City of Helena

Helena Wastewater Collection System Master Plan

CHAPTER 1

EXECUTIVE SUMMARY

1.1. INTRODUCTION

In 2006, the City of Helena continued its effort of planning for the future of City infrastructure by initiating a master plan of the sewer collection system. The goal of this planning effort was to define the existing infrastructure, estimate future growth and associated wastewater quantities, determine improvements needed to accommodate that growth and develop a capital improvements plan from the resulting recommendations.

The master planning effort was supported by the development of a hydraulic model of the existing collection system which will continue to serve as a very dynamic and evolving planning tool for the City.

1.2. BASIS OF PLANNING

The basis of planning defines the existing and future conditions within the planning area so that wastewater collection system needs can be identified. The planning period is 20 years with the end of the planning period being 2025. This planning period coincides with the recently completed 2005 Helena Water Facilities Plan.

In order to be consistent with the planning efforts that the City has recently undertaken and completed, including the 2005 Helena Water Facilities Plan and the 2004 Helena Transportation Plan, the planning area as well as population projections and land use patterns from these reports have been adopted for this master plan. They are described in Chapter 3.

Current flows have been derived from historic and recent flow records from the wastewater treatment plant and supplemented with wastewater flow monitoring performed in key locations as part of this study in 2006. From that information, coupled with the population projections, future flows are estimated.

The study area includes approximately 37,400 acres and extends over 7.5 miles north of the existing Helena city limits. The northern boundary of the study area coincides with Prairie Road while the southern boundary extends to the Jefferson County line with the exception of one parcel which is contiguous to property currently being developed in the southeastern portion of the study area and belongs to a single landowner. The east

side of the study area extends to the western edge of East Helena's city limits and extends north and the west side of the study area terminates approximately a one and a half miles west of the existing Helena city limits.

1.2.1. *Existing and Future Population Projections*

Four sources of data were used to develop the population projections for this Master Plan. They include the *2005 Helena Water Master Plan*; the *2004 Helena Transportation Plan*; the 2000 census, updated to 2005 and projected to 2025; and preliminary design information for key subdivisions currently (early 2007) in the planning phase within the study area. Based on the analysis, population projections by service area were developed for use in this Master Plan. They are shown in Table 1-1 below.

Table 1-1
Wastewater Service Area Population Projections[1]

Service Area	2005	2010[2]	2015	2025
City of Helena	27,484	28,495	29,509	32,167
East Side	1,034	2,793	4,702	4,993
Central Valley	6,293	8,724	11,245	12,523
North Valley	3,538	4,153	4,769	6,202
West Side	1,590	2,801	4,061	4,695
Fort Harrison	63	70	77	91
Service Area Population	**40,002**	**47,036**	**54,363**	**60,671**

[1] Population estimates determined from high growth scenario of *2004 Greater Helena Area Transportation Plan* using TAZ and census block areas within the Wastewater Collection System Service Areas.

[2] Population estimate based on a straight line interpolation of population estimates between 2005 and 2015 for TAZ areas.

1.2.2. *Historic Wastewater Flows*

The data indicate that wastewater flows have been steadily dropping since 2001, despite an estimated 4.5 percent increase in population within the service area. This is attributable in part to annual rehabilitation of aging sewers, elimination of known storm sewer connections, rehabilitation and lining of brick manholes, and installation of new sewer lines, resulting in a reduction in infiltration and inflow.

1.2.3. *Recommended Wastewater Flow Projections And Distributions*

Based on the existing per capita flow values compared to past values, and the recent downward trend, an average value of 118 gallons per capita per year flow is recommended. The following table summarizes the design population and resulting projected wastewater flows through the planning period.

TABLE 1-2 Projected Influent Wastewater Flows				
Flow Parameters	**2005**	**2010**	**2015**	**2025**
Design Population – Helena City Limits	27,484	28,495	29,509	32,167
Average Annual Flow, mgd	3.1	3.4	3.5	3.8
Design Population – Service Area	40,002	47,036	54,363	60,671
Average Annual Flow, mgd	4.5	6.0	6.9	7.8

1.3. EXISTING COLLECTION SYSTEM GEODATABASE

The City of Helena currently uses a Geographic Information System (GIS) and a Computerized Maintenance Management System (CMMS) to store the mapping and attribute information for the wastewater collection system. The GIS is built within the Environmental Systems Research Institute (ESRI) software platform and uses ArcGIS as the interface with the information. The City's CMMS was developed within the Hansen software platform. The master planning efforts not only needed to use this existing information during the project but also supplemented this data so that upon completion of the master plan the City's wastewater collection system data would be more complete and robust as a result of the data collection and planning efforts.

