SEWER MASTER PLAN

Prepared by:

BOWEN COLLINS & ASSOCIATES

Prepared for:

MAGNA WATER DISTRICT

August 2020

MAGNA WATER DISTRICT

SEWER MASTER PLAN

August 2020

LICENSED PROFESSIONAL ENGINEER
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15 AUG 2020
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Prepared for:

MAGNA WATER DISTRICT

Prepared by:

BOWEN COLLINS & ASSOCIATES

EXECUTIVE SUMMARY

INTRODUCTION

Magna Water District retained Bowen Collins & Associates (BC&A) to prepare a Collection System Master Plan, Wastewater Facility Plan, and an Implementation Plan. The purpose of the three separate reports are as follows:

- **Collection System Master Plan –** An evaluation of the District's existing wastewater collection system and its ability to convey wastewater from where it is generated to where it will be treated.
- **Wastewater Facility Master Plan** – An evaluation of the District's ability to treat wastewater as it is received from customers. This plan is the topic of this report.
- **Implementation and Capital Facilities Plan –** A plan for completing the necessary improvements identified in the collection system and wastewater facility master plans.

This executive summary provides a brief summary of the evaluation process and the recommended system improvements. Whereas each of the plans have been written such that they can be stand alone documents, this executive summary has been prepared to summarize all three documents.

GROWTH PROJECTIONS

Existing wastewater in the District's collection system was evaluated based data from the District's culinary water billing data. Projections of future growth in wastewater were developed based on existing production rates (gallons per day per equivalent residential unit) and anticipated growth for the District's existing service area and annexation areas. Table ES-1 and Figure ES-1 show projected growth of wastewater in the future. As can be seen, flow in the collection system is expected to increase from 2.81 mgd in 2020 to 5.3 mgd at buildout, an increase of more than 90 percent. Collection system improvements throughout the District will be needed to accommodate this additional flow.

Table ES-1
Projected Growth in Wastewater

Year	Domestic Production Projection (mgd)	High Groundwater Planning Infiltration (mgd)	Total Max Month Wastewater Projection w/o EDR Byproduct (mgd)	Peak Month Byproduct Discharge (mgd)	Total Max Month Wastewater Projection (mgd)
2009	2.07	0.72	2.79	0.72	3.51
2017	2.20	0.48[1]	2.68	0.90	3.58
2018	2.23	0.48	2.71	1.17	3.89
2019	2.25	0.48	2.73	1.14	3.88
2020	2.31	0.49	2.81	0.00[2]	2.81
2028	2.83	0.57	3.41	0.00	3.41
2030	2.92	0.59	3.50	0.00	3.50
2040	3.28	0.64	3.91	0.00	3.91
2050	3.60	0.69	4.29	0.00	4.29
2060	3.89	0.73	4.63	0.00	4.63
Buildout	4.52	0.83	5.34	0.00	5.34

1 MWD personnel believe infiltration has been reduced in recent years as a result of reduced flood irrigation
2 New byproduct pipeline to bypass treatment plant, reducing byproduct discharge to zero

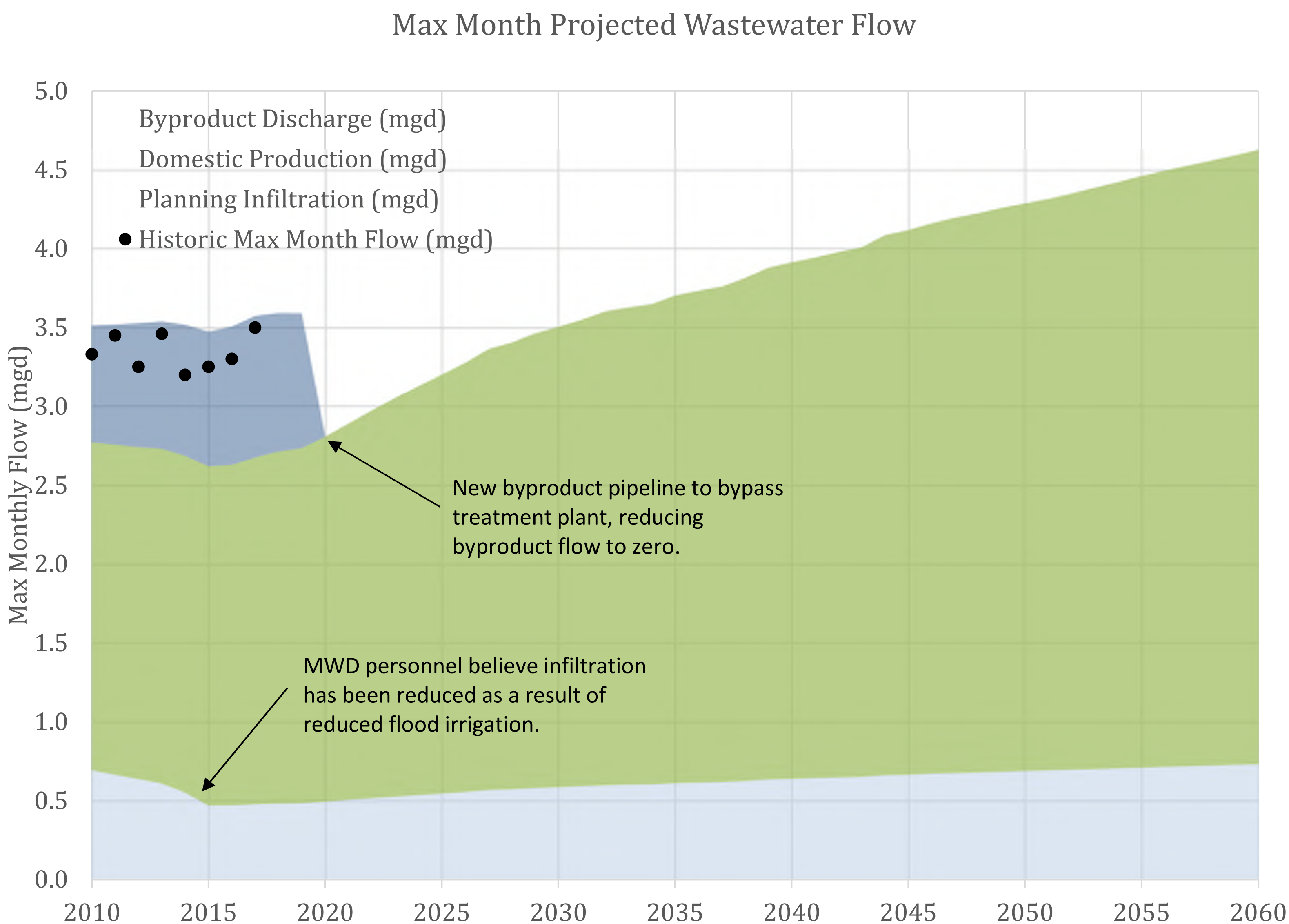


Figure ES-1
Projected Growth in Wastewater (MGD)

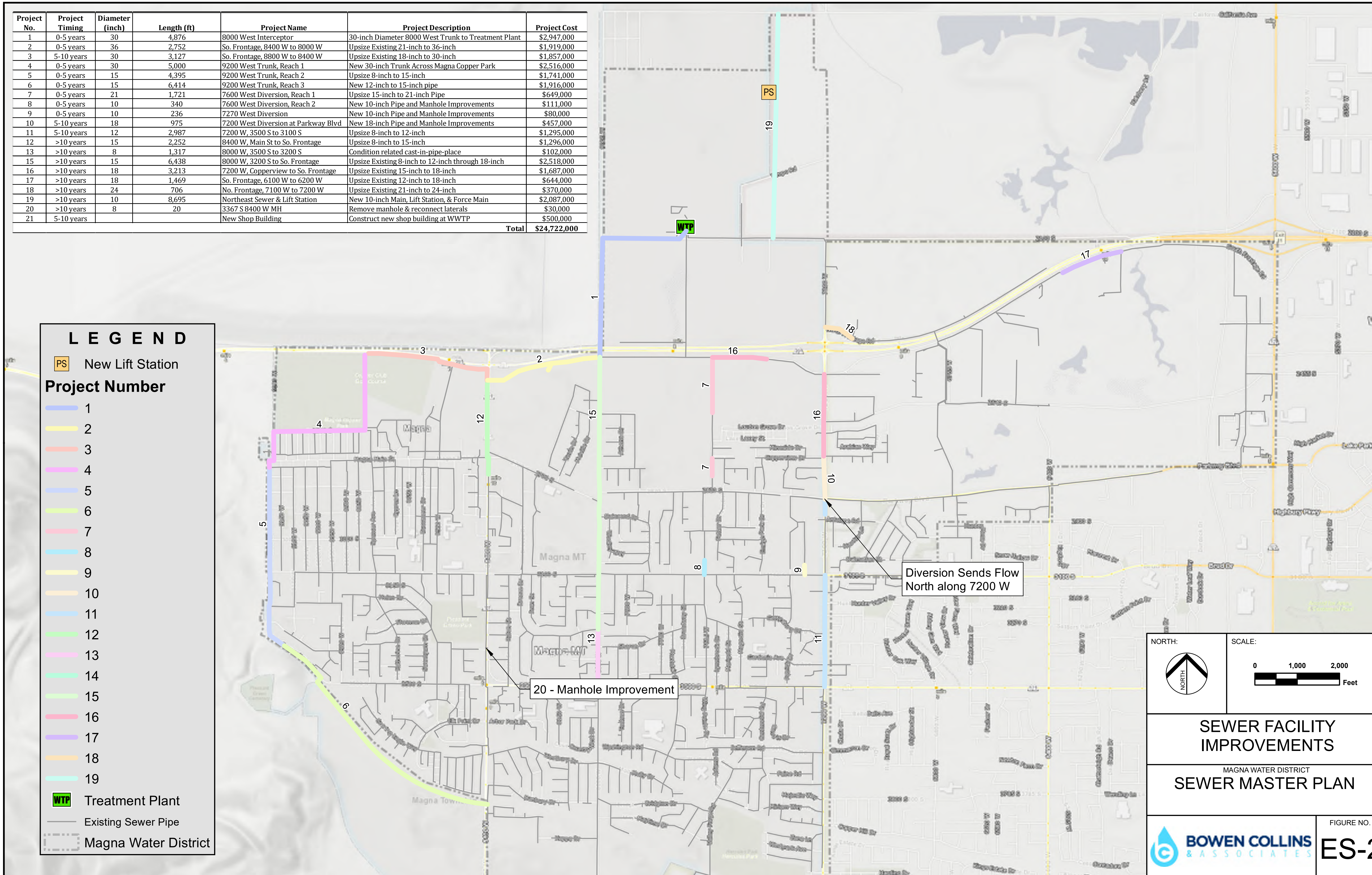
COLLECTION SYSTEM EVALUATION

Based on existing wastewater flow and projected growth in wastewater flow, the existing and future flows were simulated in a hydraulic model of the District's collection system. For existing flows, model results indicate that there are some existing deficiencies in several trunk lines in the system. For future flows, some significant deficiencies are predicted in high growth areas of the District. While much of the system has some excess capacity for future growth, several trunk lines serving high growth areas will need to be replaced with larger pipes to meet future demands. Most of the projected deficiencies are a result of growth on Kennecott property at the southwest corner of the District.

COLLECTION SYSTEM CAPACITY IMPROVEMENTS

To resolve potential deficiencies identified as part of the system evaluation, several projects have been proposed. Figure ES-2 and Table ES-2 show the projects and associated costs for these projects.

Project No.	Project Timing	Diameter (inch)	Length (ft)	Project Name	Project Description	Project Cost
1	0-5 years	30	4,876	8000 West Interceptor	30-inch Diameter 8000 West Trunk to Treatment Plant	$2,947,000
2	0-5 years	36	2,752	So. Frontage, 8400 W to 8000 W	Upsize Existing 21-inch to 36-inch	$1,919,000
3	5-10 years	30	3,127	So. Frontage, 8800 W to 8400 W	Upsize Existing 18-inch to 30-inch	$1,857,000
4	0-5 years	30	5,000	9200 West Trunk, Reach 1	New 30-inch Trunk Across Magna Copper Park	$2,516,000
5	0-5 years	15	4,395	9200 West Trunk, Reach 2	Upsize 8-inch to 15-inch	$1,741,000
6	0-5 years	15	6,414	9200 West Trunk, Reach 3	New 12-inch to 15-inch pipe	$1,916,000
7	0-5 years	21	1,721	7600 West Diversion, Reach 1	Upsize 15-inch to 21-inch Pipe	$649,000
8	0-5 years	10	340	7600 West Diversion, Reach 2	New 10-inch Pipe and Manhole Improvements	$111,000
9	0-5 years	10	236	7270 West Diversion	New 10-inch Pipe and Manhole Improvements	$80,000
10	5-10 years	18	975	7200 West Diversion at Parkway Blvd	New 18-inch Pipe and Manhole Improvements	$457,000
11	5-10 years	12	2,987	7200 W, 3500 S to 3100 S	Upsize 8-inch to 12-inch	$1,295,000
12	>10 years	15	2,252	8400 W, Main St to So. Frontage	Upsize 8-inch to 15-inch	$1,296,000
13	>10 years	8	1,317	8000 W, 3500 S to 3200 S	Condition related cast-in-pipe-place	$102,000
15	>10 years	15	6,438	8000 W, 3200 S to So. Frontage	Upsize Existing 8-inch to 12-inch through 18-inch	$2,518,000
16	>10 years	18	3,213	7200 W, Copperview to So. Frontage	Upsize Existing 15-inch to 18-inch	$1,687,000
17	>10 years	18	1,469	So. Frontage, 6100 W to 6200 W	Upsize Existing 12-inch to 18-inch	$644,000
18	>10 years	24	706	No. Frontage, 7100 W to 7200 W	Upsize Existing 21-inch to 24-inch	$370,000
19	>10 years	10	8,695	Northeast Sewer & Lift Station	New 10-inch Main, Lift Station, & Force Main	$2,087,000
20	>10 years	8	20	3367 S 8400 W MH	Remove manhole & reconnect laterals	$30,000
21	5-10 years			New Shop Building	Construct new shop building at WWTP	$500,000
					Total	$24,722,000



SEWER FACILITY IMPROVEMENTS

MAGNA WATER DISTRICT

SEWER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

ES-2

P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Sewer-Figure ES-2-Diversions Buildout Sewer System.mxd wandersen 6/5/2020

Table ES-2
Proposed Collection System Capacity Improvements

Project No.	Project Timing	Diameter (inch)	Length (ft)	Project Name	Project Description	Project Cost (2019 $s)
1	0-5 years	30	4,876	8000 West Interceptor	30-inch Diameter 8000 West Trunk to Treatment Plant	$2,947,000
2	0-5 years	36	2,752	So. Frontage, 8400 W to 8000 W	Upsize Existing 21-inch to 36-inch	$1,919,000
3	5-10 years	30	3,127	So. Frontage, 8800 W to 8400 W	Upsize Existing 18-inch to 30-inch	$1,857,000
4	0-5 years	30	5,000	9200 West Trunk, Reach 1	New 30-inch Trunk Across Magna Copper Park	$2,516,000
5	0-5 years	15	4,395	9200 West Trunk, Reach 2	Upsize 8-inch to 15-inch	$1,741,000
6	0-5 years	15	6,414	9200 West Trunk, Reach 3	New 12-inch to 15-inch pipe	$1,916,000
7	0-5 years	21	1,721	7600 West Diversion, Reach 1	Upsize 15-inch to 21-inch Pipe	$649,000
8	0-5 years	10	340	7600 West Diversion, Reach 2	New 10-inch Pipe and Manhole Improvements	$111,000
9	0-5 years	10	236	7270 West Diversion	New 10-inch Pipe and Manhole Improvements	$80,000
10	5-10 years	18	975	7200 West Diversion at Parkway Blvd	New 18-inch Pipe and Manhole Improvements	$457,000
11	5-10 years	12	2,987	7200 W, 3500 S to 3100 S	Upsize 8-inch to 12-inch	$1,295,000
12	10-15 years	15	2,252	8400 W, Main St to So. Frontage	Upsize 8-inch to 15-inch	$1,296,000
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15	10-15 years	15	6,438	8000 W, 3200 S to So. Frontage	Upsize Existing 8-inch to 12-inch through 18-inch	$2,518,000
16	10-15 years	18	3,213	7200 W, Copperview to So. Frontage	Upsize Existing 15-inch to 18-inch	$1,687,000
17	10-15 years	18	1,469	So. Frontage, 6100 W to 6200 W	Upsize Existing 12-inch to 18-inch	$644,000
18	10-15 years	24	706	No. Frontage, 7100 W to 7200 W	Upsize Existing 21-inch to 24-inch	$370,000
19	10-15 years	10	8,695	Northeast Sewer & Lift Station	New 10-inch Main, Lift Station, & Force Main	$2,087,000
20	10-15 years	8	20	3367 S 8400 W MH	Remove manhole & reconnect laterals	$30,000
21	5-10 years	-	-	New Shop Building	Construct new shop building at WWTP	$500,000
					Total	**$24,722,000**

WASTEWATER FACILITY IMPROVEMENTS

Wastewater facility improvements have been selected based results of the District's Wastewater Facility Plan and discussions with the District. Table ES-3 summarizes the projects identified in the Wastewater Facility Master Plan with their respective project timing and estimated project cost.

Table ES-3
Proposed Wastewater Facility Improvements

Project No.	Project Timing	Project Name	Project Cost (2019 $'s)
1	0-5 years	Influent Pump Station Modifications	$5,728,900
2	0-5 years	Secondary Reuse	$12,480,900
3	>10 years	Land Acquisition for Future Expansion	$5,400,000
4	0-5 years	New Dewatering Press	$440,000
5	>10 years	Modifications to Sludge Drying Beds	$500,000
6	5-10 years	SCADA Upgrades	$250,000
7	5-10 years	Asphalt Replacement	$500,000
		Total	$25,299,800

REHABILITATION AND REPLACEMENT – TOTAL RECOMMENDED INVESTMENT

Based on this analysis, the recommended District budget for rehabilitation and replacement activities is approximately $740,000 at the wastewater facility each year and an additional $700,000 in the sewer collection system each year. These values are reported in 2019 dollars and should be adjusted for construction inflation over time. These budget levels should be revisited from time to time and adjusted as part of future asset management planning.

RECOMMENDED 10-YEAR CAPITAL IMPROVEMENT PROGRAM

Based on the system improvements identified in Chapter 6 and the recommended prioritization approach discussed above, Table ES-4 lists improvement projects that are recommended within the next 10-years, the budget required to complete those projects, and the recommended timing of those projects. For budgeting purposes, capital costs for most major capital improvements have been split up into at least two years; the first year usually includes about 10% of the total project cost for design services, while future years include the remaining budget for actual construction.

Table ES-4
Recommended 10-Year Capital Improvement Plan

Project ID	Project Description	Project Total (2019 $s)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	10-yr Total	Outside of 10-Year Plan
Collection System Capacity Improvements														
1	8000 West Interceptor	$2,947,000	$303,541	$2,813,825									$3,117,366	
2	So. Frontage, 8400 W to 8000 W	$1,919,000				$215,985	$2,002,182						$2,218,167	
3	So. Frontage, 8800 W to 8400 W	$1,857,000							$228,388	$2,117,153			$2,345,540	
4	9200 West Trunk, Reach 1	$2,516,000		$266,922	$2,474,371								$2,741,293	
5	9200 West Trunk, Reach 2	$1,741,000				$195,951	$1,816,467						$2,012,418	
6	9200 West Trunk, Reach 3*	$894,133				$100,635	$932,891						$1,033,527	
7	7600 West Diversion, Reach 1	$649,000					$75,237	$697,446					$772,683	
8	7600 West Diversion, Reach 2	$111,000					$12,868	$119,286					$132,154	
9	7270 West Diversion	$80,000					$9,274	$85,972					$95,246	
10	7200 West Diversion at Parkway Blvd	$457,000						$54,568	$505,847				$560,415	
11	7200 W, 3500 S to 3100 S	$1,295,000								$164,047	$1,520,713		$1,684,760	
12	8400 W, Main St to So. Frontage	$1,296,000											$0	$1,296,000
13	8000 W, 3500 S to 3200 S	$102,000											$0	$102,000
15	8000 W, 3200 S to So. Frontage	$2,518,000											$0	$2,518,000
16	7200 W, Copperview to So. Frontage	$1,687,000											$0	$1,687,000
17	So. Frontage, 6100 W to 6200 W	$644,000											$0	$644,000
18	No. Frontage, 7100 W to 7200 W	$370,000											$0	$370,000
19	Northeast Sewer & Lift Station	$2,087,000											$0	$2,087,000
20	3367 S 8400 W MH	$30,000											$0	$30,000
21	New Shop Building	$500,000											$0	$500,000
Subtotal		***$23,700,133***	***$303,541***	***$3,080,748***	***$2,474,371***	***$512,572***	***$4,848,919***	***$957,272***	***$734,235***	***$2,281,200***	***$1,520,713***	***$0***	***$16,713,569***	***$9,234,000***
Treatment Plant Improvements														
1	Influent Pump Station Modifications	$5,728,900	$590,077	$5,470,011									$6,060,088	
2	Secondary Reuse	$12,480,900			$1,363,822	$6,321,313	$6,510,953						$14,196,088	
3	Land Acquisition for Future Expansion	$5,400,000											$0	$5,400,000
4	New Dewatering Press	$440,000			$480,800								$480,800	
5	Modifications to Sludge Drying Beds	$500,000											$0	$500,000
6	SCADA Upgrades	$250,000						$298,513					$298,513	
7	Asphalt Replacement	$500,000						$597,026					$597,026	
Subtotal		***$25,299,800***	***$590,077***	***$5,470,011***	***$1,844,622***	***$6,321,313***	***$6,510,953***	***$895,539***	***$0***	***$0***	***$0***	***$0***	***$21,632,514***	***$5,900,000***
Collection System Rehabilitation Improvements														
1	Mainline Sewer Repairs (including Western Drive)	-	$617,969	$687,025	$759,667	$836,050	$916,333	$1,000,680	$1,089,262	$1,182,260	$1,279,856	$1,382,245	$9,751,347	
2	Manhole Repairs (Epoxy Spray Lining)	-	$103,031	$114,544	$126,656	$139,391	$152,776	$166,838	$181,607	$197,112	$213,384	$230,455	$1,625,793	
Subtotal		***$0***	***$721,000***	***$801,569***	***$886,323***	***$975,441***	***$1,069,108***	***$1,167,518***	***$1,270,870***	***$1,379,372***	***$1,493,240***	***$1,612,700***	***$11,377,141***	***$0***
TOTAL		**$48,999,933**	**$1,614,618**	**$9,352,327**	**$5,205,316**	**$7,809,326**	**$12,428,980**	**$3,020,329**	**$2,005,104**	**$3,660,571**	**$3,013,954**	**$1,612,700**	**$49,723,224**	**$15,134,000**

Note: Costs include 3% inflation per year
*Project cost only includes District's portion of cost to upsize

COLLECTION SYSTEM MASTER PLAN

PART 1 OF SEWER MASTER PLAN

TABLE OF CONTENTS

Note: This report is the first in a series of three reports comprising the Magna Water District Sewer Master Plan. Chapter 7 is located in the second report in this series, and chapters 8 through 10 are in part three.

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CHAPTER 1
INTRODUCTION

INTRODUCTION

The Magna Water District (MWD or District) desires to develop an updated master plan for its sewer collection system. This is the first in a series of three expected reports that will comprise the planning documents for the District's sewer system. The expected reports will be:

- **Collection System Master Plan** – An evaluation of the District's existing wastewater collection system and its ability to convey wastewater from where it is generated to where it will be treated.
- **Wastewater Facility Master Plan** – An evaluation of the District's ability to treat wastewater as it is received from customers. In 2017, a master plan for the District's wastewater treatment plant was completed by Carollo Engineers. That plan was amended in December of 2019. That plan will not be updated as part of BC&A's efforts but is an important part of the District's overall sewer system needs and will correspondingly be referenced here.
- **Implementation and Capital Facilities Plan –** A plan for completing the necessary improvements identified in the collection system and wastewater facility master plans.

