Interceptor Sewer Modeling & Wastewater Master Plan

Final Report
January 2011

SUNRISE ENGINEERING

1.0 INTRODUCTION

1.1 SCOPE OF WORK

The purpose of this Wastewater Master plan is to provide the Town of Queen Creek with an evaluation of the Town's interceptor ("trunk line") wastewater collection system with regard to current as well as projected flows expected in a "build-out" condition within the Town boundaries and potential service area expansion of the Town's sewer system.

The scope of work for the study consists of 5 main tasks:

Task 1: Sewer Interceptor Manhole Survey & Data Collection
Task 2: Sewer Interceptor Model Data Input
Task 3: Sewer Interceptor Modeling 2010
Task 4: Sewer Interceptor Modeling General Plan Build-Out
Task 5: Sewer Interceptor Modeling Expanded Service Area

1.2 PROJECT PLANNING AREA

The Town of Queen Creek is located in southeast corner of Maricopa County approximately 30 miles southeast of Phoenix. The Town is adjacent to the Town of Gilbert to the west, City of Mesa to the north and Pinal County to the east and south.

The project planning area is within the current Town of Queen Creek boundaries as shown on **Exhibit 1.2.1 - Town Boundaries Map**. The northern boundary is approximately Germann Road. The eastern boundary is approximately Meridian Road. The southern boundary is approximately Empire Road. And the western boundary is approximately Power Road. Additional land outside the Town boundary that is being considered for future annexation is evaluated in the Expanded Service Area Model.

1.3 BACKGROUND INFORMATION

The first phase of the Town's wastewater collection and interceptor system was constructed in 1998. Since that time the Town has experienced growth and development that has necessitated the expansion of the Town's system. Most of the sizing and routing for this expansion has been based on a Wastewater Master Plan prepared by Stantec Consulting in 2002.

Over the years some of the interceptor routing shown in the 2002 Wastewater Master plan has changed. In addition, the Town's General Plan has changed, which has a direct impact on the flow loading of the Town's interceptor system.

This study has two main purposes. The first purpose of this study and modeling was to provide an analysis of Town's interceptor sewer system based on the changes that have occurred over the past eight years. The second purpose is to provide a tool for the Town to easily perform additional analyses for future development and service area expansions.

1.4 OUTFALL CAPACITIES

The Town's interceptor system has three outfalls that all convey flow to the Greenfield Water Reclamation Plant (GWRP). The GWRP is owned and operated by the Town of Gilbert with intergovernmental agreements (IGA) to service incoming flow from the City of Mesa and Town of Queen Creek. The GWRP has a planned ultimate treatment capacity of 63 MGD. The Town of Queen Creek's current IGA allows for a treatment capacity of 8 MGD.

The Rittenhouse outfall is in the northwest corner of Town. It is the 42 inch Rittenhouse Road line that connects to the 66-inch East Mesa Interceptor (EMI). The Towns current IGA allows 8MGD ADF with a peak flow capacity of 16.8 MGD.

The Queen Creek outfall is the 24 inch line in at the western border of Town. This line connects to a 24 inch line owned and operated by the Town of Gilbert. The current IGA specifies a flow of 0.69 MGD ADF.

The Ocotillo Road outfall is a 15 inch line in the Town of Gilbert on the western border of the Towns in Ocotillo Road. The Town is not currently connected to this line. The current IGA allows for 0.471 MGD ADF.

See **Figure 1.4.1 – Outfall Flows** for a comparison table for the three outfalls. The table outfall flow rates, IGA flows, full flow capacity for each downstream connection pipe and total modeled flow rate for each scenario.

1.5 PREVIOUS STUDIES

The analysis shown in this report used background data and information from two previous wastewater collection system reports prepared for the Town which are as follows:

Wastewater Master Plan, October 2002, *Stantec*: This study provided the basis for planned sewer interceptor construction around the Town from the late 90's to present. The study began work in 1993 and was upgraded several times, with the final version in October 2002. The study used the Town's January 2002 General Plan for land use within the town boundaries. The study predicted flows of 15.92 million gallons per day (MGD) average daily flow (ADF) at the Rittenhouse outfall, and 3.40 MGD ADF at the Queen Creek Road outfall.

General Plan Amendments Wastewater Impact Study, September 2006, *PBS&J:* This study was an update to the Stantec study using proposed General Plan amendments circa 2006. It quantified the change in flows if the General Plan Amendments were approved. The result was a total of 7.85MGD ADF at the Rittenhouse outfall, 2.92 MGD ADF at the Queen Creek Road outfall, and 0.54 MGD ADF at the Ocotillo Road outfall.

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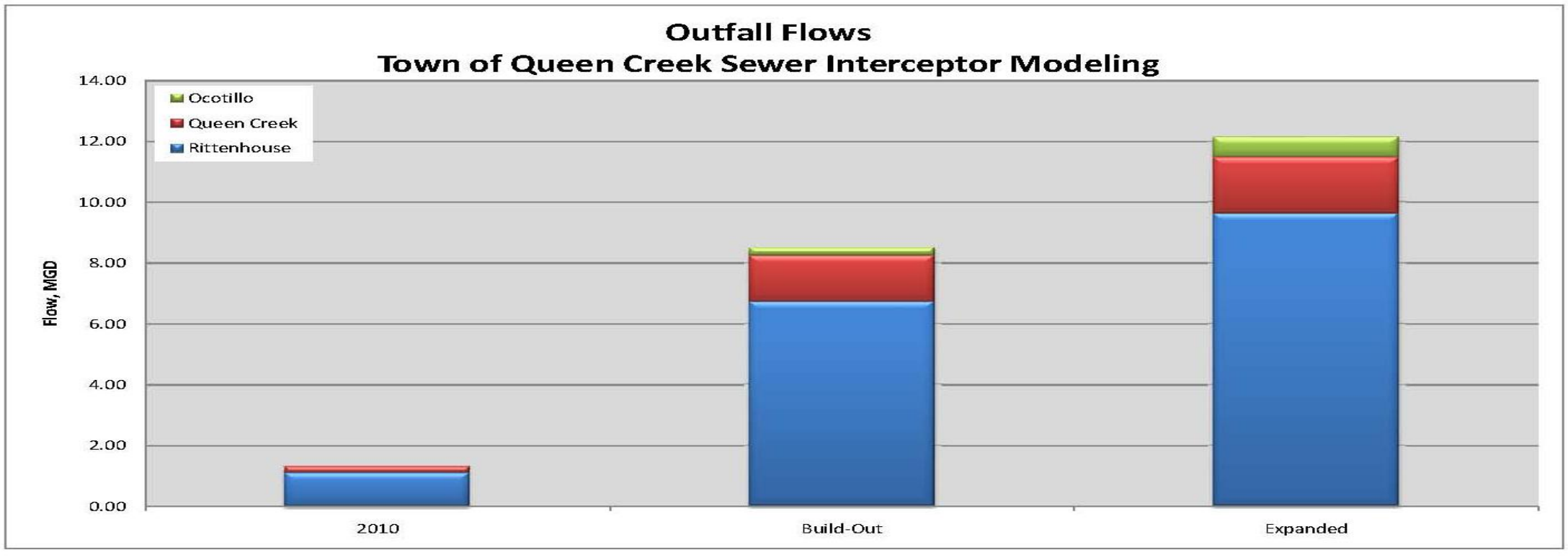
Figure 1.4.1 - Outfall Flows
Town of Queen Creek Sewer Interceptor Modeling

