MSA

APPENDIX A

STATE OF WASHINGTON
DEPARTMENT OF HEALTH
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March 6, 2002

Stephen Kutz, RN, MPH
Director of Health Services
Mason County Department of Health Services
Post Office Box 1666
Shelton, Washington 98584

Dear Mr. Kutz:

In conjunction with the Department of Ecology, the Department of Health has reviewed your submitted documentation of problems in the in the Lynch Cove area of Hood Canal. The Department agrees that conditions noted in the documentation result in a situation which has a significant potential to cause illness, and therefore declares these conditions create a severe public health hazard. This conclusion is based upon:

- On-site sewage systems at 54 of the 102 homes evaluated were either failing or suspect.
- The high ground water, soils poorly suited for on-site sewage technology, fill, antiquated systems design, and small lot sizes make on-site sewage systems impractical or unworkable in this area.
- Runoff from failed systems flows over the ground or through saturated subsurface flow into Hood Canal. This pattern has caused the bay to be unfit for human recreation and has resulted in the closure of this part of Hood Canal for shellfish harvest.
- This problem involves a serviceable area of Hood Canal in Mason County.
- The problems described cannot be corrected through more efficient operation and maintenance of the existing on-site systems. Many of these are old, and all of them are on small lots with limited depth of suitable soil.

As noted in the Department of Ecology's program guidelines for Water Quality Program Funding, a copy of this letter must be submitted with an application for financial assistance during the application period of a funding cycle. If you have any questions about the guidelines, please contact Brian Howard, Department of Ecology, at (360) 407-6510.

The submittal by you and your staff clearly identifies the extent of the problem and presents realistic short-term and long-term methods for mitigating the existing situation. If you have any further questions, please contact Selden Hall, DOH Office of Environmental Health and Safety, at (360) 236-3043 or via email at selden.hall@doh.wa.gov.

Sincerely,

Mary C. Selecky
Secretary

cc: Brian Howard
Selden Hall

APPENDIX B

What is the Belfair Urban Improvements Project Feasibility Report?

The long-term viability of Hood Canal is in jeopardy. Poor water quality at the canal's southern end is threatening its ability to sustain life. Researchers have determined that septic systems and stormwater runoff are substantial contributors to the problem, so Mason County is considering the installation of sanitary and stormwater sewers. These improvements also potentially involve State Route 3 through Belfair. In order to best provide these improvements a number of very complex questions must be answered. The *Belfair Urban Improvements Project Feasibility Report* is intended to answer those questions.

Before the County decides exactly how to proceed, it has commissioned a type of study called a Project Analysis and Feasibility Study. The findings from this effort will help the County determine the potential costs, funding sources and other critical considerations related to the project. It identifies the most workable routing for the sewer systems and presents transportation and storm drainage design concepts for the County to consider.

How will the information from the Feasibility Report be used?

The Feasibility Report is not intended to provide recommendations for how to design the project. Instead, it provides current and detailed opinions regarding potential costs and project considerations to assist the county in making project decisions. It provides a context for decision making about how best to proceed.

Isn't this just a way to avoid the Belfair Bypass Project?

Improving SR-3 is not a substitute for the North-South Alternative Route (Belfair Bypass). The alternative route is still very much needed for development of the east Belfair area and as a new route for regional traffic. An improved SR-3 and the alternative route are complementary components necessary to meet regional transportation needs and to implement the Belfair Urban Growth Area Plan.

Why consider installing sewers and improving State Route 3 at the same time?

- Thus far, Mason County has been exploring the possibility of routing the new sewer systems down the State Route 3 corridor for several reasons:
- Making use of highway right-of-way saves the substantial cost of land acquisition for the new sewer system;
- Combining the sewer work with several transportation improvements would make the highway safer for motorists, bicyclists and pedestrians;
- Combining the work could result in overall cost savings to taxpayers;
- One construction project would be less disruptive to the community than two separate projects; and
- Combining the sewer work with roadway improvements may leverage the project's ability to obtain non-local funding to cover much of the cost.

What did the Project Analysis and Feasibility Study examine?

The Belfair Urban Improvements Project proposes a number of potential solutions to manage the impacts of growth in the Belfair area and the surrounding natural environment. The project involves a series of road and sewer improvements along SR-3 in the greater Belfair area to address water-quality issues in Hood Canal, improve public health, and improve safety along the SR-3 corridor.

The sewer system would be designed to serve properties in proximity to SR-3 and within the Belfair downtown core. The sewer improvements would consist of sanitary sewer and related sewage lift stations and water reclamation facility improvements. Wastewater would be pumped from Belfair via a force main to the existing treatment facility west of Allyn. Depending upon funding availability, the sewer collection system could be extended to the Belfair State Park area to address current and ongoing health risks in the Lynch Cove/North Beach Area.

The Feasibility Report also explores proposed improvements to address traffic congestion, safety considerations and the need for pedestrian facilities on SR-3. These improvements include completing the missing center left-turn-lane sections from Romance Hill Road to SR-106, constructing pedestrian and bicycle facilities, and installing storm sewer collection and treatment systems, and other environmental mitigation requirements.

How much would this project cost?

This is the pivotal question that the Project Analysis and Feasibility Study attempts to answer. Many factors go into estimating cost, including routing, how much right-of-way may be needed, the size and positioning of the sanitary and storm sewers, the extent of safety improvements needed, availability of funding, and the design standards to be followed.

The Feasibility Report identifies and examines a number of scenarios for providing sewers to the Belfair Urban Growth Area and the Belfair State Park area, as well as improvements to the SR-3 corridor through Belfair:

- Combined Sewer and Transportation Improvements: The estimated project cost to provide sewers to the Belfair Urban Growth Area and improve SR-3 through Belfair (SR-106 to Cokelet Lane), including completing the missing center left-turn-lane segments and adding sidewalks and landscaping is $30.7 [t1]million, including $3.9 million in costs to the utilities (power, telephone, cable) to relocate their facilities to accommodate the road improvements.
- Transportation Improvements Only: The estimated cost to improve only the SR 3 corridor through Belfair (SR 106 to Cokelet Lane), including completion of the missing center left-turn-lane segments and adding sidewalks and landscaping is $15.7 million, including $3.9 in costs to the utilities to relocate their facilities to accommodate the road improvements.
- Sewer Improvements Only: The estimated cost to develop only the sewer system for Belfair, without transportation improvements but still using SR 3 as a portion of the sewer route, is $16.2 million, including over $500,000 in costs for utility relocation. The sewer utility would have to cover the cost of relocating all utilities in the roadway right-of-way, including commercial telephone, cable, etc., because this would be a sewer project, not a transportation project.
- Expanded Sewer Service Area: Extending sewer service to the Belfair State Park area would increase project costs for each scenario by $5.0 million.
- Other Utility Improvements: Burying the aerial utilities (PUD3, Qwest and WaveBroadband) along SR 3 is estimated to be an additional $5.5 million for each scenario, all of which would be at the expense of the county.

Existing Conditions *Artist's Concept of Improvements*

Why are these estimates different from previous estimates?

Although past studies and cost estimates provided valuable information in preparing this feasibility report, they did not focus on the specific combination of improvements proposed in the Belfair Urban Growth Area Plan, and they did not consider the effects of the most recent design standards. Recent changes in stormwater design standards and new design requirements provided by the Washington State Department of Transportation (WSDOT) have affected costs. Differences in estimates from earlier studies can also be attributed to the feasibility report's higher level of detail and more current economic data.

Who would pay for these improvements?

While the county has some funds to work with, additional funding would clearly be needed. There are a number of funding possibilities at the local, state and federal level. Funding requests will be successful only if strong community support for the improvements can be demonstrated.

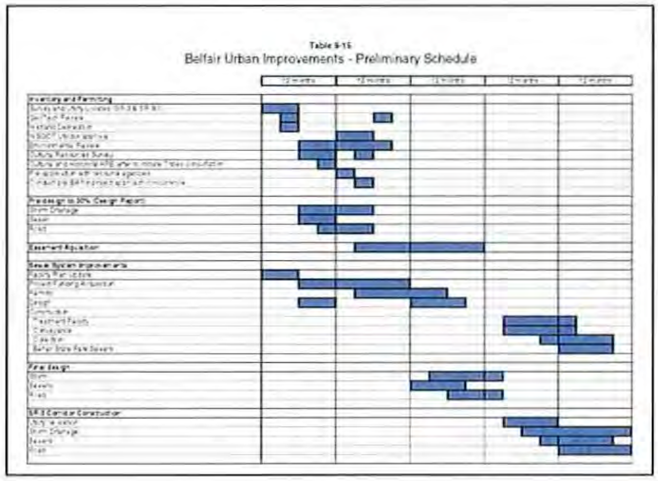
According to franchise agreements with WSDOT, the utility companies would be responsible for carrying out and paying for the necessary relocation of their facilities to accommodate the road improvements. Arranging for and paying for the relocation of utilities to accommodate the sewer installation only would most likely be the responsibility of the county sewer utility.

Funding the sewer improvements would be partially provided by a combination of connection charges, grants and loans and rates. However, loans would be the primary funding source. The expected loans for sewer construction would be repaid from sewer rates and connection charges. Costs specifically associated with hooking up individual properties to the sanitary sewer system and abandoning existing on-site septic systems may have to be borne at least partially by individual property owners.

A $1.5 million Public Works Trust Board Loan would represent the majority of the county contribution toward the road improvement and would need to be repaid from county road funds. Because the transportation improvements would be made to a state highway, the primary funding for SR-3 improvements should be from federal earmark funds and from WSDOT through legislative appropriation. Federal and state funding is not likely in the very near future, however a coordinated, consistent and persistent effort with the federal and state delegation could result in eventual funding of the project.

How soon could this project be built?

If all the funding needed was available at once, the combined road and sewer project could be built within five years. The more likely situation, however, is for funding to come in packages, spread out over time, such that the project would be designed in phases. One possible scenario for phasing the work would involve using the more immediately available local funds for the initial phase, bringing in federal and state grants and loans later to complete design and construction.



- Phase 1 (years 1-2) – Survey of SR-3, wetland delineation, permitting pre-application, cultural resources assessment, 30-percent design road/storm/sewer, funding requests/coordination.
- Phase 2 (years 3-4) – Complete design of road, stormwater and sewer, funding requests/coordination, legislative/congressional support, final permits, early start for utility relocation and drainage system.
- Phase 3 (years 5-10) – Complete utility relocation and drainage system, road and sewer construction.

What happens after the County reviews the Feasibility Report?

There are many steps to follow in implementing the urban improvements planned for Belfair. Coordination with regulatory agencies is critically important to understand and incorporate their design expectations and standards, which must be followed for their approval and support of the project. The feasibility report identifies the requirements of the many resource agencies and of WSDOT, who has control and responsibility of the SR-3 corridor. Continued investment in furthering the design of the sewer, stormwater and road improvements will be necessary for the approving agencies to commit to the project. At this early stage of project planning, we can only attain indications of probable requirements and approvals.

The project proposes to hook Belfair's new sanitary sewer system up to the North Bay/Case Inlet Water Reclamation Facility. Why doesn't Belfair get a separate reclamation facility?

Mason County's North Bay/Case Inlet Water Reclamation Facility located in Allyn is a regional county facility, designed and built to serve the sewer needs of the broader area, including Belfair. The feasibility report has confirmed that adequate capacity can be developed at the existing facility to serve the needs of both communities for the near-term. Additional studies on how to correct contamination from North Shore/Belfair State Park area and the impact of a potentially expanded sewer service area may be need to re-examine the use of existing reclamation facility in Allyn.

Won't traffic be a mess during construction?

Roadway construction can be disruptive. However, contractors understand the importance of working with local authorities and local businesses to minimize construction impacts, and two-way traffic would be maintained at all times.

How has the public weighed in on this study?

The project team has met with the community a number of times, working closely with a citizens advisory committee, coordinating open houses for the general public and affected business owners to review the study parameters, meeting with local tribes, coordinating with the North Mason Chamber of Commerce, and meeting one-on-one with potentially affected individual property owners.

As Mason County moves into the design phase of this project, the public will have ample opportunity to weigh in on design and environmental considerations. These opportunities are not only required by law, they are embraced by the county as a means of creating the most effective project possible. The information generated in this feasibility report will provide valuable information as the County and the community move forward together.

Road & Sewer Project Costs

Alternative	1	2	3	4
Belfair Urban Improvements Project	SR 3 Full Corridor Improvements with Belfair Urban Growth Area Sewers	SR 3 Full Corridor Improvements with Belfair Urban Growth Area and North Shore Area Sewers	SR 3 Full Corridor Road Only Improvement	Belfair Urban Growth Area Sewers Only
SR 106 Intersect to McDonald's Approach	7,104,000	7,104,000	7,104,000	-
Drainage Improvements	4,726,000	4,726,000	4,726,000	-
Utility Relocation For Road Improvements	3,884,000	3,884,000	3,884,000	-
SR-3 Improvement Costs	**$ 15,714,000**	**$ 15,714,000**	**$ 15,714,000**	**$ -**
NB/CI Reclaim Facility Capacity Improvements	3,203,600	3,254,600	-	3,203,600
Conveyance Sewer to NB/CI Reclaim Facility	6,181,300	6,181,300	-	6,181,300
Belfair Urban Growth Area Sewers	5,113,000	5,113,000	-	5,805,300
Sewer Utility Relocations	541,300	541,300	-	1,018,100
North Shore Area Sewers	-	5,005,800	-	-
Sewer Improvement Costs	**$ 15,039,200**	**$ 20,096,000**	**$ -**	**$ 16,208,300**
Utility Undergrounding Costs	**-**	**-**	**-**	**-**
Project Costs	**$ 30,753,200**	**$ 35,810,000**	**$ 15,714,000**	**$ 16,208,300**

(1) Utility Undergrounding Costs are an additional $5.5 million for the full SR 3 corridor.

Belfair Urban Improvements
Project Financing Scenarios

Project Elements and Funding Sources	Belfair Urban Growth Area Sewers with SR-3 Improvements	Belfair UGA/North Shore Sewers with SR-3 Improvements
SR-3 Improvement SR 106 - McDonalds	7,104,000	7,104,000
Drainage Improvements	4,726,000	4,726,000
Utility Relocation for Road Improvements	3,884,000	3,884,000
NB/CI Reclamation Facility Improvements	3,203,600	3,254,600
Conveyance System	6,181,300	6,181,300
Belfair Urban Growth Area Sewers	5,113,000	5,113,000
Utiltiy Relocation for Sewer Improvements	541,300	541,300
North Shore Area Sewers	-	5,005,800
Project Cost	**$30,753,200**	**$35,810,000**
PUD3 Responsibility	180,400	180,400
Qwest Responsibility	1,859,000	1,859,000
Belfair Water District Responsibility	1,123,400	1,123,400
Cascade Natural Gas Responsibility	716,200	716,200
WaveBroadband Responsibility	5,000	5,000
Utility Financing	**$3,884,000**	**$3,884,000**
Initial Sewer Connection Fees (SDC)	1,781,500	2,586,500
Septic System Abandonement Costs	485,500	786,500
Grants towards sewers (1)	2,500,000	2,500,000
Grants towards stormwater (2)	1,000,000	1,000,000
Grants and Fees	**$5,767,000**	**$6,873,000**
RUS - Loan (2)	$857,000	$857,000
SRF - Loan (3)	$6,000,000	$8,000,000
PWTF - Loan (4)	$3,415,200	$5,366,000
Sewer Loan Amount	**$10,272,200**	**$14,223,000**
State Road Funding	6,830,000	6,830,000
Federal Earmark Funds	2,500,000	2,500,000
PWFT Loan for Road (4)	1,500,000	1,500,000
Road Funding	**$10,830,000**	**$10,830,000**

Notes:

(1) Grant contributions may be from a number of sources including CDBG, CCWF and RUS as identified in the Facility Plan

(2) RUS loan is anticipated only if RUS grants are obtained. Loan terms are 40 years at 4.5% interest

(3) SRF loan terms are 20 years at 0% interest. It is anticipated that the project will qualify for a hardship loan, thus resulting in the 0% interest rate.

(4) PWTF loan terms are 20 years at 1% interest.

MSA

APPENDIX C

Associated Earth Sciences, Inc.

Hydrogeologic Assessment

LYNCH COVE/NORTH SHORE SEWER SERVICE AREA DELINEATION

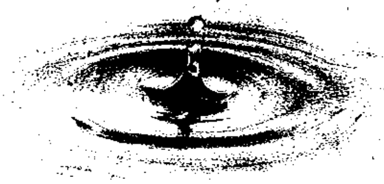
Mason County, Washington

Prepared for

Murray Smith and Associates

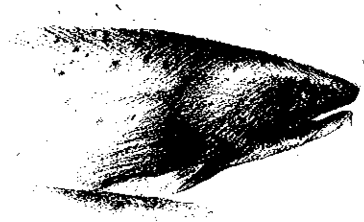
Project No. EH04539A
September 12, 2005

Geotechnical Engineering



Water Resources

Solid and Hazardous Waste



Ecological/Biological Sciences

Geologic Assessments

HYDROGEOLOGIC ASSESSMENT

LYNCH COVE/NORTH SHORE SEWER SERVICE AREA DELINEATION

Mason County, Washington

Prepared for:
Murray Smith and Associates
2707 Colby Avenue, Suite 1118
Everett, Washington 98201

Prepared by:
Associated Earth Sciences, Inc.
2911 ½ Hewitt Avenue, Suite 2
Everett, Washington 98201
425-259-0522
Fax: 425-252-3408

September 12, 2005
Project No. EH04539A

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1.0 INTRODUCTION

Associated Earth Sciences, Inc. (AESI) has completed an evaluation of the geologic and hydrogeologic conditions of a potential sewer service area located west of the Belfair Urban Growth Area (UGA) in the Lynch Cove and North Shore areas of Lower Hood Canal in Mason County, Washington (County). The approximate location of the study area for this project is shown on Figure 1.

The Washington State Department of Health (DOH) has declared that the water quality conditions in the Lynch Cove area of Hood Canal create a severe public health hazard. Previous studies conducted in the Lynch Cove/North Shore area of the County have linked septic effluent as a potential contributor to the poor water quality conditions. The DOH's declaration is based upon the following, as documented in their letter of March 6, 2002 (Appendix A):

- On-site sewage systems at 54 of the 102 homes evaluated were either failing or suspect.
- The high ground water, soils poorly suited for on-site technology, fill, antiquated systems design, and small lot sizes make on-site sewage systems impractical or unworkable in this area.
- Runoff from failed systems flow over the ground or through saturated subsurface flow into Hood Canal. This pattern has caused the bay to be unfit for human recreation and has resulted in the closure of this part of Hood Canal for shellfish harvest.
- This problem involves a serviceable area of Hood Canal in the County.
- The problems described cannot be corrected through more efficient operation and maintenance of the existing on-site systems. Many of these are old, and all of them are on small lots with limited depth of suitable soil.

The County and their consultant, Murray Smith and Associates (MSA), are currently in the process of evaluating the feasibility of providing sewer service to the general area around Lynch Cove/North Shore in an effort to improve water quality in Lynch Cove and Hood Canal.

2.0 PURPOSE AND SCOPE

The purpose of our study was to assist the County and MSA in their evaluation of the potential sewer service area by delineating the study area into areas that have either a probable, a possible or unlikely chance for septic effluent originating in the specified areas (specifically fecal coliform bacteria) to degrade water quality in Lynch Cove. Our services involved developing a conceptual hydrogeologic model of the Lynch Cove area and a potential impact ranking matrix that is based on the physical and land use characteristics of the study area. The conceptual hydrogeologic model was used in conjunction with the ranking matrix to delineate areas with a probable, a possible and/or unlikely chance for septic effluent to degrade water quality in Lynch Cove.

Our specific scope of services for the Lynch Cove/North Shore Sewer Service Area Delineation project is listed below.

- Data Review

    - Reviewed available geologic, hydrogeologic, and water quality information for the site and surrounding area. The data review included published reports and data from the County, the United States Geological Survey (USGS), the DOH, local health departments, other government agency reports, geologic maps of the area, and water well reports available from the Washington State Department of Ecology (Ecology).

- Developed Delineation Criteria

    - Worked with representatives of MSA and the County to develop general criteria for the delineation of the potential sewer service area. The delineation criteria included: (1) Soil Type/Septic Suitability, (2) Land Use/Lot Size, (3) Proximity to Surface Water, (4) Depth to Ground Water, and (5) Slope of the Ground Surface.

- Preliminary Assessment/Define Study Area

    - Conducted a reconnaissance of the potential sewer service area.

    - Based on the information review conducted and the results of the field reconnaissance, the approximate limits of the study area for the sewer service area feasibility assessment were defined.

- Soils Evaluation

    - Reviewed published soil survey maps for the defined study area.

    - Developed soil maps of the study area that identify soils based on their suitability for septic drainfield use.

- Geologic/Hydrogeologic Evaluation

    - Evaluated depth to ground water, ground water flow direction, and aquifer recharge/discharge areas in the study area based on published information and water well reports.

    - Developed a conceptual hydrogeologic model of the study area based on the available and field-generated geologic/hydrogeologic information.

    - Evaluated the available water quality information relative to the developed conceptual hydrogeologic model.

- Physical Site Constraints

    - Evaluated topography of the study area to identify slope of ground surface, proximity to surface waters, and other site conditions.

    - Evaluated lot sizes and densities based on County Assessor maps within the study area.

- Delineation and Documentation

    - Delineated the potential sewer service area based on soil, hydrogeologic, and water quality information reviewed/evaluated as described in the previous tasks.

    - Met with representatives of MSA and the County to discuss the delineation and the implications of land use zoning within the study area on the potential sewer service area.

    - Modified the delineated sewer service area, as appropriate, based on input regarding existing land use zoning in the study area.

    - Participated in public meetings.

3.0 SITE CONDITIONS

The study area includes the coastal area along North Shore Road (Highway 300) from near the Union River to approximately ¾ of a mile southwest to Belfair State Park, including the uplands to the north. The study area included portions of Sections 23, 24, 25, 26, 35, and 36, Township 23 North, Range 2 West, Sections 19, 20, 29, 30, and 31, Township 23 North, Range 1 West, and Sections 1 and 2, Township 22 North, Range 2 West. The approximate boundaries of the study area are shown on Figure 1.

Land use in the populated portions of the study area includes residential homes, a public school, several light industrial and retail businesses, and Belfair State Park. The highest population densities of the study area are located along the coastal lowlands and on the slope which extends from the uplands to the lowlands. Large portions of the upland areas and steep slope area, particularly the stream channels and erosional gullies, are densely wooded. Highway 300 extends from east to west along the coastal lowlands. The upland areas are accessed by several roads in the major stream drainages which extend from the coastal lowlands to the uplands.

Belfair State Park consists of picnic grounds, RV/tent camping sites with associated restroom facilities, and an RV wastewater dump. All facilities at the state park use septic drainfields for wastewater disposal.

4.0 METHODOLOGY

AESI reviewed available soil, hydrogeologic, and geologic data to gain an understanding of the existing conditions in the study area. Information reviewed included the following:

- *Water Resources and Geology of the Kitsap Peninsula and Certain Adjacent Islands* (Garling et al., 1965), USGS Water Supply Bulletin No. 18, 1965.

- *Land Use and Water Quality, Mission Creek, Little Mission Creek Sub-Basins, Lower Hood Canal* (Barnes et al., 1995), Ecology Watershed Management Section, Publication No. WQ-95-72, September 1995.

- *Union River Fecal Coliform Total Maximum Daily Load Study* (Ward et al., 2001), Ecology Environmental Assessment Program, Publication No. 01-03-038, October 2001.

- *Union River Fecal Coliform Total Maximum Daily Load, Submittal Report* (Sweet et al., 2002), Ecology Water Quality Program, Publication No. 02-10-022, June 2002.
- *Union River Fecal Coliform Water Cleanup, Detailed Implementation Plan* (Garland and Lawrence, 2003), Ecology Publication No. 03-10-066, August 2003.

- Mason County Health Department information.

- Water well reports on file with Ecology.

4.1 Field Activities

Field activities completed for the study included a visual reconnaissance of portions of the study area accessible by existing County roads. Our reconnaissance included inspection of soil exposures along road cuts, stream channels, and landslide scarps. Mr. Michael O'Neal (2005) of the University of Washington accompanied us during a portion of our reconnaissance. Mr. O'Neal has been conducting geologic mapping in a portion of the study area for several years. His work is focused in the Lake Wooten Quadrangle in which the western portion of the study area is located. The geologic information developed by Mr. O'Neal was used in developing the geologic setting of the study area.

5.0 GEOLOGY AND SOILS

5.1 General Physiography

The County and the community of Belfair lie within what is referred to as the Puget Lowland, which is a regional north-south trending topographic trough that extends from southern British Columbia through the western portion of Washington to northern Oregon. The western portion of the study area is generally an upland that slopes to the southeast toward Hood Canal, and ranges in elevation between roughly 20 and 500 feet (Figure 1). The very eastern portion of the study area, immediately adjacent to Hood Canal, is relatively level lowland located at elevations that range from near mean sea level (msl) to approximate elevation 20 feet. All elevations presented in this report are relative to msl unless otherwise noted.

The primary surface water drainages in the study area are Mission and Little Mission Creeks (Figure 1). Other small intermittent streams and springs are located in steep, narrow canyons and gullies along the periphery of the upland area.

5.2 General Quaternary Geology

Quaternary sediments throughout the Puget Lowland were deposited during several glacial (stade) and nonglacial intervals (interstade) during the last 2.4 million years. During glacial periods, the southwest margin of the Cordilleran ice sheet flowed southeastward from British Columbia into the Puget Lowland of western Washington (Blunt et al., 1987). The most recent glacial episode in the Puget Lowland is referred to as the Fraser Glaciation.

The Fraser Glaciation consisted of multiple stades and interstades with the most recent being the Vashon Stade. The Vashon Stade represented the maximum advance of the Cordilleran ice sheet during the Fraser Glaciation. At its maximum extent (Vashon Stade), the Puget Lobe of the Cordilleran ice sheet extended to Olympia and reached a maximum thickness of several thousand feet. Retreat of the glacial ice at the end of the Vashon Stade was rapid and deglaciation of the Puget Lowland was complete by approximately 11,300 years ago (Blunt et al., 1987).

Sediments of the Vashon Stade are present over a majority of the ground surface in the study area. Exposures of older glacial and nonglacial deposits are typically limited to bluffs and incised river/stream valley walls. The Fraser glacial and nonglacial deposits in the study area are generally underlain at depth by bedrock. A generalized geologic map of the study area is presented on Figure 2.

5.3 Study Area Geology

Michael O'Neal with the University of Washington recently completed a geologic investigation of the Lake Wooten Quadrangle, which includes a large part of the sewer service delineation study area (O'Neal, 2005). Information developed by Mr. O'Neal (2005) and published geologic information (Garling et al., 1965) were used to define the geology of the study area.

Garling et al. (1965) mapped the surficial geology in the study area as including recent alluvium, Vashon glacial deposits, and undifferentiated pre-Vashon glacial and nonglacial deposits. Recent alluvium deposits are present at the mouth of the Union River and around the several small lakes and depressions in the upland areas. Vashon recessional outwash deposits are mapped in the Union River valley and the slopes which form the walls of the valley. Vashon till is the predominant unit mapped at ground surface in the upland areas. Vashon advance outwash deposits underlie the till and are mapped at ground surface in the Mission Creek and Little Mission Creek channels, and in several steep narrow canyons, gullies, and slopes which extend from the uplands to Hood Canal. Undifferentiated pre-Vashon glacial and nonglacial deposits are mapped at ground surface in the lower reach of the Mission Creek channel. A generalized description of each major Quaternary unit in the study area is presented below.

<u>Older Quaternary-Age Sediments (Qpf)</u>

Older Quaternary-age sediments (undifferentiated pre-Vashon deposits) are mapped on the slopes between the uplands and the coastal lowlands, as shown on Figure 2 (O'Neal, 2005). The older Quaternary-age deposits underlie the surficial Vashon-age deposits on the uplands and are comprised of a very dense, matrix-supported mix of sand and silt with some gravel and cobbles. The dense nature of the deposits is due to a combination of compaction by glacial ice and cementation by iron and manganese oxides and hydroxides (O'Neal, 2005).

<u>Vashon Advance Outwash (Qva)</u>

Surface exposures of Vashon advance outwash sediments have been mapped by O'Neal (2005) on the slopes and erosional channels between the upland area and low-lying coastal areas. The base of the advance outwash deposits includes a fine-grained lacustrine unit overlain by coarser-grained sand and gravel deposited by streams emanating from the advancing ice sheet. Horizontally bedded and deltaic fan facies are present in the lower portion of the sequence where the sediments were deposited in a proglacial lake. The upper portion of the sequence is characterized by braided-stream deposits and consisted of coarser-grained sediments and cross-bedding. The advance outwash deposits are typically very dense from compaction of the sediments by the massive weight of the glacial ice. The advance outwash sequence is relatively thin (less than 30 feet). The Vashon advance outwash deposits are generally overlain by Vashon till in the uplands of the study area (Figure 2).

Vashon Till (Qvt)

Vashon till is the primary geologic unit present at ground surface in the upland areas above Lynch Cove (Figure 2). Vashon till typically consists of a very dense, unsorted mixture of sand, gravel, and cobbles in a silt/clay matrix. These sediments were deposited beneath the advancing ice sheet. The very dense characteristic of the till is the result of compaction by the massive weight of the glacial ice. O'Neal (2005) described the till deposits as no more than a few tens of feet in thickness.

Vashon Recessional Outwash (Qvr)

Surface exposures of Vashon recessional outwash sediments have been mapped in the slopes and erosional channels between the upland areas and low-lying coastal areas (Garling et al., 1965). Recent mapping by O'Neal (2005) indicates recessional outwash deposits are also present in portions of the erosional channels in the upland areas and that the sediments mapped as recessional outwash on the walls of Mission Creek by Garling et al. (1965) are likely recent alluvial terrace deposits. Vashon recessional outwash consists of sediments deposited by meltwater streams that emanated from the retreating glacial ice. Recessional outwash deposits are generally comprised of sand and gravel with varying amounts of silt and are typically loose as they have not been compacted by the glaciers.

Recent Alluvium and Other Sediments (Qal, Qb, Qf)

O'Neal (2005) indicates surficial sediments in the coastal lowlands include Quaternary-age beach deposits (Qb), fan deposits (Qf), and alluvium (Qal). Beach deposits are mapped along the coastline and extend inward to where they co-mingle with the fan deposits emanating from the steam channels which drain the upland areas. Fan deposits consist of silt, sand, gravel, and cobbles deposited in a lobate form where streams emerge from the erosional valleys and reduced gradients result in sediment loads to be deposited. Beach deposits consist of locally well-sorted sand, gravel, cobbles, and silt, locally with shells, deposited and reworked by wave action. Alluvium is mapped on the floor of the stream channels (Figure 2). The alluvium generally consists of silt, sand, and gravel deposited by local streams.

5.4 Surface Soils

Mapped soils in the study area predominantly consist of Alderwood, Everett, and Indianola Series, as shown on Figure 3. Tidal marsh soils are mapped along the coastline in a majority of the study area. The soil types identified in study area are based on the United States Department of Agriculture (USDA), Mason County Soil Survey mapping completed by the Soil Conservation Service (SCS) (1960).

Alderwood Soils (Ab)

Alderwood soils are present in the upland portions of the study area and typically develop on till. Alderwood soils are well-drained and generally consist of gravelly sandy loam. The main limitations of Alderwood soils are depth to the cemented hardpan (till) and the seasonal perched water table (interflow). In areas of moderate- and high-density population, on-site sewage disposal systems often fail or do not function properly during periods of high rainfall because of these soil limitations.

Everett and Indianola Soils (I/E)

Everett and Indianola soils are mapped in the lowland areas, in creek channels, and on the slopes which extend from the lowlands adjacent to Lynch Cove to the uplands. Everett and Indianola soils typically develop on glacial outwash sediments typically exposed in eroded channels or on outwash plains. Everett and Indianola soils are droughty because the loose gravel and sand subsoil and substratum offer little resistance to the downward movement of water. The high infiltration rates typical of Everett and Indianola soils allow infiltrated septic effluent to travel rapidly to shallow ground water without sufficient residence time in the unsaturated zone needed to allow the natural filtering and treatment of the septic effluent.

Tidal Marsh Soils (Tn)

Tidal marsh soils are mapped in the coastal areas. Tidal marsh soil is generally composed of silt with fibrous peat and, in some cases, very fine sand. Tidal marsh soils have very limited septic effluent disposal characteristics due to the very low infiltration rates and associated shallow ground water levels which are affected by tidal influences.

6.0 GROUND WATER

Based on mapped geologic conditions and available hydrogeologic data, ground water in the study area consists of: (1) a seasonal interflow zone located on top of the Vashon till, (2) unconfined/confined aquifers in the Vashon advance outwash and older Quaternary-age deposits, and 3) an unconfined aquifer in the recent alluvial sediments located in the coastal lowland areas. Our review of the water well reports indicates a majority of the domestic water wells in the area are completed in unconfined/confined aquifers located within the older Quaternary-age deposits.

6.1 Interflow Zone

A seasonal shallow interflow zone is likely present in the weathered horizon of the Vashon till mantling the upland portions of the study area. Interflow commonly accumulates seasonally in areas underlain by the relatively low-permeability till. Water in the interflow zone is comprised of precipitation that percolates down through the relatively permeable, surficial weathered till soils and accumulates on top of the underlying, low-permeability unweathered till surface. The interflow zone is typically relatively thin, ranging from less than 1 foot to several feet in thickness. Flow in the interflow zone follows topography flowing from areas of higher elevation to areas of lower elevation. Ground water flow direction in the interflow zone generally mimics topography and flows toward the incised stream channels and edges of the uplands. Discharge from the interflow zone is likely via diffuse seeps and springs which either enter the streams in the incised erosional channels or percolate into the soils on the slope faces or at the base of the slopes. A portion of the ground water in the interflow zones also likely percolates downward through the unweathered till to the underlying advance outwash deposits.

6.2 Vashon Advance Outwash/Older Quaternary Deposits

Ground water recharge to the advance outwash deposits and underlying older Quaternary-age sediments is almost completely from the infiltration of precipitation through the overlying surficial till layer. Direct infiltration of precipitation likely occurs in limited areas where the advance outwash sediments are exposed at the ground surface.

Garling et al. (1965) stated the regional water table is in most places below the elevation of the advance outwash deposits. Seeps and springs were observed during our field reconnaissance emanating from the contact between the advance outwash deposits and the underlying older Quaternary-age sediments indicating a potential perched ground water condition. It is likely that there are perched aquifers in portions of the advance outwash sediments and in the upper portion of the older Quaternary-age sediments which overlie a regional water table at depth. A review of the water well reports for the study area indicate that several domestic wells are completed in what appear to be perched zones in the Vashon advance outwash/older deposits. Many of the domestic wells capable of yielding large quantities of ground water are completed at deeper levels in a regional aquifer located in the older Quaternary-age deposits underlying the uplands.

Ground water in the advance outwash deposits, where present, and perched zones of the older Quaternary-age deposits likely flow from northwest to southeast with localized flow patterns toward the incised stream channels and erosional gullies in the study area. Ground water discharges from these perched zones in the form of seeps and springs in the creek channels, erosional gullies, and along the slope extending from the coastal area to the uplands. The regional ground water flow direction in the deep aquifer located within the older Quaternary-age deposits is likely to the southeast with ground water discharging as seeps and springs in lower portions of the creek channels, erosional gullies, and the slope between the coastal areas and the uplands with a significant component of discharge to Lynch Cove and Hood Canal.

6.3 Recent Alluvial Sediments

Ground water is present in the recent alluvial sediments comprised of Quaternary alluvium (Qal), Quaternary beach deposits (Qb), and Quaternary fan deposits (Qf) located in the coastal areas along the north shore of Lynch Cove. Ground water recharge to the recent alluvial sediments is from infiltration of precipitation, and infiltration of surface water from the creeks, springs, and seeps along the slope between the coastal lowland and the uplands. Ground water flow in the recent alluvial sediments is toward Lynch Cove with discharge occurring at or slightly below msl. Some discharge in the form of seeps from the recent alluvial sediments to Lynch Cove is likely exposed during low tides. The depth to ground water in the recent alluvial sediments is shallow based on water well information and our site reconnaissance observations.

7.0 CONCEPTUAL GROUND WATER MODEL

The conceptual ground water model describes the components of the ground water systems in the study area. The components of a conceptual ground water model include three main components: (1) inputs to the ground water system, (2) flow within the ground water system, and (3) discharge from the system. Inputs to the ground water flow system in the study area include infiltration of precipitation, irrigation of developed or farmed land, and infiltration of domestic wastewater. Flow within the ground water systems in the study area includes flow in the seasonal interflow zone, Vashon advance outwash/older Quaternary sediments, and recent alluvial sediments. Discharge from the ground water flow system occurs as regional discharge to Lynch Cove and localized discharge to seeps and springs along steep slopes. The three components which comprise the conceptual ground water flow model are described below.

As previously described, the ground water system underlying the study area consists of three ground water zones, a seasonal interflow zone on the till-mantled uplands, perched zones in the Vashon advance outwash and the older Quaternary-age sediments/regional aquifer at depth in the older Quaternary age deposits, and a water table aquifer in the recent fan and beach deposits in the coastal lowlands.

Precipitation provides a bulk of the input (recharge) to the ground water system in the study area. A portion of the precipitation falling directly on cleared areas infiltrates downward; the remainder is lost to evaporation and transpiration (uptake by vegetation). These two processes are commonly combined into one term: evapotranspiration. On developed land, precipitation infiltrates in vegetated areas, minus evapotranspiration, or runs off of impervious surfaces, which ultimately infiltrate to the ground water or are conveyed via drainage ditches to surface waters. In heavily wooded areas, the tree canopy intercepts a portion of the precipitation and some is lost as surface water runoff. The remainder infiltrates into the ground and is either lost to evapotranspiration or provides recharge to the ground water system. Water applied as irrigation in the study area provides recharge to the ground water system in the same fashion as precipitation. Wastewater effluent conveyed to the ground via drainfields provides direct recharge to the ground water system, minus transpiration from vegetation. Some component of recharge to the ground water system is via infiltration of surface waters in the streams which extend from the upland to the coastal lowland.

Precipitation, wastewater, and runoff from impervious surfaces provide direct recharge to the interflow zone in the uplands and the recent fan and beach deposits in the coastal lowlands. Infiltration of surface water from streams draining the upland areas provides additional recharge to the recent fan and beach deposits. Ground water recharge to perched zones in the Vashon advance outwash and older Quaternary-age deposits is from the downward movement of ground water in the interflow zone through the till and the direct infiltration of precipitation where the till is absent. Recharge to the deep regional aquifer is from the downward movement of water in perched zones and infiltration of surface water from streams which have eroded through the till.

Ground water flow in the interflow zone generally follows surface topography and discharges as seeps and springs at the edge of the slope extending from the uplands to the coastal lowland and in the slopes of the deeply incised surface water drainages. Ground water discharge from the interflow zone provides recharge to the underlying perched zones in the advance outwash and older Quaternary-age deposits and baseflow for the streams in the study area. Perched ground water in the advance outwash deposits and older Quaternary-age sediments discharges as seeps and springs along the slope between the coastal lowlands and upland areas, and ultimately provides recharge to the ground water in the recent fan and beach deposits in the coastal lowlands via direct infiltration and discharge to streams flowing from the uplands to the coastal lowlands. Ground water in the regional aquifer discharges as seeps and springs along the lower portions of the slope between the coastal lowlands and uplands areas, and at depth to Lynch Cove. Ground water in the recent fan and beach deposits in the coastal lowlands discharges to Lynch Cove.

Ground water travel times to Lynch Cove and stream channels are generally a function of the geology/hydrogeology of the area and the proximity of the surface water. Depth to ground water in the coastal lowlands is relatively shallow and the coastal lowlands are in close proximity to Lynch Cove; therefore, the potential for this area to contribute fecal coliform to Lynch Cove is the highest. Septic systems located in close proximity to surface waters tributary to Lynch Cove also have a high potential to contribute fecal coliform due to the short travel time of ground water to the surface water body and direct conveyance of the tributary to the waters of Lynch Cove. Septic systems located in close proximity to seeps and springs which directly flow to tributary creeks also have a high potential to contribute fecal coliform to Lynch Cove. Seeps and springs which do not directly flow to surface waters tributary to Lynch Cove are less likely to contribute fecal coliform to Lynch Cove as the residence time of the fecal coliform bacteria in the ground water system is greater. Areas with a thick, unsaturated zone between the septic system and the water table and areas with a long flow path (travel time) to the ground water discharge point have the lowest potential to contribute fecal coliform to Lynch Cove.

8.0 WATER QUALITY

In 1987, the DOH downgraded the eastern end of Lynch Cove (Hood Canal near Belfair) from Approved for direct harvest of shellfish to Prohibited due to unacceptable levels of fecal coliform bacteria. The closure halted commercial harvest from 630 acres of intertidal growing area. Recreational and tribal harvest were also curtailed at Belfair State Park (about 2 miles west-southwest of Belfair on the north shore), the second most productive public oyster site in Puget Sound. Elevated fecal coliform levels have also led to the declaration of a public health hazard by the DOH for the Lynch Cove area. Studies have been conducted by Ecology, DOH, and local health agencies in an effort to determine the source of the elevated fecal coliform levels in Lynch Cove and propose possible solutions. The following is a summary of these studies.

8.1 Washington State Department of Ecology Studies

Ecology has completed studies related to fecal coliform in the Union River Basin, and Mission Creek and Little Mission Creek Sub-Basins. The Union River studies include: *Land Use and Water Quality, Mission Creek, Little Mission Creek Sub-Basins,* dated September 1995 (Barnes et al., 1995)*; Union River Fecal Coliform Total Maximum Daily Load* (TMDL) *Study*, dated October 2001 (Ward et al., 2001); *Union River Fecal Coliform Total Maximum Daily Load Submittal Report*, dated June 2002 (Sweet et al., 2002); and *Union River Fecal Coliform Water Cleanup Detailed Implementation Plan*, dated August 2003 (Garland and Lawrence, 2003. The following is a brief summary of the Ecology studies.

The Missions Creek/Little Mission Creek 1995 study (Barnes et al., 1995) was completed to address the potential for pollution from the sub-basin to the marine waters of Lynch Cove. Results at the time of the study suggested that storm-generated fecal coliform loads from Mission and Little Mission Creeks were not an important source of fecal coliforms to the tideland at Belfair State Park. The report also concluded that conditions that minimize fecal coliform loading during heavy rain may be absent during low flow. The study concluded that the most important human source of fecal coliform contamination is likely sewage from failed on-site septic systems along the marine shoreline.

The 2001 Union River TMDL study (Ward et al., 2001) was completed to evaluate and recommend a TMDL strategy, including load allocations for fecal coliform bacteria sources on the Union River, to meet state water quality standards. The study included fecal coliform sampling in the Union River and Bear Creek. Fecal coliform levels in water samples showed a dry season concentration higher than those in the wet season suggesting that there is likely a continuous, steady component of pollution loading to the Union River and Bear Creek. Water quality data obtained in this study also indicated relatively high fecal coliform levels during the wet season when flows are dramatically higher indicating there is also a storm-related (runoff) component to loading. The study concluded pollution sources in the basin are exclusively non-point including agriculture, on-site septic systems, and post-development activities from urban development (e.g., domesticated animals).

The 2002 TMDL study (Sweet et al., 2002) was completed to establish a TMDL for fecal coliform bacteria for the Union River Watershed. The TMDL study was initiated after water quality monitoring by state and local agencies determined fecal coliform levels in the Union River had violated the Washington State Class AA standard since 1990. The TMDL study was initiated to determine the loading capacity of the river, identify non-point pollution sources of fecal coliform, and set load reductions along the stream corridor. On-site sewage system failures, inadequate agricultural and livestock practices, pet wastes and runoff from homes, highways, and commercial businesses were identified as probable sources of fecal coliform contamination.

The 2003 Union River Fecal Coliform Water Cleanup Detailed Implementation Plan (Garland and Lawrence, 2003) provides details on proposed watershed activities intended to clean up the fecal coliform bacteria contamination in the Union River. The study also summarizes potential sources of fecal coliform in the Union River Watershed. The study identified on-site sewage systems as a potential source of pollutants to the Union River if they are substandard, failing, or located near the river or a tributary.

8.2 Mason County Health Department

The Mason County Health Department (Health Department) has conducted and participated in several studies in Lynch Cove and Mission and Little Mission Creek areas with respect to water quality monitoring and source investigations. The Health Department has surveyed numerous septic systems in the study area to test for septic system failures and potential fecal coliform contamination to surface waters using visual inspection and dye testing. The Health Department concluded that failing on-site septic systems are the most likely cause of elevated fecal coliform levels in the marine waters.

9.0 SEWER SERVICE AREA RANKING MATRIX

The potential for septic effluent to impact water quality in the study area and contribute to the conditions that have led to the severe health hazard declaration is dependent on several physical characteristics of the area. Data research and detailed discussions with representatives of MSA, the County, DOH, and Ecology have led to the development of the following pertinent physical characteristics that appear to have the most control over the potential impact of septic effluent on water quality in the study area.

- Soil Type/Septic Suitability
- Land Use/Lot Size
- Proximity to Surface Water
- Depth to Ground Water
- Slope of the Ground Surface

Each of these characteristics has either a direct effect on the performance of septic systems or an effect on the ability of viable fecal coliform bacteria to travel to nearby surface water bodies. The following is a more detailed discussion of each characteristic.

9.1 Soil Type/Septic Suitability

The USDA's Natural Resources Conservation Service (NRCS) has developed a classification system which ranks soil types based on limitations that affect septic tank drainfields and/or sewage lagoons. Septic tank drainfields are defined by the USDA/NRCS as areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipes. Only the soil column between depths of 24 and 60 inches is evaluated because it represents the critical functional zone for drainfield effectiveness. These rankings include three classifications:

Not Limited: The soil has features that are very favorable for the specified use. Very good performance and very low maintenance can be expected.

Somewhat Limited: The soil has features that are moderately favorable for the specified use. The limitation could be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected.

Very Limited: The soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation work, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

For the purposes of the ranking matrix, each soil type was assigned a numerical rating based on its degree of individual limitation as described by the USDA/NRCS. The rankings are based on soil properties that affect absorption of the effluent, construction and maintenance of the system, and public health. Individual limitations include filtering capacity, seepage, slope, restricted permeability, and depth to the saturated zone. The ranking values for soil type/septic suitability is shown below.

Soil Type/Septic Suitability Ranking

Septic Suitability	Very Limited	Somewhat Limited	Not Limited
Rank	10	5	1

All soil types within the study area, Alderwood series, Indianola/Everett series, and Tidal marsh (Figure 3), are very limited with respect to septic suitability.

9.2 Land Use/Lot Size

Current housing and potential future lot size was evaluated with respect to the DOH minimum lot size for on-site residential septic systems. *Washington State Administrative Code* (WAC-246-272) presents the "minimum land area requirement" for septic drainfields. The code presents two methods for the determination of the minimum lot size required. Method I bases the minimum lot size on soil type. Method II outlines a minimum lot size determination based on a written analysis of 16 specific characteristics of the proposed lot. The DOH Method I was used to develop the delineation rankings in conjunction with regional soils maps for the study area.

The DOH Method I guidelines identify the following eight soil types with regard to on-site residential septic system suitability:

- Type 1A: Very gravelly[1] coarse sands or coarser. All extremely gravelly[2] soils.
- Type 1B: Very gravelly medium sand, very gravelly fine sand, very gravelly very fine sand, very gravelly loamy sands.
- Type 2A: Coarse sands (also includes American Society for Testing and Materials [ASTM] C-33 sand).
- Type 2B: Medium sands.
- Type 3: Fine sands, loamy coarse sands, loamy medium sands.
- Type 4: Very fine sands, loamy fine sands, loamy very fine sands, sandy loams, loams.
- Type 5: Silt loams that are porous and have well-developed structure.
- Type 6: Other silt loams, sandy clay loams, clay loams, silty clay loams.

[1] Very Gravelly = >35 percent and <60 percent gravel and coarse fragments by volume.
[2] Extremely Gravelly = >60 percent gravel and coarse fragments, by volume.

The DOH also lists sandy clay, clay, silty clay, and strongly cemented or firm soils as "Unsuitable for treatment or disposal."

The glacial till-mantled uplands in the study area are generally characterized as Type 5 or 6 soils (silt loams/clay loams). The soils mapped along the shoreline are generally tidal marsh consisting of silt and some fine sand that corresponds to the DOH Type 5 or 6 soils for septic characterization. The area between the tidal marsh soils and the till-mantled uplands includes coastal areas, the slope between the lowland and uplands, and the recessional outwash ridge in the northeast portion of the study area. Soils in these areas are generally mapped as Indianola and Everett series and correspond to DOH Type 2 and 3 soils. The following ranking values have been assigned based on the DOH Method I criteria for minimum lot sizes for on-site septic systems. A map of the land use/lot size rankings is displayed on Figure 4.

Land Use/Lot Size Ranking

Lot Size Soil Type 2 and 3 **Lot Size Soil Type 5 and 6**	< 12,500 ft^2 < 20,000 ft^2	$\geq$12,500 ft^2 < 1 acre $\geq$20,000 ft^2 < 1 acre	$\geq$1 acre
Rank	10	5	1

Lot sizes and densities are basically limited to the existing parcels within the study area. The study area is outside the Belfair UGA and land use zoning is for a minimum of 5-acre parcels. Lot sizes within the study area that are less than 5 acres are a result of plats created prior to land use zoning requirements.

9.3 Proximity to Surface Water

Proximity to surface water features was evaluated to assess the potential for septic effluent to directly enter surface waters via overland flow from failing drainfields or from ground water containing viable fecal coliform bacteria. Surface water bodies in the study area include Lynch Cove, Mission Creek, Little Mission Creek, and several unnamed drainages extending from the upland areas to the coastal lowlands. The DOH (2003) has established a distance of 200 feet as the criteria for determining if ground water has the potential to be under the influence of a surface water body. We understand that the 200-foot lateral distance was determined based on field studies and analytical testing regarding the ability of ground water to transport viable pathogens not normally found in natural ground water.

The DOH (Chapter 246-272 WAC) also provides guidelines for *Minimum Horizontal Separations* for on-site sewage systems. WAC 246-272 lists a minimum horizontal separation distance of 100 feet from the edge of the disposal component and reserve area to marine and fresh surface waters. WAC 246-272 also states "*Where any condition indicates a greater potential for contamination or pollution, the local health officer or the department may increase the minimum horizontal separations. Examples of such conditions include excessively permeable soils, unconfined aquifers, shallow or saturated soil, dug wells or improperly abandoned wells.*" The DOH also requires a horizontal separation of at least 200 feet between a surface water source of drinking water and a septic drainfield (WAC 246-272). Therefore, for the purposes of the ranking matrix, it was assumed that a 200-foot horizontal separation between surface water and septic drainfields is a conservative distance regarding the potential survival of pathogens in ground water. A map showing the distances to surface water bodies and their ranking is shown on Figure 5.

Proximity to Surface Water Ranking

Proximity to Surface Water	<200 feet	>200 feet
Rank	10	1

9.4 Depth to Ground Water

The depth to ground water is an indicator of the vertical time of travel for drainfield effluent to reach the water table. The DOH requires a minimum separation distance of 3 feet from the base of septic drainfields to ground water. Assuming that the base of the typical drainfield is located at a depth of approximately 2 feet results in a minimum separation of approximately 5 feet between ground water and the ground surface. This minimum separation is considered to be adequate to remove most pathogens from the septic effluent prior to reaching the water table for properly designed and maintained septic systems that are sited in suitable soils. Less than adequate soils and poorly designed/maintained systems decrease the ability of the unsaturated soils located beneath the drainfield to adequately treat the percolating effluent.

For the purposes of this analysis, the depth to ground water in the study area was estimated from domestic water well logs, geologic mapping, site reconnaissance, mapped surface water features, and available water level monitoring data available from the County and other state and local agencies. It should be noted that the water wells described on the domestic water well logs were not field located. Therefore, their locations should be considered approximate, which contributes to the uncertainty of the information source.

