SANITARY SEWER WASTEWATER MASTER PLAN

J4340

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Submitted to:

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II Executive Summary

The City of Rochester last completed a sanitary sewer master plan in 1996. That document served as a basis for many of the major trunkline projects completed in the past two decades. The City of Rochester's growth has now exceeded the planning horizon for the 1996 document.

This Master Plan will utilize the existing system capacity restrictions, condition defects, and the City's future growth potential to provide a document that will assist the City in making decisions for capacity investment in the trunk sewer system to the year 2045.

For sizing pipes and calculating planning rates the ultimate gravity service area based on topography is used as the design service area, except where modified in select areas by City determined service limits. Gravity sewer is preferred over siphons and lift stations by City staff. New siphon locations are minimized, and new lift stations are excluded from consideration per City direction.

This report gives an overview of the process and standards used in developing the recommended capital improvement projects as well as summaries of the cost and planning data for each major sewer district. Detailed descriptions of each project and supporting analysis data are provided in the Appendix of this report.

II.A Wastewater Collection System

II.A.1 Recommendations: Capital Improvement Projects

Sewer super districts and smaller subdistricts are generally defined by the topography and sewer collection systems, rather than political boundaries, streets, etc. The City's sewer collection system is composed of eight super sewer districts. Each super sewer district was analyzed and compiled into this Master Plan. The super sewer districts are:

- Hadley Valley
- Kings Run
- East Zumbro
- West Zumbro
- South Zumbro
- Northwest Territories
- Downtown
- Unmetered Area

We recommend that the City uses this Master Plan as a guide for funding decisions in the eight super sewer sheds.

The Hadley Valley and Kings Run super sewer districts currently have sewer capacity to serve new development. Major capital improvement projects were constructed in 2005-2006 that were sized for ultimate development. These two districts generally have the lowest sanitary service cost per acre. All other districts within the City require some improvements to alleviate existing capacity issues and support future development.

The total cost to upsize all sewer mains and construct extensions to serve the ultimate future sewer service area is approximately $362 million. The ultimate future sewer service area is approximately 86,000 gross acres, more than double the existing service area. It may take decades (or centuries) to reach ultimate development bounds in all districts. However, since any one district may see rapid development pushing the boundaries in a much shorter time frame this Master Plan uses the ultimate bounds for pipe sizing and cost recovery calculations. Sewer pipes are typically expected to last 75-100 years. Compared to the overall cost of replacing an existing sanitary pipe and restoring impacted utilities and streets, the incremental cost increase for installing larger pipes is relatively minor. This approach is intentional so investments in the sewer today will last for the lifetime of the pipes.

This Master Plan lays out a protocol for prioritizing investment in the sanitary sewer, marrying the interests of future growth, existing capacity needs, and opportunity projects such as transit improvements, street repairs, dredging, etc.

Based on the protocol East Zumbro has the most- and highest-scoring projects, followed closely by West Zumbro and Downtown. South Zumbro and Unmetered areas score lower. There are approximately six projects that rise to the top based on scores and four out of six are in East Zumbro. Absent of other pressures, East Zumbro may be the most bang-for-your-buck district to invest in the sanitary sewer system because it reduces the most existing sewer issues and provides the most developable acres per dollar.

This Master Plan does not seek to dictate the order or timing of sanitary sewer capital improvements. Timing should evolve with development priorities and opportunity projects.

This Master Plan provides the following key information for trunk projects so that design information is available when it is needed:

1. Sizing: Existing and design future capacities and diameters for all upsizing projects.

2. Existing capacity: The existing spare capacity of each trunk segment in million gallons per day and equivalent ‘acres remaining’.

3. Ultimate service area: Developable acres gained by individual projects and strings of connected projects.

4. Cost: preliminary cost opinions are provided for each project citywide in 2019 dollars.

5. Trunk Sewer Planning Rate (sewer availability charge): Shown as $/Developable Acre that includes all future upsizing, extensions, and balances from previous projects.

6. Chapter Pull-outs for presentations: Projects are presented in a chapter format for ease in extracting the necessary information to support a specific project.

II.A.2 Recommendations: I/I Reduction and O&M

Condition of the sanitary sewer collection system pipes and manholes play a role in prioritizing the order and timing of these major capital projects, but in general this Master Plan does not lay out a prioritized project list for rehabilitation/repair of the existing system. Rehabilitation/repair of the existing system is generally completed under separate programs for Inflow/Infiltration (I/I) Reduction, and Operation & Maintenance (O&M).

We recommend that the City continue to fund its annual budgets for I/I Reduction and O&M to complete repairs as needed on an annual basis. These critical projects extend the service life and capacity in existing pipes.

Effective repairs rely on current data. Citywide trunk sewer lines (12”-diameter and larger) were last televised in 2007-2010. A ten-year CCTV cycle is common among cities for inspection interval. We recommend that the City consider CCTV inspection of trunk sanitary trunk lines in 2020.

Additionally, the City should consider implementing a citywide sump pump inspection program following the findings and recommendations of the Kutzky/Slatterly Pilot I/I Program (CH2M Hill/WHKS & Co., 2010). Private sector programs such as sump pump inspection programs are typically the most cost-effective way of reducing I/I in the system.

II.B Wastewater Treatment

Please refer to the 2018 Water Reclamation Plant (WRP) Facilities Plan (City of Rochester, 2018) for wastewater treatment master planning information.

III Introduction

III.A Purpose

The City of Rochester last completed a sanitary sewer master plan in 1996. This document served as a basis for many of the major trunkline projects completed in the past two decades. The City of Rochester's growth has now exceeded the planning horizon for the 1996 document. A new Master Plan will assist the City in making decisions for investment in the trunk sewer system to the year 2045.

The overall goal of this project is the development of a new Sanitary Sewer Wastewater Master Plan. The Master Plan will utilize the existing system capacity restrictions, condition defects, and the City's future growth potential to provide a document that will assist the City in making decisions for investment in the trunk sewer system.

The City has completed several critical pieces of analysis in recent years. Information from these plans was utilized in future growth and flow projections that support the development of a new Master Plan, including:

- 2018 WRP Facilities Plan (City of Rochester, 2018).

- 2016 Comprehensive Plan for Sanitary Sewer Capacity, a high-level strategic planning document to support the City's overall Comprehensive Plan (WHKS & Co., 2016).

- 2018 5-year Capital Improvement Plan, including utility and non-utility projects that will impact timing of sewer upgrades (City of Rochester, MN, 2018).

- 2017-18 Sanitary Sewer Modeling, a detailed model of existing capacity and future capacity needs (HDR/WHKS & Co., 2017).

- 2018 City of Rochester and ROCOG Planning, which provides population growth and travel projections within the urban service area to the year 2045. (Rochester-Olmsted Council of Governments (ROCOG), 2018) (City of Rochester, MN, 2018)

- 2014 DMC Downtown Growth Utility Planning, identified utility improvements to support DMC growth in the downtown DMC area (Hammes Company et al./WHKS & Co., 2014).

- 2012 Northwest Territories Plan, which provided a detailed analysis of sewer serviceability in the Northwest Territories super sewer district (CDM Smith, 2012).

- 2010 PA3 Downtown and South Zumbro Sewer Study, which analyzed capacity in the South Zumbro super sewer district and provided the basis for recent improvements in the Soldiers Field and Downtown areas (CH2M Hill/WHKS & Co., 2011).

- 2010 Rochester Downtown Master Plan (RDMP), which projected growth in the downtown area for the planning horizon 2010-2030, prior to DMC. (Sasaki Associates et al., 2010)

- 2008-2010 Kutzky/Slatterly Pilot I/I Study, which provided detailed analysis of public and private infrastructure, provided the sizing for trunk improvements in these neighborhoods, and provided a template for city-wide I/I reduction implementation (CH2M Hill/WHKS & Co., 2010).

- 2002 Development of Sewage Pumping Stations to Serve Kings Run, Hadley Valley, and NW Territory Areas, which provided a detailed analysis of sewer serviceability in these super sewer districts and formed the basis for trunk improvements in Kings Run and Hadley Valley (HR Green/CH2M Hill, 2002).

- Yearly Sanitary Sewer Inspections performed by City staff and contractors that identify repairs and improvements needed to provide the City's desired level of service to its citizens and visitors.

III.B Scope

The Sanitary Sewer Wastewater Master Plan intends to produce the following outcomes:

- Protocol for Prioritizing Investment in the Sanitary Sewer, marrying the interests of future growth, existing capacity needs, and opportunity projects.

- Maps showing alignments, costs, and design data for future improvements in the sewer system. Sizing of future trunks accounts for total build out of system of the ultimate gravity service boundaries.

- Trunk Sewer Planning Rates for each super sewer district

- Capital Improvement Plan (CIP) recommended sewer projects

- Preparation of a Sanitary Sewer Wastewater Master Plan report.

III.C Exclusions

This Master Plan presents a plan for gravity flow sanitary sewer service. Gravity sewer is preferred over siphons and lift stations. New siphon locations are minimized, and new lift stations are excluded from consideration per City direction.

Rehabilitation/repair of the existing system is generally completed under separate programs for I/I Reduction and Operation & Maintenance. Repairs for purely condition-related issues that are not part of capacity-related major capital projects are excluded from the scope of this Master Plan.

IV Land Use and Growth Projections

IV.A Methodology

For sizing pipes and calculating planning rates, the ultimate gravity service area is used as the design service area except in selected areas of City determined service limits.

Land use and flow projection methodology and assumptions are presented in the following list format and are presented in a set of maps titled Loading and Subdistricts included with this report.

Assumptions:

1. Assumed new development, infill and redevelopment will occur.

   In platted areas, undeveloped platted lots will develop. Land use for infill development will follow the approved General Development Plan (GDP) if available, or else is assumed to follow current Zoning (City of Rochester, MN, 2018).

   Sewer subdistricts that span inside- and outside-city limits assume future zoning for the new portion will match current zoning.

   We assigned each Zoning category to the closest matching land use type shown in the NWT table below.

Development projections for the NWT Study that were used as a basis for future development and flows in this Master Plan:

Wastewater (Sanitary) Generation Rates for Northwest Territory Service Area				
Land use	**Units**	**Population Equivalent**	**Gpcpd**	**ADF (GPD/unit)**
Residential – Single Family	Dev. Acre	17.5 pop/acre	70	1,230
Residential – Multi- Family	Dev. Acre	25 pop/acre	70	1,750
Residential – Townhouse	Dev. Acre	15 pop/acre	70	1,050
Residential – Mixed Use	Dev. Acre	20 pop/acre	70	1,400
Commercial – General	Dev. Acre	12.5 pop/acre	70	880
Commercial – High Intensity	Dev. Acre	30 pop/acre	70	2,100
Commercial – Hotel	Dev. Acre	38 pop/acre	70	2,630
Commercial – Office	Dev. Acre	12.5 pop/acre	70	880
Commercial – Shopping Center	Dev. Acre	12.5 pop/acre	70	880
Commercial – Big Box	Dev. Acre	10 pop/acre	70	700
Industrial	Dev. Acre	20 pop/acre	70	1,400

The developable acreage for unplatted areas is generally assumed to equal 48% of the gross acreage. This assumption is based on (a) 60% of gross area being developable lots and the remaining 40% undevelopable being occupied by Right-of-Way, storm water ponds, etc. and (b) 80% of the developable area being developed during the planning horizon. 60% * 80% = 48%. This 48% is strikingly close to the current ratio of developed:gross acres within City limits.

Assumed wastewater generation rate for future population growth is 70 gal/person/day. This number is conservative. The actual water use in Rochester has been decreasing over the past couple decades and is currently closer to 55 gal/capita/day. The 70 gal/person/day is consistent with the 2012 Northwest Territories (NWT) study (CDM Smith, 2012) and use of this per capita number was directed by the City for use in this Master Plan to give consistency among studies and future flow projections.

The table below shows development projections for the PA3 Study that were specific to South Zumbro. These values were used in South Zumbro.

