7	29

* setback line behind erosion mitigation

Concept Design for Riprap Apron

(subject to design modifications based on grading constraints)

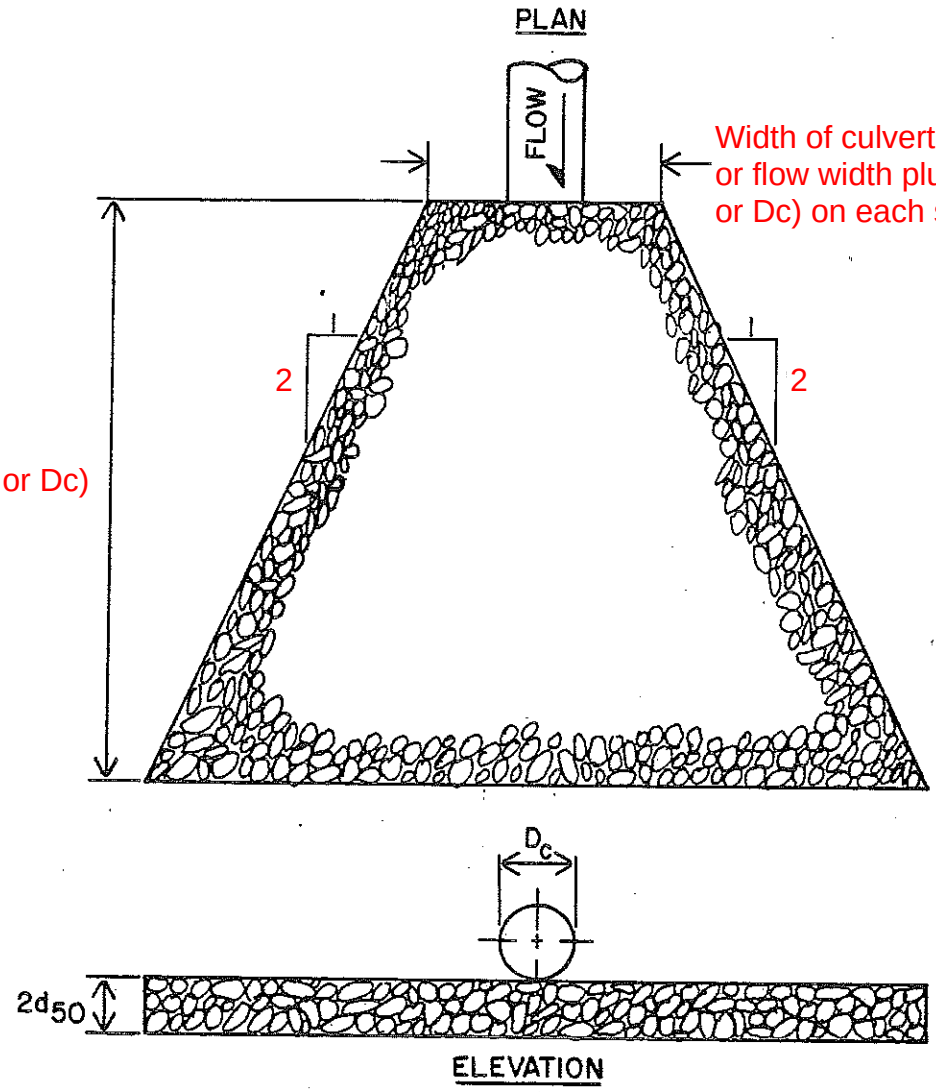


Figure 2-VI:
Recommended Configuration Of Riprap Blanket

k=2 for minimum tailwater

k=5 for maximum tailwater

L_{SB}= Length of scour basin, ft. = 8 * d (diameter or depth)

D_c = Culvert diameter, ft.

d_{50}= Riprap median diameter

$$d_{50} = 0.02 \left[\frac{Dc^2}{TW}\right](R)^{1.33}$$

$$R = \frac{Q}{D_c^{2.5}} = q/(D_c)^{1.5}$$, for other shapes

for circular or square culverts

(Modified from Pima County, 1984)

Summary of Basic Data and the Design Scour Depth

Project: Fasseas - Lomas de Oro Wash **4th submittal**
Multiple locations

BASIC DATA HEC-RAS

This section provides the input parameters that were applied to the equations identified in the subsequent computation sheets that summarize solutions for the various scour equations that are found in the "Standards Manual for Drainage Design and Floodplain Management in Tucson Arizona", City of Tucson, 1989 (hereafter referred to as the COT Drainage Design Manual).

Hydraulic Data **"Left" = east side**
"Right" = west side

Application:	Grouted RR on Left Bank	Grouted RR on Left Bank	Grouted RR on Left Bank	Grouted RR on Left Bank	Grouted RR on Both Banks	Grouted RR on Right Bank	Grouted RR on Right Bank		
Watercourse:	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash		
Section:	34	33	32-30	29	28-26.5	26-14	13-11		
Qtotal =	1642	1642	1497	1474	1474	1474	1474	cfs	total discharge (100-year)
Qch =	904	1087	1248	1383	1285	1398	1194	cfs	channel discharge
Ach =	116	136	173	194	165	215	169	sq ft	channel area of flow
Tch =	32	47	85	82	67	157	94	feet	channel topwidth of flow
Ymax =	4.3	3.6	3.0	3.1	3.1	2.1	2.7	feet	maximum depth of flow
Se =	0.0062	0.0085	0.0112	0.0090	0.0083	0.0153	0.0102	ft/ft	energy slope or channel bed slope
TW =	0.00	0.00	0.00	0.00	0.00	0.00	0.00	feet	tailwater depth (if different than Ymax; otherwise 0)

Note: The energy slope is typically used when the basic hydraulic data is obtained from a HEC-2 analysis of the watercourse, and the channel bed slope is typically used when the data is obtained from a normal-depth analysis of the channel section.

Fixed Data

Watercourse:	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash		
Section:	34	33	32-30	29	28-26.5	26-14	13-11		
rc =	320	470	850	820	670	1570	940	feet	radius of curvature of channel centerline
n-value =	0.035	0.035	0.035	0.032	0.032	0.035	0.032		Manning's n-value for channel
10*TW =	*320*	*470*	*850*	*820*	*670*	*1570*	*940*	feet	**For a straight reach, rc should be set at 10*Tch**

DESIGN SCOUR DEPTH

Per COT Drainage Design Manual, Equation 6.3:

Watercourse:	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash		
Section:	34	33	32-30	29	28-26.5	26-14	13-11		
Zgs =	0.00	0.00	0.00	0.00	0.12	0.00	0.07	feet	(general scour)
Za =	0.83	0.87	0.71	0.69	0.83	0.58	0.68	feet	(anti-dune trough)
Zls =	1.70	n/a	n/a	n/a	n/a	n/a	n/a	feet	(local scour -abutment or contraction, if applicable)
Zbs =	0.00	0.00	0.00	0.00	0.00	0.00	0.00	feet	(bend scour)
Zlft =	1.00	1.00	1.00	1.00	1.00	1.00	1.00	feet	(low-flow thalweg)
	3.53	1.87	1.71	1.69	1.95	1.58	1.75	feet	sum
	1.30	1.30	1.30	1.30	1.30	1.30	1.30		(safety factor)
Zt =	4.6	2.4	2.2	2.2	2.5	2.1	2.3	feet	**Total Scour**
	2	2	2	2	2	2	2		**Long-term degradation** **per TOV recommendation**
	6.6	**4.4**	**4.2**	**4.2**	**4.5**	**4.1**	**4.3**		***MINIMUM TOEDOWN***

Depth of Scour

Project: Fasseas - Lomas de Oro Wash
Multiple locations

GENERAL SCOUR

Per COT Drainage Design Manual, Equation 6.4:

Watercourse:	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	
Section:	34	33	32-30	29	28-26.5	26-14	13-11	
Vm =	7.79	7.99	7.21	7.13	7.79	6.50	7.07	fps
Ymax =	4.30	3.60	3.00	3.10	3.10	2.10	2.70	feet
Yh =	3.63	2.89	2.04	2.37	2.46	1.37	1.80	feet
Se =	0.0062	0.0085	0.0112	0.0090	0.0083	0.0153	0.0102	ft/ft
Zgs =	0.00	0.00	0.00	0.00	0.12	0.00	0.07	feet

(if a negative value is calculated, result appears as 0)

ANTI-DUNE TROUGH DEPTH

Per COT Drainage Design Manual, Equation 6.5:

Watercourse:	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash		
Section:	34	33	32-30	29	28-26.5	26-14	13-11		
Vm =	7.79	7.99	7.21	7.13	7.79	6.50	7.07	fps	
g =	32.20	32.20	32.20	32.20	32.20	32.20	32.20	ft/s^2	accelaration due to gravity
Za =	0.83	0.87	0.71	0.69	0.83	0.58	0.68	feet	

LOW-FLOW THALWEG

Per TOV DCM, 2020:

$Z_{LFT} = 0.0$ feet When $W_{1\%}/Y_{1\%} \leq 1.15V_{1\%}$
$Z_{LFT} = 1.0$ feet When $W_{1\%}/Y_{1\%} > 1.15V_{1\%}$ and $A < 30$ square miles
$Z_{LFT} = 2.0$ feet When $W_{1\%}/Y_{1\%} > 1.15V_{1\%}$ and $A \geq 30$ square miles

Watercourse:	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	
Section:	34	33	32-30	29	28-26.5	26-14	13-11	
W=	32	47	85	82	67	157	94	
Y=	4.3	3.6	3.0	3.1	3.1	2.1	2.7	
W/Y=	7.4	13.1	28.3	26.5	21.6	74.8	34.8	
1.15*v=	9.0	9.2	8.3	8.2	9.0	7.5	8.1	
Zlft =	1.0	1.0	1.0	1.0	1.0	1.0	1.0	feet

BEND SCOUR

Per COT Drainage Design Manual, Equation 6.6:

Watercourse:	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash	LdO Wash		
Section:	34	33	32-30	29	28-26.5	26-14	13-11		
Vm =	7.79	7.99	7.21	7.13	7.79	6.50	7.07	fps	
Ymax =	4.30	3.60	3.00	3.10	3.10	2.10	2.70	feet	
Yh =	3.63	2.89	2.04	2.37	2.46	1.37	1.80	feet	
Se =	0.0062	0.0085	0.0112	0.0090	0.0083	0.0153	0.0102	ft/ft	
rc =	320.00	470.00	850.00	820.00	670.00	1570.00	940.00	feet	
T =	32.00	47.00	85.00	82.00	67.00	157.00	94.00	feet	
rc/T =	10.00	10.00	10.00	10.00	10.00	10.00	10.00		(calculated rc/T is limited to 0.5 < rc/T < 10)
Zbs =	0.00	0.00	0.00	0.00	0.00	0.00	0.00	feet	(using rc/T and substituting Eqn. 6.7 into Eqn. 6.6)

Local Scour at Abutments

Lomas de Oro Wash
Abutment scour at cross secton 34

CITY OF TUCSON LOCAL SCOUR AT EMBANKMENT (Eqn 6.11)

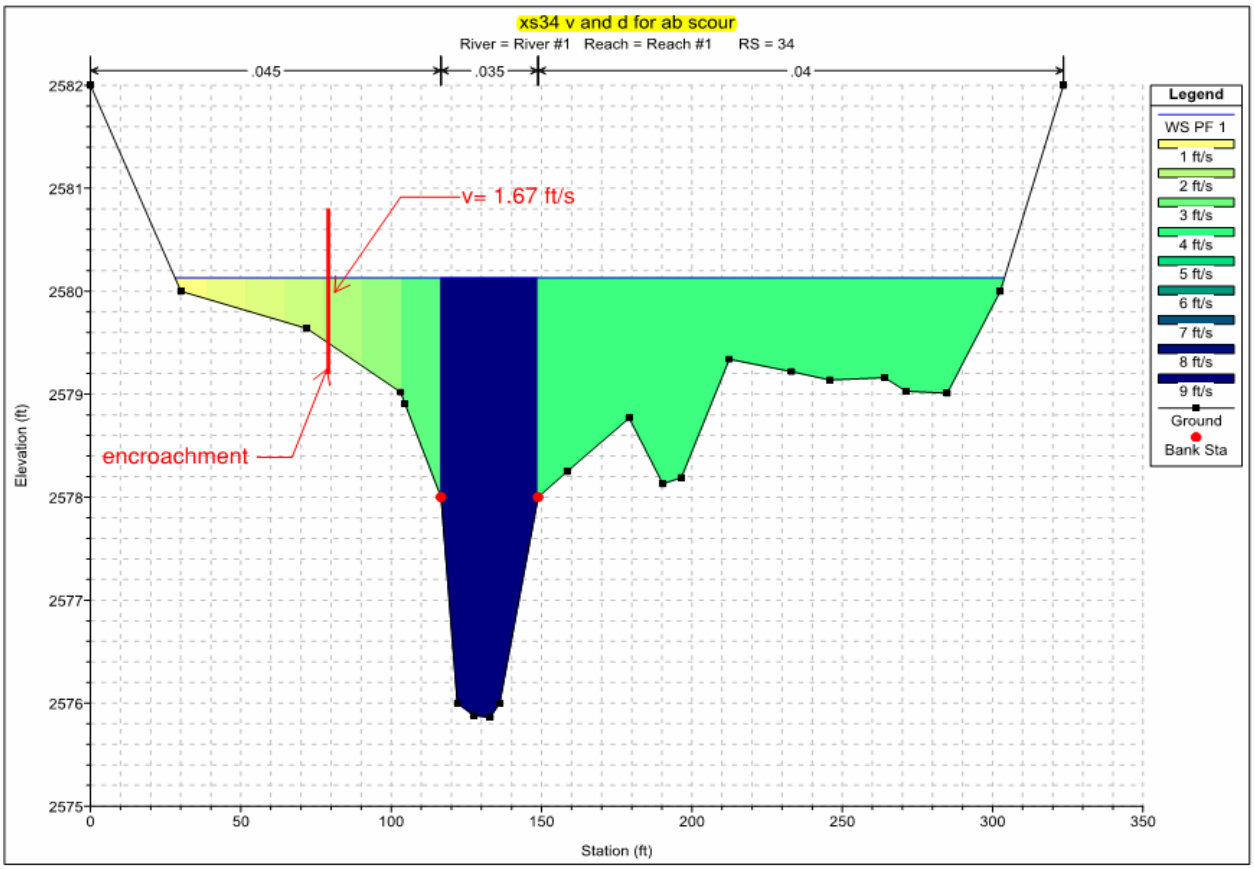
Per COT Drainage Design Manual, Equation 6.11:

v =	1.67	ft/s		
Y =	0.6	feet		
F_u =	0.4			
θ_a =	45	degrees	$\theta_a = \tan^{-1}(V/H)$	for side slope of obstruction
a_e =	63.0	feet		
Zlsf =	4.3	feet		
IF	*9.78*	**>4, use equation 6.12**		

CITY OF TUCSON LOCAL SCOUR AT EMBANKMENT (Eqn 6.12)

Per COT Drainage Design Manual, Equation 6.12: *(HIRE, 1975, Eqn. 6.5.9)*

Zlsf = 1.7 feet



Equilibrium Slopes and Long-term Degradation
Lomas de Oro Wash above proposed culvert

Equilibrium Slopes

$$S_{eq} = \left(\left[\frac{Q_{Pu,10\%}}{Q_{Pn,10\%}}\right]^{-1.1}[1 - R_s]^{0.7}\right)S_n \qquad \textit{(Equation 5.34)}$$

Q_{10} existing	693
Q_{10} developed	693
% imp existing	4%
% imp developed	50%
R_s (% imp change)	0.46
S_n	0.027
S_{eq}	0.018

Existing based on LOMR HEC-HMS
assume 50% of sediment lost behind watershed culverts

S_{eq} = Equilibrium channel slope, in feet per foot.
S_n = Natural channel slope, in feet per foot.
$Q_{Pu,10\%}$ = 10% AEP flood peak discharge for *urbanized* conditions, in cfs.
$Q_{Pn,10\%}$ = 10% AEP flood peak discharge for *natural* conditions, in cfs.
R_s = Sediment reduction factor for upstream sediment supply (i.e., typically the ratio of predicted long-term impervious area to total area. Some examples of the causes of R_s are (1) watershed urbanization, (2) sand-and-gravel mining, (3) stormwater detention and/or retention facilities. The value of R_s varies from 0.0 to 1.0 (i.e., a decimal fraction).

Typically, 0.15 would represent a reasonable average value for R_s for rural to suburban watershed conditions; 0.4 would represent a reasonable average value for R_s for moderately-urban watershed conditions, and 0.7 would represent a reasonable average value for R_s under highly-urban watershed conditions.

Also, typical values for the parameter $\left[\frac{Q_{Pu,10\%}}{Q_{Pn,10\%}}\right]^{-1.1}$ are 0.875 for suburban to moderately-urban watershed conditions and 0.833 for highly-urban watershed conditions.

5.3.9 Long-Term Degradation

$$Z_{LTD} = \frac{8}{13}(S_n - S_{eq})L_{dc} \qquad \textit{(Equation 5.31)}$$

River Sta	Invert Slope	Min Ch El	Length Chnl	L_{dc}	Z_{LTD}
		(ft)	(ft)	(ft)	(ft)
34	0.0139	2575.9	105	363	2.1
33	0.0153	2574.4	33	258	1.5
32	0.0250	2572.8	24	225	1.3
31	0.0272	2571.1	82	201	1.2
30	0.0236	2568.9	76	119	0.7
29	0.0249	2567.1	43	43	0.3
28.5	culvert	2566	0	0	0.0
	slope (ft/ft)	H (ft)	L (ft)		
	0.0273	9.9	363		

Z_{LTD} = Long-Term Degradation, in feet.
A = Drainage area of watershed, in square miles.
D_a = Armoring particle size, in millimeters.
P_c = *Percent* (%) of the material which is coarser than the armoring size.
$Q_{P10\%}$ = 10% AEP peak discharge, in cfs.
S_n = Natural channel slope, in feet per foot.
S_{eq} = Equilibrium channel slope, in feet per foot.

L_{dc} = Estimated distance to downstream control; in feet.

Equilibrium Slopes and Long-term Degradation
Lomas de Oro Wash below proposed culvert

Equilibrium Slopes

$$S_{eq} = \left(\left[\frac{Q_{Pu,10\%}}{Q_{Pn,10\%}}\right]^{-1.1}[1 - R_s]^{0.7}\right)S_n \qquad \text{(Equation 5.34)}$$

Q_{10} existing	693
Q_{10} developed	693
% imp existing	4%
% imp developed	50%
R_s (% imp change)	0.46
S_n	0.026
S_{eq}	0.017

S_{eq} = Equilibrium channel slope, in feet per foot.
S_n = Natural channel slope, in feet per foot.
$Q_{Pu,10\%}$ = 10% AEP flood peak discharge for *urbanized* conditions, in cfs.
$Q_{Pn,10\%}$ = 10% AEP flood peak discharge for *natural* conditions, in cfs.
R_s = Sediment reduction factor for upstream sediment supply (i.e., typically the ratio of predicted long-term impervious area to total area. Some examples of the causes of R_s are (1) watershed urbanization, (2) sand-and-gravel mining, (3) stormwater detention and/or retention facilities. The value of R_s varies from 0.0 to 1.0 (i.e., a decimal fraction).

Typically, 0.15 would represent a reasonable average value for R_s for rural to suburban watershed conditions; 0.4 would represent a reasonable average value for R_s for moderately-urban watershed conditions, and 0.7 would represent a reasonable average value for R_s under highly-urban watershed conditions.

Also, typical values for the parameter $\left[\frac{Q_{Pu,10\%}}{Q_{Pn,10\%}}\right]^{-1.1}$ are 0.875 for suburban to moderately-urban watershed conditions and 0.833 for highly-urban watershed conditions.

5.3.9 Long-Term Degradation

$$Z_{LTD} = \frac{8}{13}(S_n - S_{eq})L_{dc} \qquad \text{(Equation 5.31)}$$

USE 2 FEET PER TOV

NOT REASONABLE

River Sta	Invert Slope	Min Ch El	Length Chnl	L_{dc}	Z_{LTD}
		(ft)	(ft)	(ft)	(ft)
27	0.0186	2563.2	87	1697	9.5
26.5	0.0177	2561.5	87	1610	9.0
26	0.0215	2560	109	1523	8.5
25	0.0231	2557.7	104	1414	7.9
24	0.0252	2555.3	86	1310	7.3
23	0.0292	2553.1	95	1224	6.9
22	0.0235	2550.3	104	1129	6.3
21	0.0223	2547.9	97	1025	5.7
20	0.0253	2545.7	107	928	5.2
19	0.0336	2543	100	821	4.6
18	0.0327	2539.7	100	721	4.0
17	0.0258	2536.4	100	621	3.5
16	0.0264	2533.8	104	521	2.9
15	0.0308	2531.1	99	417	2.3
14	0.0317	2528	122	318	1.8
13	0.0265	2524.1	101	196	1.1
12	0.0246	2521.5	95	95	0.5
11	0.0251	2519.1	0	0	0.0
	chn		0	0	
	slope (ft/ft)	H (ft)	L (ft)		
	0.0260	44.1	1697		

Z_{LTD} = Long-Term Degradation, in feet.
A = Drainage area of watershed, in square miles.
D_a = Armoring particle size, in millimeters.
P_c = *Percent* (%) of the material which is coarser than the armoring size.
$Q_{P10\%}$ = 10% AEP peak discharge, in cfs.
S_n = Natural channel slope, in feet per foot.
S_{eq} = Equilibrium channel slope, in feet per foot.

L_{dc} = Estimated distance to downstream control; in feet.

Equilibrium Slopes and Long-term Degradation
Canyon Shadows Wash above basin

Equilibrium Slopes

$$S_{eq} = \left(\left[\frac{Q_{Pu,10\%}}{Q_{Pn,10\%}}\right]^{-1.1}[1 - R_s]^{0.7}\right)S_n \qquad \textit{(Equation 5.34)}$$

Q_{10} existing	112
Q_{10} developed	92
% imp existing	5%
% imp developed	6%
R_s (% imp change)	0.01
S_n	0.041
S_{eq}	0.051

Trends towards aggradation more than degradation

S_{eq} = Equilibrium channel slope, in feet per foot.

S_n = Natural channel slope, in feet per foot.

$Q_{Pu,10\%}$ = 10% AEP flood peak discharge for *urbanized* conditions, in cfs.

$Q_{Pn,10\%}$ = 10% AEP flood peak discharge for *natural* conditions, in cfs.

R_s = Sediment reduction factor for upstream sediment supply (i.e., typically the ratio of predicted long-term impervious area to total area. Some examples of the causes of R_s are (1) watershed urbanization, (2) sand-and-gravel mining, (3) stormwater detention and/or retention facilities. The value of R_s varies from 0.0 to 1.0 (i.e., a decimal fraction).

Typically, 0.15 would represent a reasonable average value for R_s for rural to suburban watershed conditions; 0.4 would represent a reasonable average value for R_s for moderately-urban watershed conditions, and 0.7 would represent a reasonable average value for R_s under highly-urban watershed conditions.

Also, typical values for the parameter $\left[\frac{Q_{Pu,10\%}}{Q_{Pn,10\%}}\right]^{-1.1}$ are 0.875 for suburban to moderately-urban watershed conditions and 0.833 for highly-urban watershed conditions.

Equilibrium Slopes and Long-term Degradation
Canyon Shadows Wash below basin

Equilibrium Slopes

$$S_{eq} = \left(\left[\frac{Q_{Pu,10\%}}{Q_{Pn,10\%}}\right]^{-1.1}[1 - R_s]^{0.7}\right)S_n \qquad \textit{(Equation 5.34)}$$

Q_{10} existing	112
Q_{10} developed	101
% imp existing	5%
% imp developed	20%
R_s (% imp change)	0.15
S_n	0.044
S_{eq}	0.044

Assume 100% imp (no sediment) from basin

S_{eq} = Equilibrium channel slope, in feet per foot.

S_n = Natural channel slope, in feet per foot.

$Q_{Pu,10\%}$ = 10% AEP flood peak discharge for *urbanized* conditions, in cfs.

$Q_{Pn,10\%}$ = 10% AEP flood peak discharge for *natural* conditions, in cfs.

R_s = Sediment reduction factor for upstream sediment supply (i.e., typically the ratio of predicted long-term impervious area to total area. Some examples of the causes of R_s are (1) watershed urbanization, (2) sand-and-gravel mining, (3) stormwater detention and/or retention facilities. The value of R_s varies from 0.0 to 1.0 (i.e., a decimal fraction).

Typically, 0.15 would represent a reasonable average value for R_s for rural to suburban watershed conditions; 0.4 would represent a reasonable average value for R_s for moderately-urban watershed conditions, and 0.7 would represent a reasonable average value for R_s under highly-urban watershed conditions.

Also, typical values for the parameter $\left[\frac{Q_{Pu,10\%}}{Q_{Pn,10\%}}\right]^{-1.1}$ are 0.875 for suburban to moderately-urban watershed conditions and 0.833 for highly-urban watershed conditions.

Project: Lomas de Oro Wash ConSpan

Sediment Transport Ratios per Equation 11.5, City of Tucson Drainage Standards Manual

1) channel at culvert face to inside of culvert
2) upstream channel to channel at culvert face

Rs = (Qac/Qp)*(Sac/Sp)^1.66*(Nac/Np)^-1.55*(Rac/Rp)^0.91
if Rs ≤ 1, adequate transport capacity exists in the culver

where:
- Rs = sediment-transport ratio
- Qac = discharge in approach channel in cfs
- Qp = total culvert discharge in cfs
- Sac = slope of approach channel, in ft/ft
- Sp = slope of culvert, in ft/ft
- Nac = n-value for the approach channel
- Np = n-value for culverts
- Rac = hydraulic radius of flow in approach channel, in feet
- Rp = hydraulic radius of flow within the culvert, in feet (hydraulic depth O.K.)

HEC-RAS hydraulics

Structure	D	Invert at Inlet	Invert at Outlet	WSEL inside inlet	Depth inside inlet	Area inside inlet	Hydraulic radius	Headwater Elevation	Headwater depth	HW/D
2 24x6 ConSpar	6	2565.6	2564.6	2568.7	3.1	72	2.4	2570.1	4.5	0.75

1) Section 28.5 (at face of culvert) to inside of culver

Structure	Location	Qac	Qp	Sac	Sp	Nac	Np	Rac	Rp	Rs
2 24x6 ConSpar	LdO Wash	1474	1474	0.0192	0.02	0.025	0.013	3.8	2.4	0.5

2) Upstream section 29 to Section 28.5 (at face of culver

Structure	Location	Qac	Qp	Sac	Sp	Nac	Np	Rac	Rp	Rs
2 24x6 ConSpar	LdO Wash	1474	1474	0.0342	0.0192	0.035	0.025	2.4	3.8	1.0

Appendix E. Detention Routing

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

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

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

PIMA COUNTY FLOOD CONTROL

Rev. 4/17

Basin N	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Friday, July 22, 2022	**Run Date**
Basin N pc-route.xls	**Program File Name**

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

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

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

VARIABLES:

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

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

RESULTS:

	max inflow	max outflow	total inflow volume	max stage (H) *	target ** discharge
100-Year	43.1 cfs	0.1 cfs	45733 ft³ 1.050 af	0.50 ft 87 min	44 cfs
10-Year	21.9 cfs	0.0 cfs	23319 ft³ 0.535 af	0.26 ft 98 min	18.0 csf
2-Year	8.9 cfs	0.0 cfs	10772 ft³ 0.247 af	0.12 ft 110 min	5.7 cfs

* Max Design Stage = 3.3 ft

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

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

Δt = 1.00 min 0.0167 hr inflow hydrograph time interval

index count	100-Year Inflow I, cfs	100-Year time t, hr	100-Year S/Δt+O/2 cfs	10-Year Inflow I, cfs	10-Year S/Δt+O/2 cfs	2-Year Inflow I, cfs	2-Year S/Δt+O/2 cfs	100-Year outflow O, cfs	100-Year Stage H, ft	10-Year outflow O, cfs	10-Year Stage H, ft	2-Year outflow O, cfs	2-Year Stage H, ft
0	0	0.0000	0.00	0	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	1	0.0167	0.41	0	0.20	0.1	0.07	0.00	0.00	0.00	0.00	0.00	0.00
2	2	0.0333	2.01	1	0.97	0.4	0.33	0.00	0.00	0.00	0.00	0.00	0.00
3	4	0.0500	5.45	2	2.63	0.7	0.89	0.00	0.00	0.00	0.00	0.00	0.00
4	7	0.0667	11.13	3	5.38	1.1	1.83	0.00	0.01	0.00	0.00	0.00	0.00
5	10	0.0833	19.33	5	9.35	1.6	3.19	0.00	0.01	0.00	0.01	0.00	0.00
6	13	0.1000	30.39	6	14.69	2.1	5.00	0.00	0.02	0.00	0.01	0.00	0.00
7	16	0.1167	44.65	8	21.57	2.6	7.34	0.00	0.03	0.00	0.01	0.00	0.00
8	19	0.1333	62.30	9	30.10	3.2	10.25	0.00	0.04	0.00	0.02	0.00	0.01
9	23	0.1500	83.62	11	40.40	3.8	13.75	0.00	0.06	0.00	0.03	0.00	0.01
10	28	0.1667	109.22	13	52.71	4.5	17.90	0.00	0.07	0.00	0.03	0.00	0.01
11	33	0.1833	139.75	16	67.37	5.2	22.73	0.00	0.09	0.00	0.04	0.00	0.02
12	38	0.2000	175.29	18	84.50	6.1	28.39	0.00	0.12	0.00	0.06	0.00	0.02
13	42	0.2167	215.22	20	103.86	7.0	34.96	0.00	0.14	0.00	0.07	0.00	0.02
14	43	0.2333	257.73	22	125.00	7.9	42.41	0.00	0.17	0.00	0.08	0.00	0.03
15	41	0.2500	299.60	21	146.27	8.5	50.62	0.00	0.20	0.00	0.10	0.00	0.03
16	38	0.2667	338.86	19	166.28	8.9	59.33	0.00	0.22	0.00	0.11	0.00	0.04
17	35	0.2833	375.39	18	184.98	8.4	67.98	0.00	0.25	0.00	0.12	0.00	0.04
18	33	0.3000	409.24	17	202.35	8.0	76.18	0.00	0.27	0.00	0.13	0.00	0.05
19	30	0.3167	440.50	15	218.44	7.5	83.89	0.00	0.29	0.00	0.14	0.00	0.06
20	28	0.3333	469.30	14	233.32	7.0	91.13	0.00	0.31	0.00	0.15	0.00	0.06
21	25	0.3500	495.85	13	247.02	6.5	97.89	0.00	0.33	0.00	0.16	0.00	0.06
22	24	0.3667	520.36	12	259.70	6.1	104.21	0.00	0.34	0.00	0.17	0.00	0.07
23	22	0.3833	542.88	11	271.41	5.7	110.09	0.01	0.36	0.00	0.18	0.00	0.07
24	20	0.4000	563.43	10	282.15	5.3	115.56	0.01	0.37	0.00	0.19	0.00	0.08
25	18	0.4167	582.13	9	291.94	4.9	120.68	0.02	0.39	0.00	0.19	0.00	0.08
26	16	0.4333	599.10	9	300.87	4.6	125.44	0.02	0.40	0.00	0.20	0.00	0.08
27	15	0.4500	614.43	8	308.98	4.2	129.85	0.03	0.41	0.00	0.20	0.00	0.09
28	13	0.4667	628.28	7	316.33	3.9	133.91	0.03	0.42	0.00	0.21	0.00	0.09
29	12	0.4833	640.76	6	322.97	3.6	137.66	0.04	0.42	0.00	0.21	0.00	0.09
30	11	0.5000	651.92	6	328.96	3.3	141.11	0.04	0.43	0.00	0.22	0.00	0.09
31	10	0.5167	661.93	5	334.34	3.0	144.26	0.05	0.44	0.00	0.22	0.00	0.10
32	9	0.5333	670.92	5	339.19	2.8	147.15	0.05	0.44	0.00	0.22	0.00	0.10
33	8	0.5500	678.95	4	343.54	2.5	149.80	0.06	0.45	0.00	0.23	0.00	0.10
34	7	0.5667	686.19	4	347.45	2.3	152.21	0.06	0.45	0.00	0.23	0.00	0.10
35	6	0.5833	692.73	3	351.00	2.1	154.40	0.06	0.46	0.00	0.23	0.00	0.10
36	6	0.6000	698.61	3	354.20	1.9	156.40	0.07	0.46	0.00	0.23	0.00	0.10
37	5	0.6167	703.91	3	357.10	1.7	158.22	0.07	0.47	0.00	0.24	0.00	0.10
38	5	0.6333	708.66	2	359.72	1.6	159.87	0.08	0.47	0.00	0.24	0.00	0.11
39	4	0.6500	712.92	2	362.07	1.4	161.38	0.08	0.47	0.00	0.24	0.00	0.11
40	4	0.6667	716.79	2	364.21	1.3	162.76	0.08	0.47	0.00	0.24	0.00	0.11
41	3	0.6833	720.28	2	366.15	1.2	164.03	0.08	0.48	0.00	0.24	0.00	0.11
42	3	0.7000	723.47	2	367.91	1.1	165.18	0.09	0.48	0.00	0.24	0.00	0.11
43	3	0.7167	726.43	2	369.53	1.0	166.24	0.09	0.48	0.00	0.24	0.00	0.11
44	3	0.7333	729.15	1	371.04	0.9	167.21	0.09	0.48	0.00	0.25	0.00	0.11
45	2	0.7500	731.63	1	372.43	0.8	168.09	0.09	0.48	0.00	0.25	0.00	0.11
46	2	0.7667	733.87	1	373.71	0.8	168.90	0.09	0.49	0.00	0.25	0.00	0.11
47	2	0.7833	735.91	1	374.87	0.7	169.64	0.09	0.49	0.00	0.25	0.00	0.11
48	2	0.8000	737.78	1	375.93	0.7	170.33	0.09	0.49	0.00	0.25	0.00	0.11
49	2	0.8167	739.50	1	376.92	0.6	170.97	0.10	0.49	0.00	0.25	0.00	0.11
50	2	0.8333	741.06	1	377.83	0.6	171.57	0.10	0.49	0.00	0.25	0.00	0.11
51	1	0.8500	742.47	1	378.66	0.5	172.13	0.10	0.49	0.00	0.25	0.00	0.11
52	1	0.8667	743.74	1	379.42	0.5	172.65	0.10	0.49	0.00	0.25	0.00	0.11
53	1	0.8833	744.89	1	380.10	0.5	173.13	0.10	0.49	0.00	0.25	0.00	0.11
54	1	0.9000	745.97	1	380.73	0.4	173.57	0.10	0.49	0.00	0.25	0.00	0.11
55	1	0.9167	746.96	1	381.33	0.4	173.98	0.10	0.49	0.00	0.25	0.00	0.12
56	1	0.9333	747.87	1	381.88	0.4	174.36	0.10	0.49	0.00	0.25	0.00	0.12
57	1	0.9500	748.70	0	382.39	0.3	174.72	0.10	0.50	0.00	0.25	0.00	0.12
58	1	0.9667	749.46	0	382.87	0.3	175.04	0.10	0.50	0.00	0.25	0.00	0.12
59	1	0.9833	750.15	0	383.30	0.3	175.34	0.10	0.50	0.00	0.25	0.00	0.12
60	1	1.0000	750.77	0	383.71	0.3	175.62	0.11	0.50	0.00	0.25	0.00	0.12

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

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

Worksheet to Input the Stage - Volume Relationship for the Facility

Basin N	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Friday, July 22, 2022	**Run Date**
Basin N pc-route.xls	**Program File Name**

PIMA COUNTY FLOOD CONTROL

Rev.4/17

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

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

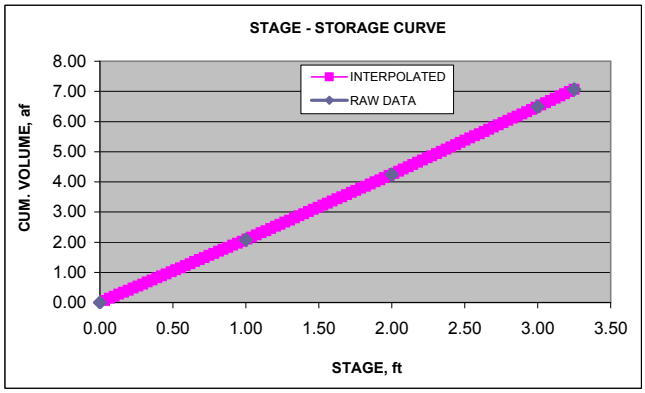
VARIABLES:

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

3.25 = max design stage (ft)

stage H, ft	area A, ac	volume ΔV, af	for information only: area A, ft²	for information only: volume ΔV, ft³	for information only: Σ ΔV S, ft³	Σ ΔV S, af	index for interpolation
0.0	2.0408	0	88897	0	0	0	1
1.00	2.1229	2.082	92474	90680	90680	2.082	2
2.0	2.2064	2.165	96111	94286	184966	4.2462	3
3.00	2.2911	2.249	99800	97950	282916	6.49	4
3.25	2.3125	0.575	100733	25067	307982	7.07	5
							6
							7
							8
							9
							10
							11
							12
							13
							14
							15
							16
							17
							18
							19
							20
							21
							22
							23
							24
							25
							26

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



PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

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

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

Rev. 4/17

Basin N	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Friday, July 22, 2022	**Run Date**
Basin N pc-route.xls	**Program File Name**

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

GOVERNING EQUATIONS:

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

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

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

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

ORIFICE PLATE OUTFLOW ELEMENT

d_o (in) =		diameter	area (ft^2) =	0.000
C =	0.60	disch coefficient		
E_o (ft) =	0.00	stage @ orifice center	inv (in) =	0.00
N =		nbr identical openings	inv (ft) =	0.000

TRIANGULAR WEIR OUTFLOW ELEMENT

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

RECTANGULAR WEIR OUTFLOW ELEMENT(S)

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

BOX, ROUND CULVERT OUTFLOW ELEMENT

	RCP	RCBC	
D (ft) =	1.0		barrel rise, dia
B (ft) =			barrel span
E_o (ft) =	0.33		barrel invert

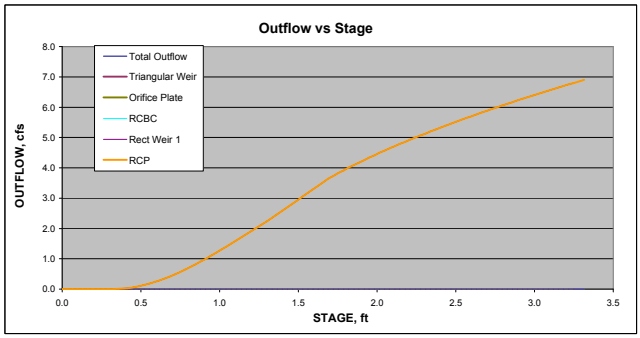
Stage	Orifice Plate	Weir Element(s)				RCP	RCBC	Outflow	Σ vol
		Triang 1	Rect 1	Rect 2	Rect 3				
H, ft	Q, cfs	Q, cfs	Q, cfs	Q, cfs	Q, cfs	Q, cfs	Q, cfs	O, cfs	S, af
0.00								0.0	0.0000
0.03								0.0	0.0687
0.07								0.0	0.1353
0.10								0.0	0.2040
0.13								0.0	0.2706
0.16								0.0	0.3393
0.20								0.0	0.4059
0.23								0.0	0.4746
0.26								0.0	0.5412
0.29								0.0	0.6099
0.33								0.0	0.6766
0.36						0.0		0.0	0.7453
0.39						0.0		0.0	0.8119
0.42						0.0		0.0	0.8806
0.46						0.1		0.1	0.9472
0.49						0.1		0.1	1.0159
0.52						0.1		0.1	1.0825
0.55						0.2		0.2	1.1512
0.59						0.2		0.2	1.2178
0.62						0.3		0.3	1.2865
0.65						0.3		0.3	1.3531
0.68						0.4		0.4	1.4218
0.72						0.5		0.5	1.4884
0.75						0.6		0.6	1.5571
0.78						0.6		0.6	1.6237
0.81						0.7		0.7	1.6924
0.85						0.8		0.8	1.7590
0.88						0.9		0.9	1.8277
0.91						1.0		1.0	1.8944
0.94						1.1		1.1	1.9631
0.98						1.2		1.2	2.0297
1.01						1.3		1.3	2.0990
1.04						1.4		1.4	2.1683
1.07						1.5		1.5	2.2397
1.11						1.6		1.6	2.3090
1.14						1.7		1.7	2.3804
1.17						1.8		1.8	2.4497
1.20						1.9		1.9	2.5211
1.24						2.0		2.0	2.5904
1.27						2.1		2.1	2.6618
1.30						2.2		2.2	2.7311
1.33						2.4		2.4	2.8025
1.37						2.5		2.5	2.8718
1.40						2.6		2.6	2.9432
1.43						2.7		2.7	3.0125
1.46						2.8		2.8	3.0839
1.50						2.9		2.9	3.1532
1.53						3.1		3.1	3.2246
1.56						3.2		3.2	3.2938
1.59						3.3		3.3	3.3653
1.63						3.4		3.4	3.4345
1.66						3.5		3.5	3.5060
1.69						3.6		3.6	3.5752
1.72						3.7		3.7	3.6467
1.76						3.8		3.8	3.7159
1.79						3.9		3.9	3.7874
1.82						4.0		4.0	3.8566
1.85						4.1		4.1	3.9280
1.89						4.2		4.2	3.9973
1.92						4.3		4.3	4.0687
1.95						4.3		4.3	4.1380
1.98						4.4		4.4	4.2094
2.02						4.5		4.5	4.2800
2.05						4.6		4.6	4.3542
2.08						4.6		4.6	4.4261
2.11						4.7		4.7	4.5003
2.15						4.8		4.8	4.5723
2.18						4.9		4.9	4.6465
2.21						4.9		4.9	4.7184
2.24						5.0		5.0	4.7926
2.28						5.1		5.1	4.8646
2.31						5.1		5.1	4.9388
2.34						5.2		5.2	5.0108
2.37						5.3		5.3	5.0850
2.41						5.3		5.3	5.1569
2.44						5.4		5.4	5.2311
2.47						5.5		5.5	5.3031
2.50						5.5		5.5	5.3773
2.54						5.6		5.6	5.4492
2.57						5.6		5.6	5.5234
2.60						5.7		5.7	5.5954
2.63						5.8		5.8	5.6696
2.67						5.8		5.8	5.7416
2.70						5.9		5.9	5.8158
2.73						5.9		5.9	5.8877
2.76						6.0		6.0	5.9619
2.80						6.1		6.1	6.0339
2.83						6.1		6.1	6.1081
2.86						6.2		6.2	6.1800
2.89						6.2		6.2	6.2542
2.93						6.3		6.3	6.3262
2.96						6.3		6.3	6.4004
2.99						6.4		6.4	6.4724
3.02						6.4		6.4	6.5478
3.06						6.5		6.5	6.6214
3.09						6.5		6.5	6.6974
3.12						6.6		6.6	6.7711
3.15						6.6		6.6	6.8470
3.19						6.7		6.7	6.9207
3.22						6.8		6.8	6.9966
3.25						6.8		6.8	7.0703
3.32						6.9		6.9	7.2199

last two cells in cum.vol column contain non-standard equations

ROUTING RESULTS FOR DESIGN OF OUTLET WORKS

Max Design Stage = 3.25 ft

	Max Inflow		Max Outflow		Max Stage				target discharges	
100-Yr	43.1	cfs	0.1	cfs	0.50	ft @	87	min	44.0	cfs
10-Yr	21.9	cfs	0.0	cfs	0.26	ft @	98	min	18.0	cfs
2 -yr	8.9	cfs	0.0	cfs	0.12	ft @	110	min	5.7	cfs



PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

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

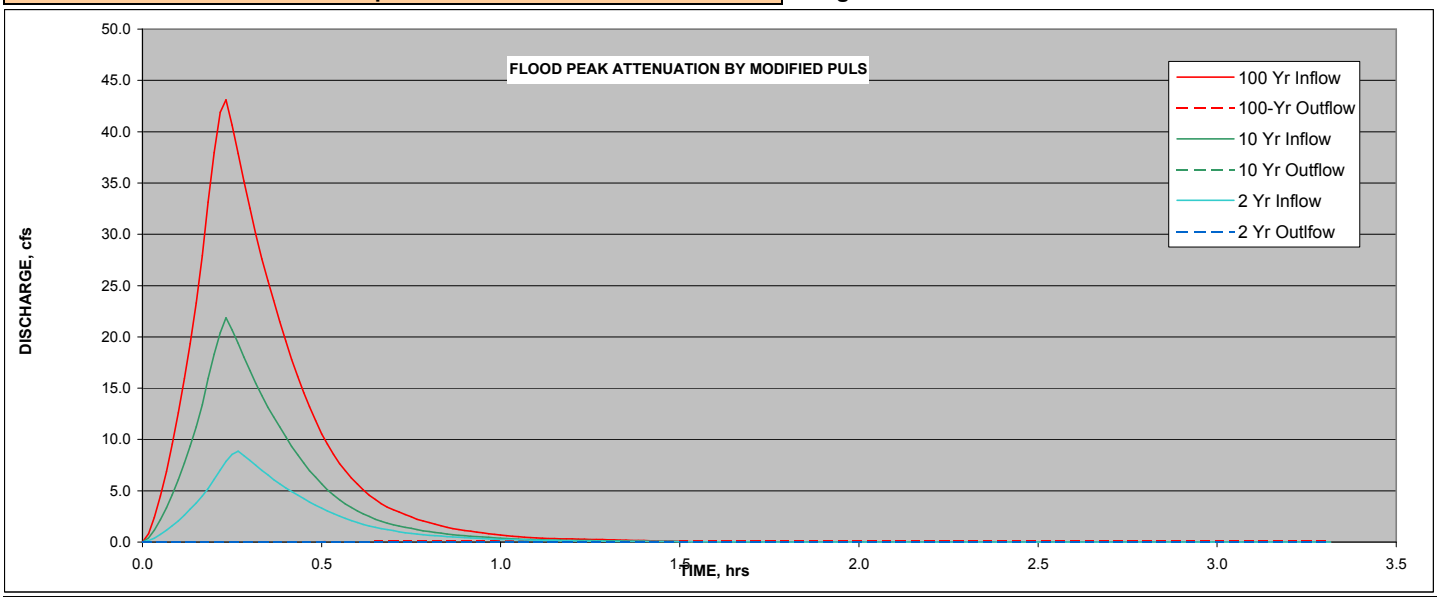
THIS TAB CONTAINS NO INPUT DATA

Summary of Reservoir Routing of the Inflow Hydrograph using the Specified Detention Facility and Outlet Works

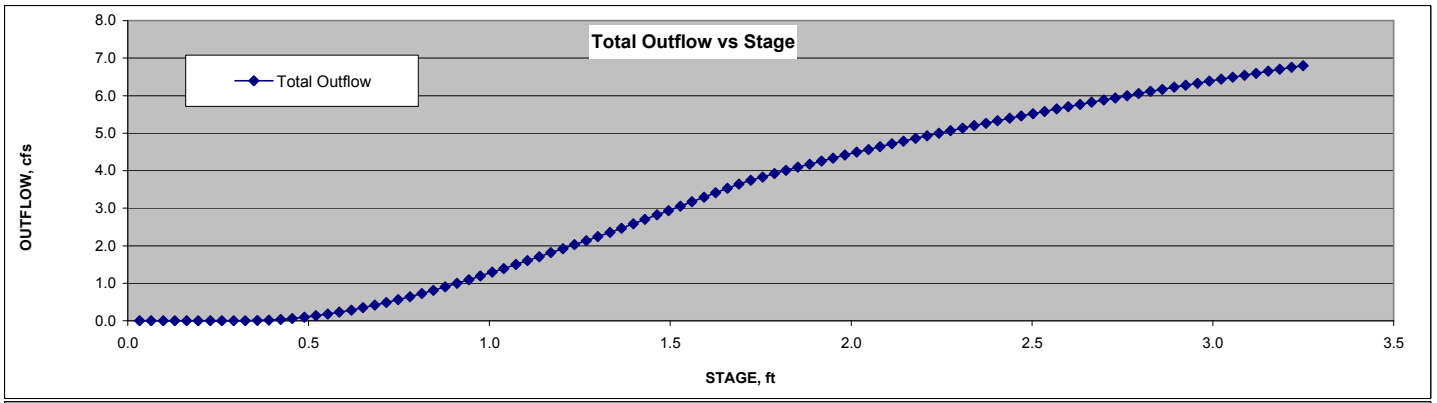
PIMA COUNTY FLOOD CONTROL

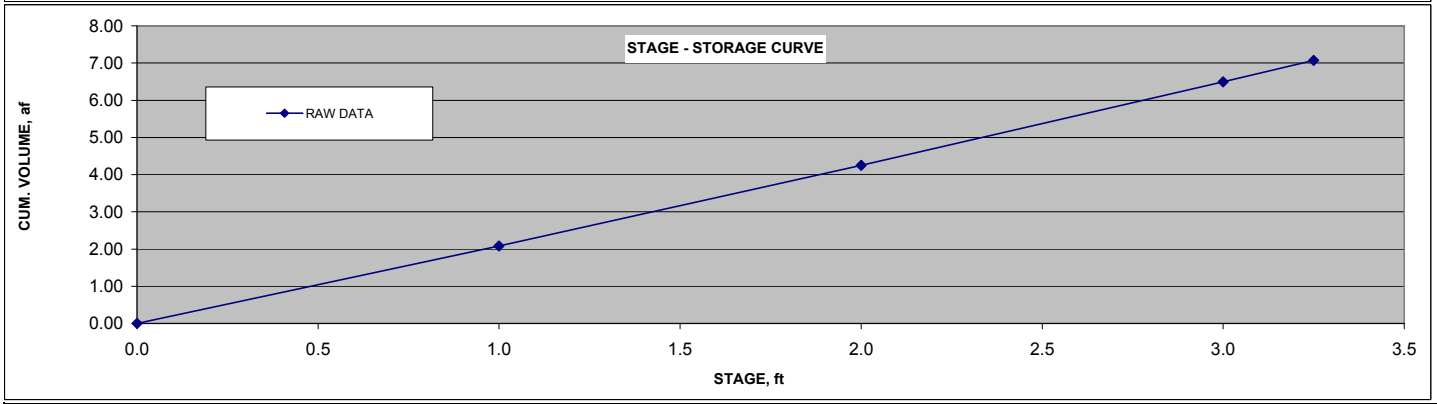
Rev.04/17

Basin N	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Friday, July 22, 2022	**Run Date**
Basin N pc-route.xls	**Program File Name**



ORIFICE PLATE			TRIANGULAR WEIR			RECTANGULAR WEIR(S)					RCP / RCBC		
							rect 1	rect 2	rect 3		RCP	RCBC	
d_o (in) =	0.0	diameter	Z =	0.0	side slope								
C (dim) =	0.60	discharge coefficient	E_w (ft) =	0.00	stage at weir crest	L (ft) =	0.0	0.0	0.0	crest length	1.0	0.0	D (ft) rise / diameter
N =	0	nbr identical openings	Θ =		° notch angle	C =	3.00	0.00	0.00	discharge coef		0.0	B (ft) span
inv (ft) =	0.00	stage at invert	C_1 =	0	discharge coefficient	E_w (ft) =	0.00	0.00	0.00	stage at crest	0.33	0.00	E_b (ft) stage at invert





RESULTS:

	max inflow	max outflow	target discharge	total inflow volume	max stage (H) *
100-Year	43.1 cfs	0.1 cfs	44 cfs	45733 ft^3 1.050 af	0.50 ft at 87 min
10-Year	21.9 cfs	0.0 cfs	18 cfs	23319 ft^3 0.535 af	0.26 ft at 98 min
2-Year	8.9 cfs	0.0 cfs	5.7 cfs	10772 ft^3 0.247 af	0.12 ft at 110 min

* Max Design Stage (ft) = 3.25

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

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

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

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

PIMA COUNTY FLOOD CONTROL

Rev. 4/17

Basin SE	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Friday, December 13, 2024	**Run Date**
FINAL Basin SE wider basin 1-12 pipe and weir pc-route.xls	**Program File Name**

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

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

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

VARIABLES:

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

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

RESULTS:

	max inflow	max outflow	total inflow volume	max stage (H) *	target ** discharge
100-Year	125.3 cfs	34.3 cfs	132947 ft³ 3.052 af	3.0 ft 29 min	37 cfs
10-Year	61.9 cfs	4.4 cfs	69301 ft³ 1.591 af	2.0 ft 45 min	csf
2-Year	28.1 cfs	1.5 cfs	35041 ft³ 0.804 af	1.1 ft 54 min	cfs

* Max Design Stage = 3.5 ft

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

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

Δt = 1.00 min 0.0167 hr inflow hydrograph time interval

index	100-Year Inflow I, cfs	100-Year time t, hr	100-Year S/Δt+O/2 cfs	10-Year Inflow I, cfs	10-Year S/Δt+O/2 cfs	2-Year Inflow I, cfs	2-Year S/Δt+O/2 cfs	100-Year outflow O, cfs	100-Year Stage H, ft	10-Year outflow O, cfs	10-Year Stage H, ft	2-Year outflow O, cfs	2-Year Stage H, ft
count													
0	0	0.0000	0.00	0	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	2	0.0167	1.18	1	0.55	0.4	0.22	0.00	0.00	0.00	0.00	0.00	0.00
2	7	0.0333	5.83	3	2.69	1.1	1.00	0.00	0.01	0.00	0.01	0.00	0.00
3	13	0.0500	15.84	6	7.25	2.2	2.67	0.00	0.03	0.00	0.02	0.00	0.01
4	20	0.0667	32.36	9	14.84	3.5	5.51	0.00	0.07	0.00	0.03	0.00	0.01
5	28	0.0833	56.20	13	25.82	4.8	9.61	0.00	0.12	0.00	0.05	0.00	0.02
6	37	0.1000	88.35	17	40.55	6.2	15.10	0.00	0.18	0.00	0.08	0.00	0.03
7	46	0.1167	129.81	21	59.52	7.9	22.13	0.00	0.27	0.00	0.12	0.00	0.05
8	56	0.1333	181.10	26	83.10	9.7	30.90	0.01	0.38	0.00	0.17	0.00	0.06
9	68	0.1500	243.06	31	111.52	11.5	41.49	0.12	0.51	0.00	0.23	0.00	0.09
10	81	0.1667	317.39	36	145.22	13.5	53.97	0.37	0.66	0.00	0.30	0.00	0.11
11	96	0.1833	405.76	44	185.27	15.6	68.52	0.81	0.84	0.02	0.39	0.00	0.14
12	110	0.2000	508.27	51	232.32	18.3	85.48	1.43	1.05	0.09	0.48	0.00	0.18
13	122	0.2167	622.91	57	285.94	21.1	105.18	2.15	1.27	0.24	0.59	0.00	0.22
14	125	0.2333	744.33	62	345.13	23.7	127.61	2.99	1.51	0.49	0.72	0.00	0.27
15	118	0.2500	863.08	61	406.19	26.1	152.50	3.78	1.74	0.81	0.84	0.00	0.32
16	110	0.2667	973.42	58	464.82	28.1	179.56	4.34	1.95	1.16	0.97	0.01	0.37
17	102	0.2833	1075.27	54	519.48	27.3	207.23	6.18	2.14	1.50	1.07	0.04	0.43
18	95	0.3000	1167.49	50	570.06	25.9	233.80	9.72	2.30	1.82	1.17	0.09	0.49
19	87	0.3167	1248.66	47	616.68	24.4	258.89	13.66	2.44	2.11	1.26	0.16	0.54
20	80	0.3333	1318.71	43	659.48	23.0	282.44	17.56	2.57	2.39	1.34	0.23	0.59
21	74	0.3500	1378.31	40	698.62	21.5	304.45	21.20	2.67	2.67	1.42	0.31	0.63
22	68	0.3667	1428.38	37	734.38	20.1	324.96	24.46	2.76	2.92	1.49	0.40	0.68
23	63	0.3833	1469.40	34	767.10	18.8	344.03	27.26	2.83	3.15	1.55	0.49	0.72
24	57	0.4000	1501.88	32	796.89	17.5	361.69	29.56	2.89	3.35	1.61	0.57	0.75
25	52	0.4167	1526.72	29	823.74	16.4	378.06	31.36	2.93	3.54	1.66	0.66	0.79
26	47	0.4333	1544.75	26	847.83	15.3	393.27	32.69	2.96	3.70	1.71	0.74	0.82
27	42	0.4500	1556.70	24	869.35	14.2	407.33	33.58	2.98	3.82	1.75	0.82	0.85
28	38	0.4667	1563.45	22	888.50	13.2	420.22	34.08	2.99	3.92	1.79	0.89	0.87
29	34	0.4833	1565.75	20	905.43	12.2	432.00	34.25	3.00	4.01	1.82	0.96	0.90
30	31	0.5000	1564.06	18	920.34	11.2	442.73	34.12	3.00	4.08	1.85	1.03	0.92
31	28	0.5167	1559.13	16	933.36	10.3	452.49	33.76	2.99	4.14	1.87	1.09	0.94
32	25	0.5333	1551.66	15	944.61	9.5	461.31	33.20	2.97	4.20	1.90	1.14	0.96
33	22	0.5500	1541.97	13	954.32	8.7	469.26	32.48	2.96	4.25	1.91	1.19	0.98
34	20	0.5667	1530.69	12	962.61	8.0	476.41	31.65	2.94	4.29	1.93	1.24	0.99
35	18	0.5833	1518.23	11	969.61	7.3	482.80	30.74	2.92	4.32	1.94	1.28	1.00
36	16	0.6000	1504.78	10	975.56	6.6	488.47	29.76	2.89	4.35	1.96	1.31	1.01
37	15	0.6167	1490.62	9	980.53	6.1	493.50	28.75	2.87	4.37	1.96	1.34	1.02
38	13	0.6333	1475.88	8	984.60	5.5	497.96	27.71	2.84	4.39	1.97	1.37	1.03
39	12	0.6500	1460.79	7	987.87	5.0	501.87	26.66	2.82	4.40	1.98	1.39	1.04
40	11	0.6667	1445.60	7	990.38	4.6	505.30	25.62	2.79	4.42	1.98	1.41	1.05
41	10	0.6833	1430.36	6	992.22	4.3	508.34	24.59	2.76	4.43	1.99	1.43	1.05
42	9	0.7000	1415.30	5	993.51	3.9	510.98	23.59	2.74	4.43	1.99	1.45	1.06
43	8	0.7167	1400.55	5	994.27	3.6	513.26	22.62	2.71	4.43	1.99	1.46	1.06
44	8	0.7333	1386.08	5	994.61	3.3	515.23	21.69	2.69	4.44	1.99	1.48	1.07
45	7	0.7500	1371.86	4	994.62	3.0	516.88	20.79	2.66	4.44	1.99	1.49	1.07
46	6	0.7667	1357.85	4	994.32	2.7	518.26	19.92	2.64	4.43	1.99	1.49	1.07
47	6	0.7833	1344.13	4	993.69	2.5	519.41	19.08	2.61	4.43	1.99	1.50	1.07
48	5	0.8000	1330.77	3	992.74	2.3	520.34	18.27	2.59	4.43	1.99	1.51	1.08
49	5	0.8167	1317.76	3	991.49	2.2	521.08	17.51	2.57	4.42	1.99	1.51	1.08
50	5	0.8333	1305.08	3	990.01	2.0	521.66	16.77	2.54	4.41	1.98	1.52	1.08
51	4	0.8500	1292.68	3	988.32	1.9	522.10	16.06	2.52	4.41	1.98	1.52	1.08
52	4	0.8667	1280.58	2	986.42	1.8	522.42	15.39	2.50	4.40	1.98	1.52	1.08
53	4	0.8833	1268.84	2	984.33	1.6	522.61	14.74	2.48	4.39	1.97	1.52	1.08
54	3	0.9000	1257.52	2	982.03	1.5	522.67	14.13	2.46	4.38	1.97	1.52	1.08
55	3	0.9167	1246.57	2	979.57	1.4	522.61	13.55	2.44	4.37	1.96	1.52	1.08
56	3	0.9333	1235.96	2	976.98	1.3	522.44	13.00	2.42	4.35	1.96	1.52	1.08
57	3	0.9500	1225.67	2	974.30	1.2	522.18	12.48	2.40	4.34	1.95	1.52	1.08
58	2	0.9667	1215.69	2	971.52	1.1	521.85	11.98	2.39	4.33	1.95	1.52	1.08
59	2	0.9833	1206.01	1	968.64	1.1	521.43	11.51	2.37	4.31	1.94	1.51	1.08
60	2	1.0000	1196.62	1	965.66	1.0	520.93	11.06	2.35	4.30	1.94	1.51	1.08

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

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

Worksheet to Input the Stage - Volume Relationship for the Facility

Basin SE	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Friday, December 13, 2024	**Run Date**
FINAL Basin SE wider basin 1-12 pipe and weir pc-route.xls	**Program File Name**

PIMA COUNTY FLOOD CONTROL

Rev.4/17

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

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

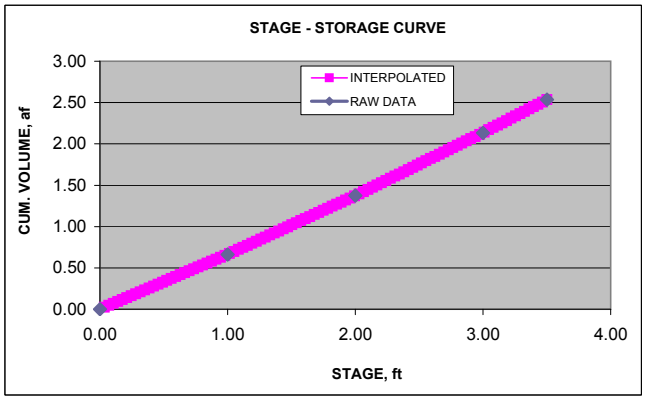
VARIABLES:

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

3.50 = max design stage (ft)

			for information only				
stage H, ft	area A, ac	volume ΔV, af	area A, ft²	volume ΔV, ft³	Σ ΔV S, ft³	Σ ΔV S, af	index for interpolation
0.0	0.6378	0	27783	0	0	0	1
1.00	0.6861	0.662	29887	28828	28828	0.662	2
2.00	0.7358	0.711	32051	30963	59791	1.3726	3
3.0	0.7868	0.761	34273	33156	92947	2.13	4
3.50	0.8128	0.400	35406	17419	110366	2.53	5
							6
							7
							8
							9
							10
							11
							12
							13
							14
							15
							16
							17
							18
							19
							20
							21
							22
							23
							24
							25
							26

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



PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

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

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

Rev. 4/17

Basin SE	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Friday, December 13, 2024	**Run Date**
FINAL Basin SE wider basin 1-12 pipe and weir pc-route.xls	**Program File Name**

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

GOVERNING EQUATIONS:

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

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

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

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

ORIFICE PLATE OUTFLOW ELEMENT

d_o (in) =		diameter	area (ft²) =	0.000
C =	0.60	disch coefficient		
E_o (ft) =	0.00	stage @ orifice center	inv (in) =	0.00
N =		nbr identical openings	inv (ft) =	0.000

TRIANGULAR WEIR OUTFLOW ELEMENT

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

RECTANGULAR WEIR OUTFLOW ELEMENT(S)

	rect 1	rect 2	rect 3	
L (ft) =	9			crest length
C =	3.00			disch coefficient
E_w (ft) =	2.00			stage at crest

BOX, ROUND CULVERT OUTFLOW ELEMENT

	RCP	RCBC	
D (ft) =	1.0		barrel rise, dia
B (ft) =			barrel span
E_b (ft) =	0.33		barrel invert

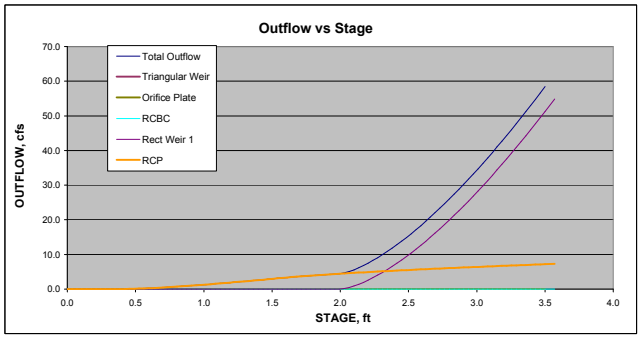
Stage	Orifice Plate	Weir Element(s) Triang 1	Rect 1	Rect 2	Rect 3	RCP	RCBC	Outflow	Σ vol
H, ft	Q, cfs	Q, cfs	Q, cfs	Q, cfs	Q, cfs	Q, cfs	Q, cfs	O, cfs	S, af
0.00								0.0	0.0000
0.04								0.0	0.0232
0.07								0.0	0.0463
0.11								0.0	0.0695
0.14								0.0	0.0927
0.18								0.0	0.1158
0.21								0.0	0.1390
0.25								0.0	0.1621
0.28								0.0	0.1853
0.32								0.0	0.2085
0.35						0.0		0.0	0.2316
0.39						0.0		0.0	0.2548
0.42						0.0		0.0	0.2780
0.46						0.1		0.1	0.3011
0.49						0.1		0.1	0.3243
0.53						0.1		0.1	0.3474
0.56						0.2		0.2	0.3706
0.60						0.2		0.2	0.3938
0.63						0.3		0.3	0.4169
0.67						0.4		0.4	0.4401
0.70						0.5		0.5	0.4633
0.74						0.5		0.5	0.4864
0.77						0.6		0.6	0.5096
0.81						0.7		0.7	0.5328
0.84						0.8		0.8	0.5559
0.88						0.9		0.9	0.5791
0.91						1.0		1.0	0.6022
0.95						1.1		1.1	0.6254
0.98						1.2		1.2	0.6486
1.02						1.3		1.3	0.6725
1.05						1.4		1.4	0.6973
1.09						1.5		1.5	0.7222
1.12						1.6		1.6	0.7471
1.16						1.8		1.8	0.7720
1.19						1.9		1.9	0.7969
1.23						2.0		2.0	0.8217
1.26						2.1		2.1	0.8466
1.30						2.2		2.2	0.8715
1.33						2.3		2.3	0.8964
1.37						2.5		2.5	0.9212
1.40						2.6		2.6	0.9461
1.44						2.7		2.7	0.9710
1.47						2.8		2.8	0.9959
1.51						3.0		3.0	1.0208
1.54						3.1		3.1	1.0456
1.58						3.2		3.2	1.0705
1.61						3.4		3.4	1.0954
1.65						3.5		3.5	1.1203
1.68						3.6		3.6	1.1452
1.72						3.7		3.7	1.1700
1.75						3.8		3.8	1.1949
1.79						3.9		3.9	1.2198
1.82						4.0		4.0	1.2447
1.86						4.1		4.1	1.2695
1.89						4.2		4.2	1.2944
1.93						4.3		4.3	1.3193
1.96						4.4		4.4	1.3442
2.00						4.4		4.4	1.3691
2.03			0.1			4.5		4.7	1.3954
2.07			0.5			4.6		5.1	1.4221
2.10			0.9			4.7		5.6	1.4487
2.14			1.4			4.8		6.1	1.4754
2.17			2.0			4.8		6.8	1.5020
2.21			2.6			4.9		7.5	1.5286
2.24			3.3			5.0		8.3	1.5553
2.28			4.0			5.1		9.1	1.5819
2.31			4.8			5.1		10.0	1.6086
2.35			5.7			5.2		10.9	1.6352
2.38			6.5			5.3		11.8	1.6618
2.42			7.5			5.3		12.8	1.6885
2.45			8.4			5.4		13.8	1.7151
2.49			9.4			5.5		14.9	1.7418
2.52			10.5			5.6		16.0	1.7684
2.56			11.5			5.6		17.2	1.7951
2.59			12.6			5.7		18.3	1.8217
2.63			13.8			5.7		19.5	1.8483
2.66			15.0			5.8		20.8	1.8750
2.70			16.2			5.9		22.0	1.9016
2.73			17.4			5.9		23.3	1.9283
2.77			18.7			6.0		24.7	1.9549
2.80			20.0			6.1		26.0	1.9815
2.84			21.3			6.1		27.4	2.0082
2.87			22.6			6.2		28.8	2.0348
2.91			24.0			6.2		30.3	2.0615
2.94			25.4			6.3		31.7	2.0881
2.98			26.9			6.4		33.2	2.1147
3.01			28.3			6.4		34.7	2.1418
3.05			29.8			6.5		36.3	2.1698
3.08			31.3			6.5		37.8	2.1977
3.12			32.8			6.6		39.4	2.2257
3.15			34.4			6.6		41.1	2.2537
3.19			36.0			6.7		42.7	2.2817
3.22			37.6			6.8		44.4	2.3097
3.26			39.2			6.8		46.0	2.3377
3.29			40.9			6.9		47.7	2.3657
3.33			42.6			6.9		49.5	2.3937
3.36			44.2			7.0		51.2	2.4217
3.40			46.0			7.0		53.0	2.4497
3.43			47.7			7.1		54.8	2.4777
3.47			49.5			7.1		56.6	2.5057
3.50			51.3			7.2		58.4	2.5336
3.57			54.9			7.3		62.2	2.5896

last two cells in cum.vol column contain non-standard equations

ROUTING RESULTS FOR DESIGN OF OUTLET WORKS

Max Design Stage = 3.50 ft

	Max Inflow	Max Outflow	Max Stage				target discharges
100-Yr	125.3 cfs	34 cfs	3.0	ft @	29	min	37.0 cfs
10-Yr	61.9 cfs	4 cfs	2.0	ft @	45	min	cfs
2 -yr	28.1 cfs	1.5 cfs	1.1	ft @	54	min	cfs



PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

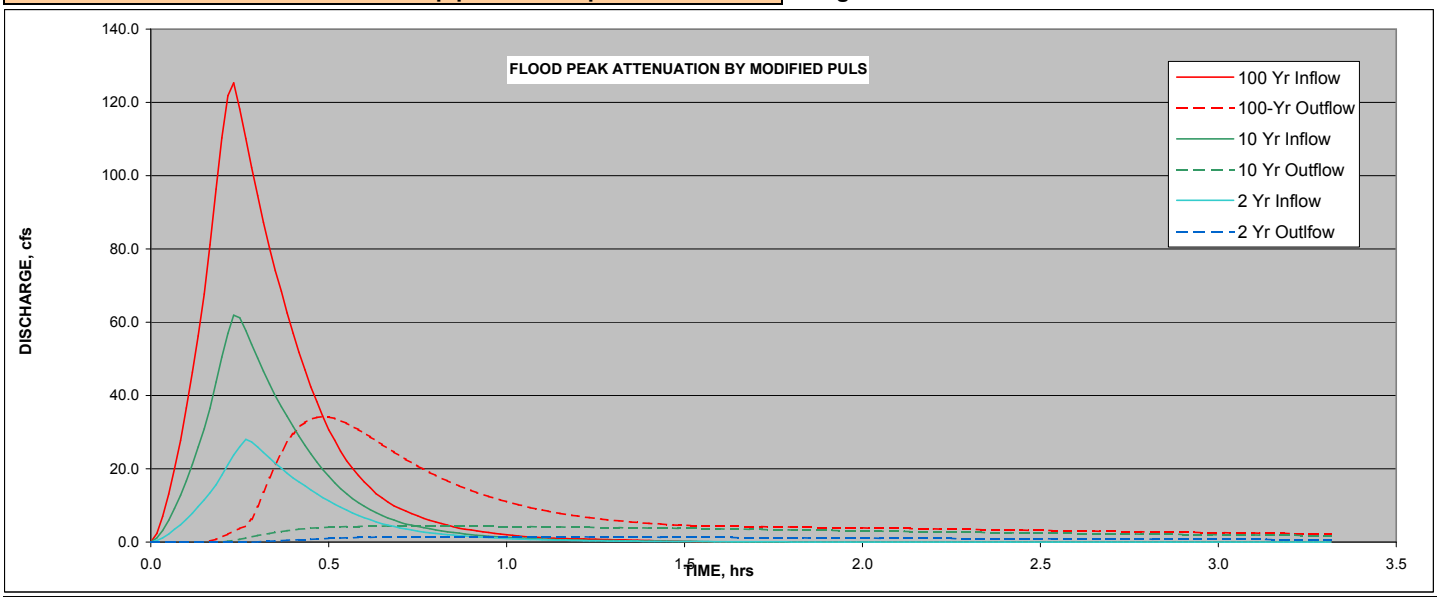
ROUTING OF A FLOOD HYDROGRAPH THROUGH A STORMWATER DETENTION / RETENTION FACILITY

THIS TAB CONTAINS NO INPUT DATA

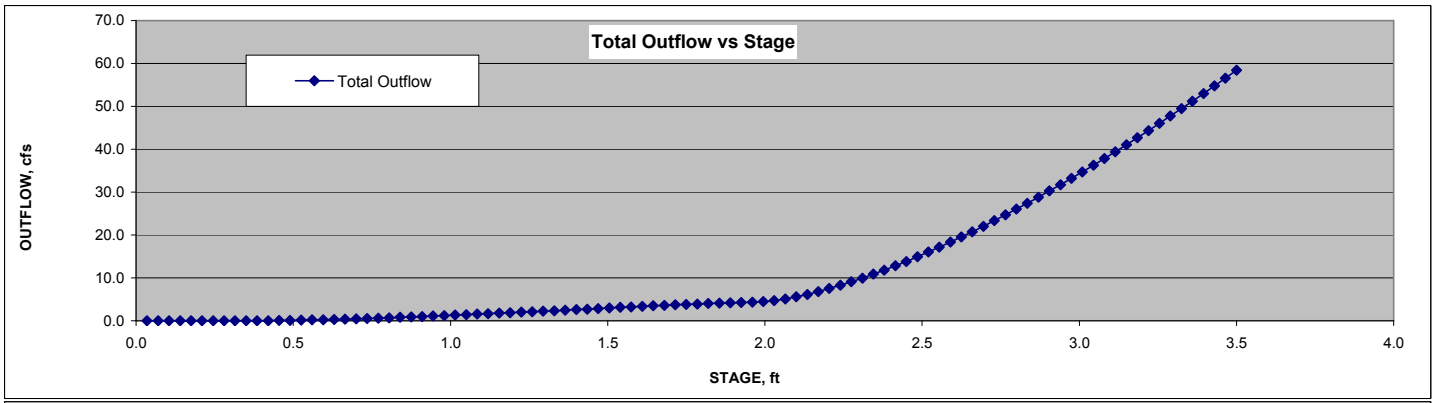
Summary of Reservoir Routing of the Inflow Hydrograph using the Specified Detention Facility and Outlet Works

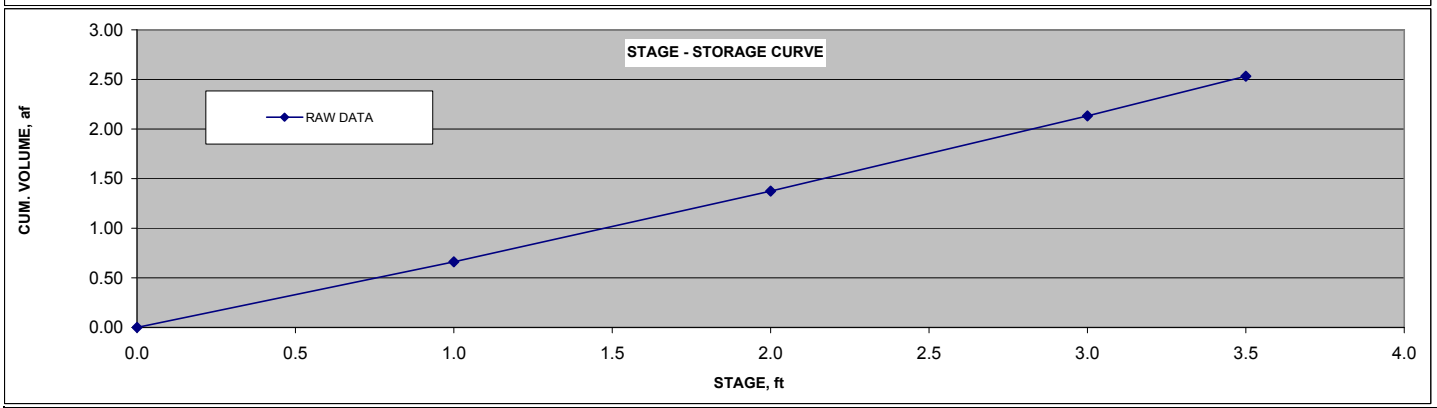
Basin SE	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Friday, December 13, 2024	**Run Date**
FINAL Basin SE wider basin 1-12 pipe and weir pc-route.xls	**Program File Name**