In portions of the study area that are underlain by relatively permeable soil with no obvious low-permeability zones that may perch ground water, the depth to ground water was obtained from available domestic water well reports, mapped surface water features, and available water level monitoring data. It should be noted that the depth to ground water information presented on typical domestic water well reports is generally recorded by the well driller shortly after the well has been installed. Consequently, the depth to water data represents a single spot measurement taken at any given time of the year and does not take into account seasonal variability of ground water levels. Seasonal variability of ground water levels can be as much as 10 feet in some portions of the study area.

We assumed that any reported water level measurement of less than 15 feet (recorded on the water well reports, inferred from nearby surface water features, and/or from water level monitoring data) indicates that the ground water level has the potential to be close to the ground surface during some time of the year and has a high potential to violate the DOH criteria of a minimum 3-foot-vertical separation rule between the base of the drainfield and ground water. Therefore, areas where the available information indicates that depths to ground water are 15 feet or less were considered to have a high potential to impact water quality. Areas where the depth to water is reported to be between 15 and 30 feet were considered to have a moderate potential to impact water quality, and water level depths greater than 30 feet were considered to have a low impact potential.

As discussed previously in this report, glacial till is a very dense, complex mixture of sand, gravel, silt, and clay that was deposited at the base of the continental ice sheet as it advanced over the study area roughly 13,000 to 18,000 years ago. Glacial till has a low permeability and tends to impede the vertical migration of infiltrated precipitation. Therefore, shallow perched (water table) aquifers tend to develop on the top of the till surface. For the purposes of this analysis, we have assumed that areas that are mapped at the ground surface as glacial till or have what appears to be locally extensive, low-permeability layers (silt and clay) located within the upper 15 feet of the soil column (as identified through water well reports) have a high potential to develop shallow perched aquifers during portions of the year. These areas of perched ground water have a high potential to violate the DOH criteria of a minimum 3-foot-vertical separation rule between the base of the drainfield and ground water. Therefore, areas which are underlain by glacial till at the ground surface or have identified low-permeability zones in the upper 15 feet of the soil column will be considered to have a high potential to impact water quality. A map showing the depth to ground water zones and associated ranking is shown on Figure 6.

Depth to Ground Water Ranking

Depth to Ground Water	≤ 15 feet[1]	> 15 and ≤ 30 feet	> 30 feet
Rank	10	5	1

[1] Includes areas underlain by glacial till and/or low-permeability zones.

9.5 Slope of Ground Surface

The slope of the land surface is a variable in the USDA/NRCS Sewage Disposal Suitability criteria. The USDA/NRCS states excessive slope may cause lateral seepage and surfacing of sewage effluent in downslope areas. However, moderately sloping land surface facilitates the transport of infiltrated effluent away from the drainfield, thus reducing the potential for a ground water mound to occur under the drainfield. The study area includes areas of relatively steep slopes extending from the upland areas to the coastal areas and within the drainage basins of Mission Creek, Little Mission Creek, and several unnamed drainages. The Washington State DOH WAC 246-272 states on-site sewage system components shall be installed only where the slope of the ground surface is less than 45 percent (24 degrees). For the purposes of the ranking matrix, we used the following ranking values for slope. A map showing the ground surface slope areas and related ranking is shown on Figure 7.

Slope of Ground Surface Ranking

Slope of Ground Surface	>30%	0% to 10%	11% to 29%
Rank	10	5	1

10.0 SEWER SERVICE AREA DELINEATION

The conceptual hydrogeologic model and ranking matrix were used conjunctively to delineate areas that have a probable, a possible, and/or an unlikely chance for septic effluent (specifically fecal coliform bacteria) to degrade water quality in Lynch Cove and Hood Canal. For the purposes of this analysis, we have assumed the following general definitions for the rankings:

Probable: Likely to occur.
Possible: Has a chance to occur.
Unlikely: Insignificant chance to occur.

The delineated areas are based on matrix ranking scores for the five primary physical characteristics discussed in the previous sections of this report. The ranking matrix scores were developed in the following manner:

- The study area was overlain with a systematic grid that consisted of 691 relatively evenly spaced node points. This resulted in a node point occurring approximately every 400 feet in the study area.

- The grid was placed over the figures that display the primary physical characteristics of the study area.

- A ranking score for each physical characteristic was noted at each node point and totaled for a final score.

- Areas with total ranking scores equal to or greater than 36 were considered to be areas that have a probable chance of impacting Lynch Cove. A score of 36 or greater indicated that the area received a maximum score of 10 points on at least three of the five primary physical characteristics and a moderate score of 5 points on at least one of the remaining two physical characteristics.

- Areas with scores from 27 to 35 points were considered to have a possible chance to impact the water quality of Lynch Cove. A score in this range indicates that the area has received a maximum score on at least two of the physical characteristics and a moderate score on at least one of the remaining characteristics.

- Areas with scores of less than 27 points were considered to have an unlikely or insignificant chance to impact the water quality in Lynch Cove.

- The total scores at each node point were then overlain on the study area to delineate general boundaries between the probable, possible, and unlikely potential impact areas. The boundary lines between the node points were based on the surrounding ranking scores and the conceptual hydrogeologic model of the study area.

A map of the study area showing the probable, possible, and unlikely impact areas is presented as Figure 8. The following is a brief description of each area.

10.1 Probable Potential Impact Areas

The areas with a probable potential to contribute viable fecal coliform bacteria to Lynch Cove included most of the developed coastal lowland areas, areas located immediately adjacent to streams, and areas with small lot sizes. The combination of poor soils, shallow ground water, small lot size, and/or steep slopes/proximity to surface water resulted in these areas having a high probability to impact water quality in Lynch Cove and/or Hood Canal with viable fecal coliform bacteria.

10.2 Possible Potential Impact Areas

The areas identified with a possible chance to contribute fecal coliform bacteria to Lynch Cove were identified as a majority of the steep slope areas which extend from the coastal lowlands to the till-mantled uplands, including portions of the stream channels and small lot size areas (Figure 8). Areas with moderate to steep slopes could allow surface seepage and runoff from failing septic systems to surface waters via overland flow. Surface water flowing toward Lynch Cove located near failing septic systems could carry fecal coliform bacteria in drainfield effluent that is flowing overland. Areas of small lot size underlain by soils classified as limited for septic suitability and moderate depths to ground water have been identified as having a possible potential to impact Lynch Cove and/or Hood Canal with viable fecal coliform bacteria.

10.3 Unlikely Potential Impact Areas

The areas identified with an unlikely or insignificant potential to contribute fecal coliform bacteria to Lynch Cove are generally the glacial till-mantled uplands that are located away from the stream channels and have generally large lot sizes (Figure 8). The soils in the uplands are predominantly Alderbrook series, which are shown to be limited for septic drainfield construction. Septic systems in the unlikely impact areas are completed in the relatively thin, weathered till soils overlying the low-permeability unweathered till. The low vertical permeability of the till results in a relatively long travel time for fecal coliform bacteria to reach Lynch Cove via ground water recharge. Therefore, the chance for viable fecal coliform to reach Lynch Cove via deep ground water is considered unlikely or insignificant in these areas.

11.0 LIMITATIONS

We have prepared this report for MSA and the County to assist in the delineation of a sewer service area near the community of Belfair in Washington State. The conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. Our conclusions and recommendations are based on review of available geologic, hydrogeologic, soils, and water quality information, and observations of exposed site conditions. If additional information becomes available that was not reviewed for this study, that information should be made available to AESI for review.

The scope of work did not include environmental assessments or evaluations regarding the presence or absence of hazardous substances in the soil, surface water, or ground water at this site.

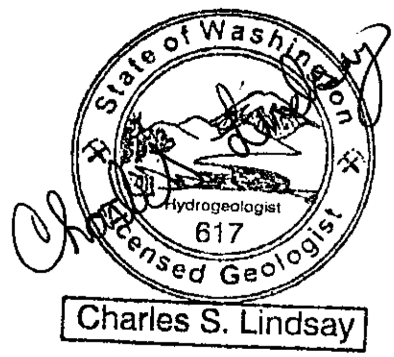
Within the limitations of scope, schedule, and budget, AESI attempted to execute these services in accordance with generally accepted professional principles in the fields of geology and hydrogeology at the time this report was prepared. No warranty, express or implied, is made.

We have enjoyed working with you on this study and are confident that these conclusions will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Everett, Washington

David J. Baumgarten, P.G., P.Hg.
Project Hydrogeologist

Charles S. Lindsay, P.G., P.E.G., P.Hg.
Principal Geologist/Hydrogeologist



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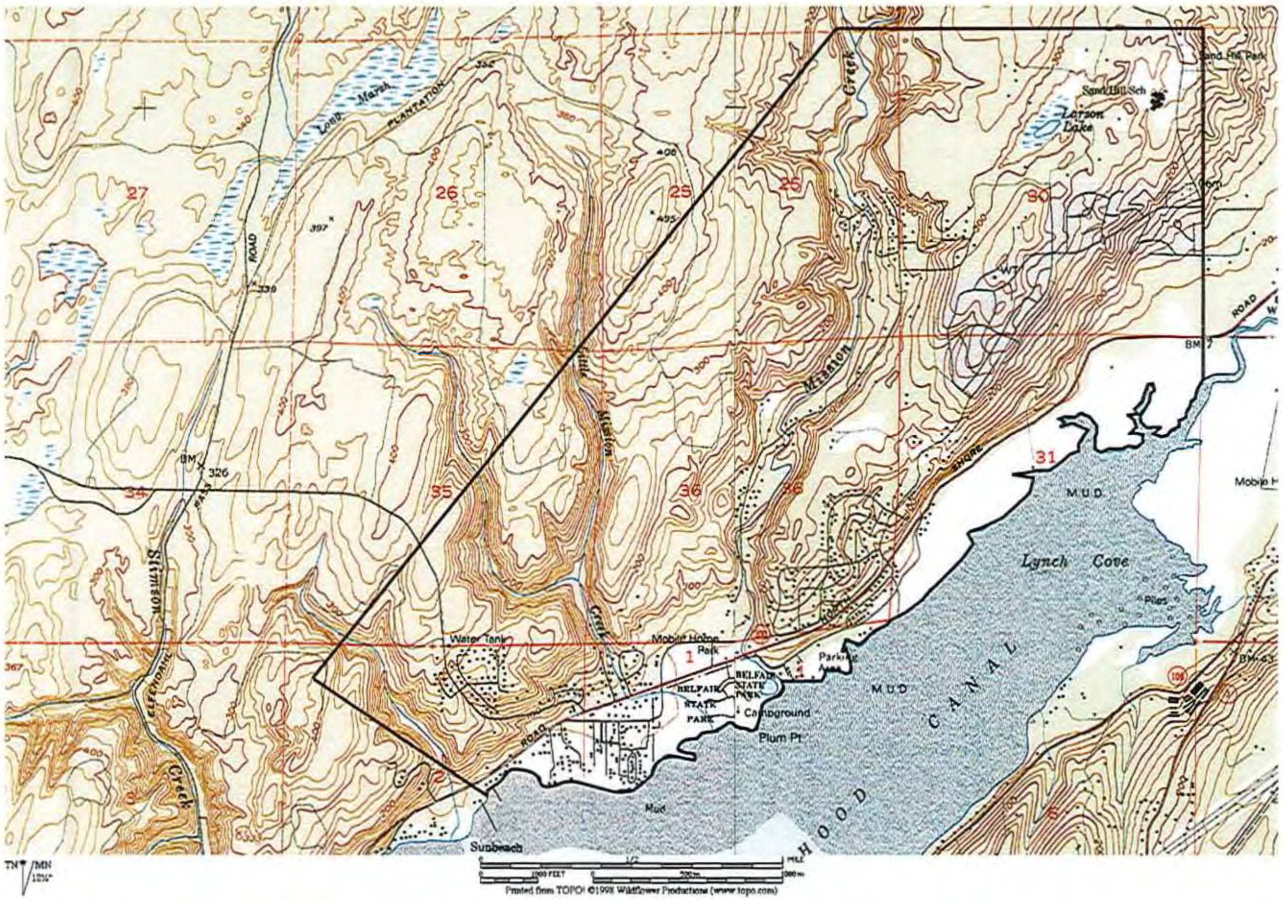
WAC 246-272, On-site sewage systems.

Washington State Department of Health, June 2003, Groundwater sources under direct influence of surface waters (GWI), DOH PUB #331-216.

Ward, W., Butkus, S., and Ehinger, W., 2001, Union River fecal coliform, total maximum daily load study: Washington State Department of Ecology, Environmental Assessment Program, Publication No. 01-03-038, 24 p.



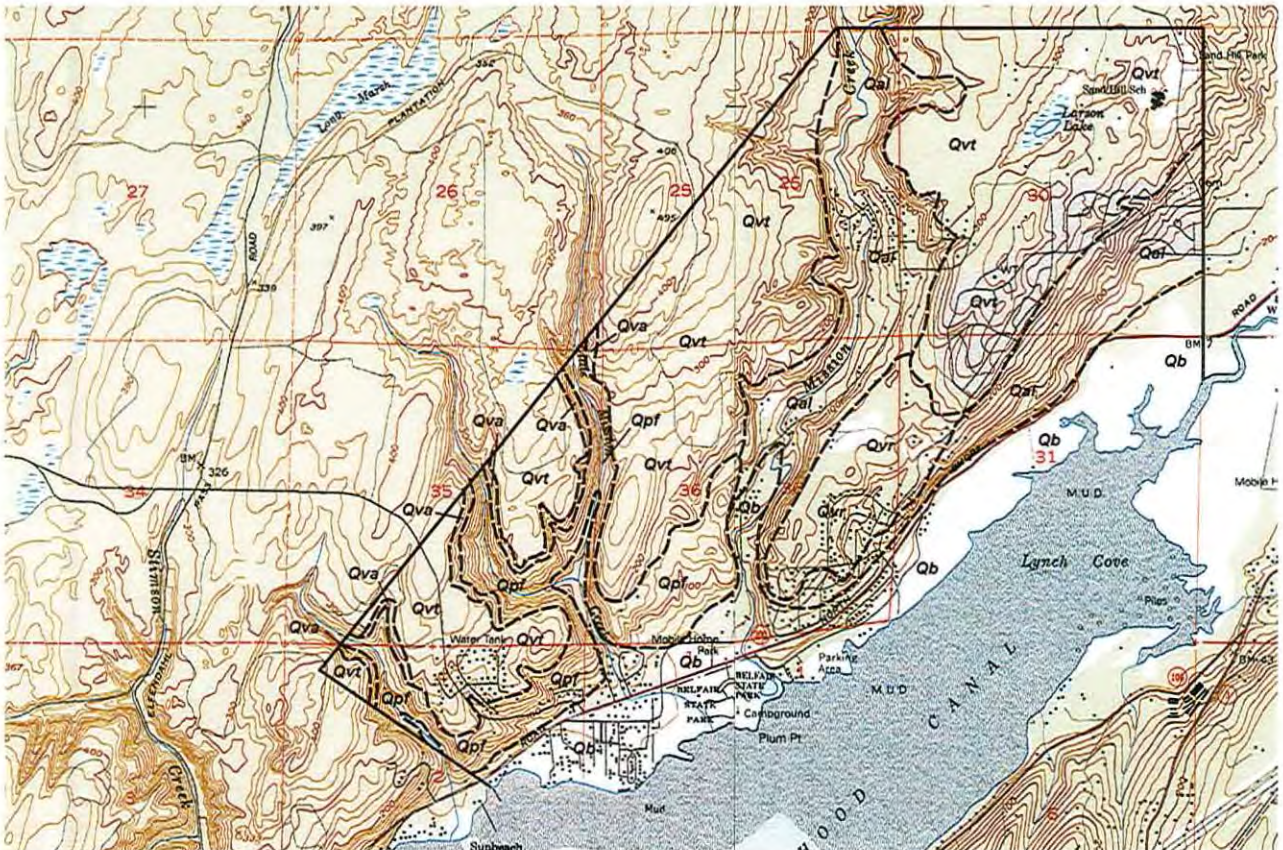
LEGEND

Study area

Associated Earth Sciences, Inc.

STUDY AREA
LYNCH COVE / NORTH SHORE SEWER SERVICE AREA DELINEATION
MASON COUNTY, WASHINGTON

FIGURE 1
DATE 9/05
PROJ. NO. EH04539A



Reference Geologic Maps:

1. Garling, M.E., Molenaar, P., Von Denburgh, A. S., Fiedler, G. H. and Bailey., 1964, water resources and geology of the Kitsap Peninsula and certain adjacent islands: Washington State Department of Conservation Water-Supply Bulletin No. 18, 309p.

2. O'Neal, M., 2005 University of Washington, personal communication.

N

LEGEND

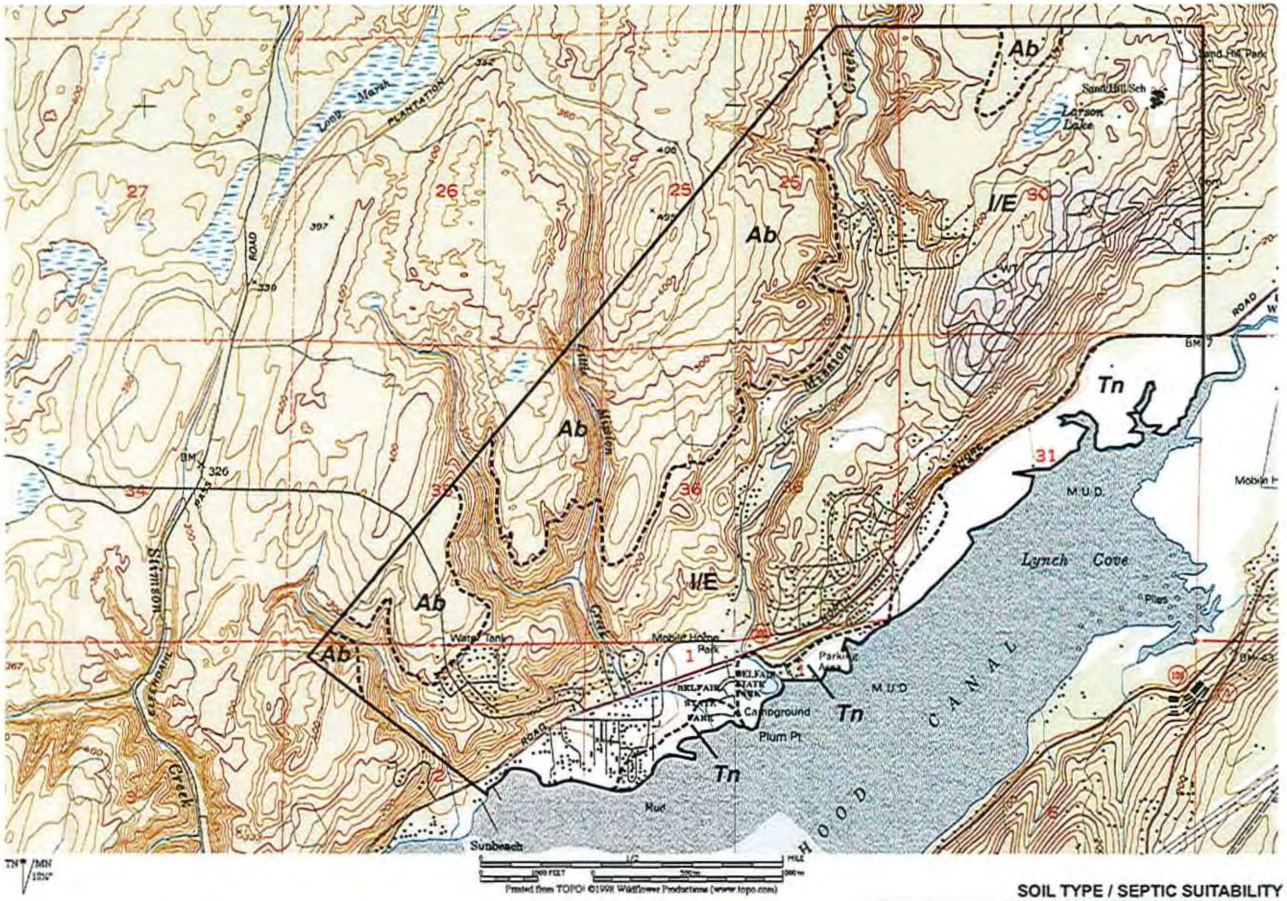
Qb	Holocene Beach Deposits	*Qal*	Alluvium	*Qvt*	Vashon Lodgement Till	*Qpf*	Older Quaternary-Age Sediments
Qf	Holocene Fan Deposits	*Qvr*	Vashon Recessional Outwash	*Qva*	Vashon Advance Outwash		

Associated Earth Sciences, Inc.

GEOLOGIC MAP
LYNCH COVE / NORTH SHORE SEWER SERVICE AREA DELINEATION
MASON COUNTY, WASHINGTON

FIGURE 2
DATE 9/05
PROJ. NO. EH04539A

04539 belfair sewer/04539 geology.cdr



Reference:

Soil Conservation Service (SCS), 1960, Soil Survey of Mason County area, Washington: United States Department of Agriculture.

SOIL TYPE / SEPTIC SUITABILITY RANKING

Legend	Soil Type	Septic Suitability	Very Limited	Somewhat Limited	Not Limited
Ab	Alderwood series soils	Very Limited	10	5	1
I/E	Indianola/Everett series soils	Very Limited	10	5	1
Tn	Tidal marsh soils	Very Limited	10	5	1

Associated Earth Sciences, Inc.

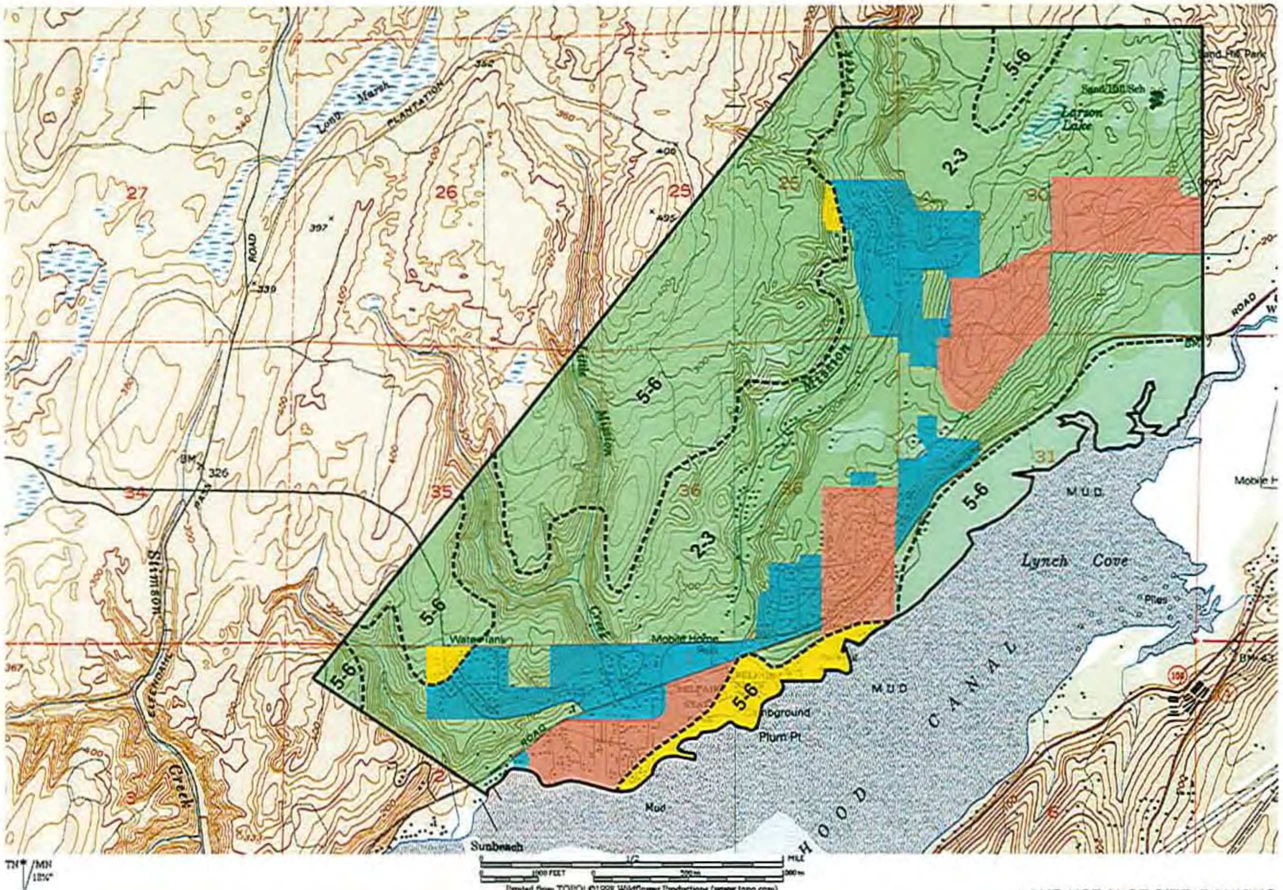
SOILS MAP

LYNCH COVE / NORTH SHORE SEWER SERVICE AREA DELINEATION
MASON COUNTY, WASHINGTON

FIGURE 3

DATE 9/05

PROJ. NO. EH04539A



N

LEGEND

------- Soil Type Boundary

Reference:

Mason County Assessor Maps

LAND USE / LOT SIZE RANKING

Lot Size	<12,500 ft²	<20,000 ft²	≥12,500 ft² < 1 Acre	≥20,000 ft² < 1 Acre	≥ 1 Acre
Soil Type "2-3"	10		5		1
Soil Type "5-6"		10		5	1

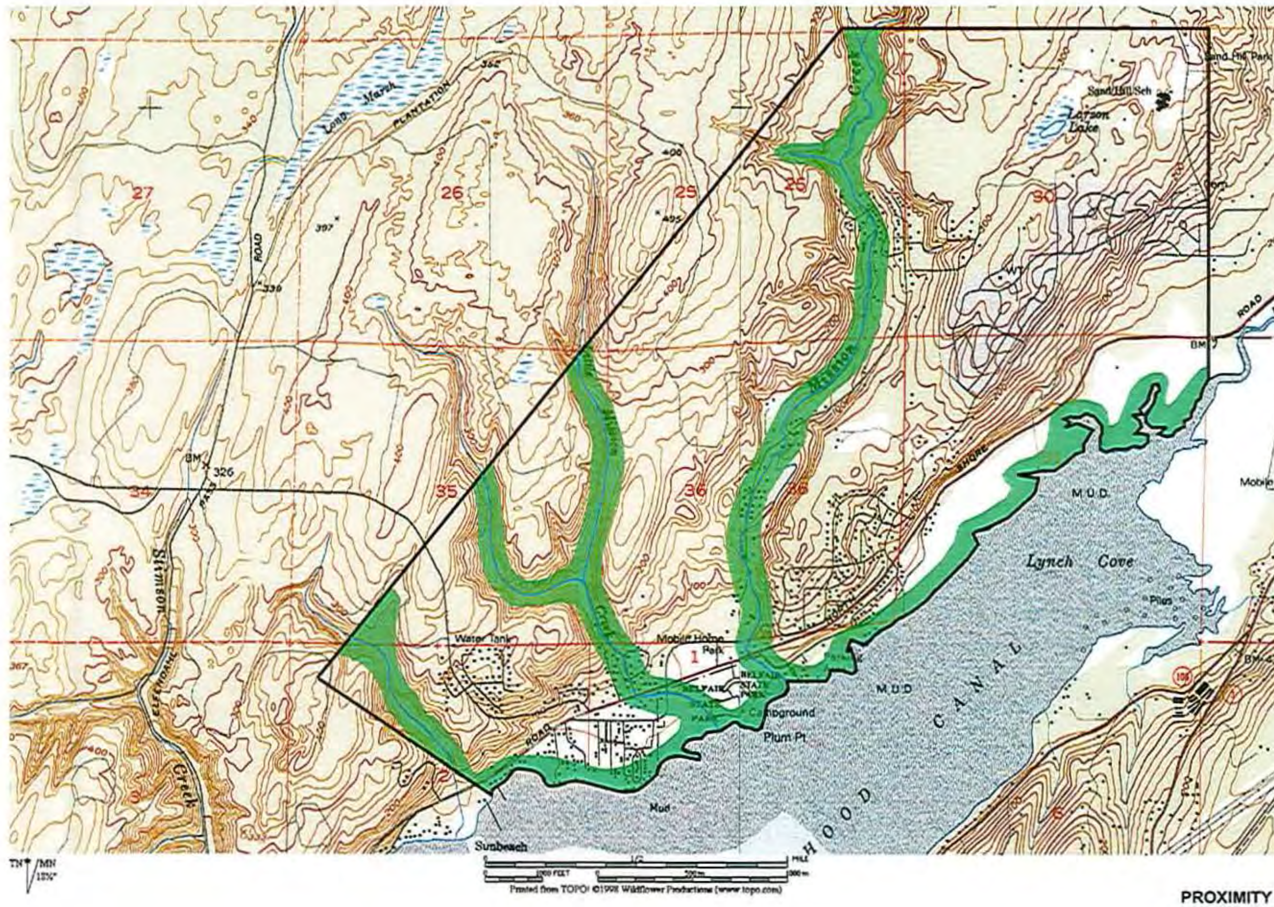
Associated Earth Sciences, Inc.

LAND USE / LOT SIZE
LYNCH COVE / NORTH SHORE SEWER SERVICE AREA DELINEATION
MASON COUNTY, WASHINGTON

FIGURE 4

DATE 9/05

PROJ. NO. EH04539A



N

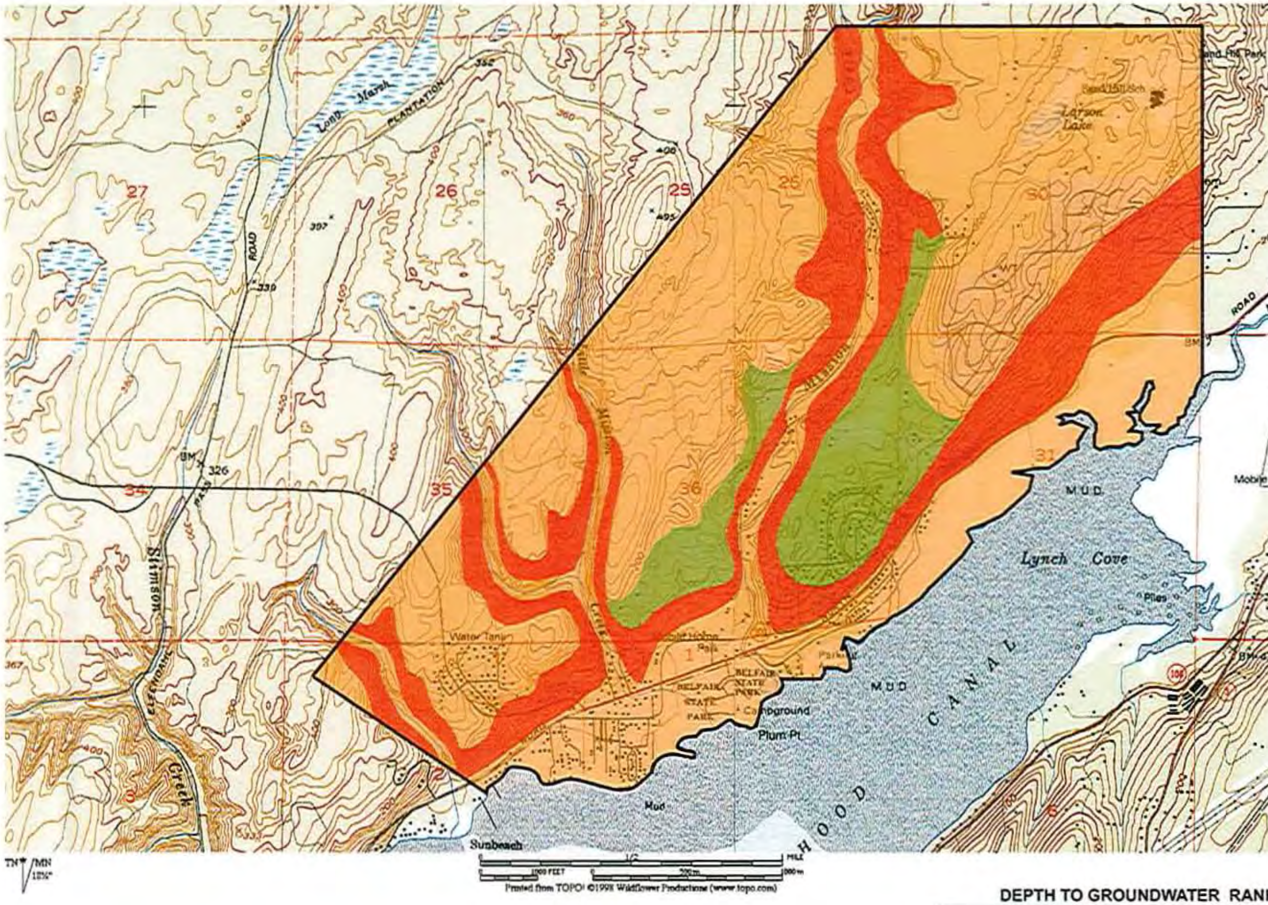
PROXIMITY TO SURFACE WATER RANKING

Proximity	< 200 ft	> 200 ft
Ranking	10	1

Associated Earth Sciences, Inc.

PROXIMITY TO SURFACE WATER
LYNCH COVE / NORTH SHORE SEWER SERVICE AREA DELINEATION
MASON COUNTY, WASHINGTON

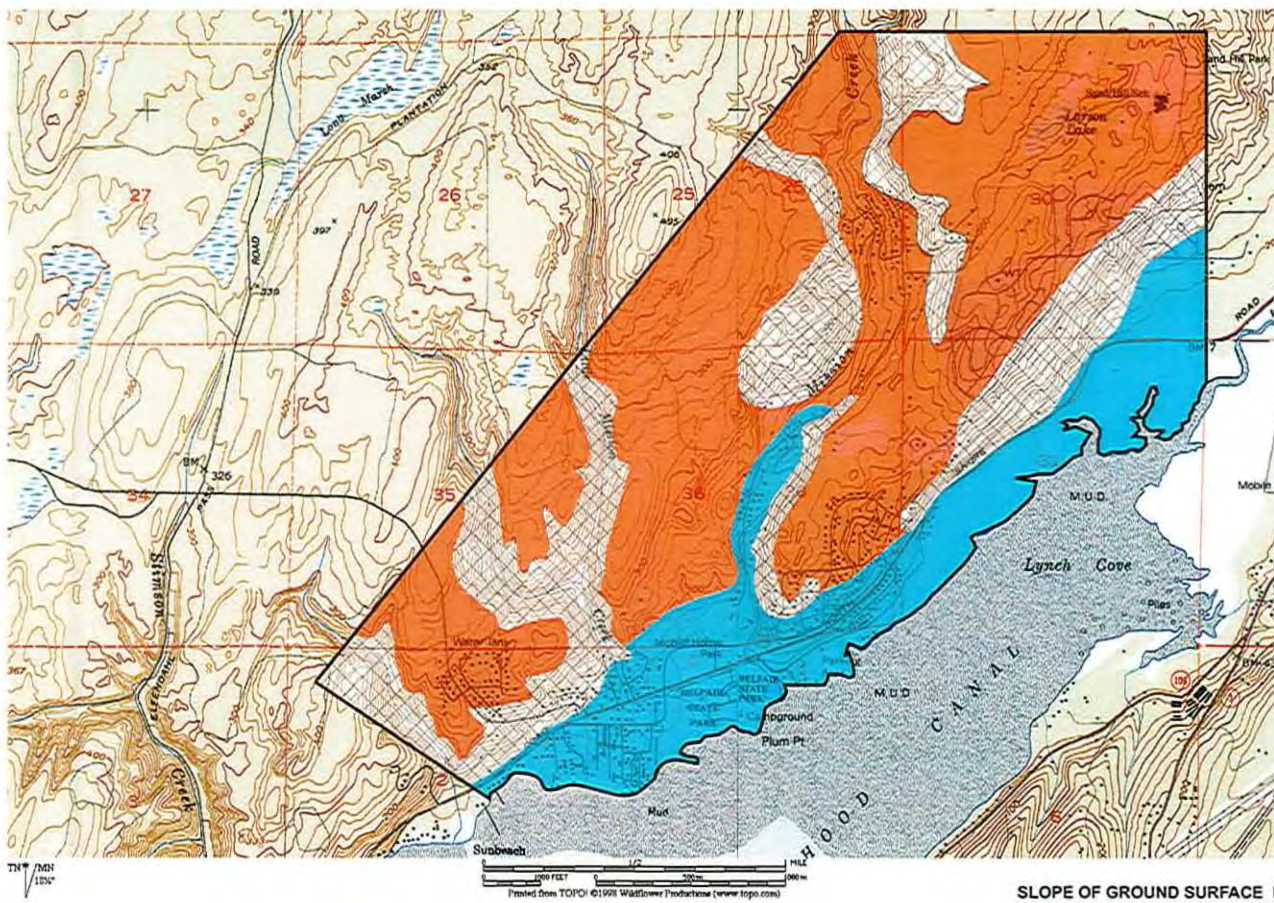
FIGURE 5
DATE 9/05
PROJ. NO. EH04539A



DEPTH TO GROUNDWATER RANKING

Depth	≤15 ft [1]	<15 ≤ 30 ft	>30 ft
Rank	10	5	1

[1] Includes areas underlain by till and/or low permeability geologic units.



Reference:

1. USGS Lake Wooten Quadrangle, 1953, photo revised 1968.
2. USGS Belfair Quadrangle, 1983, photo revised 1968.

N

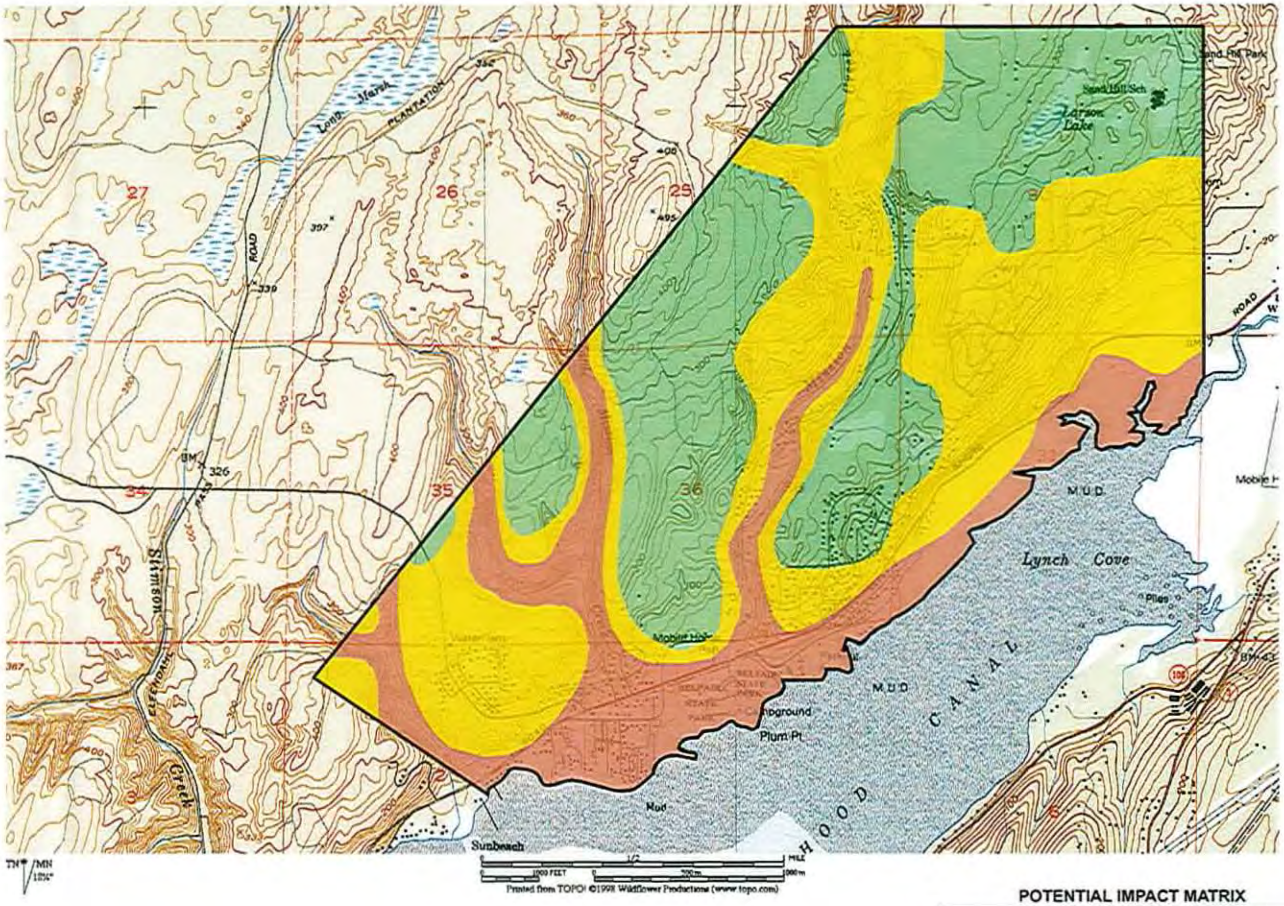
SLOPE OF GROUND SURFACE RANKING

Slope	> 30%	0-10%	11-29%
Ranking	10	5	1

Associated Earth Sciences, Inc.

SLOPE OF GROUND SURFACE
LYNCH COVE / NORTH SHORE SEWER SERVICE AREA DELINEATION
MASON COUNTY, WASHINGTON

FIGURE 7
DATE 9/05
PROJ. NO. EH04539A



POTENTIAL IMPACT MATRIX

Potential Impact	Unlikely	Possible	Probable
Matrix Score	< 27	27 to 35	≥ 36

Associated Earth Sciences, Inc.

POTENTIAL IMPACT MAP
BELFAIR SEWER
BELFAIR, WASHINGTON

FIGURE 8
DATE 9/05
PROJ. NO. EH04539A

APPENDIX A

Washington State Department of Health Letter

STATE OF WASHINGTON
DEPARTMENT OF HEALTH
1112 SE Quince Street • PO Box 47890
Olympia, Washington 98504-7890
Tel: (360) 236-4010 • FAX (360) 586-7424
TDD Relay Service: 1-800-833-6388

March 6, 2002

Stephen Kutz, RN, MPH
Director of Health Services
Mason County Department of Health Services
Post Office Box 1666
Shelton, Washington 98584

Steve
Dear Mr. Kutz:

In conjunction with the Department of Ecology, the Department of Health has reviewed your submitted documentation of problems in the in the Lynch Cove area of Hood Canal. The Department agrees that conditions noted in the documentation result in a situation which has a significant potential to cause illness, and therefore declares these conditions create a severe public health hazard. This conclusion is based upon:

- On-site sewage systems at 54 of the 102 homes evaluated were either failing or suspect.
- The high ground water, soils poorly suited for on-site sewage technology, fill, antiquated systems design, and small lot sizes make on-site sewage systems impractical or unworkable in this area.
- Runoff from failed systems flows over the ground or through saturated subsurface flow into Hood Canal. This pattern has caused the bay to be unfit for human recreation and has resulted in the closure of this part of Hood Canal for shellfish harvest.
- This problem involves a serviceable area of Hood Canal in Mason County.
- The problems described cannot be corrected through more efficient operation and maintenance of the existing on-site systems. Many of these are old, and all of them are on small lots with limited depth of suitable soil.

As noted in the Department of Ecology's program guidelines for Water Quality Program Funding, a copy of this letter must be submitted with an application for financial assistance during the application period of a funding cycle. If you have any questions about the guidelines, please contact Brian Howard, Department of Ecology, at (360) 407-6510.

The submittal by you and your staff clearly identifies the extent of the problem and presents realistic short-term and long-term methods for mitigating the existing situation. If you have any further questions, please contact Selden Hall, DOH Office of Environmental Health and Safety, at (360) 236-3043 or via email at selden.hall@doh.wa.gov.

Sincerely,

Mary C. Selecky

Mary C. Selecky
Secretary

cc: Brian Howard
Selden Hall

APPENDIX B

Public Participation

OPEN HOUSE
JUNE 8, 2005
SAND HILL ELEMENTARY

On June 8, 2005, an Open House was held at Sand Hill Elementary School to inform the public of a sewer service delineation study conducted in the Lynch Cove/North Shore region of the Lower Hood Canal. Mailers notifying the public of the Open House were sent to landowners in the study area. An address list was complied using tax lot information provided by the Mason County Assessor's Office. In total, 1454 notices were mailed, of this total 141 were returned equating to a 9.7% return rate. The following attached documents include topics presented at the open house through the use of presentation boards and handouts. Additionally, copies of the comment sheet provided at the Open House and the press release are included.

NEWS RELEASE
May 24, 2005

MASON COUNTY COMMISSIONERS
411 NORTH 5TH ST
SHELTON, WA 98584
(360) 427-9670 EXT. 419

TO: KMAS, KRXY, SHELTON-MASON COUNTY JOURNAL, THE OLYMPIAN, SHELTON CHAMBER OF COMMERCE, NORTH MASON CHAMBER OF COMMERCE, CITY OF SHELTON, ECONOMIC DEVELOPMENT COUNCIL, THE SUN

RE: Open House for the Lynch Cove/North Shore Potential Sewer Service Area

Mason County will host an open house on Wednesday, June 8 to inform residents about and solicit public input on a Delineation Study that will assist the County in defining the limits of a potential sewer service area in the Lynch Cove and North Shore areas of Lower Hood Canal.

On March 6, 2002, poor water quality conditions lead to the State of Washington Department of Health declaring a severe public health hazard in the Lynch Cove area of the Lower Hood Canal. The poor water quality conditions have been attributed to on-site sewage systems in the area.

The purpose of the Delineation Study is to identify areas in the Lynch Cove/North Shore area that are, or have the potential to, contribute to the water quality conditions that have resulted in the declaration of a severe public health hazard. Areas that are identified as having potential to contribute to the poor water quality conditions may be included in a sewer service area that would be part of the initial or future phases of the proposed Belfair Sewer System.

The open house will take place from 6:00 p.m. to 8:00 p.m. at the Sand Hill Elementary School, 791 NE Sand Hill Road, Belfair. The event will be informal. Participants can drop in any time during the open house and stay as long as they like. Those who attend will be able to talk directly with County officials and members of the consulting team the County has hired to conduct the study.

If you have questions about the scope of the ongoing Delineation Study, please contact Doug Micheau, Director of Parks, Utilities, and Waste Management at (360) 427-9670 extension 270.

BOARD OF MASON COUNTY COMMISSIONERS

Jayni L. Kamin Chairperson	Lynda Ring Erickson Commissioner	Tim Sheldon Commissioner

LYNCH COVE/NORTH SHORE
SEWER SERVICE AREA DELINEATION STUDY

Open House – June 8, 2005

PROJECT OVERVIEW

On March 6, 2002 the State of Washington Department of Health concurred with the Mason County Department of Health Services that the conditions in the Lynch Cove area of Hood Canal result in a situation which has significant potential to cause illness and declared these conditions create a severe public health hazard. These conditions which have lead to the declaration are attributed to on-site sewage systems based upon:

- On-site sewage systems at 54 of the 102 homes evaluated in the area were failing or suspect.
- The high groundwater, soils poorly suited for on-site technology, systems constructed on fill, antiquated system design, and small lot sizes make on-site sewage systems impractical or unworkable.
- The presence of fecal coliform in excess of water quality standards in Union River and tributaries and in Hood Canal. Portions of Lower Hood Canal have been prohibited for shellfish harvest since 1987 due to high levels of fecal coliform pollution.

The Belfair/Lower Hood Canal Water Reclamation Facility Plan, amended December 2003, identifies sewer service to the Belfair State Park and shoreline areas to address the public health hazard. However, the Facility Plan did not define the area where on-site sewage systems may be contributing to the conditions that created the severe public health hazard.

In order for the Mason County Department of Utilities and Waste Management to properly evaluate sewer service to this portion of the Lower Hood Canal, consideration must be given to the extent of the area that is contributing, or has the potential to contribute, to the conditions that have lead to the declaration of the severe public health hazard. Defining the contributing areas will assist the County in the planning of current and future sewer services for this portion of Lower Hood Canal.

The Lynch Cove/North Shore Sewer Service Area Delineation Study will identify an area outside the Belfair Urban Growth Area (UGA) where on-site sewage systems are contributing, or have the potential to contribute, to the current water quality problem. The Study will validate the need to provide a sanitary sewer system within this area in order to mitigate the current situation and protect basic public health as well as the environment.

FREQUENTLY ASKED QUESTIONS

What areas could be served by the sewer system?
The Delineation Study area includes the shoreline and upland areas between the Union River and Stimson Creek (west of Belfair-Tahuya Road). The Study will help the County determine what portions of this study area should be included in a sewer service area.

How much will it cost and who would pay?
The cost of the sewer system will be dependent on the size of the service area. Cost estimates for installing sewers in the Lynch Cove/North Shore area range from $5 million to $15 million, depending on the service area size. A number of funding sources are being pursued as part of the Belfair Sewer project. The County is targeting a funding level of at least 60% of the project from outside funding sources. The remaining project cost will be funded by low interest loans that will be repaid through connection fees and monthly sewer rates.

When will a sewer system be built?
A number of factors come into play with respect to the timing of sewer improvements in the Lynch Cove/North Shore Area. The Belfair Sewer System Improvements are scheduled to be completed in 3 to 4 years. It is possible that sewer service to portions of the Lynch Cove/North Shore area will be included in the Belfair project, other areas may be included in future phases of work.

Why should I hook-up to a sewer when my on-site system appears to be working fine?
The data has shown that even if your existing on-site system appears to be operating properly, with no signs of system failure, soil conditions and/or high groundwater may be preventing adequate treatment within the disposal area before it leaves the site and thus potentially contributing to the poor water quality conditions.

Are there alternatives available other than a sewer system?
Yes. Advances in on-site sewer system technology have developed systems that may be applicable to some areas, depending on site conditions. In addition, small satellite systems can be developed to serve small clusters of homes. These engineered systems may be a viable alternative; but in areas of moderate density, their cost may be prohibitive when compared to the cost of a sewer system.

Will a sewer system promote development?
No. The Study area is located outside the Belfair UGA. The installation of sewers, an urban service, in this rural area can only be permitted when it is shown to be necessary to protect basic public health and safety and the environment and <u>does not</u> permit urban development. Development will be limited to existing lots and current zoning limitations.

Mason County
Department of Utilities and Waste Management
410 N. 4th Street
Shelton, Washington 98584
(360) 427-9670

Declaration of Severe Public Health Hazard

- Issued by Washington State Department of Health, March 6, 2002

- Conditions that contributed to the Declaration:

  - On-site sewage systems at 54 of 102 homes evaluated had failing or suspect septic systems

  - High groundwater limiting vertical separation of drainfield and water table

  - Soils poorly suited for on-site sewage system technology

  - Antiquated (aging) system designs

  - Small lot sizes making on-site sewage systems impractical or unworkable

Project Purpose

To identify areas in the Lynch Cove/North Shore area of Lower Hood Canal that are contributing, or have the potential to contribute, to the water quality conditions that have resulted in the declaration of severe public health hazard by the Washington State Department of Health.

Project Participants

Mason County Department of Utilities & Waste Management
Mason County Department of Health Services
Washington State Department of Health
Washington State Department of Ecology
Murray, Smith & Associates, Inc.
Associated Earth Sciences, Inc.

MSA

Evaluation Criteria

The following site conditions will be evaluated to define areas where on-site sewage systems may be contributing to poor water quality conditions.

- **Soil Type** – Suitability of soil to accommodate on-site sewage system
- **Housing Density/Lot Size** – "Minimum land area requirements" for on-site sewage systems based on current design standards
- **Proximity to Surface Water** – Distance of on-site sewage systems to surface water bodies
- **Depth to Ground Water** – Vertical separation between drainfield and the local water table
- **Slope of Ground Surface** – Impact of the slope of the ground surface on system performance

Next Steps

- Complete draft Delineation Study
- Present draft Study to County
- Public open house to convey findings of draft Study
- Finalize Delineation Study with County and public input
- Amend the current Belfair/Lower Hood Canal Water Reclamation Facility Plan to incorporate the findings of the Delineation Study
- Implement the amended Belfair/Lower Hood Canal Water Reclamation Facility Plan – proceed with the design and construction of the Belfair Sewer Improvements

MSA

LYNCH COVE/NORTH SHORE
SEWER SERVICE AREA DELINEATION STUDY

Open House – June 8, 2005

COMMENT SHEET

Your comments regarding the Delineation Study and topics discussed tonight are welcomed and appreciated. Comments not turned in by the end of the Open House can be mailed to the following address:

Murray, Smith & Associates, Inc.
Attention: Tom Perry
2707 Colby Avenue
Suite 1118
Everett, WA 98201

Comments can also be emailed to Tom Perry at perryt@msa-ep.com. Thank you for your participation in this evening's Open House.

