HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

MASTER WATER REPORT

FOR

LEVINE GENERAL MOTORS 170

MESA, ARIZONA

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REGISTERED PROFESSIONAL ENGINEER (CIVIL)
CERTIFICATE NO.
50462
MARK K.
IPSON
Date Signed 5-11-19
ARIZONA, U.S.A.

May 2019
Project No. 2063.01

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FIGURES

TABLES

1.0 EXECUTIVE SUMMARY

Levine General Motors 170 (the Project) is a proposed approximate 157.2-acre master planned mixed-use development generally located west of 22nd Street, east of Crismon Road, north of the future SR-24 alignment (Frye Road) and south of Williams Field Road in the City of Mesa, Arizona. The Project will consist of up to 1,191 residential units, approximately 11.0 acres of commercial land use, and approximately 36.4 acres of developed open space.

This Master Water Report has been prepared in support of the General Plan Amendment (GPA) for the Project. This report identifies and evaluates the proposed water system infrastructure for serving the Project in accordance with City of Mesa design criteria. Estimated water demands for the Project have been calculated based on the proposed land uses and current City design criteria. This report also identifies the anticipated average day, maximum day, peak hour, and maximum day plus fire flow demands.

The Project lies within the Desert Wells water service zone. The proposed water system has been designed in accordance with current City of Mesa design criteria as outlined in the City's *Engineering Procedure Manual: 2017 Engineering & Design Standards* (City of Mesa, 2017). The average day, maximum day, and peak hour demands anticipated for the Project are 527,562 gpd (366.4 gpm), 894,964 gpd (621.5 gpm), and 1,262,366 gpd (876.6 gpm), respectively.

The water system identified in this report will comprise the backbone of the Project's water system and consists of proposed looped 8-inch water distribution mains. The Project will be served by the Brown Road Water Treatment Plant (BRWTP) and the Signal Butte Water Treatment Plant (SBWTP). It is anticipated that the water infrastructure serving the Project will be owned and operated by the City of Mesa.

The Project is anticipated to be developed in phases and the water system infrastructure will similarly be constructed in phases as required to serve each parcel in the Project. As such, the offsite water infrastructure required to serve the Project will be constructed at the same time each parcel is developed. Furthermore, the water mains that are installed in each phase will be sized for build-out conditions.

A hydraulic model was prepared for the proposed water system for average day, maximum day, peak hour, and maximum day plus fire flow conditions. The model results show the proposed water system meets current City of Mesa design criteria and can adequately convey projected demands throughout the development.

2.0 INTRODUCTION

1.1 Background and Project Location

Levine General Motors 170 (the Project) is located in the City of Mesa (the City) within Section 35 of Township 1 South, Range 7 East of the Gila and Salt River Base and Meridian. The Project is comprised of an approximate 157.2-acre mixed-use development in the larger Pacific Proving Grounds development. The Project is generally bound by Williams Field Road on the north, Crismon Road on the west, the future SR-24 alignment on the south, and 22nd Street on the east.

Figure 1 in Appendix A provides a vicinity map for the Project.

1.2 General Description

The Project is planned as a mixed-use development, which will include single family, medium density, and high density residential areas, parks and open space, along with commercial areas. The site currently consists completely of undeveloped desert rangeland. The site generally slopes from east to west at approximately 0.4 percent. Portions of the Project are within the City limits, with the remaining area under the jurisdiction of Maricopa County. It is assumed the areas within Maricopa County will be annexed into the City of Mesa and a General Plan Amendment and PAD Rezone will be processed and approved by the City.

The Project is located within the City of Mesa water service area within the Desert Wells service zone (pressure zone). Water infrastructure for the Project will be owned and operated by the City of Mesa.

1.3 Purpose of Report

This Master Water Report has been prepared in support of the General Plan Amendment for Levine General Motors 170. The purpose of this Master Water Report is to identify and evaluate the proposed water infrastructure and distribution system required to serve the Project based on the current land use plan and current City of Mesa design standards.

This report identifies the projected water demands for the Project for average day, maximum day, peak hour, and maximum day plus fire flow conditions. It also presents results from a hydraulic model of the proposed water infrastructure. The demand calculations presented in this Master Water Report are based on the current land uses planned for each parcel. As the Project progresses into the pre-plat phase, the demand calculations for the Project will be refined and the projected demands may change. The water analysis presented in this report is based on the City of Mesa *Engineering Procedure Manual: 2017 Engineering & Design Standards* (City of Mesa, 2017).

1.4 Previous Studies

There are no known previous water studies or plans for the Project site.

3.0 DESIGN CRITERIA

3.1 City of Mesa Design Criteria

The proposed water system for the Project has been designed in accordance with current City of Mesa design criteria as outlined in the City of Mesa *Engineering Procedure Manual: 2017 Engineering & Design Standards* (City of Mesa, 2017). A summary of the design criteria is provided in Table 1.

TABLE 1 WATER SYSTEM DESIGN CRITERIA			
Category		**Value**	**Unit**
Population Density			
	Medium Density Residential (LDR) (2-4 DU/acre)	3.0	per dwelling unit
	Medium Density Residential (LMDR) (4-6 DU/acre)	3.2	per dwelling unit
	Medium Density Residential (MDR) (6-10 DU/acre)	2.7	per dwelling unit
	High Density Residential (MHDR) (10-15 DU/acre)	2.0	per dwelling unit
	High Density Residential (HDR) (15+ DU/acre)	1.7	per dwelling unit
Demand Factors			
	Medium Density Residential (LDR) (2-4 DU/acre)	420	gpd/du
	Medium Density Residential (LMDR) (4-6 DU/acre)	400	gpd/du
	Medium Density Residential (MDR) (6-10 DU/acre)	254	gpd/du
	High Density Residential (MHDR) (10-15 DU/acre)	194	gpd/du
	High Density Residential (HDR) (15+ DU/acre)	154	gpd/du
	Commercial, Office, Industrial, Research & Development	1,500	gpad
Peaking Factors			
	Maximum Day	2.0	x Average Day Demand
	Peak Hour	3.0	x Average Day Demand
Peaking Factors (Developed Open Space)			
	Maximum Day	N/A	
	Peak Hour	N/A	
Average Day, Maximum Day, and Peak Hour System Performance			
	Minimum Pressure (static)	40	psi
	Maximum Pressure*	80	psi
	Maximum Velocity	5	fps
Maximum Day + Fire Flow System Performance			
	Minimum Pressure	20	psi
	Maximum Velocity	10	fps
	Residential Fire Flow**	1,500	gpm for 2 hours
	Commercial/Industrial Fire Flow**	3,000	gpm for 2 hours
Minimum Pipe Diameter		8	inches
Hazen Williams ‘C’ Factor		130	

<u>Notes:</u>
*Any structure experiencing pressures greater than 80 psi shall have an individual PRV.
** Fire Flow based on City of Mesa Fire Code

4.0 WATER DEMANDS

4.1 Land Use

The Project will consist of up to 1,191 residential units and up to 11.0 acres of non-residential commercial uses. The Project will also incorporate approximately 36.4 acres of open space including parks and amenities. Land use allocations and densities are assumed from the *Levine General Motors 170 Community Plan* (Greey Pickett, 2018). Figure 2 in Appendix A shows the anticipated land uses and densities throughout the Project. Table 2 below summarizes these anticipated land uses and Table B.1 in Appendix B shows the land use budget for each parcel within the Project. Land uses, areas, densities, and dwelling unit counts are subject to change as the Project moves from master planning to preliminary and final design.

TABLE 2
PROPOSED LAND USE SUMMARY

Parcel	Proposed Land Use	Gross Area	Open Space	Assumed Density	Potential Dwelling Units	Commercial Area
		(ac)	(ac)	(du/ac)	(du)	(ac)
A	Commercial	11.0	1.1	-	-	11.0
B	High Density Residential (HDR)	7.0	1.4	20.0	140	-
C	High Density Residential (HDR)	11.0	2.2	20.0	220	-
D	Medium Density Residential (MDR)	13.5	2.7	10.0	135	-
E	Low/Medium Density Residential (LMDR)	9.3	1.9	6.0	56	-
F	Low/Medium Density Residential (LMDR)	10.4	2.1	6.0	63	-
G	Low/Medium Density Residential (LMDR)	12.3	2.5	6.0	74	-
H	Low/Medium Density Residential (LMDR)	8.8	1.8	6.0	53	-
I	Low/Medium Density Residential (LMDR)	18.2	3.7	6.0	110	-
J	Low/Medium Density Residential (LMDR)	13.8	2.8	6.0	83	-
K	Low/Medium Density Residential (LMDR)	11.8	2.4	6.0	71	-
L	Low/Medium Density Residential (LMDR)	11.2	2.3	6.0	68	-
M	Medium Density Residential (MDR)	11.8	2.4	10.0	118	-
Parks	Parks/Open Space	7.1	7.1	-	-	-
GRAND TOTAL:		**157.2**	**36.4**	**-**	**1,191**	**11.0**

4.2 Water Demand Calculations

Anticipated water demands for the Project have been calculated in accordance with the design criteria listed in Table 1 and the land uses and densities listed in Table 2. A summary of the total water demands for the Project is presented in Table 3 below. Table B.1 in Appendix B presents more detailed water demand calculations for the Project.

TABLE 3
TOTAL WATER DEMAND SUMMARY

Parcel	Average Day Demand		Maximum Day Demand		Peak Hour Demand	
	gpd	gpm	gpd	gpm	gpd	gpm
A	21,340	14.8	37,840	26.3	54,340	37.7
B	27,720	19.3	49,280	34.2	70,840	49.2
C	43,560	30.3	77,440	53.8	111,320	77.3
D	46,170	32.1	80,460	55.9	114,750	79.7
E	30,760	21.4	53,160	36.9	75,560	52.5
F	34,440	23.9	59,640	41.4	84,840	58.9
G	40,600	28.2	70,200	48.8	99,800	69.3
H	29,120	20.2	50,320	34.9	71,520	49.7
I	60,280	41.9	104,280	72.4	148,280	103.0
J	45,520	31.6	78,720	54.7	111,920	77.7
K	38,960	27.1	67,360	46.8	95,760	66.5
L	37,320	25.9	64,520	44.8	91,720	63.7
M	40,532	28.1	70,504	49.0	100,476	69.8
Parks	31,240	21.7	31,240	21.7	31,240	21.7
GRAND TOTAL:	527,562	366.4	894,964	621.5	1,262,366	876.6

5.0 WATER SYSTEM INFRASTRUCTURE

5.1 Water Service Zones

The Project falls entirely within the Desert Wells service zone. The service zone boundary generally runs north-south along Ellsworth Road and along the SR-24 alignment north of Ray Road. All parcels west of this service zone boundary fall within the Falcon Field service zone while parcels east of this boundary fall within the Desert Wells service zone. This service zone boundary is shown on Figure 2 in Appendix A.

5.2 Existing Desert Wells Water System Infrastructure

Water for the Desert Wells service zone is sourced from the Central Arizona Project and a network of wells distributed throughout the area. Water treatment is currently provided by the CAP Brown Road Water Treatment Plant and the Signal Butte Water Treatment Plant (SBWTP).

As shown in Figure 2 in Appendix A, existing water infrastructure in the Project vicinity includes 16-inch water mains in Ellsworth Road, Ray Road, Eastmark Parkway, and Pecos Road. Similarly, a 16-inch water main exists in Crismon Road for approximately 2,180 feet south of Ray Road to stub out just south of Tucaman Ave. The southern 1,000 feet of this 16-inch water main is newly installed and currently waiting for acceptance from the City. A 12-inch water main exists within Cadence Parkway. 24-inch water mains exist in Signal Butte Road from Ray Road to Williams Field Road and along Williams Field Road from Signal Butte Road to Crismon Road. These 24-inch water mains are in the ground, however, have not been accepted by the City. The City plans to accept and incorporate these water mains in early 2019.

5.3 Proposed Water System Improvements

As shown on Figure 2 in Appendix A, the Project will be served by a network of looped 8-inch water mains. The Project will require connections to the existing water system at the existing 24-inch water main in Williams Field Road and at the existing 16-inch water main in Crismon Road. Stub outs for adjoining offsite developments are anticipated. The locations of these stub outs will be identified during the preliminary and final design stages.

5.4 City Required Water Main Upsizing

Per discussions with the City of Mesa and requirements set forth in the *Engineering Procedure Manual: 2017 Engineering & Design Standards* (City of Mesa, 2017), certain water mains within the Project must be upsized. While Figure 2 in Appendix A illustrates the minimum pipe sizing required to meet the demands, pressures, and fire flows of the Project, Figure 3 in Appendix A illustrates the necessary upsizing of specific water mains to meet the City's design and future water resources planning requirements. Listed below are the changes as noted on Figure 2 in Appendix A and illustrated in Figure 3 in Appendix A:

- A 24-inch water main is required in Williams Field Road along the entire northern boundary of the Project. A 24-inch water main is also required along the Crismon Road frontage of the Project south of William Fields Road.
- All lateral connections to transmission mains 24-inch and larger must be a minimum of 12-inches.
- All mile streets have 16-inch water mains and all ½-mile streets have 12-inch water mains.
  - Crismon Road is a one-mile street and pipes in Crismon Road will need to be upsized to 16-inches.
  - Although 222nd Street is not a half-mile or one-mile street, the City is requiring that the water main in 222nd Street be 12-inches in diameter and extend along the entire frontage of the Project.

5.5 Water Improvements Phasing

It is anticipated that the Project will be developed in several phases. The water mains required to serve each phase will similarly be constructed in phases as required to adequately serve each phase of development. For any given phase, the offsite water infrastructure required to serve that phase will be constructed at the same time as said phase is developed. Furthermore, the water mains that are installed will be sized for build-out conditions, will provide adequate looping in the water system (i.e. two points of connection), and will meet the required fire flows for the area that is developed.

6.0 HYDRAULIC MODEL AND RESULTS

6.1 Design Methodology

The proposed system was modeled using WaterCAD V8i by Bentley Systems, Inc. Five scenarios were modeled: average day, maximum day, peak hour, residual fire flow plus maximum day conditions, and available fire flow during maximum day conditions. A residual fire flow analysis applies the required fire flow to each corresponding junction in the system to confirm the system's ability to meet the minimum pressure and maximum velocity requirements while providing the required fire flow during maximum day conditions. The available fire flow analysis estimates the maximum flow available at each junction while maintaining the minimum allowable residual pressure throughout the proposed system during maximum day conditions.

Figure 2 in Appendix A provides an overview of the minimum required water system improvements for the Project and forms the basis for the hydraulic modeling results expressed in Section 6.2. Figure 3 in Appendix A illustrates the necessary improvements required by the City to meet City design and master planning criteria.

A hydrant flow test was conducted along the existing 16-inch offsite water main in Ray Road at the intersection of Crismon Road on February 14, 2019 at 7:36 AM by EJ Flow Tests, LLC, to identify existing system pressures in the Project vicinity. The hydrant flow test was performed by flowing two hydrants along the 16-inch water main. The flow test results at this location show a static pressure of 84.0 psi and a residual pressure of 74.0 psi at a total flow of 2,123 gpm. The flow test results and associated pump curves are located in Appendix C of this report. The flow test results were used to establish the boundary conditions for the hydraulic model of the existing and proposed water infrastructure to serve the Project.

6.2 Hydraulic Model Results

Detailed hydraulic model results for the Project are provided in Appendix D. Table 4 below summarizes the results. As shown in the table and results, pressures throughout the modeled area remained between 73.6 psi and 91.7 psi for the domestic scenarios modeled. Velocities and head losses for the peak hour scenario fall within the allowable limits established in Table 1. Furthermore, the fire flow analysis showed that the proposed system can adequately provide the required fire flow while maintaining a residual pressure of at least 20 psi. A single junction, Junction J-17, falls slightly short of the required 3,000 gpm available fire flow for the commercial sector, with an available fire flow of 2,963.4 gpm when using a maximum velocity of 10 fps. However, if the maximum allowable velocity is increased slightly to 10.3 fps, J-17 will meet and exceed the required 3,000 gpm of fire flow. Although fire flow is modeled here at a conservative 3,000 gpm, the actual required fire flow is anticipated to be lower as fire flows will be based on building size and type as the Project moves from master planning to preliminary and final design.

The hydraulic modeling summary detailed below is for the minimum required pipe sizes needed to serve the Project and based on Figure 2 in Appendix A. Upsizing pipes as required by the City will result in increased pressures and available flows in the modeled area.

TABLE 4
HYDRAULIC MODELING SUMMARY

	Average Day		Maximum Day		Peak Hour	
	Value	Location	Value	Location	Value	Location
Minimum Pressure (psi)	75.3	J-3	74.6	J-3	73.6	J-3
Maximum Pressure (psi)	91.7	J-17	90.8	J-17	89.5	J-17
Maximum Velocity (fps)	1.00	P-64, P-65	1.69	P-64, P-65	2.39	P-64, P-65
Maximum Head loss (feet/1,000 feet of pipe)	0.589	P-65	1.563	P-64, P-65	2.954	P-64

Maximum Day Demand + Fire Flow - Residual

	Value	Location	Fire Flow Location and Flow
Minimum Residual Pressure (psi)	44.0	J-17	J-17 @ 2,963.4 GPM
Maximum Velocity (fps)	10.0	P-24	J-17 @ 2,963.4 GPM

Maximum Day Demand + Fire Flow - Available

	Value	Location
Minimum Available Fire Flow - Residential (gpm)	1,780.6	J-48
Minimum Available Fire Flow - Commercial (gpm)**	2,963.4	J-17

Notes:
* Full model results are provided in Appendix D.
** See explanation of fire flow model results in Section 6.2 of this report.

7.0 CONCLUSIONS

The proposed water system will adequately serve the Project. This report has determined that:

- The average day, maximum day, and peak hour demands anticipated for the Project are 527,562 gpd (366.4 gpm), 894,964 gpd (621.5 gpm), and 1,262,366 gpd (876.6 gpm), respectively.
- The hydraulic model shows that the Project can be adequately served by the proposed system of 8-inch water mains, with connections to the existing 16-inch and 24-inch water mains in Crismon Road and Williams Field Road, respectively.
- Hydraulic model results show that pressures, velocities, and head losses for the proposed system fall within the allowable limits established by the City of Mesa during the domestic scenarios modeled.
- The proposed system can provide the required 1,500 gpm residential and 3,000 gpm commercial fire flow while maintaining the minimum required residual pressure of 20 psi.

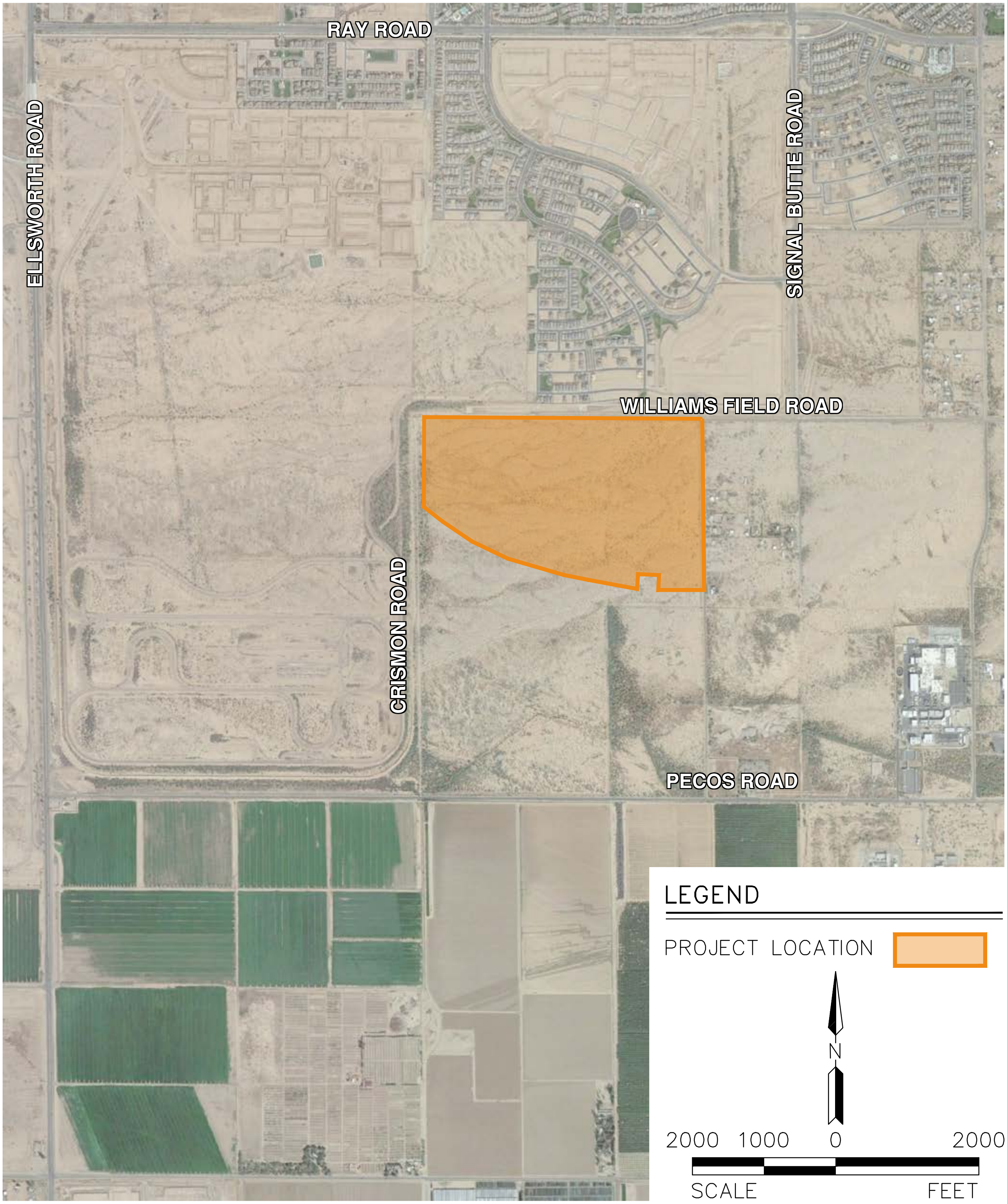
- The City will require upsizing of the proposed offsite water mains to meet City standards and master planning criteria.

8.0 REFERENCES

City of Mesa. (2017). *Engineering Procedure Manual: 2017 Engineering & Design Standards*. 2017, Mesa, AZ

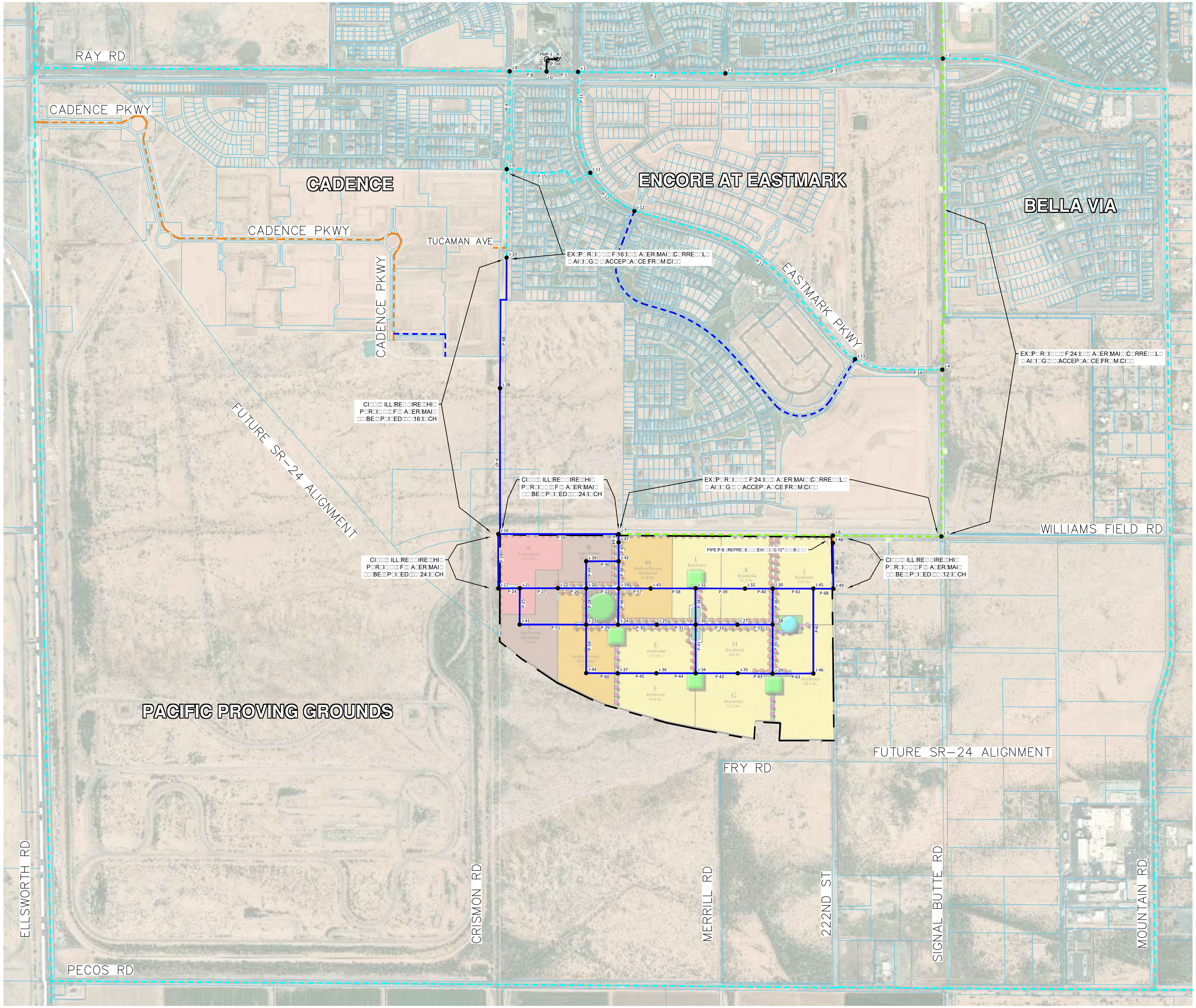
APPENDIX A

FIGURES



PROJ.NO.:	2063	LEVINE GM 170 SEC CRISMON RD & WILLIAMS FIELD RD MESA, ARIZONA	HILGARTWILSON 2141 E. HIGHLAND AVE., STE. 250 PHOENIX, AZ 85016 P: 602.490.0535 / F: 602.368.2436
DATE:	FEB 2019		
SCALE:	1" = 2,000'		
DRAWN BY:	SL	FIG 1: VICINITY MAP	
CHECKED BY:	BB		

U:\2000\2063\ENGR\EXHIBITS\2063 FIG 1 – Vicinity Map.dwg 2/18/2019 1:23 PM



LEGEND

PROJECT BOUNDARY	
PRESSURE ZONE BOUNDARY	
PROPOSED WATER MAIN	
EXISTING WATER MAIN	
FUTURE WATER MAIN	
JUNCTION	
RESERVOIR	
PUMP	

PIPE DIAMETER LEGEND
8.0 INCHES
12.0 INCHES
16.0 INCHES
24.0 INCHES

NOTES

1) LAND USE PLAN IS CONCEPTUAL AND SUBJECT TO CHANGE.
2) WATER MAIN ALIGNMENTS ARE CONCEPTUAL AND SUBJECT TO CHANGE.

N

1200 600 0 1200
SCALE FEET

HILGARTWILSON
2141 E. HIGHLAND AVE., STE. 250
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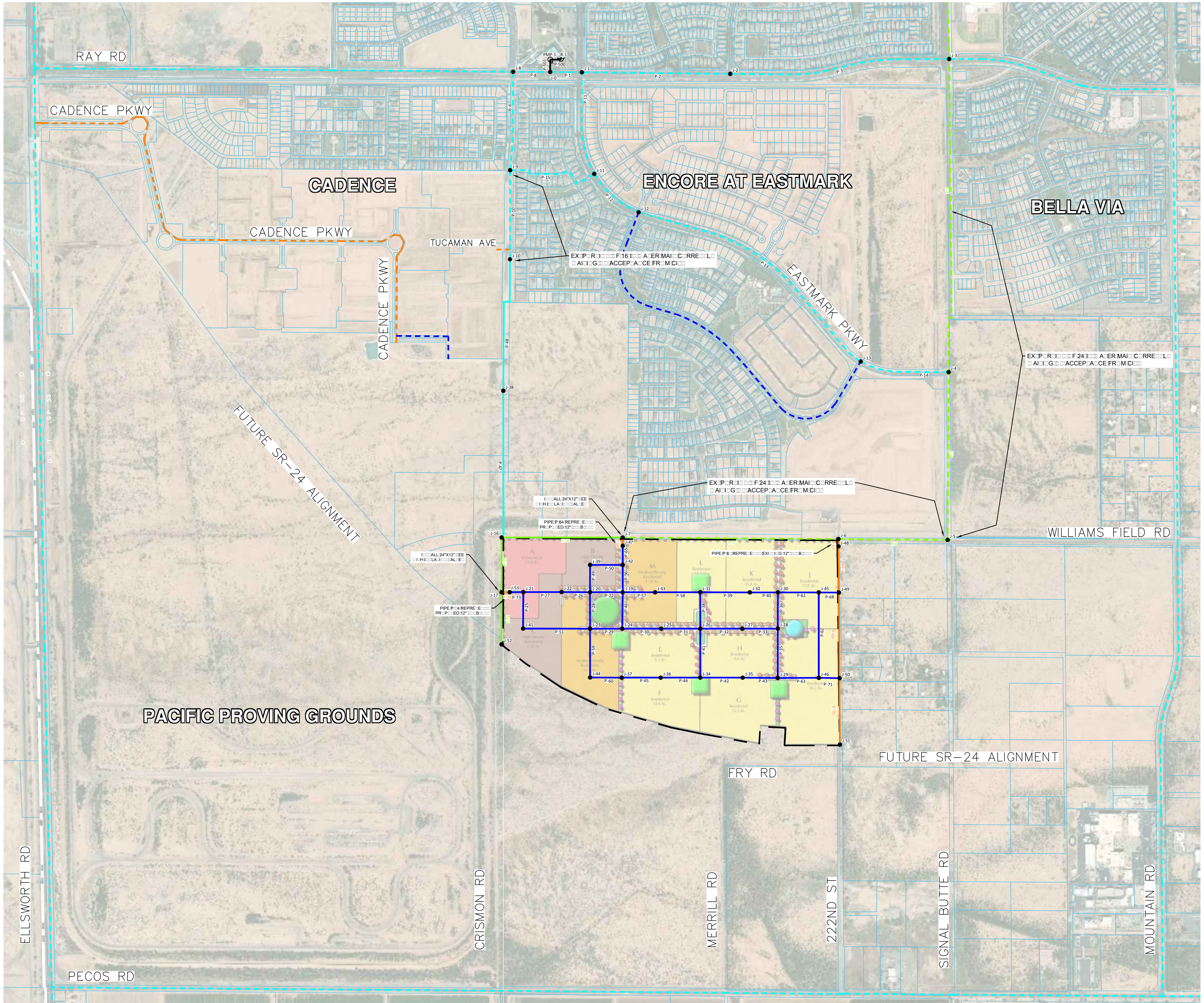
LEVINE GM 170
WILLIAMS FIELD RD & CRISMON RD
MESA, AZ

FIG 2: MINIMUM REQUIRED WATER SYSTEM IMPROVEMENTS

PROJ. NO.: 2063
DATE: MAY 2019
SCALE: 1"=1200'
DRAWN BY: MAJ
CHECKED BY: MI



LEGEND

PROJECT BOUNDARY	
PRESSURE ZONE BOUNDARY	
PROPOSED WATER MAIN	
EXISTING WATER MAIN	
FUTURE WATER MAIN	
JUNCTION	
RESERVOIR	
PUMP	

PIPE DIAMETER LEGEND
8.0 INCHES
12.0 INCHES
16.0 INCHES
24.0 INCHES

NOTES

1) LAND USE PLAN IS CONCEPTUAL AND SUBJECT TO CHANGE.
2) WATER MAIN ALIGNMENTS ARE CONCEPTUAL AND SUBJECT TO CHANGE.

N

1200 600 0 1200

SCALE FEET

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LEVINE GM 170
WILLIAMS FIELD RD & CRISMON RD
MESA, AZ

FIG 3: CITY REQUIRED WATER SYSTEM IMPROVEMENTS

PROJ. NO.: 2063
DATE: MAY 2019
SCALE: 1"=1200'
DRAWN BY: MAJ
CHECKED BY: MI

APPENDIX B

SUPPLEMENTARY TABLES

Table B.1 - Water Demand Calculations

General Motors Levine 170

Mesa, Arizona
May, 2019

HILGARTWILSON
Calculated By: MAJ
Checked By: MI

Parcel Label	Land Use	Gross Area	Open Space[6]	Assumed Density	Potential Dwelling Units	Commercial Area	Population	Average Day Demand				Max Day Demand		Peak Hour Demand	
								Land Use	Open Space	Total					
		(ac)	(ac)	(du/ac)	(du)	(ac)		(gpd)	(gpd)	(gpd)	(gpm)	(gpd)	(gpm)	(gpd)	(gpm)
A	Commercial	11.0	1.1	-	-	11.0	-	16,500	4,840	21,340	14.8	37,840	26.3	54,340	37.7
B	HDR	7.0	1.4	20.0	140	-	238	21,560	6,160	27,720	19.3	49,280	34.2	70,840	49.2
C	HDR	11.0	2.2	20.0	220	-	374	33,880	9,680	43,560	30.3	77,440	53.8	111,320	77.3
D	MDR	13.5	2.7	10.0	135	-	365	34,290	11,880	46,170	32.1	80,460	55.9	114,750	79.7
E	LMDR	9.3	1.9	6.0	56	-	179	22,400	8,360	30,760	21.4	53,160	36.9	75,560	52.5
F	LMDR	10.4	2.1	6.0	63	-	202	25,200	9,240	34,440	23.9	59,640	41.4	84,840	58.9
G	LMDR	12.3	2.5	6.0	74	-	237	29,600	11,000	40,600	28.2	70,200	48.8	99,800	69.3
H	LMDR	8.8	1.8	6.0	53	-	170	21,200	7,920	29,120	20.2	50,320	34.9	71,520	49.7
I	LMDR	18.2	3.7	6.0	110	-	352	44,000	16,280	60,280	41.9	104,280	72.4	148,280	103.0
J	LMDR	13.8	2.8	6.0	83	-	266	33,200	12,320	45,520	31.6	78,720	54.7	111,920	77.7
K	LMDR	11.8	2.4	6.0	71	-	227	28,400	10,560	38,960	27.1	67,360	46.8	95,760	66.5
L	LMDR	11.2	2.3	6.0	68	-	218	27,200	10,120	37,320	25.9	64,520	44.8	91,720	63.7
M	MDR	11.8	2.4	10.0	118	-	319	29,972	10,560	40,532	28.1	70,504	49.0	100,476	69.8
Parks	Open Space	7.1	7.1	-	-	-	-	0	31,240	31,240	21.7	31,240	21.7	31,240	21.7
GRAND TOTAL:		**157.2**	**36.4**	**-**	**1,191**	**11.0**	**3,145**	**367,402**	**160,160**	**527,562**	**366.4**	**894,964**	**621.5**	**1,262,366**	**876.6**

Notes:

Demand Factors:

		Density:	Population Factor:
Medium Density Residential (LDR):	420 gal/dwelling unit/day	2 - 4 du/ac	3.0 Persons/du
Medium Density Residential (LMDR):	400 gal/dwelling unit/day	4 - 6 du/ac	3.2 Persons/du
Medium Density Residential (MDR):	254 gal/dwelling unit/day	6 - 10 du/ac	2.7 Persons/du
High Density Residential (MHDR):	194 gal/dwelling unit/day	10 - 15 du/ac	2.0 Persons/du
High Density Residential (HDR):	154 gal/dwelling unit/day	15 + du/ac	1.7 Persons/du
High Density Condominium:	185 gal/dwelling unit/day		1.7 Persons/du
Commercial[3]:	1,500 gal/acre/day		
Office[3]:	1,500 gal/acre/day		
Turf/Irrigation:	4,400 gallons/acre/day		

Peaking Factors:

Maximum Day Demand: 2.0 x Average Day Demand
Peak Hour Demand: 3.0 x Average Day Demand

Fire Flow[4]:

Residential: 1,500 gpm for 2 hours
Commercial: 3,000 gpm for 2 hours

(1) Demand factors from the Engineering Procedure Manual - Engineering & Design Standards (City of Mesa, 2017).
(2) Values shown include inside and outside water use.
(3) Commercial/Office demand factor averaged from surrounding towns as City of Mesa standard is determined by actual square footage of building.
(4) Fire Flow assumed from City of Mesa Fire Code for general planning. Actual fire flow will be based on building size/type as these become known in preliminary/final design.
(5) Park/Open Space demands are not peaked as demands are anticipated to remain constant.
(6) Open space values assumed at 10% of the gross area for commercial parcels and 20% of the gross area for residential parcels.

APPENDIX C
HYDRANT FLOW TEST & PUMP CURVE

Flow Test Summary

Project Name:	EJFT 19034
Project Address:	10040 E Ray Rd, Mesa, AZ 85212
Date of Flow Test:	2019-02-14
Time of Flow Test:	7:36 AM
Data Reliable Until:	2019-08-14
Conducted By:	Austin Gourley & Eder Cueva (EJ Flow Tests) 602.999.7637
Witnessed By:	Wes Price (City of Mesa) 480.826.9666
City Forces Contacted:	City of Mesa (480.826.9666)
Permit Number:	ROW19-01563

Raw Flow Test Data

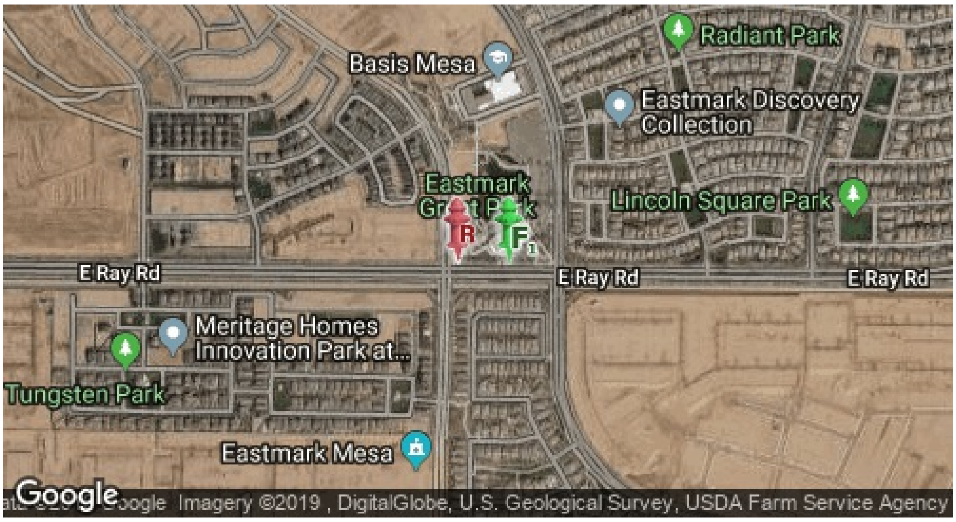
Static Pressure:	84.0 PSI
Residual Pressure:	74.0 PSI
Flowing GPM:	2,123
GPM @ 20 PSI:	5,785

Data with a 10 % Safety Factor

Static Pressure:	75.6 PSI
Residual Pressure:	65.6 PSI
Flowing GPM:	2,123
GPM @ 20 PSI:	5,362

Hydrant F_1

Pitot Pressure (1):	40	PSI
Coefficient of Discharge (1):	0.9	
Hydrant Orifice Diameter (1):	2.5	inches
Pitot Pressure (2):	40	PSI
Coefficient of Discharge (2):	0.9	
Hydrant Orifice Diameter (2):	2.5	inches



Static-Residual Hydrant

Flow Hydrant

Main Size
16 inches

Distance Between F_1 and R
356 ft (measured linearly)

Static-Residual Elevation
1423 ft (above sea level)

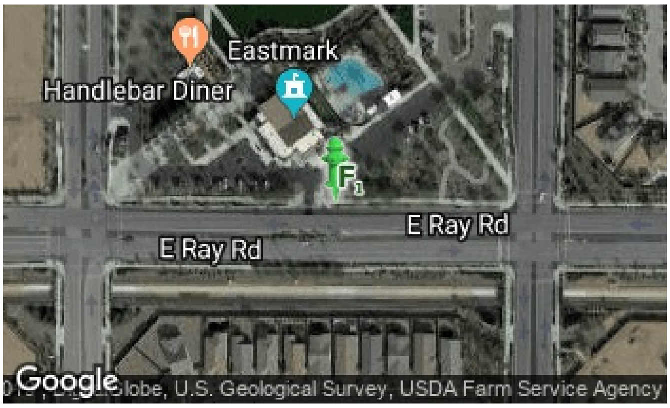
Flow Hydrant (F_1) Elevation
1423 ft (above sea level)

Elevation & distance values are approximate

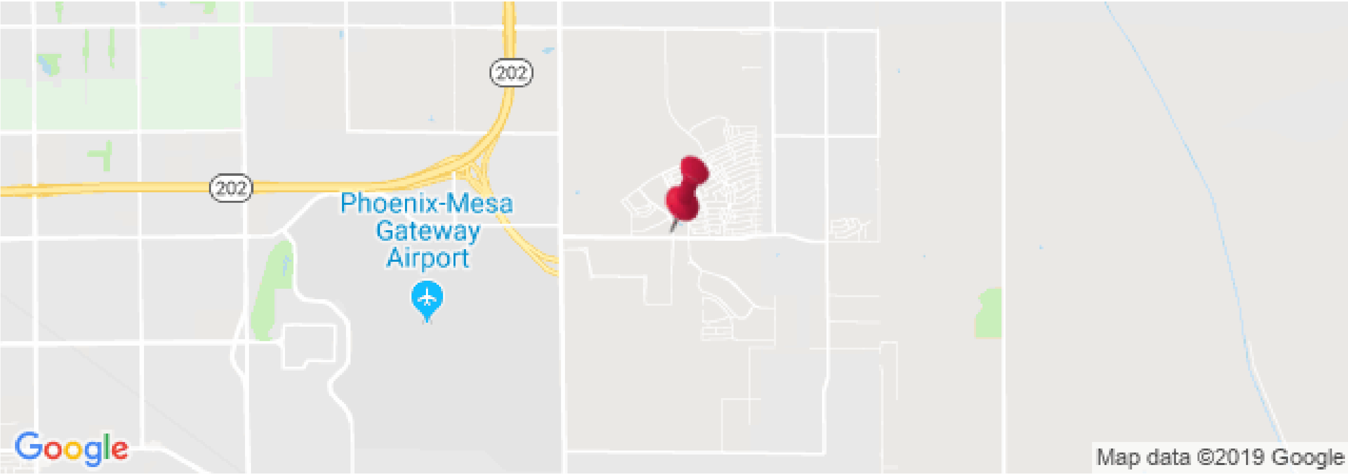
Flow Test Summary

Static-Residual Hydrant

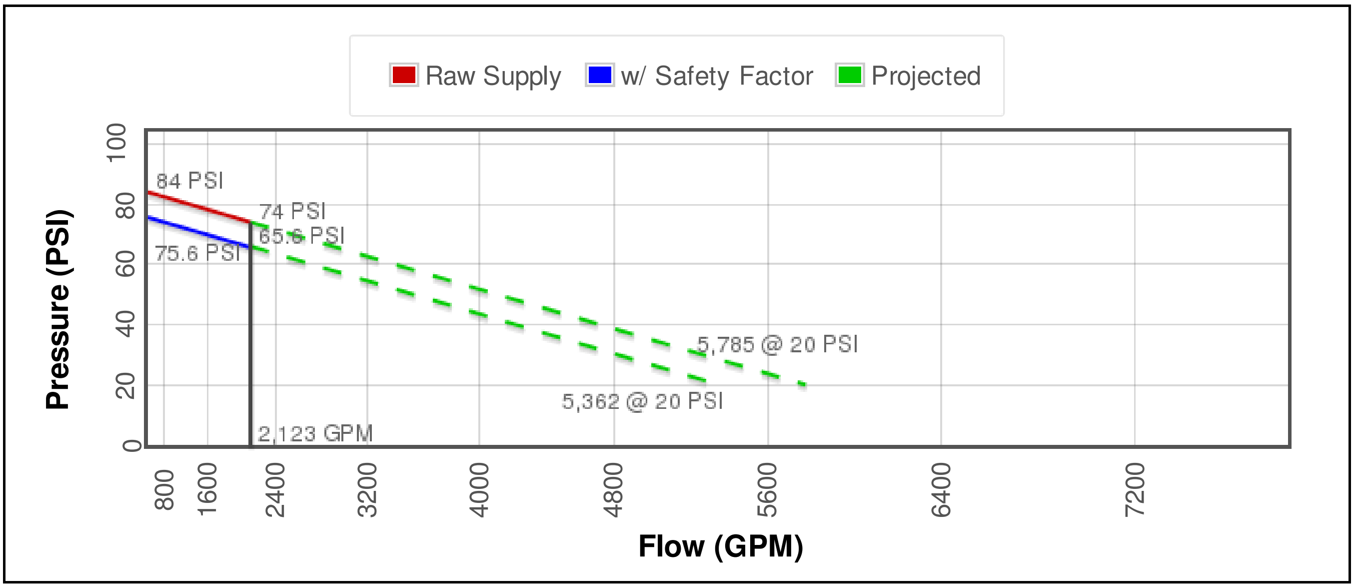
Flow Hydrant (only hydrant F1 shown for clarity)



Approximate Project Site



Water Supply Curve $N^{1.85}$ Graph



FLOW TEST PUMP CURVE
Levine General Motors 170
Mesa, AZ
Flow Test Date: February 14, 2019 (7:36 AM)

HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

Fire Flow Test Results

Static Pressure at Test Hydrant (psi)	84
Residual Pressure at Test Hydrant (psi)	74
Total Discharge at Flowed Hydrants, Qf (gpm)	2,123

