September 2017

CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

PRELIMINARY ENGINEERING REPORT

Prepared By:

Project No.: 0159.0001 **Gibbs & Olson, Inc.**

CERTIFICATE OF ENGINEER

CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

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ABBREVIATIONS

AA	Annual Average or Available Acreage
AKART	All Known Available and Reasonable Technology
BOD	Biological Oxygen Demand
CBOD	Carbonaceous Biological Oxygen Demand
CEC	Contaminants of Emerging Concern
CF	Cubic Feet
CFR	Code of Federal Regulations
cfh	cubic feet per hour
cfs	cubic feet per second
CMAS	Completely Mixed Activated Sludge
CWA	Clean Water Act
d	day
DAA	Developed Available Acreage
DEA	Developer Extension Agreement
DGC	Developed Gross-Critical Acreage
DOH	Department of Health
EDC	Endocrine Disrupting Compounds
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ERU	Equivalent Residential Unit
ESA	Endangered Species Act
EWD	Existing Water Use
ft	feet
GC	Gross-Critical Acreage
GMA	Growth Management Act
gpad	gallons per acre per day
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
HDPE	high density polyethylene
HPA	Hydraulic Project Approval
I/I	Inflow and Infiltration
IAA	Annual Average I/I Rate
IMM	Maximum Month I/I Rate
IPD	Peak Day I/I Rate
IPH	Peak Hour I/I Rate
ITP	Incidental Take Permit
in	inch
kW	kilowatt
hp	horsepower
lf	linear feet
L	liter
lbs	pounds

LOSS	Large On-Site Sewage System
mg	milligrams
mgd	million gallons per day
ml	milliliters
MLSS	Mixed Liquor Suspended Solids
µg	microgram
MG	Million Gallons
MM	Maximum Month
MSSD	Main Street Sewer District
N	nitrogen
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
NMUGA	Non-Municipal Urban Growth Area
O&M	Operation and Maintenance
P	phosphorous
PCP	Personal Care Products
PD	Peak Day
PE	Population Equivalent
PH	Peak Hour
PhAC	Pharmaceutically Active Compounds
POTW	Publicly Owned Treatment Works
PSCAA	Puget Sound Clean Air Agency
PVC	polyvinyl chloride
PWU	Projected Water Use
QA/QC	quality assurance/quality control
RAS	return activated sludge
RCW	Revised Code of Washington
SEPA	State Environmental Policy Act
SIU	Significant Industrial User
SRF	State Revolving Fund
SRT	Solids Retention Time
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TDH	Total Dynamic Head
TKN	Total Kjeldahl Nitrogen
TMDL	total maximum daily load
TN	Total Nitrogen
TSS	total suspended solids
UGA	Urban Growth Area
USFWS	United States Fish and Wildlife Service
UV	ultraviolet
WAC	Washington Administrative Code
WAS	waste activated sludge
WSDOH	Washington State Department of Health
WWTF	Wastewater Treatment Facility

CHAPTER 1

INTRODUCTION

GENERAL

This *Preliminary Engineering Report* (Report) for the Confederated Tribes of the Chehalis Reservation (Tribe) addresses the Tribe's planning needs for wastewater collection, transmission, treatment, and disposal for a 20-year planning period. The Tribe is a sovereign nation, and is not subject to state regulation and enforcements. However, to be eligible for state funding programs, this Report has been prepared in accordance with the pertinent requirements of the United States Environmental Protection Agency (USEPA); guidelines outlined in the Washington State Department of Ecology's (Ecology)current *Criteria for Sewage Works Design (Orange Book)*; and, provisions of the Revised Code of Washington (RCW), Section 90.48, *Water Pollution Control*, Washington Administrative Code (WAC) 173-240-060, *Engineering Report.* Development of this Report has been coordinated with the Tribe's *2011 Comprehensive Land Use Plan* and the Tribe's draft *General Sewer/Wastewater Facility Plan* (2016).

The proposed actions identified in this Report are intended to be feasible in terms of engineering, economic, regulatory, and political frameworks. This Report provides proposed conceptual designs, cost estimates, recommended implementation schedule, and a recommended funding plan for recommended major facility improvements. A State Environmental Policy Act (SEPA) checklist is provided in Appendix E. The projects described in this Report are consistent with Federal and Washington State regulations relating to the prevention and control of discharge of pollutants into waters of the state, anti-degradation of existing and future beneficial uses of ground waters, and anti-degradation of surface waters.

OVERVIEW

The Tribe's reservation is located in both Grays Harbor and Thurston counties in western Washington approximately 30 miles southwest of the City of Olympia. 2010 U.S. census data indicated 642 people were living on the reservation. There are currently nine separate wastewater collection and treatment systems within the reservation as listed below.

- Fern Drive Housing Development
- Oaks Housing Development
- Starrville Community
- Tahown Housing Development
- Makum Housing Development
- Vosper Place Housing Development
- Davis Drive (Petoie) Housing Development
- Community Non-Residential Area (Tribal Government Complex, Wellness Center, Department of Natural Resources, Community Center, Public Safety Building)
- Lucky Eagle Casino

The Tribe operates three separate membrane bioreactor (MBR) wastewater treatment facilities which respectively serve the Lucky Eagle Casino, the Davis Drive Housing Development, and the Tribal Complex Area. Each of these wastewater collection and treatment systems are discussed in detail in Chapter 4.

The Tribe is governed by a five-member Tribal Council.
The Tribe's mailing address is:

Confederated Tribes of the Chehalis Reservation
420 Howanut Road
Oakville, WA 98568

RELEVANT PREVIOUS PLANS AND REPORTS

Existing documents and reports that were reviewed and utilized in preparing this Report include:

- *Draft General Sewer/Wastewater Facility Plan*, Gray & Osborne, 2016
- *Petoie Back-Up Drainfield Analysis for the Confederated Tribes of the Chehalis Reservation*, Indian Health Services, 2014.
- *Results of the Chehalis Reservation Groundwater Study*, Golder and Associates, 2012.
- *Confederated Tribes of the Chehalis Reservation 2012 Community Assessment*, Chehalis Tribe, 2012.
- *Comprehensive Flood Hazard Management Plan*, GeoEngineers, 2009.
- *Geotechnical Engineering Study: Proposed Health Clinic Facility 21 Niederman Road, Oakville, Washington*, GeoEngineers, 2005.
- *Wastewater Master Plan*, Brown and Caldwell, 2004.
- *Project Summary Sanitation Facilities for the Confederated Tribes of the Chehalis Reservation, IHS Project PO-04-J98*, Indian Health Services, 2004.
- *Groundwater Modeling Report*, Pacific Groundwater Group, 2003.
- *Aquifer Evaluation for Confederated Tribes of the Chehalis Reservation*, David Evans and Associates, 1998.

CRITICAL ISSUES

This Report addresses the following critical issues related to the existing sewer collection and treatment systems:

- Provide a holistic plan for development on the reservation to include wastewater collection and treatment and protection of the drinking water supply for the future.
- Existing community septic drainfields are located above the capture zone of the community wells and sampling from the existing wells shows that the nitrate concentrations in the groundwater are relatively high. Nitrate contamination is addressed under Critical Aquifer Recharge Areas in Chapter 3.
- Additional treatment capacity is needed to treat the projected future waste flows and loads from residential and commercial growth.

SCOPE OF WORK

This Report was prepared as a Preliminary Engineering Report and includes a wastewater system analysis, recommended alternatives, and capital improvement plan with cost analysis and recommended implementation schedule.

The scope of the Report addresses the following topics:

- Background information and data;
- Service area characteristics;
- Population and land use;
- Regulatory criteria;
- Projected future waste flow and loads;
- Performance and design criteria;
- Evaluation of the existing wastewater treatment facilities (WWTFs);
- Evaluation of multiple wastewater collection and treatment system alternatives;
- Evaluation of water reuse alternatives;
- Identification of recommended system improvements with planning level opinions of cost;
- Identify potential sources of funding for recommended system improvements;
- Environmental analysis, including a SEPA checklist.

SUMMARY OF RECOMMENDED CAPITAL IMPROVEMENTS

The following is a summary of the capital improvements to address deficiencies or needs that are identified in the various sections of this report. More detailed discussions of the proposed improvements are provided in sections VI and VII of this Report.

<u>Upgrade Petoie WWTF.</u> The Petoie MBR WWTF is in relatively good shape but needs some upgrades to last through the next 20 years. Upgrades include replacing existing submerged membrane units due to age, installing a DO meter, new effluent and effluent flow meters, new turbidity meter, and a new SCADA computer.

<u>Upgrade Casino WWTF.</u> The Casino has available capacity to treat the wastewater from other housing developments near the center of reservation as well as the flow that now goes to the Public Safety WWTF. But several upgrades are recommended and include installing two new submerged membrane racks and one air scour blower to boost peak day capacity, replace existing submerged membranes due to age, new HMI and computer, new permeate pumps, new process water pump station, new effluent pumps, new influent and effluent flow meters, new turbidity meters and a new effluent composite sampler.

<u>Abandon Public Safety WWTF</u>. It is recommended that the Public Safety WWTF be abandoned due to the high cost of making needed improvements. The flow will now be directed to the Casino WWTF in a new 4-inch forcemain that will go down the Community Center Utility Access Road.

<u>Makum Housing Development</u>. The Makum housing development is currently served by individual septic tanks and drainfields. It is recommended that septic tank effluent pumps (STEP) be installed and the flow be pumped to the Casino WWTF for treatment which will free up all of the drainfield areas.

<u>Tahown Housing Development</u>. The Tahown housing development is currently served by community septic tanks and drainfields. It is recommended that septic tank effluent pumps (STEP) be installed and the flow be pumped to the Casino WWTF for treatment which will free up all of the drainfield areas.

Fern Housing Development. The Fern housing development is currently served by individual septic tanks and drainfields. It is recommended that septic tank effluent pumps (STEP) be installed and the flow be pumped to the Casino WWTF for treatment which will free up all of the drainfield areas. However, this is a future project. The Fern improvements are estimated at $649,000.

Community Non-Residential Area. The Community Non-Residential area is currently mostly served by the Public Safety WWTF which will be abandoned. The buildings which are currently served by individual septic tanks and drainfields will have septic tank effluent pumps (STEP) installed and the flow will be pumped to the Casino WWTF for treatment which will free up all the drainfield areas.

The following table is a summary of the recommended capital improvements listed along with estimated project costs. Details for estimated project cost estimates are included in Appendix D.

Capital Improvement Cost Summary		
Ref #	**Description**	**Cost**
1	Casino WWTF Improvements	$ 605,000
2	Petoie WWTF Improvements	$ 138,000
3	Makum Housing Development	$ 326,000
4	Tahown Housing Development	$ 1,300,000
5	Community Non-Residential	$ 429,000
	Total	**$ 2,798,000**

CHAPTER 2

PURPOSE AND APPROACH

PROJECT PURPOSE

The purpose of this Preliminary Engineering Report (Report) is to provide guidance to the Tribe in providing reservation wastewater collection and treatment services through the year 2037 (20 years). The Tribe wants to consolidate wastewater treatment and expand the sewer service area to serve housing areas that are now on septic systems. This Report has been prepared to conform with current Ecology regulations and guidelines. This Report is intended to serve as an Engineering Report for the recommended collection system improvements, WWTFs and end use facilities. As such, the Report has been written to meet the requirements of WAC 173-240-060.

APPROACH

A primary objective of wastewater planning is to ensure adequate treatment and conveyance capacity is provided to meet the needs of the reservation, to ensure such facilities minimize adverse impacts on the environment, and to protect the health and safety of the Tribal community. An additional priority is to accomplish these goals in an economical and efficient manner. Minimum requirements which the Tribe must abide by in the management of its wastewater collection and treatment facilities are set forth by the USEPA and Ecology.

The approach taken in preparation of this Report is to:

- Define environmental and physical conditions in the planning area.
- Develop waste flow and load projections for wastewater facilities which are to be provided for the Reservation.
- Describe existing and anticipated future effluent limitations and other water quality management goals that the Reservation must meet, or plan for.
- Evaluate the existing WWTFs and determine if upgrades to the existing facilities or if a new WWTF is the most feasible option to provide treatment for the projected waste flows and loads.
- Prepare an inventory and evaluation of the Tribe's existing wastewater collection system.
- Develop a recommended plan for extending and upgrading sewer conveyance pipelines to provide sewer service to all existing and future customers within the Service Area.
- Evaluate financial options for funding recommended improvements.
- Develop a schedule for implementing the recommended improvements.

This Report utilizes information obtained from the Tribe including WWTP records, "as-built" drawings and maps, and previous planning and design-related documents. Information provided by Tribal personnel concerning various systems and loading characteristics has been considered and included in this Report.

It is intended that this Report will be reviewed and approved by the Tribe, USEPA and Ecology.

REGULATORY REQUIREMENTS

This section identifies and summarizes the pertinent federal, state and tribal regulations that affect the planning, design, and approval of recommended improvements discussed in this Report.