Wastewater (Sanitary) Generation Rates for PA3 Study (South Zumbro)				
Land use	**Units**	**Population Equivalent**	**Gpcpd**	**ADF (GPD/unit)**
Suburban Single Family-Platted	Lot	2.58 pop/Lot	70	180
Suburban Single Family-Unplatted	Gross acre	5.4 pop/gross acre (9.0 pop/dev. Acre)	70	378

PA3 assumed 60% of Gross Area = Developable Area

Inside city limits, land use for future development is assumed to follow Zoning. It is assumed that new development (expansion of City limits) will also occur. Outside of city limits, development is assumed to follow a mix of single and multi-family residential, commercial, large retail and industrial uses that is the same as the City and Planning department developed for the 2012 NWT study.

Single family residential is 7 homes per developed acre and 2.5 people per home, equivalent to 17.5 people per developed acre. NWT assumed 60% of gross acreage would be developable for single family residential, resulting in an equivalent 4.2 homes/gross acre or 10.5 people / gross acre.

Densities and wastewater generation rates for all land use types are same as described above in item 1.

For more information on the origin of this methodology and sensitivity analysis please see the 2016 Comprehensive Plan for Sanitary Sewer Capacity (WHKS & Co., 2016).

2. Vertical redevelopment increased daytime business, daytime visitors, and transportation usage will occur, particularly in the downtown area and along the Broadway Avenue / 2nd St South axis. Several studies cover this area and overlap geographically. This Master Plan reviewed the growth and flow projections from each of the below studies and used the most conservative growth assumptions on a subdistrict-by-subdistrict basis.

    a. 2010 Rochester Downtown Master Plan (RDMP) (Sasaki Associates et al., 2010),
    b. 2014 Destination Medical Center (DMC) planning (Hammes Company et al./WHKS & Co., 2014),

c. 2018 ROCOG Long-Range Transportation planning (Rochester-Olmsted Council of Governments (ROCOG), 2018).

Wastewater loading rates used in previous studies that provided input data to the master plan in the downtown area are presented in the table below. DMC planning incorporated RDMP planning rates. The wastewater generation rates from DMC planning are shown in the table below.

Wastewater (Sanitary) Generation Rates for Destination Medical Center (DMC) Land use Equivalents			
DMC Development	**Units**	**Pop Eq., Gpcpd**	**ADF (GPD/ unit)**
Health	SF Building	No Population Equivalent Proxy was calculated.	0.10 gpd/SF
Bio-Tech	SF Building		0.60 gpd/SF
Office	SF Building		0.10 gpd/SF
Hotel	Room		50 gpd/room
Residential	Unit		142 gpd/unit
Retail	SF Building		0.10 gpd/SF
Education	SF Building		0.10 gpd/SF
Transit	Acre		500 gpd/acre
Recreation	Acre		500 gpd/acre

DMC Development 'Health' Category based on actual RPU data for Gonda and Mayo buildings assigned 2.70 diurnal peaking factor. Other development categories assigned typical loading rates from MPCA Onsite Treatment Manual and assigned 1.75 diurnal peaking factor from PA3 flow monitoring data for the Downtown area. Flows were based on projected development (SF, Acre, etc.). No population equivalent proxy was calculated.

For comparison, ROCOG Transportation Planning and Land Use gave projections as well, shown in the table below.

Wastewater (Sanitary) Generation Rates for ROCOG Transportation Planning Land Use Equivalents				
Land use	**Units**	**Population Equivalent**	**Gpcpd**	**ADF (GPD / unit)**
Suburban Single Family	Dwelling Unit	2.5 pop / DU	70	175
Urban Single Family	Dwelling Unit	2.35 pop / DU	70	165
Suburban Multi-Family	Dwelling Unit	2 pop/ DU	70	140
Urban Multi-Family	Dwelling Unit	1.85 pop/ DU	70	130
Townhome	Dwelling Unit	2.3 pop / DU	70	161
General Commercial	1000 SF	4 pop / 1000 SF	70	280
Industrial	1000 SF	1.67 pop / 1000 SF	70	117
Office	1000 SF	4 pop / 1000 SF	70	280
Church & Health Clubs	1000 SF	5 pop/ 1000 SF	70	350

Entertainment	Seat	1 pop/ seat	70	70
Secondary -Higher Education	Student	1 pop/ student	70	70
Elementary and Middle School	Student	1 pop/ student	70	70
Hotel	Lodging Unit	2 pop/ LU	70	140
High Intensity Retail	1000 SF	4 pop/ 1000 SF	70	280
Drive Through Bank	1000 SF	4 pop/ 1000 SF	70	280
Park	Acre	--	--	--
Shopping Center	1000 SF	4 pop/1000 SF	70	280
Big Box Retail	1000 SF	4 pop/1000 SF	70	280
Nursing Home – Senior Apt	Resident	1 pop/resident	70	70
Mayo (Medical)	1000 SF	2.5 pop/1000 SF	70	175
Hospital	1000 SF	2.5 pop/1000 SF	70	175
Airport	Enplanement	0.5 pop/ enplane.	70	35
Air Cargo	1000 SF	4 pop / 1000 SF	70	280
Biotech	1000 SF	2 pop/1000 SF	70	140
Future General Com Retail	1000 SF	4 pop / 1000 SF	70	280
Future Institutional	1000 SF	3.3 pop / 1000 SF	70	231
External Cordon Stations	Daily Traffic	--	--	--

IV.B Existing Service Area

IV.B.1 Study Area

The study area consists of the existing City of Rochester sanitary sewer collection system. The collection system is divided into eight major drainage basins (Super Sewer Districts):

- East Zumbro
- West Zumbro
- South Zumbro
- Hadley Valley
- Kings Run
- Northwest Territory
- Downtown
- Unmetered Trunklines

The Unmetered Trunklines is a small area along the Zumbro River downstream of the permanent meters in each sewer super shed; flows from this area are captured at the Water Reclamation Plant.

A map of the Super Sewer Districts is presented in Section XI Maps and Figures, “Figure XI.A Sewer Super Districts”.

IV.B.2 Existing Land Use and Residential Density

The Existing Land Use and Residential Densities were developed from 2018 Zoning and Parcel data. Current City limits include approximately 35,530 gross acres, 17,084 developed acres, yielding a 48.08% developed:gross area ratio. The current population is approximately 115,000 (2019) not counting daytime workers and visitors.

Determination of existing developed acres was on a parcel by parcel basis. We included those parcels with an Estimated Market Value (EMV) on the parcel buildings greater than or equal to $70,000 and spot checked with aerial photography. Using this threshhold as a proxy for developed parcels was a process developed in the Comprehensive Plan for Sewer Capacity (WHKS & Co., 2016) and is only used for gross area sewer flow projection purposes in this Master Plan.

The existing average population density is 6.7 pop / developed acre (3.2 pop / gross acre), not counting daytime workers and visitors.

IV.C Future Service Area

IV.C.1 Future Land Use and Residential Density

The future service area used in this Master Plan is the ultimate future sewer service area for the City of Rochester. The ultimate area is based on the topographic boundaries for gravity sewer service in all basins except for East, West and South Zumbro where some edges were political boundaries.

The outer extents of East and South Zumbro were defined based on City decision to limit the eastern edge of the service area to 70th Ave NE, and exclude large – lot developments that are currently on septic systems. Likewise, the west boundary of West Zumbro was defined based on the political boundary (CSAH 3) between Rochester and Byron. These areas will be consistent with the urban service areas shown in the ROCOG Comprehensive Plan (City of Rochester, MN, 2018). A comparison between the existing, ultimate, and ROCOG 2045 boundary is presented in Section XI Maps and Figures, “Figure XI.D Ultimate Sewer Service Boundary and ROCOG Comp Plan”.

The ultimate future sewer service area comprises approximately 86,000 gross acres. The ultimate service area is more than double the existing service area. It may take decades (or centuries) to reach ultimate development bounds in all Sewer Super Districts. However since any one area may see rapid development pushing the

boundaries in a much shorter time frame the City is using the ultimate bounds for pipe sizing. This approach is intended to ensure investments in the sewer today will last for the lifetime of the pipes.

The methodology for developing future land use and residential density are presented in Sections IV.A Methodology, and IV.D Population Generation Rates.

IV.D Population Generation Rates

Historical population data from the U.S. Census are presented in the table below.

Historical Population				
Year	**Population**		**Year**	**Population**
1860	1,424		1950	29,855
1870	3,953		1960	40,663
1880	5,013		1970	53,766
1890	5,321		1980	57,890
1900	6,843		1990	70,745
1910	7,844		2000	85,806
1920	13,722		2010	106,769
1930	20,621		2019	115,000 (estimated)
1940	26,312			

Population growth was not directly used to project future sanitary sewer flows. Rather, development assumptions were made based on land use and ultimate assumed densities within the gravity sewer service area.

Rochester also has a substantial amount of proposed vertical redevelopment and daytime workers and visitors in the downtown areas. These daytime populations were accounted for in existing flows by flow meter data, and accounted for in future flow projections using RDMP, DMC, and ROCOG growth projections and equivalent populations as summarized in section IV.A Methodology

V Collection System Definition

V.A Introduction

The City of Rochester's existing public sanitary sewer collection system is composed of:

- 2,544,474 linear feet of gravity main
- 15,250 linear feet of force main
- 3 active city-owned lift stations
- 12 active private lift stations
- 18 siphons

Private sewer mains and services are not included in the above totals.

V.B Gravity System Definition

Public gravity mains that are 12-inches in diameter and larger, all public/private lift stations, and all siphons were defined as the trunk system, aka the 'Tier 1 system'. The trunk (Tier 1) system was analyzed for the sanitary sewer model and this Master Plan. Analysis of the trunk (Tier 1) system stops at the WRP influent lift station. Piping within the WRP is not included, however WRP influent lift station wet well settings are included in the analysis as they have a direct effect on flow levels in the gravity interceptor pipes.

The local collector sewers, aka the 'Tier 2 system', includes 8- and 10-inch diameter sewers. The local (Tier 2) system was analyzed for the sanitary sewer model and this Master Plan in the Downtown area only. The local (Tier 2) system citywide was not analyzed.

Detailed descriptions of the existing trunk (Tier 1) system are documented in the Sanitary Sewer Model Technical Memorandum for Existing Conditions (HDR/WHKS & Co., 2017).

VI Wastewater Flows

VI.A Flow and Rainfall Monitoring Program

VI.A.1 Service Area Background Information

The City of Rochester owns and operates a system of thirteen permanent flow meters, four permanent rain gauges, and four temporary meters placed throughout the collection system. Most permanent meters were installed between 2000 and 2010. Permanent meter data generally is available back to the year 2000 for various locations.

VI.A.2 Relationship of Sewer Subdistricts and Flow Monitoring

Sewer Super Districts and smaller subdistricts are generally defined by the topography and sewer collection systems, rather than political boundaries, streets, etc. Please see the Data Gap Analysis (HDR), and Feasibility Report for Adding Additional Flow Meters (WHKS & Co., 2016) for information on permanent meter locations and hierarchies.

VI.B Rainfall and Wastewater Flow Data Analysis

VI.B.1 Analysis of Rainfall Data

Generally speaking, each sewer super district has its own permanent meter. Several large storm events were utilized for model calibration:

- September 2010 (a 25-year storm primarily focused on the south half of the city),
- September 2011,
- smaller events in 2015 and 2016.

More granular analysis of rain events was also input into the model where detailed flow data and analysis was available from temporary meters in previous studies such as:

- Kutzky/Slattery Pilot I/I Study (CH2M Hill/WHKS & Co., 2010),
- PA3 Study (CH2M Hill/WHKS & Co., 2011), and
- Sewer Model development (HDR/WHKS & Co., 2017).

The wet weather responses of the sewer system were recorded by flow meters during these events.