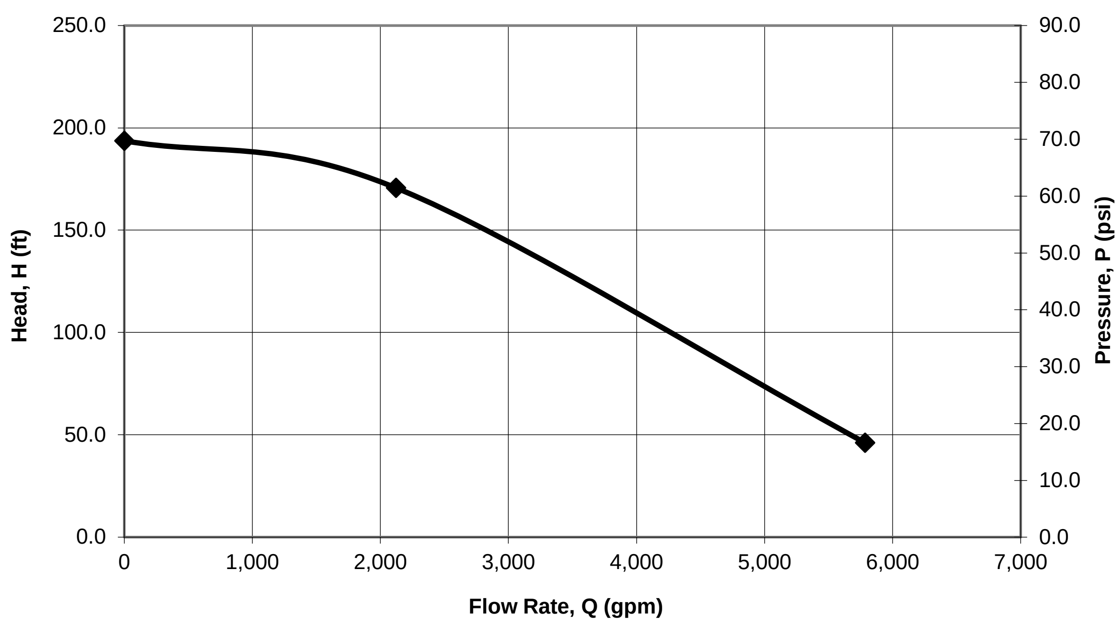
Calculations

Desired Fire Flow Residual Pressure (psi)	20.0
Pressure Drop During Test, hf (psi)	10.0
Pressure Drop During Test (%)	12%
Pressure Drop at Desired Residual Pressure, hr (psi)	64.0
Available Flow at Desired Residual Pressure, Qr (gpm)	5,785

Pump Curve

Q (gpm)	P (psi)	H (ft)
0	84.0	193.7
2,123	74.0	170.6
5,785	20.0	46.1

Pump Curve Extrapolated from Fire Flow Test Results



APPENDIX D
HYDRAULIC MODEL RESULTS

AVERAGE DAY DEMAND

Label	Elevation (ft)	Demand (gal/min)	Hydraulic Grade (ft)	Pressure (psi)
J-0	1,422.60	0.0	1,615.80	83.6
J-1	1,424.89	0.0	1,615.79	82.6
J-2	1,431.46	0.0	1,615.75	79.7
J-3	1,441.63	0.0	1,615.69	75.3
J-4	1,430.00	0.0	1,615.68	80.3
J-5	1,427.59	0.0	1,615.66	81.4
J-6	1,423.19	0.0	1,615.65	83.3
J-7	1,409.40	0.0	1,615.64	89.2
J-8	1,421.62	0.0	1,615.80	84.0
J-9	1,419.65	0.0	1,615.79	84.9
J-10	1,410.00	0.0	1,615.78	89.0
J-11	1,421.82	0.0	1,615.78	83.9
J-12	1,421.62	0.0	1,615.77	84.0
J-13	1,424.00	0.0	1,615.70	82.9
J-16	1,404.78	0.0	1,615.57	91.2
J-17	1,403.52	0.0	1,615.45	91.7
J-19	1,409.85	2.7	1,615.38	88.9
J-20	1,408.12	2.7	1,615.39	89.7
J-21	1,404.70	14.8	1,615.40	91.2
J-22	1,406.46	0.0	1,615.39	90.4
J-23	1,408.73	2.7	1,615.36	89.4
J-24	1,409.87	2.7	1,615.36	88.9
J-25	1,411.00	0.0	1,615.34	88.4
J-26	1,413.00	0.0	1,615.31	87.5
J-27	1,415.00	0.0	1,615.31	86.7
J-28	1,416.57	2.7	1,615.31	86.0
J-29	1,417.00	2.7	1,615.29	85.8
J-30	1,417.89	0.0	1,615.32	85.4
J-31	1,414.60	28.6	1,615.31	86.8
J-32	1,416.00	27.1	1,615.31	86.2
J-34	1,413.00	2.7	1,615.29	87.5
J-35	1,415.51	48.4	1,615.28	86.4
J-36	1,411.71	45.3	1,615.28	88.1
J-37	1,410.25	0.0	1,615.29	88.7
J-38	1,406.20	0.0	1,615.68	90.6
J-39	1,409.29	19.3	1,615.41	89.2
J-41	1,404.61	30.3	1,615.37	91.2
J-42	1,409.82	0.0	1,615.45	89.0
J-43	1,411.87	28.1	1,615.34	88.0
J-44	1,409.00	32.1	1,615.30	89.3
J-45	1,420.17	31.6	1,615.35	84.4
J-46	1,418.43	41.9	1,615.29	85.2
J-47	1,410.31	0.0	1,615.58	88.8
J-48	1,422.65	0.0	1,615.64	83.5
J-49	1,421.20	0.0	1,615.44	84.0

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (Absolute) (gal/min)	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-1	369	J-0	J-1	16	130.0	247.1	0.39	0.047
P-2	1,726	J-1	J-2	16	130.0	164.2	0.26	0.022
P-3	2,563	J-2	J-3	16	130.0	164.2	0.26	0.022
P-4	3,678	J-3	J-4	24	130.0	164.2	0.12	0.003
P-5	1,953	J-4	J-5	24	130.0	319.4	0.23	0.010
P-6	1,271	J-5	J-6	24	130.0	319.4	0.23	0.010
P-7	2,510	J-6	J-7	24	130.0	195.9	0.14	0.004
P-8	433	J-0	J-8	16	130.0	119.3	0.19	0.012
P-9	1,147	J-8	J-9	16	130.0	119.3	0.19	0.012
P-10	1,036	J-9	J-10	16	130.0	47.0	0.08	0.002
P-11	1,208	J-1	J-11	16	130.0	82.9	0.13	0.006
P-12	694	J-11	J-12	16	130.0	155.2	0.25	0.020
P-13	3,210	J-12	J-13	16	130.0	155.2	0.25	0.020
P-14	1,043	J-13	J-4	16	130.0	155.2	0.25	0.020
P-15	1,154	J-9	J-11	16	130.0	72.3	0.12	0.005
P-16	1,409	J-7	J-16	8	130.0	39.4	0.25	0.046
P-19	637	J-16	J-17	8	130.0	86.4	0.55	0.196
P-22	379	J-19	J-20	8	130.0	19.5	0.12	0.012
P-24	253	J-21	J-17	8	130.0	86.4	0.55	0.196
P-25	425	J-21	J-41	8	130.0	49.2	0.31	0.069
P-26	332	J-20	J-22	8	130.0	22.4	0.14	0.016
P-27	445	J-22	J-21	8	130.0	22.4	0.14	0.016
P-28	423	J-20	J-23	8	130.0	46.3	0.30	0.062
P-29	374	J-23	J-24	8	130.0	2.8	0.02	0.000
P-30	454	J-24	J-25	8	130.0	41.8	0.27	0.051
P-31	454	J-25	J-26	8	130.0	41.8	0.27	0.051
P-32	489	J-26	J-27	8	130.0	8.7	0.06	0.003
P-33	412	J-27	J-28	8	130.0	8.7	0.06	0.003
P-35	574	J-28	J-29	8	130.0	30.7	0.20	0.029
P-36	422	J-28	J-30	8	130.0	24.8	0.16	0.019
P-38	424	J-26	J-31	8	130.0	5.4	0.03	0.001
P-39	577	J-31	J-32	8	130.0	3.9	0.03	0.001
P-40	326	J-32	J-30	8	130.0	23.1	0.15	0.017
P-41	570	J-26	J-34	8	130.0	38.5	0.25	0.044
P-42	493	J-34	J-35	8	130.0	18.3	0.12	0.011
P-43	408	J-35	J-29	8	130.0	30.1	0.19	0.028
P-44	461	J-34	J-36	8	130.0	17.5	0.11	0.010
P-45	454	J-36	J-37	8	130.0	27.8	0.18	0.024
P-46	423	J-19	J-24	8	130.0	41.7	0.27	0.051
P-47	1,714	J-16	J-38	8	130.0	47.0	0.30	0.063
P-48	1,598	J-38	J-10	8	130.0	47.0	0.30	0.063
P-49	319	J-20	J-39	8	130.0	46.2	0.29	0.062
P-50	379	J-39	J-42	8	130.0	65.5	0.42	0.117
P-51	780	J-23	J-41	8	130.0	19.0	0.12	0.012
P-56	319	J-42	J-19	8	130.0	91.0	0.58	0.215
P-57	376	J-19	J-43	8	130.0	66.1	0.42	0.119
P-58	527	J-43	J-31	8	130.0	37.9	0.24	0.043
P-59	568	J-23	J-44	8	130.0	59.8	0.38	0.099
P-60	368	J-44	J-37	8	130.0	27.8	0.18	0.024

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (Absolute) (gal/min)	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-61	475	J-30	J-45	8	130.0	47.9	0.31	0.066
P-62	995	J-45	J-46	8	130.0	44.0	0.28	0.056
P-63	478	J-46	J-29	8	130.0	2.1	0.01	0.000
P-64	97	J-7	J-47	8	130.0	156.4	1.00	0.588
P-65	222	J-47	J-42	8	130.0	156.4	1.00	0.589
P-66	538	J-49	J-48	8	130.0	123.5	0.79	0.380
P-67	85	J-48	J-6	12	130.0	123.5	0.35	0.053
P-68	234	J-45	J-49	8	130.0	123.5	0.79	0.380
P-500	125	R-1	PMP-1	36	130.0	366.4	0.12	0.002
P-501	143	PMP-1	J-0	36	130.0	366.4	0.12	0.002

Label	Elevation (ft)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gal/min)	Pump Head (ft)
PMP-1	1,422.60	1,423.00	1,615.80	366.4	192.80

Label	Elevation (ft)	Flow (Out net) (gal/min)	Hydraulic Grade (ft)
R-1	1,423.00	366.4	1,423.00

MAXIMUM DAY DEMAND

Label	Elevation (ft)	Demand (gal/min)	Hydraulic Grade (ft)	Pressure (psi)
J-0	1,422.60	0.0	1,614.32	82.9
J-1	1,424.89	0.0	1,614.27	81.9
J-2	1,431.46	0.0	1,614.17	79.0
J-3	1,441.63	0.0	1,614.02	74.6
J-4	1,430.00	0.0	1,613.99	79.6
J-5	1,427.59	0.0	1,613.94	80.6
J-6	1,423.19	0.0	1,613.90	82.5
J-7	1,409.40	0.0	1,613.87	88.5
J-8	1,421.62	0.0	1,614.30	83.4
J-9	1,419.65	0.0	1,614.27	84.2
J-10	1,410.00	0.0	1,614.26	88.4
J-11	1,421.82	0.0	1,614.25	83.3
J-12	1,421.62	0.0	1,614.22	83.3
J-13	1,424.00	0.0	1,614.05	82.2
J-16	1,404.78	0.0	1,613.70	90.4
J-17	1,403.52	0.0	1,613.37	90.8
J-19	1,409.85	2.7	1,613.19	88.0
J-20	1,408.12	2.7	1,613.21	88.7
J-21	1,404.70	26.3	1,613.24	90.2
J-22	1,406.46	0.0	1,613.22	89.5
J-23	1,408.73	2.7	1,613.14	88.4
J-24	1,409.87	2.7	1,613.14	87.9
J-25	1,411.00	0.0	1,613.07	87.4
J-26	1,413.00	0.0	1,613.01	86.5
J-27	1,415.00	0.0	1,613.01	85.7
J-28	1,416.57	2.7	1,613.01	85.0
J-29	1,417.00	2.7	1,612.96	84.8
J-30	1,417.89	0.0	1,613.03	84.4
J-31	1,414.60	47.5	1,613.01	85.8
J-32	1,416.00	46.8	1,613.01	85.2
J-34	1,413.00	2.7	1,612.95	86.5
J-35	1,415.51	83.7	1,612.93	85.4
J-36	1,411.71	78.3	1,612.93	87.1
J-37	1,410.25	0.0	1,612.96	87.7
J-38	1,406.20	0.0	1,613.99	89.9
J-39	1,409.29	34.2	1,613.26	88.2
J-41	1,404.61	53.8	1,613.16	90.2
J-42	1,409.82	0.0	1,613.38	88.1
J-43	1,411.87	49.0	1,613.07	87.0
J-44	1,409.00	55.9	1,612.98	88.3
J-45	1,420.17	54.7	1,613.11	83.5
J-46	1,418.43	72.4	1,612.96	84.2
J-47	1,410.31	0.0	1,613.72	88.0
J-48	1,422.65	0.0	1,613.89	82.7
J-49	1,421.20	0.0	1,613.35	83.1

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (Absolute) (gal/min)	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-1	369	J-0	J-1	16	130.0	419.1	0.67	0.125
P-2	1,726	J-1	J-2	16	130.0	278.5	0.44	0.058
P-3	2,563	J-2	J-3	16	130.0	278.5	0.44	0.058
P-4	3,678	J-3	J-4	24	130.0	278.5	0.20	0.008
P-5	1,953	J-4	J-5	24	130.0	541.7	0.38	0.028
P-6	1,271	J-5	J-6	24	130.0	541.7	0.38	0.028
P-7	2,510	J-6	J-7	24	130.0	332.1	0.24	0.011
P-8	433	J-0	J-8	16	130.0	202.4	0.32	0.032
P-9	1,147	J-8	J-9	16	130.0	202.4	0.32	0.032
P-10	1,036	J-9	J-10	16	130.0	79.8	0.13	0.006
P-11	1,208	J-1	J-11	16	130.0	140.6	0.22	0.016
P-12	694	J-11	J-12	16	130.0	263.3	0.42	0.053
P-13	3,210	J-12	J-13	16	130.0	263.3	0.42	0.053
P-14	1,043	J-13	J-4	16	130.0	263.3	0.42	0.053
P-15	1,154	J-9	J-11	16	130.0	122.6	0.20	0.013
P-16	1,409	J-7	J-16	8	130.0	67.0	0.43	0.122
P-19	637	J-16	J-17	8	130.0	146.7	0.94	0.522
P-22	379	J-19	J-20	8	130.0	32.6	0.21	0.032
P-24	253	J-21	J-17	8	130.0	146.7	0.94	0.523
P-25	425	J-21	J-41	8	130.0	83.9	0.54	0.185
P-26	332	J-20	J-22	8	130.0	36.6	0.23	0.040
P-27	445	J-22	J-21	8	130.0	36.6	0.23	0.040
P-28	423	J-20	J-23	8	130.0	78.5	0.50	0.164
P-29	374	J-23	J-24	8	130.0	3.0	0.02	0.000
P-30	454	J-24	J-25	8	130.0	71.1	0.45	0.136
P-31	454	J-25	J-26	8	130.0	71.1	0.45	0.137
P-32	489	J-26	J-27	8	130.0	14.2	0.09	0.007
P-33	412	J-27	J-28	8	130.0	14.2	0.09	0.007
P-35	574	J-28	J-29	8	130.0	52.7	0.34	0.078
P-36	422	J-28	J-30	8	130.0	41.3	0.26	0.050
P-38	424	J-26	J-31	8	130.0	8.9	0.06	0.003
P-39	577	J-31	J-32	8	130.0	7.5	0.05	0.002
P-40	326	J-32	J-30	8	130.0	39.3	0.25	0.045
P-41	570	J-26	J-34	8	130.0	65.8	0.42	0.118
P-42	493	J-34	J-35	8	130.0	31.7	0.20	0.030
P-43	408	J-35	J-29	8	130.0	52.0	0.33	0.077
P-44	461	J-34	J-36	8	130.0	31.4	0.20	0.030
P-45	454	J-36	J-37	8	130.0	46.9	0.30	0.063
P-46	423	J-19	J-24	8	130.0	70.8	0.45	0.135
P-47	1,714	J-16	J-38	8	130.0	79.8	0.51	0.169
P-48	1,598	J-38	J-10	8	130.0	79.8	0.51	0.169
P-49	319	J-20	J-39	8	130.0	77.2	0.49	0.159
P-50	379	J-39	J-42	8	130.0	111.4	0.71	0.314
P-51	780	J-23	J-41	8	130.0	30.1	0.19	0.028
P-56	319	J-42	J-19	8	130.0	153.8	0.98	0.570
P-57	376	J-19	J-43	8	130.0	112.9	0.72	0.321
P-58	527	J-43	J-31	8	130.0	63.9	0.41	0.112
P-59	568	J-23	J-44	8	130.0	102.8	0.66	0.270
P-60	368	J-44	J-37	8	130.0	46.9	0.30	0.063

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (Absolute) (gal/min)	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-61	475	J-30	J-45	8	130.0	80.5	0.51	0.172
P-62	995	J-45	J-46	8	130.0	74.4	0.47	0.149
P-63	478	J-46	J-29	8	130.0	2.0	0.01	0.000
P-64	97	J-7	J-47	8	130.0	265.2	1.69	1.563
P-65	222	J-47	J-42	8	130.0	265.2	1.69	1.563
P-66	538	J-49	J-48	8	130.0	209.6	1.34	1.011
P-67	85	J-48	J-6	12	130.0	209.6	0.59	0.141
P-68	234	J-45	J-49	8	130.0	209.6	1.34	1.011
P-500	125	R-1	PMP-1	36	130.0	621.5	0.20	0.005
P-501	143	PMP-1	J-0	36	130.0	621.5	0.20	0.005

Label	Elevation (ft)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gal/min)	Pump Head (ft)
PMP-1	1,422.60	1,423.00	1,614.32	621.5	191.32

Label	Elevation (ft)	Flow (Out net) (gal/min)	Hydraulic Grade (ft)
R-1	1,423.00	621.5	1,423.00

PEAK HOUR DEMAND

Label	Elevation (ft)	Demand (gal/min)	Hydraulic Grade (ft)	Pressure (psi)
J-0	1,422.60	0.0	1,612.20	82.0
J-1	1,424.89	0.0	1,612.11	81.0
J-2	1,431.46	0.0	1,611.92	78.1
J-3	1,441.63	0.0	1,611.64	73.6
J-4	1,430.00	0.0	1,611.58	78.6
J-5	1,427.59	0.0	1,611.48	79.6
J-6	1,423.19	0.0	1,611.41	81.4
J-7	1,409.40	0.0	1,611.36	87.4
J-8	1,421.62	0.0	1,612.17	82.4
J-9	1,419.65	0.0	1,612.10	83.3
J-10	1,410.00	0.0	1,612.09	87.4
J-11	1,421.82	0.0	1,612.08	82.3
J-12	1,421.62	0.0	1,612.01	82.4
J-13	1,424.00	0.0	1,611.69	81.2
J-16	1,404.78	0.0	1,611.03	89.2
J-17	1,403.52	0.0	1,610.40	89.5
J-19	1,409.85	2.7	1,610.08	86.6
J-20	1,408.12	2.7	1,610.10	87.4
J-21	1,404.70	37.7	1,610.15	88.9
J-22	1,406.46	0.0	1,610.12	88.1
J-23	1,408.73	2.7	1,609.97	87.1
J-24	1,409.87	2.7	1,609.97	86.6
J-25	1,411.00	0.0	1,609.85	86.0
J-26	1,413.00	0.0	1,609.73	85.1
J-27	1,415.00	0.0	1,609.73	84.2
J-28	1,416.57	2.7	1,609.72	83.6
J-29	1,417.00	2.7	1,609.63	83.3
J-30	1,417.89	0.0	1,609.76	83.0
J-31	1,414.60	66.4	1,609.73	84.4
J-32	1,416.00	66.5	1,609.73	83.8
J-34	1,413.00	2.7	1,609.60	85.1
J-35	1,415.51	119.0	1,609.57	84.0
J-36	1,411.71	111.4	1,609.58	85.6
J-37	1,410.25	0.0	1,609.63	86.3
J-38	1,406.20	0.0	1,611.58	88.9
J-39	1,409.29	49.2	1,610.19	86.9
J-41	1,404.61	77.3	1,610.01	88.9
J-42	1,409.82	0.0	1,610.42	86.8
J-43	1,411.87	69.8	1,609.84	85.7
J-44	1,409.00	79.7	1,609.67	86.8
J-45	1,420.17	77.7	1,609.91	82.1
J-46	1,418.43	103.0	1,609.63	82.7
J-47	1,410.31	0.0	1,611.07	86.9
J-48	1,422.65	0.0	1,611.39	81.7
J-49	1,421.20	0.0	1,610.36	81.8

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (Absolute) (gal/min)	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-1	369	J-0	J-1	16	130.0	591.2	0.94	0.236
P-2	1,726	J-1	J-2	16	130.0	392.8	0.63	0.111
P-3	2,563	J-2	J-3	16	130.0	392.8	0.63	0.111
P-4	3,678	J-3	J-4	24	130.0	392.8	0.28	0.015
P-5	1,953	J-4	J-5	24	130.0	764.1	0.54	0.053
P-6	1,271	J-5	J-6	24	130.0	764.1	0.54	0.053
P-7	2,510	J-6	J-7	24	130.0	468.4	0.33	0.021
P-8	433	J-0	J-8	16	130.0	285.5	0.46	0.061
P-9	1,147	J-8	J-9	16	130.0	285.5	0.46	0.061
P-10	1,036	J-9	J-10	16	130.0	112.5	0.18	0.011
P-11	1,208	J-1	J-11	16	130.0	198.4	0.32	0.031
P-12	694	J-11	J-12	16	130.0	371.3	0.59	0.100
P-13	3,210	J-12	J-13	16	130.0	371.3	0.59	0.100
P-14	1,043	J-13	J-4	16	130.0	371.3	0.59	0.100
P-15	1,154	J-9	J-11	16	130.0	172.9	0.28	0.024
P-16	1,409	J-7	J-16	8	130.0	94.5	0.60	0.231
P-19	637	J-16	J-17	8	130.0	207.0	1.32	0.988
P-22	379	J-19	J-20	8	130.0	45.7	0.29	0.060
P-24	253	J-21	J-17	8	130.0	207.0	1.32	0.988
P-25	425	J-21	J-41	8	130.0	118.5	0.76	0.351
P-26	332	J-20	J-22	8	130.0	50.8	0.32	0.074
P-27	445	J-22	J-21	8	130.0	50.8	0.32	0.073
P-28	423	J-20	J-23	8	130.0	110.6	0.71	0.309
P-29	374	J-23	J-24	8	130.0	3.3	0.02	0.001
P-30	454	J-24	J-25	8	130.0	100.5	0.64	0.259
P-31	454	J-25	J-26	8	130.0	100.5	0.64	0.259
P-32	489	J-26	J-27	8	130.0	19.7	0.13	0.013
P-33	412	J-27	J-28	8	130.0	19.7	0.13	0.013
P-35	574	J-28	J-29	8	130.0	74.8	0.48	0.150
P-36	422	J-28	J-30	8	130.0	57.8	0.37	0.093
P-38	424	J-26	J-31	8	130.0	12.4	0.08	0.005
P-39	577	J-31	J-32	8	130.0	11.1	0.07	0.004
P-40	326	J-32	J-30	8	130.0	55.4	0.35	0.086
P-41	570	J-26	J-34	8	130.0	93.1	0.59	0.225
P-42	493	J-34	J-35	8	130.0	45.1	0.29	0.059
P-43	408	J-35	J-29	8	130.0	73.9	0.47	0.147
P-44	461	J-34	J-36	8	130.0	45.4	0.29	0.059
P-45	454	J-36	J-37	8	130.0	66.0	0.42	0.119
P-46	423	J-19	J-24	8	130.0	99.8	0.64	0.256
P-47	1,714	J-16	J-38	8	130.0	112.5	0.72	0.319
P-48	1,598	J-38	J-10	8	130.0	112.5	0.72	0.320
P-49	319	J-20	J-39	8	130.0	108.2	0.69	0.297
P-50	379	J-39	J-42	8	130.0	157.3	1.00	0.595
P-51	780	J-23	J-41	8	130.0	41.1	0.26	0.050
P-56	319	J-42	J-19	8	130.0	216.6	1.38	1.075
P-57	376	J-19	J-43	8	130.0	159.7	1.02	0.611
P-58	527	J-43	J-31	8	130.0	89.9	0.57	0.211
P-59	568	J-23	J-44	8	130.0	145.7	0.93	0.516
P-60	368	J-44	J-37	8	130.0	66.0	0.42	0.119

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (Absolute) (gal/min)	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-61	475	J-30	J-45	8	130.0	113.2	0.72	0.323
P-62	995	J-45	J-46	8	130.0	104.8	0.67	0.280
P-63	478	J-46	J-29	8	130.0	1.8	0.01	0.000
P-64	97	J-7	J-47	8	130.0	373.9	2.39	2.954
P-65	222	J-47	J-42	8	130.0	373.9	2.39	2.954
P-66	538	J-49	J-48	8	130.0	295.7	1.89	1.913
P-67	85	J-48	J-6	12	130.0	295.7	0.84	0.266
P-68	234	J-45	J-49	8	130.0	295.7	1.89	1.913
P-500	125	R-1	PMP-1	36	130.0	876.6	0.28	0.010
P-501	143	PMP-1	J-0	36	130.0	876.6	0.28	0.009

FlexTable: Pump Table

Label	Elevation (ft)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gal/min)	Pump Head (ft)
PMP-1	1,422.60	1,423.00	1,612.20	876.6	189.20

Label	Elevation (ft)	Flow (Out net) (gal/min)	Hydraulic Grade (ft)
R-1	1,423.00	876.6	1,423.00

MAXIMUM DAY DEMAND PLUS FIRE FLOW

RESIDUAL PRESSURE ANALYSIS

AVAILABLE FIRE FLOW ANALYSIS

Label	Demand (gal/min)	Fire Flow (Needed) (gal/min)	Flow (Total Needed) (gal/min)	Fire Flow (Available) (gal/min)	Flow (Total Available) (gal/min)	Pressure (Calculated Residual @ Total Flow Needed) (psi)	Pressure (Calculated Zone Lower Limit @ Total Flow Needed) (psi)	Junction w/ Minimum Pressure (Zone @ Total Flow Needed)	Pipe w/ Maximum Velocity	Velocity of Maximum Pipe (ft/s)	Satisfies Fire Flow Constraints?
J-0	0.0	1,500.0	1,500.0	1,501.0	1,501.0	74.0	65.6	J-3	P-64	1.69	True
J-1	0.0	1,500.0	1,500.0	1,501.0	1,501.0	72.8	65.4	J-3	P-1	2.51	True
J-2	0.0	1,500.0	1,500.0	1,501.0	1,501.0	69.2	64.8	J-3	P-1	2.43	True
J-3	0.0	1,500.0	1,500.0	1,501.0	1,501.0	64.3	69.4	J-4	P-1	2.34	True
J-4	0.0	1,500.0	1,500.0	1,501.0	1,501.0	69.3	64.4	J-3	P-1	2.32	True
J-5	0.0	1,500.0	1,500.0	1,501.0	1,501.0	70.1	64.4	J-3	P-1	2.31	True
J-6	0.0	1,500.0	1,500.0	1,501.0	1,501.0	71.9	64.5	J-3	P-1	2.31	True
J-7	0.0	1,500.0	1,500.0	1,501.0	1,501.0	77.7	64.5	J-3	P-1	2.30	True
J-8	0.0	1,500.0	1,500.0	1,501.0	1,501.0	74.2	65.5	J-3	P-8	2.09	True
J-9	0.0	1,500.0	1,500.0	1,501.0	1,501.0	74.8	65.4	J-3	P-1	1.81	True
J-10	0.0	1,500.0	1,500.0	1,501.0	1,501.0	78.5	65.4	J-3	P-10	2.30	True
J-11	0.0	1,500.0	1,500.0	1,501.0	1,501.0	73.9	65.3	J-3	P-1	2.13	True
J-12	0.0	1,500.0	1,500.0	1,501.0	1,501.0	73.7	65.1	J-3	P-12	2.22	True
J-13	0.0	1,500.0	1,500.0	1,501.0	1,501.0	72.0	64.6	J-3	P-1	2.30	True
J-16	0.0	3,000.0	3,000.0	3,001.0	3,001.0	46.4	46.1	J-3	P-16	7.27	True
J-17	0.0	3,000.0	3,000.0	2,963.4	2,963.4	44.0	45.8	J-3	P-24	10.00	False
J-19	2.7	1,500.0	1,502.7	1,501.0	1,503.7	74.0	64.5	J-3	P-64	6.32	True
J-20	2.7	1,500.0	1,502.7	1,501.0	1,503.7	74.7	64.5	J-3	P-64	6.25	True
J-21	26.3	3,000.0	3,026.3	3,001.0	3,027.3	45.4	45.7	J-3	P-64	9.52	True
J-22	0.0	1,500.0	1,500.0	1,501.0	1,501.0	73.9	64.5	J-3	P-64	6.02	True
J-23	2.7	1,500.0	1,502.7	1,501.0	1,503.7	73.8	64.5	J-3	P-64	6.07	True
J-24	2.7	1,500.0	1,502.7	1,501.0	1,503.7	73.0	64.5	J-3	P-64	6.11	True
J-25	0.0	1,500.0	1,500.0	1,501.0	1,501.0	71.0	64.5	J-3	P-64	5.95	True
J-26	0.0	1,500.0	1,500.0	1,501.0	1,501.0	71.2	64.5	J-3	P-64	5.73	True
J-27	0.0	1,500.0	1,500.0	1,501.0	1,501.0	68.4	64.5	J-3	P-64	5.64	True
J-28	2.7	1,500.0	1,502.7	1,501.0	1,503.7	68.7	64.5	J-3	P-64	5.53	True
J-29	2.7	1,500.0	1,502.7	1,501.0	1,503.7	67.8	64.5	J-3	P-64	5.49	True
J-30	0.0	1,500.0	1,500.0	1,501.0	1,501.0	68.5	64.5	J-3	P-64	5.40	True
J-31	47.5	1,500.0	1,547.5	1,501.0	1,548.5	70.0	64.5	J-3	P-64	5.79	True
J-32	46.8	1,500.0	1,546.8	1,501.0	1,547.8	68.1	64.5	J-3	P-64	5.57	True
J-34	2.7	1,500.0	1,502.7	1,501.0	1,503.7	69.7	64.5	J-3	P-64	5.72	True
J-35	83.7	1,500.0	1,583.7	1,501.0	1,584.7	67.3	64.5	J-3	P-64	5.61	True
J-36	78.3	1,500.0	1,578.3	1,501.0	1,579.3	68.1	64.5	J-3	P-44	5.93	True
J-37	0.0	1,500.0	1,500.0	1,501.0	1,501.0	68.5	64.5	J-3	P-64	5.91	True
J-38	0.0	1,500.0	1,500.0	1,501.0	1,501.0	71.6	65.0	J-3	P-48	5.32	True
J-39	34.2	1,500.0	1,534.2	1,501.0	1,535.2	73.2	64.5	J-3	P-64	6.63	True
J-41	53.8	1,500.0	1,553.8	1,501.0	1,554.8	73.5	64.5	J-3	P-64	5.91	True

Label	Demand (gal/min)	Fire Flow (Needed) (gal/min)	Flow (Total Needed) (gal/min)	Fire Flow (Available) (gal/min)	Flow (Total Available) (gal/min)	Pressure (Calculated Residual @ Total Flow Needed) (psi)	Pressure (Calculated Zone Lower Limit @ Total Flow Needed) (psi)	Junction w/ Minimum Pressure (Zone @ Total Flow Needed)	Pipe w/ Maximum Velocity	Velocity of Maximum Pipe (ft/s)	Satisfies Fire Flow Constraints?
J-42	0.0	1,500.0	1,500.0	1,501.0	1,501.0	74.7	64.5	J-3	P-64	6.93	True
J-43	49.0	1,500.0	1,549.0	1,501.0	1,550.0	70.8	64.5	J-3	P-64	6.08	True
J-44	55.9	1,500.0	1,555.9	1,501.0	1,556.9	69.7	64.5	J-3	P-59	6.35	True
J-45	54.7	1,500.0	1,554.7	1,501.0	1,555.7	68.1	64.5	J-3	P-68	5.78	True
J-46	72.4	1,500.0	1,572.4	1,501.0	1,573.4	65.4	64.5	J-3	P-63	5.46	True
J-47	0.0	1,500.0	1,500.0	1,501.0	1,501.0	75.9	64.5	J-3	P-64	8.75	True
J-48	0.0	1,500.0	1,500.0	1,501.0	1,501.0	71.9	64.5	J-3	P-67	4.71	True
J-49	0.0	1,500.0	1,500.0	1,501.0	1,501.0	68.3	64.5	J-3	P-66	6.52	True

Label	Demand (gal/min)	Fire Flow (Needed) (gal/min)	Flow (Total Needed) (gal/min)	Fire Flow (Available) (gal/min)	Flow (Total Available) (gal/min)	Pressure (Calculated Residual @ Total Flow Needed) (psi)	Pressure (Calculated Zone Lower Limit @ Total Flow Needed) (psi)	Junction w/ Minimum Pressure (Zone @ Total Flow Needed)	Pipe w/ Maximum Velocity	Velocity of Maximum Pipe (ft/s)	Satisfies Fire Flow Constraints?
J-0	0.0	1,500.0	1,500.0	4,745.2	4,745.2	74.0	65.6	J-3	P-64	1.69	True
J-1	0.0	1,500.0	1,500.0	4,682.8	4,682.8	72.8	65.4	J-3	P-1	6.40	True
J-2	0.0	1,500.0	1,500.0	4,521.0	4,521.0	69.2	64.8	J-3	P-1	5.93	True
J-3	0.0	1,500.0	1,500.0	4,369.2	4,369.2	64.3	69.4	J-4	P-1	5.52	True
J-4	0.0	1,500.0	1,500.0	4,397.6	4,397.6	69.3	64.4	J-3	P-1	5.50	True
J-5	0.0	1,500.0	1,500.0	4,401.9	4,401.9	70.1	64.4	J-3	P-1	5.49	True
J-6	0.0	1,500.0	1,500.0	4,404.5	4,404.5	71.9	64.5	J-3	P-1	5.48	True
J-7	0.0	1,500.0	1,500.0	4,408.3	4,408.3	77.7	64.5	J-3	P-1	5.46	True
J-8	0.0	1,500.0	1,500.0	4,719.2	4,719.2	74.2	65.5	J-3	P-8	5.88	True
J-9	0.0	1,500.0	1,500.0	4,675.8	4,675.8	74.8	65.4	J-3	P-9	4.23	True
J-10	0.0	1,500.0	1,500.0	4,671.2	4,671.2	78.5	65.4	J-3	P-10	6.88	True
J-11	0.0	1,500.0	1,500.0	4,647.2	4,647.2	73.9	65.3	J-3	P-1	5.26	True
J-12	0.0	1,500.0	1,500.0	4,598.0	4,598.0	73.7	65.1	J-3	P-12	5.83	True
J-13	0.0	1,500.0	1,500.0	4,443.6	4,443.6	72.0	64.6	J-3	P-1	5.49	True
J-16	0.0	3,000.0	3,000.0	3,968.0	3,968.0	46.4	46.1	J-3	P-16	9.54	True
J-17	0.0	3,000.0	3,000.0	2,963.4	2,963.4	44.0	45.8	J-3	P-24	10.00	False
J-19	2.7	1,500.0	1,502.7	2,680.8	2,683.5	74.0	64.5	J-3	P-64	10.00	True
J-20	2.7	1,500.0	1,502.7	2,731.0	2,733.7	74.7	64.5	J-3	P-64	10.00	True
J-21	26.3	3,000.0	3,026.3	3,188.0	3,214.3	45.4	45.7	J-3	P-64	10.00	True
J-22	0.0	1,500.0	1,500.0	2,788.8	2,788.8	73.9	64.5	J-3	P-26	10.00	True
J-23	2.7	1,500.0	1,502.7	2,847.0	2,849.7	73.8	64.5	J-3	P-64	10.00	True
J-24	2.7	1,500.0	1,502.7	2,819.1	2,821.8	73.0	64.5	J-3	P-64	10.00	True
J-25	0.0	1,500.0	1,500.0	2,917.1	2,917.1	71.0	64.5	J-3	P-64	10.00	True
J-26	0.0	1,500.0	1,500.0	3,083.3	3,083.3	71.2	64.5	J-3	P-64	10.00	True
J-27	0.0	1,500.0	1,500.0	3,072.7	3,072.7	68.4	64.5	J-3	P-32	10.00	True
J-28	2.7	1,500.0	1,502.7	3,261.1	3,263.8	68.7	64.5	J-3	P-64	10.00	True
J-29	2.7	1,500.0	1,502.7	3,299.0	3,301.7	67.8	64.5	J-3	P-64	10.00	True
J-30	0.0	1,500.0	1,500.0	3,318.7	3,318.7	68.5	64.5	J-3	P-68	10.00	True
J-31	47.5	1,500.0	1,547.5	3,036.8	3,084.3	70.0	64.5	J-3	P-64	10.00	True
J-32	46.8	1,500.0	1,546.8	2,794.0	2,840.8	68.1	64.5	J-3	P-40	10.00	True
J-34	2.7	1,500.0	1,502.7	3,091.6	3,094.3	69.7	64.5	J-3	P-64	10.00	True
J-35	83.7	1,500.0	1,583.7	2,980.4	3,064.0	67.3	64.5	J-3	P-43	10.00	True
J-36	78.3	1,500.0	1,578.3	2,582.0	2,660.3	68.1	64.5	J-3	P-44	10.00	True
J-37	0.0	1,500.0	1,500.0	2,855.8	2,855.8	68.5	64.5	J-3	P-59	10.00	True
J-38	0.0	1,500.0	1,500.0	2,873.1	2,873.1	71.6	65.0	J-3	P-48	10.00	True
J-39	34.2	1,500.0	1,534.2	2,526.0	2,560.2	73.2	64.5	J-3	P-64	10.00	True
J-41	53.8	1,500.0	1,553.8	2,762.0	2,815.8	73.5	64.5	J-3	P-25	10.00	True

Label	Demand (gal/min)	Fire Flow (Needed) (gal/min)	Flow (Total Needed) (gal/min)	Fire Flow (Available) (gal/min)	Flow (Total Available) (gal/min)	Pressure (Calculated Residual @ Total Flow Needed) (psi)	Pressure (Calculated Zone Lower Limit @ Total Flow Needed) (psi)	Junction w/ Minimum Pressure (Zone @ Total Flow Needed)	Pipe w/ Maximum Velocity	Velocity of Maximum Pipe (ft/s)	Satisfies Fire Flow Constraints?
J-42	0.0	1,500.0	1,500.0	2,371.1	2,371.1	74.7	64.5	J-3	P-64	10.00	True
J-43	49.0	1,500.0	1,549.0	2,595.6	2,644.5	70.8	64.5	J-3	P-57	10.00	True
J-44	55.9	1,500.0	1,555.9	2,431.7	2,487.6	69.7	64.5	J-3	P-59	10.00	True
J-45	54.7	1,500.0	1,554.7	2,870.6	2,925.2	68.1	64.5	J-3	P-68	10.00	True
J-46	72.4	1,500.0	1,572.4	2,786.1	2,858.5	65.4	64.5	J-3	P-63	10.00	True
J-47	0.0	1,500.0	1,500.0	1,780.6	1,780.6	75.9	64.5	J-3	P-64	10.00	True
J-48	0.0	1,500.0	1,500.0	3,553.6	3,553.6	71.9	64.5	J-3	P-67	10.00	True
J-49	0.0	1,500.0	1,500.0	2,465.9	2,465.9	68.3	64.5	J-3	P-66	10.00	True

TRAFFIC IMPACT ANALYSIS

SEC Crismon Road and Williams Field Road

Mesa, Arizona

Prepared for:

Pacific Proving, LLC

Kimley»Horn

TRAFFIC IMPACT ANALYSIS

SEC Crismon Road and Williams Field Road

Mesa, Arizona

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Contents

Figures

Tables

1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

This report documents a traffic impact analysis performed for a proposed master planned community located at the southeast corner of the future intersection of Crismon Road and Williams Field Road in Mesa, Arizona. The site will include a residential community and retail land use and is anticipated to be built out over a 10-year period by the 2040 analysis year.

1.2 REPORT PURPOSE AND OBJECTIVES

Kimley-Horn and Associates, Inc., has been retained by Pacific Proving, LLC to perform the traffic impact analysis for the proposed development.

The purpose of this study is to address traffic and transportation impacts of the proposed development on surrounding streets and intersections. This traffic impact study was prepared based on criteria set forth by the City of Mesa. The specific objectives of this study are:

- To evaluate lane requirements on all existing roadway links and at all existing intersections within the study area;
- To determine future level of service (LOS) for all existing intersections within the study area and recommend any capacity-related improvements;
- To determine necessary lane configurations at all new intersections within the proposed development in order to provide acceptable future levels of service;
- To determine appropriate cross-sections at buildout proposed roadways;
- To evaluate the need for auxiliary lanes at all study area intersections; and
- To evaluate the need for future traffic signals.

1.3 PRINCIPAL FINDINGS AND RECOMMENDATIONS

The proposed development is expected to generate 16,992 daily trips, with 1,029 trips occurring in the AM peak hour and 1,760 trips occurring in the PM peak hour. To ensure that the estimate of the traffic impacts is the maximum that can be expected, it is assumed that the site will be 100 percent occupied upon buildout by the 2040 analysis year.

- The intersections of Williams Field Road with Community Street 1 and Community Street 2 are expected to operate an acceptable level of service at buildout with the exception of the northbound left turn movement at the intersection of Community Street 2 and Williams Field Road during the peak hours. It is anticipated that drivers will utilize other available routes by turning right or exiting at the signalized intersection of Community Street 1 and Williams Field Road during the peak hours.

- The future intersection of Crismon Road and Williams Field Road is located at an appropriate location for signal control. Installation of a traffic signal at the intersection of Crismon Road and Williams Field Road is anticipated when traffic warrants are met.

- It is recommended that vehicular volumes be monitored and evaluated at the intersection of Community Street 1 and Williams Field Road as development occurs to determine the appropriate time for the addition of signal control at the intersection.

- It is recommended that the intersection of Community Street 1 and Williams Field Road provide northbound dual left turn lanes and a westbound left turn lane. It is recommended that the northbound dual left turn lanes provide 250 feet of storage and a 100 foot reverse curve per City of Mesa Engineering and Design Standards Section 212.4. It is recommended that the westbound left turn lane provide 150 feet of storage and a 100 foot reverse curve.

- It is recommended that the intersection of Community Street 2 and Williams Field Road provide a northbound left turn lane and a westbound left turn lane with 150 feet of storage and a 100 foot taper per the City of Mesa Engineering and Design Standards Section 212.4.

- It is recommended that an eastbound right turn lane be provided at the intersection of Community Street 1 and Williams Field Road with 250 feet of storage and a 100 foot taper, per the City of Mesa Engineering and Design Standards Section 208.4.2. A northbound right turn lane is recommended to be provided at the intersection of Community Street 1 and Williams Field Road with 150 feet of storage and a 100 foot taper.

- It is recommended that an eastbound and northbound right turn lane be provided at the intersection of Community Street 2 and Williams Field Road with 175 feet and 150 feet of storage, respectively, and a 100 foot taper, per the City of Mesa Engineering and Design Standards Section 208.4.2.

- A community collector road C cross section is recommended for Community Street 1 alignment with one lane in each direction, a landscaped raised median, and left turn provisions. A community collector road D cross section is recommended for Community Street 2 alignments with one lane in each direction. Typical street cross sections for the internal site roadways are attached in the **Appendix**.

2.0 PROPOSED DEVELOPMENT

2.1 SITE LOCATION

The proposed development, a master plan community, is located at the southeast corner of the future intersection of Crismon Road and Williams Field Road in Mesa, Arizona. The site boundary is Crismon Road to the west, Williams Field Road to the north, 222nd Street to the east and the future SR 24 to the south. The project location is shown in **Figure 1**.

2.2 LAND USE AND SITE PLAN

The overall development consists of residential and retail land use. The total site area is on approximately 170.5 acres. **Table 1** illustrates the land use of the proposed development.

Table 1. Land Use

Parcel	ITE Land Use	Size
Residential	Single-Family Detached Housing (210)	1,200 DU
Retail	Shopping Center (820)	150,000 SF

The retail portion of the site is located on the southeast corner of the intersection of Crismon Road and Williams Field Road. The remaining development is expected to consist of residential land use. The master planned community is anticipated to be developed in phases; however, for the purpose of this study, the project will be analyzed based on full build-out conditions. The layout of the site is illustrated in **Figure 2**.

2.3 SITE ACCESSIBILITY

The site is accessed locally via Crismon Road and Williams Field Road. Regional access is expected to be provided by the existing San Tan Freeway Loop 202, northwest of the development (~3 miles), and the proposed State Route 24, south of the development, as well as other arterial streets in the vicinity such as Pecos Road and Signal Butte Road. Direct connection to the State Route 24 will exist at Williams Field Road and Signal Butte Road traffic interchanges. The proposed State Route 24 will provide a direct connection to the Loop 202.

2.4 SITE CIRCULATION

This report focuses on the arterial and collector roadway network that is adjacent and internal to the proposed development. Community Street 1 is a proposed community collector street approximately 1,550 feet east of the proposed intersection of Crismon Road and Williams Field Road. Community Street 2 is a proposed community collector street approximately 1,750 feet east of Community Street 1 and approximately 3,300 feet east of the proposed intersection of Crismon Road and Williams Field Road. Specific traffic impact analyses relevant to the local roadways and individual parcel access will be analyzed in subsequent reports as more refined site plans become available. Site access locations should be coordinated with adjacent developments.