The Tribe is a sovereign nation and is not subject to state regulations. However, federal and state regulations serve as useful guidelines for establishing treatment and effluent quality goals, and providing protection of the environment on and surrounding the reservation. In addition, if the Tribe pursues funding from federal or state funding programs, the Tribe may be required to comply with federal and state regulations.

This chapter does not describe each regulation in detail; rather, it addresses important facets of the regulations that affect the planning and design process. Subsequent chapters of this report address technical requirements of the regulations at a level of detail appropriate for the evaluation provided by that chapter.

FEDERAL AND STATE STATUTES, REGULATIONS AND PERMITS

This section discusses some of the various federal and state laws, regulations and permits that may affect wastewater system design, construction and operations.

FEDERAL CLEAN WATER ACT

The Federal Water Pollution Control Act is the principal law regulating water quality of the nation's waterways. Originally enacted in 1948, it was significantly revised in 1972 and 1977, when it was given the common title of the "Clean Water Act" (CWA).

The CWA has been amended several times since 1977. The 1987 amendments replaced the Construction Grants program with the Water Pollution Control State Revolving Fund (SRF) that provides low-cost financing for a range of water quality infrastructure projects.

The National Pollutant Discharge Elimination System (NPDES) was established by Section 402 of the CWA and subsequent amendments to regulate and permit waste discharges to surface waters. Ecology typically administers NPDES permits in the State of Washington under the authority of the USEPA. On tribal lands, the NPDES permit would be administered by the USEPA. Most NPDES permits are valid for 5 years and place limits on the quantity and quality of pollutants that may be discharged. NPDES permits regulate point source discharges including wastewater discharges to surface water from municipal or industrial wastewater treatment facilities.

As discussed below in the "Tribe Codes and Regulations" Section, the Tribe has been granted consideration as a "Tribe" as Washington state and the USEPA have approved the Tribe's water quality standards for CWA purposes.

Section 303 of the CWA established the Total Maximum Daily Load (TMDL) program. Under this program, states must establish a list of water bodies that will not achieve water quality standards even with "all known available and reasonable technology (AKART)" in place. In such situations, Ecology conducts a TMDL analysis to determine the capacity of the water body to absorb pollutants and allocates allowable pollutant loads among point and nonpoint discharges. Based on this loading capacity, "waste load allocations" are established for different pollutant sources in the watershed.

Section 307 of the CWA established the National Pretreatment Program. This program is designed to protect publicly owned treatment works (POTWs) and limits the amount of industrial or other non-residential pollutants discharged to municipal sewer systems.

A Section 401 Water Quality Certification is required under the CWA for any activity that may result in discharge to surface waters including excavation activities that occur in streams, wetlands, or other waters of the nation. The USEPA has delegated 401 Certification in Washington state to Ecology.

The USEPA has regulatory authority for groundwater infiltration on tribal land through the Underground Injection Control (UIC) Program. This program regulates the construction, operation, and permitting of injection wells that place fluids underground for disposal. The injection of treated effluent falls under the classification of a Class V Well. The UIC program requires that groundwater injection does not result in underground sources of drinking water (USDW) failing to meet potable water quality standards. The permitting process requires the submittal of a USEPA inventory form and a groundwater monitoring plan. If the UIC Program Director finds the effluent infiltration system does not endanger the groundwater, then a permit will not be required and the facility will be approved as "rule authorized" by USEPA.

Because the Tribe does not discharge to surface waters, an NPDES permit is not required for discharge of effluent from their treatment systems. However, because the three existing WWTF's treat commercial sewage and/or serve more than 20 people and have a design capacity greater than 3,500 gallons per day, the associated effluent drainfields are required to be regulated as Class V Underground Injection Wells under 40 Code of Federal Regulations (CFR) 144. A Class V well is authorized by rule and does not require a permit. However, operators of Class V wells are required to provide basic information to USEPA regarding the well and to operate the well in a manner that protects groundwater quality.

Compared to surface water, groundwater is relatively immobile. Groundwater residence times can vary from a few weeks to thousands of years. This fact alone makes the assimilative capacity of groundwater limited. Once reaching an underground aquifer, the physical and chemical characteristics of water change slowly. While groundwater may support a number of beneficial uses, the overriding basis for the regulations is to protect all groundwater as a potential drinking water source.

The parameter of major concern with the discharge of treated wastewater to groundwater is nitrate nitrogen (NO3-N), because of its potential impact on human health. The current drinking water standard for nitrate is 10 milligrams per liter (mg/L). Nitrate is highly soluble and mobile. If it is not taken up in the root zone, it will readily migrate to groundwater.

Reduced forms of nitrogen, such as organic nitrogen and ammonia, are readily oxidized to nitrate. Therefore, reduction of total nitrogen to less than 10 mg/L prior to groundwater discharge is generally recommended. Typically, to be accepted as AKART, treatment technologies for wastewater effluent discharges to groundwater must be capable of reducing total nitrogen in the discharge to less than 10 mg/L.

Table 2-1 presents effluent design criteria, acceptable to the UIC program, for a groundwater percolation discharge.

TABLE 2-1 Probable Effluent Design Criteria for Discharge to Drainfield or Infiltration Basin[1]	
Parameter	**Design Effluent Limit**
BOD5 (mg/L)	30
TSS (mg/L)	30
Total Nitrogen (mg/L)	10
pH (S.U.)	6.8 to 8.5
Fecal Coliform (colonies/100 ml)	200

(1) Based on Skokomish Tribe Potlatch WRF UIC Permit. Sampling frequency: once per month.

Tribes can assume primary enforcement responsibility once their UIC programs have been approved by USEPA, however, to date, no tribe is currently authorized to administer the program.

PROPOSED EPA CAPACITY, MANAGEMENT, OPERATION, AND MAINTENANCE REGULATIONS

USEPA has proposed a new round of regulations titled Capacity, Management, Operation and Maintenance (CMOM). Though the regulations are yet to be formally adopted by USEPA, some municipalities are anticipating the adoption and have moved forward with implementation. CMOM focuses on the failure of collection systems and requires a program for long-term financing and repair. Under its authority granted by the federal Clean Water Act, USEPA seeks to address sanitary sewer overflows (SSO) under the CMOM program.

In general, CMOM requirements are summarized in the following elements:

1. General performance standards including system maps, information management, and odor control.

2. Program documentation including the goals, organizational and legal authority of the organization operating the collection system.

3. An overflow response plan that requires response in less than one hour and is demonstrated to have sufficient and adequate personnel and equipment. Volumes and duration of overflows must be accurately measured and reported to the regulatory agency.

4. System evaluation requires that the entire system be cleaned on a scheduled basis (for example, once every 5 years), be regularly visually inspected, and that a program for short and long-term rehabilitation replacement be generated. USEPA has proposed, as a rule of thumb, a 1.5 to 2 percent system replacement rate which implies that an entire collection system would be replaced over a 50- to 70-year time period.

5. A capacity assurance plan that will use temporary flow meters to determine and model I&I, ensure lift stations are properly operated and maintained, and that source control is maintained.

6. A self-audit program to evaluate and adjust performance.

7. A communication program to communicate problems, costs, and improvements to the public and decision makers.

USEPA is considering some changes in design standards for collection systems including requiring that sanitary sewer overflows not occur except in extreme storms. They have also decided that they will not define what design storm is “extreme”, leaving that decision to the design engineer.

FEDERAL ENDANGERED SPECIES ACT

Congress passed the Endangered Species Preservation Act in 1966 to provide limited protection for species considered in danger of “worldwide extinction.” This legislation was replaced with the Endangered Species Act (ESA) in 1973, which provides for listing and stronger protection of endangered and threatened plant and animal species.

ESA listings impact activities that affect the listed species habitat, such as water use, land use, construction activities, and wastewater disposal. Impacts to the Tribe may include longer timelines for permit approvals, and more stringent regulation of construction impacts and activities in riparian corridors.

The most significant Priority Habitats in the vicinity of the Reservation associated with species protected under the ESA previously identified are associated with Marbled Murrelet Detection Sections and 1.5-Mile Buffers west of Oakville, and Northern Spotted Owl nests and Management Circles to the west.

Fish species identified in the Chehalis River include Fall Chinook, Spring Chinook, Coho, Fall Chum, Winter Steelhead and Resident Cutthroat Trout. Fish Species present in tributaries include Coho, Resident Cutthroat Trout and Steelhead. None of these fish species are protected under the ESA; however, commercially important Chinook and Coho salmon are protected under the Magnuson Stevens Fishery Conservation and Management Act.

Significant wildlife identified in the Public Health Service (PHS) Reports include Roosevelt elk, northern goshawk, Dunn’s salamander, Van Dyke’s salamander, wood duck, trumpeter swan, harlequin duck and waterfowl concentrations.

In order to minimize liability under the ESA, local governments need to demonstrate their land use regulations will not result in a prohibited “take” of a listed species, including adverse modification of critical habitat.

NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA) was established in 1969 and requires federal agencies to determine environmental impacts on all projects requiring federal permits or utilizing federal funding. Federally delegated activities such as NPDES permits or Section 401 Certification are considered state actions and do not require NEPA compliance. If a project involves federal action (through, for example, an US Army Corps of Engineers Section 404 permit) or funding (such as USDA Rural Development grants or loans), and is determined to be environmentally insignificant, a Finding of No Significant Impact (FONSI) is issued, otherwise an Environmental Impact Statement (EIS) is required.

NEPA is not applicable to projects that do not include a federal component that would trigger the NEPA process. The USEPA issues all NPDES permits on Tribal Lands.

FEDERAL CLEAN AIR ACT

The Federal Clean Air Act requires all wastewater facilities to plan to meet the air quality limitations of the region, and authority is delegated to Ecology and the local clean air agency, which in the case of the

Tribe is the jurisdiction of the Olymic Region Clean Air Agency. Orders of approval are typically required for standby generators and odor control system equipment.

WETLANDS

Dredging and Filling Activities in Natural Wetlands – (Section 404 of the Clean Water Act)

Under Section 404 of the CWA, the US Army Corps of Engineers (USACE) is authorized to regulate discharge of fill and dredged material to waters of the United States, including wetlands. The USACE employs a system of General or Nationwide Permits for blanket authorization of activities such as utility lines that have minimal adverse impact on the environment. In situations where adverse impact is probable, the USACE may require an Individual Permit after reviewing an analysis of alternatives. Enforcement action may be taken by the USACE or the USEPA.

A USACE permit is required when locating a structure, excavating, or discharging dredged or fill material in waters of the United States or transporting dredged material for the purpose of dumping it into ocean waters. Typical projects requiring these permits include the construction and maintenance of piers, wharves, dolphins, breakwaters, bulkheads, jetties, mooring buoys and boat ramps.

If wetland fill activities cannot be avoided, negative impacts can be mitigated by creating new wetland habitat in adjacent areas or through purchase of mitigation credits in permitted regional wetland banks, and if other federal agencies agree, the USACE will generally issue a permit.

Wetlands Executive Order 11990

This order directs federal agencies to minimize degradation of wetlands and enhance and protect the natural and beneficial values of wetlands. The order also mandates avoidance and mitigation of impacts to wetlands, and must be considered before an NPDES permit is issued. Assurances must be provided that the natural and beneficial values of wetlands will be protected and enhanced by a permitted discharge.

<u>WASHINGTON STATE STATUTES, REGULATIONS AND PERMITS</u>

Because the facilities are located on tribal land, Washington state regulations do not apply to any facilities on the Reservation. However, this Report describes projects that may be Ecology and the Tribe may seek additional funding from other state funding sources for construction of wastewater facility improvements. To be eligible for state funding, the Tribe must comply with applicable state statutes and regulations. In addition, state regulations serve as useful guidelines for establishing treatment and effluent quality goals and are applicable to any effluent discharge and solids disposal off of tribal land. Pertinent Washington state regulations are summarized below.

Ecology has been delegated authority by the USEPA for implementation of several sections of the CWA, including surface water quality standards, NPDES permits for waste discharges to surface waters and Section 401 Water Quality Certification for impacts to wetlands and rivers. Ecology develops state groundwater quality standards, regulates discharge of waste to state groundwater, discharge of industrial or commercial waste to sewers, and the use of reclaimed water through the State Waste Discharge permit program. Ecology also regulates the management and disposal of septage and biosolids residuals from wastewater treatment plants.

STATE WATER POLLUTION CONTROL ACT

The intent of the state Water Pollution Control Act is to "maintain the highest possible control standards to ensure the purity of all waters of the state consistent with public health and the enjoyment thereof, the propagation and protection of wildlife, 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." Under the RCW 90.48 and the WAC 173-240, Ecology issues permits for wastewater treatment facilities. Land application of wastewater is regulated under WAC 246-271.