Comments: ______________________________

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____
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Name: ______________________________

Address: ______________________________

Telephone #: ______________________________

E-mail: ______________________________

PUBLIC MEETING
SEPTEMBER 26, 2005
SAND HILL ELEMENTARY

On September 26, 2005, a Public Meeting was held at Sand Hill Elementary School to present and discuss the completed sewer service delineation study conducted in the Lynch Cove/North Shore region of the Lower Hood Canal. Mailers notifying residents of the Public Meeting were sent to landowners in the study area. The address list used for the June 8, 2005 Open House was modified to include participants that were not notified by mail, and to omit addresses of returned mailers. A total of 1328 notices were mailed with 21 being returned equating to a return rate of 1.6%. The following documents include the press release, public notification mailer, slideshow presentation and comment sheet. Attendees of the meeting were mailed copies of the slideshow presentation for reference material.

NEWS RELEASE
September 13, 2005

MASON COUNTY COMMISSIONERS
411 NORTH 5TH ST
SHELTON, WA 98584
(360) 427-9670 EXT. 419

TO: KMAS, KRXY, SHELTON-MASON COUNTY JOURNAL, THE OLYMPIAN, SHELTON CHAMBER OF COMMERCE, NORTH MASON CHAMBER OF COMMERCE, CITY OF SHELTON, ECONOMIC DEVELOPMENT COUNCIL, THE SUN

RE: Public Meeting for the Lynch Cove/North Shore Potential Sewer Service Area

Mason County will host a public meeting on Monday, September 26 to present the findings of the Lynch Cove/North Shore Sewer Service Area Delineation Study.

Last June, Mason County hosted an open house to inform residents about and solicit public input on the Delineation Study that was being conducted to assist the County in defining the limits of a potential sewer service area in the Lynch Cove and North Shore areas of Lower Hood Canal. The Delineation Study is complete and will be presented and discussed at the public meeting.

The purpose of the Delineation Study is to identify areas in the Lynch Cove/North Shore area that are, or have the potential to, contribute to the water quality conditions that have resulted in the declaration of a severe public health hazard. Poor water quality conditions, attributed to on-site sewage systems in the area, lead to the State of Washington Department of Health (DOH) declaring a severe public health hazard in the Lynch Cove area of the Lower Hood Canal in March of 2002.

The Delineation Study will be used by Mason County to define a potential sewer service area, in which homes may be served by a public sewer system in the initial or future phases of the proposed Belfair Sewer System project.

The public meeting will begin at 6:30 p.m. at the Sand Hill Elementary School, 791 NE Sand Hill Road, Belfair and conclude at 8:30 p.m. The public meeting will consist of a formal presentation that will include a brief overview of the Delineation Study, its findings and the next steps in providing sewer service to the Belfair/Lynch Cove/North Shore area, followed by a question and answer period with county officials, staff and consultants.

The Delineation Study can be viewed and obtained on the Mason County web site at www.co.mason.wa.us. If you have questions please contact Doug Micheau, Director of Parks, Utilities, and Waste Management at (360) 427-9670 extension 270, or through the local Belfair number at 275-4467 extension 270.

BOARD OF MASON COUNTY COMMISSIONERS

Jayni L. Kamin Chairperson	Lynda Ring Erickson Commissioner	Tim Sheldon Commissioner

Important Information about Your On-Site Sewage System and Sewer Service in the Lynch Cove/North Shore Area of Lower Hood Canal

RE: Public Meeting for the Lynch Cove/North Shore Potential Sewer Service Area

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This notice was sent to property owners in the Lynch Cove/North Shore area, between Stimson Creek and Union River, and the local media.

LYNCH COVE/NORTH SHORE
SEWER SERVICE AREA DELINEATION STUDY

Public Meeting – September, 26 2005

<u>COMMENT SHEET</u>

Your comments regarding the findings of the Delineation Study presented this evening are welcomed and appreciated. Comments not turned in by the end of the Public Meeting can be mailed to the following address:

Murray, Smith & Associates, Inc.
Attention: Tom Perry
2707 Colby Avenue
Suite 1118
Everett, WA 98201

Comments can also be emailed to Tom Perry at perryt@msa-ep.com. Thank you for your participation in this evening's Public Meeting.

Comments: ______________________________

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Name: ______________________________

Address: ______________________________

Telephone #: ______________________________

E-mail: ______________________________

Lynch Cove/North Shore Sewer Service Area Delineation Study

Public Meeting
September 26, 2005

MSA

MASON COUNTY

Associated Earth Sciences, Inc.

Lynch Cove/North Shore
Sewer Service Area Delineation Study

Public Meeting – September 26, 2005

- **INTRODUCTIONS**
- **AGENDA**
  - 6:30 – 7:00 Presentation
  - 7:00 – 7:45 Questions / Answers
  - 7:45 – 8:30 Public Comments / Input

Background

- Belfair/Lower Hood Canal Water Reclamation Facility Plan – July 2001
  - Reviewed wastewater collection and treatment alternatives for Lower Hood Canal watershed
- Amended Facility Plan – December 2004
  - Recommended sewer service to Belfair State Park area to address Declaration of Severe Public Health Hazard
  - Identified flows being treated at Allyn treatment plant
- Feasibility Study – March 2005
  - Reviewed implementation of Facility Plan
  - Two limitations were discovered
    - Growth projections not current
    - Service area in the Lynch Cove/North Shore area not defined

Declaration of Severe Public Health Hazard

- Issued by Washington State Department of Health, March 6, 2002
- Conditions that contributed to the Declaration:
  - On-site sewage systems at 54 of 102 homes evaluated had failing or suspect septic systems
  - High groundwater limiting vertical separation of drainfield and water table
  - Soils poorly suited for on-site sewage system technology
  - Antiquated (aging) system designs
  - Small lot sizes making on-site sewage systems impractical or unworkable

Delineation Study

To identify areas in the Lynch Cove/North Shore area of Lower Hood Canal that are contributing, or have the potential to contribute, to the water quality conditions that have resulted in the declaration of severe public health hazard by the Washington State Department of Health.

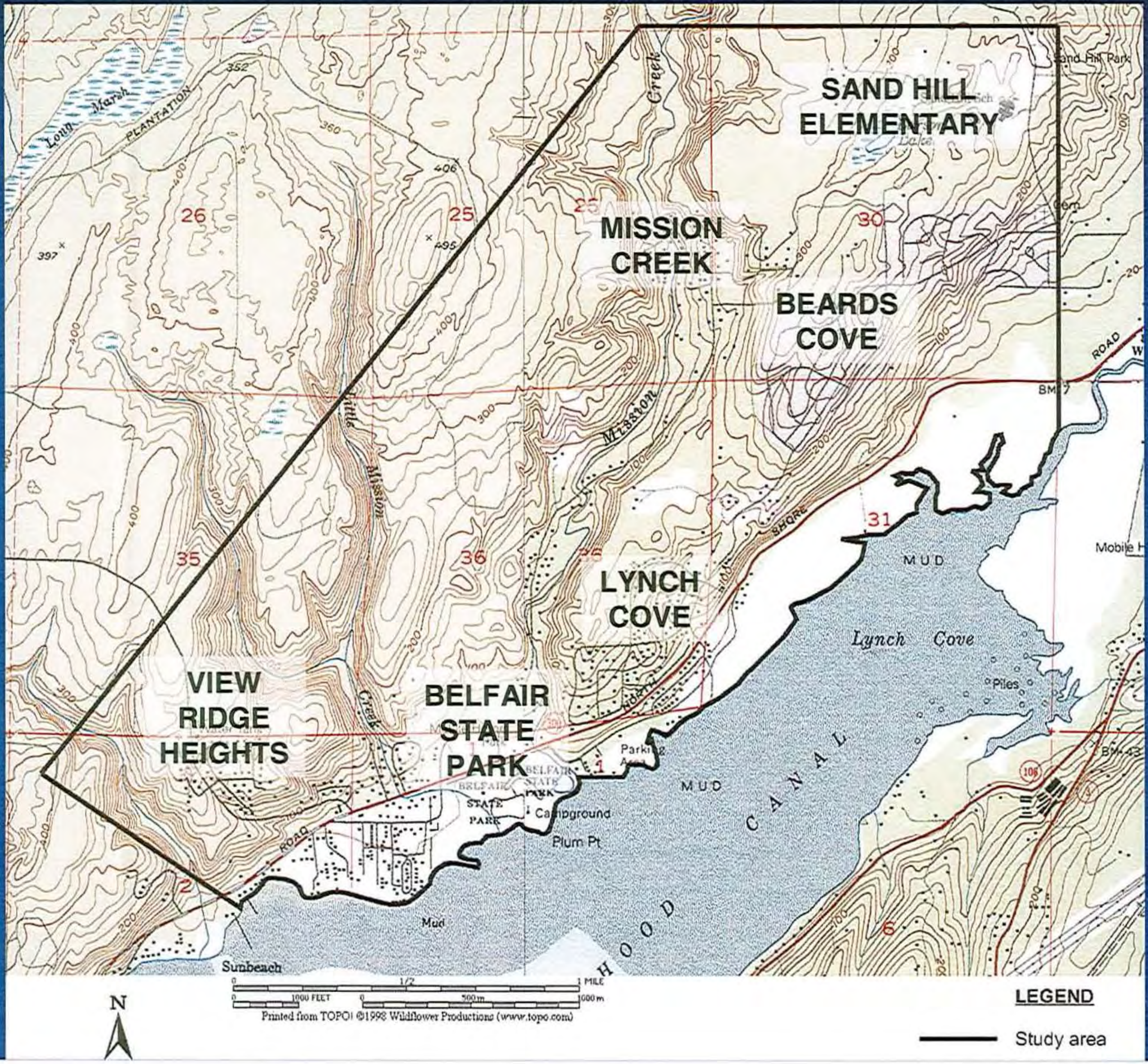
Project Participants

Mason County Department of Utilities & Waste Management
Mason County Department of Health Services
Washington State Department of Health
Washington State Department of Ecology
Murray, Smith & Associates, Inc.
Associated Earth Sciences, Inc.

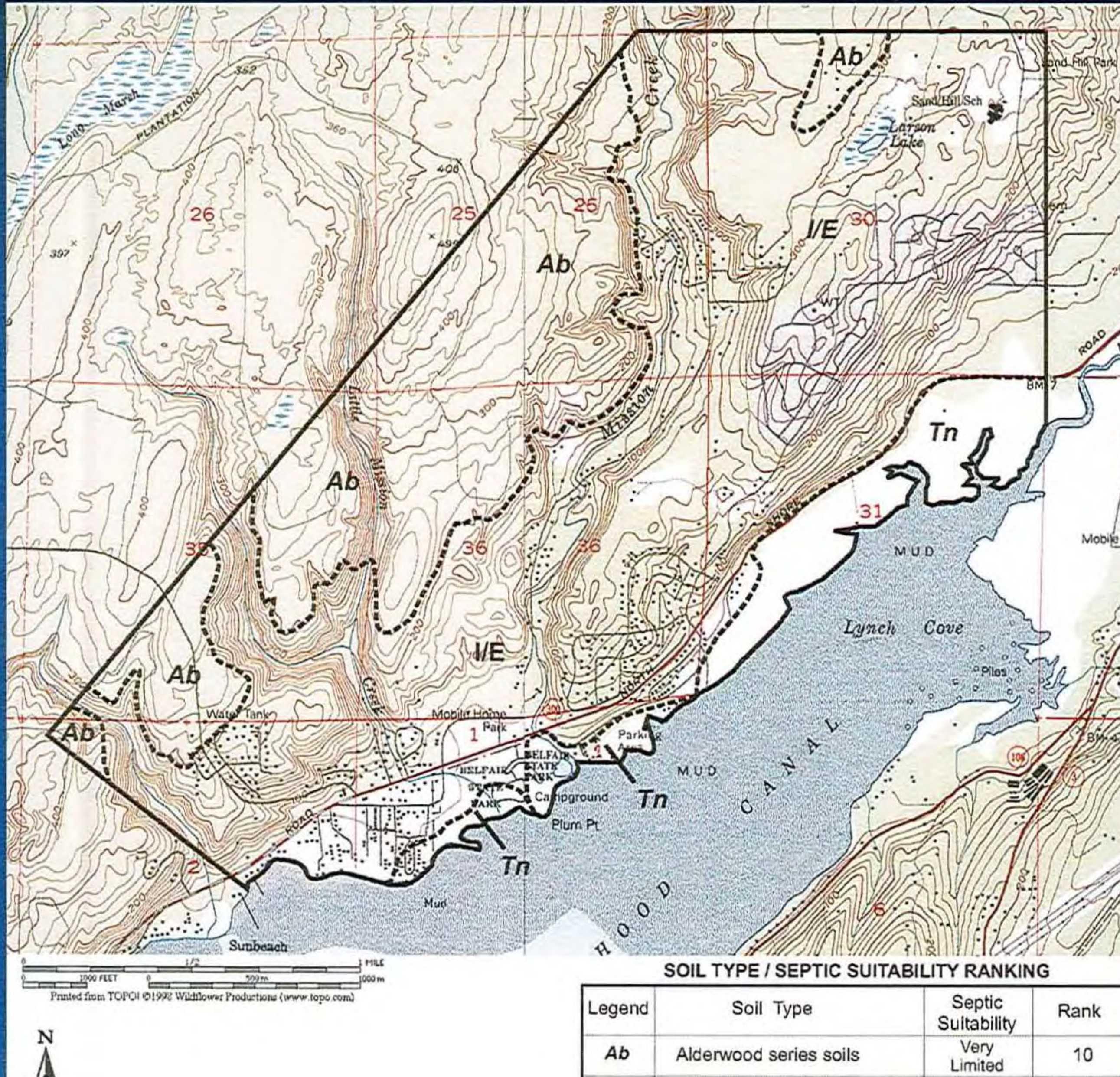
Evaluation Criteria

- **Soil Type** – Suitability of soil to accommodate on-site sewage system
- **Housing Density/Lot Size –** "Minimum land area requirements" for on-site sewage systems based on current design standards
- **Proximity to Surface Water –** Distance of on-site sewage systems to surface water bodies
- **Depth to Ground Water** – Vertical separation between drainfield and the local water table
- **Slope of Ground Surface –** Impact of the slope of the ground surface on system performance

STUDY AREA MAP



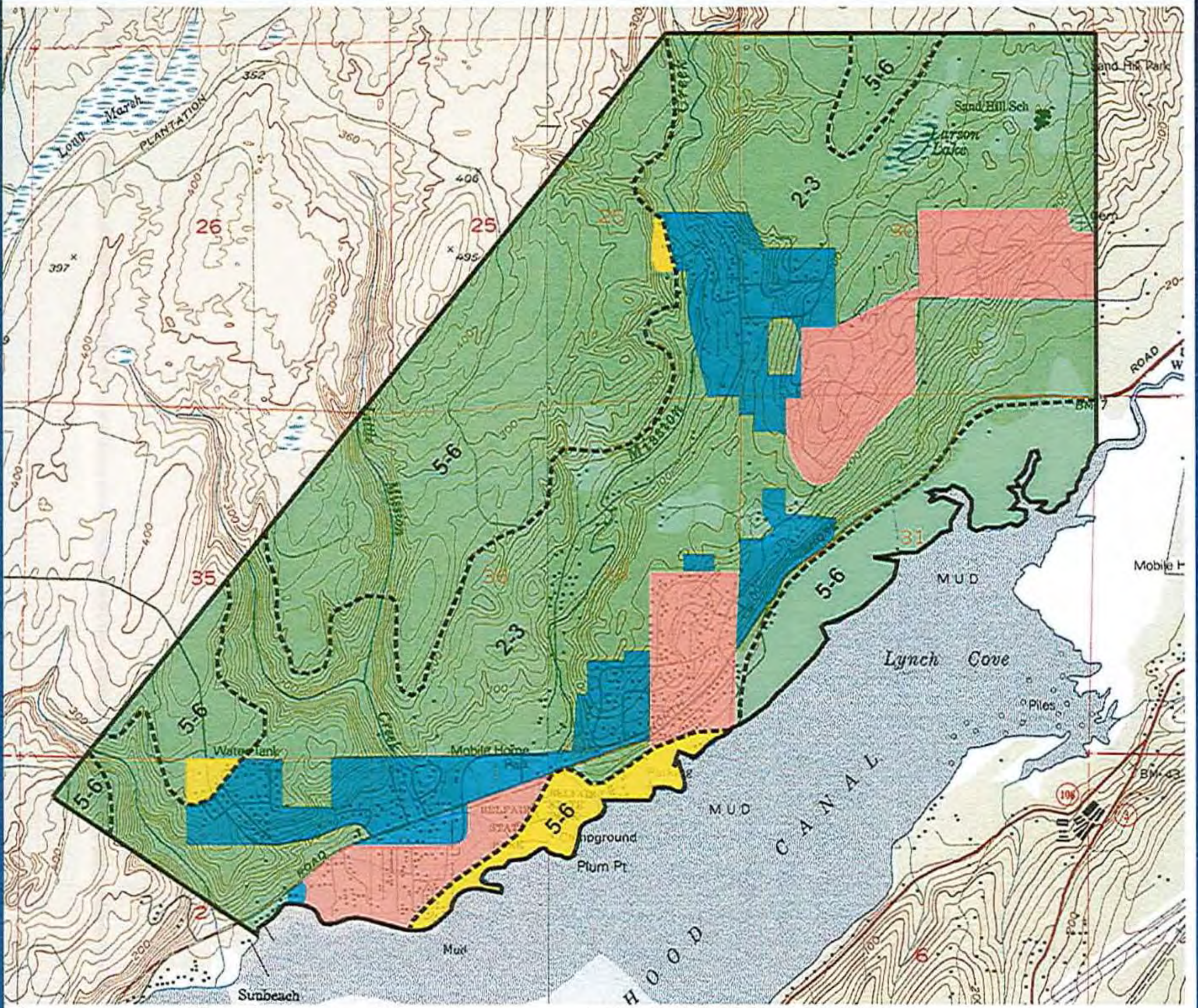
SOIL MAP



SOIL TYPE / SEPTIC SUITABILITY RANKING

Legend	Soil Type	Septic Suitability	Rank
Ab	Alderwood series soils	Very Limited	10
I/E	Indianola/Everett series soils	Very Limited	10
Tn	Tidal marsh soils	Very Limited	10

DENSITY / LOT SIZE MAP



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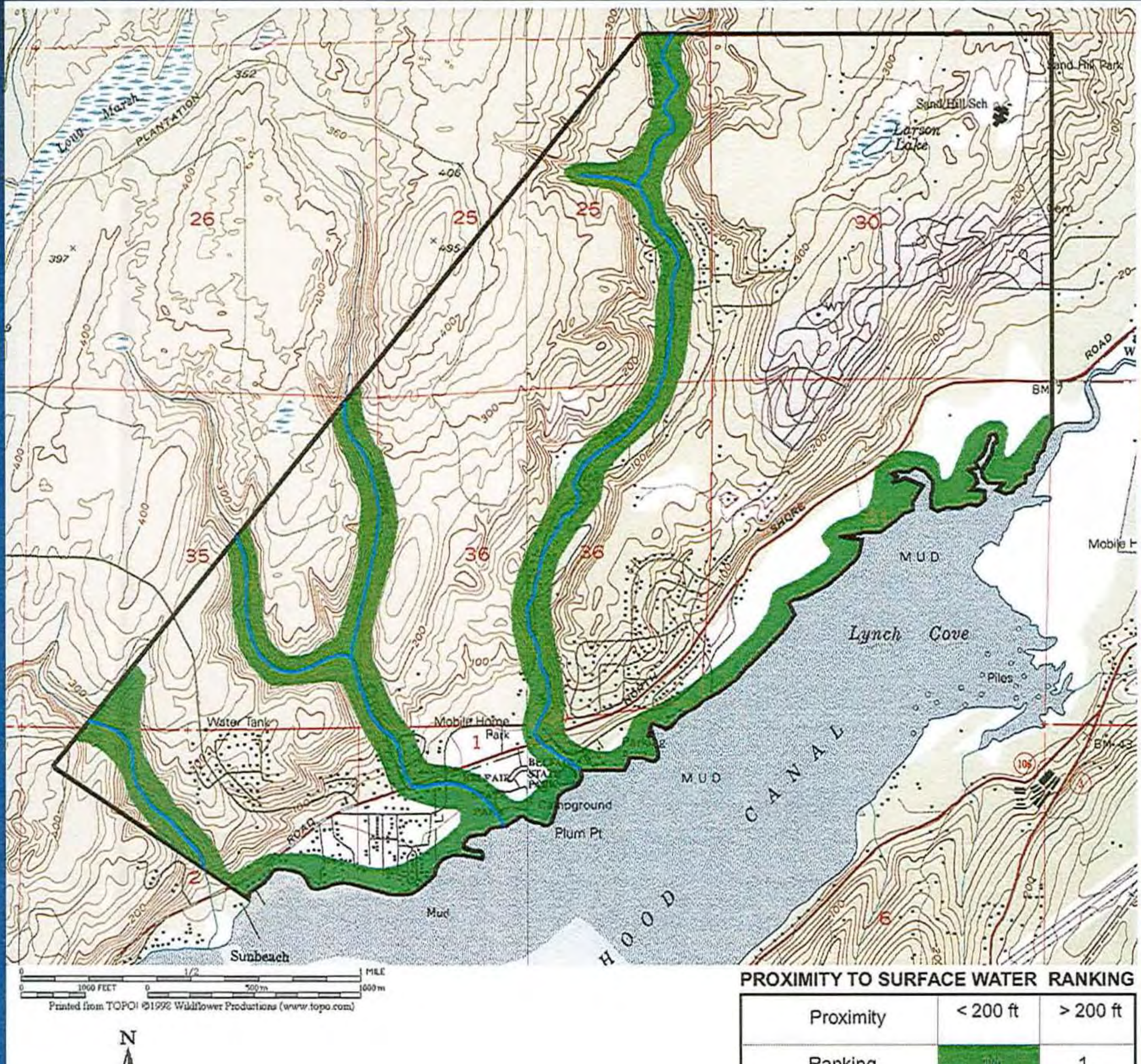
LEGEND

-------- Soil Type Boundary

LAND USE / LOT SIZE RANKING

Lot Size	<12,500 ft²	<20,000 ft²	≥12,500 ft² < 1 Acre	≥20,000 ft² < 1 Acre	≥ 1 Acre
Soil Type "2-3"	10		5		1
Soil Type "5-6"		10		5	1

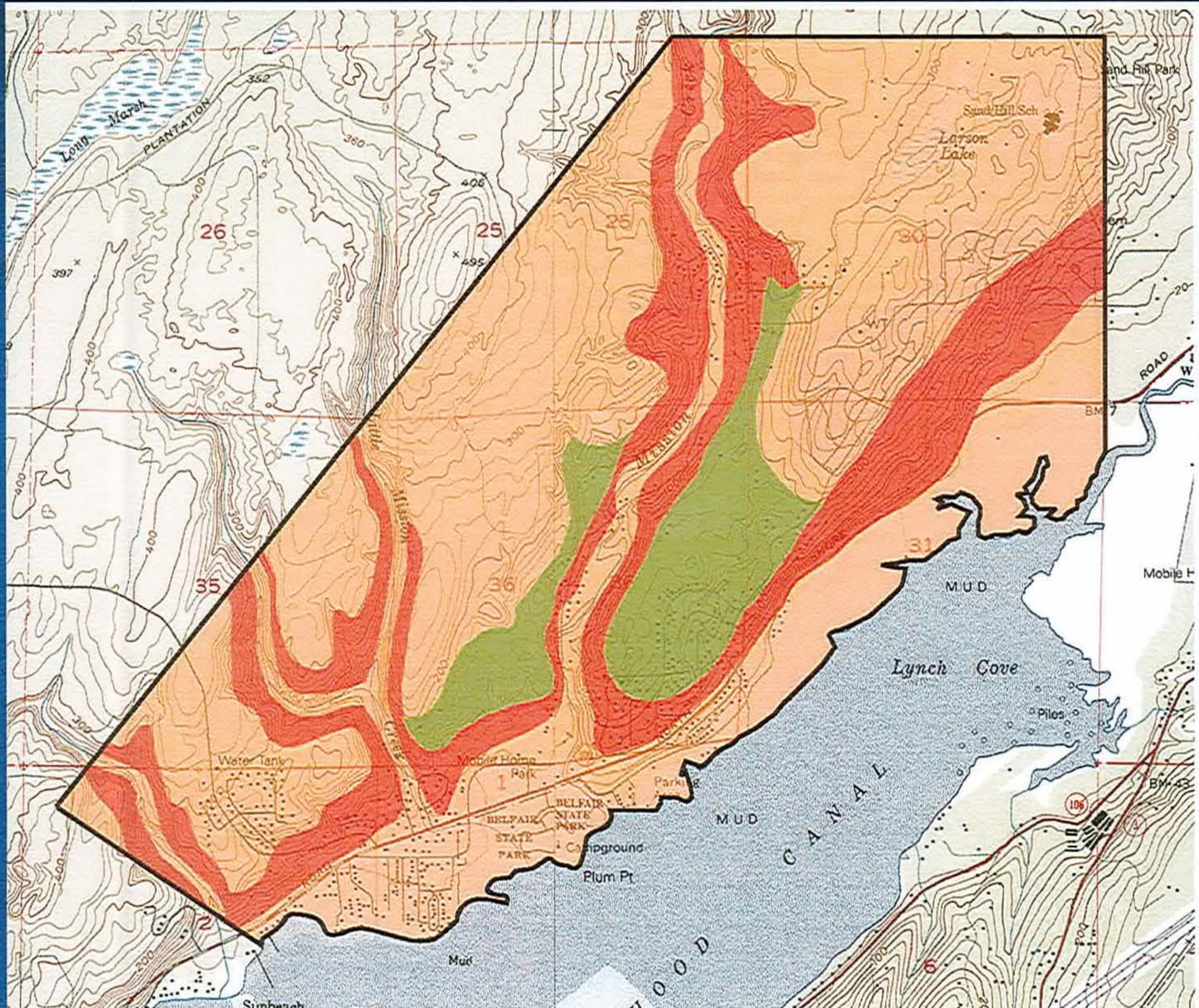
PROXIMITY TO SURFACE WATER MAP

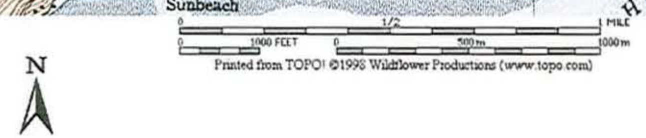


PROXIMITY TO SURFACE WATER RANKING

Proximity	< 200 ft	> 200 ft
Ranking	10	1

DEPTH TO GROUND WATER MAP

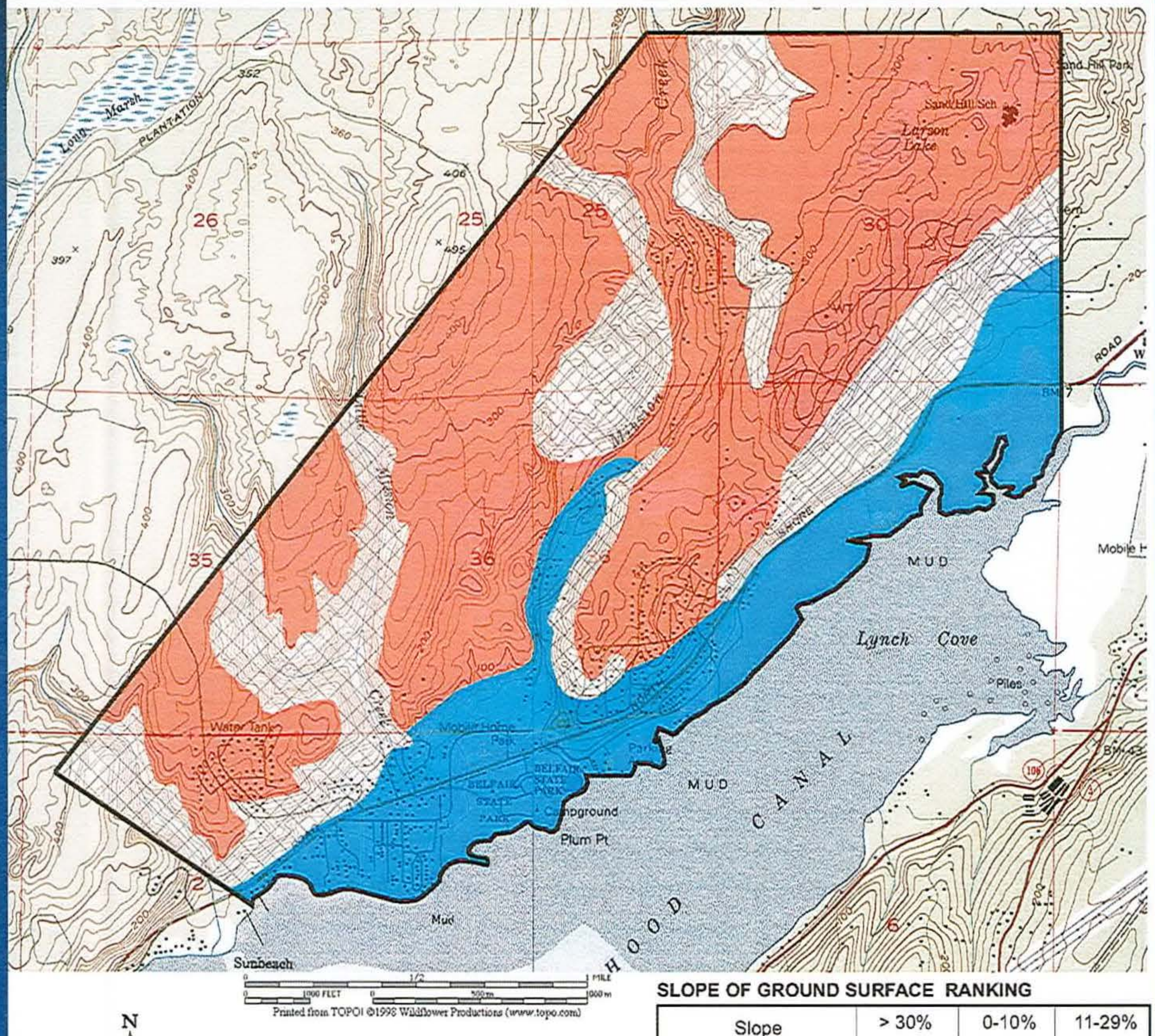




DEPTH TO GROUNDWATER RANKING

Depth	≤15 ft[1]	<15 ≤ 30 ft	>30 ft
Rank	10	5	1

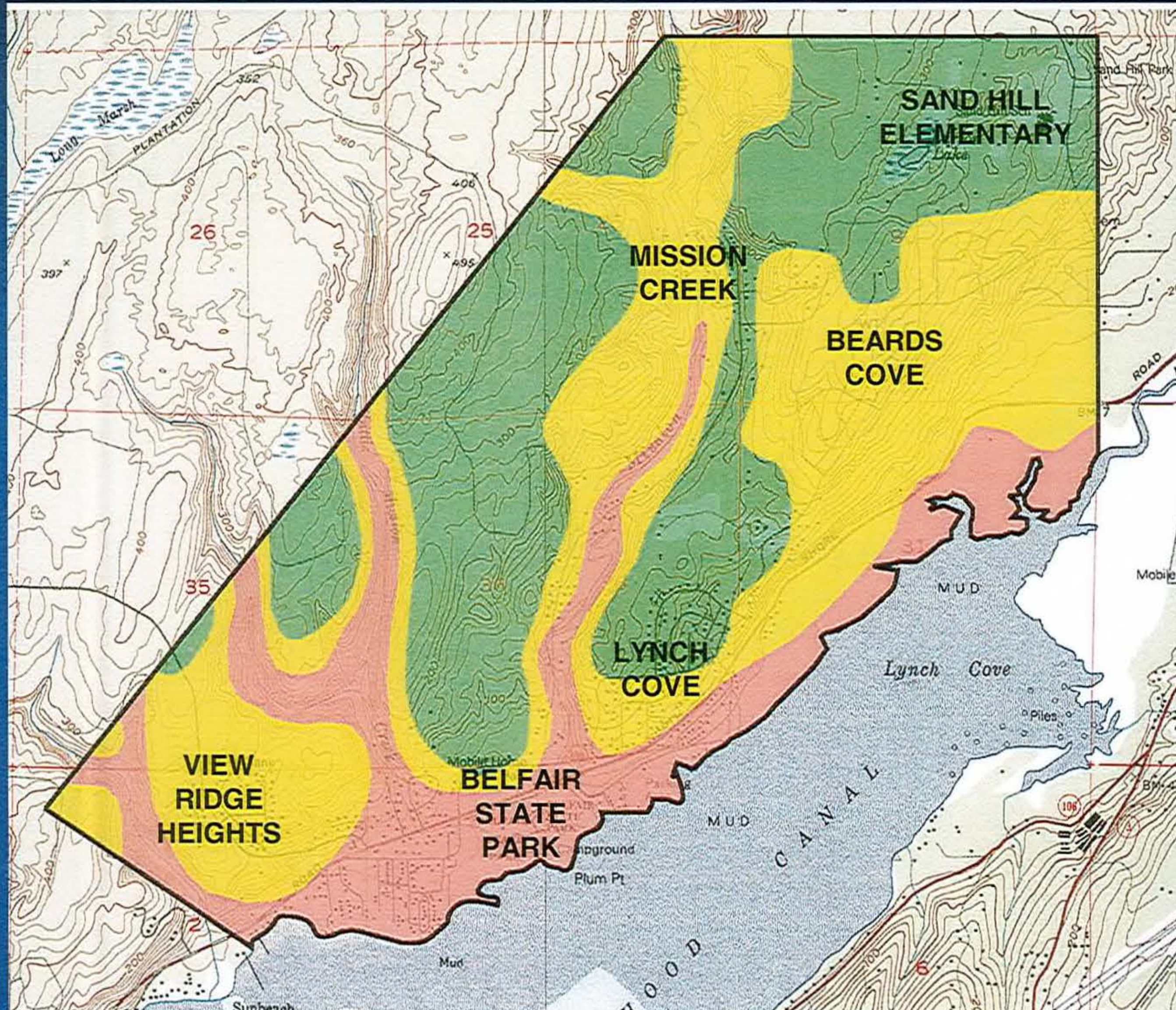
SLOPE OF GROUND SURFACE MAP



SLOPE OF GROUND SURFACE RANKING

Slope	> 30%	0-10%	11-29%
Ranking	10	5	1

POTENTIAL IMPACT MAP



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POTENTIAL IMPACT MATRIX

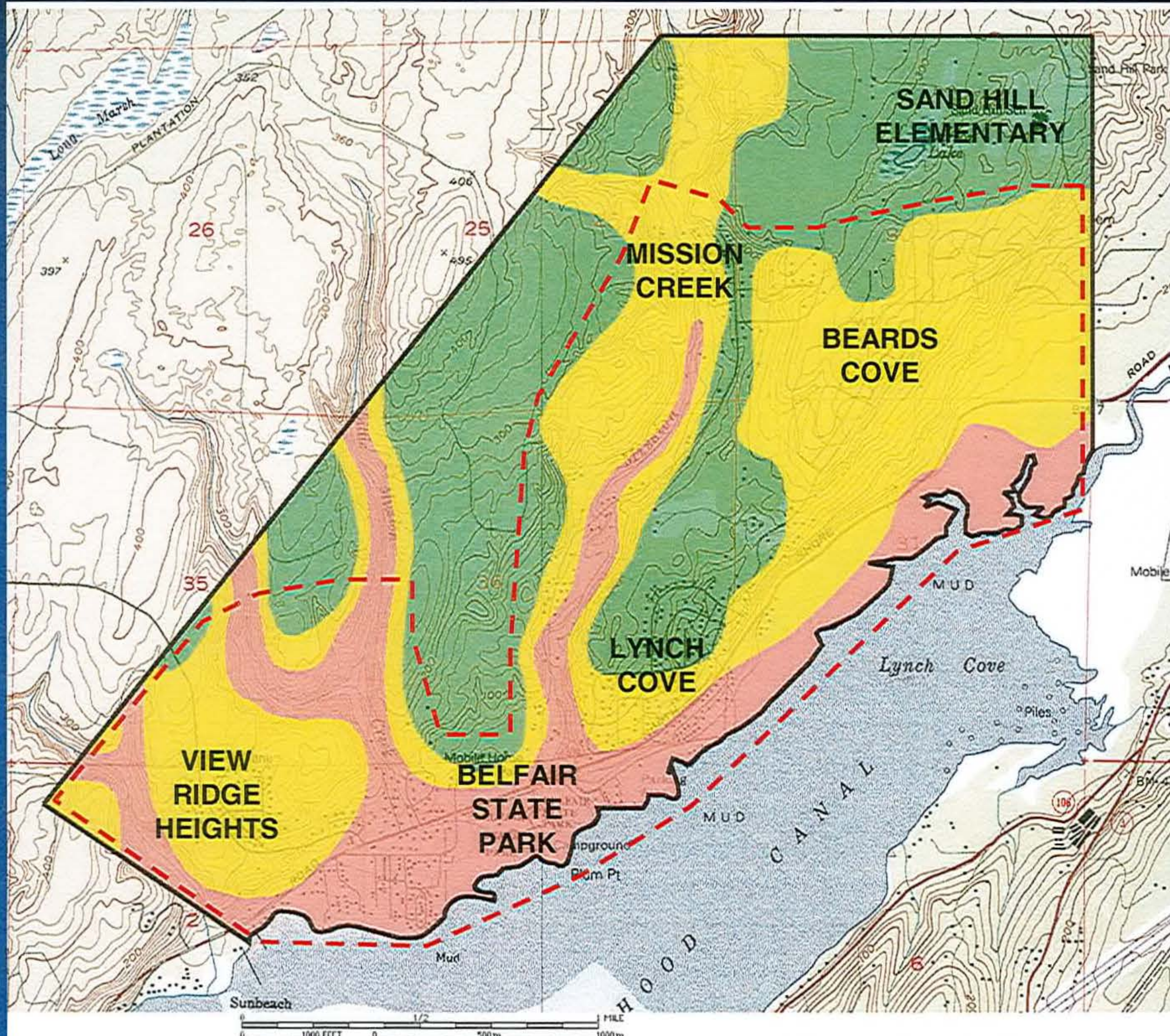
Potential Impact	Unlikely	Possible	Probable
Matrix Score	< 27	27 to 35	≥ 36

Interpretation of Delineation Study Results

Participants

Washington State Department of Health
Washington State Department of Ecology
Mason County Staff
Mason County Commissioners
Consultant Team

POTENTIAL SEWER SERVICE AREA MAP



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POTENTIAL IMPACT MATRIX

Potential Impact	Unlikely	Possible	Probable
Matrix Score	< 27	27 to 35	≥ 36

Next Steps

- Completion of Delineation Study
- Amend the current Belfair/Lower Hood Canal Water Reclamation Facility Plan to incorporate the findings of the Delineation Study
- Implement the amended Belfair/Lower Hood Canal Water Reclamation Facility Plan – proceed with the design and construction of the Belfair Sewer Improvements

Questions and Answers

Your opportunity to ask specific questions about the delineation study.

APPENDIX D

Enhanced Parcel Analysis

Mason County North Shore Area

DRAFT

April, 2006

PREPARED BY:
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206.789.9658

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INTRODUCTION

Adolfson Associates, Inc. (Adolfson) has prepared an Enhanced Environmental Parcel Overlay for the North Shore Area of Mason County, at the request of Art O'Neal and Associates. The purpose of this analysis is to characterize the environmental constraints and benefits associated with four scenarios for wastewater treatment and disposal in the North Shore Area and to characterize potential buildout under each scenario. The study area is shown in the figure attached to this report.

BACKGROUND AND PREVIOUS STUDIES

The North Shore Area of Hood Canal is facing potentially significant constraints associated with current wastewater disposal practices. The Washington State Department of Health (DOH) has determined that water quality conditions in the Lynch Cove/North Shore Area of Hood Canal create a severe public health hazard. DOH has attributed much of this problem to failing septic systems, and has determined that the problems "cannot be corrected through more efficient operation and maintenance of existing on-site systems." Mason County is evaluating the feasibility of providing sewer service to the general area around Lynch Cove/North Shore. Research by the Puget Sound Action Team and others has indicated that nitrogen from on-site septic systems is contributing to nitrogen enrichment in Hood Canal. A number of studies have been undertaken recently to determine an appropriate wastewater management approach for the Hood Canal watershed, but early efforts have focused on reducing inputs from wastewater disposal practices.

This report has been prepared to augment the *Lynch Cove/North Shore Sewer Service Area Delineation* (2005) prepared by Associated Earth Sciences, Inc. (AESI) for Murray Smith and Associates (MSA). This study, referred to subsequently as the Service Area Delineation, focused on characterizing site conditions relative to their suitability for on-site wastewater disposal. The Service Area Delineation uses geologic, hydrogeologic, topographic, and soils data to develop a Potential Impact Matrix, summarized as geographic areas on the attached figure. The matrix has three levels, according to the potential to negatively affect water quality in Lynch Cove:

- Unlikely Potential Impact (Green)
- Possible Potential Impact (Yellow)
- Probable Potential Impact (Red)

Adolfson also reviewed the *Hoodsport-Skokomish Wastewater Management Alternatives Analysis* (Gray and Osborne, 2005). Along with the Service Area Delineation, this document provided much of the background material for this analysis.

PURPOSE OF THIS REPORT

The purpose of this evaluation is to review four potential scenarios for wastewater management, and to characterize the full range of environmental impacts associated with their implementation. These four scenarios are as follows:

1. All buildable parcels would be served by individual on-site systems.

2. All buildable parcels would be served by a centralized sewer system; flows would be collected and transported to a wastewater treatment facility to serve the region.

3. Buildable parcels would be served by a combination of clustered (community) and individual on-site systems.

4. A combination of centralized sewer and on-site systems would be used; sewers would be provided in areas determined to be unsuitable for on-site systems (referred to as the "red zone" in accordance with the designation in the Service Area Delineation) and community or individual on-site systems would be used in areas determined to be potentially suitable. As a subset of this scenario, a combination of centralized treatment, with satellite treatment and disposal, and individual on-site systems could be considered.

These scenarios were evaluated in terms of their potential effectiveness for nitrogen removal for existing and new development, other environmental impacts, operational and maintenance facilities, effects on future development, comparative cost, and policy implications. This evaluation focuses on nitrogen removal, because of the high priority concern about nutrient enrichment in Hood Canal. While conventional on-site systems do not provide effective nitrogen removal, when designed and operated in accordance with applicable standards, they are effective at removing bacteria.

In addition to reviewing environmental impacts associated with the four scenarios, Adolfson characterized potential buildout for each of the four scenarios. A Parcel Analysis by MSA (2006) indicates that almost 85% of the parcels in the North Shore Area are currently developed with 203 buildable vacant parcels remaining in the North Shore area. Adolfson reviewed the available parcels in the context of the Service Area Delineation determinations of suitability for on-site sewage treatment. The results of comparing MSA's parcel analysis with AESI's map are shown in Table 1.

Table 1. Numbers of Parcels within each of AESI's Impact Zones

Parcel Type	Red	Yellow	Green	Total
Developed	286	634	201	1,121
Vacant Buildable	49	112	42	203
Total	335	746	243	1,324

ENVIRONMENTAL CONSIDERATIONS ASSOCIATED WITH WASTEWATER MANAGEMENT SCENARIOS

The scenarios, along with the key environmental considerations, are summarized in the attached matrices. These matrices are intended to illustrate the wastewater treatment and disposal elements that are included within each of the scenarios, and provide additional discussion on some of the components. Following is a discussion of the key findings of environmental considerations associated with the scenarios.

Scenario 1: All buildable parcels served by individual on-site systems.

This scenario assumes that all wastewater management within the North Shore/Lynch Cove area would occur through individual on-site systems. This represents a continuation of the current wastewater management program.

Existing on-site systems in this area have been identified as having a detrimental effect on shallow groundwater and surface waters. The Service Area Delineation identified the use of on-site septic systems in the red zone as having a “probable” likelihood of negatively affecting water quality in Lynch Cove (shown in the attached figure). The parameters of particular concern are nitrogen, because of its potential to enrich nearshore areas and result in oxygen depletion, and fecal coliform bacteria, because its presence indicates potential contamination by human waste. In order for individual on-site systems to continue to be considered for use in the North Shore/Lynch Cove area, additional pollutant removal effectiveness is needed. Properly designed and operated individual on-site systems are effective in removing bacteria, however, they are less effective at nitrogen removal. Our research focused on methods to reduce nitrogen, with the assumption that technologies that effectively removed nitrogen would also provide appropriate removal of bacteria. We reviewed possible approaches associated with this scenario that could reduce environmental impacts to a level that is potentially acceptable; as described below.

Pollutant-removal effectiveness

Conventional, individual septic systems have not been shown to be effective at nitrogen removal. Ranges of total nitrogen in septic tank discharge can range as high as 60 milligrams per liter (mg/L). Many studies cite total nitrogen ranges between 25 mg/L and 60 mg/L. Bacteria concentrations are effectively removed in a well functioning drainfield (Metcalf and Eddy, 2003), however, bacteria removal rates can be negligible in failing systems. Failing systems are those systems that are not functioning properly due to poor soil conditions, excessive hydraulic loading, or other conditions that reduce the treatment capability within the soil column.   Because current information indicates that failing systems are contributing to water quality problems in the Lynch Cove/North Shore area, it appears that continued use of on-site systems as they are currently operated will continue to affect groundwater quality and adjacent surface water bodies. In order for this scenario to be feasible, it will be necessary to improve the performance of existing systems and ensure effective operation of new systems.

Options to improve nitrogen removal. Within the green zone, and within appropriate areas within the yellow zone, conventional on-site systems will remain feasible. Within the red zone, however, additional treatment effectiveness is needed for both existing and future systems. An option for existing failing systems is replacement with alternative systems, where existing lot size and other conditions allow. One option that is often discussed is the use of “reduced discharge” systems such as composting toilets or incineration toilets, which reduce discharge volume by approximately 50%. However, because of the difficulty in retrofitting these systems into existing residences, these reduced discharge systems are likely to be best suited for new construction rather than replacement of existing systems. Other options include replacement of failing systems with alternative treatment systems. These can be generally characterized as:

aerobic treatment systems (including attached growth and suspended growth systems), and systems that provide enhanced filtration through improved media, such as mound systems, sand filters, and other types of filters. The attached matrices summarize the major characteristics of these systems. Each of these systems is appropriate under specific circumstances, and in general, these systems would be most appropriately applied for new construction. However, on a case-by-case basis, these types of systems could be considered for replacement of existing systems. Existing residences with large lots (greater than 1 acre) would have the most flexibility. Small lot sizes, particularly lots less than 1 acre in area, would be constrained in their application. Nitrogen removal achieved by these alternative systems varies, but effluent concentrations as low as 4 to 5 mg/L total nitrogen have been reported in some tests, while most studies report total nitrogen concentrations of 15 to 20 mg/L.

Another option for the continued use of individual on-site systems is to route existing failing systems to either individual or community holding tanks, with implementation of a formalized pumpout system, alarms, and other measures to increase system reliability. Holding tanks are not approved by the Washington Department of Health (DOH) unless they are "for permanent uses limited to controlled, part-time, commercial usage situations, for interim uses limited to handling of emergency situations, or for repairs" (WAC 246-272A-0240). Use of this approach would likely require development of a management utility (such as a division of Mason County or establishment of a new utility) to maintain the holding tanks, ensure alarm systems are working properly, and provide ongoing education. Use of holding tanks, while normally considered an "emergency" approach, could eliminate continued nutrient and bacterial loading within the shoreline area, but would be accompanied by significant operational and maintenance requirements.

Other environmental impacts

Continued use of septic tanks and drainfields would provide recharge to shallow groundwater, including wetlands and streams fed by shallow aquifers. If septic tanks continue to contribute nutrients and bacteria to these systems, eutrophication and public health problems could continue or accelerate. If, however, nutrient loading can be reduced to a level that does not promote eutrophication, impacts would be minimal. Additional study will be needed to determine if the nutrient contributions from on-site systems could be reliably reduced to that level.

Use of holding tanks would result in potential impacts, particularly significantly increased truck traffic for pumpouts. Depending upon the number of holding tanks, from 3 to 10 truck trips per day could be needed for regular pumpouts. There is also the potential for leakage or spillage from the tanks, or overflows if maintenance is not adequate.

Implementation of Scenario 1 would likely continue existing land use practices in the region. On-site systems would allow development to continue at a rate that is consistent with the rural zoning for the North Shore/Lynch Cove area. In some cases, limitations on wastewater disposal options could severely constrain property development, which will be of concern to existing property owners.

Operational/maintenance considerations

Successful operation of alternative systems requires regular maintenance by trained personnel, particularly to ensure nitrogen removal. In the case of the holding tank option, it would be critical that maintenance, including pumpouts, checking of emergency alarms, etc., be done on a regular schedule. It would also likely be necessary to provide plumbing upgrades for many older residences, to minimize leakage or piping inefficiencies that would contribute unwanted volumes to the holding tanks. In order for individual on-site facilities to continue to operate in the sensitive environment adjacent to Lynch Cove, a formalized maintenance organization would likely be required. This could take the form of an on-site system management utility or other organization. Funding would be critical, and would be provided by homeowner fees, performance bonds, tax assessments, utility charges, or some other mechanism. Individual property owners would likely resist this concept, so it is likely that some type of phased implementation would be required. The utility could also be responsible for monitoring surface water and groundwater quality to determine the effectiveness of on-site systems.

Effects on development

The MSA analysis indicated that 49 parcels could be developed within the red zone (Table 1). Under current regulations, septic systems in these areas would have to be augmented with additional treatment (e.g., sand mounds, aerobic treatment systems, or other approaches). Regular maintenance of these systems would be crucial to minimizing potential impacts to water quality.

Because of the need to provide enhanced nitrogen removal for individual on-site systems, it is likely that some property owners will be unable to develop their properties. Existing lots may be too small for an enhanced system, or costs could seem prohibitive. Therefore, it is likely that ultimate buildout would be less than 49 units. Similarly, it is likely that some of the parcels in the yellow zone will face constraints and would not develop to full buildout.

Policy implications

In order to implement Scenario 1, it would be necessary to create new criteria for constructing and operating on-site systems, with additionally stringent standards for nitrogen and/or bacteria removal in sensitive areas such as the red zone. More stringent regulations may be required to address existing failing septic systems, with specific options for correction outlined. All of these options will require financial investments from individual property owners, including up-front investment for an improved facility, and long-term investment for ongoing maintenance. In addition, policies would be needed to obtain access to private property, because maintenance of these systems would take place on private property.

Currently, there is no mechanism within the County to generate funding for an on-site system management utility. Such a funding mechanism appears to be a requirement to ensure that decentralized, individual on-site systems can operate effectively.

Cost

Individual on-site systems vary in cost depending on the technology and/or product used and the design necessary for a specific site. For complete installation of a conventional on-site system, costs typically range from $3,000 to $6,000 per system. The proprietary on-site system with the highest tested performance capability – the Nitrex™ System – would cost between $5,000 and $10,000 per system for complete installation. The Nitrex™ System uses a patented wood-based media filter to induce denitrification of incoming nitrate through gravity flow. Other enhanced on-site treatment options could have per system costs as high as $24,000. Alternative system cost information is included in the attached matrices.

Assuming that green zone areas received conventional on-site systems and that alternative on-site treatment is focused in yellow and red zones, total installation costs for all buildable parcels would range from $1.3 million to $3.3 million. Replacement of the existing failing systems, estimated by MSA to be approximately half of the existing 286 systems in the red zone and some smaller percentage in the yellow zone (assume 25%), could range between $4 million and $8 million, assuming that enhanced on-site systems would be required. Additionally, funding would have to be secured to implement the monitoring and on-site system management program outlined above.