The development will be accessed via Crismon Road and Williams Field Road. Several collector street and local street connections are proposed within the development. Crismon Road and Williams Field Road currently do not exist in the vicinity of the site. The cross-sections and geometry are identified in this traffic impact analysis and the City of Mesa 2040 Transportation Plan. Guidance is also provided in the Levine General Motors (LGM) 170 Community Plan Section 16.2 and the corresponding typical street cross sections attached in the **Appendix**. This traffic analysis provides the roadway recommendations for the internal community street sections and intersections along Williams Field Road. Future connections along Crismon Road should be coordinated with the City of Mesa due to the anticipated grade separated Crismon Road alignment.

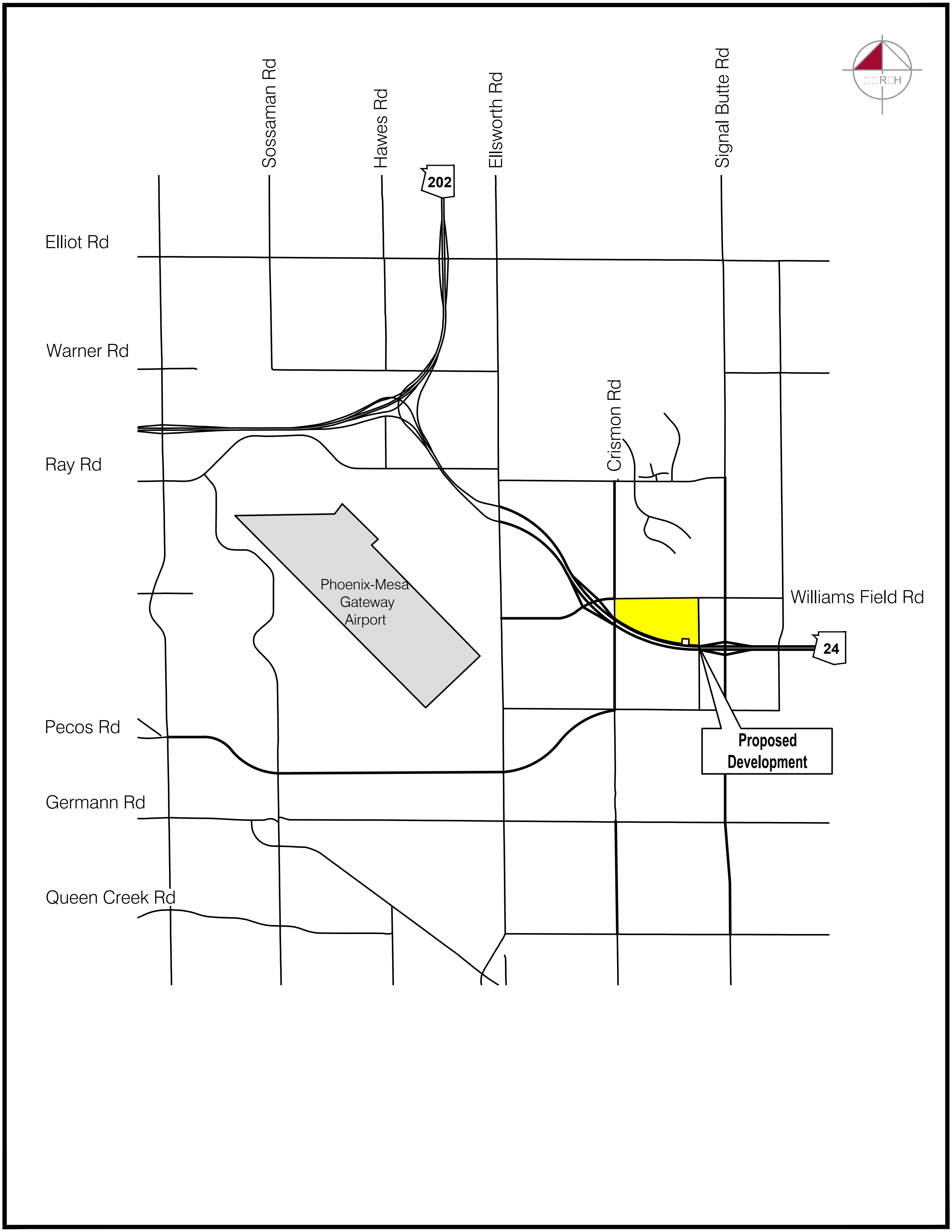

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Figure 1
Vicinity Map

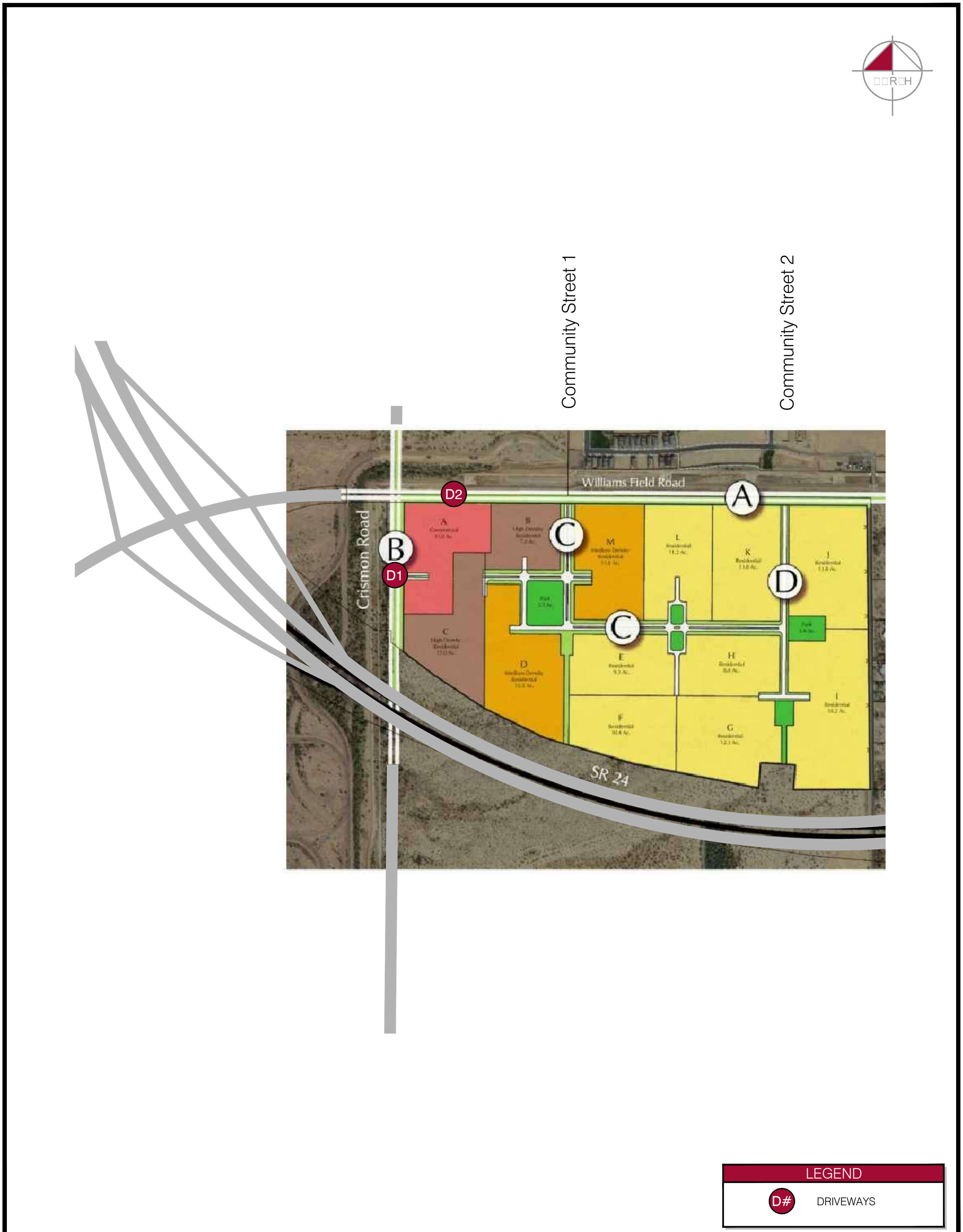

Figure 2
Site Plan

3.0 STUDY AREA

3.1 STUDY AREA

The study area includes the following intersections:

- Crismon Road and Williams Field Road (future signalization)
- Community Street 1 and Williams Field Road (future signalization)
- Community Street 2 and Williams Field Road

It is anticipated that traffic volumes at the intersections of Williams Field Road with Crismon Road and Community Street 1 will eventually warrant a traffic signal. It is recommended that vehicular volumes be monitored and evaluated at these intersections to determine the appropriate time for the addition of signal control at the intersections.

3.2 ADJACENT LAND USE

The existing land-use within the vicinity of the proposed development primarily includes agricultural, vacant land, single family residential developments, and industrial land uses. The Phoenix-Mesa Gateway Airport exists approximately two miles west of the site. Eastmark, a new residential community, is located northeast of the development. Additional residential communities exist along Signal Butte Road north of the proposed site. Industrial land uses are located near the intersection of Mountain Road and Pecos Road, southeast of the development. The Southern Pacific Transportation Company railroad tracks are located approximately 4 miles south of the development. The railroad tracks run to the southeast and to the northwest.

4.0 EXISTING CONDITIONS

4.1 PHYSICAL CHARACTERISTICS

The roadway network within the study area is currently unbuilt. Future recommended roadway improvements are summarized below as documented in the City of Mesa 2040 Transportation Plan.

Crismon Road is proposed west of the development as a 4-lane arterial with a raised median per the City of Mesa 2040 Transportation Plan. The City of Mesa 2040 Transportation Plan shows Crismon Road extending north to Ray Road. The Arizona Department of Transportation (ADOT) Final Design Concept Report (DCR) – SR 24 Interim Phase II recommends a grade separated alignment at the SR 24.

Williams Field Road currently exists as a 2-lane street with an east-west alignment between 222nd Street and Moeur Road, east of the proposed site. The City of Mesa 2040 Transportation Plan shows Williams Field Road as a 6-lane arterial with a raised median from Ellsworth Road to the intersection with Crismon Road where it transitions to a 4-lane arterial east of Crismon Road. The ADOT DCR – SR 24 Interim Phase II recommends a Williams Field Road traffic interchange at the SR 24.

The east-west ***State Route 24*** (SR-24) freeway is proposed south of the development. Interim Phase II of the SR 24 is expected to complete the segment from Ellsworth Road to Ironwood Road. Traffic interchanges are proposed at Williams Field Road and Signal Butte Road in the vicinity of the site. A grade separation is planned at the Crismon Road alignment.

An approved master traffic impact analysis report for *Pacific Proving Grounds North (PPGN)* completed by EPS Group, for the parcels west and northwest of the site, provides recommendations for the public street classifications in the vicinity of the site. Per the PPGN report, it is recommended that Williams Field Road be constructed as a six-lane arterial with a raised median from the Crismon Road intersection west to Ellsworth Road. Crismon Road is recommended as a four-lane arterial with a raised median except at Williams Field Road where it is recommended to be six lanes directly north and south of the intersection.

5.0 PROJECTED TRAFFIC

5.1 SITE TRAFFIC FORECASTS

5.1.1 TRIP GENERATION

The Institute of Transportation Engineers' (ITE) *Trip Generation, 10th Edition,* was used to obtain daily and peak-hour trip generation rates and inbound-outbound percentages, which were then used to estimate the number of daily and peak hour trips that can be attributed to the proposed development. The trip generation characteristics of the site are summarized in **Table 2**.

Table 2. Project Trip Generation

Land Use	ITE Code	Qty	Units	Daily Total	AM Peak			PM Peak		
					In	Out	Total	In	Out	Total
Single-Family Detached Housing	210	1,200	DUs	11,328	222	666	888	748	440	1,188
Shopping Center	820	150,000	SF	5,664	87	54	141	275	297	572
Total Trips				**16,992**	**309**	**720**	**1,029**	**1,023**	**737**	**1,760**

The proposed development is expected to generate 16,992 daily trips, with 1,029 trips occurring in the AM peak hour and 1,760 trips occurring in the PM peak hour.

5.1.2 TRIP DISTRIBUTION

The trip distribution is based on the future roadway network, projected traffic volumes from the Mesa 2040 Transportation Plan, and the likely travel patterns in the vicinity of site. **Figure 3** illustrates the trip distribution for the site.

5.1.3 SITE TRAFFIC ASSIGNMENT

Trips generated by the proposed development were assigned to the roadway network on the basis of the trip distribution and the likely travel patterns to and from the site. **Figure 4** shows the results of the site traffic assignment.

5.2 FUTURE TRAFFIC FORECASTING

The 2018 Southeast Mesa Land Use and Transportation Plan future traffic volumes were used for the background traffic volumes for the external road segments adjacent to the development area. The background traffic is shown in **Figure 5**.

5.3 TOTAL TRAFFIC

The results of the daily traffic assignment were used for the internal street total traffic volumes, and the 2040 volumes from the 2018 Southeast Mesa Land Use and Transportation Plan future traffic volumes were used for the external street total traffic volumes. The total traffic is shown in **Figure 6**.

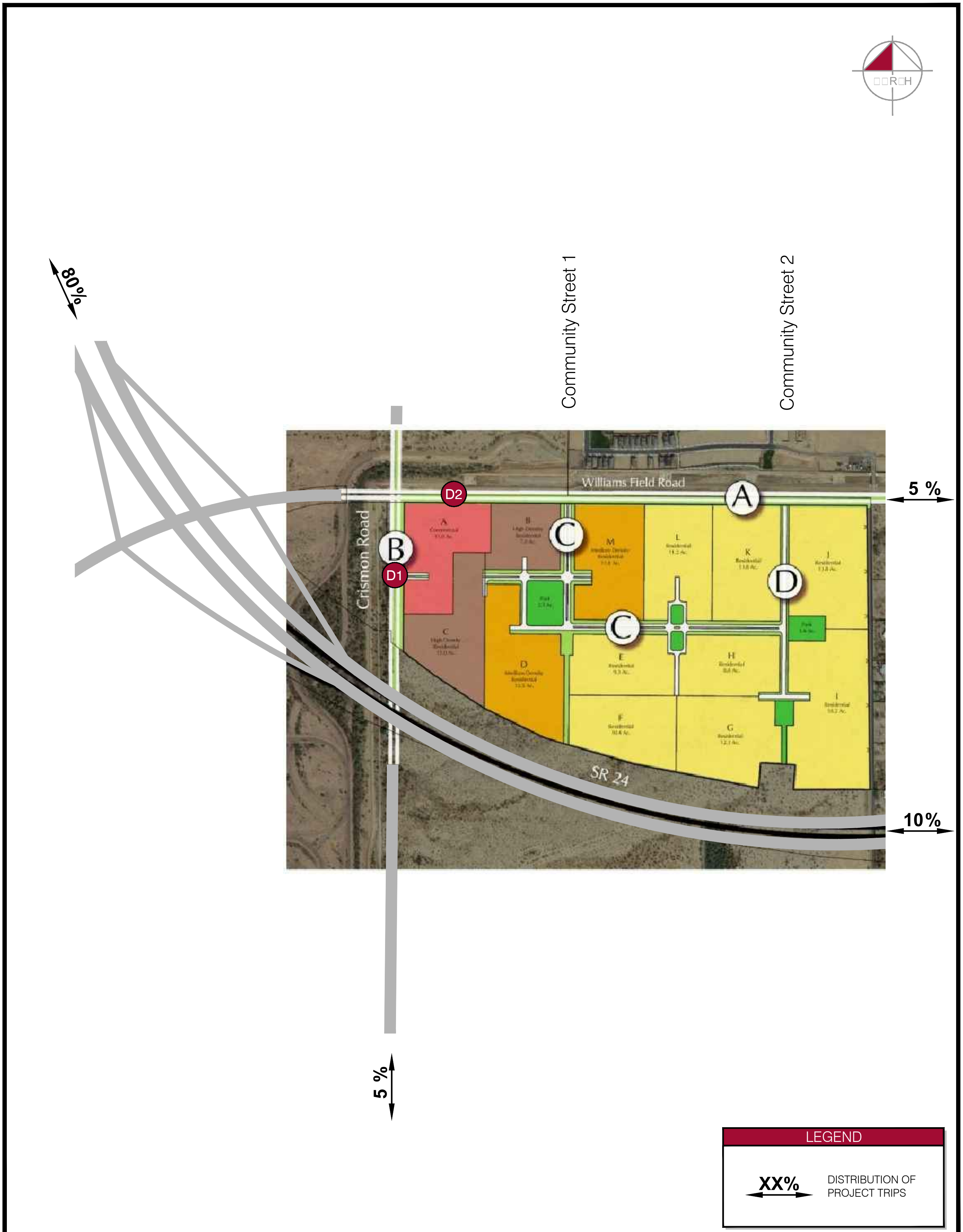

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Figure 3
Trip Distribution

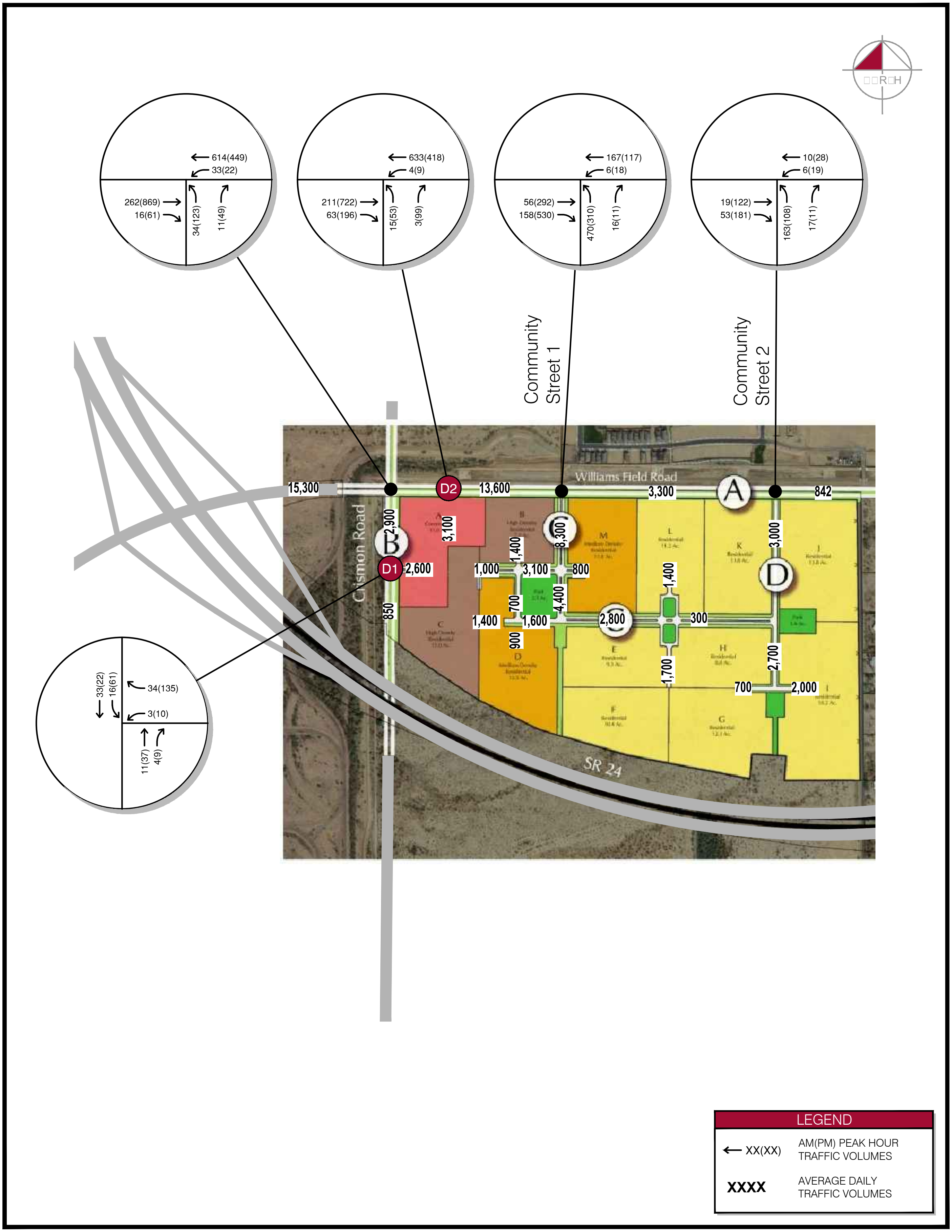

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Figure 4
Site Traffic Assignment

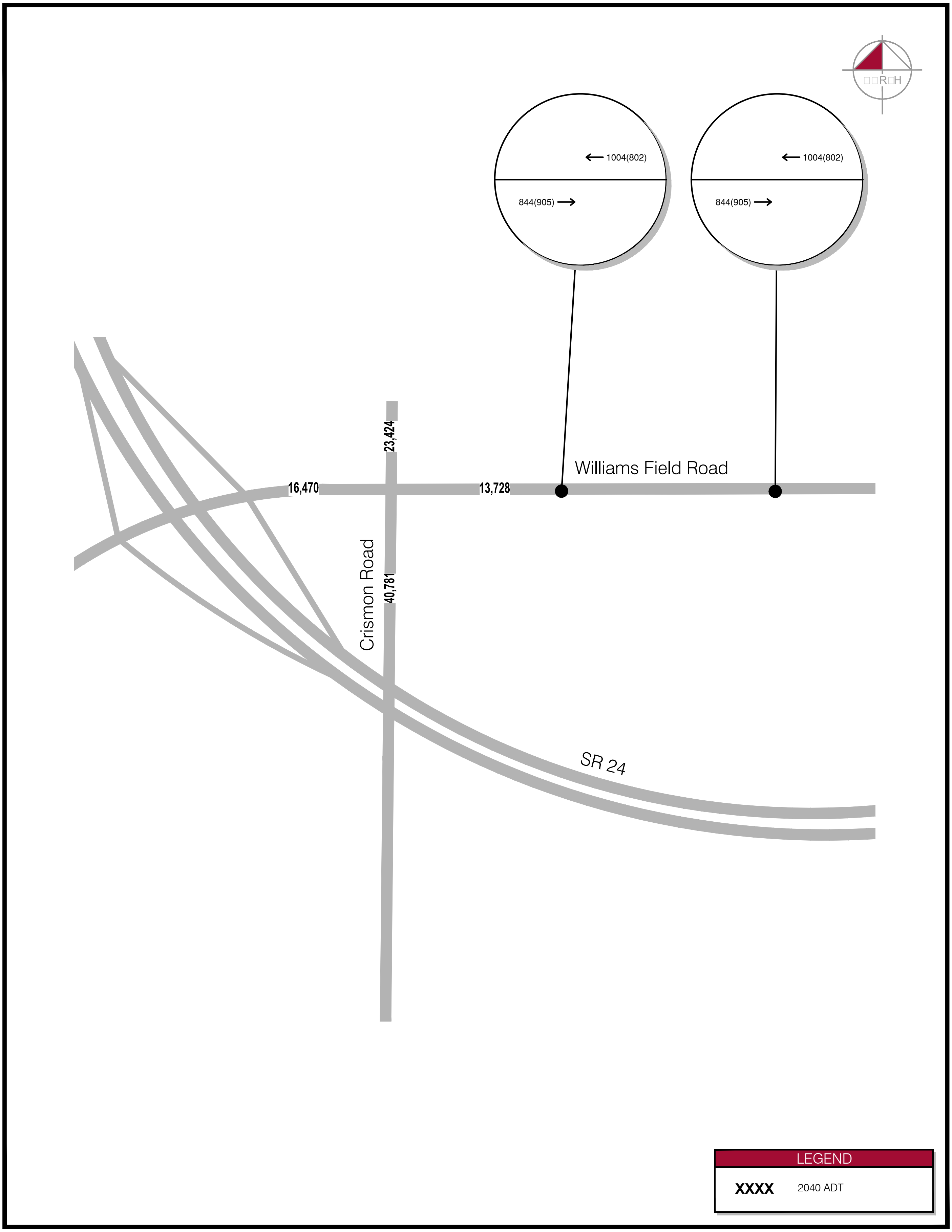

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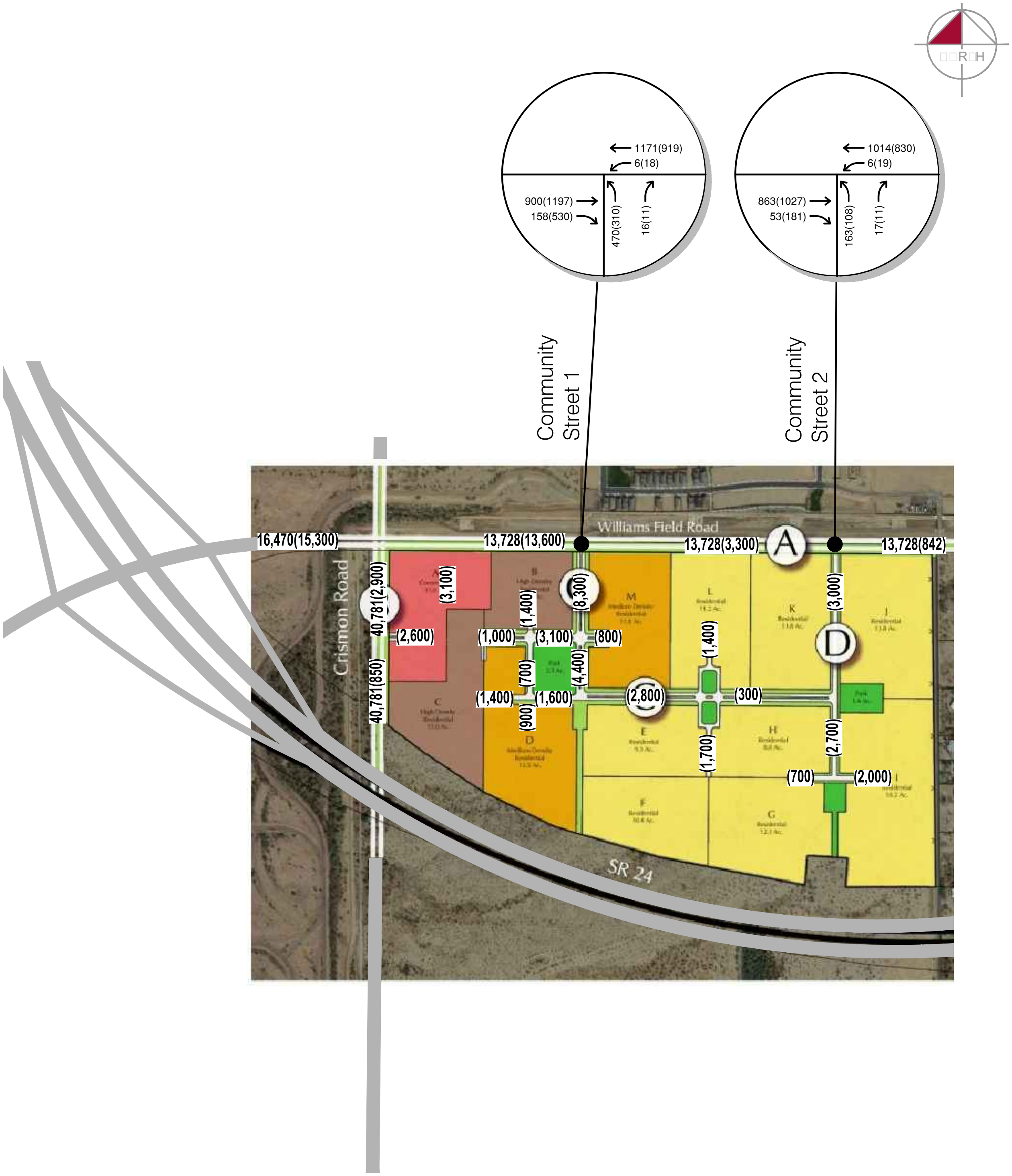
Figure 5
2040 Background Traffic



LEGEND	
XXX (XXX)	2040 ADT (SITE ADT)
XXX	SITE ADT

Kimley»Horn

Figure 6
2040 Total Traffic

6.0 TRAFFIC AND IMPROVEMENT ANALYSIS

6.1 STREET CROSS SECTION ANALYSIS

6.1.1 2040 EXTERNAL CAPACITY

The capacity was evaluated for roadway segments outside the internal network. The forecasted 2040 ADTs were compared to the daily traffic volumes provided in Table 2.1 of the Maricopa Department of Transportation (MCDOT) Roadway Design Manual, included in this report as **Table 3**. The future number of lanes and roadway classification were referenced from the City of Mesa 2040 Transportation Plan.

Table 3. Urban and Rural Roadway Planning Level of Traffic Volumes (MCDOT)

Urban Roadway Planning Level Traffic					
Road Classification	ADT / Lane	No. Thru Lanes	2-Way ADT Range	Peak Hr./ ADT% (K)	Max. Rdwy. Length*
Local	350	2	50 – 1,500	15	1,000 ft.
Minor Collector	2,500	2	500 – 5,000	12	1/2 mi.
Major Collector	3,500	2	600 – 8,500	10	2 mi.
Minor Arterial	5,500	4	5,000 – 35,000	8	---
Principal Arterial	7,500	6	30,000 – 60,000	8	---
Parkway (urban)	12,000	8	90,000 – 100,000	8	---
Rural Roadway Planning Level Traffic					
Road Classification	ADT / Lane	No. Thru Lanes	2-Way ADT Range	Peak Hr./ ADT% (K)	Max. Rdwy. Length*
Local	500	2	50 – 1,500	15	1 mi.
Minor Collector	3,000	2	800 – 5,000	12	2 mi.
Major Collector	4,000	2	1,000 – 8,500	10	---
Minor Arterial	9,000	4	5,000 – 35,000	10	---
Principal Arterial	10,000	4	10,000 – 40,000	10	---
Parkway (rural)	13,000	4	50,000 – 60,000,	10	---

*** Length may be variable as a function of degree of home frontage on the road.**

The 2040 ADTs and roadway classifications for the external roadways within the study area are summarized in **Table 4**.

Table 4. 2040 Roadway Segment Cross Section Summary

Facility	Segment	2040 ADT	2040 Lanes	Roadway Classification
Crismon Road	Williams Field Road to Pecos Road	40,781	4*	Minor Arterial
Williams Field Road	Crismon Road to Signal Butte Road	13,728	4**	Minor Arterial

*Crismon Road is anticipated to be six lanes immediately north and south of Williams Field Road.

**Williams Field Road is anticipated to be six lanes from the Crismon Road intersection to the west.

The external public road of Williams Field Road is expected to operate within MCDOT's acceptable roadway capacity range as four-lane arterials within the vicinity of the site in 2040 total traffic conditions.

Crismon Road is anticipated to be a four-lane minor arterial widening to six lanes at the intersection of Williams Field Road. The *Pacific Proving Grounds North (PPGN) Master Traffic Impact Analysis* completed by EPS Group in September 2014, is consistent with the classifications in **Table 4**. Williams Field Road is expected to transition from six lanes at the intersection of Crismon Road to four lanes before Community Street 1 and remain a four lanes street section to the east property line.

6.2 LEVEL OF SERVICE ANALYSIS

The LOS for the study area intersections for Williams Field Road with Community Street 1 and Community Street 2 were evaluated using the *Highway Capacity Manual 6th Edition* methodology for unsignalized and signalized intersections using *Synchro 10* analysis software. The *PPGN TIA* total traffic volume figures were utilized to determine the background through volumes on Williams Field Road. The *PPGN TIA* turning movement count figures, LOS analysis worksheets and signal timing assumptions are included in the **Appendix**.

6.2.1 TOTAL TRAFFIC LEVEL OF SERVICE ANALYISIS

The unsignalized intersection in the study area was evaluated on the basis of the total traffic shown in **Figure 6**, and the recommended geometry shown in **Figure 7**. The results of the analysis for the unsignalized intersection is shown in **Table 5**.

Table 5. Total Traffic Level of Service: Unsignalized Intersections

Intersection	NB			SB			EB			WB		
	L	T	R	L	T	R	L	T	R	L	T	R
Community Street 2 and Williams Field Road												
AM Peak	F	-	B	-			-	-	-	B	-	-
PM Peak	F	-	C	-			-	-	-	C	-	-

The unsignalized intersection is expected to operate at a satisfactory LOS, with the exception of the northbound left turn movement during the peak periods. It is common for left turns across arterials from the minor street to experience delay during both peak hours due to a reduction in acceptable gaps in through traffic along the major roadway. It is anticipated that drivers will utilize other available routes by turning right or exiting at the signalized intersection of Community Street 1 and Williams Field Road.

The signalized intersection in the study area was evaluated on the basis of the total traffic shown in **Figure 6**, and the recommended geometry shown in **Figure 7**. The results of this analysis are shown in **Table 6**.

Table 6. Total Traffic Level of Service: Signalized Intersection

Intersection	NB			SB			EB			WB			Intersection LOS
	L	T	R	L	T	R	L	T	R	L	T	R	
Community Street 1 and Williams Field Road													
AM Peak	B	-	B	-			-	B	B	B	B	-	B
PM Peak	C	-	C	-			-	A	B	B	A	-	B

The signalized intersection is expected to operate at an acceptable LOS.

6.3 LEFT-TURN STORAGE ANALYSIS

The collector street intersections along Williams Field Road providing access to the residential portion of the site were analyzed to determine the left-turn storage required using American Association of State Highway and Transportation Officials (AASHTO) criteria of signal cycle length for signalized intersections and vehicle arrivals within a two-minute period for unsignalized intersections to accommodate the expected traffic volumes in the year 2040. Analysis of future connections to the retail portion of the site will be evaluated when more refined plans become available. The calculations associated with these conclusions are included in the **Appendix**. The recommended storage lengths are based on total traffic volumes shown in **Figure 6**.

Table 7. Left Turn Storage

Intersection and Approach	*Existing*	Recommended
Community Street 1 and Williams Field Road (future signalization)		
- Northbound Approach	- feet	250 feet (Duals)
- Westbound Approach	- feet	150 feet
Community Street 2 and Williams Field Road		
- Northbound Approach	- feet	150 feet
- Westbound Approach	- feet	150 feet

Duals = two left turn lanes

The City of Mesa Engineering and Design Standards Section 212.4 recommends that left-turn storage lanes constructed in medians should be constructed with a minimum of 150 feet of storage and a 100-foot taper. The left-turn lanes should provide the storage recommended in **Table 7** and a 100-foot taper per City of Mesa requirements.

6.3 RIGHT-TURN LANES

Right-turn lanes are often recommended on roadways where right-turning vehicles create delays or safety concerns for other traffic movements. The need for a right-turn lane depends on the speed of traffic on the road, the volume of traffic turning right, and the through traffic volume in the same lane as the right-turning traffic.

6.3.1 INTERSECTIONS

The City of Mesa Engineering and Design Standards Section 208.4.1 recommends a right-turn deceleration lane for multi-family residential developments with 100 or more units per access point. The City of Mesa Engineering and Design Standards Section 208.4.1 recommends that a right turn lane provide at least 150 feet of storage and a 100-foot taper.

Review of the site plan and 2040 total traffic volumes reveals that the City of Mesa's criteria for a right turn deceleration lane is met at the approaches listed in **Table 8**. The recommended storage is also included in **Table 8**.

Table 8. Right Turn Storage

Intersection and Approach	*Existing*	Recommended
Community Street 1 and Williams Field Road (future signalization)		
- Northbound Approach	- feet	150 feet
- Eastbound Approach	- feet	250 feet
Community Street 2 and Williams Field Road		
- Northbound Approach	- feet	150 feet
- Eastbound Approach	- feet	150 feet

The right turn lanes should provide the storage recommended in **Table 8** and 100-foot taper per City of Mesa deceleration lane requirements.

6.4 CROSS SECTIONS

The cross-sections associated with the internal roadway network of the proposed development were reviewed using the site generated ADT's shown in **Figure 6**. The anticipated ADT volumes on the segment south of the intersections of Williams Field Road with Community Street 1 and Community Street 2 are 8,300 vehicles per day (VPD) and 3,000 vehicles per day, respectively. Based on the typical street cross sections for the internal site roadways attached in the **Appendix**, a two-lane collector street cross section with a landscaped raised median and left turn provisions, labeled C – Community Collector Road and Neighborhood Entry, is recommended for the internal community street alignment of Community Street 1. The street section labeled D – Community Collector and Neighborhood Entry, a two-lane cross section, is recommended for the internal community street alignment of Community Street 2.

Auxiliary lane locations and storage requirements for the internal roadway network will be established when detailed site plans are available for the individual parcels.

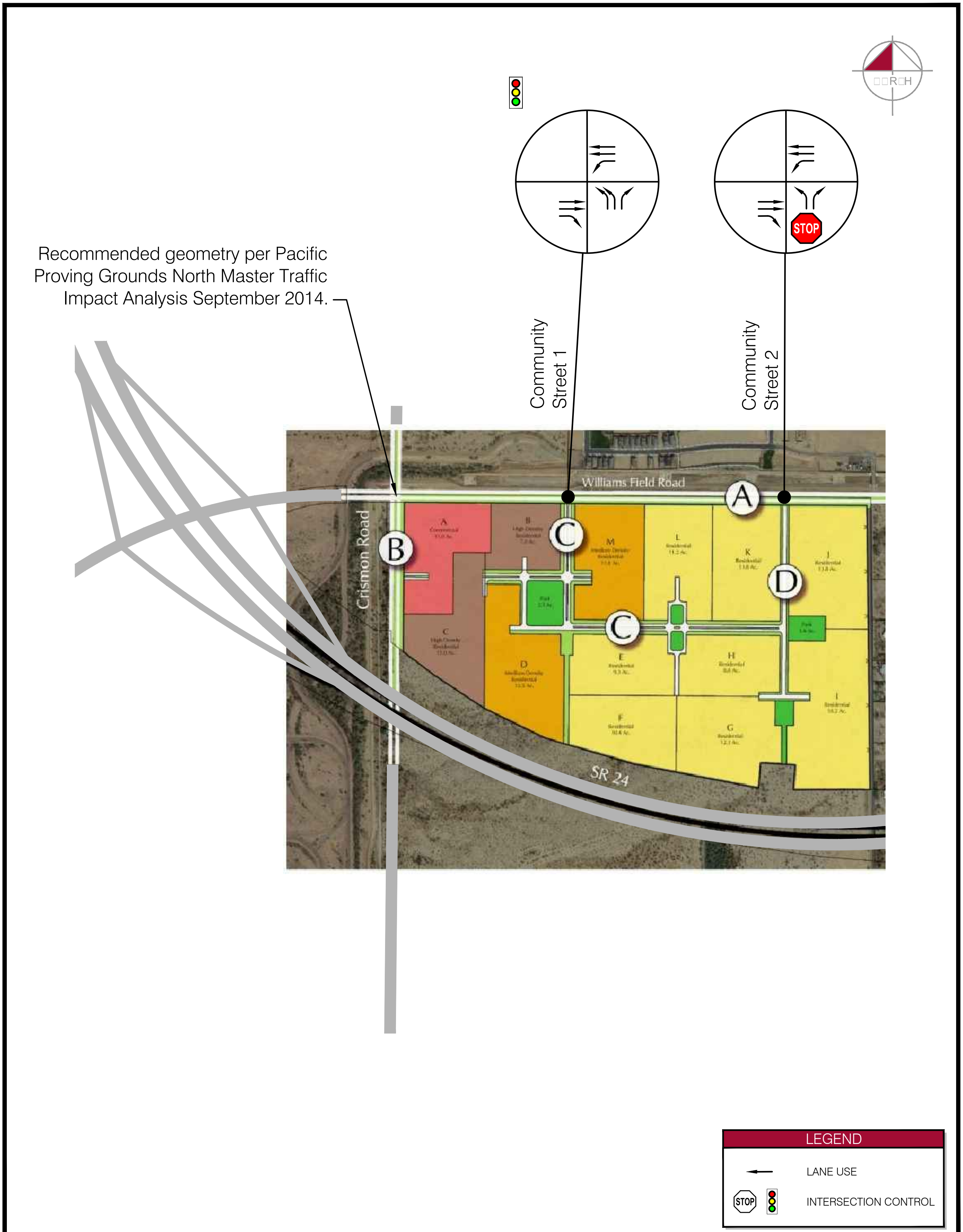


Figure 7
Recommended Geometry

7.0 CONCLUSIONS AND RECOMMENDATIONS

The proposed development is expected to generate 16,992 daily trips, with 1,029 trips occurring in the AM peak hour and 1,760 trips occurring in the PM peak hour. To ensure that the estimate of the traffic impacts is the maximum that can be expected, it is assumed that the site will be 100 percent occupied upon buildout by the 2040 analysis year.

The intersections of Williams Field Road with Community Street 1 and Community Street 2 are expected to operate an acceptable level of service at buildout with the exception of the northbound left turn movement at the intersection of Community Street 2 during the peak hours. It is anticipated that drivers will utilize other available routes by turning right or exiting at the signalized intersection of Community Street 1 and Williams Field Road during the peak hours.

The future intersection of Crismon Road and Williams Field Road is located at an appropriate location for signal control. Installation of a traffic signal at the intersection of Crismon Road and Williams Field Road is anticipated when traffic warrants are met.

It is recommended that vehicular volumes be monitored and evaluated at the intersection of Community Street 1 and Williams Field Road as development occurs to determine the appropriate time for the addition of signal control at the intersection.

It is recommended that the intersection of Community Street 1 and Williams Field Road provide northbound dual left turn lanes and a westbound left turn lane. It is recommended that the northbound dual left turn lanes provide 250 feet of storage and a 100 foot reverse curve per City of Mesa Engineering and Design Standards Section 212.4. It is recommended that the westbound left turn lane provide 150 feet of storage and a 100 foot reverse curve.

It is recommended that the intersection of Community Street 2 and Williams Field Road provide a northbound left turn lane and a westbound left turn lane with 150 feet of storage and a 100 foot taper per the City of Mesa Engineering and Design Standards Section 212.4.

It is recommended that an eastbound right turn lane be provided at the intersection of Community Street 1 and Williams Field Road with 250 feet of storage and a 100 foot taper, per the City of Mesa Engineering and Design Standards Section 208.4.2. A northbound right turn lane is recommended to be provided at the intersection of Community Street 1 and Williams Field Road with 150 feet of storage and a 100 foot taper.

It is recommended that an eastbound and northbound right turn lane be provided at the intersection of Community Street 2 and Williams Field Road with 175 feet and 150 feet of storage, respectively, and a 100 foot taper, per the City of Mesa Engineering and Design Standards Section 208.4.2.

A community collector road C cross section is recommended for Community Street 1 alignment with one lane in each direction, a landscaped raised median, and left turn provisions. A community collector road D cross section is recommended for Community Street 2 alignments with one lane in each direction. Typical cross sections for the internal site roadways are attached in the **Appendix**.

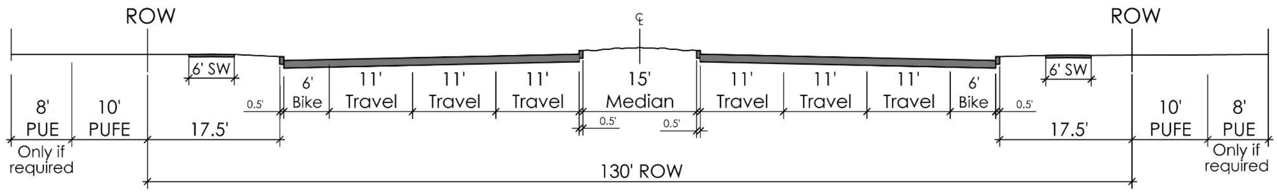
APPENDIX

- Typical Street Cross Sections
- City of Mesa Traffic Volume 2040
- City of Mesa Future Roadway Plan 2040
- PPGN TIA Total Traffic Volume Figures
- Total AM Traffic Capacity Analysis
- Total PM Traffic Capacity Analysis
- City of Mesa Engineering and Design Standards Figure 2.5 – Traffic Signal and Median Spacing
- Left-Turn Storage Calculations
- Right-Turn Storage Calculations
- City of Mesa Engineering and Design Standards Section 212
- City of Mesa Engineering and Design Standards Section 208
- Mesa Standard Details and Specifications Detail No. M-19.01

Typical Street Cross Sections

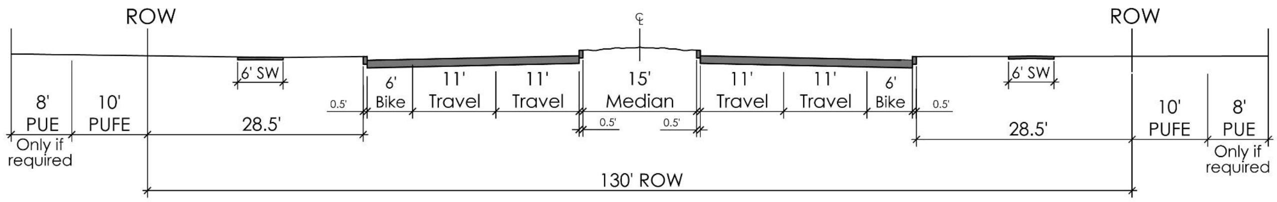
A

Arterial Roadway
(6 Lane)
Williams Field Road



B

Arterial Roadway
(4 Lane)
Crismon Road

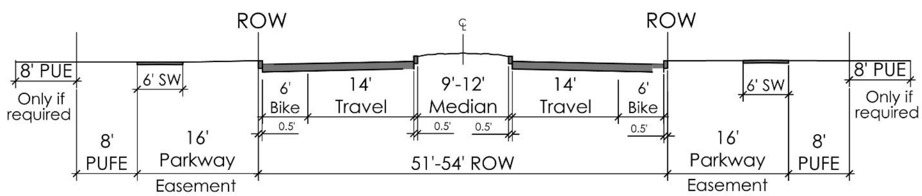


C

Community Collector Road &
Neighborhood Entry (2 Lane)

*Medians may be located within a private tract with a PUFE or Parkway Easement in certain locations upon review and approval by the Engineering Department.

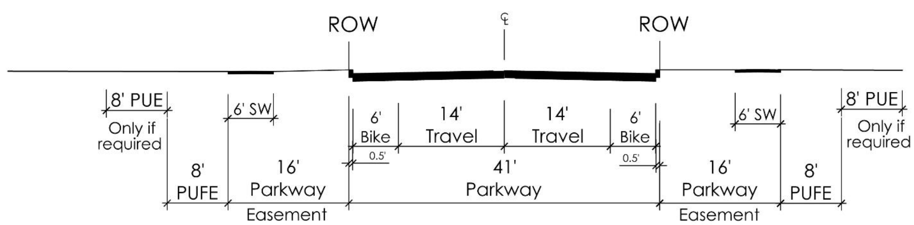
** Parkway width may vary when sidewalk is detached.



