Hoodsport-Skokomish Wastewater Project Definitions

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Using grant funds made available by the Puget Sound Action Team and the Hood Canal Coordinating Council through the Interagency Commission, this planning document was prepared on behalf of the Skokomish Indian Tribe, Mason County Public Utility District Number One and Mason County by the following individuals and firms:

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Table of Contents

Section 5 Technology Selection and Project Definitions for Skokomish Systems

Section 6 Consolidated Ownership/Operations and Maintenance

Section 7 Summary Cost Estimates and Schedules

Section 8 Funding

1.0 Introduction and Summary

This report, prepared under the collective supervision of the Skokomish Indian Tribe, Mason County and Mason County PUD #1, defines three wastewater management projects. The projects serve each of three planning areas established in the Memorandum of Understanding (see **Appendix 1.1**) approved by the Tribe, the County, and PUD #1 in August, 2006: the Hoodsport Rural Activity Center, the residential zone known in this report as the Potlatch "Bubble," and the most densely developed commercial and residential areas on the Skokomish Reservation (called "Core Reservation").

1.1 Introduction

A grant from the Puget Sound Action Team and the Hood Canal Coordinating Council made this effort financially possible. An array of consultants was chosen by staff representatives of the Tribe, the County and PUD #1 (the "TriParty Staff") using a roster of consultant-submitted statements of qualifications. The following table names the contributors and their areas of responsibility.

Responsible Organization	Hoodsport RAC	Potlatch "Bubble"	Core Reservation	Program
Sewer System Engineering Cascade Design, Inc.		●	●	
Sewer System Engineering Gray and Osborne, Inc.	●			
On-site System Engineering CH2M Hill, Inc.	●			
Environment and Permitting ESA Adolfson	●	●	●	
Geology and Hydrology HWA GeoSciences, Inc.	●	●	●	
Wetland Disposal Jones and Stokes			●	
Cultural Resources Wessen and Associates	●	●	●	
Sponsoring Entity Mason County PUD #1	○			●
Sponsoring Entity Skokomish Indian Tribe		●	●	●
Sponsoring Entity Mason County	●			●
Program & Project Mngmnt. • Art O'Neal & Associates • Linda Hoffman Consulting • Mike Sharar Consulting	●	●	●	●

Mason County had lead responsibility for the Hoodsport Planning Area and overall fiscal administration. The Skokomish Tribe had lead responsibility for the Potlatch and Core Reservation Planning Areas. The lead agencies and the TriParty Staff guided the consultants' work and the work of staff from the Skokomish Tribe and Mason County.

There are several wastewater management studies that cover all or parts of the Hoodsport-Skokomish Region. These are sited as references in this report and provide substantial planning detail for the future design activities initiated by the Project Descriptions in this report. The following table names these studies, the date of their publication, and whether they are available in the print or CD versions of this report.

Title	*Date*	*Availability*	
		Print Vers.	CD Vers.
Skokomish Indian Tribe Wastewater Master Plan *(see Appendix 1.3 CD only)*	**1998**		●
Finch Creek Wastewater Feasibility Study *(see Appendix 1.4 CD only)*	**2000**		●
Skokomish Indian Tribe Non-point Assessment Report and Preliminary Management Plan *(see Appendix 1.2)*	**2006**	●	●
Hoodsport-Skokomish Wastewater Management Alternatives Analysis *(see Appendix 1.5 CD only)*	**2006**		●

It is important to recognize that while this report focuses on descriptions of wastewater management projects, wastewater is only part of the Hood Canal water quality situation. Non-point source activities along freshwater streams tributary to the Canal and storm water management in developed areas also present significant opportunities for water quality improvement. The Skokomish Tribe is engaged with a Non-Point Source Management Plan, Mason County is preparing a storm water management plan and there are Water Resource Inventory Area efforts that, if considered as part of wastewater project design and implementation, can result in very significant water quality improvement.

The Puget Sound Action Team provided federal funds for the recently-completed, Mason County managed Hoodsport-Skokomish Wastewater Management Alternatives Analysis, a review of wastewater management options for the western shore of Hood Canal from Hoodsport south through the Skokomish Tribal Reservation. The Action Team also facilitated the review, comment and participation of several state agencies to assure a coordinated State of Washington involvement and response in the preparation of this useful document.

The Alternatives Analysis assembles data and examines ways to improve Hood Canal water quality which suffers from low dissolved oxygen and fecal contamination. One of the major sources of these problems is widely presumed to be residential and commercial wastewater along and near the shoreline. The current management technique is conventional septic systems that do not treat for nitrogen. Too much nitrogen in Hood Canal results in low dissolved oxygen. Conventional septic systems without adequate soil and geology that blocks the transport of contaminates to the Canal also result in fecal contamination.

During the summer of 2006 as the Hoodsport-Skokomish Wastewater Alternatives Analysis was being finished, Mason County, the Skokomish Tribe and Mason County PUD #1 joined in approving a Memorandum of Understanding (MOU). A reproduction of the Memorandum is found in **Appendix 1.1**.

The MOU is founded on a conclusion that a single wastewater treatment plant will not be the selected alternative for the Hoodsport-Skokomish region. While a single central treatment plant may be possible, and would certainly be reliable and very environmentally effective, it is also very costly and is difficult or impossible to coordinate with growth management laws and regulations. The MOU sets a path for wastewater management that takes a different, more localized approach. Initially, a number of localized solutions involving both very small treatment plant systems and innovative on-site septic and clustered septic systems may prove more workable.

The MOU coordinates wastewater planning activities and assigned planning responsibilities for the planning areas. Washington State Parks, the Puget Sound Action Team, EPA, the Washington State Department of Ecology, Washington State Department of Community, Trade and Economic Development and other agencies are also participating. The first step, is this report's description of three wastewater management projects for each of the three principal population centers identified in the Hoodsport – Skokomish Wastewater Management Alternatives Analysis.

In describing projects for each Planning Area, the Tribe, the PUD and the County are using the Alternatives Analysis and taking into account the complexities of growth management regulations, the concerns and opportunities arising from private and tribal land ownership, and the need to both manage costs and provide long-term solutions. The parties are committed to leaving open the possibility for areas to be interconnected at some future time. Similar design and equipment standards should be employed in all the service areas.

Finding federal, state and private funding support is another important objective of the MOU. All three entities agree their funding efforts are enhanced if there is a coordinated, multi-jurisdictional, non-competitive regional approach that restores and protects water quality. Section 8 of this report discusses funding and the TriParty commitment to pursue assistance jointly and bring equal effort and priority to the completion of each of the wastewater management projects.

Sections 2 through 5 assemble planning data for each of the planning areas and propose a project description. Because both Potlatch and the Core Reservation areas within the Skokomish Reservation, Sections 3, 4 and 5 need to be considered jointly even though separate projects are proposed for Potlatch (Section 3) and the Core Reservation (Section 4).

It is critical that this report be considered a planning document. Its purpose is to set general directions that must be refined and validated in a thorough design process. Accordingly, maps included are not precise with regard to exact boundaries of service areas and cost estimates are general with appropriate planning-level contingencies. A homeowner near the boundary of a proposed service area represented in this report cannot be certain whether their property is included or excluded. Similarly, it is inappropriate to make monthly rate determinations based on this report. While it is entirely clear substantial financial assistance beyond that which is already anticipated will be essential, feasibility will remain an open question at least through completion of Facilities Plans (the next step before Design, Construction and Commissioning).

Public input has played a substantial role in shaping the project descriptions. In the Hoodsport RAC, with the assistance and involvement of Mason County PUD #1, there have been three public meetings during the 3+ months this report has been under preparation. The Skokomish elected Tribal Council and the General Council have been kept closely informed and a special committee of the Tribal Council has provided considerable direction. Mason County's Board of Commissioners and the County's Community Development and Utilities Director have been instrumental in moving the collective, TriParty program forward.

Congressman Norm Dicks, his staff, the federal Environmental Protection Agency and several Washington State agencies, especially the Puget Sound Action Team, the Department of Ecology, the Department of Health, State Parks and Community, Trade and Economic Development have been prompt, thorough and energetic in providing essential assistance.

There is communication, collaborative commitment and action underway at all levels, and the goal of a better Hood Canal is widely embraced.

1.2 Summary

Each of the three Planning Areas, Hoodsport RAC, Potlatch "Bubble" and Core Reservation, is not well suited to conventional septic tank wastewater management. They all have comparatively shallow soil columns above soils highly likely to transport septage to the nearest water body that either flows to or is Hood Canal. Although none of the areas is a city or town, they all have one or more fairly dense population centers.

The combination of transmissive soils and greater than traditional rural densitites makes each Planning Area a Hood Canal pollution source. The pollution includes not only bacterial contimation as indicated by higher-than-acceptable levels of fecal coliform, but also the nutrient nitrogen which cannot be effectively treated by septic systems with limited soil columns.

Another shared characteristic is a limited amount of flat, dry land. Comparatively steep slopes flatten into deltas or wetlands that border Hood Canal. There is limited dry area with soil columns offering much treatment opportunity before reaching ground water or impervious soils.

In areas outside the Skokomish Indian Tribe Reservation, Washington State's Growth Management Act applies.
Sewer systems with central treatment plants are generally view as urban-style services not suitable in rural conditions. Providing sewer capacity beyond what is needed to serve existing development is inconsistent with the aims of the Growth Management Act.

All of these factors, together with the region's modest to moderate income status, serve to focus wastewater management options. A single plant system to serve all the area from Hoodsport south through the Skokomish Reservation is expensive and not easily permitted under growth management regulations. Continued reliance on traditional septic systems, even though they may be well maintained, does not address the pollution issues.

The TriParty group decided to address each Planning Area individually and find the best combination of approaches in each area while striving to use common technology among the three and work to design and construct so as to allow convenient interconnection of the systems in the future if conditions warrant.

It appears treating wastewater to Class A reclaimed water standards offer the more and best potentials for managing treated wastewater. Class A water can be infiltrated into the ground in areas with proper soil without endangering water supplies. It can be used to irrigate trees or other flora as seasonal conditions require or permit. It can also serve a variety of commercial/industrial water uses where the water cools processes or washes non-food items.

Creating Class A reclaimed water is possible using either a sequencing batch reactor (SBR) with filtration or a membrane bioreactor (MBR). MBR has certain advantages in that it provides a positive physical barrier to many pollutants and it has a comparatively small footprint. While the design phase is when technology decisions are made, MBR is the consensus technology choice for all three Planning Areas.

All three Planning Areas are unsuited for gravity sewers. The current choice for wastewater collection is either septic tank effluent pumping (STEP) or grinder pumps feeding pressurized sewer lines. Some areas are experience difficulties with STEP systems, and Mason County has considerable experience with grinder pumps. The final decision is another question to be answered during design.

Marine discharge of treated water is not seriously considered in the Hoodsport-Skokomish area. Rapid infiltration, irrigation and commercial use of Class A reclaimed water are the favored methods for handling highly treated water. There appear to be areas suitable for rapid infiltration in both Core Reservation and Potlatch. Earlier study suggests a similar opportunity, using pressurize drip discharge, exists in Hoodsport. All areas have irrigation reuse options depending on how far from the treatment site the treated water is pumped. There may also be commercial water reuse options. A decision concerning effluent fate is the most pressing issue in Hoodsport and continues to be an issue in the other two planning areas. This is a high priority matter during preparation of Facilities Plans.

This report indicates that advanced septic systems that require periodic profession inspection and operation have a role in managing Hoodsport's wastewater. For the area characterized as having "moderate risk" for transmission of pollutants to Hood Canal from conventional septic tank effluent that has not had sufficient soil treatment, advanced systems serving 7-residence clusters are proposed. These systems would be operated by a utility, not by home owners, and they would be located on public property. They are proposed to use pressurized drip systems to manage treated water. This well-treated water will receive some additional treatment in the soil column and significantly reduce the risk of pollutants being transported to Hood Canal at a cost lower than the cost of the sewer system and central treatment plant.

The cost of the wastewater management projects defined for each of the three areas is high. With development density lower than most sewered urban areas, the cost of the systems is shared by comparatively few connections. The following table shows the estimated cost to complete each of the defined projects.

Planning Area	***Total Cost to Complete***
Hoodsport RAC	$9,946,702
Potlatch "Bubble"	$3,433,430
Core Reservation	$6,465,030
Total	$19,845,162

This total is a planning level estimate and will undoubtedly change as the projects are subject to more investigation and engineering. Nonetheless, compared with the $7,017,800 in grants remaining available for projects in the Hoodsport-Skokomish region, there is a sizable difference between needs and funding.

The funding problem is further complicated by operating costs currently estimated at more than $75 per month per connection. This leaves little capacity for debt and while maintaining sewer rates at suitable levels. Substantial grant funding will need to be pursued and found to assure the projects are affordable.

The TriParty group is committed to collectively funding the projects on a regional basis. This approach has met with success so far in as much as grant money was secured continue the planning effort and define projects.

The next step is to prepare a Facilities Plan for each of the projects. When these are approved by the Washington Department of Ecology, final design can begin.

NOTE:
As this report is issued, it appears grant funding will be available to complete the Facilities Plans provided the work can be accomplished in a very short time frame. Consequently, the table above does not include the cost of Facilities Plans.

Also at the time of publication, the Washington State Legislature and the Governor are considering funding in support of these projects. Congressman Norm Dicks and the United States Environmental Protection Agency are following and actively efforts in the Hoodsport-Skokomish region, and various Washington State departments have been very helpful with both advice and funding.

If funding is secured and all three projects are aggressively advanced, it appears possible the wastewater management efforts defined here could be in place by early 2010.

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2.0 Hoodsport RAC

2.1 Existing Information

In the Mason County Comprehensive Plan, the Hoodsport area is designated as a “Rural Activity Center” (RAC), which covers approximately 584 acres. The sources of information which characterize and describe the RAC are found primarily in the *Finch Creek Wastewater Feasibility Study* (Gray & Osborne, Inc., August 2000) and the *Hoodsport-Skokomish Wastewater Management Alternatives Analysis* (Gray & Osborne, Inc., October 2006). The Finch Creek Study focused on two potential sewer service areas: the Finch Creek corridor only and Finch Creek and the shoreline area of Hoodsport. The Alternatives Analysis covered the Hoodsport RAC, the Skokomish Indian Reservation, and the shoreline area in between these two jurisdictions.

Figures 2.01 through **2.04**, respectively, present the boundaries of the Hoodsport RAC, the two service area alternatives described in the Finch Creek Study, and a population density schematic found in the Alternatives Analysis. In general, this plan will focus on the Hoodsport RAC and Service Area 2. Service Area 1, the Finch Creek corridor, covers a very limited area.

Both the Finch Creek Study and the Alternatives Analysis were prepared to address water quality problems in Hood Canal which are due to nutrient and fecal coliform loading. In part due to inadequate on-site wastewater systems, the nutrient loading, particularly nitrogen, has resulted in low dissolved oxygen concentrations and has led to fish kills in Hood Canal. In addition, elevated fecal coliform levels in Finch Creek resulted in closure by the Washington State Department of Health of public access tidelands at the mouth of Finch Creek to shellfish harvesting. This closure remains in place today.

Several alternatives for collection systems and wastewater treatment have been developed in both the Finch Creek Study and the Alternatives Analysis to address nutrient and fecal coliform loading. The Finch Creek Study considered two service areas and developed design criteria, schematics, and costs for alternatives for both areas. The Alternatives Analysis prepared similar information for all of the Hoodsport RAC. The Alternatives Analysis also considered decentralized wastewater systems and management options to reduce the nutrient and fecal coliform loadings.

Figure 2.05 summarizes the cost-effective wastewater collection and treatment alternatives considered in both reports. **Figure 2.05** lists the approximate number of equivalent residential units (ERUs), a brief description of the alternative, and the estimated capital and annual operation and maintenance (O&M) costs. The Finch Creek Study was prepared in 2000, and for any use for 2007, these costs would need to be updated.

For each of the service area alternatives, the capital costs per ERU are very high and are not likely affordable without a significant amount of funding assistance. The least cost per ERU in **Figure 2.05** is $26,000 per ERU and the highest cost is $32,500 per ERU. For the Hoodsport RAC, the capital cost per ERU is

$27,400 based on an assumption that the target year would be 2015. Most conventional funding of wastewater treatment facilities is through loan programs. However, the debt service for the loans combined with annual O&M costs likely would result in unaffordable sewer rates.

The Alternatives Analysis considered decentralized on-site systems, such as recircu-lating sand filters and proprietary products for nitrogen removal. The cost of these individual on-site systems ranges from $15,000 (low) to $30,000 (high) with additional O&M costs. The expected installation costs for a recirculating sand filter is $15,000 to $20,000 with $400 to $600 for annual O&M. These costs are less than the capital and O&M costs per ERU for a centralized wastewater collection and treatment facility. However, due to small lot sizes, high groundwater table, and unsuitable soils, the on-site alternatives may not be suitable for all areas of the Hoodsport RAC. As a result, the Alternatives Analysis recommended a combination approach utilizing centralized and decentralized alternatives. The centralized treatment alternatives would focus on the core commercial area, Finch Creek, and possibly a few other selected areas. This area closely follows Service Area 2 as outlined in the Finch Creek Study. The decentralized alternatives would focus on the larger lots which are generally located in the upland areas of the RAC.

2.1.1 Population and Land Use

Population data for the total RAC area are based on a "windshield" survey of the number of housing units within the RAC multi-plied by 2.49 (the number of person per household in Mason County during the 2000 U.S. Census). The number of residential housing units counted was 258 and the total number of commercial businesses was 38 within the RAC. The total estimated population, including both permanent and seasonal residences, is 642. Based on PUD billing records, about 30 percent of County utility customers are seasonal. It is assumed that 30 percent of the Hoodsport RAC residences are also seasonal.

The Finch Creek Study identified two potential sewer service areas. Service Area 1 covers only the Finch Creek corridor and Service Area 2 covers Finch Creek and the commercial area. Both Service Area 1 and Service Area 2 are located within the RAC boundaries.

Based on hydrogeological information provided by HWA GeoSciences, a third area is also developed as an Expanded Service Area 2. The basis of this expanded area is the area identified as the highest risk for contaminant transport to Hood Canal coinciding with existing development. In general, the intent of this expanded area is to include the small lots and near-shore areas where the highest risk exists. This expanded area is shown on Exhibit V and includes Highway 101 south to Hill Creek, Cedar Lane, part of Old Mill Hill Road, the steepest portion of North Schoolhouse Road, and North Hill Road. Each of these areas is located within the boundaries of the Hoodsport RAC. The exact number of residential connections is not known, but the estimate arrived at through the "windshield" survey is shown below:

South along Highway 101 (including Cedar Lane)	16
Old Mill Road	24
North Schoolhouse Road	20
North Hill Road	13

North Harrison	10
	83

This expanded area would add approximately 83 residential connections to Service Area 2. Along North Schoolhouse Road, there is a total of 54 residences. However, only 20 of these residences are included in the Expanded Service Area 2 area.

Figure 2.07a summarizes the existing population for the RAC and the service area alternatives.

Land use within the Hoodsport RAC is primarily residential. There are a limited number of commercial businesses and public buildings. Each of these is listed in **Figure 2.07b** along with vacant/closed structures. Most of the businesses provide essential local services while a few serve tourists. Most all of these commercial units are located along or near U.S. Highway 101.

Under the County's land use policies for RACs, the standard residential density is one dwelling per 2.5 acres. However, lots platted prior to 1996 are not subject to this density requirement and may be able to develop at an average density of one dwelling unit per acre.

Figure 2.07c summarizes the existing lot size based on a survey of County records covering 200 lots. The average lot size was calculated to be 55,666 square feet, or 1.25 acres. In general, smaller lot sizes are located near shoreline areas or the central commercial area of the RAC. Larger parcels are located in upland areas as shown in **Figure 2.01**. Most of the small parcels within the RAC are included in Service Area 2 or the Expanded Service Area 2 as shown in **Figures 2.03** and **2.06**.

2.1.2 Flows and Loadings Estimates

Flows and loadings estimates were developed both in the Finch Creek Study and the Alternatives Analysis for their respective areas. As stated in both reports, unit flows and loadings had to be assumed due to the lack of residential and commercial water use. These assumptions, which would be pertinent to the Hoodsport RAC and Service Area 2, are summarized in **Figure 2.08** The Alternatives Analysis based its assumptions on per capita flow for water usage from other areas within Mason County. Based on data from the Belfair Water District, the daily average water use was about 60 gallons per capita per day (gpcd), and in Lakeland Village, the average use during low irrigation months is 69 gpcd.

The two reports utilize similar unit loading values, but significantly different unit flow values. The Finch Creek Study assumes a significant increase in seasonal tourist activity and accordingly, develops high commercial flows. In the Finch Creek Study, the estimated peak day commercial flow is 31,056 gpd. In the Alternatives Analysis, the estimated peak day commercial flow is only 13,934 gpd, about 45 percent. For the commercial flows, the Alternatives Analysis accounts for all of the restaurant seats and motel rooms, the primary units impacted by tourist activity. The other commercial businesses shown in Table 2-3 are unlikely to be significantly impacted by tourist activity. Of the two estimates, the one presented in the Alternatives Analysis is likely the more accurate one, although it should be re-evaluated as better data become available.

Figure 2.09 presents both flow and loading estimates for existing conditions. This table presents these estimates both for the Hoodsport RAC, Service Area 2, and the Expanded Service Area 2 based on the unit flows presented in the Alternatives Analysis.

The flows and loading values presented in **Figure 2.09** indicate a wastewater strength concentration covering a range of 350 to 400 mg/L BOD_5. Historical values from the County's North Bay-Case Inlet facility suggest that this range is reasonable for planning purposes. Typically, the North Bay-Case Inlet facility has influent BOD_5 concentrations from 250 to 350 mg/L. In addition, where commercial flows include restaurants, higher BOD_5 concentrations can be expected.

2.1.3 Soils

*(The following is an excerpt from a complete report prepared by HWA GeoSciences for this effort. To fully understand the particulars of this report, its sources of information and any limitations concerning its use, please consult the full document included in this report as **Appendix 2.1**.)*

Soils in the Hoodsport RAC area consist of mainly Hoodsport series soils in the upland areas, with isolated pockets of Grove series soils in some drainages, and smaller areas of fine grained (e.g., Cloquallum and Tanwax) and alluvial (e.g., Juno) soils (Ness, 1960). **Figure 2.10** shows the mapped soil units in the Hoodsport RAC planning area.

Hoodsport soils (Hd, He, Hf) consist of well-drained, reddish soils on uplands, formed over granitic till that is highly stained by iron and contains considerable metamorphosed and basic igneous gravel and stone. The soil survey report lists Hd soils as having a "very limited" rating for septic tank absorption fields, due to slow water movement and shallow depth to saturated zone. He and Hf soils are also listed as having a "very limited" rating for septic tank **absorption** fields, due to slow water movement, shallow depth to saturated zone, and slope (Ness, 1960).

Grove series (Gh, Gk) soils consist of somewhat excessively drained, reddish-brown gravelly soils, that formed on large glacial outwash plains over Vashon glacial drift, modified considerably by inclusions of local basaltic rock and mixed material from the Olympic Mountain glaciers. The soil survey report lists Gh and Gk soils as having a "very limited" rating for septic tank absorption fields, due to "bottom layer seepage" (i.e., soils are too permeable) (Ness, 1960).

Cloquallum silt loam (Cc) is a moderately well drained, brown upland soil, developed over silty glacial-lacustrine (lake) sediments. The soil survey report lists Cc soils as having a "very limited" rating for septic tank absorption fields, due to slow water movement and shallow depth to saturated zone (Ness, 1960).

Tanwax peat (Tb) consists of brown peat formed in wet areas and bogs. The soil survey report lists Tb soils as having a "very limited" rating for septic tank absorption fields, due to shallow depth to saturated zone, subsidence, slow water movement, and ponding (Ness, 1960).

Juno Sandy Loam (Jb) consists of coarse textured, brown to reddish-brown alluvial soils, formed over glacial alluvium in small streams. The soil survey report lists Jb soils as having a “very limited” rating for septic tank absorption fields, due to flooding, bottom layer seepage, and filtering capacity (Ness, 1960).

Although the soil survey lists all soil types present in the RAC area as having “very limited” suitability for septic drainfields, HWA’s opinion is that of the soils present, the Hd Hoodsport soils (5 to 15 percent slopes) have the best septic treatment potential and least off site septic contaminant transport risk. These soils are generally found on the till uplands, on relatively flat land. Steeper Hoodsport soils (He and Hf) have a higher potential to transport contaminants, due to increased slopes. Soils with the highest potential for septic contaminant transport include Grove and Juno soils, which are found in the drainages. The Grove soils pose an increased risk due to excessive permeability. Cloquallum and Tanwax soils have a low potential for transport, but also a low potential for treatment.

2.1.4 Geology

*(The following is an excerpt from a complete report prepared by HWA GeoSciences for this effort. To fully understand the particulars of this report, its sources of information and any limitations concerning its use, please consult the full document included in this report as **Appendix 2.1**.)*

Figure 2.11 shows the mapped geology in the Hoodsport RAC planning area. According to the Logan (2003) unconsolidated sediments mapped in the Hoodsport RAC planning area include the following:

Qgt - Till, late Wisconsinan (Pleistocene). Glacial till deposits generally consist of a compact unsorted mixture of clay, silt, sand, gravel, and boulders, deposited at the base of the Puget lobe of the Cordilleran ice sheet during the latest glaciation. Occasional sand and gravel lenses may be present. Till is commonly referred to as “hardpan” due to its cement-like texture. Till does not provide a favorable infiltration medium, but may be suitable for septic drainfields if sufficient depth of soils and weathered till are present. Till acts as an aquitard that inhibits the flow of ground water, perches water on top of it where overlain by recessional outwash, and also confines water below it in the advance outwash. In general, the permeability of till ranges from low in weathered surficial deposits to relatively impermeable in very dense non-weathered materials (Logan, 2003).

Qga - Advance outwash, late Wisconsinan (Pleistocene). Advance outwash consists mostly of glaciofluvial sand and gravel, with some and lacustrine clay, silt, and sand deposited during the advance of glaciers. Sandy units are commonly thick, well sorted, and fine grained, with interlayered coarser sand, gravel, cobbles and silt (Logan, 2003). Advance outwash is typically permeable, often water-bearing, and denser than recessional outwash, having been overridden by glacial ice. Advance outwash is commonly overlain by till.

Qgo - Proglacial and recessional outwash, late Wisconsinan (Pleistocene). Recessional outwash typically includes poorly to moderately sorted, rounded gravel and sand with localized coarser- and finer-grained constituents. Some fine sand, silt, and clay form local overbank sediments may also occur. Recessional outwash thickness varies and is not well known. It most commonly occupies outwash channels scoured into or through till (Logan, 2003). Recessional outwash was not glacially overridden, and is generally poorly consolidated to loose. Typically outwash deposits exhibit moderate to high permeabilities and infiltration rates depending on silt content.

Qapo - Alpine outwash, pre–late Wisconsinan (Pleistocene). Alpine outwash consists of stratified sand, gravel, and cobbles, may include peat, silt, and clay, and may be capped by weathered loess. Clasts are generally more rounded than those in till and lack facets and striations.

Qa - Alluvium (Holocene). Alluvium may consist of silt, sand, and gravel deposited in streams and alluvial fans, locally may contain Alpine drift, peat, or landslide deposits.

The soils and geologic maps reviewed are not entirely consistent with regard to correlation of mapped glacial deposits with mapped overlying soils. For example, most of the areas mapped as outwash on the geologic maps are mapped as Hoodsport series on the soils maps. The only areas mapped as Grove soils correspond with areas mapped as alluvium on the geologic maps.

Some differences in geologic mapping based on different references also occurs, which is not uncommon. Field verification of soils and geology is therefore recommended prior to design or siting of any facility. **Figure 2.12** shows the mapped geology per Carson (1976), which is similar to the Logan map. The main till/outwash boundary (Qgt to Qga on the Logan map) is interpreted similarly in both maps.

2.1.5 Environmental Issues and Permitting

2.1.5.1 <u>Environmental Issues</u>

The Mason County Comprehensive Plan (updated 2005) mapped a number of sensitive areas on a county-wide basis. Sensitive areas mapping within the study area has not been conducted as part of this project. The sensitive areas mapping, including geologic hazard areas, flood hazard areas, aquifer recharge areas, and surface water and wetlands has been reviewed as part of this project.

Within the Hoodsport study area, the major surface water bodies include Hood Canal, Finch Creek, Hill Creek, and a number of wetlands, particularly near the mouth of Finch Creek and adjacent to Hood Canal. Potential impacts to wetlands and/or water bodies are likely the environmental issue of greatest concern. A field reconnaissance should be conducted prior to siting any treatment or disposal facilities to determine the location and extent of streams and wetlands. Conducting this review early in the process would potentially allow for wetland avoidance by making siting adjustments. Similarly, wetland delineations should be conducted when pipeline routes are determined so that wetland impacts can be avoided, or minimized to the greatest extent possible.

Water quality in Hood Canal has long been a concern. In general, Hood Canal suffers from elevated levels of nutrients and bacteria, and low levels of dissolved oxygen. Finch Creek has also exceeded water quality criteria for fecal coliform bacteria (Gray and Osborne, 2000). Implementation of the wastewater management project is expected to help reduce bacterial and nutrient loading to nearby surface water bodies from suspected poorly-functioning septic systems.

Other issues include potential impacts to groundwater, storm water impacts associated with increased development, and construction impacts to local roads.

2.1.5.2 Permits

Appendix 2.2 provides a matrix summarizing the various permits that may be required for the Hoodsport Rural Activity Center, Potlatch, and Core Reservation Wastewater Management Planning Areas. Given the general siting information currently available for the projects, a full range of permits that may be required is included. The matrix describes the type of permit, the agency responsible for reviewing the permit, the permit triggger, timelines, agency responsible, and other relevant issues.

Some permit issues of particular note for this project are further described in **Appendix 2.2**. These include permits that could require several months or longer to process, have appeal processes, require potential substantial mitigation for impacts, and/or could be difficult to attain. Requirements for these permits should be identified early and incorporated into the facilities planning process.

Of the potential permits, the permits required from the Corps of Engineers and Department of Ecology would likely represent the longest lead times. Compliance with NEPA is required prior to approval of NEPA funding, which will require completion of all federal requirements, including the Endangered Species Act and Section 106.

2.1.6 Cultural Resources

In the fall of 2006, Mason County contracted with Wessen & Associates, Inc. to assist in planning for a wastewater management system in the Hoodsport "Rural Activity Center" (RAC). Wessen & Associates' role was to prepare an inventory of cultural resources in the Hoodsport RAC and advise in the planning effort so that disturbance to known and suspected cultural resources might be avoided to the fullest possible extent. This section presents the background, goals, methods, findings, and recommendations of that effort. *(**Appendix 2.3** is the complete report with one redaction as required by Washington State law.)*

2.1.6.1 Background

The Hoodsport RAC is located in northeastern Mason County. It includes the commercial 'core' of the community of Hoodsport and residential areas to the north, west, and south (see **Figure 2.13**). Its total area is approximately 1.5 square miles.

The Hoodsport RAC is located within the traditional territory of the Tuwaduq (Twana) People. In early historic times – and for a considerable period prior to them – the Tuwaduq People occupied all of the lands in the immediate vicinity of Hood Canal. Many of their traditional settlements were located along the Hood Canal shoreline, often at or near the mouths of rivers or creeks. They also fished, hunted, and otherwise used a considerable range of lands interior to Hood Canal. Representatives of the Tuwaduq signed the Point-No-Point Treaty in 1855 and subsequently relocated onto the Skokomish Indian Reservation, approximately 2 miles south of the Hoodsport RAC. Their descendants are now usually referred to as the Skokomish Indian Tribe.

There has been only very limited archaeological research within the traditional territory of the Tuwaduq People. Few efforts to locate archaeological sites have been conducted and those which have occurred have generally been limited in their geographic focus. Large scale systematic efforts to identify prehistoric archaeological resources have yet to occur here. Similarly, there have been relatively few detailed studies of particular archaeological sites anywhere along Hood Canal. We currently know that some traditional Tuwaduq settlements near the Hoodsport RAC have been occupied for at least 1,500 to 3,300 years. Other, as yet undated, archaeological sites in the area are probably much older.

2.1.6.2 Research Design

The goals of this effort are essentially those stated above in the introduction to this document: "to prepare an inventory of cultural resources in the Hoodsport RAC and advise in the planning effort so that disturbance to known and suspected cultural resources might be avoided to the fullest possible extent". The term 'cultural resources' as used here, refers to archaeological materials. Thus, this study has not addressed the possibility that there may be historic structures in the Hoodsport RAC. To our knowledge, there aren't any and, moreover, our current understanding of the proposed wastewater management actions suggests that historic structures - - if present - - are unlikely to be affected. The focus of this effort has been directed largely toward archaeological resources representing the Native American occupants of the area. It should be noted, however, that archaeological resources representing late 19th and early 20th Century Euro-American occupants of the area could also be present in the Hoodsport RAC.

The results of the inventory effort have been summarized in two maps of the Hoodsport RAC. The first map shows the locations of recorded archaeological sites and settlements known from ethnographic and/or historical sources that may have archaeological manifestations. It is important to note here that the locations of recorded archaeological sites are protected by state and federal laws, and thus this information cannot be released to the general public. In this same regard, the Skokomish Tribal Historic Preservation Office has requested that specific information about the locations of traditional Tuwaduq settlements also not be released to the general public. These requirements, and the paucity of archaeological survey data for the Hoodsport RAC, have led us to develop a second map. The second map identifies zones of archaeological potential within the Hoodsport RAC. These zones have been developed on the basis of the distributions of the above-noted locations and generalizations about the relatively sensitivity of different types of landforms in the study area. In brief, low gradient surfaces in the immediate vicinity of the Hood Canal shoreline and the flood plains of larger creeks are considered to have a relatively high potential for archaeological resources. The vicinities of smaller low gradient creek channels and so-called vista points (i.e., locations that offer sweeping views of the surrounding landscape) are considered to have a moderate potential for archaeological resources. Steep gradient surfaces and low gradient interior surfaces that are not located near creeks or lakes are considered to have a relatively low potential for archaeological resources. The map identifying zones of archaeological potential within the Hoodsport RAC may be released to the general public.

Finally, it is important to emphasize that the study reported here is not an archaeological survey of the Hoodsport RAC. While we have considerable familiarity with this area, no actual on-the-ground inspection for archaeological resources was conducted at this time. Rather, the effort was essentially a literature review and our products are based upon examination of documents on file with the Washington State Department of Archaeology and Historic Preservation, the Skokomish Tribal Historic Preservation Office, other materials in our possession, and archaeological site survey experience in nearby areas.

2.1.6.3 The Cultural Resource Maps

Our map of the locations of recorded archaeological sites and settlements known from ethnographic and/or historical sources that may have archaeological manifestations is presented in **Figure 2.14**. Note first that there are no recorded archaeological sites in the Hoodsport RAC. This condition is undoubtedly related to the fact that there has been almost no archaeological research conducted in the Hoodsport RAC. As such, the absence of recorded archaeological sites should not be seen as suggesting that archaeological resources are unlikely to be present. **Figure 2.14** does indicate that at least three traditional Tuwaduq settlements were located within the Hoodsport RAC. All three were located along the Hood Canal shoreline at the mouths of creeks. Relatively little information is available about any of these places, but at least one is clearly identified as a ‘large winter village’. The other two settlements may have been somewhat smaller. Native American archaeological resources – potentially including artifacts, occupation refuse, and human remains – may be present at any of these locations. We have not specifically identified the early historic Hoodsport Town site in **Figure 2.14**, but it was located in what is essentially the commercial ‘core’ of the modern community of Hoodsport. Late 19th and early 20th Century Euro-American archaeological resources may be present anywhere in this area.

The information in **Figure 2.14**, and the generalizations about the relatively sensitivity of different types of landforms noted earlier, have been used to generate the archaeological sensitivity zones presented in **Figure 2.15**. Two important caveats need to be offered about this map. First, zones based upon landforms have been defined, as the landforms appear on USGS 7.5 minute topographic maps. These are valuable tools, but it is important to emphasize that there may be archaeologically sensitive features in the study area that are too small to be indicated on USGS 7.5 minute topographic maps. The zones shown in **Figure 2.15** are therefore generalizations about probable potential and should not be regard as guarantees that archaeologically sensitive areas are not present within zones here identified as having only a low potential. A second caveat concerns the low gradient surfaces in the immediate vicinity of the Hood Canal shoreline. This area has been indicated as having a relatively high potential for archaeological resources. This study has not documented whether historic filling has occurred along any portion of this shoreline. We raise this issue because we suspect that some locations – such as near the mouth of Finch Creek – may contain fill deposits, and fill deposits are a complicating consideration. At first glance, fill sediments can be expected to be culturally-sterile, and thus documented fill areas should have no potential to contain archaeological resources. The issue is actually more complicated for two reasons. First, experience elsewhere in western Washington has shown that low lying areas with archaeological resources were sometimes filled in order to raise their base level. Thus, potentially significant archaeological resources can be present underneath fill deposits. Second, there are documented cases of archaeological sediments having been used as fill materials in western Washington. This means that it is possible that archaeological materials – including human remains – could be encountered in fill deposits.

The map of zones of archaeological potential within the Hoodsport RAC indicates that high potential areas are limited to the low gradient surfaces in the immediate vicinity of the Hood Canal shoreline and the Finch Creek flood plain. These areas have the highest potential for both Native American and Euro-American archaeological resources. These are also among the most developed (i.e., disturbed) areas in the Hoodsport RAC. The history of historic disturbance may have damaged and/or destroyed archaeological resources in these areas. It would, however, be dangerous to simply assume this. In fact, there are many well documented cases of important archaeological resources having survived in badly disturbed, highly developed landscapes. (Witness the recent events at the graving dock site in Port Angeles.)

Areas thought to have a moderate potential for archaeological resources are also relatively limited within the Hoodsport RAC. They include the vicinities of two smaller low gradient creek channels to the south of Finch Creek and the areas along the tops of slopes that look out over Hood Canal and/or the lower Finch Creek canyon. Some of the latter areas have also experienced significant historic disturbance, and the above-noted caution also applies in these areas.

Finally, a significant amount of the Hoodsport RAC appears to have only a relatively low potential for archaeological resources. Areas thought to have only a relatively low potential include steep surfaces along the margin of Hood Canal and the lower Finch Creek canyon and low gradient interior surfaces in the western portion of the Hoodsport RAC. While we are confident that the latter areas have only a relatively low potential for archaeological resources, we should emphasize that there is a difference between ‘low potential’ and ‘no potential’.

It is possible that that archaeological resources could be encountered in areas we characterize as having a low potential.

2.1.6.4 Resource Management Considerations

The assessments of archaeological resource potential presented here are based upon very limited archaeological and ethnographic data and generalizations about the relative sensitivity of different types of landforms, as they appear on USGS 7.5 minute topographic maps. As already indicated, this study is not an archaeological survey of the Hoodsport RAC and should not be regarded as one. We therefore recommend that an archaeological survey of the areas to be impacted by the waste-water management system be conducted. Having said this, we think that project planners should be aware that – depending upon the system's design – it may prove to be difficult to investigate some portions of the Hoodsport RAC. In particular, we note that much of the high potential areas have been extensively developed and thus, built features such as paved road beds and structures may make effective archaeological inspection difficult. Some of this difficulty may be addressed by test boring portions of the study area, but even the feasibility of this approach is difficult to assess at this time.

As such, while an archaeological survey is an important next step, project planners should recognize that such an effort may not be sufficient to be certain that archaeological resources are not present anywhere in their project area. We therefore think that some degree of archaeological monitoring may be appropriate during the construction of the planned facilities. The specific scope and character of such a monitoring plan should be developed after the results of the archaeological survey are available.

2.2 Additional Information

2.2.1 Treatment Soils Can Provide

*(The following is an excerpt from a complete report prepared by HWA GeoSciences for this effort. To fully understand the particulars of this report, its sources of information and any limitations concerning its use, please consult the full document included in this report as **Appendix 2.1**.)*

HWA GeoSciences' scope of work for this report included using available soils and septic system information to assess which areas in the Hoodsport RAC currently served by conventional septic systems have the highest, moderate and least likely probability of causing Hood Canal contamination.

Criteria contributing to relative risk of transmitting septic contamination to Hood Canal include:

- Soils and geology (soil treatment capacity and permeability)
- Slopes
- Distance to surface water
- Depth to ground water

Several of the criteria are overlapping, for example slopes, distance to surface water, and permeable outwash soils all coincide with the coastal areas and east-west drainages in the planning area.

Soils and geology are described above. Soils with increased risk of contaminant transport and reduced treatment capacity include those that are excessively drained, such as Grove soils. These soil types would provide less treatment than slower draining soils due to less organic content and decreased residence times. Grove soils on steep slopes in and near drainages (e.g., Gk) have an added element of risk due to thinner soil profiles, and steeper hydraulic gradients. Distance to surface water relates directly to potential for septic contaminants to reach Hood Canal. For reference, Chapter 246-272A WAC, On-Site Sewage Systems specifies a setback of 100 feet for drainfields from surface water, and 30 feet from any downgradient site feature that may allow effluent to surface.

Based on these criteria, areas ranked by relative risk of transmitting septic contamination to Hood Canal include:

- Low risk – Upland areas underlain by glacial till and Hoodsport soils, not near surface water drainages.
- Moderate risk – Areas mapped as having outwash soils, but not in or near surface water drainages.
- High risk – Areas within or adjacent to surface water drainages, including the Hood Canal coastline. Most of the areas in and near drainages also contain permeable soils which are more likely to transmit water and contaminants with minimum treatment.

Figure 2.15 shows mapped geology (Logan, 2003) topography, and land parcels. **Figure 2.16** shows the major geologic contacts, topography, land parcels, and an aerial photograph, to provide some indication of land development status. **Figure 2.17** includes the three risk areas delineated in the Hoodsport RAC.

Wastewater treatment/disposal options for future development include:

- Conventional on site sewage treatment/disposal systems
- Enhanced on site sewage treatment/disposal systems (single residence or combined)
- Conveyance to a centralized waste water treatment facility (including a variety of treatment processes, effluent qualities, and effluent disposal options)

Delineation of areas for varying types or levels of treatment in the planning process may be made qualitatively, based on relative risks as outlined above, or semi-quantitatively, by establishing maximum pollutant (e.g., nitrogen) loading or downgradient concentrations, then performing analytical modeling to predict estimated concentrations for various scenarios, including effluent quality, development density, etc.

2.2.2 *Population/Land Use and Predicted Flows and Loadings*

Table 2-6 develops flows and loadings estimates for existing conditions within the RAC, Service Area 2, and the Expanded Service Area 2. Currently, the estimated populations within these respective areas are 642, 139, and 346.

Existing land use is predominantly residential, with a commercial corridor along U.S. Highway 101 and the shoreline. The smallest lot sizes and the highest density development are located within or near Service Area 2. The population density covers a range of two to six homes per acre (refer to **Figure 2.04**).

Future, or predicted, flows and loadings are dependent upon growth within the RAC and changes in land use. In the Alternatives Analysis, an annual growth rate of 3.5 percent was recommended by Mason County for the Hoodsport RAC. This rate was utilized to project population through the year 2025 and resulted in an estimated population of 1,277 for the RAC.

With an area of 584 acres, a 2025 population of 1,277 would result in a density of about 2.2 persons per acre. While approximately one-third of the RAC is characterized by steep slopes, the remaining two-thirds are characterized by a relatively flat plateau. Exhibit IV presents both existing topography and population density. As shown, the south and west areas of the RAC are characterized by low-density development.

The Finch Creek Study did not project population for Service Area 2. As shown in **Figure 2.07a**, the estimated current population is 139. As shown in **Figure 2.04**, it contains the highest density (two to six homes per acre), but is also confined by steep slopes on the uplands side of U.S. Highway 101 and Hood Canal along the shoreline. Without a conversion in land use (e.g., multi-family) and with the existing lot configuration, the high growth rate of 3.5 percent used in the Alternatives Analysis does not appear achievable for Service Area 2.

However, for the purpose of this plan, it is assumed that Service Area 2 and the Expanded Service Area 2 will be served by a central sewer system which will allow a 3.5 percent growth for commercial flows, but only a 1.5 percent growth in population. It is assumed that the higher population growth rates will occur elsewhere in the RAC. These assumptions and any others will need to be confirmed by the Mason County Department of Community Development.

Figure 2.18a summarizes the population projections both for the Hoodsport RAC and Service Area 2 through 2025.

Figure 2.18b presents future flow and loading estimates for the Hoodsport RAC, Service Area 2, and the Expanded Service Area 2. For the Hoodsport RAC, the estimates follow the work presented in the Alternatives Analysis. For the Service Area 2 alternatives, the estimates are based on the unit values in Table 2-4, a growth estimate of 3.5 percent for commercial flows, and a growth estimate of 1.5 percent for population.

2.2.3 Inventory of Applicable Technologies for Treatment Plant

Any applicable technologies suitable for all, or part of the Hoodsport RAC, will need to be capable of nutrient reduction. Since none of the disposal or reuse options is likely to include direct discharge to Hood Canal, the State's Groundwater Standards, 173-200 WAC, and the Water Reclamation and Reuse Standards, 90.46 RCW, are the most significant standards for any treated effluent from the Hoodsport RAC. Unlike most wastewater treatment facilities, which operate under an NPDES permit, any facility serving the Hoodsport RAC would be regulated by Ecology's State Waste Discharge Permit (SWD).

Based on a meeting with Ecology, the likely effluent limitations for BOD_5, TSS, dissolved oxygen, turbidity, total coliform, pH, and total nitrogen are shown in **Figure 2.19**.

The effluent limitations presented in **Figure 2.19** meet the requirements for

Class A reclaimed water to surface percolation ponds or spray irrigation. In addition to the effluent limitations shown in **Figure 2.19**, there would also be groundwater limitations summarized in **Figure 2.20**.

In the Water Reclamation and Reuse Standards, one of the listed commercial and industrial uses for reclaimed water is fish hatchery basins. Specifically, the standards state: “Reclaimed water used as a source for basins at fish hatcheries shall be at all times Class B reclaimed water or better.” This reuse option was discussed in the Finch Creek Study since the Washington State Department of Fish and Wildlife operates a fish hatchery located at the mouth of Finch Creek. According to records in 1997 to 1998, the average daily water intake at the hatchery is about 10 mgd with a range of 6 mgd (low) to 16 mgd (high). Based on the flow estimates for Service Area 2 in Table 2-8, the peak day flow of 52,000 gpd would only amount to 5 percent of the average intake. For the Expanded Service Area 2, the peak day flow of 88,000 gpd amounts to 9 percent of the average intake. However, according to Ecology representatives at the Southwest Regional Office, this use of reclaimed water has not yet been implemented in the State of Washington. The expected effluent limitations presented in **Figure 2.19** may need to be modified for this use of reclaimed water. At a minimum, there likely would be a specific concentration for dissolved oxygen and the stricter turbidity standard associated with membrane systems. Other concerns, which are not currently addressed by the reuse standards, are micro-constituents such as pharmaceuticals.

Applicable technologies to meet the requirements in **Figure 2.19**, **Figure 2.20**, and the Water Reclamation and Reuse Standards are the membrane bioreactor (MBR) process with disinfection and the sequencing batch reactor (SBR) with filtration and disinfection. Both technologies have proven capability for nutrient removal and both require a relatively small “footprint,” or site area. Both technologies are widely used for the level of flows and loadings presented in **Figure 2.18b**.

MBR facilities are in operation at the Tulalip Tribe, Stillaguamish, and the City of Duvall. Mason County operates SBR facilities at Hartstene Pointe and North Bay-Case Inlet. Among the MBR systems, there are several alternatives, including micro-filters manufactured by Zenon Corporation, and a flat plate design manufactured by Kubota. These MBR alternatives would need to be screened based on flows, capital, and annual O&M costs. There is less variability among SBR manufactured systems.

Between the two applicable technologies, MBR and SBR, the MBR systems have increasingly found greater use in western Washington. For small systems, the MBR systems produce a higher effluent quality and require less annual O&M. However, replacement of the membranes at approximately 10-year intervals is an added cost not found with the SBR systems. In addition to capital and annual O&M costs, both systems should be evaluated against non-cost factors such as the examples listed below:

- Proven reliability for nutrient and total coliform reduction;
- Highest effluent quality;

- Most expansion capability;
- Lowest maintenance requirements;
- Best aesthetics/visibility;
- Best noise and odor control;
- Least operational complexity; and
- Highest regulatory acceptance.

The quantities of flow associated with Service Area 2 (peak day of 52,000 gpd) and the Expanded Service Area 2 (peak day of 88,000 gpd) are well suited both to the MBR and SBR technologies. Which service area alternative that can be implemented will depend on several factors, including costs. The primary technical challenge is not with the treatment technologies, but with identifying a suitable reuse site capable of handling the flow quantities.

2.2.4..Inventory of Applicable Technologies for On-site Systems

(There are areas in Hoodsport where there is moderate risk of septic tank effluent reaching Hood Canal. Please see sections 2.1.3 and 2.1.4. Because of Hoodsport's Rural Activity Center status, growth from new development is limited. Advanced on-site systems hold promise for handling conventional septic tank pollution that may move to Hood Canal. CH2M Hill provided the following planning level review, presented here in its entirety.)

2.2.4.1 Non-Sewered Area Wastewater Management

The expanded sewer service area for the Hoodsport RAC encompasses the Finch Creek corridor and that area adjacent to Hood Canal. Upland from this expanded service area, the soils are marginal and have been determined not suitable for conventional septic tank systems. If you divide the Hoodsport RAC into two sections, the smaller western area, and the larger eastern area that extends farther north and south than the western area, the eastern section is the section where there will be a need to install more advanced on site systems outside of the designated sewer service area. *(**Figure 2.25** is a topographic aerial view of this general area with the Expanded Service Area identified.)*

Recent studies in New Zealand (*Nitrogen reduction trials of advanced on-site treatment systems*, Paul Scholes, Environmental Bay of Plenty Regional Council, July 2006) indicate that there are available on site systems that can meet reduced nitrogen requirements. In the study, the AdvanTex system by Orenco (Roseburg, Oregon) consistently met removal rates greater than 80% and a total N effluent concentration below 15 mg/l. While this is less that what can be accomplished with a centralized system, it will allow the soil to provide additional treatment to further reduce nitrogen.

The Orenco AdvanTex system is one of many available advance on-site systems available. Based on the New Zealand study, it appears to be the best among those systems tested. Other advanced systems are appearing in the marketplace. Huber has an on-site membrane system that shows great promise. This system is currently being pilot tested by the Karcher Creek Sewer District (Port Orchard, WA).

Regardless of the type of advance on site system, it is recommended that these systems be clustered to serve a number of homes. There are many reasons why these systems should be clustered. Here are a few of the top reasons for clustering the advance on site systems:

- Clustered systems would be owned and operated by a public agency that would maintain the integrity and water quality of the system
- Public agencies can obtain public funding where private systems are limited on funding options
- Advance on-site systems use biological treatment in an aerobic environment, clustering would help the biological system dampen the flow and load variations that are inherent with an individual on-site system.

The AdvanTex AX100 system will be used as an example for this planning level review. According to available literature, this system is capable of handling an average flow of 2,500 gallons per day (gpd) with a peak flow of 5,000 gpd. Using a peaking factor of 3.5, results in a design flow of just over 1,400 gpd. Based on the flow projections completed for the Hoodsport RAC, that would equate to a 7 equivalent residential units. (ERU) A cluster could be bigger by adding additional units (i.e. 2 units = 14 ERU, 3 units = 21 ERU).

It is possible to reuse existing septic tanks with these clustered systems. In discussions with representatives at Orenco, new septic tanks would not be required if the existing tanks are proven to meet certain leak test criteria. This would help offset the cost of the new systems. The other parts to these clustered systems would include the following:

- Septic Tank (existing or new, depending on leak test)
- Septic Tank Effluent Pump (STEP) system – a separate chamber with existing tanks, integral with new tanks – that would include a pump that would pump septic tank effluent from each residence in the cluster to the treatment unit.
- Treatment Unit – for this example we are assuming an Orenco AdvanTex AX-100.
- Recirculation Pump and holding tank – to keep re-circulating liquid through the treatment system
- Effluent system – diversion box that distributes treatment system effluent between the discharge and recirculation, pump (if necessary for pressurized discharge), and discharge piping (subsurface drip type distribution material can be used – Geoflow or similar product)

The capital costs for the 7 ERU cluster system, based on a full use of a single AdvanTex AX-100 system are detailed in **Figure 2.21**.

The costs developed in **Figure 2.21** are based on installed costs quoted by the manufacturer and similar installations. Costs assume that there would be multiple cluster systems being installed at the same time in the Hoodsport RAC. Costs also assume minimal restoration costs.

Based on the costs in **Figure 2.21**, the range of costs for this cluster system is from $90,000 to $139,000. This would equate to approximately $13,000 to $20,000 per ERU. Adding costs for easements and/or property purchase for the treatment system and discharge would add another $7,000 to $21,000 to the total cost of the system. This would increase the per ERU cost range to $14,000 to $23,000.

Operation and Maintenance (O&M) costs would be on the order of $3,000 to $4,000 per year (does not include septic tank pumping – homeowner's expense). This assumes that there are multiple clustered systems in the area and that the same O&M team that is running the centralized system for the Hoodsport RAC is also operating the advance on-site systems. If this is not the case, the O&M costs would be greater depending on location of the staff.

How will these systems be clustered in the non-sewered area of the Hoodsport RAC is beyond the scope of this planning level work. **Figure 2.22** is an example of how a cluster system might be configured. This example shows the STEP units that would be located at each property. The septic tank effluent would be pumped using a small diameter pipe to a centralized treatment unit. The treated effluent would then be discharged to a pressurized drip system located within the adjacent right of way.

Actual clustering will require further investigation, additional mapping, property investigation, title search, and survey.

2.2.4.2 Storm Water

While the focus has been on wastewater as the primary contributor to water quality issues in Hood Canal, storm water will need to be included in the overall program if the County and the agencies involved want to have a comprehensive effort to address water quality issues. Storm water management including treatment of runoff should be addressed. Other practices such as fertilization of lawns and gardens should be done using methods and applications that minimize the impact on Hood Canal.

2.3 Proposed Approach

2.3.1 Technologies for Hoodsport /Project Definition

Section 2.2.3 concludes by stating:

> *The primary technical challenge is not with the treatment technologies, but with identifying a suitable reuse site capable of handling the flow quantities.*

Both membrane bioreactor (MBR) and sequencing batch reactor (SBR) with filtration can reliably produce Class A reclaimed water. The greater question at this stage is what to do with the highly treated water.

For the purposes of estimating, MBR technology is presumed both because of its reliability and small footpring, and because it is a technology already supported by Mason County PUD #1 and accepted and used by Mason County in its North Bay utility and soon to be used in its Belfair utility.

During design, decisions concerning effluent will be made. These will be driven by land availability for infiltration, potential use of reclaimed water at the fish hatchery, and irrigation opportunities. With estimated peak daily flows at 88,000 gpd, water volumes are manageable. Class A reclaimed effluent allows the greatest flexibility for reuse or discharge and developing redundant capabilities through multiple fates. Pumping to deliver the Class A water to its fate location and purchase of land will be two significant cost factors. The cost estimate for Hoodsport assumes a lift station with 5,000 feet of force main and $250,000 to purchase land for the treatment plant and effluent fate.

Topography makes gravity sewers in Hoodsport impractical. Grinder pump technology is proposed since it is already used by Mason County wastewater utilities. Septic effluent pumping (STEP) technology could also be used. A selection will need to be made during design based on several factors previously listed including reliability, ease of maintenance, expected performance and cost.

Section 2.2.4 uses the AdvanTex system as an example while noting there are other on-site systems that can provide significant degrees of nitrogen reduction. The planning level estimates in this report suggest that such systems offer a cost advantage over central systems where soil conditions are adequate to make up the difference in nitrogen removal performance. This appears to be the case in Hoodsport. The extent of the use of advanced on-site cluster systems will need to be determined during design.

Hoodsport Project Definition
The recommended project for the Hoodsport RAC uses a grinder pump collection system to serve the Expanded Service Area2 (see **Figure 2.06**). The sewer collection system feeds a centrally located MBR treatment facility (see report's CD version **Appendix 1.4** "Finch Creek Wastewater Feasibility Study" for location possibilities) creating Class A reclaimed effluent.

During design final effluent fate must be determined. Among possible options are irrigation of forest land west of the Hoodsport RAC and infiltration of the highly treated water (see report's CD version **Appendix 1.4** "Finch Creek Wastewater Feasibility Study" for location possibilities). Another unexplored possibility is reuse of the highly treated water at the fish hatchery in Hoodsport.

Because of the risk of pollutant transport to Hood Canal, the use of advanced on-site cluster systems is proposed for an area west of the sewer service area along Hood Canal and below the plateau that occupies the western part of the Hoodsport RAC. Utility-owned and operated advanced on-site systems are envisioned with each system serving approximately 7 ERUs. Effluent would be discharged using a pressurized drip system in the public rights of way.

The current cost to complete the Hoodsport RAC project is estimated at $10.1 million in current dollars (please see Section 2.3.2 below for additional detail).

2.3.2 Planning Level Costs

As noted in Section 1, this report is using planning level estimates. A typical approach for developing planning level estimates is to first establish unit costs for parts of the conceptual project such as a cost per lineal foot of 6" sewer pipe or the installed cost of a grinder pump.

Some estimates at this level are "lump sum" based on experience. It is too costly at this stage to estimate quantities of rebar or volumes of concrete. Qualified and experience engineers are a good source for these estimates that, when summed, can provide a construction cost. The construction cost comes with a contingency factor. It is important to note that construction costs are currently very unstable. Rapidly rising prices for Portland cement and steel make construction cost estimating more difficult than normal.

Other cost elements, such as design, project administration and assistance during construction are typically derived as a percentage of the construction cost estimate. Hoodsport and the two other Planning Areas are comparatively small wastewater projects, so the percentages should arguably be larger for these costs since a certain portion of the work is fixed and not proportional to the size of the job. A “rule of thumb” at this planning level of estimating is to multiply the construction estimate by 1.5 to estimate the total project cost.

A Hoodsport RAC cost estimate is presented in **Figure 2.23a**. Gray and Osborne, Inc., developed unit cost and lump sum (LS) estimates for systems to serve Service Area 2 (from the “Finch Creek Wastewater Feasbility Study” done in 2000) and Expanded Service Area 2 that was developed in response to both public input and the predicted soil transport of pollutants to Hood Canal. This report focuses on the Expanded Service Area.

CH2M Hill provided estimates for the advanced cluster septic systems proposed to serve the “moderate transport risk” zone west of the Expanded Sewer Service Area (see **Figure 2.17**). The costs developed are for an advanced cluster system with pressurized drip effluent dispersal serving seven homes. The number of clusters to be installed will need to be addressed during design using additional soils information.

For the purposes of a planning level estimate, six cluster systems are assumed. This number was not provided by an engineer.

Firgure 2.23a notes engineer-provided numbers with an asterisk (*). The sources of these can be found by examining the detail sheets in **Figures 2.23b** and **2.23c**. Other numbers are either derived from an engineer’s estimate (6 clusters X estimated cost per cluster) or are experienced based (design cost = 12% of estimated construction cost).

The **Figure 2.23a** “bottom line” of ~$10.1 million is 15% less than the “rule of thumb” ($7.685 million X 1.5 = $11.53 miilion) would suggest. The lower estimate is offered because a substantial amount of study already exists to guide work in the Hoodsport RAC. The risk of unknowns is lowered somewhat. Also, if all three Planning Areas are designed by one firm or joint venture as recommended in Section 7, it is reasonable to expect some design cost efficiencies. These efficiencies could also extend to construction if a uniform approach is used.

2.3.3 Action Plan/Schedule

In the late ‘90s wastewater management strategies for the area now designated as the Hoodsport Rural Activity Center were actively considered. Financing was and continues to be a major hurdle in the path of completing a plan and implementing it. Congressionally sponsored State and Tribal Assistance Grants and a State of Washington grant were “earmarked” for Hoodsport and the Hoodsport-Skokomish region. By 2005 there was more widespread recognition of the importance of Hood Canal as a significant public asset. Regulatory attention was more sharply focused on the Canal’s bacterial and nutrient problems. Also, those interested in re-development, particularly in the Hoodsport commercial corridor, recognize wastewater management as an important element.

In 2007 at least two new factors are driving the need to better management of wastewater in the Hoodsport RAC. Congressional and state grants are going unused and there is substantial demand to reprogram the monies. Also, as a result of recent Puget Sound initiatives, there is greater state attention and there are more state resources available for water quality improvements. Consequently, the August, 2006, Memorandum of Understanding among the Skokomish Indian Tribe, Mason County PUD #1 and Mason County (see **Appendix 1.1**) is timely. Efforts to advance wastewater management in the MOU's three Planning Areas, including Hoodsport RAC, are securing assistance to do the vital planning efforts that must precede the design and construction work for which state and federal grants are earmarked. The activity has created a sense of both possibility and urgency to move forward. Along with the obvious need for environmental attention, there is a clear path of opportunity. It is time for action.

For the Hoodsport RAC wastewater management effort, schedule maintenance and project management are like housework: they are never finished. It is very rare that wastewater projects, regardless of how well planned, anticipate all challenges and opportunities. This dynamism has far-reaching impacts including the ability to precisely estimate performance dates, costs, and rate implications. This by no means suggests that schedule, budget and project management should not be carefully tended with the best talent available. It is to suggest that expectations must be managed along with the project, and that clear and frequent communication among owners and service providers is essential.

It appears possible to have a Hoodsport wastewater management effort in place and functioning by early 2010. This will require a high degree of aggressive attention and a fulsome measure of good fortune. In Section 5.5 a series of action steps is presented for the Potlatch and Core Reservation Planning Areas. Using those steps as a basis, a similar list of actions for the Hoodsport RAC is presented below. It is important to note that, although the steps are presented sequentially, there are opportunities to perform some actions concurrently and save time. For example, it is possible to complete design of the non-sewer advanced clustered on-site facilities independent of the sewer system. Also, collection and conveyance elements of the sewer system can be designed independent of the treatment facility once it is properly sited. **Figure 2.24** is a rough "example schedule" illustrating the ways some actions might overlap.

Action Steps

1. Prepare a Hoodsport Facilities Plan consistent with the Project Definition that is approvable by the Washington State Department of Ecology.
2. Prepare environmental documentation suitable for guiding elected officials approving the Facilities Plan and for funding that relies on the State Environmental Policy Act (SEPA), the State Environmental Review Process (SERP) for State Revolving Fund loans and National Environmental Policy Act (NEPA) documentation.

3. Carefully plan the Facilities Plan approval process to minimize delay and risk. Mason County approves wastewater Facilities Plans through the County's Comprehensive Plan amendment process. This occurs only once annually in December. Amendments to the Comprehensive Plan require environmental review and a public input process. Coordinating timely review by the Department of Ecology and initiating engineering design (see the next two steps) needs to be managed to avoid overall project delay and avoid design re-work as a result of Ecology review of the Facilities Plan.
4. Seek and secure Ecology approval of the Facilities Plan.
5. Select a design firm using Washington State procurement procedures and federal procurement procedures. This selection process can be conducted concurrently with preceding steps to minimize time loss.
6. With Environmental Protection Agency and Department of Ecology consultation, approve a scope of services, review points, schedule and contract with the selected design firm.
7. Initiate design and promptly prepare an Engineering Report for review and approval by the Washington Department of Ecology. Assure proper coordination with the Environmental Protection Agency and Ecology during the review steps of final design.
8. As design is initiated, determine the facility operator. Involve the operator in the design process and establish an operator training program to be conducted by the designer in a manner timely with plant completion. If the operator is a new organization or new to wastewater operations, operating costs may be incurred well in advance of revenues being generated by the new wastewater facilities. Currently only capital costs are anticipated during the design and construction process. It may be possible to capitalize operator costs during design and training.
9. As facilities are sited during final design, prepare site specific environmental documentation for siting options along with needed mitigation plans.
10. Assure during design that the potential for disturbing cultural resources is recognized and avoid or carefully plan for construction in these areas. Plans must include provision for construction observation by qualified personnel, methods for cost-effectively delaying construction (and continuing in other areas) in the event cultural resources are exposed, and appropriate agreed-upon arrangements are made for curation of resources if necessary. All cultural resource plans must be made with the concurrence of the Tribe and the involvement of the State Historic Preservation Officer as required by state law.
11. As soon as possible, acquire sites and start permitting activities for construction.
12. Determine how the County (or other utility owner) will supervise construction and assign responsibilities/authorities for accepting construction work. Hire or retain

necessary professional services or staff. Also assure plans are prepared for discovery of cultural resources and appropriate response plans are in place to assure sensitive and prompt handling consistent with State of Washington and Tribal requirements.

13. At the 80%-90% design stage, conduct a value engineering process managed by a qualified CVE specialist.
14. At or before the time of design approval but following preparation of plans, specifications and estimates, solicit construction bids in accordance with the construction plan. Bidding procedures must be consistent with federal and state requirements and any special requirements depending on fund sources.
15. With final approval of design, assure necessary permit applications are timely submitted and construction contracts are awarded.
16. Complete construction consistent with the construction plan.
17. Commission new facilities, initiate service, begin revenue stream.