Rev.04/17



ORIFICE PLATE			TRIANGULAR WEIR			RECTANGULAR WEIR(S)					RCP / RCBC		
							rect 1	rect 2	rect 3		RCP	RCBC	
d_o (in) =	0.0	diameter	Z =	0.0	side slope								
C (dim) =	0.60	discharge coefficient	E_w (ft) =	0.00	stage at weir crest	L (ft) =	9	0.0	0.0	crest length	1.0	0.0	D (ft) rise / diameter
N =	0	nbr identical openings	Θ =		° notch angle	C =	3.00	0.00	0.00	discharge coef		0.0	B (ft) span
inv (ft) =	0.00	stage at invert	C_1 =	0	discharge coefficient	E_w (ft) =	2.00	0.00	0.00	stage at crest	0.33	0.00	E_b (ft) stage at invert





RESULTS:

	max inflow	max outflow	target discharge	total inflow volume	max stage (H) *
100-Year	125.3 cfs	34.3 cfs	37 cfs	132947 ft^3 3.052 af	3.00 ft at 29 min
10-Year	61.9 cfs	4.4 cfs	0 cfs	69301 ft^3 1.591 af	1.99 ft at 45 min
2-Year	28.1 cfs	1.5 cfs	0 cfs	35041 ft^3 0.804 af	1.08 ft at 54 min

* Max Design Stage (ft) = 3.50

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

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

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

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

PIMA COUNTY FLOOD CONTROL

Rev. 4/17

Basin SW	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Monday, January 22, 2024	**Run Date**
Basin SW pc-route.xls	**Program File Name**

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

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

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

VARIABLES:

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

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

RESULTS:

	max inflow	max outflow	total inflow volume	max stage (H) *	target ** discharge
100-Year	224.2 cfs	115.6 cfs	237791 ft³ 5.459 af	2.99 ft 23 min	166 cfs
10-Year	125.6 cfs	17.4 cfs	133258 ft³ 3.059 af	2.53 ft 35 min	67.0 csf
2-Year	66.8 cfs	3.1 cfs	70829 ft³ 1.626 af	1.55 ft 47 min	22.0 cfs

* Max Design Stage = 3.5 ft

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

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

Δt = 1.00 min 0.0167 hr inflow hydrograph time interval

index count	100-Year Inflow I, cfs	100-Year time t, hr	100-Year S/Δt+O/2 cfs	10-Year Inflow I, cfs	10-Year S/Δt+O/2 cfs	2-Year Inflow I, cfs	2-Year S/Δt+O/2 cfs	100-Year outflow O, cfs	100-Year Stage H, ft	10-Year outflow O, cfs	10-Year Stage H, ft	2-Year outflow O, cfs	2-Year Stage H, ft
0	0	0.0000	0.00	0	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	4	0.0167	2.11	2	1.18	1.3	0.63	0.00	0.01	0.00	0.01	0.00	0.00
2	12	0.0333	10.43	7	5.84	3.7	3.11	0.00	0.05	0.00	0.03	0.00	0.01
3	23	0.0500	28.34	13	15.88	7.0	8.44	0.00	0.13	0.00	0.07	0.00	0.04
4	36	0.0667	57.88	20	32.44	10.6	17.24	0.00	0.18	0.00	0.14	0.00	0.08
5	50	0.0833	100.52	28	56.33	14.8	29.94	0.00	0.24	0.00	0.18	0.00	0.13
6	65	0.1000	158.02	37	88.56	19.5	47.07	0.00	0.32	0.00	0.22	0.00	0.16
7	83	0.1167	232.18	46	130.12	24.7	69.16	0.04	0.43	0.00	0.28	0.00	0.19
8	101	0.1333	323.87	56	181.52	30.0	96.48	0.18	0.56	0.00	0.35	0.00	0.23
9	121	0.1500	434.54	68	243.64	36.1	129.50	0.48	0.71	0.05	0.44	0.00	0.28
10	145	0.1667	567.21	81	318.20	43.2	169.16	0.97	0.90	0.17	0.55	0.00	0.34
11	172	0.1833	724.95	97	406.98	51.3	216.43	1.63	1.11	0.40	0.67	0.03	0.40
12	197	0.2000	908.12	111	510.14	58.8	271.45	2.41	1.35	0.75	0.82	0.09	0.48
13	218	0.2167	1113.33	122	625.74	64.9	333.21	3.36	1.61	1.22	0.98	0.20	0.57
14	224	0.2333	1330.98	126	748.38	66.8	398.84	4.19	1.89	1.73	1.14	0.37	0.66
15	211	0.2500	1544.53	118	868.68	62.9	463.32	4.81	2.15	2.24	1.30	0.58	0.75
16	197	0.2667	1743.85	110	980.84	58.7	523.55	5.41	2.39	2.75	1.44	0.80	0.84
17	183	0.2833	1928.36	102	1084.52	54.5	579.32	26.29	2.59	3.23	1.58	1.02	0.92
18	169	0.3000	2078.08	95	1179.92	50.4	630.72	56.43	2.75	3.67	1.70	1.24	0.99
19	156	0.3167	2184.22	87	1267.36	46.5	677.91	81.94	2.86	3.98	1.81	1.43	1.05
20	143	0.3333	2252.01	80	1347.29	42.7	721.07	99.73	2.93	4.25	1.91	1.61	1.11
21	133	0.3500	2290.30	74	1420.38	39.5	760.57	110.21	2.97	4.47	2.01	1.78	1.16
22	122	0.3667	2307.56	69	1487.35	36.5	796.76	115.01	2.99	4.66	2.09	1.93	1.21
23	112	0.3833	2309.66	63	1548.32	33.3	829.71	115.59	2.99	4.82	2.16	2.07	1.25
24	102	0.4000	2300.93	57	1603.39	30.4	859.47	113.16	2.98	4.96	2.22	2.20	1.29
25	93	0.4167	2285.06	52	1652.95	27.6	886.26	108.77	2.97	5.08	2.28	2.31	1.32
26	84	0.4333	2264.61	47	1697.37	25.0	910.25	103.14	2.95	5.19	2.33	2.42	1.35
27	76	0.4500	2241.31	42	1736.93	22.6	931.62	96.86	2.92	5.29	2.38	2.52	1.38
28	69	0.4667	2216.58	38	1772.05	20.4	950.58	90.30	2.90	6.23	2.42	2.61	1.40
29	62	0.4833	2191.35	35	1802.29	18.4	967.36	83.75	2.87	8.67	2.46	2.69	1.43
30	55	0.5000	2165.84	31	1826.25	16.3	982.02	77.32	2.84	11.22	2.48	2.75	1.44
31	50	0.5167	2140.75	28	1844.30	14.8	994.82	71.14	2.82	13.51	2.50	2.81	1.46
32	44	0.5333	2116.61	25	1857.13	13.2	1006.00	65.33	2.79	15.17	2.52	2.87	1.48
33	40	0.5500	2093.35	22	1865.54	11.8	1015.67	59.89	2.77	16.36	2.53	2.91	1.49
34	36	0.5667	2071.38	20	1870.44	10.8	1024.05	54.93	2.75	17.08	2.53	2.95	1.50
35	32	0.5833	2050.76	18	1872.58	9.7	1031.32	50.35	2.72	17.40	2.53	2.98	1.51
36	29	0.6000	2031.33	16	1872.51	8.7	1037.55	46.19	2.70	17.39	2.53	3.01	1.52
37	26	0.6167	2013.05	15	1870.77	7.9	1042.85	42.39	2.68	17.13	2.53	3.04	1.52
38	24	0.6333	1995.71	13	1867.68	7.0	1047.28	38.87	2.67	16.67	2.53	3.06	1.53
39	22	0.6500	1979.41	12	1863.65	6.4	1050.94	35.68	2.65	16.08	2.52	3.07	1.53
40	20	0.6667	1964.25	11	1859.07	5.8	1053.98	32.78	2.63	15.42	2.52	3.09	1.54
41	18	0.6833	1950.04	10	1854.07	5.3	1056.42	30.15	2.62	14.77	2.51	3.10	1.54
42	16	0.7000	1936.91	9	1848.84	4.9	1058.39	27.81	2.60	14.09	2.51	3.11	1.54
43	15	0.7167	1924.91	9	1843.60	4.5	1059.99	25.67	2.59	13.42	2.50	3.12	1.54
44	14	0.7333	1913.82	8	1838.36	4.2	1061.22	23.85	2.58	12.74	2.50	3.12	1.55
45	13	0.7500	1903.33	7	1833.11	3.8	1062.08	22.13	2.57	12.06	2.49	3.13	1.55
46	12	0.7667	1893.34	6	1827.85	3.4	1062.57	20.49	2.56	11.39	2.48	3.13	1.55
47	11	0.7833	1883.93	6	1822.67	3.2	1062.74	19.08	2.55	10.84	2.48	3.13	1.55
48	10	0.8000	1875.08	6	1817.56	2.9	1062.65	17.77	2.54	10.30	2.47	3.13	1.55
49	9	0.8167	1866.74	5	1812.54	2.7	1062.33	16.53	2.53	9.76	2.47	3.13	1.55
50	8	0.8333	1858.83	5	1807.61	2.4	1061.77	15.39	2.52	9.24	2.46	3.13	1.55
51	7	0.8500	1851.27	4	1802.76	2.2	1060.98	14.41	2.51	8.72	2.46	3.12	1.55
52	7	0.8667	1843.95	4	1798.01	2.0	1059.97	13.46	2.50	8.22	2.45	3.12	1.54
53	6	0.8833	1837.02	4	1793.45	1.9	1058.80	12.57	2.49	7.84	2.45	3.11	1.54
54	6	0.9000	1830.56	3	1789.04	1.8	1057.51	11.73	2.49	7.51	2.44	3.11	1.54
55	5	0.9167	1824.52	3	1784.72	1.6	1056.10	11.04	2.48	7.19	2.44	3.10	1.54
56	5	0.9333	1818.75	3	1780.49	1.5	1054.57	10.42	2.47	6.87	2.43	3.09	1.54
57	5	0.9500	1813.18	3	1776.33	1.4	1052.92	9.83	2.47	6.56	2.43	3.08	1.54
58	4	0.9667	1807.81	2	1772.28	1.3	1051.16	9.26	2.46	6.25	2.42	3.08	1.53
59	4	0.9833	1802.67	2	1768.34	1.2	1049.32	8.71	2.46	5.96	2.42	3.07	1.53
60	4	1.0000	1797.74	2	1764.50	1.1	1047.38	8.19	2.45	5.76	2.41	3.06	1.53

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

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

Worksheet to Input the Stage - Volume Relationship for the Facility

PIMA COUNTY FLOOD CONTROL

Rev.4/17

Basin SW	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Monday, January 22, 2024	**Run Date**
Basin SW pc-route.xls	**Program File Name**

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

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

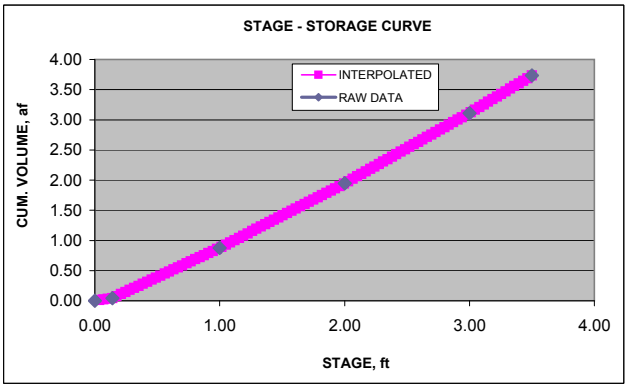
VARIABLES:

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

3.50 = max design stage (ft)

				for information only				
Elev. ft.	stage H, ft	area A, ac	volume ΔV, af	area A, ft²	volume ΔV, ft³	Σ ΔV S, ft³	Σ ΔV S, af	index for interpolation
2518.08	0.0	0.0000	0.000	0	0	0	0	1
2518.22	0.14	0.9200	0.043	40075	1870	1870	0.043	2
2519.08	1.00	1.0190	0.833	44388	36303	38173	0.876	3
2520.08	2.0	1.1179	1.068	48696	46525	84698	1.944	4
2521.08	3.0	1.2167	1.167	52999	50832	135531	3.111	5
2521.58	3.5	1.2684	0.621	55252	27061	162592	3.73	6
								7
								8
								9
								10
								11
								12
								13
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								25
								26

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



PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

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

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

Rev. 4/17

Basin SW	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Monday, January 22, 2024	**Run Date**
Basin SW pc-route.xls	**Program File Name**

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

GOVERNING EQUATIONS:

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

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

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

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

ORIFICE PLATE OUTFLOW ELEMENT

d_o (in) =		diameter	area (ft²) =	0.000
C =	0.60	disch coefficient		
E_o (ft) =		stage @ orifice center	inv (in) =	0.00
N =		nbr identical openings	inv (ft) =	0.000

TRIANGULAR WEIR OUTFLOW ELEMENT

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

RECTANGULAR WEIR OUTFLOW ELEMENT(S)

	rect 1	rect 2	rect 3	
L (ft) =	80.0			crest length
C =	3.00			disch coefficient
E_w (ft) =	2.40			stage at crest

BOX, ROUND CULVERT OUTFLOW ELEMENT

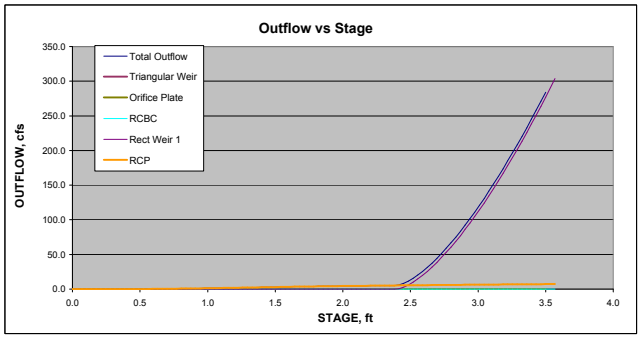
	RCP	RCBC	
D (ft) =	1.0		barrel rise, dia
B (ft) =			barrel span
E_o (ft) =	0.33		barrel invert

Stage	Orifice Plate	Weir Element(s) Triang 1	Rect 1	Rect 2	Rect 3	RCP	RCBC	Outflow	Σ vol
H, ft	Q, cfs	Q, cfs	Q, cfs	Q, cfs	Q, cfs	Q, cfs	Q, cfs	O, cfs	S, af
0.00								0.0	0.0000
0.04								0.0	0.0107
0.07								0.0	0.0215
0.11								0.0	0.0322
0.14								0.0	0.0429
0.18								0.0	0.0769
0.21								0.0	0.1108
0.25								0.0	0.1447
0.28								0.0	0.1786
0.32								0.0	0.2125
0.35						0.0		0.0	0.2464
0.39						0.0		0.0	0.2804
0.42						0.0		0.0	0.3143
0.46						0.1		0.1	0.3482
0.49						0.1		0.1	0.3821
0.53						0.1		0.1	0.4160
0.56						0.2		0.2	0.4499
0.60						0.2		0.2	0.4839
0.63						0.3		0.3	0.5178
0.67						0.4		0.4	0.5517
0.70						0.5		0.5	0.5856
0.74						0.5		0.5	0.6195
0.77						0.6		0.6	0.6535
0.81						0.7		0.7	0.6874
0.84						0.8		0.8	0.7213
0.88						0.9		0.9	0.7552
0.91						1.0		1.0	0.7891
0.95						1.1		1.1	0.8230
0.98						1.2		1.2	0.8570
1.02						1.3		1.3	0.8924
1.05						1.4		1.4	0.9297
1.09						1.5		1.5	0.9671
1.12						1.6		1.6	1.0045
1.16						1.8		1.8	1.0419
1.19						1.9		1.9	1.0793
1.23						2.0		2.0	1.1167
1.26						2.1		2.1	1.1540
1.30						2.2		2.2	1.1914
1.33						2.3		2.3	1.2288
1.37						2.5		2.5	1.2662
1.40						2.6		2.6	1.3036
1.44						2.7		2.7	1.3410
1.47						2.8		2.8	1.3783
1.51						3.0		3.0	1.4157
1.54						3.1		3.1	1.4531
1.58						3.2		3.2	1.4905
1.61						3.4		3.4	1.5279
1.65						3.5		3.5	1.5652
1.68						3.6		3.6	1.6026
1.72						3.7		3.7	1.6400
1.75						3.8		3.8	1.6774
1.79						3.9		3.9	1.7148
1.82						4.0		4.0	1.7522
1.86						4.1		4.1	1.7895
1.89						4.2		4.2	1.8269
1.93						4.3		4.3	1.8643
1.96						4.4		4.4	1.9017
2.00						4.4		4.4	1.9391
2.03						4.5		4.5	1.9794
2.07						4.6		4.6	2.0203
2.10						4.7		4.7	2.0611
2.14						4.8		4.8	2.1019
2.17						4.8		4.8	2.1428
2.21						4.9		4.9	2.1836
2.24						5.0		5.0	2.2245
2.28						5.1		5.1	2.2653
2.31						5.1		5.1	2.3062
2.35						5.2		5.2	2.3470
2.38						5.3		5.3	2.3879
2.42			0.4			5.3		5.8	2.4287
2.45			2.7			5.4		8.1	2.4695
2.49			5.9			5.5		11.4	2.5104
2.52			10.0			5.6		15.5	2.5512
2.56			14.6			5.6		20.3	2.5921
2.59			19.9			5.7		25.6	2.6329
2.63			25.6			5.7		31.4	2.6738
2.66			31.8			5.8		37.6	2.7146
2.70			38.5			5.9		44.3	2.7554
2.73			45.5			5.9		51.4	2.7963
2.77			52.9			6.0		58.9	2.8371
2.80			60.7			6.1		66.8	2.8780
2.84			68.9			6.1		75.0	2.9188
2.87			77.3			6.2		83.5	2.9597
2.91			86.1			6.2		92.4	3.0005
2.94			95.2			6.3		101.5	3.0413
2.98			104.6			6.4		111.0	3.0822
3.01			114.3			6.4		120.8	3.1238
3.05			124.3			6.5		130.8	3.1673
3.08			134.6			6.5		141.1	3.2108
3.12			145.1			6.6		151.7	3.2542
3.15			155.9			6.6		162.5	3.2977
3.19			166.9			6.7		173.6	3.3412
3.22			178.2			6.8		185.0	3.3847
3.26			189.7			6.8		196.5	3.4282
3.29			201.5			6.9		208.4	3.4717
3.33			213.5			6.9		220.4	3.5152
3.36			225.7			7.0		232.7	3.5586
3.40			238.2			7.0		245.2	3.6021
3.43			250.9			7.1		258.0	3.6456
3.47			263.8			7.1		270.9	3.6891
3.50			276.9			7.2		284.1	3.7326
3.57			303.7			7.3		311.0	3.8196

ROUTING RESULTS FOR DESIGN OF OUTLET WORKS

Max Design Stage = 3.50 ft

	Max Inflow	Max Outflow	Max Stage					target discharges	
100-Yr	224 cfs	116 cfs	3.0	ft	@	23	min	166.0	cfs
10-Yr	126 cfs	17 cfs	2.5	ft	@	35	min	67.0	cfs
2 -yr	67 cfs	3.1 cfs	1.5	ft	@	47	min	22.0	cfs



last two cells in cum.vol column contain non-standard equations

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

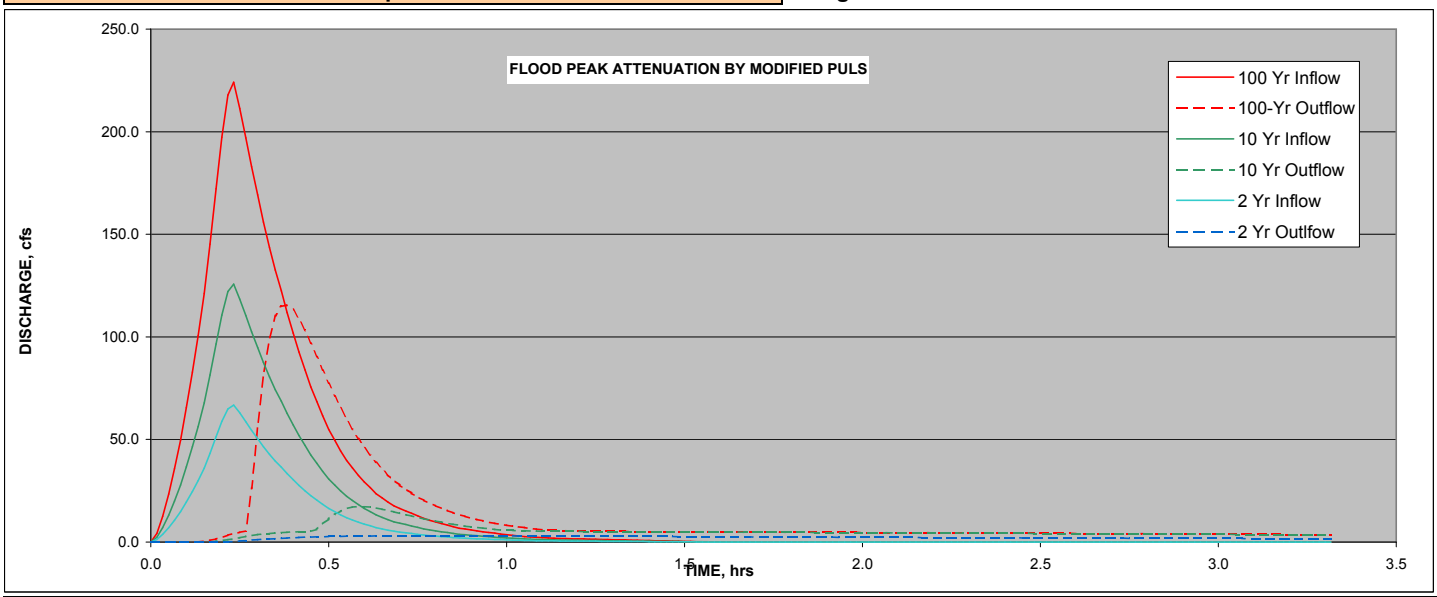
ROUTING OF A FLOOD HYDROGRAPH THROUGH A STORMWATER DETENTION / RETENTION FACILITY

THIS TAB CONTAINS NO INPUT DATA

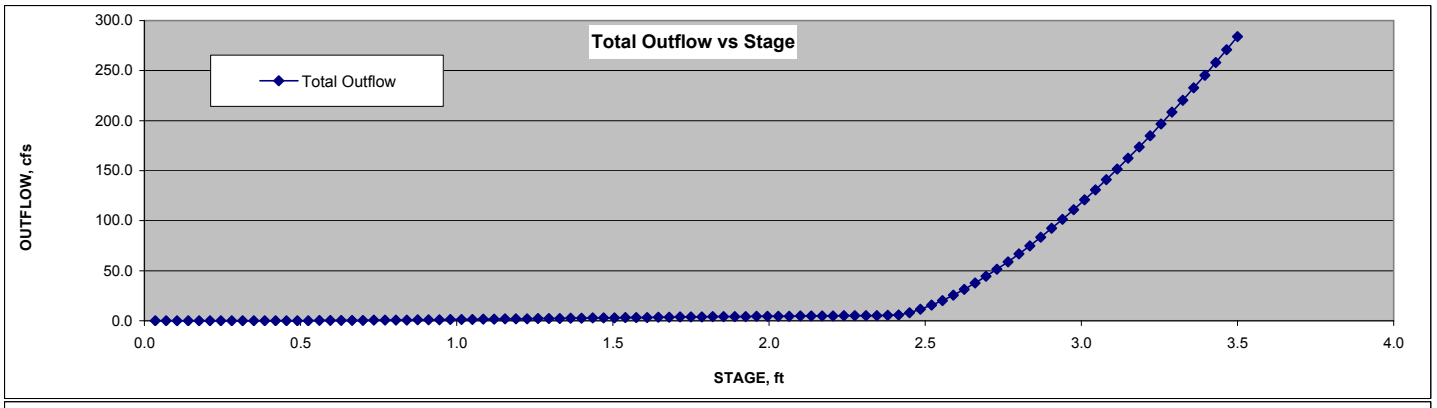
Summary of Reservoir Routing of the Inflow Hydrograph using the Specified Detention Facility and Outlet Works

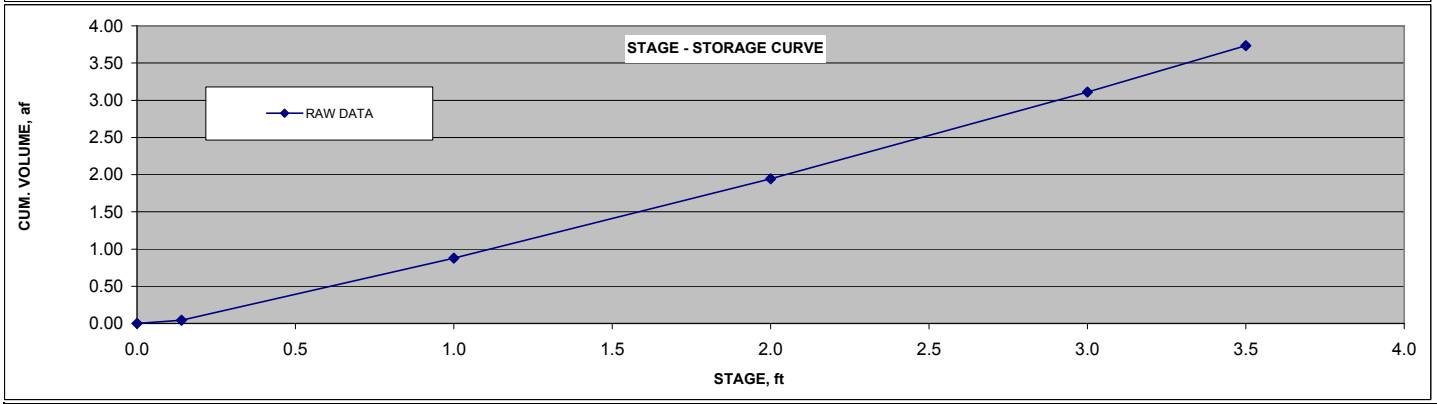
Basin SW	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Monday, January 22, 2024	**Run Date**
Basin SW pc-route.xls	**Program File Name**

Rev.04/17



ORIFICE PLATE			TRIANGULAR WEIR			RECTANGULAR WEIR(S)					RCP / RCBC		
							rect 1	rect 2	rect 3		RCP	RCBC	
d_o (in) =	0.0	diameter	Z =	0.0	side slope								
C (dim) =	0.60	discharge coefficient	E_w (ft) =	0.00	stage at weir crest	L (ft) =	80.0	0.0	0.0	crest length	1.0	0.0	D (ft) rise / diameter
N =	0	nbr identical openings	Θ =		° notch angle	C =	3.00	0.00	0.00	discharge coef		0.0	B (ft) span
inv (ft) =	0.00	stage at invert	C_1 =	0	discharge coefficient	E_w (ft) =	2.40	0.00	0.00	stage at crest	0.33	0.00	E_b (ft) stage at invert





RESULTS:

	max inflow	max outflow	target discharge	total inflow volume	max stage (H) *
100-Year	224.2 cfs	115.6 cfs	166 cfs	237791 ft^3 5.459 af	2.99 ft at 23 min
10-Year	125.6 cfs	17.4 cfs	67 cfs	133258 ft^3 3.059 af	2.53 ft at 35 min
2-Year	66.8 cfs	3.1 cfs	22 cfs	70829 ft^3 1.626 af	1.55 ft at 47 min

* Max Design Stage (ft) = 3.50

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

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

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

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

PIMA COUNTY FLOOD CONTROL

Rev. 4/17

Basin C	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Sunday, September 05, 2021	**Run Date**
Basin C pc-route 2nd sub.xls	**Program File Name**

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

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

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

VARIABLES:

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

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

RESULTS:

	max inflow	max outflow	total inflow volume	max stage (H) *	target ** discharge
100-Year	10.0 cfs	2.1 cfs	10578 ft³ 0.243 af	1.27 ft 31 min	6 cfs
10-Year	6.1 cfs	0.9 cfs	6430 ft³ 0.148 af	0.88 ft 35 min	2.6 csf
2-Year	3.5 cfs	0.2 cfs	3733 ft³ 0.086 af	0.58 ft 44 min	0.8 cfs

* Max Design Stage = 3.0 ft

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

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

Δt = 1.00 min 0.0167 hr inflow hydrograph time interval

index count	100-Year Inflow I, cfs	100-Year time t, hr	100-Year S/Δt+O/2 cfs	10-Year Inflow I, cfs	10-Year S/Δt+O/2 cfs	2-Year Inflow I, cfs	2-Year S/Δt+O/2 cfs	100-Year outflow O, cfs	100-Year Stage H, ft	10-Year outflow O, cfs	10-Year Stage H, ft	2-Year outflow O, cfs	2-Year Stage H, ft
0	0	0.0000	0.00	0	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0	0.0167	0.09	0	0.06	0.1	0.03	0.00	0.00	0.00	0.00	0.00	0.00
2	1	0.0333	0.46	0	0.28	0.2	0.16	0.00	0.00	0.00	0.00	0.00	0.00
3	1	0.0500	1.26	1	0.77	0.4	0.44	0.00	0.01	0.00	0.01	0.00	0.00
4	2	0.0667	2.57	1	1.57	0.6	0.91	0.00	0.03	0.00	0.02	0.00	0.01
5	2	0.0833	4.47	1	2.72	0.8	1.58	0.00	0.05	0.00	0.03	0.00	0.02
6	3	0.1000	7.03	2	4.27	1.0	2.48	0.00	0.07	0.00	0.04	0.00	0.03
7	4	0.1167	10.33	2	6.28	1.3	3.65	0.00	0.11	0.00	0.07	0.00	0.04
8	4	0.1333	14.41	3	8.76	1.6	5.09	0.00	0.15	0.00	0.09	0.00	0.05
9	5	0.1500	19.34	3	11.76	1.9	6.83	0.00	0.20	0.00	0.12	0.00	0.07
10	6	0.1667	25.26	4	15.36	2.3	8.92	0.00	0.26	0.00	0.16	0.00	0.09
11	8	0.1833	32.32	5	19.65	2.7	11.41	0.00	0.34	0.00	0.20	0.00	0.12
12	9	0.2000	40.54	5	24.64	3.1	14.31	0.03	0.42	0.00	0.26	0.00	0.15
13	10	0.2167	49.74	6	30.26	3.4	17.57	0.13	0.52	0.00	0.31	0.00	0.18
14	10	0.2333	59.45	6	36.23	3.5	21.04	0.28	0.62	0.01	0.38	0.00	0.22
15	9	0.2500	68.85	6	42.11	3.3	24.46	0.48	0.71	0.05	0.44	0.00	0.25
16	9	0.2667	77.46	5	47.58	3.1	27.66	0.69	0.80	0.10	0.49	0.00	0.29
17	8	0.2833	85.21	5	52.62	2.9	30.64	0.91	0.88	0.17	0.54	0.00	0.32
18	8	0.3000	92.13	5	57.21	2.7	33.41	1.12	0.95	0.24	0.59	0.00	0.35
19	7	0.3167	98.25	4	61.36	2.4	35.96	1.30	1.01	0.32	0.63	0.01	0.37
20	6	0.3333	103.61	4	65.10	2.3	38.30	1.45	1.06	0.39	0.67	0.02	0.40
21	6	0.3500	108.30	4	68.43	2.1	40.44	1.58	1.10	0.47	0.71	0.03	0.42
22	5	0.3667	112.39	3	71.41	1.9	42.41	1.70	1.13	0.54	0.74	0.05	0.44
23	5	0.3833	115.90	3	74.04	1.8	44.20	1.80	1.17	0.60	0.76	0.06	0.46
24	5	0.4000	118.86	3	76.33	1.6	45.81	1.88	1.19	0.66	0.79	0.08	0.47
25	4	0.4167	121.30	3	78.29	1.5	47.26	1.95	1.21	0.71	0.81	0.10	0.49
26	4	0.4333	123.27	2	79.97	1.3	48.55	2.01	1.23	0.76	0.83	0.11	0.50
27	3	0.4500	124.81	2	81.37	1.2	49.69	2.06	1.24	0.80	0.84	0.13	0.51
28	3	0.4667	125.97	2	82.52	1.1	50.70	2.09	1.25	0.83	0.85	0.14	0.53
29	3	0.4833	126.77	2	83.45	1.0	51.58	2.11	1.26	0.86	0.86	0.15	0.53
30	2	0.5000	127.25	1	84.16	0.9	52.34	2.13	1.27	0.88	0.87	0.16	0.54
31	2	0.5167	127.45	1	84.70	0.8	53.00	2.13	1.27	0.89	0.87	0.17	0.55
32	2	0.5333	127.41	1	85.08	0.7	53.56	2.13	1.27	0.90	0.88	0.18	0.55
33	2	0.5500	127.15	1	85.31	0.6	54.04	2.12	1.26	0.91	0.88	0.19	0.56
34	2	0.5667	126.71	1	85.43	0.6	54.45	2.11	1.26	0.91	0.88	0.19	0.56
35	1	0.5833	126.12	1	85.44	0.5	54.79	2.09	1.26	0.91	0.88	0.20	0.57
36	1	0.6000	125.41	1	85.36	0.5	55.08	2.07	1.25	0.91	0.88	0.20	0.57
37	1	0.6167	124.57	1	85.20	0.4	55.31	2.05	1.24	0.91	0.88	0.21	0.57
38	1	0.6333	123.64	1	84.97	0.4	55.50	2.02	1.23	0.90	0.88	0.21	0.57
39	1	0.6500	122.62	1	84.68	0.3	55.64	1.99	1.22	0.89	0.87	0.21	0.58
40	1	0.6667	121.54	1	84.34	0.3	55.75	1.96	1.22	0.88	0.87	0.22	0.58
41	1	0.6833	120.41	0	83.96	0.3	55.82	1.93	1.21	0.87	0.87	0.22	0.58
42	1	0.7000	119.24	0	83.55	0.3	55.87	1.89	1.20	0.86	0.86	0.22	0.58
43	1	0.7167	118.04	0	83.12	0.2	55.90	1.86	1.18	0.85	0.86	0.22	0.58
44	1	0.7333	116.83	0	82.67	0.2	55.92	1.83	1.17	0.84	0.85	0.22	0.58
45	1	0.7500	115.60	0	82.19	0.2	55.91	1.79	1.16	0.82	0.85	0.22	0.58
46	1	0.7667	114.35	0	81.70	0.2	55.88	1.75	1.15	0.81	0.84	0.22	0.58
47	0	0.7833	113.09	0	81.19	0.2	55.83	1.72	1.14	0.79	0.84	0.22	0.58
48	0	0.8000	111.83	0	80.67	0.2	55.78	1.68	1.13	0.78	0.83	0.22	0.58
49	0	0.8167	110.57	0	80.15	0.1	55.71	1.65	1.12	0.76	0.83	0.22	0.58
50	0	0.8333	109.30	0	79.62	0.1	55.63	1.61	1.11	0.75	0.82	0.21	0.58
51	0	0.8500	108.04	0	79.08	0.1	55.54	1.57	1.10	0.74	0.82	0.21	0.57
52	0	0.8667	106.78	0	78.54	0.1	55.44	1.54	1.09	0.72	0.81	0.21	0.57
53	0	0.8833	105.54	0	77.99	0.1	55.33	1.50	1.07	0.71	0.81	0.21	0.57
54	0	0.9000	104.30	0	77.45	0.1	55.22	1.47	1.06	0.69	0.80	0.21	0.57
55	0	0.9167	103.09	0	76.91	0.1	55.10	1.43	1.05	0.68	0.79	0.20	0.57
56	0	0.9333	101.89	0	76.38	0.1	54.98	1.40	1.04	0.66	0.79	0.20	0.57
57	0	0.9500	100.70	0	75.84	0.1	54.85	1.37	1.03	0.65	0.78	0.20	0.57
58	0	0.9667	99.53	0	75.32	0.1	54.72	1.34	1.02	0.64	0.78	0.20	0.57
59	0	0.9833	98.38	0	74.79	0.1	54.59	1.30	1.01	0.62	0.77	0.20	0.57
60	0	1.0000	97.24	0	74.27	0.1	54.45	1.27	1.00	0.61	0.77	0.19	0.56

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

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

Worksheet to Input the Stage - Volume Relationship for the Facility

PIMA COUNTY FLOOD CONTROL

Rev.4/17

Basin C	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Sunday, September 05, 2021	**Run Date**
Basin C pc-route 2nd sub.xls	**Program File Name**

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

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

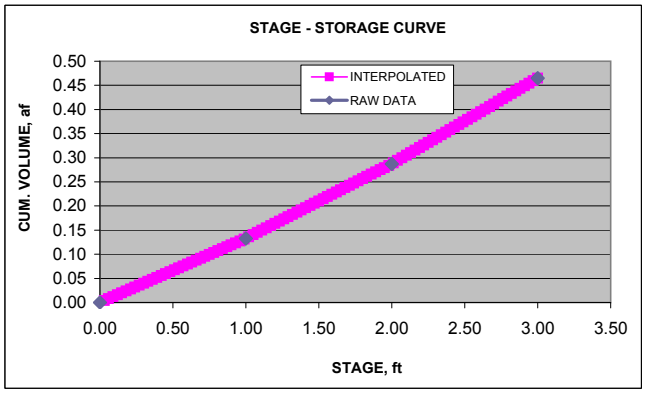
VARIABLES:

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

3.00 = max design stage (ft)

stage H, ft	area A, ac	volume ΔV, af	for information only: area A, ft²	for information only: volume ΔV, ft³	for information only: Σ ΔV S, ft³	Σ ΔV S, af	index for interpolation
0.0	0.1225	0	5336	0	0	0	1
1.00	0.1434	0.133	6247	5785	5785	0.133	2
2.0	0.1657	0.154	7218	6726	12512	0.2872	3
3.00	0.1895	0.177	8255	7730	20242	0.46	4
							5
							6
							7
							8
							9
							10
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							24
							25
							26

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



PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

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

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

Rev. 4/17

Basin C	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Sunday, September 05, 2021	**Run Date**
Basin C pc-route 2nd sub.xls	**Program File Name**

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

GOVERNING EQUATIONS:

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

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

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

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

ORIFICE PLATE OUTFLOW ELEMENT

d_o (in) =		diameter	area (ft²) =	0.000
C =	0.60	disch coefficient		
E_o (ft) =	0.00	stage @ orifice center	inv (in) =	0.00
N =		nbr identical openings	inv (ft) =	0.000

TRIANGULAR WEIR OUTFLOW ELEMENT

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

RECTANGULAR WEIR OUTFLOW ELEMENT(S)

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

BOX, ROUND CULVERT OUTFLOW ELEMENT

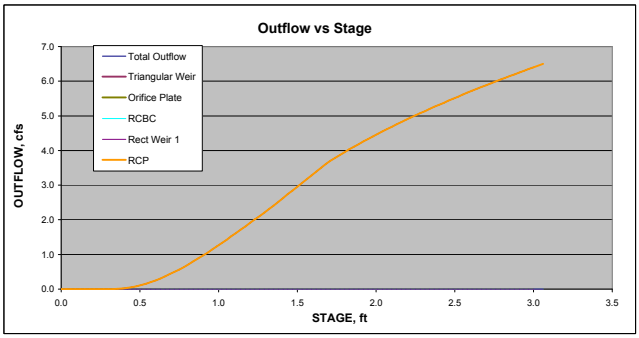
	RCP	RCBC	
D (ft) =	1.0		barrel rise, dia
B (ft) =			barrel span
E_b (ft) =	0.33		barrel invert

Stage	Orifice Plate	Weir Element(s)				RCP	RCBC	Outflow	Σ vol
		Triang 1	Rect 1	Rect 2	Rect 3				
H, ft	Q, cfs	Q, cfs	Q, cfs	Q, cfs	Q, cfs	Q, cfs	Q, cfs	O, cfs	S, af
0.00								0.0	0.0000
0.03								0.0	0.0040
0.06								0.0	0.0080
0.09								0.0	0.0120
0.12								0.0	0.0159
0.15								0.0	0.0199
0.18								0.0	0.0239
0.21								0.0	0.0279
0.24								0.0	0.0319
0.27								0.0	0.0359
0.30								0.0	0.0398
0.33								0.0	0.0438
0.36						0.0		0.0	0.0478
0.39						0.0		0.0	0.0518
0.42						0.0		0.0	0.0558
0.45						0.1		0.1	0.0598
0.48						0.1		0.1	0.0638
0.51						0.1		0.1	0.0677
0.54						0.2		0.2	0.0717
0.57						0.2		0.2	0.0757
0.60						0.3		0.3	0.0797
0.63						0.3		0.3	0.0837
0.66						0.4		0.4	0.0877
0.69						0.4		0.4	0.0916
0.72						0.5		0.5	0.0956
0.75						0.6		0.6	0.0996
0.78						0.6		0.6	0.1036
0.81						0.7		0.7	0.1076
0.84						0.8		0.8	0.1116
0.87						0.9		0.9	0.1155
0.90						1.0		1.0	0.1195
0.93						1.1		1.1	0.1235
0.96						1.1		1.1	0.1275
0.99						1.2		1.2	0.1315
1.02						1.3		1.3	0.1359
1.05						1.4		1.4	0.1405
1.08						1.5		1.5	0.1452
1.11						1.6		1.6	0.1498
1.14						1.7		1.7	0.1544
1.17						1.8		1.8	0.1591
1.20						1.9		1.9	0.1637
1.23						2.0		2.0	0.1683
1.26						2.1		2.1	0.1730
1.29						2.2		2.2	0.1776
1.32						2.3		2.3	0.1822
1.35						2.4		2.4	0.1869
1.38						2.5		2.5	0.1915
1.41						2.6		2.6	0.1961
1.44						2.7		2.7	0.2008
1.47						2.8		2.8	0.2054
1.50						3.0		3.0	0.2100
1.53						3.1		3.1	0.2147
1.56						3.2		3.2	0.2193
1.59						3.3		3.3	0.2239
1.62						3.4		3.4	0.2286
1.65						3.5		3.5	0.2332
1.68						3.6		3.6	0.2378
1.71						3.7		3.7	0.2424
1.74						3.8		3.8	0.2471
1.77						3.9		3.9	0.2517
1.80						4.0		4.0	0.2563
1.83						4.0		4.0	0.2610
1.86						4.1		4.1	0.2656
1.89						4.2		4.2	0.2702
1.92						4.3		4.3	0.2749
1.95						4.3		4.3	0.2795
1.98						4.4		4.4	0.2841
2.01						4.5		4.5	0.2890
2.04						4.5		4.5	0.2943
2.07						4.6		4.6	0.2997
2.10						4.7		4.7	0.3050
2.13						4.8		4.8	0.3103
2.16						4.8		4.8	0.3156
2.19						4.9		4.9	0.3209
2.22						4.9		4.9	0.3263
2.25						5.0		5.0	0.3316
2.28						5.1		5.1	0.3369
2.31						5.1		5.1	0.3422
2.34						5.2		5.2	0.3476
2.37						5.3		5.3	0.3529
2.40						5.3		5.3	0.3582
2.43						5.4		5.4	0.3635
2.46						5.4		5.4	0.3689
2.49						5.5		5.5	0.3742
2.52						5.6		5.6	0.3795
2.55						5.6		5.6	0.3848
2.58						5.7		5.7	0.3902
2.61						5.7		5.7	0.3955
2.64						5.8		5.8	0.4008
2.67						5.8		5.8	0.4061
2.70						5.9		5.9	0.4115
2.73						5.9		5.9	0.4168
2.76						6.0		6.0	0.4221
2.79						6.0		6.0	0.4274
2.82						6.1		6.1	0.4328
2.85						6.1		6.1	0.4381
2.88						6.2		6.2	0.4434
2.91						6.3		6.3	0.4487
2.94						6.3		6.3	0.4540
2.97						6.4		6.4	0.4594
3.00						6.4		6.4	0.4647
3.06						6.5		6.5	0.4753

ROUTING RESULTS FOR DESIGN OF OUTLET WORKS

Max Design Stage = 3.00 ft

	Max Inflow	Max Outflow	Max Stage			target discharges
100-Yr	10.0 cfs	2.1 cfs	1.27 ft @	31 min		6.3 cfs
10-Yr	6.1 cfs	0.9 cfs	0.88 ft @	35 min		2.6 cfs
2 -yr	3.5 cfs	0.2 cfs	0.58 ft @	44 min		0.8 cfs



last two cells in cum.vol column contain non-standard equations

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

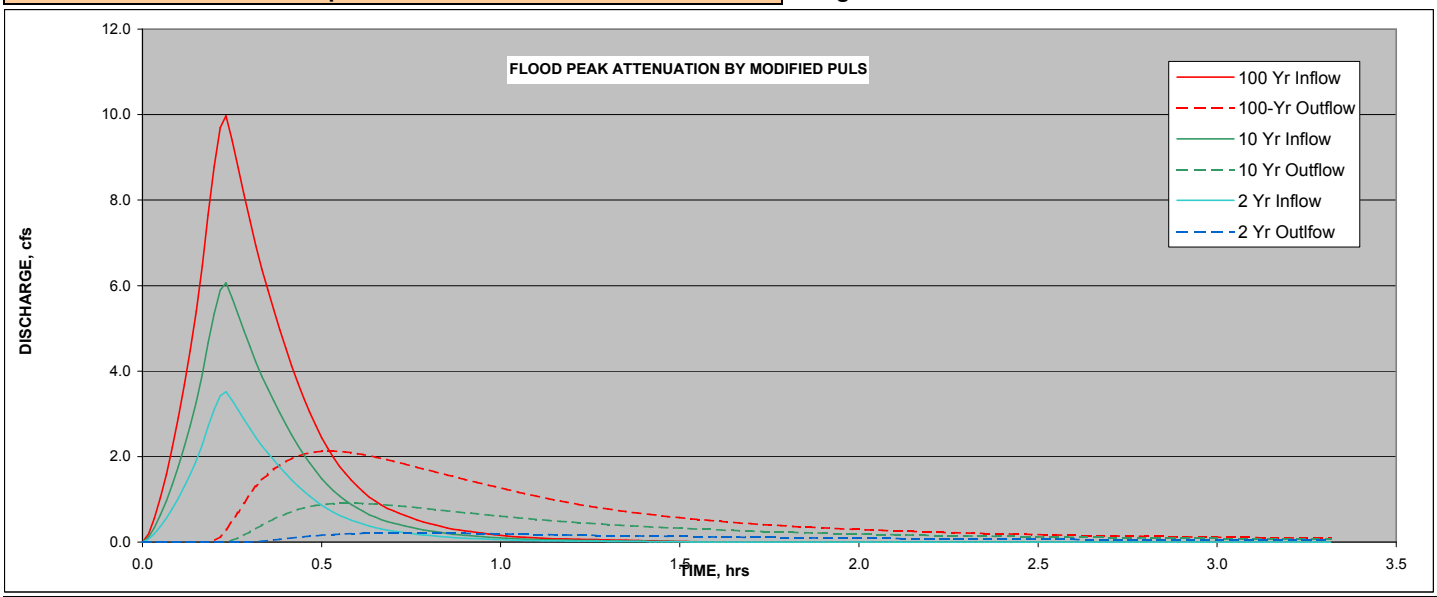
ROUTING OF A FLOOD HYDROGRAPH THROUGH A STORMWATER DETENTION / RETENTION FACILITY

THIS TAB CONTAINS NO INPUT DATA

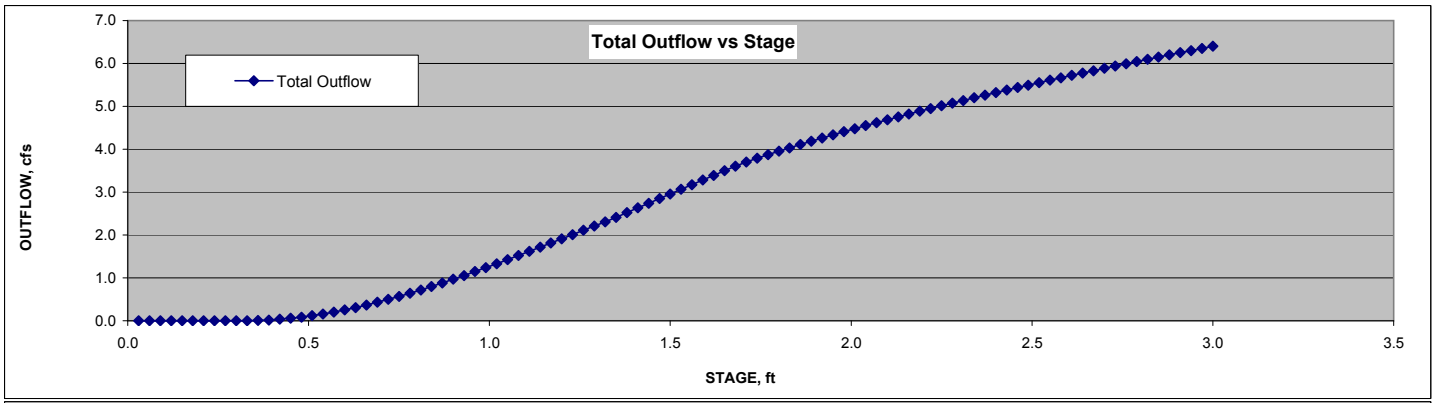
Summary of Reservoir Routing of the Inflow Hydrograph using the Specified Detention Facility and Outlet Works

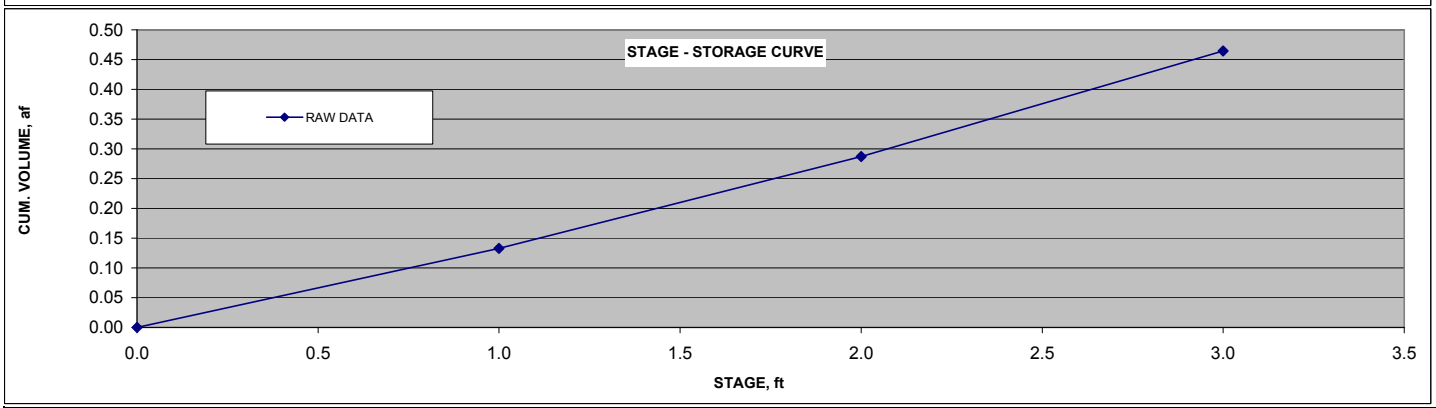
Basin C	**Project Address**
Larry K. Roberts, P.E.	**Designer**
Sunday, September 05, 2021	**Run Date**
Basin C pc-route 2nd sub.xls	**Program File Name**

Rev.04/17



ORIFICE PLATE			TRIANGULAR WEIR			RECTANGULAR WEIR(S)					RCP / RCBC		
							rect 1	rect 2	rect 3		RCP	RCBC	
d_o (in) =	0.0	diameter	Z =	0.0	side slope								
C (dim) =	0.60	discharge coefficient	E_w (ft) =	0.00	stage at weir crest	L (ft) =	0.0	0.0	0.0	crest length	1.0	0.0	D (ft) rise / diameter
N =	0	nbr identical openings	Θ =		° notch angle	C =	3.00	0.00	0.00	discharge coef		0.0	B (ft) span
inv (ft) =	0.00	stage at invert	C_1 =	0	discharge coefficient	E_w (ft) =	0.00	0.00	0.00	stage at crest	0.33	0.00	E_b (ft) stage at invert





RESULTS:

	max inflow	max outflow	target discharge	total inflow volume	max stage (H) *	
100-Year	10.0 cfs	2.1 cfs	6.3 cfs	10578 ft^3 0.243 af	1.27 ft at	31 min
10-Year	6.1 cfs	0.9 cfs	2.6 cfs	6430 ft^3 0.148 af	0.88 ft at	35 min
2-Year	3.5 cfs	0.2 cfs	0.8 cfs	3733 ft^3 0.086 af	0.58 ft at	44 min

* Max Design Stage (ft) = 3.00

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

Estimated Detention Sediment Volume Calculations
City of Tucson/Pima County Manual (1987), Eqn. 3.8

The additional storage volume which is to be incorporated in the design of "on-line" detention facilities (see definition of "on-line" detention in Section 5, Chapter 1), shall be determined from Equation 3.8. This volume is approximately equal to ten times the average-annual sediment yield from watersheds within Pima County and the City of Tucson, and roughly one-half to two-thirds the sediment transport expected during a 100-year flow event.

$$V_{SD} = 500\ A\ C_p$$

Equation 3.8

Where;

V_{SD} = additional detention/retention-basin volume required for sedimentation within an "on-line" facility, in cubic feet;

A = drainage area contributing to detention/retention basin, in acres, and;

C_p = fractional portion of the drainage area which **will** be contributing sediment. Areas which **will not** contribute sediment include all impervious areas, sodded areas, and other areas which have surface treatments that prevent soil loss.

The additional storage volume which is to be incorporated in the design of "off-line" detention facilities (again, see definition in Section 5, Chapter 1) shall be 75 percent of V_{SD}, as determined from Equation 3.8.

Project name:	Sundara			
Basin	SW	SE	N	C
Area (acres):	32.2	14.4	7.1	1.2
Cp =	0.34	0.28	0.68	0.3
V_{SD} (cf) =	5474	2016	2414	180
Basin bottom area (sf)	40075	27783	92478	5336
Sediment depth (ft)	0.14	0.07	0.03	0.03

Appendix F. Oro Valley Checklist



Drainage Report Checklist

See Cover Page of Report

Project Name:		
Firm Name:	*Engineer:*	
Address:		
City:	*State:*	*Zip:*
Phone Number:	*Fax Number:*	
Property Owner:		
Address:		
City:	*State:*	*Zip:*
Reviewed By:	*Date Reviewed:*	*Date Accepted for Review:*

The following checklist is intended as a guide for the engineer preparing a Technical Drainage Study for submittal to the Town of Oro Valley. The items listed are the minimum information required for submission to the Town. The engineer will remain responsible to ensure that the Technical Drainage Study is prepared according to guidelines set forth in the Oro Valley Drainage Criteria Manual and other applicable standards as required by the Town of Oro Valley

Cover:

- x Name, address, Township, Range, Section and Pima County Tax Code of the parcel, project or development for which the report is being submitted, as well as the Town of Oro Valley's project number.
- x Name and address of the client/owner of the parcel.
- x Name and address of the engineering/consulting firm preparing the report.

x Submittal date.
n/a state name of person preparing report, if other than registrant sealing the report.

Table of Contents:

x Seal and signature of Arizona Registered Professional Engineer (and/or on the report cover)
x Project name and legal description.
x Vicinity Map (see Location map).
x Include site location map identifying major features.
x Describe project type and size.
x Identify purpose and objectives of report (i.e. tentative plat, preliminary plat, development plan, etc.).
x Identify major drainageways and existing drainage facilities.
x Include general discussion on the topography.
x Identify the zoning.
x State whether the project site contains mapped floodplains.
x State whether detention is required.
x State sources of other reports used for the study.
x Provide a comprehensive narrative that clearly states the drainage engineer's concepts, rational, and assumptions.

2) Existing Conditions Drainage:

x On-site drainage.
i. Identify existing drainage network, patterns, watershed, and regulatory floodplain boundaries.
x Off-site watershed.

i. Note existing and future conditions, and drainage network entering the project site. Note any sheet flow conditions entering site.
ii. Identify existing drainage studies for project site or adjacent sites that 1) are impacted, or 2) impact project site.
iii.Identify existing flood hazard zones as identified by the Town of Oro Valley and/or FEMA (Include FIRM panel or applicable portion of FIRM panel).

3) Proposed Conditions Drainage Design:

x Include general description of proposed conditions, drainage facilities, and components.
x State storm water detention requirements for the proposed site as well as volume required, size and location of detention basins.
x Delineate pre-and post-runoff characteristics at concentration points exiting the site
x Identify, in detail, proposed drainage structures or drainage facilities. Include design criteria and probable effects on the existing upstream and downstream drainage system.
x Discuss any design exceptions, variations from manual, stipulations, permit issues (404 compliance statement, NPDES, FEMA), etc.

5) Hydrologic and Hydraulic Analysis:

x Hydrology
- i. Identify procedures, methods and assumptions.
- ii. Include table listing design flow rates at concentration points.

x Hydraulics
- i. Identify procedures, methods and assumptions.
- ii. Include a summary table listing channels that were analyzed with a comparison of pre-versus post-peak discharge, water surface elevation and velocities.
- iii. Describe methods used to convey onsite and offsite flows.

n/a iv. Provide standard detail # and/or regulatory agency

x Floodplain Analysis
- i. Describe the results of floodplain hydraulic analysis in terms of site design.
- ii. Include a summary table listing channels that were analyzed with a comparison of pre-verses post-peak discharge, water surface elevation and velocities.
- iii. Include method of floodplain boundary analysis and explain output messages, and how coefficients were determined.

x Storm Water Detention Calculations
- i. Identify procedures, methods and assumptions.
- ii. Include Table of Volume of Storage required, and Location and Storage Volume required
- iii. Include Table of Basin Outlet Discharge and Velocity.

x Drainage Facilities Design
- i. Identify procedures, methods and assumptions used for design of storm drains, culverts, etc.
- ii. Include a summary table of drainage facilities.

x Erosion Control
- i. Discuss the need for bank protection, the proposed location, materials and free board.
- ii. Discuss scour basin requirements, dimensions and materials.
- iii. Discuss procedures, methods and assumptions.
- iv. Include discussion of Storm Water Pollution Prevention Plan submittal requirements.

6) Conclusion:

x Discuss overall project objectives.

x Affirm compliance with criteria set forth in this manual and other Town of Oro Valley Standards.

x Discuss the influence of proposed development on existing conditions.

x Discuss the effectiveness of the drainage design to control damage from storm water runoff downstream of project site.

x Discuss impacts to adjacent properties and watershed drainage.

n/a Discuss if and how drainage improvements will be phased.

x Provide a summary of report's findings.

7) References:

x List all references used.

Appendix A – Hydrologic computations and backup:

See text Include land use assumptions, existing and proposed.

x Include soils information and exhibits.

x Include peak flow calculations.

x Include retention/detention inflow-outflow analysis and basin design calculations.

x Include computer input and output files in both hard copy and electronic format.
x Include electronic copies (AutoCAD/GIS) of basin delineations, flow paths, routing reaches, concentration points, and other supporting hydrologic data.

Appendix B – Hydraulic computations and backup:

x Include channel design calculations.
x Include floodplain calculations. At a minimum, include cross-section number, water surface elevation, top width, area, velocity, and Froude number.
x Cross-section and profile plots.
x Include erosion hazard setback calculations.
x Include culvert design calculations.
x Include curb opening and catch basin calculations.
x Include storm drain calculations.
x Include sediment and scour calculations.
x Include rip-rap sizing and stability analysis.
n/a Include finished floor elevations.
X i. Basis for setting finished floor elevations for floodplains and/or adjacent washes.
x Include computer input and output files in both hard copy and electronic format.
x Include electronic copies (AutoCAD/GIS) of floodplain delineations, cross section locations and 100 year water surface elevations.
x Include applicable plan set/sheets related to drainage activities and design.

Additional Information and Notes: none

Appendix G. LJA Final Site Plan

FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN

SUNDARA RIDGE LOTS 1 THROUGH 91

A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRB&M TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA

2101153

AS-BUILT CERTIFICATION: (LANDSCAPE)

I HEREBY CERTIFY THAT THE PLANTING AND IRRIGATION HAS BEEN DESIGNED IN ACCORDANCE WITH THE LANDSCAPING AND PLANTING GUIDELINES FOR PUBLIC SEWERS PER PIMA COUNTY RWRD ENGINEERING DESIGN STANDARDS SUBSECTION 7.7

REGISTERED LAND SURVEYOR DATE

REGISTRATION NUMBER EXPIRES

AS-BUILT CERTIFICATION: (PAVING & GRADING)

I HEREBY CERTIFY THAT THE "RECORD DRAWING" LINE AND GRADE MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION OR AS NOTED AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

REGISTERED LAND SURVEYOR DATE

REGISTRATION NUMBER EXPIRES

AS-BUILT CERTIFICATION: (SEWER)

I HEREBY CERTIFY THAT THE AS-BUILT ANNOTATIONS PROVIDED ON THIS DRAWING WERE BASED ON AN AS-BUILT SURVEY CONDUCTED UNDER MY SUPERVISION AND ACCURATELY DEPICTS EXISTING FIELD CONDITIONS TO THE BEST OF MY KNOWLEDGE AND BELIEF.

REGISTERED LAND SURVEYOR DATE

REGISTRATION NUMBER EXPIRES

ENGINEER'S STANDARD DETAILS DISCLAIMER:

COMPLYING WITH THE ARIZONA STATE BOARD OF TECHNICAL REGISTRATION'S SUBSTANTIVE POLICY STATEMENT REGARDING SEALING OF STANDARD DETAILS, THE STANDARD DETAILS USED IN THE DESIGN OF THIS PROJECT HAVE BEEN FORMALLY ADOPTED BY THE AGENCIES THAT PREPARED THEM. IN VIEW OF THEIR LONG HISTORY OF USE, APPLICABILITY, AND/OR SOUNDNESS, THE ENGINEER ACCEPTS THEIR USE FOR THIS PROJECT AND FINDS NO NEED FOR ALTERATION. EXCEPT IN CASES WHERE ITS USE MUST BE MODIFIED BY THE ENGINEER IN ORDER TO WORK WITH PROPOSED DESIGN CONDITIONS. SUCH MODIFICATIONS SHALL BE NOTED ON PLAN AND SEALED BY THE REGISTRANT ACCORDINGLY.

LEGEND

- PROPERTY LINE
- SECTION LINE
- MATCH LINE PAVING
- PROPOSED GRADING LIMITS
- MATCH LINE
- PROPOSED CENTER LINE
- PROPOSED EASEMENT
- EXISTING RIGHT-OF-WAY
- PROPOSED RIGHT-OF-WAY
- PROPOSED SURVEY MARKER
- W — PROPOSED WATER LINE
- PROPOSED FIRE HYDRANT
- PROPOSED WATER VALVE
- PROPOSED WATER METER BOX
- S — PROPOSED SEWER LINE
- (S) PROPOSED SEWER MANHOLE
- PROPOSED WEDGE CURB
- PROPOSED VERTICAL CURB
- 1200 EXISTING CONTOUR ELEVATION
- 1200 PROPOSED CONTOUR ELEVATION
- EG=*(21.20) EXISTING AND PROPOSED GRADE
- GRADE BREAK
- PROPOSED SEWER CLEANOUT
- PROPOSED TRAIL
- CRITICAL RESOURCE AREA
- PROPOSED STABILIZED TREATMENT
- EXISTING CULVERT
- PROPOSED 100-YEAR FLOODPLAIN LINE
- FEMA FLOODPLAIN
- EROSION HAZARD SETBACK
- (D) DRAINAGE MANHOLE
- STORM DRAIN PIPE
- DRIVEWAY SIDE FOR SLOPED LOT/ROAD
- Dx.x CONCENTRATION POINT (Q100)
- (BW) BACK WATER VALVE
- HIGHPOINT
- S SINGLE STORY RETAINING WALL
- SIGHT VISIBILITY TRIANGLE
- FLOW ARROWS
- LOCAL COLLECTOR CHANNEL CROSS-SECTION
- HYDRO SEED

ABBREVIATIONS LIST

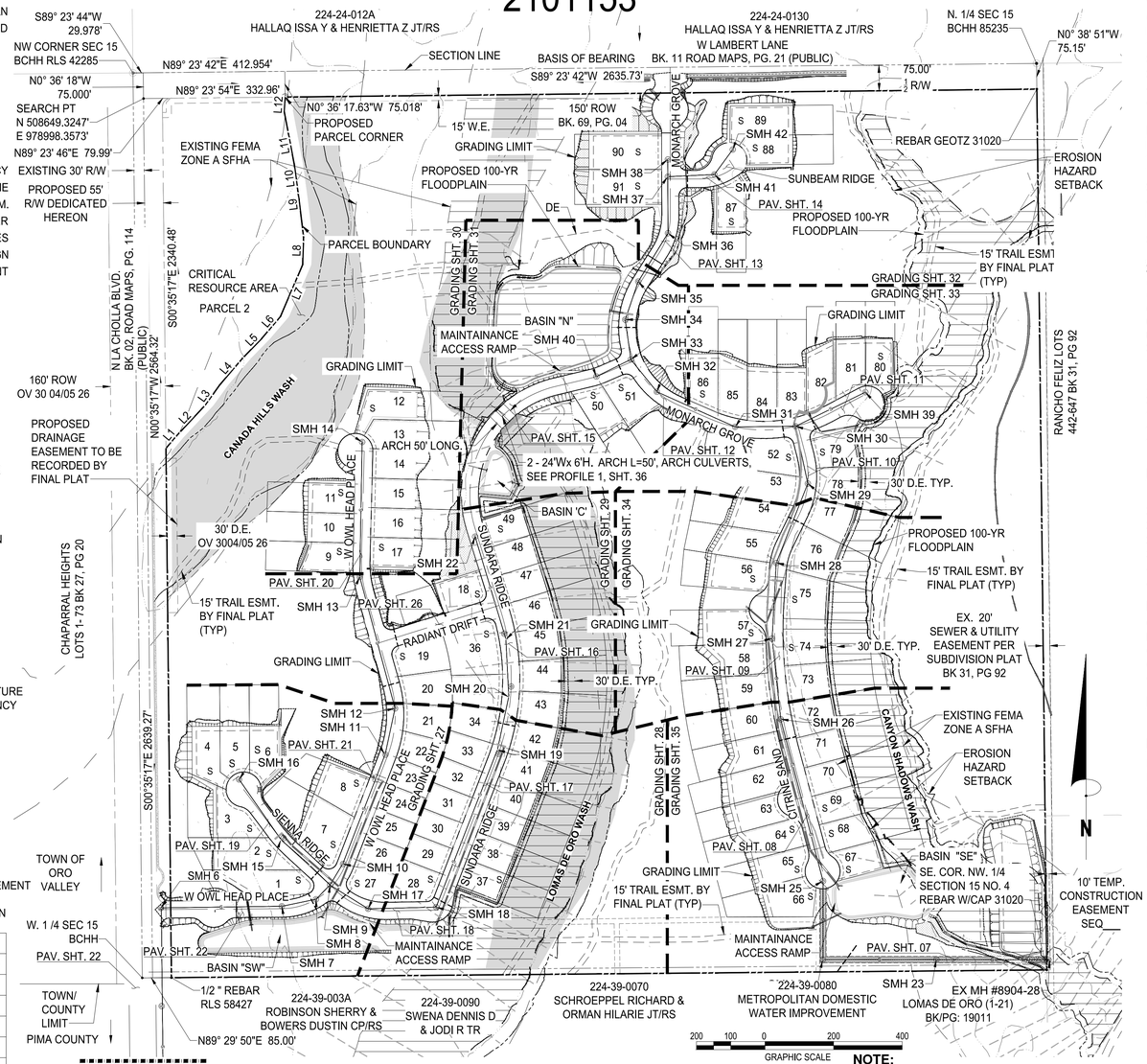
B/C	BACK OF CURB
BCHH	BRASS CAP IN HAND HOLE
BCR	BEGIN CURB RETURN
BLDG	BUILDING
C	CONCRETE
CB	CATCH BASIN
CI	CONTOUR INTERVAL
DE	DRAINAGE EASEMENT
ECR	END CURB RETURN
EL	ELEVATION
EHS	EROSION HAZARD SETBACK
EOP	EDGE OF PAVEMENT
ESMT	EASEMENT
EX	EXISTING
F	FIRE
FF	FINISHED FLOOR ELEVATION
FP	FINISHED PAD ELEVATION
FG	FINISHED GRADE
FGB	FINISHED GRADE BOTTOM
FGT	FINISHED GRADE TOP
GR	GRATE
G	GUTTER
NG	NATURAL GRADE
P	PAVEMENT
PC	PIMA COUNTY OR POINT OF CURVATURE
PRC	POINT OF REVERSE CURVATURE
PT	POINT OR POINT OF TANGENCY
PUE	PUBLIC UTILITY EASEMENT
R/W	RIGHT OF WAY
S	SEWER/SINGLE STORY LOT
SDMH	STORM DRAIN MANHOLE
SMH	SEWER MANHOLE
S/W	SIDEWALK
STW	STEMWALL
TC	TOP OF CURB
TBM	TEMPORARY BENCH MARK
TOBP	TOP OF BANK PROTECTION
TOV	TOWN OF ORO VALLEY
VG	VALLEY GUTTER
VNAE	VEHICLE NON ACCESS EASEMENT
W	WATER
WSEL	WATER SURFACE ELEVATION

ESTIMATED EARTHWORK QUANTITIES

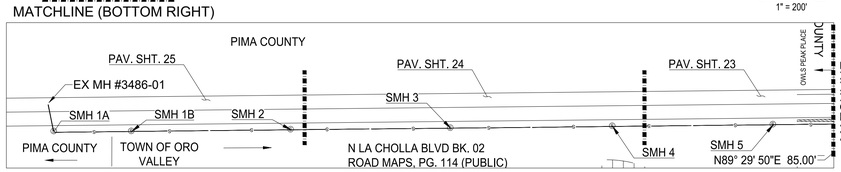
(NOT TO BE USED FOR BIDDING PURPOSE, CONTRACTOR IS RESPONSIBLE FOR HIS OWN CUT & FILL QUANTITIES)

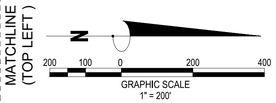
	FILL (C.Y.)	CUT (C.Y.)
RAW QUANTITIES	212,700	168,500
COMPACTION SHRINKAGE (20%)*	42,540	0
TOTAL:	255,240	168,500
NET:	86,740	0

LINE TABLE		
LINE	BEARING	DISTANCE
L1	S39°33'36"W	39.19'
L2	S43°09'17"W	128.34'
L3	S35°50'22"W	76.00'
L4	S40°33'22"W	101.11'
L5	S44°13'13"W	78.16'
L6	S40°32'21"W	86.34'
L7	S23°15'15"W	164.58'
L8	S02°01'08"W	80.84'
L9	S06°57'12"E	112.01'
L10	S07°39'12"E	98.87'
L11	S10°42'43"E	161.18'
L12	S03°46'59"W	41.04'



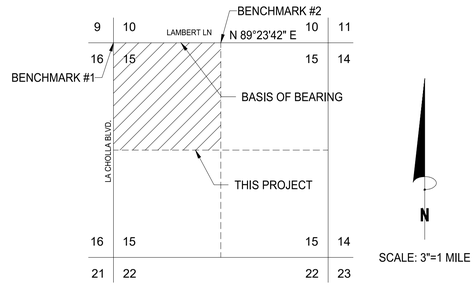
MATCHLINE (BOTTOM RIGHT)





NOTE:

ALL ONSITE STREETS ARE PRIVATE AND COMMON AREA "A" FUNCTIONAL OPEN SPACE, DRAINAGE, PUBLIC UTILITIES, ACCESS & MAINTENANACE & COMMON AREA "B" NATURAL OPEN SPACE



LOCATION MAP

A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRB&M TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA

OWNER

FUTURE ARIZONA INC.
1555 N. ASTOR STREET, APT 28W
CHICAGO, IL 60610
(312) 961-2750
ATTN: ALEXIS FASSEAS
ALXS@ME.COM

DEVELOPER

FUTURE ARIZONA INC.
1555 N. ASTOR STREET, APT 28W
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(312) 961-2750
ATTN: ALEXIS FASSEAS
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ENGINEER

LJA ENGINEERING
1860 E RIVER RD, SUITE 325
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(520) 257-3446
ATTN: ROB SCHLICHER, PE
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LANDSCAPE ARCHITECT

WILDER LANDSCAPE ARCHITECTS
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(520) 320-3936
ATTN: JENNIFER PATTON
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SHEET INDEX

SHEET NO.	TITLE
01	COVER SHEET
02	FSP NOTES SHEET
03	IP NOTES SHEET
04	E.S.O.S. MAP
05	REGULATED HILLSIDE PLAN
06	HORIZONTAL CONTROL
07-26	PAVING PLAN & PROFILES
27-35	GRADING PLAN
36-37	STORM DRAIN PLAN & PROFILES
38-42	DETAILS
43	HCS TABLES
44	CRITICAL DRAINAGE FACILITIES & MAP
45-51	ARCH CULVERT DETAILS

WATER AND SEWER SERVICE PROVIDERS

WATER: METRO WATER
SEWER: PIMA COUNTY

PAG STANDARD DETAILS

103	SURVEY MONUMENT
200	CONCRETE SIDEWALK
205	SIDEWALK SCUPPER - TYPE 5
205.5	SIDEWALK SCUPPER - TYPE 3
207	CURB ACCESS RAMP
209	CONCRETE CURB TYPE 2 (WEDGE)
209	CONCRETE CURB TYPE 2 (SINGLE VERT)
210	CONCRETE CURB TRANSITION
211	CONCRETE CURB: NEW TO EXISTING
300	STORM MANHOLE BASE (48 DIA. AND SMALLER)
302	STORM DRAIN MANHOLE

PCRWRD STANDARD DETAILS

108	SEWER/WATER CROSSING DETAILS
205	4' DIAMETER MANHOLE
211	CONCRETE COLLAR FOR PAVED AREAS
214	24" WATERTIGHT FRAME AND COVER
301	CONNECTION TO EXISTING MANHOLE
401&404	HCS WITH CLEANOUT
402	HCS CONNECTION TO MANHOLE

BASIS OF BEARING

GRID NORTH AS DEFINED BY THE ARIZONA STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. THE BEARING EQUATION FOR THIS PROJECT IS THE NORTH LINE OF NORTHWEST QUARTER (NW 1/4) OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G.&S.R.M., PIMA COUNTY, ARIZONA HAVING A BEARING OF NORTH 89°23'42" EAST BETWEEN THE NORTHWEST CORNER OF SECTION 15 AND THE NORTH QUARTER CORNER OF SECTION 15.

