HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

MASTER WASTEWATER REPORT

FOR

LEVINE GENERAL MOTORS 170

MESA, ARIZONA

Prepared For:
Pacific Proving LLC.
C/O Beus Gilbert
2201 E Camelback Road, Suite 650
Phoenix, AZ 85016

Prepared By:
HILGARTWILSON, LLC
2141 East Highland Avenue, Suite 250
Phoenix, AZ 85016
Phone: (602) 490-0535
Fax: (602) 368-2436

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

TABLE OF CONTENTS

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

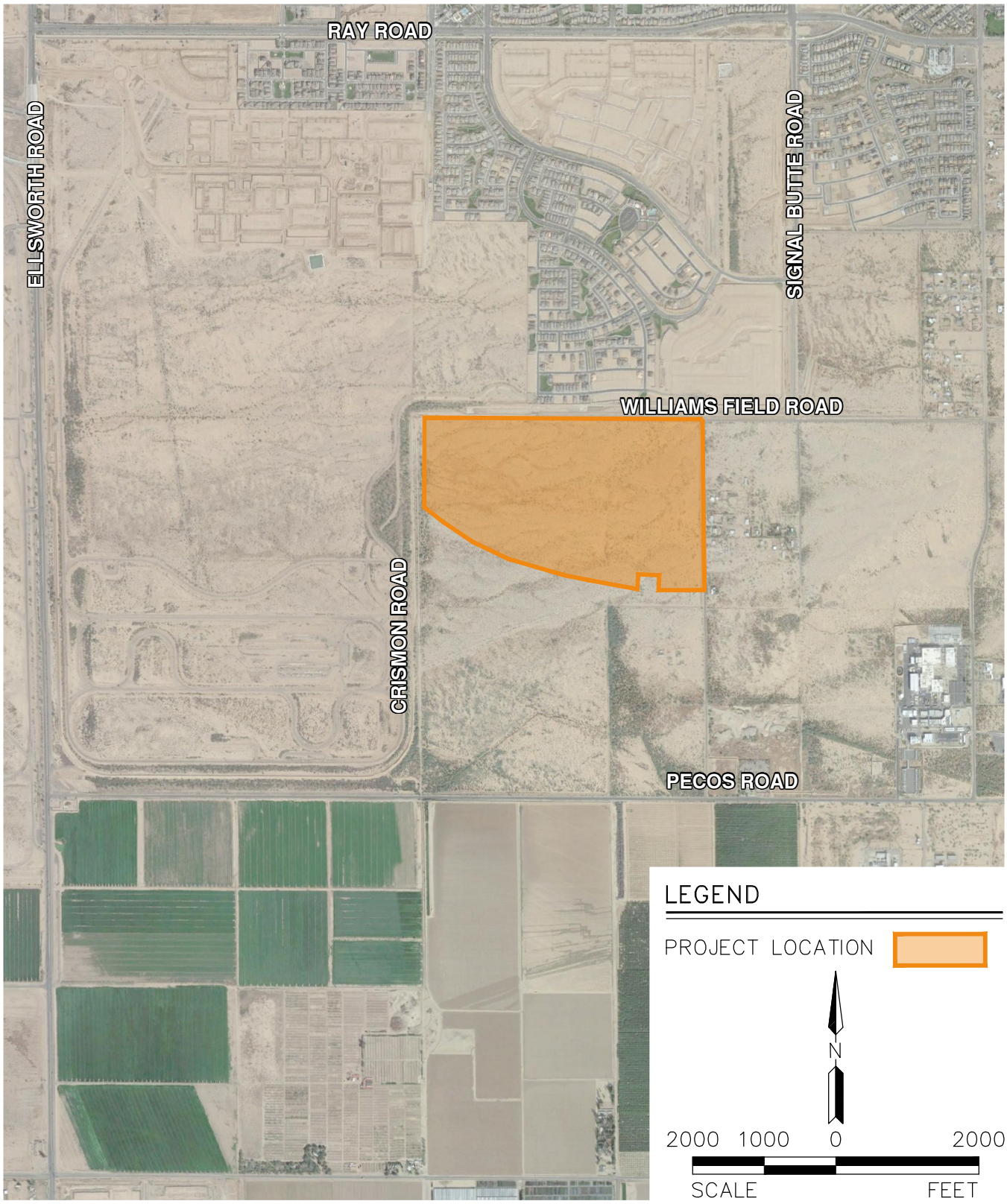
City of Mesa. (2016). *Mesa 2040 General Plan*. 2016, Mesa, AZ

