STUDY AREA 4

TABLE OF CONTENTS

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. As part of 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 4

The planning area, which includes both the areas of the UGB and the UAR, is shown in ***Figure 4-1 – 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 4, which is the northern portion of the City. This area is highlighted and labeled in ***Figure 4-1***.

Study Area 4 consists of 4,625 acres (446 parcels), which can be subdivided into four categories. Below is a summary of each category**:**

1. 96 acres (215 parcels) that receive sewer service;
2. 186 acres (158 parcels) that are developed but do not receive City sewer service (using a septic system or other type of wastewater service);

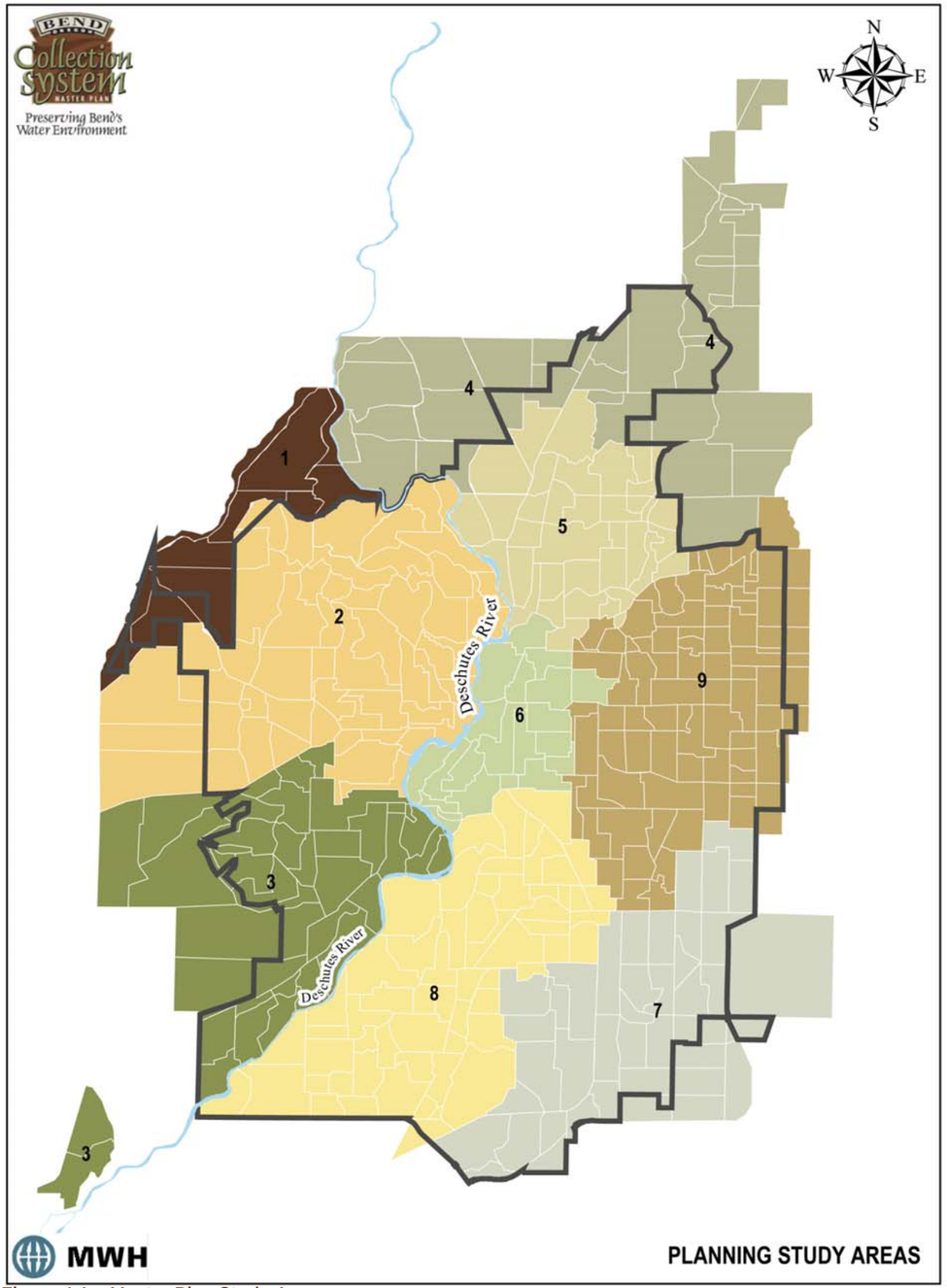


Figure 4-1 – Master Plan Study Areas

3. 125 acres (73 parcels) are undeveloped but are buildable within the UGB; and
4. 4,218 acres that are outside the UGB, but within the UAR. For this Master Plan the UAR lands were considered to be 70% developable.