Scenario 2: All buildable parcels served by a centralized wastewater system

Under this option, all existing and buildable parcels would be connected to conveyance pipelines that would transport wastewater to a centralized regional or community wastewater treatment plant. This option would require all existing properties to hook up to the sewer system as well as all new development. Treatment would occur at the treatment plant, and discharge would be to an appropriate upland location. Pollutant loading to the subsurface associated with existing on-site systems would be eliminated over time, as on-site systems were connected to the centralized sewer system.

Pollutant-removal effectiveness

Scenario 2 would eliminate pollutant loading from existing on-site systems as they become connected to the regional system. It has a high degree of reliability and pollutant removal effectiveness. Advanced treatment processes needed to provide reclaimed water quality for land application would result in effluent with very low nitrogen and bacterial concentrations.

Other environmental impacts

Construction of the conveyance system to carry wastewater from existing residences to the wastewater treatment system plant would disrupt existing roads, as well as natural resources including existing vegetated areas. Potential stream/wetland crossings may be required.

Implementation of Scenario 2 would likely result in pressure to increase density in the area served by the sewer system, to help defray the relatively high cost of sewer installation. Increased developmental density and a trend toward urbanization in the Lynch Cove area could result in higher levels of runoff and other sources of pollutants. The cost to hook up to the sewer system could be prohibitively high for some residents, forcing them to sell their properties.

Frequently, the siting of new wastewater treatment facilities, even relatively small ones, is met with resistance from adjacent property owners, who are concerned about odors, aesthetics, and changes to land use. A comprehensive public involvement program, along with additional environmental analysis, would be needed.

Operational/maintenance considerations

The centralized wastewater treatment plant would be maintained by trained operators. Individual property owners would be required to abandon or decommission their septic tanks, including a final pumpout.

Effects on development

Stringent land use controls would likely be needed to maintain a rural density within this area. Effluent from all future development (approximately 203 parcels) would be directed to the wastewater treatment plant. Therefore, there would be no difference in treatment among potential impact zones (e.g., red, yellow, or green zones).

Policy implications

It will be necessary for decision makers to review existing land use policies in rural areas, to determine whether they consider it appropriate to continue a rural land use designation in an area served by sanitary sewers. There will likely be pressure to increase the density to help defray the costs of sewering the area, and decision makers will need to address this issue and revisit previous policy decisions.

Providing urban services in a rural area is prohibited by Washington's Growth Management Act; however, exceptions can be made under extreme or emergency situations.

Cost

The *Belfair/Lower Hood Canal Reclamation Facility Plan* (Murray, Smith & Associates, Inc.) estimated that treatment alternatives would cost between $13.2 million and $13.8 million. Conveyance costs for a system serving the entire Lynch Cove / North Shore area are estimated at $23.1 million. Costs for the treatment plant would be shared by others within the service area, but the conveyance costs would be borne by the Lynch Cove/North Shore residents. Depending upon the type of treatment system and how much the Lynch Cove/North Shore residents would contribute, the costs could range from approximately $18,000 to $20,000 per ERU (equivalent residential unit).

Ongoing administrative and management costs would also require consideration under this scenario.

Scenario 3: Buildable parcels served by a combination of clustered (community) and individual on-site systems

Scenario 3 provides a combination of options, with use of individual on-site systems in areas with acceptable soils, slope and lot size (green and selected yellow zones), and clustered systems in areas where soils or lot sizes pose constraints (selected yellow and red zones). This scenario would continue to provide decentralized treatment, but site-specific applications would aim to maximize the pollutant removal effectiveness of the systems.

Pollutant-removal effectiveness

Within the green zone, conventional septic tanks would continue to be used, resulting in nitrogen levels as described above under Scenario 1. Assuming appropriate soils and adequate lot sizes, continued use of appropriately designed conventional septic tanks in the green zone appears to provide adequate removal of nitrogen and bacteria. Within selected areas of the yellow zone, where soils and lot size provide adequate water quality protection, conventional septic systems would provide appropriate water quality protection. In areas within the yellow zone where soils, slope or lot size are marginal for the use of conventional septic systems, and within the red zone, additional pollutant removal would be required. In these cases, clustered community systems or enhanced individual systems would be implemented.

Options to improve nitrogen removal. In areas where soils, lot size, slope, proximity to ground/surface water or other factors are unsuitable for conventional individual on-site systems, wastewater would be directed to community "cluster" systems, which can serve a range of residential units, from a few units to as many as a hundred residences. The volume of flows treated and types of technology determine whether the system would be permitted by Mason County or by the Department of Ecology. The treatment technologies available for cluster systems include many of the same technologies identified for enhanced on-site systems, including aerobic treatment units such as sequencing batch reactors, attached growth systems such as recirculating sand filters, membrane reactors, and proprietary products. Studies of these systems indicate that nitrogen removal effectiveness varies widely, and that 14 to 20 mg/L of total nitrogen in effluent would be expected. Recent studies for several proprietary products, including the Nitrex™ System, have indicated nitrogen levels below 5.0 mg/L, but additional data are needed to ascertain long-term performance. These systems could be installed in sensitive areas, particularly shoreline areas with relatively high densities, limited lot sizes, and other constraints. It would be necessary to have land available for the cluster system, which could require 4,000 to 5,000 square feet for a system serving 10 units.

For the North Shore area, it would be important to select technologies that provide maximum nitrogen removal and the greatest degree of reliability. In some areas, total effluent nitrogen concentrations of 14 to 20 mg/L would not be adequate to protect water quality. Therefore, those systems producing nitrogen of 10 mg/L or less would be required.

Other environmental impacts

It will be necessary to construct pipelines to carry wastewater from individual homes to the cluster system, potentially disrupting local vegetation, streams, and other resources. These pipeline distances should be relatively short, but will still be disruptive during construction.

Implementing this alternative would allow development to occur consistent with adopted land use plans and policies, and would be consistent with a rural level of development. Land acquisition for cluster systems would be required, and could encounter opposition from adjacent property owners.

Operational/maintenance considerations

Operation and maintenance is key for long-term feasibility of both individual and cluster systems in the North Shore area. As described above under Scenario 1, development of an on-site maintenance district would likely be needed to ensure that the individual as well as cluster systems are adequately maintained and operated. The increased complexity of the technologies used for alternative treatment systems suggests that trained personnel would be needed to provide reliable long-term service.

Effects on development

On-site systems would allow green and yellow zone development to continue at a rate that is consistent with the rural zoning for the North Shore/Lynch Cove area. In some cases, especially in red zone areas, cluster systems would be required to facilitate effective effluent dispersion. Existing landowner concerns would have to be addressed regarding these changes, and feasibility studies would be necessary to examine the potential of cluster systems to serve an estimated 286 (developed) and 49 (vacant and buildable) red zone parcels. Depending on feasibility, it is possible that some reduction in potential buildout would occur in red zone areas. Regular maintenance of both on-site and cluster systems would be crucial to minimizing potential impacts to water quality.

Policy implications

As described for Scenario 1, it would be necessary to create new criteria for constructing and operating on-site systems, with additionally stringent standards for nitrogen and/or bacteria removal in sensitive areas such as the red zone. More stringent regulations may be required to address existing failing or poorly functioning septic systems, with specific options for correction outlined. All of these options will require financial investments from individual property owners, including up-front investment for an improved facility, and long-term investment for ongoing maintenance. This option requires a higher level of involvement on the part of the County when reviewing building permit applications. Approval of on-site systems would require more case-by-case analysis, and additional staff for review and inspection. Additional funding would be needed for staff, as well as for studies to characterize and prioritize the study area.

It would be necessary to create a mechanism to generate funding for an on-site system management utility. This appears to be a requirement to ensure that decentralized, individual on-site systems and cluster systems can operate effectively. This utility would also need to provide or participate in ongoing monitoring to determine if the decentralized approach is effectively limiting nitrogen and bacterial loading. It would be necessary to create an adaptive management plan to deal with situations where the systems were not meeting expectations, or water quality improvements were not adequate.

Implementation of this alternative would require a long-term, phased approach. Education of the public and decision makers would be important. It would also be important to establish reasonable expectations for the system. This approach does not provide the rapid "fix" that many foresee when implementing a centralized wastewater system, and as such, requires an educated and realistic understanding of potential results before embarking upon this approach.

Cost

Alternative individual on-site systems have costs described in the *Cost* section of Scenario 1 above. In summary, installation costs should be expected to range from $6,000 and $24,000 per ERU with annual O&M costs of $250 to $600.

Costs for cluster systems are increased by the cost of the collection system. Depending on the technology or product used, total installation costs could range from $235,000 to $415,000 for a system serving 10 residential units (Gray and Osborne, 2005). However, studies in Minnesota have indicated that costs per unit are reduced substantially if more homes are served by the system. In developments surveyed (Wallace and Hallahan, 2005), costs per connection ranged from $5,500 to $13,500, with the lowest per-connection cost associated with a cluster system serving 88 homes. Costs to the existing and future red zone lots, and approximately 25% of yellow zone lots (assuming up to 25% of existing and future parcels would be constrained), would range from approximately $3 million (lowest cost option, assuming cluster systems serving more than 10 units per system) to $10 million or higher. Annual O&M costs should be expected to be similar to individual on-site systems, ranging from $400 to $700 annually per ERU.

Ongoing funding for an on-site maintenance utility or district would be required to ensure long-term effectiveness.

Scenario 4: A combination of centralized sewer and on-site systems.

Scenario 4 provides sewers in areas determined to be unsuitable for on-site systems (the “red zone”) and allows for community or individual on-site systems in areas determined to be potentially suitable. This system is a combination of Scenarios 2 and 3.

Pollutant-removal effectiveness

Scenario 4 would allow continued use of septic systems in areas with suitable soils, lot size, and other conditions, including the green zone and appropriate areas within the yellow zone. As noted above, it is assumed that these systems are adequately protective of water quality when applicable criteria are met. For the red zone areas along the shoreline and adjacent to streams that have been determined to be unsuitable for on-site wastewater treatment, flows would be directed to a regional wastewater treatment system, or to a nearby satellite treatment facility. Nitrogen loading from these areas would be eliminated for both existing and future development.

Options to improve nitrogen removal. Enhanced on-site treatment technologies could be used in green and yellow zone areas where additional nitrogen removal was determined necessary. This could include replacement of failing systems within these zones.

Other environmental impacts

Constructing a conveyance system within the red zone areas will disrupt traffic, and will potentially require crossing of sensitive areas such as streams and wetlands.

Implementing a sewer system within the red zone only will likely result in pressure to increase density within that zone, to spread out the costs of the regional wastewater system. Providing wastewater service to the red zone areas only could result in escalating property values in those areas, and the cost of providing sewer service could force some property owners to sell. Determining the boundary between areas served and not served by sewers would likely be highly contentious, because of the financial implications for those required to hook up to the sewer. Also, as noted above, there will likely be community resistance to location of the treatment plant due to concerns about odor, noise, traffic, and land use implications.

Operational/maintenance considerations

Maintenance of the wastewater treatment plant would be conducted by the plant operators. It may be advisable to provide a more formalized approach to maintenance for the areas not served by the centralized system, to ensure that on-site systems continue to function effectively. This could take the form of an organization, or could be part of the responsibilities of the wastewater utility that operates the treatment plant.

Effects on development

In green and yellow zone areas the combination of on-site and cluster systems would allow development to continue at a rate that is consistent with the rural zoning for the North Shore/Lynch Cove area. All green and yellow zone vacant buildable parcels could be successfully developed. Regular maintenance of these systems would be crucial to minimizing potential impacts to water quality.

In red zone areas served by a centralized collection and treatment system, stringent land use controls would likely be needed to maintain a rural density within this area. Effluent from all future red zone development (approximately 49 parcels) would be directed to the treatment plant with additional yellow zone sewer connections possible where viable and/or more cost-effective than on-site or cluster system treatment.

Policy implications

One of the most difficult aspects of this scenario would be determining where to draw the boundary for sewer service, how to assess those served by the centralized system, and what type of phasing would be appropriate. As described for Scenario 2, policy makers will need to evaluate land use plans and policies currently in place, and balance the cost of providing sewer service to rural areas with the need for water quality protection and other principles underlying their existing land use plans and policies. Pressure for increased developmental density in the sewered areas will undoubtedly be high, and policies will need to be in place to either preserve existing land use plans, or modify them to address the cost of urban services.

Cost

Alternative individual on-site and cluster systems have costs described in the *Cost* section of Scenario 3 above. Costs for on-site systems should be expected to range from $6,000 to $24,000 for installation per ERU with annual O&M costs of $250 to $600. Costs for a cluster system serving 10 residential units should range from $23,500 to $41,500 per ERU for installation, with O&M costs similar those seen with individual on-site systems. If systems were constructed to serve more homes installation costs could be reduced to between $5,524 and $13,699.

A centralized treatment and collection system serving red zone areas would have a treatment cost ranging from $13.2 million to $13.8 million (same as Scenario 2). The reduced service area would result in transmission costs of approximately $6.6 million. A total centralized treatment project cost of $23.6 million ($480,000 per buildable parcel) should be expected for the red zone area, with annual O&M costs of roughly $550,000.

Ongoing administrative and management costs would also require consideration under this plan.

SUMMARY/RECOMMENDATIONS

There are tradeoffs associated with all scenarios considered for managing wastewater in the North Shore area of Hood Canal. The challenge of maintaining rural densities while providing adequate wastewater management and protection of Hood Canal water quality is significant. The cost varies, but is significant for each scenario. Providing a centralized wastewater system would significantly reduce nitrogen loading to Hood Canal, but is the most expensive option under consideration and could result in changes to land use patterns in the area. Alternatives to implementing centralized sewer service in the North Shore Area exist, but will require a comprehensive management plan with a formalized long-term maintenance plan to protect water quality. Continued use of decentralized wastewater treatment (on-site systems) will require replacing failing systems with either enhanced on-site systems or cluster systems. Because the decentralized option does not reduce nitrogen as much as the centralized option, it will likely be necessary to implement other nutrient control measures throughout the area. Further evaluation of decentralized wastewater management scenarios, including review of projects in other areas, could result in identifying options that are more cost-effective than those currently identified, and should be explored if a decentralized approach is favored.

Funding is a key component for all scenarios considered. Developing a detailed funding strategy is recommended, including the potential for grants to evaluate on-site options and technologies in a pilot application. The question of public vs. property owner funding will be significant, no matter which scenario is selected for implementation.

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Table 2. Summary of environmental considerations, Scenarios 1 - 4.

Scenario	Description	Scenario Option(s) (pattern boxes indicates zone(s) which each option could serve - see key below)	Effluent nitrogen and bacteria levels: Effluent total nitrogen level (based on initial level of 40mg/L) at point of discharge [2,3,4]	Effluent nitrogen and bacteria levels: Effluent fecal coliform level [1,4]	Other Environmental Considerations and/or Constraints: Soil/groundwater constraints	Treatment system footprint	Impact on groundwater and surface water quality	Other environmental impacts
1	All buildable parcels served by individual on-site systems.	Conventional Septic and Drainfield	30 - 40 mg/L	Varies widely, 1,000 - 1,000,000 org/100 mL	Sandy clay, clay, silty clay, and strongly cemented or firm soils unsuitable for treatment disposal. Coarse soils dictate type of distribution system. High water table, flood prone areas constrain development	Varies with soil type: usually 300 to 600 ft² per on-site system	Poorly functioning systems increase nitrogen, bacterial loading to groundwater. Existing systems in high density areas present greatest risk. As flows/loadings increase, potential for groundwater impacts increase. Negative impacts on groundwater frequently lead to nitrogen and bacterial loading of surface waters, especially in conditions where conventional on-site systems are marginally appropriate (see soil/slope limitations).	Individual on-site systems are appropriate for use in low density areas with adequate site conditions. Their use is consistent for use in rural areas, but is more problematic in rural areas that are approaching suburban/urban densities. Continued use would not conflict with adopted land use plans/policies
		Alternative system: reduced discharge	2,000 - 10,000 mg/L (almost completely urea; requires specially designed discharge system)	10 - 1,000 org/100mL	Typically used when drainfield area is limited	Reduced drainfield footprint compared to conventional septic and drainfield	Reduces wastewater volume discharged to groundwater by 50%; with successful system treatment, creates potential for reduced nitrogen, bacteria loading to surrounding waters. Reduced discharges, however, minimize the positive affect that treated wastewater recharges can have on groundwater deposits.	Use would not conflict with applicable land use plans in terms of density served by the systems.
		Alternative systems: media filters	14 - 25 mg/L	<200 - <800 org/100mL (WSDOH Treatment Standards 1 and 2 for alternative OSS)	Typically used in soils not well suited for drainfields or where additional treatment standards must be met	Varies with soil type: usually 250 to 500 ft² per on-site system	Higher levels of nutrient, bacteria reduction than conventional systems; however - in areas of high density - nutrient levels could continue to rise although at a slower rate than with all conventional systems. Highly treated wastewater released in drainfields would partially recharge groundwater stores (a possible environmental benefit to properly functioning on-site systems).	Higher level of maintenance would require more interaction between property owners, utility managers Use of EOS would not conflict with adopted land use policies, that call for rural densities
		Alternative systems: Aerobic treatment units	4 mg/L with Nitrex system, others range from 15 - 20 mg/L	Varies widely, <100 - >10,000 org/100mL	Typically used in soils not well suited for drainfields or where additional treatment standards must be met	Varies with soil type: usually 250 to 500 ft² per on-site system.		Lack of long-term study surrounding proprietary systems; issues with eventual system failure must be considered when discussing this option.
		Alternative system: zero discharge	If wastewater is pumped out and transferred to regional treatment plant, nitrogen levels would be less than 10mg/L (permit limits)	If wastewater is pumped out and treated at a regional treatment plant, fecal coliform bacteria in effluent would be less than 200 org/100 mL.	Typically used in areas where soils are not suitable for drainfield disposal and sewering is not an option	Large tank's dimensional foot print (could be constructed to be subsurface)	Potential for impact if holding system leaks, cracks or overflows due to lack of maintenance or poor operation. Eventually effluent quality must meet surface water quality standards at discharge location (whether inside or outside of North Shore area).	Significant truck traffic would be required to result in zero change in storage in the system. Holding tanks not considered a long term solution because of potential to overflow, high maintenance requirements. Use would not conflict with current land use plans/policies in terms of density served. Potential for odor generation
2	All buildable parcels served by a centralized wastewater system	Conveyance system collects and transfers flows to a regional wastewater treatment plant	< 10 mg/L; lower if reclaimed water standards are met	Monthly average < 200 org/100 mL if secondary standards are met; <2.2 org/100 mL if Class A reclaimed water standards are met	Some soils/high groundwater table may present construction constraints, but no long-term constraints	100,000 square feet for treatment plant, with 2-3 additional small parcels used as pumping stations	Highly treated effluent could be used to irrigate forest lands in a suitable area, recharging groundwater with minimal nutrient loading. Groundwater recharge volume reduced in areas served by centralized wastewater system. Overall, nutrient loading to groundwater would be reduced. Effluent would be discharged at a point source location, concentrating surface water impacts in that area. Assuming all standards are met, however, impacts should be minimal. Higher density development could follow, resulting in increased non-point pollution.	Pressure to increase residential density could follow, resulting in a departure from adopted land use plans. Increased pressure for urban level services could follow. Urban levels of development would result in impacts to surface water quality, plants and animals, and transportation
3	Buildable parcels served by a combination of clustered (community) and individual on-site systems	Enhanced On-site Systems	14 - 25 mg/L (4 mg/L with Nitrex system)	10-1,000 org/100 mL for composting toilet; 100-10,000 org/100 mL for sand filter; <100 - >10,000 for proprietary systems	Same as the 3 <u>Alternative systems</u> described above	Varies with soil type: usually 250 to 500 ft² per on-site system.	Reduction of effluent nitrogen, bacteria, and possibly volume reduced into the soil (see Alternative system descriptions above)	Higher level of maintenance would require more interaction between property owners, utility managers. Use of EOS would not conflict with adopted land use policies that call for rural densities
		Cluster Systems	14 - 20 mg/L (one example of 3.5 mg/L system)	<200 - 1,000 org/100mL	Individual systems with unsuitable soils would be conveyed to a community treatment system with favorable soils.	Dependent on number of residences served: roughly 400 ft² per ECRU.	Discharge would be eliminated in specific high risk areas and relocated to more suitable soils, reducing potential for impacts to groundwater. System would also be located in areas less sensitive to surface water impacts, thus reducing potential for impact.	Would allow low levels of development to continue in areas with unsuitable soils. In general, would allow development to continue in accordance with adopted land use plans
4	A combination of sewering sites unsuitable for septic systems (red zones on Murray Smith constraints map) and community or individual on-site systems in areas determined to be suitable (yellow and green zones)	Enhanced On-site Systems	14 - 25 mg/L	10-1,000 org/100 mL for composting toilet; 100-10,000 org/100 mL for sand filter; <100 - >10,000 for proprietary systems	Typically used in soils not well suited for drainfields or where additional treatment standards must be met	Varies with soil type: usually 250 to 500 ft² per on-site system	Reduction of effluent nitrogen, bacteria, and possibly volume reduced into the soil (see Alternative system descriptions above)	Higher level of maintenance would require more interaction between property owners, utility managers. Use of EOS would not conflict with adopted land use policies that call for rural densities
		Cluster Systems	14 - 20 mg/L (one example of 3.5 mg/L system)	<200 - 1,000 org/100mL	Individual systems with unsuitable soils would be conveyed to a wastewater treatment plant	Dependant on number of residences served: roughly 400 ft2 per ERU	Discharge would be eliminated in specific high risk areas and relocated to more suitable soils, reducing potential for impacts to groundwater. System would also be located in areas less sensitive to surface water impacts, thus reducing potential for impact.	Would allow low levels of development to continue in areas with unsuitable soils. In general, would allow development to continue in accordance with adopted land use plans
		Centralized System	< 10 mg/L, lower if reclaimed water standards are met	Monthly average < 200 org/100 mL if secondary standards are met; <2.2 org/100 mL if Class A reclaimed water standards are met	Some soils/high groundwater table may present construction constraints, but no long-term constraints	100,000 square feet, with 2-3 additional small parcels used as pumping stations	(See description for fully centralized conveyance system above) Reduction of area served by conveyance system would likely allow for greater control over future high density development, reducing the consequences of other non-point pollution that more density would bring.	Construction of pipelines to convey wastewater to community holding tank would be needed, potentially disrupting roads, vegetated areas. Holding tanks not considered a long term solution because of potential to overflow, high maintenance requirements. Use would not conflict with current land use plans/policies in terms of density served. Potential for odor generation

ERU: Equivalent Residential Unit, average house with 3 residents each resident using roughly 85 GPD.	use in green zone areas
	use in green and yellow zone areas
	use in green / yellow zone areas, possible in red
	use in all areas

1. WAC.
2. CWRCB, 2002.
3. Costa et al., 2002.
4. Deschutes EHD, 2004

Table 2. Summary of environmental considerations, Scenarios 1 - 4.

Scenario	Description	Scenario Option(s) (pattern indicates zone(s) which each option could serve - see key below)	Operation Implications: Maintenance/Operational considerations	Operation Implications: Infrastructure needs	Operation Implications: Suitable for commercial/residential?	Policy Implications
1	All buildable parcels served by individual on-site systems.	Conventional Septic and Drainfield	High degree of homeowner maintenance needed for proper performance	Construction of on-site systems would occur largely on private property	Not likely suitable for commercial applications	Represents a continuation of current practices, with individual land owners responsible for the planning, financing, and construction of on-site systems. Proper function of alternative on-site systems - required for effective nitrogen removal - would require a system of regular and mandatory maintenance and operation. Creation of an on-site system management utility or other organization would be required for the area. Current land owner resistance would likely require phased implementation.
		Alternative system: reduced discharge	Increasing complexity of systems requires increased maintenance; participation in County-sponsored O&M required in sensitive areas		Under proper site conditions, suitable for both residential and commercial applications	
		Alternative systems: media filters	Regular, formalized maintenance program needed to ensure effective operation; education of system owners required		Under proper site conditions, suitable for both residential and commercial applications	
		Alternative systems: Aerobic treatment units	Dependant on particular proprietary system; generally would require a regular, formalized maintenance program with system owner education		Under proper site conditions, suitable for both residential and commercial applications	
		Alternative system: zero discharge	Regularly scheduled maintenance critical to operation; well-maintained alarm system needed	Holding tank construction may be difficult in low areas due to high groundwater; preparation for significant truck traffic would be required.	Has been used for some commercial and industrial applications, suitable for residential if appropriately maintained	Use of holding tanks would require regular, formalized monitoring and maintenance; this likely would necessitate the development of a utility district or other managing body (possibly work could be outsourced?).
2	All buildable parcels served by a centralized wastewater system	Conveyance system collects and transfers flows to a regional wastewater treatment plant	All maintenance/operation conducted by facility/utility staff	Conveyance system needed to transport wastewater to treatment facility. In some areas, low pressure system requiring pumps at each residence and main line pumping stations. Most significant infrastructure needs of system alternatives.	System is suitable for all land use types	Need for review of rural zoning of area would be required, as higher densities in sewered area would likely be desired. Construction of a centralized wastewater system would require extensive planning and review to meet state GMA requirements for rural areas. A utility district would be required for the ongoing operation of the facility and conveyance system.
3	Buildable parcels served by a combination of clustered (community) and individual on site systems	Enhanced On-site Systems	Same as for the 3 <u>Alternative systems</u> described above	For individual EOS, systems would be constructed on private property	EOS suitable for residential and commercial applications	Use of alternative on-site and cluster systems would require regular, formalized monitoring and maintenance; this would necessitate the development of a local utility district or other managing body. Funding sources would have to be secured. Current land owner resistance would likely require phased implementation.
		Cluster Systems	Maintenance/operation needs likely to great for private owner over-site; would require county oversight and/or education of system owners	Properties served by cluster systems require local conveyance, possibly pumps.	Clustered system suitable for residential and commercial; most applicable at higher density to help reduce conveyance costs	
4	A combination of sewering sites unsuitable for septic systems (red zones on Murray Smith constraints map) and community or individual on-site systems in areas determined to be suitable (yellow and green zones)	Enhanced On-site Systems	Same as for the 3 <u>Alternative systems</u> described above	For individual EOS, systems would be constructed on private property	Under proper site conditions, suitable for both residential and commercial applications	Similar to Scenario 2, a review of zoning and land practices in sewered area would be necessary to examine the consequences of a centralized system. Additionally, a strategy would need to be formulated to determine what area(s) would be served by a centralized system. Use of on-site and cluster systems would require a system management utility for the reasons described in Scenarios 1 and 3.
		Cluster Systems	Maintenance/operation needs likely to great for private owner over-site; would require county oversight and/or education of system owners	Properties served by cluster systems require local conveyance, possibly pumps.	Cluster systems likely to be used in residential areas under this scenario, with highest densities served by centralized wastewater system	
		Centralized System	All maintenance/operation conducted by facility/utility staff	Conveyance system needed to transport wastewater to treatment facility. In some areas, low pressure system requiring pumps at each residence and main line pumping stations. If transported to local "satellite" system, pipeline needs could be reduced compared to fully centralized system	Commercial areas likely served by centralized wastewater system, high density residential areas	

ERU: Equivalent Residential Unit, average house with 3 residents each resident using roughly 85 GPD.	use in green zone areas
	use in green and yellow zone areas
	use in green / yellow zone areas, possible in red
	use in all areas

Table 2 (cont). Summary of environmental considerations, Scenarios 1 - 4.

			Technologies possible with each option:				Costs		
Scenario	Description	Scenario Option(s) (pattern indicates zone(s) which each option could serve - see key below)	1	2	3	4 (distribution options)	Initial (complete installation / construction)	O & M (annual)	Comment
1	All buildable parcels served by individual on-site systems.	Conventional Septic and Drainfield	Septic Tank			Traditional Drainfield	3,000 - 6,000 per ERU[2]	250 - 600 per ERU[2]	
		Alternative system: reduced discharge	composting toilet	incinerating toilet			4,000 - 20,000 per ERU[2]	100 - 500 per ERU [2]	
		Alternative systems: media filters	Recirculation Sand/Gravel Filter (RSF), recommended in Gray & Osborne Report.	Alternative media filters (glass, peat, brick filters)	Proprietary media filters	Enhanced distribution (Mound / Open Bottom Filter)	12,250 - 20,000 per ERU[5, 6]	250 - 600 per ERU[5]	Source 3 with costs at lower end of range
		Alternative systems: Aerobic treatment units	Nitrex™ proprietary filter	Suspended growth systems	Sequencing Batch Reactor (SBR) / Membrane Bioreactor (MBR)	Drip line surface distribution	5,000 - 24,000 per ERU[2, 5]	250 - 600 per ERU[2, 5]	Unit cost range: 2,000 - 10,000 (additional expense is complete installation)
		Alternative system: zero discharge	Single or dual family storage tank				2,500 - 5,500 [10]	3,000 - 4,000 [10]	High O&M cost due to need for frequent pumping
2	All buildable parcels served by a centralized wastewater system	Conveyance system collects and transfers flows to a regional wastewater treatment plant	Membrane bioreactor (MBR)	Sequencing batch reactor (SBR)			0.2 million per buildable parcel (based on entire system cost of 40 million for entire area w/ 203 buildable parcels[7])	656,000 - 716,500 [7]	O & M could be reduced 28% with use of independent contractor.
3	Buildable parcels served by a combination of clustered (community) and individual on-site systems.	Enhanced On-site Systems	SEE THE <u>ALTERNATIVE SYSTEM</u> COMPONENT OPTIONS, LISTED IN SCENARIO 1 ABOVE				4,000 - 25,000 per ERU [2, 5, 6]	250 - 600 per ERU [5]	See above for more details.
		Cluster Systems	Recirculation Sand / Gravel Filter (RSF), recommended in Gray & Osborne Report	Variety of aerobic treatment units (see *Alternative system* descriptions in Scenario 1 above for details)		Mound System / Subsurface flow or free water wetland	5,524 - 13,599 per ERU[9]; 23,500 - 41,600 per ERU[5]	366 - 720 per ERU[9]; 200 - 450 per ERU[5]	Lower costs from Source 9 partially due to larger scale of pilot projects studied
4	A combination of sewering sites unsuitable for septic systems (red zones on Murray Smith constraints map) and community or individual on-site systems in areas determined to be suitable (yellow and green zones).	Enhanced On-site Systems	SEE THE <u>ALTERNATIVE SYSTEM</u> COMPONENT OPTIONS, LISTED IN SCENARIO 1 ABOVE				4,000 - 25,000 per ERU [2, 5, 6]	250 - 600 per ERU [5]	See above for more details.
		Cluster Systems	Recirculation Sand/Gravel Filter (RSF, recommended in Gray & Osborne Report)	Variety of aerobic treatment units (see *Alternative system* descriptions in Scenario 1 above for details)		Mound System / Subsurface flow or free water wetland	5,524 - 13,599 per ERU[9]; 23,500 - 41,600 per ERU[2]	366 - 720 per ERU[9]; 200 - 450 per ERU[5]	Lower costs from Source 9 partially due to larger scale of pilot projects studied
		Centralized System	Membrane bioreactor (MBR)	Sequencing batch reactor (SBR)			0.48 million per buildable parcel (based on entire system cost of 23.5 million for a red zone w/ 49 buildable parcels[7])	520,000 - 580,000 [7]	Reduction in total initial cost due to smaller collection system. O & M could be reduced 28% with use of independent contractor.

ERU: Equivalent Residential Unit, average house with 3 residents each resident using roughly 85 GPD.	use in green zone areas
	use in green and yellow zone areas
	use in green / yellow zone areas, possible in red
	use in all areas

1. WAC.
2. CWRCB, 2002
3. Costa et al., 2002
4. Deschutes EHD, 2004.
5. Gray & Osborne Inc., 200!
6. Deschutes County RPS, 1997
7. Murray, Smith & Associates, 2006.
8. KCM Inc., 1999.
9. Wallace and Hallahan, 2005.
10. Winter, Steve. 2005

APPENDIX E

MSA
Murray, Smith & Associates, Inc.
Engineers/Planners
2707 Colby Avenue, Suite 1110 Everett, WA 98201-3566 PHONE 425.252.9003 TOLL-FREE 888.252.9003 FAX 425.252.8853

MEMORANDUM

DATE: May 12, 2006

PROJECT: Belfair/Lower Hood Canal Water Reclamation Facility Plan Supplemental Information

TO: Mike Sharar, Mike Sharar Consulting
Art O'Neal, Art O'Neal & Associates
Linda Hoffman, Linda Hoffman Consulting

FROM: Tom Perry, P.E.
Murray, Smith & Associates, Inc.

RE: Evaluation of North Shore Wastewater Management Scenarios

Introduction

Murray, Smith & Associates, Inc. (MSA) has been retained by Mason County to update the Belfair/Lower Hood Canal Water Reclamation Facilities Plan. The plan update included providing supplemental information that reflects recent population forecasts in the Belfair Urban Growth Area (UGA) and the extension of sewer service to the Lynch Cove/North Shore area of the Lower Hood Canal. As an additional work task, MSA has been request by the County's consultant team, Mike Sharar, Art O'Neal and Linda Hoffman, to conduct a detailed evaluation of several wastewater management scenarios for the Lynch Cove/North Shore area.

Background

The Belfair/Lower Hood Canal Water Reclamation Facility Plan (Facility Plan) was submitted to the Washington State Department of Ecology in July 2001 and was approved in March 2002. The Facility Plan was amended to further review site selection for the treatment facilities and to consider service to the Belfair State Park area to address a declaration of severe public health hazard in Lynch Cove which was issued by the Washington State Department of Health (DOH). DOH has attributed the poor water quality conditions in the Lynch Cove/North Shore area of Hood Canal (North Shore) to failing septic systems and has determined that the problems "cannot be corrected through more efficient operation and maintenance of existing on-site systems." The amended Facility Plan was approved by DOE on April 15, 2004 and included the extension of sewers to the Belfair State Park area to address the current declaration of severe public health hazard.

The Belfair Urban Improvements Project Feasibility Study (Feasibility Study) was initiated in 2004 to help Mason County and the Board of Commissioners make well-informed decisions on how to move forward with needed urban improvements in the Belfair area, including roadway, storm water and sewer improvements. During the course of the Feasibility Study, it was found that population projections used in the amended Facility Plan for the Belfair UGA did not reflect the most recent projections developed by Mason County Department of Community Development. The amended Facility Plan also did not correlate the extension of the sewer services to the conditions that led to the declaration of a severe public health hazard. Thus, the service area surrounding the Belfair State Park and shoreline areas contributing to the severe public health hazard had not been defined.

To address these two issues, population projections were updated with current County planning information and the Lynch Cove/North Shore Sewer Service Area Delineation (Delineation Study) was performed by Associated Earth Sciences, Inc. (AESI) to assist the County in defining a potential sewer service area in the North Shore area.

The County has since retained the services of Adolfson Associates, Inc. (Adolfson) to prepare an Enhanced Environmental Parcel Overlay for the North Shore area of Mason County. The purpose of the analysis is to characterize the environmental constraints and benefits associated with several different scenarios for wastewater management in the North Shore area. The scenarios that Adolfson reviewed included the use of on-site systems, cluster (or community type systems), centralized sewers, and combinations of the above systems.

Purpose

The purpose of this memorandum is to present an evaluation of wastewater management scenarios in the North Shore area. The evaluation considers type of system, installation, capital costs and operation/maintenance/replacement costs. The information in this memorandum augments the Lynch Cove/North Shore Sewer Service Area Delineation Study prepared by AESI and the Enhanced Parcel Overlay Mason County North Shore Area prepared by Adolfson.

Wastewater Management Scenarios

Four wastewater management scenarios for the North Shore area were reviewed by Adolfson in April 2006. These scenarios are listed below:

1. All buildable parcels would be served by individual on-site systems.

2. All buildable parcels would be served by a centralized sewer system; flows would be collected and transported to a wastewater treatment facility to serve the region.

3. Buildable parcels would be served by a combination of clustered (community) and individual on-site systems.

4. A combination of centralized sewer and on-site systems would be used; sewers would be provided in areas determined to be unsuitable for on-site systems (referred to as the "red zone" in accordance with the designation in the Service Area Delineation by AESI) and community or individual on-site systems would be used in areas determined to be potentially suitable.

General Approach

Each scenario was evaluated for the area outlined in the Delineation Study. The study delineated three different zones in the North Shore Area: areas that have a probable, a possible, and an unlikely chance for septic effluent to degrade water quality in Lynch Cove and Hood Canal. These three zones are shown in the Figure 8 of the Delineation Study (attached) and are shown as the red, yellow, and green zones, respectively.

The number of developed parcels per zone is summarized in Adolfson's Enhanced Parcel Analysis. Each developed parcel is considered one equivalent residential unit (ERU). The Belfair State Park, located in the red zone, is equivalent to an additional 69 ERU's, and is included in this analysis. The ERU's in each Impact Zone is presented in Table 1.

Table 1
ERU's within each Impact Zone

Red (Probable)	Yellow (Possible)	Green (Unlikely)	Total
355	634	201	1,190

Estimates of probable costs have been developed as a part of this analysis of the wastewater management scenarios. These cost estimates are based upon recent experience with construction for similar work in the area and discussions with local product distributors and installers. Anticipated improvements will be accomplished by private contractors. Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory guidelines, and other factors. The estimates are preliminary, and are based on the level and detail of planning presented in this memo. The estimates should be reviewed and updated as the project(s) proceed closer to implementation.

Estimates of probable cost will include:

Capital Costs – These costs are calculated for complete and installed systems. Four major components were included in developing cost estimates: construction; contingencies; engineering; legal and administrative.

O&M&R Costs – These are annual costs required to properly operate, maintain and replace equipment, processes and facilities throughout their anticipated service life. Operation and maintenance costs include power, pumping, maintenance and other services related to the operation of the treatment process and complying with regulatory requirements. These costs also include a component for labor associated with requirements for operation and maintenance activities, where applicable. Replacement costs represent the capital costs associated with the replacement of equipment, systems, structures and other facilities that are at the end of their service life and have no additional value. In wastewater applications service life of equipment can vary depending on the type of equipment, application and use and is typically 5 to 20 years. To anticipate these expenditures, replacement costs are equated to an annual cost.

Present Worth – To quantify the cost of each wastewater management scenario in today's dollars, taking in account the initial capital costs and the annual O&M&R, the present worth of each scenario was calculated based on a 20 year planning period.

Scenario 1: On-Site Systems

This scenario assumes that all wastewater management within the North Shore area would occur through individual on-site systems, a continuation of the current wastewater management practices in the area.

As noted by Adolfson, costs of individual on-site systems vary depending on the technology used and specific site conditions for the individual system. In developing information regarding the installation and cost of on-site systems, several local installers were contacted. Many installers were reluctant to give cost information given the variability associated with each installation. Recent costs of advanced on-site systems ranged from $16,000 to upwards of $40,000, due to varying site conditions and material costs.

The evaluation of on-site systems was limited to systems that provided effective treatment of domestic wastewater, including reductions in total nitrogen. As noted in the Enhanced Parcel Analysis, nitrogen removal capabilities in on-site systems vary significantly. For this evaluation, four types of advanced on-site systems were considered: a proprietary media filter, recirculation gravel filter, SBR unit, and an aerobic treatment unit. Each system has the ability to reduce nitrogen effluent concentrations to 4-25 mg/l based on an average influent concentration of 40 mg/l.

The range of the costs of an advanced on-site system varies depending on the following factors: parcel topography, size, soil type, and the condition of the existing on-site system. For each of the four treatment technologies, four installation scenarios were developed to reflect varying site conditions and the condition and value of the existing on-site system components.

- Utilize existing on-site system with simple installation of an advanced treatment component
- Utilize existing on-site system with difficult installation of an advanced treatment component.
- Replacement of existing on-site system with simple installation of an advanced on-site treatment system
- Replacement of existing on-site system with difficult installation of an advanced on-site treatment system

Operation, Maintenance & Replacement Costs developed for advanced on-site systems take into account power costs, septic tank pumping costs, the cost for providing required annual maintenance, and the cost of replacing the treatment and disposal components.

Cost per Equivalent Residential Unit

Based on the above listed factors, Table 2 presents a summary of the range of probable costs per ERU for the installation and operation of an advanced on-site system.

Table 2
Range of Costs for Advanced On-site Systems per ERU

	Cost Range
Capital Cost / ERU	\$14,000 - \$37,000
Monthly O&M&R / ERU	\$60 - \$110
20 Year Present Worth / ERU	\$25,000 - \$58,000

The cost range represents the variability in the cost of equipment, site conditions and the condition (value) of the existing on-site system components. To develop detailed cost estimates for the installation of advanced on-site systems in the North Shore area each individual property and existing on-site system would need to be assessed.

Homeowners on small lots, many smaller than 7,000 square feet, may not have adequate area to accommodate the proper installation of advanced on-site systems. These homes may need to pursue installation of on-site systems that are located on adjacent or nearby property with sufficient area, which may significantly increase installation costs, or other wastewater management alternatives may need to be considered.

Scenario 2: Centralized Wastewater System

This scenario assumes that wastewater management within the North Shore area, or portions thereof, would consist of a centralized sewage collection system and regional water reclamation facility (WRF) that will also serve the Belfair UGA. Services in the North Shore area would be connected to the WRF through a combination of pressure and gravity sewers. The option to provide sewer service to the North Shore area is based on the approved amended Facility Plan, the Delineation Study and the current work to update the Facility Plan.

As part of the current work to update the Facility Plan, alternatives for the treatment and/or reclamation of wastewater for the Belfair area, including the North Shore service area, have been evaluated. Treatment alternatives include a sequencing batch reactor, membrane bioreactor, upgrade the existing North Bay/Case Inlet Reclamation Facility and participate in the South Kitsap Industrial Area plan. Based on preliminary cost estimates, all alternatives except the latter had similar program costs, within 5%. For the purposes of this evaluation it is anticipated that treatment of wastewater in the Belfair service area will utilize membrane biological reactor (MBR) technology.

Also evaluated in the current work to update the Facility Plan is the collection system alternative for serving the Lynch Cove/North Shore area. The shoreline homes, flat topography, stream crossings, and high groundwater conditions will require alternative forms of wastewater collection other than the use of gravity sewers. Pressure sewers are recommended to serve the majority of homes in the North Shore area. Upland from the Hood Canal in the View Ridge, Lynch Cove and Beards Cove areas, sewer service may be a mix of gravity and pressure sewers, depending on topography.

As noted by Adolfson, costs of a sewer system depend on the number of connections, which correlates to the size of the service area. Unlike the scenario for on-site systems, which can be implemented in any of the impact areas delineated by AESI, sewer service areas are additive in nature. In order to provide sewer service to the "yellow zone", it is assumed that sewer service would also have to be provided to the "red zones" as well.

Capital cost estimates were developed for the collection, transmission, and treatment of wastewater from the North Shore area. Conveyance costs for the North Shore area would be exclusively paid for by North Shore residents. Transmission and treatment costs would be shared with the Belfair UGA.

Operation and maintenance costs account for power, pumping, and labor costs for providing the required maintenance of the sewer collection, transmission and treatment system components. Replacement costs account for replacing the pumping and treatment components annualized over a 20 year expected life span. O&M&R costs are shared between the North Shore and Belfair in the same fashion as the capital costs.

Cost per Equivalent Residential Unit

Table 3 presents a summary of the probable costs per ERU for the construction and operation of a centralized wastewater collection and treatment system to serve the North Shore area.

Table 3
Range of Costs for Sewer Service per ERU

	Cost Range
Capital Cost / ERU	$29,000 - $31,000
Monthly O&M&R / ERU	$30 - $40
20 Year Present Worth / ERU	$35,000 - $38,000

The cost range presented represents cost per ERU depending on the extent of area sewered in the North Shore. The greater the area served the less cost per ERU, therefore the lower number represents service to the entire North Shore area, the higher number represents service to only the "red" zone.

Scenario 3: Cluster System

This scenario identifies wastewater management within the North Shore area, or portions thereof, through the use of decentralized clustered wastewater treatment facilities. A cluster system is a small community collection and treatment system serving a set number of homes. Cluster systems can be an effective alternative when lot-size or site conditions are not favorable for individual on-site systems. Due to the density of existing homes in the North Shore area, it is estimated that a typical size cluster system would be approximately 100 homes. The actual number of homes in each cluster would vary based on the site conditions and proximity of homes to each other. All existing and buildable parcels within a defined cluster would be connected to treatment and disposal facilities through a pressure sewer system, similar to the collection system for the Centralized Wastewater System scenario.

Two treatment technologies were evaluated in the development of probable costs for a cluster system. A recirculation gravel filter and an MBR option were selected as a representation of the treatment options available for the expected flows for a 100-home cluster. Both systems are effective in the treatment of municipal wastewater and reduce total nitrogen to effluent concentration of 10 mg/l – 20 mg/l based on an influent total nitrogen concentration of 40 mg/l. Disposal of treated effluent for both cluster system alternatives is anticipated to be through subsurface disposal trenches. Disposal trenches are low maintenance and compatible with the relatively high density areas of the North Shore.

Capital cost estimates were developed for the collection, transmission, treatment and disposal of wastewater from 100-home cluster systems. The costs associated with the implementation of cluster systems depend on the location and density of the homes in the cluster, proximity of the treatment and disposal system components, disposal area requirements, and the type of treatment system selected. For each of the treatment technologies, two installation scenarios were developed to reflect varying site conditions and the proximity of the treatment and disposal system components.

Operation and maintenance costs account for power, pumping, and labor costs for providing the required maintenance of the cluster system collection, transmission and treatment system components. Replacement costs account for replacing the pumping and treatment components.

Cost per Equivalent Residential Unit

Table 4 presents a summary of the probable costs per ERU for the construction and operation of a cluster system.

Table 4
Range of Costs for Cluster System per ERU

	Cost Range
Capital Cost / ERU	$23,000 - $33,000
Monthly O&M&R / ERU	$30 - $50
20 Year Present Worth / ERU	$29,000 - $42,000

To develop detailed cost estimates for the installation of a cluster system or multiple systems in the North Shore area additional studies will need to be conducted to determine the extent of areas served by each cluster system and the method and location of treatment and disposal.

Due to limited land availability, steep slopes and shallow ground water in the North Shore area, treatment and disposal of wastewater generated from a cluster system may be difficult to site, significantly increasing the cost of a cluster system.

Scenario 4: Combination of Systems

This scenario provides wastewater management for residents of North Shore area through a combination of a centralized sewer system, cluster systems and/or individual advanced treatment systems. In areas potentially incompatible with on-site systems, such as the 'red zone," use of a centralized sewer system and/or cluster systems may be appropriate. In the "yellow" and "green" zones installation of cluster systems and/or advanced on-site systems may adequately address wastewater management needs. To determine the wastewater management approach that is best suited to specific areas of the North Shore further on-site evaluations will be necessary.

The cost ranges provided for the previous three scenarios are applicable to this scenario and are summarized below in Table 5 for convenience.

Table 5
Estimated Costs per ERU

	On-site Systems	Sewer	Cluster Systems
Capital Cost / ERU	\$14,000 - \$37,000	\$29,000 - \$31,000	\$23,000 - \$33,000
Monthly O&M&R / ERU	\$60 - \$110	\$30 - \$40	\$30 - \$50
20 Year Present Worth / ERU	\$25,000 - \$58,000	\$35,000 - \$38,000	\$29,000 - \$42,000

Probable Program Costs

The following tables present a comparison of probable program costs for implementing wastewater management scenarios in the North Shore area. Costs are presented for advanced on-site systems, a centralized sewer system and cluster systems and are given for each impact zone (red, yellow, green) in the North Shore area. In order to equally compare all scenarios, it is assumed that all ERU's within each impact zone will have to make improvements to their existing on-site system, connect to a cluster system, or connect to a centralized sewer system.

To develop costs for the upgrade of on-site systems it was assumed that approximately 50% of the homes in the North Shore currently have systems that require extensive repair or replacement. This was based on DOH's declaration of health hazard where it was stated "On-site sewage systems at 54 out of 102 homes evaluated were either failing or suspect."

Costs developed for the centralized sewer system scenario are based on developing a wastewater reclamation facility in collaboration with the Belfair UGA and distributing the costs proportionally based on existing ERU's. Costs for collection system components will be the sole responsibility of the North Shore service area

Probable Capital Costs

Table 6 presents a comparison of the probable capital costs to implement advanced on-site systems, develop cluster systems, and provide sewer service to the North Shore area.

Table 6
Estimated Probable Capital Costs

	On-site Systems	Sewer	Cluster Systems
Probable Impact (Red) 355 ERU's	$6.6 - 12.4 million	$11.1 million	$8.1 - 11.6 million
Possible Impact (Yellow) 634 ERU's	$11.8 - 22.1 million	$17.9 million	$14.4 - 20.6 million
Potential Impact (Green) 201 ERU's	$3.8 - 7.0 million	$6.1 million	$4.6 - 6.5 million
Total Capital Cost	$22.2 - 41.5 million	$35.1 million	$27.1 - 38.7 million

Probable Operation & Maintenance & Replacement Costs (O&M&R)

Probable annual O&M&R costs for each of the three scenarios, shown in Table 7 below, are presented similarly to the capital costs. The range of costs shown depict the estimated range of annual costs to operate, maintain, and replace required equipment for operating advanced on-site systems, cluster systems, and the centralized sewer system in each impact zone.

Table 7
Estimated Probable O&M&R Costs

	On-site Systems	Sewer	Cluster Systems
Probable Impact (Red) 355 ERU's	$240,000 - 310,000	$130,000	$140,000 - 190,000
Possible Impact (Yellow) 634 ERU's	$430,000 - 550,000	$260,000	$250,000 - 350,000
Potential Impact (Green) 201 ERU's	$140,000 - 180,000	$60,000	$80,000 - 110,000
Total O&M&R Cost	$810,000 - 1,040,000	$450,000	$470,000 - 650,000

Present Worth

The present worth for the three wastewater management scenarios is presented in Table 8. The present worth value compares each of the three options with respect to the probable capital and annual O&M&R costs over the expected 20 year life span.

Table 8
Estimated 20-Year Present Worth

	On-site Systems	Sewer	Cluster Systems
Probable Impact (Red) 355 ERU's	$10.3 - 17.2 million	$13.1 million	$10.3 - 14.6 million
Possible Impact (Yellow) 634 ERU's	$18.5 - 30.7 million	$22.0 million	$18.3 - 26.1 million
Potential Impact (Green) 201 ERU's	$6.0 - 9.8 million	$7.0 million	$5.8 - 8.2 million
Total Present Worth	$34.8 - 57.7 million	$42.1 million	$34.4 - 48.9 million

Summary

The program costs presented in Table 8 represent a range of probable costs for the implementation of the various wastewater management scenarios presented. The range in costs for on-site and cluster systems reflect the variability of these systems with respect to existing site conditions. Site specific evaluations and studies will need to be conducted in the North Shore area to develop more detailed and accurate program costs for on-site and cluster systems. Program costs for the implementation of a centralized sewer system are significantly less dependant on specific site conditions and through previous and current facility planning work, the estimates of probable program costs are more defined.

The development of these scenarios and associated program costs do not take into account impacts on future development and policy implications. The information presented in this memorandum should be used in conjunction with the Lynch cove/North Shore Sewer Service Area Delineation Study, Enhanced Parcel Overlay, Mason County North Shore Area, and other relevant documentation to allow Mason County to make informed decisions regarding wastewater management in the North Shore are of Lower Hood Canal.

TJP: les

APPENDIX F

Date: May 18, 2006

To: Emmett Dobey

From: Board of Mason County Commissioners

Subj: Working Direction Concerning Belfair/Northshore Wastewater Planning

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Following our work session on May 15th, the Commissioners want to give you a working direction for continued planning of the Belfair Urban Growth Area (UGA) wastewater system. This direction is aimed at moving ahead with planning for the Belfair system and completion of the Facilities Plan Amendment (accomplished as an amendment to the Mason County Comprehensive Plan).