Submission of Plans and Reports for Construction of Wastewater Facilities, WAC 173-240
If state funding is provided for construction or modification of domestic wastewater facilities on Tribal land, engineering reports, plans and specifications must be submitted to and approved by Ecology prior to the start of construction. This regulation outlines procedures and requirements for the development of an engineering report that thoroughly examines the engineering and administrative aspects of a domestic wastewater facility project. This state regulation defines a facility plan as an engineering report complying with federal regulation 40 CFR Part 35. Key provisions of WAC 173-240 are provided below.

- An engineering report for a wastewater facility project must contain everything required for a general sewer plan unless an up-to-date general sewer plan is on file with Ecology.

- An engineering report shall be sufficiently complete so that Plans and Specifications can be developed from it without substantial changes.

- A wastewater facility engineering report must be prepared under the supervision of a professional engineer.

- The engineering report shall include the following information (letter designations are taken from WAC 173-240-060; requirements that include those found in 40 CFR 35.917 for federal facility plan requirements are noted with an asterisk, "*").

  (a) Name, address, phone number of owner.
  (b) Project description.
  (c) Current and projected wastewater flows and loadings.
  (d) Treatment standards.
  (e) Receiving water characteristics, including dilution zone.
  (f) Proposed treatment and disposal process, including an evaluation of alternatives.*
  (g) Basic design data and calculations for each unit process.
  (h) Site availability and relationship to 25-/100-year flood cycles and residential or developed areas.
  (i) Flow diagram with hydraulic profile.
  (j) Discussion of inflow and infiltration.*
  (k) Provisions for treating industrial waste, including pre-treatment programs.*
  (l) Outfall analysis.
  (m) Method of final sludge disposal and alternatives considered.
  (n) Provisions for future needs.
  (o) Staffing and testing requirements.
  (p) Estimated capital and operation and maintenance (O&M) costs, evaluated in terms of annual costs and present worth.*
  (q) A statement regarding compliance with any applicable state or local water quality plan.
  (r) A statement regarding compliance with the State (or National) Environmental Policy Act, SEPA (or NEPA) as applicable.

Criteria for Sewage Works Design, Washington State Department of Ecology (Orange Book)
Ecology's published design criteria for collection systems and wastewater treatment plants. While these criteria are not legally binding, their use is strongly encouraged by Ecology since the criteria are used by the agency to review engineering reports for upgrading wastewater treatment systems. These design criteria primarily emphasize unit processes through secondary treatment, and also include criteria for planning and design of wastewater collection systems. If expansion or modification of the Tribe's collection system and/or treatment facilities is funded by Ecology, the project will be required to comply with Ecology design criteria.

Certification of Operators of Wastewater Treatment Plants, WAC 173-230
Treatment plant operators outside of tribal lands in the State of Washington are required to be certified by the Washington state Water and Wastewater Operators Certification Board.

Wastewater treatment plant operators on tribal lands are not required to be certified but can obtain training and certification through the state. Alternatively, operators on tribal land may obtain training and certification through the Indian Health Service Environmental Health Support Center or through other public or private training and certification agencies. Training and certification of operators is strongly encouraged by Indian Health Service. Per Section 19.05.14 of the Tribe's Law and Order Code, the goal of the staff training program shall be to meet Washington state certification requirements as an Operator or Manager.

WASHINGTON STATE SURFACE-WATER QUALITY STANDARDS (WAC 173-201A)

WAC 173-201A establishes water quality standards for surface waters based on maintaining public health, recreational use, and protection of fish, shellfish, and wildlife. Ecology adopted revised water quality standards in 2003 and 2006, which have been approved by the USEPA. For each surface water body in the state, the revised standards assign specific uses, such as aquatic life, recreation, or water supply uses. Water quality standards have been developed for each use, for parameters such as fecal coliform, dissolved oxygen, temperature, pH, turbidity, toxic, radioactive, and deleterious substances.

Ecology regulates surface water discharges of wastewater effluent under the federal CWA through the issuance of NPDES permits per WAC 173-220. The NPDES permit includes effluent discharge limits, as well as operation, monitoring, and reporting requirements. Wastewater treatment plants must generally meet technology-based effluent limits. Additionally, under WAC 173-201A-060, Ecology is authorized to condition NPDES permits so that the discharge meets water quality standards. The discharge limits are developed based on the water quality classification of the receiving water body.

Ecology establishes a list of water bodies, known as the 303(d) list that will not achieve water quality standards even with AKART in place. In such situations, Ecology conducts a TMDL analysis to determine the water body's capacity to absorb pollutants and allocates pollutant loads among point and nonpoint discharges.

Washington State's policy is to maintain existing beneficial uses of surface water by preventing degradation of existing water quality through anti-degradation. The state's anti-degradation policy aims to maintain the highest possible quality of water in the state, by preventing the deterioration of water bodies that currently have higher quality than the water quality standards require. The surface water quality standards define three tiers of waters in the anti-degradation policy:

- Tier I water bodies are those with violations of water quality standards, from natural or human-caused conditions. The focus of water quality management is on maintaining or improving current uses, and preventing any further human-caused degradation.

- Tier II water bodies are those of higher quality than required by the water quality standards. The focus of the policy is on preventing degradation of the water quality, to preserve the excellent natural qualities of the water body. New or expanded actions are not allowed to cause a "measurable change" in the water quality, unless they are demonstrated to be "necessary and in the overriding public interest."

- Tier III water bodies are of exceptional quality.

Permitting of a new surface water discharge would also involve the Washington Department of Fish and Wildlife (WDFW).

The nearest and largest river, which the Tribe could discharge to, is the Chehalis River. If the Tribe were to pursue a discharge outfall to the Chehalis River, an application to the USEPA for an NPDES permit may be required since the USEPA has jurisdiction over Indian Tribes for select circumstances. The Tribe exercises its sovereignty and its rights as a "Tribe as State" and has its own Chehalis Tribe Surface Water Quality Standards as discussed below. An application to the USEPA may be required for a Chehalis River outfall, due to the fact that an outfall to the Chehalis River would provide constant flow downstream to waters of the State of Washington. If an application to the USEPA were required, USEPA will rely on Ecology's effluent limit requirements. In order to meet Ecology's Chehalis River dissolved oxygen TMDL, effluent limits will likely be the same as those for the Grand Mound WWTF, which discharges to the Chehalis River upstream of the Reservation. The Grand Mound WWTF's NPDES permit limits are presented in Table 2-2.

TABLE 2-2
Summary of Grand Mound WWTF NPDES Effluent Limits

Parameter	Value
Monthly Average BOD5 (mg/L)	30
Weekly Average BOD5 (mg/L)	45
Monthly Average TSS (mg/L)	30
Weekly Average TSS (mg/L)	45
Monthly Average Fecal Coliform Bacteria (MPN/ 100 ml)	200
Weekly Average Fecal Coliform Bacteria (MPN/ 100 ml)	400
pH (S.U.)	6-9

In addition to the NPDES permit application requirements, an application to the USACE for a Section 7 permit would be required for a river outfall, and the WDFW and the Washington State Department of Natural Resources (WDNR) would need to be consulted. Permitting of a new river outfall will be difficult and will take several years.

STATE ENVIRONMENTAL POLICY ACT

Although the Tribe is a sovereign nation and not subject to state law, if the Tribe would like to receive funding through Washington state programs, it must comply with select regulations, including the State Environmental Policy Act (SEPA). WAC 173-240-050 requires a statement in all wastewater comprehensive plans regarding proposed projects in compliance with, if applicable. Capital improvements proposed in this Report will fall under SEPA regulations. In most cases a determination of non-significance is issued (DNS); however, if a project will have a probable significant adverse environmental impact an environmental impact statement (EIS) will be required.

MINIMAL STANDARDS FOR SOLID WASTE HANDLING (WAC 173-304)

Grit, screenings, and incinerator ash are not subject to the biosolids regulations in WAC 173-308, but their disposal is regulated under the state's solid waste regulations, WAC 173-304. Waste placed in a municipal solid waste landfill must not contain free liquids, nor exhibit any of the criteria of a hazardous waste as defined by WAC 173-303. To be placed in a municipal solid waste landfill, grit, screenings, and incinerator ash must pass the paint filter test. This test determines the amount of free liquids associated within the solids, and includes the toxic characteristic leachate procedure (TCLP) test, which determines if the waste has hazardous characteristics.

While disposal of solid waste within the reservation is not subject to State regulations, disposal of solid waste generated on the reservation at a solid waste landfill outside of the reservation is subject to WAC 173-303 and 173-304.

SHORELINE MANAGEMENT ACT

The Shoreline Management Act (SMA) of 1971 (RCW 90.58) establishes a broad policy giving preference to shoreline uses that protect water quality and the natural environment, depend on proximity to the water, and preserve or enhance public access to the water.

SMA jurisdiction extends to lakes or reservoirs of 20 acres or greater in surface area, streams with a mean annual flow of 20 cubic feet per second (cfs) or greater, marine waters, and an area inland 200 feet from the ordinary high water mark. Projects are reviewed by local governments according to state guidelines and a local Shoreline Master Program.

FLOODPLAIN DEVELOPMENT PERMIT

Local governments that are participating in the National Flood Insurance Program are required to review projects (including wastewater collection facilities) in a mapped flood plain and impose conditions to reduce potential flood damage from flood water. A Floodplain Development Permit is required prior to construction.

HYDRAULIC PROJECT APPROVAL

Under the Washington State Hydraulic Code (WAC 220-660), WDFW requires a hydraulic project approval (HPA) permit for activities that will "use, divert, obstruct, or change the natural flow or bed" of any waters of the state. For activities such as pipeline crossings of streams, an HPA will be required, and will include provisions necessary to minimize project specific and cumulative impacts to fish.

If the National Marine Fisheries Service (NMFS) determines that the revisions are sufficient to protect listed species, WDFW hopes the new WAC will constitute an acceptable Habitat Conservation Plan (HCP) under Section 10 of the ESA. If the HCP is approved, NMFS issues an incidental take permit (ITP) allowing incidental take of a listed species if the permittee has complied with the HCP. This ITP expires after an agreed upon period of time, and may then be revised by NMFS.

STATE RECLAIMED WATER STANDARDS

The Tribe has previously installed purple pipe for irrigation and water reuse and has expressed interest in providing reclaimed water to this piping system. If the Tribe decides to implement a reclaimed water distribution plan, it is recommended that the Washington State Reclaimed Water Standards be used as guidance for this program.

Washington State standards for the use of reclaimed water, which do not have jurisdiction on tribal land unless state funding is provided, are outlined in RCW 90.46 and in a separate document published by the Ecology and the Washington State Department of Health (WDOH) entitled “Water Reclamation and Reuse Standards.” Reclaimed water is the effluent derived from a wastewater treatment system that has been adequately and reliably treated, such that it is no longer considered sewage and is suitable for a beneficial use or a controlled use that would not otherwise occur. The state legislature has declared that “utilization of reclaimed water by local communities for domestic, agricultural, industrial, recreational, and fish and wildlife habitat creation and enhancement purposes (including wetland enhancement) will contribute to the peace, health, safety, and welfare of the people of the State of Washington.” The Reclaimed Water Use Statute, Chapter 90.46 RCW, requires the issuance of a single permit for the development and implementation of a reclaimed water project. Therefore, all regulatory concerns and permit limitations will be included in one document, combining requirements of WDOH, Ecology’s Water Quality, and Ecology’s Water Resources Division.

The state’s *Water Reclamation and Reuse Standards* define the water quality standards for reclaimed water for Classes “A” through “D.” Class “A” reclaimed water has the highest treatment standards and is the only class of reclaimed water permitted for public contact such as irrigation of public access areas. The generation of Class “A” reclaimed water has four minimum requirements that are described below:

- **Continuously Oxidized** – Wastewater that at all times has been stabilized such that the monthly average BOD5 and TSS are less than 30 mg/L, is non-putrescible and contains dissolved oxygen.

- **Continuously Coagulated** – Oxidized wastewater that at all times has been treated by a chemical or equally effective method to destabilize and agglomerate colloidal and finely suspended matter prior to filtration.

- **Continuously Filtered** – Oxidized and coagulated wastewater that at all times has been passed through a filtering media so that the turbidity of the filtered effluent does not exceed an average of 2 nephelometric turbidity units (NTU) (0.2 for MBR treatment), determined monthly, and does not exceed 5 NTU at any time (0.5 for MBR treatment).

- **Continuously Disinfected** – Oxidized, coagulated and filtered wastewater that at all times has been disinfected to destroy or inactivate pathogenic organisms. A group of indicator microorganisms, coliform bacteria, are used to measure the effectiveness of the disinfection process. The Class “A” reclaimed water standard is a total coliform density of 2.2 Most Probable Number (MPN) per 100 milliliters (mL) for the median of the last 7 days of samples, with no sample having a density greater than 23 MPN per 100 mL.

The Class “A” reclaimed water standards are summarized in Table 2-3.

In addition to the above requirements, production of reclaimed water has rigorous treatment reliability, redundancy and alarm requirements.

