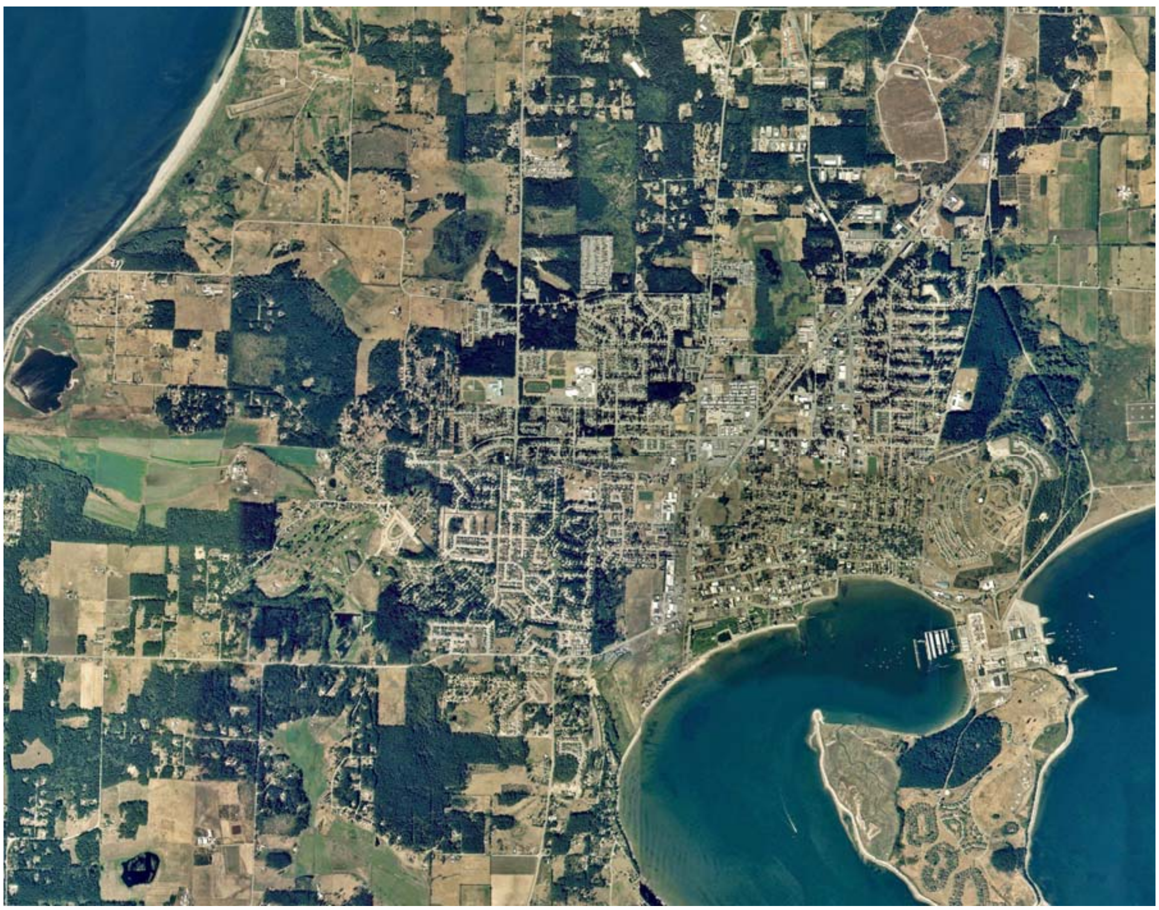
City of Oak Harbor

Comprehensive Sewer Plan



DECEMBER 2008

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CITY OF Oak Harbor
WHIDBEY ISLAND, WASHINGTON

COMPREHENSIVE SEWER PLAN

DECEMBER 2008

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Project #3530009

Cover Photo: Oak Harbor Area Aerial Photos from Island County Public Works Department Website (http://www.islandcounty.net/PublicWorks/DigitalPhotos/nwmap.htm)

Memo

Date: 12/18/2008

To: **File**

Cc:

From: **Eric Johnston, PE, City Engineer**

RE: Council Approval of Sewer Plan

At the August 8, 2007 City Council meeting the City Council approved the draft City of Oak Harbor Comprehensive Sewer Plan.

The motion for approval included a requirement to include a general statement related to the Oak Harbor with the final version. Specifically the motion stated, " To approve the 2006 City of Oak Harbor Comprehensive sewer plan with a general statement to be added referencing the Puget Sound Partnership and Island County being named as one of the counties for ongoing State efforts." This memo is the required general statement.

The Puget Sound Partnership Action Agenda published in December 2008 includes a number of action areas for cleanup of Puget Sound. Priority action area C "Reduce sources of water pollution" specifically identifies the Whidbey Basin as a target area for reducing pollutants generated by on site treatment systems and municipal wastewater treatment plants. The Oak Harbor wastewater treatment plants discharge to Oak Harbor Bay and to Crescent Harbor Bay both of which lie within the Whidbey Basin Action Area.

The City of Oak Harbor Sewer Plan identifies the need for additional treatment capacity beginning in 2017, depending on growth rates. However, in approving the sewer plan the City Council was clear that nothing bared the City from proceeding with projects for additional capacity early than 2017. The Council was clear that there may be funding opportunities through the Puget Sound Partnership efforts to assist the City in increasing wastewater treatment capacity functions while meeting the stated priorities of the Action Plan to reduce pollutants discharged to the Whidbey Basin Action Area and that the City should pursue those funding opportunities.

City of Oak Harbor
Comprehensive Sewer Plan

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ACKNOWLEDGMENTS

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Rob Kelley—Lead Wastewater Operator

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Steve Powers – Development Services Director

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David Kane—Associate Planner

EXECUTIVE SUMMARY

This Comprehensive Sewer Plan for the City of Oak Harbor updates the City's previously prepared *Comprehensive Sewerage Plan* (URS Greiner, 1997). The Washington State Growth Management Act requires the City to provide sanitary services for the anticipated growth in population that may occur during the 20 year planning period. This planning effort responds to existing system needs and the needs associated with the population increase anticipated by the City of Oak Harbor. The updates in this document address the City's sewer conveyance system and treatment needs through the planning period that extends to 2025.

BACKGROUND

Study Area

The City of Oak Harbor is near the northern end of Whidbey Island on Oak Harbor and Crescent Harbor. The eastern portion of the City is the U.S. Navy's Seaplane Base, which is one of two bases that make up Naval Air Station Whidbey Island (NAS Whidbey); the other base is Ault Field, which lies to the north of the City. The City covers 9.4 square miles, of which 4.4 square miles is the Navy's Seaplane Base and 5.0 square miles is in the "City proper".

The City's urban growth area (UGA) includes all of the City of Oak Harbor, as well as unincorporated areas to the north, between the City and Ault Field, and to the south and west. The study area for this master plan is all of the UGA, a total of 11.8 square miles. Beyond the UGA lies the Oak Harbor Island County Joint Planning Area (JPA), in which the City of Oak Harbor is likely to expand beyond the 20-year planning horizon. Figure ES-1 shows the city limits, UGA and JPA.

Land Use

The predominant land use in the City is residential development, with densities from 3 to 22 dwelling units per acre. Higher densities are located primarily near the center of the City, which features a mix of single-family and multi-family dwellings. Lower density areas, consisting mostly of single-family homes, are located to the east, west and south of the City's central core. Residential development has been limited in the northern portion of the City, due largely to noise impacts from aircraft operations at Ault Field. A survey conducted for the City's Comprehensive Plan found that Oak Harbor's mix of residential, commercial, and industrial uses is generally consistent with that of similar communities in the State of Washington. One exception is in the area of industrial land, for which Oak Harbor's total is significantly lower than other cities. However, the land use survey did not include UGA lands outside the city limits, and it is likely that the percentage of industrial land will be more in line with that of other communities as industrial land to the north of Oak Harbor is annexed over time. Table ES-1 summarizes existing land uses within the city limits.

Population

Table ES-2 summarizes estimates used in this comprehensive plan for current population and future population through the planning period

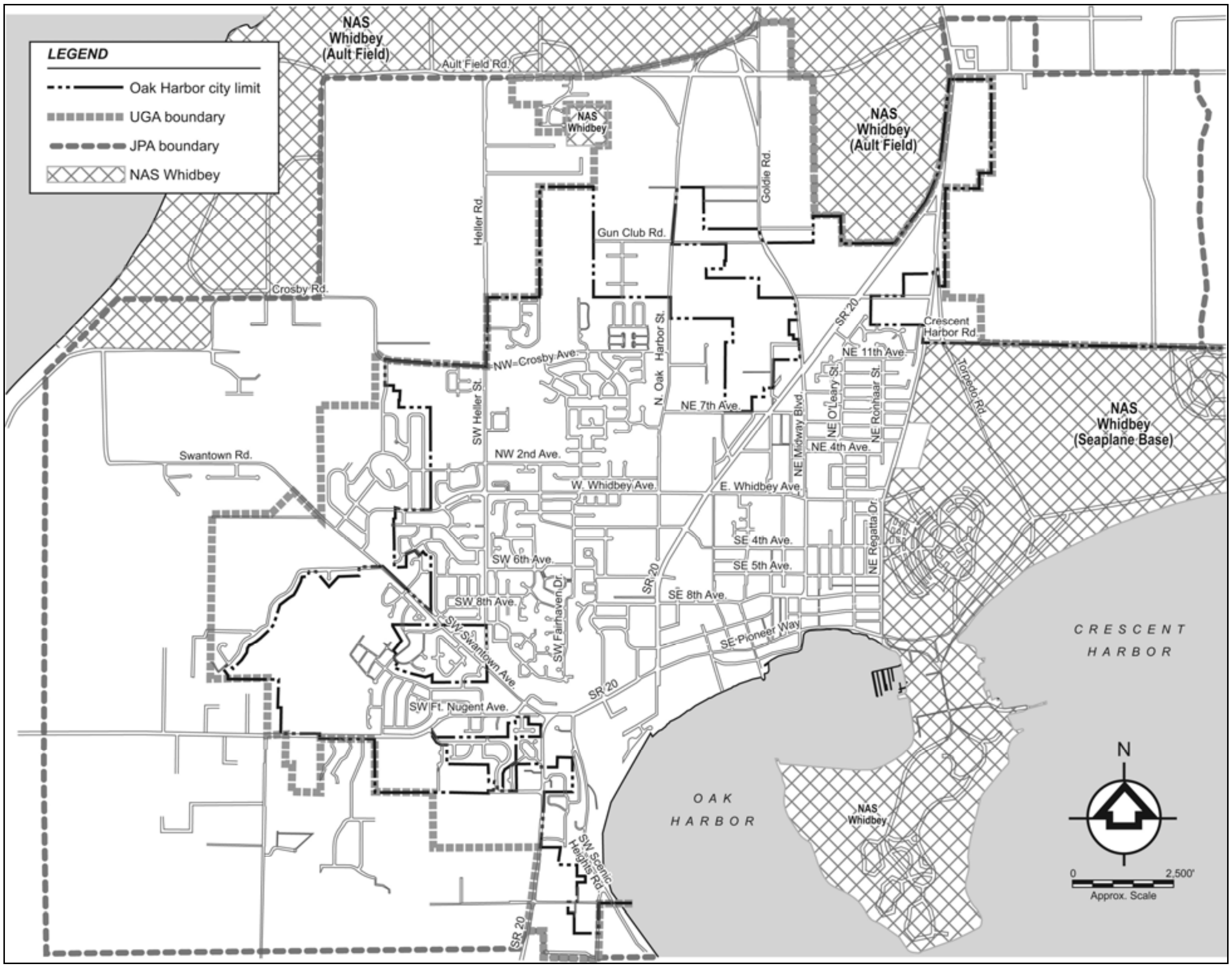

Figure ES-1. City of Oak Harbor and Vicinity

TABLE ES-1. EXISTING LAND USE IN THE CITY PROPER		
Land Use	Total Area (acres)	Portion of City Proper Total Area (%)
Single Family Residential	1,435	45
Multiple Family Residential	540	17
Commercial	420	13
Office	125	4
Industrial	120	4
Public	350	10
Open Space	220	7
Total	**3,210**	**100**

TABLE ES-2.
EXISTING AND PROJECTED FUTURE POPULATION

Year	Total	Navy Seaplane Base	City Proper
2000	19,800	4,400	15,400
2005	22,200	4,400	17,800
2011	24,200	4,400	19,800
2025	28,700	4,400	24,300

EXISTING WASTEWATER SYSTEM

Treatment Facilities

Treatment Type, Location and Ownership

The City owns, operates, and maintains a rotating biological contactor (RBC) treatment plant on SE City Beach Drive, near the City’s central business district. The City operates and maintains, under a lease agreement with the U.S. Navy, a second treatment plant on East Pioneer Avenue, on the Seaplane Base. The leased plant is an aerated lagoon facility with anaerobic pretreatment.

Flow and Load Capacity

The City’s current National Pollutant Discharge Elimination System (NPDES) permit, issued on May 25, 2005, applies to both of the City’s wastewater treatment plants. The NPDES permit establishes the following rated flow and load capacities for the treatment plants:

- RBC Plant rated capacity for wastewater influent
  - Average flow for the maximum month = 0.7 million gallons per day (mgd)
  - Biochemical oxygen demand (BOD) loading for the maximum month = 2,000 pounds per day (ppd)
- Seaplane Lagoon Plant rated capacity for wastewater influent
  - Average flow for the maximum month = 2.5 mgd
  - BOD loading for the maximum month = 4,580 ppd
  - Total suspended solids (TSS) loading for the maximum month = 5,130 ppd

Table ES-3 summarizes projections for citywide flows and BOD and TSS loads through 2025, the end of the planning period for this comprehensive sewer plan. It is recommended that the City expand the capacity of its treatment facilities for future flows within the 20 year planning period.

TABLE ES-3.
PROJECTED RAW WASTEWATER FLOWS AND LOADS THROUGH 2025

	2010	2015	2020	2025
Flow (mgd)				
Average Annual	2.08	2.22	2.36	2.50
Maximum Month	2.91	3.11	3.31	3.51
Maximum Day	5.03	5.34	5.64	5.95
BOD (ppd)				
Average Annual	4,288	4,584	4,880	5,177
Maximum Month	5,047	5,392	5,738	6,084
Maximum Day	7,447	7,973	8,499	9,026
TSS (ppd)				
Average Annual	4,305	4,618	4,931	5,243
Maximum Month	6,273	6,733	7,194	7,655
Maximum Day	9,881	10,621	11,361	12,102

Effluent and Sludge

Disinfected secondary effluent from the RBC Plant is discharged into Oak Harbor through an 18-inch-diameter corrugated metal outfall. The outfall is 1,160 feet long and terminates with a diffuser section 15 feet below mean lower low water. Disinfected effluent from the lagoon plant is discharged into Crescent Harbor through an 18-inch diameter outfall. The outfall is 3,284 feet long and terminates with a diffuser section 44 feet below mean lower low water. The NPDES permit defines the following effluent limits:

- RBC Plant
  - Monthly average effluent CBOD (carbonaceous BOD) = 25 mg/L or less
  - TSS = 30 mg/L or less
- Seaplane Lagoon Plant
  - Monthly average CBOD = 25 mg/L or less
  - TSS = 75 mg/L or less.

In recent years the Seaplane Lagoon Plant has continuously met the NPDES effluent limits, except for once in March 2004. The RBC Plant has continuously met the NPDES effluent limits except for three occasions (June 2005, August 2004 and September 2004):

Digested sludge (biosolids) from the RBC Plant is pumped to the Seaplane Lagoon Plant where it is further stabilized in anaerobic lagoons. Testing conducted in 2002 indicated that the biosolids met all criteria for “exceptional quality” as defined in federal 503 regulations. The biosolids also met the Class B requirement for testing of fecal coliform. The City plans to remove sludge from the anaerobic lagoons at least every two years and apply it as a soil amendment to permitted land application sites.

Collection Facilities

System Components

The gravity collection system serving the City proper consists of approximately 65 miles of PVC, concrete, clay and ductile iron sewer pipe ranging in diameter from 6 to 24 inches. The collection system also includes 10 lift stations and the RBC Diversion Pump Station, with approximately 5 miles of associated ductile iron, PVC and asbestos cement force mains ranging in size from 2-inch to 16-inch. Wastewater from the City proper flows to the RBC Plant, where it is either treated or pumped to the Seaplane Lagoon Plant by the RBC Diversion Pump Station.

The City owns, operates, and maintains the collection system serving users outside the Navy base and conveying flow to both treatment plants, including the conveyance infrastructure between the RBC Diversion Pump Station and the Seaplane Lagoon Plant, part of which is a 21-inch gravity sewer. The U.S. Navy owns, operates and maintains the collection system serving the Navy base, which conveys flows to the lagoon treatment plant.

System Capacity

A capacity analysis of the collection system was undertaken using computer modeling. Existing wastewater flows in the City proper were estimated from unit flows for contributions from residential, and commercial development, schools and other public facilities. Peak hour flows from these sources were obtained by use of a peaking factor. Peak Inflow and infiltration contributions were also included in the model simulations derived from typical areal contribution values related to the age of development.

Out-of-manhole flooding, sewer surcharging, capacity limitation and access restrictions were used as reference criteria for upgrading sewers. No areas of out-of-manhole flooding were identified from the computer modeling using estimated existing flows. The modeling identified peak flows approaching system capacity on some sections of conveyance pipe.

Computer modeling of the system using projected future flows showed greater levels of surcharging in the areas where surcharging is indicated for existing flows. Significant surcharging and out-of-sewer flooding are not predicted for expected flows through the end of the planning period (2025).

It is recommended that a flow monitoring study be implemented early in the planning period to verify flow modeling predictions.

POTENTIAL SYSTEM IMPROVEMENTS

Collection System

Existing System Upgrades

The results of the capacity analysis for future flow conditions expected through the end of the planning period (2025) were used to estimate when upgrades to the existing collection system would be required.

Improvement Projects for the 20-Year Planning Period

The following specific projects are to be implemented within the 20-year planning period:

- Project 1a(i)—Upgrade the RBC Diversion Pump Station to a capacity of 10 mgd, with an estimated cost of $1.86 million.

- Project 1a(ii)—Upgrade the RBC Diversion Pump Station force main. This involves the installation of 7,300 feet of new 28-inch pipe, with an estimated cost of $6.12 million.
- Project 1a(v)—Upgrade the inverted siphon to the Seaplane Lagoon headworks. This involves the installation of 1,700 feet of new 20-inch pipe, with an estimated cost of $1.07 million.
- Project 1b(ii)—Upgrade a portion of the gravity trunk sewer along Heller Street and Whidbey Avenue. This involves the installation of 1,550 feet of new 18-inch pipe, with an estimated cost of $845,000
- Project 1e(i)—Upgrade a portion of the gravity trunk sewer on Ely Street Trunk. This involves the installation of 1,300 feet of new 30-inch pipe and 1,300 feet of new 36-inch pipe, with an estimated cost of $2.11 million.

System Expansion

Improvement Projects for the 20-Year Planning Period

Expansion of the existing system will be required to support development within the UGA. The following expansion projects were identified as needing to be implemented within the 20-year planning period:

Expansion Area A—Scenic Heights

- Project A1—Install a new 600-gallon-per-minute (gpm) lift station in the southern portion of Expansion Area A, with 2,300 feet of 8-inch force main connecting to an existing trunk sewer, with an estimated cost of $600,000.
- Project A2—Install 3,100 feet of new gravity sewer in Expansion Area A connecting to the proposed new lift station, with an estimated cost of $700,000.

Expansion Area B—Fairway Lane

- Project B1—Install a new 1,700-gpm lift station north of Fairway Lane in Expansion Area B, with 8,500 feet of 12-inch force main and 400 feet of new 18-inch gravity sewer connecting to an existing trunk sewer, with an estimated cost of $3.34 million.

Expansion Area C – Crosby Road

- Project C1—Install a new 850-gpm lift station on Crosby Road in Expansion Area C, with 2,700 feet of 6-inch force main connecting to an existing trunk sewer, with an estimated cost of $1.82 million.

Expansion Area D—Goldie Road Enterprise Area

- Project D1—Install a new 1,400-gpm lift station between Oak Harbor Road and Goldie Road in Expansion Area D, with 1,700 feet of 12-inch force main connecting to an existing trunk sewer, with an estimated cost of $1.86 million.
- Project D2—Install 4,800 feet of new 18-inch gravity sewer along Goldie Road in Expansion Area D, with an estimated cost of $2.62 million.

Miscellaneous Collection System Improvements

The following miscellaneous collection system projects that are not associated with capacity deficiencies or system expansion were identified:

- Install data recording and telemetry systems at existing lift stations
- A new standby generator for emergency power at lift stations

- A flow monitoring study to verify base flows and quantify infiltration and inflow in the City's collection system
- A study to assess corrosion in the RBC Plant Diversion Pump Station force main.

Table ES-4 summarizes the resulting recommended collection system improvements and estimated costs. Figure ES-2 shows the project locations. The recommended improvements are proposed to be implemented in phases as needed. The schedule for implementation should be updated annually. The order of collection and conveyance improvements is coordinated with the recommended treatment plant improvements and assumes that all flows will be pumped from the existing diversion pump station at the RBC plant to the SPB lagoons.

Treatment Facilities

A review of the treatment capacity and alternatives is contained in the Wastewater Treatment Facilities Evaluation section of this plan. Based on cost and qualitative considerations, Alternative 3, Activated Sludge, is the recommended alternative for meeting the City's long term treatment requirements. However, the conclusions and additional alternatives should be evaluated in more detail when the City prepares a wastewater facility plan to expand the plant in the future. Several miscellaneous improvements, such as a new headworks, lagoon dike protection, and upgrades to chlorination facilities are needed at the SPB lagoon treatment plant. These miscellaneous plant improvements and common to all alternatives for lagoon plant expansion included with this study.

Table ES-5 summarizes the recommended treatment facility improvements and estimated costs. Figure ES-3 shows the layout of the proposed upgrades.

The treatment plant improvements are timed to be completed before they are projected to be needed in 2017. The need for new treatment facilities is a balance of conservative estimates of future flow, aging equipment at the RBC plant and consistency with other City planning efforts. The RBC plant must be kept in operation through the completion of treatment expansion in 2017. The RBC plant could potentially be eliminated sooner if the treatment plant expansion schedule was accelerated.

A wastewater facility plan will need to be prepared for the proposed upgrades. Typically, five to six years are needed for completion of a facility plan, design, permitting, financing and construction of major treatment plant upgrades.

It is recommended that the City begin the treatment plant facility plan no later than 2011.

It is further recommended that additional alternatives, including location and treatment technologies, be evaluated in greater detail either prior to or during preparation of a wastewater facility plan.

TABLE ES-4.
SUMMARY OF RECOMMENDED COLLECTION SYSTEM IMPROVEMENTS

Project No.	Location	Estimated Completion Year	Description	Planning Level Cost
Collection System Expansion				
A1	Scenic Heights	2007	Scenic Heights Lift Station and Force Main	$600,000
A2	Scenic Heights	2007	New Gravity Trunk Sewers	$700,000
B1	Swantown Road/ Fort Nugent Avenue	2011	Fairway Lane Lift Station, Force Main and D/S Trunk Extension	$3,341,000
C1	Crosby Road	2009	Crosby Road Lift Station and Force Main	$1,816,000
D1	Heller Rd/Goldie Road	2008	Goldie Road Lift Station and Force Main	$1,865,000
D2	Heller Rd/Goldie Road	2009	Trunk Sewer from Goldie Road to Proposed Lift Station	$2,617,000
			Subtotal	***$10,939,000***
Existing Collection System Upgrades				
1a(i)	RBC Pump Station	2009	Upgrade RBC PS to 10 mgd	$1,856,000
1a(ii)	RBC Pump Station to Seaplane Base	2012	Upgrade RBC PS Force Main	$6,123,000
1a(v)	Seaplane Base	2007	Upgrade of Inverted Siphon Capacity to Lagoon Headworks	$1,069,000
1b(ii)	Heller Road/Whidbey St.	2010	Interim Upgrades to Heller Road and Whidbey St. Trunk Sewer	$845,000
1e(i)	Ely Street to City Beach	2011	Interim Upgrade to Ely Street Sewer to RBC Pump Station	$2,113,000
			Subtotal	***$12,006,000***
Other System Improvements				
1	Various Lift Stations	2009	Install data logging/telemetry at critical lift stations.	$500,000
2	NE 7th Lift Station	2007	Purchase an additional permanent standby generator	$50,000
3	System Wide	2007	Infiltration / Inflow and Flow Monitoring Study	$175,000
4	RBC Diversion Pump Station Force Main	2007	Corrosion Study	100,000
			Subtotal	***$825,000***
Total Cost for Recommended Collection System Improvements				**$23,770,000**

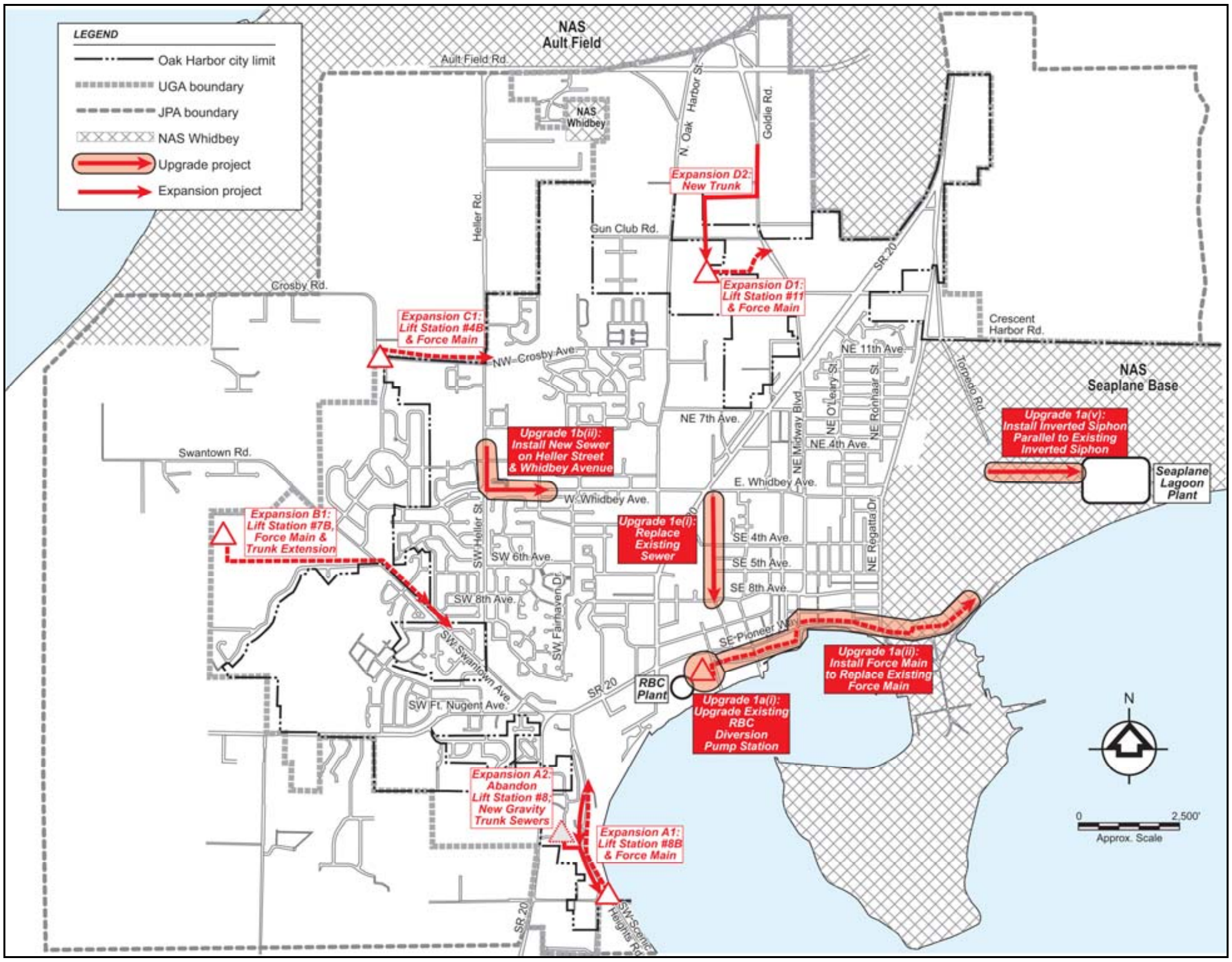

Figure ES-2. Recommended Collection System Improvements

TABLE ES-5.
ESTIMATED CAPITAL COSTS FOR RECOMMENDED WASTEWATER TREATMENT IMPROVEMENTS

Headworks	$591,965
Aeration Basins	$2,142,635
Clarifier system	$4,799,145
Lagoon Pump Station	$203,619
Disinfection & Effluent Pumping	$1,965,460
Control Building	$1,257,388
Wetland Dike Upgrades	$917,689
RBC Plant Demolition	$510,730
Subtotal	***$12,388,629***
Contingency (30%)	$3,716,589
Total estimated construction cost	**$16,105,218**
Engineering Design (15%)	$2,415,783
Construction Management (10%)	$1,610,522
Sales Tax (8.3%)	$1,336,733
Total Estimated Capital Cost	**$21,468,000**

*Estimated completion by 2017.

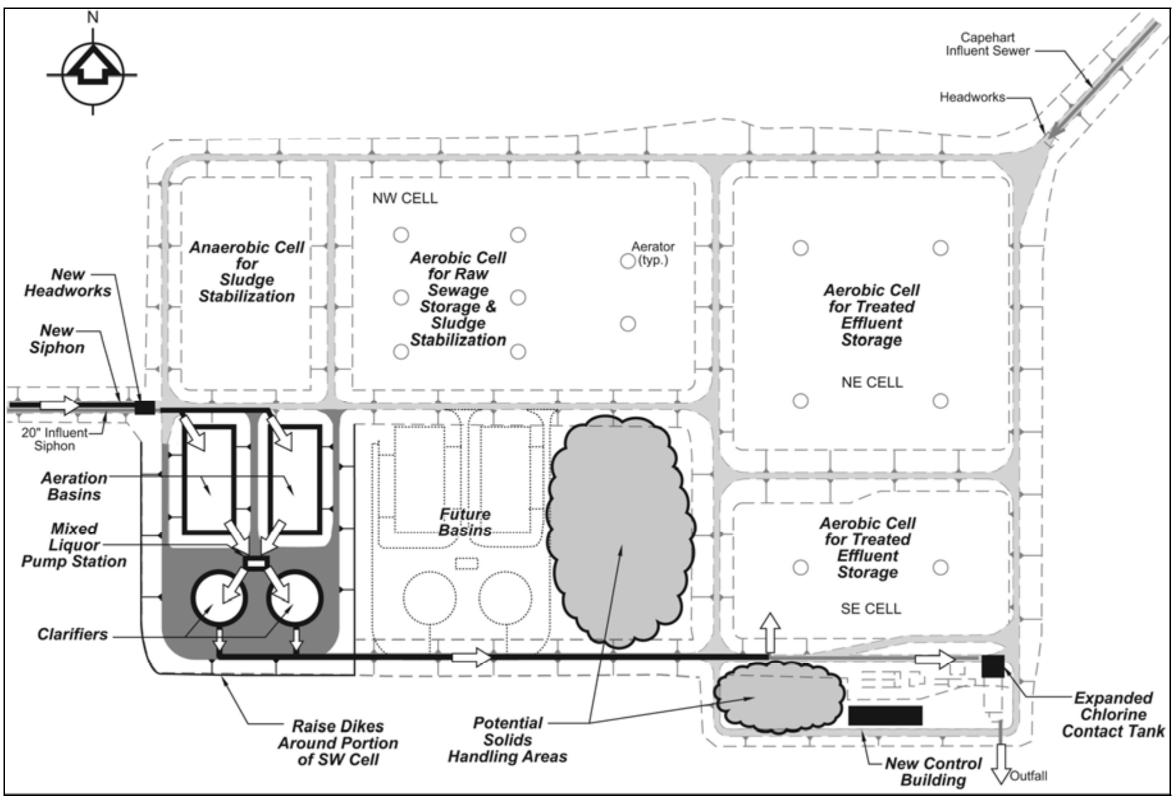

Figure ES-3. Recommended Treatment Plant Improvements

CHAPTER 1.
INTRODUCTION

PURPOSE

This Comprehensive Sewer Plan for the City of Oak Harbor updates the City's previously prepared *Comprehensive Sewerage Plan* (URS Greiner, 1997). The updates in this document address the City's sewer system and treatment plant needs through the design year, 2025. The City retained Tetra Tech/KCM, Inc. to prepare a sewer plan update that meets the requirements of Washington Administrative Code (WAC) 173-240-050 (Comprehensive Sewer Plans). The Washington State Growth Management Act requires the City to provide sanitary services for the growth in population that will occur over 20 years. This planning effort responds to existing system needs and the needs associated with the population increase forecast by the City of Oak Harbor.

AUTHORIZATION

In April 2005, Tt/KCM was authorized to update the City of Oak Harbor's *Comprehensive Sewerage Plan* in conformance with current Washington State Department of Ecology regulations and guidelines listed in the Washington Administrative Code.

SCOPE

Development of this report included the following tasks:

- Develop geographic information system (GIS) data and a GeoDatabase for report mapping.
- Inventory sewers, pump stations, force mains and wastewater treatment facilities.
- Analyze available population, flow, load, and infiltration and inflow (I/I) data.
- Develop a hydraulic capacity model for the existing collection system and assess the system under existing and projected flows.
- Develop alternatives to extend and upgrade the existing collection system to correct existing problems and accommodate projected growth.
- Evaluate flows and loads to the City's wastewater treatment plants for past, present and future conditions.
- Perform a capacity analysis for key treatment plant components (including primary and secondary treatment, disinfection and sludge management).
- Develop improvement alternatives for treatment plant liquid and solids-handling processes.
- Compare alternatives and recommend treatment plant and collection system improvements based on engineering, financial and environmental criteria. Present recommendations within a capital improvement program identifying proposed work and estimated costs.
- Prepare environmental documentation as appropriate for implementation of the capital improvement program.
- Develop a financial program for implementation of the first six years of the capital improvement program.
- Assess wastewater system operation and maintenance and the emergency response plan and recommend modifications as appropriate.

RELATED STUDIES

The following previous studies and planning documents were used in the preparation of this report:

- *City of Oak Harbor Comprehensive Plan.* City of Oak Harbor Development Services Department. October 2005.
- *Impact of Tidal Influence on the Sewage Lagoons, City of Oak Harbor Seaplane Base.* URS. September 2005.
- *Fact Sheet for NPDES Permit WA-002056-7 Oak Harbor Wastewater Treatment Plants.* Washington State Department of Ecology. 2005.
- *Operation and Maintenance Manual Update for Seaplane Wastewater Lagoon Treatment Facility, City of Oak Harbor, Washington.* Stantec Consulting, Inc. December 2004.
- *Engineering Report, RBC Wastewater Treatment Plant Capacity Analysis, An Addendum to the Engineering Report for the Upgrade of Secondary Treatment Facilities, NAS/Seaplane Base, June 1987.* URS. September 2004.
- *City of Oak Harbor 2003 Water System Plan*. Earth Tech, Inc. and Katy Isaksen & Associates. May 2004.
- *Oak Harbor Seaplane WWTP Improvement, Addendum to the 1987 Engineering Report.* Sear-Brown and URS Corporation. March 2004.
- *Crescent Bay Salt Marsh and Salmon Habitat Restoration Plan.* Philip Williams & Associates, Ltd. (PWA) and University of Washington Wetland Ecosystem Team (UW-WET). July 2003.
- *Pre-Design Study of Wastewater Treatment Lagoon Upgrades for Oak Harbor, Washington.* Sear-Brown. October 2001.
- *Comprehensive Plant Evaluation Findings for the Oak Harbor Lagoon System.* Sear-Brown. January 2001.
- *City of Oak Harbor Comprehensive Sewerage Plan.* URS Greiner. April 1997.
- *Engineering Report, RBC Wastewater Treatment Plant Evaluation, an Addendum to the Engineering Report for the Upgrade of Secondary Treatment Facilities NAS/Seaplane Base, June 1987*. URS Consultants, Inc. January 1995.

WASTEWATER SYSTEM OWNERSHIP AND OPERATION

The City of Oak Harbor owns, operates, and maintains a rotating biological contactor (RBC) treatment plant site and facilities on SE City Beach Drive, near the City's central business district. The City operates and maintains, under a long term lease agreement with the U.S. Navy, a second treatment plant, the Seaplane Base Wastewater Treatment Plant. The SPB plant is situated on land owned by the U.S. Navy. The City owns the facilities constructed by the City after signing of the lease, however the Navy retains ownership of the property. Improvements are considered tenant improvements. A copy of the lease agreement is included in Appendix A. The City owns, operates, and maintains the collection system serving users outside the Navy base and conveying flow to both treatment plants; the U.S. Navy owns, operates and maintains the collection system serving the Navy base, which conveys flows to the lagoon treatment plant.

The City's wastewater facilities representative is as follows:

Cathy Rosen, Public Works Director
City of Oak Harbor
865 SE Barrington Drive
Oak Harbor, Washington 98277
(360) 279-4500

CHAPTER 2.
BACKGROUND

STUDY AREA

The City of Oak Harbor is near the northern end of Whidbey Island in Island County, Washington. Island County consists of Whidbey Island and Camano Island, in the area where Puget Sound meets the Strait of Juan de Fuca (see Figure 2-1). The City is situated on Oak Harbor and Crescent Harbor, which are adjoining embayments off Saratoga Passage, the waterway separating Whidbey Island from Camano Island. The eastern portion of the City is the U.S. Navy's Seaplane Base, which is one of two bases that make up Naval Air Station Whidbey Island (NAS Whidbey); the other base is Ault Field, which lies to the north of the City. The City covers approximately 6,030 acres (9.4 square miles), of which 2,820 acres (4.4 square miles) is the Navy's Seaplane Base.

The City's urban growth area (UGA) includes all of the City of Oak Harbor, as well as unincorporated areas to the north, between the City and Ault Field, and to the south and west (see Figure 2-2). The UGA represents all of the Oak Harbor vicinity likely to be needed for development to accommodate urban growth over the next 20 years. Beyond the UGA lies the Oak Harbor Island County Joint Planning Area (JPA), in which the City of Oak Harbor is likely to expand beyond the 20-year planning horizon.

The study area for this master plan is all of the UGA. The total area of the study area is 7,540 acres (11.8 square miles). The JPA is not included in the study area, as it is not expected to require City sewer service within the 20-year planning period for this master plan. Some of the master plan analyses were performed separately for the incorporated portion of the study area, excluding the Seaplane Base ("the City proper") and the unincorporated portion of the UGA.

The City-owned wastewater collection and treatment system currently serves almost all of the developed area within the city limits outside the Seaplane Base. The collection system for the Seaplane Base is owned and operated by the Navy. The Seaplane Base treatment facility is owned by the Navy and operated by the City under a lease agreement, which is included in Appendix A.

TOPOGRAPHY

The study area generally consists of gently sloping terrain with undulating hills. Exceptions to this general topography are the steep bluffs adjacent to the water in the southern part of the study area and the prominent hills west of the city center. Typical slopes within the study area are 3 to 6 percent. Elevations within the study area range from just over 400 feet (City of Oak Harbor datum) to sea level (100 feet, City of Oak Harbor datum). Figure 2-2 shows the study area topography.

CLIMATE

The climate in the study area is generally mild and uniform because of the small range of elevations, the rain shadow effect of the Olympic Mountains and the tempering effect of the surrounding waters. The daily mean high temperature is 57.5ºF. Average annual precipitation is 17.73 inches, of which about 6 inches falls as snow. The City experiences fairly distinct dry and wet seasons, with most of the annual precipitation falling from October through April (URS Greiner, 1997).

SURFACE WATERS

Oak Harbor and Crescent Harbor are the main surface waters within the Oak Harbor UGA. They are marine waters on the east side of Whidbey Island next to Saratoga passage and Skagit Bay as shown in Figure 2-1.

There are no significant streams or rivers within the Oak Harbor UGA. In the central area of the City, all former open channels have been piped in the City’s storm drainage system. A few large open channels remain in Freund Marsh. There is a small lake on the grounds of the Whidbey Golf and Country Club in the southwestern part of the City. Drainage flows from farmlands south of the City through the Waterloo Marsh and Loers Pond into this lake, also known as the Golf Course Pond. The western portion of the study area includes a number of drainage sinks—topographically isolated drainage areas where stormwater that enters can leave only by infiltration to groundwater or by evaporation. Figure 2-3 shows the surface waters in the study area.

Crescent Harbor Marsh is a wetland system on the Seaplane Base that contains both saltwater marsh and freshwater marsh communities. Crescent Creek provides seasonal freshwater to the system. This marsh was once the largest (300 acres) open barrier salt marsh on Whidbey Island. Like many coastal wetlands in the Puget Sound region, Crescent Harbor Marsh has experienced a long history of hydrologic modifications. In the early 1900s, it was diked and drained for agricultural use, and the natural channel was replaced with a gated culvert. In the 1960s the U.S. Navy constructed the Seaplane Lagoons wastewater treatment plant in the center of the marsh. The plant was upgraded in 1990 by the City of Oak Harbor. Berms surrounding the plant protect it from marsh water infusion. In 1994, the tide gate separating the marsh from the harbor was permanently opened. However, the undersized culvert severely limits tidal heights during the summer and impedes freshwater discharge during the winter (URS, 2005). Currently Island County and the Navy are developing plans to restore approximately 200 acres of the marsh as natural wetlands and juvenile salmon rearing habitat. This will require larger passages for tidal circulation, such as larger culverts and notched channels or weirs across the sewer berms, and replacing portions of the roadway berms with pile supported bridges (PWA, 2003).

Interspersed throughout much of the study area are designated critical areas. Critical areas, as defined in the City’s Comprehensive Plan, include shorelines, wetlands, fish and wildlife habitat, frequently flooded areas, areas of aquifer recharge value, and hazardous slope areas. Wetlands and hazardous slope areas are illustrated in Figure 2-3. Tidal flats are found along the shoreline of Oak Harbor. Some wetland areas are found within the study area, with one large wetland system associated with the shoreline. Flood hazard areas are associated with several of the wetland areas. Geologically sensitive areas are primarily associated with the bluffs along the shoreline and other steep slopes, and potential liquefaction areas in the downtown area and on the Seaplane Base.

GROUNDWATER

Groundwater aquifers in the study area are contained in glacial and interglacial deposits, with elevations generally following the surface topography (URS Greiner, 1997).

The exact number of aquifers on the island is not known. They are numerous, of varying sizes, and are located at varying depths. These differences account for the varying depths to which wells must be drilled to reach potable water. There is no underground river that supplies water to the island. All of the aquifers on Whidbey Island are sole source aquifers replenished only by rain, and the aquifers are susceptible to contamination from various ground surface sources. The North Whidbey Watershed Non-point Pollution Prevention Plan adopted by the County in 1997 ranked residential on-site septic systems as the main source of contamination of the aquifer. (*Water Resources on Whidbey Island*, League of Women Voters, 2003).

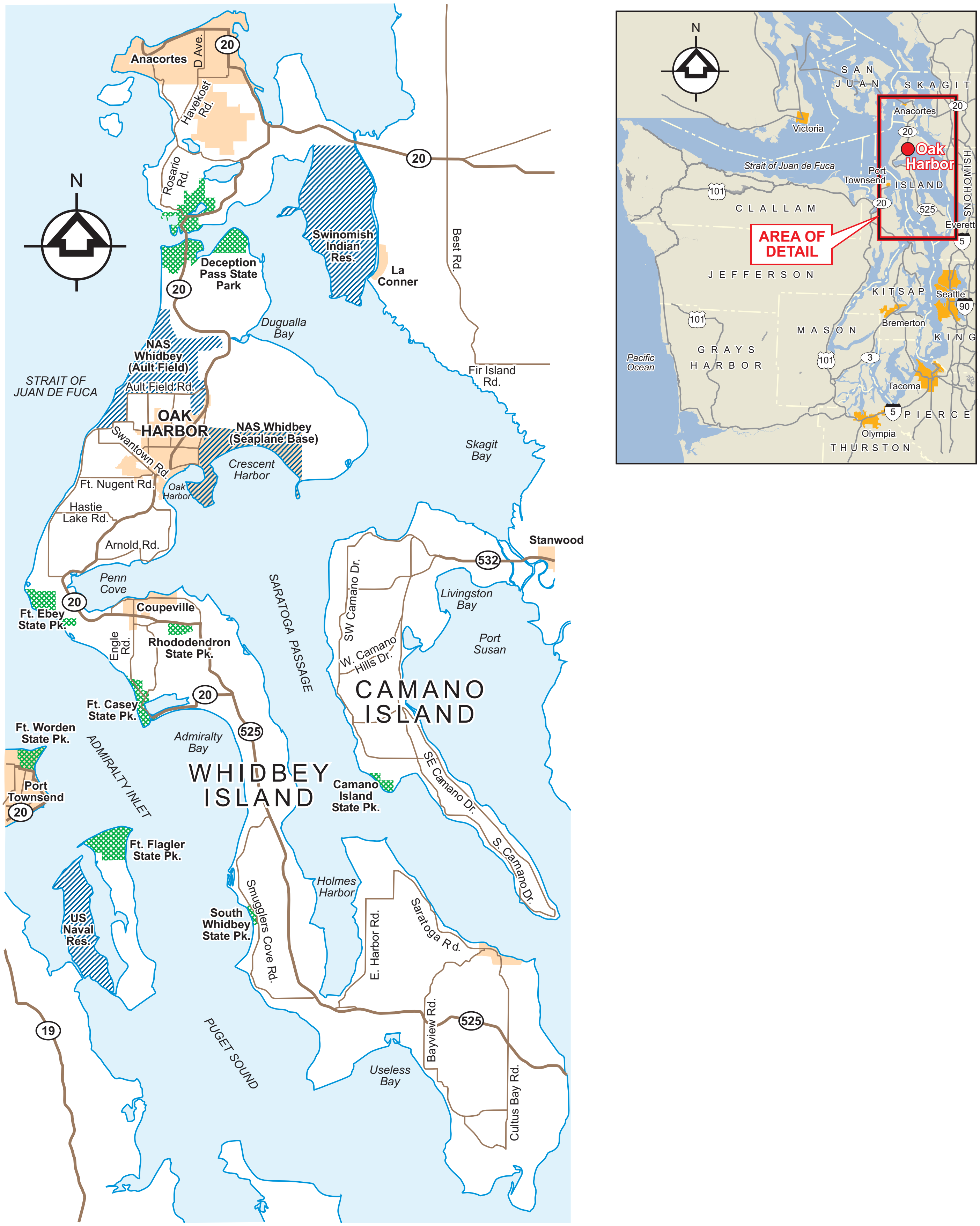

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Figure 2-1.
VICINITY MAP

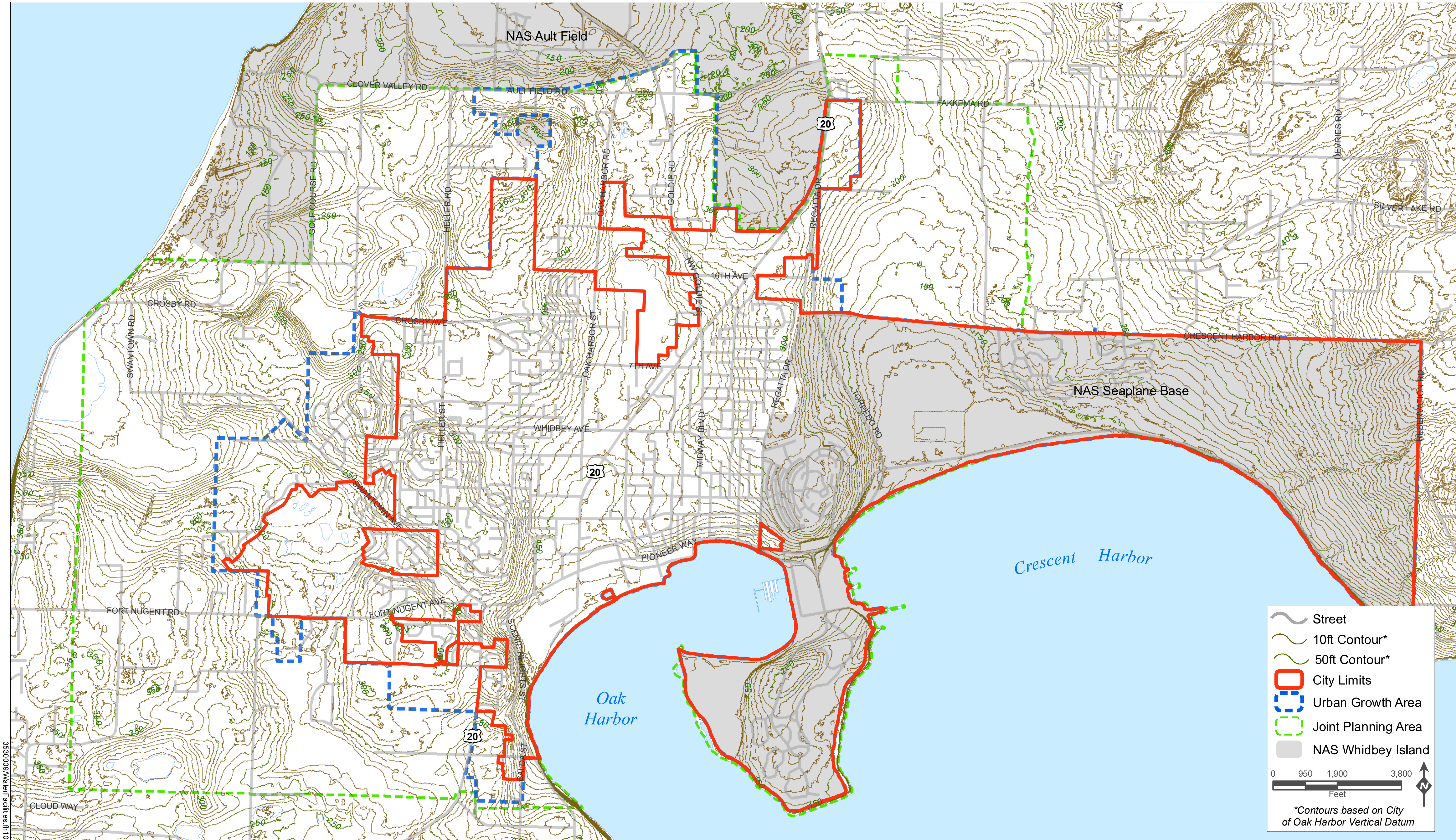

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Figure 2-2.
OAK HARBOR STUDY AREA AND TOPOGRAPHY

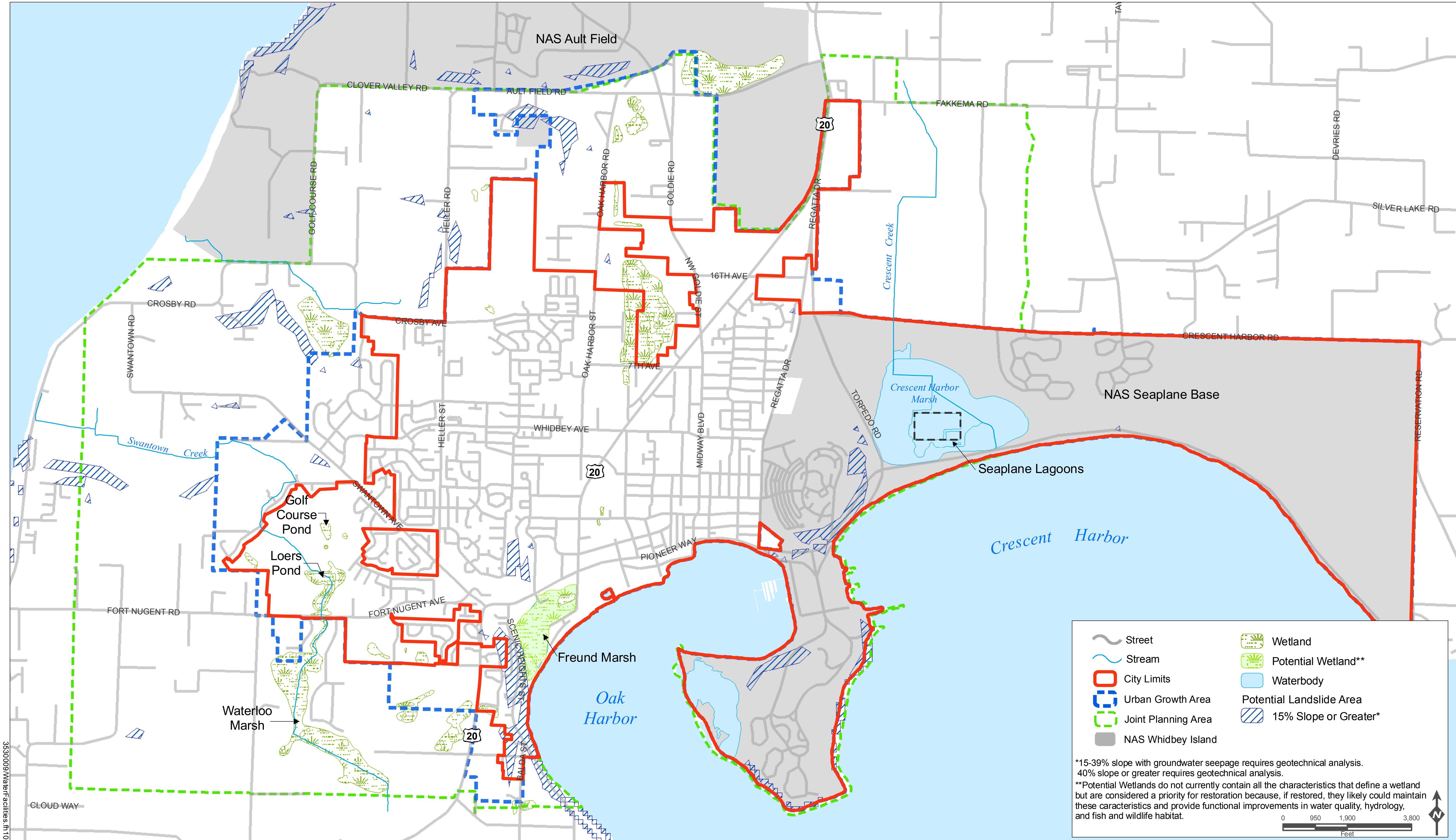

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Figure 2-3.
OAK HARBOR SURFACE WATERS
AND CRITICAL AREAS

On-site systems are a relatively minor source of groundwater contamination inside the City because the vast majority of sewage in the City is discharged to the sewer system. There are only an estimated 136 on-site septic systems inside the City as discussed in Chapter 6 of this report. Other potential sources of groundwater contamination in the City include leaking sanitary sewers, use of pesticides and herbicides, runoff of petroleum products from roads and runoff from industrial and military sites.

The depth to groundwater varies widely across the City of Oak Harbor water service area. Variations occur with both geography and seasonal variations. Generally speaking however, gravity sewers in Oak Harbor are typically constructed in the dry meaning that little or no dewatering is necessary for sewer trenches of 8-10 foot depths.

GEOLOGY

Geologic characteristics in the study area are largely the result of regional glacial processes. Erosion and deposition associated with glaciation have strongly influenced regional topography, soils, and groundwater characteristics.

Soils in the study area are generally a sandy loam developed under a heavy stand of timber in mild, moist, nearly frost-free climate. The parent material can be described as undulating and rolling, gravelly and stony, coarse to moderately coarse textured material underlain by loose glacial outwash. However, soils throughout the study area are highly variable.

There are 18 soil classifications within the study area, with subclassifications based on slope. Most soils in the central area of the City are of the Townsend variety, which are characterized by a sloping well-drained soil underlain by compact gravelly till. North of this central area, the soil transitions to Whidbey soils, which are well-drained soils underlain by a cemented glacial till. To the west, the soil transitions to Coveland soil, a poorly drained soil underlain by fine-textured till, marine or lake-laid sediments. Continuing west, the soil transitions into Hoypus soil, an excessively drained soil underlain by loose gravelly or sandy drift or wind-reworked areas.

WATER SUPPLY

The Water Division of the Oak Harbor Public Works Department provides City customers with treated water obtained from Anacortes via 10- and 24-inch transmission lines, and from an aquifer below the city via three wells. The Anacortes supply is the primary source. Oak Harbor has entered into a 20-year Water Supply Agreement with Anacortes, and renegotiates water charges and committed water volume with an annual amendment. The most recent water service amendment (2002) allows Oak Harbor to draw 2.66 million gallons per day, which is expected to be an adequate supply through 2013. The Navy and the City have an equal allocation of water capacity through the existing transmission lines. The supply and transmission system have sufficient capacity to meet the projected 2013 peak-day demand for the UGA service area (City of Oak Harbor, 2005). Figure 2-4 shows the key elements of the City water system.

The quality of treated water from Anacortes and the raw water from the City’s wells complies with state drinking water standards. The immediate area surrounding the City proper is served by about 30 water purveyors, each of which generally serves fewer than 100 customers. According to Island County Public Health and Human Services, the quality of water provided by these purveyors generally meets state drinking water standards, although the water has a high iron and manganese content (URS Greiner, 1997).

OTHER WASTEWATER FACILITIES

Under the requirements of WAC 173-240-050 for general sewer plans, the City must assess the feasibility of developing regional wastewater facilities with neighboring communities and industries within 20 miles. The following are within 20 miles of the City:

- On Whidbey Island
  - Penn Cove Water and Sewer District Wastewater Treatment Plant
  - Town of Coupeville Wastewater Treatment Plant
  - City of Langley Wastewater Treatment Plant
  - Ault Field Wastewater Treatment Plant
- Off Whidbey Island
  - City of Anacortes Wastewater Treatment Plant
  - Fisherman Bay Sewer District Wastewater Treatment Plant
  - City of Port Townsend Sewage Treatment Plant
  - Port Flagler State Park Sewage Treatment Plant
  - City of Stanwood Sewage Treatment Plant
  - City of Mount Vernon Wastewater Treatment Plant
  - Warm Beach Christian Camp & Conference Center Wastewater Treatment Plant

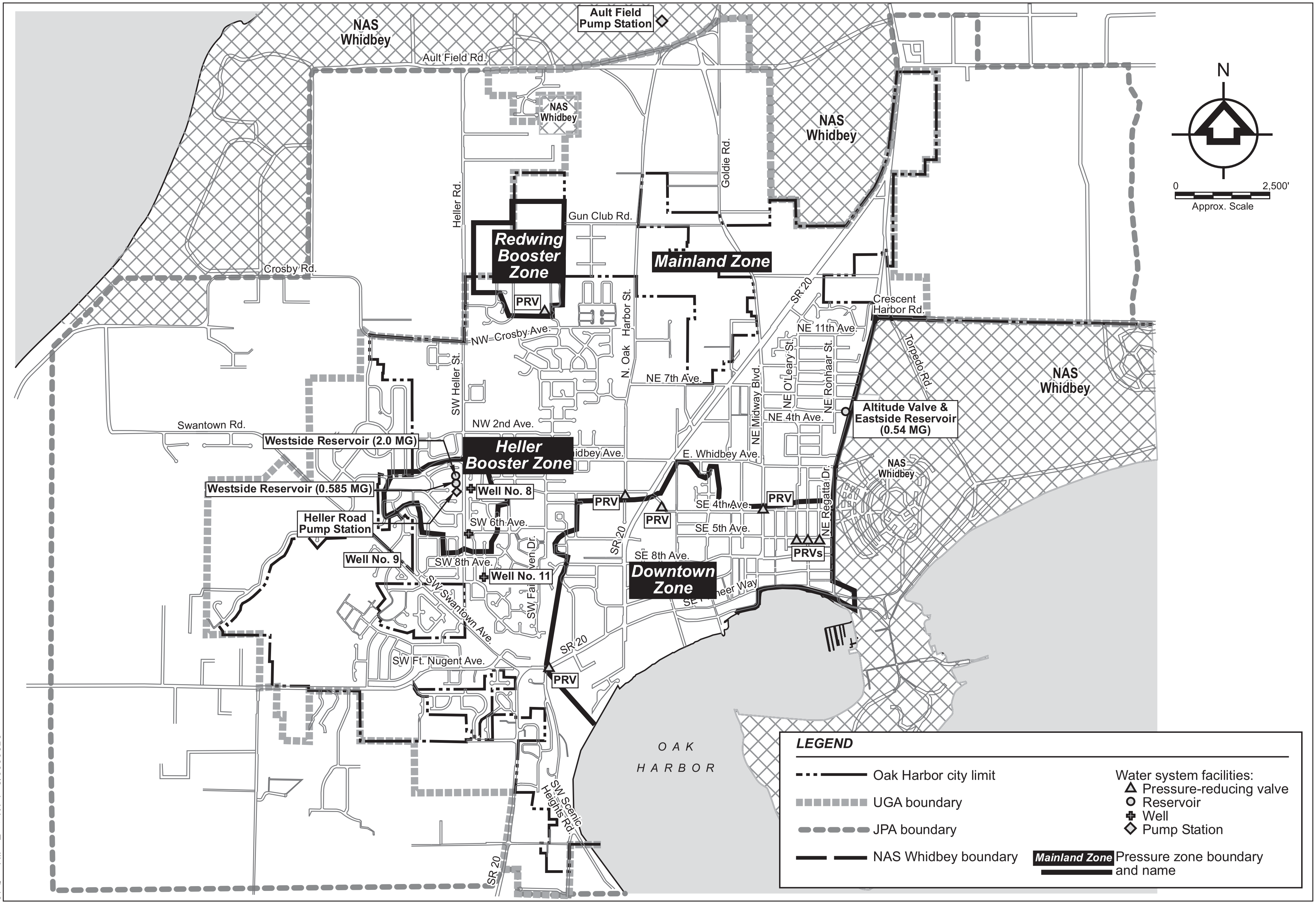

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Figure 2-4.
WATER SYSTEM FACILITIES

Due to the City of Oak Harbor's island location, pumping wastewater to treatment facilities off Whidbey Island was not considered. The four existing facilities on Whidbey Island are several miles away from Oak Harbor and were designed to serve small communities and towns. In addition, the topography is undesirable. Therefore, joint use is not feasible at this time.

CHAPTER 3.
LAND USE AND POPULATION

Planning decisions regarding sewage treatment facilities, interceptors, and collection systems rely on analysis and projection of population and land use. Population forecasting data and land use information used for the analysis in this report were provided by the City's Planning Department.

PLANNING AREAS

The study area was divided into two planning areas for analysis in this comprehensive plan:

- **The City Proper—**The area inside the current Oak Harbor city limits, excluding the Navy's Seaplane Base.
- **The Unincorporated UGA**—The area of the UGA outside the city limits.

LAND USE

Existing Land Use

The information in this section is summarized from the City of Oak Harbor Comprehensive Plan (City of Oak Harbor, 2005).

A survey conducted for the Comprehensive Plan found that Oak Harbor's mix of residential, commercial, and industrial uses is generally consistent with that of similar communities in the State of Washington. One exception is in the area of industrial land, for which Oak Harbor's total is significantly lower than other cities. However, the survey did not include UGA lands outside the city limits, and it is likely that the percentage of industrial land will be more in line with that of other communities as industrial land to the north of Oak Harbor is annexed over time. The land use designations are shown in Figure 3-1.

The predominant land use in the city is residential development with densities from 3 to 22 dwelling units per acre. Higher densities are located primarily near the center of the City, which features a mix of single-family and multi-family dwellings. Lower density areas, consisting mostly of single-family homes, are located to the east, west and south of the city's central core. Residential development has been limited in the northern portion of the City, due largely to noise impacts from aircraft operations at Ault Field. The remaining areas of the City are developed with the following land uses:

- Commercial uses include the Central Business District (CBD), smaller neighborhood businesses, and auto-oriented businesses and large retail facilities located along highway corridors. The CBD features older buildings that are home to a mix of office and retail uses, as well as restaurants. The area also includes several undeveloped and underdeveloped parcels that present opportunities for future development. The commercial area along State Route (SR) 20 has developed in a manner that accommodates the auto-oriented public; it also includes businesses that feature large-scale buildings and parking lots.
- Land developed or designated for industry is located primarily in the northern part of the City. This area is within the "Air Installation Compatible Uses Zone" designated by the Navy, based on noise impacts and accident potential associated with aircraft activity at Ault Field. This area is best suited to industrial uses, and is not suitable for residential development.

- Public and institutional uses include public and private schools, churches, municipal buildings and facilities, park and recreation facilities, and open space (whether public or private):
  - The greater Oak Harbor area is served by School District #201, which operates one high school, two middle schools and six elementary schools. Several private schools also provide educational services, generally serving the K – 8 school population. A branch of Skagit Valley College is located in Oak Harbor on 2.5 acres at the east end of Pioneer Way.
  - Municipal facilities include City Hall on SE Barrington Drive, a police station across the street from City Hall, a fire department headquarters station on E. Whidbey Avenue, the library on the Skagit Valley College campus, and the public works/municipal shops facility.
  - City parks and recreation facilities include 25 parks. In addition, the School District owns approximately 85 acres of playgrounds and athletic fields, and the Navy manages some 207 acres of parks and fields for use by Navy personnel and their dependents.

Table 3-1 summarizes existing land uses within the City Limits.

TABLE 3-1.
EXISTING LAND USE IN THE CITY PROPER

Land Use	Total Area[a] (acres)	Portion of City Proper Total Area (%)
Single Family Residential	1,435	45
Multiple Family Residential	540	17
Commercial	420	13
Office	125	4
Industrial	120	4
Public	350	10
Open Space	220	7
Total	3,210[b]	100

a. Area based on 2005 GIS data.
b. Does not include Naval Air Station. Naval Air Station contains approximately 2,820 acres.

Future Land Use

Projected land use for the Urban Growth Area, as defined in the City's 2005 Comprehensive Plan, is based on City and County zoning designations. Zoning designations are shown in Figure 3-2. Future development in any area must conform to the zoning for that area, therefore zoning designations were used as a guide in estimating future levels of development in the study area. Potential near-term and long-term growth scenarios are discussed in Chapter 7.

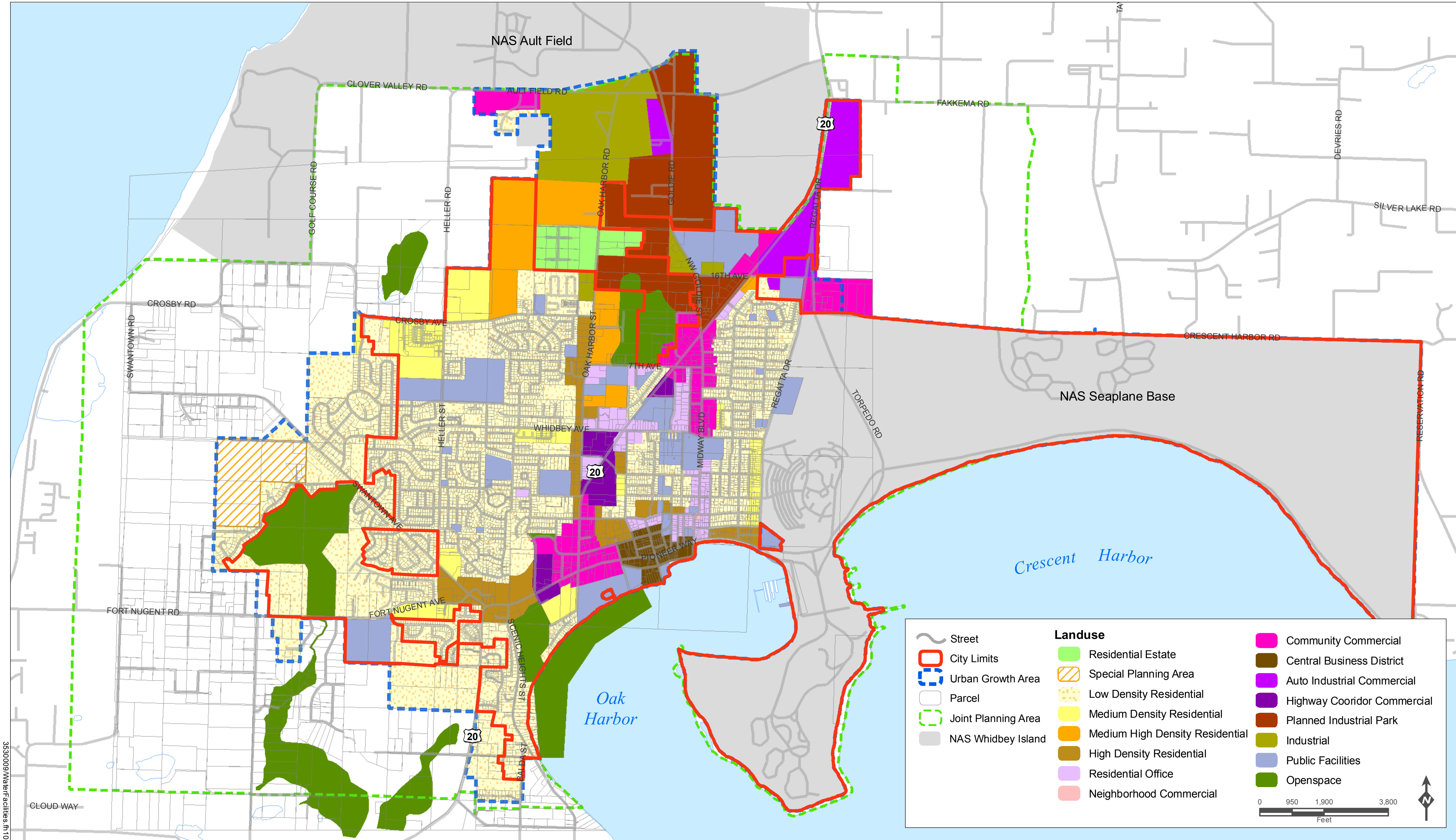

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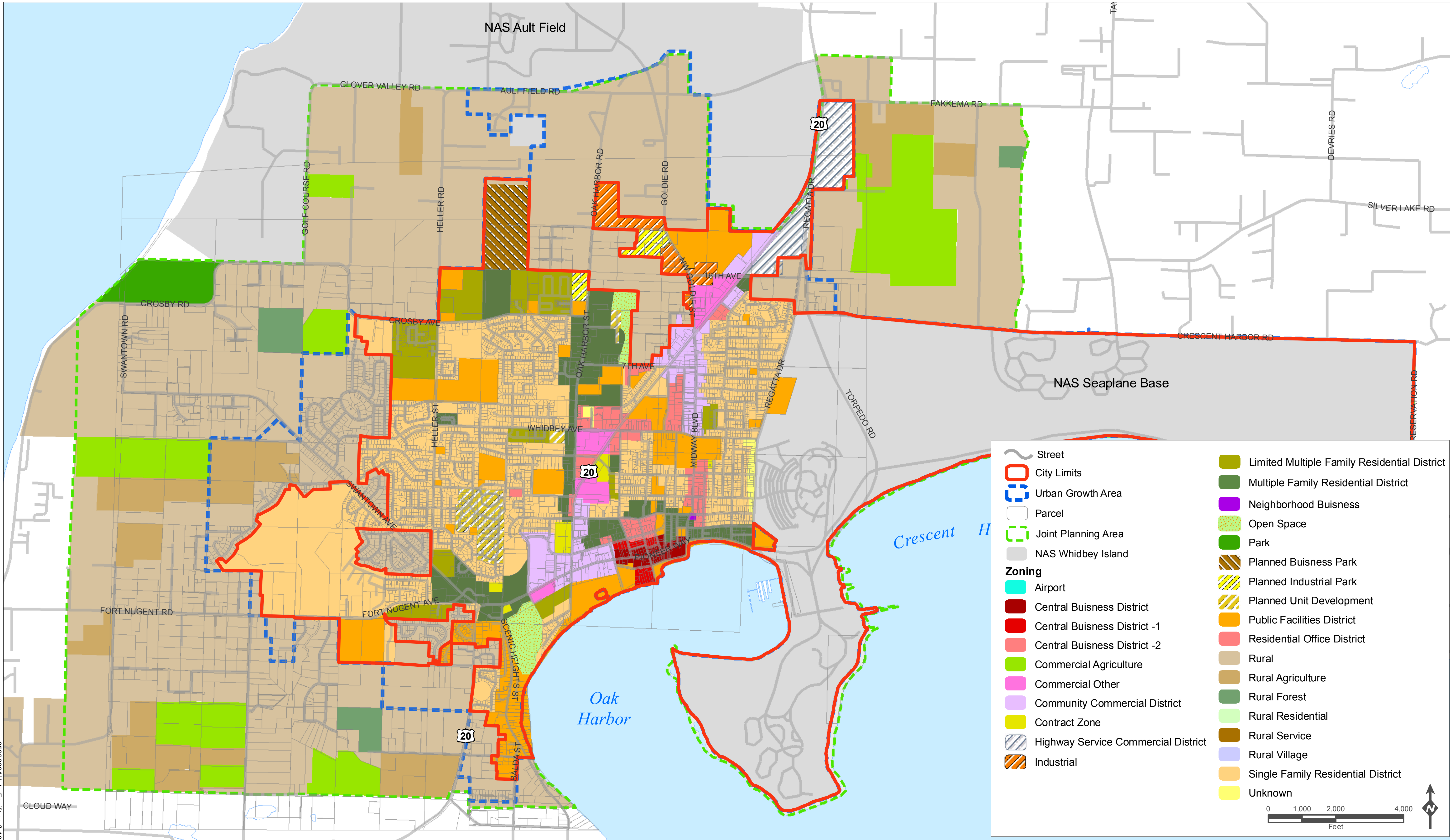
Figure 3-1.
OAK HARBOR
LANDUSE



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City of Oak Harbor
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Figure 3-2.
OAK HARBOR
ZONING

POPULATION

The following sources and methods were used to develop estimates of existing and future population in the study area:

- The City's Planning Department provided population data for the year 2000 (based on U.S. Census data) and for 2025. The numbers provided by the City's Planning Department are lower than estimates used in previous planning documents. The City's 1997 Sewer Plan references the Washington State Office of Financial Management's low, medium and high projections, and uses the high projection (2.55-percent annual growth rate) of 32,316 people in the year 2016 for planning purposes. The City's 2005 Comprehensive Plan uses the medium projection (2.05-percent annual growth rate) of 29,704 people in the year 2020. The City's 2003 Water System Plan uses the high projection and estimates a total of 31,773 people in the year 2023. The population data provided by the City's Planning Department for this report is significantly lower than previous estimates because the City recently discovered a miscalculation in the state's earlier projections.
- Population on the Seaplane Base for the year 2000 was obtained through an analysis of U.S. Census block data in a GIS format.
- In the year 2000, population for the City proper (the incorporated area outside the Seaplane Base) was calculated as the difference between the total City population provided by the Planning Department and the estimated Seaplane Base population.
- For the year 2005 population estimate, growth in the City proper since the year 2000 was estimated based on a review of plats. For collection system analysis, it was assumed that the Seaplane Base population would remain unchanged from the year 2000.
- The year 2011, population was estimated based on a review of areas that are projected to be developed within the next six years, per discussions with the City's Planning Department. For collection system analysis, it was assumed that the Seaplane Base population would remain unchanged from the year 2000.
- For the year 2025 population estimate, City staff noted that the Navy periodically considers base closures and expansions which could result in unforeseen population changes at the base during the next 20 years. However, current assumptions are based on Navy Planning which indicates no planned increase in population on the Naval Air Station Whidbey Island Seaplane Base. For this report, it was assumed that the Seaplane Base population would remain the same as the estimated 2005 population, and the population for the City proper was calculated as the difference between the total City population provided by the Planning Department and the estimated Seaplane Base population.
- Total study area population was calculated as the sum of the populations in the City proper and in the unincorporated areas of the UGA.
- A long-term growth projection of population was estimated based on future zoning designations at maximum densities for the entire UGA. Under these conditions, it is assumed that the city limits will have expanded to include all of the current urban growth area.

Table 3-2 summarizes the resulting population estimates.

**TABLE 3-2.
EXISTING AND PROJECTED FUTURE POPULATION**

Year	Total	Navy Seaplane Base[b]	City Proper[e]
2000	19,800	4,400	15,400
2005	22,200	4,400	17,800[d]
2011	24,200	4,400	19,800
2025	28,700	4,400	24,300[c]
Long Term Growth	66,100	4,400	61,700

a. Total city population for 2000 and 2025 provided by Oak Harbor Planning Department.
b. Seaplane Base population estimated from Census block data for 2000; assumed to remain constant through 2025.
c. City proper population for 2000 and 2025 calculated as difference between City total provided by Planning Department and estimated Seaplane Base population.
d. Growth in City proper population from 2000 to 2005 estimated based on review of plats.
e. City proper is the area within the current city limits for the corresponding year, excluding the Seaplane Base.

CHAPTER 4.
PERMITS, REQUIREMENTS, AND REGULATIONS

Wastewater treatment facilities must meet the regulations and requirements of many federal, state, and local regulatory agencies. This chapter summarizes applicable rules and regulations and permits that apply to Oak Harbor's wastewater facilities.

FEDERAL REGULATIONS

Federal Water Quality Acts

Programs and policies to protect water quality were first initiated on a nationwide scale by the federal Water Pollution Control Act of 1956. This act was amended by the Water Quality Act of 1965, the Clean Water Restoration Act of 1966, and the Water Quality Improvement Act of 1970. The Water Pollution Act Amendment of 1972 (Public Law 92-500) replaced the previous language of the Act entirely. This Act requires states to establish water quality standards for all of their water bodies. The standard must consist of two parts: a designation of the use of the water body; and the water quality criteria that water body must maintain to protect the designated uses from pollution. The State of Washington complies with this regulation through WAC 173-201A, which is described later.

The Clean Water Act of 1977, in further amending the 1972 amendment, required any agency conducting an activity that may result in a discharge into navigable waters to obtain certification from the appropriate water pollution control agency, verifying that the discharge complies with applicable effluent limitations and water quality standards. Further, these amendments established National Pollutant Discharge Elimination System (NPDES) permits, which regulate point discharges into water, and required various types of water quality planning by states. Grants for facilities and training were also authorized under these amendments.

With increased environmental awareness of the extent and effects of nonpoint pollution, Congress passed the Water Quality Act of 1987, which directs states in developing programs designed to reduce nonpoint source pollution and requires the following from each state:

- Submit a report identifying navigable waters that cannot meet water quality standards without action to control pollution.
- Identify the categories of pollution sources.
- Describe processes for identifying best management practices and control strategies.
- Identify state and local programs for controlling pollution from both point and nonpoint sources.

These amendments resulted in the development of the *Puget Sound Water Quality Management Plan*, which applies to Puget Sound, the Strait of Juan de Fuca, and all waters draining into them (PSAT, 2000).

Federal Effluent Limitations

Section 301 of the federal Water Pollution Control Act requires all publicly owned wastewater treatment facilities to provide a minimum of secondary treatment unless a special waiver is obtained. This act defines secondary treatment as follows:

- The monthly average of biochemical oxygen demand (BOD) and total suspended solids (TSS) concentrations shall not exceed 30 milligrams per liter (mg/L).
- The weekly average of BOD and TSS concentrations shall not exceed 45 mg/L.
- The monthly average removal of BOD and TSS shall be at least 85 percent.
- The pH of the effluent shall be between 6.0 and 9.0.

Oak Harbor's lagoon and RBC treatment plants qualify for exceptions to these secondary treatment standards as discussed later in this chapter. There can be additional exceptions to these regulations when treatment works receive combined sewer flows or certain industrial wastes. However, in general, these are the minimum federal requirements for effluent quality. The Washington State Department of Ecology administers these regulations under the NPDES as discussed later in this chapter.

Federal Standards for Use or Disposal of Sludge

The federal document that regulates the use and disposal of sewage sludge is the Code of Federal Regulations, Part 503 (40 CFR 503, EPA 1993). These regulations, published in February 1993, address three main sludge disposal options:

- Land application
- Surface disposal
- Incineration.

Land-applied sludge must meet requirements in the 503 regulations for reducing pathogens and vector attraction. Two basic classes for pathogen reduction are established in the regulations: sludge distributed in bagged form must meet Class A requirements; and sludge applied to the land in bulk form must meet Class B requirements. Only bulk land application is evaluated as a disposal option for this comprehensive sewer plan.

Pathogen Reduction

Class A sludge must have levels of fecal coliform organisms below 1,000 per gram of total solids and meet other time and temperature requirements, or the sludge must have been treated with an EPA-defined "process to further reduce pathogens." These processes include composting, heat drying, heat treatment, thermophilic aerobic digestion, irradiation, and pasteurization.

Class B sludge must have levels of fecal coliform organisms less than 2 million per gram of total solids, or meet other requirements, or the sludge must have been treated with an EPA-defined "process to significantly reduce pathogens." These processes include aerobic digestion for a mean cell residence time greater than 40 days at 20ºC or 60 days at 15ºC, air drying, anaerobic digestion, composting, or lime stabilization.

Vector Attraction Reduction

The regulations require that land-applied sludge be processed to reduce its "vector attraction." This means that the sludge should be stabilized sufficiently to not be an attraction to rodents or birds that could spread pathogens contained in the sludge and thereby increase the risk of human exposure. The basic measure of the adequacy of sludge stabilization in the regulations is that the volatile solids concentration in the sludge be reduced through processing by at least 38 percent. A series of alternative procedures are provided for reducing vector attraction, including injection below the ground surface.

Metals

Limits are specified for the concentration of various metals in the sludge and for the cumulative loading of these metals on the land used for its application. Table 4-1 lists the concentration limits for any sludge that is land applied. Table 4-2 lists further guidelines for sludge that is land applied in bulk. Either the monthly average concentration criteria or the cumulative pollutant loading rate criteria must be met.

TABLE 4-1.
CEILING CONCENTRATIONS FOR METALS IN LAND-APPLIED SLUDGE

Parameter	Ceiling Concentration Limit (mg/kg)
Arsenic	75
Cadmium	85
Copper	4,300
Lead	840
Mercury	57
Molybdenum	75
Nickel	420
Selenium	100
Zinc	7,500

TABLE 4-2.
METAL CONCENTRATION LIMITS FOR BULK SEWAGE SLUDGE LAND APPLICATION

Parameter	Monthly Average Concentration Limit (mg/kg)	Cumulative Pollutant Loading Rate (kg/hectare)
Arsenic	41	41
Cadmium	39	39
Copper	1,500	1,500
Lead	300	300
Mercury	17	17
Nickel	420	420
Selenium	100	100
Zinc	2,800	2,800

Other Measures

In addition to regulating the quality of biosolids, the regulations require specific management measures, including the following:

- Record-Keeping and Reporting—Records must be kept by the owner describing the quantity and quality of the biosolids that have been applied to specific sites for up to five years. Even if the owner has a contract for biosolids disposal with a private contractor, the owner is ultimately responsible for the record-keeping and reporting.

- Monitoring—The owner is responsible for monitoring the biosolids for metals and specific pathogens on a regular basis.
- Management Practices—Biosolids should not be applied to flooded, frozen, or snow-covered ground, so that biosolids do not enter surface waters.

EPA Reliability Criteria

An important reference for wastewater treatment plant reliability is the EPA's *Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability* (EPA 1974). This document outlines requirements in three reliability classes, with specific provisions for each unit process. Table 4-3 summarizes its requirements for component reliability.

The EPA's requirements are very similar to Ecology's reliability requirements, which are discussed later in this chapter. The wastewater facilities proposed in this sewer plan and engineering report will comply with the EPA and Ecology Class II reliability criteria.

National Environmental Protection Act

The National Environmental Protection Act (NEPA) requires appropriate environmental documentation for projects that could have a significant adverse impact on the quality of the natural and human environment. The EPA can declare that a proposed action is categorically exempt from these requirements. Otherwise, the proposing agency must prepare an Environmental Information Document (EID), commonly referred to as an Environmental Assessment or Environmental Report. An Environmental Report assesses environmental elements, such as soils, water quality, and air quality, and addresses how a proposed project complies with federal and state regulations. The EPA uses the Environmental Report to determine whether to issue a "finding of no significant impact" or to require an environmental impact statement.

Clean Air Act

The Federal Clean Air Act of 1992 requires that all federally funded projects be in compliance with state and regional air quality plans. The local air-quality authority for Island County is the Northwest Clean Air Agency; agency requirements are discussed later in this chapter.

Historical and Archaeological Sites

Both federal and state laws require agencies to assess the effects of their proposed projects on significant archeological and historic properties. If facility improvement projects impact identified historical or archaeological sites, a more detailed evaluation of the site and potential impact of the project on the site will be required.

TABLE 4-3.
SUMMARY OF EPA DESIGN CRITERIA FOR SYSTEM AND COMPONENT RELIABILITY

Component	Class I	Class II	Class III
Reliability classification	Works discharging into navigable waters that could be permanently or unacceptably damaged by effluent that was degraded in quality for only a few hours. Examples of Reliability Class I works might be those discharging near drinking water reservoirs, into shellfish waters, or in proximity to areas used for water contact sports.	Works discharging into navigable waters that would not be permanently or unacceptably damaged by short-term effluent quality degradation, but could be damaged by continued (on the order of several days) effluent degradation.	Works not otherwise classified as Reliability Class I or II
Trash removal	Required	Same as Class I	Same as Class I
Grit removal	Required if sludge is handled	Same as Class I	Same as Class I
Clean-out of solids	Provisions for cleaning of solids required for components prior to degritting or sedimentation	Same as Class I	Same as Class I
Controlled diversion	Screened, gravity overflow required with alarm, annunciation, and measurement of flow discharged. Holding basin required	Same as Class I, but no holding basin required	Same, as Class I but no holding basin required
Unit operation bypassing	Required except for unit operations with two or more open basins	Same as Class I	Same as Class I
Mechanically cleaned bar screens	Backup manual screen required	Same as Class I	Same as Class I
Pumps	Capacity to handle peak flow with any one pump out of service must be provided	Same as Class I	Same as Class I
Comminution	Overflow bypass must be provided with manual bar screen	Same as Class I	Same as Class I
Primary sedimentation basins	With largest unit out, remaining units shall have design flow of at least 50 percent of the total design flow to that unit operation	Same as Class I	At least two basins
Final and chemical sedimentation basins, trickling filters, filters, and activated carbon columns	With largest unit out, remaining units shall have design flow of at least 75 percent of the total design flow to that unit operation	With largest unit out, remaining units shall have design flow of at least 50 percent of the total design flow to that unit operation; backup not required for chemical sedimentation basins, filters, and activated carbon columns	At least two basins; backup not required for chemical sedimentation basins, filters, and activated carbon columns
Aeration basin	At least two equal volumes shall be provided	Same as Class I	Single basin permissible
Aeration blowers or aerators	Sufficient to provide for peak oxygen demands with the largest capacity unit out of service	Same as Class I	At least two units
Diffusers	Designed so that isolation of the largest section of diffusers does not measurably impair oxygen transfer capability	Same as Class I	Same as Class I

TABLE 4-3 (continued).
SUMMARY OF EPA DESIGN CRITERIA FOR SYSTEM AND COMPONENT RELIABILITY

Component	Class I	Class II	Class III
Chemical flash mixer	At least two basins or a backup means of adding chemicals	Backup not required	Backup not required
Flocculation basins	At least two basins	Backup not required	Backup not required
Disinfectant contact basins	With largest unit out, remaining units shall have design flow of at least 50 percent of the total design flow to that unit operation	Same as Class I	Same as Class I
Sludge handling	Alternate methods of sludge disposal and/or treatment shall be provided for each sludge treatment unit operation without installed backup capability. No recycles permitted that will compromise liquid treatment.	Same as Class I	Same as Class I
Sludge holding tanks	May be used to back up downstream tanks	Same as Class I	Same as Class I
Sludge pumps	A backup pump shall be provided for each set of pumps that performs the same function. The capacity of the pumps shall be such that with any one pump out of service, the remaining pumps will have capacity to handle the peak flow.	Same as Class I	Same as Class I
Anaerobic sludge digestion	At least two digestion tanks shall be provided. At least two of the digestion tanks provided shall be designed to permit processing all types of sludge normally digested. Tanks shall have sufficient flexibility or backup equipment to ensure that mixing is not lost when any one piece of equipment is out of service. Uninstalled backup is acceptable for mixing equipment	Same as Class I	Same as Class I
Aerobic sludge digestion	Backup aeration basin not required. At least two blowers shall be provided. Uninstalled backup is permissible. Largest section of diffusers can be isolated.		
Sludge holding tanks	May be used to back up downstream tanks	Same as Class I	Same as Class I
Vacuum filter	There shall be sufficient number of vacuum filters to enable the design flow to be dewatered with largest capacity unit out of service. Two vacuum pumps and two filtrate pumps shall service each vacuum filter. These may be uninstalled.	Same as Class I	Same as Class I
Centrifuges	There shall be sufficient number of units to enable the design flow to be dewatered with largest capacity unit out of service. The backup unit may be uninstalled.	Same as Class I	Same as Class I
Incinerators	A backup incinerator is not required. Auxiliary equipment shall be provided with backup.	Same as Class I	Same as Class I

TABLE 4-3 (continued).
SUMMARY OF EPA DESIGN CRITERIA FOR SYSTEM AND COMPONENT RELIABILITY

Component	Class I	Class II	Class III
Electric power source	Two separate and independent sources of electric power shall be provided to the works either from two separate utility substations or for a single substation and a works-based generator. Capacity of backup power shall be sufficient to operate all vital components, during peak wastewater flow conditions, together with critical lighting and ventilation.	Same as Class I except those vital components to support the secondary processes need not be included as long as treatment equivalent to sedimentation and disinfection is provided.	Sufficient to operate the screening or comminution facilities, the main wastewater pumps, the primary sedimentation basins, and the disinfection facility during peak flow together with critical lighting and ventilation.
Power distribution external to the works	The independent sources of power shall be distributed to the works transformers in a way to minimize common mode failures from affecting both sources.	Same as Class I	Same as Class I
Power distribution within the works	See Referenced EPA document	Same as Class I	Same as Class I
Instrumentation and control systems	Automatic control systems whose failures could result in a controlled diversion or a violation of the effluent limitations shall be provided with a manual override. Instrumentation whose failure could result in a controlled diversion or a violation of the effluent limitations shall be provided with an installed backup sensor and readout. Alarms shall be provided to monitor the condition of equipment whose failure could result in a controlled diversion or a violation of the effluent limitations. Vital instrumentation and control equipment shall be designed to permit alignment and calibration without requiring a controlled diversion or a violation of the effluent limitations	Same as Class I	Same as Class I
Auxiliary systems	If a malfunction of the system can result in controlled diversion or a violation of the effluent limitations and the required function cannot be done by any other means, then the system shall have backup capability.	Same as Class I	Same as Class I

Reference: U. S. Environmental Protection Agency. Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability. MCD-05, EPA-430-99-74-001. Office of Water Program Operations. Washington, D. C.,

Floodplains and Wetlands

The EPA restricts treatment projects on environmentally sensitive lands such as floodplains and wetlands.

Agricultural Lands

It is EPA policy under the Farmland Protection Policy Act (PL 97-98) to protect agricultural lands from “irreversible loss as an environmental or essential food production resource.”

Coastal Zone Management

The Coastal Zone Management Act requires that all federal activities be consistent with approved state coastal zone management programs to the maximum extent possible. This project is located in a coastal zone county and is consistent with Washington's Coastal Zone Management Program and enforceable regulatory policies (State Environmental Policy Act, Water Quality, Air Quality and the Shoreline Master Program). A shoreline development permit would be needed prior to construction if construction is planned within 200 feet of the ordinary high water mark.

Fish and Wildlife Protection

The Fish and Wildlife Coordination Act requires that projects "controlling or modifying any natural streams or other body of water" be done in a way that protects fish and wildlife resources and habitats.

Endangered Species Act

Projects with a federal "nexus," including federal permits, approvals or funding, require compliance with the Endangered Species Act. Listed species include the following:

- Southern resident killer whale—federally listed endangered species
- Bald eagle—federally and state listed threatened species
- Bull trout—federally listed threatened species and a state listed species of concern
- Chinook salmon— federally listed threatened species and a state listed species of concern
- Coho salmon—federal candidate species.

If a project affects an endangered species of plant or wildlife, it should include mitigating measures to reduce the impact.

Magnuson-Stevens Fishery Conservation and Management Act

In December 1998, the National Marine Fisheries Service (which has since been renamed as NOAA Fisheries) issued interim final regulations to implement the essential fish habitat (EFH) requirements of the 1996 Sustainable Fisheries Act. This act significantly amended the Magnuson-Stevens Fishery Conservation and Management Act of 1976.

The amended Magnuson-Stevens Act requires the following: for federal actions that may adversely affect EFH, except activities covered by a General Concurrence, federal agencies must provide a written assessment of the effects of that action on EFH. EFH is defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH must always include the critical habitat of endangered and threatened species.

United States Navy Seaplane Lagoon Lease Agreement

In addition to the City of Oak Harbor's rotating biological contactor (RBC) treatment plant, the City operates and maintains, under a lease agreement with the U.S. Navy, a second treatment plant on East Pioneer Avenue, on the Seaplane Base portion of NAS Whidbey. This leased plant is an aerated lagoon facility with anaerobic pretreatment that is owned by the U.S. Navy. A copy of the lease agreement is included in Appendix A. The U.S. Navy owns, operates and maintains the collection system serving the Navy base, which conveys flows to the lagoon treatment plant.

STATE POLICIES AND REGULATIONS

As allowed under the Clean Water Act, Washington State has developed requirements for surface water quality that are more stringent than those developed by the federal government. Ecology administers the NPDES wastewater and stormwater permits and has requirements relating to protection of ground and surface waters.

Agencies other than Ecology can have involvement in construction and operation of facilities located in critical areas. The Washington State Department of Fish and Wildlife (WDFW) has involvement in cases involving fish-bearing streams. In addition, the Washington State Department of Natural Resources (DNR) has authority for facilities to be constructed on tidelands or along shorelines.

Water Quality Standards for Surface Waters

The Department of Ecology adopted water quality standards that became officially effective on December 21, 2006. General conditions listed in the 2006 standards are as follows (WAC 173-201A-010):

- All surface waters are protected by narrative criteria, designated uses, and an antidegradation policy.
- Based on the use designations, numeric and narrative criteria are assigned to a water body to protect the existing and designated uses.
- Where multiple criteria for the same water quality parameter are assigned to a water body to protect different uses, the most stringent criteria for each parameter are to be applied.
- Surface waters of the state include lakes, rivers, ponds, streams, inland waters, saltwaters, wetlands, and all other surface waters and water courses within the jurisdiction of the state of Washington.

Fresh Waters

No freshwater streams in the study area for this sewer plan are specifically designated in the 2006 standards, so the following general designations apply:

- All surface waters of the state not individually designated are to be protected for the following uses:
  - Salmon and trout spawning, rearing, and migration
  - Primary contact recreation
  - Domestic, industrial, and agricultural water supply
  - Stock watering
  - Wildlife habitat
  - Harvesting
  - Commerce and navigation
  - Boating
  - Aesthetic values.
- All lakes with a mean detention time greater than 15 days and all feeder streams to lakes are to be protected for the following uses:
  - Salmon and trout spawning, core rearing, and migration

– Extraordinary primary contact recreation

Table 4-4 lists water quality standards that apply for surface waters in the study area.

TABLE 4-4.
WASHINGTON STATE FRESHWATER WATER QUALITY CRITERIA (WAC 173-201A)

Water Quality Parameter	Requirement
Fecal coliform	**Primary Contract Recreation:** Shall not exceed a geometric mean value of 100 colonies/100 ml, and shall not have more than 10% of all samples obtained for calculating the geometric mean value exceeding 200 colonies/100 ml. **Extraordinary Primary Contract Recreation:** Shall not exceed a geometric mean value of 50 colonies/100 ml, and shall not have more than 10% of all samples obtained for calculating the geometric mean value exceeding 100 colonies/100 ml.
Dissolved Oxygen	**Salmon and trout spawning, noncore rearing, and migration:** Shall exceed 8.0 mg/L **Salmon and trout spawning, core rearing, and migration:** Shall exceed 9.5 mg/L
Total Dissolved Gas	Shall not exceed 110 percent of saturation
Temperature	**Salmon and trout spawning, noncore rearing, and migration:** Shall not exceed 17.5°C due to human activities. **Salmon and trout spawning, core rearing, and migration:** Shall not exceed 16.0°C due to human activities. When natural conditions exceed the temperature criteria, no temperature increases will be allowed that increase temperature by more than 0.3°C.
pH	**Salmon and trout spawning, noncore rearing, and migration:** 6.5 to 8.5, with human-caused variation of less than 0.5 units **Salmon and trout spawning, core rearing, and migration:** 6.5 to 8.5, with human-caused variation of less than 0.2 units
Turbidity	Shall not exceed 5 NTU (nephelometric turbidity units) over background when background is 50 NTU or less, or have more than a 10% increase in turbidity when the background turbidity is more than 50 NTU.
Toxic or Radioactive Substances	Toxic, radioactive, or deleterious material concentrations must be below those which have the potential, either singularly or cumulatively, to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health. Specific criteria per WAC 173-201A-240, 173-201A-250
Aesthetic Values	Shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

Marine Waters

Ecology classifies Saratoga Passage and Skagit Bay, the marine waters east of Oak Harbor, for the following designated uses (WAC 173-201A-610):

- Aquatic life uses—excellent quality
- Shellfish (clam, oyster and mussel) harvest

- Primary contact recreation
- Wildlife habitat
- Harvesting (salmonid and other fish; crustacean and other shellfish)
- Commerce and navigation
- Boating
- Aesthetics.

Table 4-5 lists water quality standards that apply for marine waters in the study area.

TABLE 4-5.
WASHINGTON STATE MARINE WATER QUALITY CRITERIA
(EXCELLENT QUALITY AQUATIC LIFE USES; SHELLFISH HARVEST)

Water Quality Parameter	Requirement
Fecal coliform	**Shellfish Harvest and Primary Contact Recreation:** Shall not exceed a geometric mean value of 14 colonies/100 ml, and shall not have more than 10% of all samples obtained for calculating the geometric mean value exceeding 43 colonies/100 ml.
Dissolved Oxygen	Shall exceed 6.0 mg/L
Temperature	Shall not exceed 16.0°C due to human activities. When natural conditions exceed the temperature criteria, no temperature increases will be allowed that increase temperature by more than 0.3°C.
pH	7.0 to 8.5, with human-caused variation of less than 0.5 units
Turbidity	Shall not exceed 5 NTU (nephelometric turbidity units) over background when background is 50 NTU or less, or have more than a 10% increase in turbidity when the background turbidity is more than 50 NTU.
Toxic or Radioactive Substances	Toxic, radioactive, or deleterious material concentrations must be below those which have the potential, either singularly or cumulatively, to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health. Specific criteria per WAC 173-201A-240, 173-201A-250
Aesthetic Values	Shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

Source: Chapter 173-201A WAC

Anti degradation

The 2006 water quality standards emphasize anti degradation. All actions that may have an impact on the existing quality of a water body will require the project proponent to assess whether the project will have a measurable impact (called a Tier II analysis). A tier II analysis will be a required component of any facility plan the City develops for a new treatment plant or for a treatment plant expansion.

Department of Natural Resources Aquatic Lands Outfall Easement

The Washington State Department of Natural Resources (DNR) has granted an easement of aquatic land to the City of Oak Harbor for the lagoon treatment plant's outfall. This 30-year easement agreement commenced on January 1, 2000 and terminates on December 31, 2030 and includes the stipulation that the City make progress toward reducing discharges through the outfall. At this time, the City does not have an easement for the RBC treatment plant's outfall, but an easement may be required in the future. A copy of the lagoon outfall easement agreement is included in Appendix B.

NPDES Wastewater Permit

The State of Washington administers the federal NPDES effluent limitations. All wastewater discharges into the waters of the state, including treated effluent from treatment plants, must be permitted through the Department of Ecology with an NPDES permit. The City's current NPDES permit, issued on May 25, 2005, applies to both of the City's wastewater treatment plants. A copy of the permit is included in Appendix C.

Influent Limits

The NPDES permit identifies the following rated capacity for influent wastewater flow to the City's treatment plants:

- RBC plant
  - Average flow for the maximum month = 0.7 million gallons per day (mgd)
  - BOD_5 loading for the maximum month = 2,000 pounds per day (ppd)
- Lagoon plant
  - Average flow for the maximum month = 2.5 million gallons per day (mgd)
  - BOD_5 loading for the maximum month = 4,580 pounds per day (ppd)
  - TSS loading for the maximum month = 5,130 pounds per day (ppd)

Effluent Limits

Currently effluent discharges through the RBC Plant and Seaplane Lagoon outfalls are regulated by technology-based effluent limits that require secondary treatment. Under standard secondary treatment limits effluent BOD and TSS concentrations must not exceed 30 mg/L. However, both Oak Harbor treatment plants qualify for exceptions to this regulation, and they are regulated by alternative secondary treatment effluent limits.

- The alternative effluent limits for the RBC Plant require monthly average effluent CBOD (carbonaceous BOD) to be 25 mg/L or less and TSS to be 30 mg/L or less.
- The alternative effluent limits for the Seaplane Lagoon require monthly average CBOD to be 25 mg/L or less and TSS to be 75 mg/L or less.

CBOD limits are used rather than BOD limits because lagoons and RBCs generally remove less nitrogenous oxygen demand than standard secondary plants, which causes the treatment plants to exceed the standard 30-mg/L limit for BOD.

Alternative TSS limits are used because lagoons remove less TSS than standard secondary treatment. Alternative TSS limits typically are only allowed for average flows up to 2 mgd from lagoons (see WAC 173-221-050(2), in Appendix D); however the NPDES permit for the Seaplane Lagoon allows average discharges up to 2.5 mgd at alternative secondary treatment limits. The 2.5-mgd limit appears to have been set when Ecology approved the engineering report for the lagoon upgrade in 1987, months before the 2-mgd limit was formally established in the WAC (11/12/87). As long as the lagoon-based system is not expanded to treat more flow, the alternative limits will remain. If the lagoon-based system is expanded then the entire system must meet standard secondary limits.

Table 4-6 summarizes effluent limits established in the NPDES permit.

TABLE 4-6.
NPDES PERMIT LIMITS

Parameter	Outfall from RBC Treatment Plant	Outfall from Lagoon Treatment Plant
Carbonaceous Biochemical Oxygen Demand (5-day)		
Max. Average Monthly Concentration	25 mg/L	25 mg/L
Max. Average Monthly Load	146 ppd	521 ppd
Min. Average Monthly Removal of Influent Load	85%	85%
Max. Average Weekly Concentration	40 mg/L	40 mg/L
Max. Average Weekly Load	233 ppd	834 ppd
Total Suspended Solids		
Max. Average Monthly Concentration	30 mg/L	75 mg/L
Max. Average Monthly Load	175 ppd	1,564 ppd
Min. Average Monthly Removal of Influent Load	85%	65%
Max. Average Weekly Concentration	45 mg/L	110 mg/L
Max. Average Weekly Load	263 ppd	2,294 ppd
Fecal Coliform Bacteria		
Max. Average Monthly Concentration	200/100 mL	200/100 mL
Max. Average Weekly Concentration	400/100 mL	400/100 mL
Daily pH		
Minimum	6	6
Maximum	9	9
Total Residual Chlorine		
Max. Average Monthly Concentration	0.114 mg/L	0.5 mg/L
Max. Daily Concentration	0.26 mg/L	0.75 mg/L
Acute Toxicity	—	No toxicity in 1% effluent

Other Special Conditions

The NPDES permit includes additional conditions relating to facility operation and maintenance and planning for maintaining adequate capacity. There are also conditions governing the City’s ability to accept industrial wastewater and requirements to evaluate infiltration and Inflow, report overflows and bypasses and more. See all the special conditions in the permit in Appendix C.

NPDES Stormwater Permit

Construction projects recommended in this sewer plan that disturb more than 1 acre will require a construction general permit for stormwater discharge under NPDES requirements. Mitigation measures are required, including preparation of a stormwater pollution prevention plan. During construction, temporary erosion and sediment control measures are required. City policy will determine whether the permit is secured by the City or construction contractor.

Washington State Standards for Use and Disposal of Sludge

WAC 173-308, *Biosolids Management*, establishes guidelines for treatment and land application of biosolids generated by municipal wastewater treatment facilities. These mirror the federal guidelines in 40 CFR 503 that are described earlier in this chapter. The state Department of Ecology has authority to enforce these rules and may, if it chooses, delegate some of the authority to local health departments.

Washington Department of Ecology Criteria for Sewage Works Design

The Ecology-developed *Criteria for Sewage Works Design* (Ecology 2008), also known as the Orange Book, is a guide for design of sewage collection and treatment systems. Any projects initiated under the authority of this comprehensive sewer plan must conform to the most recent revision of the Orange Book that is available at the time the project is designed. The latest version of the Orange Book is available on the internet at www.ecy.wa.gov/pubs/9837.pdf.

The primary goals of the manual are as follows:

- To ensure that the design of sewage collection and treatment systems is consistent with state public health and water quality objectives
- To establish a basis for the design and review of plans and specifications for sewage treatment works and sewerage systems
- To establish the minimum requirements and limiting factors for review of sewage treatment work and sewerage system plans and specifications
- To assist the owner or the owner's authorized engineer in the preparation of plans, specifications, reports, and other data
- To guide departments in their determination of whether to issue approvals, permits, or certificates for sewage treatment works or sewer systems.

Ecology uses the Orange Book design guidelines to review and approve reports, plans, and specifications. Design guidelines presented in this book will be used to evaluate the capacity of the proposed treatment facility and to establish design criteria for this comprehensive sewer plan. The Orange Book also presents guidelines for wastewater treatment component design, including the number of units required for operation during peak flows. In general, state requirements follow the federal requirements outlined in Table 4-3. The state reliability classification scheme is shown in Table 4-7. The wastewater facilities proposed in this sewer plan and engineering report will comply with the EPA and Ecology Class II reliability criteria.

TABLE 4-7.
RELIABILITY CLASS SYSTEM IN THE ORANGE BOOK

Reliability Class	Applies to
I	Works whose discharge, or potential discharge, (1) is into public water supply, shellfish, or primary contact recreation waters, or (2) as a result of its volume and/or character, could permanently or unacceptably damage or affect the receiving waters or public health if normal operations were interrupted.
II	Works whose discharge, or potential discharge, as a result of its volume and/or character, would not permanently or unacceptably damage or affect the receiving waters or public health during periods of short-term operations interruptions, but could be damaging if continued interruption of normal operations were to occur (on the order of several days).
III	Works not otherwise classified as Reliability Class I or II.

Standards for Water Reclamation

The Washington State Departments of Health and Ecology jointly released a set of standards for wastewater reclamation projects in September 1997. The *Water Reclamation and Reuse Standards* describe the treatment and quality requirements for a variety of end uses. Four basic classes of reuse quality are listed, along with their suitability for various end uses. The four classes vary from Class A (highest quality) to Class D (lowest quality). For uses such as groundwater recharge or direct injection into a drinking water aquifer, there are more stringent standards than any of these four classes. Landscape irrigation requires Class A reclaimed water, which is defined as follows:

> *"Class A Reclaimed Water"* means reclaimed water that, at a minimum, is at all times an oxidized, coagulated, filtered, disinfected wastewater. The wastewater shall be considered adequately disinfected if the median number of total coliform organisms in the wastewater after disinfection does not exceed 2.2 per 100 milliliters, as determined from the bacteriological results of the last 7 days for which analyses have been completed, and the number of total coliform organisms does not exceed 23 per 100 milliliters in any sample.

If surface percolation is used for land application, a nitrogen removal step is required in addition to other Class A requirements.

The *Water Reclamation and Reuse Standards* also list requirements for redundancy, including redundant filtration and disinfection equipment. Storage requirements are also listed, including emergency storage and wintertime storage.

On-Site Sewage RequirementsOn-site septic systems or on-site sewage systems (OSS) are the most common methods of wastewater treatment for homes, commercial establishments, and other places that are not connected to a public sewer system. An on-site sewage system consists of a network of pipes, a septic tank, and a drainfield, and provides subsurface soil treatment and dispersal of sewage. Properly functioning on-site sewage systems protect public health and the environment by preventing untreated wastewater from coming into contact with people, ground, or surface water.

On-site sewage systems are regulated and characterized by wastewater flows. Smaller on-site sewage systems are designed for flows up to 3,500 gallons per day (gpd). The State Board of Health promulgates rules for these systems and the local health jurisdictions have the authority for implementation and approval. Large on-site sewage systems (LOSS) dispose of 3,500 to 100,000 gallons of wastewater per day.

The Departments of Ecology (Ecology) and Health (DOH) have regulatory jurisdiction over large on-site sewage systems. Ecology and DOH have split jurisdiction over the management of LOSS disposing of 3,500 to 14,500 gpd; Ecology manages mechanical systems and DOH handles non-mechanical systems. Ecology has regulatory authority for all systems over 14,500 gpd.

Legislation passed in 2007 revises the jurisdiction for large on-site systems. State Bill 5894 requires DOH to issue operating permits and develop standards for all newly-defined LOSS by July 1, 2009. The legislation re-defines large on-site sewage systems as systems disposing of 3,500 to 100,000 gpd of wastewater. Also under the new legislation LOSS may include mechanical treatment and may not be used for treatment and disposal of industrial wastewater or combined sanitary sewer and storm water systems

Joint Aquatic Resources Permit

If construction will be performed in any state waterways, a joint aquatic resources permit application (JARPA) may need to be prepared. To promote efficiency and reduce overlap, state agencies and the U.S. Army Corps of Engineers developed the JARPA, which can be submitted for the following permits:

- WDFW's Hydraulic Project Approval (HPA)
- Local agency shoreline management permits
- Department of Ecology Water Quality Certification and Approval for Exceedance of Water Quality Standards
- Corps of Engineers Section 404 and Section 10 Permits
- Marine and aquatic lease.

State Environmental Policy Act

A State Environmental Policy Act (SEPA) review is required upon completion of this comprehensive sewer plan, and the SEPA Checklist is included in Appendix E. A SEPA review is an environmental checklist or an environmental report completed to ensure that there are no adverse environmental impacts from proposed projects. The City of Oak Harbor will issue a threshold determination as to whether significant environmental impact may be expected for implementation of the recommendations in this plan. This determination will be sent to Ecology for concurrence.

State Environmental Review Process; Department of Ecology Documentation

To be eligible for financial assistance from the State Water Pollution Control Revolving Fund, this plan must comply with the State Environmental Review Process (SERP; WAC 173-98-100). The SERP was established "to help ensure that environmentally sound alternatives are selected and to satisfy the state's responsibility to help ensure that recipients comply with the National Environmental Policy Act and other applicable environmental laws, regulations, and executive orders." Development of this comprehensive sewer plan included an extensive public involvement program and environmental documentation, and these efforts fully satisfy SERP.

In addition, the Department of Ecology has adopted a set of requirements for environmental documentation in coordination with USDA Rural Development. Requirements include sending out a project description and summary of the proposed action to applicable regulatory agencies and requesting input and comments regarding the proposed action.

Office of Archaeology and Historic Preservation Approval

Cultural resources are addressed in over 100 federal laws, regulations, and guidelines, including the National Environmental Policy Act of 1969 (NEPA) and the National Historic Preservation Act of 1966, amended in 1992 (NHPA). Section 106 of the NHPA requires federally assisted undertakings to take into account the effects of those undertakings on historic properties that are included in or may be eligible to be included in the National Register of Historic Places. "Historic properties" refers to prehistoric archaeological sites as well as buildings, structures, and other historic sites.

Applicable state laws include the Indian Graves and Records Act (RCW 27.44), which prohibits knowingly disturbing a Native American or historic grave, and the Archaeological Sites and Resources Act (RCW 27.53), which requires that anyone proposing to excavate into, disturb, or remove artifacts from an archaeological site on public or private lands obtain a permit from the Office of Archaeology and Historic Preservation.

Three elements are involved in cultural resources studies:

- The identification and evaluation of historic properties.
- Assessment of effects of the proposed undertaking on historic properties.
- Consultation among principal parties to consider ways to avoid, reduce, or mitigate adverse effects.

The first element, identification and evaluation, is of most concern at the beginning stages of projects. Methods for identification of historic properties consist of archival research, field survey, and consultation.

Archival research, including a check of the Washington state site inventory and records at the Office of Archaeology and Historic Preservation (OAHP), is conducted prior to any field activity in order to determine if sites are already recorded in the project area or its vicinity. Other information is collected from ethnographic and historic accounts, previous regional cultural resource investigations, informants, maps, photographs, and environmental information. Research to determine the age of landforms involved and the extent of modern disturbance are especially important. Locations of archaeological sites may be identified by this process. The potential for buried and hence undiscovered sites, or uplifted former shorelines favorable for habitation, may also be determined. Field visits are made after completion of the background research to verify field conditions, discuss construction locations and methods, and to identify historic properties. The results of these investigations are presented in a report for submittal to appropriate agencies and tribes. The report includes recommendations for dealing with any sites discovered, additional discovery measures, if necessary, monitoring high-potential locations, and a Discovery Plan to be enacted in the event archaeological material is encountered during construction.

LOCAL POLICIES

City Sewer Regulations

City regulations pertaining to sewers are outlined in Title 14 of the Oak Harbor Municipal Code. The code identifies the following as important considerations related to the City's sewer system (Oak Harbor Municipal Code 14.01.010):

- Where sewers are available, hookup shall be mandatory.