Belfair wastewater planning paused to consider whether wastewater management for the North Shore area should to some degree be considered in development of the Belfair UGA Facilities Plan. After considering the rather limited potential effectiveness of many on-site wastewater management approaches in parts of the non-urban North Shore area, we would like planning to proceed under the following assumptions:

1. Provision should be made for treatment and conveyance to accommodate flows from the Mission Creek Correctional Facility at some appropriate location on the Belfair UGA boundary. Mission Creek is an "essential public facility" and is up gradient from North Shore. It is prudent to allow for the possibility of connecting this facility to a wastewater treatment plant.

2. Provision should be made to handle limited wastewater flows from the Belfair State Park and other near-shore existing development between the state park and the western boundary of the Belfair UGA. This is to provide a reliable alternative for addressing the existing public health probable nutrient loading problems in Lynch Cove. Specifically:

    - Consider a pipeline from the western boundary of the Belfair UGA to the State Park sized at a minimum to adequately handle wastewater from the State Park.

    - Estimate and provide for the flows from existing developed near-shore[1] structures along the pipeline that may not have effective on-

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[1] "Near-shore" means existing development between the State Park and the Belfair UGA that is within that part of the fecal coliform "red zone" described in the recent service area analysis that is along the shoreline (i.e., not upland from the shoreline along the lower-elevation fingers of the "red zone").

site treatment options or only have on-site options that are more costly and/or less environmentally effective than sewering.

- Work with state agencies to determine what justification is needed to make this sewer line a viable option and prepare an approach for gathering the needed data so that the Commission will be adequately informed before making final decisions on treatment and conveyance capacities for the Belfair UGA system. Also, develop possible approaches for suitable connection policies and implications for undeveloped near-shore parcels.

Date: August 29, 2006

To: Emmett Dobey

From: Board of Mason County Commissioners

Subj: Working Direction #2 Concerning Belfair/Northshore Wastewater Planning: Schedule Coordination with Highway Improvements and Effluent Fate

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Following our work session on July 31st, the Commissioners want to give you additional working direction for continued planning of the Belfair Urban Growth Area (UGA) wastewater system. The directions in this memorandum are aimed at moving ahead with planning for the Belfair system and completion of the Facilities Plan Amendment (accomplished as an amendment to the Mason County Comprehensive Plan).

Highway 3 Schedule Coordination with Highway Improvements

For some time Mason County has been careful to coordinate planning of the Belfair UGA sewer system with Washington State Department of Transportation (WSDOT) planning for improvements of Highway 3 and the construction of the Belfair Loop. Under ideal circumstances the Loop would be completed first and a main sewer line could be installed as Highway three is reconstructed through Belfair. Our earlier planning indicates a sewer line under the center of Highway 3 is likely the least expensive option since it avoids some conflicts with other installed utilities.

Recent staff and consultant meetings with WSDOT have resulted in two significant findings:

1. WSDOT, while wanting to coordinate, will not approve a main sewer line under the centerline of Highway 3 through Belfair due to anticipated traffic problems in the event of sewer repair. Sewer lines beneath the shoulders and sidewalk areas would be more favorably considered. Our own investigations, however, indicate utility conflicts in these areas would prove more costly than finding right of way opportunities away from the highway.
2. Construction of Highway 3 improvements are not scheduled until after 2009. This is in part due to fund availability and the time needed to do environmental and engineering work. If sewers were built with the road, they may not be available until 2010. The loop appears to be on a schedule that comes later than 2010. We believe we can start construction in 2008 and finish in 2009. It is critical to move quickly to assure our own funding.

Accordingly, we are providing a working direction that sewer planning should not be part of the roadway and routes not part of Highway 3 should be considered to assure timely completion of the Belfair project. Nonetheless, it will be important to be in close contact with WSDOT to coordinate environmental investigations and seek other opportunities where shared efforts can be beneficial for all.

Effluent Fate

It has been clear for some time that Belfair wastewater would need to be treated to a very high standard that allows water re-use and/or discharge to ground upland from Hood Canal. Staff and consultants have presented various options for the location of a discharge and we have also considered sending untreated wastewater to the North Bay utility.

Based on currently thinking, our working direction is to treat Belfair sewage to a very high standard (Class A Reclaimed Water) that allows beneficial re-use options to be developed over time. Initially, the water should be sent to suitable upland locations east of Belfair and possibly south of the power lines for use on property owned by Overton & Associates.

The above are working directions and should not be considered decisions. A decision on the Belfair Facilities Plan Amendment will be part of the Comprehensive Plan update.

Lynda Ring-Erickson, Commission Chair	Tim Sheldon, Commissioner
Jayni Kamin, Commissioner	

APPENDIX G

Technical Memorandum

Date:	**December 22, 2005**		
To:	**Tom Perry** **Murray Smith and Associates**	Project Name:	**Mason County Sewer Area Study**
From:	**AESI Chuck Lindsay/David Baumgarten**	Project No:	**EH04539B**
Subject:	**Potential Site Identification Study for Land Application of Treated Wastewater**		

We understand that Mason County (County) and their consultant, Murray, Smith & Associates, Inc. (MSA), are currently in the process of identifying areas that have the potential to be suitable for the land application of wastewater from a future wastewater treatment facility that may be built to service the Belfair Urban Growth Area (UGA) and selected surrounding areas. This technical memorandum presents our preliminary evaluation of potential site for the land application of treated wastewater in the immediate vicinity of the Belfair Urban Growth Area (UGA).

The suitability of land for the application of wastewater is generally dependent on the four physical parameters listed below.

- Soil type
- Topography
- Geology/Hydrogeology
- Proximity to Surface Water

It is anticipated that several tens of acres of land will be needed to adequately distribute the treated wastewater so as to not exceed the constraints associated the previously listed physical parameters. Therefore, at the request of MSA and the County, we also included parcel size in our evaluation of site suitability. The identification of larger parcels of potential properties is potentially more advantages to the County for the following reasons:

- The selection of larger parcels reduces the number of different owners and, consequently, may minimize the negotiations for long-term lease agreements.
- The larger parcels of land in the vicinity of the UGA are typically owned by county, state of federal government agencies that may be generally agreeable to leasing the property for land application purposes.
- The larger parcels have a higher potential for currently being used for forestry purposes. The land application of treated wastewater has been shown in the past to be beneficial to the increased growth of timber products.

Brief descriptions of each physical parameter used to evaluate the potential land application areas are presented below.

Soil Type

Soil type and thickness are critical physical components for land application of treated wastewater for the following reasons:

- The Washington State Department of Ecology (Ecology) and Washington State Department of Health (DOH) regulations require a minimum of three feet of soil column for the land application of Class A treated wastewater.
- Ecology and DOH guidelines also require surficial soils with a permeability greater than 0.5 inches per hour (in/hr) for the land application of treated wastewater.

Soils in uplands surrounding the Belfair UGA are predominantly Everett and Alderwood series, both of which form on glacial till. Each of these soil types is characterized by a typical soil column of three feet in thickness underlain by very low permeability unweathered glacial till. Rooting depths for most vegetation on Everett and Alderwood soils is relatively shallow and permabilities are typically in the 2 in/hr to 6 in/hr. Both Everett and Alderwood soils are considered suitable for use in land application systems for Class A wastewater.

Topography

The topography/slope of the land surface has a significant influence on the amount of surface water runoff and the direction of flow in the shallow interflow zone. The application of wastewater in areas with steep slopes may result in the surfacing of wastewater effluent (springs) in downslope areas and/or an increase in surface water runoff. The wastewater proposed for potential land application will be treated to Class A wastewater standards. Therefore, the potential for the surfacing of wastewater with elevated nutrient or bacteria levels is not a concern. However, steep slopes are still not ideal for land application purposes due to the significant potential for increase surface water runoff.

The topography in the upland areas surrounding the Belfair UGA is characterized by large elongated hills that have been incised by erosional drainage channels. The elongated hills extend in a northeast to southwest trend correlating to the direction of the movement of the glacial ice that moved across the area in the past. Much of the upland areas are relatively level with minor sloping areas. Therefore, much of the upland area is likely suitable for land application purposes.

Geology/Hydrogeology

The geologic and hydrogeologic setting can have a significant influence on soil type, infiltration rates and ground water conditions. Vashon till is the primary geologic unit present near the ground surface in the upland areas surrounding the Belfair UGA. Vashon till typically consists of a glacial consolidated, very dense, unsorted mixture of sand gravel and cobbles in a silt/clay matrix. Vashon till generally has a low vertical permeability and tends to create a perched water table and interflow zone. The perched water table/interflow zone results from the vertical infiltration of precipitation that accumulates on top of the underlying, low permeability unweathered till surface. The interflow zone is typically relatively thin, ranging from less than one-foot to several feet in thickness.

The soil column that develops on till deposits is typically several feet thick and may be suitable for the infiltration of treated wastewater. However, perched ground water on top of the till could significantly reduce the potential storage area for infiltrated wastewater and, therefore, increase the possibility of surface water runoff and/or ground seepage areas.

Determining the presence/absence of a perched water table/interflow zone at selected locations within the study areas was beyond our scope of services for this project. Once MSA/County has identified several potential parcels, we recommend that exploration pits be completed at the properties to evaluate the potential impact of perch ground water on the suitability of the site for the application of wastewater.

Distance to Surface Water

Distance to surface water was evaluated when identifying potential parcels for land application systems. Class A treated wastewater is of very good quality. Given the quality of the treated wastewater and expected residence time in the subsurface before reaching a ground water discharge point, it is our opinion the potential impacts to surface water quality are negligible. The areas most suitable for land application in the Belfair area are on the uplands above Hood Canal. The only surface water bodies on the upland areas are wetlands, small lakes and seasonal streams which drain the uplands. The DOH and Ecology guidelines dictate a 50 foot setback for land application of treated Class A wastewater to any potable water supply. AESI recommends the 50 foot setback also be applied to any surface water bodies in areas identified for land application of treated wastewater.

Conclusions

We identified four general areas (Area 1 through Area 4) that appear to be potentially suitable for land application of treated wastewater based on our evaluation of the parameters discussed in this technical memorandum (Figure 1). Areas 1 and 2 are located in the uplands north of Hood Canal as shown on Figure 1. Two additional areas (Area 3 and Area 4) are located in the uplands east of Hood Canal (Figure 1). All four areas have adequate soil permeability (Everett and Alderwood soils) and relatively level topography with a few minor surface water bodies. Furthermore, property parcels sizes are generally larger in the identified areas.

APPENDIX H

MSA
Murray, Smith & Associates, Inc.
Engineers/Planners
2707 Colby Avenue, Suite 1110 Everett, WA 98201-3566 PHONE 425.252.9003 TOLL-FREE 888.252.9003 FAX 425.252.8853

MEMORANDUM

DATE: June 30, 2006

PROJECT: Belfair/Lower Hood Canal Water Reclamation Facility Plan Supplemental Information

TO Ken Attebery, Port of Bremerton
Fred Salisbury, Port of Bremerton
Tim Thomson, Port of Bremerton
Dick Fitzwater, Karcher Creek Sewer District
John Poppe, Karcher Creek Sewer District
Maher Abed, City of Port Orchard

FROM: Tom Perry, P.E.
Murray, Smith & Associates, Inc.

RE: SKIA Alternative for Belfair Area Sewer System

The purpose of this memorandum is to follow-up on a meeting with SKIA stakeholders and representatives of Mason County on December 7, 2005 regarding sewer service to the community of Belfair. Mason County is currently in the process of updating the Belfair/Lower Hood Canal Water Reclamation Facilities Plan to consider potential service areas and wastewater management alternatives.

Since the December 7 meeting, Mason County has focused on evaluating and further defining the potential sewer service area in Belfair. The County has recently determined that the Belfair Sewer Service Area will consist of the Belfair Urban Growth Area (UGA) and a portion of the area along the north shore of Lower Hood Canal adjacent to, and including, the Belfair State Park. With the service area defined, the County is proceeding with work necessary to evaluate wastewater management alternatives.

Murray, Smith & Associates, Inc. (MSA) has been retained by Mason County to update the Belfair/Lower Hood Canal Water Reclamation Facilities Plan. MSA's task is to provide supplemental information to the Plan taking into consideration an expanded sewer service area and updated growth projections for the Belfair UGA. This work includes evaluating wastewater management alternatives to providing sewer service to the area, considering collection, conveyance and treatment alternatives. Given the proximity of Belfair to the South Kitsap Industrial Area (SKIA), the County would like to consider the possibility of conveyance of Belfair's wastewater to

SKIA as a conveyance and treatment alternative. The purpose of this memorandum is to document the assumptions that were made in development of the SKIA alternative.

Key Issues and Understanding. The SKIA alternative will convey wastewater from the proposed Belfair Area Sewer System to the SKIA and eventually to the Karcher Creek Treatment Plant via the City of Port Orchard Collection System. To develop this alternative, the SKIA Sub-Area Plan, Appendix G, Wastewater, May 31, 2003 was used to define the proposed SKIA wastewater collection and conveyance system (see Figure 5-1 of Appendix G of the Plan attached).

Based on the SKIA Plan and a meeting with SKIA stakeholders on December 7, 2005, the following assumptions were made in the development of the SKIA alternative:

- **Design Flows:** From Appendix G, SKIA's projected average daily flow by 2021 is 1.2 mgd and with a peaking factor of 3.5, the peak flow is estimated at 4.2 mgd. Due to the large projected growth rate in the Belfair UGA over the next 20 years, over 9% annually, a 10-year design period will be used to size Belfair's conveyance and treatment system components. This equates to an average daily flow of 0.40 mgd and a peak flow of 1.4 mgd (3.5 peaking factor). Total design flows from the Belfair/SKIA system would be 1.6 mgd average and 5.6 mgd peak.

- **Belfair System:** Wastewater flows from the Belfair Area will be conveyed to the proposed SKIA Pump Station #4 located near the intersection of SR-3 and Lake Flora Road in the southern portion of SKIA (Figure 5-1). All costs for the conveyance of wastewater from Belfair to this point will be the sole responsibility of the Belfair Area Sewer System.

- **Belfair/SKIA System:** Between Pump Station #4 and the connection to ULID #6, conveyance system components will be upsized from what is identified in the SKIA plan (Figure 5-1) to accommodate the design flows from Belfair. Costs for these shared facilities, gravity sewers, pump stations and force mains, will be based on a percentage of volumetric capacity of the conveyance component allocated to each service area.

- **Downstream Impacts:** Insufficient information is available to assess downstream impacts on the City of Port Orchard's system. Discussions with the City and the former Public Works Director indicate that improvements have been made to accommodate flow from the SKIA area and there is capacity to accommodate the initial flows from the Belfair/SKIA service areas. As identified in the SKIA plan, downstream impacts, starting at the connection to ULID #6, are not distinguished as a separate capital cost, but are included in the connection charge.

- **Treatment Plant Impacts:** From discussions with City of Port Orchard and Karcher Creek Sewer District the treatment facility has capacity to accommodate Belfair and SKIA. Impacts to the treatment facility are not distinguished as separate capital costs, but are included in the connection charge.

- **Operation and Maintenance:** Belfair's collection and conveyance systems will be owned, operated and maintained by Mason County up to the connection with the SKIA system. Based on the SKIA plan and the Interlocal Agreement between the City of Port Orchard and the Port of Bremerton, the SKIA system will be operated and maintained by the City of Port Orchard, this will include conveyance system components used by Belfair and SKIA.

- **Connection Charges and Fees:** For connection to ULID #6 collection system, late-comer charges of $720 per equivalent residential connection are identified in the SKIA plan. Currently, Port Orchard's connection fees for an equivalent residential connection are $6,000 - approximately $2,750 towards sewer collection/conveyance and $3,250 towards treatment plant. For the purpose of developing this alternative for the Belfair Area Sewer System both late-comer charges ($720) and connection fees ($6,000) will be included in the cost estimate.

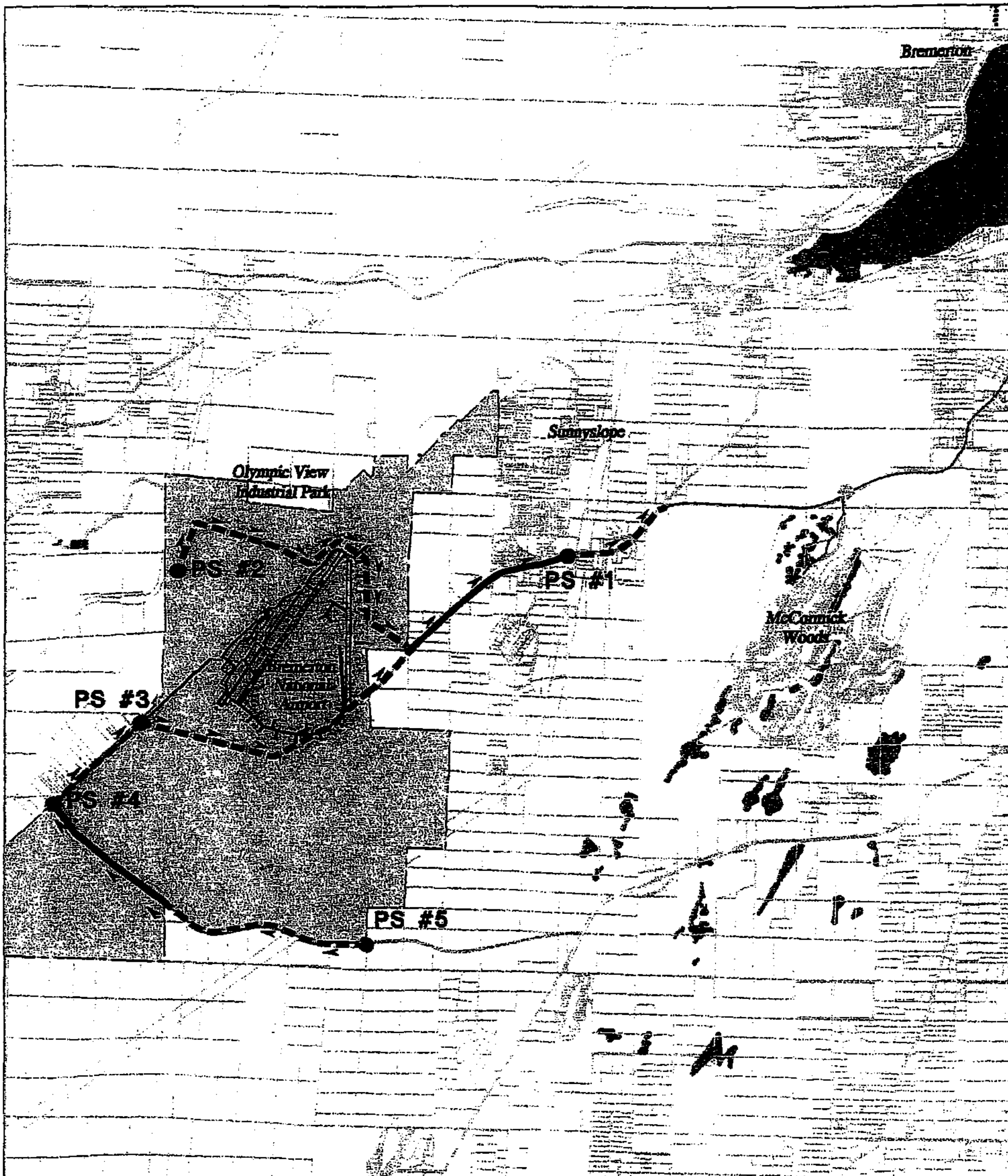
- **Sewer Rates:** The City currently has a monthly sewer rate of $36.00 per ERU. A surcharge of 50% is applied to customers outside the City limits. City records have identified that approximately $21.00 of the monthly rate is for treatment expenses. This rate was recently increased by $9.00 per month to accommodate debt service on treatment facility improvements. The rate increase was based on a 3% growth factor. The initial 900 ERU's, and the projected 2,000 ERU's in ten years, from the Belfair system will substantially impact the City's rate base, reducing the need for the recent rate increase. In addition, a portion of the rate component for the operation and maintenance of the collection system will not be necessary since Mason County will be responsible for those duties up to the connection with SKIA. Taking into consideration these factors, it is anticipated that a rate similar to the City rate without the 50% surcharge will be applicable for the Belfair system.

These initial assumptions presented are for a planning level assessment of the SKIA alterntive and the development of planning level probable program costs. This information will be utilized in the analysis of wastewater management alternatives for the Belfair Area Sewer System and will be documented in the Facility Plan Supplemental Information. Further and detailed consideration of these assumptions, particularly the structure of connection fees and rates, is necessary if and when this alternative is pursued further.

TJP: les

cc: Emmett Dobey, Mason County
Mike Sharar, Mike Sharar Consulting

Enclosure



FILE: FIGURES-2
DATE: 07/10/01

N

0 2250' 4500'
SCALE: 1"=4500'

LEGEND

GRAVITY FLOW
FORCE MAIN FLOW
PUMP STATION
DOWNSTREAM IMPACTS

Figure 5-1
PREFERRED CONVEYANCE SYSTEM

APPENDIX I

SEWER HYDRAULICS

Project No. 05-0772.107
DATE: 8/15/2006
COMP. BY: NPH
CHECKED BY: TJP

PIPE "n" FACTORS:
CMP: 0.024 CONC: 0.013 BRICK: 0.017 CAST IRON: 0.013
PVC: 0.009 STEEL: 0.011 VIT CLAY: 0.014 HELI-CMP: 0.014

Basins East of the Railroad not included in the SR3 pipeline flows - "Belfair UGA (w/out Overton) and State Park"

Nodes		Basins/Pipelines Directly Entering Up Stream Node	Basin Pipe Flows Added	Q Entering	Peaking Factor	Q total	PIPE DATA				PIPE FLOW - FULL		
UP STR.	DWN STR.		(cfs)	(cfs)		(cfs)	DIA (in)	SLOPE (%)	PIPE "n"	CAP (cfs)	EFF (%)	AREA (sft)	Rh. (ft)
SR3 Pipelines													
G	I	Overton	0.189	0.000	3.50	0.66	**8**	0.400	0.013	0.76	115%	0.349	0.167
I	H	I1	0.017	0.189	3.50	0.72	**8**	0.400	0.013	0.76	106%	0.349	0.167
H	F	F1, H1	0.040	0.206	3.50	0.86	**10**	0.280	0.013	1.16	135%	0.545	0.208
F	E	Old Belfair, E1, E2, M1	0.578	0.246	3.50	2.88	**18**	0.120	0.013	3.64	126%	1.767	0.375
C	D	C3, PS2	0.212	0.000	3.50	0.74	**8**	0.400	0.013	0.76	103%	0.349	0.167
D	E	D1,D2	0.116	0.212	3.50	1.15	**10**	0.280	0.013	1.16	101%	0.545	0.208
C	B	C1,C2	0.055	0.000	3.50	0.19	**8**	0.400	0.013	0.76	397%	0.349	0.167
A	B	A1, A2, B1, B2	0.136	0.000	3.50	0.47	**8**	0.400	0.013	0.76	161%	0.349	0.167
Roy Road Pipeline													
N	L	N1	0.048	0.000	3.50	0.17	**8**	0.400	0.013	0.76	456%	0.349	0.167
M	L	State Park	0.127	0.000	3.50	0.44	**8**	0.400	0.013	0.76	172%	0.349	0.167
Old Belfair Pipeline													
L	F	St Pk, Roy Rd., L2, L1,L3	0.522	0.000	3.50	1.83	**15**	0.150	0.013	2.50	137%	1.227	0.313
Overton Pipeline													
J	G	J1	0.189	0.000	3.50	0.66	**8**	0.400	0.013	0.76	115%	0.349	0.167

Overton Property:

Nodes		Basins/Pipelines Directly Entering Up Stream Node	Basin Pipe Flows Added	Cum Q Entering	Peaking Factor	Q total	PIPE DATA				PIPE FLOW - FULL		
UP STR.	DWN STR.		(cfs)	(cfs)		(cfs)	DIA (in)	SLOPE (%)	PIPE "n"	CAP (cfs)	EFF (%)	AREA (sft)	Rh. (ft)
Railroad Pipelines													
1	2	K1, K2	0.797	0.000	3.50	2.79	**18**	0.120	0.013	3.64	130%	1.767	0.375
2	3	J2	0.231	0.797	3.50	3.60	**18**	0.120	0.013	3.64	101%	1.767	0.375
3	4	B3	0.196	1.028	3.50	4.28	**21**	0.100	0.013	5.01	117%	2.405	0.438

Pump Stations:

Pump Station	Location	Basins Served	(cfs) entering	ratio of UGA flow
PS 1	NODE E	All Basins and State Park except for J2, K1, K2, B3	4.70	0.54
PS 2	NODE B	A1, A2, B1, B2, C1, C2	0.67	0.08
PS 4	NODE K	K1	0.45	0.05

Total Peak Flow at Build-out = 8.982 cfs Includes All basins and State Park
5.80 MGD

UGA Total Peak Flow at Build-out = 8.54 cfs
5.52 MGD

BASIN SANITARY SEWER FLOW

Project No. 05-0772.107
DATE: 8/15/2006
COMP. BY: NPH
CHECKED BY: TJP

Basin A1

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential			0.00	0.00	0.00	3.00	0.00	204.80	-	0.00
R-5 Med. Density Residential			0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	2.58		0.52	0.52	1.55	-	-	-	1800	2789.26
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	2.58				1.55		0.00			2789.26
								ratio of total flow =		0.00

Basin A2

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential	30.48	15.24	3.05	3.05	9.14	3.00	27.43	204.80	-	5617.19
R-5 Med. Density Residential			0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	7.83	0.00	1.57	1.57	4.70	-	-	-	1800	8460.74
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	38.31				13.84		27.43			14077.93

ratio of total flow = 0.01

Basin B1

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential			0.00	0.00	0.00	3.00	0.00	204.80	-	0.00
R-5 Med. Density Residential			0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	19.48	0.97	3.70	3.70	11.11	-	-	-	1800	19991.22
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	19.48				11.11		0.00			19991.22

ratio of total flow = 0.01

Basin B2

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential	66.58	42.93	4.73	4.73	14.19	3.00	42.57	204.80	-	8718.69
R-5 Med. Density Residential	4.98	0.80	0.84	0.84	2.51	5.00	12.55	204.80	-	2569.59
R-10 Multi-Family Residential	16.31		3.26	3.26	9.79	10.00	97.88	204.80	-	20045.41
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	18.00		3.60	3.60	10.80	-	-	-	1800	19440.00
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	105.87				37.29		153.00			50773.70

ratio of total flow = 0.03

Basin B3

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential			0.00	0.00	0.00	3.00	0.00	204.80	-	0.00
R-5 Med. Density Residential	184.64		36.93	36.93	110.79	5.00	553.93	204.80	-	113445.20
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	12.41		2.48	2.48	7.44	-	-	-	1800	13400.72
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	197.05				118.23		553.93			126845.93

ratio of total flow = 0.09

Basin C1

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential	28.85	13.76	3.02	3.02	9.05	3.00	27.16	204.80	-	5562.00
R-5 Med. Density Residential			0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	11.89	5.47	1.28	1.28	3.85	-	-	-	1800	6931.41
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	40.74				12.90		27.16			12493.41

ratio of total flow = 0.01

Basin C2

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential	26.16	18.17	1.60	1.60	4.79	3.00	14.38	204.80	-	2944.53
R-5 Med. Density Residential	13.00	13.00	0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	21.18	2.52	3.73	3.73	11.20	-	-	-	1800	20151.84
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	60.34				15.99		14.38			23096.37

ratio of total flow = 0.02

Basin C3

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential	2.92	1.46	0.29	0.29	0.88	3.00	2.63	204.80	-	537.74
R-5 Med. Density Residential			0.29	-0.07	1.24	5.00	6.20	204.80	-	1269.65
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	14.75	3.57	2.24	2.24	6.71	-	-	-	1800	12081.58
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	17.67				8.83		8.83			13888.97

ratio of total flow = 0.01

Basin D1

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential			0.00	0.00	0.00	3.00	0.00	204.80	-	0.00
R-5 Med. Density Residential			0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	24.14	10.04	2.82	2.82	8.46	-	-	-	1800	15224.09
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	24.14				8.46		0.00			15224.09

ratio of total flow = 0.01

Basin D2

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential	83.57	51.76	6.36	6.36	19.08	3.00	57.25	204.80	-	11724.98
R-5 Med. Density Residential	15.85	2.75	2.62	2.62	7.85	5.00	39.27	204.80	-	8043.18
R-10 Multi-Family Residential	36.14	10.70	5.09	5.09	15.26	10.00	152.62	204.80	-	31257.02
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	7.85		1.57	1.57	4.71	-	-	-	1800	8480.03
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	143.40				46.91		249.15			59505.21

ratio of total flow = 0.04

Basin E1

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential			0.00	0.00	0.00	3.00	0.00	204.80	-	0.00
R-5 Med. Density Residential			0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential	23.47	10.80	2.53	2.53	7.60	10.00	76.01	204.80	-	15566.54
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	4.10		0.82	0.82	2.46	-	-	-	1800	4431.85
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	27.58				10.06		76.01			19998.39

ratio of total flow = 0.01

Basin E2

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential			0.00	0.00	0.00	3.00	0.00	204.80	-	0.00
R-5 Med. Density Residential			0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	4.34		0.87	0.87	2.60	-	-	-	1800	4684.85
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	4.34				2.60		0.00			4684.85

ratio of total flow = 0.00

Basin F1

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential			0.00	0.00	0.00	3.00	0.00	204.80	-	0.00
R-5 Med. Density Residential			0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential	7.14	3.57	0.71	0.71	2.14	10.00	21.42	204.80	-	4385.82
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	5.37		1.07	1.07	3.22	-	-	-	1800	5804.90
GC General Commercial	2.60		0.52	0.52	1.56	-	-	-	2000	3124.34
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	15.12				6.93		21.42			13315.06

ratio of total flow = 0.01

Basin H1

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential			0.00	0.00	0.00	3.00	0.00	204.80	-	0.00
R-5 Med. Density Residential			0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential	9.16	4.58	0.92	0.92	2.75	10.00	27.47	204.80	-	5626.66
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use			0.00	0.00	0.00	-	-	-	1800	0.00
GC General Commercial	5.80		1.16	1.16	3.48	-	-	-	2000	6957.42
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	14.96				6.23		27.47			12584.08

ratio of total flow = 0.01

Basin I1

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential			0.00	0.00	0.00	3.00	0.00	204.80	-	0.00
R-5 Med. Density Residential			0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	2.43		0.49	0.49	1.46	-	-	-	1800	2621.60
GC General Commercial	6.81		1.36	1.36	4.09	-	-	-	2000	8174.76
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	9.24				5.54		0.00			10796.37

ratio of total flow = 0.01

Basin J1

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential	280.86	28.05	50.56	50.56	151.69	3.00	455.06	204.80	-	93196.57
R-5 Med. Density Residential	61.78	14.21	9.52	9.52	28.55	5.00	142.74	204.80	-	29232.53
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use			0.00	0.00	0.00	-	-	-	1800	0.00
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	342.65				180.23		597.80			122429.10

ratio of total flow = 0.08

Basin J2

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential	1.35		0.27	0.27	0.81	3.00	2.43	204.80	-	498.51
R-5 Med. Density Residential	278.75	36.80	48.39	48.39	145.17	5.00	725.85	204.80	-	148654.23
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use			0.00	0.00	0.00	-	-	-	1800	0.00
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	280.10				145.98		728.28			149152.74

ratio of total flow = 0.10

Basin K1

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential			0.00	0.00	0.00	3.00	0.00	204.80	-	0.00
R-5 Med. Density Residential			0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use			0.00	0.00	0.00	-	-	-	1800	0.00
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial	108.34		21.67	21.67	65.00	-	-	-	3000	195003.20
GC-BI	80.88		16.18	16.18	48.53				2000.00	97060.99
Total=	189.22				113.53		0.00			292064.19

ratio of total flow = 0.20

Basin K2

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential			0.00	0.00	0.00	3.00	0.00	204.80	-	0.00
R-5 Med. Density Residential	2.17		0.43	0.43	1.30	5.00	6.50	204.80	-	1330.55
R-10 Multi-Family Residential	76.98		15.40	15.40	46.19	10.00	461.91	204.80	-	94598.80
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use			0.00	0.00	0.00	-	-	-	1800	0.00
GC General Commercial	106.05		21.21	21.21	63.63	-	-	-	2000	127263.31
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
GC-BI	20.88		0.00	5.22	15.66				0.00	0.00
Total=	206.09				126.79		468.41			223192.67

ratio of total flow = 0.15

Basin L1

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential			0.00	0.00	0.00	3.00	0.00	204.80	-	0.00
R-5 Med. Density Residential			0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail	5.59		1.12	1.12	3.36	-	-	-	1800	6041.70
MU Mixed Use	4.34		0.87	0.87	2.60	-	-	-	1800	4684.85
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	9.93				5.96		0.00			10726.55

ratio of total flow = 0.01

Basin L2

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture	9.62		1.92	1.92	5.77	0.10	0.58	204.80	-	118.19
R-3 - Single Family Residential	375.08	76.53	59.71	59.71	179.13	3.00	537.39	204.80	-	110056.59
R-5 Med. Density Residential	181.80	40.86	28.19	28.19	84.56	5.00	422.80	204.80	-	86590.28
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	14.85	3.44	2.28	2.28	6.85	-	-	-	1800	12323.59
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	581.35				276.31		960.77			209088.65

ratio of total flow = 0.14

Basin L3

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential			0.00	0.00	0.00	3.00	0.00	204.80	-	0.00
R-5 Med. Density Residential			0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail	1.61		0.32	0.32	0.97	-	-	-	1800	1739.56
MU Mixed Use	2.64		0.53	0.53	1.58	-	-	-	1800	2850.34
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	4.25				2.55		0.00			4589.89

ratio of total flow = 0.00

Basin M1

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential			0.00	0.00	0.00	3.00	0.00	204.80	-	0.00
R-5 Med. Density Residential			0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail	10.50		2.10	2.10	6.30	-	-	-	1800	11334.76
MU Mixed Use			0.00	0.00	0.00	-	-	-	1800	0.00
GC General Commercial			0.00	0.00	0.00	-	-	-	2000	0.00
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	10.50				6.30		0.00			11334.76

ratio of total flow = 0.01

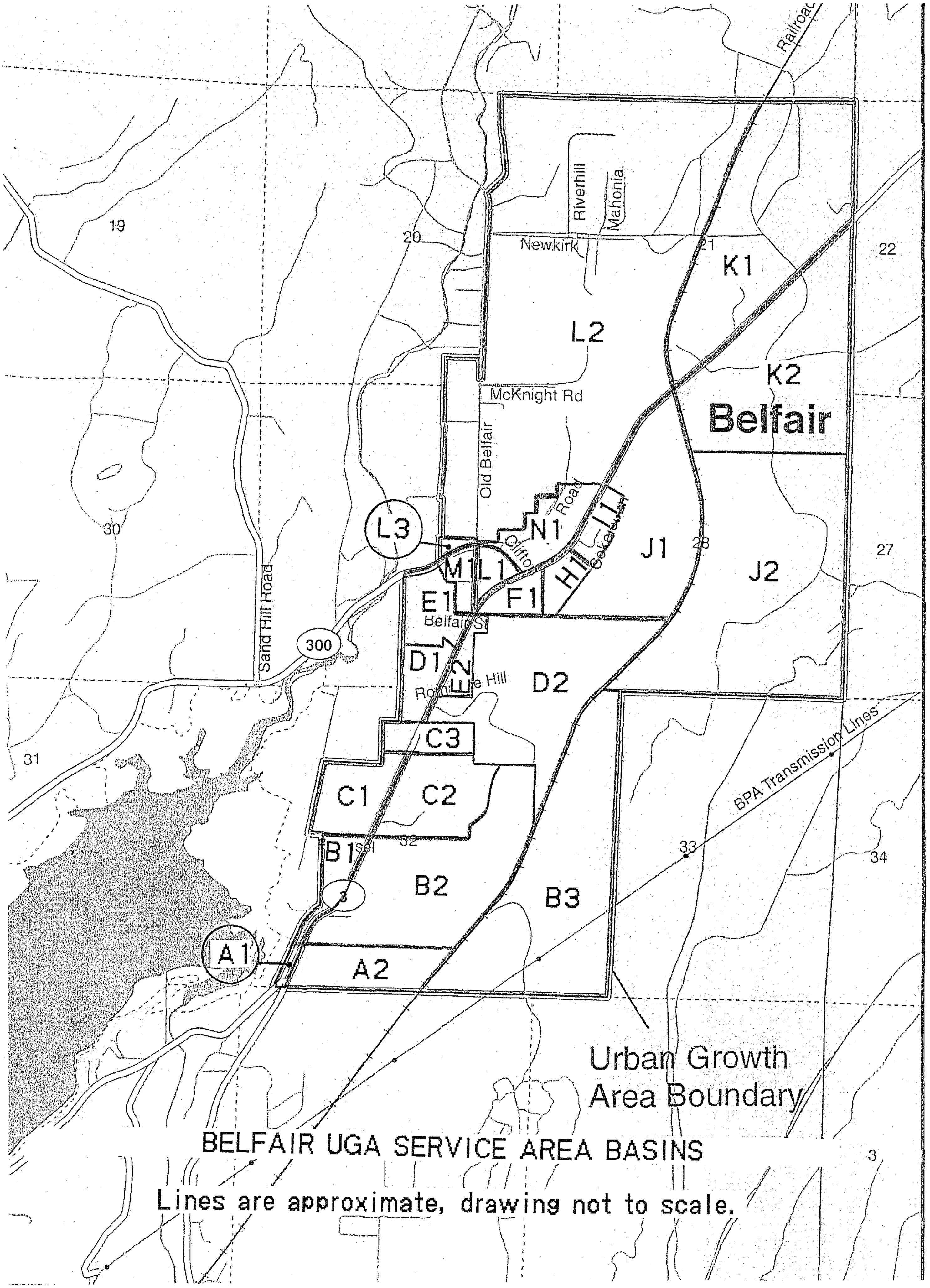
Basin N1

Zone	Total Acres	Unsuitable Land (Acres)	20% Roads (Acres)	25% Market Factor (Acres)	Buildable (Acres)	EDUs per Acre (Units)	Total EDUs	Gal. per EDU (GPD)	Gal. per Acre (GPD)	Total Flow (GPD)
LTA Long Term Agriculture			0.00	0.00	0.00	0.10	0.00	204.80	-	0.00
R-3 - Single Family Residential			0.00	0.00	0.00	3.00	0.00	204.80	-	0.00
R-5 Med. Density Residential			0.00	0.00	0.00	5.00	0.00	204.80	-	0.00
R-10 Multi-Family Residential			0.00	0.00	0.00	10.00	0.00	204.80	-	0.00
FR Festival Retail			0.00	0.00	0.00	-	-	-	1800	0.00
MU Mixed Use	13.51		2.70	2.70	8.11	-	-	-	1800	14595.54
GC General Commercial	13.61		2.72	2.72	8.16	-	-	-	2000	16327.43
BI Business-Industrial			0.00	0.00	0.00	-	-	-	3000	0.00
Total=	27.12				16.27		0.00			30922.97
								ratio of total flow =		0.02

Belfair State Park flows= 81948 GPD 2015 Projected Flows for Delineated "Red Zone" Area

Fraction of Land for Roads	0.20	
Market Factor	0.25	
Persons per household	2.56	Page 4-23 2003 Water Reclamation Facilities Plan
Gallons per Capital per Day	80.00	Page 4-23 2003 Water Reclamation Facilities Plan
FR Festival Retail	1800	GPD
MU Mixed Use	1800	GPD
GC General Commercial	2000	GPD
BI Business-Industrial	3000	GPD
GC-BI	2000	GPD

total buildable acres=	1180.39	
total acres=	2,372.02	Acres
total flow=	1,535,514.36	GPD
total EDUs=	3914.02	
total acres from UGA map=	2,338.85	Acres
total peak flow =	8.31	cfs
total commercial flow=	651975.89	GPD
	744,258.83	
overton buildable acres=	504.53	



BELFAIR UGA SERVICE AREA BASINS

Lines are approximate, drawing not to scale.

MSA

APPENDIX J

Facility Plan Supplemental Information
Treatment Alternative 1 - Belfair SBR

Items of Work and Materials		Quantity	Unit	Unit Price	Total Amount
	Mobilization	1	LS	8%	$623,938.40
Site Work (WRF)					
	Clear and Grub	15	Acre	$5,000.00	$75,000.00
	Drainage	1	LS	$40,000.00	$40,000.00
	Access Road	10000	LF	$34.00	$340,000.00
	Fence	2600	LF	$20.00	$52,000.00
	Erosion Control	1	LS	$50,000.00	$50,000.00
	Monitoring Wells	8	EA	$3,000.00	$24,000.00
				Sub-Total	**$581,000.00**
Headworks					
	Influent Mag Meter	1	LS	$10,000.00	$10,000.00
	1/8" Screen	1	LS	$95,000.00	$95,000.00
	Grit Removal	1	LS	$100,000.00	$100,000.00
	Structure	1	LS	$75,000.00	$75,000.00
	Sampler	1	LS	$5,000.00	$5,000.00
	Miscellaneous	1	LS	$30,000.00	$30,000.00
				Sub-Total	**$315,000.00**
SBR Unit w/equalization basin					
	Excavation	8900	CY	$9.00	$80,100.00
	Backfill (structural)	1650	CY	$22.00	$36,300.00
	Drainage	1	LS	$5,000.00	$5,000.00
	Concrete (slab)	725	CY	$450.00	$326,250.00
	Concrete (walls)	850	CY	$750.00	$637,500.00
	Concrete (elevated walk)	18	CY	$1,100.00	$19,800.00
	Handrail	200	LF	$20.00	$4,000.00
	Stairways	2	EA	$3,500.00	$7,000.00
	Miscellaneous Metal	1	LS	$25,000.00	$25,000.00
	SBR Process Equipment	1	LS	$650,000.00	$650,000.00
	Equalization Pump	2	EA	$12,000.00	$24,000.00
	Painting/Coatings	1	LS	$30,000.00	$30,000.00
				Sub-Total	**$1,844,950.00**
Effluent Filter and Disinfection					
	Cloth Filter System	1	LS	$375,000.00	$375,000.00
	UV Equipment	1	LS	$300,000.00	$300,000.00
	Concrete Channel	26	CY	$750.00	$19,500.00
	Covered Structure - Concrete	100	CY	$450.00	$45,000.00
	Covered Structure - Roof	1	LS	$10,000.00	$10,000.00
				Sub-Total	**$749,500.00**
Control Building					
	Building Structure	1800	SF	$120.00	$216,000.00
				Sub-Total	**$216,000.00**
Plant Drain					
	WRF drain pump	1	LS	$40,000.00	$40,000.00
	Wetwell	1	LS	$6,500.00	$6,500.00
				Sub-Total	**$46,500.00**
Effluent Pond					
	Excavation	6900	CY	$9.00	$62,100.00
	Fill	1300	CY	$12.00	$15,600.00
	40 mil PVC Geomembrane	20,000	SF	$0.75	$15,000.00
	8" Gravel	500	CY	$22.00	$11,000.00
	12" Sand	750	CY	$22.00	$16,500.00
	Fencing w/access gates	1200	LF	$20.00	$24,000.00
	Pump Station	1	LS	$175,000.00	$175,000.00
				Sub-Total	**$319,200.00**
Class A Storage Pond					
	Excavation	60,000	CY	$9.00	$540,000.00
	Fill	3,400	CY	$12.00	$40,800.00
	8" Gravel	5,400	CY	$22.00	$118,800.00
	Pump Station	1	LS	$175,000.00	$175,000.00
				Sub-Total	**$874,600.00**

Spray field					
	Valve Vault	1	LS	$10,000.00	$10,000.00
	8" Automated Valves & Piping	1	LS	$22,000.00	$22,000.00
	8" HDPE from WRF to Vault (buried)	1700	LF	$60.00	$102,000.00
	8" HDPE from Vault to fields (overland)	2000	LF	$25.00	$50,000.00
	3" HDPE Laterals	20000	LF	$8.00	$160,000.00
	Irrigation Heads	525	EA	$250.00	$131,250.00
	HDPE Fittings	1	LS	$3,000.00	$3,000.00
	Clear and Grub	33	Acres	$5,000.00	$165,000.00
	Water Level Sensors	3	EA	$2,000.00	$6,000.00
	Sprayfield pump station	1	LS	$175,000.00	$175,000.00
				Sub-Total	**$824,250.00**
Digesters / Storage					
	Excavation	3400	CY	$9.00	$30,600.00
	Backfill (structural)	1340	CY	$22.00	$29,480.00
	Drainage	1	LS	$5,000.00	$5,000.00
	Concrete (slab)	235	CY	$350.00	$82,250.00
	Concrete (walls)	265	CY	$700.00	$185,500.00
	Elevated Walk	45	LF	$200.00	$9,000.00
	Handrail	45	LF	$20.00	$900.00
	Stairways	1	EA	$3,500.00	$3,500.00
	Miscellaneous Metal	1	LS	$10,000.00	$10,000.00
	Air Diffusers	1	LS	$30,000.00	$30,000.00
	Digester Piping, Valves and Mechanical	1	LS	$15,000.00	$15,000.00
	Decant System	2	EA	$4,000.00	$8,000.00
	Blowers	2	EA	$8,000.00	$16,000.00
				Sub-Total	**$425,230.00**
Process Water System					
	Process Water System	1	LS	$23,000.00	$23,000.00
				Sub-Total	**$23,000.00**
Site Piping					
	Piping	1	LS	$320,000.00	$320,000.00
				Sub-Total	**$320,000.00**
Site Electrical					
	Electrical Service	1	LS	$100,000.00	$100,000.00
	On-Site Electrical	1	LS	$975,000.00	$975,000.00
	Stand-by Generator	1	LS	$105,000.00	$105,000.00
	SCADA/Telemetry	1	LS	$80,000.00	$80,000.00
				Sub-Total	**$1,260,000.00**
	SUBTOTAL				**$8,423,168.40**
	CONTINGENCY (20%)				**$1,684,633.68**
	GRAND TOTAL				**$10,107,802.08**
	SALES TAX (8.3%)				**$838,947.57**
	TOTAL				**$10,946,749.65**

Property Acquisition Costs					
	Utility Easements 15' permanents	0	Acre	$10,000.00	$0.00
	Property Acquisition WRF Site	15	Acre	$10,000.00	$150,000.00
	Administration	3	Ea. File	$2,000.00	$6,000.00
	SUBTOTAL				**$156,000.00**
	CONTINGENCY (20%)				**$31,200.00**
	TOTAL				**$187,200.00**

Engineering, Environmental & Admin					
	EIS	1	LS	$55,000.00	$55,000.00
	Siting Study	1	LS	$60,000.00	$60,000.00
	Engineering (13% of construction)	1	LS	$1,314,014.27	$1,314,014.27
	Administration (9%of Construction)	1	LS	$909,702.19	$909,702.19
	SUBTOTAL				**$2,338,716.46**
	CONTINGENCY (10%)				**$233,871.65**
	TOTAL				**$2,572,588.10**

GRAND TOTAL **$13,706,537.76**

DRAFT

Facility Plan Supplemental Information
Treatment Alternative 2 - Belfair MBR

	Items of Work and Materials	Quantity	Unit	Unit Price	Total Amount
	Mobilization	1	LS	8%	$592,866.40
Site Work (WRF)					
	Clear and Grub	15	Acre	$5,000.00	$75,000.00
	Drainage	1	LS	$40,000.00	$40,000.00
	Access Road	10000	LF	$34.00	$340,000.00
	Fence	2600	LF	$20.00	$52,000.00
	Erosion Control	1	LS	$50,000.00	$50,000.00
	Monitoring Wells	8	EA	$3,000.00	$24,000.00
				Sub-Total	**$581,000.00**
Headworks					
	Influent Mag Meter	1	LS	$10,000.00	$10,000.00
	1/8" Screen	1	LS	$95,000.00	$95,000.00
	Grit Removal	1	LS	$100,000.00	$100,000.00
	Structure	1	LS	$75,000.00	$75,000.00
	Sampler	1	LS	$5,000.00	$5,000.00
	Miscellaneous	1	LS	$30,000.00	$30,000.00
				Sub-Total	**$315,000.00**
MBR					
	Excavation	3000	CY	$9.00	$27,000.00
	Backfill (structural)	920	CY	$22.00	$20,240.00
	Drainage	1	LS	$5,000.00	$5,000.00
	Concrete (slab)	200	CY	$450.00	$90,000.00
	Concrete (walls)	400	CY	$750.00	$300,000.00
	Elevated Walk	60	LF	$200.00	$12,000.00
	Handrail	60	LF	$20.00	$1,200.00
	Stairways	2	EA	$3,500.00	$7,000.00
	Miscellaneous Metal	1	LS	$20,000.00	$20,000.00
	MBR Process Equipment	1	LS	$1,530,000.00	$1,530,000.00
				Sub-Total	**$2,012,440.00**
Effluent Disinfection					
	UV Equipment	1	LS	$250,000.00	$250,000.00
	Concrete Channel	26	CY	$750.00	$19,500.00
	Covered Structure - Concrete	83	CY	$500.00	$41,500.00
	Covered Structure - Roof	1	LS	$7,000.00	$7,000.00
				Sub-Total	**$318,000.00**
Equipment Building					
	Building Structure	1800	SF	$120.00	$216,000.00
				Sub-Total	**$216,000.00**
Plant Drain					
	WRF drain pump	1	LS	$40,000.00	$40,000.00
	Wetwell	1	LS	$6,500.00	$6,500.00
				Sub-Total	**$46,500.00**
Effluent Pond					
	Excavation	6900	CY	$9.00	$62,100.00
	Fill	1300	CY	$12.00	$15,600.00
	40 mil PVC Geomembrane	20,000	SF	$0.75	$15,000.00
	8" Gravel	500	CY	$22.00	$11,000.00
	12" Sand	750	CY	$22.00	$16,500.00
	Fencing w/access gates	1200	LF	$20.00	$24,000.00
	Pump Station	1	LS	$175,000.00	$175,000.00
				Sub-Total	**$319,200.00**
Class A Storage Pond					
	Excavation	60,000	CY	$9.00	$540,000.00
	Fill	3,400	CY	$12.00	$40,800.00
	8" Gravel	5,400	CY	$22.00	$118,800.00
	Pump Station	1	LS	$175,000.00	$175,000.00
				Sub-Total	**$874,600.00**

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Spray field					
	Valve Vault	1	LS	$10,000.00	$10,000.00
	8" Automated Valves & Piping	1	LS	$22,000.00	$22,000.00
	8" HDPE from WRF to Vault (buried)	1700	LF	$60.00	$102,000.00
	8" HDPE from Vault to fields (overland)	2000	LF	$25.00	$50,000.00
	3" HDPE Laterals	20000	LF	$8.00	$160,000.00
	Irrigation Heads	525	EA	$250.00	$131,250.00
	HDPE Fittings	1	LS	$3,000.00	$3,000.00
	Clear and Grub	33	Acres	$5,000.00	$165,000.00
	Water Level Sensors	3	EA	$2,000.00	$6,000.00
	Sprayfield pump station	1	LS	$175,000.00	$175,000.00
				Sub-Total	**$824,250.00**
Digesters / Storage					
	Excavation	2850	CY	$9.00	$25,650.00
	Backfill (structural)	1120	CY	$22.00	$24,640.00
	Drainage	1	LS	$5,000.00	$5,000.00
	Concrete (slab)	180	CY	$450.00	$81,000.00
	Concrete (walls)	215	CY	$750.00	$161,250.00
	Elevated Walk	40	LF	$200.00	$8,000.00
	Handrail	40	LF	$20.00	$800.00
	Stairways	1	EA	$3,500.00	$3,500.00
	Miscellaneous Metal	1	LS	$10,000.00	$10,000.00
	Air Diffusers	1	LS	$30,000.00	$30,000.00
	Digester Piping, Valves and Mechanical	1	LS	$15,000.00	$15,000.00
	Decant System	2	EA	$4,000.00	$8,000.00
	Blowers	2	EA	$8,000.00	$16,000.00
				Sub-Total	**$388,840.00**
Process Water System					
	Process Water System	1	LS	$20,000.00	$20,000.00
				Sub-Total	**$20,000.00**
Site Piping					
	Piping	1	LS	$300,000.00	$300,000.00
				Sub-Total	**$300,000.00**
Site Electrical					
	Electrical Service	1	LS	$100,000.00	$100,000.00
	On-Site Electrical	1	LS	$925,000.00	$925,000.00
	Stand-by Generator	1	LS	$105,000.00	$105,000.00
	SCADA/Telemetry	1	LS	$65,000.00	$65,000.00
				Sub-Total	**$1,195,000.00**
	SUBTOTAL				**$8,584,696.40**
	CONTINGENCY (20%)				**$1,716,939.28**
	SUBTOTAL				**$10,301,635.68**
	SALES TAX (8.3%)				**$855,035.76**
	TOTAL				**$11,156,671.44**