D

Community Collector Road &
Neighborhood Entry (2 Lane)

** Parkway width may vary when sidewalk is detached.

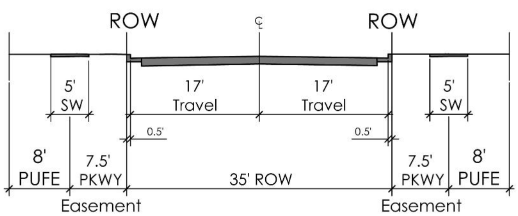


E

Local Street

*On Street Parking Allowed

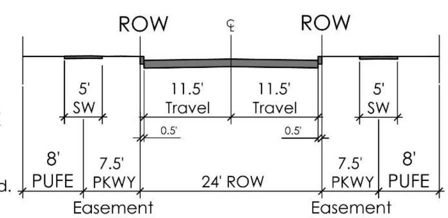
** Parkway width may vary when sidewalk is detached.



F

Local Street

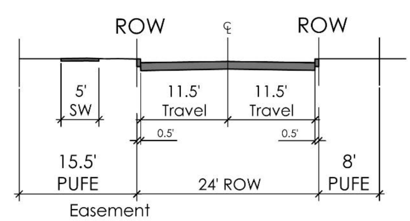
** Parkway width may vary when sidewalk is detached.



G

Local Street

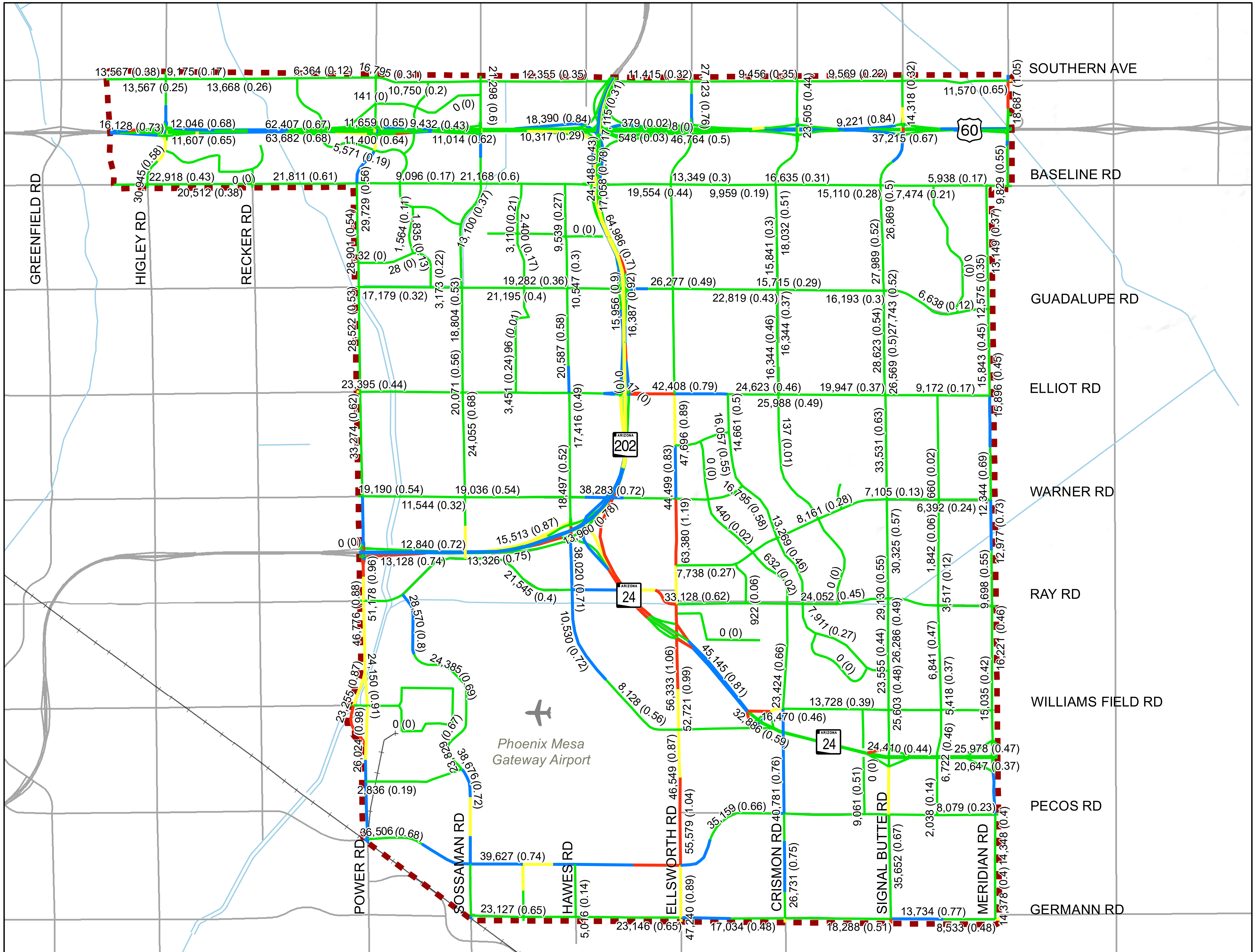
On Street Parking not allowed



City of Mesa
Traffic Volume 2040

2018 Southeast Mesa
Land Use and Transportation Plan

2040 Improved Bi-directional Level of Service



Legend

- Study Area
- Airport
- Canal
- Railroad
- Major Street

2040 Level of Service

- C+
- D
- E
- F

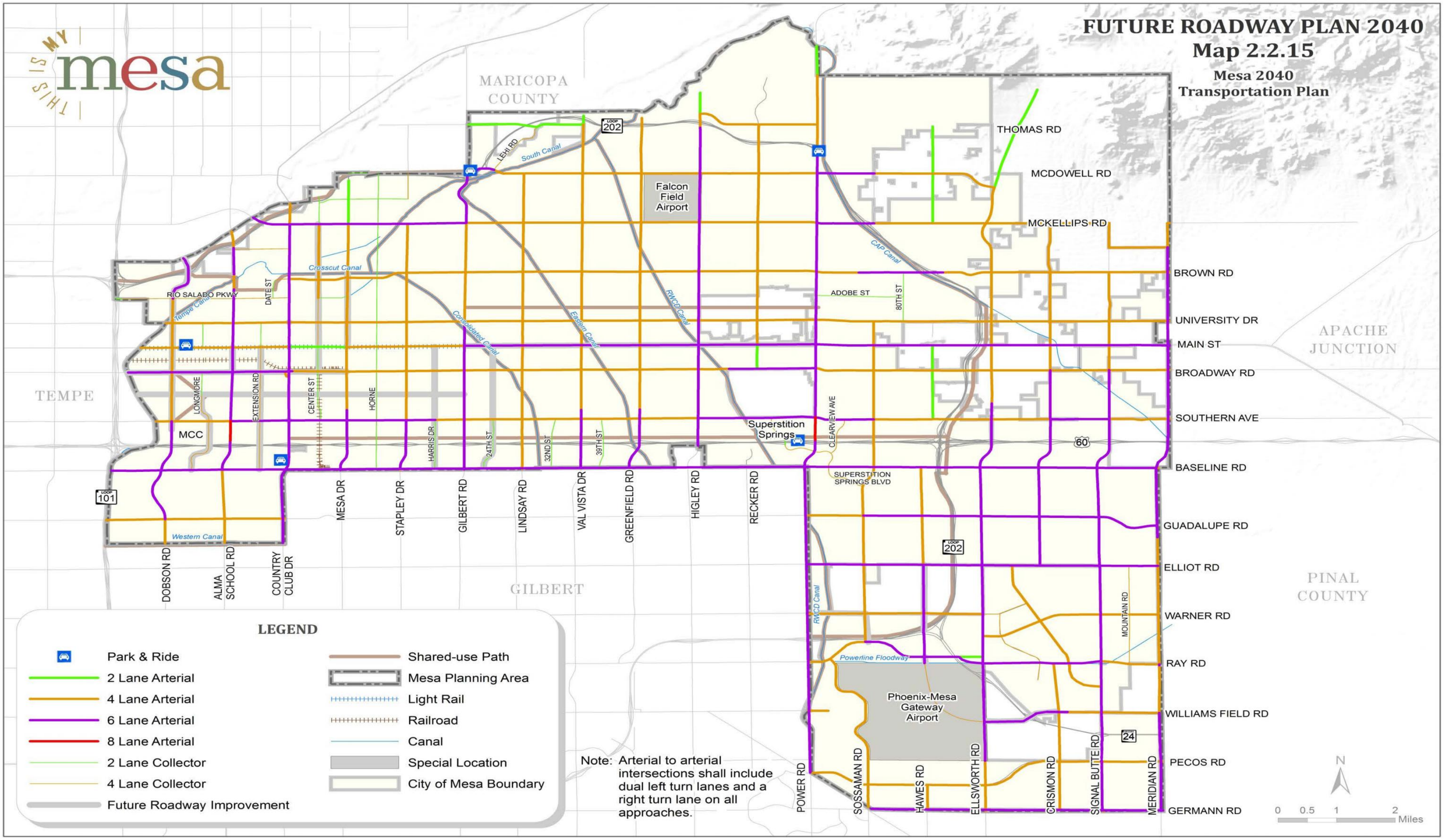
Daily Traffic Volume (Volume-to-Capacity Ratio)

N W E S

0 0.5 1 2 Miles

mesa·az

City of Mesa
Future Roadway Plan 2040


FUTURE ROADWAY PLAN 2040
Map 2.2.15
Mesa 2040
Transportation Plan
THIS IS MY mesa
MARICOPA COUNTY
TEMPE
GILBERT
APACHE JUNCTION
PINAL COUNTY
THOMAS RD
MCDOWELL RD
MCKELLIPS RD
BROWN RD
UNIVERSITY DR
MAIN ST
BROADWAY RD
SOUTHERN AVE
BASELINE RD
GUADALUPE RD
ELLIOT RD
WARNER RD
RAY RD
WILLIAMS FIELD RD
PECOS RD
GERMANN RD
DOBSON RD
ALMA SCHOOL RD
COUNTRY CLUB DR
MESA DR
STAPLEY DR
GILBERT RD
LINDSAY RD
VAL VISTA DR
GREENFIELD RD
HIGLEY RD
RECKER RD
POWER RD
SOSSAMAN RD
HAWES RD
ELLSWORTH RD
CRISMON RD
SIGNAL BUTTE RD
MERIDIAN RD
MOUNTAIN RD
RIO SALADO PKWY
ADOBE ST
80TH ST
DATE ST
LONGMORE
EXTENSION RD
CENTER ST
HORNE
HARRIS DR
24TH ST
32ND ST
39TH ST
CLEARVIEW AVE
LEHI RD
SUPERSTITION SPRINGS BLVD
MCC
Falcon Field Airport
Superstition Springs
Phoenix-Mesa Gateway Airport
South Canal
Crosscut Canal
Tempe Canal
Consolidated Canal
Eastern Canal
RWCD Canal
CAP Canal
Western Canal
Powerline Floodway
202
101
60
24
LEGEND
Park & Ride
2 Lane Arterial
4 Lane Arterial
6 Lane Arterial
8 Lane Arterial
2 Lane Collector
4 Lane Collector
Future Roadway Improvement
Shared-use Path
Mesa Planning Area
Light Rail
Railroad
Canal
Special Location
City of Mesa Boundary
Note: Arterial to arterial intersections shall include dual left turn lanes and a right turn lane on all approaches.
N
0 0.5 1 2 Miles

PPGN TIA Total Traffic Volume Figures

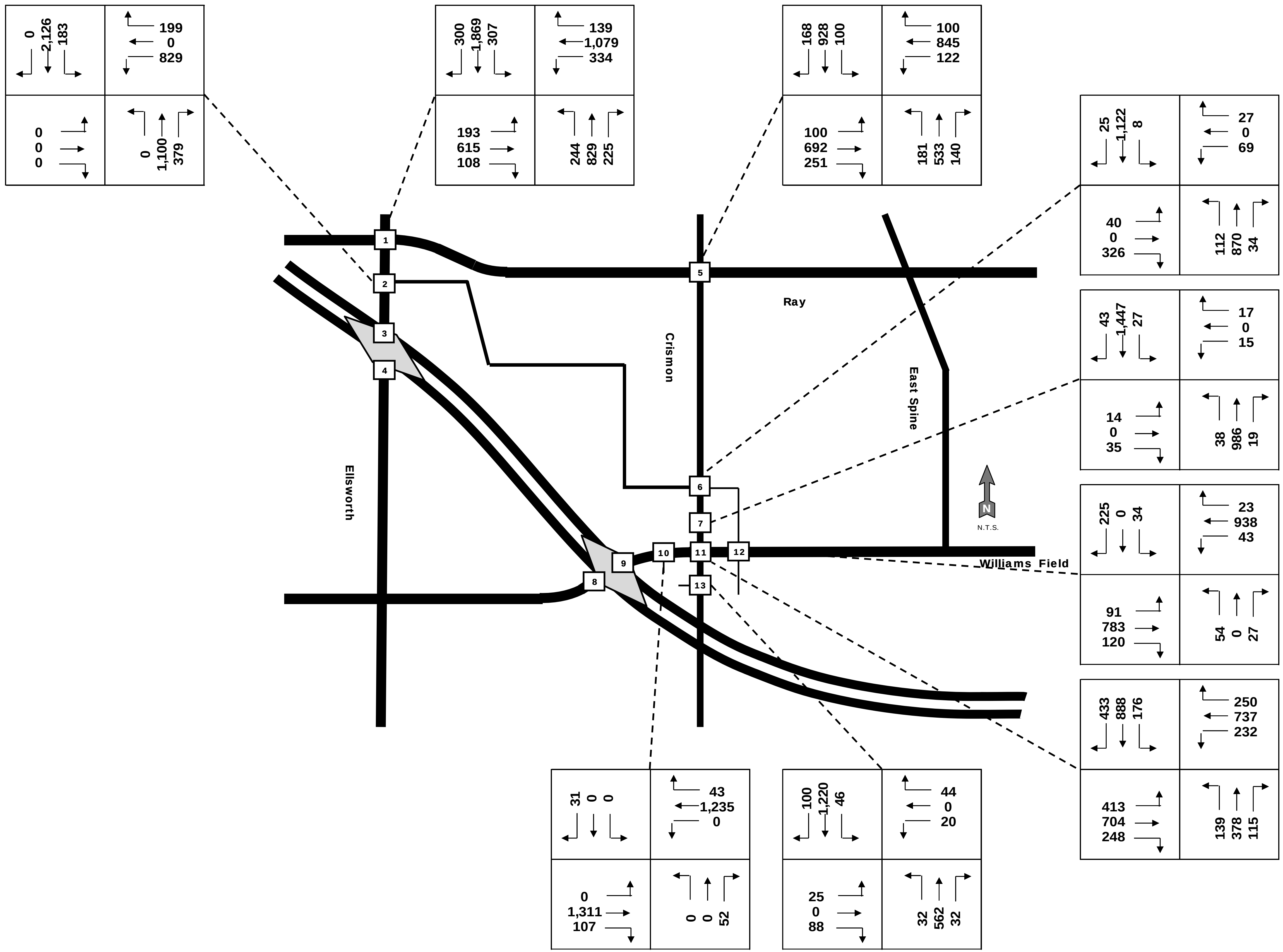


Figure 23: 2020 with PPGN Traffic Volumes – AM Peak Hour

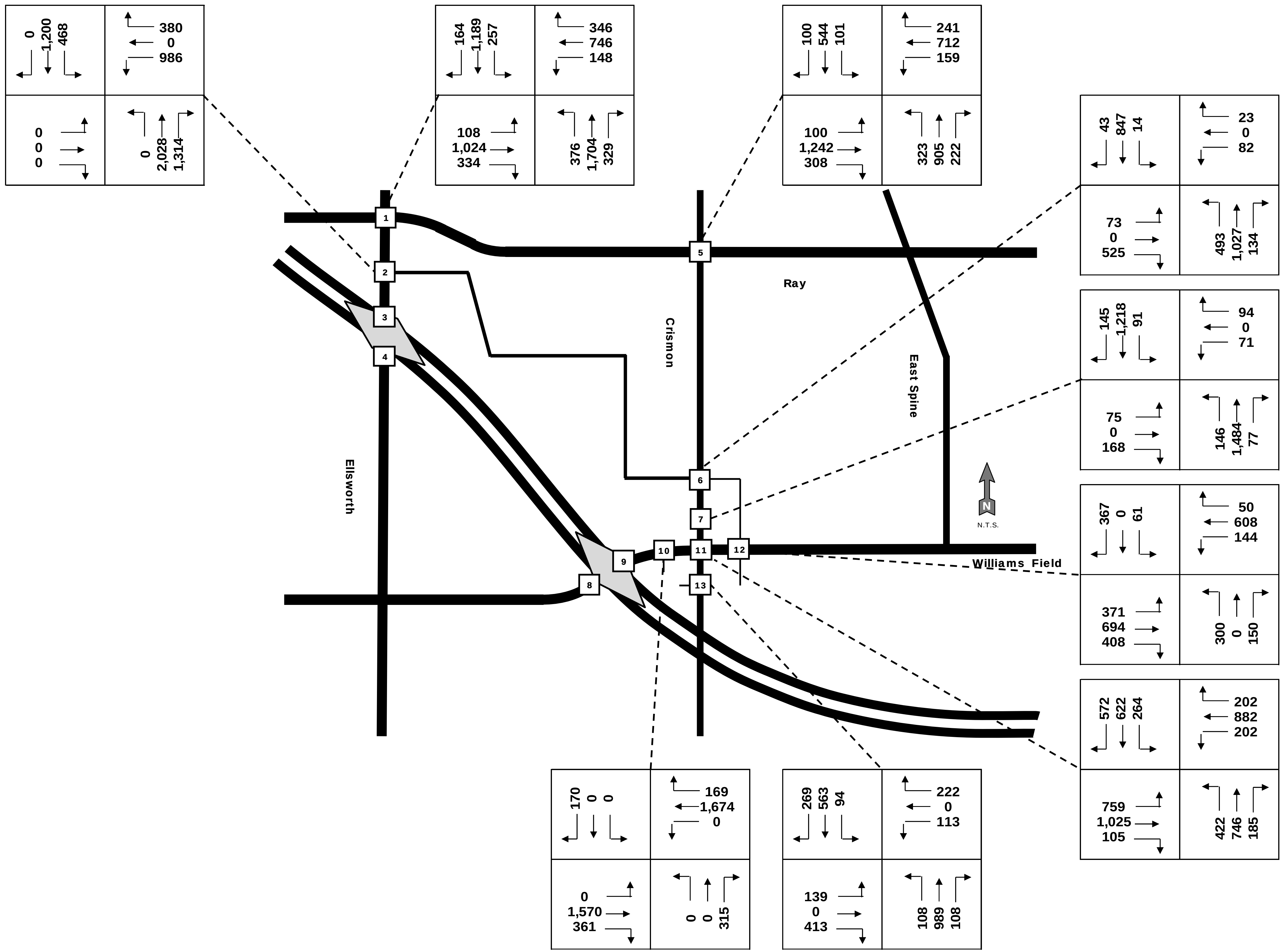


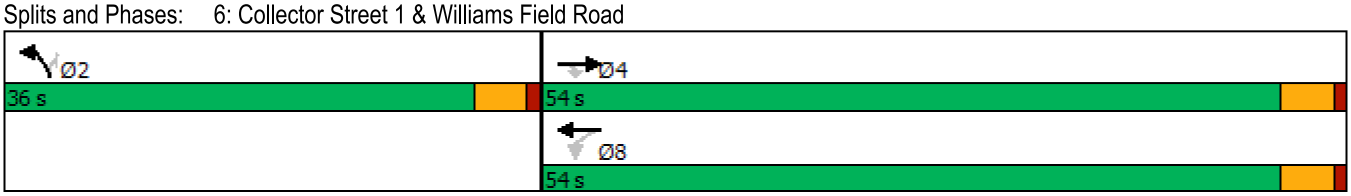
Figure 25: 2020 with PPGN Traffic Volumes – PM Peak Hour

Total AM Traffic Capacity Analysis

Phase Number	2	4	8
Movement	NBL	EBT	WBTL
Lead/Lag			
Lead-Lag Optimize			
Recall Mode	Max	None	None
Maximum Split (s)	36	54	54
Maximum Split (%)	40.0%	60.0%	60.0%
Minimum Split (s)	22.5	22.5	22.5
Yellow Time (s)	3.5	3.5	3.5
All-Red Time (s)	1	1	1
Minimum Initial (s)	5	5	5
Vehicle Extension (s)	3	3	3
Minimum Gap (s)	3	3	3
Time Before Reduce (s)	0	0	0
Time To Reduce (s)	0	0	0
Walk Time (s)	7	7	7
Flash Dont Walk (s)	11	11	11
Dual Entry	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes
Start Time (s)	0	36	36
End Time (s)	36	0	0
Yield/Force Off (s)	31.5	85.5	85.5
Yield/Force Off 170(s)	20.5	74.5	74.5
Local Start Time (s)	0	36	36
Local Yield (s)	31.5	85.5	85.5
Local Yield 170(s)	20.5	74.5	74.5

Intersection Summary	
Cycle Length	90
Control Type	Semi Act-Uncoord
Natural Cycle	50

Splits and Phases: 6: Collector Street 1 & Williams Field Road



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	900	158	6	1171	470	16
Future Volume (veh/h)	900	158	6	1171	470	16
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)		1.00	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	978	172	7	1273	511	17
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	1662	741	224	1662	1431	656
Arrive On Green	0.47	0.47	0.47	0.47	0.41	0.41
Sat Flow, veh/h	3647	1585	489	3647	3456	1585
Grp Volume(v), veh/h	978	172	7	1273	511	17
Grp Sat Flow(s),veh/h/ln	1777	1585	489	1777	1728	1585
Q Serve(g_s), s	15.4	4.9	0.8	22.6	7.7	0.5
Cycle Q Clear(g_c), s	15.4	4.9	16.2	22.6	7.7	0.5
Prop In Lane		1.00	1.00		1.00	1.00
Lane Grp Cap(c), veh/h	1662	741	224	1662	1431	656
V/C Ratio(X)	0.59	0.23	0.03	0.77	0.36	0.03
Avail Cap(c_a), veh/h	2312	1031	314	2312	1431	656
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	14.9	12.1	20.8	16.8	15.3	13.2
Incr Delay (d2), s/veh	0.3	0.2	0.1	1.0	0.7	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.7	1.6	0.1	8.5	3.0	0.2
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	15.2	12.3	20.9	17.8	16.0	13.3
LnGrp LOS	B	B	C	B	B	B
Approach Vol, veh/h	1150			1280	528	
Approach Delay, s/veh	14.8			17.9	15.9	
Approach LOS	B			B	B	

Timer - Assigned Phs	2	4	8
Phs Duration (G+Y+Rc), s	36.0	40.1	40.1
Change Period (Y+Rc), s	4.5	4.5	4.5
Max Green Setting (Gmax), s	31.5	49.5	49.5
Max Q Clear Time (g_c+I1), s	9.7	17.4	24.6
Green Ext Time (p_c), s	1.9	9.2	11.0

Intersection Summary	
HCM 6th Ctrl Delay	16.3
HCM 6th LOS	B

Intersection	
Int Delay, s/veh	29

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	863	53	6	1014	163	17
Future Vol, veh/h	863	53	6	1014	163	17
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	250	100	-	75	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	938	58	7	1102	177	18

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	996	0	1503	469
Stage 1	-	-	-	-	938	-
Stage 2	-	-	-	-	565	-
Critical Hdwy	-	-	4.14	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	-	-	2.22	-	3.52	3.32
Pot Cap-1 Maneuver	-	-	690	-	~ 112	541
Stage 1	-	-	-	-	341	-
Stage 2	-	-	-	-	532	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	690	-	~ 111	541
Mov Cap-2 Maneuver	-	-	-	-	~ 111	-
Stage 1	-	-	-	-	338	-
Stage 2	-	-	-	-	532	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.1	$ 340.5
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	111	541	-	-	690	-
HCM Lane V/C Ratio	1.596	0.034	-	-	0.009	-
HCM Control Delay (s)	$ 374.8	11.9	-	-	10.3	-
HCM Lane LOS	F	B	-	-	B	-
HCM 95th %tile Q(veh)	13.3	0.1	-	-	0	-

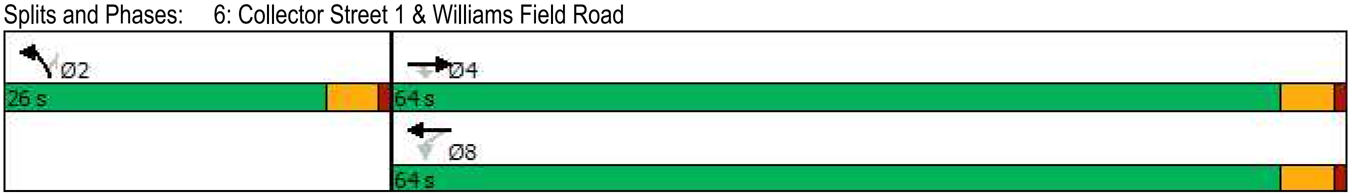
Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Total PM Traffic Capacity Analysis

Phase Number	2	4	8
Movement	NBL	EBT	WBTL
Lead/Lag			
Lead-Lag Optimize			
Recall Mode	Max	None	None
Maximum Split (s)	26	64	64
Maximum Split (%)	28.9%	71.1%	71.1%
Minimum Split (s)	22.5	22.5	22.5
Yellow Time (s)	3.5	3.5	3.5
All-Red Time (s)	1	1	1
Minimum Initial (s)	5	5	5
Vehicle Extension (s)	3	3	3
Minimum Gap (s)	3	3	3
Time Before Reduce (s)	0	0	0
Time To Reduce (s)	0	0	0
Walk Time (s)	7	7	7
Flash Dont Walk (s)	11	11	11
Dual Entry	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes
Start Time (s)	0	26	26
End Time (s)	26	0	0
Yield/Force Off (s)	21.5	85.5	85.5
Yield/Force Off 170(s)	10.5	74.5	74.5
Local Start Time (s)	0	26	26
Local Yield (s)	21.5	85.5	85.5
Local Yield 170(s)	10.5	74.5	74.5

Intersection Summary	
Cycle Length	90
Control Type	Semi Act-Uncoord
Natural Cycle	55

Splits and Phases: 6: Collector Street 1 & Williams Field Road



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1197	530	18	919	310	11
Future Volume (veh/h)	1197	530	18	919	310	11
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)		1.00	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	1301	576	20	999	337	12
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	1958	873	177	1958	1094	502
Arrive On Green	0.55	0.55	0.55	0.55	0.32	0.32
Sat Flow, veh/h	3647	1585	243	3647	3456	1585
Grp Volume(v), veh/h	1301	576	20	999	337	12
Grp Sat Flow(s),veh/h/ln	1777	1585	243	1777	1728	1585
Q Serve(g_s), s	17.6	17.4	4.3	11.9	5.0	0.4
Cycle Q Clear(g_c), s	17.6	17.4	21.9	11.9	5.0	0.4
Prop In Lane		1.00	1.00		1.00	1.00
Lane Grp Cap(c), veh/h	1958	873	177	1958	1094	502
V/C Ratio(X)	0.66	0.66	0.11	0.51	0.31	0.02
Avail Cap(c_a), veh/h	3113	1388	256	3113	1094	502
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	10.8	10.8	18.6	9.5	17.6	16.0
Incr Delay (d2), s/veh	0.4	0.9	0.3	0.2	0.7	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.8	5.2	0.2	3.9	2.0	0.1
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	11.2	11.6	18.8	9.7	18.3	16.1
LnGrp LOS	B	B	B	A	B	B
Approach Vol, veh/h	1877			1019	349	
Approach Delay, s/veh	11.3			9.9	18.2	
Approach LOS	B			A	B	

Timer - Assigned Phs		2		4				8
Phs Duration (G+Y+Rc), s		26.0		41.9				41.9
Change Period (Y+Rc), s		4.5		4.5				4.5
Max Green Setting (Gmax), s		21.5		59.5				59.5
Max Q Clear Time (g_c+I1), s		7.0		19.6				23.9
Green Ext Time (p_c), s		1.1		17.8				9.8

Intersection Summary			
HCM 6th Ctrl Delay			11.6
HCM 6th LOS			B

Intersection	
Int Delay, s/veh	13.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1027	181	19	830	108	11
Future Vol, veh/h	1027	181	19	830	108	11
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	250	100	-	75	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1116	197	21	902	117	12

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1313	0	1609	558
Stage 1	-	-	-	-	1116	-
Stage 2	-	-	-	-	493	-
Critical Hdwy	-	-	4.14	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	-	-	2.22	-	3.52	3.32
Pot Cap-1 Maneuver	-	-	523	-	~ 95	473
Stage 1	-	-	-	-	275	-
Stage 2	-	-	-	-	579	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	523	-	~ 91	473
Mov Cap-2 Maneuver	-	-	-	-	~ 91	-
Stage 1	-	-	-	-	264	-
Stage 2	-	-	-	-	579	-

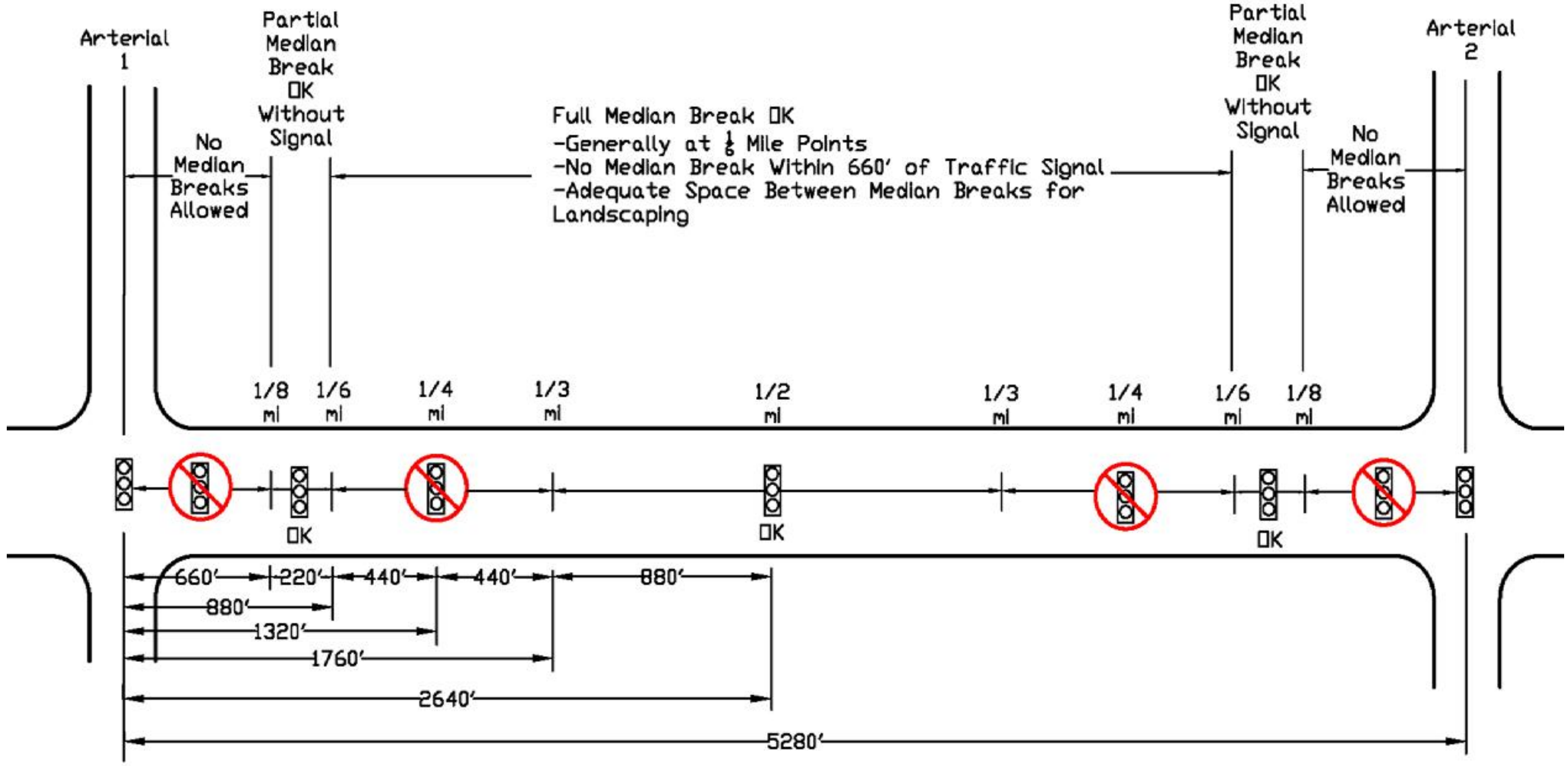
Approach	EB	WB	NB
HCM Control Delay, s	0	0.3	250.6
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	91	473	-	-	523	-
HCM Lane V/C Ratio	1.29	0.025	-	-	0.039	-
HCM Control Delay (s)	274.8	12.8	-	-	12.2	-
HCM Lane LOS	F	B	-	-	B	-
HCM 95th %tile Q(veh)	8.5	0.1	-	-	0.1	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

City of Mesa Engineering and Design Standards
Figure 2.5 – Traffic Signal and Median Spacing

Figure 2.5 – Traffic Signal and Median Spacing



New Traffic Signals Must Be Approved By City of Mesa Transportation Department

Left-Turn Storage Calculations

Left-turn Storage Analysis

Intersection	Direction (N,S,E,W)	Peak volume (vph)	Signalized??? (Place an "X")		If signalized		Required Storage per Lane (ft.) (75' min. default)
			Yes	No	Cycle Length (seconds)	# of Left-turn Lanes (#)	
							0
Community Street 1 and Williams Field Road	NB	470	X		90	2	225
	WB	18	X		90	1	75
							0
							0
							0
Community Street 2 and Williams Field Road	NB	163		X			150
	WB	19		X			75
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0

SAMPLE CALCULATIONS

SIGNALIZED INTERSECTIONS

Storage: = [((veh/interval) + z x (SQRT(veh/interval)))/L] x 25 ft/vehicle

N = (veh/interval)
N = [(V) x (C/3600)]

Where :

z = 1.282 for 90 % confidence level (Most commenly used)
z = 1.645 for 95 % confidence level

Where:

V = vehicles per hour
C = cycle length in seconds
25 ft/veh = Average Length of Vehicles
L = number of left turn lanes

UNSIGNALIZED INTERSECTIONS

Storage = [(V/60 minutes) x 2 minutes] x 25 ft/vehicle

Where:

V = vehicles per hour
25 ft/veh = Average Length of Vehicles

Right-Turn Storage Calculations

Right-turn Storage Analysis

Intersection	Direction (N,S,E,W)	Peak volume (vph)	Signalized??? (Place an "X") Yes	No	If signalized Cycle Length (seconds)	# of Left-turn Lanes (#)	Required Storage per Lane (ft.) (75' min. default)
							0
Community Street 1 and Williams Field Road	NB	16	X		90	1	75
	EB*	265	X		90	1	250
							0
							0
							0
Community Street 2 and Williams Field Road	NB	17		X			75
	EB	181		X			100
							0
*50% Right Turn on Red Reduction was Applied							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0

SAMPLE CALCULATIONS

SIGNALIZED INTERSECTIONS

Storage: = [((veh/interval) + z x (SQRT(veh/interval)))/L] x 25 ft/vehicle

N = (veh/interval)
N = [(V) x (C/3600)]

Where :

z = 1.282 for 90 % confidence level (Most commenly used)
z = 1.645 for 95 % confidence level

Where:

V = vehicles per hour
C = cycle length in seconds
25 ft/veh = Average Length of Vehicles
L = number of left turn lanes

UNSIGNALIZED INTERSECTIONS

Storage = [(V/60 minutes) x 2 minutes] x 25 ft/vehicle

Where:

V = vehicles per hour
25 ft/veh = Average Length of Vehicles

City of Mesa
Engineering and Design Standards
Section 208.4.2

208.4.1 Deceleration lanes may be provided at retail, multi-family, industrial or commercial sites depending on the size of the site. Generally, deceleration lanes should be provided at retail sites with 40,000 gross square feet or more of building area. Multi-family and private street residential developments should provide deceleration lanes if there are 100 or more units per access point for the site. Industrial parks with 200,000 gross square feet or more of building area, business parks and general office buildings with 100,000 gross square feet or more, and medical office buildings with 40,000 gross square feet or more should provide deceleration lanes. Smaller developments may need deceleration lanes also, based on site-specific conditions. Institutional sites such as hospitals and colleges are large enough to warrant deceleration lanes in most cases. Deceleration lanes should be provided for all of the driveways along a site where the lanes are required. If a driveway is mainly used for service and delivery vehicles, and it is separated from the main parking area, it may not require a deceleration lane.

208.4.2 A typical deceleration lane for a site driveway shall not be within the taper for the intersection. It shall be designed per Figure 2.2. and provide at least 150 feet of storage, a 100-foot taper or reverse curve, and a 12-foot wide lane. Longer storage or tapers may be necessary depending on the site.

Section 209 - Pavement Tapers

209.1 Projects are required to provide sufficient pavement tapers at all necessary locations (such as the beginning or end of a project) to properly guide traffic.

209.2 The pavement section for tapers shall be per C.O.M. Standard Detail M-19.01.

209.3 Pavement tapers shall be constructed with a thickened edge per M.A.G. Standard Detail 201.

209.4 **Taper Length Formulas:** Taper lengths for merging traffic (lane drop) situations are calculated by the following formulas:

When the design speed is 40 mph or Less:

$$TL = \frac{W * S^2}{60}$$

When the design speed is 45 mph or greater:

$$TL = W*S$$

TL = Taper Length in Feet
S = Design Speed in Miles per Hour. The design speed is five (5) mph over the speed limit
W = Width in feet of the offset between the edge of the travel lane and the edge of the lane after the taper

209.5 Taper length for non-merging (lane introduction) traffic situation (such as where pavement widens with traffic) is normally fifty feet (50') minimum. However, there may be some instances when more than fifty-feet (50') of taper may be required. The requirement for a longer taper will be determined on a case-by-case basis by the City.

209.6 The Engineer shall investigate the existing conditions and if determined to be substandard the project shall saw cut and remove any existing pavement tapers when extending or installing new pavement improvements.

City of Mesa
Engineering and Design Standards
Section 212.4

determined by the Transportation Department. Any trees that are to be located within SVTs must be reviewed and approved by the Transportation Department. Field changes may be required for the acceptance of a landscaping permit if it is found that the SVT is adversely impacted by new landscaping.

211.2 **Visibility of Traffic Control Devices**

211.2.1 **Stop Signs:** All stop signs shall be fully visible to approaching traffic from a distance no less than the stopping sight distance, which is to be calculated per the latest edition of the AASHTO Green Book based on a design speed of 5 mph over the speed limit. Stopping sight distance triangles for approaches controlled by stop signs are shown on Figure 2.4. There shall be no fence, wall, shrubbery, tree, or any other obstruction to vision between a height of two and one-half feet (2.5') and ten feet (10') above the sidewalk within the stopping sight distance triangle approaching a stop sign.

211.2.2 **Traffic Signals:** Visibility of traffic signal indications shall be maintained per Section 4D.12 of the 2009 Manual on Uniform Traffic Control Devices.

211.2.3 **Other Traffic Control Devices:** Visibility of all other traffic control devices has to be maintained. For instance, landscaping along a roadway shall be placed in a manner that does not block signing.

211.3 There should not be interference with the line of sight of a driver such as the overgrowth of a plant that is on the edge of the SVT.

Section 212 - Raised Medians

212.1 Raised median islands shall be installed in accordance with the adopted City of Mesa 2040 Transportation Plan as discussed in Section 202.4.

212.2 **Median Curbs:** Median curb shall be installed per M.A.G. Standard Detail 222, Type "A". In certain situations, the City may require curb and gutter to be constructed per M.A.G. Standard Detail 220, Type "A".

212.3 **Median Widths:** Median widths shall be as specified by the Transportation Department. Standard widths are sixteen feet (16') from face of curb to face of curb on full width medians and four feet (4') from face of curb to face of curb within a left turn traffic storage area. Median widths at arterial intersections shall vary in width as noted in the M-46 series of Mesa Standard Details.

212.4 **Left Turn Lanes:** Standard left turn lanes within a median shall have one hundred and fifty (150') of storage and one hundred feet (100') of reverse curve. Left turn lanes within a median at an arterial intersection shall have two hundred and fifty feet (250') of storage and one hundred and twenty feet (120') of reverse curve.

212.5 **Termination:** Medians shall terminate in a bull nose per M.A.G. Standard Detail 223. Medians shall terminate at a point perpendicular to the curb return adjacent to the median's bullnose, or as directed by the City.

2017 Mesa Standard Details and Specifications
Detail No. M-19.01

NOTES

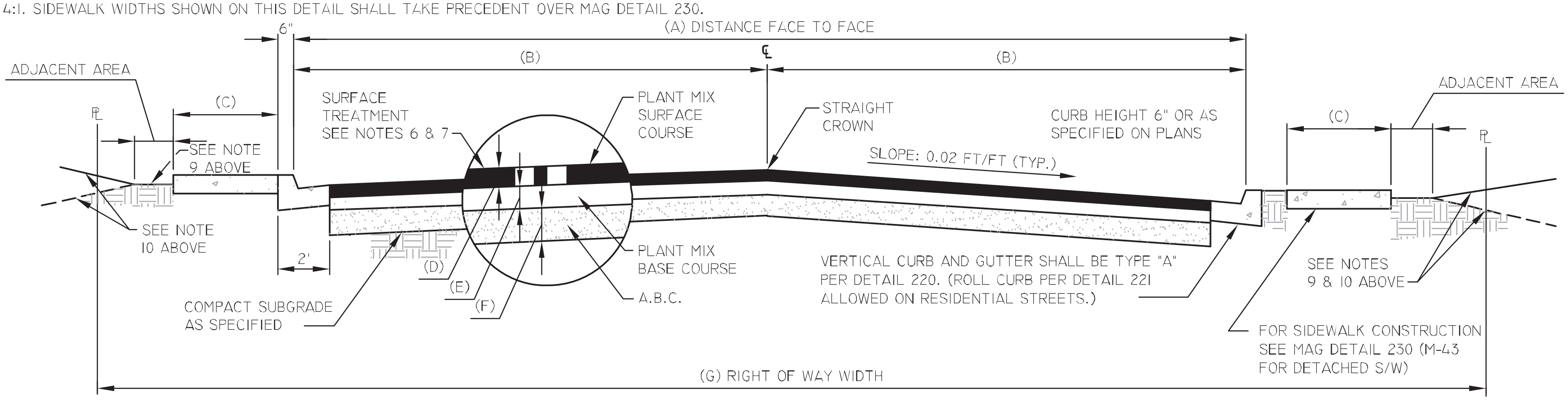
1. ALL STREETS TO BE CONSTRUCTED WITH A STRAIGHT CROWN AT A 2% CROSS SLOPE.
2. WHERE 10" A.B.C. IS REQUIRED, IT IS TO BE INSTALLED IN (2) TWO EQUAL LAYERS.
3. A.B.C. FILL TO CONFORM TO SECTION 702 (AGGREGATE BASE).
4. ASPHALT CONCRETE SHALL CONFORM TO THE CURRENT EAST VALLEY ASPHALT COMMITTEE HOT ASPHALT MIX CRITERIA, 2012 EDITION, AND BE APPROVED BY THE EAST VALLEY ASPHALT COMMITTEE (EVAC).
5. ALL NEW AND REHAB ARTERIAL STREET SURFACE COURSE ASPHALT SHALL BE POLYMER MODIFIED TERMINAL BLEND RUBBER (PMTR+) PER EVAC CRITERIA.
6. SURFACE TREATMENT OF THE FINAL SURFACE COURSE FOR "R" ASPHALT MIXES, INCLUDING PARKING LOT MIXES, SHALL BE APPLIED AS FOLLOWS:
   APPLY A POLYMER MODIFIED MASTERSEAL OR EQUIVALENT MEETING COM REQUIREMENTS (AS DETERMINED BY THE CITY REPRESENTATIVE) AT A MINIMUM APPLICATION RATE OF.12 GAL PER SQ YD FOR EACH OF TWO APPLICATIONS, NOT TO EXCEED .30 GAL PER SQ YD TOTAL (OR PER MANUFACTURER'S RECOMMENDED GUIDELINES). APPLY WITHIN 3 MONTHS OF ASPHALT PLACEMENT OR AS DIRECTED BY THE CITY REPRESENTATIVE. SEE MESA AMENDMENTS FOR SPECIFICATION AND LIST OF ACCEPTABLE PRODUCTS. EACH PRODUCT WILL REQUIRE A SUBMITTAL FOR APPROVAL PRIOR TO PLACEMENT.
7. SURFACE TREATMENT OF THE FINAL SURFACE COURSE FOR "A" ASPHALT MIXES SHALL BE APPLIED AS FOLLOWS:
   APPLY CQS-TR FOG SEAL WITH A DILUTION OF 1:1 WITH WATER AND APPLICATION RATE OF .08 GAL PER SQ YD. APPLY NO SOONER THAN 6 MONTHS AFTER ASPHALT PLACEMENT OR AS DIRECTED BY THE CITY REPRESENTATIVE WITHIN 1-YEAR OF ASPHALT PLACEMENT, NOT TO EXCEED ONE (1) TREATMENT. SEE MESA AMENDMENTS FOR SPECIFICATION. FOG SEAL WILL REQUIRE A SUBMITTAL FOR APPROVAL PRIOR TO PLACEMENT.
8. UTILITY ADJUSTMENTS SHALL BE COMPLETED PRIOR TO APPLICATION OF SURFACE TREATMENT.
9. FINISH ELEVATION OF THE ADJACENT PARKWAY SHALL BE 1" BELOW THE TOP OF SIDEWALK FOR A MINIMUM DISTANCE OF 1-FOOT. BEYOND THE 1-FOOT, THE SLOPE SHALL NOT EXCEED 6:1.
10. MAX. 6:1 SLOPE ALLOWED EXCEPT WHERE AREA IMMEDIATELY ADJACENT TO R.O.W. OR SIDEWALK HAS 4' MIN. AREA AT SLOPE OF 6:1 OR LESS. THEN SLOPE BEYOND SAID 4' AREA CAN BE INCREASED TO A MAX OF 4:1. SIDEWALK WIDTHS SHOWN ON THIS DETAIL SHALL TAKE PRECEDENT OVER MAG DETAIL 230.