BASIS OF ELEVATION

NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

BENCHMARK

BENCHMARK #1: DESCRIPTION
NORTHWEST CORNER OF SECTION 15
BRASS CAP IN HANDHOLE RLS 42285
ELEVATION = 2607.67 FEET

BENCHMARK #2: DESCRIPTION
NORTH QUARTER CORNER OF SECTION 15
BRASS CAP IN HANDHOLE RLS 85235
ELEVATION = 2600.64 FEET

BACK WATER VALVES - LOTS

3	7	8	9	10	11
15	16	17	19	20	22
24	25	26	28	29	30
31	32	37	38	39	40
41	42	46	54	55	57
59	60	62	63	64	65
67	68	69	70	71	73
76	77	79	83	84	85
86	87	89	90		

FIRE NOTES

1. IFC SECTION D107.1 ONE OR TWO FAMILY DWELLING RESIDENTIAL DEVELOPMENTS: THIS SUBDIVISION DOES NOT REQUIRE FIRE SPRINKLERS
2. BE ADVISED: IF ANY BUILDING IS OVER 4800 SF (UNDER ROOF) A FIRE SPRINKLER SYSTEM WILL BE REQUIRED IF FIRE FLOW (1750 GPM) IS NOT AVAILABLE

ACCEPTED

BY:
PLANNING & ZONING ADMINISTRATOR DATE

BY:
TOWN OF ORO VALLEY, TOWN ENGINEER DATE

RELATED CASE #
OV914-009
2100731
OV114-018

Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA811 Call 811 or click Arizona811.com

LJA Engineering, Inc.
7458 N. La Cholla Boulevard,
Tucson, AZ 85741
Phone 520.257.3400

COVER
SUNDARA RIDGE
FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil) CERTIFICATE NO. 54544 ROBERT W. SCHLICHER Date Signed 12/16/24 ARIZONA, U.S.A.

PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

H: 1"=200' C.I.=2'
V:
SCALE
12/16/24
DATE
AZ4072-1004
JOB NUMBER
ML
DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY

01 OF 51

P22WI00005
G-2022-007

DateTime - Mon, 16 Dec 2024 - 10:03am PathName - S:\ARIZ\Tucson\AZ4072\400_AND_LIA MOVING FORWARD\BASE FILES\Plot\ 01COVER.DWG

GENERAL NOTES:

1. THE GROSS AREA OF THIS DEVELOPMENT IS 145.203 ACRES.
2. THE PROPOSED NUMBER OF RESIDENTIAL UNITS IS 91 (0.63 UNIT PER ACRE)
3. TOTAL LENGTH OF NEW PUBLIC STREET IS 0.0 MILES.
4. TOTAL LENGTH OF NEW PRIVATE STREET IS 1.48 MILES.
5. ASSURANCES FOR SITE IMPROVEMENTS, LANDSCAPING, AND REVEGETATION BONDS MUST BE POSTED PRIOR TO THE ISSUANCE OF GRADING PERMITS.
6. ALL NEW PRIVATE INGRESS/EGRESS WILL BE DEDICATED BY FINAL PLAT.
7. GROSS AREA OF IMPERVIOUS SURFACES IS 15.86 AC.
8. EXISTING ZONING IS R1-43 PER (O) 16-64.
9. THE MAXIMUM LOT SIZE IS 37,257 SF (LOT #7). THE MINIMUM LOT SIZE IS 10,000 SF (LOTS # 23,24,25,26,29,30,31).THE AVERAGE LOT SIZE IS 20,000 S.F.
10. NO CULTURAL RESOURCE AREA PROTECTIVE FENCING OR OTHER APPROVED PROTECTIVE MEASURES ARE NEEDED.
11. ASSURANCES FOR WATER SERVICE, SITE STABILIZATION AND LANDSCAPING MUST BE POSTED PRIOR TO THE ISSUANCE OF GRADING PERMITS.
12. THIS PROJECT IS SUBJECT TO THE REZONING CONDITIONS SET FORTH IN (O) 16-64.
13. THE TOTAL AREA OF LANDSCAPED AND/OR OPEN SPACE COMMON AREA PROVIDED IS 108.9 AC.

PLANNING GENERAL NOTES:

1. MAXIMUM BUILDING HEIGHT ALLOWED AND PROPOSED = 28' / 2-STORY, ONE STORY LOTS ARE: 1-9, 11, 12, 17-19, 27, 28, 36, 37, 49-52, 56, 57, 64-69, 74, 75, 79, 80, 86-91. 2-STORY LOTS ARE: 10, 13-16, 20-26, 29-35, 38-48, 53-55, 58-63, 70-73, 76-78, 81-85.
2. TOTAL AMOUNT OF RECREATION AREA REQUIRED =98.90± AC. INCLUDING TOT-LOTS AND PEDESTRIAN/EQUESTRIAN TRAILS.
3. SETBACKS REQUIRED/PROVIDED PER (O)16-04 REZONING CONDITIONS OF APPROVAL: FRONT = 10' AS LONG AS A 20' ON-LOT DRIVEWAY IS PROVIDED; SIDE = 7.5'; REAR = 20'.
4. COMMON AREAS (COMMON AREA "A": PRIVATE STREETS AND COMMON AREA "B": NATURAL OPEN SPACES) SHALL BE OWNED AND MAINTAINED BY THE H.O.A. TOTAL ACRES OF LANDSCAPED AREAS AND NATURAL OPEN SPACE IS 108.9 AC.
5. ALL SIGNAGE AND LIGHTING TO BE ADDRESSED AS PART OF SEPARATE REVIEW AND APPROVAL PROCESS.
6. A MINIMUM LOT SIZE REDUCTION TO 10,000 S.F. IN ACCORDANCE WITH THE CONSERVATION SUBDIVISION DESIGN LOT REDUCTION INCENTIVE. LOT SIZE RANGE SHOWN =10,000 S.F. TO 37,257 S.F.
7. BUFFERYARD TYPES: 40' NATURAL DESERT BUFFERYARD "B" ALONG LAMBERT LANE AND LA CHOLLA BLVD. 150' BUFFERYARD LONG EASTERN AND SOUTHERN SIDES.
8. THIS PROJECT HAS BEEN DESIGNED IN ACCORDANCE WITH THE ENVIRONMENTALLY SENSITIVE LANDS REGULATIONS OF THE ZONING CODE.
9. THE NATIVE PLANT SALVAGE AND MITIGATION REQUIREMENTS OF SECTION 27.6 ARE WAIVED FOR ALL DEVELOPMENT WITHIN DEVELOPMENT ENVELOPES, AS SHOWN HEREON.
10. E.S.L.O. FLEXIBLE DESIGN OPTIONS GRANTED TO THIS DEVELOPMENT INCLUDE: MINIMUM LOT SIZE, RECREATION AREA AND BUILDING HEIGHT FLEXIBLE DESIGN OPTIONS.
11. ALL DISTURBED AREAS WITHIN THE RESOURCE MANAGEMENT TIER 1 ENVELOPE SHALL BE REVEGETATED BACK TO NATURAL CONDITIONS USING PLANTS ON THE TOWN OF ORO VALLEY APPROVED NATIVE PLANT LIST.
12. EXISTING ZONING IS R1-43 SUBJECT TO CONDITION PER (O)16-04.
13. ALL SIGNAGE AND LIGHTING TO BE ADDRESSED AS PART OF A SEPARATE REVIEW AND APPROVAL PROCESS

ENGINEERING GENERAL NOTES:

1. MATERIALS WITHIN SIGHT VISIBILITY TRIANGLES MUST BE PLACED SO AS NOT TO INTERFERE WITH A VISIBILITY PLANE DESCRIBED BY TWO HORIZONTAL LINES LOCATED THIRTY (30) INCHES AND SEVENTY TWO INCHES ABOVE FINISHED GRADE OF ROADWAY SURFACE.
2. FINAL SITE PLANS AND IMPROVEMENT PLAN MUST BE APPROVED PRIOR TO THE ISSUANCE OF ANY PERMITS BY THE TOWN ENGINEER AND/OR BUILDING OFFICIAL.
3. ALL WEATHER ACCESS MUST BE PROVIDED TO ALL LOTS WITHIN THE SUBDIVISION.
4. THE DESIGN VEHICLE FOR THIS PROJECT IS A SU-30. THE DESIGN SPEED FOR PRIVATE ROADS IS 25 MPH. THE POSTED SPEED FOR LA CHOLLA ROAD/LAMBERT ROAD IS 45 MPH.
5. ALL NEW PUBLIC ROADS WITHIN AND ADJACENT TO THIS PROJECT WILL BE CONSTRUCTED IN ACCORDANCE WITH APPROVED PLANS. SEPARATE PUBLIC IMPROVEMENT AND CONSTRUCTION PLANS WILL BE SUBMITTED TO THE TOWN ENGINEER'S OFFICE FOR REVIEW AND APPROVAL.
6. ANY RELOCATION OR MODIFICATION OF EXISTING UTILITIES AND/OR PUBLIC IMPROVEMENTS NECESSITATED BY THE PROPOSED DEVELOPMENT WILL BE AT NO EXPENSE TO THE PUBLIC.

DRAINAGE GENERAL NOTES:

1. DEVELOPER WILL COVENANT TO HOLD THE TOWN OF ORO VALLEY, ITS SUCCESSORS AND ASSIGNS, HARMLESS IN THE EVENT OF FLOODING.
2. DRAINAGE WILL NOT BE ALTERED, DISTURBED, OR OBSTRUCTED WITHOUT THE APPROVAL OF THE ORO VALLEY TOWN COUNCIL.
3. DRAINAGE STRUCTURES MUST BE CONSTRUCTED AND INSTALLED ACCORDING TO TOWN STANDARDS AND PAID FOR BY THE DEVELOPER.
4. ALL DRAINAGE STRUCTURES MUST BE DESIGNED TO CONVEY A Q100 FLOW.
5. ALL DRAINAGE FACILITIES WILL BE CONSTRUCTED ACCORDING TO APPROVED PLANS PRIOR TO THE ISSUANCE OF ANY CERTIFICATES OF OCCUPANCY FROM THE BUILDING OFFICIAL FOR ALL AFFECTED BUILDINGS.
6. THE DEVELOPER WILL ACCEPT RESPONSIBILITY FOR MAINTENANCE, CONTROL, SAFETY AND LIABILITY OF PRIVATE DRAINAGEWAYS, DRAINAGE EASEMENTS, AND COMMON AREAS UNTIL OWNERSHIP IS TRANSFERRED TO THE HOA.
7. ALL DRAINAGE WAYS WILL BE CONSTRUCTED ACCORDING TO APPROVED PLANS PRIOR TO THE ISSUANCE OF ANY PERMITS FROM THE TOWN ENGINEER AND/OR BUILDING OFFICIAL FOR PARCELS AFFECTED. AFFECTED PARCELS MUST BE SPECIFICALLY IDENTIFIED EITHER BY NUMBER IN NOTE OR OUTLINE ON THE DEVELOPMENT PLAN.
8. DRAINAGE MUST BE COLLECTED AND RELEASED FROM A PROPOSED DEVELOPMENT AT THE LOCATIONS AND THE MANNER EXISTING PRIOR TO DEVELOPMENT.
9. DRAINAGE WAYS MUST BE PROVIDED WHERE NECESSARY TO CARRY DRAINAGE FLOWS THROUGH OR FROM THE DEVELOPMENT AND SUCH DRAINAGE WAYS MUST BE DEDICATED AND MAINTAINED BY THE PROPERTY OWNERS OR PROPERTY OWNERS ASSOCIATION.
10. DRAINAGE WAYS MUST BE DESIGNED TO NOT DISCHARGE ONTO PAVED STREETS, EASEMENTS OR PARKING AREAS.
11. PARKING AREAS MUST NOT BE USED AS DETENTION BASINS.
12. ALL DRAINAGE STRUCTURES SHALL BE INSPECTED AND A SUMMARY REPORT PREPARED A MINIMUM OF ONCE EACH YEAR IN ACCORDANCE WITH THE PROCEDURES IN THE APPROVED DRAINAGE REPORT, COPIES OF THE ANNUAL INSPECTION REPORTS SHALL BE MADE AVAILABLE TO THE TOWN UPON REQUEST.
13. ALL DRAINAGE STRUCTURES SHALL BE INSPECTED AND A SUMMARY REPORT PREPARED BY AN ARIZONA REGISTERED CIVIL ENGINEER A MINIMUM OF ONCE EACH FIVE YEARS IN ACCORDANCE WITH THE PROCEDURES IN THE APPROVED DRAINAGE REPORT. COPIES OF THE 5-YEAR ANNUAL INSPECTION REPORTS SHALL BE MADE AVAILABLE TO THE TOWN UPON REQUEST. THE REPORT SHALL IDENTIFY THE MAINTENANCE NEEDS FOR THE NEXT 5-YEAR PERIOD, INCLUDING ANTICIPATED ANNUAL COSTS OF MAINTENANCE AND REPAIR
14. ALL LOTS WITHIN THIS SUBDIVISION EXCEPT LOTS 1-10, 19-34, 50-51, 52-66, 80-86 AND 87-91 ARE WITHIN A FEMA (S) ZONE A SPECIAL FLOOD HAZARD AREA (SFHA) AS SHOWN ON FEMA FLOOD INSURANCE RATE MAP (FIRM) PANEL NUMBER 04019C1070L WITH EFFECTIVE DATE JUNE 16, 2011. A CONDITIONAL LETTER OF MAP REVISION (CLOMR) WILL BE SUBMITTED TO THE TOWN OF ORO VALLEY AND FEMA FOR APPROVAL WITH THE INTENT OF REMOVING THESE LOTS FROM THE FEMA FLOODPLAIN. THE CLOMR DOES NOT GUARANTEE THESE LOTS WILL BE REMOVED FROM THE FEMA SPECIAL FLOOD HAZARD AREA (SFHA), THEREFORE FLOODPLAIN USE PERMITS, AND CORRESPONDING ELEVATIONS CERTIFICATES FOR ALL STRUCTURES LOCATED WITHIN THE EFFECTIVE SFHA SHALL BE REQUIRED UNTIL THE EFFECTIVE FLOODPLAIN HAS BEEN REVISED AND APPROVED BY FEMA. FEDERAL LAW REQUIRES THAT A FLOOD INSURANCE POLICY BE OBTAINED AS A CONDITION OF A FEDERALLY-BACKED MORTGAGE OR LOAN THAT IS SECURED BY A BUILDING LOCATED WITHIN AN EFFECTIVE SFHA.
15. REVISING THE EFFECTIVE FIRM REQUIRES COMPLETION OF THE INFRASTRUCTURE SHOWN IN THE CLOMR ,PREPARATION OF AS-BUILT PLANS FOR THE INFRASTRUCTURE, TOWN OF ORO VALLEY AND FEMA REVIEW AND APPROVAL OF THE AS-BUILT PLANS, FEMA ISSUANCE OF A LETTER OF MAP REVISION (LOMR) AND COMPLETION OF A PUBLIC COMMENT PERIOD. UNLESS AND UNTIL THE EFFECTIVE FIRM HAS BEEN REVISED. THERE IS SOME RISK TO AN OWNER OF ANY LOTS WITHIN THE EFFECTIVE FEMA FLOODPLAIN THAT THE FLOODPLAIN WILL NOT BE REVISED
16. A TYPE 2 PERMIT FOR MASS GRADING SHALL ONLY BE ISSUED AFTER THE SITE DRAINAGE REPORT, BANK-PROTECTION IMPROVEMENT PLANS, AND CLOMR REPORT HAVE BEEN ACCEPTED BY THE TOWN, AND THE CLOMR REPORT HAS BEEN SUBMITTED TO FEMA.
17. A BUILDING PERMIT FOR VERTICAL CONSTRUCTION SHALL NOT BE ISSUED BY THE TOWN UNTIL AFTER THE AS-BUILT GRADING PLAN, AND/OR THE BUILDING PAD ELEVATION CERTIFICATE, HAS BEEN ACCEPTED BY THE TOWN; AND UNTIL AFTER THE APPLICANT ACKNOWLEDGES AND ACCEPTS THE RISK THAT THE DEVELOPMENT WILL REMAIN IN THE EFFECTIVE SPECIAL FLOOD HAZARD AREA, REQUIRING FLOOD INSURANCE FOR AN INDEFINITE PERIOD OF TIME UNTIL A LOMR IS GRANTED, IF EVER.
18. THE HOA IS RESPONSIBLE FOR ALL COMMON AREAS AND MAINTENANCE OF ALL DRAINAGE STRUCTURES WITHIN COMMON AREAS.
19. LOTS ARE TO BE GRADED TO DRAIN SO AS NOT TO ADEVERSLEY AFFECT ADJACENT PROPERTIES. ALL LOTS WITH CROSS DRAINAGE FACILITIES (37 TO 49, 67-79) . SHALL BE IN AN EASEMENT GRANTING ACCESS FOR INPECTION AND MAINTENANCE. THERE SHALL BE NO PERIMTER WALLS LOCATED WITHIN SAID EASEMENT. THESE IMPROVEMENTS SHALL BE INSPECTED ON AN ANUAL BASIS PER DRAINAGE IMPROVEMENTS MAINTENANCE NOTES ON THIS SHEET DRAINAGE MAINTENANCE NOTES..

GENERAL UTILITY NOTES:

1. SHOULD AN EASEMENT BE IN CONFLICT WITH ANY PROPOSED BUILDING LOCATION, VACATION OF THE EASEMENT IS TO OCCUR PRIOR TO ISSUANCE OF BUILDING PERMITS.

PARKS AND RECREATION GENERAL NOTES:

1. ALL TRAIL EASEMENTS INDICATED ARE FOR USE BY THE GENERAL PUBLIC AS PERMANENT, NON-MOTORIZED TRAIL EASEMENTS.
2. PUBLIC TRAIL EASEMENTS MUST BE DEDICATED TO THE TOWN AS PART OF THE FINAL PLAT.
3. ALL PUBLIC TRAIL AND SIGNAGE MUST BE CONSTRUCTED BY THE DEVELOPER TO PIMA REGIONAL TRAIL SYSTEM MASTER PLAN STANDARDS IN CONSULTATION WITH THE TOWN PARKS AND RECREATION DEPARTMENT. THE APPLICABLE LOCATIONS AND DESIGN CROSS-SECTIONS ARE INCLUDED WITHIN THESE PLANS.
4. TRAIL AND SIGN LOCATIONS, AS INDICATED ON THIS PLAN, MUST BE FIELD VERIFIED BY TOWN STAFF PRIOR TO CONSTRUCTION AND ARE SUBJECT TO ADJUSTMENT.
5. TRAILS MUST BE POSITIONED IN A MANNER TO AVOID VEGETATION AND MINIMIZE POTENTIAL FOR EROSION.

GOLDER RANCH FIRE GENERAL NOTES:

1. FIRE HYDRANTS CONNECTED TO AN APPROVED WATER SUPPLY OF 1000 GPM FOR FIRE PROTECTION MUST BE INSTALLED AND IN SERVICE PRIOR TO COMBUSTIBLE MATERIAL DELIVERY TO THE SITE. TEMPORARY CONSTRUCTION OFFICE TRAILERS ARE CONSIDERED COMBUSTIBLE MATERIAL.
2. APPROVED FIRE APPARATUS ACCESS ROADS MUST BE INSTALLED AND IN SERVICE PRIOR TO COMBUSTIBLE MATERIAL DELIVERY TO THE SITE.
3. SECTION 903.2.8 GROUP R: AN AUTOMATIC SPRINKLER SYSTEM INSTALLED IN ACCORDANCE WITH SECTION 903.3 SHALL BE PROVIDED THROUGHOUT ALL BUILDINGS WITH A GROUP R FIRE AREA INCLUDING ONE- AND TWO-FAMILY DWELLINGS AND TOWNHOUSES USED AS MODEL HOMES WITH SALES OR CONSTRUCTION OFFICES AND ONE- AND TWO-FAMILY DWELLINGS AND TOWNHOUSES.

EXCEPTION: GROUP R-3 OCCUPANCIES ARE NOT REQUIRED TO INSTALL AUTOMATIC SPRINKLER SYSTEMS WHEN ALL OF THE FOLLOWING EXIST:

1.GROUP R-3 OCCUPANCIES PROVIDING THE REQUIRED FIRE FLOW IN ACCORDANCE WITH SECTION B105 AND TABLES B105.1 (1) AND B105.1 (2).

2.GROUP R-3 OCCUPANCIES WITHIN 600 FEET (182.880M) OF FIRE HYDRANTS CAPABLE OF SUPPLYING THE REQUIRED FIRE FLOW.

3.GROUP R-3 OCCUPANCIES IN COMPLIANCE WITH SECTION D106 AND D107.

4. TEMPORARY STREET SIGNS MUST BE INSTALLED AT EACH STREET INTERSECTION WHEN CONSTRUCTION OF NEW ROADWAYS ALLOWS PASSAGE OF VEHICLES. ALL STRUCTURES UNDER CONSTRUCTION MUST BE CLEARLY IDENTIFIED WITH AN APPROVED ADDRESS.
5. THE INSTALLATION OF TRAFFIC CONTROL SIGNALING DEVICES AND/OR ELECTRICALLY OPERATED GATES ON FIRE APPARATUS ACCESS ROADS SHALL INCLUDE PREEMPTIVE CONTROL EQUIPMENT COMPATIBLE WITH THE FIRE DEPARTMENT'S EXISTING SYSTEM.

ORO VALLEY WASTEWATER GENERAL NOTES:

1. PROJECT IS IN CONFORMANCE WITH SECTION J, WASTEWATER, OF THE PIMA COUNTY DEVELOPMENT PLAN REQUIREMENTS AS REFERENCED IN 18.71.030.A.
2. ANY RELOCATION, MODIFICATION, ETC., OF THE EXISTING UTILITIES AND/OR PUBLIC IMPROVEMENTS REQUIRED BY THIS DEVELOPMENT WILL BE AT NO EXPENSE TO THE PUBLIC.
3. ANY WASTEWATER DISCHARGED INTO THE PUBLIC SANITARY SEWERAGE SYSTEM SHALL MEET THE REQUIREMENTS OF THE INDUSTRIAL WASTE ORDINANCE (PIMA COUNTY ORDINANCE NO.1991-140, AS AMENDED).
4. THE ON-SITE SANITARY SEWAGE COLLECTION LINES WILL BE PUBLIC AND DESIGNED AND CONSTRUCTED TO PIMA COUNTY REGIONAL WASTEWATER RECLAMATION DEPARTMENT STANDARDS. ALL BUILDING CONNECTION SEWERS WILL BE PRIVATELY MAINTAINED.
5. A PROJECT CONSTRUCTION PERMIT MUST BE SECURED FROM PIMA COUNTY REGIONAL WASTEWATER RECLAMATION DEPARTMENT BEFORE BEGINNING ANY WORK ON THIS PROJECT.
6. CONSTRUCTION AUTHORIZATION FROM THE PIMA COUNTY DEPARTMENT OF ENVIRONMENTAL QUALITY IS REQUIRED BEFORE BEGINNING ANY WORK ON THIS PROJECT. APPROVAL OF THIS DEVELOPMENT PLAN DOES NOT CONSTITUTE CONSTRUCTION AUTHORIZATION.

PERMITTING DIVISION-BUILDING NOTES:

THE FOLLOWING CODES AND STANDARDS SHALL BE APPLICABLE TO THIS DEVELOPMENT:

1. INTERNATIONAL FIRE CODE AS AMENDED
2. INTERNATIONAL BUILDING CODES WITH LOCAL AMENDMENTS
3. NATIONAL ELECTRIC CODE
4. ADA STANDARDS FOR ACCESSIBLE DESIGN
5. GOLDER RANCH FIRE DISTRICT STANDARDS AND FORMS
6. INTERNATIONAL SWIMMING POOL AND SPA CODE
7. PAG STANDARD SPECIFICATIONS AND DETAILS FOR PUBLIC IMPROVEMENTS
8. TOWN OF ORO VALLEY DRAINAGE CRITERIA MANUAL
9. TOWN OF ORO VALLEY SUBDIVISION STREET STANDARDS AND POLICIES MANUAL
10. TOWN OF ORO VALLEY ZONING CODE, CURRENT REVISED
11. ORO VALLEY TOWN CODE, CURRENT REVISED.

REZONING CONDITIONS OF APPROVAL (O)16-04

1. THE ROADWAY CROSSING OVER THE LOMAS DE ORO WASH SHALL BE DESIGNED TO BE A WILDLIFE PERMEABLE BRIDGE THAT DOES NOT IMPEDE WILDLIFE MOVEMENT WITHIN THE WASH.
2. THE FOLLOWING GENERAL NOTES LISTED ON THE TENTATIVE DEVELOPMENT PLAN ARE CONDITIONS OF APPROVAL:
   a. MAXIMUM NUMBER OF LOTS: 91
   b. MINIMUM LOT SIZE: 10,000 SQ. FT.
   c. MAXIMUM NUMBER OF 10,000 SQ. FT. MINIMUM LOT SIZE LOTS: 18
   d. MINIMUM NUMBER OF ½-ACRE MINIMUM LOT SIZE LOTS: 73
   e. INTERNAL BUILDING SETBACKS
      i. FRONT: 10 FEET (MINIMUM 20 FEET FOR VEHICLE PARKING)
      ii. SIDE: 7.5 FEET
      iii. REAR: 20 FEET
   f. MAXIMUM BUILDING HEIGHT
      i. 1-STORY: 20 FEET
      ii. 2-STORY: 28 FEET
   g. MINIMUM PERCENT OF OPEN SPACE/COMMON AREA: 75%
   h. MINIMUM PERCENT OF ENVIRONMENTALLY SENSITIVE OPEN SPACE: 71%
   i. CORNER LOTS RESTRICTED TO SINGLE-STORY
   j. NO MORE THAN TWO 2-STORY HOMES SHALL BE LOCATED SIDE-BY-SIDE ON THE SAME STREET
   k. ORO VALLEY TRAIL #161 WILL BE PROTECTED AS A NON-MOTORIZED PUBLIC ACCESS TRAIL EASEMENT
   l. NO ROADWAY CONNECTIONS WILL BE ALLOWED BETWEEN THIS DEVELOPMENT AND THE RANCHO FELIZ NEIGHBORHOOD TO THE EAST
3. ALL PROPOSED DRAINAGE BASINS TO BE LANDSCAPED TO REDUCE THE VISIBILITY OF THE DISTURBED AREAS.
4. THE OFF-LINE DRAINAGE BASIN ADJACENT TO THE CRITICAL RESOURCE AREA, MUST BE THOROUGHLY LANDSCAPED AROUND THE PERIMETER AND INTERNALLY, TO REDUCE THE VISIBILITY OF THE DISTURBED AREA.
5. LOTS RESTRICTED TO SINGLE-STORY ARE DEPICTED ON THE TENTATIVE DEVELOPMENT PLAN DATED 5.10.2016
6. IN ACCORDANCE WITH SECTION 11.3.11 OF THE TOWN OF ORO VALLEY DRAINAGE CRITERIA MANUAL, THE APPLICANT SHALL REDUCE THE POST-DEVELOPMENT OUTFLOW OF DRAINAGE FROM THE LOMAS DE ORO AND CANYON SHADOWS WASHES, OR PROVIDE OTHER MEANS AS APPROVED BY THE TOWN ENGINEER, TO IMPROVE THE EXISTING DRAINAGE WITHIN THE DOWNSTREAM AREA. THE REDUCTION SHALL BE TO AN AMOUNT THAT HAS THE EFFECT OF MAKING EXISTING RESIDENTIAL STRUCTURES LOCATED ON IMMEDIATELY ADJACENT DOWNSTREAM PROPERTIES, AS SHOWN ON THE TENTATIVE DEVELOPMENT PLAN, ELIGIBLE TO BE REMOVED FROM THE TOWN AND FEMA FLOODPLAIN.
   a. THE REGIONAL ON-SITE DETENTION DEPICTED ON THE TENTATIVE DEVELOPMENT PLAN AND DISCUSSED IN THE SITE ANALYSIS SHALL BE DESIGNED AND CONSTRUCTED SO THAT THE EXISTING 100-YEAR LOMAS DE ORO WASH PEAK FLOW IS REDUCED BY 10% WHERE IT EXITS THE PROJECT'S SOUTHERN BOUNDARY. FURTHERMORE, THE BASIN SHALL BE DEDICATED BY THE DEVELOPER TO THE TOWN OF ORO VALLEY UPON SUCCESSFUL INSPECTION AND ACCEPTANCE BY THE TOWN ENGINEER AND PRIOR TO THE RELEASE OF BUILDING PERMITS.
   b. IF THE APPLICANT IS UNABLE TO CONSTRUCT THE PROPOSED OFF-SITE IMPROVEMENTS DEPICTED ON THE TENTATIVE DEVELOPMENT PLAN AND DISCUSSED IN THE SITE ANALYSIS, AN ON-SITE SOLUTION MUST BE ESTABLISHED AND APPROVED BY THE TOWN ENGINEER.
7. ALL CRITICAL DRAINAGE ELEMENTS DESIGNED TO PROTECT DOWNSTREAM PROPERTY OWNERS MUST BE IN PLACE BY THE ONSET OF GRADING ACTIVITIES, AS APPROVED BY THE TOWN ENGINEER. THE BASINS ARE TO BE IN PLACE AND FUNCTIONAL AT THE BEGINNING OF PROJECT CONSTRUCTION TO CAPTURE RUNOFF AND IMPROVE DOWNSTREAM CONDITIONS.
8. THE APPLICANT SHALL DEDICATE 55' OF NEW RIGHT-OF-WAY ALONG THE PROPERTY'S LA CHOLLA BOULEVARD FRONTAGE.
9. THE APPLICANT SHALL PROVIDE A 30' EASEMENT ALONG A PORTION OF THE NEW LA CHOLLA BOULEVARD RIGHT-OF-WAY FOR DRAINAGE IMPROVEMENTS. EASEMENT SHALL BE DEDICATED BY FINAL PLAT.
10. THE APPLICANT SHALL CONSTRUCT A CONTROLLED ACCESS INTERSECTION (E.G. RIGHT-IN/OUT) OR MAKE OTHER NECESSARY IMPROVEMENTS FOR SAFE SIGHT VISIBILITY AT THE LA CHOLLA ACCESS DRIVE LOCATION AS APPROVED BY THE TOWN ENGINEER IF THIS PROJECT IS CONSTRUCTED PRIOR TO THE LA CHOLLA BOULEVARD WIDENING PROJECT.
11. THE APPLICANT SHALL CONSTRUCT A MULTI-USE PATH THE LENGTH OF THE PROPERTY'S FRONTAGE ALONG THE SOUTH SIDE OF LAMBERT LANE.

DRAINAGE IMPROVEMENTS MAINTENANCE PLAN

THE FOLLOWING MAINTENANCE ACTIVITIES SHOULD BE ADDRESSED AT LEAST ANNUALLY.

(1)DEBRIS REMOVAL – ALL CHANNELS, DROP SPILLWAY STRUCTURES, AND ENERGY DISSIPATORS SHALL BE KEPT CLEAR OF TREES, LOGS, DEBRIS, TRASH, AND OTHER OBSTACLES, WHICH COULD INTERFERE WITH THE PROPER FUNCTIONING OF THE STRUCTURES.

(2)CONCRETE – CONCRETE SHALL BE VISUALLY INSPECTED FOR SPALLS, CRACKS, MISALIGNMENT, OR STRUCTURAL BREAKAGE. SPALLS DEEPER THAN 1-INCH AND CRACKS LESS THAN 0.25 INCHES SHALL BE REPAIRED WITH CEMENT MORTAR AND SEALING COMPOUND RESPECTIVELY. CRACKS GREATER THAN 0.25 INCHES, MISALIGNMENTS OF MORE THAN 0.5 INCHES, AND ANY STRUCTURAL BREAKAGE SHALL BE MEASURED, MONITORED, AND REPAIRED IN ACCORDANCE WITH TOWN OF ORO VALLEY RECOMMENDATIONS. EXPOSED JOINTS SHALL BE VISUALLY INSPECTED. ANY JOINTS WHERE THE SEALING COMPOUND OR JOINT FILLER IS MISSING SHALL BE REPAIRED WITH MATERIALS SIMILAR TO THAT USED IN THE ORIGINAL CONSTRUCTION. ANY JOINTS FOUND TO HAVE OPENED MORE THAN 1- INCH SHALL BE MEASURED AND PROMPTLY REPAIRED.

(3)EARTH FILL AREAS AND SLOPES – ALL SOIL REMOVED FROM REGRADED AREAS AND UPPER CHANNEL SLOPES BY EROSION, VANDALISM, RODENTS, VEHICLES OR OTHER CAUSES SHALL BE REPLACED TO THE ORIGINAL SLOPES AND GRADES. ALL EARTH FILL SHALL BE AN APPROVED MATERIAL THAT IS COMPACTED AND GRADED TO PREVENT PONDING OR CONCENTRATED DRAINAGE.

(4)ROCK RIPRAP – REPLACE WEATHERED OR DISPLACED ROCK RIPRAP TO CONSTRUCTED GRADES.

(5)FENCES – INSPECT ALL BARRICADE RAILINGS, FENCES AND GATES AT LEAST ONCE EACH YEAR AND REPAIR OR REPLACE AS NEEDED. ALL METALWORK SHALL BE VISUALLY INSPECTED AND REPAIRED OR REPLACED IF IT IS DAMAGED OR IMPROPERLY FUNCTIONING. ALL PAINTED SURFACES SHALL BE CLEANED AND PAINTED WHEN RUST STARTS TO APPEAR, OR THE PAINT SYSTEM SHOWS SIGNS OF PEELING OR HEAVY OXIDATION.

(6)BASIN ACCESS ROAD – MAINTAIN THE ACCESS RAMP IN DRIVABLE CONDITION. REMOVE ANY OBSTRUCTIONS TO THE PASSAGE OF VEHICLES AND ADD FILL AS NEEDED TO PREVENT PONDING OF WATER AND MAINTAIN ADEQUATE DRAINAGE. EROSION WITHIN THE ROADWAY MORE THAN 6 INCHES WIDE AND 8 INCHES DEEP WILL BE REPAIRED.

(7)ENCROACHMENTS: EXCAVATIONS, STRUCTURES, OR OTHER OBSTRUCTIONS PRESENT WITHIN THE DRAINAGE EASEMENT AREA ARE PROHIBITED.

A SCHEDULE FOR CORRECTIVE ACTIONS SHALL BE DEVELOPED FOR COMPLETION OF IDENTIFIED MAINTENANCE WORK IN A TIMELY MANNER.

INSPECTIONS:
THE FOLLOWING INSPECTIONS ARE REQUIRED TO ENSURE THAT THE FLOOD CONTROL STRUCTURES FUNCTION AS DESIGNED.
(1)ANNUAL INSPECTIONS WILL BE ACCOMPLISHED BY QUALIFIED STAFF USING THE INSPECTION FORM BELOW. INSPECTIONS WILL IDENTIFY ITEMS SUCH AS:
•DEBRIS REMOVAL•CONCRETE REPAIR/REPLACEMENT

•METALWORK (TRASH RACKS, RAILINGS, DRAINAGE)

•EROSION REPAIRS

•FENCE/GATE REPAIRS AND/OR INSTALLATION•ADDING SLOPE PROTECTION

•VANDALISM RELATED REPAIRS: FENCES, GATES, SIGNS, TRASH, GRAFFITI, ABANDONED VEHICLES, ETC.

•MISCELLANEOUS MAINTENANCE ITEMS AS APPROPRIATE.

•SEDIMENT REMOVAL•UNFORESEEN AND LONG TERM MAINTENANCE NEEDS
(2)SPECIAL INSPECTIONS WILL BE CONDUCTED IMMEDIATELY FOLLOWING SEVERE STORMS, EARTHQUAKES, VANDALISM, AND OTHER SIGNIFICANT EVENTS. ALL INSPECTIONS SHALL BE DOCUMENTED USING THE STANDARD INSPECTION FORM BELOW..

RELATED CASE #
OV914-009
2100731
OV114-018

Contact Arizona 811 at least two full working days before you begin excavation
811 or 1-800-STAKE-IT (Arizona811.com)

LJA Engineering, Inc.
7458 N. La Cholla Boulevard,
Tucson, AZ 85741
Phone 520.257.3400

FSP NOTES
SUNDARA RIDGE
FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed 07/18/24
ARIZONA U.S.A.

PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

H: C.I.=2'
V:
SCALE 12/16/24
DATE AZ4072-1004
JOB NUMBER ML
DRAWN BY LJA
DESIGNED BY RWS
CHECKED BY

02 OF 51

P22W100005
G-2022-007

GENERAL PAVING/GRADING NOTES:

1. ALL MATERIALS AND WORKMANSHIP ARE TO BE IN ACCORDANCE WITH PIMA ASSOCIATION OF GOVERNMENTS STANDARD SPECIFICATIONS FOR PUBLIC IMPROVEMENTS (PAG SSPI), EDITION OF 2015, EXCEPT AS MODIFIED HEREBY.
2. ALL CONSTRUCTION AND TESTING METHODS SHALL BE IN CONFORMANCE WITH P.A.G. SSPI, EDITION OF 2015, EXCEPT AS MODIFIED HEREBY.
3. EXCAVATION AND BACKFILL FOR STRUCTURES SHALL CONFORM TO P.A.G. SSPI, SECTION 203-5.
4. EARTHWORK, EXCEPT AS MODIFIED BY THE SOILS REPORT OF RECORD, SHALL CONFORM TO P.A.G. SSPI SECTION 203.
5. AGGREGATE BASE COURSE SHALL CONFORM TO PAG SSPI, SECTION 303.
6. ASPHALTIC CONCRETE SHALL CONFORM TO PAG SSPI, SECTION 406, ASPHALTIC CONCRETE MIXTURE NO. 2 SPECIFICATIONS.
7. ALL CONCRETE SHALL CONFORM TO PAG SSPI, SECTION 1006, CLASS S, 3,000 PSI COMPRESSIVE STRENGTH AT 28 DAYS, UNLESS OTHERWISE SPECIFIED.
8. A STAMPED SET OF APPROVED PLANS SHALL BE KEPT IN AN EASILY ACCESSIBLE LOCATION ON THE JOB SITE AT ALL TIMES OR DURING CONSTRUCTION.
9. CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION REGULATIONS.
10. CONTRACTOR SHALL CALL BLUE STAKE (ARIZONA 811) TO VERIFY LOCATION OF ALL UTILITIES PRIOR TO COMMENCEMENT OF CONSTRUCTION, A MINIMUM OF TWO (2) FULL WORKING DAYS PRIOR TO EXCAVATION.
11. CONTRACTOR SHALL OBTAIN ALL PERMITS REQUIRED BY GOVERNMENTAL AGENCIES.
12. CONTRACTOR SHALL INSTALL STREET SIGNS IN ACCORDANCE WITH THE TOWN OF ORO VALLEY SUBDIVISION STREET STANDARDS - SIGNAGE POLICY.
13. PAVING CONTRACTOR SHALL ADJUST BOTH EXISTING AND NEW WATER VALVES, BOX COVERS, WATER METER BOXES, SANITARY SEWER MANHOLES AND CLEANOUT RINGS AND COVERS, TELEPHONE AND ELECTRIC MANHOLE RING AND COVERS TO THE NEW FINISHED GRADE.
14. UPON COMMENCEMENT OF WORK, TRAFFIC CONTROL DEVICES SHALL BE POSTED AND MAINTAINED BY THE CONTRACTOR UNTIL SUCH TIME AS THE WORK IS COMPLETED. ALL WARNING SIGNS, BARRICADES, ETC., SHALL BE IN ACCORDANCE WITH THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES ADOPTED BY THE STATE OF ARIZONA PURSUANT TO A.R.S. 28-650.
15. IF UNANTICIPATED CONDITIONS ARE ENCOUNTERED DURING THE COURSE OF CONSTRUCTION AND ARE BEYOND THE SCOPE OF THE DESIGN, THE ENGINEER SHALL SUBMIT THE NECESSARY REVISED OR SUPPLEMENTAL IMPROVEMENT PLANS FOR REVIEW AND APPROVAL BY THE TOWN OF ORO VALLEY PRIOR TO SUCH REVISIONS/CHANGES BEING MADE IN THE FIELD.
16. ALL STATIONING SHOWN ON PLAN AND PROFILE ARE ALONG CONSTRUCTION CENTERLINE UNLESS OTHERWISE NOTED.
17. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CARE AND MAINTENANCE OF EXISTING IMPROVEMENTS AND VEGETATION IN THE WORK AREA. PAVEMENT, CURBS, CART PATHS AND ANY OTHER OBSTRUCTIONS DAMAGED DURING CONSTRUCTION ARE TO BE REPLACED BY THE CONTRACTOR. ANY UNDERGROUND PIPES, IRRIGATION LINES, IRRIGATION CONTROLS, DRAINS, STRUCTURES, OR OBSTRUCTIONS NOT SHOWN ON THESE PLANS SHALL BE MOVED, ALTERED, OR REPAIRED BY THE CONTRACTOR WHEN ENCOUNTERED, AS DIRECTED BY THE ENGINEER AND IS A DEFINITE PART OF THIS PROJECT.
18. ACCEPTANCE OF THESE PLANS DOES NOT CONSTITUTE OR IMPLY ACCEPTANCE OF ANY OF THE FOLLOWING:
A. WALLS(S), RETAINING OR OTHER TYPE(S).
B. ANY REINFORCED CONCRETE STRUCTURE(S).
C. ANY EMBANKMENT(S) WHOSE PRIMARY PURPOSE IS TO FUNCTION AS A RETENTION/DETENTION STRUCTURE.
THE ITEMS LISTED ABOVE ARE APPROVED FOR LOCATION ONLY. SEPARATE PLAN CHECKS AND PERMITS ARE REQUIRED, ALL IN ACCORDANCE WITH THE APPLICABLE CODES OF THE TOWN OF ORO VALLEY.
19. THE CONTRACTOR SHALL GIVE FORTY-EIGHT (48) HOURS NOTICE WHEN THEY SHALL REQUIRE THE SERVICES OF THE ENGINEER OR ANY OTHER PERSON PROPERLY AUTHORIZED FOR SUCH PURPOSE FOR LAYING OUT ANY PORTION OF THE WORK. THEY SHALL ALSO DIG ALL STAKE HOLES NECESSARY TO GIVE LINE AND LEVELS AND SHALL PROVIDE ASSISTANCE CALLED FOR BY THE ENGINEER OR HIS ASSISTANTS UPON ANY PART OF THE WORK WHENEVER SO REQUESTED, AND SHALL PRESERVE ALL STAKES SET FOR THE LINES, LEVELS OR MEASUREMENTS OF THE WORK IN THEIR PROPER PLACES UNTIL AUTHORIZED TO REMOVE THEM BY THE ENGINEERS. ANY EXPENSE INCURRED IN REPLACING ANY STAKES WHICH THE CONTRACTOR OR THEIR SUBORDINATES MAY HAVE FAILED TO PRESERVE SHALL BE CHARGED TO THE CONTRACTOR.
20. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO FURNISH, HAUL AND APPLY ALL WATER REQUIRED FOR COMPACTION AND FOR THE CONTROL OF DUST FROM CONSTRUCTION ACTIVITY. THE COST THEREOF IS TO BE INCLUDED IN THE GRADING CONSTRUCTION PRICE.
21. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO FULLY COMPLY WITH A.D.E.Q. STORMWATER POLLUTION PREVENTION PERMITS IN ACCORDANCE WITH THE REPORT AND POLLUTION PLANS PREPARED BY THE ENGINEER. THE COST THEREOF TO BE INCLUDED IN THE GRADING CONSTRUCTION PRICE.
22. BUILDING SITES SHALL BE CONSTRUCTED TO WITHIN 0.10 FOOT OF FINISH BUILDING PAD ELEVATIONS AS STAKED BY THE ENGINEER. STREETS AND PARKING AREAS SHALL BE CONSTRUCTED TO WITHIN +0.10 FEET OF FINISH SUBGRADE AS STAKED BY THE SURVEYOR.
23. A REPORT OF SOILS INVESTIGATION, INCLUDING RECOMMENDATIONS FOR GRADING PROCEDURE HAS BEEN PREPARED BY ALTA ARIZONA, PROJECT NO. 220076-G, APRIL 11, 2022. ALL EARTHWORK SHALL CONFORM TO THE RECOMMENDATIONS CONTAINED IN SAID REPORT AND ANY AMENDMENTS MADE THERETO.
24. THE SOILS ENGINEER SHALL OBSERVE, INSPECT AND TEST ALL CONSTRUCTION OPERATIONS, INCLUDING BUT NOT LIMITED TO: CLEARING, GRUBBING, SUBGRADE PREPARATION, STRUCTURAL, TRENCH EXCAVATION AND BACKFILL, MATERIAL TESTING, TOGETHER WITH PLACEMENT OF FILL. SAID ENGINEER SHALL CERTIFY IN WRITING, THAT ALL SOILS OPERATIONS AND MATERIALS USED FOR THIS DEVELOPMENT WERE PERFORMED IN ACCORDANCE WITH THE RECOMMENDATIONS AS SET FORTH IN THE GEOTECHNICAL INVESTIGATION OF RECORD AND ARE IN CONFORMANCE WITH THE ACCEPTED PLANS AND SPECIFICATIONS. CERTIFICATION, IN WRITING, IS TO BE RECEIVED BY THE TOWN OF ORO VALLEY PRIOR TO THE REQUEST FOR FINAL INSPECTION AND RELEASE OF ASSURANCES.
25. GRADING BOUNDARIES SHALL BE CLEARLY MARKED, AND ALL WORK WILL BE CONFINED TO APPROVED PROJECT LIMITS AS SHOWN ON THESE PLANS.

GENERAL PAVING/GRADING NOTES (CONT.)

26. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AND/OR THE SURVEYOR PROVIDING THE CONSTRUCTION LAYOUT TO VERIFY THE BENCHMARK AND COMPARE THE SITE CONDITIONS WITH THE PLANS AND SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES OBSERVED. SHOULD ANY BENCHMARK, GRADE OR DESIGN INDICATED ON THE PLANS BE SUSPECT, THE ENGINEER SHALL BE NOTIFIED OF SAID BENCHMARK, GRADE OR DESIGN PROBLEM AT LEAST TWENTY-FOUR HOURS BEFORE CONSTRUCTION IS SCHEDULED TO BEGIN ON THE AFFECTED AREA.
27. IT SHALL BE THE SOLE RESPONSIBILITY OF THE OWNER(S), THEIR SUCCESSORS OR ASSIGNS, (AND/OR THEIR CONTRACTOR, THEIR SUCCESSORS OR ASSIGNS AS APPLICABLE) TO PURSUE ANY NEGOTIATIONS, OBTAIN ANY AGREEMENTS AND/OR PERMITS, ETC., FROM ALL NECESSARY OWNERS, PRIVATE AND/OR GOVERNMENTAL AGENCIES IN CHARGE OF PROPERTIES AND/OR RIGHTS-OF-WAY ADJACENT TO (OR NEIGHBORING) THIS PROJECT, THAT MAY BE REQUIRED TO DO ANY WORK (CONSTRUCTION, ACCESS, MODIFICATIONS, GRADING, DRAINAGE, STRUCTURES, ROADS, ETC.) ENCROACHING OR AFFECTING - DIRECTLY OR INDIRECTLY - ON THESE ADJACENT PROPERTIES AND RIGHTS-OF-WAY IN ANY CONCEIVABLE MANNER, REGARDLESS OF WHETHER OR NOT THIS WORK IS SHOWN OR DESCRIBED ON THESE PLANS (OR) ON THIS PLAT.
28. THE PROFESSIONAL ENGINEER OF RECORD SHALL SUBMIT AS-BUILT RECORD DRAWINGS AND CERTIFY IN WRITING THAT ALL IMPROVEMENTS, WHETHER PRIVATE OR PUBLIC, HAVE BEEN CONSTRUCTED, PLACED, INSTALLED, ETC. IN SUBSTANTIAL CONFORMANCE WITH THE ACCEPTED PLANS FOR THIS DEVELOPMENT. CERTIFICATIONS IN WRITING AND THE AS-BUILT RECORD DRAWINGS ARE TO BE RECEIVED BY THE TOWN OF ORO VALLEY A MINIMUM OF TWO (2) WEEKS PRIOR TO THE REQUEST FOR CERTIFICATES OF OCCUPANCY AND/OR FINAL INSPECTION BY THE DEPARTMENT OF PUBLIC WORKS AND THE RELEASE OF ASSURANCES, EXCEPT FOR MODEL HOMES INTENDED TO BE USED FOR SALES PURPOSES. IF THE PROJECT IS PHASED THE ABOVE PERTAINS TO EACH PHASE
29. THE TOWN OF ORO VALLEY WILL, UPON RECEIPT OF ALL NECESSARY CERTIFICATIONS AS OUTLINED ON THE IMPROVEMENT PLANS AND FINAL PLAT, PERFORM A FIELD REVIEW OF THE DEVELOPMENT. FIELD CONDITIONS, DESIGN OVERSIGHTS, ETC., MAY REQUIRE ADDITIONAL WORK AND/OR IMPROVEMENTS AS A RESULT OF SAID REVIEW.
30. ALL EASEMENTS MUST BE ACQUIRED BY OWNER/BUILDER PRIOR TO CONSTRUCTION.
31. ANY PROPOSED REVISION OR MODIFICATION TO THIS APPROVED PLAN SHALL BE SUBMITTED TO THE TOWN ENGINEER'S OFFICE FOR REVIEW AND APPROVAL PRIOR TO SUCH CHANGES BEING MADE IN THE FIELD.
32. ALL TRAIL ALIGNMENTS MUST BE FIELD VERIFIED & DEDICATED BY FINAL PLAT.
33. LANDSCAPING SHALL BE LIMITED IN AREAS WHERE STORM DRAIN PIPES AND STRUCTURES ARE LOCATED.
34. ALL ARCHAEOLOGICAL MITIGATION SHALL BE APPROVED AND IMPLEMENTED TO THE SATISFACTION OF THE PLANNING AND ZONING ADMINISTRATION PRIOR TO ISSUANCE OF ANY GRADING PERMITS BY THE TOWN.
35. ALL WORK SHALL BE IN CONFORMANCE TO GRADING STANDARDS, CHAPTER 27-SECTION 27.9 OF THE ORO VALLEY ZONING CODE REVISED, YEAR 2005.
36. ALL EXPOSED CUT SLOPES SHALL BE TREATED WITH A RESTORATIVE AGENT AND REVEGETATED TO REFLECT EXISTING NATIVE VEGETATION AND DENSITIES IN ADJACENT NATURAL AREAS. ALL AREAS OF DISTURBANCE SHALL BE RECONTOURED TO MIMIC EXISTING GRADES, PER THE APPROVED GRADING EXCEPTION.
37. ALL WORK WITHIN THE PUBLIC RIGHT-OF-WAY SHALL REQUIRE SEPARATE PERMIT.
38. ALL BASIN AND OUTLET STRUCTURES, INCLUDING TEMPORARY SWALES MUST BE IN PLACE PRIOR TO COMMENCING GRADING ACTIVITIES BEYOND THESE NOTED IMPROVEMENTS.
39. ALL EXISTING DRAINAGE PATTERNS MUST BE MAINTAINED ALONG WITHOUT NEGATIVE IMPACTS TO DOWNSTREAM OFFSITE PROPERTIES.
40. BANK PROTECTION AND LOT TO LOT INFRASTRUCTURE TO BE BUILT AS PART OF THE SITES OVERALL, GRADING PLAN WITHIN AN EASEMENT FOR MAINTENANCE PURPOSES.
41. NO PERIMETER WALLS SHALL CROSS THE LOT TO LOT DRAINAGE FACILITIES.

OWNER

FUTURE ARIZONA INC.
1555 N. ASTOR STREET, APT 28W
CHICAGO, IL 60610

DEVELOPER

FUTURE ARIZONA INC.
1555 N. ASTOR STREET, APT 28W
CHICAGO, IL 60610

BASIS OF BEARING

GRID NORTH AS DEFINED BY THE ARIZONA STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. THE BEARING EQUATION FOR THIS PROJECT IS THE NORTH LINE OF NORTHWEST QUARTER (NW 1/4) OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G.&S.R.M., PIMA COUNTY, ARIZONA HAVING A BEARING OF NORTH 89°23'42" EAST BETWEEN THE NORTHWEST CORNER OF SECTION 15 AND THE NORTH QUARTER CORNER OF SECTION 15.

BASIS OF ELEVATION

NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

BENCHMARK

BENCHMARK #1:
NORTHWEST CORNER OF SECTION 15
BRASS CAP IN HANDHOLE RLS 42285
ELEVATION = 2607.67 FEET NAVD-1988

BENCHMARK #2:
NORTH QUARTER CORNER OF SECTION 15
BRASS CAP IN HANDHOLE RLS 85235
ELEVATION = 2600.64 FEET NAVD-1988

PUBLIC SEWER GENERAL NOTES:

1. ALL DESIGN STANDARDS, MATERIALS AND WORKMANSHIP FOR PUBLIC SANITARY SEWERS SHALL BE IN ACCORDANCE WITH THE PIMA COUNTY REGIONAL WASTEWATER RECLAMATION DEPARTMENT. (PCRWRD) ENGINEERING DESIGN STANDARDS (EDS 2016) AND THE STANDARD SPECIFICATIONS AND DETAILS FOR CONSTRUCTION 2016 (SSDC 2016). SAID DOCUMENTS ARE AVAILABLE THROUGH THE PCRWRD WEBSITE (www.pima.gov/wastewaterreclamation).
2. ONLY APPROVED PLANS SHALL BE USED FOR THE CONSTRUCTION OF PUBLIC SANITARY SEWER FACILITIES. APPROVED PLANS REQUIRING DESIGN REVISIONS SHALL BE RESUBMITTED TO PIMA COUNTY FOR REVIEW AND RE-APPROVAL PRIOR TO THE START OF THE REVISED SEWER WORK.

PUBLIC SEWER GENERAL NOTES (CONT.):

5. SEWER CONSTRUCTION SHALL NOT COMMENCE UNTIL: (A) THE ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY (ADEQ) OR ITS DELEGATED AUTHORITY HAS ISSUED A CONSTRUCTION AUTHORIZATION FOR THIS PROJECT; (B) THE CONTRACTOR HAS OBTAINED A PCRWRD PUBLIC SEWER CONSTRUCTION PERMIT (CONTACT THE PCRWRD PERMITS SECTION AT (520) 724-6649 FOR PERMIT APPLICATION REQUIREMENTS); (C) THE CONTRACTOR'S FLOW MANAGEMENT PLAN HAS BEEN SUBMITTED THIRTY (30) CALENDAR DAYS PRIOR TO THE PRE-CONSTRUCTION MEETING AND APPROVED BY PCRWRD FIELD ENGINEERING; AND (D) A PRE-CONSTRUCTION MEETING WITH THE ASSIGNED PIMA COUNTY PROJECT FIELD INSPECTOR IS SCHEDULED AT LEAST THREE (3) FULL BUSINESS DAYS PRIOR TO COMMENCING WITH SEWER CONSTRUCTION.
6. IMMEDIATELY REPORT ANY OF THE FOLLOWING TO THE PCRWRD OPERATIONS CONTROL CENTER (OCC) AT (520) 724-6500: ANY RELEASE OF SEWAGE, ANY DAMAGE TO THE PUBLIC SANITARY SEWER SYSTEM, OR THE DROPPING OF DEBRIS INTO A PUBLIC SANITARY SEWER MANHOLE. A PCRWRD REPRESENTATIVE WILL BE DISPATCHED TO THE SITE. THE CONTRACTOR SHALL TAKE IMMEDIATE ACTION TO CONTAIN A SANITARY SEWAGE OVERFLOW (SSO). THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL COSTS TO REPAIR THE SYSTEM, MITIGATE THE RELEASE OF SEWAGE, DISINFECT THE RELEASE AREAS, AND ANY REGULATORY PENALTIES LEVIED ON PCRWRD FOR SEWAGE ENTERING A NATURAL DRAINAGE WAY OR STORM WATER DRAINAGE SYSTEM. THE CONTRACTOR SHALL REPAIR ALL DAMAGE AS DIRECTED AND APPROVED BY THE PCRWRD FIELD REPRESENTATIVE.
7. STORM WATER AND SEDIMENT CONTROL MEASURES SHALL BE PROPERLY INSTALLED TO PROTECT PCRWRD MANHOLES AT THE BEGINNING OF CONSTRUCTION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO CONSTANTLY MAINTAIN STORM WATER AND SEDIMENT CONTROL MEASURES THAT PROTECT PCRWRD FACILITIES UNDER ALL CONDITIONS FOR THE DURATION OF THE PROJECT. UNDER NO CIRCUMSTANCES SHALL THE CONTRACTOR ALLOW STORM WATER, SEDIMENT, OR POTENTIAL POLLUTANTS FROM CONSTRUCTION SITE TO ENTER A PCRWRD MANHOLE. THE CONTRACTOR SHALL ENSURE THAT THEIR FLOW MANAGEMENT OPERATION INCLUDE CONTROLS TO PREVENT ANY INTRODUCTION OF STORM WATER, SEDIMENT, OR POLLUTANTS INTO THE PUBLIC SANITARY SEWER SYSTEM. FAILURE TO CONFORM TO THESE REQUIREMENTS SHALL RESULT IN CANCELLATION OF THE SEWER CONSTRUCTION PERMIT.
8. SPECIAL CARE SHALL BE TAKEN TO ENSURE DESIGN SLOPES ARE MAINTAINED. SEWERS CONSTRUCTED AT INSUFFICIENT SLOPES WILL NOT BE ACCEPTED BY PCRWRD FIELD ENGINEERING AND/OR ADEQ. CORRECTIVE ACTION, INCLUDING RE-CONSTRUCTION OF THE SEWER(S), WILL BE AT THE SOLE EXPENSE OF THE PROJECT OWNER/CONTRACTOR.
9. THE CONTRACTOR SHALL ADJUST OR RECONSTRUCT ALL SANITARY SEWER MANHOLES TO FINISHED ALL FRAMES AND COVER ADJUSTMENTS SHALL BE IN ACCORDANCE WITH PCRWRD SSDC 2016, DETAIL NOS. RWRD 211, 212, 304 OR 305 (AS APPLICABLE). THE CONTRACTOR SHALL PROTECT THE BENCH AND FLOW CHANNELS WITH A COVER PER PCRWRD SSDC 2016, DETAIL NO. RWRD 306. PRIOR TO COMMENCING ANY WORK TO THE MANHOLE AND REMOVE THE COVER AFTER ALL WORK IS COMPLETED. THE CONTRACTOR SHALL ENSURE THAT FRAMES AND COVERS ARE CLEAN AND FREE FROM ANY AND ALL ATTACHED MATERIALS (ASPHALT, CONCRETE, ETC.) AND THAT ALL VENT HOLES ARE OPEN AND CLEAR OF OBSTRUCTIONS, AS APPROVED BY THE PCRWRD FIELD ENGINEER. EXISTING FRAMES AND/OR COVERS THAT ARE DAMAGED OR CANNOT BE COMPLETELY CLEANED SHALL BE REPLACED WITH A NEW FRAME AND COVER IN ACCORDANCE WITH PCRWRD SSDC 2016, DETAIL NO. RWRD 213 - 218. COSTS ASSOCIATED WITH EXISTING FRAMES AND COVERS THAT ARE LOST OR DAMAGED DUE TO THE CONTRACTOR'S OPERATIONS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
10. SANITARY SEWER IS MEASURED FROM INSIDE FACE OF STRUCTURE TO INSIDE FACE OF STRUCTURE AND ALL INVERTS INDICATE INSIDE FACE OF STRUCTURE ELEVATION.

GENERAL SIGNING NOTES:

1. ALL SIGNS SHALL BE IN COMPLIANCE WITH THE 2009 EDITION OF THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES, 2000 EDITION OF THE PIMA COUNTY AND CITY OF TUCSON TRAFFIC SIGNING DESIGN MANUAL (2002 REVISION), THE CURRENT SUPPLEMENTAL SPECIFICATIONS, THESE PLANS AND THE SPECIAL PROVISIONS.
2. SIGNS MAY BE MODIFIED AND LOCATIONS ADJUSTED TO FIT CONDITIONS AS DIRECTED BY THE ENGINEER.
3. POST LENGTHS INDICATED ARE APPROXIMATE. THE CONTRACTOR SHALL VERIFY ACTUAL POST LENGTHS.
4. ALL NEW AND EXISTING SIGNS SHALL BE INSTALLED ON PERFORATED POST (SQUARE TUBE), AND SHALL BE INSTALLED IN A CONCRETE FOUNDATION, UNLESS OTHERWISE DIRECTED BY THE ENGINEER.
5. ALL SIGN STATION LOCATIONS ARE APPROXIMATE. THE CONTRACTOR SHALL VERIFY ACTUAL SIGN LOCATIONS WITH THE ENGINEER PRIOR TO THE INSTALLATION OF ALL SIGNS.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING ALL WORK WITH BLUE STAKE AND FOR INSTALLING ALL TRAFFIC SIGNS IN THE FIELD.
7. SPEED LIMIT SIGNS AND STOP SIGNS SHALL BE TYPE IX (DIAMOND GRADE) SHEETING. ALL OTHER WARNING AND REGULATORY SIGNS SHALL BE TYPE III (HIGH INTENSITY) SHEETING UNLESS OTHERWISE DETERMINED BY THE JURISDICTION ENGINEER. STREET NAME SIGNS (D3) SHALL BE FABRICATED USING TYPE III (HIGH INTENSITY) SHEETING AND ADVANCE STREET NAME SIGNS (TE9) SHALL BE FABRICATED USING TYPE III SHEETING. NO PARKING SIGNS SHALL BE TYPE II SHEETING. ALL SCHOOL ZONE SIGNS SHALL BE FLUORESCENT YELLOW-GREEN, DIAMOND GRADE SHEETING. ALL OVERHEAD SIGNS SHALL BE DIAMOND GRADE SHEETING.
8. ALL NEW SIGNS SHALL HAVE ALUMINUM BACKING, UNLESS OTHERWISE SPECIFIED.
9. ANY SALVAGED SIGN THAT IS TO BE REUSED SHALL BE TEMPORARILY STORED IN A SAFE LOCATION UNTIL REINSTALLATION.
10. THE DESIGN SPEED FOR THIS DEVELOPMENT IS: 25 M.P.H. AND THE DESIGN VEHICLE IS: SU-30. THE POSTED SPEED LIMIT FOR TANGERINE ROAD/FIRST AVENUE IS: 45 M.P.H.
11. FINAL INSPECTION/ACCEPTANCE OF SIGNING SHALL BE PERFORMED BY THE ENGINEER.

ESOS NOTE:

1. ALL ESOS AREAS ARE TO HAVE A ROPE OR FENCE BARRIER INDICATING LIMITS PRIOR TO COMMENCING GRADING ACTIVITIES

RELATED CASE #
OV914-009
2100731
OV114-018

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

LJA Engineering, Inc.
7458 N. La Cholla Boulevard,
Tucson, AZ 85741
Phone 520.257.3400

FINAL SITE PLAN IP NOTES
SUNDARA RIDGE
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
SUNDARA RIDGE LOTS 1 THROUGH 91 SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed or Sealed
ARIZONA U.S.A.

PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

H: C.I.=2'
V:
SCALE
12/16/24
DATE
AZ4072-1004
JOB NUMBER
ML
DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY

03 OF 51

P22W100005
G-2022-007

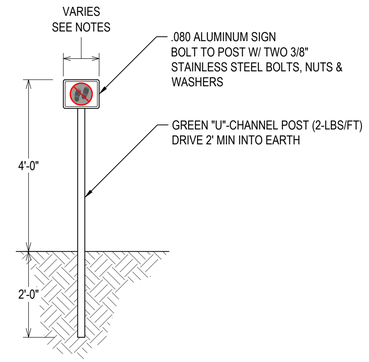
DateTime - Tue, 10 Dec 2024 - 4:10pm PathName - S:\ARIZT\Tucson\AZ4072\400_AND_LJA MOVING FORWARD\BASE FILES\PV403 IP NOTES.dwg

E.S.O.S. CATEGORY	TOTAL AREA EXISTING (AC)	REQUIRED AREA (AC)	PROVIDED ESOS (AC)
CRITICAL RESOURCE AREA	18.43±	17.51± (95.0%)	17.85± (96.9%)
RESOURCE MANAGEMENT AREA 1*	123.32±	81.39± (66.0%)	81.41± (66.0%)
TOTAL (ESOS)	141.75±	98.90± (69.8%)	104.30± (73.6%)

* REGIONAL DRAINAGE IMPROVEMENTS INCLUDED IN RESOURCE MANAGEMENT AREA 1 PER TOWN ZONING CODE SECTION 27.10.E.3.c and 27.10.F.2.2.f.vi.

LEGEND

TRAIL ROUTE SIGNAGE



NOTES:
1. Install sign 2 feet from edge of trail.
2. Install top of sign four feet above the ground.
3. Mount sign with 2 EA, 3/8" carriage bolts, flat washers, locking washers, nuts. Bend down excess bolt length to prevent theft.
4. Size of sign depends on amount of text. Use: 6" x 6", 8" x 8", 10" x 12" or 12" x 18".
5. Use white lettering on a brown background.
6. Incorporate Oro Valley jurisdictional logo on sign.
7. Treat sign with anti-grafitti clear coat.

3 ESOS / TRAIL ROUTE SIGNAGE

NTS

NOTE:
PER SECTION 26.5.D.8 WHERE THE RECREATIONAL AREA ABUTS ENVIRONMENTALLY SENSITIVE LAND (ESL), A SIGN SHALL BE POSTED EVERY ONE HUNDRED (100) FEET AT THE BORDER OF THE ESL AREA.



N

150 75 0 150 300

GRAPHIC SCALE
1" = 150'

RELATED CASE #
OV914-009
2100731
OV114-018

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

LJA Engineering, Inc.
7458 N. La Cholla Boulevard.
Tucson, AZ 85741
Phone 520.257.3400

ESOS MAP
SUNDARA RIDGE
FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed 10/18/24
ARIZONA, U.S.A.

PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

H: 1"=150'	C.I.=2'
V:	
SCALE	
12/16/24	
DATE	
AZ4072-1004	
JOB NUMBER	
ML	
DRAWN BY	
LJA	
DESIGNED BY	
RWS	
CHECKED BY	

04 OF 51

P22WI00005

G-2022-007

Date/Time: Mon, 16 Dec 2024 - 10:06am Path/Name: S:\ARIZOTucson\AZ4072\400LAND_LJA MOVING FORWARD\BASE FILES\PI\04 ESOS MAP.dwg

BCHH RLS 42285
N 508724.0040'
E 978967.5890'

224-24-012A
HALLAQ ISSA Y &
HENRIETTA Z JT/RS

224-24-0130
HALLAQ ISSA Y & HENRIETTA
Z JT/RS

FOUND BCHH 85235N
508751.8300'
E 981603.1700'

W LAMBERT LANE
BK. 11 ROAD MAPS, PG. 21
(PUBLIC)

SEARCH PT
N 508649.3247'
E 978998.3573'

SEARCH PT
N 508676.8348'
E 981604.0174'

40.00' BUFFERYARD "B"

CRITICAL RESOURCES AREA E.S.O.S.

CRITICAL RESOURCES AREA E.S.O.S.

PROPERTY BOUNDARY

PROPERTY BOUNDARY

112.010'
S6° 57' 11.63"E

GRADING LIMIT

15' TRAIL W/ ESMT BY FINAL PLAT (TYP.)

15' TRAIL W/ ESMT BY FINAL PLAT (TYP.)

15' TRAIL W/ ESMT BY FINAL PLAT (TYP.)

EXISTING SLOPES >25% (TYP.)

C. A. "B"

C. A. "A"

SUNBEAM RIDGE

MONARCH GROVE (PVT.)

PUBLIC REGIONAL DETENTION BASIN

GRADING LIMIT

CANADA HILLS WASH

MONARCH GROVE (PVT.) C. A. "A"

N0° 38' 50.54"W
2568.966'

150'

PROPERTY BOUNDARY

BUFFERYARD

RANCHO FELIZ
LOTS 442-647
BK 31, PG 92

CHAPARRAL HEIGHTS
LOTS 1- 73
BK 27, PG 20

N LA CHOLLA BLVD.
BK 02, ROAD MAPS, PG. 114

40'

BUFFERYARD "B"

GRADING LIMIT

C. A. "B"

SIENNA RIDGE (PVT.) C. A. "A"

W OWL HEAD PLACE (PVT.) C. A. "A"

SUNDARA RIDGE (PVT.) C. A. "A"

RADIANT DRIFT PVT.) C. A. "A"

LOMAS DE ORO WASH

CITRINE SAND (PVT.) C. A. "A"

CANYON SHADOWS WASH

GRADING LIMIT

1543.729'
S0° 35' 17.91"E

W OWL HEAD PLACE (PVT.) C. A. "A"

15' TRAIL W/ ESMT BY FINAL PLAT (TYP.)

15.00' WATER EASEMENT

20' SEWER EASEMENT

20' SEWER EASEMENT

10' WATER EASEMENT

15' WATER EASEMENT

150.00' BUFFERYARD

N89° 29' 49.57"E
2553.462'

20' EASEMENT

GRADING LIMIT

SEARCH PT
N 506085.1383'
E 978994.6830'

BCHH W¼
N 506084.8750'
E 978994.6830'

224-39-003A
ROBINSON SHERRY &
BOWERS DUSTIN CP/RS

224-39-0090
SWENA DENNIS D & JODI R
TR

224-39-0070
SCHROEPPEL RICHARD &
ORMAN HILARIE JT/RS

224-39-0080
METROPOLITAN DOMESTIC
WATER IMPROVEMENT

PROPERTY BOUNDARY

LOMAS DE ORO (1-21)
BK/PG: 19011

RBR CAP
N 506108.0330'
E 981633.0430'

DEVELOPMENT ENVELOPE
(APPROXIMATE
GRADING LIMIT)

EXISTING SLOPES >25%
(TYP.)

LEGEND

EXISTING SLOPES >25%

CRITICAL RESOURCE AREA

POST DEVELOPMENT 100-YR FLOODPLAIN

N

150 75 0 150 300
GRAPHIC SCALE
1" = 150'

RELATED CASE #
OV914-009
2100731
OV114-018

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RHSP
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A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12
SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
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FOR CONSTRUCTION ☐

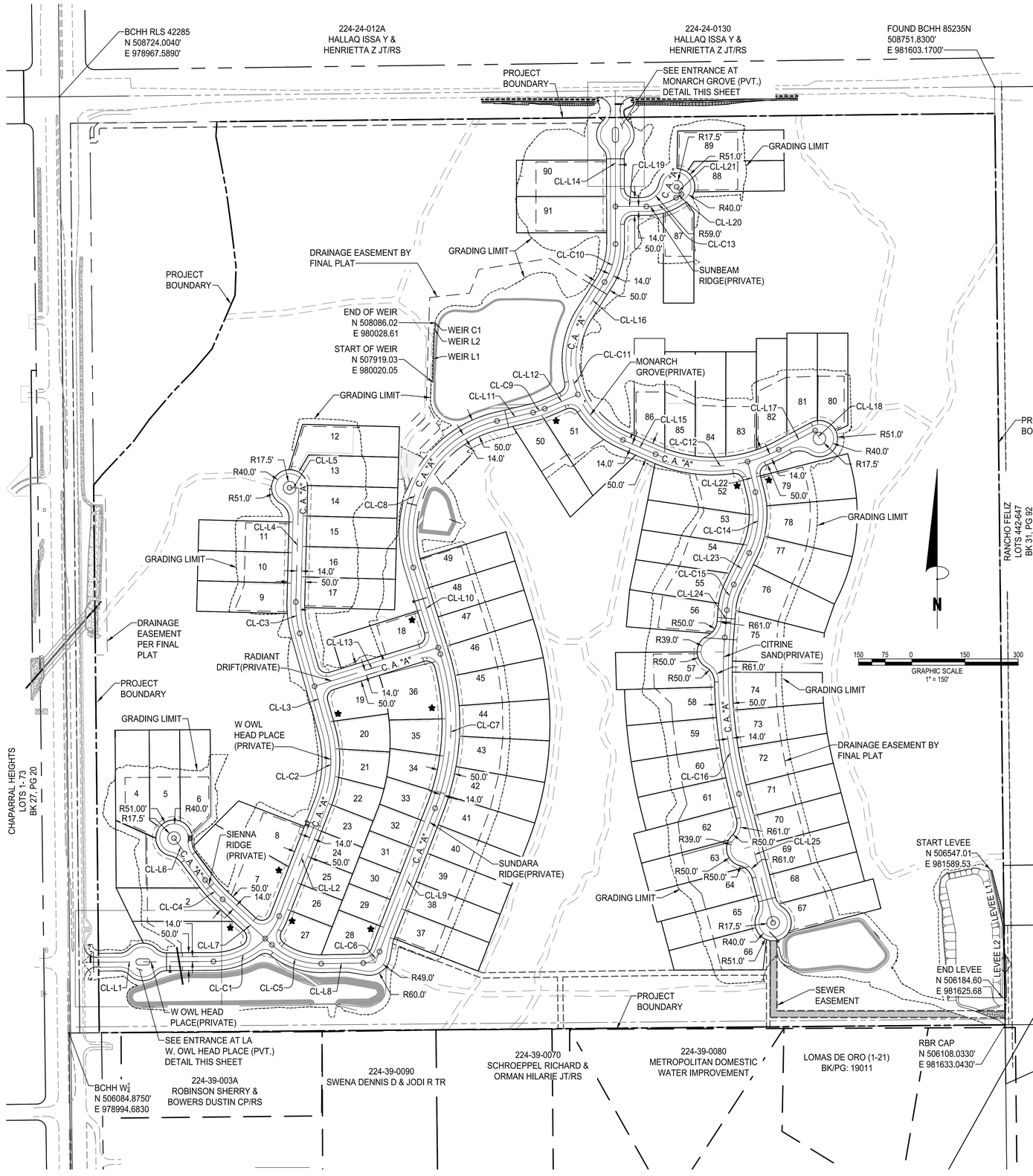
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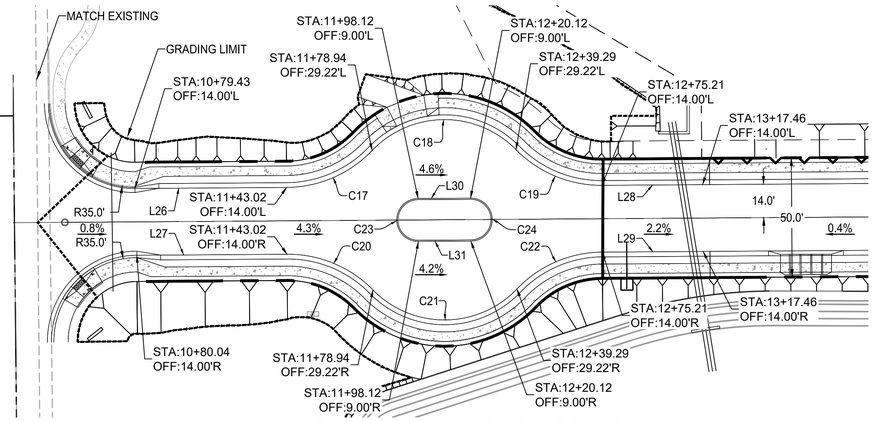
05 OF 51

P22WI00005

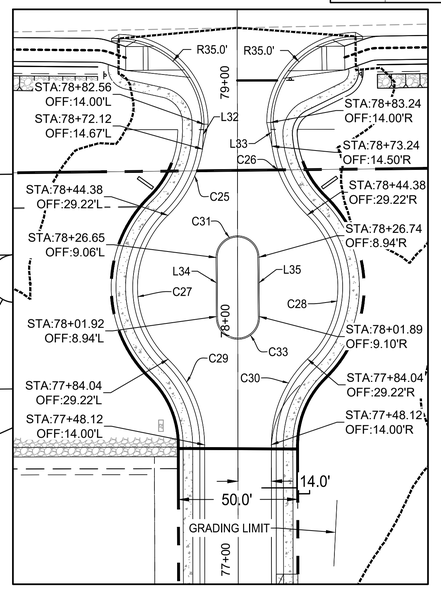
G-2022-007

Date/Time: Mon, 16 Dec 2024 - 10:08am Path/Name: S:\ARIZ\Tucson\AZ4072\400LAND_LJA MOVING FORWARD\BASE FILES\PVI\05 RHSP.dwg





ENTRANCE AT W. OWL HEAD PLACE (PRIVATE)



ENTRANCE AT MONARCH GROVE (PRIVATE)

CURVE TABLE: ALIGNMENTS

CURVE #	RADIUS	DELTA	LENGTH	CHORD
CL-C1	200.00'	68°26'34"	238.91'	224.96'
CL-C2	330.00'	36°47'43"	211.93'	208.30'
CL-C3	300.00'	17°06'34"	89.58'	89.25'
CL-C4	400.00'	10°33'52"	73.75'	73.65'
CL-C5	200.00'	43°35'24"	152.16'	148.51'
CL-C6	50.00'	67°57'27"	59.30'	55.89'
CL-C7	660.00'	38°29'20"	443.36'	435.07'
CL-C8	325.00'	94°03'49"	533.56'	475.63'
CL-C9	200.00'	9°52'41"	34.48'	34.44'
CL-C10	200.00'	32°25'37"	113.19'	111.69'
CL-C11	245.00'	98°41'14"	421.99'	371.73'
CL-C12	400.00'	51°29'51"	359.52'	347.54'
CL-C13	156.00'	32°25'31"	88.28'	87.11'
CL-C14	250.00'	40°18'38"	175.89'	172.28'
CL-C15	200.00'	21°30'56"	75.10'	74.66'
CL-C16	1320.00'	19°18'15"	444.73'	442.63'

LINE TABLE: LEVEE

LINE #	LENGTH	DIRECTION
LEVEE L1	167.96'	N11° 38' 50.54"W
LEVEE L2	197.93'	N0° 38' 54.25"W

LINE TABLE: ALIGNMENTS

LINE #	LENGTH	DIRECTION
CL-L1	357.96'	N89° 36' 46.39"E
CL-L2	341.70'	N21° 10' 12.78"E
CL-L3	280.45'	N15° 37' 29.88"W
CL-L4	321.33'	N1° 29' 03.84"E
CL-L5	26.00'	N88° 30' 56.16"W
CL-L6	147.14'	S36° 43' 04.16"E
CL-L7	163.02'	S47° 16' 56.15"E
CL-L8	118.69'	N89° 07' 39.97"E
CL-L9	433.67'	N21° 10' 12.78"E
CL-L10	255.12'	N17° 19' 06.86"W
CL-L11	104.54'	N76° 44' 42.35"E
CL-L12	101.84'	N66° 52' 01.49"E
CL-L13	365.48'	N72° 40' 53.14"E
CL-L14	356.52'	S0° 06' 17.63"E
CL-L15	100.18'	S66° 21' 54.96"E
CL-L16	106.21'	S32° 19' 19.01"W
CL-L17	115.70'	N62° 08' 14.10"E
CL-L18	26.00'	S27° 51' 45.90"E
CL-L19	87.11'	S89° 53' 42.37"W
CL-L20	17.89'	S57° 28' 11.73"W
CL-L21	25.00'	S32° 31' 48.27"E
CL-L22	88.50'	N14° 20' 10.32"W

LINE TABLE: ALIGNMENTS

LINE #	LENGTH	DIRECTION
CL-L23	98.93'	N25° 58' 27.89"E
CL-L24	77.38'	N4° 27' 31.83"E
CL-L25	376.07'	N14° 50' 42.93"W

CURVE TABLE

CURVE #	RADIUS	DELTA	LENGTH	CHORD
C17	50.00'	45°55'15"	40.07'	39.01'
C18	42.00'	91°50'30"	67.32'	60.34'
C19	50.00'	45°55'15"	40.07'	39.01'
C20	50.00'	45°55'15"	40.07'	39.01'
C21	42.00'	91°50'30"	67.32'	60.34'
C22	50.00'	45°55'15"	40.07'	39.01'
C23	9.00'	180°00'00"	28.27'	18.00'
C24	9.00'	180°00'00"	28.27'	18.00'
C25	50.00'	36°30'01"	31.85'	31.32'
C26	50.00'	37°48'20"	32.99'	32.40'
C27	42.00'	91°50'30"	67.32'	60.34'
C28	42.00'	91°50'30"	67.32'	60.34'
C29	50.00'	45°55'15"	40.07'	39.01'
C30	50.00'	45°55'15"	40.07'	39.01'
C31	9.00'	179°48'35"	28.24'	18.00'
C33	9.04'	186°31'20"	29.41'	18.04'

LINE TABLE

LINE #	LENGTH	DIRECTION
L26	63.59'	N89° 36' 46.39"E
L27	62.99'	N89° 36' 46.39"E
L28	42.25'	N89° 36' 46.39"E
L29	42.25'	N89° 36' 46.39"E
L30	22.00'	S89° 36' 46.39"W
L31	22.00'	N89° 36' 46.39"E
L32	10.46'	S3° 35' 30.03"W
L33	10.01'	S2° 58' 16.83"E
L34	24.73'	S0° 23' 13.61"E
L35	24.85'	N0° 28' 55.90"W

LINE TABLE: WEIR

LINE #	LENGTH	DIRECTION
WEIR L1	132.88'	N1° 37' 38.36"E
WEIR L2	30.82'	N7° 46' 31.64"E

CURVE TABLE: WEIR

CURVE #	RADIUS	DELTA	LENGTH	CHORD
WEIR C1	57.00'	3°41'23"	3.67'	3.67'

RELATED CASE #
OV914-009
2100731
OV114-018

LJA Engineering, Inc.
7458 N. La Cholla Boulevard,
Tucson, AZ 85741
Phone 520.257.3400

HORIZONTAL CONTROL
SUNDARA RIDGE

FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed 12/16/24
ARIZONA U.S.A.

