Sewer System Master Plan

FINAL REPORT

Prepared for:

City of National City
1243 National City Boulevard
National City, CA 91950-4301

March 2011

Prepared by:

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ABBREVIATIONS

AACE	American Association of Cost Engineers
ac	Acre
ADWF	Average Dry Weather Flow
CCTV	Closed-Circuit Television
CIP	Capital Improvement Program
City	The City of National City
d/D	Depth-to-Diameter ratio
ENR-CCI	Engineering News Record Construction Cost Index
FOG	Fats, Oil and Grease
ft	Feet
gpd	Gallons per Day
GWI	Groundwater Infiltration
IEC	Infrastructure Engineering Corporation
in	Inch
mgd	Million Gallons per Day
PACP	Pipeline Assessment and Certification Program
PDWF	Peak Dry Weather Flow
PSA	Professional Services Agreement
PWWF	Peak Wet Weather Flow
RDI/I	Rainfall Dependent Infiltration/Inflow
RTS	Return-to-Sewer
SECAP	System Evaluation and Capacity Assurance Plan
SMI	South Metro Interceptor
SSMP	Sewer System Management Plan
VCP	Vitrified Clay Pipe

EXECUTIVE SUMMARY

The City of National City (City) provides sewer service to the area generally within its corporate limits, and receives inflows from the City of San Diego and the United States Navy in route to the regional South Metro Interceptor (SMI). There are nine (9) significant sewer basins within the City that contribute wastewater flow to the National City wastewater collection system: NC2, NC3A, NC3B, NC5, NC7M, NC8M, NC13, NC15 and NC16. The City is responsible for the maintenance, operations and management of all sewer collection systems that transport flows generated within the City.

In order to plan and develop a wastewater Capital Improvement Program that ensures reliable and cost-effective service, the City retained the services of Infrastructure Engineering Corporation (IEC) to develop this sewer system master plan. The purpose of the Sewer System Master Plan was to update Existing (2009) wastewater flows, and recommend system capital improvements and proposed facility cost estimates, while incorporating the critical findings of the *2009 Sewer Closed-Circuit Television and Condition Assessment Report* and the *2010 Sewer Flow Monitoring Report*.

Based on the hydraulic analysis presented in Chapter 6, all deficient gravity mains were grouped prioritized into the projects illustrated in Figure 7-1. Recommended Immediate Projects include those gravity mains projected as unable to satisfy criteria in the hydraulic model, and for which flow monitoring data confirmed surcharging (i.e. depth-to-Diameter ratios of 1.0). All CIP projects through 2027 have an estimated probable cost of $17 Million. CIP projects are summarized in Table 7-2 and include:

- Immediate Projects: EX-P1, EX-P2, EX-P3 and EX-P4. ($1,922,275)
- Short Term Projects: EX-P5 through EX-P23. ($5,663,668)
- 2012 Projects: 2012-P1 through 2012-P9. ($5,077,759)
- 2017 Projects: 2017-P1 through 2017-P5. ($1,608,500)
- 2027 Projects: 2027-P1 through 2017-P12. ($2,762,691)

Estimates of probable capital costs provided represent Order of Magnitude level costs as established by the American Association of Cost Engineers (AACE) and represent an accuracy of +50% to -30%. Cost estimates for each project have been developed based upon the proposed replacement diameter, the estimated length of each project, and the unit costs presented in Table 7-1.

While $1.9 Million of CIP projects have been recommended for immediate replacement, an additional $5.6 Million have been included as short-term projects. These gravity mains are modeled as deficient, and should be monitored to confirm their available capacity. Once monitoring is complete, the short term projects would be identified for either immediate

replacement, or deferred until 2012. The 29 site, 14-day dry weather flow monitoring study has an estimated cost of $58,000.

As shown in Table 3-6, projected average daily wastewater flows with treatment costs allocated to the City are expected to increase 56 percent to 6.57 mgd by 2027. Based on these projections, there is no additional SMI capacity required to accommodate the projected daily wastewater flows projected through 2027.

CHAPTER 1. INTRODUCTION

1.1 GENERAL

The City's most recent sewer master plan effort was terminated in April 2002. The *Sanitary Sewer Master Plan and Storm Sewer Evaluation for the City of National City* (*2002 Sewer Master Plan*) contained wastewater flow projections based on population projections, a trunk sewer XP-SWMM hydraulic model utilized for capacity analysis, as well as a twenty (20) year Capital Improvement Program (CIP) to address system deficiencies. This document was never completed, and accordingly, never adopted by the City Council.

In July 2007, the City authorized IEC to complete the City's *Sewer System Management Plan* (SSMP), as per State Water Quality Resource Control Board Order No. 20006-0003. The SSMP, included updated wastewater flow projections for the 5-Year (2012), 10-Year (2017) and 20-Year (2027) time-increments. These wastewater flow projections were developed on a parcel level utilizing Sweetwater Authority's water meter billing data, recommended return-to-sewer ratios, SANDAG population projections, the *Downtown Specific Plan Wastewater Facilities Impact Report* and the City's current land use zoning. A major component of the City's SSMP was the System Evaluation and Capacity Assurance Plan (SECAP), which included the development of a Sewer Hydraulic Model of the City's wastewater collection system, as well as a Draft Wastewater CIP through the 20-year planning horizon.

1.2 AUTHORIZATION

This Sewer System Master Plan was authorized under a Professional Services Agreement (PSA) entered into between Infrastructure Engineering Corporation (IEC) and the City of National City, as approved by the City Council March 17, 2009.

1.2.1 2009 Sewer Closed-Circuit Television and Condition Assessment Report Authorization

The *2009 Sewer Closed-Circuit Television and Condition Assessment Report* was performed under a PSA entered into between IEC and the City, as approved by the City Council March 17, 2009. The *2009 Sewer Closed-Circuit Television and Condition Assessment Report* included all gravity mains with missing hydraulic information, areas with known Fog, Oil and Grease (FOG) issues and areas identified as deficient in the 2008 SSMP.

1.2.2 2010 Sewer Flow Monitoring Authorization

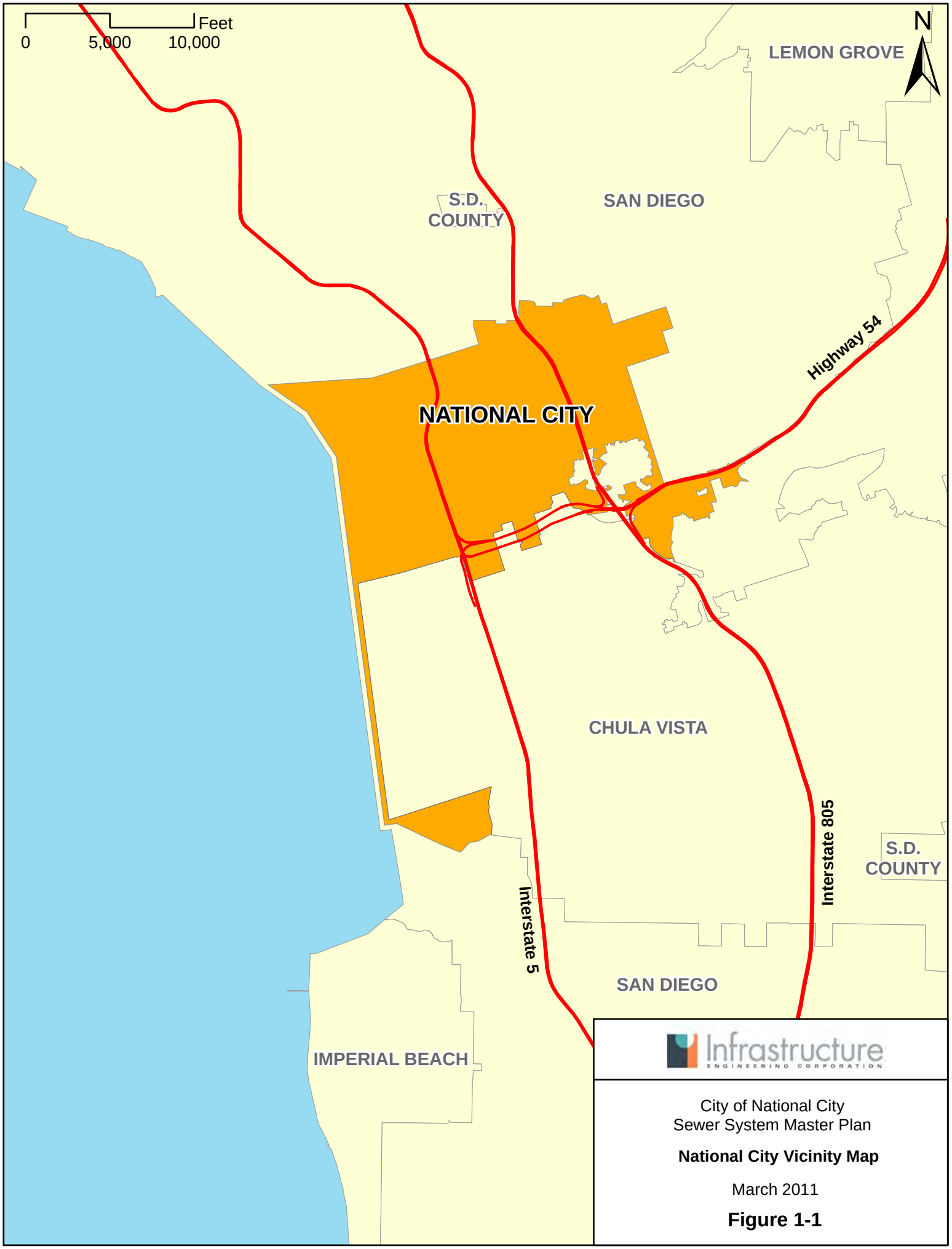
The *2010 Sewer Flow Monitoring Report* was performed under a PSA entered into between IEC and the City, as approved by the City Council March 17, 2009. This work included ten (10) flow-monitoring sites that collected flow data for a 28-day period from 01/19/2010 to 02/25/2010. Eight (8) of these monitoring sites were selected to confirm the deficiencies identified in the City's current SSMP.

1.3 BACKGROUND OF THE CITY

The City is located south of the City of San Diego and 10 miles north of the Mexican border. Incorporated on September 17, 1887, the City was originally part of the 26,000-acre El Rancho de la Nacion, which was purchased in 1868 by Frank Kimball and his brothers Warren and Levi. They cleared lands, built roads, constructed the City's first wharf and brought the railroad to the City. The location of the City is shown on Figure 1-1.

The City provides sewer service to the area generally within its corporate limits, and receives inflows from the City of San Diego and the United States Navy in route to the regional South Metro Interceptor (SMI). National City has approximately 97 miles of sewer collection pipes that drain westerly to the SMI, and ultimately to the Point Loma Wastewater Treatment Plant.

There are nine (9) significant sewer basins within the City that contribute wastewater flow to the National City wastewater collection system: NC2, NC3A, NC3B, NC5, NC7M, NC8M, NC13, NC15 and NC16. While the majority of the sewer collection system drains to the SMI by gravity, there is a low-lying area on Tidelands Avenue west of Interstate 5, which is pumped to the interceptor. The City is responsible for the maintenance, operations and management of all sewer collection systems that transport flows generated within the City.



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City of National City
Sewer System Master Plan

National City Vicinity Map

March 2011

Figure 1-1

CHAPTER 2. EXISTING SEWER COLLECTION SYSTEM

The City provides sewer service to the area generally within its corporate limits, and receives inflows from the City of San Diego and the United States Navy in route to the regional South Metro Interceptor (SMI). The City has approximately 100 miles of sewer collection pipes that drain westerly to the SMI, and ultimately to the Point Loma Wastewater Treatment Plant. There are nine (9) significant sewer basins within the City that contribute wastewater flow to the National City wastewater collection system: NC2, NC3A, NC3B, NC5, NC7M, NC8M, NC13, NC15 and NC16. While the majority of the sewer collection system drains to the SMI by gravity, there is a low-lying area on Tidelands Avenue west of Interstate 5, which is pumped to the interceptor.

2.1 SUMMARY OF WASTEWATER ASSETS

The City is responsible for the maintenance, operations and management of all sewer collection systems that transport flows generated within the City. Due to the inflows received from the City of San Diego into the SMI, the City of San Diego is responsible for contributing financially to the upgrades of the collector pipes in the SMI. This contribution will be in proportion to the amount of flow passing through the SMI at the City of National City.

2.1.1 Gravity Mains

The City owns and operates approximately 100 miles of pipe in the sewer collection system. Material information for the gravity mains was compiled for the collection system. Material for gravity mains was obtained from *2009 Sewer Closed-Circuit Television and Condition Assessment Report*, performed as part of this master plan effort. Accordingly, material has not been identified for a majority of City-owned gravity mains. As shown in Table 2-1, the predominant known material for gravity mains in the City is Vitrified Clay Pipe (VCP). Pipe material location in the collection system have been illustrated in Figure 2-1 at the end of this report.

Table 2-1 - Gravity Main by Material

Material Abbreviation	Material Name	Total Length (ft)	Total Length (miles)	Percentage of City Gravity Mains by Length
CCP	Concrete Cylinder Pipe	1,145	0.22	0.21%
CONC	Concrete	135	0.03	0.02%
CP	Concrete Pipe	2,115	0.40	0.38%
CP/PVC	Concrete Pipe/Polyvinyl Chloride Pipe	421	0.08	0.08%
CP/VCP	Concrete Pipe/Vitrified Clay Pipe	121	0.02	0.02%
PP	Plastic Pipe	211	0.04	0.04%
PVC	Polyvinyl Chloride Pipe	15,060	2.85	2.72%
PVC/VCP	Polyvinyl Chloride Pipe/Vitrified Clay Pipe	301	0.06	0.05%
VCP	Vitrified Clay Pipe	168,768	31.96	30.44%
VCP/CI	Vitrified Clay Pipe/Concrete Lined	340	0.06	0.06%
VCP/CP/CI	Vitrified Clay Pipe/Concrete Pipe/Concrete Lined	148	0.03	0.03%
UNK	Unknown	365,672	69.26	65.95%
Total		*554,437*	*105.01*	*100.00%*

The City's sewer pipe infrastructure has also been categorized by pipe diameter, is shown in Table 2-2, with 8-inch gravity main predominating. Gravity mains displayed by diameter are shown in Figure 2-2 at the end of this report. The City's current design standards call for a minimum of 8-inch to be used in future construction of gravity mains, so as infrastructure is improved in the future, the approximately 37 percent of the system that is 6-inch pipeline, will eventually be replaced by gravity mains of 8-inch diameter or larger.

Table 2-2 - Gravity Main by Diameter

Diameter (in)	Total Length (ft)	Total Length (miles)	Percentage of City Gravity Mains by Length
6	205,733	38.96	37.11%
8	257,003	48.67	46.35%
10	31,173	5.90	5.62%
12	20,365	3.86	3.67%
15	16,445	3.11	2.97%
18	8,932	1.69	1.61%
24	8,286	1.57	1.49%
27	3,485	0.66	0.63%
33	2,106	0.40	0.38%
36	910	0.17	0.16%
Total	*554,437*	*105.01*	*100.00%*

2.1.2 Lift Stations

The City owns two (2) lift stations, both on the east side of the City. The northern lift station contains two (2) submerged 6-inch (inner diameter), 15 horsepower pumps and is located at 14th St and Tidelands Ave. The wet well for this lift station is sized 13' by 25'. The southern lift station is located at 24th St and Tidelands Ave, and contains two (2) above ground pumps. Further information on the southern lift station was not available during the preparation of this report.

2.1.3 Force Mains

The City owns two (2) force mains, both on the east side of the City. The 10-inch force main extending along 24th St is approximately 1,300 feet long and carries flow from the southern lift station. The force main along Tidelands Ave has a 10-inch diameter and is approximately 25 feet long, carrying flow from the northern lift station.

CHAPTER 3. WASTEWATER FLOW PROJECTIONS

IEC completed the City's *2008 Sewer System Hydraulic Analysis*, in July 2009, which had developed wastewater flow projections for the Existing (2007), 5-Year (2012), 10-Year (2017) and 20-Year (2027) time increments.

After completion and analysis of the recommended flow monitoring program in 2009, IEC calculated new average dry weather flow (ADWF) for the Existing (2009) time increment and determined new peak dry weather flow (PDWF) and peak wet weather flow (PWWF) curves. As summarized in Table 3-7, the Existing (2009) average dry weather flow (ADWF) of 4.22 million gallons per day (mgd), with treatment costs attributed to the City, is anticipated to increase by 56 percent, reaching 6.57 mgd in 2027.

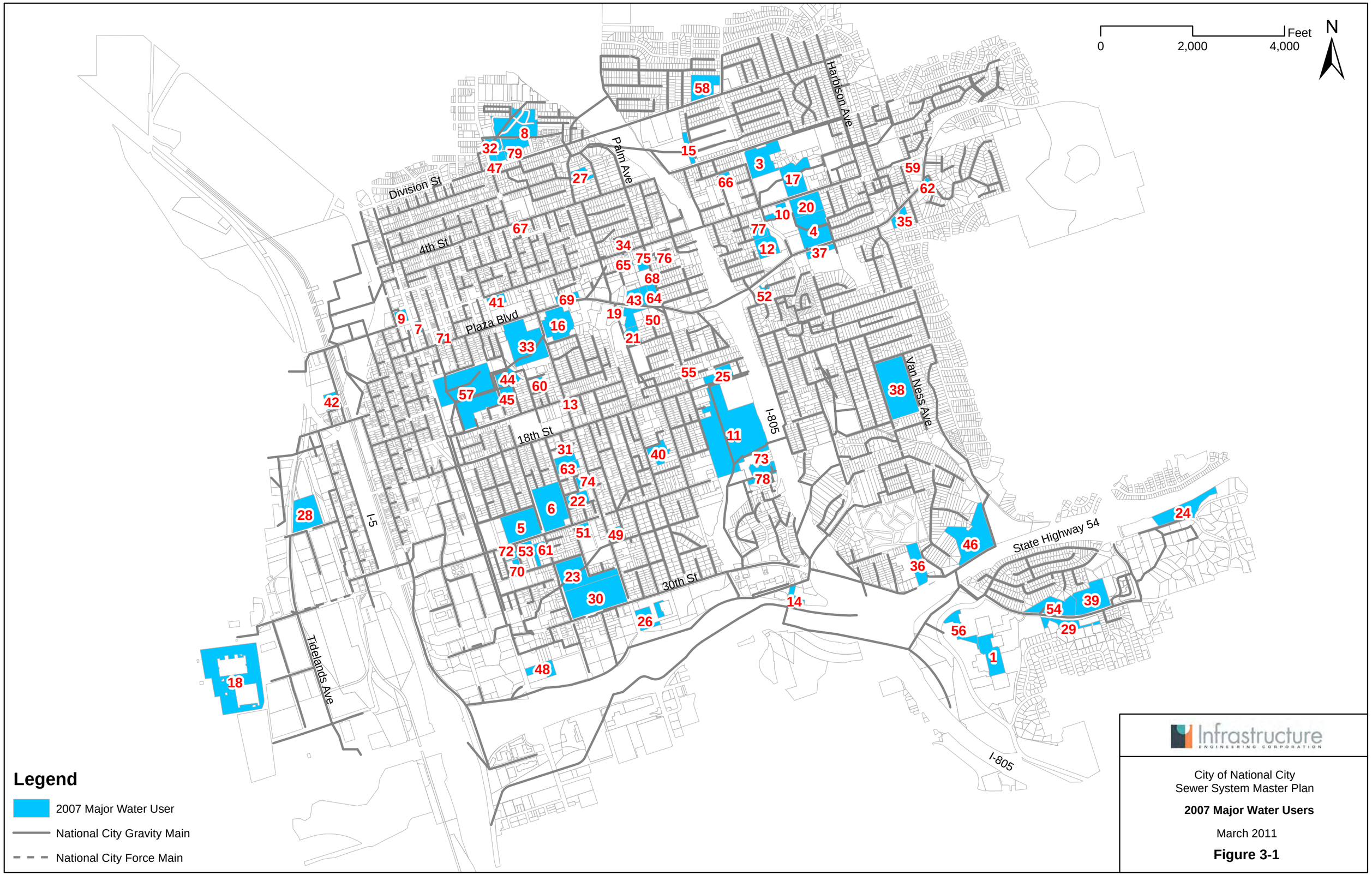
3.1 2007 AVERAGE DRY WEATHER WASTEWATER FLOW

IEC completed the City's *2008 Sewer System Hydraulic Analysis*, in July 2009, which includes wastewater flow projections for the Existing (2007), 5-Year (2012), 10-Year (2017) and 20-Year (2027) time increments. Average Dry Weather Flow (ADWF), or base flow, is domestic (or sanitary) wastewater flow from residential, commercial, and institutional (schools, churches, hospitals, etc.) sources, plus industrial wastewater. The wastewater flow is affected by population and land uses in an area. Wastewater flow varies throughout the day in response to personal habits and business operation. In this case, these flows were estimated by multiplying water demands by Return-To-Sewer (RTS) ratios based on land use and wastewater basin.