-o-

Figure
2.01

Figure 2.01

Hoodsport
Rural Activity Center (RAC)

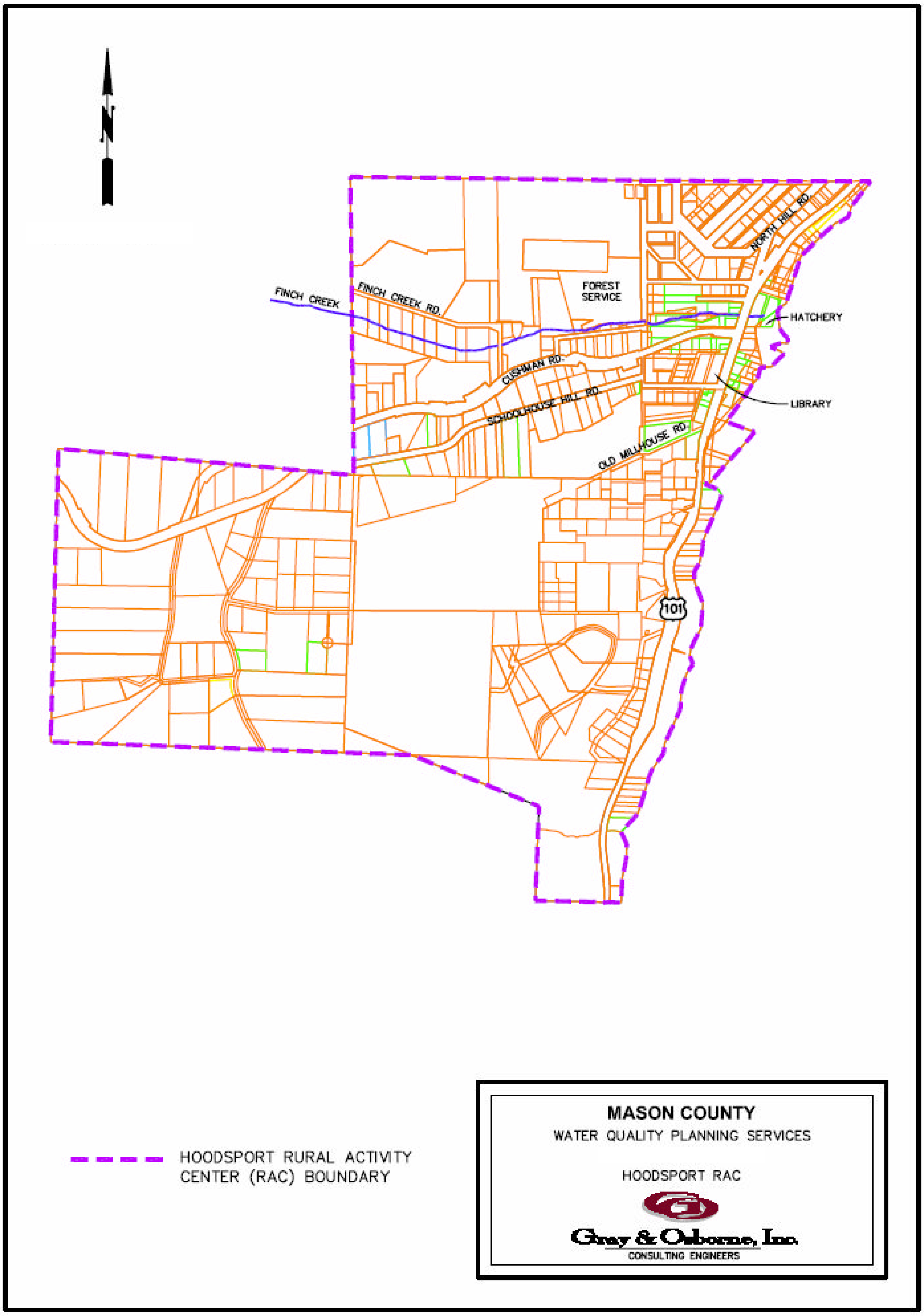

Figure 2.02

Hoodsport
Service Area 1 Alternative

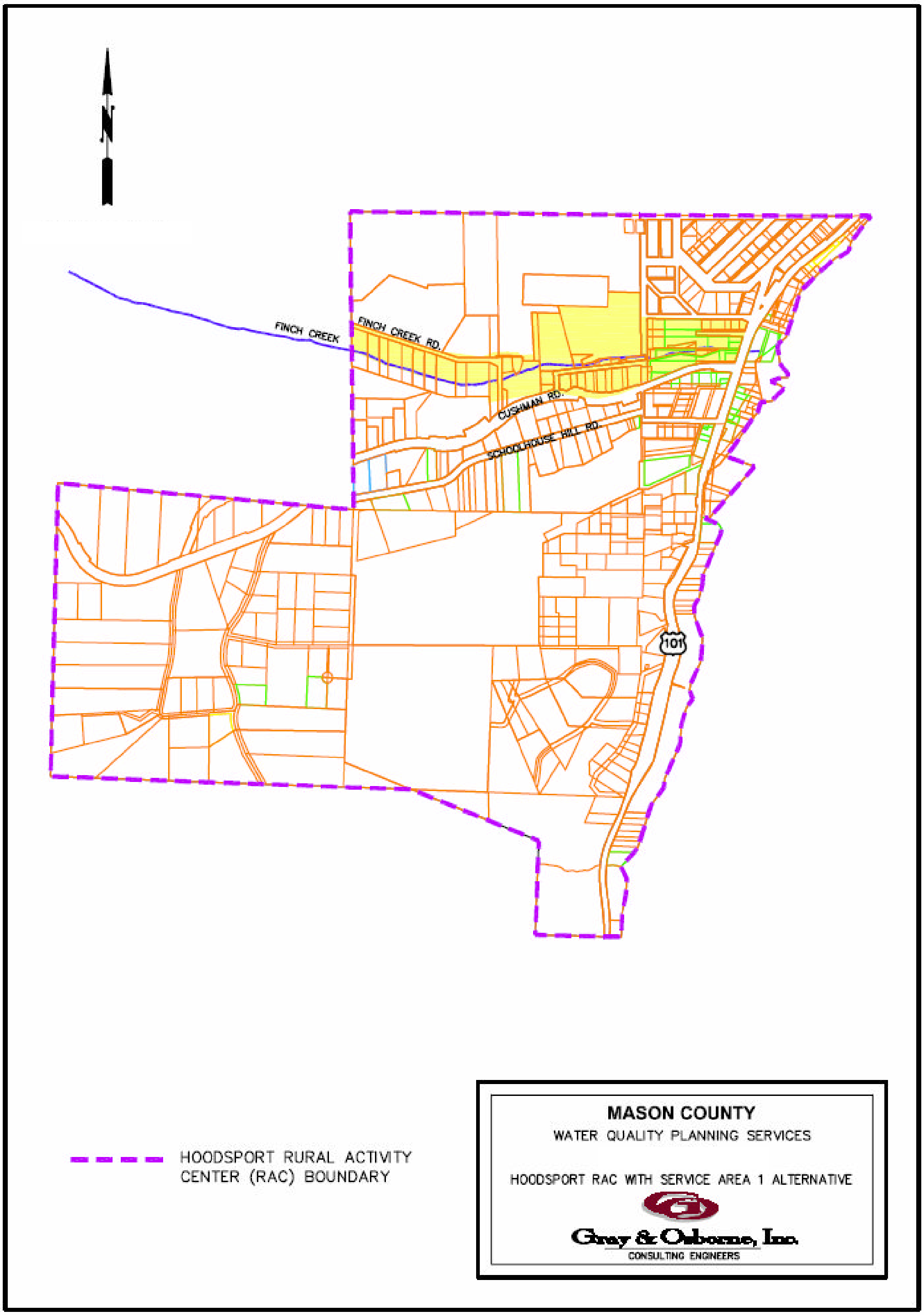

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Figure 2.03

Hoodsport
Service Area 2 Alternative

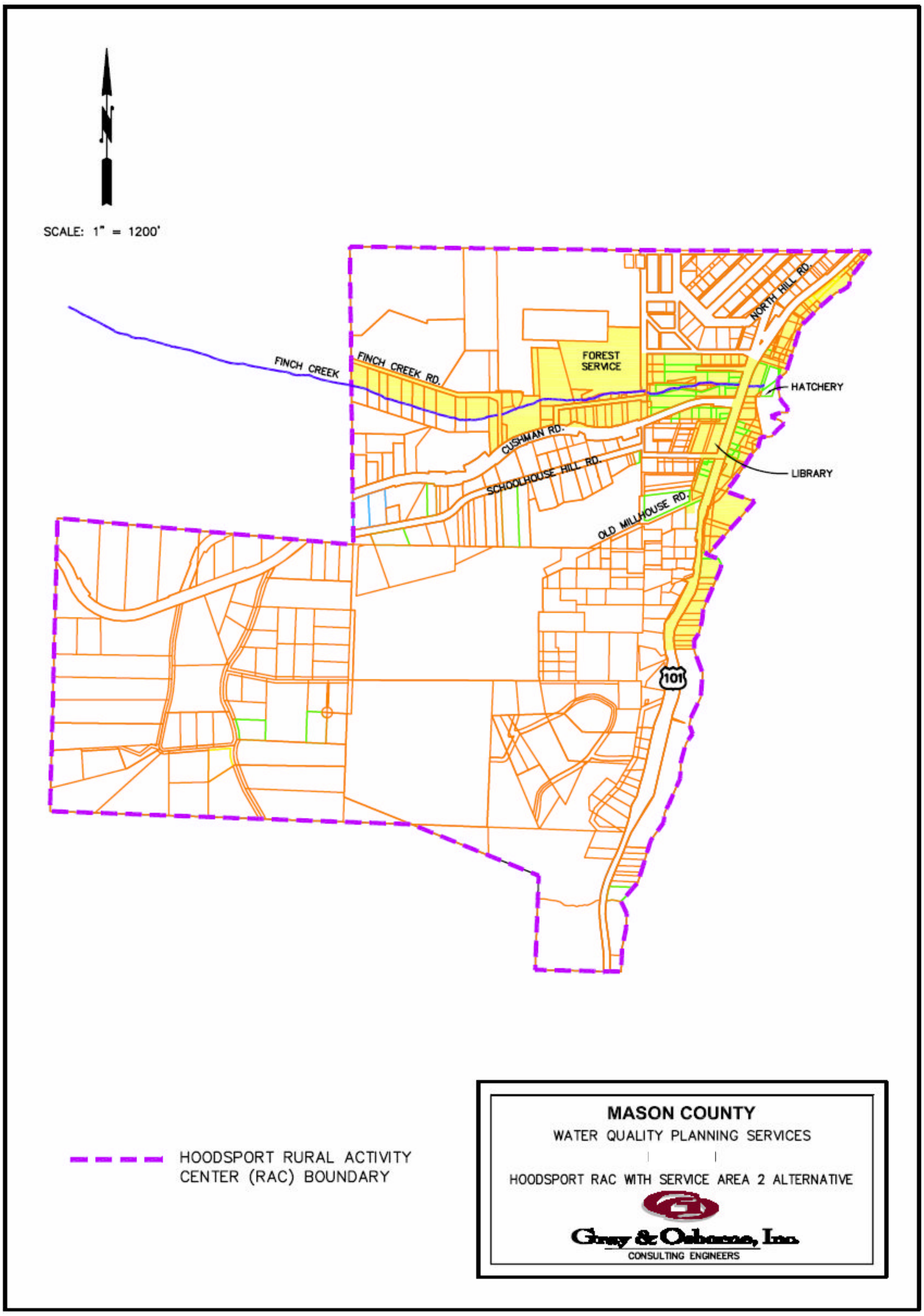

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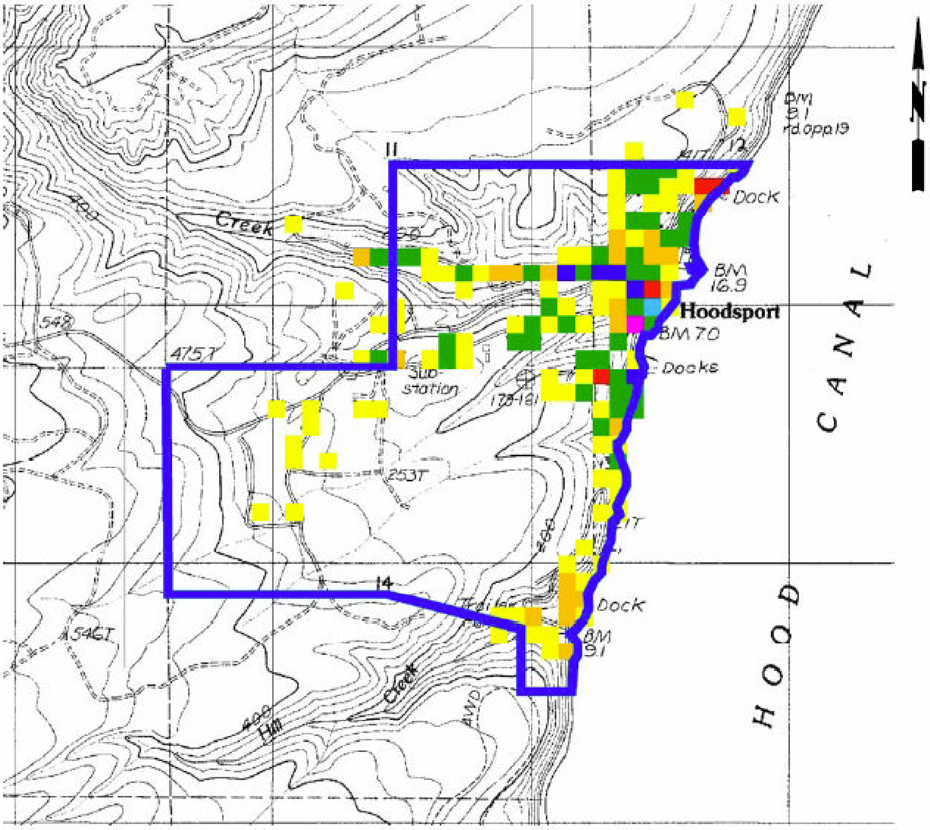
Figure
2.04

Figure 2.04
Hoodsport
Population Density



LEGEND:

- 🟨 1 HOME PER ACRE
- 🟩 2 HOMES PER ACRE
- 🟧 3 HOMES PER ACRE
- 🟥 4 HOMES PER ACRE
- 🟦 5 HOMES PER ACRE
- 🟪 6 HOMES PER ACRE
- 🟦 7 HOMES PER ACRE
- — HOODSPORT RURAL ACTIVITY CENTER (RAC) BOUNDARY

MASON COUNTY
WATER QUALITY PLANNING SERVICES

POPULATION DENSITY

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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Figure 2.05

Alternative and Cost Summary from Previous Reports

Service Area	***Estimated No. of ERUs***	***Alternative***	***Capital Cost***	***Annual O&M***
Service Area 1: Finch Creek Corridor (1)	40	STEP Collection System, Settling Tank, and Pressurized Drain Field	$1.3 million	$18,560
Service Area 2: Finch Creek Corridor and Commercial Area (2)	128	Grinder or STEP Collection System and Water Reclamation Facility	$3.3 million	$86,440- $90,360
Hoodsport RAC (3)	301 (2005) 424 (2015)	Grinder Pump Collection System, MBR or SBR Treatment Facility, and Effluent Reuse	$11.6- $11.8 million	$255,000- $267,000

(1) Table 9-1, *Finch Creek Wastewater Feasibility Study* (August 2000).
(2) Table 9-2, *Finch Creek Wastewater Feasibility Study* (August 2000).
(3) Table 8-10, *Hoodsport-Skokomish Wastewater Management Alternatives Analysis* (October 2006).

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Figure 2.06

Hoodsport
Expanded Service Area 2 Alternative

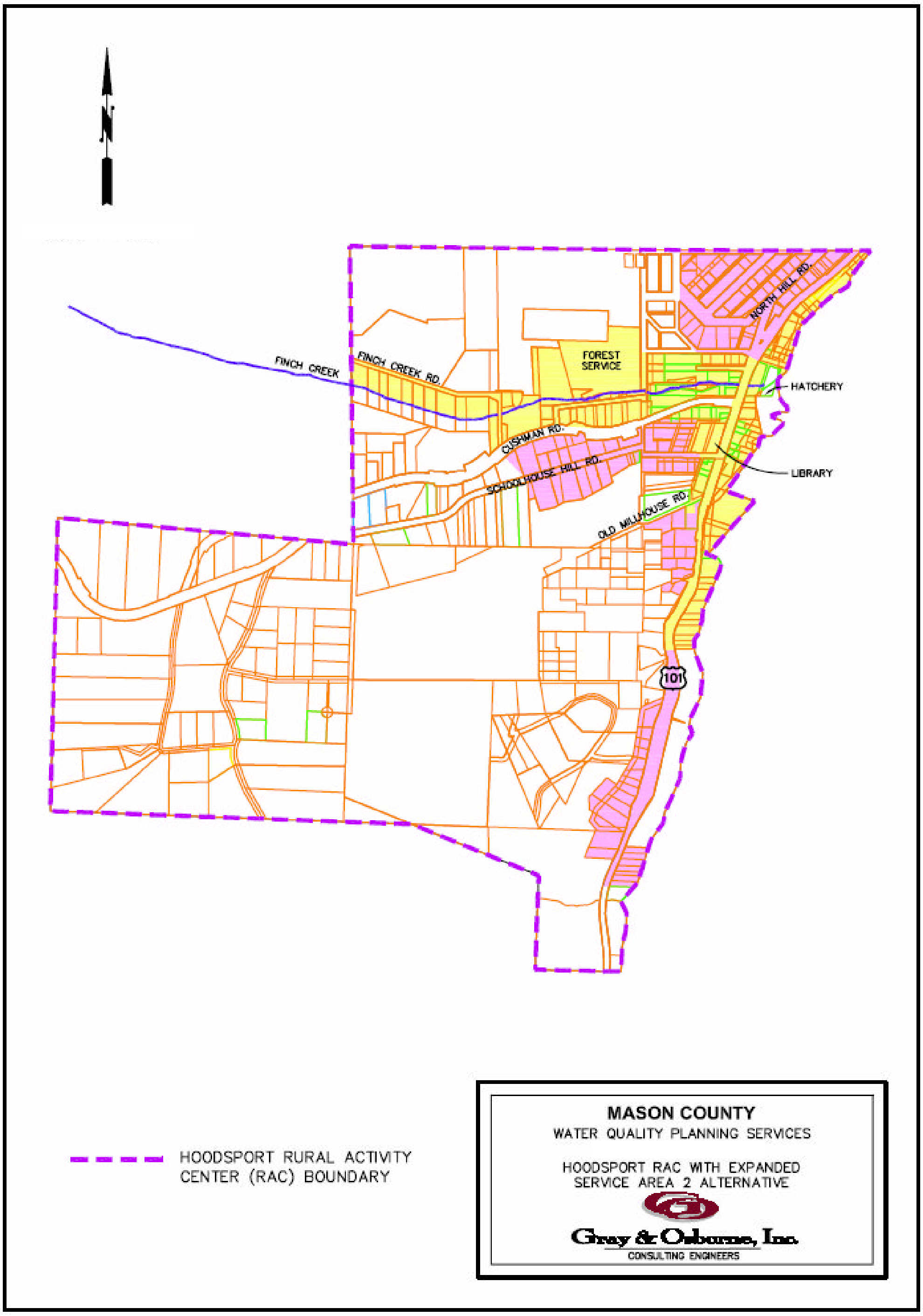

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Figure 2.07a

Existing Population

Area	*Existing Population*
Service Area 1	62 (1)
Service Area 2	139 (2)
Expanded Service Area 2	346 (3)
Hoodsport RAC	642 (4)

(1) Table 6-3, *Finch Creek Wastewater Feasibility Study* (August 2000).
(2) Table 6-3, *Finch Creek Wastewater Feasibility Study* (August 2000).
(3) (83 residences x 2.49 ppc) + 139 population for Service Area 2 = 346.
(4) Table 3-5, *Hoodsport-Skokomish Wastewater Management Alternatives Analysis* (October 2006)

Figure 2.07b

Business Types within Hoodsport RAC

Business Type	*Number within the RAC*
Restaurant/Eatery	6
Vacant/Closed	6
Boutique/Hair Salon	4
Post Office/Library/Bank	3
Churches	2
Clinics	2
Hardware Store	2
National Forest/Park Office	2
Other	2
Real Estate	2
RV Storage/Auto Repair	2
Fire Station	1
Fish Hatchery	1
Gas Station	1
Motel (15 rooms)	1
Nursery	1
Total	**38**

Figure 2.07c

Hoodsport RAC Existing Lot Sizes (1)

	<1/3 acre (2)	*1/3 to 1 acre*	*1 to 2.5 acres*	*>2.5 acres*	*Total (3)*
Number of Lots	51	65	66	18	200
Percent	26	32	33	9	100

(1) Mason County Assessor records.
(2) Mason County minimum building lot size for siting individual on-site systems: 12,500 square feet or 1/3 acre.
(3) Number of lots available in County's Assessor records.

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Figure 2.08
Unit Flows and Loading Values

	Report	
	Alternatives Analysis	*Finch Creek Study* (1)
Flows: Residential		
Average Per Capita Flow, gpcd	65	90
Maximum Month Flow, gpcd	80	135
Peaking Factors		
Maximum Day to Average Day	2.0	2.0
Peak Hourly to Average Day	3.5	—
Flows: Commercial		
Equivalent Residential Unit (ERU), gpd	200	198
Restaurant	50 gpd/seat	—
Motel	65 gpd/room	—
Peaking Factors		
Maximum Month to Average Day	1.25	2.0
Maximum Day to Average Day	2.0	2.4
Peak Hourly to Average Day	3.5	—
Loadings: Residential		
BOD_5, lbs/capita/day	0.18	0.2
TSS, lbs/capita/day	0.20	0.2
TKN, lbs/capita/day	0.029	50 mg/L
Peaking Factors		
Maximum Month to Average Day	1.25	1.5
Peak Day to Average Day	—	2.0
Loadings: Commercial		
BOD_5, lbs/ERU/day	0.45	0.43
TSS, lbs/ERU/day	0.50	0.43
TKN, lbs/ERU/day	0.072	0.077
Restaurant	0.2 lbs/day/seat for BOD_5 and TSS; 0.032 lbs/day/seat for TKN	0.2 lbs/day/seat for BOD_5 and TSS
Motel	0.26 lbs/day/room for BOD_5 and TSS; 0.042 lbs/day/room for TKN	0.26 lbs/day/room for BOD_5 and TSS
Peaking Factors		
Maximum Month to Average Day	1.25	2.0
Peak Day to Average Day	—	2.4

(1) Service Area 2. For Service Area 1, the design criterion for flow was 360 gpd per bedroom.

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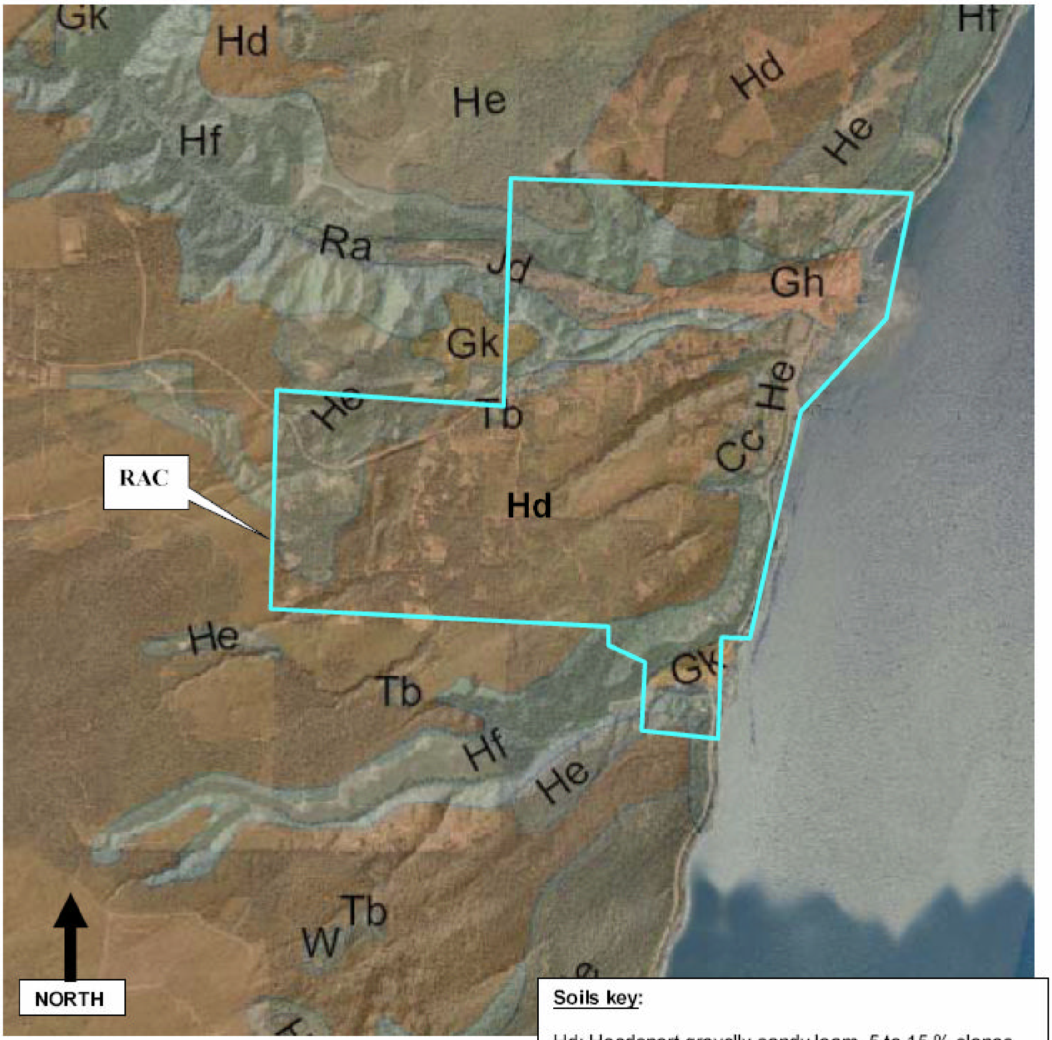
Figure 2.09

Existing Flows and Loadings Estimates

	Hoodsport RAC	*Service Area 2*	*Expanded Service Area 2*
Wastewater Flows:			
Average Flow, gpd	48,697	16,002	29,652
Maximum Month Flow, gpd	59,935	19,695	36,495
Maximum Daily Flow, gpd	97,394	32,004	59,304
Peak Hour Flow, gpd	170,439	56,006	103,782
Wastewater Loadings:			
BOD_5:			
Average, lbs/day	142	54	92
Maximum Month, lbs/day	178	68	115
TSS:			
Average, lbs/day	155	55	97
Maximum Month, lbs/day	194	69	121
TKN:			
Average, lbs/day	23	8	14
Maximum Month, lbs/day	29	10	18

Figure
2.10

Figure 2.10
Soils Map



From: Ness, A. 0., and Fowler, R. H., 1960. *Soil Survey Of Mason County, Washington,* Soil Conservation Service, United States Department of Agriculture, Washington Agricultural Experiment Stations.
http://www.or.nrcs.usda.gov/pnw_soil/wa_reports.html

Soils key:

Hd: Hoodsport gravelly sandy loam, 5 to 15 % slopes
He: Hoodsport gravelly sandy loam, 15 to 30 % slopes
Hf: Hoodsport gravelly sandy loam, 30 to 45 % slopes
Gh: Grove gravelly sandy loam, 0 to 5 % slopes
Gk: Grove gravelly sandy loam, 5 to 15 % slopes
Cc: Cloquallum silt loam, 5 to 15 % slopes
Tb: Tanwax peat, 0 to 2 % slopes
Jd: Juno sandy loam, 0 to 3 % slopes

HWA HWA GEOSCIENCES INC.

SOILS MAP

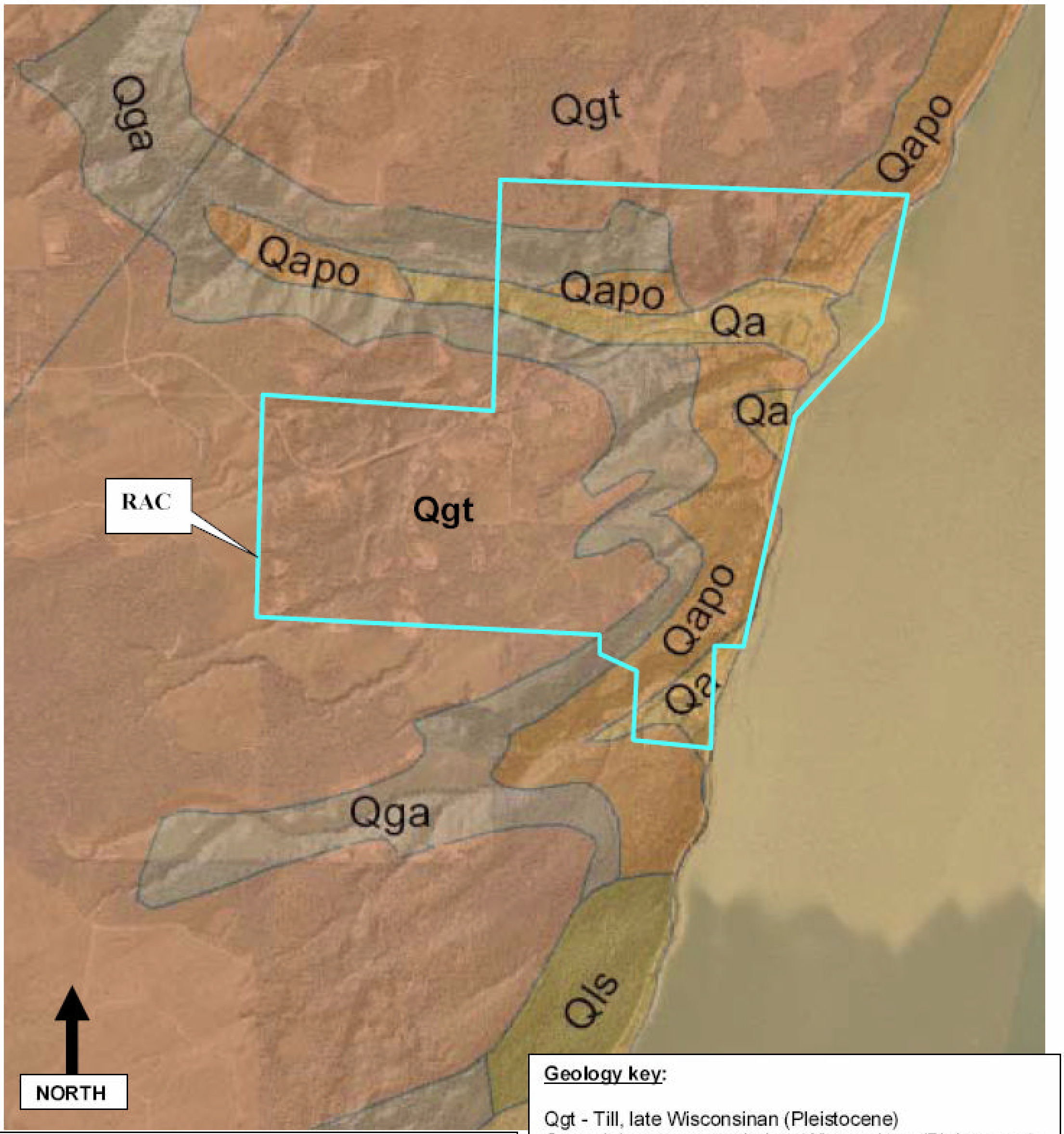
MASON COUNTY
WATER QUALITY PROJECT PLANNING
HOODSPORT RURAL ACTIVITY CENTER

PROJECT NO.
2006-172

Figure
2.11

Figure 2.11

Geologic Map (Logan)



From: Logan, R. L., 2003. *Geologic Map of the Shelton 1:100,000 Quadrangle, Washington.* 45 x 36 in. color sheet, scale 1:100,000, Washington Division of Geology and Earth Resources, Open File Report 2003-15
http://www.dnr.wa.gov/geology/pdf/ofr03-15.pdf

Geology key:

Qgt - Till, late Wisconsinan (Pleistocene)
Qga - Advance outwash, late Wisconsinan (Pleistocene)
Qgo - Proglacial and recessional outw
Wisconsinan (Pleistocene)
Qapo - Alpine outwash, pre-late Wisconsinan
(Pleistocene)
Qa - Alluvium (Holocene)

HWA GEOSCIENCES INC.

GEOLOGIC MAP (Logan, 2003)

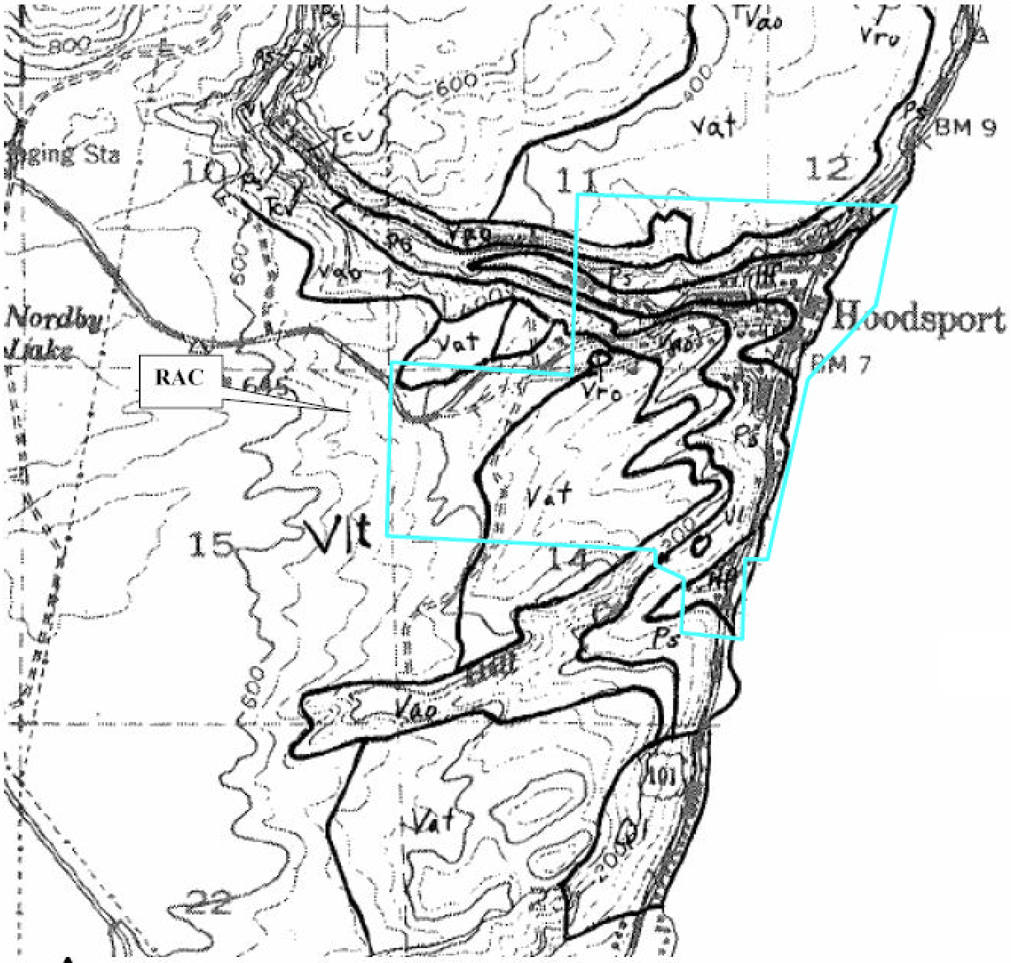
MASON COUNTY
WATER QUALITY PROJECT PLANNING
HOODSPORT RURAL ACTIVITY CENTER

FIGURE NO.

PROJECT NO.
2006-172

Figure
2.12

Figure 2.12
Geologic Map (Carson)



NORTH

From: Carson, R. J., OFR 76-2. Geologic Map of North Central Mason County, Washington, 1 sheet, scale 1:62,500, Washington Division of Geology and Earth Resources, Open File Report 76-2.

Geology key:

Vat - Ablation Till
Vro - Recessional outwash
Vrd - Recessional outwash - deltas/alluvial fans
Vl - Lacustrine sediments
Ps - Salmon Springs Drift
Hf - Flood plain alluvium

HWA GEOSCIENCES INC.

GEOLOGIC MAP (Carson, 1976)

MASON COUNTY
WATER QUALITY PROJECT PLANNING
HOODSPORT RURAL ACTIVITY CENTER

PROJECT NO.
2006-172

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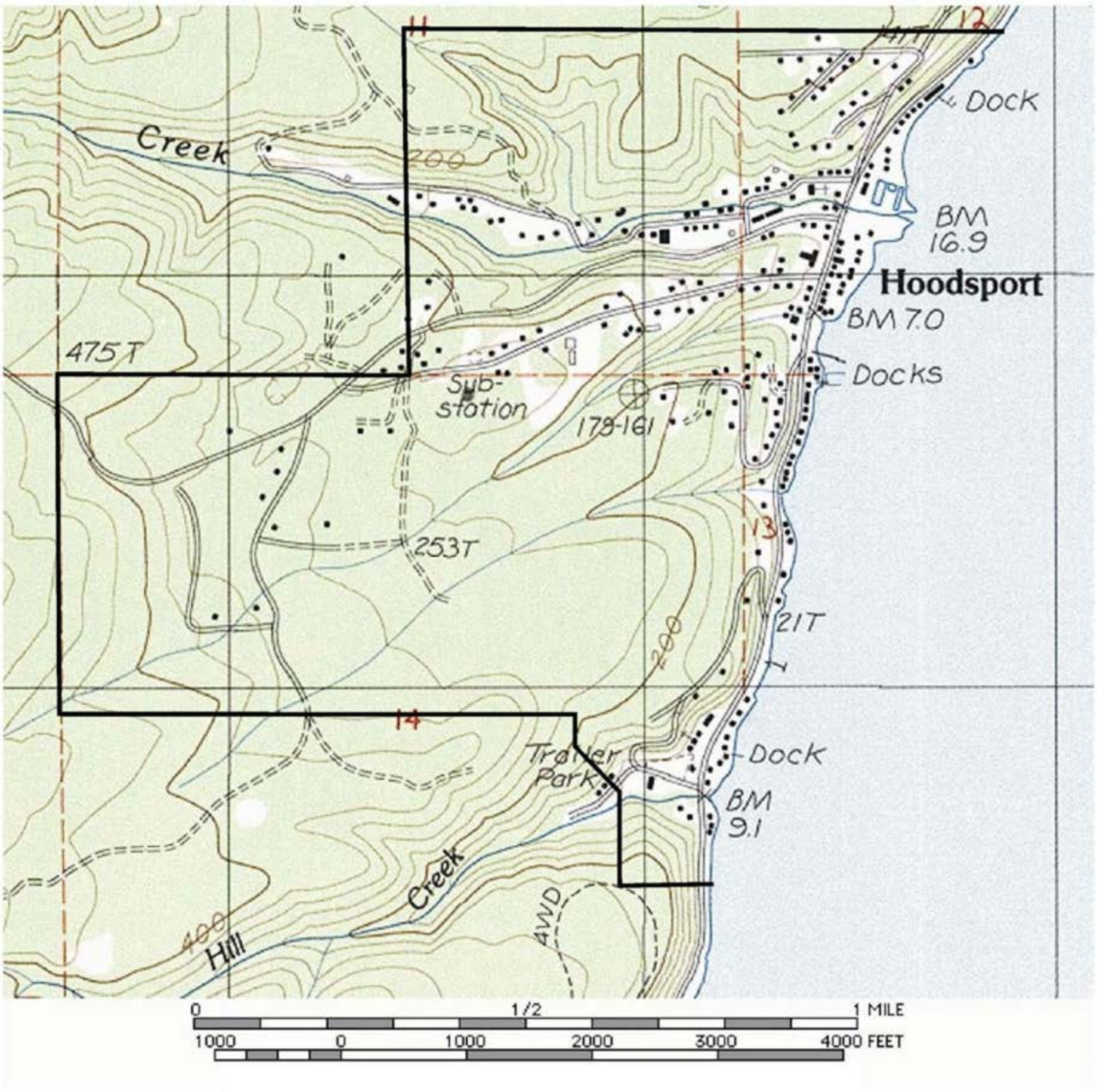
Figure 2.13



The Hoodsport RAC, Mason County, Washington

Figure
2.14

Figure 2.14

Note:

Consistent with Washington State Law, this map is redacted in widely published copies of this report. This map is intended for the use of planning and design professionals in consultation with appropriate Tribal and State historic preservation officials so that known cultural resource sites can be avoided or properly managed in the event of

Ethnographic sites in the Hoodsport RAC, Mason County, Washington

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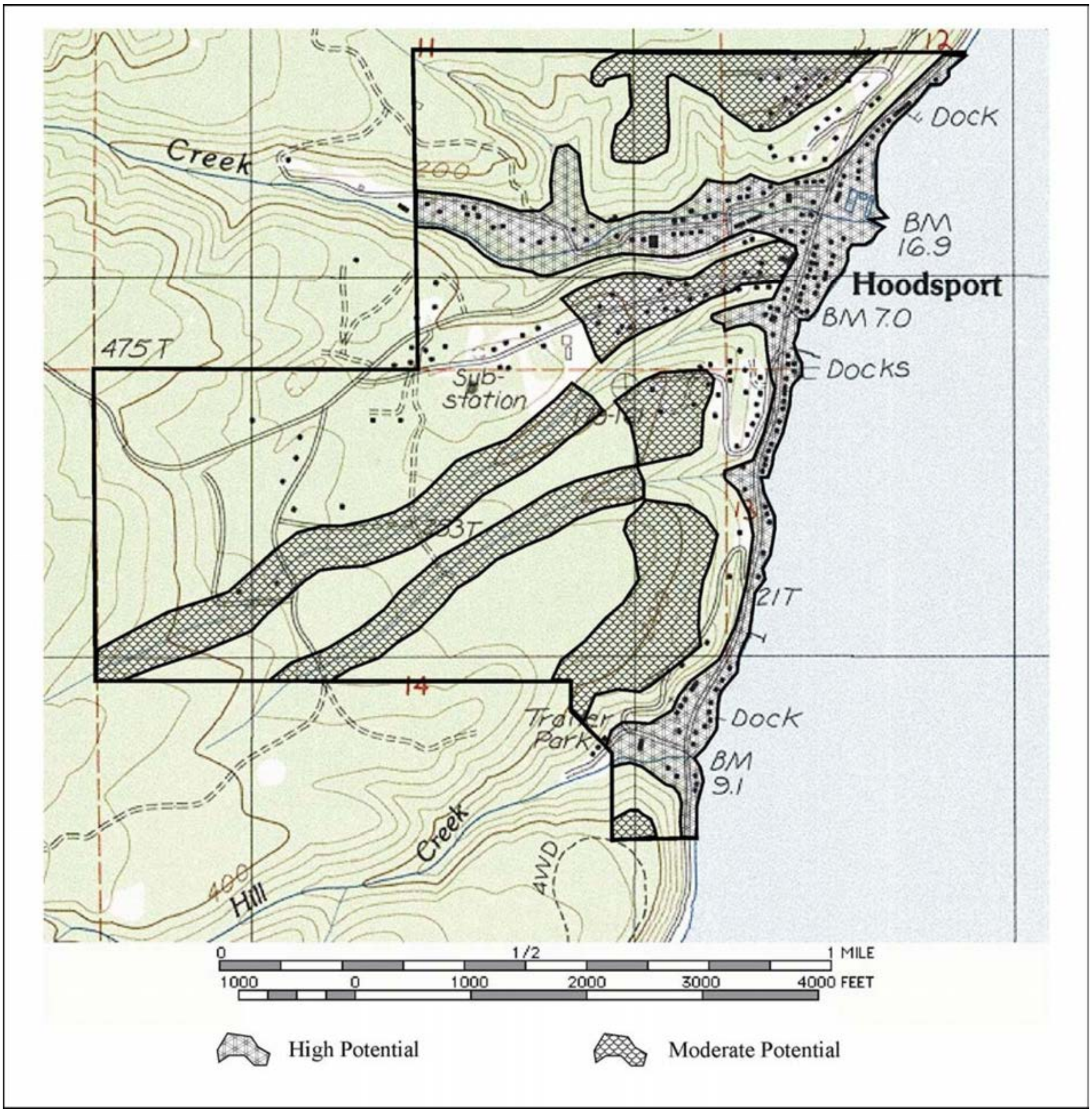
Figure 2.15



Archaeological Potentially Sensitive Zones in the Hoodsport RAC, Mason County, Washington.

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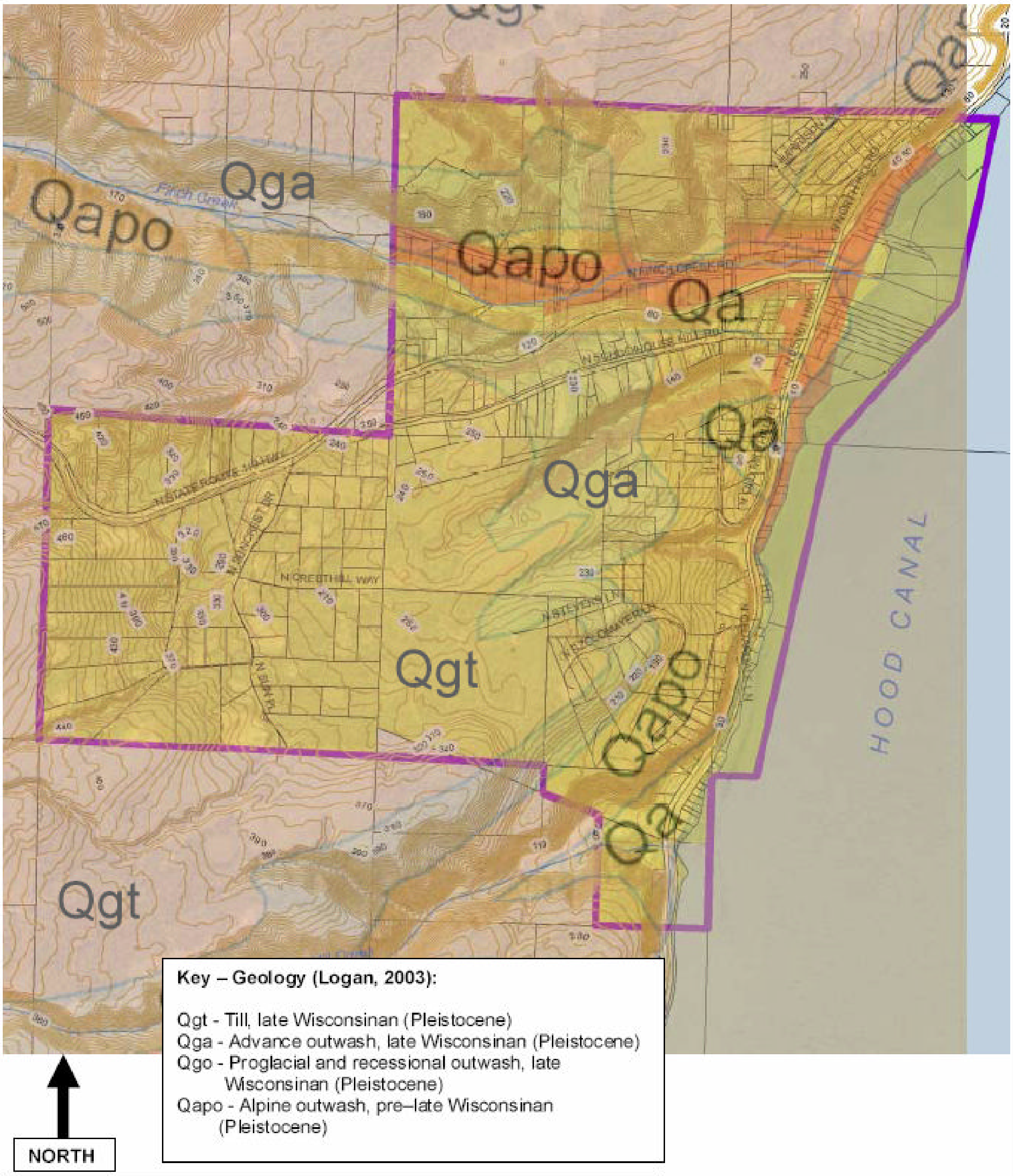
Figure
2.16

Figure 2.16
Topo, Geology & Parcels



Key – Geology (Logan, 2003):

Qgt - Till, late Wisconsinan (Pleistocene)
Qga - Advance outwash, late Wisconsinan (Pleistocene)
Qgo - Proglacial and recessional outwash, late Wisconsinan (Pleistocene)
Qapo - Alpine outwash, pre–late Wisconsinan (Pleistocene)

Base mapping by: Mason County (topo & parcels) Geology by Logan, 2003

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TOPO, GEOLOGY, & PARCELS

MASON COUNTY
WATER QUALITY PROJECT PLANNING
HOODSPORT RURAL ACTIVITY CENTER

PROJECT NO.
2006-172

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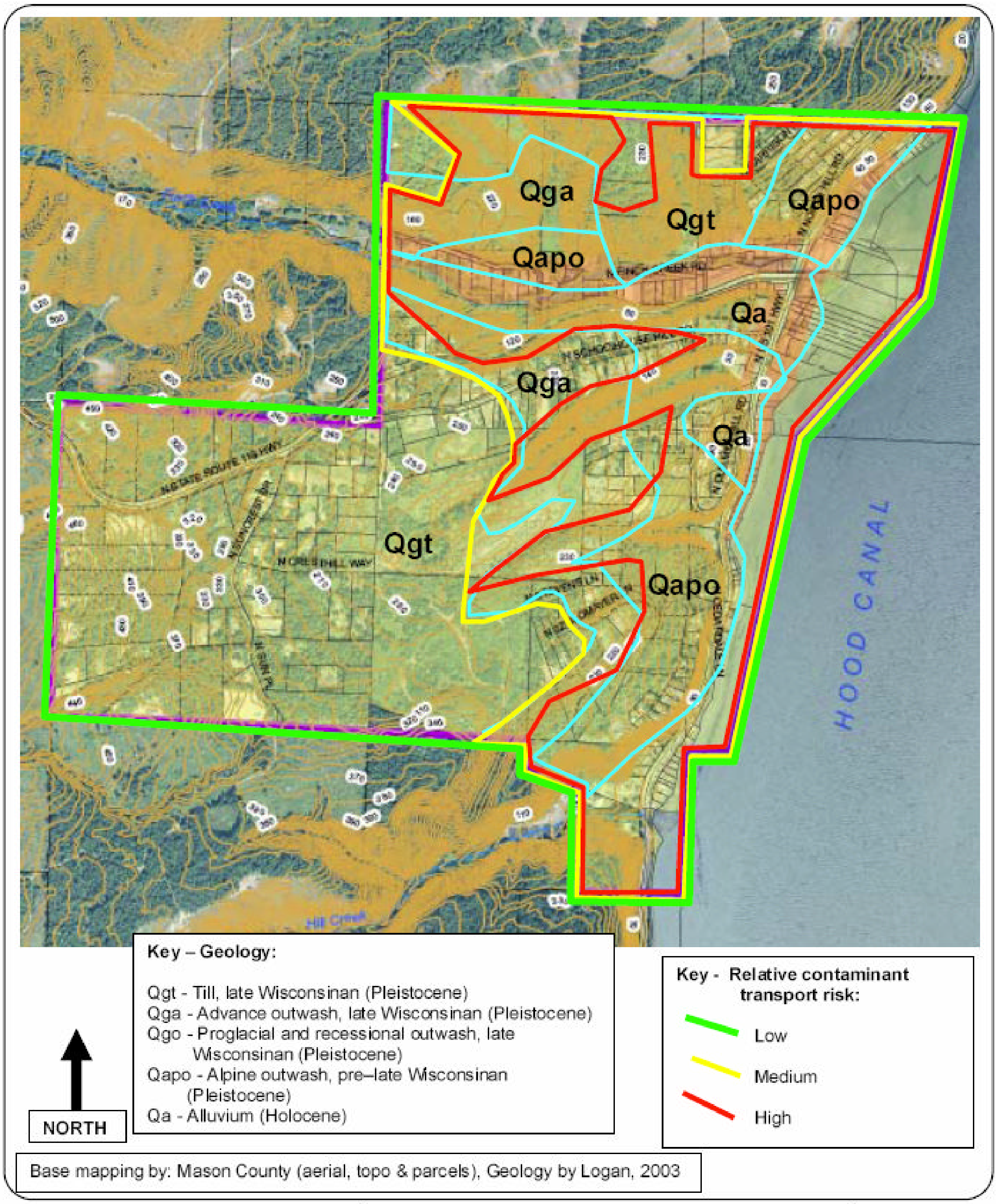
Figure
2.17

Figure 2.17
Relative Contaminant Transport Risk



Key – Geology:

Qgt - Till, late Wisconsinan (Pleistocene)
Qga - Advance outwash, late Wisconsinan (Pleistocene)
Qgo - Proglacial and recessional outwash, late Wisconsinan (Pleistocene)
Qapo - Alpine outwash, pre–late Wisconsinan (Pleistocene)
Qa - Alluvium (Holocene)

Key - Relative contaminant transport risk:

🟩 Low
🟨 Medium
🟥 High

Base mapping by: Mason County (aerial, topo & parcels), Geology by Logan, 2003

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RELATIVE CONTAMINANT TRANSPORT RISK

MASON COUNTY
WATER QUALITY PROJECT PLANNING
HOODSPORT RURAL ACTIVITY CENTER

PROJECT NO.
2006-172

Figure 2.18a

Population Projections

Area	*2005*	*2015*	*2025*
Hoodsport RAC	642	906	1,277
Service Area 2	139	161	187
Expanded Service Area 2	346	401	466

Figure 2.18b

Future Flows and Loadings

	Hoodsport RAC			*Service Area 2*			*Expanded Service Area 2*		
	Existing	*2015*	*2025*	*Existing*	*2015*	*2025*	*Existing*	*2015*	*2025*
Wastewater Flows:									
Average Flow, gpd	48,697	68,691	96,897	16,002	20,292	26,018	29,652	35,892	44,153
Maximum Month Flow, gpd	59,935	84,543	119,258	19,695	24,975	32,022	36,495	44,175	54,609
Maximum Daily Flow, gpd	97,394	137,382	193,794	32,004	40,584	52,036	59,304	71,784	88,306
Peak Hour Flow, gpd	170,439	240,418	339,139	56,006	71,022	91,063	103,782	125,622	154,535
Wastewater Loadings:									
BOD_5:									
Average, lbs/day	142	20	282	54	69	89	92	109	136
Maximum Month, lbs/day	178	250	352	68	87	112	115	136	170
TSS:									
Average, lbs/day	155	220	310	55	71	92	97	119	147
Maximum Month, lbs/day	194	274	386	69	89	115	121	149	184
TKN:									
Average, lbs/day	23	32	45	8	11	14	14	18	22
Maximum Month, lbs/day	29	40	57	10	13	17	18	22	27

Figures
2.18
a, b

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Figure 2.19

Expected Effluent Limitations

Parameter	***Average Monthly***	***Average Weekly***	***Location***
Oxidized Wastewater			
BOD_5	15 mg/L	22 mg/L	Final Effluent
TSS	15 mg/L	22 mg/L	Final Effluent
Dissolved Oxygen	Shall be measurably present in effluent		Secondary Effluent
Parameter	***Average Monthly***	***Sample Maximum***	***Location***
Coagulated and Filtered Wastewater (1)			
Turbidity	2 NTU	5 NTU	Prior to Disinfection
Disinfected Reclaimed Water			
Total Coliform	2.2 cfu/100 ml	23 cfu/100 ml	Final Reclaimed Water
pH	Shall not be outside of the range of 6 to 9 units		Final Reclaimed Water
Total Nitrogen as N	10 mg/L	—	Final Reclaimed Water

(1) Where membrane systems are installed, Ecology is considering a standard for turbidity of 0.2 NTU (average monthly) to 0.5 NTU (sample maximum) and not requiring the coagulation process step.

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Figure 2.20

Groundwater Limitations

Parameter	***Groundwater Recharge (1) Criteria (sample maximum)***
Nitrate as N	10 mg/L
Nitrite as N	1 mg/L
Arsenic	10 µg/L
Cadmium	5 µg/L
Chromium	100 µg/L
Lead	50 µg/L
Mercury	2 µg/L
Nickel	100 µg/L
Total Dissolved Solids	500 µg/L
Chloride	250 µg/L
Sulfate	250 µg/L
Copper	1,000 µg/L
Manganese	50 µg/L
Silver	100 µg/L
Zinc	5,000 µg/L
pH	6.5 to 8.5 standard units
Iron	0.3 mg/L
Toxics	No toxics in toxic amounts

(1) The sample maximum is the highest allowable concentration for any sample as measured in the groundwater at the top of the uppermost aquifer beneath or downgradient of the infiltration site.

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Figure 2.21

ERU Cluster System Estimated Capital Cost

System Type	***Septic Tank***	***STEP System***[1]	***Piping***	***Treatment***	***Effluent***	***Total***
Existing Septic Tanks (7)	N/A	7 @ $5,000 each = **$35,000**	**$15,000**	**$20,000**	**$20,000**	**$90,000** ($12,860/ERU)
New Septic Tanks (7)	7 @ $12,000 each = **$84,000**	Included with Tank	**$15,000**	**$20,000**	**$20,000**	**$139,000** ($19,860/ERU)

[1] Pump to convey septic tank effluent to treatment system

Figure 2.22

Example Cluster System

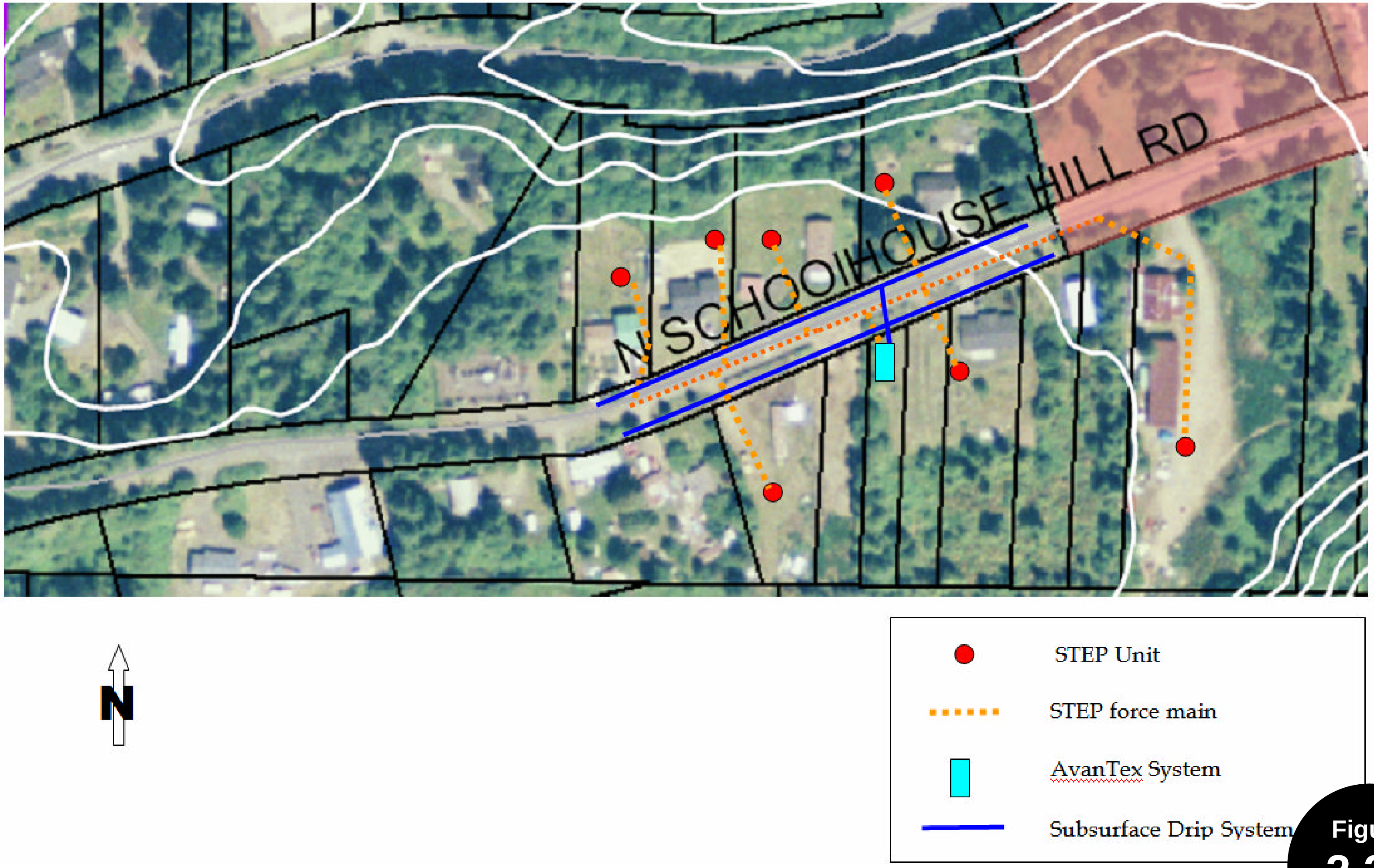

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Figure 2.23a

Hoodsport RAC Cost Summary

* = engineer's estimate		Expanded Service Area 2	Service Area 2	
Treatment Plant Estimate				
Engineer's Estimate		$1,860,000	$1,605,000	*
Contingency		$279,000	$240,750	*
8.3% Sales Tax		$177,537	$153,197	*
Construction Cost		$2,316,537	$1,998,947	*
Grinder Pump Collection System Estimate				
Engineer's Estimate		$2,859,000	$1,641,700	*
Contingency		$428,850	$328,340	*
8.3% Sales Tax		$272,892	$163,513	*
Construction Cost		$3,560,742	$2,133,553	*
Effluent Force Main and Fate Estimate				
Engineer's Estimate		$715,000	$715,000	*
Contingency		$107,250	$107,250	*
8.3% Sales Tax		$68,247	$68,247	*
Construction Cost		$890,497	$890,497	*
Advanced Cluster On-site Systems (assumes 6 clusters serving 45 ERUs)				
Engineer's Estimate		$736,071		*
Contingency		$110,411		
8.3% Sales Tax		$71,105		
Construction Cost		$917,587		
Total Construction Cost Estimates (sums similar lines above)				
Engineer's Estimate		$6,170,071	$3,961,700	
Contingency		$925,511	$676,340	
8.3% Sales Tax		$589,780	$384,957	
Construction Cost		$7,685,362	$5,022,997	
Other Costs to Complete (some a % of Construction Cost)				
Facilites Plan and Env Documentation		$108,683	$108,683	
Design Engineering[1]	12%	$922,243	$602,760	
Assistance During Const.[2]	8%	$614,829	$401,840	
Administration[3]	2%	$153,707	$100,460	
Design/Admin Contingency[4]	3%	$230,561	$150,690	
Cluster System Land[5]		$90,000		
Sewer System Land[6]		$250,000	$210,000	
		$2,370,023	$1,574,432	
Total Cost to Complete				
Grand Total		$10,055,385	$6,597,430	
Annual Operating Costs (engineer's estimates)				
Sewer SystemOperations		$169,634	$143,704	*
Cluster System Operations		$22,500		*
Total Annual Operating Cost Estimate		$192,134	$143,704	

Notes

1 For large scale projects 10% is commonly used. Small scale projects require a larger percentage of construction costs to pay for design.

2 Assistance during construction includes not only inspection and change-order tracking, but also operator training, O&M manuals, etc.

3 Administration covers local agency project management costs

4 This contingency amount is based on construction cost. It amounts to a 15% contingency on the ~25% of construction that is assigned for design and administration.