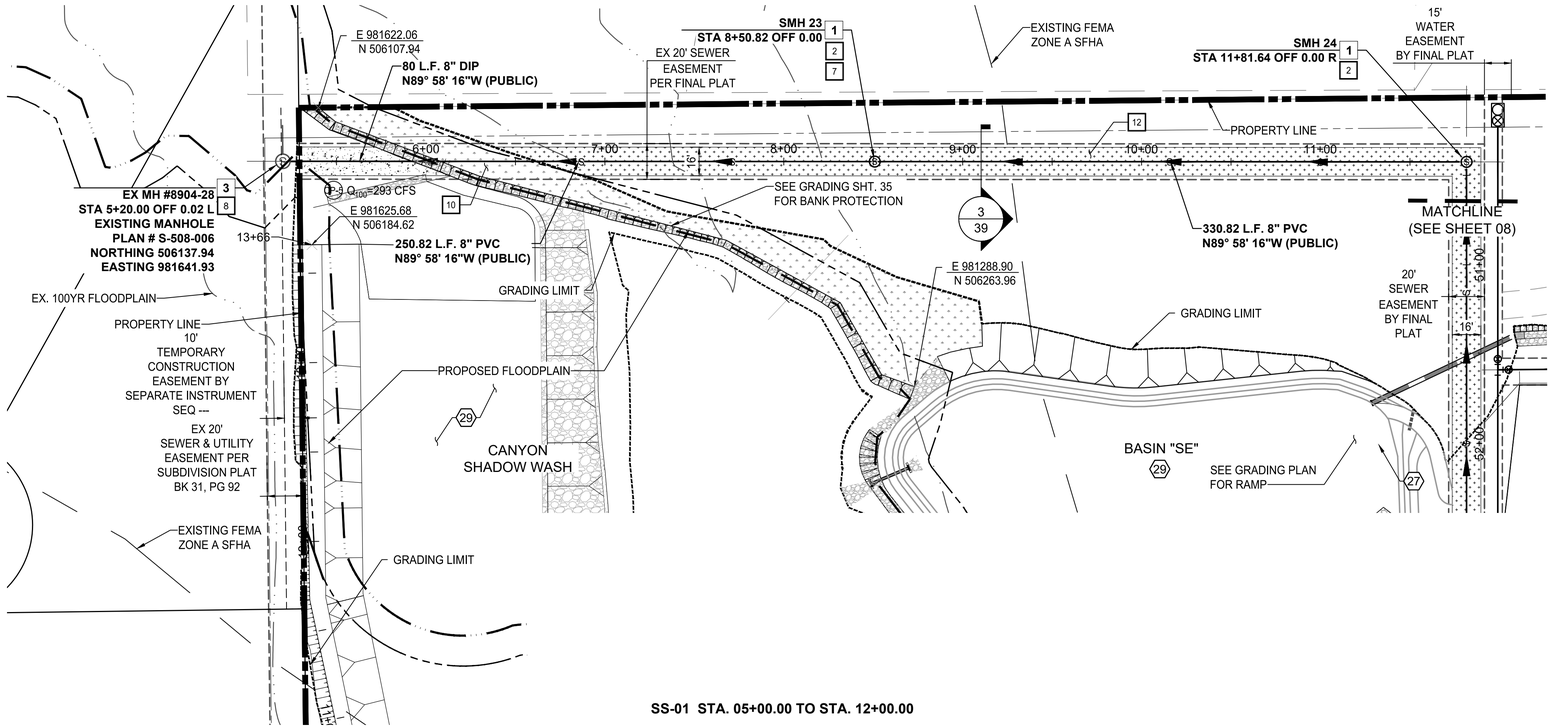
PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

H: 1"=150' C.I.=2'
V:
SCALE
12/16/24
DATE
AZ4072-1004
JOB NUMBER
ML
DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY

G-2022-007
P22WI00005

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Arizona811
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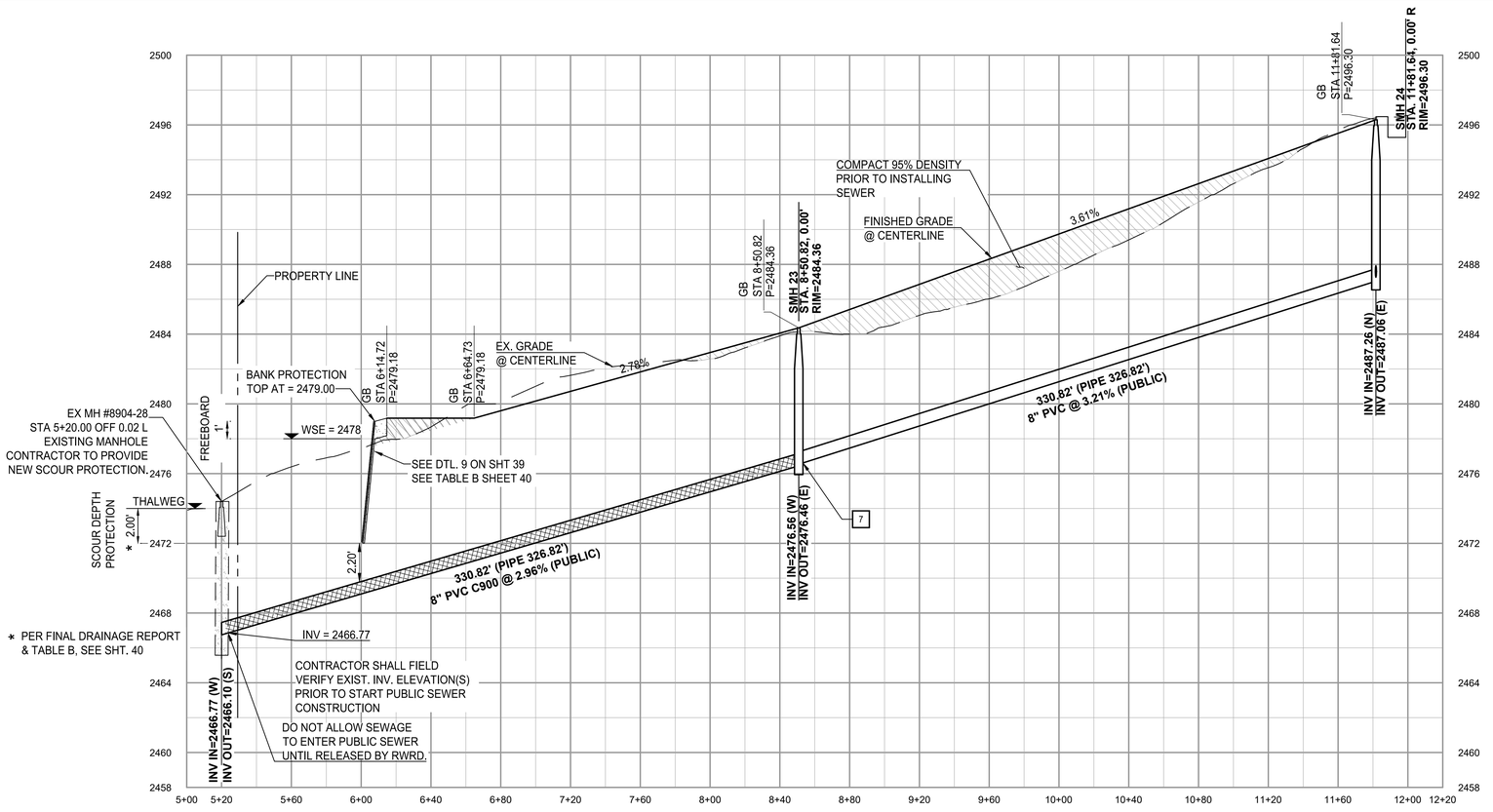
DateTime: Tue, 10 Dec 2024 - 4:13pm PathName: S:\ARIZ\Tucson\AZ4072\400\LAND_LJA MOVING FORWARD\BASE FILES\PP\06 horizontal control.dwg



SS-01 STA. 05+00.00 TO STA. 12+00.00

NOTE:
1. STATIONING IS ALONG THE SEWER CENTERLINE.

PROFILE SCALE:
HORIZ: 1" = 40'
VERT: 1" = 4'



EASEMENT KEYNOTES

1. 10' PUBLIC UTILITY, ROADWAY MAINTENANCE, & SIGNAGE EASEMENT BY FINAL PLAT
2. BUILDING SETBACK LINE, SEE DTL. 6 SHT 38.
3. DRAINAGE EASEMENT PER FINAL FLAT.

SEWER KEYNOTES

1. CONSTRUCT 4' DIA. MANHOLE PER STD. DTL. RWRD 205 WITH CONCRETE COLLAR PER STD. DTL. RWRD 211
2. INSTALL 24" WATERTIGHT FRAME AND COVER PER STD. DTL. RWRD 214.
3. INSTALL CONNECTION TO EXISTING MANHOLE BASE STD. DTL. RWRD 301.
4. INSTALL HCS CONNECTION TO MANHOLE PER STD. DTL. RWRD 402.
5. SEWER/WATER CROSSING PER STD. DTL. RWRD 108. CONTRACTOR TO VERIFY EXISTING ELEVATION PRIOR TO CONSTRUCTION. SEWER CONTRACTOR RESPONSIBLE FOR ANY DAMAGE DURING CONSTRUCTION.
6. INSTALL HCS WITH CLEANOUT PER STD. DTL. RWRD 401 AND STD. DTL. RWRD 404.
7. INSTALL BLOCK OUT PER RWRD 203, SIZE AND INVERT PER PLAN. INSTALL AT MANHOLE CONNECTION TEMPORARY PLUG AND SECURE WITH A CHAIN OR CABLE TO A MANHOLE STEP. PLUG TO INCLUDE CONTRACTOR'S COMPANY NAME. THE PLUG IS TO BE REMOVED AFTER PDEQ/ADEQ's DISCHARGE AUTHORIZATION AND POST PAVING INSPECTION AS DIRECTED BY THE FIELD ENGINEERING INSPECTOR. PLUG TO BE PLACED DOWNSTREAM OF ALL PROPOSED SERVICE LATERALS.
8. CONTRACTOR TO PROVIDE NEW SCOUR PROTECTION PER PAG AND RWRD STANDARDS
9. SEWER/STORM CROSSING PER RWRD SECTION 5.1.10.B CONTRACTOR TO VERIFY EXISTING ELEVATION PRIOR TO CONSTRUCTION. SEWER CONTRACTOR RESPONSIBLE FOR CROSSING CONSTRUCTION.
10. INSTALL SCOUR PROTECTION FOR SEWER LINES PER RWRD 113
11. NOT USED.
12. STABILIZED SURFACE PER STD. DTL. RWRD 111.

CONSTRUCTION KEYNOTES

1. INSTALL SURVEY MONUMENT PER P.A.G. STD. DTL. 103.
2. CONSTRUCT 2' WEDGE CURB (H=6") PER P.A.G. STD. DTL. 209.
3. CONSTRUCT 6" REVEAL VERTICAL CURB PER P.A.G. STD. DTL. 209. (TYPE 2).
4. CONSTRUCT MODIFIED TRANSITION CURB FROM VERTICAL CURB TO WEDGE CURB PER P.A.G. STD. DTL. 210.
5. CONSTRUCT CONCRETE SIDEWALK PER P.A.G. STD. DTL. 200. STANDARD 4' WIDE SIDEWALK UNLESS OTHERWISE NOTED.
6. NEW CONCRETE CURB TO EXISTING CONNECTION PER P.A.G. STD. DTL. 211.
7. SAWCUT 2' OF EXISTING PAVEMENT, TACK, AND JOIN TO EXISTING.
8. CONSTRUCT CURB RAMPS PER P.A.G. STD. DTL. 207. SEE PLAN FOR TYPE OF RAMPS.
9. INSTALL 3" AC OVER 5" ABC SEE DTL. 10, SHT. 38.
10. SLOPE STABILIZATION, SEE DTL. 8, SHT. 38
11. SIGHT VISIBILITY TRIANGLE, SEE DTL. 4, SHT. 38.
12. INSTALL 30" X 30" R1-1 "STOP SIGN" AND STREET NAME SIGN.
13. CONSTRUCT TYPE 3 SIDEWALK SCUPPER PER P.A.G. STD. DTL. 205.5. NUMBER OF CELLS AS NOTED. SEE SHT. 37 FOR DETAILS, W/ GUARDRAIL PER PAG. 105
22. CONSTRUCT TYPE 2 SIDEWALK SCUPPER PER P.A.G. STD. DTL. 205 NUMBER OF CELLS AS NOTED.
23. CONSTRUCT 48" STORM DRAIN MANHOLE PER PAG STD. DTL. 300 & 302.
26. INSTALL CATCH BASIN PER DETAIL 1 SHT. 40 AND SEE STORM DRAIN PROFILES ON SHT. 36-37, 40-41
27. NEW IRRIGATION LINE SLEEVE, THE CURB SHALL BE MARKED/STAMPED WITH "IS" (IRRIGATION SYSTEM), SEE LANDSCAPE PLAN FOR LINE INFORMATION.
28. INSTALL TYPE 4 CATCH BASIN PER PAG STD. DTL. 309.
29. SEE GRADING PLAN FOR DETAILS.
30. 2 - 24'x 6' ARCH CULVERTS, SEE PROFILE 1, SHT. 36 AND SHT. 45-51 FOR DTLS.
31. INSTALL HANDRAIL PER PAG STD. DTL. 105.
32. CONSTRUCT DRIVEWAY APRON PER P.A.G. STD. DTL. 206.
33. CONSTRUCT 60" STORM DRAIN MANHOLE PER PAG STD. DTL. 301 & 302.
34. CONSTRUCT 72" STORM DRAIN MANHOLE PER PAG STD. DTL. 301 & 302.
35. INSTALL RCP CLASS V STORM DRAIN PIPE. LENGTH, SLOPE, AND DIAMETER PER PLAN, SEE STORM DRAIN PROFILE ON SHT. 36-37, 40-41

RELATED CASE #
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2100731
OV114-018

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PAVING PLAN AND PROFILE
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SUNDARA RIDGE LOTS 1 THROUGH 91
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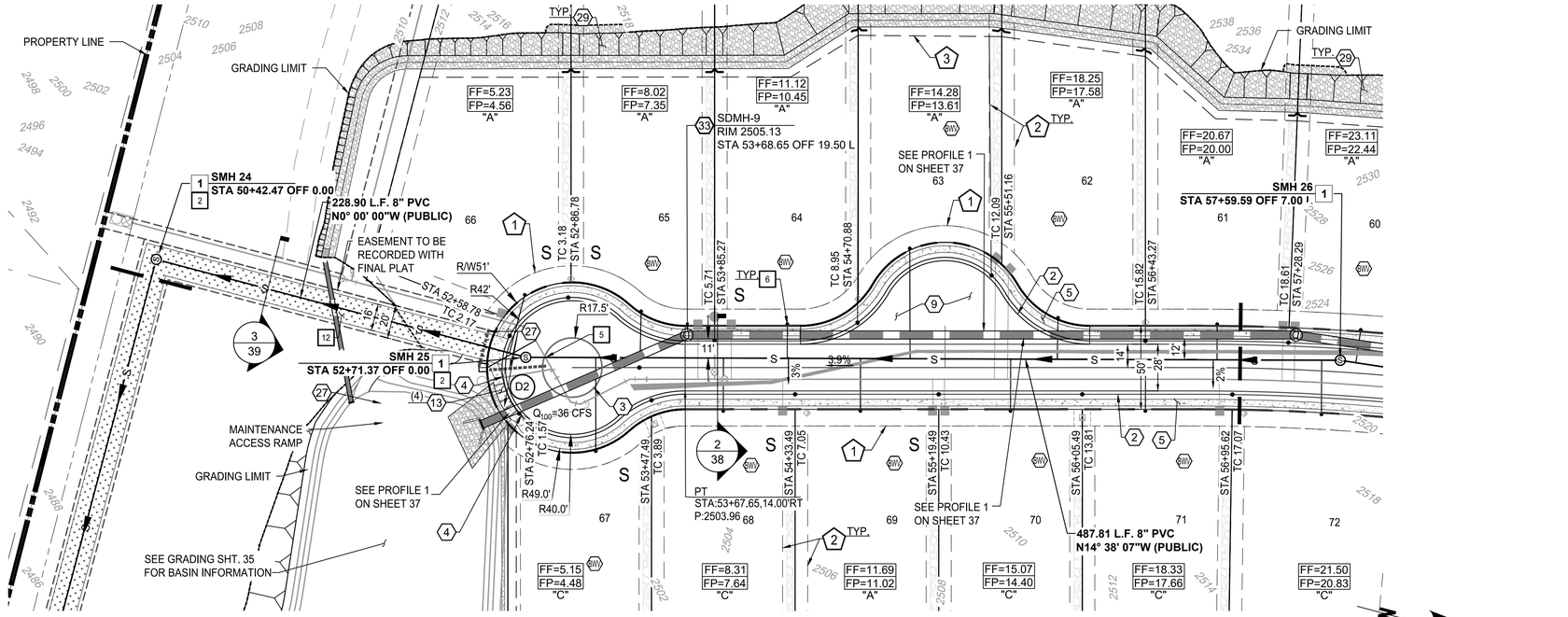
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07 OF 51

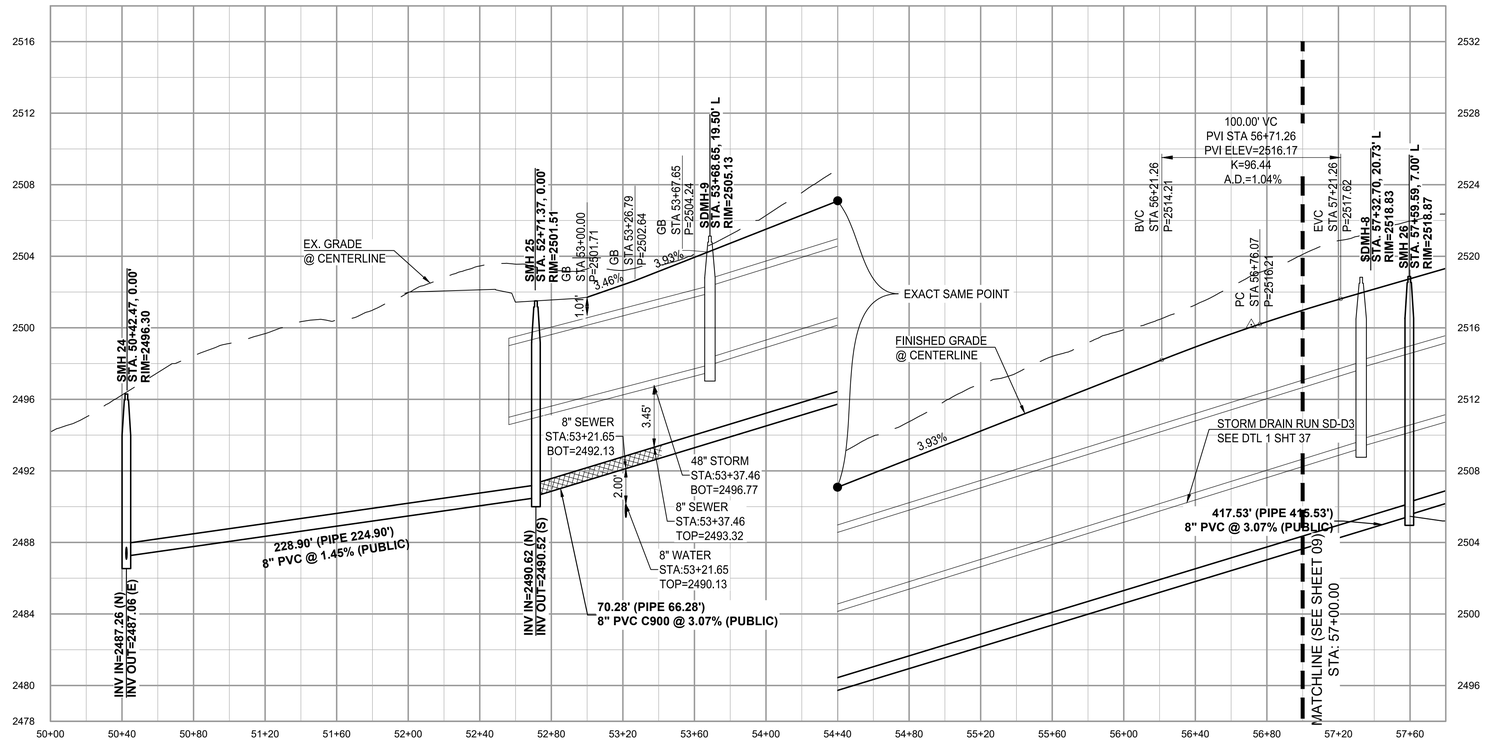
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G-2022-007

Date/Time: Mon, 16 Dec 2024 - 10:12am PathName: S:\ARIZT\tucson\AZ4072\400-AND_LJA MOVING FORWARD\BASE FILES\PV07 PAVING PLAN AND PROFILE.dwg



CITRINE SAND (PRIVATE) STA. 50+00.00 TO STA. 57+00.00

NOTE:
1. STATIONING IS ALONG THE ROAD CENTERLINE UNLESS OTHERWISE NOTED.
2. ALL SEWER H.C.S. ARE CENTERED BETWEEN LOT LINES UNLESS OTHERWISE NOTED.



EASEMENT KEYNOTES

1. 10' PUBLIC UTILITY, ROADWAY MAINTENANCE, & SIGNAGE EASEMENT BY FINAL PLAT
2. BUILDING SETBACK LINE, SEE DTL. 6 SHT 38.
3. DRAINAGE EASEMENT PER FINAL PLAT.

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5. SEWER/WATER CROSSING PER STD. DTL. RWRD 108. CONTRACTOR TO VERIFY EXISTING ELEVATION PRIOR TO CONSTRUCTION. SEWER CONTRACTOR RESPONSIBLE FOR ANY DAMAGE DURING CONSTRUCTION.
6. INSTALL HCS WITH CLEANOUT PER STD. DTL. RWRD 401 AND STD. DTL. RWRD 404.
7. INSTALL BLOCK OUT PER RWRD 203, SIZE AND INVERT PER PLAN. INSTALL AT MANHOLE CONNECTION TEMPORARY PLUG AND SECURE WITH A CHAIN OR CABLE TO A MANHOLE STEP. PLUG TO INCLUDE CONTRACTOR'S COMPANY NAME. THE PLUG IS TO BE REMOVED AFTER PDEQ/ADEQ's DISCHARGE AUTHORIZATION AND POST PAVING INSPECTION AS DIRECTED BY THE FIELD ENGINEERING INSPECTOR. PLUG TO BE PLACED DOWNSTREAM OF ALL PROPOSED SERVICE LATERALS.
8. CONTRACTOR TO PROVIDE NEW SCOUR PROTECTION PER PAG AND RWRD STANDARDS
9. SEWER/STORM CROSSING PER RWRD SECTION 5.1.10.B CONTRACTOR TO VERIFY EXISTING ELEVATION PRIOR TO CONSTRUCTION. SEWER CONTRACTOR RESPONSIBLE FOR CROSSING CONSTRUCTION.
10. INSTALL SCOUR PROTECTION FOR SEWER LINES PER RWRD 113
11. NOT USED.
12. STABILIZED SURFACE PER STD. DTL. RWRD 111.

CONSTRUCTION KEYNOTES

1. INSTALL SURVEY MONUMENT PER P.A.G. STD. DTL. 103.
2. CONSTRUCT 2' WEDGE CURB (H=6") PER P.A.G. STD. DTL. 209.
3. CONSTRUCT 6" REVEAL VERTICAL CURB PER P.A.G. STD. DTL. 209. (TYPE 2).
4. CONSTRUCT MODIFIED TRANSITION CURB FROM VERTICAL CURB TO WEDGE CURB PER P.A.G. STD. DTL. 210.
5. CONSTRUCT CONCRETE SIDEWALK PER P.A.G. STD. DTL. 200. STANDARD 4' WIDE SIDEWALK UNLESS OTHERWISE NOTED.
6. NEW CONCRETE CURB TO EXISTING CONNECTION PER P.A.G. STD. DTL. 211.
7. SAWCUT 2' OF EXISTING PAVEMENT, TACK, AND JOIN TO EXISTING.
8. CONSTRUCT CURB RAMPS PER P.A.G. STD. DTL. 207. SEE PLAN FOR TYPE OF RAMPS.
9. INSTALL 3" AC OVER 5" ABC SEE DTL. 10, SHT. 38.
10. SLOPE STABILIZATION, SEE DTL. 8, SHT. 38
11. SIGHT VISIBILITY TRIANGLE, SEE DTL. 4, SHT. 38.
12. INSTALL 30" X 30" R1-1 "STOP SIGN" AND STREET NAME SIGN.
13. CONSTRUCT TYPE 3 SIDEWALK SCUPPER PER P.A.G. STD. DTL. 205.5. NUMBER OF CELLS AS NOTED. SEE SHT. 37 FOR DETAILS, W/ GUARDRAIL PER PAG. 105
22. CONSTRUCT TYPE 2 SIDEWALK SCUPPER PER P.A.G. STD. DTL. 205 NUMBER OF CELLS AS NOTED.
23. CONSTRUCT 48" STORM DRAIN MANHOLE PER PAG STD. DTL. 300 & 302.
26. INSTALL CATCH BASIN PER DETAIL 1 SHT. 40 AND SEE STORM DRAIN PROFILES ON SHT. 36-37, 40-41
27. NEW IRRIGATION LINE SLEEVE, THE CURB SHALL BE MARKED/STAMPED WITH "IS" (IRRIGATION SYSTEM), SEE LANDSCAPE PLAN FOR LINE INFORMATION.
28. INSTALL TYPE 4 CATCH BASIN PER PAG STD. DTL. 309.
29. SEE GRADING PLAN FOR DETAILS.
30. 2 - 24'x 6' ARCH CULVERTS, SEE PROFILE 1, SHT. 36 AND SHT. 45-51 FOR DTLS.
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35. INSTALL RCP CLASS V STORM DRAIN PIPE. LENGTH, SLOPE, AND DIAMETER PER PLAN, SEE STORM DRAIN PROFILE ON SHT. 36-37, 40-41

RELATED CASE #
OV914-009
2100731
OV114-018

LJA Engineering, Inc.
7458 N. La Cholla Boulevard.
Tucson, AZ 85741
Phone 520.257.3400

PAVING PLAN AND PROFILE
SUNDARA RIDGE
FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed 10 MAY
ARIZONA, U.S.A.

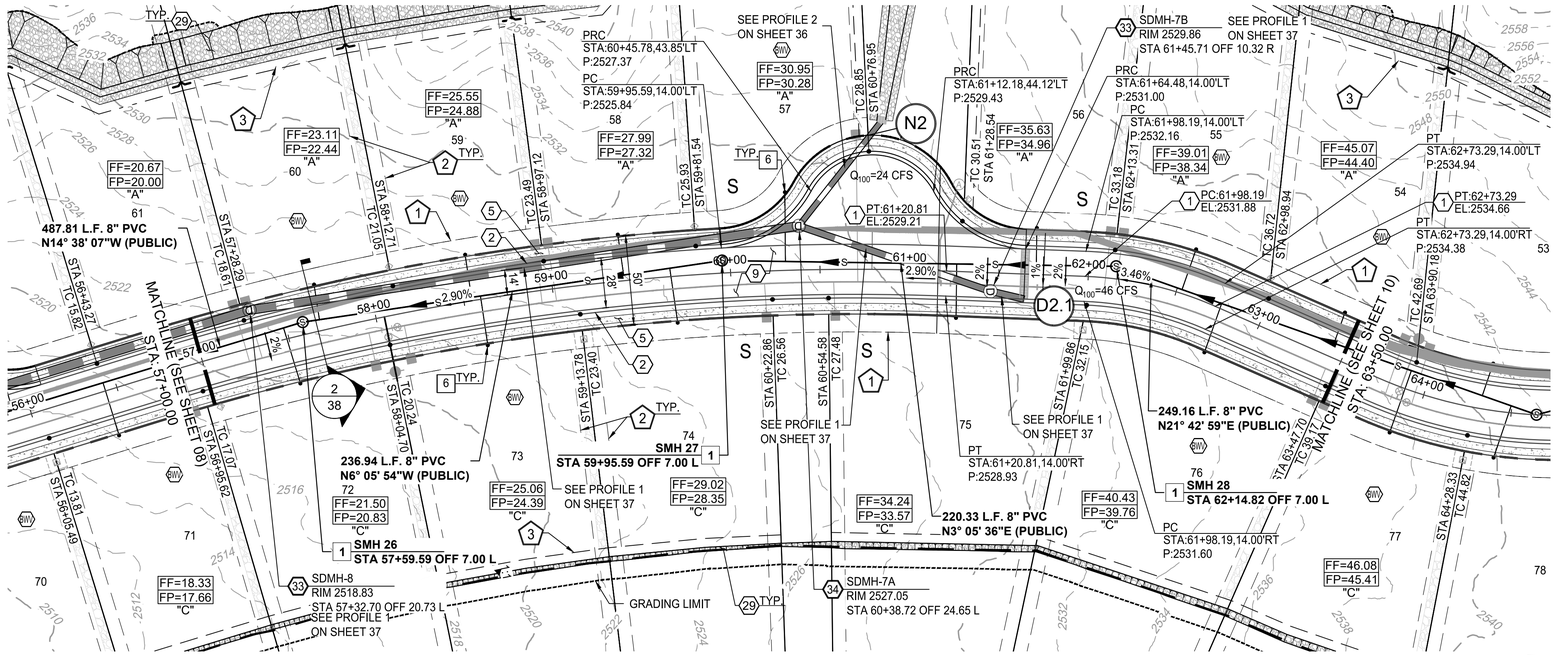
PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

H: 1"=40' C.I.=2'
V: 1"=4'
SCALE
12/16/24
DATE
AZ4072-1004
JOB NUMBER
ML
DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY

P22WI00005
G-2022-007

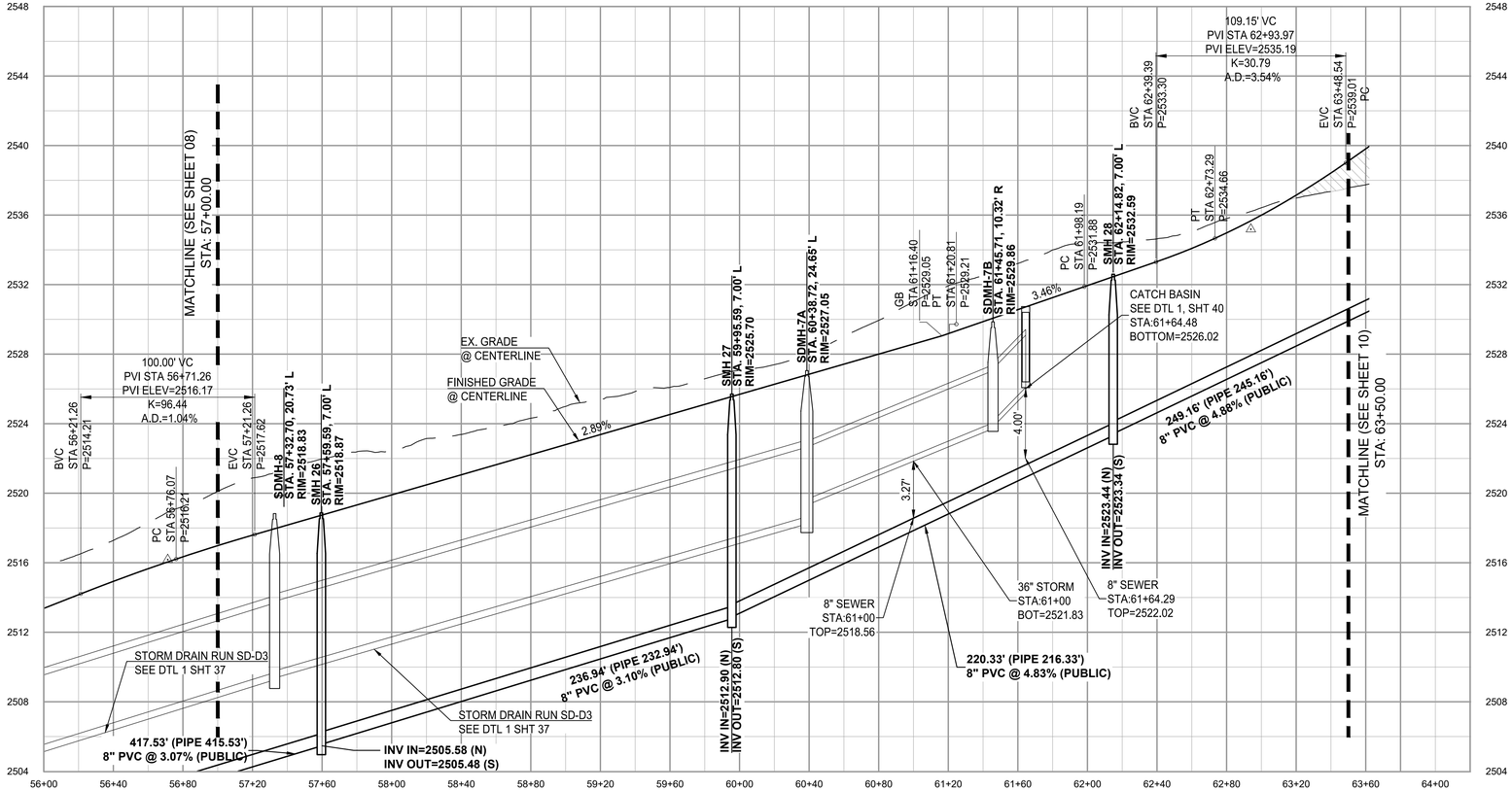
Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA811
Call 811 or visit Azbluestake.com

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NOTE:
1. STATIONING IS ALONG THE ROAD CENTERLINE UNLESS OTHERWISE NOTED.
2. ALL SEWER H.C.S. ARE CENTERED BETWEEN LOT LINES UNLESS OTHERWISE NOTED.

PROFILE SCALE:
HORIZ: 1" = 40'
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EASEMENT KEYNOTES

1. 10' PUBLIC UTILITY, ROADWAY MAINTENANCE, & SIGNAGE EASEMENT BY FINAL PLAT
2. BUILDING SETBACK LINE, SEE DTL. 6 SHT 38.
3. DRAINAGE EASEMENT PER FINAL FLAT.

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11. NOT USED.
12. STABILIZED SURFACE PER STD. DTL. RWRD 111.

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LJA Engineering, Inc.
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Tucson, AZ 85741
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PAVING PLAN AND PROFILE
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FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil) CERTIFICATE NO. 54544 ROBERT W. SCHLICHER Date Signed 12/16/24 ARIZONA, U.S.A.

PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

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12/16/24
DATE
AZ4072-1004
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ML
DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY

09 OF 51

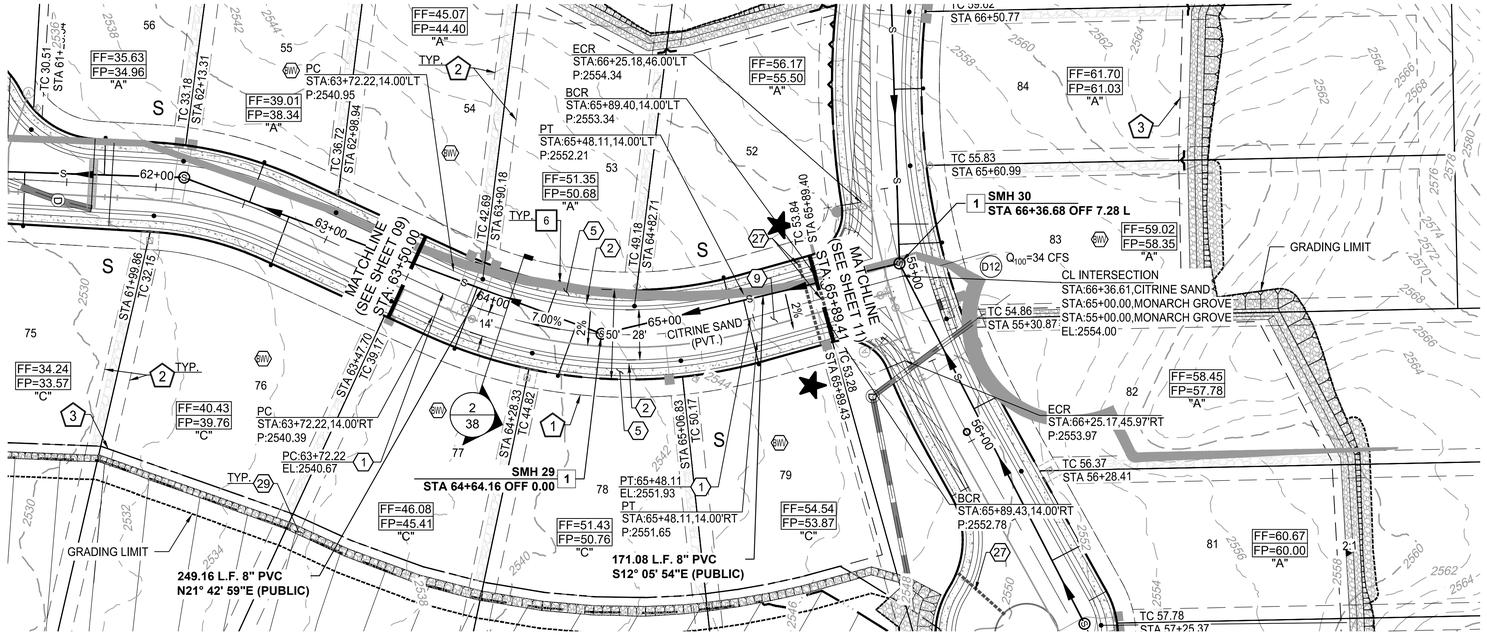
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G-2022-007

RELATED CASE #
OV914-009
2100731
OV114-018

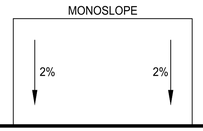
Contact Arizona 811 at least two full working days before you begin excavation. Call 811 or click Arizona811.com

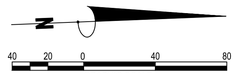
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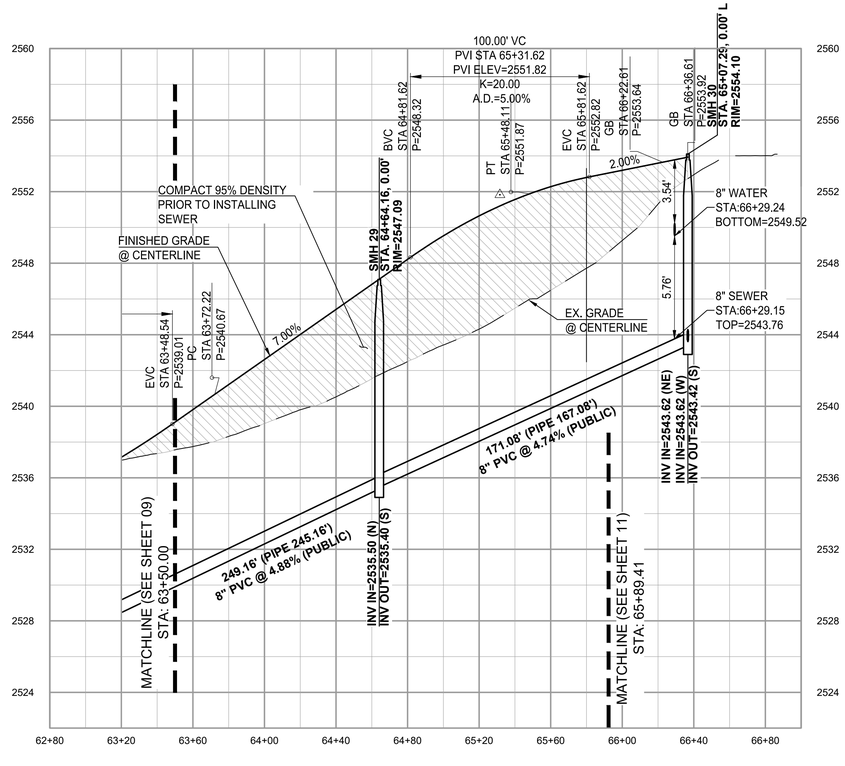
CITRINE SAND (PRIVATE) STA. 63+50.00 TO STA. 65+89.41

NOTE:
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PROFILE SCALE:
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EASEMENT KEYNOTES

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NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil) CERTIFICATE NO. 54544 ROBERT W. SCHLICHER Date Signed 12/16/24 ARIZONA U.S.A.

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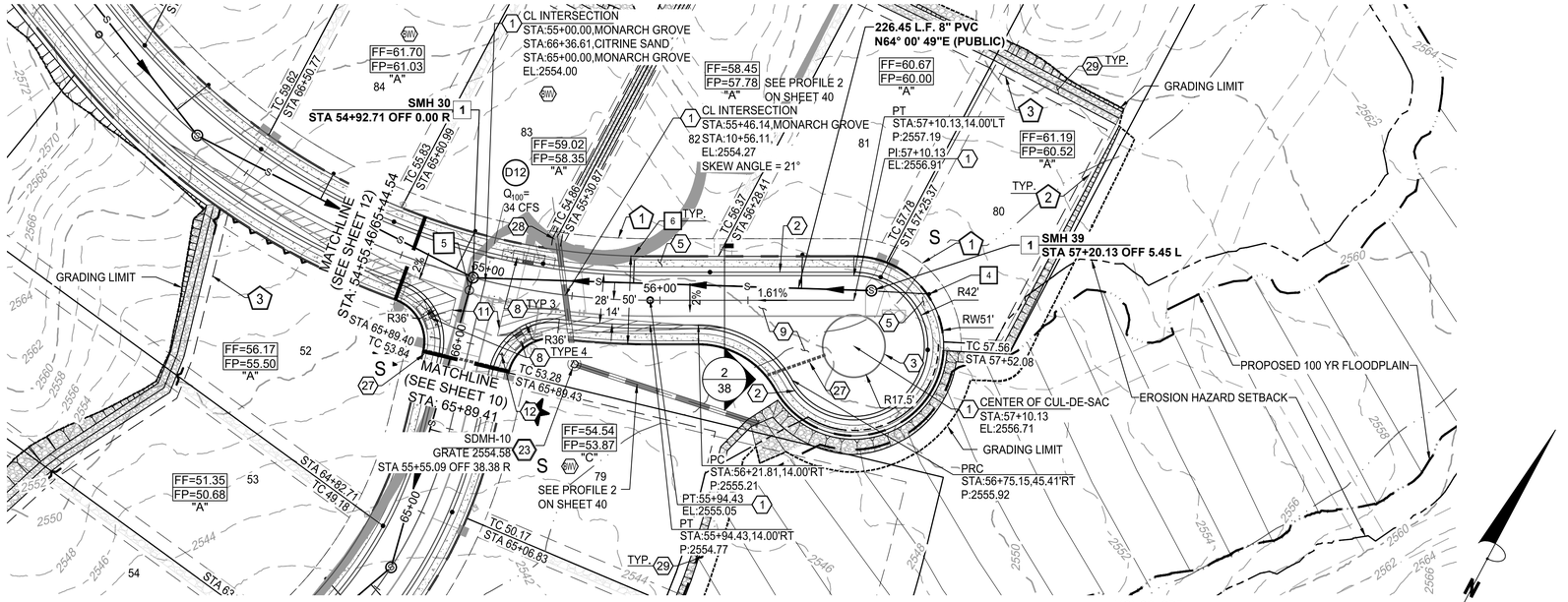
10 OF 51

RELATED CASE #
OV914-009
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Contact Arizona 811 at least two full working days before you begin excavation
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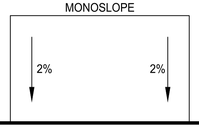
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G-2022-007

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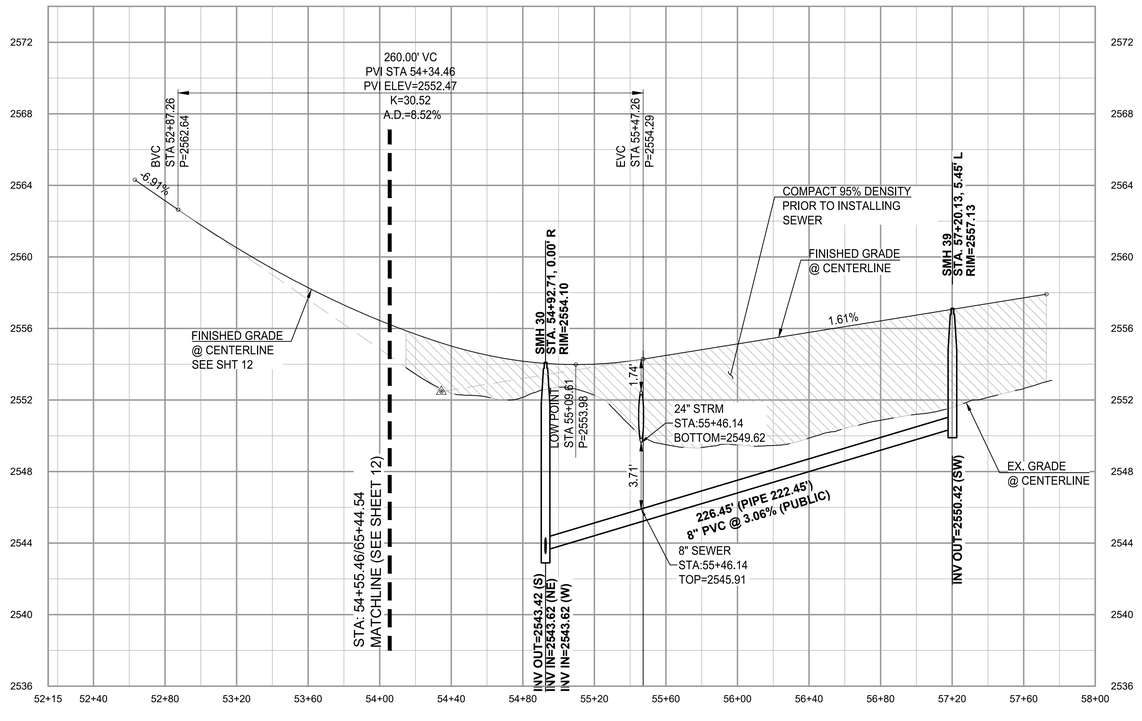
MONARCH GROVE (PRIVATE) STA. 54+55.46 TO STA. 66+89.41

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26. INSTALL CATCH BASIN PER DETAIL 1 SHT. 40 AND SEE STORM DRAIN PROFILES ON SHT. 36-37, 40-41
27. NEW IRRIGATION LINE SLEEVE, THE CURB SHALL BE MARKED/STAMPED WITH "IS" (IRRIGATION SYSTEM), SEE LANDSCAPE PLAN FOR LINE INFORMATION.
28. INSTALL TYPE 4 CATCH BASIN PER PAG STD. DTL. 309.
29. SEE GRADING PLAN FOR DETAILS.
30. 2 - 24'x 6' ARCH CULVERTS, SEE PROFILE 1, SHT. 36 AND SHT. 45-51 FOR DTLS.
31. INSTALL HANDRAIL PER PAG STD. DTL. 105.
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35. INSTALL RCP CLASS V STORM DRAIN PIPE. LENGTH, SLOPE, AND DIAMETER PER PLAN, SEE STORM DRAIN PROFILE ON SHT. 36-37, 40-41

RELATED CASE #
OV914-009
2100731
OV114-018

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PAVING PLAN AND PROFILE
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FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

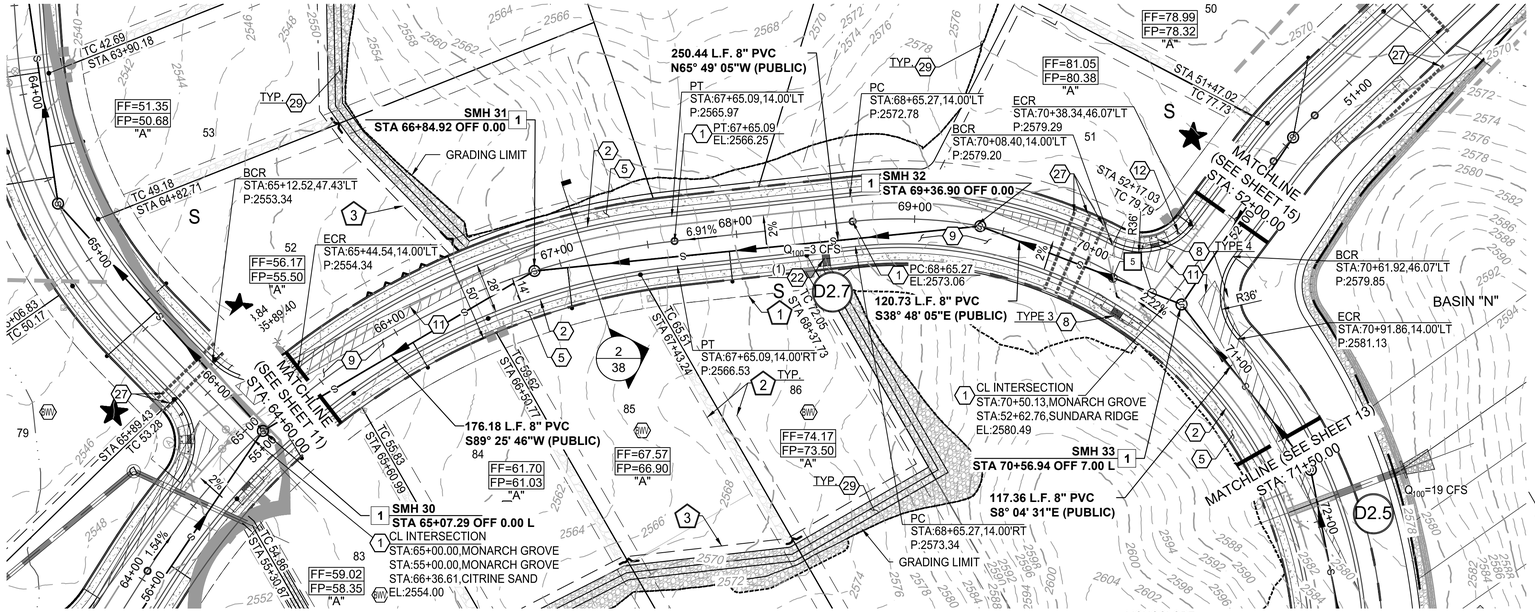
Registered Professional Engineer (Civil)
CERTIFICATE NO.
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ROBERT W. SCHLICHER
Date Signed 12/16/24
ARIZONA U.S.A.

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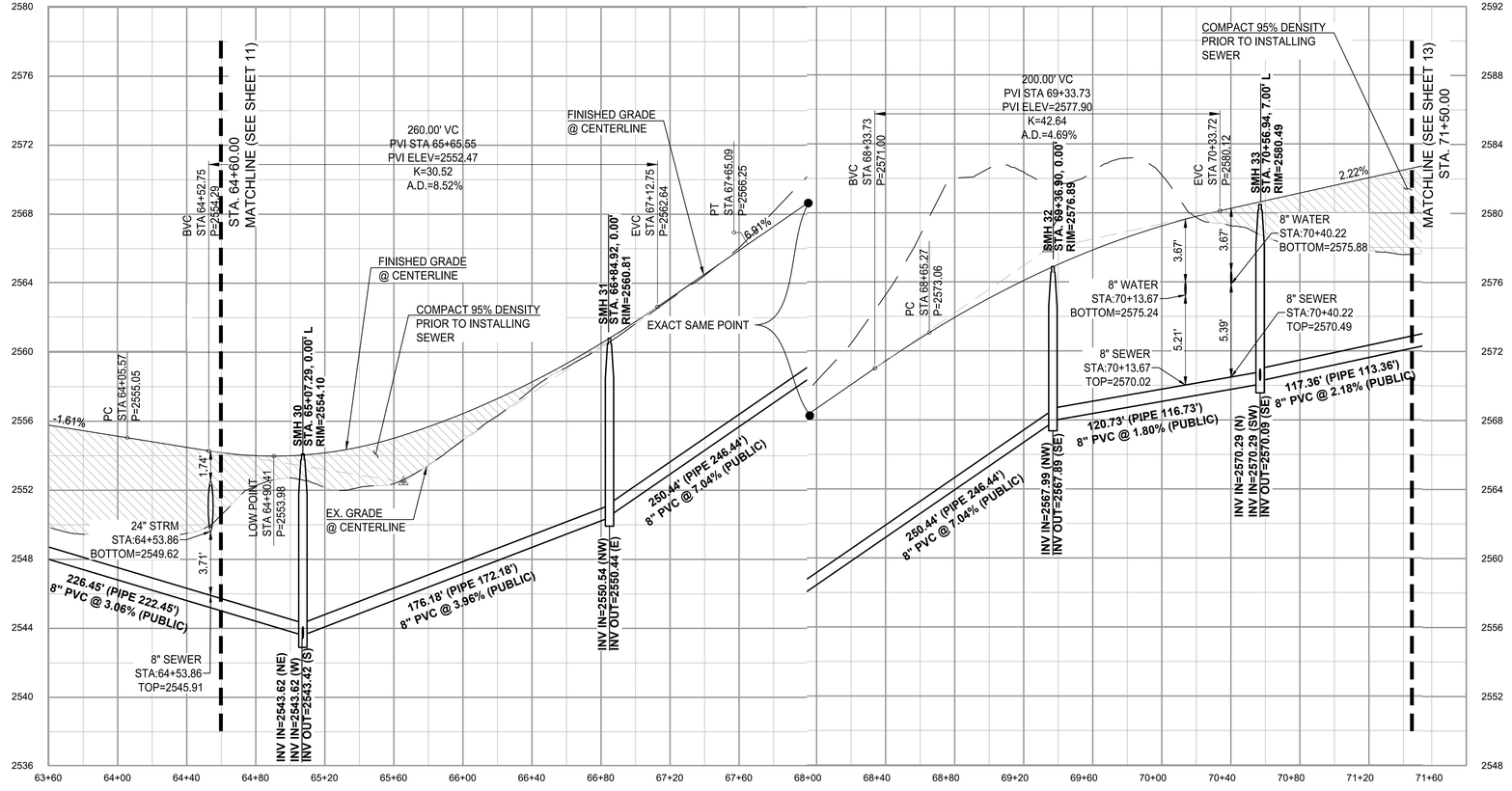
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MONARCH GROVE (PRIVATE) STA. 64+60.00 TO STA. 71+50.00

NOTE:
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OV114-018

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NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil) CERTIFICATE NO. 54544 ROBERT W. SCHLICHER Date Signed 01-16-24 ARIZONA U.S.A.

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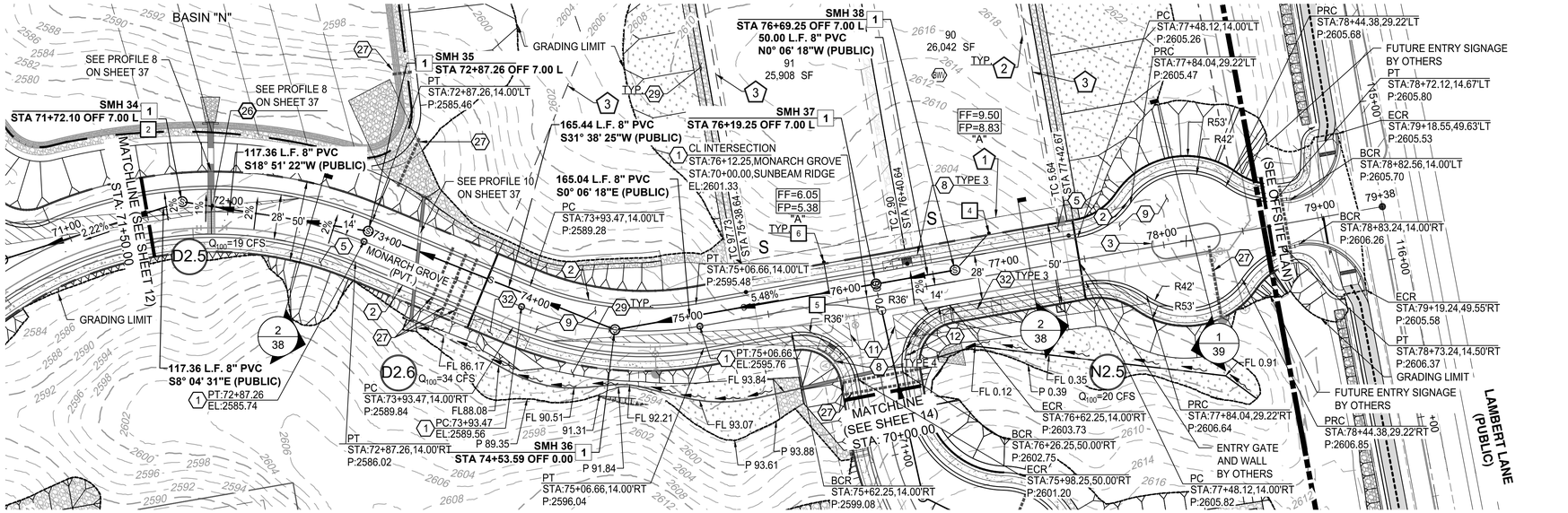
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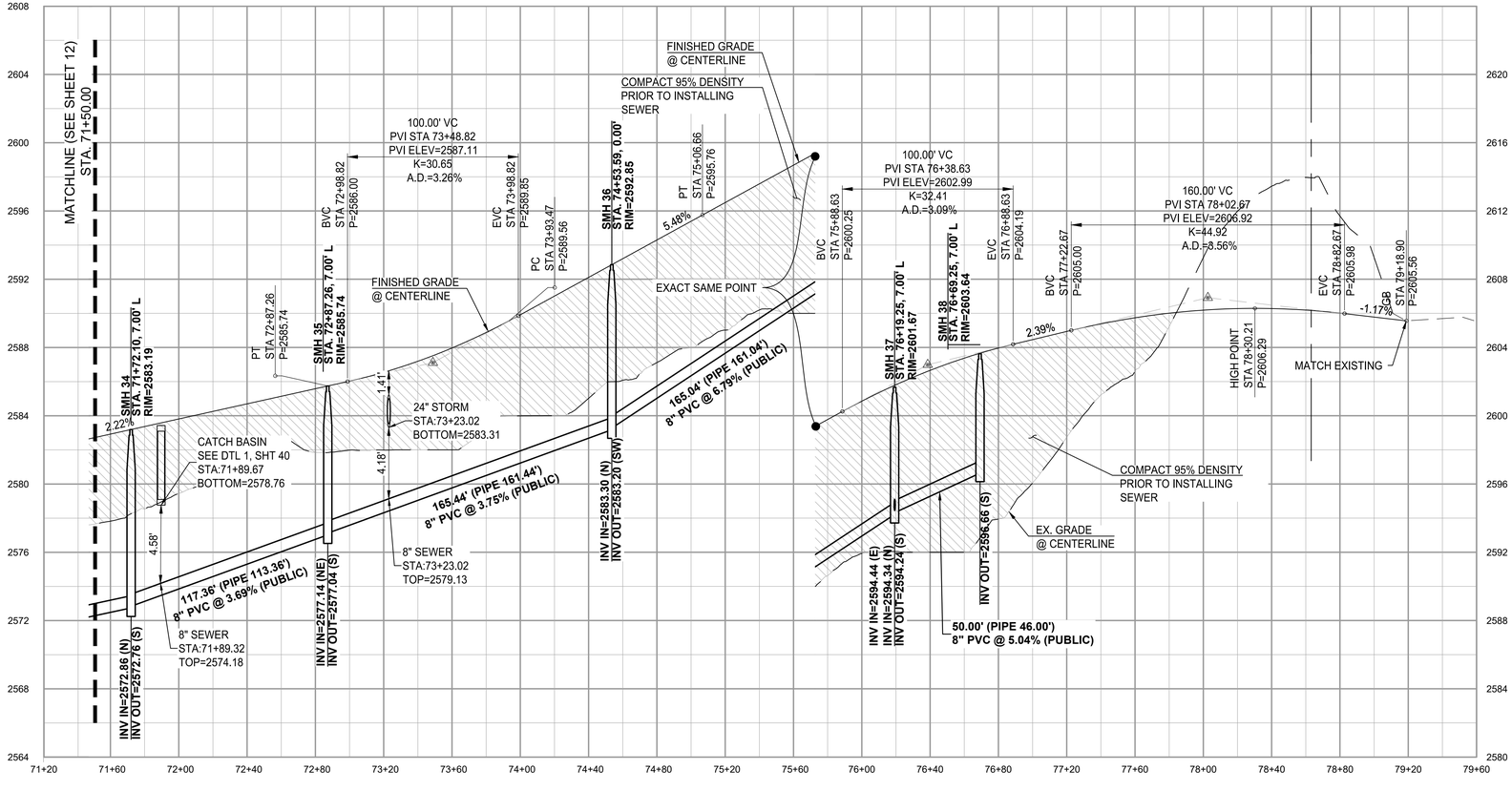
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Tucson, AZ 85741
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PAVING PLAN AND PROFILE
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SUNDARA RIDGE LOTS 1 THROUGH 91
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2101153

NO.	DATE	REVISION	APP.

54544
ROBERT W. SCHLICHER
Date signed 01/16/25
ARIZONA, U.S.A.

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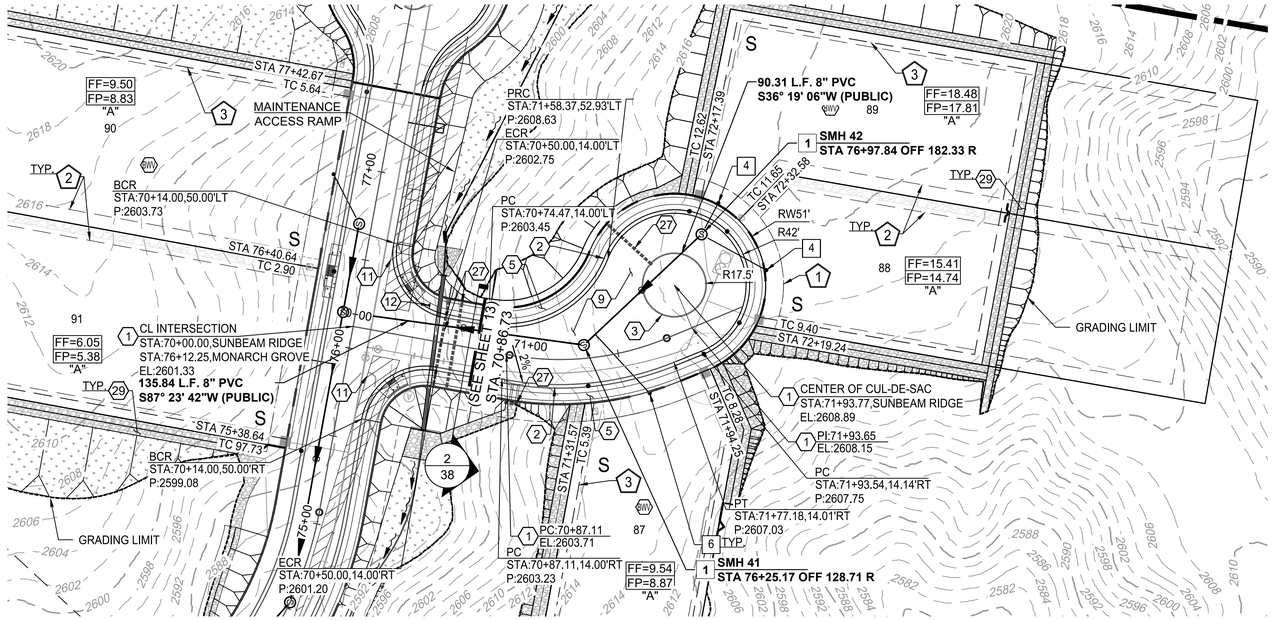
13 OF 51

P22WI0005
G-2022-007

RELATED CASE #
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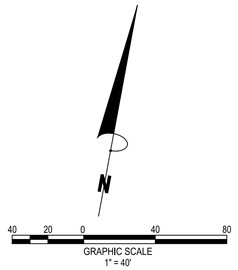
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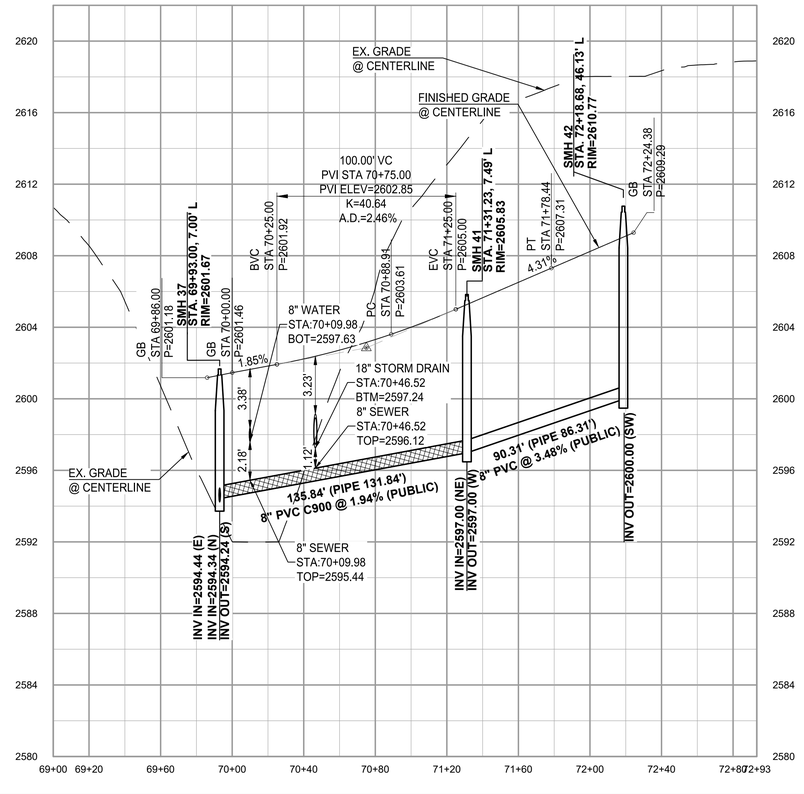
SUNBEAM RIDGE (PRIVATE) STA. 70+50.00 TO STA. 72+24.38

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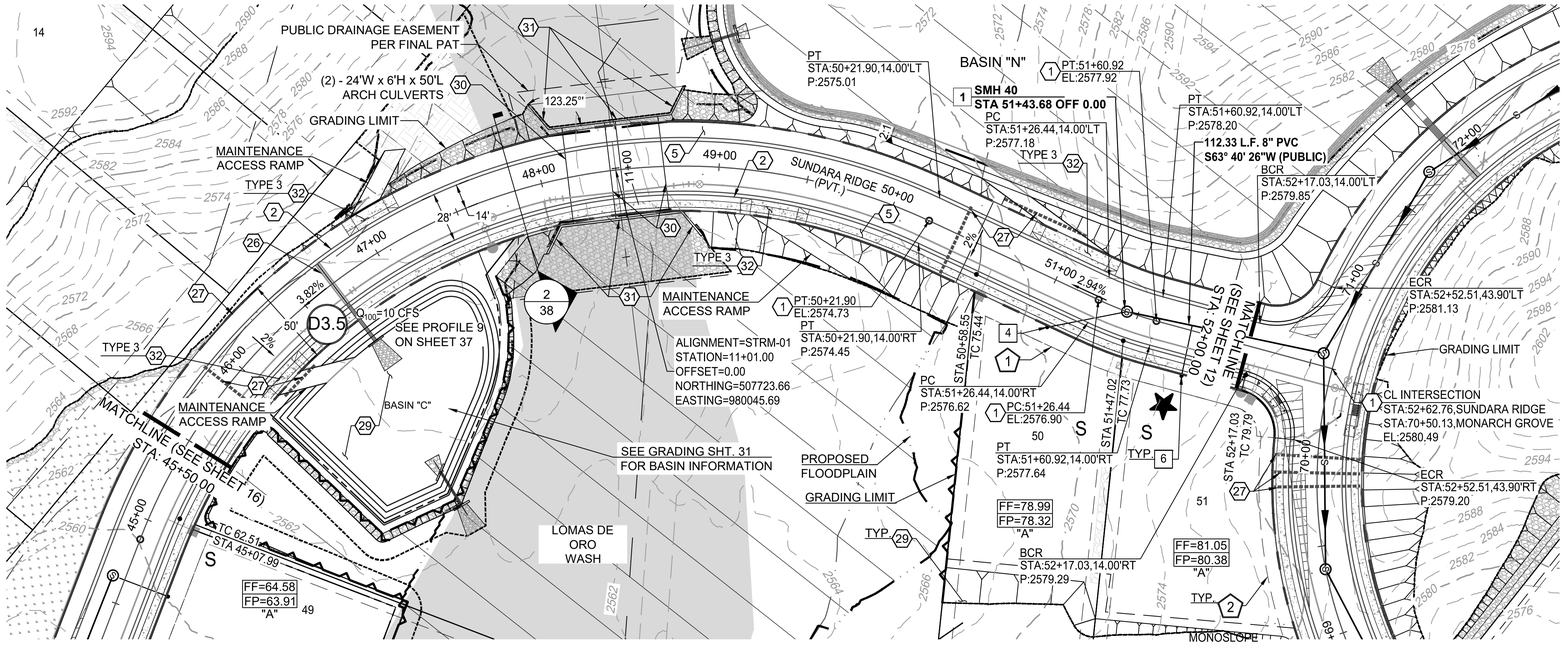
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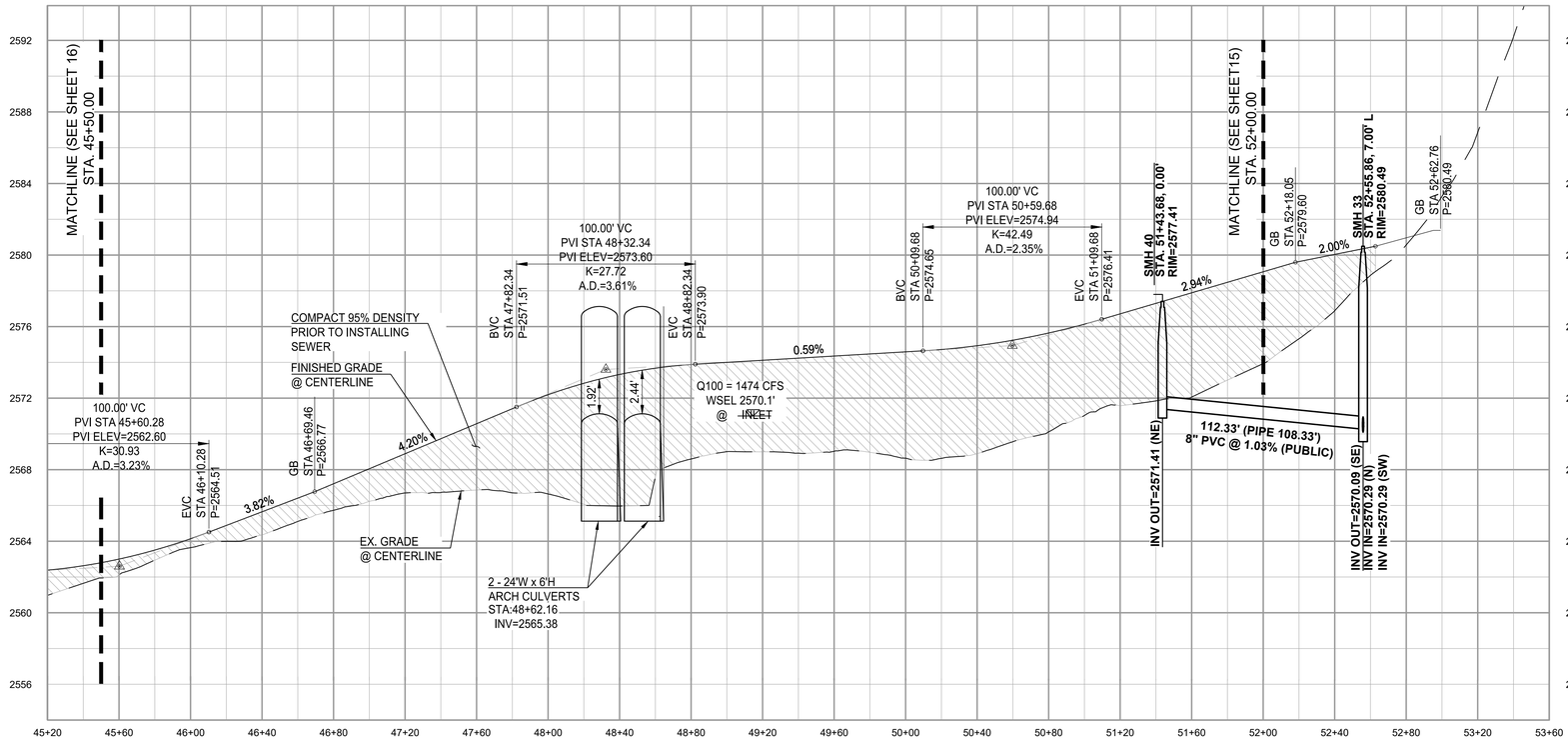
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SUNDARA RIDGE(PRIVATE) STA. 45+50.00 TO STA. 52+00.00

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PROFILE SCALE:
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EASEMENT KEYNOTES

1. 10' PUBLIC UTILITY, ROADWAY MAINTENANCE, & SIGNAGE EASEMENT BY FINAL PLAT
2. BUILDING SETBACK LINE, SEE DTL. 6 SHT 38.
3. DRAINAGE EASEMENT PER FINAL FLAT.