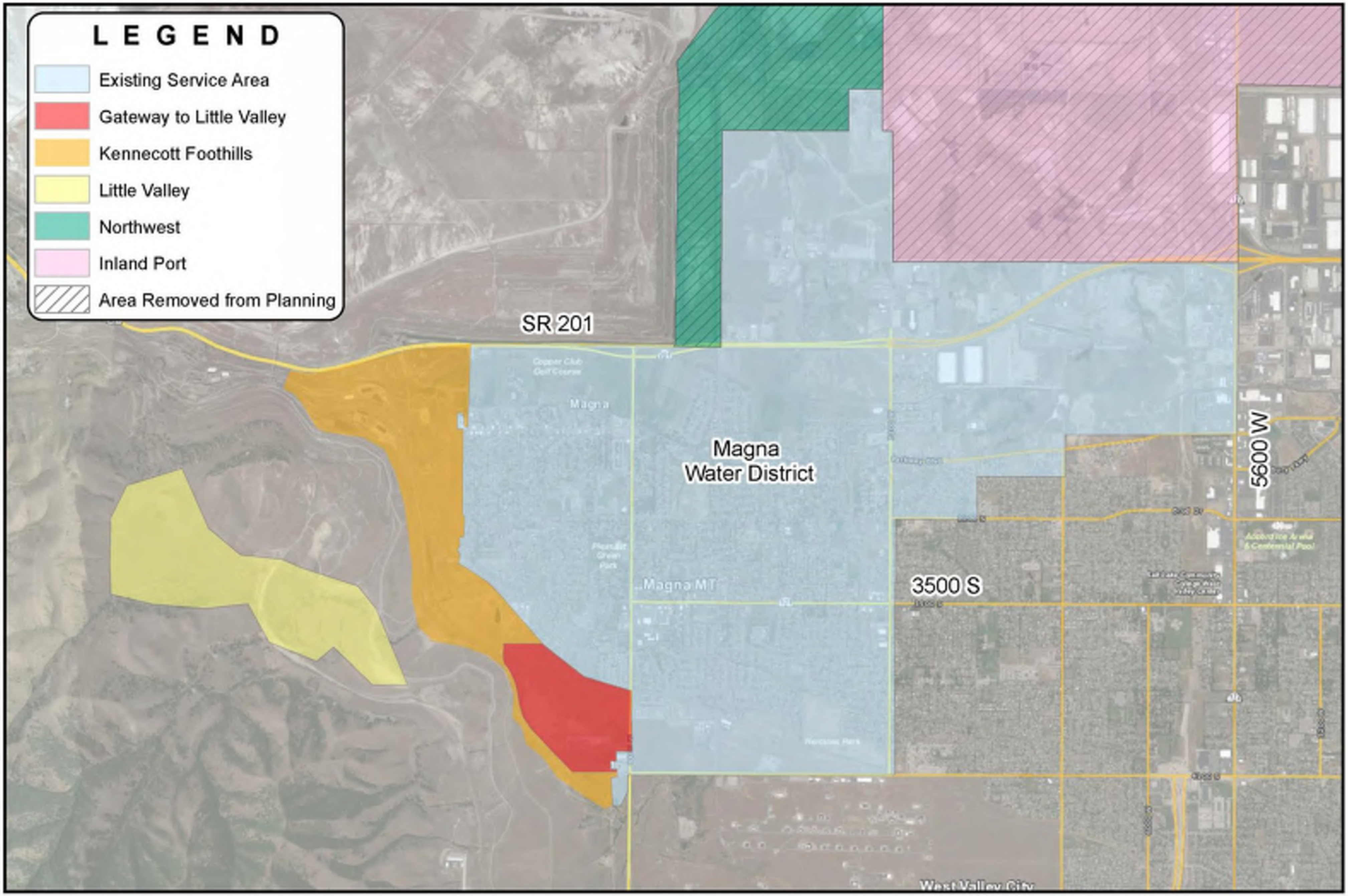
BACKGROUND

The focus of this report is the collection system. The District has previously prepared a collection system master plan and a wastewater treatment facility plan as follows:

- Culinary Water, Secondary Water, & Sanitary Sewer Impact Fee Facility Plan – Prepared by Epic Engineering in August 2013
- Wastewater Facility Plan – Prepared by Carollo in March 2017.

Since the completion of the previous studies, a number of changes have occurred. Changes that need to be evaluated and addressed for the District to meet the future needs of the system include:

- **Land Use Changes –** Since the preparation of the last master plans, several areas adjacent to the District's service area have begun development planning and are either in the process or expected to enter the process in the future to annex into the District. The District would like to plan for future areas likely to annex into the District as identified in Figure 1-1:
    - **Gateway to Little Valley –** This development sits just west of the District's current service area and includes a proposed 1,290 indoor equivalent residential connections to be built within the next 10-years. This area was included in the Carollo study, but projections for this area have been refined since the Carollo study was published.
    - **Kennecott Foothills –** Additional area directly west of the existing District service area (beyond that identified as part of Gateway to Little Valley) is likely to develop and annex into the District. For the purpose of District planning, all areas directly west of the existing service area that have an elevation of approximately 4,660 feet or lower have been included as potential annexation. This elevation was chosen as the upper boundary of likely development as it is the currently service area limitation of the District's planned Pressure Zone 3. This area was included in the Carollo study, but District personnel have adjusted density projections for this area somewhat since the Carollo study was published.



BOWEN COLLINS & ASSOCIATES

MAGNA WATER DISTRICT

SEWER MASTER PLAN

SERVICE AREA CHANGES

NORTH:

SCALE: 0 2,000 4,000 Feet

FIGURE NO. 1-1

P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Sewer-Figure 1-1 Annexation Areas.mxd AMcKinnon 3/7/2019

- **Little Valley –** Kennecott has long-term plans for development in the area called "Little Valley." This is a valley within the Oquirrh Mountains west of the District. While this area is not expected to begin development in the near future, the District would like to provide for capacity, especially in its largest outfall facilities, to meet the needs of the Little Valley. This area was not included in either of the previous facility studies.

In addition to the areas being added to the study as noted above, there are also a few areas identified in past planning documents that need to be removed from current projections:

- **Northwest Area –** The Carollo study included development in areas northwest of the District's service area. Based on recent coordination with Kennecott, it appears very unlikely that any of these areas will develop in the near term. Thus, all development associated with these areas has been removed from the planning window of this study.
- **Inland Port Area –** The Carollo study included development that is part of the Inland Port area that will not be collected or treated by the District. This area has also been removed from the growth projections for this study.

- **Continued Growth and Additional Density –** In addition to areas that will potentially annex into the District, densities for new development have generally been increasing and are higher than densities included in the previous master plans. Growth projections in this study have been updated to reflect these observed or planned increased in density.
- **Infiltration –** Previous studies were not clear on how much infiltration was included as part of planning values. This study uses historical data to identify a historic planning value that can be used to project expected infiltration during a wet climate year.

To consider these and other issues relative to the District's sewer system, the District has retained Bowen, Collins & Associates (BC&A) to evaluate sewer conveyance requirements within the District.

SCOPE OF SERVICES

The general scope of this project involved a thorough analysis of the District's sewer collection system and its ability to meet the present and future wastewater needs of its residents. As part of the Sewer Master Plan, BC&A completed the following tasks.

Task 1: Collected information as needed to develop the sewer master plan based on the District's existing facilities, known developments, and general zoning for the District.

Task 2: Updated population projections and estimated growth in sewer flow to evaluate future growth needs. This included future growth for each of the contributing agencies that flow through the District to the Magna wastewater treatment plant.

Task 3: Developed a hydraulic computer model of the District's collection system to evaluate existing and projected future system deficiencies. This included calibrating the model using data from the District's existing GIS database, water meter data from the District, and treatment plant flow data.

Task 4: Identified existing operating deficiencies.

Task 5: Identified projected future operating deficiencies.

Task 6: Evaluated alternative improvements for resolving deficiencies identified in Tasks 4 and 5. This included evaluating alternatives looking at diversion locations and reuse opportunities.

Task 7: Developed a comprehensive capital facilities plan and implementation plan incorporating all required improvements identified for the collection system.

Task 8: Documented results of the previous tasks in a report with additional memoranda as needed.

REPORT ASSUMPTIONS

As a long-term planning document, this report is based on a number of assumptions relative to future growth patterns, service area expansion, and source availability. Of special significance to the District are a number of assumptions relative to annexation areas and development densities. If any variables are significantly different than what has been assumed, the results of this report will need to be adjusted accordingly. Because of these uncertainties, this report and the associated recommendations should be updated approximately every five years. Updates may be required sooner if significant changes occur such as annexation or changes in development patterns.

ACKNOWLEDGEMENTS

The BC&A team wishes to thank the following individuals from the Magna Water District for their cooperation and assistance in working with us in preparing this report:

Terry Pollock	General Manager
Clint Dilley	District Engineer
Steve Williams	Wastewater Operations Manager
Andrew Hobson	Water Operations Manager
Jeff White	Chairman of Board of Trustees
Leisle Fitzgerald	District Controller

PROJECT STAFF

The project work was performed by the BC&A's team members listed below. Team member's roles on the project are also listed. The project was completed in BC&A's Draper, Utah office. Questions may be addressed to Keith Larson, Project Manager at (801) 495-2224.

Jason Luettinger	Principle in Charge
Keith Larson	Project Manager
Andrew McKinnon	Project Engineer, Sewer Modeling
Wyatt Andersen	Project Engineer, Sewer Modeling
Mike Hilbert	Technical Writer

CHAPTER 2
FUTURE GROWTH AND FLOW PROJECTIONS

INTRODUCTION

There are several methods that can be used to estimate future sewer loading. This study developed flow projections using equivalent residential connections (ERCs). The methodology of this approach can be summarized as follows:

1. Define the service area
2. Project residential populations for the service area based on existing and projected patterns of development
3. Project non-residential development for the service area based on existing and projected patterns of development
4. Project equivalent residential connections (including non-residential growth) for the service area based on existing and projected patterns of development
5. Estimate the contribution of various wastewater flow components including domestic flow, infiltration, inflow, and other contributions of wastewater.
6. Convert projections of growth to wastewater flows based on their historic contributions

Each step of this process is summarized in the sections below.

SERVICE AREA

As discussed in Chapter 1, the future service area of the District includes the existing District boundary area along with areas of expansion that includes the Gateway to Little Valley, Kennecott Foothills, and Little Valley areas as identified in Figure 1-1.

RESIDENTIAL POPULATION GROWTH

There are a number of planning agencies that produce growth estimates covering the area included in the Magna Water District including: the State of Utah Governor's Office of Management and Budget (GOMB), the Kem C. Gardner Policy Institute, and the Wasatch Front Regional Council (WFRC). The first two of these agencies generally plan on a county or state level. As a result, planning estimates at those scales are often unhelpful for service district's because boundaries often do not line up with service district boundaries. The WFRC does planning on a smaller scale as a result of needing to conduct traffic modeling of future conditions. The WFRC develops traffic analysis zones (TAZs) that include sub-areas that include residential and employment projections divided into relatively small areas representative of collector roads. As a result, the WFRC projections are more helpful than State of Utah estimates for projecting rates of growth for population and employment growth for service districts. Correspondingly, the most recent version of WFRC projections (Draft 2018 Projections) have been used as the basis for projecting residential growth in this report (with a few exceptions as noted in the following sections).

Existing Service Area

BC&A reviewed the WFRC draft TAZ projections for the Magna Water District and used the existing population estimates and growth rate for each TAZ within the District to help define the rate of growth for the existing service area as defined by the District's existing District boundary through the year 2050. The WFRC does not have population projections beyond the year 2050, so the rate of growth shown through 2060 is extrapolated at the 2050 rate for the existing service area.

Annexation Areas

While the WFRC projections are very useful for the more established portions of the District, they do not include much detail on growth in the currently undeveloped, potential annexation areas outside the District. Thus, the rate of growth for the annexation areas is based on discussions with Kennecott planning personnel (the developers of the Gateway to Little Valley, Kennecott Foothills, and Little Valley properties). The timelines given below are based roughly on feedback from Kennecott planning personnel.

- **Gateway to Little Valley –** The Gateway to Little Valley area has specific plans that have been submitted to the County already and the developer believes the area will develop within the next 10 years. For planning purposes, it has been conservatively assumed that this area will fully develop within 7.5 years.
- **Kennecott Foothills –** As the Gateway to Little Valley finishes developing, it is anticipated that some of the areas adjacent to the Gateway considered as part of the Kennecott Foothills will begin to develop at approximately the same rate as the Gateway area or around 120 equivalent residential connections (ERCs) per year. Once the area directly around the Gateway fully develops (the area south of 3500 South in Pressure zone 3 is anticipated to develop by approximately the year 2033), it is anticipated that the rate of growth will slow to approximately 60 ERCs per year for the remaining portion of the Kennecott Foothills. Based on the total available area, the Kennecott Foothills is projected to fully develop by approximately 2055.
- **Little Valley –** For the purposes of this report, it has been assumed that growth in the Little Valley area will not occur until the Kennecott Foothills property fully develops. Thus, growth in the Little Valley area has been assumed at a rate of 60 ERCs per year beginning in the year 2055. While no immediate plans existing, Kennecott personnel indicate that there is at least a possibility that development of Little Valley could begin quite a bit sooner than 2055. However, if that is the case, it has been assumed that any growth in Little Valley would be offset by a decrease in growth in the Kennecott Foothills. Thus, the overall growth rate would remain about the same as currently assumed.

Table 2-1 and Figure 2-1 identify the population projections for the District service area.

Table 2-1
Population Projections for Magna Water District

Year	Existing Service Area	Gateway to Little Valley	Kennecott Foothills	Little Valley	Total Population	Rate of Growth
2018	31,649	0	0	0	31,649	
2020	32,166	265	0	0	32,430	1.2%
2025	33,424	1,588	0	0	35,012	1.5%
2028	34,127	1,985	801	0	36,913	1.8%
2030	34,486	1,985	1,576	0	38,047	1.5%
2035	35,143	1,985	3,126	0	40,254	1.1%
2040	36,105	1,985	4,233	0	42,323	1.0%
2045	37,102	1,985	5,340	0	44,427	1.0%
2050	38,230	1,985	6,447	0	46,662	1.0%
2055	39,131	1,985	7,592	0	48,709	0.9%
2060	40,054	1,985	7,592	1,107	50,738	0.8%
Buildout	41,353	1,985	7,592	12,682	63,613	-

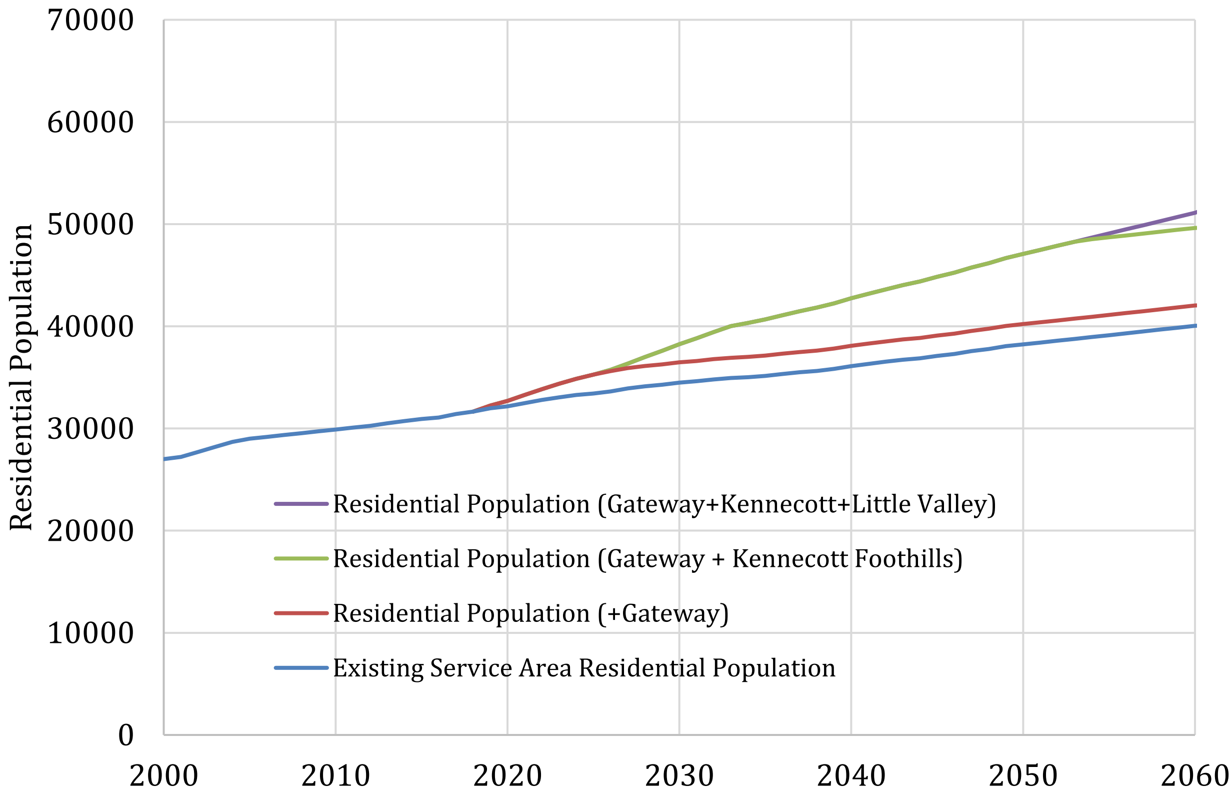


Figure 2-1
Residential Population

Buildout Population

While the rates of growth from the WFRC are useful for projecting how fast growth will occur, it is less useful for predicting final densities and buildout population for the District. This was especially true for some of the annexation areas which have little growth shown according to WFRC projections through 2050 and no land use plans by cities or other agencies. Based on recent development trends, the District would like to plan on an average density of 6 units/acre for areas generally identified as residential. Average household size for the District service area was calculated as 3.65 persons/connection using residential population information from the Wasatch Front Regional Council within the District service area boundary and the number of residential connections within the District. Figure 2-2 shows the undeveloped areas in the District along with the average planning densities used for projecting future demands.

NON-RESIDENTIAL GROWTH

Included in Figure 2-2 is identification of undeveloped areas that are planned for non-residential growth. Non-residential growth is not insignificant in the District. Of the undeveloped area in the District or its future annexation areas, approximately 56 percent of the area is currently planned as non-residential as summarized in Table 2-2.

Table 2-2
Area of Undeveloped Non-Residential Property in Service Area

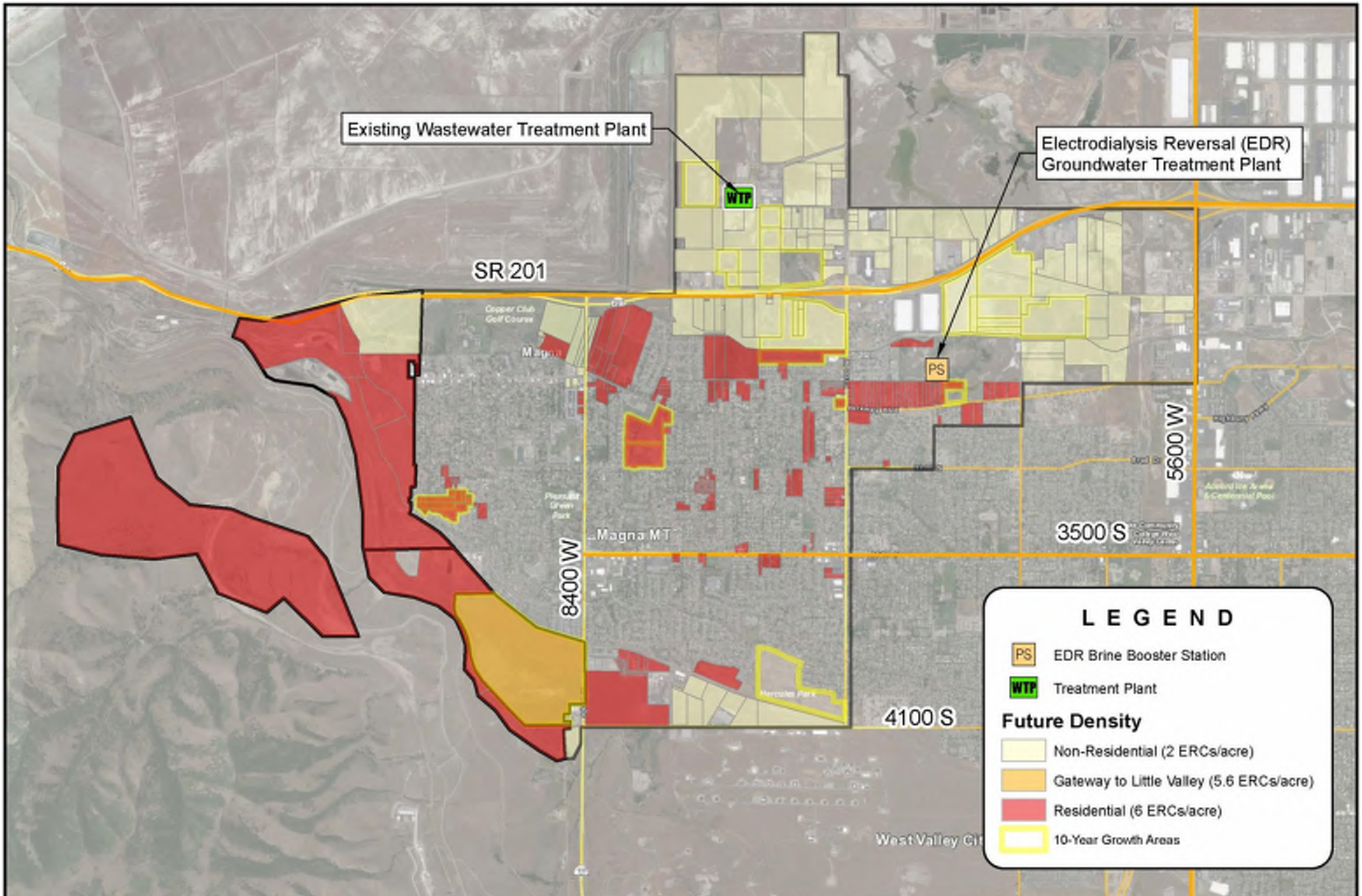
Service Area	Undeveloped Area (acres)	Non-Residential Undeveloped (acres)	Non-Residential Percentage
Existing Service Area	2,238	1,789	79.9%
Gateway to Little Valley	230	90	39.0%
Kennecott Foothills	466	75	16.1%
Little Valley	552	0	0.0%
Total	**3,486**	**1,954**	**56.0%**

For the next 10 years, projections of non-residential growth are based on development pressure that District personnel have identified as shown in Figure 2-2. For the remaining period of the service area, the non-residential growth rate has been projected to grow at the rate anticipated by the WFRC projections for employment.

Table 2-2
Non-Residential Growth Projections for Magna Water District (acres)

Year	Existing Service Area	Gateway to Little Valley	Kennecott Foothills	Little Valley	Total	Rate of Growth
2018	691[a]	0	0	0	691	
2020	765	3	0	0	768	5.5%
2025	912	50	0	0	962	4.6%
2028	943	90	8	0	1,040	2.6%
2030	979	90	13	0	1,081	2.0%
2035	1,059	90	25	0	1,174	1.7%
2040	1,177	90	38	0	1,304	2.1%
2045	1,277	90	50	0	1,417	1.7%
2050	1,294	90	63	0	1,447	0.4%
2055	1,346	90	75	0	1,511	0.9%
2060	1,393	90	75	0	1,558	0.6%
Buildout	2,480	90	75	0	2,645	

[a] estimated based on existing non-residential indoor water use.



BOWEN COLLINS & ASSOCIATES

MAGNA WATER DISTRICT

SEWER MASTER PLAN

UNDEVELOPED OR UNDER DEVELOPED LAND

NORTH:

SCALE: 0 4,000 Feet

FIGURE NO. 2-2

P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Sewer-Figure 2-2b - Existing Service Area Future Growth.mxd AMcKinnon 5/1/2019

CONVERSION OF GROWTH TO EQUIVALENT RESIDENTIAL CONNECTIONS

In order to understand the relationship between residential and non-residential growth, it is important to convert the growth projections in both categories above into a single comparable unit. The unit used for this purpose is Equivalent Residential Connections (ERCs). An ERC represents the amount of wastewater flow that is produced by a typical, single family residential connection in the MWD system.

- **Residential ERCs** – Calculation of residential ERCs from population growth projections is relatively straight forward. Based on WFRC estimates of the existing population within the District service area, the average persons per residential connection was calculated to be 3.65. Correspondingly, residential ERCs are calculated as projected population divided by 3.65.
- **Non-Residential ERCs –** Calculation of non-residential ERCs are a little more difficult. BC&A conducted an analysis of 2017 water billing data. Based on this analysis, estimated indoor water use was estimated to be approximately 247 gpd for residential connections with an associated domestic wastewater production rate of approximately 222 gpd per connection.

Based on these calculations, the estimated number of existing ERCs for 2017 was estimated to be 9,900. These baseline 2017 values were used to estimate projections of future water use for the District with conservation through the year 2060.

Table 2-4 summarizes the growth of equivalent residential connections within the District.

Table 2-4
Equivalent Residential Connections & Irrigated Area Projections

Year	Residential ERCs	Non-Residential ERCs	Total ERCs
2018	8,668	1,382	10,049
2020	8,883	1,537	10,419
2025	10,037	1,925	11,961
2028	10,681	2,080	12,761
2030	10,988	2,163	13,151
2035	11,586	2,348	13,933
2040	12,146	2,608	14,755
2045	12,716	2,834	15,550
2050	13,321	2,893	16,215
2055	13,875	3,021	16,897
2060	14,425	3,116	17,542

WASTEWATER COMPONENTS

Before projecting future growth in wastewater, one must first have an accurate understanding of wastewater flows. This includes an estimate of both the quantity and distribution of existing and future flows. For most wastewater service providers, wastewater flow can be grouped into three major components: domestic wastewater, infiltration, and inflow. For the Magna Water District, there is one additional component of wastewater that may affect planning: the brine byproduct from the District's Electrodialysis Reversal (EDR) groundwater treatment plant (described in more detail as part of Chapter 3). Each of these are components are discussed in further detail in the following sections.

Domestic Wastewater

Domestic flow consists of the wastewater contributions of residential and nonresidential customers. While domestic flow varies significantly throughout the day (as will be discussed in Chapter 4 – Hydraulic Modeling), it is relatively consistent from year to year and its growth can be closely tied to the growth of development in the District. Correspondingly, estimating domestic flows in the District is relatively straightforward. For this study, domestic flows have been estimated based on ERCs as defined previously. As discussed in the previous section, the approximate value for indoor water consumption was calculated to be 247 gallons per day per ERC with an estimated 222 gallons per day of domestic wastewater production per ERC. This equates to an estimated domestic flow of approximately 2.23 mgd in 2018.

Brine Byproduct

The District's EDR groundwater treatment plant currently produces a byproduct flow stream that is discharged into the wastewater system. This flow varies in proportion to the flow of total water treated at the EDR plant. Historic maximum month flow of the byproduct has been up to 1.2 mgd.

