

TECHNICAL MEMORANDUM



TM 3.9 – Interceptor Evaluations

To: Heidi Lansdowne, P.E.
City of Bend, Oregon
Engineering Division

Date: Draft Final March 20, 2007
Final May 2, 2007

From: R. Dale Richwine, P.E. – MWH

Prepared By: Gordon Merseth, P.E. – CaMES
Dale Richwine, P.E. – MWH

Reviewed by: Gordon Merseth - CaMES

Copies: Gordon Merseth – CaMES

TABLE OF CONTENTS

Introduction	3
Existing System Evaluation	5
Alternative Development	7
Plant Interceptor	7
North Interceptor.....	8
Alternative Alignment Evaluation	12
Plant Interceptor to Highway 97	12
Highway 97 to Deschutes River	12
Deschutes River Pump Station and Force Main	12
Deschutes River to Shevlin Park.....	16
North Interceptor Cost Estimate	18
North Interceptor Trunks 1 & 2	18
North Interceptor Trunks 3 & 4	21
North Interceptor Trunks 5	21
SE Interceptor	21
Alternative Alignment Evaluation	24
Recommended Alignment	24
Alternative Implementation Strategies	26

Alternative 1 – “All Gravity”	26
Alternative 2 – “Shallow with Pumping”	26
Interconnections	26
Plant Interceptor to Highway 20	27
Highway 20 to Reed Market Road	27
Reed Market Road to SE 15 th Street	27
Gravity Alternative	27
Pumped Alternative	30
SE 15 th Street to Murphy Road Pump Station	30
Murphy Road Pump Station to Highway 97	30
SE Interceptor Cost Estimate	30
Westside Interceptor	36
Westside Alignment Alternatives	36
Westside Alternative Alignment 1	36
Westside Alternative Alignment 2 (preferred)	37
Westside Interceptor Cost Estimate	37

Figures

Figure 1 – Existing System at Buildout Flows	6
Figure 2 – WWTP to North Trunk Junction	9
Figure 3 – Flows and Sizes for Westside and North Interceptors	11
Figure 4 – North Interceptor to North Trunk Junction Alternatives	13
Figure 5 – North Interceptor Junction to Highway 97	14
Figure 6 – Highway 97 to Deschutes River	15
Figure 7 – Deschutes River to Shevlin Park	17
Figure 8 – Proposed North Area Trunk Sewers	20
Figure 9 – Deschutes River to Shevlin Park with Trunk Sewers	22
Figure 10 – SE Interceptor	23
Figure 11 – SE Interceptor Alignment Options	25
Figure 12 – North Trunk Junction to Highway 20	28
Figure 13 – Highway 20 to Reed Market Road	29
Figure 14 – Reed Market Road to SE 15 th Street	31
Figure 15 – Pumped Alternative	32
Figure 16 – SE 15 th Street to Murphy Road Pump Station	33
Figure 17 – Murphy Road Pump Station to Business 97	34
Figure 18 – Westside Interceptor Alignment	38

Tables

Table 1 – Plant Interceptor Cost Estimate	10
Table 2 – North Interceptor Cost Estimate	19
Table 3 – SE Interceptor Cost Estimate	35
Table 4 – Westside Interceptor Cost Estimate	39

INTRODUCTION

The City of Bend (City) sanitary sewer collection system was constructed in the early 1980's. The system provided gravity sanitary sewer service to much of the developed city. In addition to the core system of gravity sewers, a trunk line was constructed approximately five miles long that transported the wastewater to the new wastewater treatment plant. The collection system on the west side of the Deschutes River flows to the Westside Pump Station where the wastewater is pumped across the Deschutes River to the gravity system on the east side of the river.

The City has grown from a population of 17,300 in 1980 to 70,330 in 2005. Over this period the wastewater collection system has been expanded as areas were developed. These expansions have connected to the original core system. Much of this sanitary sewer expansion has incorporated either pump stations to avoid deep sewer construction or use of pressure sewer systems which can also be constructed in much shallower trenches. All new sewers were oriented to discharge to the core area and ultimately flow through the plant interceptor to the Water Reclamation Facility. This has created two major issues that, unless corrected will cause problems with future sanitary sewer service.

First, because of this flow pattern recent residential and commercial growth has overloaded the original gravity system which was not designed to handle flows of this magnitude. Second, the inordinate use of shallow sewers and pump stations to serve many of the subdivisions north and south of the City's core area has increased the system maintenance requirements. The cost increase in maintenance increased the operating cost which ultimately will cause user service fees to escalate more rapidly than services with a more gravity oriented system.

Due to the extraordinary growth the City has experienced, major revisions to the system must be made. These revisions are required to accommodate growth on the City's periphery with gravity service and relieve the capacity deficiencies in the core area system. Issues that need to be resolved include:

- The plant interceptor is reaching capacity and will not be able to carry future wastewater flows generated by the growing system
- Many of the sewers in the existing core system are already at capacity
- Many of the service areas that are being served by pump stations have created a barrier to system development on the expanding periphery of the City. This will cause new developments to pump raw sewage around the existing, hydraulically-limited pressure systems
- The Westside pump station and collection system is limited in its capacity to serve the developing areas on the west side of the City
- The large number of pump stations have become an Operations and Maintenance (O&M) burden on City staff resulting in increased O&M costs

These issues are the primary focus of the 2006 Collection System Master Plan. This plan has been done in three tasks:

- Task 1 was the model development phase of planning. During this task, the current and future service areas of the City were divided into drainage basins and sub-basins and a dynamic model of the existing collection system developed and calibrated. This model has been used to evaluate system capacity under existing flows as well as in a variety of planning scenarios that were evaluated to determine the final plan. One of the outcomes of Task 1 was the identification of capacity limitations that currently exist in the system as well as the new limitations that will occur as the City population grows to build-out densities.
- Task 2 developed a concept plan for North and Southeast (SE) Interceptors. A preliminary report for each interceptor was developed providing an alternative alignment for each interceptor. This work demonstrated that with the construction of these two interceptors many of the capacity limitations in the existing system can be mitigated.
- Task 3, which is the actual development of the Master Plan. Using planning criteria developed earlier, sewage generated by future development throughout the service area was accounted for and service alternatives developed. The evaluation of alternatives was performed to identify the major system components necessary to move forward. The results were documented in the Master Plan Report and a Study Area Plan for each of the nine study areas.

In Task 3, a more detailed look at the major interceptor alignments was performed. This allowed for refinement of the conceptual work performed in Task 2. The vertical alignments were developed to be sure that gravity service could be provided wherever possible. In several cases, options for service to individual sub-basins were developed. This refinement of the interceptor concept also provided the basis for a more detailed cost estimate and a plan that could be incorporated into the 2006 Collection System Master Plan. The new interceptors will provide these basic functions:

- Provide sanitary service to the Juniper Ridge and north Bend drainage basins
- Provide sanitary service to the SE Bend drainage basins
- Reroute flows away from the downtown core area of Bend relieving current and projected future capacity deficiencies
- Provide system capacity necessary to allow the growth of sanitary service to portions of Bend west of the Deschutes River
- Provide a second (parallel) interceptor to the treatment plant providing additional capacity
- Provide a means to remove pump stations from service by providing gravity sewer service wherever possible

The cost to construct these interceptors will be a considerable investment by the City. In order to manage cash flow, the City may need to construct these lines as areas develop and the additional sanitary service is required. For this reason, each interceptor has been divided into multiple capital projects to provide the City with an opportunity to construct each interceptor using a phased construction approach and distribute capital costs over a longer period of time. All cost estimates are based on the cost criteria outlined in TM 3.6 – Cost Criteria.

This Technical Memorandum (TM) summarizes the work performed in Task 3 to refine the development of the new interceptors.

EXISTING SYSTEM EVALUATION

The base case for planning is to determine and analyze the capacity of key portions of the current system, assuming that this system would be required to carry all future flows. This information was then used to develop the most feasible and cost-effective alternatives for system expansion. The calibrated InfoSWMM model was used to model the existing system for build-out flows under the following conditions:

- The average residential density is 5.3 dwelling units per gross acre
- All newly serviced parcels within the planning area are connected to the existing system at the most practical point
- The Westside Pump Station operates with Variable Frequency Drives (VFD) allowing it to match pumped flow to influent flow.

This analysis indicated a large number of deficiencies will occur during daily peak flows during the initial model run using build-out flows. These deficiencies cause severe overloading of the system including system overflows at manholes and pump stations throughout the system. The locations of these deficiencies are shown in *Figure 1*. These deficiencies are from the initial model run. This figure shows 157,747-feet of sewer or 29.9-miles of sewer have deficient capacity. The estimated cost to fix these deficiencies by replacing the capacity limited lines with larger lines as determined by this initial model run is over \$55M.

Typical hydraulic modeling protocol is to increase the diameter of each of the overloaded pipes to eliminate these deficiencies (overcapacity and overflows). Additional model runs to determine if new downstream deficiencies will occur are then made. In this case, analysis of the initial model run results showed enough overflows that it was obvious that there would be a large number of new, downstream deficiencies when upstream pipes are enlarged. This is detailed in TM 3.7 – System Deficiencies as the various alternative scenarios were run. The ultimate cost to mitigate the existing system deficiencies resulting from these additional model runs is estimated to be over \$75M.

In addition to the high cost to fix the system deficiencies, a number of other issues, the costs for which are virtually impossible to estimate at this time, must be taken into consideration when making a decision to rebuild and enlarge the existing system. Since much of the system that would have to be enlarged is in the older areas of the City and many of the larger lines are located in major streets and in the Central Business District, project “costs” would include:

- Significant disruption to commerce and local businesses
- Major traffic issues including extensive detours during construction

Figure 1 – Existing System at Buildout Flows

- Impacts to tourism resulting from limited access to lodging and restaurants
- Multi-year construction congestion resulting from use of heavy equipment for excavation and materials delivery
- Possible structural damage to older buildings when blasting for rock removal to deepen or enlarge sanitary sewers

This information was presented to City staff in a workshop. It was determined by City staff and the project team that these deficiencies were sufficient to merit development and consideration of other alternatives. Based on this decision, it was determined to suspend additional effort on further model runs of the base scenario to determine the final number of deficiencies in the system. Therefore, no further evaluation of the base scenario was performed.