To calculate the City's 2007 ADWF, 2007 average daily water demands, as supplied by Sweetwater Authority, were allocated to individual parcels in the City's service area. 2007 water billing records were analyzed and a list of the Major Water Users, with average daily water demands greater than 10,000 gallons per day (gpd), was compiled. As presented in Table 3-1, there were 80 Major Users accounting for 1.9 mgd of the City's total water demand. These Major Users are illustrated in Figure 3-1.

Each parcel's average daily water demand was then multiplied by a corresponding RTS ratio, based on land use and sewer basin. For residential parcels, Multiple (R-4) had the highest RTS ratio of 0.80, followed by Restricted Multiple (R-3) with 0.75, Minor Multiple (R-2) with 0.71, and finally Single Family Residential (R-1) with a RTS of 0.66. Industrial (M zone) received a RTS of 0.90, Special and/or Misc. used 0.71, and Unzoned was 0.64. Commercial areas used a RTS of 0.73 or 0.60 corresponding to Restricted Commercial, with the exception of the Plaza Bonita Commercial area that utilized a RTS of 0.56 due to large scale landscaping. Several flow monitor areas utilized different RTS ratios or were calculated separately based on special cases within the zone. NC2 and NC3B ratios were derived from the above ratios using a factor of 0.743 and 0.851 respectively in order to account for higher landscaping demands in these areas.

ADWF for the parcels tributary to flow monitors NC13 and NC16 were calculated based on acreage and land use. Within zone NC13, Commercial areas received 3194 gpd/ac, while Single Family and Unzoned were assigned 1198 gpd/ac. For NC16 wastewater was assigned as follows: Commercial – 1267 gpd/ac, Industrial – 1742 gpd/ac, Minor Multiple (R-2) and Restricted Residential (R-3) – 634 gpd/ac, Multiple Residential (R-4) – 792 gpd/ac and finally Single Family and Unzoned – 475 gpd/ac. Once wastewater flow was determined for each flow monitor area, the estimated flow was then compared to the ADS Flow Monitor readings to ensure calibration of the hydraulic model.



Legend

- 2007 Major Water User
- National City Gravity Main
- National City Force Main

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City of National City
Sewer System Master Plan

2007 Major Water Users

March 2011

Figure 3-1

Table 3-1 - 2007 Major Water Users in the City of National City

2007 Major User ID	Customer Number	Service Name	Service Address	Meter Type	2007 Average Daily Water Bill Demand (gpd)	2007 Average Daily Water Demand (gpd)
1*	901-2000-0	NAVY PUBLIC WORKS CTR CODE 611	W END W 19TH ST	Government	146,835	146,835
2	902-2100-1	WESTFIELD SHOPPINGTOWN PLAZA BONITA	3030 PLAZA BONITA RD	Commercial	48,987	97,010
	902-2000-1				48,024	
3	541-4700-0	PARADISE VALLEY HOSPITAL	2400 E 4TH ST / 655 EUCLID AVE	Commercial	82,612	86,338
	541-2850-0				1,914	
	553-0980-0				1,812	
4	901-8200-1	PLAZA MANOR PRESERVATION LP	2617 - 2721 E PLAZA BLVD	MF Residential	65,117	85,481
	901-8190-1				20,364	
5	901-1500-0	AFL-CIO BLDG TRADES	309 E 24TH ST	MF Residential	80,776	80,776
6	902-2000-0	WESTFIELD SHOPPINGTOWN PLAZA BONITA	3030 PLAZA BONITA RD	Commercial	34,597	72,796
	902-2100-0				29,805	
	902-2110-0				8,394	
7	901-1000-0	AFL-CIO BLDG TRADES	525 E 24TH ST	MF Residential	72,714	72,714
8	131-2870-0	RADISSON SUITES HOTEL/ PACIFIC BAYVIEW LLC	801 NATIONAL CITY BLVD	Commercial	23,959	68,767
	131-2830-0				21,614	
	131-2870-2				13,638	
	131-2830-2				9,556	
9	100-1420-1	PARK VILLAS	817 ETA ST	MF Residential	16,911	68,691
	100-1240-1				15,630	
	100-1300-1				13,749	
	100-1360-1				10,529	
	100-1180-1				7,064	
	100-1120-1				4,808	
10	109-1682-1	HOLIDAY INN/ PACIFICA HARBORVIEW ONE LP	700 NATIONAL CITY BLVD	Commercial	15,192	49,774
	109-1682-2				13,534	
	109-1684-2				10,693	

Table 3-1 - 2007 Major Water Users in the City of National City

2007 Major User ID	Customer Number	Service Name	Service Address	Meter Type	2007 Average Daily Water Bill Demand (gpd)	2007 Average Daily Water Demand (gpd)
10	109-1684-1	HOLIDAY INN/ PACIFICA HARBORVIEW ONE LP	700 NATIONAL CITY BLVD	Commercial	10,355	49,774
11	541-2100-2	CHATEAU GARDENS APARTMENTS	2424 E 8TH ST	MF Residential	14,442	38,410
	541-2100-3				10,234	
	541-2200-3				7,416	
	541-2200-2				6,318	
12	511-1140-0	CITY OF NATIONAL CITY P/W	1780, 1800, 1810 E 22ND ST & 2100-2200 NEWELL ST	Government	13,368	35,258
	511-1300-1				9,025	
	511-1130-0				7,964	
	511-1260-0				4,043	
	511-1240-0				564	
	511-1180-1	NATIONAL CITY GOLF COURSE	1780 E 22ND ST	Golf Course	295	
13	541-1600-0	NATIONAL MANAGEMENT	910 EUCLID AVE	MF Residential	12,894	34,451
	541-1400-0				9,624	
	541-1700-0				7,769	
	541-1800-0				4,164	
14	164-2660-2	J C LAUNDRY GROUP INC	1605 HIGHLAND AVE	Commercial	17,487	34,416
	164-2660-1				16,929	
15	501-1220-0	HOLIDAY SPA HEALTH #604-01	1910 SWEETWATER RD	Commercial	25,530	33,609
	501-1220-1				8,078	
16	515-0580-0	CITY OF NATIONAL CITY P/W	226 U AVE	Government	31,549	32,047
	515-0540-0				498	
17	192-5950-1	HOMETOWN BUFFETT #714/ CAL-AMERICAN/ SHOWBIZ PIZZA PL #439/ WATERMILL EXPRESS	1135, 1143, 1145 HIGHLAND AVE & 910, 986 E PLAZA BLVD	Commercial	9,775	30,988
	192-5740-1				9,443	
	192-5950-0				8,814	
	192-5900-2				2,103	

Table 3-1 - 2007 Major Water Users in the City of National City

2007 Major User ID	Customer Number	Service Name	Service Address	Meter Type	2007 Average Daily Water Bill Demand (gpd)	2007 Average Daily Water Demand (gpd)
17	192-5720-0	HOMETOWN BUFFETT #714/ CAL-AMERICAN/ SHOWBIZ PIZZA PL #439/ WATERMILL EXPRESS	1135, 1143, 1145 HIGHLAND AVE & 910, 986 E PLAZA BLVD	Commercial	541	30,988
	192-5940-2				311	
18	541-2700-1	PARADISE VLY HEALTH CARE CTR	2575 E 8TH ST	Commercial	29,356	29,356
19	901-3000-0	SAN DIEGO UNIFIED PORT DIST	24TH AT QUAY	Government	25,975	25,975
20	192-6301-3	CENTRE DEVELOPMENT LLC	1302 E PLAZA BLVD	Commercial	25,520	25,520
21	901-8000-0	PARADISE HILLS ASSOCIATES	2606-2728 E 8TH ST	MF Residential	24,977	24,977
22	175-0660-2	BAY PLAZA LLC/ FORTUNE COMMERCIAL CORP	1420 E PLAZA BLVD	Commercial	22,053	24,543
	175-0740-4				1,928	
	175-0620-3				562	
23	169-2261-0	NATIONAL MANAGEMENT	700 E 22ND ST	MF Residential	23,965	23,965
24	191-3541-0	NC SCH DIST SWEETWATER HIGH SCHOOL	ES D AVE AT 27TH	Government	23,163	23,163
25	834-1940-3	PARK BONITA APARTMENTS	3501-3549 VALLEY RD	MF Residential	4,886	23,047
	834-2180-3				4,213	
	834-1780-3				4,107	
	834-2020-3				3,049	
	834-1540-3				2,715	
	834-1620-3				2,162	
	834-2100-3				1,914	
26	512-1180-0	B-L ENTERPRISES	1715, 1831 E 18TH ST & 1826 E 17TH ST	MF Residential	4,746	20,921
	512-0700-0				4,361	

Table 3-1 - 2007 Major Water Users in the City of National City

2007 Major User ID	Customer Number	Service Name	Service Address	Meter Type	2007 Average Daily Water Bill Demand (gpd)	2007 Average Daily Water Demand (gpd)
26	512-0660-0	B-L ENTERPRISES	1715, 1831 E 18TH ST & 1826 E 17TH ST	MF Residential	4,136	20,921
	512-0740-0				3,851	
	512-0620-0				3,828	
27	177-2474-3	BROADWAY/ SWEETWATER SQUARE LLC	3007 HIGHLAND AVE	Commercial	4,752	20,887
	177-2474-2				4,429	
	177-2400-1				3,426	
	177-2520-4				1,541	
	177-2520-3				1,492	
	177-2400-0				1,328	
	177-2478-3				1,051	
	177-2560-3				838	
	177-2476-3				611	
	177-2476-2				529	
	177-2472-2				352	
	177-2560-2				316	
	177-2220-4				172	
	177-2478-4				27	
	177-2470-3				12	
	177-2470-2				10	
28	101-7060-4	PROGRESS MANAGEMENT	203 LAUREL AVE	MF Residential	11,794	19,860
	101-8140-4				8,066	
29	152-3320-0	COSTCO WHOLESALE V#92978-00	1001 W 19TH ST	Commercial	10,066	19,534
	152-3300-1				9,468	
30	581-0795-1	BONITA CREEK HOA	3401 PASEO DE PAZ	MF Residential	2,428	18,716
	581-0741-1				1,873	
	581-0821-1				1,846	
	581-0751-1				1,644	
	581-0711-1				1,512	

Table 3-1 - 2007 Major Water Users in the City of National City

2007 Major User ID	Customer Number	Service Name	Service Address	Meter Type	2007 Average Daily Water Bill Demand (gpd)	2007 Average Daily Water Demand (gpd)
30	581-0791-1	BONITA CREEK HOA	3401 PASEO DE PAZ	MF Residential	1,350	18,716
	581-0771-1				1,328	
	581-0831-1				1,307	
	581-0793-1				1,291	
	581-0781-1				1,131	
	581-0761-1				1,027	
	581-0731-1				576	
	581-0721-1				555	
	581-0700-2				531	
	581-0753-1				316	
31	191-3860-0	NC SCH DIST SWEETWATER HIGH SCHOOL	2900 HIGHLAND AVE	Government	8,908	18,208
	171-6000-0				4,381	
	171-6010-0				3,892	
	171-3070-0				947	
	171-3055-0				80	
32	169-3580-2	NATIONAL MANAGEMENT	1917 F AVE	MF Residential	18,194	18,194
33	100-0440-1	ALL NICKS LAUNDERLAND/ ENS MANAGEMENT LLC	51-151 N HIGHLAND AVE	Commercial	11,960	18,050
	100-0400-1				3,004	
	100-0480-1				2,572	
	100-0600-1				324	
	100-0620-1				191	
34	144-0580-7	WAL-MART STORE # 01-5023	1100 HIGHLAND AVE	Commercial	17,335	17,335
35	121-5081-1	TREVOR THOMAS ENTERPRISES LLC/ MOYER, WAYNE	1417 E 8TH ST	Commercial	9,181	16,772
	121-5081-2				7,591	
36	549-0500-4	WASH AMERICA INC/ KIM, SHAN	3126-3154 PLAZA BLVD	Commercial	12,236	16,735
	549-0620-2				3,525	
	549-0540-2				973	

Table 3-1 - 2007 Major Water Users in the City of National City

2007 Major User ID	Customer Number	Service Name	Service Address	Meter Type	2007 Average Daily Water Bill Demand (gpd)	2007 Average Daily Water Demand (gpd)
37	576-1500-2	REXMERE LAKE VILLAGE LLC/ BONITA VISTA	2621 SWEETWATER RD	Mobile Homes	16,735	16,735
38	541-0680-3	NC GALLERIA	2720 E PLAZA BLVD	Commercial	16,651	16,651
39	563-1700-0	NC SCH DIST GRANGER JR HIGH SCHOOL	2101 GRANGER AVE	Government	16,640	16,640
40	581-4480-0	BONITA PARK HOA	3612-3804, 3733 FAIRLINDO WAY & 3640, 3702 FAIRLOMAS RD	MF Residential	3,324	16,354
	581-4200-0				2,990	
	581-4320-0				2,326	
	581-4360-0				1,814	
	581-4520-0				1,771	
	581-4440-0				1,676	
	581-4280-1				1,443	
	581-4400-0				785	
	581-4242-0				225	
41	167-0580-0	INTER CITY MANOR APT/ LINARES, MANUEL	2043-2123 L AVE	MF Residential	7,910	15,851
	167-0500-0				4,695	
	167-0540-0				2,340	
	167-0620-0				830	
	167-3820-2				76	
42	131-4260-1	FINBERG, FRED	801 E AVE	Commercial	8,029	15,788
	131-4240-6	J'S LAUNDRY LAND	550 E 8TH ST	Commercial	7,759	
43	152-1200-4	HANSON AGGREGATE PACIFIC SOUTHWEST	601 W 12TH ST	Commercial	14,780	14,780
44	125-4860-3	SATHAPOME, KHAMPHOU/ PLAZA SQUARE LTD/ FSC FOODS CORP/ BASKIN ROBBINS	1401 & 1493 E PLAZA BLVD	Commercial	8,755	14,521
	125-4940-1				2,890	
	125-5100-8				2,150	
	125-4900-4				541	
	125-4900-3				186	

Table 3-1 - 2007 Major Water Users in the City of National City

2007 Major User ID	Customer Number	Service Name	Service Address	Meter Type	2007 Average Daily Water Bill Demand (gpd)	2007 Average Daily Water Demand (gpd)
45	151-1700-0	COMM DEV - KIMBALL TOWERS	1317 D AVE	MF Residential	9,587	14,503
	151-1660-0				4,916	
46	901-6000-0	MORGAN TOWERS	1415 D AVE	MF Residential	14,341	14,341
47	902-1010-1	BO PARADISE MOBIL HOME PARK	WS CALLE ABAJO	Mobile Homes	14,319	14,319
48	100-0860-1	PROGRESS MANAGEMENT	31 & 131 N HIGHLAND AVE	MF Residential	7,748	14,239
	100-0820-1				6,490	
49	193-1700-6	METZGER, REINHOLD/ OLSON, ALLAN	3221 NATIONAL CITY BLVD	Mobile Homes	13,019	14,048
	193-1700-7				1,029	
50	174-3920-2	OCNNN PROPERTIES, LLC/ HIGHLANDERS SENIOR RESIDENCE	2525 HIGHLAND AVE	Commercial	7,433	13,933
	174-3930-1				3,236	
	174-3920-1				2,252	
	174-3940-4				605	
	174-3940-5				258	
	174-3930-2				150	
51	175-0860-1	PACIFIC CASTLE BAY PLAZA LLC	1430 E PLAZA BLVD BLDG E	Commercial	4,621	13,780
	175-1540-6				3,543	
	175-1220-2				1,160	
	175-1260-10				1,051	
	175-0780-1				840	
	175-1380-5				777	
	175-1380-4				607	
	175-0940-1				285	
	175-1180-6				225	
	175-1340-11				219	
	175-1300-4				215	
	175-0820-1				117	
	175-1340-10				45	

Table 3-1 - 2007 Major Water Users in the City of National City

2007 Major User ID	Customer Number	Service Name	Service Address	Meter Type	2007 Average Daily Water Bill Demand (gpd)	2007 Average Daily Water Demand (gpd)
51	175-0980-1	PACIFIC CASTLE BAY PLAZA LLC	1430 E PLAZA BLVD BLDG E	Commercial	27	13,780
	175-1060-2				23	
	175-1500-3				14	
	175-1420-2				10	
52	171-4580-2	CURREN, WILLAIM S	608 E 24TH ST	MF Residential	7,197	13,778
	171-4620-2				6,580	
53	557-0660-0	GROVE PLAZA LTD	2220 E PLAZA BLVD	Commercial	13,626	13,626
54	196-3460-1	WINDSOR CARE CENTER NC INC	220 E 24TH ST	Commercial	13,560	13,560
55	581-4000-0	BONITA PARK HOA	3231-3511, 3328-3512 FAIRLOMAS RD	MF Residential	2,166	13,450
	581-4800-0				1,807	
	581-4160-0				1,697	
	581-4560-0				1,482	
	581-4080-0				1,281	
	581-4680-0				1,072	
	581-4720-0				867	
	581-4600-0				857	
	581-4120-0				744	
	581-4760-0				672	
	581-4040-0				518	
	581-4650-0				287	
56	512-1860-6	QUIOGUI, NONIE/ 16 PALMS LLC	1629 PALM AVE	MF Residential	7,714	13,444
	512-1860-5				5,730	
57	581-5210-0	OUTBACK STEAKHOUSE #0582	2980 PLAZA BONITA RD	Commercial	6,652	13,056
	581-5200-0				6,404	
58	136-2620-0	CITY OF NATIONAL CITY	130 & 340 E 12TH ST	Government	10,013	12,997
	136-2540-0				1,381	
	143-4180-0				1,086	
	151-1600-0				516	

