STUDY AREA 6

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INTRODUCTION

The City of Bend is the provider of wastewater collection and treatment service within the City of Bend Urban Growth Boundary (UGB). The 2006 Collection System Master Plan was developed in cooperation with the City of Bend Public Works Department to provide the roadmap for the providing service to all existing users, existing developed areas that have not yet connected to the system and for new development.. This includes areas outside of the UGB but within the Urban Area Reserve (UAR). The key principles that the plan was based on were:

- Protect the public health and maintain the quality of the water environment within and around the City of Bend;
- Provide ongoing system capacity and reliability to minimize the risk of Sanitary Sewer Overflows (SSOs);
- Provide planning based on approved General Plan;
- Expand existing system using a phased approach as capacity and/or service is needed;
- Provide infrastructure capacity for existing developed areas that currently are not provided with sanitary service;
- Provide gravity-based collection system, reducing operational risk and long term life-cycle operations costs for the City wastewater collection system; and
- Develop a long-term plan for sanitary service within the existing UGB and UAR service areas.

The results and recommendations of the Master Plan are summarized in the 2006 Collection System Master Plan Report. In addition to the Master Plan Report, nine Study Area Plans were developed to provide a detailed summary of the plans for providing sanitary service to each parcel. These plans consist of three components:

1. Projects for Unserved Areas (local gravity sewers needed to provide service to currently-developed parcels that do not have City sewer service);
2. Pump Stations (recommendations on the long-term operation of each pump station); and
3. System Deficiencies (the correction of current and long-term system capacity deficiencies).

STUDY AREA 6

The planning area which includes both the areas of the UGB and the UAR is shown in ***Figure 6-1 – Master Plan Study Areas***. To organize and simplify the presentation of the information developed in the Master Plan, the planning area has been divided into nine Study Areas. This document provides the information for Study Area 6, which is the central portion of the City located on the east side of the Deschutes River. This area is highlighted and labeled in ***Figure 6-1*****.**

Study Area 6 consists of 1,218 acres (3,048 parcels), which can be subdivided into four categories**..** Below is a summary of each category**:**

1. 611 acres (2,212 parcels) that receive sewer service;
2. 28 acres (273 parcels) that are developed but do not receive City sewer service (using a septic system or other type of wastewater service);
3. 195 acres (563 parcels) are undeveloped but are buildable within the UGB; and
4. There are no UAR acres for this area.