ALTERNATIVE DEVELOPMENT

The large number of capacity limitations in the existing system led the City staff and project team to develop four interceptor concepts. An alternative evaluation workshop was held with City staff and industry experts to explore any additional alternatives that may be feasible. The results of this workshop are summarized in TM 3A – Alternative Development Workshop. It was determined that the following interceptor concepts were to be taken forward into master planning:

- Plant Interceptor – New parallel plant interceptor to provide additional capacity from the City to the Wastewater Reclamation Facility
- North Interceptor – Service to the new Juniper Ridge Development, future north Bend development and service to the northwest areas of Bend reducing flows through the Westside Pump Station Basin
- SE Interceptor – Service to unsewered areas and new development in the southeast and south Bend areas, relief of flows through the Murphy Road Pump Station (old Juniper Ridge Utility) and relief of flows from the southwest Bend areas west of the Deschutes River
- Westside Interceptor – Rerouting the flows discharged from the Westside Pump Station, Sawyer Park Pump Station and Wyndemere Pump Station to relieve the core area system by diverting these flows to the North Interceptor

Each of these four interceptor concepts has been refined to the point where a recommended alignment corridor has been identified. Interceptor sizing and the development of a cost estimate to construct each of the interceptors has been developed. These concepts are summarized in the following sections.

PLANT INTERCEPTOR

The existing plant interceptor is currently limited to a peak hydraulic flow of approximately 30-mgd. In the existing configuration, raw wastewater flows through a 30, 36 or 42-inch plant interceptor to the siphon box about 5,100-feet upstream of the plant. At that point, the system becomes pressurized (an inverted siphon) and flow continues through two pipes, a 21-inch and a 36-inch, to the treatment plant. At the treatment plant, these two lines combine into one 30-inch

line that takes the flow to the headworks. This 30-inch line limits the flow to the headworks structure. The City is currently designing new headworks for the Water Reclamation Facility (WRF) based on an instantaneous peak plant capacity of 30 MGD. Included with this design is a new distribution box. This will allow for modification of an existing bottleneck on the treatment plant grounds. The existing and proposed new plant interceptor alignment is shown on *Figure 2*.

The new plant interceptor will take flow through a 48-inch gravity sewer to an expanded inverted siphon structure. A new 48-inch siphon line will parallel the two existing inverted siphons to the treatment plant. The existing 30-inch line will be decommissioned and each of the three inverted siphon lines will be connected to the new distribution box. This new interceptor arrangement will provide a peak hydraulic capacity of up to 68 MGD which will meet the build-out flows for the current planning area. The collection system design has been planned for build-out flow conditions because of the long service life of the collection infrastructure. In addition, the headworks building was designed for a 2030 planning horizon with options to be expanded in the future. The new plant interceptor will parallel the existing line to Pioneer Loop Road. At this point, the interceptor will follow Pioneer Loop Road to Margaret Lane. The plant interceptor terminates at station 130+94 at the intersection of Margaret Lane and Pioneer Loop Road.

This new plant interceptor consists of three distinct elements. These are the inverted siphon, the siphon box, and the 48-inch interceptor from the siphon box to the junction with the North Interceptor and SE Interceptor. The total cost estimate of \$9.4M is itemized and summarized in *Table 1*.

NORTH INTERCEPTOR

The North Interceptor carries flow from the northwest areas of Bend near Shevlin Park, around Awbrey Butte on the northern border of the Urban Area Reserve (UAR) to the Deschutes River. Raw wastewater will then be pumped across the Deschutes River to continue by gravity on the northern border of the UAR to Highway 97. The alignment then crosses the new Juniper Ridge development to its downstream terminus at the Plant Interceptor. The interceptor has been divided into four parts:

- Plant Interceptor to Highway 97 – Provides service to Juniper Ridge Development, several drainage basins currently pumped south to the existing interceptor, and accepts flow from new Westside Interceptor
- Highway 97 to Deschutes River – Provides service to developed and undeveloped drainage basins along the north edge of the City
- North Interceptor Pump Station and Force Main – Provides the transmission of flow across the Deschutes River canyon
- Deschutes River to Shevlin Park – Provides service to undeveloped northwest basins of the City and provides opportunity to remove Awbrey Glen and Shevlin Commons Pump Stations from service

The recommended service area, alignment, flows and pipe diameters are shown in *Figure 3*.

Figure 2 – WWTP to North Trunk Junction

Table 1
 2006 Collection System Master Plan
 Plant Interceptor Cost Estimate

Project Element	Diameter	Total Length	Construction Cost					Allowances		Project Total
			Pipe Material	Installation	Manholes	Restoration	Easements	Engr/Admin	Contingency	
	(in)	(ft)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	
WWTP to Siphon Inlet - Gravity	48	5,100	367,200	1,275,000	0	42,500	100,000	624,700	722,800	3,132,000
North Trunk Junction to Siphon	48	8,082	575,568	2,081,060	201,200	121,500	150,000	1,095,200	1,267,400	5,492,000
Canal Crossings (1)		100		75,000				26,250	30,400	132,000
Traffic Control/Management		1 EA		20,000				7,000	8,100	35,000
Erosion Control		1 EA		200,000				70,000	81,000	351,000
Siphon Structure		1 EA		150,000				52,500	60,800	263,000
Total			942,768	3,801,060	201,200	164,000	250,000	1,825,650	2,170,500	9,405,000

NOTES:

1. Construction Costs based on ENR-CCI of 8449
2. Allowances for administration, engineering, and contingencies are set at 10%, 25% and 30% respectively
3. Assumed manhole spacing at an average of 600 ft.
4. Assumed WWTP to Sta. 125+00 restoration as native cover, rest as local road
5. Assumed 60" manholes for the 48" gravity (non-siphon) section
6. Easement allowance for the line from the WWTP to Sta.125+00

Figure 3 –Flows and sizes for Westside and North Interceptors

Alternative Alignment Evaluation

The Task 2 report for the North Interceptor followed the alignment that was used in the 1999 David Evans & Associates design of a North Interceptor. This line was not constructed. In considering this earlier work and updating it to current development plans three alternative alignments were developed and evaluated.