VI.B.2 Large User Flow Data

Large Users, aka Significant Industrial Users (SIU) were identified by RPU. Large users included various individual Mayo Clinic and St Marys buildings (medical), Crenlo (metals manufacturing), Seneca (canning), AMPI (dairy), Kemps (dairy), and others. Water consumption for SIUs was included in the model.

VI.B.3 Determination of Average Daily Dry Weather Flow

Winter water use data from winter of 2016-2017 was used as the ADF basis for existing service area. The average ADF per capita was

approximately 55 gpcpd (HDR/WHKS & Co., 2017). This value of 55 gpcpd was only used for existing users, as it matches the actual flow meter data. Future dry weather water use projections for future population growth is 70 gpcpd.

VI.B.4 Determination of Inflow and Total Infiltration

Inflow and total infiltration is modeled with RTK values. RTK values are a set of values that describe the 'leakiness' of a geographic area. Inflow spike, trailing total infiltration, and base flow conditions are represented by the first, second, and third RTK value, respectively. The RTK values used for modeling purposes were calibrated to match the metered values recorded during the calibration storm events noted in section VI.B.1.

Detailed information on flow distribution and meter areas is provided in the sanitary sewer model documentation, "Technical Memorandum: Model Development and Validation: Phase 1 Sanitary System Hydraulic Model Development" (HDR/WHKS & Co., 2017).

VI.B.5 Subsystem Distribution of I/I

Subsystem distribution of I/I was allocated within each permanent meter basin based on flow meter data. I/I was more specifically allocated within specific subsheds where detailed flow data and analysis was available from prior studies in the Kutzky Neighborhood, Slatterly Park Neighborhood, and Downtown as described above in section VI.B Rainfall and Wastewater Flow Data Analysis.

VI.B.6 Design Flow and Probability

The City of Rochester uses a synthetic 25-year recurrence interval design storm. A synthetic storm is one that is computer generated based on standard storm duration and intensity and covers the entire citywide area. The flow outputs are the predicted 25-year Peak Hourly Wet Weather flows.

Detailed documentation of the development of the sewer model by HDR/WHKS is included in the sewer modeling tech memos (HDR/WHKS & Co., 2017).

VII Existing Collection System Evaluation

VII.A Description of Hydraulic Model

The model is a dynamic model of the citywide trunk (Tier 1 >= 12") gravity trunkline collection system, all lift stations and siphons, and the local (Tier 2 8", 10" system in the downtown area). Development and calibration of the model is discussed in Section VI Wastewater Flows.

VII.B Existing System Analysis for Peak Flow Conditions

VII.B.1 Introduction

The existing collection system generally performs well under existing conditions. There are certain areas that have high flows relative to capacity and the sewer model indicates a sensitivity to potential basement backups and/or sanitary sewer overflows.

A map of existing system peak hourly wet weather flow conditions based on the updated sanitary sewer model is presented in Section XI Maps and Figures, "Figure XI.B Existing Peak Hourly Wet Weather (PHWW) Flow Conditions".

VII.B.2 Collection System Improvement Criteria

This Master Plan lays out a protocol for prioritizing investment in the sanitary sewer, marrying the interests of future growth, existing capacity needs, and opportunity projects such as transit improvements, street repairs, dredging, etc.

A project prioritization protocol was developed for this Master Plan. First, screening criteria were applied to each potential project. Every project on the proposed Priority 1 project list contains one or more of the following screening criteria, unless otherwise noted for specific projects:

VII.B.2.a ***Screening Criteria (Yes/No):***

- Existing Pipe Condition Rating is a 5 or 6 (most severe), or other risks threaten its stability (external erosion, etc.)
- Existing Sanitary Sewer Overflow (SSO) Risk
- Existing Basement Backup (BB) Risk

VII.B.2.b ***Detailed Scoring: total 1000 pts***

Detailed scoring criteria were applied to each project that passed screening. Scoring was based on a balance of risks and benefits, to existing and future users. Detailed scoring criteria and weights were as follows:

- Risk Categories: total 600 pts
    - Risk Based on Consequence: 400 pts
        - Impact to Major Users (SIUs): 150 pts
        - Existing SSO Risk or BB Risk: 150 pts
        - Quantity of SSO/BB's this pipe puts at risk during 25-year storm: 100 pts
    - Risk Based on Likelihood: 200 pts
        - Condition Score or Other Risks: 100 pts
        - Pipe Utilization (d/D): 100 pts
- Benefit Categories: total 400 pts
    - Benefit Based on Future Growth: 180 pts
        - Quantity of trunkline projects upstream of this project: 60 pts
            - Developable Acres to be gained by string of projects: 40 pts
            - Developable Acres to be gained by this project: 40 pts
            - Capacity to be gained by this project: 40 pts
    - Benefit Based on Sewer Rates: 120 pts
        - Planning Rate (typically one rate per Super District that includes all cumulative projects and acres): $/Dev. Acres gained: 60 pts
        - Capacity Recovery Rate or this project: $/ MGD gained: 60 pts
    - Benefit Based on Present Growth: 100 pts
        - Availability of Other City Services for this project: 60 pts
        - Developable Acres to be gained in valid General Development Plan by this project: 40 pts

      Please see sections XII.#.7 for each sewer super district in the Appendix for screening and scoring matrices.

VII.B.3 Improvement Cost Basis

Cost basis for proposed trunkline improvements were calculated to include sanitary sewer and simple restoration costs plus engineering, legal, administration, and construction observation. Costs are based on 2019 construction season. No forecasting for future price increases is included. Preliminary cost opinions for the proposed CIP projects are provided in the appendix.

Cost basis assumes upsizing of trunklines. Some locations may be better suited to constructing a parallel line and CIPP lining the old line to also keep it in service rather than upsizing. Constructability and O&M should be considered during design.

Water, storm sewer, traffic, streetscaping, and pedestrian improvements are not included in the cost basis but these should be considered during budgeting for planning and design.

VII.B.4 Dry Weather Analysis

The system performs adequately during dry weather. No capacity issues have been noted during dry weather.

VII.B.5 Field Inspections

Trunkline (Tier 1) CCTV and manhole inspections were performed citywide between the years 2006-2013 Supplemental manhole inspections and CCTV of smaller diameter (Tier 2) systems are performed annually by City Sewer Crew.

VII.B.6 Wet Weather Analysis

Live observations during wet weather events were performed as part of the Kutzky/Slattery Pilot I/I Study (CH2M Hill/WHKS & Co., 2010), PA3 Study (CH2M Hill/WHKS & Co., 2011), and Sewer Model development (HDR/WHKS & Co., 2017). Live observations documented the flow conditions at diversion structures during wet weather, which were used to cross check the modeled system.

VII.C Design Storm Selection

VII.C.1 Surcharged Pipes and Relief Sewers

The threshold for triggering upsizing of existing trunk pipes is generally when the pipes are full without surcharge (100% d/D) under the 25-year design storm.

In some locations, surcharge is allowable for deep trunks where there is no impact to sanitary sewer overflows (SSOs) or basement backups. These locations are reviewed on a case-by-case basis. The most significant trunk line where this is applicable are the twin 27” trunks on Broadway Ave, which are 20 – 25 ft deep and in bedrock, would be difficult to upsize, and show minimal surcharge (1-2 ft) under future peak hourly conditions.

VII.C.2 Lift Stations and Sanitary Sewer Siphons

The City currently owns and maintains major lift stations at Green Meadows, Lift Station 4, and the Water Reclamation Plant. The city also operates minor lift stations at multiple locations in the City. Generally speaking, minor lift stations are intended to be relatively temporary facilities to serve new developments until such time as a gravity trunk line sewer can be constructed to replace the lift station.

The City’s collection system currently includes multiple major (Tier 1) and minor (Tier 2) siphons.

The lift stations and siphons were evaluated under the same PHWW 25-year design storm as the collection system analysis.

VII.D I/I Reduction

Pilot I/I Study (CH2M Hill/WHKS & Co., 2010) produced a cost-effectiveness analysis that indicated approximately 30% I/I reduction within the existing sewer system was the most cost-effective amount to remove. Public and Private sector removals were included in analysis. We recommend that the City continue its annual pipe and manhole rehabilitation projects to reduce I/I, as well as implement a private sector sump-pump program. The Pilot I/I Study presented a thorough analysis and recommendations for private sector implementation.

VIII Future Collection System Evaluation

VIII.A Introduction

This Master Plan presents the major Capital Improvement Projects to upsize the trunk system and construct extensions to serve the ultimate gravity sewer service boundaries. Alignments, design capacity and sizing, preliminary engineering cost opinions, and cost recovery ($/Acre) are provided for each project. Details of constructability, parallel vs. upsizing, storm sewer and/or water main and surface improvements should be developed during preliminary design for specific projects.

All projects were screened and scored using the risk/benefit criteria discussed in section VII.B.2 Collection System Improvement Criteria.

VIII.B Future Land Use and Growth Projections

Please see section IV.C Future Service Area and section IV.D Population Generation Rates.

VIII.C Preliminary Layout of Extensions

VIII.C.1 Gravity Extensions

Gravity extension alignments are presented in the maps for each subdistrict, provided in the Appendix. Parameters for preliminary design of extensions were:

- Service Area: Ultimate service boundary
- Cover: Minimum 8 ft, Maximum 40 ft. The shallowest sewer that meets minimum cover and design grades is proposed.
- Slope: Minimum grade to achieve 2 ft/s, in accordance with 10 States Standards, and may be increased if necessary due to topography. Drop manholes are required at some locations to prevent excessive slopes.
- Roughness: Manning's n=0.013
- Area Reduction: d/D = 0.67 or 0.75 depending on diameter, see section VIII.D.2.

VIII.C.2 Lift Stations and Forcemains

The operation of the City's existing lift stations was modeled in the system analysis. Upsizing of lift stations flow rates was assumed for future service size increases where needed.

VIII.D Capacity Analysis of Extended System

VIII.D.1 Design Basis

Hadley Valley projects were evaluated in J7712 Feasibility Report (City of Rochester, MN, 2005). Costs have been updated to 2019 prices. All other information (sizing, acres, alignments, original cost opinions) comes directly from that report.

Kings Run projects were evaluated in J4366 Feasibility Report (HR Green/CH2M Hill, 2002). Costs have been updated to 2019 prices. Additional cost opinions were developed for extensions for the purpose of this report.

Northwest Territory projects were evaluated in J2131 Feasibility Report (CDM Smith, 2012). Costs have been updated to 2019 prices. All other information (sizing, acres, alignments, original cost opinions) comes directly from that report.

South Zumbro, PA3 projects were evaluated in J7769 Feasibility Report (CH2M Hill/WHKS & Co., 2011). Costs have been updated to 2019 prices. Additional load points have been added since that report and were re-analyzed and updated for this report.

Downtown projects were evaluated in the Rochester Downtown Master Plan (Sasaki Associates et al., 2010), and the DMC Subsurface Utility Improvements Report (Hammes Company et al./WHKS & Co., 2014). Loadings, sizing and alignments have been updated and reflect current 2019 data based on Zoning, TAZ data and private hospital projections.

East Zumbro, West Zumbro, Downtown and Unmetered Trunklines did not have previous feasibility reports. The design basis for these areas is described in sections VIII.B - VIII.D.

VIII.D.2 Area Reduction Factor

Design sizing is based on:

- d/D = 0.67 for pipes <=18” dia, and
- d/D = 0.75 for pipes >18” dia,
- at PHWW 25-year ultimate future flow conditions.

These area reduction factors are standard City of Rochester practice to incorporate a measure of conservativeness in the design pipe sizing.

VIII.D.3 Reduction of I/I for Future Analysis

For sizing purposes of future pipe the following I/I reduction factors were included:

- For upgrades in existing service area: zero percent (0%) I/I reduction. RTK (I/I) values based on calibrated meter data of existing system.

Sewer models of the future system indicated that a 30% vs 0% I/I reduction in the existing system did not eliminate the need for future trunk improvements. The impact of assuming zero I/I reduction is typically a one- or two- size increment increase in design diameters compared with assuming a 30% reduction. I/I reduction is still recommended as a cost-effective pursuit. Cost savings from reducing I/I will be seen in reducing pumping and WRP treatment costs, and potentially extending the service life of existing pipes before they reach full utilization.