5 See land cost estimate in Section 2.2.4.1, Section 2 Page 15.

6 This estimate is very preliminary and should be considered a "place holder."

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Figure 2.23b

Hoodsport RAC
Expanded Service Area 2
MBR Treatment Plant
Jan. 2007

Construction:

	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization Demobilization	1	LS	$150,000	$150,000
2.	Site Work	1	LS	$60,000	$60,000
3.	Influent and Effluent Flow Monitoring and Sample collection	1	LS	$25,000	$25,000
4.	MBR Equipment Package incl. Tanks	1	LS	$825,000	$825,000
5.	UV Disinfection	1	LS	$65,000	$65,000
6.	Sludge Storage, Blower and Pump	1	LS	$40,000	$40,000
7.	Operations and Equipment Building	1	LS	$160,000	$160,000
8.	Generator	1	LS	$50,000	$50,000
9.	Piping, Valves, and gates	1	LS	$200,000	$200,000
10.	Misc. Metal	1	LS	$35,000	$35,000
11.	Electrical	1	LS	$200,000	$200,000
12.	Coatings	1	LS	$30,000	$30,000
13.	Restoration	1	LS	$20,000	$20,000
				Engineer's Estimate	$1,860,000
				Contingency 15%	$279,000
				8.3% Sales Tax	$177,537
				Construction Cost	$2,316,537

Operation and Maintenance:

	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1.	Administration	1	LS	$10,000	$10,000
2.	Labor	1,040	HRS	$35	$36,400
3.	Power	220,000	KwH	$0.07	$15,400
4.	Repair and Maintenance	1	LS	$15,000	$15,000
3.	Membrane Replacement reserves	1	LS	$5,000	$5,000
4.	Sludge Hauling	200,000.0	GAL	$0.18	$36,000
	Annual Operation and Maintenance Cost Estimate				$117,800

Hoodsport RAC
Expanded Service Area 2
Grinder Pump Collection System Cost Estimate
Jan. 2007

Construction:

	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization Demobilization	1	LS	$180,000	$180,000
2.	Traffic Control	1	LS	$20,000	$20,000
3.	4-Inch Pressure Sewer	7,250	LF	$37	$268,250
4.	3-Inch Pressure Sewer	4,000	LF	$32	$128,000
5.	2-Inch Pressure Sewer	5,650	LF	$30	$169,500
6.	Grinder P.S.'s with CP: Residential and Comm. Equilvalent	178	EA	$8,000	$1,424,000
7.	Grinder P.S.'s with CP: Commercial	7	EA	$20,000	$140,000
8.	Side Sewer Stubs	30	EA	$1,200	$36,000
9.	Mainline Cleanouts	18	EA	$1,800	$32,400
11.	Abandon Septic Tanks	184	EA	$1,200	$220,800
12.	Creek Crossings	3	EA	$10,000	$30,000
14.	Restoration	1	LS	$210,000	$210,000
				Engineer's Estimate	$2,859,000
				Contingency 15%	$428,850
				8.3% Sales Tax	$272,892
				Construction Cost	$3,560,742

Operation and Maintenance:

	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1.	Administration	1	LS	$10,000	$10,000
2.	Res. Grinder Pump Repair and Maint.	177	EA	$84	$14,868
3.	Comm. Grinder Pump Repair and Maint.	7	EA	$168	$1,176
4.	Sewer Pipe	3.2	MI	$3,000	$9,540
	Annual Operation and Maintenance Cost Estimate				$35,584

Figure
2.23b

Figure 2.23c

Hoodsport RAC
Expanded Service Area 2
Force Main and Reuse Area
Jan. 2007

Construction:

	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization Demobilization	1	LS	$70,000	$70,000
2.	Traffic Control	1	LS	$5,000	$5,000
3.	4-Inch Force Main	5,000	LF	$30	$150,000
4.	Lift Station	1	LS	$160,000	$160,000
12.	Infiltration Area	1	LS	$300,000	$300,000
14.	Restoration	1	LS	$30,000	$30,000

Engineer's Estimate	$715,000
Contingency 15%	$107,250
8.3% Sales Tax	$68,247
Construction Cost	$890,497

Operation and Maintenance:

	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1.	Administration	1	LS	$5,000	$5,000
2.	Labor	150	HRS	$35	$5,250
3.	Lift Station Repair and Maintenance	1	LS	$3,000	$3,000
4.	Force Main	1.0	MI	$3,000	$3,000
	Annual Operation and Maintenance Cost Estimate				$16,250

Advanced On-site Cluster System Cost Extensions

Table from Figure 2.21 (engineer's estimates)

System Type	***Septic Tank***	***STEP System***[1]	***Piping***	***Treatment***	***Effluent***	***Total***
Existing Septic Tanks (7)	N/A	7 @ $5,000 each = **$35,000**	**$15,000**	**$20,000**	**$20,000**	**$90,000** ($12,860/ ERU)
New Septic Tanks (7)	7 @ $12,000 each = **$84,000**	Included with Tank	**$15,000**	**$20,000**	**$20,000**	**$139,000** ($19,860/ ERU)

Average Estimated Cost for one 7 ERU cluster	$114,500	based on engineer's estimates
Rough estimate ERUs served by advanced clusters	45	
Estimated number of clusters	6	
Estimate	$736,071	based on engineer's estimates
Contingency 15%	$110,411	
8.3% Sales Tax	$71,105	
Sub-total	$917,587	
Land Cost per Cluster (midpoint of estimate)	$14,000	based on engineer's estimates
Total Estimated Land Cost	$90,000	
Construction Cost (including land)	$1,007,587	
Annual Operating Cost @ $3.5K per Cluster	$22,500	based on engineer's estimates

Figure
2.23c

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Figure 2.24

Example Schedule

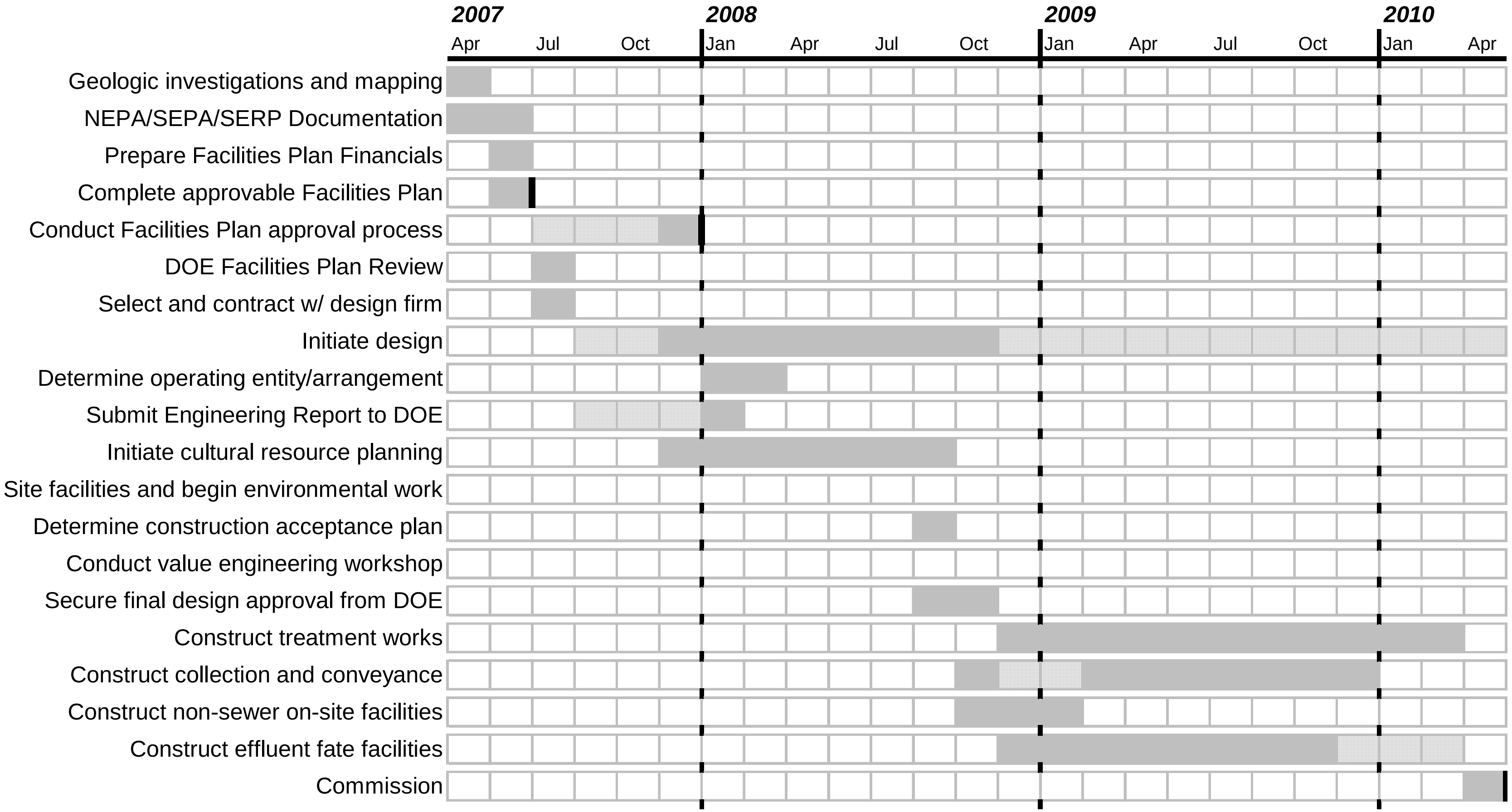

Figure
2.24

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Figure 2.25

Hoodsport Expanded Service Area

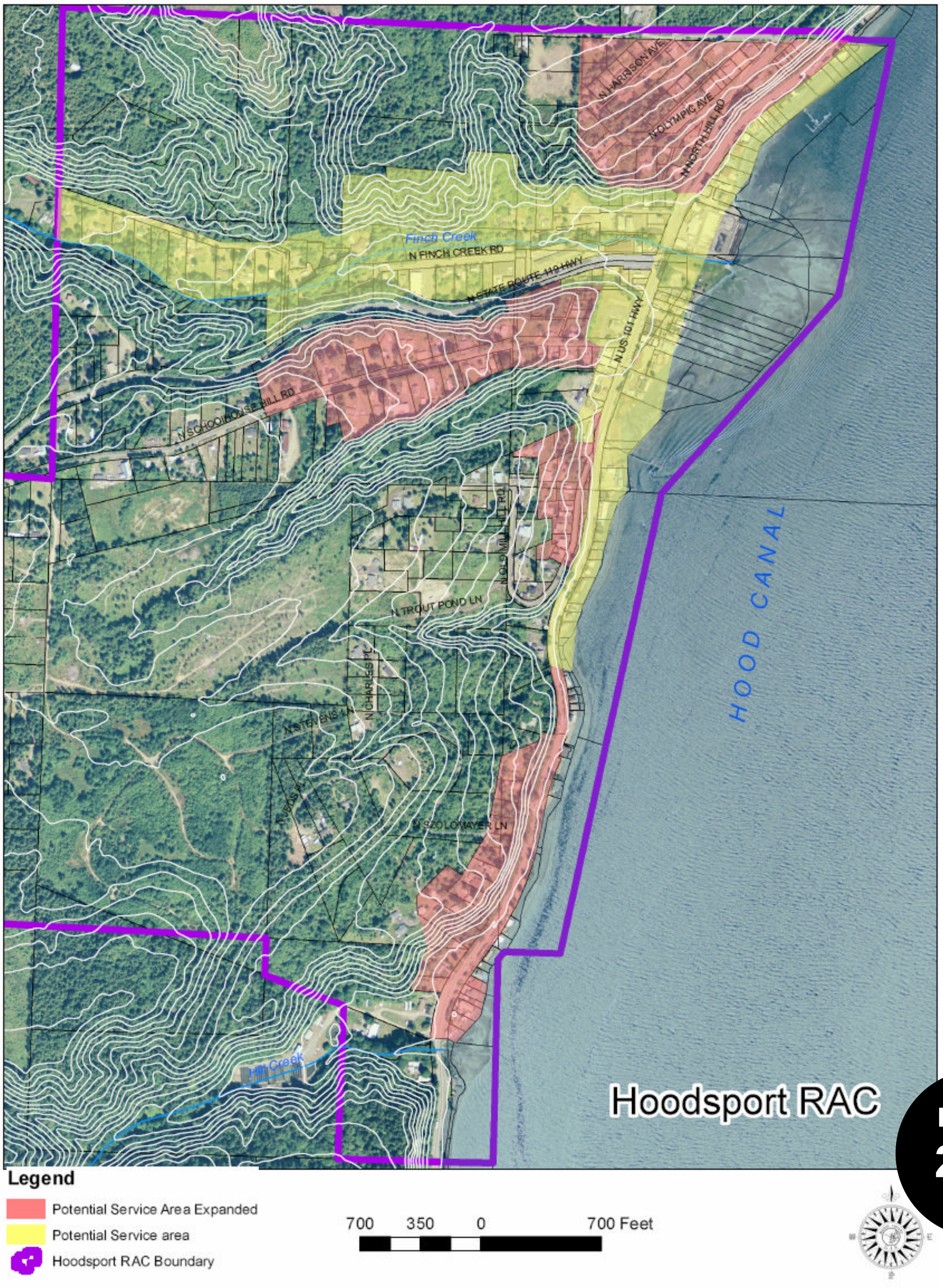

Figure
2.25

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3.0 Potlatch “Bubble” Planning Information

3.1 Existing Information

3.1.1 Population and Flow Estimates

Wastewater service areas for the Reservation near Potlatch State Park are shown in **Figure 3.01**. The service areas were developed with direction from the Skokomish Indian Tribe (SIT) Wastewater Planning Committee, which included Tribal staff, Tribal Council members and consultants. The service areas were separated into 2 phases, Phase 1 and Ultimate Build Out. The separation of the 2 phases was prepared in response to Tribal direction, as a way to define an initial project that is economically feasible.

Existing land use types based on the Skokomish Indian Tribe’s land use maps are shown in **Figure 3.02**. The Tribe is in the process of defining the land use types, therefore these maps are subject to change. However, they are sufficient for purposes of this study.

Existing population numbers were prepared by Tribal staff, using an updated residential population survey for the intended service areas. Parcel information and a household inventory (manually developed) were provided by the Tribe.

For planning purposes, the population density observed by the Tribe for their tribal-managed housing was assumed to be representative of housing density throughout the Reservation (4.16 per household). Thus, a final estimate of the total population of the Reservation was made based on 4.16 people per household.

Additional information from Washington State Parks and Recreation Commission (WSPRC), Mason County and Mason County PUD #1, was incorporated into the final population and flow estimates for the Reservation. In general, 2.5 people were assumed to live in each mobile home or recreational vehicle (RV) in the Minerva RV Park and serviced in Potlatch State Park.

Growth projections were developed in consultation with the Wastewater Planning Committee which included Tribal staff, Tribal Council members and consultants. The assumptions used as a foundation for the growth projections are included in **Appendix 3.1**. Population estimates were prepared for two planning horizons: five year (Phase 1) and 20 year (Ultimate). **Figures 3.03** and **3.04** show the Potlatch area population and flow projections for the Phase 1 and Ultimate planning timelines.

The plan for Potlatch State Park will be updated in the next five years, after adjacent Tribal lands are developed, and the wastewater project definition is adopted. Future projections for both the State Park and Minerva RV Park are based on full occupancy of existing facilities.

Tribal housing development (T3ba’das Ridge) near Potlatch State Park is in its initial construction phase, with occupancy planned for May 2008. The planned first phase of development of new homes is the basis for this report’s Phase 1 growth projections. The Ultimate growth projection was based on full build-out of the planned Skokomish Tribal housing. Population projections for the new housing are based on 4.16 people per household, as noted earlier.

Growth in the service area north of Minerva RV Park is estimated to be at a rate of 1.5% per year, according to Tribal and Mason County planning estimates (see **Appendix 3.1**). Population per household was assumed to be the same as all Tribal households, or 4.16 people. Commercial growth was assumed to be based on both acreage (north of the powerhouse) and the number of new businesses (south of the powerhouse).

3.1.2 Hydrology

The Skokomish Indian Reservation is located in the lower Skokomish River basin (**Figure 3.05**). Several spring-fed seeps are associated with the lower basin and substantial riverine and estuarine wetlands are located on the Reservation.

The river empties into Annas Bay at the Great Bend of the Hood Canal. Shellfish are harvested in the Bay by Tribal, commercial, and recreational harvesters. Bed locations are in Potlatch State Park, and to the south of the Park, and near the town of Union, in the eastward end of the Bay. Shellfish beds near the mouth of the Skokomish River recently closed due to fecal contamination (Washington Department of Health News Release August 16, 2005). The DOE has determined that the water quality of the river directly influences water quality in the Bay, including shellfish beds.

The lower section of the river (the last 10 miles) is a low gradient floodplain that has extensive wetlands and spring fed seeps. Agricultural activities and residential developments are located on the floodplain. Management practices concerning the floodplain are regulated by the Skokomish Tribe on the Reservation. The Skokomish Indian Tribe has developed a non-point source assessment (see **Appendix 1.1**), and has begun to initiate programs to reduce non-point sources of fecal coliform.

Recent concerns regarding low dissolved oxygen in Hood Canal together with significant fish kills in 2002-2003 and a smaller event in 2004 have prompted major initiatives including enhanced monitoring of the Skokomish River (Preliminary Assessment and Corrective Action Plan (PACA), May, 6 2004). The Puget Sound Partnership (Office of the Governor News Release December, 19, 2005) is an initiative organized by Washington State Governor Christine Gregoire to protect water quality throughout Puget Sound including the Hood Canal.

The natural hydrologic regime in the Skokomish basin has been altered. Research shows that land use practices have caused filling of the lower river channel with aggregate to over five times background levels (Barreca, 1998). The frequency and intensity of flood events has increased, and the water table has risen causing septic system failures.

3.1.3 Geology

The best area for rapid infiltration is in Grove gravelly loam (Gk) soils, with glacial outwash sediments underneath, and no high ground water or surface water issues. Hoodsport soils on the soils maps, or Glacial Till on the geology maps, would not be suitable for rapid infiltration. See **Figure 3.06** for geology mapping, and **Figure 3.07** for soils mapping.

The area of mapped Grove soils in Service Area A is mapped as Glacial Till on geologic maps, with a small pocket of Outwash shown on one map. The geology report (in **Appendix 3.2**) indicates the Grove soils in Service Areas B through E are over Recessional Outwash, which is consistent, and more promising for rapid infiltration.

Areas along the highway are less steep, and therefore more favorable. Slope stability parameters include the slope geometry, soils (density, permeability, saturation, layering, etc.), amount, location and distance of added water, and other site specific variables.

*(Please see **Appendix 4.1** for more.)*

3.1.4 Environmental Issues and Permitting

As described in Section 2.1.5, the Mason County Comprehensive Plan (updated 2005) mapped a number of sensitive areas on a county-wide basis. Sensitive areas mapping within the study area has not been conducted as part of this project. The sensitive areas mapping, including geologic hazard areas, flood hazard areas, aquifer recharge areas, and surface water and wetlands has been reviewed as part of this project.

Within the Potlatch study area, the major surface water bodies include Hood Canal, numerous unnamed streams, and a number of wetlands. Potential impacts to wetlands and/or water bodies are likely the environmental issue of greatest concern. A field reconnaissance should be conducted prior to siting any treatment or disposal facilities to determine the location and extent of streams and wetlands. Conducting this review early in the process would potentially allow for wetland avoidance by making siting adjustments. Similarly, wetland delineations should be conducted when pipeline routes are determined so that wetland impacts can be avoided, or minimized to the greatest extent possible.

Water quality in Hood Canal has long been a concern. In general, Hood Canal suffers from elevated levels of nutrients and bacteria, and low levels of dissolved oxygen. Finch Creek has also exceeded water quality criteria for fecal coliform bacteria (Gray and Osborne, 2000). Implementation of the wastewater management project is expected to help reduce bacterial and nutrient loading to nearby surface water bodies from suspected poorly-functioning septic systems.

Other issues include potential impacts to groundwater, storm water impacts associated with increased development, and construction impacts to local roads.

Appendix 2.2 provides a matrix summarizing the various permits that may be required for the Hoodsport Rural Activity Center, Potlatch, and Core Reservation Wastewater Management Planning areas. Given the general siting information currently available for the projects, a full range of permits that may be required is included. The matrix describes the type of permit, the agency responsible for reviewing the permit, the permit triggger, timelines, agency responsible, and other relevant issues.

3.1.5 Cultural Resources

This report section was prepared by Dr. Gary C. Wessen, a recognized archaeologist. It has been slightly edited here to be consistent with report formatting. The complete report, minus one map redacted to be consistent with state law, is **Appendix 3.3**.

3.1.5.1 Background

The Potlatch & Skokomish Indian Reservation (P & SIR) Study Area is located in northeastern Mason County. It consists of four distinct parcels on and near the Skokomish Indian Reservation (see **Figure 3.08**). The northernmost parcel is almost a square mile that includes Potlatch State Park and adjacent areas to the north, south, and west. It includes almost 1 mile of Hood Canal shoreline and much of the slope rising to the upland glacial plain to the west. A second large parcel of slightly more than a square mile includes much of the Highway 101 and 106 corridors and adjacent residential areas on the Skokomish Indian Reservation. It is entirely on the flood plain of the Skokomish River delta. A third parcel is approximately 0.25 square mile along the northern bank of the Skokomish River. It is also on the flood plain. Finally, the fourth parcel is less than 0.25 square mile on the upland glacial plain in the western part of the reservation. There are significant areas of commercial and/or residential development in portions of the first three parcels. The last parcel is currently undeveloped timber land.

The P & SIR Study Area is located within the traditional territory of the Tuwaduq (Twana) People. In early historic times - - and for a considerable period prior to them - - the Tuwaduq People occupied all of the lands in the immediate vicinity of Hood Canal. Many of their traditional settlements were located along the Hood Canal shoreline, often at or near the mouths of rivers or creeks. They also fished, hunted, and otherwise used a considerable range of lands interior to Hood Canal. Representatives of the Tuwaduq signed the Point-No-Point Treaty in 1855 and subsequently relocated onto the Skokomish Indian Reservation. Their descendants are now usually referred to as the Skokomish Indian Tribe.

There has been only very limited archaeological research within the traditional territory of the Tuwaduq People. Few efforts to locate archaeological sites have been conducted and those which have occurred have generally been limited in their geographic focus. Large scale systematic efforts to identify prehistoric archaeological resources have yet to occur here. Similarly, there have been relatively few detailed studies of particular archaeological sites anywhere along Hood Canal. We currently know that some traditional Tuwaduq settlements in the P & SIR Study Area have been occupied for at least 1,500 to 3,300 years. Other, as yet undated, archaeological sites in the area are probably much older.

3.1.5.2 Research Design

The goal of this report section is “to prepare an inventory of cultural resources in the P & SIR Study Area and advise in the planning effort so that disturbance to known and suspected cultural resources might be avoided to the fullest possible extent”. The term ‘cultural resources’ as used here, refers to archaeological materials. Thus, this study has not addressed the possibility that there may be historic structures in the P & SIR Study Area. To our knowledge, there are very few and, moreover, our current understanding of the proposed wastewater management actions suggests that historic structures are unlikely to be affected. The focus of this effort has been directed largely toward archaeological resources representing the Native American occupants of the area. It should be noted, however, that archaeological resources representing late 19th and early 20th Century Euro-American occupants of the area could also be present in the P & SIR Study Area.

The results of the inventory effort have been summarized in two maps of the P & SIR Study Area. The first map shows the locations of recorded archaeological sites and settlements known from ethnographic and/or historical sources that may have archaeological manifestations. It is important to note here that the locations of recorded archaeological sites are protected by state and federal laws, and thus this information cannot be released to the general public. In this same regard, the Skokomish Tribal Historic Preservation Office has requested that specific information about the locations of traditional Tuwaduq settlements also not be released to the general public. These requirements have led us to develop a second map. The second map identifies zones of archaeological potential within the P & SIR Study Area. These zones have been developed on the basis of the distributions of the above-noted locations and generalizations about the relatively sensitivity of different types of landforms in the study area. In brief, low gradient surfaces in the immediate vicinity of the Hood Canal shoreline, the Skokomish River and the larger creeks are considered to have a relatively high potential for archaeological resources. The flood plain of the Skokomish River, vicinities of smaller low gradient creek channels, and so-called vista points (i.e., locations that offer sweeping views of the surrounding landscape) are considered to have a moderate potential for archaeological resources. Steep gradient surfaces and low gradient upland surfaces that are not located near creeks or lakes are considered to have a relatively low potential for archaeological resources. The map identifying zones of archaeological potential within the P & SIR Study Area may be released to the general public.

Finally, it is important to emphasize that the study reported here is not an archaeological survey of the P & SIR Study Area. While we have considerable familiarity with this area, no actual on-the-ground inspection for archaeological resources was conducted at this time. Rather, the effort was essentially a literature review and our products are based upon examination of documents on file with the Washington State Department of Archaeology and Historic Preservation, the Skokomish Tribal Historic Preservation Office, other materials in our possession, and prior archaeological site survey experience in this area.

3.1.5.3 The Cultural Resource Maps

Our map of the locations of archaeological sites and settlements known from ethnographic and/or historical sources that may have archaeological manifestations is presented in **Figure 3.09**. Note first that there are six archaeological sites in the P & SIR Study Area and eight more are located near it. Further, it is important to emphasize that this inventory is based on only limited archaeological survey efforts. To a large extent, the distribution of the known sites reflects where survey coverage is. Thus, most of the surveys conducted to date have focused upon either the Hood Canal shoreline or the Skokomish River channel. Survey coverage in the interior of the flood plain of the Skokomish River and on the uplands to the west have been quite limited. **Figure 3.09** also indicates that at least 10 traditional Tuwaduq settlements were located within, or near, the P & SIR Study Area. Five were located along the Hood Canal shoreline and another five were along the Skokomish River channel. Relatively limited information is available about many of these places, but several have been identified as large winter villages. Other may have been somewhat smaller locations such as seasonal fish camps. Native American archaeological resources – potentially including artifacts, occupation refuse, and human remains – may be present at any of these locations. We have less information about 19th and early 20th Century Euro-American occupations in the area, but know that a timber-related community was present along the Hood Canal shoreline at Potlatch. (The Potlatch community was developed in the vicinity of an older Tuwaduq settlement.) We also know that there were several mid 19th Century Donation Land Claims on the Skokomish Indian Reservation, although most were abandoned shortly after the reservation was established. Thus, there is also potential 19th and early 20th Century Euro-American archaeological resources in the Potlatch area and elsewhere to the south.

The information in **Figure 3.09**, and the generalizations about the relatively sensitivity of different types of landforms noted earlier, have been used to generate the archaeological sensitivity zones presented in **Figure 3.10**. Two important caveats need to be offered about this map. First, zones based upon landforms have been defined, as the landforms appear on USGS 7.5 minute topographic maps. These are valuable tools, but it is important to emphasize that there may be archaeologically sensitive features in the study area that are too small to be indicated on USGS 7.5 minute topographic maps. The zones shown in **Figure 3.10** are therefore generalizations about probable potential and should not be regarded as guarantees that archaeologically sensitive areas are not present within zones here identified as having only a low potential. A second caveat concerns the low gradient surfaces in the immediate vicinity of the Hood Canal shoreline. This area has been indicated as having a relatively high potential for archaeological resources. This study has not documented the history of filling along this shoreline. We raise this issue because we know that some locations (e.g., near the Cushman No. 2 Powerhouse at Potlatch and in the day use area of Potlatch State Park) contain fill deposits, and fill deposits are a complicating consideration. At first glance, fill sediments can be expected to be culturally-sterile, and thus documented fill areas should have no potential to contain archaeological resources. The issue is actually more complicated for two reasons. First, experience elsewhere in western Washington has shown that low lying areas with archaeological resources were sometimes filled in order to raise their base level. Thus, potentially significant archaeological resources can be present underneath fill deposits. Second, there are documented cases of archaeological sediments having been used as fill materials in western Washington. This means that it is possible that archaeological materials – including human remains – could be encountered in fill deposits.

The map of zones of archaeological potential within the P & SIR Study Area indicates that high potential areas include the low gradient surfaces in the vicinity of the Hood Canal shoreline, the Skokomish River channel and the Skebob Creek channel. These areas have the highest potential for both Native American and Euro-American archaeological resources. These are also among the most developed (i.e., disturbed) areas in the P & SIR Study Area. The history of historic disturbance may have damaged and/or destroyed archaeological resources in these areas. It would, however, be dangerous to simply assume this. In fact, there are many well documented cases of important archaeological resources having survived in badly disturbed, highly developed landscapes. (Witness the recent events at the graving dock site in Port Angeles.)

Areas thought to have a moderate potential for archaeological resources include those portions of the flood plain of the Skokomish River delta that are not in the immediate vicinity of the Hood Canal shoreline, the Skokomish River channel, or other creek channels and areas along the tops of slopes that look out over Hood Canal and/or major creek canyons. Some of the latter areas have also experienced significant historic disturbance (e.g., the Highway 101 and 106 corridors) and the above-note caution also applies in these areas.

Finally, significant portions of the P & SIR Study Area appear to have only a relatively low potential for archaeological resources. Areas thought to have a relatively low potential include steep surfaces along the margin of Hood Canal and low gradient interior surfaces on the upland glacial plain in the western portion of the P & SIR Study Area. While we are confident that the latter areas have only a relatively low potential for archaeological resources, we should emphasize that there is a difference between ‘low potential’ and ‘no potential’. It is possible that archaeological resources could be encountered in areas we characterize as having only a relatively low potential.

3.1.5.4 Resource Management Considerations

The assessments of archaeological resource potential presented here are based upon archaeological and ethnographic data and generalizations about the relative sensitivity of different types of landforms, as they appear on USGS 7.5 minute topographic maps. As already indicated, this study is not an archaeological survey of the P & SIR Study Area and should not be regarded as one. We therefore recommend that an archaeological survey of the areas to be impacted by the waste-water management system be conducted. Having said this, we think that project planners should be aware that – depending upon the system’s design – it may prove to be difficult to investigate some portions of the P & SIR Study Area. In particular, we note that some of the high potential areas have been extensively developed and thus, built features such as paved road beds and structures may make effective archaeological inspection difficult. Some of this difficulty may be addressed by test boring portions of the study area, but even the feasibility of this approach is difficult to assess at this time.

As such, while an archaeological survey is an important next step, project planners should recognize that such an effort may not be sufficient to be certain that archaeological resources are not present anywhere in their project area. We therefore think that some degree of archaeological monitoring may be appropriate during the construction of the planned facilities. The specific scope and character of such a monitoring plan should be developed after the results of the archaeological survey are available.

3.2 Additional Information

3.2.1 Treatment Soils Can Provide

The Mason County Soil Survey (Ness, 1960) lists all soil types present in the planning area (except Made Land) as having “very limited” suitability for septic drain fields. Similarly, figures prepared by Latourell Associates show soil limitations for use of septic tanks over the entire Potlatch bubble planning area as either moderate or very severe (reproduced in HWA, 1994).

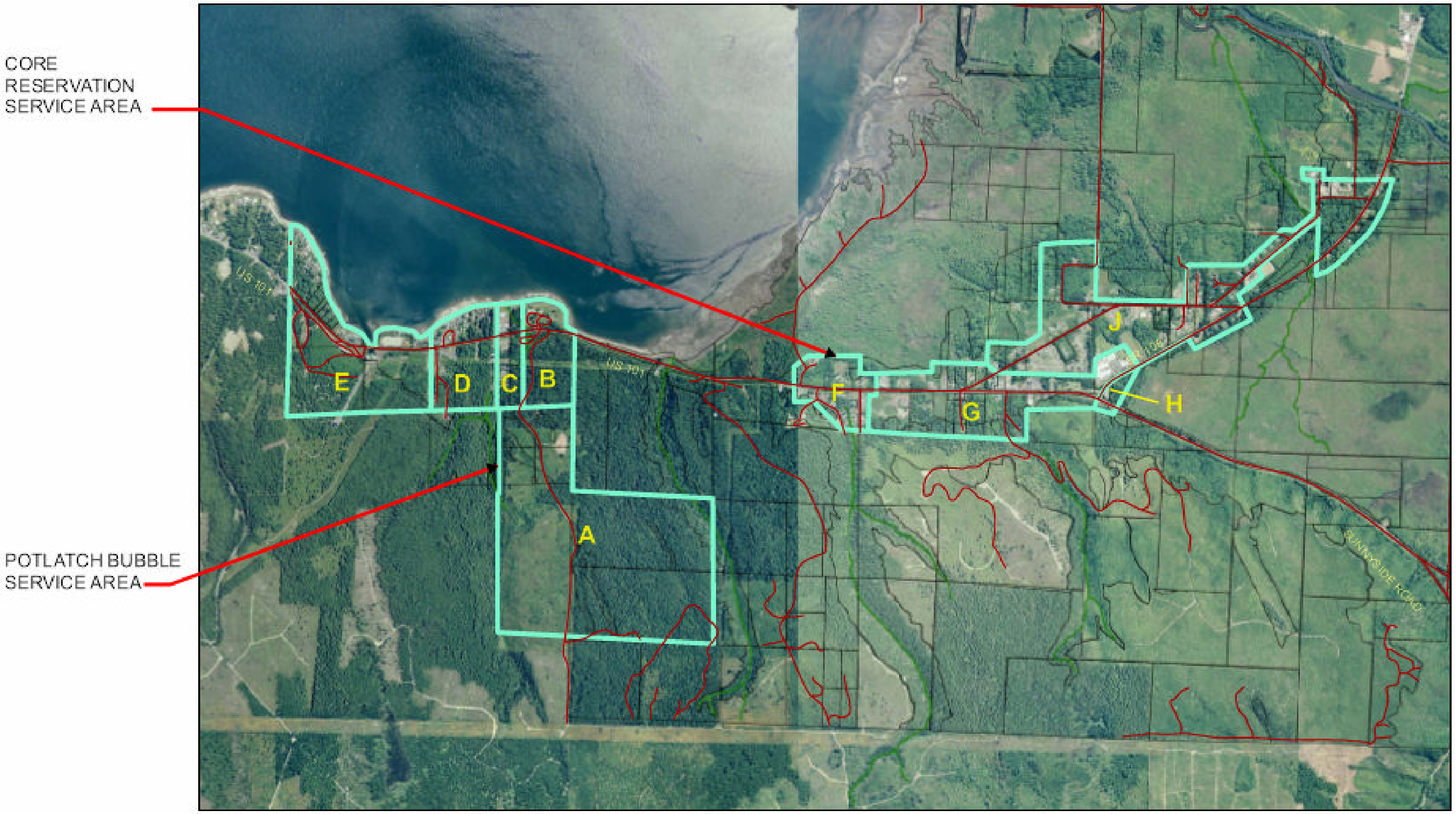
Soils with lower septic treatment capabilities include those that are excessively drained, such as Grove gravelly sandy loam, 5 to15 percent slopes (Gk), and soils formed on steep slopes, such as Hoodsport gravelly sandy loam, 30 to 45 percent slopes (Hf). These soil types would provide less treatment than slower draining soils due to higher permeability, resulting lower effluent residence times, and lower organic content.

HWA’s opinion is that of the three main soil types encountered (Hd, Hf and Gk), the Hd soils have the best septic treatment potential and least off site septic contaminant transport risk. Hf and Gk soils are both associated with surface water or drainages, and have a higher potential for off site septic contaminant transport, due to steep slopes and excessive permeability, respectively. Artificially placed or fill soils are also likely unsuitable.

Other planning criteria for enhanced treatment include distance to surface water, as it relates to potential for septic contaminant transport (e.g., BOD, nutrients, bacteria, etc.) to surface water bodies, particularly Hood Canal. Surface water for the purpose of this discussion includes creeks, intermittent drainages, tide flats, and Hood Canal. The planning area does not appear to contain isolated upland wetlands. **Figure 3.11** shows mapped wetlands and surface water features that are likely to convey septic drain field effluent rapidly and without much treatment to Hood Canal. Enhanced septic treatment (above conventional residential systems) may be considered for areas near surface water or drainages. For reference, Chapter 246-272A WAC, On-Site Sewage Systems specifies a setback of 100 feet for drain fields from surface water, and 30 feet from any down-gradient site feature that may allow effluent to surface.

-o-

Figure 3.01



Legend

Service Area Parcel Boundary

▭

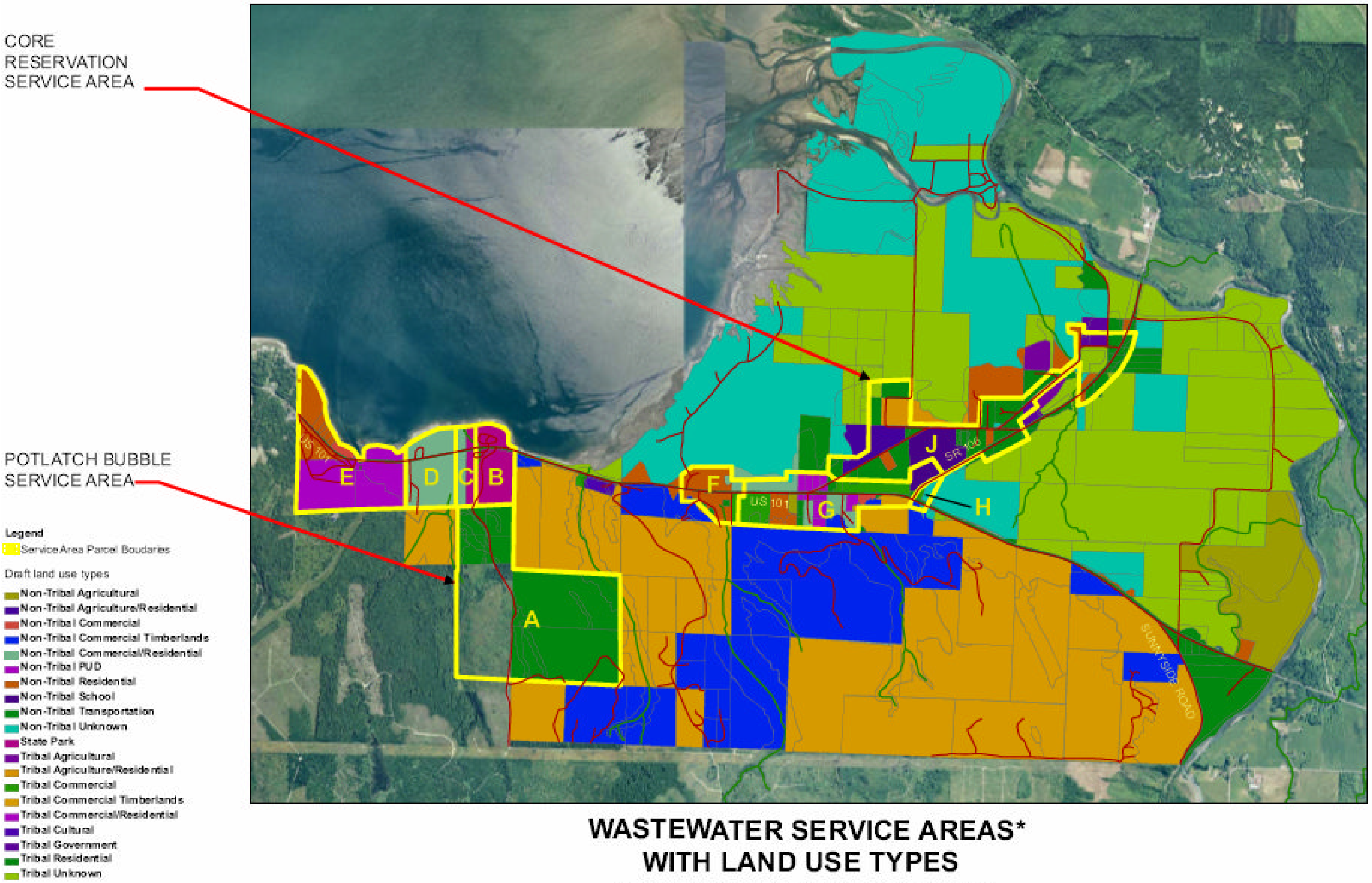
WASTEWATER SERVICE AREAS* WITH AERIAL PHOTO SKOKOMISH RESERVATION

Cascade Design Professionals, 2007

* Based on Skokomish Reservation mapping prepared by the Natural Resources Department of the Skokomish Tribe

Figure 3.01

Figure 3.02



WASTEWATER SERVICE AREAS*
WITH LAND USE TYPES
SKOKOMISH RESERVATION

Cascade Design Professionals, 2007

* Based on Skokomish Reservation existing land use mapping prepared by the Natural Resources Department of the Skokomish Tribe

Figure
3.02

Figure 3.03

Wastewater Flow for Potlatch Area – Phase 1

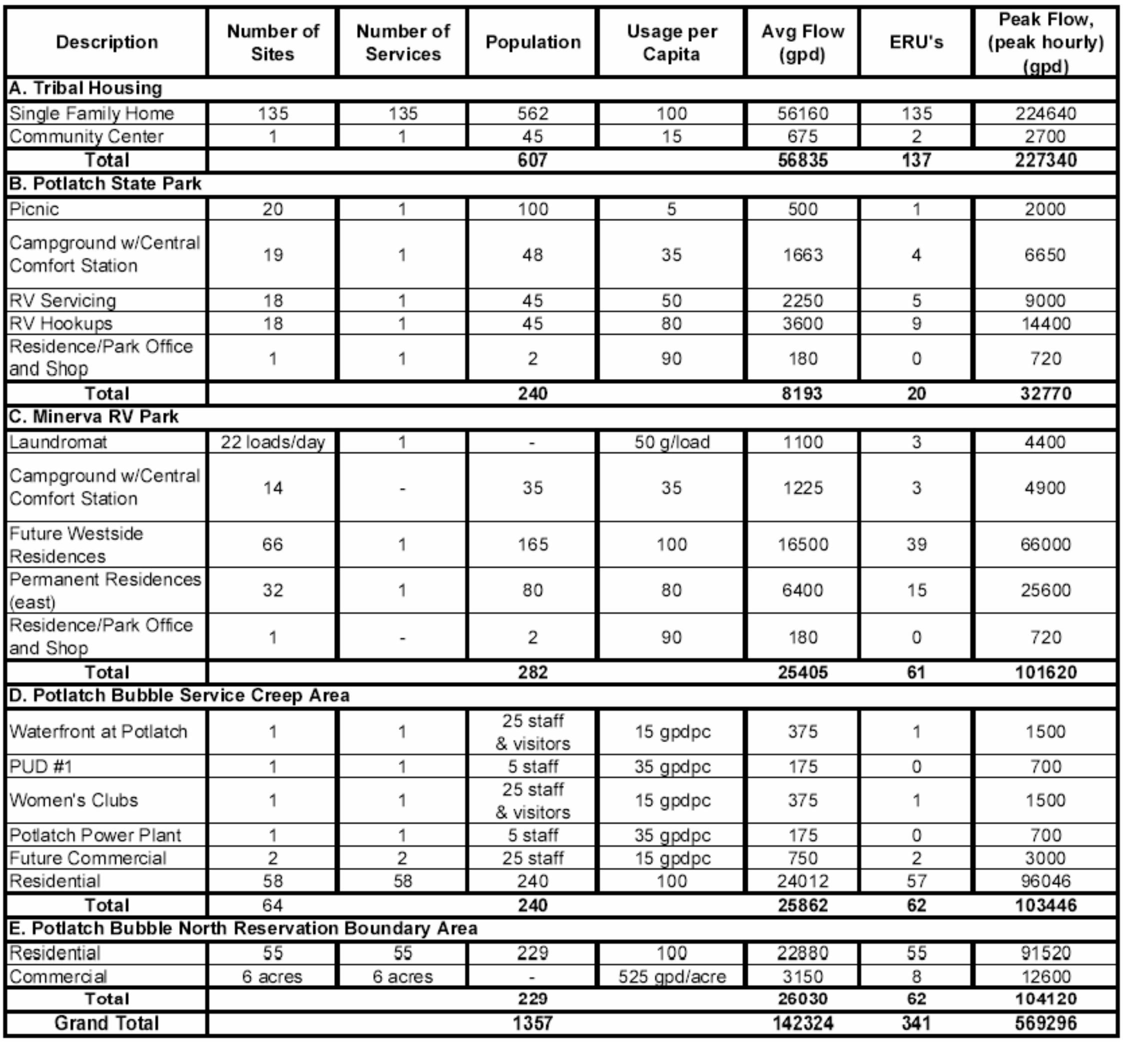
Description	Number of Sites	Number of Services	Population	Usage per Capita	Avg Flow (gpd)	ERU's	Peak Flow, (peak hourly) (gpd)
A. Tribal Housing							
Single Family Home	50	50	208	100	20800	50	83200
Community Center	1	1	10	15	150	1	600
Total		**51**	**218**		**20950**	**51**	**83800**
B. Potlatch State Park							
Picnic	20	1	100	5	500	1	2000
Campground w/Central Comfort Station	19	1	48	35	1663	4	6650
RV Servicing	18	1	45	50	2250	5	9000
RV Hookups	18	1	45	80	3600	9	14400
Residence/Park Office and Shop	1	1	2	90	180	0	720
Total		**5**	**240**		**8193**	**20**	**32770**
C. Minerva RV Park							
Laundromat	22 loads/day	1	-	50 g/load	1100	3	4400
Campground w/Central Comfort Station	14	-	35	35	1225	3	4900
RV's & Mobile Homes (west)	21	1	53	80	4200	10	-
Permanent Residences (east)	32	1	80	80	6400	15	25600
Residence/Park Office and Shop	1	-	2	90	180	0	720
Total		**3**	**170**		**13105**	**31**	**52420**
Grand Total			**627**		**42248**	**102**	**168990**

Figure
3.03

Figure
3.04

Figure 3.04

Wastewater Flows for Potlatch Area - Ultimate



Description	Number of Sites	Number of Services	Population	Usage per Capita	Avg Flow (gpd)	ERU's	Peak Flow, (peak hourly) (gpd)
A. Tribal Housing							
Single Family Home	135	135	562	100	56160	135	224640
Community Center	1	1	45	15	675	2	2700
Total			**607**		**56835**	**137**	**227340**
B. Potlatch State Park							
Picnic	20	1	100	5	500	1	2000
Campground w/Central Comfort Station	19	1	48	35	1663	4	6650
RV Servicing	18	1	45	50	2250	5	9000
RV Hookups	18	1	45	80	3600	9	14400
Residence/Park Office and Shop	1	1	2	90	180	0	720
Total			**240**		**8193**	**20**	**32770**
C. Minerva RV Park							
Laundromat	22 loads/day	1	-	50 g/load	1100	3	4400
Campground w/Central Comfort Station	14	-	35	35	1225	3	4900
Future Westside Residences	66	1	165	100	16500	39	66000
Permanent Residences (east)	32	1	80	80	6400	15	25600
Residence/Park Office and Shop	1	-	2	90	180	0	720
Total			**282**		**25405**	**61**	**101620**
D. Potlatch Bubble Service Creep Area							
Waterfront at Potlatch	1	1	25 staff & visitors	15 gpdpc	375	1	1500
PUD #1	1	1	5 staff	35 gpdpc	175	0	700
Women's Clubs	1	1	25 staff & visitors	15 gpdpc	375	1	1500
Potlatch Power Plant	1	1	5 staff	35 gpdpc	175	0	700
Future Commercial	2	2	25 staff	15 gpdpc	750	2	3000
Residential	58	58	240	100	24012	57	96046
Total	64		**240**		**25862**	**62**	**103446**
E. Potlatch Bubble North Reservation Boundary Area							
Residential	55	55	229	100	22880	55	91520
Commercial	6 acres	6 acres	-	525 gpd/acre	3150	8	12600
Total			**229**		**26030**	**62**	**104120**
Grand Total			**1357**		**142324**	**341**	**569296**

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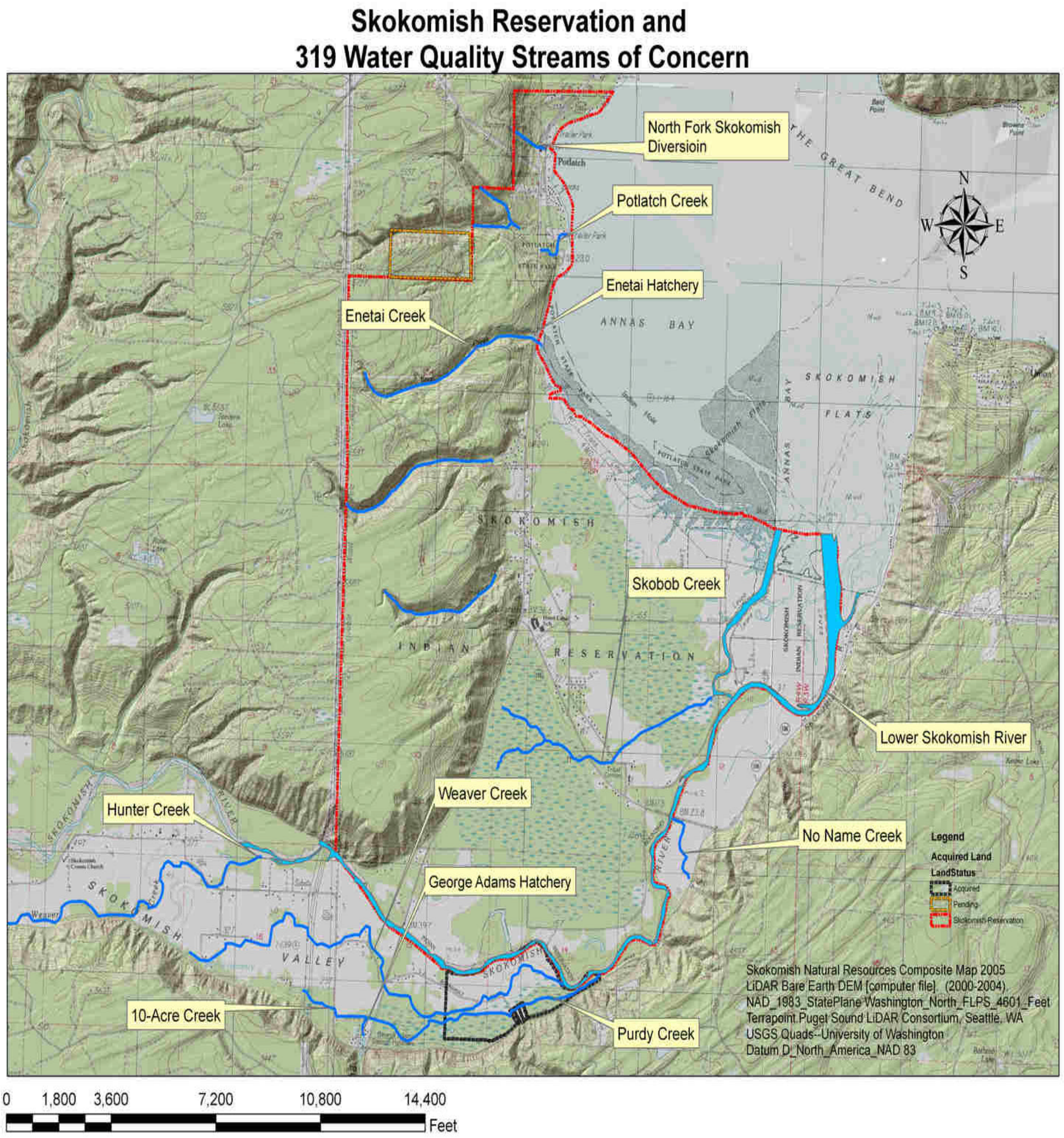
Figure
3.05

Figure 3.05



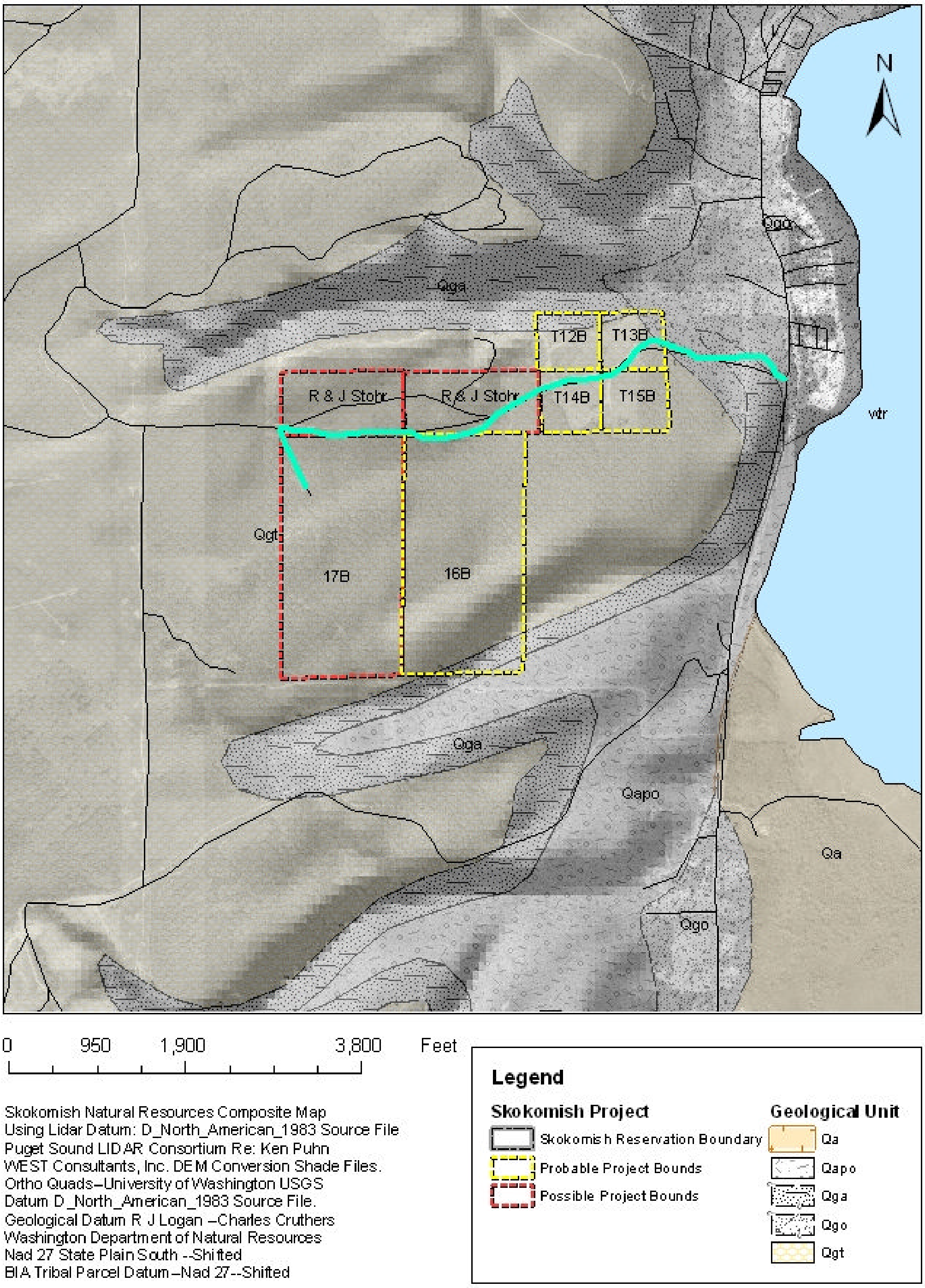
Skokomish Reservation and 319 Water Quality Streams of Concern

Skokomish Natural Resources Composite Map 2005
LiDAR Bare Earth DEM [computer file]. (2000-2004)
NAD_1983_StatePlane Washington_North_FLPS_4601_Feet
Terrapoint Puget Sound LiDAR Consortium, Seattle, WA
USGS Quads--University of Washington
Datum D_North_America_NAD 83

Figure 3.06

Figure
3.06

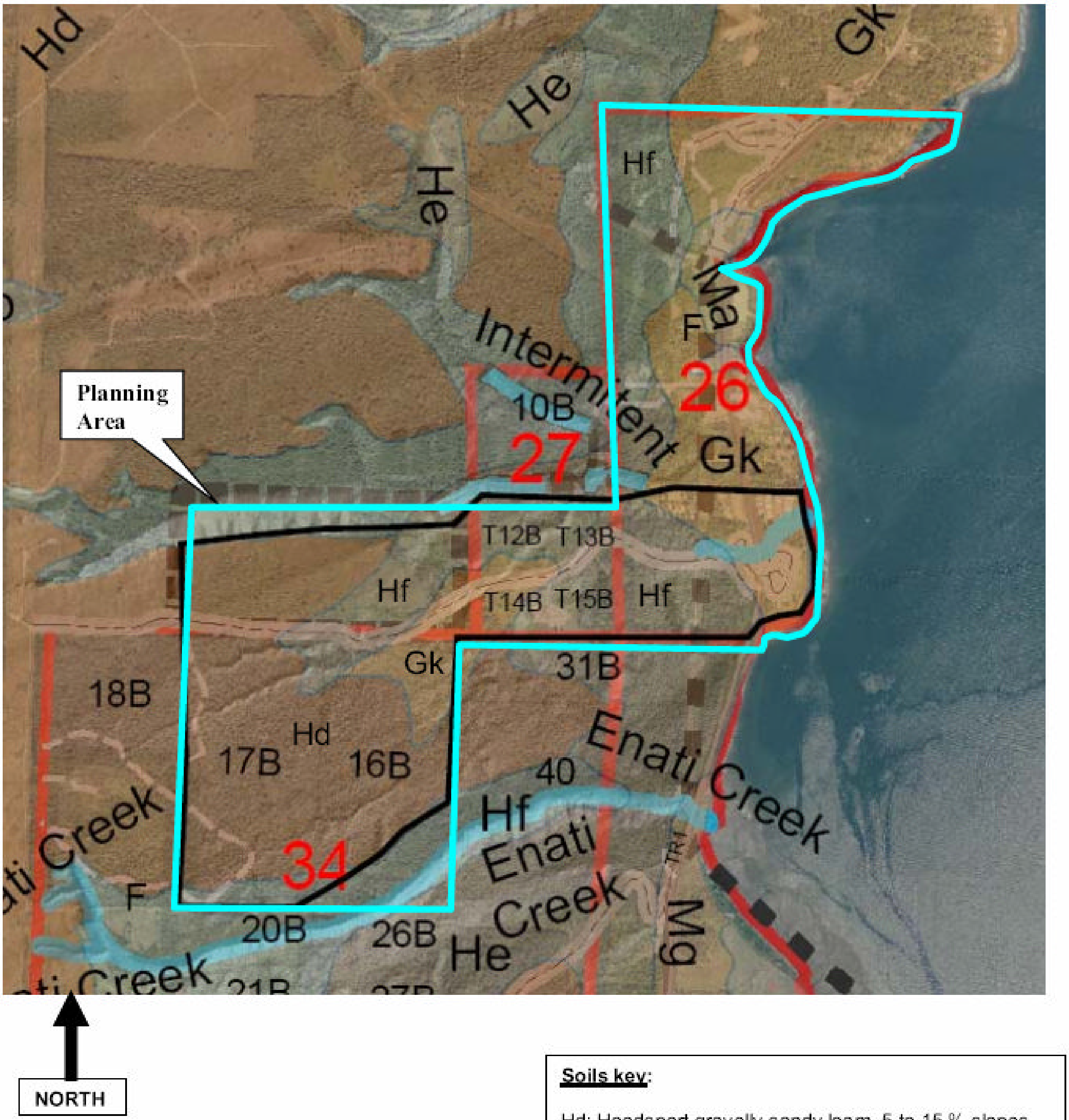
Skokomish Tribal Housing Project
Geololgical Profile



Skokomish Natural Resources Composite Map
Using Lidar Datum: D_North_American_1983 Source File
Puget Sound LIDAR Consortium Re: Ken Puhn
WEST Consultants, Inc. DEM Conversion Shade Files.
Ortho Quads–University of Washington USGS
Datum D_North_American_1983 Source File.
Geological Datum R J Logan –Charles Cruthers
Washington Department of Natural Resources
Nad 27 State Plain South --Shifted
BIA Tribal Parcel Datum–Nad 27--Shifted

Figure
3.07

Figure 3.07
Soils Mapping

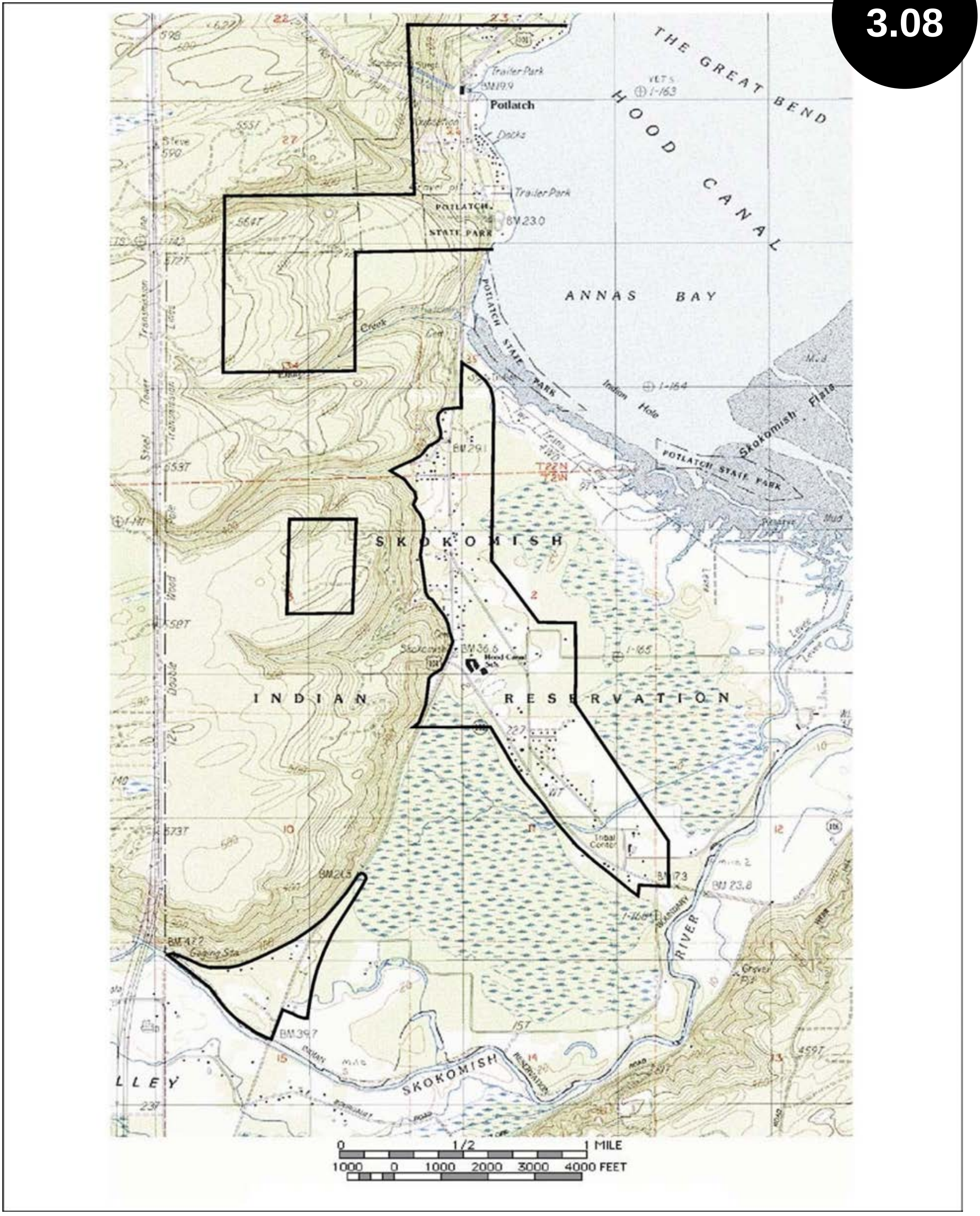


From: Ness, A. 0., and Fowler, R. H., 1960. *Soil Survey Of Mason County, Washington,* Soil Conservation Service, United States Department of Agriculture, Washington Agricultural Experiment Stations.
http://www.or.nrcs.usda.gov/pnw_soil/wa_reports.html

Soils key:

Hd: Hoodsport gravelly sandy loam, 5 to 15 % slopes
He: Hoodsport gravelly sandy loam, 15 to 30 % slopes
Hf: Hoodsport gravelly sandy loam, 30 to 45 % slopes
Gh: Grove gravelly sandy loam, 0 to 5 % slopes
Gk: Grove gravelly sandy loam, 5 to 15 % slopes
Ma - Made land

Figure 3.08



The Potlatch & Skokomish Indian Reservation Study Area, Mason County, WA

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Figure 3.09

Figure
3.09

Note:

Consistent with Washington State Law, this map is redacted in widely published copies of this report. This map is intended for the use of planning and design professionals in consultation with appro-priate Tribal and State historic preservation officials so that known cultural resource sites can be avoided or properly managed in the event of earth

Archaeological and ethnographic sites in and near the Potlatch & Skokomish Indian Reservation Study Area, Mason County, WA

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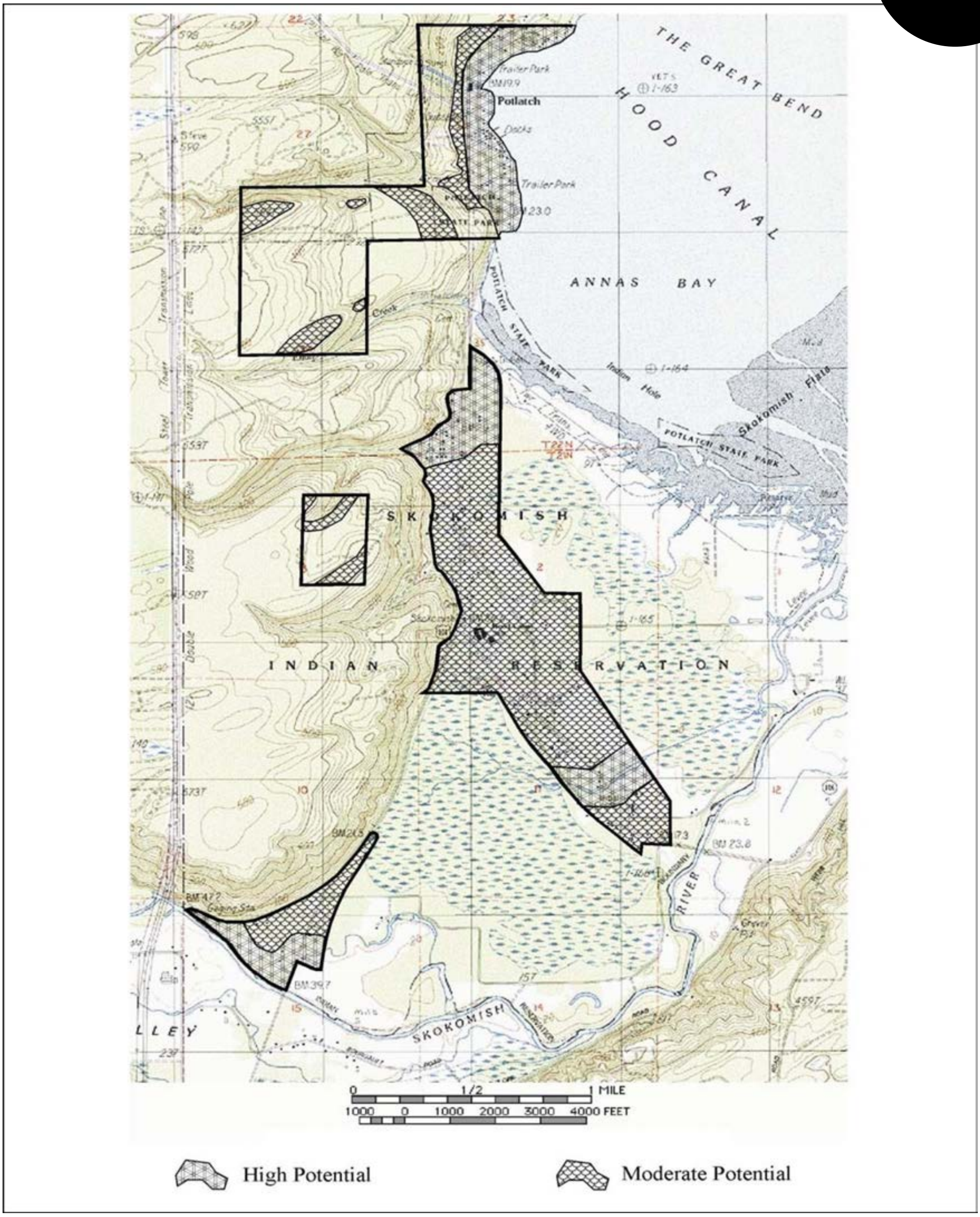
Figure 3.10



Archaeological potential zones in the Potlatch & Skokomish Indian Reservation Study Area, Mason County, WA

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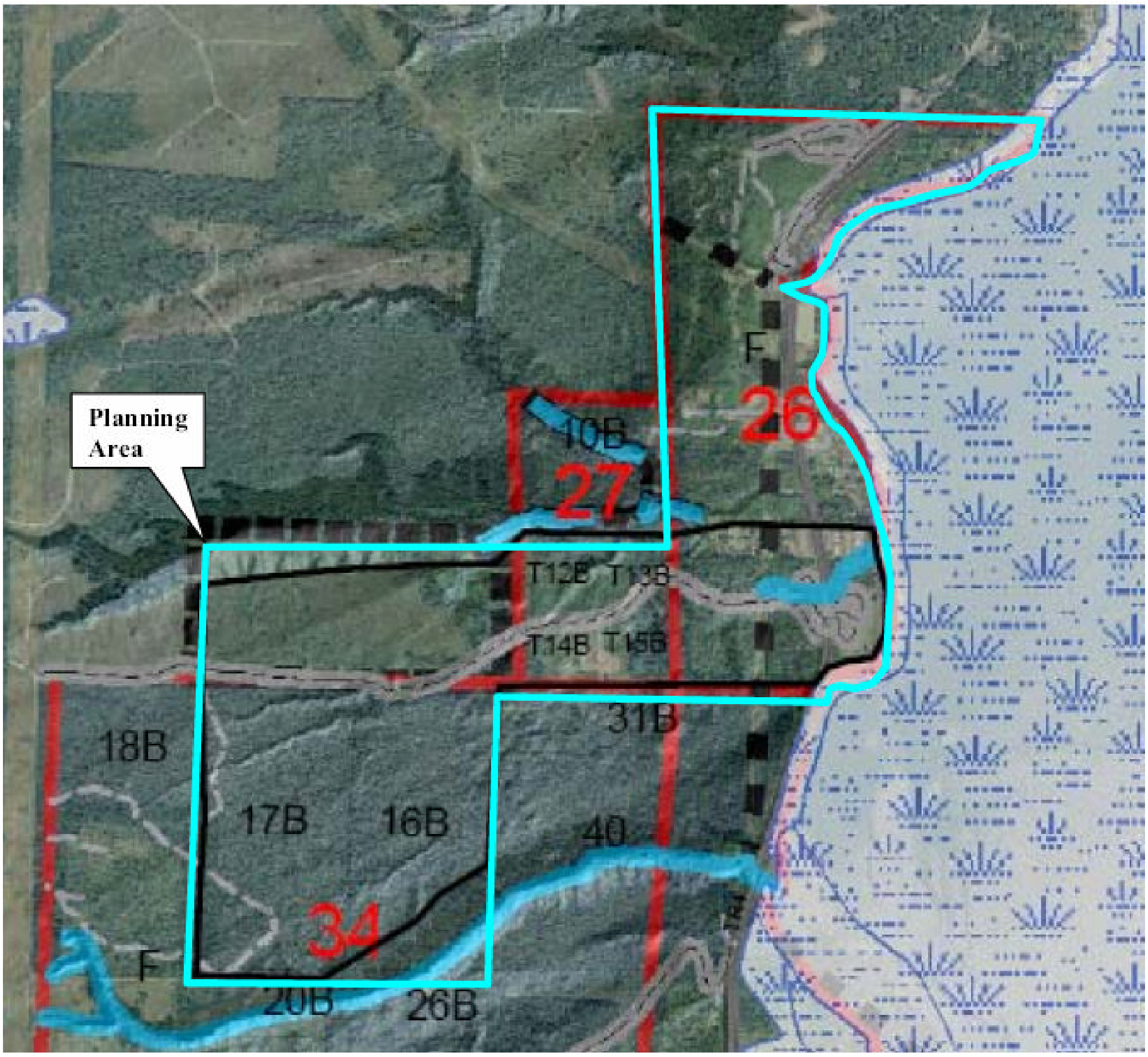
Figure
3.11

Figure 3.11



Wetlands

NORTH

From: Skokomish Tribe GIS Services

4.0 Core Reservation Planning Information

4.1 Existing Information

4.1.1 Population and Flow Estimates

Core Reservation area population and land use types were assessed in the same way as the Potlatch area (Section 3.1.1). An aerial map of the Core Reservation proposed wastewater service area can be found in the next section of this report, **Figure 5.09**.