	ROADWAY (WIDTH)		SIDEWALK (WIDTH)	SURFACE COURSE (DEPTH) (TYPE)	BASE COURSE (DEPTH) (TYPE)	A.B.C. FILL (DEPTH)	RIGHT OF WAY (WIDTH)
	FACE TO FACE	CL TO FACE					
	(A)	(B)	(C)	(D)	(E)	(F)	(G)
LOCAL STREET RESIDENTIAL LAND USE	34'	17'	5'	3.0" R-1/2"	N/A	6'	50'+8 PUFE
LOCAL STREET RESIDENTIAL LAND USE, OPTIONAL	34'	17'	5'**	3.0" R-1/2"	N/A	6"	50'+10' PUFE
LOCAL STREET INDUSTRIAL	40'	20'	5'	2.0" A-1/2"	3.0" A-3/4"	8"	60'+20' PUFE
LOCAL STREET COMMERCIAL	46'	23'	5'	2.0" A-1/2"	3.0" A-3/4"	8"	80'+8 PUFE
COLLECTOR STREET *	34'/40'/46'	17'/20'/23'	6'	3.5" R-3/4"	N/A	6"	80'/80'/80'+8 PUFE
MAJOR COLLECTOR STREET *	68'	34'	6'	2.0" A-1/2"	3 1/2" A-3/4"	10"	110'+8 PUFE
ARTERIAL STREET *	68'/72'/88'/94' ***	34'/36'/44'/47' ***	6'	2.0" A-1/2" PMTR±	3 1/2" A-3/4"	10"	110' TO 130'+8 PUFE ***

* DETACHED, LINEAR SIDEWALKS ARE REQUIRED. SEE DETAIL M-43.

** USE 5' DETACHMENT

*** MAY BE WIDER AT INTERSECTIONS AND TURN LANES - SEE M-46.01 THROUGH M-46.05.



mesa·az

TYPICAL STREET SECTION

DETAIL NO.
M-19.01

REV. 06/20/2017

HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

MASTER WASTEWATER REPORT

FOR

LEVINE GENERAL MOTORS 170

MESA, ARIZONA

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REGISTERED PROFESSIONAL ENGINEER (CIVIL)
CERTIFICATE NO.
50462
MARK K.
IPSON
Date Signed 3-5-19
ARIZONA U.S.A.

March 2019
HW Project No. 2063.01

HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

MASTER WASTEWATER REPORT
FOR
LEVINE GENERAL MOTORS 170

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APPENDICES

A. Figures
B. Tables
C. Excerpts from:
   - City of Mesa *Wastewater Master Plan Update* (City of Mesa, 2012)
   - *Mesa 2040 General Plan* (City of Mesa, 2016)
D. Hydraulic Model Results

FIGURES

TABLES

1.0 EXECUTIVE SUMMARY

Levine General Motors 170 (the Project) is a proposed approximate 157.2-acre master planned mixed-use development generally located west of 22nd Street, east of Crismon Road, north of the future SR-24 alignment (Frye Road) and south of Williams Field Road in the City of Mesa, Arizona. The Project will consist of up to 1,191 residential units, approximately 11.0 acres of commercial land use, and approximately 36.4 acres of developed open space.

This Master Wastewater Report has been prepared in support of the General Plan Amendment (GPA) for the Project. This report identifies and evaluates the proposed wastewater system infrastructure for serving the Project in accordance with City of Mesa design criteria. Estimated wastewater flows for the Project have been calculated based on the proposed land uses and current City design criteria. This report also identifies the anticipated average daily flows, peak flows, and sewer line sizes and alignments for the Project.

The proposed wastewater collection system has been designed in accordance with current City of Mesa design criteria as outlined in the City's *Engineering Procedure Manual: 2017 Engineering & Design Standards* (City of Mesa, 2017). The average daily flow projected for the Project based on the current land use plan and the City of Mesa design criteria is 265,876 gpd (184.6 gpm). Assuming a peaking factor of 3.0 for new City sewer mains, the peak flow projected for the Project and offsite areas is 1,813,104 gpd (1,259.1 gpm). Assuming a peaking factor of 2.30 for new City sewer mains, the peak flow projected for the Project and offsite areas is 1,390,046 gpd (965.3 gpm).

To avoid excessive detail at the master planning level while still ensuring the final design will meet all applicable criteria, a minimum 7-ft of cover is used wherever possible, a 0.1-ft drop is applied to all manholes, and pipe lengths conform to City of Mesa manhole spacing requirements.

The sewer lines identified in this report will comprise the backbone of the Project's wastewater system infrastructure and consist of 8-inch, 10-inch, and 18-inch sewer mains. Sewer layouts, sizing and alignments within individual parcels will be identified in detail as each parcel is developed. The Project area is currently served by the Greenfield Water Reclamation Plant (GWRP). The GWRP produces A+ effluent.

The Project is anticipated to be developed in several phases. The wastewater system infrastructure will also be constructed in phases as required to serve each phase of development. For any given phase, the downstream sewer mains required to serve that phase will be constructed at the same time as said phase is developed. Furthermore, all sewer mains constructed for each phase will be sized for build-out conditions.

2.0 INTRODUCTION

2.1 Background and Project Location

Levine General Motors 170 (the Project) is located in the City of Mesa (the City) within Section 35 of Township 1 South, Range 7 East of the Gila and Salt River Base and Meridian. The Project is comprised of an approximate 157.2-acre mixed use development in the larger Pacific Proving Grounds development. The Project is generally bound by Williams Field Road on the north, Crismon Road on the west, the future SR-24 alignment on the south, and 22nd Street on the east.

Figure 1 in Appendix A provides a vicinity map for the Project.

2.2 General Description

The Project is planned as a mixed-use development, which will include single family, medium density, and high density residential areas, parks and open space, along with commercial areas. The site currently consists completely of undeveloped desert rangeland. The site generally slopes from east to west at approximately 0.4 percent. Portions of the Project are within the City limits, with the remaining area under the jurisdiction of Maricopa County. It is assumed the area within Maricopa County will be annexed into the City of Mesa and a General Plan Amendment and PAD Rezone will be processed and approved by the City.

The Project is located within the City of Mesa wastewater service area. It is in the Greenfield Water Reclamation Plant (WRP) wastewater collection area and wastewater infrastructure for the Project will be owned and operated by the City of Mesa.

2.3 Purpose of Report

This Master Wastewater Report has been prepared in support of the Levine General Motors 170 General Plan Amendment (GPA) and supports the proposed land use plan as described in the GPA. The purpose of this report is to identify and evaluate the proposed wastewater system infrastructure for serving the Project in accordance with the City of Mesa *Engineering Procedure Manual: 2017 Engineering & Design Standards* (City of Mesa, 2017). This Master Wastewater Report discusses the proposed wastewater infrastructure within the Project and identifies average daily wastewater flows and peak wastewater flows generated by the Project. It also identifies anticipated sewer line sizes and alignments, and presents the results from a hydraulic model of the proposed wastewater infrastructure.

This report provides a conceptual design of the "backbone" wastewater infrastructure within the Project and is intended to provide an overall wastewater solution, establish design guidelines, and become the basis of design for more detailed studies for each parcel as the Project develops.

2.4 Previous Studies and Plans

There are no known previous wastewater studies or plans for the Project site.

3.0 DESIGN CRITERIA

3.1 City of Mesa Design Criteria

The proposed wastewater collection system for the Project has been designed in accordance with current City of Mesa design criteria as outlined in the City of Mesa *Engineering Procedure Manual: 2017 Engineering & Design Standards* (City of Mesa, 2017).

For the purposes of this Master Wastewater Report, to avoid excessive detail at the master planning level while still ensuring the final design will meet all applicable criteria, a 0.1-ft drop is applied to all manholes and a cover of 7.0 feet is used, where possible, to account for changes and/or extensions to sewer alignments in final design. A summary of the design criteria used in this Master Wastewater Report is provided in Table 1 and Table 2.

For the purposes of this report, since specific building sizes have not been identified for the commercial parcels, this report assumes an acreage-based flow factor (1,300 gpd/acre) for these parcels in lieu of the City's standard flow factor, which is based on building square footage. The wastewater flows for these parcels will be refined using the City's flow factors during the design stage as final building sizes are determined.

TABLE 1
WASTEWATER SYSTEM DESIGN CRITERIA

Category	Value	Unit
Population Density		
Medium Density Residential (LDR) (2-4 DU/acre)	3.0	per dwelling unit
Medium Density Residential (LMDR) (4-6 DU/acre)	3.2	per dwelling unit
Medium Density Residential (MDR) (6-10 DU/acre)	2.7	per dwelling unit
High Density Residential (MHDR) (10-15 DU/acre)	2.0	per dwelling unit
High Density Residential (HDR) (15+ DU/acre)	1.7	per dwelling unit

TABLE 1 (Continued) WASTEWATER SYSTEM DESIGN CRITERIA		
Average Daily Flow		
Medium Density Residential (LDR) (2-4 DU/acre)	80	gpcd
Medium Density Residential (LMDR) (4-6 DU/acre)	80	gpcd
Medium Density Residential (MDR) (6-10 DU/acre)	80	gpcd
High Density Residential (MHDR) (10-15 DU/acre)	80	gpcd
High Density Residential (HDR) (15+ DU/acre)	80	gpcd
Commercial/Retail/Office	1,300	gpad
System Layout		
Minimum Sewer Depth of Cover[2]	7.0	ft
Minimum Pipe Diameter	8	Inches
Minimum Manhole Invert Drop (0 - 90 degrees)[1]	0.1 – 0.2	ft drop across MH
Minimum Manhole Invert Drop (> 45 degrees) [1]	0.1	ft drop across MH
Maximum Manhole Spacing (8” to 15” pipes)	500	ft spacing
Maximum Manhole Spacing (18” to 30” pipes)	600	ft spacing
Minimum Pipe Slopes		
8-inch	0.0033	ft/ft
10-inch	0.0024	ft/ft
12-inch	0.0019	ft/ft
15-inch	0.0014	ft/ft
18-inch	0.0011	ft/ft
21-inch	0.0009	ft/ft
System Performance		
Manning’s Roughness Coefficient (n)	0.013	
Minimum Full Flow Velocity	2.0	fps
Maximum Velocity	9.0	fps
Sewer Capacity Ratio (d/D, max at peak flow)	0.67	

Notes:

1. For the purposes of this Master Wastewater Report, a drop of 0.1-ft is applied at each manhole to allow for flexibility while still meeting the City design criteria at the design stage, as additional manholes may be added at final design.
2. Per City of Mesa design criteria, 6 feet of cover will be required during final design. For the purposes of this master planning-level evaluation, 7 feet of cover is used to provide flexibility of future sewer layouts while still ensuring City design criteria can be met.

TABLE 2 CITY OF MESA PEAKING FACTORS		
Average Flow (MGD)	Existing Lines	New Lines
Less than 1.0	2.30	3.00
1.0 to 10	1.90	2.50
10 to 20	1.70	2.30
20 to 30	1.60	2.10
30 to 40	1.50	2.00
40 to 50	1.40	1.90
Greater than 50	1.30	1.75

4.0 WASTEWATER FLOWS

4.1 Land Use

The Project will consist of up to 1,191 residential units and up to 11.0 acres of non-residential commercial use. The Project will also incorporate approximately 36.4 acres of open space including parks and amenities. Land use allocations and densities are assumed from the *Levine General Motors 170 Community Plan* (Greey Pickett, 2018). Figure 2 in Appendix A shows the anticipated land uses and densities throughout the Project. Table 3 below summarizes these anticipated land uses and Table B.1 in Appendix B shows the land use budget for each parcel within the Project. Table B.1 and Table 3 also include information for two offsite areas east of the Project, which will be served by some of the proposed wastewater infrastructure discussed in this report. Land uses, areas, densities, and dwelling unit counts are subject to change as the Project moves from master planning to preliminary and final design.

TABLE 3 PROPOSED LAND USE SUMMARY						
Parcel	Proposed Land Use	Gross Area	Open Space	Assumed Density	Potential Dwelling Units	Commercial Area
		(ac)	(ac)	(du/ac)	(du)	(ac)
ONSITE						
A	Commercial	11.0	1.1	-	-	11.0
B	High Density Residential (HDR)	7.0	1.4	20.0	140	-
C	High Density Residential (HDR)	11.0	2.2	20.0	220	-
D	Medium Density Residential (MDR)	13.5	2.7	10.0	135	-
E	Low/Medium Density Residential (LMDR)	9.3	1.9	6.0	56	-
F	Low/Medium Density Residential (LMDR)	10.4	2.1	6.0	63	-
G	Low/Medium Density Residential (LMDR)	12.3	2.5	6.0	74	-
H	Low/Medium Density Residential (LMDR)	8.8	1.8	6.0	53	-
I	Low/Medium Density Residential (LMDR)	18.2	3.7	6.0	110	-
J	Low/Medium Density Residential (LMDR)	13.8	2.8	6.0	83	-
K	Low/Medium Density Residential (LMDR)	11.8	2.4	6.0	71	-
L	Low/Medium Density Residential (LMDR)	11.2	2.3	6.0	68	-
M	Medium Density Residential (MDR)	11.8	2.4	10.0	118	-
Parks	Parks/Open Space	7.1	7.1	-	-	-
Onsite Subtotal:		**157.2**	**36.4**	**-**	**1,191**	**11.0**
OFFSITE						
OFFSITE-1	Mixed Use	156.3	-	10.0	782	78.2
OFFSITE-2	Low Density Residential (SFR/LDR)	70.7	-	4.0	283	-
Offsite Subtotal:		**227.0**	**-**	**-**	**1,065**	**78.2**
GRAND TOTAL:		**384.2**	**36.4**	**-**	**2,256**	**89.2**

4.2 Wastewater Flow Calculations

Anticipated average daily wastewater flows and peak wastewater flows for the Project were calculated based on the design criteria in Table 1 and Table 2 and the land uses identified in Table B.1 in Appendix B. It is anticipated that the offsite infrastructure for the Project will also convey wastewater flows for additional offsite parcels east of the Project. The projected flows for these offsite areas were calculated based on the land use categories shown in the *Mesa 2040 General Plan* (City of Mesa, 2016). The average flow and peak flow for each grouping of land uses are summarized in Table 4 below. Detailed wastewater calculations are provided in Table B.1 in Appendix B.

TABLE 4 WASTEWATER FLOW SUMMARY					
Parcel Label	Average Daily Flow		Peaking Factor	Peak Flow	
	gpd	gpm		gpd	gpm
ONSITE FLOWS					
A	14,300	9.9	3.0	42,900	29.8
B	19,040	13.2	3.0	57,120	39.7
C	29,920	20.8	3.0	89,760	62.3
D	29,160	20.3	3.0	87,480	60.8
E	14,336	10.0	3.0	43,008	29.9
F	16,128	11.2	3.0	48,384	33.6
G	18,944	13.2	3.0	56,832	39.5
H	13,568	9.4	3.0	40,704	28.3
I	28,160	19.6	3.0	84,480	58.7
J	21,248	14.8	3.0	63,744	44.3
K	18,176	12.6	3.0	54,528	37.9
L	17,408	12.1	3.0	52,224	36.3
M	25,488	17.7	3.0	76,464	53.1
Parks/Open Space	-	-	-	-	-
Onsite Subtotal:	**265,876**	**184.6**	**3.0**	**797,628**	**553.9**
OFFSITE FLOWS					
OFFSITE-1	270,572	187.9	3.0	811,716	563.7
OFFSITE-2	67,920	47.2	3.0	203,760	141.5
Offsite Subtotal:	**338,492**	**235.1**	**3.0**	**1,015,476**	**705.2**
TOTAL (NEW PIPES)[1]:	*604,368*	*419.7*	*3.0*	*1,813,104*	*1,259.1*
TOTAL (EXISTING PIPES)[2]:	*604,368*	*419.7*	*2.3*	*1,390,046*	*965.3*

NOTES:
1) *City of Mesa peaking factor for new pipes experiencing Average Day Flows < 1.0 MGD is 3.0.*
2) *City of Mesa peaking factor for existing pipes experiencing Average Day Flows from < 1.0 MGD is 2.30.*

5.0 EXISTING WASTEWATER SYSTEM INFRASTRUCTURE

5.1 Wastewater Collection System

As shown in Figure 2 in Appendix A, existing wastewater infrastructure within the Project vicinity consists of 18-inch and 21-inch sewer mains in Ray Road and an 18-inch sewer main, upsizing to a 21-inch sewer main, in Cadence Parkway as part of the Cadence development. These three sewer mains outfall to a 24-inch sewer main in Ellsworth Road. An 18-inch sewer main also exists in Crismon Road to serve the Encore at Eastmark development. A 12-inch sewer main exists in Mountain Road and

Pecos Road and upsizes to 15-inches at the intersection of Crismon Road and Pecos Road.

5.2 Wastewater Treatment

The Project is within the Greenfield service zone and will be served by the Greenfield Water Reclamation Plant (GWRP). The GWRP was constructed in 2007 with treatment capacity for handling 16 MGD of liquids and 24 MGD of equivalent solids. The liquid process includes screening, grit removal, primary clarification and biological treatment including nitrogen removal, secondary sedimentation, filtration and disinfection. Solids handling facilities include blending, thickening, anaerobic digestion and dewatering. At build out, the liquid's facility will be able to handle 46 MGD while the solids facility will be able to handle 64 MGD. The GWRP will process biosolids from Mesa's Southeast Water Reclamation Plant, as well. The plant produces A+ effluent.

The GWRP is owned by a consortium of municipalities including the Town of Queen Creek, the Town of Gilbert, and the City of Mesa. Although the three municipalities jointly own the plant, the City of Mesa operates and maintains it. Ultimate capacity within the plant is planned to be divided, with 24 MGD owned by the City of Mesa, 20 MGD owned by the Town of Gilbert, and 8 MGD owned by the Town of Queen Creek.

6.0 PROPOSED WASTEWATER SYSTEM INFRASTRUCTURE

6.1 Proposed Wastewater Collection System Improvements

Figure 2 in Appendix A shows the backbone wastewater infrastructure proposed for the Project. The system is comprised of 8-inch, 10-inch, and 18-inch gravity sewer mains that generally route flows west and north to a tie-in point (18-inch stub) at the existing sewer infrastructure along Cadence Parkway within the Cadence development.

The system layout is designed using proposed parcel boundaries, proposed collector and arterial roadway alignments, City of Mesa quarter section maps and as-built plans that identify existing wastewater infrastructure adjacent to the Project. Elevations are based on recent aerial LIDAR topography. The system layout is designed using existing ground elevations and will be refined as each individual parcel develops. Where possible, the sewer trunk mains will follow arterial streets and major collectors to keep each parcel as independent as possible, allowing for various sub-phasing opportunities for the Project. The proposed wastewater infrastructure will tie into the existing City of Mesa wastewater infrastructure within the Cadence development. The crown of the proposed sewer main will match the crown of the existing sewer main at the tie-in location.

To ensure every parcel can be properly served and to maintain flexibility for final design, the proposed layout shown in this Master Wastewater Report incorporates a 0.1-ft drop across every manhole, regardless of pipe direction change. Pipes were also placed at a minimum depth of 7-ft where possible to allow for further flexibility during final design. Portions of the site located adjacent to the future SR-24 alignment may require some fill to meet City of Mesa cover requirements.

Based on the site's existing topography, the proposed sewer mains generally range in depth from 6-feet to 14-feet (measured to the top of pipe). Each sewer alignment was analyzed to minimize pipe depth where possible. Depths are anticipated to decrease as the final site grading is completed and as the roadway design reduces the undulations of the existing ground. The sewer depths shown herein are based on existing ground elevations and may vary.

6.2 Offsite Flows

It is anticipated that the proposed 18-inch sewer main in Williams Field Road will be used to serve both the Project as well as offsite flows from parcels east of the Project. The flows from these offsite areas were calculated based on the land use categories shown in the *Mesa 2040 General Plan* (City of Mesa, 2016). Flows from these offsite parcels are incorporated into the hydraulic model at their anticipated outfall location along Williams Field Road. If the City plans to add flow from additional offsite parcels beyond those identified herein to the proposed 18-inch sewer main in Williams Field Road and Cadence Parkway, slopes within the proposed 18-inch sewer main will need to be increased to maintain the City required d/D of 66.7% to account for the additional flows.

The proposed 18-inch sewer main in Warner Road was evaluated using a minimum slope of 0.0012 ft/ft from the existing stub along the 18-inch sewer main in Cadence Parkway. The model shows that the maximum d/D ratio for this proposed 18-inch main is 0.659 (65.9%). This d/D ratio has the potential to be lowered further by increasing the pipe's slope as the Project moves from master planning into preliminary and final design. Flows from the Project and offsite parcels will also be refined as the Project moves from master planning to preliminary design. Alternatively, in calculating the projected d/D of the proposed 18-inch sewer main using the City of Mesa peaking factor of 2.30 for flows routed through existing lines, the 18-inch sewer main is anticipated to have a d/D of 0.553 (55.3 %).

6.3 Wastewater Capacity

Existing wastewater capacity was analyzed along the existing 18-inch sewer main in Cadence Parkway. Flows from the Project, future flows from parcels east of the Project (Offsite-1 & Offsite-2), and flows from the existing Cadence development were included in the calculations. The minimum sewer slope of 0.0016 ft/ft for the existing 18-inch sewer main was taken from the as-builts titled *Improvement Plans for Cadence Parkway* (EPS Group, 2017), provided by the City. At an average daily flow of 669,787 gpd and a peaking factor of 2.30 for existing sewer mains, the existing 18-inch sewer main was found to have a depth/Diameter (d/D) of 0.538 (53.8%). Since the City requires a maximum d/D of 66.7%, the existing 18-inch sewer main in Cadence Parkway has enough capacity to support the Project and additional offsite flows. Detailed offsite wastewater capacity calculations can be found in Table B.2 in Appendix B.

6.4 Wastewater Treatment

Flows from the Project will be conveyed to the Greenfield Water Reclamation Plant (GWRP). As stated in Section 5.2, the GWRP has current capacity for 16 MGD of liquids and 24 MGD of equivalent solids. Ultimate build out capacity for solids handling at the GWRP is anticipated to be 64 MGD, with a liquids handling capacity of 46 MGD.

6.5 Wastewater System Phasing

It is anticipated that the Project will be developed in several phases. The wastewater system infrastructure will also be constructed in phases as required to serve each phase of development. For any given phase, the downstream sewer mains required to serve that phase will be constructed at the same time as said phase is developed. Furthermore, the downstream sewer mains that are installed will be sized for build-out conditions.

7.0 HYDRAULIC MODEL AND RESULTS

7.1 Design Methodology

The proposed wastewater collection system was modeled using SewerCAD V8i by Bentley Systems, Inc. The wastewater flows shown in Table B.1 in Appendix B were distributed to individual manholes throughout the collection system to provide an appropriate distribution of average daily flows and peak flows within the system. The wastewater loading for a given parcel is generally applied to the most upstream manhole within the parcel to account for flows that may enter the system at multiple points within a pipe segment, thus ensuring the entire pipe segment has sufficient capacity to convey the anticipated flow. For parcels containing multiple or diverging sewer lines, wastewater loading for the parcel is distributed to the upstream manholes based on the approximate percentage of the parcel said sewer line will serve.

The wastewater model represents the wastewater collection system's backbone trunk mains. The sewer line alignments within individual parcels will be determined at the time of each parcel's design.

The proposed wastewater collection system was optimized using aerial LIDAR topography and the proposed land use plan to determine the best sewer alignments while minimizing pipe depths. The collection system shown on Figure 2 in Appendix A was designed to meet the design criteria as specified in Table 1. Pipes were assumed to have a Manning's n value of 0.013 and were designed to convey the projected peak flows from the development.

7.2 Model Results

The hydraulic model results show that the proposed wastewater collection system for the Project will adequately convey the projected peak flows to the existing City of Mesa wastewater infrastructure in Cadence Parkway. Detailed hydraulic model results for the onsite collection system are included in Appendix D. As shown in the results, all proposed gravity sewer mains in the Project will convey the peak flows while maintaining full-flow velocities of less than nine feet per second as required by the City of Mesa.

The results from the peak flow scenario demonstrate that the gravity sewer mains within the Project will be able to convey the peak flows with a d/D ratio of less than 0.67, as required by the City of Mesa.

In accordance with the City's current design criteria, the sewer mains are anticipated to be Polyvinyl Chloride (PVC). Larger sewer mains may be constructed of other materials, as approved by the City of Mesa, and will be determined at the time of final design. Final invert and rim elevations will be determined at the time of final design. Pipe slopes will also be refined during final design as final grades are known.

8.0 CONCLUSIONS

- This Master Wastewater Report identifies the locations and sizes of the proposed onsite and offsite wastewater system infrastructure required to convey flows from the Project to the existing Greenfield Water Reclamation Plant.

- The proposed gravity wastewater collection system consists of a network of 8-inch, 10-inch, and 18-inch sewer mains, which will convey flows to the existing 18-inch stub located in Cadence Parkway to the northwest of the Project.

- The average daily flow projected for the Project based on the current land use plan and the City of Mesa design criteria is 265,876 gpd (184.6 gpm). Assuming a peaking factor of 3.0 for new sewer mains, the peak flow projected for the Project is 797,628 gpd (553.9 gpm).

- The average daily flow projected for the Project & anticipated future offsite flows based on City of Mesa design criteria is 604,368 gpd (419.7 gpm). Assuming a peaking factor of 3.0 for new sewer mains, the peak flow projected for the Project & all anticipated future offsite flows is 1,813,104 gpd (1,259.1 gpm).

- Based on the flows from the Project, future flows from anticipated offsite development east of the Project, and existing flows within the Cadence development, it is anticipated that the existing 18-inch sewer main in Cadence Parkway will have a depth over diameter ratio (d/D) of 53.8% during peak flow conditions based on the existing sewer main's minimum slope of 0.0016 ft/ft when a peaking factor of 2.3 is used.

- Flows from the Project will be conveyed to the Greenfield Water Reclamation Plant (GWRP).

9.0 REFERENCES

City of Mesa. (2017). *Engineering Procedure Manual: 2017 Engineering & Design Standards*. 2017, Mesa, AZ

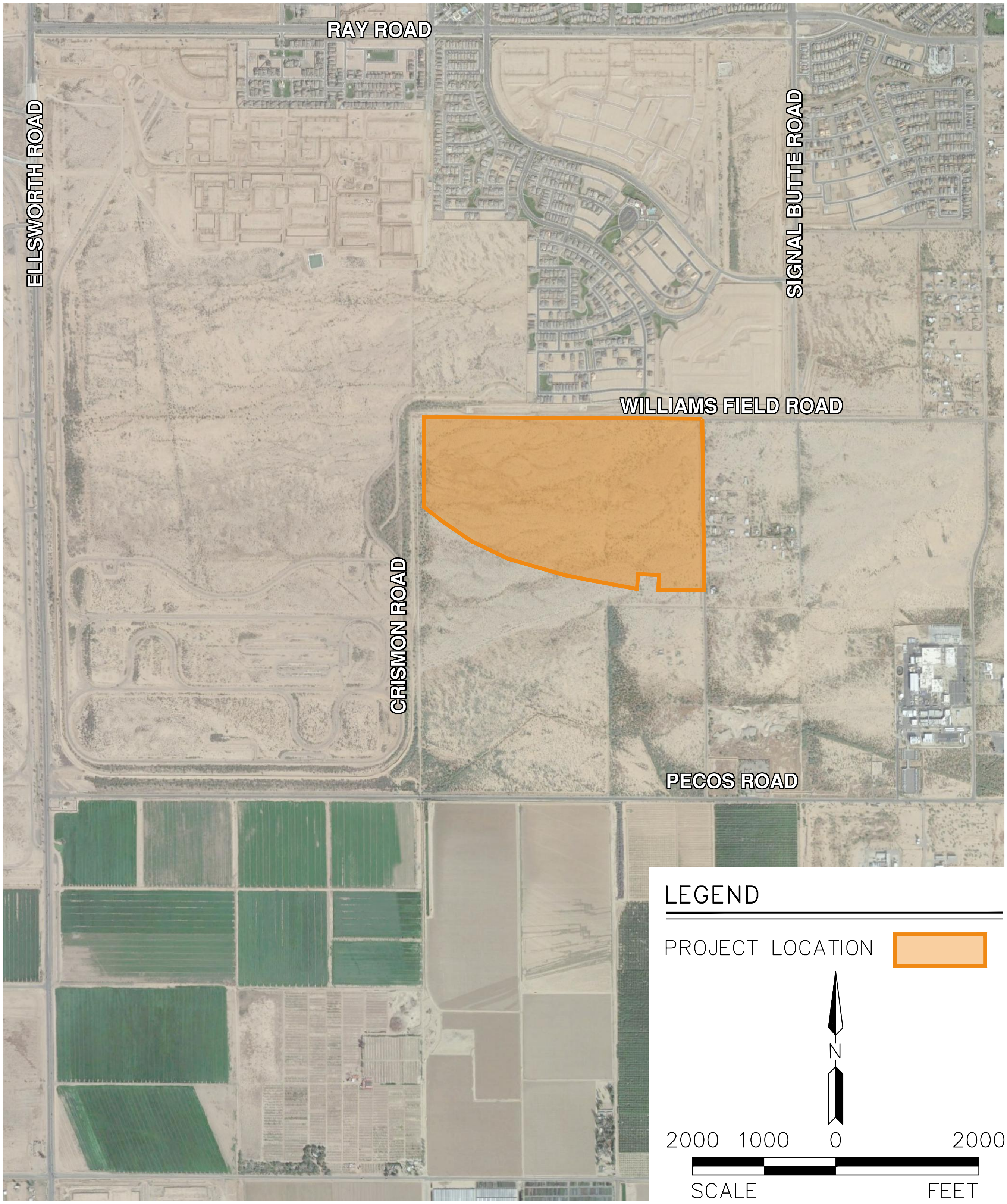
City of Mesa. (2016). *Mesa 2040 General Plan*. 2016, Mesa, AZ

City of Mesa. (2012). *Wastewater Master Plan Update*. 2012, Mesa, AZ

EPS Group. (2017) *Improvement Plans for Cadence Parkway*. 2017, Phoenix, AZ

APPENDIX A

FIGURES



PROJ.NO.:	2063
DATE:	FEB 2019
SCALE:	1" = 2,000'
DRAWN BY:	SL
CHECKED BY:	BB

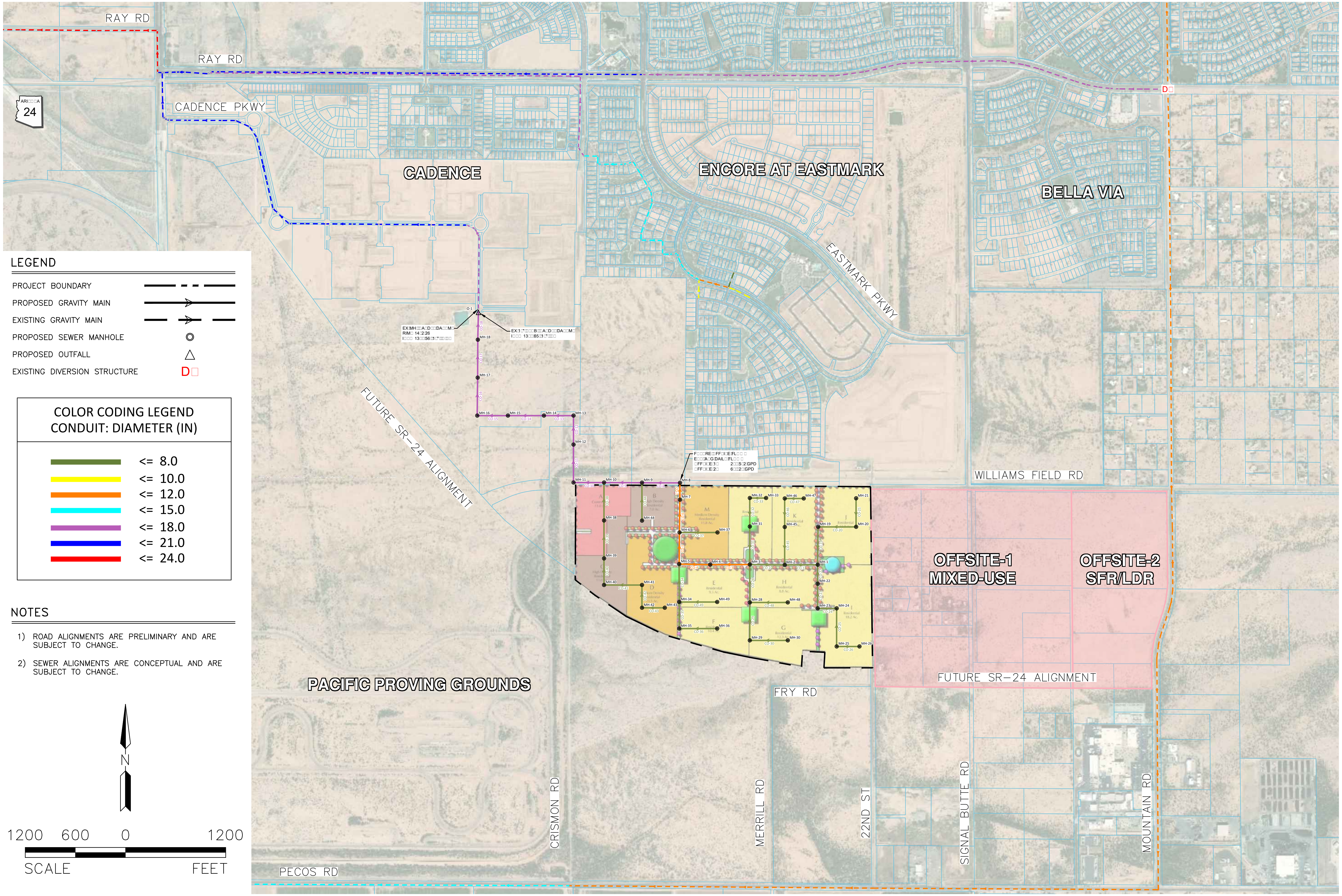
LEVINE GM 170

SEC CRISMON RD & WILLIAMS FIELD RD
MESA, ARIZONA

FIG 1: VICINITY MAP

HILGARTWILSON
2141 E. HIGHLAND AVE., STE. 250
PHOENIX, AZ 85016
P: 602.490.0535 / F: 602.368.2436

U:\2000\2063\ENGR\EXHIBITS\2063 FIG 1 – Vicinity Map.dwg 2/18/2019 1:23 PM



HILGARTWILSON
2141 E. HIGHLAND AVE., STE. 250
PHOENIX, AZ 85016
P: 602.490.0535 / F: 602.368.2436

LEVINE GM 170

SEC CRISMON RD & WILLIAMS FIELD RD
MESA, ARIZONA

FIG 2: WASTEWATER SYSTEM IMPROVEMENTS

PROJ.# 2063
DATE: FEB 2019
SCALE: 1"=1200'
DRAWN BY: MAJ
CHECKED BY: MI

U:\2000\2063\2063.01 - Pacific Proving LLC\REPORTS\SEWER\SewerCAD\Master\19-0208_2063 Master SewerCAD.dwg 2/18/2019 1:10 PM

APPENDIX B

TABLES

Wastewater Flow Calculations

Levine General Motors 170

Mesa, Arizona

February, 2019

HILGARTWILSON

Calculated By: MAJ

Checked By: MI

Parcel Label	Land Use	Gross Area (ac)	Residential Area (ac)	Density (du/ac)	Dwelling Units (du)	Commercial Area (ac)	Population	Average Daily Flow (gpd)	Average Daily Flow (gpm)	Peaking Fcator	Peak Flow (gpd)	Peak Flow (gpm)
ONSITE												
A	Commercial	11.0	0.0	-	-	11.0	-	14,300	9.9	3.0	42,900	29.8
B	HDR	7.0	7.0	20.0	140	-	238	19,040	13.2	3.0	57,120	39.7
C	HDR	11.0	11.0	20.0	220	-	374	29,920	20.8	3.0	89,760	62.3
D	MDR	13.5	13.5	10.0	135	-	365	29,160	20.3	3.0	87,480	60.8
E	LMDR	9.3	9.3	6.0	56	-	179	14,336	10.0	3.0	43,008	29.9
F	LMDR	10.4	10.4	6.0	63	-	202	16,128	11.2	3.0	48,384	33.6
G	LMDR	12.3	12.3	6.0	74	-	237	18,944	13.2	3.0	56,832	39.5
H	LMDR	8.8	8.8	6.0	53	-	170	13,568	9.4	3.0	40,704	28.3
I	LMDR	18.2	18.2	6.0	110	-	352	28,160	19.6	3.0	84,480	58.7
J	LMDR	13.8	13.8	6.0	83	-	266	21,248	14.8	3.0	63,744	44.3
K	LMDR	11.8	11.8	6.0	71	-	227	18,176	12.6	3.0	54,528	37.9
L	LMDR	11.2	11.2	6.0	68	-	218	17,408	12.1	3.0	52,224	36.3
M	MDR	11.8	11.8	10.0	118	-	319	25,488	17.7	3.0	76,464	53.1
Parks	Open Space	7.1	-	-	-	-	-	-	-	-	-	-
ONSITE SUBTOTAL:		***157.2***	***139.1***	***-***	***1,191***	***11.0***	***3,145***	***265,876***	***184.6***	***3.0***	***797,628***	***553.9***
OFFSITE (FUTURE)												
OFFSITE-1	Mixed Use[3]	156.3	78.2	10.0	782	78.2	2,111	270,572	187.9	3.0	811,716	563.7
OFFSITE-2	SFR/LDR	70.7	70.7	4.0	283	-	849	67,920	47.2	3.0	203,760	141.5
OFFSITE (FUTURE) SUBTOTAL:		***227.0***	***148.9***	***-***	***1,065***	***78.2***	***2,960***	***338,492***	***235.1***	***3.0***	***1,015,476***	***705.2***
GRAND TOTAL (New Lines):		***384.2***	***288.0***	***-***	***2,256***	***89.2***	***6,105***	***604,368***	***419.7***	***3.0***	***1,813,104***	***1,259.1***
GRAND TOTAL (Existing Lines):		***384.2***	***288.0***	***-***	***2,256***	***89.2***	***6,105***	***604,368***	***419.7***	***2.3***	***1,390,046***	***965.3***
OFFSITE (EXISTING)												
Cadence (Rec Center)	Commercial	9.7	-	-	-	9.7	-	12,555	8.7	3.0	37,666	26.2
Cadence (Parcel D)	LMDR	15.8	15.8	5.2	82	-	262	20,992	14.6	3.0	62,976	43.7
Cadence (Parcel E)	LDR	19.1	19.1	3.8	72	-	216	17,280	12.0	3.0	51,840	36.0
Cadence (Parcel F)	LDR	10.1	10.1	5.7	57	-	182	14,592	10.1	3.0	43,776	30.4
OFFSITE (EXISTING) SUBTOTAL:		***54.7***	***45.0***	***-***	***211***	***9.7***	***661***	***65,419***	***45.4***	***3.0***	***196,258***	***136.3***
GRAND TOTAL IN EX. 18-INCH SEWER:		***438.9***	***333.1***	***-***	***2,467***	***98.9***	***6,766***	***669,787***	***465.1***	***2.3***	***1,540,511***	***1,069.8***

Notes:

Demand Factors:		Density:		Population Factor:
Low Density Residential (RR):	200 gal/dwelling unit/day	< 1	du/acre	2.5 Persons/du
Low Density Residential (ER):	240 gal/dwelling unit/day	1 - 2	du/acre	3.0 Persons/du
Medium Density Residential (LDR):	240 gal/dwelling unit/day	2 - 4	du/acre	3.0 Persons/du
Medium Density Residential (LMDR):	256 gal/dwelling unit/day	4 - 6	du/acre	3.2 Persons/du
Medium Density Residential (MDR):	216 gal/dwelling unit/day	6 - 10	du/acre	2.7 Persons/du
High Density Residential (MHDR):	160 gal/dwelling unit/day	10 - 15	du/acre	2.0 Persons/du
High Density Residential (HDR):	136 gal/dwelling unit/day	15 +	du/acre	1.7 Persons/du
High Density Condominium:	136 gal/dwelling unit/day			1.7 Persons/du
Commercial[2]:	1,300 gal/acre/day			

Peaking Factors:

Average Flow (mgd)	Existing Lines	New Lines
< 1.0	2.30	3.00
1.0 - 10	1.90	2.50
10 - 20	1.70	2.30
20 - 30	1.60	2.10
30 - 40	1.50	2.00
40 - 50	1.40	1.90
> 50	1.30	1.75

(1) Demand factors from the *Engineering Procedure Manual - Engineering & Design Standards* (City of Mesa, 2017).

(2) Commercial demand factor assumed from surrounding towns as City of Mesa standard is determined by actual square footage of building

(3) Mixed use is assumed at 50% Commercial and 50% MDR Residential.

(4) OFFSITE-1 & OFFSITE-2 Land use designation taken from the *Mesa 2040 General Plan* (City of Mesa, 2016).

Table B.2 - Offsite Sewer Capacity Calculations

Project: Levine General Motors 170

February, 2019

Scenario: Flow through existing offsite 18-inch sewer main in Cadence Parkway

Levine General Motors 170	**265,876**	**gpd**
Offsite Existing Flow (Cadence):	**65,419**	**gpd**
Offsite-1 & Offsite-2 Flow:	**338,492**	**gpd**
Total Average Day Flow:	**669,787**	**gpd**
Peaking Factor*:	2.30	
Total Peak Flow:	**1,540,510**	**gpd**

Pipe Parameters:

Sewer Diameter (D):	**18**	**in.**
Manning's n-value (n):	0.013	
Slope (S):	0.00160	ft/ft
Hydraulic Radius (R):	0.392	ft (part full pipe)
Hydraulic Radius (R):	0.375	ft (full pipe; R=D/4)
Manning's Equation:	V = (1.486/n) * R^(2/3) * S^(1/2)	
Velocity (V, part full pipe):	2.46	fps
Velocity (V, full pipe):	2.38	fps
Depth/Diameter (d/D):	**53.8%**	
% Capacity (Flow/Capacity, Q/Q_{full}):	56.6%	
	Q = (1.49/n) * A * R^(2/3) * S^(1/2)	
Pipe Capacity (Full Flow):	**4.21**	**cfs**
	2,722,959	**gpd**
Capacity (Excess Design):	1,182,263	gpd

Depth/Diameter (d/D) is less than 66.7% under peak flow conditions, therefore adequate capacity is available.

Notes:

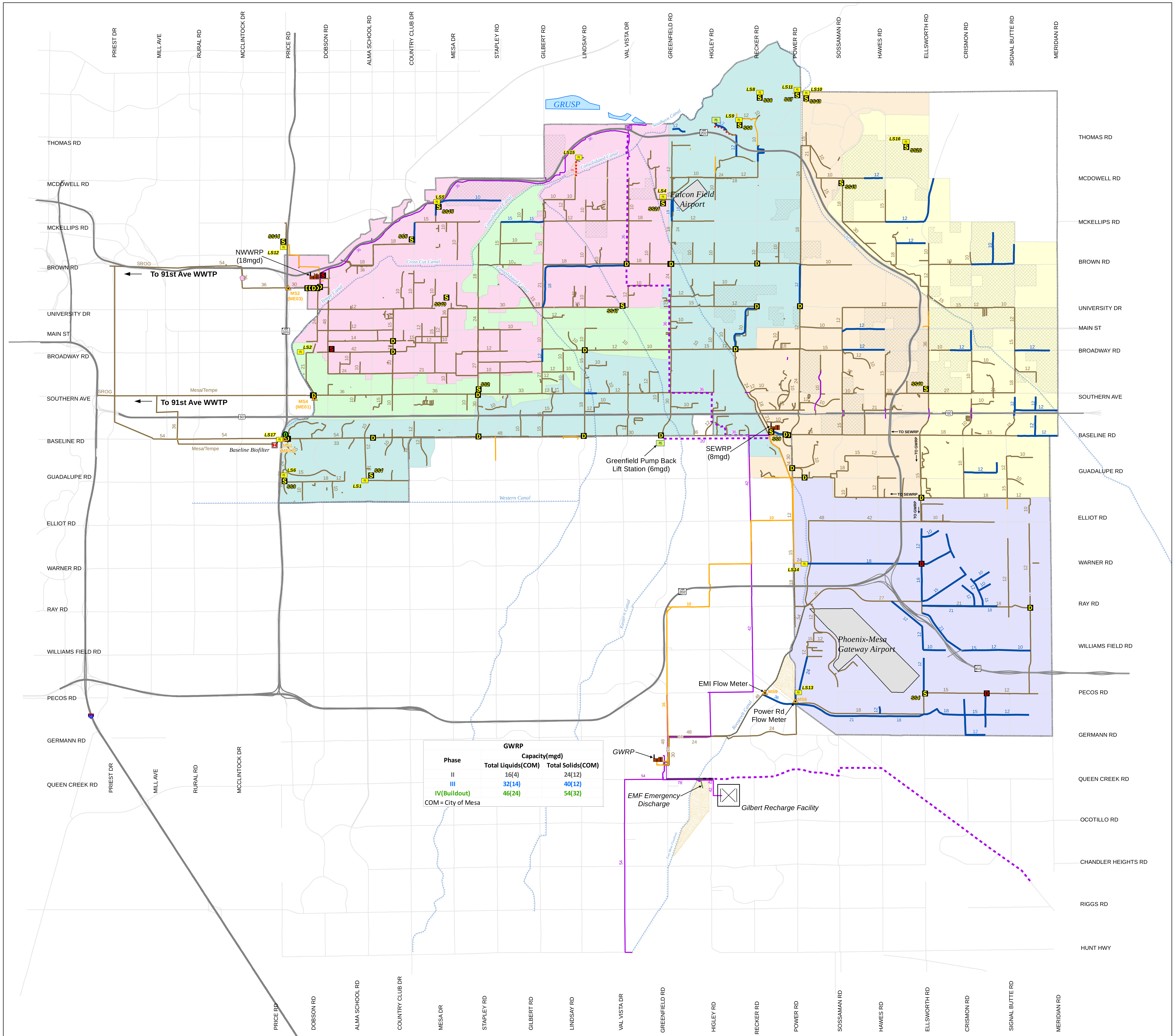
1) Design Criteria based on *Design Standards Manual for Water and Wastewater Systems (City of Phoenix, 2017).*
2) Minimum Existing Slope in 18-inch sewer = 0.0016 ft/ft.
3) Existing sewer main data taken from *Improvement Plans for Cadence Parkway* (EPS Group, 2017).