- Requirements and rates should be made as uniform as is reasonably practical so that each customer bears its proportionate share of the costs of operation.
- It is necessary to prevent introduction of pollutants and materials into the Oak Harbor sewer system that will interfere with operation of the sewage treatment plants or inhibit or prevent flow of sewage along sewer lines or through pump stations.
- It is necessary to prevent introduction of pollutants into the Oak Harbor sewer system that will pass into receiving water inadequately treated or otherwise be incompatible with the Oak Harbor sewer system.
- It is necessary to ensure compliance with all applicable statutes and regulations with regard to biosolids disposal.
- It is necessary to ensure that the general public is protected from dangerous materials being disposed of in the sewage collection and treatment process.
- It is necessary to provide a safe environment for personnel working in the Oak Harbor sewer system.
- To lower costs of operation, it is desirable to ensure that waste products be recycled.
- Properties being added to the Oak Harbor sewer system should pay a proportionate share of costs of sewer facilities to serve the property.

The City code also establishes it as a policy that sewer connections shall not be allowed outside the city limits except in areas designated by written resolution as a sewer service area (Oak Harbor Municipal Code Chapter 14.25).

SEPA Review

The City of Oak Harbor has adopted by reference the policies of the State Environmental Policy Act (Oak Harbor Municipal Code 20.04.010). The City can deny or condition actions within the city limits to mitigate or prevent adverse environmental impacts. For the implementation of any work proposed in this sewer plan, the City of Oak Harbor, as lead agency, will issue a threshold determination of likely environmental impact. A copy of the SEPA checklist for the projects recommended in this report is included in Appendix E.

If the City determines that there will be no probable significant adverse environmental impacts from the projects proposed or that the impacts would be properly mitigated, the lead agency would prepare and issue a “determination of nonsignificance” (DNS) or “mitigated determination of nonsignificance” (MDNS). A “determination of significance” (DS), which acknowledges the potential for significant environmental impacts, would require an environmental impact statement (EIS) that describes existing conditions, addresses and evaluates alternatives, analyzes potential environmental impacts and addresses mitigation measures.

Shoreline Management

Under Chapter 19.56 of the Oak Harbor Municipal Code, all development activities in shoreline areas of the City must conform to the *Oak Harbor Shoreline Master Program*.

Stormwater Regulations

The design and construction of capital improvements recommended in this sewer plan must comply with the stormwater regulations outlined in Title 12 of the Oak Harbor Municipal Code. Construction may require an erosion and sediment control plan or a permanent stormwater quality control plan (Oak Harbor Municipal Code 12.30.130). The City has adopted by reference the Washington Department of Ecology's *Storm Water Management Manual for the Puget Sound Basin* (Oak Harbor Municipal Code 12.30.310).

Critical Areas Regulations

The design and construction of capital improvements recommended in this sewer plan must comply with the regulations for environmentally sensitive areas outlined in Title 20 of the Oak Harbor Municipal Code. No action shall be taken that results in any alteration of a critical area except as consistent with the purposes, requirements, objectives and goals of this title. The *Oak Harbor Critical Areas Atlas* provides a guide for identifying the approximate location and extent of critical areas.

Local Building Codes and Permits

All new construction must abide by City and County building codes and required permits.

County Requirements for Archeological Sites

Island County maintains a current inventory of all known and suspected historical and archaeological sites. Developers should check with the Department of Community Development to determine whether a particular project within the proximity of a shoreline is located within a historical or archaeological site. For such sites, County regulations require that a professional archaeologist evaluate the site to determine potential impacts and recommend mitigation. Local tribal authorities must be contacted if human remains or historical or archaeological resources are encountered. Tribal addresses and telephone numbers include the following:

Tulalip Tribes (South Whidbey)
7615 Totem Beach Road
Marysville, WA 98271
Natural Resources Office:
(360) 651-4480
(360) 651-4490 (fax)

Swinomish Tribal Community (North Whidbey and Camano)
11404 Moorage Way
LaConner, WA 98257
(360) 466-1236
(360) 466-1615 (fax)
lcampbel@cnw.com (email)

Northwest Clean Air Agency

The Northwest Clean Air Agency (NWCAA) regulates construction and modification of potential air contaminant sources in Island, Skagit and Whatcom Counties. The Agency must be notified of construction projects so that it may review whether a permit is required; review requirements are outlined in Section 300 of the NWCAA regulations. Activities exempt from review include the following wastewater-related activities:

- Septic sewer systems, not including active wastewater treatment facilities
- NPDES permitted ponds and lagoons used solely for the purpose of settling suspended solids and skimming of oil and grease
- Sewer manholes, junction boxes, sumps and lift stations associated with wastewater treatment systems.

Uniform Fire Code

County fire officials have authority to enforce the national Uniform Fire Code (UFC). Article 80 of the UFC identifies required measures to prevent, control, and mitigate dangers related to the use and storage of hazardous chemicals.

Development Standards

All new construction must comply with the City of Oak Harbor's Development Standards. Section 4 of these standards addresses sanitary sewer development standards and is included in Appendix F.

CHAPTER 5.
COLLECTION SYSTEM DESIGN CRITERIA AND FLOWS

DESIGN CRITERIA

Collection system design criteria used for this comprehensive sewer plan are developed from the City of Oak Harbor's 2006 Development Standards, the Department of Ecology's *Criteria for Sewage Works Design* (also known as the Orange Book), the City of Oak Harbor Comprehensive Plan, and data provided by City staff. Where design or construction requirements conflict, or information is omitted, design criteria are selected based on the following order of preference:

1. City of Oak Harbor Development Standards
2. City of Oak Harbor Municipal Code
3. The current version of WSDOT and APWA Standard Specifications for Road, Bridge, and Municipal Construction
4. The Orange Book.

The City's 2006 Development Standards set requirements for the design and construction of sewage collection systems. A copy of the City's standards for sanitary sewers is included in Appendix F. Key standards include the following:

- Within the corporate City limits where a public sewer is available it must be used except as allowed by the Oak Harbor Municipal Code (OHMC) 14.03.060. "Available" will generally mean there is a main within 200 feet of the property to be served. If there is no main along the property frontage, the main shall be extended to and along the property frontage.
- For existing lots, new septic systems within the Oak Harbor City limits are not allowed if public sewer is available for connection. New lots created through a subdivision, short plat or other land use action shall provide sewer connection to each new lot.
- The design of any sewer extension/connection shall conform to City Standards and the Orange Book.
- As required by OHMC 14.03.070 the layout of extensions shall provide for future continuation of the existing system as determined by the City. Sewer mains shall extend the entire front footage of each lot to be served except where there is no possible future extension as determined by the City Engineer.
- New gravity systems shall be designed on the basis of an average daily flow of sewage not less than 65 gallons per capita per day (65 gpcd). Consideration shall be made for infiltration and inflow. A peaking factor of 2.11 should be used for major sewerage areas. Other guidelines and peaking factors and design flows are contained in the Orange Book.
- When deviations from the foregoing per-capita rates and peaking rates are used, a description of the procedure used for sewer design shall be submitted to the City's Engineering Division for review and approval.
- Construction of new sewer systems or extensions of existing systems will be allowed only if the existing receiving system is capable of supporting the added hydraulic load.
- Collection and interceptor sewers shall be designed and constructed for the ultimate development of the tributary areas.

- Sewer systems shall be designed and constructed to achieve total containment of sanitary wastes and maximum exclusion of infiltration and inflow.
- Computations and other data used for design of the sewer system shall be submitted to the City for approval.
- All sewers shall be designed to prevent damage from superimposed loads. Proper allowance for loads on the sewer because of the width and depth of trench should be made. When standard-strength sewer pipe is not sufficient, extra-strength pipe shall be used.
- Minimum size for sewer mains is 8 inches in diameter. For pipe diameters 12 inches or less and depths up to 15 feet, all gravity sewer pipe shall be PVC, ASTM D 3034 SDR 35. Material for all other diameters, depths or other special conditions, shall be appropriate for the application, must be approved by the City Engineer, and may include: PVC, ductile iron, concrete, vitrified clay, ABS, or polyethylene.
- Precast manholes shall be provided at a maximum of 400-foot intervals, at intersections, and at changes in direction, grade, or pipe size. Minimum manhole diameter is 48 inches.
- Pipes should be designed with slopes no less than those listed in Table 5-1.

**TABLE 5-1.
MINIMUM SLOPES FOR A SELECTION OF SEWER PIPE DIAMETERS**

Pipe Diameter (inches)	Minimum Slope (feet/foot)
8	0.0040
10	0.0028
12	0.0022
15	0.0015
18	0.0012
21	0.0010

Source: Ecology Orange Book 1998

- Pump systems shall be designed in accordance with the Orange Book. The number of pumps shall not be less than two. Where only two pumps are provided, they shall be of the same type, size and capacity. The minimum size of force mains shall be 4 inches.

Applications to serve property with privately operated pressure facilities such as grinder pump stations require special review and approval by the City. The City is currently reviewing design and contractual requirements associated with these facilities.

PROJECTED BASE FLOWS

Sewage base flows were estimated for 2005, 2011, 2025 and long-term growth conditions (maximum development of the sewer service area as allowed by existing zoning) within the City proper. For the purposes of the collection system analysis the base flow was subdivided into three component sources: residential; commercial; and schools.

The flow contribution from each source was examined in order to determine average unit flows. These were used in conjunction with peaking factors and the inflow and infiltration (I/I) contribution to facilitate geographic distribution of flow-loading for the collection system capacity analysis detailed in Chapter 7. The derivation of these unit flows, peaking factors and I/I contribution is detailed in the following sections.

For the treatment plant capacity analysis, detailed in Chapter 8, where the geographic distribution of flow-loading was not relevant, base flow was not divided into components but treated on a per capita basis.

Residential Unit Flow

Residential flows were determined using zoning and population projections developed by Tt/KCM and City staff. Residential zoning includes Single Family Residential (R-1), Limited Multiple Family Residential (R-2), Multiple Family Residential (R-3), and Multiple Family Residential (R-4). Development density varies among these categories and is summarized in Table 5-2.

**TABLE 5-2.
ALLOWABLE RESIDENTIAL DEVELOPMENT DENSITIES**

Zoning Designation	Units per Acre
R-1 Single Family	3-6
R-2 Limited Multi-Family	3-12
R-3 Multi-Family	6-16
R-4 Multi Family	12-22

Source: City of Oak Harbor Comprehensive Plan

An existing residential unit flow of 50 gpcd was calculated based on 2004 winter water use data and actual population provided by the City. Winter data was used because virtually all water used during this time is discharged to the sewers. This figure was validated by wastewater flow data and was therefore used for planning purposes rather than the estimate of 65 gpcd used in the previous Comprehensive Plan and incorporated into current development standards; the 50 gpcd value is based on more recent data.

The City's estimate of average household size in 2005 was 2.69 persons, down from the 2.88 persons reported in the 1990 census and slightly lower than the 2.70 persons reported in the 2000 census.

Commercial Unit Flow

Commercial properties contribute significant daily wastewater flows. Zoning in this category includes Neighborhood Commercial, Central Business District, Community Commercial, Auto Industrial Commercial, Highway Corridor Commercial, Planned Business Park, Planned Industrial Park, Industrial, and Residential Office. Public zoned areas, except schools and open areas such as parks and cemeteries, were also considered to contribute to the commercial flows.

2004 wet-weather water consumption records for commercial customers was examined to determine average commercial flows. By comparing this total to an estimate of developed commercial area served by the collection system, a unit value of approximately 500 gallons per acre per day (gpad) was determined. Due to the availability of commercial land, it was assumed that this estimate would remain appropriate for the duration of the 20-year planning horizon. However, it is projected that, as commercial development reaches saturation, this unit flow will increase to 1,500 gpad.

School Unit Flow

Oak Harbor's sewer system serves School District #201, which consists of one high school, two middle schools, six elementary schools and one alternative high school. Crescent Harbor Elementary is located on the Seaplane Base and Clover Valley Elementary is located at NAS Ault Field. The City's Comprehensive Plan estimates a 2004 enrollment of about 6,000 students in grades K-12. Historical water consumption records for these facilities, provided by the City, were reviewed and a representative value was determined for each school.

For design purposes the Orange Book indicates rates of 10 gpd per student in grade schools and junior high schools, and 16 gpd per student for high schools.

Base Flow Peaking Factors

Wastewater base flows vary over the course of each day in accordance with water usage and over the course of the year as influenced by tourism, seasonal employment, and other factors. Short duration peak flows (peak-hour) may occur at any time of the day throughout the year for various reasons. Sewer system facilities must have sufficient capacity to handle peak-hour flows.

Peaking factors for base flows are estimated based on Figure 5-1, which is from Ecology's Orange Book. For the City's 2005 population of 22,200, the graph gives a peak-hour peaking factor of 2.6, which means the peak-hour flow would be approximately 2.6 times the average daily flow. For planning purposes, a factor of 3.0 was used to estimate peak-hour base flows in the main sewer lines in the existing system, similar to the approach used in the 1997 Comprehensive Sewer Plan. For future design of infrastructure serving smaller service areas, higher peaking factors may be required.

INFILTRATION AND INFLOW

Infiltration is groundwater seepage into a sewer collection system through fractured or defective pipes, leaking pipe joints, and manhole walls. The daily volumes of groundwater infiltration fluctuate due to seasonal changes in groundwater depths and can range from almost non-existent flows in late summer to very high sustained flows during the wet spring months. Under the latter case, high infiltration flow volumes can be attributed not only to the depth of groundwater over the collection system, but also to the fact that a much greater proportion of the system is submerged. Infiltration from private side sewer laterals is generally acknowledged as one of the most significant contributors to this flow source, particularly in older systems.

Inflow is water entering the sewer collection system from street and area drains, catch basins, manhole covers, roof downspouts, and building foundation drains.

New Sewers

Infiltration and inflow (I/I) rates in new sewers are estimated based on unit I/I flow rates that have been used for many years to plan municipal sewer systems in the Puget Sound region. The unit rate used for maximum-month I/I flow is 400 gpad. The peak-day I/I rate is 900 gpad, and the peak-hour I/I rate is 1,100 gpad. The City needs to rigorously inspect construction of all new mainline sewers and side sewers to ensure that these I/I rates are achieved. Careful sewer construction is needed even with use of modern pipes and manholes with O-ring gaskets or welded plastic joints.

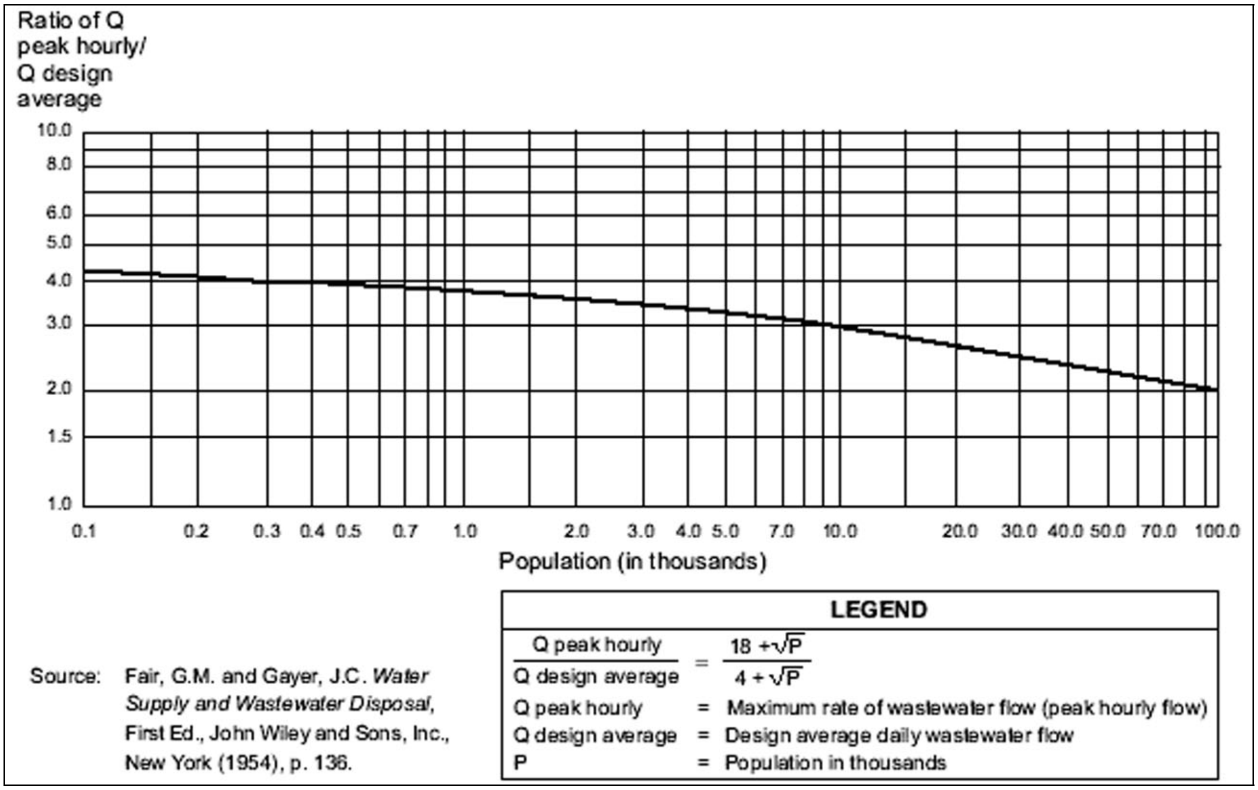


Figure 5-1. Ratio of Peak-Hour Flow to Design Average Flow

Existing Sewers

City staff indicated that there are no areas served by a combined sewerage system. However, the older sewered area bounded by SR 20, Whidbey Avenue, Regatta Street and the shoreline was noted as receiving more I/I than more recently developed areas to the north and west.

An investigation of available flow meter data was undertaken in order to examine the relationship between the inflow and infiltration components of I/I, to identify the month with maximum I/I and to estimate the peak-day and peak-hour I/I rates. Flow meter data was available for the RBC Plant, the headworks to the Seaplane Lagoon treatment plant and the inflows to the Seaplane Base.

Relationship of Inflow and Infiltration

To examine the relationship between inflow and infiltration, the correlation between rainfall and total flow was studied. Figure 5-2 shows daily rainfall totals versus daily total flows and indicates a relatively weak relationship between the two variables. In contrast, Figure 5-3 shows a strong correlation between the 30-day rainfall total and the 30-day rolling average total flow. It was therefore concluded that infiltration due to elevated groundwater levels is the more significant component of I/I in the City.

Maximum Month I/I

Maximum-month I/I rates were based on 30-day rolling average total flows for the period of record. This highest figure occurred during the period between August 22 and September 13, 2004 and equated to a flow rate of 406 gpad, based on an estimate of 2,340 acres of served area.

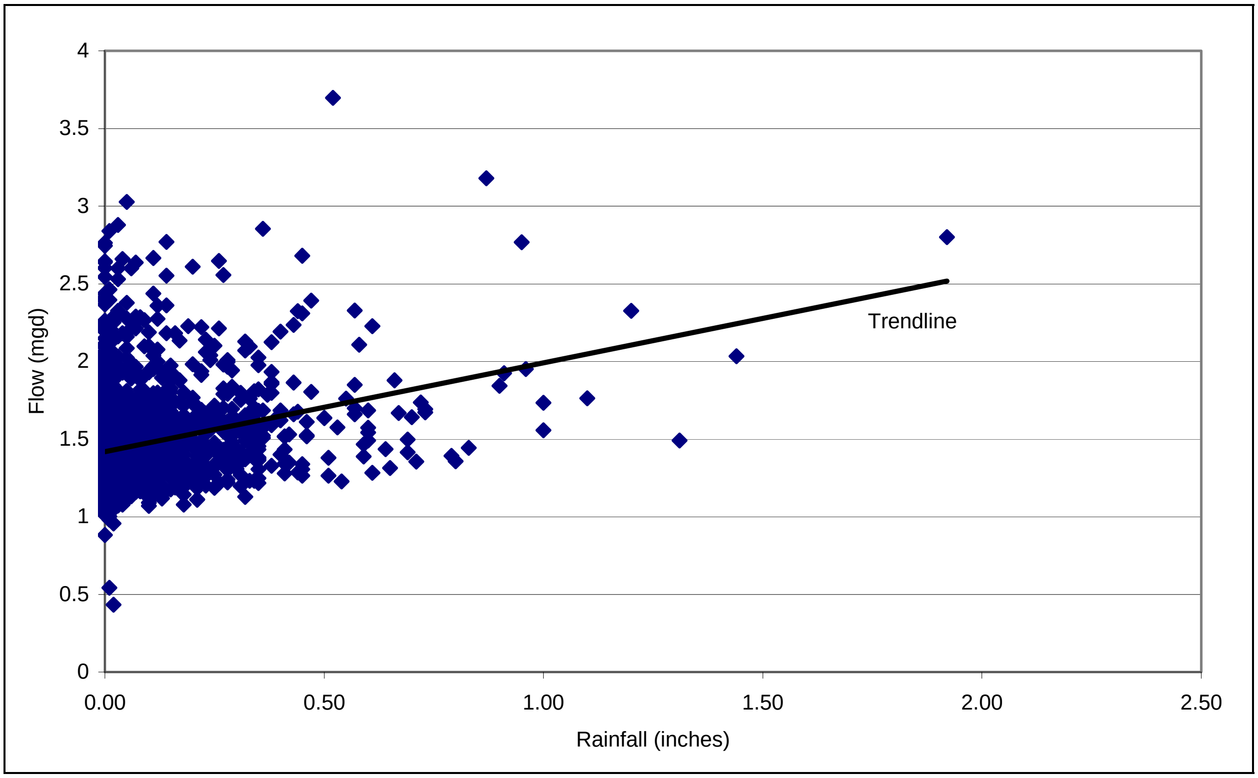


Figure 5-2. Daily Total Flow vs. Daily Rainfall, January 1999 to October 2005

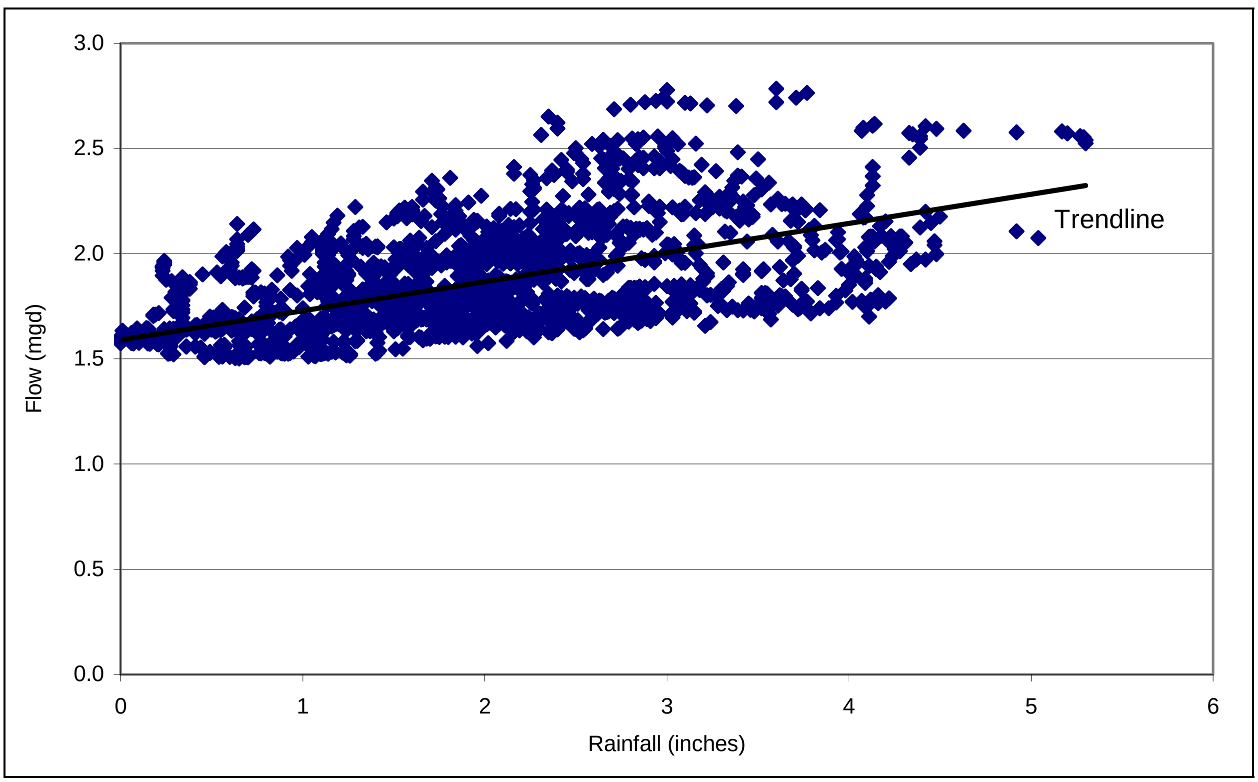


Figure 5-3. 30-Day Rolling Average Total Flow vs. 30-Day Rolling Average Rainfall, January 1999 to October 2005

Peak Day I/I

The peak-day I/I rate was estimated from the available flow records. It was determined that the maximum I/I event during that period occurred on March 20, 2002 when the I/I component of flow was estimated to be 2.08 mgd, or 884 gpad, based on 2,340 acres of serviced sewer area.

Peak Hour I/I

As discussed above, infiltration was determined to represent the most significant component of I/I. As a consequence it was estimated that the peak-hour flow would be similar to the peak-day flow. It was therefore estimated that for the downtown area, indicated as having higher I/I, the peak-hour flow would be 1,600 gpad. For areas with more recent sewers, the peak-hour flow was estimated to be 1,100 gpad. These assumptions were partially validated by comparison of the peak-hour flow recorded in the system (6.9 mgd on February 4, 1999, including Seaplane Base flow) to the peak-hour flow determined from the collection system model (6.4 mgd, excluding Seaplane Base flow).

I/I Assessment Based on EPA Criteria

The U.S. Environmental Protection Agency (EPA) has established the following criteria for defining excessive I/I:

- Infiltration is excessive if the average daily per capita flow (excluding major industrial and commercial flows) is 120 gpcd or more over a 7- to 14-day dry period during seasonal high groundwater. The flow rate of 120 gpcd for infiltration analysis contains two flow components: 70 gpcd for domestic wastewater base flow and 50 gpcd of non-excessive infiltration (EPA 1984).
- Inflow is excessive if the total daily flow (excluding major industrial and commercial flows) during periods of significant rainfall (the peak-day flow) exceeds 275 gpcd.

In order to evaluate infiltration, data for the months October to April was analyzed over the period of record. The analysis examined 7-day periods with no rainfall but with antecedent rainfall of at least 1 inch in the previous 7 days. The maximum observed per-capita flow based on residential and commercial flow was compared to the 120 gpcd threshold. The maximum per capita flow observed was 111 gpcd which occurred during the 14-day period ending November 20, 2000. This is less than the 120 gpcd threshold limit and indicates non-excessive infiltration in the City-owned collection system.

For the evaluation of inflow, the maximum observed daily flow, including residential and commercial flows, was compared to the 275 gpcd threshold. The maximum observed daily flow rate for March 20, 2002 was equivalent to 197 gpcd, significantly less than the threshold value of 275 gpcd. It was therefore concluded that the inflow in the City is non-excessive by EPA standards.

SUMMARY

Table 5-3 summarizes criteria used for calculating collection system flows for this report.

TABLE 5-3.
PROJECTED WASTEWATER UNIT FLOWS FOR PLANNING PURPOSES

Average Annual Wastewater Flow Rate	
Residential	50 gpcd
Commercial (2005 to 2025)	500 gpad
Commercial (Long-term growth)	1,500 gpad
School	School Specific
Infiltration and Inflow	
New Sewers	
Maximum Month	400 gpad
Peak Day	900 gpad
Peak Hour	1,100 gpad
Existing Sewers East of SR 20 & South of Whidbey Avenue	
Maximum Month	900 gpad
Peak Day	900 gpad
Peak Hour	1,600 gpad
Existing Sewers in the Remainder of the City	
Maximum Month	900 gpad
Peak Day	900 gpad
Peak Hour	1,100 gpad
Peak Hour Peaking Factors	
Large Service Areas	3.0

CHAPTER 6.
COLLECTION SYSTEM DESCRIPTION

HISTORY OF SYSTEM DEVELOPMENT

The City of Oak Harbor was incorporated in 1915, covering about 1 square mile on Oak Harbor. The City remained a small agricultural community until the beginning of World War II. In 1941, the U.S. Navy located a military air station east of the City. The presence of the military installation significantly changed the nature of the community and increased the population of both the City and surrounding Whidbey Island. Between 1940 and 1950, the City's population grew from 380 to 1,156. By 1970, the City's population had increased to 9,167, with annexation of the Navy's Seaplane Base and married housing areas. Since 1970, the City's growth has continued at a slower, more uniform pace.

The City's gravity collection system consists of approximately 65 miles of pipe. The oldest pipes still in service are clay pipes in the downtown area, which were installed in 1940. There are 10 lift stations and one major pump station serving the sanitary system, with approximately 5 miles of associated ductile iron, PVC and asbestos cement force mains ranging in size from 2-inch to 16-inch. The City's sewer system is shown in Figure 6-1.

As of December 2005, the City's collection system provides service to the following:

- 3,826 single-family residential accounts
- 669 multi-family residential accounts
- 396 commercial accounts
- 14 school accounts
- 9 hotel/motel accounts
- 1 marina account.

Centralized treatment was originally provided at a small facility on SE Pioneer Way. This was replaced by a primary treatment plant in City Beach Park with discharge into Oak Harbor. In 1978 this plant was upgraded to provide secondary treatment with the installation of a rotating biological contactor (RBC) system. The City also operates a multi-celled sewage lagoon at NAS Whidbey that discharges to Crescent Harbor. The lagoon system is owned and was previously operated by the Navy to serve the Seaplane Base housing areas. Under a 50-year lease agreement, the City of Oak Harbor now operates and maintains the lagoon plant to serve both the NAS facilities and part of the City. By means of the Diversion Pump Station at the RBC plant, wastewater flows in excess of 0.7 million gallons per day (mgd) are transferred to the Seaplane Lagoon Treatment Plant.

ON-SITE SEWER SYSTEMS

According to City staff, an estimated 136 households within the current city limits are not hooked up to the City's sewer system and are using on-site sewer systems. This equates to less than 2 percent of the City population. Outside the city limits but within the City's urban growth boundary, all of the existing residences and businesses are served by on-site sewer systems.

GRAVITY SEWERS

In general, the City's sewer collection system lies within the City proper (the incorporated area excluding the Seaplane Base); the collection system within the Seaplane Base is owned and operated by the Navy. The City does however own and maintain the conveyance infrastructure between the RBC Diversion Pump Station and the Seaplane Lagoon Plant, part of which is a 21-inch gravity sewer.

The City-owned gravity collection system consists of approximately 65 miles of PVC, concrete, clay and ductile iron sewer pipe ranging in diameter from 6 to 24 inches. Wastewater from the City proper flows to the RBC Plant, where it is either treated at the plant or pumped to the Seaplane Lagoon Plant by the RBC Diversion Pump Station.

PUMPED SYSTEMS

Ten lift stations have been installed to serve development where gravity service is not feasible or cost effective. These stations convey wastewater to the gravity system flowing to the RBC plant. The RBC Diversion Pump Station adjacent to the RBC Plant conveys part of the flow from the City proper to the Seaplane Lagoon Plant; the remainder enters the RBC plant. Figure 6-1 shows the location of these facilities and Table 6-1 summarizes the characteristics of the lift stations and the RBC Diversion Pump Station. Further discussion relating to each of the facilities follows Table 6-1. In addition, the City owns and maintains two small grinder pump facilities at the Marina, also shown on Figure 6-1. Key features of the lift stations and pump stations are described below.

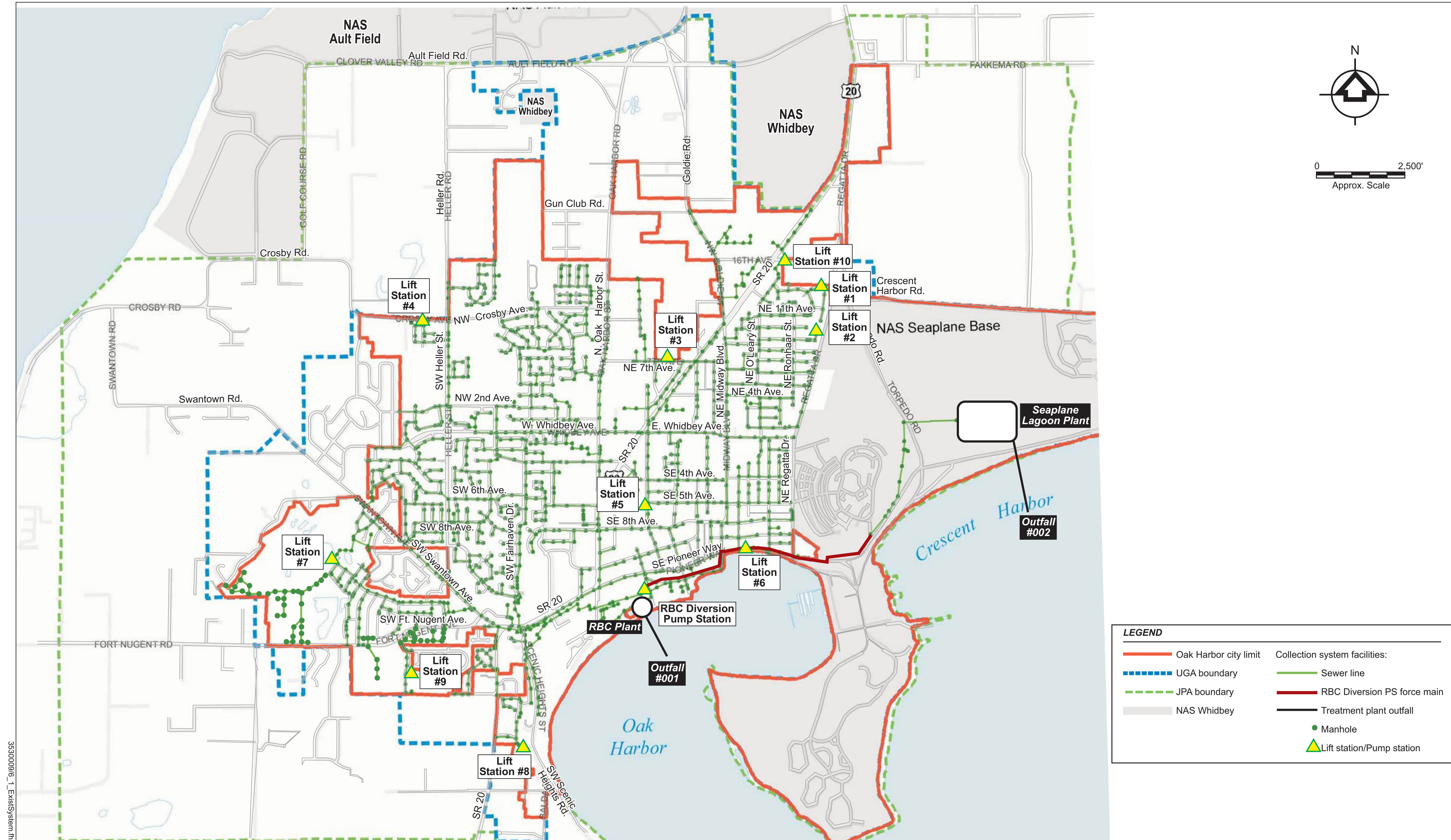
TABLE 6-1.
LIFT STATION AND PUMP STATION SUMMARY

Lift Station No.	Station Name	Station Type	No. of Pumps	Pump Manufacturer	Motor Horse Power	Firm Pump Capacity (gpm)	System Head (feet)	Standby Power
1	Taftson Street	Suction Lift	2	Smith & Loveless	7.5	115	55	Plug
2	NE 9th Avenue	Submersible	2	Hydr-O-Matic	3	125	26	None
3	NE 7th Avenue	Suction Lift	2	Smith & Loveless	15	800	43	Plug
4	Crosby Road	Suction Lift	2	Smith & Loveless	10	210	88	None
5	Cabot Street	Suction Lift	2	Smith & Loveless	5	100	50	Yes
6	East Pioneer Way	Wet Well/ Dry Well	2	Smith & Loveless	15	100	110	Plug
7	Golf Course	Suction Lift	2	Smith & Loveless	30	720	100	Yes
8	Capital Street	Suction Lift	2	Smith& Loveless	7.5	145	68	None
9	East Park	Submersible	2	Flygt	2.7 & 3	50	90[a]	Plug
10	Harbor Terrace	Submersible	2	Flygt	3	140	22	Plug
—	RBC Diversion	Wet Well/ Dry Well	2	Aurora	60 & 125	1200	113	Yes

a. Based on best efficiency point

Lift Station No. 1, Taftson Street

Lift Station No. 1 is located at 1289 NE Taftson Street, west of the intersection between Taftson Street and Regatta Drive. It serves approximately 22 houses and was constructed in 1983. The lift station, a Smith and Loveless suction lift pump assembly situated behind the rockery wall adjacent to the roadway,



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City of Oak Harbor
COMPREHENSIVE SEWER PLAN

Figure 6-1.
EXISTING WASTEWATER COLLECTION SYSTEM

has no significant operational issues. The associated 4-inch force main discharges to an 8-inch sewer in NE 11th Avenue.

It has been proposed that this lift station be removed and flows diverted to a new regional lift station. Additional detail is provided in Chapter 7.

Lift Station No. 2, NE 9th Avenue

Lift Station No. 2, constructed in 1983, is located at 2085 NE 9th Avenue, at the end of the cul-de-sac. It serves approximately six houses and operates about once a week during most conditions. The station has a wet well submersible configuration and has no major operational issues. Due to the infrequency of operation, grease build up is marginally greater than average, but this does not represent a major maintenance issue. Part of the internal pipe work has been replaced with a new section of PVC pipe. Some of the wet well metalwork has significant corrosion and may require replacement. The associated 4-inch PVC force main conveys wastewater a short distance to an 8-inch gravity sewer, also in NE 9th Avenue.

It has been proposed that this lift station be removed and flows diverted to the same proposed regional lift station that would enable decommission of the Taftson Street facility. Additional detail is provided in Chapter 7.

Lift Station No. 3, NE 7th Avenue

Lift Station No. 3 is located at 638 NE 7th Avenue. Built in 1993, it currently serves development along NE 7th Avenue in the vicinity of the lift station as well as the Oak Hollow Mobile Home Park, Woodbury Park Parade and Spring Hollow. The lift station, a Smith and Loveless suction lift pump assembly, is situated adjacent to the roadway. The fiber reinforced plastic enclosure has been repaired following damage from a traffic accident. The station has no major operational issues. However, platform supports have been installed within the wet well to facilitate periodic cleaning and grease removal from a temporary platform. The associated 4-inch force main discharges to a 12-inch sewer at the intersection of Harvest Drive and NE 7th Avenue.

Lift Station No. 4, Crosby Road

Lift Station No. 4 is located at 1765 NW Crosby Road on the south side of the roadway. It currently serves the Meadowridge development and was installed in 1994. The lift station is a Smith and Loveless suction lift pump assembly that sits on top of its wet well on the roadway shoulder. The station has no significant operational issues. The associated 4-inch PVC force main discharges to an 8-inch sewer at the intersection of NW Heller Street and NW 8th Ave (formerly 925th Avenue West).

Lift Station No. 5, Cabot Street

Lift Station No. 5 is located at 281 SE Cabot Drive beside a Home Depot store. The lift station, built in 1990, is a Smith and Loveless suction lift pump assembly that sits on top of its wet well adjacent to the parking lot. Minor changes in the control levels were made in 2005 to enable the pump station to handle the addition of the Home Depot, the AutoZone and a restaurant to the previously served area. The station has no major operational issues. However, grease buildup is higher than average at this lift station; cleaning is undertaken approximately every two months, as opposed to quarterly as done at most other stations. The station does have on-site standby power generation capability, with the generator located in a screened compound on Home Depot property. The associated 4-inch PVC force main discharges to the 15-inch trunk sewer at the intersection of Ely Street and SE 4th Avenue.

Lift Station No. 6, East Pioneer Way

Lift Station No. 6 is located at 1561 SE Pioneer Way on the shoreline side of the road adjacent to the sidewalk and is the oldest lift station in the collection system, built in 1968. The station serves a small residential area bounded by SE Pioneer Way, SE Regatta Drive, SE 6th Ave and SE Pasek Street. It also receives flows from the marina.

The station is a Smith and Loveless dry well package plant. Access to the dry well is via a ladder that extends to a hatch at grade. The station has no significant operational issues; the original pumps are still in operation although the check valves have been replaced.

The lift station is adjacent to the original treatment facility and a reinforced concrete tank that formed part of that facility. During power interruption or pump station failure, influent wastewater can overflow to the tank via a connection pipe at the manhole immediately upstream. Following mobilization of its storage volume, wastewater is removed by vactor truck. The tank receives low levels of infiltration, although no visible leaks have been identified. It is periodically pumped dry to preserve its emergency storage potential.

The associated force main discharges to a manhole in the gravity system at the intersection with SE Midway Boulevard and Pioneer Way.

Lift Station No. 7, Golf Course

Lift Station No. 7 is located at 980 SW Upland Court in a fenced compound on the eastern edge of the Whidbey Golf and Country Club. Access to the lift station compound is along the golf course road. The lift station is one of the largest in the City's collection system, with a firm capacity of about 720 gpm. It serves a number of recent residential developments in the southwest portion of the City adjacent to Swantown Road and Fort Nugent Road and has been sized to accommodate additional development.

The lift station, a Smith and Loveless suction lift pump assembly, has operated well since its construction in 1997 and no operational issues have been reported. On-site standby power is provided with a trailer-mounted generator located within the compound. To increase station reliability, a 6-inch force main bypass connection has been included in the installation to facilitate vactor removal of wastewater in the event of pump failure. This is primarily due to the station's distance from the gravity system, which would preclude use of temporary overland bypass pumping.

The associated 8-inch PVC force main runs along SW Thornberry Drive to Swantown Road, where it connects to a 10-inch PVC force main that follows Swantown Road to a manhole in the gravity system.

Lift Station No. 8, Capital Street

Lift Station No. 8 is located at 2831 SW Capital Street in the Scenic Heights area of the City. Built in 1994, it serves approximately 24 houses in the Eagle Crest development and immediate vicinity. The lift station is a Smith and Loveless suction lift pump assembly that sits on top of its wet well adjacent to the sidewalk. No significant operational problems have been noted.

The associated 4-inch PVC force main discharges to a manhole in Capital Street, at the top of a hill, from where it can flow by gravity across SR 20 toward Swantown Road.

Lift Station No. 9, East Park

Lift Station No. 9 is located at 2330 SW Rosario Drive in a fenced compound at the edge of the existing city limits. It was constructed in 2001 and currently serves approximately 40 houses in the East Park development. The station has a wet well submersible pump configuration with two Flygt pumps. Flush valves have been included in the installation to reduce grease buildup. The control panels are located adjacent to the wet well in the fenced compound. Some operational issues have been recorded at the station since its installation. Control levels have been adjusted to keep wet well levels low as a response.

The 4-inch PVC force main discharges to an 8-inch sewer at the intersection of SW Quince Street and Fort Nugent Avenue. The force main has cleanouts installed at major changes in pipe direction in Ridgeway Drive, with wyes and check valves at each.

Lift Station No. 10, Harbor Terrace

Lift Station No. 10 is located at 1631 NE 16th Avenue. It serves the Harbor Terrace development of multi-family residential units. It is the most recently installed lift station in the City's collection system, commissioned in 2003 to replace a lift station that served the area prior to the development. The facility is a wet well submersible station with two Flygt pumps. Flush valves have been included in the installation to reduce grease buildup. No significant operational problems have been noted. The control panels are located adjacent to the wet well in the fenced compound.

The 4-inch PVC force main conveys the wastewater a short distance to a manhole in the gravity system that discharges into the 8-inch sewer in NE O'Leary Street.

RBC Diversion Pump Station

The RBC Diversion Pump Station is located in City Beach Street adjacent to the RBC Plant. It began operation in 1991. The pump station conveys a portion of the wastewater flow from the City proper to the Seaplane Lagoon Plant via a 16-inch forcemain, a 21-inch gravity sewer and a 20-inch inverted siphon, also constructed at that time.

The station has a wet well/dry well configuration with the wet well divided into a three-hopper arrangement. Currently only two pumps are installed in the station, so only two of the three hoppers are in use. All flows from the City proper flow through a concrete inlet trough that runs through the pump station. Openings in the trough permit flow to fall into the wet well hoppers, and gates on these openings assist in regulating the flow into the wet well. The remainder of the wastewater flows through the RBC Plant influent meter and into the treatment plant.

The current vertically oriented pumps, which are located on the lower pump floor, are connected to the motors on an intermediate floor by vertical drive shafts. A single-story building houses the electrical room, the screen room and the pump access room. A surge tank and activated carbon odor control unit and standby power generator are located in the walled courtyard outside the main pump station building.

The larger 125-hp pump has a capacity of approximately 2.9 mgd (2,000 gpm). The smaller 60-hp pump has a capacity of approximately 1.7 mgd (1,200 gpm). During combined operation, the flow is approximately 3.6 mgd (2,500 gpm). The firm pump capacity (with the largest pump out of service) is 1.7 mgd, the capacity of the smaller pump.

While station performance has, in general, been good, several operational and maintenance issues have been noted:

- Check valves in the discharge header pipe work have needed frequent maintenance as a result of seat deterioration, possibly due to a combination of grit and high velocities in the relatively small pump discharge piping. Planned future enlargement of the pumps may diminish this issue. However, the frequent maintenance increases the time when the station is reduced to using one pump.

- The odor control facility requires additional maintenance to ensure its effectiveness.
- A permanent on-site generator provides sufficient power for the larger pump. However, the generator is aging and requires replacement within the next six years. An additional mobile standby generator is used to provide power to the smaller pump.
- The mechanical raked vertical bar screen at the inlet to the pump station has a spacing of 0.75 inches. This operates well, but significant amounts of solids reach the Seaplane Lagoon Plant headworks.

The 16-inch ductile iron force main from the pump station is routed along SE Bayshore Drive and Pioneer Way, discharging to a manhole inside the Seaplane Base close to the intersection of Wake Avenue and East Pioneer Way. The discharge elevation is approximately 101 feet above the pump discharge elevation. During installation, an odor control facility was installed at the force main discharge and an air injection facility was installed along its length. Neither facilities are currently in use and no odor issues at the force main discharge have not been reported.

In 2005, a pipe break occurred adjacent to the pump station. Subsequent investigation by a representative of the Ductile Iron Pipe Research Association (DIPRA) indicated that soils in the City Beach and SE Bayshore Drive area are highly corrosive. Sections of the force main in that area, approximately 2,500 feet in length, could be affected by corrosion.

The 21-inch gravity sewer conveys flow from the force main discharge to the inverted siphon. The sewer is steep over much of its length, with gradients up to 5.5 percent for some sections. Access to this line is limited due to topography and vegetation. While no known problems have been noted the pipe condition has not been inspected recently.

The inverted siphon runs between the connection with the gravity sewer at Torpedo Road and the headworks of the Seaplane Lagoon Plant. An access road has been constructed on the raised berm above the route of the inverted siphon.

Marina Grinder Stations

The City has two small grinder pumps serving the City-owned marina, which was constructed in 1974. Both facilities use dual grinder pumps in coated steel sumps. One sump is located at the marina’s Building 2. It pumps flows from the boat pump-out, Building 2 and some commercial property to the other sump at the Harbor Master’s office, which also receives flows from the marina’s showers and restrooms. The grinder pumps in the Harbor Master’s office building pump flow in a 4-inch force main that discharges on SE Pioneer Way upstream of the Pioneer Street Lift Station.

The two grinder stations are operated and maintained by the City’s Marina Department. However, periodic cleaning and annual flushing is done by Public Works personnel using their vactor truck. Sump pumps are replaced on average on a 2- or 3-year cycle. The rails in the Building 2 sump were replaced in 2001. In general these facilities have sufficient capacity and operate well. During the annual July regatta week, additional portable restrooms are provided and the City vactor truck is utilized when necessary to supplement system capacity.

Pump facilities are being considered in more detail in the Marina Master Plan study currently being conducted on behalf of the City.

Reliability Summary

Standby Power

Two of the lift stations, Golf Course and Cabot Street, have a permanent on-site, hardwired emergency generator. The RBC Diversion Pump Station also has a permanent on-site, hardwired emergency generator capable of supplying power to the larger of its two pumps, with a portable generator capable of supplying power to the smaller pump.

Five of the lift stations have an emergency power receptacle and a transfer switch. In the event of a failure of the power supply, these pump stations are designed to receive and use power from the City's portable generator set.

The three lift station and City-owned grinder pump facilities that do not have an emergency generator hook-up receive relatively low flows. These are required to be pumped out during power outages by the City's portable 6-inch Goodwin bypass pump or vactor truck.

Telemetry

At each lift station, a radio wave telemetry system is used for transmitting status signals. High-level alarms, low-level alarms, check valve failure alarms, pump failure alarms, and pump run status are transmitted. Pump failure is sensed by a limit switch on each pump's check valve. If flow causes the arm on the check valve to lift off the switch within the set time limit, the pump is assumed to be operational. If the arm remains on the limit switch beyond the timed period, a "pump fail" signal is transmitted. All stations have, at a minimum, float-type level sensors. No data is currently stored at the lift station site.

Overflows

There are no recorded overflows at the lift stations, RBC Diversion Pump Station or City-owned grinder pump facilities.

Sewer Operation and Maintenance

The City has a full-time supervisor in charge of operation and maintenance of the present system including the two treatment facilities.

The maintenance schedule for the collection system includes periodic cleaning of the sewer mains, adjusting manhole covers and general manhole maintenance. Some flow testing and televised inspection has been done in areas of suspected high infiltration/inflow. Grease traps are inspected about twice per year. Garbage grinders are not allowed. All lift stations are maintained on a weekly basis.

The City has a range of equipment which it uses in maintenance of the system. In addition to standard equipment such as service vehicles, boom truck and backhoes, the City owns and uses a high velocity sewer cleaner. The cleaner includes eductor and hydraulic root cutter attachments to remove debris from cleaning operations and to correct any root intrusion problems. The City has also purchased a television camera system to inspect sewer lines. TV cameras are valuable in detecting points of high infiltration/inflow, defective pipe, root intrusion and inspection of new construction. The City also has a Vactor (2100 Series; 14 cubic yard box; 1,800 gallon tank).

The collection system has been rapidly increasing in size and growth is projected to continue. With a larger and aging system, more burden will fall on maintenance of that system. Scheduled maintenance of the collection system is known to extend its useful life, reduce the number of plugged sewers and backups, and in the long term, reduce the cost of operation and repair.

The City maintains centralized records for maintenance and operation of the treatment facilities and collection system. This includes maintenance schedules, and an inventory of plant equipment and materials on hand.

Emergency Response

Emergency response planning is an essential part of managing a wastewater system. It is a process in which wastewater system managers and staff explore responses to vulnerabilities, make improvements and establish procedures to follow in the event of man-made or natural emergencies. The process encourages people to form partnerships and better understand support capabilities. Preparing an emergency response plan and practicing it can save lives, prevent illness, enhance system security, minimize property damage and environmental impact, and lessen liability.

The City has a range of standard procedures for emergency response in both the collection system and at the treatment plants. Currently however, these are not collated in a formalized document, and the City plans to develop a more formalized emergency response plan as discussed in Chapter 9..

CHAPTER 7.
COLLECTION SYSTEM ANALYSIS

The collection system was analyzed to evaluate the capacity of the existing network and to identify other issues that would warrant upgrade or improvement. The analysis also examined system development and expansion and the capacity requirements to serve projected increases in flows. In general the analysis focused on trunk sewers and pump stations; local sewers were not evaluated.

ANALYSIS OF EXISTING SYSTEM CAPACITY

The capacity analysis was conducted using a SewerGEMS computer model of the core elements of the existing sewer system. Figure 7-1 shows the system elements included in the model. Appendix G details data sources and elements used in the modeling.

The sewer lines modeled were simplified to optimize the number of nodes; not every manhole was included. Three of the 10 lift stations were incorporated into the model, including the Golf Course Lift Station. Following input of the physical features of the system, hydraulic loads (flows) were determined and applied to the model as discussed below.

Model Loading

The service area of the existing collection system was divided into basins for the modeling, based on topography, zoning, parcel boundaries and sewer service. Hydraulic loads were derived for each basin. The flows associated with each basin were assigned to a single model manhole. Normally the model manhole receiving the flow was within the basin boundary. However, where the model did not extend into the basin, the flow was assigned to the most appropriate model manhole in the downstream system. Five sources of flows were estimated for each basin, as shown below, and their hydraulic loads estimated using the projected base flow and Inflow/Infiltration contribution information outlined in Chapter 5.0:

- Residential—The 2000 population for each basin was estimated using the ArcView GIS program and U.S. Census block data. Population growth in each basin between 2000 and 2005 was estimated using plat approval information obtained from the City. The resulting total basin population was entered into the designated loading node for each basin. It was assumed that the entire population within the existing city limits receives sewer service.
- Commercial—This category was used for a range of City zoning types as defined in Chapter 5. An estimate of the area zoned as commercial/industrial was determined for each basin, and flows were estimated based on these areas. For basins with areas currently zoned as commercial land but with no commercial development yet connected to the collection system, factors were used to better reflect the flows.
- Schools—Water consumption data for the schools within the City was reviewed and a representative flow for each was assigned to the relevant basins.
- Other Public Facilities—Areas zoned as public facilities were reviewed to determine their current function. Parks were assumed to contribute zero flow to the collection system. Other facilities were assumed to contribute flows based on area, with the same unit contribution as used for commercial areas.
- Inflow/Infiltration—The total area served by the sewer system was calculated for each basin. The total area was reduced by the area for which there currently is no sewer service. Peak-hour I/I values were assigned to each basin based on the area served within each basin and the unit I/I flows discussed in Chapter 5: 1,600 gpad for areas served by older sewers and 1,100 gpad for areas served by newer sewers.

Model Scenarios

For evaluation of the existing collection system capacity, a peak-hour flow scenario was simulated in the model, as required by the Department of Ecology. The peak-hour flows were estimated using the methodology outlined in Chapter 5.0. For the model scenarios the peak flow was assumed to be constant, in order to examine the full impact of flows across the whole system.

Capacity Analysis Results

Figure 7-2 shows the results of the model simulation of peak-hour conditions in the collection system. No areas of out-of-manhole flooding were identified by the model, although some sections of sewer were indicated as having peak flows approaching system capacity. The model indicated surcharging in the Ely Street trunk sewer between Whidbey Avenue and SE Barrington Drive and in the sewer just upstream of the RBC Diversion Pump Station, but the hydraulic grade levels are estimated to be more than 10 feet below grade.

The results indicate a maximum peak-hour flow at the entrance to the RBC Diversion Pump Station of 6.4 mgd. This is greater than the combined capacity of the plant and diversion pump station and suggests that additional surcharging may occur in the sewer immediately upstream during peak flow conditions. Potential capacity limitation was also identified in the sewer close to Heller Street and NW 2nd Avenue. Other short sections of sewer were identified by the model as having minor capacity issues; but surcharging results for these sections are likely due to model assumptions that are not reflected in the actual system.

SYSTEM EXPANSION

Expansion of the existing collection system will be required to enable development in the periphery of the City and in the future incorporated area within the UGA. For the analysis of future collection system needs, system expansion projects were identified that would enable service of these outlying areas. Development of these projects was undertaken in consultation with City staff on the following basis:

- Expansion of the existing collection system was considered from a regional infrastructure perspective. Identified improvements are aimed at providing the most effective service to the area as a whole, not necessarily as a series of successive extensions. Improvement recommendations reflect development only within the existing UGA, but are mindful of appropriate service routes in the event of future expansion of the UGA.
- The routing of trunk sewers was established in order to most effectively serve as much of the service development areas as possible. However, it was expected that trunk sewers would be constructed along with local collection sewers as part of the development of the areas served. As such, some flexibility in alignment is acknowledged, depending on the nature of development proposals.
- A number of sources were reviewed, including the 1997 Wastewater Comprehensive Plan, existing mapping and topography, the preliminary design of improvements in Scenic Heights by Berryman & Henigar, Inc., and the Northeast Drainage Basin Study prepared by URS.
- In general, the identified service strategies are similar to those recommended in the 1997 Comprehensive Plan, with the exception of the northern development area between Heller Street and Goldie Road.
- The City of Oak Harbor has a adopted a vertical datum 100 feet lower than that established by the NGVD 1929, so that elevation 100 is approximately sea level. This datum provides positive elevations for most City facilities below sea level. Because the project areas extend

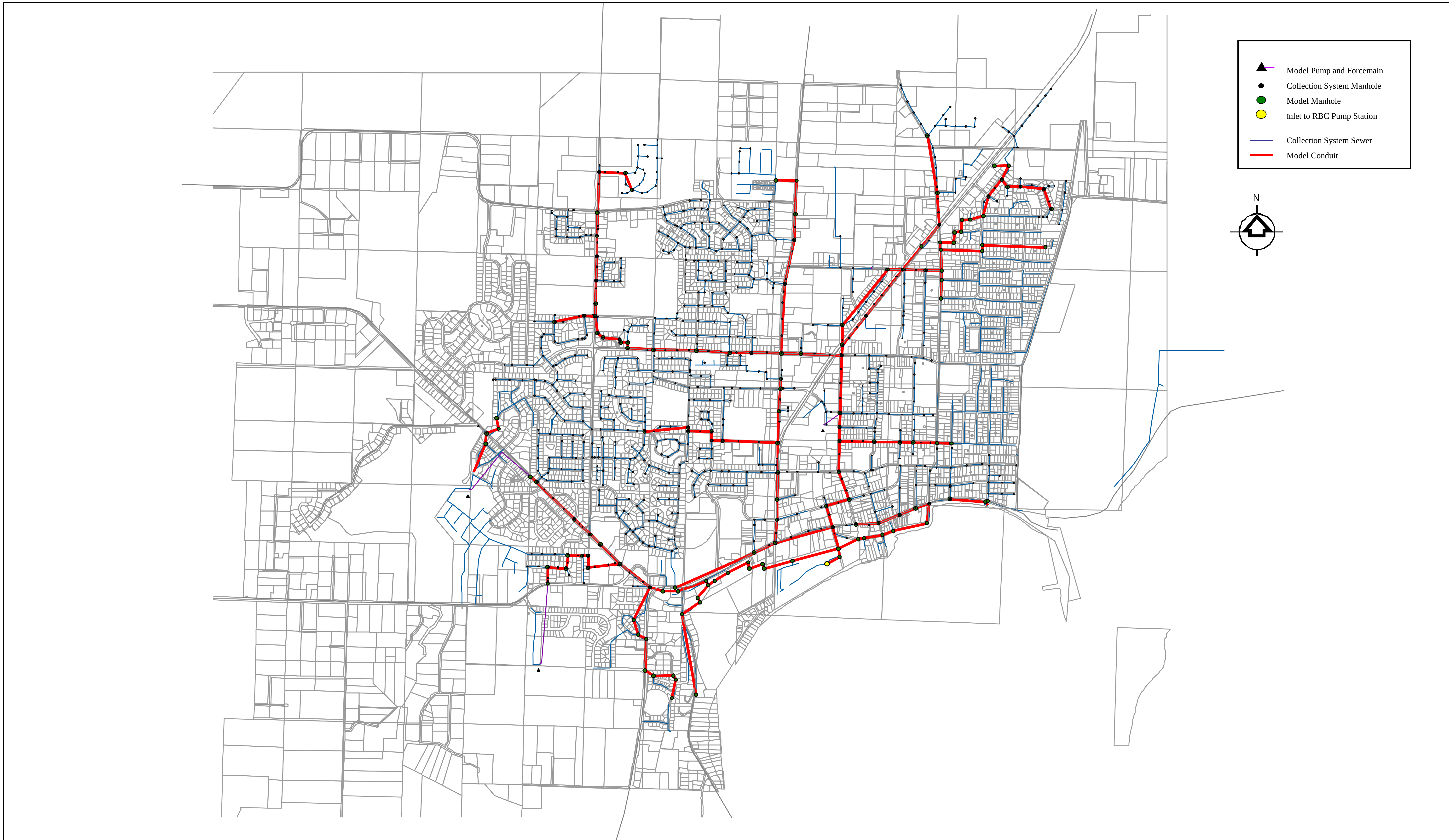

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Figure 7-1.
COLLECTION SYSTEM MODEL COVERAGE

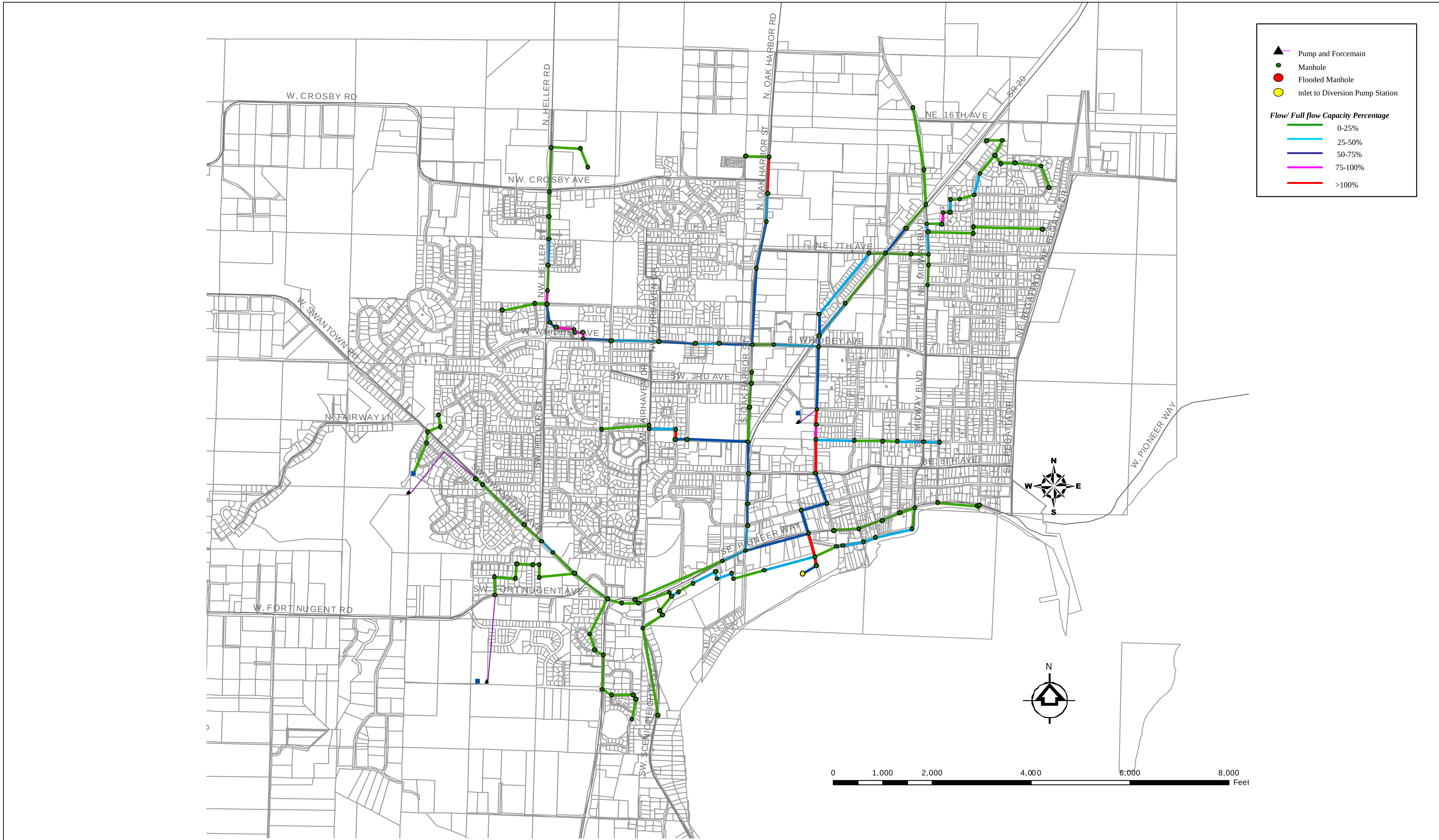

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Figure 7-2.
2005 CAPACITY ANALYSIS RESULTS

> beyond current city limits and contour coverage, contours were generated from aerial mapping conducted for Island County, which is based upon NAVD'88 datum. NAVD'88 differs from NGVD'29 by approximately 3.5 feet, but the difference varies spatially and should be established by a licensed surveyor on a case-by-case basis. Thus, elevations in the City's datum will be about 96.5 feet higher than those shown in NAVD'88. These project layouts should be verified through more detailed mapping during design development.

The peripheral development land that will require expansion of the collection system for sewer service was divided into five areas, designated System Expansion Areas A through E. Initial improvement projects were identified for each area to address the needs of long-term growth. These improvements consist of trunk sewers, lift stations, and force mains. Detailed cost estimates for all elements of these projects are included in Appendix H. From these initial projects, a list of projects was developed for improvements to be implemented within the 20-year planning period. The following sections identify the long-term growth needs as well as the projects proposed for the planning period.

System Expansion Area A—Scenic Heights

A portion of the Scenic Heights service area has been the subject of a local improvement district in the past. The City is currently starting a project to construct the Scenic Heights lift station in the southern portion of this area. The general layout of the project is shown in Figure 7-3. It includes a gravity sewer southward along SW Scenic Heights Street to the edge of the UGA, including a branch sewer up a hill to allow abandonment of the existing Capital Street Lift Station. The Scenic Heights lift station would be located at the edge of the UGA, with the force main pumping back up this street to the existing gravity sewer flowing north on the same street.

There are a number of currently developed lots in the unincorporated portion of the UGA as well as several developable parcels further up the hill to the west, most of which can be served by the new lift station. There may be limited areas near the top of the hill or areas partially isolated by wetlands that would require alternative service methods. Deeper sewers might alleviate this, as might grinder pumps or a small, local lift station. The latter may be a good alternative, as future expansion of the UGA in this area might expand downhill toward the southwest and a likely local lift station.

Both elements of this project (Project A1 and Project A2) are proposed as improvements within the 20-year planning period. The estimated cost of the two elements is about $1.3 million.

System Expansion Area B—Swantown Road and Fort Nugent Avenue

Current development to the east, south and southwest of the Golf Course is served by the existing Golf Course Lift Station, which pumps back to the gravity system on Swantown Avenue. Potential development areas lie to the south of the Fort Nugent Road and to the north and west of the Golf Course.

With improvements to meet long-term growth needs, illustrated in Figure 7-4, the development area to the south of Fort Nugent Road would drain to the existing Golf Course Lift Station. The development area to the north and west of the Golf Course would drain to a new lift station (referred to as the Fairway Lane Lift Station) situated at the low point within the UGA Boundary to the west of Fairway Lane. The force main would pump up and then southeast along Swantown Road to a high point, discharging to a new gravity main extension from the high point to the end of the existing gravity system on Swantown Avenue.

Project B1 is proposed as an improvement within the 20-year planning period. The estimated cost is about $3.3 million.

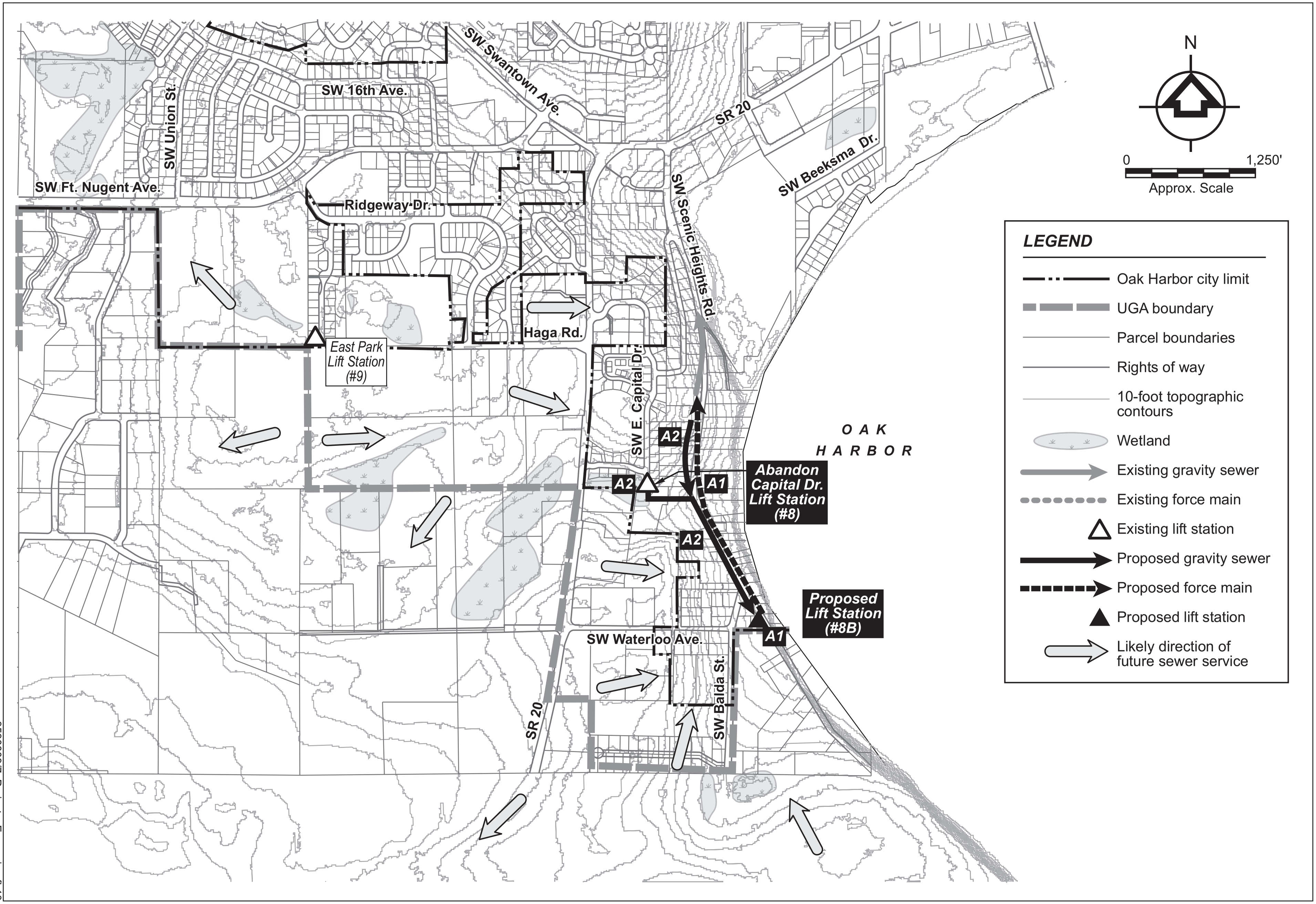

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Figure 7-3.
SYSTEM EXPANSION AREA A: SCENIC HEIGHTS

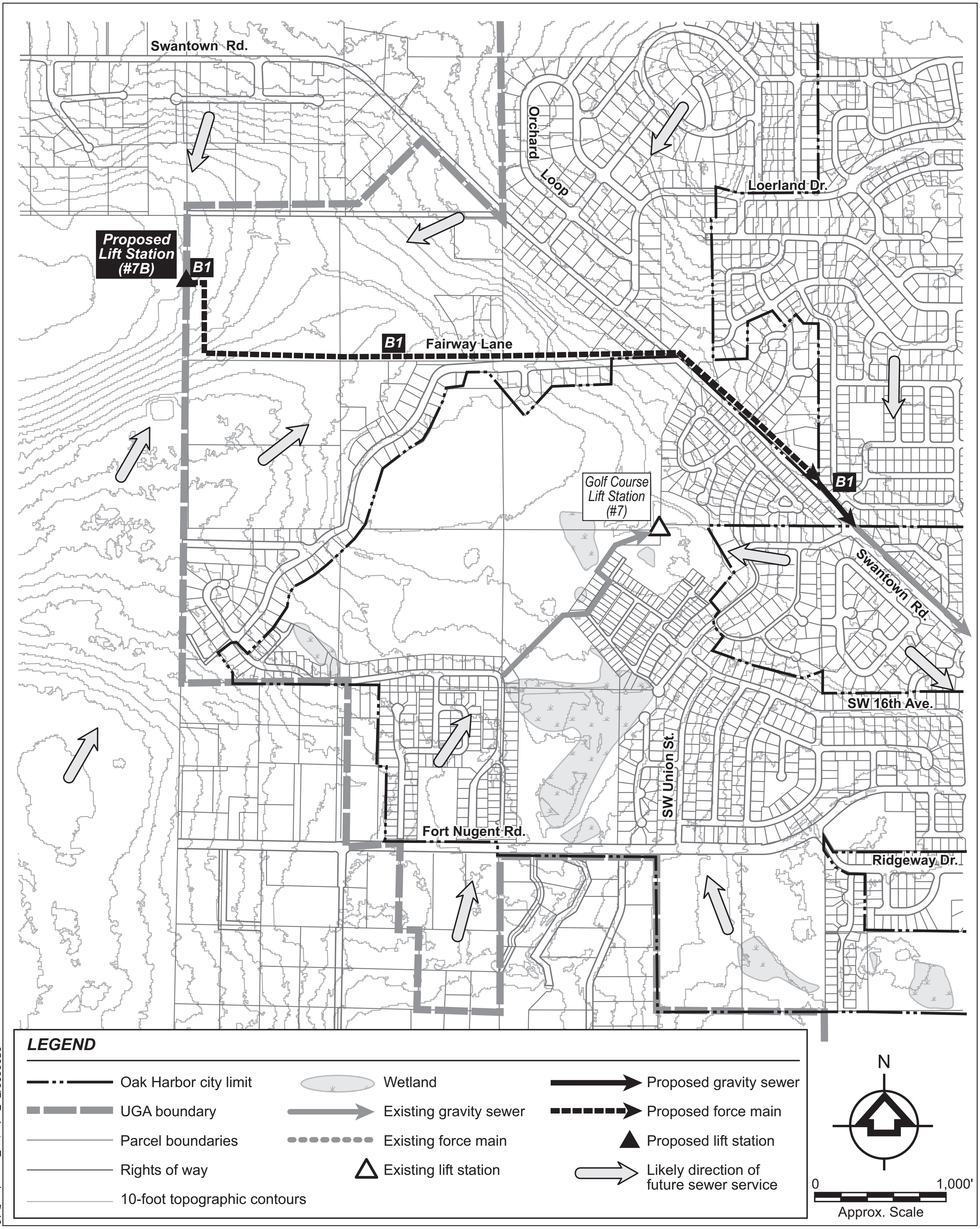

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Figure 7-4.
SYSTEM EXPANSION AREA B:
SWANTOWN ROAD AND
FORT NUGENT AVENUE

System Expansion Area C—Crosby Road

Developed portions of this area are served by the lift station on Crosby Road, which pumps uphill to the east. Improvements to meet long-term growth needs, shown in Figure 7-5, include a new trunk sewer from the existing Crosby Road Lift Station westward to a new lift station at the northwest corner of the expansion area. This would allow the abandonment of the existing lift station. The force main would be routed to the east along Crosby Road to Northwest Heller Street.

Were the UGA to expand in the future, a new lift station could be located downhill to the northwest and pump back up Crosby Road, so the identified improvements are consistent with possible future growth patterns.

Project C1 is proposed as an improvement within the 20-year planning period. The estimated cost is about $1.8 million.

System Expansion Area D—Heller Road to Goldie Road

The area to the north of the City between Heller Road and Goldie Road represents a relatively large acreage straddling a shallow valley. The eastern and western portions of the area are the flanks of the valley, with a low-lying area in the center. The majority of the lower central area can be drained to the south. The higher areas in the southwest and southeast can be served by extension of the existing gravity collection system. The low-lying central area is likely to require a lift station, although topography suggests that a gravity route may be feasible. Service to the northern part of the area is likely to require a lift station to enable discharge into the gravity system. The choice of gravity service or lift stations will be based on the reasonable depth of gravity sewers. Deeper gravity sewers would have a higher initial cost and lower operation and maintenance costs if they lead to less area being served by lift stations.

Improvements to meet long-term growth needs, shown in Figure 7-6, consist of three subsystems:

- The first subsystem would extend the existing trunk sewer along Oak Harbor Road north, possibly as far as the current northernmost city limit, depending on local topography. This line would serve areas upland to the west. It could also be extended farther north in the future if it runs uphill to the west of Oak Harbor Road. As this line provides gravity service all the way to the RBC plant, development to the west of Oak Harbor Road should connect to this line to the greatest extent possible.
- The second subsystem would consist of a lift station (referred to as the Goldie Road Lift Station) midway between Oak Harbor Road and Goldie Road at about NE 18th Avenue (about the north end of a wetland). A trunk sewer would extend northward along the center of the low area to Oak Street, eastward to Goldie Road and then northward until minimum depth is reached, estimated to be approximately at the intersection of Goldie and Old Goldie Roads. The lift station would discharge to the east to the existing gravity system along Goldie Road. It would eventually be abandoned in favor of a line extending south around the east side of the wetland to the present NE 7th Lift Station.

  An alternative to this second subsystem would be to continue the trunk sewer from the lift station further north past Oak Street along the bottom of the low area before heading east toward Goldie Road. This alternative is not part of the recommended improvements, but might be worth considering depending on development patterns. This alternative would likely require more easements and is closer to wetlands, but might allow portions of the sewer to be shallower.

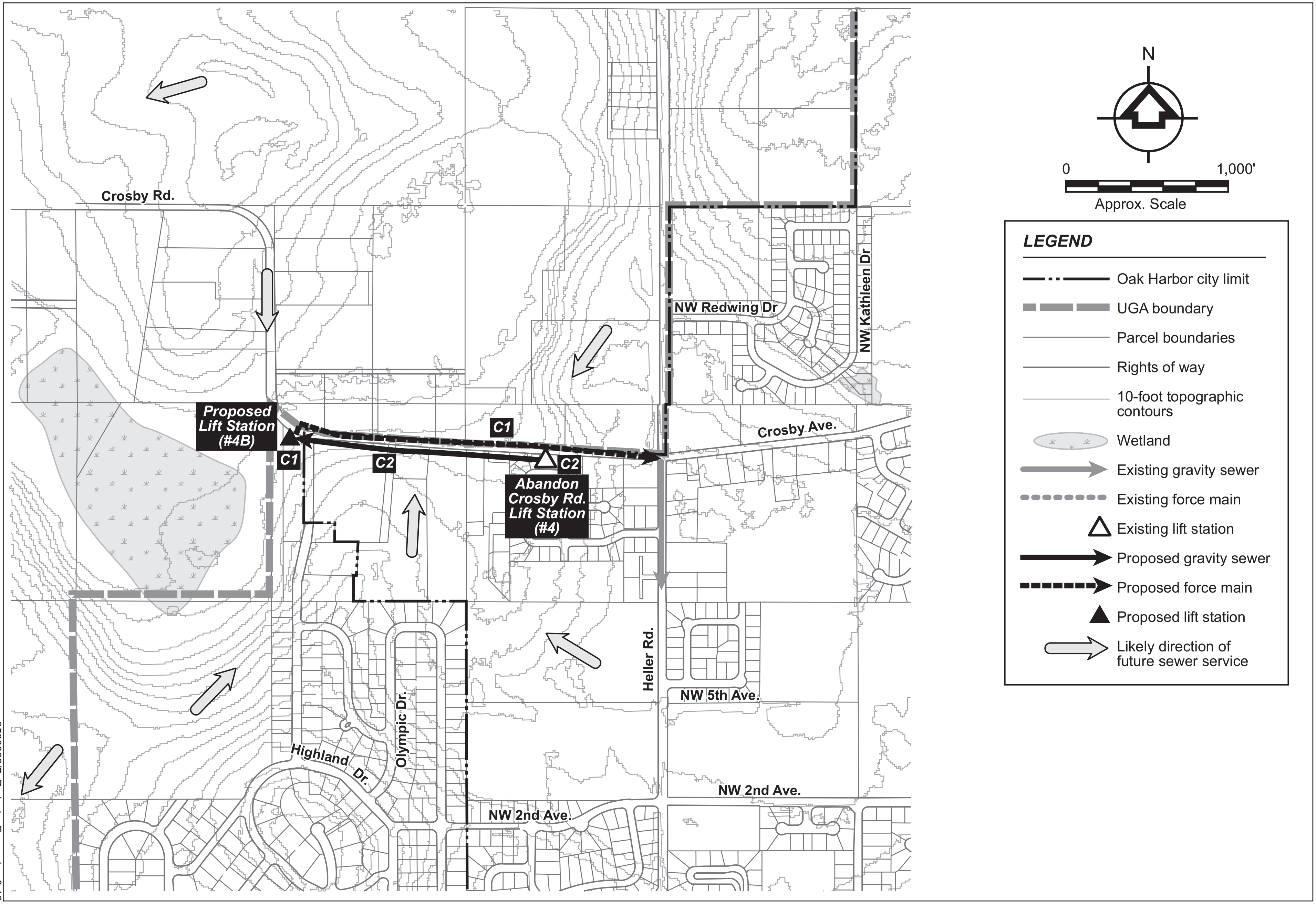

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Figure 7-5.
SYSTEM EXPANSION AREA C: CROSBY ROAD

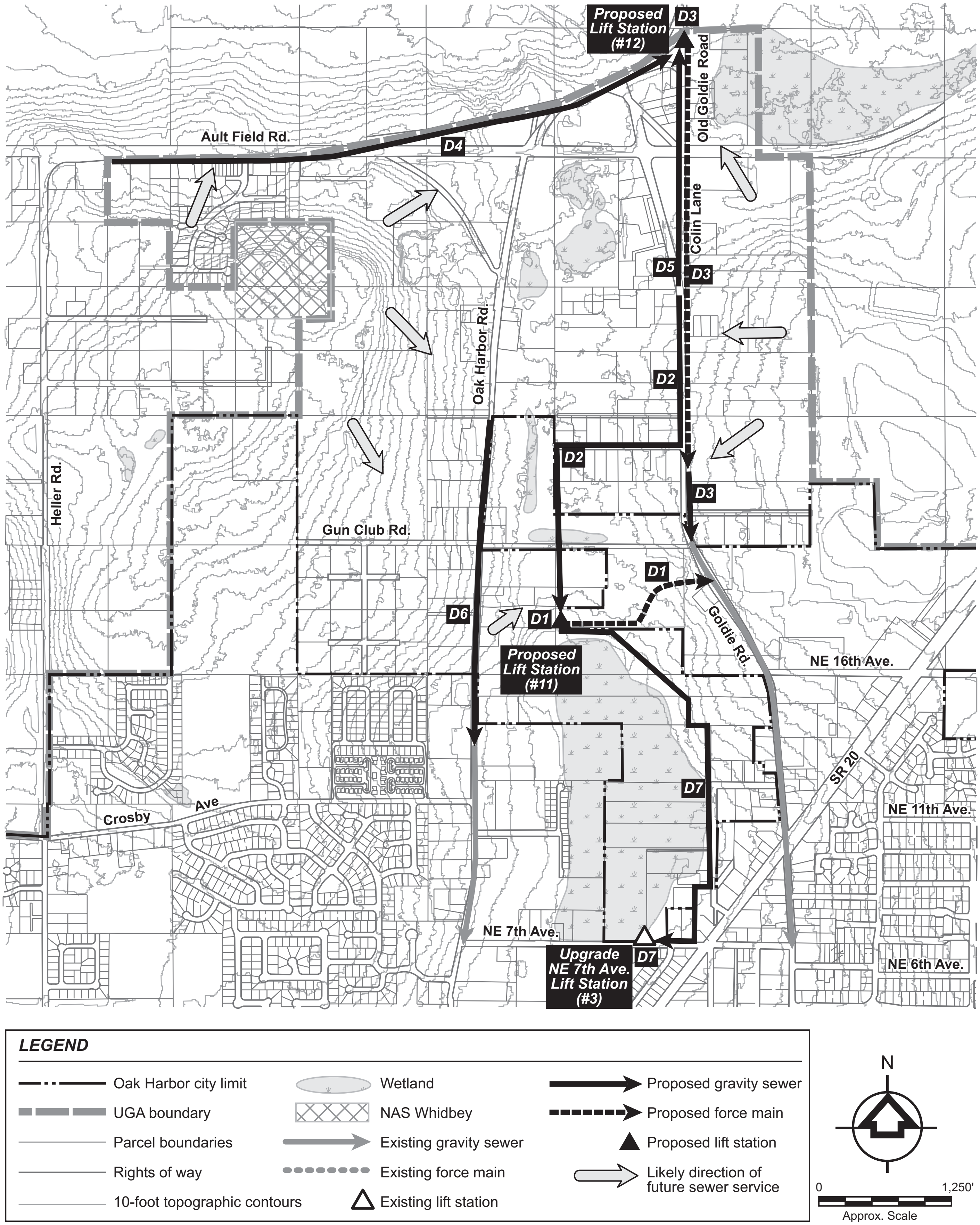

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Figure 7-6.
SYSTEM EXPANSION AREA D:
HELLER ROAD TO GOLDIE ROAD

- The third subsystem would consist of a lift station in the north end near Old Goldie Road at the present UGA boundary. It would be fed by a trunk sewer along Old Goldie Road and a trunk sewer running west along Christian Road and Clover Valley Road. The discharge for this force main would travel south along Old Goldie Road either to the trunk sewer that is part of the second subsystem or another 1,800 feet south to the existing gravity system on Goldie Road. The latter option is recommended; although it would require additional force main and have a higher initial cost, it would avoid pumping these flows an additional time.

  This configuration is consistent with potential future expansion of the UGA in that future UGA expansion should allow lift stations to serve downhill from the identified new lift stations.

Projects D1 and D2 are proposed as improvements within the 20-year planning period. The estimated cost for the two is about $4.5 million.

System Expansion Area E—Crescent Harbor

Improvements to meet long-term growth needs in the Crescent Harbor area, shown in Figure 7-7, would serve the area east of SR 20 between West Fakkema Road and Crescent Harbor Road as far east as the UGA boundary. They consist of gravity sewers throughout the area and a lift station in the southeast corner. The force main would be routed to the west along NE 16th Street. It could discharge to the existing gravity system on SR 20, but the downstream capacity would require upgrading. It may also be conveyed to the sewer on Goldie Road. The improvements would allow the abandonment of two local lift stations (Taftson and NE 9th) by construction of additional gravity sewer within the existing development to the south and west of the expanded service area.

Should the UGA expand to the north, it may require service through a new lift station to serve that area, as the terrain generally slopes away from the system that would be constructed through the identified improvements. If the UGA expands eastward, it should be possible to abandon the new lift station in favor of one at a lower elevation to the east.

None of the projects identified in this expansion area are proposed for implementation within the 20-year planning period. They would be implemented as warranted by future development as it occurs.

ANALYSIS OF FUTURE SYSTEM CAPACITY

Capacity Analysis Approach

Capacity analysis of the existing collection system was undertaken with projected flows for 2011, 2025 and the long-term growth condition.

When considering the analysis of the future capacity within the existing system and the upgrades that would be required, it was assumed that treatment of all wastewater flows ultimately would move to a proposed facility at the Seaplane Lagoon Plant, as detailed in Chapter 9. While the RBC Treatment Plant is likely to remain in service in the short term, it was assumed that this would be decommissioned as a treatment facility by 2015. All wastewater flows from the City proper will need to be pumped to the Lagoon site, since topography prohibits gravity flow for almost the entire City.

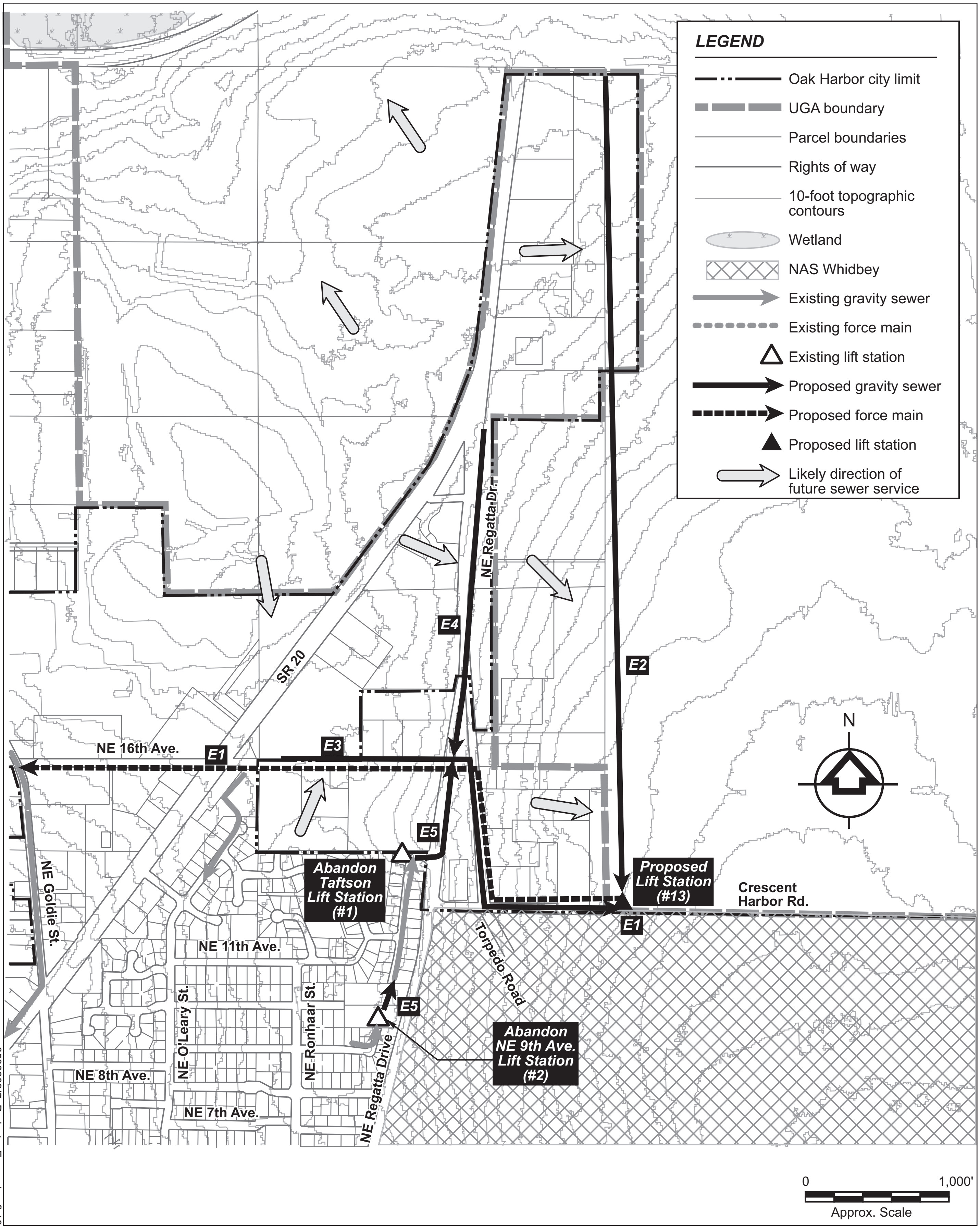

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Figure 7-7.
SYSTEM EXPANSION AREA E:
CRESCENT HARBOR ROAD

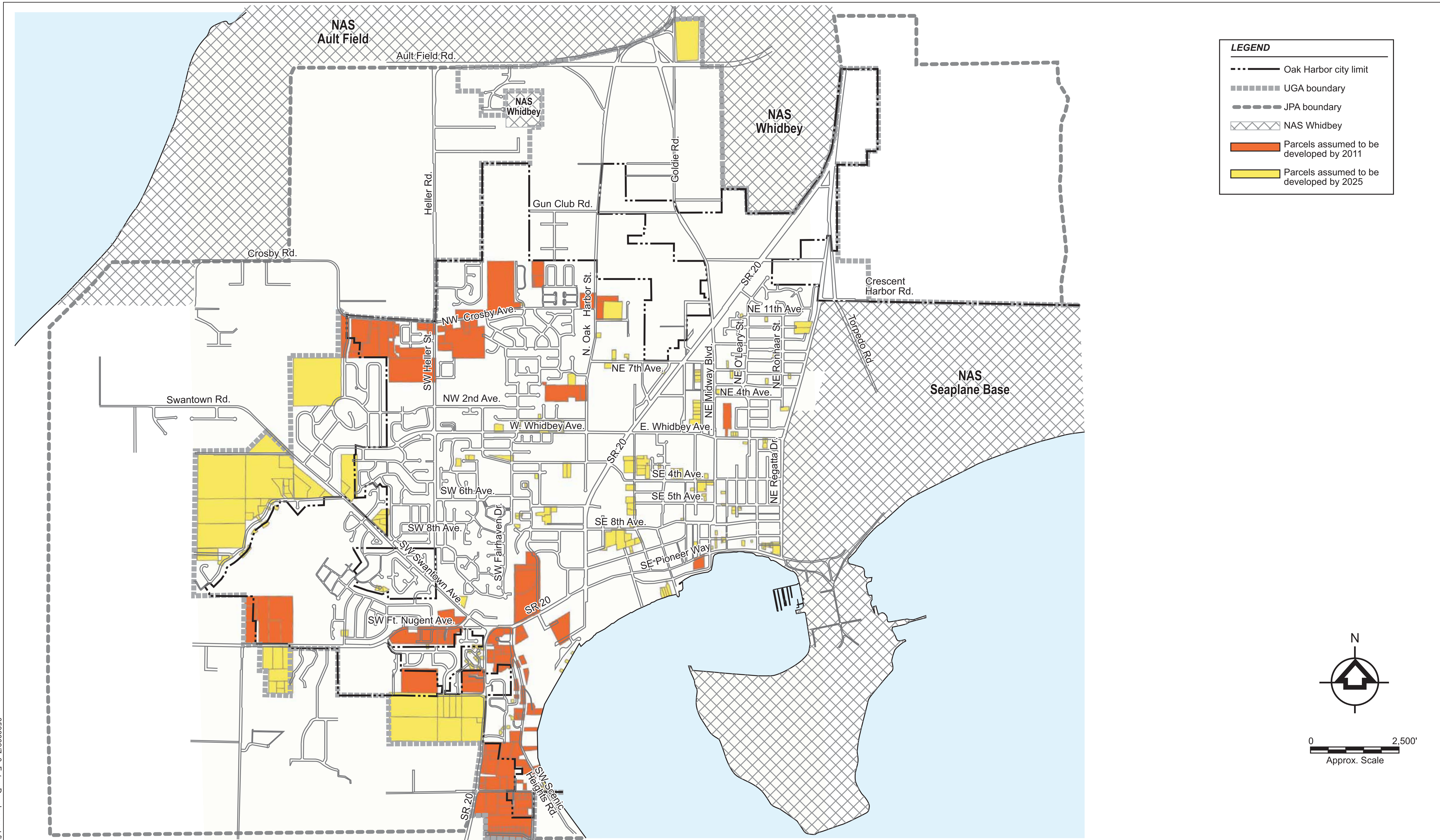

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Figure 7-8.
ASSUMED FUTURE DEVELOPMENT FOR 2011 AND 2025

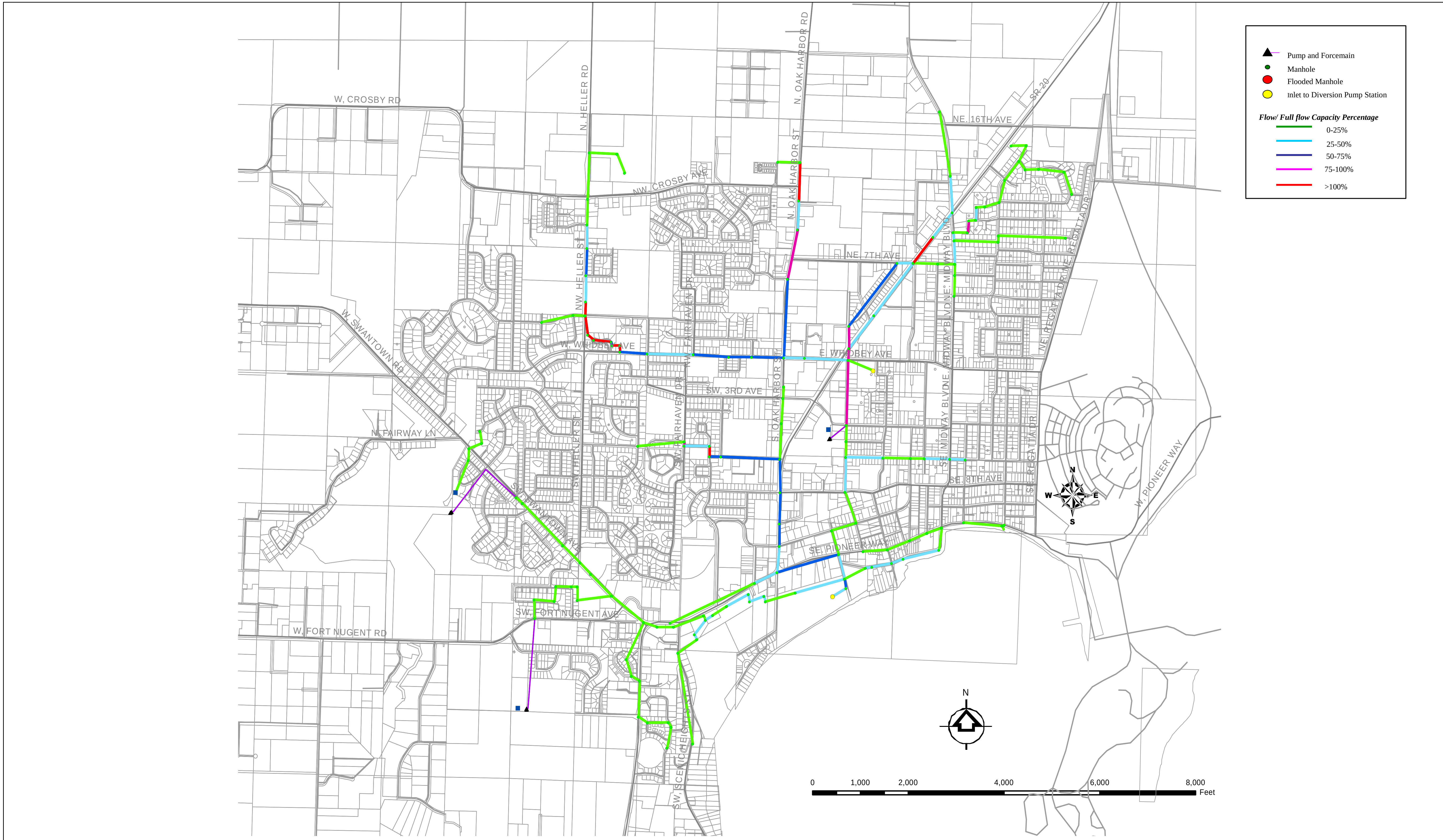

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Figure 7-9.
ALTERNATIVE 1: 2011 CAPACITY ANALYSIS RESULTS

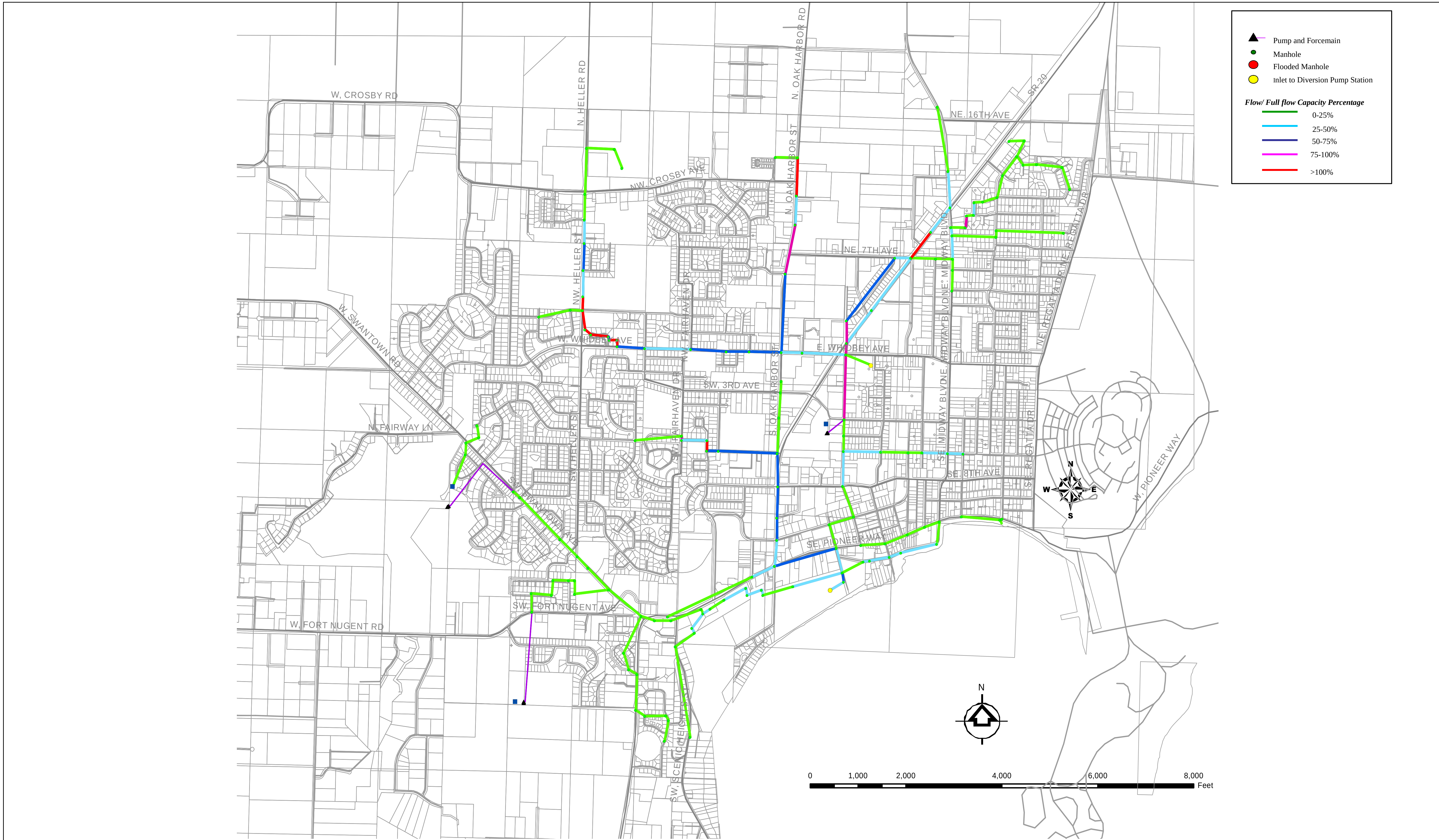

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Figure 7-10.
ALTERNATIVE 1: 2025 CAPACITY ANALYSIS RESULTS

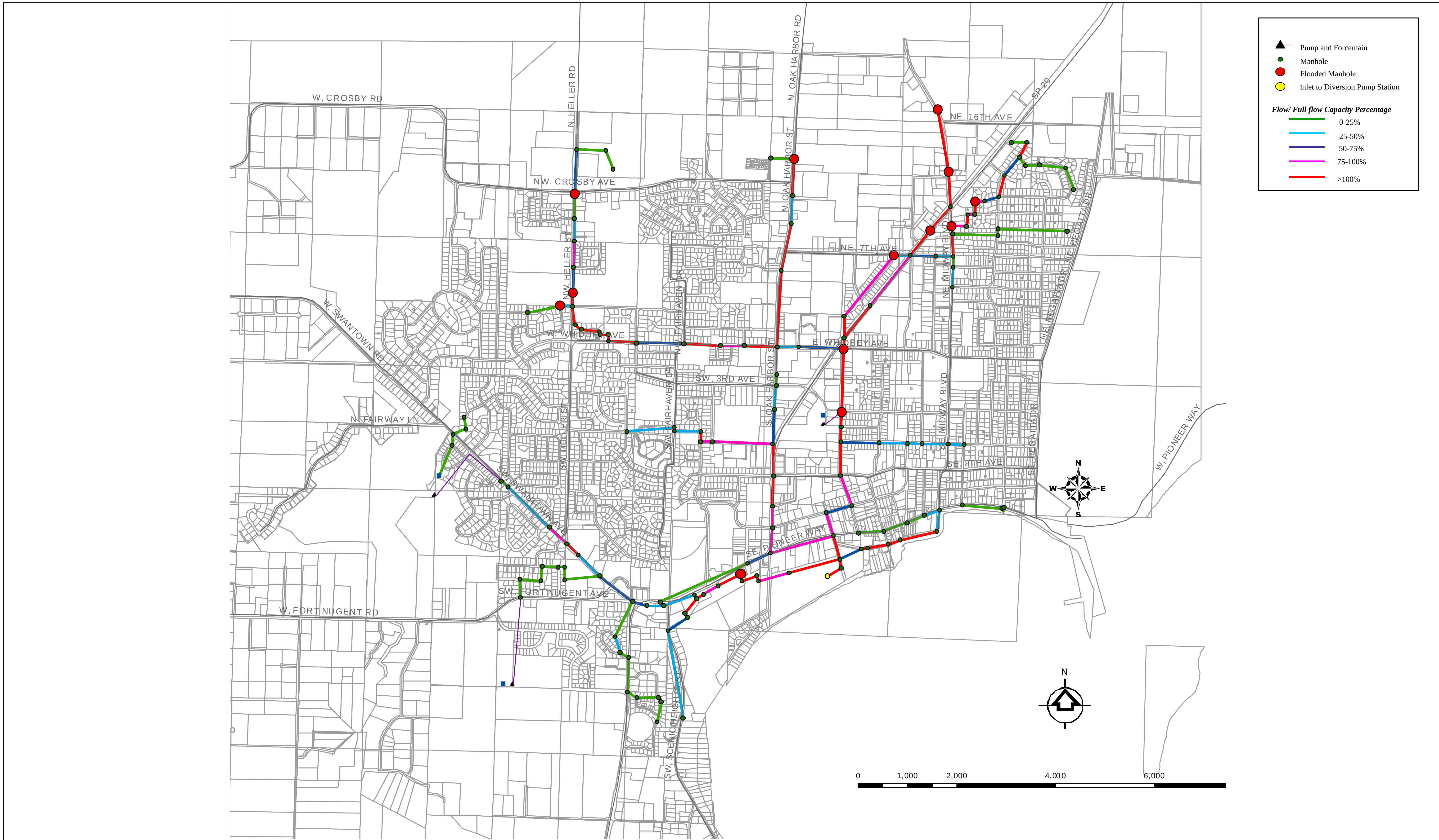

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Figure 7-11.
ALTERNATIVE 1: LONG-TERM GROWTH CAPACITY ANALYSIS RESULTS

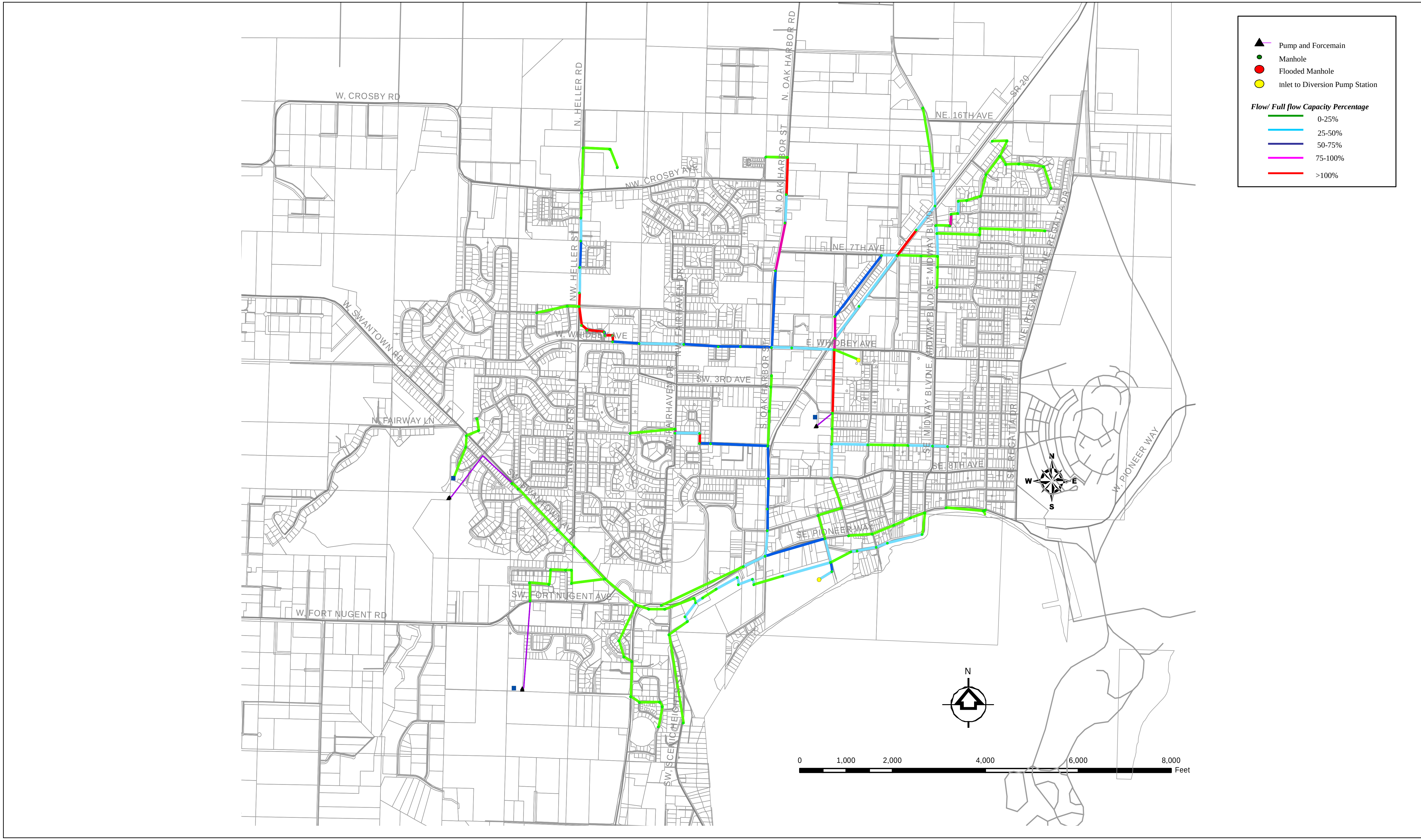

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Figure 7-12.
ALTERNATIVE 2: 2011 CAPACITY ANALYSIS RESULTS

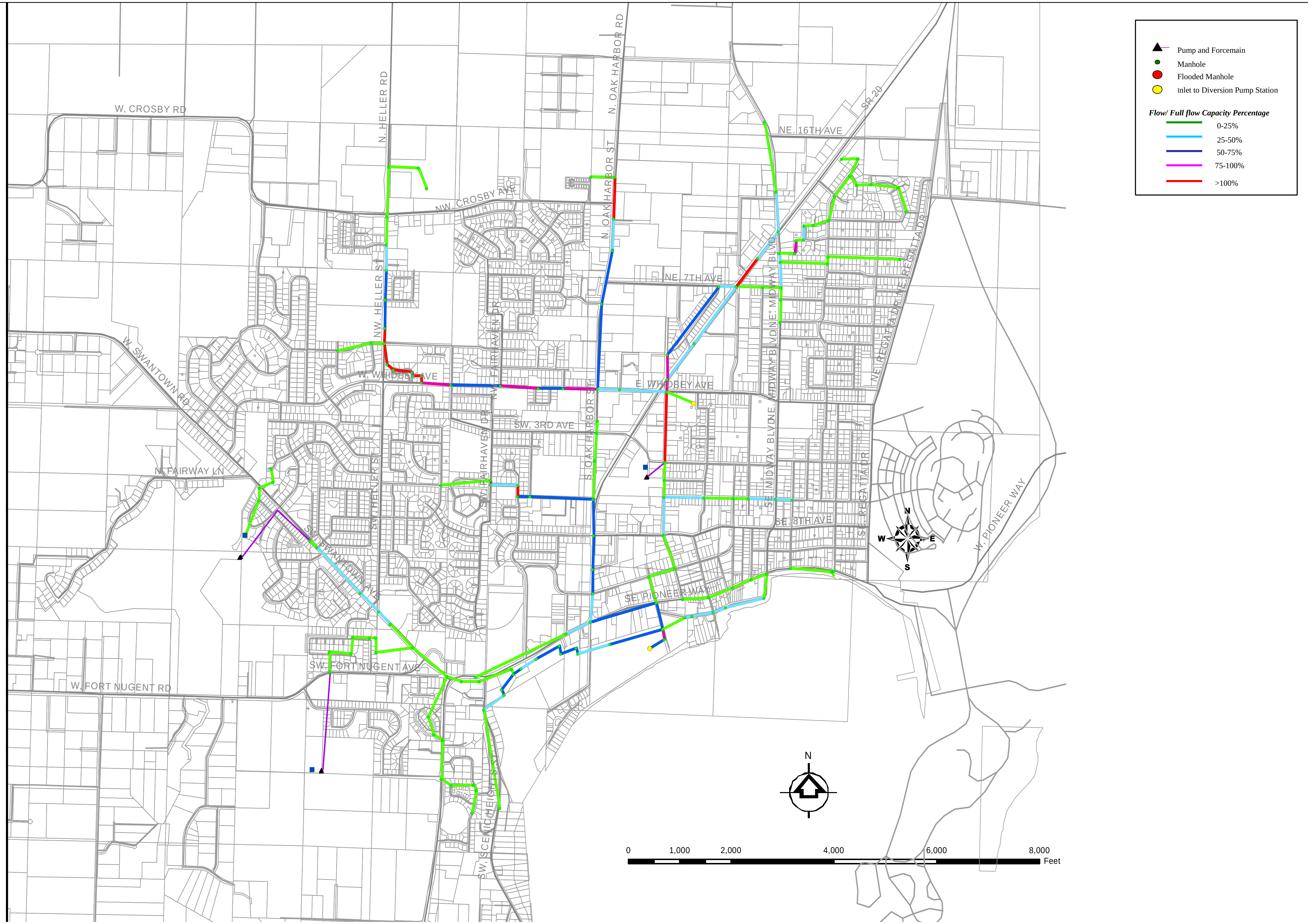

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Figure 7-13.
ALTERNATIVE 2: 2025 CAPACITY ANALYSIS RESULTS

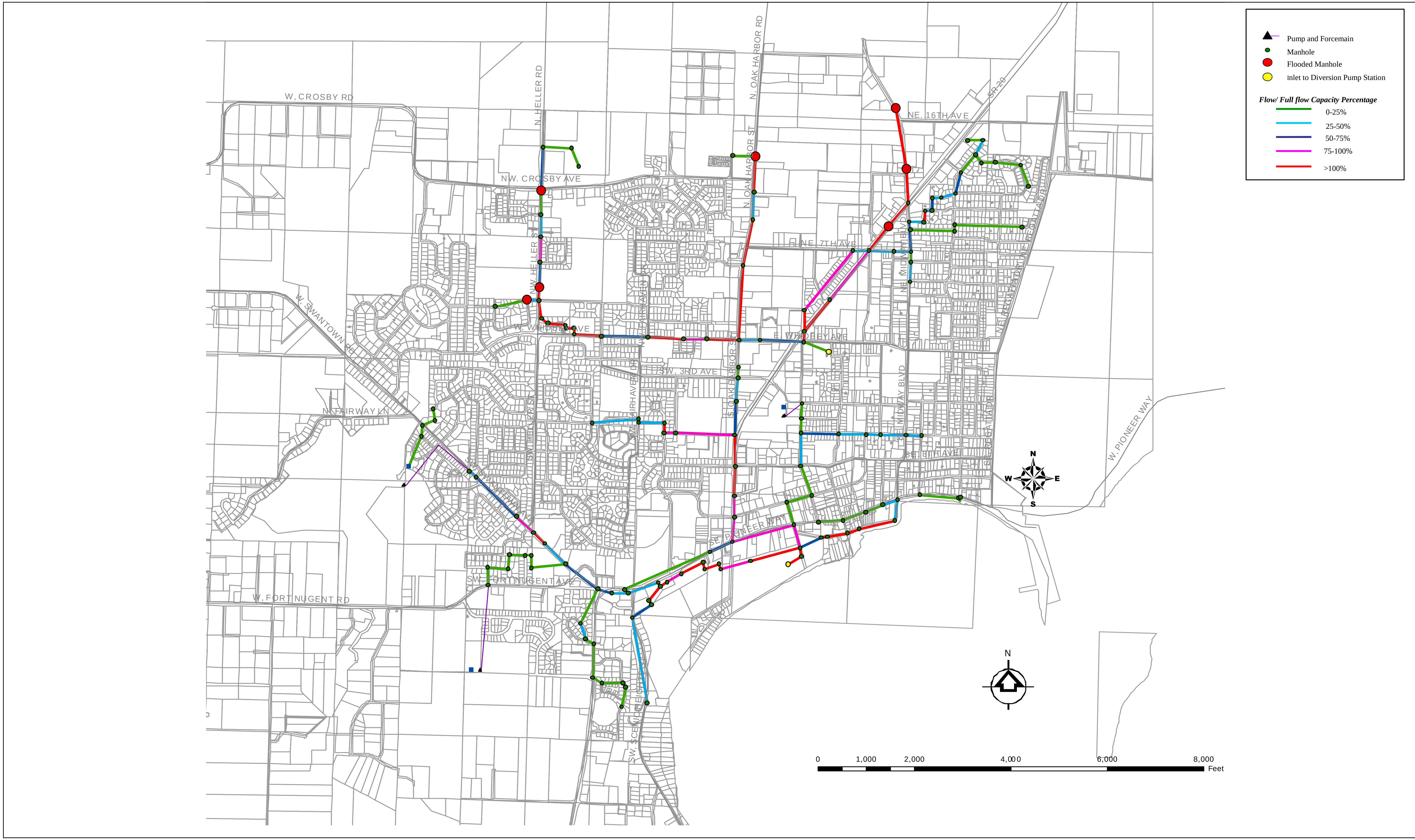

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Figure 7-14.
ALTERNATIVE 2: LONG-TERM GROWTH CAPACITY ANALYSIS RESULTS

In the 1997 Comprehensive Sewerage Plan update, two main pumping alternatives were considered:

- Alternative 1—All flows continue to flow to a facility at the current RBC Diversion Pump Station location for onward conveyance.
- Alternative 2—A new pump station would be installed close to the intersection of Whidbey Avenue and SR 20 to intercept flow from the north and west and convey it directly to the Seaplane Lagoon site. Screening of the flows from this pump station would be undertaken at the headworks of the Seaplane Lagoon site which was upgraded in summer 2008. The RBC Diversion Pump Station would continue to operate, collecting wastewater from the remainder of the City and pumping it to the Seaplane Lagoon site.