EXISTING SEWERS

Study Area 4 currently has 4.97-miles of gravity sewers ranging in size from 8-inches in diameter to 42-inches in diameter. A summary of the total length of gravity sewer by line size is summarized in ***Table 4-1***. 3.97-miles or 80% of these gravity sewers are 8-inch lines serving local neighborhoods. There are only 1.0-mile of trunk sewers that are 10-inch or larger.

Table 4-1
Study Area 4
Gravity Sewer Statistics

Line Diameter (inches)	Length		Percent of Total
	Linear Feet	Miles	
8	20981	3.97	79.9
21	132	0.03	0.5
36	2640	0.50	10.1
42	2490	0.47	9.5

Note: Data summary as of May 2005

PROJECTS FOR UNSERVED AREAS

There are many areas within Study Area 4 with no sanitary service. For each of these areas, a project has been defined so that every parcel within Study Area 4 can be served. Service for parcels outside of the UGB was not specifically defined because the location of streets and sewer easements are not known. The flows that will be generated from parcels located in the UAR were included in the analysis of the sewer system capacity, so the build-out capacity for all of the system sewers includes the flows that will be generated in the UAR. An emphasis was placed on providing service through a gravity system, unless it was either not technically feasible or cost prohibitive.

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 4-2 – Study Area 2 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 4-2***. 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 4 currently has seven 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 4-3 – Current Pump Station Basins***. A list of the pump stations is shown in ***Table 4-3***. *Table 4-3* 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 4-3*:

- 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 4-2
Study Area 4
Proposed Sanitary Sewer System Projects

Project ID	Length (feet)	Diameter (inches)	Notes
4.01	2,570	8	Provides sewers to unsewered area
4.02	2,867	8	Provides sewers to unsewered area
4.03	560	8	Provides sewers to unsewered area
4.04	590	8	Provides sewers to unsewered area
4.05	2,155	8	Provides sewers to unsewered area
4.06	7,630	8	Provides sewers to unsewered area Allows removal of Phoenix Pump Station
4.07	485	8	Provides sewers to unsewered area
4.08	250	8	Provides sewers to unsewered area
4.09	450	8	Provides sewers to unsewered area Allows removal of Summer Meadows Pump Station
4.10	3,906	8	Provides sewers to unsewerd area Allows removal of North Wind Pump Station
4.11	2,512	8	Provides sewers to unsewerd area Allows removal of Highlands Pump Station
4.12	382	8	Allows removal of Holiday Inn Pump Station
4.13	350	8	Allows removal of Northpoint Pump Station
4.14	1,800	8	Allows removal of Majestic Pump Station

Table 4-3
Study Area 4 Pump Stations
Existing Installed Information

Pump Station Name	Modeled	Number Of Pumps	Firm Capacity (gpm)	Force Main	
				Diameter (in)	Length (ft)
Boyd Acres	N	2	65	4	1195
Highlands	N	2	250	4	4908
Holiday Inn	N	-	-	4	3117
Northpointe	Y	2	265	6	4018
North Wind	Y	2	270	6	199
Phoenix	Y	2	228	6	65
Summer Meadows	N	2	125	4	892