APPENDIX C

EXCERPTS FROM:

CITY OF MESA WASTEWATER MASTER PLAN UPDATE (CITY OF MESA, 2012)

MESA 2040 GENERAL PLAN (CITY OF MESA, 2016)



Phase	GWRP Capacity(mgd) Total Liquids(COM)	Total Solids(COM)
II	16(4)	24(12)
III	32(14)	40(12)
IV(Buildout)	46(24)	54(32)

COM = City of Mesa

mesa·az

WASTEWATER and RECLAIMED WATER INFRASTRUCTURE

- Metering Station
- Odor Control
- Siphon Structure
- Sulfide Station
- Reclamation Plant
- Lift Station
- Biofilter
- Existing Diversion Structure
- Proposed Sulfide Station
- Proposed Lift Station
- Proposed Diversion Structure
- Existing Wastewater Main
- Existing Reclaimed Main
- Existing Force Main
- GWRP Emergency Discharge to EMF
- Proposed Collection System
- Proposed Reclaimed System
- Proposed Force Main

COLLECTION SYSTEM DRAINAGE AREA

- Southeast or Greenfield WRP
- SROG ME01
- SROG ME02
- Northwest WRP / SROG ME03
- Southeast WRP
- Greenfield WRP
- City of Mesa Planning Area Boundary
- Septic System Areas as of 2008
- FCDMC Basin
- GRUSP
- Airport

SURFACE INFRASTRUCTURE

- Freeway
- Proposed Parkway
- Canal

Future reclaimed water utilization alternatives include potential recharge opportunities on the GRIC lot at Schnepf Farms. Further evaluation by City staff is required to select an appropriate alternative.

Additional reclaimed water CIP projects will be necessary once the City selects an appropriate reclaimed water utilization alternative.

N

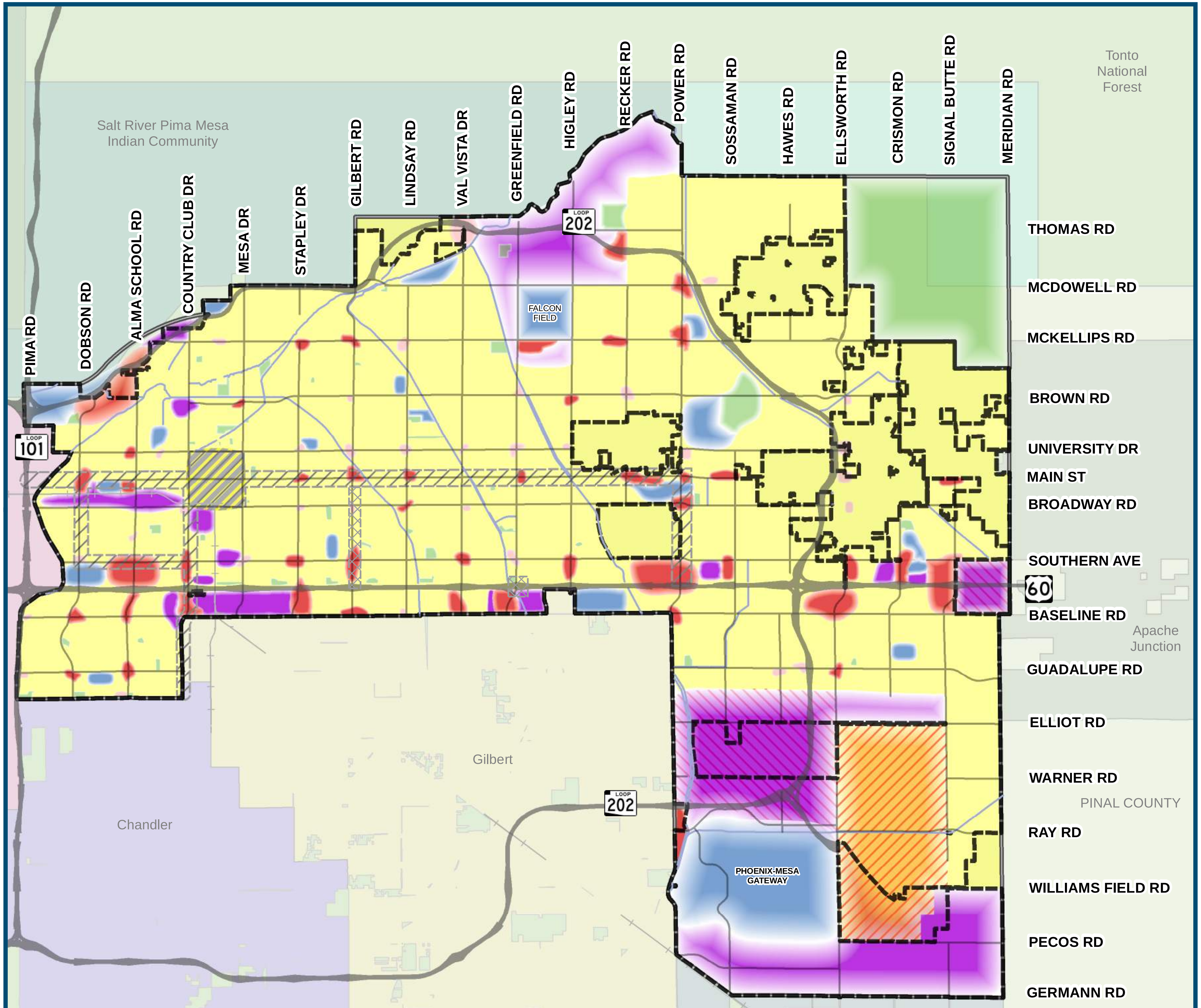
Miles

0 1.5 3

CITY OF MESA WASTEWATER MASTER PLAN UPDATE, INFRASTRUCTURE AT BUILDOUT JULY 2012

This GIS map is a limited representation of facilities, intended for planning purposes only. It is not intended for construction or other purposes requiring greater positional accuracy.

\\isr04\utwrgisshare\GIS\Projects\Jarrod\Master Plan\MP2011



Mesa 2040 General Plan

THIS IS MY mesa

RECOGNIZABLE NEIGHBORHOODS * INNOVATIVE JOBS * MEMORABLE PUBLIC SPACES

Character Areas

Figure 7-1

Character Types

- Downtown
- Park
- Mixed Use Community
- Neighborhood Village Center
- Mixed Use Activity District
- Specialty District
- Employment
- Neighborhoods
- Employment / Mixed Use Activity District
- Transit Corridor
- Proposed Transit Corridor

- Freeways
- Arterials
- Canals
- City Limits

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Miles

APPENDIX D

HYDRAULIC MODEL RESULTS

AVERAGE DAY FLOW

1. **Master Manhole Report** – This provides detailed information such as the rim elevation and structure depth of each manhole within the system.

2. **Master Gravity Pipe Report** – This provides detailed information such as the velocity, capacity, and percent full in each pipe in the system. Please note that the “Average Velocity” presented in the Master Gravity Pipe Report is actual velocity and not full flow velocity.

3. **Master Outlet Report** – This provides the invert, structure depth and flow at the outlet of the system.

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Depth (Structure) (ft)	Flow (Total Out) (gal/day)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
MH-1	1,416.57	1,405.60	10.96	49,408	1,405.75	1,405.75
MH-2	1,415.00	1,404.07	10.93	67,584	1,404.25	1,404.25
MH-3	1,413.00	1,402.29	10.71	117,504	1,402.52	1,402.52
MH-4	1,411.00	1,400.94	10.06	117,504	1,401.14	1,401.14
MH-5	1,409.75	1,399.06	10.69	147,968	1,399.32	1,399.32
MH-6	1,409.89	1,397.96	11.92	173,456	1,398.25	1,398.25
MH-7	1,410.91	1,396.83	14.08	173,456	1,397.11	1,397.11
MH-8	1,410.10	1,395.63	14.47	511,948	1,396.12	1,396.12
MH-9	1,408.78	1,395.08	13.70	530,988	1,395.43	1,395.43
MH-10	1,408.00	1,392.90	15.10	604,368	1,393.42	1,393.42
MH-11	1,404.63	1,392.32	12.31	604,368	1,392.84	1,392.84
MH-12	1,405.00	1,391.72	13.28	604,368	1,392.24	1,392.24
MH-13	1,406.00	1,391.16	14.84	604,368	1,391.68	1,391.68
MH-14	1,404.00	1,390.70	13.30	604,368	1,391.21	1,391.21
MH-15	1,402.22	1,390.13	12.10	604,368	1,390.65	1,390.65
MH-16	1,400.26	1,389.54	10.72	604,368	1,390.06	1,390.06
MH-17	1,401.54	1,388.94	12.60	604,368	1,389.46	1,389.46
MH-18	1,402.00	1,388.34	13.65	604,368	1,388.80	1,388.80
MH-19	1,417.64	1,409.87	7.77	21,248	1,409.96	1,409.96
MH-20	1,420.37	1,411.99	8.37	21,248	1,412.09	1,412.09
MH-21	1,421.00	1,413.33	7.67	21,248	1,413.43	1,413.43
MH-22	1,418.52	1,406.53	11.99	28,160	1,406.64	1,406.64
MH-23	1,417.00	1,407.70	9.30	28,160	1,407.82	1,407.82
MH-24	1,418.00	1,408.63	9.37	28,160	1,408.74	1,408.74
MH-25	1,417.14	1,410.38	6.77	28,160	1,410.49	1,410.49
MH-26	1,418.85	1,412.18	6.67	28,160	1,412.28	1,412.28
MH-28	1,413.00	1,404.25	8.75	32,512	1,404.37	1,404.37
MH-29	1,412.77	1,406.00	6.77	18,944	1,406.09	1,406.09
MH-30	1,415.00	1,408.33	6.67	18,944	1,408.42	1,408.42
MH-31	1,414.55	1,404.90	9.65	17,408	1,404.98	1,404.98
MH-32	1,414.00	1,406.23	7.77	17,408	1,406.32	1,406.32
MH-33	1,415.62	1,407.95	7.67	17,408	1,408.03	1,408.03
MH-34	1,410.57	1,400.98	9.60	30,464	1,401.10	1,401.10
MH-35	1,409.00	1,402.23	6.77	16,128	1,402.32	1,402.32
MH-36	1,411.74	1,405.07	6.67	16,128	1,405.15	1,405.15
MH-37	1,412.23	1,404.56	7.67	25,488	1,404.65	1,404.65
MH-38	1,405.39	1,395.39	10.00	73,380	1,395.57	1,395.57
MH-39	1,405.58	1,397.14	8.45	73,380	1,397.32	1,397.32
MH-40	1,405.53	1,398.39	7.14	59,080	1,398.56	1,398.56
MH-41	1,407.68	1,400.14	7.54	29,160	1,400.26	1,400.26
MH-42	1,408.00	1,401.23	6.77	29,160	1,401.35	1,401.35
MH-43	1,410.00	1,403.33	6.67	29,160	1,403.43	1,403.43
MH-44	1,407.53	1,399.87	7.67	19,040	1,399.95	1,399.95
MH-45	1,415.49	1,406.90	8.59	18,176	1,406.98	1,406.98
MH-46	1,416.00	1,408.23	7.77	18,176	1,408.32	1,408.32
MH-47	1,419.11	1,411.45	7.67	18,176	1,411.52	1,411.52
MH-48	1,416.00	1,408.33	7.67	13,568	1,408.40	1,408.40
MH-49	1,412.33	1,404.66	7.67	14,336	1,404.73	1,404.73

Label	Diam (in)	Length (Scaled) (ft)	Manning's n	Slope (Calculated) (ft/ft)	Start Node	Invert (Start) (ft)	Cover (Start) (ft)	Stop Node	Invert (Stop) (ft)	Cover (Stop) (ft)	Flow (gal/day)	Velocity (ft/s)	Flow / Capacity (Design) (%)	Capacity (Design) (gal/day)	Depth (Normal) / Diam (%)	Capacity (Full Flow) (gal/day)
CO-1	8.0	434.1	0.013	0.0033	MH-1	1,405.60	10.29	MH-2	1,404.17	10.16	49,408	1.31	14.0	351,677	22.4	448,636
CO-2	8.0	459.5	0.013	0.0033	MH-2	1,404.07	10.26	MH-3	1,402.56	9.78	67,584	1.43	19.2	351,677	26.2	448,636
CO-3	10.0	521.7	0.013	0.0024	MH-3	1,402.29	9.88	MH-4	1,401.04	9.13	117,504	1.47	21.6	543,775	27.8	693,696
CO-4	10.0	407.0	0.013	0.0044	MH-4	1,400.94	9.23	MH-5	1,399.16	9.75	117,504	1.81	16.0	732,956	24.0	935,035
CO-5	10.0	416.6	0.013	0.0024	MH-5	1,399.06	9.85	MH-6	1,398.06	10.99	147,968	1.56	27.2	543,775	31.4	693,696
CO-6	10.0	431.0	0.013	0.0024	MH-6	1,397.96	11.09	MH-7	1,396.93	13.15	173,456	1.63	31.9	543,775	34.1	693,696
CO-7	10.0	221.5	0.013	0.0024	MH-7	1,396.83	13.25	MH-8	1,396.30	12.97	173,456	1.63	31.9	543,775	34.1	693,696
CO-8	18.0	500.0	0.013	0.0011	MH-8	1,395.63	12.97	MH-9	1,395.08	12.20	511,948	1.60	29.0	1,764,967	32.4	2,251,577
CO-9	18.0	500.0	0.013	0.0044	MH-9	1,395.08	12.20	MH-10	1,392.90	13.60	530,988	2.63	15.1	3,510,458	23.3	4,478,309
CO-10	18.0	402.0	0.013	0.0012	MH-10	1,392.90	13.60	MH-11	1,392.42	10.71	604,368	1.72	32.8	1,844,731	34.6	2,351,696
CO-11	18.0	500.0	0.013	0.0012	MH-11	1,392.32	10.81	MH-12	1,391.72	11.78	604,368	1.72	32.8	1,844,731	34.6	2,351,696
CO-12	18.0	380.3	0.013	0.0012	MH-12	1,391.72	11.78	MH-13	1,391.26	13.24	604,368	1.72	32.8	1,844,731	34.6	2,351,696
CO-13	18.0	390.7	0.013	0.0012	MH-13	1,391.16	13.34	MH-14	1,390.70	11.80	604,368	1.72	32.8	1,844,731	34.6	2,351,696
CO-14	18.0	473.7	0.013	0.0012	MH-14	1,390.70	11.80	MH-15	1,390.13	10.60	604,368	1.72	32.8	1,844,731	34.6	2,351,696
CO-15	18.0	404.4	0.013	0.0012	MH-15	1,390.13	10.60	MH-16	1,389.64	9.12	604,368	1.72	32.8	1,844,731	34.6	2,351,696
CO-16	18.0	499.9	0.013	0.0012	MH-16	1,389.54	9.22	MH-17	1,388.94	11.10	604,368	1.72	32.8	1,844,731	34.6	2,351,696
CO-17	18.0	499.9	0.013	0.0012	MH-17	1,388.94	11.10	MH-18	1,388.34	12.15	604,368	1.72	32.8	1,844,731	34.6	2,351,696
CO-18	18.0	353.1	0.013	0.0020	MH-18	1,388.34	12.15	O-1	1,387.65	13.85	604,368	2.06	25.6	2,357,680	30.4	3,005,612
CO-19	8.0	500.0	0.013	0.0083	MH-19	1,409.87	7.10	MH-1	1,405.70	10.19	21,248	1.41	3.8	559,121	11.9	713,273
CO-20	8.0	500.0	0.013	0.0040	MH-20	1,411.99	7.71	MH-19	1,409.97	7.00	21,248	1.10	5.5	389,131	14.1	496,416
CO-21	8.0	375.0	0.013	0.0033	MH-21	1,413.33	7.00	MH-20	1,412.09	7.61	21,248	1.02	6.0	351,677	14.8	448,636
CO-22	8.0	250.0	0.013	0.0033	MH-22	1,406.53	11.32	MH-1	1,405.70	10.19	28,160	1.11	8.0	351,677	17.0	448,636
CO-23	8.0	325.4	0.013	0.0033	MH-23	1,407.70	8.63	MH-22	1,406.63	11.22	28,160	1.11	8.0	351,677	17.0	448,636
CO-24	8.0	250.0	0.013	0.0033	MH-24	1,408.63	8.70	MH-23	1,407.80	8.53	28,160	1.11	8.0	351,922	17.0	448,636
CO-25	8.0	500.0	0.013	0.0033	MH-25	1,410.38	6.10	MH-24	1,408.73	8.60	28,160	1.11	8.0	351,922	17.0	448,636
CO-26	8.0	300.0	0.013	0.0057	MH-26	1,412.18	6.00	MH-25	1,410.48	6.00	28,160	1.34	6.1	461,320	14.9	588,099
CO-28	8.0	500.0	0.013	0.0034	MH-28	1,404.25	8.08	MH-3	1,402.56	9.78	32,512	1.17	9.1	356,507	18.1	454,798
CO-29	8.0	500.0	0.013	0.0033	MH-29	1,406.00	6.10	MH-28	1,404.35	7.98	18,944	0.99	5.4	351,922	14.0	448,636
CO-30	8.0	500.0	0.013	0.0045	MH-30	1,408.33	6.00	MH-29	1,406.10	6.00	18,944	1.10	4.6	409,269	13.0	521,744
CO-31	8.0	500.0	0.013	0.0047	MH-31	1,404.90	8.99	MH-3	1,402.56	9.78	17,408	1.09	4.2	418,875	12.4	534,360
CO-32	8.0	375.0	0.013	0.0033	MH-32	1,406.23	7.10	MH-31	1,405.00	8.89	17,408	0.96	4.9	351,677	13.5	448,636
CO-33	8.0	215.3	0.013	0.0075	MH-33	1,407.95	7.00	MH-32	1,406.33	7.00	17,408	1.28	3.3	531,185	11.0	677,635
CO-34	8.0	500.0	0.013	0.0033	MH-34	1,400.98	8.93	MH-5	1,399.33	9.75	30,464	1.14	8.7	351,677	17.6	448,636
CO-35	8.0	350.0	0.013	0.0033	MH-35	1,402.23	6.10	MH-34	1,401.08	8.83	16,128	0.94	4.6	351,922	13.0	448,636
CO-36	8.0	500.0	0.013	0.0055	MH-36	1,405.07	6.00	MH-35	1,402.33	6.00	16,128	1.12	3.6	453,198	11.5	577,745
CO-37	8.0	500.0	0.013	0.0127	MH-37	1,404.56	7.00	MH-6	1,398.23	10.99	25,488	1.72	3.7	689,096	11.7	879,084
CO-38	8.0	500.0	0.013	0.0033	MH-38	1,395.39	9.33	MH-10	1,393.74	13.60	73,380	1.46	20.9	351,677	27.4	448,636
CO-39	8.0	500.0	0.013	0.0033	MH-39	1,397.14	7.78	MH-38	1,395.49	9.23	73,380	1.46	20.9	351,677	27.4	448,636
CO-40	8.0	350.0	0.013	0.0033	MH-40	1,398.39	6.47	MH-39	1,397.24	7.68	59,080	1.38	16.8	351,922	24.5	448,636

Label	Diam (in)	Length (Scaled) (ft)	Manning's n	Slope (Calculated) (ft/ft)	Start Node	Invert (Start) (ft)	Cover (Start) (ft)	Stop Node	Invert (Stop) (ft)	Cover (Stop) (ft)	Flow (gal/day)	Velocity (ft/s)	Flow / Capacity (Design) (%)	Capacity (Design) (gal/day)	Depth (Normal) / Diam (%)	Capacity (Full Flow) (gal/day)
CO-41	8.0	500.0	0.013	0.0033	MH-41	1,400.14	6.87	MH-40	1,398.49	6.37	29,160	1.12	8.3	351,922	17.3	448,636
CO-42	8.0	300.0	0.013	0.0033	MH-42	1,401.23	6.10	MH-41	1,400.24	6.77	29,160	1.12	8.3	351,922	17.3	448,636
CO-43	8.0	300.0	0.013	0.0067	MH-43	1,403.33	6.00	MH-42	1,401.33	6.00	29,160	1.43	5.8	500,413	14.6	637,936
CO-44	8.0	500.0	0.013	0.0079	MH-44	1,399.87	7.00	MH-9	1,395.91	12.20	19,040	1.34	3.5	544,487	11.4	694,604
CO-45	8.0	500.0	0.013	0.0054	MH-45	1,406.90	7.92	MH-2	1,404.17	10.16	18,176	1.16	4.0	451,903	12.2	576,495
CO-46	8.0	375.0	0.013	0.0033	MH-46	1,408.23	7.10	MH-45	1,407.00	7.82	18,176	0.97	5.2	351,677	13.7	448,636
CO-47	8.0	250.0	0.013	0.0124	MH-47	1,411.45	7.00	MH-46	1,408.33	7.00	18,176	1.55	2.7	683,059	10.0	871,381
CO-48	8.0	500.0	0.013	0.0080	MH-48	1,408.33	7.00	MH-28	1,404.35	7.98	13,568	1.21	2.5	546,372	9.7	697,010
CO-49	8.0	500.0	0.013	0.0072	MH-49	1,404.66	7.00	MH-34	1,401.08	8.83	14,336	1.19	2.8	518,207	10.2	661,079

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (gal/day)
O-1	1,403.00	1,387.65	1,388.01	604,368

PEAK FLOW

1. **Master Manhole Report** – This provides detailed information such as the rim elevation and structure depth of each manhole within the system.

2. **Master Pipe Report** – This provides detailed information such as the velocity, capacity, and percent full in each pipe in the system for the peak flow. Please note that the "Average Velocity" presented in the Master Pipe Report is actual velocity and not full flow velocity.

3. **Master Outlet Report** – This provides the invert, structure depth and flow at the outlet of the system.

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Depth (Structure) (ft)	Flow (Total Out) (gal/day)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
MH-1	1,416.57	1,405.60	10.96	148,224	1,405.87	1,405.87
MH-2	1,415.00	1,404.07	10.93	202,752	1,404.39	1,404.39
MH-3	1,413.00	1,402.29	10.71	352,512	1,402.71	1,402.71
MH-4	1,411.00	1,400.94	10.06	352,512	1,401.29	1,401.29
MH-5	1,409.75	1,399.06	10.69	443,904	1,399.55	1,399.55
MH-6	1,409.89	1,397.96	11.92	520,368	1,398.50	1,398.50
MH-7	1,410.91	1,396.83	14.08	520,368	1,397.37	1,397.37
MH-8	1,410.10	1,395.63	14.47	1,535,844	1,396.53	1,396.53
MH-9	1,408.78	1,395.08	13.70	1,592,964	1,395.70	1,395.70
MH-10	1,408.00	1,392.90	15.10	1,813,104	1,393.88	1,393.88
MH-11	1,404.63	1,392.32	12.31	1,813,104	1,393.31	1,393.31
MH-12	1,405.00	1,391.72	13.28	1,813,104	1,392.69	1,392.69
MH-13	1,406.00	1,391.16	14.84	1,813,104	1,392.15	1,392.15
MH-14	1,404.00	1,390.70	13.30	1,813,104	1,391.68	1,391.68
MH-15	1,402.22	1,390.13	12.10	1,813,104	1,391.10	1,391.10
MH-16	1,400.26	1,389.54	10.72	1,813,104	1,390.53	1,390.53
MH-17	1,401.54	1,388.94	12.60	1,813,104	1,389.92	1,389.92
MH-18	1,402.00	1,388.34	13.65	1,813,104	1,389.18	1,389.18
MH-19	1,417.64	1,409.87	7.77	63,744	1,410.02	1,410.02
MH-20	1,420.37	1,411.99	8.37	63,744	1,412.16	1,412.16
MH-21	1,421.00	1,413.33	7.67	63,744	1,413.50	1,413.50
MH-22	1,418.52	1,406.53	11.99	84,480	1,406.73	1,406.73
MH-23	1,417.00	1,407.70	9.30	84,480	1,407.90	1,407.90
MH-24	1,418.00	1,408.63	9.37	84,480	1,408.82	1,408.82
MH-25	1,417.14	1,410.38	6.77	84,480	1,410.57	1,410.57
MH-26	1,418.85	1,412.18	6.67	84,480	1,412.35	1,412.35
MH-28	1,413.00	1,404.25	8.75	97,536	1,404.46	1,404.46
MH-29	1,412.77	1,406.00	6.77	56,832	1,406.16	1,406.16
MH-30	1,415.00	1,408.33	6.67	56,832	1,408.48	1,408.48
MH-31	1,414.55	1,404.90	9.65	52,224	1,405.04	1,405.04
MH-32	1,414.00	1,406.23	7.77	52,224	1,406.39	1,406.39
MH-33	1,415.62	1,407.95	7.67	52,224	1,408.08	1,408.08
MH-34	1,410.57	1,400.98	9.60	91,392	1,401.18	1,401.18
MH-35	1,409.00	1,402.23	6.77	48,384	1,402.38	1,402.38
MH-36	1,411.74	1,405.07	6.67	48,384	1,405.20	1,405.20
MH-37	1,412.23	1,404.56	7.67	76,464	1,404.72	1,404.72
MH-38	1,405.39	1,395.39	10.00	220,140	1,395.72	1,395.72
MH-39	1,405.58	1,397.14	8.45	220,140	1,397.47	1,397.47
MH-40	1,405.53	1,398.39	7.14	177,240	1,398.68	1,398.68
MH-41	1,407.68	1,400.14	7.54	87,480	1,400.34	1,400.34
MH-42	1,408.00	1,401.23	6.77	87,480	1,401.43	1,401.43
MH-43	1,410.00	1,403.33	6.67	87,480	1,403.50	1,403.50
MH-44	1,407.53	1,399.87	7.67	57,120	1,400.00	1,400.00
MH-45	1,415.49	1,406.90	8.59	54,528	1,407.03	1,407.03
MH-46	1,416.00	1,408.23	7.77	54,528	1,408.39	1,408.39
MH-47	1,419.11	1,411.45	7.67	54,528	1,411.58	1,411.58
MH-48	1,416.00	1,408.33	7.67	40,704	1,408.45	1,408.45
MH-49	1,412.33	1,404.66	7.67	43,008	1,404.78	1,404.78

Label	Diam (in)	Length (Scaled) (ft)	Manning's n	Slope (Calculated) (ft/ft)	Start Node	Invert (Start) (ft)	Cover (Start) (ft)	Stop Node	Invert (Stop) (ft)	Cover (Stop) (ft)	Flow (gal/day)	Velocity (ft/s)	Flow / Capacity (Design) (%)	Capacity (Design) (gal/day)	Depth (Normal) / Diam (%)	Capacity (Full Flow) (gal/day)
CO-1	8.0	434.1	0.013	0.0033	MH-1	1,405.60	10.29	MH-2	1,404.17	10.16	148,224	1.78	42.1	351,677	39.6	448,636
CO-2	8.0	459.5	0.013	0.0033	MH-2	1,404.07	10.26	MH-3	1,402.56	9.78	202,752	1.94	57.7	351,677	47.1	448,636
CO-3	10.0	521.7	0.013	0.0024	MH-3	1,402.29	9.88	MH-4	1,401.04	9.13	352,512	1.98	64.8	543,775	50.5	693,696
CO-4	10.0	407.0	0.013	0.0044	MH-4	1,400.94	9.23	MH-5	1,399.16	9.75	352,512	2.47	48.1	732,956	42.5	935,035
CO-5	10.0	416.6	0.013	0.0024	MH-5	1,399.06	9.85	MH-6	1,398.06	10.99	443,904	2.09	81.6	543,775	58.1	693,696
CO-6	10.0	431.0	0.013	0.0024	MH-6	1,397.96	11.09	MH-7	1,396.93	13.15	520,368	2.16	95.7	543,775	64.6	693,696
CO-7	10.0	221.5	0.013	0.0024	MH-7	1,396.83	13.25	MH-8	1,396.30	12.97	520,368	2.16	95.7	543,775	64.6	693,696
CO-8	18.0	500.0	0.013	0.0011	MH-8	1,395.63	12.97	MH-9	1,395.08	12.20	1,535,844	2.12	87.0	1,764,967	60.6	2,251,577
CO-9	18.0	500.0	0.013	0.0044	MH-9	1,395.08	12.20	MH-10	1,392.90	13.60	1,592,964	3.59	45.4	3,510,458	41.2	4,478,309
CO-10	18.0	402.0	0.013	0.0012	MH-10	1,392.90	13.60	MH-11	1,392.42	10.71	1,813,104	2.27	98.3	1,844,731	65.9	2,351,696
CO-11	18.0	500.0	0.013	0.0012	MH-11	1,392.32	10.81	MH-12	1,391.72	11.78	1,813,104	2.27	98.3	1,844,731	65.9	2,351,696
CO-12	18.0	380.3	0.013	0.0012	MH-12	1,391.72	11.78	MH-13	1,391.26	13.24	1,813,104	2.27	98.3	1,844,731	65.9	2,351,696
CO-13	18.0	390.7	0.013	0.0012	MH-13	1,391.16	13.34	MH-14	1,390.70	11.80	1,813,104	2.27	98.3	1,844,731	65.9	2,351,696
CO-14	18.0	473.7	0.013	0.0012	MH-14	1,390.70	11.80	MH-15	1,390.13	10.60	1,813,104	2.27	98.3	1,844,731	65.9	2,351,696
CO-15	18.0	404.4	0.013	0.0012	MH-15	1,390.13	10.60	MH-16	1,389.64	9.12	1,813,104	2.27	98.3	1,844,731	65.9	2,351,696
CO-16	18.0	499.9	0.013	0.0012	MH-16	1,389.54	9.22	MH-17	1,388.94	11.10	1,813,104	2.27	98.3	1,844,731	65.9	2,351,696
CO-17	18.0	499.9	0.013	0.0012	MH-17	1,388.94	11.10	MH-18	1,388.34	12.15	1,813,104	2.27	98.3	1,844,731	65.9	2,351,696
CO-18	18.0	353.1	0.013	0.0020	MH-18	1,388.34	12.15	O-1	1,387.65	13.85	1,813,104	2.75	76.9	2,357,680	56.0	3,005,612
CO-19	8.0	500.0	0.013	0.0083	MH-19	1,409.87	7.10	MH-1	1,405.70	10.19	63,744	1.96	11.4	559,121	20.2	713,273
CO-20	8.0	500.0	0.013	0.0040	MH-20	1,411.99	7.71	MH-19	1,409.97	7.00	63,744	1.51	16.4	389,131	24.2	496,416
CO-21	8.0	375.0	0.013	0.0033	MH-21	1,413.33	7.00	MH-20	1,412.09	7.61	63,744	1.41	18.1	351,677	25.5	448,636
CO-22	8.0	250.0	0.013	0.0033	MH-22	1,406.53	11.32	MH-1	1,405.70	10.19	84,480	1.52	24.0	351,677	29.4	448,636
CO-23	8.0	325.4	0.013	0.0033	MH-23	1,407.70	8.63	MH-22	1,406.63	11.22	84,480	1.52	24.0	351,677	29.4	448,636
CO-24	8.0	250.0	0.013	0.0033	MH-24	1,408.63	8.70	MH-23	1,407.80	8.53	84,480	1.52	24.0	351,922	29.4	448,636
CO-25	8.0	500.0	0.013	0.0033	MH-25	1,410.38	6.10	MH-24	1,408.73	8.60	84,480	1.52	24.0	351,922	29.4	448,636
CO-26	8.0	300.0	0.013	0.0057	MH-26	1,412.18	6.00	MH-25	1,410.48	6.00	84,480	1.85	18.3	461,320	25.6	588,099
CO-28	8.0	500.0	0.013	0.0034	MH-28	1,404.25	8.08	MH-3	1,402.56	9.78	97,536	1.60	27.4	356,507	31.5	454,798
CO-29	8.0	500.0	0.013	0.0033	MH-29	1,406.00	6.10	MH-28	1,404.35	7.98	56,832	1.36	16.1	351,922	24.1	448,636
CO-30	8.0	500.0	0.013	0.0045	MH-30	1,408.33	6.00	MH-29	1,406.10	6.00	56,832	1.52	13.9	409,269	22.3	521,744
CO-31	8.0	500.0	0.013	0.0047	MH-31	1,404.90	8.99	MH-3	1,402.56	9.78	52,224	1.50	12.5	418,875	21.1	534,360
CO-32	8.0	375.0	0.013	0.0033	MH-32	1,406.23	7.10	MH-31	1,405.00	8.89	52,224	1.33	14.8	351,677	23.1	448,636
CO-33	8.0	215.3	0.013	0.0075	MH-33	1,407.95	7.00	MH-32	1,406.33	7.00	52,224	1.78	9.8	531,185	18.8	677,635
CO-34	8.0	500.0	0.013	0.0033	MH-34	1,400.98	8.93	MH-5	1,399.33	9.75	91,392	1.56	26.0	351,677	30.6	448,636
CO-35	8.0	350.0	0.013	0.0033	MH-35	1,402.23	6.10	MH-34	1,401.08	8.83	48,384	1.30	13.7	351,922	22.2	448,636
CO-36	8.0	500.0	0.013	0.0055	MH-36	1,405.07	6.00	MH-35	1,402.33	6.00	48,384	1.55	10.7	453,198	19.6	577,745
CO-37	8.0	500.0	0.013	0.0127	MH-37	1,404.56	7.00	MH-6	1,398.23	10.99	76,464	2.39	11.1	689,096	19.9	879,084
CO-38	8.0	500.0	0.013	0.0033	MH-38	1,395.39	9.33	MH-10	1,393.74	13.60	220,140	1.98	62.6	351,677	49.4	448,636
CO-39	8.0	500.0	0.013	0.0033	MH-39	1,397.14	7.78	MH-38	1,395.49	9.23	220,140	1.98	62.6	351,677	49.4	448,636
CO-40	8.0	350.0	0.013	0.0033	MH-40	1,398.39	6.47	MH-39	1,397.24	7.68	177,240	1.87	50.4	351,922	43.7	448,636

Label	Diam (in)	Length (Scaled) (ft)	Manning's n	Slope (Calculated) (ft/ft)	Start Node	Invert (Start) (ft)	Cover (Start) (ft)	Stop Node	Invert (Stop) (ft)	Cover (Stop) (ft)	Flow (gal/day)	Velocity (ft/s)	Flow / Capacity (Design) (%)	Capacity (Design) (gal/day)	Depth (Normal) / Diam (%)	Capacity (Full Flow) (gal/day)
CO-41	8.0	500.0	0.013	0.0033	MH-41	1,400.14	6.87	MH-40	1,398.49	6.37	87,480	1.54	24.9	351,922	29.9	448,636
CO-42	8.0	300.0	0.013	0.0033	MH-42	1,401.23	6.10	MH-41	1,400.24	6.77	87,480	1.54	24.9	351,922	29.9	448,636
CO-43	8.0	300.0	0.013	0.0067	MH-43	1,403.33	6.00	MH-42	1,401.33	6.00	87,480	1.98	17.5	500,413	25.0	637,936
CO-44	8.0	500.0	0.013	0.0079	MH-44	1,399.87	7.00	MH-9	1,395.91	12.20	57,120	1.86	10.5	544,487	19.4	694,604
CO-45	8.0	500.0	0.013	0.0054	MH-45	1,406.90	7.92	MH-2	1,404.17	10.16	54,528	1.61	12.1	451,903	20.8	576,495
CO-46	8.0	375.0	0.013	0.0033	MH-46	1,408.23	7.10	MH-45	1,407.00	7.82	54,528	1.35	15.5	351,677	23.5	448,636
CO-47	8.0	250.0	0.013	0.0124	MH-47	1,411.45	7.00	MH-46	1,408.33	7.00	54,528	2.15	8.0	683,059	17.0	871,381
CO-48	8.0	500.0	0.013	0.0080	MH-48	1,408.33	7.00	MH-28	1,404.35	7.98	40,704	1.69	7.4	546,372	16.4	697,010
CO-49	8.0	500.0	0.013	0.0072	MH-49	1,404.66	7.00	MH-34	1,401.08	8.83	43,008	1.65	8.3	518,207	17.3	661,079

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (gal/day)
O-1	1,403.00	1,387.65	1,388.29	1,813,104

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MASTER DRAINAGE REPORT
FOR
LEVINE GENERAL MOTORS 170

MESA, ARIZONA

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Registered Professional Engineer (Civil)
CERTIFICATE NO.
59301
BRIAN
BROCKMAN
DATE SIGNED 5/13/19
ARIZONA U.S.A.

May 2019
HILGARTWILSON Project No. 2063

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MASTER DRAINAGE REPORT
FOR
LEVINE GENERAL MOTORS 170

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MASTER DRAINAGE REPORT
FOR
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FIGURES

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1.0 INTRODUCTION

1.1 PROJECT NAME, LOCATION AND TOPOGRAPHY

Levine General Motors 170 (the Project) is located in the City of Mesa (the City) in Section 34 of Township 1 South, Range 7 East of the Gila and Salt River Base and Meridian. The Project is comprised of a 170-acre (gross) master planned mixed use development. The Project is bound by Williams Field Road to the north, the future SR24 Freeway alignment to the south, 222^{nd} Street to the east, and Crismon Road to the west, as illustrated on Figure 1 (Vicinity Map) of Appendix A.

The Project is planned as a mixed-use development, which will include a commercial area, medium and high density residential as well as parks and open space. The site is currently comprised of undeveloped desert rangeland which generally slopes from northeast to southwest at approximately 0.5 percent.

1.2 PURPOSE

This Master Drainage Report (MDR) has been prepared in support of the Community Plan for Levine General Motors. The purpose of this report is to provide conceptual hydrologic and hydraulic analyses of the Project property, including existing and proposed drainage systems, and address potential drainage related constraints relative to project development. In addition to identifying the drainage constraints, this report is intended to identify overall drainage management concepts and establish design guidelines for future improvement plans for the property. This report will become the basis for more detailed hydrologic and hydraulic designs, performed during the preliminary and final plat submittals. Site specific drainage reports will be prepared to address internal drainage at the parcel level, and will be submitted in conjunction with the site plan and subdivision plat stages of development of the property as required by the City.

This report has been prepared in accordance with the City's Engineering and Design Standards (EDS, City of Mesa 2019) and the Flood Control District of Maricopa County's (FCDMC) current versions of the Drainage Policies and Standards (DPSM) (FCDMC 2016), Drainage Design Manuals (DDM) for Maricopa County, Volume 1 - Hydrology (FCDMC 2013a) and Volume 2 - Hydraulics (FCDMC 2013b).

1.3 SITE LOCATION RELATIVE TO KNOWN FEMA FLOOD HAZARD ZONES

The property is located within the Federal Emergency Management Agency's (FEMA) Zone X (Shaded) within the FEMA Flood Insurance Rate Map (FIRM) panel number 04013C2790L, revised October 16^{th}, 2013 which is presented on Figure 2 (FEMA Flood Map) of Appendix A. The flood map for this location has a status of "not printed". The Zones associated with this Project are defined below.

Zone X (Shaded):

The flood insurance rate zone that corresponds to areas between the 100-year and 500-year floodplains, areas of 100-year sheet flow flooding where average depths are less than 1 foot, areas of 100-year stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

2.0 PREVIOUS STUDIES

2.1 EAST MESA AREA DRAINAGE MASTER PLAN UPDATE

In March 2014, the FCDMC completed the *East Mesa Area Drainage Master Plan Update* (ADMPU, FCDMC 2014) which provided an updated hydrologic analysis of the East Mesa Area Drainage Master Plan in which the Project is located within. The analysis detailed the methodology and results of revised HEC-1 models referencing updated parameters including NOAA 14 rainfall precipitation depths. Excerpts from the ADMPU are included for reference in Appendix B.

3.0 MANAGEMENT OF OFFSITE DRAINAGE

3.1 EXISTING PATTERNS

As previously mentioned, tributary drainage areas to the Project generally slope west and southwest, approaching as sheet flow and shallow concentrated flows originating from undeveloped desert rangeland and rural residential drainage areas east of the 222nd Street alignment. Flows passing through the property discharge from the site along the west and southwest boundaries, continuing as sheet and shallow concentrated flows. Runoff generated north and east of the Project are intercepted by a large engineered channel along Williams Field Road and conveyed to the west and then south around the Project.

3.2 PROPOSED PATTERNS

Offsite flows approaching the Project will continue to be received as they do under existing conditions. Engineered channels will route the collected runoff to the historical outfall points within or along the downstream limits of the property.

Grade control will be implemented to reduce channel velocities wherever necessary. Where steeper channels and higher velocities are unavoidable, erosion protection will be provided. Erosion protection for channels will be specified in future phasing with more detailed site plans. The primary channel corridors within the property will likely be designed with many natural elements including the use of native vegetation and typical desert landscaping materials. Some locations, particularly channels located in the vicinity of amenity areas, may be turf lined. Other locations, such as those that may be prone to erosion or that are located in areas of more intense land uses, may include sections that require other linings such as riprap or other robust revetment. All channel linings will be selected in accordance with the City's standards The proposed management of offsite flow is discussed in further detail below.

4.0 HYDROLOGIC ANALYSIS

The amount of offsite runoff approaching the Project from the east was quantified referencing the ADMPU 100-year, 6-hour HEC-1 model in order to adequately size onsite drainage infrastructure for peak flows. Results from the ADMPU report that between the 100-year, 6-hour and 24-hour storm events, the 6-hour event yielded larger flows. A hydrologic exhibit, referenced from the ADMPU, provides detail of the tributary drainage areas impacting the Project which can be seen on Figure 3 (HEC-1 Hydrologic Exhibit) of Appendix A. The following sections further describe the methodology used for the analysis in this report. Hydrologic equations, calculations, and results from the analyses can be found in Appendix C.

4.1 DDMS/HEC-1 ANALYSIS

A HEC-1 analysis using the FCDMC Drainage Design Management System (DDMS) was performed to quantify flows impacting the site generated from the tributary drainage areas (E23 and a portion of E27). Hydrologic calculations used to determine flows can be found Appendix C. An electronic copy of the DDMS model on CD is also provided in Appendix C. The following sections describe the HEC-1/DDMS methodology used for the analysis of this report.

4.1.1 RAINFALL DATA

Precipitation depths were not modified from the original HEC-1 model.

4.1.2 DRAINAGE AREAS

Topographic contour data obtained from the FCDMC was used confirm the delineation of the offsite drainage areas. The obtained topographic data was the same data used in the in the ADMPU hydrologic analyses.

4.1.3 RAINFALL LOSSES

Drainage area E23 remained unchanged compared to the original ADMPU HEC-1 model. As the Project boundary is located completely within the larger drainage area E27, various parameters were required to be reevaluated which are described below.

Composite rainfall loss parameters, used to calculate peak flows and volumes, are determined within DDMS for each sub-basin. These rainfall loss parameters, described in further detail below, are; 1) Initial Abstraction (IA), 2) hydraulic conductivity at natural saturation (XKSAT), 3) soil moisture deficit (DTHETA), and 4) wetting front capillary suction (PSIF).

In order to determine XKSAT, DTHETA, and PSIF, soil data for the site was required, which was referenced from United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey website. Shape files were imported into CAD from the NRCS website to calculate the soil type percentage compositions of the individual sub basins. The NCRS Custom Soil Resource Map is provided in Appendix C. It should be noted that soil areas for E23 were compared to the ADMPU model and were nearly identical suggesting that the same methodology was utilized.

The XKSAT, DTHETA, Initial abstraction (IA), and percent impervious (RTIMP) values remained consistent with the ADMPU.

5.0 HYDRAULIC ANALYSIS

5.1 PRELIMINARY OPEN CHANNEL DESIGN

Figure 4 (Master Drainage Exhibit) of Appendix A details the various channel segment ID's and the associated hydrologic flows through the property along with the approximate channel footprint. Hydraflow was used to perform normal depth calculations for each channel section which have been included in Appendix D.

Channels have been sized referencing parameters from the DDM, Volume 2. Design parameters and results for the proposed channel corridors are presented in the Channel Summary Table included in Appendix D. All channels will have a minimum freeboard of 1 foot. Other pertinent design criteria for the channels are described below:

- Manning's n: A Manning's n value of 0.030 has been used to represent the proposed channel lining for the offsite flow drainage corridors. Use of a mid-range roughness coefficient allows for some flexibility in the channel lining, such as a combination of grass with native vegetation, sparsely placed shrubs, and decomposed granite.

- Side Slopes: Offsite drainage conveyance channels located through the property boundary have been designed at 6H: 1V side slopes. Steeper slopes may be utilized depending on the lining composition and location.

- Permissible velocities: A maximum permissible velocity of 5 feet per second (fps) has been used for the preliminary design of the channels, consistent with the maximum velocity specified for natural channels in the DDM.

- Longitudinal Slopes: Preliminary longitudinal slopes were determined based on existing ground slopes and were found to be approximately 0.2 %.

5.2 PRELIMINARY CULVERT DESIGN

Along with the channel configurations, Figure 4 also details approximate locations of culverts throughout the property based on conceptual roadway layouts which will be needed to pass offsite 100-year peak flows under the roads assuming no overtopping. Similar to the open channel calculations, Hydraflow was utilized to quantify the approximate number and size of culverts required to convey flow beneath the roadways with no overtopping. Hydraflow cross sections are included in Appendix D.

6.0 DRAINAGE INFRASTRUCTURE CONSTRUCTION PHASING

The Project will most likely develop various parcels at different times. In order to provide safe conveyance of 100-year peak flows and to minimize flood hazards during the construction of the development, the timing of construction of the proposed drainage corridors will need to be considered in order to safely manage offsite runoff through the site. In addition, temporary interim retention basins may be employed in order to protect the developing properties from runoff generated from undeveloped land within the overall Project boundary.