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2. INSTALL 24" WATERTIGHT FRAME AND COVER PER STD. DTL. RWRD 214.
3. INSTALL CONNECTION TO EXISTING MANHOLE BASE STD. DTL. RWRD 301.
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6. INSTALL HCS WITH CLEANOUT PER STD. DTL. RWRD 401 AND STD. DTL. RWRD 404.
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9. SEWER/STORM CROSSING PER RWRD SECTION 5.1.10.B CONTRACTOR TO VERIFY EXISTING ELEVATION PRIOR TO CONSTRUCTION. SEWER CONTRACTOR RESPONSIBLE FOR CROSSING CONSTRUCTION.
10. INSTALL SCOUR PROTECTION FOR SEWER LINES PER RWRD 113
11. NOT USED.
12. STABILIZED SURFACE PER STD. DTL. RWRD 111.

CONSTRUCTION KEYNOTES

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RELATED CASE #
OV914-009
2100731
OV114-018

LJA Engineering, Inc.
7458 N. La Cholla Boulevard.
Tucson, AZ 85741
Phone 520.257.3400

PAVING PLAN AND PROFILE
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FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil) CERTIFICATE NO. 54544 ROBERT W. SCHLICHER Date Signed 12/16/24 ARIZONA U.S.A.

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FOR CONSTRUCTION ☐

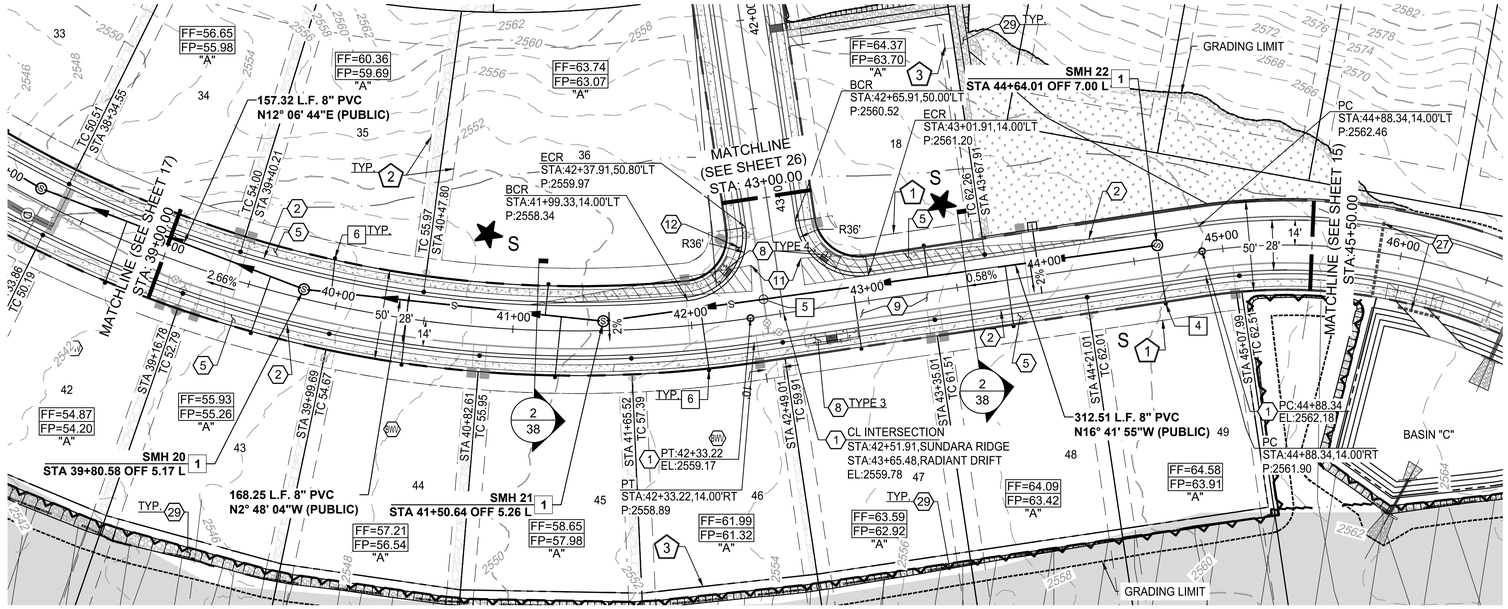
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15 OF 51

P22WI00005
G-2022-007

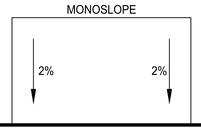
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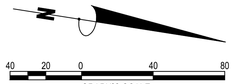
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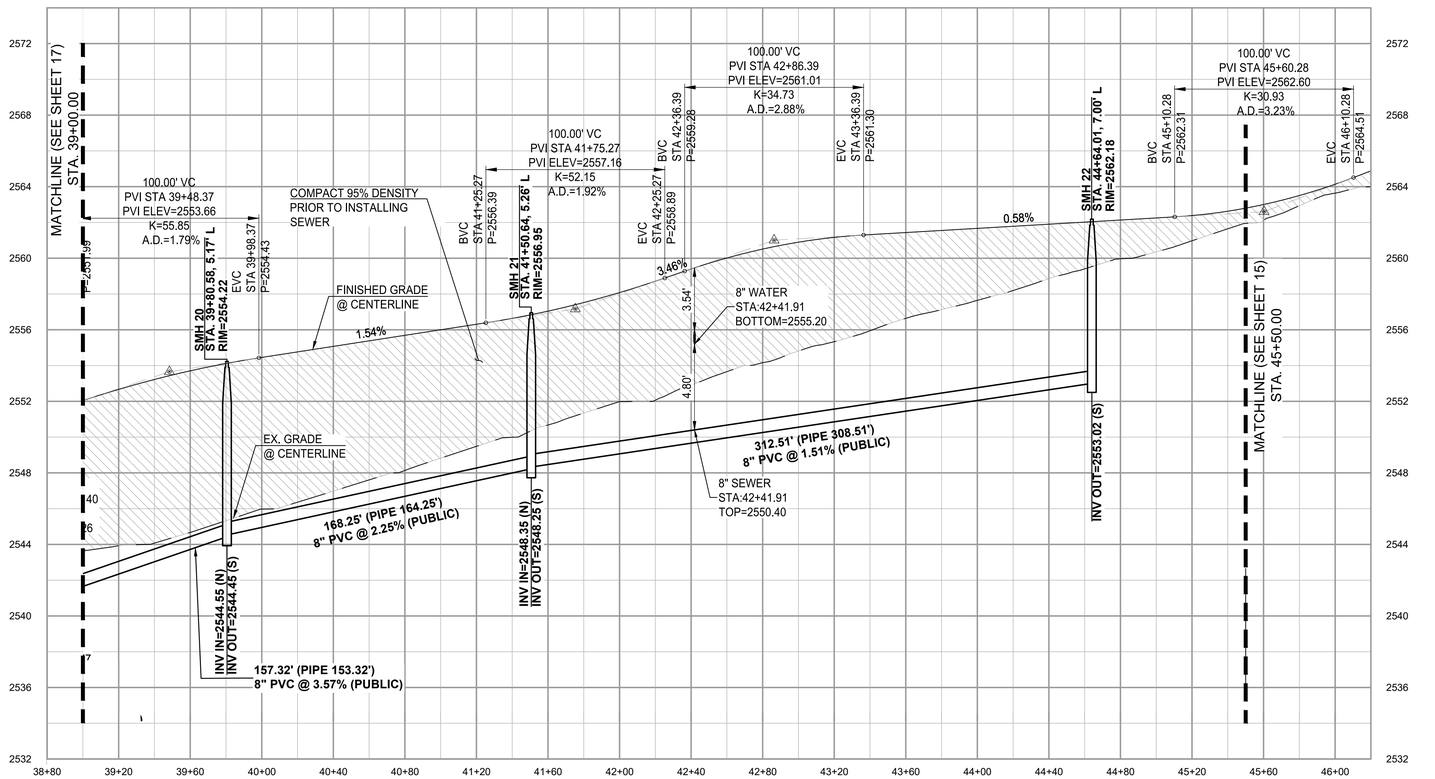
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RELATED CASE #
OV914-009
2100731
OV114-018

LJA Engineering, Inc.
7458 N. La Cholla Boulevard.
Tucson, AZ 85741
Phone 520.257.3400

PAVING PLAN AND PROFILE
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SUNDARA RIDGE LOTS 1 THROUGH 91
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NO	DATE	REVISION	APP.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed 12/16/24
ARIZONA U.S.A.

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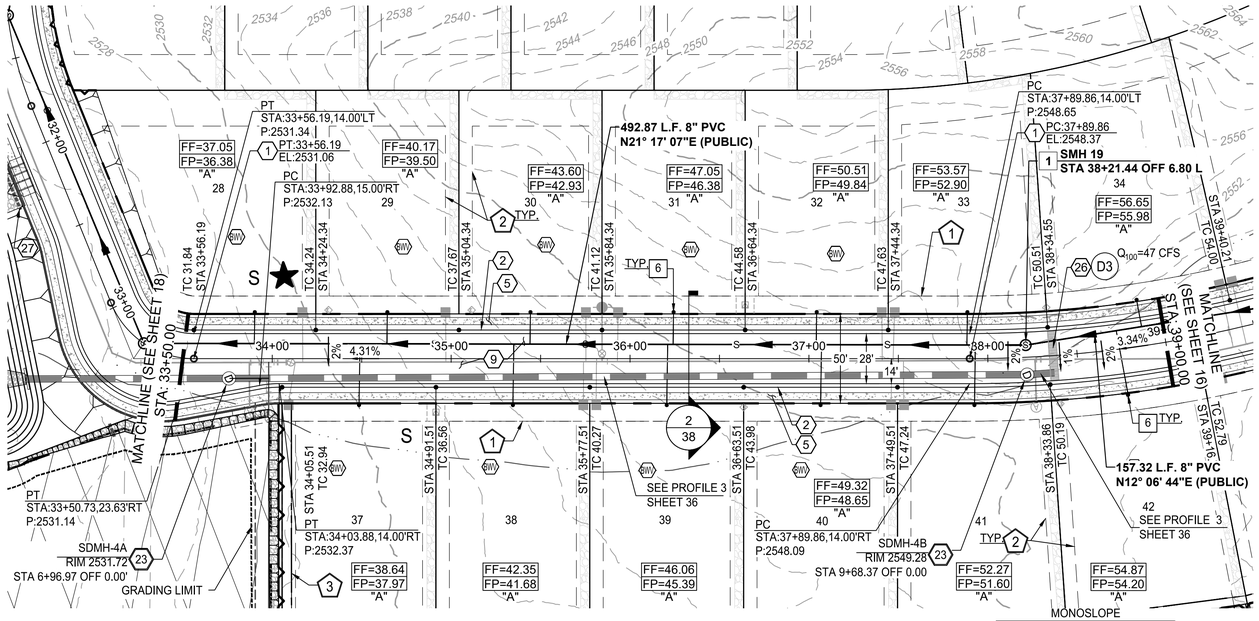
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16 OF 51

P22WI00005
G-2022-007

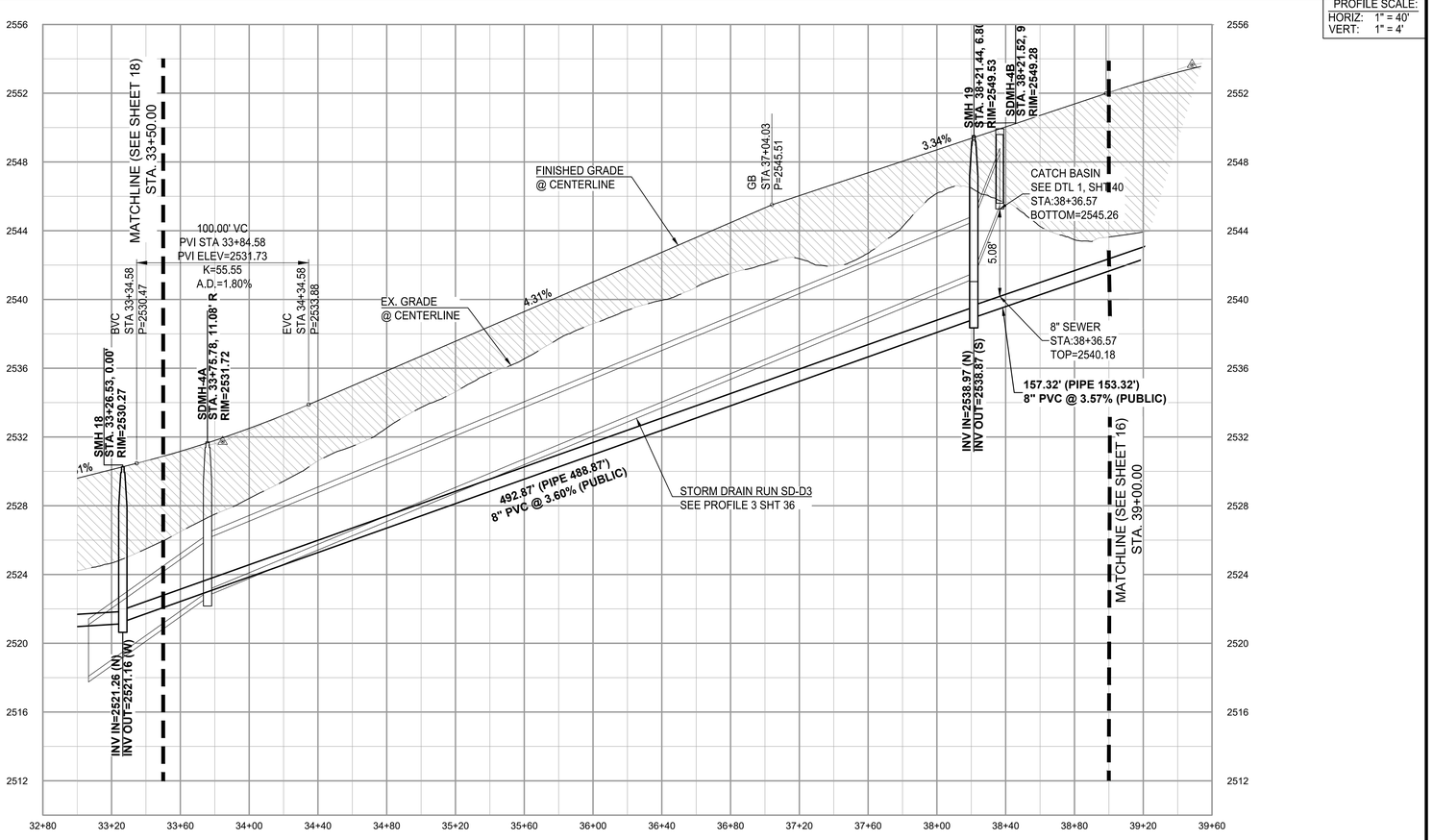
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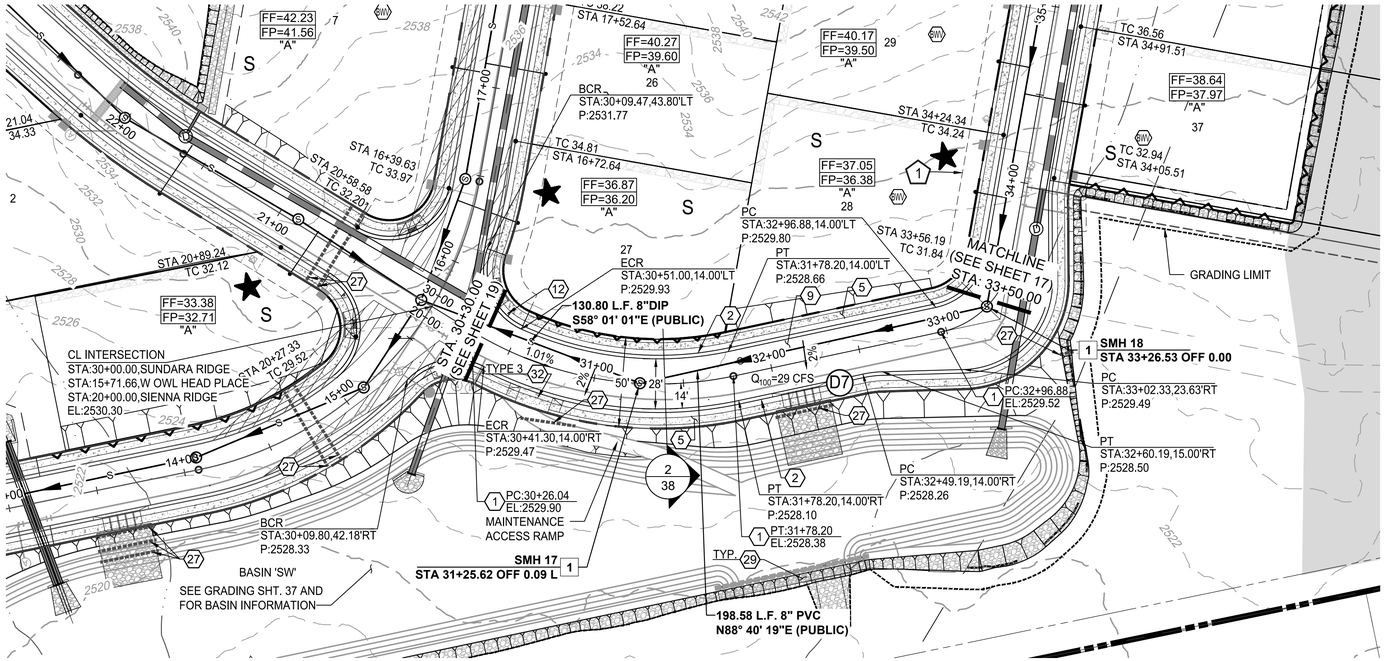
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P22WI00005

G-2022-007

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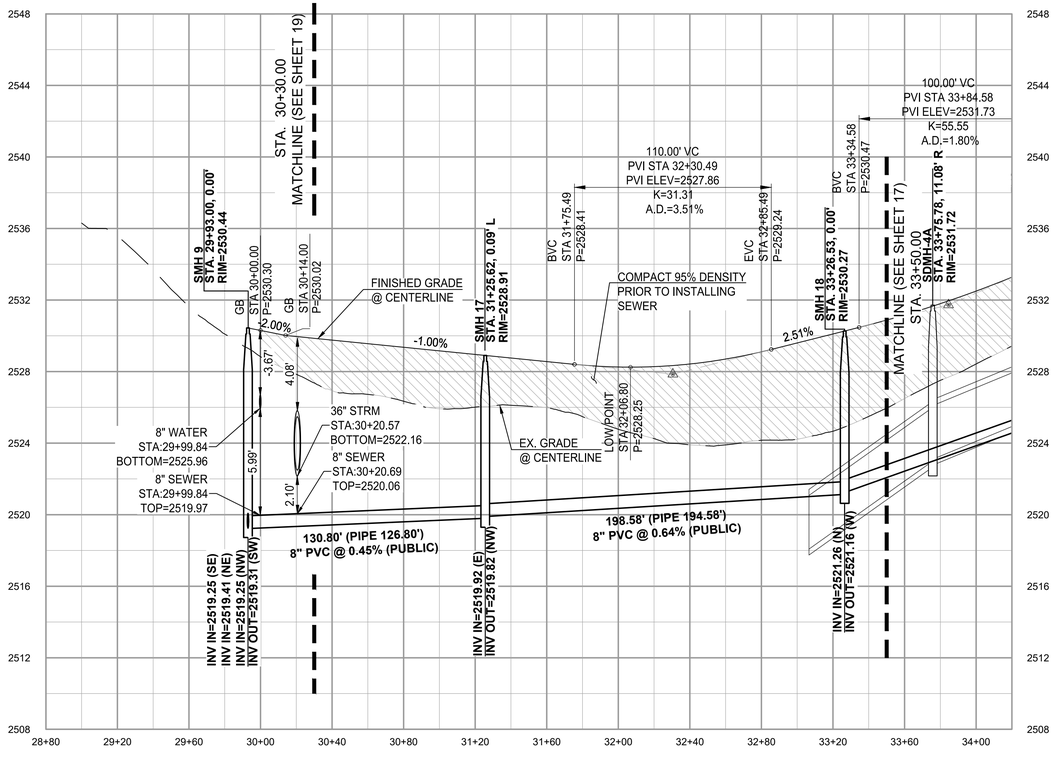
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6. NEW CONCRETE CURB TO EXISTING CONNECTION PER P.A.G. STD. DTL. 211.
7. SAWCUT 2' OF EXISTING PAVEMENT, TACK, AND JOIN TO EXISTING.
8. CONSTRUCT CURB RAMPS PER P.A.G. STD. DTL. 207. SEE PLAN FOR TYPE OF RAMPS.
9. INSTALL 3" AC OVER 5" ABC SEE DTL. 10, SHT. 38.
10. SLOPE STABILIZATION, SEE DTL. 8, SHT. 38
11. SIGHT VISIBILITY TRIANGLE, SEE DTL. 4, SHT. 38.
12. INSTALL 30" X 30" R1-1 "STOP SIGN" AND STREET NAME SIGN.
13. CONSTRUCT TYPE 3 SIDEWALK SCUPPER PER P.A.G. STD. DTL. 205.5. NUMBER OF CELLS AS NOTED. SEE SHT. 37 FOR DETAILS, W/ GUARDRAIL PER PAG. 105
22. CONSTRUCT TYPE 2 SIDEWALK SCUPPER PER P.A.G. STD. DTL. 205 NUMBER OF CELLS AS NOTED.
23. CONSTRUCT 48" STORM DRAIN MANHOLE PER PAG STD. DTL. 300 & 302.
26. INSTALL CATCH BASIN PER DETAIL 1 SHT. 40 AND SEE STORM DRAIN PROFILES ON SHT. 36-37, 40-41
27. NEW IRRIGATION LINE SLEEVE, THE CURB SHALL BE MARKED/STAMPED WITH "IS" (IRRIGATION SYSTEM), SEE LANDSCAPE PLAN FOR LINE INFORMATION.
28. INSTALL TYPE 4 CATCH BASIN PER PAG STD. DTL. 309.
29. SEE GRADING PLAN FOR DETAILS.
30. 2 - 24'x 6' ARCH CULVERTS, SEE PROFILE 1, SHT. 36 AND SHT. 45-51 FOR DTLS.
31. INSTALL HANDRAIL PER PAG STD. DTL. 105.
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35. INSTALL RCP CLASS V STORM DRAIN PIPE. LENGTH, SLOPE, AND DIAMETER PER PLAN, SEE STORM DRAIN PROFILE ON SHT. 36-37, 40-41

RELATED CASE #
OV914-009
2100731
OV114-018

LJA Engineering, Inc.
7458 N. La Cholla Boulevard.
Tucson, AZ 85741
Phone 520.257.3400

PAVING PLAN AND PROFILE
SUNDARA RIDGE
FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed 12/16/24
ARIZONA U.S.A.

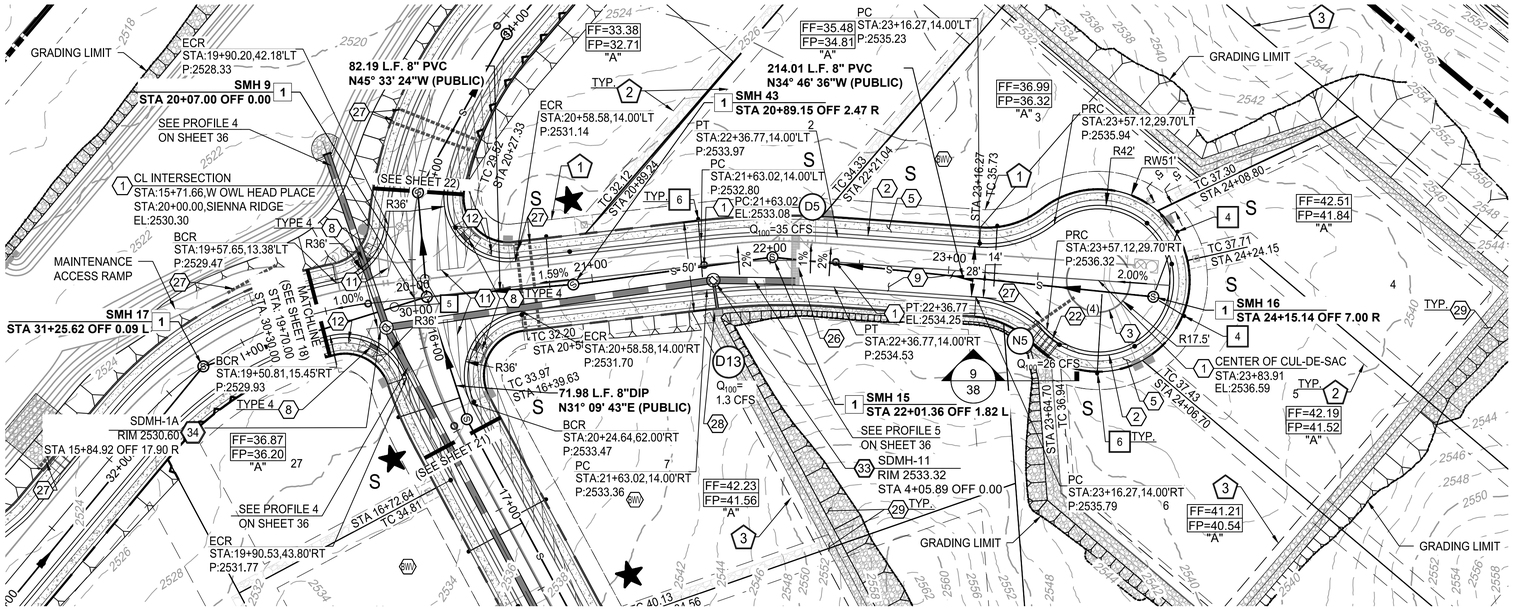
PLAN STATUS:
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12/16/24
DATE
AZ4072-1004
JOB NUMBER
ML
DRAWN BY
LJA
DESIGNED BY
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P22WI00005
G-2022-007

Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA 811
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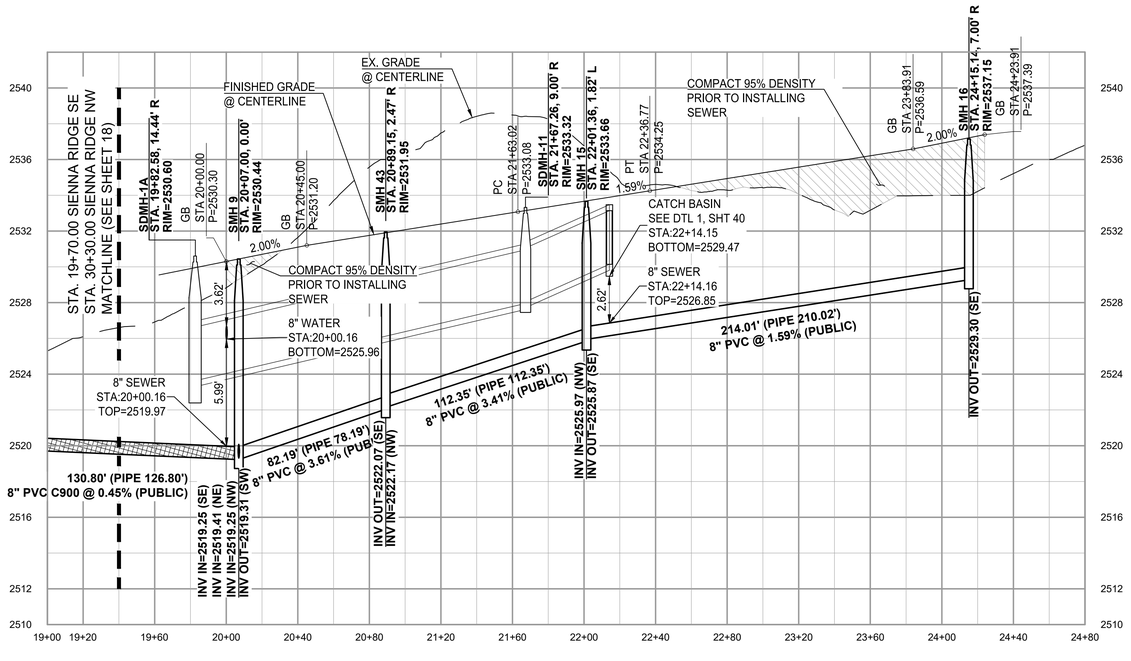
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SIENNA RIDGE (PRIVATE) STA. 19+70.00 TO STA. 23+83.91

NOTE:
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2. ALL SEWER H.C.S. ARE CENTERED BETWEEN LOT LINES UNLESS OTHERWISE NOTED.

PROFILE SCALE:
HORIZ: 1" = 40'
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EASEMENT KEYNOTES

1. 10' PUBLIC UTILITY, ROADWAY MAINTENANCE, & SIGNAGE EASEMENT BY FINAL PLAT
2. BUILDING SETBACK LINE, SEE DTL. 6 SHT 38.
3. DRAINAGE EASEMENT PER FINAL FLAT.

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10. INSTALL SCOUR PROTECTION FOR SEWER LINES PER RWRD 113
11. NOT USED.
12. STABILIZED SURFACE PER STD. DTL. RWRD 111.

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RELATED CASE #
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2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil) CERTIFICATE NO. 54544 ROBERT W. SCHLICHER Date Signed 12/16/24 ARIZONA U.S.A.

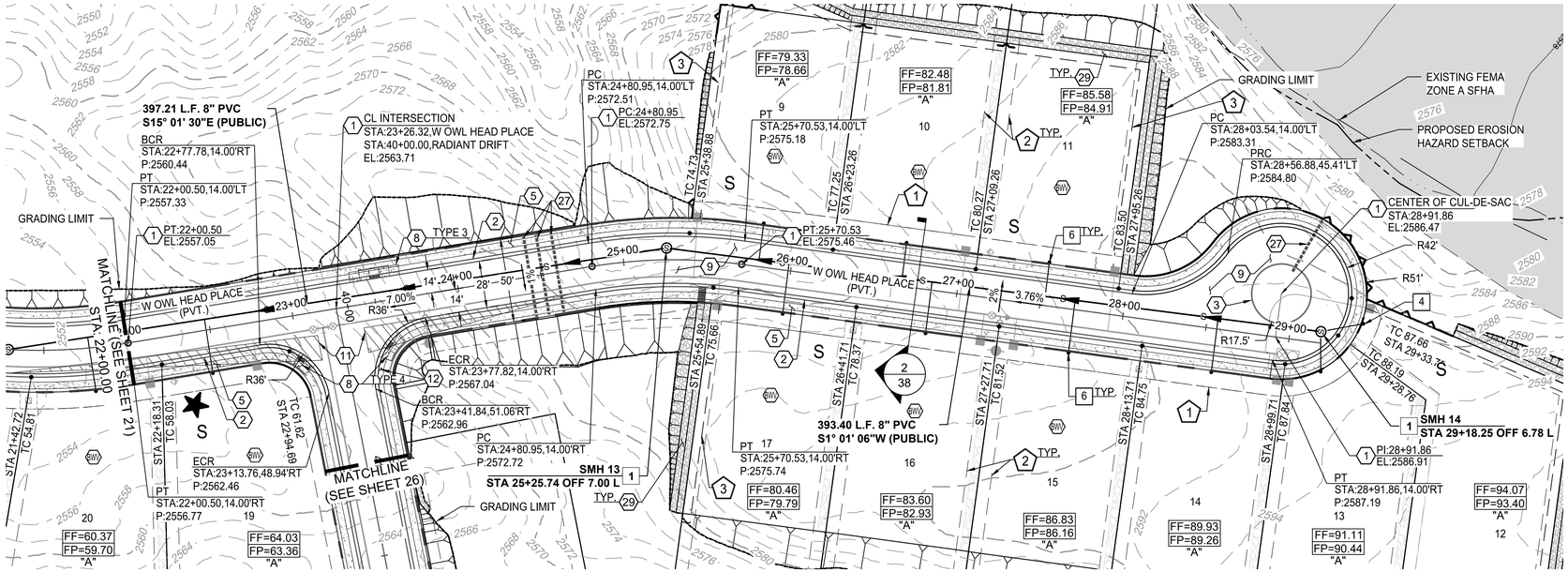
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P22WI00005
G-2022-007

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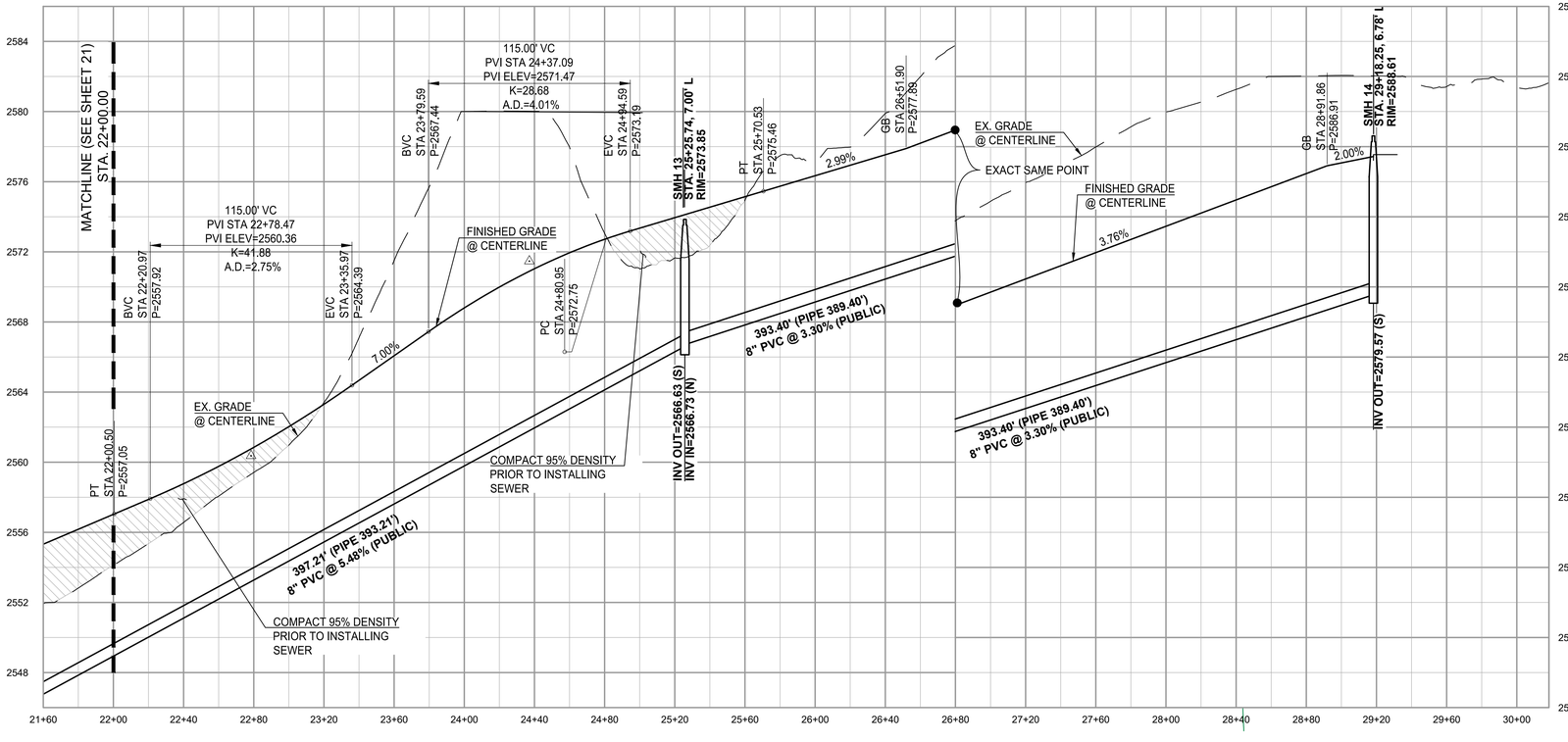
W OWL HEAD PLACE(PRIVATE) STA. 22+00.00 TO STA. 29+18.23

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MONOSLOPE

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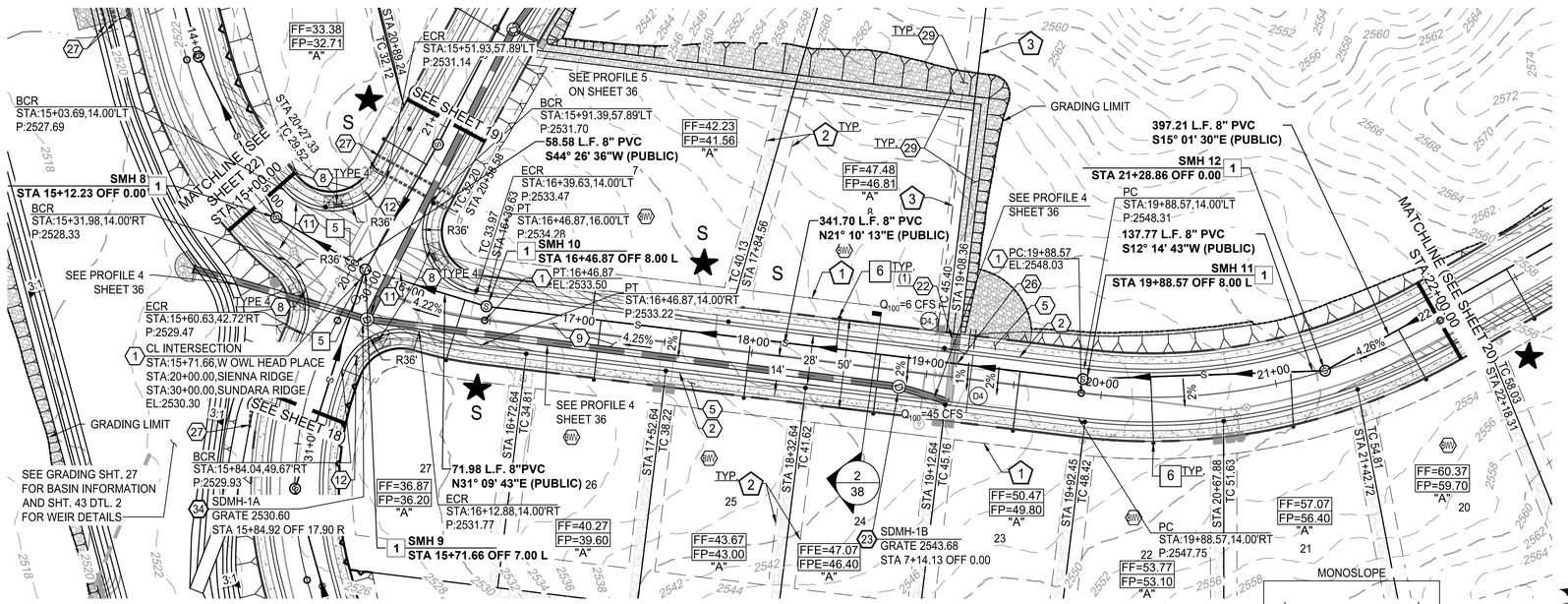
Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed 12/16/24
ARIZONA U.S.A.

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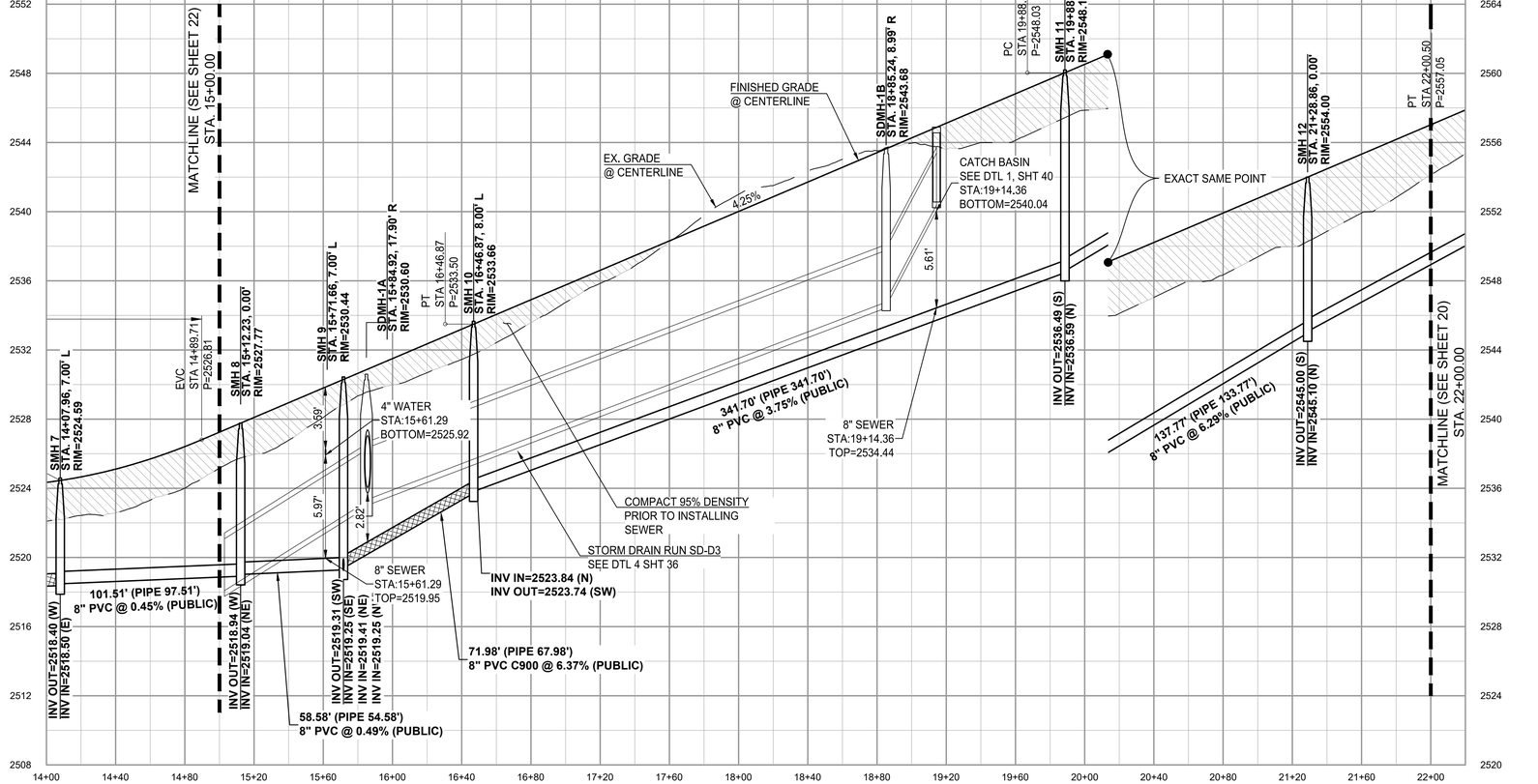
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W OWL HEAD PLACE (PRIVATE) STA. 15+00.00 TO STA. 22+00.00

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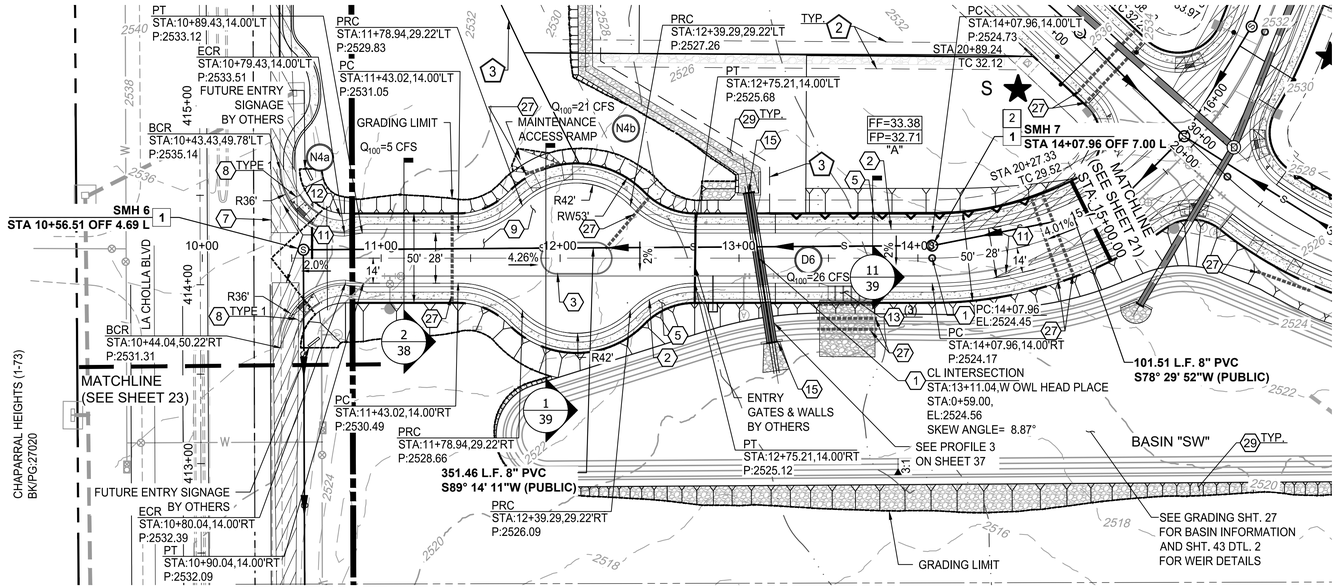
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P22WI00005
G-2022-007

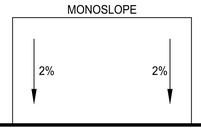
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Call 811 or click Arizona811.com

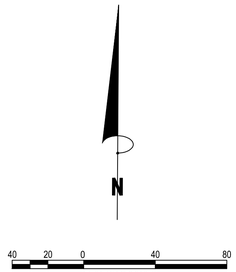
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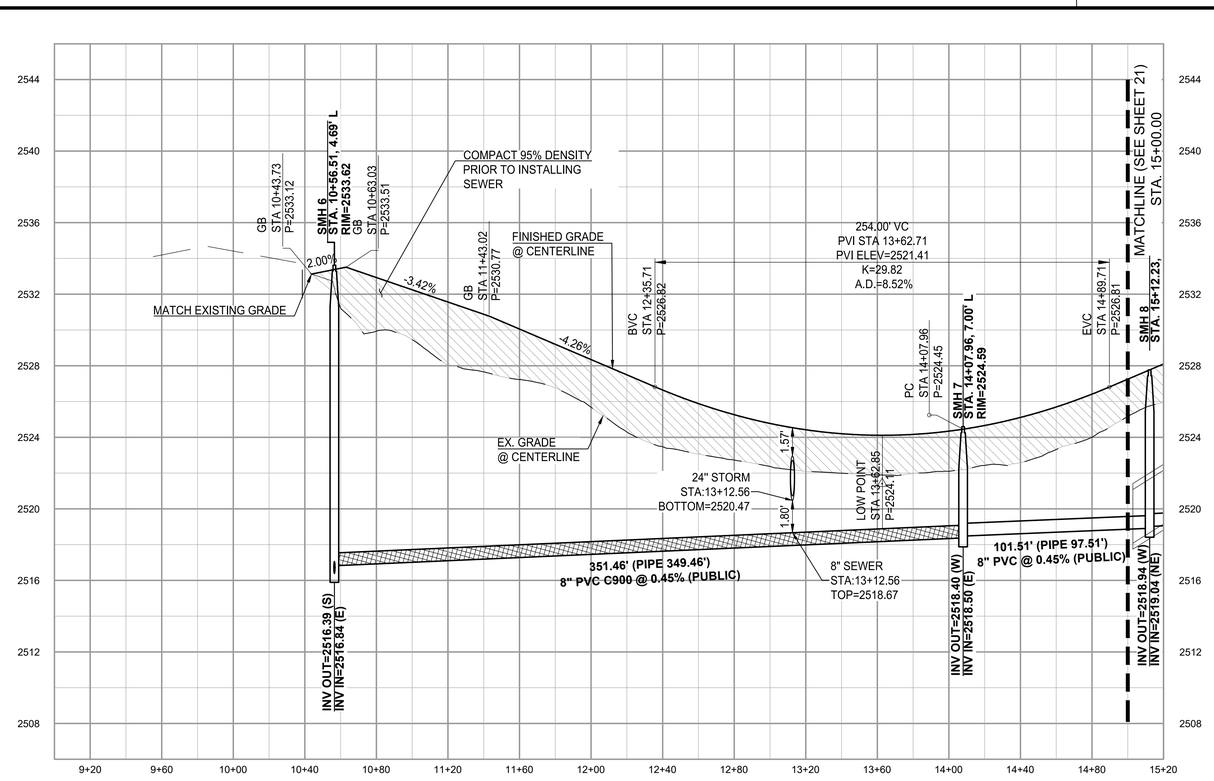
W OWL HEAD PLACE (PRIVATE) STA. 9+50.00 TO STA. 15+00.00

NOTE:
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2. ALL SEWER H.C.S. ARE CENTERED BETWEEN LOT LINES UNLESS OTHERWISE NOTED.





PROFILE SCALE:
HORIZ: 1" = 40'
VERT: 1" = 4'



EASEMENT KEYNOTES

1. 10' PUBLIC UTILITY, ROADWAY MAINTENANCE, & SIGNAGE EASEMENT BY FINAL PLAT
2. BUILDING SETBACK LINE, SEE DTL. 6 SHT 38.
3. DRAINAGE EASEMENT PER FINAL FLAT.

SEWER KEYNOTES

1. CONSTRUCT 4' DIA. MANHOLE PER STD. DTL. RWRD 205 WITH CONCRETE COLLAR PER STD. DTL. RWRD 211
2. INSTALL 24" WATERTIGHT FRAME AND COVER PER STD. DTL. RWRD 214.
3. INSTALL CONNECTION TO EXISTING MANHOLE BASE STD. DTL. RWRD 301.
4. INSTALL HCS CONNECTION TO MANHOLE PER STD. DTL. RWRD 402.
5. SEWER/WATER CROSSING PER STD. DTL. RWRD 108. CONTRACTOR TO VERIFY EXISTING ELEVATION PRIOR TO CONSTRUCTION. SEWER CONTRACTOR RESPONSIBLE FOR ANY DAMAGE DURING CONSTRUCTION.
6. INSTALL HCS WITH CLEANOUT PER STD. DTL. RWRD 401 AND STD. DTL. RWRD 404.
7. INSTALL BLOCK OUT PER RWRD 203, SIZE AND INVERT PER PLAN. INSTALL AT MANHOLE CONNECTION TEMPORARY PLUG AND SECURE WITH A CHAIN OR CABLE TO A MANHOLE STEP. PLUG TO INCLUDE CONTRACTOR'S COMPANY NAME. THE PLUG IS TO BE REMOVED AFTER PDEQ/ADEQ's DISCHARGE AUTHORIZATION AND POST PAVING INSPECTION AS DIRECTED BY THE FIELD ENGINEERING INSPECTOR. PLUG TO BE PLACED DOWNSTREAM OF ALL PROPOSED SERVICE LATERALS.
8. CONTRACTOR TO PROVIDE NEW SCOUR PROTECTION PER PAG AND RWRD STANDARDS
9. SEWER/STORM CROSSING PER RWRD SECTION 5.1.10.B CONTRACTOR TO VERIFY EXISTING ELEVATION PRIOR TO CONSTRUCTION. SEWER CONTRACTOR RESPONSIBLE FOR CROSSING CONSTRUCTION.
10. INSTALL SCOUR PROTECTION FOR SEWER LINES PER RWRD 113
11. NOT USED.
12. STABILIZED SURFACE PER STD. DTL. RWRD 111.

CONSTRUCTION KEYNOTES

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11. SIGHT VISIBILITY TRIANGLE, SEE DTL. 4, SHT. 38.
12. INSTALL 30" X 30" R1-1 "STOP SIGN" AND STREET NAME SIGN.
13. CONSTRUCT TYPE 3 SIDEWALK SCUPPER PER P.A.G. STD. DTL. 205.5. NUMBER OF CELLS AS NOTED. SEE SHT. 37 FOR DETAILS, W/ GUARDRAIL PER PAG. 105
22. CONSTRUCT TYPE 2 SIDEWALK SCUPPER PER P.A.G. STD. DTL. 205 NUMBER OF CELLS AS NOTED.
23. CONSTRUCT 48" STORM DRAIN MANHOLE PER PAG STD. DTL. 300 & 302.
26. INSTALL CATCH BASIN PER DETAIL 1 SHT. 40 AND SEE STORM DRAIN PROFILES ON SHT. 36-37, 40-41
27. NEW IRRIGATION LINE SLEEVE, THE CURB SHALL BE MARKED/STAMPED WITH "IS" (IRRIGATION SYSTEM), SEE LANDSCAPE PLAN FOR LINE INFORMATION.
28. INSTALL TYPE 4 CATCH BASIN PER PAG STD. DTL. 309.
29. SEE GRADING PLAN FOR DETAILS.
30. 2 - 24'x 6' ARCH CULVERTS, SEE PROFILE 1, SHT. 36 AND SHT. 45-51 FOR DTLS.
31. INSTALL HANDRAIL PER PAG STD. DTL. 105.
32. CONSTRUCT DRIVEWAY APRON PER P.A.G. STD. DTL. 206.
33. CONSTRUCT 60" STORM DRAIN MANHOLE PER PAG STD. DTL. 301 & 302.
34. CONSTRUCT 72" STORM DRAIN MANHOLE PER PAG STD. DTL. 301 & 302.
35. INSTALL RCP CLASS V STORM DRAIN PIPE. LENGTH, SLOPE, AND DIAMETER PER PLAN, SEE STORM DRAIN PROFILE ON SHT. 36-37, 40-41

LJA Engineering, Inc.
7458 N. La Cholla Boulevard.
Tucson, AZ 85741
Phone 520.257.3400

PAVING PLAN AND PROFILE
SUNDARA RIDGE
FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed 12/16/24
ARIZONA U.S.A.

PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

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V: 1"=4'
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12/16/24
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DESIGNED BY
RWS
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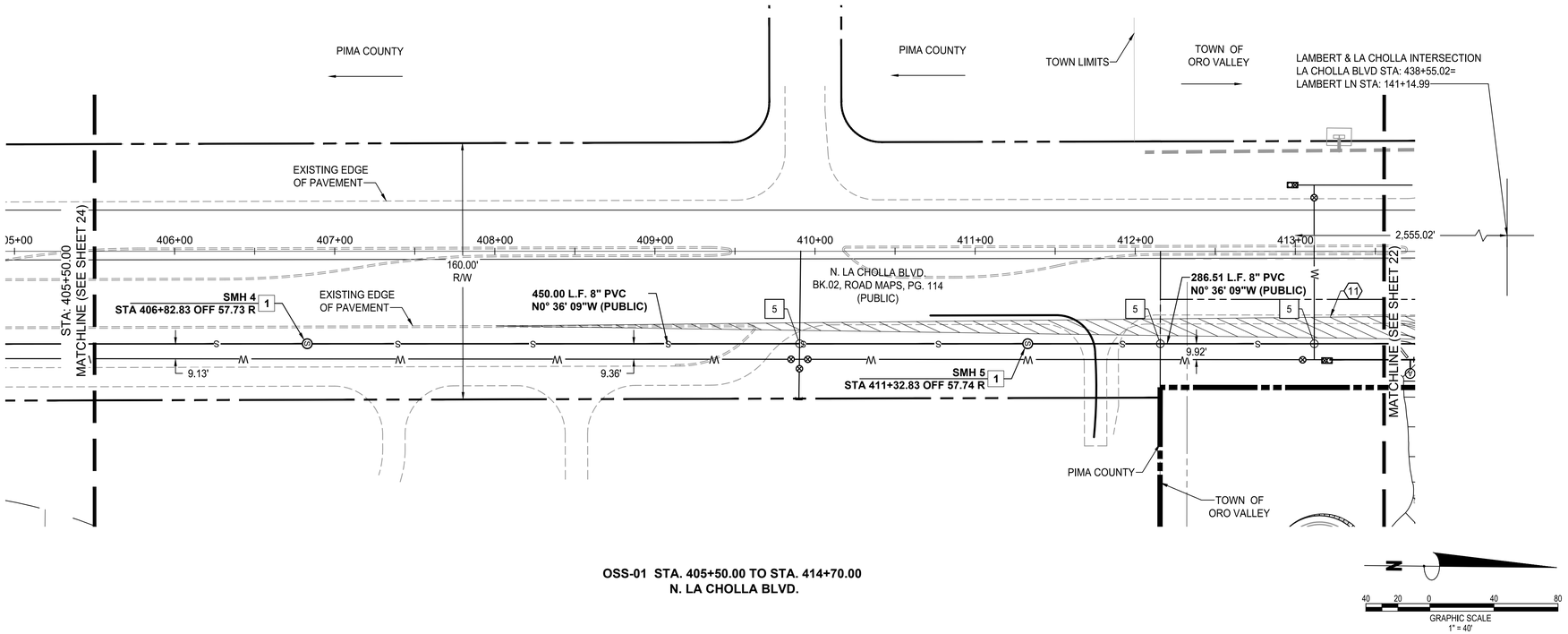
22 OF 51

RELATED CASE #
OV914-009
2100731
OV114-018

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P22WI00005
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Date/Time: Tue, 10 Dec 2024 - 5:01pm PathName: S:\ARIZTucson\AZ4072-1004\LJA MOVING FORWARD\BASE FILES\PV22 PAVING PLAN AND PROFILE.dwg

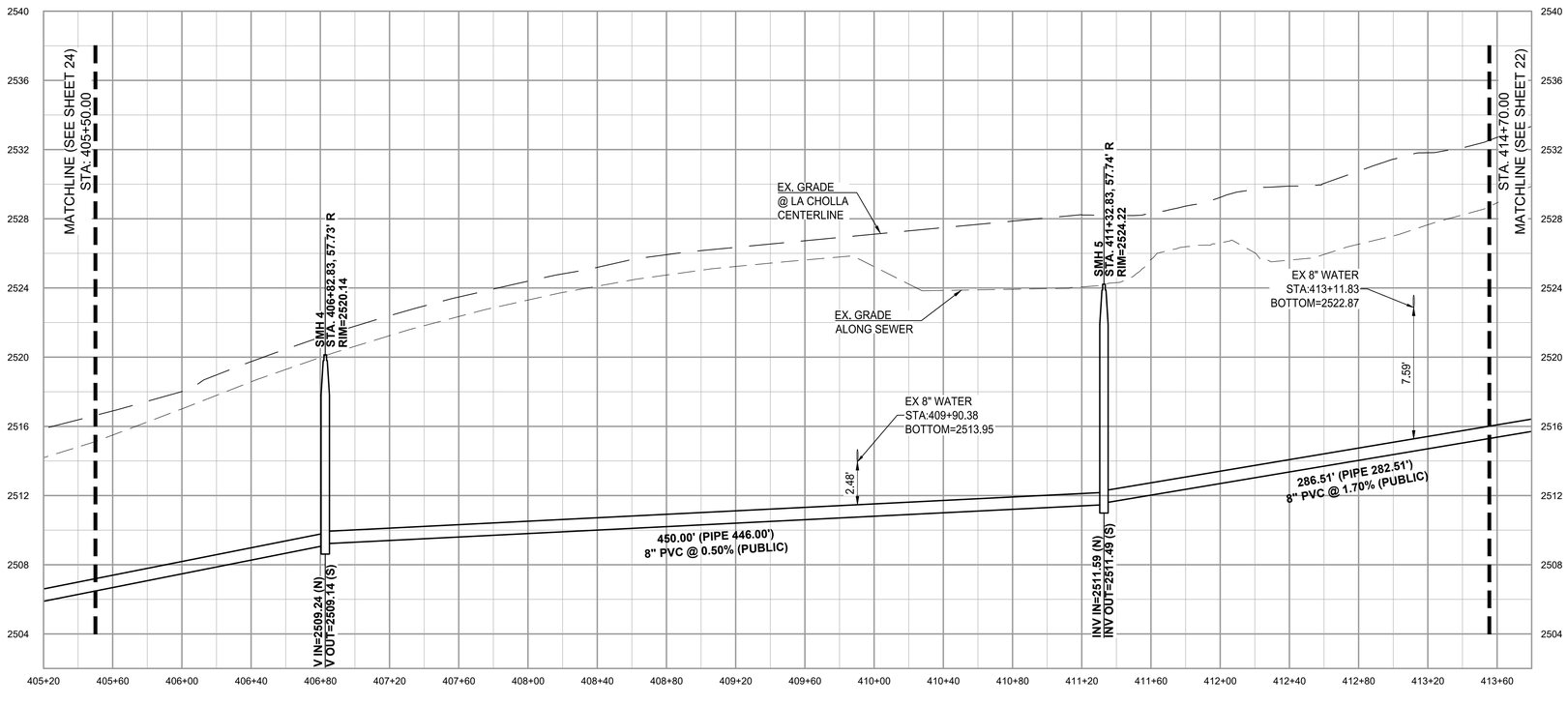


OSS-01 STA. 405+50.00 TO STA. 414+70.00
N. LA CHOLLA BLVD.

N

40 20 0 40 80
GRAPHIC SCALE
1" = 40'

PROFILE SCALE:
HORIZ: 1" = 40'
VERT: 1" = 4'



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11. NOT USED.
12. STABILIZED SURFACE PER STD. DTL. RWRD 111.

RELATED CASE #
OV914-009
2100731
OV114-018

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SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

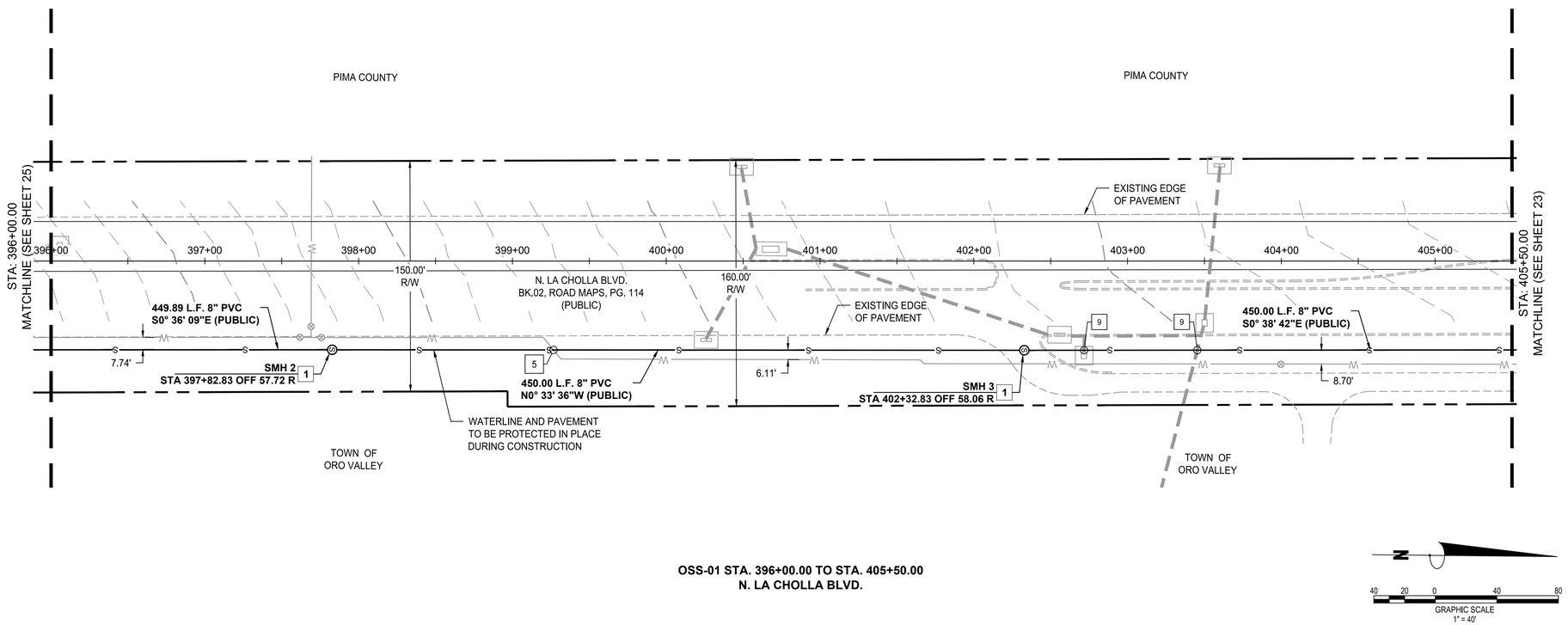
Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed 12/16/24
ARIZONA, U.S.A.

PLAN STATUS:
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FOR CONSTRUCTION ☐

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V: 1"=4'
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JOB NUMBER
ML
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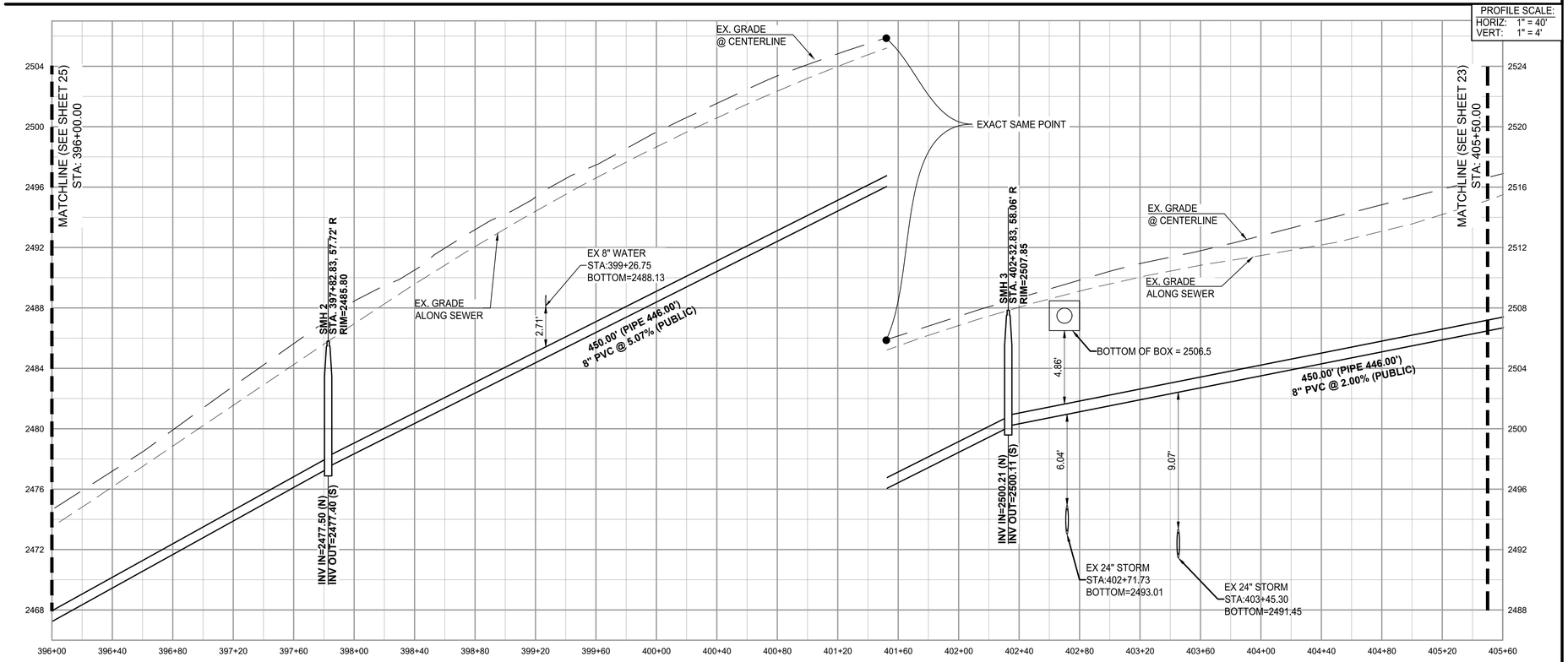
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G-2022-007

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OSS-01 STA. 396+00.00 TO STA. 405+50.00
N. LA CHOLLA BLVD.

PROFILE SCALE:
HORIZ: 1" = 40'
VERT: 1" = 4'



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PAVING PLAN AND PROFILE
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SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date signed 12/16/24
ARIZONA, U.S.A.