- For extensions to future service areas: assumed RTK (I/I) equal to 30th percentile of current citywide RTK values. Essentially this is assuming that future areas will be dryer than 69% but wetter than 30% of existing areas.

VIII.D.4 Results of Analysis for Sewer Service Areas

In some areas of the City, the existing system has adequte capacity to serve future growth. In other areas of the City, the existing system is almost fully utilized by existing residents and has little capacity for growth.

The 2016 Comprehensive Plan for Sanitary Sewer Capacity (WHKS & Co., 2016) analyzed each of the seven super sewer districts for sewer availability and cost to expand sewer service. The analysis included existing available sewer capacity, cost to upsize to serve ultimate area, and carryover of previous outstanding project debt. Costs and sewer availability were expressed numerically as 'Planning Rates', ($/Acre of new development), where low planning rates were good and indicated available sewer capacity and high planning rates indicated limited sewer availability and higher costs to upsize the system.

Of the seven sewer super-districts, the north side of the City including Kings Run, Hadley Valley, and a portion of the Northwest Territory have the most available capacity to add sewer service areas. These are relatively newer areas of the city. Previous investments into trunk sewer projects provide these areas with large trunk pipes already in place ready to accept new development.

On the other hand, the south and western sides of the City including South Zumbro, West Zumbro, portions of East Zumbro, and Downtown have the least available sewer capacity. These areas are sewer constrained. These are relatively older portions of the City and already significantly established/developed. Areas where development might occur are primarily on the fringes of the urban service area. Significant lengths of existing sewers would need to be upsized to serve these areas. The cost to upsize existing trunk sewers and the incidental restoration of streets and other infrastructure drives up the cost to provide new sanitary sewer service in these areas higher than other areas of the city.

The 2016 Comprehensive Plan for Sanitary Sewer Capacity analyzed the sewer super districts' capacity for development and analagous cost

to upsize sewers for development (WHKS & Co., 2016). The 2016 sewer anlaysis was incorporated into the 2018 City of Rochester Comprehensive Plan (City of Rochester, MN, 2018). The 2018 Rochester Comprehensive Plans vision included themes of utilizing available infrastructure rather than low-density development, cost-effectively developing in areas that had available capacity, and considering the cost of sewer projects in context with the total cost to develop all infrastructure (water, streets, etc) in these areas.

Please see Section XI Maps and Figures, "Figure XI.C Sewer Restricted Areas from ROCOG Comp Plan" for a map of the super districts' capacity to support development.

VIII.D.4.a Trunk Sewers

Due to the life cycle operation and maintenance costs and reliability considerations of lift stations, the City of Rochester prefers to utilize gravity sewer wherever possible and not construct lift stations. The City prefers to construct gravity sewer and eliminate siphons where feasible.

Therefore, this Master Plan assumes gravity main construction wherever possible and only uses siphons where feasible alignments for gravity sewer are not available.

VIII.D.4.b Lift Stations and Forcemains

New major lift stations and forcemains were excluded from future improvements based on the City's preference for gravity sewer over lift stations. The only notable major potential lift stations would be to serve development in the Northwest Territory.

This document does not provide analysis of lift stations as alternatives to gravity main. Users should be aware of the limitation of this document and may wish to consider cost/benefit of lift stations as part of the preliminary design phase for projects.

In limited circumstances, minor private lift stations may be needed to serve small areas of new development. For example, the southern-most tip of East Zumbro by the airport will likely require a small lift station to serve the entire extents of that area. Users should consider those costs along with future extensions during preliminary design.

IX Implementation Plan

IX.A Introduction

Sanitary sewer systems require inspections, maintenance, and rehabilitation when needed. This section briefly highlights all of these aspects of collection system operation.

IX.B Field Investigation

IX.B.1 Collection System Inspections

Televised inspection of Tier 1 sanitary sewer is generally outsourced to contractors due to need for specialty equipment in inspecting large diameter lines. The Tier 1 system was last inventoried citywide in 2005-2011, inspection data is reaching 14 years old in some sections. We recommend renewing this inspection data within the next five years.

The City inspects all of its Tier 2 collection system pipes on a rotating basis as part of regular jetting and televising. The entire system is inspected approximately every 8 – 10 years.

Manholes are critical elements of the collection system. Cost effective I/I removal is often from manhole repairs rather than pipes. Manhole condition can change abruptly due to snowplow or large vehicle damage, erosion, and street repair projects. Therefore having updated manhole information is a key element of the collection system inspection portfolio.

Trunk manholes were last systematically inspected citywide during the Tier 1 program in 2005-2011. City crews update manhole inspection data and compile defect reports during daily work on the Tier 2 and Tier 1 systems. We recommend reviewing inspection data citywide and re-inspecting any manholes that have not been inspected within the past 10 years, particularly any that are in flood-prone areas and those in ‘leaky’(high I/I) basins.

IX.B.2 Estimated Inspection Costs

Typical costs for outsourced inspection of pipe and manholes are $1/LF-$2/LF for sanitary sewer televising and heavy cleaning, and $50-$100/structure for manhole inspections. We recommend the City continue to budget for inspections to keep collection system inventory data current and reliable.

IX.C Rehabilitation

IX.C.1 Rehabilitation

Identification of rehabilitation needs is based on collection system inspections. The City currently budgets and contracts out pipe and manhole rehabilitation projects each year based on defects identified by sewer crews. We recommend the City continue to budget and

complete sanitary sewer repairs to keep the system in good condition. An alternate approach to repair projects may be to focus on specific flood-prone areas and those in 'leaky'(high I/I) basins to gain maximum I/I reduction benefit from the work.

Rehabilitation of sanitary sewer generally includes cured-in-place lining, chemical pressure grouting, manhole repair, and occasionally full reconstruction when conditions do not allow trenchless techniques. Oftentimes a combination of these approaches is needed to restore the condition of a collection system. Projects may be grouped by geographic area or rehabilitation technique for best cost effectiveness.

IX.C.2 Estimated Rehabilitation Costs

Rehabilitation and I/I Reduction repairs in the collection system are completed under the City's O&M and I/I Reduction programs and funded out of general sewer funds. Therefore this report does not address rehabilitation costs unless that rehabilitation is specifically part of a Capital Improvement Project. Specific Tier 1 condition-related improvement projects are called out in the specific project descriptions.

IX.D Relief Sewers and Future Extensions

Relief sewers and future extensions are included in section IX.E.5 Future Needs.

IX.E Capital Improvement Plan

IX.E.1 CIP Alternatives

This Master Plan presents a plan for improvements to gravity flow sanitary sewer trunk lines. For sizing pipes the ultimate gravity service area is used as the design service area. Gravity sewer is preferred over siphons and lift stations. New siphon locations are minimized, and new lift stations are excluded from consideration per City direction. All CIP projects are given as upsize projects. Evaluation of parallel versus upsize and other constructability constraints should be part of preliminary design of each project.

IX.E.1 CIP Cost per Acre

IX.E.1.a Definition

CIP cost per acre (Trunk Sewer Rate) in this Master Plan is intended to be a recovery rate for upsizing the trunk sewer system within each super district.

Generally speaking the proposed Trunk Sewer Rates in this Master Plan are given as one rate per sewer super district, which is intended to simplify the process of establishing developer fees citywide. The except to this is in East Zumbro, where the area was subdivided into smaller districts.

The Trunk Sewer Rate is the total cost for all Priority 1 and Priority 2 capital improvement projects plus future trunk line extensions, divided by total developable acres ($/Dev.Ac), in each super sewer district. An alternate recovery rate is also provided that includes outstanding balances from previous capital projects. Trunk Sewer Rates do not include costs for; general system I/I reduction, maintenance/rehabilitation, or small-diameter (Tier 2) future extensions.

Calculations of all rates and previous balances are provided in the Appendix.

IX.E.1.b ***Table of Citywide Trunk Sewer Rates***

CIP Cost Per Acre: Trunk Sewer Rates				
Super Sewer District	**CIP + Extensions+ Shared District* Project Costs ($)**	**Dev. Acres (DA)**	**Trunk Sewer Rate* ($/DA)**	**Trunk Sewer Rate* w/ Previous Balance Fwd ($/DA)**
East Zumbro:				
Phase 1:				
Silver Creek	$10,003,455	1,127	$ 8,878	$9,752
Bear Creek	$16,008,496	1,904	$ 8,407	$8,725
Willow Creek	$63,586,634	3,680	$17,279	$17,301
Phase 2:				
Silver Creek	$11,915,794	2,129	$ 5,596	$ 5,596
Bear Creek	$19,129,860	1,218	$15,700	$15,700
Willow Creek	$10,034,882	3,502	$ 2,865	$ 2,865
Hadley Valley	$9,587,000	2,579	$ 3,717	$ 7,029
Kings Run	$28,855,087	2,987	$ 9,660	$11,559
West Zumbro	$88,728,270	5,862	$15,136	$15,330
Northwest Territory	$65,056,913	2,730	$23,830	$24,669
South Zumbro	$40,110,126	1,071	$37,438	$38,130

*Costs and sewer rates shown for South, West, and East Zumbro include prorated costs for Downtown and Unmetered Trunklines.
*Costs and sewer rates shown for Kings Run and Northwest Territory include prorated shared costs for projects that benefit both districts.

IX.E.1.c ***East Zumbro Phasing***

East Zumbro is an exception to the single-rate rule due to its exceptionally large area. The East Zumbro Sewer Super District was split into two phases to better reflect cost recovery timelines: East Zumbro Phase 1 is within the ROCOG 2045 urban service boundary and Phase 2 is outside of the ROCOG 2045 boundary. East Zumbro was further subdivided into Silver Creek, Bear Creek, and Willow Creek areas. Projects that serve multiple areas were prorated by developable acres in each area. Outstanding

project balances from previous projects are only applied to Phase 1 trunk sewer rates.

IX.E.1.d ***<u>Shared District Costs: Downtown and Unmetered Trunklines</u>***

Projects in the Downtown and Unmetered Trunkline super districts serve development in the South, West, and East Zumbro areas as well as the Downtown and Unmetered Trunkline districts themselves. Furthermore, Downtown development is generally vertical redevelopment rather than greenfield, which complicates any $/acre recovery calculation. Therefore, project costs in Downtown and Unmetered Trunkline districts were allocated to South, West, and East Zumbro super districts and prorated by developable acres in each sewer super district. The costs and sewer rates shown for South, West, and East Zumbro include Downtown and Unmetered Trunkline prorated costs.

IX.E.1.e ***<u>Shared District Costs: Kings Run and Northwest Territory</u>***

Some improvements in Kings Run serve both Kings Run and Northwest Territory so those costs are prorated by developable acres in each of those super districts. The costs and sewer rates shown for Kings Run and Northwest Territory include prorated shared costs.

IX.E.2 Marginal Cost Analysis

Marginal cost analysis is condensed into the Trunk Sewer Rate (typically one Trunk Sewer Rate per Super District that includes all cumulative projects and acres) expressed as $/Dev. Acres gained, and Capacity Recovery Rate (unique for each project) expressed as $/ MGD gained. Projects with better marginal cost:benfit ratios scored higher in the ranking system. These two factors are included in the scoring matrix for each project provided in the appendix.

IX.E.3 CIP Prioritization

Recommended projects for each of the Sewer Super Districts are presented in this section.

Priority 1 projects passed screening criteria developed by the City to prioritize service to existing residents, which means each of these projects addresses existing backups, sanitary sewer overflows, and/or deteriorated condition of an existing sewer trunkline.

Priority 2 projects did not pass screening criteria. These can be thought of as potentially longer-term projects to serve future development.

Both Priority 1 and Priority 2 projects are included in the Trunk Sewer Rates to reflect the cost of serving the ultimate sewer service boundary in each Sewer Super District.