Ecology has developed a draft Reclaimed Water Rule (WAC 173-219) to codify many of the provisions established in the *Water Reclamation and Reuse Standards*. Additionally, Ecology and WDOH have recently published a draft Reclaimed Water Facility Manual (Purple Book) for implementation guidance. Final issuance of the proposed WAC 173-219 is anticipated occur in February 2018.

TABLE 2-3 Summary of Class-A Reclaimed Water Standards[1]	
Parameter	**Value**
Monthly Average BOD5 (mg/L)	30
Weekly Average BOD5 (mg/L)	45
Monthly Average TSS (mg/L)	30
Weekly Average TSS (mg/L)	45
pH (S.U.)	6-9
Monthly Average Turbidity (NTU)	0.2
Daily Maximum Total Coliform Count (MPN/100 ml)	23
7-Day Geometric Mean Total Coliform Count (MPN/100 ml)	2.2

(1) Based on Washington State Draft Reclaimed Water Rule.

TRIBE CODES AND REGULATIONS

11.45 – GROUNDWATER PROTECTION

This Ordinance is administered by the Chehalis Tribe Department of Natural Resources. Pertinent sections of the code are summarized below:

- Section 11.45.050 Reservation Groundwater Protection: A person shall not adversely affect the quality and/or quantity of the groundwater of the Reservation by introduction of pollution or pollutants or otherwise.

- Section 11.45.060 Water Quality Standards: The water quality standards adopted pursuant to Title 7, Chapter 7, Surface Water Quality Stands, shall apply to groundwaters of the Reservation as well. In the absence of water quality standards adopted by the Director for the protection of drinking water, those set forth by the EPA, 40 C.F.R., shall apply.

- Section 11.45.070 Establishment of Sanitary Control Areas: Unless engineering justification supports a smaller area, the minimum sanitary control area around a public water supply well shall be a radius of 100 feet.

11.50 – SURFACE WATER QUALITY STANDARDS

The Tribe exercises its sovereignty and its rights as a "Tribe as State" and has its own Chehalis Tribe Surface Water Quality Standards. The Tribe is recognized by the USEPA as having completed the process of obtaining EPA's approval to be treated in a manner similar to a state (Tribe as State), and adopting standards for tribal waters that USEPA has approved. The Tribe was granted treatment as a Tribe as State on March 7, 1995, and the Tribe's water quality standards were approved on February 3, 1997. This Ordinance is administered by the Chehalis Tribe Department of Natural Resources and sets pollutant limits for various classifications of surface waters (Class AA, A, B and C). The water quality standards for these classes are summarized in Table 2-4.

TABLE 2-4 Summary of Chehalis Tribe Surface Water Quality Standards			
Water Quality Classification	**AA**	**A**	**B**
Fecal Coliform (Geometric Mean of Colony Count)	≤ 50/100 mL	≤ 100/100mL	≤ 200/100mL
Dissolved Oxygen	≥ 9.5 mg/L	≥ 8.0 mg/L	≥ 6.5 mg/L
Total Dissolved Gas (% Saturation)	≤ 110 %	≤ 110 %	≤ 110 %
Temperature	≤ 16 °C	≤ 18 °C	≤ 21 °C
pH	6.5-8.5	6.5-8.5	6.5-8.5
Turbidity	≤ 5 NTU	≤ 5 NTU	≤ 10 NTU

The general rule is that point discharges into a water body must:

1. Not cause the water body to exceed the limits described above.

2. Not degrade the existing quality of the water body within a prescribed range (see standards for details).

The Chehalis and Black Rivers, and Willamette Creek are all designated as Class A waters. The Chehalis Tribe Surface Water Quality Standards are included in Appendix A of this document.

CHAPTER 3

LAND USE, POPULATION PROJECTIONS AND SERVICE AREA CHARACTERISTICS

The *2003 Chehalis Reservation Comprehensive Land Use Plan*, the *2010 Master Facilities Plan Update*, the *2012 Community Assessment* and the *2014 Confederated Tribes of the Chehalis Reservation's Comprehensive Park and Recreation Plan* were used as the basis for the descriptions of land use and planning criteria included in this chapter.

Note: All of the figures for this chapter are from the Tribe's 2016 Draft General Sewer/Facility Plan and are included in Appendix B as a convenience to the reader.

PLANNING PERIOD

In order to provide wastewater services for future growth, the wastewater system is in need of continuous evaluation and improvement. A planning period for the evaluation of the wastewater utility should be long enough to be useful for an extended period of time, but not so long as to be impractical. The planning period for this *Preliminary Engineering Report* is 20-years, from 2017 through 2037.

STUDY AREA

This study is restricted to the main body of the Chehalis Reservation as shown on Figure 3-1. The study area lies at the southeast corner of Grays Harbor County and the southwest corner of Thurston County, approximately 26 miles southwest of Olympia and 6 miles northwest of Centralia. It is bounded on the south and west by the Chehalis River, on the east by Moon Road and lies generally south of U.S. Highway 12. The city of Oakville and the unincorporated community of Rochester are the Chehalis Reservation's nearest neighbors.

Housing in the study area is concentrated in areas above the 100-year flood plain, which covers approximately two-thirds of the Reservation and divides it into two (east and west) residential zones, as shown on Figure 3-2 and Figure 3-3. Figure 3-3 was generated from the Comprehensive Flood Hazard Management Plan referenced in Chapter 1 and is based on a study commissioned by the Tribe and is not based on FEMA standards.

There is currently no FEMA flood mapping for the Chehalis Reservation. Most of the housing in the study area is in the eastern zone, near the Tribal Government Complex, including the Tahown, Makum, Davis, and Fern housing developments. The western zone contains the Vosper and Oaks housing developments and the Starrville community. These housing developments are described further in Chapter 4. Housing built by individual land owners is interspersed with these developments in the east and west zones and is also scattered in areas below the flood plain. Based on 2010 census estimates, the Chehalis Reservation population is 649 individuals.

Commercial development in the study area includes the Tribal Government Complex, the End of the Trail II gas station and convenience store, Lucky Eagle Casino, the Eagles Landing hotel, Briarwood Chicken Farm, the Community Center, and the Wellness Center. All of these developments except for the chicken farm are owned and operated by the Tribe.

Within the study area, land is held both in fee and in trust. The owners of fee land and the beneficiaries of trust land have control of how the land is used, and thus, how it will be developed. The following description of these types of ownership is from the *Confederated Tribes of the Chehalis Reservation 2012 Community Assessment*.

Tribal Trust – Tribal trust land is held communally by the tribe and is managed by the tribal government. Tribal members share in the enjoyment of the entire property without laying claim to individual parcels.

Individual Trust Land – Allotted trust lands are held in trust for the use of individual tribal members (or their heirs). The Bureau of Indian Affairs holds the title, and the individual (or heirs) holds the beneficial interest. Because of the large number of owners, it is typically difficult to get a consensus on how individual trust properties can be developed.

Fee Land – Land whose title is held absolutely by the owner, without restriction, in the same way that lands are generally held throughout the United States. On the Chehalis Reservation, there are both tribal member and non-tribal members with fee land.

The distribution of tribal properties in the study is shown on Figure 3-4 using data provided by the Tribe's Department of Natural Resources.

SEWER SERVICE AREA

In the 2003 *Comprehensive Land Use Plan*, the Tribe has placed significant restrictions to the construction of residential or commercial sites outside of areas zoned for residential and commercial development. (The Plan has declared the reservation, as a whole, to be unsuitable for industrial development). Since sewer services are provided in support of residential and commercial sites, the sewer service area has been restricted to areas zoned for residential and commercial use.

Existing wastewater services in the sewer service area are provided by two different treatment methods: membrane bioreactor (MBR) wastewater treatment facilities (WWTF), and septic tanks with drainfields. There are three separate MBR WWTFs in the sewer service area: one serving the Davis Drive neighborhood, one serving the Tribal Complex, and and one serving the Lucky Eagle Casino. Wastewater in the Tahown neighborhood is treated by a community septic tank and drainfield. All other residential areas are served by individual septic tanks and drainfields. Detailed maps for each of these facilities are provided in Chapter 4.

NEARBY JURISDICTIONS

City of Oakville

The City of Oakville lies north of the study area, near the Vosper and Oaks neighborhoods. Oakville is served by individual on-site septic systems and drainfields, or alternative on-site sewage treatment technologies. No community-wide wastewater collection or treatment system is currently in place. Currently, there are no plans in place to discontinue use of individual on-site septic systems and drainfields, and alternative on-site sewage treatment technologies.

Rochester

Rochester is a census-designated place in Thurston County which lies 2 miles east of the study area on U.S. Highway 12. The Rochester community is served by individual on-site septic systems and drainfields, or alternative on-site sewage treatment technologies. No community-wide wastewater collection or treatment system is currently in place.

Currently, there are no plans in place to discontinue use of individual on-site septic systems and drainfields, and alternative on-site sewage treatment technologies.

Grand Mound

Grand Mound is a census-designated place located at the intersection of Interstate 5 and U.S. Highway 12, immediately southeast of Rochester. Thurston County owns and operates a sewage collection and treatment system that conveys all of the sewage from Grand Mound to a wastewater treatment facility which the County also owns and operates. The collection system includes two vacuum stations, one pump station, 6-inch to 8-inch diameter force mains, and 12-inch to 15-inch diameter gravity sewers. The Grand Mound Wastewater Treatment Plant treats sewage from residential, commercial, and industrial sources, with the Great Wolf Lodge producing 45 percent of the system's average daily flow. The Grand Mound WWTF consists of an extended aeration activated sludge system with one oxidation ditch, two secondary clarifiers, chlorine disinfection, and an outfall in the Chehalis River at river mile 59.17. The WWTF is permitted for a maximum monthly average daily flow of 380,000 gallons per day.

AGREEMENTS AND INTERTIES

The Tribe does not have any agreements or wastewater interties with the adjacent communities.

FUTURE LAND USE

RESIDENTIAL GROWTH

In order to create a reasonable projection of growth for the Tribe over the 20-year planning period, it is necessary to observe trends in development within the boundaries of the study area. Satellite imagery of the study area from 1990 and 2015 were compared to assess growth patterns. Through this process, three consistent trends were observed. These trends were used to make inferences about the patterns of future growth.

First, growth in low density residential areas has been relatively slow and has clustered around existing, higher density growth. In low density residential areas, only 16 new homes were built in the 25-year observation period. Seven of those were built on the streets immediately south of Oakville; 7 were in the Core Residential area, near Tahown or the Community Center. Only 2 new homes were built in low density residential areas away from existing development.

Second, most of the new construction took place in the form of new planned communities or additions to existing planned communities. At least 40 new units were built in this way: 13 in Mitchell and Merritt, 22 in Vosper, 5 in Davis. Of these, 18 units (45%) were built as multi-family housing.

Third, planned developments never displaced existing homes. While there were some instances of homes being removed or replaced by the owner, this never occurred as a result of parcels being purchased by the Tribe for the purpose of new developments.

The trends described above have been consistent over the last 25 years, and there are no signs that these trends will significantly change in the 20-year planning period. As such, the following assumptions have been made regarding the location and nature of future development:

- Existing homes will not be demolished or if so, they will be replaced by similarly sized homes. (All new growth takes place on open land).

- No low density residential zones outside of the Core Area or on the outskirts of Oakville will see any growth.
- In the Core Area and near Oakville, some low density residential parcels will be converted to medium density to reflect additional independent home construction.
- Existing planned housing areas will be fully developed to their zoned density[1].
- New planned communities will be developed in anticipation of new growth.
- Planned communities are most likely to be built on land already owned by the Tribe.

To obtain a realistic picture of population density in future growth projections, a study was performed of the existing population densities within the study area. The average number of persons per housing unit was estimated based on U.S. census data from 1990 to 2010. During this period, the Tribe averaged between 2.6 and 3.2 persons per housing unit, as reported in Table 3-1.

TABLE 3-1
U.S. Census Data for the
Confederated Tribes of the Chehalis Reservation

Year	Population	Percent Growth	Total Housing Units	Persons per Housing Unit
1980	405	-	N/A	N/A
1990	491	21%	181	2.7
2000	691	41%	215	3.2
2010	642	-7%	245	2.6

For the purposes of projecting future population growth, a value of 2.8 persons per housing unit will be used in this plan. This value reflects the size of the average housing unit over the past three census periods, as well as the ratio of occupied-to-total housing units.

To establish a number of housing units per acre, existing developments within the Reservation were analyzed based on their maximum number of planned units (i.e., “Units at Buildout”). These values are listed in Table 3-2, ranked from high to low in units per acre. The subdivisions fall mainly into two clusters: 3.4 to 4.5 units per acre, and 1.8 to 1.9 units per acre. These two clusters were labeled “high density” and “medium density,” respectively. It is worth noting that while Tahown and Makum are described as “high density” in the 2003 Comprehensive Plan, they are much closer in density to Vosper – which is described as medium density – than to Davis, Fern, or Oaks, which are the other high-density developments. Estimates of housing units per acre in low density residential areas were determined by counting current residential buildings in areas with low density zoning and dividing by the total area. The average housing unit density of low density areas was 0.06 housing units per acre.