Table 3-1 - 2007 Major Water Users in the City of National City

2007 Major User ID	Customer Number	Service Name	Service Address	Meter Type	2007 Average Daily Water Bill Demand (gpd)	2007 Average Daily Water Demand (gpd)
59	525-5420-5	NATIONAL CITY PLAZA LLC	4-36 N EUCLID AVE	Commercial	6,619	12,702
	525-5800-0				1,693	
	525-5620-2				1,119	
	525-5180-0				1,004	
	525-5700-6				717	
	525-5340-3				420	
	525-5540-1				371	
	525-5260-5				324	
	525-5580-6				199	
	525-5460-3				90	
	525-5220-7				86	
	525-5300-7				41	
	525-5500-6				18	
60	549-2130-0	NORDAN PLAZA/ NORMY'S HAIR STYLING	3400 E 8TH ST	Commercial	8,828	12,638
	549-2130-1				3,810	
61	144-2810-0	TELACU HOUSING-NAT'L CITY INC	650 E 14TH ST	MF Residential	8,025	12,515
	144-2815-0				4,490	
62	191-0900-5	H VIEW RESIDENCIES LLC	2420 D AVE	MF Residential	7,076	12,443
	191-0500-11				3,910	
	191-0500-12				1,457	
63	556-3340-7	ILLINOIS ST LLC/ MANCHESTER HILLS 29 LLC	900-910 MANCHESTER	MF Residential	7,306	12,224
	556-3340-8				4,918	
64	169-3260-10	PROFESSIONAL REAL ESTATE MANAGEMENT	2005 F AVE	MF Residential	6,574	12,171
	169-3380-11				5,597	
65	125-4820-3	HA PENNY INN	1535 E PLAZA BLVD	Commercial	12,060	12,060
66	125-1820-3	MC DONALD, ZORA	1442 E 8TH ST	MF Residential	11,945	11,945
67	515-2860-1	GHC OF NATIONAL CITY II LLC	541 S V AVE	Commercial	11,847	11,847

Table 3-1 - 2007 Major Water Users in the City of National City

2007 Major User ID	Customer Number	Service Name	Service Address	Meter Type	2007 Average Daily Water Bill Demand (gpd)	2007 Average Daily Water Demand (gpd)
68	117-2060-4	GUERRERO, CLARISSA/ ALVES JR, JOHN F	404 I AVE	MF Residential	5,757	11,511
	117-2060-3				5,754	
69	125-4740-6	PINEWOOD APARTMENTS	1104 PALM AVE	MF Residential	11,499	11,499
70	125-5380-4	PERFORMANCE PROPERTY MANAGMENT	925-1105 E PLAZA BLVD	Commercial	5,879	11,470
	125-5340-9				5,591	
71	196-3180-5	GOLDEN TREE APARTMENTS	2500, 2510, 2520, 2530 B AVE	MF Residential	3,201	11,341
	196-3220-5				3,039	
	196-3140-5				2,744	
	196-3100-6				2,357	
72	131-1860-3	MASON FAMILY PROPERTIES LLC	930 B AVE	MF Residential	5,961	11,337
	131-1860-4				5,375	
73	196-2940-5	GOLDEN TREE APARTMENTS	2400, 2410, 2420, 2430 B AVE	MF Residential	3,246	11,228
	196-2980-5				2,912	
	196-3020-5				2,578	
	196-3060-5				2,492	
74	511-2140-3	LAS PALMAS PARK VILLAS HOA	1904, 1905, 1915, 1925 VIA LAS PALMAS	MF Residential	2,857	11,224
	511-2020-3				2,580	
	511-2260-3				1,857	
	511-2180-3				1,795	
	511-2220-3				1,484	
	511-2060-3				652	
75	169-2660-3	LEWIS, THOMAS L	2115-2145 G AVE	MF Residential	5,691	11,179
	169-2700-3				5,488	
76	125-2310-0	PALM AVE INVESTORS LTD	900 PALM AVE	MF Residential	6,156	11,138
	125-2300-3				4,982	
77	513-1580-9	ALOHA VILLAGE APTS	1604 E 9TH ST	MF Residential	11,031	11,031
78	523-3140-2	GHC OF NATIONAL CITY I LLC	902 EUCLID AVE	Commercial	7,669	10,859
	523-2240-1				3,191	

Table 3-1 - 2007 Major Water Users in the City of National City

2007 Major User ID	Customer Number	Service Name	Service Address	Meter Type	2007 Average Daily Water Bill Demand (gpd)	2007 Average Daily Water Demand (gpd)
79	511-1900-4	PACIFIC PALMS HOMEOWNERS ASSN	1842-1928, 1935 VIA LAS PALMAS	MF Residential	2,676	10,517
	511-1820-4				2,519	
	511-1980-4				2,166	
	511-1780-4				1,769	
	511-1860-4				916	
	511-1940-4				471	
80	100-1000-3	HAPPY HOLLOW MOBILE HOME PARK	999 E DIVISION ST	Mobile Homes	10,234	10,234
Total					***1,902,791***	***1,902,791***

3.2 EXISTING (2009) AVERAGE DRY WEATHER WASTEWATER FLOW

Recent economic conditions have had a significant impact on the people and businesses within the City. Accordingly, wastewater flow projections based on 2007 water usage do not accurately describe the quantities of existing wastewater flows. As shown in Table 3-2, four weeks of ADS flow monitor data was compared to the same flow meters in 2007, with any rain events excluded. As the differences in the 2007 and 2009 ADS flow meter data illustrates, the 2007 wastewater flow projects varied significantly by basin from those projected in 2007.

Table 3-2 - 2007 and 2009 Average Dry Weather Flow Comparison

Flow Monitor	ADWF (gpd)		Difference (gpd)
	2007	Existing (2009)	
NC2	393,732	434,000	-40,268
NC3A	3,415,425	2,782,000	633,425
NC3B	571,287	722,000	-150,713
NC4M	284,678	403,000	-118,322
NC5	840,475	1,095,000	-254,525
NC6	28,963	15,000	13,963
NC7M	1,387,498	1,418,000	-30,502
NC8M	101,369	101,000	369
NC9M	681,286	673,000	8,286
NC10	1,295,466	1,135,000	160,466
NC11	58,386	50,000	8,386
NC12	340,989	338,000	2,989
NC13	33,250	21,000	12,250
NC15	163,499	134,000	29,499
NC16	222,297	249,000	-26,703
Total	***9,818,600***	***9,570,000***	***248,600***

3.2.1 Duty Factors

The 2009 Average Dry Weather Flows by sewer basin were recalculated to correspond to the observed Existing (2009) ADWF obtained for each ADS Flow Meter. Wastewater duty factors indicate the amount of wastewater flow per gross parcel area expected from a specific land use. The average dry weather flow for each ADS Meter was attributed to a basin and wastewater duty factors were developed by integrating land acreage, land use classifications, flow monitoring data and GIS data available during this Master Plan. Table 3-3 displays basic land use duty factors that were applicable across all sewer basins and Table 3-4 shows duty factors that applied to specific land uses in specific sewer basins in National City, in order to match recorded basin flows.

Table 3-3 –Land Use Duty Factors

Land Use	Duty Factor (gpd/ac)
Commercial	2,150
Industrial (M zone)	1,400
Minor multiple (R-2)	1,850
Multiple residential (R-4)	2,550
Restricted commercial	1,250
Restricted multiple (R-3)	2,150
Single family residential (R-1)	1,300
Special and/or misc.	1,100
Unzoned	250

Table 3-4 – Basin-Specific Land Use Duty Factors

Land Use	Duty Factor (gpd/ac)
NC2	
Commercial	700
Industrial (M zone)	500
Minor multiple (R-2)	1,275
Multiple residential (R-4)	1,750
Restricted multiple (R-3)	1,475
Single family residential (R-1)	900
Special and/or misc.	500
Unzoned	200
NC3A	
Commercial	1,100
Industrial (M zone)	900
Special and/or misc.	500
NC3B	
Unzoned	1,350
NC5	
Commercial	4,750
Industrial (M zone)	3,500
Special and/or misc.	2,400
Unzoned	800
NC7M	
Commercial	2,775
Special and/or misc.	2,400
Unzoned	800
NC8M	
Commercial	1,400
NC13	
Unzoned	200
NC15	
Restricted multiple (R-3)	1,475
Single family residential (R-1)	900

3.3 AVERAGE DRY WEATHER WASTEWATER FLOWS (ADWF) PROJECTIONS

Flow projections for 2012, 2017 and 2027 were taken from the City's *2008 Sewer System Hydraulic Analysis*. In this analysis, once the ADWF was established for 2007 conditions, SANDAG population projections by census tract were utilized to create projected annual growth rates. These growth rates were interpolated and then applied to the existing ADWF wastewater flows to generate the 2012 (5-Year), 2017 (10-Year) and 2027 (20-Year) wastewater flow projections. When available, specific plans were utilized in the more immediate time-increments. El Centro, a portion of the Downtown Specific Plan, is assumed to reach build-out in the 2012 time increment. The remaining portions of the Downtown Specific Plan are assumed to develop at the appropriate SANDAG census tract rate, with build-out anticipated in the 2027 time-increment. The Richard A. Reynolds Groundwater Desalination Facility is not anticipated to affect existing National City gravity mains, as it is assumed that the Desalination Facility will construct a separate, parallel gravity main, to convey their discharge directly to the SMI. The projected ADWF in gpd at each ADS Flow Meter site is presented below in Table 3-5.

Table 3-5 - Projected ADWF by ADS Flow Meter

Flow Meter	ADWF (gpd)				
	2007	Existing (2009)	2012	2017	2027
NC2	398,131	465,348	414,289	443,373	509,944
NC3A	3,426,126	2,863,831	3,695,641	4,033,664	4,572,693
NC3B	553,247	690,913	565,527	568,759	654,719
NC5	791,092	1,010,193	923,587	1,124,592	2,285,377
NC6	28,438	15,000	40,718	57,522	69,802
NC7M	1,380,533	1,357,266	1,420,605	1,460,030	1,536,296
NM8M	102,118	100,179	109,228	111,167	118,922
NC9M	681,218	673,000	696,730	714,827	741,972
NC10	1,295,219	1,135,000	1,414,142	1,555,039	1,664,266
NC11	58,169	50,000	63,339	69,802	74,973
NC12	341,255	338,000	381,973	458,885	536,443
NC13	33,608	21,328	34,255	34,901	41,364
NC15	162,226	135,727	175,152	177,737	190,664
NC16	221,687	270,807	232,674	244,308	285,026
Un-metered Flow	48,155	48,155	48,155	48,155	48,155

3.3.1 South Metro Interceptor Capacity

The costs of treatment are allocated to the City from the City of San Diego based on, among other things, these ADS Flow Meter readings and previously submitted house counts. Utilizing these equations, Table 3-6 presents the ADWF in the 2007, Existing (2009), 2012, 2017 and 2027 time-increments, whose treatment costs are attributed to the City.

The projected wastewater flows presented in Table 3-6, that will be attributed to National City treatment costs, were used to analyze potential capacity issues for the City in regards to the SMI.

According to City Staff, the City has average daily capacity rights of, at least, 7.10 mgd in the SMI. Based on the most recent *Quarterly Metropolitan Sewage System Billing Invoice*, prepared by the City of San Diego's Metropolitan Wastewater Division and submitted to the City in the First Quarter of 2008, the City is currently utilizing 4.25 mgd of their average daily flow capacity in the SMI.

As shown in Table 3-6, projected average daily wastewater flows with treatment costs allocated to the City are expected to increase 56 percent to 6.57 mgd in the 2027 time increment. Based on these projections, there is no additional SMI capacity required to accommodate the projected daily wastewater flows projected for the 2027 time increment.

Table 3-6 - Projected Flows Attributed to National City Treatment Costs by ADS Flow Meter

Flow Meter	ADWF (gpd) Attributed to National City Treatment Costs					Formula
	2007	Existing (2009)	2012	2017	2027	
NC2*	289,728	347,313	301,406	325,773	372,955	NC2-(NC13*0.6853)-(NC16*0.3674)-(29.6*240)-(12*265)
NC3A	1,745,263	1,354,611	1,849,967	1,963,718	2,310,791	NC3A-NC10-NC11-NC12+(46*265)+(6*265)
NC3B	553,247	690,913	565,527	568,759	654,719	NC3B
NC5	755,685	988,224	875,900	1,060,100	2,208,605	NC5-NC6-(26.3*265)
NC7M	565,887	550,838	590,448	611,776	660,896	NC7M-NC9M-(18*265)-(42*265)-(16*265)-(291*265)-(36*265)-(100.5*265)
NM8M	102,118	100,179	109,228	111,167	118,922	NC8M
NC15	162,226	135,727	175,152	177,737	190,664	NC15
Un-metered Flow	48,155	48,155	48,155	48,155	48,155	((43+47+76.5)*265)+(16.8*240)
Total	**4,222,308**	**4,215,959**	**4,515,781**	**4,867,184**	**6,565,706**	**---**

* - Based on National City being responsible for 31.47 percent of NC13 flow and 63.26 percent of NC16 flow.

3.4 PEAK DRY WEATHER WASTEWATER FLOW (PDWF)

Wastewater flow varies throughout the day in response to personal habits and business operation. Peak Dry Weather Flow (PDWF), which accounts for peak usage patterns and includes estimates of Groundwater Infiltration (GWI). GWI is defined as groundwater entering the collection system through pipe joints and manhole walls due to an aging system or improper construction. The magnitude of GWI depends on the depth of the groundwater table above the pipelines, the percentage of the system submerged, and the physical condition of the system. Variation in groundwater levels in the City is seasonal in nature. The GWI tends to be low during the summer and fall months (dry weather) and increases gradually as the wet weather season progresses. While GWI is affected by rainfall, it responds gradually and is not directly related to any one (1) individual rainfall event. It is assumed that the ADWF and GWI are taken into account in the peak dry weather flow equations. Therefore, no further contingency for these components is necessary.

To calculate PDWF, ADWF was then multiplied by a peaking factor. The 2009 Peak Dry Factor was established based on the data gathered during the *2010 Sewer Flow Monitoring Study* performed by IEC. The curve has moved downward in comparison to the 2007 Peak Dry Factor curve used in the City's *2008 Sewer System Hydraulic Analysis*. Based on the peak factor data in the study, the peak dry weather factor curve was created by graphing the peak dry factor in relation the seven (7) day ADWF. Figure 3-2 shows the equation and curve generated for the 2009 Peak Dry Factor, in mgd; as well as the 2007 Peak Dry Factor.

$$\textbf{Peak Dry Weather Factor} = 1.6487 \times (\textbf{Average Dry Weather Flow Rate})^{-0.035}$$

3.5 PEAK WET WEATHER WASTEWATER FLOW (PWWF)

Peak Wet Weather Wastewater Flow (PPWF) is estimated as Peak Dry Weather Flow (PDWF) plus Rainfall Dependent Infiltration/Inflow (RDI/I). RDI/I is storm water that enters the wastewater collection system in direct response to the intensity and duration of individual rainfall events. RDI/I may recede gradually after a storm; however, any residual flow is considered to be a general increase in GWI.

To calculate PWWF, ADWF was then multiplied by a peaking factor. The peaking factor was established based on the data gathered during the *2010 Sewer Flow Monitoring Study* performed by IEC. The curve has moved upward in comparison to the 2007 Peak Wet Factor curve used in the City's *2008 Sewer System Hydraulic Analysis*. Based on the peak factor data in the study, the peak wet weather factor curve was created by graphing the peak wet factor in relation the seven (7) day ADWF. Figure 3-3 shows the equation and curve generated for the 2009 Peak Wet Factor, in mgd; as well as the 2007 Peak Wet Factor.

$$\textbf{Peak Wet Weather Factor} = 3.0461 \times (\textbf{Average Dry Weather Flow Rate})^{-0.052}$$