						2010		Build-Out		Expanded	
	Downstream Connecting Pipe Size, in	Slope, ft/ft	Full Flow Capacity, MGD	QC Capacity per IGA, MGD	Peaked QC Capacity per IGA, MGD	Average Daily Flow, MGD	Peaked Flow, MGD	Flow, MGD	Peaked Flow, MGD	Flow, MGD	Peaked Flow, MGD
Rittenhouse	66	0.005	48.53	8.00	16.80	1.10	1.96	6.71	10.45	9.63	14.73
Queen Creek	24	0.002 assumed	6.54	0.69	n/a	0.21	0.44	1.53	2.66	1.84	3.16
Ocotillo	15	0.0011	1.38	0.47	n/a	0.00	0.00	0.26	0.54	0.67	1.26
					Total Flow for Treatement	**1.31**		**8.50**		**12.14**	



2.0 SURVEY & DATA COLLECTION

Task 1 of the project was to field survey the existing interceptor system manholes and collect Town data to input into the model. Sunrise worked with Town staff to obtain the most recent existing digital files from the Town's GIS system to support the completion of the collection system mapping and modeling. The files collected included the following:

- Aerial Images
- Current General Plan Map
- Parcel Information
- Topography (contours)
- Sewer Flow Data (from outfall meters)
- Sewer As-built Record Drawings

2.1 INTERCEPTOR MANHOLE SURVEY

Sunrise conducted a field survey of approximately 500 sewer interceptor manholes within the Town. The survey collected manhole location (northing & easting), rim elevation, depth to inverts, and compass direction of inverts. In addition, the pipe size was observed and recorded in each manhole to verify the as-built information provided by the Town.

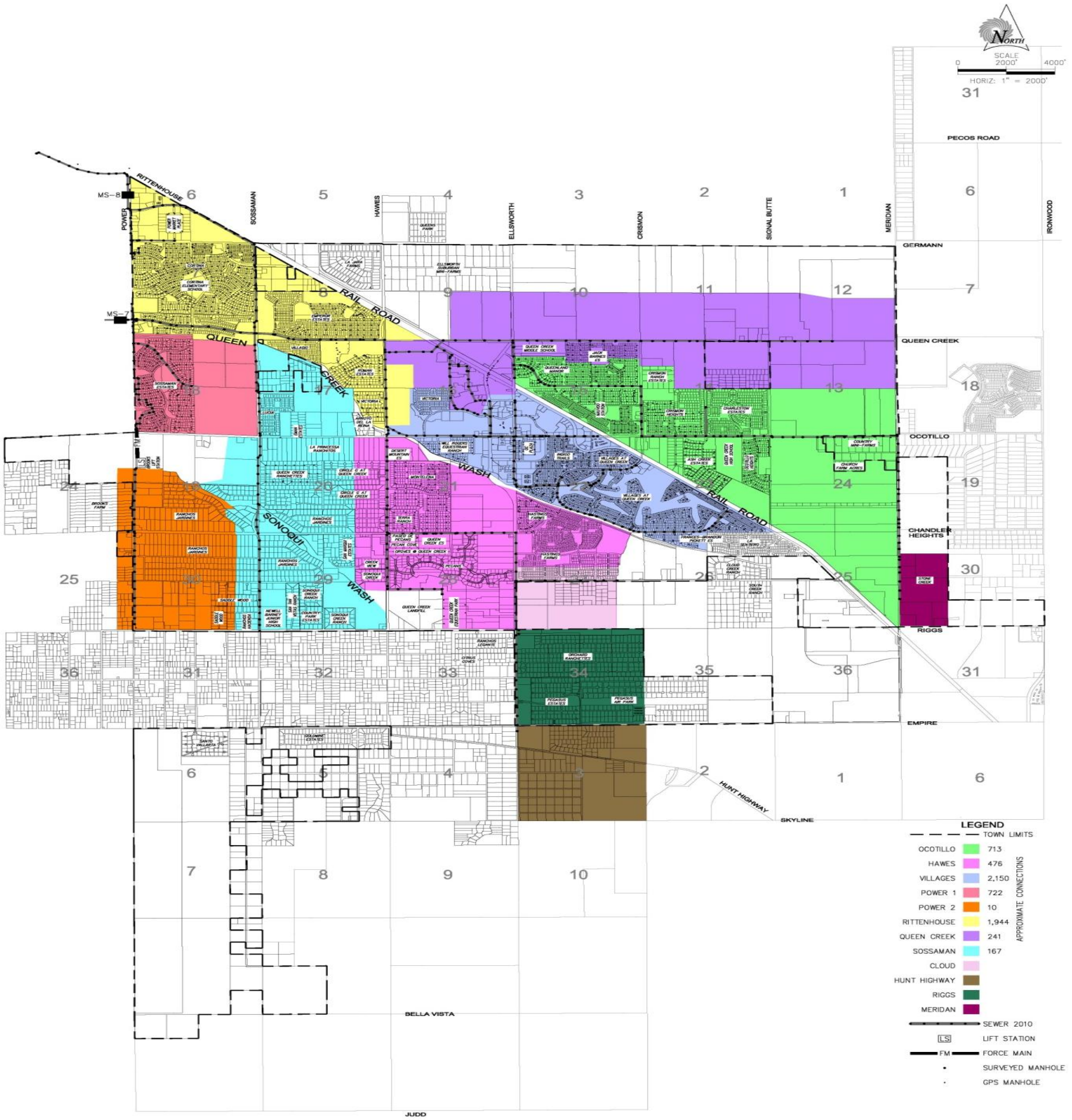
After the field survey was completed the information was exported to a spread sheet where actual invert elevations were calculated by subtracting the rim elevation from the measured invert depth to arrive at invert elevation. The data from this survey was used as input into the model.