Infiltration

The next component of wastewater flow that must be considered is infiltration. Infiltration is defined as water that enters into the sewer system which is not directly or indirectly related to either domestic wastewater or to a specific storm event. This flow can enter as a result of open pipe joints, cracks in pipes, pipes poorly connected at manholes, leaky lateral connections, roots, etc. Temporary increases in the amount of water that enters the system after a storm because of an increase in ground water or direct connection to collection lines will be considered as inflow.

Factors that can affect infiltration include pipe age, material, and number and condition of lateral connections. Age can contribute to infiltration in two ways. First, older pipes are more likely to be in poor condition. Cracks, separated joints, and other defects can contribute significantly to increased infiltration. Second, older pipes do not have the benefit of improvements in construction techniques that have occurred over time. Gasketed pipe joints, rubber boots at manholes and laterals, and other improvements have contributed greatly to reducing system infiltration over time.

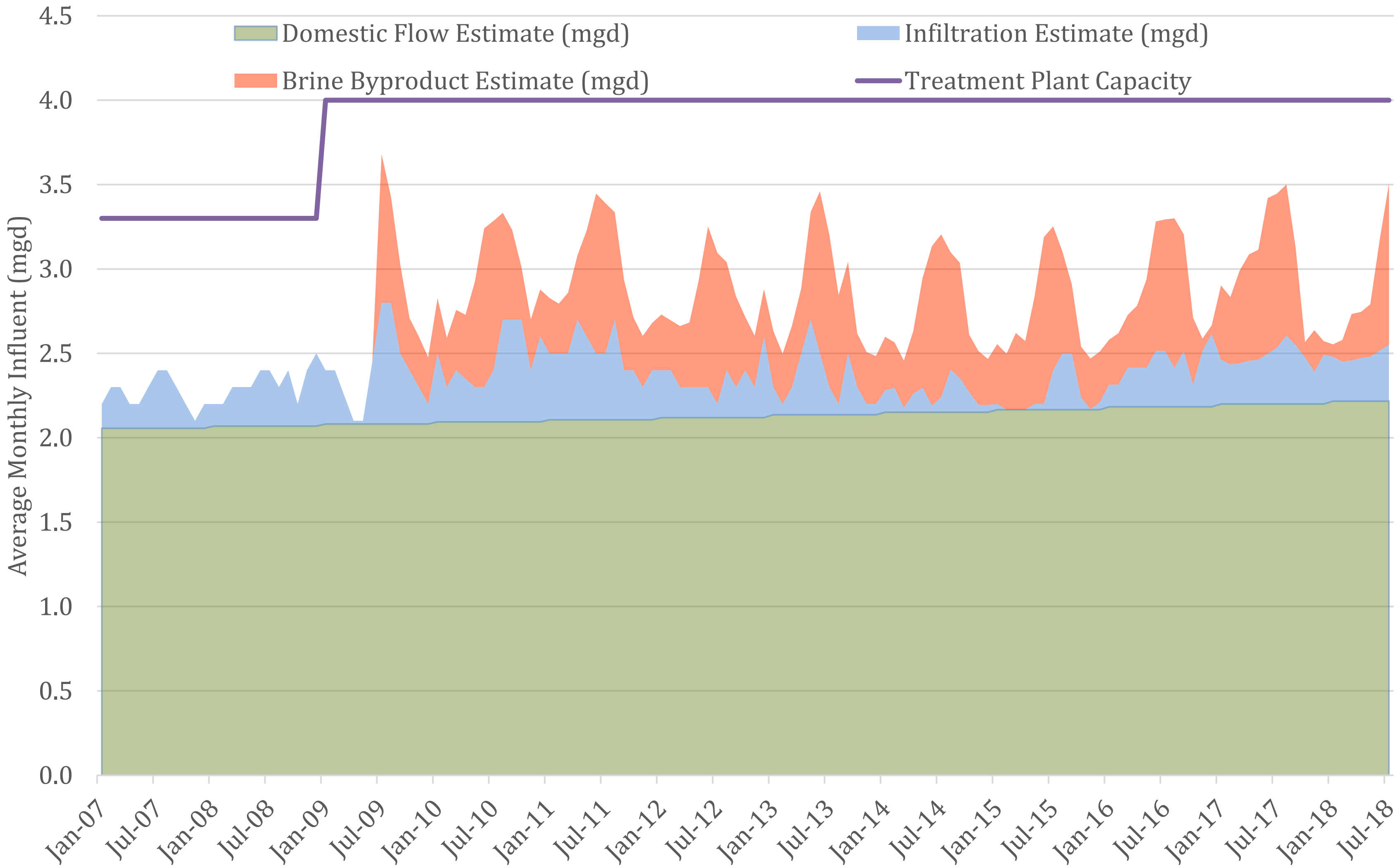
Infiltration can be difficult to estimate because it can vary over time. Infiltration is generally a function of groundwater levels. Groundwater levels in the service area fluctuate depending on climate and season. Infiltration rates will correspondingly change seasonally and from year to year depending on climate.

To account for these challenges, infiltration must be estimated by looking at long-term flow trends. Table 2-5 and Figure 2-3 show the average wastewater at the District's wastewater treatment plant from 2014 through 2018. Included in the figure is a breakdown of flow between domestic, byproduct, and infiltration flows. Domestic and byproduct flows have be estimated as described previously. Infiltration correspondingly becomes the difference between total flow and the flow accounted for through other components.

Table 2-5
Wastewater Influent by Year with EDR Brine Byproduct Included

Month	2014	2015	2016	2017	2018
January	2.60	2.55	2.58	2.90	2.54
February	2.56	2.43	2.62	2.83	2.56
March	2.46	2.55	2.73	2.99	2.72
April	2.63	2.51	2.78	3.09	2.73
May	2.95	2.83	2.94	3.11	2.77
June	3.14	3.19	3.28	3.42	3.15
July	3.20	3.25	3.29	3.45	3.49
August	3.10	3.10	3.30	3.50	
September	3.04	2.91	3.21	3.13	
October	2.61	2.54	2.71	2.57	
November	2.51	2.47	2.59	2.64	
December	2.47	2.51	2.67	2.57	
Average Day	2.77	2.74	2.89	3.02	2.85
Max Month	3.20	3.25	3.30	3.50	3.49

Figure 2-3
Historical Treatment Plant Average Monthly Influent Flow



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[1] For pre-2014 data, see March 2017 Corrolo Wastewater Facility Plan. Infiltration after 2014 estimated based on historical data and available brine byproduct data.

As can be seen in the figure, flows to the treatment plant in winter months (December, January, February) are approximately 0.5 to 1.0 million gallons per day (mgd) lower than peak times of the year when flow approaches 3.5 mgd. This is the result of both fluctuating infiltration and brine byproduct production. Based on this analysis, the max month planning infiltration was estimated to be approximately 0.72 mgd based on 2009 treatment plant influent data (or approximately 34 percent of estimated domestic flow within the District in 2009). Since that time, there is an observable decline in estimated infiltration. The max estimated infiltration in 2015 was estimated to be approximately 0.47 mgd (or approximately 22 percent of domestic flow for 2015) and this level of infiltration has been relatively consistent over the past several years. It is believed that this can be explained, at least in part, by a significant decrease in flood irrigation within the District which has led to lower groundwater levels. Based on this observed reduction, the estimated planning infiltration for existing District development is 0.47 mgd.

Inflow

Similar to infiltration, inflow is also the intrusion of unwanted water into the sewer system. In the case of inflow, however, this water comes from rainfall and snowmelt instead of groundwater. Inflow may enter the sewer system through roof and foundation drains, yard and area drains, manhole covers, and illicit storm drain connections. In the case of the assorted roof and yard drains, discharge into the sanitary system is against District ordinances. However, illegal connections often exist and can significantly affect the performance of the sewer system.

Inflow into a collection system can be highly variable and depends on the placement and construction of sewer collection systems as well as the type of storm events that occur. In addition, a long record of rainfall and flow monitoring data is needed to accurately predict how storm events may impact the District's collection system or treatment plant. Thus, no inflow is specifically shown in the projections used in this report. Instead, inflow is accounted for in the sewer master plan by reserving a portion of capacity in pipelines and the treatment plant inflow. In other words, a pipe will be identified as having inadequate capacity at projected flows less than the full flow capacity of the pipe. Magna Water District's design criteria for pipe capacity includes a 50 percent capacity buffer for pipes 12-inch and smaller and 25 percent capacity buffer for pipes 15-inch or greater. This buffer provides capacity for inflow and other unusual flow events when sewer production may peak (e.g. Super Bowl, holidays, etc.).

WASTEWATER GROWTH PROJECTIONS

With the contribution of each type of flow identified and growth in the District projected through the planning window. It is possible to project future wastewater flows in the District as follows:

- **Domestic Flow –** The projected domestic flow in future years can be estimated as the number of ERCs in that year (see Table 2-4) times the average observed domestic flow per ERC (222 gallons per day).
- **Byproduct Flow –** It should be noted that byproduct flow from the EDR plant will be bypassed around the treatment plant facility once the District constructs a brine pump station and byproduct pipeline (completion planned for 2019). Thus, after completion of these facilities, projected byproduct flow is zero.
- **Infiltration –** Although future infiltration will be a function of many different variables (water table, pipe depth, pipe diameter, pipe length, construction materials, etc), projections of future infiltration have been simplified by assuming a specific amount of infiltration per growth in population or ERCs. For planning purposes, it is assumed that future infiltration will increase at a rate of approximately 33 gallons per day for each added equivalent

residential connection (or approximately 15 percent of domestic production). This estimate is based on recommendations for current construction materials and methods and average development density in the District. Future infiltration is anticipated to be less than historic infiltration (observed between 22 and 34 percent) due to improvements in construction materials and technologies.

Based on these projections, Table 2-6 and Figure 2-4 show the expected growth in wastewater flows in the District through the year 2060.

Figure 2-4
Max Month Projected Wastewater Flow

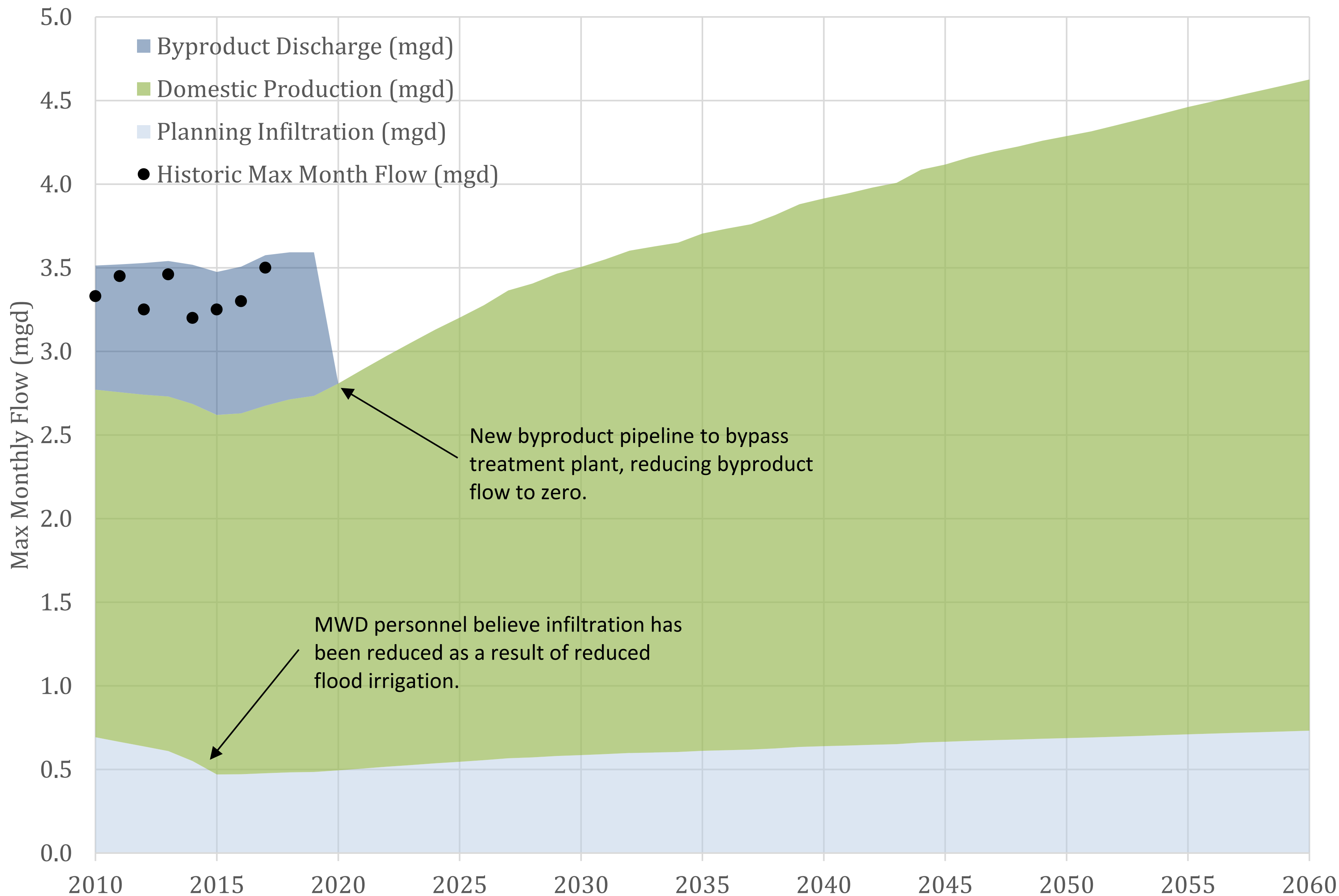


Table 2-6
Projected Growth in Wastewater

Year	Domestic Production Projection (mgd)	High Groundwater Planning Infiltration (mgd)	Total Max Month Wastewater Projection w/o EDR Byproduct (mgd)	Peak Month Byproduct Discharge (mgd)	Total Max Month Wastewater Projection (mgd)
2009	2.07	0.72	2.79	0.72	3.51
2017	2.20	0.48[1]	2.68	0.90	3.58
2018	2.23	0.48	2.71	1.17	3.89
2019	2.25	0.48	2.73	1.14	3.88
2020	2.31	0.49	2.81	0.00[2]	2.81
2028	2.83	0.57	3.41	0.00	3.41
2030	2.92	0.59	3.50	0.00	3.50
2040	3.28	0.64	3.91	0.00	3.91
2050	3.60	0.69	4.29	0.00	4.29
2060	3.89	0.73	4.63	0.00	4.63
Buildout	4.52	0.83	5.34	0.00	5.34

1 MWD personnel believe infiltration has been reduced in recent years as a result of reduced flood irrigation
2 New byproduct pipeline to bypass treatment plant, reducing byproduct discharge to zero

CHAPTER 3
EXISTING SYSTEM FEATURES

INTRODUCTION

As part of this Master Plan, BC&A has assembled an inventory of existing infrastructure within the sewer collection system. The purpose of this chapter is to present a summary of the inventory of District's existing sewer collection system that can be used as a reference for future studies.

SERVICE AREA

Magna Water District provides wastewater services for almost all residents within its corporate boundaries as shown in Figure 3-1. In 2018, this equated to an approximate Magna Water District service population of 31,650 permanent residents. In addition to permanent residents, the District also serves many commercial, industrial, and institutional entities. The southwest side of the District is largely residential and is mostly built out. The northeast side of the District is mostly commercial/industrial, with some large areas still available for future development.

TOPOGRAPHY

The Magna Water District water system existing service area is approximately 9.25 square miles and is bordered by the following: The Oquirrh Mountain Range to the west, Granger-Hunter Improvement District to the southeast, and Salt Lake City Department of Public Utilities to the northeast.

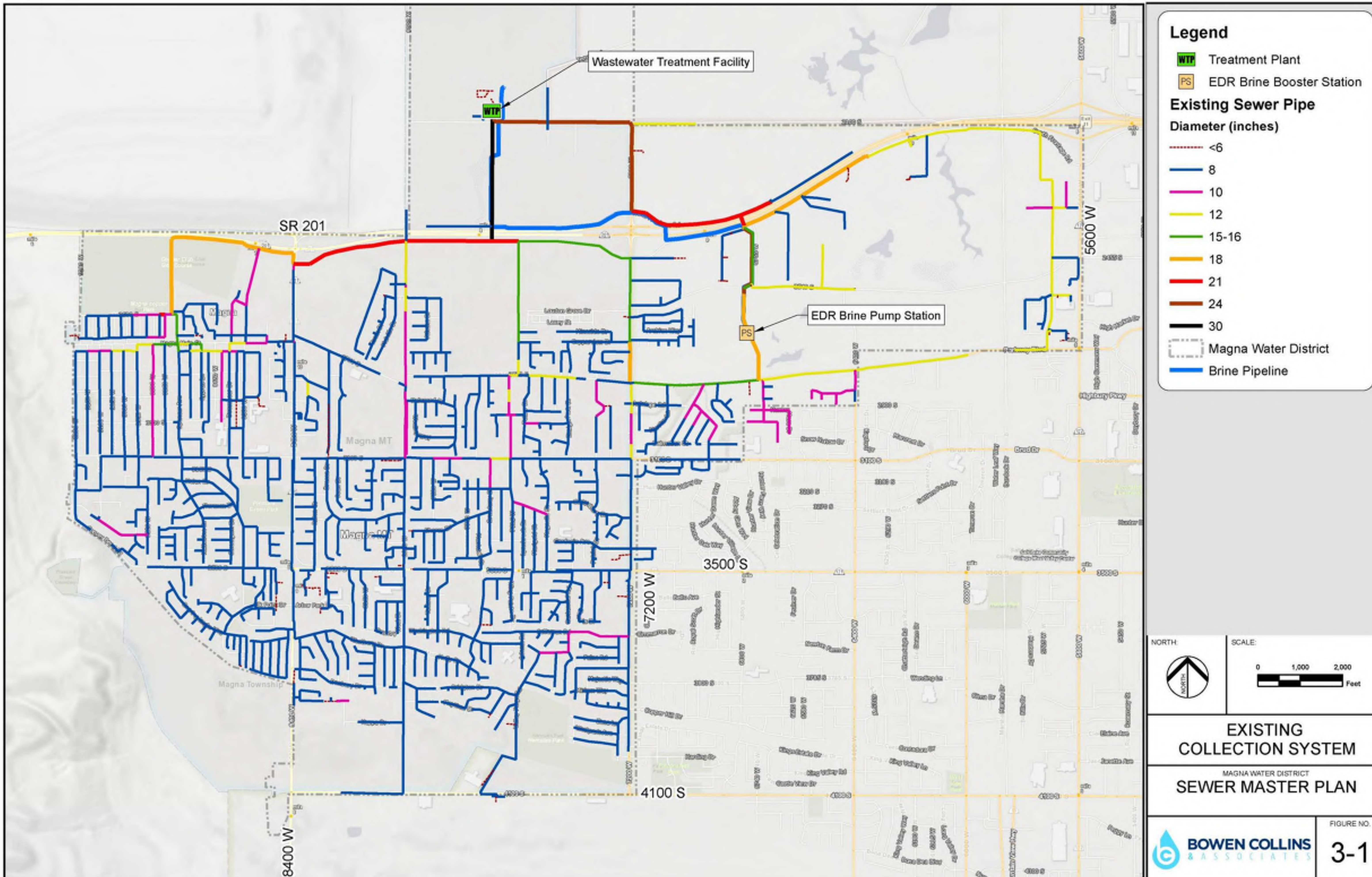
The topography of the District generally slopes from south to north with the District's wastewater treatment plant located at the north central side of the District. All of the District's wastewater collection system currently flows by gravity to the wastewater treatment plant.

COLLECTION SYSTEM

Major attributes of the various components of the collection system are summarized in the following sections.

Sewer Collection Pipes

There are about 103 miles of sewer mains and over 1,700 manholes in the Magna District Sewer System that are cataloged in the GIS database. Table 3-1 contains a summary of the sewer pipes for the Magna District sewer collection system. As can be seen in the table, 78 percent of the pipe in the system is 8 inches in diameter. This represents the vast network of small collection mains in neighborhoods throughout the District.



EXISTING
COLLECTION SYSTEM

MAGNA WATER DISTRICT
SEWER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
3-1

Table 3-1
Sewer Collection System Sizes and Lengths

Diameter (in)	Length (ft)	Length (mi)	Percentage (%)
Unknown	8,200	1.55	1.5
4	1,313	0.25	0.24
6	5,852	1.11	1.1
8	419,448	79.44	77.4
10	35,103	6.65	6.5
12	27,474	5.20	5.1
15	13,774	2.61	2.5
18	11,566	2.19	2.1
21	9,288	1.76	1.7
24	7,244	1.37	1.3
30	2,978	0.56	0.55
Total	**542,240**	**102.69**	**100.00%**

Collection System Connectivity

The District's collection system has many locations where multiple outlets may be possible from a single manhole. For most cases, the District has a primary outlet direction with a potential overflow path for wastewater. The overflow is typically only used for flushing lines and maintenance, but in some cases could serve as a potential diversion of flow. Flow direction for pipes was identified by District personnel as part of the hydraulic model calibration (discussed in more detail in Chapter 4).

Lift Stations

The District does not have any existing lift stations.

EDR Water Treatment Byproduct

In 2008, the Districted obtained funding to construct a membrane water treatment plant to improve the water quality of groundwater used in the District's culinary water system. The District selected a demineralization process called electrodialysis reversal (EDR) that can effectively remove arsenic, perchlorate, and TDS. A byproduct of this process is the production of a concentrated brine solution that is discharged to the District's wastewater system. Historically, the brine byproduct has discharged to wastewater collection mains near the EDR plant and have been conveyed to the District's Wastewater Treatment Plant along with domestic wastewater and any infiltration or inflow in the system. However, in 2018, the District completed a dedicated brine pipeline for brine byproduct and began construction of a brine pump station to pump directly to the wastewater treatment plant. The new brine pump station is anticipated to begin operation in 2019 with the following characteristics.

- Pump Station Capacity – The pump station is equipped with four pumps (one 555 gpm pump, three 1,120 gpm pumps) to accommodate the various flow trains of the EDR plant. A peak flow of 2,240 gpm is the maximum flow of the pump station. This peak flow would typically be only for short durations depending on backwash conditions and the number of treatment trains running in the EDR plant.

- Pump Station Lift – The maximum lift of the pump station will be up to 100 feet (43 psi).
- Pipeline Characteristics – The brine pipeline itself consists of approximately 2.5 miles of 16-inch DR17 HDPE 4710 pipe. The brine pump station includes a pig launching and receiving facility to clean the pipeline as required.

Operation of the brine pump station and pipeline will allow the District to separate brine byproduct from domestic wastewater so that it does not need to be processed through the biological treatment systems of the wastewater treatment plant.

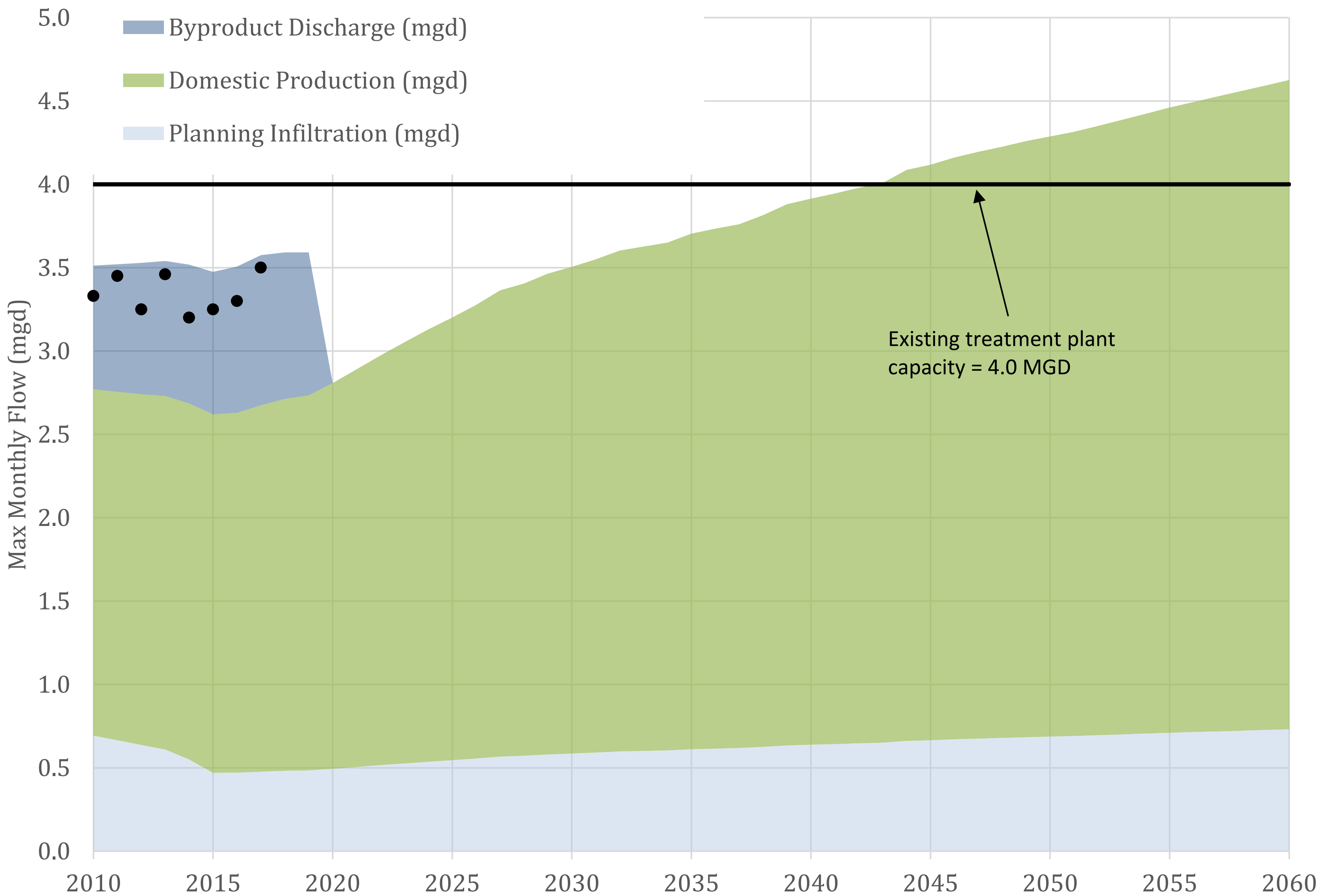
MAGNA WASTEWATER TREATMENT FACILITY

The Magna Wastewater Treatment Plant facility (WWTP) is an activated sludge plant which was first constructed in the 1985 with a design capacity of 3.3 MGD. The treatment plant's process flow includes: influent pump station, course screening, grit removal, fine screening, an intermediate pump station, oxidation ditches, secondary clarifiers, chlorine disinfection, and solids handling. In 2009, flows increased as a result of the addition of disposal concentrate from the District's EDR groundwater treatment facility to the sanitary sewer system. The District applied for and received a permitted capacity increase from 3.3 MGD to 4.0 MGD.