Figure 3-2 - Peak Dry Weather Factor Curve

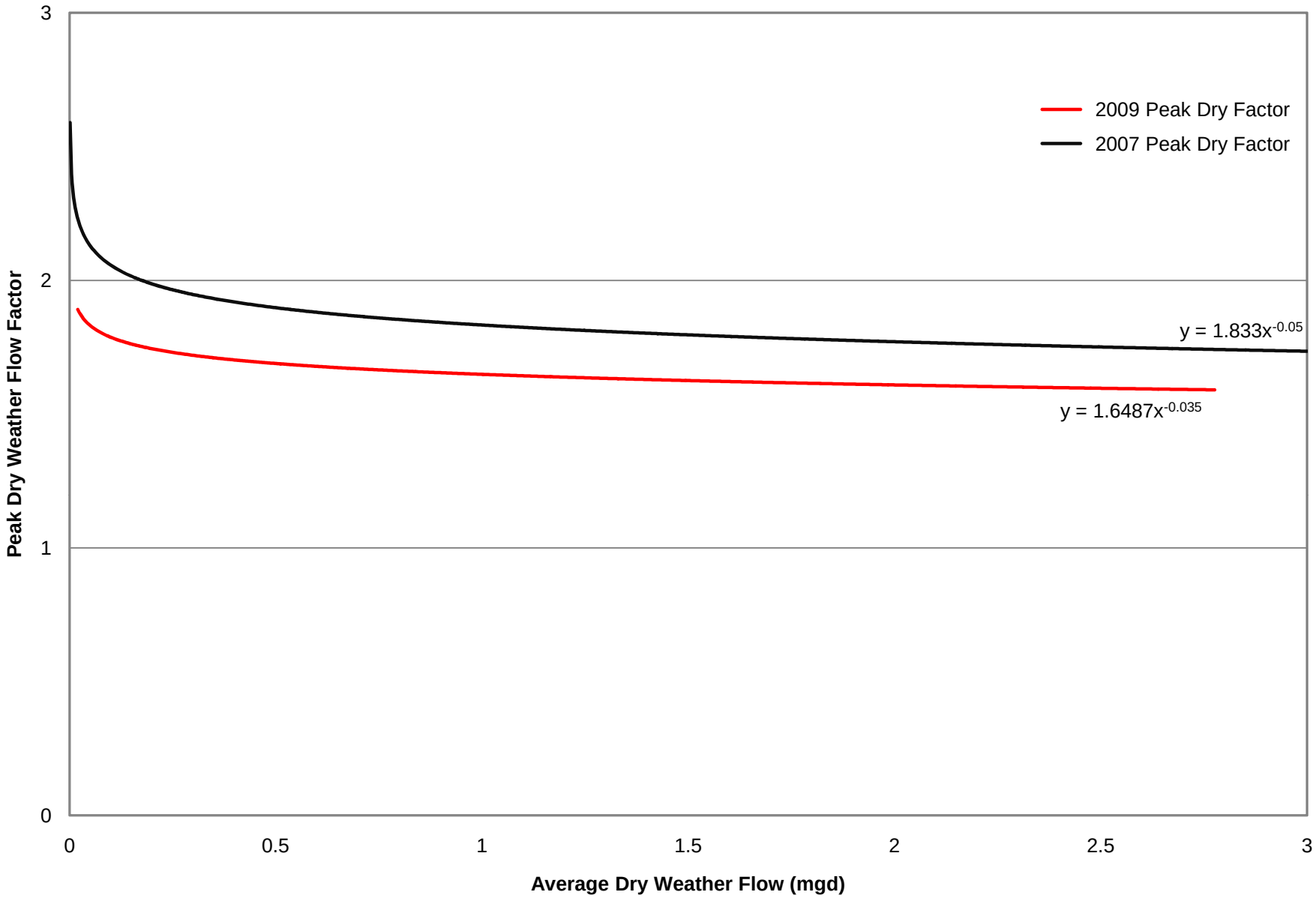
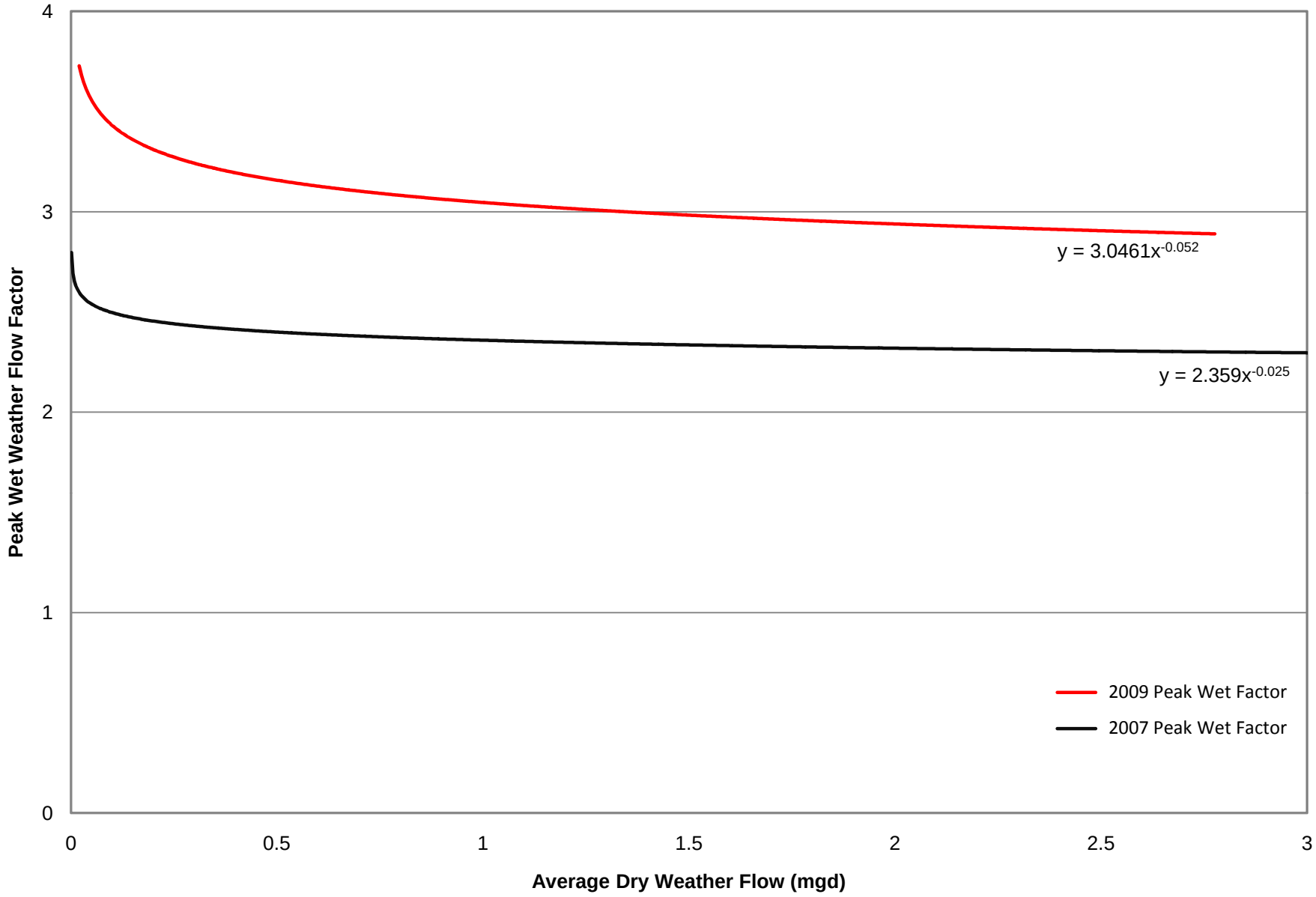


Figure 3-3 - Peak Wet Weather Factor Curve



CHAPTER 4. SEWER COLLECTION SYSTEM CRITERIA

A hydraulic model is the primary tool for evaluating the capacity of the pipes in a sewer collection system. An effective hydraulic model accurately represents collection system facilities and collection system flows for capacity analysis. This chapter describes the selection of system criteria, the development of collection system facilities, and the calculation of flows in the collection system model for the City.

In analyzing a wastewater system, it is necessary to derive standards regarding the amount of flow that may be efficiently conveyed by a given wastewater pipeline. In an effort to provide reliable gravity sewer service while minimizing excessive wear or energy usage through force mains and lift stations, sanitary sewers shall be designed according to the following criteria:

4.1 GRAVITY MAIN DESIGN CRITERIA

Sizing a new pipeline is based on the Manning's equation and the following design criteria:

- Pipes less than 12-inches in diameter: 0.50 full at peak wet weather flow
- Pipes 12-inches in diameter and larger: 0.75 full at peak wet weather flow
- Minimum velocity: 2 feet per second
- Maximum velocity: 10 feet per second
- Manning's n: .013
- Minimum slope requirements for pipes 0.1% (0.001 ft/ft)
- Minimum pipe diameter for new construction: 8 in

4.2 GRAVITY MAIN REPLACEMENT CRITERIA

The National Clay Pipe Institute (NCPI) recommends that smaller pipelines (8" and smaller) be designed to flow at levels not exceeding half-full (d/D=0.50) during peak conditions. For larger pipelines, the tributary area is larger. Local deviation from design wastewater flows tend to balance one another for larger areas, resulting in a closer correlation of actual and design wastewater flows. Consequently, the NCPI recommends that these larger wastewater pipelines should be designed for a d/D not to exceed 0.75.

In analyzing the City's existing sewer gravity mains, it is unnecessary to allow for an excessive factor of safety. This is because the City's sewer basins are largely built out, and future development patterns are relatively certain. As new major wastewater users apply for wastewater service, they should be evaluated on a case-by-case basis, including estimated flow rates and impacts to City-owned sewer facilities. Therefore, City-owned sewer gravity mains may be flowing at levels above a d/D of 0.50 and still be operating satisfactorily.

Remaining pipeline capacity, above d/D = 0.75 has been reserved to handle emergency flows such as I&I beyond that planned for in a design storm, and to provide for ventilation within the pipe. This should not be considered a component of the pipeline capacity.

In an effort to account for the City being mostly built-out and ensure that gravity main segments are replaced due to capacity and flow constraints, the following describes the City's replacement criteria:

- Maximum Peak Wet Weather Flow depth-to-Diameter d/D = 0.75
- Maximum Peak Dry Weather Flow depth-to Diameter d/D = 0.55
  for pipes less than 12-inches in Diameter.
- All pipes requiring replacement shall be designed in
  accordance with the City's design criteria.

In the event that a gravity main satisfies these replacement criteria, but the pipeline immediately upstream requires upsizing, one (1) additional replacement stipulation may be applicable. The purpose of this replacement stipulation is to insure that pipe-reaches increase in diameter as they progress downstream, and prevent, wherever possible, pipe-reaches from fluctuating up and down in diameter. If a gravity main requires upsizing to a diameter larger than the diameter of the gravity main(s) immediately downstream in the same pipe-reach, and the downstream pipe(s) are less than 750 ft in length before conveying flow to a gravity main of equal or larger diameter than the diameter recommended for the deficient upstream gravity main, then the downstream gravity main(s) of less than 750 ft shall be upsized to the same diameter of the upstream pipe.

4.3 FORCE MAINS

- Minimum velocity — 3 feet per second
- Maximum velocity — 5 feet per second
- Maximum Allowable Headloss — 10 ft/1,000 ft of pipeline
- Maximum Desired Headloss — 5 ft/ 1,000 ft of pipeline

4.4 LIFT STATIONS

Lift Stations should be sized for peak wet weather flow with manufacturer's recommended cycling times for pumping equipment and should be sized based upon the following criteria:

- Lift stations should be capable of meeting the criteria with the largest capacity pump serving as standby.
- 65 percent pump efficiency should be assumed, except where other information is available.
- 95 percent motor efficiency should be assumed, except where other information is available.

- Wet well should be sized for a minimum of two (2) hours of peak wet weather flow.
- Lift Stations should have emergency stand-by power.

CHAPTER 5. HYDRAULIC MODEL DEVELOPMENT

IEC utilized MWH Soft, Inc.'s InfoSewer GIS 6.0 software to create a wastewater collection system model for the City. The model was used to evaluate existing City owned wastewater facilities and provide recommendations for upsizing. The main components involved in developing the City's sewer hydraulic model are assigning attribute data to emulate the City's physical facilities and loading Existing (2009) and projected 2012, 2017 and 2027 wastewater flows.

5.1 HYDRAULIC MODEL DEVELOPMENT

The City's most current GIS data, originally developed by PBS&J as part of their previous master planning effort (ssewerpipe2.shp and ssmh2.shp), was utilized as the basis for the model infrastructure. While mostly completed, approximately 150 gravity mains were missing invert information. All City owned wastewater facilities, excluding laterals, were then input into the hydraulic model from this data. This included invert elevations, length, location and diameters for approximately 2,100 gravity mains, as well as two (2) lift stations.

As part of the *2009 Sewer Closed-Circuit Television and Condition Assessment Report*, all missing invert information was obtained. In addition, Affordable Pipelines identified 42 map corrections which IEC incorporated into the hydraulic model, including pipeline alignment and length corrections, as well as missing manholes..

Three (3) steady-state scenarios were created in the hydraulic model for the Existing (2009), 2012, 2017, 2027 time-increments: Average Dry Weather Flow (ADWF), Peak Dry Weather Flow (PDWF) and Peak Wet Weather Flow (PWWF). These scenarios were then loaded with the wastewater flow projections developed on a parcel-level as previously described.

5.2 WASTEWATER HYDRAULIC MODEL CALIBRATION

When calibrating a hydraulic model, the best available metered data is utilized to either confirm or correct the results predicted by the model. The City provided ADS flow meter data for the NC2, NC3A, NC3B, NC4M, NC5, NC6, NC7M, NC8M, NC9M, NC10, NC11, NC12, NC13, NC15 and NC16 meter sites from 01/19/2010 to 02/25/2010. Once ADWF wastewater flow was determined for each flow meter area in the hydraulic model, the estimated flow was then compared to the ADS Flow Meter readings to ensure calibration of the hydraulic model was within 10 percent, as shown in Table 5-1.

Table 5-1 – 2009 Average Dry Weather Flow Monitor Calibration

ADS Flow Monitor	Flow Monitor	Land Use Designation	Total Acreage (ac)	Duty Factor (gpd/ac)	Calculated Flow w/ Duty Factor (gpd)	Calculated Total Flow (gpd)	Measured ADS Flow Monitor ADWF (gpd)	Adjusted Measured ADS Flow Monitor ADWF for City Flows Tributary Directly to Meter (gpd)	Percent Difference Between Calculated and Measured Flow
NC2	NC2	Commercial	59.7	700	41,812	164,757	434,000	153,860	7.1%
	NC2	Industrial (M zone)	53.7	500	26,861				
	NC2	Minor multiple (R-2)	8.7	1,275	11,155				
	NC2	Multiple residential (R-4)	21.3	1,750	37,196				
	NC2	Restricted multiple (R-3)	0.2	1,475	281				
	NC2	Single family residential (R-1)	32.1	900	28,896				
	NC2	Special and/or misc.	1.6	500	799				
	NC2	Unzoned	88.8	200	17,756				
NC3A	NC3A	Commercial	244.0	1,100	268,365	1,340,025	2,782,000	1,272,780	5.3%
	NC3A	Industrial (M zone)	16.1	900	14,504				
	NC3A	Minor multiple (R-2)	55.2	1,850	102,152				
	NC3A	Multiple residential (R-4)	212.7	2,550	542,364				
	NC3A	Restricted commercial	1.1	1,250	1,407				
	NC3A	Restricted multiple (R-3)	0.8	2,150	1,742				
	NC3A	Single family residential (R-1)	280.8	1,300	365,022				
	NC3A	Special and/or misc.	35.1	500	17,569				
	NC3A	Unzoned	107.6	250	26,901				
NC3B	NC3B	Commercial	83.8	2,150	180,085	690,002	722,000	722,000	-4.4%
	NC3B	Industrial (M zone)	67.6	1,400	94,632				
	NC3B	Minor multiple (R-2)	21.5	1,850	39,716				
	NC3B	Multiple residential (R-4)	88.0	2,550	224,373				
	NC3B	Restricted multiple (R-3)	0.1	2,150	305				
	NC3B	Single family residential (R-1)	68.9	1,300	89,538				
	NC3B	Special and/or misc.	3.0	1,100	3,266				
	NC3B	Unzoned	43.0	1,350	58,086				

Table 5-1 – 2009 Average Dry Weather Flow Monitor Calibration

ADS Flow Monitor	Flow Monitor	Land Use Designation	Total Acreage (ac)	Duty Factor (gpd/ac)	Calculated Flow w/ Duty Factor (gpd)	Calculated Total Flow (gpd)	Measured ADS Flow Monitor ADWF (gpd)	Adjusted Measured ADS Flow Monitor ADWF for City Flows Tributary Directly to Meter (gpd)	Percent Difference Between Calculated and Measured Flow
NC5	NC5	Commercial	81.8	4,750	388,716	986,607	1,095,000	1,073,031	-8.1%
	NC5	Industrial (M zone)	108.9	3,500	381,143				
	NC5	Minor multiple (R-2)	0.9	1,850	1,695				
	NC5	Multiple residential (R-4)	59.6	2,550	151,926				
	NC5	Single family residential (R-1)	19.2	1,300	25,006				
	NC5	Special and/or misc.	0.6	2,400	1,529				
	NC5	Unzoned	45.7	800	36,593				
NC7M	NC7M	Commercial	28.3	2,775	78,479	550,833	1,418,000	611,573	-9.9%
	NC7M	Industrial (M zone)	1.2	1,400	1,692				
	NC7M	Minor multiple (R-2)	13.8	1,850	25,526				
	NC7M	Multiple residential (R-4)	40.5	2,550	103,155				
	NC7M	Restricted multiple (R-3)	11.4	2,150	24,489				
	NC7M	Single family residential (R-1)	185.6	1,300	241,246				
	NC7M	Special and/or misc.	13.2	2,400	31,799				
	NC7M	Unzoned	55.6	800	44,448				
NC8M	NC8M	Commercial	71.7	1,400	100,372	100,372	101,000	101,000	-0.6%
NC13	NC13	Commercial	5.8	2,150	12,507	21,717	21,000	21,000	3.4%
	NC13	Single family residential (R-1)	6.3	1,300	8,146				
	NC13	Unzoned	5.3	200	1,064				
NC15	NC15	Multiple residential (R-4)	0.7	2,550	1,774	136,465	134,000	134,000	1.8%
	NC15	Restricted multiple (R-3)	12.0	1,475	17,648				
	NC15	Single family residential (R-1)	127.8	900	115,054				
	NC15	Unzoned	8.0	250	1,988				

Table 5-1 – 2009 Average Dry Weather Flow Monitor Calibration

ADS Flow Monitor	Flow Monitor	Land Use Designation	Total Acreage (ac)	Duty Factor (gpd/ac)	Calculated Flow w/ Duty Factor (gpd)	Calculated Total Flow (gpd)	Measured ADS Flow Monitor ADWF (gpd)	Adjusted Measured ADS Flow Monitor ADWF for City Flows Tributary Directly to Meter (gpd)	Percent Difference Between Calculated and Measured Flow
NC16	NC16	Commercial	41.9	2,150	90,075	271,413	249,000	249,000	9.0%
	NC16	Industrial (M zone)	0.3	1,400	467				
	NC16	Minor multiple (R-2)	22.4	1,850	41,500				
	NC16	Multiple residential (R-4)	23.6	2,550	60,127				
	NC16	Restricted multiple (R-3)	0.6	2,150	1,253				
	NC16	Single family residential (R-1)	48.6	1,300	63,148				
	NC16	Unzoned	59.4	250	14,842				

Flows occurring in the model during the PDWF scenario were compared to peak flows during the 28-day span to make certain that each area was peaking correctly in accordance with the ADS flow meter data. Table 5-2 presents the comparison between the results generated with the InfoSewer steady state scenarios and the recorded ADS flow meter data.

Table 5-2 - Hydraulic Model Calibration

Flow Monitor	ADS Flow Meter Data			Hydraulic Model				
	ADWF (gpd)	PDWF (gpd)	PDPF	ADWF (gpd)	Percent Difference Between Model and Measured Flow	PDWF (gpd)	PDPF	Percent Difference Between Model and Measured Flow
NC2	434,000	645,000	1.49	465,348	7.22%	787,860	1.69	22.15%
NC3A	2,782,000	4,232,000	1.52	2,863,831	2.94%	4,550,718	1.59	7.53%
NC3B	722,000	1,017,000	1.41	690,913	-4.31%	1,154,322	1.67	13.50%
NC5	1,095,000	1,322,000	1.21	1,010,193	-7.74%	1,706,277	1.69	29.07%
NC7M	1,418,000	2,103,000	1.48	1,357,266	-4.28%	2,213,636	1.63	5.26%
NC8M	101,000	169,000	1.67	100,179	-0.81%	179,030	1.79	5.93%
NC13	21,000	33,000	1.57	21,328	1.56%	40,072	1.88	21.43%
NC15	134,000	253,000	1.89	135,727	1.29%	244,308	1.80	-3.44%
NC16	249,000	375,000	1.51	270,807	8.76%	467,287	1.73	24.61%

All average dry weather flows in the hydraulic model are within 10% of those measured by ADS. Sewer basins NC2 and NC16 peak flow predictions in the model registered over 20 percent higher than the ADS flow meter data. NC3B also predicted peak flows 14 percent higher then what was observed in from the ADS meter data. Peak flows at the NC13 meter are 21 percent too high, but due to the low average flow at NC13 (21,000 gpd) this discrepancy is less than 8,000 gpd. Peak predictions at the NC5 meter are also 29 percent too large and it is recommended that the City further investigate flows tributary to meter NC5 and try to identify potentially large base flow infiltration.

CHAPTER 6. HYDRAULIC ANALYSIS

Utilizing the InfoSewer hydraulic model, the ability of City-owned wastewater infrastructure to satisfy the design criteria summarized in *Chapter 4* was evaluated in the Existing (2009), 2012, 2017 and 2027 time-increments. There is 219 gravity mains that are unable to satisfy the City's replacement criteria in 2027, with an additional 41 gravity mains identified for upsizing to ensure that pipe-reaches increase in diameter as they progress downstream. Accordingly, 260 gravity mains are recommended for upsizing by 2027. Replacement diameters for all gravity mains were identified to satisfy the City's design criteria, and accommodate peak flows in 2027. Figure 6-1, placed at the end of this report, illustrates the location of these gravity mains. Specific information for the lift stations and force mains were not available during this study, and have therefore not included in this hydraulic analysis.