Please refer to section VII.C.2 for scoring and prioritization process description, and refer to the appendix for detailed scoring information on each project.

A general note on the order of projects shown below: elevations of trunk projects are laid out to provide 8-ft minimum cover to extensions out to ultimate service boundaries. Users should review this assumption is appropriate for future extension areas prior to upsizing existing trunks and adjust elevations --- and order of projects --- as needed.

IX.E.4 Scheduled Projects

Generally speaking, all of the Priority 1 projects are within the ROCOG 2045 urban service area but no 5-, 20- or 50-year timeframes are attached to any of these tables. Users should prioritize projects and timeframes in context of development priorities, utility upgrades (streets, water, storm, etc), opportunity projects (streetscaping, transit, dredging, etc), and available sanitary sewer funds.

IX.E.5 Future Needs

The following pages summarize projects for each sewer super district.

IX.E.5.a East Zumbro

East Zumbro Priority 1 Projects

East Zumbro sewer capital improvement projects that passed screening are presented in the table below in order of scored highest priority. Priority 1 projects benefit existing customers or address a severe condition issue in an existing pipe. Each Priority 1 project includes a CIP writeup and detailed analysis data provided in the Appendix.

East Zumbro Priority 1 Projects					
Rank	**Project Name**	**Project ID#**	**Cost**	**Dev. Acres***	**Rate****
1	Silver Lake Siphon	EZ-01-1009	$ 3,400,000	13,323	$ 8,725
2	Silver Lake Trunk Line C1	EZ-02-1095	$ 1,189,000	12,993	$ 8,725
3	Silver Lake Trunk Line C2	EZ-03-1096	$ 4,876,000	13,323	$ 8,725
4	Bear Creek Trunk Line F	EZ-04-1073	$ 5,683,000	10,145	$ 8,725
5	Bear Creek Trunk Line G	EZ-05-1015	$ 7,512,000	9,928	$ 8,725
6	Willow Creek Trunk Line J	EZ-06-1074	$ 3,948,000	6,940	$17,301
7	Willow Creek Trunk Line P	EZ-07-1093	$ 438,000	2,149	$17,301
8	Silver Creek Trunk Line D	EZ-08-1025	$ 2,734,000	1,675	$ 9,752
9	Willow Creek Trunk Line L	EZ-09-1024	$ 8,339,000	5,434	$17,301
10	Willow Creek Trunk Line O	EZ-10-1092	$ 2,729,000	3,238	$17,301

*Developable acres to be gained by string of connected projects **Trunk Sewer Rate, $/Developable acre

East Zumbro Priority 2 Projects

East Zumbro sewer capital improvement projects that did not pass screening are presented in the table below. Priority 2 projects may be considered as longer-term projects to provide for future development. Project #18 was previously identified as a project but model refinements have since deleted the need for it. Its inclusion on the list is for reference purposes.

East Zumbro Priority 2 Projects					
Rank	**Project Name**	**Project ID#**	**Cost**	**Dev. Acres***	**Rate****
11	Willow Creek Trunk Line M	EZ-11-1090	$4,182,000	2,904	$17,301
12	Bear Creek Trunk Line H	EZ-12-1087	$3,462,000	999	$15,700
13	Silver Lake Trunk Line E	EZ-13-1026	$1,113,000	608	$ 5,596
14	Willow Creek Trunk Line N	EZ-14-1091	$1,144,000	1,742	$ 2,865
15	Bear Creek Trunk Line K	EZ-15-1089	$2,598,000	601	$ 2,865
16	Bear Creek Trunk Line I	EZ-16-1088	$4,503,000	881	$15,700
17	Scenic Oaks	EZ-17-1010	combination of EZ 10-1092 and EZ 07-1093		
18	Oakwood Cemetery	EZ-18-1050	No project		
19	Willow Creek Trunk Line Q	EZ-19-1094	$2,670,000	278	$17,301
20	Silver Creek Extension North	EZ-20-1071	$9,624,000	3,703	$ 5,596
21	North West Trunk Highway 63	EZ-21-1063	$1,199,000	40	$17,301
22	Willow Commons	EZ-22-1054	$1,649,000	245	$17,301
23	Bear Creek Extension West	EZ-23-1068	$2,357,000	374	$ 8,725
24	Silver Creek Extension South	EZ-24-1070	$4,927,000	1,144	$ 5,596
25	East Trunk Highway 63 Airport Extension	EZ-25-1053	$7,809,000	1,742	$17,301
26	Willow Creek Sewer Extension to Serve SSA 15E, 15-11 and 15-12	EZ-26-1038	$4,183,000	148	$17,301
27	Bear Creek Extension North	EZ-27-1065	$3,586,000	183	$17,301
28	West Trunk Highway 63 Airport Extension	EZ-28-1064	$7,524,000	1,766	$17,301
29	Willow Creek Extension East	EZ-29-1067	$5,014,000	1,328	$17,301
30	Bear Creek Extension East	EZ-30-1069	$10,781,000	1,523	$ 15,700

*Developable acres to be gained by string of connected projects

**Trunk Sewer Rate, $/Developable acre

IX.E.5.b ***South Zumbro***

South Zumbro Priority 1 Projects

South Zumbro sewer capital improvement projects that passed screening are presented in the table below in order of scored highest priority. Priority 1 projects benefit existing customers or address a severe condition issue in an existing pipe. In South Zumbro there are several projects (#1, #6, #7, #8) that are rehabilitation or upsizing to relieve existing capacity restrictions for existing developed areas. Each Priority 1 project includes a CIP writeup and detailed analysis data provided in the Appendix.

South Zumbro Priority 1 Projects					
Rank	**Project Name**	**Project ID#**	**Cost**	**Dev. Acres***	**Rate****
1	Apache Mall	SZ-01-1102	$4,000,000	0	$38,130
2	West Golf Course	SZ-02-1101	$1,730,000	183	$38,130
3	SW Hy-Vee	SZ-03-1104	$1,170,000	823	$38,130
4	Bible College	SZ-04-1105	$1,368,000	790	$38,130
5	South Golf Course	SZ-05-1103	$1,214,000	671	$38,130
6	10th St SE	SZ-06-1099	$ 788,400	0	$38,130
7	3rd Ave	SZ-07-1041	$ 722,400	0	$38,130
8	11th Ave	SZ-08-1098	$ 211,400	0	$38,130

*Developable acres to be gained by string of connected projects
**Trunk Sewer Rate, $/Developable acre

South Zumbro Priority 2 Projects

South Zumbro sewer capital improvement projects that did not pass screening are presented in the table below. Priority 2 projects may be considered as longer-term projects to provide for future development. Project #9 was previously identified as a project but model refinements have since deleted the need for it. Its inclusion on the list is for reference purposes.
writeup and detailed analysis data provided in the Appendix.

South Zumbro Priority 2 Projects					
Rank	**Project Name**	**Project ID#**	**Cost**	**Dev. Acres***	**Rate****
9	Salem Rd	SZ-09-1100	No project		
10	Bamber Valley	SZ-10-1106	$2,640,000	557	$38,130
11	County Road 8	SZ-11-1107	$ 834,000	86	$38,130
12	Mayowood Realignment	SZ-12-1108	$ 197,000	0	$38,130
13	10th St SW Realignment	SZ-13-1003	$1,699,000	0	$38,130
14	South Zumbro Extension South	SZ-14-1066	$3,086,000	305	$38,130
15	Mayowood Road Extension	SZ-15-1057	$ 591,000	108	$38,130

*Developable acres to be gained by string of connected projects
**Trunk Sewer Rate, $/Developable acre

IX.E.5.c ***West Zumbro***

West Zumbro Priority 1 Projects

West Zumbro sewer capital improvement projects that passed screening are presented in the table below in order of scored highest priority. Priority 1 projects benefit existing customers or address a severe condition issue in an existing pipe. Each Priority 1 project includes a CIP writeup and detailed analysis data provided in the Appendix.

West Zumbro Priority 1 Projects					
Rank	**Project Name**	**Project ID#**	**Cost**	**Dev. Acres***	**Rate****
1	Valleyhigh Drive	WZ-01-1018	$5,983,000	26	$15,330
2	Cascade Meadows	WZ-02-1021	$1,799,000	2,433	$15,330
3	Kadlec/Whiting	WZ-03-1020	$2,889,000	2,523	$15,330
4	Redi-Mix	WZ-04-1019	$2,506,000	2,343	$15,330
5	Quarry Ridge	WZ-05-1046	$ 711,000	34	$15,330
6	Cascade Lake	WZ-06-1044	$3,912,000	1,847	$15,330
7	W Frontage Road	WZ-07-1047	$ 729,000	8	$15,330
8	Country Club Manor	WZ-08-1051	$2,534,000	1,340	$15,330

*Developable acres to be gained by string of connected projects
**Trunk Sewer Rate, $/Developable acre

West Zumbro Priority 2 Projects

West Zumbro sewer capital improvement projects that did not pass screening are presented in the table on the next page. Priority 2 projects may be considered as longer-term projects to provide for future development. Projects #9, #13, #15 and #16 were previously identified as projects but other improvements, reroutes and/or model refinements have since deleted the need for them. Their inclusion on the list is for reference purposes.

West Zumbro Priority 2 Projects					
Rank	**Project Name**	**Project ID#**	**Cost**	**Dev. Acres***	**Rate****
9	KR6	WZ-09-1037	No project		
10	Cooke Park East	WZ-10-1062	$1,229,000	1,535	$15,330
11	NW Hy-Vee	WZ-11-1022	$6,330,000	2,232	$15,330
12	13th Ave Extension (Reroute of 12th Ave Sewer from SMH)	WZ-12-1006	$2,291,000	0	$15,330
13	R.A.C.	WZ-13-1043	No project		
14	Cascade Creek	WZ-14-1045	$6,389,000	5,156	$15,330
15	West Circle Drive	WZ-15-1023	No project		
16	Cooke Park	WZ-16-1002	No project		
17	West Zumbro Crossover	WZ-17-1004	$ 462,000	26	$15,330
18	J7793 Extension	WZ-18-1060	$18,582,000	2,875	$15,330
19	Kutzky Park	WZ-19-1097	$4,848,000	1,415	$15,330
20	Interlachen	WZ-20-1011	$2,454,000	1,514	$15,330
21	J7773 Extension	WZ-21-1059	$3,528,000	521	$15,330
22	Meadow Lakes Extension	WZ-22-1058	$6,827,000	1693	$15,330

*Developable acres to be gained by string of connected projects
**Trunk Sewer Rate, $/Developable acre

IX.E.5.d ***Hadley Valley***

Hadley Valley Priority 1 Projects
There are no projects that passed screening in Hadley Valley. Ultimate-sized trunk sewer projects "Phase 1" and "Phase 2" (J7712) were constructed in 2005-2006. Only future extensions are needed in Hadley Valley, presented here as 'Priority 2' projects.

Hadley Valley Priority 2 Projects
Hadley Valley sewer capital improvement projects that did not pass screening are presented in the table below. Priority 2 projects may be considered as longer-term projects to provide for future development.

Hadley Valley Priority 2 Projects					
Rank	**Project Name**	**Project ID#**	**Cost**	**Dev. Acres***	**Rate****
1	Emerald Hills J7816 Gravity Sewer Replacement of Existing Lift Station (under construction as of July 2019)	HV-01-1048	$711,000	307	$7,029
2	Hadley Valley Extensions J7712 (east half of Phase 3, Phase 4, Phase 5)	HV-02-1055	$7,577,000	2,579	$7,029
3	Hadley Valley Extension South	HV-03-1072	$1,299,000	307	$7,029

*Developable acres to be gained by string of connected projects
**Trunk Sewer Rate, $/Developable acre

IX.E.5.e ***Kings Run***

Kings Run Priority 1 Projects
There are no projects that passed screening in Kings Run. Ultimate-sized trunk sewer projects out to 60th Ave were constructed in 2005-2006. Essex Park Lift Station 'LS4' was built in 2005-06. Crimson/Overland Drive sewers have existing capacity.