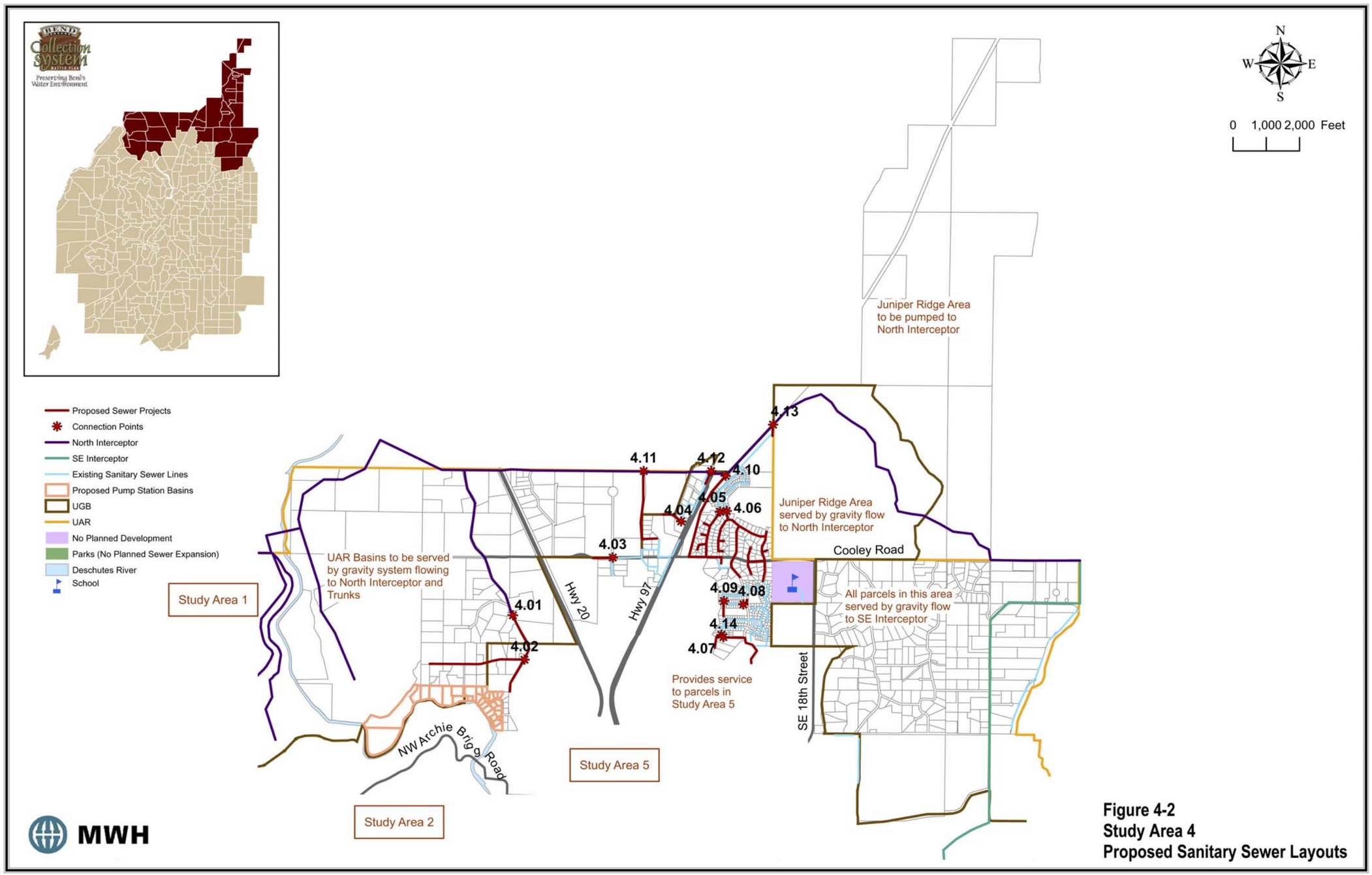
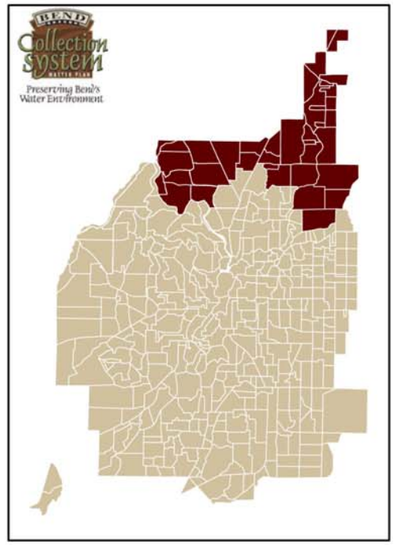