The three alternative alignments were developed in an attempt to locate the interceptor more to the north. This would allow more of the Juniper Ridge development to be served by gravity. Flows from developments that are on the north side of the interceptor will need to be pumped to the interceptor because the topography falls off to the north. None of the northern routes were better than the recommended alternative. Each of these alternatives require a deeper cut than the recommended alternative, therefore they would have a higher cost, while only adding minimally to the Juniper Ridge gravity service potential. The recommended alignment and the three alternative alignments that were evaluated are shown in *Figure 4*. The preferred alignment is the same one that was developed in the Task 2 report.

Plant Interceptor to Highway 97

The first element of the North Interceptor is the portion between the Plant Interceptor terminus and Highway 97. This element is 15,010 LF long, 12,405 LF of 48-inch line and 2605-feet of 42-inch line. The alignment will provide gravity service to most of Juniper Ridge – Phase I and to the Westside Interceptor at the junction with Highway 97. The alignment for this portion of the interceptor is shown on *Figure 5*.

Highway 97 to Deschutes River

The second element of the North Interceptor is the portion between Highway 97 and the Deschutes River. This element is 14,340-feet long and is 30-inches in diameter. This alignment generally follows the northern border of the UAR. This alignment will allow all of the undeveloped areas south of the interceptor to be served by gravity through a network of trunk sewers that are discussed in a later section. The alignment for this portion of the interceptor is shown in *Figure 6*.

Deschutes River Pump Station and Force Main

The Deschutes River Canyon is a direct barrier to the gravity interceptor. To cross this barrier, a pump station will need to be constructed on the west side of the river to pump flow across the river to the gravity interceptor on the east side. The pump station will be sized for a peak buildout flow of 4,400-gpm and will require a 15-inch force main that will be approximately 1,610 LF in length. This length is predicated on the assumption that a structure will be used to support the force main (aerial crossing) rather than installing the force main below the river. For this river crossing to be cost effective, a bridge must be constructed over the river. This will be dependent on development that will occur in the future on the west side of the river. Therefore, the construction of the North Interceptor on the west side of the

Figure 4 – North Interceptor to North Trunk Junction Alternative Alignments

Figure 5 – North Interceptor Junction to Highway 97

Figure 6 - Highway 97 to Deschutes River

Deschutes is completely dependent on the construction of a bridge. The ultimate placement of the pump station and force main will be dependent on where this bridge is located. Development and analysis of this option to convey wastewater across the Deschutes River Canyon were beyond the scope of this study and was not performed.

Deschutes River to Shevlin Park

The fourth element of the North Interceptor is the gravity sewer from the Deschutes River pump station to Shevlin Park. This element is 23,810 LF long made up of 1,605 LF of 27-inch line, 10,455 LF of 15-inch line, 1,110 LF of 10-inch line and 10,640 LF of 8-inch line. This alignment generally follows the northwest border of the UAR. This line will allow the undeveloped areas on the south and east sides of the interceptor to be served by gravity. The alignment for this portion of the interceptor is shown on *Figure 7*.

This line segment has also been designed to provide for the removal of the Shevlin Commons Pump Station. Undeveloped areas to the south of Shevlin Commons will also be served by gravity with this interceptor as shown in the basin plan on *Figure 3*.

Figure 7 – Deschutes River to Shevlin Park

North Interceptor Cost Estimate

The estimated cost of the complete North Interceptor is \$25M. This cost estimate is itemized and summarized in *Table 2*. Below is an estimated cost of each of the four elements of the interceptor area:

- \$ 8.8M -- Plant Interceptor to Juniper Ridge
- \$ 1.5M -- Juniper Ridge to Hwy 97
- \$ 6.5M – Hwy 97 to the Deschutes River
- \$5.1M -- Deschutes River to Shelvin (includes 8” to 27” segments)
- \$1.5M – Deschutes River Force Main (excludes support structure) and North Interceptor Pump Station
- \$ 1.6M -- Canal Crossings, Traffic and Erosion Control, Hwy Bores, and Railroad Crossings

This project can be completed in phases beginning with the Plant Interceptor to Highway 97 element following the construction of the Plant Interceptor. Construction of this phase of the project will provide the opportunity to construct and place the Westside Interceptor into service, providing capacity relief to the existing system.

North Interceptor – Trunks 1 & 2

The alignments for two trunk sewers to serve the undeveloped areas within the UAR south of the North Interceptor between Highway 97 and the Deschutes River have been identified. The alignments and the subbasins the trunk lines will provide service to are shown on *Figure 8*.

Trunk No. 1 connects to the North Interceptor at station 225+00. This trunk is a 4,865 LF in length and is a 12-inch line. The estimated project cost for this trunk sewer is \$834,600.

Trunk No. 2 connects to the North Interceptor at station 293+50. This trunk is a 4,920 LF in length and is a 12-inch line. The estimated project cost for this trunk sewer is \$843,800.