Figure 3-2 compares projected wastewater growth in the District relative to existing capacity at the wastewater treatment plant. Based on the projected growth, the following conclusions about District treatment plant capacity can be made:

- **Brine Byproduct –** The brine byproduct makes up a significant portion of the District's overall treatment demand. Beginning operation of the new brine pump station in 2019 will significantly reduce hydraulic loading requirements through the facility.
- **Plant Expansion –** Once the brine pump and pipeline are operational, it does not appear that projected demand will exceed plant capacity until approximately the year 2043. Thus, no major expansions of plant capacity are projected to be needed in the near future. However, this does not mean that smaller projects will not be needed at the plant before 2043. Projects to improve system redundancy or other level of service concerns have been identified in a separate plan (2017 Wastewater Facility Plan, Carollo Engineers).

Figure 3-2
Max Month Projected Wastewater Flow



CHAPTER 4
HYDRAULIC MODELING

INTRODUCTION

A critical component in identifying areas in the District collection system where pipes have capacity deficiencies is the development of a hydraulic computer model. An extended period simulation (EPS) hydraulic model was developed using Innovyze's InfoSWMM software using data provided by the District. The purpose of this chapter is to present a summary of the methodology used to develop this model.

GEOMETRIC MODEL DATA

There are two major types of data required to develop a hydraulic model of a sewer system: geometric data and flow data. Geometric data consists of information on the location and size of system facilities including pipes, manholes, and lift stations. It also includes the physical characteristics of the facilities including pipe roughness, invert elevations at manholes, pump settings in lift stations, and a description of any diversions present. This information is generally collected from system inventory data or through direct field measurement. The following sections describe how geometric data was assembled for use in the hydraulic model.

Pipeline and Manhole Locations

The District has spent considerable time assembling a GIS inventory of its existing sewer facilities. That database includes information on the location and size of manholes and pipelines in the District collection system. Based on direction from District personnel, pipeline and manhole data was taken directly from the GIS database for use in the model. In some cases, existing GIS data had gaps in data such as inverts or rims. The following documents BC&A's approach for dealing with missing data in the District's existing GIS data base:

- **Omitted Manholes from Model –** In many cases, the missing data was associated with manholes serving only a small area. Where pipelines serve only a small area, it is usually unnecessary to model their hydraulic performance as they will have adequate hydraulic capacity based on State minimum slope standards alone. This is generally true for any pipelines or manholes downstream of contributing areas less than 150 acres. In these cases the manholes without invert data (and corresponding pipelines) were simply omitted from the hydraulic model.
- **Interpolation / Extrapolation** – In some cases, there was enough data known about inverts in the vicinity of the missing data that there was only a small amount of reasonable variability in what the missing invert information could be. In these cases, manhole inverts were interpolated between manholes with known inverts or extrapolated based on State minimum slope criteria for known pipe diameters.
- **Additional Survey** – Where deemed necessary to maintain model accuracy, BC&A requested additional invert information be surveyed in the field by MWD personnel. This information was then updated in the GIS database.

Pipe Flow Coefficients

Pipes throughout the hydraulic model were assigned a Manning's flow coefficient of 0.013. This is approximately equal to the flow coefficient of concrete and clay pipe. While there are other materials in the system with lower published flow coefficients (e.g. PVC), 0.013 was used throughout the system as a conservative approach for estimating pipe capacity. In addition, most collection pipes develop thin layers of bacteria and solids (a slime layer) over time that result in relatively similar flow coefficients between pipes despite varying materials.

Overflows/Diversions

There are a number of manholes that have two potential flow directions based on the available invert information provided by the District. In all cases, there is a primary flow direction where all flow is conveyed under dry weather conditions with a potential "overflow" direction primarily used for flushing lines and system maintenance. The location and primary flow direction of the manholes that have potential overflows are shown in Figure 4-1. These potential overflows were identified so that the hydraulic model would correctly simulate the proper flow path for wastewater through the collection system.

Sediment and Debris

Because of the transportable nature of grease and debris in a sewer collection system, it is not possible to identify the exact location and quantity of grease or debris accumulation in the system for any specific point in time. Similarly, the build-up and erosion rates of sediment in sanitary sewer systems are not always well understood. As a result, the detailed modeling of sediment, grease, and debris on a system wide basis is not possible because of continually changing conditions. Therefore, no sediment was included in the various runs of the hydraulic model. Instead, the design and evaluation criteria for the District collection system is based on "clean" pipes, with an allowance for capacity lost to the accumulation of sediment (see Chapter 5).

It should be noted that the hydraulic modeling software used to simulate the operation of the District wastewater collection system does have the ability to set sediment depth in pipes. Therefore, if the District does collect detailed sediment data for a given section of pipe, the sediment may be added to the model and its effects evaluated. However, it should be emphasized that any sediment levels defined today will change in the future as flow conditions change.

FLOW DATA

Once all required geometric data was collected and a physical model of the system was developed, flow data was obtained to model the system hydraulics. Three types of flow information were required for hydraulic modeling: domestic wastewater magnitude and distribution, domestic wastewater flow timing, and infiltration magnitude and distribution. Each of these flow characteristics is discussed below.

Domestic Wastewater Magnitude & Distribution

For existing conditions, domestic flows were distributed based on winter water use records. For typical connections, indoor water use is closely related to domestic wastewater production. This is not true for highly consumptive uses such as food processing/bottling. However, Magna Water District does not have any such connections at this time. The total magnitude of domestic wastewater was discussed in more detail in Chapter 2. The distribution of future domestic wastewater was distributed based on land use and undeveloped areas as described in Chapter 2.

Domestic Wastewater Timing

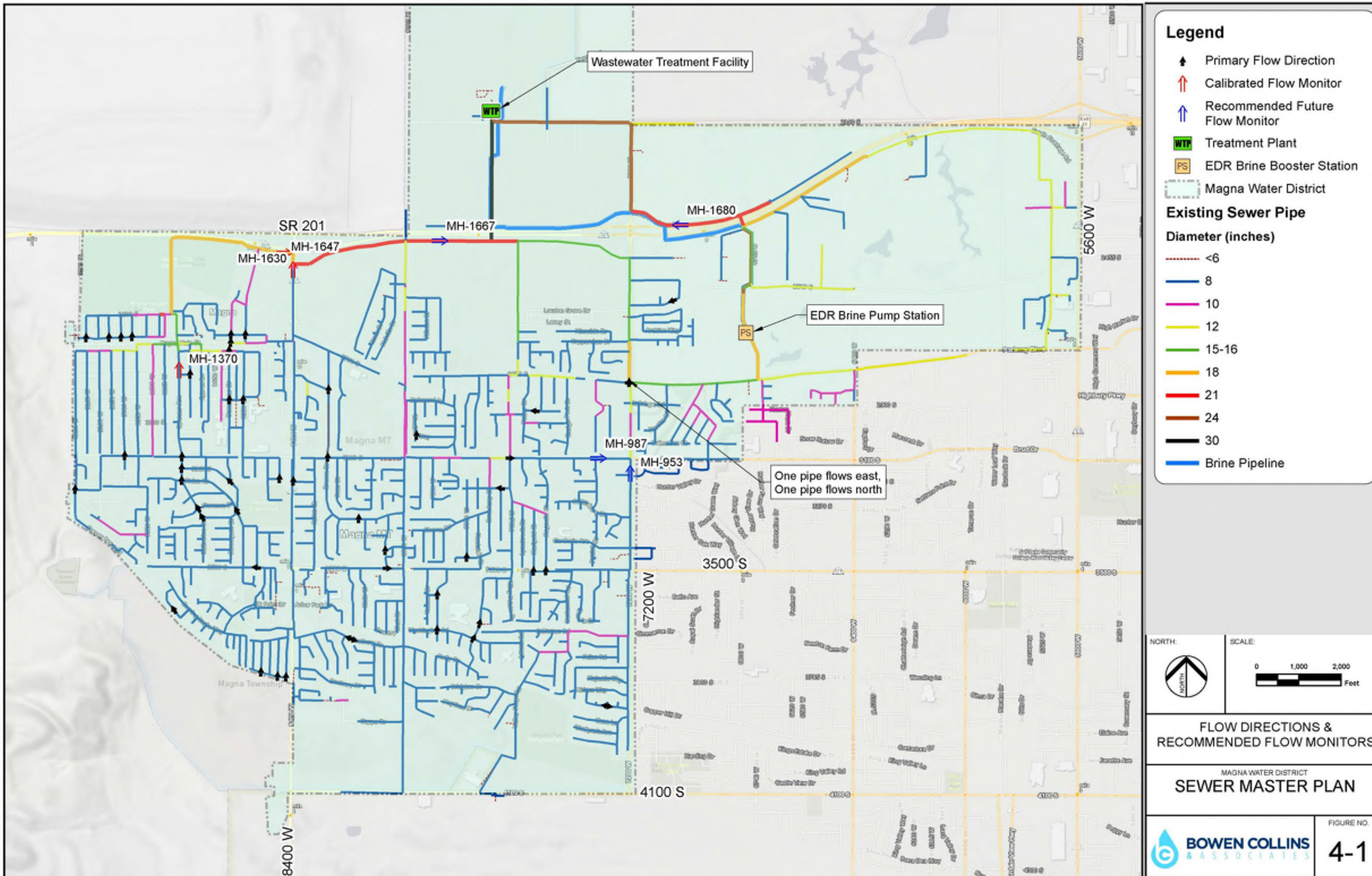
The pattern of fluctuating domestic water use is often referred to as a diurnal pattern. These patterns vary depending on the type of user. The District recently began collecting flow monitoring data to identify flows and patterns for some parts of the collection system. Three critical locations were identified for beginning calibration of the District's sewer model. The location of these three flow monitors are shown in Figure 4-1. Figure 4-1 also includes recommended locations to perform future flow monitoring to continue to improve the model calibration.

From the collected flow monitoring data, a typical domestic demand pattern was identified for the District. Domestic flow from residential and non-residential customers varies throughout the day. Peak flows are generated during the morning hours as residents prepare for the day (including showers for one portion of the population). There is a another peak in the early evening as residents return from work and clean up from the day (including showers for another portion of the population). Domestic sewer flows are generally lower throughout the remainder of the day and are just a trickle during the early morning hours when most residents are asleep. The District has some commercial or non-residential users for which flow patterns can be different. However, the ratio of non-residential to residential use is relatively small and does not appear to affect the general patterns observed by the District thus far. The most conservative pattern identified as part of flow monitoring was calculated and applied to the hydraulic modeling of domestic wastewater flows. Figure 4-2 and Table 4-1 show the diurnal pattern assumed for the District.

Infiltration Magnitude & Distribution

As discussed in Chapter 2, infiltration may vary on a seasonal basis but does not generally vary on a daily basis. Thus, it has been assumed that infiltration remains constant throughout the day in the collection system model. The total magnitude of infiltration was discussed in more detail in Chapter 2. Existing infiltration was distributed uniformly to manholes within the District. Typically, infiltration is a function of pipe length, size, and depth; but can be represented by manhole distribution well. As flow monitoring is conducted within the District, it may be possible to identify higher infiltration in some areas of the system. Growth of infiltration within the District was added to the future hydraulic model simulations at a rate of approximately 33 gpd per new connection.

Inflow – For this study, inflow has not been modeled directly because of the wide variability in storm events and inflow response possible in the District. For design purposes, the District has included a capacity allowance in its design criteria to account for inflow into its collection system.



FLOW DIRECTIONS & RECOMMENDED FLOW MONITORS

MAGNA WATER DISTRICT

SEWER MASTER PLAN

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FIGURE NO.

4-1

Figure 4-2
Diurnal Patterns Applied to Hydraulic Model

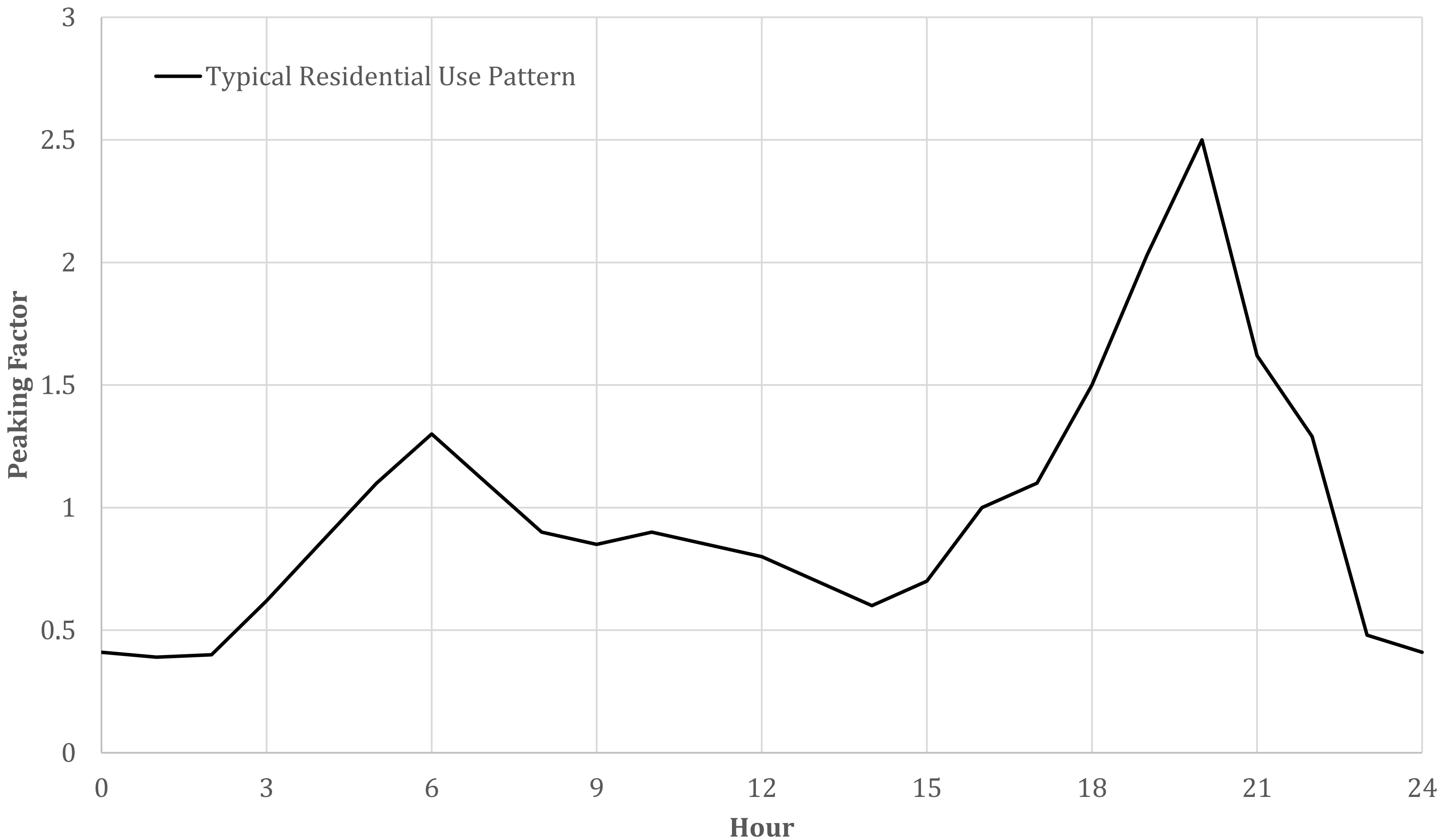


Table 4-1
Hydraulic Model Diurnal Pattern

Hour	Ratio of Average Day Flow
0	0.41
1	0.39
2	0.4
3	0.62
4	0.86
5	1.1
6	1.3
7	1.1
8	0.9
9	0.85
10	0.9
11	0.85
12	0.8
13	0.7
14	0.6
15	0.7
16	1
17	1.1
18	1.5
19	2.03
20	2.5
21	1.62
22	1.29
23	0.48
24	0.41

MODEL CALIBRATION

The District has limited flow data to perform model calibration. However, based on available data, Figures 4-3 to 4-5[1] show the calibration at the three flow monitor sites collected thus far by the District. Planning infiltration in the model simulation may be slightly higher than for 2019 conditions as observed in the data shown in the figures, but results track well with peak observed flows. The peaking factor of 2.5 (which is recommended by the State of Utah for pipe sizing) may also be a little high compared to observed conditions. The calibration for the model is based on a weekday demand pattern. Weekend demand patterns have a later morning peak.

[1] The flow monitor used for Figure 4-4 appears to have malfunctioned after just a few days of data collection. Only the days that appears to be producing accurate data have been shown here.

Figure 4-3
MH-1370 Observed versus Simulated Flow

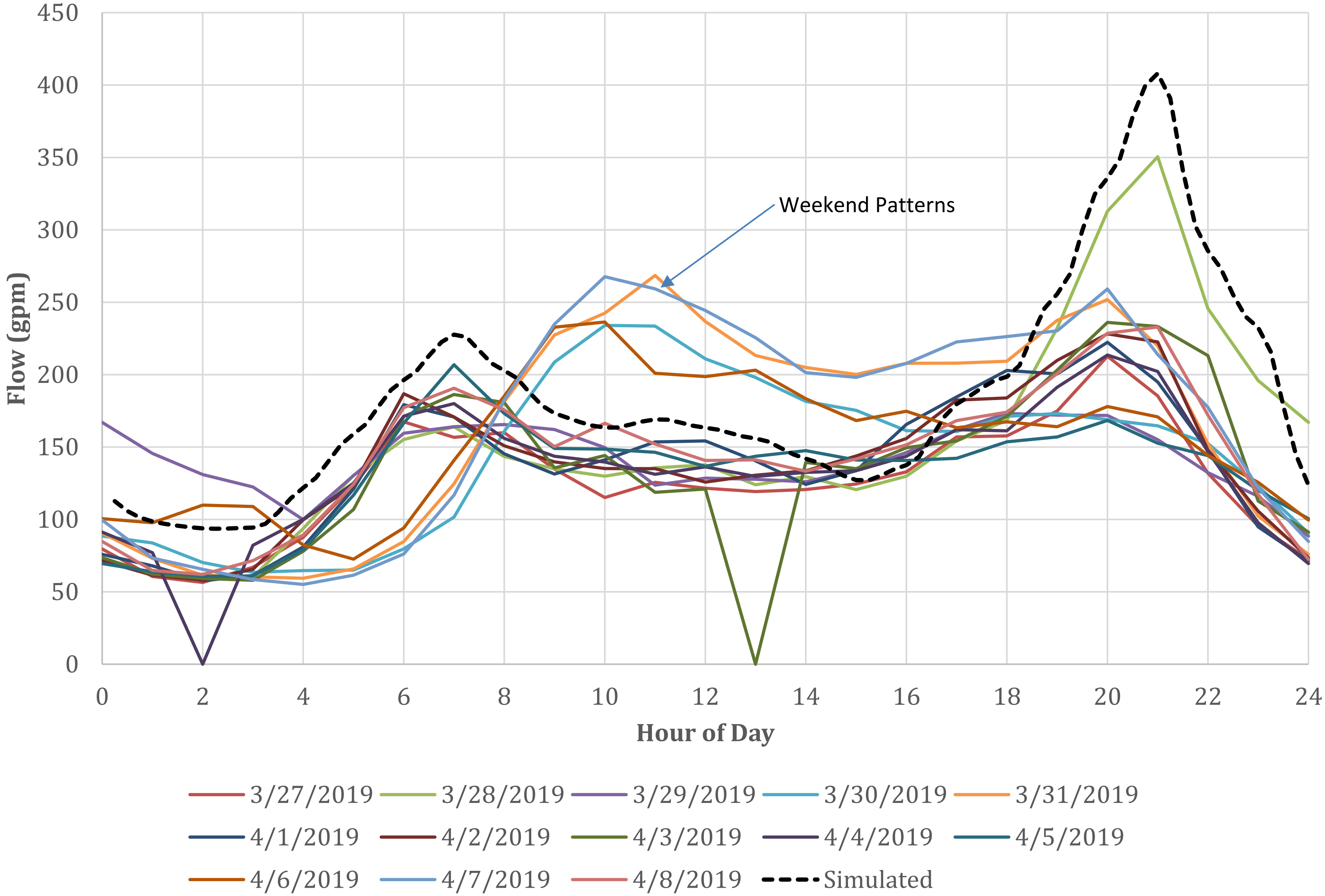


Figure 4-4
MH-1630 Observed versus Simulated Flow

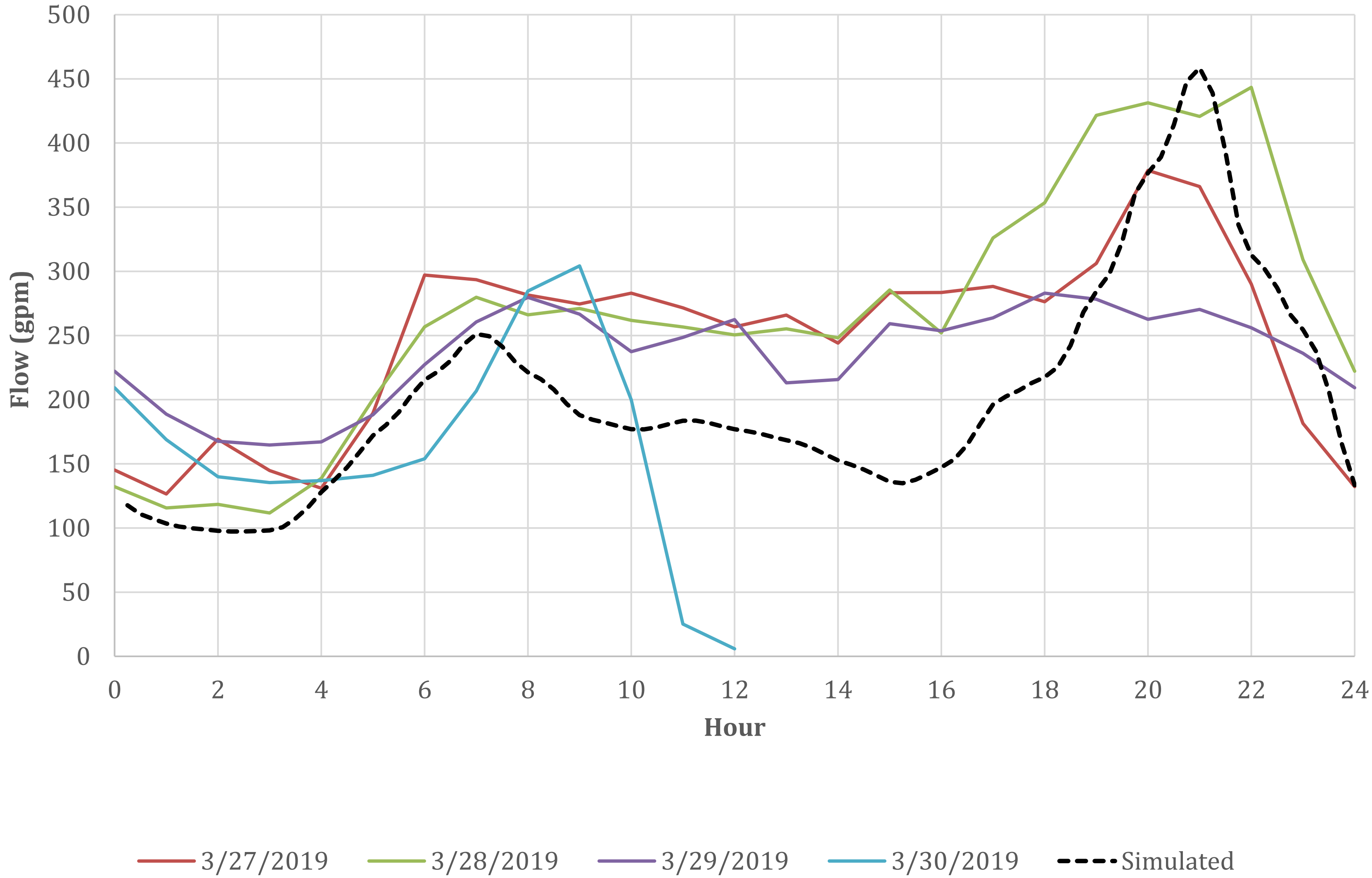
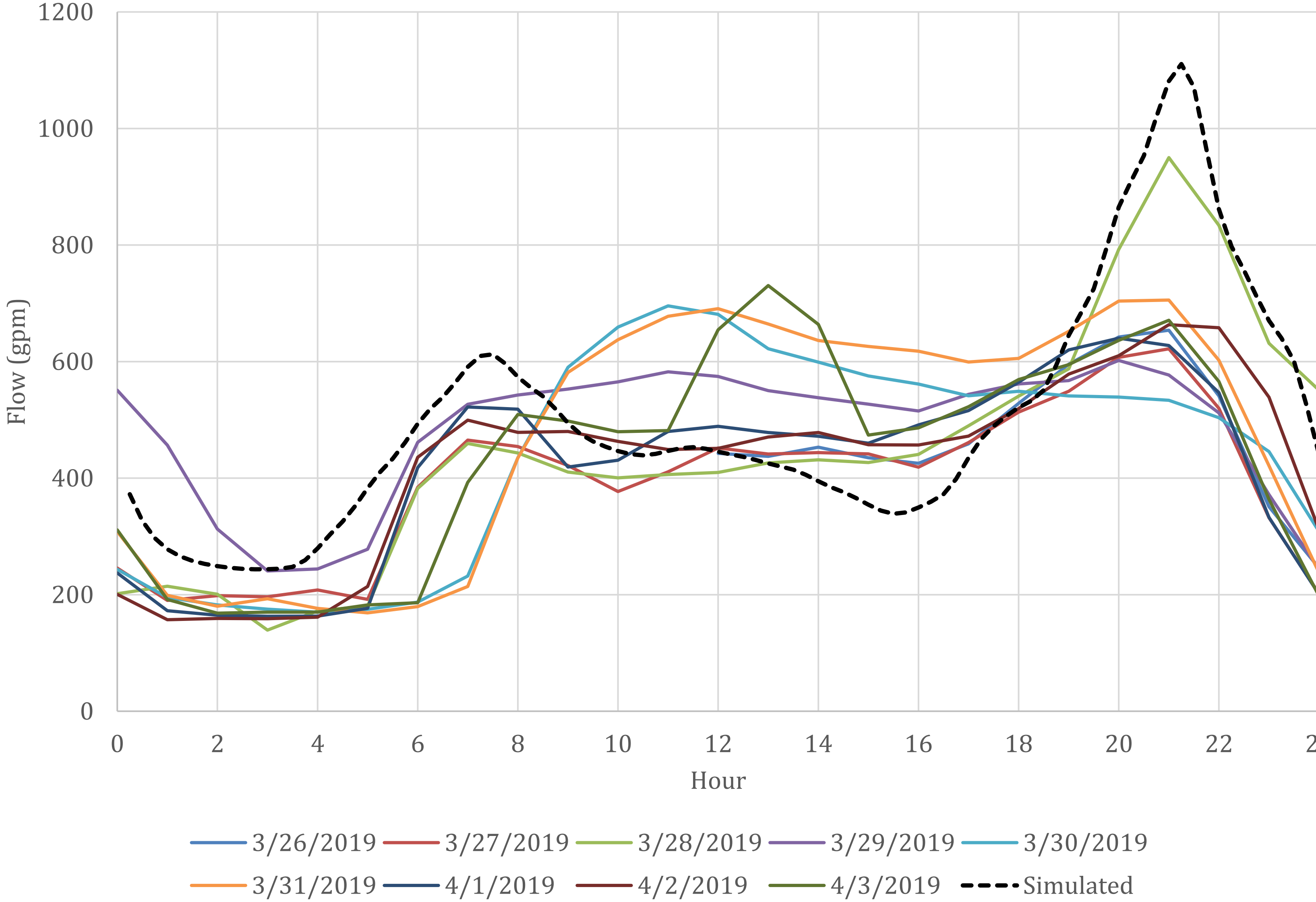


Figure 4-5
MH-1647 Observed versus Simulated Flow



CHAPTER 5
COLLECTION SYSTEM EVALUATION

With the development and calibration of a hydraulic sewer model, it is possible to simulate sewer system operating conditions for both present and future conditions. The purpose of this chapter is to evaluate hydraulic performance of the collection system and identify potential hydraulic deficiencies.