Property Acquisition Costs					
	Utility Easements 15' permanents	0	Acre	$10,000.00	$0.00
	Property Acquisition WRF Site	15	Acre	$10,000.00	$150,000.00
	Administration	3	Ea. File	$2,000.00	$6,000.00
	SUBTOTAL				**$156,000.00**
	CONTINGENCY (20%)				**$31,200.00**
	TOTAL				**$187,200.00**

Engineering, Environmental & Admin					
	Environmental Reviews/Permitting	1	LS	$210,000.00	$210,000.00
	Siting Study	1	LS	$60,000.00	$60,000.00
	Engineering (11% of construction)	1	LS	$1,133,179.92	$1,133,179.92
	Administration (9%of Construction)	1	LS	$927,147.21	$927,147.21
	SUBTOTAL				**$2,330,327.14**
	CONTINGENCY (10%)				**$233,032.71**
	TOTAL				**$2,563,359.85**

GRAND TOTAL **$13,907,231.29**

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Facility Plan Supplemental Information
Treatment Alternative 3 - Expansion of NB-CI Facility

Items of Work and Materials		Quantity	Unit	Unit Price	Total Amount
	Mobilization	1	LS	8%	$384,090.40
Headworks					
	Influent Mag Meter	1	LS	$12,000.00	$12,000.00
	Piping Modifications	1	LS	$5,000.00	$5,000.00
	Collection Basin	1	LS	$2,000.00	$2,000.00
	New 1/8" Drum Screen	1	LS	$102,000.00	$102,000.00
	Grit Removal	1	LS	$0.00	$0.00
	Structure modifications	1	LS	$15,000.00	$15,000.00
				Sub-Total	**$136,000.00**
New MBR					
	Excavation	3000	CY	$9.00	$27,000.00
	Backfill (structural)	920	CY	$22.00	$20,240.00
	Drainage	1	LS	$5,000.00	$5,000.00
	Concrete (slab)	200	CY	$450.00	$90,000.00
	Concrete (walls)	400	CY	$750.00	$300,000.00
	Elevated Walk	60	LF	$200.00	$12,000.00
	Handrail	60	LF	$20.00	$1,200.00
	Stairways	2	EA	$3,500.00	$7,000.00
	Miscellaneous Metal	1	LS	$25,000.00	$25,000.00
	MBR Process Equipment	1	LS	$1,530,000.00	$1,530,000.00
	Electrical	1	LS	$150,000.00	$150,000.00
	Scada Programming	1	LS	$35,000.00	$35,000.00
				Sub-Total	**$2,202,440.00**
Effluent Filter Modifications					
	None Required				
				Sub-Total	**$0.00**
Effluent Disinfection Modifications					
	Channel Demolition	1	LS	$5,000.00	$5,000.00
	UV Equipment Upgrade	1	LS	$98,000.00	$98,000.00
				Sub-Total	**$103,000.00**
Existing Effluent Pond/Access Ramp					
	Surfacing	50	CY	$22.00	$1,100.00
	Rip-Rap	200	CY	$30.00	$6,000.00
	Chain Gate w/Bollards	1	LS	$400.00	$400.00
	Pond Excavation (cleaning)	4000	CY	$7.00	$28,000.00
				Sub-Total	**$35,500.00**
Effluent Pond					
	Excavation	6900	CY	$9.00	$62,100.00
	Fill	1300	CY	$12.00	$15,600.00
	40 mil PVC Geomembrane	20,000	SF	$0.75	$15,000.00
	8" Gravel	500	CY	$22.00	$11,000.00
	12" Sand	750	CY	$22.00	$16,500.00
	Fencing w/access gates	1200	LF	$20.00	$24,000.00
	Pump Station	1	LS	$175,000.00	$175,000.00
				Sub-Total	**$319,200.00**
Class A Storage Pond					
	Excavation	60,000	CY	$9.00	$540,000.00
	Fill	3,400	CY	$12.00	$40,800.00
	8" Gravel	5,400	CY	$22.00	$118,800.00
	Pump Station	1	LS	$175,000.00	$175,000.00
				Sub-Total	**$874,600.00**

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Spray field					
	Connection to existing header	1	LS	$1,800.00	$1,800.00
	8" Automated Valve	1	LS	$2,200.00	$2,200.00
	8" HDPE Header	2400	LF	$25.00	$60,000.00
	8" HDPE Header (buried)	1000	LF	$50.00	$50,000.00
	3" HDPE Laterals	20000	LF	$4.00	$80,000.00
	Irrigation Heads	525	EA	$250.00	$131,250.00
	HDPE Fittings	1	LS	$3,000.00	$3,000.00
	Clear and Grub	33	Acres	$5,000.00	$165,000.00
	Water Level Sensors	3	EA	$2,500.00	$7,500.00
	New Valve Vault	0	LS	$15,000.00	$0.00
	Electrical (at vault)	1	LS	$5,000.00	$5,000.00
	Programming (PLC at vault)	1	LS	$6,500.00	$6,500.00
	Upgrade sprayfield pumps	1	LS	$50,000.00	$50,000.00
				Sub-Total	**$562,250.00**
Drain Pump					
	Upgrade WRF drain pump	1	LS	$20,000.00	$20,000.00
				Sub-Total	**$20,000.00**
Digesters / Storage					
	Excavation	2850	CY	$7.00	$19,950.00
	Backfill (structural)	1120	CY	$22.00	$24,640.00
	Drainage	1	LS	$5,000.00	$5,000.00
	Concrete (slab)	180	CY	$450.00	$81,000.00
	Concrete (walls)	215	CY	$750.00	$161,250.00
	Elevated Walk	40	LF	$200.00	$8,000.00
	Handrail	40	LF	$20.00	$800.00
	Stairways	1	EA	$3,500.00	$3,500.00
	Miscellaneous Metal	1	LS	$10,000.00	$10,000.00
	Air Diffusers	1	LS	$30,000.00	$30,000.00
	Digester Piping, Valves and Mechanical	1	LS	$15,000.00	$15,000.00
	Decant System	2	EA	$4,000.00	$8,000.00
	Blowers	2	EA	$8,000.00	$16,000.00
				Sub-Total	**$383,140.00**
Miscellaneous					
	Site piping	1	LS	$75,000.00	$75,000.00
	Electrical	1	LS	$30,000.00	$30,000.00
	Upgrade Generator	1	LS	$50,000.00	$50,000.00
	Site	1	LS	$10,000.00	$10,000.00
				Sub-Total	**$165,000.00**
	SUBTOTAL				**$5,185,220.40**
	CONTINGENCY (20%)				**$1,037,044.08**
	GRAND TOTAL				**$6,222,264.48**
	SALES TAX (8.3%)				**$516,447.95**
	TOTAL				**$6,738,712.43**

Property Acquisition Costs					
	Utility Easements 15' permanents	1	Acre	$10,000.00	$10,000.00
	Property Acquisition WRF Site	12	Acre	$10,000.00	$120,000.00
	Administration	1	Ea. File	$2,000.00	$2,000.00
	SUBTOTAL				**$132,000.00**
	CONTINGENCY (20%)				**$26,400.00**
	TOTAL				**$158,400.00**

Engineering, Environmental & Admin					
	Engineering (12% of construction)	1	LS	$746,671.74	$746,671.74
	Administration (9%of Construction)	1	LS	$560,003.80	$560,003.80
	SUBTOTAL				**$1,306,675.54**
	CONTINGENCY (10%)				**$130,667.55**
	TOTAL				**$1,437,343.09**

	Shared Reclamation Facility Costs	1	LS	$746,900.00	$746,900.00

GRAND TOTAL **$9,081,355.53**

Facility Plan Supplemental Information
Treatment Alternative 4 - SKIA

Items of Work and Materials		Quantity	Unit	Unit Price	Total Amount
	Mobilization	1	LS	8%	$409,799.26
	Traffic Control	1	LS	$70,000.00	$70,000.00
Pump Station No. 1					
	Electrical Service to Pump Station	1	LS	$10,000.00	$10,000.00
	Pump Station Mechanical Equipment	1	LS	$250,000.00	$250,000.00
	Wetwell	1	LS	$80,000.00	$80,000.00
	Chemical Feed/Electrical Building	400	SF	$150.00	$60,000.00
	Odor Control	1	LS	$60,000.00	$60,000.00
	Electrical Equipment	1	LS	$100,000.00	$100,000.00
	Telemetry/SCADA	1	LS	$35,000.00	$35,000.00
	Generator	1	LS	$60,000.00	$60,000.00
	Fencing	1	LS	$5,000.00	$5,000.00
	Site Work & Landscaping	1	LS	$10,000.00	$10,000.00
	Erosion Control	1	LS	$3,500.00	$3,500.00
	Valves and Vault	1	LS	$40,000.00	$40,000.00
	Meter and Vault	1	LS	$20,000.00	$20,000.00
				Sub-Total	**$733,500.00**
Force Main Costs (PS1 to Convey PS)					
	12-inch Force Main	7600	LF	$100.00	$760,000.00
	Bore/Direct Drill	100	LF	$550.00	$55,000.00
	Surface restoration/Pavement	3000	SY	$32.00	$96,000.00
	Erosion Control	1	LS	$20,000.00	$20,000.00
	Air Release Valves and Vaults	4	EA	$10,000.00	$40,000.00
	Access Roads	1400	SY	$30.00	$42,000.00
				Sub-Total	**$1,013,000.00**
Conveyance Pump Station					
	Electrical Service to Pump Station	1	LS	$10,000.00	$10,000.00
	Pump Station Mechanical Equipment	1	LS	$185,000.00	$185,000.00
	Wetwell	1	LS	$60,000.00	$60,000.00
	Chemical Feed/Electrical Building	400	SF	$150.00	$60,000.00
	Electrical	1	LS	$100,000.00	$100,000.00
	Telemetry/SCADA	1	LS	$35,000.00	$35,000.00
	Generator	1	LS	$50,000.00	$50,000.00
	Fencing	1	LS	$5,000.00	$5,000.00
	Site Work & Landscaping	1	LS	$10,000.00	$10,000.00
	Erosion Control	1	LS	$3,500.00	$3,500.00
	Valves and Vault	1	LS	$40,000.00	$40,000.00
	Meter and Vault	1	LS	$20,000.00	$20,000.00
				Sub-Total	**$578,500.00**
Force Main Costs (Conveyance PS to SKIA)					
	12-inch Force Main	8250	LF	$100.00	$825,000.00
	Surface restoration	3700	SY	$10.00	$37,000.00
	Erosion Control	1	LS	$30,000.00	$30,000.00
	Air Release Valves and Vaults	4	EA	$10,000.00	$40,000.00
				Sub-Total	**$932,000.00**
Belfair Portion of SKIA Costs					
	Upsize 3,900 LF of 10" FM to 14" FM	1	LS	$205,931.94	$205,931.94
	Upsize 8,350 LF of 12" FM to 18" FM	1	LS	$360,740.92	$360,740.92
	Upsize 6,100 LF of 18" PVC Gravity to 21"	1	LS	$229,102.37	$229,102.37
	Upsize 3,850 LF of 18" FM to 21" FM	1	LS	$140,715.59	$140,715.59
	Upsize PS #4	1	LS	$444,000.00	$444,000.00
	Upsize PS #3	1	LS	$287,000.00	$287,000.00
	Upsize PS #1	1	LS	$128,000.00	$128,000.00
				Sub-Total	**$1,795,490.81**

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Hookup Costs					
	Latecomer charge	1989	ERU	$720.00	$1,432,080.00
	Connection fees	1989	ERU	$6,000.00	$11,934,000.00
				Sub-Total	**$13,366,080.00**
	SUBTOTAL				**$18,898,370.07**
	CONTINGENCY (20%)				**$3,779,674.01**
	GRAND TOTAL				**$22,678,044.09**
	SALES TAX (8.3%)				**$1,882,277.66**
	TOTAL				**$24,560,321.75**

Property Acquisition Costs					
	Easements 15' permanent w/const.	0.2	Acre	$40,000.00	$8,000.00
	Property Acquisition PS Sites	0.2	Acre	$200,000.00	$40,000.00
	Administration	6	Ea. File	$2,000.00	$12,000.00
	SUBTOTAL				**$60,000.00**
	CONTINGENCY (20%)				**$12,000.00**
	TOTAL				**$72,000.00**

Engineering, Environmental & Admin					
	EIS	1	LS	$55,000.00	$55,000.00
	Engineering (10% of construction)	1	LS	$2,267,804.41	$2,267,804.41
	Administration (8%of Construction)	1	LS	$1,814,243.53	$1,814,243.53
	SUBTOTAL				**$4,137,047.94**
	CONTINGENCY (10%)				**$413,704.79**
	TOTAL				**$4,550,752.73**

GRAND TOTAL **$29,183,074.48**

Facility Plan Supplemental Information
Transmission to Belfair Facility

Items of Work and Materials		Quantity	Unit	Unit Price	Total Amount
	Mobilization	1	LS	8%	$164,080.00
Pump Station No. 1					
	Electrical Service to Pump Station	1	LS	$10,000.00	$10,000.00
	Pump Station Mechanical Equipment	1	LS	$325,000.00	$325,000.00
	Wetwell	1	LS	$80,000.00	$80,000.00
	Chemical Feed/Electrical Building	400	SF	$150.00	$60,000.00
	Odor Control	1	LS	$60,000.00	$60,000.00
	Electrical Equipment	1	LS	$150,000.00	$150,000.00
	Telemetry/SCADA	1	LS	$35,000.00	$35,000.00
	Generator	1	LS	$60,000.00	$60,000.00
	Fencing	1	LS	$5,000.00	$5,000.00
	Site Work & Landscaping	1	LS	$15,000.00	$15,000.00
	Erosion Control	1	LS	$3,500.00	$3,500.00
	Valves and Vault	1	LS	$40,000.00	$40,000.00
	Meter and Vault	1	LS	$20,000.00	$20,000.00
				Sub-Total	**$863,500.00**
Force Main Costs (PS1 to WRF)					
	Traffic Control	1	LS	$20,000.00	$20,000.00
	12-inch Force Main	7000	LF	$100.00	$700,000.00
	Bore/Direct Drill	450	LF	$550.00	$247,500.00
	Surface restoration - seeding	2000	SY	$10.00	$20,000.00
	Surface restoration - pavement	1000	SY	$32.00	$32,000.00
	Erosion Control	1	LS	$30,000.00	$30,000.00
	Air Release Valves and Vaults	6	EA	$10,000.00	$60,000.00
	Access Roads	2600	SY	$30.00	$78,000.00
				Sub-Total	**$1,167,500.00**
	SUBTOTAL				**$2,195,080.00**
	CONTINGENCY (20%)				**$439,016.00**
	GRAND TOTAL				**$2,634,096.00**
	SALES TAX (8.3%)				**$218,629.97**
	TOTAL				**$2,852,725.97**

Property Acquisition Costs					
	Easements 15' permanent w/const.	2	Acre	$40,000.00	$80,000.00
	Property Acquisition PS1 Site	0.1	Acre	$200,000.00	$20,000.00
	Administration	8	Ea. File	$2,000.00	$16,000.00
	SUBTOTAL				**$116,000.00**
	CONTINGENCY (20%)				**$23,200.00**
	TOTAL				**$139,200.00**

Engineering, Environmental & Admin					
	Environmental Reviews/Permitting	1	LS	$60,000.00	$60,000.00
	Engineering (9% of construction)	1	LS	$237,068.64	$237,068.64
	Administration (7%of Construction)	1	LS	$184,386.72	$184,386.72
	SUBTOTAL				**$481,455.36**
	CONTINGENCY (10%)				**$48,145.54**
	TOTAL				**$529,600.90**

GRAND TOTAL **$3,521,526.86**

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Facility Plan Supplemental Information
Transmission to NB-CI Facility

	Items of Work and Materials	Quantity	Unit	Unit Price	Total Amount
	Mobilization	1	LS	8%	$461,592.00
Pump Station No. 1					
	Electrical Service to Pump Station	1	LS	$10,000.00	$10,000.00
	Pump Station Mechanical Equipment	1	LS	$325,000.00	$325,000.00
	Wetwell	1	LS	$80,000.00	$80,000.00
	Chemical Feed/Electrical Building	400	SF	$150.00	$60,000.00
	Odor Control	1	LS	$60,000.00	$60,000.00
	Electrical Equipment	1	LS	$150,000.00	$150,000.00
	Telemetry/SCADA	1	LS	$35,000.00	$35,000.00
	Generator	1	LS	$60,000.00	$60,000.00
	Fencing	1	LS	$5,000.00	$5,000.00
	Site Work & Landscaping	1	LS	$15,000.00	$15,000.00
	Erosion Control	1	LS	$3,500.00	$3,500.00
	Valves and Vault	1	LS	$40,000.00	$40,000.00
	Meter and Vault	1	LS	$20,000.00	$20,000.00
				Sub-Total	**$863,500.00**
Force Main Costs (PS1 to Convey PS)					
	Traffic Control	1	LS	$20,000.00	$20,000.00
	12-inch Force Main	5550	LF	$100.00	$555,000.00
	Bore/Direct Drill	150	LF	$550.00	$82,500.00
	Surface restoration/Pavement	3000	SY	$2.00	$6,000.00
	Erosion Control	1	LS	$24,000.00	$24,000.00
	Air Release Valves and Vaults	4	EA	$10,000.00	$40,000.00
	Access Roads	1400	SY	$30.00	$42,000.00
				Sub-Total	**$749,500.00**
Conveyance Pump Station					
	Electrical Service to Pump Station	1	LS	$65,000.00	$65,000.00
	Pump Station Mechanical Equipment	1	LS	$165,000.00	$165,000.00
	Wetwell	1	LS	$60,000.00	$60,000.00
	Chemical Feed/Electrical Building	400	SF	$150.00	$60,000.00
	Odor Control	1	LS	$55,000.00	$55,000.00
	Electrical	1	LS	$125,000.00	$125,000.00
	Telemetry/SCADA	1	LS	$40,000.00	$40,000.00
	Generator	1	LS	$55,000.00	$55,000.00
	Fencing	1	LS	$5,000.00	$5,000.00
	Site Work	1	LS	$15,000.00	$15,000.00
	Access Road	1	LS	$50,000.00	$50,000.00
	Erosion Control	1	LS	$7,000.00	$7,000.00
	Valves and Vault	1	LS	$40,000.00	$40,000.00
	Meter and Vault	1	LS	$20,000.00	$20,000.00
				Sub-Total	**$762,000.00**
Force Main Costs (Convey PS to WRF)					
	Access During Construction	30700	SY	$5.00	$153,500.00
	12-inch Force Main	27600	LF	$100.00	$2,760,000.00
	Bore/Direct Drill	300	LF	$550.00	$165,000.00
	Surface restoration	9200	SY	$2.00	$18,400.00
	Erosion Control	1	LS	$24,000.00	$24,000.00
	Air Release Valves and Vaults	17	EA	$10,000.00	$170,000.00
	Access Roads	2800	SY	$30.00	$84,000.00
				Sub-Total	**$3,374,900.00**
	SUBTOTAL				**$6,211,492.00**
	CONTINGENCY (20%)				**$1,242,298.40**
	GRAND TOTAL				**$7,453,790.40**
	SALES TAX (8.3%)				**$618,664.60**
	TOTAL				**$8,072,455.00**

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Property Acquisition Costs					
	Easements 15' permanent w/const.	6.3	Acre	$10,000.00	$63,000.00
	Property Acquisition PS Site	0.6	Acre	$200,000.00	$120,000.00
	Administration	32	Ea. File	$2,000.00	$64,000.00
	SUBTOTAL				**$247,000.00**
	CONTINGENCY (20%)				**$49,400.00**
	TOTAL				**$296,400.00**

Engineering, Environmental & Admin					
	EIS	1	LS	$55,000.00	$55,000.00
	Engineering (10% of construction)	1	LS	$745,379.04	$745,379.04
	Administration (8%of Construction)	1	LS	$596,303.23	$596,303.23
	SUBTOTAL				**$1,396,682.27**
	CONTINGENCY (10%)				**$139,668.23**
	TOTAL				**$1,536,350.50**

GRAND TOTAL **$9,905,205.50**

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Facility Plan Supplemental Information
Belfair UGA Collection System

	Items of Work and Materials	Quantity	Unit	Unit Price	Total Amount
	MOBILIZATION, 8%	1	LS	8%	$358,418.00
	UGA Misc				
	Traffic Control	1	LS	$200,000.00	$200,000.00
	Clearing and Grubbing	2	AC	$5,000.00	$10,000.00
	Erosion Control	1	LS	$75,000.00	$75,000.00
	Dewatering	9,000	LF	$4.50	$40,500.00
	Landscaping/Restoration	12,000	SY	$10.00	$120,000.00
	Pavement Restoration	5,300	SY	$32.00	$169,600.00
	Potholing	50	EA	$500.00	$25,000.00
	Saw Cutting	22,500	LF	$1.30	$29,250.00
	Septic System Abandonment	250	EA	$1,200.00	$300,000
				Misc. Sub-Total	**$969,350.00**
	UGA Pump Station No. 2				
	Pump Station 2	1	LS	$ 400,000.00	$400,000.00
	6-inch Force Main (From PS 2 to PS 1)	2,900	LF	$50.00	$145,000.00
	Air Release Valves and Vaults	2	EA	$10,000.00	$20,000.00
				Pump Station 2 Sub-Total	**$565,000.00**
	UGA Pressure Sewer				
	Grinder Pump	110	EA	$6,000.00	$660,000.00
	3-inch Force Main	5,200	LF	$35.00	$182,000.00
	4-inch Force Main	1,950	LF	$40.00	$78,000.00
				UGA Pressure System Sub-Total	**$920,000.00**
	UGA Gravity Sewer Collection System				
	8" Gravity Sewer Pipe, 0-6 Feet Deep	2,625	LF	$85.00	$223,125.00
	8" Gravity Sewer Pipe, 6-9 Feet Deep	6,375	LF	$90.00	$573,750.00
	8" Gravity Sewer Pipe, 9-12 Feet Deep	1,350	LF	$100.00	$135,000.00
	10" Gravity Sewer Pipe, 6-9 Feet Deep	950	LF	$120.00	$114,000.00
	15" Gravity Sewer Pipe, 9-12 Feet Deep	1,250	LF	$200.00	$250,000.00
	18" Gravity Sewer Pipe, 6-9 Feet Deep	1,100	LF	$200.00	$220,000.00
	48" STD Precast Manhole	42	EA	$5,000.00	$210,000.00
	Sanitary Sewer Service Connection	250	EA	$1,200.00	$300,000.00
				UGA Gravity System Sub-Total	**$2,025,875.00**
	SUBTOTAL				**$4,838,643.00**
	CONTINGENCY (20%)				**$967,728.60**
	TOTAL				**$5,806,371.60**
	SALES TAX (8.3%)				**$481,928.84**
	GRAND TOTAL				**$6,288,300.44**

Property Acquisition Costs					
	Easements 20' permanent w/const.	5	Acre	$40,000.00	$200,000.00
	Property Acquisition PS Sites	0.1	Acre	$200,000.00	$20,000.00
	Administration	58	Ea. File	$2,000.00	$116,000.00
	SUBTOTAL				**$336,000.00**
	CONTINGENCY (20%)				**$67,200.00**
	TOTAL				**$403,200.00**

Engineering, Environmental & Admin					
	Environmental Reviews/Permitting	1	LS	$160,000.00	$160,000.00
	Engineering (9% of construction)	1	LS	$522,573.44	$522,573.44
	Administration (7%of Construction)	1	LS	$406,446.01	$406,446.01
	SUBTOTAL				**$1,089,019.46**
	CONTINGENCY (10%)				**$108,901.95**
	TOTAL				**$1,197,921.40**

GRAND TOTAL **$7,889,421.84**

Facility Plan Supplemental Information
Lynch Cove/North Shore Collection System

	Items of Work and Materials	Quantity	Unit	Unit Price	Total Amount
	MOBILIZATION, 8%	1	LS	8%	$413,423.68
	North Shore Misc				
	Traffic Control	1	LS	$ 100,000.00	$100,000.00
	Dewatering	14900	LF	$ 4.50	$67,050.00
	Erosion Control	1	LS	$75,000.00	$75,000.00
	Gravel Surface Restoration/Landscaping	3889	SY	$10.00	$38,890.00
	Pavement Restoration	10033	SY	$32.00	$321,056.00
	Saw Cutting	30000	LF	$ 1.30	$39,000.00
	Septic System Abandonment	293	EA	$1,200.00	$351,600.00
				Misc. Sub-Total	**$992,596.00**
	State Park Pump Station No. 4				
	Electrical Service to Pump Station	1	LS	$ 8,000.00	$8,000.00
	Pump Station Mechanical Equipment	1	LS	$ 65,000.00	$65,000.00
	Wetwell	1	LS	$ 55,000.00	$55,000.00
	Chemical Feed/Electrical Building	400	SF	$ 150.00	$60,000.00
	Electrical Equipment	1	LS	$ 80,000.00	$80,000.00
	Telemtry/SCADA	1	LS	$ 20,000.00	$20,000.00
	Generator	1	LS	$ 50,000.00	$50,000.00
	Fencing	1	LS	$ 5,000.00	$5,000.00
	Site Work & Landscaping	1	LS	$ 7,000.00	$7,000.00
	Valves and vault	1	LS	$ 30,000.00	$30,000.00
	Meter and vault	1	LS	$ 20,000.00	$20,000.00
				Park Pump Station Sub-Total	**$400,000.00**
	Force Main Costs (PS 4 to PS 1)				
	6-inch Force Main to PS 3	15000	LF	$50.00	$750,000.00
	Bore/Direct Drill	450	LF	$550.00	$247,500.00
	Air Release Valves and Vaults	4	EA	$10,000.00	$40,000.00
				Force Main Sub-Total	**$1,037,500.00**
	North Shore Pressure Sewer Collection System				
	Grinder Pump	293	EA	$6,000.00	$1,758,000.00
	1 1/2-inch Low Pressure Main	350	LF	$28.00	$9,800.00
	2-inch Low Pressure Main	10200	LF	$32.00	$326,400.00
	3-inch Low Pressure Main	13300	LF	$35.00	$465,500.00
	4-inch Low Pressure Main	2950	LF	$40.00	$118,000.00
	Air Release Valves and Vaults	6	EA	$10,000.00	$60,000.00
				North Shore Low Pressure System Sub-Total	**$2,737,700.00**
	SUBTOTAL				**$5,581,219.68**
	CONTINGENCY (20%)				**$1,116,243.94**
	TOTAL				**$6,697,463.62**
	SALES TAX (8.3%)				**$555,889.48**
	GRAND TOTAL				**$7,253,353.10**

	Property Acquisition Costs				
	Easements 15' permanent w/const.	0.2	Acre	$10,000.00	$2,000.00
	Property Acquisition PS Sites	0.1	Acre	$50,000.00	$5,000.00
	Administration	3	Ea. File	$2,000.00	$6,000.00
	SUBTOTAL				**$13,000.00**
	CONTINGENCY (20%)				**$2,600.00**
	TOTAL				**$15,600.00**

	Engineering, Environmental & Admin				
	Environmental Reviews/Permitting	1	LS	$180,000.00	$180,000.00
	Engineering (7% of construction)	1	LS	$468,822.45	$468,822.45
	Administration (7%of Construction)	1	LS	$468,822.45	$468,822.45
	SUBTOTAL				**$1,117,644.91**
	CONTINGENCY (10%)				**$111,764.49**
	TOTAL				**$1,229,409.40**

GRAND TOTAL **$8,498,362.49**

Facility Plan Supplemental Information
Treatment Alternative 1 - Belfair SBR Annual O&M Costs

	O&M activities	Quantity	Unit	Unit Price	Total Amount
	Operations				
	Operating supplies	1	LS	$ 30,000.00	$30,000.00
	Professional Services	1	LS	$ 25,000.00	$25,000.00
	Biosolids contract	1	LS	$ 55,000.00	$55,000.00
	Utilities Power	1	LS	$ 40,000.00	$40,000.00
	Contracted Repairs/Maintenance	1	LS	$ 15,000.00	$15,000.00
	Filter Replacement Costs	1	LS	$ 10,000.00	$10,000.00
	UV Bulb Replacement	1	LS	$ 4,000.00	$4,000.00
	Interfund Payment for Services	1	LS	$ 20,000.00	$20,000.00
	Miscellaneous	1	LS	$ 4,000.00	$4,000.00
	Lab and Waste permits	1	LS	$ 4,000.00	$4,000.00
	Labor				
	Two persons	1	LS	$118,600.00	$118,600.00
	Land Lease				
	Sprayfield	1	LS	$10,000.00	$10,000.00
	Excise Tax	1	LS	$12,000.00	$12,000.00
	Administration (20%)	1	LS	$69,520.00	$69,520.00
	TOTAL				**$417,120.00**

Facility Plan Supplemental Information
Treatment Alternative 2 - Belfair MBR Annual O&M Costs

	O&M activities	Quantity	Unit	Unit Price	Total Amount
	Operations				
	Operating supplies	1	LS	$ 30,000.00	$30,000.00
	Professional Services	1	LS	$ 25,000.00	$25,000.00
	Biosolids contract	1	LS	$ 45,000.00	$45,000.00
	Utilities Power	1	LS	$ 32,000.00	$32,000.00
	Contracted Repairs/Maintenance	1	LS	$ 15,000.00	$15,000.00
	UV Bulb Replacement	1	LS	$ 3,200.00	$3,200.00
	MBR Replacement	1	LS	$ 18,000.00	$18,000.00
	Interfund Payment for Services	1	LS	$ 20,000.00	$20,000.00
	Miscellaneous	1	LS	$ 4,000.00	$4,000.00
	Lab and Waste permits	1	LS	$ 4,000.00	$4,000.00
	Labor				
	One person	1	LS	$59,300.00	$59,300.00
	Land Lease				
	Sprayfield	1	LS	$10,000.00	$10,000.00
	Excise Tax	1	LS	$12,000.00	$12,000.00
	Administration (20%)	1	LS	$55,500.00	$55,500.00
	TOTAL				**$333,000.00**

Facility Plan Supplemental Information
Treatment Alternative 3 - NB-CI Annual O&M Costs

O&M activities		Quantity	Unit	Unit Price	Total Amount
	Operations				
	Operating supplies	1	LS	$ 15,000.00	$15,000.00
	Professional Services	1	LS	$ 10,000.00	$10,000.00
	Biosolids contract	1	LS	$ 60,000.00	$60,000.00
	Utilities Power	1	LS	$ 30,000.00	$30,000.00
	Contracted Repairs/Maintenance	1	LS	$ 10,000.00	$10,000.00
	UV Bulb Replacement	1	LS	$ 1,600.00	$1,600.00
	MBR Replacement	1	LS	$ 18,000.00	$18,000.00
	Miscellaneous	1	LS	$ 4,000.00	$4,000.00
	Lab and Waste permits	1	LS	$ 1,000.00	$1,000.00
	Labor				
	Increase Staff by One person	1	LS	$59,300.00	$59,300.00
	Land Lease				
	Sprayfield	1	LS	$9,900.00	$9,900.00
	Excise Tax	1	LS	$12,000.00	$12,000.00
	Administration (20%)	1	LS	$46,160.00	$46,160.00
	TOTAL				**$276,960.00**

O&M costs represent the incremental costs for the Belfair system.

O&M cost were derived from the 2005 NBCI Budget

Facility Plan Supplemental Information
Treatment Alternative 4 - SKIA Annual O&M Costs

O&M activities		Quantity	Unit	Unit Price	Total Amount
	Transmission				
	Labor				
	Pump Station Visit (12 hrs/week)	624	Hrs	$ 27.00	$16,848.00
	Air release Station maintenance	192	Hrs	$ 27.00	$5,184.00
	Pump Station Cleaning	32	Hrs	$ 27.00	$864.00
	Power (PS1)	125,000	Kw-hrs	$0.08	$10,000.00
	Power (Transmission PS)	53,000	Kw-hrs	$0.08	$4,240.00
	Chemical Cost	1	LS	$7,000.00	$7,000.00
	Gen Maintenance/fuel	1	LS	$4,000.00	$4,000.00
	Excise Tax	1	LS	$6,000.00	$6,000.00
				Labor Subtotal	**$54,136.00**
	Rates				
	Rate Charges to Port Orchard	1	LS	$365,904.00	$365,904.00
				Rate Subtotal	**$365,904.00**
	Administration				
	Administration & Oversight (20%)	1	LS	10827.2	$10,827.20
				Administration Subtotal	**$10,827.20**
	TOTAL				**$430,867.20**
	Total Labor Hours	**848**			

Facility Plan Supplemental Information
Sewer Transmission to Belfair Facility Annual O&M Costs

	O&M activities	Quantity	Unit	Unit Price	Total Amount
	Transmission				
	Labor				
	Pump Station Visit (6 hrs/week)	312	Hrs	$ 35.00	$10,920.00
	Air release Station maintenance	128	Hrs	$ 35.00	$4,480.00
	Pump Station Cleaning	16	Hrs	$ 35.00	$560.00
	Power (PS1)	380,000	Kw-hrs	$0.08	$30,400.00
	Chemical Cost	1	LS	$3,500.00	$3,500.00
	Gen Maintenance/fuel	1	LS	$2,000.00	$2,000.00
	Excise Tax	1	LS	$6,000.00	$6,000.00
				Conveyance Subtotal	**$57,860.00**
	Administration				
	Administration & Oversight (20%)	1	LS	11572	$11,572.00
				Administration Subtotal	**$11,572.00**
	TOTAL				**$69,432.00**
	Total Labor Hours	**456**			

Facility Plan Supplemental Information
Sewer Transmission to NB-CI Annual O&M Costs

O&M activities	Quantity	Unit	Unit Price	Total Amount
Transmission				
Labor				
Pump Station Visit (12 hrs/week)	624	Hrs	$ 27.00	$16,848.00
Air release Station maintenance	504	Hrs	$ 27.00	$13,608.00
Pump Station Cleaning	32	Hrs	$ 27.00	$864.00
Power (PS1)	380,000	Kw-hrs	$0.08	$30,400.00
Power (Transmission PS)	53,000	Kw-hrs	$0.08	$4,240.00
Chemical Cost	1	LS	$3,500.00	$3,500.00
Gen Maintenance/fuel	1	LS	$4,000.00	$4,000.00
Excise Tax	1	LS	$6,000.00	$6,000.00
			Conveyance Subtotal	**$79,460.00**
Administration				
Administration & Oversight (20%)	1	LS	15892	$15,892.00
			Administration Subtotal	**$15,892.00**
TOTAL				**$95,352.00**
Total Labor Hours	**1160**			

Facility Plan Supplemental Information
Sewer Collection Annual O&M Costs

O&M activities	Quantity	Unit	Unit Price	Total Amount
Lynch Cove/North Shore				
Labor				
Pump Station Visit (5 hrs/week)	260	Hrs	$ 35.00	$9,100.00
Air release Station maintenance	72	Hrs	$ 35.00	$2,520.00
e-one pump responses (16 hrs/month)	60	Hrs	$ 35.00	$2,100.00
Line Cleaning and flushing	138	Hrs	$ 35.00	$4,830.00
Pump Station Cleaning	16	Hrs	$ 35.00	$560.00
Power (PS3)	26,500	Kw-hrs	$0.08	$2,120.00
Gen Maintenance/fuel	1	LS	$1,200.00	$1,200.00
e-one pump replacement	9	EA	$3,300.00	$29,700.00
Equipment Rental	1	LS	$2,000.00	$2,000.00
Excise Tax	1	LS	$2,100.00	$2,100.00
	Lynch Cove/North Shore Subtotal			**$56,230.00**
Belfair Collection				
Labor				
Pump Station Visit (5hrs/week)	260	Hrs	$ 35.00	$9,100.00
e-one pump responses (8 hrs/month)	24	Hrs	$ 35.00	$840.00
Line Cleaning and flushing	92	Hrs	$ 35.00	$3,220.00
Pump Station Cleaning	16	Hrs	$ 35.00	$560.00
Power (PS2)	6,125	Kw-hrs	$0.08	$490.00
Gen Maintenance/fuel	1	LS	$1,200.00	$1,200.00
e-one pump replacement	3	EA	$3,300.00	$9,900.00
Equipment Rental	1	LS	$2,000.00	$2,000.00
Excise Tax	1	LS	$3,900.00	$3,900.00
			Belfair Subtotal	**$31,210.00**
Administration				
Administration & Oversight (20%)	1	LS	$ 17,488.00	$17,488.00
			Administration Subtotal	**$17,488.00**
TOTAL				**$104,928.00**
Total Labor Hours	**938**			

RECOMMENDED PLAN
DETAILED PROGRAM COST ESTIMATES

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Facility Plan Supplemental Information
Treatment Alternative 2 - Belfair MBR
Belfair UGA Only (0.32 mgd)

	Items of Work and Materials	Quantity	Unit	Unit Price	Total Amount
	Mobilization	1	LS	8%	$570,826.40
Site Work (WRF)					
	Clear and Grub	12	Acre	$5,000.00	$60,000.00
	Drainage	1	LS	$40,000.00	$40,000.00
	Access Road	10000	LF	$34.00	$340,000.00
	Fence	2600	LF	$20.00	$52,000.00
	Erosion Control	1	LS	$50,000.00	$50,000.00
	Monitoring Wells	8	EA	$3,000.00	$24,000.00
				Sub-Total	**$566,000.00**
Headworks					
	Influent Mag Meter	1	LS	$10,000.00	$10,000.00
	1/8" Screen	1	LS	$95,000.00	$95,000.00
	Grit Removal	1	LS	$100,000.00	$100,000.00
	Structure	1	LS	$75,000.00	$75,000.00
	Sampler	1	LS	$5,000.00	$5,000.00
	Miscellaneous	1	LS	$30,000.00	$30,000.00
				Sub-Total	**$315,000.00**
MBR					
	Excavation	2700	CY	$9.00	$24,300.00
	Backfill (structural)	830	CY	$22.00	$18,260.00
	Drainage	1	LS	$5,000.00	$5,000.00
	Concrete (slab)	180	CY	$450.00	$81,000.00
	Concrete (walls)	360	CY	$750.00	$270,000.00
	Elevated Walk	60	LF	$200.00	$12,000.00
	Handrail	60	LF	$20.00	$1,200.00
	Stairways	2	EA	$3,500.00	$7,000.00
	Miscellaneous Metal	1	LS	$20,000.00	$20,000.00
	MBR Process Equipment	1	LS	$1,530,000.00	$1,530,000.00
				Sub-Total	**$1,968,760.00**
Effluent Disinfection					
	UV Equipment	1	LS	$250,000.00	$250,000.00
	Concrete Channel	26	CY	$750.00	$19,500.00
	Covered Structure - Concrete	83	CY	$500.00	$41,500.00
	Covered Structure - Roof	1	LS	$7,000.00	$7,000.00
				Sub-Total	**$318,000.00**
Equipment Building					
	Building Structure	1800	SF	$120.00	$216,000.00
				Sub-Total	**$216,000.00**
Plant Drain					
	WRF drain pump	1	LS	$40,000.00	$40,000.00
	Wetwell	1	LS	$6,500.00	$6,500.00
				Sub-Total	**$46,500.00**
Effluent Pond					
	Excavation	4000	CY	$9.00	$36,000.00
	Fill	1200	CY	$12.00	$14,400.00
	40 mil PVC Geomembrane	19,000	SF	$0.75	$14,250.00
	8" Gravel	475	CY	$22.00	$10,450.00
	12" Sand	700	CY	$22.00	$15,400.00
	Fencing w/access gates	1200	LF	$20.00	$24,000.00
	Pump Station	1	LS	$175,000.00	$175,000.00
				Sub-Total	**$289,500.00**
Class A Storage Pond					
	Excavation	55,000	CY	$9.00	$495,000.00
	Fill	3,200	CY	$12.00	$38,400.00
	8" Gravel	5,200	CY	$22.00	$114,400.00
	Pump Station	1	LS	$175,000.00	$175,000.00
				Sub-Total	**$822,800.00**

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Spray field					
	Valve Vault	1	LS	$10,000.00	$10,000.00
	8" Automated Valves & Piping	1	LS	$22,000.00	$22,000.00
	8" HDPE from WRF to Vault (buried)	1700	LF	$60.00	$102,000.00
	8" HDPE from Vault to fields (overland)	1800	LF	$25.00	$45,000.00
	3" HDPE Laterals	18000	LF	$8.00	$144,000.00
	Irrigation Heads	385	EA	$250.00	$96,250.00
	HDPE Fittings	1	LS	$2,900.00	$2,900.00
	Clear and Grub	24	Acres	$5,000.00	$120,000.00
	Water Level Sensors	3	EA	$2,000.00	$6,000.00
	Sprayfield pump station	1	LS	$175,000.00	$175,000.00
				Sub-Total	**$723,150.00**
Digesters / Storage					
	Excavation	2600	CY	$9.00	$23,400.00
	Backfill (structural)	1110	CY	$22.00	$24,420.00
	Drainage	1	LS	$5,000.00	$5,000.00
	Concrete (slab)	165	CY	$450.00	$74,250.00
	Concrete (walls)	195	CY	$750.00	$146,250.00
	Elevated Walk	40	LF	$200.00	$8,000.00
	Handrail	40	LF	$20.00	$800.00
	Stairways	1	EA	$3,500.00	$3,500.00
	Miscellaneous Metal	1	LS	$10,000.00	$10,000.00
	Air Diffusers	1	LS	$30,000.00	$30,000.00
	Digester Piping, Valves and Mechanical	1	LS	$15,000.00	$15,000.00
	Decant System	2	EA	$4,000.00	$8,000.00
	Blowers	2	EA	$8,000.00	$16,000.00
				Sub-Total	**$364,620.00**
Process Water System					
	Process Water System	1	LS	$20,000.00	$20,000.00
				Sub-Total	**$20,000.00**
Site Piping					
	Piping	1	LS	$290,000.00	$290,000.00
				Sub-Total	**$290,000.00**
Site Electrical					
	Electrical Service	1	LS	$100,000.00	$100,000.00
	On-Site Electrical	1	LS	$925,000.00	$925,000.00
	Stand-by Generator	1	LS	$105,000.00	$105,000.00
	SCADA/Telemetry	1	LS	$65,000.00	$65,000.00
				Sub-Total	**$1,195,000.00**
	SUBTOTAL				**$8,272,156.40**
	CONTINGENCY (20%)				**$1,654,431.28**
	SUBTOTAL				**$9,926,587.68**
	SALES TAX (8.3%)				**$823,906.78**
	TOTAL				**$10,750,494.46**

Property Acquisition Costs					
	Utility Easements 15' permanents	0	Acre	$10,000.00	$0.00
	Property Acquisition WRF Site	12	Acre	$10,000.00	$120,000.00
	Administration	3	Ea. File	$2,000.00	$6,000.00
	SUBTOTAL				**$126,000.00**
	CONTINGENCY (20%)				**$25,200.00**
	TOTAL				**$151,200.00**

Engineering, Environmental & Admin					
	Environmental Reviews/Permitting	1	LS	$210,000.00	$210,000.00
	Siting Study	1	LS	$60,000.00	$60,000.00
	Engineering (11% of construction)	1	LS	$1,091,924.64	$1,091,924.64
	Administration (9%of Construction)	1	LS	$893,392.89	$893,392.89
	SUBTOTAL				**$2,255,317.54**
	CONTINGENCY (10%)				**$225,531.75**
	TOTAL				**$2,480,849.29**

GRAND TOTAL **$13,382,543.75**

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Facility Plan Supplemental Information
Treatment Alternative 3 - Expansion of NB-CI Facility
Belfair UGA Only (0.32 mgd)

	Items of Work and Materials	Quantity	Unit	Unit Price	Total Amount
	Mobilization	1	LS	8%	$365,554.40
Headworks					
	Influent Mag Meter	1	LS	$12,000.00	$12,000.00
	Piping Modifications	1	LS	$5,000.00	$5,000.00
	Collection Basin	1	LS	$2,000.00	$2,000.00
	New 1/8" Drum Screen	1	LS	$102,000.00	$102,000.00
	Grit Removal	1	LS	$0.00	$0.00
	Structure modifications	1	LS	$15,000.00	$15,000.00
				Sub-Total	**$136,000.00**
New MBR					
	Excavation	2700	CY	$9.00	$24,300.00
	Backfill (structural)	830	CY	$22.00	$18,260.00
	Drainage	1	LS	$5,000.00	$5,000.00
	Concrete (slab)	180	CY	$450.00	$81,000.00
	Concrete (walls)	360	CY	$750.00	$270,000.00
	Elevated Walk	60	LF	$200.00	$12,000.00
	Handrail	60	LF	$20.00	$1,200.00
	Stairways	2	EA	$3,500.00	$7,000.00
	Miscellaneous Metal	1	LS	$25,000.00	$25,000.00
	MBR Process Equipment	1	LS	$1,530,000.00	$1,530,000.00
	Electrical	1	LS	$150,000.00	$150,000.00
	Scada Programming	1	LS	$35,000.00	$35,000.00
				Sub-Total	**$2,158,760.00**
Effluent Filter Modifications					
	None Required				
				Sub-Total	**$0.00**
Effluent Disinfection Modifications					
	Channel Demolition	1	LS	$5,000.00	$5,000.00
	UV Equipment Upgrade	1	LS	$98,000.00	$98,000.00
				Sub-Total	**$103,000.00**
Existing Effluent Pond/Access Ramp					
	Surfacing	50	CY	$22.00	$1,100.00
	Rip-Rap	200	CY	$30.00	$6,000.00
	Chain Gate w/Bollards	1	LS	$400.00	$400.00
	Pond Excavation (cleaning)	4000	CY	$7.00	$28,000.00
				Sub-Total	**$35,500.00**
Effluent Pond					
	Excavation	4000	CY	$9.00	$36,000.00
	Fill	1200	CY	$12.00	$14,400.00
	40 mil PVC Geomembrane	19,000	SF	$0.75	$14,250.00
	8" Gravel	475	CY	$22.00	$10,450.00
	12" Sand	700	CY	$22.00	$15,400.00
	Fencing w/access gates	1200	LF	$20.00	$24,000.00
	Pump Station	1	LS	$175,000.00	$175,000.00
				Sub-Total	**$289,500.00**
Class A Storage Pond					
	Excavation	55,000	CY	$9.00	$495,000.00
	Fill	3,200	CY	$12.00	$38,400.00
	8" Gravel	5,200	CY	$22.00	$114,400.00
	Pump Station	1	LS	$175,000.00	$175,000.00
				Sub-Total	**$822,800.00**

Spray field					
	Connection to existing header	1	LS	$1,800.00	$1,800.00
	8" Automated Valve	1	LS	$2,200.00	$2,200.00
	8" HDPE Header	2400	LF	$25.00	$60,000.00
	8" HDPE Header (buried)	1000	LF	$50.00	$50,000.00
	3" HDPE Laterals	18000	LF	$4.00	$72,000.00
	Irrigation Heads	385	EA	$250.00	$96,250.00
	HDPE Fittings	1	LS	$3,000.00	$3,000.00
	Clear and Grub	24	Acres	$5,000.00	$120,000.00
	Water Level Sensors	3	EA	$2,500.00	$7,500.00
	New Valve Vault	0	LS	$15,000.00	$0.00
	Electrical (at vault)	1	LS	$5,000.00	$5,000.00
	Programming (PLC at vault)	1	LS	$6,500.00	$6,500.00
	Upgrade sprayfield pumps	1	LS	$50,000.00	$50,000.00
				Sub-Total	**$474,250.00**
Drain Pump					
	Upgrade WRF drain pump	1	LS	$20,000.00	$20,000.00
				Sub-Total	**$20,000.00**
Digesters / Storage					
	Excavation	2600	CY	$9.00	$23,400.00
	Backfill (structural)	1110	CY	$22.00	$24,420.00
	Drainage	1	LS	$5,000.00	$5,000.00
	Concrete (slab)	165	CY	$450.00	$74,250.00
	Concrete (walls)	195	CY	$750.00	$146,250.00
	Elevated Walk	40	LF	$200.00	$8,000.00
	Handrail	40	LF	$20.00	$800.00
	Stairways	1	EA	$3,500.00	$3,500.00
	Miscellaneous Metal	1	LS	$10,000.00	$10,000.00
	Air Diffusers	1	LS	$30,000.00	$30,000.00
	Digester Piping, Valves and Mechanical	1	LS	$15,000.00	$15,000.00
	Decant System	2	EA	$4,000.00	$8,000.00
	Blowers	2	EA	$8,000.00	$16,000.00
				Sub-Total	**$364,620.00**
Miscellaneous					
	Site piping	1	LS	$75,000.00	$75,000.00
	Electrical	1	LS	$30,000.00	$30,000.00
	Upgrade Generator	1	LS	$50,000.00	$50,000.00
	Site	1	LS	$10,000.00	$10,000.00
				Sub-Total	**$165,000.00**
	SUBTOTAL				**$4,934,984.40**
	CONTINGENCY (20%)				**$986,996.88**
	GRAND TOTAL				**$5,921,981.28**
	SALES TAX (8.3%)				**$491,524.45**
	TOTAL				**$6,413,505.73**

Property Acquisition Costs					
	Utility Easements 15' permanents	1	Acre	$10,000.00	$10,000.00
	Property Acquisition WRF Site	12	Acre	$10,000.00	$120,000.00
	Administration	1	Ea. File	$2,000.00	$2,000.00
	SUBTOTAL				**$132,000.00**
	CONTINGENCY (20%)				**$26,400.00**
	TOTAL				**$158,400.00**

Engineering, Environmental & Admin					
	Engineering (12% of construction)	1	LS	$710,637.75	$710,637.75
	Administration (9%of Construction)	1	LS	$532,978.32	$532,978.32
	SUBTOTAL				**$1,243,616.07**
	CONTINGENCY (10%)				**$124,361.61**
	TOTAL				**$1,367,977.68**

	Shared Reclamation Facility Costs	1	LS	$746,900.00	$746,900.00

GRAND TOTAL **$8,686,783.40**

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Facility Plan Supplemental Information
Transmission to Belfair Facility
Belfair UGA Only (0.32 mgd)

	Items of Work and Materials	Quantity	Unit	Unit Price	Total Amount
	Mobilization	1	LS	8%	$152,080.00
Pump Station No. 1					
	Electrical Service to Pump Station	1	LS	$10,000.00	$10,000.00
	Pump Station Mechanical Equipment	1	LS	$275,000.00	$275,000.00
	Wetwell	1	LS	$70,000.00	$70,000.00
	Chemical Feed/Electrical Building	400	SF	$150.00	$60,000.00
	Odor Control	1	LS	$50,000.00	$50,000.00
	Electrical Equipment	1	LS	$140,000.00	$140,000.00
	Telemetry/SCADA	1	LS	$35,000.00	$35,000.00
	Generator	1	LS	$60,000.00	$60,000.00
	Fencing	1	LS	$5,000.00	$5,000.00
	Site Work & Landscaping	1	LS	$15,000.00	$15,000.00
	Erosion Control	1	LS	$3,500.00	$3,500.00
	Valves and Vault	1	LS	$40,000.00	$40,000.00
	Meter and Vault	1	LS	$20,000.00	$20,000.00
				Sub-Total	**$783,500.00**
Force Main Costs (PS1 to WRF)					
	Traffic Control	1	LS	$20,000.00	$20,000.00
	10-inch Force Main	7000	LF	$90.00	$630,000.00
	Bore/Direct Drill	450	LF	$550.00	$247,500.00
	Surface restoration - seeding	2000	SY	$10.00	$20,000.00
	Surface restoration - pavement	1000	SY	$32.00	$32,000.00
	Erosion Control	1	LS	$30,000.00	$30,000.00
	Air Release Valves and Vaults	6	EA	$10,000.00	$60,000.00
	Access Roads	2600	SY	$30.00	$78,000.00
				Sub-Total	**$1,097,500.00**
	SUBTOTAL				**$2,033,080.00**
	CONTINGENCY (20%)				**$406,616.00**
	GRAND TOTAL				**$2,439,696.00**
	SALES TAX (8.3%)				**$202,494.77**
	TOTAL				**$2,642,190.77**