2.2 TOWN OF QUEEN CREEK GENERAL PLAN

The Town's General Plan dated September 2008 (with update in 2010) was the basis for all future land uses as future development occurs.

2.3 HISTORIC SEWAGE FLOWS

The Town provided historic sewage flow and connection data for years 2008, 2009, and 2010. Flow data was provided as the total daily flow at the two active outfall locations. In addition, the Town provided the average number of active sewer connections (by month) within the Town's sewer system. This information was established to determine the actual average flow per connection within the system.



TOWN OF QUEEN CREEK

INTERCEPTOR SEWER MODELING

EXHIBIT 4.2.1 - 2010 DRAINAGE AREAS MAP

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EAST MESA 66" INTERCEPTOR

TO GREENFIELD WATER RECLAMATION PLANT

QAVG = 1.10 MGD
QPEAKED = 1.96 MGD
QIGA = 8 MGD
MS-8

24" INTERCEPTOR TO GREENFIELD WATER RECLAMATION PLANT
MS-7
QAVG = 0.21 MGD
QPEAKED = 0.44 MGD
QIGA = 0.69 MGD

15" INTERCEPTOR TO GREENFIELD WATER RECLAMATION PLANT

FM
LS

SCALE 0 2000' 4000'
HORIZ: 1" = 2000'

RITTENHOUSE
POWER
SOSSAMAN
HAWES
ELLSWORTH
CRISMON
SIGNAL BUTTE
MERIDIAN
IRONWOOD
PECOS ROAD
GERMANN
QUEEN CREEK
OCOTILLO
CHANDLER HEIGHTS
RIGGS
EMPIRE
HUNT HIGHWAY
SKYLINE
BELLA VISTA
JUDD

RAIL ROAD
QUEEN CREEK WASH
SONOQUI WASH
RAIL ROAD

LEGEND
- TOWN LIMITS
- 8" SEWER
- 10" SEWER
- 12" SEWER
- 15" SEWER
- 18" SEWER
- 21" SEWER
- 24" SEWER
- 30" SEWER
- 36" SEWER
- 42" SEWER
- LS LIFT STATION
- FM FORCE MAIN
- SURVEYED MANHOLE
- GPS MANHOLE

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TOWN OF QUEEN CREEK
INTERCEPTOR SEWER MODELING
EXHIBIT 4.1.1 - 2010 SYSTEM MAP

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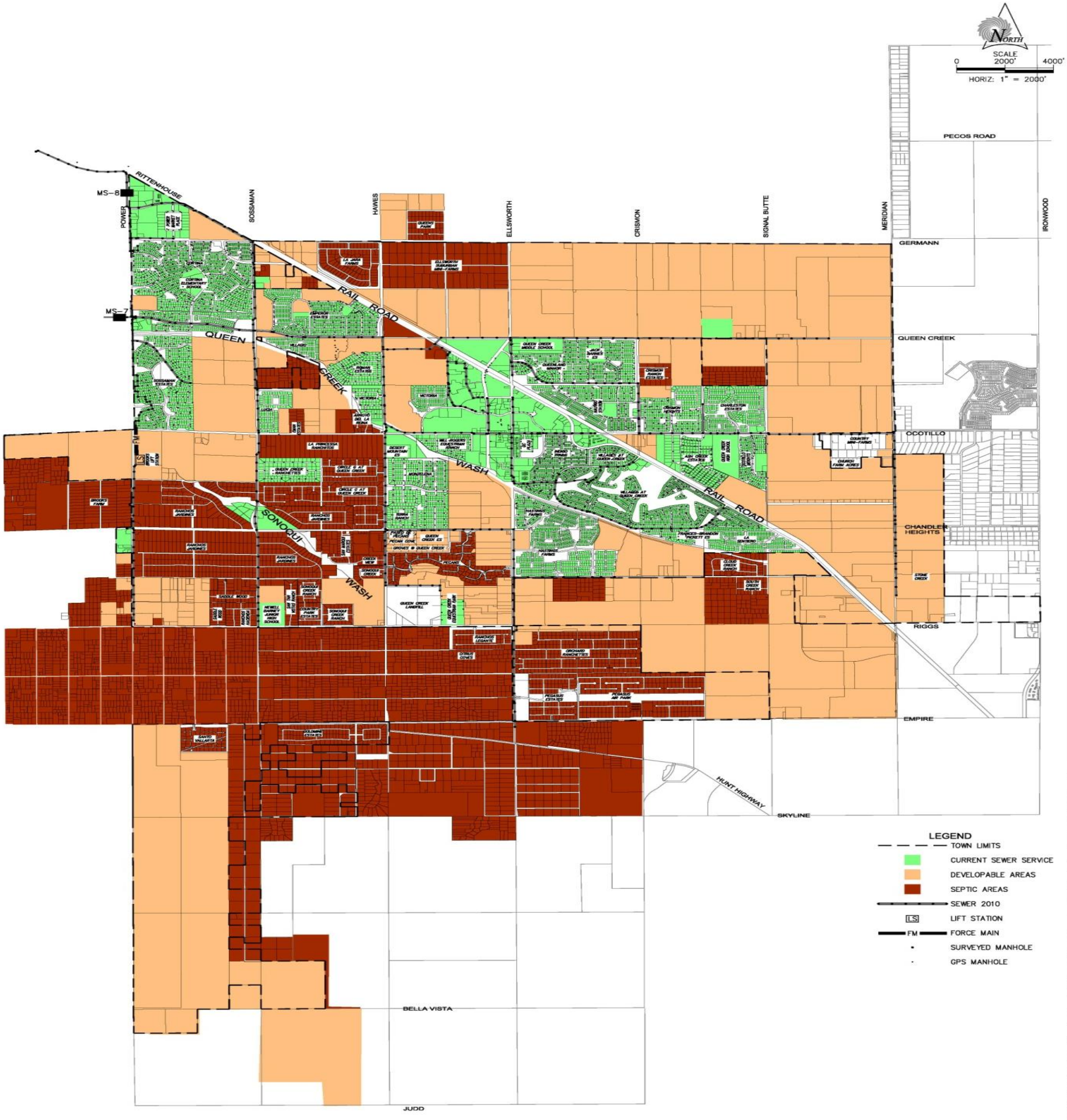