EVALUATION CRITERIA

In defining what constitutes a hydraulic deficiency, it is important to consider the assumptions made in estimating sewer flows in the model. As described in Chapters 3 and 4, the sewer flow included in the model is composed of two parts: domestic sewer flow and infiltration. These inputs are based on available historic data. Based on the nature of this data, the hydraulic criteria used for evaluating hydraulic performance must take the following issues into account:

- **Dry Weather vs. Wet Weather Flows** – As noted above, the sewer flows modeled in the system include only domestic flows and infiltration. For reasons enumerated previously, inflow is not included. This means that model results are essentially for dry weather conditions. In wet weather, inflow will be added to the system and must be accounted for. The criteria established for identifying deficiencies should leave some unused capacity available for inflow during wet weather events.
- **Flow Variability** – Because these estimates are based on average values and a limited data set, actual flows will fluctuate and may be greater or lower than the model estimates. For example, infiltration during extremely wet years could be more than estimated in the model (e.g. 1983 was a statewide historically wet year that led to high infiltration and flooding in many areas). The criteria established for identifying deficiencies should be sufficiently conservative to account for occasional flows higher than those estimated in the model.

With these issues in mind, the following criteria have been established to identify capacity deficiencies in the system:

Pipelines

The evaluation criteria for pipelines varies by pipe size:

- **Pipeline Capacity (12-inch and smaller) –** Peak flow in the pipe must be less than 50 percent of the full flow pipe capacity.
- **Pipeline Capacity (15-inch and larger)** – Peak flow in the pipe must be less than 75 percent of the full flow pipe capacity.

As can be seen, all pipelines include a portion of the pipeline that is reserved for inflow and/or unaccounted for fluctuations in domestic flow and infiltration. The design criteria requires the portion of capacity allocated for this purpose be greater for smaller sized pipes because of the greater potential for peaking variability in smaller pipes.

It should be noted that there are occasionally situations in which a relatively short section of pipe is installed at flat slope comparative to the pipes around it. In this case, a strict review of the flat section of pipe's capacity against existing or projected flows may identify it as hydraulically deficient. However, it may not actually cause any problems in the field because the overall slope of the larger reach of pipeline has adequate capacity and the flat section of pipeline is not long enough to appreciably restrict the flow. In this situation, the flat section of pipeline will only be considered deficient if the maximum depth of flow at its upstream end exceeds 50 percent of the pipeline diameter for pipes 12-inch and smaller and 65 percent[1] of pipeline depth for pipes 15-inch and larger.

Lift Stations

The District does not have any existing lift stations in its collection system. If any are built in the future, the following minimum standards will apply:

- **Lift Station Capacity –** Based on industry standards and good design practice, it is recommended that peak daily flow into a lift station not exceed 85 percent of the lift station's hydraulic pumping capacity. Allowing for a modest amount of capacity above projected flows accounts for unknowns associated with flow projections and mechanical wear at each lift station.
- **Wet Well Capacity –** The minimum wet well volume for lift stations should be large enough to prevent excessive cycling of lift station pumps. Based on manufacture recommendations for pump operation, the maximum number of cycles per hour should be six or less. Exceeding this value will significantly shorten the lifespan of the lift station pumps.

Force Mains

Because the District does not have any existing lift stations in its collection system, it also does not have any existing force mains. If any are built in the future, the following minimum standards will apply:

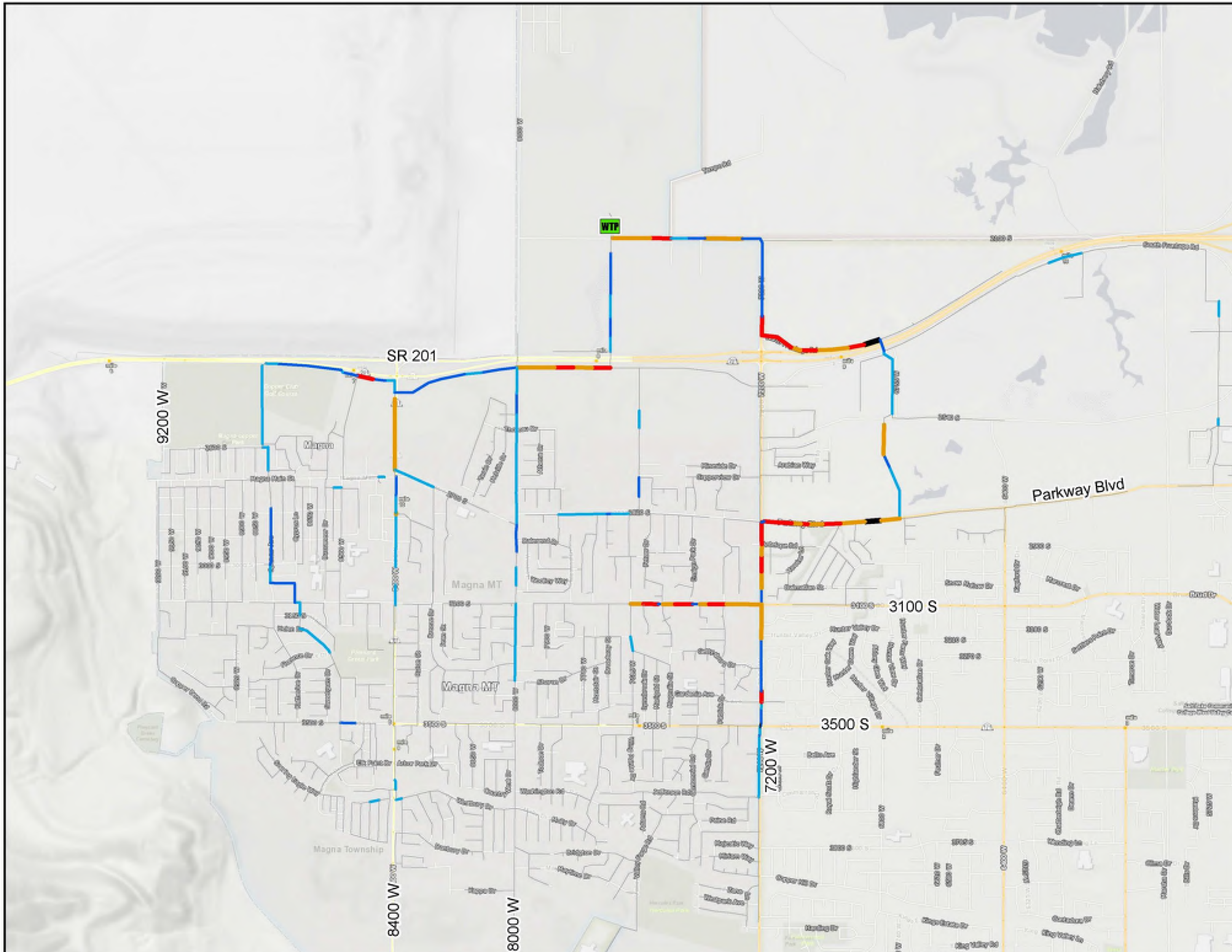
- **Average Velocity –** Per State of Utah standards, a velocity of not less than 2 feet per second shall be maintained at the average design flow, to avoid septic sewage and resulting odors.
- **Maximum Velocity –** Peak velocity through the force main should not exceed 7 feet per second.

EXISTING SYSTEM ANALYSIS

Figure 5-1 displays the hydraulic capacity of the sewer system under existing peak hour flow conditions. Pipes in the figure are color coded to show the ratio of peak flow in the pipe to the pipe's full capacity. Based on peak flow and pipe capacities alone, there are a few areas of the District that do not meet the District's design criteria, as shown with orange, red, and black colored pipes in Figure 5-1. Area of concerns for existing conditions include the following:

- 3100 South, 7615 West to 7200 West
- 7200 West, Gardenia Ave to Parkway Blvd
- Parkway Blvd, 7200 West to 6755 West
- SR201 South Frontage Road, 8000 West to 7700 West (SR201 crossing)
- SR201 North Frontage Road, 6800 West to 7200 West (the new brine pipeline will resolve this issue for the short term)
- 8400 West, 2700 South to 2100 South

[1] Approximate depth of flow in a pipeline with flow at 75% of full flow capacity.



Legend

Existing Pipes

Peak Flow / Capacity

- 0.00 - 0.25
- 0.26 - 0.50
- 0.51 - 0.75
- 0.76 - 1.00
- 1.01 - 2.00
- >2

NORTH:

SCALE:

0 1,000 2,000 Feet

EXISTING SEWER PIPE PEAK FLOW TO CAPACITY RATIO

MAGNA WATER DISTRICT

SEWER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

5-1

A few observations regarding existing pipelines indicate that many of the District's major collection lines are only 8 inched in diameter. An example of this is the existing collection line on 7200 West beginning at 3500 South. Even though it is only 8 inches in diameter, that existing collection line collects an area of approximately 327 acres of mixed residential and commercial developments. Many of these small pipelines are at the very edge of their capacity and additional larger outfalls are needed to serve the District.

FUTURE SYSTEM ANALYSIS

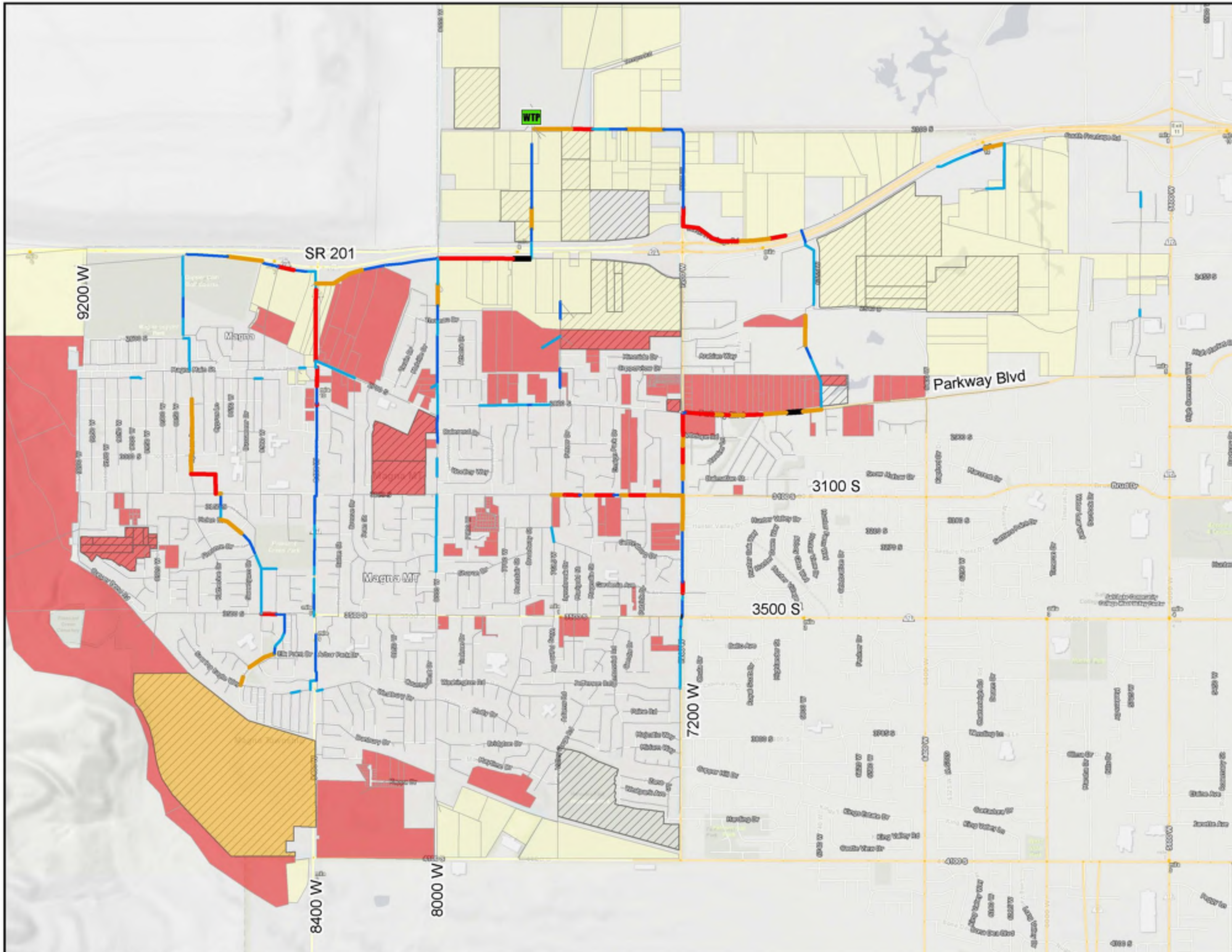
Figures 5-2 through 5-4 show the hydraulic performance as calculated in the hydraulic model for sewer flows as projected through full buildout conditions if no improvements are made to the existing system. These results assume that sewer flows associated with future development will flow to the nearest manhole in the existing system. While the majority of the system under buildout conditions has adequate capacity, some significant deficiencies can be observed in the model results. Most of the deficiencies are the result of growth in the three annexation areas discussed in Chapter 2. These deficiencies follow the main trunk lines all the way to the District's wastewater treatment plant. Figures 5-2 through 5-4 help identify how soon some of the deficiencies are projected to occur.

Short-Term Growth (10-year Planning Window)

As shown in Figure 5-2, contributions of wastewater from the Gateway to Little Valley worsen existing deficiencies on 8400 West north of 2700 West and along the South Frontage road of SR201. Additional deficiencies develop along Spencer Avenue and 8400 West. Additional improvements will be needed to these collection lines before Gateway to Little Valley can fully develop. The District will need to begin design and construction of several improvement projects to avoid exacerbating existing deficiencies.

Long-Term Growth (beyond 10-year Growth)

As shown in the Figures 5-3 and 5-4, growth beyond the 10-year window worsens some of the existing and short-term deficiencies and results in some additional new deficiencies. Note that the primary difference between Figures 5-3 and 5-4 is the development of the Little Valley area to the west. Figure 5-3 shows deficiencies without Little Valley development; Figure 5-4 shows deficiencies with Little Valley development.



10 YEAR FUTURE SEWER PIPE PEAK FLOW TO CAPACITY RATIO

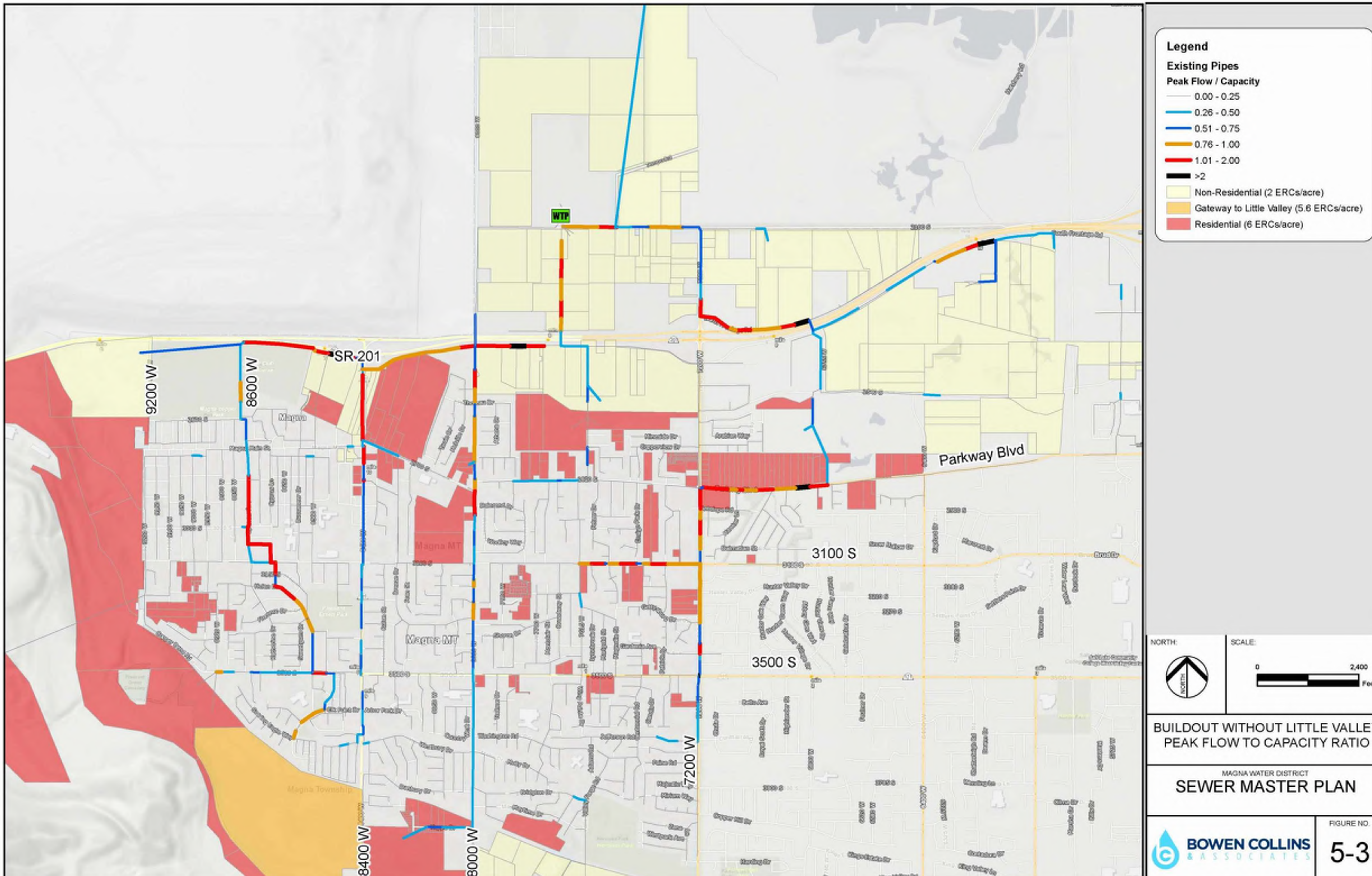
MAGNA WATER DISTRICT

SEWER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

5-2

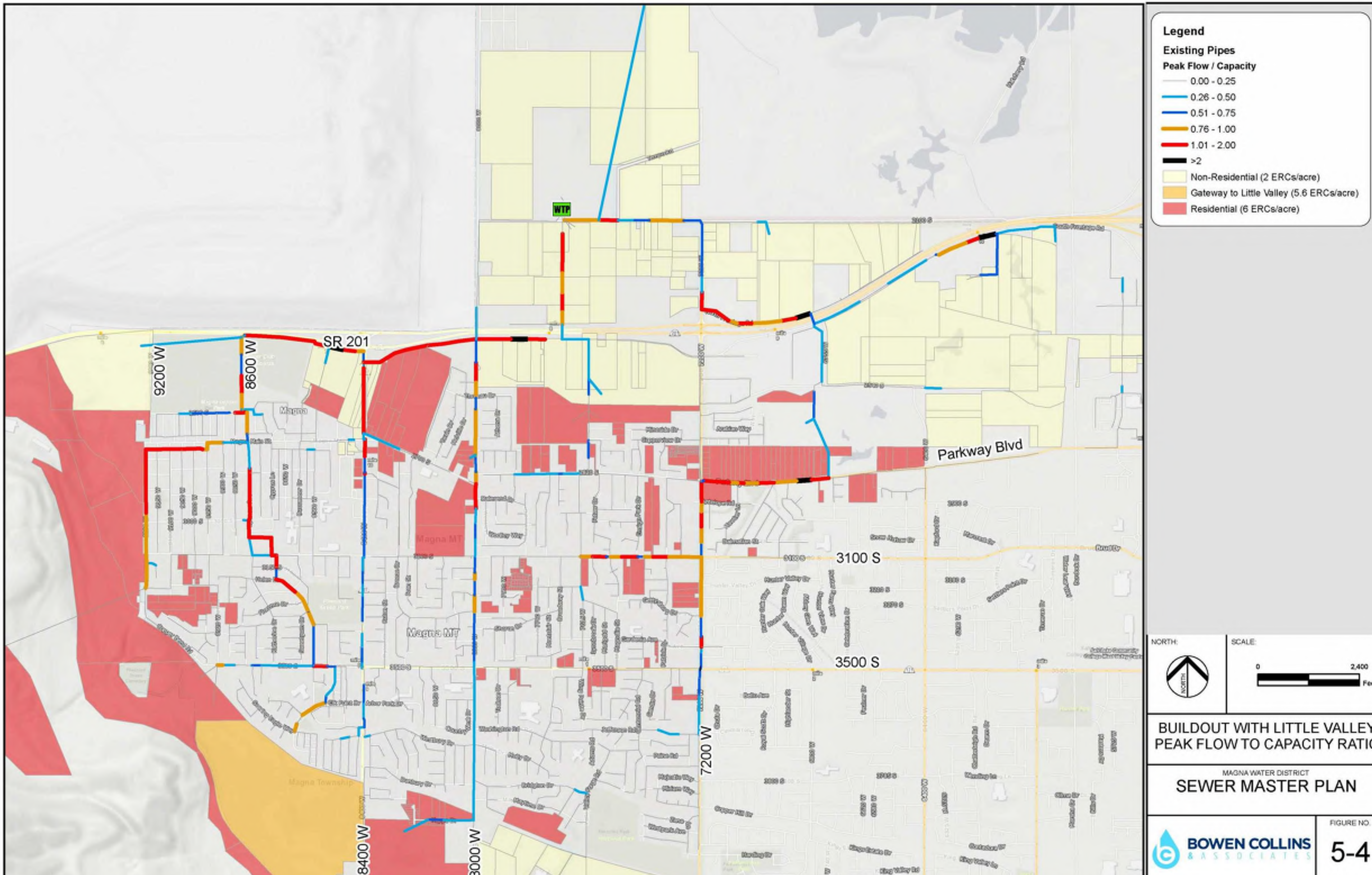


BUILDOUT WITHOUT LITTLE VALLEY
PEAK FLOW TO CAPACITY RATIO

MAGNA WATER DISTRICT
SEWER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
5-3



BUILDOUT WITH LITTLE VALLEY
PEAK FLOW TO CAPACITY RATIO

MAGNA WATER DISTRICT
SEWER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
5-4

P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Sewer\Figure 5-4-Buildout Sewer Performance.mxd AMcKinnon 5/2/2019

CHAPTER 6
SYSTEM IMPROVEMENTS

The hydraulic model results were used to evaluate various alternatives to eliminate projected deficiencies in the sewer system under existing and build-out conditions. This chapter identifies all required system improvements to solve deficiencies as the District approaches build-out. Prioritization, phasing, and other issues relative to project timing will be addressed as part of the implementation plan for the improvements as a later section of this report.