The 1997 update identified Alternative 2 as the preferred alternative because it would prevent the need for expansion of the RBC Diversion Pump Station and because installing a parallel force main from the RBC Diversion Pump Station would be difficult due to potential conflicts with existing utilities, busy roadways, a high groundwater table, and other factors. However, the 1997 Plan did not account for treatment of all flows at the Seaplane Lagoon site, and the potential corrosion problems of the 16-inch force main from the RBC Diversion Pump Station had not been determined. Therefore, for this analysis, both alternatives were re-examined in detail.

Flows for 2011, 2025 and the long-term growth condition were modeled as follows:

- For the 2011 planning horizon, residential lots most likely to be developed within six years were identified based on discussions with City staff. These lots, shown in Figure 7-8, include the Scenic Heights and West Meadows areas not currently in the city limits but within the UGA. It was assumed that each lot in these areas represents a single-family residence with an average population of 2.69, similar to the number of people per household found in current City development. It was assumed that commercial flows would represent a portion of the total collection system flow similar to current conditions. Commercial growth was assumed to occur in the Goldie Road area north of the current city limits but within the UGA.
- For the 2025 planning horizon, information on residential developable lots, which formed the basis for the City's 2025 population projection detailed in Chapter 3, was obtained from the City Planning Department. These lots are also shown on Figure 7-8. Population growth was distributed on an area basis across these lots. As with 2011, it was assumed that commercial flows would represent a portion of the total collection system flow similar to current conditions, with growth occurring in the Goldie Road area.
- For the long-term growth condition, it was assumed that the entire area within the UGA, with the exception of wetlands, would be developed to the maximum zoned allowances. Further, it assumed that existing development would be replaced to enable the higher densities to be reached.

To incorporate the projected development into the model, additional basins were delineated around the periphery of the existing system within the UGA. As with the analysis of the collection system, flows were determined for each basin. These flows were applied to a designated manhole in the existing model network. For the peripheral development areas, the flows were applied with reference to the proposed service strategies.

Capacity Analysis Results

Figures 7-9 to 7-11 show the existing collection system performance for Alternative 1 with the 2011, 2025 and long-term growth peak-hour flows. Capacity issues were identified in four main sewer lines:

- Heller Street/Whidbey Avenue Trunk—In Heller Street, some potential for minor surcharging was indicated in the vicinity of NW 2nd Avenue with 2011 flows. Significant surcharging and out-of-sewer flooding would only occur with flows associated with the long-term growth condition.
- Goldie Street/SR 20 to Whidbey Avenue Trunk—Some minor surcharging was indicated in the sewer just upstream of NE 7th Street for 2011 and 2025 peak flows, largely due to commercial development in the Goldie Road area. Surcharging was indicated upstream of Whidbey Avenue due to restriction in capacity in the downstream Ely Street sewer with the 2011 and 2025 scenarios. Significant surcharging and out-of-sewer flooding would occur with flows associated with long-term growth.
- Oak Harbor Street Trunk—No capacity issues were identified within the 20-year planning period, but long-term growth could lead to capacity issues in this trunk's contributing area.
- Ely Street to RBC Plant Trunk—As indicated previously surcharging was identified during 2005 peak hour conditions in the Ely Street trunk sewer upstream of SE Barrington Drive. This is predicted to increase with additional flow from the northern part of the City and require upgrading of part of the Ely Street sewer. Capacity in the installed 15-inch section recommended in the 1997 Comprehensive Plan and the downstream sewer is likely to be sufficient through the 20-year planning period, but this section may experience surcharging with the flows associated with long-term growth. Surcharging in the sewer just upstream of the RBC Plant is predicted to remain minor through the 20-year planning period; however, this could be affected by backwater from the RBC Plant, and monitoring should be undertaken to examine this.

Figures 7-12 to 7-14 show the existing collection system performance for Alternative 2 for the 2011, 2025 and long-term growth peak flows. For this condition, the Ely Street trunk sewer between the location of the Whidbey Diversion Pump Station and the RBC Diversion Pump Station would have sufficient capacity for flows under the long-term growth condition, so upgrades for capacity reasons are unlikely to be required.

Capacity issues associated with the RBC Diversion Plant pump station and the downstream conveyance to the Seaplane Lagoon Plant are discussed in the subsequent sections relating to upgrades for Alternatives 1 and 2.

UPGRADES FOR FUTURE SYSTEM CAPACITY

Criteria for Upgrading

The results of the 2005, 2011 and 2025 peak hour flow capacity analysis were used to estimate when upgrades to the existing collection system would be required. To determine which sewer lines required upgrade, the following criteria were applied:

- Manhole Flooding—Where model results predicted sanitary sewer overflows due to elevation of the hydraulic grade line relative to grade level, upgrades were classified as essential.
- Significant Sewer Surcharging—Where model results indicate the hydraulic grade line to be above the crown of a pipe and within 10 feet of the ground surface, upgrades were classified as essential.
- Minor Sewer Surcharging—Where model result indicate the hydraulic grade line to be above the crown of the pipe but more than 10 feet below the ground elevation, further investigation is recommended to confirm model accuracy and determine potential impacts of surcharging.

Upgrade should be considered but may be deferred if flooding or other operational issues will not occur as determined by the investigation.

- Sewer Approaching Capacity Limit—Where the flow through the sewer is between 75 and 100 percent of the pipe-full capacity, upgrade may be considered.
- Access Restrictions—Where access to manholes for sewer maintenance is restricted, such as along the sewer route in the vicinity of Heller Street and NW 2nd Avenue, upgrade may be considered.

The long-term growth condition was not used to determine which sewer lines require upgrading. However, where sewers were identified as requiring upgrades and as sewers have a significantly longer lifespan than the twenty year planning period, the upgrades were in general sized to provide sufficient capacity for long-term growth conditions. In discussions with City staff, it was agreed that upsizing pipes to resolve a localized capacity issue should not trigger increase in the downstream pipe sizes unless warranted by economic factors. For example, upsizing a section of 8-inch sewer with minimum gradient due to capacity limitations will not necessitate replacement of 8-inch sewer downstream that has a steeper grade and sufficient capacity. This policy may increase the potential for blockage at the manhole where the pipe size reduction occurs. However, it enables sufficient capacity to be provided in a timely manner and enables future upgrading to be based on the then-current understanding of development needs and boundaries.

For this analysis, it was assumed, except where noted otherwise, that increasing sewer capacity would be achieved by replacing the existing sewer with a larger diameter pipe laid along the same route and at the same grade as the existing sewer. Design of these upgrades should investigate in more detail the routing, alignment and grade.

Upgrade Alternative 1—One Diversion Pump Station

RBC Diversion Pump Station and Downstream Conveyance

Table 7-1 shows the estimated peak-hour flows to the RBC Diversion Pump Station. Of the flow arriving at the RBC Diversion Pump Station, up to 2.6 mgd of peak flow may be conveyed to the RBC Plant; the remainder of flow would require pumping. However, the treatment plant is rated for 0.7 mgd on a daily average basis and flows in excess of this quantity typically are diverted by the pump station to the Seaplane Lagoon Plant. Other plant restrictions may also limit the peak flow to less than the nominal 2.6 mgd; the influent meter is set to read a maximum flow of 2.0 mgd.

TABLE 7-1.
PEAK-HOUR FLOWS AT RBC DIVERSION PUMP STATION

	Flow[a] (mgd)
2011	7.7
2025	8.6
Long term growth	20.9

a. Flows assume capacity restrictions in network are eliminated by system upgrades

The current peak pumping capacity at the RBC Diversion Pump Station is approximately 3.6 mgd. However, the firm capacity (with the largest pump out of service) is only 1.7 mgd since only two of the three available pump bays are being used. Therefore, an increase in pump capacity would be required prior to 2011 for this alternative, not only to improve station reliability but also to provide sufficient capacity for peak-hour flows.

From review of the existing pump station layout, it may be feasible to increase pump capacity to approximately 10 mgd within the existing structure. This would be sufficient for 2025 peak-hour flows. Provision of significant capacity beyond 10 mgd would necessitate extension of the existing structure or construction of an adjacent ancillary pump station. If this alternative were adopted it would be proposed that an interim upgrade of the existing station be undertaken to increase the capacity to 10 mgd and space secured for future expansion.

Increase in pumping capacity may require upgrade or replacement of other systems at the pump station, including motors, controls, surge protection, odor control and standby generation. Further study would be needed to determine the upgrade requirements.

The existing 16-inch force main has an approximate maximum capacity of 7 mgd, assuming a maximum allowable velocity of 8 feet per second (fps). Therefore the existing force main has sufficient hydraulic capacity through 2011, assuming that the RBC Plant remains in operation and can receive a proportion of the influent. Additional capacity would be required prior to decommissioning the RBC plant. It has been assumed that the force main break due to corrosion represents a localized fault. The City does plan to conduct further investigations to determine the extent of the corrosion. If it were determined that the corrosion is more widespread, sections of the force main may require replacement prior to capacity restrictions being reached.

The replacement should be sized to accommodate build-out conditions, with a maximum capacity of approximately 21 mgd. Due to the corrosive ground conditions, it is recommended that design incorporate corrosion protection or a corrosion resistant pipe material such as HDPE. For this analysis, it was assumed that a single HDPE force main with internal diameter of 28 inches would be installed adjacent to the existing force main, which would be decommissioned following transfer of flow.

Increasing the capacity at the RBC Diversion Pump Station to 10 mgd would also increase the flows in downstream the existing 21-inch gravity sewer. The capacity of this sewer varies between 3.8 mgd close to the force main discharge and 24 mgd in the steepest section of sewer. Surcharging will occur during peak pumping conditions in the section with the shallowest gradient but this may would be acceptable provided no side sewer connections from the Seaplane Base are affected. Otherwise upgrading this section (approximately 300 feet) would be necessary. By accepting larger diameter pipe sections upstream of steeper pipe sections, the extent of the upgrade could be limited or phased. This increases the potential for blockage, but, as the majority of flow in the sewer is from the pump station or small diameter Seaplane Base collection system, the increase in risk of blockage is low.

The existing inverted siphon would have sufficient capacity for an increased pump capacity of 10 mgd, sufficient for 2025 flows although the driving head would be increased. With long term growth conditions, the velocity during peak-hour flows would be excessive and additional capacity would be required. Although this upgrade could be delayed until after 2025, the Navy has plans to flood the area across which the existing siphon crosses prior to 2011, in order to restore a salt marsh. Increasing inverted siphon capacity following this restoration would have additional cost and environmental impact. Therefore, it would be prudent to install additional capacity in advance. For this analysis, it was assumed that a parallel siphon would be installed but that the existing pipe would remain in operation.

Based on the above analysis, the Alternative 1 improvements required to address long-term growth needs for conveying flows from the RBC Diversion Pump Station to the Seaplane Lagoon Plant are those

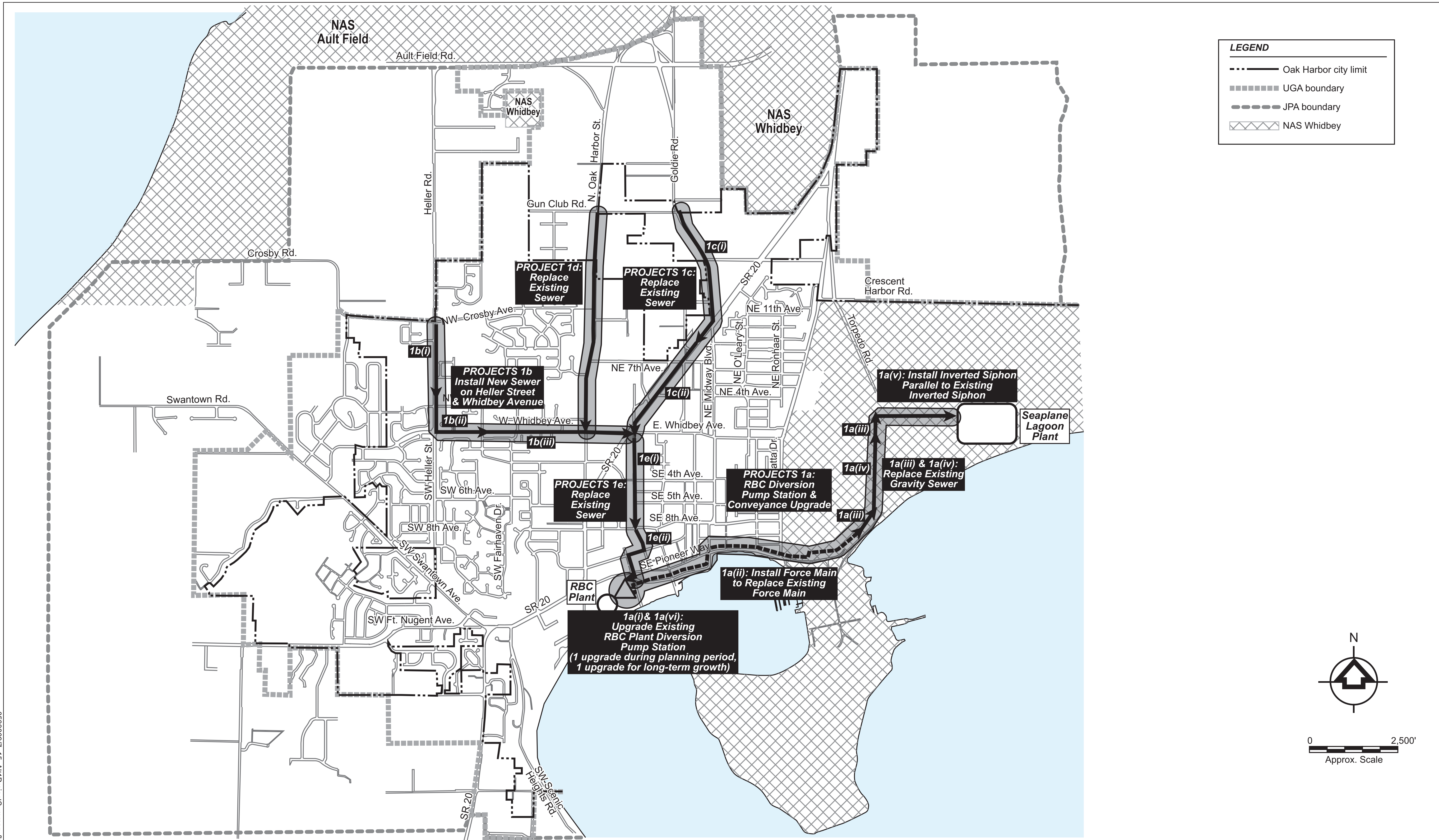

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Figure 7-15.
ALTERNATIVE 1 IMPROVEMENT PROJECTS

identified as Projects 1a on Figure 7-15. Appendix H provides detailed location maps and cost estimates for each of these projects. From this set of projects, the following were identified for implementation within the 20-year planning period:

- Project 1a(i), upgrading the RBC Diversion Pump Station to a capacity of 10 mgd, with an estimated cost of $1,856,000
- Project 1a(ii), upgrading the RBC Diversion Pump Station force main, with an estimated cost of $6,123,000
- Project 1a(v), upgrading the inverted siphon to the Seaplane Lagoon headworks, with an estimated cost of $1,069,000.

Gravity Collection Sewers

The initially identified gravity sewer improvements to address long-term growth needs under Alternative 1 consist of four sets of projects, one for each of the main sewer lines identified as deficient by the capacity analysis: Heller Street/Whidbey Avenue Trunk (Projects 1b); Goldie Street/SR 20 Trunk (Projects 1c); Oak Harbor Street Trunk (Projects 1d); and Ely Street Trunk (Projects 1e). Appendix H identifies all these projects and provides a cost estimate for each. Figure 7-15 shows the project locations.

From the set of initially identified gravity sewer projects for Alternative 1, two main sewer lines were identified as requiring upgrade within the 20-year planning period:

- Project 1b(ii) on the Heller Street/Whidbey Avenue Trunk, with an estimated cost of $845,000
- Project 1e(i) on the Ely Street Trunk, with an estimated cost of $2,113,000.

Upgrade Alternative 2—Two Diversion Pump Stations

Diversion Pump Stations and Downstream Conveyance

Table 7-2 shows the projected peak-hour flows at the Whidbey Diversion Pump Station and the RBC Diversion Pump Station. Installing the Whidbey Diversion Pump Station would significantly reduce the projected flows arriving at the RBC Diversion Pump Station.

TABLE 7-2.
PEAK-HOUR FLOWS AT DIVERSION PUMP STATIONS

	Flow[a] (mgd)	
	Whidbey Diversion Pump Station	RBC Diversion Pump Station
2011	3.6	4.1
2025	3.7	5.0
Long term growth	11.2	10.1

a. Flows assume capacity restrictions in network are eliminated by system upgrades

RBC Diversion Pump Station

At the RBC Diversion Pump Station, the existing firm capacity (1.7 mgd) is just sufficient to handle the projected 2011 peak-hour flows, assuming that the RBC Plant can receive peak-hour flows of 2.6 mgd.

An increase in the pump capacity would be required prior to decommissioning of the RBC Plant. For this alternative it is recommended that the firm capacity be increased to facilitate 2025 flows (approximately 6 mgd) and avoid sending large peaks through the RBC Plant. It is likely that this could be done without major rehabilitation of the station but installation of new pumps.

More significant rehabilitation of the station would be required after 2025 to enable pumping of the projected flows under long term growth conditions. It is likely that the existing structure would be sufficient for the increased capacity. However, it would be recommended that additional space be retained adjacent to the station or within the compound to enable future expansion in the event that planning areas are modified.

The existing 16-inch force main has an approximate maximum capacity of 7 mgd, assuming a maximum allowable velocity of 8 fps. This would be sufficient to convey projected 2025 flows and would not need upgrading until a later time unless investigations into the extent of corrosion indicate that parts require replacement for that reason. For planning purposes it has been assumed that the force main will not be replaced until after 2025.

If a significant section of force main requires replacement then it should be sized to accommodate long term growth conditions, with a maximum capacity of approximately 11 mgd. Due to the corrosive ground conditions, it is recommended that design incorporate sufficient corrosion protection or a corrosion resistant pipe material such as HDPE not subject to corrosion. For planning purposes it was assumed that a single HDPE force main with internal diameter of 20-inches would be installed adjacent to the existing force main, which would be decommissioned following transfer of flow.

The section of the 21-inch gravity sewer with capacity less than 6.0 mgd will be subject to some surcharging. As with Alternative 1, if this surcharging is not acceptable it would be necessary to upgrade its capacity. As with Alternative 1, it is assumed that larger diameter pipe sections upstream of other pipe sections would be accepted in order to limit the extent of upgrading required.

As with Alternative 1, additional capacity in the inverted siphon would be required for flows under long term growth conditions. The extent of the additional capacity would be similar to Alternative 1 since it would receive the combined flow from the RBC Diversion Pump Station and the Whidbey Diversion Pump Station. As discussed previously it would be prudent to install additional prior to flooding of the salt marsh area.

Based on the above analysis, the Alternative 2 improvements required to address long-term growth needs for conveying flows from the RBC Diversion Pump Station to the Seaplane Lagoon Plant are those identified as Projects 2a on Figure 7-16. Appendix H provides detailed location maps and cost estimates for each of these projects. From this set of projects, the following were identified for implementation within the 20-year planning period:

- Project 2a(i), upgrading the RBC Diversion Pump Station to a capacity of 6 mgd, with an estimated cost of $1,856,000
- Project 2a(vi), upgrading the inverted siphon to the Seaplane Lagoon headworks, with an estimated cost of $1,069,000.

Whidbey Diversion Pump Station

The Whidbey Diversion Pump Station may adopt a wet well submersible or a wet well/dry well configuration. An above-ground building is likely to be required, particularly for a wet well/dry well configuration. The associated structures should be designed where feasible to facilitate the future long term growth flows and pumping capacity requirements. However, initial pump capacities in the station could be lower, in line with the projected flows at the interim planning horizons.

Further study would be required for site selection for the Whidbey Diversion Pump Station. However, preliminary investigations have identified a number of potentially suitable sites near the intersection of Whidbey Ave and SR 20. Evaluation of space requirements for the facility should be undertaken, including consideration of odor control, chemical injection, surge protection and standby power generation. In addition, space should be reserved for future expansion of the facility in the event of modification to the planning boundaries.

A new force main and gravity sewer would be required to convey wastewater to the inverted siphon. The alignment has been assumed to be similar to that proposed in the 1997 Comprehensive Plan, which routed the force main along Whidbey Avenue to Regatta Drive, with the gravity sewer routed on previously acquired easements across the Seaplane Base property to the connection with the inverted siphon.

The projects associated with the new Whidbey Diversion Pump Station are identified as Projects 2b on Figure 7-16. All of the projects would be implemented within the 20-year planning period, and a single cost estimate was developed for the entire improvement. The estimated cost is $8,579,000.

Gravity Collection Sewers

The initially identified gravity sewer improvements to address long-term growth needs under Alternative 2 consist of three sets of projects, one for each of the main sewer lines identified as deficient by the capacity analysis: Heller Street/Whidbey Avenue Trunk (Projects 2c); Goldie Street/SR 20 Trunk (Projects 2d); and Oak Harbor Street Trunk (Projects 2e). Appendix H identifies all these projects and provides a cost estimate for each. Figure 7-16 shows the project locations. By intercepting flow at the Whidbey Diversion Pump Station prior to 2011, the requirement to upgrade the Ely Street trunk sewer upgrade would be avoided.

From the set of initially identified gravity sewer projects for Alternative 2, one main sewer line was identified as requiring upgrade within the 20-year planning period:

- Project 2c(ii) on the Heller Street/Whidbey Avenue Trunk, with an estimated cost of $845,000

The capacity analysis assumed that the sewers upstream of the Whidbey Diversion Pump Station would not be affected by backwater effects from the wet well. This assumption would need to be incorporated into the pump station design or the design of the upstream sewers would need to incorporate the backwater effects.

Comparison of Alternative 1 and Alternative 2

A life cycle cost analysis was performed to compare the relative economic merits of the alternatives. The analysis assumptions, detailed in Appendix I, include the following:

- Calculations assume a real discount rate of 3.0 percent.
- Costs do not include sewer upgrade projects along Heller Road, which are common to both projects.
- Costs associated with land purchase for the Whidbey Diversion Pump Station or easement acquisition are excluded.

The projected cumulative costs for both alternatives are shown in Figure 7-17; the detailed life cycle cost analysis is included in Appendix H. The estimated net present cost is $16.5 million for Alternative 1 and $17.3 million for Alternative 2. While Alternative 1 was determined to be the more cost-effective solution, the difference in cost is relatively small. Therefore, other factors not fully reflected in the economic analysis may be of greater significance in the selection:

- The City is currently evaluating redevelopment of the Windjammer Park area associated with removal of the RBC plant.
- Alternative 1 is likely to require a larger compound footprint than Alternative 2 in the area of the existing RBC Diversion Pump Station, and this may not be preferable.
- Alternative 1 would represent a significant deviation from the existing phased upgrading plans for the RBC Diversion Pump Station associated with the 1997 Comprehensive Plan;
- Alternative 1 would require paralleling of the existing 16-inch force main with a larger force main than Alternative 2. This may increase the risk of significant utility conflict and could prevent the use of the existing routing.
- Alternative 1 would result in all flow being conveyed along the one pipeline route with potentially a single force main, similar to all collection system pump stations. The City would need to review the reliability and vulnerability issues of using a single force main to convey the entire flow. Increased capital expenditure may be required to mitigate some of those factors. An evaluation of risk will be included in a Facility Plan to be developed as part of the treatment plant expansion process. Alternative 2 which employs two pump stations may also offer some advantages for operational flexibility and reduction in vulnerability.
- Alternative 2 assumes that upgrade of the 16-inch RBC Diversion Pump Station force main to increase its capacity will not be required until well beyond the 20 year planning horizon. However, if further investigation of the potential force main corrosion indicates a need for replacement sooner, then the advantage of the deferred cost would be negated.
- The study assumed that the Seaplane Lagoon Plant area represents the location of treatment. If an alternative location were adopted, then this could have a significant impact on the economic analysis.

Conclusion

For the purposes of this report, Alternative 1 is recommended on the basis of the life cycle analysis. However, final selection of the Alternative will be undertaken by the City following more detailed analysis of the issue.

OTHER SYSTEM IMPROVEMENTS

Miscellaneous collection system projects that are relevant within the 20-year planning period are summarized below:

- The existing Golf Course Lift Station was identified as potentially requiring additional pump capacity by 2025.
- It is recommended that data logging capability be added at critical lift stations. This could record a range of operational data that would facilitate problem diagnosis and system planning, including instances of two-pump operation. Telemetry at critical lift stations may also be upgraded so that data can be transmitted and saved centrally for review. The estimated cost for lift station data logging and telemetry upgrades is $500,000.

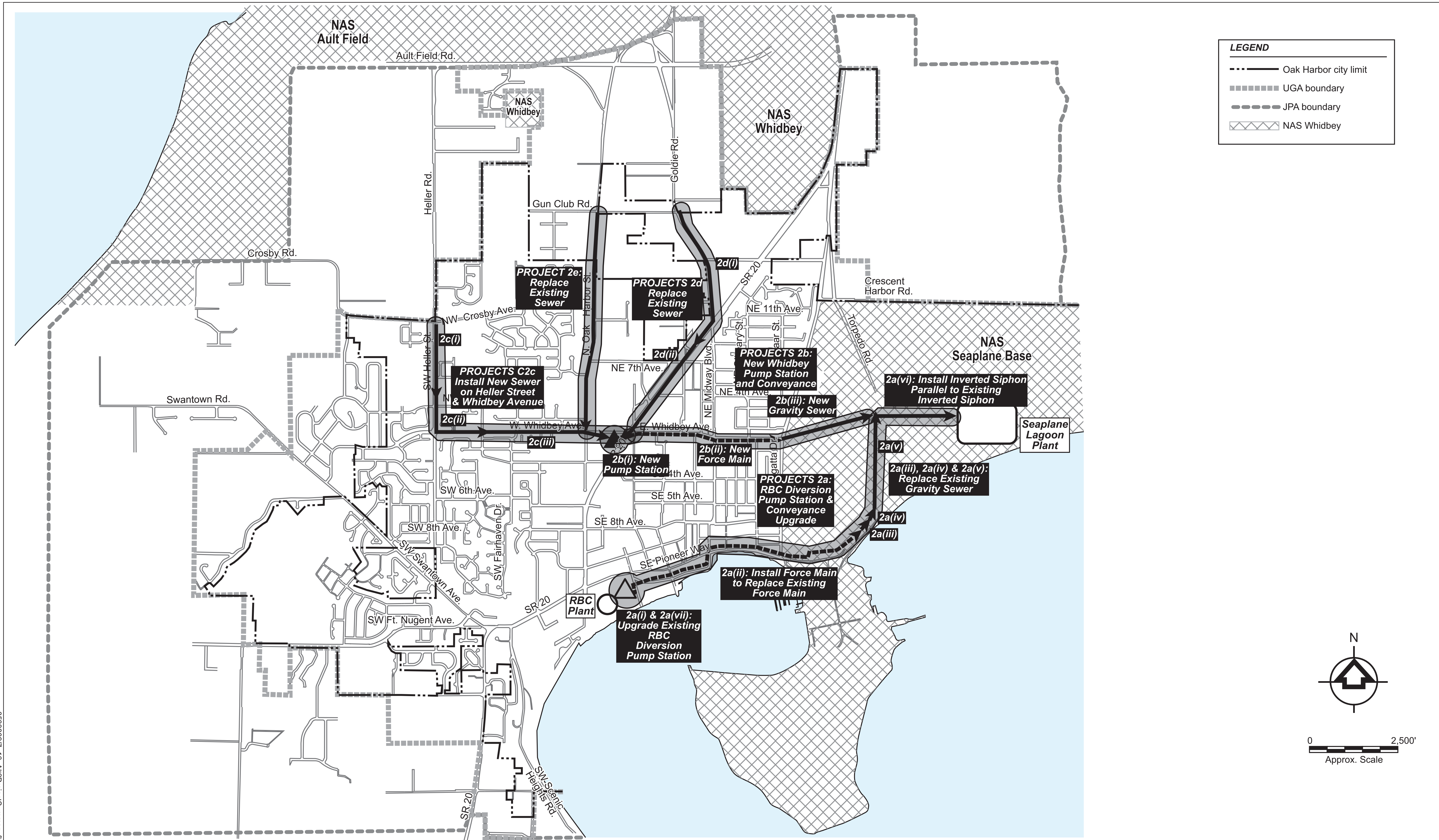

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Figure 7-16.
ALTERNATIVE 2 IMPROVEMENT PROJECTS

- An additional generator is to be added at the NE 7th Street Lift Station to provide additional station reliability. Purchase of an additional standby generator may be required due to installation of new regional lift stations associated with peripheral development. For this plan, the estimated cost of purchasing an additional generator is $50,000
- A study is planned to evaluate infiltration and inflow in the City's collection system, to allow better estimates of existing and future flows and required system capacity. The estimated cost of this study is $175,000.
- A study is planned to assess corrosion in the RBC Diversion Pump Station Force Main, in order to better determine when to upgrade the force main. The estimated cost of this study is $100,000.

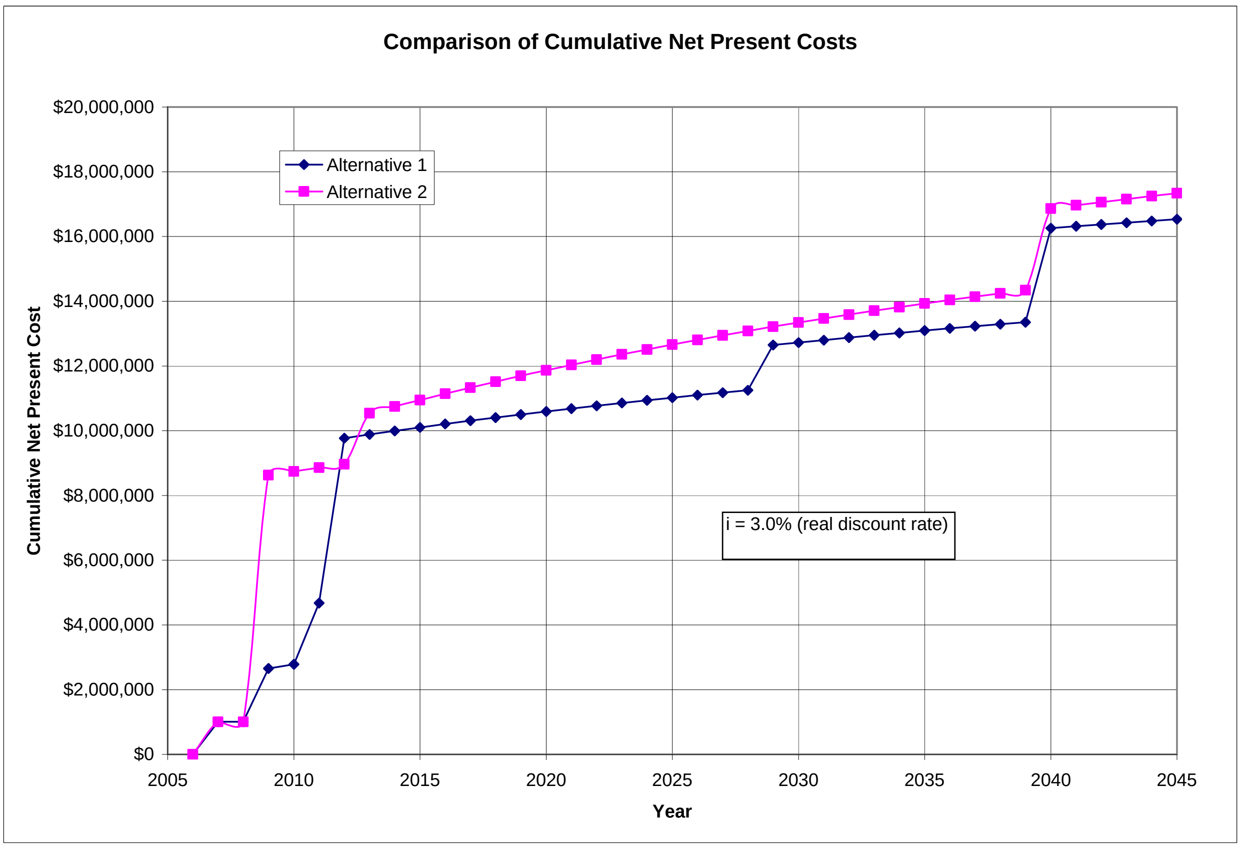


Figure 7-17. Comparison of Cumulative Net Present Costs

CHAPTER 8.
WASTEWATER TREATMENT ALTERNATIVES

This chapter reviews the City of Oak Harbor's existing treatment facilities, including their history, outfalls, land use considerations, permit compliance and biosolids. It reviews existing and future wastewater flows and loads expected in the City through year 2025. It also reviews effluent disposal alternatives and preliminary alternatives for improving the City wastewater treatment plants for the projected wastewater flows and loads.

EXISTING TREATMENT FACILITIES

The City currently operates two wastewater treatment facilities: the RBC Plant and the Seaplane Lagoon Plant. The locations of the plants and their outfalls are shown in Figure 6-1.

RBC Plant

History

The RBC Plant was constructed in 1978 to upgrade an existing primary treatment plant that was constructed in 1954. Parts of the primary treatment plant, including the primary clarifiers and a digester, were incorporated into the RBC Plant design. The treatment processes include pretreatment screening, primary and secondary clarifiers, and two parallel trains of RBCs, followed by a chlorine disinfection facility and two sludge digesters. A gravity thickener was added in 1997.

In response to increasing flows and loads in the late 1980s, additional treatment capacity was sought to handle future City growth. A pump station was constructed at the RBC Plant to divert flows in excess of 0.7 mgd to the Seaplane Base sewage lagoons, starting in March 1991. A mechanical screen and screenings washer compacter were added to the RBC Diversion Pump Station in 1997. On-site chlorine power generation facilities and dechlorination with calcium sulfate were added later. The current configuration of the RBC Plant is shown in Figure 8-1; Appendix J includes design criteria and process schematics. The plant's capacity ratings are as follows:

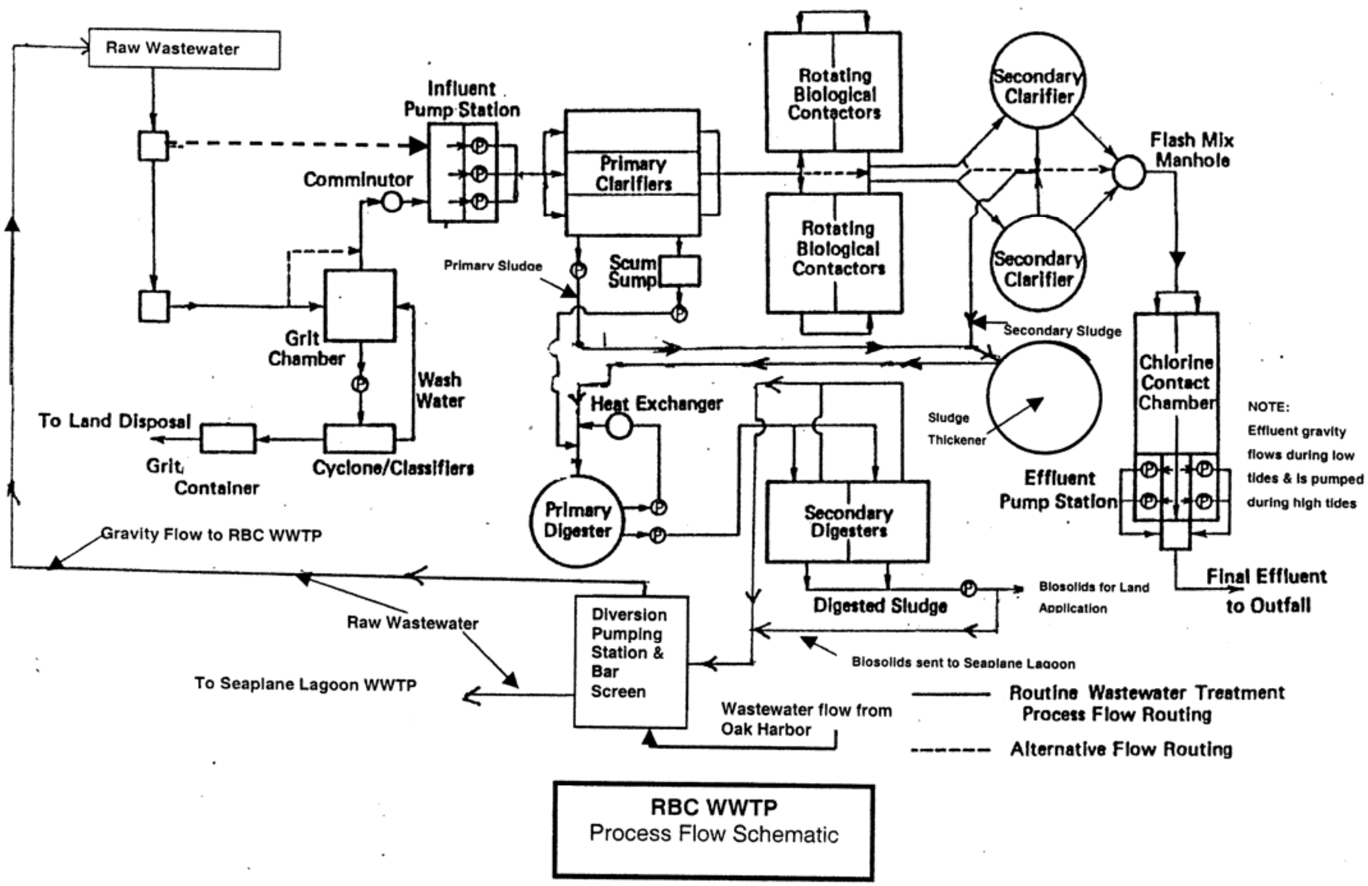
- Rated maximum-month flow = 0.7 mgd
- Rated maximum-month BOD = 2,000 ppd

Outfall

Disinfected secondary effluent from the RBC Plant is discharged into Oak Harbor through an 18-inch-diameter corrugated metal outfall. The outfall is 1,160 feet long and terminates with a diffuser section that has four 8-inch side ports, a 6-inch top port and an 8-inch top port. The diffuser section is at 15 feet below mean lower low water (MLLW) (78.59 feet City datum).

Land Use Issues

The RBC Plant is located on the shoreline of Oak Harbor next to Windjammer Park. The City's master plan for the park recommends demolishing the RBC Plant to eliminate odors and aesthetic issues associated with the plant and enhance the park. The master plan calls for construction of a destination resort hotel adjacent to the park, and the presence of the plant in the park is considered incompatible with this land use.



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Permit Compliance

Table 8-1 summarizes effluent limits established in the City's NPDES permit for the RBC Plant.

TABLE 8-1.
NPDES PERMIT LIMITS FOR RBC PLANT OUTFALL

Carbonaceous Biochemical Oxygen Demand (5-day)	
Max. Average Monthly Concentration	25 mg/L
Max. Average Monthly Load	146 ppd
Min. Average Monthly Removal of Influent Load	85%
Max. Average Weekly Concentration	40 mg/L
Max. Average Weekly Load	233 ppd
Total Suspended Solids	
Max. Average Monthly Concentration	30 mg/L
Max. Average Monthly Load	175 ppd
Min. Average Monthly Removal of Influent Load	85%
Max. Average Weekly Concentration	45 mg/L
Max. Average Weekly Load	263 ppd
Fecal Coliform Bacteria	
Max. Average Monthly Concentration	200/100 mL
Max. Average Weekly Concentration	400/100 mL
Daily pH	
Minimum	6
Maximum	9
Total Residual Chlorine	
Max. Average Monthly Concentration	0.114 mg/L
Max. Daily Concentration	0.26 mg/L

In recent years the RBC Plant has continuously met the NPDES effluent limits, with the following exceptions:

- In June 2005, the plant violated its permit requirement for monthly-average fecal coliform with a reading of 800/100 mL.
- In August 2004, the plant violated its permit requirement for monthly average chlorine residual with a reading of 0.33 mg/L.
- In August and September 2004, the plant violated its permit requirement for peak day chlorine residual limit with total residual chlorine ranging from 0.28 mg/L to 0.39 mg/L.

Biosolids

Primary and secondary sludge flows from the clarifiers at the RBC Plant are sent to a gravity thickener. The thickened sludge is processed through one primary and two secondary digesters. The digested sludge is pumped to the RBC Diversion Pump Station, which pumps it to the Seaplane Lagoon Plant.

Seaplane Lagoon Plant

History

The Seaplane lagoons were constructed and operated by NAS Whidbey to serve the Seaplane Base. The original plant included a large facultative cell and a small settling cell, each 3 to 4 feet deep, a physical-chemical system for polishing lagoon effluent followed by chlorine disinfection, and a marine outfall discharging into Crescent Harbor.

In 1990, the City secured a 50-year lease from the Navy to operate the lagoons. The City upgraded the lagoons to 2.5 mgd monthly average capacity to serve both the Seaplane Base and the City of Oak Harbor. With construction of the RBC Diversion Pump Station in 1991, City flows in excess of 0.7 mgd were diverted from the RBC Plant to the Seaplane Lagoon Plant.

The City upgraded the lagoons by converting them to a deeper three-cell aerated lagoon system (northwest, northeast and southeast cells) followed by new chlorine disinfection and effluent pumping systems. Space was reserved to construct a fourth (southwest) cell as needed for expansion. Mechanical surface aerators were added to the lagoons to provide aeration and mixing. The physical-chemical effluent polishing system was retained. It includes two flash mix basins, two flocculation basins and two rectangular clarifiers, and can feed both ferric sulfate and polymer. The polishing system's capacity remains at 0.885 mgd average flow.

In 2004, the northwest lagoon was divided, and approximately one-third of the volume at the head of the cell was converted to an anaerobic pretreatment cell. The pretreatment cell was designed to increase BOD and solids removal capacity, reduce algae growth in downstream cells and improve final effluent quality.

The current configuration of the lagoon plant is shown in Figure 8-2. The plant's capacity ratings are as follows:

- Rated maximum-month flow = 2.5 mgd
- Rated maximum-month BOD = 4,580 ppd
- Rated maximum-month TSS = 5,130 ppd

Outfall

Disinfected effluent from the lagoon plant is discharged into Crescent Harbor through an 18-inch diameter outfall. The outfall is 3,284 feet long and terminates at -44 feet MLLW (49.59 feet City datum). The diffuser is 184 feet long with 24 2.25-inch ports alternately spaced on 8 foot centers.

Land Use Issues

The Seaplane Lagoon Plant is constructed in the center of the Crescent Harbor Salt Marsh as shown in Figure 2-3. This marsh was once the largest (300 acres) open barrier salt marsh on Whidbey Island. However, access roadways, sewer berms and sewage lagoon dikes constructed in the marsh currently restrict tidal exchange and fresh water drainage through the marsh.

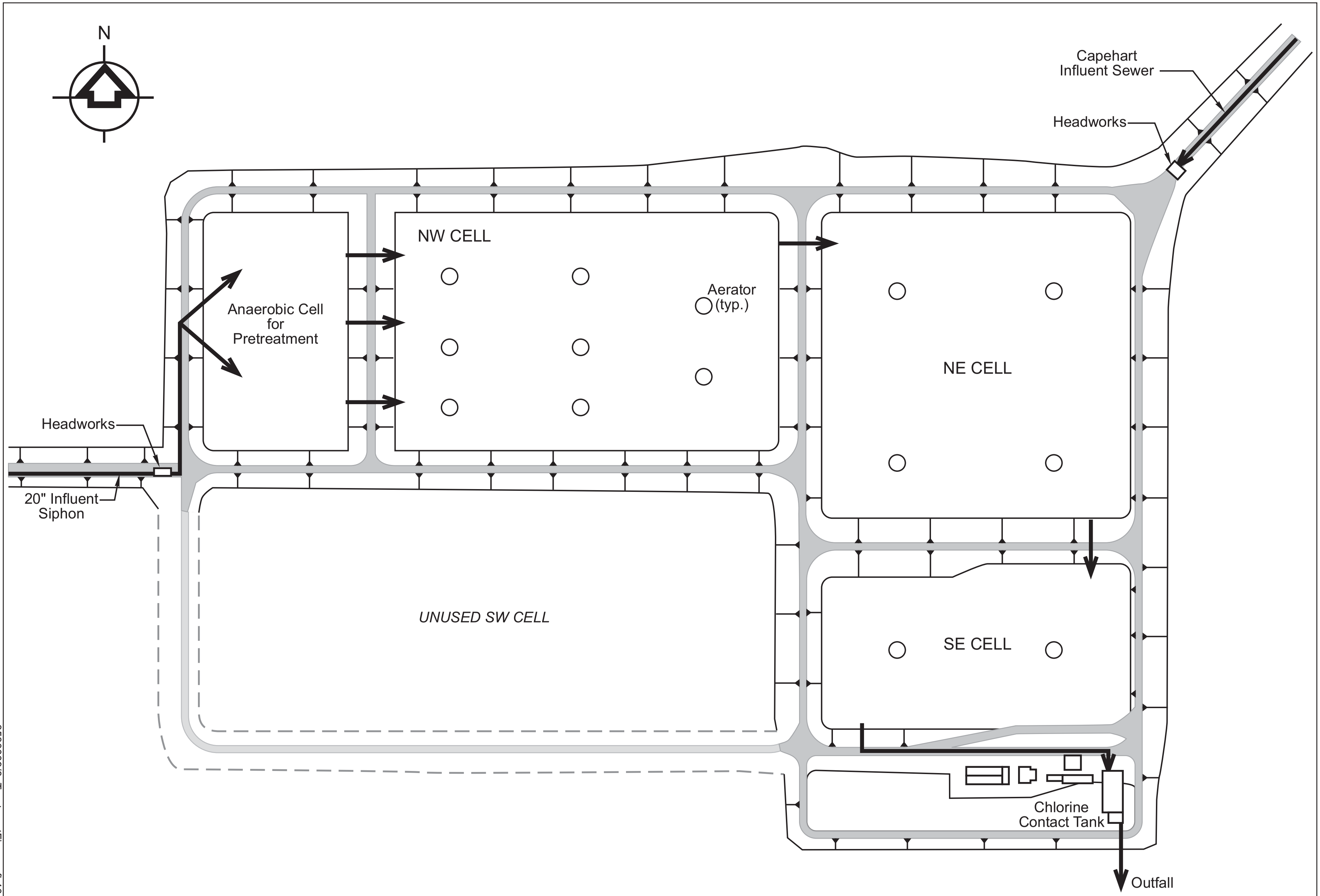

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Figure 8-2.
EXISTING LAGOON TREATMENT PLANT SITE

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Island County and the Navy are developing plans to restore approximately 200 acres of the marsh as natural wetlands and juvenile salmon rearing habitat. An initial analysis prepared for the County and Navy indicated that the proposed increases in tidal circulation would result in an average water surface elevation of approximately 5.5 feet MSL (105.5 feet City datum). This corresponds to 3-foot average depth of water over the marsh plain and 1 foot average depth over the west sewer berm that covers the lagoon plant's siphon influent pipe. Higher water levels will occur during high tide and storm events. The analysis concluded that these water levels would have limited impact on the sewer berms and lagoon dikes, and the impacts could be mitigated with modest improvements (PWA 2003).

Subsequent analysis by the City indicates that the proposed increased tidal flow will have more substantial impacts. The City analysis indicates that the outside flanks of the sewer berms and dikes could be eroded by wave action because they are constructed with 2:1 slopes and have no erosion protection. Also, during periods of high tide and severe storm events, high water would overtop the treatment plant access road and flood the south area of the plant (URS 2005).

Permit Compliance

The NPDES permit for the Seaplane Lagoon Plant establishes effluent limits for CBOD, TSS, fecal coliform bacteria, pH, and total residual chlorine, as summarized in Table 8-2

TABLE 8-2.
NPDES PERMIT LIMITS FOR SEAPLANE LAGOON PLANT OUTFALL

Carbonaceous Biochemical Oxygen Demand (5-day)	
Max. Average Monthly Concentration	25 mg/L
Max. Average Monthly Load	521 ppd
Min. Average Monthly Removal of Influent Load	85%
Max. Average Weekly Concentration	40 mg/L
Max. Average Weekly Load	834 ppd
Total Suspended Solids	
Max. Average Monthly Concentration	75 mg/L
Max. Average Monthly Load	1,564 ppd
Min. Average Monthly Removal of Influent Load	65%
Max. Average Weekly Concentration	110 mg/L
Max. Average Weekly Load	2,294 ppd
Fecal Coliform Bacteria	
Max. Average Monthly Concentration	200/100 mL
Max. Average Weekly Concentration	400/100 mL
Daily pH	
Minimum	6
Maximum	9
Total Residual Chlorine	
Max. Average Monthly Concentration	0.5 mg/L
Max. Daily Concentration	0.75 mg/L

CBOD and TSS

Figures 8-3 and 8-4 show that the Seaplane Lagoon plant consistently meets permit limits for CBOD and TSS. Since startup of the anaerobic pretreatment cells in 2005, the monthly-average effluent CBOD concentration has dropped to below 20 mg/L. Effluent TSS meets the current permit limit of 75 mg/L but has not improved since startup of the anaerobic cells. The plant would not meet a 30mg/L effluent limit that could be required by Ecology if the City expands the lagoon capacity above the current capacity rating of 2.5 mgd, as discussed later in this chapter.

Fecal Coliform Bacteria

Figure 8-5 shows that effluent fecal coliform counts generally meet the NPDES permit limit of 200/100 mL (monthly average) and 400/100 mL (weekly-average). In March 2004, the plant slightly violated the monthly average permit limit.

pH

Effluent pH was within the permit limits during the period reviewed. Average pH measurements typically were between 6.5 and 8. The highest pH reading, 8.8, occurred in April 2001. Figure 8-6 shows that effluent pH decreases during the summer the. This is attributed to partial nitrification, which reduces alkalinity and increases the concentration of nitrite in the lagoon. In response to low pH, the City has been adding soda ash to improve nitrification and denitrification and reduce nitrite concentrations. Figure 8-6 demonstrates that alkalinity and pH increase when the City adds soda ash to the lagoons during the summer.

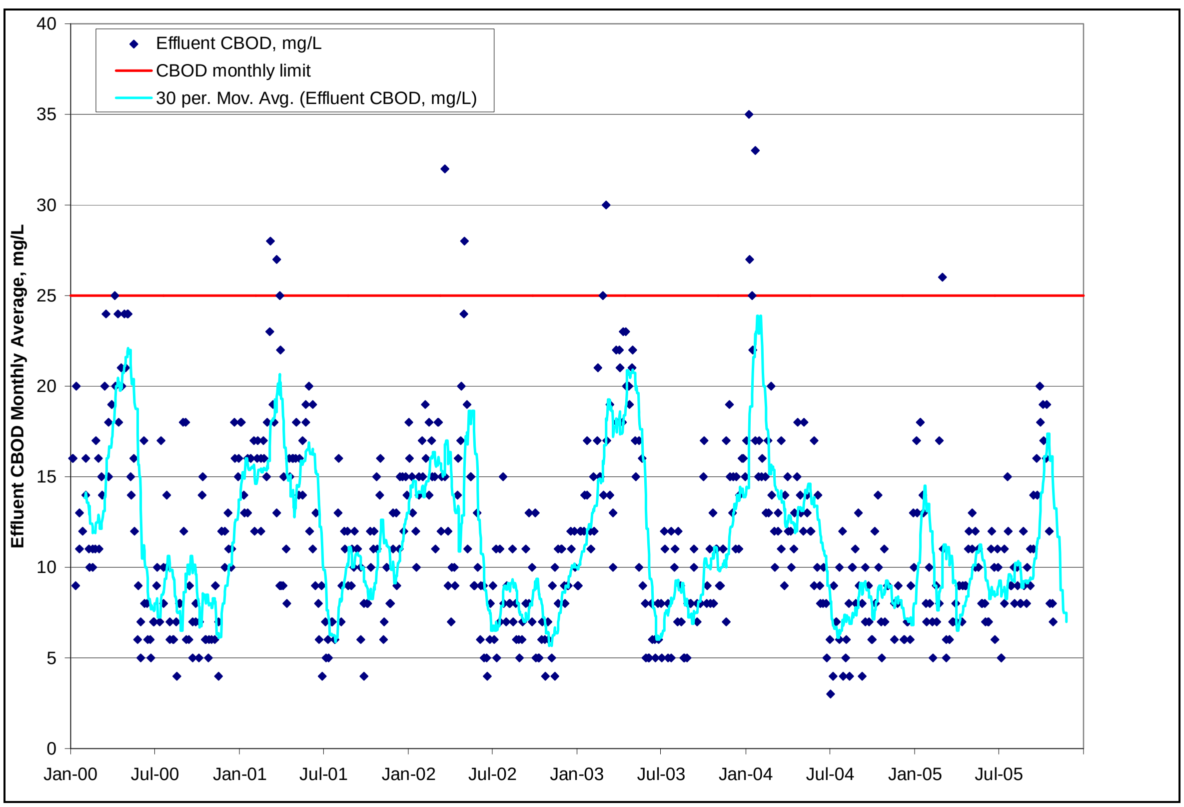


Figure 8-3. Historical Monthly Average Effluent CBOD Data

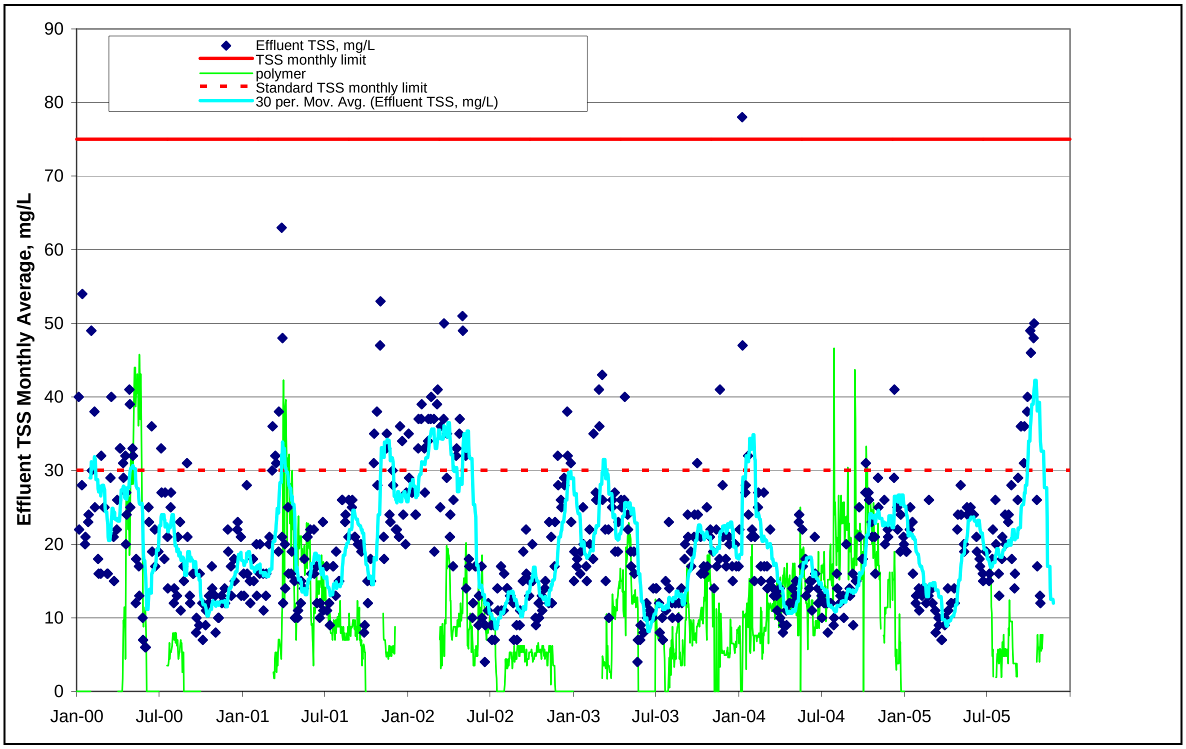


Figure 8-4. Historical Monthly Average Effluent TSS Data

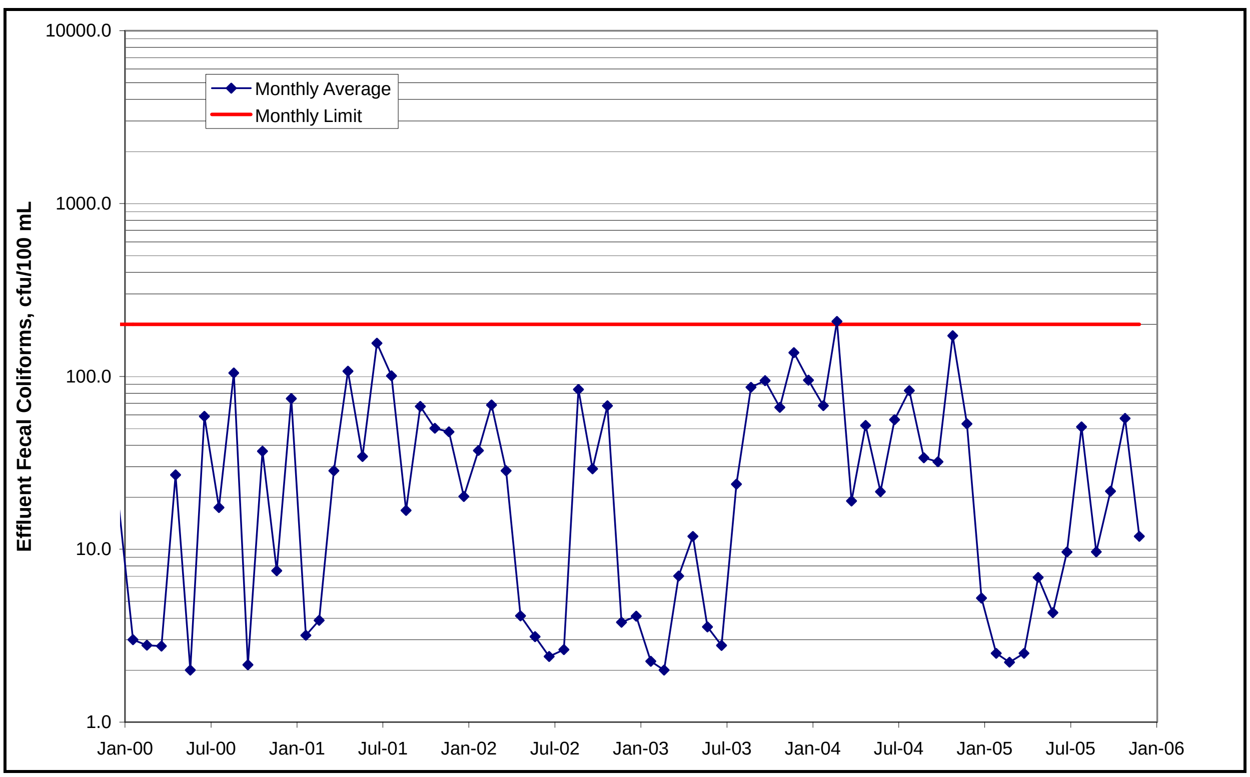


Figure 8-5. Historical Monthly Average Effluent Fecal Coliform Concentrations

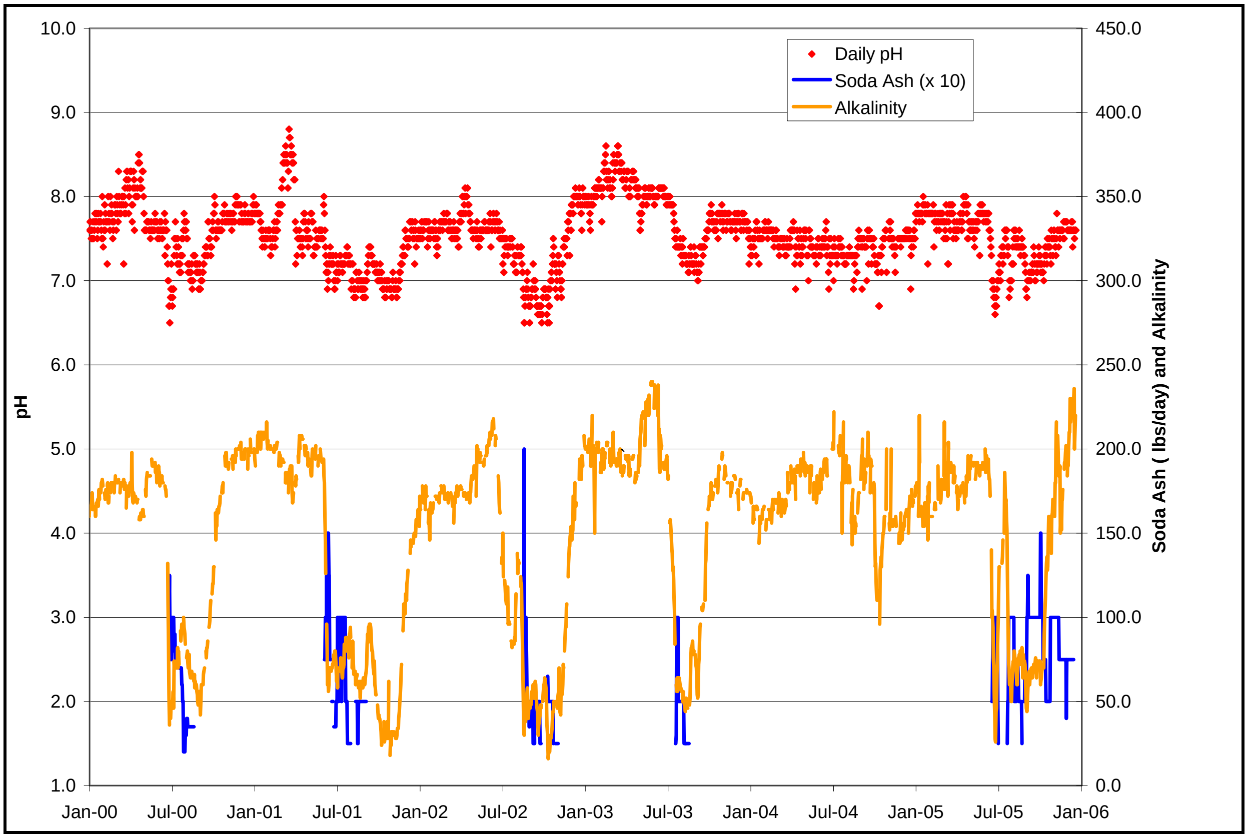


Figure 8-6. Historical Daily Effluent pH, Alkalinity and Soda Ash Dose

Total Residual Chlorine

The NPDES permit limits the monthly-average total chlorine residual to 0.5 mg/L and the maximum-daily residual to 0.75 mg/L. The monthly-average effluent chlorine residual has ranged between 0.32 and 0.38 mg/L, well below the permit limit.

Biosolids

Prior to construction of the anaerobic pretreatment cells, the aerobic lagoons stored the incoming waste sludge. In the past, removal of biosolids from the aerobic lagoons consisted of contract dredging and disposal. The new anaerobic pretreatment cells commissioned in December 2004 were designed with a manifold piping system to pump sludge directly from the anaerobic cells. To date, the manifold piping system has not been used.

Biosolids removed from the northwest lagoon during 2002 and 2004 sludge removal projects were used to evaluate the total mass of biosolids accumulated since the Seaplane Lagoons were leased to the City in 1991. The total biosolids removed between the two sludge removal projects was 2,043 dry tons. It is estimated that the lagoons yielded 0.30 pounds of biosolids (waste sludge) per pound of influent BOD.

Testing conducted in year 2002 indicated that the biosolids met all criteria for "exceptional quality" as defined in federal 503 regulations. The biosolids also met the Class B requirement for testing of fecal coliform.

WASTEWATER FLOWS AND LOADS

This section reviews historical wastewater flows and loads and estimates future wastewater flows and loads through 2025. The flow and load analysis is explained in detail in a separate technical memorandum (Tt/KCM, March 1, 2006).

Historical Flows

The City continuously monitors wastewater flow to the Seaplane Lagoon Plant at the headworks with a Parshall flume. The Seaplane Lagoon Plant influent flow includes flows from the Seaplane Base, the Capehart housing facilities and the RBC Diversion Pump Station.

Flows from the Seaplane Base and Capehart facilities are monitored with two independent Parshall flumes, so it is possible to independently characterize wastewater flows from the Navy facilities and the rest of the City. The influent flow to the RBC Plant is not monitored, but the effluent flow is monitored and can be used to estimate the RBC Plant influent flow. For this evaluation, the influent wastewater flow to the RBC plant is assumed to be equal to the effluent flow rate. The total City wastewater flow then is estimated as the sum of all the Seaplane Lagoon Plant influent flows and the RBC Plant effluent flow. Figure 8-7 shows the total daily flow from 1999 through 2005, and Figure 8-8 shows the average daily total flow for each year from 2001 through 2005. In general, the data indicate that there has been no significant change in the flows over the last six years.

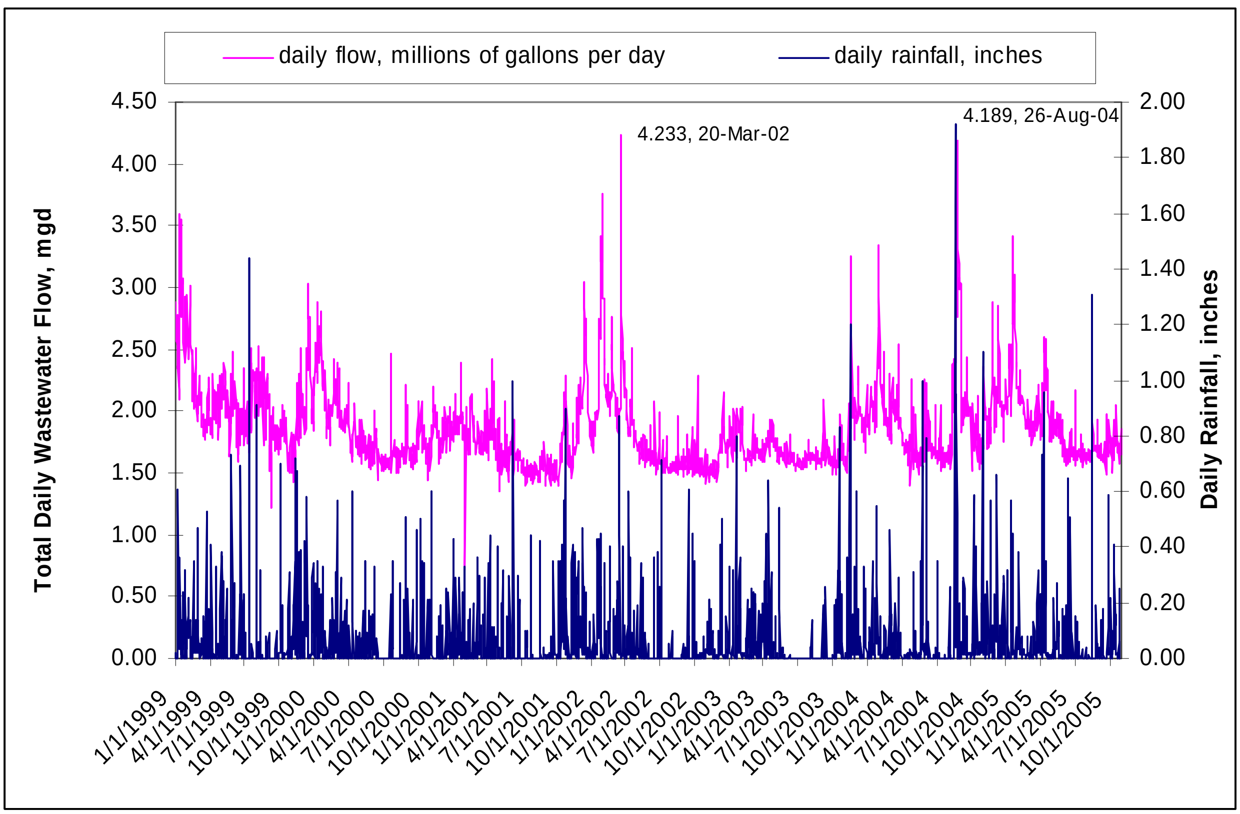
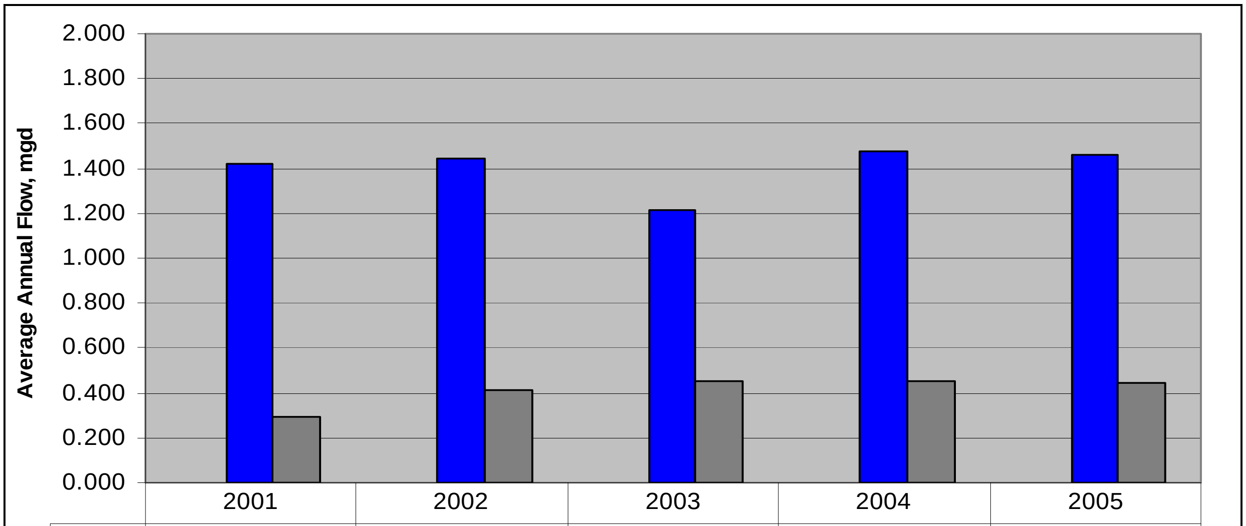


Figure 8-7. Daily Wastewater Flow



	2001	2002	2003	2004	2005
Total	1.712	1.857	1.663	1.928	1.902
City	1.421	1.445	1.213	1.475	1.457
Navy	0.292	0.412	0.450	0.453	0.445

Figure 8-8. Average Daily Wastewater Flow

Historical BOD Loads

The records of BOD_5 loads in the City's wastewater over the last five years (see Figures 8-9 and 8-10) show a trend of gradual increase that appears to be congruent with the rate of growth in the portion of the City outside the Seaplane Base. BOD_5 loads from the Seaplane Base gradually increased until January 2002, then remained relatively constant until about May 2003, at which time the loads declined steadily until August 2003.

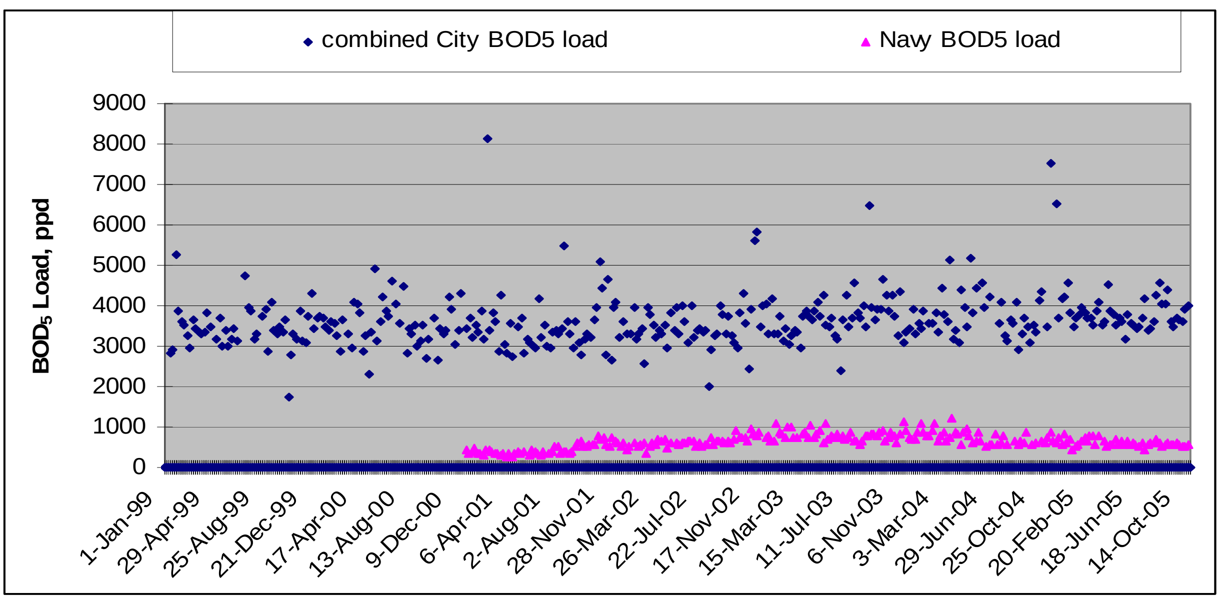
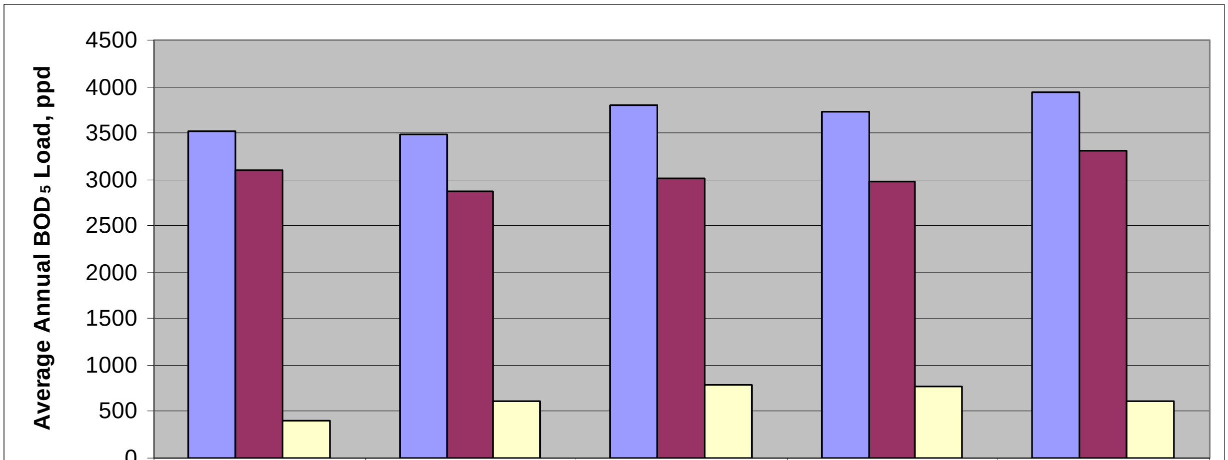


Figure 8-9. Daily BOD_5 Load



	2001	2002	2003	2004	2005
Total	3511	3490	3798	3730	3935
City	3107	2879	3005	2968	3315
Navy	404	611	793	762	620

Figure 8-10. Average Daily BOD_5 Load

Historical TSS Loads

The records of TSS loads in the City's wastewater over the last five years (see Figures 8-11 and 8-12) show a trend of gradual increase that appears to be congruent with the rate of growth in the portion of the City outside the Seaplane Base. TSS loads from the Seaplane Base gradually increased until January 2002, then remained relatively constant until about May 2003, at which time the loads declined steadily until May 2003. The discharge of anaerobically digested sludge from the RBC plant has a significant effect on the TSS concentration and load of the influent wastewater to the lagoon.

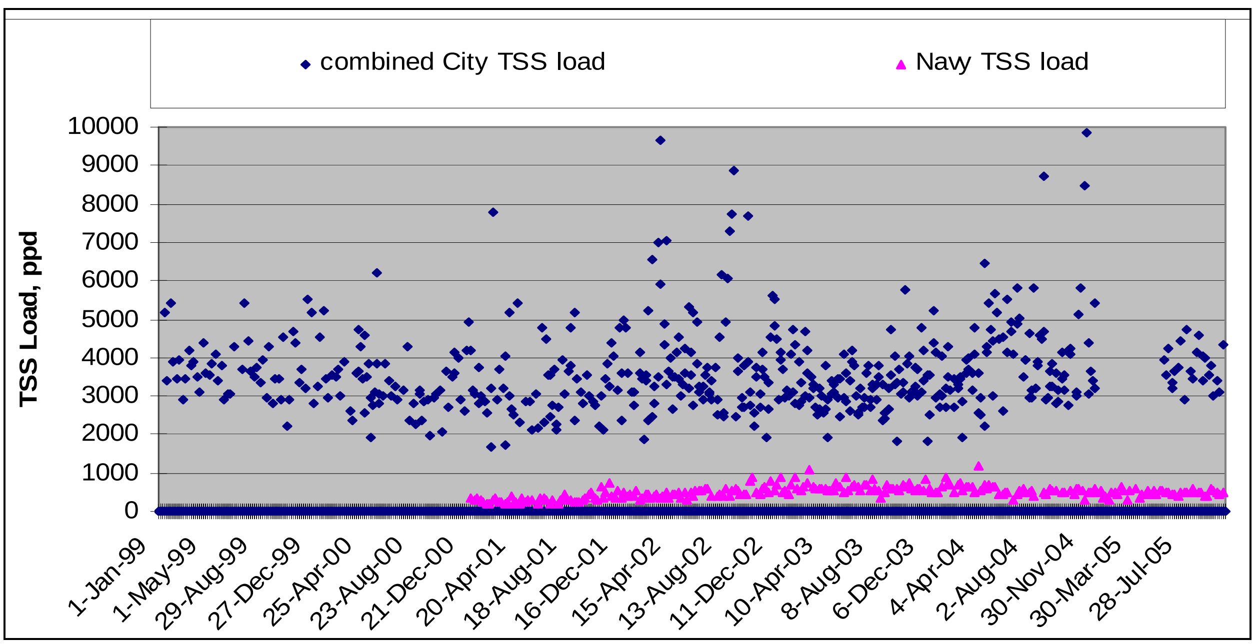
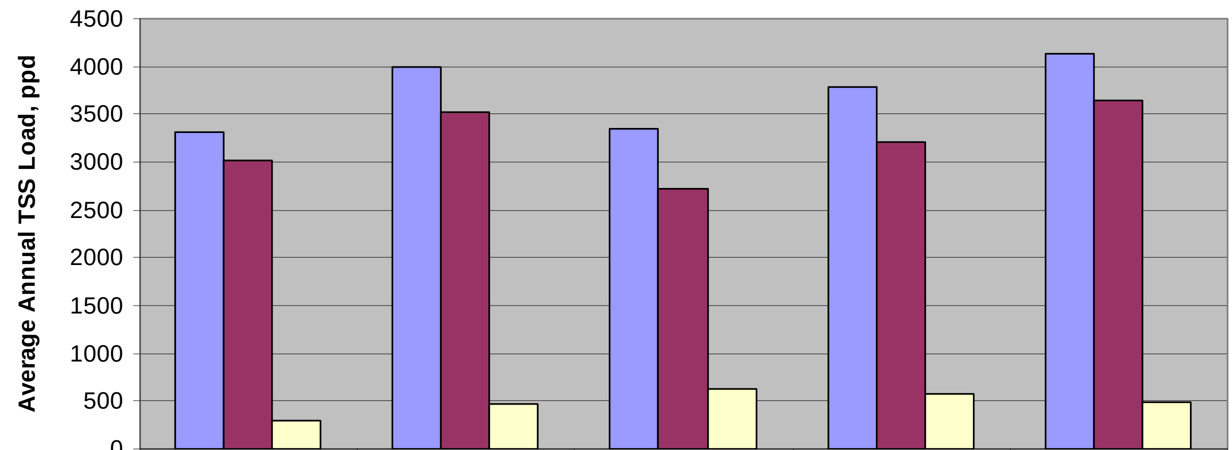


Figure 8-11. Daily TSS Load



	2001	2002	2003	2004	2005
Total	3315	3989	3346	3791	4131
City	3013	3523	2725	3217	3650
Navy	301	466	621	574	481

Figure 8-12. Annual Daily TSS Loads

Projected Flows and Loads

Population in the portion of the City outside the Seaplane Base is projected to increase from 17,800 at the end of 2005 to 24,300 at the end of 2025. The population of the Seaplane Base is projected to remain at the 2005 level of 4,400 through 2025. Estimated future flows and loads were calculated based on the growth projections and the per capita flows and loads shown in Tables 8-3 and 8-4. Table 8-5 shows the projected flows and loads.

Figures 8-13, 8-14 and 8-15 show the projections for flow, BOD_5 and TSS along with the combined existing capacity of the RBC and Seaplane Lagoon Plants. Existing flows are close to 85 percent of the combined maximum-month flow capacity rating of the plants; future flows are expected to reach the combined design capacity of the plants by 2017. The plants have significant reserve capacity for BOD loads; the projections indicate that BOD will reach 85 percent of the maximum-month capacity rating around 2018, and the full combined capacity rating after 2025. The plants also have some reserve capacity for TSS; the projections indicate that TSS will reach 85 percent of the maximum-month capacity rating around 2008 and the full combined capacity rating around 2019.

Flow and Load Conclusions

This analysis of flows and loads indicates that in the near future the City needs to prepare a wastewater facility plan to expand the capacity of its treatment facilities for future flows. Ecology's policy is to require preparation of a facility plan when any of the three common design parameters, such as flow, BOD or Suspended Solids exceed 85 percent of the maximum-month rating for three consecutive months.

TABLE 8-3.
CRITERIA FOR PROJECTING RAW WASTEWATER FLOWS AND LOADS FOR THE CITY OUTSIDE THE SEAPLANE BASE FOR 2006 THROUGH 2025

Condition	Unit Flow (gallons per capita/day)	Unit BOD_5 (pounds per capita/day)	Unit TSS (pounds per capita/day)
Average Annual	84	0.18	0.19
Maximum Month	121	0.21	0.28
Maximum Day	185	0.32	0.45

TABLE 8-4.
CRITERIA FOR PROJECTING RAW WASTEWATER FLOWS AND LOADS FOR THE SEAPLANE BASE FOR 2006 THROUGH 2025

Condition	Unit Flow (gallons per capita/day)	Unit BOD_5 (pounds per capita/day)	Unit TSS (pounds per capita/day)
Average Annual	102	0.18	0.14
Maximum Month	127	0.22	0.19
Maximum Day	327	0.28	0.26

TABLE 8-5.
PROJECTED RAW WASTEWATER FLOWS AND LOADS THROUGH 2025

	2005	2010	2015	2020	2025
City Proper Population	17,800	19,400	21,000	22,700	24,300
Navy Population	4,400	4,400	4,400	4,400	4,400
Flow (mgd)					
Average Annual	1.94	2.08	2.22	2.36	2.50
Maximum Month	2.71	2.91	3.11	3.31	3.51
Maximum Day	4.73	5.03	5.34	5.64	5.95
BOD (ppd)					
Average Annual	3992	4,288	4,584	4,880	5,177
Maximum Month	4,702	5,047	5,392	5,738	6,084
Maximum Day	6,920	7,447	7,973	8,499	9,026
TSS (ppd)					
Average Annual	3,993	4,305	4,618	4,931	5,243
Maximum Month	5,812	6,273	6,733	7,194	7,655
Maximum Day	9,140	9,881	10,621	11,361	12,102

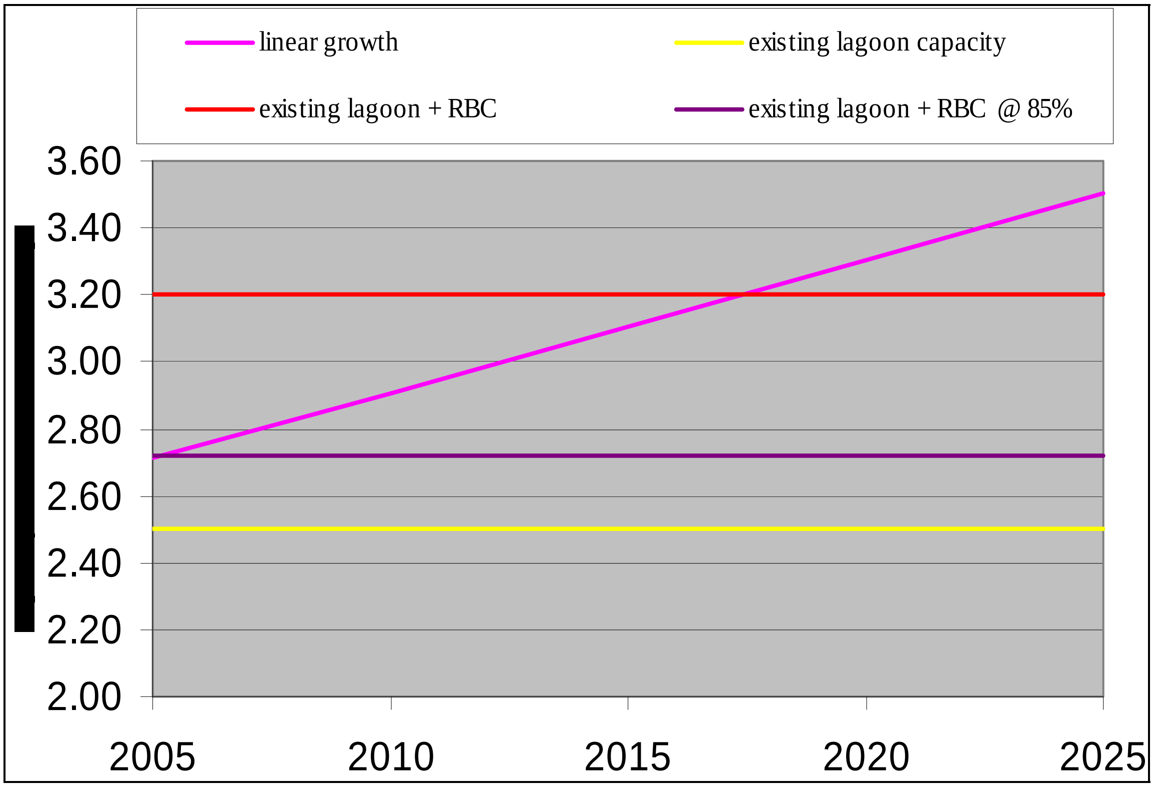


Figure 8-13. Average Flow Projection and Treatment Capacity

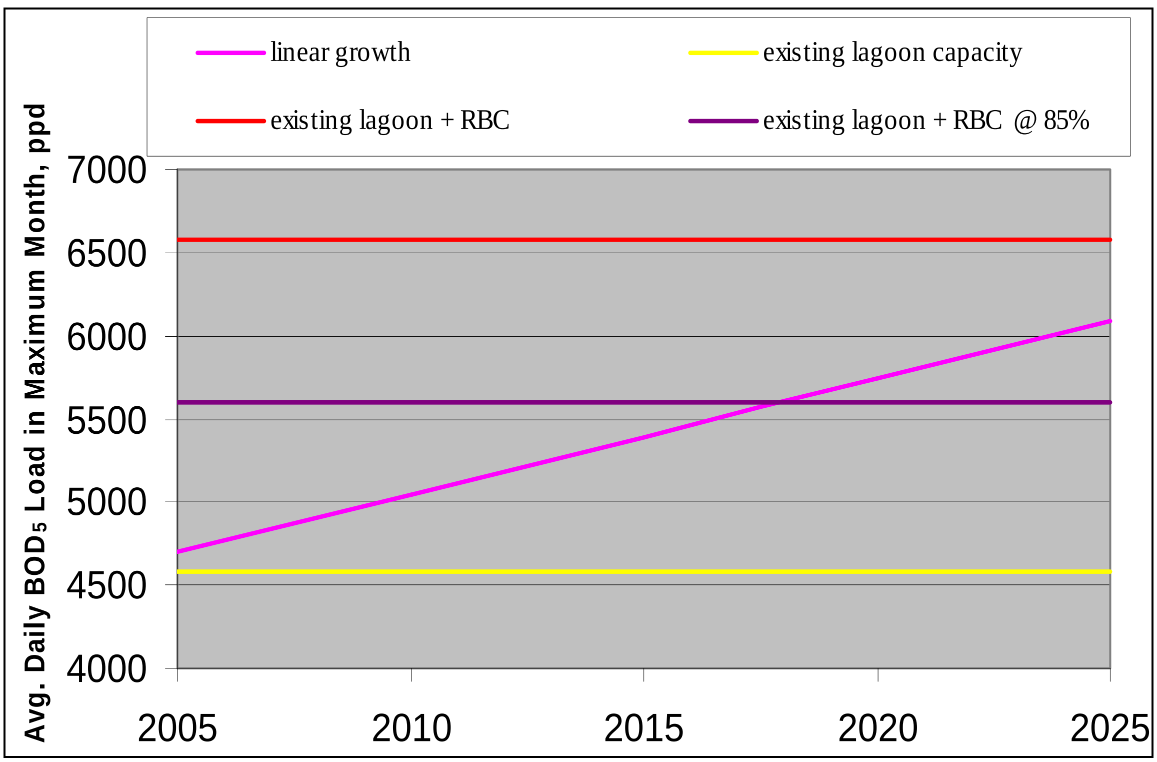


Figure 8-14. Average BOD_5 Projection and Treatment Capacity

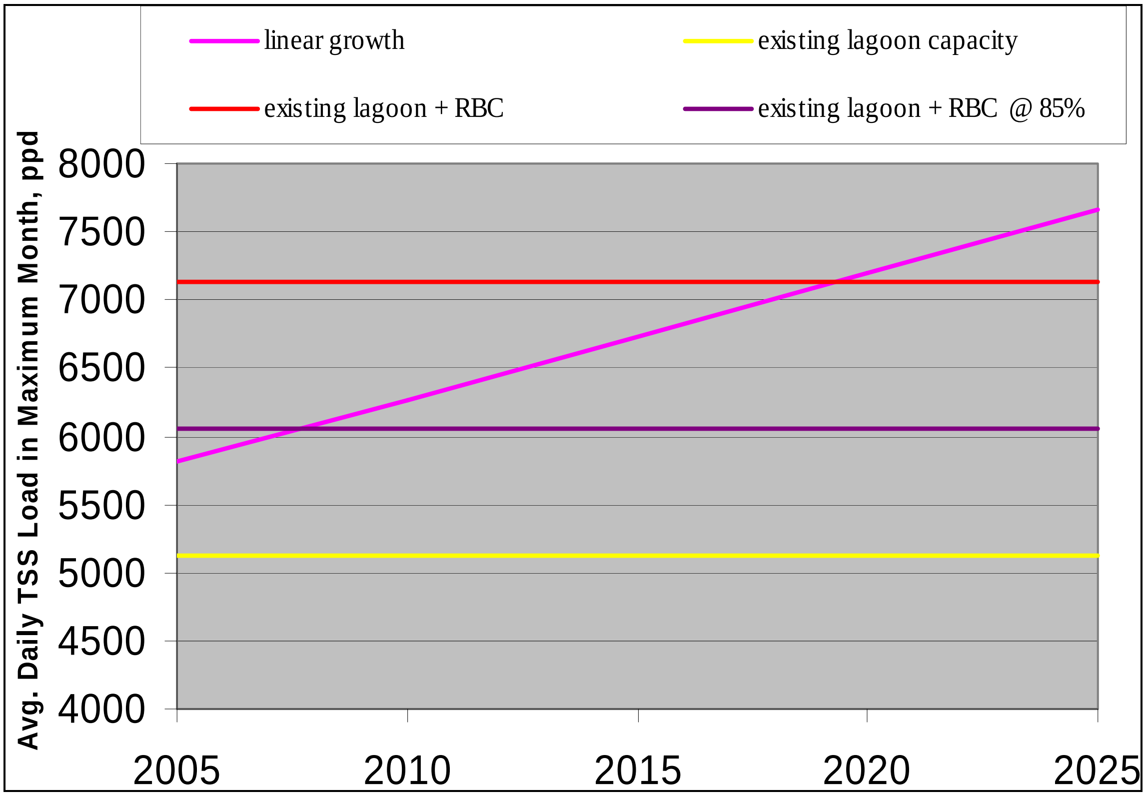


Figure 8-15. Average TSS Projection and Treatment Capacity

EFFLUENT DISPOSAL

This section reviews alternatives for disposal of effluent from the City's treatment facilities. Effluent discharge criteria are the key parameters controlling treatment requirements. Treated wastewater effluent must be disposed of or reused. The City of Oak Harbor disposes of treated effluent by discharge through its outfalls to Oak Harbor and Crescent Harbor. Alternatively, effluent could be discharged to a Puget Sound outfall, land-applied for disposal or reused elsewhere in the City.

The City expects to use the Oak Harbor outfall with the RBC treatment plant until the plant is eliminated as recommended in the master plan for Windjammer Park. With this approach, peak flows through the Oak Harbor outfall will be limited to the existing 2.6 mgd peak capacity of the RBC plant.

The City expects to use the Crescent Harbor outfall through the end of the planning period in 2025. The peak flow to the Seaplane lagoon plant could reach 9.7 mgd if the RBC plant is retained through 2025, and 12.3 mgd if the RBC plant is eliminated by 2025. These peak flows exceed the existing peak hydraulic capacity of the Crescent Harbor outfall, which is 5 mgd with both effluent pumps running. The high peak wastewater flows will need to be stored and equalized to 5 mgd in the Seaplane lagoons to avoid the expense of replacing the outfall with a larger pipe. A new outfall dilution zone study may be needed to confirm that the existing outfall provides sufficient dilution for increased average flows.

Additional effluent disposal and reuse alternatives can be considered in the future when the City prepares a wastewater facility plan. These alternatives could include a new plant with an outfall to Puget Sound, joint treatment and discharge through the Ault Field plant and outfall, or a new wastewater reclamation plant and effluent reuse.

Effluent Discharge Limits

Currently, effluent discharges through the Oak Harbor and Crescent Harbor outfalls are regulated by technology-based effluent limits that require secondary treatment. A standard requirement for secondary treatment is that effluent BOD and TSS concentrations not exceed 30 mg/L. However, both City treatment plants qualify for exceptions to this requirement and are regulated by alternative effluent limits established in the NPDES permit:

- The effluent limits for the RBC Plant require monthly-average effluent CBOD to be 25 mg/L or less and monthly-average TSS to be 30 mg/L or less.
- The effluent limits for the Seaplane Lagoon Plant require monthly-average CBOD to be 25 mg/L or less and TSS to be 75 mg/L or less.

The effluent limits for the RBC plant are expected to be the same if it continues to operate through 2025.. The effluent limits at the Seaplane Lagoon are “grandfathered” at the approved hydraulic rating of 2.5 mgd, and they will stay the same as long as lagoon-based treatment is not expanded beyond the currently rated capacity. If lagoon-based treatment is expanded beyond 2.5 mgd, then the resulting facility will be expected to meet standard secondary treatment limits. Expanding service with a parallel conventional plant could allow the City to maintain some form of alternative limits. Ecology does have authority to establish “performance-based” limits for lagoon facilities and may exercise this authority in future permits.

The Washington State DNR could require more treatment at the Seaplane Lagoon Plant than standard secondary treatment because the outfall lease issued by DNR in 2004 requires the City to reduce discharges through the Crescent Harbor outfall. Alternatively. DNR may accept more flow through the Crescent Harbor outfall, such as if the effluent meets standard 30-mg/LTSS effluent limits rather than the current limit of 75 mg/L. This might be acceptable to DNR because it would allow the City to eliminate discharges through the existing Oak Harbor outfall and would reduce TSS emissions below the current combined TSS discharges through the two outfalls at the projected maximum-month flow of 3.5 mgd. The effluent limit for CBOD would need to be below 22 mg/L to reduce emissions below the current combined CBOD discharges of the RBC and Seaplane Lagoon plants.

TREATMENT PLANT ALTERNATIVES

This section evaluates alternatives for improving the City’s wastewater facilities to accommodate projected future flows and loads.

Treatment Plant Design Conditions

The evaluation of treatment plant improvement alternatives for this report is based on the flows and loads shown in Table 8-5. The evaluation also relies on the following general assumptions:

- The Seaplane Lagoon Plant is the preferred site for the City’s treatment plant through 2025.
- The RBC Plant will be demolished as soon as economically feasible.
- Other treatment plant sites can be considered when the City prepares a wastewater facility plan in the future. The comprehensive sewer plan will need to be updated if an alternative site is selected.
- Ecology and DNR will allow average flows up to 3.5 mgd to be discharged through the existing Seaplane Lagoon Plant outfall to Crescent Harbor.

- A new dilution zone study may be required to verify that the outfall will provide sufficient dilution for 3.5 mgd average flows.
- Ecology will require standard 30 mg/L TSS effluent limits for the entire 3.5 mgd average flow expected in the City by 2025.
- DNR may require mass emissions of BOD and TSS below current permit levels, additional disinfection to reduce shellfish closure zones, additional ammonia and priority pollutant removal to reduce effluent toxicity and water reuse to reduce discharges into Oak Harbor

Treatment Alternatives

This section analyzes alternatives for achieving an acceptable level of secondary treatment for the City of Oak Harbor throughout the planning period. Four alternatives were evaluated as discussed below. Additional alternatives can be developed in the future when the City prepares a wastewater facility plan.

Alternative 1—RBC and Lagoon Plants

This alternative would continue the use of the RBC Plant to treat average flows of 0.7 mgd, and all other flows would be diverted to the Seaplane Lagoon Plant for treatment. The Seaplane Lagoon Plant would be upgraded to 3.0-mgd average flow capacity. This approach would build an anaerobic pretreatment cell in the southwest lagoon and add effluent filtration, with a capacity for average flows of 3.0 mgd, to meet 30 mg/L TSS effluent limits throughout the year. This alternative is shown in Figure 8-16. In the future it may be possible to eliminate the filters from this alternative if the recently installed anaerobic pretreatment cells improve performance of the existing lagoons as expected by the designer. However, this report assumes that filters are needed to meet 30 mg/L TSS.

Alternative 2—Lagoon Plant

This alternative would eliminate the RBC Plant and treat all flows at the Seaplane Lagoon Plant. The Seaplane Lagoon Plant would be upgraded to 3.5-mgd average flow capacity. This approach is the same as Alternative 1, except that the effluent filters would be rated for 3.5 mgd. This alternative is also shown in Figure 8-16.

Alternative 3—Activated Sludge Plant

This alternative would eliminate the RBC Plant and treat all flows at the Seaplane Lagoon Plant site. The lagoon plant would be converted to a 3.5-mgd activated sludge plant to provide secondary treatment. The existing northwest lagoon would store peak raw sewage flows and stabilize waste sludge, and the northeast and southeast cells would store treated effluent flows that exceed the 5-mgd capacity of the existing outfall. This alternative is shown in Figure 8-17.

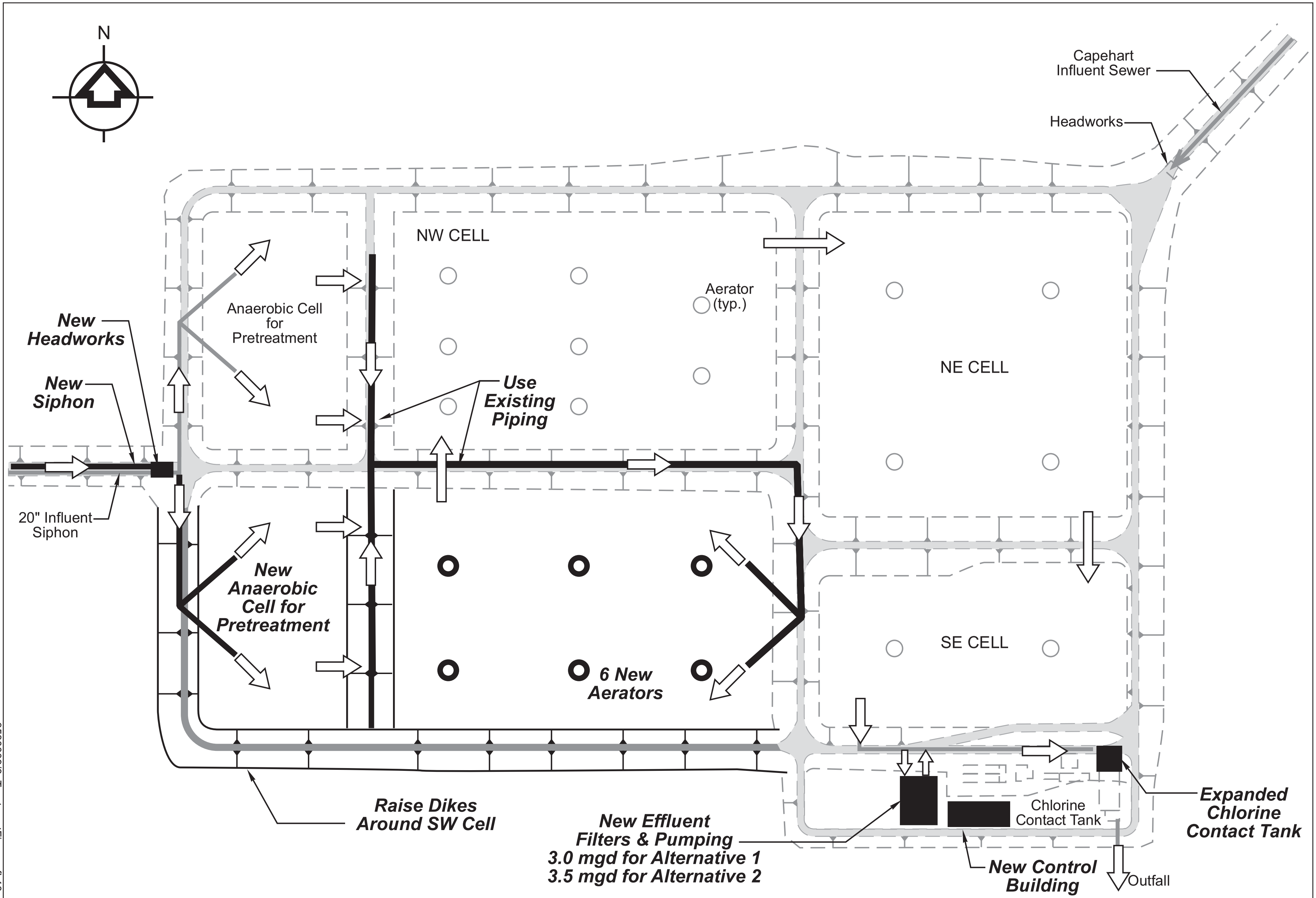
Alternative 4—Membrane Bioreactor Plant

This alternative would eliminate the RBC Plant and treat all flows at the Seaplane Lagoon Plant site. The lagoon plant would be converted to a 3.5-mgd membrane bioreactor (MBR) plant to provide secondary treatment and polish the effluent to meet Class A reclaimed water standards. Like Alternative 3, the existing lagoons would be used for raw sewage storage, treated effluent storage and sludge stabilization. This alternative is shown in Figure 8-18.

Common Elements

The following common improvements are included in all treatment alternatives:

- Construct new headworks with mechanical screen, grit removal and flow measurement.



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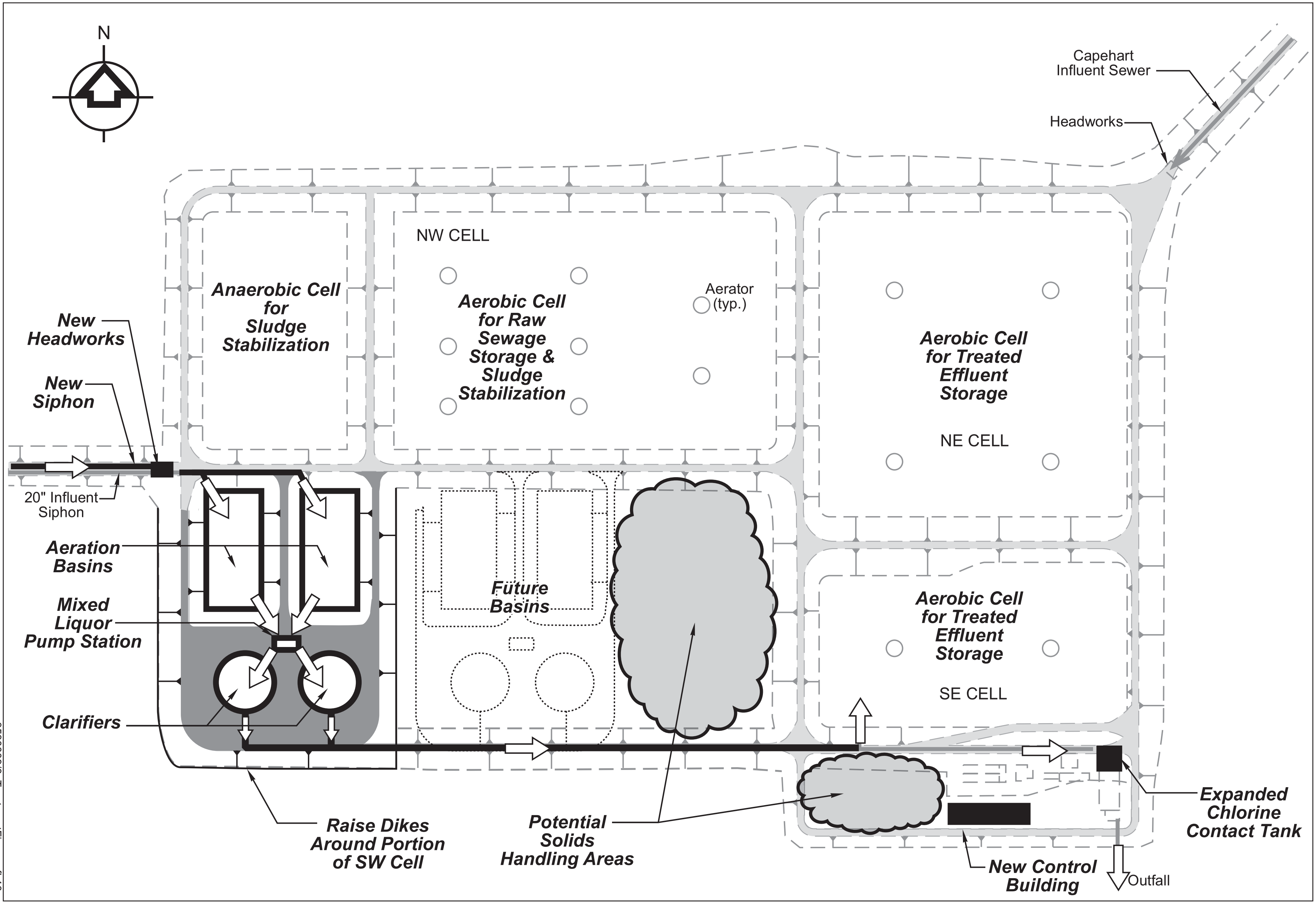
City of Oak Harbor
COMPREHENSIVE SEWER PLAN

Figure 8-16.
TREATMENT PLANT IMPROVEMENT ALTERNATIVES 1 AND 2



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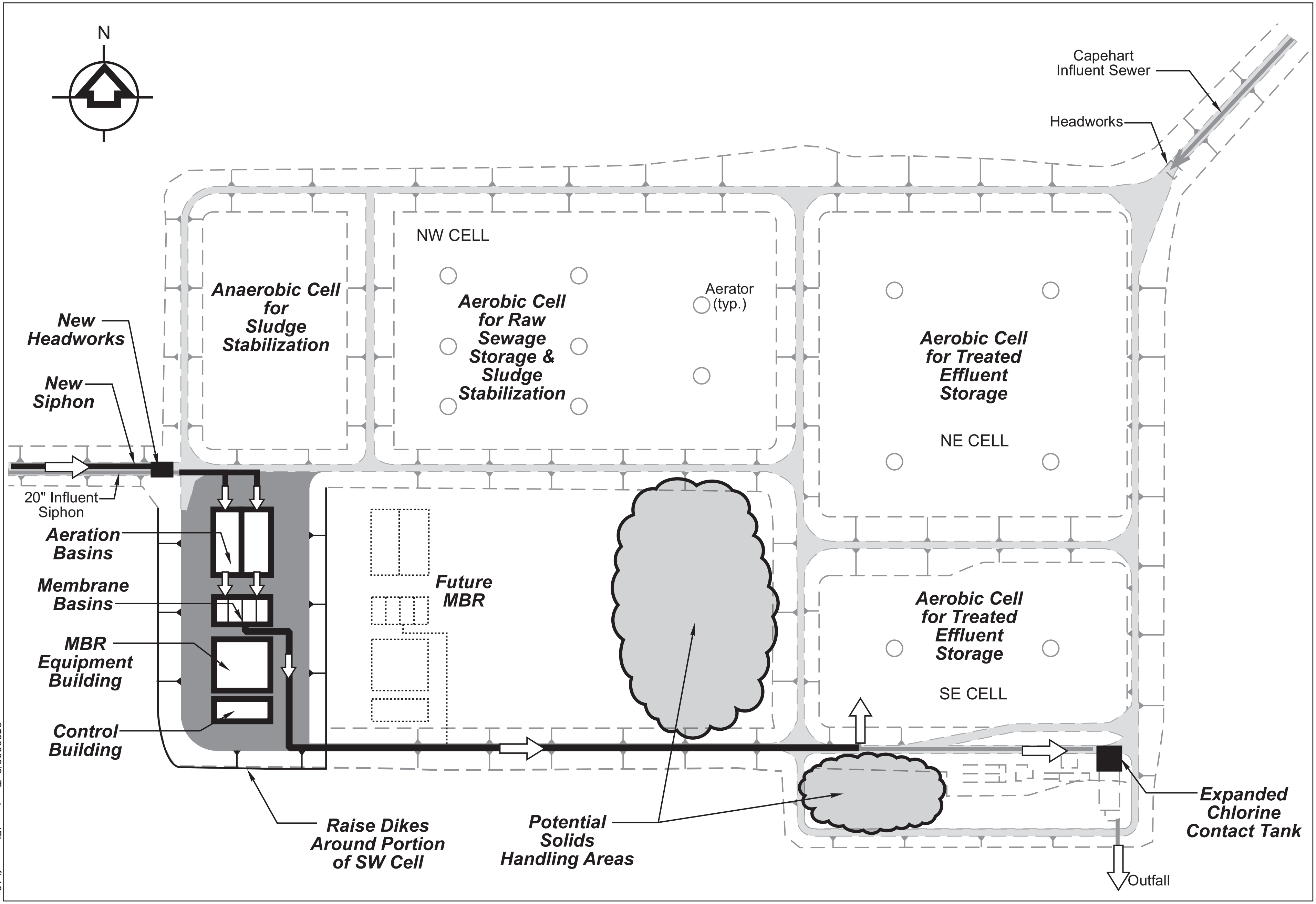
City of Oak Harbor
COMPREHENSIVE SEWER PLAN

Figure 8-17
TREATMENT PLANT IMPROVEMENT ALTERNATIVE 3



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City of Oak Harbor
COMPREHENSIVE SEWER PLAN

Figure 8-18
TREATMENT PLANT IMPROVEMENT ALTERNATIVE 4

- Upgrade the existing chlorine disinfection system including expanded chlorine contact tank, larger on-site chlorine generation system, larger hypochlorite and bisulfate feed systems, chemical storage tanks, lagoon water pump station and larger effluent pumps.
- Protect the lagoon facilities from erosion and flooding that could occur because of increased tidal circulation around the lagoons proposed in the Crescent Harbor Marsh Restoration Project. Improvements include gabions on the outside flanks of the lagoon dikes and sewer berms, and flood control dikes around the Capehart headworks and the existing chlorination and physical-chemical treatment facilities.
- Construct a new control building at the lagoon plant for Alternatives 2, 3 and 4, including offices, laboratory and maintenance facilities.
- Demolish the existing RBC treatment plant for Alternatives 2, 3 and 4. (The existing diversion pump station at the RBC plant will be retained and remodeled to convey all sewage flows to the lagoon plant, as described separately in Chapter 7.)
- Sludge disposal will continue to be accomplished by contract dredging and disposal.