Planning assumptions for the Core Reservation area reviewed by the Skokomish Indian Tribe Wastewater Planning Committee are outlined in **Appendix 3.1**. In general, residential growth in this area is limited, due to the presence of the Skokomish River floodplain. Projection of wastewater flows assumed that land near Hwy 101 was above the floodplain, and available for development.

Residential growth was projected along Hwy 101 at a rate of 2% per year. Commercial growth was projected on a per acre basis in a narrowly defined corridor as approximated on the mapping.

The Tribal Center is planned for relocation during Phase 1, as is construction of a new Boys and Girls Club near the elementary school.

The Casino was projected to grow 400% over a period of 5 years, during Phase 1. Core Reservation population and flow estimates are included in **Figures 4.01** and **4.02**.

4.1.2 Hydrology

Section 3.1.3 of this report includes hydrology information for the Core Reservation Planning Area of the Skokomish Reservation.

4.1.3 Geology

Geologic and soils maps for the Skokomish Reservation are included in section 3.1.4.

Two or three sites appear to be favorable for rapid infiltration in the Core Reservation Area.

- Along Hwy 101, on the east side
- Near the top stream banks, east of Hwy 101, where Outwash is the geologic profile
- On the WSDOT property, where Outwash is the geologic profile.

There are also indications that suitable sites are available in or near Potlatch State Park and up on the new Skokomish Housing Area site.

The absence of outwash at the surface indicates low infiltration potential. Areas with outwash near (but not at) the surface (within 10 feet or so) may be suitable for deep systems (ponds, trenches, galleries, etc) but there is no way to determine this from the maps. As was outlined in section 3.1.4, Grove gravelly loam is the soil type favorable for rapid infiltration.

(Additional soils-related investigations were performed as this report was being finished. See ***Appendix 4.1*** *for more information about testing done in the Core Reservation Planning Area.)*

4.1.4 Cultural Resources

Section 3.1.6 includes discussion of cultural resources for the Skokomish Reservation.

4.1.5 Environmental Issues and Permitting

The environmental and permitting issues associated with the Core Reservation area are very similar to those described for the Hoodsport and Potlatch areas in Sections 2 and 3, specifically 2.1.5 and 3.1.4. Within the Core Reservation study area, the major surface water bodies include Hood Canal, Entai Creek, numerous unnamed streams, and an extensive number of wetlands. Potential impacts to wetlands and/or water bodies are likely the environmental issue of greatest concern. A field reconnaissance should be conducted prior to siting any treatment or disposal facilities to determine the location and extent of streams and wetlands. Conducting this review early in the process would potentially allow for wetland avoidance by making siting adjustments. Similarly, wetland delineations should be conducted when pipeline routes are determined so that wetland impacts can be avoided, or minimized to the greatest extent possible.

Appendix 2.2 provides a matrix summarizing the various permits that may be required for the Hoodsport Rural Activity Center, Potlatch, and Core Reservation Wastewater Management Planning areas.

4.2 Additional Information

4.2.1 Treatment Soils Can Provide

Section 3.2.1 includes discussion of soils for the entire Reservation.

4.2.2 Wetland Effluent Disposal

*(The Skokomish Indian Tribe is interested in considering the used of wetlands to manage highly treated wastewater. The firm Jones and Stokes was retained to explore this potential on the Skokomish Reservation. The following is a summary of the Jones and Stokes report. The complete report can be found in **Appendix 4.2**)*

The feasibility of using natural or created wetlands is being considered as one of several options for effluent disposal to be evaluated in the update to the Skokomish Tribe Wastewater Facility Plan.

For the purpose of the analysis, it was assumed that the proposed wastewater treatment plant (WWTP) would treat wastewater to a “Class A” reclaimed water quality standard as defined by RCW 90.46 and the “Water Reclamation and Reuse Standards” manual (Washington State Department of Health and Washington State Department of Ecology 1997).

NATURAL WETLANDS

The Washington Department of Health and the Washington State Department of Ecology (1997) have developed a manual of Water Reclamation and Reuse Standards manual, including reclaimed water standards for use in wetlands. As a general guideline, discharge of reclaimed water into Category I or to saltwater dominated wetlands is not recommended except where it can be demonstrated that no existing wetland functions would be decreased and that overall net environmental benefits would result from the discharge.

Jones & Stokes conducted a “desktop” review of wetlands in the Core Reservation Area. Wetland information was derived from GIS data and mapping (Skokomish Tribe 2006) based on the

National Wetland Inventory (NWI), and a reservation-wide wetland inventory of Skokomish Tribal lands conducted by Sheldon & Associates (1994). No isolated or highly degraded wetlands (i.e., Category III or IV) wetlands occur in close proximity of the proposed WWTP. However, based on the desktop review, Jones & Stokes investigated four candidate wetland disposal locations in the "North Wetland", a Category I wetland located east of the proposed WWTP, and within one half mile the proposed WWTP. The sites were selected based on considerations of access, distance from the treatment plant, wetland class and condition, soils, and land use, and the possibility that, based on review of aerial photographs, the sites might benefit from reclaimed water. Field investigation revealed that none of the candidate sites were feasible for use of reclaimed water since all sites contained intact wetlands and no overriding net environmental benefit could be achieved from discharging reclaimed water to those sites.

CONSTRUCTED WETLANDS

Constructed wetlands are artificial wetlands constructed on non-wetland sites and designed to provide some measure of social or environmental benefit or treatment (i.e., polishing).

CONSTRUCTED BENEFICIAL USE WETLANDS

Constructed beneficial use wetlands can be used for recreational, cultural, or environmental benefits. Beneficial use wetlands can also be used as mitigation for the conversion or loss of wetlands caused by the development of a proposed project. Wetlands for this use are usually become "waters of the U.S." (i.e., jurisdictional wetlands).

The required quality of reclaimed water discharged to constructed beneficial use wetlands differs from the use of constructed wetlands for additional wastewater treatment (i.e., treatment wetlands). Reclaimed water discharged to constructed beneficial use wetlands must be Class B or better, while a lesser standard is applicable constructed wetlands used for treatment.

CONSTRUCTED TREATMENT WETLANDS

Constructed treatment wetlands are systems that are engineered and constructed in non-wetland sites and managed for the primary purpose of wastewater treatment. Constructed treatment wetlands are considered part of the wastewater collection and treatment system and are not considered "waters of the state" or "waters of the U.S."(i.e., and therefore not jurisdictional wetlands).

Findings and Recommendations

NATURAL WETLANDS

An analysis of the feasibility of using reclaimed water in natural wetland included a review of literature and background GIS information of the Reservation, and field reconnaissance of four candidate wetland sites located in the North Wetland (a Category I wetland) east of Highway 101.

The analysis concluded that none of the four sites were found suitable for discharge for a variety of reasons, but with one overriding conclusion that none of the sites possessed degraded wetland functions or habitat conditions that would benefit from the discharge of reclaimed water.

CONSTRUCTED BENEFICIAL USE WETLANDS

Beneficial use wetlands can have recognized cultural, recreational, or environmental benefits that are associated more with the use of reclaimed water to achieve those benefits than for the purpose of effluent treatment.

As a next step, the applicability and benefits of using constructed beneficial use wetlands for the Skokomish WWTP project should be determined if the Tribe is interested in using reclaimed water for cultural, educational, or scientific use. This decision should be based on such considerations as the goals and objectives for use of reclaimed wastewater, definable environmental and social benefits to be derived, and engineering considerations such as the location and size of the wetland and cost.

This analysis could include the feasibility and value or using a constructed beneficial wetland as storage in conjunction with a seasonal land application (e.g., to forest land) and infiltration discharge.

CONSTRUCTED TREATMENT WETLANDS

Constructed treatment wetlands are recognized primarily for their value to treat wastewater rather than to provide wetland functional benefits. Constructed treatment wetlands are usually constructed in an upland setting, with the size and configuration of the wetland based on the desired pollutant reduction prior to discharge. Treatment wetlands require an ultimate discharge of the treated wastewater, either through infiltration, spray irrigation, or as a point discharge to a receiving water.

Class A reclaimed water cannot be achieved using constructed wetlands for treatment unless the effluent from the wetland is filtered prior to discharge (Fricke pers. comm.). The feasibility of using constructed surface-flow and subsurface flow wetlands for treatment, should be explored further if the Tribe chooses to consider discharging effluent of a lesser quality than Class A. For example, a treatment wetland could possibly be used to polish Class D effluent from the WWTP to a Class C quality for discharge. The feasibility of this analysis would be dependent on type of disposal (e.g., spray irrigation or infiltration) and the water quality requirements. This analysis is largely an engineering exercise based on projected flows, projected quality of effluent to be treated, the desired quality for discharge, land availability, and costs for construction, operation, and monitoring.

-o-

Figure 4.01

Wastewater Flow for Core Area – Phase 1

Description	Number of Sites	Number of Services	Population	Usage per Capita	Avg Flow (gpd)	ERU's	Peak Flow, (peak hourly) (gpd)
G. Hwy 101 Commercial Area, N. of Hwy 106 to WSDOT property (including WSDOT)							
Tribal Center, including Public & Social Services (future)	1	1	200 staff & visitors	15 gpdpc	3000	7	12000
Twin Totems/ Lucky Dog	1	1	800 slots	45 gpd/slot	36000	206	144000
Residential	7	7	29	100	2912	7	11648
Total		**9**	**29**		**41912**	**220**	**167648**
J. Reservation Rd & Hwy 106 mixed use							
Hood Canal School	1	1	300 students	15 gpdpc	4500	11	18000
Boys & Girls Club and Community Center	1	1	50 children	15 gpdpc	750	2	3000
Tribal Center, including Health Center	4	4	120 staff & visitors	15 gpdpc	1800	4	7200
Fire and Natural Resources	2	2	20 staff & visitors	15 gpdpc	300	1	1200
Residential	108	108	449	100	44928	107	179712
Total		**118**	**449**		**52278**	**125**	**209112**
Grand Total		**127**	**478**		**94190**	**345**	**376760**

Figure
4.01

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Figure 4.02

Wastewater Flow for Core Area – Ultimate

Description	Number of Sites	Number of Services	Population	Usage per Capita	Avg Flow (gpd)	ERU's	Peak Flow, (peak hourly) (gpd)
F. Hwy 101 Residential Area, N. of WSDOT property							
Residential	22	22	92	100	9152	22	36608
Total		**22**	**92**		**9152**	**22**	**36608**
G. Hwy 101 Commercial Area, N. of Hwy 106 to WSDOT property (including WSDOT)							
Tribal Center, including Public & Social Services (future)	1	1	200 staff & visitors	15 gpdpc	3000	7	12000
Twin Totems/ Lucky Dog	1	1	800 slots	45 gpd/slot	36000	206	144000
Future Commercial	-	30 acres	30 acres	525 gpd/acre	15750	38	63000
Residential	47	47	197	100	19702	47	78807
Total		**49**	**197**		**74452**	**299**	**297807**
H. Junction Hwys 101 & 106							
Future Commercial	6 acres	6 acres	-	525 gpd/acre	3150	8	12600
Total			**-**		**3150**	**8**	**12600**
J. Reservation Rd & Hwy 106 mixed use							
Hood Canal School	1	1	450 students	15 gpdpc	6750	16	27000
Boys & Girls Club and Community Center	1	1	50 children & visitors	15 gpdpc	750	2	3000
Tribal Center, including Health Center	4	4	5 staff & visitors	15 gpdpc	75	0	300
Fire and Natural Resources	2	2	20 staff & visitors	15 gpdpc	300	1	1200
Residential	136	136	566	100	56576	136	226304
Total		**144**			**64451**	**155**	**257804**
Grand Total		**215**	**289**		**151205**	**483**	**604819**

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5.0 Technology Selection and Project Definitions for Skokomish Systems

5.1 Technologies

5.1.1 Inventory of Applicable Technologies

The Wastewater Master Plan (November 1998) identified two acceptable treatment alternatives, the Biolac aerated lagoon system (manufactured by Parkson, Inc.) and the Sequencing Batch Reactor (SBR) system. The Biolac system does not provide adequate nutrient removal, and it can not meet the desired Class A effluent standards.

The Membrane Bioreactor (MBR) system (manufactured by Enviroquip, Zenon, and Koch) has become more prevalent and widely accepted as a reliable, cost-effective treatment technology for small flows. Several systems are operating successfully in the Northwest, as well. In addition, it has proven successful at treating to DOE's Class A standards for reclaimed wastewater Consequently, the MBR and SBR are the preferred alternatives.

Based on current Tribal Council direction, the preferred treatment plant will be a "good neighbor" facility, with low visibility and high air quality (EPA FARR guidelines), including odor control. The plant should optimize the use of space, and be easily upgraded for increased flows as needed for phasing or future growth. Though the Tribe has not adopted its own standards or Washington Department of Ecology (WDOE) standards, regulatory direction concerning water quality in this region should meet or exceed effluent discharge requirements that are equivalent to DOE's Class A reclaimed water standards. Class A reclaimed water is of such high quality that its use is unrestricted and direct human exposure (but not routine consumption) is allowed.

Estimated land area needed for the water reclamation plant and effluent disposal options are in **Figure 5.01**.

Of the area required for the treatment plant approximately 75 percent of the plant will be used for treatment of the wastewater, which includes tanks and equipment for influent pumping, influent screening, flow equalization, bioreactors, membrane skids/cells, and disinfection equipment. Also included are facilities for storing materials, treatment chemicals, operator offices, and laboratory.

As much as 25% of the land for the plant may be needed for sludge management. The Master Plan includes a description of sludge management alternatives. Sludge, or biosolids, may be stored and dried on-site, or hauled off to reduce the capital cost of the plant. There is an onsite sludge composting program at the Washington Corrections Center in Shelton which may be available to receive the sludge. For purposes of this study, provisions of sludge treatment include sludge stabilization and dewatering sufficient for disposal on land or in a landfill.

Criteria used to review the treatment alternatives include:

- Effectiveness and reliability
- Land requirements and future expansion requirements

- Cost and operations and maintenance requirements
- Environmental impacts and aesthetics

5.1.1.1 MBR Treatment Plant(s)

The MBR design provides a more consistent, high quality effluent, with fewer solids to handle. Wastewater is drawn through membrane filters by applying a suction pressure across the membrane. The pressure differential is generally provided by pumping; however some experimental gravity systems are being tested. Pumping increases operation costs.

The risk of exceeding water quality standards with the MBR plant is low because the membrane acts as a positive barrier to solids carryover.

5.1.1.2 SBR Treatment Plant(s) with Filtration

In most treatment plant designs, to meet Class A standards the SBR is followed by an effluent polishing system using a sand filter. The MBR facility does not require advanced treatment because the membrane is a positive barrier that provides that same level (or better) particle removal as the sand filter. To meet Class A reuse standards, particles are removed down to 5NTU's.

The SBR effluent quality is generally more sensitive to BOD loading in the influent. If the plant is overloaded and low dissolved oxygen conditions occur, the settling characteristics of the sludge may be affected and not enough solids are removed during the settling process. The remaining solids would then have to be removed by the filter, which in turn would affect its performance. However, the membrane in a MBR provides a positive barrier that always prevents solids from passing through in the effluent, even if the biological process is upset from overloading.

The risk of a biological system upset with an SBR is much higher, but with flow equalization and good operator attentiveness, SBR's can be very reliable and consistently produce a high quality effluent. However, effluent quality from an SBR may have BOD, TSS and TKN loading as much as 2 to 3 times the effluent quality from an MBR.

5.1.2 Effluent Disposal Technologies

5.1.2.1 Rapid Infiltration

Rapid infiltration is the most efficient means for effluent disposal, in terms of capital and O & M costs, as well as in terms of the land requirements. However, rapid infiltration requires good geotechnical conditions, in order for it to work. These conditions include good soils, good geologic subsurface conditions and a relatively flat site.

In rapid infiltration systems, effluent flows through an array of parallel perforated pipes that are buried in a gravel filled basin. The flow is distributed evenly across the gravel bed and allowed to percolate into the groundwater. No significant impact to the groundwater would occur, because of the high quality of the effluent.

5.1.2.2 Forest Irrigation

Forest irrigation is land intensive and has high capital and O & M costs. An economic benefit can be developed from forest irrigation for effluent disposal, which may offset the costs. Land available for forest irrigation for both the Potlatch and Core Area is high above the proposed treatment plant location, and far away. Costs for pumping water and storing water, during the wet season, appear to be prohibitive.

Forest irrigation may be used in a natural forest or plantation (such as hybrid poplar). The effluent must be applied at agronomic rates, appropriate for the trees and depending upon the rate of evapotranspiration. Since uptake varies with weather, age, and season, effluent must be stored. Storage is also land intensive, requiring several acres to store 4 to 6 months of effluent. Storage would consist of a lined lagoon 8 to 10 feet deep.

5.1.2.3 Wetland Use of Treated Effluent

Wetland augmentation is the discharge of effluent into an existing wetland, "augmenting" the existing water supply. The existing wetlands on the Skokomish Reservation are Type 1, high quality wetlands. Augmenting the water supply of a Type 1 wetland cannot enhance the quality of the wetland, therefore wetland augmentation is not allowed.

Constructed wetlands may be an option for effluent disposal; however constructed wetlands would not be considered a final point of disposal. Water would be discharged at some point from the constructed wetland, either to a surface water body or to a rapid infiltration basin. In addition, the water quality of a constructed wetland would not be Class A. Water fowl impacts to water quality would cause problems in meeting water quality goals for Hood Canal.

(See Section 4.2.2 for details on using wetlands. ***Appendix 4.2*** *is a technical memorandum by Jones and Stokes.)*

5.1.3 Technology Alternatives Considered

Alternatives for wastewater treatment and effluent disposal were developed as follows:

- Alternative 1, Potlatch Bubble – Consisting of four sub alternatives each with conveyance piping and pumping, either of two treatment types (MBR and SBR), and two types of effluent disposal (rapid infiltration and forest irrigation)
- Alternative 2, Core Reservation - Consisting of four sub alternatives each with conveyance piping and pumping, either of two treatment types (MBR and SBR), and two types of effluent disposal (rapid infiltration and forest irrigation)
- Alternative 3, Potlatch and Core Reservation Combined – Consisting of combining Alternatives 1 and 2 together to form one alternative to service both areas.

The configuration of each alterative is shown in **Figures 5.02, 5.03**, and **5.04**, respectively.

5.1.4 Recommended Technology

Each alternative was compared on a cost and non-cost basis. Comparison of costs is presented in the following section. Non-cost criteria used in the comparison were as follows:

1. Land acquisition
2. Ease of construction
3. Expandability
4. Flexibility for meeting future regulations
5. Ability to permit and satisfy environmental concerns
6. Visual impact
7. Ease of operation and maintenance

8. Odor potential
9. Environmental Impact
10. Land requirements

Of the technologies considered, it was determined that MBR treatment with rapid infiltration disposal was found to be preferred over SBR and/or forest irrigation for the following reasons:

1. MBR and RI require the least amount of land to acquire because they consume the least amount of land area.
2. Ease of construction for both options is similar
3. Both technology options are similar in their expandability, that is, treatment technology can be designed for a phased expansion. Rapid infiltration beds can also be sized for phased expansion.
4. Each technology is highly reliable and can be easily modified to meet future regulations.
5. MBR does a better job of meeting environmental concerns because it reliably produces a very high quality effluent
6. The SBR and MBR both have small visual impact because they can be easily screened with a building. The RI system has a much smaller visual impact than the much larger forest irrigation system.
7. Operation and maintenance of the MBR is easier than the SBR. The RI system has low O&M requirements when compared to the forest irrigation system.
8. Both technologies are similar in odor potential, because odors from both can be controlled with odor control systems
9. Forest irrigation system has the largest environmental impact because it uses the most land.
10. Both MBR and RI are the least land intensive of the technology options.

The MBR system was identified as the preferred method based on all the non-cost criteria reviewed.

5.2 One vs. Two Plants for Potlatch and Core

This report was started on the assumption each of the three Planning Areas (Hoodsport, Potlatch Bubble and Core Reservation) would be handled separately. During planning, the possible advantages of serving the Potlatch Bubble and the Core Reservation were actively discussed. Distance between the two service areas was one important factor (see **Figure 5.05**). Another was operating costs associated with one vs. two treatment plants. A third factor, schedule, emerged as significant.

The following sub-sections capture the discussion and recommendation to develop separate systems for the Potlatch Bubble and the Core Reservation.

5.2.1 Capital Cost Comparison

5.2.1.1 <u>Conveyance Cost Comparison</u>

All costs were developed for the ultimate system development.

The combined treatment alternative requires conveyance of Potlatch area flows to the Core Reservation treatment plant. The total additional cost for conveyance to the combined plant is $1,266,000.

Approximately $600,000 of this additional cost could be saved if the Core Area plant is sited to the east of the WSDOT parcel, allowing the elimination of the pump station to the plant. The cost of a separate plant for the Core Area would also be reduced by relocating the plant (approximately $400,000).

An inventory of the additional conveyance system components needed include:

1. A gravity sewer from the existing Potlatch Park drainfield to connect the new Tribal housing to the main sewer in Hwy 101 (approximately 2000 ft long, estimated at $80,000).
2. The pump station at Potlatch State Park would be redesigned to pump wastewater to the Core Reservation Area treatment plant. The existing pump station will be redesigned regardless of whether a combined or separate treatment system is constructed. Cost impacts for the combined system pump station redesign are associated with increased flows (additional flow from the new housing project) and decreased system headloss (since the pumps no longer discharge upslope in the Park). The increased cost is approximately $50,000.
3. Additional sewer is required to connect the Potlatch Area to the Core Reservation Area treatment plant (0.8 miles, estimated at $536,000).
4. The pump station to lift the flows from Hwy 101 to the treatment plant (assuming the plant is built west of the highway, on the former WSDOT parcel) must be redesigned for the increased flows (estimated at $600,000).

5.2.1.2 Comparison of Treatment/Re-use/Disposal Costs

A single treatment plant would cost less than two separate plants (approximately $310,000, or 4%of the plant costs). The estimated savings is based on a conceptual level review of treatment plant costs. In general, larger facilities have an economy of scale, meaning that a linear increase in capacity does not result in a linear increase in cost.

Effluent disposal costs are approximately $49,000 less for the combined treatment plant, roughly 8% of the total disposal costs. However, the estimates are based on the assumption that the infiltration rates are ½ inch / hour for both the Potlatch and the Core Area. Preliminary geotechnical data suggests the rates may be higher for the Core Area, reducing costs, and potentially difficult to achieve near the Potlatch Area. A favorable infiltration site for the Potlatch Area has not yet been located, however, recent field investigations indicate that some favorable sites may be located at or near Potlatch State Park west of the Park in the new Skokomish Indian Tribe housing area. *(Please see **Appendix 4.1** for the most recent information.)*

5.2.2 Operation and Maintenance Cost Comparison

Operation and maintenance costs for a combined system are approximately 25% less, primarily because of reduced staffing but also because of reduced power costs. The annual operation and maintenance costs for the combined system were estimated at $380,000.

5.2.3 Lifecycle Cost Comparison

Present worth costs for both separate and combined systems were compared in

Figure **5.06**. The alternative with the lowest present worth cost is a combined system with SBR treatment and rapid infiltration effluent disposal.

However, the capital cost for a separate system, MBR and rapid infiltration is only 4% higher (approximately $730,000). The reduced risk of exceeding water quality goals may be considered "worth" the additional capital cost.

The present worth analysis estimates that annual labor and power costs will be 29% more for separate MBR plants, than for a combined SBR plant (approximately $106,000).

5.2.4 Recommended Plant Configuration for Skokomish Reservation

The most effective system, to achieve water quality goals, facilitate project phasing, and meet "good neighbor" objectives is the separate MBR and rapid infiltration systems.

To facilitate review of the difference in cost and design for combined vs. separate systems, a summary of cost differences for the MBR and rapid infiltration system is provided:

1. Conveyance costs are higher for a combined system ($627,000 if the plant is located east of Hwy 101, or $1,270,000 if located west of Hwy 101),
2. Treatment plant capital costs are higher for separate plants ($310,000),
3. O & M costs are higher for separate treatment plants ($92,000 annually).

Additional field investigation and evaluation is required in locating a good site for a rapid infiltration system for the Potlatch Area. *(Please see* ***Appendix 4.1*** *for the latest information.)*

Based on the information outlined above, and concerns that the construction schedule for a combined system may not meet the needs for the new tribal housing development, the recommended system is for separate treatment plants for the Potlatch and Core Reservation service areas.

5.3 Proposed Potlatch Project Definition

5.3.1 Project Definition

The recommended system for the Potlatch service area is a separate MBR treatment plant with a rapid infiltration effluent disposal system.

Tribal review determined this to be the most effective system, to achieve water quality goals, facilitate project phasing and related construction schedules, and to meet "good neighbor" objectives.

A preliminary layout of the conveyance system and phasing of the project is shown in **Figure 5.07**.

5.3.2 Planning Level Costs and Project Phasing

Phased system costs for the Potlatch Area were developed after reviewing four alternative treatment and disposal systems.

Estimates for the number of services were developed per Section 3.1.2, through the population assessment process. The phased system costs for the Potlatch Area are summarized in **Figure 5.08**. The table includes phased costs for both the Potlatch and Core Areas.

An important element in the process of developing system costs is the cost per service. The cost estimate includes infrastructure costs for hooking up each service, or in some cases each septic tank, for example at Minerva RV Park. The final cost for the entire system is then analyzed using Equivalent Residential Units (ERU's) to distribute costs fairly among users. In this way the Casino flows and loadings can be expressed in terms of ERU's, equalizing the financial burden fairly. By definition, a household is 1 ERU, however homes in Minerva RV Park may be slightly lower than 1 ERU.

Treatment costs for Phase 1 are based on an over-sized plant being constructed, equal to one-half the size needed for the ultimate build out in 20-years. Typical process design for treatment plants provide for redundancy to allow the plant to stay operational during maintenance. Because the Phase 1 flows are less than 50,000 gpd, a package plant would typically be constructed. But package plants can be 10% higher in cost. Further review of this approach to estimating the costs will occur as the project is developed.

5.4 Proposed Core Reservation Project Definition

5.4.1 Project Definition

The recommended system for the Core Reservation service area is a separate MBR treatment plant with a rapid infiltration system.

Tribal review determined this to be the most effective system, to achieve water quality goals, facilitate project phasing and related construction schedules, and to meet "good neighbor" objectives.

A map of the Core Area phased conveyance system is shown in **Figure 5.09**.

5.4.2 Planning Levels Costs and Project Phasing

The conveyance system was assumed to be a pressure system or septic tank effluent pumping system (STEP) based on the work done in the 1998 Wastewater Master Plan prepared by KCM. The phased costs for the Core Area are included in **Figure 5.08**.

A discussion on the number of services and ERU's is included in Section 5.3.2.

5.5 Combined Potlatch "Bubble" and Core Reservation Action Steps

The Potlatch Housing Project is underway and decisions concerning wastewater management are the highest priority among the various efforts necessary to implement the defined projects serving Potlatch and the Core Reservation. Every effort must be made to avoid costly duplicate or "interim" wastewater management approaches in the Potlatch Planning Area. Further, the Washington State Parks Department is in urgent need of a Potlatch State Park wastewater solution to assure protection of the environment and funding availability.

Further, the Core Reservation project is in need of prompt attention. The Tribe's desire to relocate the Tribal Center and meet expanding economic development centered around the Lucky Dog Casino demand quick and thoughtful management of wastewater issues.

The following steps offer an overview of how the defined projects can be successfully implemented over a three year period.

1. Complete Facilities Plan Amendments to the Department of Ecology approved Skokomish Indian Tribe Wastewater Master Plan for the Potlatch and Core Reservation Project Definitions.
4. Prepare environmental documentation suitable for funding that relies on the State Environmental Policy Act (SEPA), State Environmental Review Process (SERP) for State Revolving Fund loans and National Environmental Policy Act (NEPA) documentation.
5. Seek and secure Ecology approval of the Facilities Plan Amendments.
6. Select a design firm using Washington State procurement procedures and federal procurement procedures.
7. With Environmental Protection Agency and Department of Ecology consultation, approve a scope of services, review points, schedule and contract with the design firm.
8. Design facilities and submit design status reports and final design to the Environmental Protection Agency and Washington Department of Ecology for review and approval.
9. As design is initiated, determine what organization will be the operator. Involve the operator in the design process and establish an operator training program to be conducted by the designer in a manner timely with plant completion.
10. To the greatest extent possible, determine final siting of key facilities in advance of completing final design. Prepare site specific environmental documentation and, if necessary, mitigation plans. Make certain appropriate consideration is given to the potential for disturbing cultural resources and avoid or carefully plan for construction in these areas. As soon as possible acquire sites and initiate necessary permitting activities.
11. Determine the approach for construction supervision and assign responsibilities/authorities for accepting construction work. Hire or retain necessary professional services or staff. Also assure plans are prepared for discovery of cultural resources and appropriate response plans are in place to assure sensitive and prompt handling consistent with State of Washington and Tribal requirements.
12. At or before the time of design approval but following preparation of plans, specifications and estimates, solicit construction bids in accordance with the construction plan. Bidding procedures must be consistent with federal and state requirements and any special requirements depending on fund sources.
13. With final approval of design, assure necessary permit applications are timely submitted and construction contracts are awarded.
14. Complete construction consistent with the construction plan.

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Figure 5.01

Land Area Requirements for Treatment and Disposal

All Units in Acres

System	***MBR***	***SBR***	***Rapid Infiltration***	***Irrigation***	***Storage Pond***
Potlatch	1.7	2.0	3.5	20.9	7.8
Core	1.8	2.2	4.4	26.1	9.8
Combined	2.0	2.4	7.9	47.0	17.6

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Figure 5.02

COMPARISON OF SYSTEM ALTERNATIVES
SEPARATE SYSTEM - POTLATCH BUBBLE

Item	Description	Alt 1A	Alt 1B	Alt 1C	Alt 1D
CONVEYANCE					
1	Gravity sewer for new Tribal Housing connection	750 LF pipe , 2 manholes			
2	Potlatch State Park system improvements	Upgrade pump station, 5 commercial services			
3	Minerva RV Park system improvements	2040 LF pipe, 3 commercial services			
4	Service Area Creep plus North Boundary Area (Area D & E) system improvements	6250 LF pipe, 113 residential services, 3 commercial services			
WASTEWATER TREATMENT					
5	Wastewater Treatment Plant	MBR, 142,300 gpd, 1.7 acres, 1.5 staff, reliable Class A effluent		SBR, 142,300 gpd, 1.5 staff, less reliable Class A effluent	
DISPOSAL					
6	Effluent Disposal	Rapid infiltration near access road, 2.0 acres, 0.5 staff, beneficial increased flow to unnamed stream	Upslope forest irrigation (27 acres), 20 Hp pump station, storage pond (10 acres), 0.5 staff	Rapid infiltration near access road, 2.0 acres, 0.5 staff, beneficial increased flow to unnamed stream	Upslope forest irrigation (27 acres), 20 Hp pump station, storage pond (10 acres), 0.5 staff

Figure
5.02

Figure 5.03

<table>
<tr><th colspan="6">COMPARISON OF SYSTEM ALTERNATIVES
SEPARATE SYSTEM - CORE AREA</th></tr>
<tr><th>Item</th><th>Description</th><th>Alt 2A</th><th>Alt 2B</th><th>Alt 2C</th><th>Alt 2D</th></tr>
<tr><td colspan="6">CONVEYANCE</td></tr>
<tr><td>1</td><td>Hwy 101 (Areas F, G & H) system improvements</td><td colspan="4">11,500 LF pipe, future tribal center, 47 residential services, 7 commercial services</td></tr>
<tr><td>2</td><td>Reservation Road (Area J) system improvements</td><td colspan="4">18,150 LF pipe, school, 108 residential services, 9 commercial services</td></tr>
<tr><td colspan="6">WASTEWATER TREATMENT</td></tr>
<tr><td>3</td><td>Wastewater Treatment Plant</td><td colspan="2">MBR, 151,200 gpd, 1.8 acres, 2.0 staff, reliable Class A effluent</td><td colspan="2">SBR, 151,200 gpd, 2.2 acres, 2.0 staff, less reliable Class A effluent</td></tr>
<tr><td colspan="6">DISPOSAL</td></tr>
<tr><td>4</td><td>Effluent Disposal</td><td>Rapid infiltration east of Hwy 101, 2.0 acres, 0.5 staff, beneficial increased flow to northern slough area</td><td>Upslope forest irrigation (26 acres), 20 Hp pump station, storage pond (9.8 acres), 0.5 staff</td><td>Rapid infiltration east of Hwy 101, 2.0 acres, 0.5 staff, beneficial increased flow to northern slough area</td><td>Upslope forest irrigation (26 acres), 20 Hp pump station, storage pond (9.8 acres), 0.5 staff</td></tr>
</table>

Figure 5.04

COMPARISON OF SYSTEM ALTERNATIVES
COMBINED SYSTEM - CORE AREA

Item	Description	Alt 3A	Alt 3B	Alt 3C	Alt 3D
CONVEYANCE					
1	Gravity sewer for new Tribal Housing connection	750 LF pipe , 2 manholes			
2	Potlatch State Park system improvements	Upgrade pump station, 5 commercial services			
3	Minerva RV Park system improvements	2040 LF pipe, 3 commercial services			
4	Service Area Creep plus North Boundary Area (Area D &	6250 LF pipe, 113 residential services, 3 commercial services			
5	Hwy 101 (Areas F, G & H) system improvements	11,500 LF pipe, future tribal center, 47 residential services, 7 commercial			
6	Reservation Road (Area J) system improvements	18,150 LF pipe, school, 108 residential services, 9 commercial services			
WASTEWATER TREATMENT					
7	Wastewater Treatment Plant	MBR, 293,500 gpd, 2.0 acres, 2.0 staff, reliable Class A effluent		SBR, 293,500 gpd, 2.4 acres, 2.0 staff, less reliable Class A effluent	
DISPOSAL					
8	Effluent Disposal	Rapid infiltration east of Hwy 101, 4.0 acres, 0.5 staff, beneficial increased flow to northern slough area	Upslope forest irrigation (55 acres), 35 Hp pump station, storage pond (21 acres), 1.0 staff	Rapid infiltration east of Hwy 101, 4.0 acres, 0.5 staff, beneficial increased flow to northern slough area	Upslope forest irrigation (55 acres), 35 Hp pump station, storage pond (21 acres), 1.0 staff

Figure
5.04

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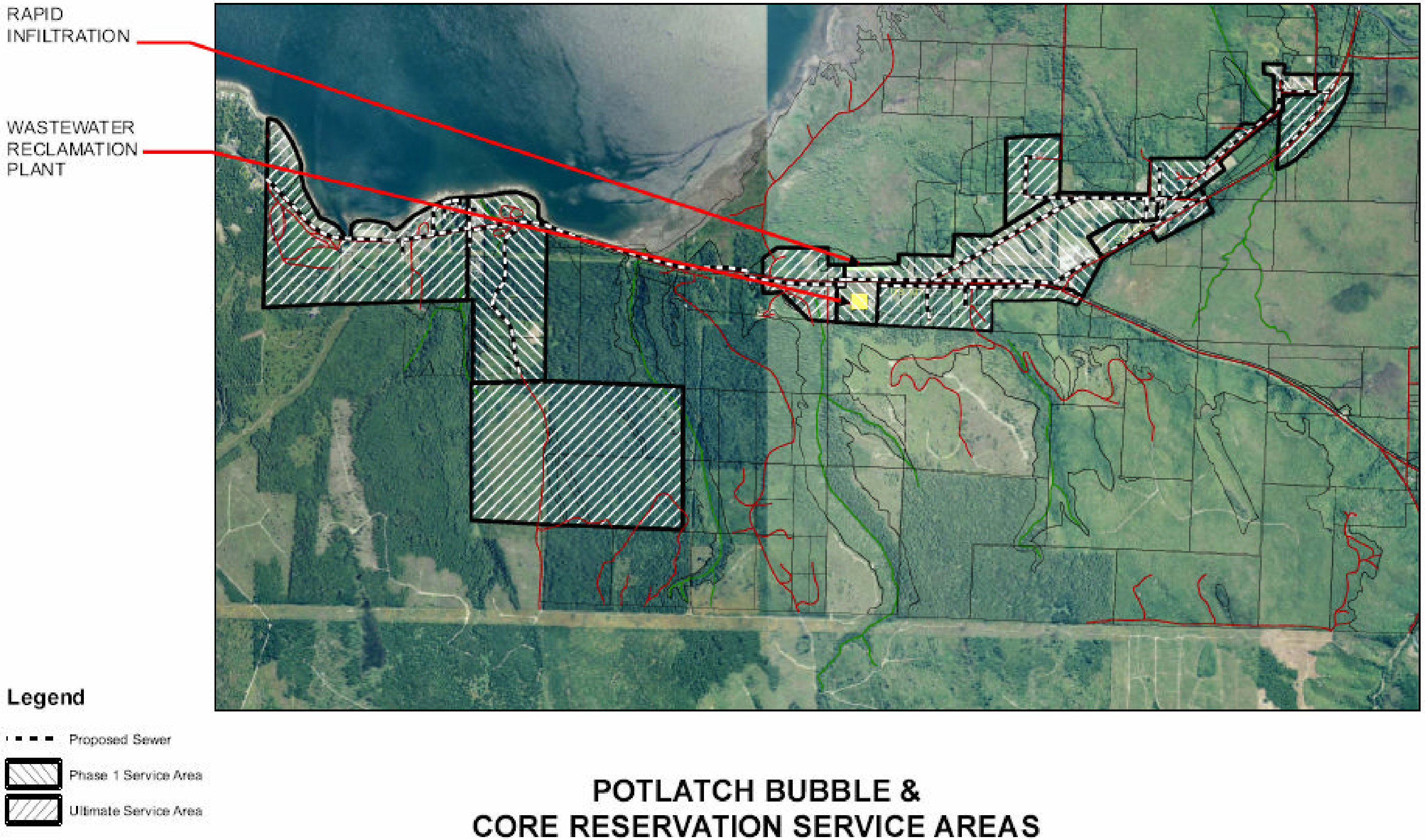
Figure 5.05



POTLATCH BUBBLE & CORE RESERVATION SERVICE AREAS

COMBINED TREATMENT SYSTEMS

Cascade Design Professionals, 2007

N
Feet
0 1,000 2,000

*Based on Skokomish Reservation mapping prepared by the Natural Resources Department of the Skokomish Tribe

Figure
5.05

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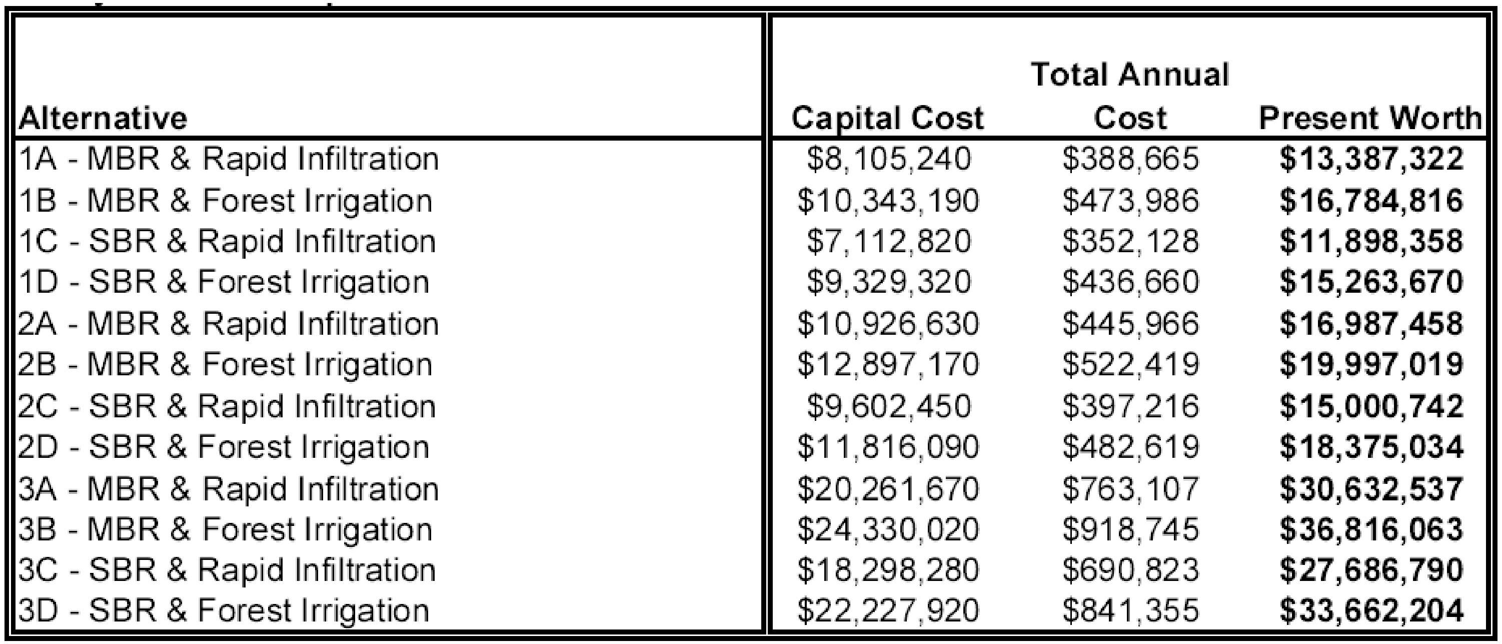
Figure 5.06

Life Cycle Cost Comparison



Alternative	Capital Cost	Total Annual Cost	Present Worth
1A - MBR & Rapid Infiltration	$8,105,240	$388,665	**$13,387,322**
1B - MBR & Forest Irrigation	$10,343,190	$473,986	**$16,784,816**
1C - SBR & Rapid Infiltration	$7,112,820	$352,128	**$11,898,358**
1D - SBR & Forest Irrigation	$9,329,320	$436,660	**$15,263,670**
2A - MBR & Rapid Infiltration	$10,926,630	$445,966	**$16,987,458**
2B - MBR & Forest Irrigation	$12,897,170	$522,419	**$19,997,019**
2C - SBR & Rapid Infiltration	$9,602,450	$397,216	**$15,000,742**
2D - SBR & Forest Irrigation	$11,816,090	$482,619	**$18,375,034**
3A - MBR & Rapid Infiltration	$20,261,670	$763,107	**$30,632,537**
3B - MBR & Forest Irrigation	$24,330,020	$918,745	**$36,816,063**
3C - SBR & Rapid Infiltration	$18,298,280	$690,823	**$27,686,790**
3D - SBR & Forest Irrigation	$22,227,920	$841,355	**$33,662,204**

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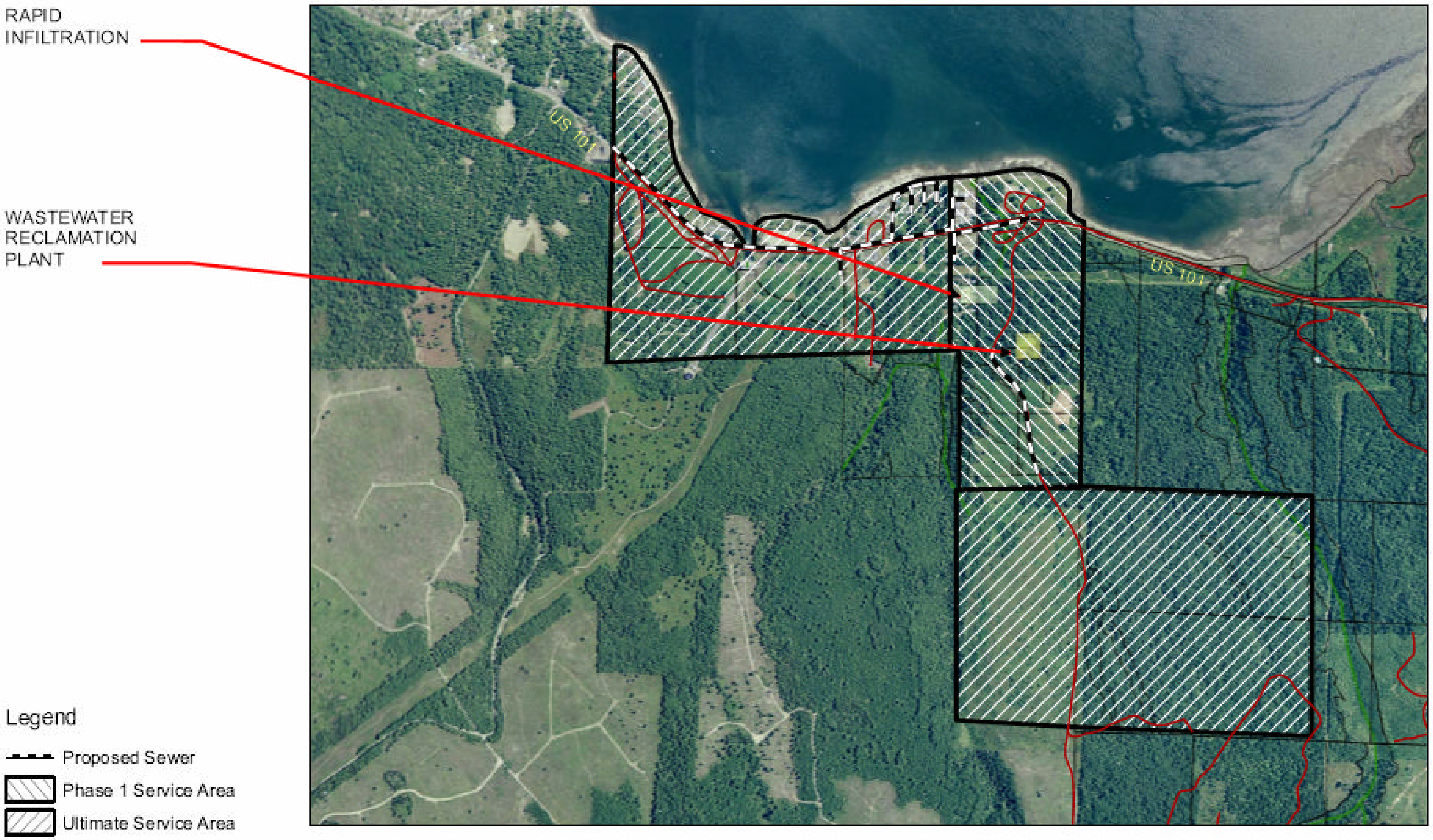
Figure 5.07



POTLATCH BUBBLE SERVICE AREA

SEPARATE TREATMENT SYSTEMS

Cascade Design Professionals, 2007

*Based on Skokomish Reservation mapping prepared by the Natural Resources Department of the Skokomish Tribe

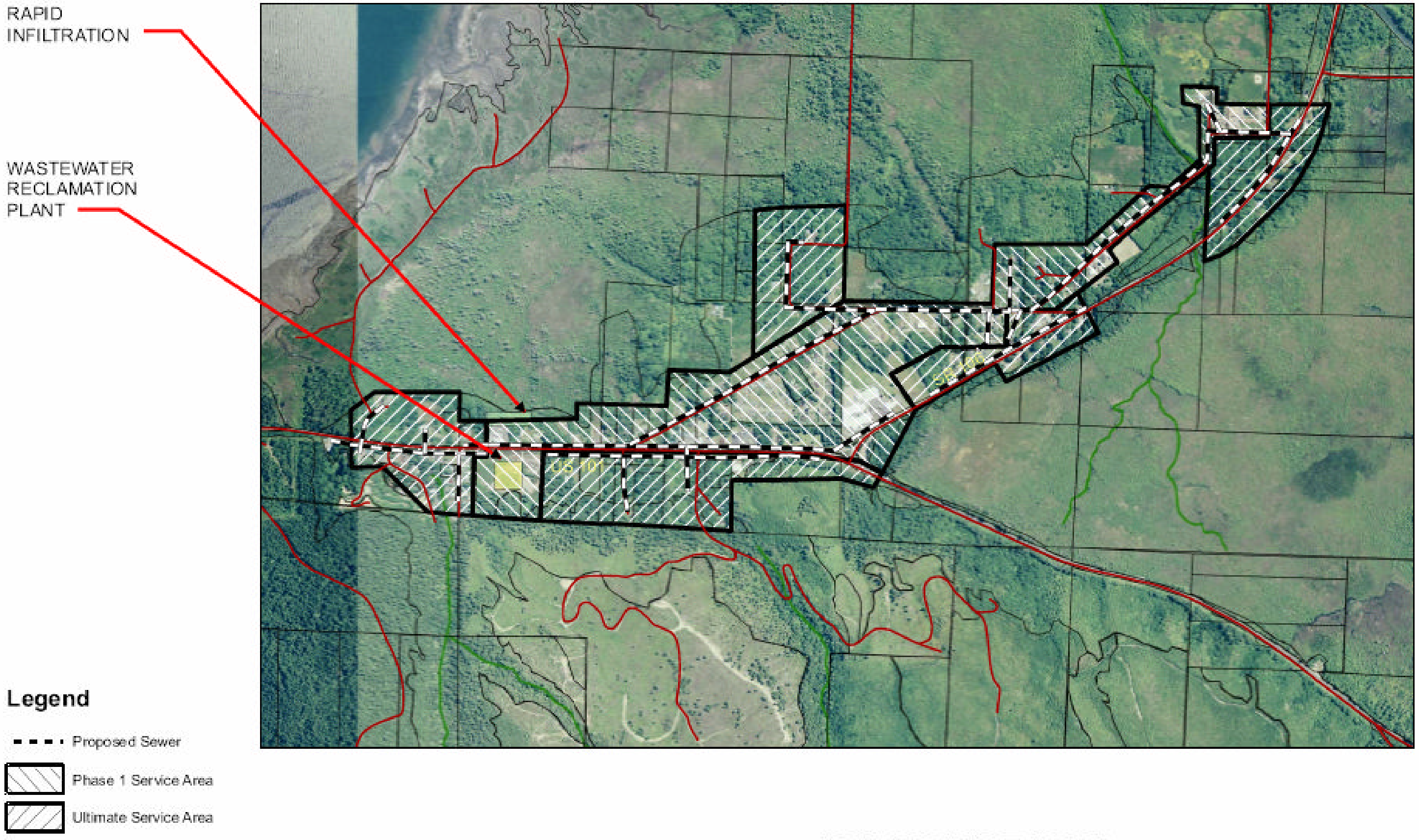
Figure
5.07

Figure 5.08

COST COMPARISONS - PHASED
(MBR & RAPID INFILTRATION)

Alt.	Description	Conveyance	Treatment	Disposal	Construction Total	Contingency	Eng, Admin & Perm	Total	Cost / ERU
PHASE 1									
1A	Potlatch Bubble, separate treatment	294,000	1,917,000	190,000	2,401,000	600,250	432,180	3,433,430	33,661
2A	Core Area, separate treatment	1,722,000	2,565,000	234,000	4,521,000	1,130,250	813,780	6,465,030	18,739
3A	Combined Treatment	3,210,000	3,546,000	317,000	7,073,000	1,768,250	1,273,140	10,114,390	22,627
PHASE 2									
1A	Potlatch Bubble, separate treatment	1,208,000	1,917,000	142,000	3,267,000	816,750	588,060	4,671,810	19,547
2A	Core Area, separate treatment	1,467,000	1,539,000	114,000	3,120,000	780,000	561,600	4,461,600	32,330
3A	Combined Treatment	2,700,000	4,082,000	314,000	7,096,000	1,774,000	1,277,280	10,147,280	26,916
TOTAL									
1A	Potlatch Bubble, separate treatment	1,502,000	3,834,000	332,000	5,668,000	1,417,000	1,020,240	8,105,240	23,769
2A	Core Area, separate treatment	3,189,000	4,104,000	348,000	7,641,000	1,910,250	1,375,380	10,926,630	22,622
3A	Combined Treatment	5,910,000	7,628,000	631,000	14,169,000	3,542,250	2,550,420	20,261,670	24,589

Figure 5.09



CORE RESERVATION SERVICE AREA

SEPARATE TREATMENT SYSTEMS

Cascade Design Professionals, 2007

*Based on Skokomish Reservation mapping prepared by the Natural Resources Department of the Skokomish Tribe

Figure
5.09

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6.0 Consolidated Ownership/Operations and Maintenance

6.1 Background and Process Overview

One of the principal requirements for every new sewer system is to establish who will own, operate and maintain their particular system. The Skokomish Tribal Council, the Board of PUD # 1 and the Mason County Board of Commissioners began their discussions on these issues at the most general level, as early as July and August of 2006. Since then, the staffs of these elected bodies, meeting as the TriParty Staff, have held a series of discussions to develop answers to the issues. For the purpose of these discussions, the following definitions have been developed:

Ownership: The role played by the party who holds the permit for the legal operation of a system; also responsible for the design, development and financing of the system, along with the necessary land acquisition and construction oversight. Once the system has been commissioned, the owner is responsible for setting and maintaining rates sufficient to ensure financial solvency of the system at a minimum and, ideally, a strong credit rating with critical bond rating agencies.

Operations: The role played by the party who is charged with the physical operation of the Wastewater Treatment facility, sending periodic bills for service, collecting customer payments, dealing with customers as they come and go on the system, and handling day-to-day financial matters within the budget established by the owner.

Maintenance: This is the role played by the party who performs preventive and reactive maintenance to the physical assets of the system, monitoring system performance to ensure compliance within the permit requirements, and making recommendations to the operator regarding plant upgrades and equipment replacement.

Consultants to the TriParty Staff generated a list of possible alternative models for ownership, operation and maintenance. The Tri- Party Staff was able to narrow the list of alternatives just through conversation, some being to complex and time-consuming to establish and others being infeasible from a practical or political perspective. At a subsequent meeting, the consultants facilitated the TriParty Staff's development of set of criteria to be applied to the remaining alternatives (see **Figure 6.1**). These criteria were loosely applied by the TriParty Staff to those alternatives and a few more of them were eliminated. Next, the consultants were asked to develop some possible scenarios around the remaining alternatives, setting a more detailed evaluation of the remaining alternatives. This evaluation was held in early February of this year and, as a result of the Tri-Party Staff's review, the following alternatives were recommended to the elected officials of the three entities for their review and approval.

6.2 Criteria for Reviewing Ownership

- Financial capacity
    - Ability to forecast, plan for and finance capital needs
    - Ability to issue debt and maintain suitable capital bond rating
    - Ability to generate revenue (rate-setting willingness/courage)
- Public willingness/acceptance of entity role
- Public willingness/acceptance of project
- Experience and capacity to oversee planning, design, permitting and construction
- Stability of governance and institutional structure
- Relates productively to community vision and intergovernmental (single and multi) objectives
- Regulatory and grant agencies accept owner eligibility and credibility

6.3 Criteria for Reviewing Operations and Maintenance

- Staff capacity, training and experience and equipment
- Systems and management methods
- Revenue collection capacity
- Systems
- Ability/willingness to exercise enforcement authority
- Ability and experience to balance cost and operational reliability
- Capacity, authority and ability to execute the plan/vision

6.4 Scenarios Considered

The Tri-Party staff developed role scenarios in terms of options for which entity could own and which could operate the recommended wastewater facilities for each planning area. These are summarized below.

6.4.1 Hoodsport RAC Central Wastewater Facilities

- County owns and operates
- County owns and PUD operates under contract with the County
- County owns and contracts with another public or private entity for operations
- County owns in the short term and PUD owns in the longer term. PUD operates with mutual aid agreement for operations among the three entities

6.4.2 Core and Potlatch Central Wastewater Facilities

- Skokomish Indian Tribe owns and operates
- Skokomish Indian Tribe owns and PUD operates under contract with the Tribe
- Skokomish Indian Tribe owns and PUD operates in the short term, then Tribe operates in the longer term, with mutual aid agreement for operations among the three entities

6.4.3 Managed On-site Facilities

- County manages and operates
- PUD manages and operates under contract with owners
- Private entity manages and operates under contract with owners
- Skokomish Indian Tribe manages and operates on Reservation

- Whatever entity operates the central facilities should operate the managed on-site facilities for that area

6.4 Recommended Approach

The recommended approach to ownership and operations is based on the entities' understandings of their respective capacities to take on the ownership or operations role and to meet the established criteria for the role.

HOODSPORT RAC CENTRAL WASTEWATER FACILITIES

The recommended approach for the Hoodsport RAC is for the County to finance, design and construct the wastewater facilities and to establish the utility and rates for the system. The County and PUD would consider transfer of ownership after some period of County ownership. Operations would be done by the PUD under contract with the County.

A proposed mutual aid agreement would be executed between the County, Skokomish Tribe and PUD #1. This agreement would provide the terms for providing operations and maintenance assistance among the entities upon request by one of the entities.

CORE RESERVATION AND POTLATCH CENTRAL WASTEWATER FACILITIES

The recommended approach for the Skokomish Reservation Core and Potlatch areas is for the Skokomish Tribe to finance, design and construct the wastewater facilities and to establish the utility and rates for the system. The Tribe would contract with the PUD for operations initially, and the Tribe would operate the facilities in the longer term when it gains the required staff and systems capacity and experience.

As discussed above, a mutual aid agreement executed between the three entities would provide back-up assistance for operations and maintenance among the entities.

MANAGED ON-SITE FACILITIES

The recommended approach for operations of "managed" on-site facilities is for the entity that operates the central facilities to also operate the managed facilities for that area. If the PUD becomes the primary operator of central wastewater facilities, then the PUD would be the primary contract operator for managed on site facilities for the Hoodsport to Skokomish region

AGREEMENTS NEEDED

In order to pursue the approaches recommended above the following agreements would be needed:

- Contract between Mason County and the PUD for the PUD to operate and maintain facilities in the Hoodsport RAC
- Mutual aid intergovernmental agreement between Mason County, the Skokomish Indian Tribe and PUD #1

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7.0 Summary Cost Estimates and Schedules

The following table presents a summary of the estimated project costs by stages. Facilities planning is the next step toward completion of the three projects defined in this report. Although the Skokomish Indian Tribe is not compelled to following Washington Department of Ecology's planning procedures (the Tribe is within the federal Environmental Protection Agency's jurisdiction), Skokomish officials have decided to follow the steps set forth in Washington Administrative Code 173.240. Not only will this simplify collective management of the three proposed projects, it also clearly indicates the Skokomish Indian Tribe's intention to meet or exceed both federal and state water quality requirements.

Under 173.240 a Facilities Plan is submitted for review and approval. The Facilities Plan describes in general terms the wastewater management approach, general location of facilities and financial considerations. This is followed by initiation of design and submittal of an Engineering Report that describes treatment processes, facility sizing and other factors that serve as the basis for final design. Ecology approval of the Engineering Report leads to preparation of the final designs, specifications and estimates necessary to secure bids for construction.

In the table below, costs for facilities planning are distinguished from design and design-related activities since grant funding necessitates this distinction. Similarly, design, engineering assistance during construction, permitting and project administration are included under design to make these activities distinct from actual construction as necessitated by grant funding.

The estimates for facilities planning, design, and construction/land acquisition are summed in the total cost to complete column. It is once again important to stress that these are planning level cost estimates. The construction costs are composed of unit cost estimates (such as the cost of a lineal foot of a certain type of pipe multiplied by the estimated feet required) and lump sum estimates for structures, etc. The sum of these construction estimates and a contingency factor of 15% to 25%, comprise the construction cost estimate for a project.

Other cost elements, such as design and project administration, are estimated as percentages of the construction cost. It is very likely that during preparation of an Engineering Report and during final design, construction cost elements will change. Accordingly, these estimates should not be considered final.

Cost Estimate Summary

Planning Area	*Facilities Plan*	*Eng. Rpt. & Admin./Design*	*Construction & Land*	*Total Cost to Complete*
Hoodsport RAC	$108,683	$1,921,340	$8,025,362	$9,946,702
Potlatch "Bubble"	---	$432,180	$3,001,250	$3,433,430
Core Reservation	---	$813,780	$5,651,250	$6,465,030
Potlatch+Core Reservation	$175,257	---	---	$0
Total for 3 Planning Areas	$283,940	$3,167,300	$16,677,862	$19,845,162

Details behind the numbers presented in the table above can be found in **Figure 7.01**. Three engineering firms developed estimates for this project definition effort. Their estimating approached differed somewhat. The Hoodsport estimates are presented in tabular form in **Figure 2.23a**. The estimates developed by engineers have an asterisk beside them. The numbers for the Potlatch "Bubble" and Core Reservation projects (found in the table at the bottom of **Figure 7.01**) were all prepared by engineers using the technique described above. Consequently, there are slight differences in developing the estimates, but these differences are not consequential at this stage of cost estimating.

During preparation of the Facilities Plans, it is recommended that a common cost estimating approach be used. It is especially important that a common estimating system be used during design. This is easily achieved if a single firm or joint venture is employed as designer.