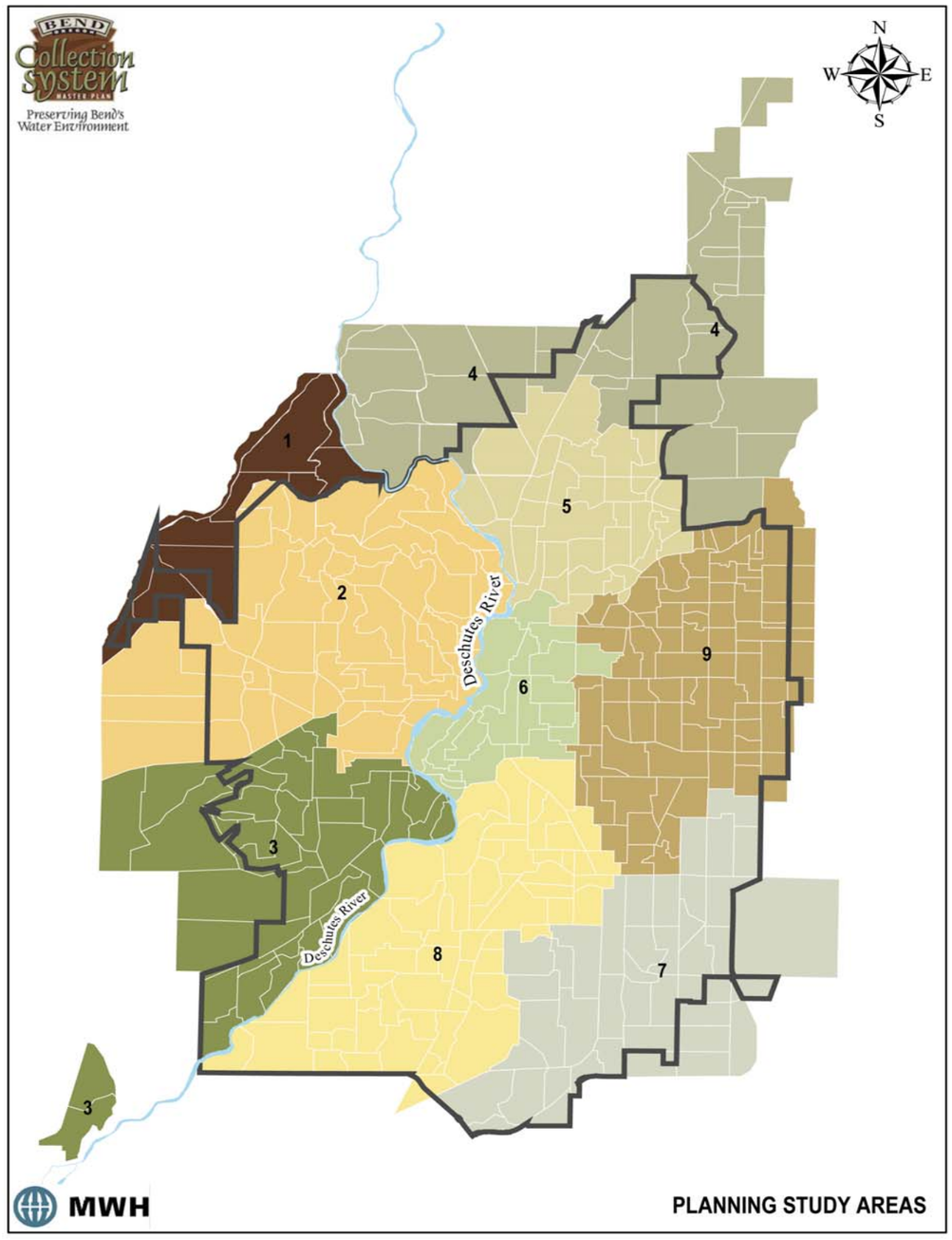


Figure 6-1 – Master Plan Study Areas

EXISTING SEWERS

Study Area 6 currently has 30.8-miles of gravity sewers ranging in size from 6-inches in diameter to 36-inches in diameter. A summary of the total length of gravity sewer by line size is summarized in ***Table 6-1***. 23.4-miles or 76% of these gravity sewers are 6 and 8-inch lines serving local neighborhoods. There are only 7.4-miles of trunk sewers that are 10-inch or larger.

Table 6-1
Study Area 6
Gravity Sewer Statistics

Line Diameter (inches)	Length		Percent of Total
	Linear Feet	Miles	
6	8,587	1.6	5.3
8	115,288	21.8	70.8
10	9,940	1.9	6.1
12	7,682	1.5	4.7
15	3,014	0.6	1.9
16	4,663	0.9	2.9
18	2,013	0.4	1.2
21	2,862	0.5	1.8
24	592	0.1	0.4
27	3,996	0.8	2.5
30	2,281	0.4	1.4
36	1,854	0.4	1.1

Note: Data summary as of May 2005

CRITERIA FOR LATERAL SEWERS

Determination of the feasibility of gravity sewer laterals to service currently unsewered areas in the Bend system depends on several factors. These include:

- The depth of the existing connection manhole or cleanout;
- The distance from the connecting manhole to the most distant property parcel to be served;
- The average slope of the terrain between the parcel to be served and the connecting manhole;
- Diameter adequate for estimated flows;
- Minimum grades used for gravity sewers (i.e. – 8” @ 0.004 ft/ft, 12” @ 0.0028 ft/ft, etc) to allow a minimum velocity of 2 ft/sec;
- The depth of gravity sewer designs will not be driven by the existence or potential existence of basements in structures;
- Gravity sewer service is possible when the finished floor of the structure to be serviced is at least 3 feet above the invert of the main in the street; and
- Surface features or conflicting utilities that would prevent the installation of gravity sewers were not evaluated.

The existing topography within the UGB is limited to 2-foot contours. The inverts for existing manhole or cleanouts were not always available; therefore some assumptions were made regarding the feasibility of extending gravity sewers to the unsewered parcels. The proposed sanitary sewer layouts for projects to provide service to the unsewered areas within the UGB were developed within the guidelines and limitations of the available information. Confirming field work to ascertain the elevation difference between the connecting manhole and the parcel(s) to be served, along with confirmation of the connecting manhole depth, must be done prior to design of these proposed projects.