For the purposes of projecting future population growth, medium and high-density developments will have 1.8 and 3.6 units per acre, respectively. These values are consistent with guidance from the Chehalis Planning Department that new developments will have lot sizes of either 1/2 or 1/4 acre, allowing 10 percent of space for streets and other utilities. These values are summarized in Table 3-3.

TABLE 3-2 Housing Unit Densities for Growth Projections		
Zoning Density	**Housing Units per Acre**	**Justification**
High	3.6	1/4 acre lots
Medium	1.8	1/2 acre lots
Low	0.06	Average density of existing low-density

2017 POPULATION ESTIMATE

The current population density of the study area is shown on Figure 3-5 and summarized in Table 3-4. A total population of 579 persons in the sewer service area was estimated using the values for persons per housing unit and housing units per acre described above. This value does not include persons living in the study area (the reservation) but outside the sewer service area (residential and commercial zones).

Likely locations for future housing developments were previously discussed with the Chehalis Tribes Planning Department. Using their guidance and the assumptions listed above, growth projections were developed for the years 2027 and 2037.

2027 POPULATION PROJECTION

Three areas are projected for additional development by 2027, as shown on Figure 3-6. First, the Oaks neighborhood is projected to grow to its full capacity. This neighborhood is projected for development because, although the land is not currently owned by the Tribe, the Housing Authority has expressed an interest in seeing the remaining properties developed. This development will convert 4.4 acres of low density housing into high density housing.

A second, new housing development is projected on tribally-owned land south of Vosper. This is a likely site for a new housing development because it is trust land with the Tribe listed as beneficiaries. This development will convert 31.6 acres from low density to medium density housing. However, only 50 percent of this housing is projected to be occupied by 2027. The northern-most parcel of tribally-owned land in this block has been omitted from the development scheme because it is already the site of several independently built homes. In keeping with the Tribe's tradition of respecting the development efforts of their members, we expect that these homes will be left in place to serve as a buffer between the new development and the wooded area to the north.

Third, a housing development for tribal elders is projected east of the Davis and Fern neighborhoods. This property currently has individual trust status, but is planned to be converted to tribal trust status in the near future.

Like the development in west part, the new housing development near Vosper? and the elder housing in the east are projected to achieve only 50 percent of its zoned density by 2027. The 2027 population projection is summarized in Table 3-4.

2037 POPULATION PROJECTION

By 2037, the two new housing developments anticipated to be at 50 percent capacity in 2027 are projected to reach full capacity. This is consistent with the growth rate observed in the recently developed Vosper neighborhood. Additionally, it is projected that two parcels immediately south of Oakville totaling 9.6

acres will reach medium density as new homes are gradually constructed. This is consistent with the pattern of low-density parcels gradually increasing in density along the fringes of population centers. These changes are shown on Figure 3-7, and the 2037 population projection is summarized in Table 3-4.

As discussed above, using the values of 2.8 persons per housing unit and the housing unit densities described in Table 3-3, the growth patterns shown in Figure 3-6 and Figure 3-7 were assigned population estimates, which are a summarized in Table 3-4 and shown graphically on Figure 3-8. The populations associated with the west and east residential areas are separated in Table 3-5. In this context, the west residential area refers to the area zoned residential immediately south of Oakville and the area divided by Balch Road; the east residential area refers to the Core Residential Area, near the Tribal Government Complex.

TABLE 3-3
Study Area Projected Populations in Planning Period

Residential Density	Persons per Unit	Units per Acre	2017 Population			2027 Population			2037 Population		
			Acres	Units	Population	Acres	Units	Population	Acres	Units	Population
High	2.8	3.6	23.4	84	236	27.8	100	280	27.8	100	280
Medium	2.8	1.8	46.9	84	237	97.0*	129	364*	106.6	192	537
Low	2.8	0.055	686.7	38	106	632.2	35	98	622.6	34	96
Total			757.0	206	579	757.0	264	742	757.0	326	913

* In 2027, 50 of the 97 acres are evaluated at 50 percent occupancy.

TABLE 3-4
Study Area Projected Populations, West and East

Residential Density	2017 Population		2027 Population		2037 Population	
	West	East	West	East	West	East
High	70	166	114	181	114	166
Medium	134	103	214	150	341	196
Low	55	51	50	46	48	48
Total	**259**	**320**	**378**	**364**	**503**	**410**

COMMERCIAL GROWTH

Historical trends for commercial growth are not readily available, making specific projections about future land use difficult. In lieu of specific areas of commercial expansion, this report assumes that commercial wastewater use will increase proportionally to increased residential use. However, rather than growing by occupying additional parcels of land, commercial growth will occur through increasing density in existing commercial areas.

WATER SYSTEM

The tribal water system is fed by two wells near the Tribal Government Complex and water is distributed through 4.1 miles of water mains to 99 service connections. Water is disinfected with chlorine and aerated prior to storage in two reservoirs totaling 816,295 gallons of storage (base to overflow). In the years between 2006 and 2014, total community water system production has averaged 27.7 million gallons per year. A comprehensive description of the water system is available in the Tribe's *Water System Evaluation Report for the Confederated Tribes of the Chehalis Reservation*.

SEWER SYSTEMS

Residences in the study area are serviced a by individual septic systems and drainfields, community septic systems and drainfields, or MBR WWTFs. This is true of the Oaks, Fern, Vosper Place, and Makum housing developments as well as Starville and all other houses and manufactured homes located outside of formal housing developments. The Davis and Tahown housing developments were both built with conventional gravity sewers leading to community septic tanks and drainfields. Since then, an MBR WWTF has been added to the Davis housing development.

The commercial and administrative buildings are serviced by a combination of individual septic systems and drainfields and MBR WWTFs. Most, although not all, buildings in the Tribal Government Complex area are serviced by a septic tank effluent pump (STEP) collection system and a MBR WWTF; the remainder are serviced by individual septic systems and drainfields. The Lucky Eagle Casino and Eagles Landing Hotel are both served by a septic tank effluent pump and gravity (STEP-STEG) collection system and an MBR WWTF. The End of the Trail II gas station and convenience store is serve by an individual septic system and drainfield.

These sewer systems are described in detail in Chapter 4.

NATURAL ENVIRONMENT

GEOGRAPHY AND CLIMATE

The Chehalis Reservation is located in the Chehalis River valley, at the point where the Black River flows into the Chehalis River, approximately 30 miles southwest of Olympia. These two rivers are fed by streams and wetlands which cover much of the 100-year flood plain, which are discussed under Site Sensitive Areas. The study area comprises 4,803 acres, 67 percent of which lies below the 100-year flood plain. The Chehalis River valley consists of a thick layer of sedimentary deposits which are well drained and support a substantial forested area. The Reservation land is very flat, with a high point 120 feet above mean sea level near the Core Residential Area and a low point of 70 feet above mean sea level where the Chehalis River flows northwest past Oakville.

The region has a temperate climate with warm, dry summers and mild, wet winters. The summers are fairly warm with daily high temperatures averaging 75 degrees F, exceeding 90 degrees F only a few days each year. The average daily temperature in the winter is 40 degrees F. The annual precipitation between 2011 and 2014 averaged 36 inches, with less than 2 inches total falling from June through August each year. Precipitation data gathered from the University of Washington’s Centralia Washington weather station is presented in Figure 3-9. The weather station is located at Latitude 46.720°N Longitude 122.953°W.

SOILS AND GEOLOGY

Soils in the study area consist of a deep series of flood and alluvial deposits from the Black and Chehalis Rivers. The USDA Natural Resource Conservation Service (NRCS) reports the dominant soil types on the reservation are Spanaway gravelly sandy loam, Chehalis silt loam, Newberg silt loam, and Cloquato silt loam. Together, these comprise 73 percent of soils in the Study Area.

Brief descriptions of these soils from the NRCS are provided below.

Spanaway – The Spanaway series consists of very deep, somewhat excessively drained soils that formed in glacial outwash. They are on terraces and plains. Slopes are typically between 0 to 15 percent.

Chehalis – The Chehalis series consists of very deep, well drained soils that formed in silty and loamy mixed alluvium. Chehalis soils are nearly level to undulating flood plains.

Newberg – The Newberg series consists of very deep, somewhat excessively drained soils that formed in loamy and sandy alluvium from sedimentary and basic igneous rocks. Newberg soils are on flood plains with slopes of 0 to 4 percent.

Cloquato – The Cloquato series consists of very deep, well drained soils formed in mixed alluvium. Cloquato soils are on flood plains at elevations of 30 to 800 feet. Slopes are 0 to 5 percent.

An aquifer evaluation prepared by David Evans and Associates in 1998 describes the stratigraphy of the study area. The deepest stratigraphic unit is consolidated bedrock of sedimentary and volcanic origin, lying over 1,000 feet below ground level. Above it, an unconsolidated unit consists of flood and alluvial deposits from the Black and Chehalis Rivers. This unit exhibits some cementation varying in thickness from between 10 and 50 feet, restricting groundwater flows. Below 50 feet, the silt and fine sands give way to coarser sand and gravel, which permit much greater hydraulic conductivity. This pattern of silty, sandy loams over a region of cemented gravel, followed by sandy gravel with less silt is supported in monitoring wells drilled in 2012 for a study by Golder Associates Inc.

The NRCS descriptions of these soils as being "well drained" or "excessively drained" indicate that, in spite of regions of cementation which inhibit groundwater flow near the surface, there are sufficient breaks in this region to permit drainage from the surface into the shallow aquifer. This theory is supported by observations in the 2012 Golder study that dissolved organic carbon concentrations in the groundwater point to aquifer recharge primarily by direct rainfall infiltration rather than by river through-flow.

SURFACE WATERS

The study area lies in the Upper Chehalis River watershed, identified by the Washington State Department of Ecology as Watershed Resource Inventory Area 23. The Chehalis River supports many species of salmonids, which are integral to the Tribe's traditional fishing practices. However, due to water quality degradation, the Upper Chehalis is subject to Total Maximum Daily Loads (TMDLs) for ammonia, 5-day biochemical oxygen demand (BOD-5), dissolved oxygen, fecal coliform, and temperature. The Chehalis Basin Partnership, of which the Tribe is an active member, has been working to improve water quality in these areas. However, these TMDLs may influence the limits approved under future surface water discharge permits for wastewater treatment facilities.

SITE SENSITIVE AREAS

The following section summarizes information regarding site-sensitive/critical areas within the sewer service area of the reservation. Site sensitive areas within the sewer service area include those classified as wetlands, seismic hazard areas, slide hazard areas, flood hazard areas, and water bodies.

SEISMIC HAZARD AREAS

Seismic hazard areas are those with low-density soils that are more likely to experience greater damage due to seismic-induced subsidence, liquefaction, or landslides. Seismic hazard areas are regulated mainly with respect to public safety, and with the exception of a severe earthquake, these hazard areas do not impact wastewater facilities. Most of the land in the study area is rated as moderate to high susceptibility to liquefaction. Only the area corresponding roughly with the western region above the 100-year flood plain is rated low susceptibility for liquefaction. Results of liquefaction include structures sinking into the ground, water rising up from the ground, and the formation of fissures in pavement.

Sources of seismic activity near the study area include the Olympia structure, 19.5 miles to the northeast, and the Cascadia subduction zone off the Pacific Coast. According to projections by the Washington State Department of Natural Resources (WDNR), a magnitude 5.7 earthquake along the Olympia structure fault line would be felt as a magnitude 3 earthquake in the study area, which would pose no threat to persons or property. WDNR projects that a subduction zone earthquake would be felt as magnitude 6.0 or higher in the study area, with a 49 to 64 percent chance of moderate or worse damage to wastewater treatment plants in the study area. Moderate damage is defined as, "malfunction of plant for about a week due to loss of electric power and backup power if any, extensive damage to various equipment, considerable damage to sedimentation basins, considerable damage to chlorination tanks with no loss of contents, or considerable damage to chemical tanks."

FLOOD HAZARD AREAS

Flood hazard areas are areas adjacent to lakes, rivers, and streams that are prone to flooding during peak runoff periods. Flood hazard areas deserve special attention due to the sensitive nature of their ecosystems as well as the potential for damage to structures located in the flood plain. The 100-year flood plain is shown on Figure 3-3.

SLIDE HAZARD AREAS

Slide hazards areas are those that are prone to unstable behavior due to steep slopes, lack of vegetation, or unconsolidated soils. The study area is situated in a river basin with very little elevation change, and therefore little chance of slides originating within the study area. However, the study area is bordered by steep slopes to the north and south which may become unstable and slide into the study area. This would likely result in temporarily damming the Chehalis River, shifting its flow and flooding the river valley upstream of the slide. The topography of the study area is shown on Figure 3-10.