NOTE:
As this report was being prepared an opportunity for funding a major portion, if not all, of the cost of preparing Facilities Plans arose. It appears that sufficient funding will be available to prepare these plans provided the Tri-Party group (the Skokomish Indian Tribe, Mason County PUD #1 and Mason County) can act quickly enough to meet the timing conditions for use of the money.

*For this reason the Facilities Plan elements of the table presented above and the table presented in **Figure 2.23a** are shaded. **It is also critical to note that the "Cost to Complete" column in the table above <u>no longer includes numbers in the "Facilities Plan" column</u>.***

Several schedules for the projects defined in this report have been developed. The example schedule for Hoodsport, presented in **Figure 2.24**, indicates the possibility of completion by early 2010. Similar schedules could also apply for the Potlatch "Bubble" and the Core Reservation. However, the greatest urgency surrounds the Potlatch "Bubble."

As noted in Section 5, several factors make the Potlatch effort critical:

- New Skokomish Indian Tribe housing is being constructed in the Potlatch service area. A wastewater project timely completed would avoid the need for interim septic systems serving the new housing.
- Potlatch State Park has funding and is in urgent need of a wastewater project to satisfy legislative concern for improved wastewater management.
- A land transfer involving the Tribe, State Parks and the Minerva Beach Community presents timely opportunity for improved wastewater management.

The Hoodsport and Core Reservation projects also have many factors arguing for their prompt completion. Relocation of the Tribal Center and commercial redevelopment pressures in both Hoodsport and the Core Reservation need wastewater management attention.

Throughout the planning process to develop the project definitions in this report there has been agreement that if at all possible the projects should be designed so as to not preclude the very long term possibility that all three wastewater systems might one day be connected. Further, if similar design standards, similar equipment and similar operating procedures were designed into the projects, there would likely be cost savings achieved through joint operations (see Section 6).

Because it would be efficient for the three projects to be similarly designed, because the TriParty group has agreed to pursue funding and development of the projects collectively, and because prompt completion is important for all three projects, it is recommended a single design firm or joint venture be retained to engineer all three projects. Assuming a firm or joint venture with sufficient capacity is retained, all three projects could move forward together and benefit from joint equipment selection and other design design decisions being made concurrently rather than sequentially. Additionally, worked together, the collective effort becomes large enough to enjoy a more favorable bidding climate with larger contractors seeing opportunities to have one vs. three mobilizations, etc.

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Figure 7.01

Hoodsport-Skokomish Facilities Planning Summary

Activity	*Hoodsport*	*Potlatch*	*Core Res*	*Pot + Core*
Engineering	$24,516			$38,424
Hydrogeology + Survey	$31,500	$15,750	$15,750	$31,500
Environmental Documentation	$30,000	$30,000	$30,000	$60,000
Financial	$22,667	$22,667	$22,667	$45,333
	$108,683	$68,417	$68,417	$175,257

Funding available for Facilities Planning as of March 22, 2007

Hoodsport RAC Cost Summary

* = engineer's estimate		Expanded Service Area 2	Service Area 2
Total Construction Cost Estimates (sums similar lines above)			
Engineer's Estimate		$6,170,071	$3,961,700
Contingency		$925,511	$676,340
8.3% Sales Tax		$589,780	$384,957
Construction Cost		$7,685,362	$5,022,997
Other Costs to Complete (some a % of Construction Cost)			
Facilites Plan and Env Documentation		$108,683	$108,683
Design Engineering	12%	$922,243	$602,760
Assistance During Const.	8%	$614,829	$401,840
Administration	2%	$153,707	$100,460
Design/Admin Contingency	3%	$230,561	$150,690
Cluster System Land		$90,000	
Sewer System Land		$250,000	$210,000
		$2,370,023	$1,574,432
Total Cost to Complete			
Grand Total		$10,055,385	$6,597,430

Figure 5.08

COST COMPARISONS - PHASED

(MBR & RAPID INFILTRATION)

Alt.		Conveyance	Treatment	Disposal	Construction Total	Contingency	Eng, Admin & Perm	Total	Cost/ERU
PHASE 1									
1A	Potlatch Bubble, separate treatment	294,000	1,917,000	190,000	2,401,000	600,250	432,180	3,433,430	33,661
2A	Core Reservation, separate treatment	1,722,000	2,565,000	234,000	4,521,000	1,130,250	813,780	6,465,030	18,739
3S	Combined Treatment	3,210,000	3,548,000	317,000	7,075,000	1,768,750	1,273,500	10,117,250	22,627

Figure
7.01

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8.0 Funding

Wastewater management infrastructure is expensive. Regardless of the treatment technology, the underground conveyance systems and treatment facilities involve are comparatively long-lived, but capital intensive. Typically, areas that are more densely populated develop wastewater infrastructure as population increases. In the Hoodsport-Skokomish region, however, no conveyance systems are in place and treatment is generally conventional individual on-site septic systems. This means conveyance must be built in already-built environments with various other buried utilities and/or developed public rights-of-way. This adds to the cost.

The following table lists funding that has already been offered for the Hoodsport-Skokomish region. The funding in the shaded area is spent. The rest of the funding remains available as of early 2007.

Grants for Hoodsport-Skokomish Wastewater Management			
Puget Sound Early Action	$57,000	Alternatives Study	Spent and completed
Puget Sound Action Team-Hood Canal Coordinating Council	$177,320	Project Definitions	Spent and completed
STAG ’03 for Hoodsport	$667,800	Construction	Grantee = PUD (45% needed match $601K)
STAG ’06 for Hoodsport – Skokomish Region	$4,300,000	Construction	Grantee = unassigned (45% needed match $3,870K)
Centennial Clean Water Fund	$1,000,000	Design/Construct	Grantee = unassigned
State Parks – Potlatch	$1,050,000	Design/Construct	’06 Leg. Appropriation
Unused “Earmarked” or Committed Funds	**$7,017,800**		

All of the funding listed above is in the form of grants. The two State and Tribal Assistance Grants (STAG) require 45% matching funds. Federal money may not be used f6r matching purposes, however state and private grants and loans as well as “in kind” efforts such as allowable staff costs may be suitable for match. Neither State and Tribal Assistance Grant is “under contract” (no specific grant agreement has been established that specifies exactly how the money is to be used and what entity is responsible for its proper management). The ’03 money in particular may be at risk for continued re-appropriation.

STAG funds are administered by the Environmental Protection Agency. In the table they are listed as being for construction. It is possible to use these funds for design, but the justification and administration of STAG money for services which are not competitively bid is comparatively complex and is not commonly done in US Region 10.

The Washington State Centennial Clean Water Fund grant may be used for both design and construction and is generally suitable for meeting federal grant match requirements. Like the STAG funding, no contract has been executed for this grant. The $1,050,000 state legislative appropriation listed is money assigned to the Washington State Parks Department for improving wastewater management at Potlatch State Park. It is intended to be obligated by the end of June, 2007, and its expenditure is expected to result in suitable resolution of wastewater management for the park. The State Parks Department has been a willing and active participant in discussions and planning for a wastewater project in the Potlatch Planning Area. The $1,050,000, by current estimates, may be approximately the right amount to cover State Park's appropriate share of the project defined for Potlatch.

As always, grants are more desirable than even zero interest loans. The absence of any existing utility to initiate borrowing, the need for nearly all facilities to be completed and operational before there is any revenue to pay back borrowed money, and the comparatively small number of customers relative to the substantial operating and capital requirements leave limited capacity to handle borrowing as a major sources of funding.

8.1 Potential Funding Sources

The TriParty Staff reviewed potential funding sources and completed development of a grant and loan source inventory. The inventory is presented on the next three pages. It is divided into three sections that list relevant sources for planning, designing and constructing wastewater management facilities. Among the most conveniently available loans are those from the Washington Public Works Board that administers the Public Works Trust Fund. Grants are typically available competitively on an annual cycle such as those from the Department of Ecology's Centennial Clean Water Fund.

Federal funding typically requires completion of a National Environmental Policy Act (NEPA) environmental review. Many organizations elect to prepare a State Environmental Policy Act (SEPA) reviews concurrently. See Sections 2.1.5, 3.1.5, 4.1.5 and the related **Appendix 2.2** for additional details.

Funding Sources Table

TriParty Staff
1/13/07

Source	*Maximum*	*Match*	*Interest*	*Term*	*Available Grants*	*Availability of Funds*
Planning						
Public Works Trust Fund: Applications due 5th of each month. Awards occur monthly.	$100,000	None	0%	1-6 years	None	90 days after approval
Community Development Block Grant: Planning Only Continuously open, planning only Awards follow staff resources meeting	$35,000	Should Offer	-	-	Jurisdictions with >51% lower/middle income	90 days following approval
Community Economic Revitalization Board: Submit 45 days prior to quarterly meetings in January, March, July and November. Award follows Board meeting.	$50,000	10%	-	-	Yes	When grant contract is executed
USDA Rural Development: Predevelopment Grants[i] Must meet with RD to determine if eligible	$28,000	None	-	-	Available only if future funding is through RD	When grant contract is executed
USDA Forest Service:	Funding is cut					
State Revolving Fund: Applications due in October Awards announced in January	<50% of funds available	-	0% - 2.6%	6 -20 yrs.		Spring

Source	Maximum	Match	Interest	Term	Available Grants	Availability of Funds
Design						
State Revolving Fund: Applications due in October Awards announced in January	<50% of funds available		0% - 2.6%	6 -20 yrs.		Spring
Centennial Clean Water Grant Fund: Applications due in October Awards announced in January	<50% of funds available		0% - 2.6%	6 -20 yrs.		Spring
State Revolving Fund: Applications due in October Awards announced in January	<50% of funds available	-	0% - 2.6%	6 -20 yrs.		Spring
Public Works Trust Fund: Pre-Construction Applications due 5th of each month. Awards occur monthly.	$1,000,000	15% 10% 5%	0.5% 1.0% 2.0%	20 yrs		90 days after approval
State and Tribal Assistance Grants: Congressional grant administered by EPA		45%	-	-		When grant contract is executed
US Dept. of Commerce: Federal Economic Development Administration						
Bureau of Indian Affairs*						

Construction *-continues on next page-*						
Public Works Trust Fund: Construction Applications due in May. Awards occur in August.	$10,000,000	15% 10% 5%	0.5% 1.0% 2.0%	20 yrs	None	May following award
Community Trade and Economic Development: Jobs/Communities Can be Legislative ear mark		-	-	-		
Community Trade and Economic Development: Job Development Can be Legislative ear mark		-	-	-		

Source	*Maximum*	*Match*	*Interest*	*Term*	*Available Grants*	*Availability of Funds*
Centennial Clean Water Grant Fund: Facility Projects Applications due in October Awards announced in January	<50% of funds available	-	0% - 2.6%	6 -20 yrs.		Spring
Community Development Block Grant: General Purpose Apply in November Award by April	$1,000,000	Should Offer	-	-	Jurisdictions with >51% lower/middle income	June
Community Development Block Grant: Community Investment Fund[ii] Continuously open Awards follow staff resources meeting	$1,000,000	Should Offer	-	-	Jurisdictions with >51% lower/middle income	90 days after approval
Community Economic Revitalization Board: Submit 45 days prior to quarterly meetings in January, March, July and November. Award follows Board meeting.	$1,000,000	10%	-	Tied to cost of 10 yr. bond		When grant contract is executed
State and Tribal Assistance Grants: Congressional grant administered by EPA		45%	-	-		When grant contract is executed
Centennial Clean Water Grant Fund: Hardship Facility Projects Applications due in October Awards announced in January	$10,000,000	Grant matched by mandatory SRF loan	0% - 1.5%	6 -20 yrs.	<$5,000,000 based on hardship	Spring
Centennial Clean Water/State Revolving Fund: Activity Applications due in October Awards announced in January	$500,000	Cash, in-kind, other grants/loans	0% - 1.3%	5 yrs.	Up to 75% grant based on hardship	Spring
USDA: Tribal Wastewater Assistance*	$1,000,000					
Indian Health Services*						
Private Foundation Assistance						
Tacoma City Light*						

*Available to Skokomish Tribe

Half of one percent of the money for the Water and Waste grant program is available for Engineering Report and NEPA documentation.

i Must be in top three on County's WA-CERT list.

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The preceding inventory is neither complete nor static. It is a starting point. Public Utility District #1, the Skokomish Tribe and Mason County is each experienced at making application for, being awarded and managing grants and loans. Individuals on the staffs of each entity can make application for and pursue grant and loan opportunities. To aid this effort, it is recommended files of relevant wastewater grant and loan applications and relevant data be actively maintained by some person or position responsible to the TriParty group so as to assure consistency and simplicity when submitting grant and loan applications

8.2 Unified Funding Strategy

The TriParty Staff and the elected officials of the three parties to the August Memorandum of Understanding have had frequent and substantial discussion concerning the pursuit of funding. Prior to the February 6, 2007, meeting of elected officials from the PUD, the Tribe and the County, staff used a funding planning tool to consider various approaches for using the grant funds already available and filling in the voids with applications for other assistance. Attempting to fairly allocate existing grant resources among the three planning area projects proved complex and ineffective, not unlike "fitting square pegs in round holes." Dealing with various stages (pre-design, design, construction) of the three projects in aggregate proved more satisfactory.

The TriParty staff's review showed better ability to promptly use existing grants and probably better chances and flexibility in getting additional funding by the parties working together. This viewpoint was presented to elected officials on February 6th. Although no specific action was taken, the group reaffirmed an earlier position to pursue funding collectively, not competitively, to fullest extent possible with the understanding that…

> Full commitment exists currently by all entities to this memorandum to plan, design, and implement and operate wastewater solutions all three planning areas although work schedules and completion dates may vary.
>
> *August 31, 2006*
> *Memorandum of Understanding*

The parties recognize that a unified funding approach among the three parties makes efficient use of funding resources, provides a stronger voice in securing funds, and draws on the best talent from each entity to vigorously pursue the common goal of completing projects in all three Planning Areas. The parties will work jointly to secure and manage funding. It is completely clear that the parties to the Memorandum of Understanding do not collectively constitute a corporate entity. As a group they have no ability to execute grant and loan contracts with funding agencies. Agreements will need to be executed by one or more of the parties for each funding opportunity.

The proposed Unified Funding Strategy to pay for the implementation of all three project definitions includes the following:

1. Arrange "fiscal agent" status for one entity
2. Find $160,000 to do pre-design (complete Facilities Plans)
3. Concurrent with the preceding step, fund NEPA/SEPA as required for grants
4. Plan for state and private funding and "in-kind" efforts to serve as

federal match with particular attention to federal eligibility

5. Work through agreements necessary to sign grant contracts for pre-design
6. Arrange management structure and staff (someone providing on-going attention to TriParty matters) to suit funding strategy and figure out how to pay for it during pre-design, design and construction
7. Pursue construction funding gap on various fronts

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Appendix 1.1

Memorandum of Understanding
Mason County PUD #1, Skokomish Indian Tribe, Mason County
August 31, 1006

COPY

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Page: 1 of 9
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MASON COUNTY COMMISSIONERS MEMO 40.00 Mason Co, WA

After Recording Return to:
Mason County Commissioners

MEMORANDUM OF UNDERSTANDING BETWEEN THE SKOKOMISH INDIAN TRIBE, PUBLIC UTILITY DISTRICT NO. #1, AND MASON COUNTY FOR THE IMPROVEMENT AND PROTECTION OF THE WATER QUALITY OF HOOD CANAL

I. INTRODUCTION AND PURPOSE:

This 'Memorandum of Understanding' (MOU) is made, voluntarily agreed upon, and entered into this 31st day August, 2006, between the Skokomish Indian Tribe (hereinafter referred to as 'The Tribe'), Public Utility District #1(hereinafter referred to as 'PUD #1), and Mason County, a subdivision of the State of Washington (hereinafter referred to as 'The County'). The three, above-cited entities recognize the need to work in a joint effort to protect the public health, particularly the water quality of the lower Hood Canal. Each government entity further recognizes the necessity of improving proper sewage disposal as a principal tool to improving and maintaining the Hood Canal water quality at a healthy level and protecting marine and near-shore resources. The three, above-cited entities also understand they must work in collaboration to formulate a comprehensive strategy to develop the necessary planning framework to construct and manage the sewerage and wastewater works required for improving and maintaining the water quality of the Hood Canal. This agreement enumerates the understandings of the three, above-cited entities. This agreement also sets forth the responsibilities each entity must undertake to ensure wastewater systems are planned, developed, and properly managed and maintained in the Hoodsport Rural Activity Center (RAC), within the Potlatch Park and Minerva Beach areas within the boundaries of the Skokomish Indian Reservation and other areas within the Skokomish Indian Reservation all located within Mason County.

II. AUTHORITY:

This Memorandum of Understanding involving the three, above-cited government entities is made as a result of dire concern for the water quality of the lower Hood Canal, which has been targeted by the Washington State Legislature as 'Aquatic Rehabilitation Zone No. 1' (A.R.Z. No. 1) in 2005. The three entities of this agreement realize the significance of this designation and the need for immediate action to cure water quality issues plaguing the Hood Canal. Further, the three entities privy to this agreement place great significance on and in full support of the public policy intended and addressed by the Revised Code of Washington (R.C.W.) 90.48, 90.54, 40 C.F.R. 131.12 and Washington Administrative Code (W.A.C.) 173-201A regarding water quality standards for surface waters. In the present matter, this Memorandum is made to address specific water quality issues plaguing the State Waters of the lower Hood Canal. The entities involved in this Memorandum support the pronouncement made in R.C.W. 90.48 as the basis of the intent of this Memorandum of Understanding:

> It is declared to be the public policy of the state of Washington to maintain the highest possible standards to insure the purity of all waters of the state consistent with public health and public enjoyment thereof, the propagation and protection of wild life, birds, game, fish and other aquatic life, and the industrial development of the state, and to that end require the use of all known available and reasonable methods by industries and others to prevent and control the pollution of the waters of the state of Washington. Consistent with this policy, the state of Washington will exercise its powers, as fully and as effectively as possible, to retain and secure high quality for all waters of the state. The state of Washington in recognition of the federal government's interest in the quality of the navigable waters of the United States, of which certain portions thereof are within the jurisdictional limits of this state, proclaims a public policy of working cooperatively with the federal government in a joint effort to extinguish the sources of water quality degradation, while at the same time preserving and vigorously exercising state powers to insure that present and future standards of water quality within the state shall be determined by the citizenry, through and by the efforts of state government, of the state of Washington. (R.C.W. 90.48.010).

The entities to this agreement further support the goals expressed in the Skokomish Tribal Code (S.T.C.) 6.03.003:

a) To protect the natural resources of the Skokomish Reservation from contamination, pollution and other degradation;

b) To protect and enhance the habitat of all types of fish, shellfish, and wildlife resources, particularly the Skokomish River estuary and associated wetlands that are critically important components of the ecosystem which support fish and shellfish resources;

c) To minimize the adverse impacts that would result from locating developments in environmentally sensitive areas;

d) To preserve the open, rural environment that has been traditional for Skokomish Indians; and

e) To allow sufficient development within this natural environment to enable all Skokomish families who desire housing and public services to obtain them.

III. UNDERSTANDINGS AND RESPONSIBILITIES:

A. The Skokomish Tribe, PUD No. #1, and Mason County share serious concerns about wastewater impacts on public health and marine resources of the lower Hood Canal in the region of the Skokomish Reservation through the Hoodsport area of Mason County immediately adjacent the Hood Canal. The Canal is identified as a waterway of Statewide Significance within the State of Washington and as an arm of Puget Sound as part of an estuary of national significance. All entities of this agreement are committed to urgent and immediate action to improve the present, dire situation of the water quality of the lower Hood Canal.

B. The Skokomish Tribe, PUD #1, and Mason County are the government entities best positioned to: 1) Develop area planning strategies; 2) Take immediate action to assure public health protection via addressing water quality concerns; and 3) Monitor water quality conditions as a part of this agreement; 4) Further, the above-cited entities are also positioned to ensure the compatibility of different sub-systems in the larger planning area of Mason County and the State of Washington and the federal government as related to the Skokomish Indian Reservation; & 5) Ensure the long-term operation and maintenance of the wastewater facilities involved in this project.

C. The Skokomish Tribe, PUD #1, and Mason County are committed to a collaborative approach for addressing wastewater impacts on public health marine resource protection and water quality in the lower Hood Canal region cited in 'Section III: Subsection A' of this agreement.

D. The 'Wastewater Management Alternatives Analysis' report prepared by Gray and Osbourne is accepted as the agreed upon and the appropriate guiding report for directing the work necessary to begin improving the water quality of lower Hood Canal in the area described by 'Section III: Subsection A' of this agreement.

E. Each entity to this agreement understands a central treatment plant for the Hoodsport to Skokomish region may be possible, reliable, and environmentally effective. However, each entity also understands such a treatment plant would also be very costly and difficult to reconcile/coordinate with local land use plans, growth management laws, other applicable environmental laws and regulations for the State of Washington, the United States and the Skokomish Tribe.

F. Each entity of this agreement understands and acknowledges a multiple wastewater management approach (small treatment plants, clustered and enhanced on-site systems, managed on-site systems, pilot or demonstration projects) may be the best means of improving and maintaining water quality in the lower Hood Canal area described in this agreement. Such multiple wastewater approaches include tailoring the approaches to specific local conditions in order to protect the public health by improving and maintaining water quality. Further, such multiple wastewater approaches can be implemented quickly under all applicable local, state, and federal laws.

G. Mason County, in particular its Board of Health, is moving forward to develop and implement an enhanced on-site wastewater management program to protect public health sensitive and marine areas in a manner intended to be consistent with new state legislation and forthcoming agency rules.

H. The three most densely developed neighborhoods; 1) Hoodsport; 2) Potlatch/Minerva Beach area; and 3) the Skokomish Indian Reservation are in the most urgent need of wastewater management solutions and can be considered initial individual planning areas.

I. Assignment of responsibilities for planning, designing, and implementing appropriate strategies and developing suitable funding for these activities is a critical first step which needs to be addressed first and foremost.

J. Sufficient funding exists now to start with preliminary planning, design, and some implementation while seeking additional funds to complete wastewater management solution implementation.

K. Full commitment exists currently by all entities to this memorandum to plan, design, and implement and operate wastewater solutions in all three planning areas although work schedules and completion dates may vary.

L. Full commitment exists currently by all entities to this memorandum to involve the affected public in meaningful ways at critical steps in the process for all the planning work in the areas subject to this agreement.

M. Designing, implementing, and operating wastewater management solutions should, to the fullest extent possible, rely on uniform engineering standards and compatible approaches so as to be as efficient as possible.

N. Determining these assignments requires preliminary study before agreement can be reached on near and long-term responsibilities.

O. A uniform, master strategy consisting of the wastewater management solutions, including phasing, cost estimates, methods of financing, and any facility management shall be approved by each of the entities privy to this MOU prior to being implemented.

IV. REPORTS

The 'Wastewater Management Alternatives Analysis' report prepared by Gray and Osbourne is accepted as the agreed upon and the appropriate guiding report for directing the work necessary to begin improving the water quality of lower Hood Canal in the area described by 'Section III: Subsection A' of this agreement. The County through use of the existing EPA- State/Tribal Assistance (STAG) grant will pay all costs for the guiding report and associated documentation.

In addition, the County will facilitate the work effort through a separate, executed professional services contract with Art O'Neil and Associates, hired to address and resolve wastewater management, including sewage, concerns for the County.

V. FUNDING:

Each entity privy to this MOU intends to work towards providing adequate funding, whether by grant or otherwise, to help assist in bearing the cost as each entity sees fit and economically feasible to do so. Funding of the different multiple wastewater management approaches shall be paid by each entity capable to do so at the time whether through grants or other means. The exact detailing of such costs and parties responsible for such costs shall be specified during the initial planning strategy stage so all funding issues are resolved prior to the commencement of work as agreed upon by the parties in writing via future agreements to be negotiated and finalized. All funding issues must be resolved to the full satisfaction of all three entities engaging and agreeing to this Memorandum of Understanding prior any party becoming legally obligated to provide such funding.

VI. OTHER PROVISIONS:

A. Amendment: This agreement may be amended at any time by mutual written agreement of all, three parties.

B. Liability/Hold harmless/indemnification: Each party shall be responsible for its own liability arising from its respective acts or omissions. Each party shall be liable and responsible for the consequence of any negligent or wrongful act or failure to act on the part of itself and its officers and employees. No party privy to this MOU agrees to assume liability for the others, or defend the other parties from the other party's negligent acts or omissions. No party privy to this MOU shall seek damages or any other remedy from the other parties for the consequences of any act or omission of any person, firm or corporation not party to this Agreement.

C. Duration and Termination: This Memorandum of Understanding shall become effective commencing at the time of the signing by the final party to this MOU. This agreement shall continue until otherwise modified or terminated. Modification will occur only with mutual and written consent of all parties privy to this MOU. Termination may be pursuant written notice to the other entities, and shall be effective upon receipt of such written notice by the other entities, or within three (3) days of mailing such notice, whichever comes first. Upon termination, property acquired shall be the property of the entity purchasing it and that entity may hold or sell the property as it deems fit. The parties agree this MOU should be reviewed at least every five (5) years.

D. Implementation: A Master strategy consisting of the wastewater management solutions, including phasing, cost estimates, methods of financing, and any facility management shall be approved by each of the parties privy to this MOU prior to being implemented.

E. Non-waiver of rights. The parties agree the excuse or forgiveness of performance, or waiver of any provisions(s) of this Agreement does not constitute a waiver of such provisions(s) or future performance, or prejudice the right of the waiving party to enforce any of the provisions of this agreement at a later time.

F. Joint Technical Advisory Board: There shall be a Joint Technical Advisory Board, which shall consist of: (1) One duly authorized representative from P.U.D. No. 1; (2) One duly authorized representative from the Skokomish Indian Tribe; and (3) the Director of the Department of Community Development for Mason County. This Joint Technical Advisory Board shall be responsible for administering any joint and cooperative undertakings originating from this agreement. Any action of the Joint Technical Advisory Board shall be decided by majority of the Joint Board. This Advisory Board may adopt rules of procedure, as they deem fit.

G. Regular Meetings: The parties to this agreement, through authorized representatives, agree to meet at a minimum of at least quarterly (four times per year), to assess the operating efficiency of this project to ensure the highest compatibility with the goals and intentions pronounced by this agreement. These meetings consisting of duly appointed representatives shall occur separate and distinct from the meetings involving the Joint Technical Advisory Board.

///

H. Notices: Notices shall to the other party shall be sufficient if delivered personally, or mailed, to the following representatives:

MASON COUNTY CONTACT INFORMATION:

Clerk of the Board
Mason County Board of Commissioners
411 North Fifth Street
Shelton, WA 98584

SKOKOMOSH TRIBE CONTACT INFORMATION:

Darlyn Warren, Executive Secretary
Skokomish Tribal Council
N. 80 Tribal Center Road
Skokomish Nation, WA 98584

PUBLIC UTILITY DISTRICT NO. 1 CONTACT INFORMATION:

Richard Wilson, Manager
PUD No. 1 of Mason County
N. 21971 Hwy. 101
Shelton, WA 98584

I. Severability. If a court of competent jurisdiction holds any part, term or provision of this Agreement to be illegal or invalid in whole or in part, the validity of the remaining provisions shall not be affected, and the parties' rights and obligations shall be construed and enforced as if the agreement did not contain the particular provision held to be invalid.

J. Authority: Each entity to this agreement represents to the others that the undersigned of each entity signing on behalf of the entity represented has the requisite authority to into this MOU.

K. Further Obligation: The entities to this MOU recognize there does not exist any obligation of any entity into further agreement and the obligation contained herein represent the only obligation any entity has to the other parties privy to this MOU concerning the subject matter of this MOU.

L. Entire agreement: The parties agree this MOU is the complete expression of its terms and conditions. Any oral or written representations or understandings not incorporated in this MOU are specifically excluded.

This 'MEMORANDUM OF UNDERSTANDING' (MOU) is made between the Skokomish Indian Tribe, Mason County, and Public Utility District (P.U.D.) Number One:

Mason County

Dated this 31st day of August, 2006.

Lynda Ring Erickson

Lynda Ring Erickson, Chair
On Behalf of Mason County

Attest:	Approved as to form:
Becky Rogers	
Becky Rogers Clerk of the Board For the Mason County Commissioners	T.J. Martin Deputy Prosecuting Attorney Attorney on behalf of Mason County

Skokomish Indian Tribe

Dated this 31st day of August, 2006.

Denese LaClair

Denese LaClair, Chair

Brian H. Collins
Senior Tribal Attorney
Skokomish Indian Tribe

///

Public Utility District (PUD) No. 1

Dated this 31st day of August, 2006.

Karl Denison

Karl Denison, President

THIS MEMORANDUM OF UNDERSTANDING IS FURTHER SUPPORTED AND MADE WITNESS BY:

Cong. Norm Dicks

Congressman Norm Dicks
Sixth Congressional District Representative
State of Washington

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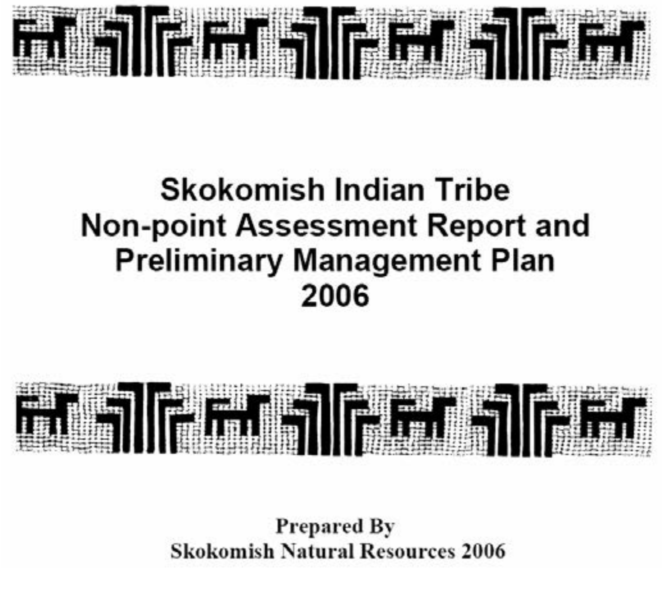
Appendix 1.2

Skokomish Indian Tribe
Non-Point Assessment Report and
Preliminary Management Plan
2006

Because of its size, this document is NOT included in this printed report version. It is include in the compact disk (CD) version of this report.



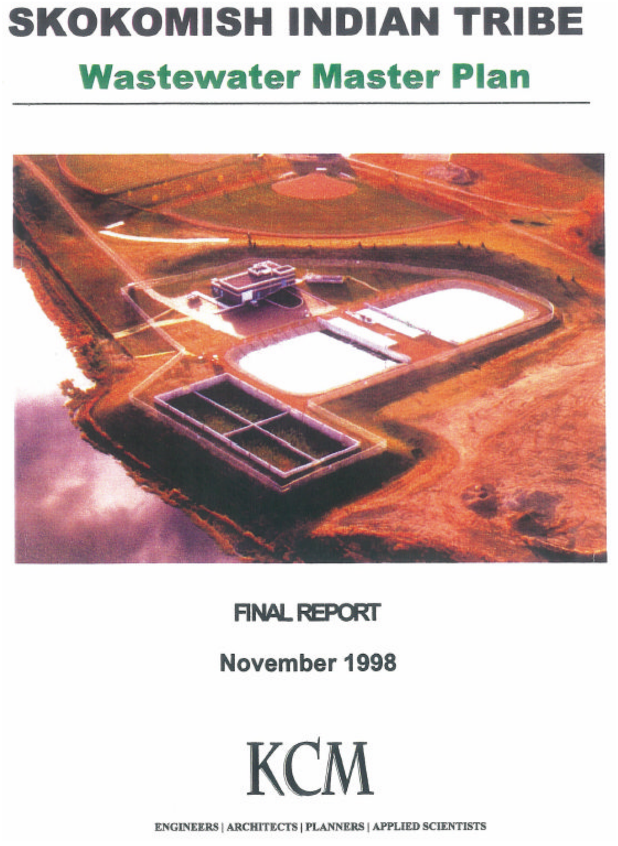
Skokomish Indian Tribe
Non-point Assessment Report and
Preliminary Management Plan
2006

Prepared By
Skokomish Natural Resources 2006

Appendix 1.3

Skokomish Indian Tribe
Wastewater Master Plan
November 1998

Because of its size, this document is NOT included in this printed report version. It is include in the compact disk (CD) version of this report.



SKOKOMISH INDIAN TRIBE

Wastewater Master Plan

FINAL REPORT

November 1998

KCM

ENGINEERS | ARCHITECTS | PLANNERS | APPLIED SCIENTISTS

Appendix 1.5

Mason County PUD #1
Finch Creek Wastewater Feasibility Study
August 2000

Because of its size, this document is NOT included in this printed report version. It is include in the compact disk (CD) version of this report.

MASON COUNTY PUD NO. 1

MASON COUNTY WASHINGTON

FINCH CREEK WASTEWATER
FEASIBILITY STUDY

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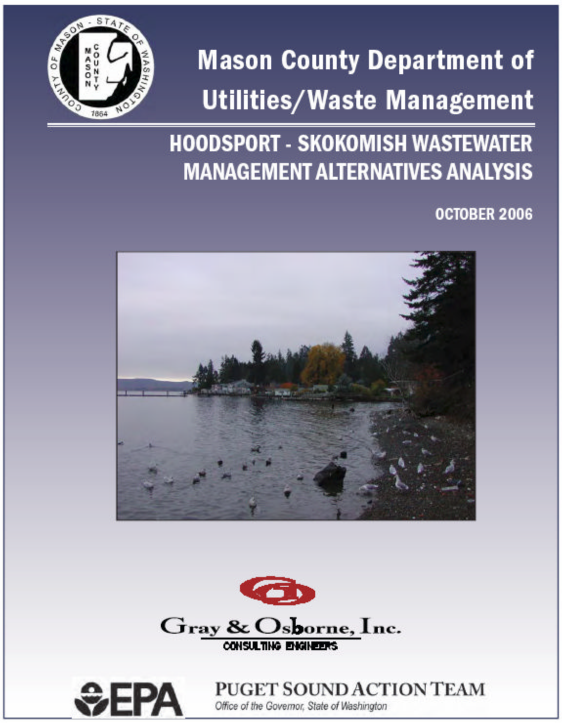
Appendix 1.5

Mason County
Hoodsport-Skokomish Wastewater Management Alternatives Analysis
October 2006

Because of its size, this document is NOT included in this printed report version. It is include in the compact disk (CD) version of this report.



Mason County Department of
Utilities/Waste Management

HOODSPORT - SKOKOMISH WASTEWATER
MANAGEMENT ALTERNATIVES ANALYSIS

OCTOBER 2006

Gray & Osborne, Inc.
CONSULTING ENGINEERS

EPA

PUGET SOUND ACTION TEAM
Office of the Governor, State of Washington

Appendix 2.1

HWA GeoSciences Inc.
Hoodsport Report
February 2007

HWA GEOSCIENCES INC.
Geotechnical Engineering • Hydrogeology • Geoenvironmental Services • Inspection and Testing

February 7, 2007
HWA Project No. 2006-172

Mike Sharar Consulting
3515 Gainsborough Ct. SE
Olympia, WA 98501-7020

Attention: Mike Sharar

Subject: **MASON COUNTY**
WATER QUALITY PROJECT PLANNING
HOODSPORT RURAL ACTIVITY CENTER
MASON COUNTY, WASHINGTON

Dear Mr. Sharar:

HWA GeoSciences Inc. (HWA) is pleased to submit this soils and hydrogeologic evaluation of the Hoodsport Rural Activity Center (RAC), Mason County, Washington, in support of the Mason County Water Quality Project Planning.

INTRODUCTION

HWA GeoSciences Inc. was contracted by Mason County to evaluate areas within the Hoodsport RAC for potential of septic-related contamination impacting Hood Canal, based on geologic, soils, and physiographic criteria.

SOILS

Soils in the Hoodsport RAC area consist of mainly Hoodsport series soils in the upland areas, with isolated pockets of Grove series soils in some drainages, and smaller areas of fine grained (e.g., Cloquallum and Tanwax) and alluvial (e.g., Juno) soils (Ness, 1960). Figure 1 shows the mapped soil units in the Hoodsport RAC planning area.

Hoodsport soils (Hd, He, Hf) consist of well-drained, reddish soils on uplands, formed over granitic till that is highly stained by iron and contains considerable metamorphosed and basic igneous gravel and stone. The soil survey report lists Hd soils as having a “very limited” rating for septic tank absorption fields, due to slow water movement and shallow depth to saturated zone. He and Hf soils are also listed as having a “very limited” rating for septic tank absorption fields, due to slow water movement, shallow depth to saturated zone, and slope (Ness, 1960).

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www.hwageosciences.com

Grove series (Gh, Gk) soils consist of somewhat excessively drained, reddish-brown gravelly soils, that formed on large glacial outwash plains over Vashon glacial drift, modified considerably by inclusions of local basaltic rock and mixed material from the Olympic Mountain glaciers. The soil survey report lists Gh and Gk soils as having a “very limited” rating for septic tank absorption fields, due to “bottom layer seepage” (i.e., soils are too permeable) (Ness, 1960).

Cloquallum silt loam (Cc) is a moderately well drained, brown upland soil, developed over silty glacial-lacustrine (lake) sediments. The soil survey report lists Cc soils as having a “very limited” rating for septic tank absorption fields, due to slow water movement and shallow depth to saturated zone (Ness, 1960).

Tanwax peat (Tb) consists of brown peat formed in wet areas and bogs. The soil survey report lists Tb soils as having a “very limited” rating for septic tank absorption fields, due to shallow depth to saturated zone, subsidence, slow water movement, and ponding (Ness, 1960).

Juno Sandy Loam (Jb) consists of coarse textured, brown to reddish-brown alluvial soils, formed over glacial alluvium in small streams. The soil survey report lists Jb soils as having a “very limited” rating for septic tank absorption fields, due to flooding, bottom layer seepage, and filtering capacity (Ness, 1960).

Although the soil survey lists all soil types present in the RAC area as having “very limited” suitability for septic drainfields, HWA’s opinion is that of the soils present, the Hd Hoodsport soils (5 to 15 percent slopes) have the best septic treatment potential and least off site septic contaminant transport risk. These soils are generally found on the till uplands, on relatively flat land. Steeper Hoodsport soils (He and Hf) have a higher potential to transport contaminants, due to increased slopes. Soils with the highest potential for septic contaminant transport include Grove and Juno soils, which are found in the drainages. The Grove soils pose an increased risk due to excessive permeability. Cloquallum and Tanwax soils have a low potential for transport, but also a low potential for treatment.

GENERAL GEOLOGIC CONDITIONS

Figure 2 shows the mapped geology in the Hoodsport RAC planning area. According to the Logan (2003) unconsolidated sediments mapped in the Hoodsport RAC planning area include the following:

Qgt - Till, late Wisconsinan (Pleistocene). Glacial till deposits generally consist of a compact unsorted mixture of clay, silt, sand, gravel, and boulders, deposited at the base of the Puget lobe of the Cordilleran ice sheet during the latest glaciation. Occasional sand and gravel lenses may be present. Till is commonly referred to as “hardpan” due to its cement-like texture. Till does not provide a favorable infiltration medium, but may be suitable for septic drainfields if sufficient depth of soils and weathered till are present. Till acts as an aquitard that inhibits the flow of ground water, perches water on top of it where overlain by recessional outwash, and also confines water below it in the advance outwash. In general, the permeability of till ranges from low in weathered surficial deposits to relatively impermeable in very dense non-weathered materials (Logan, 2003).

Qga - Advance outwash, late Wisconsinan (Pleistocene). Advance outwash consists mostly of glaciofluvial sand and gravel, with some and lacustrine clay, silt, and sand deposited during the advance of glaciers. Sandy units are commonly thick, well sorted, and fine grained, with interlayered coarser sand, gravel, cobbles and silt (Logan, 2003). Advance outwash is typically permeable, often water-bearing, and denser than recessional outwash, having been overridden by glacial ice. Advance outwash is commonly overlain by till.

Qgo - Proglacial and recessional outwash, late Wisconsinan (Pleistocene). Recessional outwash typically includes poorly to moderately sorted, rounded gravel and sand with localized coarser- and finer-grained constituents. Some fine sand, silt, and clay form local overbank sediments may also occur. Recessional outwash thickness varies and is not well known. It most commonly occupies outwash channels scoured into or through till (Logan, 2003). Recessional outwash was not glacially overridden, and is generally poorly consolidated to loose. Typically outwash deposits exhibit moderate to high permeabilities and infiltration rates depending on silt content.

Qapo - Alpine outwash, pre–late Wisconsinan (Pleistocene). Alpine outwash consists of stratified sand, gravel, and cobbles, may include peat, silt, and clay, and may be capped by weathered loess. Clasts are generally more rounded than those in till and lack facets and striations.

Qa - Alluvium (Holocene). Alluvium may consist of silt, sand, and gravel deposited in streams and alluvial fans, locally may contain Alpine drift, peat, or landslide deposits.

The soils and geologic maps reviewed are not entirely consistent with regard to correlation of mapped glacial deposits with mapped overlying soils. For example, most of the areas mapped as outwash on the geologic maps are mapped as Hoodsport series on the soils maps. The only areas mapped as Grove soils correspond with areas mapped as alluvium on the geologic maps.

Some differences in geologic mapping based on different references also occurs, which is not uncommon. Field verification of soils and geology is therefore recommended prior to design or siting of any facility. Figure 3 shows the mapped geology per Carson (1976), which is similar to the Logan map. The main till/outwash boundary (Qgt to Qga on the Logan map) is interpreted similarly in both maps.

RISK CLASSIFICATION

Our scope of work includes using available soils and septic system information to assess which areas in the Hoodsport RAC currently served by conventional septic systems have the highest, moderate and least likely probability of causing Hood Canal contamination.

Criteria contributing to relative risk of transmitting septic contamination to Hood Canal include:

- Soils and geology (soil treatment capacity and permeability)
- Slopes
- Distance to surface water
- Depth to ground water

Several of the criteria are overlapping, for example slopes, distance to surface water, and permeable outwash soils all coincide with the coastal areas and east-west drainages in the planning area.

Soils and geology are described above. Soils with increased risk of contaminant transport and reduced treatment capacity include those that are excessively drained, such as Grove soils. These soil types would provide less treatment than slower draining soils due to less organic content and decreased residence times. Grove soils on steep slopes in and near drainages (e.g., Gk) have an added element of risk due to thinner soil profiles, and steeper hydraulic gradients. Distance to surface water relates directly to potential for septic contaminants to reach Hood Canal. For reference, Chapter 246-272A WAC, On-Site Sewage Systems specifies a setback of 100 feet for drainfields from surface water, and 30 feet from any downgradient site feature that may allow effluent to surface.

Based on these criteria, areas ranked by relative risk of transmitting septic contamination to Hood Canal include:

- Low risk – Upland areas underlain by glacial till and Hoodsport soils, not near surface water drainages.
- Moderate risk – Areas mapped as having outwash soils, but not in or near surface water drainages.

- High risk – Areas within or adjacent to surface water drainages, including the Hood Canal coastline. Most of the areas in and near drainages also contain permeable soils which are more likely to transmit water and contaminants with minimum treatment.

Figure 4 shows mapped geology (Logan, 2003) topography, and land parcels. Figure 5 shows the major geologic contacts, topography, land parcels, and an aerial photograph, to provide some indication of land development status. Figure 5 includes the three risk areas delineated in the Hoodsport RAC.

Wastewater treatment/disposal options for future development include:

- Conventional on site sewage treatment/disposal systems

- Enhanced on site sewage treatment/disposal systems (single residence or combined)

- Conveyance to a centralized waste water treatment facility (including a variety of treatment processes, effluent qualities, and effluent disposal options)

Delineation of areas for varying types or levels of treatment in the planning process may be made qualitatively, based on relative risks as outlined above, or semi-quantitatively, by establishing maximum pollutant (e.g., nitrogen) loading or downgradient concentrations, then performing analytical modeling to predict estimated concentrations for various scenarios, including effluent quality, development density, etc.

REFERENCES

Carson, R. J., 1976. OFR 76-2. *Geologic Map of North Central Mason County, Washington,* 1 sheet, scale 1:62,500, Washington Division of Geology and Earth Resources, Open File Report 76-2.

Ecology, Washington State Department of, 2005, *Stormwater Management Manual for Western Washington*, Publications Numbers 05-10-029 through 05-10-033, Water Quality Program, Washington State Department of Ecology

HWA GeoSciences, Inc., September 19, 1994. *Preliminary Hydrogeologic Evaluation, Skokomish Wastewater Facility Report*, prepared for KCM Portland.

Logan, R. L., 2003. *Geologic Map of the Shelton 1:100,000 Quadrangle,* *Washington.* 45 x 36 in. color sheet, scale 1:100,000, Washington Division of Geology and Earth Resources, Open File Report 2003-15 http://www.dnr.wa.gov/geology/pdf/ofr03-15.pdf

Ness, A. 0., and Fowler, R. H., 1960. *Soil Survey Of Mason County, Washington,* Soil Conservation Service, United States Department of Agriculture, Washington Agricultural Experiment Stations. http://www.or.nrcs.usda.gov/pnw_soil/wa_reports.html

LIMITATIONS

The conclusions expressed by HWA are based solely on material referenced in this report. Observations were made under the conditions stated. Within the limitations of scope, schedule and budget, HWA attempted to execute these services in accordance with generally accepted professional principles and practices in the area at the time the report was prepared. No warranty, express or implied, is made. HWA's findings and conclusions must not be considered as scientific or engineering certainties, but rather as our professional opinion concerning the significance of the limited data gathered and interpreted during the course of the assessment.

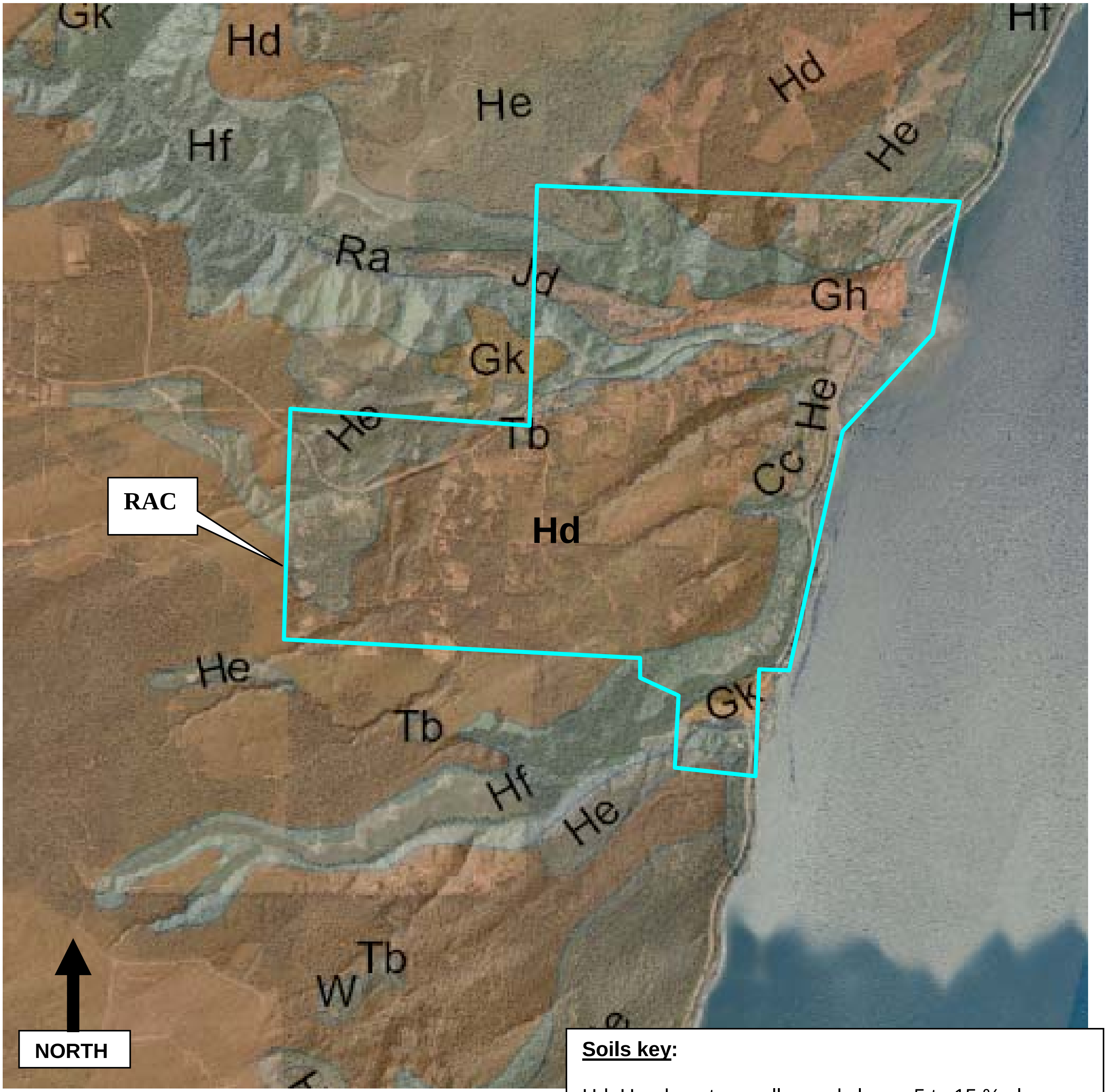
This study and report have been prepared on behalf of Mason County for the specific application to the subject property. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, nor the use of segregated portions of this report.

We appreciate the opportunity to provide our services. Please feel free to call us if you have any questions or need more information.

Sincerely,
HWA GEOSCIENCES INC.

Hydrogeologist
170
Arnon Sugar

Arnie Sugar, LG, LHG
Vice President



Soils key:

Hd: Hoodsport gravelly sandy loam, 5 to 15 % slopes
He: Hoodsport gravelly sandy loam, 15 to 30 % slopes
Hf: Hoodsport gravelly sandy loam, 30 to 45 % slopes
Gh: Grove gravelly sandy loam, 0 to 5 % slopes
Gk: Grove gravelly sandy loam, 5 to 15 % slopes
Cc: Cloquallum silt loam, 5 to 15 % slopes
Tb: Tanwax peat, 0 to 2 % slopes
Jd: Juno sandy loam, 0 to 3 % slopes

From: Ness, A. 0., and Fowler, R. H., 1960. *Soil Survey Of Mason County, Washington*, Soil Conservation Service, United States Department of Agriculture, Washington Agricultural Experiment Stations.
http://www.or.nrcs.usda.gov/pnw_soil/wa_reports.html

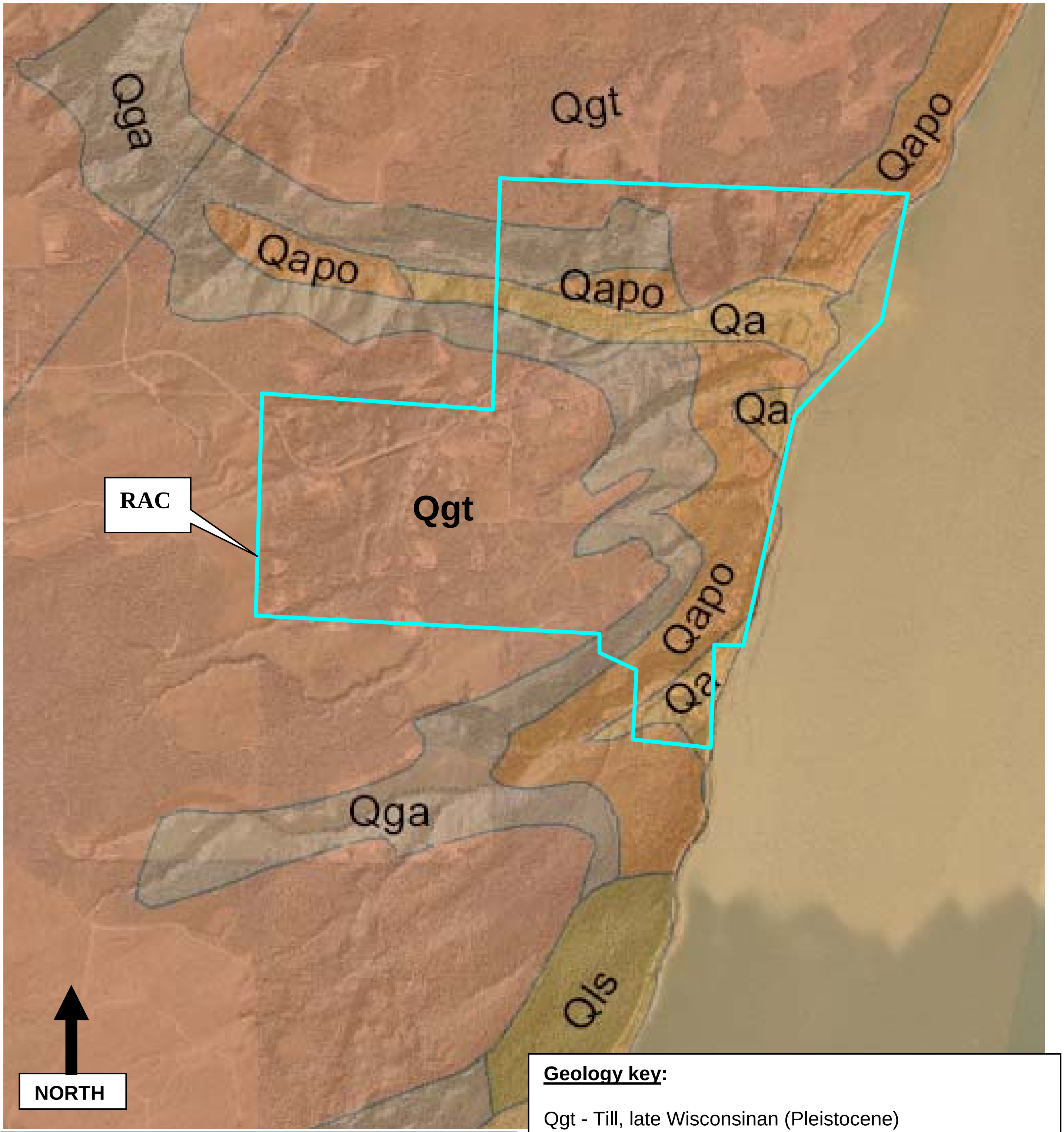
HWA GEOSCIENCES INC.

SOILS MAP

MASON COUNTY
WATER QUALITY PROJECT PLANNING
HOODSPORT RURAL ACTIVITY CENTER

FIGURE NO.
1

PROJECT NO.
2006-172



Geology key:

Qgt - Till, late Wisconsinan (Pleistocene)
Qga - Advance outwash, late Wisconsinan (Pleistocene)
Qgo - Proglacial and recessional outwash, late Wisconsinan (Pleistocene)
Qapo - Alpine outwash, pre–late Wisconsinan (Pleistocene)
Qa - Alluvium (Holocene)

From: Logan, R. L., 2003. *Geologic Map of the Shelton 1:100,000 Quadrangle, Washington.* 45 x 36 in. color sheet, scale 1:100,000, Washington Division of Geology and Earth Resources, Open File Report 2003-15 http://www.dnr.wa.gov/geology/pdf/ofr03-15.pdf

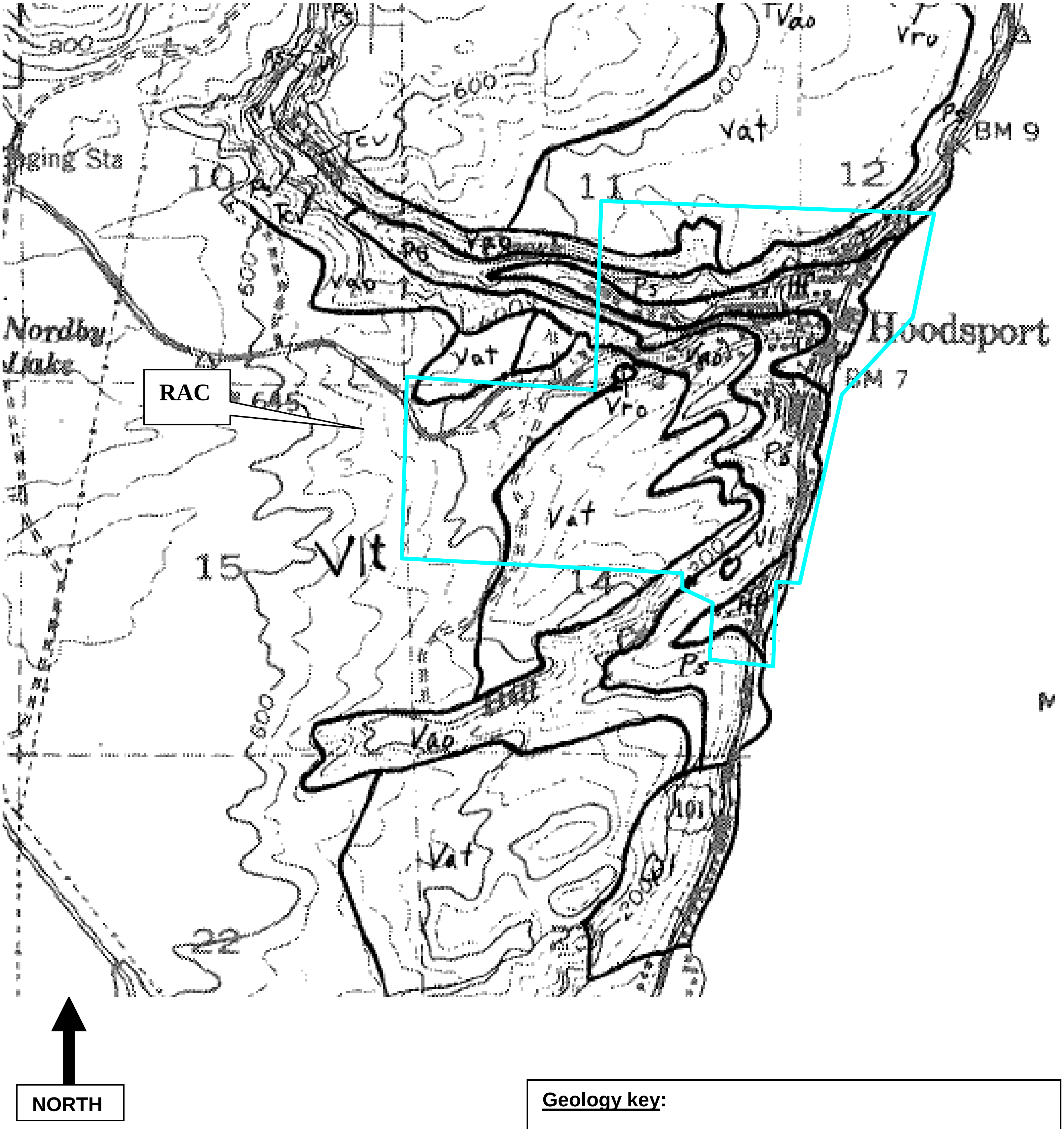
HWA GEOSCIENCES INC.

GEOLOGIC MAP (Logan, 2003)

MASON COUNTY
WATER QUALITY PROJECT PLANNING
HOODSPORT RURAL ACTIVITY CENTER

FIGURE NO.
2

PROJECT NO.
2006-172



From: Carson, R. J., OFR 76-2. Geologic Map of North Central Mason County, Washington, 1 sheet, scale 1:62,500, Washington Division of Geology and Earth Resources, Open File Report 76-2.

Geology key:

Vat - Ablation Till
Vro - Recessional outwash
Vrd - Recessional outwash - deltas/alluvial fans
Vl - Lacustrine sediments
Ps - Salmon Springs Drift
Hf - Flood plain alluvium

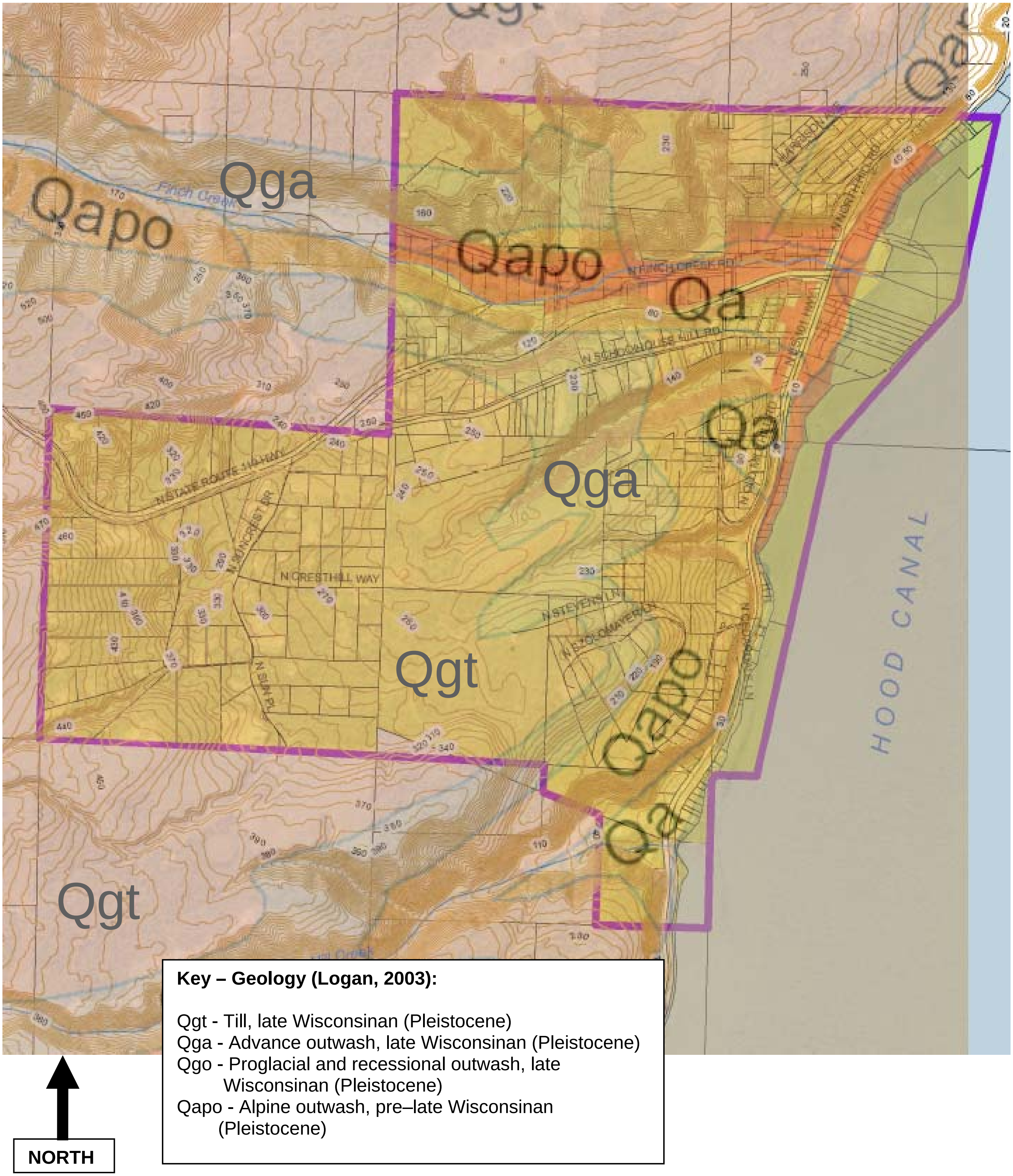
HWA GEOSCIENCES INC.

GEOLOGIC MAP (Carson, 1976)

MASON COUNTY
WATER QUALITY PROJECT PLANNING
HOODSPORT RURAL ACTIVITY CENTER

FIGURE NO.
3

PROJECT NO.
2006-172



Key – Geology (Logan, 2003):

Qgt - Till, late Wisconsinan (Pleistocene)
Qga - Advance outwash, late Wisconsinan (Pleistocene)
Qgo - Proglacial and recessional outwash, late Wisconsinan (Pleistocene)
Qapo - Alpine outwash, pre–late Wisconsinan (Pleistocene)

Base mapping by: Mason County (topo & parcels) Geology by Logan, 2003

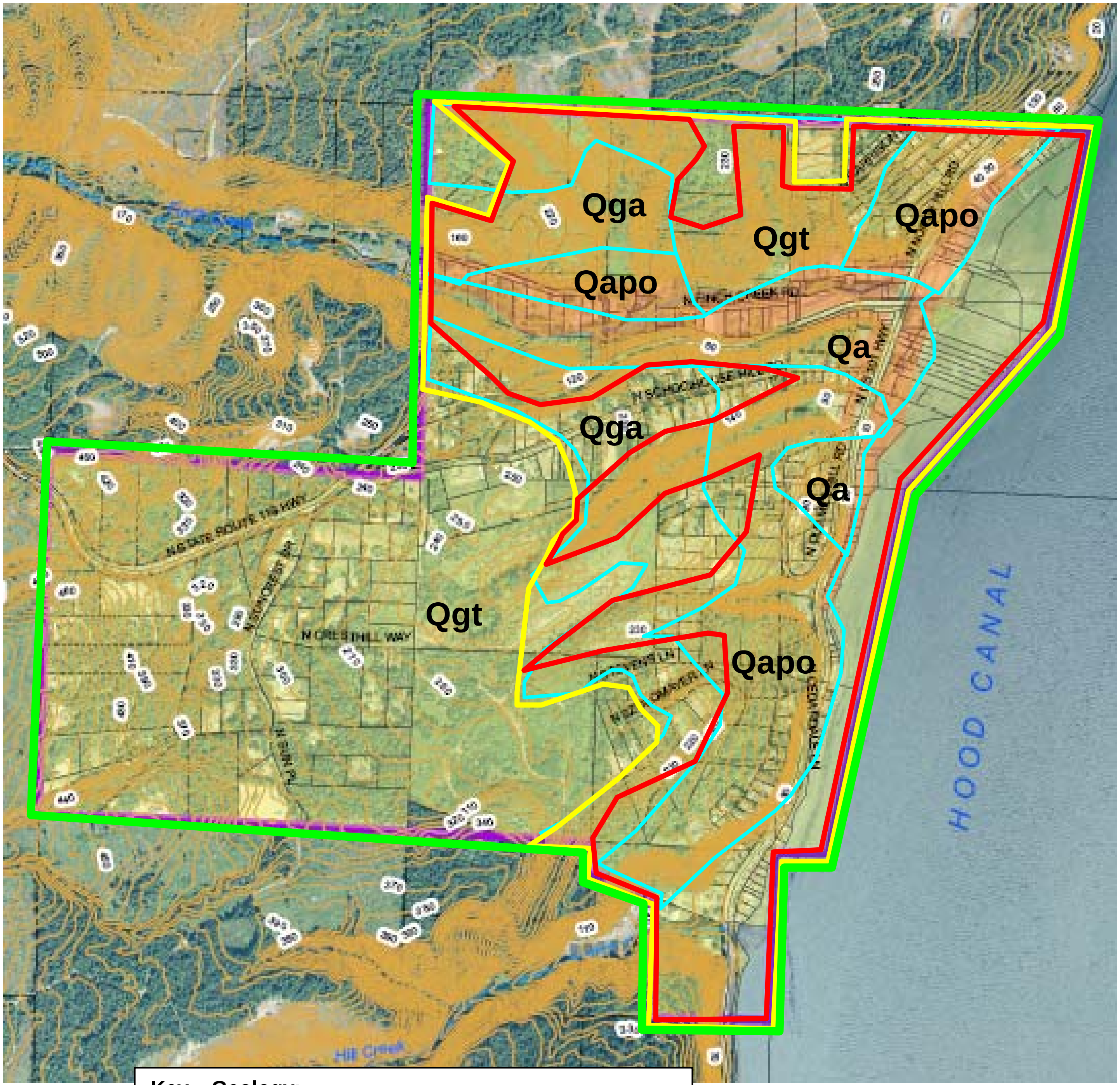
HWA GEOSCIENCES INC.