SANITARY SEWER PROJECT DEVELOPMENT

The sanitary sewer projects are shown in ***Figure 6-2 – Study Area 6 Proposed Sanitary Sewer Layout***. Each project has been given a Project ID. The Project ID is based on the number format of X-Y. This number is based on the following codes:

- X – Study Area Number
- Y – Project Number within the Study Area

This Project ID system will be used to identify each of these projects during system development. Each project has been summarized in ***Table 6-2***. A more detailed figure of the study area proposed projects with the 2-foot topography overlay is provided in the ***Appendix***.

PUMP STATIONS

Study Area 6 currently has five pump stations. Detailed pump station analysis is available in TM 3.8; this section summarizes the process and results. The service area for each of these pump stations is shown in ***Figure 6-3***. A list of the pump stations is shown in ***Table 6-3.*** *Table 6-3* also identifies which pumps were included in the model. The capacity for each pump station was evaluated to determine if the existing station has adequate capacity for future growth conditions. For stations that were modeled, the dynamic peak flow determined by the InfoSWMM model was used as the peak flow. For stations that were not modeled, first the current and future service area for each station was determined. Next, the number of dwelling units and base flow for each service area was determined based on the land area and zoning based on the criteria outlined in TM 3.1 – Planning Criteria. Finally, the peak flow was calculated by applying peaking factors and an RDII flow of 150 gallons/acre/day. The following terms and peaking factors were used in the evaluation of each pump station that supports *Table 6-3*:

- Modeled – Yes means that pump station is included in the INFOSWMM hydraulic model. No means it has not been included in the model;
- Firm Capacity – The firm capacity is the capacity of the station with one pump out of service to act as a redundant pump. This is a regulatory requirement;
- Base Flow –winter season flow based on area zoning;
- RDII Flow –flow due to inflow into the system during heavy rainfall; and
- Peak Flow – The peak hour flow for non-modeled pumps was estimated as the base flow multiplied by a diurnal peaking factor of 1.8 and the seasonal peaking factor of 1.25 to which the RDII flow was added.

The application of this criteria determined if the pump station will meet the build-out flow of its respective service area or not. For stations where the installed capacity will not serve the build-out flows, the time at which the stations will reach capacity was not part of this evaluation. This must be determined by the respective growth rate in each pump station's service area. The respective service area data for the estimated growth rates was not available for this evaluation.

Table 6-2
Study Area 6 New Sewer Systems
Capital Project Cost Estimates Study

Project ID	Length (feet)	Diameter (inches)	Notes
6.01	473	8	Provides sewers to unsewered area
6.02	1,387	8	Provides sewers to unsewered area
6.03	335	8	Provides sewers to unsewered area
6.04	395	8	Provides sewers to unsewered area
6.05	180	8	Provides sewers to unsewered area
6.06	235	8	Provides sewers to unsewered area
6.07	525	8	Provides sewers to unsewered area
6.08	344	8	Provides sewers to unsewered area
6.09	281	8	Provides sewers to unsewered area
6.10	443	8	Provides sewers to unsewered area
6.11	124	8	Provides sewers to unsewered area
6.12	1,297	8	Provides sewers to unsewered area
6.13	85	8	Provides sewers to unsewered area
6.14	155	8	Provides sewers to unsewered area
6.15	185	8	Provides sewers to unsewered area
6.16	724	8	Provides sewers to unsewered area
6.17	100	8	Provides sewers to unsewered area
6.18	280	8	Provides sewers to unsewered area
6.19	239	8	Provides sewers to unsewered area
6.20	387	8	Provides sewers to unsewered area

Table 6-3
Study Area 6 Pump Stations
Existing Installed Information

Pump Station Name	Modeled	Number Of Pumps	Firm Capacity (gpm)	Force Main	
				Diameter (in)	Length (ft)
DRAKE	Y	2	650	6	557
LINSTER	N	2	100	4	1,854
PACIFIC	N	2	50	2	398
PIONEER	N	2	60	6	-
UNDERWOOD	N	2	150	4	564

Drake

The Drake Pump Station serves an area of 155 acres. This station service area is currently 53% sewered serving 654 of the 1,228 potential build-out dwelling units. The current (2005) estimated base flow for this station is 89-gpm with a peak hour flow of 233-gpm. The build-out estimated base flow for this

station is 177-gpm with a peak flow of 446-gpm. The force main for this pump station is a 557-foot long 6-inch line. The design velocity in this force main under firm pumping conditions is 7.4-fps. The design TDH for this station is currently 64-feet. The existing station capacity of 650-gpm will meet the long-term requirements of the service area, but the station is in poor physical condition. It is recommended that this station be replaced with a new pump station located in the same area.