WATER BODIES

Buffers zones of 300 feet and 150 feet extending from rivers and creeks, respectively, are classified as sensitive areas due to the variety of plants and animals that they support. These regions are shown on Figure 3-10.

WETLANDS

Wetlands are defined by the EPA as areas that are inundated for at least part of the year. Wetlands support valuable and complex ecosystems and consequently development is severely restricted if not prohibited in most wetlands. Wetland areas listed by Ecology in their 2011 Wetland Inventory are shown on Figure 3-11. All but a few of these areas lie in the 100-year flood plain.

CRITICAL AQUIFER RECHARGE AREAS

The Tribe uses groundwater from an unconfined shallow aquifer which flows generally northwest, as described in *Results of the Chehalis Reservation Groundwater Study*, prepared by Golder Associates in 2012. The Golder report states that the aquifer is "highly sensitive to activities occurring in the developed area of the study site" and recommends that "best-use land and wastewater management practices are particularly important in this area."

For the purposes of this report, critical aquifer recharge areas will be equivalent to the well-capture zones for the Tribe's water supply wells, which are identified in *Groundwater Modeling Report: Chehalis Reservation* by Pacific Groundwater Group (2003). These capture zones, reproduced from that report on Figure 3-12, extend due east from the supply wells. Golder described the captures zones extending southeast.

However, the Golder report appears to define its groundwater gradient by a close grouping of monitoring wells around the main Tribal Housing Well, and ignores the presence of neighboring wells that show the general east-west direction of flow along the Chehalis River Valley.

NITRATE CONTAMINATION

Nitrate contamination of groundwater within the Reservation is a critical issue for wastewater and drinking water planning. Nitrate is a common component of effluent from failing septic tanks. Nitrate levels above 10 mg/L-N in drinking water can cause serious illness or death for infants under the age of 6 months. A summary of key nitrate values from the 2012 Golder report is provided in Table 3-6. As shown in this table, while the average value of nitrate in the Tribe's water supply wells between 2009 and 2011 was slightly lower than the previous decade, it is still markedly higher than the monitoring wells farthest from wastewater drainfields (Wells 8 and 9).

TABLE 3-5
Summary of Nitrate Concentrations

Time of Study	**2009 – 2011[1]**		
Sample Location	**Average (mg/L-N)**	**Minimum (mg/L-N)**	**Maximum (mg/L-N)**
Supply Wells 1 and 2	4.1	3.4	4.7
Monitoring Well 8	1.0	0.9	1.2
Monitoring Well 9	0.8	0.7	1.0
Time of Study	**1996 – 2007[2]**		
Sample Location	Average (mg/L-N)	Minimum (mg/L-N)	Maximum (mg/L-N)
Supply Well 1	4.7	2.5	6.3

(1) Study performed by Golder Associates and published in *Results of the Chehalis Reservation Groundwater Study* (2012)
(2) Cited in *Results of the Chehalis Reservation Groundwater Study* (2012)

As the Tribe develops their wastewater treatment facilities, several approaches will help to minimize the presence of nitrate from wastewater in the water supply wells. First, new treatment facilities should be located such that effluent infiltration areas are well outside critical aquifer recharge areas. To the extent possible, septic tanks should be disconnected from drainfields currently within critical aquifer recharge areas and their effluent should be conveyed to a treatment facility outside of these areas, to provide a greater level of treatment. Second, any new treatment facilities should be designed for a high degree of denitrification. This will minimize the quantity of nitrate entering the groundwater. Third, the existing MBR treatment operations should be optimized to ensure a maximum level of denitrification.

FISH AND WILDLIFE HABITAT CONSERVATION AREAS

Sensitive fish and wildlife habitat is defined as areas which meet the definition of a "Fish and Wildlife Habitat Critical Area" pursuant to WAC 365-190-080(5) and is essential for maintaining specifically listed species in suitable habitats. As described previously, fish and wildlife habitat is of particular importance to the Tribe for cultural and financial reasons. In their *2003 Chehalis Reservation Comprehensive Land Use Plan*, the Tribe has established a forested zone as a means of protecting fish and wildlife within the Reservation, as shown on Figure 3-2.

CHAPTER 4

EXISTING FACILITIES

INTRODUCTION

This Chapter describes existing facilities that comprise the wastewater collection and treatment systems located within the study area. These facilities include force mains and gravity sewers, pump stations, septic systems, membrane bioreactor treatment facilities effluent drainfields and rapid infiltration basins.

Note: All of the figures in this chapter are from the Gray & Osborne General Sewer/Facility Plan and are included in Appendix C as a convenience to the reader.

There are currently nine separate collection and treatment systems within the reservation as listed below with a short summary of the collection and treatment systems for each. A detailed discussion of each system follows.

- <u>Fern Housing Development:</u> Individual septic tanks and drainfields.
- <u>Oaks Housing Development:</u> Individual septic tanks and drainfields.
- <u>Starrville Community:</u> Individual septic tanks and drainfields.
- <u>Tahown Housing Development:</u> Gravity sewer to community septic tanks and drainfield.
- <u>Makum Housing Development:</u> Individual septic tanks and drainfields.
- <u>Vosper Place Housing Development:</u> Individual septic tanks and drainfields.
- <u>Davis Housing Development:</u> Gravity sewer to community septic tanks which discharge to Petoie MBR WWTF.
- <u>Community Non-Residential Area (Tribal Government Complex, Wellness Center, Department of Natural Resources, Community Center, Public Safety Building):</u> Septic tank effluent pump collection system to Public Safety MBR WWTF.
- <u>Lucky Eagle Casino and Hotel:</u> Septic tank effluent pump collection system to Lucky Eagle Casino MBR WWTF.

Figure 4-1 provides the locations of sewer facilities within the reservation. Primarily, these systems are composed of septic tank and effluent drainfields designed to service individual lots or small local developments. Three areas, the Community Non-Residential Area, the Davis Housing Development and the Lucky Eagle Casino and Hotel utilize membrane bioreactors (MBRs) to provide treatment to septic tank effluent prior to discharging to drainfields.

In addition to the above areas, Valley Fresh Foods owns and operates a poultry farm on Private Fee land within the Reservation. Valley Fresh has been issued a Concentrated Animal Feeding Operation permit by the Tribe under Title 7 Chapter 9 of the Chehalis Tribal Code. It is the Tribe's understanding that the current practice of the poultry farm is to collect all poultry associated waste in a covered area and haul off-site for disposal.

Wastewater from the office is treated in an individual septic tank and discharged to an onsite drainfield. The poultry farm does not impact any of the tribally owned sewer collection or treatment facilities and has its own well for water production.

A discussion of the existing nine separate collection and treatment systems within the Reservation follows.

FERN HOUSING DEVELOPMENT

The Fern Housing Development was developed by the Chehalis Housing Authority (CHA) and is located to the south of the Davis Housing Development, west off of Niederman Road on Tribal Trust land zoned by the Tribe as residential. The neighborhood includes a total of 17 lots developed with 3- and 4-bedroom single family residences. Each lot has an individual septic system including septic tank, drainfield and reserve drainfield area. Drainfields were sized according to the number of bedrooms in the unit at 35 linear feet of drainfield trench for each bedroom. There are no known problems or deficiencies with the current drainfields serving the development. The Fern Housing Development is shown in Figure 4-2.

OAKS HOUSING DEVELOPMENT

The Oaks Housing Development was developed by the CHA and is located on Merritt Lane east of State Street South in the northwest corner of the reservation on Tribal Fee land zoned by the Tribe as residential. The development consists of ten lots, five of which are currently developed. Two of the developed lots contain duplex housing units. Double wide manufactured homes are located on the three other developed lots. There is no centralized conveyance or treatment facility for wastewater in the development. Each of the developed lots has an individual septic tank and onsite drainfield.

There are no known problems or deficiencies with the current drainfields serving the development.

STARRVILLE COMMUNITY

The Starrville Community is located west of the Vosper housing development on South Bank Road on Tribal Trust land zoned as residential by the Tribe. The community consists of six homes all with individual septic tanks and onsite drainfields to treat the wastewater generated within the community. There are no known issues with the current drainfields serving the properties within the Starrville community.

TAHOWN HOUSING DEVELOPMENT

The Tahown Housing Development was developed by the CHA and is located to on the southwest corner of the intersection of Anderson Road and Hawanut Road on Tribal Trust land zoned by the Tribe as residential. The neighborhood includes a total of 25 lots, 23 of which are developed with 3- and 4-bedroom, single-family dwellings. Additional dwellings are planned on the remaining two lots. All of the houses are connected to a gravity sewer system, which drains to two community septic tanks in series. The second septic tank is equipped with two submersible effluent pumps, which pump the septic tank effluent to a community drainfield. There are no known problems or deficiencies with the current drainfield. Sewer infrastructure for the Tahown development is shown in Figure 4-3.

MAKUM HOUSING DEVELOPMENT

The Makum housing development was developed by the CHA and is located on the southwest corner of the intersection of Anderson Road and Hawanut Road on Tribal Trust land zoned as residential by the Tribe. The neighborhood includes a total of 25 lots, 23 of which are developed with 3- and 4-bedroom, single-family dwellings. Additional dwellings are planned on the remaining two lots. Each of the developed lots has an individual septic tank and drainfield. There are no known problems or deficiencies with the current drainfields serving the development.

VOSPER PLACE HOUSING DEVELOPMENT

The Vosper Place Housing Development was developed by the CHA and is located on Sickman Loop off of Balch Road south of Oakville Road. The neighborhood includes a total of 22 lots, two of which are reserved, one for a drainfield and another for a proposed water reservoir. There are currently 13 lots developed, 12 of which are developed with 4-bedroom, single-family residences and the other is developed with two 5-plexes on the single lot. All lots are served by individual on-site septic tanks and drainfields with the exception of the lot containing the 5-plexes, which is served by a communal drainfield on the adjacent lot to the east. There are no known problems or deficiencies with the current drainfields serving this development. Sewer infrastructure for the Vosper development is shown in Figure 4-4.

DAVIS HOUSING DEVELOPMENT (PETOIE WWTF)

The Davis Housing Development was developed by the CHA and is located west of Niederman Road to the south of the Public Safety building on Tribal Trust land zoned as residential by the Tribe. The neighborhood includes a total of 32 housing units and the CHA offices. Wastewater from the housing units and CHA offices is collected in a gravity collection system, which drains to the Petoie MBR WWTF. The collection system and the WWTF are discussed in more detail below.

Collection System

The collection system for the Davis Housing Development was constructed with the housing development in 1982. Initially, a conventional gravity collection system conveyed wastewater from the original 32 housing units and a housing office to a community septic tank with an effluent overflow to two drainfields southwest of the septic tank. Since that time, five additional housing units (one single-family home and a block of four one-bedroom apartments) have been added to the collection system, and the treatment facilities have been upgraded as discussed below, but the collection system has not been significantly expanded.

The collection system currently consists of 1,143 feet of 8-inch diameter gravity sewer mains connected by seven manholes which drain to two community septic tanks, as shown in Figure 4-2. Septic tank effluent is pumped either to the WWTF or to the backup drainfield. Following treatment in the WWTF, the MBR effluent, known as permeate, is pumped to an effluent pump station, where it is pumped through 424 feet of 2-inch PVC pipe to two splitter valves which sequentially dose six 10 foot by 104 foot drainfields.

Collection System Planned Expansions

Expanding the Davis Housing Development collection system to include the properties of the Fern Housing Development has been of interest to the Tribe.

Funding has been requested through the Indian Health Services' Sanitation Tracking and Reporting System in the past but it is not likely to receive funding in the near future. The Fern Housing Development includes 17 properties, each with individual septic tanks and drainfields.

The development topography slopes gently downhill toward the MBR facility, making it a reasonable candidate for connection by gravity sewer lines. However, there are currently no specific plans for connecting the Fern Housing development to the Petoie WWTF.

PETOIE WASTEWATER TREATMENT FACILITY

Information provided in the following sections is from documents obtained from the Tribe and equipment manufacturers. The provided documents consisted of Operations and Maintenance manuals for the WWTF, partial as-built drawings for the collection system, manufacturer's proposals and proposed partial Scopes of Supply for the WWTF. No design or planning documentation was received for either the WWTF or the collection system. In 2016, Gray and Osborne conducted several site visits to supplement and verify the documentation in an attempt to provide a complete understanding of the operation and condition of the facilities; however, they were not able to verify all components of the systems; therefore, some equipment models, capacities and volumes are listed as unknown in the following tables.

History of Petoie Wastewater Treatment Facility

A series of septic drainfield failures at the Petoie WWTF site eventually led to the construction of the Petoie MBR WWTF. A detailed history of these drainfields is provided in two Indian Health Services documents: *Petoie Back-Up Drainfield Analysis for the Confederated Tribes of the Chehalis Reservation* (2014), and *Project Summary Sanitation Facilities for the Confederated Tribes of the Chehalis Reservation, IHS Project PO-04-J98* (2004). A summary of these documents is presented here.