Cost Comparison

Table 8-6 shows the total capital costs associated with each alternative. Alternative 1 has the lowest capital costs at approximately $19.4 million. If the City eliminates the RBC plant, Alternative 3 has the lowest capital cost at approximately $21.5 million. Alternative 2 would be the least costly alternative to eliminate the RBC plant, if the anaerobic pretreatment cells can reduce effluent TSS to 30 mg/L, because this would eliminate the cost for effluent filters.

TABLE 8-6.
ESTIMATED CAPITAL COSTS FOR TREATMENT PLANT ALTERNATIVES

	Alternative 1 RBC & Lagoon	Alternative 2 Lagoon	Alternative 3 Activated Sludge	Alternative 4 MBR
Headworks	$591,965	$591,965	$591,965	$932,713
Anaerobic Cell in Southwest Lagoon	$3,008,258	$3,008,258	$0	$0
Effluent Filtration	$4,933,340	$6,084,453	$0	$0
Aeration Basins	$0	$0	$2,142,635	$0
Clarifier system	$0	$0	$4,799,145	$0
Lagoon Pump Station	$0	$0	$203,619	$203,619
MBR system	$0	$0	$0	$14,800,000
Disinfection & Effluent Pumping	$1,761,873	$1,965,460	$1,965,460	$1,965,460
Control Building	$0	$1,257,388	$1,257,388	$1,257,388
Wetland Dike Upgrades	$917,689	$917,689	$917,689	$917,689
RBC Plant Demolition	$0	$510,730	$510,730	$510,730
Subtotal	***$11,213,125***	***$14,335,942***	***$12,388,629***	***$20,587,598***
Contingency (30%)	$3,363,937	$4,300,782	$3,716,589	$6,176,279
Total estimated construction cost	$14,577,062	$18,636,724	$16,105,218	$26,763,877
Engineering Design (15%)	$2,186,559	$2,795,509	$2,415,783	$4,014,582
Construction Management (10%)	$1,457,706	$1,863,672	$1,610,522	$2,676,388
Sales Tax (8.3%)	$1,209,896	$1,546,848	$1,336,733	$2,221,402
Total Estimated Capital Cost	**$19,431,000**	**$24,843,000**	**$21,468,000**	**$35,676,000**

Qualitative Comparison

The key qualitative differences among the alternatives are summarized in Table 8-7.

TABLE 8-7.
QUALITATIVE SUMMARY OF SECONDARY PROCESS ALTERNATIVES

	RBC Plant & Lagoons with Filters (Alt. 1)	Lagoons with Filters (Alt. 2)	Activated Sludge (Alt. 3)	MBR Process (Alt. 4)
Eliminates Outfall and Treatment Plant at Windjammer Park?	No	Yes	Yes	Yes
Room for Expansion and Solids Facilities?	No	No	Yes	Yes
O&M Complexity	High	Moderate	Low to Moderate	High
Performance History	Relatively few installations, good to moderate performance	Relatively few installations, good to moderate performance	Well proven, good performance	New process, very good performance
Class A Water Reuse Potential	None	None	Good with added filters	Excellent
Shellfish Closure Zone Size	Smallest	Smallest	Medium	Small
Ammonia Removal	Poor	Poor	Excellent	Excellent

Treatment Plant Conclusions

Based on the cost and qualitative considerations discussed above, Alternative 3, Activated Sludge, is the most promising alternative for meeting the City’s treatment requirements through the end of the planning period. This is a preliminary conclusion and additional alternatives will be evaluated in more detail when the City prepares a wastewater facility plan to expand the plant in the future.

CHAPTER 9.
RECOMMENDED IMPROVEMENTS

This chapter summarizes recommended upgrade projects and associated costs for the City of Oak Harbor wastewater collection system (see Figure 9-1). It also identifies potential upgrades to the wastewater treatment facilities that would meet the City's treatment requirements through the end of the planning period in 2025. A wastewater facilities plan will need to be prepared before proceeding with the identified treatment facility improvements.

COLLECTION SYSTEM IMPROVEMENTS

System Expansion

The expansion of the collection system required to serve peripheral areas of development is discussed in detail in Chapter 7 of this report. Detailed cost estimates are included in Appendix H. Projects to be implemented within the 20-year planning period were identified following consultation with the City. Table 9-1 summarizes the proposed improvements to be undertaken by the City during the 20-year planning period and provides planning-level project cost estimates.

Existing System Upgrades

Upgrades of the existing collection system to serve projected population growth and development are discussed in detail in Chapter 7. Alternative 1, which continues to use the RBC Diversion Pump Station to convey all flows from the City proper to the Seaplane Lagoon Plant was determined to be slightly more cost-effective than Alternative 2 (installation of an additional pump station close to the intersection of Whidbey Avenue and SR 20). Alternative 1 projects that would be implemented within the 20-year planning period have been incorporated into the recommended upgrade projects, as detailed in Table 9-1. Detailed cost estimates are included in Appendix H.

Operation and Maintenance

The proposed collection system improvements will entail additional operation and maintenance (O&M):

- At the RBC Diversion Pump Station, the upgraded capacity and projected growth in flow will result in higher power consumption and associated costs. The upgrade may also increase the requirement for odor control supplies.
- With additional lift stations in the development areas, there will be an associated increase in power consumption. Further, these lift stations should be incorporated into the weekly inspection and regular maintenance schedules. This will result in an increase in staff hours.
- Additional trunk sewers should be added to the inspection and cleaning schedule, which will increase the staff hours associated with these tasks.

TABLE 9-1.
SUMMARY OF RECOMMENDED COLLECTION SYSTEM IMPROVEMENTS

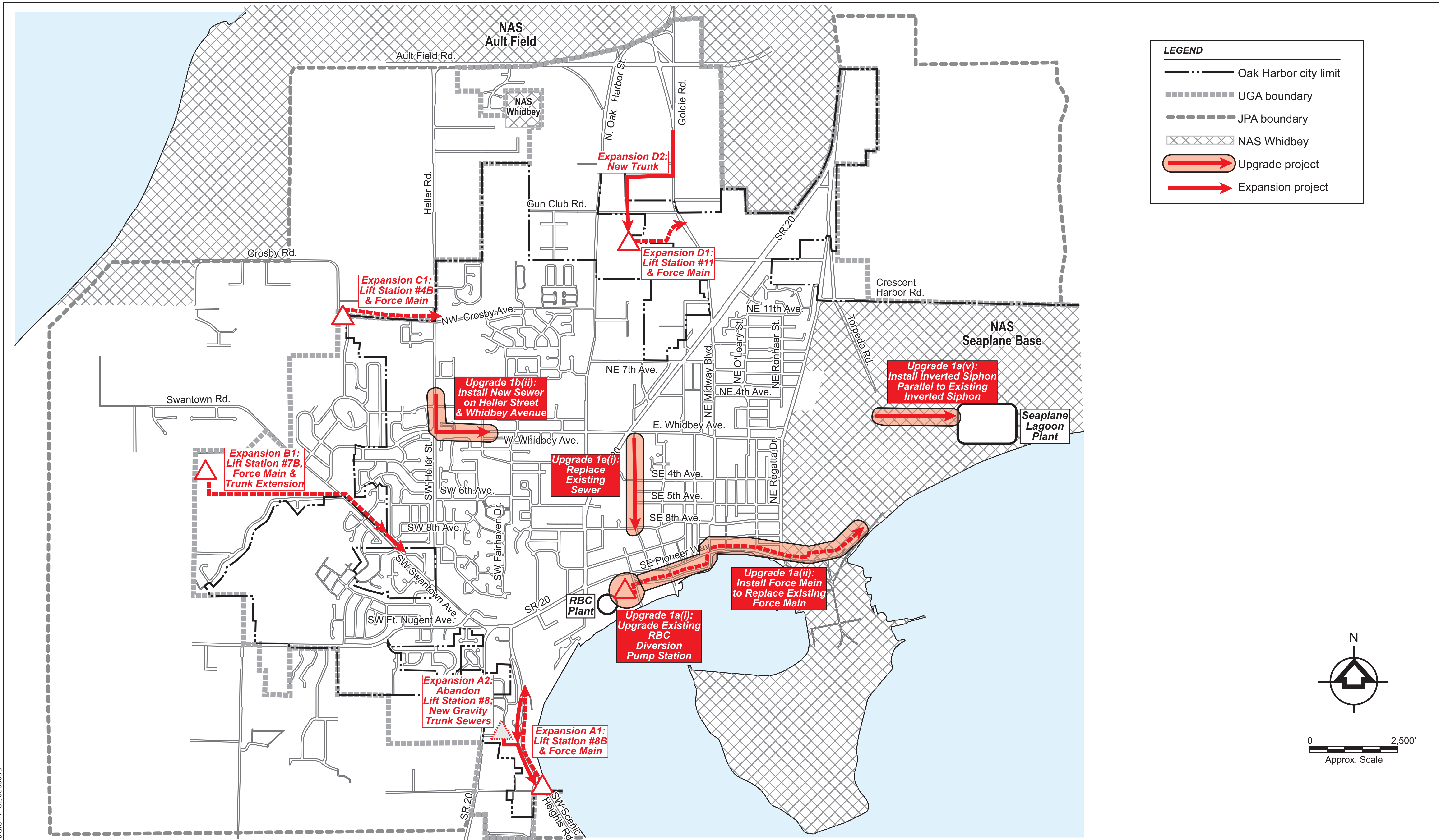
Project No.	Location	Description	Planning Level Cost
Collection System Expansion			
A1	Scenic Heights	Scenic Heights Lift Station and Force Main	$595,000
A2	Scenic Height	Scenic Heights Gravity Trunk Sewers	$705,000
C1	Crosby Road	Crosby Road Lift Station and Force Main	$1,816,000
D1	Heller Road/Goldie Road	Goldie Road Lift Station and Force Main	$1,865,000
D2	Heller Road/Goldie Road	Trunk Sewer from Goldie Road to Proposed Lift Station	$2,617,000
B1	Swantown Road/ Fort Nugent Avenue	Fairway Lane Lift Station, Force Main and D/S Trunk Extension	$3,341,000
		Subtotal	***$10,939,000***
Existing Collection System Upgrades			
1a(i)	RBC Pump Station	Upgrade RBC PS to 10 mgd	$1,856,000
1a(ii)	RBC Pump Station to Seaplane Base	Upgrade RBC PS Force Main	$6,123,000
1a(v)	Seaplane Base	Upgrade of Inverted Siphon Capacity to Lagoon Headworks	$1,069,000
1b(ii)	Heller Road/Whidbey St.	Interim Upgrades to Heller Road and Whidbey St. Trunk Sewer	$845,000
1e(i)	Ely Street to City Beach	Interim Upgrade to Ely Street Sewer to RBC Pump Station	$2,113,000
		Subtotal	***$12,006,000***
Other System Improvements			
1	Various Lift Stations	Install data logging/telemetry at critical lift stations.	$500,000
2	NE 7th Lift Station	Purchase an additional permanent standby generator	$50,000
3	System Wide	Infiltration / Inflow and Flow Monitoring Study	$175,000
4	RBC Diversion Pump Station Force Main	Corrosion Study	100,000
		Subtotal	***$825,000***

All costs are in December 2005 dollars (ENR Cost Index for Seattle = 8458; 20-City Index = 7647).

Emergency Response Plan

As discussed in Chapter 6, the City does respond to wastewater emergencies, however, a response plan has not been formally documented. Ecology strongly recommends that the City develop and adopt an emergency response plan to ensure compliance with state regulations, and the City plans to develop a formal emergency response plan for the collection system and treatment plants.

Emergency response planning is a process by which wastewater system managers and staff explore responses to vulnerabilities, make improvements, and establish procedures to follow in an emergency. It is also a process that encourages partnerships and better understanding of support capabilities. Preparing an emergency response plan and practicing it has potential to save lives, prevent illness, enhance system security, minimize property damage and environmental impact, and lessen liability.



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City of Oak Harbor
COMPREHENSIVE SEWER PLAN

Figure 9-1.
RECOMMENDED CAPITAL IMPROVEMENT PROJECTS

Four key references provide a framework for the development of the emergency response plan:

- Ecology regulations. WAC 173-240-080, subsections 4(j) and 4(l) require wastewater facility Operation and Maintenance manuals to include emergency response plans and procedures
- Ecology Orange Book. The Orange Book, section G1-4.4.2 and table G1-3 provide guidance on the expected content of wastewater facility O&M manuals, including emergency response and safety content.
- Emergency Response Plan Guidance for Wastewater Systems, Final Report 2004, WERF – Water Environment Research Foundation. Based on the WERF document the emergency response plan could have eight chapters, as follows:
  - Introduction
  - General Emergency Planning Information
  - Emergency Response Plan – Core Elements
  - Decision Process and Emergency Response Plan Activation
  - Emergency Response, Recovery and Termination
  - Action Plans
  - Emergency Plan Approval, Update and Training
- Additional Resources• Water and Wastewater System Emergency Response Plan Template, July 2003, Kentucky Rural Water Association.

WASTEWATER TREATMENT PLANT IMPROVEMENTS

Capital Improvements

Chapter 8 provides preliminary recommendations for upgrading the City’s wastewater treatment facilities. The recommendations identify the magnitude of costs and issues that will need to be addressed when the City eliminates the RBC Plant from Windjammer Park, as recommended in the master plan for the Park, or when the facilities are upgraded by 2017 to accommodate projected future flows and loads.

In either case, a wastewater facility plan will need to be prepared per WAC 173-240-060 to plan the proposed upgrades. Typically at least five years are needed to complete a facility plan, design, permitting, financing and construction of major treatment plant upgrades, and 10 years can be needed if there are complications. Therefore, the City should begin the facility plan no later than 2012. To be conservative, this report assumes planning will begin in 2011 and construction will be complete by 2015.

The preliminary recommendations for upgrading the treatment plant are as follows:

- Upgrade the Seaplane Lagoon Plant to treat an average flow of 3.5 mgd.
- Construct new headworks at the northwest lagoon, including a manually cleaned bar rack, mechanically cleaned fine screen with 1/4-inch openings, screenings washer compacter, Pista grit style grit system and Parshall flume.
- Construct an activated sludge secondary treatment system in the southwest cell of the Seaplane Lagoon Plant, including peak flow diversion weir, flow splitter box, two activated sludge aeration basins with earth dikes and floating surface aerators, mixed liquor pump station and splitter box, and two 80-foot diameter concrete clarifiers.
- Upgrade the existing chlorine disinfection system, including expanded chlorine contact tank, larger on-site chlorine generation system, larger hypochlorite and bisulfate feed systems, chemical storage tanks, lagoon water pump station and larger effluent pumps.

- Construct wetland erosion control and flood protection improvements, including gabions on the outside flanks of the lagoon dikes and sewer berms and flood control dikes around the Capehart headworks and the existing chlorination and physical-chemical treatment facilities at the southeast area of the lagoon plant site.
- Construct a new control building at the Seaplane Lagoon Plant, including offices, laboratory and maintenance facilities.
- Demolish the existing RBC Plant. The existing diversion pump station at the RBC Plant will be retained and remodeled to convey all sewage flows to the Seaplane Lagoon Plant.

Table 9-2 summarizes the estimated capital costs for the recommended improvements.

TABLE 9-2.
ESTIMATED CAPITAL COSTS FOR RECOMMENDED WASTEWATER TREATMENT IMPROVEMENTS

Headworks	$591,965
Anaerobic Cell in Southwest Lagoon	$0
Effluent Filtration	$0
Aeration Basins	$2,142,635
Clarifier system	$4,799,145
Lagoon Pump Station	$203,619
MBR system	$0
Disinfection & Effluent Pumping	$1,965,460
Control Building	$1,257,388
Wetland Dike Upgrades	$917,689
RBC Plant Demolition	$510,730
Subtotal	***$12,388,629***
Contingency (30%)	$3,716,589
Total estimated construction cost	**$16,105,218**
Engineering Design (15%)	$2,415,783
Construction Management (10%)	$1,610,522
Sales Tax (8.3%)	$1,336,733
Total Estimated Capital Cost	**$21,468,000**

All costs are in December 2005 dollars (ENR Cost Index for Seattle = 8458; 20-City Index = 7647).

Treatment Plant O&M Requirements

Treatment plant O&M costs are estimated to be significantly lower with the recommended treatment facilities than with the existing plants. The O&M savings could make immediate implementation cost-effective, if the O&M savings are greater than the interest costs for financing. Staffing requirements are estimated to decrease by approximately 2 full-time equivalents. Power costs for the RBC plant will be eliminated, and power costs for the upgraded Seaplane Lagoon Plant are expected to change little. Chemical costs will be eliminated for soda ash and polymer at the lagoon plant, and for hypochlorite at the RBC plant. Repair and replacement costs for old equipment at the RBC plant will be eliminated.

IMPLEMENTATION SCHEDULE

The recommended improvements are proposed to be implemented in phases as the City's growth takes place. Table 9-3 shows an overall schedule. The schedule for collection system improvements is coordinated with treatment plant improvements, so that all the City flows can be conveyed to the Seaplane Lagoon Plant when the plant improvements are completed. To be conservative, the treatment plant improvements are timed to be completed a few years before they are projected to be needed in 2017. The City can accelerate the treatment plant schedule if it decides to eliminate the RBC plant sooner than shown, or it can extend the schedule if plant improvements can be deferred longer. The schedule is subject to change and can be revised over the course of the planning period.

TABLE 9-3.
PROPOSED IMPLEMENTATION SCHEDULE FOR RECOMMENDED IMPROVEMENTS

Project Number & Description	Total Project Cost	Annual Expenditure ($1000) 2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Collection System projects																					
Upgrade of Existing Collection System																					
1a(i) RBC Pump Station Upgrade to 13 mgd	$1,856,000			300	1556																
1a(ii) Upgrade RBC Pump Station Force Main	$6,123,000						900	5,223													
1a(v) Upgrade of Siphon	$1,069,000	160	909																		
1b(ii) Interim Upgrades to Heller Road and Whidbey St. Trunk Sewer	$845,000				150	695															
1e(i) Interim Upgrade to Ely Street Sewer and D/S to RBC	$2,113,000					320	1,793														
Collection System Expansion																					
A1 Scenic Heights Lift Station and Force Main	$595,000	100	495																		
A2 Scenic Heights Gravity Trunk Sewers	$705,000	200	505																		
B1 Lift Station, Force Main and D/S Trunk Extension	$3,341,000					500	2,841														
C1 Crosby Road Lift Station and Force Main	$1,816,000			300	1,516																
D1 Goldie Road Lift Station and Force Main	$1,865,000		300	1,565																	
D2 Trunk Sewer from Goldie Road to Proposed Lift Station	$2,617,000			400	2,217																
Other System Improvements																					
1 Lift Station Telemetry Upgrades	$500,000		200	300																	
2 Permanent Standby Generator at NE 7th Lift Station	$50,000		50																		
3 Infiltration/Inflow and Flow Monitoring Study	$175,000	75	100																		
4 RBC PS FM Corrosion Study	$100,000		100																		
O&M Cost Changes	$3,474,000	0	0	11	27	46	198	228	228	228	228	228	228	228	228	228	228	228	228	228	228
Wastewater Treatment Facilities																					
Capital Costs																					
1 Facility Plan	$300,000						300														
2 Seaplane Lagoon Plant Upgrade	$21,500,000								1,600	9,600	9,600	700									
Changes to Annual O&M Costs																					
1 Treatment Plant O&M	($1,888,000)		4	8	12	16	20	24	28	32	36	-221	-218	-215	-212	-209	-205	-202	-199	-195	-192
2 Biosolids Removal	$4,974,000		283		290		297		304		1,259					1,233					1,308
Total	**$52,130,000**	**535**	**2,946**	**2,884**	**5,768**	**1,577**	**6,349**	**5,475**	**2,160**	**9,860**	**11,123**	**707**	**10**	**13**	**16**	**1,252**	**23**	**26**	**29**	**33**	**1,344**

CHAPTER 10.
FINANCING ANALYSIS

This chapter addresses financing alternatives for the capital improvements recommended in the previous chapter, as well as the identified changes in operations and maintenance (O&M) costs.

CURRENT SEWER FUNDING

The City has a dedicated source of revenue in the form of monthly sewer utility fees.

Sewer Fund 402 Summary	2002	2003	2004	2005
Charges for Service	$2,885,258	$3,037,858	$3,172,764	$3,270,597

These charges are deposited in the Sewer Fund 402 and used for operating expenses, repair and replacement, capital improvements, debt service and reserves. Each year the Finance Director prepares a statement of Revenues, Expenses and Changes in Fund Net Assets as part of the annual financial report. This statement indicates that operating revenue has been greater than operating expenses and depreciation in each year 2002-4.

In addition, there is a Sewer Cumulative Reserve Fund 412 where capital-related revenue is deposited for future capital improvements. The City collects a system development fee, a trunk line fee, potentially a latecomer's recovery fee for new connections to the system as appropriate.

Sewer Cumulative Reserve Revenue	2003	2004	2005
System Development Fees	$307,325	$561,117	$210,437
Trunk Line Fees	$ 36,125	$ 50,105	$ 43,775

There is approximately $3,000,000 in cumulative reserves at the beginning of 2006. The City also has a policy of holding reserves in the operating fund of 5 to 10 percent of annual expenditures. The estimated 2005 ending balance in Sewer Fund 402 was $1,350,000.

The City prepares a two-year budget every other year and monitors the activity on a regular basis. The next biennial budget is 2007-2008. One part of the budget process is to review rate revenue to ensure it is sufficient to meet operating needs, debt repayment and planned capital investment. When necessary, the Finance Director works with the City Council on rate increases to ensure rates are keeping pace with expenses.

Because the rate review already takes place within the City's normal course of business, this financial chapter focuses on funding the capital improvements recommended in the planning period.

OUTSTANDING SEWER DEBT

The water and sewer utility are combined legally in the Waterworks Utility to support revenue bond issues. There are currently two revenue bond issues being repaid by the sewer utility, 1996 and 2004. At the beginning of 2006, there was $2,000,000 in outstanding principal on the 1996 revenue bond issue. Interest rates vary between 5.5 and 5.9 percent. The final maturity is scheduled for 2011, yet this issue is callable after September 1, 2006.

The 2004 bond issue for $2,865,000 carries interest rates between 2.25 and 4.55 percent. This 20-year issue will be repaid through the year 2024 and can be called after September 1, 2015. At the beginning of 2006, there was $2,735,000 in outstanding principal.

CURRENT SEWER RATES AND CHARGES

Residential sewer customers are charged a flat amount of $33.66 per month. With bi-monthly billing, the residential sewer charge is $67.32. This includes a customer charge per account plus a fixed capacity charge. Multi-residential units sharing a meter are charged a customer charge plus a fixed capacity charge per unit. Hotel/motel, marina and commercial accounts are charged a customer charge plus volume charge based on water usage in excess of 100 cubic feet. Schools are charged a customer charge plus volume rate on all water consumption.

Table 10-1 shows the current monthly sewer rates. Any customers outside of the city limits are charged 1.5 times the in-city customer rates. All utility bills also include a 6 percent utility tax.

TABLE 10-1.
MONTHLY SEWER RATES

	Monthly Rates		
Customer Class	Customer Charge per Account	Fixed Capacity Charge per Unit	Volume Charge
Residential	$3.57	$30.09	
Multi-Residential (per unit)	$3.57	$30.09	
Hotel/Motel	$33.69		$4.00 per 100 cubic feet in excess of 100 cf
Marina	$33.69		$4.00 per 100 cubic feet in excess of 100 cf
Commercial	$33.69		$4.00 per 100 cubic feet in excess of 100 cf
Schools	$3.57		$4.00 per 100 cubic feet

Outside City Limits = 1.5 times above rates for in-city customers.

The monthly sewer rates were adjusted early in 2006 to reflect increases in the cost of service since the last rate increase in March 2003. The adjustment of 3.82 percent was applied to all portions of the monthly rate. A separate discussion is anticipated for funding the capital improvements.

New connections to the sewer system pay some combination of fees for the ability to connect. The Sewer Permit Inspection Fees are intended to recover the cost of inspection and issuance of the sewer permit. These fees are deposited into the operating fund.

Sewer System Development Charges (SDC) are one-time fees that represent the equitable share of the system cost to be borne by new connections. These fees are deposited into the Sewer Cumulative Reserve fund for debt repayment or future capital improvements. The SDC is in need of revision to reflect the City’s current capital plans.

TABLE 10-2. SEWER CONNECTION FEES	
Sewer Permit Inspection Fees	
Main to Property Line	$62.00
Property Line To Building	$62.00
Multi-residential, add Fee for each dwelling unit over one and up to 20	$19.00
Repair to Sewer Main or Side Sewer Connection	$52.00
Sewer System Development Charge	
3/4" Meter	$1,680.00
1" Meter	$4,200.00
1-1/2" Meter	$8,399.00
2" Meter	$13,439.00
3" Meter	$26,879.00
4" Meter	$41,998.00
Sewer Trunk Line Fee	$425.00
(for existing and new homes connecting to City sanitary sewer located in the NW and SW quadrants of the City limits)	
Un-Assessed Frontage Connection Fee (varies with size of parcel and the cost per linear foot)	$25.00 Per linear foot x front footage
Latecomer Recovery (varies based on recovery contract)	Varies

Sewer Trunk Line Fees and Un-Assessed Frontage Connection Fees are methods of ensuring that new customers pay their fair share of the costs of installing the sewer lines and trunk lines that serve the property. Each of these fees was developed at a different time to recover certain investments made by the city, developers or property owners. These could be reviewed to determine whether the charges could be simplified for the benefit of the new customers and the administration of such fees.

Finally, the City allows Latecomer Recovery Contracts where a developer pays for and perhaps installs a necessary facility that future customers may connect into at a later date. The City is the intermediary that collects the appropriate latecomer fees and passes them through to the developer according to the latecomer agreement.

CAPITAL PROGRAM FUNDING METHODS

The City of Oak Harbor has used revenue bonds to fund sewer improvements over the years. In addition, the City has used Public Works Trust Fund loans from the State of Washington for water. These could also be considered for sewer improvements. Care must be taken to recognize the biennial maximum, currently $7 million per jurisdiction.

Some cities prefer a “pay-as-you-go” method of funding capital improvements and seek grants and/or partnerships to leverage ratepayer investment in the system. This means that the capital portion of the rate is either used in the year collected or held in reserve for future capital improvements as can be afforded. The fund balance typically fluctuates under this method of funding. In the years that the fund balance appears high, it is important to identify the minimum target reserve or set aside emergency and cash flow reserves to avoid potential misinterpretation.

Other common methods of funding capital improvements include some form of borrowing ranging from selling bonds on the open market to procuring low-interest loans or grants from a state or federal program. The choice of financing at any time should include an evaluation of the risks associated with the various alternatives:

- Risk that project costs will increase;
- Risk of not receiving the funding package; and
- Total cost with financing.

The risks mentioned above change over time depending on the trends related to the construction cost index and interest rates.

There are other sources of funding that are available for capital projects and are not recommended for on-going operations:

- Grants – Grant funds are a good source of capital funding because the money does not have to be repaid. Unfortunately, grants can be hard to come by. The City should continue to monitor and pursue grants when available.
- Low-Interest Loans – The State of Washington operates several low-interest loan programs for surface water and water quality capital projects. The Public Works Trust Fund has both a Pre-Construction and a Construction program with loans with interest rates up to two percent and loan terms up to 20 years. In addition, the Department of Ecology operates several programs: the Centennial Clean Water Fund and the Water Pollution Control State Revolving Fund. The DOE funds may include partial grants and loans with interest up to two percent.

  Grant funding eligibility from Ecology programs is based on the level of hardship the capital project will place on the residential ratepayers. Hardship is based on the percentage of Median Household Income (MHI) needed to pay monthly residential sewer rates. The minimum level of hardship for consideration is 2.0% of MHI; approximately $75 per month based on current data for Oak Harbor. Grants are also only available for construction projects.

  Low interest financing is available on a competitive basis. Ecology loans can be used for financing both construction and planning projects. Interest rates for loans are set by regulation (WAC 173-95A and 173-98) at a percentage of the average market rate for municipal bonds. Loans with terms up to 5 years are offered at 30% of the market rate and loans with terms up to 20 years are offered at 60% of market. Over recent years this translates into approximately 1.5% for 5-year loans and approximately 3.0% for 20-year (actual rates are typically set late summer of each year.)
- Bond sales – The City has the authority to sell several types of bonds that would be appropriate for capital projects: revenue, general obligation, limited general obligation and local improvement district bonds. In general, bonds can be a more costly form of funding capital projects than grants and low-interest loans from the State, yet the timing is controlled by the utility and the assurance of receiving financing is higher than applying to competitive programs.
- Contributions, Joint projects – Pursuing contributions from benefiting parties or joint projects can provide cost savings to the sewer ratepayers when appropriate for the project.
- System Development Charge (SDC) – This is a method of having development contribute their fair share of the system cost upon connection. This recognizes that the sewer system is in place and the new development benefits by connecting into the system. In return for connection, they pay a one-time fee that is deposited into the capital reserves and used to fund capital projects or associated debt. These charges can be calculated for system-wide

improvements or can differ by specific area or facility. Oak Harbor currently uses system development charges for water and sewer.

- Developer Extension – The developer is required to extend the system to serve its property boundaries. These projects are funded and completed by the developer. When complete, the facilities are deeded to the City.
- Latecomer's Fees – This fee would be the result of a latecomer's agreement with a developer that has constructed an improvement that serves beyond his/her property and is deeded to the City. The latecomer's agreement specifies that other properties that connect into the improvements within a certain period of time must contribute their fair share. The City would collect the latecomer's fee and forward to the developer.
- Local Improvement Districts (LID / ULID) – All benefiting properties share in the cost of installing the improvements necessary to serve. Assessments are filed on each property and the property owners pay the annual assessments over a specified number of years.
- Fee-In-Lieu-Of – This method works with regional-type facilities. The City would fund the capital improvement up-front and would be repaid as development occurs and pays its share of the cost.
- City Participation in Oversizing – When the comprehensive plan calls for a larger facility or line than is necessary for the next development, the City may participate in the cost of oversizing according to City policy. In order to do so, the capital improvement must have been identified as city-funded in the capital facility plan. Some cities may provide a credit toward the system development charge and others may have a reserve for oversizing. In order to provide credit, the project must be included in the system development charge calculation.

These methods can be used in combination with one another and should be consistent with City policy.

ALTERNATIVE CAPITAL PROGRAM FUNDING SCENARIOS

The capital projects identified and scheduled in Table 9-3 are used to develop the funding program. The project costs were estimated in December 2005 dollars ($2005). Table 10-3 summarizes the capital program by planning period.

TABLE 10-3.
FUNDING SOURCES FOR CAPITAL IMPROVEMENTS
(Costs Estimated Using December 2005 ENR Index)

Sewer Capital Improvement Projects	2006-2011 Total	2012-2025 Total	20-Yr Total	Funding Source
Upgrade of Existing Collection System	6,783,000	5,223,000	12,006,000	R / SDC
Collection System Expansion	10,939,000	-	10,939,000	SDC / SSDC
Other Collection System Improvement Measures	825,000	-	825,000	R / SDC
Treatment - Facility Plan	300,000	-	300,000	SDC
Treatment - Seaplane Lagoon Plant Upgrade	-	21,500,000	21,500,000	SDC
TOTAL CAPITAL IMPROVEMENT PROJECTS	$18,847,000	$26,723,000	$45,570,000	
CHANGES TO O&M COSTS				
Collection System	282,000	3,192,000	3,474,000	R
WWTP O&M	60,000	(1,948,000)	(1,888,000)	R
Biosolids Removal	870,000	4,104,000	4,974,000	R
TOTAL O&M CHANGES	$1,212,000	$5,348,000	$6,560,000	
OVERALL TOTAL	$20,059,000	$32,071,000	$52,130,000	

Funding Sources: R=Monthly Rates, SDC=System Development Charge, SSDC=Special System Development Charge

The total capital program is really shown in two parts – capital improvements and changes to operations and maintenance (O&M) costs. The capital improvements portion will need to be funded one time, either by cash or financing. The six-year study period of 2006-2011 is scheduled for $18,847,000 (41 percent) in capital improvements and another $26,723,000 (59 percent) from 2012-2025.

Funding sources are suggested for the projects. The upgrade of existing collection system and other system improvements are split between existing customers and future customers to be paid by rates and system development charges. The collection system expansion is all for growth and can be paid by either special system development charges by lift station or included in all system development charges. The treatment plant facility plan and upgrade are identified as funded by system development charges.

Annual O&M Changes

The changes in O&M costs shown in Table 10-3 include a summary of the six-year period. The total $1,212,000 averages $242,400 over the remaining five years 2007-2011. The primary cost driver is the biosolids removal effort scheduled for the odd years. Given the current rates and revenue, 7.4 percent rate increase would fund the changes in O&M costs. This equates to an increase of $2.50 per month for residential customers. Once instituted, these rates would keep up with inflation under the City's current philosophy of Cost of Living Adjustments (COLA).

CHANGES IN O&M COSTS	**$1,212,000**
Average per Year (2007-2011)	$ 242,400
2005 Rate Revenue	$3,270,000
Percent Rate Increase for Changes in O&M	*7.4%*
Current Residential Monthly Rate	$33.66
Rate Increase for O&M Changes	**$2.50 per month**

During the 2012-2025 period, there is a planned decrease in the wastewater treatment plant O&M costs. Unfortunately this will not be realized until the Seaplane lagoon plant upgrade is completed (scheduled for 2016). The stream of revenue used to pay for the operation of two plants will be reduced to one and can be viewed as a stream of revenue available to assist in funding the capital improvements.

Escalated Project Costs

Table 10-4 provides the same summary after escalating the estimated project costs to the year of construction using 5.0 percent annual increase in the construction cost index. Recent history indicates that construction costs are highly volatile with large increases occurring between 2003 and 2006. More recent history is showing a downward trend in costs. Over the long term, a 5.0 percent escalation is reasonable for sewer planning purposes in Oak Harbor. The financing plan will focus on the six-year improvements based on the planning level cost estimates and 5.0 percent escalation. However, as individual projects are implemented, the estimates should take note of current market conditions.

TABLE 10-4.
ESCALATED COSTS TO YEAR OF CONSTRUCTION
(Costs Escalated to Year of Construction)

Sewer Capital Improvement Projects	2006-2011 Total	2012-2025 Total	20-Yr Total	Funding Source
Upgrade of Existing Collection System	8,495,417	7,349,286	15,844,703	R / SDC
Collection System Expansion	13,353,108	-	13,353,108	SDC/ SSDC
Other System Improvement Measures	922,163	-	922,163	R / SDC
Treatment – Facility Plan	402,029	-	402,029	SDC
Treatment – Seaplane Lagoon Plant Upgrade	-	34,091,306	34,091,306	SDC
TOTAL CAPITAL PROJECTS (Escalated)	23,172,716	41,440,591	64,613,307	

The collection system expansion refers to a series of regional pump stations that must be constructed to serve new areas connecting to the sewer. This would lend itself to a special system development charge where the areas draining into the pump station would share in the cost at the time of connection. This would be in addition to the system development charge that all new connections pay. An alternative method was attempted in the form of a ULID that did not progress. Another alternative would be to spread the costs over the entire system by including them in the general system development fee. A review of the system development charge philosophy and calculation is necessary to ensure the costs are appropriately recovered.

If bonds were sold to finance the 2006-2011 capital projects, the debt service would be repaid by system development charges and a contribution from rates. Table 10-5 calculates what a bond repayment schedule might look like all projects were financed at once. With such a high debt repayment, one bond sale is not recommended.

TABLE 10-5.
DEBT REPAYMENT IF BONDS SOLD FOR ALL 6-YEAR CIP

Sell Bonds for all 6-Year CIP		$23,172,716
Less: Contribution from Cumulative Reserve		(2,500,000)
Less: Funding for Scenic Heights in previous bond sale		(500,000)
	Subtotal	$20,172,716
Add 12% for finance costs + borrow reserve		2,420,726
	Est. Bond Principal	$22,593,442
	Est. Annual Repayment - (20 Yr Term, 6% Interest)	$1,969,799
	Est. Annual Repayment - (30 Yr Term, 6% Interest)	$1,641,389

Note: Special System Development Charges on regional facilities plus System Development Charges would offset debt repayment

If the collection system expansion was excluded and the policy was changed to require developers to provide necessary lift stations prior to development, the estimated bond principal would be reduced to $7.6 million with a 20-year debt repayment of $666,000 per year.

Table 10-6 matches the collection system expansion projects with planned ERU's to indicate what the special system development charge might be for each area. It will be important to update the calculation when the cost of each project is updated to ensure proper recovery.

TABLE 10-6.
COLLECTION SYSTEM EXPANSION PER ERU

	Collection System Expansion	Est. Cost	Est. 2025 ERU's	SSDC
A1/2	Scenic Heights Lift Station and Force Main/Grav Trnk	$1,300,000	822	$1,582
C1	Crosby Road Lift Station and Force Main	$1,816,000	468	$3,880
D1	Goldie Road Lift Station and Force Main	$1,865,000	148	$12,601
D2	Trunk Sewer from Goldie Road to Proposed Lift Station	$2,617,000	148	$17,682
B1	Fairway Lane Lift Station, Force Main and D/S Trunk Ex	$3,341,000	671	$4,979
	Subtotal Expansion of Collection	$10,939,000		

The Sewer SDC does not appear to have been updated for some time and has not been keeping up with the investment in the system. Using the net asset value of the sewer system, adding interest and dividing by the estimated equivalent residential units (ERU's) of treatment plant capacity, Table 10-7 approximates the SDC value.

TABLE 10-7.
APPROXIMATE SYSTEM DEVELOPMENT CHARGE

Calculate Net Assets Per ERU		
	Approximate Capacity ERU's	10,000
Net Assets, December 31, 2004		$18,091,172
Plus: 10 Years of Accrued Interest (6%)		10,854,703
	Subtotal	$28,945,875
	Net Assets / Revenue ERU	$ 2,895

This calculation should be revised to reflect the City's method of determining ERU's. This provides an estimate to use in the financing plan. There are 4,647 ERU's anticipated from 2006-2025. With a SDC of $2,895, this would generate $13,451,148 over the 20-year period. For the six-year period, 861 ERU's would generate $2,492,240. Special System Development Charges would be in addition to the general SDC collected from all new connections.

TABLE 10-8.
ESTIMATED CUMULATIVE RESERVE

Cumulative Reserve	Beginning	2006	2007	2008	2009	2010	2011
Estimated Cumulative Reserve Balance less Emergency Reserve	2,500,000	3,000,000	3,344,400	3,846,951	4,349,502	4,852,053	5,251,489
2004 Bond Proceeds for Scenic Heights	500,000						
System Development Charges @ 100 ERU/Year		289,459	289,459	376,296	720,752	532,604	532,604
SSDC - Scenic Heights			158,151	158,151	158,151	55,036	55,036
SSDC - Crosby Road				116,410	388,034	388,034	388,034
SSDC - Goldie Road					1,494,000	1,494,000	1,494,000
SSDC - Fairway Lane							-
Est. Cumulative Reserve Available	3,289,459	3,737,068	4,271,516	5,150,419	5,738,059	6,325,700	3,289,459

Table 10-8 provides an estimate of cumulative reserves available to fund the projects. Each of the special areas has more connections in the first 3 years and then fewer per year through 2025.

Table 10-9 summarizes the plan for capital funding. The collection system expansion projects are lumped into one line. It is assumed that these would be debt financed and use any available special system development charges to reduce the need to borrow – either through bonds or loans. The general system improvements are lumped into the second line. These can be staged and funded by PWTF loans for both pre-construction and construction separately.

TABLE 10-9.
CAPITAL FUNDING PLAN

Funding Plan	2006	2007	2008	2009	2010	2011	2006-2011 Total
Sell Revenue Bonds - Exp. Coll. Syst.	315,000	1,433,250	2,622,021	4,537,485	638,141	3,807,212	13,353,108
Borrow PWTF Loans/DOE Loans - Gen. Imp.	-	-	347,288	2,073,654	1,295,426	3,608,878	7,325,245
Cumulative Reserve	207,375	1,250,235	173,644	-	-	402,029	2,033,282
Rate Contribution	39,375	248,063	173,644	-	-	-	461,081
TOTAL FUNDING	561,750	2,931,548	3,316,596	6,611,138	1,933,567	7,818,118	23,172,716

With anticipated SDC collections, it appears the 2006 and 2007 projects could be funded by the cumulative reserve fund and it would be down to the minimum emergency reserve level of $500,000. This would allow the City the opportunity to apply for PWTF loans to continue the general improvements and consider the direction for carrying out and recovering the investment in the regional pump stations as a separate issue requiring financing. The City could roll the financing together for bonds or loans.

This six-year plan does not address the costly improvements that are scheduled for 2012-2025 and it appears that significant borrowing will be required.

City of Oak Harbor
Comprehensive Sewer Plan

APPENDIX A.
NAVY SEAPLANE BASE LEASE AGREEMENT

December 2008

RESOLUTION NO. 87-18

RESOLUTION approving acquisition of sewage treatment facilities by lease.

WHEREAS, the City of Oak Harbor is in need of additional sewage treatment plant capacity to comply with current state and federal requirements; and

WHEREAS, the United States Navy is willing to lease the Seaplane Base treatment plant in exchange for the City providing to them sewer treatment services; now, therefore,

BE IT RESOLVED by the City Council of the City of Oak Harbor as follows:

THAT the City shall enter into a Sewer Service Contract with the United States Navy under the terms and conditions set forth in the form attached hereto. It is further directed that the Mayor of the City of Oak Harbor shall sign the Agreement for the City of Oak Harbor.

PASSED AND APPROVED by the City Council this 7th day of JULY, 1987.

THE CITY OF OAK HARBOR

Mayor

Attest:

Rosemary Morrison

City Clerk/~~Treasurer~~

Approved as to form:

City Attorney

Contract No. N62474-85-C-6905

SEWAGE SERVICE SPECIFICATIONS

1. SPECIFIC PREMISES TO BE SERVED: Naval Air Station, Whidbey Island Seaplane Base, Oak Harbor, WA

2. ESTIMATED SERVICE:

   Estimated average daily flow: 500,000 gallons

   Estimated maximum peak hourly flow: 147,500 gallons

   Estimated maximum annual volume: 182,500,000 gallons

3. SERVICE TO BE RENDERED: The Contractor shall furnish a sanitary sewer connection and sanitary sewage service as required by the Government and shall receive, carry, treat, and dispose of all sanitary sewage originating at the project, as governed by the rate of delivery specified hereinafter, and in a manner and by such means as will constitute no hazard to the public health. The Contractor shall operate his sewage facilities in conformity with applicable laws, rules and regulations promulgated by Federal, State, and local authorities.

4. POINT OF DELIVERY. The sewage shall be delivered to the Contractor by the Government at the Contractor's metering facility, as generally described in EXHIBIT "A", attached hereto and made a part hereof.

5. RATE OF DELIVERY. The amount of sewage delivered to the Contractor for treatment or disposal shall not exceed an average daily flow of 500,000 gallons per day, determined on the basis of thirty (30) continuous days.

6. SEWAGE AND WASTEWATER REQUIREMENT. The quality of sewage wastewater delivered by the Government to the Contractor shall be in accordance with treatment standards as established by Federal, State, or local laws, rules, or regulations as may be hereafter made applicable upon due notice to the Government by the Contractor. Should such rules and regulations require an upgrading of Contractor's then existing Seaplane Base Sewerage Treatment Facilities, such upgrading costs will be shared by the then existing users in proportion to the quantity of sewerage then being required or delivered, whichever amount is greater, by each such user. Such quality criteria may be amended from time to time by Contractor, provided that such modifications are applicable throughout the service area within the wastewater utility service boundaries of the Contractor. Additionally, the Government will not be required to financially participate in any future expansion based upon capacity in the Contractor's sewerage treatment facilities at the Seaplane Base until the Government has exhausted its capacity of 885,000 gallons per day reserved for its use and has a need for additional capacity in the system. It is understood by the Government and Contractor that a minimum of three years in time delays are encountered by the Government in acquiring funding. The Contractor will make reasonable effort to notify the Government of funding requirement at the earliest possible time.

Payments will be made by.

Fleet Accounting and Disbursing Center,
Pacific
San Diego, CA 92132

Communications. All Communication and modifications regarding this Contract shall be addressed as follows:

Contractor.

City of Oak Harbor
3075 300 Avenue West
Oak Harbor, WA 98277

Government.

Commanding Officer (Code 1131)
Western Division
Naval Facilities Engineering Command
P.O. Box 727
San Bruno, CA 94066-0720

This Contract is negotiated pursuant to 10 U.S.C. 2304 (c)(1)

Contract No. N62474-85-C-6905

THIS CONTRACT is entered into as of 1 October 1987 by and between the UNITED STATES OF AMERICA, hereinafter called the Government, represented by the Contracting Officer executing this contract, and City of Oak Harbor, whose address is 3075 300 Avenue West, Oak Harbor, WA 98227, hereinafter called the Contractor.

I. SCOPE. Subject to the terms and conditions hereinafter set forth, the Contractor shall furnish, and the Government shall purchase and receive sewage service (hereinafter called service) requested by the Government from the Contractor at the premises to be served hereunder (hereinafter called the service location), in accordance with the General and Technical Provisions and the sewage service specifications, attached hereto and made a part hereof.

II. TERM. This contract shall continue in effect until terminated at the option of either party by the giving of written notice not less than two years in advance of the effective date of termination.

IN WITNESS WHEREOF, the parties hereto have executed this contract as of the day and year first above written.

CITY OF OAK HARBOR	
NAME OF CONTRACTOR	UNITED STATES OF AMERICA
BY	BY
Al Koetje (typed name)	C. C. HOFFNER, JR. (typed name)
Mayor (title)	Director, Utilities Division (title)

TECHNICAL AND GENERAL PROVISIONS FOR UTILITY SERVICE

1. TECHNICAL PROVISIONS

1. DEFINITIONS. For the purpose of this agreement, unless it is plainly evident from the context that a different meaning is intended, the following words and phrases when used are defined as follows.

(a) Operating Cost. Operation expense shall include all costs related to the day-to-day operation of the treatment facility, including but not limited to.

(1) Labor. Direct expenses and cost of associated benefits for scheduled normal activities at the Seaplane Base treatment facility, directly related to managerial and administrative time, and training of facility operators.

(2) Materials and Supplies. Expenses such as electricity, chemicals, and other materials and supplies used in the normal operation of the Seaplane Base Lagoon.

(3) Vehicles and Equipment. The cost of equipment used or rented, including vehicles, used to routinely operate the Seaplane Base treatment facility.

(4) Services. Expenses related to laboratory test, training class expenses, and expenses of any legal, financial, or engineering services incurred at the Seaplane Base treatment facilities in order to determine or update the unit cost basis for charges.

(b) Maintenance Costs. Maintenance costs shall include all costs related to the upkeep and repair of the Seaplane Base treatment facility, including expenses for labor, material, and supplies, vehicles and equipment, and services as defined above. Maintenance costs would also include.

(c) Replacement Parts & Equipment. Expenses related to the purchase of replacements for failed or faulty parts or equipment at the Seaplane Base treatment facility.

2. USE OF SEAPLANE BASE SEWAGE TREATMENT FACILITIES.

(a) The Government will grant the Contractor a fifty (50) Year easement for the purpose of operating and maintaining the sewage lagoon which includes, but is not limited to the influent lines, sewage outfall, and associated facilities. Parcel descriptions as provided by the Contractor per survey of land and appurtenances.

(b) Should the Contractor decide to return the lagoon and associated facilities to the Government at the end of the fifty (50) year agreement (or at any time before), the Contractor will be responsible that all facilities will meet existing Environmental Protection Agency (EPA) and National Pollution Discharge Elimination System (NPDES) permit requirements at such time.

(c) The use of the sewage lagoon facility will be for the exclusive use of the citizens residing within the boundaries of Oak Harbor as it currently exists, plus future annexation.

3. MEASUREMENT OF SERVICE

(a) All service furnished by the Contractor shall be measured by metering equipment of standard manufacture, furnished, installed, maintained, calibrated, and read by the Contractor at his expense. When more than a single meter is installed at the service location, the readings thereof shall be billed conjunctively. In the event that any meter fails to register or registers incorrectly, the quantity of service delivered through it during that period shall be determined and an equitable adjustment based upon an average thirty (30) day pre and post period shall be made in the Government bills (for this purpose any meter which registers not more than five (5) percent slow or fast shall be deemed correct). Failure to agree on any adjustment shall be a dispute concerning a question of fact within the meaning of the "Disputes" clause of this contract.

(b) The Contractor shall read all meters at periodic intervals of approximately thirty (30) days.

(c) The Contractor will provide a separate connection to the existing influent line, and flow meters on all influent lines to determine Government/Contractor percent of flow to the treatment system.

4. METER TEST.

The Contractor, at his expense, shall periodically inspect and test the meters installed, at intervals of no longer than one (1) year. At the written request of the Contracting Officer, the Contractor, in the presence of the Government representatives shall make additional tests of any or all meters. The cost of such additional tests shall be borne by the Government if the percentage of error is found to be not more than five (5) percent slow or fast. No meter shall be placed in service which on test registers in excess of one hundred (100) percent under normal operating conditions.

II. GENERAL PROVISIONS

1. PAYMENT

(a) The Contractor shall be paid by the designated disbursing officer for service furnished hereunder at the rates specified, provided, that the Government shall be liable for the minimum monthly charge, if any, specified, in this contract commencing with the billing period in which service is initially furnished and continuing until this contract is terminated, except that the minimum monthly charge shall be equitably prorated for the billing period in which commencement and termination of this contract shall become effective.

(b) Payment hereunder shall be contingent upon the availability of appropriations therefor, and shall not be made in advance of the service rendered.

(c) All bills for regular monthly service, shall be paid according to "Prompt Payment Act," Public Law 97-177. The Government shall be entitled to any discounts customarily applicable to payment of Bills by all customers of the Contractor under like conditions of service.

(d) Invoices for service rendered hereunder shall contain statements of the meter readings at the beginning and at the end of the billing period, meter constants, consumption during the billing period, and such other pertinent data as shall be required by the Government.

(e) The Contractor hereby declares that rates are not in excess of the lowest rates now available to any existing or prospective customer under like conditions of service, or of the same classification, and agrees that during the life of this contract the Government shall continue to be billed at the lowest available rate for similar conditions of service.

2. RATES AND CHARGES.

(a) For all monthly service furnished under this contract to the service location, the Government shall pay the Contractor as follows.

Government will receive treatment of its sewage at the treatment rate of $0.35 per thousand gallons for twenty (20) years. Billing will be monthly. The Contractor will establish an accounting system which may be used to track the major capital repairs and improvements to the lagoon. The operation and maintenance costs for years eighteen (18), nineteen (19), and twenty (20) will be audited by the Defense Contract Audit Agency. The audit findings will form a basis for renegotiating a new treatment rate for Government sewage that will apply to year twenty one (21) of this contract and all subsequent contract years mutually agreed to. The Government will be billed at the $0.35 per thousand gallon rate until the new rate is mutually established. Billings for year twenty one (21) will be retroactively adjusted to reflect the new rate.

3. CHANGE IN VOLUME OR CHARACTER OF SERVICE.

(a) The Contracting Officer shall give reasonable notice to the Contractor respecting any material changes anticipated in the volume or characteristics of the utility service required at each location. The Government agrees that the character of the sewage shall continue to be domestic and commercial in nature. The Government further agrees to prevent, to the greatest extent possible, the discharge to the lagoon, of objectionable material, including toxics and flammables. The Contracting Officer shall notify the Contractor of any hazardous waste spills occurring on the Seaplane Base.

(b) The Government will be entitled to use up to 100% of the design capacity of the existing lagoon without incurring any expense for capital expansion of the lagoon facility to achieve this capacity. The Government is currently utilizing less than its assigned capacity. In the event the Government intends to utilize all or a portion of the remaining unused capacity of the existing lagoon, Government will provide reasonable notice, not less than one year, of such intent. Should the Contractor be utilizing the Government's unused capacity and expansion of the lagoon facility will be necessary to meet the Contractor's needs, the Contractor will so expand the facility at no expense to the Government. Based upon 1986 records, the capacity of the existing lagoon is hereby defined as follows for the life of this contract:

Total Capacity	885,000 Gallons Per Day	(100%)
Current Government Use	500,000 Gallons Per Day	(56%)
Unused Capacity	385,000 Gallons Per Day	(44%)

4. CONTINUITY OF SERVICE AND CONSUMPTION

(a) The Contractor shall use reasonable diligence to provide a regular and uninterrupted supply of service at the service location, but shall not be liable to the Government for damages, breach of contract, or otherwise, for failure, suspension, diminution, or other variations of service occasioned by any cause beyond the control and without the fault or negligence of the Contractor. Such causes may include, but are not restricted to, acts of God or of the public enemy, acts of the Government in either its sovereign or contractual capacity, fires, floods, epidemics, quarantine restrictions, strikes, or failure or breakdown of transmission or other facilities; provided, that when any failure, suspension, diminution, or variation of service shall aggregate more than one (1) hour during any billing period hereunder, an equitable adjustment shall be made in the monthly rates specified in the contract (including the minimum monthly charge).

(b) In the event the Government is unable to operate the service location in whole or in part for any cause beyond its control and without its fault or negligence, including but not limited to acts of God or the public enemy, fires, floods, epidemics, quarantine restrictions, or strikes, an equitable adjustment shall be made in the monthly rates specified in this contract (including the minimum monthly charge) if the period during which the Government is unable to operate the service location in whole or part shall exceed fifteen (15) days during any billing period hereunder.

5. CONTRACTOR'S FACILITIES.

(a) The Contractor, at his expense, shall furnish, install, operate, and maintain all facilities required to furnish service hereunder to, and to measure the service at the point of delivery specified in the Utility Service Specifications.

(b) The facilities which the Contractor will lease from the Government consists of Parcel "A", a strip of land containing 294,801 sq. ft., 6.768 acres, Parcel "B", a strip of land containing 178,710 sq. ft., 4.103 acres and Parcel "C", a strip of land containing 4,510,000 sq. ft., 105.83 acres all as fully described in Grant of Easement Number N6247487RP00R29.

6. MAINTENANCE AND REPAIRS TO THE LAGOON AND ASSOCIATED STRUCTURES. The Contractor agrees to accept the lagoon and associated structures in a reasonable working condition. Navy will participate on a shared basis, subject to availability of appropriated funds, in the expansion of the existing outfall to meet compliance standards as set forth by a proposed NPDES Permit requirements per letter dated 21 May 1987 to Commanding Officer, NAS Whidbey Island from U.S. Environmental Protection Agency, NPDES Permit number WA-000346-8. Minor maintenance and repairs to the lagoon and associated structures incident to the transfer to the contractor for operations will be borne by the contractor.

7. FUTURE CAPITAL REPAIRS TO SEWAGE LAGOON AND ASSOCIATED STRUCTURES.

Future capital repairs will be shared by the Contractor and the Government on a proportional basis determined by volume of sewage flow. Future repairs are defined as those occurring in year two (2) of the contract and subsequent years. Capital repairs are defined as undertakings of value in excess of $25,000 which must be accomplished as a single undertaking due to the nature of the work to be performed. Repair efforts below $25,000 are defined as part of normal operating and maintenance expenses. The Contractor will provide maximum notice to the Government of funds required for such repairs. This notice will include a detailed engineering cost estimate prepared by a competent engineering consultant.

8. EXPANSION OF SEAPLANE BASE SEWAGE TREATMENT FACILITIES.

(a) Expansion of the lagoon to meet Contractor requirements will be at Contractor expense and will be conducted in a manner that will not interrupt or unduly jeopardize proper treatment of Government sewage. The Contractor shall notify the Government of any plan to expand the facility, at least one (1) year prior to the anticipated start of construction. The engineering design for the expansion shall be submitted to the Government for approval. Construction methods, construction access to the site, security of the surrounding Government property, and construction practices associated with safety and good housekeeping shall be subject to Government review and approval. The Contractor will keep the Government apprised of construction progress and projected completion. Any damage to surrounding Government property will be promptly repaired.

(b) The Government and Contractor will share all expenses, on a proportional basis calculated from sewage treatment volume over the life of the contract, for all facility expansions and/or improvements required by increases in treatment standards as legally mandated by appropriate authority and/or statute or regulation. The Contractor will provide notice to the Government of such requirement as early as possible that funds are required for award of the necessary upgrade contract. The Government will approve all design and construction plans, methods, and practices as noted above.

(c) The Contractor will accomplish all operation, maintenance, repairs, upgrades, expansions, construction as required to meet Contractor and Government requirements for use of the sewage lagoon facility. Government reimbursements to the Contractor for these services will only be as separately defined in this contract. The Contractor will obtain all necessary permits, licenses, approvals, etc., to operate, repair, expand, improve, or upgrade the facility as required jointly or individually by the Contractor and Government.

9. REVIEW OF CONTRACTOR'S EXPANSION PLAN. The Government reserves the right to review and approve any proposed expansion to the Seaplane Base Sewage Treatment Facilities to insure that any contemplated expansion plans will not be in conflict with the mission of the Naval Air Station, Whidbey Island.

10. LIABILITY. The Contractor shall hold and save the Government, its officers, agents, and employees, harmless from liability of any nature or kind, for or on account of any claims or action that may be asserted in connection with the Contractor's lease and operation of the Seaplane Base Sewage Treatment Facilities. Liability and costs arising from existing conditions at the time of lease should be the sole responsibility of the Government.

11. CONFLICT. To the extent of any inconsistencies between the provisions of this contract, and the provisions of any schedule, rider, or exhibit incorporated in this contract by reference or otherwise, the provisions of this contract shall control.

12. ADDITIONAL GENERAL PROVISIONS. (Utility Service Contract), all as attached hereto and made a part of Contract N62474-85-C-6905.

City of Oak Harbor
Comprehensive Sewer Plan

APPENDIX B.
DNR AQUATIC LANDS OUTFALL EASEMENT

December 2008

Lagoon Outfall

STATE OF WASHINGTON
DEPARTMENT OF NATURAL RESOURCES
DOUG SUTHERLAND, Commissioner of Public Lands

AQUATIC LANDS OUTFALL EASEMENT NO. 51-073213

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STATE OF WASHINGTON
DEPARTMENT OF NATURAL RESOURCES
DOUG SUTHERLAND, Commissioner of Public Lands

AQUATIC LANDS OUTFALL EASEMENT

AQUATIC LANDS EASEMENT NO. 51-073213

THIS EASEMENT is made by and between the STATE OF WASHINGTON, acting through the Department of Natural Resources (State), and CITY OF OAK HARBOR, a government entity (Grantee).

SECTION 1 GRANT AND LOCATION OF EASEMENT

1.1 Easement Property. State grants and conveys to Grantee a nonexclusive easement for a term of years (the Easement) over, upon, and under the property described in Exhibit A (the Easement Property).

1.2 Rights of Third Parties. This Easement is subject to all valid interests of third parties noted in the records of Island County, or on file in the office of the Commissioner of Public Lands, Olympia, Washington; rights of the public under the Public Trust Doctrine or the federal navigation servitude; and treaty rights of Indian Tribes. Not included in this Easement are any right to harvest or collect any natural resource, including aquatic life or living plants, any water rights, or any mineral rights, including any right to excavate or withdraw sand, gravel or other valuable materials. State reserves the right to grant easements and other land uses on the Easement Property to others when the easement or other land uses will not unreasonably interfere with Grantee's Permitted Use.

1.3 Inspection. State makes no representation regarding the condition of the Easement Property, improvements located on the Easement Property, the suitability of the Easement Property for Grantee's Permitted Use, compliance with governmental laws and regulations, availability of utility rights, access to the Easement Property or the existence of hazardous substances on the Easement Property. Grantee has inspected the Easement Property and accepts it "AS IS."

1.4 Surveys, Maps, and Plans. In executing this Easement, State is relying upon the surveys, plats, diagrams, and/or legal descriptions provided by Grantee. Grantee is not relying upon and State is not making any representations about any surveys, plats, diagrams, and/or legal descriptions provided by State.

SECTION 2 USE OF EASEMENT

2.1 Permitted Use. This Easement is granted for the purpose of and is limited to constructing, installing, operating, maintaining, and repairing the outfall pipeline shown in Exhibit A ("Permitted Use") and Exhibit B, ("Plan of Operations"). No modification to the permitted use shall be allowed without State's prior written consent. Any modification to the improvements approved under this subsection shall only be undertaken after complying with Sections 6 and 13. The outfall, and associated facilities that make use of the outfall, shall be constructed and operated in accordance with the provisions of the Plan of Operations contained in Exhibit B.

2.2 Restrictions on Use. Grantee shall not cause or permit any damage to natural resources on or adjacent to the Easement Property. Grantee shall also not cause or permit any filling activity to occur on the Easement Property. This prohibition includes any deposit of rock, earth, ballast, refuse, garbage, waste matter (including chemical, biological or toxic wastes), hydrocarbons, any other pollutants, or other matter in, on, or adjacent to the Easement Property, except as approved in writing by State or pursuant to discharges made in full compliance with a valid NPDES permit. Grantee shall neither commit nor allow waste to be committed to, on, or adjacent to the Easement Property. If Grantee fails to comply with all or any of the restrictions on use set out in this Subsection 2.2, State may terminate this Easement in accordance with Section 12 and, at State's discretion, may take any steps reasonably necessary to remedy such failure. Upon demand by State, Grantee shall pay all costs of such remedial action, including but not limited to the costs of removing and disposing of any material deposited improperly in, on, or adjacent to the Easement Property. This section shall not in any way limit Grantee's liability under Section 8, below.

2.3 Conformance with Laws. Grantee shall, at all times, keep current and comply with all conditions and terms of any permits, licenses, certificates, regulations, ordinances, statutes, and other government rules and regulations regarding its use or occupancy of the Easement Property. This includes, but is not limited to, all state and federal laws, regulations, order or permits governing the construction, operation, repair and maintenance of the outfall pipeline shown in Exhibit A.

2.4 Liens and Encumbrances. Grantee shall keep the Easement Property free and clear of any liens and encumbrances arising out of or relating to its use or occupancy of the Easement Property.

2.5 Amendment upon Change of Permit Status. This Easement is granted in reliance upon Grantee's agreement to operate an outfall in substantially the same manner as described in the regulatory permits it has obtained as of the date this Easement was executed, and in full compliance with those permits. State reserves the right to amend the terms and conditions of this easement in those cases where any regulatory permit (including, but not limited to, any National Pollutant Discharge Elimination Systems (NPDES) Permit, Hydraulic Project Approval, U.S. Army Corps of Engineers Section 404 Permit, or Shoreline Substantial Development Permit) is modified in any manner that affects the performance of any obligation or covenant under this Easement. This right to amend the Easement shall expressly include those circumstances where the permit is modified to allow for a change in the manner in which the outfall is operated, or a change in the type, quality, or quantity of effluent being discharged. State similarly reserves the right to amend this Easement where Grantee fails to operate in conformance with its permits and where such failure could affect the lands and natural resources associated with the Easement area and any adjacent state lands or natural resources. This right to amend the Easement shall operate independent of any right to terminate the Easement pursuant to Section 12 or any other provision of this Easement. In the event that Grantee disagrees with any amendments that are required by State under this Subsection, Grantee's sole option shall be to request that the Easement be terminated upon sixty days written notice. In the event that the Easement is terminated under these circumstances, Grantee shall be allowed a pro rata reduction in any fees paid under Subsection 4.1 for the remaining unused Term, with the exception that no refund of any fees shall be provided if the outfall is allowed to remain in place pursuant to the provisions of Subsection 13.4.

SECTION 3 TERM

3.1 Term Defined. The term of this Easement is Thirty (30) years (the "Term"), beginning on the 1st day of January, 2000 (the "Commencement Date"), and ending on the 31st day of Decemaber, 2030, (the "Termination Date"), unless renewed pursuant to subsection 3.2 or terminated sooner under the terms of this Easement.

3.2 Renewal of the Easement. No interim renewals are contemplated. Grantee may apply for a new easement prior to, or upon expiration of this easement. Any renewal application will be evaluated using the statutes, guidelines and policies utilized by State at the time the application is being reviewed in conjunction with the provisions of Subsection 3.3.

3.3 Development of Disposal Alternatives. Grantee acknowledges that it is State's goal to reduce the reliance on the receiving waters of Washington State for the disposal of waste effluent, stormwater and other discharges, and to promote water re-use. Any renewal of this easement shall be dependent upon Grantee's satisfactory progress towards the implementation of reasonably practical disposal alternatives that abate the effect of the pollution constituents on state-owned aquatic lands and their associated biological communities. To assure that such progress is made during the Term of this Easement, Grantee shall submit a written report at the time of application to renew the NPDES Permit, or every five (5) years, whichever is sooner. The report will identify: (1) activities undertaken since the previous report to reduce discharges as well as efforts to decrease chemical, biological and physical impacts to state-owned aquatic lands and their associated biological communities; and (2) current and future plans, including funding, for reducing discharges and decreasing chemical, biological and physical impacts to state-owned aquatic lands and their associated biological communities. In any request for renewal, if Grantee has not provided evidence satisfactory to State, that it is making progress towards disposal alternatives that abate pollution impacts, the State may require

Grantee to undertake a thorough investigation and analysis of reasonably practical disposal alternatives to the Permitted Use. If such review is required, it shall be completed prior to any renewal of this Easement. In the alternative, State may rely on its own alternatives analysis in accordance with WAC 332-30-122 and such other regulations as State has or may promulgate. Grantee acknowledges that State's obligation to renew this Easement pursuant to Subsection 3.2 is contingent upon compliance with this Subsection 3.3, and that State is under no obligation to issue a new Easement after all renewal periods specified in Subsection 3.2 have elapsed. Grantee acknowledges that the processing of any renewal application submitted pursuant to Subsection 3.2 is contingent upon compliance with this Subsection 3.3, and that State is under no obligation to issue a new Easement. Grantee further acknowledges that a failure to anticipate and conduct the disposal alternatives investigation and analysis may delay or prevent renewal of this Easement.

3.4 Delay in Delivery of Possession. If State, for any reason whatsoever, cannot deliver possession of the Easement Property to Grantee on the Commencement Date, this Easement shall not be void or voidable, nor shall State be liable to Grantee for any loss or damage resulting from the delay in delivery of possession. In such event, the date of delivery of possession shall be the Commencement Date for all purposes, including the payment of any Use Fee. In the event Grantee takes possession before the Commencement Date, the date of possession shall be the Commencement Date for all purposes, including the payment of any Use Fee. If the Easement Term commences earlier or later than the scheduled Commencement Date, the Termination Date shall be adjusted accordingly.

3.5 End of Term. Upon the expiration or termination of this Easement, Grantee shall surrender the Easement Property to State in the same or better condition as on the Commencement Date.

SECTION 4 USE FEE

4.1 Fee. Pursuant to RCW 79.90.470 and RCW 79.90.575, so long as the Permitted Use is consistent with the purposes of RCW 79.90.450 through RCW 79.90.460 and does not obstruct navigation or other public uses of Crescent Harbor and its surrounding waters, this use is Granted to government owned public utilities for the cost of administrative fees associated with the processing of the application and document, plus the cost of administrative fees associated with the processing of any future application made with respect to this easement for the term specified in Section 3.1 (Term Defined). The use fee specified pursuant to RCW 79.90.575 shall be paid upon execution of this easement. Any administrative fees shall be paid within thirty (30) days after a bill is submitted to Grantee. Nothing in this subsection shall preclude State's ability to charge Grantee a fee for any impacts to natural resources on or adjacent to the Easement Property that are directly or indirectly associated with the Permitted Use or Grantee's use or occupation of the Easement Property.

4.2 Payment Place. Payment for any annual Use Fee or other sum payable to State under the terms of this agreement is to be made to State at the following address:

DEPARTMENT OF NATURAL RESOURCES
Financial Management Division
1111 Washington St SE
PO Box 47041
Olympia, WA 98504-7041

4.3 Late Charges and Interest. If any Use Fee or sum payable to State under the terms of this Easement is not received by State within ten (10) days of the date due, Grantee shall pay to State a late charge equal to four percent (4%) of the amount of the payment or Fifty Dollars ($50), whichever is greater, to defray the overhead expenses of State as a result of the delay. If any Use Fee is not paid within thirty (30) days of the date due, then Grantee shall, in addition to paying the late charges established above, pay interest on the amount outstanding at the rate of one percent (1%) per month until paid.

4.4 No Accord and Satisfaction. If Grantee pays, or State otherwise receives, an amount less than the full amount then due, State may apply such payment as it elects. In the absence of an election, the payment or receipt shall be applied first to accrued taxes which State has advanced or may be obligated to pay, then to other amounts advanced by State, then to late charges and accrued interest, and then to the earliest Use Fee due. State may accept any payment in any amount without prejudice to State's right to recover the balance of the Use Fee or pursue any other right or remedy. No endorsement or statement on any check, any payment, or any letter accompanying any check or payment shall constitute or be construed as accord and satisfaction.

4.5 No Counterclaim, Setoff, or Abatement of Use Fee. Except as expressly set forth elsewhere in this Easement, the Use Fee and all other sums payable by Grantee pursuant to this Easement shall be paid without the requirement that State provide prior notice or demand, and shall not be subject to any counterclaim, setoff, deduction, defense or abatement.

SECTION 5 COORDINATION OF ACTIVITIES

Grantee shall coordinate the dates of its construction and other major activities on the Easement Property with State. Except in the case of an emergency, Grantee shall provide State with written notice of its intent to enter upon the Easement Property at least five (5) days prior to entry.

SECTION 6 MAINTENANCE AND REPAIR OF EASEMENT AND IMPROVEMENTS

During the term of this Easement, Grantee shall maintain the outfall pipeline, and any other Improvements on the Easement Property, in good condition and working order. Subject to the limitations in Section 13, Grantee shall promptly repair, at its sole cost, all damages to any improvements on the Easement Property, or to any natural resources on or adjacent to the Easement Property, which are caused by Grantee's activities. All work performed by Grantee shall be completed in a careful and workmanlike manner to State's satisfaction, free of any claims or liens. Upon completion of any work performed by Grantee, Grantee shall remove all debris and restore the Easement Property, as nearly as possible, to the condition it was in prior to commencement of the work. Pursuant to Section 13 of this Easement, State's prior written consent and approval shall be required prior to undertaking any significant work within the Easement Property, but shall not be required for any routine maintenance or repair of improvements made by the Grantee pursuant to its obligation to maintain the Easement Property in good order and repair. Exhibit B describes the routine maintenance that does not require State's prior consent. In the event of an Emergency, Grantee may take reasonable steps to abate the emergent event, but shall promptly notify State in writing of the actions it has taken and that it proposes to take thereafter. Once the immediate emergency is under control, any further work shall require State's prior written consent in accordance with the provisions of this Easement.

SECTION 7 INTERFERENCE WITH OTHER USES OF EASEMENT PROPERTY

Grantee shall exercise its rights under this Easement so as to minimize and avoid, to the fullest extent reasonably possible, interference with State's use of the Easement Property or with the public's right to use Crescent Harbor and its associated waters for purposes of recreation, navigation, or commerce including rights under the Public Trust Doctrine. Any improvements constructed by Grantee on the Easement Property shall be placed and constructed so as to allow, to the fullest extent reasonably possible, unobstructed movement through the water column in the Easement Property. Grantee shall also mark or record the location of the Permitted Use and any related improvements in such locations and with such publications as are necessary to give reasonable notice to the public of the existence of any hazards associated with the improvements, and the location and limitations, if any, of the improvements. The signs and notices shall identify the type of installation (e.g., an outfall pipe) and shall identify Grantee as the person responsible for the Permitted Use and its maintenance.

SECTION 8 ENVIRONMENTAL LIABILITY/RISK ALLOCATION

8.1 Definition. "Hazardous Substance" means any substance which now or in the future becomes defined or regulated under any federal, state, or local statute, ordinance, rule, regulation, or other law relating to human health, environmental protection, contamination or cleanup, including, but not limited to, the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), 42 U.S.C. 9601 *et seq.*, and Washington's Model Toxics Control Act (MTCA), RCW 70.105D.010 *et seq.*

8.2 Use of Hazardous Substances. Grantee covenants and agrees that Hazardous Substances will not be used, stored, generated, processed, transported, handled, released, or disposed of on, in, under, or above the Easement Property, except in accordance and compliance with all applicable laws, permits or licenses.

8.3 Current Conditions, Duty of Utmost Care, and Duty to Investigate.

(a) With regard to any Hazardous Substances that may exist in, on, under, or above the Easement Property, State disclaims any and all responsibility to conduct investigations, to review any State records, documents or files, or to obtain or supply any information to Grantee.

(b) Grantee shall exercise the utmost care with respect to both Hazardous Substances in, on, under, or above the Easement Property as of the Commencement Date, and any Hazardous Substances that come to be located in, on, under, or above the Easement Property during the Term of this agreement, along with the foreseeable acts or omissions of third parties affecting those Hazardous Substances, and the foreseeable consequences of those acts or omissions. The obligation to exercise utmost care under this Subsection 8.3 includes, but is not limited to, the following requirements:

(1) Grantee shall not undertake activities that will cause, contribute to, or exacerbate contamination of the Easement Property;

(2) Grantee shall not undertake activities that damage or interfere with the operation of remedial or restoration activities on the Easement Property or undertake activities that result in human or environmental exposure to contaminated sediments on the Easement Property;

(3) Grantee shall not undertake any activities that result in the mechanical or chemical disturbance of on-site habitat mitigation;

(4) If requested, Grantee shall allow reasonable access to the Easement Property by employees and authorized agents of the Environmental Protection Agency, the Washington State Department of Ecology, or other similar environmental agencies; and

(5) If requested, Grantee shall allow reasonable access to potentially liable or responsible parties who are the subject of an order or consent decree which requires access to the Easement Property. Grantee's obligation to provide access to potentially liable or responsible parties may be conditioned upon the negotiation of an access agreement with such parties, provided that such agreement shall not be unreasonably withheld.

(c) It shall be Grantee's obligation to gather sufficient information concerning the Easement Property and the existence, scope, and location of any Hazardous Substances on the Easement Property, or adjoining the Easement Property, that allows Grantee to effectively meet its obligations under this easement. The standard of care required of Grantee by this Subsection 8.3 shall be that required of a person with actual knowledge of the presence of Hazardous Substances, whether or not Grantee had such actual knowledge.

8.4 Notification and Reporting.

(a) Grantee shall immediately notify State if Grantee becomes aware of any of the following:

(1) A release or threatened release of Hazardous Substances in, on, under, or above the Easement Property, any adjoining property, or any other property subject to use by Grantee in conjunction with its use of the Easement Property;

(2) Any problem or liability related to, or derived from, the presence of any Hazardous Substance in, on, under, or above the Easement Property, any adjoining property, or any other property subject to use by Tenant in conjunction with its use of the Easement Property;

(3) Any actual or alleged violation of any federal, state, or local statute, ordinance, rule, regulation, or other law pertaining to Hazardous Substances with respect to the Easement Property, any adjoining property, or any other property subject to use by Grantee in conjunction with its use of the Easement Property;

(4) Any lien or action with respect to any of the foregoing; or,

(5) Any notification from the US Environmental Protection Agency (EPA) or the Washington State Department of Ecology (DOE) that remediation or removal of Hazardous Substances is or may be required at the Easement Property.

8.5 Indemnification and Burden of Proof.

(a) Notwithstanding any NPDES permit or other permit or license that authorizes the discharge or release of Hazardous Substances or other deleterious substances, Grantee shall fully indemnify, defend, and hold State harmless from and against any and all claims, demands, damages, natural resource damages, response costs, remedial costs, cleanup costs, losses, liens, liabilities, penalties, fines, lawsuits, other proceedings, costs, and expenses (including attorneys' fees and disbursements), that arise out of or are in any way related to:

(1) The use, storage, generation, processing, transportation, handling, or disposal of any Hazardous Substance by Grantee, its subgrantees, contractors, agents, employees, guests, invitees, or affiliates in, on, under, or above the Easement Property or any adjoining property during the term of this Easement or during any time when Grantee occupies or occupied the Easement Property or any adjoining property;

(2) The release or threatened release of any Hazardous Substance in, on, under, or above the Easement Property or any adjoining property, which release or threatened release occurs or occurred during the term of this Easement or during any time when Grantee occupies or occupied the Easement Property or adjoining property and as a result of:

(i) Any act or omission of Grantee, its subgrantees, contractors, agents, employees, guests, invitees, or affiliates; or,

(ii) Any foreseeable act or omission of a third party unless Grantee exercised the utmost care with respect to the foreseeable acts or omissions of the third party and the foreseeable consequences of those acts or omissions.

(3) A breach of the obligations of Subsection 8.3, above, by Grantee, its subgrantees, contractors, agents, employees, guests, invitees, or affiliates.

(b) Grantee will have use of and access to the Easement Property. Accordingly, if State seeks to impose liability under Subsection 8.5(a), State will have the initial burden of proving by a preponderance of the evidence the existence, release, or threatened release of Hazardous Substances in, on, under, or above the Easement Property or any adjoining property. Grantee shall then have the burden of proving by a preponderance of the evidence that none of the indemnification provisions apply.

8.6 Cleanup. If a release of Hazardous Substances occurs on, in, under, or above the Easement Property or other State-owned property arising out of any action or inaction described or referred to in Subsection 8.5 above, Grantee shall, at its sole expense, promptly take all actions necessary or advisable to clean up the Hazardous Substances. These actions shall include, without limitation, removal, containment and remedial actions and shall be performed in accordance with all applicable laws, rules, ordinances, and permits. Grantee shall also be solely responsible for all cleanup, administrative, and enforcement costs of governmental agencies, including natural resource damage claims. Any cleanup shall be performed in a manner approved in advance in writing by State, except that in emergency situations Grantee may take reasonable and appropriate actions without advance approval.

8.7 Sampling.

(a) As a condition of State entering into this Easement, Grantee agrees to promptly conduct the environmental investigation specified in Exhibit B (Section 8) of this document. The investigation specified in Exhibit B will be conducted in accordance with generally accepted scientific methods and principles. State shall be provided the opportunity to review and approve the sampling and analysis plan.

(b) State may conduct sampling, tests, audits, surveys, or investigations ("Tests") of the Easement Property at any time to determine the existence, scope, or effects of Hazardous Substances on the Easement Property, any adjoining property, any other property subject to use by Grantee in conjunction with its use of the Easement Property, or any natural resources. If such Tests, along with any other information, demonstrates the existence, release, or threatened release of Hazardous Substances arising out of any action, inaction, or event described or referred to in Subsection 8.5, above, Grantee shall promptly reimburse State for all costs associated with such Tests.

(c) State's ability to seek reimbursement for any Tests under this Subsection shall be conditioned upon State providing Grantee written notice of its intent to conduct any Tests at least thirty (30) calendar days prior to undertaking such Tests, unless such Tests are performed in response to an emergency situation in which case State shall only be required to give such notice as is reasonably practical.

(d) Grantee shall be entitled to obtain split samples of any Test samples obtained by State, but only if Grantee provides State with written notice requesting such samples within twenty (20) calendar days of the date Grantee is deemed to have received notice of State's intent to conduct any non-emergency Tests. The additional cost, if any, of split samples shall be borne solely by Grantee. Any additional costs State incurs by virtue of Grantee's split sampling shall be reimbursed to State within thirty (30) calendar days after a bill with documentation for such costs is sent to Grantee.

(e) Within thirty (30) calendar days of a written request (unless otherwise required pursuant to Subsection 8.4(b), above), either party to this Easement shall provide the other party with validated final data, quality assurance/quality control information, and chain of custody information, associated with any Tests of the Easement Property performed by or on behalf of State or Grantee. There is no obligation to provide any analytical summaries or expert opinion work product.

8.8 Sediment Investigation.

(a) If State has reason to believe that a release or threatened release of Hazardous Substances has occurred on the Easement Property during Grantee's occupancy, State may require Grantee to conduct a Closeout Environmental Assessment (Closeout Assessment) by providing Grantee with written notice of this requirement no later than one hundred eighty (180) calendar days prior to the Termination Date, or within ninety (90) days of any valid notice to terminate the easement earlier than originally agreed. The purpose of the Closeout Assessment shall be to determine the existence, scope, or effects of any Hazardous Substances on the Easement Property and any associated natural resources. If the initial results of the Closeout Assessment disclose the existence of Hazardous Substances that may have migrated to other property, State may require additional Closeout Assessment work to determine the existence, scope, and effect of any Hazardous Substances on adjoining property, any other property subject to use by Grantee in conjunction with its use of the Easement Property, or on any associated natural resources. The Closeout Assessment may include Sediment Sampling. Any Sediment Sampling must include those sample locations and parameters reported in Grantee's Sediment Investigation Report completed at the initiation of this Easement as well as any additional testing requirements State may require based on changes in scientific, statutory, or regulatory standards for information concerning the activities of Grantee, its subgrantees, contractors, agents, employees, guests, invitees, or affiliates.

(b) Prior to undertaking the Closeout Assessment, Grantee shall submit a proposed plan in writing for State's approval. The plan shall be provided to State within sixty (60) days of the State's notice requiring the Closeout Assessment. If State fails to respond in writing, either approving or disapproving of the proposed plan, within sixty (60) days of its receipt, the proposed plan shall be deemed approved. Grantee shall be responsible for all costs required to complete planning, sampling, analyzing, and reporting associated with the Closeout Assessment.

8.9 Reservation of Rights. The parties have agreed to allocate certain environmental risks, liabilities, and responsibilities by the terms of Section 8. With respect to those environmental liabilities covered by the indemnification provisions of Subsection 8.5, that subsection shall exclusively govern the allocation of those liabilities. With respect to any environmental risks, liabilities, or responsibilities not covered by Subsection 8.5, the parties expressly reserve and do not waive or relinquish any rights, claims, immunities, causes of action, or defenses relating to the presence, release, or threatened release of Hazardous Substances in, on, under, or above the Easement Property, any adjoining property, or any other property subject to use by Grantee in conjunction with its use of the Easement Property, that either party may have against the other under federal, state, or local laws, including but not limited to, CERCLA, MTCA, and the common law. No right, claim, immunity, or defense either party may have against third parties is affected by this Easement and the parties expressly reserve all such rights, claims, immunities, and defenses. The allocations of risks, liabilities, and responsibilities set forth above do not release either party from, or affect either party's liability for, claims or actions by federal, state, or local regulatory agencies concerning Hazardous Substances.

SECTION 9 NATURAL RESOURCE DAMAGES

9.1 Impacts to Natural Resources. In accordance with Subsection 2.2, Grantee's use or occupation of the Easement Property must be undertaken in a manner that will not result in any damage to natural resources on or adjacent to the Easement Property. In the event that Grantee's use or occupation of the Easement Property results in damage to natural resources, Grantee shall be in default of this Easement agreement and State may exercise its right to terminate the Easement pursuant to Section 12 of this agreement in addition to any other remedies available to State under Sections 8 and 9 of this agreement or at law or in equity.

9.2 Mitigation for Unanticipated or Excessive Natural Resource Damages. Grantee agrees that if any natural resources are lost or damaged as a direct or indirect result of the Permitted Use, then Grantee shall be required to undertake the following steps:

(a) Grantee shall be required to prepare and implement a written plan for eliminating or minimizing any future impacts that is satisfactory to State;

(b) To the extent that it is not possible to avoid impacts, Grantee shall be required to prepare and implement a plan for the replacement of any lost or damaged natural resource values that is satisfactory to the State;

(c) Grantee shall be required to prepare and implement a written plan for monitoring and reporting on the implementation of all actions required under Subsections 9.2(a) and (b) that is satisfactory to State.

(d) To the extent that lost resource values cannot be replaced, or continue to be damaged, Grantee shall pay State for the value of the lost or damaged resource values. In the event the parties to this Agreement cannot agree upon any measure of damages, a three-member panel of appraisers shall be appointed, consisting of natural resource economists. One member shall be appointed by and at the cost of State, one member by and at the cost of Grantee, and the third member by mutual agreement of the first two panel members with the cost to be borne equally by State and Grantee.

The decision of a majority of the members of the panel shall be made based upon generally accepted valuation principles utilized by natural resource damage trustees in Comprehensive Environmental Response, Compensation, and Liability Act and Model Toxic Control Act proceedings. The decision shall be binding on the parties to this Agreement.

9.3 **Indemnification.** Notwithstanding any mitigation plan, any regulatory permits or licenses authorizing discharges, or any other provision in this Agreement (including subsection 2.1), Grantee shall indemnify, defend, and hold the State harmless from all claims for damages to, or the loss of, natural resource values that are made against the State as a direct or indirect result of Grantee's Permitted Use, including all resource claims brought by Indian tribes, other federal, state, or local agencies, or members of the public. No damages or fees paid by Grantee to State under any other provision of this Agreement shall be allowed as a setoff against Grantee's obligations under this Subsection 9.5 to indemnify, defend, and hold the State harmless against the claims of third parties.

SECTION 10 REPORTING

Grantee shall, at State's request, provide State with copies of all reports, studies, or audits which pertain to environmental problems and concerns associated with the Easement Property, and which are or were prepared by or for Grantee and submitted to any federal, state, or local authorities as required by any federal, state, or local permit, license, or law. These permits include, but are not limited to, any National Pollution Discharge and Elimination System Permit, any Army Corps of Engineers permit, any State Hydraulics Permit, any State Water Quality Certification, or Substantial Development Permit.

SECTION 11 PRESERVATION OF SURVEY CORNERS

Grantee shall exercise the utmost care to ensure that all legal land subdivision survey corners and witness objects are preserved. If any survey corners or witness objects are destroyed or disturbed, Grantee shall reestablish them by a registered professional engineer or licensed land surveyor in accordance with U.S. General Land Office standards, at Grantee's own expense. Corners and/or witness objects that must necessarily be disturbed or destroyed in the process of construction of improvements must be adequately referenced and/or replaced in accordance with all applicable laws and regulations in force at the time, including but not limited to, Chapter 58.24 RCW. The references must be approved by State prior to removal of the survey corners and/or witness objects.

SECTION 12 TERMINATION OF EASEMENT

This Easement shall terminate if Grantee receives notice from State that Grantee is in breach of this Easement and Grantee fails to cure that breach within sixty (60) days of State's notice. If the breach is not reasonably capable of being cured within the sixty (60) days, Grantee shall commence the cure within the sixty (60) day period and continue the cure with diligence until completion. In addition to terminating this Easement, State shall have any other remedy available to it. State's failure to exercise its right to terminate at any time shall not waive State's right to terminate for any future breach. If Grantee ceases to use the Easement Property for the purposes set forth in this Easement for a period of five (5) successive years, this Easement shall terminate without further action by State and Grantee's rights shall revert to State. This Easement may also terminate if Grantee provides State with sixty (60) days written notice of its intent to terminate the Easement, in a form satisfactory to State. Any obligations of Grantee which are not fully performed upon termination of this Easement shall not cease, but shall continue as obligations until fully performed.

SECTION 13 OWNERSHIP AND REMOVAL OF IMPROVEMENTS AND EQUIPMENT

13.1 Existing Improvements. On the Commencement Date, the following improvements are located on the Easement Property: 18" outfall pipe and a 184 foot long diffuser. These improvements are not owned by State "Existing Improvements".

13.2 Grantee-Owned Improvements. So long as this Easement remains in effect, Grantee shall retain ownership of all improvements and trade fixtures it may place on the Easement Property in accordance with Subsection 2.1 (collectively Grantee-Owned Improvements as more fully described in Exhibits A and B). Grantee-Owned Improvements shall not include any construction, reconstruction, alteration, or addition to any Unauthorized Improvements as defined in Subsection 13.5 below. No Grantee-Owned Improvements shall be placed on the Easement Property without State's prior written consent.

13.3 Construction. Prior to any construction, alteration, replacement, removal or major repair of any improvements (whether State-Owned or Grantee-Owned), Grantee shall submit to State plans and specifications which describe the proposed activity. A "major repair" or an "alteration" shall be defined as any work performed within the Easement Property that substantially changes the configuration or location of any Improvement or that may result in substantial adverse impacts to the environment. State shall have sixty (60) days in which to review the proposed plans and specifications. The plans and specifications shall be deemed approved unless State notifies Grantee otherwise within the sixty (60) days. Upon completion of construction, Grantee shall promptly provide State with as-built plans and specifications. Routine maintenance and emergency maintenance activities shall be undertaken in accordance with the provisions of Section 6.

13.4 Removal. Upon the termination of this Easement without any renewal, Grantee shall remove or retire any improvements located upon the Easement Property in accordance with the provisions of this Subsection and shall restore the Easement Property to a condition substantially similar to its natural state prior to the construction and operation of the outfall.

(a) Notification. Prior to, or within one hundred eighty (180) days after, the Termination Date, State shall notify Grantee in writing whether it intends to require the removal of the improvements or whether the improvements shall be abandoned in place. In the event State fails to provide any notice of its intent, Grantee shall remove the improvements in accordance with the provisions of this Subsection.

(b) Removal. In those cases where the improvements shall be removed, Grantee agrees to provide a written plan, to be approved in writing by State, for the removal of the improvements and for the restoration of the Easement Property. The plan shall identify a timeline for removal and restoration, shall identify any impacts to the Easement Property, associated natural resources, or surrounding lands and resources, and shall identify any measures needed to restore the Easement Property. In those cases where State determines that the proposed removal would disrupt existing state lands or natural resources and would be detrimental to the long term use and management of the state's lands and resources, State may notify Grantee that the improvements must be abandoned in place in accordance with the provisions of this Subsection.

(c) Abandonment. In those cases where the improvements shall be abandoned in place, Grantee agrees to provide a written plan, to be approved in writing by State, for abandonment and restoration. The plan shall identify a timeline for abandonment and restoration, shall identify the location of the improvements, shall propose a suitable means for plugging any abandoned pipelines, shall identify the means for notifying the public of the existence of any abandoned improvements, and shall identify any measures needed to restore the Easement Property. In those cases where State determines that the proposed abandonment would be detrimental to the long-term use and management of the state's lands and resources, State may notify Grantee that the improvements must be removed in accordance with the provisions of this Subsection.

(d) Plans for Removal or Abandonment. Grantee shall provide the plan for removal or abandonment within ninety (90) days after the actual or deemed notification of state's removal or abandonment requirement is provided. State shall then have ninety (90) days in which to approve or reject the plan. State's failure to respond within the time allowed shall be deemed an approval of the plan.

(e) Costs to Remove or Abandon, and to Restore. Grantee agrees to undertake the removal and disposal of the improvements, or the abandonment of the improvements, and the restoration of the Easement Property, at its sole cost and expense. Grantee agrees to perform any removal and restoration activities in a prompt and expeditious manner upon approval of any plans. If Grantee fails to timely meet its obligations under this Subsection State may perform Grantee's obligations and seek reimbursement.

(f) Ownership of Abandoned Improvements. Any improvements that are allowed to be abandoned in place shall become the property of State without any payment by State.

To the extent that Grantee-Owned Improvements include items of personal property which may be removed from the Easement Property without harming the Property, or diminishing the value of the Property or the improvements, State asserts no ownership interest in these improvements unless the parties agree otherwise in writing upon termination of this Easement. Any Grantee-Owned Improvements specifically identified as personal property in Exhibit A or B shall be treated in accordance with this provision.

13.5 Unauthorized Improvements. Improvements made on the Easement Property without State's prior written consent or which are not in conformance with the plans submitted to and approved by State in Exhibit A (Unauthorized Improvements) shall immediately become the property of State, unless State elects otherwise. Regardless of ownership of Unauthorized Improvements, State may, at its option, require Grantee to sever, remove, and dispose of them, charge Grantee a Use Fee for the use of them, or both. If Grantee fails to remove an Unauthorized Improvement upon request, State may remove it and charge Grantee for the cost of removal and disposal.

SECTION 14 INDEMNITY

Grantee shall indemnify, defend, and hold harmless State, its employees, officers, and agents from any and all liability, damages (including bodily injury, personal injury and damages to land, aquatic life, and other natural resources), expenses, causes of action, suits, claims, costs, fees (including attorneys fees), penalties, or judgments, of any nature whatsoever, arising out of the use, occupation, or control of the Easement Property by Grantee, its contractors, subcontractors, invitees, agents, employees, licensees, or permittees, except as may arise solely out of the willful or negligent act of State or State's elected officials, employees, or agents. To the extent that RCW 4.24.115 applies, Grantee shall not be required to indemnify, defend, and hold State harmless from State's sole or concurrent negligence. This section shall not in any way limit Grantee's liability under Section 8 or Section 9, above.

SECTION 15 INSURANCE

15.1 Financial Security.

(a) At its own expense, Grantee shall procure and maintain a corporate surety bond or provide other financial security satisfactory to State (the "Bond") in an amount equal to Zero Dollars ($ 0.00) , which shall secure Grantee's full performance of its obligations under this Easement, with the exception of the obligations under Section 8 (Environmental Liability/Risk

Allocation) above. The Bond shall be in a form and issued by a surety company acceptable to State. State may require an adjustment in the amount of the Bond.

(b) Upon any default by Grantee in its obligations under this Easement, State may collect on the Bond to offset the liability of Grantee to State. Collection on the Bond shall not relieve Grantee of liability, shall not limit any of State's other remedies, and shall not reinstate or cure the default or prevent termination of the Easement because of the default.

15.2 Insurance. At its own expense, Grantee shall procure and maintain during the Term of this Easement, the insurance coverages and limits described in Subsections 15. 2 (a) and (b) below. This insurance shall be issued by an insurance company or companies admitted and licensed by the Insurance Commissioner to do business in the State of Washington. Insurers must have a rating of B+ or better by Best's Insurance Reports, or a comparable rating by another rating company acceptable to State. If non-admitted or non-rated carriers are used, the policies must comply with Chapter 48.15 RCW.

(a) Types of Required Insurance.

(1) Commercial General Liability Insurance. Grantee shall procure and maintain Commercial General Liability insurance covering claims for bodily injury, personal injury, or property damage arising on the Property and/or arising out of Grantee's operations. If necessary, commercial umbrella insurance covering claims for these risks shall be procured and maintained. Insurance must include liability coverage with limits not less than those specified below:

Description	
Each Occurrence	$1,000,000
General Aggregate Limit	$2,000,000

State may impose changes in the limits of liability:

(i) As a condition of approval of assignment of this Easement;

(ii) Upon any breach of Section 8, above;

(iii) Upon a material change in the condition of the Property or any improvements; or,

(v) Upon a change in the Permitted Use.

New or modified insurance coverage shall be in place within thirty (30) days after changes in the limits of liability are required by State.

(2) Property Insurance. Grantee shall procure and maintain property insurance covering all real property located on or constituting a part of the Easement Property in an amount equal to the replacement value of all improvements on the Easement Property. Such insurance may have commercially reasonable deductibles.

(3) Worker's Compensation/Employer's Liability Insurance. Grantee shall procure and maintain:

(i) State of Washington Worker's Compensation coverage, as applicable, with respect to any work by Grantee's employees on or about the Easement Property and on any improvements;

(ii) Employers Liability or "Stop Gap" insurance coverage with limits not less than those specified below. Insurance must include bodily injury coverage with limits not less than those specified below:

Each Employee By Accident	By Disease	Policy Limit By Disease
$1,000,000	$1,000,000	$1,000,000

(iii) Longshore and Harbor Worker's Act and Jones Act coverage, as applicable, with respect to any work by Grantee's employees on or about the Easement Property and on any improvements.

(4) Builder's Risk Insurance. As applicable, Grantee shall procure and maintain builder's risk insurance in an amount reasonably satisfactory to State during construction, replacement, or material alteration of the Property or improvements on the Easement Property. Coverage shall be in place until such work is completed and evidence of completion is provided to State.

(5) Business Auto Policy Insurance. As applicable, Grantee shall procure and maintain a business auto policy. The insurance must include liability coverage with limits not less than those specified below:

Description	Each Accident
Bodily Injury and Property Damage	$1,000,000

(6) Contractor's Pollution Liability. Grantee shall obtain procure and maintain contractor's pollution legal liability, including investigation and defense costs, for bodily injury and property

damage, including loss of use of damaged property or of property that has been physically damaged or destroyed. Such coverage must provide for both on-site and off-site clean-up costs, cover gradual and sudden pollution, and includes in its scope of coverage natural resource damage claims. Coverage shall be maintained in an amount of at least:

1. $1,000,000 each occurrence for contractor's operations at the site(s) identified above; and

2. If the policy contains a general aggregate limit or policy limit, it shall be at least $5,000,000.

Such insurance may be provided on an occurrence or claims-made basis. If such coverage is obtained as an endorsement to the CGL and is provided on a claims-made basis, the following additional conditions must be met:

(i) The Insurance Certificate must state that the insurer is covering hazardous substance removal.

(ii) The policy must contain no retroactive date, or the retroactive date must precede abatement services.

(iii) Coverage must be continuously maintained with the same insurance carrier through the official completion of any work on the Easement Property.

(iv) The extended reporting period (tail) must be purchased to cover a minimum of thirty six (36) months beyond completion of work.

(b) Terms of Insurance. The policies required under Subsection 15.2 shall name the State of Washington, Department of Natural Resources as an additional insured (except for State of Washington Worker's Compensation coverage, and Federal Jones' Act and Longshore and Harbor Worker's Act coverages). Furthermore, all policies of insurance described in Subsection 15.2 shall meet the following requirements:

(1) Policies shall be written as primary policies not contributing with and not in excess of coverage that State may carry;

(2) Policies shall expressly provide that such insurance may not be canceled or nonrenewed with respect to State except upon forty-five (45) days prior written notice from the insurance company to State;

(3) To the extent of State's insurable interest, property coverage shall expressly provide that all proceeds shall be paid jointly to State and Grantee;

(4) With the exception of Contractor's Pollution Liability (governed by the provisions of Subsection 15.2(a)(6)), all liability policies must provide coverage on an occurrence basis; and,

(5) Liability policies shall not include exclusions for cross liability.

(c) Proof of Insurance. Grantee shall furnish evidence of insurance in the form of a Certificate of Insurance satisfactory to the State accompanied by a checklist of coverages provided by State, executed by a duly authorized representative of each insurer showing compliance with the insurance requirements described in Section 15, and, if requested, copies of policies to State. The Certificate of Insurance shall reference the State of Washington, Department of Natural Resources and the easement number. Receipt of such certificates or policies by State does not constitute approval by State of the terms of such policies. Grantee acknowledges that the coverage requirements set forth herein are the minimum limits of insurance the Grantee must purchase to enter into this agreement. These limits may not be sufficient to cover all liability losses and related claim settlement expenses. Purchase of these limits of coverage does not relieve the Grantee from liability for losses and settlement expenses greater than these amounts.

15. 3 State's Acquisition of Insurance. If Grantee fails to procure and maintain the insurance described above within fifteen (15) days after Grantee receives a notice to comply from State, State shall have the right to procure and maintain comparable substitute insurance and to pay the premiums. Grantee shall pay to State upon demand the full amount paid by State, together with interest at the rate provided in Subsection 4.3 from the date of State's notice of the expenditure until Grantee's repayment.

15.4 Self-Insurance. Grantee warrants that it has the capacity to self insure for the risks and coverages specified in Subsection 15.2. Grantee' s obligations under Subsection 15.2 may be met by providing evidence of self-insurance that is acceptable to the State. Any evidence of Grantee's proof of self insurance by State must be obtained in writing. The decision to accept, or reject, Grantee's proof of self-insurance is within the sole discretion of State. Grantee must provide State with proof of continuing ability to provide self-insurance within thirty (30) days of any written request by State for such proof. Grantee shall also provide State with written notice within seven (7) days of any material change in it ability to self insure, or to its program of self-insurance. If Grantee elects to discontinue its program of self-insurance, or if State provides written notice withdrawing its acceptance of Grantee's proof of self-insurance, Grantee shall be subject to the requirements of Subsections 15.2 and 15.3. Grantee shall be in compliance with the requirements of Subsection 15.2 prior to exercising an election to terminate self-insurance coverage and shall comply with those requirements within thirty (30) days of receipt of any notice from State withdrawing its consent to self-insurance.

SECTION 16 TAXES AND ASSESSMENTS

Grantee shall promptly pay all taxes, assessments and other governmental charges of any kind whatsoever levied as a result of this Easement or relating to Grantee's improvements constructed pursuant to this Easement.

SECTION 17 ADVANCE BY STATE

If State advances or pays any costs or expenses for or on behalf of Grantee, including but not limited to taxes, assessments, insurance premiums, costs of removal and disposal of unauthorized materials, costs of removal and disposal of improvements, or other amounts not paid when due, Grantee shall reimburse State the amount paid and shall pay interest on such amount at the rate of one percent (1%) per month from the date State notifies Grantee of the advance or payment.

SECTION 18 NOTICE

Any notices required or permitted under this Easement may be personally delivered, delivered by facsimile machine, or mailed by certified mail, return receipt requested, to the following addresses or to such other places as the parties may direct in writing from time-to-time:

To State: DEPARTMENT OF NATURAL RESOURCES
Northwest Region
919 North Township Street
Sedro Woolley, WA 98284

To Grantee: CITY OF OAK HARBOR
865 SE Barrington Drive
Oak Harbor, WA 98277

A notice shall be deemed given and delivered upon personal delivery, upon receipt of a confirmation report if delivered by facsimile machine, or three (3) days after being mailed as set forth above, whichever is applicable.

SECTION 19 ASSIGNMENT

Grantee shall not assign its rights in the Easement or grant any rights or franchises to third parties, without State's prior written consent. State reserves the right to change the terms and conditions of this Easement upon its consent to any assignment.

SECTION 20 SUCCESSORS AND ASSIGNS

This Easement shall be binding upon and inure to the benefit of the parties, their successors and assigns.

SECTION 21 TIME IS OF THE ESSENCE

TIME IS OF THE ESSENCE as to each and every provision of this Easement.

SECTION 22 APPLICABLE LAW AND VENUE

This Easement shall be interpreted and construed in accordance with the laws of the State of Washington. Any reference to a statute shall mean that statute as presently enacted or hereafter amended or superseded. Venue for any action arising out of or in connection with this Easement shall be in the Superior Court for Thurston County, Washington.

SECTION 23 RECORDATION

Grantee shall record this Easement in the county in which the Easement Property is located, at Grantee's sole expense. Grantee shall provide State with recording information, including the date of recordation and file number. Grantee shall have thirty (30) days from the Commencement Date to comply with the requirements of this subsection. If Grantee fails to record this Easement, State may record it and Grantee shall pay the costs of recording upon State's demand.

SECTION 24 MODIFICATION

Any modification of this Easement must be in writing and signed by the parties. State shall not be bound by any oral representations or statements.

SECTION 25 MISCELLANEOUS

25.1 Authority. Grantee and the person or persons executing this Easement on behalf of Grantee represent that Grantee is qualified to do business in the State of Washington, that Grantee has full right and authority to enter into this Easement, and that each and every person signing on behalf of Grantee is authorized to do so. Upon State's request, Grantee will provide evidence satisfactory to State confirming these representations. This Easement is entered into by State pursuant to the authority granted it in Chapters 79.90 to 79.96 RCW and the Constitution of the State of Washington.

25.2 Headings. The headings used in this Easement are for convenience only and in no way define, limit, or extend the scope of this Easement or the intent of any provision.

25.3 Entire Agreement. This Easement, including the exhibits and addenda, if any, contains the entire agreement of the parties. All prior and contemporaneous agreements, promises, representations, and statements relating to this transaction or to the Easement Property, if any, are merged into this Easement.

25.4 Waiver. The waiver by State of any breach or default of any term, covenant, or condition of this Easement shall not be deemed to be a waiver of such term, covenant, or condition; of any subsequent breach or default of the same; or of any other term, covenant, or condition of this Easement.

25.5 Cumulative Remedies. The rights and remedies of State under this Easement are cumulative and in addition to all other rights and remedies afforded to State by law or equity or otherwise.

25.6 Language. The word "Grantee" as used in this Easement shall be applicable to one or more persons, as the case may be. The singular shall include the plural, and the neuter shall include the masculine and feminine. If there is more than one Grantee, their obligations shall be joint and several. The word "persons," whenever used, shall include individuals, firms, associations, and corporations.

25.7 Invalidity. If any provision of this Easement shall prove to be invalid, void, or illegal, it shall in no way affect, impair, or invalidate any other provision of this Easement.

THIS EASEMENT requires the signature of all parties and is executed as of the date of the last signature below.

CITY OF OAK HARBOR,
a government entity

Dated: ____________________, 20___

By: ______________________________
PATTY COHEN

Title: Mayor of Oak Harbor

Address: 865 SE Barrington Drive
Oak Harbor, WA 98277

STATE OF WASHINGTON
DEPARTMENT OF NATURAL RESOURCES

Dated: ____________________, 20___

By: ______________________________
DOUG SUTHERLAND

Title: Commissioner of Public Lands

Address: 1111 Washington St SE
Olympia, WA 98504-7027

Approved as to form
this 14th day of October, 2002
Michael S. Grossmann
Assistant Attorney General
State of Washington

REPRESENTATIVE ACKNOWLEDGMENT

STATE OF WASHINGTON)
) ss.
COUNTY OF________________)

I certify that I know or have satisfactory evidence that PATTY COHEN is the person who appeared before me, and said person acknowledged that she signed this instrument, on oath stated that she was authorized to execute the instrument, and acknowledged it as the Mayor of the City of Oak Harbor to be the free and voluntary act of such party for the uses and purposes mentioned in the instrument.

____

____
(Type/Print Name)
Notary Public in and for the State of Washington,
residing at: ______________________.
My Commission Expires: ______________.

STATE ACKNOWLEDGMENT

STATE OF WASHINGTON)
)ss
County of)

On this _________ day of _________________________, 20___, personally appeared before me DOUG SUTHERLAND, to me known to be the Commissioner of Public Lands of the Department of Natural Resources, State of Washington, who executed the within and foregoing instrument on behalf of the State of Washington, and acknowledged said instrument to be the free and voluntary act and deed of the State of Washington for the uses and purposes therein mentioned, and on oath stated that he was authorized to execute said instrument and that the seal affixed is the official seal of the Commissioner of Public Lands for the State of Washington.

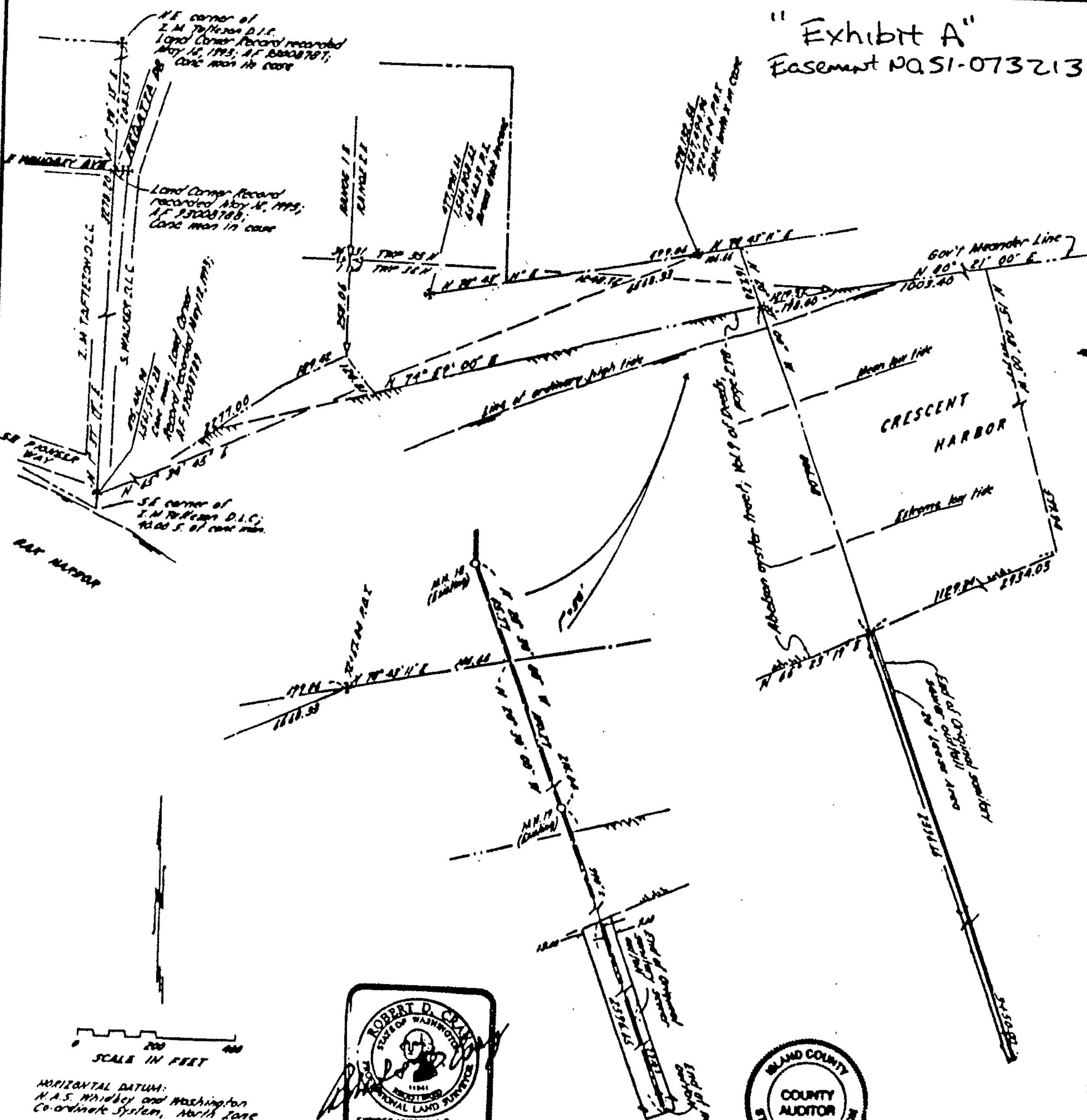
IN WITNESS WHEREOF, I have hereunto set my hand and seal the day and year first above written.

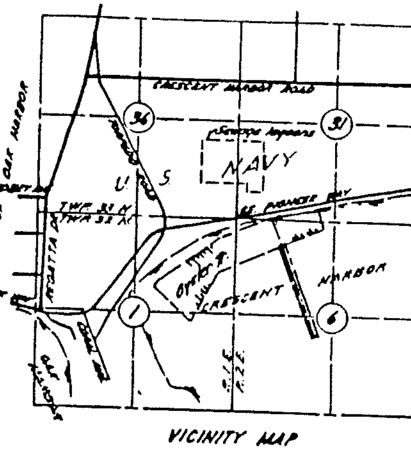
____

____

Notary Public in and for the State of Washington,
residing at ______________________________.
My appointment expires ____________________.

"Exhibit A"
Easement No 51-073213





VICINITY MAP

SEC 36, TWP 33 N, R 1 E, W.M.
SEC 31, TWP 33 N, R 2 E, W.M.
SEC 1, TWP 32 N, R 1 E, W.M.
SEC 6, TWP 32 N, R 2 E, W.M.