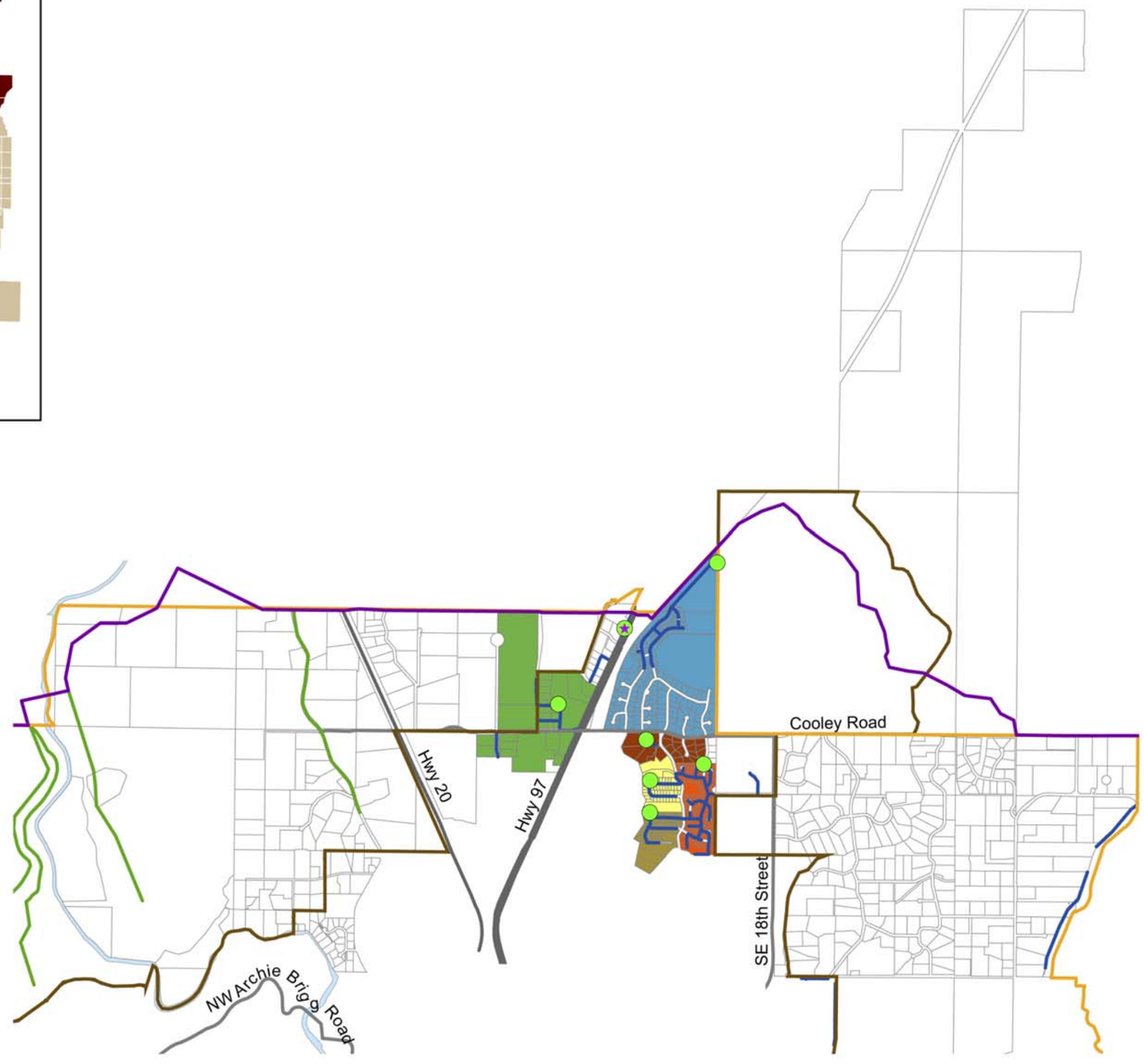