TOWN OF QUEEN CREEK

INTERCEPTOR SEWER MODELING

EXHIBIT 4.4.1 - 2010 SERVICE AREA MAP

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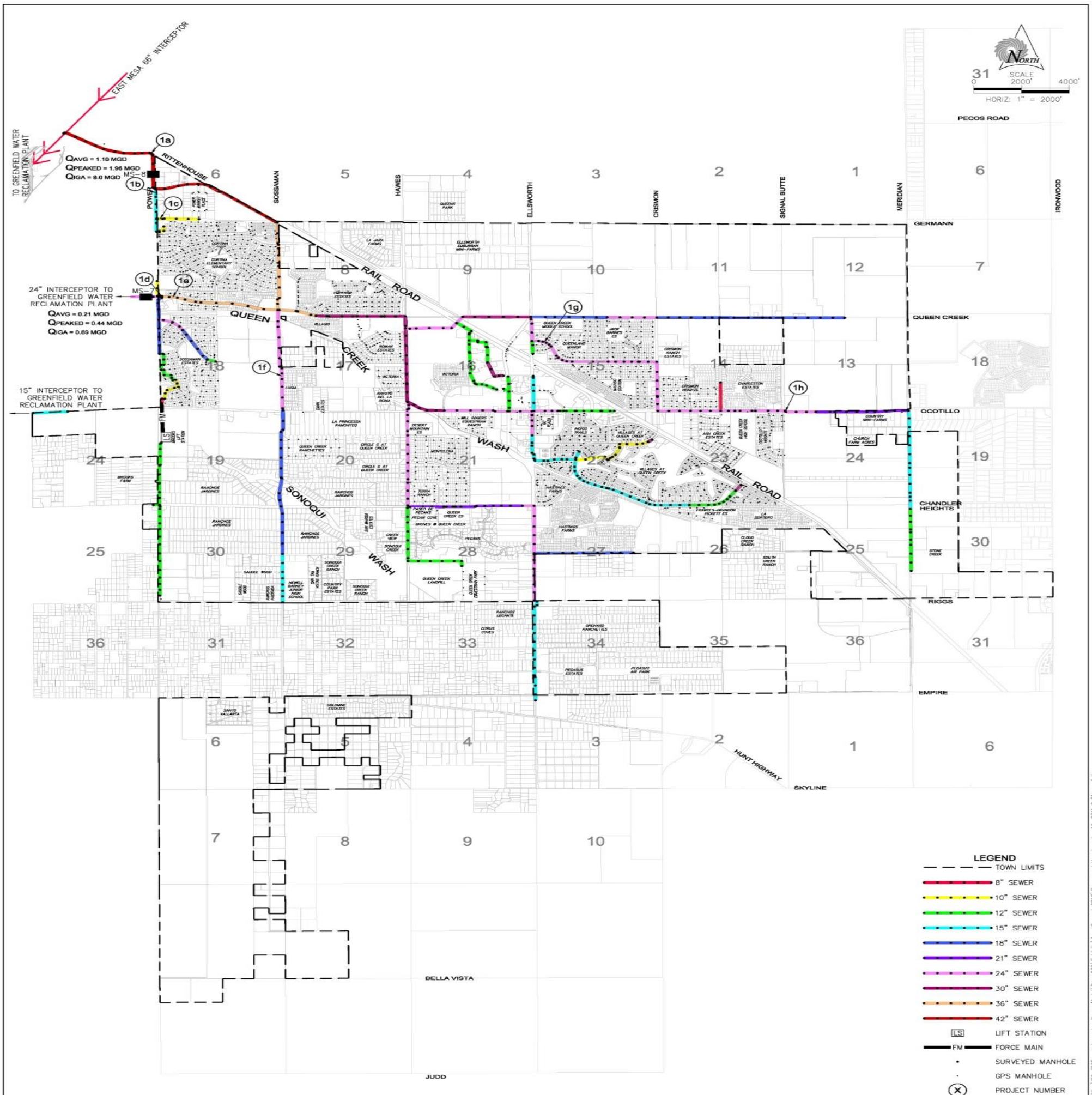

TOWN OF QUEEN CREEK

INTERCEPTOR SEWER MODELING

EXHIBIT 4.6.1 - 2010 RECOMMENDATIONS MAP

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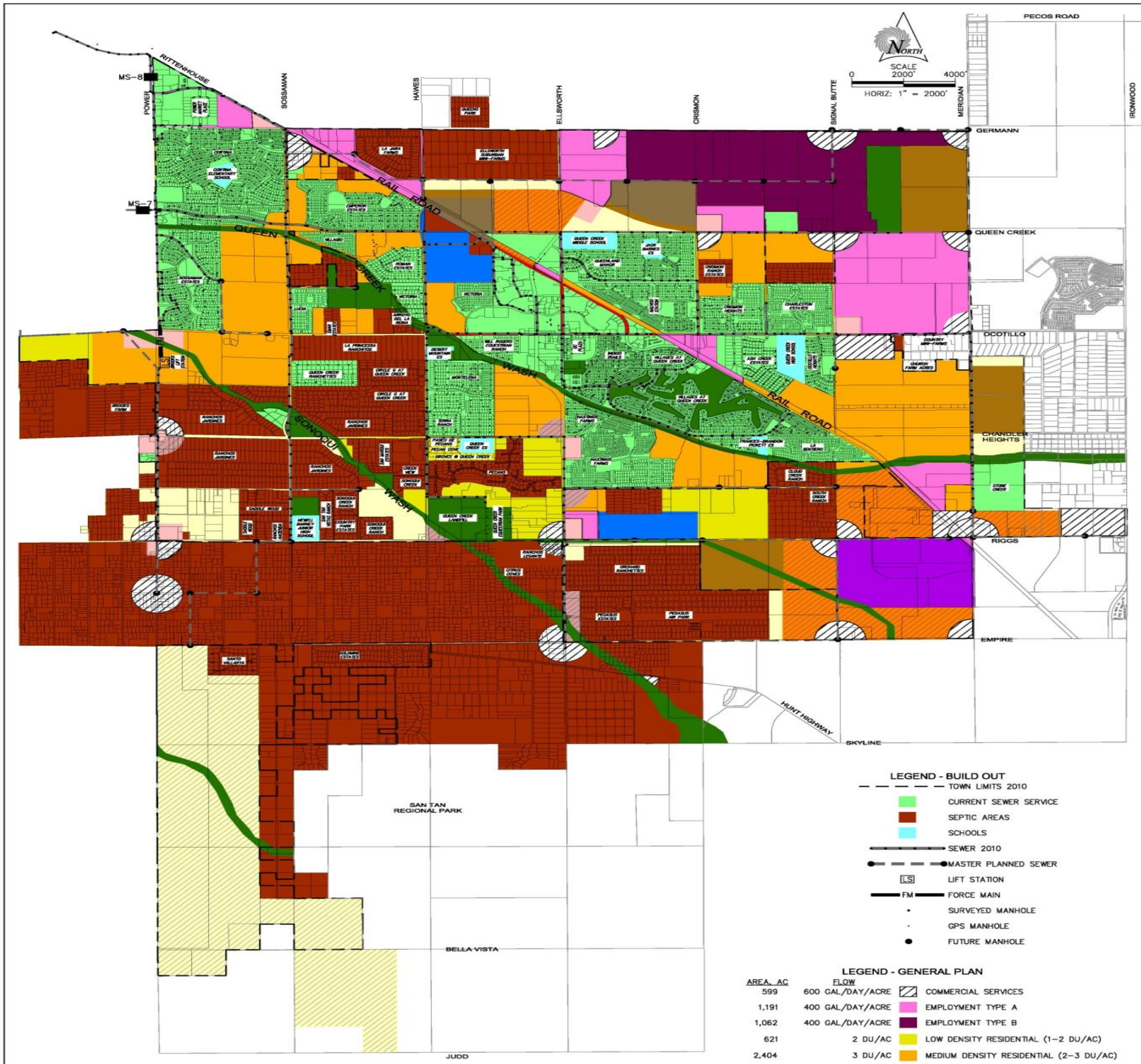
Figure 4.6.2 - 2010 Recommendations Cost Estimate *