EQUIPMENT: TOPCON Geodetic total station (GTS-4) with retro-prisms.

METHOD: Control traverse and field locations.

LEASE AREA DESCRIPTION FOR AQUATIC LEASE 51-73213

A strip of land 20.00 feet in width in Section 6, Township 32 North, Range 2 East of the Willamette Meridian, Island County, Washington, said strip lying 13.00 feet southwesterly and 7.00 feet northeasterly of the following described centerline:

Commencing at the Northeast corner of the Z. M. Taftezon Donation Land Claim; thence

South 01° 38' 13" West along the East line thereof, a distance of 2083.54 feet to the centerline of East Whidbey Avenue; thence continuing along said East line, being also along the West line of the Samuel Walker, D.L.C.

South 01° 37' 19" West 3278.20 feet to a point which is reputed to lie 40.00 feet North of the Southeast corner of said Z.M. Taftezon D.L.C., as shown on those maps recorded November 1, 1984, under Auditor's File No. 84005043, records of Island County; thence

North 65° 34' 45" East 6568.33 feet to a point on the centerline of SE Pioneer Way, said point being a spike with X in case at P.O.T. Station 72+67.84; thence along said centerline

North 78° 43' 11" East 106.66 feet to the centerline of the sanitary sewer outfall line; thence

South 20° 30' 00" East along said outfall line, centerline, and southerly extension thereof, a distance of 3450.00 feet to the True Point of Beginning of herein described centerline; thence

North 20° 30' 00" West 2396.66 feet to the South line of the oyster tract deeded by the State of Washington to N. P. Abelson, November 20, 1909, under Application No. 4328, Volume 9 of Deeds, page 278, records of Island County, and the northerly terminus of herein described centerline.

Situate in Island County, Washington.

Containing 1.10 acres.

NOTES:

1. Horizontal control is based on U.S. Navy coordinate system as measured from U.S. Navy control Stations 65+68.33 P.I. and 72+67.84 P.O.T., as shown on engineering drawings on file with the N.A.S. Whidbey Public Works Department (Seaplane Base Horizontal and Vertical Control Map, PW Dwg. No. 81-16, Sheet 12, and 81-17, Sheet 13 of 18).
2. Vertical control is based on U.S. Navy datum as measured from "TORPEDO" (brass disk in concrete monument, Southeast of intersection of Torpedo Road and SE Pioneer Way) Elevation 6.42 feet, NGVD 29 (112.84, Navy datum = 6.42 feet + 6.42 feet, MLLW to MSL + 100.00 feet) (reference Crescent Harbor, Whidbey Island, Tidal B.M. No. 2, circa 1954, 12.77 feet NGVD 29 + 106.42 feet = 119.19 Navy datum) as shown on engineering drawings on file with the N.A.S. Whidbey Public Works Department.

ROBERT D. CRAY, STATE OF WASHINGTON, 11941, PROFESSIONAL LAND SURVEYOR, EXPIRES 12/16/03

ISLAND COUNTY, COUNTY AUDITOR, STATE OF WASHINGTON

SURVEYOR'S CERTIFICATE:

This map correctly represents a survey made by me or under my direction in conformance with the requirements of the Survey Recording Act at the request of City of Oak Harbor in July, 1987.

7/29/02 Robert D. Cray
Certificate No. 11941

AUDITOR'S CERTIFICATE:

Filed for record this 3rd day of July 2002, at 10:41 AM, in Book 12 of Surveys at Page 57 at the request of Fakkema & Kingma, Inc. under Auditor's File No. 4027034

County Auditor

MAP OF LEASE AREA FOR WASTEWATER TREATMENT PLANT EFFLUENT OUTFALL

OAK HARBOR, (FOR CITY OF OAK HARBOR) WASHINGTON

FAKKEMA & KINGMA, INC.
CONSULTING ENGINEERS & SURVEYORS

Checked by	F.G.H.	Date	12/87	F.B. No.	1-80	Scale	1" = 240'
Drawn by	EKF	Date	3/87	Dwg. by	RDC	Project No.	3131

EXHIBIT B

AQUATIC LANDS OUTFALL EASEMENT
PLAN OF OPERATIONS AND MAINTENANCE
CITY OF OAK HARBOR SEAPLANE LAGOON WWTP

EASEMENT No. 51-073213

SITE DESCTIPTION AND PRESENT USE

The Oak Harbor Seaplane Lagoon WWTP Outfall is located beneath the waters of Crescent Harbor (sub area of Puget Sound) offshore of the Crescent Harbor Marsh and adjacent NAS Whidbey Island Seaplane Base and the City of Oak Harbor, Washington. The surrounding area is primarily natural habitat owned by the Federal Government.

The original outfall for the Oak Harbor Seaplane Lagoon WWTP was installed in the early 1960's by Naval Air Station (NAS) Whidbey Island. It consisted of an 18-inch reinforced concrete pipe and extended out some 886 feet into Puget Sound, Crescent Harbor. The outfall diffuser was located in an average water depth of 15 feet.

In the late 1980's the City of Oak Harbor and NAS Whidbey Island established a contractual agreement to expand the 0.85 MGD Navy Lagoon WWTP and construct the current 2.5 MGD Oak Harbor Seaplane Lagoon WWTP and treat wastewater flows from both the Navy and the City of Oak Harbor. In 1989, to accommodate the expansion of the Seaplane Lagoon WWTP, the existing outfall was extended some 2,396 feet out into Crescent Harbor. The new outfall extension is constructed of 18 inch diameter HDPE pipe and is connected to the existing 18 inch concrete pipe with a transition piece using a "ROMAC" type coupling. The outfall carries lagoon secondary effluent from the Oak Harbor Seaplane Lagoon WWTP to discharge into Crescent Harbor, Puget Sound. The influent wastewater is comprised of primarily residential dischargers local restaurants, commercial enterprises, and a few small industrial dischargers located on NAS Whidbey Island Seaplane Base.

The City of Oak Harbor began operating the Navy's Lagoon Facility in the late 1980's and through the expansion phase. Once construction was completed of the 2.5 MGD Secondary Lagoon treatment plant in 1990, the city then became the NPDES Permit holder and all Operation & Maintenance (O&M) activities became the city's responsibility. The current Department of Ecology NPDES Waste Discharge Permit Number for the Oak Harbor Seaplane Lagoon is WA-002056-7, Outfall 002. The 2.5 MGD Oak Harbor Seaplane Lagoon WWTP includes flow measurement, debris grinders, aerated three cell lagoon process, disinfection, and effluent flow measurement, and effluent pumping. In 2004 the city repaired and modified the 1st cell lagoon process and constructed an Anaerobic Pretreatment cell to better control the accumulation of biosolids and improve treatment plant performance.

FUTURE USE AND CONDITIONS

The City of Oak Harbor intends to continue operating its Seaplane Lagoon WWTP professionally using the Best Management Practices recommended by Washington Department of Ecology, while keeping the public's interest and the Puget Sound's water quality in mind. The site has been designed as described above and any modifications to this configuration on State-Owned Aquatic Land will need to be authorized by the Washington State Department of Natural Resources in writing prior to its reconfiguaration.

REGARDING SECTIONS OF THE EASEMENT

SECTION 1 - GRANT AND LOCATION OF THE EASEMENT

1.4 Surveys, Maps, and Plans

The easement area will be further described in the legal record of survey for this easement. An as-built legal survey will be submitted to State within 90 days of completion of construction.

SECTION 2 USE OF EASEMENT

2.1 Permitted Use

Construction and operation of a municipal wastewater outfall for the discharge of treated effluent from the Oak Harbor Seaplane Lagoon WWTP. The permanent easement will be a strip of land with a width of 20 feet and a length of 2,396.65 feet long.

2.3 Conformance with Laws

Grantee will provide State with copies of all renewals, modifications, or appeals of any regulatory permits, approvals, or authorizations relating to Grantee's activities on the Property. Operation of this outfall is contingent on continued compliance with required permits.

2.5 Amendment upon Change of Permit Status

This Easement is issued based on the assumption that Grantee's activities on the Property are not likely to jeopardize the continued existence of species listed as threatened or endangered under the federal Endangered Species Act (ESA), and/or that the federal agencies responsible for administering the ESA have been consulted pursuant to Section 7(a)(2) of the Easement and Grantee's activities on the Property will comply with any terms or conditions lawfully imposed by those agencies through that ESA Section 7 consultation

SECTION 3 TERM

3.3 Development of Disposal Alternatives

Grantee will provide updated reports to Washington DNR at each renewal of its NPDES permit for the project addressing the progress made toward reducing the reliance on the receiving waters of Washington State for the disposal of waste effluent and to promote water re-use. Progress includes, but is not limited to:

- Reduction of inflow and infiltration (I & I);
- Groundwater recharge;
- The beneficial reuse of reclaimed water as authorized by RCW 90.46 (i.e. stream augmentation, industrial process supply, agricultural application);
- All other efforts related to water re-use and recycling.

SECTION 6 MAINTENANCE AND REPAIR OF EASEMENT AND IMPROVEMENTS

Maintenance defined - Washington DNR defines maintenance as those usual acts designed to prevent a decline, lapse, or cessation of the approved use and associated improvements. Maintenance does not include any expansion of the permitted use nor does it result in any substantive change from the granted use and associated improvements.

SECTION 8 ENVIRONMENTAL LIABILITY/RISK ALLOCATION

8.2 Use of Hazardous Substances

Grantee shall handle and dispose of all solid waste material to a certified disposal site to prevent entry into state ground or surface water.

8.7(a) Sediment Sampling

Grantee must conduct sediment sampling that is representative of the discharge depositional zone and in compliance with all of the Department of Ecology (Ecology) requirements and/or the Sediment Sampling and Analysis Plan Appendix[1], Sediment

[1] Ecology 2003. Sediment Sampling and Analysis Plan Appendix: Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards (Chapter 173-204 WAC). Revised April 2003.

Management Standards[2], and Sediment Source Control Standards User Manual[3]. At a minimum the following sampling events must be conducted:

- Baseline: Conducted before the outfall is commissioned
- Interim: Conducted within 5 years of commencement of effluent discharge to determine if effluent is impacting sediment
- Close-out sampling within 5 years of termination of the easement

The State will allow Grantee to adhere to a sediment-sampling schedule determined by Ecology through the NPDES permit. In the event that Ecology does not require sediment sampling that is satisfactory to the State, Grantee will be notified by State to conduct the above-mentioned sediment sampling. Grantee agrees to comply with any notification by State or Ecology to conduct initial, baseline, or continued sediment sampling.

Grantee conducted sediment sampling in May 2004 that meets the above-mentioned baseline sampling requirements and the data report was submitted to State in September 2004. This data report must also be submitted to the Department of Ecology in electronic SEDQUAL format[4].

8.8 Sediment Investigation

Refer to Exhibit C: Sediment Sampling Results Crescent Harbor Wastewater Treatment Facility Oak Harbor, Washington Data Report, September 9, 2004

SECTION 10 REPORTING

Permits - In addition to providing current copies of all regulatory permits, Grantee agrees to notify Grantor in writing of the renewal, modification, rescission, or appeal of any regulatory permits relating to the Grantee's activities on the Easement Property.

In addition to being obligated to provide State with copies of all reporting documents supplied to Ecology, Grantee agrees to notify the appropriate State Land Manager of any of the following occurrences:

- NPDES Permit Violation:
    - Including effluent exceedances, sediment quality criteria, or special conditions.
    - Notify State 30 days after completion of the Discharge Monitoring Report (DMR).
    - Notification must be in writing and include a copy of the DMR and a letter explaining the cause of the violation and detailing the steps that have been, or will be, taken to bring the facility into compliance.
- Outfall Malfunctions:

[2] Ecology 1995. Sediment Management Standards, Chapter 173-204. Amended December 1995.
[3] http://www.ecy.wa.gov/programs/tcp/smu/sediment.html
[4] Sediment Quality Information System www.ecy.wa.gov/programs/tcp/smu/sedqualfirst.htm

- Includes damages or leaks
- Notify the State within 30 days of becoming aware of the problem.
- Notification must be in writing explaining the cause of the problem detailing the steps that have been, or will be taken, to remedy the issue.

SECTION 13 OWNERSHIP AND REMOVAL OF IMPROVEMENTS AND EQUIPMENT

13.2 Grantee-Owned Improvements
The improvements proposed to be located on SOAL for the Seaplane Lagoon WWTP outfall include: The existing outfall is some 2,396 feet out into Crescent Harbor. The outfall extension is constructed of 18 inch diameter HDPE pipe and is connected to the existing 18 inch concrete pipe with a transition piece using a "ROMAC" type coupling.

13.3 Construction

All construction permits for the use defined in Section 2.1 of this document shall be in place before construction commences, with construction contingent upon continued compliance with required permits. No construction activities affecting the outfall have been identified or proposed by the Grantee. Should this circumstance change, Grantee shall provide WA DNR six (6) months notice prior to undertaking any such proposed activities.

SECTION 18 NOTICE

Personnel changes related to the Oak Harbor Seaplane Lagoon WWTP shall be conveyed to Washington DNR at the time they occur. Should either party deem it necessary, the change may lead to a meeting whereby the terms and conditions of this contract may be discussed.

Operations Contact/Plant Manager
Name: Robert Jarski
Title: PW Operations Manager
Address: City of Oak Harbor
865 SE Barrington Drive
Oak Harbor , WA 98277
Phone: (360)-679-6302
E-mail: bob.jarski@oakharbor.org

WA DNR Contact
Name: Chad Unland
Title: Land Manager
Address: DNR, Northwest Region
919 North Township Street
Sedro-Woolley, WA 98284
Phone: (360) 854-2835
E-mail: chad.unland@wadnr.gov

MITIGATION REQUIREMENTS

In the event that any regulatory permit requires the Grantee to provide mitigation on state-owned aquatic lands, Grantee shall complete an authorization to use such state owned aquatic lands prior to implementation of any required mitigation.

City of Oak Harbor
Comprehensive Sewer Plan

APPENDIX C.
NPDES PERMIT

December 2008

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Northwest Regional Office • 3190 160th Avenue SE • Bellevue, Washington [illegible]

December 16, 2004

Mr. Robert Jarski
City of Oak Harbor
Wastewater/Stormwater/Solid Waste Operations Manager
865 S.E. Barrington Drive
Oak Harbor, WA 98277

Dear Mr. Jarski:

Re: NPDES Permit #WA-002056-7
Engineering Report: RBC Wastewater Treatment
Plant Capacity Analysis

In accordance with RCW 90.48.110 and WAC 173-240-010 through 180 of the Department of Ecology, the Engineering Report Addendum titled *"RBC Wastewater Treatment Plant Capacity analysis: An Addendum to the Engineering Report for the Upgrade of the Secondary Treatment Facilities NAS/Seaplane Base, 1987"*, dated September 2004, has been reviewed and is hereby **approved**. The following recommendations made in the report will be incorporated in the next NPDES permit currently being drafted:

1. Effluent reporting parameters will be changed to $CBOD_5$ from BOD_5
2. Maximum organic loading for the plant will be set at 2,000 pounds of BOD_5 per day

Increased organic loading is approved with the understanding of the following conditions:

1. Hydraulic loading will not increase from the current rating of 0.7 MGD
2. The City of Oak Harbor shall make full use of its ability to divert flow to the Seaplane Lagoon Treatment Facility at any time effluent quality from the RBC plant is unable to meet permit limitations.

An approved copy of the document is enclosed for your records.

Nothing in this approval shall be construed as satisfying other applicable federal, state or local statutes, ordinances or regulations. This review and approval is limited to assuring compliance with the State water quality laws and regulations listed above.

For additional information, please contact Mr. Shawn McKone, Facility Manager, at the address above or telephone (425) 649-7037.

Sincerely,

Kevin C. Fitzpatrick
Water Quality Section Manager

KCF:SM:dh

cc: Richard Grodt, URS
Shawn McKone
Central Files: City of Oak Harbor WWTP, WA0020567, WQ 7.1

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
WASTE DISCHARGE PERMIT No. WA-002056-7

State of Washington
DEPARTMENT OF ECOLOGY
Northwest Regional Office
3190 160th Avenue SE
Bellevue, Washington 98008-5452

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1251 et seq.

CITY OF OAK HARBOR
865 - SE Barrington Drive
Oak Harbor, Washington 98277

Outfall: 001	Outfall: 002
Plant Location: 1501 SE City Beach Drive Oak Harbor, WA 98277	Plant Location: 60 E. Pioneer Avenue Oak Harbor, WA 98277
Water Body I.D. No.: WA-06-0010	Water Body I.D. No.: WA-06-0010
Plant Type: Rotating Biological Contactor (Secondary Treatment)	Plant Type: Aerated Lagoon with Anaerobic Pretreatment (Secondary Treatment)
Receiving Water: Oak Harbor (Class A Marine)	Receiving Water: Crescent Harbor (Class A Marine)
Discharge Location: Latitude: 48° 16' 59" N Longitude: 122° 38' 51" W	Discharge Location: Latitude: 48° 17' 18" N Longitude: 122° 36' 17" W

is authorized to discharge in accordance with the Special and General Conditions that follow.

Kevin C. Fitzpatrick
Water Quality Section Manager
Northwest Regional Office
Washington State Department of Ecology

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SPECIAL CONDITIONS

GENERAL CONDITIONS

SUMMARY OF PERMIT REPORT SUBMITTALS

Refer to the Special and General Conditions of this permit for additional submittal requirements.

Permit Section	Submittal	Frequency	First Submittal Date
S3.A.1.	Discharge Monitoring Report	Monthly	July 15, 2005
S3.A.2.	Lagoon Anaerobic Cell Process Monitoring Data	Monthly	July 15, 2005
S3.E.	Noncompliance Notification	As necessary	
S3.G.	Shellfish Protection	As necessary	
S4.B.	Plans for Maintaining Adequate Capacity	As necessary	
S4.D.	Notification of New or Altered Sources	As necessary	
S4.E.	Infiltration and Inflow Evaluation	1/permit cycle	November 26, 2009
S4.F.	Waste Load Assessment	1/year	December 31, 2005
S5.G.	Operations and Maintenance Manual	As necessary	
S6.D.	Industrial User Survey	1/year	December 31, 2005
S8.B.	Acute Toxicity Compliance Monitoring Reports – Discharge #002	quarterly	November 30, 2005 (for sampling completed by September 30, 2005)
S8.C.	Acute Toxicity Report: "Causes and Preventative Measures for Transient Events" – Discharge #002	As necessary	
S8.C.	Acute Toxicity TI/TRE Plan – Discharge #002	As necessary	
S9.A.	Chronic Toxicity Effluent Characterization with Permit Renewal Application – Discharge #002	2/permit cycle	November 26, 2009 (for winter sampling to be completed by April 30, 2009 and summer sampling to be completed by September 30, 2009)
S10.A.	Sediment Baseline Sampling and Analysis Plan – Discharge #001	1/permit cycle	May 31, 2006
S10.B.	Sediment Chemistry Analyses – Discharge #001	1/permit cycle	May 31, 2007

Permit Section	Submittal	Frequency	First Submittal Date
S11.	Outfall Evaluation – Discharge #002	1/permit cycle	November 26, 2009
G1.	Notice of Change in Authorization	As necessary	
G4.	Reporting Planned Changes	As necessary	
G5.	Engineering Report for Construction or Modification Activities	As necessary	
G7.	Application for Permit Renewal	1/permit cycle	November 26, 2009
G21.	Reporting Anticipated Noncompliance	As necessary	
G22.	Reporting Other Information	As necessary	

SPECIAL CONDITIONS

S1. DISCHARGE LIMITATIONS

A. Effluent Limitations

All discharges and activities authorized by this permit shall be consistent with the terms and conditions of this permit. The discharge of any of the following pollutants more frequently than, or at a level in excess of, that identified and authorized by this permit shall constitute a violation of the terms and conditions of this permit.

Beginning on the effective date of this permit and lasting through the expiration date, the Permittee is authorized to discharge municipal wastewater at the permitted location subject to complying with the following limitations:

EFFLUENT LIMITATIONS[a]: DISCHARGE # 001		
Parameter	**Average Monthly**	**Average Weekly**
Carbonaceous Biochemical Oxygen Demand (5-day)	25 mg/L, 146 lbs/day 85% removal of influent BOD	40 mg/L, 233 lbs/day
Total Suspended Solids	30 mg/L, 175 lbs/day 85% removal of influent TSS	45 mg/L, 263 lbs/day
Fecal Coliform Bacteria	200/100 mL	400/100 mL
pH	Daily minimum is equal to or greater than 6 and the daily maximum is less than or equal to 9.	
Parameter	**Average Monthly**	**Maximum Daily[b]**
Total Residual Chlorine[c]	0.114 mg/L	0.26 mg/L
[a] The average monthly and weekly effluent limitations are based on the arithmetic mean of the samples taken with the exception of fecal coliform, which is based on the geometric mean.		
[b] The maximum daily effluent limitation is defined as the highest allowable daily discharge. The daily discharge means the discharge of a pollutant measured during a calendar day. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For other units of measurement, the daily discharge is the average measurement of the pollutant over the day.		
[c] This effluent limit applies whenever chlorine is used in the facility. If no chlorine is used during the monitoring period enter “no discharge of chlorine” on the DMR for the period.		

EFFLUENT LIMITATIONS[a]: DISCHARGE # 002		
Parameter	**Average Monthly**	**Average Weekly**
Carbonaceous Biochemical Oxygen Demand (5-day)	25 mg/L, 521 lbs/day 85% removal of influent BOD	40 mg/L, 834 lbs/day
Total Suspended Solids	75 mg/L, 1564 lbs/day 65% removal of influent TSS	110 mg/L, 2294 lbs/day
Fecal Coliform Bacteria	200/100 mL	400/100 mL
pH	Daily minimum is equal to or greater than 6 and the daily maximum is less than or equal to 9.	
Parameter	**Average Monthly**	**Maximum Daily[b]**
Total Residual Chlorine[c]	0.5 mg/l	0.75 mg/l
Acute Toxicity	No toxicity in 1.0% Effluent	

[a] The average monthly and weekly effluent limitations are based on the arithmetic mean of the samples taken with the exception of fecal coliform, which is based on the geometric mean.

[b] The maximum daily effluent limitation is defined as the highest allowable daily discharge. The daily discharge means the discharge of a pollutant measured during a calendar day. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For other units of measurement, the daily discharge is the average measurement of the pollutant over the day.

[c] This effluent limit applies whenever chlorine is used in the facility. If no chlorine is used during the monitoring period enter "no discharge of chlorine" on the DMR for the period.

B. Mixing Zone Descriptions

Secondary treated and disinfected effluent from the RBC Plant is discharged via outfall #001 through an 1160-foot long, 18-inch corrugated steel outfall pipe. As described in the fact sheet, the outfall is equipped with a diffuser consisting of a 6-inch port that discharges vertically and an 8-inch port that discharges horizontally. The outfall terminates at a depth of -15 feet MLLW at a constricted section of Oak Harbor. The mixing zone for this discharge shall conform to the following dimensions and limitations:

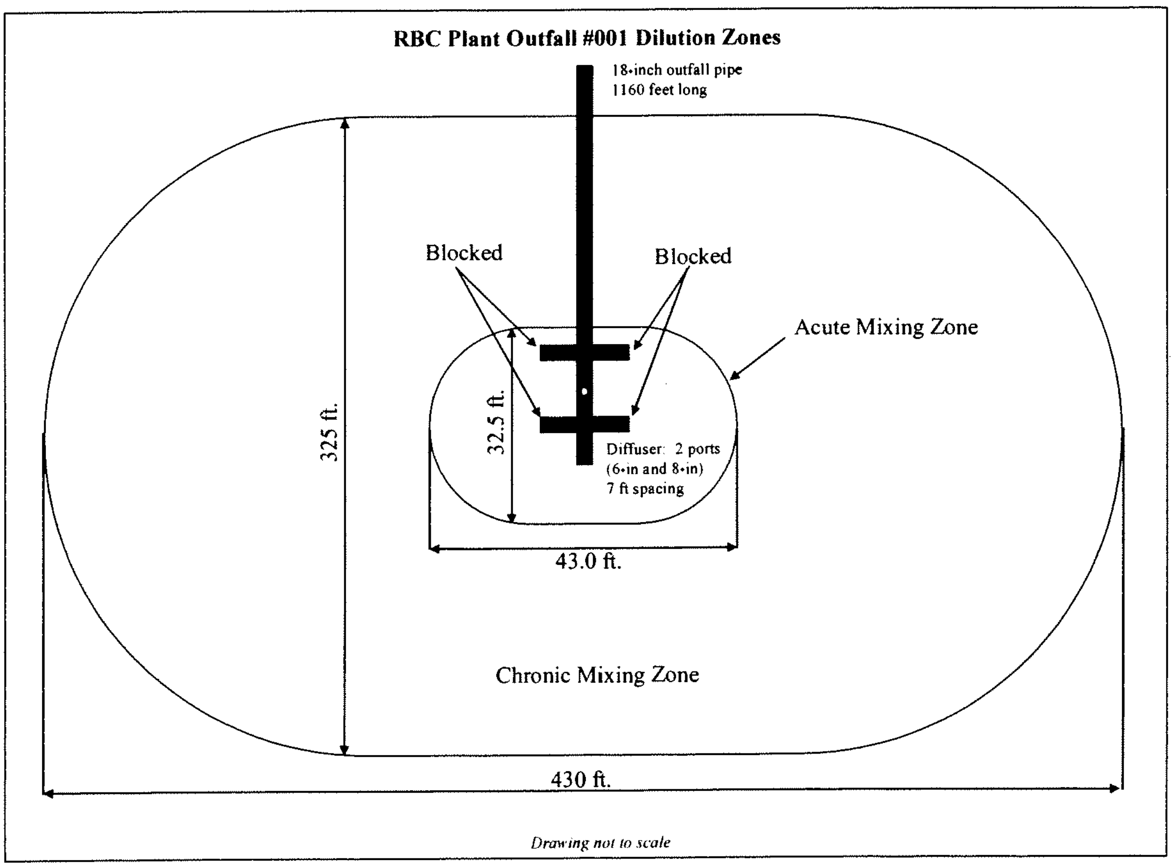
1. The acute and chronic mixing zones extend vertically from the outfall diffuser to an upper boundary at the water surface. The most restrictive upper boundary occurs at Mean Lower Low Water (MLLW).

2. The allowable zone of chronic criteria exceedance shall not occupy more than 25% of the constricted width of the water body at MLLW and shall not extend more than 200 feet plus the depth of water at MLLW from each port. For this location, the chronic mixing zone, as shown in the following illustration, will have an allowable width of 325 feet in the direction parallel to the outfall line and 430 feet in the direction perpendicular to the outfall line.

3. The allowable zone of acute criteria exceedance shall be no more than 10% of the dimensions of the chronic mixing zone. For this outfall, the acute mixing zone will be allowed a width of 32.5 feet in the direction parallel to the outfall line and 43 feet in the direction perpendicular to the outfall line.

4. The minimum dilution at the edge of the chronic criteria exceedance shall be 50:1.

5. The minimum dilution at the edge of the zone of acute criteria exceedance shall be 19:1.



Secondary treated and disinfected effluent from the Seaplane Lagoon facility is discharged via outfall #002 through a 3284-foot long, 18-inch outfall pipe. The outfall is equipped with a 184-foot long diffuser section, consisting of 24 ports with 2 ¼" diameters spaced alternately on 8-foot centers. The ports discharge horizontally at the center of the spring line of the diffuser. The outfall terminates at a depth of -44 feet MLLW in Crescent Harbor. The mixing zone for this discharge shall conform to the following dimensions and limitations:

6. The acute and chronic mixing zones extend vertically from the outfall diffuser to an upper boundary at the water surface. The most restrictive upper boundary occurs at Mean Lower Low Water (MLLW).

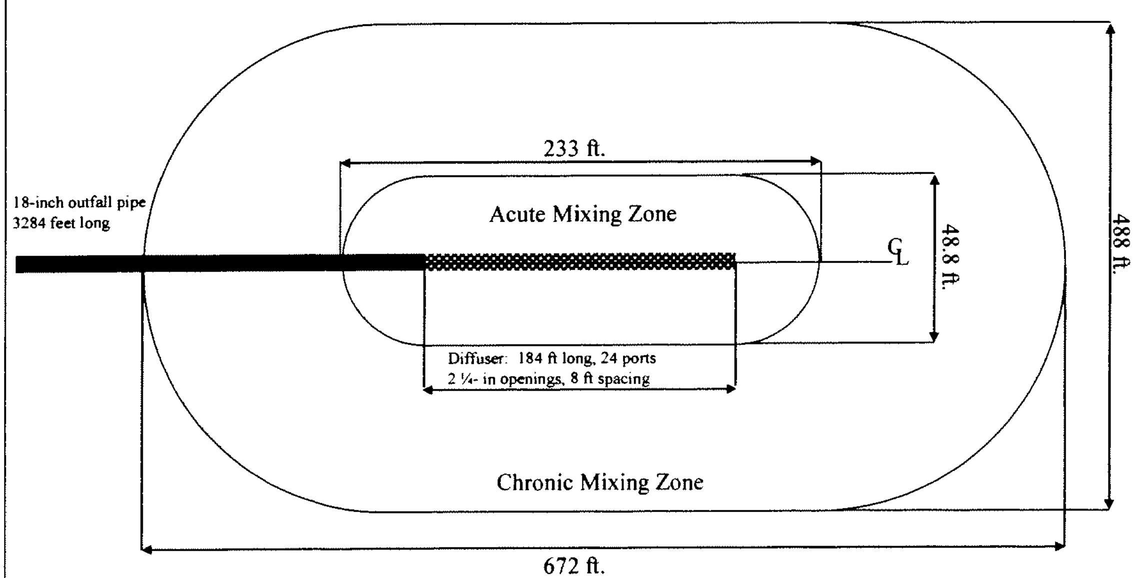
7. The allowable zone of chronic criteria exceedance shall not extend more than 200 feet plus the depth of water at MLLW from each port. For this location, the chronic mixing zone, as shown in the following illustration, will have an allowable width of 488 feet in the direction parallel to the outfall line and 672 feet in the direction perpendicular to the outfall line.

8. The allowable zone of acute criteria exceedance shall be no more than 10% of the dimensions of the chronic mixing zone. For this outfall, the acute mixing zone will be allowed a width of 233 feet in the direction parallel to the outfall line and 48.8 feet in the direction perpendicular to the outfall line.

9. The minimum dilution at the edge of the chronic criteria exceedance shall be 138:1, which equates to a Chronic Critical Effluent Concentration (CCEC) of 0.7% effluent.

10. The minimum dilution at the edge of the zone of acute criteria exceedance shall be 97:1, which equates to an Acute Critical Effluent Concentration (ACEC) of 1.0% effluent.

Lagoon Outfall #002 Dilution Zones



Drawing not to scale

S2. MONITORING REQUIREMENTS

A. Monitoring Schedule

1. The Permittee shall monitor in accordance with the following schedule for the Rotating Biological Contactor Plant, Discharge #001:

Category	Parameter	Units	Sample Point	Minimum Sampling Frequency	Sample Type
Wastewater Influent	BOD_5	mg/l	Influent	2/month	24-hr composite
"	$CBOD_5$	mg/l	Influent	2/week	24-hr composite
"	TSS	mg/l	Influent	2/week	24-hr composite
Wastewater Effluent	Flow	MGD	Effluent	Continuous	Recording
"	$CBOD_5$	mg/l	Effluent	2/week	24-hr composite
"	TSS	mg/l	Effluent	2/week	24-hr composite
"	pH	Standard Units	Effluent	Daily	Grab
"	Chlorine	mg/l	Effluent	Daily	Grab
"	Fecal Coliform	Org./100 ml	Effluent	2/week	Grab
"	Ammonia	mg/l as N	Effluent	2/year (during the period of October through February)	24-hr composite
"	Dissolved oxygen, total Kjeldahl nitrogen, NO3+NO2-N, oil & grease, total phosphorus, total dissolved solids				
		mg/l	Effluent	3/permit cycle*	
Sediment	Toxicity		Region near outfall	1/permit cycle	See Condition S10
*To be submitted with the next application for permit renewal					

2. The Permittee shall monitor in accordance with the following schedule for the Rotating Biological Contactor Plant, Discharge #002:

Category	Parameter	Units	Sample Point	Minimum Sampling Frequency	Sample Type
Wastewater Influent	BOD_5	mg/l	Influent	2/month	24-hr Composite
"	$CBOD_5$	mg/l	Influent	2/week	24-hr composite
"	TSS	mg/l	Influent	2/week	24-hr Composite
Wastewater Effluent	Flow	MGD	Effluent	Continuous	Recording
"	$CBOD_5$	mg/l	Effluent	2/week	24-hr composite
"	TSS	mg/l	Effluent	2/week	24-hr composite
"	pH	Standard Units	Effluent	Daily	Grab
"	Chlorine	mg/l	Effluent	Daily	Grab
"	Fecal Coliform	Org./ 100 ml	Effluent	2/week	Grab
"	Dissolved oxygen, total Kjeldahl nitrogen, NO3+NO2-N, oil & grease, total phosphorus, total dissolved solids				
		mg/l	Effluent	3/permit cycle*	
"	Priority pollutant scan for metals, volatile organics, acid extractables, base neutrals, cyanide, total phenolics and hardness. See EPA Application for complete list of compounds and applicable units.				
			Effluent	3/permit cycle*	
Effluent	Acute Whole Effluent Toxicity - limit compliance testing. See Section S8.A.		Effluent, prior to chlorination	1/3 months	24-hr composite
Effluent	Chronic Whole Effluent Toxicity – characterization. See Section S9.A.		Effluent, prior to chlorination	2/year in the last year of the permit.*	24-hr composite

*To be submitted with the next application for permit renewal

3. In addition to the monitoring listed above, process monitoring of the anaerobic pretreatment cell at the Lagoon Facility is required to demonstrate treatment abilities as "New or Developmental Technology." Process monitoring, according to the following schedule, will remain in effect until December 31, 2005. Monitoring data shall be submitted with monthly Discharge Monitoring Reports for Outfall #002.

Category	Parameter	Units	Sample Point	Minimum Sampling Frequency	Sample Type
Anaerobic Cell Process	$CBOD_5$	mg/l	Anaerobic Cell Overflow	1/week	24-hr composite
"	Soluble $CBOD_5$	mg/l	Anaerobic Cell Overflow	1/week	24-hr composite
"	TSS	mg/l	Anaerobic Cell Overflow	1/week	24-hr composite
"	pH	Standard Units	Anaerobic Cell Overflow	Daily	Grab
"	Alkalinity	mg/l	Anaerobic Cell Overflow	1/week	Grab
"	Dissolved Oxygen	mg/l	Anaerobic Cell Overflow	Daily	Grab

Anaerobic cell process monitoring shall also include an evaluation of odors produced by the facility. Included in this evaluation is a determination by city staff of the distance from the facility where odors are noticeable along with a record of any citizen complaints regarding odors from the lagoon area.

B. Sampling and Analytical Procedures

Samples and measurements taken to meet the requirements of this permit shall be representative of the volume and nature of the monitored parameters, including representative sampling of any unusual discharge or discharge condition, including bypasses, upsets, and maintenance-related conditions affecting effluent quality.

Sampling and analytical methods used to meet the monitoring requirements specified in this permit shall conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 CFR Part 136 or to the latest revision of *Standard Methods for the Examination of Water and Wastewater* (APHA), unless otherwise specified in this permit or approved in writing by the Department of Ecology (Department).

C. Flow Measurement

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the quantity of monitored flows. The devices shall be installed, calibrated, and maintained to ensure that the accuracy of the measurements is consistent with the accepted industry standard for that type of device. Frequency of calibration shall be in conformance with manufacturer's recommendations and at a minimum frequency of at least one calibration per year. Calibration records shall be maintained for at least three years.

D. Laboratory Accreditation

All monitoring data required by the Department shall be prepared by a laboratory registered or accredited under the provisions of, *Accreditation of Environmental Laboratories*, Chapter 173-50 WAC. Flow, temperature, settleable solids, conductivity, pH, and internal process control parameters are exempt from this requirement. Conductivity and pH shall be accredited if the laboratory must otherwise be registered or accredited. The Department exempts crops, soils, and hazardous waste data from this requirement pending accreditation of laboratories for analysis of these media.

S3. REPORTING AND RECORDKEEPING REQUIREMENTS

The Permittee shall monitor and report in accordance with the following conditions. The falsification of information submitted to the Department shall constitute a violation of the terms and conditions of this permit.

A.1. Reporting

The first monitoring period begins on the effective date of the permit. Monitoring results shall be submitted monthly. Monitoring data obtained during each monitoring period shall be summarized, reported, and submitted on a Discharge Monitoring Report (DMR) form provided, or otherwise approved, by the Department. DMR forms shall be received by the Department no later than the 15th day of the month following the completed monitoring period, unless otherwise specified in this permit. Priority pollutant analysis data shall be submitted no later than forty-five (45) days following the monitoring period. The report(s) shall be sent to the Department of Ecology, Northwest Regional Office, 3190 – 160th Avenue SE, Bellevue, Washington 98008.

All laboratory reports providing data for organic and metal parameters shall include the following information: sampling date, sample location, date of analysis, parameter name, CAS number, analytical method/number, method detection limit (MDL), laboratory practical quantitation limit (PQL), reporting units, and concentration detected.

Discharge Monitoring Report forms must be submitted monthly whether or not the facility was discharging. If there was no discharge during a given monitoring period, submit the form as required with the words "no discharge" entered in place of the monitoring results.

A.2. Process Monitoring Reporting

Reporting shall also include submittal of process monitoring data for the anaerobic pretreatment cell, as outlined in Section S2.A.3. Monitoring data shall be submitted with monthly Discharge Monitoring Reports for the Lagoon Facility. Process monitoring requirements for the anaerobic pretreatment cell expire December 31, 2005. The final submission of data will be due no later than January 15, 2006.

B. Records Retention

The Permittee shall retain records of all monitoring information for a minimum of three (3) years. Such information shall include all calibration and maintenance records and all original recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit. This period of retention shall be extended during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by the Department.

C. Recording of Results

For each measurement or sample taken, the Permittee shall record the following information: (1) the date, exact place, method, and time of sampling or measurement; (2) the individual who performed the sampling or measurement; (3) the dates the analyses were performed; (4) the individual who performed the analyses; (5) the analytical techniques or methods used; and (6) the results of all analyses.

D. Additional Monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by this permit using test procedures specified by Condition S2 of this permit, then the results of such monitoring shall be included in the calculation and reporting of the data submitted in the Permittee's DMR.

E. Noncompliance Notification

In the event the Permittee is unable to comply with any of the terms and conditions of this permit due to any cause, the Permittee shall:

1. Immediately take action to stop, contain, and cleanup unauthorized discharges or otherwise stop the noncompliance, correct the problem and, if applicable, repeat sampling and analysis of any noncompliance immediately and submit the results to the Department within thirty (30) days after becoming aware of the violation.

2. Immediately notify the Department of the failure to comply.

3. Submit a detailed, written report to the Department within thirty (30) days (five [5] days for upsets, bypasses and spills), unless requested earlier by the Department. The report shall contain a description of the noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply.

F. Maintaining a Copy of This Permit

A copy of this permit must be kept at the treatment plant and be made available upon request to the public or Ecology inspectors.

G. Reporting - Shellfish Protection

Unauthorized discharges, such as collection system overflows, plant bypasses, or failure of the disinfection system, shall be reported immediately to the Department of Ecology and the Department of Health, Shellfish Program. The Department of Ecology's Northwest Regional Office 24-hr. number is (425) 649-7000, and the Department of Health's Shellfish 24-hr. number is (360) 236-3330.

S4. FACILITY LOADING

A. Design Criteria

Flows or waste loadings of the following design criteria for the Rotating Biological Contactor treatment facility shall not be exceeded:

Average flow for the maximum month:	0.7 MGD
BOD_5 loading for maximum month:	2000 lbs/day

Flows or waste loadings of the following design criteria for the Lagoon treatment facility shall not be exceeded:

Average flow for the maximum month:	2.5 MGD
BOD_5 loading for maximum month:	4580 lbs/day
TSS loading for maximum month:	5130 lbs/day

B. Plans for Maintaining Adequate Capacity

The Permittee shall submit to the Department a plan and a schedule for continuing to maintain capacity when:

1. The actual flow or waste load reaches 85 percent of any one of the design criteria in S4.A for three consecutive months; or

2. When the projected increase would reach design capacity within five years,

whichever occurs first. If such a plan is required, it shall contain a plan and schedule for continuing to maintain capacity. The capacity as outlined in this plan must be sufficient to achieve the effluent limitations and other conditions of this permit. This plan shall address any of the following actions or any others necessary to meet the objective of maintaining capacity.

1. Analysis of the present design including the introduction of any process modifications that would establish the ability of the existing facility to achieve the effluent limits and other requirements of this permit at specific levels in excess of the existing design criteria specified in paragraph A above.

2. Reduction or elimination of excessive infiltration and inflow of uncontaminated ground and surface water into the sewer system.

3. Limitation on future sewer extensions or connections or additional waste loads.

4. Modification or expansion of facilities necessary to accommodate increased flow or waste load.

5. Reduction of industrial or commercial flows or waste loads to allow for increasing sanitary flow or waste load.

Engineering documents associated with the plan must meet the requirements of WAC 173-240-060, "Engineering Report," and be approved by the Department prior to any construction. If the Permittee intends to apply for State or Federal funding for the design or construction of a facility project, the plan must also meet the requirements of a "Facility Plan" as described in 40 CFR 35.2030. The plan shall specify any contracts, ordinances, methods for financing, or other arrangements necessary to achieve this objective.

C. Duty to Mitigate

The Permittee is required to take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment.

D. Notification of New or Altered Sources

The Permittee shall submit written notice to the Department whenever any new discharge or a substantial change in volume or character of an existing discharge into the POTW is proposed which: (1) would interfere with the operation of, or exceed the design capacity of, any portion of the POTW; (2) is not part of an approved general sewer plan or approved plans and specifications; or (3) would be subject to pretreatment standards under 40 CFR Part 403 and Section 307(b) of the Clean Water Act. This notice shall include an evaluation of the POTW's ability to adequately transport and treat the added flow and/or waste load, the quality and volume of effluent to be discharged to the POTW, and the anticipated impact on the Permittee's effluent [40 CFR 122.42(b)].

E. Infiltration and Inflow Evaluation

1. The Permittee shall prepare a report that summarizes any measurable infiltration and inflow. The report shall also include a summary of maintenance activities undertaken to correct or prevent excessive infiltration and inflow.

2. The report shall be submitted with the next application for permit renewal.

F. Waste Load Assessment

The Permittee shall conduct an annual assessment of their flow and waste load and submit a report to the Department by December 31, 2005, and annually thereafter. The report shall contain the following: an indication of compliance or noncompliance with the permit effluent limitations; a comparison between the existing and design monthly average dry weather and wet weather flows, peak flows, BOD, and total suspended solids loadings; and (except for the first report) the percentage increase in these parameters since the last annual report. The report shall also state the present and design population or population equivalent, projected population growth rate, and the estimated date upon which the design capacity is projected to be reached, according to the most restrictive of the parameters above. The interval for review and reporting may be modified if the Department determines that a different frequency is sufficient.

S5. OPERATION AND MAINTENANCE

The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems, which are installed by a Permittee only when the operation is necessary to achieve compliance with the conditions of this permit.

A. Certified Operator

An operator certified for at least a Class II plant by the state of Washington shall be in responsible charge of the day-to-day operation of the wastewater treatment plant. An operator certified for at least a Class I plant shall be in charge during all regularly scheduled shifts.

B. O & M Program

The Permittee shall institute an adequate operation and maintenance program for the entire sewage system. Maintenance records shall be maintained on all major electrical and mechanical components of the treatment plant, as well as the sewage system and pumping stations. Such records shall clearly specify the frequency and type of maintenance recommended by the manufacturer and shall show the frequency and type of maintenance performed. These maintenance records shall be available for inspection at all times.

C. Short-term Reduction

If a Permittee contemplates a reduction in the level of treatment that would cause a violation of permit discharge limitations on a short-term basis for any reason, and such reduction cannot be avoided, the Permittee shall give written notification to the Department, if possible, thirty (30) days prior to such activities, detailing the reasons for, length of time of, and the potential effects of the reduced level of treatment. This notification does not relieve the Permittee of its obligations under this permit.

D. Electrical Power Failure

The Permittee is responsible for maintaining adequate safeguards to prevent the discharge of untreated wastes or wastes not treated in accordance with the requirements of this permit during electrical power failure at the treatment plant and/or sewage lift stations either by means of alternate power sources, standby generator, or retention of inadequately treated wastes.

The Permittee shall maintain Reliability Class II (EPA 430/9-74-001) at the wastewater treatment plant, which requires a backup power source sufficient to operate all vital components and critical lighting and ventilation during peak wastewater flow conditions, except vital components used to support the secondary processes (i.e., mechanical aerators or aeration basin air compressors) need not be operable to full levels of treatment, but shall be sufficient to maintain the biota.

E. Prevent Connection of Inflow

The Permittee shall strictly enforce their sewer ordinances and not allow the connection of inflow (roof drains, foundation drains, etc.) to the sanitary sewer system.

F. Bypass Procedures

Bypass, which is the intentional diversion of waste streams from any portion of a treatment facility, is prohibited, and the Department may take enforcement action against a Permittee for bypass unless one of the following circumstances (1, 2, or 3) is applicable.

1. Bypass for essential maintenance without the potential to cause violation of permit limits or conditions.

   Bypass is authorized if it is for essential maintenance and does not have the potential to cause violations of limitations or other conditions of this permit, or adversely impact public health as determined by the Department prior to the bypass. The Permittee shall submit prior notice, if possible, at least ten (10) days before the date of the bypass.

2. Bypass which is unavoidable, unanticipated, and results in noncompliance of this permit.

   This bypass is permitted only if:

   a. Bypass is unavoidable to prevent loss of life, personal injury, or severe property damage. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.

   b. There are no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment downtime (but not if adequate backup equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance), or transport of untreated wastes to another treatment facility.

   c. The Department is properly notified of the bypass as required in Condition S3E of this permit.

3. Bypass which is anticipated and has the potential to result in noncompliance of this permit

   The Permittee shall notify the Department at least thirty (30) days before the planned date of bypass. The notice shall contain: (1) a description of the bypass and its cause; (2) an analysis of all known alternatives which would eliminate, reduce, or mitigate the need for bypassing; (3) a cost-effectiveness analysis of alternatives including comparative resource damage assessment; (4) the minimum and maximum duration of bypass under each alternative; (5) a recommendation as to the preferred alternative for conducting the bypass; (6) the projected date of bypass initiation; (7) a statement of compliance with SEPA; (8) a request for modification of water quality standards as provided for in WAC 173-201A-110, if an exceedance of any water quality standard is anticipated; and (9) steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass.

For probable construction bypasses, the need to bypass is to be identified as early in the planning process as possible. The analysis required above shall be considered during preparation of the engineering report or facilities plan and plans and specifications and shall be included to the extent practical. In cases where the probable need to bypass is determined early, continued analysis is necessary up to and including the construction period in an effort to minimize or eliminate the bypass.

The Department will consider the following prior to issuing an administrative order for this type bypass:

a. If the bypass is necessary to perform construction or maintenance-related activities essential to meet the requirements of this permit.

b. If there are feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment down time, or transport of untreated wastes to another treatment facility.

c. If the bypass is planned and scheduled to minimize adverse effects on the public and the environment.

After consideration of the above and the adverse effects of the proposed bypass and any other relevant factors, the Department will approve or deny the request. The public shall be notified and given an opportunity to comment on bypass incidents of significant duration, to the extent feasible. Approval of a request to bypass will be by administrative order issued by the Department under RCW 90.48.120.

G. Operations and Maintenance Manual

The approved Operations and Maintenance (O&M) manual shall be kept available at the treatment plant and all operators shall follow the instructions and procedures of this manual.

The O&M manual shall be reviewed by the Permittee at least annually for accuracy and updated content. Substantial changes or updates to the O&M manual shall be submitted to the Department for review and approval whenever they are incorporated into the manual.

S6. PRETREATMENT

A. General Requirements

The Permittee shall work with the Department to ensure that all commercial and industrial users of the publicly owned treatment works (POTW) are in compliance with the pretreatment regulations promulgated in 40 CFR Part 403 and any additional regulations that may be promulgated under Section 307(b) (pretreatment) and 308 (reporting) of the Federal Clean Water Act.

B. Wastewater Discharge Permit Required

The Permittee shall not allow significant industrial users (SIUs) to discharge wastewater to the Permittee's sewerage system until such user has received a wastewater discharge permit from the Department in accordance with Chapter 90.48 RCW and Chapter 173-216 WAC, as amended.

C. Identification and Reporting of Existing, New, and Proposed Industrial Users

1. The Permittee shall take continuous, routine measures to identify all existing, new, and proposed SIUs and potential significant industrial users (PSIUs) discharging or proposing to discharge to the Permittee's sewerage system (see Appendix B of fact sheet for definitions).

2. Within thirty (30) days of becoming aware of an unpermitted existing, new, or proposed industrial user who may be an SIU, the Permittee shall notify such user by registered mail that, if classified as an SIU, they shall be required to apply to the Department and obtain a State Waste Discharge Permit. A copy of this notification letter shall also be sent to the Department within this same thirty (30)-day period.

3. The Permittee shall also notify all PSIUs, as they are identified, that if their classification should change to an SIU, they shall be required to apply to the Department for a State Waste Discharge Permit within thirty (30) days of such change.

D. Annual Submittal of List of Industrial Users

The Permittee shall submit annually to the Department a list summarizing all existing and proposed SIUs and PSIUs. This list must be received by the Department by December 31 of each year of the permit.

E. Duty to Enforce Discharge Prohibitions

1. In accordance with 40 CFR 403.5(a), the Permittee shall not authorize or knowingly allow the discharge of any pollutants into its POTW which cause pass through or interference, or which otherwise violates general or specific discharge prohibitions contained in 40 CFR Part 403.5 or WAC-173-216-060.

2. The Permittee shall not authorize or knowingly allow the introduction of any of the following into their treatment works:

   a. Pollutants which create a fire or explosion hazard in the POTW (including, but not limited to waste streams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR 261.21).

   b. Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, or greater than 11.0 standard units, unless the works are specifically designed to accommodate such discharges.

   c. Solid or viscous pollutants in amounts that could cause obstruction to the flow in sewers or otherwise interfere with the operation of the POTW.

   d. Any pollutant, including oxygen-demanding pollutants, (BOD, etc.) released in a discharge at a flow rate and/or pollutant concentration which will cause interference with the POTW.

   e. Petroleum oil, nonbiodegradable cutting oil, or products of mineral origin in amounts that will cause interference or pass through.

   f. Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity which may cause acute worker health and safety problems.

   g. Heat in amounts that will inhibit biological activity in the POTW resulting in interference but in no case heat in such quantities such that the temperature at the POTW headworks exceeds 40° C (104° F) unless the Department, upon request of the Permittee, approves, in writing, alternate temperature limits.

   h. Any trucked or hauled pollutants, except at discharge points designated by the Permittee.

   i. Wastewaters prohibited to be discharged to the POTW by the Dangerous Waste Regulations (Chapter 173-303 WAC), unless authorized under the Domestic Sewage Exclusion (WAC 173-303-071).

3. All of the following are prohibited from discharge to the POTW unless approved in writing by the Department under extraordinary circumstances (such as a lack of direct discharge alternatives due to combined sewer service or the need to augment sewage flows due to septic conditions):

   a. Noncontact cooling water in significant volumes.

   b. Stormwater, and other direct inflow sources.

c. Wastewaters significantly affecting system hydraulic loading, which do not require treatment, or would not be afforded a significant degree of treatment by the system.

4. The Permittee shall notify the Department if any industrial user violates the prohibitions listed in this section.

S7. RESIDUAL SOLIDS

Residual solids include screenings, grit, scum, primary sludge, waste activated sludge, and other solid waste. The Permittee shall store and handle all residual solids in such a manner so as to prevent their entry into state ground or surface waters. The Permittee shall not discharge leachate from residual solids to state surface or ground waters.

S8. ACUTE TOXICITY – DISCHARGE #002

A. Effluent Limit for Acute Toxicity

The effluent limit for acute toxicity is no acute toxicity detected in a test concentration representing the acute critical effluent concentration (ACEC).

The ACEC means the maximum concentration of effluent during critical conditions at the boundary of the zone of acute criteria exceedance assigned pursuant to WAC 173-201A-100. The zone of acute criteria exceedance is authorized in Section S1.B of this permit. The ACEC equals 1.0 % effluent.

In the event of failure to pass the test described in Subsection B of this section for compliance with the effluent limit for acute toxicity, the Permittee is considered to be in compliance with all permit requirements for acute whole effluent toxicity as long as the requirements in Subsection C are being met to the satisfaction of the Department.

B. Monitoring for Compliance With an Effluent Limit for Acute Toxicity

The Permittee shall conduct monitoring to determine compliance with the effluent limit for acute toxicity. The acute toxicity tests shall be performed using at a minimum 100% effluent, the ACEC, and a control. Acute toxicity testing shall follow protocols, monitoring requirements, and quality assurance/quality control procedures specified in this Section. Testing shall begin within sixty (60) days of the permit effective date. A written report shall be submitted to the Department within sixty (60) days after the sample date. The percent survival in 100% effluent shall be reported along with all compliance monitoring results.

Compliance monitoring shall be conducted quarterly using each of the species and protocols listed below on a rotating basis:

1) Fathead minnow, *Pimephales promelas* (96-hour static-renewal test, method: EPA/600/4-90/027F)

2) Daphnid, *Ceriodaphnia dubia*, *Daphnia pulex*, or *Daphnia magna* (48-hour static test, method: EPA/600/4-90/027F).

The Permittee is in violation of the effluent limit for acute toxicity in Subsection A and shall immediately implement Subsection C if any acute toxicity test conducted for compliance monitoring determines a statistically significant difference in survival between the control and the ACEC using hypothesis testing at the 0.05 level of significance (Appendix H, EPA/600/4-89/001). If the difference in survival between the control and the ACEC is less than 10%, the hypothesis test shall be conducted at the 0.01 level of significance.

C. Response to Noncompliance With an Effluent Limit for Acute Toxicity

If a toxicity test conducted for compliance monitoring under Subsection B determines a statistically significant difference in response between the ACEC and the control, the Permittee shall begin additional compliance monitoring within one week from the time of receiving the test results. This additional monitoring shall be conducted weekly for four consecutive weeks using the same test and species as the failed compliance test. Testing shall be conducted using a series of at least five effluent concentrations and a control in order to be able to determine appropriate point estimates. One of these effluent concentrations shall equal the ACEC and be compared statistically to the nontoxic control in order to determine compliance with the effluent limit for acute toxicity as described in Subsection B. The discharger shall return to the original monitoring frequency in Subsection B after completion of the additional compliance monitoring.

If the Permittee believes that a test indicating noncompliance will be identified by the Department as an anomalous test result, the Permittee may notify the Department that the compliance test result might be anomalous and that the Permittee intends to take only one additional sample for toxicity testing and wait for notification from the Department before completing the additional monitoring required in this subsection. The notification to the Department shall accompany the report of the compliance test result and identify the reason for considering the compliance test result to be anomalous. The Permittee shall complete all of the additional monitoring required in this subsection as soon as possible after notification by the Department that the compliance test result was not anomalous. If the one additional sample fails to comply with the effluent limit for acute toxicity, then the Permittee shall proceed without delay to complete all of the additional monitoring required in this subsection. The one additional test result shall replace the compliance test result upon determination by the Department that the compliance test result was anomalous.

If all of the additional compliance monitoring conducted in accordance with this subsection complies with the permit limit, the Permittee shall search all pertinent and recent facility records (operating records, monitoring results, inspection records, spill reports, weather records, production records, raw material purchases, pretreatment records, etc.) and submit a report to the Department on possible causes and preventive measures for the transient toxicity event which triggered the additional compliance monitoring.

If toxicity occurs in violation of the acute toxicity limit during the additional compliance monitoring, the Permittee shall submit a Toxicity Identification/Reduction Evaluation (TI/RE) plan to the Department within sixty (60) days after the sample date. The TI/RE plan shall be based on WAC 173-205-100(2) and shall be implemented in accordance with WAC 173-205-100(3).

D. Sampling and Reporting Requirements

1. All reports for effluent characterization or compliance monitoring shall be submitted in accordance with the most recent version of Department of Ecology Publication # WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* in regards to format and content. Reports shall contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data on floppy disk for electronic entry into the Department's database, then the Permittee shall send the disk to the Department along with the test report, bench sheets, and reference toxicant results.

2. Testing shall be conducted on 24-hour composite effluent samples. Samples taken for toxicity testing shall be cooled to 4 degrees Celsius while being collected and shall be sent to the lab immediately upon completion. The lab shall begin the toxicity testing as soon as possible but no later than 36 hours after sampling was ended.

3. All samples and test solutions for toxicity testing shall have water quality measurements as specified in Department of Ecology Publication # WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* or most recent version thereof.

4. All toxicity tests shall meet quality assurance criteria and test conditions in the most recent versions of the EPA manual listed in Subsection A and the Department of Ecology Publication # WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If test results are determined to be invalid or anomalous by the Department, testing shall be repeated with freshly collected effluent.

5. Control water and dilution water shall be laboratory water meeting the requirements of the EPA manual listed in Subsection A or pristine natural water of sufficient quality for good control performance.

6. Effluent samples for whole effluent toxicity testing shall be collected just prior to the chlorination step in the treatment process.

7. The Permittee may choose to conduct a full dilution series test during compliance monitoring in order to determine dose response. In this case, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the ACEC.

E. Removal of Testing Requirement

After successful demonstration of compliance with the acute performance limit for a period of three consecutive testing years (twelve consecutive successful tests), the Permittee may request removal of the performance limit test requirement. Upon receipt of the request the Department shall review the history of testing results. If the department concurs that successful performance has been demonstrated, the limit testing requirement will be removed. The Permittee will still be required to perform characterization testing of the final effluent once on the last summer and once in the last winter prior to submission of application for permit renewal. Characterization testing shall use the same procedures established for compliance testing.

S9. CHRONIC TOXICITY – DISCHARGE #002

A. Effluent Characterization

The Permittee shall test final effluent once in the last summer and once in the last winter prior to submission of the application for permit renewal. Winter sampling shall be completed by April 30, 2009; summer sampling shall be completed by September 30, 2009. All of the chronic toxicity tests listed below shall be conducted on each sample. The results of this chronic toxicity testing shall be submitted to the Department as a part of the permit renewal application process.

The Permittee shall conduct chronic toxicity testing on a series of at least five concentrations of effluent and a control in order to be able to determine appropriate point estimates and an NOEC. This series of dilutions shall include the acute critical effluent concentration (ACEC) of 1.0% effluent and the Chronic Critical Effluent Concentration (CCEC) of 0.7% effluent. The Permittee shall compare the ACEC to the control using hypothesis testing at the 0.05 level of significance as described in Appendix H, EPA/600/4-89/001.

Chronic toxicity tests shall be conducted with the following species and the most recent version of the following protocols:

Saltwater Chronic Toxicity Test Species		Method
Topsmelt	*Atherinops affinis*	EPA/600/R-95/136
Mysid shrimp	*Holmesimysis costata* or *Mysidopsis bahia*	EPA/600/R-95/136 or EPA/600/4-91/003

The Permittee shall use the West Coast mysid (*Holmesimysis costata*) for toxicity testing unless the lab cannot obtain a sufficient quantity of a West Coast species in good condition in which case the East Coast mysid (*Mysidopsis bahia*) may be substituted.

B. Sampling and Reporting Requirements

1. All reports for effluent characterization or compliance monitoring shall be submitted in accordance with the most recent version of Department of Ecology Publication # WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* in regards to format and content. Reports shall contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data on floppy disk for electronic entry into the Department's database, then the Permittee shall send the disk to the Department along with the test report, bench sheets, and reference toxicant results.

2. Testing shall be conducted on 24-hour composite effluent samples. Samples taken for toxicity testing shall be cooled to 4 degrees Celsius while being collected and shall be sent to the lab immediately upon completion. The lab shall begin the toxicity testing as soon as possible but no later than 36 hours after sampling was ended.

3. All samples and test solutions for toxicity testing shall have water quality measurements as specified in Department of Ecology Publication # WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* or most recent version thereof.

4. All toxicity tests shall meet quality assurance criteria and test conditions in the most recent versions of the EPA manual listed in Subsection A and the Department of Ecology Publication # WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If test results are determined to be invalid or anomalous by the Department, testing shall be repeated with freshly collected effluent.

5. Control water and dilution water shall be laboratory water meeting the requirements of the EPA manual listed in Subsection A or pristine natural water of sufficient quality for good control performance.

6. Effluent samples for whole effluent toxicity testing shall be collected just prior to the chlorination step in the treatment process.

7. The Permittee may choose to conduct a full dilution series test in order to determine dose response. In this case, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the ACEC and the CCEC. The ACEC and CCEC may either substitute for the effluent concentration that is closest to it in the dilution series or be an extra effluent concentration.

8. All whole effluent toxicity tests that involve hypothesis testing and do not comply with the chronic statistical power standard of 39% as defined in WAC 173-205-020 must be repeated on a fresh sample with an increased number of replicates to increase the power.

S10. SEDIMENT MONITORING – DISCHARGE #001

A. Sediment Sampling and Analysis Plan

The Permittee shall submit to the Department for review and approval a Sediment Sampling and Analysis Plan for sediment monitoring no later than one year after permit effective date. The purpose of the plan is to characterize sediment quality in the vicinity of the Rotating Biological Contactor plant's Outfall #001. The Permittee shall follow the guidance provided in the Sediment Source Control Standards User Manual, Appendix B: Sediment Sampling and Analysis Plan (Ecology, 2003).

The Sediment Sampling and Analysis Plan shall include a minimum of 6 stations in the vicinity of the discharge.

B. Sediment Data Report

Following Department approval of the Sediment Sampling and Analysis Plan, sediments will be collected and analyzed. The Permittee shall submit to the Department a Sediment Data Report containing the results of the sediment sampling and analysis no later than 12 months after Department approval of sediment sampling and analysis plan or within 3 years after permit effective date, whichever occurs first. The Sediment Data Report shall conform with the approved Sampling and Analysis Plan. The Data Report shall include electronic copies of the sediment chemical and biological data reported in the Department's current Sediment Quality Information System (SEDQUAL) template format.

S11. OUTFALL EVALUATION – DISCHARGE #002

The Permittee shall inspect the submerged portion of the Lagoon Facility Outfall (#002) line and diffuser to document its integrity and continued function. The inspection shall evaluate the condition of the pipe material and diffuser section and determine if any ports are hindered by sediment deposition and/or marine growth. The results of the inspection shall be submitted in a brief report to the Department by December 31, 2008, together with recommendations for any needed maintenance or repairs. If conditions allow for a photographic verification, it shall be included in the report.

GENERAL CONDITIONS

G1. SIGNATORY REQUIREMENTS

All applications, reports, or information submitted to the Department shall be signed and certified.

A. All permit applications shall be signed by either a principal executive officer or a ranking elected official.

B. All reports required by this permit and other information requested by the Department shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

1. The authorization is made in writing by a person described above and submitted to the Department.

2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

C. Changes to authorization. If an authorization under paragraph B.2 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph B.2 above must be submitted to the Department prior to or together with any reports, information, or applications to be signed by an authorized representative.

D. Certification. Any person signing a document under this section shall make the following certification:

> *"I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."*

G2. RIGHT OF INSPECTION AND ENTRY

The Permittee shall allow an authorized representative of the Department, upon the presentation of credentials and such other documents as may be required by law:

A. To enter upon the premises where a discharge is located or where any records must be kept under the terms and conditions of this permit.

B. To have access to and copy - at reasonable times and at reasonable cost - any records required to be kept under the terms and conditions of this permit.

C. To inspect - at reasonable times - any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.

D. To sample or monitor - at reasonable times - any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act.

G3. PERMIT ACTIONS

This permit may be modified, revoked and reissued, or terminated either at the request of any interested person (including the Permittee) or upon the Department's initiative. However, the permit may only be modified, revoked and reissued, or terminated for the reasons specified in 40 CFR 122.62, 122.64 or WAC 173-220-150 according to the procedures of 40 CFR 124.5.

A. The following are causes for terminating this permit during its term, or for denying a permit renewal application:

1. Violation of any permit term or condition.

2. Obtaining a permit by misrepresentation or failure to disclose all relevant facts.

3. A material change in quantity or type of waste disposal.

4. A determination that the permitted activity endangers human health or the environment, or contributes to water quality standards violations and can only be regulated to acceptable levels by permit modification or termination [40 CFR Part 122.64(3)].

5. A change in any condition that requires either a temporary or permanent reduction, or elimination of any discharge or sludge use or disposal practice controlled by the permit [40 CFR Part 122.64(4)].

6. Nonpayment of fees assessed pursuant to RCW 90.48.465.

7. Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.

B. The following are causes for modification but not revocation and reissuance except when the Permittee requests or agrees:

1. A material change in the condition of the waters of the state.

2. New information not available at the time of permit issuance that would have justified the application of different permit conditions.

3. Material and substantial alterations or additions to the permitted facility or activities which occurred after this permit issuance.

4. Promulgation of new or amended standards or regulations having a direct bearing upon permit conditions, or requiring permit revision.

5. The Permittee has requested a modification based on other rationale meeting the criteria of 40 CFR Part 122.62.

6. The Department has determined that good cause exists for modification of a compliance schedule, and the modification will not violate statutory deadlines.

7. Incorporation of an approved local pretreatment program into a municipality's permit.

C. The following are causes for modification or alternatively revocation and reissuance:

1. Cause exists for termination for reasons listed in A1 through A7 of this section, and the Department determines that modification or revocation and reissuance is appropriate.

2. The Department has received notification of a proposed transfer of the permit. A permit may also be modified to reflect a transfer after the effective date of an automatic transfer (General Condition G8) but will not be revoked and reissued after the effective date of the transfer except upon the request of the new permittee.

G4. REPORTING PLANNED CHANGES

The Permittee shall, as soon as possible, but no later than sixty (60) days prior to the proposed changes, give notice to the Department of planned physical alterations or additions to the permitted facility, production increases, or process modification which will result in: 1) the permitted facility being determined to be a new source pursuant to 40 CFR 122.29(b); 2) a significant change in the nature or an increase in quantity of pollutants discharged; or 3) a significant change in the Permittee's sludge use or disposal practices. Following such notice, and the submittal of a new application or supplement to the existing application, along with required engineering plans and reports, this permit may be modified, or revoked and reissued pursuant to 40 CFR 122.62(a) to specify and limit any pollutants not previously limited. Until such modification is effective, any new or increased discharge in excess of permit limits or not specifically authorized by this permit constitutes a violation of the terms and conditions of this permit.

G5. PLAN REVIEW REQUIRED

Prior to constructing or modifying any wastewater control facilities, an engineering report and detailed plans and specifications shall be submitted to the Department for approval in accordance with Chapter 173-240 WAC. Engineering reports, plans, and specifications shall be submitted at least one hundred and eighty (180) days prior to the planned start of construction unless a shorter time is approved by Ecology. Facilities shall be constructed and operated in accordance with the approved plans.

G6. COMPLIANCE WITH OTHER LAWS AND STATUTES

Nothing in this permit shall be construed as excusing the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G7. DUTY TO REAPPLY

The Permittee shall apply for permit renewal at least 180 days prior to the specified expiration date of this permit.

G8. TRANSFER OF THIS PERMIT

In the event of any change in control or ownership of facilities from which the authorized discharge emanate, the Permittee shall notify the succeeding owner or controller of the existence of this permit by letter, a copy of which shall be forwarded to the Department.

A. Transfers by Modification

Except as provided in paragraph (B) below, this permit may be transferred by the Permittee to a new owner or operator only if this permit has been modified or revoked and reissued under 40 CFR 122.62(b)(2), or a minor modification made under 40 CFR 122.63(d), to identify the new Permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

B. Automatic Transfers

This permit may be automatically transferred to a new Permittee if:

1. The Permittee notifies the Department at least thirty (30) days in advance of the proposed transfer date.
2. The notice includes a written agreement between the existing and new Permittees containing a specific date transfer of permit responsibility, coverage, and liability between them.
3. The Department does not notify the existing Permittee and the proposed new Permittee of its intent to modify or revoke and reissue this permit. A modification under this subparagraph may also be minor modification under 40 CFR 122.63. If this notice is not received, the transfer is effective on the date specified in the written agreement.

G9. REDUCED PRODUCTION FOR COMPLIANCE

The Permittee, in order to maintain compliance with its permit, shall control production and/or all discharges upon reduction, loss, failure, or bypass of the treatment facility until the facility is restored or an alternative method of treatment is provided. This requirement applies in the situation where, among other things, the primary source of power of the treatment facility is reduced, lost, or fails.

G10. REMOVED SUBSTANCES

Collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall not be resuspended or reintroduced to the final effluent stream for discharge to state waters.

G11. DUTY TO PROVIDE INFORMATION

The Permittee shall submit to the Department, within a reasonable time, all information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee shall also submit to the Department upon request, copies of records required to be kept by this permit.

G12. OTHER REQUIREMENTS OF 40 CFR

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

G13. ADDITIONAL MONITORING

The Department may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

G14. PAYMENT OF FEES

The Permittee shall submit payment of fees associated with this permit as assessed by the Department.

G15. PENALTIES FOR VIOLATING PERMIT CONDITIONS

Any person who is found guilty of willfully violating the terms and conditions of this permit shall be deemed guilty of a crime, and upon conviction thereof shall be punished by a fine of up to ten thousand dollars ($10,000) and costs of prosecution, or by imprisonment in the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit shall incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to ten thousand dollars ($10,000) for every such violation. Each and every such violation shall be a separate and distinct offense, and in case of a continuing violation, every day's continuance shall be deemed to be a separate and distinct violation.

G16. UPSET

Definition – "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of the following paragraph are met.

A Permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:
1) an upset occurred and that the Permittee can identify the cause(s) of the upset;
2) the permitted facility was being properly operated at the time of the upset;
3) the Permittee submitted notice of the upset as required in Condition S3.E; and
4) the Permittee complied with any remedial measures required under S4.C of this permit.

In any enforcement proceeding, the Permittee seeking to establish the occurrence of an upset has the burden of proof.

G17. PROPERTY RIGHTS

This permit does not convey any property rights of any sort, or any exclusive privilege.

G18. DUTY TO COMPLY

The Permittee shall comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

G19. TOXIC POLLUTANTS

The Permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

G20. PENALTIES FOR TAMPERING

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two (2) years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this Condition, punishment shall be a fine of not more than $20,000 per day of violation, or by imprisonment of not more than four (4) years, or by both.

G21. REPORTING ANTICIPATED NONCOMPLIANCE

The Permittee shall give advance notice to the Department by submission of a new application or supplement thereto at least one hundred and eighty (180) days prior to commencement of such discharges, of any facility expansions, production increases, or other planned changes, such as process modifications, in the permitted facility or activity which may result in noncompliance with permit limits or conditions. Any maintenance of facilities, which might necessitate unavoidable interruption of operation and degradation of effluent quality, shall be scheduled during noncritical water quality periods and carried out in a manner approved by the Department.

G22. REPORTING OTHER INFORMATION

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to the Department, it shall promptly submit such facts or information.

G23. COMPLIANCE SCHEDULES

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than fourteen (14) days following each schedule date.

City of Oak Harbor

Comprehensive Sewer Plan

APPENDIX D.
WAC 173-221

December 2008

Chapter 173-221 WAC **Last Update: 11/12/87**

Discharge standards and effluent limitations for domestic wastewater facilities

WAC Sections

173-221-010
Purpose and scope.

(1) The purpose of this chapter is to implement RCW 43.21A.010, 90.48.010, and 90.52.040 by setting discharge standards which represent "all known, available, and reasonable methods" of prevention, control, and treatment for domestic wastewater facilities which discharge to waters of the state. This chapter supplements WAC 173-220-130. Guidelines or policies of the department not included in this chapter are not affected by this chapter, except that if such guidelines or policies are in conflict, the requirements of this chapter shall take precedence.

(2) This chapter also supplements 40 CFR Part 133; Secondary Treatment Regulation. Wherever this chapter is more stringent than the federal regulation, the requirements of this chapter shall take precedence.

[Statutory Authority: RCW 90.48.035 and 90.48.260. 87-23-020 (Order 87-26), § 173-221-010, filed 11/12/87.]

173-221-020
Policy.

Waters of the state shall be of the highest possible quality. Regardless of the quality of the waters of the state, all wastes and other materials and substances proposed for discharge into said waters shall be provided with all known, available, and reasonable methods of treatment prior to discharge. Even though standards of quality established for the waters of the state would not be violated, wastes and other materials and substances shall not be allowed to enter such waters which will reduce the existing quality thereof, except (1) in those situations where it is clear that overriding considerations of the public interest will be served, and (2) they receive all known, available, and reasonable methods of treatment prior to discharge.

[Statutory Authority: RCW 90.48.035 and 90.48.260. 87-23-020 (Order 87-26), § 173-221-020, filed 11/12/87.]

173-221-030
Definitions.

As used in this chapter, unless the context indicates otherwise:

(1) "Seven-day average" means the arithmetic mean of pollutant parameter values for samples collected in a period of seven consecutive days. The department may use pollutant parameter values for samples collected in a calendar week for determining compliance with permit conditions.

(2) "Thirty-day average" means the arithmetic mean of pollutant parameter values for samples collected in a period of thirty consecutive

days. The department may use pollutant parameter values for samples collected in a calendar month for determining compliance with permit conditions.

(3) "BOD" means five-day biochemical oxygen demand.

(4) "CBOD" means five-day carbonaceous biochemical oxygen demand.

(5) "Combined sewer" means a sewer which has been designed to serve as a sanitary sewer and a storm sewer, and into which inflow is allowed by local ordinance.

(6) "Department" means the Washington department of ecology.

(7) "Director" means the director of the Washington department of ecology.

(8) "Discharge standard" means a minimum performance requirement established in regulation by the department. Effluent limitations for a pollutant parameter shall not be less stringent than the applicable discharge standard.

(9) "Domestic wastewater" means water carrying human wastes, including kitchen, bath, and laundry wastes from residences, buildings, industrial establishments, or other places, together with such ground water infiltration or surface waters as may be present.

(10) "Domestic wastewater facility" means all structures, equipment, or processes required to collect, carry away, treat, reclaim, or dispose of domestic wastewater together with such industrial waste as may be present. In the case of subsurface sewage treatment and disposal, the term is restricted to mean those facilities treating and disposing of domestic wastewater only from:

(a) A septic tank system with subsurface sewage treatment and disposal and an ultimate design capacity exceeding fourteen thousand five hundred gallons per day at any common point; or

(b) A mechanical treatment system or lagoon followed by subsurface disposal with an ultimate design capacity exceeding three thousand five hundred gallons per day at any common point.

Where the proposed system utilizing subsurface disposal has received a state construction grant or a federal construction grant under the Federal Water Pollution Control Act as amended, such system is a "domestic wastewater facility" regardless of size.

(11) "Effluent concentrations consistently achievable through proper operation and maintenance" means:

(a) For a given pollutant parameter, the 95th percentile value for the thirty-day average effluent quality achieved by a wastewater facility in a period of at least twenty-four consecutive months, excluding values attributable to equipment failures, operational errors, overloading, and other unusual conditions; and

(b) A seven-day average value equal to 1.5 times the value derived under (a) of this subsection.

(12) "Effluent limitation" means any restriction, prohibition, or specification established by the department in a permit or administrative order on:

(a) Quantities, rates, percent removals, and/or concentrations of physical, chemical, or biological characteristics of wastes which are discharged into waters of the state; and

(b) Management practices relevant to the prevention or control of such waste discharges.

Effluent limitations shall be derived from discharge standards and other relevant factors identified in chapter 173-220 WAC.

(13) "Expansion" means the construction of additional treatment units to accommodate hydraulic flow and/or pollutant load for the purpose of increasing the existing design capacity of the wastewater facility.

(14) "Fecal coliform" means the group of coliform bacteria which originate in the intestinal tract of warm-blooded animals.

(15) "Industrial wastewater" means the water or liquid carried wastes from industrial or commercial processes as distinct from domestic wastewater. These wastes may result from any process or activity of industry, manufacture, trade, or business, from the development of any natural resource, or from animal operations such as feedlots, poultry houses, or dairies. The term includes contaminated stormwater and also leachate from solid waste facilities.

(16) "Infiltration" means the addition of ground water into a sewer through joints, the sewer pipe material, cracks, and other defects.

(17) "Inflow" means the addition of rainfall-caused surface water drainage from roof drains, yard drains, basement drains, street catch basins, etc., into a sewer.

(18) "Interfere with" means a discharge by an industrial user which, alone or in conjunction with discharges by other sources, inhibits or disrupts the domestic wastewater facility, its treatment processes or operations, or its sludge processes, use or disposal and which is a cause of a violation of any requirement of the domestic wastewater facility's permit (including an increase in the magnitude or duration of a violation) or of the prevention of sewage sludge use or disposal by the domestic wastewater facility in accordance with the following

statutory provisions and regulations or permits issued thereunder (or more stringent state or local regulations): Section 405 of the Federal Water Pollution Control Act, the Solid Waste Disposal Act (SWDA) (including Title II, more commonly referred to as the Resource Conservation and Recovery Act (RCRA)), and including state regulations contained in any state sludge management plan prepared pursuant to Subtitle D or the SWDA, the Clean Air Act, the Toxic Substances Control Act, and the Marine Protection Research and Sanctuaries Act.

(19) "Permittee" means the entity to which the department issues a permit.

(20) "pH" means the negative logarithm of the hydrogen ion concentration.

(21) "Sanitary sewer" means a sewer which is designed to convey domestic wastewater and infiltration.

(22) "State" means the state of Washington.

(23) "Trickling filter" means a fixed growth biological treatment system in which wastewater is sprayed over the top surface of a column of rock or synthetic media. This definition does not include fixed growth biological systems which have a supplemental biological treatment system, other than a waste stabilization pond(s), for the principal wastewater stream.

(24) "TSS" means total suspended solids.

(25) "TSS concentrations achievable with waste stabilization ponds" means a TSS value, determined by the department, which is equal to the effluent concentrations achieved ninety percent of the time within the state or appropriate contiguous geographical area by waste stabilization ponds that are achieving the levels of effluent quality for BOD specified in WAC 173-221-050 (2)(a).

(26) "Waste stabilization pond" means basins built by excavating the ground and by diking for the purpose of treating wastewater under conditions that favor natural biological treatment and accompanying bacterial reduction. This includes domestic wastewater facilities which are classified as stabilization ponds, or aerated lagoons per the department's Criteria for Sewage Works Design.

(27) "Wastewater facility" means all structures and equipment required to collect, transport, treat, reclaim, or dispose of domestic, industrial, or combined domestic/industrial wastewaters.

(28) "Waters of the state" means all lakes, rivers, ponds, streams, inland waters, ground waters, salt waters, and all other waters and watercourses within the jurisdiction of the state of Washington.

(29) "Water quality standards" means the standards set forth in chapter 173-201 WAC.

(30) "Wet weather" means the time during and immediately following rainfall events which cause large quantities of inflow.

[Statutory Authority: RCW 90.48.035 and 90.48.260. 87-23-020 (Order 87-26), § 173-221-030, filed 11/12/87.]

173-221-040
Domestic wastewater facility discharge standards.

(1) Except as allowed under WAC 173-221-050, domestic wastewater facilities which discharge to surface waters shall not exceed a thirty-day average of 30 milligrams per liter (mg/L) BOD, 30 mg/L TSS. Seven-day averages shall not exceed 45 mg/L BOD, 45 mg/L TSS. Additionally, the thirty-day average percent removals of BOD and TSS shall not be less than eight-five percent of influent concentrations.

(2) Fecal coliform limits shall not exceed a monthly geometric mean of 200 organisms/100 milliliters (mL), and a weekly geometric mean of 400 organisms per 100 mL.

(3) The effluent pH value shall be between 6.0 and 9.0 standard units unless the permittee demonstrates that:

(a) Inorganic chemicals are not added to the waste stream as part of the treatment process; and

(b) Contributions from industrial sources do not cause the pH of the effluent to be less than 6.0 or greater than 9.0; and

(c) The discharge does not cause water quality violations outside of an approved dilution zone.

[Statutory Authority: RCW 90.48.035 and 90.48.260. 87-23-020 (Order 87-26), § 173-221-040, filed 11/12/87.]

173-221-050
Alternative domestic wastewater facility discharge standards and effluent limitations.

(1) Alternative discharge standards for trickling filters which were constructed and/or expanded prior to November 1984 are:

(a) Up to a thirty-day average of 45 mg/L BOD, 45 mg/L TSS. Seven-day averages shall not exceed 65 mg/L BOD, 65 mg/L TSS. In addition, the thirty-day average percent removals of BOD and TSS shall not be less than sixty-five percent of influent concentrations;

(b) Notwithstanding (a) of this subsection, not any less stringent than "effluent concentrations consistently achievable through proper operation and maintenance" of the wastewater facility based on an analysis of the past performance, the design, and the design capacity of the wastewater facility;

(c) Fecal coliform and pH discharge standards are as established in WAC 173-221-040.

(2) Alternative discharge standards for waste stabilization ponds which are the principal treatment process and which either have less than a two million gallon per day design capacity or have received, prior to the effective date of this regulation, the department's approval under chapter 173-240 WAC, for a greater design capacity, are:

(a) Up to a thirty-day average of 45 mg/L BOD, 45 mg/L TSS. Seven-day averages shall not exceed 65 mg/L BOD, 65 mg/L TSS. Additionally, the thirty-day average percent BOD removal shall not be less than sixty-five percent of influent concentrations.

(b) The discharge standards for TSS in (a) of this subsection may be adjusted by the department to conform to the "TSS concentrations achievable with waste stabilization ponds," provided that operation and maintenance data indicate that the TSS values specified in (a) of this subsection cannot be achieved.

(c) Notwithstanding (a) and (b) of this subsection, not any less stringent than "effluent concentrations consistently achievable through proper operation and maintenance" of the wastewater facility based upon an analysis of the past performance.

(d) Fecal coliform and pH discharge standards shall be as established in WAC 173-221-040.

(3) For domestic wastewater facilities which receive flows from combined sewers, the department shall decide on a case-by-case basis whether any attainable percent removal can be defined during wet weather. If it can be defined, the department will set an alternative percent removal effluent limitation for the wet weather period. A permittee who requests such alternative limits shall submit supporting documentation to the department.

(4)(a) For domestic wastewater facilities which receive less concentrated influent wastewater, permittees can request and submit supporting documentation for:

(i) A lower percent removal effluent limitation than the discharge standards set forth in WAC 173-221-040, or subsections (1) and (2) of this section; or

(ii) A mass loading limit based upon the lower percent removal.

(b) To qualify for alternative effluent limitations because of less concentrated influent wastewater, the permittee must demonstrate:

(i) The wastewater facility is consistently achieving, and/or will consistently achieve, the effluent concentration limits and mass limits based upon the effluent concentrations in its permit; and

(ii) That to meet the percentage removal requirements set forth in WAC 173-221-040 or subsections (1) and (2) of this section, the wastewater facility would have to achieve an effluent concentration at least 5 mg/L below the effluent concentration which is otherwise required; and

(iii) The less concentrated influent is not the result of excessive infiltration and/or inflow. The department will use federal regulations and guidance in defining excessive infiltration and inflow; and

(iv) The development and implementation of a program, subject to the department's approval, for ongoing wastewater facility maintenance, repair, and replacement, including infiltration and inflow control. A goal of the program shall be eventual achievement of the percent removal requirements specified in WAC 173-221-040 and subsection (1) or (2) of this section, whichever is applicable. The department shall incorporate the approved infiltration and inflow control program into the permit for the wastewater facility.

(5) Subject to the department's approval, a request for alternative effluent limitations pursuant to subsections (1) through (4) of this section must meet all of the following conditions:

(a) The effluent shall not cause water quality violations; and

(b) The permittee shall identify effluent concentrations consistently achievable through proper operation and maintenance; and

(c) The permittee shall demonstrate that industrial wastewater does not interfere with the domestic wastewater facility; and

(d) The wastewater facility must be within department approved hydraulic and organic design capacity; and

(e) The permittee must complete an analysis of whether seasonal alternative effluent limits are more appropriate than year-round; and

(f) The wastewater facility must be able to meet all other permit requirements and conditions.

(6)(a) At the option of the department, in lieu of the parameter BOD and the levels of the BOD effluent quality specified in WAC 173-221-040, the parameter CBOD may be substituted as an effluent limitation with the following levels of the CBOD effluent quality provided: The thirty-day average shall not exceed 25 mg/L. The seven-day average shall not exceed 40 mg/L. Additionally, the thirty-day average percent removal shall not be less than eighty-five percent of the influent concentration.

(b) At the option of the department, in lieu of the parameter BOD and the levels of the BOD effluent quality specified in subsections (1) and (2) of this section, the parameter CBOD may be substituted as an effluent limitation on a case-by-case basis where data are available. The levels of CBOD effluent quality shall not be less stringent than the following: The thirty-day average shall not exceed 40 mg/L. The seven-day average shall not exceed 60 mg/L. The thirty-day average percent removal shall not be less than sixty-five percent of the influent concentration.

(c) Permittee applications for substitution of CBOD for BOD under (b) of this subsection shall include parallel CBOD and BOD data.

[Statutory Authority: RCW 90.48.035 and 90.48.260. 87-23-020 (Order 87-26), § 173-221-050, filed 11/12/87.]

173-221-100
Severability.

If any provision of this chapter or the application thereof to any person or circumstance is held invalid, such invalidity shall not affect other provisions or applications of this chapter which can be given effect without the invalid provision or application.

[Statutory Authority: RCW 90.48.035 and 90.48.260. 87-23-020 (Order 87-26), § 173-221-100, filed 11/12/87.]

City of Oak Harbor

Comprehensive Sewer Plan

APPENDIX E.
SEPA CHECKLIST

December 2008

WAC 197-11-960 Environmental checklist.

ENVIRONMENTAL CHECKLIST

Purpose of checklist:

The State Environmental Policy Act (SEPA), chapter 43.21C RCW, requires all governmental agencies to consider the environmental impacts of a proposal before making decisions. An environmental impact statement (EIS) must be prepared for all proposals with probable significant adverse impacts on the quality of the environment. The purpose of this checklist is to provide information to help you and the agency identify impacts from your proposal (and to reduce or avoid impacts from the proposal, if it can be done) and to help the agency decide whether an EIS is required.

Instructions for applicants:

This environmental checklist asks you to describe some basic information about your proposal. Governmental agencies use this checklist to determine whether the environmental impacts of your proposal are significant, requiring preparation of an EIS. Answer the questions briefly, with the most precise information known, or give the best description you can.

You must answer each question accurately and carefully, to the best of your knowledge. In most cases, you should be able to answer the questions from your own observations or project plans without the need to hire experts. If you really do not know the answer, or if a question does not apply to your proposal, write "do not know" or "does not apply." Complete answers to the questions now may avoid unnecessary delays later.

Some questions ask about governmental regulations, such as zoning, shoreline, and landmark designations. Answer these questions if you can. If you have problems, the governmental agencies can assist you.

The checklist questions apply to all parts of your proposal, even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The agency to which you submit this checklist may ask you to explain your answers or provide additional information reasonably related to determining if there may be significant adverse impact.

Use of checklist for nonproject proposals:

Complete this checklist for nonproject proposals, even though questions may be answered "does not apply." IN ADDITION, complete the SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS (part D).

For nonproject actions, the references in the checklist to the words "project," "applicant," and "property or site" should be read as "proposal," "proposer," and "affected geographic area," respectively.

A. BACKGROUND

1. Name of proposed project, if applicable:

   Comprehensive Sewer Plan (CSP)

2. Name of applicant:

   City of Oak Harbor

3. Address and phone number of applicant and contact person:

   Brad Gluth
   865 SE Barrington Drive
   Oak Harbor, WA 98277

4. Date checklist prepared:

   February 27, 2006

5. Agency requesting checklist:

City of Oak Harbor

6. Proposed timing or schedule (including phasing, if applicable):

The project outlines a recommended Capital Improvement Plan (CIP) for the City of Oak Harbor's collection system and treatment plants to provide sufficient capacity for existing and projected sewage flows. A phased schedule is proposed for the implementation of the CIP projects recommended in the CSP. A copy of the proposed schedule is located in Chapter 11 of the CSP.

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.

No further additions to the proposed projects are anticipated at this time.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.

A report, titled Crescent Bay salt Marsh and Salmon Habitat Restoration Plan, was developed for the Island County Public Works and the Naval Air Station, in 2003, to look at restoring the tidal influence to Crescent Harbor Marsh. An additional report conducted in 2005 reviewed the results of the 2003 report and expressed concerns for the long term stability of the waste water treatment plant if the tidal influences were restored. Both of these documents will be considered when choosing design alternatives and preparing the design.

No additional known environmental information is available that relates directly to this plan. As the proposed projects are designed, environmental data may be required or identified..

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain.

Not applicable.

10. List any government approvals or permits that will be needed for your proposal, if known.

Since this document is just a plan no government approvals or permits will be required. Permits and Department of Environment approval will likely be required prior to the construction of the proposed projects in this plan. Those permits will be identified during the design phase of the projects.

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page. (Lead agencies may modify this form to include additional specific information on project description.)

The City of Oak Harbor has authorized an evaluation of the sanitary sewer collection and treatment systems within the city limits and in adjacent areas in order to plan for existing and future infrastructure needs. This report documents the sanitary sewer collection and treatment problems identified by the evaluation, assesses alternative solutions, and outlines a recommended capital improvement program (CIP) to solve the problems. It also includes an assessment of the city's sanitary sewer rate structure to ensure that there will be adequate funds into the future to finance the identified improvements. The recommended CIP projects are prioritized to help guide the effective use of the city's limited funding resources.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist.

The plan proposes improvements throughout the City. Maps of these locations can be found in Appendix H of the CSP.

B. ENVIRONMENTAL ELEMENTS

1. **Earth**

a. General description of the site (circle one): Flat, rolling, hilly, steep slopes, mountainous, other . . . . . .

The topography of the study area may generally be described as gently sloping with undulating hills. Exceptions include the steep bluffs to the southwest adjacent to the water and the prominent hills to the west of the city center. Typical slopes in the study area are 3 to 6 percent. Elevation in the study area range from just over 400 feet (city of Oak Harbor datum) to sea level (100 feet, City of Oak Harbor datum).

b. What is the steepest slope on the site (approximate percent slope)?

The slope varies across all of the proposed projects outlined in this plan, but does not exceed a 10 percent grade. Additional survey information will likely be collected during the design phase of each of the proposed projects.

A near vertical bluff is present within the city limits, but does not affect any of the proposed projects.

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any prime farmland.

Soils in the study area are highly variable but are generally a sandy loam developed under a heavy stand of timber in a mild, moist, nearly frost-free climate. The parent material is undulating and rolling, gravelly and stony, coarse to moderately coarse textured material, underlain by loose glacial outwash.

There are 18 soil classifications in the study area, plus sub varieties based on slope. Most soils in the central area of the city are of the Townsend variety, which are characterized by a sloping well drained soil underlain by compact gravelly till. In the northern part of this basin, the soil transitions to Whidbey soils, which are well-drained soils underlain by a cemented glacial till. To the west the soil transitions to Coveland soil, a poorly drained soil underlain by fine-textured till, marine or lake-laid sediments. Continuing west, the soil transitions into the Hoypus soil category. The general characteristics of this soil group include an excessively drained soil underlain by loose gravelly or sandy drift or wind-reworked areas. Key features of these major groups are as follows:

- ***Townsend Soils****—This soil occurs from very near or adjoining the coast to moderately steep slopes of intermittent drainageways. This soil is closely associated with Coveland loams and with Whidbey gravelly sandy loams. Oak Harbor is one of two locations where this soil type is predominant; the other location is at San de Fuca. The soil was developed from cemented gravelly till. Because it is near the coast, its parent materials are mixed with marine and glacial lake sediments. The soil is well drained. Internal drainage is medium, however, because of the nearly impervious hardpan. Native vegetation consisted of grasses, with a few clumps of Garry oak scattered over the area and a few Douglas firs along the outer edges.*

- ***Whidbey Soils****—Whidbey soils are the most common over Island County, covering about one-third of the county. The cemented gravelly till from which this soil developed was derived largely from granite, quartzite, schist, basalt, slate, and sandstone. Natural drainage is good in this soil. Surface runoff is slow because the surface layer and subsoil absorb the water readily. During the rainy season the lower part of the subsoil immediately above the hardpan remains saturated for long periods. Native vegetation consisted largely of conifers, predominantly Douglas fir with a few hemlocks and cedars.*

- ***Coveland Soils****—This soil occupies slight depressions in uplands or terraces next to bays and inlets. It is associated with Townsend soils but occupies lower-lying positions. Because of its position in depressions, the soil receives runoff and seepage from higher-lying areas. Although surface runoff is slow,* *the soil has enough slope that excess water runs off. During rainy seasons, the soil becomes saturated, but the water stands on the surface for only a short time. Native vegetation was mainly grass, with some brush and a few scattered trees.*

- ***Hoypus Soils***—*Hoypus soil is extensive on Whidbey Island. It occupies moraines and outwash plains. The parent material of this soil consists of different kinds of rock. Rock of acid igneous and metamorphic origin predominates, but some basic rocks are included. Natural drainage is somewhat excessive. Internal drainage is very rapid, and the water-holding capacity is low. Native vegetation consisted largely of Douglas fir mixed with some hemlock, spruce, and cedar.*

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.

There is no evidence of unstable soil in the immediate vicinity of the project locations.

e. Describe the purpose, type, and approximate quantities of any filling or grading proposed. Indicate source of fill.

The purpose, type and approximate quantities of filling or grading will be identified in the design phase after an alternative has been chosen.

f. Could erosion occur as a result of clearing, construction, or use? If so, generally describe.

Construction of these system improvements could lead to soil erosion and sedimentation. Appropriate soil erosion and sedimentation control permits will be acquired, if applicable, and appropriate Best Management Practices (BMPs) will be installed and maintained to address the potential for soil erosion and sedimentation.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?

The majority of the projects proposed under this comprehensive sewer plan will be replacing existing or upgrading existing underground sanitary pipes, pump station and treatment systems. Some additional new pump stations, force mains and gravity sewers may be added on the west side of the City. Imperviousness may increase slightly, but not noticeably, if the alternatives involving new construction are chosen. The degree, if any, of impervious material added will not be known until the alternatives have been chosen and the design begun.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:

The CSP is proposing a series of improvements to the wastewater collection and treatment system, therefore soil erosion and sedimentation control plans have not yet been developed. As the projects are designed soil erosion and sedimentation control will be considered. Appropriate soil erosion and sedimentation control permits will be acquired, if applicable, and appropriate Best Management Practices (BMPs) will be installed and maintained to address the potential for soil erosion and sedimentation.

2. **Air**

a. What types of emissions to the air would result from the proposal (i.e., dust, automobile, odors, industrial wood smoke) during construction and when the project is completed? If any, generally describe and give approximate quantities if known.

Typical construction equipment will be utilized for the implementation of these projects. It is expected that there will be minimal exposure of sediment, which could become entrained into the air. Appropriate soil erosion and sedimentation control permits will be acquired, if applicable, and appropriate Best Management Practices (BMPs) will be utilized to address the potential for airborne sediment particles.

Sewage odor may be present through out the project site from time to time, but since most of the work is involving upgrades to existing systems, it is not expected that the amount of odor or frequency will increase as a result of the *implementation of this plan. The exception may be along Whidbey Street where a new pump station and force mains are part of a proposed alternative. Odor control devices will be present in lift stations and pump stations. Odor issues will be addressed in the design phase once an alternative has been chosen.*

b. Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe.

There are no off-site sources of emissions or odor that may affect the proposal.

c. Proposed measures to reduce or control emissions or other impacts to air, if any:

Appropriate soil erosion and sedimentation control permits will be acquired, if applicable, and appropriate Best Management Practices (BMPs) will be utilized to address the potential for airborne sediment particles. BMPs utilized may include covering staged soil and spraying water on exposed soil to reduce the potential for entrainment.

Odor control devices will be installed in pump and lift stations. The type of device and level of treatment will be determined during the design process, once an alternative has been chosen.

3. **Water**

a. Surface:

1) Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into.

The City of Oak Harbor and its RBC wastewater treatment plant are located directly on the shore of Oak Harbor, an inlet within Puget Sound. The Seaplane Lagoon wastewater treatment plant is located in a marsh like area, adjacent to Crescent Harbor, an inlet within Puget Sound. No additional surface waterbodies are located in the immediate vicinity of the project sites or within the City. The drainage from the project sites is carried via the storm sewer system to Oak Harbor.

2) Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans.

Several alternatives are proposed for the lagoon wastewater treatment plant located in Crescent Harbor Marsh. The proposed alternatives do not call for any construction to occur in the marsh, but will require construction on the berms within the marsh. Specifics of the activities will be identified in the design phase once an alternative is chosen. At this point methods to reduce impacts will also be considered.

3) Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.

It is not expected that dredge and/or fill material will be placed or removed from surface waters or wetlands in the proposed alternatives, but final determinations will be made during the design phase once and alternative has been chosen.

4) Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known.

No surface water withdrawals or diversion will be required for these projects.

5) Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.

Currently, the lagoon wastewater treatment plant is located within the Crescent Harbor Marsh. Berms, previously constructed around the site, prohibit high tides potentially capable of flooding portions of the wastewater treatment plant. A separate plan is being developed by the City to explore the possibility of reconnecting a portion of the marsh to full tidal influences. This could potentially place part of the treatment plant within a flood zone. Additional details will be addressed during the design phase of the chosen alternative.

6) Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.

No new outfalls from the wastewater treatment plant are proposed in this plan, therefore, no new discharges of waste materials to surface waters is expected.

b. Ground:

1) Will ground water be withdrawn, or will water be discharged to ground water? Give general description, purpose, and approximate quantities if known.

Groundwater will not be withdrawn as a part of these proposed projects.

2) Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: Domestic sewage; industrial, containing the following chemicals. . . ; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.

No waste material will be discharged into the ground as a result of these proposed alternatives.

c. Water runoff (including stormwater):

1) Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.

The effective impervious area for the City of Oak Harbor is approximately 20 percent. A significant amount of the runoff in Oak Harbor is originating from these impervious areas and other less pervious areas like manicured lawns. Runoff is collected throughout the City of Oak Harbor through its separated storm sewer system, which ultimately discharges to Puget Sound. The alternatives proposed in this report are not expected to change the percent imperviousness of Oak Harbor or increase the quantity of storm water runoff.

2) Could waste materials enter ground or surface waters? If so, generally describe.

The direct discharge of waste materials to ground or surface waters as a result of the proposed projects in the CIP is unlikely.

d. Proposed measures to reduce or control surface, ground, and runoff water impacts, if any:

As specified previously, appropriate soil erosion and sedimentation control permits will be acquired, if applicable, and appropriate Best Management Practices (BMPs) will be installed and maintained to address the potential for soil erosion and sedimentation.

4. **Plants**

a. Check or circle types of vegetation found on the site:

√______ deciduous tree: alder, maple, aspen, other

√______ evergreen tree: fir, cedar, pine, other

√______ shrubs

√ ——— grass

——— pasture

——— crop or grain

√ ——— wet soil plants: cattail, buttercup, bullrush, skunk cabbage, other

——— water plants: water lily, eelgrass, milfoil, other

——— other types of vegetation

b. What kind and amount of vegetation will be removed or altered?

The proposed alternatives listed in the CSP have not been chosen or designed, therefore the limits of construction are unknown and an estimate of the amount of vegetation removed or altered cannot be determined at this time. Since most projects proposed are replacing or upgrading existing systems, which are predominantly located in the municipal roadway, vegetation will likely not be affected.

c. List threatened or endangered species known to be on or near the site.

Since this CSP is only proposing projects and alternatives a comprehensive site inspection has not been conducted. The following is a list of endangered, threatened, and sensitive plant species listed in Island County's Critical Area Ordinance.

Scientific Name	*Common Name*	*Status*
Agroseris elata	*Tall Agroseris*	*Sensitive*
Aster curtus	*White-top Aster*	*Sensitive*
Castilleja levisecta	*Golden Indian Paintbrush*	*Endangered*
Circuta bulbifera	*Bulb Bearing Water Hemlock*	*Sensitive*
Fritillaria camschatcensis	*Black Lily*	*Sensitive*
Meconella oregana	*White Meconella*	*Threatened*
Puccinella nutkaensis	*Alaska Alkaligrass*	*Sensitive*

The plant species listed are consistent with the Washington State Department of Natural Resource listings for endangered, threatened, and sensitive plants found at the following web site: *http://www.dnr.wa.gov/nhp/refdesk/lists/plantsxco/island.html*

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any:

The use of native plants and other vegetations will be determined in the design phase of the proposed projects. In most cases the project will be occurring in municipal roadways where landscaping will not be applicable.

5. **Animals**

a. Circle any birds and animals which have been observed on or near the site or are known to be on or near the site:

√ ______ birds: hawk, heron, eagle, songbirds, other:

√ ______ mammals: deer, bear, elk, beaver, other: coyote

______ fish: bass, salmon, trout, herring, shellfish, other:

b. List any threatened or endangered species known to be on or near the site.

Since this CSP is only proposing projects and alternatives a comprehensive site inspection has not been conducted. The following is a list of endangered, threatened, and sensitive animal species listed in Island County's Critical Area Ordinance.

Scientific Name	*Common Name*	*Status*
Eumetopias jubatus	*Northern Sea Lion*	*Threatened*
Haliaeetus leucocephalus	*Bald Eagle*	*Threatened*
Pandion haliaetus	*Peregrine Falcon*	*Endangered*
Eschrichtius glaucus	*Gray Whale*	*Sensitive*
Brachyramphus marmoratus	*Marmoratus Marbled Murrelet*	*Threatened*

Additional species of threatened or endangered animals may be present, which are not listed in the County's Critical Area Ordinance. A state list of threatened and endangered species may be found at the following website:

http://www.wdfw.wa.gov/wlm/diversty/soc/soc.htm

c. Is the site part of a migration route? If so, explain.

Puget Sound acts as an environment for many migrating animals, but due to the size and location of the proposed projects it is unlikely that the project sites coincide with these migration routes or impair the routes.

d. Proposed measures to preserve or enhance wildlife, if any:

The proposed alternatives listed in the CSP have not been chosen or designed, therefore it has not been determined if measures to preserve or enhance wildlife will be included or necessary.

6. **Energy and natural resources**

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

Pump and lift stations will require electricity to operate pumps and/or generators.

b. Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe.

The proposed projects in this plan will not affect the use of solar energy by adjacent properties.

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:

The proposed projects in the comprehensive sewer plan have not been chosen or designed, therefore energy conservation features have not been considered.

7. **Environmental health**

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste, that could occur as a result of this proposal? If so, describe.

Likely, there are not environmental health hazards that will occur as a result of the proposed projects in the comprehensive sewer plan.

1) Describe special emergency services that might be required.

No special emergency services will be required.

2) Proposed measures to reduce or control environmental health hazards, if any:

Likely there are not environmental health hazards that will occur as a result of the proposed projects in the CSP.

b. **Noise**

1) What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)?

There are no major sources of noise within the project are that would affect any of the proposed projects.

2) What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site.

The construction of the project alternatives outlined in the plan would require the use of heavy equipment. Although the projects are only in the planning phase it would be safe to assume that heavy equipment generating noise would be present during typical working hours or between dawn and dusk.

Normal operation of proposed pump stations would be negligible, but weekly maintenance would likely produce some noise during typical work hours between 8:00 AM and 5:00 PM. The noise produced during this period would be within normal noise regulations.

3) Proposed measures to reduce or control noise impacts, if any:

All local noise ordinances will be followed during construction.

8. **Land and shoreline use**

a. What is the current use of the site and adjacent properties?

The comprehensive sewer plan contains multiple proposed alternatives; the final alternatives have not been chosen or designed. In general, most of the proposed projects would be constructed in transportation right-of-ways or on public lands.

b. Has the site been used for agriculture? If so, describe.

No proposed sites have been used for agriculture in recent history.

c. Describe any structures on the site.

The comprehensive sewer plan contains multiple proposed alternatives; the final alternatives have not been chosen or designed. In general, most of the proposed projects would be constructed in transportation right-of-ways or on public lands, where structures are not present.

d. Will any structures be demolished? If so, what?

The comprehensive sewer plan contains multiple proposed alternatives; the final alternatives have not been chosen or designed. The identification of existing structures and the potential for demolition will be conducted during the design phase.

e. What is the current zoning classification of the site?

The comprehensive sewer plan contains multiple proposed alternatives; the final alternatives have not been chosen or designed. Since the most of the proposed project alternatives involve work on existing sewer networks, the zoning will be variable throughout the sites.

f. What is the current comprehensive plan designation of the site?

The comprehensive plan designation for the proposed sites will be identified once an alternative is chosen.

g. If applicable, what is the current shoreline master program designation of the site?

Urban Environment (Island County Comprehensive Plan, Shoreline Management)

h. Has any part of the site been classified as an "environmentally sensitive" area? If so, specify.

Crescent Harbor Marsh is considered an environmentally sensitive area within the proposed areas. Additional research regarding environmentally sensitive areas will be collected during the design phase of the proposed projects.

i. Approximately how many people would reside or work in the completed project?

Not applicable

j. Approximately how many people would the completed project displace?

No displacement would occur as a result of this project.

k. Proposed measures to avoid or reduce displacement impacts, if any:

Not applicable

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

The projects in this plan are sanitary conveyance and treatment improvement based projects; therefore, existing and projected land uses and plans are not directly applicable. However, indirect effects of land use, such as population and type of business constructed in the area can affect the sizing of project elements.

9. **Housing**

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

Not applicable

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

Not applicable

c. Proposed measures to reduce or control housing impacts, if any:

Not applicable

10. **Aesthetics**

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?

The use of buildings to house pump station controls will be determined during the design phase. No other above ground structures are proposed.

b. What views in the immediate vicinity would be altered or obstructed?

Likely no views would be altered or obstructed from any of the proposed projects.

c. Proposed measures to reduce or control aesthetic impacts, if any:

Measures to reduce or control aesthetic impacts of any structures above ground would be developed during the design stage of the project.

11. **Light and glare**

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

Likely no light or glare will be produced from the proposed projects, but the potential and impacts of that design will be reviewed during the design phase if that alternative is chosen.

b. Could light or glare from the finished project be a safety hazard or interfere with views?

Unlikely, but the potential and impacts of that design will be reviewed during the design phase if that alternative is chosen.

c. What existing off-site sources of light or glare may affect your proposal?

Existing off-site sources of light or glare will most likely not affect the proposed projects in the plan, but those issues will be addressed during the design phase.

d. Proposed measures to reduce or control light and glare impacts, if any:

If glare is an issue from any of the proposed projects that problem will be addressed during the design phase.

12. **Recreation**

a. What designated and informal recreational opportunities are in the immediate vicinity?

Some sewer improvements may occur in the vicinity of existing City parks.

b. Would the proposed project displace any existing recreational uses? If so, describe.

It is unlikely that the proposed projects in this plan will displace any existing recreational uses, but a review will be conducted during the design phase.

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any:

Not applicable

13. **Historic and cultural preservation**

a. Are there any places or objects listed on, or proposed for, national, state, or local preservation registers known to be on or next to the site? If so, generally describe.

A review of the project site will be conducted in the design phase once an alternative is chosen.

b. Generally describe any landmarks or evidence of historic, archaeological, scientific, or cultural importance known to be on or next to the site.

A review will be conducted in the design phase once an alternative is chosen.

c. Proposed measures to reduce or control impacts, if any:

If potentially significant archaeological sites are discovered during excavation, construction will be halted, and the City will be notified to determine the course of action.

14. **Transportation**

a. Identify public streets and highways serving the site, and describe proposed access to the existing street system. Show on site plans, if any.

Not applicable

b. Is site currently served by public transit? If not, what is the approximate distance to the nearest transit stop?

Not applicable

c. How many parking spaces would the completed project have? How many would the project eliminate?

Not applicable

d. Will the proposal require any new roads or streets, or improvements to existing roads or streets, not including driveways? If so, generally describe (indicate whether public or private).

Existing roadways will likely be disturbed and restored to install improvements to the sanitary system. Specifics on changes to the existing streets or developing new streets will be addressed in the design phase of these projects.

e. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.

Water, rail, and air transportation will not be used and is not in the immediate vicinity of the proposed projects identified in the plan.

f. How many vehicular trips per day would be generated by the completed project? If known, indicate when peak volumes would occur.

Not applicable.

g. Proposed measures to reduce or control transportation impacts, if any:

Not applicable.

15. **Public services**

a. Would the project result in an increased need for public services (for example: fire protection, police protection, health care, schools, other)? If so, generally describe.

The proposed projects, after construction, would require periodic maintenance.

b. Proposed measures to reduce or control direct impacts on public services, if any.

Not Applicable

16. **Utilities**

a. Circle utilities currently available at the site: electricity, natural gas, water, refuse service, telephone, sanitary sewer, septic system, other.

Utilities are present on the site, but are not pertinent to the function of the proposed projects.

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed.

Not Applicable

C. SIGNATURE

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature: ....

Date Submitted: ....

D. SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS

(do not use this sheet for project actions)

Because these questions are very general, it may be helpful to read them in conjunction with the list of the elements of the environment.

When answering these questions, be aware of the extent the proposal, or the types of activities likely to result from the proposal, would affect the item at a greater intensity or at a faster rate than if the proposal were not implemented. Respond briefly and in general terms.

1. How would the proposal be likely to increase discharge to water; emissions to air; production, storage, or release of toxic or hazardous substances; or production of noise?

The proposed projects in this plan are improvement projects to the sanitary system in the City of Oak Harbor. No additional discharges of materials are expected.

Proposed measures to avoid or reduce such increases are:

Not Applicable

2. How would the proposal be likely to affect plants, animals, fish, or marine life?

Likely the implementation of this plan would not impact plants, animals, fish, or marine life.

Proposed measures to protect or conserve plants, animals, fish, or marine life are:

All applicable permits, including soil erosion control permits, will be acquired and BMPs installed to protect plants, animals, fish and marine life will be utilized, as necessary.

3. How would the proposal be likely to deplete energy or natural resources?

It is not expected that the projects in this plan will deplete energy or natural resources.

Proposed measures to protect or conserve energy and natural resources are:

Not applicable.

4. How would the proposal be likely to use or affect environmentally sensitive areas or areas designated (or eligible or under study) for governmental protection; such as parks, wilderness, wild and scenic rivers, threatened or endangered species habitat, historic or cultural sites, wetlands, floodplains, or prime farmlands?

The alternatives to improve the infrastructure at the lagoon waste water treatment plant located at the Crescent Harbor Marsh are all being conducted within pre-existing berms. No work will be conducted within the Marsh. As a result, the marsh should not be impacted. Impacts to any other environmentally sensitive areas are not expected as a result of implementing the proposed projects in this plan, further consideration will be given during the design phase once alternatives are chosen.

Proposed measures to protect such resources or to avoid or reduce impacts are:

All applicable permits, including soil erosion control permits, will be acquired and BMPs installed. During the design phase a construction exclusion zone will likely be developed.

5. How would the proposal be likely to affect land and shoreline use, including whether it would allow or encourage land or shoreline uses incompatible with existing plans?

It is not expected that the implementation this plan would conflict with any existing plans for land and shoreline use.

Proposed measures to avoid or reduce shoreline and land use impacts are:

Not applicable.

6. How would the proposal be likely to increase demands on transportation or public services and utilities?

Some additional maintenance may be required with new facilities.

Proposed measures to reduce or respond to such demand(s) are:

The demands on maintenance crews would likely be minimal and infrequent, no measures will be required.

7. Identify, if possible, whether the proposal may conflict with local, state, or federal laws or requirements for the protection of the environment.

The proposed projects will likely not conflict with local, state, or federal laws or requirements for the protection of the environment. This issue will be reviewed again, once alternatives have been chosen and the design process begins.

APPENDIX F.
CITY OF OAK HARBOR SANITARY SEWER DESIGN STANDARDS

December 2008

4 Sewer Systems

4.1 General Requirements

The standards established by this chapter are intended to represent the minimum standards for the design and construction of sanitary sewer facilities and are authorized per OHMC 14.03.280. Greater or lesser requirements may be mandated by the City due to localized conditions. Washington State Department of Ecology's Criteria for Sewage Works Designs (DOE Manual) and the current version of the Washington State Department of Transportation (WSDOT) and American Public Works Association (APWA) Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT Standard Specs) shall be used for design of system connections, extensions, and/or modifications. Where the Ecology manual and WSDOT Standard Specifications use the passive verb forms "should, can or may", the City of Oak Harbor has, as a general rule, substituted the active verb forms "shall, will and must".

Sewage facilities shall be constructed in conformance with the most recent edition of the WSDOT Standard Specifications for Road, Bridge, and Municipal Construction, and current amendments thereto revised as to form to make reference to Local Governments, and as modified by any special City requirements and standards contained herein.

Where the design or construction requirements conflict or information is omitted, the order of precedence of reference application used shall be the following:

1. City of Oak Harbor Development Standards
2. Oak Harbor Municipal Code
3. The current version of the Washington State Department of Transportation (WSDOT) and American Public Works Association

(APWA) Standard Specifications for Road, Bridge, and Municipal Construction

4. The Washington State Department of Ecology's Criteria for Sewage Works Designs

Special or unique circumstances may cause the City Engineer to allow or require deviations from the above design and construction requirements.