TOPO, GEOLOGY, & PARCELS

MASON COUNTY
WATER QUALITY PROJECT PLANNING
HOODSPORT RURAL ACTIVITY CENTER

FIGURE NO.
4

PROJECT NO.
2006-172



Key – Geology:

Qgt - Till, late Wisconsinan (Pleistocene)
Qga - Advance outwash, late Wisconsinan (Pleistocene)
Qgo - Proglacial and recessional outwash, late Wisconsinan (Pleistocene)
Qapo - Alpine outwash, pre–late Wisconsinan (Pleistocene)
Qa - Alluvium (Holocene)

Key - Relative contaminant transport risk:

🟩 Low
🟨 Medium
🟥 High

NORTH

Base mapping by: Mason County (aerial, topo & parcels), Geology by Logan, 2003

HWA GEOSCIENCES INC.

RELATIVE CONTAMINANT TRANSPORT RISK

MASON COUNTY
WATER QUALITY PROJECT PLANNING
HOODSPORT RURAL ACTIVITY CENTER

FIGURE NO.
5

PROJECT NO.
2006-172

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Appendix 2.2

ESA Adolfson
Environmental Permitting Matrix
February 2007

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Appendix ___

Environmental Permitting Matrix

The table beginning on the third page of this Appendix is a matrix summarizing the various permits that may be required for the Hoodsport Rural Activity Center, Potlatch, and Core Reservation Wastewater Management Planning Areas. Given the general siting information currently available for the projects, a full range of permits that may be required is included. The matrix describes the type of permit, the agency responsible for reviewing the permit, the permit triggger, timelines, agency responsible, and other relevant issues.

Federal approvals. Two potential federal approvals are included in the matrix (Corps permit and ESA Section 7 consultation). Because of the prevalence of wetlands in the project area, the final siting of the plant or collection system may require a Corps permit, which would then trigger ESA consultation. This has implications for siting decisions, because a Section 7 process can be very time-consuming, often requiring a year or longer to complete. In addition, mitigation requirements for impacts to regulated areas can be substantial.

Section 106. The Department of Community Trade and Economic Development, Department of Archaeology and Historic Preservation (DAHP) must be consulted when projects are subject to review under Section 106 of the National Historic Preservation Act of 1966. This act requires all federal agencies to take into account the affect of the project on historic properties.

NEPA. If the project triggers a permit from the Corps or has federal funding, compliance with the National Environmental Policy Act (NEPA) would be required. Prior to beginning this process, a federal lead agency would need to be determined. This is an important consideration because each agency has different requirements for NEPA compliance. Likely candidates would be the U.S. Environmental Protection Agency, U.S. Department of Agriculture, or the Bureau of Indian Affairs. Lead agency status will likely depend upon funding. Public and agency notification is required under NEPA.

SEPA. Mason County would serve as the lead agency under the State Environmental Policy Act (SEPA). The SEPA process may be combined with the NEPA process if NEPA is triggered. Public and agency notification is required.

SERP (State Environmental Review Process). This process is required when State Revolving Funds are applied for. It is a NEPA-like process that is administered through the Department of Ecology. The SEPA, NEPA and/or SERP processes can be duplicative, therefore early identification of the likely sources of funding is important.

Waste Discharge Permit – Reclaimed Water. A wastewater discharge permit is a legal document issued by the Department of Ecology to control the discharge of wastewater to surface or groundwaters. The permit application submittal to the Departments of Ecolgoy and Health would be accompanied by an engineering report. When the application is accepted by Ecology, the public notification, involvement, and hearings process begins. At the end of the comment period, Ecology prepares a Responsiveness Summary that details and significant changes, if warranted. When this process is complete, Ecology may issue a draft permit.

The Washington Department of Fish and Wildlife (WDFW) Hydraulic Project Approval (HPA). The HPA permit is required for work that uses, diverts, obstructs, or changes the natural flow or bed of any fresh water or saltwater of the state. Recent precedent set by WDFW suggests that any project work “over” water may require an HPA. This permit may be required for the wastewater collection pipelines. Because the proposed project area includes a number of surface water bodies, it is likely that this permit will be required.

Mason County ShorelineMaster Program. If the wastewater treatment plant or conveyance facilities are located within 200 feet of the shoreline of a lake, river, or saltwater body, including Hood Canal, it will be necessary to comply with the Mason County Shoreline Master Program. The type of permit or approval will depend upon the shoreline designation and the type of construction proposed within the shoreline zone. The type of permit could be a Substantial Development Permit, Conditional Use Permit, a Variance, or a combination of these permits. If not done as part of other permit processes, an Environmental Permit and/or a Habitat Management Plan may be required. The procedure for obtaining these permits varies, as does processing time, but could take from several weeks to six months or more. Generally, a public hearing is required.

Tribal Coordination. Environmental review by the Skokomish Tribe for any work on tribal lands would be accomplished through the Skokomish Environmental Protection Act (SKEPA) process. This process is similar to NEPA and SEPA, but also requires a Tribal Council Decision. Continued coordination with the Skokomish Tribe should be conducted for any work that would potentially affect Hood Canal water quality.

Hoodsport RAC, Potlatch, and Core Reservation Wastewater Management Planning
Potential Permit Requirements

Potential Permits	Permit Trigger	Permit Review Timeline	Suggested Submittal Schedule	Permit Considerations and Issues	Agency
Federal					
US Army Corps of Engineers (Corps) Section 404 Nationwide 12 Permit or Nationwide 33 Permit	Work in wetland or water of the US. - NW 12 - Utility line construction through wetland. Discharges of dredged or fill material associated with excavation, backfill, or bedding for utility lines, including intake and outfall structures, or - NW 33 -Temporary construction, access, and dewatering (including cofferdams) necessary for construction activities	Nationwide Permit (45 to 60 days) Individual Permit (6 months to 1 year)	After alternatives analysis prepared and construction method selected	- May not be required if pipeline remains in road right-of-way, and wetlands are not impacted. - The NWP-12 authorizes mechanized land clearing necessary for the installation of utility lines including any pipe or pipeline, but does not authorize changes in pre-construction contours. - The NWP-33 authorizes cofferdams, access fills, and dewatering of construction sites. The stream area must be restored to pre-construction conditions, and appropriate measures must be taken to insure near normal downstream flows. - Public Notification (30 days). - Due to the unique nature of the construction project, an individual permit may be necessary for this project. - Included in JARPA.	Washington State Department of Ecology (Ecology) Corps: Regulatory Section
National Marine Fisheries Service (NMFS) Section 7 ESA Consultation **US Fish and Wildlife Service (USFWS)** Section 7 ESA Consultation	Section 7 of the ESA requires all federal agencies to insure that any actions they authorize are not likely to jeopardize a listed species or adversely modify its critical habitat. The Corps must consult with NMFS and/or USFWS for this project	Up to 120 days after submittal to the Corps, and up to 180 days after submittal to NMFS and/or USFWS	After construction details are finalized	- A Biological Assessment (BA) addressing fish and potentially other listed species will likely be needed for this project as a federal is anticipated. - The BA must be reviewed by the appropriate regulatory agency (NMFS or USFWS), and special provisions may be necessary for the project construction to avoid negative impacts on listed species.	NMFS and/or USFWS

Hoodsport RAC, Potlatch, and Core Reservation Wastewater Management Planning

Potential Permit Requirements

Potential Permits	Permit Trigger	Permit Review Timeline	Suggested Submittal Schedule	Permit Considerations and Issues	Agency
Department of Archaeology and Historic Preservation (DAHP) Section 106	Federal nexus such as federal funding or a federal permit. Review conducted to determine affect on historic properties.	1 to 3 months	After selection of preferred alternative and project "footprint" After funding sources are determined	• Section 106 initiation started after project footprint has been determined. • High probability for encountering cultural resources.	Department of Archaeology and Historic Preservation
NEPA EA or EIS SERP ER	Federal nexus such as federal funding or a federal permit.	EA – 6 to 12 months EIS – 12 to 18 months ER – 6 to 12 months	After selection of preferred alternative and project "footprint" After funding sources are determined	• The NEPA lead agency would need to be determined; likely US Environmental Protection Agency, US Department of Agriculture, or Bureau of Indian Affairs. • The State Environmental Review Process (SERP) would be required if State Revolving Funds are obtained. This process satisfies NEPA.	NEPA Lead Agency to be determined
State					
Ecology/ Washington Department of Health Waste Discharge Permit – Reclaimed Water (90.46, 90.48, 43.20 RCW)	Discharging reclaimed water from wastewater treatment plants to surface or ground waters.		After approved Wastewater Facilities Plan; submitted with engineering report	• Permits place limits on the quantity and concentrations of contaminants that may be discharged. • Public Notification (30 days) • Permits valid to 5 years	Washington State Departments of Ecology and Health
Washington Department of Ecology (Ecology) Coastal Zone Management Consistency (CZM) Federal Coastal Zone Management Act (Sec. 307 16 USC 145 RCW 90-58)	Wetland fills in the 15 coastal counties of WA	Typically 1 month; may take up to 6 months		• Public Notification (30 days)	Washington State Department of Ecology Corps: Regulatory Section

Hoodsport RAC, Potlatch, and Core Reservation Wastewater Management Planning
Potential Permit Requirements

Potential Permits	Permit Trigger	Permit Review Timeline	Suggested Submittal Schedule	Permit Considerations and Issues	Agency
Ecology Section 401/Water Quality Certification Permit Federal Water Pollution Control Act Section 401; RCW 90.48.260 WAC 173-225	Federal Permits affecting waters of the State	2 - 3 months; (agency has up to 1 year to act)		• Public notification (20 days), and up to one year to approve, condition, or deny.	Washington State Department of Ecology Corps: Regulatory Section
Ecology National Pollutant Discharge Elimination System (NPDES) for Construction Activity Act 402 WAC 173-220 33 USC 1344 RCW 90.48.260	Construction activities, including clearing, grading, and excavation, that disturb 1 or more acres of land	Up to 30 days	After site details are produced (e.g., disturbance area, staging and access areas); at least 30 days prior to start of construction.	• Stormwater Pollution Prevention Plan • Public notification	Washington State Department of Ecology
Washington Department of Fish and Wildlife (WDFW) Hydraulic Project Approval (HPA) RCW 75.20 WAC 220-110	Work that uses, diverts, obstructs, or changes the natural flow or bed of state waters	Up to 45 days	After site details are produced (e.g., disturbance area, staging and access areas); at least 30 days prior to start of construction.	• SEPA compliance required • Included as part of JARPA	Washington Department of Fish and Wildlife
Washington Department of Transportation (WSDOT) WSDOT Utility	Work in WSDOT right of way	3 to 6 months	After siting details are produced.	• Complete the “State Highway Crossing Permit Application Checklist.” Information requires complete application form and project plans.	Washington State Department of Transportation
Tribal					
Skokomish Tribe Skokomish Environmental Protection Act (SKEPA)	Activities within the boundaries of the Skokomish Indian Reservation		After selection of preferred alternative and project “footprint”	• Similar process to SEPA and NEPA. • Tribal Council approval required.	Skokomish Tribe Department of Natural Resources

Hoodsport RAC, Potlatch, and Core Reservation Wastewater Management Planning
Potential Permit Requirements

Potential Permits	Permit Trigger	Permit Review Timeline	Suggested Submittal Schedule	Permit Considerations and Issues	Agency
Water Quality Certification Section 401 of the Clean Water Act	Under Section 401 of the Clean Water Act, tribes can approve, condition, or deny all Federal Permits or licenses that might result in a discharge to Tribal waters, including wetlands.			• Tribes have the option to waive their Section 401 certification authority.	Skokomish Tribe Department of Natural Resources
County					
Mason County SEPA Threshold Determination WAC 197-11	State or local "actions" such as issuing permits, or adopting plans. SEPA requires all governmental agencies to consider the environmental impacts of a proposal before making decisions. The checklist provides information to help the agency identify impacts and decide whether an EIS is required.	30 days	After selection of preferred alternative and project "footprint"	• To determine if project will have significant adverse environmental impacts and as a result require a SEPA EIS. • May be combined with NEPA or SERP documentation if NEPA is required. • Mitigation may be required.	Mason County
Mason County Shoreline Master Program WAC 173-14	Activities within 200 feet of Hood Canal and streams segments with a mean annual flow >20 cubic ft./sec., *and* associated wetlands	28-day waiting period; maximum 120-day review (concurrent)	After site details are produced	• Public hearing • Included in JARPA	Mason County
Mason County Sensitive Areas Review Local Regulations	Alteration of a site which impacts a sensitive area or is within an identified sensitive area buffer	Variable	After selection of preferred alternative and project "footprint"	• May be required to submit a critical areas study. • May be required to develop mitigation and monitoring plans.	Mason County
Mason County Clearing/Grading Permit	Required for clearing and grading activities.		After site details are produced (e.g., disturbance area, staging and access areas); at least 30 days prior to start of construction.	• Need excavation volumes	Mason County
Mason County Right of Way Permit MCC 12.24	Required for work in county road rights of way.		After site details are produced for work in right of way		Mason County Public Works
Other Considerations					

Hoodsport RAC, Potlatch, and Core Reservation Wastewater Management Planning
Potential Permit Requirements

Potential Permits	Permit Trigger	Permit Review Timeline	Suggested Submittal Schedule	Permit Considerations and Issues	Agency
WDFW Priority Habitats Species (PHS) Consideration	A search of the WDFW PHS database is required to determine if state and federal listed species including those that are designated as endangered, threatened, sensitive, candidate, and monitor.	Data is usually sent within 30 days and is accurate up to 6 months.	Information is included in SEPA documentation	• The PHS Request Form is available online at: http://www.wa.gov/wdfw/hab/orderfrm.pdf	WDFW
Washington Department of Natural Resources (DNR) Washington Natural Heritage Program (WNHP) Consideration	Determining if a proposed project may affect rare plant species and natural ecosystems in Washington State.	Within 30 days.	Information is included in SEPA documentation	• WNHP data request forms are available online at: http://www.wa.gov/dnr/htdocs/fr/nhp/refdesk/forms/inforeq.html	DNR

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Appendix 2.3

Wessen & Associates, Inc.
An Assessment of Archaeological Resource Potential in the Hoodsport RAC
Mason County, Washington
January 2007

AN ASSESSMENT OF ARCHAEOLOGICAL RESOURCE POTENTIAL IN THE HOODSPORT RAC, MASON COUNTY, WASHINGTON

Gary C. Wessen, Ph.D.
Wessen & Associates, Inc.
January 2007

INTRODUCTION

In the fall of 2006, Mason County contracted with Wessen & Associates, Inc. to assist in planning for a wastewater management system in the Hoodsport “Rural Activity Center” (RAC). Wessen & Associates’ role was to prepare an inventory of cultural resources in the Hoodsport RAC and advise in the planning effort so that disturbance to known and suspected cultural resources might be avoided to the fullest possible extent. This document presents the background, goals, methods, findings, and recommendations of our effort.

BACKGROUND

The Hoodsport RAC is located in northeastern Mason County. It includes the commercial ‘core’ of the community of Hoodsport and residential areas to the north, west, and south (see Appendix Figure 1). Its total area is approximately 1.5 square miles.

The Hoodsport RAC is located within the traditional territory of the Tuwaduq (Twana) People. In early historic times - - and for a considerable period prior to them - - the Tuwaduq People occupied all of the lands in the immediate vicinity of Hood Canal. Many of their traditional settlements were located along the Hood Canal shoreline, often at or near the mouths of rivers or creeks. They also fished, hunted, and otherwise used a considerable range of lands interior to Hood Canal. Representatives of the Tuwaduq signed the Point-No-Point Treaty in 1855 and subsequently relocated onto the Skokomish Indian Reservation, approximately 2 miles south of the Hoodsport RAC. Their descendants are now usually referred to as the Skokomish Indian Tribe.

There has been only very limited archaeological research within the traditional territory of the Tuwaduq People. Few efforts to locate archaeological sites have been conducted and those which have occurred have generally been limited in their geographic focus. Large scale systematic efforts to identify prehistoric archaeological resources have yet to occur here. Similarly, there have been relatively few detailed studies of particular archaeological sites anywhere along Hood Canal. We currently know that some traditional Tuwaduq settlements near the Hoodsport RAC have been occupied for at least 1,500 to 3,300 years. Other, as yet undated, archaeological sites in the area are probably much older.

RESEARCH DESIGN

The goals of this effort are essentially those stated above in the introduction to this document: “to prepare an inventory of cultural resources in the Hoodsport RAC and advise in the planning effort so that disturbance to known and suspected cultural resources might be avoided to the fullest possible extent”. The term ‘cultural resources’ as used here, refers to archaeological materials. Thus, this study has not addressed the possibility that there may be historic structures in the Hoodsport RAC. To our knowledge, there aren’t any and, moreover, our current understanding of the proposed wastewater management actions suggests that historic structures - - if present - - are unlikely to be affected. The focus of this effort has been directed largely toward archaeological resources representing the Native American occupants of the area. It should be noted, however, that archaeological resources representing late 19th and early 20th Century Euro-American occupants of the area could also be present in the Hoodsport RAC.

The results of the inventory effort have been summarized in two maps of the Hoodsport RAC. The first map shows the locations of recorded archaeological sites and settlements known from ethnographic and/or historical sources that may have archaeological manifestations. It is important to note here that the locations of recorded archaeological sites are protected by state and federal laws, and thus this information cannot be released to the general public. In this same regard, the Skokomish Tribal Historic Preservation Office has requested that specific information about the locations of traditional Tuwaduq settlements also not be released to the general public.
These requirements, and the paucity of archaeological survey data for the Hoodsport RAC, have led us to develop a second map. The second map identifies zones of archaeological potential within the Hoodsport RAC. These zones have been developed on the basis of the distributions of the above-noted locations and generalizations about the relatively sensitivity of different types of landforms in the study area. In brief, low gradient surfaces in the immediate vicinity of the Hood Canal shoreline and the flood plains of larger creeks are considered to have a relatively high potential for archaeological resources. The vicinities of smaller low gradient creek channels and so-called vista points (i.e., locations that offer sweeping views of the surrounding landscape) are considered to have a moderate potential for archaeological resources. Steep gradient surfaces and low gradient interior surfaces that are not located near creeks or lakes are considered to have a relatively low potential for archaeological resources. The map identifying zones of archaeological potential within the Hoodsport RAC may be released to the general public.

Finally, it is important to emphasize that the study reported here is not an archaeological survey of the Hoodsport RAC. While we have considerable familiarity with this area, no actual on-the-ground inspection for archaeological resources was conducted at this time. Rather, the effort was essentially a literature review and our products are based upon examination of documents on file with the Washington State Department of Archaeology and Historic Preservation, the Skokomish Tribal Historic Preservation Office, other materials in our possession, and archaeological site survey experience in nearby areas.

THE MAPS

Our map of the locations of recorded archaeological sites and settlements known from ethnographic and/or historical sources that may have archaeological manifestations is presented in Appendix Figure 2. Note first that there are no recorded archaeological sites in the Hoodsport RAC. This condition is undoubtedly related to the fact that there has been almost no archaeological research conducted in the Hoodsport RAC. As such, the absence of recorded archaeological sites should not be seen as suggesting that archaeological resources are unlikely to be present. Figure 2 does indicate that at least three traditional Tuwaduq settlements were located within the Hoodsport RAC. All three were located along the Hood Canal shoreline at the mouths of creeks. Relatively little information is available about any of these places, but at least one is clearly identified as a ‘large winter village’. The other two settlements may have been somewhat smaller. Native American archaeological resources - - potentially including artifacts, occupation refuse, and human remains - - may be present at any of these locations. We have not specifically identified the early historic Hoodsport Town site in Figure 2, but it was located in what is essentially the commercial ‘core’ of the modern community of Hoodsport. Late 19th and early 20th Century Euro-American archaeological resources may be present anywhere in this area.

The information in Figure 2, and the generalizations about the relatively sensitivity of different types of landforms noted earlier, have been used to generate the archaeological sensitivity zones presented in Appendix Figure 3. Two important caveats need to be offered about this map. First, zones based upon landforms have been defined, as the landforms appear on USGS 7.5 minute topographic maps. These are valuable tools, but it is important to emphasize that there may be archaeologically sensitive features in the study area that are too small to be indicated on USGS 7.5 minute topographic maps. The zones shown in Figure 3 are therefore generalizations about probable potential and should not be regard as guarantees that archaeologically sensitive areas are not present within zones here identified as having only a low potential. A second caveat concerns the low gradient surfaces in the immediate vicinity of the Hood Canal shoreline. This area has been indicated as having a relatively high potential for archaeological resources. This study has not documented whether historic filling has occurred along any portion of this shoreline. We raise this issue because we suspect that some locations - - such as near the mouth of Finch Creek - - may contain fill deposits, and fill deposits are a complicating consideration. At first glance, fill sediments can be expected to be culturally-sterile, and thus documented fill areas should have no potential to contain archaeological resources. The issue is actually more complicated for two reasons. First, experience elsewhere in western Washington has shown that low lying areas with archaeological resources were sometimes filled in order to raise their base level. Thus, potentially significant archaeological resources can be present underneath fill deposits. Second, there are documented cases of archaeological sediments having been used as fill materials in western Washington. This means that it is possible that archaeological materials - - including human remains - - could be encountered in fill deposits.

The map of zones of archaeological potential within the Hoodsport RAC indicates that high potential areas are limited to the low gradient surfaces in the immediate vicinity of the Hood Canal shoreline and the Finch Creek flood plain. These areas have the highest potential for both Native American and Euro-American archaeological resources. These are also among the most developed (i.e., disturbed) areas in the Hoodsport RAC. The history of historic disturbance may have damaged and/or destroyed archaeological resources in these areas. It would, however, be dangerous to simply assume this. In fact, there are many well documented cases of important archaeological resources having survived in badly disturbed, highly developed landscapes. (Witness the recent events at the graving dock site in Port Angeles.)

Areas thought to have a moderate potential for archaeological resources are also relatively limited within the Hoodsport RAC. They include the vicinities of two smaller low gradient creek channels to the south of Finch Creek and the areas along the tops of slopes that look out over Hood Canal and/or the lower Finch Creek canyon. Some of the latter areas have also experienced significant historic disturbance, and the above-noted caution also applies in these areas.

Finally, a significant amount of the Hoodsport RAC appears to have only a relatively low potential for archaeological resources. Areas thought to have only a relatively low potential include steep surfaces along the margin of Hood Canal and the lower Finch Creek canyon and low gradient interior surfaces in the western portion of the Hoodsport RAC. While we are confident that the latter areas have only a relatively low potential for archaeological resources, we should emphasize that there is a difference between ‘low potential’ and ‘no potential’. It is possible that that archaeological resources could be encountered in areas we characterize as having a low potential.

RESOURCE MANAGEMENT CONSIDERATIONS

The assessments of archaeological resource potential presented here are based upon very limited archaeological and ethnographic data and generalizations about the relative sensitivity of different types of landforms, as they appear on USGS 7.5 minute topographic maps. As already indicated, this study is not an archaeological survey of the Hoodsport RAC and should not be regarded as one. We therefore recommend that an archaeological survey of the areas to be impacted by the waste-water management system be conducted. Having said this, we think that project planners should be aware that - - depending upon the system’s design - - it may prove to be difficult to investigate some portions of the Hoodsport RAC. In particular, we note that much of the high potential areas have been extensively developed and thus, built features such as paved road beds and structures may make effective archaeological inspection difficult. Some of this difficulty may be addressed by test boring portions of the study area, but even the feasibility of this approach is difficult to assess at this time.

As such, while an archaeological survey is an important next step, project planners should recognize that such an effort may not be sufficient to be certain that archaeological resources are not present anywhere in their project area. We therefore think that some degree of archaeological monitoring may be appropriate during the construction of the planned facilities. The specific scope and character of such a monitoring plan should be developed after the results of the archaeological survey are available.

APPENDIX - MAPS

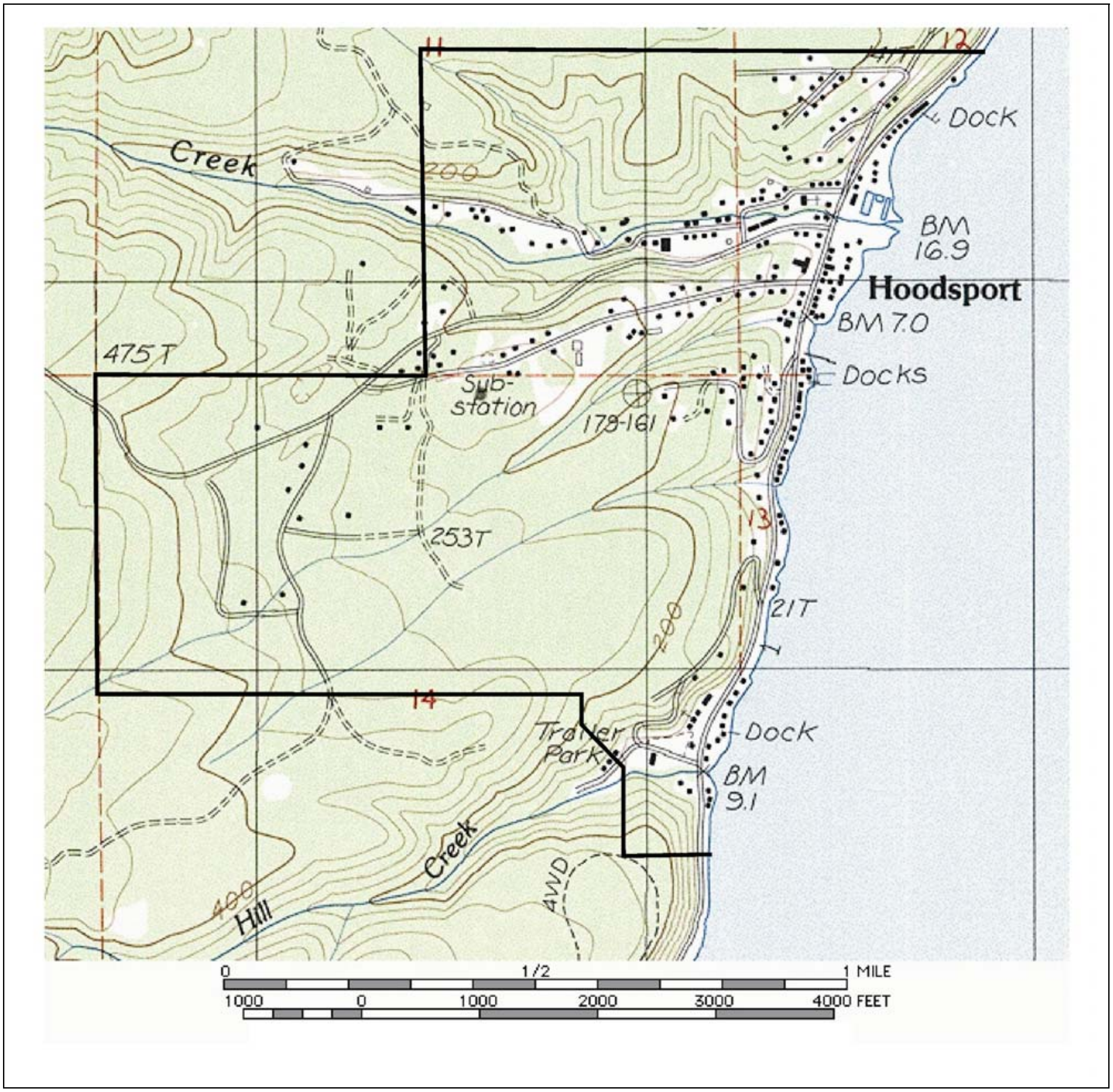

Figure 1 The Hoodsport RAC, Mason County, Washington.

Note:

Consistent with Washington State Law, this map is redacted in widely published copies of this report. This map is intended for the use of planning and design professionals in consultation with appropriate Tribal and State historic preservation officials so that known cultural resource sites can be avoided or properly managed in the event of earth disturbing activities.

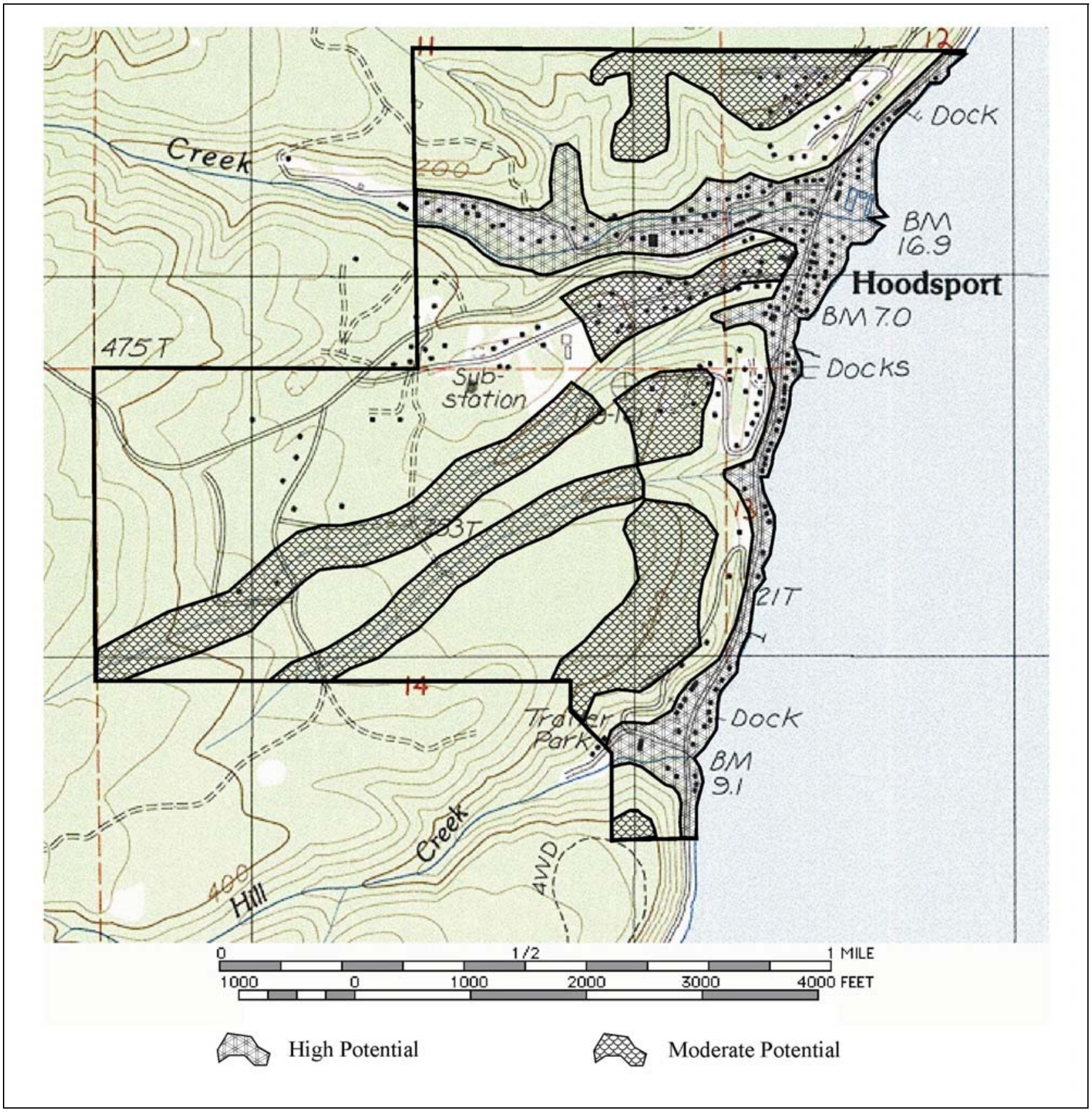

Figure 3 Archaeological potential zones in the Hoodsport RAC, Mason County, Washington.

Appendix 3.1

Wastewater Planning Assumptions for Core Reservation and Potlatch Bubble
December 2006

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WASTEWATER PLANNING ASSUMPTIONS

FOR CORE RESERVATION AND POTLATCH BUBBLE

12/8/06

- **Population**

    1. Population will grow at approximately 1-2 % per year according to Mason County state and tribal census; according to tribal administration, the anticipated growth rate will be 2% annually (see spreadsheet with number of households/current population estimates).

    2. There is a waiting list for housing on the reservation 111 families.

- There has been an increase in younger population with higher household size due to more families with children and extended multi-generational families (assume 4.16 people per household).

- **Land Use**

    1. 1977 Draft Land Use Plan, but no current comprehensive plan (comprehensive master plan for entire Reservation is in progress—on fast track/simultaneous to the wastewater development plan)

    2. Moving the Tribal Center to the WSDOT site has been discussed as possible opportunity in 2008+ (tribal government employment at the Tribal Center is anticipated to double in 5 years to about 200). Assume a major building and several small buildings and treatment facility at the site.

    3. Consider footprint of the MBR facility at the DOT site and potential neighbor impacts

    4. Treatment plant has “first dibs” on the WSDOT site.

    5. If above takes place, consider possible alternative uses for the lower reservation (many options are being evaluated).

    6. Continuing upland residential opportunities primarily in tribal village site (138 homes in new housing development within 15 years—also at new housing site will be community use facilities)

    7. New residential development will not occur in the floodplain except remodels

8. East side of 101 portion of Minerva Beach will remain the same for approx 10 years

9. West side of Minerva Beach will be modified by State Parks over 2-3 (3-5?) years according to a yet-to–be developed comprehensive plan

- **Commercial and Economic Development**

  1. Substantial economic development will occur primarily at the intersection of Highway 101 and Highway 106. This will be more economic development than commercial services.

  2. Only 6 +/- acres of the 51 at the intersection of 101 and 106 in service area H are developable.

  3. Additional economic opportunities are the west side of 101 and perhaps WSDOT site…..potential for other sites immediately north of Potlatch currently in fee status

  4. At least four new businesses are anticipated within 20 years (2 large-scale, 2 moderate-scale)

  5. The load capacity at the Casino will quadruple within 5 years.

- **Service Areas**

  1. Wastewater service will not be planned for the Sunnyside area (service area K) UNLESS a site specific cluster system outside of these planning efforts

  2. Wastewater service will not be planned for Area I.

  3. Area G –there is economic development potential on both sides of 101. Want to be able to serve with sewer.

  4. The east side of 106, south of the intersection will have sewer service in Area J. The area is planned to have a community center, Boys and Girls Club. Assume 50 staff and visitors.

  5. The Area E service area for the Potlatch Bubble will be planned to go to the north boundary of the Reservation

- **Wastewater Treatment Areas, Treatment Sites and Methods, Effluent Disposal**

    1. Assume we will carry 2 options for the planning: two separate facilities for Potlatch and the Core Reservation, and one facility for Potlatch and the Core.

    2. There are several options for sewage treatment for the Potlatch State Park, Minerva Beach and some of the nearby residential and commercial areas (within maybe a half mile north of the northern State Park boundary.as per the service area above which could include Waterfront at Potlatch, PUD, Womens Clubs, Potlatch Power Plant

    3. Consider treatment options that produce Class A reclaimed water;

    4. Evaluate treatment and disposal options in terms of opportunities to use effluent for economic benefit (forest treatments et.al., using dry/intermittent streambed for disposal, creating catch wetland/lake).

    5. The new treatment facilities are to be low visibility and should meet high air quality standards (new FARR guidelines per EPA)

    6. The southwest corner of the WSDOT site (14 acres) is the focus of planning for a Treatment Facility. This planning effort will focus on the back part of the DOT site at tow of slope.

    7. No direct surface marine discharge will be allowed

    8. Upland discharge (spray irrigation) of treated Wastewater should be studied along with wetland disposal in new and/ or constructed wetlands and infiltration

    9. First phase of new homes in the new residential housing project (20 homes)will be clustered with an onsite system or use Potlatch Park/Minerva drainfield in newly acquired area with ability at a later date to drain down to the lowland portion of the Potlatch Bubble where the waste from those homes will be treated either at some type of community on-site system or at a sewer treatment facility

    10. As new housing is built, provide for the ability to easily connect new houses to the sewer system – sooner or later

    11. Some new method of managing wastewater will need to be available as the new homes on the reservation come along by Fall 2008

12. Any future new resort/casino development on the upland area (Simpson / Green Diamond parcels on Rez) would have self-contained wastewater treatment, and should not be included for these planning efforts.

- Phasing of Growth and Sewer Service

  1. Projected residential growth follows housing policy workgroup goals (Growth rate for new residential area includes 138 homes in three phases over 15 years with anticipated overall Reservation annual population growth rates of 2%)

  2. Opportunities exist for expanded commercial development in service areas 2 and 3 by the Tribe along owned and newly acquired properties INCLUDING Twin Totems, Lucky Dog Casino and Hood Canal School #404. As the Tribe provides water and wastewater support, non –tribal owned entities can be tie into tribal system(s), thru incentives, ordinances, codes (Mason County reciprocal connection.)

  Utility and rate structure(s) can be tasked from the planning effort to provide certain financial assumptions in levies, pay-back debt-servicing.

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Appendix 3.2

HWA GeoSciences Inc.
Potlatch Bubble Report
January 2007

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HWA GEOSCIENCES INC.
Geotechnical Engineering • Hydrogeology • Geoenvironmental Services • Inspection and Testing

January 30, 2007
HWA Project No. 2006-172

Art O'Neal & Associates
127 17th Avenue SW
Olympia, WA 98501

Attention: Art O'Neal

Subject: **MASON COUNTY**
WATER QUALITY PROJECT PLANNING
POTLATCH "BUBBLE" PLANNING AREA
MASON COUNTY, WASHINGTON

Dear Mr. O'Neal:

HWA GeoSciences Inc. (HWA) is pleased to submit this draft report of our soils and hydrogeologic evaluation at the Potlatch "bubble" planning area, Mason County, Washington, in support of the Mason County Water Quality Project Planning.

EXECUTIVE SUMMARY

HWA GeoSciences Inc. was contracted by Mason County to evaluate areas within the Potlatch "Bubble" area for soil septic treatment capability and infiltration potential based on geologic, soils, and physiographic criteria.

Soils in the Potlatch Bubble area include mostly Hoodsport and Grove series soils. Hoodsport soils are well-drained upland soils developed over glacial till. Grove soils are excessively drained, and formed on glacial outwash. The geology of the project area consists of glacial till and advance outwash. Glacial till generally consist of a compact unsorted mixture of clay to boulder-size particles, deposited at the base of a glacier. Till is usually very dense, with low permeability, but may be suitable for septic drainfields if sufficient depth of soils and weathered till are present. Glacial outwash consists mostly of permeable sand and gravel (with some clay and silt) deposited by glacial rivers and streams, both during glacial advance (advance outwash) and retreat (recessional outwash).

Criteria for establishing areas requiring a higher level septic treatment include soils, geology, slopes, distance to surface water, depth to ground water, and presence of sensitive receptors (e.g., shallow water wells, wetlands, recharge areas, etc.) Several of these criteria overlap, for example slopes, distance to surface water, and permeable outwash soils all occur at drainages in the planning area. Soils suggesting the need for enhanced treatment include those that are excessively drained and soils on steep slopes or near surface water.

INTRODUCTION

HWA GeoSciences Inc. was contracted by Mason County to evaluate areas within the Potlatch "bubble" for soil septic treatment capability and infiltration potential, based on geologic, soils, and physiographic criteria. HWA reviewed published soils, geologic and other data, in addition to the 1994 HWA *Preliminary Hydrogeologic Evaluation,* prepared for the KCM *Skokomish Wastewater Facility Report* (HWA, 1994).

SOILS

Soils in the Potlatch Bubble area include mostly Hoodsport and Grove series soils (Ness, 1960). Figure 1 shows the mapped soil units in the Potlatch planning area.

Hoodsport series (Hd, He, Hf) soils consists of well-drained upland soils developed over glacial till. The characteristic reddish color is derived from iron staining of granitic, metamorphic, and basic igneous gravel and stone. The Hoodsport soils are shallower, stonier, and more acid than other typical soils formed over till like the Alderwood series. In addition, they developed under heavier rainfall. Flatter, upland areas of the Potlatch Bubble are mapped as Hoodsport gravelly sandy loam, 5 to 15 percent slopes (Hd). The drainages and slopes present at the north, south, and east portions of the planning area are mapped as Hoodsport gravelly sandy loam, 30 to 45 percent slopes (Hf). These steeper soils have developed more slowly, have shallower profiles, are less vegetated, and may be altered by slips, slides, and soil creep (Ness, 1960).

The soil survey report lists Hd soils as having a "very limited" rating for septic tank absorption fields, due to slow water movement and shallow depth to saturated zone. Hf soils are also listed as having a "very limited" rating for septic tank absorption fields, due to slow water movement, shallow depth to saturated zone, and slope (Ness, 1960).

Grove series (Gk) soils consist of somewhat excessively drained, reddish-brown gravelly soils, formed on glacial outwash plains. The Grove soils have developed over Vashon glacial drift, modified considerably by inclusions of local basaltic rock and mixed material from the Olympic Mountain glaciers. The soil survey report (Ness, 1960) lists Grove gravelly sandy loam, 5 to 15 percent slopes (Gk), as having a “very limited” rating for septic tank absorption fields, due to “bottom layer seepage” (i.e., soils are too permeable).

Made land (Ma) consists of soils that have been modified through dredging, grading, or industrial operations. Although rated as “not limited” for septic tank absorption fields (Ness, 1960), artificial or fill soils are generally not considered suitable for septic drainfields per Chapter 246-272 and 272A WAC, On-site Sewage Systems, which typically require “original, undisturbed soil” for drainfields.

The soils and geologic maps reviewed are not entirely consistent with regard to correlation of mapped glacial deposits with mapped overlying soils. For example, the soil maps shows Grove soils (described as forming over outwash) in some areas mapped as till on the geologic map, and Hoodsport soils (described as forming over till) over mapped outwash. Some differences in geologic mapping based on different references also occurs, which is not uncommon, as geologic mapping is highly interpretive in nature. Field verification of soils and geology is therefore recommended prior to design or siting of any facility.

GENERAL GEOLOGIC CONDITIONS

The geology of the project area has been mapped in detail by Carson (1976) Shannon and Wilson (1978), and Logan (2003). Ground water resources are described in Molenaar & Cummins (1973). In general, upland areas are covered by Pleistocene (0.01 to 1.6 million years ago) glacial drift consisting of Vashon Glacial Till and Vashon Advance Outwash. The Vashon Glaciation covered the project area most recently (approximately 12,000 years ago) and extended as far south as Olympia. The compact, lower permeability till typically overlies the sandy, higher permeability outwash except along the bluffs and in stream canyons where the outwash has been exposed. Beneath the Vashon Advance Outwash older, Pre-Vashon glacial drift and interglacial deposits occur with fine grained Pre-Vashon till and outwash well exposed along the lower bluff immediately adjacent to Highway 101. Lowland areas are mapped as Recessional outwash.

Planning Area Geology

Figure 2 shows the mapped geology in the Potlatch “bubble” planning area according to the Logan (2003). Figure 3 shows the mapped geology per Carson (1976). Unconsolidated sediments mapped in the Potlatch planning area include the following:

Qgt - Till, late Wisconsinan (Pleistocene). Glacial till deposits generally consist of a compact unsorted mixture of clay, silt, sand, gravel, and boulders, deposited at the base of the Puget lobe of the Cordilleran ice sheet during the latest glaciation. Occasional sand and gravel lenses may be present. Till is commonly referred to as “hardpan” due to its cement-like texture. Till does not provide a favorable infiltration medium, but may be suitable for septic drainfields if sufficient depth of soils and weathered till are present. Till acts as an aquitard that inhibits the flow of ground water, perches water on top of it where overlain by recessional outwash, and also confines water below it in the advance outwash. In general, the permeability of till ranges from low in weathered surficial deposits to relatively impermeable in very dense non-weathered materials (Logan, 2003).

Qga - Advance outwash, late Wisconsinan (Pleistocene). Advance outwash consists mostly of glaciofluvial sand and gravel, with some and lacustrine clay, silt, and sand deposited during the advance of glaciers. Sandy units are commonly thick, well sorted, and fine grained, with interlayered coarser sand, gravel, cobbles and silt (Logan, 2003). Advance outwash is typically denser than recessional outwash, having been overriden by glacial ice, and is commonly overlain by till.

Qgo - Proglacial and recessional outwash, late Wisconsinan (Pleistocene). Recessional outwash typically includes poorly to moderately sorted, rounded gravel and sand with localized coarser- and finer-grained constituents. Some fine sand, silt, and clay form local overbank sediments may also occur. Recessional outwash thickness varies and is not well known. It most commonly occupies outwash channels scoured into or through till (Logan, 2003). Recessional outwash was not glacially overridden, and is generally poorly consolidated to loose. Typically outwash deposits exhibit moderate to high permeabilities and infiltration rates depending on silt content.

Qapo - Alpine outwash, pre–late Wisconsinan (Pleistocene). Alpine outwash consists of stratified sand, gravel, and cobbles, may include peat, silt, and clay, and may be capped by weathered loess. Clasts are generally more rounded than those in till and lack facets and striations.

SOIL TREATMENT CAPACITY

Our scope of work includes identifying areas likely to require more than traditional on-site septic treatment. Criteria for establishing areas requiring a higher level septic treatment include:

- Soils/geology
- Slopes
- Distance to surface water

- Depth to ground water

- Presence of sensitive receptors (shallow water wells, wetlands, recharge areas, etc.)

Several of the criteria are overlapping, for example slopes, distance to surface water, and permeable outwash soils all occur in the east-west drainages north and south of the planning area.

The Mason County Soil Survey (Ness, 1960) lists all soil types present in the planning area (except Made Land) as having “very limited” suitability for septic drainfields. Similarly, figures prepared by Latourell Associates show soil limitations for use of septic tanks over the entire Potlatch bubble planning area as either moderate or very severe (reproduced in HWA, 1994).

Soils with lower septic treatment capabilities include those that are excessively drained, such as Grove gravelly sandy loam, 5 to 15 percent slopes (Gk), and soils formed on steep slopes, such as Hoodsport gravelly sandy loam, 30 to 45 percent slopes (Hf). These soil types would provide less treatment than slower draining soils due to higher permeability, resulting lower effluent residence times, and lower organic content.

HWA’s opinion is that of the three main soil types encountered (Hd, Hf and Gk), the Hd soils have the best septic treatment potential and least off site septic contaminant transport risk. Hf and Gk soils are both associated with surface water or drainages, and have a higher potential for off site septic contaminant transport, due to steep slopes and excessive permeability, respectively. Artificially placed or fill soils are also likely unsuitable.

Other planning criteria for enhanced treatment include distance to surface water, as it relates to potential for septic contaminant transport (e.g., BOD, nutrients, bacteria, etc.) to surface water bodies, particularly Hood Canal. Surface water for the purpose of this discussion includes creeks, intermittent drainages, tide flats, and Hood Canal. The planning area does not appear to contain isolated upland wetlands. Figure 4 shows mapped wetlands and surface water features that are likely to convey septic drainfield effluent rapidly and without much treatment to Hood Canal. Enhanced septic treatment (above conventional residential systems) may be considered for areas near surface water or drainages. For reference, Chapter 246-272A WAC, On-Site Sewage Systems specifies a setback of 100 feet for drainfields from surface water, and 30 feet from any downgradient site feature that may allow effluent to surface.

INFILTRATION POTENTIAL - CORE RESERVATION AREA

Of the geologic units found in the planning area, glacial till is expected to have poor to negligible infiltration potential, whereas outwash (both recessional and advance) is likely have moderate to high infiltration potential. Recessional outwash may be limited by lateral extent or thickness, as it typically overlies the till. Infiltrating water will generally perch on the till surface, and flow down the slope of the till surface, which often follows topography. Recessional outwash may contain ground water in some areas, which would limit infiltration potential depending on the depth to water. Advance outwash may be also limited by lateral extent or depth to ground water. Advance outwash deposits at the surface in the project area are generally located in drainages, which have been incised through the till to expose the underlying outwash.

The Ecology 2005 *Stormwater Management Manual for Western Washington* provides general infiltration rates based on grain size distribution and soil classifications. This guidance document is intended primarily for stormwater, but can be used to estimate infiltration rates from other sources (e.g., treated waste water effluent). Table 3.7 (reproduced from the Ecology Manual) shows estimated infiltration rates for USDA soil types.

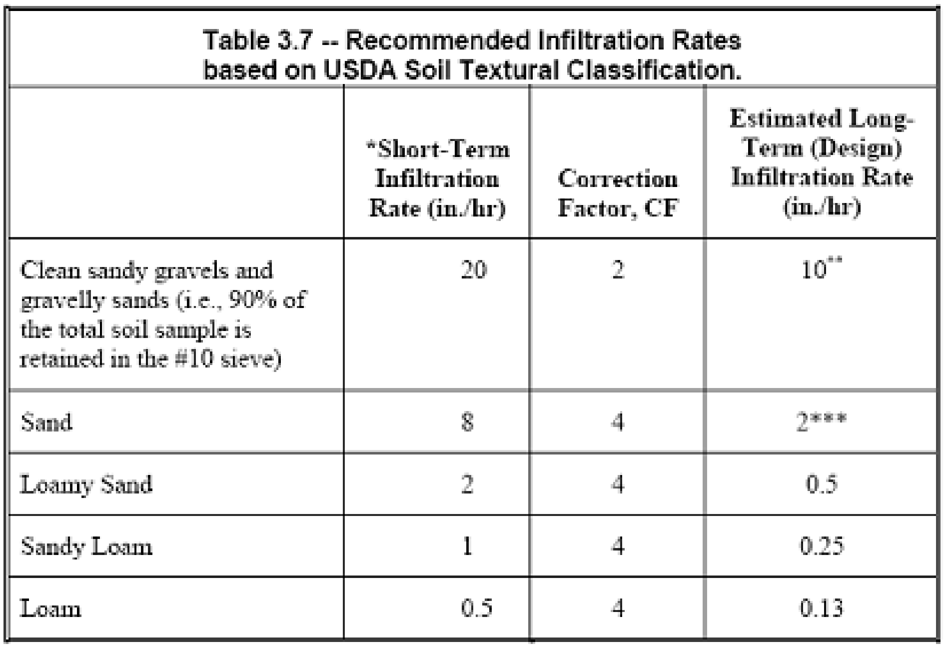

Table 3.7 -- Recommended Infiltration Rates based on USDA Soil Textural Classification.

	*Short-Term Infiltration Rate (in./hr)	Correction Factor, CF	Estimated Long-Term (Design) Infiltration Rate (in./hr)
Clean sandy gravels and gravelly sands (i.e., 90% of the total soil sample is retained in the #10 sieve)	20	2	10**
Sand	8	4	2***
Loamy Sand	2	4	0.5
Sandy Loam	1	4	0.25
Loam	0.5	4	0.13

HWA also reviewed infiltration potential in the northern portion of the Core Reservation planning area, to evaluate suitability for rapid infiltration of treated effluent from a proposed membrane bioreactor wastewater treatment plant. Geology of the proposed treatment plant site is mapped as Qgo, Proglacial and

Recessional Outwash (Logan, 2003). Recessional outwash typically is associated with high permeability and favorable infiltration potential. Soils at the treatment plant site are mapped as Mg, Mukilteo peat, 0 to 2 percent slopes (Ness, 1960). These soils are formed in peat bogs and are very poorly drained. Although not entirely consistent with the geologic map, the Mg soils have formed in peat bogs over outwash at this location due to drainage patterns (e.g., low lying area with shallow ground water). Two test pits conducted in this area by HWA in 1994 indicate the presence of clean and silty sands to depths of six feet, suggesting the presence of outwash, not peat (HWA, 1994).

An intermittent drainage located northwest of the proposed treatment plant site is known locally as Dry Bed Creek. The drainage is mapped as Qapo, Alpine Outwash, with Qga, Advance Outwash mapped further upstream (Logan, 2003). Another reference shows this area as Recessional Outwash, Glacial Drift, and Advance Outwash mapped further upstream (Carson, 1976). For site suitability purposes, differentiation of outwash as alpine, advance, or recessional is not critical.

HWA visited the Dry Bed Creek area on December 6, 2006, and observed bank exposures in the steeply incised (dry) channel consisting of stratified clean sands and gravels, with some thin layers of silty sand, consistent with the mapped designation of glacial outwash. Local residents report the channel rarely contains any water; even after heavy precipitation events, it flows for a few days, then dries out. HWA observed glacial till in an excavation just north and outside the edge of the channel, more consistent with Carson (1976) than the Logan (2003) map, and suggesting the outwash may only crop out at and near the channel in this area.

HWA recommends explorations in this area to establish actual soil types and ground water depths, to determine suitable areas for infiltration and allow estimation of infiltration rates. The geologic investigation would likely consist of test pit explorations and/or soil borings followed by classification and laboratory grain size distribution analysis of potential receptor soils. This evaluation (along with other criteria such as steep slopes, property availability, distance to wastewater infrastructure, elevation, presence of receptors, etc.) would allow selection of the most appropriate site and estimation of infiltration capacities. Once a site is selected, ground water monitoring and pilot infiltration testing would be needed to size the facility for design flows. The pilot infiltration test typically entails a 17-24 hour period of infiltration at rates scaled to design flows, into an approximately 100 square-foot pit (Ecology, 2005). Discharge and water levels are monitored and long term infiltration rates can be approximated.

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LIMITATIONS

The conclusions expressed by HWA are based solely on material referenced in this report. Observations were made under the conditions stated. Within the limitations of scope, schedule and budget, HWA attempted to execute these services in accordance with generally accepted professional principles and practices in the area at the time the report was prepared. No warranty, express or implied, is made. HWA's findings and conclusions must not be considered as scientific or engineering certainties, but rather as our professional opinion concerning the significance of the limited data gathered and interpreted during the course of the assessment.

This study and report have been prepared on behalf of Mason County for the specific application to the subject property. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, nor the use of segregated portions of this report.

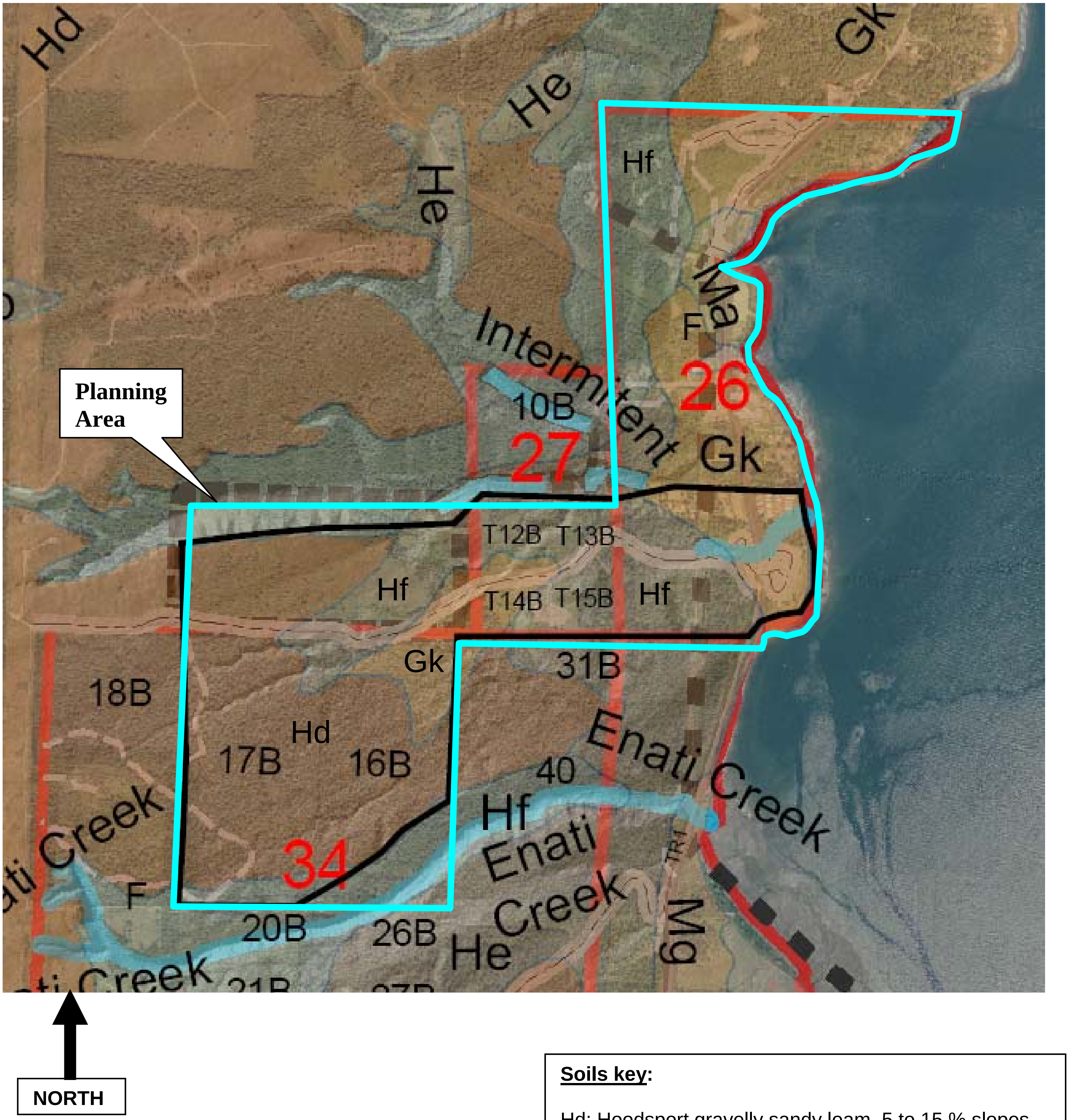
We appreciate the opportunity to provide our services. Please feel free to call us if you have any questions or need more information.

Sincerely,

HWA GEOSCIENCES INC.

State of Washington
Hydrogeologist
170
Licensed Geologist
Arnon Sugar

Arnie Sugar, LG, LHG
Vice President



From: Ness, A. 0., and Fowler, R. H., 1960. *Soil Survey Of Mason County, Washington*, Soil Conservation Service, United States Department of Agriculture, Washington Agricultural Experiment Stations.
http://www.or.nrcs.usda.gov/pnw_soil/wa_reports.html

Soils key:

Hd: Hoodsport gravelly sandy loam, 5 to 15 % slopes
He: Hoodsport gravelly sandy loam, 15 to 30 % slopes
Hf: Hoodsport gravelly sandy loam, 30 to 45 % slopes
Gh: Grove gravelly sandy loam, 0 to 5 % slopes
Gk: Grove gravelly sandy loam, 5 to 15 % slopes
Ma - Made land

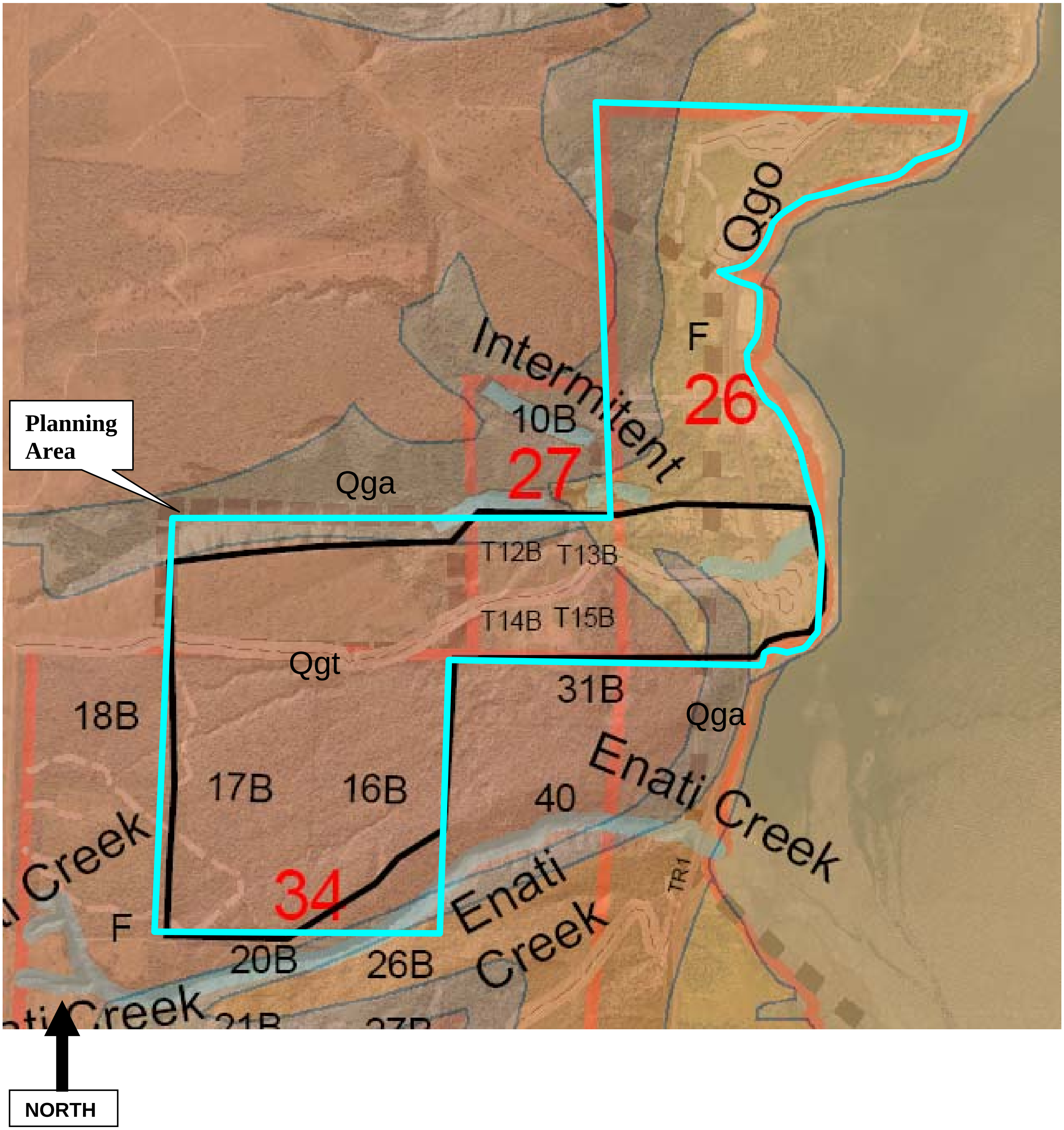
HWA GEOSCIENCES INC.