Property Acquisition Costs					
	Easements 15' permanent w/const.	2	Acre	$40,000.00	$80,000.00
	Property Acquisition PS1 Site	0.1	Acre	$200,000.00	$20,000.00
	Administration	8	Ea. File	$2,000.00	$16,000.00
	SUBTOTAL				**$116,000.00**
	CONTINGENCY (20%)				**$23,200.00**
	TOTAL				**$139,200.00**

Engineering, Environmental & Admin					
	Environmental Reviews/Permitting	1	LS	$60,000.00	$60,000.00
	Engineering (9% of construction)	1	LS	$219,572.64	$219,572.64
	Administration (7%of Construction)	1	LS	$170,778.72	$170,778.72
	SUBTOTAL				**$450,351.36**
	CONTINGENCY (10%)				**$45,035.14**
	TOTAL				**$495,386.50**

GRAND TOTAL **$3,276,777.26**

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Facility Plan Supplemental Information
Transmission to NB-CI Facility
Belfair UGA Only (0.32 mgd)

	Items of Work and Materials	Quantity	Unit	Unit Price	Total Amount
	Mobilization	1	LS	8%	$431,512.00
Pump Station No. 1					
	Electrical Service to Pump Station	1	LS	$10,000.00	$10,000.00
	Pump Station Mechanical Equipment	1	LS	$275,000.00	$275,000.00
	Wetwell	1	LS	$70,000.00	$70,000.00
	Chemical Feed/Electrical Building	400	SF	$150.00	$60,000.00
	Odor Control	1	LS	$50,000.00	$50,000.00
	Electrical Equipment	1	LS	$140,000.00	$140,000.00
	Telemetry/SCADA	1	LS	$35,000.00	$35,000.00
	Generator	1	LS	$60,000.00	$60,000.00
	Fencing	1	LS	$5,000.00	$5,000.00
	Site Work & Landscaping	1	LS	$15,000.00	$15,000.00
	Erosion Control	1	LS	$3,500.00	$3,500.00
	Valves and Vault	1	LS	$40,000.00	$40,000.00
	Meter and Vault	1	LS	$20,000.00	$20,000.00
				Sub-Total	**$783,500.00**
Force Main Costs (PS1 to Convey PS)					
	Traffic Control	1	LS	$20,000.00	$20,000.00
	12-inch Force Main	5550	LF	$100.00	$555,000.00
	Bore/Direct Drill	150	LF	$550.00	$82,500.00
	Surface restoration/Pavement	3000	SY	$2.00	$6,000.00
	Erosion Control	1	LS	$24,000.00	$24,000.00
	Air Release Valves and Vaults	4	EA	$10,000.00	$40,000.00
	Access Roads	1400	SY	$30.00	$42,000.00
				Sub-Total	**$749,500.00**
Conveyance Pump Station					
	Electrical Service to Pump Station	1	LS	$65,000.00	$65,000.00
	Pump Station Mechanical Equipment	1	LS	$155,000.00	$155,000.00
	Wetwell	1	LS	$55,000.00	$55,000.00
	Chemical Feed/Electrical Building	400	SF	$150.00	$60,000.00
	Odor Control	1	LS	$55,000.00	$55,000.00
	Electrical	1	LS	$120,000.00	$120,000.00
	Telemetry/SCADA	1	LS	$40,000.00	$40,000.00
	Generator	1	LS	$55,000.00	$55,000.00
	Fencing	1	LS	$5,000.00	$5,000.00
	Site Work	1	LS	$15,000.00	$15,000.00
	Access Road	1	LS	$50,000.00	$50,000.00
	Erosion Control	1	LS	$7,000.00	$7,000.00
	Valves and Vault	1	LS	$40,000.00	$40,000.00
	Meter and Vault	1	LS	$20,000.00	$20,000.00
				Sub-Total	**$742,000.00**
Force Main Costs (Convey PS to WRF)					
	Access During Construction	30700	SY	$5.00	$153,500.00
	10-inch Force Main	27600	LF	$90.00	$2,484,000.00
	Bore/Direct Drill	300	LF	$550.00	$165,000.00
	Surface restoration	9200	SY	$2.00	$18,400.00
	Erosion Control	1	LS	$24,000.00	$24,000.00
	Air Release Valves and Vaults	17	EA	$10,000.00	$170,000.00
	Access Roads	2800	SY	$30.00	$84,000.00
				Sub-Total	**$3,098,900.00**
	SUBTOTAL				**$5,805,412.00**
	CONTINGENCY (20%)				**$1,161,082.40**
	GRAND TOTAL				**$6,966,494.40**
	SALES TAX (8.3%)				**$578,219.04**
	TOTAL				**$7,544,713.44**

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Property Acquisition Costs					
	Easements 15' permanent w/const.	6.3	Acre	$10,000.00	$63,000.00
	Property Acquisition PS Site	0.6	Acre	$200,000.00	$120,000.00
	Administration	32	Ea. File	$2,000.00	$64,000.00
	SUBTOTAL				**$247,000.00**
	CONTINGENCY (20%)				**$49,400.00**
	TOTAL				**$296,400.00**

Engineering, Environmental & Admin					
	EIS	1	LS	$55,000.00	$55,000.00
	Engineering (10% of construction)	1	LS	$696,649.44	$696,649.44
	Administration (8%of Construction)	1	LS	$557,319.55	$557,319.55
	SUBTOTAL				**$1,308,968.99**
	CONTINGENCY (10%)				**$130,896.90**
	TOTAL				**$1,439,865.89**

GRAND TOTAL **$9,280,979.33**

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Facility Plan Supplemental Information
Belfair UGA Collection System
Belfair UGA Only (0.32 mgd)

	Items of Work and Materials	Quantity	Unit	Unit Price	Total Amount
	MOBILIZATION, 8%	1	LS	8%	$358,418.00
	UGA Misc				
	Traffic Control	1	LS	$200,000.00	$200,000.00
	Clearing and Grubbing	2	AC	$5,000.00	$10,000.00
	Erosion Control	1	LS	$75,000.00	$75,000.00
	Dewatering	9,000	LF	$4.50	$40,500.00
	Landscaping/Restoration	12,000	SY	$10.00	$120,000.00
	Pavement Restoration	5,300	SY	$32.00	$169,600.00
	Potholing	50	EA	$500.00	$25,000.00
	Saw Cutting	22,500	LF	$1.30	$29,250.00
	Septic System Abandonment	250	EA	$1,200.00	$300,000
				Misc. Sub-Total	**$969,350.00**
	UGA Pump Station No. 2				
	Pump Station 2	1	LS	$ 400,000.00	$400,000.00
	6-inch Force Main (From PS 2 to PS 1)	2,900	LF	$50.00	$145,000.00
	Air Release Valves and Vaults	2	EA	$10,000.00	$20,000.00
				Pump Station 2 Sub-Total	**$565,000.00**
	UGA Pressure Sewer				
	Grinder Pump	110	EA	$6,000.00	$660,000.00
	3-inch Force Main	5,200	LF	$35.00	$182,000.00
	4-inch Force Main	1,950	LF	$40.00	$78,000.00
				UGA Pressure System Sub-Total	**$920,000.00**
	UGA Gravity Sewer Collection System				
	8" Gravity Sewer Pipe, 0-6 Feet Deep	2,625	LF	$85.00	$223,125.00
	8" Gravity Sewer Pipe, 6-9 Feet Deep	6,375	LF	$90.00	$573,750.00
	8" Gravity Sewer Pipe, 9-12 Feet Deep	1,350	LF	$100.00	$135,000.00
	10" Gravity Sewer Pipe, 6-9 Feet Deep	950	LF	$120.00	$114,000.00
	15" Gravity Sewer Pipe, 9-12 Feet Deep	1,250	LF	$200.00	$250,000.00
	18" Gravity Sewer Pipe, 6-9 Feet Deep	1,100	LF	$200.00	$220,000.00
	48" STD Precast Manhole	42	EA	$5,000.00	$210,000.00
	Sanitary Sewer Service Connection	250	EA	$1,200.00	$300,000.00
				UGA Gravity System Sub-Total	**$2,025,875.00**
	SUBTOTAL				**$4,838,643.00**
	CONTINGENCY (20%)				**$967,728.60**
	TOTAL				**$5,806,371.60**
	SALES TAX (8.3%)				**$481,928.84**
	GRAND TOTAL				**$6,288,300.44**

Property Acquisition Costs					
	Easements 20' permanent w/const.	5	Acre	$40,000.00	$200,000.00
	Property Acquisition PS Sites	0.1	Acre	$200,000.00	$20,000.00
	Administration	58	Ea. File	$2,000.00	$116,000.00
	SUBTOTAL				**$336,000.00**
	CONTINGENCY (20%)				**$67,200.00**
	TOTAL				**$403,200.00**

Engineering, Environmental & Admin					
	Environmental Reviews/Permitting	1	LS	$160,000.00	$160,000.00
	Engineering (9% of construction)	1	LS	$522,573.44	$522,573.44
	Administration (7%of Construction)	1	LS	$406,446.01	$406,446.01
	SUBTOTAL				**$1,089,019.46**
	CONTINGENCY (10%)				**$108,901.95**
	TOTAL				**$1,197,921.40**

GRAND TOTAL **$7,889,421.84**

Facility Plan Supplemental Information
Treatment Alternative 2 - Belfair MBR Annual O&M Costs

O&M activities		Quantity	Unit	Unit Price	Total Amount
	Operations				
	Operating supplies	1	LS	$ 28,000.00	$28,000.00
	Professional Services	1	LS	$ 24,000.00	$24,000.00
	Biosolids contract	1	LS	$ 26,000.00	$26,000.00
	Utilities Power	1	LS	$ 22,000.00	$22,000.00
	Contracted Repairs/Maintenance	1	LS	$ 14,000.00	$14,000.00
	UV Bulb Replacement	1	LS	$ 3,100.00	$3,100.00
	MBR Replacement	1	LS	$ 18,000.00	$18,000.00
	Miscellaneous	1	LS	$ 4,000.00	$4,000.00
	Lab and Waste permits	1	LS	$ 4,000.00	$4,000.00
	Labor				
	One person	1	LS	$59,300.00	$59,300.00
	Land Lease				
	Sprayfield	1	LS	$7,200.00	$7,200.00
	Excise Tax	1	LS	$12,000.00	$12,000.00
	Administration (20%)	1	LS	$44,320.00	$44,320.00
	TOTAL				**$265,920.00**

Facility Plan Supplemental Information
Treatment Alternative 3 - NB-CI Annual O&M Costs

O&M activities	Quantity	Unit	Unit Price	Total Amount
Operations				
Operating supplies	1	LS	$ 14,000.00	$14,000.00
Professional Services	1	LS	$ 10,000.00	$10,000.00
Biosolids contract	1	LS	$ 35,000.00	$35,000.00
Utilities Power	1	LS	$ 21,000.00	$21,000.00
Contracted Repairs/Maintenance	1	LS	$ 10,000.00	$10,000.00
UV Bulb Replacement	1	LS	$ 1,500.00	$1,500.00
MBR Replacement	1	LS	$ 18,000.00	$18,000.00
Miscellaneous	1	LS	$ 4,000.00	$4,000.00
Lab and Waste permits	1	LS	$ 1,000.00	$1,000.00
Labor				
Increase Staff by One person	1	LS	$59,300.00	$59,300.00
Land Lease				
Sprayfield	1	LS	$7,200.00	$7,200.00
Excise Tax	1	LS	$12,000.00	$12,000.00
Administration (20%)	1	LS	$38,600.00	$38,600.00
TOTAL				**$231,600.00**

O&M costs represent the incremental costs for the Belfair system.

O&M cost were derived from the 2005 NBCI Budget

Facility Plan Supplemental Information
Sewer Transmission to Belfair Facility Annual O&M Costs

O&M activities	Quantity	Unit	Unit Price	Total Amount
Transmission				
Labor				
Pump Station Visit (6 hrs/week)	312	Hrs	$ 35.00	$10,920.00
Air release Station maintenance	128	Hrs	$ 35.00	$4,480.00
Pump Station Cleaning	16	Hrs	$ 35.00	$560.00
Power (PS1)	285,000	Kw-hrs	$0.08	$22,800.00
Chemical Cost	1	LS	$3,500.00	$3,500.00
Gen Maintenance/fuel	1	LS	$2,000.00	$2,000.00
Excise Tax	1	LS	$6,000.00	$6,000.00
			Conveyance Subtotal	**$50,260.00**
Administration				
Administration & Oversight (20%)	1	LS	$10,052.00	$10,052.00
			Administration Subtotal	**$10,052.00**
TOTAL				**$60,312.00**
Total Labor Hours	**456**			

Facility Plan Supplemental Information
Sewer Transmission to NB-CI Annual O&M Costs

	O&M activities	Quantity	Unit	Unit Price	Total Amount
	Transmission				
	Labor				
	Pump Station Visit (12 hrs/week)	624	Hrs	$ 27.00	$16,848.00
	Air release Station maintenance	504	Hrs	$ 27.00	$13,608.00
	Pump Station Cleaning	32	Hrs	$ 27.00	$864.00
	Power (PS1)	285,000	Kw-hrs	$0.08	$22,800.00
	Power (Transmission PS)	50,000	Kw-hrs	$0.08	$4,000.00
	Chemical Cost	1	LS	$3,500.00	$3,500.00
	Gen Maintenance/fuel	1	LS	$4,000.00	$4,000.00
	Excise Tax	1	LS	$6,000.00	$6,000.00
		Conveyance Subtotal			**$71,620.00**
	Administration				
	Administration & Oversight (20%)	1	LS	$14,324.00	$14,324.00
		Administration Subtotal			**$14,324.00**
	TOTAL				**$85,944.00**
	Total Labor Hours	**1160**			

Facility Plan Supplemental Information
Sewer Collection Annual O&M Costs

O&M activities	Quantity	Unit	Unit Price	Total Amount
Labor				
Pump Station Visit (5hrs/week)	260	Hrs	$ 35.00	$9,100.00
e-one pump responses (8 hrs/month)	24	Hrs	$ 35.00	$840.00
Line Cleaning and flushing	92	Hrs	$ 35.00	$3,220.00
Pump Station Cleaning	16	Hrs	$ 35.00	$560.00
Power (PS2)	6,125	Kw-hrs	$0.08	$490.00
Gen Maintenance/fuel	1	LS	$1,200.00	$1,200.00
e-one pump replacement	3	EA	$3,300.00	$9,900.00
Equipment Rental	1	LS	$2,000.00	$2,000.00
Excise Tax	1	LS	$3,900.00	$3,900.00
			Belfair Subtotal	**$31,210.00**
Administration				
Administration & Oversight (20%)	1	LS	$ 6,242.00	$6,242.00
			Administration Subtotal	**$6,242.00**
TOTAL				**$37,452.00**
Total Labor Hours	**392**			

APPENDIX K

Belfair Sewer Project

November 15th Public Meeting
N. Mason School District Office

Betty Wing

Director of Administration
Mason County

Tonight's Items

- Facilities Plan Summary
- LAMIRD for North Shore
- Septic System Role
- Draft Programmatic EIS
- Meeting/Comment Opportunities
- Financial Considerations

Tom Perry, PE

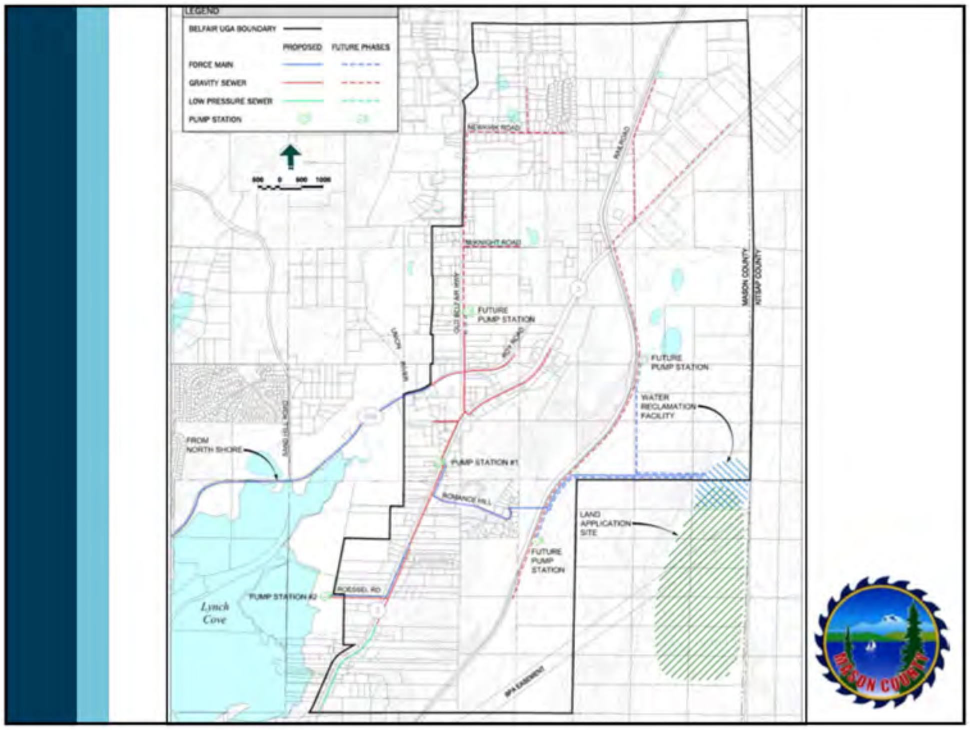
Vice President
Murray Smith & Associates
Belfair Facilities Plan Consultant

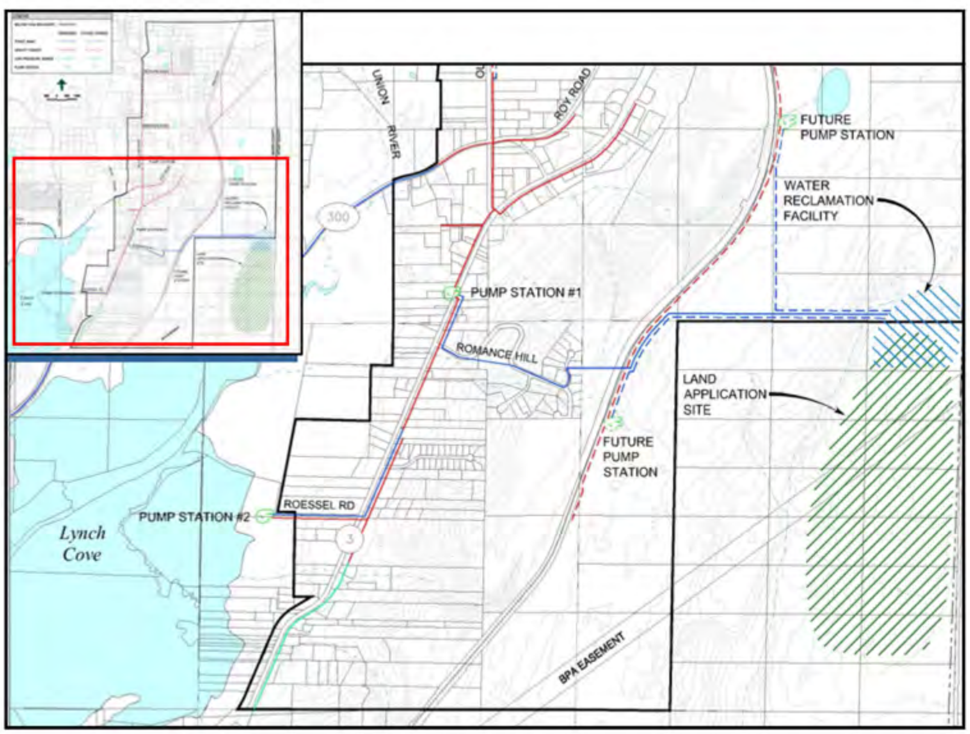
Current Plan Amendment

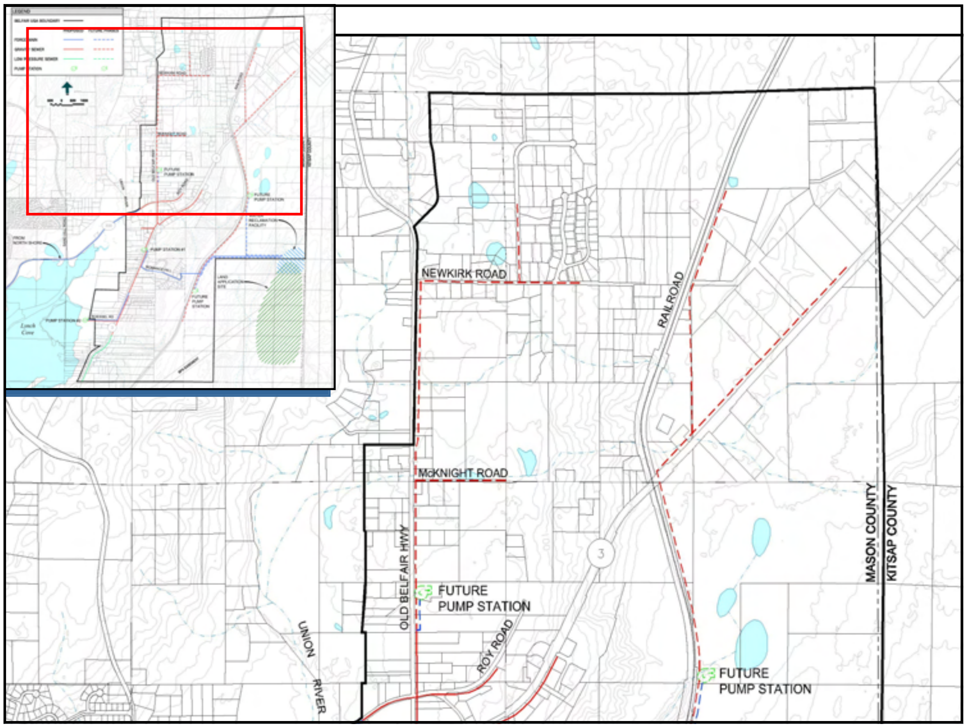
- Based on current population forecasts for Belfair UGA
- Considered other treatment options – now focused on a Belfair membrane bioreactor
- Class A reclaimed water will be produced and used to spray irrigate or infiltrate on forest land

Current Plan Amendment

- Sewer now not in Highway 3 right-of-way
- Will cooperate/coordinate with DOT as much as possible, especially on environmental review/documentation
- Service area is Belfair UGA plus limited, most critical part of North Shore


LEGEND
BELFAIR UGA BOUNDARY
PROPOSED
FUTURE PHASES
FORCE MAIN
GRAVITY SEWER
LOW PRESSURE SEWER
PUMP STATION
FUTURE PUMP STATION
ROY ROAD
FUTURE PUMP STATION
WATER RECLAMATION FACILITY
FROM NORTH SHORE
PUMP STATION #1
ROMANCE HILL
LAND APPLICATION SITE
FUTURE PUMP STATION
ROESSEL RD
PUMP STATION #2
Lynch Cove
BPA EASEMENT
MASON COUNTY
KITSAP COUNTY


UNION RIVER
ROY ROAD
FUTURE PUMP STATION
WATER RECLAMATION FACILITY
300
PUMP STATION #1
ROMANCE HILL
LAND APPLICATION SITE
FUTURE PUMP STATION
ROESSEL RD
PUMP STATION #2
Lynch Cove
3
BPA EASEMENT



North Shore LAMIRD

Steve Goins
Mason County
Planning Manager

North Shore

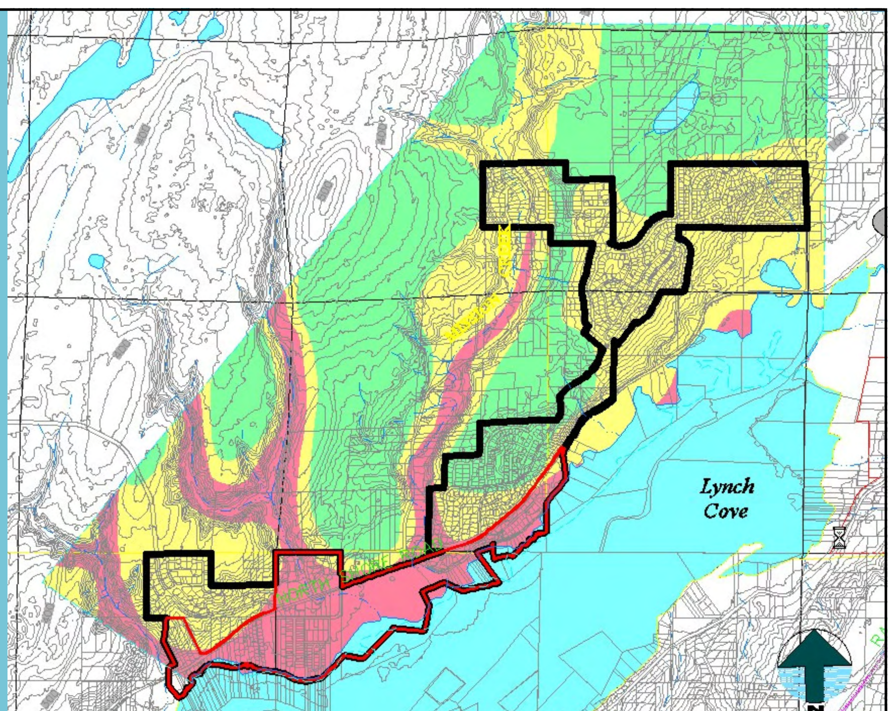
- North Shore is a rural, not an urban area
  - Growth Management Act considers sewers an urban service
  - Court cases support not extending sewers in areas designated as rural

North Shore LAMIRD

- Limited Area of More Intense Rural Development (LAMIRD)
- What is a LAMIRD?
  - Allows some urban-style amenities for existing development
  - A one time Comprehensive Plan amendment
- Why would we want one?

LAMIRD

- North Shore LAMIRD proposal…
  - Covers more area than intended for sewers
  - Water quality results from the first phase of North Shore sewering will be evaluated before considering more sewers to serve existing development



Septic Systems

Debbie Riley
Environmental Health Manager
Mason County

Septic Systems

- Septic systems are a big part of Mason County's water quality program
- Belfair's sewers will come in phases
- Get ready for change because of new state law…no more "business as usual"

Lisa Adolfson

ESA Adolfson | Water
Environmental Consultant

Draft Programmatic EIS

- "Program" level is start of "phased review"
- Broad look at three alternatives
  1. Belfair UGA + LAMIRD – plant near Belfair – land application
  2. Belfair UGA + LAMIRD – use Allyn plant – land application
  3. No action

Major Findings – Alts. 1 & 2

- Water reclamation and land appli-cation result in minimal surface/ groundwater impacts
- Odors not noticible nearby
- Construction-related impacts from force mains:
  - Can be mitigated
  - Alternative 2 has higher impact potential

Major Findings – Alts. 1 & 2

- Wastewater collection will cut bacterial and nutrient loading in Lynch Cove…especially in LAMIRD
- Wastewater improvements could be off-set by increased storm water if controls are not implemented
- Traffic congestion during construction will happen

Major Findings – Alts. 1 & 2

- North Shore is currently 80% developed so growth in LAMIRD will be limited
- Cost of sewering will be a financial hardship

Major Findings – Alt. 3

- No action has fewer construction impacts
- Water quality degradation from failing or malfunctioning septics will continue
- Septic suitability, not land use plan, will determine development
- Upgrading failed or malfunctioning septics will be financial hardship

Commenting on the DEIS

- Comment period ends 12/11/06
- Use postal mail for Comment Forms
- e-mail comments to: steveg@co.mason.wa.us
- Offer testimony at Public Hearing on **November 28, 2006**

Betty Wing

Director of Administration
Mason County

Schedule

Day	Date	Event
Wed	10/4/06	Scoping Note to Agencies
Wed	10/11/06	Public Information Meeting
Wed	10/25/06	Scoping Period Ends
Thu	11/9/06	Draft Programmatic EIS Issued
Wed	11/15/06	Public Information/Workshop
Tue	11/28/06	Hearing on the EIS
Mon	12/11/06	EIS Comments Due
Mon	12/18/06	Planning Advisory Commission Hearing
Mon	1/8/07	Planning Advisory Commission Recommendations
Mon	1/22/07	Final Programmatic EIS Issued
Tue	1/23/07	Board of County Commissioners' Hearing
Tue	1/30/07	Board of County Commissioners' Decision

Financial Considerations

Ed Cebron
Principal – FCS Group
Facilities Plan Financial Consultant

Mike Sharar
Mason County Wastewater Consultant

“Is” and “Is Not”

- **Is** an alarming problem
- **Is** the start of a longer conversation
- **Is** vital to have clearly before you

- **Is not** a recommendation or a planned action or a Commission position
- **Is not** the end of this effort

A Starting Point

$$\frac{\text{Numerator}}{\text{Denominator}}$$

A Starting Point

Numerator

Denominator

What you must pay every year or month

How many households (ERUs) there are to pay it

A Starting Point

Numerator

Denominator

What you have to pay every year or month

It's nice if this number gets smaller

How many households (ERUs) there are to pay it

It's better if this number does NOT get smaller

Summary of Capital Costs

	2006 Cost	Escalated Cost
2007 Design Costs	$ 2,660,000	$ 2,766,400
2008 Projected Spending	15,575,000	16,845,920
2009 Projected Spending	15,575,000	17,519,757
	$ 33,810,000	$ 37,132,077

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ERU and Growth Data

ERUs	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Belfair UGA (5% annual)	508	533	560	588	617	648	681	715	751	788	827
North Shore	372	372	372	372	372	372	372	372	372	372	372
Total Customer Base	880	905	932	960	989	1,020	1,053	1,087	1,123	1,160	1,199
Effective Utility Annual Growth Rate		2.89%	2.95%	3.00%	3.06%	3.12%	3.18%	3.23%	3.29%	3.34%	3.40%
Belfair UGA (9.7% annual)	508	557	611	671	736	807	885	971	1,065	1,169	1,282
North Shore	372	372	372	372	372	372	372	372	372	372	372
Total Customer Base	880	929	983	1,043	1,108	1,179	1,257	1,343	1,437	1,541	1,654
Effective Utility Annual Growth Rate		5.60%	5.82%	6.03%	6.24%	6.44%	6.64%	6.83%	7.01%	7.19%	7.36%

Annual Growth Basis:

Belfair UGA - Projected 9.7% - Analysis assumption 5%
North Shore - Projected 0% - Analysis assumption 0%

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Capital Financing

Financing Options:

- Public Works Trust Fund Loans (assumed $7m in 2009)
- CERB Grants and Loans (existing $11.2 million grant)
- Department of Ecology Grants and Loans (existing loans totaling ~$2.4 million) – rate outcomes may qualify the county for hardship status in consideration for Centennial Grants
- Federal Programs including STAG, Rural Development and CDBG
- Public Debt including Revenue and G.O. Bonds (including short-term G.O. debt)

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Capital Financing Summary

- Existing DOE loans are used for 2007 design costs
- $11.2 million in existing grants
- $7 million of PWTF assumed for 2009
- Revenue bonds finance the balance of costs: $15.7 million

	2007	2008	2009	2010	2011	2012
Costs to Finance	$ 2,766,400	$ 16,845,920	$ 17,519,757	$ -	$ -	$ -
Funding Sources						
Grant	$ 337,294	$ 10,862,706	$ -	$ -	$ -	$ -
State Loans (SRF/PWTF)	2,429,106	-	7,000,000	-	-	-
ULID	-	-	-	-	-	-
Revenue Bond	-	5,983,214	10,519,757	-	-	-
	$ 2,766,400	$ 16,845,920	$ 17,519,757	$ -	$ -	$ -

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Key Projection Assumptions

• ULID Formation Costs	5% of Capital Construction Cost (5-15% is common)
• Operating Budget	$625,000 first year of operation
• Bond Terms	5% interest, 25 years for Scenario 1 5% interest, 20 years for Scenarios 2 & 3
• Bond Coverage	1.25 for rate-funded debt (Sc. 1) 1.0 for ULID funded debt (Sc. 2 & 3)
• Assessment Terms	5% interest, 20 years
• General Cost Inflation	3% annually
• Construction Cost Inflation	4% annually

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Summary of Annual Revenue Needs

Scenario 1: Debt Service is paid from Rate Revenue

Annual Revenue Needs Summary	2007	2008	2009	2010	2011	2012	2017	2022	2027
Non-Capital Costs									
Administration & Overhead	$ -	$ -	$ -	$ 90,000	$ 92,700	$ 95,481	$ 110,689	$ 128,318	$ 148,756
Operations and Maintenance	-	-	-	422,000	434,660	447,700	519,007	601,671	697,502
Build-up of Reserves	-	-	-	53,276	2,138	-	-	-	-
Excise Tax	0	0	0	66,428	68,562	70,803	83,806	91,138	109,759
	$ 0	$ 0	$ 0	$ 631,703	$ 598,060	$ 613,984	$ 713,501	$ 821,128	$ 956,017
Debt Service	*capitalized interest period*								
State Loans	$ -	$ -	$ -	$ 567,705	$ 563,946	$ 560,186	$ 541,387	$ 522,592	$ 503,798
Revenue Bond	-	-	-	1,547,211	1,547,211	1,547,211	1,547,211	1,547,211	1,547,211
	$ -	$ -	$ -	$ 2,114,916	$ 2,111,157	$ 2,107,397	$ 2,088,598	$ 2,069,804	$ 2,051,010
Net Coverage Increment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Annual Costs	$ 0	$ 0	$ 0	$ 2,746,620	$ 2,709,216	$ 2,721,381	$ 2,802,099	$ 2,890,931	$ 3,007,027
Monthly Rate	**$ 0.00**	**$ 0.00**	**$ 0.00**	**$ 212.73**	**$ 212.73**	**$ 212.73**	**$ 212.73**	**$ 212.73**	**$ 212.73**
Monthly Assessment per ERU	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Financing Customer Connections	$ -	$ -	$ -	$ 11.75	$ 11.75	$ 11.75	$ 11.75	$ 11.75	$ 11.75
Total Monthly Impact	**$ 0.00**	**$ 0.00**	**$ 0.00**	**$ 224.48**	**$ 224.48**	**$ 224.48**	**$ 224.48**	**$ 224.48**	**$ 224.48**
ERU Basis	**880**	**905**	**932**	**960**	**989**	**1,020**	**1,199**	**1,428**	**1,720**

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Summary of Annual Revenue Needs

Scenario 2: Debt Service is paid from ULIDs

Annual Revenue Needs Summary	2007	2008	2009	2010	2011	2012	2017	2022	2027
Non-Capital Costs									
Administration & Overhead	$ -	$ -	$ -	$ 90,000	$ 92,700	$ 95,481	$ 110,689	$ 128,318	$ 148,756
Operations and Maintenance	-	-	-	422,000	434,660	447,700	519,007	601,671	697,502
Build-up of Reserves	-	-	-	43,665	1,469	-	-	-	-
Excise Tax	0	0	0	12,550	12,934	13,338	15,679	18,668	22,482
	$ 0	$ 0	$ 0	$ 568,215	$ 541,763	$ 556,519	$ 645,375	$ 748,658	$ 868,740
Debt Service	*capitalized interest period*								
State Loans	$ -	$ -	$ -	$ 567,705	$ 563,946	$ 560,186	$ 541,387	$ 522,592	$ 503,798
Revenue Bond	-	-	-	1,646,162	1,646,162	1,646,162	1,646,162	1,646,162	1,646,162
	$ -	$ -	$ -	$ 2,213,868	$ 2,210,108	$ 2,206,348	$ 2,187,549	$ 2,168,755	$ 2,149,961
Net Coverage Increment	$ -	$ -	$ -	$ -	$ -	$ -	$ 478,694	$ 559,900	$ 64,825
Total Annual Costs	$ 0	$ 0	$ 0	$ 2,782,082	$ 2,751,871	$ 2,762,867	$ 3,311,618	$ 3,477,312	$ 3,083,526
Monthly Rate	**$ 0.00**	**$ 0.00**	**$ 0.00**	**$ 43.57**	**$ 43.57**	**$ 43.57**	**$ 49.88**	**$ 58.05**	**$ 56.96**
Monthly Assessment per ERU	$ -	$ -	$ -	$ 99.68	$ 99.50	$ 99.31	$ 98.36	$ 97.41	$ 96.47
Financing Customer Connections	$ -	$ -	$ -	$ 11.85	$ 11.85	$ 11.85	$ 11.85	$ 11.85	$ 11.85
Total Monthly Impact	**$ 0.00**	**$ 0.00**	**$ 0.00**	**$ 155.11**	**$ 154.92**	**$ 154.73**	**$ 160.08**	**$ 167.31**	**$ 165.28**
ERU Basis	**880**	**905**	**932**	**960**	**989**	**1,020**	**1,199**	**1,428**	**1,720**

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MASON COUNTY

Summary of Annual Revenue Needs

Scenario 3: Combination of Rates and ULID

Annual Revenue Needs Summary	2007	2008	2009	2010	2011	2012	2017	2022	2027
Non-Capital Costs									
Administration & Overhead	$ -	$ -	$ -	$ 90,000	$ 92,700	$ 95,481	$ 110,689	$ 128,318	$ 148,756
Operations and Maintenance	-	-	-	422,000	434,660	447,700	519,007	601,671	697,502
Build-up of Reserves	-	-	-	48,967	1,874	-	-	-	-
Excise Tax	0	0	0	31,480	32,457	33,484	39,439	45,796	55,153
	$ 0	$ 0	$ 0	$ 592,447	$ 561,691	$ 576,665	$ 669,134	$ 775,786	$ 901,411
Debt Service	*capitalized interest period*								
State Loans	$ -	$ -	$ -	$ 567,705	$ 563,946	$ 560,186	$ 541,387	$ 522,592	$ 503,798
Revenue Bond	-	-	-	1,547,211	1,547,211	1,547,211	1,547,211	1,547,211	1,547,211
	$ -	$ -	$ -	$ 2,114,916	$ 2,111,157	$ 2,107,397	$ 2,088,598	$ 2,069,804	$ 2,051,010
Net Coverage Increment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Annual Costs	$ 0	$ 0	$ 0	$ 2,707,363	$ 2,672,848	$ 2,684,062	$ 2,757,732	$ 2,845,589	$ 2,952,420
Monthly Rate	**$ 0.00**	**$ 0.00**	**$ 0.00**	**$ 106.89**	**$ 106.89**	**$ 106.89**	**$ 106.89**	**$ 106.89**	**$ 106.89**
Monthly Assessment per ERU	$ -	$ -	$ -	$ 59.46	$ 59.35	$ 59.24	$ 58.72	$ 58.19	$ 57.66
Financing Customer Connections	$ -	$ -	$ -	$ 11.75	$ 11.75	$ 11.75	$ 11.75	$ 11.75	$ 11.75
Total Monthly Impact	**$ 0.00**	**$ 0.00**	**$ 0.00**	**$ 178.10**	**$ 177.99**	**$ 177.89**	**$ 177.36**	**$ 176.83**	**$ 176.30**
ERU Basis	**880**	**905**	**932**	**960**	**989**	**1,020**	**1,199**	**1,428**	**1,720**

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Summary of Capital Facilities Charge

Cost Basis		
CAPITAL PLAN		
Total Future Projects	$	31,510,000
less: ULID/Assessment-Funded Projects		-
less: Grants and Contributions		(11,200,000)
TOTAL FUTURE COST BASIS	**$**	**20,310,000**

Customer Base	**ERUs**
Existing Residential Customer Equivalents	880
Future Residential Customer Equivalents (10-yr Incremental)	774
TOTAL CUSTOMER BASE	**1,654**

Resulting Charge		**Total**
Total Cost Basis	$	20,310,000
Total Customer Base		1,654
TOTAL CHARGE PER ERU	**$**	**12,278**
Treatment	***$***	***8,419***
Collection	***$***	***3,859***

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Major Utility Formation Issues

- Continued pursuit of grants, loans
- Defining criteria for viability of project
- Cash flow during construction and start-up
- Requiring connection to the system
- Private customer costs to connect
- Regulating & enabling interim development
- Developing financial administration structure

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Basics of a Financial Strategy

1. Pursue additional funding assistance - $1 million in grants reduces
   - Rates by about $**7**/month; or
   - Assessments by about $**3**/month

2. Consider use of non-voted GO debt to fund project cash flow
   - Provides capital funding in advance of costs
   - Provides initial working capital for utility initiation
   - Can be repaid from project funding and rates
   - Constrains availability of non-voted capacity for other purposes

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Basics of a Financial Strategy

3. Plan Use of Rate and ULID funding to…
   - Enable grant eligibility in assistance programs
   - Focus grants on non-rate elements first
   - Allow for rates and charges more consistent with other County service areas

4. Develop Financial Action Plan to implement funding
   - Criteria for Proceeding
   - Schedule & requirements for funding applications
   - Assistance programs to mitigate customer impacts
   - Prepayment programs and options with rate classes
   - ULID formation process
   - Development of rates and charges

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MASON COUNTY

A Starting Point…

$$\frac{\text{Numerator}}{\text{Denominator}}$$

Emmett Dobey

Director of Community Development and Utilities

Mason County

Energy Check

Facilities Plan	LAMIRD/Septics
Financial Considerations	Environmental Documentation

?

Betty Wing

Director of Administration
Mason County

Documents Available

Good Night!

Population

Table ES-1
Sewer Service Area Population Forecast Summary

Year	Belfair UGA Service Population	Lynch Cove/ North Shore Service Population	Total Service Population
2005	594	750	1,344
2010	1,041	750	1,791
2015	1,824	750	2,574
2020	3,195	750	3,945
2025	5,600	750	6,350

Flows and Loadings

Table ES-2
Potential Belfair Sewer Service Area Design Flows and Loadings

Design Flows (mgd)	2005	2010	2015	2025
Average Daily	0.18	0.26	0.40	1.07
Maximum Daily	0.36	0.52	0.80	2.14
Peak Hourly	0.63	1.91	1.40	3.74
Design Loadings (lbs/day)				
Average Daily BOD	226	325	499	1,344
Average Daily TSS	226	325	499	1,344

Land Requirements

Table ES-3
Land Area Requirements

	2015 Projected Flow (0.40 mgd)	2025 Projected Flow (1.10 mgd)
Land Area Required for Irrigation	33 acres	84 acres
Land Area Required for Reclamation Facilities	15 acres	30 acres
Total Land Area Required	48 acres	114 acres

Capital Costs

Table ES-4
Capital Cost Summary

Sewer Component	Belfair MBR	North Bay-Case Inlet Expansion
Collection System		
Belfair UGA	$7,900,000	$7,900,000
Lynch Cove/North Shore	$8,500,000	$8,500,000
Transmission and Treatment		
Transmission	$3,500,000	$9,900,000
Treatment	$13,900,000	$9,100,000
Total Capital Cost	**$33,800,000**	**$35,400,000**

Present Worth

Table ES-5
Present Worth Summary

Sewer Component	Belfair MBR	North Bay-Case Inlet Expansion
Total Capital Costs	$33,800,000	$35,400,000
Annual O&M Costs	$507,000	$477,000
Annual Replacement Costs	$554,000	$552,000
20-Year Present Worth	**$49,600,000**	**$50,700,000**

Current Funding

Table ES-6
Summary of Current Available Funding

Source	Amount
State Revolving Fund '04	$518,940
State Revolving Fund '06	$802,352
State Revolving Fund '07	$1,107,814
CTED Jobs/Communities	$8,000,000
CTED Jobs Development	$8,000,000
CTED Grant Reduction	-($4,800,000)
State Parks - Belfair	$700,000
Total Committed Funding	**$15,929,106**

Finance Scenarios to Date

Table ES-7
Funding Scenarios

	Scenario 1 Rate Financing	Scenario 2 ULID Financing	Scenario 3 Rate/ULID Financing
Annual Costs (2010)			
Non-Capital Costs (O&M)	$632,000	$568,000	$592,000
Debt Service	$2,115,000	$2,214,000	$2,115,000
Total Annual Costs	**$2,747,000**	**$2,782,000**	**$2,707,000**
Revenue (per ERU)			
Monthly Rate	$212.73	$43.57	$106.89
Monthly Assessment		$99.68	$59.46
Financing Private Costs	$11.75	$11.75	$11.75
Total Monthly Impact per ERU	**$224.48**	**$155.11**	**$178.00**

Belfair Sewer Project

Public Information Meeting

A public information meeting will be held to advise all interested citizens about the steps ahead in the Belfair Sewer Project. Between now and the end of January there will be several public opportunities to review and influence preparation of the Belfair Wastewater Facilities Plan Amendment. The Facilities Plan precedes design and construction.

Belfair Sewer Project Public Information Meeting
Wednesday, October 11, 2006
6:00 – 8:00 p.m.
Theler Center, Salmon Room #1
Belfair, WA

- Learn the status of planning efforts for the Belfair Sewer Project
- Get a schedule of dates for future public information and involvement sessions and public hearings for:
    - the plan's environmental documentation
    - the Mason County Planning Advisory Commission
    - the Mason County Board of Commissioners
- Find out about possible limited sewer service to Belfair State Park and near-shoreline structures in North Shore
- Financial analysis of the Facilities Plan will not be finished until early November. There will not be information about possible sewer rates at the October 11th meeting.

Mason County Community Development and Utilities Department
Contact: Susie Ellingson (360) 427-9670 ext. 282

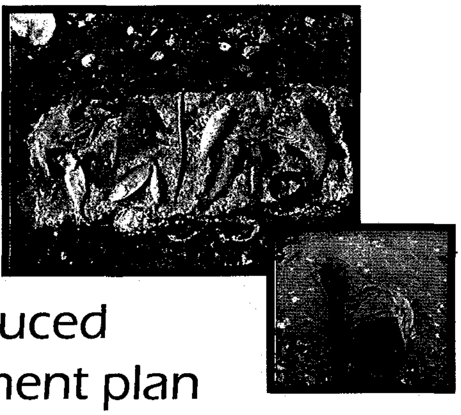
Belfair Wastewater Project

Public Meeting
October 11, 2006

Welcome!

- We'll present...
  - Short review of the rather long history
  - Update on development of the "Facilities Plan"
  - Information about sewering limited parts of the North Shore
  - An explanation about the Programmatic EIS
  - The dates and process between now and the end of January
- The problem...