Kings Run Priority 2 Projects
Kings Run sewer capital improvement projects that did not pass screening are presented in the table below. Priority 2 projects may be considered as longer-term projects to provide for future development.

Kings Run Priority 2 Projects					
Rank	**Project Name**	**Project ID#**	**Cost**	**Dev. Acres***	**Rate****
1	Crimson Ridge / Overland Drive***	KR-01-1014	$2,672,000	480	$11,559
2	Extensions to Serve SSA "28F- Mod"	KR-02-1117	$2,916,000	1008	$11,559
3	Extensions to serve SSA "UNNAMED 28-1" west of 60th Ave	KR-03-1061	$6,987,000	1008	$11,559
4	60" Tunnel option from Essex Park Lift Station 'LS4' to WRP***,****	KR-04-1056	$36,000,000	5,717	$11,559

*Developable acres to be gained by string of connected projects
**Trunk Sewer Rate, $/Developable acre
***Projects benefit Kings Run and Northwest Territory. The total project costs and acreages gained are shown here. Trunk Sewer Rates are based on prorated costs per developable acreage gained in each super district.
****Alternative: add twin 24" forcemain and upsize Essex Park LS4

IX.E.5.f ***Northwest Territory***

Northwest Territory Priority 1 Projects
There are no projects that passed screening in Northwest Territory. Aside from Prairie Crossing and Menards this super district is generally undeveloped.

Northwest Territory Priority 2 Projects
Northwest Territory sewer capital improvement projects that did not pass screening are presented in the table below. Priority 2 projects may be considered as longer-term projects to provide for future development.

Northwest Territory Priority 2 Projects					
Rank	**Project Name**	**Project ID#**	**Cost**	**Dev. Acres***	**Rate****
1	Prairie Crossing Improvements	NWT-01-1013	$1,499,000	480	$24,669
2	Phase I – 5A4 Lift Station @ NW of Prairie Crossing, permanent LS 10.7 MGD, 58' deep, 24" FM to south of 55th St. Also gravity sewers 5A1, 5A2, and 5A5. "Option 1B" to serve service area 30A, year 0.	NWT-02-1114	$18,199,000	796 Phase I 2,653 Ph I-II-III	$24,669
3	Phase II – 5B3 Lift Station @ 2,700' north of 75th St NW. 3 MGD (9 MGD in Phase III) LS 49' deep, 18" FM, and gravity sewers 5B1, 5B2, and 5B4. "Option 2C2" to serve part of service area 30B, year 5.	NWT-03-1115	$12,764,000	1,565 Ph I-II 2,653 Ph I-II-III	$24,669
4	Phase III – Upgrade Lift Station at 2,700' north of 75th St to 9 MGD. Gravity sewers 5C1, 5B4, 5B6, and 5B7. "Option 3C" to service area 30C and part of 30B, year 30.	NWT-04-1121	$12,875,000	2,653 Ph I-II-III	$24,669

*Developable acres to be gained by string of connected projects
**Trunk Sewer Rate, $/Developable acre

IX.E.5.g ***Downtown***

Downtown Priority 1 Projects
Downtown sewer capital improvement projects that passed screening are presented in the table below in order of scored highest priority. DMC Phasing is also included in the Project Name as those opportunity projects may drive implementation schedule. Priority 1 projects benefit existing customers or address a severe condition issue in an existing pipe. Each Priority 1 project includes a CIP writeup and detailed analysis data provided in the Appendix.

Downtown Priority 1 Projects					
Rank	**Project Name**	**Project ID#**	**Cost**	**Dev. Acres***	**Rate****
1	Slatterly Park DMC Phase 2	DT-01-1110	$2,937,400	Downtown + 1,071 DA in S. Zumbro	n/a
2	1st Ave Relief Line J78251 A, J75252 B-C, J78253 D (A complete, B-C-D under construction as of July 2019) DMC Phase 2	DT-01-1116	$8,189,000	Downtown + 1,071 DA in S. Zumbro	n/a
3	7th Ave Relief Line DMC Phase 2	DT-01-1029	$5,659,870	Downtown + 5,583 DA in W. Zumbro	n/a
4	N Broadway Reroute DMC Phases 1 & 3	DT-01-1111	$2,463,900	Downtown + 5,583 DA in W. Zumbro	n/a
5	N Broadway Reconstruction	DT-01-1112	$ 416,400	Downtown + 5,583 DA in W. Zumbro	n/a
6	2nd Ave Relief Line DMC Phase 1	DT-01-1016	$ 341,000	Downtown + 5,583 DA in W. Zumbro	n/a
7	Goose Egg Park Relief Line DMC Phase 1	DT-01-1028	$ 529,000	Downtown + 5,583 DA in W. Zumbro	n/a

*Developable acres to be gained by string of connected projects.
**Trunk Sewer Rate, $/Developable acre. Please see section IX.E.1.d Shared District Costs: Downtown and Unmetered Trunklines.

Downtown Priority 2 Projects
Downtown sewer capital improvement projects that did not pass screening are presented in the table on the next page. Priority 2 projects may be considered as longer-term projects to provide for future development. DMC and other opportunity projects may drive implementation schedule. Projects #10, #11, and #13 were previously identified as projects but other improvements or reroutes have since deleted the need for them. Their inclusion on the list is for reference purposes.

Downtown Priority 2 Projects					
Rank	**Project Name**	**Project ID#**	**Cost**	**Dev. Acres***	**Rate****
8	Discovery Square DMC Phase 2	DT-08-1109	$ 692,600	Downtown + 1,071 DA in S. Zumbro	n/a
9	S Broadway Relief Line DMC Phase 1	DT-09-1031	$2,422,500	Downtown + 1,071 DA in S. Zumbro	n/a
10	2nd St Relief Line (replaced by Discovery Square)	DT-10-1032	No project		
11	Civic Center Drive Relief Line (replaced by 1st Ave)	DT-11-1027	No project		
12	4th St SW Relief Line DMC Phase 2	DT-12-1030	$4,646,346	Downtown + 1,071 DA in S. Zumbro	n/a
13	University Center Reroute (replaced by Discovery Square and N Broadway Reroute)	DT-13-1113	No Project		

*Developable acres to be gained by string of connected projects.

**Trunk Sewer Rate, $/Developable acre. Please see section IX.E.1.d Shared District Costs: Downtown and Unmetered Trunklines.

IX.E.5.h Unmetered Trunkline

Unmetered Trunkline Priority 1 Projects
Unmetered Trunkline sewer capital improvement projects that passed screening are presented in the table below in order of scored highest priority. Priority 1 projects benefit existing customers or address a severe condition issue in an existing pipe. Each Priority 1 project includes a CIP writeup and detailed analysis data provided in the Appendix.

Unmetered Trunkline Priority 1 Projects					
Rank	**Project Name**	**Project ID#**	**Cost**	**Dev. Acres***	**Rate****
1	Zumbro River West Trunk	UMT-01-1042	$10,232,000	13,560 in E. Zumbro + 5,583 in W. Zumbro + 1,071 in S. Zumbro 20,214 total	n/a
2	East Zumbro Crossover	UMT-02-1118	$2,139,000	13,560 in E. Zumbro + 5,583 in W. Zumbro + 1,071 in S. Zumbro 20,214 total	n/a
3	Rocky Creek Pipe Rehabilitation	UMT-03-1040	$177,900	0	n/a
4	14th St NE Pipe Rehabilitation	UMT-04-1039	$332,400	0	n/a

*Developable acres to be gained by string of connected projects.
**Trunk Sewer Rate, $/Developable acre. Please see section IX.E.1.d Shared District Costs: Downtown and Unmetered Trunklines.

Unmetered Trunkline Priority 2 Projects

Unmetered Trunkline sewer capital improvement projects that did not pass screening are presented in the table on the next page. Priority 2 projects may be considered as longer-term projects to provide for future development. Projects #5, #8, and #9 were previously identified as projects but other improvements and/or model refinements have since deleted the need for them. The most significant of these is the 66" East Zumbro Trunkline (#5). By upsizing the West Zumbro Trunkline and the East Zumbro Crossover, the existing 66" East Zumbro should have adequate capacity to remain in service for its design life. The inclusion of deleted projects on this list is for reference purposes.

Unmetered Trunkline Priority 2 Projects					
Rank	**Project Name**	**Project ID#**	**Cost**	**Dev. Acres***	**Rate****
5	East Zumbro Trunk Section B	UMT-05-1086	$4,911,000	13,560 in E. Zumbro + 1,071 UMT 14,631 total	n/a
6	East Zumbro Trunk Section A (replaced by Crossover modification)	UMT-06-1085	No project		
7	Silver Lake Siphon 36" Option Line Rehabilitation (secondary option for siphon flow)	UMT-07-1119	$335,400	14,631 total	
8	West Zumbro – IBM Trunkline	UMT-08-1034	No project		
9	West Zumbro - 41st St NW	UMT-09-1120	No Project		

*Developable acres to be gained by string of connected projects.

**Trunk Sewer Rate, $/Developable acre. Please see section IX.E.1.d Shared District Costs: Downtown and Unmetered Trunklines.

IX.F Implementation Summary

IX.F.1.a ***Sewer Restricted Areas and Available Areas***

Generally speaking, Hadley Valley and Kings Run super districts have the most existing sewer capacity to support development. Large capital improvements were constructed in 2005-06 which were sized for ultimate development. These areas generally carry the lowest Trunk Sewer Rate ($/DA).

Other areas require investment to support development. Sewer restricted areas and available areas are shown in Section XI Maps and Figures, “Figure XI.C Sewer Restricted Areas from ROCOG Comp Plan”.

IX.F.1.b ***Citywide Highest Scoring Priority 1 Projects***

The table on the next page presents the citywide pool of projects that passed screening criteria (Priority 1 projects), sorted in descending order by Total Score. This table is not intended to be an implementation schedule as it would not make sense to jump around doing projects in this order. Actual timeframe for constructing improvements should evolve with development pressures as they occur, and context of other non-sanitary projects.

But this ranking may indicate which district(s) provide the most immediate benefits to existing users and marginal benefit for future development.

East Zumbro has the most- and highest-scoring projects that satisfied the most scoring criteria, followed closely by West Zumbro and Downtown. South Zumbro and Unmetered areas score lower. There are approximately six projects that rise to the top based on risk/benefit scores and four out of six are in East Zumbro.