When the Petoie treatment facilities were first constructed in 1982, a single 9,000-gallon septic tank received wastewater from the collection system and the effluent flowed by gravity to a drainfield 8 feet below the surface. This drainfield failed in the late 1980s, likely due to its extreme depth and has been abandoned. A second drainfield was constructed nearby, but the funding for it was partially diverted to other projects. The resulting drainfield was too small and it failed within a year and has also been abandoned. In 1997, a third drainfield was constructed east of the septic tank, and a second, 10,000-gallon septic tank was added to provide additional pretreatment and solids storage capacity. This drainfield began to fail by 2001 due to organic over-loading. However, it is currently being used as the backup drainfield for the MBR facility. The MBR WWTF was constructed in 2006 to treat the septic tank effluent before discharging it to a fourth drainfield west of the treatment facility. The drainfield was designed for a hydraulic loading of between 1.5 gallons/ft^2-day and 3.8 gallons/ft^2-day. This drainfield is still in operation, while the failed drainfield to the east is still used as a backup septic tank drainfield for periods when the MBR is out of operation.

UIC Injection Well Inventory Facility Number

The UIC facility identification number for the WWTF is WA105T-97-11088.

Petoie WWTF Building

The WWTF building contains the MBR tank, equipment pad, electrical panel, transformer, and control panel, as well as a gantry crane. The control panel contains the equipment motor starters and a PLC to control the process equipment. The building has a wooden frame with sheet metal exterior on a concrete pad. The structure is generally in good condition with no obvious rot or rust. The layout of the building is shown in Figure 4-5.

Description of Process Flow

Figures 4-5 and 4-6 show the facility layout and process schematic for the MBR, respectively. Raw wastewater flows from the housing units through the collection system to the two septic tanks in series. In the second septic tank, the wastewater flows by gravity through a fine-screen filter and into an equalization basin/pump station. Septic tank effluent is pumped from the equalization basin/pump station into either the WWTF or the "backup" septic drainfield by dedicated submersible pumps. The WWTF consists of a single 16,500-gallon tank with concrete baffle walls partitioning the tank into three sections; the Anoxic Basin, the Pre-Aeration Basin and the MBR Basin. Septic tank effluent is first pumped to the anoxic basin. In the anoxic basin, the septic effluent combines with an activated sludge recycle stream returning from the MBR basin. Activated sludge from the anoxic basin is pumped by air-lift pumps to the Pre-Aeration Basin, where it flows by gravity through the MBR Basin and back to the Anoxic Basin. The recycle pump discharge is periodically diverted to an aerated waste activated sludge (WAS) storage basin, which is periodically emptied by a vacuum truck and taken for additional treatment at another location by a contracted sludge hauler. Permeate is pumped by two permeate pumps from the membranes in the MBR Basin to an effluent pump basin where it is pumped by two effluent pumps to the effluent drainfield. Final effluent is not disinfected. Individual components of the treatment system are discussed in more detail below.

The WWTF does not have any means to provide backup power to the plant in the event of a utility power failure.

Septic Tanks

Two septic tanks, operating in series, provide screening and primary treatment for the MBR facility. Solids which readily float or sink are trapped in the tanks and must be periodically emptied by a vacuum truck. Having the tanks arranged in series provides a backup in the event that the first tank becomes overly full of solids. The second tank contains a vertical baffle separating the 10,000-gallon tank into sections of approximately 6,700 gallons for additional septic treatment and 3,300 gallons for equalization and pumping. Between the two sections of the 10,000-gallon tank, the septage is screened by an Orenco Biotube. Screened septic effluent is pumped from the second septic tank into the anoxic basin of the MBR tank by a single influent pump, unless the liquid level in the MBR is too high or the MBR is out of service. In these cases, the screened effluent is pumped by a single septic drainfield pump to a backup septic drainfield. Petoie septic tank design criteria is included in Table 4-1.

TABLE 4-1 Petoie Septic Tank Design Criteria	
Parameter	**Value**
Septic Tank 1	
Total Volume	9,000 gal
Number of Chambers	1
Septic Tank 2	
Total Volume	10,000 gal
Number of Chambers	2
Septic Volume	6,700 gal
Equalization Volume	3,300 gal
Filter	
Make and Model	Orenco Biotube, Unknown Model
Pore size	1/8-inch
Septic Drainfield Pump	
Quantity	1
Make and Model	Orenco PF500512
Capacity	50 gpm
Motor	½ hp, 240V, 1 Phase
Type	High Head Submersible Effluent Pump
MBR Tank Influent Pump	
Quantity	1
Make and Model	Orenco PF500512
Capacity	50 gpm
Motor	½ hp, 240V, 1 Phase
Type	High Head Submersible Effluent Pump

MBR Treatment Tank

The MBR tank provides all aspects of secondary treatment, biological nutrient removal, and solids filtration in the Petoie WWTF. The MBR tank consists of a single concrete tank partitioned into three separate basins, the Anoxic Basin, the Pre-Aeration Basin and the MBR basin using 6-inch concrete baffle walls. The total MBR tank volume is 16,500 gallons. The design of the plant was based on the following septic tank effluent flows and loadings.

TABLE 4-2
Petoie MBR Design Flows and Loadings [1]

Parameter	Value
Flow	
Maximum Month Flow (MMF)	15,000 gpd
Peak Day Flow	30,000 gpd
Peak Instantaneous Flow	37,500 gpd
Max Duration of Peak Instantaneous Flow	6 hrs
Loading	
BOD	300 mg/L @ MMF
TSS	300 mg/L @ MMF
TKN	40 mg/L @ MMF
NO_3	0 mg/L
Effluent	
BOD	< 5 mg/L
TSS	< 5 mg/L
TKN	< 3 mg/L
TN	< 10 mg/L
Fecal Coliform	Non-Detect

(1) Enviroquip MBR Final Proposal, May 2006.

Anoxic Basin

Septic tank effluent is pumped to the first step of the MBR treatment facility, the Anoxic Basin. In the anoxic basin, the septic tank effluent is mixed with a recycle stream of nitrified wastewater, which is pumped by submersible "feed forward" Recycle Pumps to the Pre-Aeration Basin, where it flows by gravity through the MBR Basin back to the anoxic basin.

The anoxic basin contains a submersible mixer to combine the nitrate-rich recycle stream returning by gravity from the MBR Basin with the BOD-rich septic effluent, creating an environment for denitrification (converting nitrate to nitrogen gas). Level floats in the tank control the permeate pumps located in the MBR basin. The pumps are controlled based on signals from four level float switches that the plant's Programmable Logic Controller (PLC) uses to start/stop the permeate pumps. The design criteria for the Anoxic Basin is provided in Table 4-3.

TABLE 4-3
Petoie Anoxic Basin Design Criteria

Parameter	Value
Anoxic Basin	
Tank Volume	2,500 gal
Dimensions	4'-0" x 8'-4" (LxW)
Side Water Depth(1)	10 ft.
Mixer	
Number of Mixers	1
Make and Model	ABS - RW-3021
Capacity	2,400 gpm
Motor	1/2 hp, 460 V, 3 Phase
Recycle Pumps	
Quantity	2
Type	Submersible Centrifugal Pump
Model	Unknown
Capacity	Unknown
Control	Level Float Switch
Instrumentation	
Influent Flow Meter	Master Meter - Impeller
Automatic Influent Sampler	None
Automatic Effluent Sampler	None

(1) Assumes 2-foot freeboard in tank.

Pre-Aeration Basin

From the Anoxic Basin, the activated sludge mixed liquor is pumped via the feed forward pumps to the Pre-Aeration Basin. Two side channel vacuum pump blowers feed air through a fine bubble diffuser to provide oxygen to aerobic bacteria in the activated sludge. Air flow to the basin is controlled via manually operated valves on the air lines. The aerobic bacteria in the Pre-Aeration Basin nitrify ammonia (convert it to nitrate) and consume most of the remaining BOD in the Pre-Aeration Basin. The basin is equipped with a sensor/transmitter monitoring temperature and dissolved oxygen in the basin. Design criteria for the Pre-Aeration Basin is provided in Table 4-4, below.

TABLE 4-4
Petoie Pre-Aeration Basin Design Criteria

Parameter	Value
Preaeration Basin	
Tank Volume	2,500 gal
Dimensions	4'-0" x 8'-4" (LxW)
Side Water Depth(1)	10 ft.
Diffusers	
Type	Fine Bubble
Make and Model	EDI Flex Air
Blowers	
Number of Blowers	2 (1 air scour, 1 aeration)
Type	Side Channel Vacuum Pump
Make and Model	Gardner Denver (Rietschle) SAH 95
Motor	2 hp, 230V, 3 Phase, 60 Hz
Blower Capacity	44 cfm @ 108 in. water
Instrumentation	
Dissolved Oxygen/Temperature	Danfoss – Oxy 4100

(1) Assumes 2-foot freeboard in tank.

MBR Basin

From the Pre-Aeration Basin, the activated sludge flows through an opening in the partition wall into the MBR Basin. The MBR Basin is equipped with two cassettes of Kubota flat plate membranes. Coarse bubble air diffusers are mounted below each cassette to scour the membrane plates during operation. These diffusers are periodically cleaned by automatically opening a motor-operated valve to draw fluid into the air openings and discharge the fluid back in the MBR Basin. Two permeates pumps draw filtered effluent permeate through the membranes, out of the MBR tank, and into an effluent wet well to be stored until it is applied to the drainfields. Permeate flow rate is regulated via a motorized valve on the discharge of the permeate pumps. An effluent flow meter and a turbidity meter are also provided on the discharge line from the permeate pumps. A chemical dosing tank is configured to clean the membranes when they experience excessive fouling. Design criteria for the MBR Basin is provided in Table 4-5.

TABLE 4-5 Petoie MBR Basin Design Criteria	
Parameter	**Value**
MBR Basin	
Tank Volume	4,000 gal
Dimensions	7'-8" x 8'-4" (LxW)
Side Water Depth	8'-6"
MBR Blowers	
Quantity	2
Make/Model	Rietschle SH BS-155-000-D (A)
Motor	5 hp, 230V, 3 Phase, 60 Hz
Blower Capacity	88 cfm @ 90 in. water
Permeate Pumps	
Quantity	2
Model	AMT 1626-309-00
Motor	1.0 hp, 230V, 3 Phase, 60 Hz
Capacity	25 gpm
Control	Float Switch (Anoxic Basin)
Membrane Filters	
No of Units	2
Cassettes per Unit	75
Make and Model	Kubota, Model No. ES 75
Effective Membrane Area	8.6 ft^2 per Cassette, 1,290 ft^2 Total
Membrane Flux @ MMF[1]	11.6 gallons/ft^2/day
Membrane Flux @ PDF[1]	23.3 gallons/ft^2/day
Type	Submerged Plate
Instrumentation	
Effluent Flow Meter	Endress Hauser - Promag 50
Turbidity Meter	Hach 1720 E Low Range

(1) Membrane Flux is calculated from design flow/effective membrane area. The Operations and Maintenance Manual provided by Enviroquip for the Petoie WWTF lists the "Approximate Design Flux" as 14.7 gallons/ft^2/day (gpd/sf) @ 15 degrees C and the "Nominal Peak Capacity" as 29.4 - 36.7 gpd/sf @ 15 degrees C. However, since design temperatures for the Petoie WWTF range from 10 to 20 degrees C, flux rates should be evaluated at 10 degrees C. Manufacturers currently recommend MMF and PDF flux rates of 13.5 and 18.2 gpd/sf, respectively, at 10 degrees C.

WAS Storage Tank

The Waste Activated Sludge (WAS) Storage Tank stores wasted activated sludge, which is transferred from the Anoxic Basin by the Recycle Pumps. The tank contains coarse bubble air diffusers to provide aeration and mixing. The WAS Storage Tank is a precast concrete vault with a capacity of 3,500 gallons. The MBR Blowers provide air to the WAS tank coarse bubble diffusion system. The operators do not use the WAS storage tank. Waste solids are removed from the system periodically by pumping directly from the MBR Basin to a sludge hauler for disposal offsite.

Effluent Pump Station

Permeate is discharged by the permeate pumps to the effluent pump station, which is a precast concrete vault with a capacity of 3,500 gallons. The effluent pump station contains two float-actuated submersible pumps. Each effluent pump conveys permeate to a mechanically operated distribution valve, which distributes flow between the three beds of the drainfield. Each distribution valve directs all of its incoming flow to one bed at a time, changing to a new bed each time the pumps turn on. The effluent pump station and distribution valves are summarized in Table 4-6.