These interim facilities would be shallow in nature consisting of storage depths of 1 foot or less, sized to retain the existing conditions 100-year, 2-hour runoff generated onsite.

7.0 ONSITE DRAINAGE

The proposed drainage infrastructure to manage stormwater generated within the Project consist of manmade channels, culverts, street drainage networks, and retention basins. This section describes the proposed concepts and future design of the required drainage infrastructure.

7.1 LOT DRAINAGE

Lots are to be graded to drain from the rear to the front and into the street. A minimum lot drainage time of concentration of 5-minutes for residential and commercial will be used to determine rainfall intensities in accordance with the EDS.

7.2 ONSITE STREET DRAINAGE

The Rational Method will be used to calculate 10- and 100-year onsite flows for pavement drainage design. For local streets, the onsite system will be designed to convey the peak 10-year flow between curbs and 100-year flow within the street right-of-way or drainage easements. Where possible, this will be accomplished with the use of 4-inch roll curb. 6-inch vertical curb will be constructed where a 4-inch curb cannot meet the above requirements. Arterial and major collector streets shall be designed utilizing 6-inch vertical curbs and will convey peak flows generated by the 10-year event such that the flows will be limited to a spread of one traffic lane in each direction and 100-year flow within the street right-of-way or drainage easements. Furthermore, an underground storm drain network will be utilized in design where a 6-inch curb cannot meet the aforementioned requirements.

7.3 DRAINAGE STRUCTURES

The drainage design for the Project outlines a system in which street flows will be directed to concentration points throughout the site where catch basins and storm drains will be placed to collect and convey the street runoff to retention basins. Underground storage basins may also be utilized for non-residential developments within the site in accordance with the EDS. Calculations to determine storm drain locations and sizes will be provided with the final drainage plans for each parcel of the development.

Erosion revetment such as riprap aprons, will be designed downstream of all concentrated discharge points, including storm drain pipe outlets, to protect against scour around these areas, facilitate uniform spreading of flows and decrease flow velocities. These structures will be designed in accordance with the design guidelines.

7.4 ONSITE STORMWATER STORAGE REQUIREMENTS

7.4.1 ONSITE RETENTION

The onsite rainfall runoff from the site will be routed via in-street flow and storm drains, where necessary. The City requires 100-year, 2-hour retention to be provided for new developments. The equations to calculate the 100-year, 2-hour required retention volumes are detailed below:

100-Year, 2-Hour

$$V_R = P/12*(C)*A$$

Where:

V_R is the 100-year, 2-hour retention volume (ft^3)
C is the runoff coefficient
P is the 100-year, 2-hour rainfall depth (inches)
A is the drainage area (ft^2).

The NOAA Atlas 14 100-year, 2-hour rainfall depth of 2.21 inches was used as the precipitation depth. The NOAA 14 report for the Project has been included in Appendix C. Runoff coefficients for onsite drainage sub-basins were taken from Table 6.3 of the DPSM detailed in Table 2 below. The applicable runoff coefficients from this table were weighted based on the land uses and gross areas and are presented in Appendix E. Common retention basins may be employed, in lieu of individual basins or underground storage, combining one or more parcels in order to make the most efficient use of the property. Onsite retention solutions will be determined as the Project is developed considering future phasing which will be detailed in subsequent parcel drainage reports.

Table 2:
Land Use Summary Table

Land Use	Density (du/ac)	FCDMC Land Use Class	"C" Coefficient
Medium Density Residential (LMDR)	4-6	150	0.84
Medium Density Residential (MDR)	6-10	170	0.94
High Density Residential (HDR)	15+	190	0.94
Commercial	--	220	0.95
Park/Open Space	--	710	0.31

Excess flows generated from major storm events (those events exceeding the design storm event) will overtop the basins and be routed downstream via channels, in-street flows, storm drain pipes, and other retention basins to historical outfalls. The resulting peak flows discharging from the site will not be increased as a result of development.

Stormwater storage basins will be designed such that retained or detained water will preclude a water surface depth over 3.5-feet and will be discharged within 36-hours of the storm event.

7.4.2 RETENTION BASIN DEWATERING

Outlet facilities will generally consist of natural infiltration and gravity bleed-off pipes wherever possible, in accordance with the EDS. Retention basins will be placed at strategic locations to allow retained runoff to discharge to historical outfall locations. It should be noted that there are currently no existing stromdrain networks in the vicinity in which the development can drain via gravity bleed-off. To the extent possible, existing washes and other onsite and offsite drainage infrastructure will be utilized such that retention basins can bleed-off by gravity. However, due to the relatively flat terrain (approximately 0.5 percent), gravity bleed-off may not be feasible for all portions of the site. If gravity bleed-off is not deemed feasible for portions of the Project, other alternatives for dewatering will be considered at final design in accordance with Section 806.21.2.1 of the EDS. Post construction geotechnical tests will be performed in order to determine the natural infiltration rate of each basin.

8.0 FINISHED FLOOR ELEVATIONS

In the event of a storm where retention volumes are exceeded, the Project will be designed with a means to outfall at a number of locations throughout the site. Finished floor elevations within the Project will be set a minimum of 12-inches above the high adjacent 100-year water surface elevation.

9.0 SUMMARY AND CONCLUSIONS

The proposed development will comply with the City of Mesa's required drainage standards as well as Maricopa County Planning and Development Design guidelines and regulations. Levine General Motors 170 will meet the specified retention requirements such that flows generated from the 100-year event will not be anticipated to result in adverse impacts to either downstream existing properties or drainage ways from the Project. This report has determined that:

- The design of the hydraulic facilities is in accordance with the City's and the FCDMC's requirements.
- Channels will be designed to convey offsite 100-year peak flows through the Project with a minimum 1-foot of freeboard. Maximum flow velocities in the channels will be less than permissible velocities for the selected linings.
- Streets will be designed to adequately convey the calculated peak 10-year flows between curbs and 100-year flows within the street right-of-ways or drainage easements.
- Onsite flows will be conveyed to stormwater storage basins or underground storage near low points via surface flow and, when necessary, storm drain pipes.

- Riprap aprons will be placed downstream of all storm drain outlets and other points of concentrated flow to protect against scour.
- Onsite retention basins and underground storage will provide, at a minimum, a storage volume equivalent to the 100-year, 2-hour runoff.
- Basins will be drained within 36 hours. The dewatering of the retention basins will be accomplished by the combination of natural infiltration and bleed-off pipes wherever possible.
- Shallow interim retention basins may be employed upstream of developing parcels in order to protect the properties from runoff generated onsite.
- All finished floor elevations will be set a minimum of 12 inches above the retention basin overflow elevations and 100-year water surface elevations in the adjacent drainage corridors.
- Individual parcel drainage reports will be prepared based on the future phasing of the Project. These reports will contain final calculations and design for the following:
    - In-street flow capacities;
    - Scupper and catch basin sizing;
    - Storm drain pipe system design capacities;
    - Retention basin geometries and volumes;
    - Retention basin high-water outlet structures;
    - Retention dewatering measures.

10.0 REFERENCES

City of Mesa, 2019. *Engineering and Design Standards*. City of Mesa, Arizona. April, 2019.

FCDMC, 2011. *East Mesa Area Drainage Master Plan Update*. Maricopa County, Arizona. August, 2011

FCDMC, 2013a. *Drainage Design Manual for Maricopa County, Arizona, Volume 1 - Hydrology*. Phoenix, Arizona.

FCDMC, 2013b. *Drainage Design Manual for Maricopa County, Arizona, Volume 2 - Hydraulics*. Phoenix, Arizona.

FCDMC, 2016. *Drainage Policies and Standards Manual for Maricopa County, Arizona*. Phoenix, Arizona.

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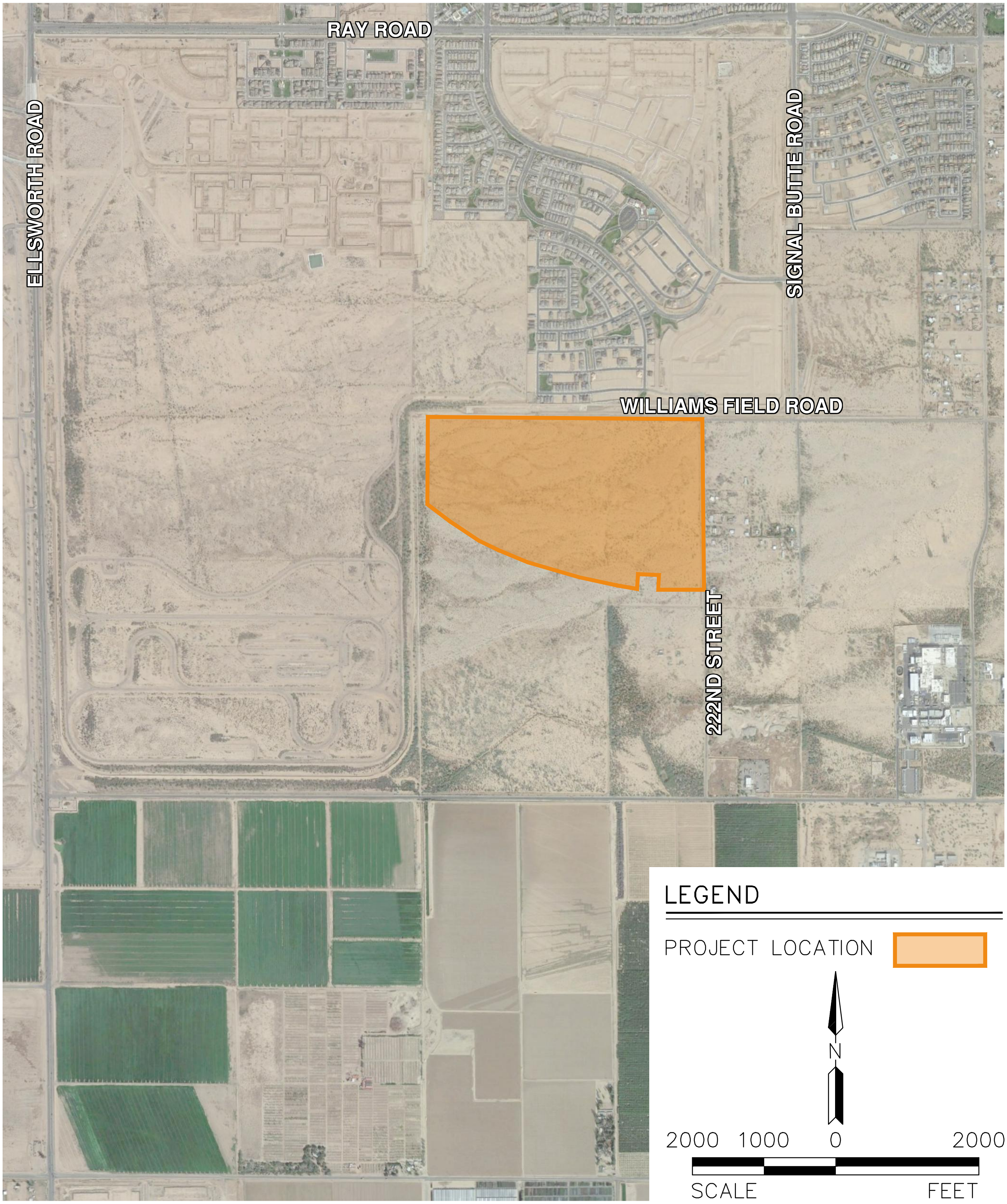
APPENDIX A

FIGURES



PROJ.NO.:	2063
DATE:	FEB 2019
SCALE:	1" = 2,000'
DRAWN BY:	SL
CHECKED BY:	BB

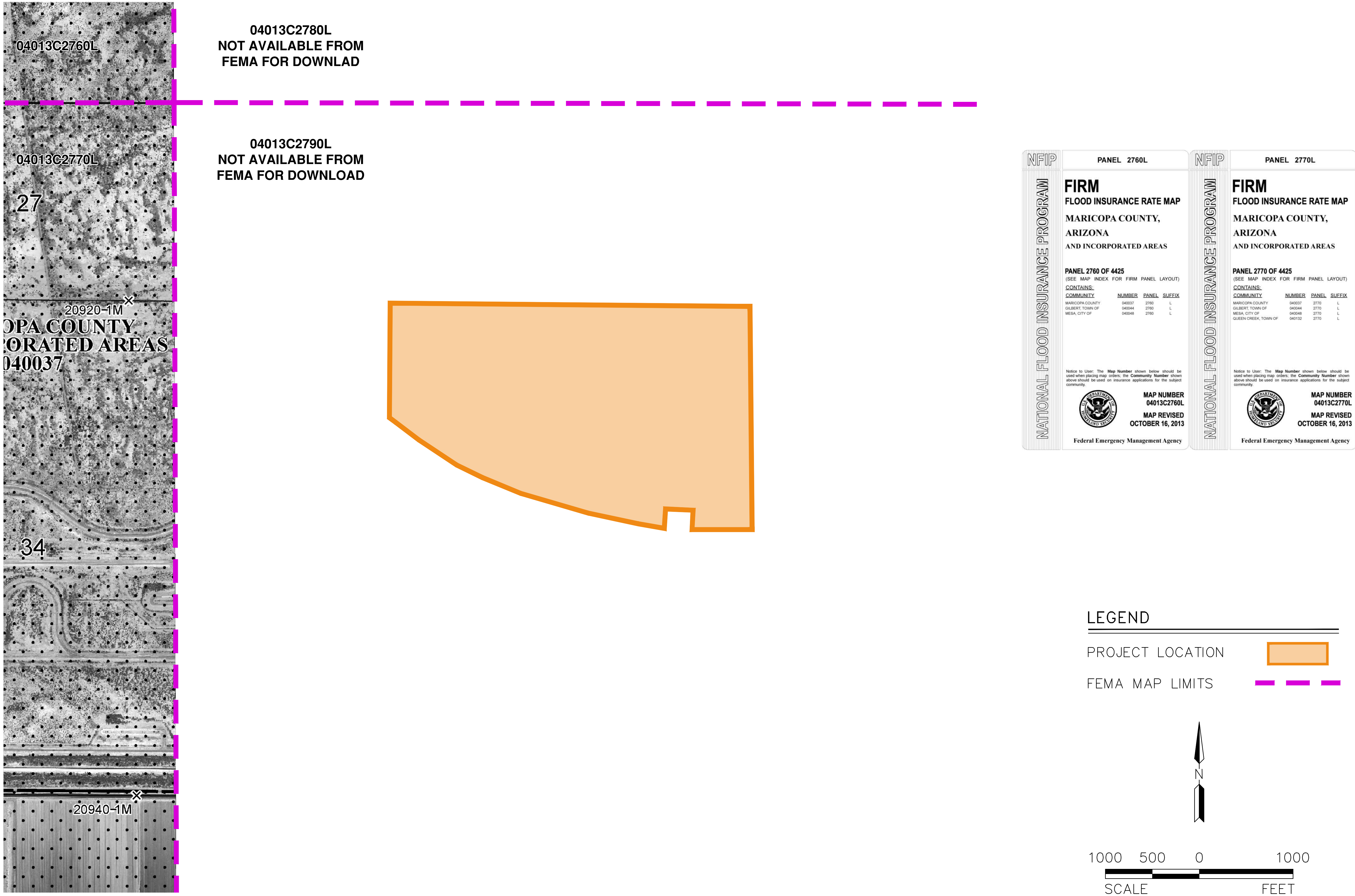
LEVINE 170

MARICOPA COUNTY, ARIZONA

FIG 1: VICINITY MAP

HILGARTWILSON
2141 E. HIGHLAND AVE., STE. 250
PHOENIX, AZ 85016
P: 602.490.0535 / F: 602.368.2436

U:\2000\2063\2063.01 – Pacific Proving LLC\REPORTS\DRAINAGE\Exhibits\2063 FIG 1 – Vicinity Map.dwg 2/27/2019 3:12 PM



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LEVINE 170

MARICOPA COUNTY, ARIZONA

FIG 2: FEMA FLOOD MAP

PROJ. NO.: 2063
DATE: FEB 2019
SCALE: 1" = 1,000'
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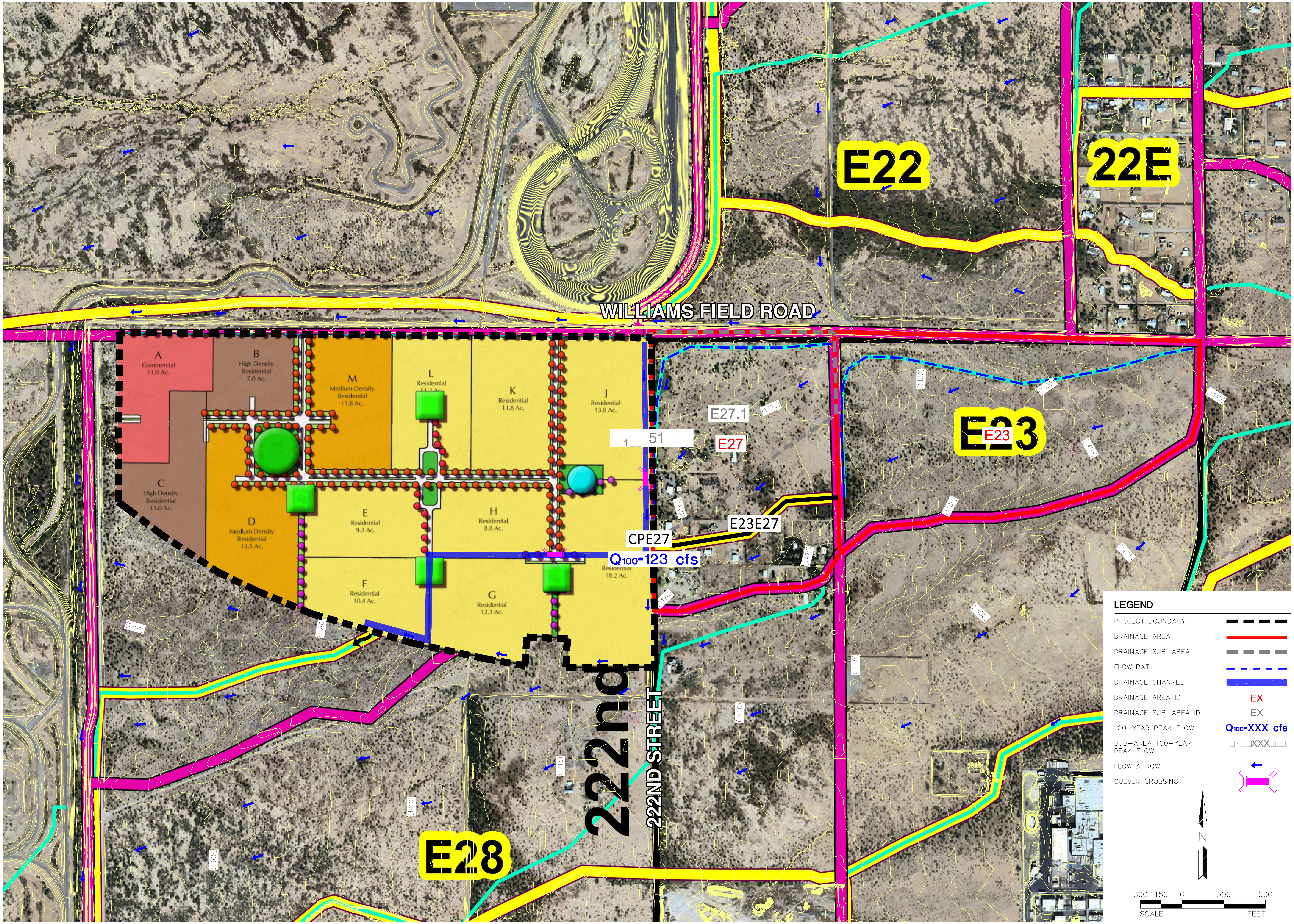
CHECKED BY: BB

U:\2000\2063\2063.01 – Pacific Proving LLC\REPORTS\DRAINAGE\Exhibits\2063 FIG 2 – FEMA Flood Map.dwg 2/27/2019 2:01 PM



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LEVINE 170

CITY OF MESA, ARIZONA

FIG 3: HEC-1 HYDROLOGY EXHIBIT

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PROJ NO.: 2063
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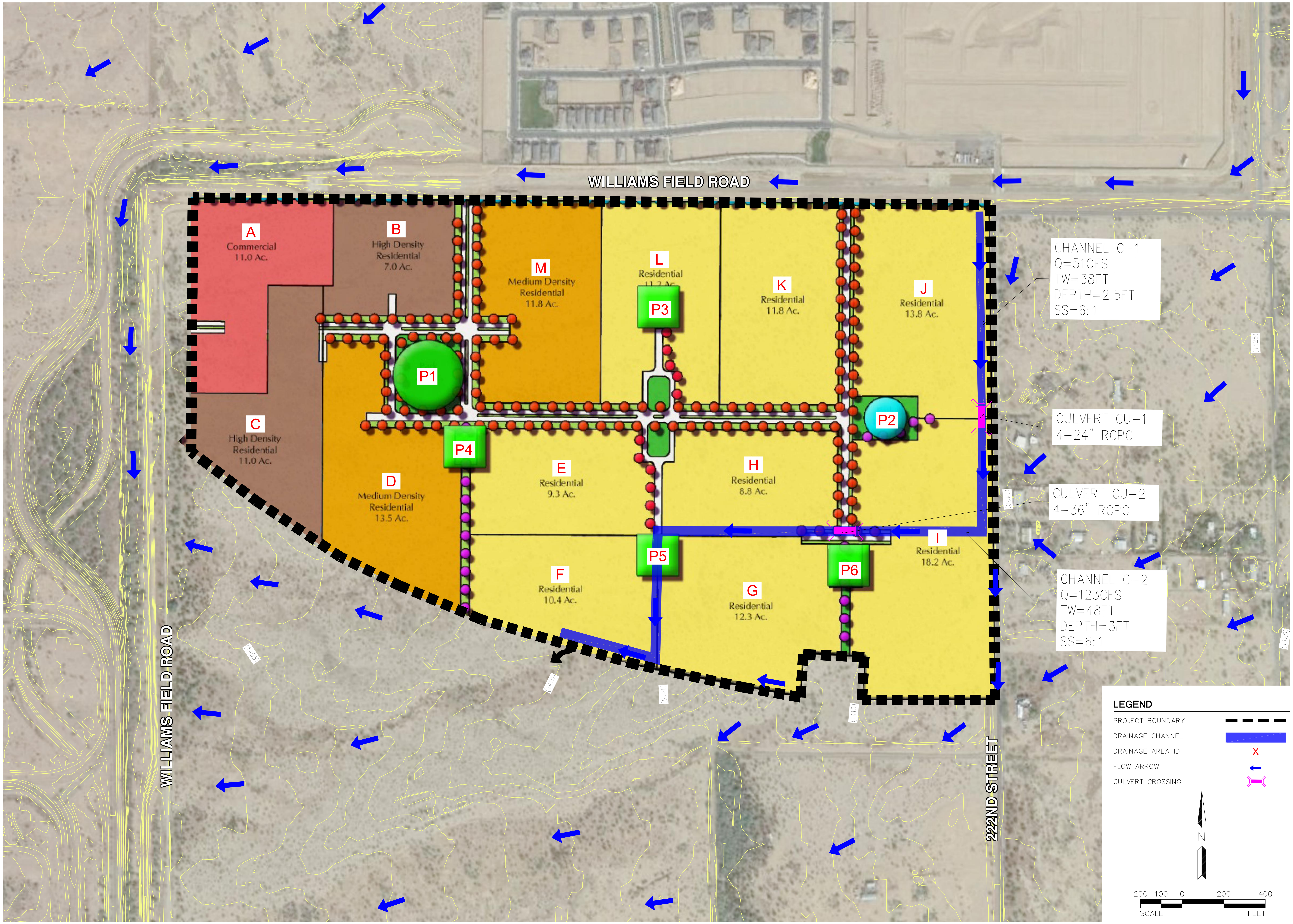
DESIGNED: HW
APPROVED: BB
DWG. NO.
3
SHT. 3 OF 4

U:\2000\2063\2063.01 – Pacific Proving LLC\REPORTS\DRAINAGE\Exhibits\2063 FIG 3 – East Mesa ADMP.dwg 2/27/2019 1:59 PM



REV.:

HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE
2141 E. HIGHLAND AVE., STE. 250
PHOENIX, AZ 85016
P: 602.490.0535 / F: 602.368.2436
www.hilgartwilson.com

LEVINE 170

CITY OF MESA, ARIZONA

FIG 4: MASTER DRAINAGE EXHIBIT

HILGARTWILSON
PROJ NO.: 2063
DATE: FEB 2019
SCALE: 1" = 200'
DRAWN: SL
DESIGNED: HW
APPROVED: BB

DWG. NO.
4
SHT. 4 OF 4

U:\2000\2063\2063.01 - Pacific Proving LLC\REPORTS\DRAINAGE\Exhibits\2063 FIG 4 - Drainage Summary Exhibit.dwg 2/27/2019 3:30 PM

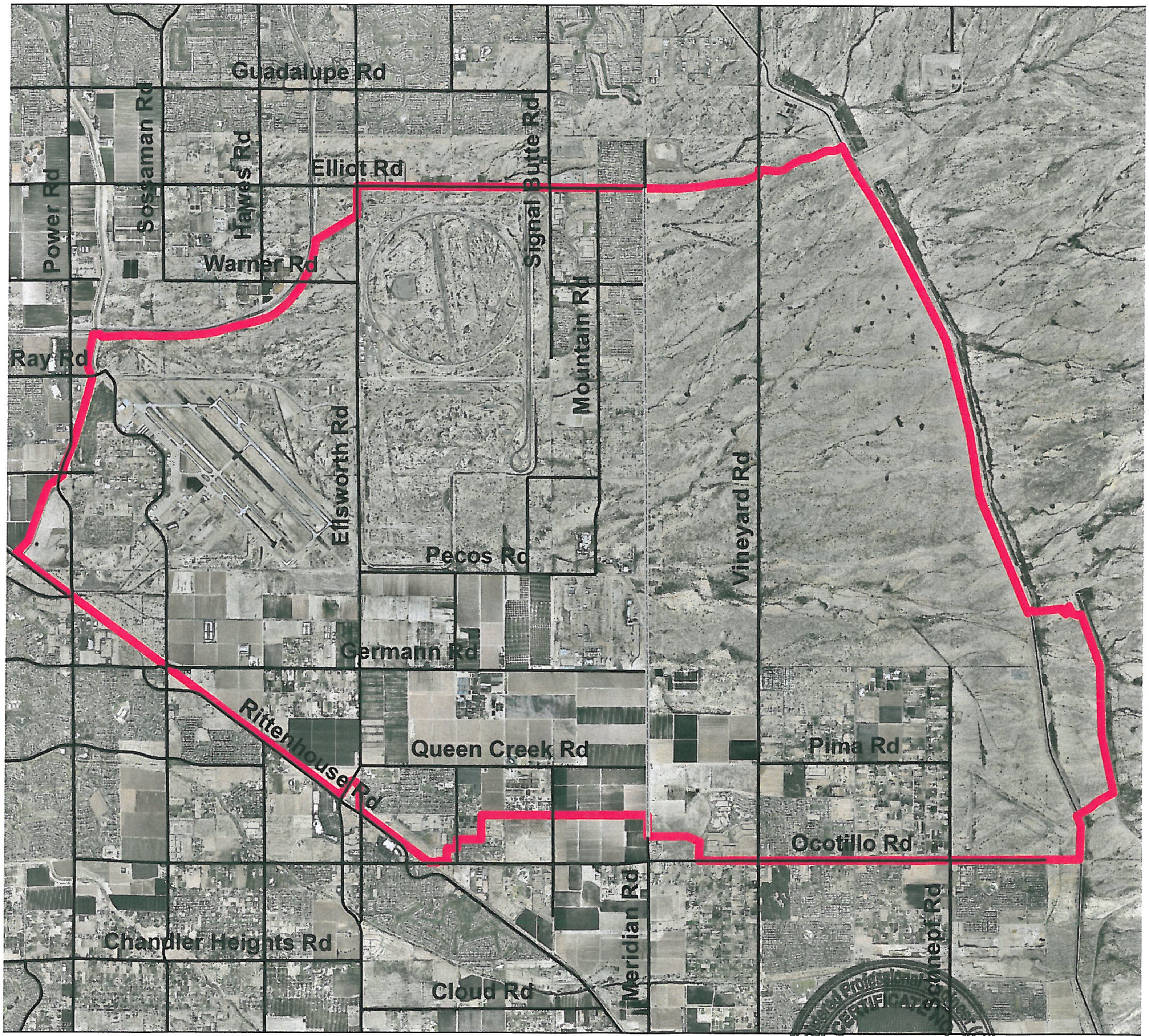
HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

APPENDIX B

PREVIOUS DRAINAGE STUDIES

Flood Control District of Maricopa County

East Mesa Area Drainage Master Plan Update



Prepared by:
Flood Control District of Maricopa County
Engineering Division
Hydrology & Hydraulics Branch
August 2011

Registered Professional Engineer (Civil)
CERTIFICATE NO.
37883
CATHERINE WEDIG
REGESTER
Date Signed 8/11/11
ARIZONA, U.S.A.

Catherine W. Regester

EXPIRES 9/30/11

Table 4.5.1-1 Existing Conditions HEC-1 Model Results in Model Order													
HEC-1 ID	Area (Sq. Mi.)	10 Year				50 Year				100 Year			
		6 Hour		24 Hour		6 Hour		24 Hour		6 Hour		24 Hour	
		Peak (cfs)	Time (Hr)	Peak (cfs)	Time (Hr)	Peak (cfs)	Time (Hr)	Peak (cfs)	Time (Hr)	Peak (cfs)	Time (Hr)	Peak (cfs)	Time (Hr)
E8E6	1.1	121	6.17	**182**	14.08	221	6.25	**251**	15	253	6.75	**307**	15.33
CPE6	3.63	214	5.5	**510**	13.5	643	5.67	**1174**	13.5	977	5.67	**1514**	13.5
DRE9	3.63	1	5.5	**8**	13.5	13	5.67	**238**	13.5	144	5.67	**509**	13.5
DE6S	3.63	177	5.5	**502**	13.5	630	5.67	**936**	13.5	833	5.67	**1005**	13.5
E6E15	3.63	167	6.17	**428**	15.42	547	7.33	**826**	15.08	747	7.17	**938**	15
E15	0.78	181	4.92	**202**	12.92	359	4.92	**375**	12.92	447	4.92	**458**	12.92
DRE9	3.63	1	5.5	**8**	13.5	13	5.67	**238**	13.5	144	5.67	**509**	13.5
RTE6E9	3.63	1	6.25	**7**	14.08	11	6.08	**199**	13.83	132	5.92	**456**	13.75
E9	0.72	166	5	**177**	13	319	5	**329**	13	397	5	**401**	13
CPE9	4.35	53	5.08	**171**	13	188	5.08	**321**	13	258	5	**591**	13.67
DRR5	4.35	1	5.08	**49**	13	63	5.08	**159**	13	112	5	**374**	13.67
DE9S	4.35	52	5.08	**122**	13	125	5.08	**163**	13	146	5	**217**	13.67
E9E16	4.35	39	6	**107**	13.75	116	5.75	**150**	13.67	138	5.75	**196**	14.5
E16	0.4	**120**	4.83	110	12.83	**220**	4.83	204	12.83	**269**	4.83	250	12.83
CPE16	4.75	38	6	**122**	13.5	141	5.5	**212**	13.25	191	5.17	**269**	12.92
E16E15	4.75	35	6.42	**120**	14	138	5.83	**209**	13.58	187	5.67	**259**	13.42
CPE15	12.37	180	6.17	**423**	14	536	7.25	**888**	15.08	742	7.17	**1078**	14.92
E15E24	12.37	66	7.58	**412**	15.58	421	7.5	**859**	15.5	624	7.67	**1046**	15.33
CPE24	14.73	69	5.33	**630**	15.58	559	6.25	**1224**	15.58	840	7.75	**1470**	15.42
E24E28	14.73	57	8.92	**600**	16.5	552	7.33	**1190**	16.5	821	8.75	**1427**	16.33
E23	0.11	**51**	4.5	46	12.5	**95**	4.5	85	12.5	**115**	4.5	104	12.5
E23E27	0.11	**23**	5.75	21	13.83	**51**	5.58	46	13.58	**66**	5.5	61	13.5
E27	0.47	**186**	4.83	173	12.83	**321**	4.83	299	12.83	**387**	4.83	356	12.83
CPE27	0.58	**178**	4.83	173	12.83	**312**	4.83	299	12.83	**377**	4.83	356	12.83
E27E28	0.58	**163**	5	160	13	**283**	5	272	13	**346**	5	329	13
E28	0.56	**257**	4.83	249	12.83	**426**	4.83	401	12.83	**503**	4.83	470	12.83
CPE28	15.87	176	4.92	**599**	16.5	549	7.33	**1190**	16.5	818	7	**1427**	16.33
E28E31	15.87	153	5.58	**591**	16.92	536	8	**1166**	17	791	7.5	**1400**	16.83
E25	0.93	523	4.58	**529**	12.58	**834**	4.58	824	12.5	**984**	4.5	965	12.5
RETE25	0.93	523	4.58	**529**	12.58	**834**	4.58	824	12.5	**984**	4.5	965	12.5
DIVE25	0.93	0	0	0	0	0	0	0	0	0	0	0	0
E25E29	0.93	0	0	0	0	0	0	0	0	0	0	0	0

East Mesa Area Drainage Master Plan Update

Existing Conditions 100 Year 6 Hour HEC-1 Schematic

HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

APPENDIX C

PRELIMINARY HYDROLOGIC CALCULATIONS AND ELECTRONIC DATA FILES (CD)

HEC-1/DDMSW ANALYSIS

Major Basin ID	Type	Area		2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
Major Basin 01									
E23	Hydrograph	0.1100	Flow (cfs)						115
			Volume (Inches)						0.936
			Volume (Ac-Ft)						5.64
			Ac-Ft/Sq Mi						51.27
			Time to Peak (Hrs)						4.50
E23E27	Routed	0.1100	Flow (cfs)						33
			Volume (Inches)						0.936
			Volume (Ac-Ft)						5.64
			Ac-Ft/Sq Mi						51.27
			Time to Peak (Hrs)						4.83
E27	Hydrograph	0.0900	Flow (cfs)						103
			Volume (Inches)						1.236
			Volume (Ac-Ft)						5.93
			Ac-Ft/Sq Mi						65.89
			Time to Peak (Hrs)						4.50
CPE27	Combined	0.2000	Flow (cfs)						123
			Volume (Inches)						1.068
			Volume (Ac-Ft)						11.56
			Ac-Ft/Sq Mi						57.80
			Time to Peak (Hrs)						4.58
E27.1	Hydrograph	0.0500	Flow (cfs)						51
			Volume (Inches)						1.107
			Volume (Ac-Ft)						3.01
			Ac-Ft/Sq Mi						60.20
			Time to Peak (Hrs)						4.58

Area ID	Sub Basin Parameters Area (sq mi)	Length (mi)	Slope (ft/mi)	S-Graph	Lca (mi)	Lag (min)	Velocity (f/s)	Kn	Rainfall Losses IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)

Major Basin ID: 01

Area ID	Area (sq mi)	Length (mi)	Slope (ft/mi)	S-Graph	Lca (mi)	Lag (min)	Velocity (f/s)	Kn	IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)
E23	0.113	0.67	22.4	VALLEY	0.33	31.40	1.87	0.070	0.35	0.35	4.72	0.315	
E27	0.090	0.49	18.4	VALLEY	0.68	34.30	1.25	0.063	0.33	0.30	6.34	0.165	4
E27.1	0.051	0.49	18.4	VALLEY	0.68	38.10	1.13	0.070	0.35	0.39	6.16	0.164	

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetation Cover (%)	DTHETA	Kn		Description
Major Basin ID: 01										
E23	900	0.1132	100.0	0.35	0	25.0	DRY	0.070	*	Vacant (Existing land use database only)
		0.1132	**100.0**							
E27	120	0.0222	24.6	0.30	5	30.0	NORMAL	0.060	*	Estate Residential (1/5 du per acre to 1 du per acre)
	130	0.0191	21.1	0.30	15	50.0	NORMAL	0.050	*	Large Lot Residential - Single Family (1-2 du per acre)
	900	0.0491	54.3	0.35	0	25.0	DRY	0.070	*	Vacant (Existing land use database only)
		0.0904	**100.0**							
E27.1	900	0.0509	100.0	0.35	0	25.0	DRY	0.070	*	Vacant (Existing land use database only)
		0.0509	**100.0**							

Area ID	Book Number	Map Unit	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)	Comments
Major Basin ID: 01									
E23	645	1	6451	0.012	10.60	0.410	-	100	
	645	22	64522	0.015	13.40	0.040	-	100	
	645	77	64577	0.001	1.20	0.050	-	100	
	645	78	64578	0.003	2.50	0.050	-	100	
	645	112	645112	0.082	72.20	0.390	-	100	
E27	645	77	64577	0.031	33.80	0.050	-	100	
	645	78	64578	0.017	18.90	0.050	-	100	
	645	112	645112	0.043	47.30	0.390	-	100	
E27.1	645	77	64577	0.025	49.90	0.050	-	100	
	645	112	645112	0.026	50.10	0.390	-	100	

Route ID	LOB N	Chan N	ROB N	Length (ft)	Slope (ft/ft)	Max Elev (ft)		1.	2.	3.	4.	5.	6.	7.	8.
NORMAL DEPTH															
Major Basin 01															
E23E27	0.045	0.040	0.045	6,329.70	0.0037	6.00	X:	-	500.00	950.00	1,003.00	1,007.00	1,061.00	1,511.00	2,011.00
							Y:	6.00	3.00	2.00	1.00	1.00	2.00	3.00	6.00

RAINFALL DATA
Project Reference: EMADMPU6_20110518

ID	Method	Duration	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
DEFAULT	NOAA14	5 MIN	0.251	0.340	0.408	0.500	0.572	0.645
	NOAA14	10 MIN	0.383	0.518	0.621	0.762	0.871	0.981
	NOAA14	15 MIN	0.474	0.642	0.770	0.944	1.079	1.216
	NOAA14	30 MIN	0.639	0.865	1.037	1.272	1.453	1.638
	NOAA14	1 HOUR	0.791	1.070	1.283	1.574	1.799	2.027
	NOAA14	2 HOUR	0.897	1.193	1.422	1.731	1.971	2.219
	NOAA14	3 HOUR	0.944	1.239	1.472	1.797	2.055	2.324
	NOAA14	6 HOUR	1.126	1.438	1.686	2.025	2.293	2.572
	NOAA14	12 HOUR	1.278	1.611	1.874	2.231	2.505	2.785
	NOAA14	24 HOUR	1.547	1.982	2.330	2.809	3.184	3.579

```
1*****************************************                                                           ***************************************
 *                                       *                                                           *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                           *   U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998               *                                                           *   HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                 *                                                           *        609 SECOND STREET            *
 *                                       *                                                           *     DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   27FEB19  TIME  14:13:48   *                                                           *         (916) 756-1104              *
 *                                       *                                                           *                                     *
 *****************************************                                                           ***************************************


                                 X     X  XXXXXXX   XXXXX          X
                                 X     X  X        X     X        XX
                                 X     X  X        X               X
                                 XXXXXXX  XXXX     X       XXXXX   X
                                 X     X  X        X               X
                                 X     X  X        X     X         X
                                 X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   1           ID        Flood Control District of Maricopa County
   2           ID        EMADMPU6_20110518 - EMADMPU6 20110518
   3           ID        100 YEAR
   4           ID        6 Hour  Storm
   5           ID        Unit Hydrograph: S-Graph
   6           ID        Storm: Multiple
   7           ID        02/27/2019
               *DIAGRAM
   8           IT      5  1JAN99       0    2000
   9           IO      5
  10           IN     15
               *
  11           JD  2.572  0.0001
  12           PC  0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
  13           PC  0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
  14           PC  0.962   0.972   0.983   0.991   1.000
  15           JD  2.557  0.5000
  16           PC  0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
  17           PC  0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
  18           PC  0.962   0.972   0.983   0.991   1.000
               *
               *

  19           KK    E23   BASIN
  20           KM
  21           BA  0.113
  22           LG   0.35    0.35    4.72    0.32       0
  23           UI      0      12      28      56      72      91     136     134     101      79
  24           UI     61      38      21      17      12       4       4       4       4       0
  25           UI      0       0       0       0       0       0       0       0       0       0
  26           UI      0       0       0       0       0       0       0       0       0       0
  27           UI      0       0       0       0       0       0       0       0       0       0
               *

  28           KK  E23E27   ROUTE
  29           KM
  30           RS      1    FLOW
  31           RC  0.045   0.040   0.045    6330  0.0037    6.00
  32           RX   0.00  500.00  950.00 1003.00 1007.00 1061.00 1511.00 2011.00
  33           RY   6.00    3.00    2.00    1.00    1.00    2.00    3.00    6.00
               *

  34           KK    E27   BASIN
  35           KM
  36           BA  0.090
  37           LG   0.33    0.30    6.34    0.17       4
  38           UI      0       9      17      38      49      61      80     110      86      69
  39           UI     55      43      28      15      13       9       5       3       3       3
  40           UI      3       0       0       0       0       0       0       0       0       0
  41           UI      0       0       0       0       0       0       0       0       0       0
  42           UI      0       0       0       0       0       0       0       0       0       0
               *
```



```
 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


  43           KK   CPE27 COMBINE
  44           KM
  45           HC      2
               *

  46           KK   E27.1   BASIN
  47           BA  0.051
  48           LG   0.35    0.39    6.16    0.16       0
  49           UI      0       5       7      17      23      28      34      47      55      42
  50           UI     35      28      23      16       9       8       5       5       2       1
  51           UI      1       1       1       0       0       0       0       0       0       0
  52           UI      0       0       0       0       0       0       0       0       0       0
  53           UI      0       0       0       0       0       0       0       0       0       0
```

```
                              *
            54           ZZ
1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    19         E23
                 V
                 V
    28      E23E27
                 .
                 .
    34           .         E27
                 .           .
                 .           .
    43       CPE27...........
                 .
                 .
    46           .       E27.1

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************                                                  ****************************************
 *                                       *                                                  *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                  *    U.S. ARMY CORPS OF ENGINEERS      *
 *             JUN   1998                *                                                  *    HYDROLOGIC ENGINEERING CENTER     *
 *          VERSION 4.1                  *                                                  *          609 SECOND STREET           *
 *                                       *                                                  *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   27FEB19  TIME  14:13:48   *                                                  *           (916) 756-1104             *
 *                                       *                                                  *                                      *
 ****************************************                                                  ****************************************



                                    Flood Control District of Maricopa County
                                    EMADMPU6_20110518 - EMADMPU6 20110518
                                    100 YEAR
                                    6 Hour  Storm
                                    Unit Hydrograph: S-Graph
                                    Storm: Multiple
                                    02/27/2019

    9 IO          OUTPUT CONTROL VARIABLES
                        IPRNT          5  PRINT CONTROL
                        IPLOT          0  PLOT CONTROL
                        QSCAL         0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                         NMIN          5  MINUTES IN COMPUTATION INTERVAL
                        IDATE     1JAN99  STARTING DATE
                        ITIME       0000  STARTING TIME
                           NQ       2000  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE     7JAN99  ENDING DATE
                       NDTIME       2235  ENDING TIME
                        ICENT         19  CENTURY MARK

                    COMPUTATION INTERVAL    0.08 HOURS
                         TOTAL TIME BASE  166.58 HOURS

           ENGLISH UNITS
                DRAINAGE AREA         SQUARE MILES
                PRECIPITATION DEPTH   INCHES
                LENGTH, ELEVATION     FEET
                FLOW                  CUBIC FEET PER SECOND
                STORAGE VOLUME        ACRE-FEET
                SURFACE AREA          ACRES
                TEMPERATURE           DEGREES FAHRENHEIT

   11 JD          INDEX STORM NO. 1
                         STRM       2.57  PRECIPITATION DEPTH
                         TRDA       0.00  TRANSPOSITION DRAINAGE AREA

   12 PI            PRECIPITATION PATTERN
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.01      0.01      0.01      0.01      0.01      0.01      0.03
                       0.03      0.03      0.05      0.05      0.05      0.15      0.15      0.15      0.03      0.03
                       0.03      0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00

   15 JD          INDEX STORM NO. 2
                         STRM       2.56  PRECIPITATION DEPTH
                         TRDA       0.50  TRANSPOSITION DRAINAGE AREA

   16 PI            PRECIPITATION PATTERN
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00      0.00      0.01      0.01      0.01      0.01      0.01      0.01      0.03
                       0.03      0.03      0.05      0.05      0.05      0.15      0.15      0.15      0.03      0.03
                       0.03      0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00
                       0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                       0.00      0.00
1
                                                               RUNOFF SUMMARY
                                                        FLOW IN CUBIC FEET PER SECOND
                                                     TIME IN HOURS,  AREA IN SQUARE MILES

                                          PEAK    TIME OF      AVERAGE FLOW FOR MAXIMUM PERIOD       BASIN      MAXIMUM      TIME OF
            OPERATION       STATION       FLOW     PEAK                                               AREA       STAGE      MAX STAGE
+                                                               6-HOUR      24-HOUR      72-HOUR
```

```
          HYDROGRAPH AT
+                             E23       115.    4.50          11.          3.          1.       0.11

          ROUTED TO
+                          E23E27        33.    4.83          11.          3.          1.       0.11

          HYDROGRAPH AT
+                             E27       103.    4.50          12.          3.          1.       0.09

          2 COMBINED AT
+                           CPE27       123.    4.58          22.          6.          2.       0.20

          HYDROGRAPH AT
+                           E27.1        51.    4.58           6.          2.          1.       0.05


 *** NORMAL END OF HEC-1 ***
```