4.2 Consistency with Comprehensive Plan

All public sewer mains, lift station and appurtenant facilities shall be planned, designed and constructed consistent with the most recent version of the City of Oak Harbor Comprehensive Sewerage Plan and amendments or updates thereto.

Where extension of the public system occurs in an area not served by the Oak Harbor Sanitary Sewer System (OHSS), the system shall be designed to serve the basin(s) as outlined in the Comprehensive Sewerage Plan. Gravity mains, interceptors or laterals shall be designed and constructed for the ultimate build out of the basin to be served. Mains and manholes shall be constructed at sufficient depth to allow for the basin to be served. Pump stations and force mains shall be likewise constructed to serve the entire basin.

The City may consider improvements that deviate from the Comprehensive Sewerage Plan on a case by case basis. A variance shall be granted only upon a finding that, where because of the size of the tract to be subdivided, its topography, the condition or nature of adjoining areas, or the existence of unusual physical conditions, strict compliance with the provisions for subdivision, short subdivision or dedication would cause unusual and unnecessary hardship on the Developer.

4.3 Service Area

The City of Oak Harbor Sanitary Sewer Service area is defined, as general policy, by the Oak Harbor Municipal Code as the current City limits.

Within the corporate City limits where a public sewer is available it must be used except as allowed by OHMC 14.03.060 Available will generally mean there is a main within 200-ft of the property to be served. If there is no main along the property frontage, the main shall be extended to and along the property frontage.

For existing lots, new septic systems within the Oak Harbor City limits are not allowed if a public sewer is available for connection. New lots created through a subdivision, short plat or other land use action shall provide sewer connection to each new lot.

4.4 Construction Plans and Plan Review

Detailed engineering plans prepared by an Engineer licensed in the State of Washington shall be submitted for the City's review. The plans shall indicate the location, size, and the type of pipe material for the proposed sewers and the connection with existing sewers. These plans shall be separate from other utility plans, but may be combined with water system plans, and depending upon the size of the project, stormwater system plans. Plans and profiles shall show:

1. Location of existing or proposed streets, rights-of-way, easements, utilities, sewers and all significant surface features.
2. Existing and proposed ground surface, pipe type, class and size, manhole stationing, invert and surface elevation at each manhole, and grade of sewer between adjacent manholes. All manholes shall be numbered on the plans and correspondingly numbered on the profile. In addition, plans

shall show the locations of associated facilities such as cleanouts, traps, interceptors, sampling facilities and fixtures to be connected therewith.

3. Where there is any question of the sewer being sufficiently deep to serve any residence, the elevation and location of the basement floor, if basements are served, shall be plotted on the profile of the sewer that is to serve the house in question. The Developer shall state that all sewers are sufficiently deep to serve adjacent basements, except where otherwise noted on the plans.
4. All known existing structures, both above and below ground, which might interfere with the proposed construction, particularly water mains, gas mains, storm drain, overhead and underground power lines, telephone lines, and television cables.
5. Details which clearly show special sewer joints and cross-sections, and sewer appurtenances such as manholes, trenching, pavement restoration, backfill and bedding and other related items as well as all other items as required by the City to clearly identify construction items, materials, and/or methods.
6. Sewer plans and profiles shall be drawn with a horizontal scale of 1:20 and vertical scale of 1:5

4.4.1 General Notes

The following general notes are to be included on all sanitary sewer construction plans submitted to the City of Oak Harbor Engineering Division for review. These general notes may or may not apply to all projects.

1. All workmanship and materials shall be in accordance with City of Oak Harbor Utility Standards and the most recent copy of the State of Washington Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT/APWA).

2. City of Oak Harbor datum, NGVD 1929 Mean Sea Level (MSL) plus 100.00 feet, shall be used for all vertical control [0.00,ft. NGVD 1929 Mean Sea Level = 100.00 ft., City of Oak Harbor Datum]. As published in 1954 for Tidal Benchmark CRESCENT HARBOR, WHIDBEY ISLAND, NGVD 1929 MSL of 0.00 feet corresponds to USCGS Tidal Datum of 6.41 feet [Mean Lower Low Water, Tidal Datum = 0.00 feet].
3. All approvals and permits required by the City of Oak Harbor shall be obtained by the Contractor prior to the start of construction. All Contractors working within City Limits are required to have a City of Oak Harbor business license and be bonded and insured.
4. Contractor shall perform the work in compliance with all OSHA, L&I and other safety laws and regulations for workplace safety, including trenching and confined space entry.
5. If construction is to take place in County Rights-of-way, the Contractor shall obtain all the required approvals, franchises and permits.
6. A preconstruction meeting shall be held with the City of Oak Harbor Engineering Inspector prior to the start of construction. Requests to schedule preconstruction meetings shall be in advance of the meeting date by 7 calendar days.
7. The City of Oak Harbor Engineering Division shall be notified a minimum of 48 hours in advance of a tap or connection to an existing sanitary sewer main. The inspector shall be present at the time of the tap or connection.
8. The Contractor shall be fully responsible for the location and protection of all existing utilities. The Contractor shall verify all utility locations prior to construction and call the Underground Locate Line at 1-800-424-5555 a minimum of 48 hours prior to any excavation.
9. For pipe diameters 12-inches or less and depths up to 15-ft, all gravity sewer pipe shall be PVC, ASTM D 3034 SDR 35 and comply with WSDOT Standard Specifications Section 7-17 .
10. Precast manholes shall meet the requirements of WSDOT Standard Specifications 9-12.4. Joints shall be rubber gasketed conforming to

WSDOT Standard Specifications 9-04.4. Lift holes shall be grouted from the outside and inside of the manhole. Manholes frames and covers shall be Olympic Foundry MH52 or equivalent.

11. Side sewer services shall be PVC, ASTM D 3034 SDR 35 with flexible gasketed joints. Side sewer connections shall be made by a tap to an existing main or a 90-degree sanitary tee from a new main connected above the spring line of the pipe. Connections to existing mains shall be made by machine tap and shall use a fully gasketed fitting, Romac Style "CB" sewer saddle or equivalent.
12. Side sewers shall be installed at the time of new sewer main installation and shall be coordinated for clearance with power, telephone, and other utilities.
13. All sewer mains shall be field staked for grades and alignment prior to construction by, or under the direction of, a licensed engineer or licensed surveyor qualified to perform such work. Prior to constructing any sewer, the lot corners shall be staked and sewer line location established by survey, cost of which shall be borne by the Developer.
14. All sewer pipe, both mains and side sewers, shall be installed with continuous 12-gauge green insulated tracer wire. Side sewer tracer wires shall be brought to the surface and wrapped around the side sewer marker.
15. Each side sewer location shall be marked with a pressure treated 2x4 marker. The marker shall be a minimum of 4-feet long and shall extend a minimum of 1-foot above the ground surface. Marker shall be placed in contact with the end of the side sewer stub. A 2x4 cleat shall be nailed to the bottom of marker to prevent withdrawal. Above the ground surface, the marker shall be painted "green" with "S/S" and the depth to the side sewer shall be indicated, in feet, stenciled in black letters 2-inches in height.
16. All side sewers shall be installed 10 feet into each lot as shown on the approved sewer plan and staked at the upstream end. Inspection tees shall

be installed within the standard utility easement that fronts the property per the City's Side Sewer Standard Detail.

17. All pipes shall be installed in accordance with WSDOT Standard Specifications for Section 7-08.3 except where City Standard Trench Details exceed WSDOT bedding and backfill specifications. Installation of pipe shall include necessary leveling of the trench bottom or foundation materials as well as placement and compaction of required bedding material to uniform grade so that the entire length of the pipe will be supported on a uniformly dense unyielding base.
18. Sediment laden water, gravel, rocks, soil, trash, or other debris accumulated during construction shall be removed from the new sewers and shall not be permitted to enter the existing system. A plug, cap or screen shall be installed to prevent such debris from entering the existing system.
19. The Contractor shall be responsible for all flushing, cleaning or repairs to any existing sewer facility into which gravel, rocks, or other debris has entered the system or which has been damaged as a result of the Contractor's operations.
20. Traffic control plan(s) in accordance with the current Manual on Uniform Traffic Control Devices (MUTCD) are required for any work within City Rights-of Way. Traffic control plans are required to be approved by the City Engineer prior to the start of work.
21. The Contractor shall have a copy of the approved construction plans on site at all times.
22. Any changes to the approved design shall first be reviewed and approved by the design engineer and the City of Oak Harbor.
23. All lines shall be flushed, cleaned and pressure tested prior to paving in conformance with the above referenced specifications. Testing of the public sanitary sewer mains and private laterals shall include video camera inspection by the City. Video camera inspection shall take place after installation of all underground utilities and compaction of the subgrade is

completed. Immediately prior to video camera inspection, enough water shall be run down the line so it comes out the lower manhole.

24. Prior to backfill all mains and appurtenances shall be inspected and approved for backfill by the City Engineering Division. Approval to backfill shall not relieve the Contractor of responsibility for correction of any deficiencies and/or failures as determined by subsequent testing and inspections. It shall be the Contractor's responsibility to notify the City of Oak Harbor for the required inspections.

4.5 Design Standards

The design of any sewer extension/connection shall conform to City Standards, Department of Ecology's "Criteria for Sewage Works Design," and any applicable standards as set forth herein.

As required by OHMC section 14.03.070 the layout of extensions shall provide for the future continuation of the existing system as determined by the City. Sewer mains shall extend the entire frontage of each lot to be served.

New gravity sewer systems shall be designed on the basis of an average daily per capita flow of sewage of not less than 65 gallons per day (65 gpcd). Consideration shall be made for infiltration and inflow. A peaking factor of 2.11 should be used for major sewerage areas. Other guidelines for peaking factors and design flows are contained in the DOE "Criteria for Sewage Works Design", see table G2-1.

When deviations from the foregoing per capita rates and peaking rates are used, a description of the procedure used for sewer design shall be submitted to the Engineering Division for review and approval.

Construction of new sewer systems or extensions of existing systems will be allowed only if the existing receiving system is capable of supporting the added hydraulic load.

Collection and interceptor sewers shall be designed and constructed for the ultimate development of the tributary areas.

Sewer systems shall be designed and constructed to achieve total containment of sanitary wastes and maximum exclusion of infiltration and inflow.

Computations and other data used for design of the sewer system shall be submitted to the City for approval.

All sewers shall be designed to prevent damage from superimposed loads. Proper allowance for loads on the sewer because of the width and depth of trench should be made. When standard-strength sewer pipe is not sufficient, extra-strength pipe shall be used.

4.6 Existing utilities

Conflicts with existing utilities shall be avoided where possible in the design of new sewers. Where conflicts with existing utilities are unavoidable, minimum separation shall be provided. All sewer pipes (mains and side sewers) shall be separated from water pipes (mains and services) a minimum of 10-ft horizontally and 1.5-ft vertically, measured from edge of pipe to edge of pipe. Where unusual conditions exist, separation from other utilities shall be provided as outlined in the DOE "Criteria for Sewage Works Design."

Side sewer services shall be separated from gas lines, cable, telephone, power and other underground utilities, excluding water, a minimum of 18-inches, edge to edge. Where side sewer lines cross underground utilities, except for water, (or vice versa) with less than 12-inches of vertical separation a styrofoam block shall be used to separate the lines. Common trenching is permissible provided the minimum separation described herein is maintained.

4.7 Staking

All construction surveying and staking shall be performed under the supervision of a Professional Engineer or Professional Land Surveyor licensed by the State of Washington.

The minimum staking of sewer lines shall be as follows or as directed by the City Engineer:

1. Stake location of mainline pipe and laterals every 50 feet with cut or fill to invert of pipe, or utilize a calibrated, accurate pipe laser.
2. Stake location of all manholes for alignment and grade with cut or fill to rim and invert of pipes.
3. Front lot corners shall be staked prior to construction for side sewer location or actual side sewer locations shall be staked.
4. Lot corners, shall be located prior to connection of side sewer to building sewer.

4.8 Gravity Sewers

4.8.1 Mains

The minimum size for sewer mains is 8-inches in diameter.

All sewer pipe materials shall meet the requirements contained in the current version of the WSDOT Standard Specifications and amendments thereto. For pipe diameters 12-inches or less and depths up to 15-ft, all gravity sewer pipe shall be PVC, ASTM D 3034 SDR 35. Material for other diameters, depths or other special conditions, shall be appropriate for the application, must be approved by the City Engineer, and may include: PVC, Ductile Iron, Concrete, Vitrified Clay, ABS or polyethylene. Construction methods, trenching, backfilling, pipe laying and other construction methods shall meet the requirements contained in the current version of the WSDOT Standard Specifications and amendments thereto except where City Standard Trench Details exceed WSDOT bedding and backfill specifications.

4.8.2 Manholes

Precast manholes shall be provided at a maximum of 400-foot intervals, at intersections, and at changes in direction, grade, or pipe size. Manholes shall be provided at the end of all sewer mains to facilitate maintenance, access and future extension. Cleanouts are not acceptable substitutes for manholes at the end of public sewer mains or private laterals.

When the practicality of extension is limited, the City Engineer may at their discretion authorize the use of cleanouts for termination of 8-inch sewer lines no more than 150-feet from the nearest manhole.

A drop of 0.1-feet to 0.2-feet, from invert in to invert out, shall be provided for all manholes and connections thereto.

Side sewers shall not directly connect to manholes.

Where a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation.

The minimum manhole diameter is 48-inches. Type I Manholes shall not be less than 8 feet in depth and Type III shall not be more than 8 feet in depth. Diameter of new manholes shall be determined by the following criteria:

<u>48" Manhole</u>

- 2 connecting pipes, 8 inch to 12 inch diameter
- 3 connecting pipes, 8 inch to 10 inch diameter, perpendicular
- 4 connecting pipes, 8 inch diameter, perpendicular

<u>54" Manhole</u>

- 2 connecting pipes, 8 inch to 12 inch with more than 45 degree deflection
- 3 connecting pipes, 10 inch to 12 inch diameter, perpendicular
- 4 connecting pipes, 10 inch to 12 inch diameter, perpendicular

<u>72" Manhole</u>

- 2 connecting pipes, 15 inch to 18 inch diameter with less than 45 degree deflection
- 3 connecting pipes, 15 inch diameter, perpendicular
- 4 connecting pipes, 15 inch diameter, perpendicular

In the above criteria "deflection" refers to the angle between any 2-pipe channels in the manhole. For other pipe configurations, the City shall approve the size of the manhole.

Precast manholes shall meet the requirements of the current version of the WSDOT Standard Specifications. Pipe connection to precast manholes shall be made using a cast in place manhole coupling; or by a machine core with a water tight flexible rubber boot, KOR-N-SEAL pipe to manhole connector, or equal, in manhole wall.

Manhole channels shall be either precast or cast in place. Cast in place channels and benches shall be constructed using Class 2,000, or better, concrete. Quick set grout shall not be used for channel construction. Cast in place channeling shall be constructed in accordance with WSDOT Standard Specifications. Grouting of manhole connections, joints, risers etc., shall be performed in accordance with WSDOT Standard Specifications. Grout shall be installed as per manufacturer specifications and shall at no time be retempered.

Eccentric manhole cones shall be offset so as not to be located in the tire track of a traveled lane and shall be oriented to permit access to manhole ladder rungs. Ladder rungs shall be positioned on the side of the manhole with largest channel shelf and inline with the vertical wall of the eccentric cone. The first ladder rung shall be installed in the eccentric cone and be no more than 28-inches below grade. No ladder rungs shall be installed in manhole adjustment rings.

Manhole frames and covers shall be cast iron casting marked "Sewer" conforming to the requirements of ASTM A-30, Class 25, and shall be free of porosity, shrink cavities, cold shuts or cracks, or any surface defects which would impair serviceability. The minimum clear opening in the manhole frame shall be 24 inches. Manhole frames and covers shall be Olympic Foundry Part No. MH52, MH52A or equivalent. Repairs of defects by welding or by the use of smooth-on or similar material will not be permitted. Manhole rings and covers shall be machine-finished or ground-on seating surfaces so as to assure non-rocking fit in any position and interchangeability. Manhole frames and covers shall be installed on a minimum of 8-inches of standard radial manhole adjustment rings. All new manholes in pedestrian paths, cross walks, road shoulders, or outside the roadway shall be equipped with bolt down, or locking, covers.

4.8.3 Drops

Straight grades between invert out of last manhole and connection to existing are preferred over drops whenever possible. Care must be taken when designing steep grades so as not to create a situation of excessive velocity or excavation. Grade changes associated with "sweeps" shall not be allowed unless otherwise approved by the City Engineer.

A drop connection shall be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert shall have a fillet to prevent solids deposition. For new construction, drop connections shall be of the outside type unless the City engineer approves otherwise.

Outside drop structures shall be constructed consistent with WSDOT Standard Specifications and Plans.

4.8.4 Slopes

Minimum slopes of sewer mains shall be as recommended in DOE "Criteria for Sewage Works Design."

Under special conditions, slopes slightly less than those listed in the DOE manual may be permitted by the City Engineer. Whenever decreased slopes are proposed, the design engineer shall furnish justification, with the plans, and including computations of the depths of flow in such pipes at minimum, average, and daily or hourly rates of flow.

Sewers shall be laid with uniform (constant) slope between manholes.

4.8.5 Private Sewers (Side Sewers and Laterals)

A private sewer is defined as that portion of a side sewer connection beginning two feet outside the inner face of the wall and ending at the connection to the publicly owned sewer main. Private sewers for single connections shall be 6-inch diameter from the public main to the property line. Cleanouts shall be provided at the edge (property line) of the public right-of-way, utility easement, or the public sewer easement and at a distance of no more than 36 inches from the exterior wall of the structure. Maintenance of the private sewer is the responsibility of the property owner. A permit must be obtained from the City prior to connection, repair or modification to a private sewer.

Commercial, multi-family, industrial and all other non-single family properties shall have 6-inch side sewers from the property line to the building sewer. Side sewers for single family residences can be 4-inch diameter from the property line to the building sewer. The minimum slope for all side sewers is 2%. Side sewer slopes less than 2% require approval from the City Engineer.

Side sewer connections to new mains shall be made with a sweep 90 type tee. Connections to existing main shall be made with a machine tap and a fully gasketed sewer saddle, Romac Style "CB" sewer saddle or equivalent.

Side sewer trenches shall be bedded with clean sand. Bedding shall extend 6-inches below the invert and 4-inches above the crown of the pipe and shall extend the full width of the trench.

Inspection tees and cleanouts shall be installed not less than 6-inches and no more than 12-inches below final grade. Cleanouts shall be spaced at no more than 90-foot intervals and at each total change of 90 degrees of grade or alignment. Sanitary tees and/or wye type fittings are acceptable for cleanouts and inspection tees.

For new main construction each side sewer location shall be marked with a pressure treated 2x4 marker. The marker shall be a minimum of 4-feet long and shall extend a minimum of 1-foot above the ground surface. A 2x4 cleat shall be nailed to the bottom of marker to prevent withdrawal. Above the ground surface, the marker shall be painted "green" with "S/S" and the depth to the side sewer be indicated, in feet, stenciled in black letters 2-inches in height.

The City Engineer may authorize or require the construction of private laterals to serve more than one connection from a single property. Private laterals shall be designed and constructed to the same standard as public sewer mains. The minimum size for private laterals is 8-inches. Private laterals shall connect to the public system with a manhole and terminate with a manhole.

When the practicality of extension is limited, the City Engineer may at their discretion authorize the use of cleanouts for termination of 8-inch laterals no more than 150-feet from the nearest manhole.

Private side sewers shall not cross adjacent parcels without approval of the City Engineer. Easements for sewers crossing private property shall be filed with the County prior to installation. Side sewer connections shall be contained on the lot to be served and shall directly connect to the public main at the most practical frontage. Gravity connections are preferred and private pumps are to be avoided where possible. Where approved for use by the City Engineer, private pump systems shall be designed by a licensed professional engineer in accordance with the DOE "Criteria for Sewage Works Design" and Section 4.9. A schematic of a typical residential pump is shown in Standard Detail SS-2.

4.9 Pressure systems

Pressure sewer systems must meet site specific design criteria. The standards presented here are the minimum standards for pump stations and pressure sewers. Site specific criteria dictates that pump stations and force mains be designed to meet the basin needs. This information is generally intended to be schematic in order to illustrate the minimum necessary components and not to dictate layout or design. Due to changing technologies, the City Engineer may alter any presented design specifics at the time of the project design to serve the same or similar purposes intended by the information presented herein. All pressure systems require design by a licensed Professional Engineer. See section 4.8.5 for single family residential private pump requirements.

4.9.1 Pump systems

Pump systems shall be designed in accordance with the Department of Ecology's "Criteria for Sewage Works Design" Chapter C2-1 and C2-2.

The number of pumps shall not be less than two. Where only two pumps are provided, they shall be of the same type, size and capacity.

Pump stations smaller than 15 horsepower per pump shall have (suction lift pumps) and shall be of the type manufactured by Smith and Loveless, Inc. Equivalent systems by other manufacturers may be acceptable provided that the City's maintenance capabilities are compatible. Stations with higher than 15 horsepower per pump shall be designed on a case by case basis.

All pump stations shall have area lighting for security and maintenance purposes and a potable water service for wash down and flushing of wet well. In addttion the peak pumping capacity is defined as the capacity of the station with one of the pumps out of service.

An operations and maintenance manual shall be submitted to the City prior to acceptance of any new pump station.

4.9.2 Force Mains

Force Mains shall be designed in accordance with Department of Ecology's "Criteria for Sewage Works Design" Chapter C2-3.

The minimum size of force mains shall be 4-inches.

Pressure rated cleanouts shall be provided at 1,000 foot intervals. A cleaning pig device launching port shall be provided. A typical cleaning pig port consists of a 4-way cross with valving on three sides (one for the lines in from each pump and one for the force main out) and blind flange on the fourth.

4.9.3 Power

Pump stations shall be designed and built for the most efficient power use. Pump stations shall use 3 phase power supplies. Where 3 phase power is not available, phase converters shall be provided.

4.9.4 Controls

The pump controls and control panel shall include the following functions:

1. Hand-Off-Auto (H-O-A) selector switches for each pump.
2. Run lights. Lights to show that a pump is running, pump failure and high water in lift station shall be included in the station.
3. A high water alarm will be provided.
4. Auxiliary contacts for telemetry (telemetry by others).
5. Mini-CAS relay for moisture detection.

6. Elapsed time meters.
7. An ultrasonic level control device or mechanical floats shall be provided and set for lead pump on, lag pump on, high water alarm and pump off.
8. Phase monitor.
9. Dome light high water.
10. Inner door.
11. Wire diagrams.
12. Convenience outlet 110V 15 amps.
13. Manual transfer switch with a generator receptacle or on site generation.
14. Anti-condensation heaters.
15. An electronic alternator providing automatic alternation of the pumps under normal operating conditions and allowing both pumps to operate simultaneously if there are high inflow conditions.

4.9.5 Emergency backup

On site self contained diesel power generating equipment shall be provided for all lift stations where any single pump is rated at 20 horsepower or greater. On site generators shall include automatic transfer switching and generator exercising capabilities. In addition all lift stations, regardless of size, shall be equipped with an emergency bypass access point to allow for connection of a temporary portable bypass pump. The pig launching port described in Section 4.9.3 can also serve as the bypass port.

4.9.6 Security

Sufficient measures shall be provided to protect any lift station or waste water pump from unauthorized access, vandalism, theft, sabotage, terrorism etc. Security measures for all public lift stations shall include 24-hr remote monitoring including unauthorized entry and operation trouble alarms. The facility shall be located off the traffic way of streets and alleys. Security fencing and access hatches with locks shall be provided. Developers shall be responsible for all costs of installing and activating security monitoring. Developers shall be responsible for monitoring and power costs until the City formally accepts the improvement.

4.10 Inspections and Testing

4.10.1 Gravity Sewer

Prior to acceptance of the project, the gravity sewer pipe shall be subject to a low-pressure air test per WSDOT/APWA Standards Section 7-17.3(2). The Contractor shall furnish all equipment and personnel for conducting the test under the observation of the City inspector. The testing equipment shall be subject to the approval of the City.

The Contractor shall make an independent air test prior to notifying the City to witness the test. The acceptance air test shall be made after trench is backfilled and compacted and the roadway section is completed to subgrade.

Side sewer stubs shall be tested concurrent with main testing. All wyes, tees, and end of side sewer stubs shall be plugged with flexible joint caps, or acceptable alternates, securely fastened to withstand the internal test pressures. Such plugs or caps shall be readily removable and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.

Testing of the sewer main shall include a video camera inspection by the City. The cost for video camera inspection by the City shall be included in the sewer permit issued by the City of Oak Harbor Engineering Division. Video camera inspection shall be done after the air test has passed and before the roadway is paved. All utilities within the roadway area shall be installed and backfilled prior to video camera inspection. Sewer lines and manholes shall be cleaned and flushed as needed prior to video camera inspection. Immediately prior to a video camera inspection, enough water shall be run down the line so it comes out the lower manhole.

No ponding shall be permitted within any new sanitary sewer line.

The City may require infiltration, exfiltration or deflection testing where sewer facilities are constructed in areas of high groundwater, questionable soil conditions or when the construction methods are suspect.

4.10.2 Side Sewer

For new or planned construction, notice in writing must be given to the City Engineer's Inspector at his office by any person desiring to make connection with the public sewer 2 business days previous to the time of making such connection and to when such work will be ready for inspection.

Side sewers from the property line to the building shall be inspected and pressure tested prior to backfill. Side sewer pressure tests shall be air tested or exfiltration tested per WSDOT Standard Spec. 7-17.3(2).

An 8.5x 11 –inch record drawing shall be provided to the City inspector at the time of inspection. Side sewer record drawins shall indicate the building footprint, location and depth of side sewer and location and depths of cleanout.

4.10.3 Pressure Sewer

Pressure sewer systems and lift station shall be tested in accordance with WSDOT specifications and the recommendations contained in DOE "Criteria for Sewage Works Design" manual. Lift stations controls and alarms shall be tested prior to acceptance. The City Inspector shall be present to observe the controls and alarm testing. An operations and maintenance walk through shall be conducted by the design engineer for the benefit of City Maintenance crews upon successful completion of all pressure, control systems, and alarm systems testing. The O&M walk through shall include a description of the operation theory, maintenance schedules and an overview of the control panel operation.

4.11 Pretreatment

4.11.1 Application

As established by OHMC 14.09 Fat, Oils and Grease (FOG) pretreatment is required for many service connections. The following uses shall meet the requirements of this chapter whether or not they are otherwise required by state or federal law to engage in pretreatment actions:

1. Restaurants, school kitchens, cafes, butcher shops, delicatessens, lunch counters, cafeterias, bars, hospitals, nursing homes, senior centers, hotels with dish washing capabilities;
2. Hotels, grocery stores, factories, or other establishments that prepare, serve or sell food or related cleanup, where grease may be introduced to the sewer system.

Exceptions to required FOG pretreatment are restaurants, delicatessens, grocery stores, lunch counters, cafeterias, bars, clubs, hotels, hospitals, sanitariums, factories or school kitchens which meet all of the following criteria:

1. Do not do any preparation or cooking of meats and do no food cleanup of any sort; or
2. Which only use prepackaged foods and serve beverages.

See OHMC 14.09 BOD, TSS AND FOG CONTROL for more specific information.

4.12 Standard Details

Side sewer connection	SS-1
Residential sewage grinder pump	SS-2
Type I Manhole	SS-3
Type III Manhole	SS-4
Manhole Ladder	SS-5
Force Main Discharge Manhole	SS-6

4.13 Sewer plan checklist

4.13 Any item marked NO requires revision of plan set prior to approval

Y	N	
☐	☐	Existing main, side sewer connections and easements shown
☐	☐	Proposed main connections shown
☐	☐	Proposed facility [redacted] consistent with Comprehensive plan
☐	☐	Proposed new service is inside Sewer Utility Service Area
☐	☐	Calculation on design flow and capacity of new main included with plans
☐	☐	Is there adequate capacity in the downstream system
☐	☐	Is the proponent requesting a reimbursement agreement or city participation
☐	☐	If yes is there a regional benefit and has agreement been approved
☐	☐	New facilities are located in right or way or easement approved by City Engineer
☐	☐	Plan shows plan and profile with existing and proposed ground surface
☐	☐	Plan is prepared and stamped by a registered Engineer
☐	☐	Plan is to scale, legible, and identifies all existing structures and utilities
☐	☐	Applicable Oak Harbor standard details or equivalent are included in plans
☐	☐	New/Existing main extends frontage of all properties to be served
☐	☐	Are there private laterals to serve multiple buildings on one lot
☐	☐	Maintenance agreement in place for private lateral
☐	☐	Single side sewer connection to each lot shown
☐	☐	New main meets minimum size and slope requirements
☐	☐	Pipe type is specified and is acceptable
☐	☐	Manholes
☐	☐	400-ft max spacing
☐	☐	at end of all mains
☐	☐	at changes in grade or direction
☐	☐	at all street intersections
☐	☐	at change in diameter of pipe

- ❑ ❑ Drops are consistent with Oak harbor standard
- ❑ ❑ 6-inch side sewers shown with wye connection to main
- ❑ ❑ Side sewers stub outs meet minimum depth requirements
- ❑ ❑ Side sewers to serve property can connect with minimum 2% slope
- ❑ ❑ Typical trench section and backfill requirements are specified
- ❑ ❑ Oak Harbor General notes are included
- ❑ ❑ FOG pretreatment required
- ❑ ❑ pretreatment device is adequately designed and sized
- ❑ ❑ maintenance agreement in place
- ❑ ❑ Are there private single user grinder pumps proposed
  IF YES SPECIAL REVIEW IS REQUIRED
- ❑ ❑ Is there a large pump station
  IF YES SPECIAL REVIEW IS REQUIRED.

City of Oak Harbor

Comprehensive Sewer Plan

APPENDIX G
MODELING INPUT DATA AND RESULTS

December 2008

APPENDIX G.
CAPACITY ANALYSIS MODELING APPROACH

This appendix describes the software used for the General Sewer Plan capacity analysis, highlighting the specific software elements used to develop models for the Plan. It also presents the supporting calculations that were undertaken and a tabular version of the model output. It is intended that the appendix supplement rather than replace the need for relevant software training and reference to the Software Guide included in the Help menu.

MODELING SOFTWARE

SewerGEMS (Version 8.0 – release 01.01.013.00) by Bentley Software (formerly Haestad) was used for the modeling. The license purchased by the City allowed a model with up to 250 nodes (model nodes include manholes, pumps and junctions in force mains)

Platforms

The software can be operated either as a Stand-alone version or within a GIS platform. The stand alone version provides a graphical user interface with full model functionality. It also allows GIS shape files to be displayed as background images in the model plan view. However, this version does not permit editing of shape file information. This version is recommended for most users, particularly where GIS is not available or where GIS user training has not been provided. For the Stand-alone version, the model data is held in a database file (FILENAME.dbf, shown in Windows Explorer as a Microsoft Office Access Application) and information on its display is contained in the associated SWG file.

The City's license permits use of software in the GIS platform mode. This enables SewerGEMS to run within a GIS environment such as ArcGIS 9.1 with commands accessible through a SewerGEMS toolbar. Using the GIS platform version requires the model file to be attached to a personal geodatabase.

Details of the software operations referred to in the rest of this appendix describe the stand-alone version. While the general principals of operation apply to both platforms, the visual display operational elements vary between the two.

Maintenance

For subsequent use of the model, it is recommended that an annual maintenance agreement be obtained from Bentley in order to access technical support and to receive updates of the model software.

NETWORK CONSTRUCTION

To model the core of the system, information on pipes and manholes was entered into the model. Information was obtained from the City's sewer records, supplemented as necessary by as-built drawings provided by the City.

Pipes with diameter greater than 8 inches were included in the model, as well as main sewers with 8-inch diameter pipe. The model did not include the RBC Diversion Pump Station, the gravity sewer and siphon downstream of the pump station, or the marina network. The capacity analysis for these facilities did not warrant detailed modeling. The model also did not include the sewers in the Seaplane Base, which are not in City ownership.

A rationalization process was undertaken to reduce the number of manholes modeled. In general, only manholes at significant changes in diameter, direction or gradient were included in the model. Pipe lengths were adjusted to reflect the combination of sections.

Limited information on pump installations prevented inclusion of a number of pumps in the model. Where lift stations were not included explicitly in the model, their contributory flows were added to the downstream gravity flows. This assumes that reduced, continuous gravity flow will have an impact on the downstream collection system similar to that of higher but intermittent pumped flows. Model results were reviewed to determine whether this assumption was justified and whether downstream capacity could be significantly affected by the lift station flows.

Table G1 shows the hydraulic elements that were used in the model and summarizes the principal data fields relevant to each.

For examination of the major network alternative where a second diversion pump station would be installed close to the intersection of Whidbey Avenue and Ely Street, a new file was created and separate simulations were undertaken.

FLOW CALCULATIONS

The area within the city limits and within the urban growth area was subdivided into basins as shown in Figure G1. The basins were sized to be approximately 100 acres, and their boundaries were drawn with reference to sewer layout and topography.

Flow loads were calculated for each of these basins at each of the planning horizons using a Flow-Load Allocation Spreadsheet. Each basin was assigned a contributing manhole or wet well element where the flow load would enter the model network and best represent the impact on the sewer network. As the model was intended to facilitate the capacity analysis of the existing system, the model network was not extended geographically for future planning horizons. Rather those flow load basins representing future peripheral growth were assigned to manholes within the existing sewer network.

For each basin the residential and commercial flows were calculated and the amount of I/I estimated. The basis of these calculations is detailed in Chapter 5. Tables G2 through G5 show the Flow Load Allocation spreadsheet data used to determine the loads for 2005, 2011, 2025 and long term growth.

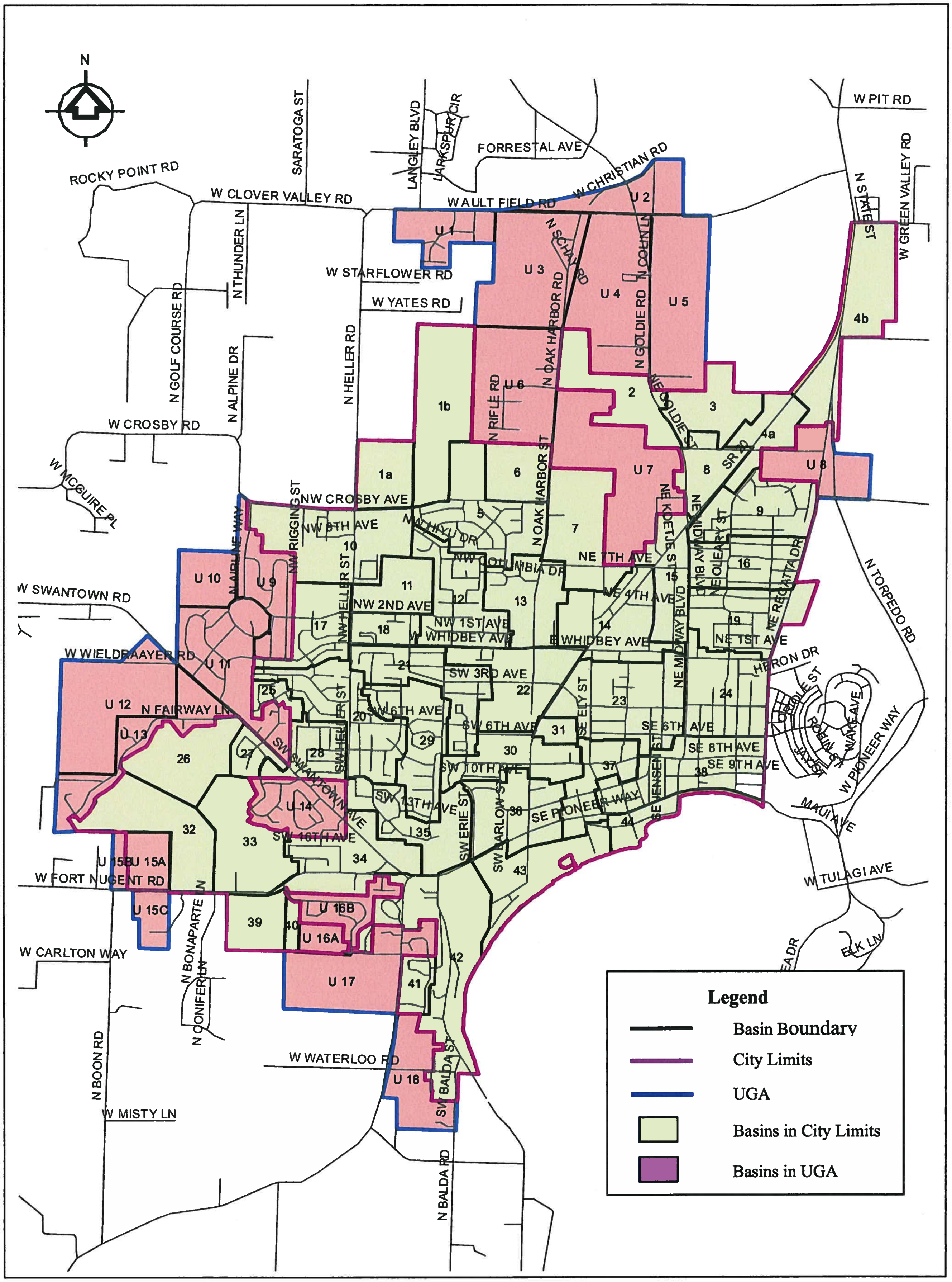
MODEL APPLICATION OF FLOWS

Three flow types were used in the model: residential flows, commercial flows and I/I flows. SewerGEMS fields and values used to generate the flows are described below.

Residential and Commercial Flows

Residential and commercial flows are generated by SewerGEMS using the following modeling parameters.

- A Unit Sanitary Load (UDL) was created for both of these flow types with the information shown in Table G6. A separate UDL was created for each planning horizon (2005, 2011, 2025 and long-term growth).



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City of Oak Harbor
COMPREHENSIVE SEWER PLAN

Figure G1.
MODELED BASINS WITHIN THE URBAN GROWTH BOUNDARY

TABLE G1.
MODEL ELEMENTS USED IN NETWORK CONSTRUCTION

Elements	Use/Purpose	Fields	Definition
Manhole	Manhole	Label	City's manhole naming convention used
		Ground elevation	The ground elevation for manhole
		Invert elevation	The elevation at the bottom of the manhole
		Diameter	The diameter of the manhole – manhole shape set to circular
		Sanitary loading	Flows associated with residential or commercial inputs
		Inflow collection	Flows associated with infiltration and inflow
Conduits / Pressure Pipes	Pipes / Force Mains	Start node ID	The manhole (pump or other element) where the pipe starts
		Stop node ID	The manhole (pump or other element) where the pipe ends
		Set invert to node	This option was selected so that the manhole invert data would be used to set the pipe invert elevations.
		Diameter	The internal pipe diameter
		User-defined length	In general, pipe lengths were entered from City records rather than determined from distances in plan view
		Manning's n	A measure of pipe roughness; 0.013 used in all cases
Outfall	Downstream Boundary Condition Used to Represent Diversion Pump Stations	Ground elevation	Ground elevation at the outfall node
		Invert elevation	The elevation at the bottom of the manhole.
		Boundary condition type	A free discharge was assumed for modeling purposes
Pump	Pump (where sufficient information permits and flow merits inclusion)	Elevation	The (bottom) elevation of the pump
		Suction element ID	The wet well node associated with the pump
		Pump	Refers to a table where the pump name, pump curve and pump control levels are specified Pump curve definitions set (see Analysis pull down menu)
		Downstream link	Displays the ID of the downstream link element to which the pump is connected.
Wet Well	Necessary Element Used in Conjunction with Pumps	Invert elevation	The invert, or bottom, elevation for the wet well
		Maximum depth	The maximum depth for the wet well
		Area	The cross sectional area of the wet well
		Initial elevation	Invert elevation was selected as the initial elevation
		Sanitary loading	Flows associated with residential or commercial input
		Inflow collection	Flows associated with infiltration and inflow
Pressure Junction	Element Used for Junctions Bends in Pressure Pipes	Ground elevation	Displays the ground elevation for manhole
		Invert elevation	The elevation at the bottom of the manhole

TABLE G6. UNIT SANITARY LOADS USED			
	Load Type	Units	Unit Load
Residential	Population	Capita	50.0
Commercial	Discharge Units	Gallons per Day	1.0

- The relevant flow was entered in the Sanitary Load Input Field (in the manhole or wet well flex table). The estimated population was entered for the residential contribution and the estimated commercial flow was entered for commercial contribution.
- The Load Pattern permits the input of diurnal flow patterns or peaking factors. Load patterns were created for both sanitary and commercial flows with a constant peaking factor over a 4-hour period (the duration of the simulations).
- The Pattern Setup enabled combinations of UDLs and load patterns.

Inflow and Infiltration

I/I was entered in the Inflow Collection Field in the Manhole or Wet Well flex tables. A fixed flow was used for I/I inputs so that this flow component was constant throughout the individual simulations.

MODEL SIMULATIONS

Individual model simulations are referred to by SewerGEMS as scenarios. The Scenario Manager window facilitates creating and running the individual scenarios. Scenarios combine Alternatives and Calculation Options to create distinct simulations.

SewerGEMS uses the concept of Alternatives to represent the basic building blocks used in a Scenario. Table G7 shows the principal Alternatives. It also permits creating "child" scenarios that retain the majority of contributing components while facilitating alteration of some of them.

TABLE G7. PRINCIPAL SEWERGEMS ALTERNATIVES	
Alternative	Purpose
Physical Alternative	The physical layout of pipes and manholes. Different Physical Alternatives were used to reflect increases in pipe size associated with proposed upgrading measures. Note: When modifications to the layout other than for pipe size were required, a new file was used rather than a new alternative.
Base Boundary Condition	Reflects the condition used at the outfall / model boundary. This was kept constant for the Scenarios
Infiltration and Inflow Alternative	Different alternatives allowed for the loadings associated with different planning horizons to be applied
Sanitary Loading Alternative	Different alternatives allowed for the loadings associated with different planning horizons to be applied

Table G2: 2005 Flow Allocation Spreadsheet

												2005 Hydraulic Loading						
Basin No.	2000 Census Population	Additional Population	I/I Characteristic	Total Area Resid	% of Resid Area Developed	Net Resid Area (for I/I) (acres)	Gross Area Com/Ind (acres)	Undevelopable Area	% of Com/Ind Developed	% Connected	Net Com/Ind Area	Total Population	Commercial Load (gpd)	Other Load (gpd)	Other Load Note	I/I Area	I/I (gpd)	Load Node
1a	175	148	L	33.05	100.00	30.00	0.00		100	100	0	323	0			30	30,000	22-067
1b	0	0	L	26.62	100.00	30.00	75.69		0	100	0	0	0				30,000	20-024
2	59	0	L	0.00	100.00	0.00	21.78	4.01	0	100	0	59	0			0	0	23-010
3	0	0	L	0.00	100.00	0.00	8.72		100	100	10	0	5,000		Pub Works; Public	10	10,000	23-010
4a	72	0	L	3.66	100.00	0.00	38.91		40	100	20	72	10,000			20	20,000	17-043
4b				0.00		0.00	87.85		40	0	0							23-010
5	1118	441	L	98.64	100.00	100.00	0.04		100	100	0	1559	0			100	100,000	20-024
6	203	409	L	30.01	100.00	30.00	9.83		100	100	10	612	5,000			40	40,000	20-077
7	828	180	L	46.55	100.00	50.00	10.65	0.76	100	100	10	1008	5,000			60	60,000	19-012B
8	139	0	L	0.00	100.00	0.00	84.66		50	100	40	139	20,000			40	40,000	18-023
9	555	0	L	67.71	100.00	70.00	7.94		100	100	10	555	5,000			80	80,000	17-033
10	335	0	L	117.83	70.00	80.00	0.00		100	100	0	335	0			80	80,000	22-045AT
11	108	0	L	0.40	100.00	0.00	0.00		100	100	0	108	0	19,460	School High Schoo	0	0	22-013
12	696	0	L	84.38	100.00	80.00	0.01		100	100	0	696	0			80	80,000	21-018
13	783	0	L	55.79	100.00	60.00	4.56		100	100	0	783	0			60	60,000	20-010
14	602	0	L	36.08	100.00	40.00	31.41		100	100	30	602	15,000	2,051	ool N Whidbey Mi	70	70,000	19-019
15	245	0	L	0.00	100.00	0.00	57.94		100	100	60	245	30,000			60	60,000	18-018
16	530	0	L	59.53	100.00	60.00	7.12		100	100	10	530	5,000			70	70,000	17-005
17	316	0	L	38.68	75.00	30.00	0.00		100	100	0	316	0	3,323	School Hillcrest	30	30,000	22-020
18	141	0	L	26.71	100.00	30.00	0.00		100	100	0	141	0			30	30,000	22-008
19	483	0	H	60.95	100.00	60.00	5.48		100	100	10	483	5,000	3,691	School Olympic Vie	70	112,000	16-002
20	824	0	L	77.02	100.00	80.00	15.11		100	100	20	824	10,000			100	100,000	13-037
21	596	0	L	79.23	100.00	80.00	2.02		100	100	0	596	0			80	80,000	13-004
22	444	73	L	37.83	100.00	40.00	30.74		100	100	30	517	15,000	1,165	OH Mid. Sch.	70	70,000	12-004
23	594	0	H	73.79	100.00	70.00	18.59	0.48	100	100	20	594	10,000	662	El. Sch.	90	144,000	15-003
24	693	0	H	46.43	100.00	50.00	15.79		100	100	20	693	10,000			70	112,000	15-012
25	115	0	L	15.65	100.00	20.00	0.00		100	100	0	115	0			20	20,000	25-018
26	73	0	L	73.78	100.00	70.00	0.00		100	100	0	73	0			70	70,000	WW 28-030
27	83	0	L	20.23	100.00	20.00	0.00		100	100	0	83	0			20	20,000	WW 28-030
28	415	0	L	44.49	100.00	40.00	0.00		100	100	0	415	0			40	40,000	28-001
29	775	0	L	25.29	100.00	30.00	40.15		100	100	40	775	20,000	3,495	Bvd El. Sch.	70	70,000	13-024
30	451	0	L	52.21	100.00	50.00	12.19	0.86	100	100	10	451	5,000			60	60,000	07-015
31	14	0	H	0.00	100.00	0.00	12.63	1.38	100	100	10	14	5,000			10	16,000	WW 12-013
32	74	0	L	91.24	100.00	90.00	0.00		100	100	0	74	0			90	90,000	WW 28-030
33	88	769	L	86.18	100.00	90.00	0.00		100	100	0	857	0			90	90,000	WW 28-030
34	538	89	L	85.93	100.00	90.00	0.01		100	100	0	627	0			90	90,000	08-039
35	515	0	L	73.24	100.00	70.00	3.04		100	100	0	515	0			70	70,000	08-008
36	148	0	H	4.57	100.00	0.00	73.47		100	100	70	148	35,000			70	112,000	07-004
37	354	0	H	19.95	100.00	20.00	30.34		100	100	30	354	15,000		Public facility inclu	50	80,000	06-015
38	723	0	H	56.74	100.00	60.00	40.13		100	100	40	723	20,000		Public facility inclu	100	160,000	05-002
39	0	0	L	0.08	100.00	0.00	0.00		100	100	0	0	0			0	0	-
40	0	94	L	9.17	100.00	10.00	0.00		100	100	0	94	0			10	10,000	WW 08-129
41	115	0	L	22.35	100.00	20.00	0.00		100	100	0	115	0			20	20,000	26-007
42	382	0	L	17.89	100.00	20.00	1.24		100	100	0	382	0			20	20,000	08-031
43	124	0	L	27.76	100.00	30.00	7.22		100	100	10	124	5,000			40	40,000	01-012
44	30	0	H	0.02	100.00	0.00	18.39		100	100	20	30	10,000			20	32,000	02-020
	15556						773.65				530	17,759	265,000			2,300	2,618,000	

Table G3: 2011 Flow Allocation Spreadsheet

Current Basin No.	2005 Population	Add Pop Unit (05-11)	Add Pop (05-11)	I/I Characteristic	Gross Area Resid	Undevelopable Area	% of Resid Area Developed	% Connected	Net Resid Area (for I/I) (acres)	Gross Area Com/Ind (acres)	Undevelopable Area	% of Com/Ind Developed	% Connected	Net Com/Ind Area	2011 Hydraulic Loading Total Served Population	Commercial Load (gpd)	Other Load (gpd)	Other Load Note	I/I Area	I/I (gpd)	Load Node
1a	323	139	374	L	33.05	1.87	100.00	100	30	0.00		100	100	0	697	0			30	30,000	22-067
1b					26.62	1.87	100.00	100	20	75.69		100	101	80	0	40,000			100	160,000	20-024
2	59			L	0.00		100.00	100	0	21.78	4.01	100	100	20	59	10,000			20	20,000	23-010
3	0			L	0.00		100.00	100	0	8.72		100	100	10	0	5,000		Pub Works: Public facility included in commerial a	10	10,000	23-010
4a	72			L	3.66		100.00	100	0	38.91		100	100	40	72	20,000			40	40,000	17-043
4b					0.00		100.00	100	0	87.85		100	0	0	0	0			0	0	23-010
5	1559	35	94	L	98.64		100.00	100	100	0.04		100	100	0	1653	0			100	100,000	20-024
6	612	48	129	L	30.01		100.00	100	30	9.83		100	100	10	741	5,000			40	40,000	20-077
7	1008	39	105	L	46.55	3.56	100.00	100	40	10.65	0.76	100	100	10	1113	5,000			50	50,000	19-012B
8	139			L	0.00		100.00	100	0	84.66		100	100	80	139	40,000			80	80,000	18-023
9	555			L	67.71		100.00	100	70	7.94		100	100	10	555	5,000			80	80,000	17-033
10	335	374	1006	L	117.83		70.00	100	80	0.00		100	100	0	1341	0			80	80,000	22-045AT
11	108			L	0.40		100.00	100	0	0.00		100	100	0	108	0	19,460	School High School	0	0	22-013
12	696	1	3	L	84.38		100.00	100	80	0.01		100	100	0	699	0			80	80,000	21-018
13	783	42	113	L	55.79		100.00	100	60	4.56		100	100	0	896	0			60	60,000	20-010
14	602			L	36.08	0.01	100.00	100	40	31.41		100	100	30	602	15,000	2,051	School N Whidbey Middle	70	70,000	19-019
15	245			L	0.00		100.00	100	0	57.94		100	100	60	245	30,000			60	60,000	18-018
16	530			L	59.53		100.00	100	60	7.12		100	100	10	530	5,000			70	70,000	17-005
17	316	0	0	L	38.68		75.00	100	30	0.00		100	100	0	316	0	3,323	School Hillcrest	30	30,000	22-020
18	141			L	26.71		100.00	100	30	0.00		100	100	0	141	0			30	30,000	22-008
19	483	21	56	H	60.95		100.00	100	60	5.48		100	100	10	539	5,000	3,691	School Olympic View	70	112,000	16-002
20	824			L	77.02		100.00	100	80	15.11		100	100	20	824	10,000			100	100,000	13-037
21	596			L	79.23		100.00	100	80	2.02		100	100	0	596	0			80	80,000	13-004
22	517			L	37.83		100.00	100	40	30.74		100	100	30	517	15,000	1,165	OH Mid. Sch.	70	70,000	12-004
23	594			H	73.79		100.00	100	70	18.59	0.48	100	100	20	594	10,000	662	El. Sch.	90	144,000	15-003
24	693	2	5	H	46.43		100.00	100	50	15.79		100	100	20	698	10,000			70	112,000	15-012
25	115			L	15.65		100.00	100	20	0.00		100	100	0	115	0			20	20,000	25-018
26	73			L	73.78	1.92	100.00	100	70	0.00		100	100	0	73	0			70	70,000	WW 28-030
27	83			L	20.23	0.49	100.00	100	20	0.00		100	100	0	83	0			20	20,000	WW 28-030
28	415			L	44.49		100.00	100	40	0.00		100	100	0	415	0			40	40,000	28-001
29	775			L	25.29		100.00	100	30	40.15		100	100	40	775	20,000	3,495	Bvd El. Sch.	70	70,000	13-024
30	451			L	52.21	0.30	100.00	100	50	12.19	0.86	100	100	10	451	5,000			60	60,000	07-015
31	14			H	0.00		100.00	100	0	12.63	1.38	100	100	10	14	5,000			10	16,000	WW 12-013
32	74			L	91.24	15.92	100.00	100	80	0.00		100	100	0	74	0			80	80,000	WW 28-030
33	857			L	86.18	6.39	100.00	100	80	0.00		100	100	0	857	0			80	80,000	WW 28-030
34	627	215	578	L	85.93		100.00	100	90	0.01		100	100	0	1205	0			90	90,000	08-039
35	515	231	621	L	73.24		100.00	100	70	3.04		100	100	0	1136	0			70	70,000	08-008
36	148	0	0	H	4.57	0.00	100.00	100	0	73.47		100	100	70	148	35,000			70	112,000	07-004
37	354			H	19.95		100.00	100	20	30.34		100	100	30	354	15,000		Public facility included in commerial area	50	80,000	06-015
38	723			H	56.74		100.00	100	60	40.13		100	100	40	723	20,000		Public facility included in commerial area	100	160,000	05-002
39	0			L	0.08		100.00	100	0	0.00		100	100	0	0	0			0	0	-
40	94	0	0	L	9.17	0.60	100.00	100	10	0.00		100	100	0	94	0			10	10,000	WW 08-129
41	115	0	0	L	22.35	1.62	100.00	100	20	0.00		100	100	0	115	0			20	20,000	26-007
42	382	219	589	L	17.89		100.00	100	20	1.24		100	100	0	971	0			20	20,000	08-031
43	124	44	118	L	27.76	3.04	100.00	100	20	7.22		100	100	10	242	5,000			30	30,000	01-012
44	30	40	108	H	0.02		100.00	100	0	18.39		100	100	20	138	10,000			20	32,000	02-020
U1				L	0.00		100.00	100	0	47.59		20	0	0	0	0			0	0	23-010
U2		0	0	L	0.00		100.00	100	0	54.54	8.14	20	0	0	0	0			0	0	23-010
U3				L	0.00		100.00	100	0	124.87	0.40	0	100	0	0	0			0	0	23-010
U4				L	0.00		100.00	100	0	134.31	10.84	20	100	20	0	10,000			20	20,000	23-010
U5				L	0.00		100.00	100	0	120.71		20	100	20	0	10,000			20	20,000	23-010
U6				L	0.00		100.00	100	0	116.76		0	100	0	0	0			0	0	20-077
U7				L	0.00		100.00	100	0	143.76	59.69	0	100	0	0	0			0	0	19-012B
U8				L	0.00		100.00	100	0	60.38	10.17	0	100	0	0	0			0	0	23-010
U9		38	102	L	8.51		100.00	100	10	0.00		100	100	0	102	0			10	10,000	22-045AT
U10				L	0.00	0.37	100.00	100	0	0.00		100	100	0	0	0			0	0	22-045AT
U11				L	0.00		100.00	100	0	0.00		100	100	0	0	0			0	0	28-001
U12				L	0.00		100.00	100	0	0.00		100	100	0	0	0			0	0	28-001
U13				L	0.00		100.00	100	0	0.00		100	100	0	0	0			0	0	28-001
U14				L	0.00		100.00	100	0	0.00		100	100	0	0	0			0	0	08-085
U15a*		190	511	L	30.71		100.00	100	30	0.00		100	100	0	511	0			30	30,000	WW 28-030
U15b*		40	108	L	10.19		100.00	100	10	0.00		100	100	0	108	0			10	10,000	WW 28-030
U15c*				L	0.00	3.31	100.00	100	0	0.00		100	100	0	0	0			0	0	WW 28-030
U16a*	6	50	135	L	15.19	6.79	100.00	100	10	0.00		100	100	0	141	0			10	10,000	08-058
U16b*		0	0	L	0.04	0.04	100.00	100	0	0.00		100	100	0	0	0			0	0	08-058
U17		17	46	L	10.25	6.32	100.00	100	0	0.00		100	100	0	46	0			0	0	26-021
U18		190	511	L	57.47	0.55	100.00	100	60	0.00		100	100	0	511	0			60	60,000	26-021
	17765	1975	3427												23,078	365,000	33,847			2,948,000	

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Table G4: 2025 Flow Allocation Spreadsheet

																	2025 Hydraulic Loading						
Basin No.	2000 Census Population	Add Pop Unit (00-05)	Add Pop (00-05)	Add Pop Unit (05-25)	Add Pop (05-25)	I/I Characteristic	Gross Area Resid	Undevelopable Area	% of Resid Area Developed	% Connected	Net Resid Area (for I/I) (acres)	Gross Area Com/Ind (acres)	Undevelopable Area	% of Com/Ind Developed	% Connected	Net Com/Ind Area	Total Served Population	Commercial Load (gpd)	Other Load (gpd)	Other Load Note	I/I Area	I/I (gpd)	Load Node
1a	175	55	148	139	278	L	33.05	1.87	100.00	100	30	0.00		100	100	0	601	0			30	30,000	22-067
1b						L			100.00	100	0	75.69		100	100	80	0	40,000			80	80,000	20-024
2	59	0	0			L	0.00		100.00	100	0	21.78	4.01	100	100	20	59	10,000			20	20,000	23-010
3	0	0	0			L	0.00		100.00	100	0	8.72		100	100	10	0	5,000		Pub Works; Public facility included in commeri	10	10,000	23-010
4a	72	0	0			L	3.66		100.00	100	0	38.91		100	100	40	72	20,000			40	40,000	17-043
4b						L	0.00		100.00	100	0	87.85		100	0	0	0	0			0	0	23-010
5	1118	164	441	30	60	L	98.64		100.00	100	100	0.04		100	100	0	1619	0			100	100,000	20-024
6	203	152	409	48	96	L	30.01		100.00	100	30	9.83		100	100	10	708	5,000			40	40,000	20-077
7	828	67	180	50	100	L	46.55	3.56	100.00	100	40	10.65	0.76	100	100	10	1108	5,000			50	50,000	19-012B
8	139	0	0			L	0.00		100.00	100	0	84.66		100	100	80	139	40,000			80	80,000	18-023
9	555	0	0	16	32	L	67.71		100.00	100	70	7.94		100	100	10	587	5,000			80	80,000	17-033
10	335	0	0	374	748	L	117.83		70.00	100	80	0.00		100	100	0	1083	0			80	80,000	22-045AT
11	108	0	0			L	0.40		100.00	100	0	0.00		100	100	0	108	0	19,460	School High School	0	0	22-013
12	696	0	0	7	14	L	84.38		100.00	100	80	0.01		100	100	0	710	0			80	80,000	21-018
13	783	0	0	49	98	L	55.79		100.00	100	60	4.56		100	100	0	881	0			60	60,000	20-010
14	602	0	0	1	2	L	36.08	0.01	100.00	100	40	31.41		100	100	30	604	15,000	2,051	School N Whidbey Middle	70	70,000	19-019
15	245	0	0	41	82	L	0.00		100.00	100	0	57.94		100	100	60	327	30,000			60	60,000	18-018
16	530	0	0	6	12	L	59.53		100.00	100	60	7.12		100	100	10	542	5,000			70	70,000	17-005
17	316	0	0	0	0	L	38.68		75.00	100	30	0.00		100	100	0	316	0	3,323	School Hillcrest	30	30,000	22-020
18	141	0	0			L	26.71		100.00	100	30	0.00		100	100	0	141	0			30	30,000	22-008
19	483	0	0	25	50	H	60.95		100.00	100	60	5.48		100	100	10	533	5,000	3,691	School Olympic View	70	112,000	16-002
20	824	0	0	0	0	L	77.02		100.00	100	80	15.11		100	100	20	824	10,000			100	100,000	13-037
21	596	0	0	9	18	L	79.23		100.00	100	80	2.02		100	100	0	614	0			80	80,000	13-004
22	444	27	73	7	14	L	37.83		100.00	100	40	30.74		100	100	30	531	15,000	1,165	OH Mid. Sch.	70	70,000	12-004
23	594	0	0	127	254	H	73.79		100.00	100	70	18.59	0.48	100	100	20	848	10,000	662	El. Sch.	90	144,000	15-003
24	693	0	0	9	18	H	46.43		100.00	100	50	15.79		100	100	20	711	10,000			70	112,000	15-012
25	115	0	0	0	0	L	15.65		100.00	100	20	0.00		100	100	0	115	0			20	20,000	25-018
26	73	0	0	0	0	L	73.78	1.92	100.00	100	70	0.00		100	100	0	73	0			70	70,000	WW 28-030
27	83	0	0	0	0	L	20.23	0.49	100.00	100	20	0.00		100	100	0	83	0			20	20,000	WW 28-030
28	415	0	0	0	0	L	44.49		100.00	100	40	0.00		100	100	0	415	0			40	40,000	28-001
29	775	0	0	2	4	L	25.29		100.00	100	30	40.15		100	100	40	779	20,000	3,495	Bvd El. Sch.	70	70,000	13-024
30	451	0	0	58	116	L	52.21	0.30	100.00	100	50	12.19	0.86	100	100	10	567	5,000			60	60,000	07-015
31	14	0	0	0	0	H	0.00		100.00	100	0	12.63	1.38	100	100	10	14	5,000			10	16,000	WW 12-013
32	74	0	0	0	0	L	91.24	15.92	100.00	100	80	0.00		100	100	0	74	0			80	80,000	WW 28-030
33	86	286	769	0	0	L	86.18	6.39	100.00	100	80	0.00		100	100	0	857	0			80	80,000	WW 28-030
34	538	33	89	192	384	L	85.93		100.00	100	90	0.01		100	100	0	1011	0			90	90,000	08-039
35	515	0	0	231	462	L	73.24		100.00	100	70	3.04		100	100	0	977	0			70	70,000	08-008
36	148	0	0	3	6	H	4.57	0.00	100.00	100	0	73.47		100	100	70	154	35,000			70	112,000	07-004
37	354	0	0	59	118	H	19.95		100.00	100	20	30.34		100	100	30	472	15,000		Public facility included in commerial area	50	80,000	06-015
38	723	0	0	49	98	H	56.74		100.00	100	60	40.13		100	100	40	821	20,000		Public facility included in commerial area	100	160,000	05-002
39	0	0	0			L	0.08		100.00	100	0	0.00		100	100	0	0	0			0	0	-
40	0	35	94	0	0	L	9.17	0.60	100.00	100	10	0.00		100	100	0	94	0			10	10,000	WW 08-129
41	115	0	0	4	8	L	22.35	1.62	100.00	100	20	0.00		100	100	0	123	0			20	20,000	26-007
42	382	0	0	236	472	L	17.89		100.00	100	20	1.24		100	100	0	854	0			20	20,000	08-031
43	124	0	0	47	94	L	27.76	3.04	100.00	100	20	7.22		100	100	10	218	5,000			30	30,000	01-012
44	30	0	0	60	120	H	0.02		100.00	100	0	18.39		100	100	20	150	10,000			20	32,000	02-020
U1				0	0	L	0.00		100.00	100	0	47.59		0	100	0	0	0			0	0	23-010
U2				0	0	L	0.00		100.00	100	0	54.54	8.14	0	100	0	0	0			0	0	23-010
U3				0	0	L	0.00		100.00	100	0	124.87	0.40	0	100	0	0	0			0	0	23-010
U4				0	0	L	0.00		100.00	100	0	134.31	10.84	20	100	20	0	10,000			20	20,000	23-010
U5				0	0	L	0.00		100.00	100	0	120.71		20	100	20	0	10,000			20	20,000	23-010
U6				0	0	L	0.00		100.00	100	0	116.76		40	100	50	0	25,000			50	50,000	20-077
U7				0	0	L	0.00		100.00	100	0	143.76	59.69	20	100	20	0	10,000			20	20,000	19-012B
U8				0	0	L	0.00	10.17	100.00	100	-10	60.38	10.17	20	100	10	0	5,000			0	0	23-010
U9				40	72	L	65.05		100.00	100	70	0.00		100	100	0	72	0			70	70,000	22-045AT
U10				157	282.6	L	38.63	0.37	100.00	100	40	0.00		100	100	0	283	0			40	40,000	22-045AT
U11				53	95.4	L	108.26		100.00	100	110	0.00		100	100	0	95	0			110	110,000	28-001
U12				387	696.6	L	126.59		100.00	100	130	0.00		100	100	0	697	0			130	130,000	28-001
U13				97	174.6	L	71.81		100.00	100	70	0.00		100	100	0	175	0			70	70,000	28-001
U14				3	5.4	L	61.96		100.00	100	60	0.00		100	100	0	5	0			60	60,000	08-085
U15a*				190	342	L	30.71		100.00	100	30	0.00		100	100	0	342	0			30	30,000	WW 28-030
U15b*				40	72	L	10.19		100.00	100	10	0.00		100	100	0	72	0			10	10,000	WW 28-030
U15c*				80	144	L	22.63	3.31	100.00	100	20	0.00		100	100	0	144	0			20	20,000	WW 28-030
U16a*				50	90	L	16.20	6.79	100.00	100	10	0.00		100	100	0	90	0			10	10,000	08-058
U16b*				1	1.8	L	38.08	0.04	100.00	100	40	0.00		100	100	0	2	0			40	40,000	08-058
U17				318	572.4	L	103.32	6.32	100.00	100	100	0.00		100	100	0	572	0			100	100,000	26-021
U18				190	342	L	61.06	0.55	100.00	100	60	0.00		100	100	0	342	0			60	60,000	26-021
				3,485	**6,649**							1576.58				810	24,408	405,000	33,847			3,568,000	

Table G5: Long Term Growth Flow Allocation Spreadsheet

														Long Term Growth Hydraulic Loading						
Current Basin No.	Long Term Growth Unit	Long Term Growth Population	I/I Characteristic	Gross Area Resid	Undevelopable Area	% of Resid Area Developed	% Connected	Net Resid Area (for I/I) (acres)	Gross Area Com/Ind (acres)	Undevelopable Area	% of Com/Ind Developed	% Connected	Net Com/Ind Area	Total Served Population	Commercial Load (gpd)	Other Load (gpd)	Other Load Note	I/I Area	I/I (gpd)	Load Node
1a	822.22	2212	L	33.05	1.87	100.00	100.00	30	0.00		100	100.00	0	2212	0			30	30,000	22-067
1b			L	26.62		100.00	100.00	30	75.69		100	100.00	80	0	120,000			110	110,000	20-024
2	0.00	0	L	0.00		100.00	100.00	0	21.78	4.01	100	100.00	20	0	30,000			20	20,000	23-010
3	0.00	0	L	0.00		100.00	100.00	0	8.72		100	100.00	10	0	15,000		Pub Works; Public facility included in commer	10	10,000	23-010
4a	80.41	216	L	3.66		100.00	100.00	0	38.91		100	100.00	40	216	60,000			40	40,000	17-043
4b			L	0.00		100.00	100.00	0	87.85		100	100.00	90	0	135,000			90	90,000	23-010
5	917.83	2469	L	98.64		100.00	100.00	100	0.04		100	100.00	0	2469	0			100	100,000	20-024
6	360.94	971	L	30.01		100.00	100.00	30	9.83		100	100.00	10	971	15,000			40	40,000	20-077
7	768.51	2067	L	46.55	3.56	100.00	100.00	40	10.65	0.76	100	100.00	10	2067	15,000			50	50,000	19-012B
8	0.00	0	L	0.00		100.00	100.00	0	84.66		100	100.00	80	0	120,000			80	80,000	18-023
9	406.27	1093	L	67.71		100.00	100.00	70	7.94		100	100.00	10	1093	15,000			80	80,000	17-033
10	1015.50	2732	L	117.83		70.00	100.00	80	0.00		100	100.00	0	2732	0			80	80,000	22-045AT
11	2.38	6	L	0.40		100.00	100.00	0	0.00		100	100.00	0	6	0	19,460	School High School	0	0	22-013
12	506.37	1362	L	84.38		100.00	100.00	80	0.01		100	100.00	0	1362	0			80	80,000	21-018
13	773.08	2080	L	55.79		100.00	100.00	60	4.56		100	100.00	0	2080	0			60	60,000	20-010
14	324.40	873	L	36.08	0.01	100.00	100.00	40	31.41		100	100.00	30	873	45,000	2,051	School N Whidbey Middle	70	70,000	19-019
15	0.00	0	L	0.00		100.00	100.00	0	57.94		100	100.00	60	0	90,000			60	60,000	18-018
16	357.16	961	L	59.53		100.00	100.00	60	7.12		100	100.00	10	961	15,000			70	70,000	17-005
17	232.41	625	L	38.68		75.00	100.00	30	0.00		100	100.00	0	625	0	3,323	School Hillcrest	30	30,000	22-020
18	239.57	644	L	26.71		100.00	100.00	30	0.00		100	100.00	0	644	0			30	30,000	22-008
19	410.05	1103	H	60.95		100.00	100.00	60	5.48		100	100.00	10	1103	15,000	3,691	School Olympic View	70	112,000	16-002
20	552.81	1487	L	77.02		100.00	100.00	80	15.11		100	100.00	20	1487	30,000			100	100,000	13-037
21	475.54	1279	L	79.23		100.00	100.00	80	2.02		100	100.00	0	1279	0			80	80,000	13-004
22	565.52	1521	L	37.83		100.00	100.00	40	30.74		100	100.00	30	1521	45,000	1,165	OH Mid. Sch.	70	70,000	12-004
23	557.28	1499	H	73.79		100.00	100.00	70	18.59	0.48	100	100.00	20	1499	30,000	662	El. Sch.	90	144,000	15-003
24	279.97	753	H	46.43		100.00	100.00	50	15.79		100	100.00	20	753	30,000			70	112,000	15-012
25	93.92	253	L	15.65		100.00	100.00	20	0.00		100	100.00	0	253	0			20	20,000	25-018
26	442.68	1191	L	73.78	1.92	100.00	100.00	70	0.00		100	100.00	0	1191	0			70	70,000	WW 28-030
27	121.37	326	L	20.23	0.49	100.00	100.00	20	0.00		100	100.00	0	326	0			20	20,000	WW 28-030
28	266.95	718	L	44.49		100.00	100.00	40	0.00		100	100.00	0	718	0			40	40,000	28-001
29	392.64	1056	L	25.29		100.00	100.00	30	40.15		100	100.00	40	1056	60,000	3,495	Bvd El. Sch.	70	70,000	13-024
30	523.78	1409	L	52.21	0.30	100.00	100.00	50	12.19	0.86	100	100.00	10	1409	15,000			60	60,000	07-015
31	0.00	0	H	0.00		100.00	100.00	0	12.63	1.38	100	100.00	10	0	15,000			10	16,000	WW 12-013
32	547.45	1473	L	91.24	15.92	100.00	100.00	80	0.00		100	100.00	0	1473	0			80	80,000	WW 28-030
33	517.07	1391	L	86.18	6.39	100.00	100.00	80	0.00		100	100.00	0	1391	0			80	80,000	WW 28-030
34	1165.96	3136	L	85.93		100.00	100.00	90	0.01		100	100.00	0	3136	0			90	90,000	08-039
35	805.40	2167	L	73.24		100.00	100.00	70	3.04		100	100.00	0	2167	0			70	70,000	08-008
36	99.75	268	H	4.57	0.00	100.00	100.00	0	73.47		100	100.00	70	268	105,000			70	112,000	07-004
37	534.30	1437	H	19.95		100.00	100.00	20	30.34		100	100.00	30	1437	45,000		Public facility included in commerial area	50	80,000	06-015
38	1370.22	3686	H	56.74		100.00	100.00	60	40.13		100	100.00	40	3686	60,000		Public facility included in commerial area	100	160,000	05-002
39	0.47	1	L	0.08		100.00	100.00	0	0.00		100	100.00	0	1	0			0	0	-
40	55.04	148	L	9.17	0.60	100.00	100.00	10	0.00		100	100.00	0	148	0			10	10,000	WW 08-129
41	134.10	361	L	22.35	1.62	100.00	100.00	20	0.00		100	100.00	0	361	0			20	20,000	26-007
42	333.63	897	L	17.89		100.00	100.00	20	1.24		100	100.00	0	897	0			20	20,000	08-031
43	238.03	640	L	27.76	3.04	100.00	100.00	20	7.22		100	100.00	10	640	15,000			30	30,000	01-012
44	405.06	1090	H	0.02		100.00	100.00	0	18.39		100	100.00	20	1090	30,000			20	32,000	02-020
U1	0.00	0	L	0.00		100.00	100.00	0	47.59		100	100.00	50	0	75,000			50	50,000	23-010
U2	0.00	0	L	0.00		100.00	100.00	0	54.54	8.14	100	100.00	50	0	75,000			50	50,000	23-010
U3	0.00	0	L	0.00		100.00	100.00	0	124.87	0.40	100	100.00	120	0	180,000			120	120,000	23-010
U4	0.00	0	L	0.00		100.00	100.00	0	134.31	10.84	100	100.00	120	0	180,000			120	120,000	23-010
U5	0.00	0	L	0.00		100.00	100.00	0	120.71		100	100.00	120	0	180,000			120	120,000	23-010
U6	0.00	0	L	0.00		100.00	100.00	0	116.76		100	100.00	120	0	180,000			120	120,000	20-077
U7	0.00	0	L	0.00		100.00	100.00	0	143.76	59.69	100	100.00	80	0	120,000			80	80,000	19-012B
U8	0.00	0	L	0.00	10.17	100.00	100.00	-10	60.38	10.17	100	100.00	50	0	75,000			40	40,000	23-010
U9	390.32	1050	L	65.05		100.00	100.00	70	0.00		100	100.00	0	1050	0			70	70,000	22-045AT
U10	231.80	624	L	38.63	0.37	100.00	100.00	40	0.00		100	100.00	0	624	0			40	40,000	22-045AT
U11	649.55	1747	L	108.26		100.00	100.00	110	0.00		100	100.00	0	1747	0			110	110,000	28-001
U12	1467.97	3949	L	126.59		100.00	100.00	130	0.00		100	100.00	0	3949	0			130	130,000	28-001
U13	430.87	1159	L	71.81		100.00	100.00	70	0.00		100	100.00	0	1159	0			70	70,000	28-001
U14	371.77	1000	L	61.96		100.00	100.00	60	0.00		100	100.00	0	1000	0			60	60,000	08-085
U15a*	184.23	496	L	30.71		100.00	100.00	30	0.00		100	100.00	0	496	0			30	30,000	WW 28-030
U15b*	61.16	165	L	10.19		100.00	100.00	10	0.00		100	100.00	0	165	0			10	10,000	WW 28-030
U15c*	135.81	365	L	22.63	3.31	100.00	100.00	20	0.00		100	100.00	0	365	0			20	20,000	WW 28-030
U16a*	97.22	262	L	16.20	6.79	100.00	100.00	10	0.00		100	100.00	0	262	0			10	10,000	08-058
U16b*	228.50	615	L	38.08	0.04	100.00	100.00	40	0.00		100	100.00	0	615	0			40	40,000	08-058
U17	619.94	1668	L	103.32	6.32	100.00	100.00	100	0.00		100	100.00	0	1668	0			100	100,000	26-021
U18	366.38	986	L	61.06	0.55	100.00	100.00	60	0.00		100	100.00	0	986	0			60	60,000	26-021
Sum	22931.58	61686							1576.58					61686	2,235,000	33,847			4,278,000	

SewerGEMS refers to its Calculation Options when running a scenario. In general, default values were used. However, the simulation time was set to 4 hours. In addition, the Pattern Setup was set in the Calculation Options window, which was important for determining correct flow application.

MODEL CALIBRATION

In order to determine the accuracy of the spreadsheet used to allocate flows, flow records at the treatment plant were examined. No single flow meter provided a record of the total flows from the sewer network in the City Proper, so estimating flows required a synthesis of flows at the RBC Treatment Plant, the Seaplane Lagoon Plant and the two meters recording inflows from the Seaplane Base.

The analysis estimated the peak wet-weather flow arriving at the bottom of the sewer network in the City Proper. It also provided an estimate of the I/I component experienced in the City. The results of the analysis, summarized in Table G8, indicate that the model output represents a suitable match to the historical data for use in a planning-level capacity analysis.

TABLE G8.
COMPARISON OF RECORDED FLOWS AT ENTRANCE TO THE RBC DIVERSION PUMP STATION WITH PEAK FLOW ESTIMATED IN THE FLOW ALLOCATION SPREADSHEET

Flow Type	Flow Records (mgd)	Flow Allocation Spreadsheet Estimate for 2005 (mgd)
Maximum Peak Hour Flow	6.0[a]	6.1
Peak I/I Component	2.0[b]	2.6

a. Estimated from maximum flow at Seaplane Lagoon Plant of 6.9 mgd (February 4, 1999 and December 16, 1999), excluding estimate of peak-hour flow from the Seaplane Base contribution.
b. Peak-day maximum I/I in record; information on peak-hour flow was not available.

After it was confirmed that the estimate of peak-hour flow was similar to peak flows observed in the historical data, the peak flows estimated by the model at the entrance to the RBC Diversion Pump Station were also checked. These also showed a good match. This quality control check was also undertaken for the 2011, 2025 and long term growth scenarios.

The metering information available did not permit calibration of flows in other parts of the sewer network. However, the census block and land use data did provide a high quality of information and permitted a satisfactory degree of confidence in the flow distribution throughout the network.

MODEL RESULTS DISPLAY

SewerGEMS provided a number of methods to review of the results of the model simulations:

- The Element Symbology Window (analogous to the ArcGIS legend) permits the application of color coding to manholes, pipes and other hydraulic elements in the Plan View, based on element properties including scenario results. For example, this permitted a visual review of such metrics as the flow rate in pipes or the sanitary loads at manholes. Note that for time-variable properties such as pipe flow, it is important to use the Animation Control. The Element Symbology Window also permits text information to be displayed on the Plan View.

- SewerGEMS permits selection of profiles along sections of the sewer network. A series of standard profiles was generated during the modeling process, and these have been included with the model files.
- Results can be viewed in tabular form by using the Flex Tables (referred to as Element Tables). The results for the 2005, 2011, 2025 and long-term growth scenarios for Alternative 1 (as described in Chapter 7) are shown in Tables G9 through G12. The results from the 2011, 2025 and long-term growth scenarios for Alternative 2 (also described in Chapter 7) are shown in Tables G13 through G15.

Table G9: 2005 Conduit Results of Peak Hour Flows for Alternative 1

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
55: MH-17-043	56: MH-17-041	268.22	262.08	330	8	0.06	1.07	5.7	412
56: MH-17-041	79: MH-17-039	262.08	242.06	498	8	0.06	1.57	3.9	413
58: MH-17-046	56: MH-17-041	268.66	262.08	185	8	0	1.47	0	59
60: MH-17-047	58: MH-17-046	271.45	268.66	309	8	0	0.74	0	426
62: MH-17-049	60: MH-17-047	280.46	271.45	554	8	0	1	0	425
64: MH-17-051	62: MH-17-049	286.41	280.46	443	8	0	0.91	0	424
79: MH-17-039	81: MH-17-033	242.06	240.51	451.8	8	0.06	0.46	13.3	414
81: MH-17-033	83: MH-17-032	240.51	220.28	315	8	0.24	1.98	12.1	415
83: MH-17-032	85: MH-17-031	220.28	212.1	195	8	0.24	1.6	14.9	86
85: MH-17-031	87: MH-17-028	212.1	209.4	270	8	0.24	0.78	30.6	417
87: MH-17-028	89: MH-17-027	209.4	202.78	172	8	0.24	1.53	15.6	418
89: MH-17-027	91: MH-17-026	202.78	202.29	266	8	0.24	0.34	71.3	419
91: MH-17-026	93: MH-17-025	202.29	191.61	270	8	0.24	1.55	15.4	420
93: MH-17-025	105: MH-17-002	191.61	190.23	146	8	0.24	0.76	31.5	421
105: MH-17-002	107: MH-17-001	190.23	186.87	467.6	10	0.4	1.2	33.6	422
107: MH-17-001	576: MH-18-010	186.87	177.32	348.75	12	0.61	3.81	16.1	577
109: MH-16-001	107: MH-17-001	192.11	186.87	195	12	0.21	3.77	5.6	110
111: MH-16-002	109: MH-16-001	194.75	192.11	400	10	0.21	1.15	18.3	112
113: MH-17-005	105: MH-17-002	235.75	190.23	911.5	8	0.16	1.75	9.4	114
115: MH-17-012	113: MH-17-005	237.47	235.75	124	8	0	0.92	0	116
119: MH-18-001	146: MH-19-019	165.72	157.55	1323.3	12	0.4	1.81	22.2	147
119: MH-18-001	121: MH-19-012	165.72	162	317.3	12	0.55	2.49	22.2	122
121: MH-19-012	139: MH-19-002	162	154.77	1590.2	12	0.78	1.55	50.2	140
139: MH-19-002	141: MH-19-022	154.77	153.35	673	12	0.78	1.06	73.7	142
141: MH-19-022	143: MH-06-056	153.35	151.77	220	12	1.39	1.95	71.4	144
143: MH-06-056	161: MH-06-030	151.77	140.61	1282.4	15	2.85	3.89	73.2	162
146: MH-19-019	141: MH-19-022	157.55	153.35	900	12	0.61	1.57	39	148
151: MH-20-004	143: MH-06-056	157.6	151.77	847	18	1.46	5.63	25.9	152
153: MH-20-005	151: MH-20-004	163.23	157.6	597	18	1.46	6.59	22.1	154
155: MH-20-010	153: MH-20-005	180.6	163.23	1515	10	0.84	1.52	55.3	156
157: MH-20-024	155: MH-20-010	188.27	180.6	1060	10	0.66	1.2	54.8	158
159: MH-20-026	157: MH-20-024	191.76	188.27	583.5	10	0.3	1.1	27.1	160
161: MH-06-030	163: MH-06-025	140.61	139.71	320	15	2.83	2.21	127.8	164
163: MH-06-025	165: MH-06-024	139.71	138.11	300	15	2.83	3.05	92.8	166
165: MH-06-024	167: MH-06-015	138.11	136.53	653.5	15	3.34	2.05	162.8	168
167: MH-06-015	169: MH-06-011	136.53	124.7	691.9	15	3.52	5.46	64.5	170
169: MH-06-011	171: MH-06-007	124.7	109.73	518	15	3.52	7.1	49.6	172
171: MH-06-007	173: MH-06-003	109.73	97.16	558	15	3.52	6.27	56.2	174
173: MH-06-003	175: MH-06-002	97.16	96.27	420	21	4.94	4.71	104.7	176
175: MH-06-002	405: MH-06-001	96.27	96	165	24	6.32	5.91	106.8	439
179: MH-02-004	494: MH-02-003	99.45	98.81	110	10	0.39	1.08	36.3	495
181: MH-02-009	179: MH-02-004	101.25	99.45	410	10	0.39	0.94	41.8	182
183: MH-02-020	368: MH-02-015	106.05	102.25	800	10	0.39	0.98	40.2	409
189: MH-07-004	173: MH-06-003	103.2	97.16	1317.8	15	1.42	2.83	50.1	190
191: MH-07-012	189: MH-07-004	108.01	103.2	537	12	1.03	2.18	47.2	192
193: MH-07-013	191: MH-07-012	116.48	108.01	436	10	1.03	1.97	52.1	194
195: MH-07-015	193: MH-07-013	127.37	116.48	607.2	10	1.03	1.9	54.3	196
197: MH-11-006	195: MH-07-015	132.8	127.37	664.5	10	0.89	1.28	69.3	198
199: MH-01-009	175: MH-06-002	99.52	96.27	1047	18	0.99	3.78	26.1	200
201: MH-01-012	199: MH-01-009	103.21	99.52	628	18	0.99	5.2	18.9	202
203: MH-01-013	201: MH-01-012	103.58	103.21	135	18	0.91	3.55	25.6	204
205: MH-08-022	203: MH-01-013	104.32	103.58	322	18	0.91	3.25	28	206
207: MH-08-023	205: MH-08-022	104.76	104.32	169	18	0.9	3.46	26.1	208
209: MH-08-016	497: MH-08-026	112.54	111.25	172.63	15	0.95	3.61	26.2	499
215: MH-08-031	339: MH-08-027	170.9	118	872	15	0.95	10.28	9.2	374
217: MH-08-032	215: MH-08-031	187	170.9	360	15	0.85	8.83	9.6	218
219: MH-08-033	217: MH-08-032	193	187	189	15	0.83	7.44	11.2	220
221: MH-08-060	219: MH-08-033	244.1	193	767.9	8	0.04	2.01	1.8	222
223: MH-08-058	221: MH-08-060	248.9	244.1	390.18	8	0.04	0.87	4.3	224
225: MH-08-048	223: MH-08-058	251.21	248.9	209.8	8	0.04	0.82	4.5	226
229: MH-26-001	225: MH-08-048	262.52	251.21	692.4	8	0.04	1	3.7	862
231: MH-26-002	229: MH-26-001	265.68	262.52	195	8	0.04	0.99	3.7	232
233: MH-26-004	231: MH-26-002	268.14	265.68	452	8	0.04	0.58	6.5	234
239: MH-21-002	153: MH-20-005	179.13	163.23	696	8	0.62	1.18	52.6	435
247: MH-21-015	239: MH-21-002	195.5	179.13	531	8	0.62	1.37	45.3	324
260: MH-21-018	247: MH-21-015	211.14	195.5	705	8	0.62	1.16	53.4	261
262: MH-21-023	260: MH-21-018	237.5	211.14	918	8	0.44	1.32	33	263
264: MH-22-002	262: MH-21-023	245.14	237.5	595	8	0.44	0.88	49.3	265
266: MH-22-003	264: MH-22-002	245.79	245.14	130	8	0.44	0.55	79	267
268: MH-22-007	266: MH-22-003	246.62	245.79	165	8	0.44	0.55	78.8	269
270: MH-22-008	268: MH-22-007	247.55	246.62	75	8	0.44	0.87	50.2	271
272: MH-22-009	270: MH-22-008	248.6	247.55	332	8	0.39	0.44	87.7	273
274: MH-22-010	272: MH-22-009	249.82	248.6	215	8	0.39	0.59	65.5	275
282: MH-22-045AT	365: MH-22-036	267.48	266.25	378.78	12	0.21	1.31	15.9	367
286: MH-22-063	351: MH-22-061	270.92	269.61	881.98	12	0.08	0.89	8.8	352

Table G9: 2005 Conduit Results of Peak Hour Flows for Alternative 1

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
290: MH-08-039	219: MH-08-033	209	193	828	15	0.78	5.8	13.5	291
292: MH-08-054	290: MH-08-039	214.21	209	802.1	8	0.02	0.63	3.9	293
294: MH-08-055	292: MH-08-054	215.37	214.21	264.3	8	0	0.52	0	295
296: MH-08-082	294: MH-08-055	216.79	215.37	119.07	8	0	0.85	0	297
298: MH-08-057	296: MH-08-082	225.92	216.79	327.24	8	0	1.3	0	299
300: MH-08-093	298: MH-08-057	259.8	225.92	461	8	0	2.12	0	301
302: MH-08-091	300: MH-08-093	275.8	259.8	367	8	0	1.63	0	303
304: MH-08-096	302: MH-08-091	289	275.8	476	8	0	1.3	0	305
312: MH-08-042	500: MH-08-041	225.1	224	350	16	0.7	2.78	25.1	502
316: MH-28-001	503: MH-08-085	246.94	227.64	1124.6	15	0.46	5.47	8.4	505
339: MH-08-027	209: MH-08-016	118	112.54	42	15	0.95	15.05	6.3	340
351: MH-22-061	282: MH-22-045A	269.61	267.48	580.56	12	0.08	1.39	5.6	353
363: MH-22-034	558: MH-22-013	261.02	253.72	456.78	8	0.21	0.99	21.1	559
365: MH-22-036	363: MH-22-034	266.25	261.02	545.3	8	0.21	0.76	27.3	366
368: MH-02-015	181: MH-02-009	102.25	101.25	225	10	0.39	0.94	41.6	369
375: MH-26-005	233: MH-26-004	268.61	268.14	73	8	0.04	0.63	5.9	376
377: MH-26-007	375: MH-26-005	272.9	268.61	431	8	0.04	0.78	4.8	378
383: MH-28-002	316: MH-28-001	253.02	246.94	205	15	0.67	7.19	9.3	384
405: MH-06-001	725: 01-001TP	96	94.7	343.94	24	6.32	8.99	70.3	731
432: MH-22-012	274: MH-22-010	251.91	249.82	378.75	8	0.39	0.58	66.4	434
436: MH-05-001	183: MH-02-020	113.78	106.05	379.48	10	0.33	2.02	16.3	438
482: MH-17-017	115: MH-17-012	292.8	237.47	1384.8	8	0	1.56	0	484
494: MH-02-003	175: MH-06-002	98.81	96.27	500	12	0.39	1.64	23.9	496
497: MH-08-026	936: MH-08-025	111.25	106.28	253	15	0.94	5.85	16	937
500: MH-08-041	290: MH-08-039	224	209	651	15	0.64	6.34	10.1	501
503: MH-08-085	312: MH-08-042	227.64	225.1	477	16	0.51	3.62	14	504
546: MH-22-075	547: MH-22-067	280	279	432.04	12	0	1.11	0	548
547: MH-22-067	286: MH-22-063	279	270.92	801.44	12	0.08	2.31	3.4	549
550: MH-20-079	551: MH-20-077	207	192	467.36	8	0.07	1.4	4.8	552
551: MH-20-077	159: MH-20-026	192	191.76	789.72	8	0.3	0.14	217.9	553
554: MH-22-022	555: MH-22-020	273.35	254.15	569	8	0.01	1.43	0.5	556
555: MH-22-020	432: MH-22-012	254.15	251.91	347	8	0.1	0.63	16.2	557
558: MH-22-013	432: MH-22-012	253.72	251.91	798.03	8	0.28	0.37	76.2	562
563: MH-23-010	564: MH-18-023	223.7	190.36	1282.8	8	0.03	1.26	2.7	565
564: MH-18-023	566: MH-18-020	190.36	179	710	8	0.15	0.99	15.7	567
566: MH-18-020	568: MH-18-018	179	168.31	675.4	8	0.15	0.98	15.7	569
568: MH-18-018	119: MH-18-001	168.31	165.72	645.3	8	0.34	0.49	69	570
576: MH-18-010	119: MH-18-001	177.32	165.72	527.5	12	0.61	3.41	18	578
582: MH-15-012	583: MH-15-011	181.3	179.1	322	8	0.25	0.65	38.1	584
583: MH-15-011	597: MH-15-006	179.1	175.4	524.1	8	0.25	0.66	37.5	598
586: MH-13-001	587: MH-11-009	172.07	165.3	230	8	0.68	1.34	50.7	588
587: MH-11-009	197: MH-11-006	165.3	132.8	1234	8	0.68	1.27	53.6	589
590: MH-12-026	592: MH-12-004	157.98	150.05	310	8	0.01	1.25	0.4	593
592: MH-12-004	608: MH-12-002A	150.05	140.6	501	8	0.21	1.07	19.3	609
597: MH-15-006	602: MH-15-005	175.4	169.7	295	8	0.25	1.09	22.7	603
602: MH-15-005	605: MH-15-003	169.7	158.4	566	8	0.25	1.1	22.3	606
605: MH-15-003	165: MH-06-024	158.4	138.11	783.3	8	0.51	1.26	40.7	607
608: MH-12-002A	197: MH-11-006	140.6	132.8	672	8	0.21	0.84	24.6	610
611: MH-13-037	612: MH-13-024	243	198.5	1025	8	0.25	1.63	15.6	613
612: MH-13-024	656: MH-13-006	198.5	198.03	72	8	0.51	0.63	80.9	657
614: MH-13-004	586: MH-13-001	173.11	172.07	187	8	0.68	0.58	116.7	621
622: MH-25-018	623: MH-28-043	250	248	241.97	8	0.04	0.71	5.2	624
623: MH-28-043	625: MH-28-037	248	229.22	329.51	8	0.04	1.86	2	626
625: MH-28-037	627: MH-28-035	229.22	216.01	234.7	8	0.04	1.85	2	628
627: MH-28-035	793: WW-28-030	216.01	169.6	530.8	8	0.04	2.31	1.6	797
632: MH-08-008	633: MH-07-006	172.15	106.04	1908	10	0.15	2.64	5.6	634
633: MH-07-006	189: MH-07-004	106.04	103.2	550	8	0.15	0.56	26.2	635
636: MH-05-009	638: MH-05-004	116.5	116	511.4	10	0	0.44	0	639
638: MH-05-004	640: MH-05-003	116	115.4	494.8	12	0	0.8	0	641
640: MH-05-003	642: MH-05-002	115.4	114.5	384.5	12	0	1.11	0	643
642: MH-05-002	436: MH-05-001	114.5	113.78	324.6	15	0.33	1.97	16.8	646
656: MH-13-006	614: MH-13-004	198.03	173.11	530	8	0.51	1.69	30.1	658
774: MH-17-046	55: MH-17-043	274	268.22	276.25	8	0	1.13	0	775
936: MH-08-025	207: MH-08-023	106.28	104.76	660	18	0.91	3.26	27.9	939
942: MH-26-021	943: MH-08-021	204	120	1776.64	8	0	1.7	0	944
943: MH-08-021	945: MH-08-019	120	113.97	469.89	8	0	0.88	0	946
945: MH-08-019	947: MH-08-018	113.97	113.79	60	8	0	0.43	0	948
947: MH-08-018	209: MH-08-016	113.79	112.54	437.94	8	0	0.42	0	949

Results File: S:\GIS\3530009 Oak Harbor Sewer Plan\Model\Model Submitted\OH Sewers.swg

Table G10: 2011 Conduit Results of Peak Hour Flows for Alternative 1

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
55: MH-17-043	56: MH-17-041	268.22	262.08	330	8	0.11	1.07	10.4	412
56: MH-17-041	79: MH-17-039	262.08	242.06	498	8	0.11	1.57	7.1	413
58: MH-17-046	56: MH-17-041	268.66	262.08	185	8	0	1.47	0	59
60: MH-17-047	58: MH-17-046	271.45	268.66	309	8	0	0.74	0	426
62: MH-17-049	60: MH-17-047	280.46	271.45	554	8	0	1	0	425
64: MH-17-051	62: MH-17-049	286.41	280.46	443	8	0	0.91	0	424
79: MH-17-039	81: MH-17-033	242.06	240.51	451.8	8	0.11	0.46	24.2	414
81: MH-17-033	83: MH-17-032	240.51	220.28	315	8	0.29	1.98	14.6	415
83: MH-17-032	85: MH-17-031	220.28	212.1	195	8	0.29	1.6	18.1	86
85: MH-17-031	87: MH-17-028	212.1	209.4	270	8	0.29	0.78	37	417
87: MH-17-028	89: MH-17-027	209.4	202.78	172	8	0.29	1.53	18.9	418
89: MH-17-027	91: MH-17-026	202.78	202.29	266	8	0.29	0.34	86.2	419
91: MH-17-026	93: MH-17-025	202.29	191.61	270	8	0.29	1.55	18.6	420
93: MH-17-025	105: MH-17-002	191.61	190.23	146	8	0.29	0.76	38.1	421
105: MH-17-002	107: MH-17-001	190.23	186.87	467.6	10	0.45	1.2	37.8	422
107: MH-17-001	576: MH-18-010	186.87	177.32	348.75	12	0.67	3.81	17.6	577
109: MH-16-001	107: MH-17-001	192.11	186.87	195	12	0.22	3.77	5.8	110
111: MH-16-002	109: MH-16-001	194.75	192.11	400	10	0.22	1.15	19	112
113: MH-17-005	105: MH-17-002	235.75	190.23	911.5	8	0.16	1.75	9.4	114
115: MH-17-012	113: MH-17-005	237.47	235.75	124	8	0	0.92	0	116
119: MH-18-001	146: MH-19-019	165.72	157.55	1323.3	12	0.53	1.81	29.4	147
119: MH-18-001	121: MH-19-012	165.72	162	317.3	12	0.73	2.49	29.4	122
121: MH-19-012	139: MH-19-002	162	154.77	1590.2	12	0.96	1.55	62.1	140
139: MH-19-002	141: MH-19-022	154.77	153.35	673	12	0.96	1.06	91.2	142
141: MH-19-022	143: MH-06-056	153.35	151.77	220	12	1.71	1.95	87.5	144
143: MH-06-056	161: MH-06-030	151.77	140.61	1282.4	15	3.86	3.89	99	162
146: MH-19-019	141: MH-19-022	157.55	153.35	900	12	0.74	1.57	47.2	148
151: MH-20-004	143: MH-06-056	157.6	151.77	847	18	2.15	5.63	38.1	152
153: MH-20-005	151: MH-20-004	163.23	157.6	597	18	2.16	6.59	32.7	154
155: MH-20-010	153: MH-20-005	180.6	163.23	1515	10	1.29	1.52	84.9	156
157: MH-20-024	155: MH-20-010	188.27	180.6	1060	10	1.09	1.2	90.7	158
159: MH-20-026	157: MH-20-024	191.76	188.27	583.5	10	0.3	1.1	27.8	160
161: MH-06-030	163: MH-06-025	140.61	139.71	320	15	3.84	2.21	173.5	164
163: MH-06-025	165: MH-06-024	139.71	138.11	300	15	3.85	3.05	126.3	166
165: MH-06-024	167: MH-06-015	138.11	136.53	653.5	15	4.37	2.05	212.7	168
167: MH-06-015	169: MH-06-011	136.53	124.7	691.9	15	4.56	5.46	83.4	170
169: MH-06-011	171: MH-06-007	124.7	109.73	518	15	4.57	7.1	64.4	172
171: MH-06-007	173: MH-06-003	109.73	97.16	558	15	4.58	6.27	73.1	174
173: MH-06-003	175: MH-06-002	97.16	96.27	420	21	6.07	4.71	128.8	176
175: MH-06-002	405: MH-06-001	96.27	96	165	24	7.94	5.91	134.3	439
179: MH-02-004	494: MH-02-003	99.45	98.81	110	10	0.41	1.08	38.3	495
181: MH-02-009	179: MH-02-004	101.25	99.45	410	10	0.41	0.94	44	182
183: MH-02-020	368: MH-02-015	106.05	102.25	800	10	0.41	0.98	42.3	409
189: MH-07-004	173: MH-06-003	103.2	97.16	1317.8	15	1.51	2.83	53.3	190
191: MH-07-012	189: MH-07-004	108.01	103.2	537	12	1.03	2.18	47.1	192
193: MH-07-013	191: MH-07-012	116.48	108.01	436	10	1.03	1.97	52	194
195: MH-07-015	193: MH-07-013	127.37	116.48	607.2	10	1.03	1.9	54.1	196
197: MH-11-006	195: MH-07-015	132.8	127.37	664.5	10	0.88	1.28	69	198
199: MH-01-009	175: MH-06-002	99.52	96.27	1047	18	1.46	3.78	38.5	200
201: MH-01-012	199: MH-01-009	103.21	99.52	628	18	1.47	5.2	28.3	202
203: MH-01-013	201: MH-01-012	103.58	103.21	135	18	1.4	3.55	39.3	204
205: MH-08-022	203: MH-01-013	104.32	103.58	322	18	1.39	3.25	42.8	206
207: MH-08-023	205: MH-08-022	104.76	104.32	169	18	1.38	3.46	39.8	208
209: MH-08-016	497: MH-08-026	112.54	111.25	172.63	15	1.26	3.61	34.8	499
215: MH-08-031	339: MH-08-027	170.9	118	872	15	1.13	10.28	11	374
217: MH-08-032	215: MH-08-031	187	170.9	360	15	1.02	8.83	11.5	218
219: MH-08-033	217: MH-08-032	193	187	189	15	1.05	7.44	14.1	220
221: MH-08-060	219: MH-08-033	244.1	193	767.9	8	0.07	2.01	3.4	222
223: MH-08-058	221: MH-08-060	248.9	244.1	390.18	8	0.07	0.87	7.9	224
225: MH-08-048	223: MH-08-058	251.21	248.9	209.8	8	0.04	0.82	4.5	226
229: MH-26-001	225: MH-08-048	262.52	251.21	692.4	8	0.04	1	3.7	862
231: MH-26-002	229: MH-26-001	265.68	262.52	195	8	0.04	0.99	3.7	232
233: MH-26-004	231: MH-26-002	268.14	265.68	452	8	0.04	0.58	6.5	234
239: MH-21-002	153: MH-20-005	179.13	163.23	696	8	0.86	1.18	72.8	435
247: MH-21-015	239: MH-21-002	195.5	179.13	531	8	0.86	1.37	62.6	324
260: MH-21-018	247: MH-21-015	211.14	195.5	705	8	0.86	1.16	73.8	261
262: MH-21-023	260: MH-21-018	237.5	211.14	918	8	0.67	1.32	50.9	263
264: MH-22-002	262: MH-21-023	245.14	237.5	595	8	0.67	0.88	76.2	265
266: MH-22-003	264: MH-22-002	245.79	245.14	130	8	0.67	0.55	122.1	267
268: MH-22-007	266: MH-22-003	246.62	245.79	165	8	0.67	0.55	121.7	269
270: MH-22-008	268: MH-22-007	247.55	246.62	75	8	0.67	0.87	77.5	271
272: MH-22-009	270: MH-22-008	248.6	247.55	332	8	0.62	0.44	141.9	273
274: MH-22-010	272: MH-22-009	249.82	248.6	215	8	0.62	0.59	105.9	275
282: MH-22-045AT	365: MH-22-036	267.48	266.25	378.78	12	0.44	1.31	33.6	367
286: MH-22-063	351: MH-22-061	270.92	269.61	881.98	12	0.13	0.89	15.2	352

Table G10: 2011 Conduit Results of Peak Hour Flows for Alternative 1

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
290: MH-08-039	219: MH-08-033	209	193	828	15	1.07	5.8	18.4	291
292: MH-08-054	290: MH-08-039	214.21	209	802.1	8	0.04	0.63	5.7	293
294: MH-08-055	292: MH-08-054	215.37	214.21	264.3	8	0.05	0.52	9.6	295
296: MH-08-082	294: MH-08-055	216.79	215.37	119.07	8	0.04	0.85	4.9	297
298: MH-08-057	296: MH-08-082	225.92	216.79	327.24	8	0.03	1.3	2.4	299
300: MH-08-093	298: MH-08-057	259.8	225.92	461	8	0.01	2.12	0.7	301
302: MH-08-091	300: MH-08-093	275.8	259.8	367	8	0	1.63	0	303
304: MH-08-096	302: MH-08-091	289	275.8	476	8	0	1.3	0	305
312: MH-08-042	500: MH-08-041	225.1	224	350	16	0.67	2.78	24	502
316: MH-28-001	503: MH-08-085	246.94	227.64	1124.6	15	0.96	5.47	17.6	505
339: MH-08-027	209: MH-08-016	118	112.54	42	15	1.11	15.05	7.4	340
351: MH-22-061	282: MH-22-045A	269.61	267.48	580.56	12	0.13	1.39	9.6	353
363: MH-22-034	558: MH-22-013	261.02	253.72	456.78	8	0.44	0.99	44.7	559
365: MH-22-036	363: MH-22-034	266.25	261.02	545.3	8	0.44	0.76	57.7	366
368: MH-02-015	181: MH-02-009	102.25	101.25	225	10	0.41	0.94	43.8	369
375: MH-26-005	233: MH-26-004	268.61	268.14	73	8	0.04	0.63	5.9	376
377: MH-26-007	375: MH-26-005	272.9	268.61	431	8	0.04	0.78	4.8	378
383: MH-28-002	316: MH-28-001	253.02	246.94	205	15	0.77	7.19	10.7	384
405: MH-06-001	725: 01-001TP	96	94.7	343.94	24	7.94	8.99	88.3	731
432: MH-22-012	274: MH-22-010	251.91	249.82	378.75	8	0.62	0.58	107.4	434
436: MH-05-001	183: MH-02-020	113.78	106.05	379.48	10	0.33	2.02	16.3	438
482: MH-17-017	115: MH-17-012	292.8	237.47	1384.8	8	0	1.56	0	484
494: MH-02-003	175: MH-06-002	98.81	96.27	500	12	0.41	1.64	25.2	496
497: MH-08-026	936: MH-08-025	111.25	106.28	253	15	1.26	5.85	21.6	937
500: MH-08-041	290: MH-08-039	224	209	651	15	0.79	6.34	12.5	501
503: MH-08-085	312: MH-08-042	227.64	225.1	477	16	0.57	3.62	15.7	504
546: MH-22-075	547: MH-22-067	280	279	432.04	12	0	1.11	0	548
547: MH-22-067	286: MH-22-063	279	270.92	801.44	12	0.13	2.31	5.8	549
550: MH-20-079	551: MH-20-077	207	192	467.36	8	0.07	1.4	4.8	552
551: MH-20-077	159: MH-20-026	192	191.76	789.72	8	0.3	0.14	224	553
554: MH-22-022	555: MH-22-020	273.35	254.15	569	8	0.01	1.43	0.8	556
555: MH-22-020	432: MH-22-012	254.15	251.91	347	8	0.11	0.63	17.1	557
558: MH-22-013	432: MH-22-012	253.72	251.91	798.03	8	0.52	0.37	138.6	562
563: MH-23-010	564: MH-18-023	223.7	190.36	1282.8	8	0.18	1.26	14.6	565
564: MH-18-023	566: MH-18-020	190.36	179	710	8	0.4	0.99	41	567
566: MH-18-020	568: MH-18-018	179	168.31	675.4	8	0.4	0.98	41.2	569
568: MH-18-018	119: MH-18-001	168.31	165.72	645.3	8	0.59	0.49	119.5	570
576: MH-18-010	119: MH-18-001	177.32	165.72	527.5	12	0.67	3.41	19.7	578
582: MH-15-012	583: MH-15-011	181.3	179.1	322	8	0.25	0.65	38.2	584
583: MH-15-011	597: MH-15-006	179.1	175.4	524.1	8	0.25	0.66	37.6	598
586: MH-13-001	587: MH-11-009	172.07	165.3	230	8	0.68	1.34	50.7	588
587: MH-11-009	197: MH-11-006	165.3	132.8	1234	8	0.68	1.27	53.6	589
590: MH-12-026	592: MH-12-004	157.98	150.05	310	8	0.01	1.25	0.4	593
592: MH-12-004	608: MH-12-002A	150.05	140.6	501	8	0.2	1.07	18.9	609
597: MH-15-006	602: MH-15-005	175.4	169.7	295	8	0.25	1.09	22.7	603
602: MH-15-005	605: MH-15-003	169.7	158.4	566	8	0.25	1.1	22.4	606
605: MH-15-003	165: MH-06-024	158.4	138.11	783.3	8	0.51	1.26	40.6	607
608: MH-12-002A	197: MH-11-006	140.6	132.8	672	8	0.2	0.84	24.2	610
611: MH-13-037	612: MH-13-024	243	198.5	1025	8	0.25	1.63	15.6	613
612: MH-13-024	656: MH-13-006	198.5	198.03	72	8	0.51	0.63	80.9	657
614: MH-13-004	586: MH-13-001	173.11	172.07	187	8	0.68	0.58	116.7	621
622: MH-25-018	623: MH-28-043	250	248	241.97	8	0.04	0.71	5.2	624
623: MH-28-043	625: MH-28-037	248	229.22	329.51	8	0.04	1.86	2	626
625: MH-28-037	627: MH-28-035	229.22	216.01	234.7	8	0.04	1.85	2	628
627: MH-28-035	793: WW-28-030	216.01	169.6	530.8	8	0.04	2.31	1.6	797
632: MH-08-008	633: MH-07-006	172.15	106.04	1908	10	0.24	2.64	9.1	634
633: MH-07-006	189: MH-07-004	106.04	103.2	550	8	0.24	0.56	42.8	635
636: MH-05-009	638: MH-05-004	116.5	116	511.4	10	0	0.44	0	639
638: MH-05-004	640: MH-05-003	116	115.4	494.8	12	0	0.8	0	641
640: MH-05-003	642: MH-05-002	115.4	114.5	384.5	12	0	1.11	0	643
642: MH-05-002	436: MH-05-001	114.5	113.78	324.6	15	0.33	1.97	16.8	646
656: MH-13-006	614: MH-13-004	198.03	173.11	530	8	0.51	1.69	30.1	658
774: MH-17-046	55: MH-17-043	274	268.22	276.25	8	0	1.13	0	775
936: MH-08-025	207: MH-08-023	106.28	104.76	660	18	1.33	3.26	40.7	939
942: MH-26-021	943: MH-08-021	204	120	1776.64	8	0.14	1.7	8.5	944
943: MH-08-021	945: MH-08-019	120	113.97	469.89	8	0.14	0.88	16.2	946
945: MH-08-019	947: MH-08-018	113.97	113.79	60	8	0.14	0.43	33.6	948
947: MH-08-018	209: MH-08-016	113.79	112.54	437.94	8	0.14	0.42	34.4	949

Results File S:\GIS\3530009 Oak Harbor Sewer Plan\Model\Model Submitted\OH Sewers.swg

Table G11: 2025 Conduit Results of Peak Hour Flows for Alternative 1

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
55: MH-17-043	56: MH-17-041	268.22	262.08	330	8	0.11	1.07	10.4	412
56: MH-17-041	79: MH-17-039	262.08	242.06	498	8	0.11	1.57	7.1	413
58: MH-17-046	56: MH-17-041	268.66	262.08	185	8	0	1.47	0	59
60: MH-17-047	58: MH-17-046	271.45	268.66	309	8	0	0.74	0	426
62: MH-17-049	60: MH-17-047	280.46	271.45	554	8	0	1	0	425
64: MH-17-051	62: MH-17-049	286.41	280.46	443	8	0	0.91	0	424
79: MH-17-039	81: MH-17-033	242.06	240.51	451.8	8	0.11	0.46	24.2	414
81: MH-17-033	83: MH-17-032	240.51	220.28	315	8	0.29	1.98	14.8	415
83: MH-17-032	85: MH-17-031	220.28	212.1	195	8	0.29	1.6	18.4	86
85: MH-17-031	87: MH-17-028	212.1	209.4	270	8	0.29	0.78	37.6	417
87: MH-17-028	89: MH-17-027	209.4	202.78	172	8	0.29	1.53	19.2	418
89: MH-17-027	91: MH-17-026	202.78	202.29	266	8	0.29	0.34	87.7	419
91: MH-17-026	93: MH-17-025	202.29	191.61	270	8	0.29	1.55	18.9	420
93: MH-17-025	105: MH-17-002	191.61	190.23	146	8	0.29	0.76	38.7	421
105: MH-17-002	107: MH-17-001	190.23	186.87	467.6	10	0.46	1.2	38.3	422
107: MH-17-001	576: MH-18-010	186.87	177.32	348.75	12	0.68	3.81	17.8	577
109: MH-16-001	107: MH-17-001	192.11	186.87	195	12	0.22	3.77	5.8	110
111: MH-16-002	109: MH-16-001	194.75	192.11	400	10	0.22	1.15	19	112
113: MH-17-005	105: MH-17-002	235.75	190.23	911.5	8	0.17	1.75	9.5	114
115: MH-17-012	113: MH-17-005	237.47	235.75	124	8	0	0.92	0	116
119: MH-18-001	146: MH-19-019	165.72	157.55	1323.3	12	0.55	1.81	30.1	147
119: MH-18-001	121: MH-19-012	165.72	162	317.3	12	0.75	2.49	30.1	122
121: MH-19-012	139: MH-19-002	162	154.77	1590.2	12	1.03	1.55	66.5	140
139: MH-19-002	141: MH-19-022	154.77	153.35	673	12	1.03	1.06	97.6	142
141: MH-19-022	143: MH-06-056	153.35	151.77	220	12	1.79	1.95	91.7	144
143: MH-06-056	161: MH-06-030	151.77	140.61	1282.4	15	3.73	3.89	95.7	162
146: MH-19-019	141: MH-19-022	157.55	153.35	900	12	0.76	1.57	48.1	148
151: MH-20-004	143: MH-06-056	157.6	151.77	847	18	1.96	5.63	34.7	152
153: MH-20-005	151: MH-20-004	163.23	157.6	597	18	2	6.59	30.4	154
155: MH-20-010	153: MH-20-005	180.6	163.23	1515	10	1.06	1.52	70.1	156
157: MH-20-024	155: MH-20-010	188.27	180.6	1060	10	0.87	1.2	72.3	158
159: MH-20-026	157: MH-20-024	191.76	188.27	583.5	10	0.33	1.1	30	160
161: MH-06-030	163: MH-06-025	140.61	139.71	320	15	3.88	2.21	175.2	164
163: MH-06-025	165: MH-06-024	139.71	138.11	300	15	3.87	3.05	127	166
165: MH-06-024	167: MH-06-015	138.11	136.53	653.5	15	4.41	2.05	215	168
167: MH-06-015	169: MH-06-011	136.53	124.7	691.9	15	4.63	5.46	84.8	170
169: MH-06-011	171: MH-06-007	124.7	109.73	518	15	4.6	7.1	64.8	172
171: MH-06-007	173: MH-06-003	109.73	97.16	558	15	4.57	6.27	73	174
173: MH-06-003	175: MH-06-002	97.16	96.27	420	21	6.06	4.71	128.6	176
175: MH-06-002	405: MH-06-001	96.27	96	165	24	8.6	5.91	145.3	439
179: MH-02-004	494: MH-02-003	99.45	98.81	110	10	0.43	1.08	39.8	495
181: MH-02-009	179: MH-02-004	101.25	99.45	410	10	0.43	0.94	45.8	182
183: MH-02-020	368: MH-02-015	106.05	102.25	800	10	0.43	0.98	44	409
189: MH-07-004	173: MH-06-003	103.2	97.16	1317.8	15	1.51	2.83	53.4	190
191: MH-07-012	189: MH-07-004	108.01	103.2	537	12	1.05	2.18	48.3	192
193: MH-07-013	191: MH-07-012	116.48	108.01	436	10	1.05	1.97	53.3	194
195: MH-07-015	193: MH-07-013	127.37	116.48	607.2	10	1.05	1.9	55.5	196
197: MH-11-006	195: MH-07-015	132.8	127.37	664.5	10	0.89	1.28	69.7	198
199: MH-01-009	175: MH-06-002	99.52	96.27	1047	18	2.09	3.78	55.3	200
201: MH-01-012	199: MH-01-009	103.21	99.52	628	18	2.11	5.2	40.5	202
203: MH-01-013	201: MH-01-012	103.58	103.21	135	18	2.04	3.55	57.4	204
205: MH-08-022	203: MH-01-013	104.32	103.58	322	18	2.05	3.25	62.9	206
207: MH-08-023	205: MH-08-022	104.76	104.32	169	18	2.05	3.46	59.3	208
209: MH-08-016	497: MH-08-026	112.54	111.25	172.63	15	1.99	3.61	55	499
215: MH-08-031	339: MH-08-027	170.9	118	872	15	1.67	10.28	16.2	374
217: MH-08-032	215: MH-08-031	187	170.9	360	15	1.53	8.83	17.3	218
219: MH-08-033	217: MH-08-032	193	187	189	15	1.53	7.44	20.6	220
221: MH-08-060	219: MH-08-033	244.1	193	767.9	8	0.1	2.01	5.1	222
223: MH-08-058	221: MH-08-060	248.9	244.1	390.18	8	0.1	0.87	11.8	224
225: MH-08-048	223: MH-08-058	251.21	248.9	209.8	8	0.04	0.82	4.7	226
229: MH-26-001	225: MH-08-048	262.52	251.21	692.4	8	0.04	1	3.9	862
231: MH-26-002	229: MH-26-001	265.68	262.52	195	8	0.04	0.99	3.9	232
233: MH-26-004	231: MH-26-002	268.14	265.68	452	8	0.04	0.58	6.7	234
239: MH-21-002	153: MH-20-005	179.13	163.23	696	8	0.94	1.18	80	435
247: MH-21-015	239: MH-21-002	195.5	179.13	531	8	0.94	1.37	68.9	324
260: MH-21-018	247: MH-21-015	211.14	195.5	705	8	0.94	1.16	81.2	261
262: MH-21-023	260: MH-21-018	237.5	211.14	918	8	0.76	1.32	57.3	263
264: MH-22-002	262: MH-21-023	245.14	237.5	595	8	0.76	0.88	85.7	265
266: MH-22-003	264: MH-22-002	245.79	245.14	130	8	0.76	0.55	137.3	267
268: MH-22-007	266: MH-22-003	246.62	245.79	165	8	0.76	0.55	136.9	269
270: MH-22-008	268: MH-22-007	247.55	246.62	75	8	0.76	0.87	87.2	271
272: MH-22-009	270: MH-22-008	248.6	247.55	332	8	0.71	0.44	161	273
274: MH-22-010	272: MH-22-009	249.82	248.6	215	8	0.71	0.59	120.2	275
282: MH-22-045AT	365: MH-22-036	267.48	266.25	378.78	12	0.53	1.31	40.1	367
286: MH-22-063	351: MH-22-061	270.92	269.61	881.98	12	0.12	0.89	13.5	352