6.1 EXISTING (2009) RESULTS

In 2009, 139 gravity mains are unable to satisfy the depth-to-Diameter (d/D) ratio replacement criteria during peak wet weather flow, with an additional 23 gravity mains requiring upsizing to ensure that pipe-reaches increase in diameter as they progress downstream, for a total of 41,850 linear feet. The projected flow rates and corresponding d/D rations for these 162 gravity mains are presented in Table 6-1, with the exception of the 13 pipes shown in Table 6-2, which only fail to satisfy the replacement criteria during the Existing (2009) scenario.

6.2 2012 RESULTS

In 2012, an additional 29 gravity mains are unable to satisfy the d/D ratio replacement criteria during peak wet weather flow, with 9 gravity mains requiring upsizing to ensure that pipe-reaches increase in diameter as they progress downstream, for a total of 9,190 linear feet. These 38 gravity mains are presented in Table 6-3.

6.3 2017 RESULTS

In 2017, an additional 11 gravity mains are unable to satisfy the d/D ratio replacement criteria during peak wet weather flow for a total of 3,075 linear feet. These 11 gravity mains are presented in Table 6-4.

6.4 2027 RESULTS

In 2027, an additional 40 gravity mains are unable to satisfy the d/D ratio replacement criteria during peak wet weather flow, with 9 gravity mains requiring upsizing to ensure that pipe-reaches increase in diameter as they progress downstream, for a total of 14,250 linear feet. These 49 gravity mains are presented in Table 6-5. The 2027 scenario also takes into account the full Downtown Specific Plan being implemented and any upsizing needed in that area.

Table 6-1 - Gravity Mains Unable to Satisfy Criteria in Existing (2009) Conditions

Pipe ID	Existing Diameter (in)	Pipe Length (ft)	Slope	Upstream Manhole ID	Downstream Manhole ID	Average Dry Weather Flow (gpd)	Peak Dry Weather Factor	Peak Dry Weather Flow (gpd)	Peak Dry Weather d/D	Peak Wet Weather Factor	Peak Wet Weather Flow (gpd)	Peak Wet Weather d/D	Replacement Diameter (in)	Replacement Peak Wet Weather d/D
GM1	8	58	0.005	538	534	102,764	1.79	183,554	0.39	3.43	352,243	0.57	10	0.40
GM2	8	310	0.005	534	532	120,861	1.78	214,577	0.42	3.40	411,058	0.62	10	0.44
GM3	8	423	0.007	532	531	126,032	1.77	222,979	0.40	3.39	427,216	0.59	10	0.41
GM4*	8	330	0.024	531	530	126,678	1.77	224,272	0.29	3.39	429,154	0.41	10	0.30
GM5*	8	386	0.045	530	470	127,971	1.77	226,211	0.25	3.39	433,679	0.35	10	0.26
GM6	8	378	0.007	470	469	149,946	1.76	264,344	0.44	3.36	504,127	0.66	10	0.44
GM7	8	305	0.007	469	468	168,042	1.75	294,721	0.47	3.34	561,649	0.71	10	0.47
GM8	8	215	0.005	468	467	169,335	1.76	297,306	0.52	3.34	565,527	1.00	10	0.47
GM9	8	130	0.010	467	466	182,261	1.75	318,634	0.44	3.33	606,245	0.65	10	0.47
GM10	8	196	0.007	466	465	182,908	1.75	319,927	0.49	3.33	608,184	0.76	10	0.47
GM11	8	169	0.007	465	464	186,786	1.75	327,036	0.50	3.33	621,111	0.78	10	0.47
GM12*	8	238	0.038	464	463	197,127	1.75	344,487	0.32	3.32	654,073	0.46	10	0.33
GM13	8	252	0.020	463	462	197,773	1.75	345,780	0.38	3.32	656,012	0.56	10	0.39
GM14	8	470	0.015	462	461	199,712	1.75	349,011	0.42	3.31	661,829	0.61	10	0.43
GM15*	8	401	0.038	461	460	199,712	1.75	349,011	0.33	3.31	661,829	0.46	10	0.33
GM16	8	31	0.017	460	460A	199,712	1.75	349,011	0.41	3.31	661,829	0.59	10	0.42
GM17	6	26	0.011	460A	459	199,712	1.75	349,011	0.76	3.31	661,829	1.00	10	0.47
GM18*	8	293	0.027	459	453	199,712	1.75	349,011	0.36	3.31	661,829	0.51	10	0.36
GM19	6	83	0.044	453	452	199,712	1.75	349,011	0.47	3.31	661,829	0.72	10	0.32
GM20	6	160	0.046	452	451	201,651	1.75	352,243	0.47	3.31	668,292	0.71	10	0.32
GM21	6	140	0.014	451	450	202,944	1.75	354,182	0.70	3.31	672,170	1.00	10	0.44
GM22	6	110	0.001	442	458	50,413	1.82	91,777	0.68	3.54	178,383	1.00	10	0.44
GM23*	6	310	0.010	458	450	51,705	1.81	93,716	0.35	3.54	182,908	0.50	10	0.24
GM24	6	393	0.004	6207	502	675,401	1.67	1,129,116	1.00	3.11	2,099,884	1.00	15	0.67
GM25	15	309	0.001	500	3100	1,270,013	1.64	2,076,617	1.00	3.01	3,821,026	1.00	27	0.62
GM27*	24	125	0.004	3101	591a	1,284,232	1.63	2,099,238	0.32	3.01	3,861,098	0.45	27	0.38
GM28	6	195	0.007	591a	591	1,284,232	1.63	2,099,238	1.00	3.01	3,861,098	1.00	27	0.33
GM29	8	67	0.011	591	10002	1,357,266	1.63	2,213,636	1.00	3.00	4,069,212	1.00	27	0.30
GM30	6	317	0.006	571	585	60,107	1.82	109,228	0.43	3.52	211,346	0.65	8	0.41
GM31	6	130	0.006	585	586	64,632	1.81	116,983	0.45	3.51	226,857	0.68	8	0.43
GM32*	6	190	0.019	586	587	65,278	1.81	118,276	0.33	3.50	228,796	0.48	8	0.31
GM33*	6	78	0.017	587	587a	70,449	1.81	127,324	0.35	3.50	246,247	0.51	8	0.33
GM34	6	136	0.010	587a	591	71,741	1.80	129,263	0.41	3.49	250,125	0.61	8	0.39
GM36	6	330	0.006	1517	1079	62,693	1.81	113,752	0.44	3.52	220,394	0.67	8	0.42
GM37	6	313	0.006	1079	1078	63,985	1.81	115,691	0.44	3.49	223,626	0.66	8	0.41

Table 6-1 - Gravity Mains Unable to Satisfy Criteria in Existing (2009) Conditions

Pipe ID	Existing Diameter (in)	Pipe Length (ft)	Slope	Upstream Manhole ID	Downstream Manhole ID	Average Dry Weather Flow (gpd)	Peak Dry Weather Factor	Peak Dry Weather Flow (gpd)	Peak Dry Weather d/D	Peak Wet Weather Factor	Peak Wet Weather Flow (gpd)	Peak Wet Weather d/D	Replacement Diameter (in)	Replacement Peak Wet Weather d/D
GM38	6	334	0.006	1078	1077	77,558	1.79	138,958	0.50	3.47	268,868	0.78	8	0.47
GM39	6	331	0.009	1077	1076	77,558	1.79	138,958	0.44	3.47	268,868	0.66	8	0.42
GM40*	6	331	0.024	1076	1075	83,375	1.79	149,299	0.35	3.45	287,611	0.51	8	0.33
GM41*	6	286	0.059	1075	1074	84,668	1.79	151,238	0.28	3.45	292,135	0.40	8	0.26
GM42	6	331	0.006	1074	1073	86,606	1.79	155,116	0.53	3.45	298,598	1.00	10	0.36
GM43	6	341	0.024	1073	1071	108,581	1.77	192,602	0.41	3.41	370,340	0.60	10	0.28
GM44	6	322	0.006	1071	1070	109,874	1.78	195,188	0.61	3.41	374,864	1.00	10	0.40
GM45	6	327	0.006	1070	1069	111,813	1.77	198,419	0.62	3.40	380,681	1.00	10	0.41
GM46	6	339	0.006	1069	1067	120,861	1.78	214,577	0.65	3.40	411,058	1.00	10	0.42
GM47	6	331	0.006	1067	1062	128,617	1.77	227,504	0.68	3.39	436,264	1.00	10	0.44
GM48	6	265	0.007	1062	1953	130,556	1.77	230,735	0.67	3.39	442,081	1.00	10	0.43
GM50*	8	272	0.124	1954	1054	131,202	1.77	232,028	0.20	3.38	444,020	0.27	10	0.20
GM56	8	331	0.013	36	37	182,908	1.75	319,927	0.41	3.33	608,184	0.61	10	0.43
GM57	8	389	0.009	37	1883	200,358	1.75	349,657	0.49	3.31	663,121	0.75	12	0.38
GM58	8	269	0.005	1883	39	203,590	1.74	354,828	0.58	3.31	673,462	1.00	12	0.45
GM59	8	345	0.005	39	3	216,516	1.74	376,803	0.60	3.30	714,180	1.00	12	0.46
GM60*	10	144	0.060	3	1	296,660	1.72	510,590	0.26	3.25	963,012	0.36	12	0.28
GM61	10	63	0.010	1	2	324,451	1.72	556,479	0.43	3.23	1,047,680	0.64	12	0.47
GM65	10	319	0.013	2	43	414,936	1.70	705,778	0.46	3.19	1,323,011	0.68	12	0.50
GM89	10	330	0.003	130	129	147,360	1.76	259,819	0.40	3.36	495,725	0.58	15	0.32
GM90	10	330	0.003	129	128	160,287	1.76	281,794	0.41	3.35	537,089	0.61	15	0.32
GM99	8	331	0.006	89	88	116,983	1.78	208,114	0.41	3.41	398,778	0.60	10	0.42
GM100	8	340	0.005	88	87	118,922	1.78	211,346	0.42	3.41	405,241	0.62	10	0.43
GM101*	8	98	0.035	87	359	130,556	1.77	231,381	0.27	3.39	442,727	0.38	10	0.28
GM102	18	348	0.000	1544a	1544	1,136,872	1.64	1,865,917	1.00	3.03	3,440,345	1.00	21	0.58
GM110	18	344	0.003	1439	1422	1,312,024	1.63	2,142,541	0.54	3.00	3,940,595	1.00	21	0.57
GM116	8	177	0.003	1413	1412	77,558	1.79	138,958	0.38	3.47	268,868	0.55	10	0.39
GM117	6	233	0.017	1411	1410	86,606	1.79	155,116	0.39	3.46	299,245	0.58	8	0.37
GM118	8	35	0.004	1446a	1446	113,105	1.78	201,005	0.44	3.41	385,851	0.66	12	0.35
GM124	10	331	0.008	764	766	341,902	1.71	585,563	0.47	3.22	1,101,324	0.70	12	0.51
GM126	10	330	0.006	767	768	347,719	1.71	594,612	0.52	3.22	1,118,775	1.00	12	0.54
GM127	10	333	0.013	768	769	349,657	1.71	597,843	0.42	3.22	1,124,592	0.62	12	0.48
GM128	10	332	0.013	769	769a	395,546	1.70	674,109	0.45	3.20	1,264,196	0.66	12	0.49
GM129	10	241	0.015	769a	770	402,655	1.70	685,742	0.44	3.19	1,285,525	0.64	12	0.47
GM130*	10	278	0.076	770	743	402,655	1.70	685,742	0.28	3.19	1,285,525	0.39	12	0.31

Table 6-1 - Gravity Mains Unable to Satisfy Criteria in Existing (2009) Conditions

Pipe ID	Existing Diameter (in)	Pipe Length (ft)	Slope	Upstream Manhole ID	Downstream Manhole ID	Average Dry Weather Flow (gpd)	Peak Dry Weather Factor	Peak Dry Weather Flow (gpd)	Peak Dry Weather d/D	Peak Wet Weather Factor	Peak Wet Weather Flow (gpd)	Peak Wet Weather d/D	Replacement Diameter (in)	Replacement Peak Wet Weather d/D
GM131	10	52	0.015	743	1386	403,948	1.70	687,681	0.44	3.19	1,290,049	0.64	12	0.29
GM132	6	325	0.008	742a	742	475,043	1.69	804,018	1.00	3.17	1,503,980	1.00	12	0.58
GM133	8	115	0.026	742	741	475,689	1.69	804,665	0.58	3.17	1,505,919	1.00	12	0.47
GM134*	10	33	0.071	354	353	476,982	1.69	807,250	0.31	3.17	1,509,797	0.44	12	0.34
GM135	10	80	0.004	353	352	478,275	1.69	809,189	0.74	3.16	1,513,674	1.00	12	0.59
GM136	10	30	0.017	352	352b	482,799	1.69	816,298	0.46	3.16	1,527,247	0.69	12	0.59
GM137	10	258	0.011	352b	351	485,384	1.69	820,823	0.53	3.16	1,535,003	1.00	12	0.59
GM138	10	120	0.014	351	350	495,725	1.69	837,627	0.50	3.16	1,566,026	0.77	12	0.59
GM139	10	151	0.002	350	1366	496,371	1.69	838,919	1.00	3.16	1,567,965	1.00	12	0.59
GM140	10	280	0.008	1366	1365	498,310	1.69	841,505	0.59	3.16	1,573,782	1.00	12	0.57
GM141	10	204	0.004	1365	1364	502,835	1.69	849,261	0.75	3.16	1,587,355	1.00	12	0.53
GM142	10	100	0.016	1364	1947	507,359	1.69	856,370	0.49	3.16	1,600,927	0.74	12	0.53
GM143	10	140	0.029	1947	1994	515,761	1.69	870,589	0.42	3.15	1,626,134	0.60	12	0.53
GM144	10	175	0.035	1994	1356	518,993	1.69	875,760	0.39	3.15	1,635,828	0.57	12	0.58
GM148	8	479	0.003	189	406	123,447	1.77	218,455	0.49	3.39	418,167	0.76	12	0.39
GM149*	8	190	0.043	406	407	124,093	1.77	219,101	0.25	3.39	420,752	0.35	12	0.20
GM150	8	103	0.002	407	407a	124,093	1.77	219,101	0.55	3.39	420,752	1.00	12	0.43
GM151	8	185	0.003	407a	407b	130,556	1.77	230,735	0.50	3.38	441,435	0.79	12	0.39
GM152*	8	81	0.037	407b	408	131,202	1.76	231,381	0.27	3.38	443,373	0.37	12	0.21
GM167	27	165	0.002	1249	199	2,750,079	1.59	4,375,566	0.52	2.89	7,947,114	0.79	33	0.54
GM169	27	250	0.002	343	378	2,844,441	1.59	4,521,634	0.51	2.89	8,206,933	0.77	33	0.55
GM170	27	308	0.002	378	378A	2,851,551	1.59	4,531,975	0.53	2.88	8,225,676	0.81	33	0.55
GM171	27	308	0.002	378A	943	2,854,136	1.59	4,535,853	0.53	2.88	8,232,786	0.81	33	0.55
GM176	8	349	0.004	1847	740	89,838	1.79	160,933	0.39	3.45	310,232	0.57	10	0.41
GM178	8	244	0.004	739	738	90,484	1.79	162,226	0.39	3.45	312,171	0.58	10	0.41
GM179	8	353	0.004	738	737	91,131	1.79	162,872	0.40	3.45	314,110	0.58	10	0.41
GM180	8	344	0.005	737	703	91,777	1.79	164,165	0.38	3.45	316,695	0.56	10	0.40
GM181*	8	100	0.040	703	702A	135,727	1.77	239,784	0.26	3.38	458,885	0.37	10	0.27
GM182*	8	40	0.040	702A	702	93,716	1.76	164,811	0.22	3.35	314,110	0.30	10	0.23
GM183	8	467	0.003	702	701	93,716	1.78	166,750	0.42	3.42	320,573	0.63	12	0.34
GM184	8	440	0.002	6049	1892a	100,179	1.79	179,030	0.52	3.43	343,841	1.00	12	0.41
GM195	8	85	0.007	1640	1639	228,796	1.74	397,485	0.56	3.29	752,313	1.00	12	0.43
GM196	8	80	0.003	1639	1638	229,443	1.74	398,131	0.76	3.29	754,898	1.00	12	0.56
GM197	8	186	0.003	1638	1804	250,771	1.73	433,679	0.79	3.27	820,823	1.00	12	0.57
GM198	10	251	0.010	1804	1804b	255,942	1.73	442,081	0.39	3.27	836,981	0.56	12	0.42

Table 6-1 - Gravity Mains Unable to Satisfy Criteria in Existing (2009) Conditions

Pipe ID	Existing Diameter (in)	Pipe Length (ft)	Slope	Upstream Manhole ID	Downstream Manhole ID	Average Dry Weather Flow (gpd)	Peak Dry Weather Factor	Peak Dry Weather Flow (gpd)	Peak Dry Weather d/D	Peak Wet Weather Factor	Peak Wet Weather Flow (gpd)	Peak Wet Weather d/D	Replacement Diameter (in)	Replacement Peak Wet Weather d/D
GM199	10	189	0.004	1804b	1804a	266,929	1.73	460,824	0.52	3.26	870,589	1.00	12	0.57
GM200	10	232	0.004	1804a	1803	270,807	1.73	467,287	0.52	3.26	882,869	1.00	12	0.57
GM201	10	596	0.007	1803	1802	270,807	1.73	467,287	0.44	3.26	882,869	0.64	12	0.50
GM202	10	260	0.001	1802	1801	280,502	1.72	483,445	0.76	3.25	912,600	1.00	12	0.60
GM209	8	340	0.003	1753	1754	87,253	1.79	155,762	0.41	3.44	300,537	0.60	12	0.33
GM210	8	259	0.002	1754	1756	116,337	1.77	206,175	0.53	3.40	395,546	1.00	12	0.41
GM211	8	276	0.003	1756	1756a	117,630	1.77	208,114	0.48	3.40	399,424	0.74	12	0.38
GM212	8	65	0.001	1756a	1801a	118,276	1.77	209,407	0.65	3.39	401,363	1.00	12	0.50
GM213	12	349	0.002	1801a	1800-2	398,778	1.70	678,633	0.59	3.19	1,273,244	1.00	15	0.71
GM214	12	398	0.002	1800-2	1800-1	407,180	1.70	692,206	0.63	3.19	1,298,451	1.00	18	0.56
GM215	12	404	0.002	1800-1	1800	407,180	1.70	692,206	0.64	3.19	1,298,451	1.00	18	0.58
GM216	12	325	0.002	1800	1800A	408,472	1.70	694,791	0.62	3.19	1,302,329	1.00	15	0.51
GM217	12	325	0.002	1800A	1799	408,472	1.70	694,791	0.62	3.19	1,302,329	1.00	15	0.64
GM218	12	781	0.002	1799	1798	409,765	1.70	696,730	0.63	3.19	1,306,207	1.00	15	0.65
GM219	12	497	0.002	1798	1797	413,643	1.70	703,193	0.64	3.19	1,317,840	1.00	15	0.66
GM220	12	333	0.002	1797	1796	429,154	1.70	728,399	0.65	3.18	1,365,022	1.00	15	0.60
GM221	12	324	0.004	1796	1795A	429,154	1.70	728,399	0.52	3.18	1,365,022	0.81	15	0.58
GM222	12	71	0.004	1795A	1795	446,605	1.69	756,837	0.52	3.17	1,417,373	1.00	15	0.53
GM223	15	373	0.001	1795	1794	446,605	1.69	756,837	0.50	3.17	1,417,373	0.77	18	0.55
GM224	15	263	0.001	1794	1793a	452,422	1.69	766,532	0.52	3.17	1,435,470	0.82	18	0.57
GM225	15	298	0.001	1793a	1793	452,422	1.69	766,532	0.53	3.17	1,435,470	1.00	18	0.57
GM226	15	265	0.001	1793	1792	454,361	1.69	769,764	0.52	3.17	1,441,287	1.00	18	0.57
GM227	15	524	0.001	1792	1791	454,361	1.69	769,764	0.52	3.17	1,441,287	1.00	18	0.57
GM228	15	286	0.001	1791	918	458,239	1.69	776,227	0.52	3.17	1,452,921	1.00	18	0.57
GM229	15	318	0.001	918	1790	458,239	1.69	776,227	0.52	3.17	1,452,921	1.00	18	0.57
GM230*	15	357	0.012	1790	1789	465,348	1.69	787,860	0.28	3.17	1,474,249	0.39	18	0.30
GM232	8	326	0.007	180	179	173,213	1.75	303,769	0.48	3.34	577,807	0.72	10	0.49
GM233	8	248	0.017	179	178	228,796	1.74	397,485	0.43	3.29	752,313	0.64	10	0.44
GM234	8	498	0.020	178	176	233,320	1.73	404,594	0.42	3.29	766,532	0.62	10	0.43
GM235	8	600	0.005	176	175	265,636	1.73	458,239	0.70	3.26	866,711	1.00	12	0.56
GM236	8	243	0.000	175	174	265,636	1.73	458,239	1.00	3.26	866,711	1.00	12	0.68
GM237	8	485	0.004	174	173	283,087	1.72	487,323	0.79	3.25	920,355	1.00	12	0.57
GM238	8	238	0.005	173	172	285,672	1.72	491,847	0.74	3.25	928,111	1.00	12	0.54
GM239	8	80	0.005	172	171	288,257	1.72	496,371	0.76	3.25	935,867	1.00	12	0.55
GM240	8	100	0.005	171	170	290,196	1.72	499,603	0.76	3.25	942,330	1.00	12	0.55