NOAA 14 REPORT

NOAA Atlas 14, Volume 1, Version 5
Location name: Queen Creek, Arizona, USA*
Latitude: 33.3041°, Longitude: -111.6121°
Elevation: 1413.45 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**	**1000**
5-min	**0.192** (0.162-0.233)	**0.251** (0.213-0.306)	**0.339** (0.285-0.411)	**0.406** (0.339-0.491)	**0.498** (0.409-0.600)	**0.570** (0.462-0.683)	**0.642** (0.511-0.769)	**0.715** (0.559-0.855)	**0.814** (0.620-0.975)	**0.889** (0.664-1.07)
10-min	**0.292** (0.247-0.355)	**0.381** (0.324-0.465)	**0.516** (0.434-0.626)	**0.619** (0.516-0.747)	**0.758** (0.622-0.913)	**0.867** (0.703-1.04)	**0.977** (0.777-1.17)	**1.09** (0.851-1.30)	**1.24** (0.944-1.48)	**1.35** (1.01-1.63)
15-min	**0.362** (0.306-0.440)	**0.473** (0.402-0.576)	**0.640** (0.538-0.776)	**0.767** (0.640-0.927)	**0.940** (0.771-1.13)	**1.08** (0.871-1.29)	**1.21** (0.964-1.45)	**1.35** (1.06-1.61)	**1.54** (1.17-1.84)	**1.68** (1.25-2.02)
30-min	**0.487** (0.411-0.593)	**0.637** (0.541-0.776)	**0.862** (0.724-1.05)	**1.03** (0.861-1.25)	**1.27** (1.04-1.52)	**1.45** (1.17-1.74)	**1.63** (1.30-1.95)	**1.82** (1.42-2.17)	**2.07** (1.58-2.48)	**2.26** (1.69-2.71)
60-min	**0.603** (0.509-0.734)	**0.788** (0.669-0.961)	**1.07** (0.896-1.29)	**1.28** (1.07-1.54)	**1.57** (1.29-1.89)	**1.79** (1.45-2.15)	**2.02** (1.61-2.42)	**2.25** (1.76-2.69)	**2.56** (1.95-3.07)	**2.80** (2.09-3.36)
2-hr	**0.691** (0.585-0.827)	**0.897** (0.762-1.08)	**1.19** (1.00-1.43)	**1.42** (1.19-1.70)	**1.73** (1.43-2.05)	**1.97** (1.60-2.34)	**2.21** (1.77-2.62)	**2.46** (1.94-2.91)	**2.80** (2.14-3.30)	**3.06** (2.30-3.63)
3-hr	**0.737** (0.626-0.891)	**0.943** (0.803-1.14)	**1.24** (1.05-1.50)	**1.47** (1.23-1.77)	**1.80** (1.48-2.15)	**2.05** (1.67-2.45)	**2.32** (1.85-2.76)	**2.60** (2.04-3.09)	**2.99** (2.28-3.56)	**3.31** (2.45-3.94)
6-hr	**0.892** (0.770-1.05)	**1.13** (0.976-1.33)	**1.44** (1.24-1.69)	**1.69** (1.45-1.98)	**2.03** (1.71-2.36)	**2.30** (1.91-2.67)	**2.58** (2.10-2.99)	**2.86** (2.30-3.31)	**3.25** (2.54-3.77)	**3.56** (2.72-4.14)
12-hr	**1.01** (0.889-1.16)	**1.28** (1.12-1.46)	**1.61** (1.41-1.83)	**1.87** (1.63-2.13)	**2.23** (1.92-2.52)	**2.50** (2.13-2.82)	**2.78** (2.33-3.14)	**3.06** (2.53-3.47)	**3.44** (2.78-3.92)	**3.74** (2.96-4.28)
24-hr	**1.22** (1.09-1.38)	**1.54** (1.38-1.74)	**1.97** (1.75-2.22)	**2.31** (2.05-2.60)	**2.79** (2.45-3.13)	**3.16** (2.75-3.55)	**3.55** (3.06-3.99)	**3.95** (3.36-4.45)	**4.51** (3.76-5.09)	**4.95** (4.07-5.61)
2-day	**1.27** (1.14-1.43)	**1.61** (1.44-1.82)	**2.09** (1.86-2.35)	**2.46** (2.19-2.77)	**2.98** (2.63-3.34)	**3.39** (2.96-3.79)	**3.81** (3.29-4.26)	**4.25** (3.63-4.76)	**4.85** (4.06-5.46)	**5.33** (4.39-6.03)
3-day	**1.36** (1.23-1.51)	**1.73** (1.57-1.93)	**2.26** (2.04-2.50)	**2.68** (2.40-2.97)	**3.26** (2.92-3.61)	**3.73** (3.31-4.13)	**4.23** (3.71-4.68)	**4.75** (4.12-5.26)	**5.47** (4.68-6.08)	**6.05** (5.11-6.76)
4-day	**1.45** (1.33-1.60)	**1.85** (1.69-2.04)	**2.42** (2.21-2.66)	**2.89** (2.62-3.17)	**3.55** (3.20-3.88)	**4.08** (3.66-4.47)	**4.64** (4.14-5.09)	**5.24** (4.62-5.76)	**6.09** (5.29-6.71)	**6.78** (5.83-7.50)
7-day	**1.60** (1.47-1.76)	**2.04** (1.87-2.25)	**2.68** (2.44-2.94)	**3.20** (2.91-3.50)	**3.93** (3.55-4.30)	**4.52** (4.06-4.95)	**5.16** (4.59-5.65)	**5.83** (5.14-6.39)	**6.78** (5.89-7.46)	**7.55** (6.48-8.34)
10-day	**1.74** (1.60-1.91)	**2.22** (2.04-2.43)	**2.91** (2.66-3.18)	**3.47** (3.16-3.78)	**4.25** (3.86-4.63)	**4.88** (4.39-5.32)	**5.54** (4.96-6.04)	**6.24** (5.54-6.82)	**7.23** (6.32-7.92)	**8.02** (6.94-8.82)
20-day	**2.16** (1.97-2.37)	**2.77** (2.52-3.04)	**3.63** (3.31-3.98)	**4.29** (3.89-4.70)	**5.18** (4.69-5.67)	**5.86** (5.28-6.42)	**6.56** (5.87-7.19)	**7.26** (6.47-7.97)	**8.22** (7.25-9.05)	**8.95** (7.83-9.89)
30-day	**2.52** (2.31-2.76)	**3.23** (2.96-3.53)	**4.23** (3.87-4.62)	**4.99** (4.56-5.44)	**6.02** (5.47-6.56)	**6.81** (6.16-7.43)	**7.62** (6.86-8.33)	**8.44** (7.55-9.24)	**9.55** (8.46-10.5)	**10.4** (9.13-11.5)
45-day	**2.95** (2.70-3.23)	**3.79** (3.46-4.15)	**4.96** (4.52-5.42)	**5.82** (5.31-6.37)	**6.96** (6.32-7.61)	**7.82** (7.07-8.56)	**8.69** (7.82-9.51)	**9.55** (8.54-10.5)	**10.7** (9.47-11.7)	**11.5** (10.2-12.7)
60-day	**3.29** (3.01-3.60)	**4.23** (3.87-4.62)	**5.51** (5.04-6.02)	**6.45** (5.88-7.05)	**7.67** (6.98-8.38)	**8.58** (7.77-9.37)	**9.48** (8.56-10.4)	**10.4** (9.30-11.3)	**11.5** (10.3-12.6)	**12.4** (10.9-13.6)

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

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

Please refer to NOAA Atlas 14 document for more information.

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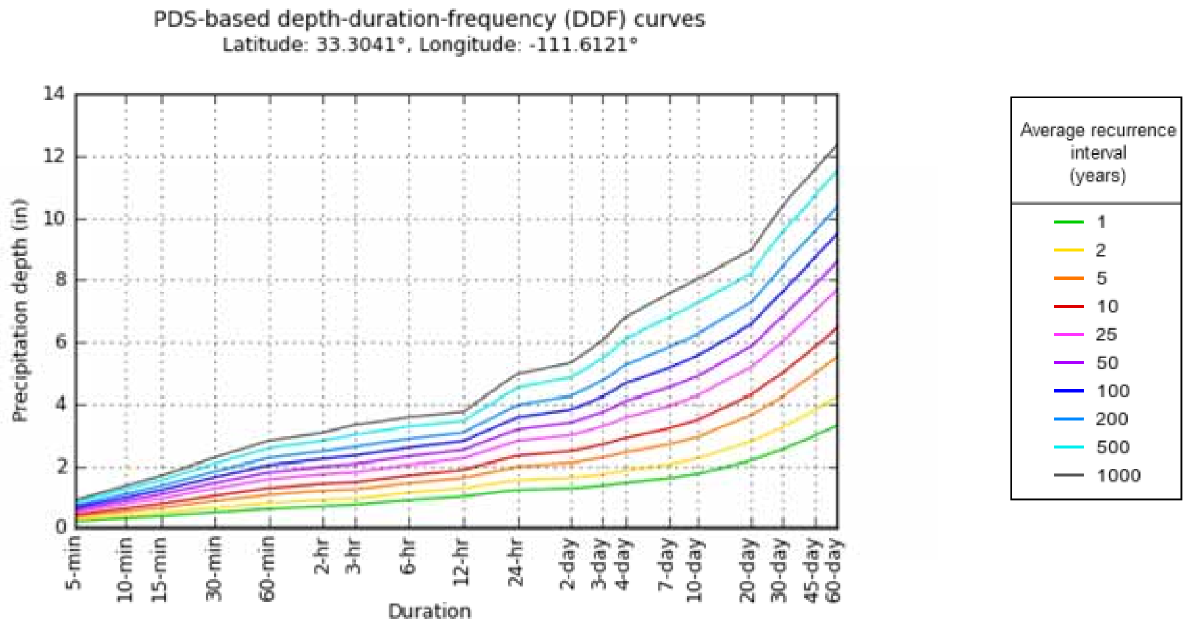
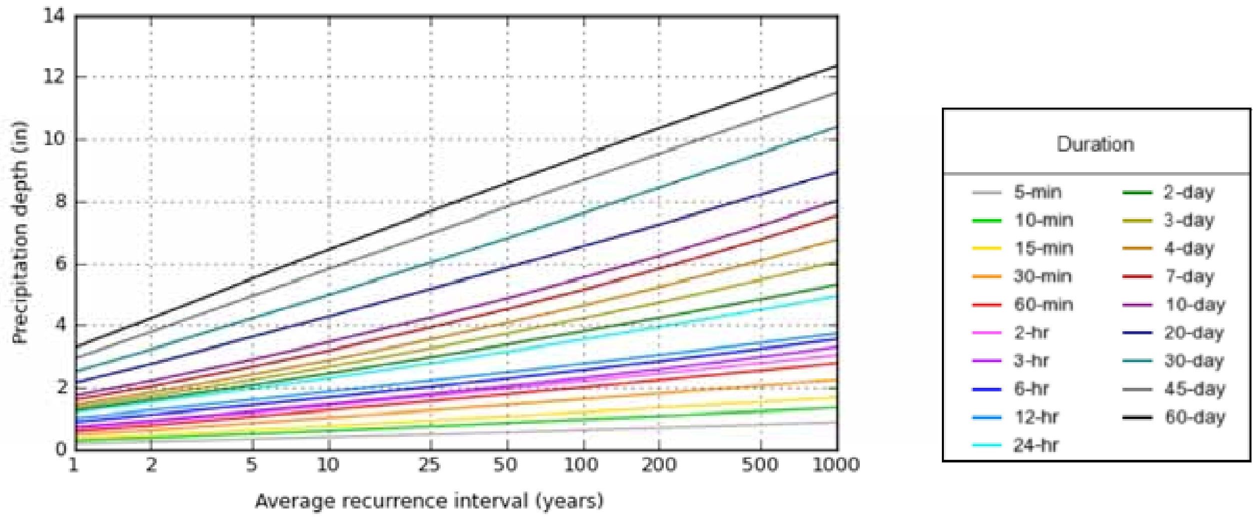
PF graphical





NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Thu Feb 21 22:08:32 2019

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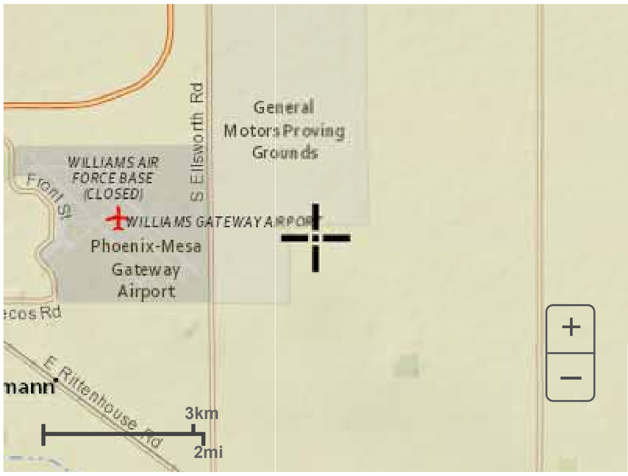
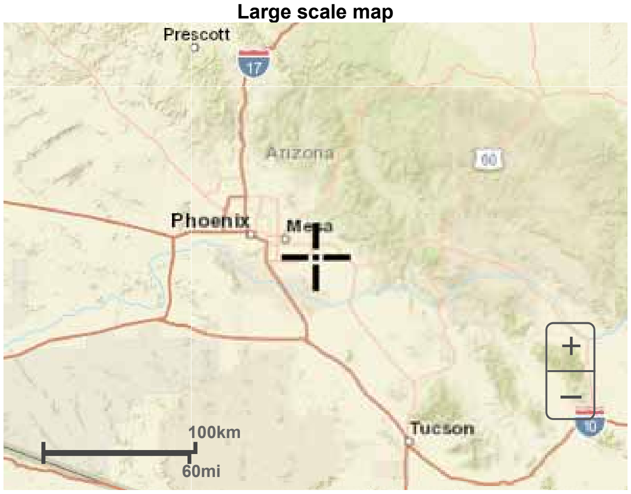
Maps & aerials

Small scale terrain



Large scale terrain

Large scale map



Large scale aerial

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National Oceanic and Atmospheric Administration
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Disclaimer

NRCS SOILS REPORT

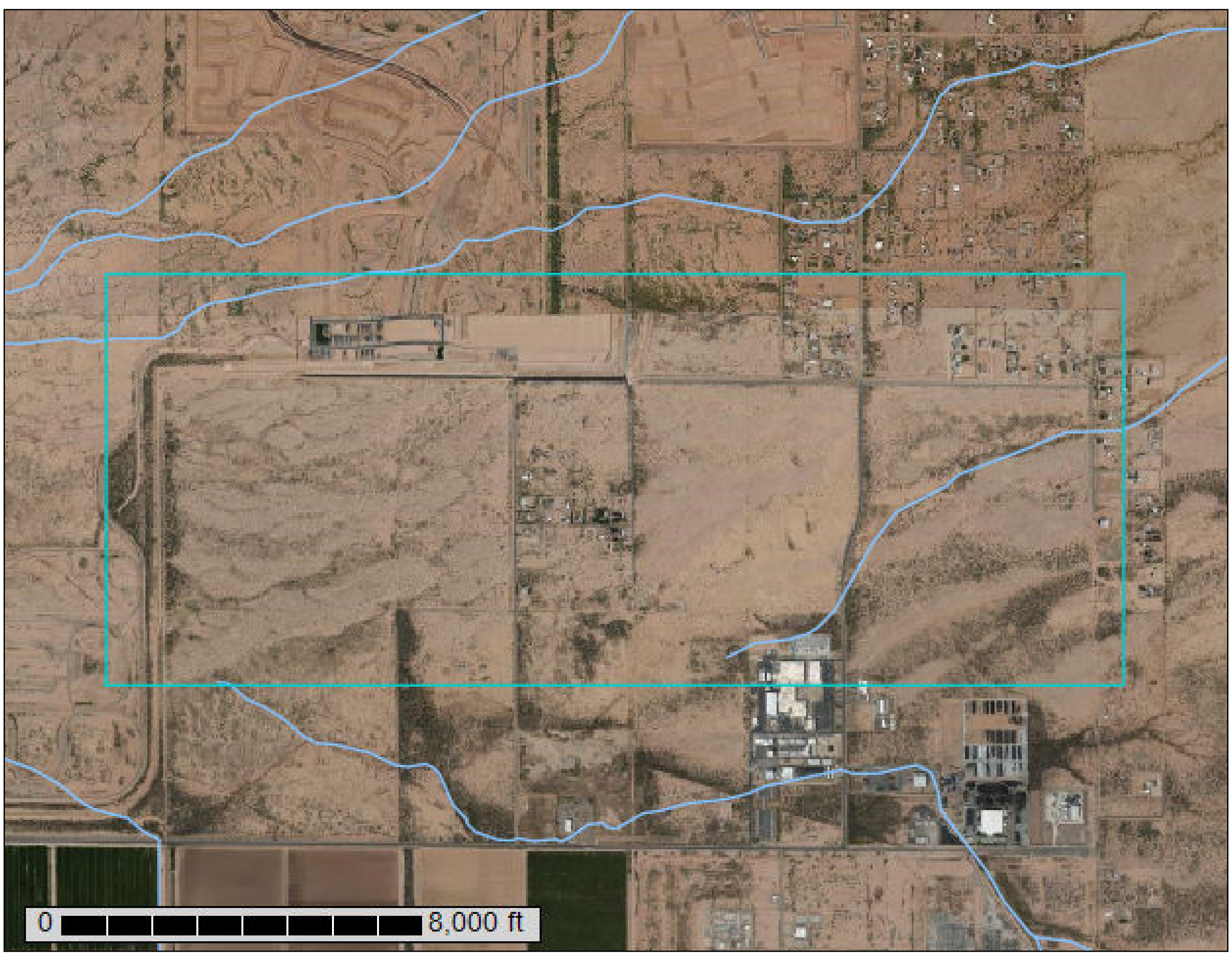
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Aguila-Carefree Area, Arizona, Parts of Maricopa and Pinal Counties; and Eastern Pinal and Southern Gila Counties, Arizona



February 18, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

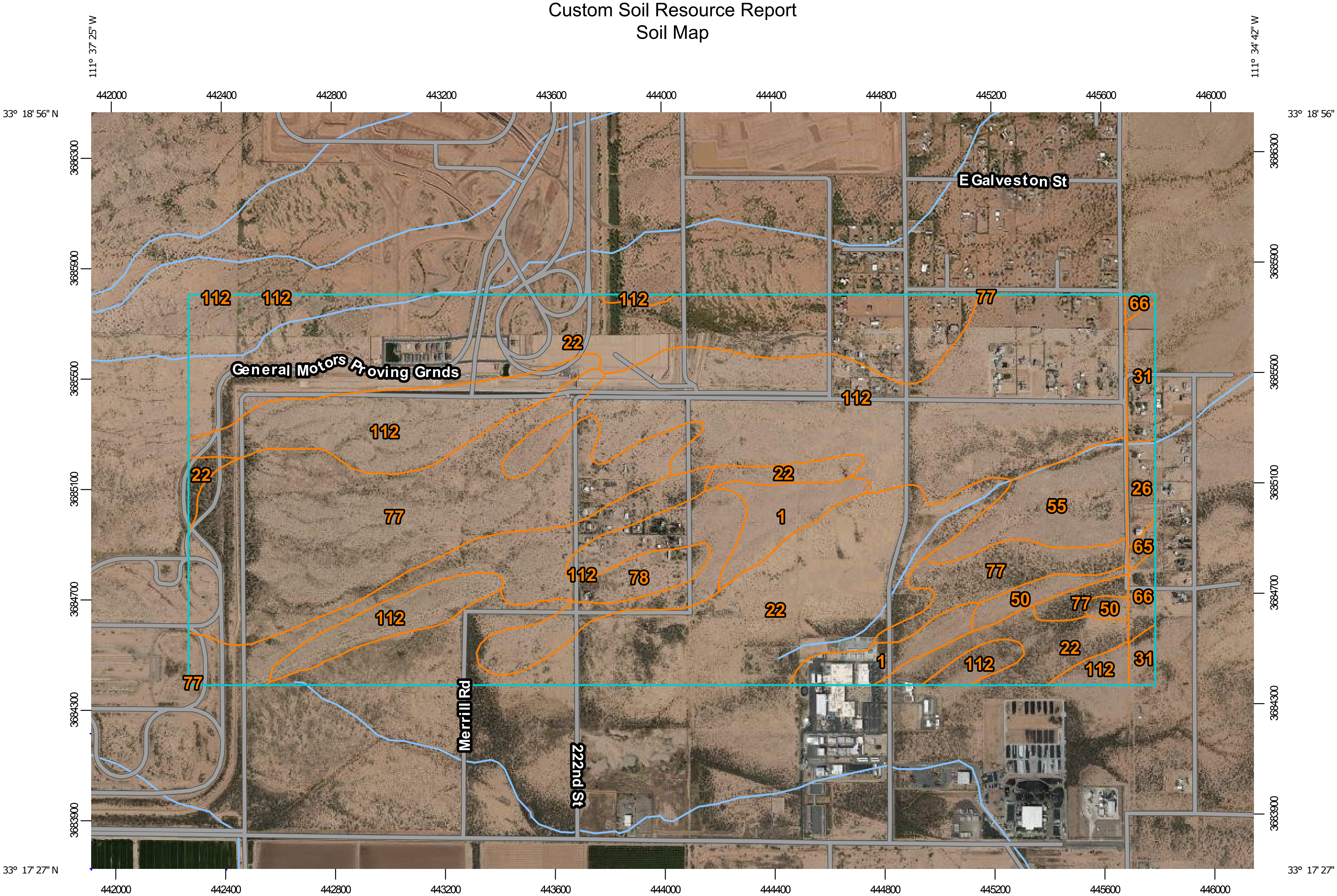
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Map Scale: 1:19,300 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 250, 500, 1000, 1500

Feet: 0, 500, 1000, 2000, 3000

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Aguila-Carefree Area, Arizona, Parts of Maricopa and Pinal Counties
Survey Area Data: Version 12, Sep 15, 2018

Soil Survey Area: Eastern Pinal and Southern Gila Counties, Arizona
Survey Area Data: Version 13, Sep 15, 2018

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 1, 2018—Jun 1, 2018

MAP LEGEND	MAP INFORMATION
	The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Antho sandy loams	39.8	3.2%
22	Contine clay loam	425.9	34.5%
50	Estrella loams	12.4	1.0%
55	Gilman loams	41.4	3.3%
77	Mohall clay loam	225.3	18.2%
78	Mohall clay loam, calcareous solum	73.7	6.0%
112	Tremant gravelly sandy loams	381.3	30.9%
Subtotals for Soil Survey Area		**1,199.8**	**97.1%**
Totals for Area of Interest		**1,235.5**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
26	Dateland loam, 0 to 2 percent slopes	8.5	0.7%
31	Denure sandy loam, 1 to 3 percent slopes	16.7	1.4%
65	Mohall clay loam, 0 to 5 percent slopes	2.4	0.2%
66	Mohall sandy loam, 0 to 3 percent slopes	8.1	0.7%
Subtotals for Soil Survey Area		**35.7**	**2.9%**
Totals for Area of Interest		**1,235.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

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APPENDIX D

PRELIMINARY HYDRAULIC CALCULATIONS

PRELIMINARY CHANNEL CALCULATIONS

CHANNEL PARAMETER SUMMARY

Project: Inner Loop

Prepared by: BB

Date: Feb, 2019

HILGARTWILSON

Channel ID	Model Q[1] [ft^3/sec]	Side Slopes [H:V]	Minimum Channel Bottom Width [ft]	Channel Top Width [ft]	Total Channel Depth [ft]	Manning's n[2]	Slope [%]	Velocity[3] [ft/sec]	Water Surface Depth[4] [ft]	Freeboard Provided[5] [ft]	Top Width of Flow [ft]	Cross-Sectional Area of Flow [ft^2]	Froude Number[6,7]
C-1	51	6:1	8	38	2.50	0.030	0.20	2.11	1.45	1.05	25.40	24.21	0.38
C-2	123	6:1	12	48	3.00	0.030	0.20	2.62	1.97	1.03	35.64	46.93	0.40

NOTES:

(1) Model Q is peak flow determined in DDMSW/HEC-1.

(2) Channels are currently modeled as having a composite channel lining that may consist of desert landscaping, turf, riprap or a combination thereof.

(3) Maximum allowable velocity of 5ft/sec from Table 6.2 of the Drainage Design Manual of Maricopa County, Hydraulics: Rational Method, Chapter 3 (August, 2013).

(4) Maximum flow depth of 3 ft from Section 1.4.3 of the Drainage Design Manual of Maricopa County, Hydraulics: Safety, Chapter 1 (August, 2013).

(5) Minimum 1 ft of freeboard required from Section 6.5.4 of the Drainage Design Manual of Maricopa County, Hydraulics: Feeboard, Chapter 6 (August, 2013).

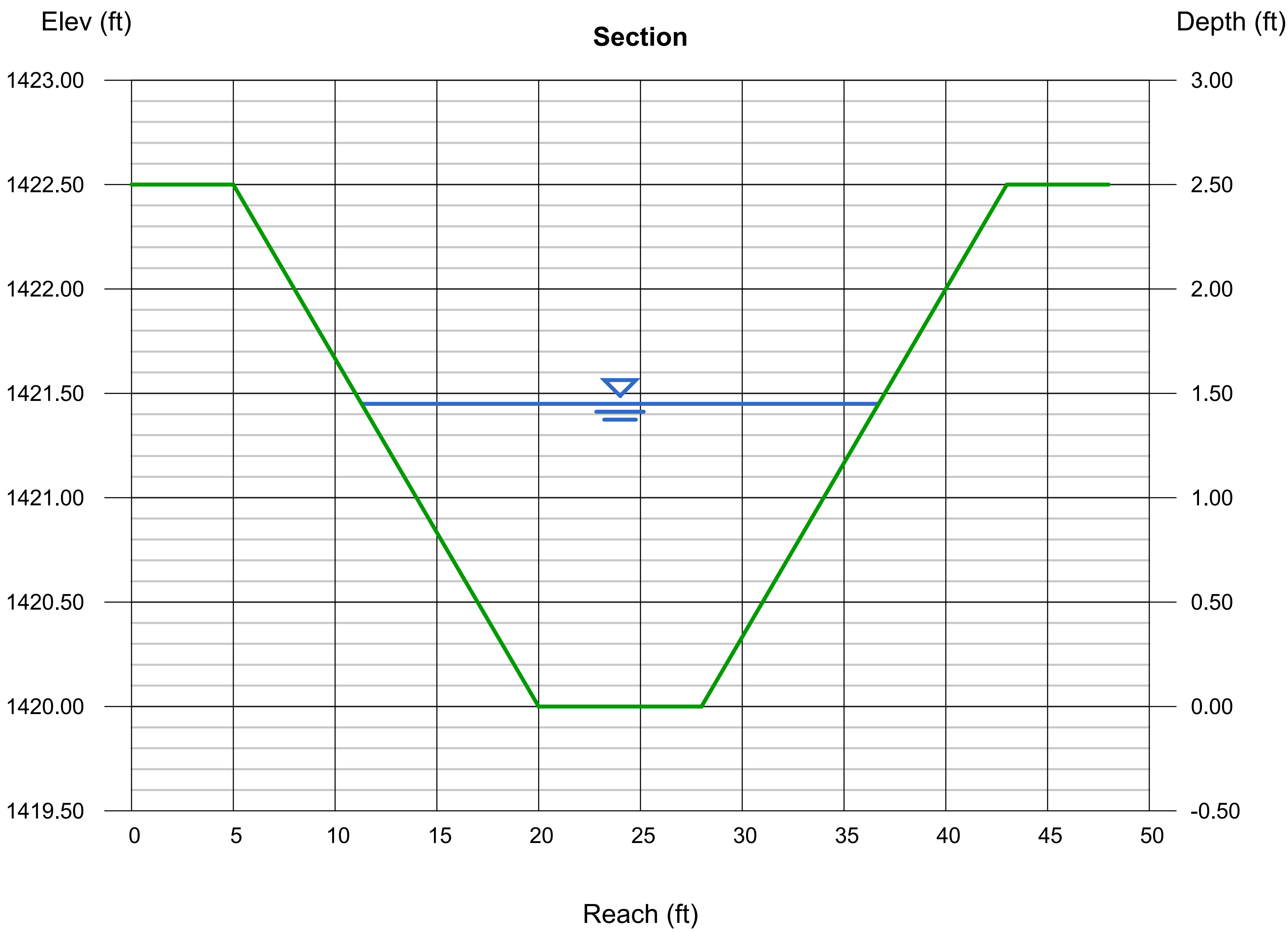
(6) $Fr=V/(g*D)^{0.5}$ where V=velocity, g=32.2 ft/s^2, and D=(Cross-sectional area)/(Top width)

(7) Fr<0.86 indicates subcritical flow and Fr>0.86 indicates supercritical flow

Channel Report

C-1 (Q = 51CFS)

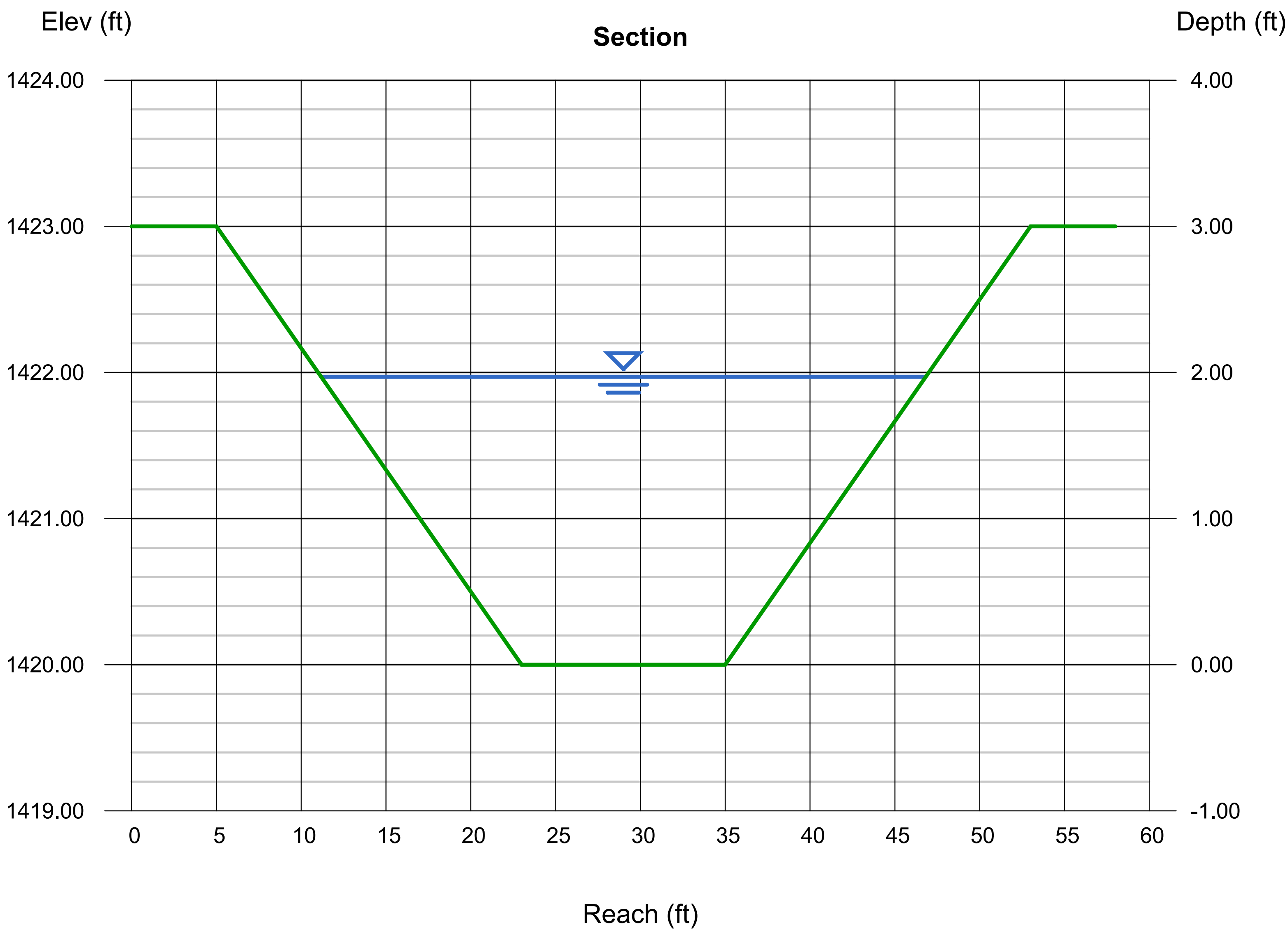
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 8.00	Depth (ft)	= 1.45
Side Slopes (z:1)	= 6.00, 6.00	Q (cfs)	= 51.00
Total Depth (ft)	= 2.50	Area (sqft)	= 24.21
Invert Elev (ft)	= 1420.00	Velocity (ft/s)	= 2.11
Slope (%)	= 0.20	Wetted Perim (ft)	= 25.64
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.87
		Top Width (ft)	= 25.40
Calculations		EGL (ft)	= 1.52
Compute by:	Known Q		
Known Q (cfs)	= 51.00		



Channel Report

C-2 (Q = 123CFS)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 12.00	Depth (ft)	= 1.97
Side Slopes (z:1)	= 6.00, 6.00	Q (cfs)	= 123.00
Total Depth (ft)	= 3.00	Area (sqft)	= 46.93
Invert Elev (ft)	= 1420.00	Velocity (ft/s)	= 2.62
Slope (%)	= 0.20	Wetted Perim (ft)	= 35.97
N-Value	= 0.030	Crit Depth, Yc (ft)	= 1.21
		Top Width (ft)	= 35.64
Calculations		EGL (ft)	= 2.08
Compute by:	Known Q		
Known Q (cfs)	= 123.00		



PRELIMINARY CULVERT CALCULATIONS

CULVERT SUMMARY

Project: Levine 170

Prepared by: BB

Date: Feb, 2019

HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

Culvert ID	Model Q[1] [cfs]	Quantity	Culvert Type
CU-1	51	4	24" RCPC
CU-2	123	4	36" RCPC

Notes:

(1) Model Q referneced from calculated HEC-1.

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Feb 27 2019

CU-1 (4-24IN RCPC)

Invert Elev Dn (ft)	=	1420.00
Pipe Length (ft)	=	100.00
Slope (%)	=	0.20
Invert Elev Up (ft)	=	1420.20
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	4
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

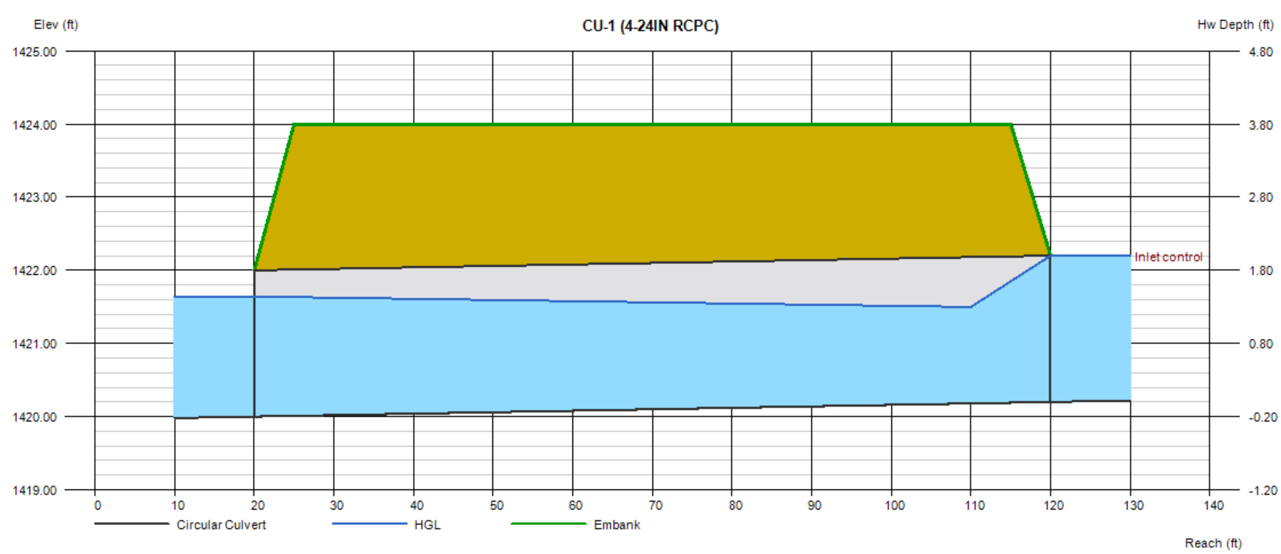
Top Elevation (ft)	=	1424.00
Top Width (ft)	=	90.00
Crest Width (ft)	=	90.00

Calculations

Qmin (cfs)	=	51.00
Qmax (cfs)	=	51.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	51.00
Qpipe (cfs)	=	51.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.62
Veloc Up (ft/s)	=	5.99
HGL Dn (ft)	=	1421.64
HGL Up (ft)	=	1421.48
Hw Elev (ft)	=	1422.20
Hw/D (ft)	=	1.00
Flow Regime	=	Inlet Control



Culvert Report

CU-2 (4-36IN RCPC)

Invert Elev Dn (ft)	=	1417.00
Pipe Length (ft)	=	100.00
Slope (%)	=	0.20
Invert Elev Up (ft)	=	1417.20
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	4
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

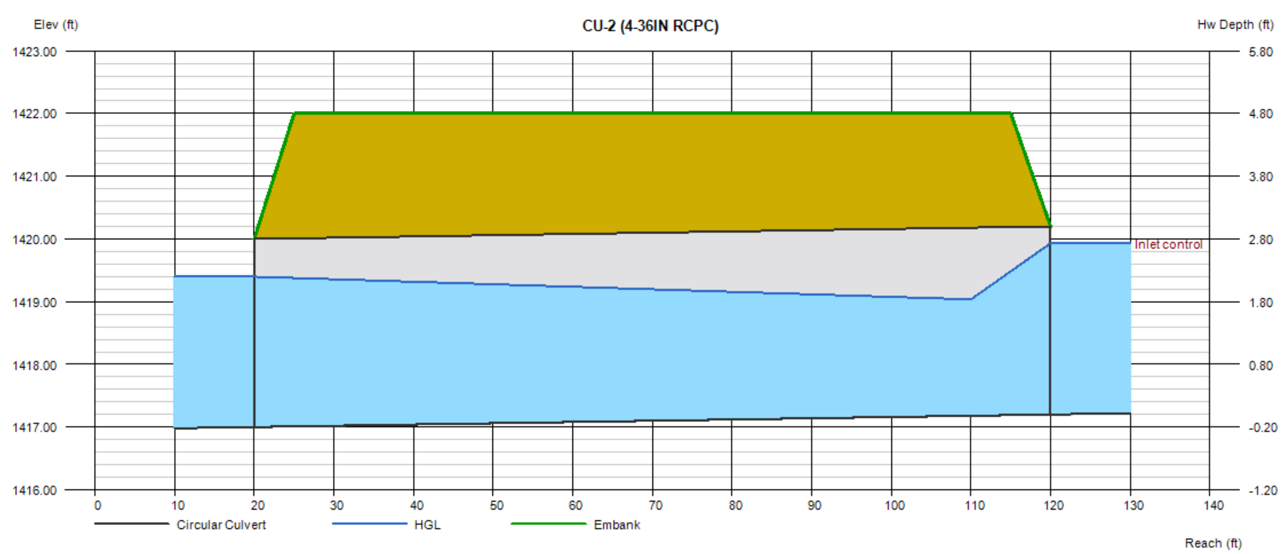
Top Elevation (ft)	=	1422.00
Top Width (ft)	=	90.00
Crest Width (ft)	=	90.00

Calculations

Qmin (cfs)	=	123.00
Qmax (cfs)	=	123.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	123.00
Qpipe (cfs)	=	123.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.08
Veloc Up (ft/s)	=	6.96
HGL Dn (ft)	=	1419.40
HGL Up (ft)	=	1419.00
Hw Elev (ft)	=	1419.93
Hw/D (ft)	=	0.91
Flow Regime	=	Inlet Control



APPENDIX E

PRELIMINARY RETENTION CALCULATIONS

Sub-Basin Hydraulic Parameters - Developed Conditions

Project: Levine 170

Prepared by: BB

Date: Feb, 2019

HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

Drainage Subarea ID(s)	Retention Basin	Land Use Category					Total Area	Total Area
		Medium Density Residential (LMDR)	Medium Density Residential (MDR)	High Density Residential (HDR)	Commercial	Park/Open Space		
		[ft^2]	[ft^2]	[ft^2]	[ft^2]	[ft^2]	[ft^2]	[ac]
ONSITE DRAINAGE AREAS								
A	RB-A	0	0	0	479,160	0	479,160	11.0
B	RB-B	0	0	304,920	0	0	304,920	7.0
C	RB-C	0	0	479,160	0	0	479,160	11.0
D	RB-D	0	588,060	0	0	0	588,060	13.5
E	RB-E	405,108	0	0	0	0	405,108	9.3
F	RB-F	453,024	0	0	0	0	453,024	10.4
G	RB-G	535,788	0	0	0	0	535,788	12.3
H	RB-H	383,328	0	0	0	0	383,328	8.8
I	RB-I	792,792	0	0	0	0	792,792	18.2
J	RB-J	601,128	0	0	0	0	601,128	13.8
K	RB-K	514,008	0	0	0	0	514,008	11.8
L	RB-L	487,872	0	0	0	0	487,872	11.2
M	RB-M	0	514,008	0	0	0	514,008	11.8
P1	RB-P1	0	0	0	0	108,900	108,900	2.5
P2	RB-P2	0	0	0	0	43,560	43,560	1.0
P3	RB-P3	0	0	0	0	39,204	39,204	0.9
P4	RB-P4	0	0	0	0	39,204	39,204	0.9
P5	RB-P5	0	0	0	0	39,204	39,204	0.9
P6	RB-P6	0	0	0	0	39,204	39,204	0.9
TOTAL		4,173,048	1,102,068	784,080	479,160	309,276	6,847,632	157.2

WEIGHTED RUNOFF COEFFICIENT CALCULATIONS

Project: Levine 170

Prepared by: BB

Date: Feb, 2019

Land Use[1]	Density (du/ac)	FCDMC Land Use Class	C Coefficient
Medium Density Residential (LMDR)	4-6	150	0.84
Medium Density Residential (MDR)	6-10	170	0.94
High Density Residential (HDR)	15+	190	0.94
Commercial	--	220	0.95
Park/Open Space	--	710	0.31

NOTES:

(1) From Table 6.3 of the FCDMC Drainage Policies and Standards, Arizona (January, 2016)

Drainage Subarea ID(s)	Concentration Point	Subarea Surface Types & Areas							Weighted C Coefficient
		Medium Density Residential (LMDR) [ft^2]	Medium Density Residential (MDR) [ft^2]	High Density Residential (HDR) [ft^2]	Commercial [ft^2]	Park/Open Space [ft^2]	Total [ft^2]	Total [ac]	C_w - 100 Year
ONSITE DRAINAGE AREAS									
A	RB-A	0	0	0	479,160	0	479,160	11.0	0.95
B	RB-B	0	0	304,920	0	0	304,920	7.0	0.94
C	RB-C	0	0	479,160	0	0	479,160	11.0	0.94
D	RB-D	0	588,060	0	0	0	588,060	13.5	0.94
E	RB-E	405,108	0	0	0	0	405,108	9.3	0.84
F	RB-F	453,024	0	0	0	0	453,024	10.4	0.84
G	RB-G	535,788	0	0	0	0	535,788	12.3	0.84
H	RB-H	383,328	0	0	0	0	383,328	8.8	0.84
I	RB-I	792,792	0	0	0	0	792,792	18.2	0.84
J	RB-J	601,128	0	0	0	0	601,128	13.8	0.84
K	RB-K	514,008	0	0	0	0	514,008	11.8	0.84
L	RB-L	487,872	0	0	0	0	487,872	11.2	0.84
M	RB-M	0	514,008	0	0	0	514,008	11.8	0.94
P1	RB-P1	0	0	0	0	108,900	108,900	2.5	0.31
P2	RB-P2	0	0	0	0	43,560	43,560	1.0	0.31
P3	RB-P3	0	0	0	0	39,204	39,204	0.9	0.31
P4	RB-P4	0	0	0	0	39,204	39,204	0.9	0.31
P5	RB-P5	0	0	0	0	39,204	39,204	0.9	0.31
P6	RB-P6	0	0	0	0	39,204	39,204	0.9	0.31
TOTAL		**4,173,048**	**1,102,068**	**784,080**	**479,160**	**309,276**	**6,847,632**	**157.2**	--

RETENTION CALCULATION TABLE

Project: Levine 170

Prepared by: BB

Date: Feb, 2019

HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

Volume Required = C * (P/ 12) * A   Where: A= Plan-view area of an individual drainage area

Cw=Weighted Runoff Coefficient (100-Yr)

P=2.21 in (100-Yr, 2-Hr)

Retention Basin ID	Drainage Area(s)	Total Area A [ft^2]	Total Area A [ac]	Weighted Runoff "C" Coefficient	100-Yr, 2-Hr Volume Required [ft^3]	100-Yr, 2-Hr Volume Required [ac-ft]
RB-A	A	479,160	11.0	0.95	83,833	1.9
RB-B	B	304,920	7.0	0.94	52,787	1.2
RB-C	C	479,160	11.0	0.94	82,951	1.9
RB-D	D	588,060	13.5	0.94	101,803	2.3
RB-E	E	405,108	9.3	0.84	62,670	1.4
RB-F	F	453,024	10.4	0.84	70,083	1.6
RB-G	G	535,788	12.3	0.84	82,886	1.9
RB-H	H	383,328	8.8	0.84	59,301	1.4
RB-I	I	792,792	18.2	0.84	122,645	2.8
RB-J	J	601,128	13.8	0.84	92,995	2.1
RB-K	K	514,008	11.8	0.84	79,517	1.8
RB-L	L	487,872	11.2	0.84	75,474	1.7
RB-M	M	514,008	11.8	0.94	88,983	2.0
RB-P1	P1	108,900	2.5	0.31	6,217	0.1
RB-P2	P2	43,560	1.0	0.31	2,487	0.1
RB-P3	P3	39,204	0.9	0.31	2,238	0.1
RB-P4	P4	39,204	0.9	0.31	2,238	0.1
RB-P5	P5	39,204	0.9	0.31	2,238	0.1
RB-P6	P6	39,204	0.9	0.31	2,238	0.1
TOTAL		6,847,632	157.2	--	1,073,584	24.6