Table G11: 2025 Conduit Results of Peak Hour Flows for Alternative 1

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
290: MH-08-039	219: MH-08-033	209	193	828	15	1.46	5.8	25.1	291
292: MH-08-054	290: MH-08-039	214.21	209	802.1	8	0.02	0.63	2.5	293
294: MH-08-055	292: MH-08-054	215.37	214.21	264.3	8	0.05	0.52	10.4	295
296: MH-08-082	294: MH-08-055	216.79	215.37	119.07	8	0.05	0.85	5.8	297
298: MH-08-057	296: MH-08-082	225.92	216.79	327.24	8	0.04	1.3	3.2	299
300: MH-08-093	298: MH-08-057	259.8	225.92	461	8	0.03	2.12	1.2	301
302: MH-08-091	300: MH-08-093	275.8	259.8	367	8	0.01	1.63	0.4	303
304: MH-08-096	302: MH-08-091	289	275.8	476	8	0	1.3	0	305
312: MH-08-042	500: MH-08-041	225.1	224	350	16	1.12	2.78	40.2	502
316: MH-28-001	503: MH-08-085	246.94	227.64	1124.6	15	1.44	5.47	26.3	505
339: MH-08-027	209: MH-08-016	118	112.54	42	15	1.68	15.05	11.2	340
351: MH-22-061	282: MH-22-045A	269.61	267.48	580.56	12	0.12	1.39	8.6	353
363: MH-22-034	558: MH-22-013	261.02	253.72	456.78	8	0.53	0.99	53.2	559
365: MH-22-036	363: MH-22-034	266.25	261.02	545.3	8	0.53	0.76	68.7	366
368: MH-02-015	181: MH-02-009	102.25	101.25	225	10	0.43	0.94	45.5	369
375: MH-26-005	233: MH-26-004	268.61	268.14	73	8	0.04	0.63	6.1	376
377: MH-26-007	375: MH-26-005	272.9	268.61	431	8	0.04	0.78	4.9	378
383: MH-28-002	316: MH-28-001	253.02	246.94	205	15	0.64	7.19	8.9	384
405: MH-06-001	725: 01-001TP	96	94.7	343.94	24	8.6	8.99	95.6	731
432: MH-22-012	274: MH-22-010	251.91	249.82	378.75	8	0.71	0.58	121.9	434
436: MH-05-001	183: MH-02-020	113.78	106.05	379.48	10	0.35	2.02	17.1	438
482: MH-17-017	115: MH-17-012	292.8	237.47	1384.8	8	0	1.56	0	484
494: MH-02-003	175: MH-06-002	98.81	96.27	500	12	0.43	1.64	26.2	496
497: MH-08-026	936: MH-08-025	111.25	106.28	253	15	2	5.85	34.2	937
500: MH-08-041	290: MH-08-039	224	209	651	15	1.21	6.34	19	501
503: MH-08-085	312: MH-08-042	227.64	225.1	477	16	1.13	3.62	31.2	504
546: MH-22-075	547: MH-22-067	280	279	432.04	12	0	1.11	0	548
547: MH-22-067	286: MH-22-063	279	270.92	801.44	12	0.12	2.31	5.2	549
550: MH-20-079	551: MH-20-077	207	192	467.36	8	0.01	1.4	0.5	552
551: MH-20-077	159: MH-20-026	192	191.76	789.72	8	0.33	0.14	241.4	553
554: MH-22-022	555: MH-22-020	273.35	254.15	569	8	0.01	1.43	0.8	556
555: MH-22-020	432: MH-22-012	254.15	251.91	347	8	0.11	0.63	17.1	557
558: MH-22-013	432: MH-22-012	253.72	251.91	798.03	8	0.6	0.37	161.3	562
563: MH-23-010	564: MH-18-023	223.7	190.36	1282.8	8	0.2	1.26	15.8	565
564: MH-18-023	566: MH-18-020	190.36	179	710	8	0.42	0.99	42.5	567
566: MH-18-020	568: MH-18-018	179	168.31	675.4	8	0.42	0.98	42.7	569
568: MH-18-018	119: MH-18-001	168.31	165.72	645.3	8	0.62	0.49	125.1	570
576: MH-18-010	119: MH-18-001	177.32	165.72	527.5	12	0.68	3.41	19.9	578
582: MH-15-012	583: MH-15-011	181.3	179.1	322	8	0.25	0.65	38.5	584
583: MH-15-011	597: MH-15-006	179.1	175.4	524.1	8	0.25	0.66	37.9	598
586: MH-13-001	587: MH-11-009	172.07	165.3	230	8	0.68	1.34	51	588
587: MH-11-009	197: MH-11-006	165.3	132.8	1234	8	0.68	1.27	53.9	589
590: MH-12-026	592: MH-12-004	157.98	150.05	310	8	0.01	1.25	0.5	593
592: MH-12-004	608: MH-12-002A	150.05	140.6	501	8	0.21	1.07	19.5	609
597: MH-15-006	602: MH-15-005	175.4	169.7	295	8	0.25	1.09	22.9	603
602: MH-15-005	605: MH-15-003	169.7	158.4	566	8	0.25	1.1	22.5	606
605: MH-15-003	165: MH-06-024	158.4	138.11	783.3	8	0.55	1.26	43.9	607
608: MH-12-002A	197: MH-11-006	140.6	132.8	672	8	0.21	0.84	24.9	610
611: MH-13-037	612: MH-13-024	243	198.5	1025	8	0.25	1.63	15.6	613
612: MH-13-024	656: MH-13-006	198.5	198.03	72	8	0.51	0.63	81	657
614: MH-13-004	586: MH-13-001	173.11	172.07	187	8	0.68	0.58	117.3	621
622: MH-25-018	623: MH-28-043	250	248	241.97	8	0.04	0.71	5.2	624
623: MH-28-043	625: MH-28-037	248	229.22	329.51	8	0.04	1.86	2	626
625: MH-28-037	627: MH-28-035	229.22	216.01	234.7	8	0.04	1.85	2	628
627: MH-28-035	793: WW-28-030	216.01	169.6	530.8	8	0.04	2.31	1.6	797
632: MH-08-008	633: MH-07-006	172.15	106.04	1908	10	0.22	2.64	8.2	634
633: MH-07-006	189: MH-07-004	106.04	103.2	550	8	0.22	0.56	38.6	635
636: MH-05-009	638: MH-05-004	116.5	116	511.4	10	0	0.44	0	639
638: MH-05-004	640: MH-05-003	116	115.4	494.8	12	0	0.8	0	641
640: MH-05-003	642: MH-05-002	115.4	114.5	384.5	12	0	1.11	0	643
642: MH-05-002	436: MH-05-001	114.5	113.78	324.6	15	0.35	1.97	17.6	646
656: MH-13-006	614: MH-13-004	198.03	173.11	530	8	0.51	1.69	30.2	658
774: MH-17-046	55: MH-17-043	274	268.22	276.25	8	0	1.13	0	775
936: MH-08-025	207: MH-08-023	106.28	104.76	660	18	2.04	3.26	62.7	939
942: MH-26-021	943: MH-08-021	204	120	1776.64	8	0.3	1.7	17.5	944
943: MH-08-021	945: MH-08-019	120	113.97	469.89	8	0.3	0.88	33.6	946
945: MH-08-019	947: MH-08-018	113.97	113.79	60	8	0.3	0.43	69.5	948
947: MH-08-018	209: MH-08-016	113.79	112.54	437.94	8	0.3	0.42	71.2	949

Results File: S:\GIS\3530009 Oak Harbor Sewer Plan\Model\Model Submitted\OH Sewers.swg

Table G12: Long Term Growth Conduit Results of Peak Hour Flows for Alternative 1

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
55: MH-17-043	56: MH-17-041	268.22	262.08	330	8	1.12	1.07	105.3	412
56: MH-17-041	79: MH-17-039	262.08	242.06	498	8	1.12	1.57	71.6	413
58: MH-17-046	56: MH-17-041	268.66	262.08	185	8	0	1.47	0	59
60: MH-17-047	58: MH-17-046	271.45	268.66	309	8	0	0.74	0	426
62: MH-17-049	60: MH-17-047	280.46	271.45	554	8	0	1	0	425
64: MH-17-051	62: MH-17-049	286.41	280.46	443	8	0	0.91	0	424
79: MH-17-039	81: MH-17-033	242.06	240.51	451.8	8	1.12	0.46	245.2	414
81: MH-17-033	83: MH-17-032	240.51	220.28	315	8	1.41	1.98	71.3	415
83: MH-17-032	85: MH-17-031	220.28	212.1	195	8	1.41	1.6	88.2	86
85: MH-17-031	87: MH-17-028	212.1	209.4	270	8	1.28	0.78	163.3	417
87: MH-17-028	89: MH-17-027	209.4	202.78	172	8	1.27	1.53	83.1	418
89: MH-17-027	91: MH-17-026	202.78	202.29	266	8	1.28	0.34	382	419
91: MH-17-026	93: MH-17-025	202.29	191.61	270	8	1.28	1.55	82.5	420
93: MH-17-025	105: MH-17-002	191.61	190.23	146	8	1.22	0.76	160.7	421
105: MH-17-002	107: MH-17-001	190.23	186.87	467.6	10	1.48	1.2	123.3	422
107: MH-17-001	576: MH-18-010	186.87	177.32	348.75	12	1.86	3.81	48.7	577
109: MH-16-001	107: MH-17-001	192.11	186.87	195	12	0.33	3.77	8.8	110
111: MH-16-002	109: MH-16-001	194.75	192.11	400	10	0.33	1.15	29	112
113: MH-17-005	105: MH-17-002	235.75	190.23	911.5	8	0.26	1.75	14.8	114
115: MH-17-012	113: MH-17-005	237.47	235.75	124	8	0	0.92	0	116
119: MH-18-001	146: MH-19-019	165.72	157.55	1323.3	12	1.37	1.81	75.4	147
119: MH-18-001	121: MH-19-012	165.72	162	317.3	12	1.59	2.49	63.6	122
121: MH-19-012	139: MH-19-002	162	154.77	1590.2	12	1.48	1.55	95.3	140
139: MH-19-002	141: MH-19-022	154.77	153.35	673	12	1.48	1.06	139.7	142
141: MH-19-022	143: MH-06-056	153.35	151.77	220	12	3.19	1.95	163.3	144
143: MH-06-056	161: MH-06-030	151.77	140.61	1282.4	15	4.34	3.89	111.4	162
146: MH-19-019	141: MH-19-022	157.55	153.35	900	12	1.71	1.57	108.7	148
151: MH-20-004	143: MH-06-056	157.6	151.77	847	18	2.97	5.63	52.8	152
153: MH-20-005	151: MH-20-004	163.23	157.6	597	18	2.97	6.59	45.1	154
155: MH-20-010	153: MH-20-005	180.6	163.23	1515	10	1.74	1.52	114.5	156
157: MH-20-024	155: MH-20-010	188.27	180.6	1060	10	1.36	1.2	113.2	158
159: MH-20-026	157: MH-20-024	191.76	188.27	583.5	10	0.36	1.1	32.6	160
161: MH-06-030	163: MH-06-025	140.61	139.71	320	15	3.74	2.21	169	164
163: MH-06-025	165: MH-06-024	139.71	138.11	300	15	3.74	3.05	122.7	166
165: MH-06-024	167: MH-06-015	138.11	136.53	653.5	15	4.52	2.05	220.1	168
167: MH-06-015	169: MH-06-011	136.53	124.7	691.9	15	4.95	5.46	90.6	170
169: MH-06-011	171: MH-06-007	124.7	109.73	518	15	4.95	7.1	69.7	172
171: MH-06-007	173: MH-06-003	109.73	97.16	558	15	4.95	6.27	79	174
173: MH-06-003	175: MH-06-002	97.16	96.27	420	21	7.75	4.71	164.5	176
175: MH-06-002	405: MH-06-001	96.27	96	165	24	13.55	5.91	229.1	439
179: MH-02-004	494: MH-02-003	99.45	98.81	110	10	1.18	1.08	109.1	495
181: MH-02-009	179: MH-02-004	101.25	99.45	410	10	1.18	0.94	125.6	182
183: MH-02-020	368: MH-02-015	106.05	102.25	800	10	1.18	0.98	120.7	409
189: MH-07-004	173: MH-06-003	103.2	97.16	1317.8	15	2.8	2.83	99.2	190
191: MH-07-012	189: MH-07-004	108.01	103.2	537	12	1.94	2.18	89.1	192
193: MH-07-013	191: MH-07-012	116.48	108.01	436	10	1.94	1.97	98.4	194
195: MH-07-015	193: MH-07-013	127.37	116.48	607.2	10	1.94	1.9	102.4	196
197: MH-11-006	195: MH-07-015	132.8	127.37	664.5	10	1.63	1.28	127	198
199: MH-01-009	175: MH-06-002	99.52	96.27	1047	18	4.62	3.78	122.1	200
201: MH-01-012	199: MH-01-009	103.21	99.52	628	18	4.62	5.2	88.8	202
203: MH-01-013	201: MH-01-012	103.58	103.21	135	18	4.45	3.55	125.2	204
205: MH-08-022	203: MH-01-013	104.32	103.58	322	18	4.45	3.25	136.7	206
207: MH-08-023	205: MH-08-022	104.76	104.32	169	18	4.45	3.46	128.4	208
209: MH-08-016	497: MH-08-026	112.54	111.25	172.63	15	4.47	3.61	123.9	499
215: MH-08-031	339: MH-08-027	170.9	118	872	15	3.92	10.28	38.2	374
217: MH-08-032	215: MH-08-031	187	170.9	360	15	3.78	8.83	42.8	218
219: MH-08-033	217: MH-08-032	193	187	189	15	3.78	7.44	50.9	220
221: MH-08-060	219: MH-08-033	244.1	193	767.9	8	0.26	2.01	12.7	222
223: MH-08-058	221: MH-08-060	248.9	244.1	390.18	8	0.26	0.87	29.5	224
225: MH-08-048	223: MH-08-058	251.21	248.9	209.8	8	0.07	0.82	9.1	226
229: MH-26-001	225: MH-08-048	262.52	251.21	692.4	8	0.07	1	7.4	862
231: MH-26-002	229: MH-26-001	265.68	262.52	195	8	0.07	0.99	7.5	232
233: MH-26-004	231: MH-26-002	268.14	265.68	452	8	0.07	0.58	12.9	234
239: MH-21-002	153: MH-20-005	179.13	163.23	696	8	1.24	1.18	104.9	435
247: MH-21-015	239: MH-21-002	195.5	179.13	531	8	1.24	1.37	90.3	324
260: MH-21-018	247: MH-21-015	211.14	195.5	705	8	1.24	1.16	106.5	261
262: MH-21-023	260: MH-21-018	237.5	211.14	918	8	0.95	1.32	72.1	263
264: MH-22-002	262: MH-21-023	245.14	237.5	595	8	0.95	0.88	107.8	265
266: MH-22-003	264: MH-22-002	245.79	245.14	130	8	0.95	0.55	172.8	267
268: MH-22-007	266: MH-22-003	246.62	245.79	165	8	0.95	0.55	172.3	269
270: MH-22-008	268: MH-22-007	247.55	246.62	75	8	0.95	0.87	109.7	271
272: MH-22-009	270: MH-22-008	248.6	247.55	332	8	0.83	0.44	188.4	273
274: MH-22-010	272: MH-22-009	249.82	248.6	215	8	0.83	0.59	140.7	275
282: MH-22-045AT	365: MH-22-036	267.48	266.25	378.78	12	0.64	1.31	48.7	367
286: MH-22-063	351: MH-22-061	270.92	269.61	881.98	12	0.5	0.89	56.5	352

Table G12: Long Term Growth Conduit Results of Peak Hour Flows for Alternative 1

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
290: MH-08-039	219: MH-08-033	209	193	828	15	3.53	5.8	60.8	291
292: MH-08-054	290: MH-08-039	214.21	209	802.1	8	0.05	0.63	8.6	293
294: MH-08-055	292: MH-08-054	215.37	214.21	264.3	8	0.04	0.52	8.3	295
296: MH-08-082	294: MH-08-055	216.79	215.37	119.07	8	0.03	0.85	3.9	297
298: MH-08-057	296: MH-08-082	225.92	216.79	327.24	8	0.02	1.3	1.7	299
300: MH-08-093	298: MH-08-057	259.8	225.92	461	8	0.01	2.12	0.3	301
302: MH-08-091	300: MH-08-093	275.8	259.8	367	8	0	1.63	0	303
304: MH-08-096	302: MH-08-091	289	275.8	476	8	0	1.3	0	305
312: MH-08-042	500: MH-08-041	225.1	224	350	16	2.94	2.78	105.8	502
316: MH-28-001	503: MH-08-085	246.94	227.64	1124.6	15	2.61	5.47	47.7	505
339: MH-08-027	209: MH-08-016	118	112.54	42	15	3.92	15.05	26	340
351: MH-22-061	282: MH-22-045A	269.61	267.48	580.56	12	-0.21	1.39	-15.2	353
363: MH-22-034	558: MH-22-013	261.02	253.72	456.78	8	0.64	0.99	64.7	559
365: MH-22-036	363: MH-22-034	266.25	261.02	545.3	8	0.64	0.76	83.6	366
368: MH-02-015	181: MH-02-009	102.25	101.25	225	10	1.18	0.94	124.8	369
375: MH-26-005	233: MH-26-004	268.61	268.14	73	8	0.07	0.63	11.8	376
377: MH-26-007	375: MH-26-005	272.9	268.61	431	8	0.07	0.78	9.5	378
383: MH-28-002	316: MH-28-001	253.02	246.94	205	15	0.23	7.19	3.2	384
405: MH-06-001	725: 01-001TP	96	94.7	343.94	24	13.55	8.99	150.8	731
432: MH-22-012	274: MH-22-010	251.91	249.82	378.75	8	0.83	0.58	142.6	434
436: MH-05-001	183: MH-02-020	113.78	106.05	379.48	10	0.89	2.02	44.2	438
482: MH-17-017	115: MH-17-012	292.8	237.47	1384.8	8	0	1.56	0	484
494: MH-02-003	175: MH-06-002	98.81	96.27	500	12	1.18	1.64	71.8	496
497: MH-08-026	936: MH-08-025	111.25	106.28	253	15	4.47	5.85	76.4	937
500: MH-08-041	290: MH-08-039	224	209	651	15	2.92	6.34	46.1	501
503: MH-08-085	312: MH-08-042	227.64	225.1	477	16	3.06	3.62	84.6	504
546: MH-22-075	547: MH-22-067	280	279	432.04	12	0.14	1.11	12.6	548
547: MH-22-067	286: MH-22-063	279	270.92	801.44	12	0.5	2.31	21.7	549
550: MH-20-079	551: MH-20-077	207	192	467.36	8	0.01	1.4	0.6	552
551: MH-20-077	159: MH-20-026	192	191.76	789.72	8	0.36	0.14	262.4	553
554: MH-22-022	555: MH-22-020	273.35	254.15	569	8	0.03	1.43	2.2	556
555: MH-22-020	432: MH-22-012	254.15	251.91	347	8	0.19	0.63	31	557
558: MH-22-013	432: MH-22-012	253.72	251.91	798.03	8	0.63	0.37	170.2	562
563: MH-23-010	564: MH-18-023	223.7	190.36	1282.8	8	1.29	1.26	102.7	565
564: MH-18-023	566: MH-18-020	190.36	179	710	8	1.01	0.99	102.7	567
566: MH-18-020	568: MH-18-018	179	168.31	675.4	8	1.01	0.98	103.2	569
568: MH-18-018	119: MH-18-001	168.31	165.72	645.3	8	0.91	0.49	183.3	570
576: MH-18-010	119: MH-18-001	177.32	165.72	527.5	12	1.86	3.41	54.4	578
582: MH-15-012	583: MH-15-011	181.3	179.1	322	8	0.31	0.65	48.8	584
583: MH-15-011	597: MH-15-006	179.1	175.4	524.1	8	0.31	0.66	48	598
586: MH-13-001	587: MH-11-009	172.07	165.3	230	8	1.1	1.34	82.4	588
587: MH-11-009	197: MH-11-006	165.3	132.8	1234	8	1.1	1.27	87.1	589
590: MH-12-026	592: MH-12-004	157.98	150.05	310	8	0.05	1.25	4	593
592: MH-12-004	608: MH-12-002A	150.05	140.6	501	8	0.52	1.07	48.7	609
597: MH-15-006	602: MH-15-005	175.4	169.7	295	8	0.31	1.09	29	603
602: MH-15-005	605: MH-15-003	169.7	158.4	566	8	0.31	1.1	28.5	606
605: MH-15-003	165: MH-06-024	158.4	138.11	783.3	8	0.78	1.26	61.7	607
608: MH-12-002A	197: MH-11-006	140.6	132.8	672	8	0.52	0.84	62	610
611: MH-13-037	612: MH-13-024	243	198.5	1025	8	0.41	1.63	25.4	613
612: MH-13-024	656: MH-13-006	198.5	198.03	72	8	0.83	0.63	131.8	657
614: MH-13-004	586: MH-13-001	173.11	172.07	187	8	1.1	0.58	189.5	621
622: MH-25-018	623: MH-28-043	250	248	241.97	8	0.06	0.71	8.2	624
623: MH-28-043	625: MH-28-037	248	229.22	329.51	8	0.06	1.86	3.1	626
625: MH-28-037	627: MH-28-035	229.22	216.01	234.7	8	0.06	1.85	3.1	628
627: MH-28-035	793: WW-28-030	216.01	169.6	530.8	8	0.06	2.31	2.5	797
632: MH-08-008	633: MH-07-006	172.15	106.04	1908	10	0.4	2.64	15	634
633: MH-07-006	189: MH-07-004	106.04	103.2	550	8	0.4	0.56	70.4	635
636: MH-05-009	638: MH-05-004	116.5	116	511.4	10	0	0.44	0	639
638: MH-05-004	640: MH-05-003	116	115.4	494.8	12	0	0.8	0	641
640: MH-05-003	642: MH-05-002	115.4	114.5	384.5	12	0	1.11	0	643
642: MH-05-002	436: MH-05-001	114.5	113.78	324.6	15	0.89	1.97	45.4	646
656: MH-13-006	614: MH-13-004	198.03	173.11	530	8	0.83	1.69	49.1	658
774: MH-17-046	55: MH-17-043	274	268.22	276.25	8	0.02	1.13	2.1	775
936: MH-08-025	207: MH-08-023	106.28	104.76	660	18	4.47	3.26	137.2	939
942: MH-26-021	943: MH-08-021	204	120	1776.64	8	0.56	1.7	32.9	944
943: MH-08-021	945: MH-08-019	120	113.97	469.89	8	0.56	0.88	63.1	946
945: MH-08-019	947: MH-08-018	113.97	113.79	60	8	0.56	0.43	130.5	948
947: MH-08-018	209: MH-08-016	113.79	112.54	437.94	8	0.56	0.42	133.8	949

Results File S:\GIS\3530009 Oak Harbor Sewer Plan\Model\Model Submitted\OH Sewers.swg

Table G13: 2011Conduit Results of Peak Hour Flows for Alternative 2

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
55: MH-17-043	56: MH-17-041	268.22	262.08	330	8	0.11	1.07	10.4	412
56: MH-17-041	79: MH-17-039	262.08	242.06	498	8	0.11	1.57	7.1	413
58: MH-17-046	56: MH-17-041	268.66	262.08	185	8	0	1.47	0	59
60: MH-17-047	58: MH-17-046	271.45	268.66	309	8	0	0.74	0	426
62: MH-17-049	60: MH-17-047	280.46	271.45	554	8	0	1	0	425
64: MH-17-051	62: MH-17-049	286.41	280.46	443	8	0	0.91	0	424
79: MH-17-039	81: MH-17-033	242.06	240.51	451.8	8	0.11	0.46	24.2	414
81: MH-17-033	83: MH-17-032	240.51	220.28	315	8	0.29	1.98	14.6	415
83: MH-17-032	85: MH-17-031	220.28	212.1	195	8	0.29	1.6	18.1	86
85: MH-17-031	87: MH-17-028	212.1	209.4	270	8	0.29	0.78	37	417
87: MH-17-028	89: MH-17-027	209.4	202.78	172	8	0.29	1.53	18.9	418
89: MH-17-027	91: MH-17-026	202.78	202.29	266	8	0.29	0.34	86.2	419
91: MH-17-026	93: MH-17-025	202.29	191.61	270	8	0.29	1.55	18.6	420
93: MH-17-025	105: MH-17-002	191.61	190.23	146	8	0.29	0.76	38.1	421
105: MH-17-002	107: MH-17-001	190.23	186.87	467.6	10	0.45	1.2	37.8	422
107: MH-17-001	576: MH-18-010	186.87	177.32	348.75	12	0.67	3.81	17.6	577
109: MH-16-001	107: MH-17-001	192.11	186.87	195	12	0.22	3.77	5.8	110
111: MH-16-002	109: MH-16-001	194.75	192.11	400	10	0.22	1.15	19	112
113: MH-17-005	105: MH-17-002	235.75	190.23	911.5	8	0.16	1.75	9.4	114
115: MH-17-012	113: MH-17-005	237.47	235.75	124	8	0	0.92	0	116
119: MH-18-001	121: MH-19-012	165.72	162	317.3	12	0.73	2.49	29.4	122
119: MH-18-001	146: MH-19-019	165.72	157.55	1323.3	12	0.53	1.81	29.4	147
121: MH-19-012	139: MH-19-002	162	154.77	1590.2	12	0.96	1.55	62.1	140
139: MH-19-002	141: MH-19-022	154.77	153.35	673	12	0.96	1.06	91.2	142
141: MH-19-022	143: MH-06-056	153.35	151.77	220	12	1.71	1.95	87.5	144
143: MH-06-056	1135: OF-1	151.77	148	247.65	48	3.85	114.54	3.4	1136
146: MH-19-019	141: MH-19-022	157.55	153.35	900	12	0.74	1.57	47.2	148
151: MH-20-004	143: MH-06-056	157.6	151.77	847	18	2.15	5.63	38.1	152
153: MH-20-005	151: MH-20-004	163.23	157.6	597	18	2.15	6.59	32.6	154
155: MH-20-010	153: MH-20-005	180.6	163.23	1515	10	1.29	1.52	84.9	156
157: MH-20-024	155: MH-20-010	188.27	180.6	1060	10	1.09	1.2	90.7	158
159: MH-20-026	157: MH-20-024	191.76	188.27	583.5	10	0.3	1.1	27.8	160
161: MH-06-030	163: MH-06-025	140.61	139.71	320	15	0	2.21	0	164
163: MH-06-025	165: MH-06-024	139.71	138.11	300	15	0	3.05	0	166
165: MH-06-024	167: MH-06-015	138.11	136.53	653.5	15	0.5	2.05	24.3	168
167: MH-06-015	169: MH-06-011	136.53	124.7	691.9	15	0.68	5.46	12.4	170
169: MH-06-011	171: MH-06-007	124.7	109.73	518	15	0.68	7.1	9.6	172
171: MH-06-007	173: MH-06-003	109.73	97.16	558	15	0.68	6.27	10.9	174
173: MH-06-003	175: MH-06-002	97.16	96.27	420	21	2.26	4.71	47.9	176
175: MH-06-002	405: MH-06-001	96.27	96	165	24	4.15	5.91	70.2	439
179: MH-02-004	494: MH-02-003	99.45	98.81	110	10	0.41	1.08	38.3	495
181: MH-02-009	179: MH-02-004	101.25	99.45	410	10	0.41	0.94	44	182
183: MH-02-020	368: MH-02-015	106.05	102.25	800	10	0.41	0.98	42.3	409
189: MH-07-004	173: MH-06-003	103.2	97.16	1317.8	15	1.51	2.83	53.3	190
191: MH-07-012	189: MH-07-004	108.01	103.2	537	12	1.03	2.18	47.1	192
193: MH-07-013	191: MH-07-012	116.48	108.01	436	10	1.03	1.97	52	194
195: MH-07-015	193: MH-07-013	127.37	116.48	607.2	10	1.03	1.9	54.1	196
197: MH-11-006	195: MH-07-015	132.8	127.37	664.5	10	0.88	1.28	69	198
199: MH-01-009	175: MH-06-002	99.52	96.27	1047	18	1.46	3.78	38.5	200
201: MH-01-012	199: MH-01-009	103.21	99.52	628	18	1.47	5.2	28.3	202
203: MH-01-013	201: MH-01-012	103.58	103.21	135	18	1.4	3.55	39.3	204
205: MH-08-022	203: MH-01-013	104.32	103.58	322	18	1.39	3.25	42.8	206
207: MH-08-023	205: MH-08-022	104.76	104.32	169	18	1.38	3.46	39.8	208
209: MH-08-016	497: MH-08-026	112.54	111.25	172.63	15	1.26	3.61	34.8	499
215: MH-08-031	339: MH-08-027	170.9	118	872	15	1.13	10.28	11	374
217: MH-08-032	215: MH-08-031	187	170.9	360	15	1.02	8.83	11.5	218
219: MH-08-033	217: MH-08-032	193	187	189	15	1.05	7.44	14.1	220
221: MH-08-060	219: MH-08-033	244.1	193	767.9	8	0.07	2.01	3.4	222
223: MH-08-058	221: MH-08-060	248.9	244.1	390.18	8	0.07	0.87	7.9	224
225: MH-08-048	223: MH-08-058	251.21	248.9	209.8	8	0.04	0.82	4.5	226
229: MH-26-001	225: MH-08-048	262.52	251.21	692.4	8	0.04	1	3.7	862
231: MH-26-002	229: MH-26-001	265.68	262.52	195	8	0.04	0.99	3.7	232
233: MH-26-004	231: MH-26-002	268.14	265.68	452	8	0.04	0.58	6.5	234
239: MH-21-002	153: MH-20-005	179.13	163.23	696	8	0.86	1.18	72.8	435
247: MH-21-015	239: MH-21-002	195.5	179.13	531	8	0.86	1.37	62.6	324
260: MH-21-018	247: MH-21-015	211.14	195.5	705	8	0.86	1.16	73.8	261
262: MH-21-023	260: MH-21-018	237.5	211.14	918	8	0.67	1.32	50.9	263
264: MH-22-002	262: MH-21-023	245.14	237.5	595	8	0.67	0.88	76.2	265
266: MH-22-003	264: MH-22-002	245.79	245.14	130	8	0.67	0.55	122.1	267
268: MH-22-007	266: MH-22-003	246.62	245.79	165	8	0.67	0.55	121.7	269
270: MH-22-008	268: MH-22-007	247.55	246.62	75	8	0.67	0.87	77.5	271
272: MH-22-009	270: MH-22-008	248.6	247.55	332	8	0.62	0.44	141.9	273
274: MH-22-010	272: MH-22-009	249.82	248.6	215	8	0.62	0.59	105.9	275
282: MH-22-045AT	365: MH-22-036	267.48	266.25	378.78	12	0.44	1.31	33.6	367
286: MH-22-063	351: MH-22-061	270.92	269.61	881.98	12	0.13	0.89	15.2	352

Table G13: 2011Conduit Results of Peak Hour Flows for Alternative 2

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
290: MH-08-039	219: MH-08-033	209	193	828	15	1.07	5.8	18.4	291
292: MH-08-054	290: MH-08-039	214.21	209	802.1	8	0.04	0.63	5.7	293
294: MH-08-055	292: MH-08-054	215.37	214.21	264.3	8	0.05	0.52	9.6	295
296: MH-08-082	294: MH-08-055	216.79	215.37	119.07	8	0.04	0.85	4.9	297
298: MH-08-057	296: MH-08-082	225.92	216.79	327.24	8	0.03	1.3	2.4	299
300: MH-08-093	298: MH-08-057	259.8	225.92	461	8	0.01	2.12	0.7	301
302: MH-08-091	300: MH-08-093	275.8	259.8	367	8	0	1.63	0	303
304: MH-08-096	302: MH-08-091	289	275.8	476	8	0	1.3	0	305
312: MH-08-042	500: MH-08-041	225.1	224	350	16	0.67	2.78	24	502
316: MH-28-001	503: MH-08-085	246.94	227.64	1124.6	15	0.96	5.47	17.6	505
339: MH-08-027	209: MH-08-016	118	112.54	42	15	1.11	15.05	7.4	340
351: MH-22-061	282: MH-22-045A	269.61	267.48	580.56	12	0.13	1.39	9.6	353
363: MH-22-034	558: MH-22-013	261.02	253.72	456.78	8	0.44	0.99	44.7	559
365: MH-22-036	363: MH-22-034	266.25	261.02	545.3	8	0.44	0.76	57.7	366
368: MH-02-015	181: MH-02-009	102.25	101.25	225	10	0.41	0.94	43.8	369
375: MH-26-005	233: MH-26-004	268.61	268.14	73	8	0.04	0.63	5.9	376
377: MH-26-007	375: MH-26-005	272.9	268.61	431	8	0.04	0.78	4.8	378
383: MH-28-002	316: MH-28-001	253.02	246.94	205	15	0.77	7.19	10.7	384
405: MH-06-001	725: 01-001TP	96	94.7	343.94	24	4.16	8.99	46.3	731
432: MH-22-012	274: MH-22-010	251.91	249.82	378.75	8	0.62	0.58	107.4	434
436: MH-05-001	183: MH-02-020	113.78	106.05	379.48	10	0.33	2.02	16.3	438
482: MH-17-017	115: MH-17-012	292.8	237.47	1384.8	8	0	1.56	0	484
494: MH-02-003	175: MH-06-002	98.81	96.27	500	12	0.41	1.64	25.2	496
497: MH-08-026	936: MH-08-025	111.25	106.28	253	15	1.26	5.85	21.6	937
500: MH-08-041	290: MH-08-039	224	209	651	15	0.79	6.34	12.5	501
503: MH-08-085	312: MH-08-042	227.64	225.1	477	16	0.57	3.62	15.7	504
546: MH-22-075	547: MH-22-067	280	279	432.04	12	0	1.11	0	548
547: MH-22-067	286: MH-22-063	279	270.92	801.44	12	0.13	2.31	5.8	549
550: MH-20-079	551: MH-20-077	207	192	467.36	8	0.07	1.4	4.8	552
551: MH-20-077	159: MH-20-026	192	191.76	789.72	8	0.3	0.14	224	553
554: MH-22-022	555: MH-22-020	273.35	254.15	569	8	0.01	1.43	0.8	556
555: MH-22-020	432: MH-22-012	254.15	251.91	347	8	0.11	0.63	17.1	557
558: MH-22-013	432: MH-22-012	253.72	251.91	798.03	8	0.52	0.37	138.6	562
563: MH-23-010	564: MH-18-023	223.7	190.36	1282.8	8	0.18	1.26	14.6	565
564: MH-18-023	566: MH-18-020	190.36	179	710	8	0.4	0.99	41	567
566: MH-18-020	568: MH-18-018	179	168.31	675.4	8	0.4	0.98	41.2	569
568: MH-18-018	119: MH-18-001	168.31	165.72	645.3	8	0.59	0.49	119.5	570
576: MH-18-010	119: MH-18-001	177.32	165.72	527.5	12	0.67	3.41	19.7	578
582: MH-15-012	583: MH-15-011	181.3	179.1	322	8	0.25	0.65	38.2	584
583: MH-15-011	597: MH-15-006	179.1	175.4	524.1	8	0.25	0.66	37.6	598
586: MH-13-001	587: MH-11-009	172.07	165.3	230	8	0.68	1.34	50.7	588
587: MH-11-009	197: MH-11-006	165.3	132.8	1234	8	0.68	1.27	53.6	589
590: MH-12-026	592: MH-12-004	157.98	150.05	310	8	0.01	1.25	0.4	593
592: MH-12-004	608: MH-12-002A	150.05	140.6	501	8	0.2	1.07	18.9	609
597: MH-15-006	602: MH-15-005	175.4	169.7	295	8	0.25	1.09	22.7	603
602: MH-15-005	605: MH-15-003	169.7	158.4	566	8	0.25	1.1	22.4	606
605: MH-15-003	165: MH-06-024	158.4	138.11	783.3	8	0.51	1.26	40.6	607
608: MH-12-002A	197: MH-11-006	140.6	132.8	672	8	0.2	0.84	24.2	610
611: MH-13-037	612: MH-13-024	243	198.5	1025	8	0.25	1.63	15.6	613
612: MH-13-024	656: MH-13-006	198.5	198.03	72	8	0.51	0.63	80.9	657
614: MH-13-004	586: MH-13-001	173.11	172.07	187	8	0.68	0.58	116.7	621
622: MH-25-018	623: MH-28-043	250	248	241.97	8	0.04	0.71	5.2	624
623: MH-28-043	625: MH-28-037	248	229.22	329.51	8	0.04	1.86	2	626
625: MH-28-037	627: MH-28-035	229.22	216.01	234.7	8	0.04	1.85	2	628
627: MH-28-035	793: WW-28-030	216.01	169.6	530.8	8	0.04	2.31	1.6	797
632: MH-08-008	633: MH-07-006	172.15	106.04	1908	10	0.24	2.64	9.1	634
633: MH-07-006	189: MH-07-004	106.04	103.2	550	8	0.24	0.56	42.8	635
636: MH-05-009	638: MH-05-004	116.5	116	511.4	10	0	0.44	0	639
638: MH-05-004	640: MH-05-003	116	115.4	494.8	12	0	0.8	0	641
640: MH-05-003	642: MH-05-002	115.4	114.5	384.5	12	0	1.11	0	643
642: MH-05-002	436: MH-05-001	114.5	113.78	324.6	15	0.33	1.97	16.8	646
656: MH-13-006	614: MH-13-004	198.03	173.11	530	8	0.51	1.69	30.1	658
774: MH-17-046	55: MH-17-043	274	268.22	276.25	8	0	1.13	0	775
936: MH-08-025	207: MH-08-023	106.28	104.76	660	18	1.33	3.26	40.7	939
942: MH-26-021	943: MH-08-021	204	120	1776.64	8	0.14	1.7	8.5	944
943: MH-08-021	945: MH-08-019	120	113.97	469.89	8	0.14	0.88	16.2	946
945: MH-08-019	947: MH-08-018	113.97	113.79	60	8	0.14	0.43	33.6	948
947: MH-08-018	209: MH-08-016	113.79	112.54	437.94	8	0.14	0.42	34.4	949

Results File S:\GIS\3530009 Oak Harbor Sewer Plan\Model\Model Submitted\OH Sewers (Divert Flows at Whidbey).swg

Table G14: 2025 Conduit Results of Peak Hour Flows for Alternative 2

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
55: MH-17-043	56: MH-17-041	268.22	262.08	330	8	0.11	1.07	10.4	412
56: MH-17-041	79: MH-17-039	262.08	242.06	498	8	0.11	1.57	7.1	413
58: MH-17-046	56: MH-17-041	268.66	262.08	185	8	0	1.47	0	59
60: MH-17-047	58: MH-17-046	271.45	268.66	309	8	0	0.74	0	426
62: MH-17-049	60: MH-17-047	280.46	271.45	554	8	0	1	0	425
64: MH-17-051	62: MH-17-049	286.41	280.46	443	8	0	0.91	0	424
79: MH-17-039	81: MH-17-033	242.06	240.51	451.8	8	0.11	0.46	24.2	414
81: MH-17-033	83: MH-17-032	240.51	220.28	315	8	0.29	1.98	14.8	415
83: MH-17-032	85: MH-17-031	220.28	212.1	195	8	0.29	1.6	18.4	86
85: MH-17-031	87: MH-17-028	212.1	209.4	270	8	0.29	0.78	37.6	417
87: MH-17-028	89: MH-17-027	209.4	202.78	172	8	0.29	1.53	19.2	418
89: MH-17-027	91: MH-17-026	202.78	202.29	266	8	0.29	0.34	87.7	419
91: MH-17-026	93: MH-17-025	202.29	191.61	270	8	0.29	1.55	18.9	420
93: MH-17-025	105: MH-17-002	191.61	190.23	146	8	0.29	0.76	38.7	421
105: MH-17-002	107: MH-17-001	190.23	186.87	467.6	10	0.46	1.2	38.3	422
107: MH-17-001	576: MH-18-010	186.87	177.32	348.75	12	0.68	3.81	17.8	577
109: MH-16-001	107: MH-17-001	192.11	186.87	195	12	0.22	3.77	5.8	110
111: MH-16-002	109: MH-16-001	194.75	192.11	400	10	0.22	1.15	19	112
113: MH-17-005	105: MH-17-002	235.75	190.23	911.5	8	0.17	1.75	9.5	114
115: MH-17-012	113: MH-17-005	237.47	235.75	124	8	0	0.92	0	116
119: MH-18-001	121: MH-19-012	165.72	162	317.3	12	0.75	2.49	30.1	122
119: MH-18-001	146: MH-19-019	165.72	157.55	1323.3	12	0.55	1.81	30.1	147
121: MH-19-012	139: MH-19-002	162	154.77	1590.2	12	1.03	1.55	66.5	140
139: MH-19-002	141: MH-19-022	154.77	153.35	673	12	1.03	1.06	97.6	142
141: MH-19-022	143: MH-06-056	153.35	151.77	220	12	1.79	1.95	91.7	144
143: MH-06-056	1135: OF-1	151.77	148	247.65	48	3.8	114.54	3.3	1136
146: MH-19-019	141: MH-19-022	157.55	153.35	900	12	0.76	1.57	48.1	148
151: MH-20-004	143: MH-06-056	157.6	151.77	847	18	2.01	5.63	35.7	152
153: MH-20-005	151: MH-20-004	163.23	157.6	597	18	2.01	6.59	30.5	154
155: MH-20-010	153: MH-20-005	180.6	163.23	1515	10	1.06	1.52	70.1	156
157: MH-20-024	155: MH-20-010	188.27	180.6	1060	10	0.87	1.2	72.4	158
159: MH-20-026	157: MH-20-024	191.76	188.27	583.5	10	0.33	1.1	30	160
161: MH-06-030	163: MH-06-025	140.61	139.71	320	15	0	2.21	0	164
163: MH-06-025	165: MH-06-024	139.71	138.11	300	15	0	3.05	0	166
165: MH-06-024	167: MH-06-015	138.11	136.53	653.5	15	0.55	2.05	26.6	168
167: MH-06-015	169: MH-06-011	136.53	124.7	691.9	15	0.74	5.46	13.6	170
169: MH-06-011	171: MH-06-007	124.7	109.73	518	15	0.74	7.1	10.4	172
171: MH-06-007	173: MH-06-003	109.73	97.16	558	15	0.74	6.27	11.8	174
173: MH-06-003	175: MH-06-002	97.16	96.27	420	21	2.31	4.71	49.1	176
175: MH-06-002	405: MH-06-001	96.27	96	165	24	4.86	5.91	82.2	439
179: MH-02-004	494: MH-02-003	99.45	98.81	110	10	0.43	1.08	39.8	495
181: MH-02-009	179: MH-02-004	101.25	99.45	410	10	0.43	0.94	45.8	182
183: MH-02-020	368: MH-02-015	106.05	102.25	800	10	0.43	0.98	44	409
189: MH-07-004	173: MH-06-003	103.2	97.16	1317.8	15	1.51	2.83	53.4	190
191: MH-07-012	189: MH-07-004	108.01	103.2	537	12	1.05	2.18	48.3	192
193: MH-07-013	191: MH-07-012	116.48	108.01	436	10	1.05	1.97	53.3	194
195: MH-07-015	193: MH-07-013	127.37	116.48	607.2	10	1.05	1.9	55.5	196
197: MH-11-006	195: MH-07-015	132.8	127.37	664.5	10	0.89	1.28	69.7	198
199: MH-01-009	175: MH-06-002	99.52	96.27	1047	18	2.09	3.78	55.4	200
201: MH-01-012	199: MH-01-009	103.21	99.52	628	18	2.11	5.2	40.6	202
203: MH-01-013	201: MH-01-012	103.58	103.21	135	18	2.04	3.55	57.5	204
205: MH-08-022	203: MH-01-013	104.32	103.58	322	18	2.05	3.25	63	206
207: MH-08-023	205: MH-08-022	104.76	104.32	169	18	2.05	3.46	59.1	208
209: MH-08-016	497: MH-08-026	112.54	111.25	172.63	15	1.97	3.61	54.7	499
215: MH-08-031	339: MH-08-027	170.9	118	872	15	1.68	10.28	16.3	374
217: MH-08-032	215: MH-08-031	187	170.9	360	15	1.55	8.83	17.5	218
219: MH-08-033	217: MH-08-032	193	187	189	15	1.55	7.44	20.9	220
221: MH-08-060	219: MH-08-033	244.1	193	767.9	8	0.1	2.01	5.1	222
223: MH-08-058	221: MH-08-060	248.9	244.1	390.18	8	0.1	0.87	11.8	224
225: MH-08-048	223: MH-08-058	251.21	248.9	209.8	8	0.04	0.82	4.7	226
229: MH-26-001	225: MH-08-048	262.52	251.21	692.4	8	0.04	1	3.9	862
231: MH-26-002	229: MH-26-001	265.68	262.52	195	8	0.04	0.99	3.9	232
233: MH-26-004	231: MH-26-002	268.14	265.68	452	8	0.04	0.58	6.7	234
239: MH-21-002	153: MH-20-005	179.13	163.23	696	8	0.94	1.18	80	435
247: MH-21-015	239: MH-21-002	195.5	179.13	531	8	0.94	1.37	68.9	324
260: MH-21-018	247: MH-21-015	211.14	195.5	705	8	0.94	1.16	81.2	261
262: MH-21-023	260: MH-21-018	237.5	211.14	918	8	0.76	1.32	57.3	263
264: MH-22-002	262: MH-21-023	245.14	237.5	595	8	0.76	0.88	85.7	265
266: MH-22-003	264: MH-22-002	245.79	245.14	130	8	0.76	0.55	137.3	267
268: MH-22-007	266: MH-22-003	246.62	245.79	165	8	0.76	0.55	136.9	269
270: MH-22-008	268: MH-22-007	247.55	246.62	75	8	0.76	0.87	87.2	271
272: MH-22-009	270: MH-22-008	248.6	247.55	332	8	0.71	0.44	161	273
274: MH-22-010	272: MH-22-009	249.82	248.6	215	8	0.71	0.59	120.2	275
282: MH-22-045AT	365: MH-22-036	267.48	266.25	378.78	12	0.53	1.31	40.1	367
286: MH-22-063	351: MH-22-061	270.92	269.61	881.98	12	0.12	0.89	13.5	352

Table G14: 2025 Conduit Results of Peak Hour Flows for Alternative 2

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
290: MH-08-039	219: MH-08-033	209	193	828	15	1.45	5.8	25	291
292: MH-08-054	290: MH-08-039	214.21	209	802.1	8	0.04	0.63	5.6	293
294: MH-08-055	292: MH-08-054	215.37	214.21	264.3	8	0.05	0.52	9.6	295
296: MH-08-082	294: MH-08-055	216.79	215.37	119.07	8	0.04	0.85	4.9	297
298: MH-08-057	296: MH-08-082	225.92	216.79	327.24	8	0.03	1.3	2.4	299
300: MH-08-093	298: MH-08-057	259.8	225.92	461	8	0.01	2.12	0.7	301
302: MH-08-091	300: MH-08-093	275.8	259.8	367	8	0	1.63	0	303
304: MH-08-096	302: MH-08-091	289	275.8	476	8	0	1.3	0	305
312: MH-08-042	500: MH-08-041	225.1	224	350	16	1.13	2.78	40.7	502
316: MH-28-001	503: MH-08-085	246.94	227.64	1124.6	15	1.44	5.47	26.3	505
339: MH-08-027	209: MH-08-016	118	112.54	42	15	1.67	15.05	11.1	340
351: MH-22-061	282: MH-22-045A	269.61	267.48	580.56	12	0.12	1.39	8.6	353
363: MH-22-034	558: MH-22-013	261.02	253.72	456.78	8	0.53	0.99	53.2	559
365: MH-22-036	363: MH-22-034	266.25	261.02	545.3	8	0.53	0.76	68.7	366
368: MH-02-015	181: MH-02-009	102.25	101.25	225	10	0.43	0.94	45.5	369
375: MH-26-005	233: MH-26-004	268.61	268.14	73	8	0.04	0.63	6.1	376
377: MH-26-007	375: MH-26-005	272.9	268.61	431	8	0.04	0.78	4.9	378
383: MH-28-002	316: MH-28-001	253.02	246.94	205	15	1.09	7.19	15.2	384
405: MH-06-001	725: 01-001TP	96	94.7	343.94	24	4.87	8.99	54.1	731
432: MH-22-012	274: MH-22-010	251.91	249.82	378.75	8	0.71	0.58	121.9	434
436: MH-05-001	183: MH-02-020	113.78	106.05	379.48	10	0.35	2.02	17.1	438
482: MH-17-017	115: MH-17-012	292.8	237.47	1384.8	8	0	1.56	0	484
494: MH-02-003	175: MH-06-002	98.81	96.27	500	12	0.43	1.64	26.2	496
497: MH-08-026	936: MH-08-025	111.25	106.28	253	15	1.98	5.85	33.8	937
500: MH-08-041	290: MH-08-039	224	209	651	15	1.16	6.34	18.3	501
503: MH-08-085	312: MH-08-042	227.64	225.1	477	16	1.31	3.62	36.1	504
546: MH-22-075	547: MH-22-067	280	279	432.04	12	0	1.11	0	548
547: MH-22-067	286: MH-22-063	279	270.92	801.44	12	0.12	2.31	5.2	549
550: MH-20-079	551: MH-20-077	207	192	467.36	8	0.01	1.4	0.5	552
551: MH-20-077	159: MH-20-026	192	191.76	789.72	8	0.33	0.14	241.4	553
554: MH-22-022	555: MH-22-020	273.35	254.15	569	8	0.01	1.43	0.8	556
555: MH-22-020	432: MH-22-012	254.15	251.91	347	8	0.11	0.63	17.1	557
558: MH-22-013	432: MH-22-012	253.72	251.91	798.03	8	0.6	0.37	161.3	562
563: MH-23-010	564: MH-18-023	223.7	190.36	1282.8	8	0.2	1.26	15.8	565
564: MH-18-023	566: MH-18-020	190.36	179	710	8	0.42	0.99	42.5	567
566: MH-18-020	568: MH-18-018	179	168.31	675.4	8	0.42	0.98	42.7	569
568: MH-18-018	119: MH-18-001	168.31	165.72	645.3	8	0.62	0.49	125.1	570
576: MH-18-010	119: MH-18-001	177.32	165.72	527.5	12	0.68	3.41	19.9	578
582: MH-15-012	583: MH-15-011	181.3	179.1	322	8	0.25	0.65	38.5	584
583: MH-15-011	597: MH-15-006	179.1	175.4	524.1	8	0.25	0.66	37.9	598
586: MH-13-001	587: MH-11-009	172.07	165.3	230	8	0.68	1.34	51	588
587: MH-11-009	197: MH-11-006	165.3	132.8	1234	8	0.68	1.27	53.9	589
590: MH-12-026	592: MH-12-004	157.98	150.05	310	8	0.01	1.25	0.5	593
592: MH-12-004	608: MH-12-002A	150.05	140.6	501	8	0.21	1.07	19.5	609
597: MH-15-006	602: MH-15-005	175.4	169.7	295	8	0.25	1.09	22.9	603
602: MH-15-005	605: MH-15-003	169.7	158.4	566	8	0.25	1.1	22.5	606
605: MH-15-003	165: MH-06-024	158.4	138.11	783.3	8	0.55	1.26	43.9	607
608: MH-12-002A	197: MH-11-006	140.6	132.8	672	8	0.21	0.84	24.9	610
611: MH-13-037	612: MH-13-024	243	198.5	1025	8	0.25	1.63	15.6	613
612: MH-13-024	656: MH-13-006	198.5	198.03	72	8	0.51	0.63	81	657
614: MH-13-004	586: MH-13-001	173.11	172.07	187	8	0.68	0.58	117.3	621
622: MH-25-018	623: MH-28-043	250	248	241.97	8	0.04	0.71	5.2	624
623: MH-28-043	625: MH-28-037	248	229.22	329.51	8	0.04	1.86	2	626
625: MH-28-037	627: MH-28-035	229.22	216.01	234.7	8	0.04	1.85	2	628
627: MH-28-035	793: WW-28-030	216.01	169.6	530.8	8	0.04	2.31	1.6	797
632: MH-08-008	633: MH-07-006	172.15	106.04	1908	10	0.22	2.64	8.2	634
633: MH-07-006	189: MH-07-004	106.04	103.2	550	8	0.22	0.56	38.6	635
636: MH-05-009	638: MH-05-004	116.5	116	511.4	10	0	0.44	0	639
638: MH-05-004	640: MH-05-003	116	115.4	494.8	12	0	0.8	0	641
640: MH-05-003	642: MH-05-002	115.4	114.5	384.5	12	0	1.11	0	643
642: MH-05-002	436: MH-05-001	114.5	113.78	324.6	15	0.35	1.97	17.6	646
656: MH-13-006	614: MH-13-004	198.03	173.11	530	8	0.51	1.69	30.2	658
774: MH-17-046	55: MH-17-043	274	268.22	276.25	8	0	1.13	0	775
936: MH-08-025	207: MH-08-023	106.28	104.76	660	18	2.02	3.26	62	939
942: MH-26-021	943: MH-08-021	204	120	1776.64	8	0.3	1.7	17.5	944
943: MH-08-021	945: MH-08-019	120	113.97	469.89	8	0.3	0.88	33.6	946
945: MH-08-019	947: MH-08-018	113.97	113.79	60	8	0.3	0.43	69.5	948
947: MH-08-018	209: MH-08-016	113.79	112.54	437.94	8	0.3	0.42	71.2	949

Results File S:\GIS\3530009 Oak Harbor Sewer Plan\Model\Model Submitted\OH Sewers (Divert Flows at Whidbey).swg

Table G15: Long Term Growth Conduit Results of Peak Hour Flows for Alternative 2

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
55: MH-17-043	56: MH-17-041	268.22	262.08	330	8	1.12	1.07	105.3	412
56: MH-17-041	79: MH-17-039	262.08	242.06	498	8	1.12	1.57	71.6	413
58: MH-17-046	56: MH-17-041	268.66	262.08	185	8	0	1.47	0	59
60: MH-17-047	58: MH-17-046	271.45	268.66	309	8	0	0.74	0	426
62: MH-17-049	60: MH-17-047	280.46	271.45	554	8	0	1	0	425
64: MH-17-051	62: MH-17-049	286.41	280.46	443	8	0	0.91	0	424
79: MH-17-039	81: MH-17-033	242.06	240.51	451.8	8	1.12	0.46	245.2	414
81: MH-17-033	83: MH-17-032	240.51	220.28	315	8	1.41	1.98	71.3	415
83: MH-17-032	85: MH-17-031	220.28	212.1	195	8	1.41	1.6	88.2	86
85: MH-17-031	87: MH-17-028	212.1	209.4	270	8	1.27	0.78	163.2	417
87: MH-17-028	89: MH-17-027	209.4	202.78	172	8	1.27	1.53	82.8	418
89: MH-17-027	91: MH-17-026	202.78	202.29	266	8	1.28	0.34	382	419
91: MH-17-026	93: MH-17-025	202.29	191.61	270	8	1.28	1.55	82.6	420
93: MH-17-025	105: MH-17-002	191.61	190.23	146	8	1.22	0.76	160.7	421
105: MH-17-002	107: MH-17-001	190.23	186.87	467.6	10	1.48	1.2	123.3	422
107: MH-17-001	576: MH-18-010	186.87	177.32	348.75	12	1.86	3.81	48.7	577
109: MH-16-001	107: MH-17-001	192.11	186.87	195	12	0.33	3.77	8.8	110
111: MH-16-002	109: MH-16-001	194.75	192.11	400	10	0.33	1.15	29	112
113: MH-17-005	105: MH-17-002	235.75	190.23	911.5	8	0.26	1.75	14.8	114
115: MH-17-012	113: MH-17-005	237.47	235.75	124	8	0	0.92	0	116
119: MH-18-001	121: MH-19-012	165.72	162	317.3	12	1.44	2.49	57.6	122
119: MH-18-001	146: MH-19-019	165.72	157.55	1323.3	12	1.45	1.81	80.2	147
121: MH-19-012	139: MH-19-002	162	154.77	1590.2	12	1.58	1.55	101.5	140
139: MH-19-002	141: MH-19-022	154.77	153.35	673	12	1.57	1.06	148.9	142
141: MH-19-022	143: MH-06-056	153.35	151.77	220	12	3.37	1.95	172.7	144
143: MH-06-056	1135: OF-1	151.77	148	247.65	48	6.39	114.54	5.6	1136
146: MH-19-019	141: MH-19-022	157.55	153.35	900	12	1.79	1.57	114.1	148
151: MH-20-004	143: MH-06-056	157.6	151.77	847	18	3.02	5.63	53.6	152
153: MH-20-005	151: MH-20-004	163.23	157.6	597	18	3.02	6.59	45.8	154
155: MH-20-010	153: MH-20-005	180.6	163.23	1515	10	1.78	1.52	117.5	156
157: MH-20-024	155: MH-20-010	188.27	180.6	1060	10	1.41	1.2	117	158
159: MH-20-026	157: MH-20-024	191.76	188.27	583.5	10	0.4	1.1	36.8	160
161: MH-06-030	163: MH-06-025	140.61	139.71	320	15	0	2.21	0	164
163: MH-06-025	165: MH-06-024	139.71	138.11	300	15	0	3.05	0	166
165: MH-06-024	167: MH-06-015	138.11	136.53	653.5	15	0.79	2.05	38.5	168
167: MH-06-015	169: MH-06-011	136.53	124.7	691.9	15	1.22	5.46	22.4	170
169: MH-06-011	171: MH-06-007	124.7	109.73	518	15	1.22	7.1	17.2	172
171: MH-06-007	173: MH-06-003	109.73	97.16	558	15	1.22	6.27	19.5	174
173: MH-06-003	175: MH-06-002	97.16	96.27	420	21	4.04	4.71	85.7	176
175: MH-06-002	405: MH-06-001	96.27	96	165	24	9.88	5.91	167.1	439
179: MH-02-004	494: MH-02-003	99.45	98.81	110	10	1.18	1.08	109.1	495
181: MH-02-009	179: MH-02-004	101.25	99.45	410	10	1.18	0.94	125.6	182
183: MH-02-020	368: MH-02-015	106.05	102.25	800	10	1.18	0.98	120.7	409
189: MH-07-004	173: MH-06-003	103.2	97.16	1317.8	15	2.81	2.83	99.4	190
191: MH-07-012	189: MH-07-004	108.01	103.2	537	12	1.95	2.18	89.3	192
193: MH-07-013	191: MH-07-012	116.48	108.01	436	10	1.94	1.97	98.5	194
195: MH-07-015	193: MH-07-013	127.37	116.48	607.2	10	1.94	1.9	102.5	196
197: MH-11-006	195: MH-07-015	132.8	127.37	664.5	10	1.63	1.28	127.1	198
199: MH-01-009	175: MH-06-002	99.52	96.27	1047	18	4.66	3.78	123.2	200
201: MH-01-012	199: MH-01-009	103.21	99.52	628	18	4.66	5.2	89.5	202
203: MH-01-013	201: MH-01-012	103.58	103.21	135	18	4.48	3.55	126.2	204
205: MH-08-022	203: MH-01-013	104.32	103.58	322	18	4.48	3.25	137.7	206
207: MH-08-023	205: MH-08-022	104.76	104.32	169	18	4.48	3.46	129.3	208
209: MH-08-016	497: MH-08-026	112.54	111.25	172.63	15	4.47	3.61	123.9	499
215: MH-08-031	339: MH-08-027	170.9	118	872	15	3.92	10.28	38.1	374
217: MH-08-032	215: MH-08-031	187	170.9	360	15	3.77	8.83	42.7	218
219: MH-08-033	217: MH-08-032	193	187	189	15	3.77	7.44	50.7	220
221: MH-08-060	219: MH-08-033	244.1	193	767.9	8	0.26	2.01	12.7	222
223: MH-08-058	221: MH-08-060	248.9	244.1	390.18	8	0.26	0.87	29.5	224
225: MH-08-048	223: MH-08-058	251.21	248.9	209.8	8	0.07	0.82	9.1	226
229: MH-26-001	225: MH-08-048	262.52	251.21	692.4	8	0.07	1	7.4	862
231: MH-26-002	229: MH-26-001	265.68	262.52	195	8	0.07	0.99	7.5	232
233: MH-26-004	231: MH-26-002	268.14	265.68	452	8	0.07	0.58	12.9	234
239: MH-21-002	153: MH-20-005	179.13	163.23	696	8	1.24	1.18	104.9	435
247: MH-21-015	239: MH-21-002	195.5	179.13	531	8	1.24	1.37	90.3	324
260: MH-21-018	247: MH-21-015	211.14	195.5	705	8	1.24	1.16	106.5	261
262: MH-21-023	260: MH-21-018	237.5	211.14	918	8	0.95	1.32	72.1	263
264: MH-22-002	262: MH-21-023	245.14	237.5	595	8	0.95	0.88	107.8	265
266: MH-22-003	264: MH-22-002	245.79	245.14	130	8	0.95	0.55	172.8	267
268: MH-22-007	266: MH-22-003	246.62	245.79	165	8	0.95	0.55	172.3	269
270: MH-22-008	268: MH-22-007	247.55	246.62	75	8	0.95	0.87	109.7	271
272: MH-22-009	270: MH-22-008	248.6	247.55	332	8	0.83	0.44	188.5	273
274: MH-22-010	272: MH-22-009	249.82	248.6	215	8	0.83	0.59	140.7	275
282: MH-22-045AT	365: MH-22-036	267.48	266.25	378.78	12	0.62	1.31	47.6	367
286: MH-22-063	351: MH-22-061	270.92	269.61	881.98	12	0.5	0.89	56.5	352

Table G15: Long Term Growth Conduit Results of Peak Hour Flows for Alternative 2

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
290: MH-08-039	219: MH-08-033	209	193	828	15	3.5	5.8	60.4	291
292: MH-08-054	290: MH-08-039	214.21	209	802.1	8	0.05	0.63	7.7	293
294: MH-08-055	292: MH-08-054	215.37	214.21	264.3	8	0.05	0.52	10.3	295
296: MH-08-082	294: MH-08-055	216.79	215.37	119.07	8	0.05	0.85	5.7	297
298: MH-08-057	296: MH-08-082	225.92	216.79	327.24	8	0.04	1.3	3.2	299
300: MH-08-093	298: MH-08-057	259.8	225.92	461	8	0.02	2.12	1.2	301
302: MH-08-091	300: MH-08-093	275.8	259.8	367	8	0.01	1.63	0.3	303
304: MH-08-096	302: MH-08-091	289	275.8	476	8	0	1.3	0	305
312: MH-08-042	500: MH-08-041	225.1	224	350	16	2.93	2.78	105.6	502
316: MH-28-001	503: MH-08-085	246.94	227.64	1124.6	15	2.64	5.47	48.2	505
339: MH-08-027	209: MH-08-016	118	112.54	42	15	3.91	15.05	26	340
351: MH-22-061	282: MH-22-045A	269.61	267.48	580.56	12	-0.23	1.39	-16.3	353
363: MH-22-034	558: MH-22-013	261.02	253.72	456.78	8	0.62	0.99	63.2	559
365: MH-22-036	363: MH-22-034	266.25	261.02	545.3	8	0.62	0.76	81.6	366
368: MH-02-015	181: MH-02-009	102.25	101.25	225	10	1.18	0.94	124.8	369
375: MH-26-005	233: MH-26-004	268.61	268.14	73	8	0.07	0.63	11.8	376
377: MH-26-007	375: MH-26-005	272.9	268.61	431	8	0.07	0.78	9.5	378
383: MH-28-002	316: MH-28-001	253.02	246.94	205	15	0.23	7.19	3.2	384
405: MH-06-001	725: 01-001TP	96	94.7	343.94	24	9.89	8.99	110	731
432: MH-22-012	274: MH-22-010	251.91	249.82	378.75	8	0.83	0.58	142.7	434
436: MH-05-001	183: MH-02-020	113.78	106.05	379.48	10	0.89	2.02	44.2	438
482: MH-17-017	115: MH-17-012	292.8	237.47	1384.8	8	0	1.56	0	484
494: MH-02-003	175: MH-06-002	98.81	96.27	500	12	1.18	1.64	71.9	496
497: MH-08-026	936: MH-08-025	111.25	106.28	253	15	4.48	5.85	76.5	937
500: MH-08-041	290: MH-08-039	224	209	651	15	2.91	6.34	46	501
503: MH-08-085	312: MH-08-042	227.64	225.1	477	16	3.07	3.62	84.9	504
546: MH-22-075	547: MH-22-067	280	279	432.04	12	0.14	1.11	12.6	548
547: MH-22-067	286: MH-22-063	279	270.92	801.44	12	0.5	2.31	21.7	549
550: MH-20-079	551: MH-20-077	207	192	467.36	8	0.02	1.4	1.1	552
551: MH-20-077	159: MH-20-026	192	191.76	789.72	8	0.4	0.14	296.2	553
554: MH-22-022	555: MH-22-020	273.35	254.15	569	8	0.03	1.43	2.2	556
555: MH-22-020	432: MH-22-012	254.15	251.91	347	8	0.19	0.63	31	557
558: MH-22-013	432: MH-22-012	253.72	251.91	798.03	8	0.63	0.37	170.3	562
563: MH-23-010	564: MH-18-023	223.7	190.36	1282.8	8	1.29	1.26	102.7	565
564: MH-18-023	566: MH-18-020	190.36	179	710	8	1.01	0.99	102.7	567
566: MH-18-020	568: MH-18-018	179	168.31	675.4	8	1.01	0.98	103.2	569
568: MH-18-018	119: MH-18-001	168.31	165.72	645.3	8	0.91	0.49	183.3	570
576: MH-18-010	119: MH-18-001	177.32	165.72	527.5	12	1.86	3.41	54.3	578
582: MH-15-012	583: MH-15-011	181.3	179.1	322	8	0.31	0.65	48.8	584
583: MH-15-011	597: MH-15-006	179.1	175.4	524.1	8	0.31	0.66	48	598
586: MH-13-001	587: MH-11-009	172.07	165.3	230	8	1.1	1.34	82.4	588
587: MH-11-009	197: MH-11-006	165.3	132.8	1234	8	1.1	1.27	87.1	589
590: MH-12-026	592: MH-12-004	157.98	150.05	310	8	0.05	1.25	4.1	593
592: MH-12-004	608: MH-12-002A	150.05	140.6	501	8	0.52	1.07	48.9	609
597: MH-15-006	602: MH-15-005	175.4	169.7	295	8	0.32	1.09	29	603
602: MH-15-005	605: MH-15-003	169.7	158.4	566	8	0.31	1.1	28.5	606
605: MH-15-003	165: MH-06-024	158.4	138.11	783.3	8	0.78	1.26	61.7	607
608: MH-12-002A	197: MH-11-006	140.6	132.8	672	8	0.52	0.84	62.2	610
611: MH-13-037	612: MH-13-024	243	198.5	1025	8	0.41	1.63	25.4	613
612: MH-13-024	656: MH-13-006	198.5	198.03	72	8	0.83	0.63	131.8	657
614: MH-13-004	586: MH-13-001	173.11	172.07	187	8	1.1	0.58	189.5	621
622: MH-25-018	623: MH-28-043	250	248	241.97	8	0.06	0.71	8.2	624
623: MH-28-043	625: MH-28-037	248	229.22	329.51	8	0.06	1.86	3.1	626
625: MH-28-037	627: MH-28-035	229.22	216.01	234.7	8	0.06	1.85	3.1	628
627: MH-28-035	793: WW-28-030	216.01	169.6	530.8	8	0.06	2.31	2.5	797
632: MH-08-008	633: MH-07-006	172.15	106.04	1908	10	0.4	2.64	15	634
633: MH-07-006	189: MH-07-004	106.04	103.2	550	8	0.4	0.56	70.4	635
636: MH-05-009	638: MH-05-004	116.5	116	511.4	10	0	0.44	0	639
638: MH-05-004	640: MH-05-003	116	115.4	494.8	12	0	0.8	0	641
640: MH-05-003	642: MH-05-002	115.4	114.5	384.5	12	0	1.11	0	643
642: MH-05-002	436: MH-05-001	114.5	113.78	324.6	15	0.89	1.97	45.4	646
656: MH-13-006	614: MH-13-004	198.03	173.11	530	8	0.83	1.69	49.1	658
774: MH-17-046	55: MH-17-043	274	268.22	276.25	8	0.02	1.13	2.1	775
936: MH-08-025	207: MH-08-023	106.28	104.76	660	18	4.48	3.26	137.4	939
942: MH-26-021	943: MH-08-021	204	120	1776.64	8	0.56	1.7	32.9	944
943: MH-08-021	945: MH-08-019	120	113.97	469.89	8	0.56	0.88	63.1	946
945: MH-08-019	947: MH-08-018	113.97	113.79	60	8	0.56	0.43	130.5	948
947: MH-08-018	209: MH-08-016	113.79	112.54	437.94	8	0.56	0.42	133.8	949

Results File: S:\GIS\3530009 Oak Harbor Sewer Plan\Model\Model Submitted\OH Sewers (Divert Flows at Whidbey).swg

Table G15: Long Term Growth Conduit Results of Peak Hour Flows for Alternative 2

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
55: MH-17-043	56: MH-17-041	268.22	262.08	330	8	1.12	1.07	105.3	412
56: MH-17-041	79: MH-17-039	262.08	242.06	498	8	1.12	1.57	71.6	413
58: MH-17-046	56: MH-17-041	268.66	262.08	185	8	0	1.47	0	59
60: MH-17-047	58: MH-17-046	271.45	268.66	309	8	0	0.74	0	426
62: MH-17-049	60: MH-17-047	280.46	271.45	554	8	0	1	0	425
64: MH-17-051	62: MH-17-049	286.41	280.46	443	8	0	0.91	0	424
79: MH-17-039	81: MH-17-033	242.06	240.51	451.8	8	1.12	0.46	245.2	414
81: MH-17-033	83: MH-17-032	240.51	220.28	315	8	1.41	1.98	71.3	415
83: MH-17-032	85: MH-17-031	220.28	212.1	195	8	1.41	1.6	88.2	86
85: MH-17-031	87: MH-17-028	212.1	209.4	270	8	1.27	0.78	163.2	417
87: MH-17-028	89: MH-17-027	209.4	202.78	172	8	1.27	1.53	82.8	418
89: MH-17-027	91: MH-17-026	202.78	202.29	266	8	1.28	0.34	382	419
91: MH-17-026	93: MH-17-025	202.29	191.61	270	8	1.28	1.55	82.6	420
93: MH-17-025	105: MH-17-002	191.61	190.23	146	8	1.22	0.76	160.7	421
105: MH-17-002	107: MH-17-001	190.23	186.87	467.6	10	1.48	1.2	123.3	422
107: MH-17-001	576: MH-18-010	186.87	177.32	348.75	12	1.86	3.81	48.7	577
109: MH-16-001	107: MH-17-001	192.11	186.87	195	12	0.33	3.77	8.8	110
111: MH-16-002	109: MH-16-001	194.75	192.11	400	10	0.33	1.15	29	112
113: MH-17-005	105: MH-17-002	235.75	190.23	911.5	8	0.26	1.75	14.8	114
115: MH-17-012	113: MH-17-005	237.47	235.75	124	8	0	0.92	0	116
119: MH-18-001	121: MH-19-012	165.72	162	317.3	12	1.44	2.49	57.6	122
119: MH-18-001	146: MH-19-019	165.72	157.55	1323.3	12	1.45	1.81	80.2	147
121: MH-19-012	139: MH-19-002	162	154.77	1590.2	12	1.58	1.55	101.5	140
139: MH-19-002	141: MH-19-022	154.77	153.35	673	12	1.57	1.06	148.9	142
141: MH-19-022	143: MH-06-056	153.35	151.77	220	12	3.37	1.95	172.7	144
143: MH-06-056	1135: OF-1	151.77	148	247.65	48	6.39	114.54	5.6	1136
146: MH-19-019	141: MH-19-022	157.55	153.35	900	12	1.79	1.57	114.1	148
151: MH-20-004	143: MH-06-056	157.6	151.77	847	18	3.02	5.63	53.6	152
153: MH-20-005	151: MH-20-004	163.23	157.6	597	18	3.02	6.59	45.8	154
155: MH-20-010	153: MH-20-005	180.6	163.23	1515	10	1.78	1.52	117.5	156
157: MH-20-024	155: MH-20-010	188.27	180.6	1060	10	1.41	1.2	117	158
159: MH-20-026	157: MH-20-024	191.76	188.27	583.5	10	0.4	1.1	36.8	160
161: MH-06-030	163: MH-06-025	140.61	139.71	320	15	0	2.21	0	164
163: MH-06-025	165: MH-06-024	139.71	138.11	300	15	0	3.05	0	166
165: MH-06-024	167: MH-06-015	138.11	136.53	653.5	15	0.79	2.05	38.5	168
167: MH-06-015	169: MH-06-011	136.53	124.7	691.9	15	1.22	5.46	22.4	170
169: MH-06-011	171: MH-06-007	124.7	109.73	518	15	1.22	7.1	17.2	172
171: MH-06-007	173: MH-06-003	109.73	97.16	558	15	1.22	6.27	19.5	174
173: MH-06-003	175: MH-06-002	97.16	96.27	420	21	4.04	4.71	85.7	176
175: MH-06-002	405: MH-06-001	96.27	96	165	24	9.88	5.91	167.1	439
179: MH-02-004	494: MH-02-003	99.45	98.81	110	10	1.18	1.08	109.1	495
181: MH-02-009	179: MH-02-004	101.25	99.45	410	10	1.18	0.94	125.6	182
183: MH-02-020	368: MH-02-015	106.05	102.25	800	10	1.18	0.98	120.7	409
189: MH-07-004	173: MH-06-003	103.2	97.16	1317.8	15	2.81	2.83	99.4	190
191: MH-07-012	189: MH-07-004	108.01	103.2	537	12	1.95	2.18	89.3	192
193: MH-07-013	191: MH-07-012	116.48	108.01	436	10	1.94	1.97	98.5	194
195: MH-07-015	193: MH-07-013	127.37	116.48	607.2	10	1.94	1.9	102.5	196
197: MH-11-006	195: MH-07-015	132.8	127.37	664.5	10	1.63	1.28	127.1	198
199: MH-01-009	175: MH-06-002	99.52	96.27	1047	18	4.66	3.78	123.2	200
201: MH-01-012	199: MH-01-009	103.21	99.52	628	18	4.66	5.2	89.5	202
203: MH-01-013	201: MH-01-012	103.58	103.21	135	18	4.48	3.55	126.2	204
205: MH-08-022	203: MH-01-013	104.32	103.58	322	18	4.48	3.25	137.7	206
207: MH-08-023	205: MH-08-022	104.76	104.32	169	18	4.48	3.46	129.3	208
209: MH-08-016	497: MH-08-026	112.54	111.25	172.63	15	4.47	3.61	123.9	499
215: MH-08-031	339: MH-08-027	170.9	118	872	15	3.92	10.28	38.1	374
217: MH-08-032	215: MH-08-031	187	170.9	360	15	3.77	8.83	42.7	218
219: MH-08-033	217: MH-08-032	193	187	189	15	3.77	7.44	50.7	220
221: MH-08-060	219: MH-08-033	244.1	193	767.9	8	0.26	2.01	12.7	222
223: MH-08-058	221: MH-08-060	248.9	244.1	390.18	8	0.26	0.87	29.5	224
225: MH-08-048	223: MH-08-058	251.21	248.9	209.8	8	0.07	0.82	9.1	226
229: MH-26-001	225: MH-08-048	262.52	251.21	692.4	8	0.07	1	7.4	862
231: MH-26-002	229: MH-26-001	265.68	262.52	195	8	0.07	0.99	7.5	232
233: MH-26-004	231: MH-26-002	268.14	265.68	452	8	0.07	0.58	12.9	234
239: MH-21-002	153: MH-20-005	179.13	163.23	696	8	1.24	1.18	104.9	435
247: MH-21-015	239: MH-21-002	195.5	179.13	531	8	1.24	1.37	90.3	324
260: MH-21-018	247: MH-21-015	211.14	195.5	705	8	1.24	1.16	106.5	261
262: MH-21-023	260: MH-21-018	237.5	211.14	918	8	0.95	1.32	72.1	263
264: MH-22-002	262: MH-21-023	245.14	237.5	595	8	0.95	0.88	107.8	265
266: MH-22-003	264: MH-22-002	245.79	245.14	130	8	0.95	0.55	172.8	267
268: MH-22-007	266: MH-22-003	246.62	245.79	165	8	0.95	0.55	172.3	269
270: MH-22-008	268: MH-22-007	247.55	246.62	75	8	0.95	0.87	109.7	271
272: MH-22-009	270: MH-22-008	248.6	247.55	332	8	0.83	0.44	188.5	273
274: MH-22-010	272: MH-22-009	249.82	248.6	215	8	0.83	0.59	140.7	275
282: MH-22-045AT	365: MH-22-036	267.48	266.25	378.78	12	0.62	1.31	47.6	367
286: MH-22-063	351: MH-22-061	270.92	269.61	881.98	12	0.5	0.89	56.5	352

Table G15: Long Term Growth Conduit Results of Peak Hour Flows for Alternative 2

Start Manhole	Stop Manhole	Start Invert	End Invert	Length (ft)	Diameter (inches)	Flow (MGD)	Full Capacity (MGD)	Flow/Full Capacity (%)	Model ID
290: MH-08-039	219: MH-08-033	209	193	828	15	3.5	5.8	60.4	291
292: MH-08-054	290: MH-08-039	214.21	209	802.1	8	0.05	0.63	7.7	293
294: MH-08-055	292: MH-08-054	215.37	214.21	264.3	8	0.05	0.52	10.3	295
296: MH-08-082	294: MH-08-055	216.79	215.37	119.07	8	0.05	0.85	5.7	297
298: MH-08-057	296: MH-08-082	225.92	216.79	327.24	8	0.04	1.3	3.2	299
300: MH-08-093	298: MH-08-057	259.8	225.92	461	8	0.02	2.12	1.2	301
302: MH-08-091	300: MH-08-093	275.8	259.8	367	8	0.01	1.63	0.3	303
304: MH-08-096	302: MH-08-091	289	275.8	476	8	0	1.3	0	305
312: MH-08-042	500: MH-08-041	225.1	224	350	16	2.93	2.78	105.6	502
316: MH-28-001	503: MH-08-085	246.94	227.64	1124.6	15	2.64	5.47	48.2	505
339: MH-08-027	209: MH-08-016	118	112.54	42	15	3.91	15.05	26	340
351: MH-22-061	282: MH-22-045A	269.61	267.48	580.56	12	-0.23	1.39	-16.3	353
363: MH-22-034	558: MH-22-013	261.02	253.72	456.78	8	0.62	0.99	63.2	559
365: MH-22-036	363: MH-22-034	266.25	261.02	545.3	8	0.62	0.76	81.6	366
368: MH-02-015	181: MH-02-009	102.25	101.25	225	10	1.18	0.94	124.8	369
375: MH-26-005	233: MH-26-004	268.61	268.14	73	8	0.07	0.63	11.8	376
377: MH-26-007	375: MH-26-005	272.9	268.61	431	8	0.07	0.78	9.5	378
383: MH-28-002	316: MH-28-001	253.02	246.94	205	15	0.23	7.19	3.2	384
405: MH-06-001	725: 01-001TP	96	94.7	343.94	24	9.89	8.99	110	731
432: MH-22-012	274: MH-22-010	251.91	249.82	378.75	8	0.83	0.58	142.7	434
436: MH-05-001	183: MH-02-020	113.78	106.05	379.48	10	0.89	2.02	44.2	438
482: MH-17-017	115: MH-17-012	292.8	237.47	1384.8	8	0	1.56	0	484
494: MH-02-003	175: MH-06-002	98.81	96.27	500	12	1.18	1.64	71.9	496
497: MH-08-026	936: MH-08-025	111.25	106.28	253	15	4.48	5.85	76.5	937
500: MH-08-041	290: MH-08-039	224	209	651	15	2.91	6.34	46	501
503: MH-08-085	312: MH-08-042	227.64	225.1	477	16	3.07	3.62	84.9	504
546: MH-22-075	547: MH-22-067	280	279	432.04	12	0.14	1.11	12.6	548
547: MH-22-067	286: MH-22-063	279	270.92	801.44	12	0.5	2.31	21.7	549
550: MH-20-079	551: MH-20-077	207	192	467.36	8	0.02	1.4	1.1	552
551: MH-20-077	159: MH-20-026	192	191.76	789.72	8	0.4	0.14	296.2	553
554: MH-22-022	555: MH-22-020	273.35	254.15	569	8	0.03	1.43	2.2	556
555: MH-22-020	432: MH-22-012	254.15	251.91	347	8	0.19	0.63	31	557
558: MH-22-013	432: MH-22-012	253.72	251.91	798.03	8	0.63	0.37	170.3	562
563: MH-23-010	564: MH-18-023	223.7	190.36	1282.8	8	1.29	1.26	102.7	565
564: MH-18-023	566: MH-18-020	190.36	179	710	8	1.01	0.99	102.7	567
566: MH-18-020	568: MH-18-018	179	168.31	675.4	8	1.01	0.98	103.2	569
568: MH-18-018	119: MH-18-001	168.31	165.72	645.3	8	0.91	0.49	183.3	570
576: MH-18-010	119: MH-18-001	177.32	165.72	527.5	12	1.86	3.41	54.3	578
582: MH-15-012	583: MH-15-011	181.3	179.1	322	8	0.31	0.65	48.8	584
583: MH-15-011	597: MH-15-006	179.1	175.4	524.1	8	0.31	0.66	48	598
586: MH-13-001	587: MH-11-009	172.07	165.3	230	8	1.1	1.34	82.4	588
587: MH-11-009	197: MH-11-006	165.3	132.8	1234	8	1.1	1.27	87.1	589
590: MH-12-026	592: MH-12-004	157.98	150.05	310	8	0.05	1.25	4.1	593
592: MH-12-004	608: MH-12-002A	150.05	140.6	501	8	0.52	1.07	48.9	609
597: MH-15-006	602: MH-15-005	175.4	169.7	295	8	0.32	1.09	29	603
602: MH-15-005	605: MH-15-003	169.7	158.4	566	8	0.31	1.1	28.5	606
605: MH-15-003	165: MH-06-024	158.4	138.11	783.3	8	0.78	1.26	61.7	607
608: MH-12-002A	197: MH-11-006	140.6	132.8	672	8	0.52	0.84	62.2	610
611: MH-13-037	612: MH-13-024	243	198.5	1025	8	0.41	1.63	25.4	613
612: MH-13-024	656: MH-13-006	198.5	198.03	72	8	0.83	0.63	131.8	657
614: MH-13-004	586: MH-13-001	173.11	172.07	187	8	1.1	0.58	189.5	621
622: MH-25-018	623: MH-28-043	250	248	241.97	8	0.06	0.71	8.2	624
623: MH-28-043	625: MH-28-037	248	229.22	329.51	8	0.06	1.86	3.1	626
625: MH-28-037	627: MH-28-035	229.22	216.01	234.7	8	0.06	1.85	3.1	628
627: MH-28-035	793: WW-28-030	216.01	169.6	530.8	8	0.06	2.31	2.5	797
632: MH-08-008	633: MH-07-006	172.15	106.04	1908	10	0.4	2.64	15	634
633: MH-07-006	189: MH-07-004	106.04	103.2	550	8	0.4	0.56	70.4	635
636: MH-05-009	638: MH-05-004	116.5	116	511.4	10	0	0.44	0	639
638: MH-05-004	640: MH-05-003	116	115.4	494.8	12	0	0.8	0	641
640: MH-05-003	642: MH-05-002	115.4	114.5	384.5	12	0	1.11	0	643
642: MH-05-002	436: MH-05-001	114.5	113.78	324.6	15	0.89	1.97	45.4	646
656: MH-13-006	614: MH-13-004	198.03	173.11	530	8	0.83	1.69	49.1	658
774: MH-17-046	55: MH-17-043	274	268.22	276.25	8	0.02	1.13	2.1	775
936: MH-08-025	207: MH-08-023	106.28	104.76	660	18	4.48	3.26	137.4	939
942: MH-26-021	943: MH-08-021	204	120	1776.64	8	0.56	1.7	32.9	944
943: MH-08-021	945: MH-08-019	120	113.97	469.89	8	0.56	0.88	63.1	946
945: MH-08-019	947: MH-08-018	113.97	113.79	60	8	0.56	0.43	130.5	948
947: MH-08-018	209: MH-08-016	113.79	112.54	437.94	8	0.56	0.42	133.8	949

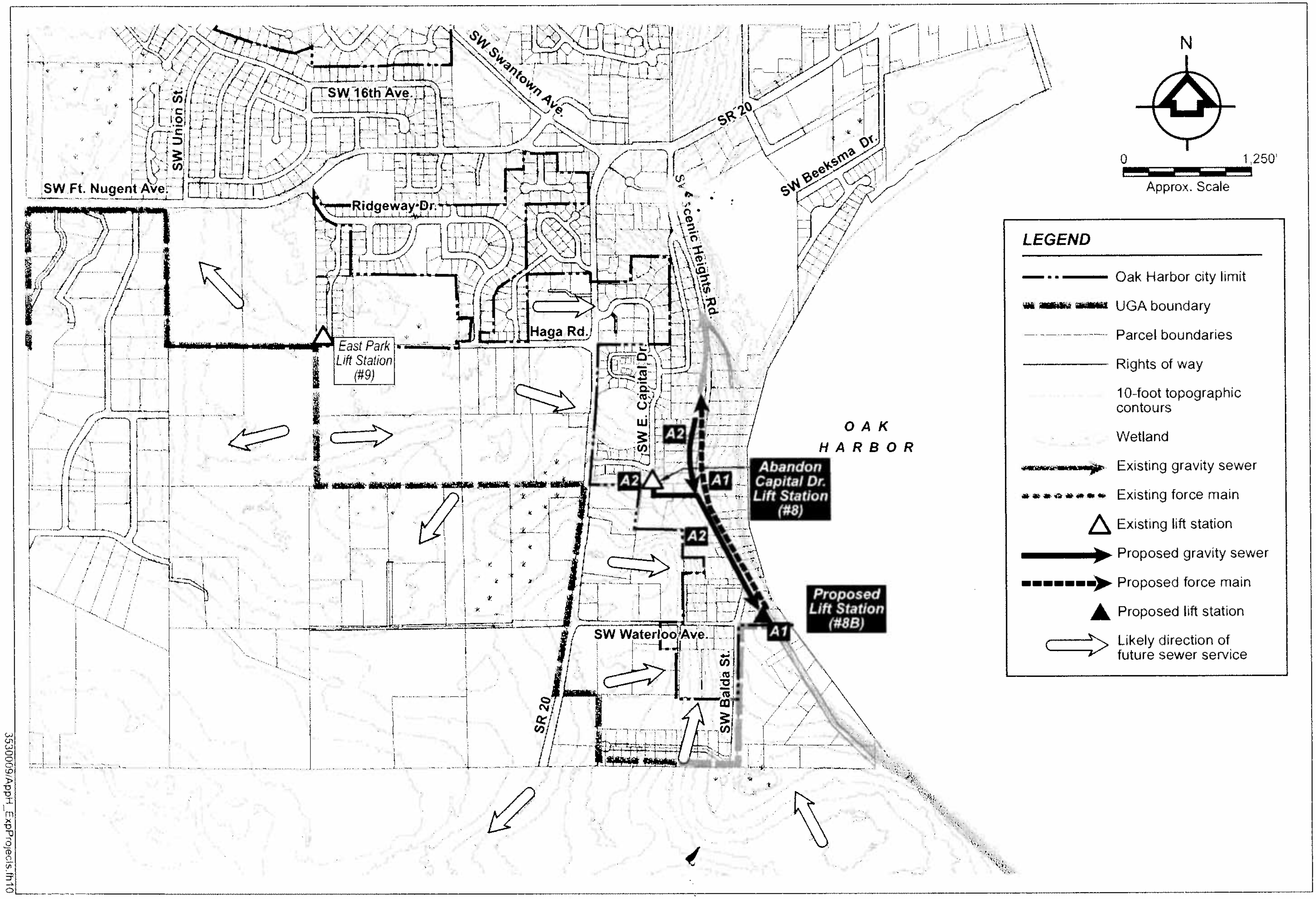
Results File: S:\GIS\3530009 Oak Harbor Sewer Plan\Model\Model Submitted\OH Sewers (Divert Flows at Whidbey).swg

City of Oak Harbor

Comprehensive Sewer Plan

APPENDIX H
POTENTIAL COLLECTION SYSTEM IMPROVEMENTS COST ESTIMATION DATA

December 2008



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City of Oak Harbor
COMPREHENSIVE SEWER PLAN

Figure H-1.
SYSTEM EXPANSION AREA A: SCENIC HEIGHTS

Study:	Oak Harbor Sewer Comp Plan	
Project	System Expansion Area A: Scenic Heights	
Sub-label	A1	Scenic Heights Lift Station and Force Main

Construction Start: Mo/Yr: Dec-05

Prepared By:	DIS	Checked:	
Date:	8/23/06	Date:	

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
A1	Lift Station, 600 gpm, 20 hp	1	ea	$ 118,000	$ 118,000
				Subtotal Mechanical	$ 118,000
Piping Items					
A1	6-inch Force Main, Roadway	2300	l.f.	$ 70.00	$ 161,000
					$ -
					$ -
				Subtotal Piping	$ 161,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 279,000

General / Other Costs			
Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 16,700
Startup	5%	of Mech/Elect/I&C	$ 5,900
Contractor Overhead and Profit	15%	of Categorized Costs	$ 41,900
		Subtotal Construction Cost	$ 343,500
Contingency	30%		$ 103,100
Subtotal Construction Cost			$ 446,600
Design Engineering	15%		$ 67,000
Construction Engineering	10%		$ 44,700
Sales Tax	8.30%		$ 37,100
		Total Estimated Capital Cost	**$ 595,000**

Study:	Oak Harbor Sewer Comp Plan	
Project	System Expansion Area A: Scenic Heights	
Sub-label	A2	Scenic Heights Gravity Trunk Sewers

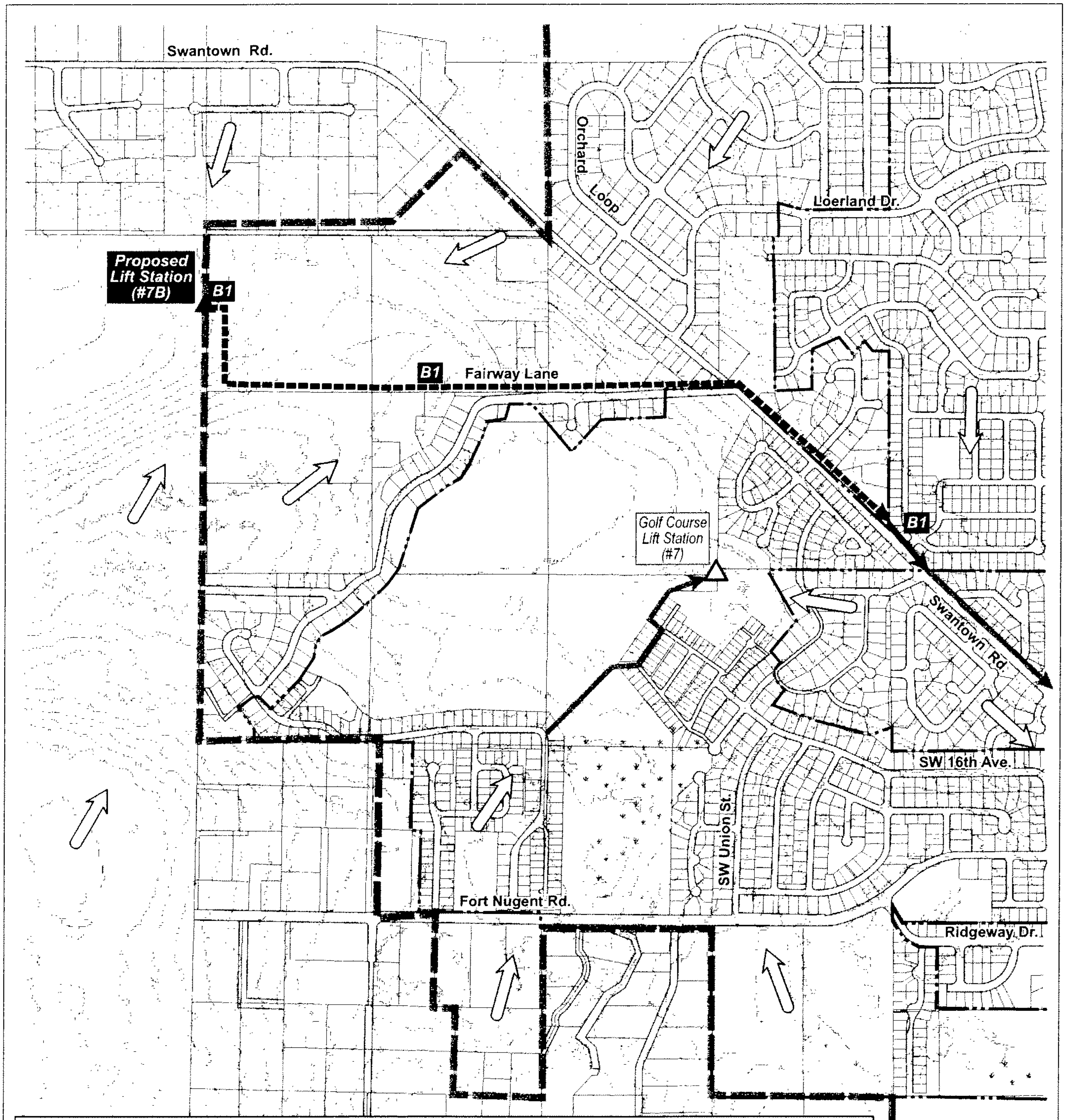
Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/1/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
					$ -
				Subtotal Mechanical	$ -
Piping Items					
A2	8-inch Gravity, Easement	600	l.f.	$ 100.00	$ 60,000
A2	8-inch Gravity, Roadway	2300	l.f.	$ 120.00	$ 276,000
					$ -
				Subtotal Piping	$ 336,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 336,000
General / Other Costs					
	Mobilization, Demob., Bonds	6%	of Categorized Costs		$ 20,200
	Startup	5%	of Mech/Elect/I&C		$ -
	Contractor Overhead and Profit	15%	of Categorized Costs		$ 50,400
				Subtotal Construction Cost	$ 406,600
	Contingency	30%			$ 122,000
	Subtotal Construction Cost				$ 528,600
	Design Engineering	15%			$ 79,300
	Construction Engineering	10%			$ 52,900
	Sales Tax	8.30%			$ 43,900
				Total Estimated Capital Cost	**$ 705,000**



LEGEND

Oak Harbor city limit	Wetland	Proposed gravity sewer
UGA boundary	Existing gravity sewer	Proposed force main
Parcel boundaries	Existing force main	Proposed lift station
Rights of way	Existing lift station	Likely direction of future sewer service
10-foot topographic contours		

N

0 1,000'
Approx. Scale

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City of Oak Harbor
COMPREHENSIVE SEWER PLAN

FigureH-2.
SYSTEM EXPANSION AREA B: SWANTOWN ROAD AND FORT NUGENT AVENUE

Study: Oak Harbor Sewer Comp Plan
Project System Expansion Area B: Swantown Rd & Fort Nugent Ave
Sub-label B1 Fairway Lane Lift Station, Force Main and D/S Trunk Extension

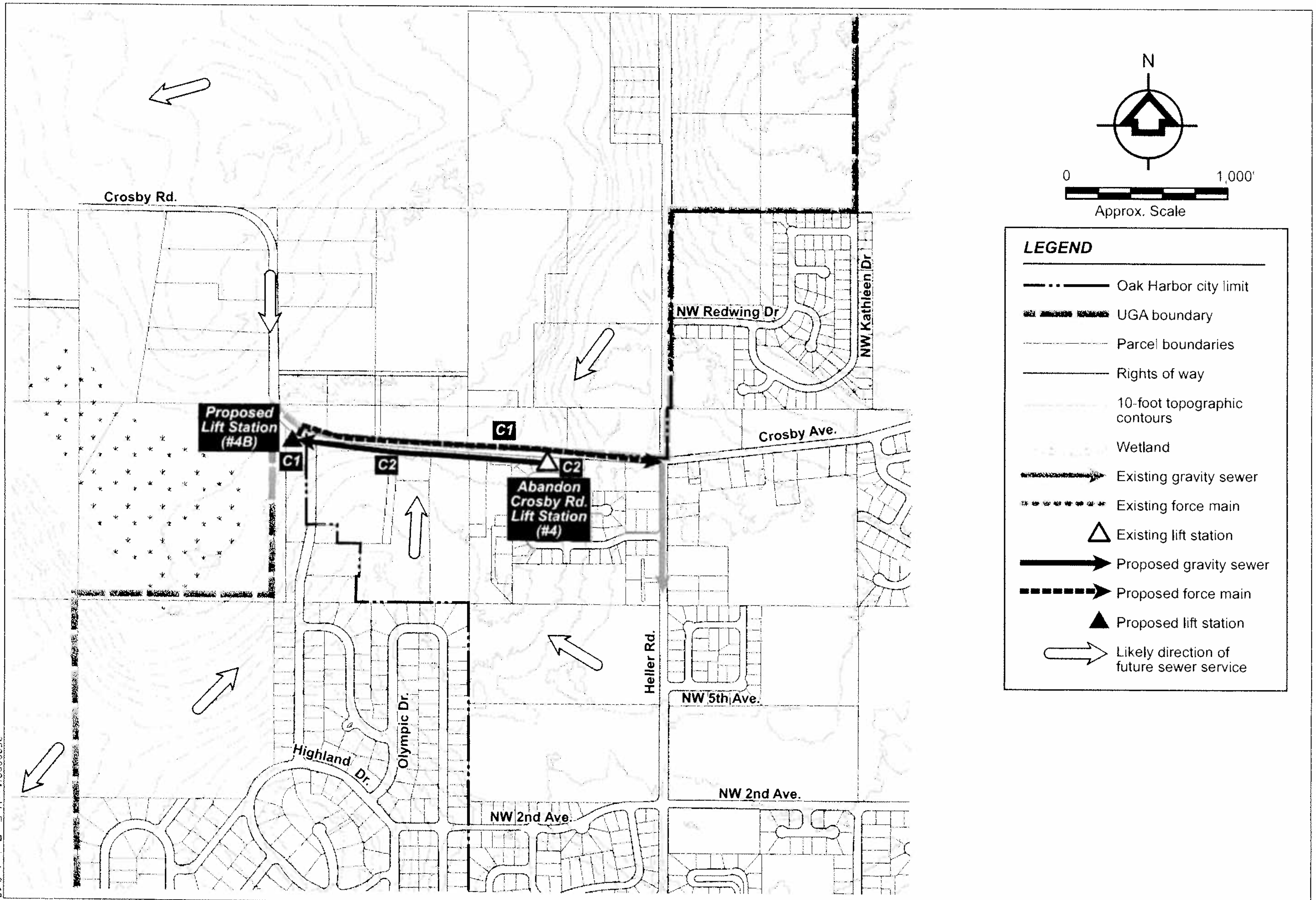
Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/1/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
B1	Lift Station, 1700 gpm, 125 hp	1	ea	$ 650,000	$ 650,000
				Subtotal Mechanical	$ 650,000
Piping Items					
B1	Swantown Trunk Ext, 18-inch, Roadway	400	l.f.	$ 260.00	$ 104,000
B1	Force Main, 12-inch, Roadway	6500	l.f.	$ 125.00	$ 812,500
					$ -
				Subtotal Piping	$ 916,500
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 1,566,500
General / Other Costs					
	Mobilization, Demob., Bonds	6%	of Categorized Costs		$ 94,000
	Startup	5%	of Mech/Elect/I&C		$ 32,500
	Contractor Overhead and Profit	15%	of Categorized Costs		$ 235,000
				Subtotal Construction Cost	$ 1,928,000
	Contingency	30%			$ 578,400
	Subtotal Construction Cost				$ 2,506,400
	Design Engineering	15%			$ 376,000
	Construction Engineering	10%			$ 250,600
	Sales Tax	8.30%			$ 208,000
				Total Estimated Capital Cost	**$ 3,341,000**



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City of Oak Harbor
COMPREHENSIVE SEWER PLAN

Figure H-3.
SYSTEM EXPANSION AREA C: CROSBY ROAD

Study: Oak Harbor Sewer Comp Plan
Project: System Expansion Area C: Crosby Road
Sub-label: C1 Crosby Road Lift Station and Force Main

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/1/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
C1	Lift Station, 850 gpm, 40 hp	1	ea	$ 650,000	$ 650,000
				Subtotal Mechanical	$ 650,000
Piping Items					
C1	6-inch Force Main, Roadway	2700	l.f.	$ 70.00	$ 189,000
					$ -
				Subtotal Piping	$ 189,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 839,000

General / Other Costs

Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 50,300
Startup	5%	of Mech/Elect/I&C	$ 32,500
Contractor Overhead and Profit	15%	of Categorized Costs	$ 125,900
		Subtotal Construction Cost	$ 1,047,700
Contingency	30%		$ 314,300
Subtotal Construction Cost			$ 1,362,000
Design Engineering	15%		$ 204,300
Construction Engineering	10%		$ 136,200
Sales Tax	8.30%		$ 113,000
		Total Estimated Capital Cost	**$ 1,816,000**

Study: Oak Harbor Sewer Comp Plan
Project: System Expansion Area C: Crosby Road
Sub-label: C2 Trunk Sewer from Current to Proposed Lift Station 4

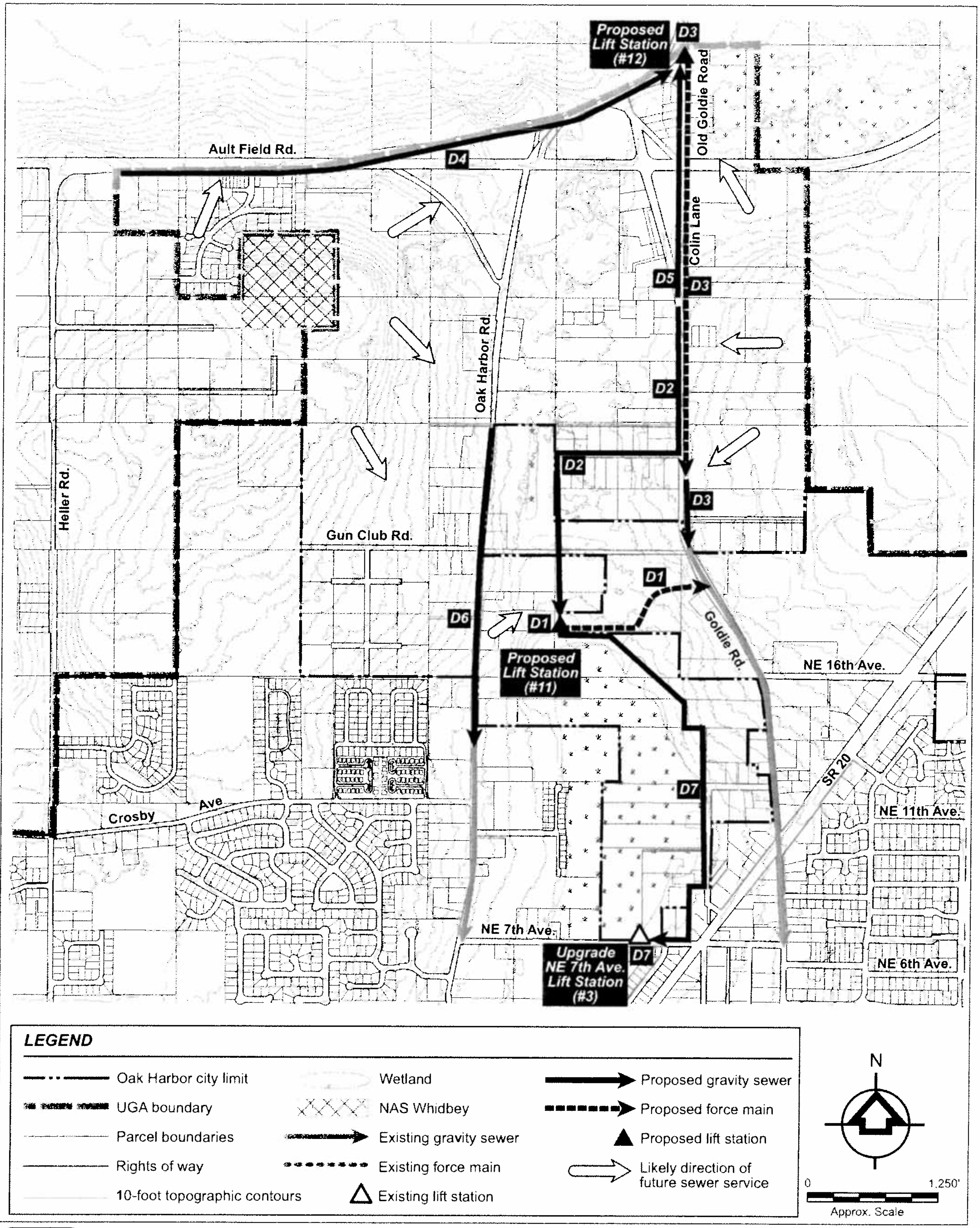
Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/1/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
C2	8-inch from Old to New LS, Roadway	1650	l.f.	$ 120.00	$ 198,000
					$ -
				Subtotal Piping	$ 198,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 198,000
General / Other Costs					
	Mobilization, Demob., Bonds	6%	of Categorized Costs		$ 11,900
	Startup	5%	of Mech/Elect/I&C		$ -
	Contractor Overhead and Profit	15%	of Categorized Costs		$ 29,700
				Subtotal Construction Cost	$ 239,600
	Contingency	30%			$ 71,900
	Subtotal Construction Cost				$ 311,500
	Design Engineering	15%			$ 46,700
	Construction Engineering	10%			$ 31,200
	Sales Tax	8.30%			$ 25,900
				Total Estimated Capital Cost	**$ 415,000**



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City of Oak Harbor
COMPREHENSIVE SEWER PLAN

Figure H-4.
SYSTEM EXPANSION AREA D:
HELLER ROAD TO GOLDIE ROAD

Study: **Oak Harbor Sewer Comp Plan**
Project: System Expansion Area D: Heller Rd to Goldie Rd
Sub-label: D1 Goldie Road Lift Station and Force Main

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
D1	Lift Station #11, 1400 gpm, 50 hp	1	ea	$ 650,000	$ 650,000
				Subtotal Mechanical	$ 650,000
Piping Items					
D1	Force Main to Goldie Road, 12-inch, Roadwa	1700	l.f.	$ 125.00	$ 212,500
				Subtotal Piping	$ 212,500
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 862,500

General / Other Costs			
Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 51,800
Startup	5%	of Mech/Elect/I&C	$ 32,500
Contractor Overhead and Profit	15%	of Categorized Costs	$ 129,400
		Subtotal Construction Cost	$ 1,076,200
Contingency	30%		$ 322,900
Subtotal Construction Cost			$ 1,399,100
Design Engineering	15%		$ 209,900
Construction Engineering	10%		$ 139,900
Sales Tax	8.30%		$ 116,100
		Total Estimated Capital Cost	**$ 1,865,000**

Study: **Oak Harbor Sewer Comp Plan**
Project System Expansion Area D: Heller Rd to Goldie Rd
Sub-label D2 Trunk Sewer from Goldie Road to Proposed Lift Station

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Trunk Sewer to Oak, On Oak, On Goldie				$ -
D2	18-inch, Roadway	4800	l.f.	$ 260.00	$ 1,248,000
				Subtotal Piping	$ 1,248,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 1,248,000

General / Other Costs

Mobilization, Demob., Bonds	6% of Categorized Costs	$ 74,900
Startup	5% of Mech/Elect/I&C	$ -
Contractor Overhead and Profit	15% of Categorized Costs	$ 187,200
	Subtotal Construction Cost	$ 1,510,100
Contingency	30%	$ 453,000
Subtotal Construction Cost		$ 1,963,100
Design Engineering	15%	$ 294,500
Construction Engineering	10%	$ 196,300
Sales Tax	8.30%	$ 162,900
	Total Estimated Capital Cost	**$ 2,617,000**

Study:	Oak Harbor Sewer Comp Plan	
Project	System Expansion Area D: Heller Rd to Goldie Rd	
Sub-label	D3	Lift Station 12, Force Main, D/S Trunk Sewer Extension

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG Checked:
Date: 2/1/06 Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
D3	Lift Station #12, 1100 gpm, 20 hp	1	ea	$ 100,000	$ 100,000
				Subtotal Mechanical	$ 100,000
Piping Items					
	Goldie Road Extension		l.f.		$ -
D3	8-inch, Roadway	950	l.f.	$ 120	$ 114,000
	Force Main on Goldie, 12-inch, Roadway	4250	l.f.	$ 125.00	$ 531,250
				Subtotal Piping	$ 645,250
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 745,300

General / Other Costs			
Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 44,700
Startup	5%	of Mech/Elect/I&C	$ 5,000
Contractor Overhead and Profit	15%	of Categorized Costs	$ 111,800
		Subtotal Construction Cost	$ 906,800
Contingency	30%		$ 272,000
Subtotal Construction Cost			$ 1,178,800
Design Engineering	15%		$ 176,800
Construction Engineering	10%		$ 117,900
Sales Tax	8.30%		$ 97,800
		Total Estimated Capital Cost	**$ 1,571,000**

Study: **Oak Harbor Sewer Comp Plan**
Project System Expansion Area D: Heller Rd to Goldie Rd
Sub-label D4 Ault Field Road Trunk Sewer

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
D4	West Trunk, 12-inch, Roadway	6150	l.f.	$ 175.00	$ 1,076,250
				Subtotal Piping	$ 1,076,250
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 1,076,300
General / Other Costs					
	Mobilization, Demob., Bonds	6%	of Categorized Costs		$ 64,600
	Startup	5%	of Mech/Elect/I&C		$ -
	Contractor Overhead and Profit	15%	of Categorized Costs		$ 161,400
				Subtotal Construction Cost	$ 1,302,300
	Contingency	30%			$ 390,700
	Subtotal Construction Cost				$ 1,693,000
	Design Engineering	15%			$ 254,000
	Construction Engineering	10%			$ 169,300
	Sales Tax	8.30%			$ 140,500
				Total Estimated Capital Cost	**$ 2,257,000**

Study: **Oak Harbor Sewer Comp Plan**
Project: System Expansion Area D: Heller Rd to Goldie Rd
Sub-label: D5 North Draining Trunk Sewer on Goldie Road