Table 6-1 - Gravity Mains Unable to Satisfy Criteria in Existing (2009) Conditions

Pipe ID	Existing Diameter (in)	Pipe Length (ft)	Slope	Upstream Manhole ID	Downstream Manhole ID	Average Dry Weather Flow (gpd)	Peak Dry Weather Factor	Peak Dry Weather Flow (gpd)	Peak Dry Weather d/D	Peak Wet Weather Factor	Peak Wet Weather Flow (gpd)	Peak Wet Weather d/D	Replacement Diameter (in)	Replacement Peak Wet Weather d/D
GM241	8	278	0.004	170	169	291,489	1.72	501,542	0.78	3.25	946,208	1.00	12	0.57
GM242	8	268	0.004	169	168a	293,428	1.72	504,774	0.79	3.24	952,025	1.00	12	0.57
GM243	8	43	0.009	168a	168	299,245	1.72	514,468	0.61	3.24	970,122	1.00	12	0.46
GM244	8	310	0.005	168	166	301,184	1.72	517,700	0.79	3.24	975,939	1.00	12	0.57
GM245	8	35	0.003	166	550	301,830	1.72	518,993	1.00	3.24	977,878	1.00	12	0.65
GM247	10	50	0.007	551	926	312,817	1.72	537,089	0.46	3.23	1,011,486	0.69	12	0.51
GM248	12	413	0.002	926	1834a	350,304	1.71	598,490	0.51	3.21	1,125,884	0.80	15	0.52
GM258	6	217	0.005	955	956	82,729	1.79	148,007	0.54	3.46	286,318	1.00	10	0.36
GM260	10	60	0.003	957	959	218,455	1.74	380,034	0.49	3.30	720,643	0.74	12	0.53

* - Reflects gravity mains being upsized due to adjacent gravity upsizing driven by capacity criteria

Table 6-2 - Gravity Mains Unable to Satisfy Criteria in Existing (2009) Conditions Only

Pipe ID	Existing Diameter (in)	Pipe Length (ft)	Slope	Upstream Manhole ID	Downstream Manhole ID	Average Dry Weather Flow (gpd)	Peak Dry Weather Factor	Peak Dry Weather Flow (gpd)	Peak Dry Weather d/D	Peak Wet Weather Factor	Peak Wet Weather Flow (gpd)	Peak Wet Weather d/D	Replacement Diameter (in)	Replacement Peak Wet Weather d/D
GM35	6	340	0.006	1515	1517	58,815	1.81	106,642	0.43	3.52	206,821	0.64	8	0.40
GM51	8	328	0.007	58	56	111,813	1.78	199,066	0.38	3.42	381,973	0.55	10	0.39
GM52*	8	330	0.010	56	49	126,032	1.77	222,979	0.36	3.39	427,862	0.53	10	0.38
GM53	8	165	0.010	49	831	155,116	1.76	272,746	0.41	3.35	520,285	0.60	10	0.42
GM54*	8	320	0.015	831	35	157,701	1.76	277,270	0.37	3.35	528,687	0.53	10	0.38
GM55	8	329	0.012	35	36	162,226	1.76	285,026	0.40	3.35	542,906	0.58	10	0.41
GM191	8	169	0.006	1679	1673	116,337	1.78	206,821	0.40	3.41	396,192	0.59	10	0.42
GM192	8	260	0.012	1645	1644	157,701	1.76	277,270	0.39	3.35	528,687	0.57	10	0.40
GM193	8	140	0.007	1644	1643	158,348	1.76	277,916	0.45	3.35	530,626	0.68	10	0.49
GM194	8	140	0.005	1643	1640	158,348	1.76	277,916	0.49	3.35	530,626	0.76	10	0.50
GM246	10	241	0.014	550	551	312,817	1.72	537,089	0.39	3.23	1,011,486	0.56	12	0.58
GM249	12	414	0.002	1834a	1834	350,304	1.71	598,490	0.51	3.21	1,125,884	0.80	15	0.52
GM251	6	327	0.002	1161	1139	38,133	1.85	70,449	0.44	3.59	137,019	0.66	8	0.41

* - Reflects gravity mains being upsized due to adjacent gravity upsizing driven by capacity criteria

Table 6-3 - Gravity Mains Unable to Satisfy Criteria in 2012

Pipe ID	Existing Diameter (in)	Pipe Length (ft)	Slope	Upstream Manhole ID	Downstream Manhole ID	Average Dry Weather Flow (gpd)	Peak Dry Weather Factor	Peak Dry Weather Flow (gpd)	Peak Dry Weather d/D	Peak Wet Weather Factor	Peak Wet Weather Flow (gpd)	Peak Wet Weather d/D	Replacement Diameter (in)	Replacement Peak Wet Weather d/D
GM49	8	346	0.01	1953	1954	143,482	1.76	252,710	0.39	3.36	482,799	0.57	10	0.402
GM98	6	160	0.004	6110	144	59,461	1.73	102,764	0.47	3.26	193,895	0.70	8	0.435
GM103	18	85	0.003	1544	1543	1,415,434	1.63	2,305,413	0.54	2.99	4,234,669	1.00	21	0.584
GM107	18	227	0.005	1481a	1481	1,580,891	1.62	2,565,232	0.51	2.97	4,702,602	0.77	21	0.571
GM108*	18	332	0.01	1481	1440	1,600,281	1.62	2,595,609	0.43	2.97	4,756,893	0.63	21	0.485
GM111	18	328	0.005	1422	1438	1,611,268	1.62	2,612,413	0.53	2.97	4,787,916	1.00	21	0.598
GM112*	18	290	0.047	1438	1446	1,624,841	1.62	2,633,742	0.29	2.97	4,826,049	0.39	21	0.317
GM113	8	165	0.002	1417	1416	67,863	1.81	122,800	0.39	3.51	238,491	0.57	10	0.401
GM114*	8	157	0.011	1416	1415	78,851	1.80	142,190	0.28	3.48	274,685	0.40	10	0.288
GM115*	8	164	0.014	1415	1413	79,497	1.80	143,482	0.27	3.48	276,624	0.37	10	0.274
GM119	18	224	0.007	1446	1445	1,787,067	1.62	2,887,098	0.50	2.96	5,281,703	0.76	21	0.564
GM120	8	148	0.002	1404	1403	61,400	1.81	111,167	0.41	3.52	215,870	0.61	10	0.426
GM121*	8	181	0.018	1403	1401a	61,400	1.81	111,167	0.22	3.52	215,870	0.31	10	0.227
GM122*	8	106	0.012	1401a	1401	61,400	1.81	111,167	0.24	3.52	215,870	0.34	10	0.25
GM123*	8	55	0.012	1401	344	62,046	1.81	112,459	0.25	3.51	217,809	0.35	10	0.254
GM153	24	370	0.003	235	636	3,193,452	1.58	5,056,138	0.55	2.87	9,158,312	1.00	27	0.66
GM154	24	219	0.004	636	638	3,199,269	1.58	5,065,186	0.52	2.87	9,173,823	0.79	27	0.653
GM155	24	287	0.004	638	1326	3,213,488	1.58	5,086,515	0.52	2.87	9,212,603	0.79	27	0.621
GM156	24	248	0.004	1326	1325	3,228,353	1.58	5,109,136	0.52	2.87	9,253,320	0.80	27	0.624
GM157	24	566	0.004	1325	1312	3,238,694	1.58	5,124,647	0.52	2.87	9,281,112	0.80	27	0.624
GM158*	24	252	0.012	1312	1958	3,263,255	1.58	5,162,134	0.39	2.86	9,347,683	0.55	27	0.456
GM159*	24	262	0.017	1958	1321	3,263,901	1.58	5,163,427	0.35	2.86	9,349,622	0.49	27	0.411
GM160	24	288	0.004	1321	1320	3,401,566	1.58	5,373,480	0.54	2.86	9,723,193	1.00	27	0.645
GM162	24	78	0.004	1319a	1319	3,401,566	1.58	5,373,480	0.55	2.86	9,723,193	1.00	27	0.661
GM163	24	253	0.004	1319	1300	3,401,566	1.58	5,373,480	0.54	2.86	9,723,193	1.00	27	0.645
GM164	24	341	0.005	1300	1296	3,414,493	1.58	5,393,515	0.52	2.86	9,758,094	0.78	27	0.613
GM168	33	68	0.001	341	343	3,669,142	1.58	5,779,367	0.54	2.85	10,445,129	1.00	36	0.551
GM177	8	300	0.005	740	739	99,533	1.79	177,737	0.40	3.44	341,902	0.58	10	0.409
GM186	8	404	0.004	1617	1629	87,253	1.79	156,409	0.39	3.46	301,830	0.56	10	0.399
GM187	8	415	0.004	1629	1635	120,215	1.77	213,285	0.46	3.40	409,119	0.69	12	0.362
GM188	8	140	0.005	1635	1636	120,215	1.77	213,285	0.42	3.40	409,119	0.62	12	0.333
GM189	8	306	0.005	1636	1637	120,215	1.77	213,285	0.43	3.40	409,119	0.64	12	0.341
GM190	8	321	0.005	1637	1638	120,215	1.77	213,285	0.44	3.40	409,119	0.66	12	0.35
GM253	6	301	0.005	1185	1168	54,937	1.81	99,533	0.43	3.51	192,602	0.65	8	0.407
GM254	6	325	0.005	1168	1164	55,583	1.81	100,825	0.44	3.50	194,541	0.65	8	0.409

Table 6-3 - Gravity Mains Unable to Satisfy Criteria in 2012

Pipe ID	Existing Diameter (in)	Pipe Length (ft)	Slope	Upstream Manhole ID	Downstream Manhole ID	Average Dry Weather Flow (gpd)	Peak Dry Weather Factor	Peak Dry Weather Flow (gpd)	Peak Dry Weather d/D	Peak Wet Weather Factor	Peak Wet Weather Flow (gpd)	Peak Wet Weather d/D	Replacement Diameter (in)	Replacement Peak Wet Weather d/D
GM255	6	332	0.005	1164	1166	56,876	1.81	102,764	0.44	3.50	199,066	0.66	8	0.414
GM256	8	24	0.004	954	953	91,777	1.80	164,811	0.39	3.46	317,342	0.57	10	0.406
GM259	8	122	0.005	956	957	93,716	1.79	168,042	0.38	3.46	323,805	0.56	10	0.396

* - Reflects gravity mains being upsized due to adjacent gravity upsizing driven by capacity criteria

Table 6-4 - Gravity Mains Unable to Satisfy Criteria in 2017

Pipe ID	Existing Diameter (in)	Pipe Length (ft)	Slope	Upstream Manhole ID	Downstream Manhole ID	Average Dry Weather Flow (gpd)	Peak Dry Weather Factor	Peak Dry Weather Flow (gpd)	Peak Dry Weather d/D	Peak Wet Weather Factor	Peak Wet Weather Flow (gpd)	Peak Wet Weather d/D	Replacement Diameter (in)	Replacement Peak Wet Weather d/D
GM63	8	336	0.005	6	4	104,703	1.70	178,383	0.39	3.17	332,207	0.56	12	0.31
GM83	10	180	0.005	131a	131	196,480	1.66	327,036	0.39	3.07	602,367	0.56	12	0.42
GM94	10	330	0.011	307	226	373,571	1.65	615,940	0.45	3.03	1,130,408	0.66	15	0.35
GM104	18	175	0.005	1543	1542	1,556,331	1.62	2,526,453	0.51	2.98	4,633,447	0.78	21	0.71
GM105	18	283	0.005	1542	1541	1,574,428	1.62	2,554,891	0.52	2.98	4,684,506	0.80	21	0.70
GM106	18	189	0.006	1461	1481a	1,730,837	1.62	2,799,845	0.53	2.96	5,124,001	0.81	21	0.59
GM109	18	324	0.007	1440	1439	1,762,506	1.62	2,848,965	0.51	2.96	5,213,193	0.77	21	0.60
GM125	10	330	0.025	766	767	471,165	1.69	797,555	0.41	3.17	1,492,346	0.60	12	0.45
GM161	24	201	0.006	1320	1319a	3,702,104	1.57	5,830,426	0.51	2.85	10,534,967	0.76	27	0.60
GM175	33	330	0.002	937	935	4,612,764	1.56	7,209,020	0.52	2.81	12,977,399	0.77	36	0.65
GM185	8	396	0.004	1619	1617	84,668	1.79	151,884	0.38	3.46	292,782	0.55	10	0.39

* - Reflects gravity mains being upsized due to adjacent gravity upsizing driven by capacity criteria

Table 6-5 - Gravity Mains Unable to Satisfy Criteria in 2027

Pipe ID	Existing Diameter (in)	Pipe Length (ft)	Slope	Upstream Manhole ID	Downstream Manhole ID	Average Dry Weather Flow (gpd)	Peak Dry Weather Factor	Peak Dry Weather Flow (gpd)	Peak Dry Weather d/D	Peak Wet Weather Factor	Peak Wet Weather Flow (gpd)	Peak Wet Weather d/D	Replacement Diameter (in)	Replacement Peak Wet Weather d/D
GM26	24	230	0.001	3100	3101	1,454,860	1.63	2,367,459	0.51	2.99	4,347,128	0.77	27	0.61
GM62	8	330	0.007	7	6	136,373	1.73	235,906	0.42	3.27	445,312	0.61	10	0.43
GM64	8	324	0.006	4	2	272,099	1.70	462,117	0.67	3.18	865,418	1.00	12	0.50
GM66	12	296	0.004	43	424	801,433	1.63	1,302,975	0.74	2.97	2,378,447	1.00	15	0.74
GM67	12	466	0.01	424	814	910,014	1.62	1,476,834	0.58	2.96	2,695,142	1.00	15	0.58
GM68*	12	238	0.048	814	814a	910,014	1.62	1,476,834	0.37	2.96	2,695,142	0.52	15	0.37
GM69	12	308	0.015	814a	830	910,014	1.62	1,476,834	0.52	2.96	2,695,142	0.79	15	0.52
GM70	12	300	0.008	830	817	910,014	1.62	1,476,834	0.61	2.96	2,695,142	1.00	15	0.62
GM71	8	371	0.005	46	10007	129,910	1.77	230,089	0.44	3.39	440,142	0.65	10	0.45
GM72	10	325	0.003	2370	2368	129,910	1.77	230,089	0.39	3.39	440,142	0.57	12	0.43
GM73*	10	306	0.003	2368	2369	129,910	1.77	230,089	0.36	3.39	440,142	0.52	12	0.40
GM74	10	355	0.002	2369	2371	129,910	1.77	230,089	0.40	3.39	440,142	0.59	12	0.44
GM75	10	381	0.003	2371	2367	129,910	1.77	230,089	0.38	3.39	440,142	0.56	12	0.42
GM76*	10	250	0.008	2367	2372	129,910	1.77	230,089	0.29	3.39	440,142	0.41	12	0.32
GM77*	10	300	0.008	2372	817	129,910	1.77	230,089	0.29	3.39	440,142	0.41	12	0.32
GM78	12	50	0.009	817	817a	1,039,924	1.62	1,684,302	0.67	2.95	3,072,591	1.00	15	0.67
GM79	12	240	0.008	817a	455	1,109,726	1.62	1,795,469	0.71	2.95	3,273,596	1.00	15	0.71
GM80	8	190	0.006	149	148	140,897	1.75	246,893	0.45	3.33	469,872	0.67	10	0.46
GM81	10	330	0.004	148	145	224,918	1.73	389,083	0.46	3.27	734,862	0.69	12	0.50
GM82	10	335	0.005	145	131a	423,338	1.70	718,058	0.62	3.17	1,343,047	1.00	12	0.69
GM84	10	330	0.019	131	130	455,007	1.69	769,764	0.44	3.16	1,438,702	0.64	12	0.47
GM85	6	308	0.008	140a	140	54,937	1.82	100,179	0.38	3.53	193,895	0.56	8	0.36
GM86	8	350	0.003	135	134	124,093	1.77	219,748	0.51	3.39	420,106	0.81	12	0.40
GM87	8	310	0.003	134	133	129,263	1.77	228,150	0.52	3.37	435,618	1.00	12	0.41
GM88	8	330	0.003	133	130	132,495	1.76	233,320	0.53	3.37	445,959	1.00	12	0.41
GM91	10	330	0.022	128	307	882,869	1.65	1,459,384	0.61	3.06	2,699,020	1.00	15	0.46
GM92	6	115	0.005	101a	899	44,596	1.83	81,436	0.39	3.57	158,994	0.57	8	0.37
GM93	6	328	0.006	899	307	47,827	1.82	87,253	0.38	3.55	169,981	0.56	8	0.36
GM95	10	330	0.024	226	265	930,696	1.65	1,535,649	0.62	3.05	2,838,624	1.00	15	0.46
GM96	18	200	0.001	265	454	1,175,004	1.63	1,916,976	0.64	3.00	3,519,196	1.00	21	0.72
GM97*	18	240	0.008	454	455	1,175,004	1.63	1,916,976	0.39	3.00	3,519,196	0.55	21	0.43
GM145	15	144	0.003	1356	1357	802,079	1.66	1,332,706	0.53	3.08	2,471,516	1.00	18	0.58
GM146*	15	148	0.007	1357	1358	807,896	1.66	1,341,754	0.43	3.08	2,488,320	0.63	18	0.47
GM147*	15	149	0.012	1358	1359	809,189	1.66	1,343,693	0.37	3.08	2,492,198	0.52	18	0.40
GM165	27	361	0.004	1296	1294	4,041,420	1.57	6,345,540	0.52	2.83	11,448,213	0.79	30	0.63
GM166	6	201	0.016	338	236	90,484	1.79	162,226	0.41	3.45	312,171	0.61	8	0.39