Project: Sewer System Modeling - TOQC Project Order No. 005
Owner: Town of Queen Creek
Prepared By: RH/RP

1/17/11

No.	Item Description - Construction	Total	Unit	Unit Price	Total
1	8" Gravity Sewer Pipe (PVC SDR 35 ASTM)	0	LF	$78.00	$0
2	10" Gravity Sewer Pipe (PVC SDR 35 ASTM)	300	LF	$88.00	$26,400
3	12" Gravity Sewer Pipe (PVC SDR 35 ASTM)	0	LF	$98.00	$0
4	15" Gravity Sewer Pipe (PVC SDR 35 ASTM)	900	LF	$108.00	$97,200
5	18" Gravity Sewer Pipe (PVC SDR 35 ASTM)	0	LF	$118.00	$0
6	21" Gravity Sewer Pipe (PVC SDR 35 ASTM)	0	LF	$128.00	$0
7	24" Gravity Sewer Pipe (PVC SDR 35 ASTM)	1,600	LF	$138.00	$220,800
8	30" Gravity Sewer Pipe (PVC SDR 35 ASTM)	0	LF	$148.00	$0
9	36" Gravity Sewer Pipe (PVC SDR 35 ASTM)	1,100	LF	$158.00	$173,800
10	42" Gravity Sewer Pipe (PVC SDR 35 ASTM)	500	LF	$168.00	$84,000
11	60" Manhole (Precast Concrete)	16	EA	$6,000.00	$96,000
12	Lift Station	0	EA	$250,000.00	$0
13	Force Main	0	LF	$20.00	$0
14	Remove Existing 12" Gravity Sewer Pipe	0	LF	$20.00	$0
15	Remove Existing 21" Gravity Sewer Pipe	0	LF	$25.00	$0
16	Remove Existing 24" Gravity Sewer Pipe	0	LF	$30.00	$0
17	Remove Existing 60" Manhole	24	EA	$2,500.00	$60,000
18	Mobilization	5%	LS	$37,910.00	$37,910
19	Traffic Control	10%	LS	$75,820.00	$75,820
20	Engineering & Administration	10%	LS	$75,820.00	$75,820
21	Staking and Construction Management	10%	LS	$75,820.00	$75,820
				Sub-Total	**$1,023,570**
				20% Contingency	$204,714
				PROJECT TOTAL	**$1,228,000**

*In providing opinions of probable construction cost the Client understands that the Engineer has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinion of probable construction cost provided herein is made on the basis of the Engineer's qualifications and experience. The Engineer makes no warranty, expressed or implied, as the accuracy if such opinions compared to bid or actual costs.



LEGEND - BUILD OUT

- TOWN LIMITS 2010
- CURRENT SEWER SERVICE
- SEPTIC AREAS
- SCHOOLS
- SEWER 2010
- MASTER PLANNED SEWER
- LS — LIFT STATION
- FM — FORCE MAIN
- SURVEYED MANHOLE
- GPS MANHOLE
- FUTURE MANHOLE

LEGEND - GENERAL PLAN

AREA, AC	FLOW	
599	600 GAL/DAY/ACRE	COMMERCIAL SERVICES
1,191	400 GAL/DAY/ACRE	EMPLOYMENT TYPE A
1,062	400 GAL/DAY/ACRE	EMPLOYMENT TYPE B
621	2 DU/AC	LOW DENSITY RESIDENTIAL (1–2 DU/AC)
2,404	3 DU/AC	MEDIUM DENSITY RESIDENTIAL (2–3 DU/AC)
643	5 DU/AC	MEDIUM HIGH DENSITY RESIDENTIAL TYPE A (3–5 DU/AC)
241	8 DU/AC	MEDIUM HIGH DENSITY RESIDENTIAL TYPE B (5–8 DU/AC)
2,167	2 DU/AC	MASTER PLANNED COMMUNITY
972	1,300 GAL/DAY/ACRE	MIXED USE
190	600 GAL/DAY/ACRE	NEIGHBORHOOD COMMERCIAL
66	600 GAL/DAY/ACRE	OFFICE / SERVICES
309	200 GAL/DAY/ACRE	PUBLIC / QUASI–PUBLIC
175	0	RECREATION / CONSERVATION / PARKS
422	800 GAL/DAY/ACRE	REGIONAL COMMERCIAL CENTER
39	1,300 GAL/DAY/ACRE	TOWN CENTER
1,569	1 DU/AC	VERY LOW DENSITY RESIDENTIAL (0–1 DU/AC)

TOWN OF QUEEN CREEK

INTERCEPTOR SEWER MODELING

EXHIBIT 5.4.1 - BUILD-OUT SERVICE AREA MAP

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Table 3.3.1 – Commercial Flow Rates

Town of Queen Creek Land Use Category	Town of Gilbert Land Use Category	Unit Load (Gallons per Acre per Day)
Commercial Services	Commercial	600
Employment Type A & B	Industrial	400
Mixed Use	Vertical Development	1,300
Neighborhood Commercial	Commercial	600
Office / Services	Commercial	600
Public / Quasi-Public	Public	200
Regional Commercial Center	Regional Commercial	800
Town Center	Vertical Development	1,300

Flow projections applied to the interceptor model for the development areas in the Town's General Plan are based on the Unit Loads shown **Table 3.3.1. - Commercial Flow Rates**