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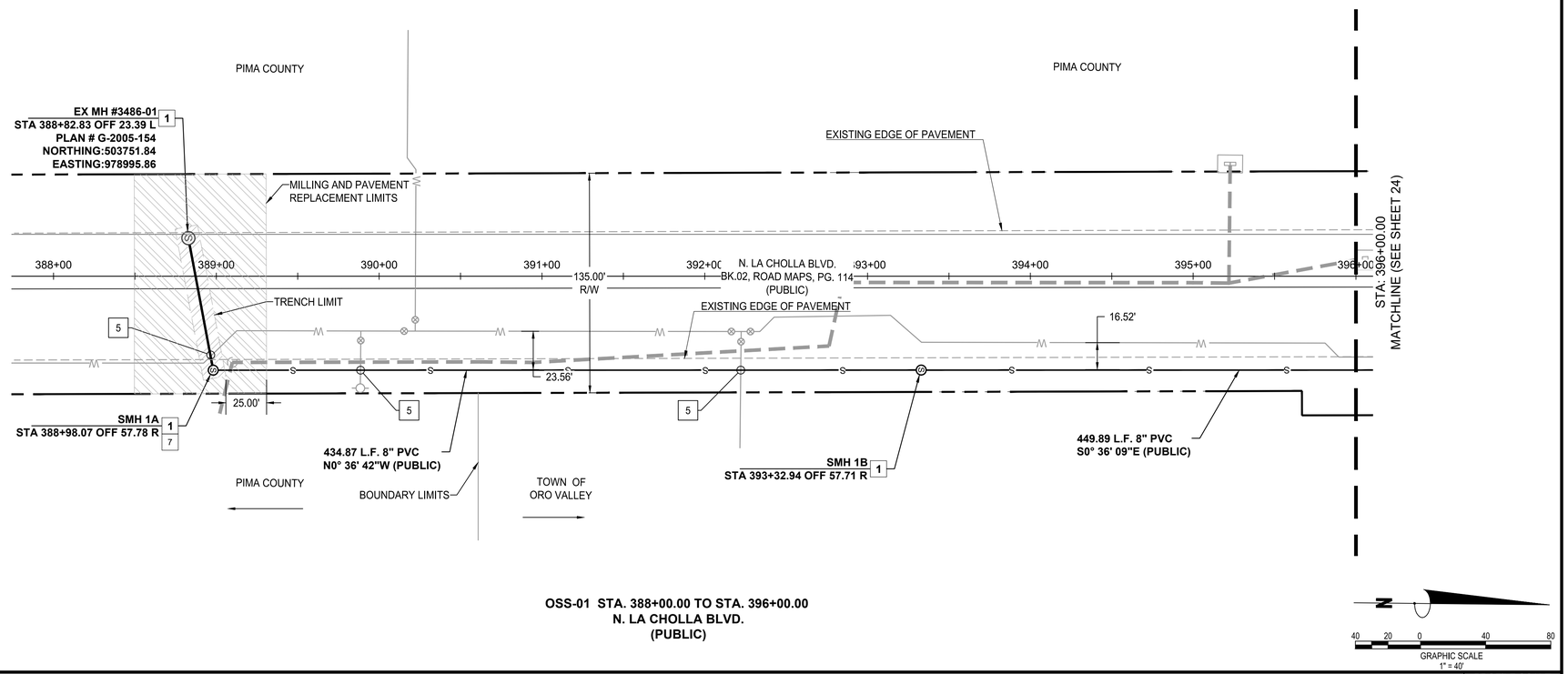
H: 1"=40' / V: 1"=4'	C.I.=2'
SCALE	
12/16/24	DATE
AZ4072-1004	JOB NUMBER
ML	DRAWN BY
LJA	DESIGNED BY
RWS	CHECKED BY

RELATED CASE #
OV914-009
2100731
OV114-018

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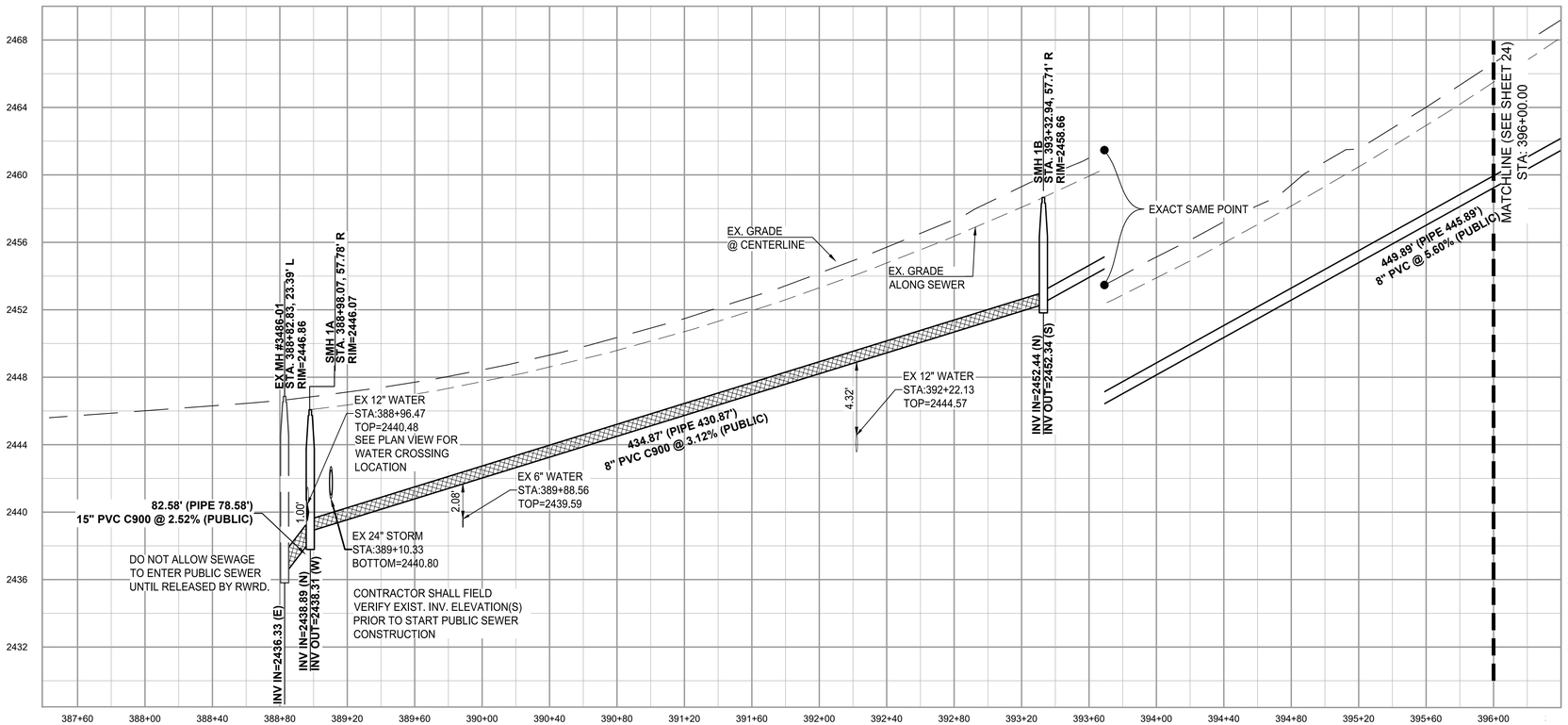
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OSS-01 STA. 388+00.00 TO STA. 396+00.00
N. LA CHOLLA BLVD.
(PUBLIC)

PROFILE SCALE:
HORIZ: 1" = 40'
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A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12
SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

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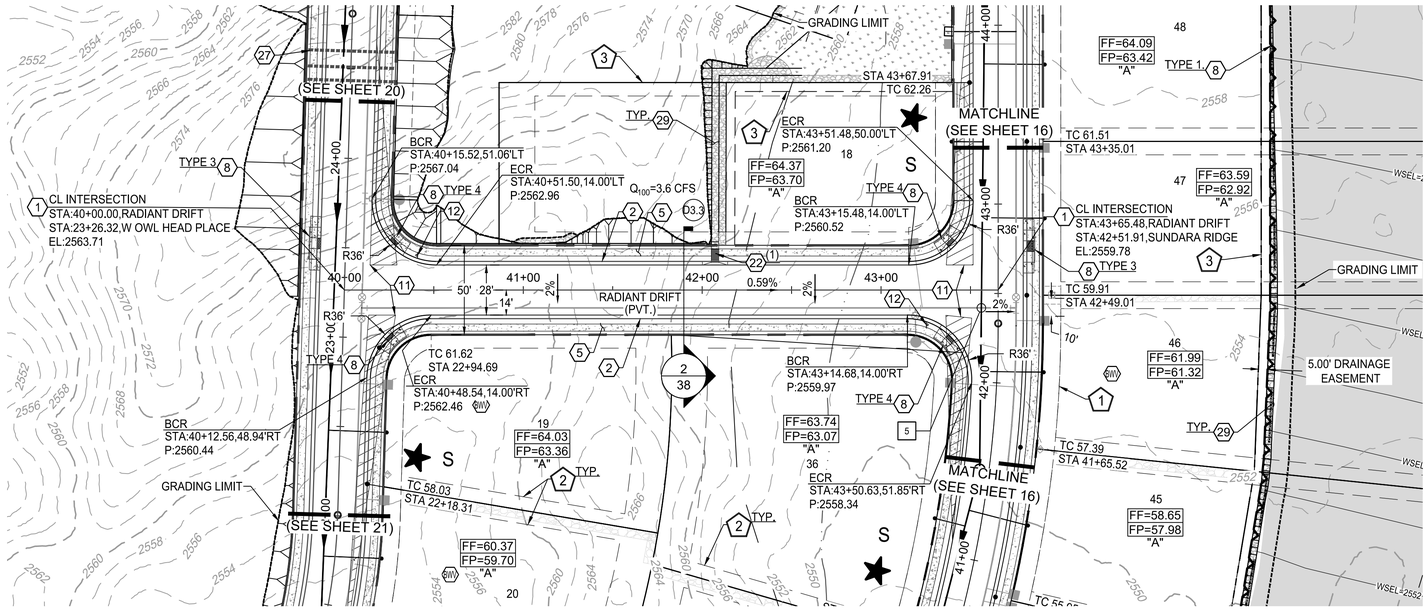
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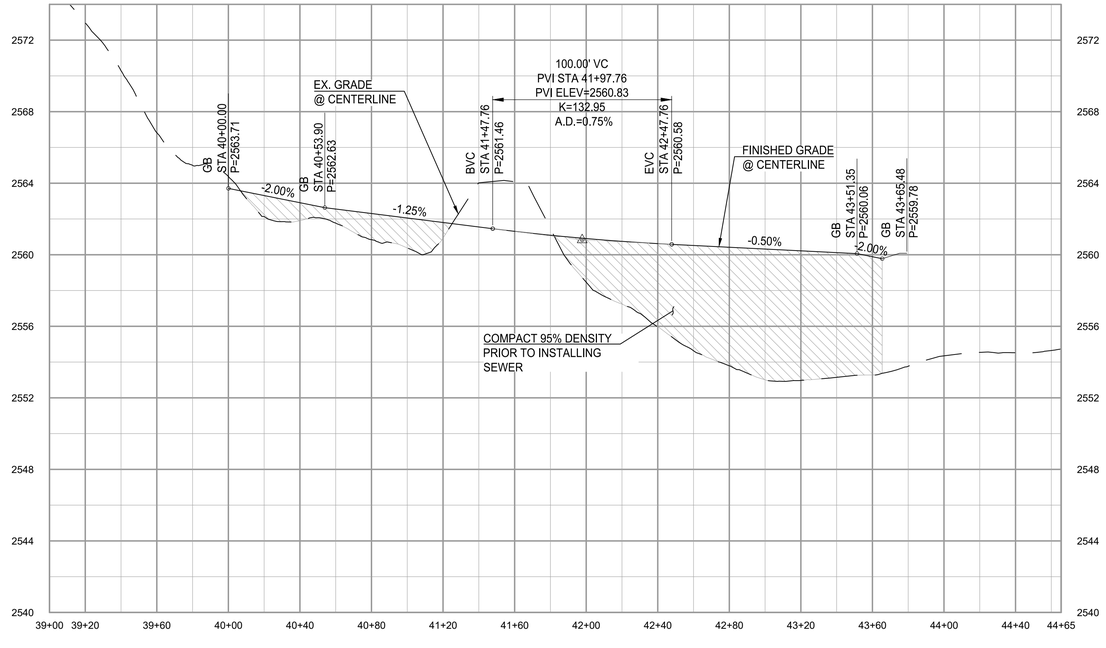
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RADIANT DRIFT (PRIVATE) STA. 40+00.00 TO STA. 43+65.48

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13. CONSTRUCT TYPE 3 SIDEWALK SCUPPER PER P.A.G. STD. DTL. 205.5. NUMBER OF CELLS AS NOTED. SEE SHT. 37 FOR DETAILS, W/ GUARDRAIL PER PAG. 105
22. CONSTRUCT TYPE 2 SIDEWALK SCUPPER PER P.A.G. STD. DTL. 205 NUMBER OF CELLS AS NOTED.
23. CONSTRUCT 48" STORM DRAIN MANHOLE PER PAG STD. DTL. 300 & 302.
26. INSTALL CATCH BASIN PER DETAIL 1 SHT. 40 AND SEE STORM DRAIN PROFILES ON SHT. 36-37, 40-41
27. NEW IRRIGATION LINE SLEEVE, THE CURB SHALL BE MARKED/STAMPED WITH "IS" (IRRIGATION SYSTEM), SEE LANDSCAPE PLAN FOR LINE INFORMATION.
28. INSTALL TYPE 4 CATCH BASIN PER PAG STD. DTL. 309.
29. SEE GRADING PLAN FOR DETAILS.
30. 2 - 24'x 6' ARCH CULVERTS, SEE PROFILE 1, SHT. 36 AND SHT. 45-51 FOR DTLS.
31. INSTALL HANDRAIL PER PAG STD. DTL. 105.
32. CONSTRUCT DRIVEWAY APRON PER P.A.G. STD. DTL. 206.
33. CONSTRUCT 60" STORM DRAIN MANHOLE PER PAG STD. DTL. 301 & 302.
34. CONSTRUCT 72" STORM DRAIN MANHOLE PER PAG STD. DTL. 301 & 302.
35. INSTALL RCP CLASS V STORM DRAIN PIPE. LENGTH, SLOPE, AND DIAMETER PER PLAN, SEE STORM DRAIN PROFILE ON SHT. 36-37, 40-41

RELATED CASE #
OV914-009
2100731
OV114-018

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

LJA Engineering, Inc.
7458 N. La Cholla Boulevard.
Tucson, AZ 85741
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PAVING PLAN AND PROFILE
SUNDARA RIDGE
FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil) CERTIFICATE NO. 54544 ROBERT W. SCHLICHER Date Signed 12/16/24 ARIZONA U.S.A.

PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

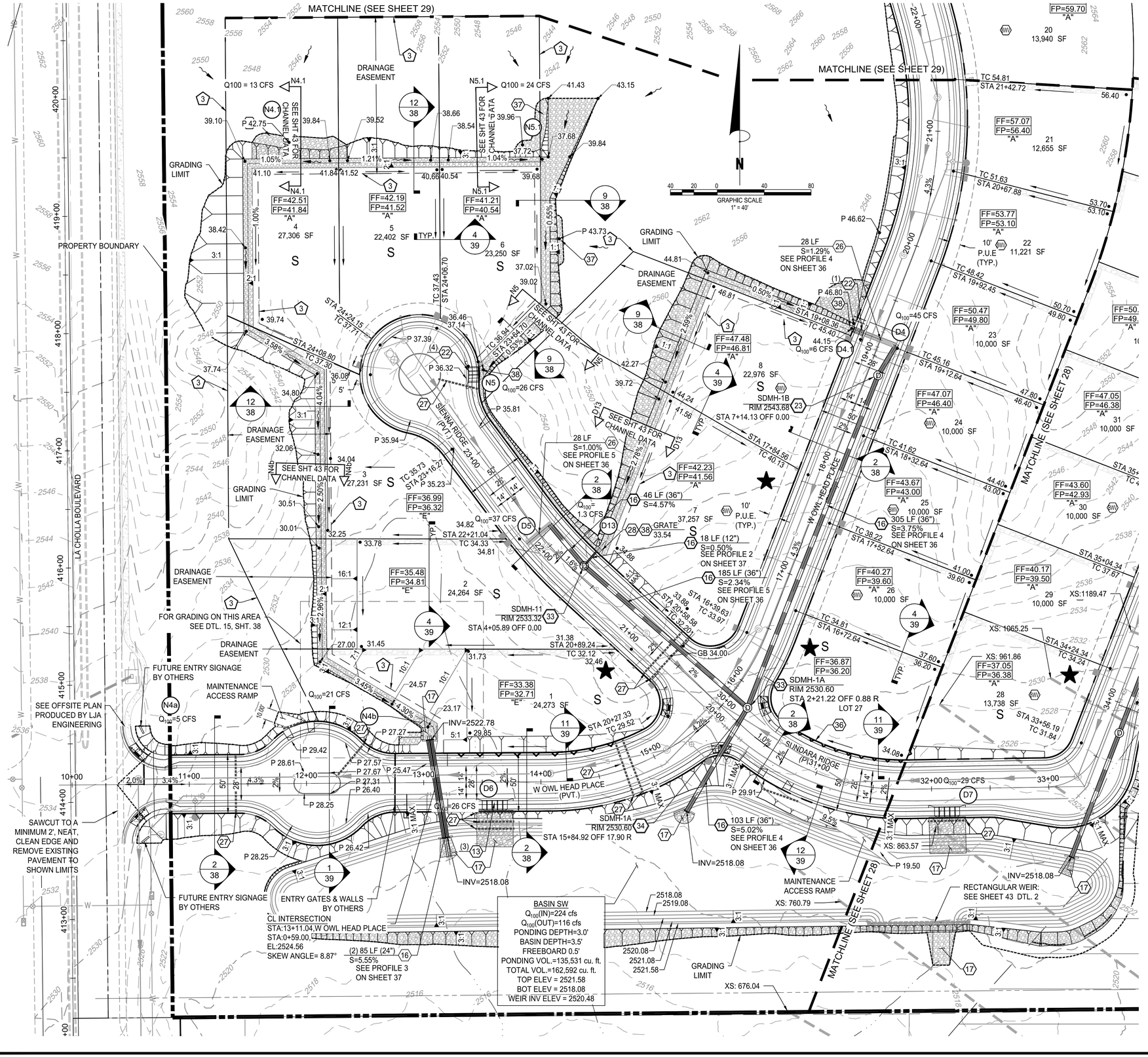
H: 1"=40' C.I.=2'
V: 1"=4'
SCALE
12/16/24
DATE
AZ4072-1004
JOB NUMBER
ML
DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY

26 OF 51

P22WI00005

G-2022-007

Date/Time: Tue, 10 Dec 2024 - 5:07pm PathName: S:\ARIZT\cson\AZ4072-1004\LAND_LJA MOVING FORWARD\BASE FILES\PVJ26 PAVING PLAN AND PROFILE.dwg



EASEMENT KEYNOTES

1. 10' PUBLIC UTILITY, ROADWAY MAINTENANCE, & SIGNAGE EASEMENT BY FINAL PLAT
2. BUILDING SETBACK LINE, SEE DTL. 6 SHT 38.
3. PRIVATE DRAINAGE EASEMENT PER FINAL PLAT.

CONSTRUCTION KEYNOTES

10. SLOPE STABILIZATION, SEE DTL. 8, SHT. 38
12. INSTALL 30" X 30" R1-1 "STOP SIGN" AND STREET NAME SIGN.
13. CONSTRUCT TYPE 3 SIDEWALK SCUPPER PER P.A.G. STD. DTL. 205.5. W/ GUARDRAIL PER PAG. 105, NUMBER OF CELLS AS NOTED. SEE SHT. 37 FOR DETAILS.
14. INSTALL BANK PROTECTION PER DTL. 7 ON SHT. 38
15. INSTALL INLET AND OUTLET STRUCTURES PER ADOT (SD 6: DRAINAGE STRUCTURES-SD 6.30 SERIES) SEE STORM DRAIN PROFILE ON SHT.36-37,40-41
16. INSTALL SRP (16 GAUGE) STORM DRAIN PIPE. LENGTH, SLOPE, AND DIAMETER PER PLAN, SEE STORM DRAIN PROFILE ON SHT. 36-37, 40-41
17. TYPICAL ROCK RIP-RAP SPLASH PAD, SEE DTL. 3, SHT. 38 FOR CULVERTS, FOR SCUPPER SPILL WAYS AND CHANNELS.
18. RETAINING WALL BY OTHERS, REQUIRES SEPARATE PERMIT.
22. CONSTRUCT TYPE 2 SIDEWALK SCUPPER PER P.A.G. STD. DTL. 205 NUMBER OF CELLS AS NOTED.
23. CONSTRUCT 48" STORM DRAIN MANHOLE PER PAG STD. DTL. 300 & 302.
25. CONSTRUCT GROUTED RIP RAP BANK PROTECTION PER DTL. 9, SHT. 39
26. INSTALL CATCH BASIN PER DTL. 1 SHT. 40 AND SEE STORM DRAIN PROFILES ON SHT. 36-37, 40-41
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36. INSTALL RETAINING WALL PER DTL. 2 ON SHT. 39
37. INSTALL RIP RAP PROTECTION PER DTL. 13 ON SHT. 38
38. INSTALL SEDIMENT TRAP PER DTL. 1 & 3, SHT. 43, SEE GRADATION PER DTL. 8, SHT. 38
39. SAW CUT AND REMOVE EXISTING M.U.P. AT ENTRANCE MATCH GRADE AT RAMP REPLACE AS NEEDED PER DTL. 8 SHT. 39.
40. INSTALL BANK PROTECTION PER DTL. 9 ON SHT. 39
41. INSTALL RIP-RAP PROTECTION PER DTL. 9 ON SHT. 41

LJA Engineering, Inc.
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GRADING
SUNDARA RIDGE

FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed 9/18/24
ARIZONA U.S.A.

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FOR CONSTRUCTION ☐

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Date/Time - Tue, 10 Dec 2024 - 5:08pm Path/Name - S:\ARIZ\Tucson\AZ4072-1004\LJA MOVING FORWARD\BASE FILES\IP\v27 GRADING.dwg



LOMAS DE ORO WASH FLOODPLAIN

LOT#	WATER SURFACE ELEVATION (WSE)	REGULATORY FLOOD ELEVATION (RFE)	FINISHED FLOOR ELEVATION (FFE)
49	2562.17	2563.17	2564.58
48	2559.67	2560.67	2564.09
47	2557.75	2558.75	2563.59
46	2555.71	2556.71	2561.99
45	2553.12	2554.12	2558.65
44	2550.31	2551.31	2557.21
43	2547.65	2548.65	2555.93
42	2544.81	2545.81	2554.87
41	2541.65	2542.65	2552.27
40	2538.95	2539.95	2549.32
39	2536.32	2537.32	2546.06
38	2533.93	2534.93	2542.35
37	2530.98	2531.98	2538.64

EASEMENT KEYNOTES

1. 10' PUBLIC UTILITY, ROADWAY MAINTENANCE, & SIGNAGE EASEMENT BY FINAL PLAT
2. BUILDING SETBACK LINE, SEE DTL. 6 SHT 38.
3. PRIVATE DRAINAGE EASEMENT PER FINAL PLAT.

CONSTRUCTION KEYNOTES

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12. INSTALL 30" X 30" R1-1 "STOP SIGN" AND STREET NAME SIGN.
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14. INSTALL BANK PROTECTION PER DTL. 7 ON SHT. 38
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41. INSTALL RIP-RAP PROTECTION PER DTL. 9 ON SHT. 41

RELATED CASE #
OV914-009
2100731
OV114-018

LJA Engineering, Inc.
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Tucson, AZ 85741
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GRADING
SUNDARA RIDGE
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SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
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Registered Professional Engineer (Civil)
CERTIFICATE NO.
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ROBERT W. SCHLICHER
Date Signed 12/16/24
ARIZONA, U.S.A.

PLAN STATUS:
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FOR CONSTRUCTION ☐

H: 1"=40' C.I.=2'
V:
SCALE 12/16/24
DATE AZ4072-1004
JOB NUMBER ML
DRAWN BY LJA
DESIGNED BY RWS
CHECKED BY

28 OF 51

P22WI00005
G-2022-007

Contact Arizona 811 at least two full working days before you begin excavation
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DateTime: Tue, 10 Dec 2024 - 5:09pm PathName: S:\ARIZ\Tucson\AZ4072-1004\LAND_LJA MOVING FORWARD\BASE FILES\IP\28 GRADING.dwg

LOMAS DE ORO WASH FLOODPLAIN			
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SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

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CERTIFICATE NO.
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ROBERT W. SCHLICHER
Date Signed 12/16/24
ARIZONA, U.S.A.

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29 OF 51

RELATED CASE #
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Date/Time: Tue, 10 Dec 2024 - 5:11pm Path/Name: S:\ARIZOTucson\AZ4072400LAND_LJA MOVING FORWARD\BASE FILES\P\v29 GRADING.dwg



EASEMENT KEYNOTES

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41. INSTALL RIP-RAP PROTECTION PER DTL. 9 ON SHT. 41

TABLE 'A' _ SCOUR DEPTH PROTECTION

LOMAS DE ORO WASH

LOT	WASH THALWEG ELEV.	MIN. TOE DOWN	TOE DOWN ELEV.
37	2528.00	4.1	2523.90
38	2531.47	4.1	2527.37
39	2533.99	4.1	2529.89
40	2536.00	4.1	2531.90
41	2538.00	4.1	2533.90
42	2541.71	4.1	2537.61
43	2544.71	4.1	2540.61
44	2547.20	4.1	2543.10
45	2551.96	4.1	2547.86
46	2552.62	4.1	2548.52
47	2555.67	4.1	2551.57
48	2557.09	4.1	2552.99
49	2559.65	4.6	2555.05
Basin "C"	2563.00	4.6	2558.40
Basin "N"	2573.00	4.2	2568.80
Basin "SW"	2522.00	4.2	2517.80

RELATED CASE #
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OV114-018

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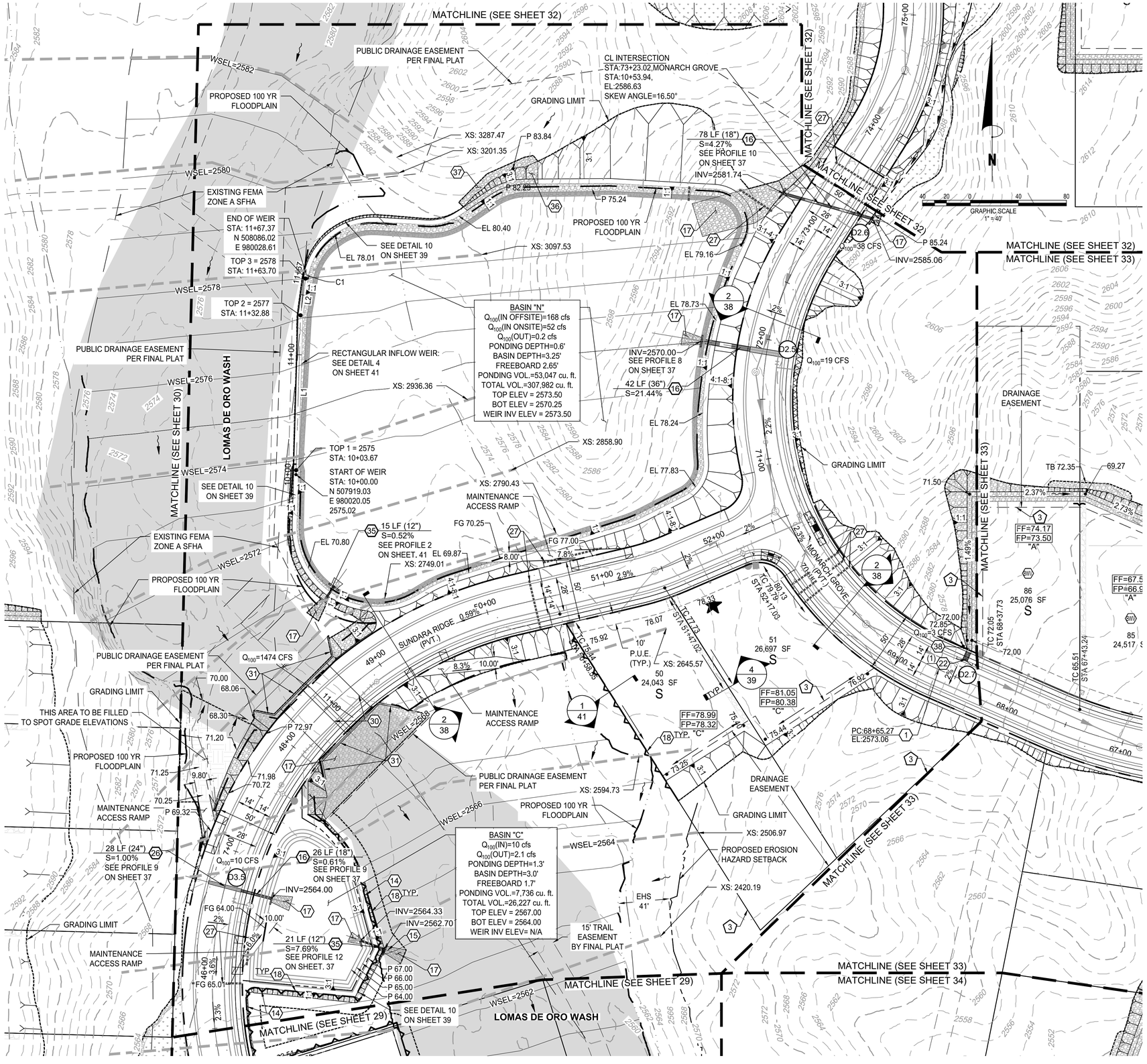
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16. INSTALL SRP (16 GAUGE) STORM DRAIN PIPE. LENGTH, SLOPE, AND DIAMETER PER PLAN, SEE STORM DRAIN PROFILE ON SHT. 36-37, 40-41
17. TYPICAL ROCK RIP-RAP SPLASH PAD, SEE DTL. 3, SHT. 38 FOR CULVERTS, FOR SCUPPER SPILL WAYS AND CHANNELS.
18. RETAINING WALL BY OTHERS, REQUIRES SEPARATE PERMIT.
22. CONSTRUCT TYPE 2 SIDEWALK SCUPPER PER P.A.G. STD. DTL. 205 NUMBER OF CELLS AS NOTED.
23. CONSTRUCT 48" STORM DRAIN MANHOLE PER PAG STD. DTL. 300 & 302.
25. CONSTRUCT GROUTED RIP RAP BANK PROTECTION PER DTL. 9, SHT. 39
26. INSTALL CATCH BASIN PER DTL. 1 SHT. 40 AND SEE STORM DRAIN PROFILES ON SHT. 36-37, 40-41
27. NEW IRRIGATION LINE SLEEVE, THE CURB SHALL BE MARKED/STAMPED WITH "IS" (IRRIGATION SYSTEM), SEE LANDSCAPE PLAN FOR LINE INFORMATION.
28. INSTALL TYPE 4 CATCH BASIN PER PAG STD. DTL. 309.
30. 2 - 24'x 6' ARCH CULVERTS, SEE PROFILE 1, SHT. 36 AND SHT. 45-51 FOR DTLS.
31. INSTALL HANDRAIL PER PAG STD. DTL. 105.
33. CONSTRUCT 60" STORM DRAIN MANHOLE PER PAG STD. DTL. 301 & 302.
34. CONSTRUCT 72" STORM DRAIN MANHOLE PER PAG STD. DTL. 301 & 302.
35. INSTALL RCP STORM DRAIN PIPE. LENGTH, SLOPE, AND DIAMETER PER PLAN, CLASS PER PROFILE, SEE STORM DRAIN PROFILE ON SHT. 36-37, 40-41
36. INSTALL RETAINING WALL PER DTL. 2 ON SHT. 39
37. INSTALL RIP RAP PROTECTION PER DTL. 13 ON SHT. 38
38. INSTALL SEDIMENT TRAP PER DTL. 1 & 3, SHT. 43, SEE GRADATION PER DTL. 8, SHT. 38
39. SAW CUT AND REMOVE EXISTING M.U.P. AT ENTRANCE MATCH GRADE AT RAMP REPLACE AS NEEDED PER DTL. 8 SHT. 39.
40. INSTALL BANK PROTECTION PER DTL. 9 ON SHT. 39
41. INSTALL RIP-RAP PROTECTION PER DTL. 9 ON SHT. 41

CONSTRUCTION TABLE BASIN "N"

BASIN "N" - CURVE TABLE

Curve #	Length	Radius	Delta	Chord Direction	Chord Length
C1	3.67	57.00	3.69	N9° 37' 13"E	3.67

BASIN "N" - LINE TABLE

Line #	Length	Direction
L1	132.88	N1° 37' 38.36"E
L2	30.82	N7° 46' 31.64"E

RELATED CASE #
OV914-009
2100731
OV114-018

Contact Arizona 811 at least two full working days before you begin excavation.
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7458 N. La Cholla Boulevard.
Tucson, AZ 85741
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GRADING
SUNDARA RIDGE
FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil) CERTIFICATE NO. 54544 ROBERT W. SCHLICHER. Date Signed 12/16/24 ARIZONA, U.S.A.

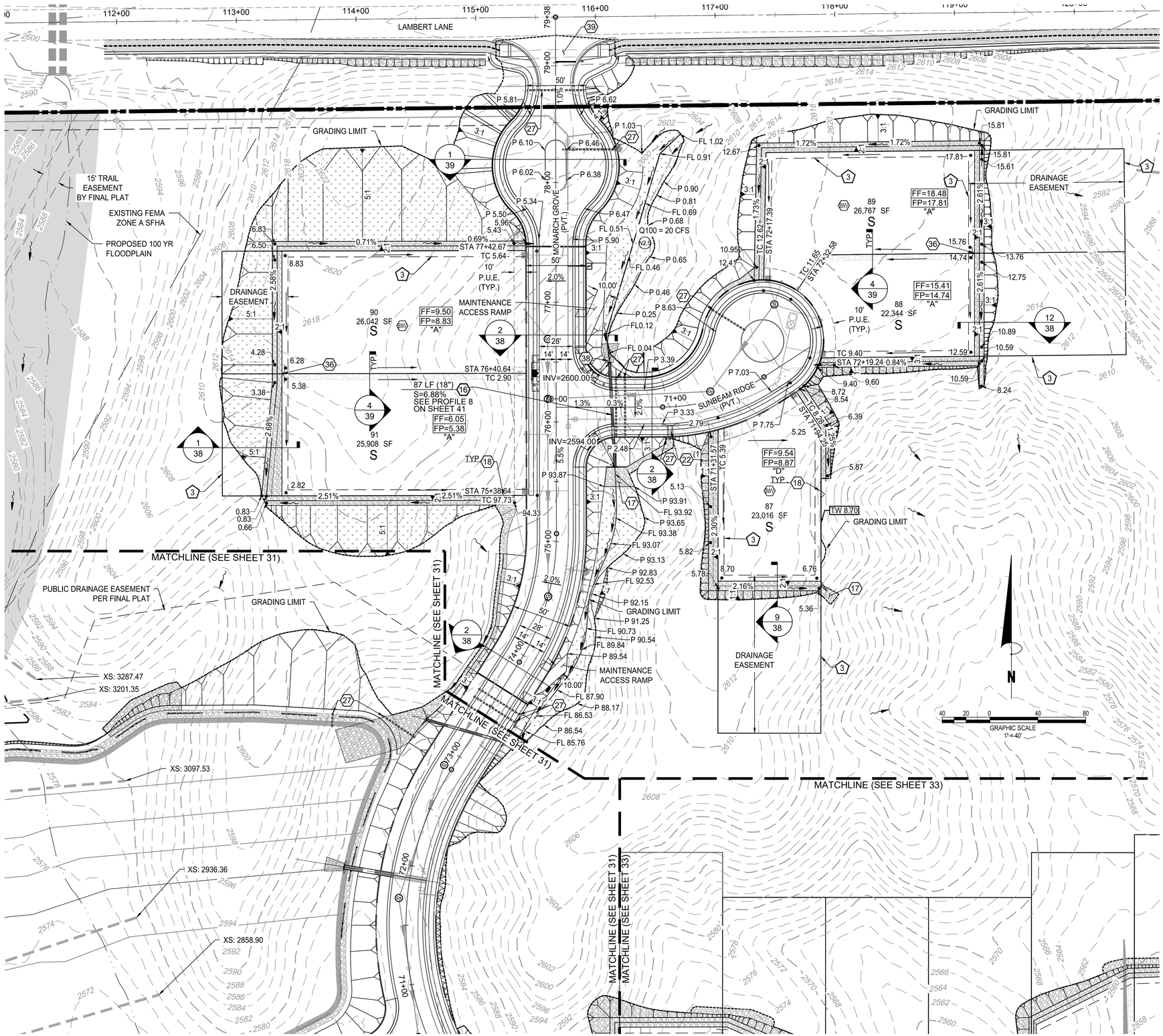
PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

H: 1"=40' C.I.=2'
V:
SCALE
12/16/24
DATE
AZ4072-1004
JOB NUMBER
ML
DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY

31 OF 51

P22WI00005
G-2022-007

DateTime: Tue, 10 Dec 2024 - 5:14pm PathName: S:\ARIZT\Tucson\AZ4072\400\LAND_LJA MOVING FORWARD\BASE FILES\P\31 GRADING.dwg



EASEMENT KEYNOTES

1. 10' PUBLIC UTILITY, ROADWAY MAINTENANCE, & SIGNAGE EASEMENT BY FINAL PLAT
2. BUILDING SETBACK LINE, SEE DTL. 6 SHT 38.
3. PRIVATE DRAINAGE EASEMENT PER FINAL PLAT.

CONSTRUCTION KEYNOTES

10. SLOPE STABILIZATION, SEE DTL. 8, SHT. 38
12. INSTALL 30" X 30" R1-1 "STOP SIGN" AND STREET NAME SIGN.
13. CONSTRUCT TYPE 3 SIDEWALK SCUPPER PER P.A.G. STD. DTL. 205.5. W/ GUARDRAIL PER PAG. 105, NUMBER OF CELLS AS NOTED. SEE SHT. 37 FOR DETAILS.
14. INSTALL BANK PROTECTION PER DTL. 7 ON SHT. 38
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RELATED CASE #
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2100731
OV114-018

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FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
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2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed 12/16/24
ARIZONA, U.S.A.

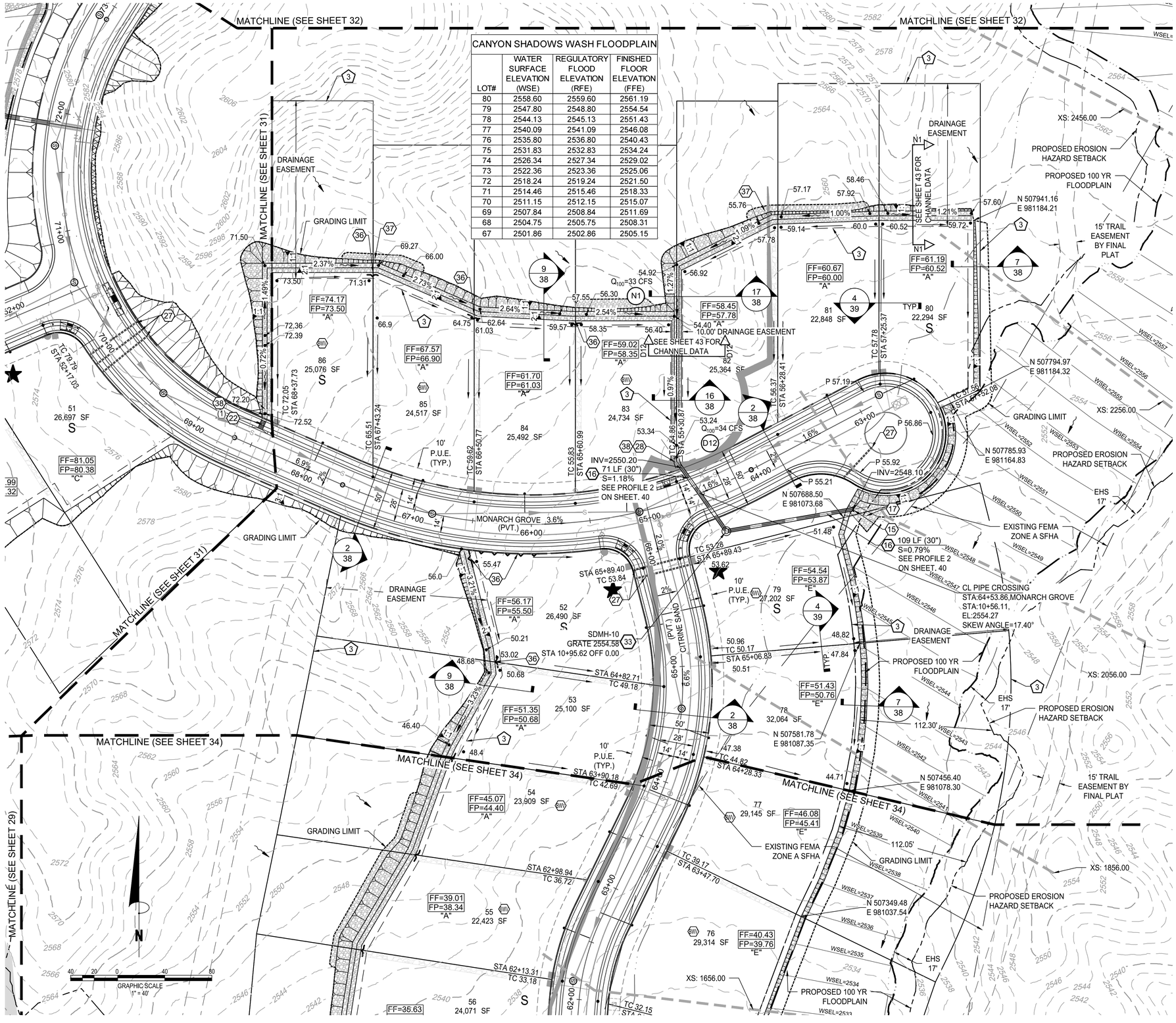
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32 OF 51

P22WI00005
G-2022-007

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EASEMENT KEYNOTES

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SUNDARA RIDGE

FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed 12/16/24
ARIZONA, U.S.A.

PLAN STATUS:
FOR REVIEW [X]
FOR CONSTRUCTION [ ]

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SCALE	
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AZ4072-1004	
JOB NUMBER	
ML	
DRAWN BY	
LJA	
DESIGNED BY	
RWS	
CHECKED BY	

33 OF 51

RELATED CASE #
OV914-009
2100731
OV114-018

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ARIZONA811
Arizona 811 or online.Arizona811.com

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Date/Time - Tue, 10 Dec 2024 - 5:15pm Path/Name - S:\ARIZ\Tucson\AZ4072\400_AND_LIA MOVING FORWARD\BASE FILES\Plv33 GRADING.dwg



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CANYON SHADOWS WASH FLOODPLAIN

LOT#	WATER SURFACE ELEVATION (WSE)	REGULATORY FLOOD ELEVATION (RFE)	FINISHED FLOOR ELEVATION (FFE)
80	2558.60	2559.60	2561.19
79	2547.80	2548.80	2554.54
78	2544.13	2545.13	2551.43
77	2540.09	2541.09	2546.08
76	2535.80	2536.80	2540.43
75	2531.83	2532.83	2534.24
74	2526.34	2527.34	2529.02
73	2522.36	2523.36	2525.06
72	2518.24	2519.24	2521.50
71	2514.46	2515.46	2518.33
70	2511.15	2512.15	2515.07
69	2507.84	2508.84	2511.69
68	2504.75	2505.75	2508.31
67	2501.86	2502.86	2505.15

RELATED CASE #
OV914-009
2100731
OV114-018

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GRADING
SUNDARA RIDGE

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SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil) CERTIFICATE NO. 54544 ROBERT W. SCHLICHER Date Signed 10/18/24 ARIZONA, U.S.A.

PLAN STATUS:
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Date/Time - Tue, 10 Dec 2024 - 5:16pm Path/Name - S:\ARGBT\tucson\AZ4072\400LAND_LJA MOVING FORWARD\BASE FILES\PI\34 GRADING.dwg

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CONSTRUCTION KEYNOTES (CONTINUED)

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BANK PROTECTION TABLE

Line #	Length	Direction
L1	19.48	S69° 56' 08.54"E
L2	46.53	S29° 54' 41.69"E
L3	72.54	S61° 17' 06.24"E
L4	142.53	S75° 26' 32.46"E
L5	86.07	S69° 18' 46.35"E
L6	12.43	S50° 24' 10.60"E

BANK PROTECTION TABLE

Line #	Length	Direction
L7	165.87	N0° 38' 54.25"W
L8	167.96	N11° 38' 50.54"W

CANYON SHADOWS WASH FLOODPLAIN

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75	2531.83	2532.83	2534.24
74	2526.34	2527.34	2529.02
73	2522.36	2523.36	2525.06
72	2518.24	2519.24	2521.50
71	2514.46	2515.46	2518.33
70	2511.15	2512.15	2515.07
69	2507.84	2508.84	2511.69
68	2504.75	2505.75	2508.31
67	2501.86	2502.86	2505.15

BASIN "SE"
Q_{100}(IN)=125 cfs
Q_{100}(OUT)=34 cfs
PONDING DEPTH=3.0'
BASIN DEPTH=3.5'
FREEBOARD 0.5'
PONDING VOL.=92,947 cu. ft.
TOTAL VOL.=110,366 cu. ft.
TOP ELEV =2498.50
BOT ELEV = 2495.00
WEIR INV ELEV =2497.00

GRAPHIC SCALE
1" = 40'

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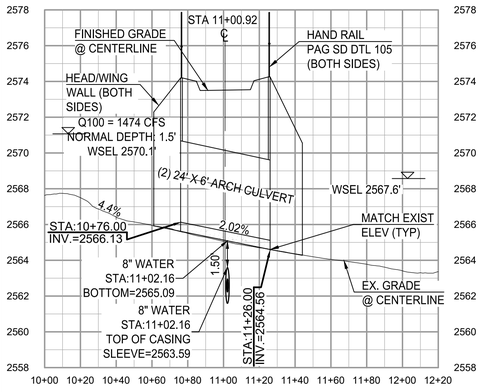
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12/16/24
DATE
AZ4072-1004
JOB NUMBER
ML
DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY

RELATED CASE #
OV914-009
2100731
OV114-018

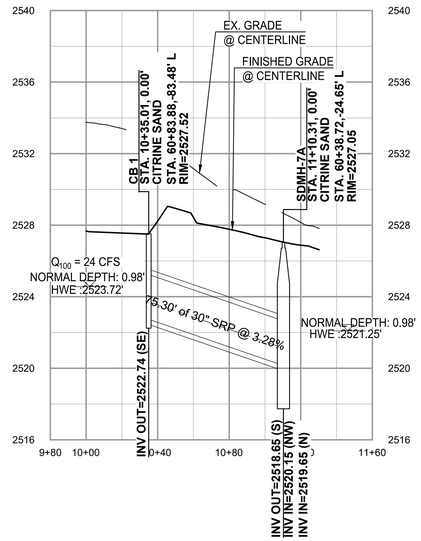
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G-2022-007

Dig Safe. Call 811 or visit Arizona811.com
Dial 811 or visit Arizona811.com before you begin excavation
ARIZONA811

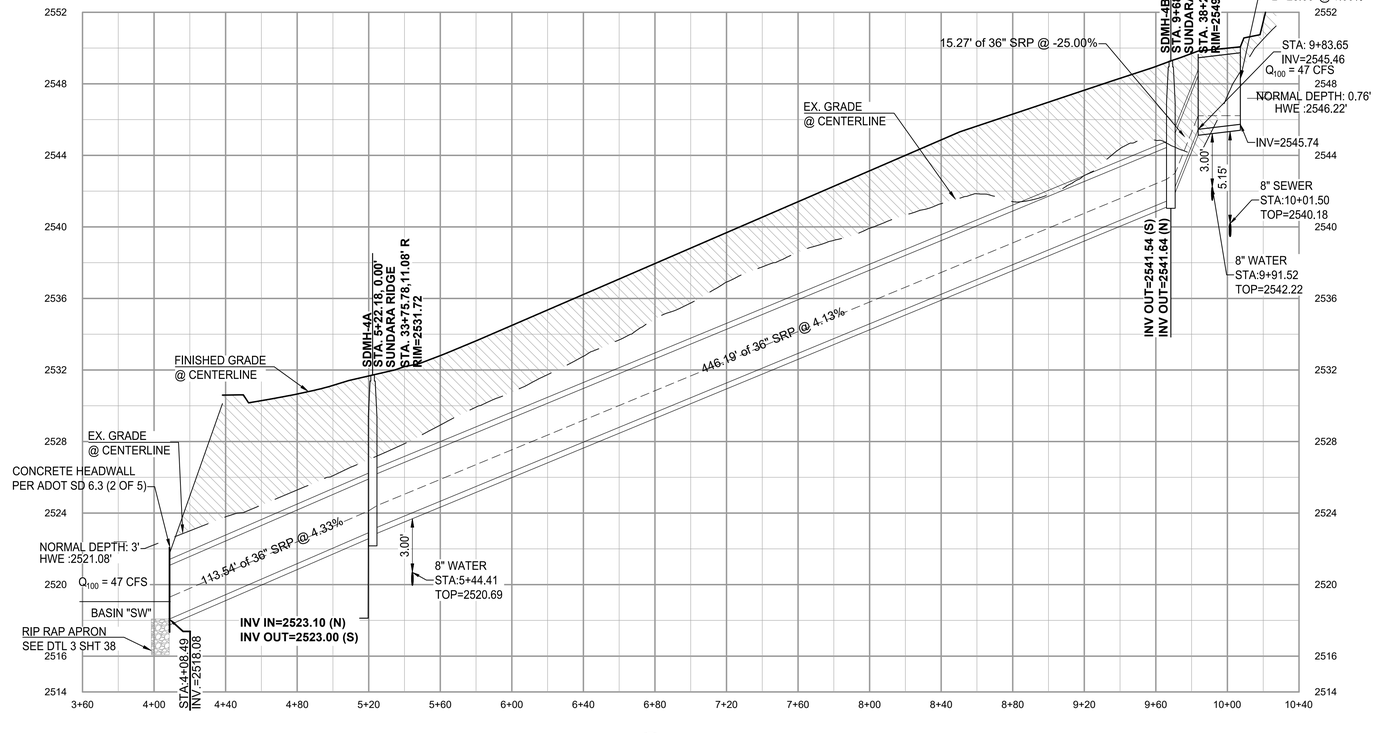
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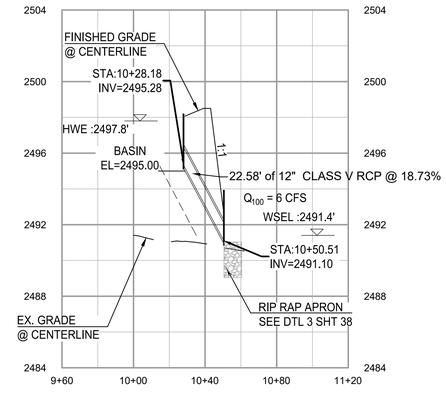
1 STORM DRAIN RUN LDO @ STREET SUNDARA RIDGE
SCALE: H:1"=40', V:1"=4'



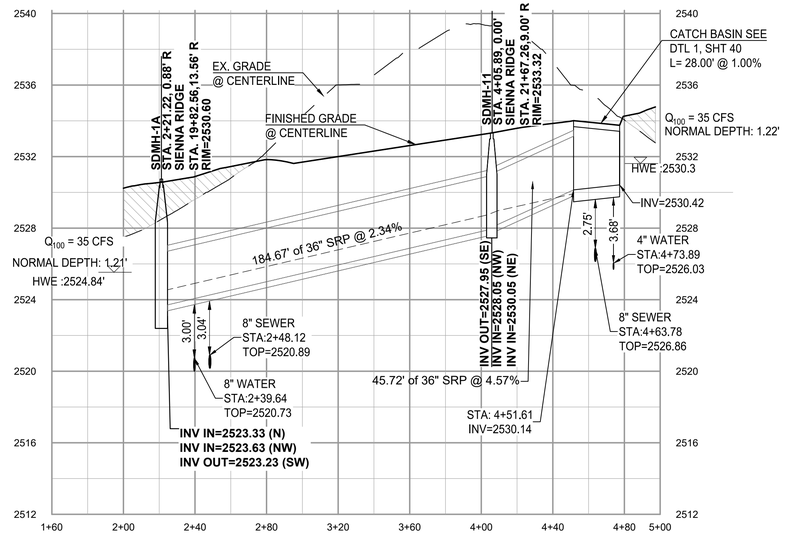
2 STORM DRAIN RUN N2 @ CITRINE SAND
SCALE: H:1"=40', V:1"=4'



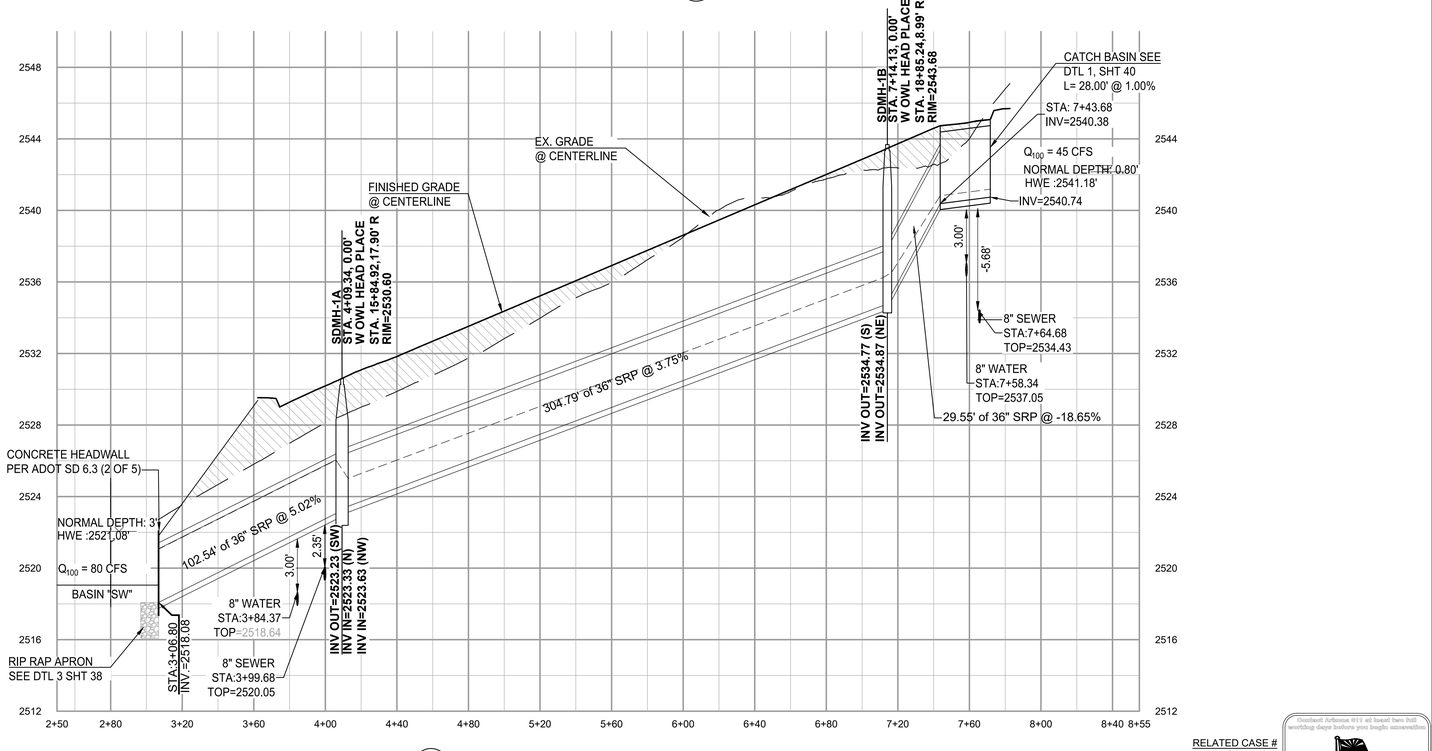
3 STORM DRAIN RUN D3 @ SUNDARA RIDGE
SCALE: H:1"=40', V:1"=4'



6 STORM DRAIN @ BASIN "SE"
SCALE: H:1"=40', V:1"=4'



5 STORM DRAIN RUN D5 @ STREET SIENNA RIDGE
SCALE: H:1"=40', V:1"=4'



4 STORM DRAIN RUN D4 @ STREET W OWL HEAD PLACE
SCALE: H:1"=40', V:1"=4'

RELATED CASE #
OV914-009
2100731
OV114-018

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STORM DRAIN PROFILES
SUNDARA RIDGE
FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Professional Engineer (Civil) CERTIFICATE NO. 54544 ROBERT W. SCHLICHER Date Signed 01/31/25 ARIZONA U.S.A.

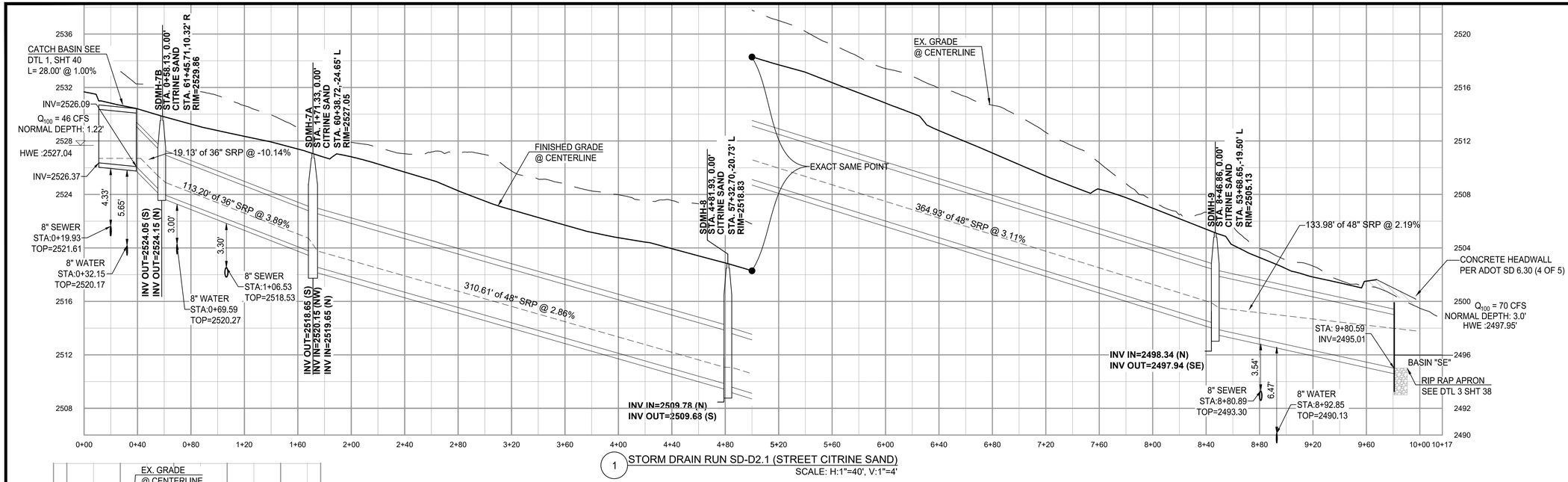
PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

H:	C.I.=2'
V:	
SCALE	
12/16/24	
DATE	
AZ4072-1004	
JOB NUMBER	
ML	
DRAWN BY	
LJA	
DESIGNED BY	
RWS	
CHECKED BY	

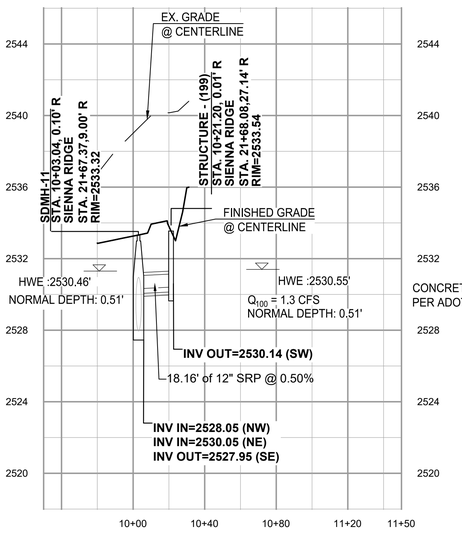
P22W100005

G-2022-007

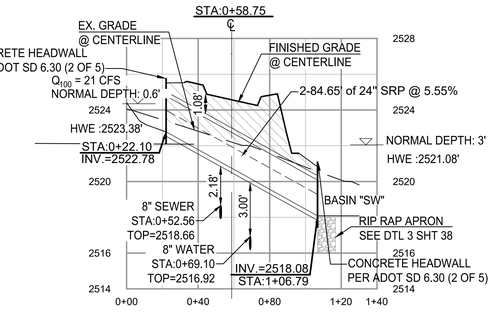
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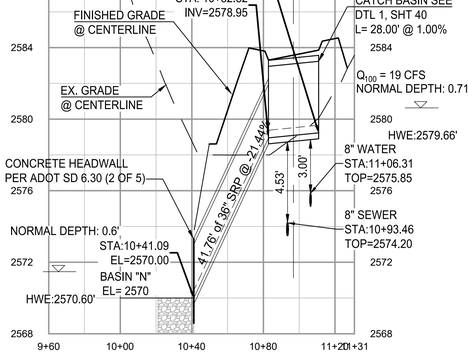
1 STORM DRAIN RUN SD-D2.1 (STREET CITRINE SAND)
SCALE: H:1"=40', V:1"=4'



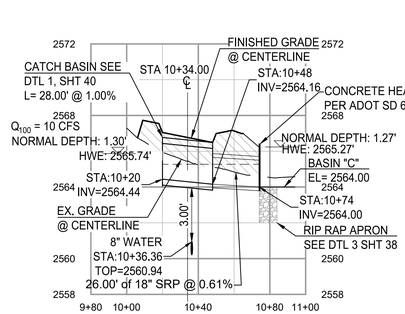
2 STORM DRAIN RUN SD-D13 @ SIENNA RIDGE
SCALE: H:1"=40', V:1"=4'



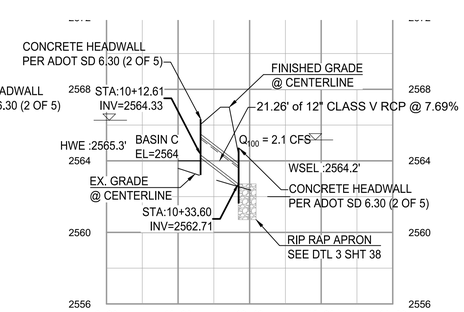
3 STORM DRAIN RUN SD-N4b @ STREET W OWL HEAD PLACE
SCALE: H:1"=40', V:1"=4'



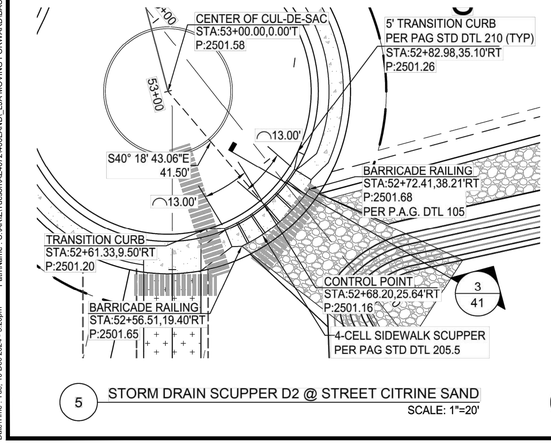
8 STORM DRAIN RUN SD-D2.5 @ STREET MONARCH GROVE
SCALE: H:1"=40', V:1"=4'



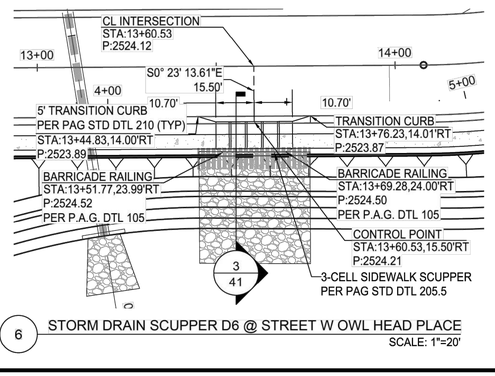
9 STORM DRAIN RUN SD-D3.5 @ STREET SUNDARA RIDGE
SCALE: H:1"=40', V:1"=4'



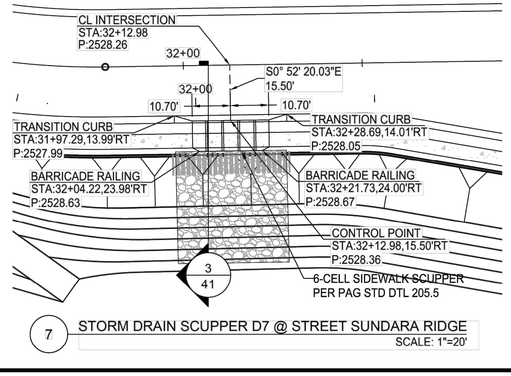
12 STORM DRAIN @ BASIN "C"
SCALE: H:1"=40', V:1"=4'



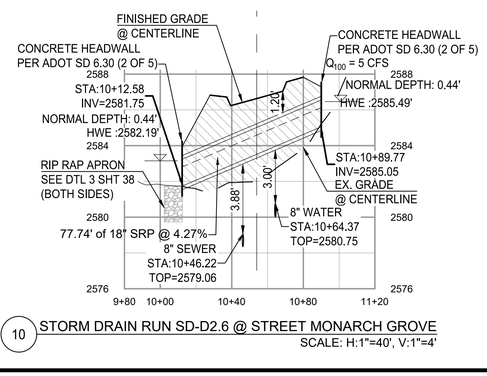
5 STORM DRAIN SCUPPER D2 @ STREET CITRINE SAND
SCALE: 1"=20'



6 STORM DRAIN SCUPPER D6 @ STREET W OWL HEAD PLACE
SCALE: 1"=20'



7 STORM DRAIN SCUPPER D7 @ STREET SUNDARA RIDGE
SCALE: 1"=20'



10 STORM DRAIN RUN SD-D2.6 @ STREET MONARCH GROVE
SCALE: H:1"=40', V:1"=4'

RELATED CASE #
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2100731
OV114-018

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2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed 12/16/24
ARIZONA, U.S.A.

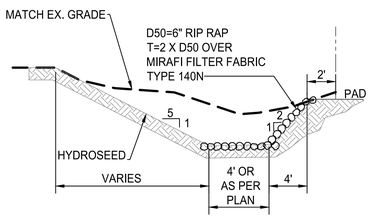
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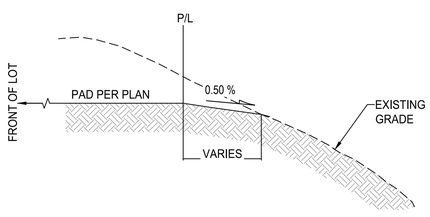
37 OF 51

P22WI00005
G-2022-007

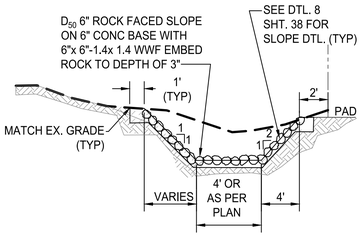
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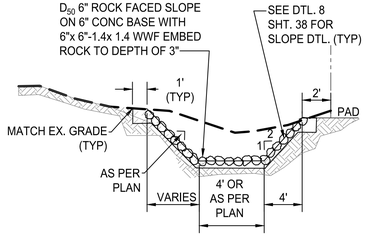
1 SECTION N.T.S.



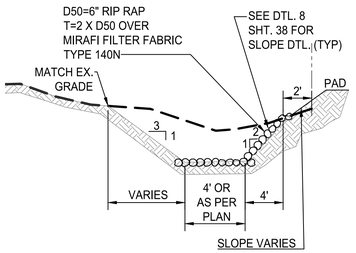
5 SECTION LOT 12 TO 17 N.T.S.



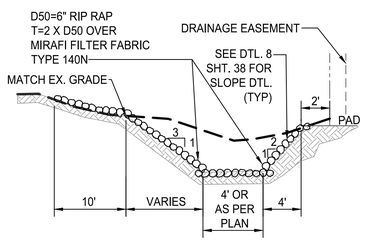
9 SECTION N.T.S.



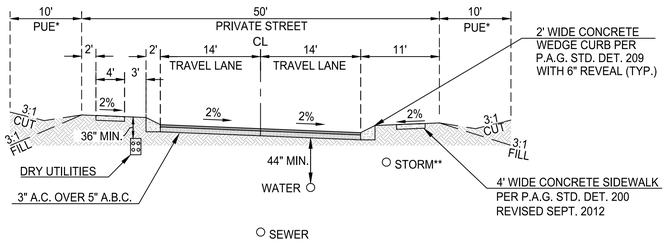
11 SECTION N.T.S.



12 SECTION N.T.S.

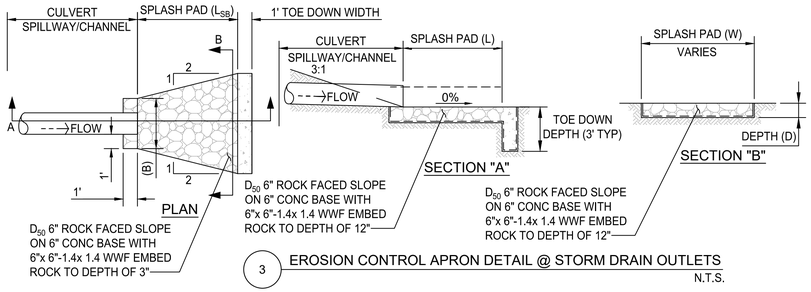


13 SECTION N.T.S.



2 TYPICAL ROADWAY CROSS SECTION N.T.S.

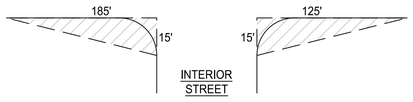
* PUE SECTION ONLY APPLIES TO SIDE(S) WITH ADJACENT LOT LINE THAT INCLUDE A PUE
** STORM LOCATION VARIES, SEE PLAN FOR LOCATION, SIZE, SLOPE, AND MATERIAL



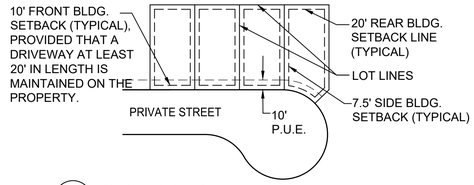
3 EROSION CONTROL APRON DETAIL @ STORM DRAIN OUTLETS N.T.S.

Design[1] for Erosion Control Aprons				
Location	Pipe size	Apron upstream width[B] (ft)	Length of Apron[A] (L_{SB}) (ft)	Riprap (d_{50})
LdO Wash	2 24'x6' ConSpan	48'+(2*4.5') = 57'	36	Grouted 6 inch
D12	1 30-inch	2.5'+(2*2.5') = 7.5'	20	Grouted 6 inch
N2.5	2 18-inch	3'+(2*1.5') = 6'	12	Grouted 6 inch
D2.65	3' scupper	3'+1.3' = 4.3'	5	Grouted 6 inch
Basin outlets				
Basin SW	1 12-inch	3	8	Grouted 6 inch
	80-ft weir, d= 0.6'	80'+(2*0.6') = 81.2'	5	Grouted 6 inch
Basin SE	1 12-inch	3	8	Grouted 6 inch
	19-ft weir, d= 1.0	19'+(2*1.0') = 21'	8	Grouted 6 inch
Basin N	1 12-inch	3	8	Grouted 6 inch
Basin C	1 12-inch	3	8	Grouted 6 inch
Basin inlets				
D2.1	1 48-inch	4'+(2*1.6') = 7.2'	32	Grouted 6 inch
D2	13' scupper	13'+1.3' = 14.3'	5	Grouted 6 inch
D2.5	1 36-inch	3'+(2*0.7') = 4.4'	24	Grouted 6 inch
D2.6	2 24-inch	4'+(2*2') = 8'	16	Grouted 6 inch
D3	1 36-inch	3'+(2*1.2') = 5.4'	24	Grouted 6 inch
D3.5	1 18-inch	1.5'+(2*1.5') = 4.5'	12	Grouted 6 inch
D4+5	1 36-inch	3'+(2*1.6') = 6.2'	24	Grouted 6 inch
D6	10' scupper	10'+1.3' = 11.3'	5	Grouted 6 inch
D7	11' scupper	11'+1.3' = 12.3'	5	Grouted 6 inch
N3	2 24-inch	4'+(2*2.0') = 8'	16	Grouted 6 inch
N4b	2 24-inch	4'+(2*2.0') = 8'	16	Grouted 6 inch

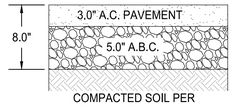
[1] **Concept design may vary on LJA Final Site Plan depending on site grading constraints**
[A] L_{SB} = (8 * pipe diameter or flow depth),
[B] apron upstream width = culvert spread + 1D or 1Dc on each side
For dumped riprap. apron thickness = 2 * d_{50}



4 SIGHT VISIBILITY TRIANGLE N.T.S.

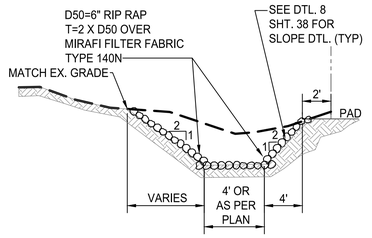


6 LOT SETBACK DETAIL (FOR REFERENCE ONLY) N.T.S.

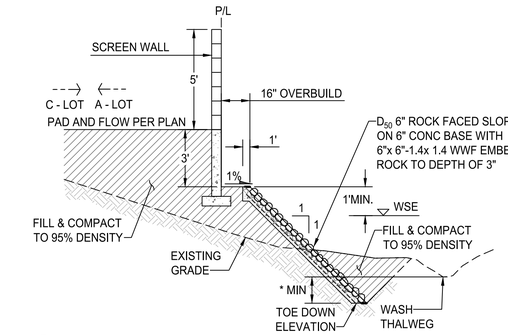


*SEE GEOTECHNICAL INVESTIGATION REPORT

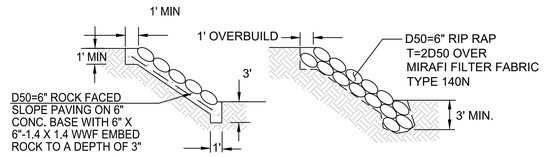
10 PAVEMENT STRUCTURE N.T.S.



14 SECTION N.T.S.

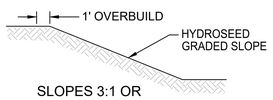


7 BANK PROTECTION ADJACENT TO LOMAS DE ORO WASH N.T.S.
* = SEE SCOUR DEPTH PROTECTION
PROFILES & TABLES A & B ON DTL. 06, SHT. 40 FOR MIN. TOE DOWN DEPTH.



SLOPES BETWEEN 1:1 & <1.99:1 AND ALL LOCATIONS WITH CONCENTRATED FLOW REGARDLESS OF SLOPE

SLOPES BETWEEN 2:1 & <2.99:1 OR FLATTER



SLOPES 3:1 OR FLATTER

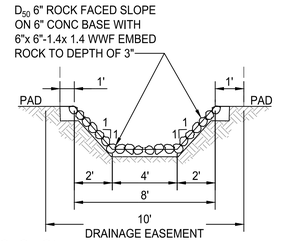
8 SLOPE STABILIZATION DETAILS N.T.S.

NOTE: ALL RIP RAP TO BE EARTHEN COLORED (SHADES OF BROWN) REFERENCE 2015 P.A.G. STANDARD SPECIFICATIONS SECTION 912 FOR MORE DETAIL.

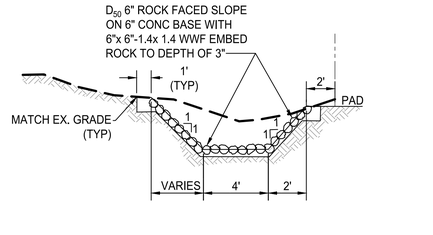
RIP-RAP GRADATION TABLE

% GRADATION FINER THAN	SIEVE OPENING
100	2.0 D_{50}
85	1.65 D_{50}
50	1.0 D_{50}
15	0.5 D_{50}

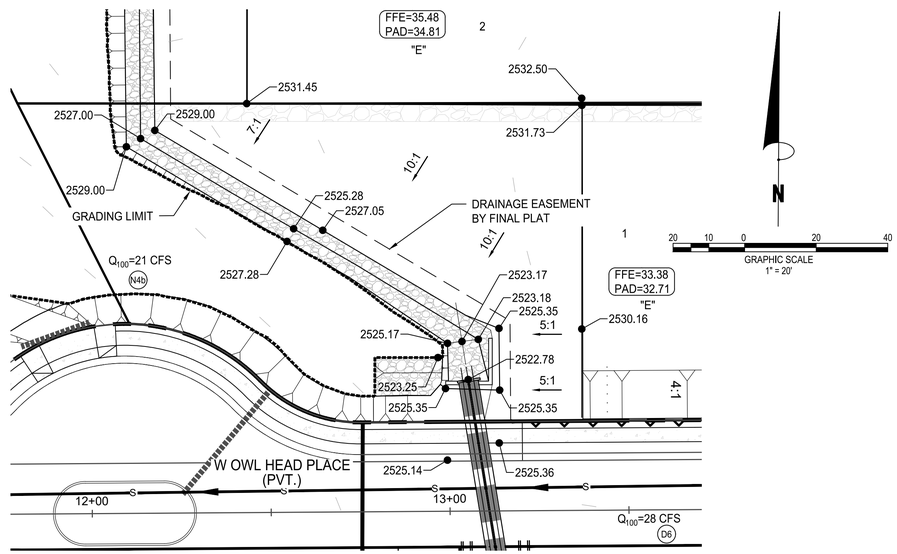
RIP-RAP GRADATION TABLE PER P.A.G. STD. SPEC 912 FOR SLOPE PAVING & 913 FOR BANK PROTECTION TO BE USED ON ALL OF PROJECT UNLESS OTHERWISE NOTED. ALL RIP-RAP SHALL BE OF A NATURAL COLOR AND BLEND IN WITH THE ENVIRONMENT.



16 SECTION N.T.S.



17 SECTION N.T.S.



15 LOT 1 - GRADING DETAIL 1" = 20'

RELATED CASE #
OV914-009
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OV114-018

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7458 N. La Cholla Boulevard.
Tucson, AZ 85741
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DETAILS
SUNDARA RIDGE
FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12
SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

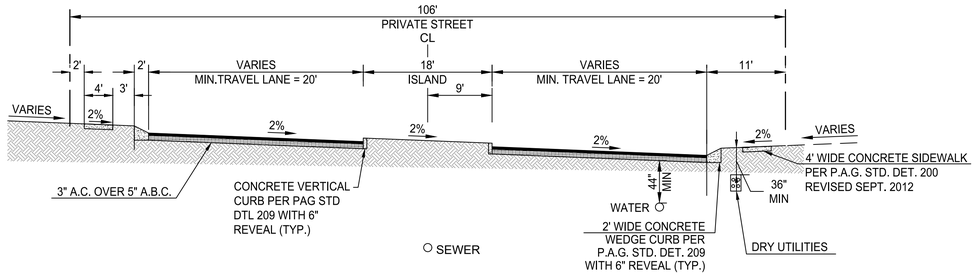
Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W.
SCHLICHER
Date Signed 10/16/24
ARIZONA, U.S.A.

PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

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V:
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12/16/24
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DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY

P22WI00005
G-2022-007

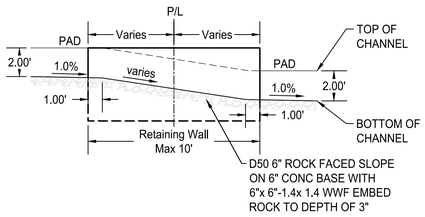
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1 ROADWAY CROSS SECTION

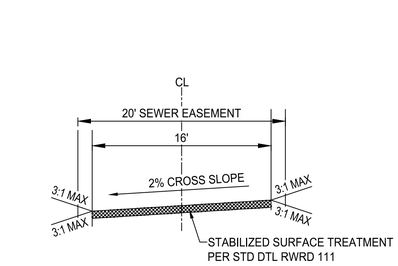
NOTE:
LOCATION OF UTILITIES VARIES, SEE PLAN FOR LOCATION

N.T.S.



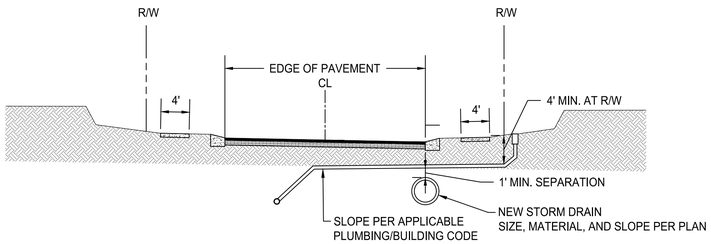
2 RETAINING WALL ON DROP SLOPE DETAIL

N.T.S



3 SEWER EASEMENT

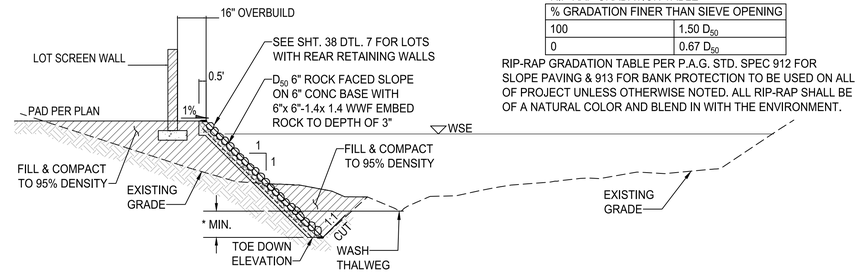
N.T.S.