Table 6-5 - Gravity Mains Unable to Satisfy Criteria in 2027

Pipe ID	Existing Diameter (in)	Pipe Length (ft)	Slope	Upstream Manhole ID	Downstream Manhole ID	Average Dry Weather Flow (gpd)	Peak Dry Weather Factor	Peak Dry Weather Flow (gpd)	Peak Dry Weather d/D	Peak Wet Weather Factor	Peak Wet Weather Flow (gpd)	Peak Wet Weather d/D	Replacement Diameter (in)	Replacement Peak Wet Weather d/D
GM172	33	330	0.002	943	379	4,570,754	1.56	7,145,681	0.51	2.81	12,866,233	0.77	36	0.64
GM173	33	330	0.002	379	938	4,575,278	1.56	7,152,790	0.51	2.81	12,877,866	0.77	36	0.64
GM174	33	330	0.002	938	937	4,575,278	1.56	7,152,790	0.51	2.81	12,877,866	0.77	36	0.64
GM203	8	300	0.003	209	1748	85,960	1.79	153,823	0.41	3.46	297,306	0.60	10	0.42
GM204	8	300	0.004	1748	1765	85,960	1.79	153,823	0.38	3.46	297,306	0.55	10	0.39
GM205	8	300	0.004	1765	1750	85,960	1.79	153,823	0.38	3.46	297,306	0.56	10	0.39
GM206	8	440	0.004	1750	1751	85,960	1.79	153,823	0.40	3.46	297,306	0.58	10	0.41
GM207*	8	330	0.004	1751	1752	85,960	1.79	153,823	0.38	3.46	297,306	0.55	10	0.39
GM208*	8	160	0.007	1752	1753	95,009	1.79	169,981	0.35	3.44	327,036	0.50	10	0.36
GM231	8	337	0.005	984	180	107,289	1.78	191,310	0.40	3.43	367,754	0.59	10	0.41
GM250	6	330	0.001	997	994	20,682	1.91	39,425	0.38	3.72	76,912	0.56	8	0.36
GM252	6	331	0.008	1186	1185	56,230	1.80	101,472	0.39	3.48	195,834	0.56	8	0.36
GM257	8	331	0.005	953	955	110,520	1.78	197,127	0.41	3.43	378,742	0.60	10	0.42

* - Reflects gravity mains being upsized due to adjacent gravity upsizing driven by capacity criteria

CHAPTER 7. RECOMMENDATIONS AND IMPROVEMENTS

IEC utilized the results of the hydraulic analysis in *Chapter 6*, in conjunction with the findings of the *2009 Sewer Closed-Circuit Television and Condition Assessment Report* and the *2010 Sewer Flow Monitoring Report*, to developed a phased and prioritized Capital Improvement Program (CIP). Recommended Immediate Projects include those projected as unable to satisfy criteria, and for which flow monitoring data confirmed surcharging (i.e. depth-to-Diameter ratio of 1.0). All CIP projects through 2027 have an estimated probable cost of $17 Million and are illustrated in Figure 7-1 at the end of this report. CIP projects are summarized in Table 7-2 and include:

- Immediate Projects: EX-P1, EX-P2, EX-P3 and EX-P4. ($1,922,275)
- Short Term Projects: EX-P5 through EX-P23. ($5,663,668)
- 2012 Projects: 2012-P1 through 2012-P9. ($5,077,759)
- 2017 Projects: 2017-P1 through 2017-P5. ($1,608,500)
- 2027 Projects: 2027-P1 through 2017-P12. ($2,762,691)

Estimates of probable capital costs provided represent Order of Magnitude level costs as established by the American Association of Cost Engineers (AACE) and represent an accuracy of +50% to -30%. In addition, IEC has developed a set of Immediate monitoring and sewer CCTV recommendations.

7.1 UNIT COSTS

Unit costs used to develop capital cost estimates for proposed facilities were developed using the Engineering News Record Construction Cost Index (ENR-CCI) 20-city national average, and recently completed projects by IEC of a similar nature. These estimates are based on the best available data at the time of this report; however, since prices of materials and labor fluctuate with time, new estimates should be obtained during pre-design for proposed facilities to confirm budget amounts. Recent market trends have indicated substantial volatility in the price of construction materials such as steel and concrete. These factors, coupled with the high level of similar work currently being performed, have on occasion resulted in a generally unpredictable bidding environment.

The ENR-CCI is an inflation index used to adjust prices from one (1) time period to another. The cost estimates presented in this report are based upon an ENR-CCI cost index of 8,921 for October 2010. Costs estimated herein for recommended facilities should be adjusted in the future either by making new estimates or by comparing the future ENR-CCI index to 8,921.

A factor of 20 percent of total construction cost has been used for engineering and administration, which includes, but is not limited to the following:

- Planning and design reports
- Design
- CEQA compliance
- Permits
- Surveying
- Service during construction (submittals, as-builts)
- Inspection

A factor of 30 percent has been added for contingencies. These engineering, administration and contingency factors have been incorporated into all unit costs. Estimates of probable capital costs provided represent Order of Magnitude level costs as established by the American Association of Cost Engineers (AACE) and represent an accuracy of +50% to -30%.

Gravity main materials, pavement saw cutting, removal and replacement, traffic control, installation of miscellaneous appurtenances, excavation, bedding and backfill were taken into consideration in developing unit costs for gravity man construction. Table 7-1 shows the gravity main unit costs used to determine the costs of recommended gravity mains improvements, aside from those crossing either the I-5 or I-805. A unit cost of $550 ($/LF) was applied to alignments intersecting the I-5 or I-805.

Table 7-1 - Gravity Main Unit Costs

Pipe Diameter (in)	Pipe Unit Cost ($/LF)
8	$144
10	$180
12	$216
15	$270
18	$324
21	$378
24	$432
27	$486
33	$594

Note: Units costs include Engineering, Legal, Administration, and Contingencies

7.2 RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

Based on the hydraulic model results presented in *Chapter 6*, gravity mains were grouped into the projects illustrated in Figure 7-1 at the end of this report. Projects were prioritized in a specific year by their inability to satisfy criteria in peak dry conditions, and then by their inability to satisfy criteria in peak wet conditions. Eight (8) monitoring sites in the *2010 Sewer Flow Monitoring Report* were selected to confirm the deficiencies identified in the City's current SSMP. Accordingly, the four (4) projects measured as surcharging in the *2010 Sewer Flow Monitoring Report* have been identified for immediate replacement. Similarly, projects measured with sufficient capacity were deferred until 2012.

As most of these projects had been previously identified in the current SSMP, almost all of the recommended CIP projects were included in the *2009 Sewer Closed-Circuit Television and Condition Assessment Report*. As such, IEC utilized the NASSCO Pipeline Assessment and Certification Program (PACP) Quick Rating structural integrity scores to further prioritize projects within time-increments. Recommended Immediate Projects include those projected as unable to satisfy criteria, and for which flow monitoring data confirmed surcharging (i.e. depth-to-Diameter ratio of 1.0). All CIP projects through 2027 have an estimated probable cost of $17 Million and are illustrated in Figure 7-1 at the end of this report. CIP projects are summarized in Table 7-2 and include:

- Immediate Projects: EX-P1, EX-P2, EX-P3 and EX-P4. ($1,922,275)
- Short Term Projects: EX-P5 through EX-P23. ($5,663,668)
- 2012 Projects: 2012-P1 through 2012-P9. ($5,077,759)
- 2017 Projects: 2017-P1 through 2017-P5. ($1,608,500)
- 2027 Projects: 2027-P1 through 2017-P12. ($2,762,691)

Estimates of probable capital costs provided represent Order of Magnitude level costs as established by the American Association of Cost Engineers (AACE) and represent an accuracy of +50% to -30%. Cost estimates for each project have been developed based upon the proposed replacement diameter, the estimated length of each project, and the unit costs presented in Table 7-1.

While $1.9 Million of CIP projects have been recommended for immediate replacement, an additional $5.6 Million have been included as short-term projects. These gravity mains are modeled as deficient, and should be monitored to confirm their available capacity. Once monitoring is complete, the short term projects would be identified as either immediate, or deferred until 2012.

As shown in Table 3-6, projected average daily wastewater flows with treatment costs allocated to the City are expected to increase 56 percent to 6.57 mgd in the 2027 time increment. Based on these projections, there is no additional SMI capacity required to accommodate the projected daily wastewater flows projected for the 2027 time increment.

7.3 RECOMMENDED MONITORING PROGRAM

IEC recommends developing a wastewater flow monitoring plan to evaluate the necessity of short-term CIP projects. Projects recommended for monitoring include MON-P1 through MON-P10 and EX-P5 through EX-P23. MON-P1 through MON-P10 include gravity mains that were identified as deficient in Existing (2009), but not projected to be deficient in future time increments. Also included in MON-P1 through MON-P10 are projects that were monitoring in the *2010 Sewer Flow Monitoring Report*, and for which measure peak flows warrant continued monitoring but not immediate replacement.

Projects EX-P5 through EX-P23 have been recommended for monitoring in order to confirm projected capacity limitations. Once monitoring is completed, projects requiring immediate replacement can proceed, with some projects capable of being deferred until 2012.

An estimated probable cost of $2,000 per site was assumed as the cost of performing a 14-day dry weather flow monitoring study at a single manhole. Accordingly, it is estimated that the 29 site, 14-day flow monitoring study will cost $58,000.

7.4 RECOMMENDED CCTV PROGRAM

The *2009 Sewer Closed-Circuit Television and Condition Assessment Report* included all gravity mains with missing hydraulic information, areas with known Fog, Oil and Grease (FOG) issues and areas identified as deficient in the 2008 SSMP. Accordingly, those gravity mains identified in the CIP which were not included in the 2009 effort, should be included in the City's next CCTV project.

Table 7-2 - Gravity Mains Included in the Capital Improvement Program (CIP) and Monitoring Program

Project	Pipe ID	Upstream Manhole ID	Downstream Manhole ID	Existing Diameter (in)	Pipe Length (ft)	Service PACP Quick Rating	Structural PACP Quick Rating	Replacement Diameter (in)	Cost per Foot ($/LF)	Total Cost per Pipe ($)	Total Cost per Project ($)
Existing (2009) CIP Projects											
EX-P1	GM235	176	175	8	600	3100	0000	12	$216	$129,600	$578,880
	GM236	175	174	8	243	4A2B	0000	12	$216	$52,488	
	GM237	174	173	8	485	4H31	2100	12	$216	$104,749	
	GM238	173	172	8	238	4426	3400	12	$216	$51,402	
	GM239	172	171	8	80	482A	4222	12	$216	$17,280	
	GM240	171	170	8	100	492B	2400	12	$216	$21,632	
	GM241	170	169	8	278	514B	3122	12	$216	$60,141	
	GM242	169	168a	8	268	4D2B	2400	12	$216	$57,780	
	GM243	168a	168	8	43	2700	5100	12	$216	$9,288	
	GM244	168	166	8	310	4328	2500	12	$216	$66,960	
	GM245	166	550	8	35	2400	3122	12	$216	$7,560	
EX-P2	GM106	1461	1481a	18	189	2E00	2200	21	$378	$71,574	$860,968
	GM107	1481a	1481	18	227	0000	0000	21	$378	$85,732	
	GM108*	1481	1440	18	332	2I00	0000	21	$378	$125,390	
	GM109	1440	1439	18	324	2N11	2800	21	$378	$122,385	
	GM110	1439	1422	18	344	322C	0000	21	$378	$130,032	
	GM111	1422	1438	18	328	2K00	2200	21	$378	$123,984	
	GM112*	1438	1446	18	290	-	-	21	$378	$109,620	
	GM118	1446a	1446	8	35	-	-	12	$216	$7,560	
	GM119	1446	1445	18	224	-	-	21	$378	$84,691	
EX-P3	GM132	742a	742	6	325	-	-	12	$216	$70,200	$344,736
	GM133	742	741	8	115	0000	0000	12	$216	$24,840	

Table 7-2 - Gravity Mains Included in the Capital Improvement Program (CIP) and Monitoring Program

Project	Pipe ID	Upstream Manhole ID	Downstream Manhole ID	Existing Diameter (in)	Pipe Length (ft)	Service PACP Quick Rating	Structural PACP Quick Rating	Replacement Diameter (in)	Cost per Foot ($/LF)	Total Cost per Pipe ($)	Total Cost per Project ($)
EX-P3	GM134*	354	353	10	33	4100	0000	12	$216	$7,128	$344, 736
	GM135	353	352	10	80	4431	2200	12	$216	$17,280	
	GM136	352	352b	10	30	4100	3200	12	$216	$6,480	
	GM137	352b	351	10	258	4131	2300	12	$216	$55,728	
	GM138	351	350	10	120	4200	2400	12	$216	$25,920	
	GM139	350	1366	10	151	4231	3523	12	$216	$32,616	
	GM140	1366	1365	10	280	4E2G	3222	12	$216	$60,480	
	GM141	1365	1364	10	204	4A2F	2600	12	$216	$44,064	
EX-P4	GM256	954	953	8	24	2200	0000	10	$180	$4,320	$137,691
	GM257	953	955	8	331	2L1C	3122	10	$180	$59,542	
	GM258	955	956	6	217	2G18	0000	10	$180	$38,981	
	GM259	956	957	8	122	4935	2400	10	$180	$21,888	
	GM260	957	959	10	60	4231	2200	12	$216	$12,960	
EX-P5	GM24	6207	502	6	393	2K11	2100	15	$270	$106,110	$556,523
	GM25	500	3100	15	309	-	-	27	$486	$150,190	
	GM26	3100	3101	24	230	2100	0000	27	$486	$111,780	
	GM27*	3101	591a	24	125	2H00	2200	27	$486	$60,750	
	GM28	591a	591	6	195	-	-	27	$486	$94,926	
	GM29	591	10002	8	67	-	-	27	$486	$32,768	
EX-P6	GM102	1544a	1544	18	348	0000	0000	21	$378	$131,494	$131,494
EX-P7	GM22	442	458	6	110	0000	5241	10	$180	$19,800	$75,600
	GM23*	458	450	6	310	2200	5242	10	$180	$55,800	
EX-P8	GM195	1640	1639	8	85	-	-	12	$216	$18,360	$405,801

Table 7-2 - Gravity Mains Included in the Capital Improvement Program (CIP) and Monitoring Program

Project	Pipe ID	Upstream Manhole ID	Downstream Manhole ID	Existing Diameter (in)	Pipe Length (ft)	Service PACP Quick Rating	Structural PACP Quick Rating	Replacement Diameter (in)	Cost per Foot ($/LF)	Total Cost per Pipe ($)	Total Cost per Project ($)
EX-P8	GM196	1639	1638	8	80	2F12	2711	12	$216	$17,280	$405,801
	GM197	1638	1804	8	186	4E31	5141	12	$216	$40,176	
	GM198	1804	1804b	10	251	312S	4131	12	$216	$54,133	
	GM199	1804b	1804a	10	189	-	-	12	$216	$40,754	
	GM200	1804a	1803	10	232	-	-	12	$216	$50,202	
	GM201	1803	1802	10	596	312A	2300	12	$216	$128,736	
	GM202	1802	1801	10	260	322E	2215	12	$216	$56,160	
EX-P9	GM124	764	766	10	331	2J11	2311	12	$216	$71,496	$481,017
	GM125	766	767	10	330	2L11	2213	12	$216	$71,280	
	GM126	767	768	10	330	4422	5131	12	$216	$71,280	
	GM127	768	769	10	333	1100	3100	12	$216	$71,928	
	GM128	769	769a	10	332	2L16	0000	12	$216	$71,675	
	GM129	769a	770	10	241	2H12	0000	12	$216	$52,117	
	GM130*	770	743	10	278	2K12	0000	12	$216	$60,006	
	GM131	743	1386	10	52	0000	0000	12	$216	$11,235	
EX-P10	GM213	1801a	1800-2	12	349	4722	0000	15	$270	$94,311	$1,940,683
	GM214	1800-2	1800-1	12	398	3100	0000	18	$324	$128,984	
	GM215	1800-1	1800	12	404	422E	2400	18	$324	$130,799	
	GM216	1800	1800A	12	325	3100	0000	15	$270	$87,791	
	GM217	1800A	1799	12	325	-	-	15	$270	$87,791	
	GM218	1799	1798	12	781	4D00	0000	15	$270	$210,816	
	GM219	1798	1797	12	497	4722	2200	15	$270	$134,244	
	GM220	1797	1796	12	333	4B33	2200	15	$270	$89,964	

Table 7-2 - Gravity Mains Included in the Capital Improvement Program (CIP) and Monitoring Program

Project	Pipe ID	Upstream Manhole ID	Downstream Manhole ID	Existing Diameter (in)	Pipe Length (ft)	Service PACP Quick Rating	Structural PACP Quick Rating	Replacement Diameter (in)	Cost per Foot ($/LF)	Total Cost per Pipe ($)	Total Cost per Project ($)
EX-P10	GM221	1796	1795A	12	324	-	-	15	$270	$87,372	$1,940,683
	GM222	1795A	1795	12	71	-	-	15	$270	$19,116	
	GM223	1795	1794	15	373	-	-	18	$324	$120,820	
	GM224	1794	1793a	15	263	312I	2200	18	$324	$85,351	
	GM225	1793a	1793	15	298	2K00	2200	18	$324	$96,523	
	GM226	1793	1792	15	265	3100	0000	18	$324	$85,701	
	GM227	1792	1791	15	524	-	-	18	$324	$169,614	
	GM228	1791	918	15	286	-	-	18	$324	$92,615	
	GM229	918	1790	15	318	-	-	18	$324	$103,090	
	GM230*	1790	1789	15	357	-	-	18	$324	$115,781	
EX-P11	GM184	6049	1892a	8	440	0000	0000	12	$216	$95,040	$95,040
EX-P12	GM167	1249	199	27	165	4100	0000	33	$594	$98,010	$98,010
EX-P13	GM168	341	343	33	68	-	-	36	$648	$44,064	$557,874
	GM169	343	378	27	250	312J	0000	33	$594	$148,500	
	GM170	378	378A	27	308	3100	0000	33	$594	$182,655	
EX-P13	GM171	378A	943	27	308	-	-	33	$594	$182,655	$557,874
EX-P14	GM248	926	1834a	12	413	2512	4336	15	$270	$111,456	$111,456
EX-P15	GM30	571	585	6	317	4421	3600	8	$144	$45,648	$122,554
	GM31	585	586	6	130	312D	3D24	8	$144	$18,720	
	GM32*	586	587	6	190	4D00	3F00	8	$144	$27,360	
	GM33*	587	587a	6	78	3100	5242	8	$144	$11,304	
	GM34	587a	591	6	136	-	-	8	$144	$19,522	
EX-P16	GM116	1413	1412	8	177	312F	5241	10	$180	$31,860	$31,860

Table 7-2 - Gravity Mains Included in the Capital Improvement Program (CIP) and Monitoring Program