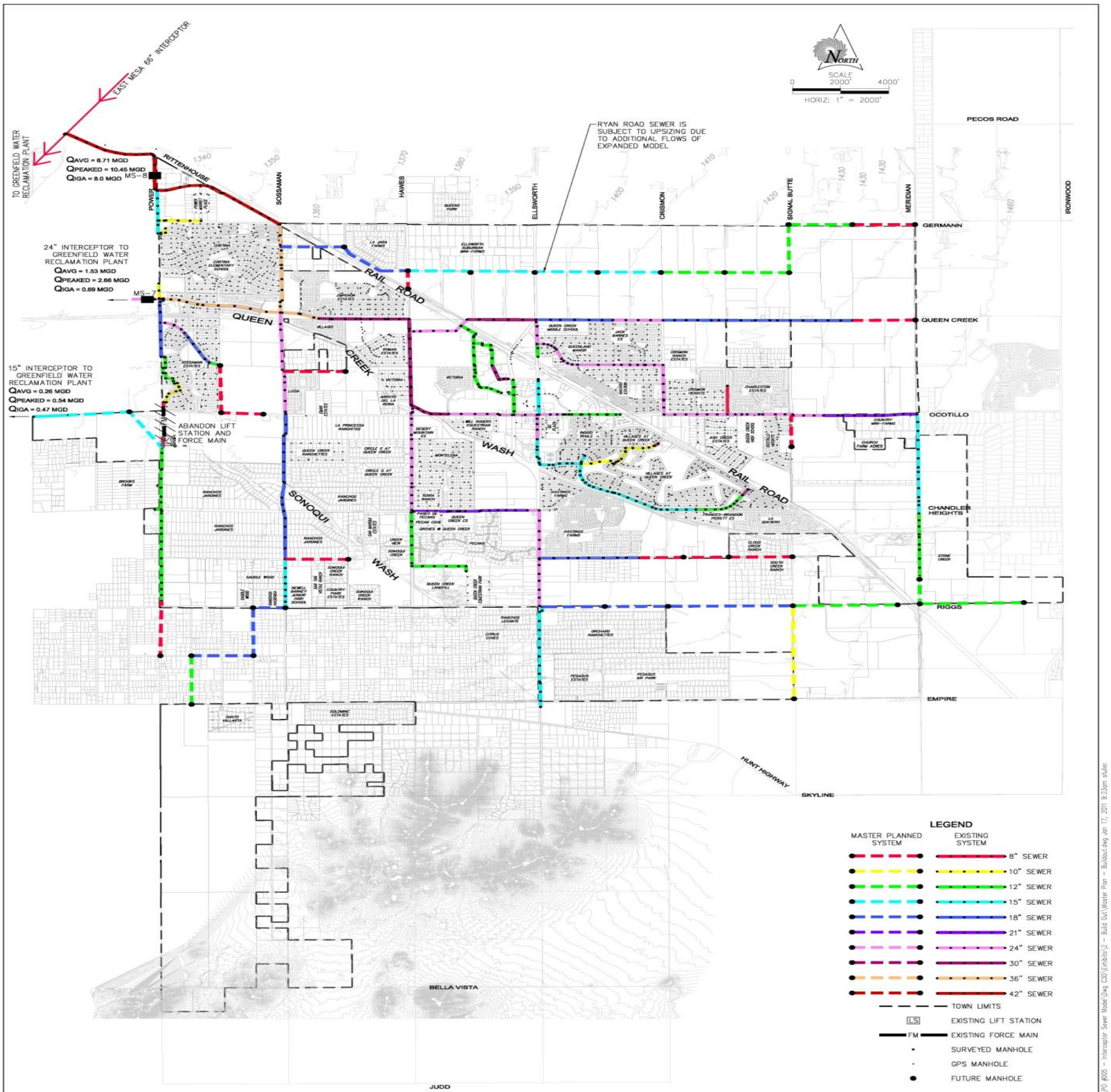
To help the Town with future land use decisions a comparison of commercial flow rates was conducted. It compares commercial, residential, and total flow for each scenario and provides an additional scenario of what the total flow would be using City of Phoenix commercial flows versus the Town of Gilbert commercial flows that were used for the rest of the model. For the comparison the City of Phoenix flows were applied to the Expanded Services areas and not the Build-Out commercial areas. See **Figure 3.3.1 – Phoenix / Gilbert Commercial Flow Rate Comparison.**

3.4 PEAKING FACTORS

Dry Weather Peaking Factors were applied to all flows within the model based upon the total population upstream of the calculation point. ADEQ recommended peaking factors per R18-9-E301(D)(1)(b)(i) (See **Appendix A - ADEQ Minimum Standards** for Dry Weather Peaking Factor Table) were entered into the model via a table of peaking factor versus population. The peaking factor was calculated with the given equation and entered into the model.

Population calculations were used for calculation of peaking factors only. Actual Town population projections were not estimated for this project. Residential peaking factor populations were calculated with the rate of 2.7 people per dwelling unit. For commercial land uses peaking factor populations were simulated by taking the flow rate of the land area and dividing by the Town's historic water usage rate of 75 gal/day/person.

The H_2OMAP Sewer Pro model applies peaking factors to flows by adding the population of the upstream manholes and looking up the appropriate peaking factor in the loaded table. The peaking factor is then applied to the total non-peaked flow to that point.



LEGEND

MASTER PLANNED SYSTEM	EXISTING SYSTEM
	8" SEWER
	10" SEWER
	12" SEWER
	15" SEWER
	18" SEWER
	21" SEWER
	24" SEWER
	30" SEWER
	36" SEWER
	42" SEWER
TOWN LIMITS	
	LS EXISTING LIFT STATION
	FM EXISTING FORCE MAIN
	SURVEYED MANHOLE
	GPS MANHOLE
	FUTURE MANHOLE