Table 2
2006 Collection System Master Plan
North Interceptor Cost Estimate

Project Element	Diameter	Total Length	Construction Cost					Allowances		Project Total
			Pipe Material	Installation	Manholes	Restoration	Easements	Engr/Admin	Contingency	
			(IN)	(LF)	(\$)	(\$)	(\$)	(\$)	(\$)	
Plant Interceptor to Juniper Ridge	48	12,405	893,200	3,441,800	560,700	124,100	0	1,757,000	2,033,000	8,809,800
Juniper Ridge to Hwy 97	42	2,605	148,500	630,500	74,400	26,100	0	307,900	356,200	1,543,600
Hwy 97 to the Deschutes River	30	14,495	573,600	2,677,500	201,100	138,200	143,400	1,306,900	1,512,200	6,552,900
Deschutes River to Shevlin Park								0		
27" Segment	27	1,605	56,200	216,700	14,600	17,700	16,100	112,400	130,100	563,800
15" Segment	15	10,455	196,600	788,300	101,800	82,400	104,600	445,800	515,900	2,235,400
10" Segment	10	1,110	9,800	77,700	10,100	8,200	11,100	40,900	47,300	205,100
8" Segment	8	10,640	60,100	810,600	114,900	78,200	106,400	409,600	473,900	2,053,700
Deschutes River Force Main	15	1,610	42,400	115,900				55,400	64,100	277,800
North Interceptor Pump Station				1,226,400						1,226,400
Canal Crossings (3)		300		225,000				78,800	91,100	394,900
Traffic Control/Management		1 EA		50,000				17,500	20,300	87,800
Erosion Control		1 EA		212,640				74,500	86,100	373,200
Hwy 97 and Hwy 20 Bores		250		250,000				87,500	101,300	438,800
Railroad Undercrossing		150		150,000				52,500	60,800	263,300
			1,980,400	10,873,040	1,077,600	474,900	381,600	4,746,700	5,492,300	25,027,000

NOTES:

1. Construction Costs based on ENR-CCI of 8449
2. Allowances for administration, engineering, and contingencies are 10%, 25% and 30% respectively
3. Assumed manhole spacing at an average of 400 ft.
4. Assumed North Trunk Junction to Hwy 97 restoration as native cover
5. Assumed Hwy 97 to Deschutes River restoration as half local street and half as native
6. Assumed 72" manholes for the 48" section, 60" manholes for the 42" and 48" manholes for the remainder.
7. Assumed no easement costs through Juniper Ridge
8. North Interceptor Pump Station - 4400-gpm, 6.3-mgd
9. Deschutes River crossing force main (1610+/- feet); Pipeline on bridge

Figure 8 – Proposed North Area Trunk Sewers

North Interceptor – Trunks 3 & 4

Two trunk sewers will be required to serve two drainage basins on the west side of the Deschutes River. The alignments and the sub basins that will be served by these trunks are shown on *Figure 8*.

Trunk No. 3 connects to the Deschutes River Pump Station at station 309+50 of the North Interceptor. This trunk drains a fairly small basin. This trunk is a 6,430 LF long 12-inch line. The estimated project cost for this trunk sewer is \$1,103,000.

Trunk No. 4 also connects to the Deschutes River Pump Station at station 309+50 of the North Interceptor. This trunk terminates at the Awbrey Glen Pump Station allowing this station to be removed from service. This trunk is an 8,350 LF long 12-inch line. The estimated project cost for this trunk sewer is \$1,433,000.

North Interceptor – Trunk 5

Trunk sewer No. 5 connects to the North Interceptor at station 419+50. This trunk is a 3,430 LF long 12-inch line. The estimated project cost for this trunk sewer is \$588,000. The alignment and sub basins that will be served by this trunk are shown on *Figure 9*.

SOUTHEAST INTERCEPTOR

The Southeast Interceptor takes flow from the east, southeast and south areas of Bend. The recommended alignment goes east from the intersection of Highway 97 and Murphy Road to SE 15th Street. It then turns north up SE 15th to the Central Oregon Irrigation District (COID) canal where it goes through a neighborhood on the north side of the canal following local street right-of-ways (ROW) to Reed Market Road and 27th Street. It then goes through a neighborhood on the north side of the canal following local street right-of-way to Reed Market Road and 27th Street. It then goes north in the 27th Street ROW to Butler Market Road, following Butler Market Road east to Deschutes Market Road, turning north to intersect with the North Interceptor and discharges into the Plant Interceptor.

The interceptor has been divided into five parts:

- Plant Interceptor to Highway 20
- Highway 20 to Reed Market Road
- Reed Market Road to SE 15th Street
- SE 15th Street to Murphy Road Pump Station
- Murphy Road Pump Station to Highway 97

The recommended service area, alignment, flows and diameters are shown in *Figure 10*.

Figure 9 – Deschutes River to Shevlin Park with Trunk Sewers

Figure 10 – SE Interceptor – Alignment and Flows

Alternative Alignment Evaluation

The Task 2 report for the SE Interceptor evaluated four alignment options. These included:

- An existing natural gas transmission pipeline corridor owned by TransCanada Gas
- A high-voltage electric transmission line corridor owned by Bonneville Power Authority and used by Central Electric Cooperative (CEC) and Pacific Corp.
- The system of irrigation canals owned by the Central Oregon Irrigation District (COID) and a portion of the Main Canal owned by the North Unit Irrigation District (NUID)
- Local road rights-of-way including a major portion of Hamby and Hamehook Roads

The local road right-of-way option along Hamby and Hamehook Roads were determined to be the best alignment at that time. Following the Task 3 value engineering workshop (TM 3A – Alternative Development Workshop), an alignment along 27th Street was proposed as an alternative route to be evaluated. The five alignment options are shown on *Figure 11*.