COLLECTION SYSTEM IMPROVEMENTS

System improvements required to resolve hydraulic deficiencies and improve system operation as identified in the hydraulic model are shown in Figure 6-1. A summary of the major purposes of each project are as follows:

- **Project 1 – 8000 West Interceptor** – The existing sewer trunk following the South Frontage road of SR201 from 8000 West to the treatment is undersized for existing peak flows and exceeds District design criteria. A new interceptor is recommended to split and convey a portion of existing flows such that the deficiency on the Frontage Road is eliminated. This new interceptor should be designed with adequate capacity to also capture and convey all flow from any new growth that enters the system upstream of 8000 West. This includes Gateway to Little Valley, Little Valley, and other Kennecott foothill properties.
- **Projects 2 & 3 – South Frontage Road, 8800 West to 8000 West** – The pipes along the South Frontage Road from 8800 West to 8000 West are nearing capacity for existing conditions. Growth projected within 10-years is anticipated to exceed the design criteria along these two sections of pipe within the District. The existing pipes have a relatively shallow bury depth in some areas.
- **Projects 4 to 6 – 9200 West Sewer Trunk** – The areas developing outside of the historical boundary of the Magna Water District will contribute a significant amount of wastewater to District collection lines. Most of the District's existing collection lines were not sized to accommodate this growth because these areas were outside of the service area when the collection lines were designed and built. As a result, if new growth from the Gateway to Little Valley or the Kennecott foothill areas discharge to existing sewer mains, many of the sewer mains conveying this flow from the discharge point to SR201 would need to be replaced.

  MWD reviewed several potential improvement alternatives to serve new growth following either 8400 West or 8800 West to the SR201 South Frontage road sewer trunk. After review, the alignment of Projects 4 to 6 was selected as the most cost effective. Although the length of pipe needed to be installed is slightly longer than other alignments, much of the pipe can be constructed as part of new development, and roads impacted by construction will have significantly less traffic and utility congestion by comparison. As a result, the construction cost for the 9200 West alignment is less than other alignments evaluated.

  It is also worth noting that the area west of 9200 West abutting SR201 will be difficult to serve by gravity due to the depths of existing pipes along SR201. Manholes at the west end of the SR201 trunkline are only 6 to 7 feet deep already. Any lift station constructed to service that area would likely need to be a project level improvement and has not been listed as a District project for that reason.

- **Projects 7 & 8 – 7600 West Diversion –** Sewer mains along 3100 South and 7200 West exceed the District's design criteria for existing conditions or will exceed criteria with short-term growth. As a result, Projects 7 and 8 area recommended to divert a portion of this flow north on a more direct path to the District's wastewater treatment plant. The proposed diversion will shorten the distance traveled to the treatment plant from the diversion point by 55 percent or by about 2 miles. This will significantly reduce the amount of pipes that are needed to convey the same flow, reducing deficiencies and long-term system improvements as a result.

  In order for the recommended diversion to function, Project 7 must be completed first to establish needed downstream capacity in the system. Once this capacity is in place, Project 8 can be completed to divert 100 percent of the flow currently traveling east in 3100 South to the north into an existing pipeline in White's Way (approx. 7600 West).

- **Project 9 – 7270 West Diversion –** Sewer mains along 7200 West exceed the District's design criteria for existing conditions. Project 9 will divert flow from 3100 South to the north into an existing pipeline in 7270 West. This will reduce the flow to 7200 West so that pipes along 7200 West do not exceed design criteria. Because of limited capacity in 7270 West, this project cannot be completed until some of the existing flow in 3100 South is diverted through Projects 7 and 8.

- **Project 10 – 7200 West Diversion at Parkway Blvd –** Project 10 is intended to divert flow north along 7200 West. For short-term growth, this project reduces flows along Parkway Blvd. east of 7200 West where flow through existing pipes exceeds the District's design criteria for existing conditions. This project also reduces the overall length of pipe traveled by flow at the diversion point by 40 percent or by more than one mile. This reduces deficiencies for long-term conditions along the North Frontage road of SR201 where existing pipes have extremely shallow slopes. While some improvements will eventually be required along 7200 West and the South Frontage Road of SR201, the length of improvements required is much shorter than would be required if flow continues along the existing flow path. To divert 100 percent of flow north at 7200 West, Project 16 will need to be completed within 10-years to avoid exceeding 65 percent of the depth for the reaches of pipe identified as Project 16. A partial diversion could be used to divert 75 percent of flow for 10-years without constructing Project 16.

- **Project 11 – 7200 West, 3500 South to 3100 South –** Project 11 is intended to upsize the existing 8-inch pipes in 7200 West from 3500 South to 3100 South to eliminate existing and projected future deficiencies along this reach.

  It should be noted that it may be possible to add several diversions beginning at the intersection of Jefferson Rd & Centennial Road to keep flows further to the west, but a similar pipe upsize project would be required further to the west as well. For the purpose of this study, project costs for the 7200 West pipe upsize have been included. Additional investigation of diversions and alternate pipe upsize projects may be warranted during design if the District would prefer an alignment for the pipe project in a potentially less busy road.

- **Project 12 – 8400 West, Main Street to South Frontage Road –** Project 12 is intended to upsize the existing 8-inch pipes in 8400 West to resolve an existing deficiency and accommodate future growth. An alternate alignment for improvements would be preferred for this project if development of the property to the east makes a new alignment for a larger sewer main possible. Cost estimates currently assume the project will be within the UDOT right-of-way but would likely be reduced if an alternative alignment can be secured.

- **Project 13 – 8000 West, 3500 South to 3200 South –** Project 13 will require the existing pipe to be lined due to age and deterioration issues. This section of pipe may require upsizing in the future depending on the timing of future development. If possible, areas south of the Union Pacific Railroad should be conveyed to the proposed 9200 South trunk line to reduce the potential effects of future flow on the 8000 West sewer mains.
- **Project 14 – 8800 West, 2600 South to South Frontage Road –** Project 14 will require the existing pipe to be lined due to age and deterioration issues. It should be noted that the District combined Project 4 and Project 14, so that is why this project was removed from this report.
- **Project 15 – 8000 West, 3200 South to SR201 –** Project 15 includes upsizing the 8-inch to 12-inch pipes along 8000 West to accommodate growth within Zone 3 that is likely to contribute to 8000 West. It is worth noting that if more of the Zone 3 flow can be conveyed west through the 9200 West trunk line, it may be possible to reduce the amount of pipes along 8000 West that require upsizing. This project will not be required within the 10-year development window.
- **Project 16 – 7200 West & SR201 Upsize –** Project 16 includes upsizes of pipes along 7200 West and SR201 as required to convey 100 percent of flow diverted from 7200 West at Parkway Blvd. This project can be postponed outside of the 10-year window if the diversion at Parkway Blvd diverts 75 percent of flow.
- **Project 17 – South Frontage Road, 6000 West to 6300 West –** Some pipes along the south frontage road of SR201 may require upsizing as the non-residential area to the south develops. This project is not anticipated within the 10-year window based on developing areas identified by District personnel.
- **Project 18** – **North Frontage Road, 7100 West to 7200 West –** The pipes along the North Frontage Road have a very shallow slope. Some of these pipes will likely need to be upsized in the future to accommodate future growth. The proposed diversion at 7200 West Parkway Blvd along with the new brine byproduct projects will postpone the need for this project outside of the 10-year development window.
- **Project 19** – **North of 2100 South –** The area north of the wastewater treatment plant will require new gravity sewer mains, a lift station, and a force main to service. Depending on the timing and location of potential growth north of 2100 South, a single lift station will be needed. It is possible more than one lift station will be required depending on where development pressure begins. This project is not anticipated within the 10-year window based on developing areas identified by District personnel.
- **Project 20** – **3367 South 8400 West Manhole –** The manhole at 3367 South 8400 West needs to be removed due to poor conditions. Laterals that discharge to the manhole will need to be relocated to improve hydraulic conditions.
- **Project 21** – **New Shop Building** – The District wants to build a new shop building at the wastewater treatment plant. This building will provide additional capacity for additional staff and equipment needed to serve the District's growing service area.
- **Project 22** – **Relocate RV Dump Station** – The District currently has an RV dump station located at the treatment plant. While this location is convenient in some ways, it can create problems for the treatment plant because the strength of the septage received is generally much greater than the strength of the District's average wastewater. To resolve this problem, the District would like to acquire additional land and relocate the existing RV

Dump to somewhere higher up in the system. This would allow the septage to mix with and be diluted by other wastewater prior to entering the treatment plant.

Project Costs

Projects costs are summarized in Table 6-1. Project costs are based on average unit costs for projects of a similar nature. Costs include consideration of all components of the sanitary sewer system including pipelines, manholes, and surface restoration as appropriate. Costs also include 15 percent of the estimated total construction price for engineering, legal, and administrative services.

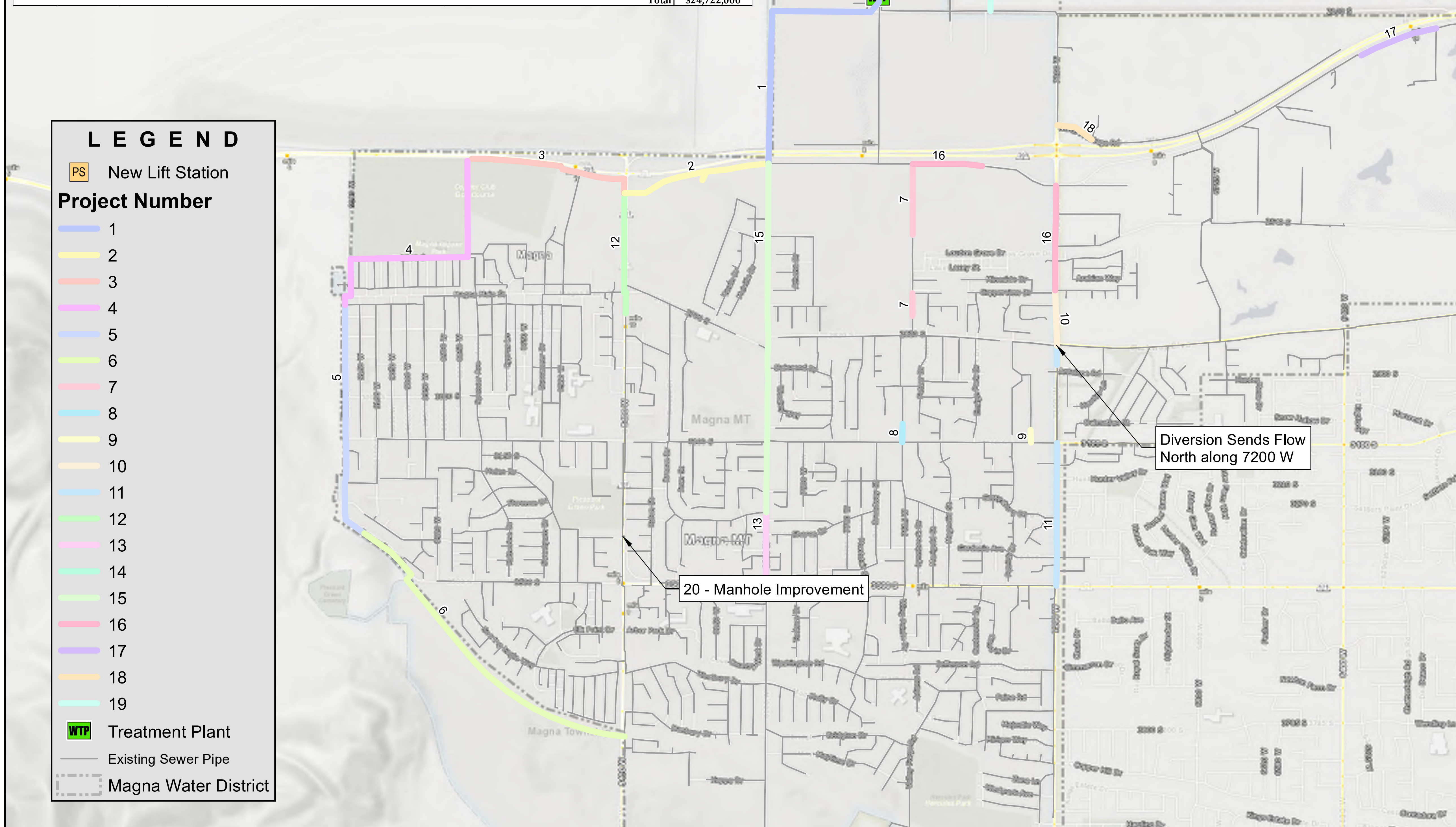
Also included in the table is an estimate of the required size of each project. These sizes are based on estimated pipe slopes (per inverts in the model and/or existing surface topography) and projected capacity needs at build-out. Once design of sewer mains commences, the actual size of pipe should be revisited based on surveyed field conditions, needed phasing, etc.

Appendix 1-A includes detailed project worksheets for each of the projects listed in this chapter. Included in the worksheets is more detailed information for each project including maps, extended descriptions, and cost estimates. The worksheets also include an explanation of project timing, including identification of any events that will trigger the need for each project (if not already needed to solve existing deficiencies), and the potential consequences of not completing the projects with the time recommended.

Table 6-1
Proposed Collection System Improvements

Project No.	Project Timing	Diameter (inch)	Length (ft)	Project Name	Project Description	Project Cost (2019 $s)
1	0-5 years	30	4,876	8000 West Interceptor	30-inch Diameter 8000 West Trunk to Treatment Plant	$2,947,000
2	0-5 years	36	2,752	So. Frontage, 8400 W to 8000 W	Upsize Existing 21-inch to 36-inch	$1,919,000
3	5-10 years	30	3,127	So. Frontage, 8800 W to 8400 W	Upsize Existing 18-inch to 30-inch	$1,857,000
4	0-5 years	30	4,092	9200 West Trunk, Reach 1	New 30-inch Trunk Across Magna Copper Park	$2,516,000
5	0-5 years	15	4,395	9200 West Trunk, Reach 2	Upsize 8-inch to 15-inch	$1,741,000
6	0-5 years	15	6,414	9200 West Trunk, Reach 3	New 12-inch to 15-inch pipe	$1,916,000
7	0-5 years	21	1,721	7600 West Diversion, Reach 1	Upsize 15-inch to 21-inch Pipe	$649,000
8	0-5 years	10	340	7600 West Diversion, Reach 2	New 10-inch Pipe and Manhole Improvements	$111,000
9	0-5 years	10	236	7270 West Diversion	New 10-inch Pipe and Manhole Improvements	$80,000
10	5-10 years	18	975	7200 West Diversion at Parkway Blvd	New 18-inch Pipe and Manhole Improvements	$457,000
11	5-10 years	12	2,987	7200 W, 3500 S to 3100 S	Upsize 8-inch to 12-inch	$1,295,000
12	>10 years	15	2,252	8400 W, Main St to So. Frontage	Upsize 8-inch to 15-inch	$1,296,000
13	>10 years	8	1,317	8000 W, 3500 S to 3200 S	Condition related cast-in-pipe-place	$102,000
15	>10 years	15	6,438	8000 W, 3200 S to So. Frontage	Upsize Existing 8-inch to 12-inch through 18-inch	$2,518,000
16	>10 years	18	3,213	7200 W, Copperview to So. Frontage	Upsize Existing 15-inch to 18-inch	$1,687,000
17	>10 years	18	1,469	So. Frontage, 6100 W to 6200 W	Upsize Existing 12-inch to 18-inch	$644,000
18	>10 years	24	706	No. Frontage, 7100 W to 7200 W	Upsize Existing 21-inch to 24-inch	$370,000
19	>10 years	10	8,695	Northeast Sewer & Lift Station	New 10-inch Main, Lift Station, & Force Main	$2,087,000
20	>10 years	8	20	3367 S 8400 W MH	Remove manhole & reconnect laterals	$30,000
21	5-10 years	-	-	New Shop Building	Construct new shop building at WWTP	$500,000
					Total	**$24,722,000**

Project No.	Project Timing	Diameter (inch)	Length (ft)	Project Name	Project Description	Project Cost
1	0-5 years	30	4,876	8000 West Interceptor	30-inch Diameter 8000 West Trunk to Treatment Plant	$2,947,000
2	0-5 years	36	2,752	So. Frontage, 8400 W to 8000 W	Upsize Existing 21-inch to 36-inch	$1,919,000
3	5-10 years	30	3,127	So. Frontage, 8800 W to 8400 W	Upsize Existing 18-inch to 30-inch	$1,857,000
4	0-5 years	30	5,000	9200 West Trunk, Reach 1	New 30-inch Trunk Across Magna Copper Park	$2,516,000
5	0-5 years	15	4,395	9200 West Trunk, Reach 2	Upsize 8-inch to 15-inch	$1,741,000
6	0-5 years	15	6,414	9200 West Trunk, Reach 3	New 12-inch to 15-inch pipe	$1,916,000
7	0-5 years	21	1,721	7600 West Diversion, Reach 1	Upsize 15-inch to 21-inch Pipe	$649,000
8	0-5 years	10	340	7600 West Diversion, Reach 2	New 10-inch Pipe and Manhole Improvements	$111,000
9	0-5 years	10	236	7270 West Diversion	New 10-inch Pipe and Manhole Improvements	$80,000
10	5-10 years	18	975	7200 West Diversion at Parkway Blvd	New 18-inch Pipe and Manhole Improvements	$457,000
11	5-10 years	12	2,987	7200 W, 3500 S to 3100 S	Upsize 8-inch to 12-inch	$1,295,000
12	>10 years	15	2,252	8400 W, Main St to So. Frontage	Upsize 8-inch to 15-inch	$1,296,000
13	>10 years	8	1,317	8000 W, 3500 S to 3200 S	Condition related cast-in-pipe-place	$102,000
15	>10 years	15	6,438	8000 W, 3200 S to So. Frontage	Upsize Existing 8-inch to 12-inch through 18-inch	$2,518,000
16	>10 years	18	3,213	7200 W, Copperview to So. Frontage	Upsize Existing 15-inch to 18-inch	$1,687,000
17	>10 years	18	1,469	So. Frontage, 6100 W to 6200 W	Upsize Existing 12-inch to 18-inch	$644,000
18	>10 years	24	706	No. Frontage, 7100 W to 7200 W	Upsize Existing 21-inch to 24-inch	$370,000
19	>10 years	10	8,695	Northeast Sewer & Lift Station	New 10-inch Main, Lift Station, & Force Main	$2,087,000
20	>10 years	8	20	3367 S 8400 W MH	Remove manhole & reconnect laterals	$30,000
21	5-10 years			New Shop Building	Construct new shop building at WWTP	$500,000
					Total	$24,722,000



SEWER FACILITY IMPROVEMENTS

MAGNA WATER DISTRICT

SEWER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

6-1

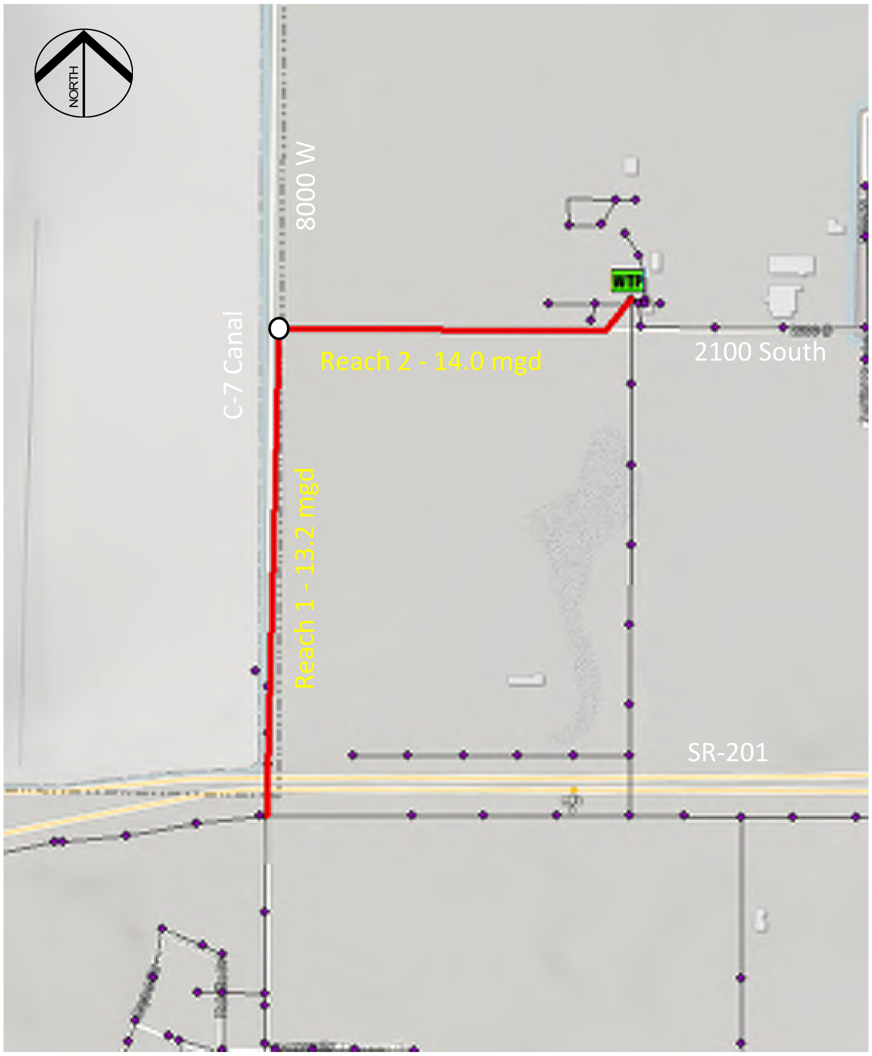
P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Sewer-Figure 6-1-Diversions Buildout Sewer System.mxd wandersen 6/5/2020

APPENDIX 1A

IMPROVEMENT PROJECT SUMMARY

Improvement Project Summary

Magna Water District



Project Map

Project ID:		1
Project Name: 8000 West Interceptor		
Description: Construct a 30-inch interceptor pipeline beginning at Manhole 1668 and ending at the wastewater treatment plant. The existing sewer trunk following the South Frontage road of SR201 from 8000 West to the treatment is undersized for existing peak flows. A new interceptor is recommended to split and convey a portion of existing flows such that the deficiency on the Frontage Road is eliminated. This new interceptor should be designed with adequate capacity to also capture and convey all flow from any new growth that enters the system upstream of 8000 West. This includes Gateway to Little Valley, Little Valley, and other Kennecott foothill properties.		
Project Components		
Quantity	***Size***	***Design Flow****
2,900 LF	30-inch	13.2 MGD
2,000 LF	30-inch	14.0 MGD
** Design flow is based on full flow capacity of pipe and includes all peaking and safety factors for projected flows.*		
Cost Estimate (2019 $s):		$2,947,000

Project Need:

Resolve Existing Deficiency. Existing main 21- and 30-inch main trunklines exceed capacity under existing conditions. This project would divert flow to a new section of pipe that has available capacity.

Capacity for Future Growth. Projected growth associated with Kennecott Foothills and Little Valley will excerbate existing capacity issues in main 21- and 30-inch trunklines into the treatment plant.

Potential Consequences of Failing to Complete Project:

The 21- and 36-inch main trunklines into the wastewater treatment plant already exceed design capacity. There are no existing connections along this segement so the risk associated with potential surcharging is low. However, as additional development occurs in the area and with system growth the risk to damages associated with surcharging will increase. And because of the size of these pipelines, consequences could be far reaching and expensive.

Project Triggers:

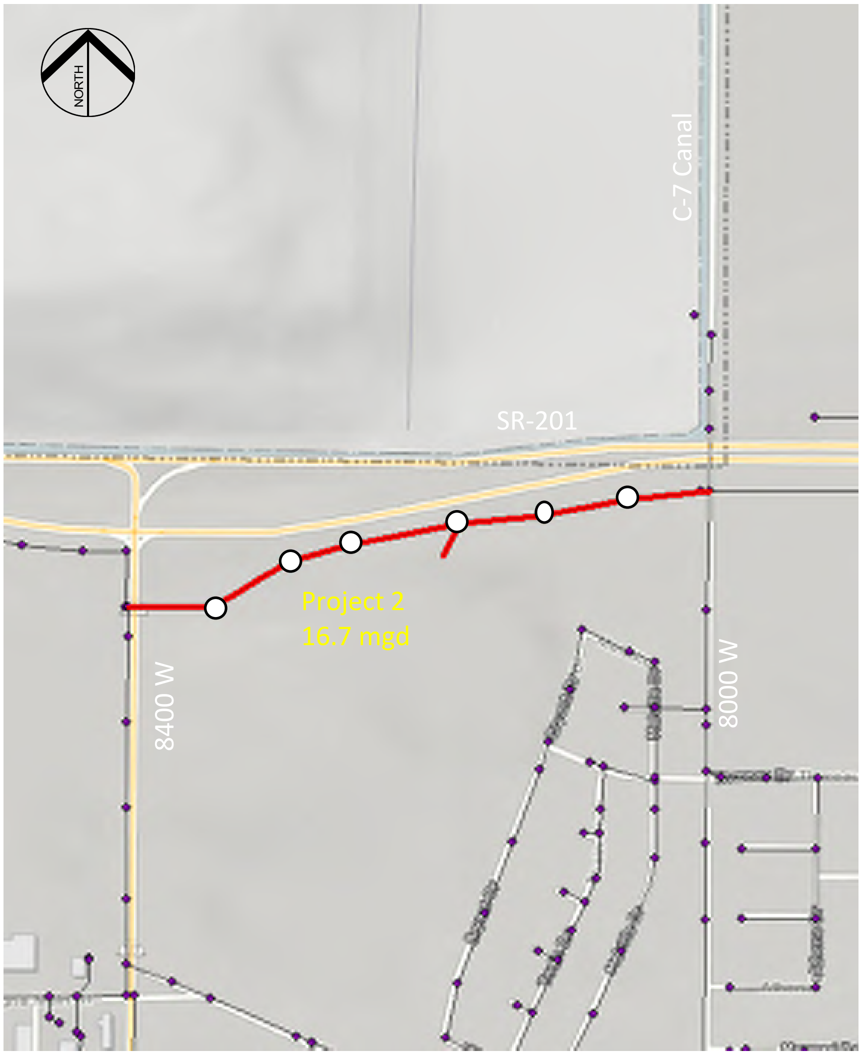
The existing section of pipe from Manhole 1668 to Manhole 1664 is deficient under existing conditions. This project should be constructed as soon as possible to relieve the existing deficiencies.