Citywide Priority 1 Projects by Total Score – Not an Implementation Schedule						
Rank	**Super District**	**Project Name**	**Project ID#**	**Risk Score (Max 600)**	**Benefit Score (Max 400)**	**Total Score (Max 1000)**
1	East Zumbro	Silver Lake Siphon	EZ-01-1009	420	286	706
2	East Zumbro	Silver Lake Trunk C Part 1	EZ-02-1095	420	258	678
3	East Zumbro	Silver Lake Trunk C Part 2	EZ-03-1096	440	216	656
4	West Zumbro	Valleyhigh Drive	WZ-01-1018	530	126	656
5	Downtown	Slatterly Park	DT-01-1110	530	94	624
6	East Zumbro	Bear Creek Trunk Section F	EZ-04-1073	265	286	551
7	Downtown	1st Ave Relief Line (A-D)	DT-02-1116	355	126	481
8	West Zumbro	Cascade Meadows	WZ-02-1021	285	176	461
9	Unmetered	Zumbro River West Trunk	UMT-01-1042	285	142	427
10	South Zumbro	Apache Mall	SZ-01-1102	335	106	441
11	West Zumbro	Kadlec/Whiting	WZ03-1020	285	134	419
12	West Zumbro	Redi-Mix	WZ-04-1019	285	122	407
13	South Zumbro	West Golf Course	SZ-02-1101	285	106	391
14	South Zumbro	SW Hy-Vee	SZ-03-1104	265	118	383
15	South Zumbro	Bible College	SZ-04-1105	265	118	383
16	Downtown	7th Ave Relief Line	DT-03-1029	285	94	379
17	Downtown	N Broadway Reroute	DT-04-1111	285	94	379
18	Downtown	N Broadway Reconstruction	DT-05-1112	285	94	379
19	East Zumbro	Bear Creek Section G	EZ-05-1015	230	146	376
20	South Zumbro	South Golf Course	SZ-05-1103	245	118	363
21	West Zumbro	Quarry Ridge	WZ-05-1046	220	142	362
22	Unmetered	Rocky Creek	UMT-02-1040	235	106	341
23	West Zumbro	Cascade Lake	WZ-06-1044	200	134	334
24	West Zumbro	W Frontage Road	WZ-07-1047	220	94	314
25	East Zumbro	Willow Creek Section J	EZ-06-1074	160	134	294
26	East Zumbro	Willow Creek Section P	EZ-07-1093	90	200	290
27	East Zumbro	Silver Lake Section D	EZ-08-1025	110	180	290
28	Downtown	2nd Ave Relief Line	DT-06-1016	180	106	286
29	Downtown	Goose Egg Park Relief Line	DT-07-1028	180	106	286
30	East Zumbro	Willow Creek Section L	EZ-09-1024	140	134	274
31	South Zumbro	10th St SE	SZ-06-1099	150	106	256
32	South Zumbro	3rd Ave	SZ-07-1041	150	106	256
33	South Zumbro	11th Ave	SZ-08-1098	150	106	256
34	Unmetered	14th St NE Pipe Rehab	UMT-03-1039	150	106	256
35	East Zumbro	Willow Creek Section O	EZ-10-1092	110	134	244
36	West Zumbro	Country Club Manor	WZ-08-1051	110	106	216

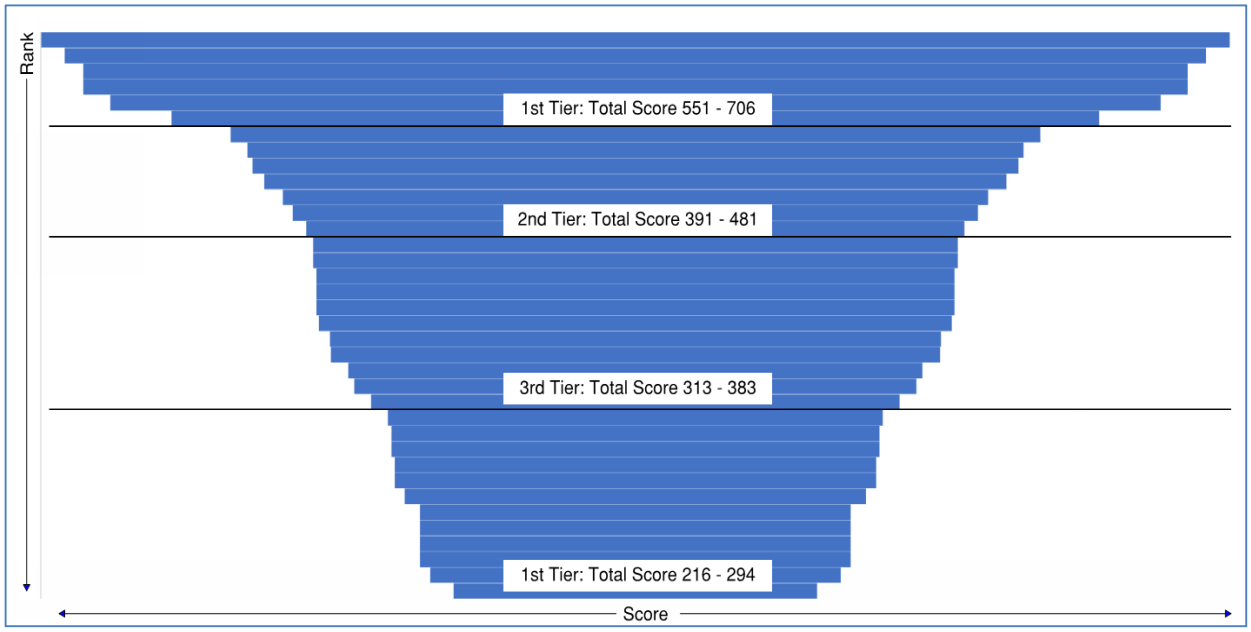

Figure 1 Funnel Chart of Citywide Priority 1 Projects' Total Score. 1st Tier projects with scores between 551-706 are East Zumbro's Silver Lake Siphon and Trunk C Parts 1 and 2, followed by West Zumbro Valleyhigh Drive, Downtown Slatterly Park, and East Zumbro Bear Creek Section F.

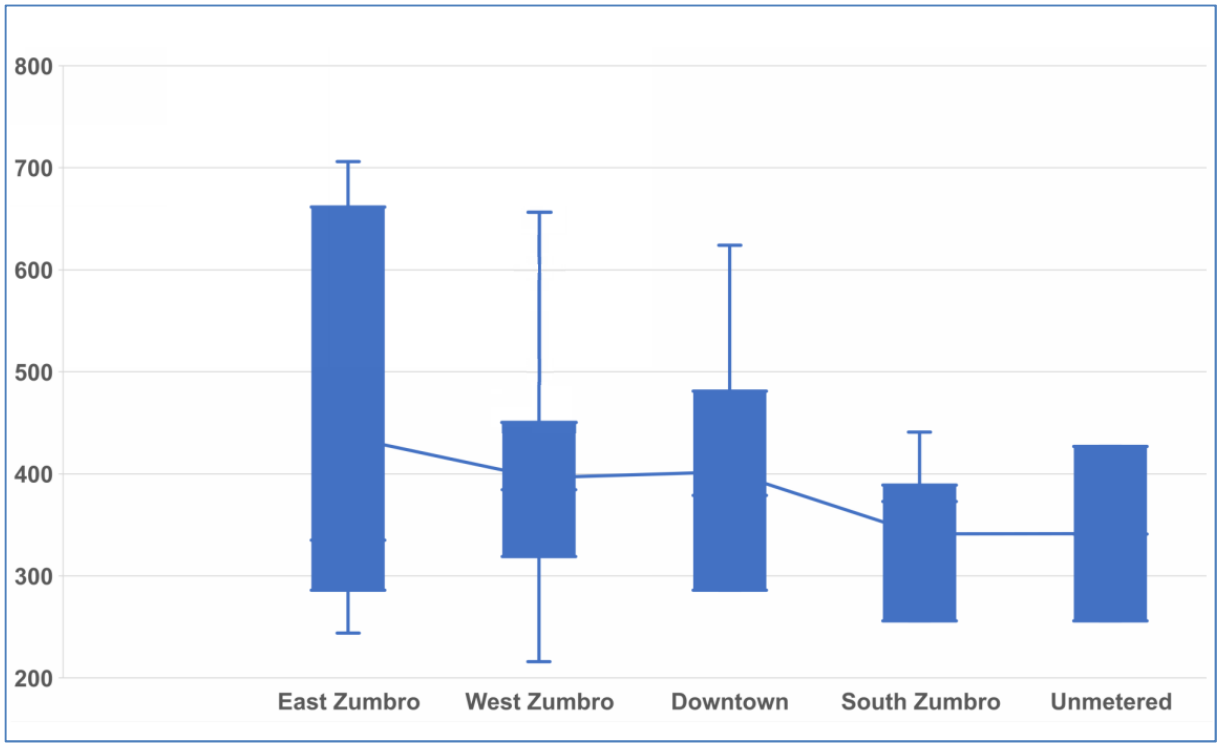

Figure 2 Box & Whisker Plot of Citywide Priority 1 Projects' Total Score. 1st and 3rd Quartile scores form the box, minimum and maximum are whiskers, and median value is the line connecting the data series. East Zumbro has the most- and highest-scoring projects followed closely by West Zumbro and Downtown. South Zumbro and Unmetered areas score lower.

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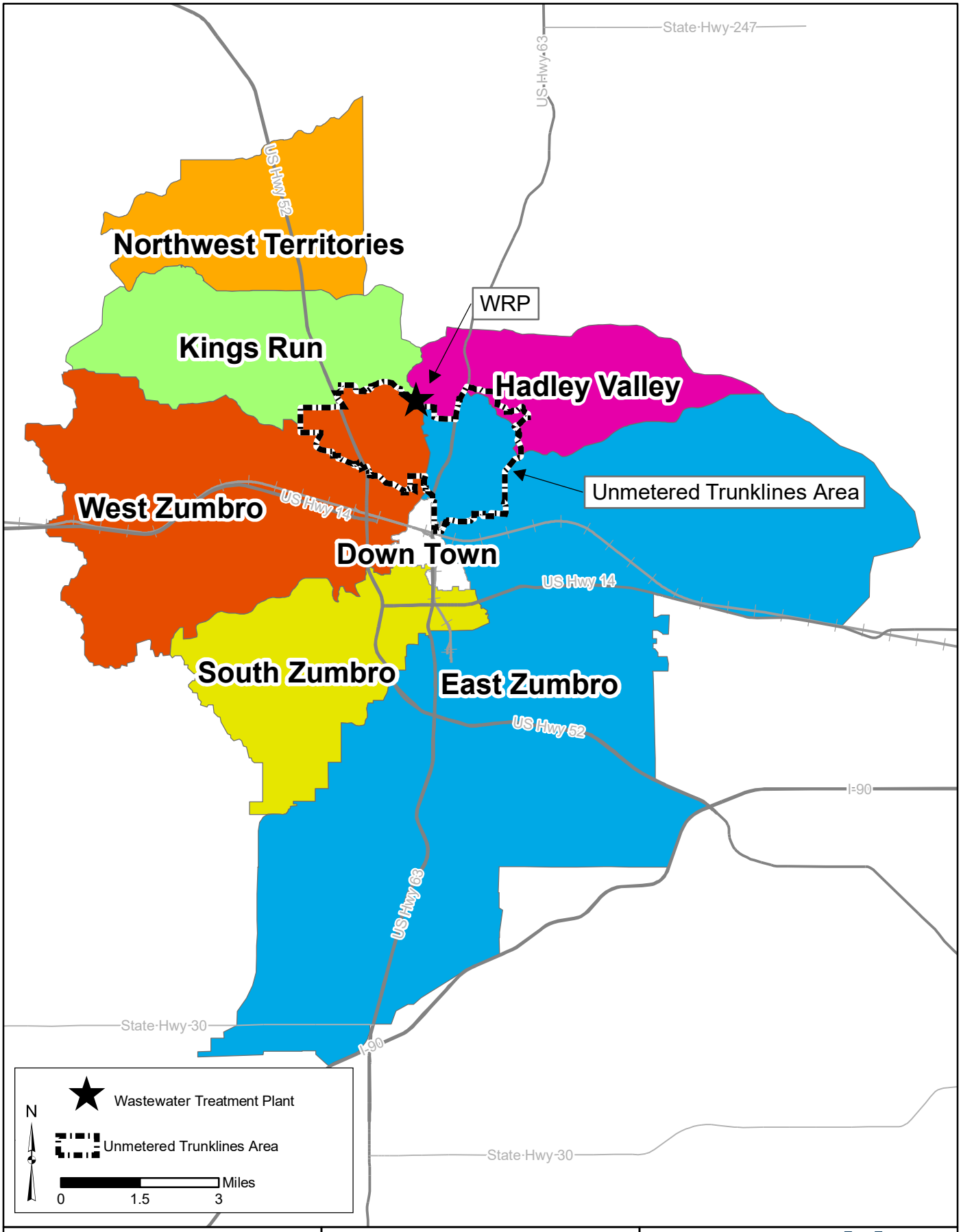
XI Maps and Figures