SOILS MAP

MASON COUNTY
WATER QUALITY PROJECT PLANNING
POTLATCH BUBBLE AREA

FIGURE NO.
1

PROJECT NO.
2006-172



From: Logan, R. L., 2003. *Geologic Map of the Shelton 1:100,000 Quadrangle, Washington.* 45 x 36 in. color sheet, scale 1:100,000, Washington Division of Geology and Earth Resources, Open File Report 2003-15 http://www.dnr.wa.gov/geology/pdf/ofr03-15.pdf

Geology key:

Qgt - Till, late Wisconsinan (Pleistocene)
Qga - Advance outwash, late Wisconsinan (Pleistocene)
Qgo - Proglacial and recessional outwash, late Wisconsinan (Pleistocene)

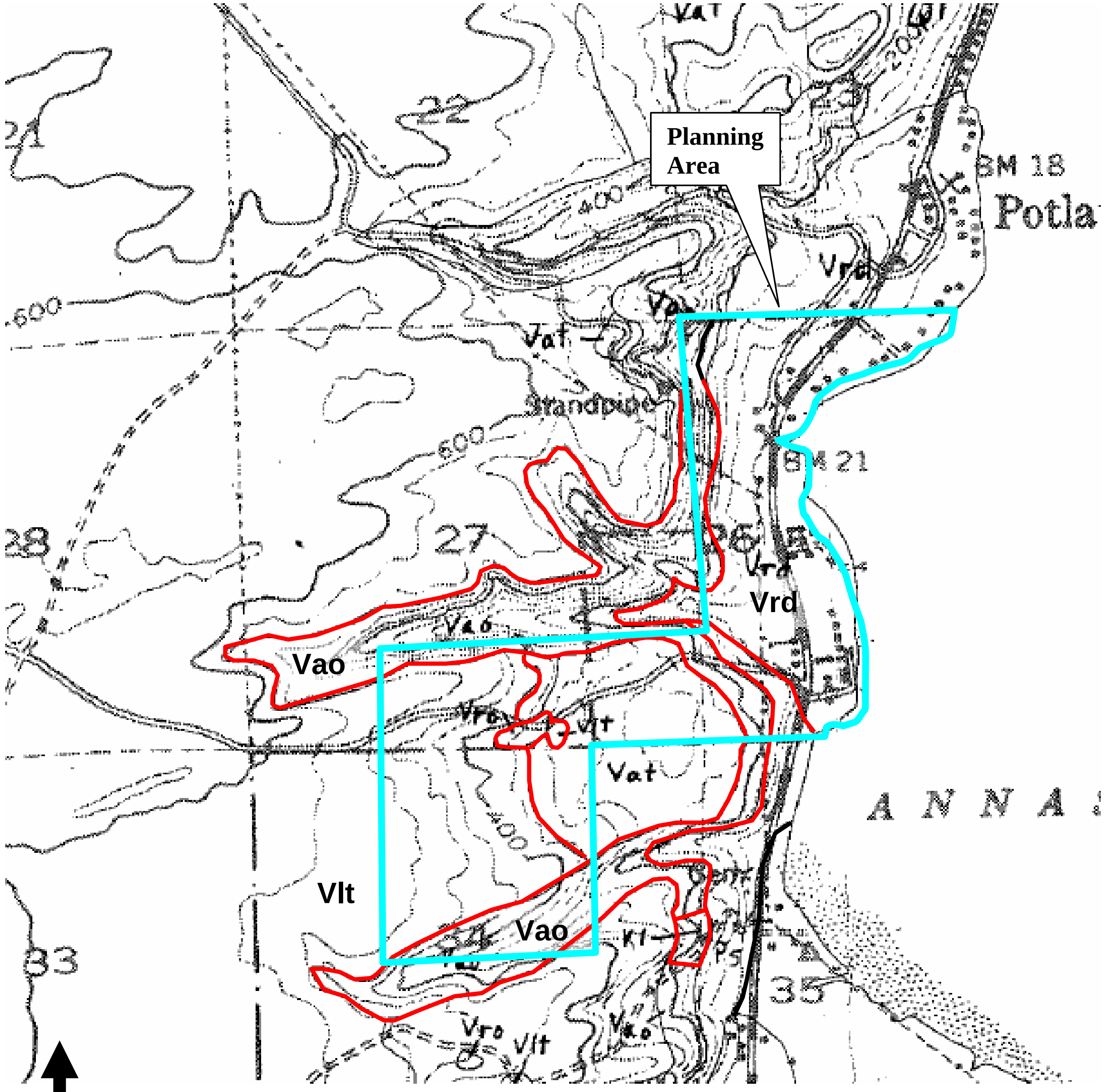
HWA GEOSCIENCES INC.

GEOLOGIC MAP (Logan, 2003)

MASON COUNTY
WATER QUALITY PROJECT PLANNING
POTLATCH BUBBLE AREA

FIGURE NO.
2

PROJECT NO.
2006-172

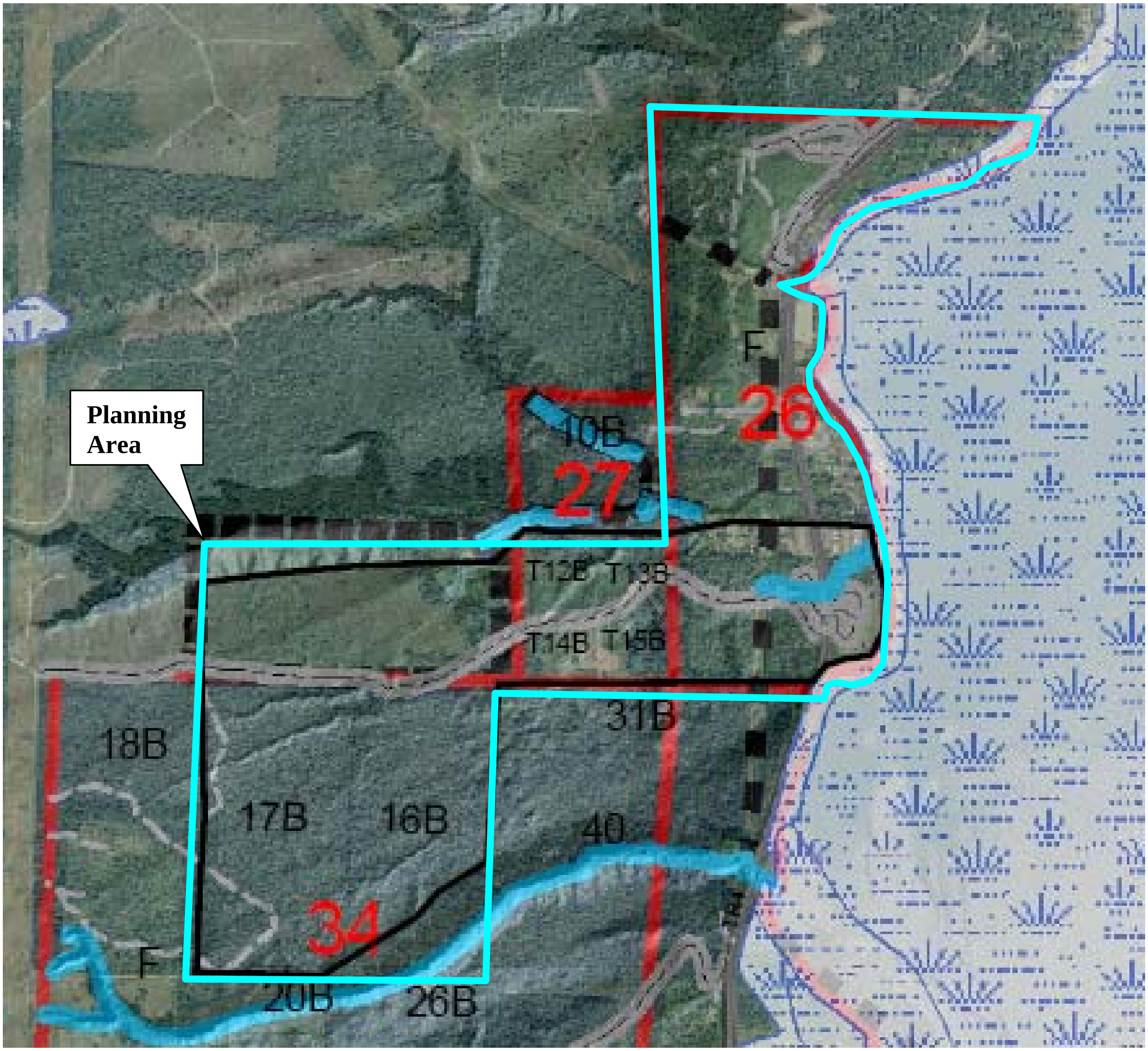


From: Carson, R. J., OFR 76-2. Geologic Map of North Central Mason County, Washington, 1 sheet, scale 1:62,500, Washington Division of Geology and Earth Resources, Open File Report 76-2.

Geology key:

Vat - Ablation Till
Vlt - Lodgment till
Vro - Recessional outwash
Vrd - Recessional outwash - deltas/alluvial fans
Vl - Lacustrine sediments
Ps - Salmon Springs Drift

HWA GEOSCIENCES INC.	**GEOLOGIC MAP (Carson, 1976)**	FIGURE NO. 3
	MASON COUNTY WATER QUALITY PROJECT PLANNING POTLATCH BUBBLE AREA	PROJECT NO. **2006-172**



NORTH

From: Skokomish Tribe GIS Services

HWA GEOSCIENCES INC.

WETLANDS

MASON COUNTY
WATER QUALITY PROJECT PLANNING
POTLATCH BUBBLE AREA

FIGURE NO.
4

PROJECT NO.
2006-172

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Appendix 3.3

Wessen & Associates, Inc.
An Assessment of Archaeological Resource Potential in the Potlatch and Skokomish Indian Reservation Areas, Mason County, Washington
January 2007

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AN ASSESSMENT OF ARCHAEOLOGICAL RESOURCE POTENTIAL IN THE POTLATCH AND SKOKOMISH INDIAN RESERVATION AREAS, MASON COUNTY, WASHINGTON

Gary C. Wessen, Ph.D.
Wessen & Associates, Inc.
January 2007

INTRODUCTION

In the fall of 2006, Mason County contracted with Wessen & Associates, Inc. to assist in planning for a wastewater management system in the Potlatch and Skokomish Indian Reservation areas. Wessen & Associates' role was to prepare an inventory of cultural resources in this study area and advise in the planning effort so that disturbance to known and suspected cultural resources might be avoided to the fullest possible extent. This document presents the background, goals, methods, findings, and recommendations of our effort.

BACKGROUND

The Potlatch & Skokomish Indian Reservation (P & SIR) Study Area is located in northeastern Mason County. It consists of four distinct parcels on and near the Skokomish Indian Reservation (see Appendix Figure 1). The northernmost parcel is almost a square mile that includes Potlatch State Park and adjacent areas to the north, south, and west. It includes almost 1 mile of Hood Canal shoreline and much of the slope rising to the upland glacial plain to the west. A second large parcel of slightly more than a square mile includes much of the Highway 101 and 106 corridors and adjacent residential areas on the Skokomish Indian Reservation. It is entirely on the flood plain of the Skokomish River delta. A third parcel is approximately 0.25 square mile along the northern bank of the Skokomish River. It is also on the flood plain. Finally, the fourth parcel is less than 0.25 square mile on the upland glacial plain in the western part of the reservation. There are significant areas of commercial and/or residential development in portions of the first three parcels. The last parcel is currently undeveloped timber land.

The P & SIR Study Area is located within the traditional territory of the Tuwaduq (Twana) People. In early historic times - - and for a considerable period prior to them - - the Tuwaduq People occupied all of the lands in the immediate vicinity of Hood Canal. Many of their traditional settlements were located along the Hood Canal shoreline, often at or near the mouths of rivers or creeks. They also fished, hunted, and otherwise used a considerable range of lands interior to Hood Canal. Representatives of the Tuwaduq signed the Point-No-Point Treaty in 1855 and subsequently relocated onto the Skokomish Indian Reservation. Their descendants are now usually referred to as the Skokomish Indian Tribe.

There has been only very limited archaeological research within the traditional territory of the Tuwaduq People. Few efforts to locate archaeological sites have been conducted and those which have occurred have generally been limited in their geographic focus. Large scale systematic efforts to identify prehistoric archaeological resources have yet to occur here. Similarly, there have been relatively few detailed studies of particular archaeological sites anywhere along Hood Canal. We currently know that some traditional Tuwaduq settlements in the P & SIR Study Area have been occupied for at least 1,500 to 3,300 years. Other, as yet undated, archaeological sites in the area are probably much older.

RESEARCH DESIGN

The goals of this effort are essentially those stated above in the introduction to this document: "to prepare an inventory of cultural resources in the P & SIR Study Area and advise in the planning effort so that disturbance to known and suspected cultural resources might be avoided to the fullest possible extent". The term 'cultural resources' as used here, refers to archaeological materials. Thus, this study has not addressed the possibility that there may be historic structures in the P & SIR Study Area. To our knowledge, there are very few and, moreover, our current understanding of the proposed wastewater management actions suggests that historic structures are unlikely to be affected. The focus of this effort has been directed largely toward archaeological resources representing the Native American occupants of the area. It should be noted, however, that archaeological resources representing late 19th and early 20th Century Euro-American occupants of the area could also be present in the P & SIR Study Area.

The results of the inventory effort have been summarized in two maps of the P & SIR Study Area. The first map shows the locations of recorded archaeological sites and settlements known from ethnographic and/or historical sources that may have archaeological manifestations. It is important to note here that the locations of recorded archaeological sites are protected by state and federal laws, and thus this information cannot be released to the general public. In this same regard, the Skokomish Tribal Historic Preservation Office has requested that specific information about the locations of traditional Tuwaduq settlements also not be released to the general public. These requirements have led us to develop a second map. The second map identifies zones of archaeological potential within the P & SIR Study Area. These zones have been developed on the basis of the distributions of the above-noted locations and generalizations about the relatively sensitivity of different types of landforms in the study area. In brief, low gradient surfaces in the immediate vicinity of the Hood Canal shoreline, the Skokomish River and the larger creeks are considered to have a relatively high potential for archaeological resources. The flood plain of the Skokomish River, vicinities of smaller low gradient creek channels, and so-called vista points (i.e., locations that offer sweeping views of the surrounding landscape) are considered to have a moderate potential for archaeological resources. Steep gradient surfaces and low gradient upland surfaces that are not located near creeks or lakes are considered to have a relatively low potential for archaeological resources. The map identifying zones of archaeological potential within the P & SIR Study Area may be released to the general public.

Finally, it is important to emphasize that the study reported here is not an archaeological survey of the P & SIR Study Area. While we have considerable familiarity with this area, no actual on-the-ground inspection for archaeological resources was conducted at this time. Rather, the effort was essentially a literature review and our products are based upon examination of documents on file with the Washington State Department of Archaeology and Historic Preservation, the Skokomish Tribal Historic Preservation Office, other materials in our possession, and prior archaeological site survey experience in this area.

THE MAPS

Our map of the locations of archaeological sites and settlements known from ethnographic and/or historical sources that may have archaeological manifest-ations is presented in Appendix Figure 2. Note first that there are six archaeological sites in the P & SIR Study Area and eight more are located near it. Further, it is important to emphasize that this inventory is based on only limited archaeological survey efforts. To a large extent, the distribution of the known sites reflects where survey coverage is. Thus, most of the surveys conducted to date have focused upon either the Hood Canal shoreline or the Skokomish River channel. Survey coverage in the interior of the flood plain of the Skokomish River and on the uplands to the west have been quite limited. Figure 2 also indicates that at least 10 traditional Tuwaduq settlements were located within, or near, the P & SIR Study Area. Five were located along the Hood Canal shoreline and another five were along the Skokomish River channel. Relatively limited information is available about many of these places, but several have been identified as large winter villages. Other may have been somewhat smaller locations such as seasonal fish camps. Native American archaeological resources - - potentially including artifacts, occupation refuse, and human remains - - may be present at any of these locations. We have less information about 19th and early 20th Century Euro-American occupations in the area, but know that a timber-related community was present along the Hood Canal shoreline at Potlatch. (The Potlatch community was developed in the vicinity of an older Tuwaduq settlement.) We also know that there were several mid 19th Century Donation Land Claims on the Skokomish Indian Reservation, although most were abandoned shortly after the reservation was established. Thus, there is also potential 19th and early 20th Century Euro-American archaeological resources in the Potlatch area and elsewhere to the south.

The information in Figure 2, and the generalizations about the relatively sensitivity of different types of landforms noted earlier, have been used to generate the archaeological sensitivity zones presented in Appendix Figure 3. Two important caveats need to be offered about this map. First, zones based upon landforms have been defined, as the landforms appear on USGS 7.5 minute topographic maps. These are valuable tools, but it is important to emphasize that there may be archaeologically sensitive features in the study area that are too small to be indicated on USGS 7.5 minute topographic maps. The zones shown in Figure 3 are therefore generalizations about probable potential and should not be regard as guarantees that archaeologically sensitive areas are not present within zones here identified as having only a low potential. A second caveat concerns the low gradient surfaces in the immediate vicinity of the Hood Canal shoreline. This area has been indicated as having a relatively high potential for archaeological resources. This study has not documented the history of filling along this shoreline. We raise this issue because we know that some locations (e.g., near the Cushman No. 2 Powerhouse at Potlatch and in the day use area of Potlatch State Park) contain fill deposits, and fill deposits are a complicating consideration. At first glance, fill sediments can be expected to be culturally-sterile, and thus documented fill areas should have no potential to contain archaeological resources. The issue is actually more complicated for two reasons. First, experience elsewhere in western Washington has shown that low lying areas with archaeological resources were sometimes filled in order to raise their base level. Thus, potentially significant archaeological resources can be present underneath fill deposits. Second, there are documented cases of archaeological sediments having been used as fill materials in western Washington. This means that it is possible that archaeological materials - - including human remains - - could be encountered in fill deposits.

The map of zones of archaeological potential within the P & SIR Study Area indicates that high potential areas include the low gradient surfaces in the vicinity of the Hood Canal shoreline, the Skokomish River channel and the Skebob Creek channel. These areas have the highest potential for both Native American and Euro-American archaeological resources. These are also among the most developed (i.e., disturbed) areas in the P & SIR Study Area. The history of historic disturbance may have damaged and/or destroyed archaeological resources in these areas. It would, however, be dangerous to simply assume this. In fact, there are many well documented cases of important archaeological resources having survived in badly disturbed, highly developed landscapes. (Witness the recent events at the graving dock site in Port Angeles.)

Areas thought to have a moderate potential for archaeological resources include those portions of the flood plain of the Skokomish River delta that are not in the immediate vicinity of the Hood Canal shoreline, the Skokomish River channel, or other creek channels and areas along the tops of slopes that look out over Hood Canal and/or major creek canyons. Some of the latter areas have also experienced significant historic disturbance (e.g., the Highway 101 and 106 corridors) and the above-note caution also applies in these areas.

Finally, significant portions of the P & SIR Study Area appear to have only a relatively low potential for archaeological resources. Areas thought to have a relatively low potential include steep surfaces along the margin of Hood Canal and low gradient interior surfaces on the upland glacial plain in the western portion of the P & SIR Study Area. While we are confident that the latter areas have only a relatively low potential for archaeological resources, we should emphasize that there is a difference between ‘low potential’ and ‘no potential’. It is possible that that archaeological resources could be encountered in areas we characterize as having only a relatively low potential.

RESOURCE MANAGEMENT CONSIDERATIONS

The assessments of archaeological resource potential presented here are based upon archaeological and ethnographic data and generalizations about the relative sensitivity of different types of landforms, as they appear on USGS 7.5 minute topographic maps. As already indicated, this study is not an archaeological survey of the P & SIR Study Area and should not be regarded as one. We therefore recommend that an archaeological survey of the areas to be impacted by the waste-water management system be conducted. Having said this, we think that project planners should be aware that - - depending upon the system's design - - it may prove to be difficult to investigate some portions of the P & SIR Study Area. In particular, we note that some of the high potential areas have been extensively developed and thus, built features such as paved road beds and structures may make effective archaeological inspection difficult. Some of this difficulty may be addressed by test boring portions of the study area, but even the feasibility of this approach is difficult to assess at this time.

As such, while an archaeological survey is an important next step, project planners should recognize that such an effort may not be sufficient to be certain that archaeological resources are not present anywhere in their project area. We therefore think that some degree of archaeological monitoring may be appropriate during the construction of the planned facilities. The specific scope and character of such a monitoring plan should be developed after the results of the archaeological survey are available.

APPENDIX - MAPS

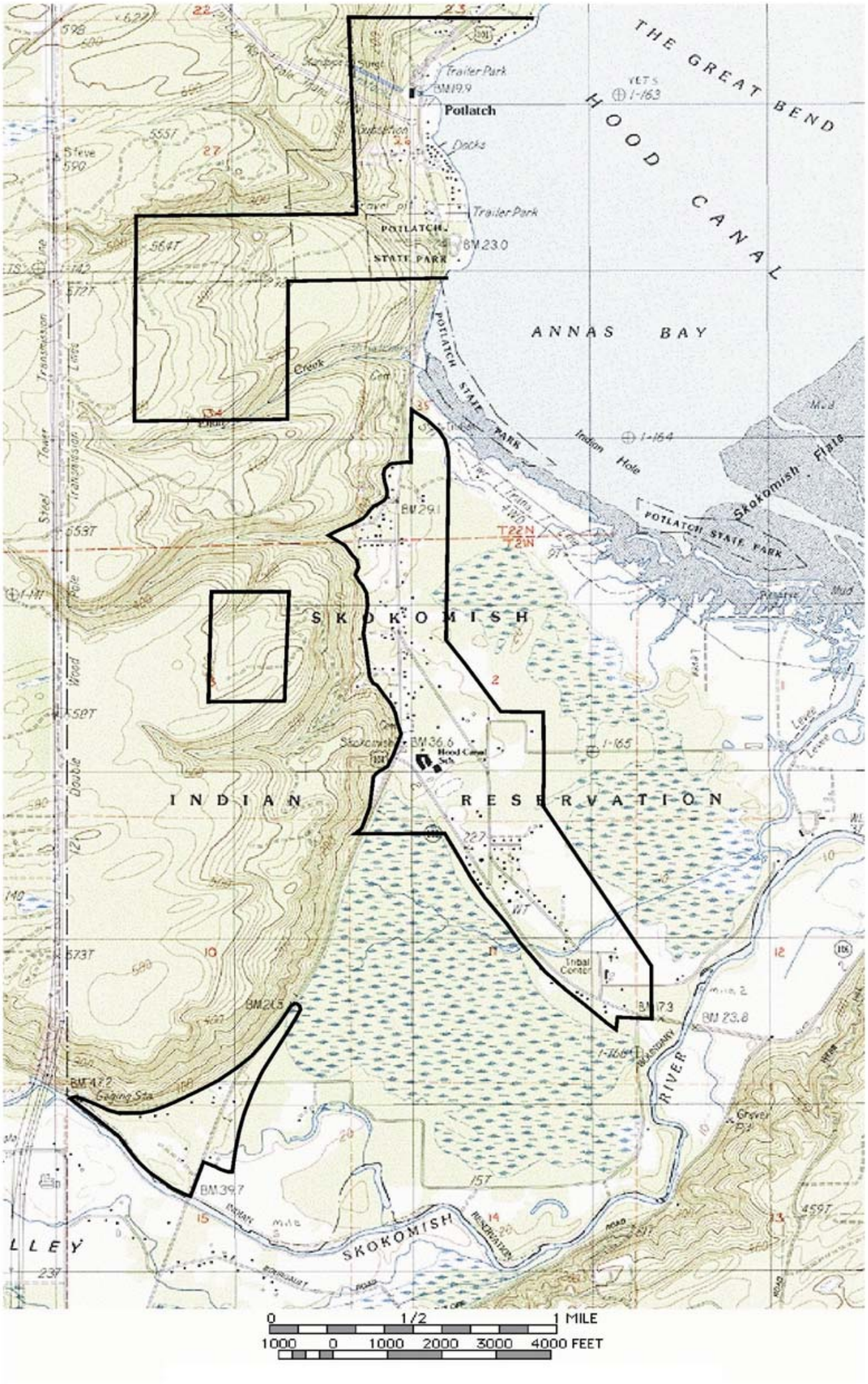

Figure 1 The Potlatch & Skokomish Indian Reservation Study Area, Mason County, Washington.

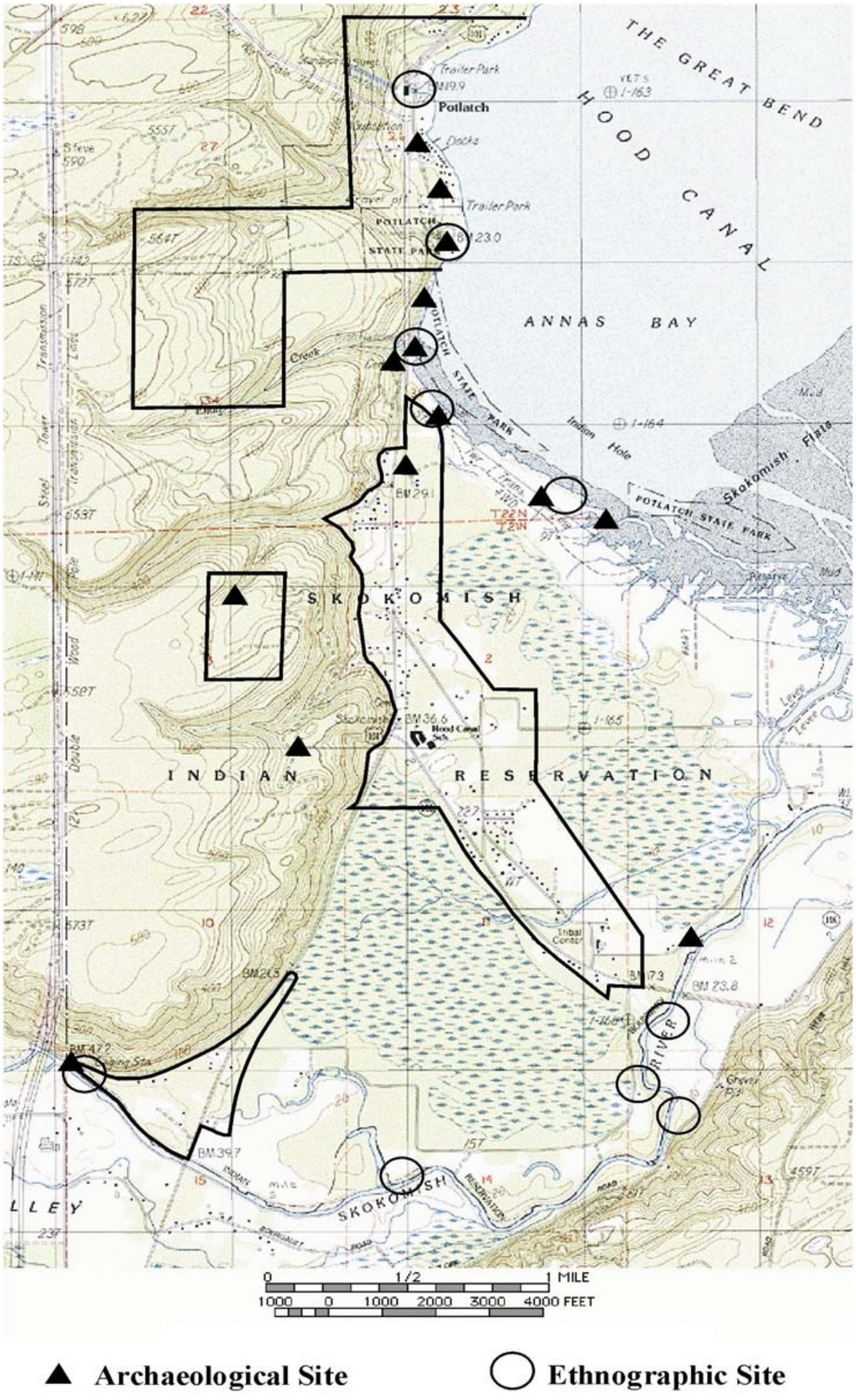

Figure 2 Archaeological and ethnographic sites in and near the Potlatch & Skokomish Indian Reservation Study Area, Mason County, Washington.

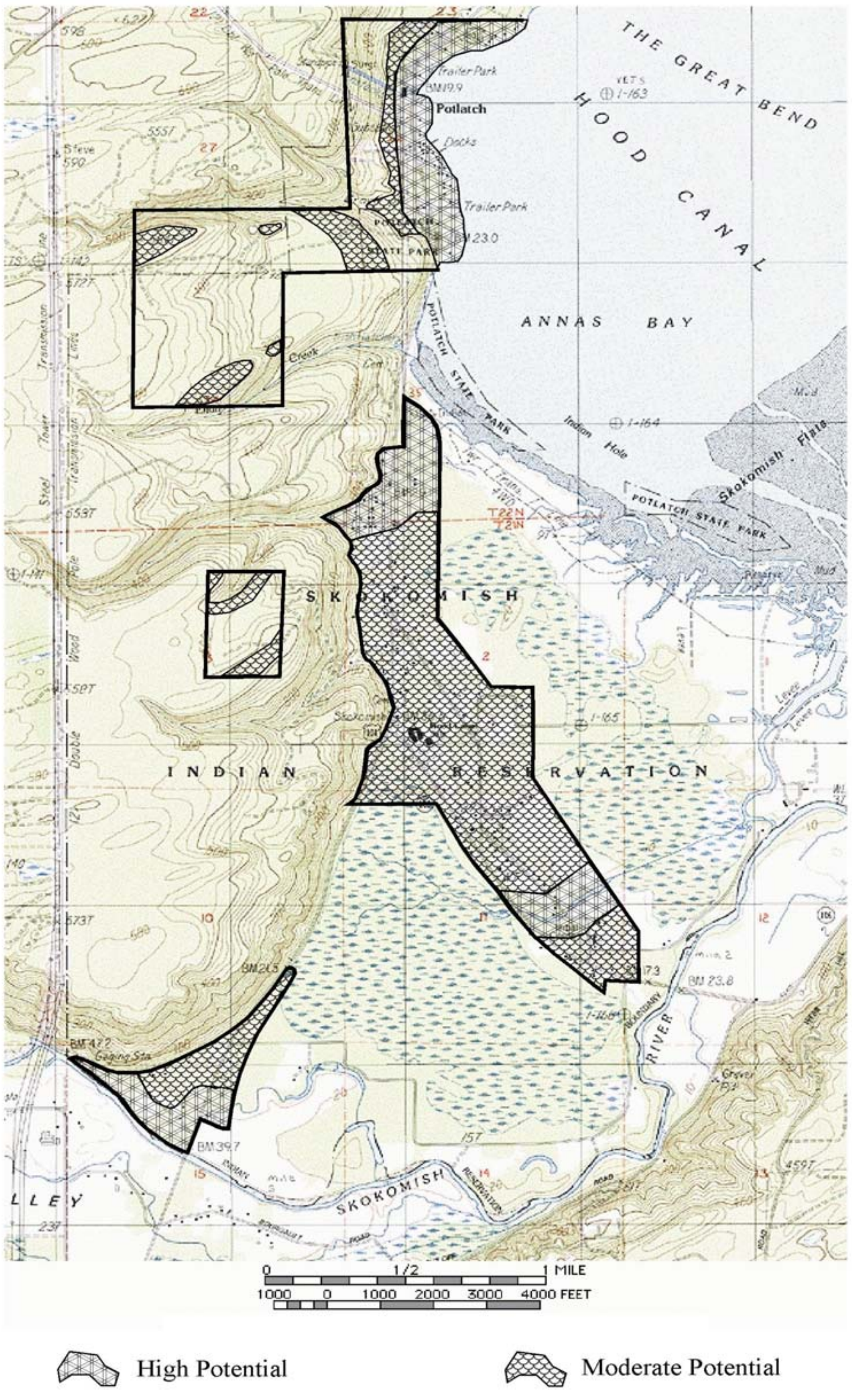

Figure 3 Archaeological potential zones in the Potlatch & Skokomish Indian Reservation Study Area, Mason County, Washington.

Appendix 4.1

HWA GeoSciences Inc.
Potlatch “Bubble” and Core Reservation Planning Areas Report
March 2007

HWA GEOSCIENCES INC.
Geotechnical & Pavement Engineering • Hydrogeology • Geoenvironmental • Inspection & Testing

March 8, 2007
HWA Project No. 2006-172-300

Art O'Neal & Associates
127 17th Avenue SW
Olympia, WA 98501

Attention: Art O'Neal

Subject: **INFILTRATION EVALUATION**
WATER QUALITY PROJECT PLANNING
POTLATCH "BUBBLE" AND CORE RESERVATION PLANNING AREAS
MASON COUNTY, WASHINGTON

Dear Mr. O'Neal:

HWA GeoSciences Inc. (HWA) is pleased to submit this effluent disposal/infiltration feasibility review at the Potlatch "Bubble" and Core Reservation planning areas in Mason County, Washington.

INTRODUCTION

HWA's soils and hydrogeologic evaluation dated January 30, 2007 provides a general evaluation of soil septic treatment capability and infiltration potential based on geologic, soils, and physiographic criteria in the planning area, based on review of existing geologic and hydrogeologic data (HWA, 2007). The report contained herein summarizes site specific explorations conducted at selected sites within the Potlatch and Reservation planning areas, for evaluation of infiltration potential.

Goals and Objectives

The goals and objectives of this study were to evaluate the infiltration potential and site suitability of selected sites. Figures 1, 2 and 3 show the location of the areas investigated, which included:

- Potlatch State Park Campground (TP-11, TP-12, and TP-13)
- Potlatch State Park Drainfield (TP-14 and TP-15)
- New Skokomish Tribal Housing Area (TP-2, TP-8, TP-9, and TP-10)
- North Reservation Area (TP-3, TP-4, TP-6, and TP-7)

19730 - 64th Avenue W.
Suite 200
Lynnwood, WA 98036.5957

Tel: 425.774.0106
Fax: 425.774.2714
www.hwageosciences.com

SITE EXPLORATIONS

HWA monitored the excavation of five test pits on January 23, 2007, and eight test pits on February 21, 2007. Excavation services were provided by the Skokomish Tribe Natural Resources Department. We also observed soils exposed at several existing excavations. Figures 1, 2 and 3 show the test pit locations. Test pit logs are included in Appendix A. The objective of this study was to determine soil types and shallow ground water depths at the sites to identify potentially suitable infiltration receptor soils. The four general areas are discussed below.

Potlatch State Park Campground

The State Park campground area west of Highway 101 is mapped as recessional outwash (Logan, 2003, Carson, 1976, and Shannon & Wilson, 1978) and Grove soil (Ness and Fowler, 1960). Refer to the HWA January 30, 2007 report for geologic and soils maps of this area (HWA, 2007). Accessible areas within the campground include an approximately 200 foot long strip adjacent to the parking area near the entrance, and areas at the west end of the site, near the Park's water well.

Most of the campground area is relatively flat, with uplands to the west rising over 250 feet, starting at the west part of the campground area. The campground area slopes and drains to the east, towards Hood Canal. A creek runs through the campground area, which originates from springs at the base of the steep slope west of the site, and flows via culverts under Highway 101.

HWA monitored the excavation of three test pits in this area, designated TP-11, TP-12, and TP-13. Figure 2 shows the test pit locations. A Washington State Parks archaeologist observed all excavations, and we understand no cultural resource issues were identified during excavation at the campground area.

Soils encountered in the test pits included dense silty sand (glacial till) in TP-11, and loose sand (recessional outwash) in TP-12 and TP-13. Shallow ground water was encountered in all three test pits, ranging from three to four feet below grade in TP-12 and TP-13, and 6 feet below grade in TP-11. Ground water, where encountered, is noted on the test pit logs. HWA conducted this study in winter, during a period of high seasonal ground water. Soil moisture/ground water conditions will likely change in response to rainfall, time of year, creek stage, and other factors. Shallow ground water gradient in this area is likely to the east, following topography.

Although this area contains permeable soils with high infiltration rates, the presence of shallow ground water may limit the feasibility of rapid infiltration at this site. Most of the infiltrated water will reach shallow ground water and travel horizontally to the creek, and/or daylight in the roadside ditch along Highway 101. Site and highway stormwater systems (culverts, ditches, outfalls, etc.) would need to be evaluated to accommodate the added flow from a wastewater effluent infiltration system.

Potlatch State Park Drainfield

The State Parks drainfield is located west and uphill from the campground area, reportedly due to the high ground water at the campground and beachfront Park sites. The site is a cleared, grassy area surrounded by forested land, and slopes to the east. The drainfield area is mapped near the contact between glacial till and outwash by Logan (2003) and Carson (1976) and as glacial till by Shannon & Wilson (1978). The soils map indicates Hoodsport (till-derived) soils in this area (Ness and Fowler, 1960).

HWA monitored the excavation of two test pits, designated TP-14 and TP-15, one at either end of the drainfield, at the edge of the cleared area. Figures 2 and 3 show the test pit locations. Soils encountered in both test pits included approximately three feet of topsoil and silty sands (weathered outwash) over relatively clean sands and gravels (outwash) to depths of up to nine feet below grade. Ground water was not encountered in the two test pits at this location, and is likely deep, based on the topography (i.e., upland location, approximate elevation of 200 feet). Ground water gradient at the site is likely to the east, or downslope. We observed numerous ground water springs at the base of the hillside along the western side of Highway 101 in the general area south of the State Park. This seepage is likely occurring along the advance outwash exposure at the base of the hill.

This site appears favorable for rapid infiltration, and presumably could be expanded by additional clearing. A preliminary northeast-southwest slope profile constructed through the drainfield commencing uphill of the drainfield area and extending towards the flat ground in the campground area shows that the slope is approximately 25 to 30 percent. According to the geologic maps described earlier and HWA test pit explorations, the site is underlain by glacial advance outwash deposits. These deposits formed within proglacial stream channels and braided plains that developed in front of the advancing glacial ice sheet and were subsequently over-ridden, and are dense to very dense. Typically, this soil is stable and has high shear strength (internal friction angle of up to 45 degrees). According to Mason County Resource Ordinance (Ordinance No. 77 - 93), Chapter 17.01.100 – Landslide Hazard Area , Section E, Geotechnical Report, Category D, "*Areas with slopes between 15 and 40 percent will require a geological assessment, and may further require a geotechnical report…* ". Therefore, HWA recommends additional soil exploration in the vicinity of the drainfield prior to addition of any new flows to the drainfield area to characterize the soil unit underlying the advance outwash deposits and evaluate the stability of the slope, which extends from the existing drainfield area to the campground area.

New Skokomish Tribal Housing area

The New Skokomish Tribal Housing area is mapped as glacial till by Logan (2003) and Shannon & Wilson (1978) and as Till with a small pocket of recessional outwash by Carson (1976). The soils map indicates Hoodsport (till-derived) soils, with a large swath of Grove soils (outwash-derived) in the central portion of the proposed development (Ness and Fowler, 1960).

HWA monitored the excavation of four test pits in this area, designated TP-2 , TP-8, TP-9, and TP-10. Figures 1 and 3 show the test pit locations. Explorations in this area were limited by access, as the area is currently heavily timbered, and new roads were being created at the time of our explorations. Soils encountered included:

TP-2 - This test pit encountered stratified silty sands with silt layers to a depth of eight feet, and clean sands (outwash) from eight feet to the maximum excavated depth of nine feet. Deeper soils appeared more permeable, although additional exploration in this area would be required to assess the feasibility of rapid infiltration. Infiltration facilities in these conditions would require overexcavation of surficial lower permeability soils, or installation of subsurface infiltration facilities (trenches, galleries, etc.) to a sufficient depth to access suitable soils.

TP-8 - This test pit encountered sandy and gravelly, silts (glacial till) and is not likely suitable for rapid infiltration.

TP-9 – This test pit encountered silt and silty sands, and is not likely suitable for rapid infiltration.

TP10 – This test pit encountered a six foot thick veneer of glacial till over gravel (outwash) to the maximum excavated depth of eight feet. As in TP-2, this area may be suitable for rapid infiltration provided surficial low permeability soils are removed, or the facility is constructed below them. Additional exploration in this area would be required to assess the feasibility of rapid infiltration.

North Reservation Area

HWA monitored the excavation of four test pits in this area designated TP-3, TP-4, TP-6, and TP-7. Figure 1 shows the test pit locations. These locations were suggested by Cascade Design Professionals, Inc., and are discussed below.

<u>TP-3</u> - This test pit was located east of Highway 101, at the edge of a mapped wetland area. Soils encountered included silty sands with gravel, with a high ground water table (1.5 feet below grade). Ground water, where encountered, is noted on the test pit logs. HWA conducted this study in winter, during a period of high seasonal ground water. Soil moisture/ground water conditions will likely change in response to rainfall, time of year, creek stage, and other factors. Shallow ground water in this area likely drains to Hood

Canal, to the east. This area is unsuitable for rapid infiltration due to low permeability soils, high ground water, and the presence of wetlands. This area may be suitable for discharge of reclaimed water to wetlands.

TP-4 - This area is mapped as recessional outwash (Logan, 2003, Shannon & Wilson, 1978). Soils are mapped as Grove soils (outwash-derived) (Ness and Fowler, 1960). Test pit TP-4 encountered fill soils and debris to a depth of seven feet, with outwash sands from seven to ten feet. Ground water was not encountered to a maximum depth of 10 feet. Shallow ground water in this area likely drains to Hood Canal, to the east.

This site contained abundant debris at the surface, including demolition debris, automobiles, and other refuse. It is possible that outwash soils exist at shallower depths in other parts of this site unaffected by local grading and filling. Rapid infiltration may be feasible at this site, provided the extent of fill and potential soil or ground water contamination from historic site use are addressed (i.e., phase I-II environmental site assessment).

Two test pits conducted in this general area by HWA in 1994 indicate the presence of clean and silty sands to depths of six feet, suggesting the presence of outwash (HWA, 1994).

TP-6 - This area is also mapped as recessional outwash and Grove soils similar to TP-4 above. This site was formerly owned by WSDOT, and was the subject of several previous investigations, including:

- Pacific Groundwater Group (PGG), September 8, 2005 *WSDOT-Potlatch Maintenance Yard Environmental Assessment,* Draft Report and soil logs.

- A Hydrogeologic Study and ground water mounding analysis conducted in 1999-2000 (mentioned in the PGG report, but no information on authors). Monitoring well records on file at Department of Ecology indicate the driller was employed by Ecology. This study, if it could be obtained from WSDOT, might provide design level information for rapid infiltration at this site, depending on the report contents and quality.

HWA test pit TP-6 encountered four feet of fill soils over sandy outwash soils, with no ground water encountered to a depth of 10 feet. Shallow ground water in this area likely drains to Hood Canal, to the east.

Other boring and test pit logs obtained indicate variable thickness of fill and glacial till at the site. Ground water is reported at 17 feet depth on one boring log, which also indicates approximately 15 feet of recessional outwash over five feet of glacial till, over saturated advance outwash at 25 feet (PGG, 2005).

Rapid infiltration may be feasible at this site, provided the extent of fill and potential soil or ground water contamination from historic site use are addressed.

TP-7 - This area, located at the edge of a steep (40 percent slope) bluff, is mapped as Alpine or Advance Outwash by Logan (2003), and Advance Outwash by Shannon & Wilson (1978). The soils map indicates Hoodsport (till-derived) soils in this area (Ness and Fowler, 1960). Areas uphill of TP-7, on flatter ground, are generally mapped as glacial till. Test pit TP-7 encountered clean, sandy outwash soils. Ground water was not encountered to a maximum depth of eight feet. Shallow ground water in this area likely follows the steep topography to the east, towards Hood Canal. Water infiltrated in this area will likely surface along the slope, or at the base of the slope, impacting downslope areas. Although this area has permeable outwash soils, rapid infiltration may not be feasible due to slope stability issues. According to Mason County Resource Ordinance (Ordinance No. 77 - 93), Chapter 17.01.100 – Landslide Hazard Area , Section A and E, *"Any area with a slope of forty percent or steeper and with a vertical relief of ten or more feet except areas composed of consolidated rock is classified as a landslide hazard area and will require a geotechnical report."* Therefore, HWA recommends additional soil exploration and slope stability evaluation in this area in order to establish feasibility of infiltration.

LABORATORY TESTING

Laboratory tests were conducted on selected soil samples to characterize relevant properties of the on-site soils. Laboratory testing included determination of moisture content and grain size distribution. All testing was conducted in accordance with appropriate ASTM standards. The test results and a discussion of laboratory test methodology are presented in Appendix B.

INFILTRATION ESTIMATES

The Washington State Department of Ecology (Ecology) 2005 *Stormwater Management Manual for Western Washington* recommends utilizing one of three methods for determining infiltration rates: USDA textural analysis, ASTM grain size distribution from soil samples, and in-situ field measurements.

This guidance document is intended primarily for stormwater, and therefore does not apply at this site, but contains results of recent research and principles of hydrogeology which can be used to estimate infiltration rates from other sources (e.g., treated waste water effluent). HWA utilized USDA textural analysis and ASTM grain size distribution to estimate infiltration rates for this project.

USDA Soil Textural Classification

Infiltration rates can be estimated from grain size distribution data using the USDA textural analysis approach. HWA analyzed 11 soil samples collected from test pits for grain size distribution and textural classification in accordance with ASTM test procedures, corrected to approximate the USDA procedures. Table 2 shows the results of the grain size analyses and Appendix B presents the soil laboratory data.

To determine long-term infiltration rates based on the USDA method, Ecology recommends that the short-term infiltration rates be reduced by a correction factor based on the soil textural classification, average degree of long-term facility maintenance, TSS (total suspended solids) reduction through pretreatment, and site subsurface variability.

Based on the USDA grain size method, laboratory test results indicate estimated long-term infiltration rates of two in/hr for most of the sandy soils encountered in our explorations at the Parks campground, Parks drainfield, and at TP-4 and TP-6 in the north Reservation area. USDA infiltration rates at the new housing area range from 0.25 to 0.5 in/hr at TP-10 and TP2, respectively.

ASTM Grain Size Distribution

The ASTM grain size distribution method compares infiltration measurements from full-scale infiltration facilities to soil gradation data developed using the ASTM procedure (ASTM D422). Because this method compares data from existing full-scale infiltration facilities, the estimated infiltration rates are presented as estimated long-term infiltration rates. The estimated long-term infiltration rates assume an average degree of long-term facility maintenance, TSS control, and site variability in the subsurface conditions. Table 2 shows the results of the grain size analyses and Appendix B presents the soil laboratory data.

Based on the ASTM grain size method, our laboratory test results indicate estimated infiltration rates of up to 9 in/hr for sandy soils encountered at the Parks campground, TP-2, TP-4,and TP-6; ranging from 2 to 6 in/hr at the Parks Drainfield; and 2.4 in/hr at TP-10.

Table 2
Long-Term Infiltration Rates*
Based On USDA and ASTM Soil Textural Classification

				Ecology Long Term rates	
Test Pit	**Depth**	**ASTM description**	**USDA Classification**	**ASTM (in/hr)**	**USDA (in/hr)**
Campground					
TP-12	4	Well graded SAND with gravel	Sand	9	2
TP13	4.5	Well graded SAND with gravel	Sand	9	2
Drainfield					
TP-14	22.5	Poorly graded SAND with gravel	Sand	6.5	2
TP-14	8.5	Well graded GRAVEL with sand	Sand	4.2	2
TP-15	3.5	Poorly graded SAND with gravel	Sand	1.8	2
TP-15	5.3	Well graded GRAVEL with sand	Sand	5.5	2
TP-15	6.5	Poorly graded GRAVEL w/ sand	Sand	5	2
New Housing area					
TP-2	6	Poorly graded GRAVEL w/ sand	Loamy Sand	9	0.5
TP-10	7.6	Poorly graded GRAVEL w/ silt and sand	Sandy Loam	2.4	0.25
North Reservation Area					
TP-4	8	Poorly graded SAND with gravel	Sand	9	2
TP-6	8	Well graded GRAVEL with sand	Sand	9	2

* based on *Stormwater Management Manual for Western Washington*, Ecology, 2005.

Infiltration Estimates

Based on HWA's grain size testing, long term infiltration rates for soils encountered at the site range from 0.25 to 2 in/hr using the USDA method, and up to 9 in/hr using the ASTM method.

These estimates should be considered preliminary, with no factor of safety, unknown ground water depths, no accounting for ground water mounding (see below) and subject to additional testing and design data as outlined below. Vertical infiltration is limited by the least permeable layer in the soil profile. HWA did not analyze the fine grained soils (e.g., silts and silty sands) encountered in our explorations. The infiltration rates provided herein should therefore be used in conjunction with the test pit logs (Appendix A) to evaluate infiltration feasibility.

GROUND WATER MOUNDING

Ground water mounding is a local raising of the ground water table due to infiltrating water from the surface. If a ground water mound reaches the infiltration facility, infiltration rates are greatly reduced, and facility failure may occur, depending on flow rates and storage volume.

Evaluation of ground water mounding is best accomplished by understanding ground water levels, gradient, and aquifer characteristics. Because ground water levels were deeper than most of the test pits, the infiltration receptor soils at the selected site should be evaluated by installing ground water monitoring wells and measuring ground water levels. For areas with shallow ground water, aquifer properties should be evaluated by conducting pumping or slug tests. Mounding potential can then be predicted by 1) analytical solutions using infiltration rates and ground water levels, 2) measuring shallow ground water levels during pilot infiltration testing, or 3) performing predictive ground water flow modeling.

RECOMMENDATIONS

If a site is selected, HWA recommends more detailed on-site hydrogeologic, geotechnical, and in some cases environmental investigations. The investigation would likely consist of additional test pit explorations and soil laboratory testing in areas not previously accessible. Borings and monitoring wells should also be installed and tested to establish ground water levels, gradients, quality, and aquifer parameters. Seasonal ground water changes should be evaluated. Monitoring during one wet season at a minimum is recommended. A ground water mounding analysis and modeling to predict flow rates and impacts to nearby surface water features should also be performed as described above. Some of the sites will require a slope stability evaluation. A Phase I (and possibly II) Environmental Site Assessment should also be conducted prior to any property purchase, or to evaluate impacts of infiltration over potentially contaminated soils or ground water.

Pilot infiltration testing would be needed to size the facility for design flows. The pilot test typically entails a 17-24 hour period of infiltration at rates scaled to design flows, into an approximately 100 square-foot pit or 8 foot diameter steel ring excavated to the receptor soils. Discharge and water levels are monitored and long term infiltration rates can be approximated.

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LIMITATIONS

The conclusions expressed by HWA are based solely on material referenced in this report. Observations were made under the conditions stated. Within the limitations of scope, schedule and budget, HWA attempted to execute these services in accordance with generally accepted professional principles and practices in the area at the time the report was prepared. No warranty, express or implied, is made. Experience has shown that subsurface soil and groundwater conditions can vary significantly over small distances. It is always possible that contamination may exist in areas that were not sampled. HWA's findings and conclusions must not be considered as scientific or engineering certainties, but rather as our professional opinion concerning the significance of the limited data gathered and interpreted during the course of the assessment.

We recommend that HWA be retained to review the plans and specifications to verify that our recommendations have been interpreted and implemented as intended. Sufficient field monitoring, testing and consultation should be provided during construction to confirm that the conditions encountered are consistent with those indicated by explorations, and to provide recommendations should conditions revealed during construction differ from those anticipated. HWA does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and cannot be responsible for the safety of personnel other than our own on the site.

This study and report have been prepared on behalf of Art O'Neal Associates and Mason County, for the specific application to the subject property. This report should be provided in its entirety to prospective contractors for bidding and estimating purposes; however, the conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, nor the use of segregated portions of this report.

◆

We appreciate the opportunity to provide our services. Please feel free to call us if you have any questions or need more information.

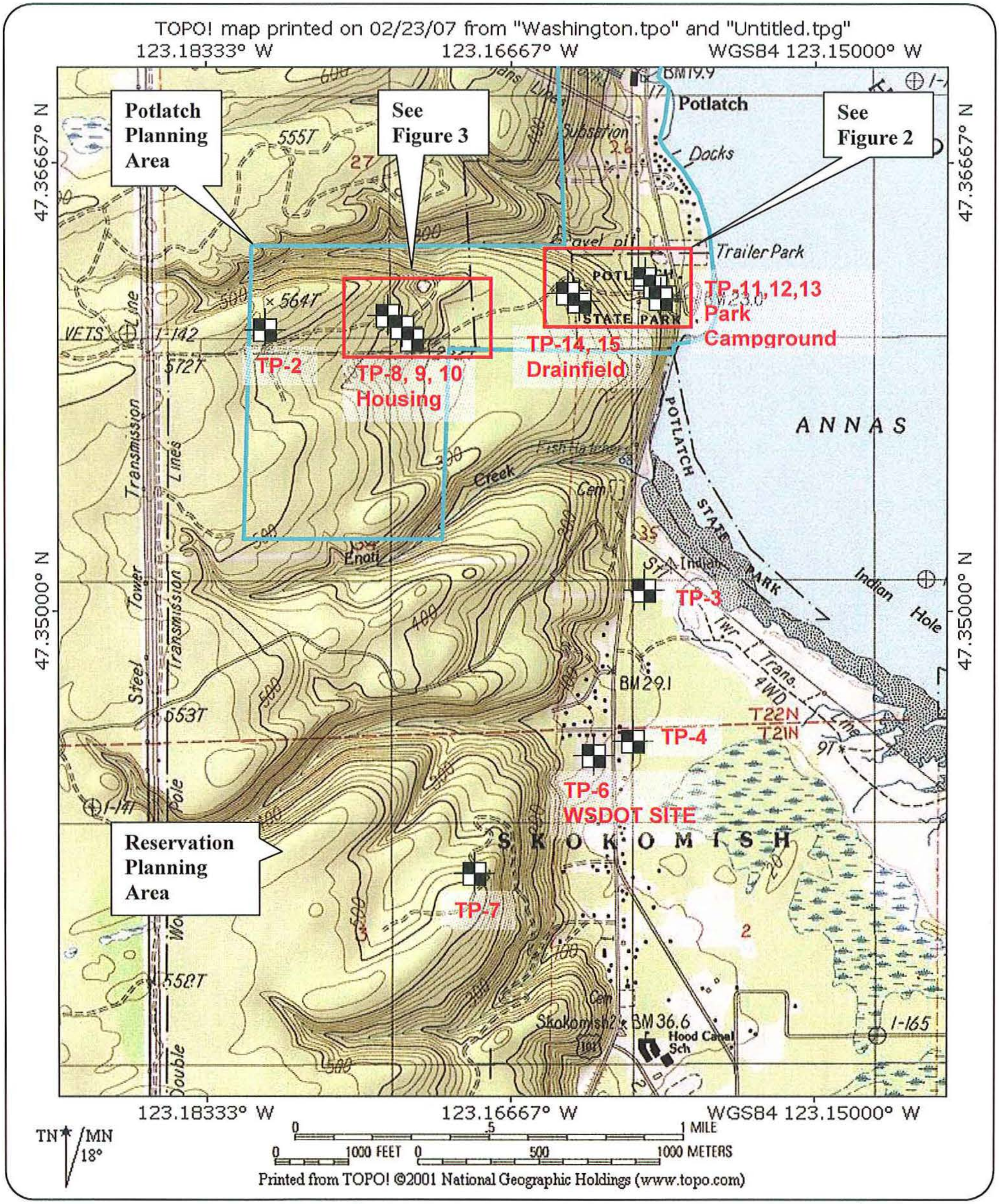
Sincerely,

HWA GEOSCIENCES INC.

State of Washington
Licensed Geologist
Hydrogeologist
170
Arnon Sugar

3-8-07

Arnie Sugar, LG, LHG
Vice President



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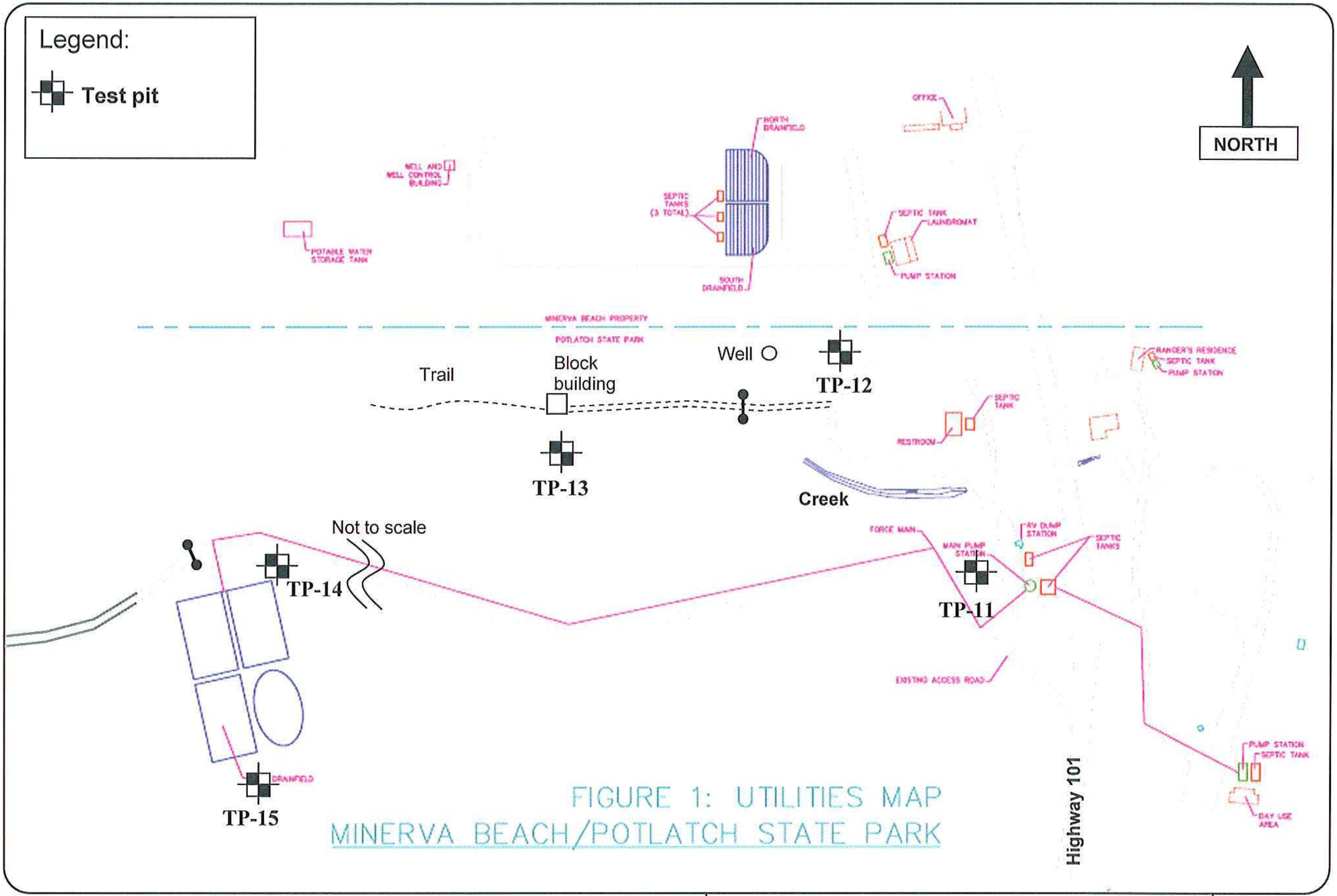
EXPLORATION LOCATIONS

MASON COUNTY
WATER QUALITY PROJECT PLANNING
POTLATCH BUBBLE & RESERVATION AREAS

FIGURE NO.
1

PROJECT NO.
2006-172-300



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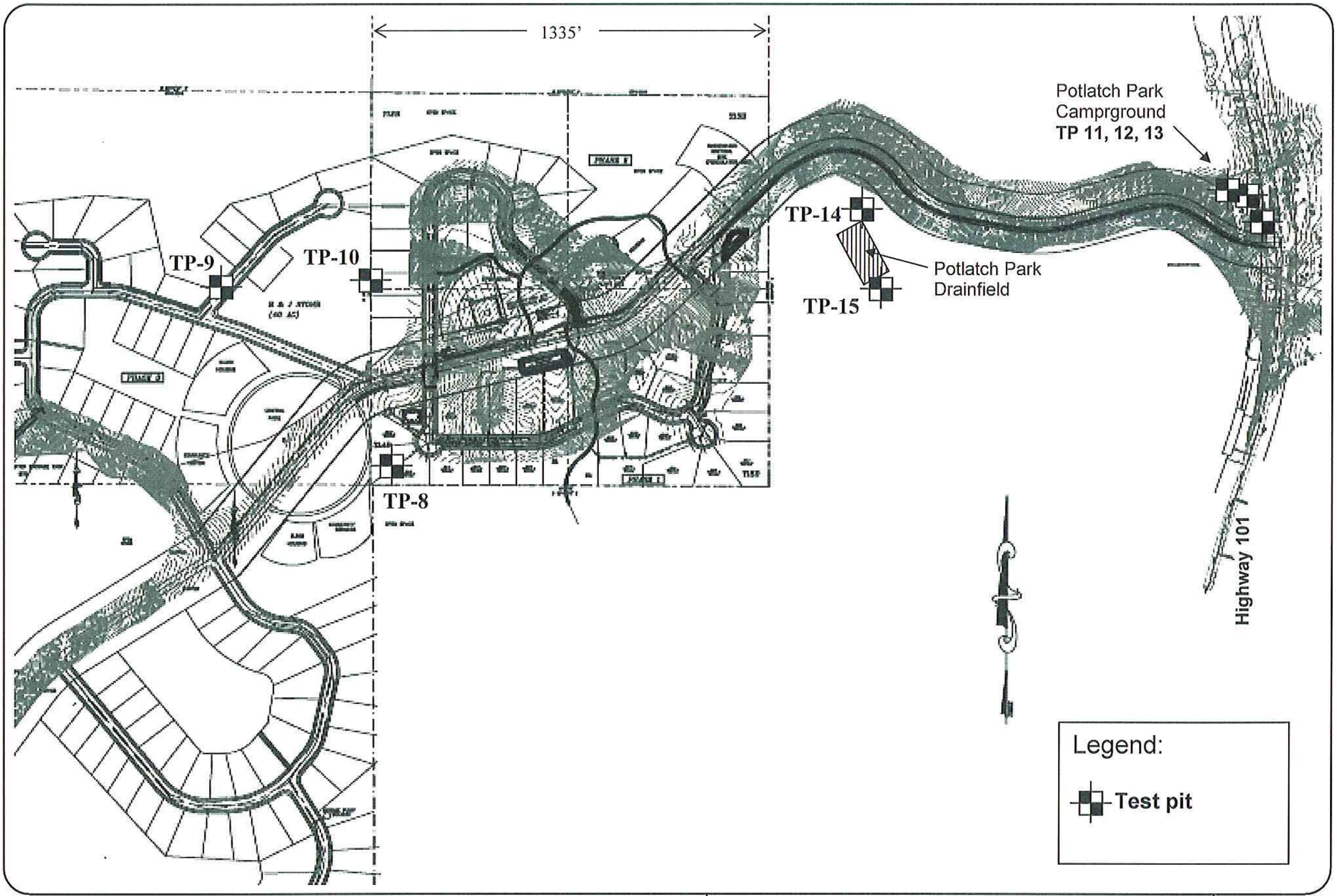
EXPLORATION LOCATIONS – POTLATCH STATE PARK
CAMPGROUND AREA

MASON COUNTY
WATER QUALITY PROJECT PLANNING
POTLATCH BUBBLE AREA

FIGURE NO.
2

PROJECT NO.
2006172-300



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EXPLORATION LOCATIONS – NEW HOUSING AREA

MASON COUNTY
WATER QUALITY PROJECT PLANNING
POTLATCH BUBBLE AREA

FIGURE NO.
3

PROJECT NO.
2006172-300

APPENDIX A

TEST PIT AND WELL LOGS

NOTE: THERE IS NO TP-1 OR TP-5

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALUE

COHESIONLESS SOILS			COHESIVE SOILS		
Density	N (blows/ft)	Approximate Relative Density(%)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	0 - 15	Very Soft	0 to 2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	35 - 65	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	over 30	>4000

USCS SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP DESCRIPTIONS		
Coarse Grained Soils More than 50% Retained on No. 200 Sieve Size	Gravel and Gravelly Soils More than 50% of Coarse Fraction Retained on No. 4 Sieve	Clean Gravel (little or no fines)	●	GW	Well-graded GRAVEL
			○	GP	Poorly-graded GRAVEL
		Gravel with Fines (appreciable amount of fines)	○	GM	Silty GRAVEL
			▨	GC	Clayey GRAVEL
	Sand and Sandy Soils 50% or More of Coarse Fraction Passing No. 4 Sieve	Clean Sand (little or no fines)	⁘	SW	Well-graded SAND
			░	SP	Poorly-graded SAND
		Sand with Fines (appreciable amount of fines)	▥	SM	Silty SAND
			▨	SC	Clayey SAND
Fine Grained Soils 50% or More Passing No. 200 Sieve Size	Silt and Clay	Liquid Limit Less than 50%	▥	ML	SILT
			▨	CL	Lean CLAY
			▤	OL	Organic SILT/Organic CLAY
	Silt and Clay	Liquid Limit 50% or More	▥	MH	Elastic SILT
			▨	CH	Fat CLAY
			≋	OH	Organic SILT/Organic CLAY
Highly Organic Soils			⁂	PT	PEAT

TEST SYMBOLS

%F	Percent Fines	
AL	Atterberg Limits:	PL = Plastic Limit LL = Liquid Limit
CBR	California Bearing Ratio	
CN	Consolidation	
DD	Dry Density (pcf)	
DS	Direct Shear	
GS	Grain Size Distribution	
K	Permeability	
MD	Moisture/Density Relationship (Proctor)	
MR	Resilient Modulus	
PID	Photoionization Device Reading	
PP	Pocket Penetrometer Approx. Compressive Strength (tsf)	
SG	Specific Gravity	
TC	Triaxial Compression	
TV	Torvane Approx. Shear Strength (tsf)	
UC	Unconfined Compression	

SAMPLE TYPE SYMBOLS

☒	2.0" OD Split Spoon (SPT) (140 lb. hammer with 30 in. drop)
⌶	Shelby Tube
▪	3-1/4" OD Split Spoon with Brass Rings
○	Small Bag Sample
▙	Large Bag (Bulk) Sample
‖	Core Run
⧄	Non-standard Penetration Test (3.0" OD split spoon)

GROUNDWATER SYMBOLS

▽	Groundwater Level (measured at time of drilling)
▼	Groundwater Level (measured in well or open hole after water level stabilized)

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5 mm) to No. 200 (0.074 mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074mm)

COMPONENT PROPORTIONS

PROPORTION RANGE	DESCRIPTIVE TERMS
< 5%	Clean
5 - 12%	Slightly (Clayey, Silty, Sandy)
12 - 30%	Clayey, Silty, Sandy, Gravelly
30 - 50%	Very (Clayey, Silty, Sandy, Gravelly)
Components are arranged in order of increasing quantities.	