The wastewater data within the GIS contained many attributes that were useful during the master planning process. The Hansen CMMS data contained over 600 tables of information including some data that was a duplicate of the GIS data. The majority of the data within the CMMS was related to the maintenance and operations of the wastewater and stormwater systems within the City; however, there were physical data for the wastewater collection system such as pipe materials, diameters, and invert elevations. The geodatabase design and loading process is discussed in Chapter 4.

1.4. EXISTING COLLECTION SYSTEM EVALUATION

The City of Helena wastewater collection system is comprised of approximately 3,000 manholes, approximately 154-miles of gravity sewer mains, and 10 lift stations including three that are owned and operated by City of Helena with associated wet wells, pumps, and force mains. All wastewater is conveyed to the City of Helena Wastewater Treatment Facility. Chapter 5 provides an overview of the existing collection system, describes the hydraulic model developed for the City, and provides an evaluation of the existing collection system.

Meetings with City maintenance personnel were held during the preparation of the collection system model to discuss areas where problems have occurred in the collections system. They include the following:

- Home Depot 12-inch Trunk Main from I-15 crossing to Custer Avenue. This line is undersized and frequently experiences surcharging in the manholes in the downstream section of the line adjacent to Interstate 15.

- N. Harris St. between Phoenix and Cedar St. This section of Harris St. experiences surcharging due to storm events. City staff has bolted down numerous manhole lids on the N. Harris St. line to prevent overflows during storm events. The N. Harris line was identified in the *1997 Wastewater Facility Master Plan* as being at 88 percent capacity on a peak hourly basis.

- 10 block area on Boulder and E. Lyndale Avenues and bounded by N. Harris Street and N. Washington Street. This area experiences frequent surcharging due to insufficient pipe slopes. Two blocks of this area were recommended for replacement by the *1997 Wastewater Facility Master Plan* and were since replaced by pipe bursting although the pipe slopes were not increased.

The City maintenance staff performs annual closed circuit television (CCTV) inspection and jetting of sewer mains. In recent years, the annual program goal is approximately 500,000 lineal feet of jetting and 65,000 lineal feet of CCTV each year. The jetting and CCTV activities are scheduled on a three-year basis.

Since 1989, the City has performed annual slip lining and replacement of aging and broken pipes. Since then, a total of 69,246 lineal feet of pipe (8.5 percent of the total collection system) has been slip lined. In addition, the City has lined 131 manholes or 4 percent of the total manholes since 1996. These improvements have likely contributed to a reduction in infiltration and inflow as demonstrated by declining flows to the wastewater treatment plant despite an increase in service connections.

General conclusions about the condition of the collection system are as follows:

- Aging infrastructure continues to be a long term challenge for the entire system despite a comprehensive annual replacement program of manhole lining and pipe lining and replacement.

- City staff indicate that the majority of the sump pump and storm drain cross connections in the collection system have been eliminated; however, there are likely remaining sump pump connections in the downtown (Last Chance Gulch) area.

- The airport lift station has inadequate capacity for the development currently identified on the southeast side of Helena. The City has identified replacement of the lift station and force main with a gravity trunk main; however, the planned diameter may need to be increased.

1.4.1. *Development of the Hydraulic Model*

To fully characterize the Helena collection system, four drainage basins were delineated and further divided into subbasins. Each of the basins is drained by one of four main

trunk lines. In order to create an accurate hydraulic model of the collection system, the existing domestic flows were measured and the data analyzed. For three months, from April 1, 2006 to June 28, 2006, wastewater flow in the four main trunk lines of the system and rainfall data from four locations was continuously collected and logged. While an analysis of infiltration and inflow was outside the scope of this project, the rainfall data allowed general observations regarding the collection system flow response to rainfall events.

The final model incorporates all 10-inch diameter and greater gravity mains, key 8-inch gravity mains, and all manholes associated with these mains. Also included in the model were the larger capacity lift stations and associated force mains. Sanitary flows in the pipes upstream of the flow monitoring locations were estimated using water meter data obtained from the City for the months of November through March. The resulting flows generated by the model were compared to the measured flows and the loading was scaled appropriately to approximate the measured flows.