Current Estimated Project Completion Year:	2021

Improvement Project Summary

Magna Water District

BOWEN COLLINS & ASSOCIATES



Project Map

Project ID:	2
Project Name:	
South Frontage Road, 8400 W to 8000 West	
Description:	
Upsize the existing 21-inch pipeline to a 36-inch pipeline. The pipes along the South Frontage Road from 8400 West to 8000 West are nearing capacity for existing conditions. Growth projected within 10-years is anticipated to exceed the design criteria along this section of pipe. The existing pipes have a relatively shallow bury depth in some areas.	

Project Components		
Quantity	***Size***	***Design Flow****
2,752 LF	36-inch	16.7 MGD

** Design flow is based on full flow capacity of pipe and includes all peaking and safety factors for projected flows.*

Cost Estimate (2019 $s): $1,919,000

Project Need:
Capacity for Future Growth. Projected growth associated with Kennecott Foothills and Little Valley will exceed existing capacity of main 21-inch trunkline into the treatment plant.

Potential Consequences of Failing to Complete Project:
Projected growth will result in flows in the 21-inch main trunkline into the wastewater treatment plant exceeding design capacity. Failure to complete this project will eventually require a moritorium on any growth once this pipeline reaches its capacity. If additional growth is allowed, the District risks flooding along SR-201.

Project Triggers:
The existing section of pipe that this project is intended to replace is not deficient under existing conditions, but becomes deficient at the end of the 10-year window.

Current Estimated Project Completion Year: 2029

Project Map

Project ID:	3
Project Name:	
South Frontage Road, 8800 W to 8400 West	
Description:	
Upsize the existing 18-inch pipeline to a 30-inch pipeline. The pipes along the South Frontage Road from 8800 West to 8400 West are nearing capacity for existing conditions. Growth projected within 10-years is anticipated to exceed the design criteria along this section of pipe. The existing pipes have a relatively shallow bury depth in some areas.	

Project Components		
Quantity	***Size***	***Design Flow****
3,127 LF	30-inch	7.9 MGD

** Design flow is based on full flow capacity of pipe and includes all peaking and safety factors for projected flows.*

Cost Estimate (2019 $s): $1,857,000

Project Need:

Resolve Existing Deficiency. Existing main 18-inch main trunkline exceeds capacity under existing conditions. This project would provide capacity for the existing deficiencies.

Capacity for Future Growth. Projected growth associated with Kennecott Foothills and Little Valley will exceed existing capacity of main 21-inch trunkline into the treatment plant.

Potential Consequences of Failing to Complete Project:

A segement of the 18-inch main trunkline already exceeds design capacity. However, this is a very short segment of pipe and there are no existing connections along this segement so the risk associated with potential surcharging is low. Unfortunately, projected growth will result in a larger extent of the 18-inch main trunkline exceeding design capacity. If additional growth is allowed, the District risks flooding along SR-201.

Project Triggers:

There is already a section of pipe that this is deficient under existing conditions. However, this segement is relatively short and the deficiency does not worsen until toward the end of the 10-year planning window. Thus, this project has technically already been triggered but can be a lower priority improvement until towards the end of the 10-year planning

Current Estimated Project Completion Year: 2027

Improvement Project Summary

Magna Water District

Project Map

Project ID:		4
Project Name:		
9200 West Trunkline, Reach 1		
Description:		
New 30-inch trunkline across Magna Copper Park. The areas developing outside of the historical boundary of the Magna Water District will contribute a significant amount of wastewater to District collection lines. Most of the District's existing collection lines were not sized to accommodate this growth because these areas were outside of the service area when the collection lines were designed and built. As a result, if new growth from the Gateway to Little Valley or the Kennecott foothill areas discharge to existing sewer mains, many of the sewer mains conveying this flow from the discharge point to SR201 will need to be replaced.		
Project Components		
Quantity	***Size***	***Design Flow****
5,000 LF	30-inch	8.1 MGD
** Design flow is based on full flow capacity of pipe and includes all peaking and safety factors for projected flows.*		
Cost Estimate (2019 $s):		$2,516,000

Project Need:

Capacity for Future Growth. Projected growth associated with Kennecott Foothills and Little Valley will exceed existing capacity of existing pipeline in the system.

Potential Consequences of Failing to Complete Project:

Projected growth will result in flows in the existing system exceeding design capacity. Failure to complete this project will require a moritorium on any growth beyond this amount. If additional growth is allowed, the District risks flooding along SR-201 and through Magna Copper Park.

Project Triggers:

This project needs to be in place and have wastewater flowing through it when the peak hour, dry weather flow in pipe 1861 reaches 395 GPM. The current peak flow in pipe 1861 is 280 GPM. Pipe 1861 is located to the west of the Cyprus High football field. There are about 290 ERCs of available until this project needs to be in place.

Current Estimated Project Completion Year:	2022

Improvement Project Summary

Magna Water District

Project Map

Project ID:	5A & 5B
Project Name: 9200 West Trunkline, Reach 2	
Description: New 30-inch casing under the 9200 West bridge. The areas developing outside of the historical boundary of the Magna Water District will contribute a significant amount of wastewater to District collection lines. Most of the District's existing collection lines were not sized to accommodate this growth because these areas were outside of the service area when the collection lines were designed and built. As a result, if new growth from the Gateway to Little Valley or the Kennecott foothill areas discharge to existing sewer mains, many of the sewer mains conveying this flow from the discharge point to SR201 will need to be replaced. Project 5A is the crossing of 9200 West and will need to be completed when bridge work is done in that area. Project 5B is the remainder of the project.	

Project Components

Quantity	*Size*	*Design Flow**
50 LF	30-inch	7.4 MGD

** Design flow is based on full flow capacity of pipe and includes all peaking and safety factors for projected flows.*

Cost Estimate (2019 $s):

Project 5A = $100,000

Project 5B = $1,741,000

Project Need:

Capacity for Future Growth. Projected growth associated with Kennecott Foothills and Little Valley will exceed existing capacity of existing pipeline in the system.

Potential Consequences of Failing to Complete Project:

Projected growth will result in flows in the existing system exceeding design capacity. Failure to complete this project will require a moritorium on any growth beyond this amount. If additional growth is allowed, the District risks flooding throughout neighborhoods at the west end of its service area.

Project Triggers:

This project needs to be in place and have wastewater flowing through it when the peak hour, dry weather flow in pipe 1861 reaches 395 GPM. The current peak flow in pipe 1861 is 280 GPM. Pipe 1861 is located to the west of the Cyprus High football field. There are about 290 ERCs available until this project needs to be in place.

Current Estimated Project Completion Year (Project 5A):	2020
Current Estimated Project Completion Year (Project 5B):	2023

Project Map

Project ID: 6

Project Name:
9200 West Trunkline, Reach 3

Description:
Upsize the existing 12-inch pipe to a 15-inch pipe. The areas developing outside of the historical boundary of the Magna Water District will contribute a significant amount of wastewater to District collection lines. Most of the District's existing collection lines were not sized to accommodate this growth because these areas were outside of the service area when the collection lines were designed and built. As a result, if new growth from the Gateway to Little Valley or the Kennecott foothill areas discharge to existing sewer mains, many of the sewer mains conveying this flow from the discharge point to SR201 will need to be replaced.

Project Components

Quantity	*Size*	*Design Flow**
6,414 LF	15-inch	2.1 MGD

** Design flow is based on full flow capacity of pipe and includes all peaking and safety factors for projected flows.*

Cost Estimate (2019 $s): $894,133

Project Need:
Capacity for Future Growth. Projected growth associated with Kennecott Foothills and Little Valley will exceed existing capacity of existing pipeline in the system.

Potential Consequences of Failing to Complete Project:
Projected growth will result in flows in the existing system exceeding design capacity. Failure to complete this project will require a moritorium on any growth beyond this amount. If additional growth is allowed, the District risks flooding throughout neighborhoods at the west end of its service area.

Project Triggers:
This project needs to be in place and have wastewater flowing through it when the peak hour, dry weather flow in pipe 1861 reaches 395 GPM. The current peak flow in pipe 1861 is 280 GPM. Pipe 1861 is located to the west of the Cyprus High football field. There are about 290 ERCs available until this project needs to be in place.

Current Estimated Project Completion Year: 2024

Project Map

Project ID:	7
Project Name: 7600 West Diversion, Reach 1	
Description: Upsize the existing 15-inch pipe to a 21-inch pipe. Sewer mains along 3100 South and 7200 West exceed the District's design criteria for existing conditions or will exceed criteria with short-term growth. As a result, Projects 7 and 8 area recommended to divert a portion of this flow north on a more direct path to the District's wastewater treatment plant. The proposed diversion will shorten the distance traveled to the treatment plant from the diversion point by 55 percent or by about 2 miles. This will significantly reduce the amount of pipes that are needed to convey the same flow, reducing deficiencies and long-term system improvements as a result.	

Project Components

Quantity	*Size*	*Design Flow**
1,721 LF	21-inch	3.9 MGD

** Design flow is based on full flow capacity of pipe and includes all peaking and safety factors for projected flows.*

Cost Estimate (2019 $s): $649,000

Project Need:

Resolve Existing Deficiency. Pipelines on 3100 South and 7200 West exceed capacity under existing conditions. This project would upsize some existing sections of pipe that would then allow flow to be diverted (See Project 8) from other portions of the existing system to reduce or eliminate deficiencies.

Potential Consequences of Failing to Complete Project:

Existing wastewater production is resulting in flows in the main trunkline into the wastewater treatment plant to exceed design capacity. Potential flooding can occur throughout the neighborhoods that this project is adjacent to if this problem is not solved. Failure to complete this project will require a moritorium on any growth beyond this amount.

Project Triggers:

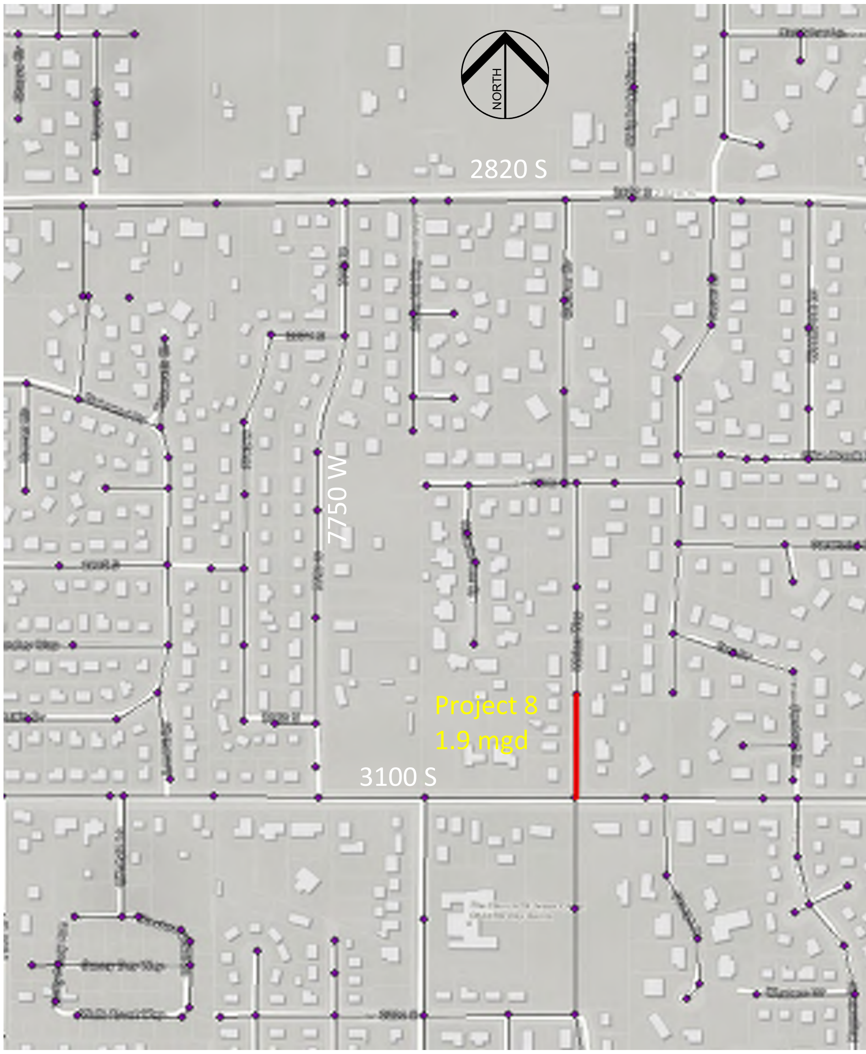
The existing section of pipe that this project is intended to divert from is already deficient under existing conditions. This project must be completed before Project 8 and Project 9.

Current Estimated Project Completion Year: 2021

Improvement Project Summary

Magna Water District

BOWEN COLLINS & ASSOCIATES



Project Map

Project ID:	8
Project Name:	
7600 West Diversion, Reach 2	
Description:	
New 10-inch pipe and manhole improvements. Sewer mains along 3100 South and 7200 West exceed the District's design criteria for existing conditions or will exceed criteria with short-term growth. As a result, Projects 7 and 8 area recommended to divert a portion of this flow north on a more direct path to the District's wastewater treatment plant. The proposed diversion will shorten the distance traveled to the treatment plant from the diversion point by 55 percent or by about 2 miles. This will significantly reduce the amount of pipes that are needed to convey the same flow, reducing deficiencies and long-term system improvements as a result.	

Project Components

Quantity	*Size*	*Design Flow**
340 LF	10-inch	1.9 MGD

** Design flow is based on full flow capacity of pipe and includes all peaking and safety factors for projected flows.*

Cost Estimate (2019 $s): $111,000

Project Need:
Resolve Existing Deficiency. Downstream pipelines exceed capacity under existing conditions. This project would divert flow to other portions of the existing system with remaining available capacity.

Potential Consequences of Failing to Complete Project:
Existing wastewater production is resulting in flows in the main trunkline into the wastewater treatment plant to exceed design capacity. Potential flooding can occur throughout the neighborhoods that this project is adjacent to if this problem is not solved. Failure to complete this project will require a moritorium on any growth beyond this amount.

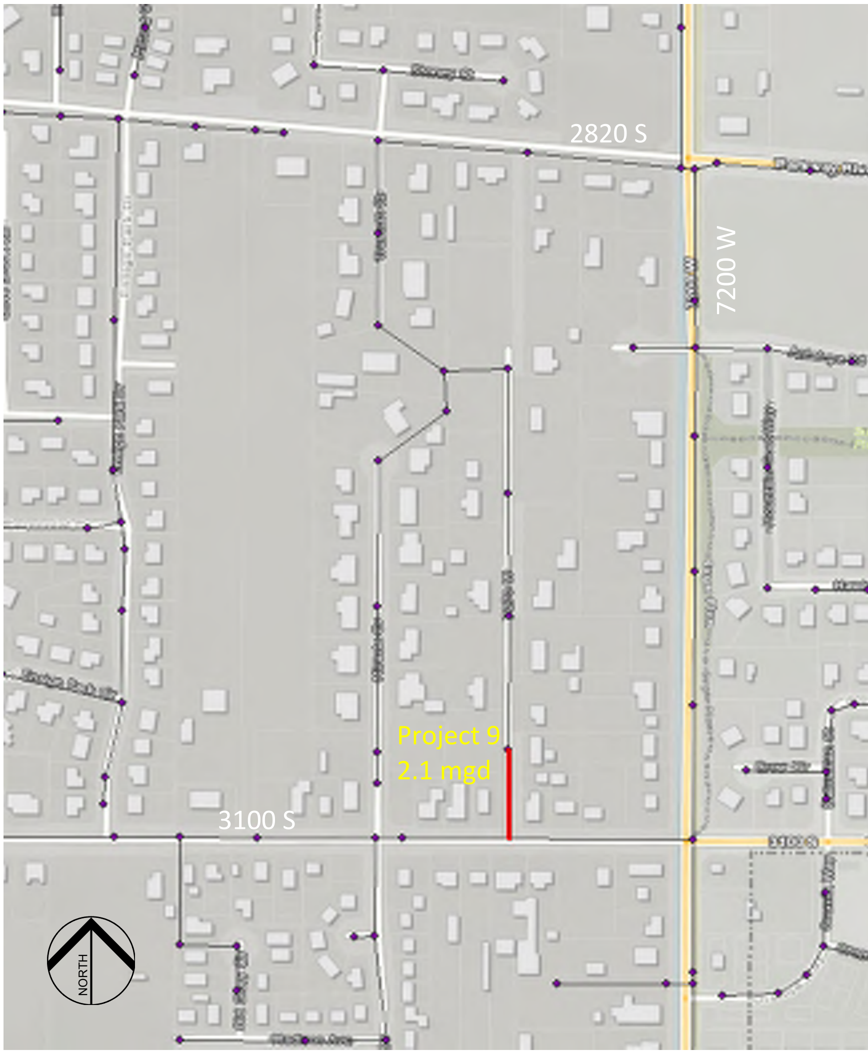
Project Triggers:
The existing section of pipe that this project is intended to divert from is already deficient under existing conditions. This project cannot be completed until Project 8 is completed. This project must be completed before Project 9 is completed.

Current Estimated Project Completion Year: 2021

Improvement Project Summary

Magna Water District

BOWEN COLLINS & ASSOCIATES



Project Map

Project ID: 9

Project Name:
7270 West Diversion

Description:
New 10-inch pipe and manhole improvements. Sewer mains along 7200 West exceed the District's design criteria for existing conditions. Project 9 will divert flow from 3100 South to the north into an existing pipeline in 7270 West. This will reduce the flow to 7200 West so that pipes along 7200 West do not exceed design criteria. Because of limited capacity in 7270 West, this project cannot be completed until some of the existing flow in 3100 South is diverted through Projects 7 and 8.

Project Components

Quantity	*Size*	*Design Flow**
236 LF	10-inch	2.1 MGD

** Design flow is based on full flow capacity of pipe and includes all peaking and safety factors for projected flows.*

Cost Estimate (2019 $s): $80,000

Project Need:
Resolve Existing Deficiency. Downstream pipelines exceed capacity under existing conditions. This project would divert flow to other portions of the existing system with remaining available capacity.

Potential Consequences of Failing to Complete Project:
Existing wastewater production is resulting in flows in the main trunkline into the wastewater treatment plant to exceed design capacity. Potential flooding can occur throughout the neighborhoods that this project is adjacent to if this problem is not solved. Failure to complete this project will require a moritorium on any growth beyond this amount.

Project Triggers:
The existing section of pipe that this project is intended to divert from is already deficient under existing conditions. This project cannot be completed until Project 7 and Project 8 are completed.

Current Estimated Project Completion Year: 2021

Improvement Project Summary

Magna Water District

BOWEN COLLINS & ASSOCIATES

Project Map

Project ID: 10

Project Name:
7270 West Diversion at Parkway Blvd

Description:
New 18-inch pipe and manhole improvements. – Project 10 is intended to divert flow north along 7200 West. For short-term growth, this project reduces flows along Parkway Blvd. east of 7200 West where flow through existing pipes exceeds the District's design criteria for existing conditions. This project also reduces the overall length of pipe traveled by flow at the diversion point by 40 percent or by more than one mile. This reduces deficiencies for long-term conditions along the North Frontage road of SR201 where existing pipes have extremely shallow slopes. While some improvements will eventually be required along 7200 West and the South Frontage Road of SR201, the length of improvements required is much shorter than would be required if flow continues along the existing flow path.

Project Components

Quantity	*Size*	*Design Flow**
975 LF	18-inch	4.9 MGD

** Design flow is based on full flow capacity of pipe and includes all peaking and safety factors for projected flows.*

Cost Estimate (2019 $s): $457,000

Project Need:
Resolve Existing Deficiency. Downstream pipelines exceed capacity under existing conditions. This project would divert flow to other portions of the existing system with remaining available capacity.

Potential Consequences of Failing to Complete Project:
Existing wastewater production is resulting in flows in the main trunkline into the wastewater treatment plant to exceed design capacity. Potential flooding can occur throughout the neighborhoods that this project is adjacent to if this problem is not solved. Failure to complete this project will require a moritorium on any growth beyond this amount.

Project Triggers:
The existing section of pipe that this project is intended to divert from is already deficient under existing conditions.

Current Estimated Project Completion Year: 2026

Project Map

Project ID:	11
Project Name:	
7200 West, 3500 South to 3100 South	
Description:	
Upsize existing 8-inch pipe to a 12-inch pipe. Project 11 is intended to upsize the existing 8-inch pipes in 7200 West from 3500 South to 3100 South to eliminate existing and projected future deficiencies along this reach.	

Project Components		
Quantity	***Size***	***Design Flow****
2,987 LF	12-inch	1.5 MGD

** Design flow is based on full flow capacity of pipe and includes all peaking and safety factors for projected flows.*

Cost Estimate (2019 $s): $1,295,000

Project Need:
Resolve Existing Deficiency. Section of this pipeline exceed capacity under existing conditions. This project would eliminate these capacity deficiencies.

Potential Consequences of Failing to Complete Project:
Existing wastewater production is resulting in flows in the main trunkline into the wastewater treatment plant to exceed design capacity. Potential flooding can occur throughout the neighborhoods that this project is adjacent to if this problem is not solved. Failure to complete this project will require a moritorium on any growth beyond this amount.

Project Triggers:
The existing section of pipe that this project is intended to replace is already deficient under existing conditions.

Current Estimated Project Completion Year: 2028

WASTEWATER FACILITY PLAN

PART 2 OF SEWER MASTER PLAN

MAGNA WATER DISTRICT

BOWEN COLLINS & ASSOCIATES

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Note: This report is the second in a series of three reports comprising the Magna Water District Sewer Master Plan. Chapters 1 through 6 are located in the first report in this series, and chapters 8 through 10 are in part three.

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CHAPTER 7
WASTEWATER FACILITY PLAN

INTRODUCTION

The Magna Water District (MWD or District) desires to develop an updated master plan for its sewer collection system. This is the second in a series of three expected reports that will comprise the planning documents for the District's sewer system. The expected reports will be:

- **Collection System Master Plan** – An evaluation of the District's existing wastewater collection system and its ability to convey wastewater from where it is generated to where it will be treated.
- **Wastewater Facility Master Plan** – An evaluation of the District's ability to treat wastewater as it is received from customers. This plan is the topic of this report.
- **Implementation and Capital Facilities Plan –** A plan for completing the necessary improvements identified in the collection system and wastewater facility master plans.

BACKGROUND

The focus of this report is the wastewater treatment facility. The District has previously prepared a wastewater treatment facility plan as follows:

- **Wastewater Facility Plan –** Prepared by Carollo in March 2017. This report can be found in Appendix 2-A.
- **Updated Facility Plan –** Prepared by Carollo in December 2019. This report can be found in Appendix 2-B.

These plans will not be updated as part of BC&A's efforts. However, they are obviously an important part of the District's overall sewer system needs and will correspondingly be referenced here. The remainder of this chapter summarizes the major improvements recommended in the plans. For additional details, please see the applicable appendices.

WASTEWATER FACILITY IMPROVEMENTS

Wastewater facility improvements were identified from the District's Wastewater Facility Plan and discussions with the District. A summary of the recommended projects and their major purposes are as follows:

- **Project 1 – Influent Pump Station Modifications** – The District is currently using two separate headworks buildings for the wastewater treatment plant. This project would upgrade the East Headworks to take all the flow entering the plant so that the West Headworks could be abandoned. This project includes demolition of the west headworks, demolition of the west influent pump station, replacing the east influent pumps, replacing the blend tank influent pumps, headworks mechanical piping modifications, yard piping modifications, site work, electrical work and I&C work. (See p. 6, Updated Facility Plan)
- **Project 2 – Secondary Reuse** – This project will increase treatment at the wastewater treatment plant with the purpose of creating an effluent that is appropriate for reuse in the District's secondary irrigation system. This project includes rehabilitation of the BIOBROx equipment, a BIOBROx feed pump station, disinfection, chlorine feed for residual, finished water pumps, yard piping, site work, electrical work, and I&C work. (See p. 12, Updated Facility Plan)

- **Project 3 – Land Acquisition for Future Expansion** – Capacity of the existing wastewater treatment plant is 4.0 mgs. Projected growth is not expected to exceed this capacity until sometime beyond 2040 (See Chapter 3, Collection System Master Plan). Even though capacity will not be needed in the near future, the District would like to be prepared to purchase land for a future expansion of the wastewater treatment plant when the opportunity arises. It is proposed that the District being planning for the purchase of approximately 36 acres for this purpose. At approximately $150,000/acre, acquisition of this land is expected to cost about $5.4 million.
- **Project 4 – New Dewatering Press –** District staff have identified a need to purchase a new dewatering press for solids handling.
- **Project 5 – Modifications to Sludge Drying Beds** – The District would like to make modifications to their current sludge drying beds to make the process more efficient and cost effective.
- **Project 6** – **SCADA Upgrades** – Improvements in technology have resulted in portions of the District's treatment plant control system needing updates. The District would like to make upgrades to their SCADA system to make control easier and more reliable at the existing wastewater treatment plant.
- **Project 7** – **Asphalt Replacement** – There is a large amount of asphalt at the treatment plant. As it ages, this asphalt will eventually need replacement. While minor repairs to the asphalt are normally accommodated through the O&M budget, replacement of the asphalt is expected to be a large enough budget item that it has been budgeted for separately here.