Figure 4-2
Study Area 4
Proposed Sanitary Sewer Layouts





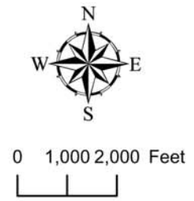


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Figure 4-3
Study Area 4
Current Pump Station Service Areas

Boyd Acres

The Boyd Acres Pump Station serves an area of 18 acres. This station service area is currently at 50% sewered serving 46 of the potential build-out 92 dwelling units. The current (2005) estimated base flow for this station is 6-gpm with a peak hour flow of 17-gpm. The build-out estimated base flow for this station is 12-gpm with a peak flow of 31-gpm. The force main for this pump station is an 1195-foot long 4-inch line. The design velocity in this force main under firm pumping conditions is 1.7-fps. The existing station capacity of 65-gpm will meet the long-term requirements of the service area.

Highlands

The Highlands Pump Station serves an area of 110 acres. This station service area is currently 5% sewered serving 13 of the 278 potential build-out dwelling units. The current (2005) estimated base flow for this station is 2-gpm with a peak hour flow of 27-gpm. The build-out estimated base flow for this station is 77-gpm with a peak flow of 196-gpm. The force main for this pump station is a 4908-foot long 4-inch line. The design velocity in this force main under firm pumping conditions is 6.4-fps. The existing station capacity of 250-gpm will meet the long-term requirements of the service area.

Holiday Inn

The Holiday Inn Pump Station is only serving the Holiday Inn hotel at this time. The force main for this pump station is a 3117-foot long 4-inch line. This station pumps to the Highlands Pump Station. It is assumed that the existing station capacity will meet the long-term requirements of the service area.

Northpointe

The Northpointe Pump Station serves an area of 128 acres. This station service area is currently at 32% sewered serving 147 of the 467 potential build-out dwelling units. The current (2005) estimated base flow for this station is 20-gpm with a peak hour flow of 72-gpm. The build-out estimated base flow for this station is 58-gpm with a peak flow of 157-gpm. The force main for this pump station is a 4018-foot long 6-inch line. The design velocity in this force main under firm pumping conditions is 3.0-fps. The design TDH for this station is currently 152-feet. The existing station capacity of 265-gpm will meet the long-term requirements of the service area.

North Wind

The North Wind Pump Station serves an area of 21 acres. This station service area is currently at 21% sewered serving 22 of the 106 potential build-out dwelling units. The current (2005) estimated base flow for this station is 3-gpm with a peak hour flow of 11-gpm. The build-out estimated base flow for this station is 13-gpm with a peak flow of 34-gpm. The force main for this pump station is a 199-foot long 6-inch line. The design velocity in this force main under firm pumping conditions is 3.1-fps. The design TDH for this station is currently 54-feet. The existing station capacity of 270-gpm will meet the long-term requirements of the service area.

Phoenix

The Phoenix Pump Station serves an area of 25 acres. This station service area is currently at 42% sewered serving 75 of the 180 potential build-out dwelling units. The current (2005) estimated base flow for this station is 10-gpm with a peak hour flow of 28-gpm. The build-out estimated base flow for this station is 17-gpm with a peak flow of 44-gpm. The force main for this pump station is a 65-foot long 6-inch line. The design velocity in this force main under firm pumping conditions is 2.6-fps. The design TDH for this station is currently 70-feet. The existing station capacity of 228-gpm will meet the long-term requirements of the service area.

Summer Meadows

The Summer Meadows Pump Station serves an area of 19 acres. This station service area is currently 22% sewered serving 23 of the 104 potential build-out dwelling units. The current (2005) estimated base flow for this station is 3-gpm with a peak hour flow of 11-gpm. The build-out estimated base flow for this station is 12-gpm with a peak flow of 31-gpm. The force main for this pump station is an 892-foot long 4-inch line. The design velocity in this force main under firm pumping conditions is 3.2-fps. The existing station capacity of 125-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. No pump station upgrades are required for this area.

REMOVAL OF EXISTING PUMP STATIONS

To remove the pump stations from service, a new gravity trunk will need to be constructed to transport the flow from the existing pump station influent sewer to another point in the collection system. Each of the pump stations were evaluated to determine if they could be cost effectively removed from service. The pump stations that can be removed from service are shown in ***Table 4-4.***

Boyd Acres

The Boyd Acres Pump Station can be removed from service with the construction of a 460-foot 8’ trunk sewer (Project P.25 in Study Area 5). This new trunk will connect to a new sewer serving the area to the west of the existing service area. This new sewer will flow by gravity for discharge into the new North Interceptor. The estimated project cost to construct the gravity sewer to remove the station from service is $72,000. The estimated cost to remove the pump station is $25,000. A present value analysis of this project was done to determine the cost-effectiveness of this project. In this analysis it was assumed that the project would occur in the year 2015. Growth in the area would grow at a constant growth rate until build-out of the area occurs in 2020. Based on these assumptions, the 20-year and 50-year present values for continuing operation of the station (starting in 2006) are $204,000 and $497,000, respectively. Based on the same assumptions, the 20-year and 50-year present values for removing the pump station in 2015 are $181,000 and $187,000, respectively. This analysis shows that replacement of the pump station is cost effective when possible.