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

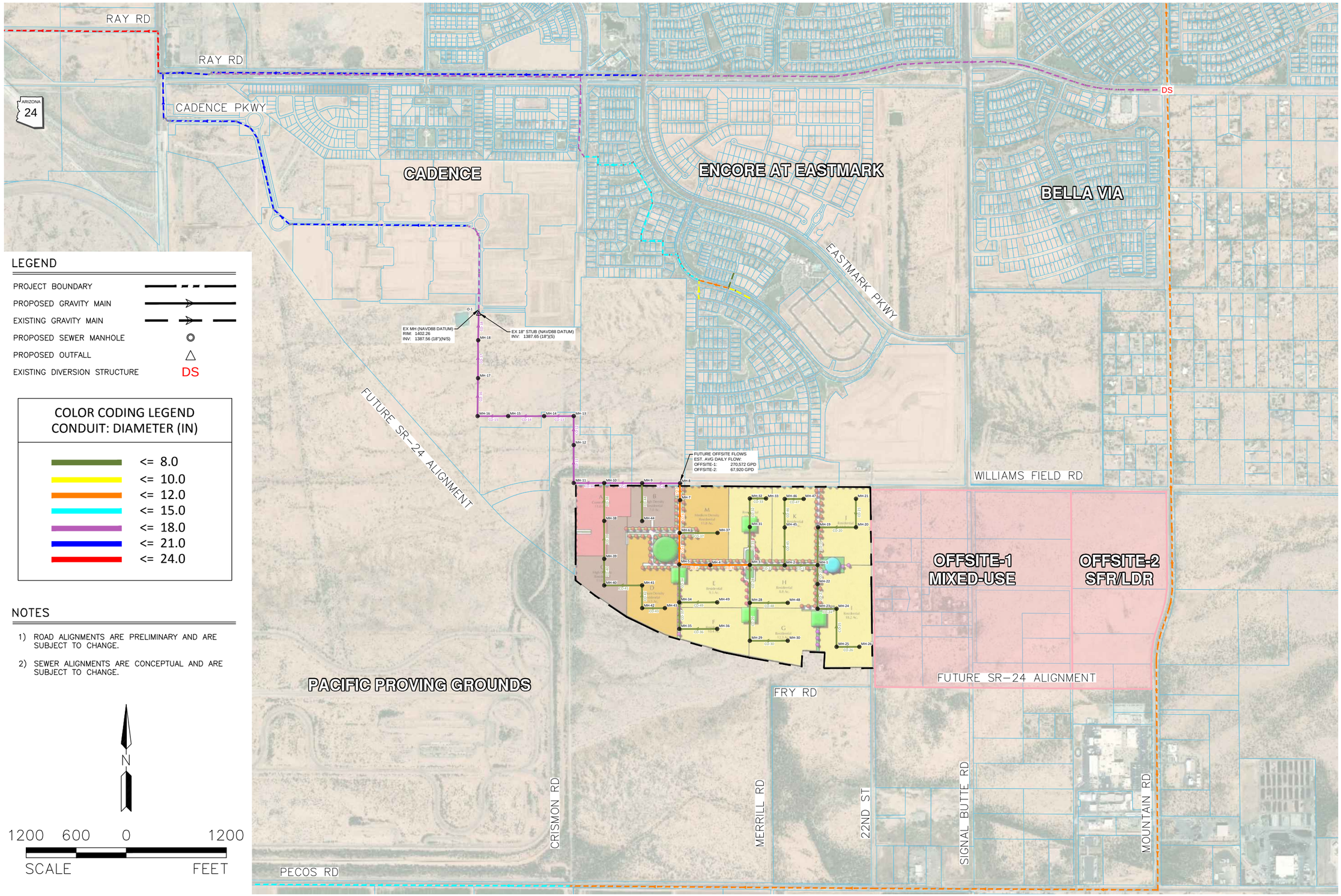
LEVINE GM 170

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



LEGEND

- PROJECT BOUNDARY
- PROPOSED GRAVITY MAIN
- EXISTING GRAVITY MAIN
- PROPOSED SEWER MANHOLE
- PROPOSED OUTFALL
- EXISTING DIVERSION STRUCTURE — DS

COLOR CODING LEGEND CONDUIT: DIAMETER (IN)
<= 8.0
<= 10.0
<= 12.0
<= 15.0
<= 18.0
<= 21.0
<= 24.0

NOTES

1) ROAD ALIGNMENTS ARE PRELIMINARY AND ARE SUBJECT TO CHANGE.
2) SEWER ALIGNMENTS ARE CONCEPTUAL AND ARE SUBJECT TO CHANGE.