TOWN OF QUEEN CREEK

INTERCEPTOR SEWER MODELING

EXHIBIT 5.1.1 - BUILD-OUT SYSTEM MAP

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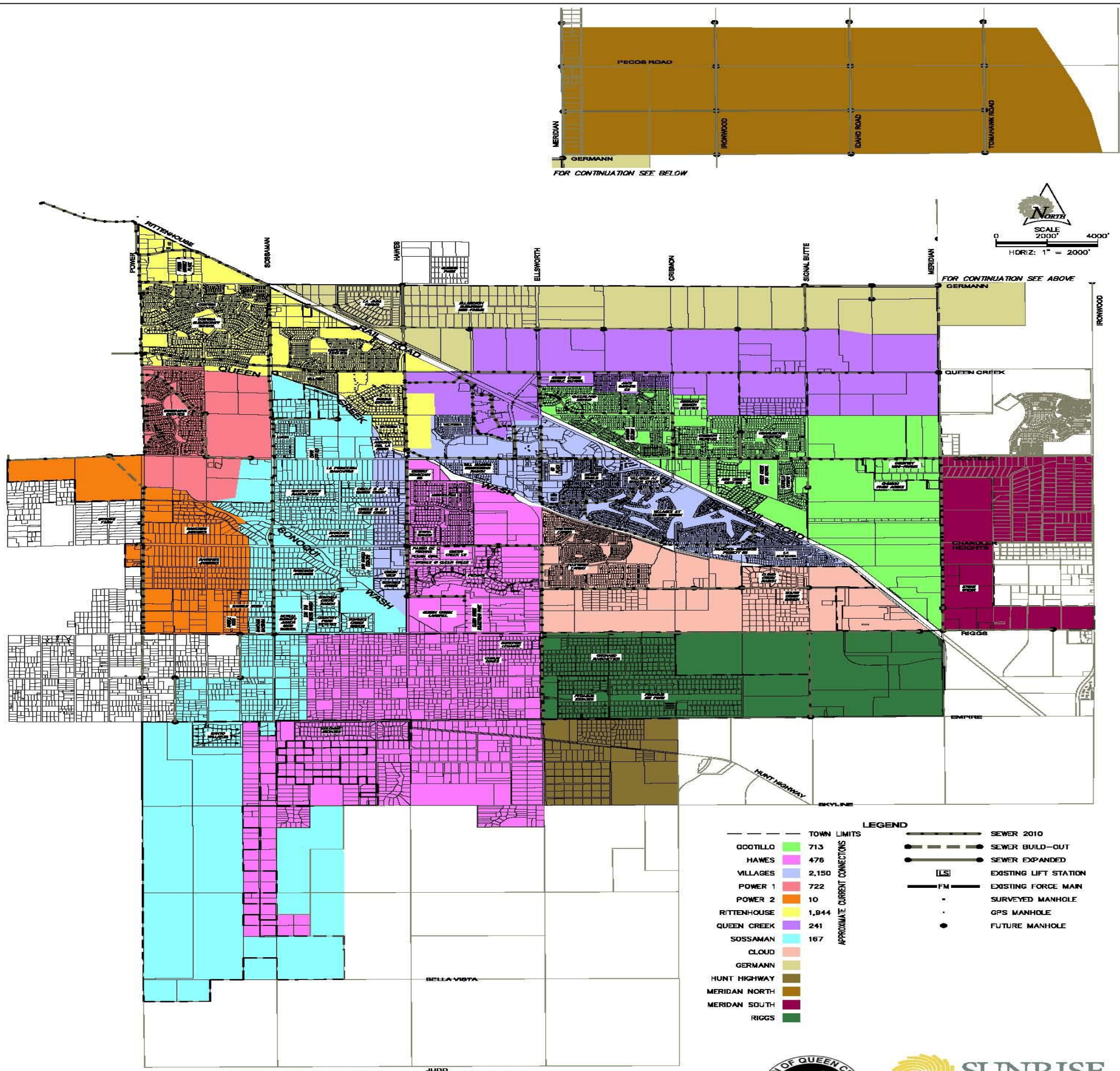
Figure 5.6.2 - Build-Out Recommendations Cost Estimate *

Project: Sewer System Modeling - TOQC Project Order No. 005
Owner: Town of Queen Creek
Prepared By: RH/RP

1/17/11

No.	Item Description - Construction	Total	Unit	Unit Price	Total
1	8" Gravity Sewer Pipe (PVC SDR 35 ASTM)	25,700	LF	$78.00	$2,004,600
2	10" Gravity Sewer Pipe (PVC SDR 35 ASTM)	5,300	LF	$88.00	$466,400
3	12" Gravity Sewer Pipe (PVC SDR 35 ASTM)	23,700	LF	$98.00	$2,322,600
4	15" Gravity Sewer Pipe (PVC SDR 35 ASTM)	16,400	LF	$108.00	$1,771,200
5	18" Gravity Sewer Pipe (PVC SDR 35 ASTM)	23,000	LF	$118.00	$2,714,000
6	21" Gravity Sewer Pipe (PVC SDR 35 ASTM)	0	LF	$128.00	$0
7	24" Gravity Sewer Pipe (PVC SDR 35 ASTM)	0	LF	$138.00	$0
8	30" Gravity Sewer Pipe (PVC SDR 35 ASTM)	0	LF	$148.00	$0
9	36" Gravity Sewer Pipe (PVC SDR 35 ASTM)	0	LF	$158.00	$0
10	42" Gravity Sewer Pipe (PVC SDR 35 ASTM)	0	LF	$168.00	$0
11	60" Manhole (Precast Concrete)	197	EA	$6,000.00	$1,182,000
12	Lift Station	0	EA	$250,000.00	$0
13	Force Main	0	LF	$20.00	$0
14	Remove Existing 12" Gravity Sewer Pipe	0	LF	$20.00	$0
15	Remove Existing 21" Gravity Sewer Pipe	0	LF	$25.00	$0
16	Remove Existing 24" Gravity Sewer Pipe	0	LF	$30.00	$0
17	Remove Existing 60" Manhole	0	EA	$2,500.00	$0
18	Mobilization	5%	LS	$523,040.00	$523,040
19	Traffic Control	10%	LS	$1,046,080.00	$1,046,080
20	Engineering & Administration	10%	LS	$1,046,080.00	$1,046,080
21	Staking and Construction Management	10%	LS	$1,046,080.00	$1,046,080
				Sub-Total	**$14,122,080**
				20% Contingency	$2,824,416
				PROJECT TOTAL	**$16,946,000**

*In providing opinions of probable construction cost the Client understands that the Engineer has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinion of probable construction cost provided herein is made on the basis of the Engineer's qualifications and experience. The Engineer makes no warranty, expressed or implied, as the accuracy if such opinions compared to bid or actual costs.