Water Quality



- September 19th
- Dissolved oxygen, fecal coliform and excess nitrogen need to be reduced
- Belfair's urban development plan needs a central plant sewer system
- Extreme health hazard requires action in the highly developed but rural North Shore
- Tom Perry – Murray Smith & Associates

Short Review

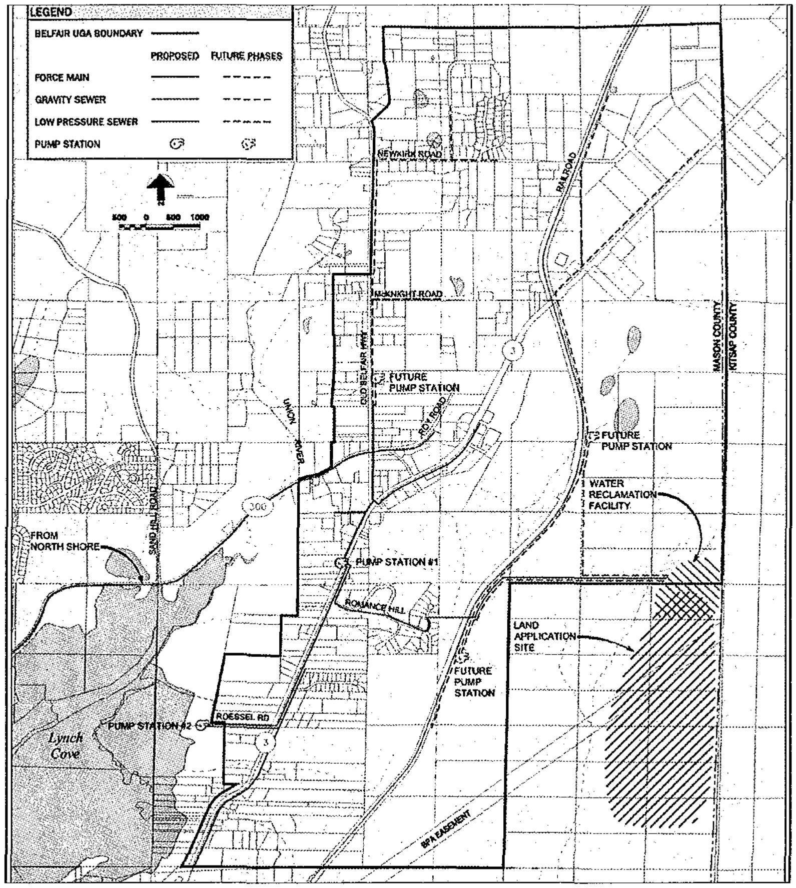
- First Facilities Plan – July 2001
  - Initially included Union, Tahuya and Belfair
  - Focused on Belfair UGA
  - Recommended Reclaimed Water treatment plant in Belfair
- First Amendment – December 2003
  - Belfair State Park added to service area
  - Treatment moved to North Bay/Case Inlet plant

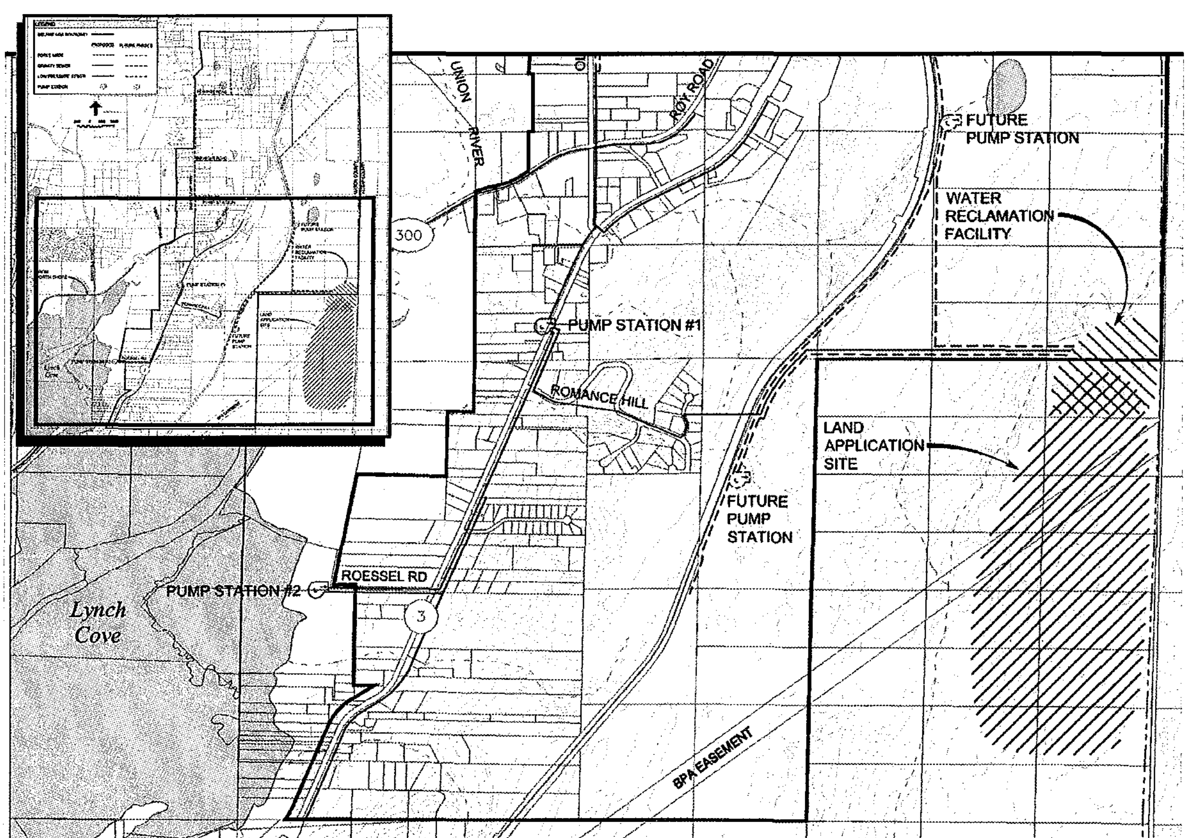
Current Plan Amendment

- Based on current population forecasts for Belfair UGA
- Considered other treatment options – now focused on a Belfair membrane bioreactor
- Class A reclaimed water will be produced and used to spray irrigate or infiltrate on forest land
- Service area is Belfair UGA plus limited, most critical part of North Shore

Current Plan cont'd

- Highway 3 improvements now scheduled for 2011-2013
- Funding resources and water quality need for sewer project likely won't wait
- Sewer now not in Highway 3 right-of-way
- Will cooperate/coordinate with DOT as much as possible, especially on environmental review/documentation


LEGEND
BELFAIR UGA BOUNDARY
PROPOSED
FUTURE PHASES
FORCE MAIN
GRAVITY SEWER
LOW PRESSURE SEWER
PUMP STATION
500 0 500 1000
NEWKIRK ROAD
RAILROAD
McKNIGHT ROAD
OLD BELFAIR HWY
FUTURE PUMP STATION
UNION RIVER
ROY ROAD
MASON COUNTY
KITSAP COUNTY
3
300
SAND HILL ROAD
FROM NORTH SHORE
FUTURE PUMP STATION
WATER RECLAMATION FACILITY
PUMP STATION #1
ROMANCE HILL
LAND APPLICATION SITE
FUTURE PUMP STATION
ROESSEL RD
PUMP STATION #2
Lynch Cove
BPA EASEMENT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PUMP STATION #2
Lynch Cove
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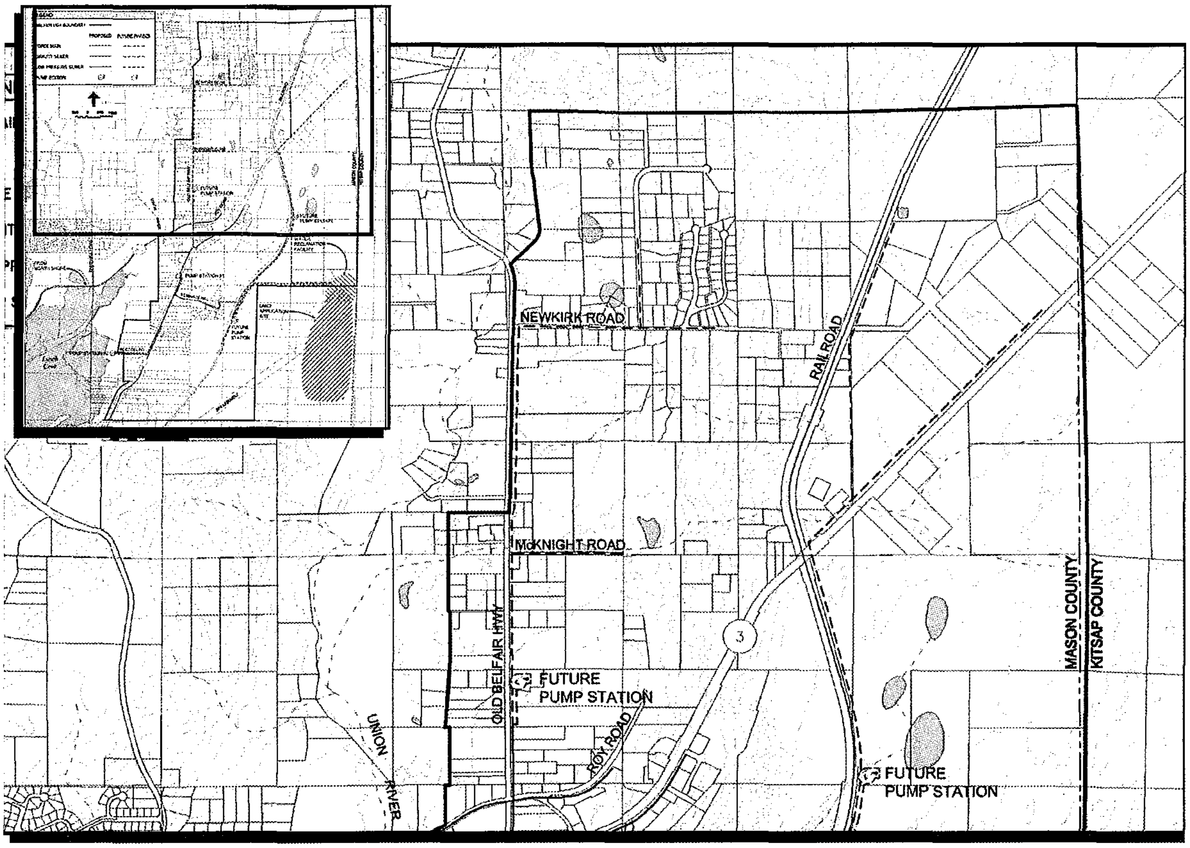
BPA EASEMENT

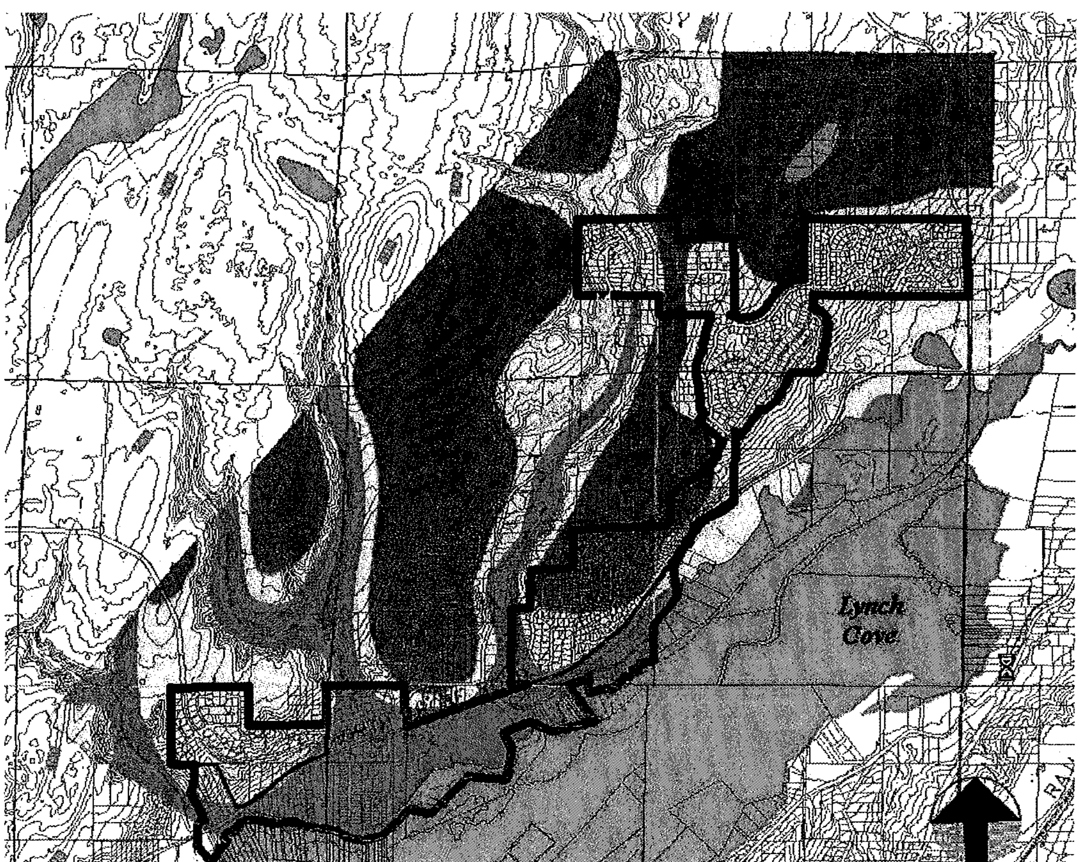


North Shore

- Declaration of "severe public health hazard"
  - Using assessor maps, inventoried existing development
  - Considered topography, soil conditions, water courses to determine most probable problem areas
- Steve Goins – Mason Co. Planning Manager
- North Shore is a rural, not an urban area
  - Growth Management Act considers sewers an urban service
  - Court cases support not extending sewers in areas designated as rural

North Shore LAMIRD

- Limited Area of More Intense Rural Development (LAMIRD)
  - What is a LAMIRD?
  - Why would we want one?
- LAMIRD proposal...
  - Is a Comprehensive Plan amendment done once
  - Covers more area than intended for sewers
  - Septic systems throughout the state will have stepped up regulation starting next summer



Environmental Documentation

- County Commissioners need environmental review to make LAMIRD change in Comprehensive Plan
- Environmental review also useful for approving Amended Belfair Facilities Plan portion of Comprehensive Plan
- Molly Adolfson – ESA Adolfson

Programmatic EIS

- Documentation covers both Amended Facilities Plan and LAMIRD
- Deals with broad issues and focuses on matters ready for decision now
- Impacts and mitigations defined in general terms
- Later environmental documentation addressing specific pipes, pump stations, the plant, etc. will reference this EIS

Scoping Notice: Right Issues?

- Programmatic EIS "scope" is under review to see if we are considering the right issues
- Issues include...
  - Air quality, odors
  - Environmental/public health
  - Fish, shellfish habitat
  - Land use: indirect impacts
  - Other
- Mike Sharar – O'Neal and Associates

Three Schedules Together

- There are three threads
  - Amending the Facilities Plan by amending the County Comprehensive Plan
  - Adding the LAMIRED designations by amending the Comprehensive Plan
  - Preparing the Programmatic EIS for both
- Doing them together is easier to understand and more comprehensive

Near-Term Schedule

Day	Date	Event
Wed	10/4/06	Scoping Note to Agencies
Wed	10/11/06	Public Information Meeting
Wed	10/25/06	Scoping Period Ends
Thu	11/9/06	Draft Programmatic EIS Issued
Wed	11/15/06	Public Information/Workshop
Tue	11/28/06	Hearing on the EIS
Mon	12/11/06	EIS Comments Due
Mon	12/18/06	Planning Advisory Commission Hearing
Mon	1/8/07	Planning Advisory Commission Recommendations
Mon	1/22/07	Final Programmatic EIS Issued
Tue	1/23/07	Board of County Commissioners' Hearing
Tue	1/30/07	Board of County Commissioners' Decision

Longer Term Plan

- 2007
  - Secure Ecology approval of Facilities Plan
  - Begin design, property acquisition and permitting
  - Secure Ecology approval of Engineering Report
  - Work on final design
- 2008
  - Complete and get final Ecology review of some elements final design
  - Start construction of pipes and pump stations
  - Complete and get final Ecology review of plant and effluent fate design
  - Start construction of treatment plant
- 2009
  - Complete construction
  - Commissioning

Available Financial Resources

Belfair Funding Summary

State Revolving Fund '04	$518,940	Planning & Design	*Being 'Re-packaged*
State Revolving Fund '06	$802,352	Design	*Being 'Re-packaged*
State Revolving Fund '07	$1,107,814	Design	Preliminary List
CTED Jobs/Communities	$8,000,000	Construction	Leg. Appropriation '05
CTED Job Development	$8,000,000	Construction	Leg. Appropriation '05
CTED Grant Reduction	-$4,800,000	Construction	Leg. Appropriation '06
State Parks – Belfair	$700,000		Leg. Appropriation '06
Committed Funding	**$15,929,106**		

Discussion

Mason County
Belfair/Lower Hood Canal
Water Reclamation Facilities Plan
October 11, 2006

Scoping Comment Form

Please provide us with your comments on the Programmatic Environmental Impact Statement for the proposed Mason County Belfair/Lower Hood Canal Water Reclamation Plan. Comments can be submitted at tonight's meeting or mailed to Steve Goins, Planning Manager, Mason County, P.O. Box 279, Shelton WA 98584 by October 25, 2006. Comments can also be emailed to steveg@co.mason.wa.us.

GOOD JOB IN PREPARATION

LAMIRD IS A GREAT CONCEPT TO UTILIZE FOR N SHORE

SPRAYING EFFLUENT IS A GOOD USE OF WATER FOR FORESTRY APPLICATIONS.

EFFLUENT COULD ALSO BE UTILIZED FOR IRRIGATING BALL FIELDS & OTHER LANDSCAPING.

IF ~~IT IS A CONCERN~~ THERE IS A CONCERN IN MOVING WATER FROM ONE WATERSHED TO ANOTHER - THERE IS FOREST LAND IN THE HOOD CANAL WATERSHED.

I SUPPORT THIS PROJECT
OUR FAMILY OWNS A FEW PROPERTIES IN THE LAMIRD -

From: Phil Wolff
Name / Affiliation

Address: 191 BOARD HOUSE RD
BELFAIR WA 98528

Gary Parrott
81 NE Gladwin Beach Road
Belfair, WA 98528
10/11/06
garyparrott@yahoo.com

COMMENTS TO THE SEWER PLANNING MEETING
10/11/06

There is a proposal for a sewer line running from Belfair to the Belfair State Park .

According to statute, before a sewer can be run outside an Urban Growth Area, there must first be a determination of a "Severe Public Health Hazard".

This happened in 2002 when the "Washington State Department of Health concurred with the Mason County Department of Health Services that conditions in the Lynch Cove area of Hood Canal result in a situation which has a significant potential to cause illness and declared these conditions create a Severe Public Health Hazard".

That was 5 years ago. Things have changed a lot since then. Lynch Cove deserves a closer look.

I challenge that a Serious Health Hazard exists today along the proposed route of the North Shore Sewer extension from the mouth of the Union River to the Belfair State Park. All available data should be reviewed prior to beginning sewer planning. If no "Serious Health Hazard" currently exists, it is both illegal and foolish to begin constructing a North Shore Sewer extension.

It's in everybody's interest to make sure there is a proper cause for this construction. Furthermore, everyone should realize there are some unintended consequences of a sewer which which may in fact degrade the water quality we have in Lynch Cove today.

Those factors are:

Increased residential construction along Lynch Cove. Each new residence brings new shoreside lawns, gardens, fertilizer, and pets. Each of these contributes nitrogen or fecal coliform into the Lynch Cove system.

Increased construction...driveways, roofs and lawns...will speed the movement of surface water into the estuary. This process increases nitrogen loading into an already nitrogen-stressed ecosystem.

Today's data suggests that a Severe Public Health Hazard no longer exists in Lynch Cove.

First, we have the "State of the Oyster Study" which gives us oyster fecal coliform counts going back to 1992. Those data are worth looking at. Oysters don't fib.

Back in 1992 things in Lynch Cove were really bad. Let me give you some figures.

Bear in mind, the maximum level of fecal coliform allowable for commercial oysters is **230 fecal coliform bacteria per 100 grams of oystermeat.**

In 1992 we were seeing CONSISTENT fecal counts of 1500 in oysters at the Union River's mouth. Between 2004 and 2006, those same Union River oysters went from 43 to 23 to 15 to 4 to "Undetectable"... or less than 3 in year 2006.

At the Belfair State Park we saw 1993 counts of 4,900. That's not a misprint. By 2003, those same State Park oysters were showing a maximum of 4.

In 2006, we all rejoiced to see the Belfair State Park reopened to recreational shellfish harvest.

There were two more oyster sampling stations between the Union River and the State Park during the years 2004 and 2006.

The first was at the Beards Cove Community Beach. The coliform levels there ranged between 23 and 4.

The second location was behind the Red Barn Restaurant. The 2006 coliform levels there ranged from 23 to 4. Remember...23 is only one tenth of the allowable level.

It should be no surprise that water quality has improved in the Lynch Cove estuary in the last five years.

Since the 2002 Declaration of Severe Health Hazard, look at some of the things which have happened along the North Shore from Belfair to the State Park.

1. The county instigated more stringent criteria for new septic construction. Where gravity systems used to be the norm, new pressure dosing systems became the rule.

1. The Belfair State Park, clearly a major polluter put in a completely new mounded septic system. The results were dramatic, resulting in re-certification of the oysters.

2. The Park Place Trailer park across from the State Park was closed due to a failing septic.

3. The Silver Sand Apartment complex put in a new pressure dosing septic on the opposite side of Gladwin Beach Road.

4. The Snooze Junction Trailer park was shut down due to failing septic.

5. The Red Barn Restaurant now has a State of the Art sewage treatment system.

6. The Beard's Cove Community Beach pool with its septic were abandoned.

Here are some concluding observations and questions:

If the water quality in the proposed sewer route supports a declaration of Sever Health Hazard, then oystermeat samples should reflect that health hazard. They do not. In fact, the oyster samples tell us we've done an excellent job of cleaning up the hazard which existed prior to 2002.

If a Severe Health Hazard still exists in Lynch Cove, why has the Health Department not warned residents and visitors against swimming in this area. Why is swimming encouraged at the Belfair State Park?

If a Severe Health Hazard exists in Lynch Cove, why haven't similar declarations been made for every place on the Hood Canal where water quality is below what we're measuring in Lynch Cove?

By installing a mounded system, The Belfair State Park has reduced the oyster fecal count from 4900 to 4. If something works this well, why not replicate it where needed rather than constructing a sewer with the previously mentioned unintended consequences?

Belfair Sewer EIS scoping issues.

Overall I don't think "best available science" supports failing septics as primary source of nitrogen in the Hood Canal. Sewering issue should be looked at from a "landscape" perspective, not just from a line drawn on map,(UGA boundary), or the once upon a time existance of a severe health hazard in Lynch Cove.

The potential for sewering the Belfair UGA, has created a very real and noticable "land rush" with property values skyrocketing. Being able to develop previously undevelopable land in a very sensitive environment has created strife and friction in what was once a quiet rural community. Its my feelings Belfair is more of a buisness center than a UGA. Not sure how you would address in an EIS, maybe under social/political aspects.

Some other issue of concern.

Within Belfair UGA

1. Current UGA boundary does not adequately protect Union River Valley as identified in Comprehensive plan.
2. Native American and early settler cultural sites.
3. Critical areas and salmon bearing streams- identification and protection.
4. Wildlife habitat- bald eagle nesting area
5. Aquifer depletion
6. How many private and community water wells in proposed service area?
7. Type II Critical Aquifer Recharge Area, in proposed service area.
8. Recharge area impacted by R-10 intense development, more impervious surfaces, with sewer facilitating development. Reexamine Belfair sub-area plan for compliance, and location of development nodes.
9. Lack of other urban services
10. Stormwater plan lacking
11. Proximity of UGA to conservation areas, with no buffering
12. Economically depressed area
13. Safety of construction timing, highway 3 is a high accident cooridor in the Belfair UGA
14. Changes in the rural character and quality of life
15. Financial impact to school district -(with 700 people at Belfair Elementary daily would be one of

biggest users.)

16. Population allocations allotment between Allyn and Belfair UGA's
17. Proposed pump station #2 is in close proximity to Theler wetlands and Hood Canal, potential for spills. Proposed pumpstation 1 very close to salmon bearing stream.

North Shore Inclusion-LAMIRD

1. Cultural sites in close proximity both Native American, (Union River) and pre-statehood. (abandoned Cemetary, hotel, ect)
2. Wetlands and critical area identification and assessment on both sides of SR 300.
3. High tides frequently cross SR 300.
4. Private and community H2O wells.
5. Conservation areas.
6. Wildlife habitat
7. Reexamine health hazard declaration.
8. Placement of sewer line will bring unwarrented development pressure.

HOOD CANAL ENVIRONMENTAL COUNCIL
America's Unique Heritage
P. O. BOX 87 · SEABECK, WASHINGTON 98380

RECEIVED
OCT 16 2006
MASON CO. PLANNING DEPT.

Mason County
Attn: Steve Goins, Planning Manager
P.O.Box 279
Shelton, WA 98584

Re: Belfair/Lower Hood Canal Plan

Dear Mr. Goins,

At our Board meeting last evening, we found the notice too short to get anyone to the meeting in Belfair tomorrow evening. I was asked however to write you indicating our great interest, with a request to be kept in the loop as things progress.

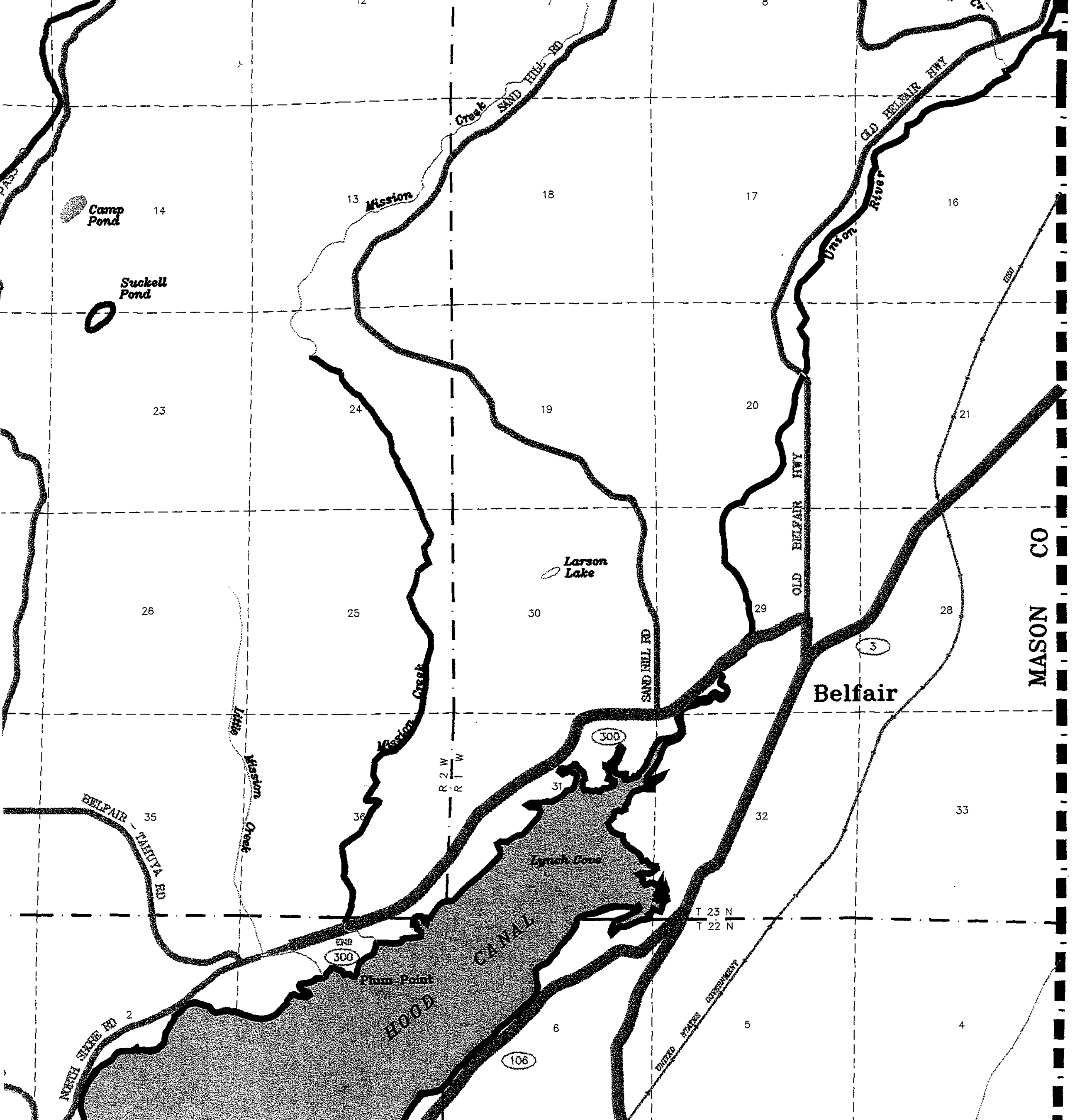
We wish at this time to raise one question and to make one comment. Why is not attention being paid to the South Shore? Problems there seem just as important as are those on the North Shore.

The comment: given the "severe public health hazard," no LAMIRD is required in order to take necessary corrective action. The law allows for this without the further complications of setting up a LAMIRD.

We will be giving close attention to developments and wish the project well. We will no doubt have more detailed comments once the EIS is in existence.

Sincerely,

William H. Matchett
President



MASON COUNTY
SHORELINE INVENTORY

Panel No. 4
SHORELINE ENVIRONMENT DESIGNATIONS

LEGEND:

- URBAN
- UR URBAN RESIDENCIAL
- UC URBAN COMMERCIAL
- UI URBAN INDUSTRIAL
- RURAL
- CONSERVANCY
- NATURAL
- NEW JURISDICTION
- INTERIM CONSERVANCY

DATA SOURCE:
Washington State Department of Ecology.
Mason County Assessor's Office.

0 1/2 1 MILE
GRAPHIC SCALE

MASON COUNTY
Department Of Community Development
Shelton, WA April/1995

NEWS RELEASE
November 1, 2005

MASON COUNTY COMMISSIONERS
411 NORTH 5TH ST
SHELTON, WA 98584
(360) 427-9670 EXT. 419

TO: KMAS, KRXY, SHELTON-MASON COUNTY JOURNAL, THE OLYMPIAN, SHELTON CHAMBER OF COMMERCE, NORTH MASON CHAMBER OF COMMERCE, CITY OF SHELTON, ECONOMIC DEVELOPMENT COUNCIL, THE SUN

RE: Public Meeting for the Proposed Belfair Sanitary Sewer System

Mason County will host a public meeting on Tuesday, November 8th, 6:30 p.m., to inform residents about and solicit public input on updating the Belfair/Lower Hood Canal Water Reclamation Facility Plan.

The Belfair/Lower Hood Canal Water Reclamation Facility Plan (Facility Plan) is a planning document for the development of the proposed sanitary sewer system in the Belfair area. The Facility Plan was originally submitted in final form to the Washington State Department of Ecology (DOE) in July 2001. In December 2003, it was amended to further review treatment alternatives and consider service to the Lynch Cove/North Shore area to address a declaration of severe public health hazard in Lynch Cove that was issued by the Washington State Department of Health.

Mason County is in the process of revising population projections for the Belfair Urban Growth Area and a Sewer Service Delineation Study that defined a potential sewer service area in the Lynch Cove/North Shore area has been recently completed. With the revised population projections and extended Lynch Cove/North Shore service area, population and associated wastewater flows are significantly greater than what is presented in the current Facility Plan. This deviation in service population and wastewater flows requires an update of the Facility Plan.

The public meeting will begin at 6:30 p.m. at the Belfair Elementary School, 22900 NE Hwy. 3, Belfair and will conclude at 8:00 p.m. The public meeting will consist of a brief presentation on the history of this project, the planning process and the next steps for the project, followed by a question and answer period with county officials, staff and consultants.

If you have questions please contact Doug Micheau, Director of Parks, Utilities, and Waste Management at (360) 427-9670 extension 270, or through the local Belfair number at 275-4467 extension 270.

BOARD OF MASON COUNTY COMMISSIONERS

Jayni L. Kamin Chairperson	Lynda Ring Erickson Commissioner	Tim Sheldon Commissioner

Belfair Area Sewer System Facility Plan Update
Public Meeting – November 8, 2005

Summary

Tom Perry presented information about the Facility Plan Update work that is currently in progress. A brief history of the project was given followed by a summary of the current work and findings. A potential sewer service area map was displayed for the public as well.

Following the presentation, a question and answer period was facilitated by Tom Perry and Doug Micheau for about 1 hour. Tim Sheldon, County Commissioner, and Debbie Riley, County Department of Health, also answered the public's questions.

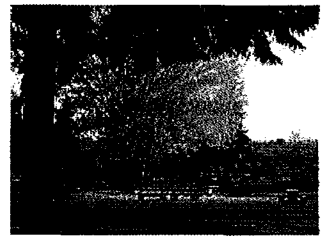
The following is a short summary of the questions asked:

How is the growth projections different than the Facility Plan identified?
Declaration of Health Hazard is from 2002, is it still valid?
Mission Creek Corrections Facility is a long way away from Belfair.
How much will the system cost?
How long is the state's $16 million good for?
What about the South Shore of Hood Canal?

Tim Sheldon's comments:
Hood canal water quality an extremely important issue – almost to the national level.
Great opportunities for Belfair with the use of new membrane technology
Risks also associated with the project – primarily the costs
State has guaranteed $16 million for the project
State almost passed another $5 million for the North Shore area.
Not an advocate of sending wastewater flows to Allyn facility. Belfair needs their own system.
Over 1.4 million visitors to the County's 3 state parks each year – county to benefit if beaches/shellfish harvesting is opened again.

Belfair Area Sewer System Facility Plan Update

Public Meeting
November 8, 2005



Belfair Area Sewer System Facility Plan Update

Public Meeting – November 8, 2005

- INTRODUCTIONS
- AGENDA
  - 6:30 – 7:00 Presentation
  - 7:00 – 7:30 Questions / Answers
  - 7:30 – 8:00 Public Comments / Input

Belfair Area Sewer System
Facility Plan Update
Public Meeting – November 8, 2005

Background

- Belfair/Lower Hood Canal Water Reclamation Facilities Plan – July 2001
  - Reviewed wastewater collection and treatment alternatives for Lower Hood Canal watershed
  - Recommended sewer system for Belfair SR 3 Corridor
  - Recommended Reclaimed Water Facility in Belfair

Belfair Area Sewer System
Facility Plan Update
Public Meeting – November 8, 2005

Background (cont'd)

- Belfair/Lower Hood Canal Water Reclamation Facilities Plan – Amended December 2003
  - Recommended sewer service to Belfair State Park area to address Declaration of Severe Public Health Hazard
  - Identified flows being conveyed and treated at Allyn treatment plant

Belfair Area Sewer System
Facility Plan Update
Public Meeting – November 8, 2005

Background (cont'd)

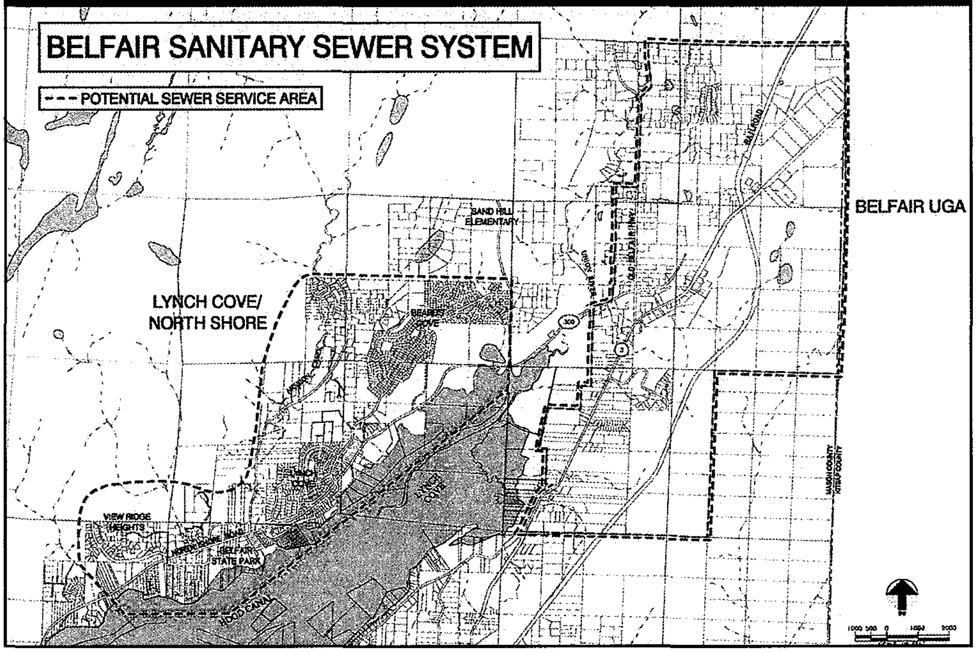
- Belfair Urban Improvements Project Feasibility Study – March 2005
  - Reviewed implementation of Facilities Plan
  - Considered benefits of implementing sewer improvements with SR 3 improvements
  - Two limitations were discovered in the amended Facilities Plan
    - Growth projections not current
    - Service area in the Lynch Cove/North Shore area not defined

Belfair Area Sewer System
Facility Plan Update
Public Meeting – November 8, 2005

Background (cont'd)

- Lynch Cove/North Shore Sewer System Delineation Study – September 2005
  - Defined areas that have the potential to contribute to the declaration of severe public health hazard
  - Multi-agency coordination
  - Used to define potential sewer service area in Lynch Cove/North Shore area

POTENTIAL SEWER SERVICE AREA MAP



Belfair Area Sewer System
Facility Plan Update
Public Meeting – November 8, 2005

Potential Sewer Service Areas

Area	Potential Service Population
Belfair UGA	594
Lynch Cove/North Shore	2,900
State Park	180
Other	

Belfair Area Sewer System
Facility Plan Update
Public Meeting – November 8, 2005

Belfair/Lower Hood Canal Water Reclamation Facilities Plan Supplemental Information

- Purpose
  - To update the facility plan information to reflect the revised potential service area and population forecasts
- Approach
  - To supplement current information in the existing Facility Plan

Belfair Area Sewer System
Facility Plan Update
Public Meeting – November 8, 2005

Belfair/Lower Hood Canal Water Reclamation Facilities Plan Supplemental Information

- Considerations
  - Planning Criteria
    - Service Area
    - Population Forecasts
    - Wastewater Flow Projections
  - Reclamation Facility Site Alternatives
  - Treatment Alternatives
  - Cost Estimates
  - Financing Strategies

Belfair Area Sewer System
Facility Plan Update
Public Meeting – November 8, 2005

Belfair/Lower Hood Canal Water Reclamation Facilities Plan Supplemental Information

- Public Participation:
  - Public Meetings
    - Information Exchange
    - Input
  - Mail in Survey
    - Assist in acquiring financing

Belfair Area Sewer System
Facility Plan Update
Public Meeting – November 8, 2005

Project Schedule

Mail in Survey	November 2005
Next Public Meeting	January 2006
Draft Supplemental Information	January 2006
Agency Review	February 2006

Belfair Area Sewer System
Facility Plan Update
Public Meeting – November 8, 2005

Next Steps

- Complete Supplemental Information
- Begin Design (2006-2007)
  - Site surveys
  - Site investigations
  - Permitting
- Begin construction of Belfair Area Sewer System (2007)

Belfair Area Sewer System
Facility Plan Update
Public Meeting – November 8, 2005

Questions and Answers

Your opportunity to ask specific questions about the Belfair Sanitary Sewer System

BELFAIR AREA
SEWER SYSTEM
FACILITY PLAN UPDATE

Public Meeting – November 8, 2005

SIGN-UP SHEET (OPTIONAL)

Name	Address	Phone
KEN VANBUSKIRK	61 NE DAVIS Farm Rd	360-275-3890
Ken Atteberry	Port of Bremerton 8850 SW St Hwy 3 Port Orchard WA 98367	360-674-2381
Debbey Baker		360·275·4267
BOB HARRIS	140 NE RAINIER PL. N. BELFAIR, 98528	(360) 275-9346
BOB KUGEN	PO Box 3119 Belfair	360-277-3226
Patty Stone	381 NE Landon Rd PO Box 869	360·275·6979
Linda Blackwell	E200 Sunset View Ln Belfair	360·275·3288
GARY PARROTT	81 NE GLADWIN BEACH Rd	
CHRIS SKINNER	110 N.E. MISSION CR. LN	360-275-3718
Lew + Mae San Agustin	PO BOX 1934, Belfair	360-275-9391
BILL/SUE BURKE	31 Fairway Dr Allyn	275-7978
Damon McAlister		
John Poppe	9278 MORNINGSIDE DR	360-698-1290
Glenn Landram	53 E Sunset Beach Ln	275-7060
[illegible] Scott	4968 SE Horstman Rd.	871-8193
HERB GERHARDT	90 NE RAINBOW PL N	275-6876
Debbie Riley	Mason Co Health	

BELFAIR AREA
SEWER SYSTEM
FACILITY PLAN UPDATE

Public Meeting – November 8, 2005

COMMENT SHEET

Your comments regarding the progress towards the Belfair Sanitary Sewer System are welcomed and appreciated. Comments not turned in by the end of the Public Meeting can be mailed to the following address:

Murray, Smith & Associates, Inc.
Attention: Tom Perry
2707 Colby Avenue
Suite 1118
Everett, WA 98201

Comments can also be emailed to Tom Perry at perryt@msa-ep.com. Thank you for your participation in this evening's Public Meeting.

Comments:

- Any consideration given to forming a Local Improvement District with local control & oversight?

- Any thought given to a local/regional solution to the Belfair State Park area problem? (Stand alone system)

- If Sandhill/Lynch Cove is included, how does that synchronize with so much of the sewer system being outside of the UGA?

Name: Glenn Landram
Address: 53 E Sunset Beach Ln, Belfair, 98528
Telephone #: (360) 275-7060
E-mail: glennlandram@wavecable.com

16 November 2005

Dear Tom,

You asked for some written public comment on the 8 November public meeting. At that meeting I tried to simply ask questions, not to challenge or to argue with what was being said. I hope these comments are useful.

I asked two questions at the 8 November meeting, prefaced by this observation:

"The whole sewer proposal is based on a Mason County Health Department's 'Declaration of Severe Health Hazard' in the Lynch Cove area issued in 2002."

Question A. Can you tell me if that situation is still valid? Answer: You said that it was still legally valid.

Question B. Can you tell me if the situation is getting better or worse. And if so, can you quantify how much better or worse?

Your answer indicated you could NOT quantitatively compare the fecal coliform situation in 2002 to that in 2005. It seems you do NOT have data to determine if the hazard has improved or deteriorated since 2002. However, you did opine that given the assumptions used in the 2000 declaration regarding soil analysis and housing density, there is no reason to suspect the situation has improved. I hope I have not mischaracterized your answer, but that's how I understood it.

I asked my question because things HAVE happened in the Lynch Cove area since 2002 which DO support the supposition that the fecal coliform count might have significantly changed.

Since 2002 several notorious sources of Lynch Cove fecal coliform have been removed or improved.

1. The Belfair State Park installed a new pressure dosing system.
2. The Park Place Trailer Park adjacent to Belfair State Park was shut down because of a failing septic

system.

The data from the voluntary "State of the Oyster" study are interesting. That study was halted in 1993 and restarted in 2003.

Following the two improvements cited above, the Park's oysters showed a huge drop in fecal coliform samples. How big was the change?
The three 1993 sampling periods showed fecal coliform counts in Park oysters at. 4,900, 930 and 4,300 per 100 grams of oyster meat. What does that mean? It means that with a published safe limit of 230 fecal coliform per 100 grams of oyster meat, those Park oysters carried 21 times the safe limit of fecal bacteria.
In 2005, those same Park oysters tested at 93 fecals per 100 gm...far below the safe limit. We now see the State Park's Oyster being opened for human consumption after being closed since 1988. This development is consistent with the State of the Oyster data, but it's inconsistent with the "Declaration of Severe Health Hazard" in Lynch Cove. This inconsistency should trigger a review of data and assumptions.

Here are some other improvements made since 2002.

3. The Snooze Junction Trailer Park on Gladwin Beach Road was shut down due to a failing septic system.

4. The Silver Sands Apartment complex on Gladwin Beach Road installed a modern pressure-dosing drainfield on the upland side of Gladwin Beach Road.

5. Many local homeowners have upgraded their septics and installed pressure dosing systems.

It's reasonable to believe these improvements would correlate with a reduction in Lynch Cove fecal coliform. "The State of the Oyster" study tends to bear this out. 2004 and 2005 test results have shown dramatic improvement in fecal coliform levels from oyster meat samples throughout Lynch Cove.

In fact, between 2003 and 2005, the highest level of oyster meat contamination recorded in Lynch Cove was 93, and that was at the Belfair State Park. Even the oysters at very mouth of the Union River had 2005 fecal levels between 9 and 43 throughout 2005. In 1993 they were above 1500. Something's going on in Lynch Cove and for once, it looks good.

I don't claim these figures definitively prove anything. But they need to be evaluated, reconciled and explained in relation to the Health Department water sample data before spending $100 million on a system to clear up a "severe health hazard" which may not presently exist. Why has the Sewer Project, the Health Department and the Consultants so completely ignored the data flowing from the "State of the Oyster Study" and the steady march of reopening oyster beds?
In answer to another question at that meeting, Ms Riley of the Mason County Health Department said that the shellfish are the primary health concern. The fecal coliforms in Lynch Cove waters don't make the shellfish sick. Those bacteria make us sick only when we eat the uncooked oysters. When asked how the Health Department would measure success of a Sewer System, Ms Riley said she hoped to see all the oyster beds from Stimpson Creek to the Union River reopened.

We all share Ms Riley's hope. However, it disturbs me that the Sewer project presently lacks a clearly defined and quantifiable objective. If the problem is a Severe Health Hazard in Lynch Cove due to fecal coliform, we need to know where those fecal coliform are coming from and we need to state the level to which we propose to reduce them by building a Sewer.

No project of this magnitude should be undertaken without a clear declaration of what's to be gained and how that gain is to be measured. So far, there are no such stated goals.

The proposition seems to be: "We SHOULD have a sewer... as a key to further develop in the Belfair UGA." Or, "We SHOULD have a Sewer because money is now available to build one."

There are bound to be some unintended negative and irreversible negative impacts from a North Shore sewer system. However, I have yet to hear the consultants or the Health Department address any negative consequences.

Here are a few negatives which may accompany a Sewer:

It's reasonable to anticipate increased development as a result of the Belfair Sewer and the consequent removal of septic requirements. The consultants' insistence that the Lynch Cove area is "already fully developed" and, furthermore, protected by a 5 acre minimum rural lot size is neither reassuring nor realistic.

Additional homes will be built when a sewer arrives. With each home come lawns, paving, reduction of groundwater recharge area, and an increased velocity of pollutants flowing toward the Canal. With lawns come fertilizers, chemicals, pet waste and yard waste. With the paving and increased flows come increased non-point source pollution. If those factors are not included in our analysis and modeling, the Hood Canal will pay the price.

The Department of ecology tells us additional homes add to the nitrogen loading of nearby waters...not just from septics, but from runoff. So far I have not seen any calculations regarding these factors. If the Sewer improves fecal coliform levels at the expense of adding other pollutants, has the Sewer benefited Lynch Cove?

Lets look at the post-sewer development which the consultants say is not a problem.

This summer, the oysters in lower Lynch Cove from the Union River to the Lynch Cove park tested in the range of 9 to 43 fecal coliform per 100 grams of oyster meat. That huge sweep of Saltmarsh and mudflats is now as pristine as we could possibly hope for.
If a sewer comes down the North Shore Road, all the land north of Highway 300 will probably be developed. Will the water quality along that 2 mile stretch of road suffer as a result? Will those oysters stay below 43 and will the nitrogen loading increase along what is already the most oxygen deprived section of the entire Hood Canal? Only careful calculation and modeling will predict an answer.

As another example, with the introduction of a North Shore Sewer, it's reasonable that Snooze Junction and Park Place trailer parks will be put back into service. And why not? They would go on the Sewer and help pay for it's operation.

But think about this: How much will the pet waste, fertilizer and non-point source pollution of those trailer parks detract from the sewer's benefits? It may be a small amount, but it deserves to be factored in. Despite the appearance that the Lynch Cove area is fully developed, there are many lots available to be developed with the benefit of a sewer. All those parcels should be identified and factored into the benefit calculations for the sewer.

NON-HUMAN SOURCES OF FECAL COLIFORM

For the past ten years there has been speculation both public and private about the amount of fecal coliform entering Lynch Cove from non-human sources like birds, seals, and pets. Unfortunately there was no method available to discriminate between human and wildlife fecal coliform.

That has changed. A recent report on National Public Radio (http://www.npr.org/templates/story/story.php?storyId=4798461) featured a new forensic technology which can tell whether fecal bacteria come from human, bird or wild mammal sources. That NPR report told of an East Coast community, similar to ours, which was well along on a sewer plan when the fecal coliform discrimination technology was utilized. That study showed the offending fecal coliform was coming primarily from pet waste, so the sewer would have done little to solve the community's problem.

Here we are on the verge of spending $100 million to reduce our fecal coliform count, but nobody knows for sure the source of those fecal coliform bacteria. The technology exists to give us that information.

I know there are many who believe it's fanciful to suspect that significant fecal coliform comes from non- human sources. However, I recall 10 years ago when Rick McNicholas was working for Mason County Health Department. He found very high levels of fecal coliform in the "Belfair Creek" which now flows past the Peterson Chiropractic Building. The Health Department was sure it was a result of failing septics. Surprisingly, the source of that high fecal coliform was traced to a household kennel at the four-way stop corner. When that was cleaned up, the fecals dropped to insignificant levels. And that was just a few family dogs.

Interestingly, the NPR report mentions that one mature goose produces, in a 24 hour period, approximately the same number of fecal coliform bacteria as one human. We all know that 8 years ago a goose was a rare sight on Lynch Cove. Now we have a resident population of several hundred. On my property alone, I have more than 70 geese most days eating grass and fallen apples. When they get full, they fly out and land on the mudflats. This situation did not exist as a fecal coliform source 8 years ago.

If NPR's figures are correct, the goose population on Lynch Cove is equivalent to the entire assumed population of the Belfair State Park which is 160. Remember... the Belfair State Park generated fecal coliform counts of 4900 in 1993 through a failing septic system. If NPR is right that one goose produces fecal coliform equivalent to one human, what kind of fecal coliform contribution is this goose flock contributing to the declaration of Extreme Health Hazard in Lynch Cove? So far it is not even being considered.

There are 100 million dollars earmarked for a Sewage System. The technology is available to quantify the fecal coliform contribution from pets and wildlife. But does anyone really want that answer? We have no idea how much of the Lynch Cove fecal coliform is coming from the South Shore. But does anybody want that answer?

I asked a third question at the meeting. It was simply this: "Can anyone tell me how we will measure the success of the proposed sewer?-- Have we won if we simply reduce the fecal coliform counts? Have we won if we can remove the word 'Severe' from 'Severe Health Hazard'? Are we designing to enable the Health Department declare that there's 'NO Health Hazard'? Are we designing such that we can open all the oyster beds in Lynch cove from Stimpson Creek to the Union River?"

I should have phrased the question like this: "Please complete this statement with a quantifiable result: WE ARE BUILDING A SEWER SO THAT______

It seems to me this should be the easiest question for the Sewer engineers and financiers to answer. That they cannot, or will not answer that question gives me great pause.
Until they fill in that blank, the proposition remains, "We are building a sewer so that we can further develop in the Belfair UGA."
In ALICE IN WONDERLAND, the Cheshire Cat gives Alice some good advice.

Alice: Can you tell me which path I should take?
Cheshire Cat: That depends a good deal on where you want to go!
Alice: I don't really know.
Cheshire Cat: Then, clearly, any path will do!
MORAL: If you're not sure where you're going, you're liable to end up someplace else - and not even know it.
Best wishes,

Gary Parrott

Nathan Hardy

Subject: Re: Old landfill in Beards Cove, Lynch Cove area

-----Original Message-----
From: Teri King
Sent: Thursday, November 10, 2005 2:26 PM
To: Ken & Peggy
Cc: Tom Perry; Doug Micheau; Constance Ibsen
Subject: Re: Old landfill in Beards Cove, Lynch Cove area

Ken,

There are a number of land fills in the area of Beard and Lynch Cove that were noted in the Lower Hood Canal Watershed Characterization Report in the early 1990's. An action item in the subsequent Lower Hood Canal Watershed Implementation Plan called for the 'official' closing of the various landfills that were throughout this area by Mason County. It has always been a concern that there were a number of ill placed 'landfills' in this area. A description of the various landfills were provided to the County solid waste staff for follow up, but I am not sure what actions have been taken. I am sure local residents would still be willing to point out the out fills if needed. You might know of one or two yourself?

Teri

Teri King
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Shelton, WA 98584
360-432-3054

On Thu, 10 Nov 2005, Ken & Peggy wrote:

> Tom, I think I had mentioned this to your consultant group last spring.
> In the 60's and 70's Mason county operated a "burning landfill"
> similar, though not as big, to the "superfund" site near the Bremerton Airport.
> Mason County's site was in the proposed service area of the Lynch Cove
> sewer. The best I can remember puts it in the W1/2 of the NW 1/4 of
> Section 31, Township 23N and Range 1 West. I would suspect that the
> site has been built upon now. As you are still in the public input-
> discovery phase, and trying to determine funding sources, maybe this
> site could be located and analyzed to see if it might be having some
> impact on the health issues of Lynch Cove-Hood Canal and could
> possibly be a source of funding. Im confident the county must have
> some records of its location and that it would show up on aerial
> photos from that time. Ken VanBuskirk
>

Nathan Hardy

Subject: Old landfill in Beards Cove, Lynch Cove area

From: Ken & Peggy [mailto:dukeof@hctc.com]
Sent: Thursday, November 10, 2005 11:40 AM
To: Tom Perry
Cc: Doug Micheau; Teri King; Constance Ibsen
Subject: Old landfill in Beards Cove, Lynch Cove area

Tom, I think I had mentioned this to your consultant group last spring. In the 60's and 70's Mason county operated a "burning landfill" similar, though not as big, to the "superfund" site near the Bremerton Airport. Mason County's site was in the proposed service area of the Lynch Cove sewer. The best I can remember puts it in the W1/2 of the NW 1/4 of Section 31, Township 23N and Range 1 West. I would suspect that the site has been built upon now. As you are still in the public input- discovery phase, and trying to determine funding sources, maybe this site could be located and analyzed to see if it might be having some impact on the health issues of Lynch Cove-Hood Canal and could possibly be a source of funding. Im confident the county must have some records of its location and that it would show up on aerial photos from that time. Ken VanBuskirk

Nathan Hardy

From: Ken & Peggy |
Sent: Wednesday, November 09, 2005 12:14 PM
To: Tom Perry
Subject: Fw: Belfair Public Meeting 11-8-05

One addittional important piece of information. The free and reduced lunch rate at Sandhill Elementary School is 46-48%. The school services children from the proposed sewer area and I think that is a valid indicator of the general poverty level in that area. (Might be able to leverage some federal or state monies with that fact.) best Ken 360-275-3890

Tom, thanks for hosting the meeting last evening. I put my comments from last night down in this e-mail.

I feel your time frame is a little optimistic, and I would anticipate if you expanded the survey a bit it would take longer to analyze the data. The survey should be more like the one the coordinating council sent out rather than a wage survey. Few people in the room last night understood the different surveys and it should go to all the affected people.

The biggest issue is affordability and you need to tell the people how much it will cost and who will be affected. If you tell all the people in the Lynch Cove that they are going to hook up to a sewer and what it will cost, we dont have a big enough room to hold all the people. You can call Belfair and Allyn UGA's but Mason County is still a rural county, that is why a lot of people live here and commute.

Before the sewer is constructed the bypass needs to be built first, that should be the number one priority.

The option of including Mission Creek Correctional Center has little merit other than to garner additional state dollars, it would be a waste to run a line that far. There is little residential development from Sandhill Elementary School to the Correctional Center and none planned as it is primarily Tahuya State Forest.

Lynch Cove was added due to a health Issue declared by the State Department of Health. That same Department of Health has been conducting ongoing studies with some of their sites in Lynch Cove being newly established and not enough data to fully analyze. . The State Park at Belfair has just put in a new septic system, and the trailer park across from the State Park is gone. Now the state department of Health is talking about opening some of those beaches. There is a credibility issue!. Is the county rushing to use this declaration before studies are complete as a mandate to put in the sewer, thereby passing a vote of the people?

North Bay sewer was put in to correct a health issue. Allyn became a UGA afterwards and development is ongoing. I am concerned that running a sewer down the North Shore will spur development in otherwise undevelopeable land and developments impact on the Critical Aquifer recharge area. If a sewer is put in no infill should be allowed on previously undeveloped land.

Mason County is still in process of updating the comp plan, in particular the population allocations and the UGA boundaries. The Belfair UGA boundary , especially in the Union River Valley has been an area of concern for at least 10 years. In addition the state Department of Ecology is asking the county to look at their comp plans in regards to the Critical Aquifer Recharge areas in 2006, and a large potion of the downtown portion of Belfair UGA and the Union River Valley set on top of a Critical aquifer Recharge Area. .

Where will the water come form to energize the system?

Storm water from impervious surfaces and development, not just highway 3, continue to be an issue. Storm water needs to be addressed as it relates to the Canal, Belfair and the Critical Aquifer recharge area.

The county passed a resolution on 11-8 asking the state to consider removing fees for day use at State Parks. The county should pass a resolution to have the state revoke Alderbrook's sewage outfall into the Canal, as it is the only outfall in the Canal.

Thank you

Ken VanBuskirk 360-275-3890. .