Linster

The Linster Pump Station serves an area of 23 acres. This station service area is currently 68% sewered serving 199 of the 292 potential build-out dwelling units. The current (2005) estimated base flow for this station is 25-gpm with a peak hour flow of 61-gpm. The build-out estimated base flow for this station is 37-gpm with a peak flow of 88-gpm. The force main for this pump station is an 1854-foot long 4-inch line. The design velocity in this force main under firm pumping conditions is 2.6-fps. The existing station capacity of 100-gpm will meet the long-term requirements of the service area.

Pacific

The Pacific Pump Station serves an area of 8 acres. This station serves a commercial area. The build-out estimated flow for this station is a peak flow of 11-gpm. The force main for this pump station is a 480-foot long 2-inch line. The design velocity in this force main under firm pumping conditions is 5.1-fps. The design TDH for this station is currently 34-feet. The existing station capacity of 50-gpm should meet the long-term requirements of the service area.

Pioneer

The Pioneer Pump Station serves an area of 8 acres. This station serves the restroom facilities a Pioneer Park. The existing station capacity of 60-gpm should meet the long-term requirements of the service area.

Underwood

The Underwood Pump Station serves an area of 16 acres. This station serves a commercial area. The build-out estimated flow for this station is a peak flow of 35-gpm. The force main for this pump station is a 564-foot long 4-inch line. The design velocity in this force main under firm pumping conditions is 3.8-fps. The design TDH for this station is currently 18-feet. The existing station capacity of 150-gpm will meet the long-term requirements of the service area.

PUMP STATION UPGRADES

Pump station upgrades will be required to ensure that adequate pumping capacity is available to ensure that there are no Sanitary Sewer Overflows (SSOs) in the system. The station capacity has been developed to ensure that adequate redundancy is provided. There are no pump station upgrades required for capacity increases. The only system upgrade that is recommended is the replacement of the Drake Pump Station due to poor physical condition. This recommended pump station upgrade is shown in ***Table 6-4.***

Drake Pump Station Replacement

This physical condition of this station is questionable for long-term operation. The station has undergone multiple modifications over its service life and the capability of the existing infrastructure has been maximized. The City needs to evaluate and incorporate into their CIP the replacement of the current station. The estimated cost to construct a new station is $363,000 not including land and easements for the new station.

REMOVAL OF EXISTING PUMP STATIONS

Each of the existing pump stations was evaluated to determine if they could be removed from service by construction a gravity sewer. None of the pump stations in Study Area 6 can be cost-effectively removed from service.

Table 6-4
Recommended Pump Station Upgrades

Project ID	Pump Station Name	Upgrade	Cost ($)	Period
6.PS01	Drake Pump Station	Replace Drake Pump Station with new station	$363,000	2006 - 2010

SYSTEM DEFICIENCIES

The City's Collection System was evaluated to determine if there were any deficiencies under existing and build-out flows. The analysis was performed using the calibrated 2005 INFOSWMM hydraulic model. Each deficiency was analyzed to determine how the deficiency could be eliminated. Alternative methods that were evaluated to eliminate each deficiency were: 1) Rerouting of flow to other points in the system, 2) Upsizing the existing lines and 3) Parallel sewers. The most cost effective alternative was identified as a capital project for removal of the deficiency. Capacity deficiencies under existing and build-out flows are shown schematically in ***Figure 6-4***. The line segments shown in this figure are those that were modeled in the INFOSWMM hydraulic model.

EXISTING

This analysis showed two existing capacity deficiencies in Study Area 6. These capacity deficiencies are defined as Capital Projects 6-1 and 6-2. The line segments and the breakdown of the estimated cost for the projects to correct these deficiencies are shown in ***Table 6-6***. These projects will provide adequate capacity to meet the required capacity through system build-out.