Highlands Pump Station

The Highlands Pump Station can be removed from service with the construction of a 2512-foot 8’ trunk sewer. This is shown as Project 4.11 in ***Figure 4.2***. This project will also provide for the sewering of some currently unsewered parcels. If the sewering of these parcels is done, then the removal of the Highlands Pump Station will be become cost-effective.

Table 4-4
Recommended Pump Station Decommissioning

Project ID	Pump Station Name	Upgrade	Cost ($)	Period
4.PS01	Boyd Acres	New 460-ft 8” Sewer	$72,000	With construction of Project 5.P04
4.PS02	Boyd Acres	Removal of Pump Station	$25,000	On completion of Project 4.PS01
4.PS03	Highlands	New 2512-ft 8” Sewer	$393,000	With construction of Project 4.11
4.PS04	Highlands	Removal of Pump Station	$25,000	On completion of Project 4.PS03
4.PS05	Holiday Inn	New 382-ft 8” Sewer	$60,000	With construction of Project 4.12
4.PS06	Holiday Inn	Removal of Pump Station	$10,000	On completion of Project 4.PS05
4.PS07	Northpointe	New 350-ft 8” Sewer	$55,000	With construction of Project 4.13
4.PS08	Northpointe	Removal of Pump Station	$25,000	On completion of Project 4.PS07
4.PS09	North Wind	New 300-400ft 8” Sewer	$63,000	With construction of Project 4.10
4.PS10	North Wind	Removal of Pump Station	$25,000	On completion of Project 4.PS09
4.PS11	Phoenix	Removal of pump station including the inter-tie between Phoenix and Northpointe Pump station basin	$41,000	With construction of Project 4.06
4.PS12	Summer Meadows	New 450-ft 8” Sewer	$70,000	With construction of Project 4.09 On completion of removal of Boyd Acres Pump Station in Project 4.PS01
4.PS13	Summer Meadows	Removal of Pump Station	$25,000	On completion of Project 4.PS12

Notes:
1. Project 4.PS01 is shown as Sanitary Sewer Project 5.25 in Study Area 5

This new trunk will discharge into the new North Interceptor. The estimated project cost to construct the gravity sewer to remove the station from service is $393,000. The estimated cost to remove the pump station is $25,000. A present value analysis of this project was done to determine the cost-effectiveness of this project as a standalone project. In this analysis it was assumed that the project would occur in the year 2015. Growth in the area would grow at a constant growth rate until build-out of the area occurs in 2033. Based on these assumptions, the 20-year and-50 year present values for continuing operation of the station (starting in 2006) are $275,000 and $759,000, respectively. Based on the same assumptions, the 20-year and 50-year present values for removing the pump station in 2015 are $527,500 and $561,500, respectively. This analysis shows that replacement of the pump station is cost effective in the long run, but not in a 20-year planning period.

Holiday Inn

The Holiday Inn Pump Station can be removed from service with the construction of a 382-foot 8’ trunk sewer. This new trunk will discharge into the new North Interceptor through Project 4.12 (See ***Figure 4.2***). The estimated project cost to construct the gravity sewer to remove the station from service is $60,000. The estimated cost to remove the pump station is $10,000. A present value analysis of this project was done to determine the cost-effectiveness of this project. In this analysis it was assumed that the project would occur in the year 2015. A 5-gpm base flow was estimated for the life of the station. No bioxide was fed for odor control. Based on these assumptions, the 20-year and 50-year present values for continuing operation of the station (starting in 2006) are $214,000 and $517,000, respectively. Based on the same assumptions, the 20-year and 50-year present values for removing the pump station in 2015 are $159,500 and $164,500, respectively. This analysis shows that replacement of the pump station is cost effective when possible.

Northpointe

The Northpointe Pump Station can be removed from service with the construction of a 350-foot 8’ trunk sewer. This new trunk will discharge into the new North Interceptor through Project 4.13 (See ***Figure 4.2***).