XI.A Sewer Super Districts

XI.B Existing Peak Hourly Wet Weather (PHWW) Flow Conditions

XI.C Sewer Restricted Areas from ROCOG Comp Plan

XI.D Ultimate Sewer Service Boundary and ROCOG Comp Plan



Sanitary Sewer
Wastewater Master Plan
Rochester, MN

Sewer Super Districts

whks
engineers + planners + land surveyors

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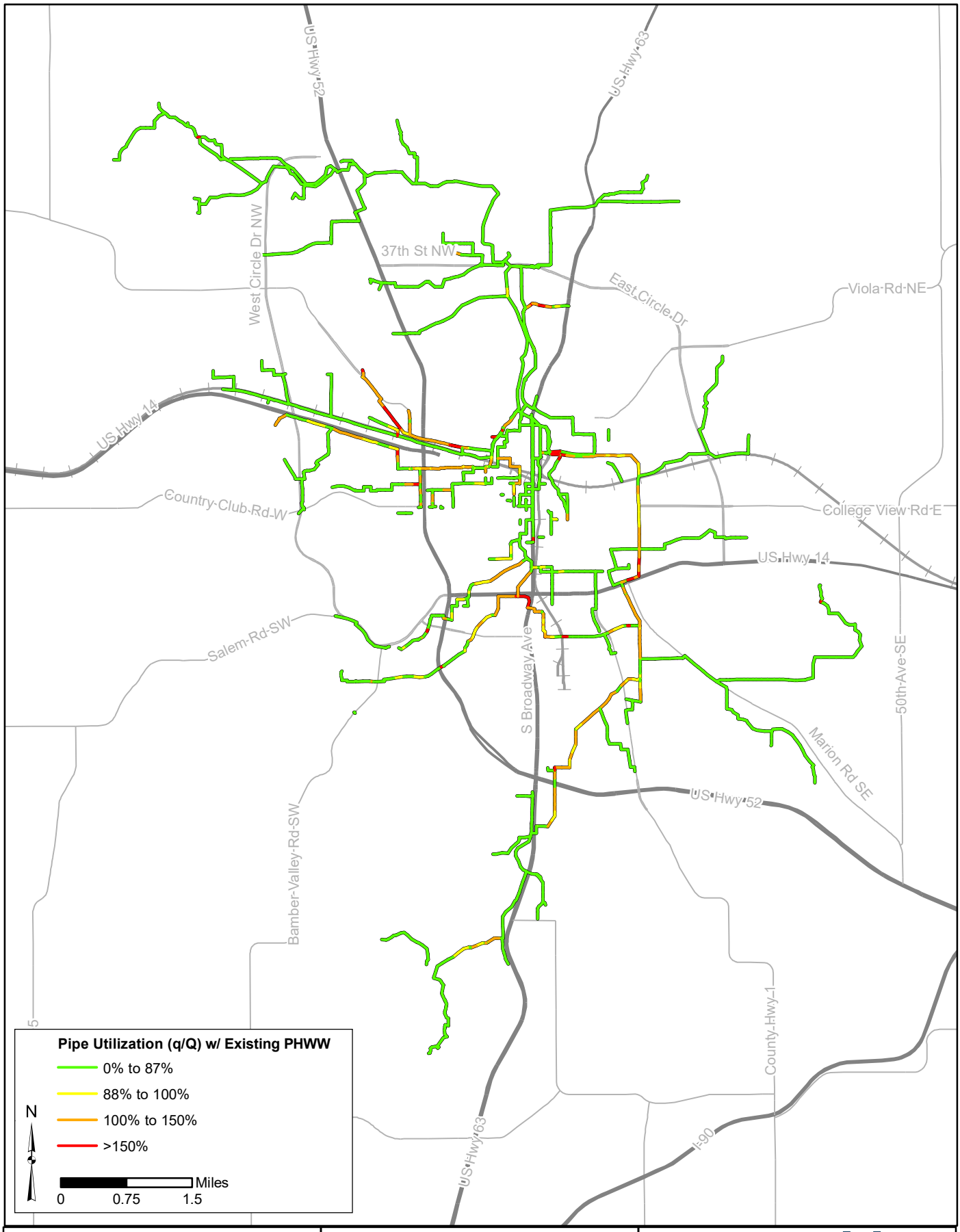

Sanitary Sewer
Wastewater Master Plan
Rochester, MN

Existing
Peak Hourly Wet Weather
(PHWW)
Flow Conditions

whks
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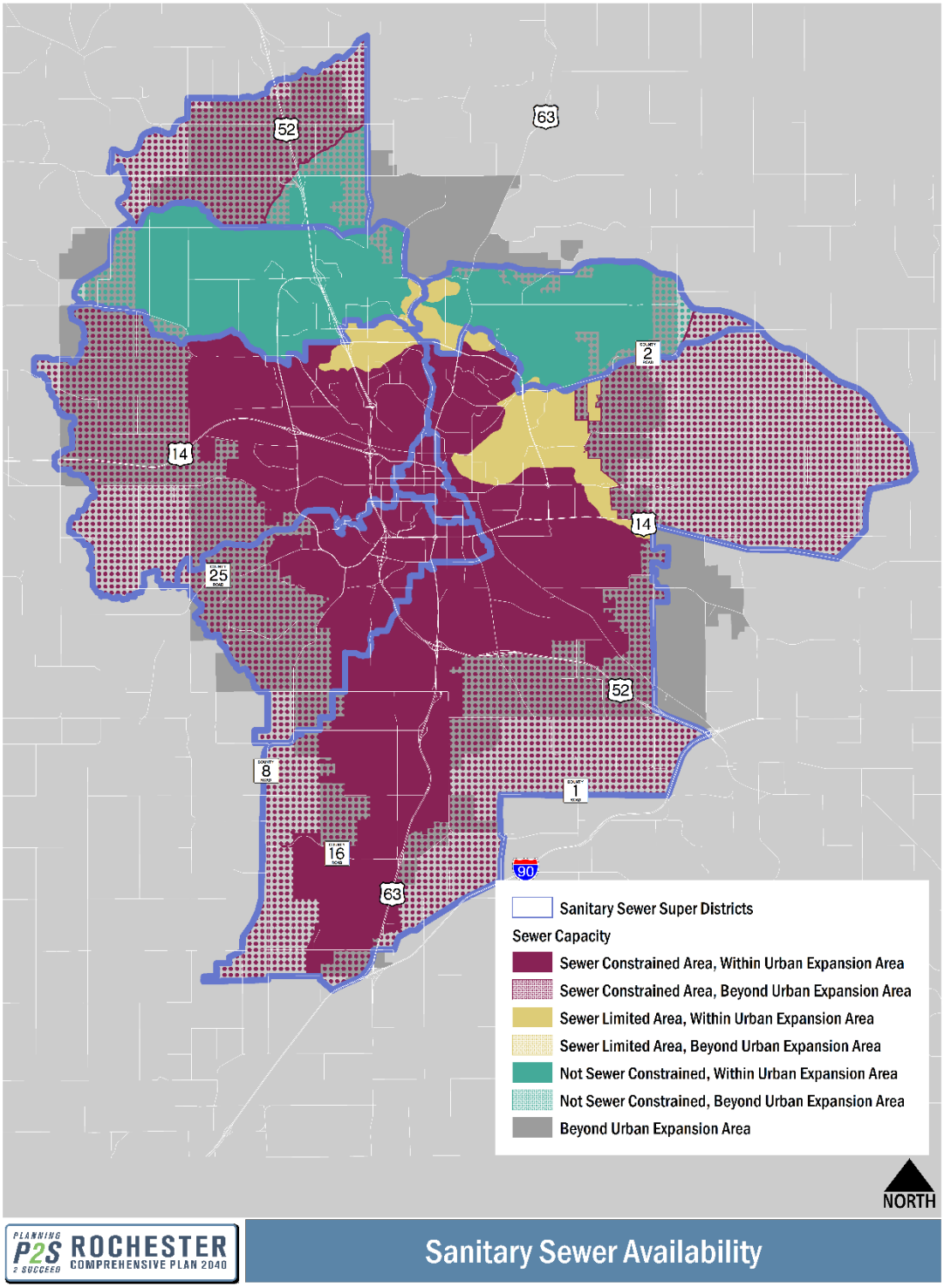
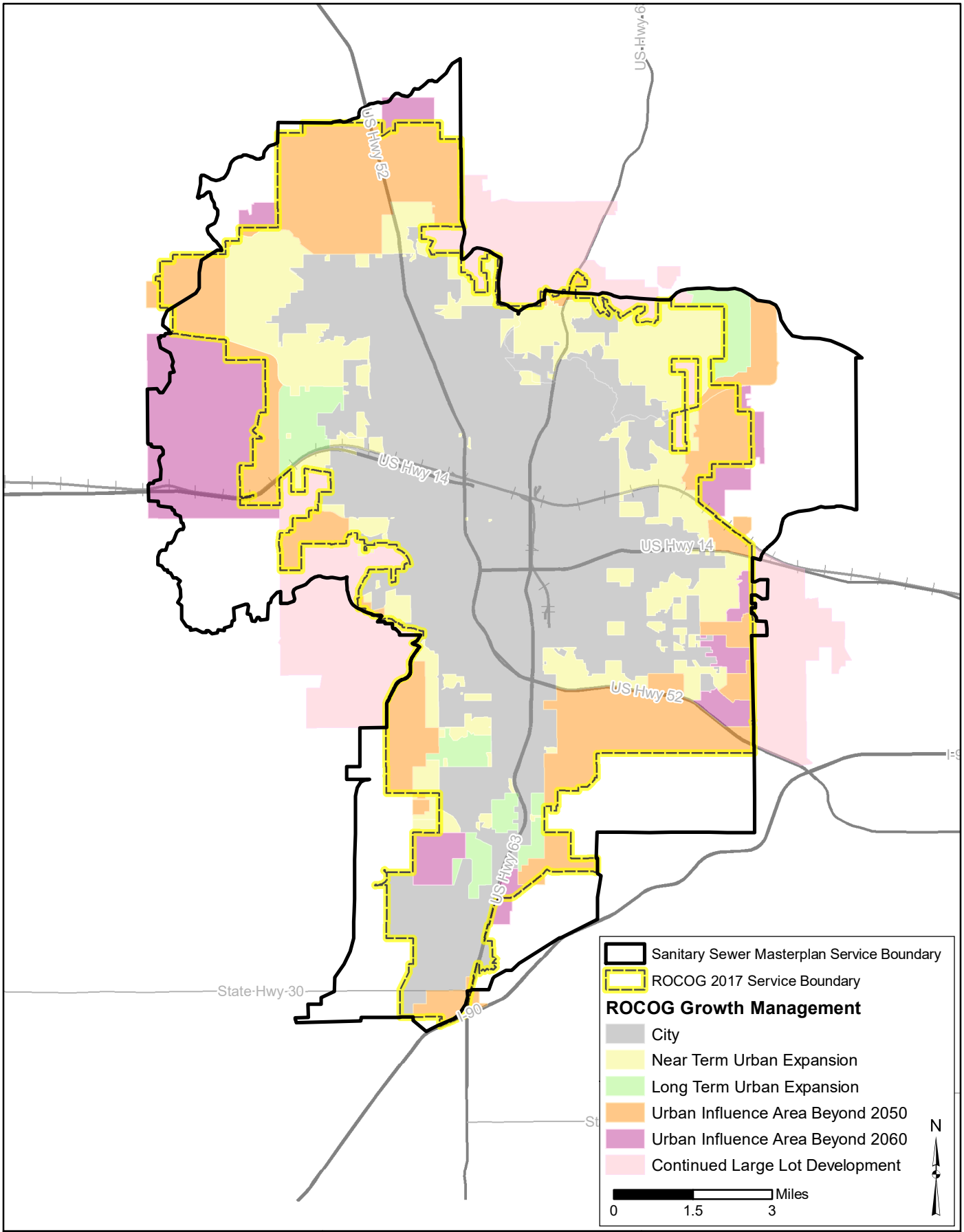
FIGURE 2-9: SANITARY SEWER CAPACITY LEVEL OF CONSTRAINT





Sanitary Sewer
Wastewater Master Plan
Rochester, MN

Ultimate Sewer Service Boundary
ROCOG Comp Plan

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