7 TYPICAL HCS CONNECTION TO SEWER LINE OVER STORM DRAIN

PIMA COUNTY - DETAIL RWRD 401

N.T.S.



RIP-RAP GRADATION TABLE

% GRADATION FINER THAN SIEVE OPENING	
100	1.50 D_{50}
0	0.67 D_{50}

RIP-RAP GRADATION TABLE PER P.A.G. STD. SPEC 912 FOR SLOPE PAVING & 913 FOR BANK PROTECTION TO BE USED ON ALL OF PROJECT UNLESS OTHERWISE NOTED. ALL RIP-RAP SHALL BE OF A NATURAL COLOR AND BLEND IN WITH THE ENVIRONMENT.

5 CANYON SHADOWS WASH CROSS SECTION

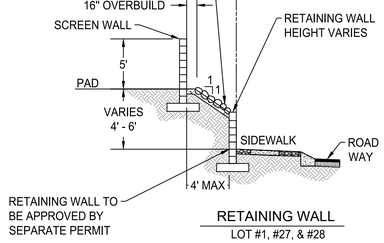
N.T.S

* = SEE SCOUR DEPTH PROTECTION
PROFILES & TABLES A & B ON DTL. 06, SHT. 40 FOR MIN. TOE DOWN DEPTH.

X NOT USED

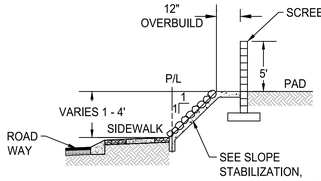
N.T.S.

Onsite Hydraulic Structures – Grate Inlets				
Conc. Pt.	Q_{100} (cfs)	Grate width (lf)	Grate inlet (max slope [sL] for 100% intercention)	Bypass flow at curbs (cfs)
D2.1	46	28	7.4%	1.9
D2.5	19	28	6.3%	0.8
D3	47	28	6.6%	1.9
D3.5	10	28	8.8%	0.4
D4	45	28	6.6%	1.8
D5	35	28	7.7%	1.4

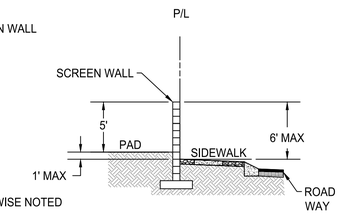


RETAINING WALL

LOT #1, #27, & #28



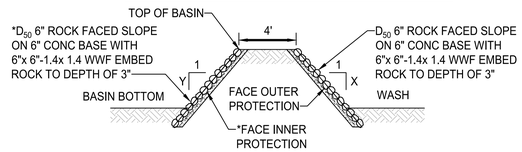
SIDEWALK TO PAD GRADING



SINGLE WALL

8 MULTI-USE PATH TYPICAL SECTION DETAIL

N.T.S.

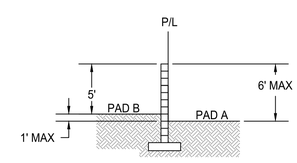


10 BANK PROTECTION ON BASINS

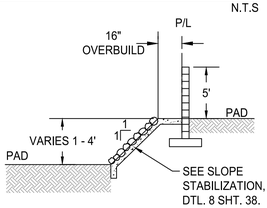
*NO RIP RAP FOR 3:1 OR GREATER SLOPES WITHIN BASIN

N.T.S.

Rip Rap Protection				
Basin	Y	X	Face Inner	Face Outter
SE	3	1	No	Yes
SW	3	3	No	Yes
C	3	1	No	Yes
N	1	1	No	Yes



SINGLE WALL



PAD TO PAD GRADING

11 LOT TO SIDEWALK GRADING

N.T.S

4 LOT TO LOT GRADING

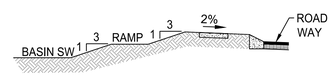
N.T.S.

Onsite Hydraulic Structures – Storm Drains (1 of 3)							
Storm Drain Outfall at SW Basin = D4+D5							
RUN D4							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
306.80	2518.08	1	36	80	3.00	0.0	
length	*102.5*						5.02%
409.34	2523.23	1	36	80	1.56	21.5	
Manhole and D5 lateral inflow							
409.34	2523.33	1	36	45	1.22	16.6	
length	*304.8*						3.75%
714.13	2534.77	1	36	45	1.22	16.6	
Manhole							
714.13	2534.87	1	36	45	0.80	29.7	
length	*29.6*						18.65%
743.68	2540.38	1	36	45	0.80	29.7	
Storm Drain Lateral from D5 to D4							
RUN D5							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
221.22	2523.63	1	36	35	1.21	13.1	
length	*184.7*						2.34%
405.89	2527.95	1	36	35	1.21	13.1	
Manhole and D13 lateral inflow							
405.89	2528.05	1	36	35	1.22	12.9	
length	*45.7*						2.25%
451.64	2529.08	1	36	35	1.22	12.9	
Storm Drain Lateral from D13 to D5							
RUN SD-D13							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
1003.04	2529.95	1	12	1.3	0.51	3.2	
length	18.2						0.50%
1021.20	2530.04	1	12	1.3	0.51	3.2	

Onsite Hydraulic Structures – Storm Drains (2 of 3)							
Storm Drain Outfall at SW Basin = D3							
RUN D3							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
408.49	2518.08	1	36	47	3.00	0.0	
length	113.7						4.33%
522.18	2523.00	1	36	47	1.20	17.7	
Manhole							
522.18	2523.10	1	36	47	1.22	17.4	
length	446.2						4.13%
968.38	2541.54	1	36	47	1.22	17.4	
968.38	2541.54	1	36	47	1.22	17.4	
Manhole							
968.38	2541.64	1	36	47	0.76	33.3	
length	15.3						25.02%
983.65	2545.46	1	36	47	0.76	33.3	
Storm Drain Outfall at SE Basin = D2.1+N2							
RUN SD-D2.1							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
997.10	2494.95	1	48	70	3.0	0.0	
length	-150.5						1.99%
846.61	2497.94	1	48	70	1.62	14.6	
Manhole							
846.86	2498.34	1	48	70	1.44	17.2	
length	-364.93						3.11%
481.93	2509.68	1	48	70	1.44	17.2	
Manhole							
481.93	2509.78	1	48	70	1.47	16.7	
length	-310.6						2.86%
171.33	2518.65	1	48	70	1.47	16.7	
Manhole and N2 lateral inflow							
171.33	2519.65	1	36	46	1.22	17.0	
length	-113.20						3.89%
58.13	2524.05	1	36	46	1.22	17.0	
Manhole							
58.13	2524.15	1	36	46	0.95	24.0	
length	-19.13						10.14%
39.00	2526.09	1	36	46	0.95	24.0	

Onsite Hydraulic Structures – Storm Drains (3 of 3)							
Storm Drain Lateral from N2 to D2.1							
RUN N2							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
1110.31	2520.27	1	30	24	0.98	13.5	
length	-75.3						3.28%
1035.01	2522.74	1	30	24	0.98	13.5	
Storm Drain from D2.5 to Basin N							
RUN SD-D2.5							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
1041.09	2570.00	1	36	38	0.60	0	
length	41.7						21.45%
1082.82	2578.95	1	36	38	0.71	29.7	
Storm Drain from D3.5 to Basin C							
RUN SD-D3.5							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
1074.00	2564.00	1	18	10	1.30	0.0	
length	-54.0						-0.81%
1020.00	2564.44	1	18	10	1.33	6.0	
Storm Drain at D12							
RUN SD-D12							
Station	Inv. Elev.	# pipes	Dia. (in)	Q (cfs)	Depth (ft)	V (ft/s)	s (%)
1205.09	2548.10	1	30	34	1.91	8.4	
length	-109.5						0.79%
1095.62	2548.96	1	30	34	1.91	8.4	
Manhole							
1097.52	2549.36	1	30	34	1.64	10.0	
length	-71.5						1.18%
1026.04	2550.20	1	30	34	1.64	10.0	

Onsite Hydraulic Structures – Scuppers								
Scupper Conc. Pt.	Q_{100} (cfs)	Bypass flow from upstream vane grate		Design Q_{100} (cfs)	Opening height (h) (ft)	Scupper thickness (t) (ft)	Yi (ft)	Minimum width (L) (ft)
		CP	Q (cfs)					
D2	36	D2.1+D2.5	2.7	38.7	0.67	0.33	1	13
D2.65	8	n/a		8	0.67	0.33	1	3
D6	26	D4+D5	3.2	29.2	0.67	0.33	1	10
D7	29	D3	1.9	30.9	0.67	0.33	1	11
N2.4	2	reverse scupper		2	0.67	0.33	1	1
N5	26	reverse scupper		26	0.67	0.33	1	9
D2.7	3	reverse scupper		3	0.67	0.33	1	1
D3.3	3.6	reverse scupper		3.6	0.67	0.33	1	1
D4.1	6	reverse scupper		6	0.67	0.33	1	2



12 RAMP SECTION DETAIL

N.T.S.

RELATED CASE #
OV914-009
2100731
OV114-018

Dial 811 or visit azbluestake.com
Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA811

LJA Engineering, Inc.
7458 N. La Cholla Boulevard.
Tucson, AZ 85741
Phone 520.257.3400

DETAILS
SUNDARA RIDGE
FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12
SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

APP.
REVISION
DATE
NO.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W.
SCHLICHER
Date signed 01/16/24
ARIZONA, U.S.A.

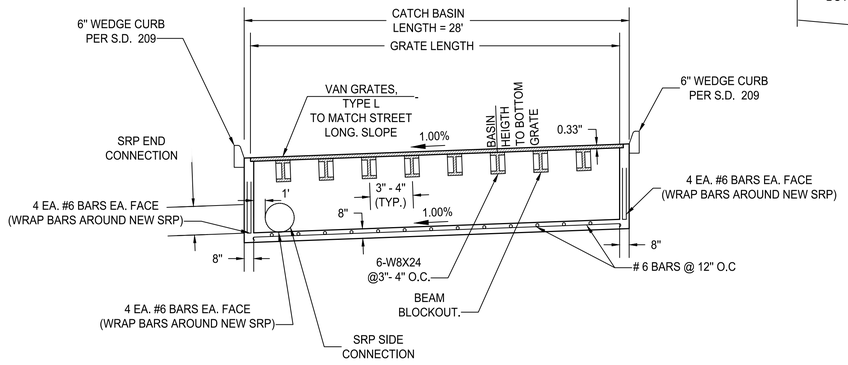
PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

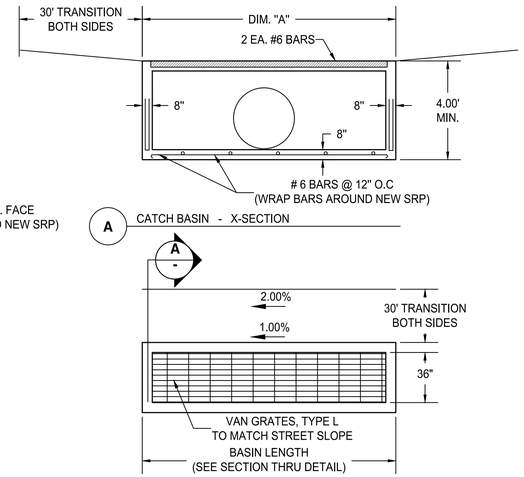
H: N/A
V:
C.I.=2'
SCALE
12/16/24
DATE
AZ4072-1004
JOB NUMBER
ML
DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY

39 OF 51

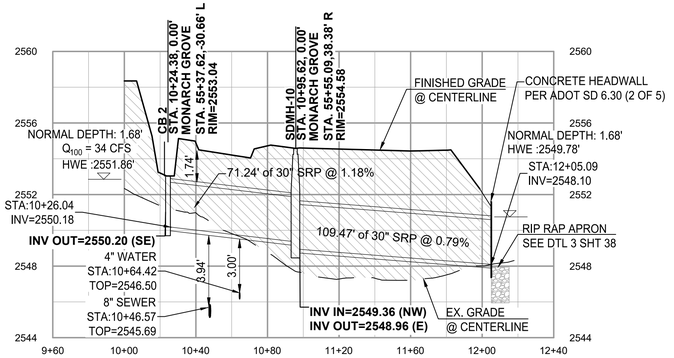
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G-2022-007

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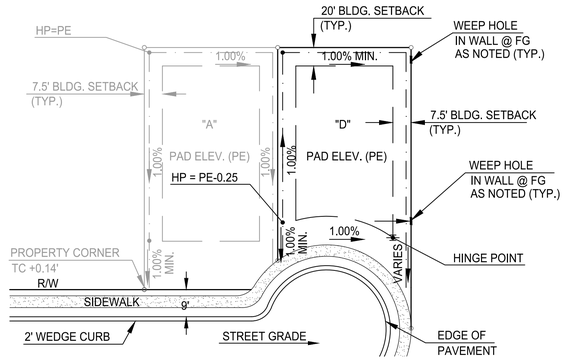




1 SECTION (CATCH BASIN DETAIL)
SEE RIGHT "A" AND "B" FOR X-SECTION AND PLAN VIEW
N.T.S.

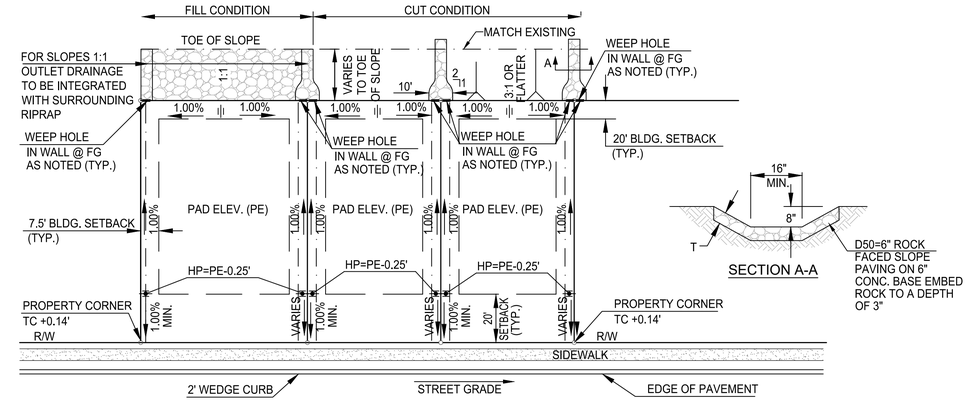


2 STORM DRAIN RUN SD-D12 @ CANYON SHADOWS WASH
SCALE: H:1"=40', V:1"=4'



NOTE: NO WALLS AND/OR GATES SHALL BE CONSTRUCTED ACROSS THE REAR YARD UNTIL THE FINAL LOT GRADING HAS BEEN ESTABLISHED TO MEET THE 1% MIN. DRAINAGE REQUIREMENTS. OUTLET INVERTS SHALL BE DESIGNED TO MEET THE FINAL GRADES. FINAL LOT GRADING SHALL NOT EXCEED 2.5% IN ANY DIRECTION.

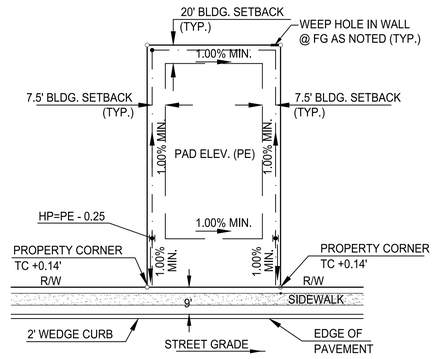
5 TYPE "D" LOT GRADING
N.T.S.



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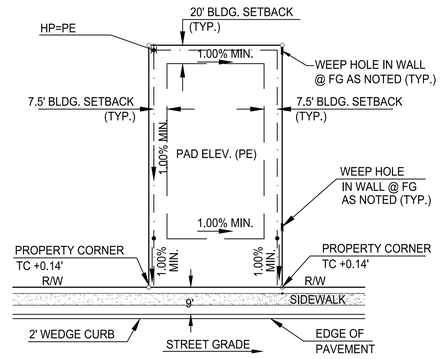
7 TYPE "E" LOT GRADING
N.T.S.

4 TYPE "C" LOT GRADING
N.T.S.

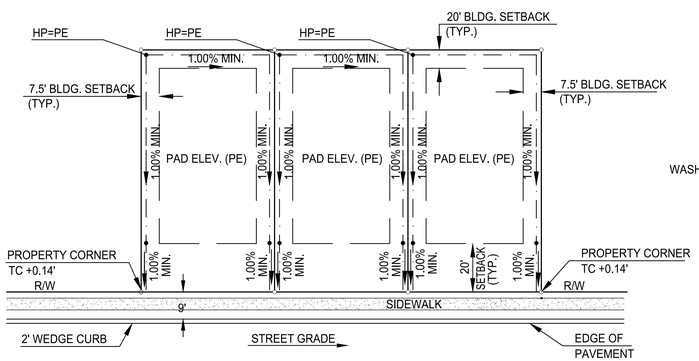


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FINAL LOT GRADING SHALL NOT EXCEED 2.5% IN ANY DIRECTION.

8 TYPE "F" LOT GRADING
N.T.S.

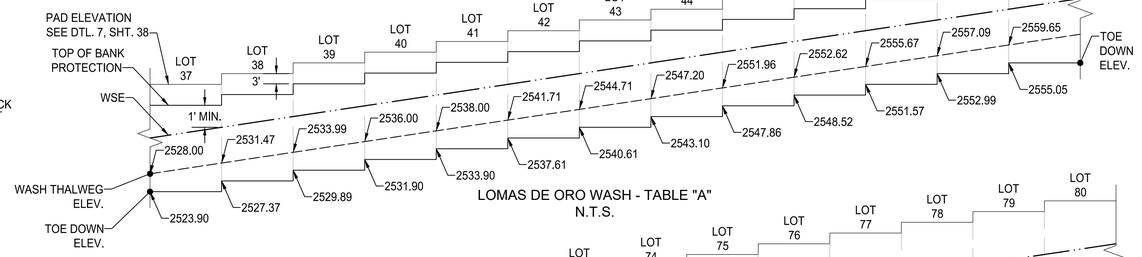


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FINAL LOT GRADING SHALL NOT EXCEED 2.5% IN ANY DIRECTION.

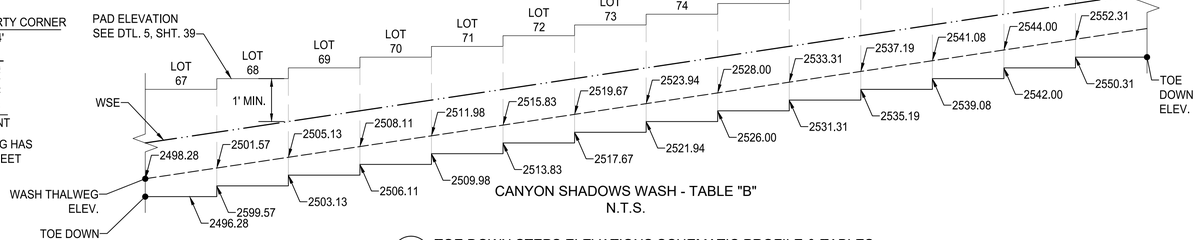


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FINAL LOT GRADING SHALL NOT EXCEED 2.5% IN ANY DIRECTION.

3 TYPE "A" LOT GRADING
N.T.S.



LOMAS DE ORO WASH - TABLE "A"
N.T.S.



CANYON SHADOWS WASH - TABLE "B"
N.T.S.

6 TOE DOWN STEPS ELEVATIONS SCHEMATIC PROFILE & TABLES
N.T.S.

TABLE 'A' _ SCOUR DEPTH PROTECTION
LOMAS DE ORO WASH

LOT	WASH THALWEG ELEV.	MIN. TOE DOWN	TOE DOWN ELEV.
37	2528.00	4.1	2523.90
38	2531.47	4.1	2527.37
39	2533.99	4.1	2529.89
40	2536.00	4.1	2531.90
41	2538.00	4.1	2533.90
42	2541.71	4.1	2537.61
43	2544.71	4.1	2540.61
44	2547.20	4.1	2543.10
45	2551.96	4.1	2547.86
46	2552.62	4.1	2548.52
47	2555.67	4.1	2551.57
48	2557.09	4.1	2552.99
49	2559.65	4.6	2555.05
Basin "C"	2563.00	4.6	2558.40
Basin "N"	2573.00	4.2	2568.80
Basin "SW"	2522.00	4.2	2517.80

BASIN TOE DOWN DEPTH= TOE DOWN ELEVATION

TABLE 'B' _ SCOUR DEPTH PROTECTION
CANYON SHADOWS WASH

LOT	WASH THALWEG ELEV.	MIN. TOE DOWN	TOE DOWN ELEV.
67	2498.28	2	2496.28
68	2501.57	2	2499.57
69	2505.13	2	2503.13
70	2508.11	2	2506.11
71	2511.98	2	2509.98
72	2515.83	2	2513.83
73	2519.67	2	2517.67
74	2523.94	2	2521.94
75	2528.00	2	2526.00
76	2533.31	2	2531.31
77	2537.19	2	2535.19
78	2541.08	2	2539.08
79	2544.00	2	2542.00
80	2552.31	2	2550.31
Basin "SE"	2492.00	2	2490.00

BASIN TOE DOWN DEPTH= TOE DOWN ELEVATION

RELATED CASE #
OV914-009
2100731
OV114-018

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

LJA Engineering, Inc.
7458 N. La Cholla Boulevard.
Tucson, AZ 85741
Phone 520.257.3400

DETAILS
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FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO	DATE	REVISION	APP.

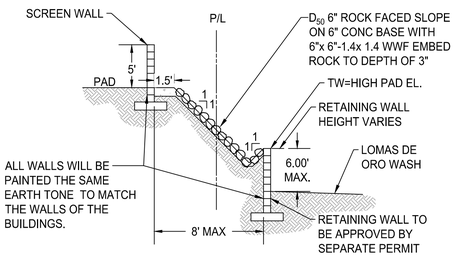
Registered Professional Engineer (Civil) CERTIFICATE NO. 54544 ROBERT W. SCHLICHER Date Signed 12/16/24 ARIZONA U.S.A.

PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

H: N/A C.I.=2'
V:
SCALE
12/16/24
DATE
AZ4072-1004
JOB NUMBER
ML
DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY

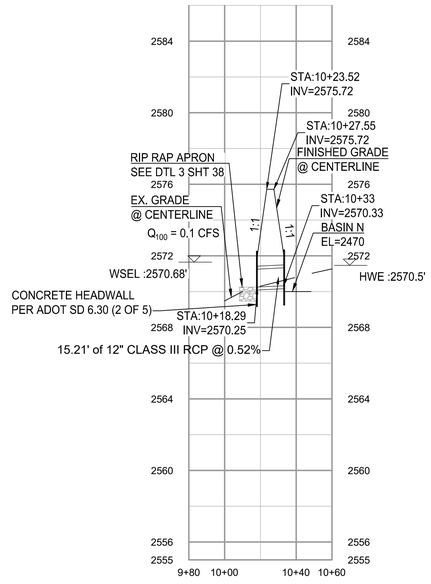
P22WI00005
G-2022-007

Date/Time - Tue, 10 Dec 2024 - 5:23pm Path/Name - S:\ARIZ\Tucson\AZ4072-006\ANDI, LIA MOVING FORWARD\BASE FILES\PI-40 DETAILS.dwg



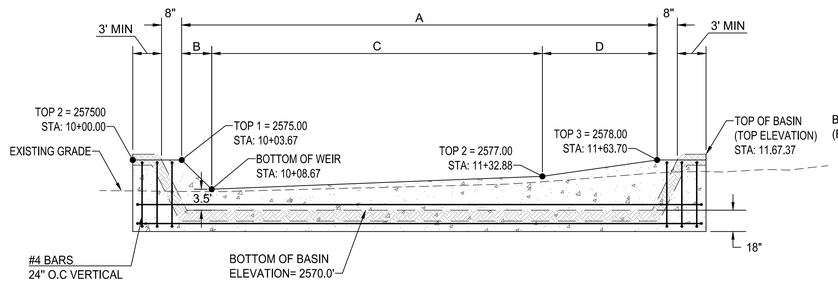
1 RETAINING WALL DETAIL

N.T.S.



2 STORM DRAIN @ BASIN "N"

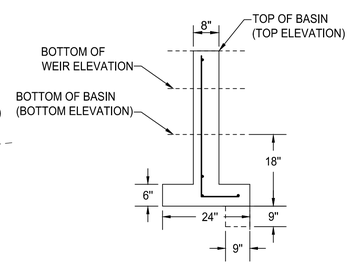
N.T.S.

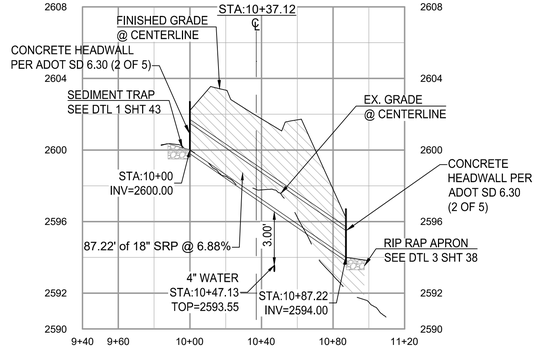


WEIR DIMENSIONS								
BASIN	A (FT)	B (FT)	C (FT)	D (FT)	TOP 1 (FT)	TOP 2 (FT)	TOP 3 (FT)	BOTTOM OF WEIR
N	160.03'	5.00'	124.21'	30.82'	2575.00	2577.00	2578.00	2573.50

4 BASIN "N" WEIR DETAIL

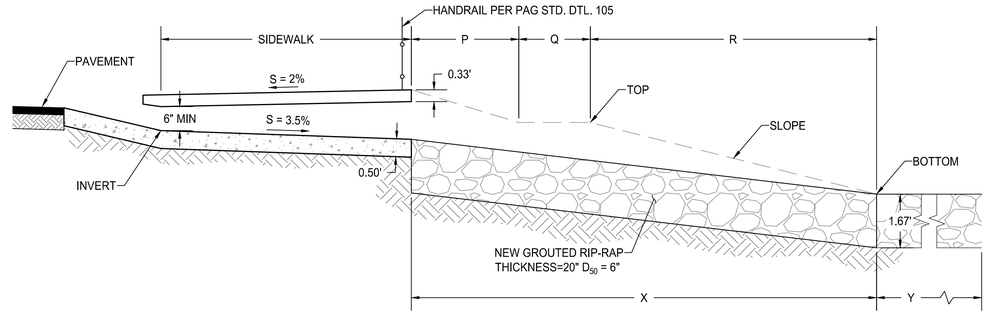
N.T.S.





8 STORM DRAIN RUN @ STREET SUNBEAM RIDGE

N.T.S.

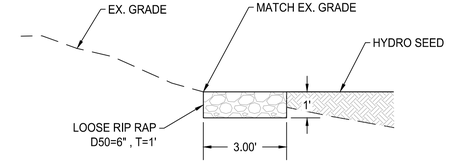


SIDEWALK SCUPPER (TYPE 3) PER PAG DETAIL 205.5

SIDEWALK SCUPPER (TYPE 3) DIMENSIONS									
SCUPPER	INVERT	P (FT)	Q (FT)	R (FT)	SLOPE	X (FT)	Y (FT)	TOP	BOTTOM
D6	2523.31'	6.9'	4.0'	10.5'	3:1	21.4'	9.7'	2521.58'	2518.08'
D7	2524.95'	-	-	21.2'	3:1	21.2'	9.0'	2521.58'	2518.08'
D2	2500.29'	-	-	31.1'	3:1	31.1'	16.0'	2495.00'	2498.50'

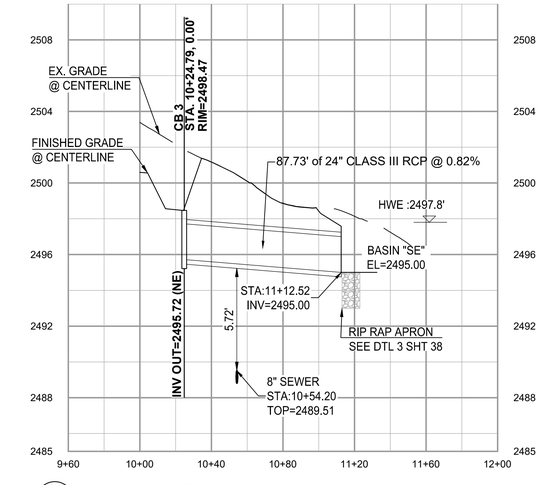
3 SCUPPER CROSS SECTION DETAIL

N.T.S.



9 RIP RAP PROTECTION

N.T.S.



10 STORM DRAIN @ BASIN "SE" (WEST SIDE)

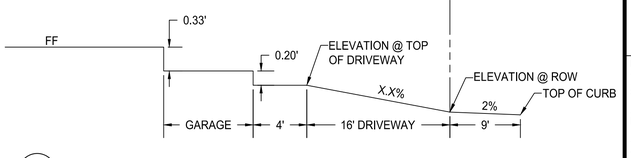
N.T.S.

LOT #	Driveway Length (ft)	Slope
1	16	3%
2	16	3%
3	16	3%
4	48	9%
5	37	10%
6	23	13%
7	16	9%
8	16	9%
9	16	9%
10	16	9%
11	16	9%
12	55	9%
13	16	14%
14	16	9%
15	16	9%
16	16	9%
17	16	9%
18	16	9%
19	16	11%
20	16	10%
21	16	10%
22	16	9%
23	16	8%
24	16	7%
25	16	8%
26	16	8%
27	16	8%
28	16	13%
29	16	11%
30	16	11%
31	16	11%
32	16	14%
33	17	14%
34	16	12%
35	16	11%
36	16	11%
37	16	9%
38	16	9%
39	16	9%
40	16	9%
41	16	9%
42	16	9%
43	16	3%
44	16	3%
45	16	3%
46	16	9%

LOT #	Driveway Length (ft)	Slope
47	16	9%
48	16	9%
49	16	8%
50	16	3%
51	19	14%
52	20	8%
53	16	9%
54	16	10%
55	16	10%
56	16	11%
57	16	9%
58	16	8%
59	16	8%
60	16	8%
61	16	8%
62	16	11%
63	16	9%
64	16	9%
65	16	10%
66	16	8%
67	16	3%
68	16	3%
69	16	3%
70	16	3%
71	16	3%
72	16	3%
73	16	6%
74	16	11%
75	16	9%
76	16	3%
77	16	3%
78	16	3%
79	16	3%
80	20	13%
81	16	14%
82	16	9%
83	18	14%
84	16	9%
85	16	8%
86	16	9%
87	16	3%
88	35	9%
89	40	13%
90	23	14%
91	23	11%

7 DRIVEWAY GRADE TABLE

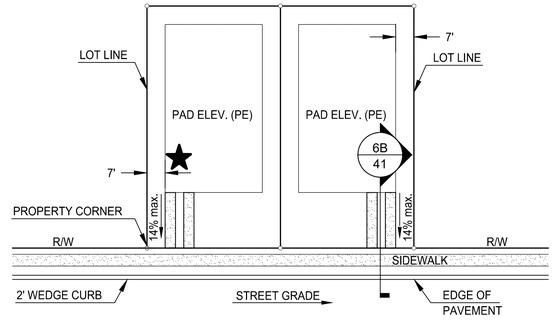
N.T.S.



6B DRIVEWAY CROSS-SECTION

SEE DRIVEWAY GRADE TABLE

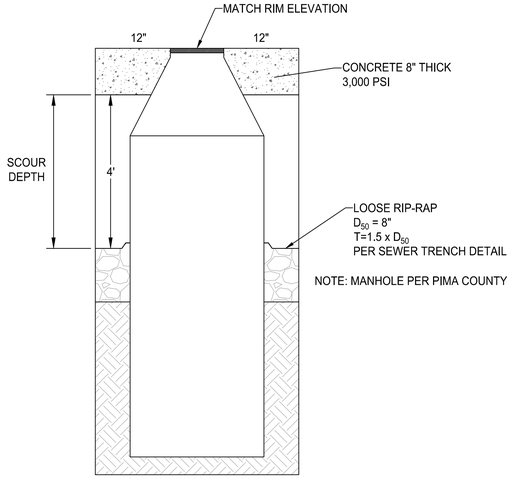
N.T.S.



6 DRIVEWAY LOCATION DETAIL

SEE DRIVEWAY GRADE TABLE

N.T.S.



11 MANHOLE SCOUR PROTECTION DETAIL

N.T.S.

RELATED CASE #
OV914-009
2100731
OV114-018

Contact Arizona 811 at least two full working days before you begin excavation

ARIZONA811

Call 811 or visit Arizona811.com

LJA Engineering, Inc.
7458 N. La Cholla Boulevard.
Tucson, AZ 85741
Phone 520.257.3400

DETAILS
SUNDARA RIDGE
FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed 12/16/24
ARIZONA, U.S.A.

PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

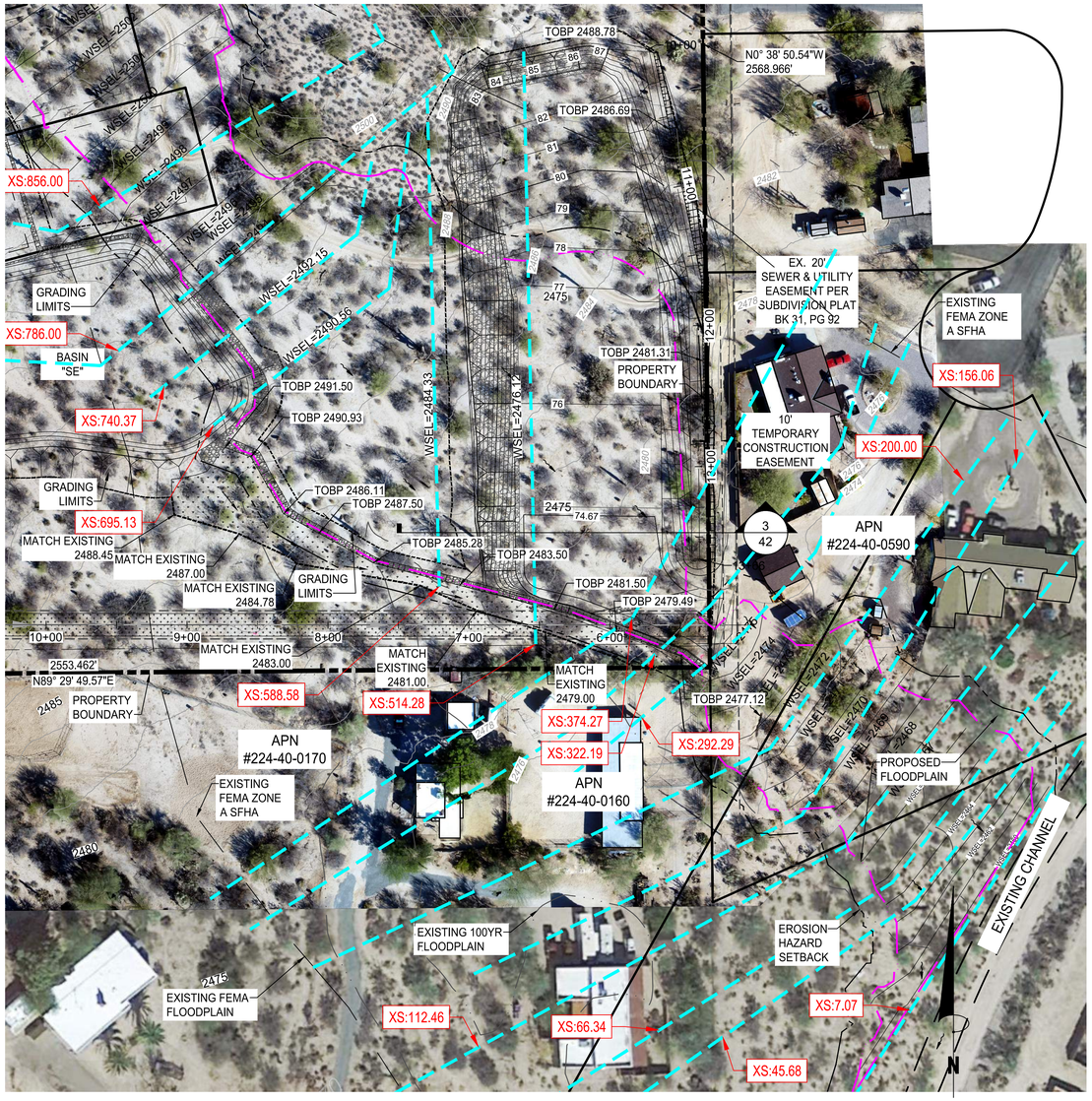
H: N/A C.I.=2'
V:
SCALE
12/16/24
DATE
AZ4072-1004
JOB NUMBER
ML
DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY

41 OF 51

P22WI00005

G-2022-007

Date/Time: Wed, 11 Dec 2024 - 11:03am Path/Name: S:\ARIZ\Tucson\AZ4072\400LAND_LJA MOVING FORWARD\BASE FILES\PW\41 DETAILS.dwg



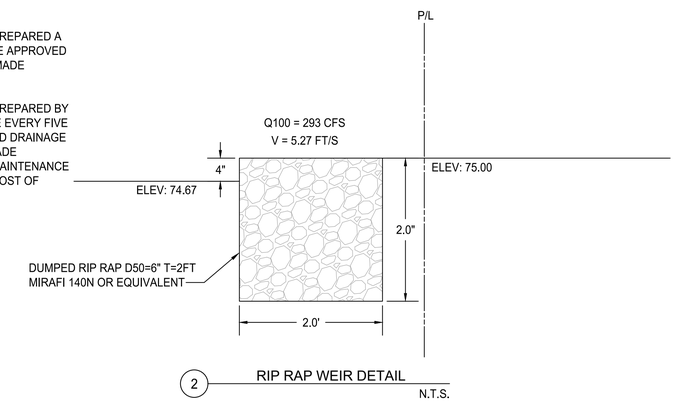
1 GRADING DETAIL - CORNER SE

N.T.S.

NOTES:

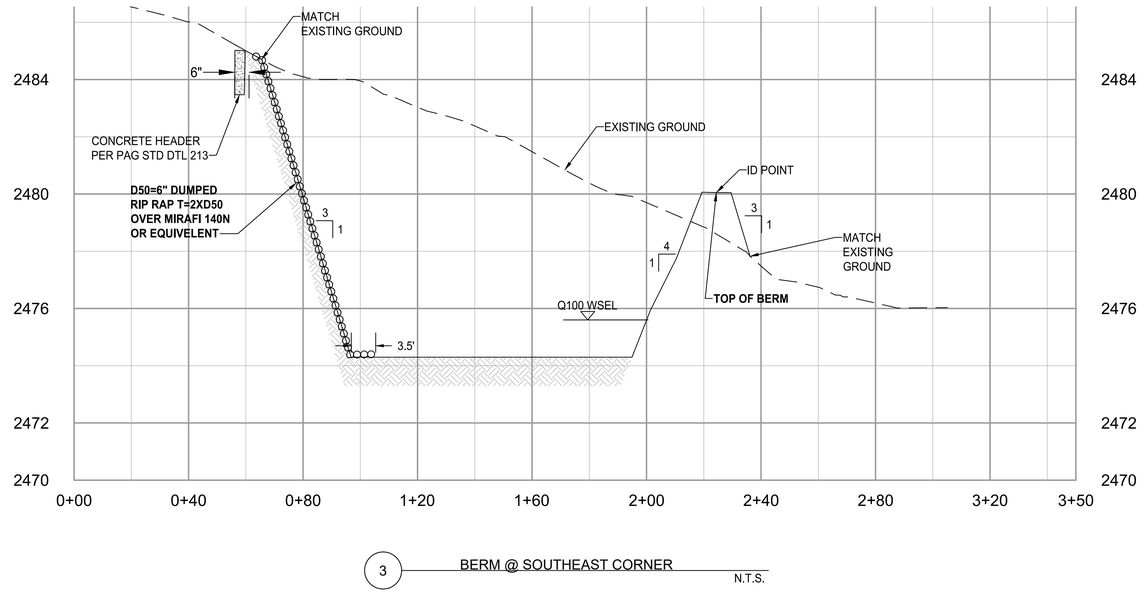
1. ALL DRAINAGE STRUCTURES SHALL BE INSPECTED AND A SUMMARY REPORT PREPARED A MINIMUM OF ONCE EACH YEAR IN ACCORDANCE WITH THE PROCEDURES IN THE APPROVED DRAINAGE REPORT. COPIES OF THE ANNUAL INSPECTION REPORTS SHALL BE MADE AVAILABLE TO THE TOWN UPON REQUEST.

2. ALL DRAINAGE STRUCTURES SHALL BE INSPECTED AND A SUMMARY REPORT PREPARED BY AN ARIZONA REGISTERED PROFESSIONAL CIVIL ENGINEER A MINIMUM OF ONCE EVERY FIVE YEARS IN ACCORDANCE WITH THE PROCEDURES PRESENTED IN THE APPROVED DRAINAGE REPORT. COPIES OF THE 5-YEAR-INTERVAL INSPECTION REPORTS SHALL BE MADE AVAILABLE TO THE TOWN UPON REQUEST. THE REPORT SHALL IDENTIFY THE MAINTENANCE NEEDS FOR THE NEXT 5-YEAR PERIOD, INCLUDING THE ANTICIPATED ANNUAL COST OF MAINTENANCE AND REPAIR.



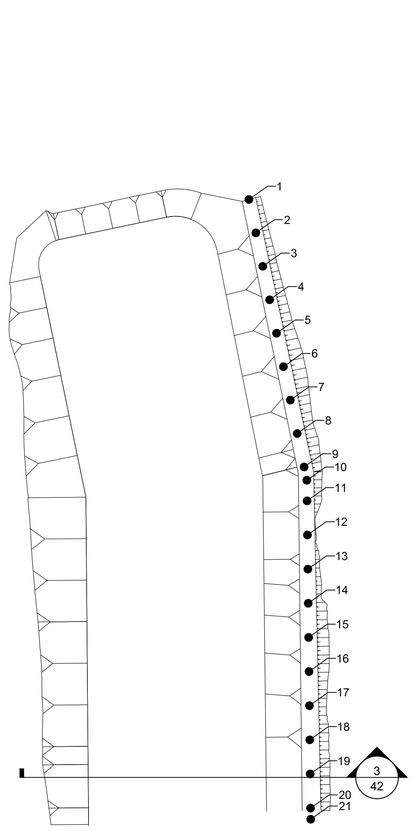
2 RIP RAP WEIR DETAIL

N.T.S.



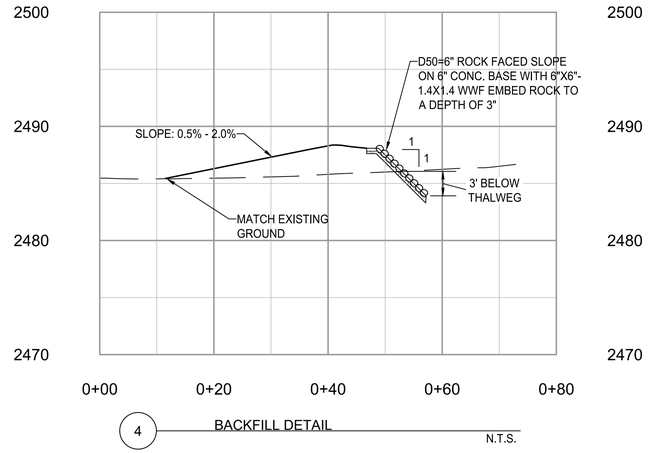
3 BERM @ SOUTHEAST CORNER

N.T.S.



3A BASIN WITH POINT ID

N.T.S.



4 BACKFILL DETAIL

N.T.S.

BERM PROTECTION TABLE							
POINT ID	NORTHING	EASTING	CANYON SHADOWS WASH BOTTOM	Q100 WSEL	TOP OF BERM	FREEBOARD	EXISTING GRADE ON PROTECTED SIDE
1	506547.01	981589.53	2486.59		2488.71		2488.02
2	506527.43	981593.57	2482.74		2488.19		2487.02
3	506507.84	981597.61	2481.90		2487.43		2486.01
4	506488.25	981601.65	2481.06		2486.67		2484.98
5	506468.66	981605.68	2480.23		2485.91		2483.95
6	506449.07	981609.72	2479.39		2485.16		2482.47
7	506429.49	981613.76	2478.55		2484.41		2481.97
8	506409.90	981617.80	2477.71		2483.65		2481.81
9	506390.31	981621.84	2476.87	2475.90	2482.90	7.00	2480.96
10	506382.51	981623.44	2476.77	2475.89	2482.60	6.71	2480.92
11	506370.47	981623.58	2476.23	2475.89	2482.33	6.44	2480.85
12	506350.47	981623.81	2475.78	2475.89	2481.88	5.99	2482
13	506330.48	981624.03	2475.33	2475.88	2481.44	5.56	2480.64
14	506310.48	981624.26	2474.88	2475.88	2480.99	5.11	2480.02
15	506290.48	981624.48	2474.43	2475.88	2480.54	4.66	2478.35
16	506270.48	981624.71	2474.00	2475.87	2480.09	4.22	2477.85
17	506250.48	981624.94	2474.00	2475.87	2479.65	3.78	2478.03
18	506230.48	981625.16	2474.00	2475.87	2479.20	3.33	2477.37
19	506210.48	981625.39	2474.00	2475.75	2478.75	3.00	2476.79
20	506190.48	981625.62	2474.00	2475.29	2478.31	3.02	2476.44
21	506183.95	981625.69	2474.00	2475.12	2478.13	3.01	2476.43

*REFER TO DETAIL 3 ON THIS PAGE, FOR GRAPHICAL REPRESENTATION.

RELATED CASE #
OV914-009
2100731
OV114-018

LJA Engineering, Inc.
7458 N. La Cholla Boulevard,
Tucson, AZ 85741
Phone 520.257.3400

BASIN DETAILS
SUNDARA RIDGE
FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil) CERTIFICATE NO. 54544 ROBERT W. SCHLICHER Date Signed 12/16/24 ARIZONA, U.S.A.

PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

H: 1"=50' C.I.=2'
V:
SCALE
12/16/24
DATE
AZ4072-1004
JOB NUMBER
ML
DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY

42 OF 51

P22WI00005
G-2022-007

Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA811
Call 811 or visit Arizona811.com

Date/Time: Mon, 16 Dec 2024 - 10:18am PathName: S:\ARIZ\Tucson\AZ4072-1004_AND_ LJA MOVING FORWARD\BASE FILES\IP\A2 DETAILS.dwg

HCS DESIGN AND AS-BUILT INFORMATION

LOT #	CLEANOUT LOCATION			DISTANCE TO DOWNSTREAM MH		AS-BUILT		
						STATE PLANE COORDINATES (ARIZONA CENTRAL) NAD 83 INTERNATIONAL FEET AT HCS CLEANOUT		DISTANCE TO DOWNSTREAM MANHOLE
	STATION	OFFSET	INVERT	MH#	DISTANCE	NORTHING	EASTING	DISTANCE
1	20+78.79	-26.00	2528.53	SMH 9	70.54			
2	21+62.73	-26.00	2529.85	SMH 9	154.40			
3	23+25.39	-26.60	2533.12	SMH 15	125.07			
4	24+26.17	-30.31	2534.55	SMH 16	0.00			
5	24+33.23	16.48	2534.67	SMH 16	0.00			
6	23+86.86	51.92	2534.07	SMH 15	185.93			
7	17+07.25	-26.00	2533.48	SMH 10	60.38			
8	18+47.16	-26.00	2540.88	SMH 10	200.29			
9	25+80.25	-26.00	2574.64	SMH 14	55.56			
10	26+66.26	-26.00	2577.21	SMH 14	141.57			
11	27+52.26	-26.00	2579.96	SMH 14	227.57			
12	29+66.95	-7.55	2585.97	SMH 14	0.00			
13	29+26.31	25.38	2584.87	SMH 14	401.20			
14	28+56.71	26.00	2582.94	SMH 14	331.59			
15	27+70.75	26.00	2580.19	SMH 14	245.64			
16	26+84.71	26.00	2577.78	SMH 14	159.60			
17	25+98.71	26.00	2574.54	SMH 14	73.60			
18	43+34.91	-26.00	2556.95	SMH 22	166.03			
19	22+47.42	26.00	2559.21	SMH 13	118.34			
20	21+78.60	26.00	2555.20	SMH 13	47.81			
21	21+04.08	26.00	2551.91	SMH 12	118.61			
22	20+29.67	26.00	2548.72	SMH 12	38.73			
23	19+52.64	26.00	2545.84	SMH 11	305.77			
24	18+72.64	26.00	2541.74	SMH 11	225.77			
25	17+98.47	26.00	2538.57	SMH 11	151.60			
26	17+12.61	26.00	2534.91	SMH 11	65.73			
27	16+30.04	26.00	2531.43	SMH 10	59.51			
28	33+90.26	-26.00	2525.67	SMH 19	61.71			
29	34+64.34	-26.00	2528.36	SMH 19	135.78			
30	35+44.34	-26.00	2532.09	SMH 19	215.77			
31	36+24.34	-26.00	2535.39	SMH 19	295.76			
32	37+04.34	-26.00	2538.62	SMH 19	375.74			
33	37+88.59	-26.00	2541.75	SMH 19	459.98			
34	38+87.34	-26.00	2545.40	SMH 20	77.01			
35	39+93.96	-26.00	2549.02	SMH 20	179.22			
36	41+19.27	-26.00	2553.57	SMH 21	107.26			
37	34+48.51	26.00	2526.82	SMH 19	120.84			
38	35+34.51	26.00	2530.32	SMH 19	206.82			
39	36+20.51	26.00	2533.83	SMH 19	292.81			
40	37+06.51	26.00	2537.33	SMH 19	378.80			
41	37+92.41	26.00	2540.63	SMH 19	464.79			
42	38+75.30	26.00	2542.39	SMH 20	62.64			
43	39+58.25	26.00	2543.88	SMH 20	148.80			
44	40+41.13	26.00	2545.36	SMH 21	26.22			
45	41+24.04	26.00	2546.93	SMH 21	112.22			
46	42+07.00	26.00	2549.03	SMH 22	37.65			
47	42+92.01	26.00	2551.29	SMH 22	123.69			
48	43+78.01	26.00	2553.95	SMH 22	209.68			
49	44+64.01	26.00	2556.61	SMH 22	0.00			
50	51+06.92	26.00	2572.79	SMH 40	0.00			
51	51+82.48	26.00	2574.28	SMH 40	75.11			
52	65+38.93	-26.00	2549.80	SMH 30	73.62			
53	64+35.68	-26.00	2543.64	SMH 29	216.85			
54	63+41.14	-26.00	2537.13	SMH 29	129.22			
55	62+53.30	-26.00	2531.90	SMH 29	38.99			
56	61+70.28	-26.00	2528.35	SMH 28	175.71			
57	60+31.65	-43.67	2525.27	SMH 28	34.59			
58	59+39.33	-26.00	2521.81	SMH 27	181.40			
59	58+54.92	-26.00	2519.54	SMH 27	95.36			
60	57+70.49	-26.00	2516.99	SMH 27	9.39			
61	56+86.08	-26.00	2514.32	SMH 26	414.04			
62	55+90.94	-29.82	2511.23	SMH 26	318.69			
63	55+02.16	-71.40	2508.70	SMH 26	229.75			
64	54+28.83	-26.00	2505.20	SMH 26	156.58			
65	53+41.28	-33.70	2501.32	SMH 26	69.01			
66	52+71.61	-43.57	2498.65	SMH 25	218.77			
67	53+14.09	50.05	2499.74	SMH 26	42.13			
68	53+90.45	26.00	2503.02	SMH 26	118.40			
69	54+72.56	25.99	2506.23	SMH 26	200.51			
70	55+62.49	26.00	2509.68	SMH 26	290.44			

MANHOLE AS-BUILT INFORMATION

MH NO	STATE PLANE COORDINATES (ARIZONA CENTRAL) NAD 83 INTERNATIONAL FEET	
	NORTHING	EASTING
1		
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HCS DESIGN AND AS-BUILT INFORMATION

LOT #	CLEANOUT LOCATION			DISTANCE TO DOWNSTREAM MH		AS-BUILT		
						STATE PLANE COORDINATES (ARIZONA CENTRAL) NAD 83 INTERNATIONAL FEET AT HCS CLEANOUT		DISTANCE TO DOWNSTREAM MANHOLE
	STATION	OFFSET	INVERT	MH#	DISTANCE	NORTHING	EASTING	DISTANCE
71	56+43.27	26.00	2512.22	SMH 26	371.22			
72	57+50.17	26.00	2515.93	SMH 26	476.63			
73	58+59.25	26.00	2519.13	SMH 27	100.50			
74	59+68.33	26.00	2522.25	SMH 27	207.36			
75	61+27.02	26.00	2526.72	SMH 28	131.22			
76	62+78.14	26.00	2533.26	SMH 29	62.53			
77	63+89.20	26.00	2539.34	SMH 29	175.08			
78	64+43.44	26.00	2543.97	SMH 29	234.53			
79	65+46.04	26.00	2549.36	SMH 30	81.59			
80	57+52.91	-3.57	2551.55	SMH 39	0.00			
81	56+80.94	-26.00	2550.77	SMH 39	186.60			
82	55+84.92	-26.00	2550.93	SMH 39	91.25			
83	65+13.04	26.00	2550.38	SMH 31	10.98			
84	66+06.10	26.00	2556.98	SMH 31	97.43			
85	66+99.50	26.00	2562.36	SMH 32	18.80			
86	67+94.82	26.00	2567.07	SMH 32	109.53			
87	71+60.81	25.20	2606.04	SMH 42	8.77			
88	72+43.51	-13.99	2608.70	SMH 42	0.00			
89	72+33.50	-58.02	2609.26	SMH 42	0.00			
90	76+94.02	-26.00	2598.89	SMH 38	0.00			
91	75+89.64	-26.00	2594.91	SMH 37	135.43			

Onsite Hydraulic Structures - Local Collector Channels

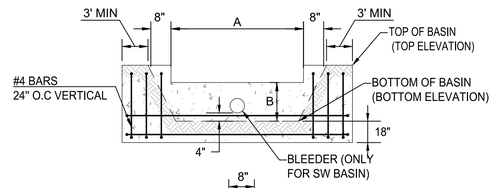
Location	Q100	Flow Depth (ft)	Design Depth (ft)	Bottom width (ft)	Design Topwidth (ft)	Left sideslope (xH:1V)	Left lining	Right sideslope (xH:1V)	Right lining	min slope %
	(cfs)									
N1	34	1.6	3.1	4	13	1	grouted riprap	2	grouted riprap	0.5
N2	24	1.3	2.6	4	12	2	grouted riprap	1	grouted riprap	0.5
N3	21	1.1	2.2	4	15	2	grouted riprap	1	grouted riprap	0.5
N4.1	13	0.9	1.8	4	13	2	dumped riprap	3	earthen	0.5
N4b	21	1.1	2.2	4	15	2	dumped riprap	3	earthen	0.51
N5	26	1.4	2.9	4	12	1	grouted riprap	2	grouted riprap	0.5
N5.1	24	1.2	2.4	4	16	3	earthen	2	dumped riprap	0.5
D3.3	3.6	0.4	0.9	4	8	2	dumped riprap	2	dumped riprap	0.54
D13	1.3	0.2	0.4	4	5	2	grouted riprap	1	grouted riprap	1.0

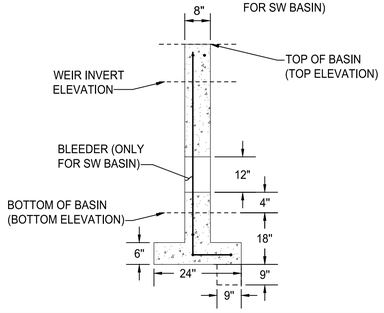
d_{50} = 6 inches

Onsite Hydraulic Structures - Local Channels

Location	Q100	Flow Depth (ft)	Design Depth[a] (ft)	Bottom width (ft)	Design Topwidth (ft)	Left sideslope (xH:1V)	Left lining	Right sideslope (xH:1V)	Right lining	min slope %
	(cfs)									
D12	34	1.4	1.7	4	7	1	grouted riprap	1	grouted riprap	0.97
N2	24	1.7	2	4	8	1	grouted riprap	1	grouted riprap	0.25
N3	21	1.1	1.3	4	7	1	grouted riprap	1	grouted riprap	0.85

[a] = includes freeboard, d_{50} = 6 inches for grouted riprap

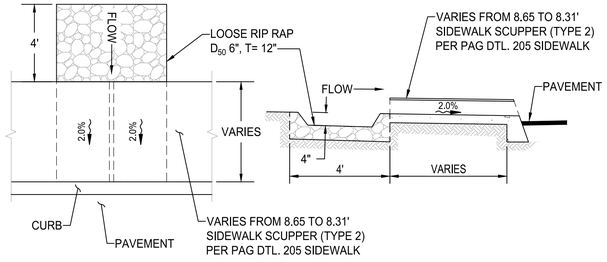




WEIR DIMENSIONS				
BASIN	A (FT)	B (FT)	WEIR ELEVATION	BLEEDER DIAM.
SW	80.0	2.4	2520.48	12"
SE	9.0	2.0	2407.00	NA

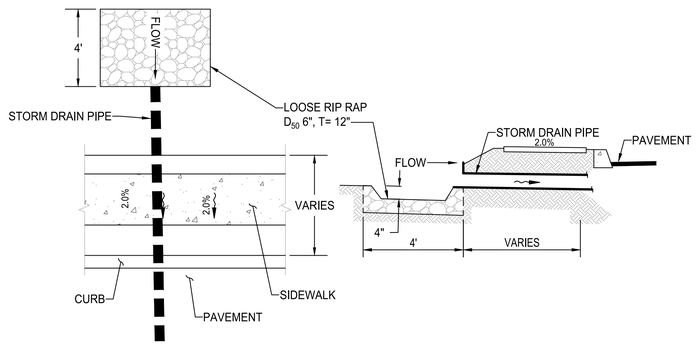
2 BASIN WEIR

N.T.S.



1 SEDIMENT TRAP DETAIL

N.T.S.



3 SEDIMENT TRAP DETAIL

N.T.S.

RELATED CASE #
OV914-009
2100731
OV114-018

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

LJA Engineering, Inc.
7458 N. La Cholla Boulevard,
Tucson, AZ 85741
Phone 520.257.3400

HCS TABLE
SUNDARA RIDGE
FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12
SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

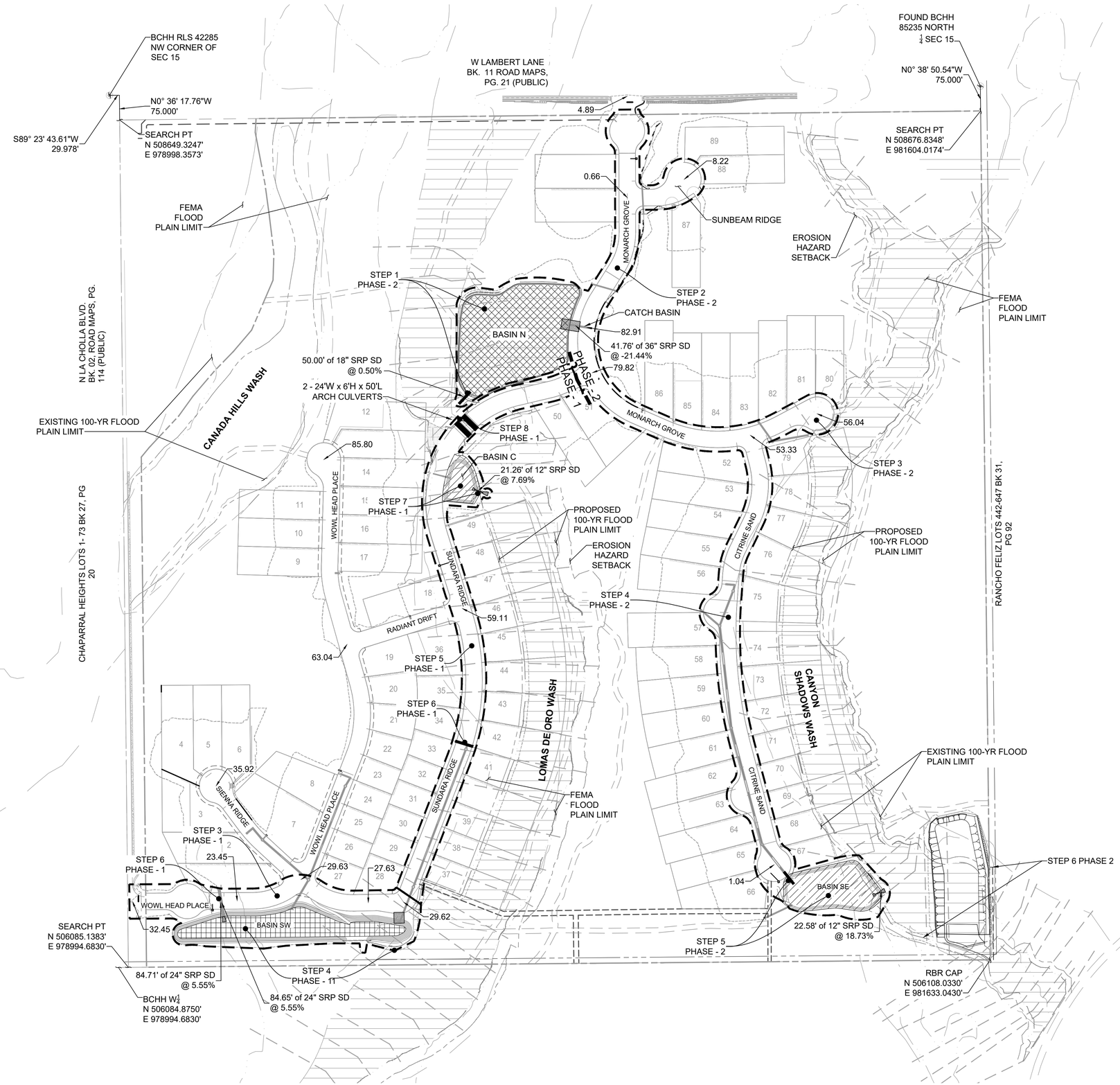
Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W. SCHLICHER
Date Signed 12-16-24
ARIZONA, U.S.A.

PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

H: C.I.=2'
V:
SCALE
12/16/24
DATE
AZ4072-1004
JOB NUMBER
ML
DRAWN BY
LJA
DESIGNED BY
RWS
CHECKED BY

P22WI00005
G-2022-007

Date/Time: Tue, 10 Dec 2024 - 5:26pm Path/Name: S:\ARIZ\Tucson\AZ4072\400\LAND_LIA MOVING FORWARD\BASE FILES\P\v43 HCS TABLE.dwg



LEGEND

- BASIN C
- BASIN N
- BASIN SE
- BASIN SW
- CATCH BASIN
- TEMP RIP-RAP
- DRAINAGE MANHOLE
- STORM DRAIN PIPE

CRITICAL GRADING & STORM DRAINAGE SEQUENCE

PHASE 1:

STEP 1. STAKE CLEARING LIMITS

STEP 2. INSTALL BEST MANAGEMENT PRACTICES

STEP 3. GRADE "WOWL HEAD PLACE" (FROM "LA CHOLLA" TO "SUNDARA RIDGE")

STEP 4. BUILD BASIN "SW" AND INSTALL OUTLET STRUCTURE

STEP 5. GRAD "SUNDARA RIDGE"

STEP 6. INSTALL DRAINAGE TEMPORARY SWALES AT STRUCTURE LOCATIONS.

STEP 7. BUILD BASIN "C" AND INSTALL OUTLET STRUCTURE.

STEP 8. INSTALL ARCH CULVERTS

PHASE 2:

STEP 1. BUILD BASIN "N" AND INSTALL OUTLET STRUCTURE

STEP 2. GRADE "MONARCH GROVE" (FROM "LAMBERT" TO "CITRINE SAND"

STEP 3. GRADE "MONARCH GROVE"

STEP 4. GRADE "CITRINE SAND"

STEP 5. BUILD BASIN "SE" AND INSTALL OUTLET STRUCTURE

RELATED CASE #
OV914-009
2100731
OV114-018

LJA Engineering, Inc.
7458 N. La Cholla Boulevard.
Tucson, AZ 85741
Phone 520.257.3400

CDFMA

SUNDARA RIDGE

FINAL SITE PLAN, IMPROVEMENT PLAN AND PUBLIC SEWER PLAN
SUNDARA RIDGE LOTS 1 THROUGH 91
A PORTION OF THE NORTHWEST QUARTER OF SECTION 15, TOWNSHIP 12
SOUTH, RANGE 13 EAST, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
2101153

NO.	DATE	REVISION	APP.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54544
ROBERT W.
SCHLICHER
Date signed 12/16/24
ARIZONA, U.S.A.

PLAN STATUS:
FOR REVIEW ☒
FOR CONSTRUCTION ☐

H: 1"=150'	C.I.=2'
V:	
SCALE	
12/16/24	
DATE	
AZ4072-1004	
JOB NUMBER	
ML	
DRAWN BY	
LJA	
DESIGNED BY	
RWS	
CHECKED BY	

P22WI00005

G-2022-007

Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA811
Call 811 or visit Arizona811.com

DateTime: Mon, 16 Dec 2024 - 10:21am PathName: S:\ARIZ\Tucson\AZ4072\400\AND_LJA MOVING FORWARD\BASE FILES\PLN\44 CDFMA.dwg

CON/SPAN B-Series DYO
TWIN 24 x 6

NOTES

GENERAL NOTES:

1. THIS BRIDGE HAS BEEN DESIGNED FOR GENERAL SITE CONDITIONS. THE PROJECT ENGINEER SHALL BE RESPONSIBLE FOR THE STRUCTURE'S SUITABILITY TO THE EXISTING SITE CONDITIONS AND FOR THE HYDRAULIC EVALUATION -- INCLUDING SCOUR AND CONFIRMATION OF SOIL CONDITIONS.

2. PRIOR TO CONSTRUCTION, CONTRACTOR MUST VERIFY ALL ELEVATIONS SHOWN THROUGH THE ENGINEER.

3. ONLY CONTECH ENGINEERED SOLUTIONS LLC, THE CON/SPAN® APPROVED PRECASTER IN ARIZONA MAY PROVIDE THE STRUCTURE DESIGNED IN ACCORDANCE WITH THESE PLANS.

4. THE USE OF ANOTHER PRECAST STRUCTURE WITH THE DESIGN ASSUMPTIONS USED FOR THE CON/SPAN® STRUCTURE MAY LEAD TO SERIOUS DESIGN ERRORS. USE OF ANY OTHER PRECAST STRUCTURE WITH THIS DESIGN AND DRAWINGS VOIDS ANY CERTIFICATION OF THIS DESIGN AND WARRANTY. CONTECH ASSUMES NO LIABILITY FOR DESIGN OF ANY ALTERNATE OR SIMILAR TYPE STRUCTURES.

5. ALTERNATE STRUCTURES MAY BE CONSIDERED, PROVIDED THAT DRAWINGS AND CALCULATIONS SIGNED AND SEALED BY A PROFESSIONAL ENGINEER, REGISTERED IN THE STATE OF ARIZONA, EMPLOYED BY THE PRECAST CONCRETE BRIDGE SUPPLIER, ARE SUBMITTED TO THE ENGINEER 2 WEEKS PRIOR TO THE BID DATE FOR REVIEW AND APPROVAL.

6. ALTERNATE STRUCTURES MAY BE CONSIDERED, PROVIDED THAT THE ALTERNATE DESIGN DOES NOT REDUCE THE HYDRAULIC OPENING OF THE STRUCTURE AS SHOWN ON THE DRAWINGS. AT A MINIMUM THE ALTERNATE STRUCTURE MUST PROVIDE THE SAME OR LARGER SPAN AND RISE AS THE STRUCTURE SHOWN ON THE DRAWINGS.

7. THE PRECAST ARCH SUPPLIER MUST ATTEND THE PRE-BID MEETING, IF ONE IS HELD.

8. SUPPLIER OF PROPOSED ALTERNATES TO A CON/SPAN® BRIDGE SYSTEM MUST SUBMIT AT LEAST TWO (2) INDEPENDENTLY VERIFIED FULL SCALE LOAD TESTS THAT CONFIRM THE PROPOSED DESIGN METHODOLOGY OF THE THREE SIDED/ARCH STRUCTURE(S). THE PROPOSED ALTERNATE, UPON SATISFACTORY CONFIRMATION OF DESIGN METHODOLOGY, MAY BE CONSIDERED AN ACCEPTABLE ALTERNATE.

9. PROPOSED ALTERNATE STRUCTURES MAY BE CONSIDERED, PROVIDED THAT THE PRECAST CONCRETE BRIDGE STRUCTURES ARE PROVIDED BY A SUPPLIER THAT HAS A MINIMUM OF TWO (2) REGISTERED PROFESSIONAL ENGINEERS ON STAFF THAT ARE DEDICATED TO THE DESIGN OF THESE TYPES OF STRUCTURES. SUPPLIER MUST PROVIDE THESE NAMES, P.E. LICENSE NUMBERS AND DATES OF HIRE AT TIME OF ALTERNATE SUBMITTAL.

DESIGN DATA

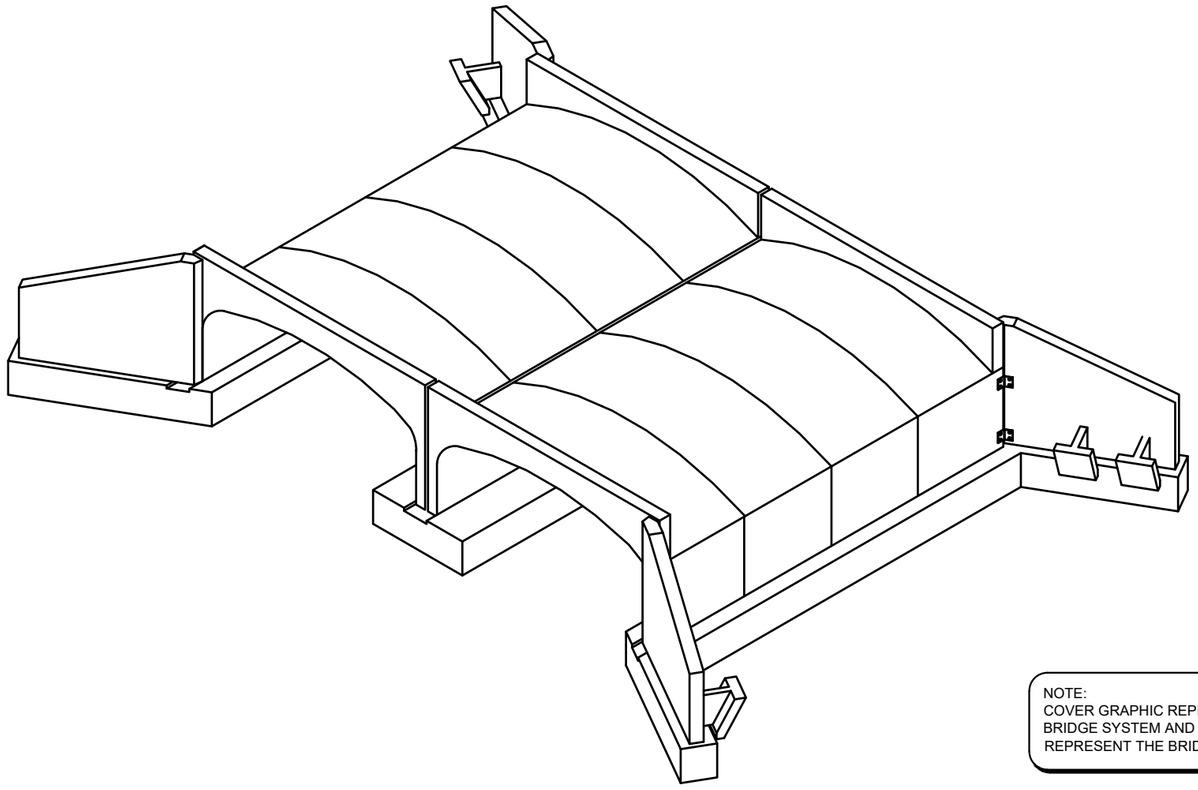
DESIGN LOADING:
- BRIDGE UNITS: HL93
- HEADWALLS: EARTH PRESSURE ONLY
- WINGWALLS: EARTH PRESSURE ONLY

DESIGN FILL HEIGHT: 2'-0" TO 3'-0"
FROM TOP OF CROWN TO TOP OF PAVEMENT.
DESIGN METHOD: LOAD RESISTANCE FACTOR DESIGN PER AASHTO LRFD SPECIFICATION

*AT THE TIME OF DESIGN, A GEOTECHNICAL REPORT FOR THE PROJECT SITE WAS NOT AVAILABLE. IT IS THE PROJECT ENGINEER'S, OWNER'S AND/OR THE CONTRACTOR'S RESPONSIBILITY TO VERIFY THAT THE ACTUAL SITE CONDITIONS AT THE TIME OF CONSTRUCTION ARE CONSISTENT WITH THE FOUNDATION BEARING PRESSURES SHOWN WITH A GEOTECHNICAL INVESTIGATION FROM A QUALIFIED GEOTECHNICAL ENGINEER.

MATERIALS

PRECAST UNITS SHALL BE CONSTRUCTED AND INSTALLED IN ACCORDANCE WITH CON/SPAN® SPECIFICATIONS. CONCRETE FOR FOOTINGS SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI. REINFORCING STEEL FOR FOOTINGS SHALL CONFORM TO ASTM A615 OR A996-GRADE 60.



ISOMETRIC VIEW

NOTE:
COVER GRAPHIC REPRESENTS CON/SPAN® BRIDGE SYSTEM AND IS NOT INTENDED TO REPRESENT THE BRIDGE DESIGNED HEREIN.

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PRELIMINARY
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MARK	DATE	REVISION DESCRIPTION	BY

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www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CON/SPAN BRIDGE SYSTEMS

DYOB
DRAWING

SUNDARA RIDGE
TWIN 24 x 6
ORO VALLEY, AZ
B Series, 24' Span x 6' Rise

PROJECT No.:	DYO No.:	DATE:
16385	24776	4/12/23
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 45	OF 51	

NOTES

GENERAL NOTES:

1. THIS BRIDGE HAS BEEN DESIGNED FOR GENERAL SITE CONDITIONS. THE PROJECT ENGINEER SHALL BE RESPONSIBLE FOR THE STRUCTURE'S SUITABILITY TO THE EXISTING SITE CONDITIONS AND FOR THE HYDRAULIC EVALUATION -- INCLUDING SCOUR AND CONFIRMATION OF SOIL CONDITIONS.

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3. ONLY CONTECH ENGINEERED SOLUTIONS LLC, THE CON/SPAN® APPROVED PRECASTER IN ARIZONA MAY PROVIDE THE STRUCTURE DESIGNED IN ACCORDANCE WITH THESE PLANS.

4. THE USE OF ANOTHER PRECAST STRUCTURE WITH THE DESIGN ASSUMPTIONS USED FOR THE CON/SPAN® STRUCTURE MAY LEAD TO SERIOUS DESIGN ERRORS. USE OF ANY OTHER PRECAST STRUCTURE WITH THIS DESIGN AND DRAWINGS VOIDS ANY CERTIFICATION OF THIS DESIGN AND WARRANTY. CONTECH ASSUMES NO LIABILITY FOR DESIGN OF ANY ALTERNATE OR SIMILAR TYPE STRUCTURES.