N

1200 600 0 1200

SCALE FEET

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

APPENDIX B

TABLES

Wastewater Flow Calculations

Levine General Motors 170

Mesa, Arizona

February, 2019

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:

Low Density Residential (RR):	200	gal/dwelling unit/day	
Low Density Residential (ER):	240	gal/dwelling unit/day	
Medium Density Residential (LDR):	240	gal/dwelling unit/day	
Medium Density Residential (LMDR):	256	gal/dwelling unit/day	
Medium Density Residential (MDR):	216	gal/dwelling unit/day	
High Density Residential (MHDR):	160	gal/dwelling unit/day	
High Density Residential (HDR):	136	gal/dwelling unit/day	
High Density Condominium:	136	gal/dwelling unit/day	
Commercial[2]:	1,300	gal/acre/day	

Density:		Population Factor:	
< 1	du/acre	2.5	Persons/du
1 - 2	du/acre	3.0	Persons/du
2 - 4	du/acre	3.0	Persons/du
4 - 6	du/acre	3.2	Persons/du
6 - 10	du/acre	2.7	Persons/du
10 - 15	du/acre	2.0	Persons/du
15 +	du/acre	1.7	Persons/du
		1.7	Persons/du

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:

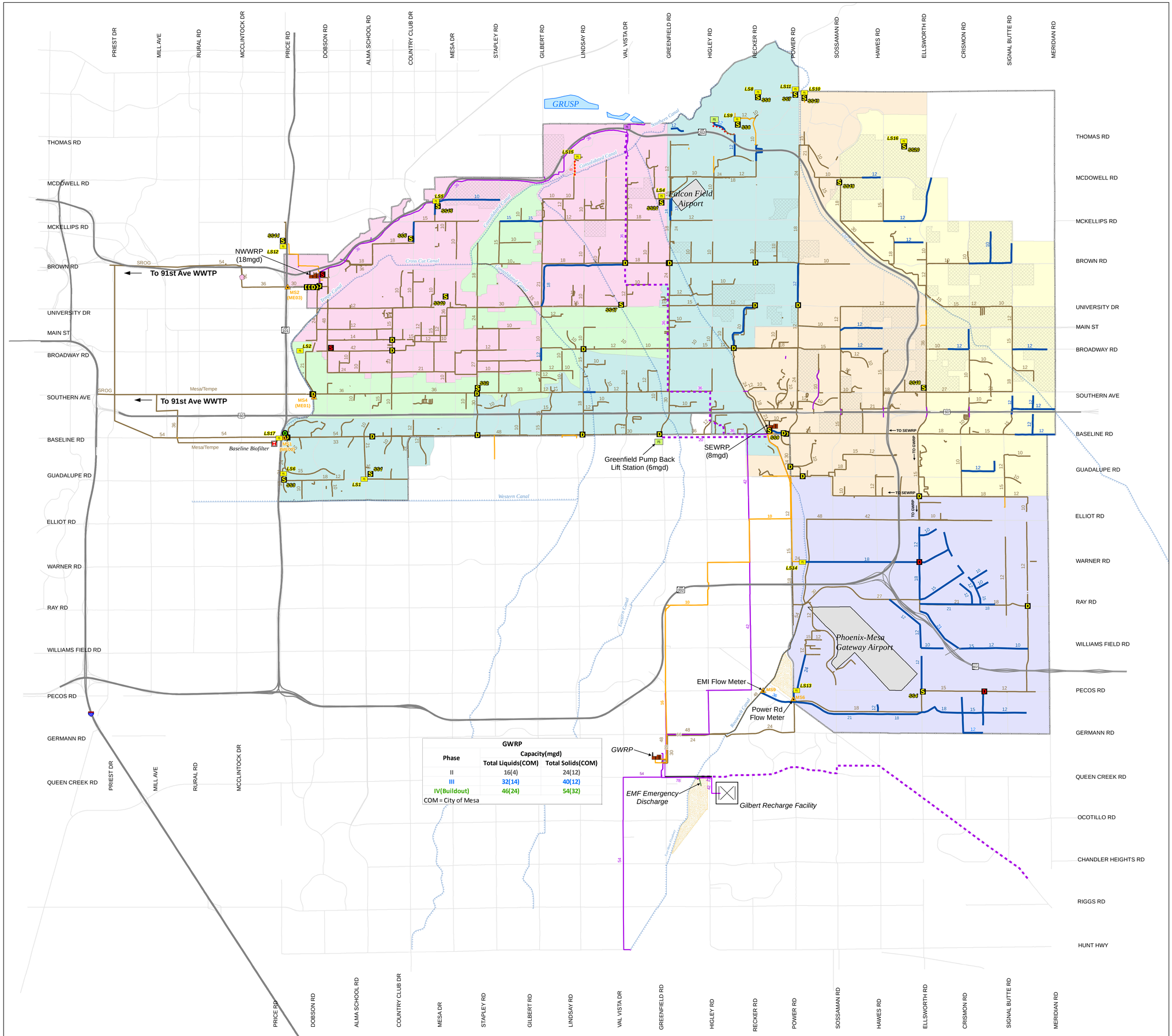
1) Design Criteria based on *Design Standards Manual for Water and Wastewater Systems (City of Phoenix, 2017).*
2) Minimum Existing Slope in 18-inch sewer = 0.0016 ft/ft.
3) Existing sewer main data taken from *Improvement Plans for Cadence Parkway* (EPS Group, 2017).