Similar to the four options presented in Task 2, an interceptor located along 27th Street will provide sanitary sewer service to the same southeasterly area, but the routing of the line along 27th Street will also provide service to a number of existing sewer and unsewered areas east and west of 27th Street as well that are currently within the UGB.

Recommended Alignment

A review of each of the alternatives was performed and the 27th Street became the recommended alternative. This alternative was recommended because it provides the following advantages over the other alignments:

- The 27th Street route is within the UGB
- The 27th Street route provides an alternative that locates the new trunk line primarily within the 27th Street right-of-way and other public right-of-ways reducing the issues relating to obtaining easements
- The 27th Street route will be able to provide gravity service to a number of areas currently served by the City east of 27th Street. Diverting those flows from the downtown trunk area will relieve some of the capacity limitations in that system

Figure 11 – SE Interceptor Alternative Alignments

- As more of the areas between 27th Street and Hamby Road are developed, sewage from these areas may also be routed to a new 27th Street trunk line.
- The 27th Street route will be easier to permit so the short-term service needs of the SE Bend area can be met because the route is inside the UGB.

The 27th Street alignment can share a portion of the new plant interceptor with the North Interceptor effectively shortening the 27th Street line when compared with the other options which required construction to the Water Reclamation Facility.

Alternative Implementation Strategies

Two alternative implementation strategies were evaluated for the 27th Street SE Interceptor. The first alternative is the “All Gravity” plan which has deeper cuts, but provides for gravity flow from the intersection of Highway 97 and Murphy Road to the treatment plant. The second alternative is the “Shallow with Pumping” plan which will require one or two pump stations along the route. This alternative does not have the deeper cuts but will require long-term operation and maintenance of the pump stations. The specific alternative that will be implemented will be determined during the preliminary design of the interceptor. The “All Gravity” alternative will be used as the basis for the Master Plan.

Alternative 1 – “All Gravity”

The “All Gravity” alternative proposes a new line that will be constructed at an elevation suitable to connect the lowest influent line at the Murphy Road Pump Station to the wastewater treatment plant using gravity service. This option will provide the lowest long-term operating cost and will provide the opportunity to interconnect some of the existing basins on the east side of 27th Street. The disadvantage is that the deeper cuts will require more difficult construction in high-traffic areas. The estimated capital cost for this “All Gravity” alternative is \$19.03M.

Alternative 2 – “Shallow with Pumping”

The “Shallow with Pumping” alternative proposes a more shallow line which requires one or two lift stations. This option will result in higher operating costs and a higher operational risk due to the potential for extended pump station outages. Failure of one of the pump stations will result in the loss of service to the complete service area of the SE Interceptor. The advantage of this alternative is that the construction in the high-traffic areas will take less time due to the shallower cuts. The estimated capital cost for this “Shallow with Pumping” alternative is \$20.30M.

Interconnections

Two points of interconnection are proposed. One is where the existing plant interceptor is crossed by the SE Interceptor on Deschutes Market Road north of the NUID Main Canal. The other is at the junction of the terminus of the SE and North Interceptors where they discharge to the new Plant Interceptor. The system hydraulics and the hydraulic grade lines of the North Interceptor, SE Interceptor, new Plant Interceptor and existing Plant Interceptor need to be

designed so they are close enough for flows from the three drainage areas, North Interceptors, SE Interceptor and Downtown Core, to be routed into either plant interceptor. This will allow either of the plant interceptors to be taken out of service for inspection, repair, cleaning or general maintenance.

Plant Interceptor to Highway 20

The first section of the SE Interceptor is the portion between the Plant Interceptor and Highway 20. This portion of the interceptor is 23,000-feet long. From the Plant Interceptor, the first 3,678 LF is a 36-inch diameter gravity sewer and the remaining 19,322 LF is a 24-inch gravity sewer. This section of the interceptor provides service to undeveloped areas located outside of the UGB, but within the UAR, on the west side of Deschutes Market Road as shown in *Figure 10*. This section also provides service to the sub-basins east of 27th Street. As the alignment then extends south on 27th Street, the interceptor will collect flows from existing system on the east side of 27th Street, when the elevation allows. New development on the east side of 27th Street can be designed to provide gravity discharge to the SE Interceptor. The alignment for this portion of the interceptor is shown in *Figure 12*.

Highway 20 to Reed Market Road

The second section of the SE Interceptor is the portion between Highway 20 and Reed Market Road. This section will be 6,500 LF of 24-inch diameter gravity sewer. This section begins with a crossing of Highway 20. This can be done with a bore or a direct cut. The method to be used will be determined during preliminary design, based on the allowable impact to traffic in this busy intersection. The interceptor then follows the right-of-way south on 27th Street collecting existing flows from developed and undeveloped areas east and west of 27th Street. This section ends at station 295+00 at Reed Market Road. The alignment for this portion of the interceptor is shown in *Figure 13*.

Reed Market Road to SE 15th Street

The third section of the SE Interceptor is the portion between Reed Market Road and SE 15th Street. This section will be 9,200 LF of 24-inch diameter line. There are two alternative alignments for this section of the interceptor. The first alternative is a gravity alternative and the second is a pumped alternative. The preferred alternative for the Master Plan is the gravity alternative.

Gravity Alternative

The route for the gravity alternative line alignment turns west on Reed Market Road to SE Camelot Place. The interceptor will then follow SE Camelot Place, cross private property to SE Orion Drive and then continue down SE King Solomon Lane and follows the COID canal on the north side within local street rights-of-way.