Table 7-1 shows the projects mentioned above with their respective project timing and estimated project cost.

Table 7-1
Proposed Wastewater Facility Improvements

Project No.	Project Timing	Project Name	Project Cost (2019 $'s)
1	0-5 years	Influent Pump Station Modifications	$5,728,900
2	0-5 years	Secondary Reuse	$12,480,900
3	>10 years	Land Acquisition for Future Expansion	$5,400,000
4	0-5 years	New Dewatering Press	$440,000
5	>10 years	Modifications to Sludge Drying Beds	$500,000
6	5-10 years	SCADA Upgrades	$250,000
7	5-10 years	Asphalt Replacement	$500,000
		Total	$25,299,800

IMPLEMENTATION PLAN

PART 3 OF SEWER MASTER PLAN

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Note: This report is the third in a series of three reports comprising the Magna Water District Sewer Master Plan. Chapters 1 through 6 are located in the first report in this series, and chapter 7 is in part three.

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CHAPTER 8
IMPLEMENTATION PLAN INTRODUCTION

INTRODUCTION

The Magna Water District (MWD or District) desires to develop an updated master plan for its sewer collection system. This is the last in a series of three reports that comprise the planning documents for the District's sewer system. The reports are:

- **Collection System Master Plan** – An evaluation of the District's existing wastewater collection system and its ability to convey wastewater from where it is generated to where it will be treated.
- **Wastewater Facility Plan** – An evaluation of the District's ability to treat wastewater as it is received from customers.
- **Implementation and Capital Facilities Plan –** A plan for completing the necessary improvements identified in the collection system and wastewater facility master plans.

BACKGROUND

The purpose of the last part of this sewer master plan is to introduce recommended rehabilitation and replacement projects that the District would like to accomplish in the next ten years then provide a recommended implementation plan for the District to know the timing for the recommended collection system projects, wastewater facility projects, and rehabilitation/ replacement projects and how much it will cost the District to complete these projects. Chapter 8 summarizes the recommended improvements identified in the previous two reports. Chapter 9 will discuss the recommended rehabilitation and replacement projects associated with aging infrastructure and Chapter 10 will discuss the recommended implementation plan.

COLLECTION SYSTEM CAPACITY IMPROVEMENTS

Based on existing wastewater flow and projected growth in wastewater flow, the existing and future flows were simulated in a hydraulic model of the District's collection system. For existing flows, model results indicate that there are some existing deficiencies in several trunk lines in the system. For future flows, some significant deficiencies are predicted in high growth areas of the District. While much of the system has some excess capacity for future growth, several trunk lines serving high growth areas will need to be replaced with larger pipes to meet future demands. Most of the projected deficiencies are a result of growth on Kennecott property at the southwest corner of the District.

To resolve potential deficiencies identified as part of the system evaluation, several projects have been proposed. Table 8-1 summarizes the recommended projects and associated costs for these projects. (See Collection System Master Plan for details).

Table 8-1
Proposed Collection System Capacity Improvements

Project No.	Project Timing	Diameter (inch)	Length (ft)	Project Name	Project Description	Project Cost (2019 $s)
1	0-5 years	30	4,876	8000 West Interceptor	30-inch Diameter 8000 West Trunk to Treatment Plant	$2,947,000
2	0-5 years	36	2,752	So. Frontage, 8400 W to 8000 W	Upsize Existing 21-inch to 36-inch	$1,919,000
3	5-10 years	30	3,127	So. Frontage, 8800 W to 8400 W	Upsize Existing 18-inch to 30-inch	$1,857,000
4	0-5 years	30	4,092	9200 West Trunk, Reach 1	New 30-inch Trunk Across Magna Copper Park	$2,516,000
5	0-5 years	15	4,395	9200 West Trunk, Reach 2	Upsize 8-inch to 15-inch	$1,741,000
6	0-5 years	15	6,414	9200 West Trunk, Reach 3	New 12-inch to 15-inch pipe	$1,916,000
7	0-5 years	21	1,721	7600 West Diversion, Reach 1	Upsize 15-inch to 21-inch Pipe	$649,000
8	0-5 years	10	340	7600 West Diversion, Reach 2	New 10-inch Pipe and Manhole Improvements	$111,000
9	0-5 years	10	236	7270 West Diversion	New 10-inch Pipe and Manhole Improvements	$80,000
10	5-10 years	18	975	7200 West Diversion at Parkway Blvd	New 18-inch Pipe and Manhole Improvements	$457,000
11	5-10 years	12	2,987	7200 W, 3500 S to 3100 S	Upsize 8-inch to 12-inch	$1,295,000
12	>10 years	15	2,252	8400 W, Main St to So. Frontage	Upsize 8-inch to 15-inch	$1,296,000
13	>10 years	8	1,317	8000 W, 3500 S to 3200 S	Condition related cast-in-pipe-place	$102,000
15	>10 years	15	6,438	8000 W, 3200 S to So. Frontage	Upsize Existing 8-inch to 12-inch through 18-inch	$2,518,000
16	>10 years	18	3,213	7200 W, Copperview to So. Frontage	Upsize Existing 15-inch to 18-inch	$1,687,000
17	>10 years	18	1,469	So. Frontage, 6100 W to 6200 W	Upsize Existing 12-inch to 18-inch	$644,000
18	>10 years	24	706	No. Frontage, 7100 W to 7200 W	Upsize Existing 21-inch to 24-inch	$370,000
19	>10 years	10	8,695	Northeast Sewer & Lift Station	New 10-inch Main, Lift Station, & Force Main	$2,087,000
20	>10 years	8	20	3367 S 8400 W MH	Remove manhole & reconnect laterals	$30,000
21	5-10 years	-	-	New Shop Building	Construct new shop building at WWTP	$500,000
					Total	**$24,722,000**

WASTEWATER FACILITY IMPROVEMENTS

Wastewater facility improvements have been selected based results of the District's Wastewater Facility Plan and discussions with the District. Table 8-2 summarizes the projects identified in the Wastewater Facility Master Plan with their respective project timing and estimated project cost.

Table 8-2
Proposed Wastewater Facility Improvements

Project No.	Project Timing	Project Name	Project Cost (2019 $'s)
1	0-5 years	Influent Pump Station Modifications	$5,728,900
2	0-5 years	Secondary Reuse	$12,480,900
3	>10 years	Land Acquisition for Future Expansion	$5,400,000
4	0-5 years	New Dewatering Press	$440,000
5	>10 years	Modifications to Sludge Drying Beds	$500,000
6	5-10 years	SCADA Upgrades	$250,000
7	5-10 years	Asphalt Replacement	$500,000
		Total	$25,299,800

CHAPTER 9
REHABILITATION AND REPLACEMENT

INTRODUCTION

Most of the projects in Chapter 8 have been identified to meet capacity needs in the District's system. These projects do not necessarily address the rehabilitation or replacement of existing facilities due to age or condition related concerns. The purpose of this chapter is to recommend the rehabilitation and replacement investment needed to sustainably maintain the District's sewer collection system. This is not a comprehensive evaluation of system conditions, nor is it a complete asset management plan. Instead, it is a collection of general observations assembled during the master planning process relative to system rehabilitation and replacement.

REHABILITATION AND REPLACEMENT – COLLECTION SYSTEM

While it is beyond the scope of this study to identify a detailed list of rehabilitation projects for the District, it is important that future financial planning include a sustainable budget that can then be used for rehabilitation as specific projects are identified. One of the best ways to identify a recommended level of system renewal funding is to consider system service life. As with all utilities, each component of a sewer system has a finite service life. Therefore, it is necessary to continually spend money towards the rehabilitation or replacement of these components. If adequate funds are not set aside for regular system renewal, the collection system and wastewater treatment plant will fall into a state of disrepair and be incapable of providing the level of service that customers expect.

The District's sewer collection system is composed of about 540,000 feet of pipe and over 1,500 manholes. The total cost to replace all of the pipes and manholes in the District collection system would be approximately $160 million based on 2019 construction costs. In reality, it will not be necessary to completely replace the entire system as it ages because of rehabilitation technologies (e.g. slip lining, cast-in-place pipe, etc.). Rehabilitation costs are much lower than replacement costs (20% to 60% depending on pipe diameter). If the District were able to rehabilitate the entire system rather than replace components, it would drastically reduce the "replacement value" to $32 million. Unfortunately, it is generally not possible to rehabilitate all system components due to either condition or capacity issues. Some pipes are beyond saving with rehabilitation, while others may require upsizing or correction of grade issues; all of these scenarios would require a replacement.

To account for the limitations on rehabilitation, BC&A recommends a renewal budget derived from a combination of rehabilitation and replacement using an approximate design life of 80 years. Table 9-1 shows a comparison of the required annual budget based on replacement, rehabilitation, and the recommended combination of both values.

Table 9-1
Recommended Sewer Collection System Renewal Budget

System Renewal	Annual Budget (2019 Dollars)*
Replacement of all system components	$1,988,000
Rehabilitation of all system components	$405,000
50% replacement 50% rehabilitation	**$1,197,000**

*1.25% of complete system "replacement" which assumes an average 80 year life cycle for all system components

The current proposed annual budget for improvements associated with rehabilitation and replacement that the District would like to complete in the next ten years is summarized in Table 9-2.

Table 9-2
District Proposed Collection System Rehabilitation and Replacement Improvements

Project No.	Project Timing	Project Name	Project Cost (2019 $'s)
1	Annually	Mainline Sewer Repairs (including Western Drive)	$600,000
2	Annually	Manhole Repairs (Epoxy Spray Lining)	$100,000
		Total	$700,000

Comparing the budgeted value proposed by District staff in Table 9-2 to the recommended long-term level of renewal funding as identified in Table 9-1 would suggest the District should be spending about $500,000 more annually for its sewer collection system renewal. However, because the District is still expanding and much of its infrastructure is still relatively new, it may be acceptable to keep rehabilitation funding a little lower than long-term recommended levels for a period of time. For planning purposes, it has been assumed that the District will start with and keep a budget of $700,000 from 2020 through 2030, then gradually increase their investments over the next 10 years past 2030 until it reaches the recommended $1.2 million (adjusted for inflation).

REHABILITATION AND REPLACEMENT – TREATMENT FACILITY

A similar process as described above can be followed to calculate a recommended level of renewal funding at the District wastewater treatment facility. For the District's existing 4.0 MGD wastewater facility, it is estimated that replacement of the facility would cost no less than $36 million. Dividing this cost over a maximum recommended design life of 50 years, would suggest that the District should be spending and average of about $720,000 annually for system renewal of the wastewater facility.

Many of the wastewater facility projects in Chapter 7 identified to be completed over the next 10 years are system renewal type projects. While there are projects that increase capacity (e.g. Project 3 - Land Acquisition for Future Expansion) or increase levels of service (e.g. Project 2 – Secondary Reuse), many of the projects are being primarily completed to replace aging or underperforming components (e.g. Project 1 – Influent Pump Station Modifications). If only projects falling into this last category are considered, the corresponding average annual investment value is around $740,000, about the same as the proposed annual system renewal value. Thus, the District will be on track with their necessary annual investments if they follow through with the recommended 10-year wastewater facility improvements. Correspondingly, no additional investment needs to be set aside for the purpose of rehabilitation and replacement projects, at least during the 10-year planning window covered by this implementation plan.

REHABILITATION AND REPLACEMENT – TOTAL RECOMMENDED INVESTMENT

Based on this analysis, the recommended District budget for the 10-year planning window of this implementation plan is approximately $740,000 towards rehabilitation and replacement activities at the wastewater facility each year and an additional $700,000 towards rehabilitation and replacement activities in the sewer collection system each year. These values are reported in 2019 dollars and should be adjusted for construction inflation over time. These budget levels should be revisited from time to time and adjusted as part of future asset management planning.

CHAPTER 10
IMPLEMENTATION PLAN

Previous chapters of this sewer master plan have identified improvements to resolve future deficiencies and to accommodate wastewater flow from future growth while providing an acceptable level of service. The purpose of this chapter is to assemble a 10-year capital improvement program to implement the recommended improvements. This plan should be updated at least every five years to re-prioritize system improvements to achieve District goals.

CAPITAL IMPROVEMENT PRIORITIZATION

A discussion of each of the major budget categories and how they will be prioritized in the 10-year implementation plan is included below:

- **Collection System Capacity Improvements** – BC&A used the growth projections discussed in Chapter 2 of this report and the existing collection system hydraulic model to determine when collection system capacity improvements are needed. There is not much flexibility with the scheduling of these projects. While moving a project a few years forward or a few years back may be a possibility, major changes in timing cannot be accommodated. Unless growth occurs at rates significantly different that those projected, failure to complete the projects at the recommended dates will result in the District running out of available capacity and being forced to implement restrictions on development.
- **Collection System Rehabilitation Improvements** – A recommended budget level for collection system rehabilitation improvements was developed in Chapter 9. Although this exact amount does not need to be spent in every single year, failure to invest in this system at approximately this level over time will result in system degradation and costly system failures. While the District does have some flexibility with these expenditures, this implementation plan assumes annual rehab and replacement investments through the entire 10-year planning window based on the recommended funding level.
- **Treatment Plant Improvements –** A prioritized list of treatment plant improvements was developed for the District's 2019 Updated Facility Plan. BC&A worked with District personnel to determine which recommended treatment plant improvement projects from the 2019 Updated Facility Plan have been completed, are in progress, or have been superseded by other projects. For those projects that still need to be completed, this implementation plan generally follows the same timing identified in Updated Facility Plan with only a few exceptions to accommodate other needed expenditures.

RECOMMENDED 10-YEAR CAPITAL IMPROVEMENT PROGRAM

Based on the system improvements identified in Chapter 6 and the recommended prioritization approach discussed above, Table 10-1 lists improvement projects that are recommended within the next 10-years, the budget required to complete those projects, and the recommended timing of those projects. For budgeting purposes, capital costs for most major capital improvements have been split up into at least two years; the first year usually includes about 10% of the total project cost for design services, while future years include the remaining budget for actual construction.

Figure 10-1 summarizes the annual capital expenditures that will be required to support the recommended capital improvement plan. Expenditures have been grouped by major category for reference.

Table 10-1
Recommended 10-Year Capital Improvement Plan

Project ID	Project Description	Project Total (2019 $s)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	10-yr Total	Outside of 10-Year Plan
Collection System Capacity Improvements														
1	8000 West Interceptor	$2,947,000	$303,541	$2,813,825									$3,117,366	
2	So. Frontage, 8400 W to 8000 W	$1,919,000				$215,985	$2,002,182						$2,218,167	
3	So. Frontage, 8800 W to 8400 W	$1,857,000							$228,388	$2,117,153			$2,345,540	
4	9200 West Trunk, Reach 1	$2,516,000		$266,922	$2,474,371								$2,741,293	
5	9200 West Trunk, Reach 2	$1,741,000				$195,951	$1,816,467						$2,012,418	
6	9200 West Trunk, Reach 3*	$894,133				$100,635	$932,891						$1,033,527	
7	7600 West Diversion, Reach 1	$649,000					$75,237	$697,446					$772,683	
8	7600 West Diversion, Reach 2	$111,000					$12,868	$119,286					$132,154	
9	7270 West Diversion	$80,000					$9,274	$85,972					$95,246	
10	7200 West Diversion at Parkway Blvd	$457,000						$54,568	$505,847				$560,415	
11	7200 W, 3500 S to 3100 S	$1,295,000								$164,047	$1,520,713		$1,684,760	
12	8400 W, Main St to So. Frontage	$1,296,000											$0	$1,296,000
13	8000 W, 3500 S to 3200 S	$102,000											$0	$102,000
15	8000 W, 3200 S to So. Frontage	$2,518,000											$0	$2,518,000
16	7200 W, Copperview to So. Frontage	$1,687,000											$0	$1,687,000
17	So. Frontage, 6100 W to 6200 W	$644,000											$0	$644,000
18	No. Frontage, 7100 W to 7200 W	$370,000											$0	$370,000
19	Northeast Sewer & Lift Station	$2,087,000											$0	$2,087,000
20	3367 S 8400 W MH	$30,000											$0	$30,000
21	New Shop Building	$500,000											$0	$500,000
Subtotal		***$23,700,133***	***$303,541***	***$3,080,748***	***$2,474,371***	***$512,572***	***$4,848,919***	***$957,272***	***$734,235***	***$2,281,200***	***$1,520,713***	***$0***	***$16,713,569***	***$9,234,000***
Treatment Plant Improvements														
1	Influent Pump Station Modifications	$5,728,900	$590,077	$5,470,011									$6,060,088	
2	Secondary Reuse	$12,480,900			$1,363,822	$6,321,313	$6,510,953						$14,196,088	
3	Land Acquisition for Future Expansion	$5,400,000											$0	$5,400,000
4	New Dewatering Press	$440,000			$480,800								$480,800	
5	Modifications to Sludge Drying Beds	$500,000											$0	$500,000
6	SCADA Upgrades	$250,000						$298,513					$298,513	
7	Asphalt Replacement	$500,000						$597,026					$597,026	
Subtotal		***$25,299,800***	***$590,077***	***$5,470,011***	***$1,844,622***	***$6,321,313***	***$6,510,953***	***$895,539***	***$0***	***$0***	***$0***	***$0***	***$21,632,514***	***$5,900,000***
Collection System Rehabilitation Improvements														
1	Mainline Sewer Repairs (including Western Drive)	-	$617,969	$687,025	$759,667	$836,050	$916,333	$1,000,680	$1,089,262	$1,182,260	$1,279,856	$1,382,245	$9,751,347	
2	Manhole Repairs (Epoxy Spray Lining)	-	$103,031	$114,544	$126,656	$139,391	$152,776	$166,838	$181,607	$197,112	$213,384	$230,455	$1,625,793	
Subtotal		***$0***	***$721,000***	***$801,569***	***$886,323***	***$975,441***	***$1,069,108***	***$1,167,518***	***$1,270,870***	***$1,379,372***	***$1,493,240***	***$1,612,700***	***$11,377,141***	***$0***
TOTAL		**$48,999,933**	**$1,614,618**	**$9,352,327**	**$5,205,316**	**$7,809,326**	**$12,428,980**	**$3,020,329**	**$2,005,104**	**$3,660,571**	**$3,013,954**	**$1,612,700**	**$49,723,224**	**$15,134,000**

Note: Costs include 3% inflation per year

*Project cost only includes District's portion of cost to upsize

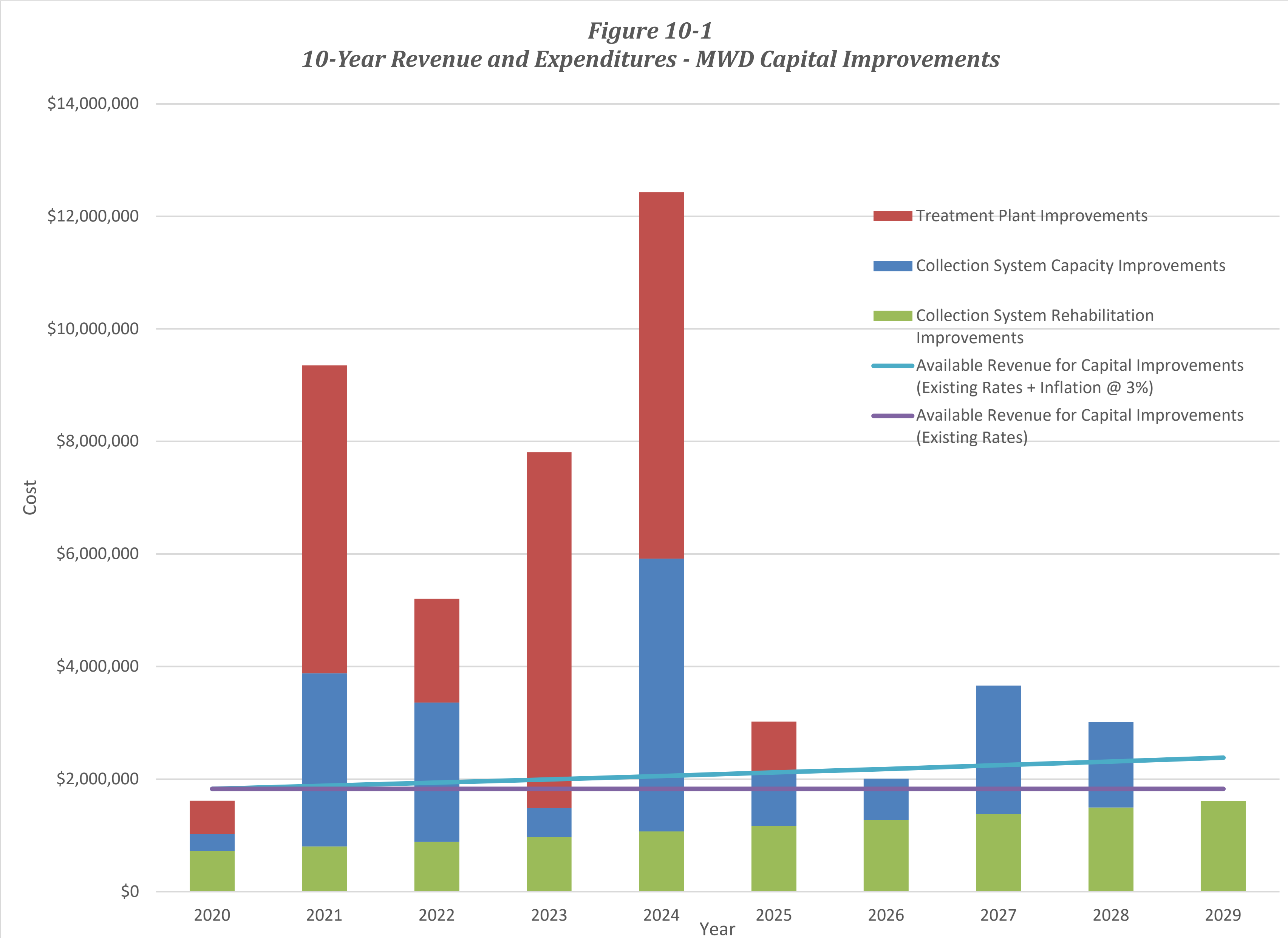

Figure 10-1
10-Year Revenue and Expenditures - MWD Capital Improvements
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
Cost
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
Year
Treatment Plant Improvements
Collection System Capacity Improvements
Collection System Rehabilitation Improvements
Available Revenue for Capital Improvements (Existing Rates + Inflation @ 3%)
Available Revenue for Capital Improvements (Existing Rates)

For comparison purposes, Figure 10-1 also includes the historic level of funding available for capital improvements based on data from the District for budgets in 2017, 2018, and 2019. The average inflation adjusted revenue for capital improvements in the District during this period was $1.8 million as shown in the figure. The figure also includes an estimate of annual available revenue if historic revenues are increased at 3% per year to account for inflation.

A few conclusions can be made based on Table 10-1 and Figure 10-1:

- **Short-term Level of Funding** – The District is facing some significant expenditures in the near future. This is the result of two factors. First, significant growth will require several expensive collection system improvements in the next five years. Second, there are a significant number of high priority projects, especially at the treatment plant, that are recommended for completion in the next few years. These projected expenditures are significantly greater than historic funding levels.
- **Long-term Level of Funding –** The District's historic level of available funding for capital projects is not far off of recommended long-term levels. As can be seen in the later years of Figure 10-1, once the District addresses several short-term needs, historic levels of funding a little short, but not too far below projected project needs. Thus, long-term funding will need increase to meet the required needs, but this increase may not be quite as large as suggested by short-term needs.

RECOMMENDATIONS

Based on the analysis contained in this report and the conclusions above, the following actions are recommended:

- **Adopt the Proposed Implementation Plan –** The 10-year capital improvement plan summarized in Table 10-1 represents the best available assessment of District capital needs in the upcoming years. It is recommended that this plan be adopted for budgeting, staffing, rate making and impact fee calculation purposes.
- **Complete a Rate Study –** As noted above, historic funding levels will not be adequate to address projected District needs over the next several years. The District will need to explore options for funding the recommended projects. This will likely include increasing rates, bonding for projects, or some combination of the two. It is recommended that the District complete a detailed rate study to explore their options.
- **Develop a Plan for Project Completion –** In addition to having adequate funding to complete the needed projects in upcoming years, the District will also need to make sure it has adequate help to manage and execute the needed projects. There may be too many capital projects for the District's existing staff to manage. It is recommended that the District identify a plan for increasing its capacity in this regard, either through the acquisition of additional staff or securing assistance from a consultant.
- **Update this Sewer Master Plan Regularly –** This sewer master plan should be viewed as a living document. The conclusions contained herein are based on several assumptions that will assuredly change from time to time. Examples of this include assumptions associated with development patterns, regulatory requirements, economic conditions, etc. As changes occur in these areas, the conclusions and recommendations in this report may need to be revised. For this reason, it is recommended that this report be updated on a regular basis. This should be at least once every 5 years and more often if necessitated by a major change in the District (e.g. major new regulatory requirement, annexation of a new area, etc.)