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	
Piping Items					
D5	South Trunk on Goldie, 18-inch, Roadway	2500	l.f.	$ 260.00	$ 650,000
				Subtotal Piping	$ 650,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 650,000

General / Other Costs			
Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 39,000
Startup	5%	of Mech/Elect/I&C	$ -
Contractor Overhead and Profit	15%	of Categorized Costs	$ 97,500
		Subtotal Construction Cost	$ 786,500
Contingency	30%		$ 236,000
Subtotal Construction Cost			$ 1,022,500
Design Engineering	15%		$ 153,400
Construction Engineering	10%		$ 102,300
Sales Tax	8.30%		$ 84,900
		Total Estimated Capital Cost	**$ 1,363,000**

Study: Oak Harbor Sewer Comp Plan
Project System Expansion Area D: Heller Rd to Goldie Rd
Sub-label D6 Extension to Oak Harbor Road Sewer

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/1/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Oak Harbor Road Extension				$ -
D6	18-inch, Roadway	3550	l.f.	$ 260	$ 923,000
				Subtotal Piping	$ 923,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 923,000
General / Other Costs					
	Mobilization, Demob., Bonds	6%	of Categorized Costs		$ 55,400
	Startup	5%	of Mech/Elect/I&C		$ -
	Contractor Overhead and Profit	15%	of Categorized Costs		$ 138,500
				Subtotal Construction Cost	$ 1,116,900
	Contingency	30%			$ 335,100
	Subtotal Construction Cost				$ 1,452,000
	Design Engineering	15%			$ 217,800
	Construction Engineering	10%			$ 145,200
	Sales Tax	8.30%			$ 120,500
				Total Estimated Capital Cost	**$ 1,936,000**

Study: **Oak Harbor Sewer Comp Plan**
Project System Expansion Area D: Heller Rd to Goldie Rd
Sub-label D7 Divert Flow to NE 7th Lift Station & Upgrade

Construction Start: Mo/Yr: Dec-05

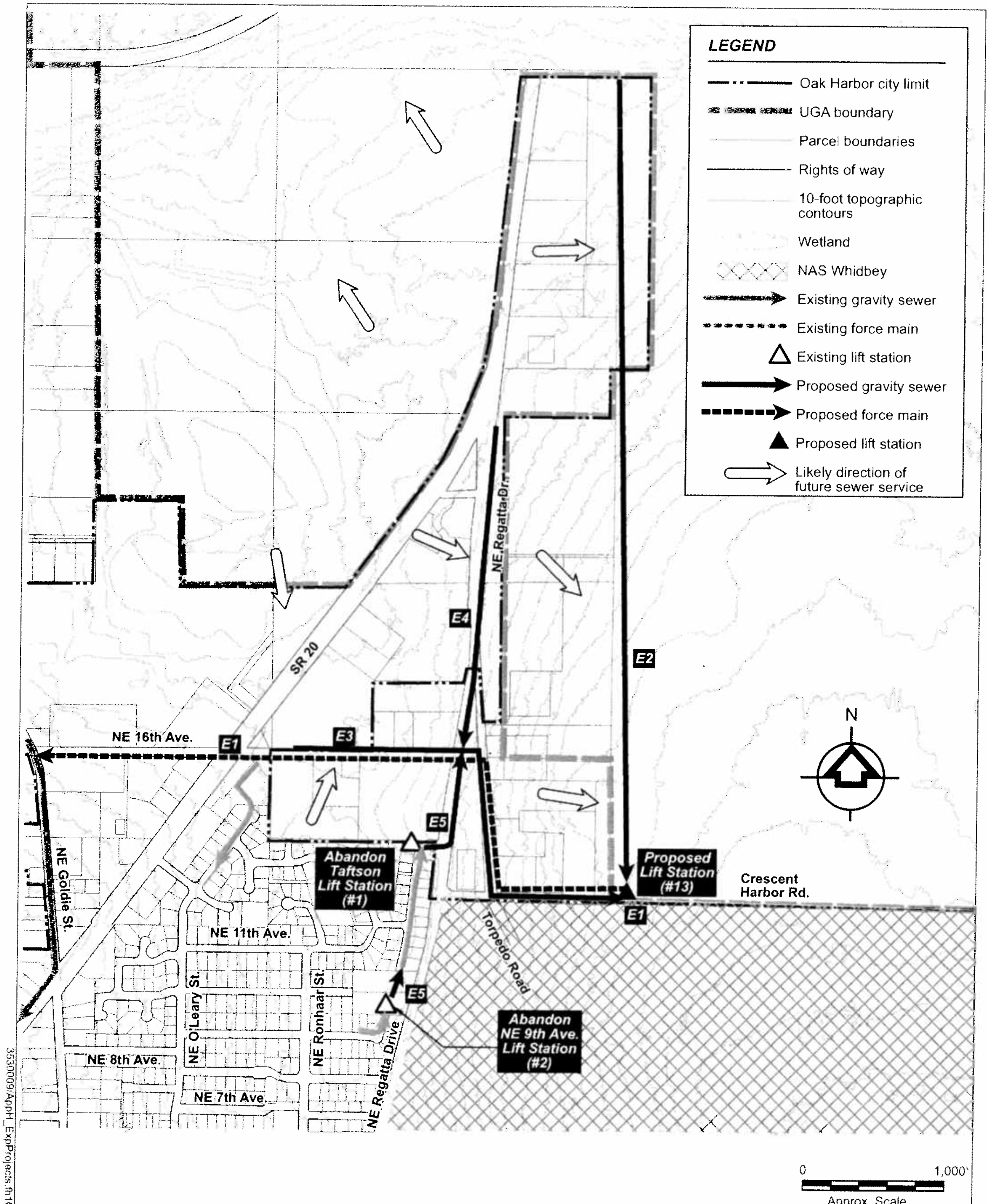
Prepared By: KRG
Date: 2/3/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
D7	Upgrade NE 7th LS (#3B), 2500 gpm, 40 hp	1	ea	$ 650,000	$ 650,000
				Subtotal Mechanical	$ 650,000
Piping Items					
D7	Trunk sewer to south, 18-inch, Roadway	5300	l.f.	$ 260	$ 1,378,000
D7	Force Main to Goldie, 12-inch, Roadway	750	l.f.	125	$ 93,750
				Subtotal Piping	$ 1,471,750
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 2,121,800

General / Other Costs			
Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 127,300
Startup	5%	of Mech/Elect/I&C	$ 32,500
Contractor Overhead and Profit	15%	of Categorized Costs	$ 318,300
		Subtotal Construction Cost	$ 2,599,900
Contingency	30%		$ 780,000
Subtotal Construction Cost			$ 3,379,900
Design Engineering	15%		$ 507,000
Construction Engineering	10%		$ 338,000
Sales Tax	8.30%		$ 280,500
		Total Estimated Capital Cost	**$ 4,505,000**



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City of Oak Harbor
COMPREHENSIVE SEWER PLAN

Figure H-5.
SYSTEM EXPANSION AREA E:
CRESCENT HARBOR ROAD

Study: Oak Harbor Sewer Comp Plan
Project System Expansion Area E: Crescent Harbor
Sub-label E1 Lift Station and Force Main

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/2/06

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
E1	Lift Station #13, 750 gpm, 50 hp	1	ea	$ 650,000	$ 650,000
				Subtotal Mechanical	$ 650,000
Piping Items					
E1	Force Main, 6-inch, Roadway	3450	l.f.	$ 70.00	$ 241,500
				Subtotal Piping	$ 241,500
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 891,500
General / Other Costs					
	Mobilization, Demob., Bonds	6%	of Categorized Costs		$ 53,500
	Startup	5%	of Mech/Elect/I&C		$ 32,500
	Contractor Overhead and Profit	15%	of Categorized Costs		$ 133,700
				Subtotal Construction Cost	$ 1,111,200
	Contingency	30%			$ 333,400
	Subtotal Construction Cost				$ 1,444,600
	Design Engineering	15%			$ 216,700
	Construction Engineering	10%			$ 144,500
	Sales Tax	8.30%			$ 119,902
				Total Estimated Capital Cost	**$ 1,926,000**

Study: Oak Harbor Sewer Comp Plan
Project System Expansion Area E: Crescent Harbor
Sub-label E2 Gravity Sewer from North

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/2/06

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
					$ -
				Subtotal Mechanical	$ -
Piping Items					
E2	8-inch, Easement	3000	l.f.	$ 100.00	$ 300,000
E2	12-inch, Easement	3100	l.f.	$ 150.00	$ 465,000
				Subtotal Piping	$ 765,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 765,000

General / Other Costs

Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 45,900
Startup	5%	of Mech/Elect/I&C	$ -
Contractor Overhead and Profit	15%	of Categorized Costs	$ 114,800
		Subtotal Construction Cost	$ 925,700
Contingency	30%		$ 277,700
Subtotal Construction Cost			$ 1,203,400
Design Engineering	15%		$ 180,500
Construction Engineering	10%		$ 120,300
Sales Tax	8.30%		$ 99,882
		Total Estimated Capital Cost	**$ 1,604,000**

Study: Oak Harbor Sewer Comp Plan
Project System Expansion Area E: Crescent Harbor
Sub-label E3 Gravity Sewer from West

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/2/06

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
					$ -
				Subtotal Mechanical	$ -
Piping Items					
E3	8-inch, Roadway	3500	l.f.	$ 120.00	$ 420,000
				Subtotal Piping	$ 420,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 420,000
General / Other Costs					
	Mobilization, Demob., Bonds	6% of Categorized Costs			$ 25,200
	Startup	5% of Mech/Elect/I&C			$ -
	Contractor Overhead and Profit	15% of Categorized Costs			$ 63,000
				Subtotal Construction Cost	$ 508,200
	Contingency	30%			$ 152,500
	Subtotal Construction Cost				$ 660,700
	Design Engineering	15%			$ 99,100
	Construction Engineering	10%			$ 66,100
	Sales Tax	8.30%			$ 54,838
				Total Estimated Capital Cost	**$ 881,000**

Study: Oak Harbor Sewer Comp Plan
Project System Expansion Area E: Crescent Harbor
Sub-label E4 Gravity Sewer from North on Regatta Drive

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/2/06

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
					$ -
				Subtotal Mechanical	$ -
Piping Items					
E4	8-inch, Roadway	2400	l.f.	$ 120.00	$ 288,000
				Subtotal Piping	$ 288,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 288,000

General / Other Costs			
Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 17,300
Startup	5%	of Mech/Elect/I&C	$ -
Contractor Overhead and Profit	15%	of Categorized Costs	$ 43,200
		Subtotal Construction Cost	$ 348,500
Contingency	30%		$ 104,600
Subtotal Construction Cost			$ 453,100
Design Engineering	15%		$ 68,000
Construction Engineering	10%		$ 45,300
Sales Tax	8.30%		$ 37,607
		Total Estimated Capital Cost	**$ 604,000**

Study: Oak Harbor Sewer Comp Plan
Project System Expansion Area E: Crescent Harbor
Sub-label E5 Gravity Sewers from Lift Stations 1 & 2

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/2/06

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
					$ -
				Subtotal Mechanical	$ -
Piping Items					
E5	8-inch, Roadway	1400	l.f.	$ 120.00	$ 168,000
				Subtotal Piping	$ 168,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 168,000
General / Other Costs					
	Mobilization, Demob., Bonds	6%		of Categorized Costs	$ 10,100
	Startup	5%		of Mech/Elect/I&C	$ -
	Contractor Overhead and Profit	15%		of Categorized Costs	$ 25,200
				Subtotal Construction Cost	$ 203,300
	Contingency	30%			$ 61,000
	Subtotal Construction Cost				$ 264,300
	Design Engineering	15%			$ 39,600
	Construction Engineering	10%			$ 26,400
	Sales Tax	8.30%			$ 21,937
				Total Estimated Capital Cost	**$ 352,000**

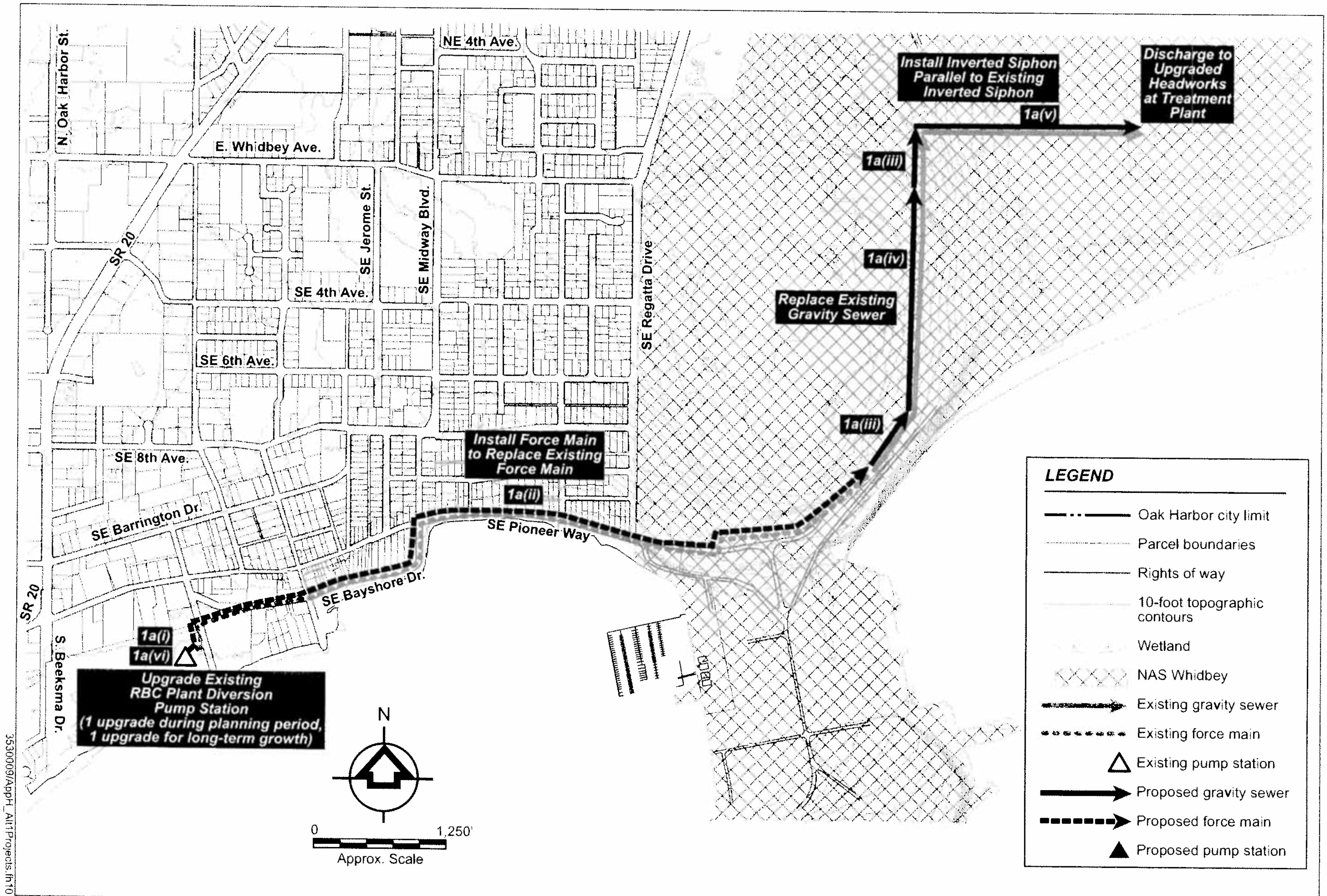

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Figure H-6.
EXISTING SYSTEM UPGRADE
ALTERNATIVE 1, PROJECTS 1a

Study: **Oak Harbor Sewer Comp Plan**
Project Alternative 1a
Sub-label 1a(i) RBC PS Upgrade to 10 MGD

Construction Start: Mo/Yr: Dec-05

Prepared By: DIS
Date: 8/23/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
1a(i)	RBC Pump Station Upgrade 10 mgd	1	ea	850000	$ 850,000
					$ -
				Subtotal Mechanical	$ 850,000
Piping Items					
				Subtotal Piping	$ -
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 850,000

General / Other Costs

Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 51,000
Startup	5%	of Mech/Elect/I&C	$ 42,500
Contractor Overhead and Profit	15%	of Categorized Costs	$ 127,500
		Subtotal Construction Cost	$ 1,071,000
Contingency	30%		$ 321,300
Subtotal Construction Cost			$ 1,392,300
Design Engineering	15%		$ 208,800
Construction Engineering	10%		$ 139,200
Sales Tax	8.30%		$ 115,600
		Total Estimated Capital Cost	**$ 1,856,000**

Study:	**Oak Harbor Sewer Comp Plan**	
Project	Alternative 1a	
Sub-label	1a(ii)	Upgrade RBC PS FM

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Force Main to Seaplane Base				$ -
1a(ii)	28-inch, Roadway	7300	l.f.	400	$ 2,920,000
				Subtotal Piping	$ 2,920,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 2,920,000
General / Other Costs					
	Mobilization, Demob., Bonds	6%	of Categorized Costs		$ 175,200
	Startup	5%	of Mech/Elect/I&C		$ -
	Contractor Overhead and Profit	15%	of Categorized Costs		$ 438,000
				Subtotal Construction Cost	$ 3,533,200
	Contingency	30%			$ 1,060,000
	Subtotal Construction Cost				$ 4,593,200
	Design Engineering	15%			$ 689,000
	Construction Engineering	10%			$ 459,300
	Sales Tax	8.30%			$ 381,200
				Total Estimated Capital Cost	**$ 6,123,000**

Study: **Oak Harbor Sewer Comp Plan**
Project Alternative 1a
Sub-label 1a(iii) Upgrade of Gravity Sewer D/S of RBC PS

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Gravity Main to Siphon				$ -
1a(iii)	30-inch, Roadway	1480	l.f.	350	$ 518,000
				Subtotal Piping	$ 518,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 518,000

General / Other Costs			
	Mobilization, Demob., Bonds	6% of Categorized Costs	$ 31,100
	Startup	5% of Mech/Elect/I&C	$ -
	Contractor Overhead and Profit	15% of Categorized Costs	$ 77,700
		Subtotal Construction Cost	$ 626,800
	Contingency	30%	$ 188,000
	Subtotal Construction Cost		$ 814,800
	Design Engineering	15%	$ 122,200
	Construction Engineering	10%	$ 81,500
	Sales Tax	8.30%	$ 67,600
		Total Estimated Capital Cost	**$ 1,086,000**

Study: **Oak Harbor Sewer Comp Plan**
Project Alternative 1a
Sub-label 1a(iv) Upgrade of Gravity Sewer D/S of RBC PS

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Gravity Main to Siphon				$ -
1a(iv)	30-inch, Roadway	1830	l.f.	350	$ 640,500
				Subtotal Piping	$ 640,500
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 640,500

General / Other Costs

Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 38,400
Startup	5%	of Mech/Elect/I&C	$ -
Contractor Overhead and Profit	15%	of Categorized Costs	$ 96,100
		Subtotal Construction Cost	$ 775,000
Contingency	30%		$ 232,500
Subtotal Construction Cost			$ 1,007,500
Design Engineering	15%		$ 151,100
Construction Engineering	10%		$ 100,800
Sales Tax	8.30%		$ 83,600
		Total Estimated Capital Cost	**$ 1,343,000**

Study: **Oak Harbor Sewer Comp Plan**
Project: Alternative 1a
Sub-label: 1a(v) Upgrade of Siphon

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
1a(v)	20-inch Siphon, Roadway	1700	l.f.	300	$ 510,000
				Subtotal Piping	$ 510,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 510,000
General / Other Costs					
	Mobilization, Demob., Bonds	6% of Categorized Costs			$ 30,600
	Startup	5% of Mech/Elect/I&C			$ -
	Contractor Overhead and Profit	15% of Categorized Costs			$ 76,500
				Subtotal Construction Cost	$ 617,100
	Contingency	30%			$ 185,100
	Subtotal Construction Cost				$ 802,200
	Design Engineering	15%			$ 120,300
	Construction Engineering	10%			$ 80,200
	Sales Tax	8.30%			$ 66,600
				Total Estimated Capital Cost	**$ 1,069,000**

Study: **Oak Harbor Sewer Comp Plan**
Project: Alternative 1a
Sub-label: 1a(vi) RBC PS Upgrade to 22 MGD

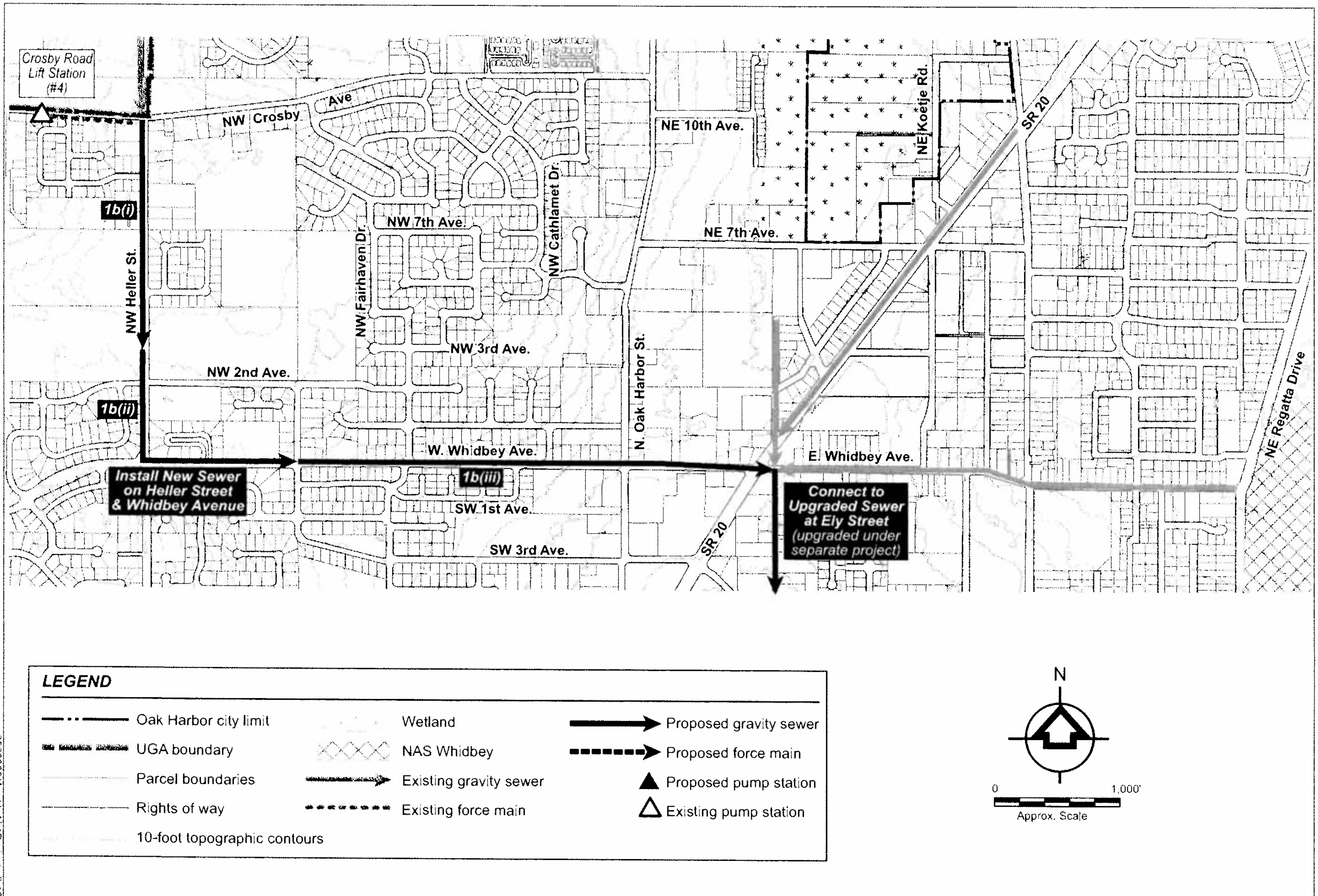
Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
1a(i)	RBC Pump Station Upgrade 22 mgd, 800 hp	1	ea	2550000	$ 2,550,000
					$ -
				Subtotal Mechanical	$ 2,550,000
Piping Items					
				Subtotal Piping	$ -
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 2,550,000

General / Other Costs		
Mobilization, Demob., Bonds	6% of Categorized Costs	$ 153,000
Startup	5% of Mech/Elect/I&C	$ 127,500
Contractor Overhead and Profit	15% of Categorized Costs	$ 382,500
	Subtotal Construction Cost	$ 3,213,000
Contingency	30%	$ 963,900
Subtotal Construction Cost		$ 4,176,900
Design Engineering	15%	$ 626,500
Construction Engineering	10%	$ 417,700
Sales Tax	8.30%	$ 346,700
	Total Estimated Capital Cost	**$ 5,568,000**



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COMPREHENSIVE SEWER PLAN

Figure H-7.
EXISTING SYSTEM UPGRADE
ALTERNATIVE 1, PROJECTS 1b

Study: **Oak Harbor Sewer Comp Plan**
Project Alternative 1b
Sub-label 1b(ii) Upgrades to Heller Road and Whidbey Avenue Trunk Sewer

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG Checked:
Date: 2/3/06 Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Heller from Crosby to Whidbey, Whidbey				$ -
1b(ii)	18-inch, Roadway	1550	l.f.	$ 260	$ 403,000
				Subtotal Piping	$ 403,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 403,000
General / Other Costs					
	Mobilization, Demob., Bonds	6%	of Categorized Costs		$ 24,200
	Startup	5%	of Mech/Elect/I&C		$ -
	Contractor Overhead and Profit	15%	of Categorized Costs		$ 60,500
				Subtotal Construction Cost	$ 487,700
	Contingency	30%			$ 146,300
	Subtotal Construction Cost				$ 634,000
	Design Engineering	15%			$ 95,100
	Construction Engineering	10%			$ 63,400
	Sales Tax	8.30%			$ 52,600
				Total Estimated Capital Cost	**$ 845,000**

Study: **Oak Harbor Sewer Comp Plan**
Project Alternative 1b
Sub-label 1b(i) & 1b(iii) Upgrades to Heller Road and Whidbey Street Trunk Sewer

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

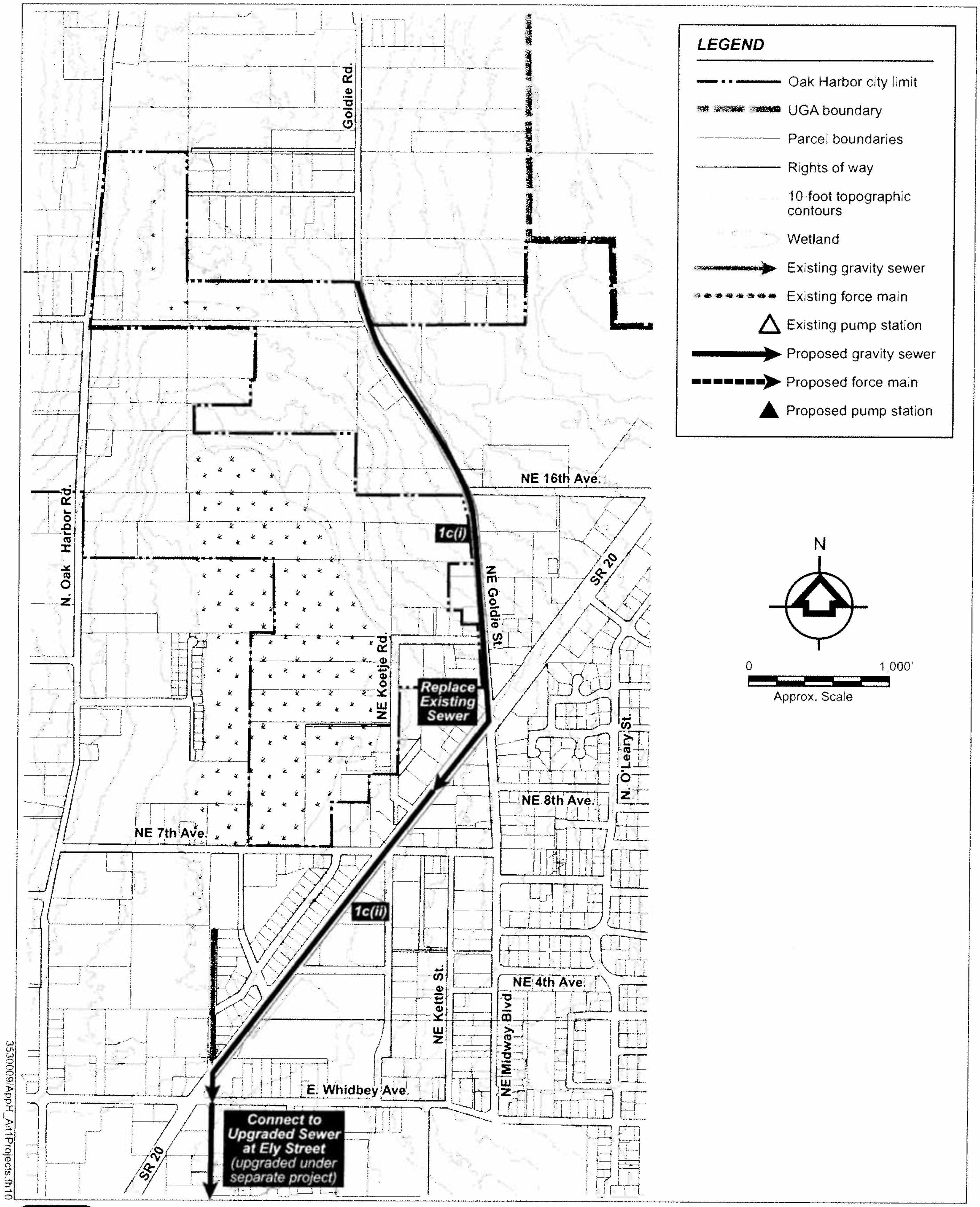
Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Heller from Crosby to Whidbey, Whidbey				$ -
1b(i)	18-inch, Roadway	2100	l.f.	$ 260	$ 546,000
1b(iii)	18-inch, Roadway	3300	l.f.	$ 260	$ 858,000
	Whidbey from Oak Harbor to Ely St				$ -
1b(iii)	24-inch, Roadway	1100	l.f.	315	$ 346,500
					$ -
				Subtotal Piping	$ 1,750,500
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 1,750,500

General / Other Costs

Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 105,000
Startup	5%	of Mech/Elect/I&C	$ -
Contractor Overhead and Profit	15%	of Categorized Costs	$ 262,600
		Subtotal Construction Cost	$ 2,118,100
Contingency	30%		$ 635,400
Subtotal Construction Cost			$ 2,753,500
Design Engineering	15%		$ 413,000
Construction Engineering	10%		$ 275,400
Sales Tax	8.30%		$ 228,500
		Total Estimated Capital Cost	**$ 3,670,000**



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COMPREHENSIVE SEWER PLAN

Figure H-8.
EXISTING SYSTEM UPGRADE
ALTERNATIVE 1, PROJECTS 1c

Study: **Oak Harbor Sewer Comp Plan**
Project Alternative 1c
Sub-label 1c(i) Upgrade to Goldie Road and SR20 Trunk Sewer

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG Checked:
Date: 2/3/06 Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Goldie from MH 23-013 to SR20				$ -
1ci	18-inch, Roadway	3550	l.f.	$ 260	$ 923,000
	SR20 to Whidbey to Ely St				$ -
1ci	24-inch, Roadway	850	l.f.	315	$ 267,750
				Subtotal Piping	$ 1,190,750
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 1,190,800

General / Other Costs		
Mobilization, Demob., Bonds	6% of Categorized Costs	$ 71,400
Startup	5% of Mech/Elect/I&C	$ -
Contractor Overhead and Profit	15% of Categorized Costs	$ 178,600
	Subtotal Construction Cost	$ 1,440,800
Contingency	30%	$ 432,200
Subtotal Construction Cost		$ 1,873,000
Design Engineering	15%	$ 281,000
Construction Engineering	10%	$ 187,300
Sales Tax	8.30%	$ 155,500
	Total Estimated Capital Cost	**$ 2,497,000**

Study: **Oak Harbor Sewer Comp Plan**
Project: Alternative 1c
Sub-label: 1c(ii) Upgrade to Goldie Road and SR20 Trunk Sewer

Construction Start: Mo/Yr: Dec-05

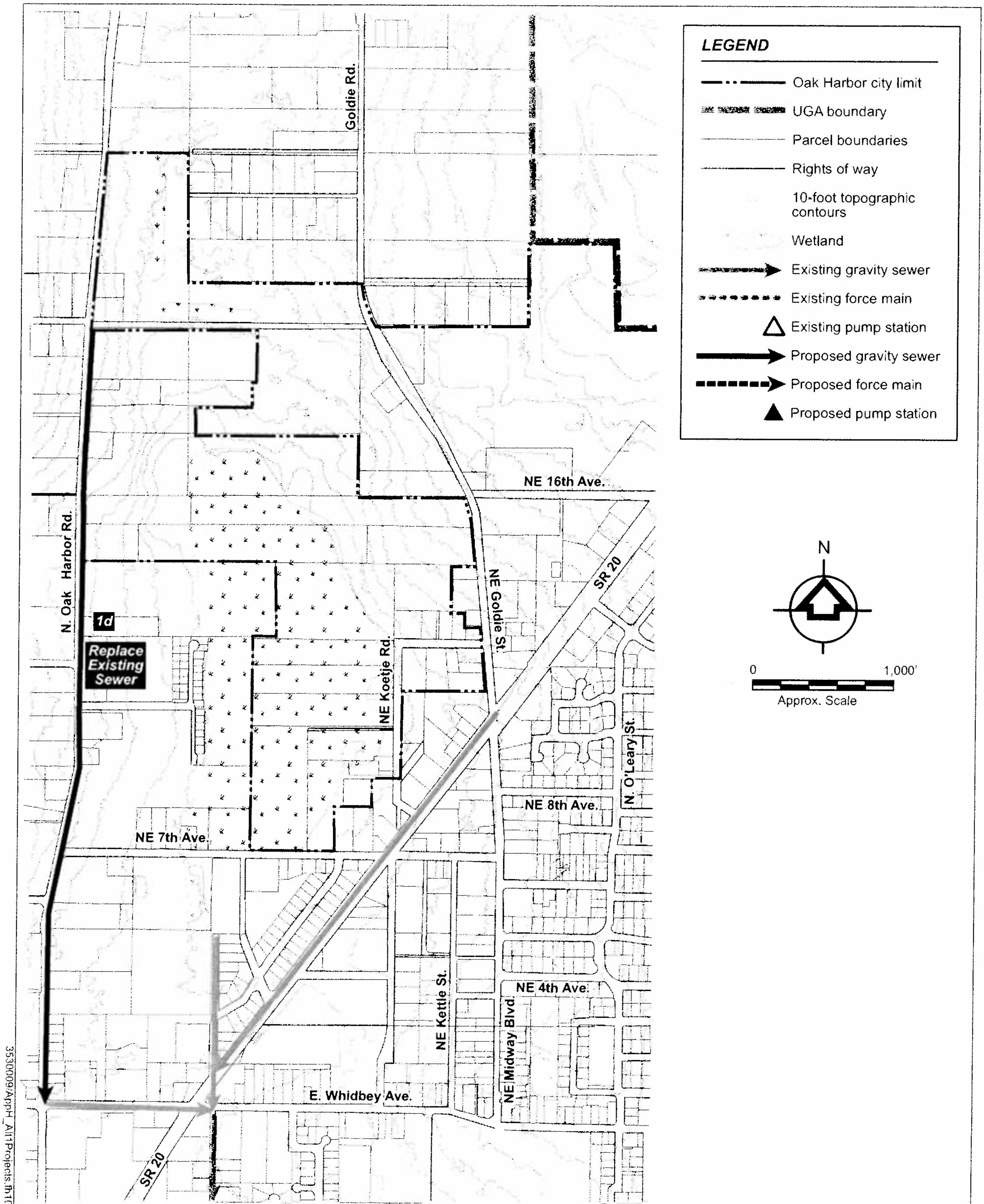
Prepared By: KRG
Date: 2/3/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	SR20 to Whidbey to Ely St				$ -
1cii	24-inch, Roadway	3100	l.f.	$ 315	$ 976,500
				Subtotal Piping	$ 976,500
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 976,500

General / Other Costs			
Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 58,600
Startup	5%	of Mech/Elect/I&C	$ -
Contractor Overhead and Profit	15%	of Categorized Costs	$ 146,500
		Subtotal Construction Cost	$ 1,181,600
Contingency	30%		$ 354,500
Subtotal Construction Cost			$ 1,536,100
Design Engineering	15%		$ 230,400
Construction Engineering	10%		$ 153,600
Sales Tax	8.30%		$ 127,500
		Total Estimated Capital Cost	**$ 2,048,000**



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City of Oak Harbor
COMPREHENSIVE SEWER PLAN

Figure H-9.
EXISTING SYSTEM UPGRADE
ALTERNATIVE 1, PROJECT 1d

Study: **Oak Harbor Sewer Comp Plan**
Project: Alternative 1d
Sub-label: 1d Upgrade to Oak Harbor Road Sewer

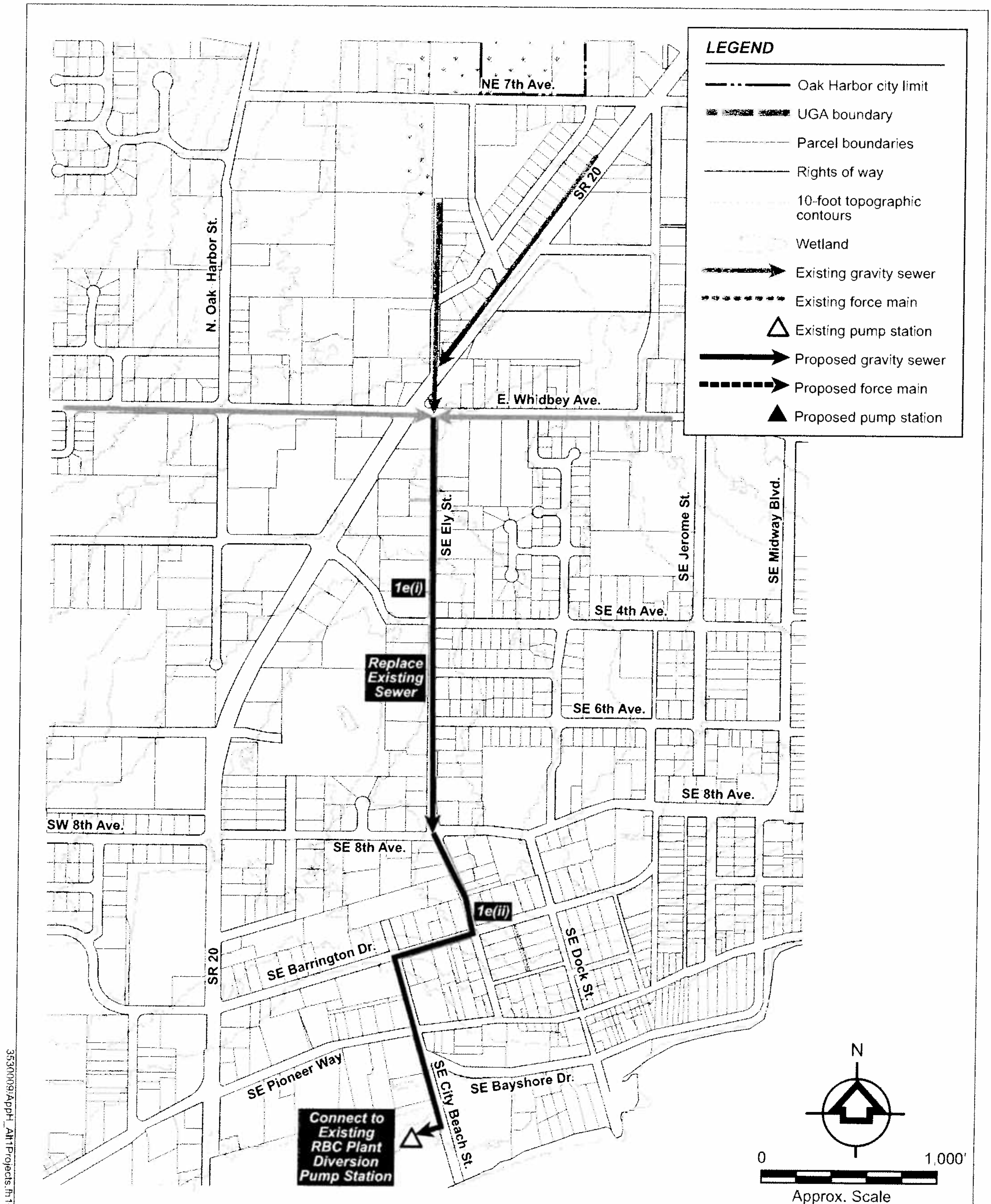
Construction Start: Mo/Yr: Dec-05

Prepared By: DIS
Date: 2/10/06

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Gravity Sewer, On Oak Harbor from				$ -
	North end to Whidbey				$ -
1d	15-inch, Roadway	3950	l.f.	260	$ 1,027,000
				Subtotal Piping	$ 1,027,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 1,027,000

General / Other Costs			
Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 61,600
Startup	5%	of Mech/Elect/I&C	$ -
Contractor Overhead and Profit	15%	of Categorized Costs	$ 154,100
		Subtotal Construction Cost	$ 1,242,700
Contingency	30%		$ 372,800
Subtotal Construction Cost			$ 1,615,500
Design Engineering	15%		$ 242,300
Construction Engineering	10%		$ 161,600
Sales Tax	8%		$ 134,100
		Total Estimated Capital Cost	**$ 2,154,000**



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City of Oak Harbor
COMPREHENSIVE SEWER PLAN

Figure H-10.
EXISTING SYSTEM UPGRADE
ALTERNATIVE 1, PROJECTS 1e

Study: **Oak Harbor Sewer Comp Plan**
Project Alternative 1e
Sub-label 1e(i) Upgrade to Ely Street Sewer

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG Checked: KRG
Date: 1/25/06 Date: 1/26/06

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
1ei	30-inch, Roadway	1300	l.f.	350	$ 455,000
1ei	36-inch, Roadway	1300	l.f.	425	$ 552,500
				Subtotal Piping	$ 1,007,500
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 1,007,500

General / Other Costs			
Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 60,500
Startup	5%	of Mech/Elect/I&C	$ -
Contractor Overhead and Profit	15%	of Categorized Costs	$ 151,100
		Subtotal Construction Cost	$ 1,219,100
Contingency	30%		$ 365,700
Subtotal Construction Cost			$ 1,584,800
Design Engineering	15%		$ 237,700
Construction Engineering	10%		$ 158,500
Sales Tax	8.30%		$ 131,500
		Total Estimated Capital Cost	**$ 2,113,000**

Study: **Oak Harbor Sewer Comp Plan**
Project: Alternative 1e
Sub-label: 1e(ii) Upgrade Ely Street to RBC Sewer

Construction Start: Mo/Yr: Dec-05

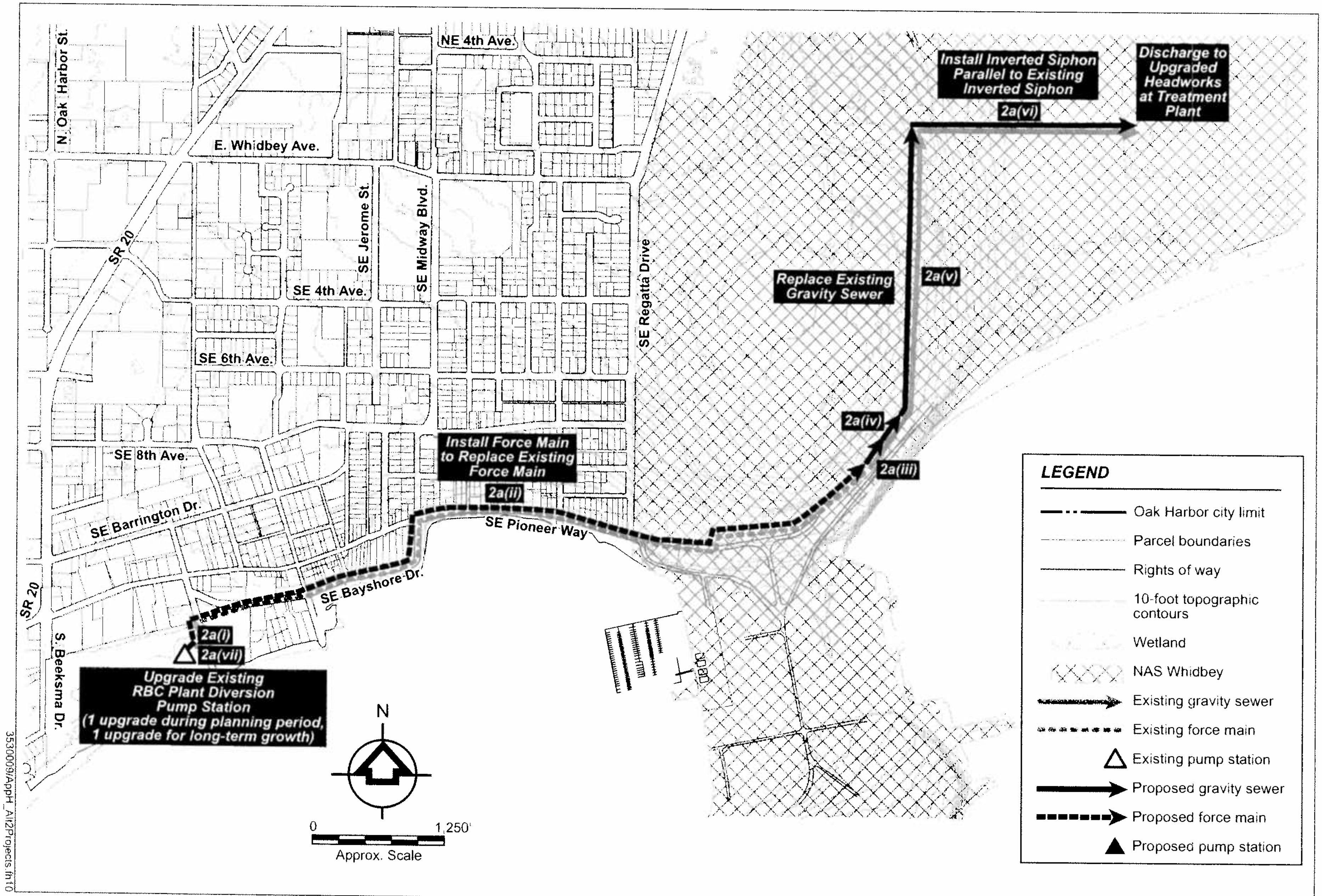
Prepared By: KRG
Date: 1/25/06

Checked: KRG
Date: 1/26/06

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
1eii	36-inch, Roadway	1750	l.f.	425	$ 743,750
1eii	42-inch, Roadway	450	l.f.	525	$ 236,250
1eii	48-inch, Roadway	500	l.f.	625	$ 312,500
				Subtotal Piping	$ 1,292,500
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 1,292,500

General / Other Costs			
Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 77,600
Startup	5%	of Mech/Elect/I&C	$ -
Contractor Overhead and Profit	15%	of Categorized Costs	$ 193,900
		Subtotal Construction Cost	$ 1,564,000
Contingency	30%		$ 469,200
Subtotal Construction Cost			$ 2,033,200
Design Engineering	15%		$ 305,000
Construction Engineering	10%		$ 203,300
Sales Tax	8.30%		$ 168,800
		Total Estimated Capital Cost	**$ 2,710,000**



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COMPREHENSIVE SEWER PLAN

Figure H-11.
EXISTING SYSTEM UPGRADE
ALTERNATIVE 2, PROJECTS 2a

Study: **Oak Harbor Sewer Comp Plan**
Project: Alternative 2a
Sub-label: 2a(i) RBC PS Upgrade to 6 MGD

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
	RBC PS Upgrade	1	ea	850000	$ 850,000
2a(i)	6 mgd				$ -
				Subtotal Mechanical	$ 850,000
Piping Items					
				Subtotal Piping	$ -
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 850,000

General / Other Costs			
Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 51,000
Startup	5%	of Mech/Elect/I&C	$ 42,500
Contractor Overhead and Profit	15%	of Categorized Costs	$ 127,500
		Subtotal Construction Cost	$ 1,071,000
Contingency	30%		$ 321,300
Subtotal Construction Cost			$ 1,392,300
Design Engineering	15%		$ 208,800
Construction Engineering	10%		$ 139,200
Sales Tax	8.30%		$ 115,600
		Total Estimated Capital Cost	**$ 1,856,000**

Study: **Oak Harbor Sewer Comp Plan**
Project Alternative 2a
Sub-label 2a(ii) Upgrade of RBC FM

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Force Main to Seaplane Base				
2a(ii)	20-inch, Roadway	7300	l.f.	300	$ 2,190,000
				Subtotal Piping	$ 2,190,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
		Subtotal of Categorized Costs			$ 2,190,000
General / Other Costs					
	Mobilization, Demob., Bonds	6% of Categorized Costs			$ 131,400
	Startup	5% of Mech/Elect/I&C			$ -
	Contractor Overhead and Profit	15% of Categorized Costs			$ 328,500
		Subtotal Construction Cost			$ 2,649,900
	Contingency	30%			$ 795,000
	Subtotal Construction Cost				$ 3,444,900
	Design Engineering	15%			$ 516,700
	Construction Engineering	10%			$ 344,500
	Sales Tax	8.30%			$ 285,900
		Total Estimated Capital Cost			**$ 4,592,000**

Study: **Oak Harbor Sewer Comp Plan**
Project Alternative 2a
Sub-label 2a(iii) Upgrade of D/S Gravity Sewer (1)

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG Checked:
Date: 2/3/06 Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Gravity Main to Siphon				
2a(iii)	24-inch, Roadway	285	l.f.	315	$ 89,775
				Subtotal Piping	$ 89,775
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 89,800

General / Other Costs

Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 5,400
Startup	5%	of Mech/Elect/I&C	$ -
Contractor Overhead and Profit	15%	of Categorized Costs	$ 13,500
		Subtotal Construction Cost	$ 108,700
Contingency	30%		$ 32,600
Subtotal Construction Cost			$ 141,300
Design Engineering	15%		$ 21,200
Construction Engineering	10%		$ 14,100
Sales Tax	8.30%		$ 11,700
		Total Estimated Capital Cost	**$ 188,000**

Study: **Oak Harbor Sewer Comp Plan**
Project: Alternative 2a
Sub-label: 2a(iv) Upgrade of D/S Gravity Sewer (2)

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Gravity Main to Siphon				
2a(iv)	24-inch, Roadway	295	l.f.	315	$ 92,925
				Subtotal Piping	$ 92,925
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 92,900
General / Other Costs					
	Mobilization, Demob., Bonds	6%	of Categorized Costs		$ 5,600
	Startup	5%	of Mech/Elect/I&C		$ -
	Contractor Overhead and Profit	15%	of Categorized Costs		$ 13,900
				Subtotal Construction Cost	$ 112,400
	Contingency	30%			$ 33,700
	Subtotal Construction Cost				$ 146,100
	Design Engineering	15%			$ 21,900
	Construction Engineering	10%			$ 14,600
	Sales Tax	8.30%			$ 12,100
				Total Estimated Capital Cost	**$ 195,000**

Study:	**Oak Harbor Sewer Comp Plan**	
Project	Alternative 2a	
Sub-label	2a(v)	Ultimate Upgrade of D/S Gravity Sewer

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Gravity Main to Siphon				
2a(v)	24-inch, Roadway	2730	l.f.	315	$ 859,950
				Subtotal Piping	$ 859,950
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 860,000
General / Other Costs					
	Mobilization, Demob., Bonds	6%	of Categorized Costs		$ 51,600
	Startup	5%	of Mech/Elect/I&C		$ -
	Contractor Overhead and Profit	15%	of Categorized Costs		$ 129,000
				Subtotal Construction Cost	$ 1,040,600
	Contingency	30%			$ 312,200
	Subtotal Construction Cost				$ 1,352,800
	Design Engineering	15%			$ 202,900
	Construction Engineering	10%			$ 135,300
	Sales Tax	8.30%			$ 112,300
				Total Estimated Capital Cost	**$ 1,803,000**

Study: **Oak Harbor Sewer Comp Plan**
Project Alternative 2a
Sub-label 2a(vi) Upgrade of Siphon

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Capital Cost

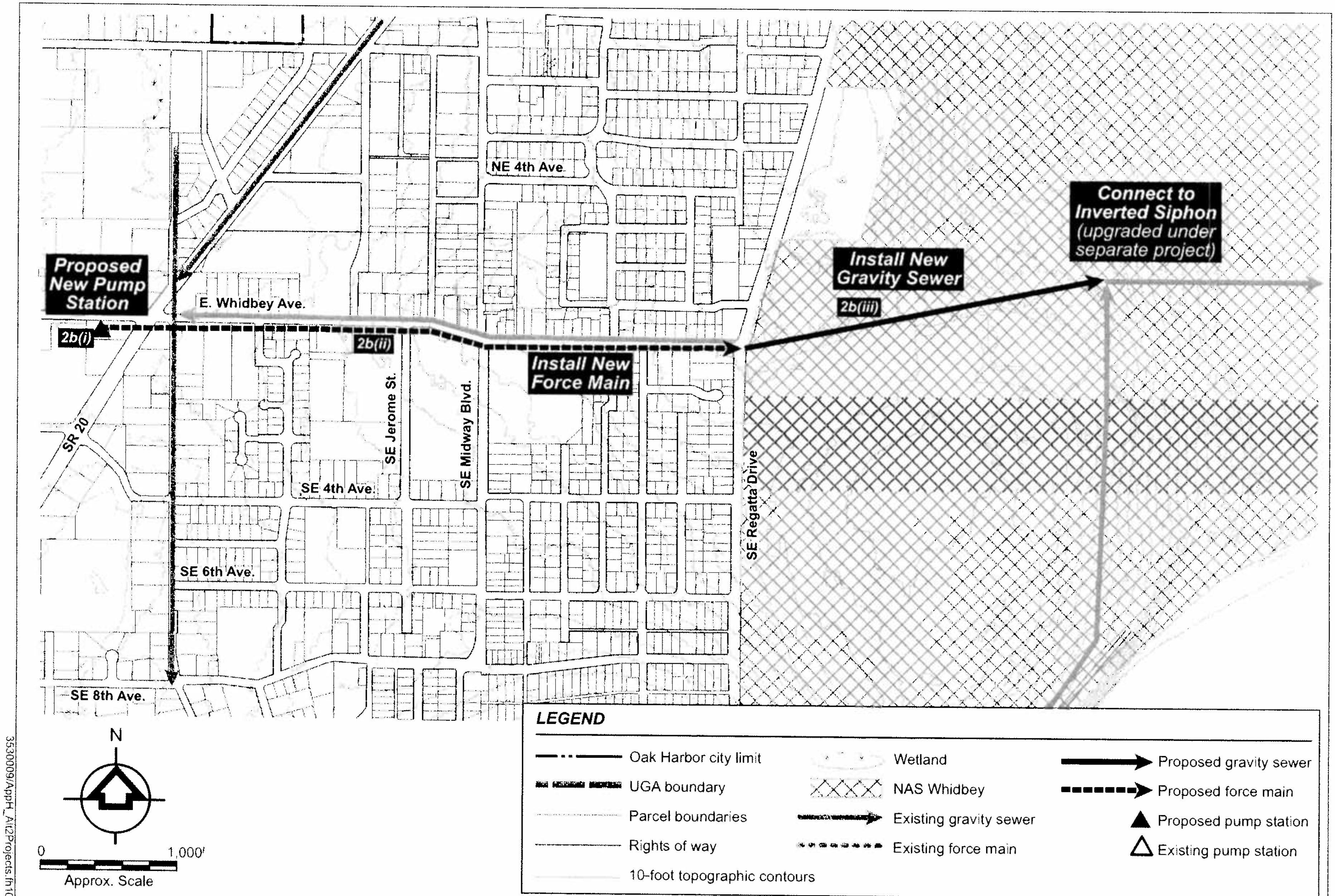
	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
2a(vi)	20-inch Siphon, Roadway	1700	l.f.	300	$ 510,000
				Subtotal Piping	$ 510,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 510,000
General / Other Costs					
	Mobilization, Demob., Bonds	6% of Categorized Costs			$ 30,600
	Startup	5% of Mech/Elect/I&C			$ -
	Contractor Overhead and Profit	15% of Categorized Costs			$ 76,500
				Subtotal Construction Cost	$ 617,100
	Contingency	30%			$ 185,100
	Subtotal Construction Cost				$ 802,200
	Design Engineering	15%			$ 120,300
	Construction Engineering	10%			$ 80,200
	Sales Tax	8.30%			$ 66,600
				Total Estimated Capital Cost	**$ 1,069,000**

Study:	**Oak Harbor Sewer Comp Plan**		
Project	Alternative 2a		
Sub-label	2a(vii)	RBC PS Upgrade to 11 MGD	
Construction Start:		Mo/Yr:	Dec-05

Prepared By: KRG Checked:
Date: 2/3/06 Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
	RBC PS Upgrade	1	ea	850000	$ 850,000
2a(i)	11 mgd				$ -
				Subtotal Mechanical	$ 850,000
Piping Items					
				Subtotal Piping	$ -
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 850,000
General / Other Costs					
	Mobilization, Demob., Bonds	6%	of Categorized Costs		$ 51,000
	Startup	5%	of Mech/Elect/I&C		$ 42,500
	Contractor Overhead and Profit	15%	of Categorized Costs		$ 127,500
				Subtotal Construction Cost	$ 1,071,000
	Contingency	30%			$ 321,300
	Subtotal Construction Cost				$ 1,392,300
	Design Engineering	15%			$ 208,800
	Construction Engineering	10%			$ 139,200
	Sales Tax	8.30%			$ 115,600
				Total Estimated Capital Cost	**$ 1,856,000**



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COMPREHENSIVE SEWER PLAN

Figure H-12.
EXISTING SYSTEM UPGRADE
ALTERNATIVE 2, PROJECTS 2b

Study: **Oak Harbor Sewer Comp Plan**
Project: Alternative 2b
Sub-label: 2b(i) - 2b(iii) Whidbey PS and D/S Conveyance

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 1/25/06

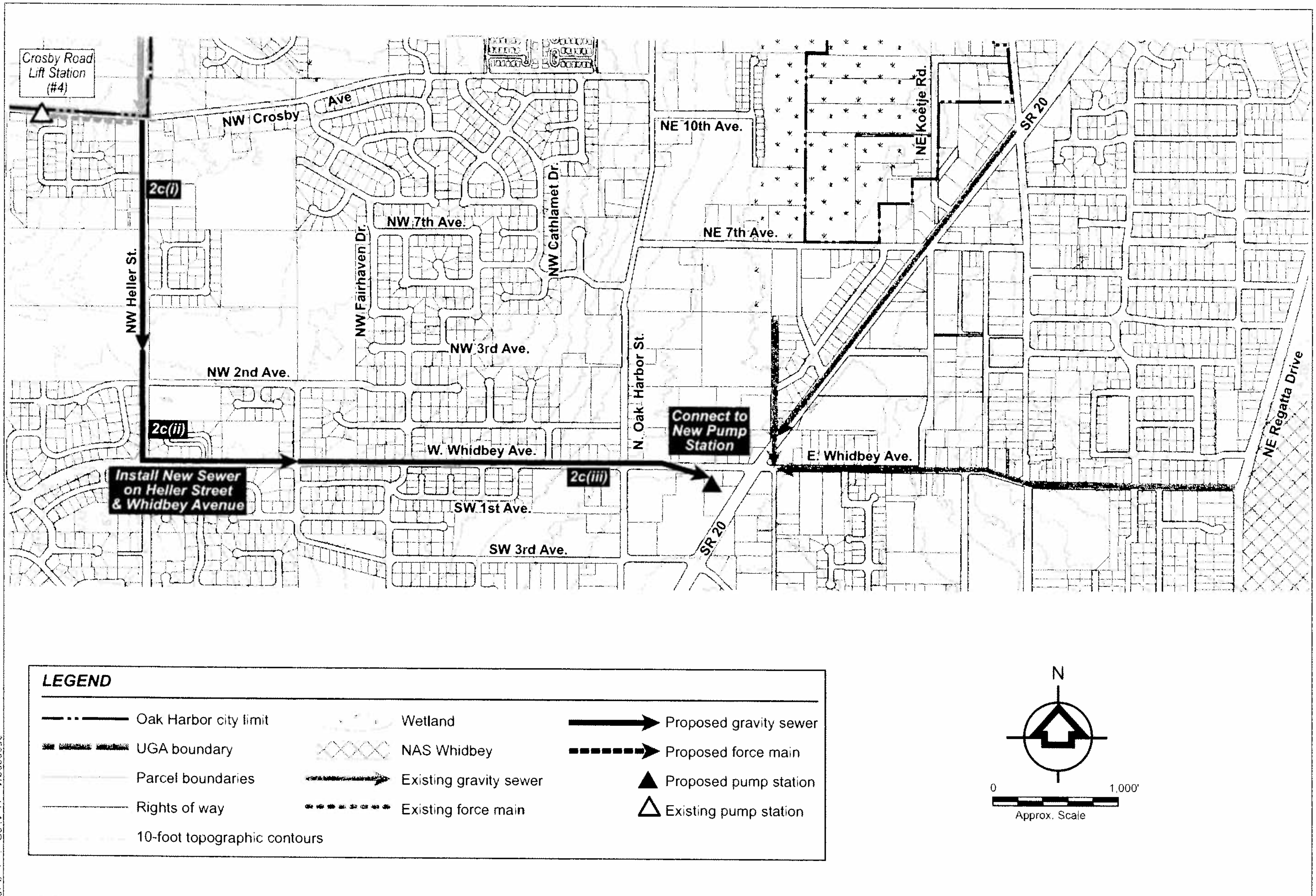
Checked: KRG
Date: 1/26/06

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
2b(i)	Pump Station, 11 mgd	1	ea	1700000	$ 1,700,000
				Subtotal Mechanical	$ 1,700,000
Piping Items					
	Force Main from Diversion PS to Top of Hill				$ -
2b(ii)	20-inch, Roadway	6350	l.f.	300	$ 1,905,000
	Gravity Sewer, Top of Hill to Torpedo Road				$ -
	Top of Hill to Torpedo Road				$ -
2b(iii)	24-inch, Easement	1600	l.f.	260	$ 416,000
				Subtotal Piping	$ 2,321,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 4,021,000

General / Other Costs

Mobilization, Demob., Bonds	6% of Categorized Costs	$ 241,300
Startup	5% of Mech/Elect/I&C	$ 85,000
Contractor Overhead and Profit	15% of Categorized Costs	$ 603,200
	Subtotal Construction Cost	$ 4,950,500
Contingency	30%	$ 1,485,200
Subtotal Construction Cost		$ 6,435,700
Design Engineering	15%	$ 965,400
Construction Engineering	10%	$ 643,600
Sales Tax	8.30%	$ 534,200
	Total Estimated Capital Cost	**$ 8,579,000**



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COMPREHENSIVE SEWER PLAN

Figure H-13.
EXISTING SYSTEM UPGRADE
ALTERNATIVE 2, PROJECTS 2c

Study: **Oak Harbor Sewer Comp Plan**
Project: Alternative 2c
Sub-label: 2c(i) & 2c(iii) Upgrades to Heller Road and Whidbey Street Trunk Sewer

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Heller from Crosby to Whidbey, Whidbey				$ -
2c(i)	18-inch, Roadway	2100	l.f.	$ 260	$ 546,000
2c(iii)	18-inch, Roadway	3300	l.f.	$ 260	$ 858,000
	Whidbey from Oak Harbor to Div. PS		l.f.		$ -
2c(iii)	24-inch, Roadway	600	l.f.	$ 315	$ 189,000
				Subtotal Piping	$ 1,593,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 1,593,000
General / Other Costs					
	Mobilization, Demob., Bonds	6%	of Categorized Costs		$ 95,600
	Startup	5%	of Mech/Elect/I&C		$ -
	Contractor Overhead and Profit	15%	of Categorized Costs		$ 239,000
				Subtotal Construction Cost	$ 1,927,600
	Contingency	30%			$ 578,300
	Subtotal Construction Cost				$ 2,505,900
	Design Engineering	15%			$ 375,900
	Construction Engineering	10%			$ 250,600
	Sales Tax	8.30%			$ 208,000
				Total Estimated Capital Cost	**$ 3,340,000**

Study: **Oak Harbor Sewer Comp Plan**
Project: Alternative 2c
Sub-label: 2c(ii) Upgrades to Heller Road and Whidbey Street Trunk Sewer

Construction Start: Mo/Yr: Dec-05

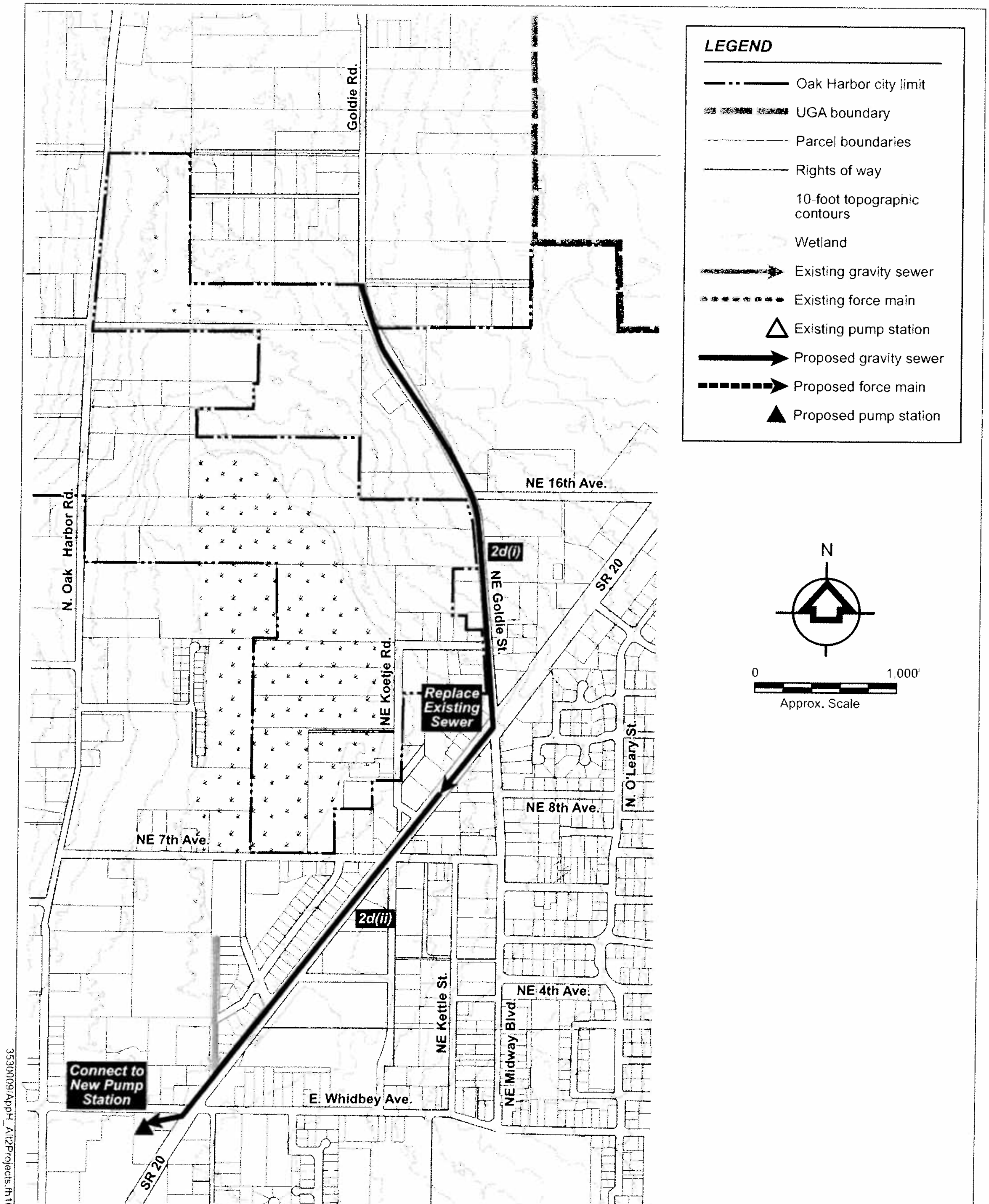
Prepared By: KRG
Date: 2/3/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Heller from Crosby to Whidbey, Whidbey				$ -
2c(ii)	18-inch, Roadway	1550	l.f.	$ 260	$ 403,000
				Subtotal Piping	$ 403,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 403,000

General / Other Costs			
Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 24,200
Startup	5%	of Mech/Elect/I&C	$ -
Contractor Overhead and Profit	15%	of Categorized Costs	$ 60,500
		Subtotal Construction Cost	$ 487,700
Contingency	30%		$ 146,300
Subtotal Construction Cost			$ 634,000
Design Engineering	15%		$ 95,100
Construction Engineering	10%		$ 63,400
Sales Tax	8.30%		$ 52,600
		Total Estimated Capital Cost	**$ 845,000**



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COMPREHENSIVE SEWER PLAN

Figure H-14.
EXISTING SYSTEM UPGRADE
ALTERNATIVE 2, PROJECTS 2d

Study:	**Oak Harbor Sewer Comp Plan**	
Project	Alternative 2d	
Sub-label	2d(i)	Upgrade to Goldie Road and SR20 Trunk Sewer

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Goldie from MH 23-013 to SR20				$ -
2di	18-inch, Roadway	3550	l.f.	$ 260	$ 923,000
	SR20 to Whidbey to Div. PS				$ -
2di	24-inch, Roadway	850	l.f.	315	$ 267,750
					$ -
				Subtotal Piping	$ 1,190,750
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 1,190,800

General / Other Costs			
Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 71,400
Startup	5%	of Mech/Elect/I&C	$ -
Contractor Overhead and Profit	15%	of Categorized Costs	$ 178,600
		Subtotal Construction Cost	$ 1,440,800
Contingency	30%		$ 432,200
Subtotal Construction Cost			$ 1,873,000
Design Engineering	15%		$ 281,000
Construction Engineering	10%		$ 187,300
Sales Tax	8.30%		$ 155,500
		Total Estimated Capital Cost	**$ 2,497,000**

Study: **Oak Harbor Sewer Comp Plan**
Project Alternative 2d
Sub-label 2d(ii) Upgrade to Goldie Road and SR20 Trunk Sewer

Construction Start: Mo/Yr: Dec-05

Prepared By: KRG
Date: 2/3/06

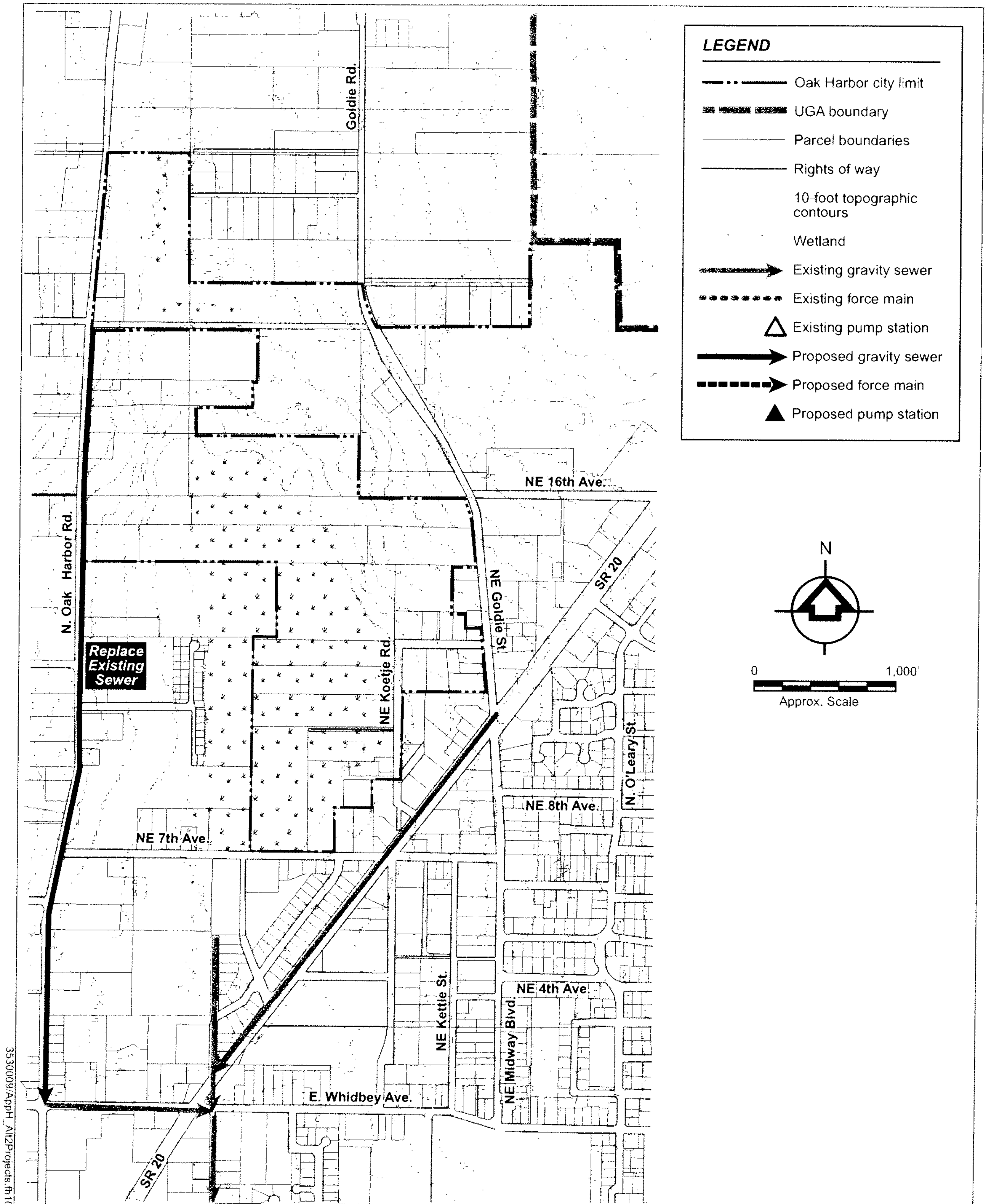
Checked:
Date:

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	SR20 to Whidbey to Div. PS				$ -
2dii	24-inch, Roadway	3100	l.f.	$ 315	$ 976,500
				Subtotal Piping	$ 976,500
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 976,500

General / Other Costs

Mobilization, Demob., Bonds	6%	of Categorized Costs	$ 58,600
Startup	5%	of Mech/Elect/I&C	$ -
Contractor Overhead and Profit	15%	of Categorized Costs	$ 146,500
		Subtotal Construction Cost	$ 1,181,600
Contingency	30%		$ 354,500
Subtotal Construction Cost			$ 1,536,100
Design Engineering	15%		$ 230,400
Construction Engineering	10%		$ 153,600
Sales Tax	8.30%		$ 127,500
		Total Estimated Capital Cost	**$ 2,048,000**



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City of Oak Harbor
COMPREHENSIVE SEWER PLAN

Figure H-15.
EXISTING SYSTEM UPGRADE
ALTERNATIVE 2, PROJECT 2e

Study: **Oak Harbor Sewer Comp Plan**
Project: Alternative 2e
Sub-label: 2e Upgrade to Oak Harbor Road Sewer

Construction Start: Mo/Yr: Dec-05

Prepared By: DIS
Date: 2/10/06

Capital Cost

	Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Structural Items					
				Subtotal Structural	$ -
Mechanical Items					
				Subtotal Mechanical	$ -
Piping Items					
	Gravity Sewer, On Oak Harbor from				$ -
2e	North end to Whidbey				$ -
	15-inch, Roadway	3950	l.f.	260	$ 1,027,000
				Subtotal Piping	$ 1,027,000
Electrical Items					
				Subtotal Electrical	$ -
Instrumentation and Control (I&C) Items					
				Subtotal I&C	$ -
Site Development Items					
				Subtotal Site	$ -
				Subtotal of Categorized Costs	$ 1,027,000

General / Other Costs			
	Mobilization, Demob., Bonds	6% of Categorized Costs	$ 61,600
	Startup	5% of Mech/Elect/I&C	$ -
	Contractor Overhead and Profit	15% of Categorized Costs	$ 154,100
		Subtotal Construction Cost	$ 1,242,700
	Contingency	30%	$ 372,800
	Subtotal Construction Cost		$ 1,615,500
	Design Engineering	15%	$ 242,300
	Construction Engineering	10%	$ 161,600
	Sales Tax	8%	$ 134,100
		Total Estimated Capital Cost	**$ 2,154,000**

COST COMPARISON TABLES FOR COLLECTION SYSTEM ALTERNATIVES 1 AND 2

	Alternative 1 - 1 PS	Project Cost	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1a(v)	Upgrade of Siphon	$1,069,000	$1,069,000									$1,069,000
1e(i)	Upgrade to Ely Street Sewer	$2,113,000					$2,113,000					
1a(ii)	Upgrade RBC PS FM	$6,123,000						$6,123,000				
1a(i)	RBC PS Upgrade to 10 MGD	1856000			$1,856,000							
1e(ii)	Upgrade to Ely Street Sewer and D/S to RBC	$2,710,000										
1a(iii)	Upgrade of Gravity Sewer D/S of RBC PS	$1,086,000										
1a(iv)	Upgrade of Gravity Sewer D/S of RBC PS	1343000										
1a(vi)	RBC PS Upgrade to 22 MGD	$5,568,000										
	RBC PS O&M Costs	varies				$144,800	$144,800	$144,800	$144,800	$144,800	$144,800	
	Total Cost		$1,069,000	$0	$1,856,000	$144,800	$2,257,800	$6,267,800	$144,800	$144,800	$144,800	$1,069,000
	P/F factor		0.9426	0.9151	0.8885	0.8626	0.8375	0.8131	0.7894	0.7664	0.7441	0.9426
	Present Worth		$1,007,635	$0	$1,649,032	$124,906	$1,890,872	$5,096,295	$114,306	$110,977	$107,745	$1,007,635
	Cumulative Present Worth		$1,007,635	$1,007,635	$2,656,667	$2,781,573	$4,672,445	$9,768,740	$9,883,046	$9,994,023	$10,101,768	$1,007,635

	Alternative 1 - 1 PS	Project Cost	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1a(v)	Upgrade of Siphon	$1,069,000										
1e(i)	Upgrade to Ely Street Sewer	$2,113,000										
1a(ii)	Upgrade RBC PS FM	$6,123,000										
1a(i)	RBC PS Upgrade to 10 MGD	1856000										
1e(ii)	Upgrade to Ely Street Sewer and D/S to RBC	$2,710,000										
1a(iii)	Upgrade of Gravity Sewer D/S of RBC PS	$1,086,000										
1a(iv)	Upgrade of Gravity Sewer D/S of RBC PS	1343000										
1a(vi)	RBC PS Upgrade to 22 MGD	$5,568,000										
	RBC PS O&M Costs	varies	$144,800	$144,800	$144,800	$144,800	$144,800	$144,800	$144,800	$144,800	$144,800	$144,800
	Total Cost		$144,800	$144,800	$144,800	$144,800	$144,800	$144,800	$144,800	$144,800	$144,800	$144,800
	P/F factor		0.7224	0.7014	0.6810	0.6611	0.6419	0.6232	0.6050	0.5874	0.5703	0.5537
	Present Worth		$104,607	$101,560	$98,602	$95,730	$92,942	$90,235	$87,606	$85,055	$82,577	$80,172
	Cumulative Present Worth		$10,206,375	$10,307,934	$10,406,536	$10,502,266	$10,595,208	$10,685,442	$10,773,049	$10,858,103	$10,940,681	$11,020,853

	Alternative 1 - 1 PS	Project Cost	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
1a(v)	Upgrade of Siphon	$1,069,000										
1e(i)	Upgrade to Ely Street Sewer	$2,113,000										
1a(ii)	Upgrade RBC PS FM	$6,123,000										
1a(i)	RBC PS Upgrade to 10 MGD	1856000										
1e(ii)	Upgrade to Ely Street Sewer and D/S to RBC	$2,710,000				$2,710,000						
1a(iii)	Upgrade of Gravity Sewer D/S of RBC PS	$1,086,000										
1a(iv)	Upgrade of Gravity Sewer D/S of RBC PS	1343000										
1a(vi)	RBC PS Upgrade to 22 MGD	$5,568,000										
	RBC PS O&M Costs	varies	$144,800	$144,800	$144,800	$144,800	$144,800	$170,300	$170,300	$170,300	$170,300	$170,300
	Total Cost		$144,800	$144,800	$144,800	$2,854,800	$144,800	$170,300	$170,300	$170,300	$170,300	$170,300
	P/F factor		0.5375	0.5219	0.5067	0.4919	0.4776	0.4637	0.4502	0.4371	0.4243	0.4120
	Present Worth		$77,837	$75,570	$73,369	$1,404,372	$69,157	$78,967	$76,667	$74,434	$72,266	$70,161
	Cumulative Present Worth		$11,098,690	$11,174,260	$11,247,629	$12,652,002	$12,721,159	$12,800,126	$12,876,793	$12,951,227	$13,023,494	$13,093,655

	Alternative 1 - 1 PS	Project Cost	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
1a(v)	Upgrade of Siphon	$1,069,000										
1e(i)	Upgrade to Ely Street Sewer	$2,113,000										
1a(ii)	Upgrade RBC PS FM	$6,123,000										
1a(i)	RBC PS Upgrade to 10 MGD	1856000										
1e(ii)	Upgrade to Ely Street Sewer and D/S to RBC	$2,710,000										
1a(iii)	Upgrade of Gravity Sewer D/S of RBC PS	$1,086,000					$1,086,000					
1a(iv)	Upgrade of Gravity Sewer D/S of RBC PS	1343000					$1,343,000					
1a(vi)	RBC PS Upgrade to 22 MGD	$5,568,000					$5,568,000					
	RBC PS O&M Costs	varies	$170,300	$170,300	$170,300	$170,300	$170,300	$170,300	$170,300	$170,300	$170,300	$170,300
	Total Cost		$170,300	$170,300	$170,300	$170,300	$8,167,300	$170,300	$170,300	$170,300	$170,300	$170,300
	P/F factor		0.4000	0.3883	0.3770	0.3660	0.3554	0.3450	0.3350	0.3252	0.3158	0.3066
	Present Worth		$68,118	$66,134	$64,208	$62,337	$2,902,523	$58,759	$57,048	$55,386	$53,773	$52,207
	Cumulative Present Worth		$13,161,773	$13,227,907	$13,292,114	$13,354,452	$16,256,974	$16,315,733	$16,372,781	$16,428,167	$16,481,940	$16,534,147

COST COMPARISON TABLES FOR COLLECTION SYSTEM ALTERNATIVES 1 AND 2

	Alternative 2 - 2 PS	Project Cost	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2a(vi)	Upgrade of Siphon	$1,069,000		$1,069,000								
2b(i) - 2b(iii)	Whidbey PS and D/S Conveyance	$8,579,000				8579000						
2a(i)	RBC PS Upgrade to 6 MGD	$1,856,000								1856000		
2a(ii)	Upgrade of RBC FM	$4,592,000										
2a(vii)	RBC PS Upgrade to 11 MGD	$1,856,000										
2a(iii)	Upgrade of D/S Gravity Sewer (1)	$188,000										
2a(iv)	Upgrade of D/S Gravity Sewer (2)	$195,000										
	O&M at Whidbey PS						$135,100	$135,100	$135,100	$135,100	$135,100	$135,100
	O&M at RBC PS										$134,400	$134,400
	Total Costs		$0	$1,069,000	$0	$8,579,000	$135,100	$135,100	$135,100	$1,991,100	$269,500	$269,500
	P/F factor (i=3%)		0.9709	0.9426	0.9151	0.8885	0.8626	0.8375	0.8131	0.7894	0.7664	0.7441
	Present Worth		$0	$1,007,635	$0	$7,622,330	$116,538	$113,144	$109,849	$1,571,793	$206,549	$200,533
	Cumulative Present Worth		$0	$1,007,635	$1,007,635	$8,629,965	$8,746,504	$8,859,648	$8,969,497	$10,541,289	$10,747,839	$10,948,372

	Alternative 2 - 2 PS	Project Cost	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
2a(vi)	Upgrade of Siphon	$1,069,000										
2b(i) - 2b(iii)	Whidbey PS and D/S Conveyance	$8,579,000										
2a(i)	RBC PS Upgrade to 6 MGD	$1,856,000										
2a(ii)	Upgrade of RBC FM	$4,592,000										
2a(vii)	RBC PS Upgrade to 11 MGD	$1,856,000										
2a(iii)	Upgrade of D/S Gravity Sewer (1)	$188,000										
2a(iv)	Upgrade of D/S Gravity Sewer (2)	$195,000										
	O&M at Whidbey PS		$135,100	$135,100	$135,100	$135,100	$135,100	$135,100	$135,100	$135,100	$135,100	$135,100
	O&M at RBC PS		$134,400	$134,400	$134,400	$134,400	$134,400	$134,400	$134,400	$134,400	$134,400	$134,400
	Total Costs		$269,500	$269,500	$269,500	$269,500	$269,500	$269,500	$269,500	$269,500	$269,500	$269,500
	P/F factor (i=3%)		0.7224	0.7014	0.6810	0.6611	0.6419	0.6232	0.6050	0.5874	0.5703	0.5537
	Present Worth		$194,693	$189,022	$183,516	$178,171	$172,982	$167,943	$163,052	$158,303	$153,692	$149,216
	Cumulative Present Worth		$11,143,065	$11,332,086	$11,515,603	$11,693,774	$11,866,756	$12,034,699	$12,197,751	$12,356,054	$12,509,746	$12,658,962

	Alternative 2 - 2 PS	Project Cost	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
2a(vi)	Upgrade of Siphon	$1,069,000										
2b(i) - 2b(iii)	Whidbey PS and D/S Conveyance	$8,579,000										
2a(i)	RBC PS Upgrade to 6 MGD	$1,856,000										
2a(ii)	Upgrade of RBC FM	$4,592,000										
2a(vii)	RBC PS Upgrade to 11 MGD	$1,856,000										
2a(iii)	Upgrade of D/S Gravity Sewer (1)	$188,000										
2a(iv)	Upgrade of D/S Gravity Sewer (2)	$195,000										
	O&M at Whidbey PS		$135,100	$135,100	$135,100	$135,100	$135,100	$135,100	$135,100	$135,100	$135,100	$135,100
	O&M at RBC PS		$134,400	$134,400	$134,400	$134,400	$134,400	$134,400	$134,400	$134,400	$134,400	$134,400
	Total Costs		$269,500	$269,500	$269,500	$269,500	$269,500	$269,500	$269,500	$269,500	$269,500	$269,500
	P/F factor (i=3%)		0.5375	0.5219	0.5067	0.4919	0.4776	0.4637	0.4502	0.4371	0.4243	0.4120
	Present Worth		$144,870	$140,650	$136,553	$132,576	$128,715	$124,966	$121,326	$117,792	$114,361	$111,030
	Cumulative Present Worth		$12,803,831	$12,944,481	$13,081,035	$13,213,611	$13,342,326	$13,467,291	$13,588,617	$13,706,409	$13,820,771	$13,931,801

	Alternative 2 - 2 PS	Project Cost	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
2a(vi)	Upgrade of Siphon	$1,069,000										
2b(i) - 2b(iii)	Whidbey PS and D/S Conveyance	$8,579,000										
2a(i)	RBC PS Upgrade to 6 MGD	$1,856,000										
2a(ii)	Upgrade of RBC FM	$4,592,000					4592000					
2a(vii)	RBC PS Upgrade to 11 MGD	$1,856,000					1856000					
2a(iii)	Upgrade of D/S Gravity Sewer (1)	$188,000					188000					
2a(iv)	Upgrade of D/S Gravity Sewer (2)	$195,000					195000					
	O&M at Whidbey PS		$135,100	$135,100	$135,100	$135,100	$135,100	$135,100	$135,100	$135,100	$135,100	$135,100
	O&M at RBC PS		$134,400	$134,400	$134,400	$134,400	$134,400	$152,800	$152,800	$152,800	$152,800	$152,800
	Total Costs		$269,500	$269,500	$269,500	$269,500	$7,100,500	$287,900	$287,900	$287,900	$287,900	$287,900
	P/F factor (i=3%)		0.4000	0.3883	0.3770	0.3660	0.3554	0.3450	0.3350	0.3252	0.3158	0.3066
	Present Worth		$107,797	$104,657	$101,609	$98,649	$2,523,400	$99,335	$96,442	$93,633	$90,905	$88,258
	Cumulative Present Worth		$14,039,598	$14,144,255	$14,245,863	$14,344,512	$16,867,912	$16,967,247	$17,063,689	$17,157,321	$17,248,227	$17,336,484

City of Oak Harbor
Comprehensive Sewer Plan

APPENDIX I
COST MODEL

December 2008

COST ESTIMATING CRITERIA

This section summarizes the protocols used for developing cost estimates for the City of Oak Harbor upgrade alternatives. An important element in selecting a preferred alternative for any project is to perform a cost-effectiveness analysis comparing different alternatives. This evaluation must include consideration of both capital and operating and maintenance costs for new or upgraded facilities. A convenient method to compare the combined capital and annual operating and maintenance cost of alternatives is to present both capital and operating and maintenance costs on the same basis, either a present value or an equivalent annual cost.

The purpose of this memorandum is to document cost estimating criteria and formulas to be used in evaluation of collection system and treatment alternatives for the City of Oak Harbor. A summary of proposed criteria are presented in Table 1.

TABLE 1.
COST ESTIMATING CRITERIA

Item	Value
Period of analysis for treatment system, years	20
Period of analysis for collection system, years	40
Discount rate, percent	3.0 percent
Operations labor, $/hr (with fringes)	$35
Diesel oil, $/gal	$2.50
Power cost, $/kWh	$0.08
Chemical Cost	
Sodium Hypochlorite, $/lb	$0.60
Polymer, $/lb	$3.00
Calcium Nitrate (Bioxide), $/gal	$2.00
Carbon Media Replacement, $/lb	$3.00
Structural Maintenance Cost, percent per year	2 percent
Equipment Maintenance Cost, percent per year	4 percent
Engineering design, percent	15 percent
Construction management, percent	10 percent
Sales tax, percent	8.3 percent
Contingency, percent	30 percent

PERIOD OF ANALYSIS

The planning period is chosen to approximate the life of the capital facilities to be compared in the economic analysis. It is chosen to capture the influence of significant factors on economic choices. For this project a planning period of 20 years was chosen. This is a typical period for facilities planning and approximates the life of major equipment in sewage treatment plants. 20 years is the planning period required in EPA Facilities Planning (Federal Register, 40 CFR Part 35 Paragraph 35.2030 (b) (3)).

DISCOUNT RATE

The discount rate is the rate used for calculation of the present worth of future costs, usually expressed as an annual percentage rate. The discount rate is used to reduce operating costs to a comparable value to capital expenditures so capital-intensive and operations cost-intensive alternatives can be evaluated on a fair basis. As discussed below, if future costs are calculated in terms of future purchasing power (adjusted for inflation), then the appropriate discount rate for cost-effectiveness analysis is the same as the expected market rate for interest on borrowed money. If future costs (operating costs) are calculated in constant dollars, however, then the appropriate discount rate is the expected market rate for borrowing less the inflation rate inherent in the market interest rate. Prior to 1980, cost effectiveness analyses performed as a part of Facilities Plans funded by the Environmental Protection Agency (EPA) required that the discount rate be the one dictated by EPA for the purpose. This rate was adjusted on a quarterly basis. With the demise of the EPA construction grants program a variety of capital sources are available to publicly owned treatment works for new facilities and EPA does not require that plans use a particular rate. EPA still updates the discount rate, however, on a quarterly basis, as an aid to those preparing Facilities Plans. A selection of possible funding options with corresponding interest rates are presented in Table 2.

In the current work the discount rate will be used to compare the cost of operation and maintenance costs on an equivalent basis to costs for construction of new facilities. A present worth factor, PWF, will be calculated to reduce annual operation and maintenance costs, A, to a present value, P.

$$PWF = P / A = [(1 + i)^n - 1] / [i (1 + i)^n]$$

Where,

PWF	=	Present Worth Factor
P	=	Present Value, 2004 dollars (Present Value of Operations and Maintenance Cost)
A	=	Annual Value, 2004 dollars (Operations and Maintenance Cost)
i	=	Discount Rate, percent
n	=	Period of Analysis, n (years)

TABLE 2.
DISCOUNT RATE OPTIONS

Funding Option	Administering Agency	Rate, percent
State Revolving Fund	Washington State Department of Ecology	
Up to 5-years		0.5%
6 – 20 year payback period		1.5%
Rural Development Funding	USDA Rural Development	
Median income < $37,987 per year		4.5%
Median income < $47,479 per year		4.5%
Median income > $47,479 per year		4.63%
Public Works Trust Fund	Washington State Department of Community Trade and Economic Development	
5% Matching Funds		2%
10% Matching Funds		1%
15% Matching Funds		0.5%
Nominal Interest Rate on Treasury Notes and Bonds	Federal Office of Management and Budget	
10 year maturity		4.6%
30 year maturity		5.5%
Real Interest Rate on Treasury Notes and Bonds	Federal Office of Management and Budget	
10 year maturity		2.8%
30 year maturity		3.5%
Federal Discount Rate	USEPA	6.375%

A low discount rate increases the present worth factor and therefore increases the influence of operating and maintenance cost in a comparison of alternatives with both capital and operating and maintenance costs. In consideration of two alternatives, for example, one with a high operating cost and a low capital cost and the other with a lower operating cost and a higher capital cost, a low discount rate would tend to favor the alternative with the lower operating and higher capital cost. Conversely, a higher discount rate would tend to favor the alternative with the lower capital and higher annual cost.

For cost-effectiveness analysis, the appropriate discount rate for calculation of present worth is either the real or nominal rate, depending on whether future costs are calculated based on constant value in a given year. The nominal rate is the rate paid for a bank loan or municipal bond. It includes an assumed compensation for inflation added by the lender. For this project, operation and maintenance costs will be calculated based on their constant value in the year 2006. Therefore, the appropriate discount rate is the real discount rate, that is, the discount rate "that has been adjusted to eliminate the effect of expected inflation." (1994, Office of Management and Budget (OMB), Circular Number A-94, "Memorandum for heads of executive departments and establishments, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs."

The real discount rate is given in a January 2006 update to the OMB circular referenced above as 2.8 percent for 10-year notes and 3.0 percent for 30-year notes. (http://www.whitehouse.gov/omb/circulars/a094/a94_appx-c.html.) The document states that for "programs with durations longer than 30 years may use the 30-year interest rate." Therefore, for the planning period used in this analysis, a discount rate of 3.0 percent was used.

INFLATION RATE

The inflation rate is the rate of decrease in the value of money expressed as an annual percentage. In comparison of alternatives, the inflation rate is used to escalate construction costs from their current value to their estimated value at the time of construction. The average inflation rate for a common index of construction costs, the Engineering News Record Construction Cost Index (ENRCCI), was 2.8 percent from August 2002 to August 2004. This is in line with the average inflation rate since 1990, which is approximately 2.7 percent.

CONSTRUCTION DATE

The estimated construction date for new facilities or for facility upgrade projects may vary for different alternatives. For an estimate based on analysis of lump sum bid breakdowns from previous projects, the appropriate construction date for escalation is the construction bid date. The reason for this is that the construction bids upon which the estimate is based have already been adjusted for the length of construction by the bidding contractor. For cost estimates based on estimates of individual construction components using current prices, the appropriate reference date for analysis is the estimated mid-point in the construction cash flow. For the current project component estimates will be used, and the default value for the mid-point of construction is assumed to be December, 2005.

OPERATIONS LABOR RATE

This rate is estimated at $35 per hour with fringe costs.

DIESEL OIL COST

The current rate is approximately $2.50 per gallon.

POWER COST

A value of $0.08/kWhr will be used. Power costs can differ for various uses. For example, rates for pump stations may be higher than for treatment because demand charges play a more significant role in determining the annual charge.

CHEMICAL COST

Estimated costs for commonly used chemicals at collection systems and wastewater treatment plants are shown in the table. Costs are shown for sodium hypochlorite and polymer. In addition, costs for calcium nitrate, used for chemical injection for odor and corrosion control are included. These costs have been estimated based on historical experience.

MAINTENANCE COST

To estimate the cost of maintenance of new facilities an allowance is made based on the original construction cost of the facilities. For this analysis an allowance of 2 percent per year is used for structural maintenance and 4 percent for maintenance of mechanical equipment for treatment plants. For pump stations, an allowance of 1.5 percent per year is used for both structural and mechanical maintenance combined.

CONTINGENCY

Contingency allowances are made to reflect uncertainty in engineering estimates for construction. Higher contingency allowances are appropriate for projects earlier in the cycle of planning, design, and construction. For a project with a construction bid in hand, for example, a contingency amount of 5 percent may be appropriate to cover unanticipated changes in the project which occur during construction. For projects where a detailed engineering design is complete, but bids are not yet in hand, an allowance of 15 percent may be appropriate. For planning projects, where a detailed engineering design has not been completed, uncertainty in the estimate is greater. Tt/KCM recommends an uncertainty allowance of 30 percent for planning projects.

ENGINEERING DESIGN

Allowances must be made for project costs including engineering design and other owner costs during the process of design. Based on the experience of similar projects, an allowance of 15 percent is proposed for this project.

CONSTRUCTION MANAGEMENT

Similarly, an allowance must be made for the costs of construction administration, on-site inspection of construction projects, engineering review of construction submittals, preparation of operating and maintenance manuals, start-up services, and other owner costs occurring during construction, over and above the contractor bid price. Based on the experience of similar projects, Tt/KCM recommends an allowance of 10 percent for construction management costs.

SALES TAX

The implementing agency is liable for sales tax on construction projects in the State of Washington. The current sales tax rate in Island County is 8.3 percent.

TYPICAL ALLOWANCES

Cost estimates are based on an estimate of major structural and mechanical components with allowances made for piping and miscellaneous mechanical components, electrical and instrumentation costs, contractor overhead and profit, site work, and costs for mobilization, demobilization, and construction bonds. Appropriate allowances may vary, depending on the individual alternate. For example, on buried piping, no allowances would typically be used because pricing is fairly straightforward, and unit costs are generally based from recent bid tabs that may be fairly similar to the projects being evaluated. Typical values are presented in Table 3.

TABLE 3.
TYPICAL COST ESTIMATING ALLOWANCES

Construction Element	Allowance
Piping and Miscellaneous Mechanical	40 percent of Equipment Cost
Electrical	20 percent of Equipment Cost
Instrumentation and Control	15 percent of Equipment Cost
Contractor Overhead and Profit	15 percent of Subtotal Cost
Site work	15 percent of Subtotal Cost
Mobilization, demobilization, & bond	6 percent of Subtotal Cost

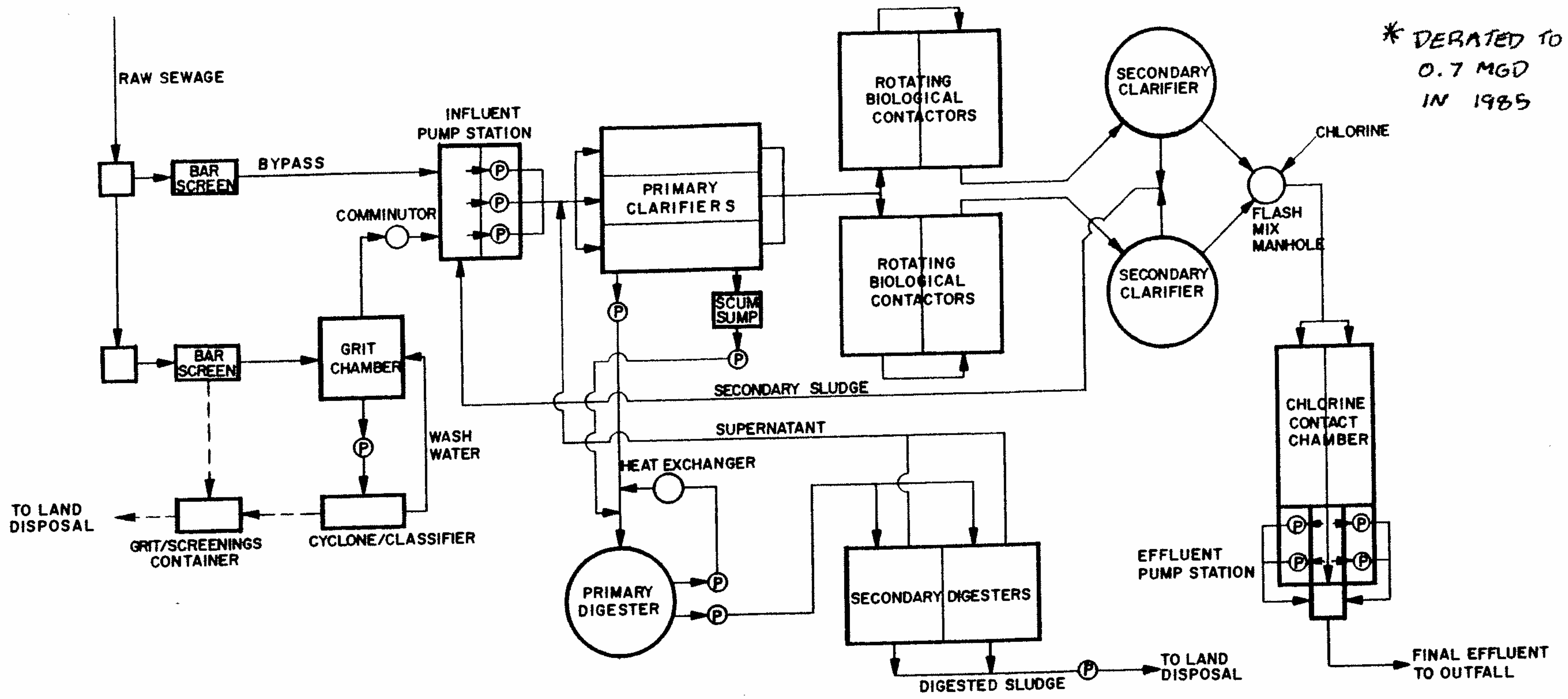
City of Oak Harbor

Comprehensive Sewer Plan

APPENDIX J
RBC PLANT DATA

December 2008

WASTEWATER TREATMENT PLANT



FLOW DIAGRAM

* DERATED TO 0.7 MGD IN 1985

DESIGN DATA

BASIC DESIGN DATA

Avg. Daily Flow	0.85 MGD *
Max. Daily Flow	1.50 MGD
Peak Instantaneous Flow	2.60 MGD
BOD Loading	2060 lbs/day
Design Population	10300 P.E.

BAR SCREENS

Number	1 existing (by-pass) 1 new
Width	2 ft.
Openings	1 inch

GRIT COLLECTOR TANK

Surface Area	64 ft.^{2}
Overflow Rate @ Peak Flow	40625 gpd/ft.^{2}
Max. Liquid Depth	1.5 ft.

GRIT CYCLONE

Diameter	12 inch
Feed Rate	205 gpm

GRIT CLASSIFIER

Capacity	15 lbs dry solids/min.

COMMINUTOR

Size	15 inch
Max. Hydraulic Capacity	3.4 MGD

PRIMARY CLARIFIERS (Existing)

Number	3
Total Surface Area	1296 ft.^{2}
Avg. Depth	7 ft.
Overflow Rate @ Avg. Flow	654 gpd/ft.^{2}
Detention Time @ Avg. Flow	1.92 hrs.

ROTATING BIOLOGICAL CONTACTORS

Number of Shafts	4
Stages per Shaft	2
Surface Area per Shaft	91,500 ft.^{2}
Hydraulic Loading @ Avg. Flow	2.32 gpd/ft.^{2}

SECONDARY CLARIFIERS

Number	2
Diameter	35 ft.
Side Water Depth	10 ft.
Overflow Rate @ Avg. Flow	442 gpd/ft.^{2}
Overflow Rate @ Max. Flow	780 gpd/ft.^{2}
Overflow Rate @ Peak Flow	1351 gpd/ft.^{2}

FLASH MIXER

Tank Diameter	6 ft.
Liquid Depth @ Peak Flow	5.8 ft.
Detention Time @ Peak Flow	40 sec.
Mixer Horsepower	3 hp.

CHLORINE CONTACT CHAMBER

Number of Passes	2
Volume	38,290 gals.
Avg. Depth	7.5 ft.
Length:Width	78:1
Detention Time @ Peak Flow	21 min.
Detention Time @ Avg. Flow	65 min.

PRIMARY DIGESTER

Diameter	30 ft.
Max. Side Water Depth	20 ft.
Total Volume	15,000 cu. ft.
Total Solids Feed	2,100 lbs/day
Volatile Solids Feed	1,550 lbs/day
Solids Content	4%
Volatile Solids Loading	0.1 lbs vs./cu.ft./day
Detention Time	17.8 days
Design Temperature	95°F

SLUDGE HEATING SYSTEM

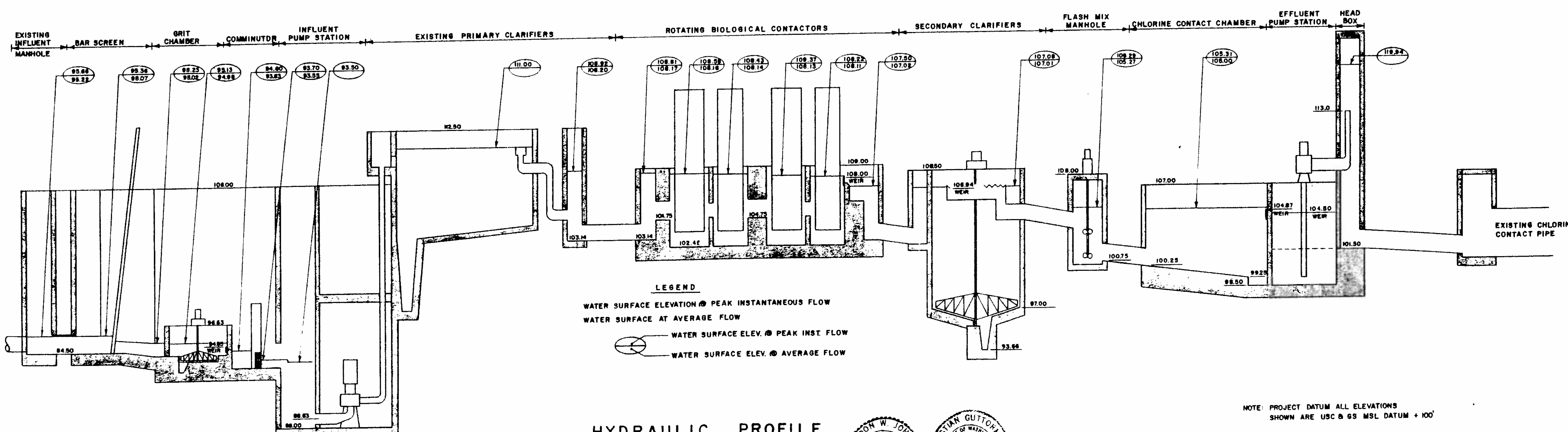
Type	External Heat Exchanger
Heat Exchanger Capacity	240,000 BTU/hr.
Sludge Recirculation Rate	75 gpm

SECONDARY DIGESTERS (Existing)

Number	2
Total Volume	12,960 cu. ft.
Storage Capacity @ 6% TS	37 days.

PUMP DATA

Influent Pumps:	
Number	3
Capacity, each	1,000 gpm
Effluent Pumps:	
Number	4
Capacity, each	600 gpm
Raw Sludge Pumps:	
Number	2
Capacity, new pump	57 gpm
Capacity, existing pump	90 gpm
Sludge Recirculation Pumps:	
Number	2
Capacity, new pump	75 gpm
Capacity, existing pump	200 gpm
Sludge Transfer Pump:	
Number	1
Capacity	86 gpm
Grit Pump:	
Number	1
Capacity	205 gpm
Scum Pump:	
Number	1
Capacity	200 gpm.



NOTE: PROJECT DATUM ALL ELEVATIONS SHOWN ARE USC & GS MSL DATUM + 100'

HYDRAULIC PROFILE

GORDON W. JOHNSON — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER

KRISTIAN GUTTORMSEN — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER

Job No. 4361-71-50	Designed K.G.	Proj. Engr. K.G.	
SCALE NO SCALE	Drawn by RL	Approved by	
	Checked by J.L.B.	Date 4/77	

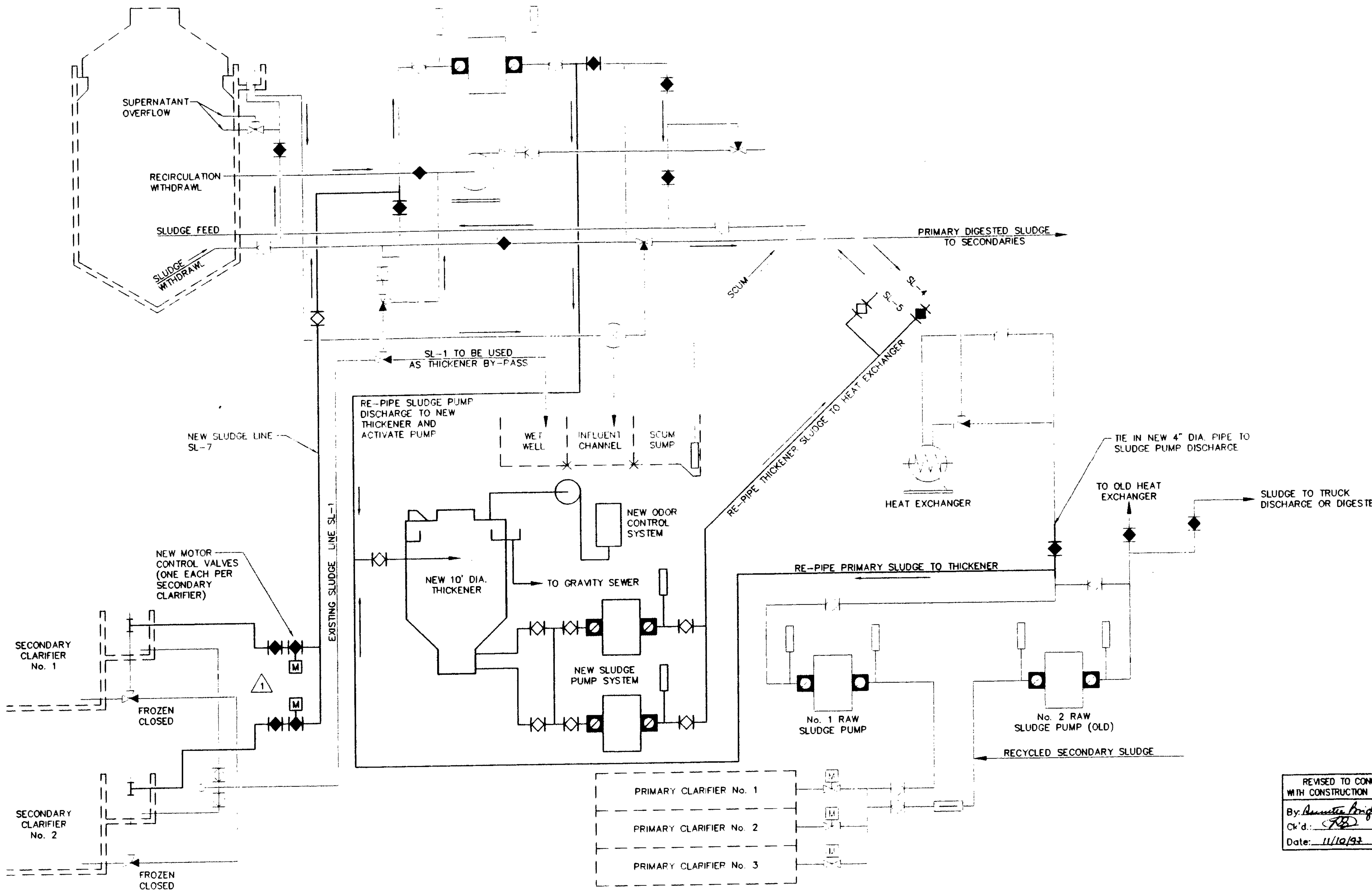
REVISION

URS COMPANY
A Professional Services Organization
Seattle, Washington

CITY OF OAK HARBOR WASHINGTON
WASTEWATER TREATMENT FACILITY

FLOW DIAGRAM-DESIGN DATA
HYDRAULIC PROFILE

SHEET G 4



REVISED TO CONFORM WITH CONSTRUCTION RECORDS
By: Annette Brigham
Ck'd.: RB
Date: 11/10/97

& IMPROVEMENT

FILENAME: H:\72003.03\ASBUILTS\G3-ASBUILT.DWG (5372003.03)
EDIT DATE: 10/06/97 AT: 4:34
DRAWN BY: KJF/AB SCALE: 1=1 (22x34, H:\FULL.PCP)

NO.	DATE	BY	REVISION
1	7/12/96	RS	REVISED MOTOR CONTROL VALVES

JOB NO.: 5371947.01
SCALE: NOT TO SCALE
DESIGNED BY: KEH
DRAWN BY: KJF, AB
CHECKED BY: RS
PROJECT ENGINEER: JRG
APPROVED BY:
DATE: 5-16-96

URS CONSULTANTS

ENGINEERING SERVICES
1100 OLIVE WAY
SUITE 200
SEATTLE, WA 98101
(206) 623-1800

J. RICHARD GROUT — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER
EXPIRES 4/23/98

CITY OF OAK HARBOR

WASTEWATER TREATMENT PLANT UPGRADE AND IMPROVEMENTS
CONTRACT 96-3
FLOW DIAGRAM

SHEET: G 3
SHT ___ OF ___