This alternative will provide service to the unsewered area north of the canal between SE 15th and 27th Streets. The interceptor crosses the canal as it leaves the local streets near SE 15th

Figure 12 – Plant Interceptor to Hwy 20

Figure 13 – Hwy 20 to Reed Market Road

Street. The gravity alternative is preferred because of the low long-term operations and maintenance costs. The alignment for this alternative is shown in *Figure 14*.

Pumped Alternative

The pumped alternative was developed as an alternative to the gravity interceptor. This was done in an effort to provide a system that could be implemented in the near-term. In the pumped alternative, a pump station is constructed near the intersection of 15th Street and the COID canal. The station then pumps through a force main with an alignment that leaves the pump station and follows the south side of the canal to the east to Ferguson Road. The force main then goes east on Ferguson Road to 27th Street. The force main turns north on 27th Street where it flows north by gravity. A new 18-inch gravity sewer follows 27th Street north to the intersection of the COID canal and 27th Street. On the south side of the canal, the size of the gravity sewer is increased to a 24-inch line. This section of the 24-inch gravity sewer then follows 27th Street to Reed Market Road. The alignment for this alternative is shown in *Figure 15*.

SE 15th Street to Murphy Road Pump Station

The fourth section of the SE Interceptor is the portion between 15th Street and the Murphy Road Pump Station. This section will be 4,100 LF of 24-inch diameter line. The gravity sewer follows 15th Street south a point approximately even with the east/west alignment of Murphy Road. The interceptor then goes west on the existing Murphy Road to the Murphy Road Pump Station.

This section allows for the decommissioning of the Murphy Road Pump Station by redirecting the flow from the Murphy Road Pump Station (old Juniper Utilities) to the east and away from the downtown core system. The Murphy Road Pump Station is currently capacity limited and this gravity sewer will allow for removing the station from service in lieu of investing in additional capacity and a new force main. The alignment for this alternative is shown in *Figure 16*.

Murphy Road Pump Station to Highway 97

The fifth section of the SE Interceptor is the portion between Murphy Road Pump Station and Business 97 (old Highway 97). This section will be 5,980-feet of 18-inch diameter line. This gravity sewer follows the alignment of Murphy Road west to Highway 97. This line then is connected to the existing gravity sewer providing service to the southern areas of the City. These flows will then be diverted east through the SE Interceptor to the treatment plant providing relief to the downtown core system. The alignment for this alternative is shown in *Figure 17*.

SE Interceptor Cost Estimate

The estimated cost of the complete SE Interceptor is \$19.03M. This cost estimate is itemized and summarized in *Table 3*.

Figure 14 – Reed Market Road to SE 15th – Gravity Alternative

Figure 15 – Reed Market Road to SE 15th – Pumped Alternative

Figure 16 - SE 15th Street to Murphy Road Pump Station

Figure 17 - Murphy Road PS to Business 97

Table 3
2006 Collection System Master Plan
SE Interceptor Cost Estimate

Project Element	Diameter	Total Length	Construction Cost					Allowances		Project Total
			Pipe Material	Installation	Manholes	Restoration	Easements	Engr/Admin	Contingency	
			(IN)	(LF)	(\$)	(\$)	(\$)	(\$)	(\$)	
North Trunk Junction to JD Estates Drive	36	3,678	169,188	744,090	95,595	52,154	0	371,359	429,716	1,862,102
JD Estates Drive to Hwy 20	24	19,986	439,692	2,729,702	292,678	383,321	0	1,345,888	1,557,384	6,748,665
Hwy 20 to Reed Market Road	24	6,324	139,128	829,350	86,047	135,840	0	416,628	482,098	2,089,090
Reed Market Road to SE 15 th St.	24	8,554	188,188	946,316	83,603	80,835	0	454,630	526,072	2,279,644
SE 15 th to Murphy Road PS	24	4,278	94,116	542,464	54,661	40,427	10,000	259,584	300,375	1,301,627
Murphy Road PS to Hwy 97	18	5,980	101,660	723,886	92,605	114,158	0	361,308	418,085	1,811,702
Canal Crossings (2)		200		150,000				52,500	60,750	263,250
Railroad Undercrossing		230		230,000				80,500	93,150	403,650
Intertie Structures		2 EA		400,000				140,000	162,000	702,000
Traffic Control/Management		1 EA		450,000				157,500	182,250	789,750
Erosion Control		1 EA		195,200				68,320	79,055	342,575
US Hwy 20 Undercrossing		250		250,000				87,500	101,250	438,750
Totals		48,800	1,131,972	8,191,008	705,188	806,735	10,000	3,795,716	4,392,186	19,032,805

NOTES:

1. Construction Costs based on ENR-CCI of 8449
2. Allowances for engineering, administration and contingencies are set at 25%, 10% and 30% respectively
3. Assumed manhole spacing at an average of 400 ft.
4. Assumed Junction Sta. 00+00 to Sta. 75+00 restoration as local street
5. Assumed Sta. 75+00 to Sta. 299+88 restoration as arterial (27th Street)
6. Assumed Sta. 299+88 to Sta. 428+20 restoration as local street
7. Assumed Sta. 428+20 to 488+00 restoration to arterial (Murphy Road)
8. Assumed 60" manholes for the 36" section and 48" manholes for the 24" and 18" sections.
9. Easement allowance for 1000' east of Murphy Road

The estimated costs for each interceptor and associated elements are:

- \$ 1.86M -- North Trunk Junction to JD Estates Drive
- \$ 6.75M -- JD Estates Drive to Hwy 20
- \$ 2.09M -- Hwy 20 to Reed Market Rd
- \$ 2.28M -- Reed Market Rd to SE 15th St.
- \$ 1.30M -- SE 15th to Murphy Rd PS
- \$ 1.80M – Murphy Rd PS to Hwy 97
- \$ 1.11M – Canal, Railroad, and US Hwy 20 Crossings
- \$ 0.70M – Intertie Structures
- \$ 1.14M – Traffic and Erosion Control

This project can be completed in phases beginning with the Plant Interceptor to Highway 20 element following the construction of the Plant Interceptor.