NOTES: Soil classifications presented on exploration logs are based on visual and laboratory observation. Soil descriptions are presented in the following general order:

Density/consistency, color, modifier (if any) GROUP NAME, additions to group name (if any), moisture content. Proportion, gradation, and angularity of constituents, additional comments. (GEOLOGIC INTERPRETATION)

Please refer to the discussion in the report text as well as the exploration logs for a more complete description of subsurface conditions.

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
MOIST	Damp but no visible water.
WET	Visible free water, usually soil is below water table.

HWA GEOSCIENCES INC.

Mason County Wastewater
Infiltration Evaluation
Mason County
Washington

LEGEND OF TERMS AND SYMBOLS USED ON EXPLORATION LOGS

PROJECT NO.: 2006-172-22 FIGURE: 1

LEGEND 2006172.GPJ 2/26/07

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 1/25/07
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0			Topsoil + gravel	
		SM	Dense or very dense gray and brown silty SAND with gravel and cobbles, slightly stratified, diamict texture, moist **[SANDY TILL/DRIFT]**	
3		SP SM	Brown & gray silty fine to coarse SAND with gravel and cobbles to 1', moist. Some silt seams. **[OUTWASH, SILTY]**	○
6				○
			Dense brown & gray silty SAND with gravel and cobbles, moist. Some 1-2" brown silt seams, non plastic.	
9		SP	Gray fine to coarse SAND, moist. Angular, clean sand.	
12				
15				

Test pit terminated at about 10 feet below the ground surface.
No ground water encountered during this exploration.

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

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LOG OF TEST PIT
TP-2

PAGE: 1 of 1

PROJECT NO.: 2006-172-22 FIGURE: 2

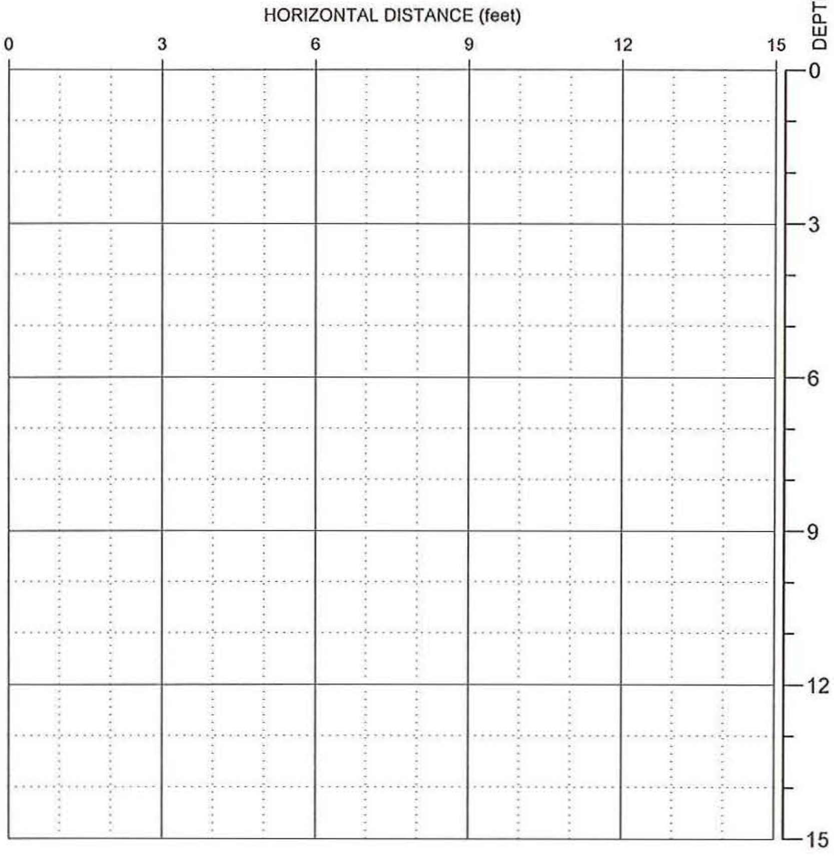
EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 1/25/07
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Brown, silty SAND with gravel, roots, moist to wet.					
		SM	Blue-gray, silty SAND with gravel and cobbles, wet. Some silt seams.	○ ○				

Test pit terminated at about 5 feet below the ground surface.
Ground water observed at about 1.5 feet depth.
Caving noted below 3 feet.

SKETCH OF SIDE OF PIT



NOTE: For a proper understanding of the nature of subsurface conditions, this exploration log should be read in conjunction with the text of the geotechnical report. This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Mason County Wastewater
Infiltration Evaluation
Mason County
Washington

LOG OF TEST PIT
TP-3

PAGE: 1 of 1

PROJECT NO.: 2006-172-22 FIGURE: 3

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 1/25/07
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		SM	Brown, silty SAND with gravel, moist	
3		SP	Seam of gray fine to coarse SAND with gravel.	
		ML SM	Brown, SILT, silty SAND, and large woody debris [fill] Reddish brown, silty SAND with gravel and silt, moist	
6		ML	Brown SILT	○
		ML		
		SM SP	Reddish brown, fine to coarse SAND, few gravel, moist	○
9				
12				
15				

Test pit terminated at about 10 feet below the ground surface.
No ground water encountered during this exploration.

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-4

PAGE: 1 of 1

PROJECT NO.: 2006-172-22 FIGURE: 4

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 1/25/07
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		SP	Gray, fine to medium SAND with gravel and cobbles, moist. **[FILL?]**	
3		ML SM	Reddish brown, silty SAND with gravel and silt lenses, moist.	○
		GP	Lens of brown GRAVEL with sand (one sidewall only)	
		SM	Brown, silty fine to coarse SAND with gravel, moist, some silt lenses. **[FILL?]**	
6		SP	Brown, fine to coarse SAND with gravel and cobbles, moist.	
9		GW	Gray, well graded GRAVEL with fine to coarse sand and cobbles, moist.	○
12			Test pit terminated at about 10 feet below the ground surface. No ground water encountered during this exploration.	
15				

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-6

PAGE: 1 of 1

PROJECT NO.: 2006-172-22 FIGURE: 5

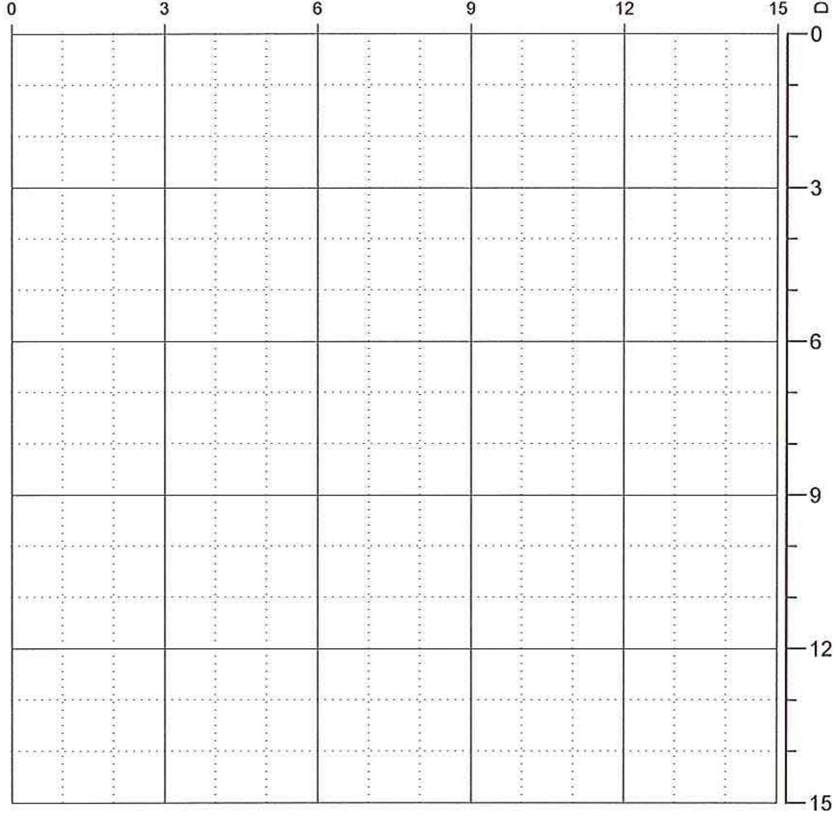
EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 1/25/07
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Forest duff, roots to 3 feet.					
		SP						
			Loose gray and brown fine to medium SAND, moist. Slighlly stratified, but no silt layers. **(OUTWASH)**	○				
3								
				○				
6			Loose, gray fine to mediuam SAND, some gravel and cobbles, moist.	○				
9								
12								
15								

Test pit terminated at about 8 feet below the ground surface.
No ground water encountered during this exploration.
No caving observed.

SKETCH OF SIDE OF PIT



NOTE: For a proper understanding of the nature of subsurface conditions, this exploration log should be read in conjunction with the text of the geotechnical report. This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Mason County Wastewater
Infiltration Evaluation
Mason County
Washington

LOG OF TEST PIT
TP-7

PAGE: 1 of 1

PROJECT NO.: 2006-172-22 FIGURE: 6

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		ML	Soft, yellow brown to reddish brown, fine to coarse sandy, fine to coarse gravelly, SILT, roots and rootlets. Cobbles noted, organics. **(TOPSOIL/WEATHERED TILL)**	○
3		ML	Hard, olive gray, fine to coarse sandy, fine to coarse gravelly, SILT, moist. **(GLACIAL TILL)**	○ ○
6			Test pit terminated at about 5.65 feet below the ground surface. No ground water observed during this exploration.	
9				
12				
15				

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-8

PAGE: 1 of 1

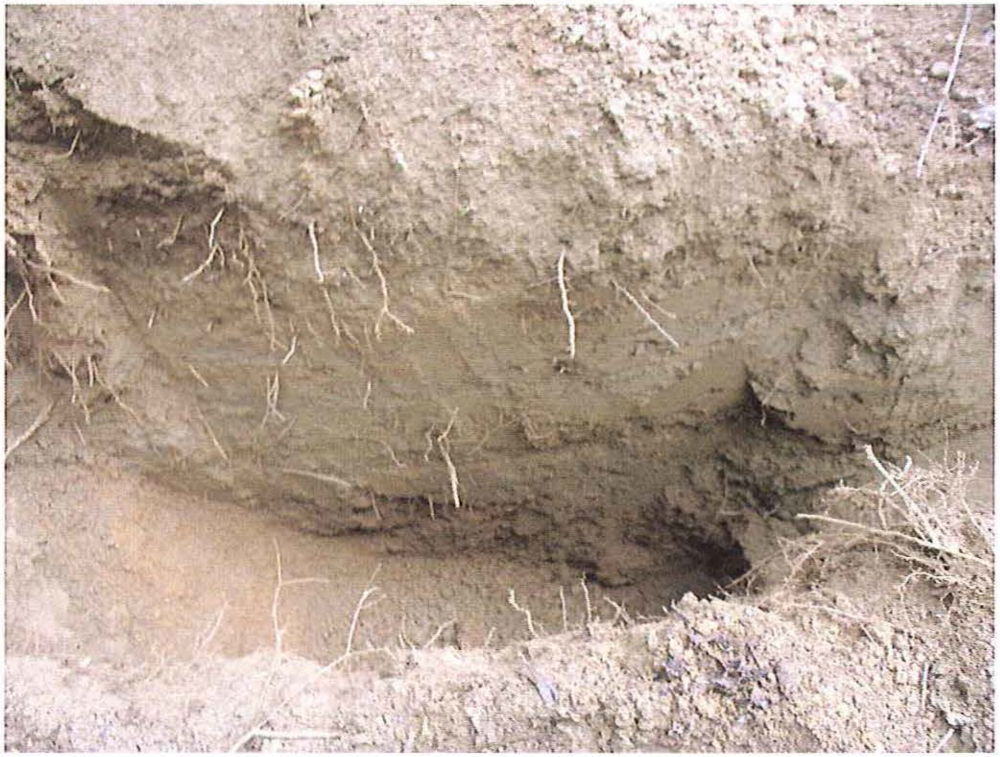
PROJECT NO.: 2006-172-300 FIGURE: 7

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		SM	Loose, brown, silty, fine gravelly, fine to coarse SAND, roots and rootlets, moist, organics. **(TOPSOIL)**	○
		ML	Soft to medium stiff, brown, fine sandy, SILT, scattered gravel, moist, roots and rootlets. Fine to medium sandy seams noted. **(MASS WASTING DEPOSITS/WEATHERED NATIVE?)**	○
3		ML SM	Alternating layers of medium stiff, brown to reddish, fine to coarse sandy, coarse gravelly, clayey, SILT with brown, silty, fine to coarse gravelly, fine to coarse SAND, moist.	○ ○ ○ ○ ○
6				○
		SM	Medium dense, reddish brown, silty, fine to coarse gravelly, fine to coarse, SAND. **(WEATHERED NATIVE?)**	○
9			Test pit terminated at about 7.6 feet below the ground surface. No ground water observed during this exploration. Minor caving observed from about 5.5 to 6 feet below the ground surface.	
12				
15				

PHOTOGRAPH OF TEST PIT



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-9

PAGE: 1 of 1

PROJECT NO.: 2006-172-300 FIGURE: 8

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		SM	Loose, black to dark brown, silty, fine to coarse gravelly, SAND, moist, roots and rootlets. **(TOPSOIL)**	
		SM	Loose, dark brown, silty, fine to coarse gravelly, SAND, moist, roots and rootlets. **(WEATHERED TILL)**	○ ○
3		ML SM	Soft to medium stiff, reddish brown, fine to coarse gravelly, sandy SILT to silty, SAND, moist to wet. Roots noted.	
6		GM	Very dense, gray, silty, fine to coarse sandy, fine to coarse GRAVEL, moist. **(GLACIAL TILL)**	○ ○
		GP GM	Very dense, gray, olive gray, slightly silty, fine to coarse, sandy, fine to coarse GRAVEL. **(ADVANCE OUTWASH)**	○ ○ ○

Test pit terminated at about 8.3 feet below the ground surface.
No ground water seepage observed during this exploration.

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-10

PAGE: 1 of 1

PROJECT NO.: 2006-172-300 FIGURE: 9

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		ML	Soft, dark brown, fine to coarse sandy, fine to coarse gravelly, SILT, roots and rootlets, moist. **(TOPSOIL)**	
		SM	Loose to medium dense, yellow brown, silty, fine to coarse gravelly, fine to coarse SAND, moist, roots and rootlets. **(WEATHERED TILL)** Big boulder noted at about 2.5 feet below the ground surface.	○ ○ ○
3				
		GM	Very dense, gray, fine to coarse sandy, silty, fine to coarse GRAVEL. Cobbles noted. **(GLACIAL TILL)**	○ ○ ○
6				
9				
12				
15				

Test pit terminated at about 6.9 feet below the ground surface.
Minor to moderate seepage observed at about 5.8 feet during this exploration.
Minor cavings observed from about 2 to 3.5 feet and from 6 to 6.7 feet below the ground surface.

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-11

PAGE: 1 of 1

PROJECT NO.: 2006-172-300 FIGURE: 10

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0	▥	ML	Soft, dark brown, fine to coarse gravelly, fine to coarse sandy, SILT, organics, roots and rootlets, moist. **(TOPSOIL)**	○
	▥	SM	Loose, brown, silty, fine to coarse gravelly, fine to coarse SAND, organics, moist, roots and rootlets. **(WEATHERED OUTWASH)**	○
3	⁙	SW	Loose, olive gray, fine to coarse gravelly, fine to coarse well graded SAND with cobbles, wet. **(RECESSIONAL OUTWASH)**	○
6				
9				
12				
15				

Test pit terminated at about 5 feet below the ground surface.
Moderate to heavy seepage observed at about 4.3 feet during this exploration.

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

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LOG OF TEST PIT
TP-12

PAGE: 1 of 1

PROJECT NO.: 2006-172-300 FIGURE: 11

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0	‖	SM	Loose, dark brown, silty, fine to coarse gravelly, fine to coarse SAND, roots and rootlets, moist. **(TOPSOIL)**	○
3	‖	SM	Loose, reddish brown, silty, fine to coarse SAND, scattered gravel, moist to wet. **(WEATHERED OUTWASH)**	○
	⁘	SW	Loose, olive gray, fine gravelly, fine to coarse well graded SAND, wet. **(RECESSIONAL OUTWASH)**	○
6				
9				
12				
15				

Test pit terminated at about 5 feet below the ground surface.
Heavy seepage observed at about 3.75 feet during this exploration.
Moderate caving observed from about 2 to 2.8 feet below the ground surface.

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-13

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		SM	Loose, olive gray, silty, fine gravelly, fine to coarse SAND, organics, moist. **(TOPSOIL)**	
		ML SM	Soft, reddish brown, fine to coarse gravelly, fine to coarse sandy, SILT to fine to coarse SAND, roots and rootlets. Cobbles, boulders noted. **(WEATHERED OUTWASH)**	○ ○
3		SP	Medium dense, olive gray, slightly silty, fine to coarse gravelly, fine to coarse SAND. **(ADVANCE OUTWASH?)** Sand becoming coarse.	○
6		GP	Medium dense, brown to olive brown, slightly silty, fine to coarse sandy, fine to coarse GRAVEL, moist.	○
9		GW	Medium dense, olive gray, slightly silty, fine to coarse, well graded GRAVEL with fine to medium SAND, moist.	○
12				
15				

Test pit terminated at about 9.25 feet below the ground surface.
No ground water encountered during this exploration.
Moderate caving observed from about 4.5 to 8 feet.

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-14

PAGE: 1 of 1

PROJECT NO.: 2006-172-300 FIGURE: 13

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		SM	Loose, brown, silty, fine gravelly, fine to medium SAND, organics, moist, roots and rootlets. **(TOPSOIL)**	○
		SM	Loose to medium dense, laminated, olive gray and olive brown, slightly silty, fine to coarse gravelly, fine to coarse SAND, moist, roots and rootlets. **(WEATHERED OUTWASH)**	○
3		SP SP SM	Loose to med. dense, olive gray, sl. silty, fine to med. SAND, moist. Scattered fine to coarse gravel. **(ADVANCE OUTWASH?)**	○
		GW	Loose to medium dense, olive gray, slightly silty, fine to coarse gravelly, fine to medium SAND, moist. Traces of till noted.	○
6		GP	Loose to medium dense, olive gray, slightly silty, well graded GRAVEL with fine to medium SAND, moist. Traces of till noted.	○
			Medium dense, olive brown, fine to medium sandy, fine to coarse GRAVEL, moist. Cobbles noted.	
9				
12				
15				

Test pit terminated at about 8.75 feet below the ground surface.
No ground water encountered during this exploration.
Moderate caving observed from about 1.5 to 3.0 feet.

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

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LOG OF TEST PIT
TP-15

PAGE: 1 of 1

PROJECT NO.: 2006-172-300 FIGURE: 14

APPENDIX B

LABORATORY TESTING

APPENDIX B

LABORATORY TESTING

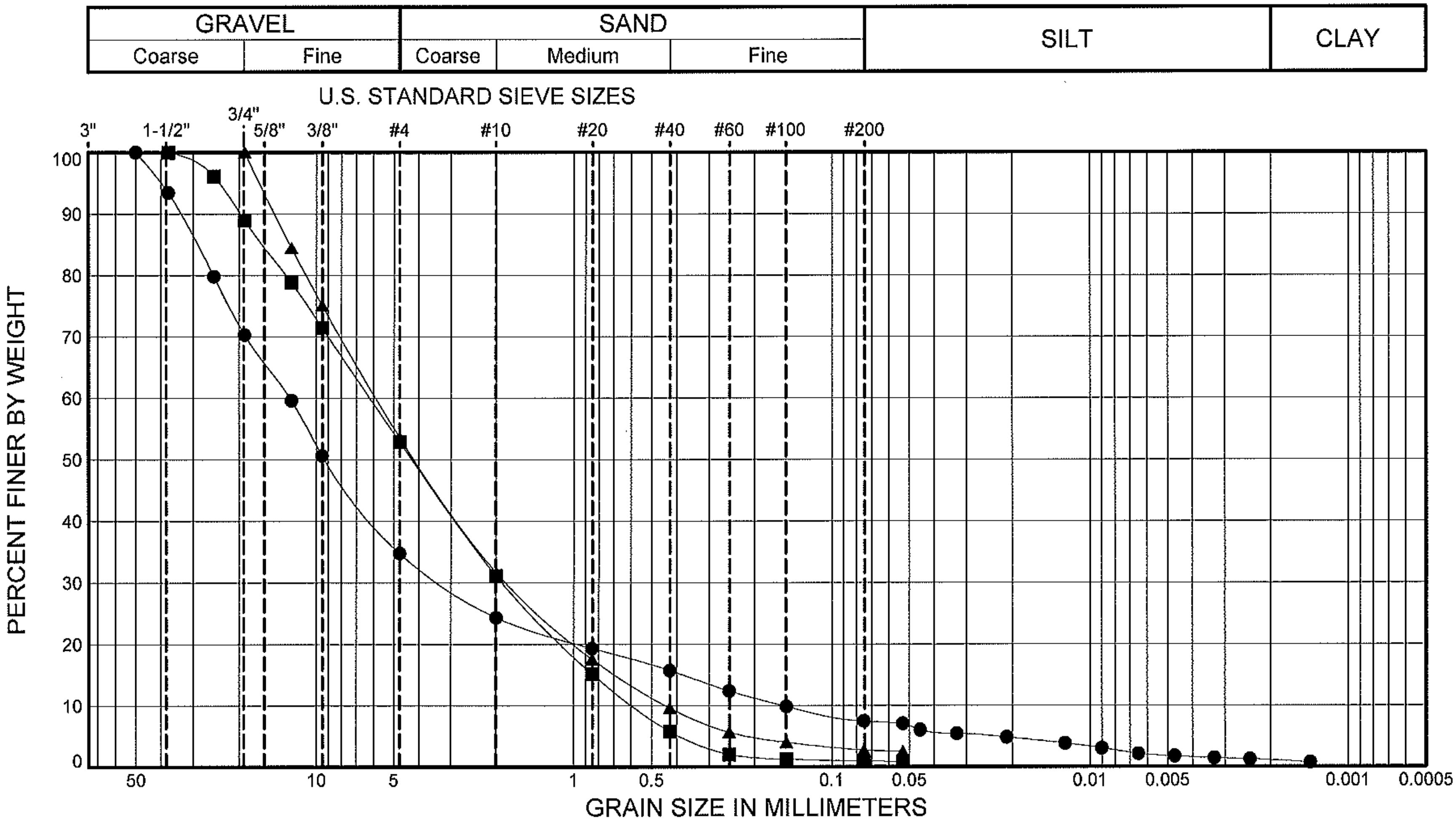
Representative soil samples obtained from the borings were returned to the HWA laboratory for further examination and testing. Laboratory tests were conducted on selected soil samples to characterize certain properties of the on-site soils. Laboratory tests, as described below, included determination grain size distribution.

MOISTURE CONTENT

The natural moisture contents of selected samples were determined in general accordance with ASTM D 2216. The results are plotted at the sampled intervals on the exploration log as appropriate.

GRAIN SIZE ANALYSIS

The grain size distribution of selected soil samples was determined in general accordance with ASTM D 422. Grain size distribution curves for the tested samples are presented in figures B-1 through B-4.



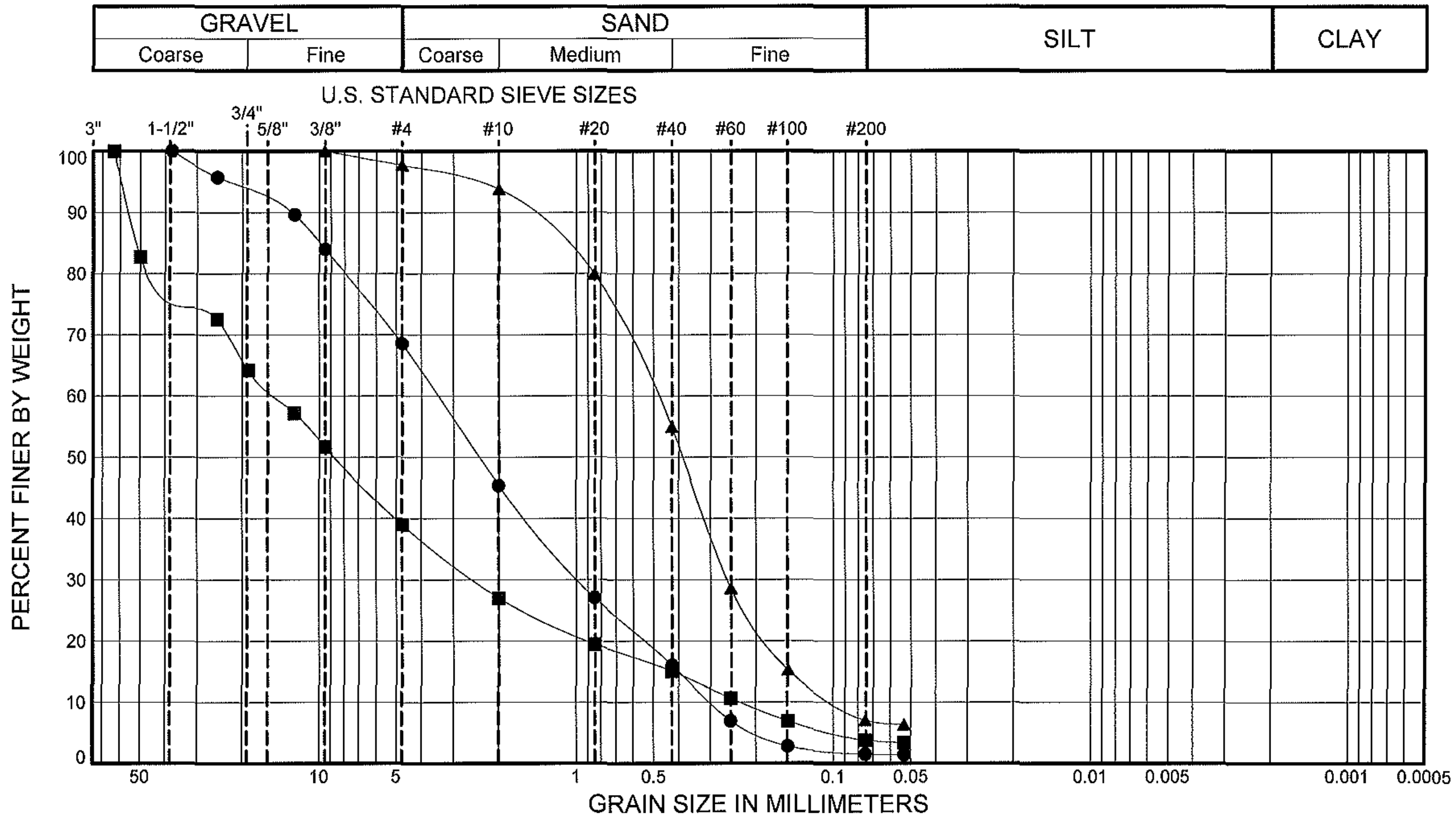
SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	TP-10	S-7	7.6 - 8.1	(GP-GM) Brown, poorly graded GRAVEL with silt and sand	7				65.3	27.3	7.4
■	TP-12	S-3	4.0 - 4.5	(SW) Brown, well graded SAND with gravel	13				47.1	52.0	0.9
▲	TP-13	S-3	4.5 - 4.8	(SW) Brown, well graded SAND with gravel	15				46.4	50.9	2.7

HWA GEOSCIENCES INC.

Mason County Wastewater
Infiltration Evaluation
Mason County
Washington

PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D422

PROJECT NO.: 2006-172-22 FIGURE: 1



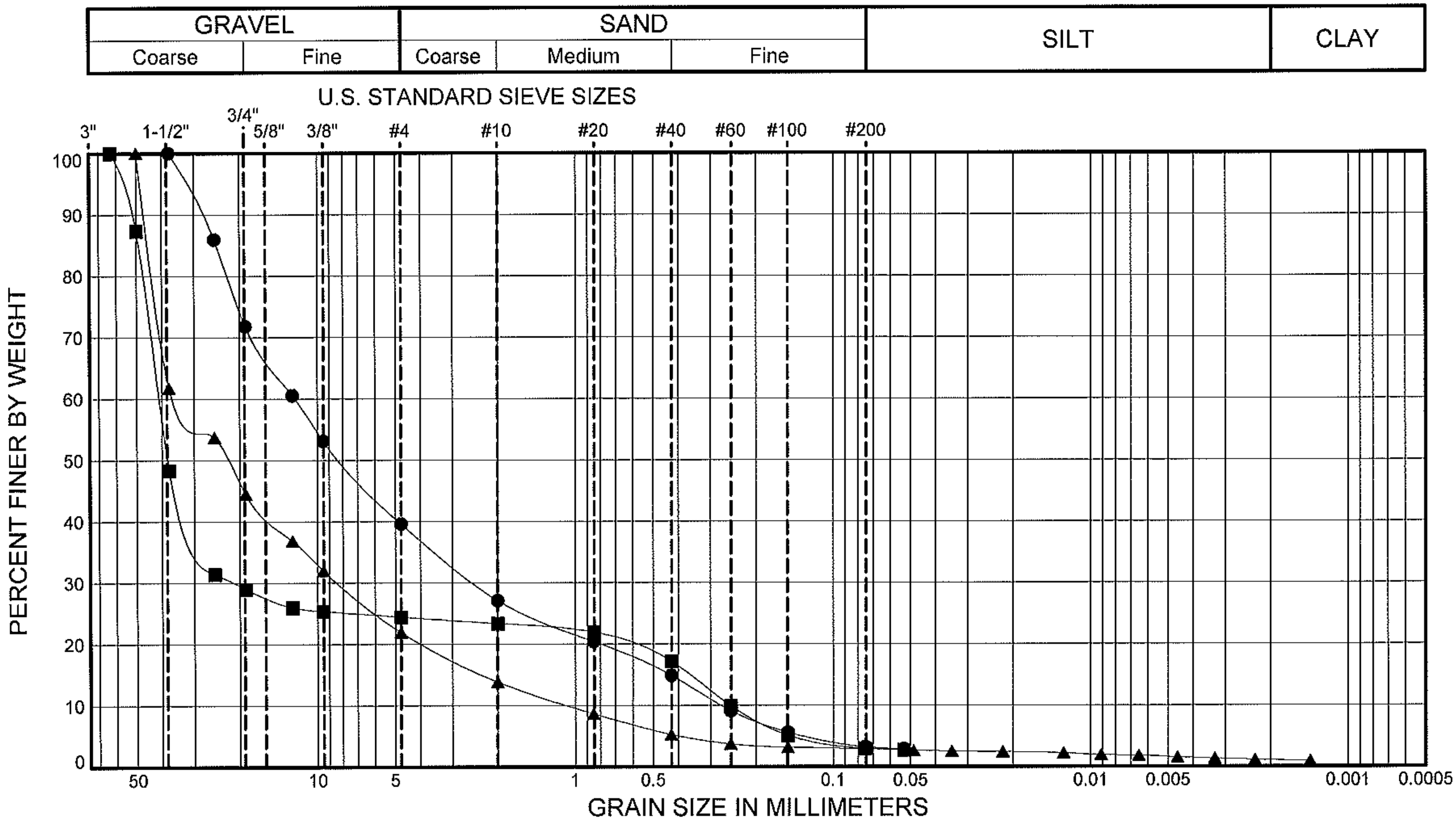
SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	TP-14	S-2	2.5 - 3.5	(SP) Brown, poorly graded SAND with gravel	7				31.5	67.0	1.5
■	TP-14	S-5	8.5 - 9.0	(GW) Brown, well graded GRAVEL with sand	6				61.0	35.2	3.8
▲	TP-15	S-3	3.5 - 4.0	(SP-SM) Brown, poorly graded SAND with silt	14				2.3	90.7	7.0

HWA GEOSCIENCES INC.

Mason County Wastewater
Infiltration Evaluation
Mason County
Washington

PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D422

PROJECT NO.: 2006-172-22 FIGURE: 2



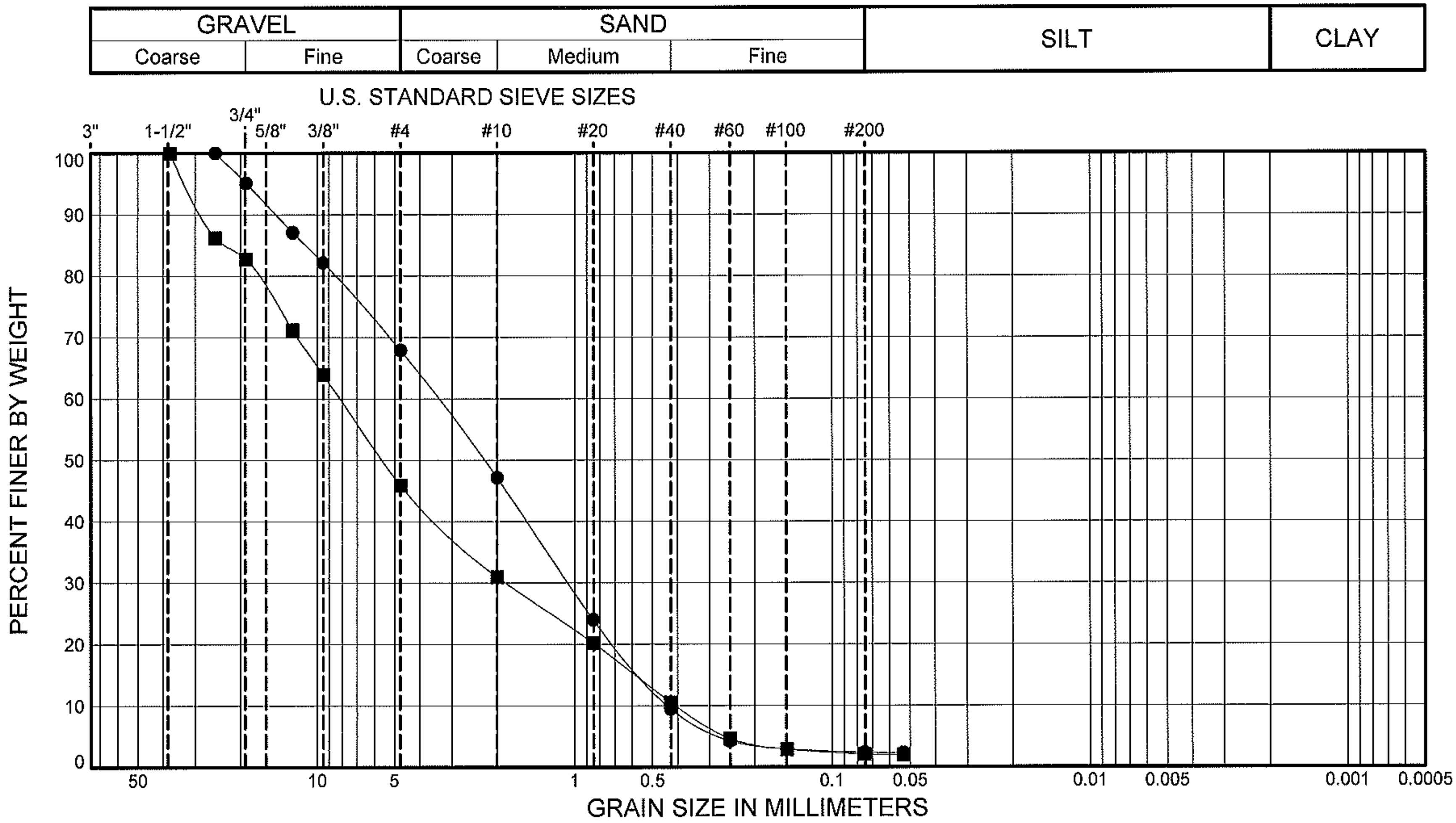
SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	TP-15	S-4	5.3 - 5.5	(GW) Brown, well graded GRAVEL with sand	6				60.4	36.4	3.2
■	TP-15	S-5	6.5 - 6.8	(GP) Brown, poorly graded GRAVEL with sand	6				75.6	21.4	2.9
▲	TP-2		6.0 - 6.5	(GP) Brown, poorly graded GRAVEL with sand	4				78.1	19.0	2.9

HWA GEOSCIENCES INC.

Mason County Wastewater
Infiltration Evaluation
Mason County
Washington

PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D422

PROJECT NO.: 2006-172-22 FIGURE: 3



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	TP-4		8.0 - 8.5	(SP) Brown, poorly graded SAND with gravel	6				32.1	65.5	2.3
■	TP-6		8.0 - 8.5	(GW) Brown, Well-graded GRAVEL with sand	5				54.1	43.8	2.1

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Mason County Wastewater
Infiltration Evaluation
Mason County
Washington

PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D422

PROJECT NO.: 2006-172-22 FIGURE: 4

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Appendix 4.2

Jones & Stokes
Skokomish Core Reservation Area
Analysis of Using Wetlands for Effluent Disposal
January 2007

Jones & Stokes

Technical Memorandum

Date: January 7, 2007

To: Linda Hoffman, Art O'Neal & Associates

From: Jonathan Ives, Principal Scientist

cc: Herb Fricke, PE, Cascade Design Professionals, Inc.

Subject: Skokomish Core Reservation Area – Analysis of Using Wetlands for Effluent Disposal

1.0 Introduction

This technical memorandum provides an analysis of the feasibility of using natural or constructed wetlands to dispose of treated effluent from the proposed wastewater treatment plant (WWTP) to serve the core area of the Skokomish Tribal Reservation (Core Reservation Area) (Figure 1). The feasibility of using wetlands is being considered as one of several options for effluent disposal to be evaluated in the update to the Skokomish Tribe Wastewater Facility Plan.

Tasks to conduct the analysis and to prepare this memorandum included:

- Review of existing wetland, soils, topographic, and related GIS information for the project area, and research use of reclaimed water for wetlands;
- Conduct of reconnaissance-level visits to and characterization of candidate wetland sites;
- Coordination with the project team and calculations of loading capacity and planning level cost estimates.

For the purpose of this analysis, it has been assumed that the proposed WWTP would treat wastewater to a "Class A" reclaimed water quality standard as defined by RCW 90.46 and the "Water Reclamation and Reuse Standards" manual (Washington State Department of Health and Washington State Department of Ecology 1997). This high quality treatment (i.e., advanced treatment) would be achieved using a membrane bioreactor (MBR) system). This high level of quality would allow the reclaimed water to be used for a variety of beneficial reuses, including discharge to natural or constructed wetlands.

1.1 Natural and Constructed Wetlands

1.1.1 Natural Wetlands

Section 2 “Reclaimed Water Standards for Wetlands” of the Water Reclamation and Reuse Standards manual, provides guidance for the discharge of reclaimed water into natural wetlands. Appendix A of this memo presents a summary of the standards. As a general guideline, discharge of reclaimed water into Category I or to salt-water dominated wetlands is not permitted except where it can be demonstrated that no existing wetland functions would be decreased *and* that overall net environmental benefits would result from the discharge (Washington Department of Health and Washington State Department of Ecology 1997).

The standards do however, encourage and provide guidance for use of reclaimed water in Category II, III, and IV wetlands. These are wetlands that have had some degree of disturbance, such as physical changes to topography (e.g., placement of fill) or vegetation structure and diversity (e.g., clearing, invasive species), and may benefit from the introduction of reclaimed water. The following are definitions of wetland categories from the Washington State Department of Health and Washington State Department of Ecology (1997):

- Category I wetlands are wetlands that provide a documented significant life support function for threatened or endangered species, represent a high quality example of a rare wetland type, are rare within a given region, or are relatively undisturbed and contain ecological attributes that are impossible to replace within a human lifetime;
- Category II wetlands are wetlands that provide habitat for very sensitive or important wildlife or plants that are difficult to replace, or provide very high functional quality, particularly for wildlife habitat;
- Category III wetlands are wetlands that provide important functions and values, but are smaller, less diverse, and/or more isolated in the landscape than Category II wetlands; and
- Category IV wetlands are small. Isolated, and lack vegetation diversity, and may be able to be enhanced, restored, or replaced.

The U.S. Environmental Protection Agency (EPA) recognizes the value of using natural wetlands to provide “further treatment” of secondary effluent to meet receiving water standards, with the objective of further treatment being to reduce biochemical oxygen demand (BOD_5), suspended solids, and nutrients such as ammonia, other forms of nitrogen, and pathogens. EPA’s primary concern regarding the use of natural wetlands is the potential to permanently alter biotic communities through the continuous discharge of wasterwater (Hammer 1989).

1.1.2 Constructed Beneficial Use Wetlands

Constructed beneficial use wetlands are artificial wetlands constructed on non-wetland sites designed to provide treatment and, in some cases, some measure of benefits to society or to the environment, relative to the following recognized wetland functions and values:

- Storm/flood water storage and retention;
- Hydrologic functions of low flow augmentation, ground water discharge and recharge, and surface water flow;
- Filtration, storage, and transformation of sediment, nutrients, and toxics;
- Shoreline protection from erosion;
- Habitat for aquatic organisms;
- Habitat for wildlife; and
- Recreational, cultural, educational, scientific, and natural aesthetic values and uses.

The construction of wetlands for treatment and beneficial uses is of particular value in arid regions where wetlands are uncommon, where development has eliminated or modified historic wetland resources and where large areas of land are available to construct wetlands (Hammer 1989). While constructed wetlands provide the important function of treating wastewater, these systems rarely achieve the biological complexity of natural wetlands, and their ecological values are correspondingly less than natural systems (Hammer 1989). This is particularly true for small wastewater facilities having relatively low flows and therefore requiring a small wetland area for treatment. In such cases the small constructed wetland area is generally insufficient to provide significant ecological functions and values.

In Washington State, constructed beneficial use wetlands can be used as mitigation for the conversion or loss of wetlands caused by the development of a proposed project. The required quality of reclaimed water discharged to constructed beneficial use wetlands differs from the use of constructed wetlands for additional wastewater treatment (i.e., treatment wetlands). Reclaimed water discharged to constructed beneficial use wetlands must be Class B or better, while a lesser standard is applicable constructed wetlands used for treatment (see Appendix A, Section 1, Article 2 General Requirements, Impoundments for Constructed Beneficial Use and Constructed Treatment Wetlands) of the Water Reclamation and Reuse Standards manual).

At the Federal level, the EPA has established guiding principles for constructed treatment wetlands (EPA 2000).

1.1.3 Constructed Treatment Wetlands

Constructed treatment wetlands are systems that are engineered and constructed in non-wetland sites and managed for the primary purpose of wastewater treatment. Constructed treatment wetlands become part of the wastewater collection and treatment system and are not considered “waters of the state” or “waters of the U.S.” (Washington Department of Health and Washington State Department of Ecology 1997; EPA 2000).

The use of constructed wetlands for treatment is of recognized value because of the ability of wetlands to transform many of the common pollutants in wastewater into harmless byproducts or essential nutrients that can be used for additional biological productivity. Additionally, these pollutant transformations can be achieved for the relatively low cost of earthwork, piping, pumping, and concrete structures (Kadlec and Knight 1996).

Constructed wetlands can be used for secondary treatment or “polishing” effluent from a mechanical wastewater treatment plant. Constructed wetlands for the Skokomish Core Reservation would most likely be used for effluent polishing since secondary treatment wetlands would require a large impoundment and large area of land (Fricke pers. comm.).

The benefit of constructed treatment wetlands is to provide further treatment of wastewater using a “natural” system rather than a mechanical process. However, constructed wetlands require the construction of an impoundment of a prescribed size to handle projected flows and to achieve desired treatment and water quality. Additionally, treatment wetlands require the ultimate discharge of the treated wastewater, either through infiltration or at a point discharge to a receiving water (e.g., stream).

The size of the wetland needed to accomplish a desired pollutant reduction involves the development of a mass balance design model that includes the calculation of influent, internal and out concentrations; water flow rates, and other factors such as temperature and seasonal variation in biological uptake and productivity (Kadlec and Knight 1996).

Surface-Flow Wetlands

Surface-flow wetlands rely a combination of water movement, evapo-transpiration, and biological activity associated with the vegetation, microbes, wildlife, and other physical and biological factors, to treat effluent to a prescribed level of quality. These wetlands mimic natural wetlands in that water flows principally above ground through a growth of emergent plants. Features common to surface-flow wetlands include an inlet device, a bermed impoundment having a variable number of cells or basins, wetland plants, and an outlet structure. The inlet device initiates a sheet flow of wastewater into the wetland. The number of cells for treatment is based on calculated treatment ability of the wetland (i.e., based on physical and biological factors) to provide compliance with regulatory limits. Wetland plants provide mineral cycling and attachment area for microbial populations. The outlet structure collects the surface water for discharge to the ultimate receiving water or point of disposal (Kadlec and Knight 1996).

Subsurface Flow Wetlands

Subsurface flow wetlands rely on effluent flowing through a porous media (e.g., gravel) planted with wetland plants to achieve the prescribed water quality. Subsurface flow wetlands are designed to achieve a continuous and uniform flow of wastewater through a porous medium without overflooding the system. The two most common reasons for overflooding are clogging of the media with particulates (i.e., caused by buildup of organic matter from vegetation and other sources) and improper hydraulic design (Kadlec and Knight 1996). The accumulation of organic material from wastewater biosolids and vegetation is an expected occurrence, and can be accounted for in the design of the media bed and wetland.

1.2 Water Quality

By definition, reclaimed water is effluent derived from a wastewater treatment system that has been adequately and reliably treated, so that as a result of that treatment, it is suitable for beneficial use. "Class A" reclaimed water is oxidized, coagulated, filtered, and disinfected wastewater and is the highest quality for beneficial uses (Washington Department of Health and Washington State Department of Ecology 1997).

Chapter 90.46.090 (1) RCW indicates that reclaimed water may be beneficially used to discharge into constructed beneficial use wetlands provided the reclaimed water meets the Class A or B reclaimed water standards. Reclaimed water that does not meet Class A or B reclaimed water standards may be discharged into constructed treatment wetlands provided the lesser standard is approved and a comprehensive monitoring program is included. For discharge of reclaimed water to natural wetlands,

The Washington Department of Health and Washington State Department of Ecology manual (1997) indicates that reclaimed water shall, at a minimum, be treated to Class D reclaimed water standards, or Class B standards when reclaimed water would provide fisheries or potential human non-contact recreational of educational beneficial uses. Where natural wetlands receiving reclaimed water provide potential non-contact recreational or educational beneficial uses through restricted access, discharge shall, at a minimum, meet Class C reclaimed water standards. The proposed Class A quality for the Skokomish WWTP would exceed that minimum requirement.

Water quality criteria indicate that reclaimed water discharged to wetlands is not to exceed, on an average annual basis, the following concentrations unless net environmental benefits are provided:

BOD_5	20 mg/l
TSS	20 mg/l
Total Kjeldahl Nitrogen (as Nitrogen)	3 mg/l
Total Phosphorous (as Phosphorous)	1 mg/l

Source: Washington Department of Health and Washington State Department of Ecology (1997)

2.0 Methodology

2.1 Review of Existing Information

The evaluation for use of reclaimed water in wetlands for the Skokomish Core Reservation began with review of existing published and unpublished descriptions of the project area and general setting. This information included Skokomish Tribe GIS data and maps (aerial photographs, wetlands, soils, topography, streams, and other environmental factors), the Skokomish Indian

Tribe Wastewater Master Plan (KCM 1998), Mason County soils information (USDA 1960), water resources of Skokomish Indian Reservation (USDI 1973), and project information provided by the Skokomish Tribe and Cascade Design Professionals.

An analysis of GIS data and aerial photos of the project area followed review of the information. GIS data layers reviewed included aerial photographs, topography, soils, wetland boundaries and classifications, land use, roads, and surface water. Also Included in the review was a LIDAR (Light detecting and Ranging) bare earth composite map of topography and soils on the Skokomish Reservation.

Information gained during the review and analysis was used to identify candidate wetlands based on the following evaluation criteria:

- Distance from WWTP
- Access
- Wetland Class and Type
- Topography and Soils
- Land Use

Four candidate wetland disposal sites were identified as part of a "desktop" analysis (Figure 1) of the existing information. The four sites are all within 3,000 feet of the proposed WWTP and located east of Highway 101.

2.2 Field Investigation

A reconnaissance-level field investigation of the candidate wetland sites was conducted December 18, 2006. Field observations included:

- Characterizing vegetation composition and diversity;
- Shovel probes to observe soils characteristics and saturated soils;
- Observing topographic and surface water features;
- Verifying adjacent land use; and
- Characterizing access conditions.

Field investigations included completing a qualitative wetland assessment (Appendix B) of each site and taking digital photographs of the sites.

The information was used to characterize and screen the wetland candidate sites for suitability for discharge of reclaimed water.

3.0 Study Area Resources

3.1 Wetlands

Wetland information for the Skokomish Reservation was derived from GIS data and mapping (Skokomish Tribe 2006) based on the National Wetland Inventory (NWI), and a reservation-wide wetland inventory of Skokomish Tribal lands conducted by Sheldon & Associates (1994).

The GIS mapping identified approximate wetland boundaries and the general wetland classification (e.g., forested/shrub freshwater wetland, freshwater emergent wetland, estuarine and marine wetland) based on Cowardin et. al (1979). Additional information was derived from a field reconnaissance conducted December 18, 2006 by Skokomish Tribe and Jones & Stokes project personnel.

A contiguous wetland, named the North Wetland, is approximately 816 acres in size, and is located east of the proposed WWTP site and Highway 101. The wetland includes both freshwater and estuarine systems and 10 vegetation communities (KCM 1998). Based on the Washington State Department of Ecology's classification system, the North Wetland is considered a Category I wetland.

Vegetation present in the North Wetland varies from forested/shrub (Sitka spruce, cottonwood, alder, red cedar, Spirea, red-tipped dogwood) on the western edge of the wetland to tidal marsh (three-square bulrush, *Salicornia*) adjacent to Hood Canal.

Hydrology of the North Wetland is derived from a combination of groundwater contributions from uplands to the west, precipitation, and tidal influence. Additionally, several unnamed streams originating in the uplands west of the wetland also contribute to the hydrology of the wetlands. A majority of the hydrology in freshwater wetlands along the western edge of the North Wetland is provided by groundwater seepage and springs emanating from the upland slopes (HWA 1998).

Even though the North Wetland has an overall rating as Category I, variability in the quality of habitat and wetland conditions exists throughout the system. For example, some portions of the wetland adjacent to development (e.g., within the Core Reservation Area east of Highway 101) have been cleared of trees and shrubs, while some levees, roads, and drainage channels have been constructed within estuarine wetlands. These degraded portions of the wetland may offer opportunity for improvement of habitat and function using reclaimed water.

3.2 Soils

Soils information for the project area was derived from Skokomish Tribe GIS and LIDAR data and the Soil Survey for Mason County (USDA 1960). Soils at the candidate wetland sites include the following:

Puget Silt Loam (0 to 2 percent slopes)

The Puget Series consists of poorly drained, light brownish-gray soils in wetland areas. The subsoil is highly mottled, with mottling oftentimes near the surface. Subsurface soils consist of highly mottled silt and moderately plastic, stratified clay and silty clay. The soil is waterlogged much of the year. Within the project area, this soil is found east of the mouth of the unnamed dry creek to the east of Highway 101. This soil occurs at Wetland Candidate sites 1, 2, and 3.

Mukilteo Peat (0 to 2 percent slopes)

The Mukilteo Series consists of peat that is mainly partly decomposed sedges, spirea, twigs and roots. The soil is strongly acid and saturated throughout the year. Within the project area, this soil is found east of Highway 101, north of the Core Reservation and south of Enati Creek. This soil occurs at Wetland Candidate site 4.

4.0 Results

4.1 Natural Wetlands

As previously mentioned, four candidate natural wetland sites for reclaimed water disposal were identified in the vicinity of the proposed wastewater treatment facility. A reconnaissance-level survey of the four sites was conducted December 18, 2006.

These sites were evaluated following the overarching guideline that discharge of reclaimed water into wetlands would not result in a decrease in existing wetland functions and that overall net environmental benefits would result from the discharge.

4.1.1 Candidate Site 1

Using aerial photographs, Wetland Candidate Site 1 was selected because of its close proximity to the proposed wastewater treatment facility (Figure 1). Site 1 is located approximately 700 feet east of Highway 101 and 300 feet from a residential use, on the western edge of the North Wetland. A copy of the Qualitative Wetland Assessment Checklist and representative photographs for Site 1 is presented in Appendix B.1). Table 1 provides a summary of wetland conditions at Site 1.

Table 1. Summary Characteristics of Wetland Candidate Site 1

Site Evaluation Criteria	Site Characteristics
Wetland Class, Type; Vegetation	Category I Freshwater Forested/Shrub; 30 to 40% tree canopy of alder with understory of salmonberry and sword ferns (see Appendix B.1 for more detail and representative photographs).
Distance from WWTP; Access	Approximately 1,000 ft from WWTP and west of Highway 101; No existing road, access adjacent to residential use.
Topography and Soils	Approximate elevation 20 ft; slight slope (~1 to 2 %) to east; soils dark brown sandy with gravels, saturated 3 to 4 inches below surface and in pockets on the surface.
Land Use and Adjacent Land Use	Undeveloped, portions of site cleared of trees with scattered debris (old tires and remnants of vehicles). Adjacent land use undeveloped to north, south, and east, with residential upslope to west.

Suitability for Discharge of Reclaimed Water

Wetland Candidate Site 1 is a Category 1 freshwater forested wetland. Field review of the site revealed that the functional attributes of the wetland were essentially intact, and that no clearly evident environmental benefits could be derived from discharging reclaimed water at this location (see photographs in Appendix B.1). As previously mentioned, the use of natural wetland for disposal of reclaimed water is not recommended unless it can be demonstrated that no existing wetland functions would be decreased and overall net environmental benefits will result from the discharge (Washington Department of Health and Washington State Department of Ecology 1997).

Based on the hydraulic loading guidelines of 0.8 in (2 cm)/day, approximately 9.5 acres of wetland would be needed to assimilate the projected wastewater volumes for the core reservation area (see Table 5). The reclaimed water would need to be distributed into the wetland using a linear spreader line located along the western side of the wetland.

Even with consideration for hydraulic loading mentioned above, there would be the following potential impacts of discharging reclaimed water into the Site 1 wetland:

- Increasing the quantity of water to the forested wetland could lead to the loss of forested wetland habitat if water elevations and the duration of the higher elevations exceed the tolerance limits of the existing tree and shrub species.
- Application of the reclaimed water could lead to an increase in the area of open water and emergent wetland habitat, thereby resulting in incremental effects on wildlife species that are “closely associated” with forested wetland.
- Use of Site 1 would result in impacts associated with the construction of approximately 700 feet of access road from Highway 101 and a maintenance road and spreader trench to distribute the reclaimed water.

Based on field review, Site 1 was determined to not be suitable for discharge of reclaimed water because of the potential to degrade several of the existing wetland functions (e.g., potential loss of forested and shrub habitat and impacts to wildlife) and the lack of any overall net environmental benefits from the discharge.

4.1.2 Candidate Site 2

Wetland Candidate Site 2 was selected because of its close location to the mouth of the unnamed dry creek and the relatively close to the proposed wastewater treatment facility (Figure 1). Site 2 is located approximately 700 feet east of Highway 101 and 400 feet from a residential use, on the western edge of the North Wetland. A copy of the Qualitative Wetland Assessment Checklist and representative photographs for Site 2 is presented in Appendix B.2). Table 2 provides a summary of wetland conditions at Site 2.

Table 2. Summary Characteristics of Wetland Candidate Site 2

Site Evaluation Criteria	Site Characteristics
Wetland Class, Type; Vegetation	Category I Freshwater Forested/Shrub; 70% tree canopy of alder, red cedar, cottonwood with understory of vine maple, red-twig dogwood, salmonberry and sword ferns (see Appendix B.2 for more detail and representative photographs).
Distance from WWTP; Access	Approximately 1,700 ft from WWTP and west of Highway 101; No existing road, access adjacent to residential use.
Topography and Soils	Approximate elevation 20 ft; slight slope (~1 to 2 %) to east; soils dark brown coarse sandy with gravels, saturated 3 to 4 inches below surface and on the surface within a defined channel east of the gravel outwash delta formed at the end of the unnamed dry creek.
Land Use and Adjacent Land Use	Undeveloped. Adjacent land use undeveloped to north, south, and east, with residential upslope to west.

Suitability for Discharge of Reclaimed Water

As with Site 1, Wetland Candidate Site 2 is a Category 1 freshwater forested wetland. Field review of the site revealed that the functional attributes of the wetland were not only intact, but also unique due the location of the wetland abutting glacial outwash soils and gravels associated with the mouth of the unnamed dry creek (see photographs in Appendix B.2). In addition, there was no clear evidence that environmental benefits could be derived from discharging reclaimed water at this location.

Based on the hydraulic loading guidelines of 0.8 in (2 cm)/day, approximately 9.5 acres of wetland would be needed to assimilate the projected wastewater volumes for the core reservation area (see Table 5). The reclaimed water would need to be distributed into the wetland using a linear spreader line located along the western side of the wetland. Even with consideration for hydraulic loading mentioned above, there would be the following potential impacts of discharging reclaimed water into the Site 2 wetland:

- Increasing the quantity of water to the forested wetland could lead to the loss of forested wetland habitat if water elevations and the duration of the higher elevations exceed the tolerance limits of the existing tree and shrub species at that location.
- Application of the reclaimed water could lead to an increase in the area of open water and emergent wetland habitat, thereby resulting in incremental effects on wildlife species that are "closely associated" with forested wetland.
- Use of Site 2 would result in impacts associated with the construction of approximately 700 feet of access road from Highway 101 and a maintenance road and spreader trench to distribute the reclaimed water.

Based on field review, Site 2 was determined to not be suitable for discharge of reclaimed water because of the unique nature of the wetland, the potential to degrade several of the existing wetland functions (e.g., potential loss of forested and shrub habitat and impacts to wildlife) and the lack of any overall net environmental benefits from the discharge.

4.1.3 Candidate Site 3

Wetland Candidate Site 3 was selected because of the potential for using reclaimed water to enhance wetland habitat adjacent to Transmission Line Road and in the adjacent slough (Figure 1). Site 3 is located approximately 1,300 feet east of Highway 101 and 400 feet from the eastern edge of the freshwater forested portion of the North Wetland. A copy of the Qualitative Wetland Assessment Checklist and representative photographs for Site 3 is presented in Appendix B.3).

Table 3. Summary Characteristics of Wetland Candidate Site 3

Site Evaluation Criteria	Site Characteristics
Wetland Class, Type; Vegetation	Category I Tidal Emergent Estuarine wetland with an edge of shrubs consisting of wild rose, red-twig dogwood and salmonberry (see Appendix B.3 for more detail and representative photographs).
Distance from WWTP; Access	Approximately 2,500 ft from WWTP and west of Highway 101; Existing Transmission Line Road from Highway 101.
Topography and Soils	Approximate elevation 8 ft; slight slope; standing water in wetland at high tide; slough carries significant freshwater flows from groundwater and unnamed creek.
Land Use and Adjacent Land Use	Undeveloped. Adjacent land use undeveloped.

Suitability for Discharge of Reclaimed Water

Wetland Candidate Site 3 is a Category 1 tidal emergent estuarine wetland (see Table 3 above). Field review of the site revealed that the functional attributes of the wetland were not only intact, but also of unique high quality due the diversity of habitat, the large quantity of fresh water entering the estuary from upland groundwater sources, and the presence of salmon spawning (Chum salmon) (see photographs in Appendix B.3).

Based on field review, Site 3 was determined to not be suitable for discharge of reclaimed water because of the unique nature of the wetland and the lack of any overall net environmental benefits that could be derived from discharge.

4.1.4 Candidate Site 4

Wetland Candidate Site 4 was selected based on review of aerial photographs indicating possible disturbance/modification to the wetland that could benefit from the use of reclaimed water (Figure 1). Site 4 is located approximately 100 feet east of Highway 101. A copy of the Qualitative Wetland Assessment Checklist and representative photographs for Site 4 is presented in Appendix B.4). Table 4 provides a summary of wetland conditions at Site 4.

Table 4. Summary Characteristics of Wetland Candidate Site 4

Site Evaluation Criteria	Site Characteristics
Wetland Class, Type; Vegetation	Category I Freshwater tidal wetland with an edge of Sitka spruce and shrubs consisting of wild rose, red-twig dogwood (see Appendix B.4 for more detail and representative photographs).
Distance from WWTP; Access	Approximately 2,277 ft from WWTP and west of Highway 101; access directly from Highway 101.
Topography and Soils	Approximate elevation 12 ft; slight slope; standing water in wetland at high tide.
Land Use and Adjacent Land Use	Undeveloped. Due east of Highway 101; some trees cleared along 135-kV transmission line.

Suitability for Discharge of Reclaimed Water

As with Site 3, Wetland Candidate Site 4 is a Category 1 tidal emergent estuarine wetland. Field review of the site revealed that the functional attributes of the wetland are intact and that the wetland is of unique high quality due the diversity of habitat (see photographs in Appendix B.4). The wetland has a complex and diverse assemblage of wetland types (open water, emergent marsh, shrub, and forested) and diverse structure.

Based on field review, Site 4 was determined to not be suitable for discharge of reclaimed water because of the unique nature of the wetland and the lack of any overall net environmental benefits that could be derived from discharge.

4.2 Hydraulic Loading

The “Water Reclamation and Reuse Standards” manual (Washington State Department of Health and Washington State Department of Ecology 1997) has defined hydraulic loading criteria for discharging reclaimed water to Category II, III, and IV natural wetlands; no criteria were defined for Category I wetlands. The purpose of the criteria is to ensure that the hydrologic conditions of the wetland are maintained and that vegetation and other wetland functions are not adversely affected by the addition of reclaimed water.

For the purpose of this feasibility analysis, we used the Category II maximum annual loading rate of 2 cm/day (0.8 in) as a guide. The hydraulic loading rate is the ratio of the average annual flow rate of reclaimed water to the effective "wetted" area of the wetland, reported in cm/day. Table 5 presents an estimate of "wetted" wetland acreage required to meet a maximum loading rate of 2 cm/day guideline for the projected Core Reservation and Potlatch flows combined, and for the Core Reservation alone.

Table 5. Wetland Acreage to Meet Hydraulic Loading Criteria of 2 cm/day

Service Area	Estimated Average Flow (gpd)	Acreage Requirement
Core Reservation	140,000	9.5 acres
Core Reservation and Potlatch Combined	252,000	17 acres

Insufficient data are available to determine the transmissivity of Puget Silt Loam, however for the purpose of this analysis it is assumed that reclaimed water applied to the wetland would combine with existing groundwater and move laterally through the wetlands to the east and Hood Canal as described in the hydrologic evaluation technical memorandum prepared by HWA (*in* KCM 1998).

In order to meet the loading requirement and to distribute the reclaimed water, a level spreader or similar distribution system would need to be installed along the upper margin of the wetland.

5.0 Findings and Recommendations

5.1 Natural Wetlands

The use of natural wetlands for the discharge of reclaimed water is recognized as a potential benefit to Category II, III, or IV wetlands having degraded or compromised functions (Washington State Department of Health and Washington State Department of Ecology 1997). No Category II, III, or IV wetlands are present within the proposed WWTP project area, and none of the four sites evaluated within the Category I North Wetland possess degraded functions or habitat conditions that would benefit from the discharge of reclaimed water.

Based on the review of existing resource information and scientific literature, and the reconnaissance field investigations, no benefits to natural wetland resources would be derived from the discharge of reclaimed water.

5.2 Constructed Beneficial Use Wetlands

The construction of wetlands for "beneficial uses" (e.g., storm/flood water storage and retention; hydrologic functions of low flow augmentation; filtration and storage; habitat for aquatic organisms and wildlife; and recreational, cultural, educational, and scientific uses) is recognized as an environmental and social benefit. The reclaimed water standard for beneficial use is Class B or higher (Washington State Department of Health and Washington State Department of Ecology 1997). The environmental and social value of this approach is dependent on the location and size of the constructed wetland.

As a next step, the applicability and benefits of using constructed beneficial use wetlands for the Skokomish WWTP project should be determined if the Tribe is interested in using reclaimed water for cultural, educational, or scientific use. This decision should be based on such considerations as the goals and objectives for use of reclaimed wastewater, definable environmental and social benefits to be derived, and engineering considerations such as the location and size of the wetland and cost. This analysis could include the feasibility and value or using a constructed beneficial wetland as storage in conjunction with a seasonal land application (e.g., to forest land) and infiltration discharge. It is anticipated that this task could be accomplished in one technical working session.

5.3 Constructed Treatment Wetlands

The construction of treatment wetlands is recognized as a "natural" and "low-tech" approach to treating wastewater to meet discharge requirements. Constructed treatment wetlands are usually constructed in an upland setting, with the size and configuration of the wetland based on the desired pollutant reduction prior to discharge. Treatment wetlands require an ultimate discharge of the treated wastewater, either through infiltration, spray irrigation, or as a point discharge to a receiving water. Constructed treatment wetlands are recognized primarily for their value to treat wastewater rather than to provide wetland functional benefits. Most often, constructed wetlands are not considered waters of the United States (i.e., wetlands by definition).

Class A reclaimed water cannot be achieved using constructed wetlands for treatment unless the effluent from the wetland was filtered prior to discharge (Fricke pers. comm.). The feasibility of using constructed surface-flow and subsurface flow wetlands for treatment, should be explored further if the Tribe chooses to consider discharging effluent of a lesser quality than Class A. For example, a treatment wetland could possibly be used to polish Class D effluent from the WWTP to a Class C quality for discharge. The feasibility of this analysis would be dependent on type of disposal (e.g., spray irrigation or infiltration) and the water quality requirements. This analysis is largely an engineering exercise based on projected flows, projected quality of effluent to be treated, the desired quality for discharge, land availability, and costs for construction, operation, and monitoring.

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