Project	Pipe ID	Upstream Manhole ID	Downstream Manhole ID	Existing Diameter (in)	Pipe Length (ft)	Service PACP Quick Rating	Structural PACP Quick Rating	Replacement Diameter (in)	Cost per Foot ($/LF)	Total Cost per Pipe ($)	Total Cost per Project ($)
EX-P17	GM142	1364	1947	10	100	0000	4131	12	$216	$21,600	$89,640
	GM143	1947	1994	10	140	2100	0000	12	$216	$30,240	
	GM144	1994	1356	10	175	2F00	1100	12	$216	$37,800	
EX-P18	GM232	180	179	8	326	3126	2200	10	$180	$58,613	$192,845
	GM233	179	178	8	248	422I	2A11	10	$180	$44,550	
	GM234	178	176	8	498	4C31	2B00	10	$180	$89,681	
EX-P19	GM247	551	926	10	50	0000	3200	12	$216	$10,800	$10,800
EX-P20	GM176	1847	740	8	349	-	-	10	$180	$62,878	$412,343
	GM177	740	739	8	300	-	-	10	$180	$54,000	
	GM178	739	738	8	244	3100	0000	10	$180	$43,981	
	GM179	738	737	8	353	3100	0000	10	$180	$63,596	
	GM180	737	703	8	344	4931	2600	10	$180	$61,888	
	GM181*	703	702A	8	100	2E00	2113	10	$180	$18,000	
EX-P20	GM182*	702A	702	8	40	0000	0000	10	$180	$7,200	$412,343
	GM183	702	701	8	467	0000	0000	12	$216	$100,801	
EX-P21	GM99	89	88	8	331	-	-	10	$180	$59,580	$138,376
	GM100	88	87	8	340	-	-	10	$180	$61,200	
	GM101*	87	359	8	98	-	-	10	$180	$17,596	
EX-P22	GM89	130	129	10	330	5131	0000	15	$270	$89,100	$178,200
	GM90	129	128	10	330	312L	2411	15	$270	$89,100	
EX-P23	GM117	1411	1410	6	233	2100	523G	8	$144	$33,552	$33,552
MON-P1	GM148	189	406	8	479	312N	2B00	12	$216	$103,533	$224,363
	GM149*	406	407	8	190	2F00	1100	12	$216	$41,046	

Table 7-2 - Gravity Mains Included in the Capital Improvement Program (CIP) and Monitoring Program

Project	Pipe ID	Upstream Manhole ID	Downstream Manhole ID	Existing Diameter (in)	Pipe Length (ft)	Service PACP Quick Rating	Structural PACP Quick Rating	Replacement Diameter (in)	Cost per Foot ($/LF)	Total Cost per Pipe ($)	Total Cost per Project ($)
MON-P1	GM150	407	407a	8	103	422B	3222	12	$216	$22,309	$224,363
	GM151	407a	407b	8	185	352D	4125	12	$216	$39,971	
	GM152*	407b	408	8	81	452B	4200	12	$216	$17,504	
MON-P2	GM56	36	37	8	331	2X00	0000	10	$180	$59,580	$389,844
	GM57	37	1883	8	389	442Z	2611	12	$216	$84,024	
	GM58	1883	39	8	269	422N	2800	12	$216	$58,104	
	GM59	39	3	8	345	4A31	2200	12	$216	$74,520	
	GM60*	3	1	10	144	2J00	0000	12	$216	$31,104	
	GM61	1	2	10	63	4A00	2200	12	$216	$13,608	
	GM65	2	43	10	319	492N	3223	12	$216	$68,904	
MON-P3	GM209	1753	1754	8	340	4133	0000	12	$216	$73,440	$203,018
	GM210	1754	1756	8	259	422I	322A	12	$216	$55,987	
MON-P3	GM211	1756	1756a	8	276	4933	2600	12	$216	$59,551	$203,018
	GM212	1756a	1801a	8	65	4300	0000	12	$216	$14,040	
MON-P4	GM249	1834a	1834	12	414	-	-	15	$270	$111,726	$111,726
MON-P5	GM192	1645	1644	8	260	-	-	10	$180	$46,800	$97,200
	GM193	1644	1643	8	140	-	-	10	$180	$25,200	
	GM194	1643	1640	8	140	-	-	10	$180	$25,200	
MON-P6	GM35	1515	1517	6	340	-	-	8	$144	$48,960	$48,960
MON-P7	GM51	58	56	8	328	-	-	10	$180	$59,040	$264,960
	GM52*	56	49	8	330	-	-	10	$180	$59,400	
	GM53	49	831	8	165	-	-	10	$180	$29,700	
	GM54*	831	35	8	320	-	-	10	$180	$57,600	

Table 7-2 - Gravity Mains Included in the Capital Improvement Program (CIP) and Monitoring Program

Project	Pipe ID	Upstream Manhole ID	Downstream Manhole ID	Existing Diameter (in)	Pipe Length (ft)	Service PACP Quick Rating	Structural PACP Quick Rating	Replacement Diameter (in)	Cost per Foot ($/LF)	Total Cost per Pipe ($)	Total Cost per Project ($)
MON-P7	GM55	35	36	8	329	-	-	10	$180	$59,220	$264,960
MON-P8	GM246	550	551	10	241	4131	0000	12	$216	$52,056	$52,056
MON-P9	GM251	1161	1139	6	327	-	-	8	$144	$47,030	$47,030
MON-P10	GM191	1679	1673	8	169	-	-	10	$180	$30,330	$30,330
2012 CIP Projects											
2012-P1	GM1	538	534	8	58	2900	2200	10	$180	$10,404	$1,242,627
	GM2	534	532	8	310	0000	2800	10	$180	$55,818	
	GM3	532	531	8	423	2O00	2800	10	$180	$76,140	
	GM4*	531	530	8	330	2K00	3124	10	$180	$59,400	
	GM5*	530	470	8	386	4132	2100	10	$180	$69,480	
	GM6	470	469	8	378	312I	3122	10	$180	$68,040	
	GM7	469	468	8	305	2K00	4125	10	$180	$54,900	
	GM8	468	467	8	215	2F12	0000	10	$180	$38,700	
	GM9	467	466	8	130	2E00	2411	10	$180	$23,400	
	GM10	466	465	8	196	2G12	0000	10	$180	$35,280	
	GM11	465	464	8	169	422D	2511	10	$180	$30,420	
	GM12*	464	463	8	238	2100	0000	10	$180	$42,840	
	GM13	463	462	8	252	0000	2100	10	$180	$45,360	
	GM14	462	461	8	470	2M00	5100	10	$550**	$258,500	
	GM15*	461	460	8	401	2211	0000	10	$550**	$220,550	
	GM16	460	460A	8	31	2700	2611	10	$550**	$17,225	
	GM17	460A	459	6	26	2H00	2100	10	$550**	$14,464	
	GM18*	459	453	8	293	0000	0000	10	$180	$52,768	

Table 7-2 - Gravity Mains Included in the Capital Improvement Program (CIP) and Monitoring Program

Project	Pipe ID	Upstream Manhole ID	Downstream Manhole ID	Existing Diameter (in)	Pipe Length (ft)	Service PACP Quick Rating	Structural PACP Quick Rating	Replacement Diameter (in)	Cost per Foot ($/LF)	Total Cost per Pipe ($)	Total Cost per Project ($)
2012-P1	GM19	453	452	6	83	2100	0000	10	$180	$14,937	$1,242,627
	GM20	452	451	6	160	312E	2100	10	$180	$28,800	
	GM21	451	450	6	140	2D00	5131	10	$180	$25,200	
2012-P2	GM36	1517	1079	6	330	-	-	8	$144	$47,520	$794,466
	GM37	1079	1078	6	313	-	-	8	$144	$45,072	
	GM38	1078	1077	6	334	2100	3122	8	$144	$48,096	
	GM39	1077	1076	6	331	-	-	8	$144	$47,664	
	GM40*	1076	1075	6	331	-	-	8	$144	$47,664	
	GM41*	1075	1074	6	286	-	-	8	$144	$41,184	
	GM42	1074	1073	6	331	5100	0000	10	$180	$59,580	
	GM43	1073	1071	6	341	4212	2100	10	$180	$61,380	
	GM44	1071	1070	6	322	4431	3224	10	$180	$57,960	
	GM45	1070	1069	6	327	4223	0000	10	$180	$58,860	
	GM46	1069	1067	6	339	4300	1100	10	$180	$60,966	
2012-P2	GM47	1067	1062	6	331	2111	0000	10	$180	$59,580	$794,466
	GM48	1062	1953	6	265	4525	0000	10	$180	$47,700	
	GM49	1953	1954	8	346	3122	0000	10	$180	$62,280	
	GM50*	1954	1054	8	272	2J00	0000	10	$180	$48,960	
2012-P3	GM103	1544	1543	18	85	312J	2400	21	$378	$32,300	$32,300
2012-P4	GM153	235	636	24	370	312J	2400	27	$486	$179,820	$1,829,911
	GM154	636	638	24	219	2G00	2200	27	$486	$106,434	
	GM155	638	1326	24	287	2J00	2200	27	$486	$139,482	
	GM156	1326	1325	24	248	2H00	0000	27	$486	$120,528	

Table 7-2 - Gravity Mains Included in the Capital Improvement Program (CIP) and Monitoring Program

Project	Pipe ID	Upstream Manhole ID	Downstream Manhole ID	Existing Diameter (in)	Pipe Length (ft)	Service PACP Quick Rating	Structural PACP Quick Rating	Replacement Diameter (in)	Cost per Foot ($/LF)	Total Cost per Pipe ($)	Total Cost per Project ($)
2012-P4	GM157	1325	1312	24	566	2U00	2300	27	$486	$275,076	$1,829,911
	GM158*	1312	1958	24	252	2I00	0000	27	$486	$122,472	
	GM159*	1958	1321	24	262	2I00	0000	27	$486	$127,332	
	GM160	1321	1320	24	288	2J00	2200	27	$486	$139,968	
	GM161	1320	1319a	24	201	312F	1100	27	$486	$97,457	
	GM162	1319a	1319	24	78	-	-	27	$486	$37,717	
	GM163	1319	1300	24	253	2H00	2100	27	$486	$122,958	
	GM164	1300	1296	24	341	-	-	27	$486	$165,726	
	GM165	1296	1294	27	361	-	-	30	$540	$194,940	
2012-P5	GM98	6110	144	6	160	4131	3523	8	$144	$23,040	$23,040
2012-P6	GM113	1417	1416	8	165	-	-	10	$180	$29,700	$87,451
	GM114*	1416	1415	8	157	-	-	10	$180	$28,260	
	GM115*	1415	1413	8	164	4224	2211	10	$180	$29,491	
2012-P7	GM120	1404	1403	8	148	2C00	2212	10	$180	$26,593	$88,192
	GM121*	1403	1401a	8	181	312D	2811	10	$180	$32,644	
	GM122*	1401a	1401	8	106	-	-	10	$180	$19,056	
	GM123*	1401	344	8	55	2A00	0000	10	$180	$9,900	
2012-P8	GM185	1619	1617	8	396	-	-	10	$180	$71,347	$793,940
	GM186	1617	1629	8	404	4432	3124	10	$180	$72,659	
	GM187	1629	1635	8	415	4821	413B	12	$550**	$228,085	
	GM188	1635	1636	8	140	2C00	4131	12	$550**	$77,000	
	GM189	1636	1637	8	306	4B2J	3124	12	$550**	$168,300	
	GM190	1637	1638	8	321	312D	2200	12	$550**	$176,550	

Table 7-2 - Gravity Mains Included in the Capital Improvement Program (CIP) and Monitoring Program

Project	Pipe ID	Upstream Manhole ID	Downstream Manhole ID	Existing Diameter (in)	Pipe Length (ft)	Service PACP Quick Rating	Structural PACP Quick Rating	Replacement Diameter (in)	Cost per Foot ($/LF)	Total Cost per Pipe ($)	Total Cost per Project ($)
2012-P9	GM252	1186	1185	6	331	512L	0000	8	$144	$47,707	$185,832
	GM253	1185	1168	6	301	412K	5126	8	$144	$43,409	
	GM254	1168	1164	6	325	312M	2700	8	$144	$46,850	
	GM255	1164	1166	6	332	4821	5132	8	$144	$47,866	
2017 CIP Projects											
2017-P1	GM104	1543	1542	18	175	312J	2800	21	$378	$66,272	$173,318
	GM105	1542	1541	18	283	-	-	21	$378	$107,046	
2017-P2	GM172	943	379	33	330	-	-	36	$648	$213,931	$856,105
	GM173	379	938	33	330	-	-	36	$648	$214,125	
	GM174	938	937	33	330	-	-	36	$648	$214,112	
	GM175	937	935	33	330	-	-	36	$648	$213,937	
2017-P3	GM94	307	226	10	330	2Y00	3126	15	$270	$89,117	$89,117
2017-P4	GM62	7	6	8	330	-	-	10	$180	$59,400	$201,960
	GM63	6	4	8	336	312K	2400	12	$216	$72,576	
	GM64	4	2	8	324	472K	2800	12	$216	$69,984	
2017-P5	GM80	149	148	8	190	2E11	2200	10	$180	$34,200	$288,000
	GM81	148	145	10	330	2K11	2600	12	$216	$71,280	
	GM82	145	131a	10	335	2M00	2911	12	$216	$72,360	
	GM83	131a	131	10	180	4131	2200	12	$216	$38,880	
	GM84	131	130	10	330	412M	2200	12	$216	$71,280	
2027 CIP Projects											
2027-P1	GM66	43	424	12	296	2L00	0000	15	$270	$79,920	$564,699
	GM67	424	814	12	466	4131	2200	15	$550**	$256,300	

Table 7-2 - Gravity Mains Included in the Capital Improvement Program (CIP) and Monitoring Program

Project	Pipe ID	Upstream Manhole ID	Downstream Manhole ID	Existing Diameter (in)	Pipe Length (ft)	Service PACP Quick Rating	Structural PACP Quick Rating	Replacement Diameter (in)	Cost per Foot ($/LF)	Total Cost per Pipe ($)	Total Cost per Project ($)
2027-P1	GM68*	814	814a	12	238	3121	4722	15	$270	$64,277	$564,699
	GM69	814a	830	12	308	-	-	15	$270	$83,202	
	GM70	830	817	12	300	312C	2612	15	$270	$81,000	
2027-P2	GM72	2370	2368	10	325	-	-	12	$216	$70,200	$492,372
	GM73*	2368	2369	10	306	-	-	12	$216	$66,096	
	GM74	2369	2371	10	355	-	-	12	$216	$76,680	
	GM75	2371	2367	10	381	-	-	12	$216	$82,296	
	GM76*	2367	2372	10	250	-	-	12	$216	$54,000	
	GM77*	2372	817	10	300	-	-	12	$216	$64,800	
	GM78	817	817a	12	50	3129	1100	15	$270	$13,500	
	GM79	817a	455	12	240	4C31	2300	15	$270	$64,800	
2027-P3	GM86	135	134	8	350	312K	2611	12	$216	$75,600	$213,840
	GM87	134	133	8	310	2B11	2200	12	$216	$66,960	
	GM88	133	130	8	330	2C12	2113	12	$216	$71,280	
2027-P4	GM91	128	307	10	330	2Y13	5122	15	$550**	$181,500	$378,460
	GM92	101a	899	6	115	-	-	8	$144	$16,560	
	GM93	899	307	6	328	-	-	8	$550**	$180,400	
2027-P5	GM95	226	265	10	330	2C00	2200	15	$270	$89,136	$255,456
	GM96	265	454	18	200	2D00	2100	21	$378	$75,600	
	GM97*	454	455	18	240	0000	0000	21	$378	$90,720	
2027-P6	GM145	1356	1357	15	144	-	-	18	$324	$46,656	$142,884
	GM146*	1357	1358	15	148	-	-	18	$324	$47,952	
	GM147*	1358	1359	15	149	2C00	3122	18	$324	$48,276	

Table 7-2 - Gravity Mains Included in the Capital Improvement Program (CIP) and Monitoring Program

Project	Pipe ID	Upstream Manhole ID	Downstream Manhole ID	Existing Diameter (in)	Pipe Length (ft)	Service PACP Quick Rating	Structural PACP Quick Rating	Replacement Diameter (in)	Cost per Foot ($/LF)	Total Cost per Pipe ($)	Total Cost per Project ($)
2027-P7	GM71	46	10007	8	371	4213	4231	10	$550**	$204,050	$204,050
2027-P8	GM166	338	236	6	201	2900	2200	8	$144	$28,944	$28,944
2027-P9	GM203	209	1748	8	300	-	-	10	$180	$54,054	$329,454
	GM204	1748	1765	8	300	-	-	10	$180	$54,000	
	GM205	1765	1750	8	300	-	-	10	$180	$54,000	
	GM206	1750	1751	8	440	-	-	10	$180	$79,200	
	GM207*	1751	1752	8	330	-	-	10	$180	$59,400	
	GM208*	1752	1753	8	160	-	-	10	$180	$28,800	
2027-P10	GM231	984	180	8	337	-	-	10	$180	$60,660	$60,660
2027-P11	GM85	140a	140	6	308	-	-	8	$144	$44,352	$44,352
2027-P12	GM250	997	994	6	330	-	-	8	$144	$47,520	$47,520
Total					*68,364*	-	-	-	-	*$18,504,381*	*$18,504,381*

* - Reflects gravity mains being upsized due to adjacent gravity upsizing driven by capacity criteria

** - Unit cost reflects the fact that pipeline is located under Interstate-5 or Interstate-805

0 2,000 4,000 Feet

N

Legend

- National City Flow Monitor
- Lift Station
- Manhole
- Force Main

Gravity Main Material

- Concrete Cylinder Pipe
- Concrete
- Concrete Pipe
- Concrete Pipe/Polyvinyl Chloride Pipe
- Concrete Pipe/Vitrified Clay Pipe
- Plastic Pipe
- Polyvinyl Chloride Pipe
- Polyvinyl Chloride Pipe/Vitrified Clay Pipe
- Vitrified Clay Pipe
- Vitrified Clay Pipe/Concrete Lined
- Vitrified Clay Pipe/Concrete Pipe/Concrete Lined
- Unknown

NC9M NC7M NC10 NC11 NC6 NC5 NC12 NC4M NC3A NC3B NC13 NC16 NC15 NC8M NC2

Infrastructure ENGINEERING CORPORATION

City of National City
Sewer System Master Plan

Gravity Mains by Material

March 2011

Figure 2-1

Infrastructure
ENGINEERING CORPORATION

City of National City
Sewer System Master Plan

Gravity Mains by Diameter

March 2011

Figure 2-2

0 2,000 4,000 Feet

N

Legend

- National City Flow Monitor
- Lift Station
- Manhole
- Force Main

Gravity Main

- Existing (2009) Deficient
- Existing (2009) Deficient Only
- 2012 Deficient
- 2017 Deficient
- 2027 Deficient
- Gravity Main within Replacement Criteria

Infrastructure ENGINEERING CORPORATION

City of National City
Sewer System Master Plan

Deficient Gravity Mains by Year

March 2011

Figure 6-1

0 2,000 4,000 Feet

N

Legend

- National City Flow Monitor
- Lift Station
- Manhole
- Force Main
- Gravity Main within Replacement Criteria

Infrastructure ENGINEERING CORPORATION

City of National City
Sewer System Master Plan

Sewer Capital Improvement Program and Monitoring Program

March 2011

Figure 7-1