Finally, the diurnal flow pattern for each of the four basins generated from the flow monitoring was applied to simulate the high and low flow periods of a typical day. The final collection system model contains four flow condition scenarios:

- Dry Weather (Average Day) Loading Condition
- Wet Weather (Maximum Day) Loading Condition
- Wet Weather (Maximum Day) Loading Condition with 5-Year 60-Minute Storm Event
- Wet Weather (Maximum Day) Loading Condition with 10-Year 60-Minute Storm Event

1.4.2. *Evaluation of the Existing System*

The City of Helena wastewater collection system currently experiences some deficiencies with sewer main capacity. These capacity issues are primarily due to either under-sized mains or inadequate main slopes.

Overall, the existing system is adequately sized to convey the average day and maximum day flow conditions with the exception of 12 gravity main sections, which confirmed areas already identified by the City. Modeling of the wet weather (Maximum Day) flows with a 10-year 60-minute storm event did not demonstrate significant capacity deficiencies within the system. There were 22 gravity mains sections with flows in excess of 75 percent compared to the 12 mains identified under maximum day conditions.

1.4.3. *Conclusions*

A total of 49,635 lineal feet of pipe in the collection system has been identified for slip lining or replacement due to age, condition or capacity of the pipe. Of that amount, 32,400 lineal feet, or 65 percent, of that pipe is scheduled for slip lining due to aging

clay and cement pipe. These projects should remain a priority for the City since data show that slip lining efforts since 1989 have helped reduced flows to the wastewater treatment plant, effectively adding hydraulic capacity to the plant.

Based on the flow monitoring performed and the documented response to rainfall within the system, it is recommended that the City continue flow monitoring to further define and quantify inflow and infiltration so that collection system improvements can be better prioritized. In general, it is recommended that slip lining projects in the Central basin be given a higher priority, given the significant response to rainfall measured in this basin.

The City's current program of CCTV inspection and documentation has been very effective in identifying specific problems in the collection system. Currently, there is no qualitative scoring system in place, although the Hansen software allows for a scoring system for structural and root defect problems. Scoring should be associated with each manhole and segment of pipe so that projects can more easily be prioritized by City staff.

1.5. FUTURE COLLECTION SYSTEM EVALUATION

The City of Helena and the adjacent planning area is currently experiencing a high rate of development with some large residential and commercial subdivisions currently in various stages of planning, approval and construction. Some of these proposed developments are requesting annexation into the City limits which, if approved, will require connection to City water and sewer services.

The hydraulic model of the collection system was set up and loaded in a way that recognizes three types of areas: 1) developed areas within the City limits, 2) commercial and residential developments currently requesting annexation (near-term development), and 3) developed and undeveloped areas within the planning area, but outside the City limits.

1.5.1. *Near-Term System Expansion Evaluation*

Modeling of the maximum day flows with a 10-year 60-minute storm event for the near-term subdivisions demonstrated significant capacity deficiencies in several areas of the system. However, system-wide capacity issues were not observed. The model results showed 56 gravity main sections with flows that exceeded 75 percent capacity compared to the 22 mains identified under maximum day conditions for the existing conditions. All subdivisions included in the evaluation were assumed to be at full build out (2015). The improvements needed to accommodate near-term flows are summarized in Table 1-3.

Table 1-3 **Near-Term Collection System Improvements (2015)**	
Sewer Line	Total Length (LF)
New Airport Gravity Main	7,150
South Railroad from P3052 to P473	2,738
B Street	2,529
Tricia Street	484
Airport Road	424
Custer Outfall	100
HD 12" Outfall	3,868
Fort Harrison Gravity Main	4,838
Fort Harrison Gravity Main (with all Ft. Harrison flow reserve)	*6,613*[1]
Oakes (Lyndale to Lewis)	178
Lyndale (Oakes to Hannaford)	931
Lewis (Harris to Oakes)	469
Boulder (Hannaford to Washington)	940
Hannaford (Lyndale to Boulder)	372
Skyway Drive	400
TOTAL	**25,421**
[1] These pipe lengths are not included in the total pipe lengths	

1.5.2. *Future System Expansion Evaluation*

Key deficiencies within the existing collection system at 2025 flows include:

- 12-inch Home Depot line: Existing capacity issues worsen; the ratio of actual flow versus pipe capacity (q/Q) ranges from 1.1 to 4 times capacity under peak flow conditions.
- Harris Street line: Portions of this line between Phoenix and Cole Avenues are at 90 percent capacity under peak flow conditions.
- East Side system: Capacity issues identified under the near-term scenario worsen under future peak flow conditions.
- Stewart Street line: Portions of this line exceed 50 percent capacity at 2025 flows.