The estimated project cost to construct the gravity sewer to remove the station from service is $55,000. The estimated cost to remove the pump station is $25,000. A present value analysis of this project was done to determine the cost-effectiveness of this project. In this analysis it was assumed that the project would occur in the year 2015. Growth in the area would grow at a constant growth rate until build-out of the area occurs in 2028. Based on these assumptions, the 20-year and 50-year present values for continuing operation of the station (starting in 2006) are $264,000 and $678,000, respectively. This includes the cost of a pump station capacity upgrade in the year 2015. Based on the same assumptions, the 20-year and 50-year present values for removing the pump station in 2015 are $187,000 and $191,000, respectively. This analysis shows that replacement of the pump station is cost effective when possible.

North Wind

The North Wind Pump Station can be removed from service to allow the system to flow by gravity to the North Pointe Pump Station Basin with the sewering of the area north of the North Wind basin. This new trunk will discharge into the new North Interceptor through Project 4.10 (See ***Figure 4.2***). Project 4.10 will need to be completed prior to this station being removed from service.

This inter-tie can be done by constructing between 300 and 400-feet of gravity sewer at an estimated cost of $63,000. The estimated cost to remove the pump station is $25,000. A present value analysis of this project was done to determine the cost-effectiveness of this project. In this analysis it was assumed that the project would occur in the year 2015. Growth in the area would grow at a constant growth rate until build-out of the area occurs in 2036. Based on these assumptions, the 20-year and 50-year present values for continuing operation of the station (starting in 2006) are $195,000 and $481,000, respectively. This includes the cost of a pump station capacity upgrade in the year 2015. Based on the same assumptions, the 20-year and 50-year present values for removing the pump station in 2015 are $167,000 and $172,000, respectively. This analysis shows that replacement of the pump station is cost effective, when the area north of the North Wind basin is sewered.

Phoenix

The Phoenix station can be removed from service to allow the system to flow by gravity to the North Pointe Pump Station Basin with the sewering of the area north of the Phoenix basin. This project cannot be completed until Project 4.06 is completed (See ***Figure 4.02***).

This inter-tie can be done at an estimated cost of $16,000. The estimated project cost is $41,000 which includes the cost to remove the pump station from service. The present value cost for removal was assumed to be $41,000, because no date for removal could be determined. The 20-year and 50-year present value costs for continued operation of the station are $209,000 and $506,000, respectively. Removal of this station from service will be a cost-effective project. This project cannot be done until sanitary service is provided to the unsewered area north of the Phoenix basin.

Summer Meadows

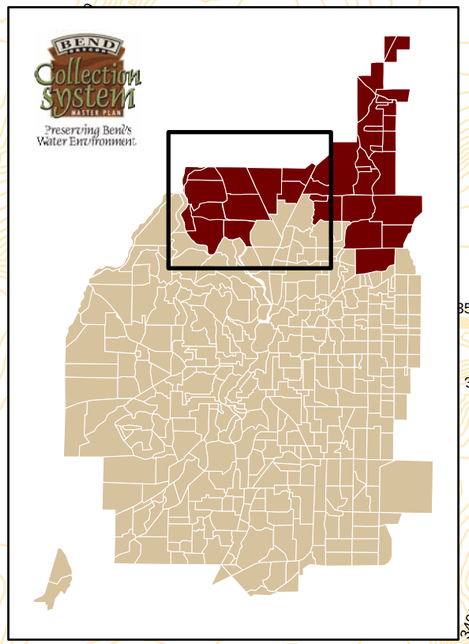
The Summer Meadows Pump Station can be removed from service with the construction of a 450-foot 8' trunk sewer. This new trunk will discharge into a Boyd Acres Pump Station basin to the north of the station. This project cannot be done until the Boyd Acres Pump Station is removed from service. This connection is shown as Project 4.09 on ***Figure 4.2***.