WESTSIDE INTERCEPTOR

The Westside Interceptor redirects the flow from the Westside Pump Station to the North Interceptor providing capacity relief for the downtown core system. Raw wastewater is pumped from the Westside pump station to a gravity interceptor that discharges into the North Interceptor as it crosses Highway 97 on the north end of the City. This interceptor will also receive flow from the Sawyer Park and Wyndemere Pump Stations. This will relieve many of the capacity problems that exist now and in the future in the NE Bend gravity system. Two alignments are proposed for this interceptor and are shown in *Figure 18*.

Westside Alignment Alternatives

There have been two alignments defined for the Westside Interceptor. The preferred alignment is Alternative 2. Variations are possible, but they will generally follow the corridors of Alignments 1 or 2. One possible variation is to follow the Alternative 2 alignment to the intersection with Highway 20, then go east to the Alternative 1 alignment and follow it to the North Interceptor. This variation will allow for some pump stations to be removed earlier and will eliminate other projects that will be required along NE Vogt Street.

Westside Alternative Alignment 1

The Westside Alternative Alignment 1 is the easterly alternative. In this alternative the flow is pumped through an 18-inch force main that crosses the Deschutes River on Portland Avenue and follows NE Olney east. The line turns to a 27-inch gravity sewer between NE 3rd and 4th Avenue. The gravity sewer turns north on NE 4th Avenue and follows NE 4th to NE Studio and then to NE Boyd Acres. The 27-inch gravity sewer follows NE Boyd Acres to NE Vogt to where it discharges into the North Interceptor east of Highway 97.

The advantage of this alternative is that it will replace other planned gravity sewers along NE Vogt. This will reduce the overall cost for providing gravity sewers to the unsewered north

area. This alternative will make removal of some of the northern pump station more cost effective. Another advantage is that there will be less disruption to traffic along Highway 97 as the alignment follows local neighborhood streets. The disadvantage of this alternative is that it is longer than Alignment 2.

Westside Alternative Alignment 2 (preferred)

The Westside Alternative 2 is the westerly alternative. In this alternative, the alignment crosses the river on the NW Portland Avenue bridge and turns north on NW Hill Street. The alignment then follows NW Hill Street north to NE Revere Avenue where it turns east to Division Street. The alignment then turns north onto Division Street and follows Division Street north until it intersects with Highway 97 following Highway 97 north to the point of intersection and discharges into the North Interceptor.

Westside Interceptor Cost Estimate

The estimated cost of the alternative 2 alignment (preferred) for the Westside Interceptor is \$8.94M. This cost estimate is itemized and summarized in *Table 4* and does not include the costs of a new Westside Pump Station. The estimated cost of each element of the interceptor is:

- \$ 0.42M – Westside Force Main
- \$ 6.96M – Gravity Interceptor
- \$ 1.11M – Undercrossings (US Hwy 97 and railroad)
- \$ 0.45M – Traffic and Erosion Control

The Westside interceptor is unlike the other two interceptors and cannot be constructed in phases. This interceptor cannot be placed into operation until the Plant Interceptor and the segment of the North Interceptor between the Plant Interceptor Highway 97 is completed.

Figure 18 – Westside Interceptor Alignments

Table 4
 2006 Collection System Master Plan
 Westside Interceptor Cost Estimate

Project Element	Diameter	Total Length	Construction Cost					Allowances		Project Total
			Pipe Material	Installation	Manholes	Restoration	Easements	Engr/Admin	Contingency	
	(IN)	(LF)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	
Westside Force Main	18	1,600	66,848	139,200	0	30,544		82,807	95,820	415,219
Gravity Interceptor	27	19,981	546,350	2,853,875	208,595	359,658		1,388,968	1,607,234	6,964,680
								0		
US Hwy 97 Undercrossing		400		400,000				140,000	162,000	702,000
Railroad Undercrossing		230		230,000				80,500	93,150	403,650
Traffic Control/Management		1 EA		176,400				61,740	71,442	309,582
Erosion Control		1 EA		84,000				29,400	34,020	147,420
Totals		21,581	613,198	3,883,475	208,595	390,202	0	1,783,415	2,063,666	8,942,551

NOTES:

1. Construction Costs based on ENR-CCI of 8449
2. Allowances for administration, engineering, and contingencies are set at 10%, 25% and 30%, respectively
3. Assumed manhole spacing in the gravity segment at an average of 400 ft.
4. Assumed restoration as improved cover along Hwy 97
5. Assumed force main in arterial street pavement
6. Costs do not include extending force mains from existing pump stations
7. Assumed 48" manholes for the 27" gravity interceptor.
8. Easement allowance includes costs of permit acquisition