FUTURE

The system was also evaluated under build-out flow conditions with the proposed interceptor system. No future capacity deficiencies were found.

NEW PUMP STATION

One of the primary goals of the master plan was to implement gravity solutions whenever possible. In some cases, pump stations are required due to topography. A pump station was removed at 4th and Addison in 2001. This station was replaced with a manhole and 14.6-feet of 21-inch PVC line. The flow enters this manhole 4.5-feet lower than it exits the manhole. This results in the surcharge of 1200-feet of gravity sewer upstream of the manhole. The upstream gravity sewer is located in an area that would make it extremely difficult to replace the upstream gravity sewer at a new grade. This would require replacing up to 2700-feet of gravity sewer and a bore under Highway 97. For this reason, it is recommended that a new pump station be constructed to lift the flow and eliminate the system surcharging. This pump station will need to pump a peak flow of 300-gpm at system build-out. The estimated cost of this station is $575,000, including an estimated cost for land of $200,000. The project to add this new station is summarized in ***Table 6***-5.

Table 6-5
New Pump Station

Project ID	Pump Station Name	Upgrade	Cost ($)	Period
6.3	New Station	Correct grade problem at 4th and Addison	$575,000	2006 - 2010

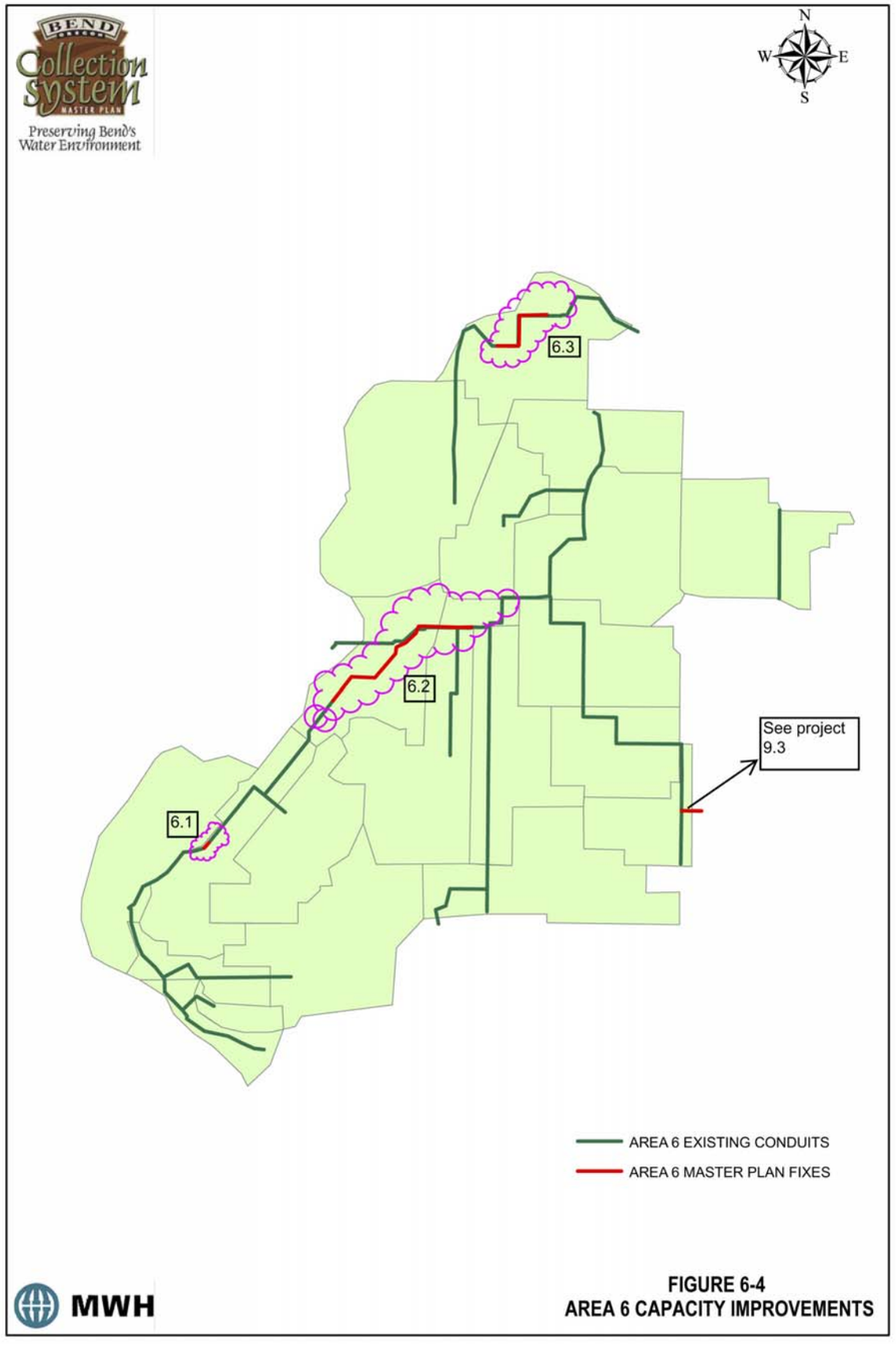


FIGURE 6-4
AREA 6 CAPACITY IMPROVEMENTS

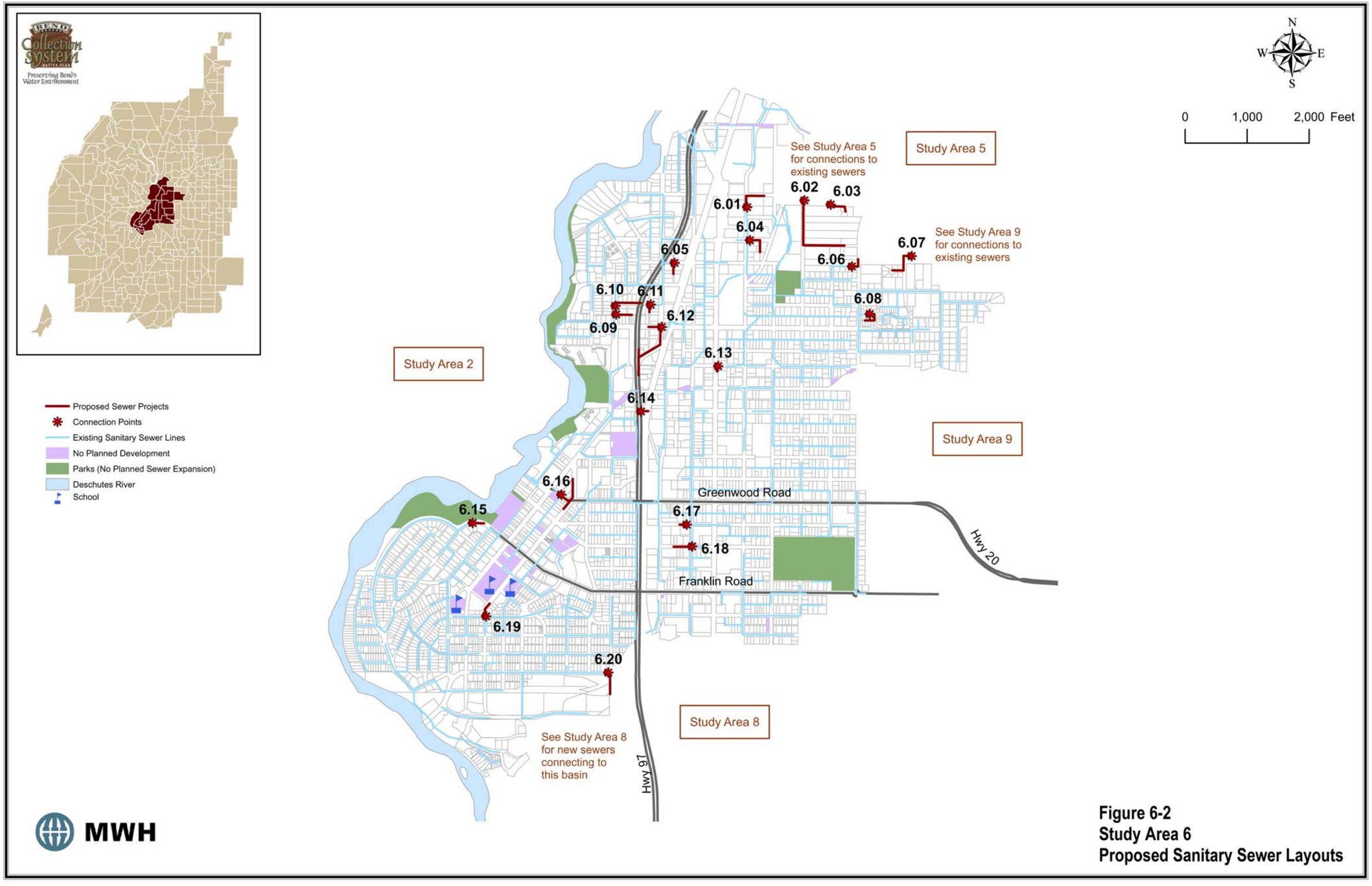


Figure 6-2
Study Area 6
Proposed Sanitary Sewer Layouts

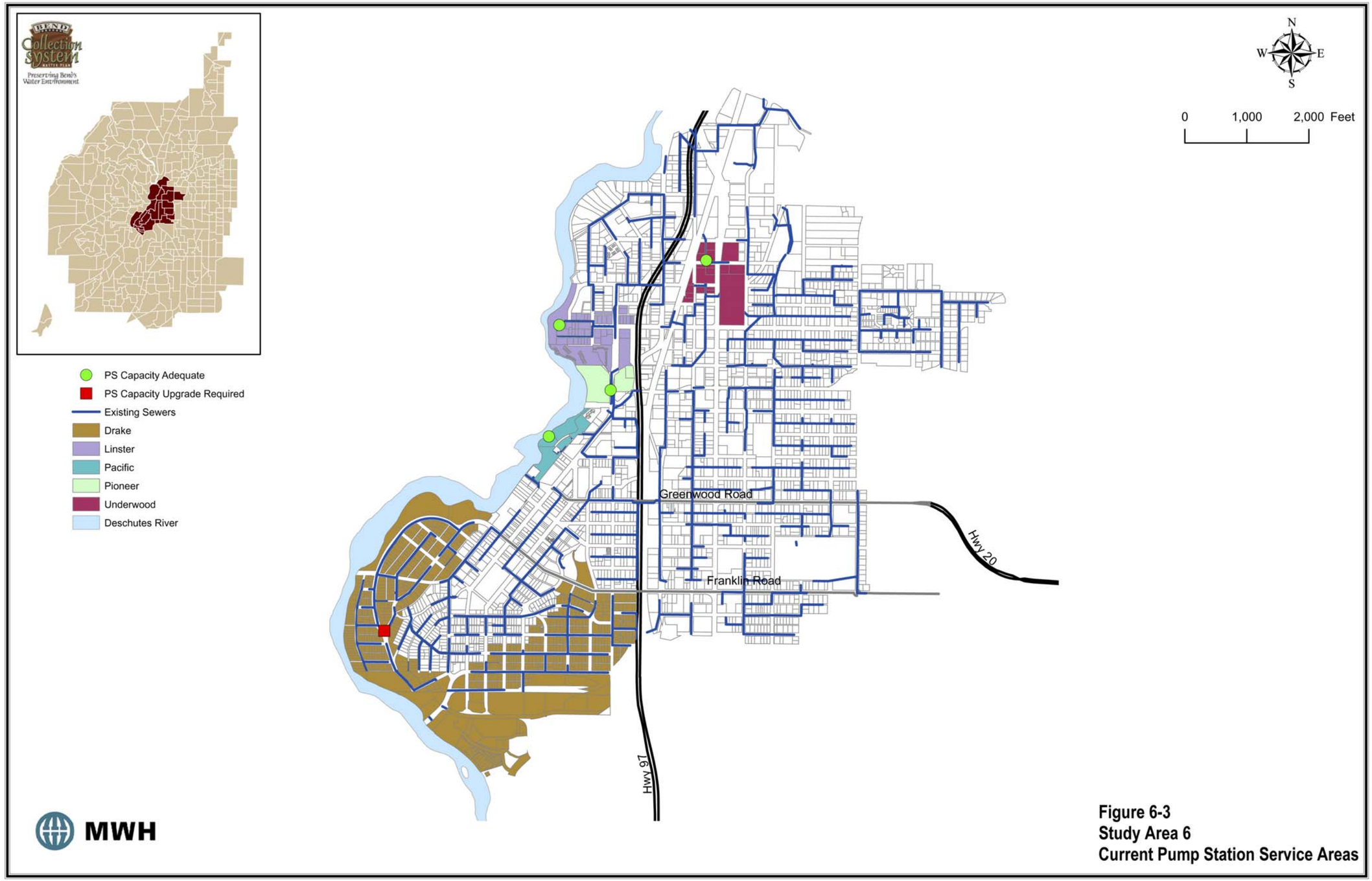


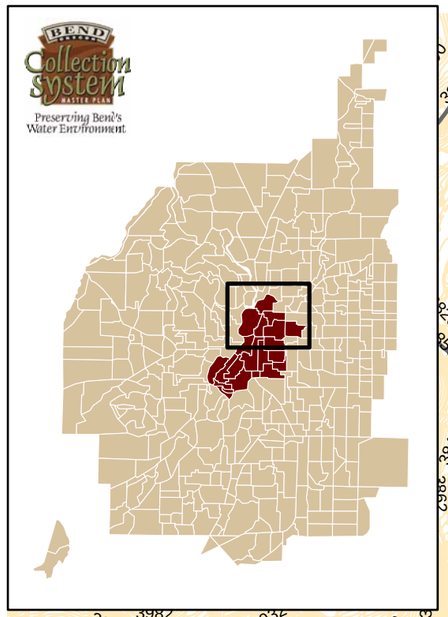
Figure 6-3