5. ALTERNATE STRUCTURES MAY BE CONSIDERED, PROVIDED THAT DRAWINGS AND CALCULATIONS SIGNED AND SEALED BY A PROFESSIONAL ENGINEER, REGISTERED IN THE STATE OF ARIZONA, EMPLOYED BY THE PRECAST CONCRETE BRIDGE SUPPLIER, ARE SUBMITTED TO THE ENGINEER 2 WEEKS PRIOR TO THE BID DATE FOR REVIEW AND APPROVAL.

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DESIGN DATA

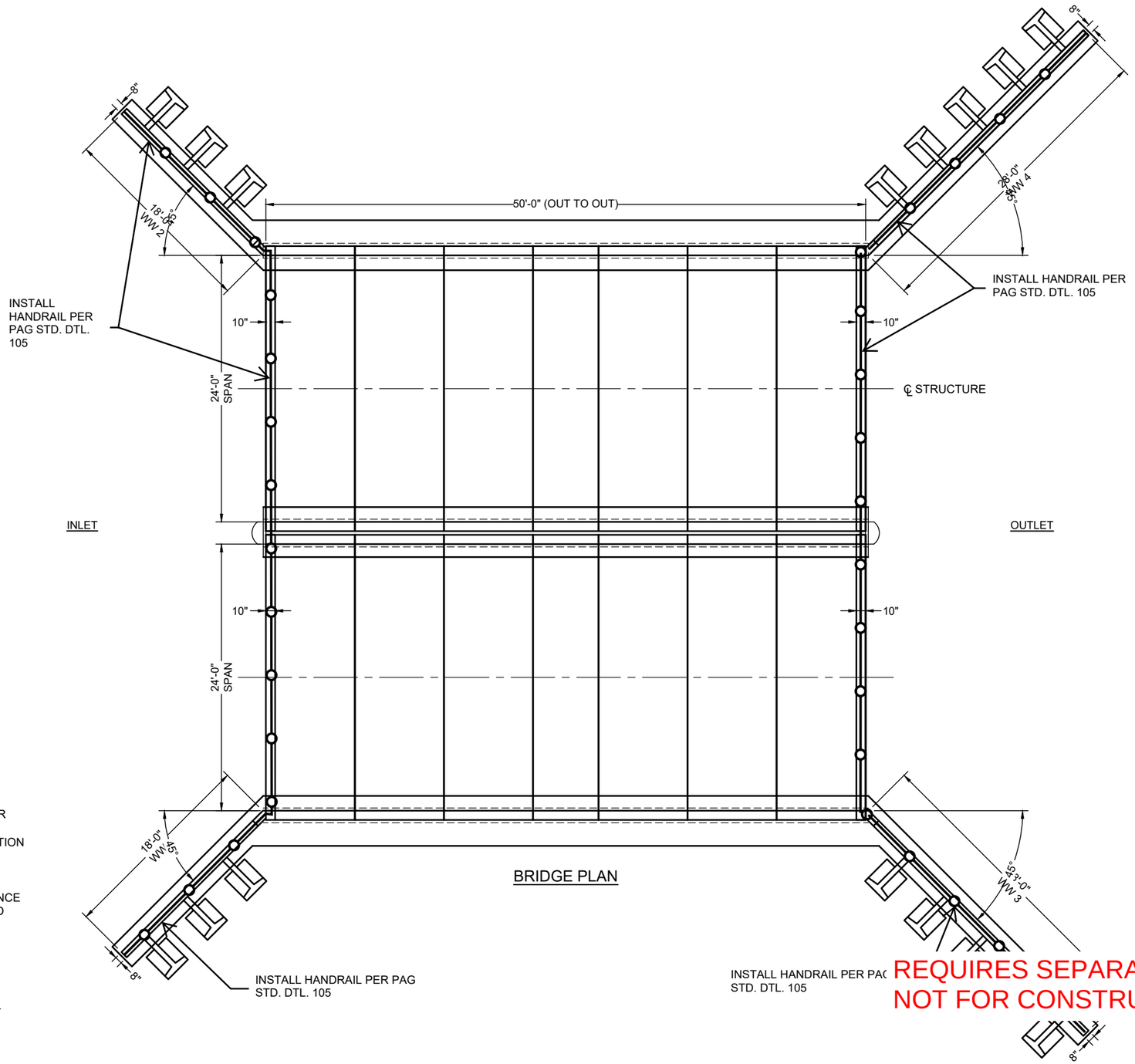
DESIGN LOADING:
- BRIDGE UNITS: HL93
- HEADWALLS: EARTH PRESSURE ONLY
- WINGWALLS: EARTH PRESSURE ONLY

DESIGN FILL HEIGHT: 2'-0" TO 4'-0"
FROM TOP OF CROWN TO TOP OF PAVEMENT.
DESIGN METHOD (ARCHES, HEADWALLS & WINGWALLS): LOAD RESISTANCE FACTOR
DESIGN PER AASHTO LRFD SPECIFICATION
DESIGN METHOD (FOUNDATION): PER STANDARD AASHTO SPECIFICATION, 17th EDITION
NET ALLOWABLE SOIL BEARING PRESSURE: 3,000 PSF*
GROSS ALLOWABLE SOIL BEARING PRESSURE: 3,300 PSF*

*FOUNDATION EXCAVATION AND SUBGRADE PREPARATION SHALL BE IN ACCORDANCE WITH THE GEOTECHNICAL REPORT FOR THIS PROJECT PREPARED BY SPEEDIE AND ASSOCIATES DATED MARCH 28, 2019.

MATERIALS

PRECAST UNITS SHALL BE CONSTRUCTED AND INSTALLED IN ACCORDANCE WITH CON/SPAN® SPECIFICATIONS. CONCRETE FOR FOOTINGS SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI. REINFORCING STEEL FOR FOOTINGS SHALL CONFORM TO ASTM A615 OR A996-GRADE 60.



BRIDGE PLAN

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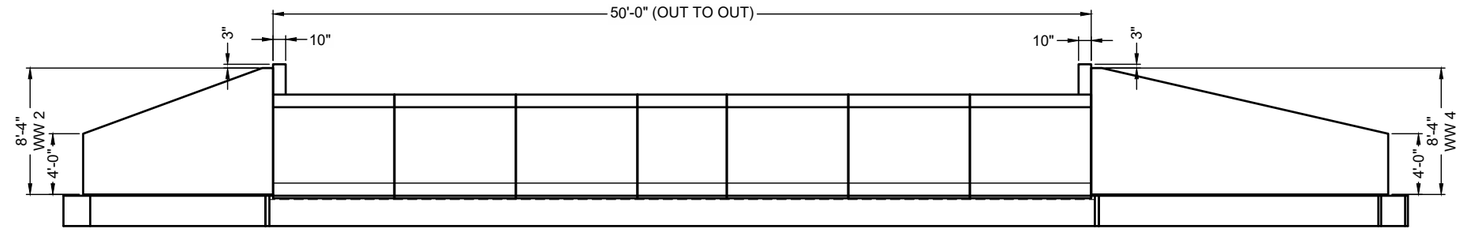
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CON/SPAN BRIDGE SYSTEMS

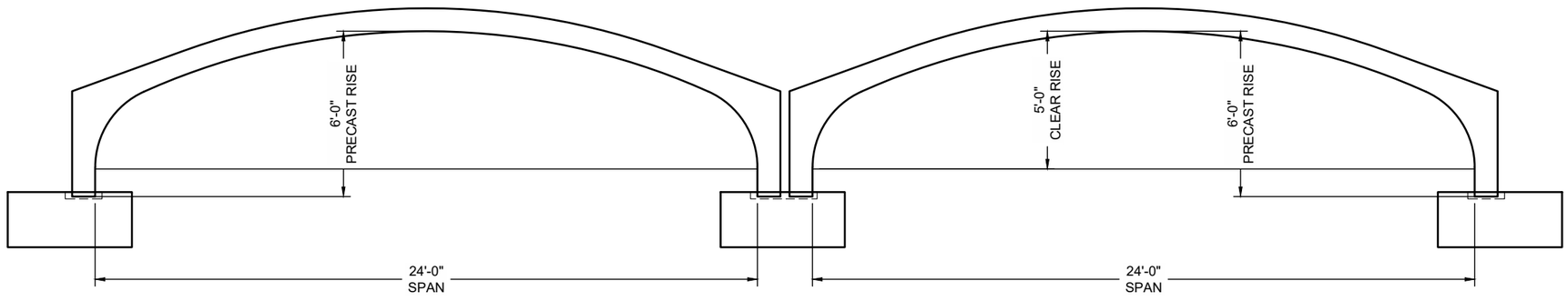
DYOB
DRAWING

SUNDARA RIDGE
TWIN 24 x 6
ORO VALLEY, AZ
B Series, 24' Span x 6' Rise

PROJECT No.:	DYO No.:	DATE:
16385	24776	4/12/23
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 46	OF 51	



LONGITUDINAL SECTION



CROSS SECTION

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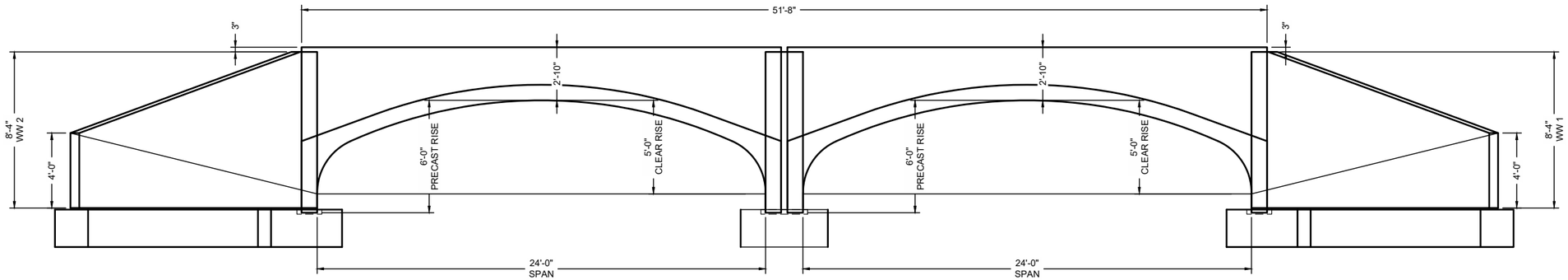
CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONSPAN BRIDGE SYSTEMS

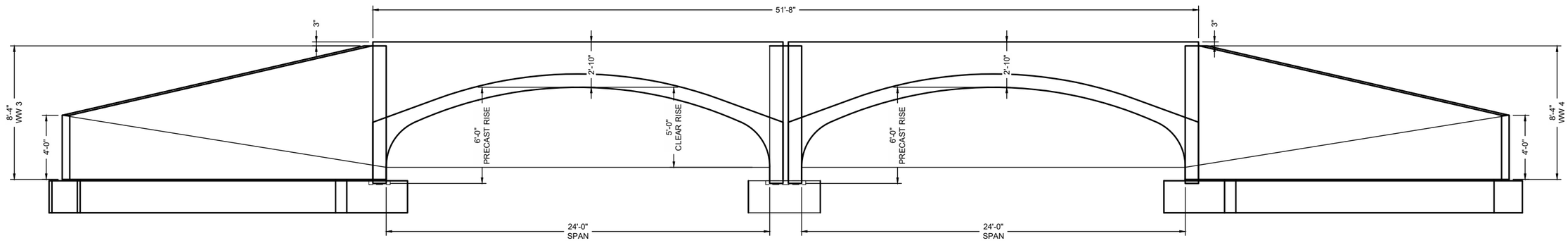
DYOB
DRAWING

SUNDARA RIDGE
TWIN 24 x 6
ORO VALLEY, AZ
B Series, 24' Span x 6' Rise

PROJECT No.:	DYO No.:	DATE:
16385	24776	4/12/23
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 47	OF 51	



INLET END ELEVATION



OUTLET END ELEVATION

REQUIRES SEPARATE PERMIT.
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PRELIMINARY
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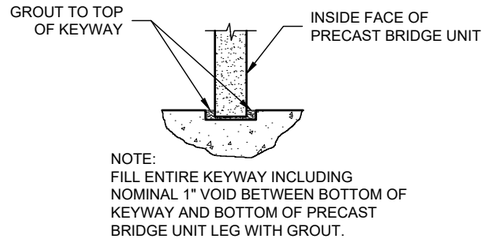
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CON/SPAN BRIDGE SYSTEMS

DYOB
DRAWING

SUNDARA RIDGE
TWIN 24 x 6
ORO VALLEY, AZ
B Series, 24' Span x 6' Rise

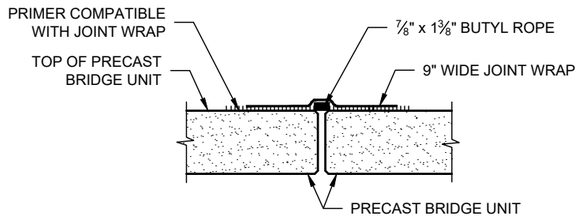
PROJECT No.:	DYO No.:	DATE:
16385	24776	4/12/23
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 48	OF 51	



NOTE:
FILL ENTIRE KEYWAY INCLUDING NOMINAL 1" VOID BETWEEN BOTTOM OF KEYWAY AND BOTTOM OF PRECAST BRIDGE UNIT LEG WITH GROUT.

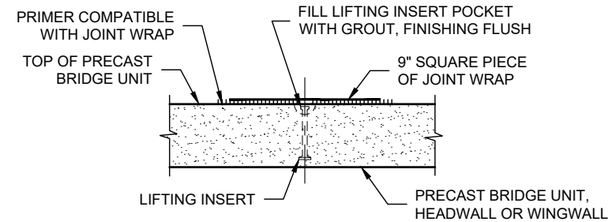
TYPICAL BRIDGE UNIT GROUT DETAIL

NOT TO SCALE



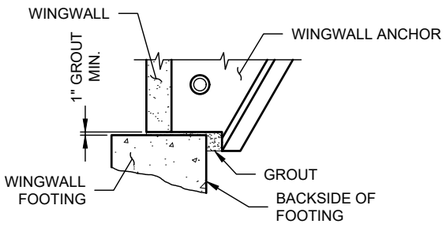
TYPICAL JOINT SEAL DETAIL

NOT TO SCALE



TYPICAL LIFT INSERT SEALING DETAIL

NOT TO SCALE

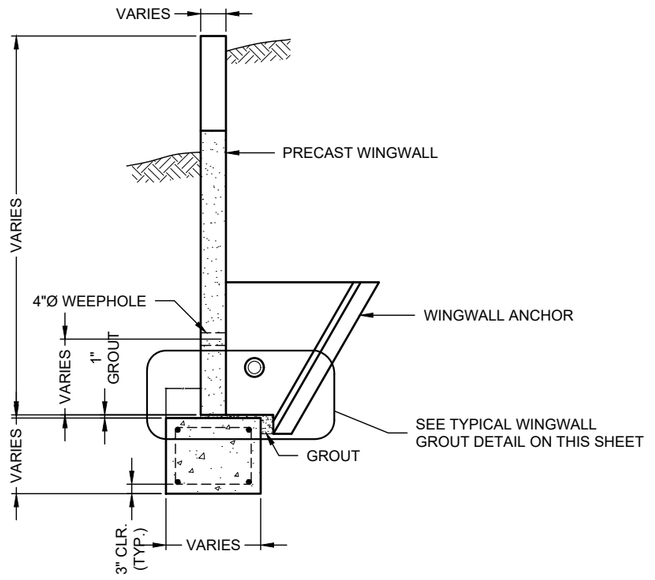


NOTES:

- MINIMUM 1" GROUT UNDER WINGWALL LEG & ANCHOR STEM.
- AREA BETWEEN WINGWALL FOOTING AND WINGWALL ANCHOR SHALL BE GROUTED SOLID BEFORE BACKFILL.
- FORM BACKSIDE OF FOOTING TO DIMENSIONS SHOWN ON FOUNDATION PLAN.

TYPICAL WINGWALL GROUT DETAIL

NOT TO SCALE



TYPICAL WINGWALL SECTION

NOT TO SCALE

REQUIRES SEPARATE PERMIT.
NOT FOR CONSTRUCTION

PRELIMINARY
NOT FOR CONSTRUCTION

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CON/SPAN BRIDGE SYSTEMS

DYOB
DRAWING

SUNDARA RIDGE
TWIN 24 x 6
ORO VALLEY, AZ
B Series, 24' Span x 6' Rise

PROJECT No.:	DYO No.:	DATE:
16385	24776	4/12/23
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 49	OF 51	

SPECIFICATIONS FOR MANUFACTURE AND INSTALLATION OF CON/SPAN® BRIDGE SYSTEMS

1. DESCRIPTION
   1.1. TYPE - THIS WORK SHALL CONSIST OF FURNISHING AND CONSTRUCTING A CON/SPAN® BRIDGE SYSTEM IN ACCORDANCE WITH THESE SPECIFICATIONS AND IN REASONABLY CLOSE CONFORMITY WITH THE LINES, GRADES, DESIGN AND DIMENSIONS SHOWN ON THE PLANS OR AS ESTABLISHED BY THE ENGINEER. IN SITUATIONS WHERE TWO OR MORE SPECIFICATIONS APPLY TO THIS WORK, THE MOST STRINGENT REQUIREMENTS SHALL GOVERN.
   1.2. DESIGNATION - PRECAST REINFORCED CONCRETE CON/SPAN® BRIDGE UNITS MANUFACTURED IN ACCORDANCE WITH THIS SPECIFICATION SHALL BE DESIGNATED BY SPAN AND RISE. PRECAST REINFORCED CONCRETE WINGWALLS AND HEADWALLS MANUFACTURED IN ACCORDANCE WITH THIS SPECIFICATION SHALL BE DESIGNATED BY LENGTH, HEIGHT, AND DEFLECTION ANGLE. PRECAST REINFORCED CONCRETE EXPRESS™ FOUNDATION UNITS MANUFACTURED IN ACCORDANCE WITH THIS SPECIFICATION SHALL BE DESIGNATED BY LENGTH, HEIGHT AND WIDTH.

2. DESIGN
   2.1. SPECIFICATIONS - THE PRECAST ELEMENTS ARE DESIGNED IN ACCORDANCE WITH THE "AASHTO LRFD BRIDGE SPECIFICATION" 6TH EDITION, ADOPTED BY THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS, 2012. A MINIMUM OF ONE FOOT OF COVER ABOVE THE CROWN OF THE BRIDGE UNITS IS REQUIRED IN THE INSTALLED CONDITION. (UNLESS NOTED OTHERWISE ON THE SHOP DRAWINGS AND DESIGNED ACCORDINGLY.)

3. MATERIALS
   3.1. CONCRETE - THE CONCRETE FOR THE PRECAST ELEMENTS SHALL BE AIR-ENTRAINED WHEN INSTALLED IN AREAS SUBJECT TO FREEZE-THAW CONDITIONS, COMPOSED OF PORTLAND CEMENT, FINE AND COARSE AGGREGATES, ADMIXTURES AND WATER. AIR-ENTRAINED CONCRETE SHALL CONTAIN 6 ± 2 PERCENT AIR. THE AIR- ENTRAINING ADMIXTURE SHALL CONFORM TO AASHT0 M154. THE MINIMUM CONCRETE COMPRESSIVE STRENGTH SHALL BE AS SHOWN ON THE SHOP DRAWINGS.
      3.1.1. PORTLAND CEMENT - SHALL CONFORM TO THE REQUIREMENTS OF ASTM SPECIFICATIONS C150-TYPE I, TYPE II, OR TYPE III CEMENT.
      3.1.2. COARSE AGGREGATE - SHALL CONSIST OF STONE HAVING A MAXIMUM SIZE OF 1 INCH. AGGREGATE SHALL MEET REQUIREMENTS FOR ASTM C33.
      3.1.3. WATER REDUCING ADMIXTURE - THE MANUFACTURER MAY SUBMIT, FOR APPROVAL BY THE ENGINEER, A WATER-REDUCING ADMIXTURE FOR THE PURPOSE OF INCREASING WORKABILITY AND REDUCING THE WATER REQUIREMENT FOR THE CONCRETE.
      3.1.4. CALCIUM CHLORIDE - THE ADDITION TO THE MIX OF CALCIUM CHLORIDE OR ADMIXTURES CONTAINING CALCIUM CHLORIDE WILL NOT BE PERMITTED.
      3.1.5. MIXTURE - THE AGGREGATES, CEMENT AND WATER SHALL BE PROPORTIONED AND MIXED IN A BATCH MIXER TO PRODUCE A HOMOGENEOUS CONCRETE MEETING THE STRENGTH REQUIREMENTS OF THIS SPECIFICATION. THE PROPORTION OF PORTLAND CEMENT IN THE MIXTURE SHALL NOT BE LESS THAN 564 POUNDS (6 SACKS) PER CUBIC YARD OF CONCRETE.
   3.2. STEEL REINFORCEMENT
      3.2.1. THE MINIMUM STEEL YIELD STRENGTH SHALL BE 60,000 PSI, UNLESS OTHERWISE NOTED ON THE SHOP DRAWINGS.
      3.2.2. ALL REINFORCING STEEL FOR THE PRECAST ELEMENTS SHALL BE FABRICATED AND PLACED IN ACCORDANCE WITH THE DETAILED SHOP DRAWINGS SUBMITTED BY THE MANUFACTURER.
      3.2.3. REINFORCEMENT SHALL CONSIST OF WELDED WIRE FABRIC CONFORMING TO ASTM SPECIFICATION A 185 OR A 497, OR DEFORMED BILLET STEEL BARS CONFORMING TO ASTM SPECIFICATION A 615, GRADE 60. LONGITUDINAL DISTRIBUTION REINFORCEMENT MAY CONSIST OF WELDED WIRE FABRIC OR DEFORMED BILLET-STEEL BARS.
   3.3. STEEL HARDWARE
      3.3.1. BOLTS AND THREADED RODS FOR WINGWALL CONNECTIONS SHALL CONFORM TO ASTM A 307. NUTS SHALL CONFORM TO AASHTO M292 (ASTM A194) GRADE 2H. ALL BOLTS, THREADED RODS AND NUTS USED IN WINGWALL CONNECTIONS SHALL BE MECHANICALLY ZINC COATED IN ACCORDANCE WITH ASTM B695 CLASS 50.
      3.3.2. STRUCTURAL STEEL FOR WINGWALL CONNECTION PLATES AND PLATE WASHERS SHALL CONFORM TO AASHTO M 270 (ASTM A 709) GRADE 36 AND SHALL BE HOT DIP GALVANIZED AS PER AASHTO M111 (ASTM A123).
      3.3.3. INSERTS FOR WINGWALLS SHALL BE 1" DIAMETER TWO-BOLT PRESET WINGWALL ANCHORS AS MANUFACTURED BY DAYTON SUPERIOR CONCRETE ACCESSORIES, MIAMISBURG, OHIO, (800) 745-3700 AND SHALL BE MECHANICALLY ZINC COATED IN ACCORDANCE WITH ASTM B695 CLASS 50.
      3.3.4. FERRULE LOOP INSERTS SHALL BE F-64 FERRULE LOOP INSERTS AS MANUFACTURED BY DAYTON SUPERIOR CONCRETE ACCESSORIES, MIAMISBURG, OHIO, (800) 745-3700.
      3.3.5. HOOK BOLTS USED IN ATTACHED HEADWALL CONNECTIONS SHALL BE ASTM A307.
      3.3.6. INSERTS FOR DETACHED HEADWALL CONNECTIONS SHALL BE AISI TYPE 304 STAINLESS STEEL, EXPANDED COIL INSERTS AS MANUFACTURED BY DAYTON SUPERIOR CONCRETE ACCESSORIES, MIAMISBURG, OHIO, (800) 745-3700. COIL RODS AND NUTS USED IN HEADWALL CONNECTIONS SHALL BE AISI TYPE 304 STAINLESS STEEL. WASHERS USED IN HEADWALL CONNECTIONS SHALL BE EITHER AISI TYPE 304 STAINLESS STEEL PLATE WASHERS OR AASHTO M270 (ASTM A709) GRADE 36 PLATE WASHERS HOT DIP GALVANIZED AS PER AASHTO M111 (ASTM A123).
      3.3.7. MECHANICAL SPLICES OF REINFORCING BARS SHALL BE MADE USING THE DOWEL BAR SPLICER SYSTEM AS MANUFACTURED BY DAYTON SUPERIOR CONCRETE ACCESSORIES, MIAMISBURG, OHIO, (800) 745-3700, AND SHALL CONSIST OF THE DOWEL BAR SPLICER (DB-SAE) AND DOWEL-IN (DI).

4. MANUFACTURE OF PRECAST ELEMENTS - SUBJECT TO THE PROVISIONS OF SECTION 5, BELOW, THE PRECAST ELEMENT DIMENSION AND REINFORCEMENT DETAILS SHALL BE AS PRESCRIBED IN THE PLAN AND SHOP DRAWINGS PROVIDED BY THE MANUFACTURER.
   4.1. FORMS - THE FORMS USED IN MANUFACTURE SHALL BE SUFFICIENTLY RIGID AND ACCURATE TO MAINTAIN THE REQUIRED PRECAST ELEMENT DIMENSIONS WITHIN THE PERMISSIBLE VARIATIONS GIVEN IN SECTION 5 OF THESE SPECIFICATIONS. ALL CASTING SURFACES SHALL BE OF A SMOOTH MATERIAL.
   4.2. PLACEMENT OF REINFORCEMENT
      4.2.1. PLACEMENT OF REINFORCEMENT IN PRECAST BRIDGE UNITS - THE COVER OF CONCRETE OVER THE OUTSIDE CIRCUMFERENTIAL REINFORCEMENT SHALL BE 2" MINIMUM. THE COVER OF CONCRETE OVER THE INSIDE CIRCUMFERENTIAL REINFORCEMENT SHALL BE 1½" MINIMUM, UNLESS OTHERWISE NOTED ON THE SHOP DRAWINGS. THE CLEAR DISTANCE OF THE END CIRCUMFERENTIAL WIRES SHALL NOT BE LESS THAN 1" NOR MORE THAN 2" FROM THE ENDS OF EACH SECTION. REINFORCEMENT SHALL BE ASSEMBLED UTILIZING SINGLE OR MULTIPLE LAYERS OF WELDED WIRE FABRIC (NOT TO EXCEED 3 LAYERS), SUPPLEMENTED WITH A SINGLE LAYER OF DEFORMED BILLET-STEEL BARS, WHEN NECESSARY. WELDED WIRE FABRIC SHALL BE COMPOSED OF CIRCUMFERENTIAL AND LONGITUDINAL WIRES MEETING THE SPACING REQUIREMENTS OF 4.3, BELOW, AND SHALL CONTAIN SUFFICIENT LONGITUDINAL WIRES EXTENDING THROUGH THE BRIDGE UNIT TO MAINTAIN THE SHAPE AND POSITION OF THE REINFORCEMENT. LONGITUDINAL DISTRIBUTION REINFORCEMENT MAY BE WELDED WIRE FABRIC OR DEFORMED BILLET-STEEL BARS AND SHALL MEET THE SPACING REQUIREMENTS OF 4.3, BELOW. THE ENDS OF THE LONGITUDINAL DISTRIBUTION REINFORCEMENT SHALL BE NOT MORE THAN 3" AND NOT LESS THAN 1½" FROM THE ENDS OF THE BRIDGE UNIT.
      4.2.2. BENDING OF REINFORCEMENT FOR PRECAST BRIDGE UNITS - THE OUTSIDE AND INSIDE CIRCUMFERENTIAL REINFORCING STEEL FOR THE CORNERS OF THE BRIDGE SHALL BE BENT TO SUCH AN ANGLE THAT IS APPROXIMATELY EQUAL TO THE CONFIGURATION OF THE BRIDGE'S OUTSIDE CORNER.
      4.2.3. PLACEMENT OF REINFORCEMENT FOR PRECAST WINGWALLS AND HEADWALLS - THE COVER OF CONCRETE OVER THE LONGITUDINAL AND TRANSVERSE REINFORCEMENT SHALL BE 2" MINIMUM. THE CLEAR DISTANCE FROM THE END OF EACH PRECAST ELEMENT TO THE END OF REINFORCING STEEL SHALL NOT BE LESS THAN 1½" NOR MORE THAN 3". REINFORCEMENT SHALL BE ASSEMBLED UTILIZING A SINGLE LAYER OF WELDED WIRE FABRIC, OR A SINGLE LAYER OF DEFORMED BILLET-STEEL BARS. WELDED WIRE FABRIC SHALL BE COMPOSED OF TRANSVERSE AND LONGITUDINAL WIRES MEETING THE SPACING REQUIREMENTS OF 4.3, BELOW, AND SHALL CONTAIN SUFFICIENT LONGITUDINAL WIRES EXTENDING THROUGH THE ELEMENT TO MAINTAIN THE SHAPE AND POSITION OF THE REINFORCEMENT. LONGITUDINAL REINFORCEMENT MAY BE WELDED WIRE FABRIC OR DEFORMED BILLET-STEEL BARS AND SHALL MEET THE SPACING REQUIREMENTS OF 4.3, BELOW.
      4.2.4. PLACEMENT OF REINFORCEMENT FOR PRECAST FOUNDATION UNITS - THE COVER OF CONCRETE OVER THE BOTTOM REINFORCEMENT SHALL BE 3 INCHES MINIMUM. THE COVER OF CONCRETE FOR ALL OTHER REINFORCEMENT SHALL BE 2 INCHES MINIMUM. THE CLEAR DISTANCE FROM THE END OF EACH PRECAST ELEMENT TO THE END OF REINFORCING STEEL SHALL NOT BE LESS THAN 2 INCHES NOR MORE THAN 3 INCHES. REINFORCEMENT SHALL BE ASSEMBLED UTILIZING A SINGLE LAYER OF WELDED WIRE FABRIC OR A SINGLE LAYER OF DEFOREMED BILLET-STEEL BARS. WELDED WIRE FABRIC SHALL BE COMPOSED OF TRANSVERSE AND LONGITUDINAL WIRES MEETING THE SPACING REQUIREMENTS OF 4.3, BELOW, AND SHALL CONTAIN SUFFICIENT LONGITUDINAL WIRES EXTENDING THROUGH THE ELEMENT TO MAINTAIN THE SHAPE AND POSITION OF THE REINFORCEMENT. LONGITUDINAL REINFORCEMENT MAY BE WELDED WIRE FABRIC OR DEFORMED BILLET-STEEL BARS AND SHALL MEET THE SPACING REQUIREMENTS OF 4.3, BELOW.
   4.3. LAPS, WELDS, SPACING
      4.3.1. LAPS, WELDS, AND SPACING FOR PRECAST BRIDGE UNITS - TENSION SPLICES IN THE CIRCUMFERENTIAL REINFORCEMENT SHALL BE MADE BY LAPPING. LAPS MAY BE TACK WELDED TOGETHER FOR ASSEMBLY PURPOSES. FOR SMOOTH WELDED WIRE FABRIC, THE OVERLAP SHALL MEET THE REQUIREMENTS OF AASHTO 5.11.2.5.2 AND 5.11.6.2. FOR DEFORMED WELDED WIRE FABRIC, THE OVERLAP SHALL MEET THE REQUIREMENTS OF AASHTO 5.11.2.5.1 AND 5.11.6.1. THE OVERLAP OF WELDED WIRE FABRIC SHALL BE MEASURED BETWEEN THE OUTER-MOST LONGITUDINAL WIRES OF EACH FABRIC SHEET. FOR DEFORMED BILLET-STEEL BARS, THE OVERLAP SHALL MEET THE REQUIREMENTS OF AASHTO 5.11.2.1 FOR SPLICES OTHER THAN TENSION SPLICES, THE OVERLAP SHALL BE A MINIMUM OF 1'-0" FOR WELDED WIRE FABRIC OR DEFORMED BILLET-STEEL BARS. THE SPACING CENTER TO CENTER OF THE CIRCUMFERENTIAL WIRES IN A WIRE FABRIC SHEET SHALL BE NOT LESS THAN 2" NOR MORE THAN 4". THE SPACING CENTER TO CENTER OF THE LONGITUDINAL WIRES SHALL NOT BE MORE THAN 8". THE SPACING CENTER TO CENTER OF THE LONGITUDINAL DISTRIBUTION STEEL FOR EITHER LINE OF REINFORCING IN THE TOP SLAB SHALL BE NOT MORE THAN 1'-4".
      4.3.2. LAPS, WELDS, AND SPACING FOR PRECAST WINGWALLS, HEADWALLS AND FOUNDATIONS - SPLICES IN THE REINFORCEMENT SHALL BE MADE BY LAPPING. LAPS MAY BE TACK WELDED TOGETHER FOR ASSEMBLY PURPOSES. FOR SMOOTH WELDED WIRE FABRIC, THE OVERLAP SHALL MEET THE REQUIREMENTS OF AASHTO 5.11.2.5.2 AND 5.11.6.2. FOR DEFORMED WELDED WIRE FABRIC, THE OVERLAP SHALL MEET THE REQUIREMENTS OF AASHTO 5.11.2.5.1 AND 5.11.6.1. FOR DEFORMED BILLET-STEEL BARS, THE OVERLAP SHALL MEET THE REQUIREMENTS OF AASHTO 5.11.2.1. THE SPACING CENTER-TO-CENTER OF THE WIRES IN A WIRE FABRIC SHEET SHALL BE NOT LESS THAN 2" NOR MORE THAN 8".
   4.4. CURING - THE PRECAST CONCRETE ELEMENTS SHALL BE CURED FOR A SUFFICIENT LENGTH OF TIME SO THAT THE CONCRETE WILL DEVELOP THE SPECIFIED COMPRESSIVE STRENGTH IN 28 DAYS OR LESS. ANY ONE OF THE FOLLOWING METHODS OF CURING OR COMBINATIONS THERE OF SHALL BE USED:
      4.4.1. STEAM CURING - THE PRECAST ELEMENTS MAY BE LOW-PRESSURE STEAM CURED BY A SYSTEM THAT WILL MAINTAIN A MOIST ATMOSPHERE.
      4.4.2. WATER CURING - THE PRECAST ELEMENTS MAY BE WATER CURED BY ANY METHOD THAT WILL KEEP THE SECTIONS MOIST.
      4.4.3. MEMBRANE CURING - A SEALING MEMBRANE CONFORMING TO THE REQUIREMENTS OF ASTM SPECIFICATION C309 MAY BE APPLIED AND SHALL BE LEFT INTACT UNTIL THE REQUIRED CONCRETE COMPRESSIVE STRENGTH IS ATTAINED. THE CONCRETE TEMPERATURE AT THE TIME OF APPLICATION SHALL BE WITHIN +/- 10 DEGREES F OF THE ATMOSPHERIC TEMPERATURE. ALL SURFACES SHALL BE KEPT MOIST PRIOR TO THE APPLICATION OF THE COMPOUNDS AND SHALL BE DAMP WHEN THE COMPOUND IS APPLIED.
   4.5. STORAGE, HANDLING & DELIVERY
      4.5.1. STORAGE - PRECAST CONCRETE BRIDGE ELEMENTS SHALL BE LIFTED AND STORED IN "AS-CAST" POSITION. PRECAST CONCRETE HEADWALL AND WINGWALL UNITS ARE CAST, STORED AND SHIPPED IN A FLAT POSITION. THE PRECAST ELEMENTS SHALL BE STORED IN SUCH A MANNER TO PREVENT CRACKING OR DAMAGE. STORE ELEMENTS USING TIMBER SUPPORTS AS APPROPRIATE. THE UNITS SHALL NOT BE MOVED UNTIL THE CONCRETE COMPRESSIVE STRENGTH HAS REACHED A MINIMUM OF 2500 PSI, AND THEY SHALL NOT BE STORED IN AN UPRIGHT POSITION.
      4.5.2. HANDLING - HANDLING DEVICES SHALL BE PERMITTED IN EACH PRECAST ELEMENT FOR THE PURPOSE OF HANDLING AND SETTING. SPREADER BEAMS MAY BE REQUIRED FOR THE LIFTING OF PRECAST CONCRETE BRIDGE ELEMENTS TO PRECLUDE DAMAGE FROM BENDING OR TORSION FORCES.
      4.5.3. DELIVERY - PRECAST CONCRETE ELEMENTS MUST NOT BE SHIPPED UNTIL THE CONCRETE HAS ATTAINED THE SPECIFIED DESIGN COMPRESSIVE STRENGTH, OR AS DIRECTED BY THE DESIGN ENGINEER. PRECAST CONCRETE ELEMENTS MAY BE UNLOADED AND PLACED ON THE GROUND AT THE SITE UNTIL INSTALLED. STORE ELEMENTS USING TIMBER SUPPORTS AS APPROPRIATE.
   4.6. QUALITY ASSURANCE - THE PRECASTER SHALL DEMONSTRATE ADHERENCE TO THE STANDARDS SET FORTH IN THE NPCA QUALITY CONTROL MANUAL. THE PRECASTER SHALL MEET EITHER SECTION 4.6.1 OR 4.6.2
      4.6.1. CERTIFICATION - THE PRECASTER SHALL BE CERTIFIED BY THE PRECAST/PRESTRESSED CONCRETE INSTITUTE PLANT CERTIFICATION PROGRAM OR THE NATIONAL PRECAST CONCRETE ASSOCIATION'S PLANT CERTIFICATION PROGRAM PRIOR TO AND DURING PRODUCTION OF THE PRODUCTS COVERED BY THIS SPECIFICATION.
      4.6.2. QUALIFICATIONS, TESTING AND INSPECTION
         4.6.2.1. THE PRECASTER SHALL HAVE BEEN IN THE BUSINESS OF PRODUCING PRECAST CONCRETE PRODUCTS SIMILAR TO THOSE SPECIFIED FOR A MINIMUM OF THREE YEARS. HE SHALL MAINTAIN A PERMANENT QUALITY CONTROL DEPARTMENT OR RETAIN AN INDEPENDENT TESTING AGENCY ON A CONTINUING BASIS. THE AGENCY SHALL ISSUE A REPORT, CERTIFIED BY A LICENSED ENGINEER, DETAILING THE ABILITY OF THE PRECASTER TO PRODUCE QUALITY PRODUCTS CONSISTENT WITH INDUSTRY STANDARDS.
         4.6.2.2. THE PRECASTER SHALL SHOW THAT THE FOLLOWING TESTS ARE PERFORMED IN ACCORDANCE WITH THE ASTM STANDARDS INDICATED. TESTS SHALL BE PERFORMED AS INDICATED IN SECTION 6 OF THESE SPECIFICATIONS.
            4.6.2.2.1. AIR CONTENT: C231 OR C173
            4.6.2.2.2. COMPRESSIVE STRENGTH: C31,C39,C497
         4.6.2.3. THE PRECASTER SHALL PROVIDE DOCUMENTATION DEMONSTRATING COMPLIANCE WITH THIS SECTION TO CONTECH® ENGINEERED SOLUTIONS AT REGULAR INTERVALS OR UPON REQUEST.
         4.6.2.4. THE OWNER MAY PLACE AN INSPECTOR IN THE PLANT WHEN THE PRODUCTS COVERED BY THIS SPECIFICATION ARE BEING MANUFACTURED.
      4.6.3. DOCUMENTATION - THE PRECASTER SHALL SUBMIT PRECAST PRODUCTION REPORTS TO CONTECH® ENGINEERED SOLUTIONS AS REQUIRED.

5. PERMISSIBLE VARIATIONS
   5.1. BRIDGE UNITS
      5.1.1. INTERNAL DIMENSIONS - THE INTERNAL DIMENSION SHALL VARY NOT MORE THAN 1% FROM THE DESIGN DIMENSIONS NOR MORE THAN 1½" WHICHEVER IS LESS.
      5.1.2. SLAB AND WALL THICKNESS - THE SLAB AND WALL THICKNESS SHALL NOT BE LESS THAN THAT SHOWN IN THE DESIGN BY MORE THAN ¼". A THICKNESS MORE THAN THAT REQUIRED IN THE DESIGN SHALL NOT BE CAUSE FOR REJECTION.
      5.1.3. LENGTH OF OPPOSITE SURFACES - VARIATIONS IN LAYING LENGTHS OF TWO OPPOSITE SURFACES OF THE BRIDGE UNIT SHALL NOT BE MORE THAN ½" IN ANY SECTION, EXCEPT WHERE BEVELED ENDS FOR LAYING OF CURVES ARE SPECIFIED BY THE PURCHASER.
      5.1.4. LENGTH OF SECTION - THE UNDERRUN IN LENGTH OF A SECTION SHALL NOT BE MORE THAN ½" IN ANY BRIDGE UNIT.
      5.1.5. POSITION OF REINFORCEMENT - THE MAXIMUM VARIATION IN POSITION OF THE REINFORCEMENT SHALL BE ± ½". IN NO CASE SHALL THE COVER OVER THE REINFORCEMENT BE LESS THAN ½" FOR THE OUTSIDE CIRCUMFERENTIAL STEEL OR BE LESS THAN 1" FOR THE INSIDE CIRCUMFERENTIAL STEEL AS MEASURED TO THE EXTERNAL OR INTERNAL SURFACE OF THE BRIDGE. THESE TOLERANCES OR COVER REQUIREMENTS DO NOT APPLY TO MATING SURFACES OF THE JOINTS.
      5.1.6. AREA OF REINFORCEMENT - THE AREAS OF STEEL REINFORCEMENT SHALL BE THE DESIGN STEEL AREAS AS SHOWN IN THE MANUFACTURER'S SHOP DRAWINGS. STEEL AREAS GREATER THAN THOSE REQUIRED SHALL NOT BE CAUSE FOR REJECTION. THE PERMISSIBLE VARIATION IN DIAMETER OF ANY REINFORCEMENT SHALL CONFORM TO THE TOLERANCES PRESCRIBED IN THE ASTM SPECIFICATION FOR THAT TYPE OF REINFORCEMENT.
   5.2. WINGWALLS & HEADWALLS
      5.2.1. WALL THICKNESS - THE WALL THICKNESS SHALL NOT VARY FROM THAT SHOWN IN THE DESIGN BY MORE THAN ½".
      5.2.2. LENGTH/HEIGHT OF WALL SECTIONS - THE LENGTH AND HEIGHT OF THE WALL SHALL NOT VARY FROM THAT SHOWN IN THE DESIGN BY MORE THAN ½".
      5.2.3. POSITION OF REINFORCEMENT - THE MAXIMUM VARIATION IN THE POSITION OF THE REINFORCEMENT SHALL BE ± ½". IN NO CASE SHALL THE COVER OVER THE REINFORCEMENT BE LESS THAN 1½".
      5.2.4. SIZE OF REINFORCEMENT - THE PERMISSIBLE VARIATION IN DIAMETER OF ANY REINFORCING SHALL CONFORM TO THE TOLERANCES PRESCRIBED IN THE ASTM SPECIFICATION FOR THAT TYPE OF REINFORCING. STEEL AREA GREATER THAN THAT REQUIRED SHALL NOT BE CAUSE FOR REJECTION.
   5.3. FOUNDATION UNITS
      5.3.1. WALL THICKNESS - THE WALL THICKNESS SHALL NOT VARY FROM THAT SHOWN IN THE DESIGN BY MORE THAN ½".
      5.3.2. LENGTH/ HEIGHT/WIDTH OF FOUNDATION SECTIONS - THE LENGTH, HEIGHT AND WIDTH OF THE FOUNDATION UNITS SHALL NOT VARY FROM THAT SHOWN IN THE DESIGN BY MORE THAN ½".
      5.3.3. POSITION OF REINFORCEMENT - THE MAXIMUM VARIATION IN THE POSITION OF THE REINFORCEMENT SHALL BE ± ½". IN NO CASE SHALL THE COVER OVER THE REINFORCEMENT BE LESS THAN 1½".
      5.3.4. SIZE OF REINFORCEMENT - THE PERMISSIBLE VARIATION IN DIAMETER OF ANY REINFORCING SHALL CONFORM TO THE TOLERANCES PRESCRIBED IN THE ASTM SPECIFICATION FOR THAT TYPE OF REINFORCING. STEEL AREA GREATER THAN THAT REQUIRED SHALL NOT BE CAUSE FOR REJECTION.

6. TESTING/ INSPECTION
   6.1. TESTING
      6.1.1. TYPE OF TEST SPECIMEN - CONCRETE COMPRESSIVE STRENGTH SHALL BE DETERMINED FROM COMPRESSION TESTS MADE ON CYLINDERS OR CORES. FOR CYLINDER TESTING, A MINIMUM OF 4 CYLINDERS SHALL BE TAKEN FOR EACH BRIDGE ELEMENT. EACH ELEMENT SHALL BE CONSIDERED SEPARATELY FOR THE PURPOSE OF TESTING AND ACCEPTANCE.
      6.1.2. COMPRESSION TESTING - CYLINDERS SHALL BE MADE AND TESTED AS PRESCRIBED BY THE ASTM C39 SPECIFICATION. CYLINDERS SHALL BE CURED IN THE SAME ENVIRONMENT AS THE BRIDGE ELEMENTS. CORES SHALL BE OBTAINED AND TESTED FOR COMPRESSIVE STRENGTH IN ACCORDANCE WITH THE PROVISIONS OF THE ASTM C42 SPECIFICATION.
      6.1.3. ACCEPTABILITY OF CYLINDER TESTS - WHEN THE AVERAGE COMPRESSIVE STRENGTH OF ALL CYLINDERS TESTED IS EQUAL TO OR GREATER THAN THE DESIGN COMPRESSIVE STRENGTH, AND NOT MORE THAN 10% OF THE CYLINDERS TESTED HAVE A COMPRESSIVE STRENGTH LESS THAN THE DESIGN CONCRETE STRENGTH, AND NO CYLINDER TESTED HAS A COMPRESSIVE STRENGTH LESS THAN 80% OF THE DESIGN COMPRESSIVE STRENGTH, THEN THE ELEMENT SHALL BE ACCEPTED. WHEN THE COMPRESSIVE STRENGTH OF THE CYLINDERS TESTED DOES NOT CONFORM TO THESE ACCEPTANCE CRITERIA, THE ACCEPTABILITY OF THE ELEMENT MAY BE DETERMINED AS DESCRIBED IN SECTION 6.1.4, BELOW.
      6.1.4. ACCEPTABILITY OF CORE TESTS - THE COMPRESSIVE STRENGTH OF THE CONCRETE IN A BRIDGE ELEMENT IS ACCEPTABLE WHEN THE AVERAGE CORE TEST STRENGTH IS EQUAL TO OR GREATER THAN THE DESIGN CONCRETE STRENGTH. WHEN THE COMPRESSIVE STRENGTH OF A CORE TESTED IS LESS THAN THE DESIGN CONCRETE STRENGTH, THE PRECAST ELEMENT FROM WHICH THAT CORE WAS TAKEN MAY BE RE-CORED. WHEN THE COMPRESSIVE STRENGTH OF THE RE-CORE IS EQUAL TO OR GREATER THAN THE DESIGN CONCRETE STRENGTH, THE COMPRESSIVE STRENGTH OF THE CONCRETE IN THAT BRIDGE ELEMENT IS ACCEPTABLE.
         6.1.4.1. WHEN THE COMPRESSIVE STRENGTH OF ANY RECORE IS LESS THAN THE DESIGN CONCRETE STRENGTH, THE PRECAST ELEMENT FROM WHICH THAT CORE WAS TAKEN SHALL BE REJECTED.
         6.1.4.2. PLUGGING CORE HOLES - THE CORE HOLES SHALL BE PLUGGED AND SEALED BY THE MANUFACTURER IN A MANNER SUCH THAT THE ELEMENTS WILL MEET ALL OF THE TEST REQUIREMENTS OF THIS SPECIFICATION. PRECAST ELEMENTS SO SEALED SHALL BE CONSIDERED SATISFACTORY FOR USE.
         6.1.4.3. TEST EQUIPMENT - EVERY MANUFACTURER FURNISHING PRECAST ELEMENTS UNDER THIS SPECIFICATION SHALL FURNISH ALL FACILITIES AND PERSONNEL NECESSARY TO CARRY OUT THE TEST REQUIRED.
   6.2. INSPECTION - THE QUALITY OF MATERIALS, THE PROCESS OF MANUFACTURE, AND THE FINISHED PRECAST ELEMENTS SHALL BE SUBJECT TO INSPECTION BY THE PURCHASER.

7. JOINTS
   THE BRIDGE UNITS SHALL BE PRODUCED WITH FLAT BUTT ENDS. THE ENDS OF THE BRIDGE UNITS SHALL BE SUCH THAT WHEN THE SECTIONS ARE LAID TOGETHER THEY WILL MAKE A CONTINUOUS LINE WITH A SMOOTH INTERIOR FREE OF APPRECIABLE IRREGULARITIES, ALL COMPATIBLE WITH THE PERMISSIBLE VARIATIONS IN SECTION 5, ABOVE. THE JOINT WIDTH BETWEEN ADJACENT PRECAST UNITS SHALL NOT EXCEED ¾".

8. WORKMANSHIP/ FINISH
   THE BRIDGE UNITS, WINGWALLS, HEADWALLS AND FOUNDATION UNITS SHALL BE SUBSTANTIALLY FREE OF FRACTURES. THE ENDS OF THE BRIDGE UNITS SHALL BE NORMAL TO THE WALLS AND CENTERLINE OF THE BRIDGE SECTION, WITHIN THE LIMITS OF THE VARIATIONS GIVEN IN SECTION 5, ABOVE, EXCEPT WHERE BEVELED ENDS ARE SPECIFIED. THE FACES OF THE WINGWALLS AND HEADWALLS SHALL BE PARALLEL TO EACH OTHER, WITHIN THE LIMITS OF VARIATIONS GIVEN IN SECTION 5, ABOVE. THE SURFACE OF THE PRECAST ELEMENTS SHALL BE A SMOOTH STEEL FORM OR TROWELED SURFACE. TRAPPED AIR POCKETS CAUSING SURFACE DEFECTS SHALL BE CONSIDERED AS PART OF A SMOOTH, STEEL FORM FINISH.

9. REPAIRS
   PRECAST ELEMENTS MAY BE REPAIRED, IF NECESSARY, BECAUSE OF IMPERFECTIONS IN MANUFACTURE OR HANDLING DAMAGE AND WILL BE ACCEPTABLE IF, IN THE OPINION OF THE PURCHASER, THE REPAIRS ARE SOUND, PROPERLY FINISHED AND CURED, AND THE REPAIRED SECTION CONFORMS TO THE REQUIREMENTS OF THIS SPECIFICATION.

10. REJECTION
    THE PRECAST ELEMENTS SHALL BE SUBJECT TO REJECTION ON ACCOUNT OF ANY OF THE SPECIFICATION REQUIREMENTS. INDIVIDUAL PRECAST ELEMENTS MAY BE REJECTED BECAUSE OF ANY OF THE FOLLOWING:
    10.1. FRACTURES OR CRACKS PASSING THROUGH THE WALL, EXCEPT FOR A SINGLE END CRACK THAT DOES NOT EXCEED ONE HALF THE THICKNESS OF THE WALL.
    10.2. DEFECTS THAT INDICATE PROPORTIONING, MIXING, AND MOLDING NOT IN COMPLIANCE WITH SECTION 4 OF THESE SPECIFICATIONS.
    10.3. HONEYCOMBED OR OPEN TEXTURE.
    10.4. DAMAGED ENDS, WHERE SUCH DAMAGE WOULD PREVENT MAKING A SATISFACTORY JOINT.

REQUIRES SEPARATE PERMIT.
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CON/SPAN BRIDGE SYSTEMS

DYOB DRAWING

SUNDARA RIDGE
TWIN 24 x 6
ORO VALLEY, AZ
B Series, 24' Span x 6' Rise

PROJECT No.:	DYO No.:	DATE:
16385	24776	4/12/23
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 50	OF 51	

SPECIFICATIONS FOR MANUFACTURE AND INSTALLATION OF CON/SPAN® BRIDGE SYSTEMS (CONT'D)

11. MARKING
EACH BRIDGE UNIT SHALL BE CLEARLY MARKED BY WATERPROOF PAINT. THE FOLLOWING SHALL BE SHOWN ON THE INSIDE OF THE VERTICAL LEG OF THE BRIDGE SECTION:
BRIDGE SPAN x BRIDGE RISE
DATE OF MANUFACTURE
NAME OR TRADEMARK OF THE MANUFACTURER

12. INSTALLATION PREPARATION
TO ENSURE CORRECT INSTALLATION OF THE PRECAST CONCRETE BRIDGE SYSTEM, CARE AND CAUTION MUST BE EXERCISED IN FORMING THE SUPPORT AREAS FOR BRIDGE UNITS, HEADWALL, AND WINGWALL ELEMENTS. EXERCISING SPECIAL CARE WILL FACILITATE THE RAPID INSTALLATION OF THE PRECAST COMPONENTS.

12.1. FOOTINGS
DO NOT OVER EXCAVATE FOUNDATIONS UNLESS DIRECTED BY SITE SOIL ENGINEER TO REMOVE UNSUITABLE SOIL.

THE SITE SOILS ENGINEER SHALL CERTIFY THAT THE BEARING CAPACITY MEETS OR EXCEEDS THE FOOTING DESIGN REQUIREMENTS, PRIOR TO THE CONTRACTOR POURING OF THE FOOTINGS.

THE BRIDGE UNITS AND WINGWALLS SHALL BE INSTALLED ON EITHER PRECAST OR CAST-IN-PLACE CONCRETE FOOTINGS. THE SIZE AND ELEVATION OF THE FOOTINGS SHALL BE AS DESIGNED BY THE ENGINEER. A KEYWAY SHALL BE FORMED IN THE TOP SURFACE OF THE BRIDGE FOOTING AS SPECIFIED ON THE PLANS. NO KEYWAY IS REQUIRED IN THE WINGWALL FOOTINGS, UNLESS OTHERWISE SPECIFIED ON THE PLANS.

THE FOOTINGS SHALL BE GIVEN A SMOOTH FLOAT FINISH AND SHALL REACH A COMPRESSIVE STRENGTH OF 2,000 PSI BEFORE PLACEMENT OF THE BRIDGE AND WINGWALL ELEMENTS. BACKFILLING SHALL NOT BEGIN UNTIL THE FOOTING HAS REACHED THE FULL DESIGN COMPRESSIVE STRENGTH.

THE FOOTING SURFACE SHALL BE CONSTRUCTED IN ACCORDANCE WITH GRADES SHOWN ON THE PLANS. WHEN TESTED WITH A 10'-0" STRAIGHT EDGE, THE SURFACE SHALL NOT VARY MORE THAN ¼" IN 10'-0".

IF A PRECAST CONCRETE FOOTING IS USED, THE CONTRACTOR SHALL PREPARE A 4" THICK BASE LAYER OF COMPACTED GRANULAR MATERIAL THE FULL WIDTH OF THE FOOTING PRIOR TO PLACING THE PRECAST FOOTING.

THE FOUNDATIONS FOR PRECAST CONCRETE BRIDGE ELEMENTS AND WINGWALLS MUST BE CONNECTED BY REINFORCEMENT TO FORM ONE MONOLITHIC BODY. EXPANSION JOINTS SHALL NOT BE USED.

THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONSTRUCTION OF THE FOUNDATIONS PER THE PLANS AND SPECIFICATIONS.

13. INSTALLATION
13.1. GENERAL - THE INSTALLATION OF THE PRECAST CONCRETE ELEMENTS SHALL BE AS EXPLAINED IN THE PUBLICATION CON/SPAN BRIDGE SYSTEMS INSTALLATION HANDBOOK.

13.1.1. LIFTING - IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE THAT A CRANE OF THE CORRECT LIFTING CAPACITY IS AVAILABLE TO HANDLE THE PRECAST CONCRETE UNITS. THIS CAN BE ACCOMPLISHED BY USING THE WEIGHTS GIVEN FOR THE PRECAST CONCRETE COMPONENTS AND BY DETERMINING THE LIFTING REACH FOR EACH CRANE UNIT. SITE CONDITIONS MUST BE CHECKED WELL IN ADVANCE OF SHIPPING TO ENSURE PROPER CRANE LOCATION AND TO AVOID ANY LIFTING RESTRICTIONS. THE LIFT ANCHORS OR HOLES PROVIDED IN EACH UNIT ARE THE ONLY MEANS TO BE USED TO LIFT THE ELEMENTS. THE PRECAST CONCRETE ELEMENTS MUST NOT BE SUPPORTED OR RAISED BY OTHER MEANS THAN THOSE GIVEN IN THE MANUALS AND DRAWINGS WITHOUT WRITTEN APPROVAL FROM CONTECH® ENGINEERED SOLUTIONS.

13.1.2. CONSTRUCTION EQUIPMENT WEIGHT RESTRICTIONS - IN NO CASE SHALL EQUIPMENT OPERATING IN EXCESS OF THE DESIGN LOAD (HL-93) BE PERMITTED OVER THE BRIDGE UNITS UNLESS APPROVED BY CONTECH® ENGINEERED SOLUTIONS.

13.1.2.1. IN THE IMMEDIATE AREA OF THE BRIDGE UNITS, THE FOLLOWING RESTRICTIONS FOR THE USE OF HEAVY CONSTRUCTION MACHINERY DURING BACKFILLING OPERATIONS APPLY:

- NO CONSTRUCTION EQUIPMENT SHALL CROSS THE BARE PRECAST CONCRETE BRIDGE UNIT.
- AFTER THE COMPACTED FILL LEVEL HAS REACHED A MINIMUM OF 4" OVER THE CROWN OF THE BRIDGE, CONSTRUCTION EQUIPMENT WITH A WEIGHT OF LESS THAN 10 TONS MAY CROSS THE BRIDGE.
- AFTER THE COMPACTED FILL LEVEL HAS REACHED A MINIMUM OF 1'-0" OVER THE CROWN OF THE BRIDGE, CONSTRUCTION EQUIPMENT WITH A WEIGHT OF LESS THAN 30 TONS MAY CROSS THE BRIDGE.
- AFTER THE COMPACTED FILL LEVEL HAS REACHED THE DESIGN COVER, OR 2'-0" MINIMUM, OVER THE CROWN OF THE PRECAST CONCRETE BRIDGE, CONSTRUCTION EQUIPMENT WITHIN THE DESIGN LOAD LIMITS FOR THE ROAD MAY CROSS THE PRECAST CONCRETE BRIDGE.

13.2. LEVELING PAD/SHIMS - THE BRIDGE UNITS AND WINGWALLS SHALL BE SET ON HARDBOARD SHIMS CONFORMING TO ASTM D1037 OR PLASTIC SHIMS (DAYTON SUPERIOR P-80, P-81 OR APPROVED EQUAL) MEASURING 5" x 5", MINIMUM, UNLESS SHOWN OTHERWISE ON THE PLANS. A MINIMUM GAP OF ½" SHALL BE PROVIDED BETWEEN THE FOOTING AND THE BOTTOM OF THE BRIDGE'S VERTICAL LEGS OR THE BOTTOM OF THE WINGWALL. ALSO, A SUPPLY OF ½", ½" AND ¼" THICK HARDBOARD OR PLASTIC SHIMS FOR VARIOUS SHIMMING PURPOSES SHALL BE ON SITE.

13.3• PLACEMENT OF BRIDGE UNITS - THE BRIDGE UNITS SHALL BE PLACED AS SHOWN ON THE ENGINEER'S PLAN DRAWINGS. SPECIAL CARE SHALL BE TAKEN IN SETTING THE ELEMENTS TO THE TRUE LINE AND GRADE. THE JOINT WIDTH BETWEEN ADJACENT PRECAST UNITS SHALL NOT EXCEED ¾".

13.4. IT IS THE CONTRACTOR'S RESPONSIBILITY TO MAINTAIN THE STRUCTURE SPAN DURING ALL PHASES OF INSTALLATION. DUE TO THE ARCH SHAPE, BRIDGE ELEMENTS WILL TEND TO SPREAD UNDER SELF-WEIGHT. IT IS IMPERATIVE THAT ANY LATERAL SPREADING OF THE BRIDGE ELEMENTS BE AVOIDED DURING AND AFTER THEIR PLACEMENT. GENERALLY, HORIZONTAL CABLE TIES OR TIE RODS ARE SHIPPED IN THE LARGER BRIDGE ELEMENTS TO ASSIST IN PREVENTING THIS SPREADING. CABLE TIES/TIE RODS SHALL NOT BE REMOVED UNTILL BRIDGE UNITS ARE GROUTED AND GROUT HAS CURED. IT IS RECOMMENDED THAT TEMPORARY HARDWOOD BLOCKS BE USED IN CONJUNCTION WITH THE CABLE TIES/TIE RODS TO MAINTAIN SPAN. IF, HOWEVER, DUE TO SITE RESTRICTIONS, THESE CABLE TIES/TIE RODS MUST BE REMOVED PRIOR TO PLACEMENT OF THE BRIDGE ELEMANTS, THE CONTRACTOR MUST NOTIFY CONTECH (MANUFACTURER) AND REQUEST A SUGGESTED INSTALLATION PROCEDURE.

IN ADDITION, IF THE CABLE TIES/TIE RODS MUST BE REMOVED PRIOR TO SETTING ARCH UNITS, THE FOLLOWING QUALITY CONTROL PROCEDURE MUST BE FOLLOWED:
1) FIND "MEASURED SPAN" UPON ARCH UNIT'S DELIVERY TO SITE, PRIOR TO LIFTING FROM TRUCK AND REMOVING CABLE TIES/TIE RODS. "MEASURED SPAN" SHALL BE THE AVERAGE OF (3) SPAN MEASUREMENTS ALONG THE LAY LENGTH OF THE ARCH UNIT.
2) AFTER SETTING OF BRIDGE UNIT ON THE FOUNDATION, VERIFY THE SPAN. THIS "INSTALLED SPAN MEASUREMENT" SHALL NOT EXCEED THE MAXIMUM OF:
A) THE NOMINAL SPAN +½" OR
B) THE "MEASURED SPAN"
IF THE "INSTALLED SPAN MEASUREMENT" EXCEEDS THIS AMOUNT, THE ARCH UNIT SHALL BE LIFTED AND RE-SET UNTIL THE "INSTALLED SPAN MEASUREMENT" MEETS THE LIMITS.

13.5. PLACEMENT OF WINGWALLS, HEADWALLS AND FOUNDATION UNITS - THE WINGWALLS, HEADWALLS AND FOUNDATIONS SHALL BE PLACED AS SHOWN ON THE PLAN DRAWINGS. SPECIAL CARE SHALL BE TAKEN IN SETTING THE ELEMENTS TO THE TRUE LINE AND GRADE.

13.6. WATERPROOFING/JOINT PROTECTION AND SUBSURFACE DRAINAGE

13.6.1. EXTERNAL PROTECTION OF JOINTS - THE BUTT JOINT MADE BY TWO ADJOINING BRIDGE UNITS SHALL BE COVERED WITH A 7" x 1⅛" PREFORMED BITUMINOUS JOINT SEALANT AND A MINIMUM OF A 9" WIDE JOINT WRAP. THE SURFACE SHALL BE FREE OF DIRT BEFORE APPLYING THE JOINT MATERIAL. A PRIMER COMPATIBLE WITH THE JOINT WRAP TO BE USED SHALL BE APPLIED FOR A MINIMUM WIDTH OF 9" ON EACH SIDE OF THE JOINT. THE EXTERNAL WRAP SHALL BE CS212 BY CONCRETE SEALANTS INC., EZ-WRAP RUBBER BY PRESS-SEAL GASKET CORPORATION, SEAL WRAP BY MAR MAC MANUFACTURING CO. INC. OR APPROVED EQUAL. THE JOINT SHALL BE COVERED CONTINUOUSLY FROM THE BOTTOM OF ONE BRIDGE SECTION LEG, ACROSS THE TOP OF THE BRIDGE AND TO THE OPPOSITE BRIDGE SECTION LEG. ANY LAPS THAT RESULT IN THE JOINT WRAP SHALL BE A MINIMUM OF 6" LONG WITH THE OVERLAP RUNNING DOWNHILL.

13.6.2. IN ADDITION TO THE JOINTS BETWEEN BRIDGE UNITS, THE JOINT BETWEEN THE END BRIDGE UNIT AND THE HEADWALL SHALL ALSO BE SEALED AS DESCRIBED ABOVE. IF PRECAST WINGWALLS ARE USED, THE JOINT BETWEEN THE END BRIDGE UNIT AND THE WINGWALL SHALL BE SEALED WITH A 2'-0" STRIP OF FILTER FABRIC. ALSO, IF LIFT HOLES ARE FORMED IN THE BRIDGE UNITS, THEY SHALL BE PRIMED AND COVERED WITH A 9" x 9" SQUARE OF JOINT WRAP.

13.6.3. DURING THE BACKFILLING OPERATION, CARE SHALL BE TAKEN TO KEEP THE JOINT WRAP IN ITS PROPER LOCATION OVER THE JOINT.

13.6.4. SUBSOIL DRAINAGE SHALL BE AS DIRECTED BY THE ENGINEER.

13.7. GROUTING

13.7.1. GROUTING SHALL NOT BE PERFORMED WHEN TEMPERATURES ARE EXPECTED TO GO BELOW 35° FOR A PERIOD OF 72 HOURS. FILL THE BRIDGE-FOUNDATION KEYWAY WITH CEMENT GROUT (PORTLAND CEMENT AND WATER OR CEMENT MORTAR COMPOSED OF PORTLAND CEMENT, SAND AND WATER) WITH A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 3000 PSI. VIBRATE AS REQUIRED TO ENSURE THAT THE ENTIRE KEY AROUND THE BRIDGE ELEMENT IS COMPLETELY FILLED. IF BRIDGE ELEMENTS HAVE BEEN SET WITH TEMPORARY TIES (CABLES, BARS, ETC.) GROUT MUST ATTAIN A MINIMUM COMPRESSIVE STRENGTH OF 1500 PSI BEFORE TIES MAY BE REMOVED.

13.7.2. ALL GROUT SHALL HAVE A MAXIMUM AGGREGATE SIZE OF ¼".

13.7.3. LIFTING AND ERECTION ANCHOR RECESSES SHALL BE FILLED WITH GROUT.

13.7.4. AFTER GROUT HAS REACHED ITS DESIGN STRENGTH THE TEMPORARY HARDWOOD WEDGES SHALL BE REMOVED AND THEIR HOLES FILLED WITH GROUT.

13.8. BACKFILL

13.8.1. DO NOT PERFORM BACKFILLING DURING WET OR FREEZING WEATHER.

13.8.2. NO BACKFILL SHALL BE PLACED AGAINST ANY STRUCTURAL ELEMENTS UNTIL THEY HAVE BEEN APPROVED BY THE ENGINEER.

13.8.3. BACKFILL SHALL BE CONSIDERED AS ALL REPLACED EXCAVATION AND NEW EMBANKMENT ADJACENT TO THE PRECAST CONCRETE ELEMENTS. THE PROJECT CONSTRUCTION AND MATERIAL SPECIFICATIONS, WHICH INCLUDE THE SPECIFICATIONS FOR EXCAVATION FOR STRUCTURES AND ROADWAY EXCAVATION AND EMBANKMENT CONSTRUCTION, SHALL APPLY EXCEPT AS MODIFIED IN THIS SECTION.

13.8.4. BACKFILL ZONES:

- IN-SITU SOIL
- ZONE A: CONSTRUCTED EMBANKMENT OR OVERFILL.
- ZONE B: FILL THAT IS DIRECTLY ASSOCIATED WITH PRECAST CONCRETE BRIDGE INSTALLATION.
- ZONE C: ROAD STRUCTURE.

13.8.5. REQUIRED BACKFILL PROPERTIES

13.8.5.1. IN-SITU SOIL - NATURAL GROUND IS TO BE SUFFICIENTLY STABLE TO ALLOW EFFECTIVE SUPPORT TO THE PRECAST CONCRETE BRIDGE UNITS. AS A GUIDE, THE EXISTING NATURAL GROUND SHOULD BE OF SIMILAR QUALITY AND DENSITY TO ZONE B MATERIAL FOR MINIMUM LATERAL DIMENSION OF ONE BRIDGE SPAN OUTSIDE OF THE BRIDGE FOOTING.

13.8.5.2. ZONE A - ZONE A REQUIRES FILL MATERIAL WITH SPECIFICATIONS AND COMPACTING PROCEDURES EQUAL TO THAT FOR NORMAL ROAD EMBANKMENTS.

13.8.5.3. ZONE B - GENERALLY, SOILS SHALL BE REASONABLY FREE OF ORGANIC MATTER, AND, NEAR CONCRETE SURFACES, FREE OF STONES LARGER THAN 3" IN DIAMETER SEE CHARTS FOR DETAILED DESCRIPTIONS OF ACCEPTABLE SOILS.

13.8.5.4. ZONE C - ZONE C IS THE ROAD SECTION OF GRAVEL, ASPHALT OR CONCRETE BUILT IN COMPLIANCE WITH LOCAL ENGINEERING PRACTICES.

13.8.5.5. GEOTECHNICAL ENGINEER SHALL REVIEW GRADATIONS OF ALL INTERFACING MATERIALS AND, IF NECESSARY, RECOMMEND GEOTEXTILE FILTER FABRIC (PROVIDED BY CONTRACTOR)

13.8.6. PLACING AND COMPACTING BACKFILL
DUMPING FOR BACKFILLING IS NOT ALLOWED ANY NEARER THAN 3'-0" FROM THE BRIDGE LEG.

THE FILL MUST BE PLACED AND COMPACTED IN LAYERS NOT EXCEEDING 8". THE MAXIMUM DIFFERENCE IN THE SURFACE LEVELS OF THE FILL ON OPPOSITE SIDES OF THE BRIDGE MUST NOT EXCEED 2'-0".

THE FILL BEHIND WINGWALLS MUST BE PLACED AT THE SAME TIME AS THAT OF THE BRIDGE FILL. IT MUST BE PLACED IN PROGRESSIVELY PLACED HORIZONTAL LAYERS NOT EXCEEDING 8" PER LAYER.

THE BACKFILL OF ZONE B SHALL BE COMPACTED TO A MINIMUM DENSITY OF 95% OF THE STANDARD PROCTOR, AS REQUIRED BY AASHTO T-99.

SOIL WITHIN 1'-0" OF CONCRETE SURFACES SHALL BE HAND-COMPACTED. ELSEWHERE, USE OF ROLLERS IS ACCEPTABLE. IF VIBRATING ROLLER-COMPACTORS ARE USED, THEY SHALL NOT BE STARTED OR STOPPED WITHIN ZONE B AND THE VIBRATION FREQUENCY SHOULD BE AT LEAST 30 REVOLUTIONS PER SECOND.

THE BACKFILL MATERIAL AND COMPACTING BEHIND WINGWALLS SHALL SATISFY THE CRITERIA FOR THE BRIDGE BACKFILL, ZONE B.

BACKFILL AGAINST A WATERPROOFED SURFACE SHALL BE PLACED CAREFULLY TO AVOID DAMAGE TO THE WATERPROOFING MATERIAL.

13.8.7. BRIDGE UNITS
FOR FILL HEIGHTS OVER 12 FEET (AS MEASURED FROM TOP CROWN OF BRIDGE TO FINISHED GRADE), NO BACKFILLING MAY BEGIN UNTIL A BACKFILL COMPACTION TESTING PLAN HAS BEEN COORDINATED WITH AND APPROVED BY CONTECH® ENGINEERED SOLUTIONS.

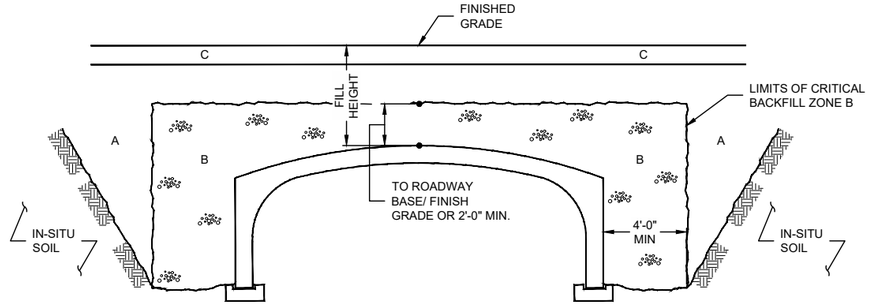
13.8.8. WINGWALLS
BACKFILL IN FRONT OF WINGWALLS SHALL BE CARRIED TO GROUND LINES SHOWN IN THE PLANS.

13.8.9. MONITORING
THE CONTRACTOR SHALL CHECK SETTLEMENTS AND HORIZONTAL DISPLACEMENT OF FOUNDATION TO ENSURE THAT THEY ARE WITHIN THE ALLOWABLE LIMIT PROVIDED BY THE ENGINEER. THESE MEASUREMENTS SHOULD GIVE AN INDICATION OF THE SETTLEMENTS AND DEFORMATIONS ALONG THE LENGTH OF THE FOUNDATIONS.

THE FIRST MEASUREMENT SHOULD TAKE PLACE AFTER THE ERECTION OF ALL PRECAST BRIDGE SYSTEM ELEMENTS, A SECOND AFTER COMPLETION OF BACKFILLING, AND A THIRD BEFORE OPENING OF THE BRIDGE TO TRAFFIC. FURTHER MEASUREMENTS MAY BE MADE ACCORDING TO LOCAL CONDITIONS.

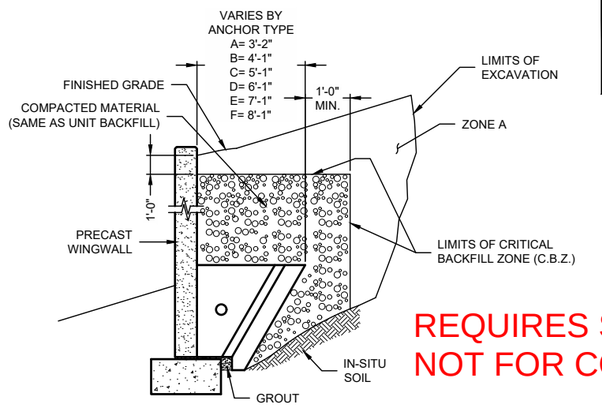
ACCEPTABLE SOILS FOR USE IN ZONE B BACKFILL

TYPICAL USCS MATERIALS	AASHTO GROUP	AASHTO SUBGROUP	PERCENT PASSING US SIEVE NO.			CHARACTER OF FRACTION PASSING NO. 40 SIEVE		SOIL DESRIPTION
			#10	#40	#200	LIQUID LIMIT	PLASTICITY INDEX	
GW, GP, SP	A1	A-1a	50 MAX	30 MAX	15 MAX		6 MAX	LARGELY GRAVEL BUT CAN INCLUDE SAND AND FINES
GM, SW, SP, SM		A-1b		50 MAX	25 MAX		6 MAX	GRAVELLY SAND OR GRADED SAND, MAY INCLUDE FINES
GM, SM, ML, SP, GP	A2	A-2-4			35 MAX	40 MAX	10 MAX	SANDS, GRAVELS WITH LOW-PLASTICITY SILT FINES
SC, GC, GM		A-2-5			35 MAX	41 MIN	10 MAX	SANDS, GRAVELS WITH PLASTIC SILT FINES
SP, SM, SW	A3			51 MIN	10 MAX		NON-PLASTIC	FINE SANDS
ML, SM, SC	A4				36 MIN	40 MAX	10 MAX	LOW-COMPRESSIBILTY SILTS

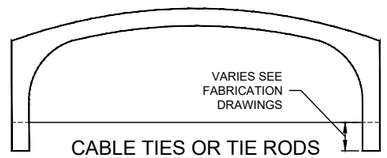


SPAN	FILL HEIGHT	ACCEPTABLE MATERIAL INSIDE ZONE B
≤ 24'-0"	≥ 12'-0"	A1, A3
≤ 24'-0"	< 12'-0"	A1, A2, A3, A4
> 24'-0"	ALL	A1, A3

BACKFILL REQUIREMENTS



WALL BACKFILL REQUIREMENTS



CABLE TIES OR TIE RODS

(> 24'-0" SPAN)

REQUIRES SEPARATE PERMIT.
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CON/SPAN BRIDGE SYSTEMS

DYOB
DRAWING

SUNDARA RIDGE
TWIN 24 x 6
ORO VALLEY, AZ
B Series, 24' Span x 6' Rise

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16385	24776	4/12/23
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 51	OF 51	