TOWN OF QUEEN CREEK

INTERCEPTOR SEWER MODELING

EXHIBIT 6.2.1 - EXPANDED SERVICE AREA DRAINAGE AREA MAP

TOWN OF QUEEN CREEK ARIZONA

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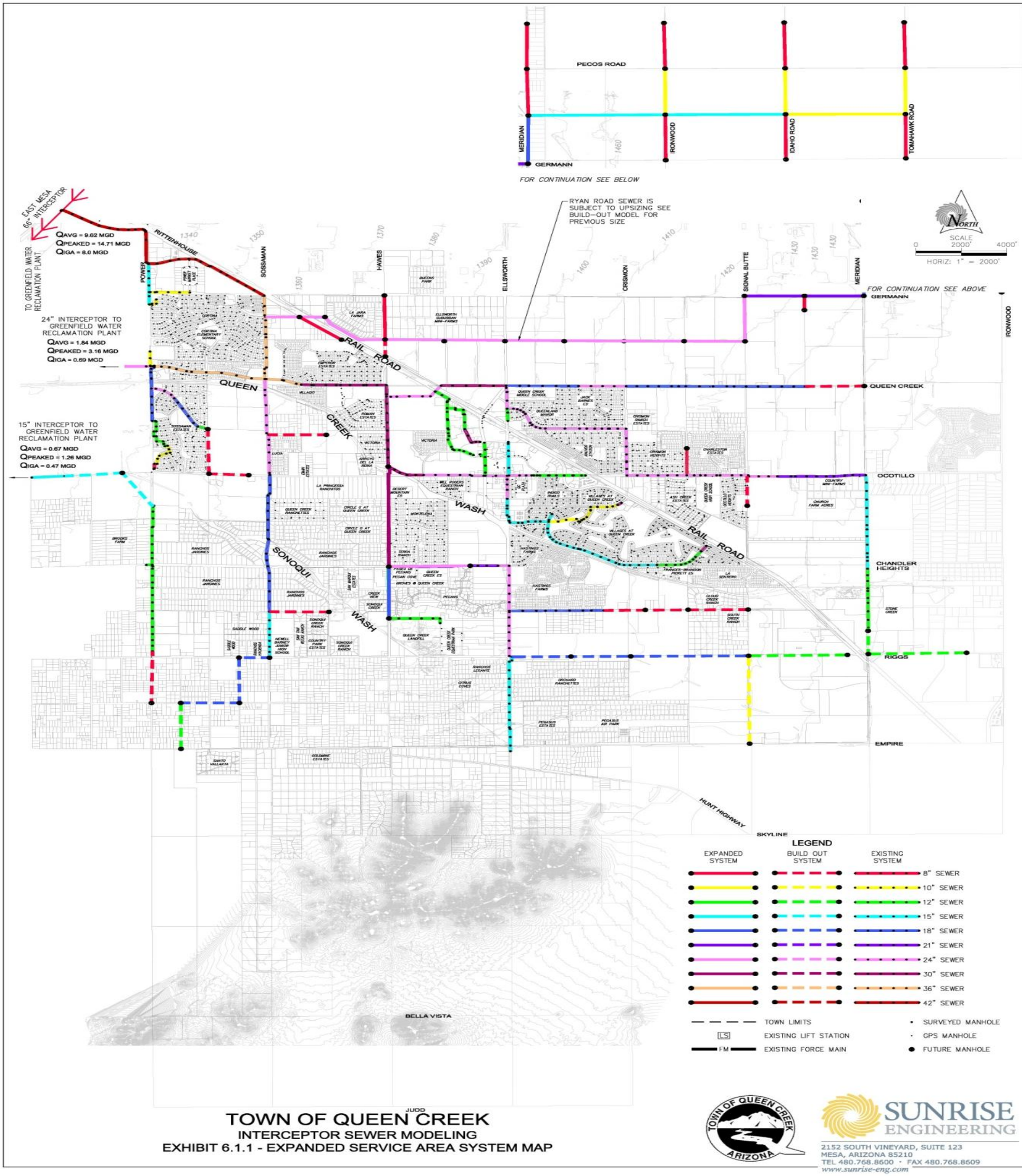

TOWN OF QUEEN CREEK

INTERCEPTOR SEWER MODELING

EXHIBIT 6.1.1 - EXPANDED SERVICE AREA SYSTEM MAP

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Figure 6.6.2 - Expanded Service Area Recommendations Cost Estimate *

Project: Sewer System Modeling - TOQC Project Order No. 005
Owner: Town of Queen Creek
Prepared By: RH/RP

1/17/11

No.	Item Description - Construction	Total	Unit	Unit Price	Total
1	8" Gravity Sewer Pipe (PVC SDR 35 ASTM)	27,800	LF	$78.00	$2,168,400
2	10" Gravity Sewer Pipe (PVC SDR 35 ASTM)	13,400	LF	$88.00	$1,179,200
3	12" Gravity Sewer Pipe (PVC SDR 35 ASTM)	0	LF	$98.00	$0
4	15" Gravity Sewer Pipe (PVC SDR 35 ASTM)	11,600	LF	$108.00	$1,252,800
5	18" Gravity Sewer Pipe (PVC SDR 35 ASTM)	5,800	LF	$118.00	$684,400
6	21" Gravity Sewer Pipe (PVC SDR 35 ASTM)	5,300	LF	$128.00	$678,400
7	24" Gravity Sewer Pipe (PVC SDR 35 ASTM)	27,900	LF	$138.00	$3,850,200
8	30" Gravity Sewer Pipe (PVC SDR 35 ASTM)	5,900	LF	$148.00	$873,200
9	36" Gravity Sewer Pipe (PVC SDR 35 ASTM)	0	LF	$158.00	$0
10	42" Gravity Sewer Pipe (PVC SDR 35 ASTM)	0	LF	$168.00	$0
11	60" Manhole (Precast Concrete)	184	EA	$6,000.00	$1,104,000
12	Lift Station	0	EA	$250,000.00	$0
13	Force Main	0	LF	$20.00	$0
14	Remove Existing 12" Gravity Sewer Pipe	3,200	LF	$20.00	$64,000
15	Remove Existing 21" Gravity Sewer Pipe	3,600	LF	$25.00	$90,000
16	Remove Existing 24" Gravity Sewer Pipe	5,900	LF	$30.00	$177,000
17	Remove Existing 60" Manhole	37	EA	$2,500.00	$92,500
18	Mobilization	5%	LS	$610,705.00	$610,705
19	Traffic Control	10%	LS	$1,221,410.00	$1,221,410
20	Engineering & Administration	10%	LS	$1,221,410.00	$1,221,410
21	Staking and Construction Management	10%	LS	$1,221,410.00	$1,221,410
				Sub-Total	**$16,489,035**
				20% Contingency	$3,297,807
				PROJECT TOTAL	**$19,787,000**

*In providing opinions of probable construction cost the Client understands that the Engineer has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinion of probable construction cost provided herein is made on the basis of the Engineer's qualifications and experience. The Engineer makes no warranty, expressed or implied, as the accuracy if such opinions compared to bid or actual costs.

Questions?