The estimated project cost to construct the gravity sewer to remove the station from service is $70,000. The estimated cost to remove the pump station is $25,000. A present value analysis of this project was done to determine the cost-effectiveness of this project. In this analysis it was assumed that the project would occur in the year 2015. Growth in the area would grow at a constant growth rate until build-out of the area occurs in 2034. Based on these assumptions, the 20-year and 50-year present values for continuing operation of the station (starting in 2006) are $201,000 and $494,000, respectively. Based on the same assumptions, the 20-year and 50-year present values for removing the pump station in 2015 are $176,000 and $183,000, respectively. This analysis shows that replacement of the pump station is cost effective. This station should be removed from service when the new gravity system to the west of the station is constructed

SYSTEM DEFICIENCIES

The existing system was evaluated to determine if there were any existing deficiencies. The analysis was performed using the calibrated 2005 INFOSWMM hydraulic model. This area does not have any deficiencies, existing or in the future. This is because most of the existing is local neighborhood collection systems that can easily handle the neighborhood flows. The larger trunk sewers will not be greatly influenced by future flows because most of the flows in this area will be redirected to the north to the new North Interceptor, which will be sized to handle the ultimate build-out flows.

APPENDIX



4.01 4.02 4.03 4.04 4.05 4.06 4.07 4.08 4.09 4.10 4.11 4.12 4.13 4.14

Hwy 97
Hwy 20
NW Archie Briggs Road
SE 18th Street

Proposed Sewer Projects
Connection Points
Proposed Pump Station Basins
North Interceptor
Existing Sanitary Sewer Lines
UGB
UAR
No Planned Development
Parks (No Planned Sewer Expansion)
Deschutes River
School

0 1,000 2,000 Feet

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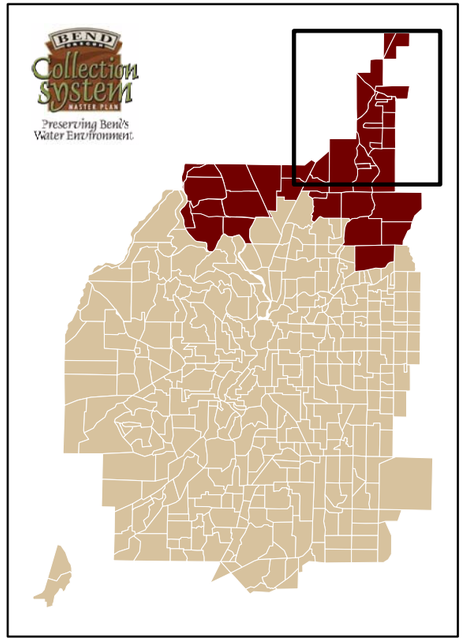
N W E S

Figure A.4-1
Study Area 4
Proposed Sanitary Sewer Layouts



Proposed Sewer Projects
Connection Points
North Interceptor
SE Interceptor
Existing Sanitary Sewer Lines
UGB
UAR
No Planned Development
Parks (No Planned Sewer Expansion)
Deschutes River
School

0 1,000 2,000 Feet

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Figure A.4-2
Study Area 4
Proposed Sanitary Sewer Layouts

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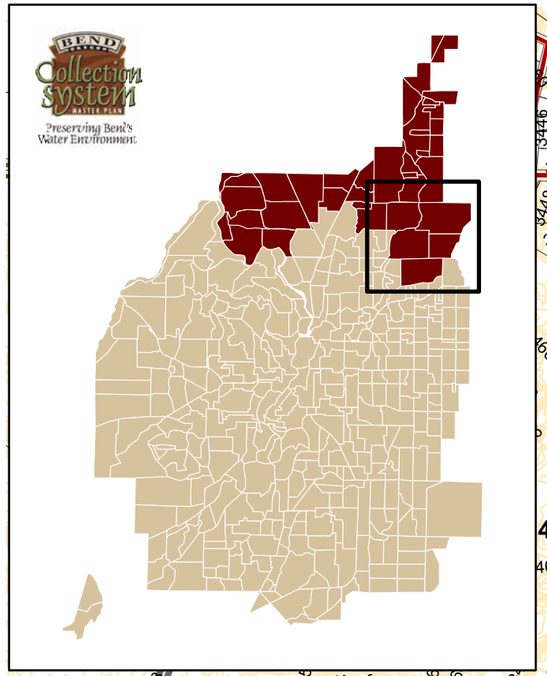

Proposed Sewer Projects
Connection Points
North Interceptor
SE Interceptor
Existing Sanitary Sewer Lines
UGB
UAR
No Planned Development
Parks (No Planned Sewer Expansion)
Deschutes River
School

0 1,000 2,000 Feet

MWH

Figure A.4-3
Study Area 4
Proposed Sanitary Sewer Layouts

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