Study Area 6
Current Pump Station Service Areas

Table 6-6
Study Area 6 System Deficiencies
Capital Project Cost Estimates

Project ID	Manhole ID From	Manhole ID To	Quantities				Unit Costs ($)						Total			
			Existing Diameter (in)	Upgraded Diameter (in)	Length (ft)	Manholes (#)	Materials ($/ft)	Installation ($/ft)	Bypass Pumping ($/ft)	Manholes ($/each)	Reconnection ($/each)	Restoration ($/ft)	Subtotal ($)	Engr/Legal/ Admin @40%	Contingency @30%	Total ($)
6.1	E1A-5	E1A-4	8	12	95	0	12.75	72.00	11.60	3640	1000	7.35	12,616	5,046	5,299	22,961
	Total	-	-	-	-	-	-	-	-	-	-	-	***12,616***	***5,046***	***5,299***	**22,961**
6.2	1913-SW.17	E6.1-1	12	15	2235	6	18.80	77.00	11.60	3640	1000	7.88	322,689	129,076	135,530	587,295
	E6.1-1	A-1	12	15	195	0	18.80	77.00	11.60	3640	1000	7.88	28,154	11,262	11,825	51,240
	Total	-	-	-	-	-	-	-	-	-	-	-	***350,843***	***140,338***	***147,355***	**638,535**
6.3	**New Pump Station**															**575,000**
Total All Projects																**1,236,496**

Construction Costs based on ENR-CCI of 8449

APPENDIX

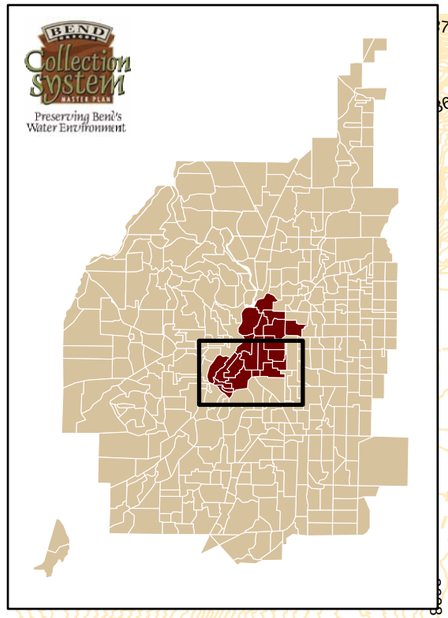


Proposed Sewer Projects
Connection Points
Existing Sanitary Sewer Lines
No Planned Development
Parks (No Planned Sewer Expansion)
Deschutes River
School

0 1,000 2,000 Feet

MWH

Figure A.6-1
Study Area 6
Proposed Sanitary Sewer Layouts



Proposed Sewer Projects
Connection Points
Existing Sanitary Sewer Lines
No Planned Development
Parks (No Planned Sewer Expansion)
Deschutes River
School

0 1,000 2,000 Feet

MWH

Figure A.6-2
Study Area 6
Proposed Sanitary Sewer Layouts

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W E
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