APPENDIX C

EXCERPTS FROM:

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

MESA 2040 GENERAL PLAN (CITY OF MESA, 2016)



GWRP		
Phase	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		

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

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

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.

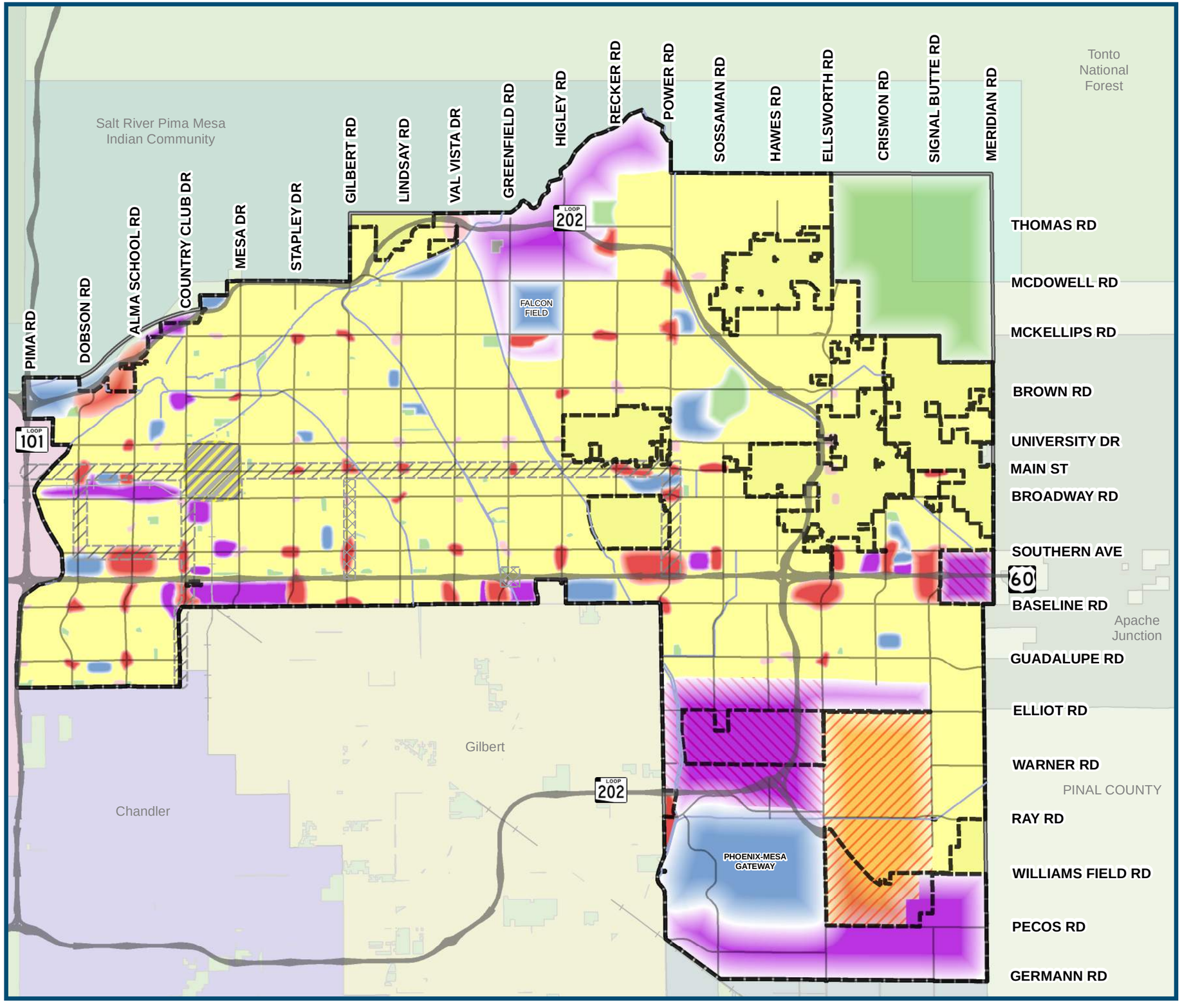
\\isr04\utwrgisshare\GIS\Projects\Jarrod\Master Plan\MP2011

Mesa 2040 General Plan

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

mesa·az

0 2 4

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

FlexTable: Outfall Table

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