- Brady Street line: Portions of this line exceed 50 percent capacity at 2025 flows.
- Country Club Avenue: The area south of West Euclid Avenue between Country Club Avenue and Brady Street has pipe segments that exceed 100 percent capacity at 2025 flows.
- Custer Avenue line: Portions of this line exceed 75 percent capacity. Included in the Custer Avenue line is a portion near the west end of the existing service area identified as West Euclid, which is in excess of 100% capacity.

The future conditions identified needed improvements to the City's west side and improvements to the City's lift stations as well as extension of the collection system into the planning area. The required improvements to accommodate 2025 conditions in addition to the near-term improvements are summarized in Tables 1-4, 1-5, and 1-6.

Table 1-4
Existing Collection System Improvements to Accommodate Future (2025) Flows

Sewer Line	Total Length (LF)
B Street	354
Custer Trunk	1,246
West Euclid Area	2,097
HD 12" Outfall	315
Harris (Phoenix to Walnut & Cedar to Cole)	540
TOTAL	**4,552**

Table 1-5 **Summary of Future Lift Stations and Force Mains**				
Lift Station	**Force Main Dia (in)**	**Length of Force Main (LF)**	**Firm Capacity (gpm)**	**Discharge Trunk**
Fort Harrison	18	5,000	2,432	Custer Avenue
Northside	8	4,400	180	Custer Avenue
Artisan Park	12	3,684	900	Fort Harrison Gravity Main
Aspen Trails Ranch	16	12,170	1,357	42-inch WWTF Interceptor
Eastside	10	13,100	292	42-inch WWTF Interceptor
Regional	30[1]	20,000	5,200	42-inch WWTF Interceptor

[1] The model shows that a force main with an equivalent diameter of 30-inches is required. This would be accomplished with multiple smaller diameter force mains installed parallel to each other. See Table 7-4.

Table 1-6 **Proposed Collection System Extensions for Future (2025) Conditions**	
Sewer Line	Total Length (LF)
West Side Service Area - Highway 12 Extension	7,250
West Side Service Area - Williams St. Extension	5,235
West Side Service Area - Fort Harrison Extension	3,175
East Side Lift Station Extension	17,280
East Side Service Area Extensions - South of Highway 12	42,230
Fort Harrison Service Area - Barrett Road Extension	2,495
Fort Harrison Service Area - Birdseye Road Extension	4,490
Central Valley Service Area – Fort Harrison LS Extension	3,515
Central Valley Service Area - Northside LS Extension	1,685
East Side Service Area - Aspen Trails Ranch Extensions	22,180
Central Valley Service Area - Aspen Trails Ranch Extensions	5,145
Central Valley and North Valley Service Area's Extensions to Regional Lift Station	298,585
TOTAL	**413,265**

1.6. SUMMARY OF RECOMMENDATIONS AND CAPITAL IMPROVEMENTS SUMMARY

The City's future system improvements include few capacity related improvements within the existing collection system. Continued focus on rehabilitation to address aging pipe is already a priority for the City. The major infrastructure improvements identified are those required to extend the collection system to accommodate projected growth within the service area. They include extensions, lift stations and force main installation.

Chapter 7 provides estimates of probable cost for the prioritized improvements of the collection system. The cost estimates for new and replacement pipes have been based on a general cost per lineal foot basis for each pipe diameter. The costs are 2008 costs and allow for all typical construction costs such as mobilization, sitework, overhead and profit, and have been based on recent, similar projects in the region. The costs do not include engineering services for design, bidding, or construction oversight.

A total of $3.25 million in capacity-related improvements within the existing collection system is required to accommodate near-term growth. Full build out and expansion of the City collection system within the entire service area is estimated to be $41.5 million in 2008 dollars. The total cost of upgrading existing and proposed lift stations to accommodate the full build out scenario is estimated to be approximately $12.8 million in 2008 dollars. Much of this infrastructure will likely be installed as part of construction of new residential and commercial development, although as the City continues to annex, new sewer may be required to connect annexed areas together to build out the collection system.