TABLE 4-6
Effluent Pump Station and Distribution Valves

Parameter	Value
Effluent Pump Station	
Tank Volume	3,500 gallons
Quantity of Pumps	2
Manufacturer and Model	Manufacturer: Geyser, Model: Not Available
Design Capacity	60 gpm
Motor	3/4 hp, 230 V, 60 Hz, 3 phase
Distribution Valve Assembly	
Number of Valves	2
Beds per Valve	3
Make and Model	Orenco V6606A
Type	Automatic Distributing Valve

Effluent Drainfield

The WWTF effluent drainfield consists of a set of six beds, each 10 feet wide by 104 feet long with an overall depth of approximately 4 feet, as shown previously on Figure 4-2. Each bed contains four laterals running the length of the bed. Figure 4-7, taken from the Petoie MBR Sanitation Facilities As-Built, shows the profile for a typical bed in this drainfield (Ayres & Associates, 2008). Each lateral terminates in a blowout valve and was pressure tested at 2.2 psi at startup.

The design capacity of the 6,240 ft^2 effluent drainfield is listed at 15,000 gpd in a draft report by the Indian Health Service (2006), which implies an infiltration rate of 2.4 gallons per square foot per day (gpd/ft^2) at MMADF and 4.8 gpd/ ft^2 at PDF (30,000 gpd). Test pits dug in this area by the IHS in 2004 showed coarse sand mixed with volcanic ash going to a depth of up to than 43 inches, followed by clean coarse sand extending beyond 72 inches. This is consistent with the typical soil profile of this area given by the NRCS, which describes the top 16 inches of soil being "gravelly sandy loam," followed by "extremely gravelly sand." The soils types described herein are consistent with Soils Types 1 and 2, which Ecology prescribes a maximum hydraulic loading rate for septic tank effluent of 1.0 gpd/ft^2 for properly constructed drainfields (WAC 246-272B-03400).

For on-site treatment systems with a design flow above 14,500 gpd, WAC 246-272B-06350 of the same code allows a hydraulic loading rate of up to 2 times the rate listed above for facilities discharging a high-quality effluent, such as MBR facilities. The maximum design hydraulic capacity of the drainfield should therefore be 2 gpd/ft^2 per the WAC guidelines. The actual design capacity therefore exceeds WAC guidelines. The actual design capacity may be sufficient for the soils present, but this should be confirmed by groundwater monitoring and accurate effluent flow monitoring.

Design criteria for the Petoie effluent drainfield is provided in Table 4-7.

TABLE 4-7
Petoie WWTF Effluent Drainfield

Parameter	Value
Force Main	
Diameter	2 in.
Material	PVC
Pressure Laterals	
Diameter	1-1/4 in.
Hole Size	Not Available
Hole Spacing	Not Available
Inspection Ports	
Number per Bed	Not Available
Diameter	Not Available
Distribution Valves	
Number of Valves	2
Beds per Valve	3
Make and Model	Orenco V6606A
Type	Mechanical Distribution Valve
Flow Range	15 – 100 gpm
Effluent Drainfield Beds	
Number of Beds	6
Length per Bed x Width Per Bed	104 ft.x 10 ft.
Space between Beds	10 ft.
Number of Pressure Laterals per Bed	4
Space between Pressure Laterals	2.5 ft.
Total Lateral Length	2,496 ft.
Effective Drainfield Area	6,240 ft^2
Loading Rate @ MMADF & PDF	2.4 gpd/ft^2 & 4.8 gpd/ft^2

Backup Drainfield

The drainfield to the east of the MBR facility is used as a backup in the event that the operator decides to bypass the WWTF for maintenance. The location of the drainfield is shown on Figure 4-2.

Septic tank effluent is conveyed to the drainfield under pressure by the septic drainfield pump located in the influent equalization basin. A mechanical distribution valve cycles flow among the three beds of the drainfield. Each bed consists of seven pressure laterals, each covered by a gravelless infiltration chamber and terminating in a pressure blowoff valve. Design criteria are listed in Table 4-8.

Portions of this drainfield failed due to organic over-loading in 2001 as described in a report titled *"Project Summary - Sanitation Facilities for the Confederated Tribes of the Chehalis Reservation"* (IHS 2004). The report states that septic effluent was observed on the surface of the drainfield and in a road side drainage ditch. The extent of failure is unknown, although in the 2004 report, IHS estimated that less than half the area of the drainfield was actually infiltrating into the soil. This document reports that the Tribe constructed 1,100 feet of new trenches in this drainfield to replace one of the three infiltration beds, but no documentation has been found to show where this took place. As discussed previously, based on the soil Types 1 and 2 which are consistent with the documented soils on site, Ecology prescribes a maximum hydraulic loading rate for septic tank effluent of gpd/ft^2 for properly constructed drainfields (WAC 246-272B-03400). Table 4-8 shows that the design infiltration rate (2.12 gpd/ft^2) is higher than that prescribed in the WAC.

TABLE 4-8 Backup Drainfield Design Criteria	
Parameter	**Val**
Force Main	
Diameter	3 in.
Material	PVC
Pressure Laterals	
Diameter	1½ in.
Hole Size	3/32 in.
Hole Spacing	2 ft.
Inspection Ports	
Number per Bed	3
Diameter	4 in.
Distribution Valve Assembly	
Number of Valve Assemblies	1
Beds per Valve Assembly	3
Make and Model	Orenco V6403A
Type	Mechanical Distribution Valve
Flow Range	15 – 100 gpm
Drainfield Beds	
Number of Beds	3
Length per Bed	112.5 ft.
Width per Bed	45 ft.
Number of Laterals per Bed	7
Infiltration Chamber Width	3 ft.
Space between Laterals	6 ft., O.C.
Total Lateral Length	2,360 ft.
Parameter	**Val**
Drainfield Beds	
Number of Beds	3
Length per Bed	112.5 ft.
Width per Bed	45 ft.
Number of Laterals per Bed	7
Infiltration Chamber Width	3 ft.
Space between Laterals	6 ft., O.C.
Total Lateral Length	2,360 ft.
Total Drainfield Area	7,080 ft^2
Loading Rate @ MMADF (15,000 gpd)	2.12 gpd/ft^2

COMMUNITY NON-RESIDENTIAL AREA

The Community Non-Residential Area (CNA) consists of the following developments:

- Tribal Government Complex, including Tribal Administration Offices, Family Services Center, Day Care/Elder Care Center and Youth Center.
- Wellness Center.
- Department of Natural Resources Building.
- Public Safety Building.
- Community Center.

Information provided in the following sections is from documents obtained from the Tribe and equipment manufacturers. The provided documents consisted of partial as-built drawings for the collection system, manufacturer's proposals and proposed partial Scopes of Supply for the WWTF. No design or planning documentation was received for either the WWTF or the collection system. In 2016, Gray and Osborne conducted numerous site visits to supplement and verify the documentation in an attempt to provide a complete understanding of the operations and condition of the facilities; however, they were not able to verify all components of the systems; therefore, some equipment models, capacities and volumes are listed as unknown in the following tables.

Wastewater from most of the facilities within these developments is collected in septic tanks and the septic tank effluent is pumped to the Public Safety MBR WWTF. Some of the buildings have not been connected to the collection system and are currently served by individual septic tanks and drainfields. The collection systems and WWTF are discussed in further detail below.

COLLECTION SYSTEMS

Prior to Construction of the Public Safety WWTF in 2005, all of the existing facilities now served by the Public Safety WWTF relied on individual septic tanks and drainfields for the treatment and disposal of their wastewater. Upon completion of the WWFT, collection systems, owned and operated by the Tribe, were installed at the Tribal Government Complex, Public Safety Building, Wellness Center and Community Center, to take septic tank effluent from these locations to the treatment facility. Figure 4-8 shows the approximate location of the septic tanks and the routing of the collection system force mains. The individual septic systems and force mains for each connection is described below.

Community Center Septic Tank and Effluent Pump Station

Wastewater from the Community Center flows by gravity in 4-inch pipe to a 1,500-gallon septic tank located at the northwest corner of the property. Solids are settled out in the septic tank and the effluent is pumped through a 1-1/2-inch PVC force main to the 3,500-gallon septic tank serving the Public Safety building, as shown in Figure 4-8. The Community Center septic tank and effluent pump station design criteria are provided in Table 4-9.

TABLE 4-9 Community Center Septic Tank and Effluent Pump Station Design Criteria	
Parameter	**Value**
Septic Tank	
Number of Tanks	1
Total Volume	1,500 gallons
Number of Chambers	1
Septic Effluent Pump	
Number of Pumps	2
Make and Model	Goulds Submersible Model 3885
Motor	1-1/2 hp, 120 V, 3-phase
Type	High Head Submersible Effluent
Force Main	
Size	2 in.
Length	1,400 linear feet
Material	PVC

Public Safety Septic Tank and Effluent Pump Station

Wastewater from the Public safety building flows by gravity in an 8-inch pipe to a 3,500-gallon septic tank located northeast of the Public Safety Building as shown in Figure 4-8. In addition to the wastewater collected from the Public Safety Building, septic tank effluent pumped from the Community Center is also discharged into the Public Safety Building septic tank. Solids are settled out in the septic tank and the effluent is pumped through a 1-1/2-inch PVC force main to the Public Safety MBR Treatment Facility. The Public Safety Building septic tank and effluent pump station design criteria is provided in Table 4-10.

TABLE 4-10 Public Safety Building Septic Tank and Effluent Pump Station Design Criteria	
Parameter	**Value**
Septic Tank	
Number of Tanks	2
Total Volume	7,000 gallons
Screen	
Make and Model	Orenco ES2460 Effluent Screen
Diameter	24 in.
Capacity	50 gpm
Screen Opening	1/8 in.
Septic Effluent Pump	
Make and Model	Hydromatic SKHD150
Motor	1-1/2 hp, 230 V, 3 Phase
Type	High Head Submersible Effluent
Force Main	
Size	1-1/2 in.
Length	1,100 LF
Material	PVC

Tribal Government Complex Septic Tank and Effluent Pump Station

Wastewater from the Tribal Government Complex flows in 6-inch sewer pipes to a septic tank system located to the west of the Daycare/Elder Center. Solids are settled out in two septic tanks operating in series and septic tank effluent is pumped from a third tank to the WWTF septic tank/equalization basin. Connections are made to the septic tanks from the Daycare/Elders building, Health Clinic and Family Services Building and the Administration Building. The Youth Center and the Public Safety Offices and Natural Resources Offices are not currently connected to the WWTF and are served by individual septic tank/drainfield collection and treatment systems. Prior to the construction of the WWTF the effluent from the septic tanks serving the Daycare/Elder Center, Health Clinic and Family Services Center and Administration building was discharged to a drainfield west of the baseball diamond between the diamond and the Daycare/Elder Center.

Following the construction of the WWTF the septic tank effluent force main was extended around the south side of the baseball diamond and east to Niederman Road where it connects to the 1½-inch septic tank effluent force main from the Public Safety Building. The Tribal Government Complex septic tank and effluent pump station design criteria is provided in Table 4-11. The store and the office building located on the northeast side of the government complex are each served by an individual septic tank with a dedicated septic tank effluent pump as shown in Figure 4-8. No information is available on the design of these two septic tanks and associated pumps.

TABLE 4-11
Tribal Government Complex Septic Tank and Effluent Pump Station Design Criteria

Parameter	Value
Septic Tanks	
Number of Tanks	3
Total Volume	3,600 gallons
Number of Chambers	1 per tank
Septic Effluent Pump	
Number of Pumps	2
Make and Model	Hydromatic SP50
Motor	Unknown
Type	High Head Submersible Effluent
Wet Well Volume	1,500 gallons
Force Main	
Size	1-1/2 inch
Length	950 LF
Material	Unknown

Wellness Center Septic Tank and Effluent Pump Station

Wastewater from the Wellness Center flows by gravity in 4-inch sewer pipe to the Wellness Center septic tank located to the north of the MBR building. The septic tank consists of two chambers in series. Solids are settled out in the first chamber and the effluent is pumped to the WWTF from the second chamber. A single, float controlled, submersible pump draws the effluent through a filter and pumps through a 3-inch PVC force main to the WWTF equalization basin. The Wellness Center septic tank and effluent pump station design criteria is provided in Table 4-12.

TABLE 4-12 Wellness Center Septic Tank and Effluent Pump Station Design Criteria	
Parameter	**Value**
Septic Tank	
Volume	Unknown
Number of Chambers	2
Septic Effluent Pump	
Number of Pumps	1
Make and Model	Orenco-P Series
Motor	Unknown
Type	High Head Submersible Effluent
Control	Float Switch
Filter	
Make and Model	Orenco Biotube
Mesh Opening	1/8 in.
Material	PVC

PUBLIC SAFETY WASTEWATER TREATMENT FACILITY

History of Public Safety Wastewater Treatment Facility

Prior to 2006 when the MBR facility was brought on-line all facilities currently served by the Public Safety MBR treatment facility utilized individual septic tanks and drainfields for the treatment and disposal of the wastewater. The plant was originally designed to treat an annual average flow 6,000 gpd using a single membrane cassette to treat septic tank effluent from the Community Center, Public Safety Building and Tribal Government Complex. Following the completion of the Wellness Center, a second membrane cassette was added to the existing tanks doubling the treatment capacity to 12,000 gpd. The design criteria for this plant are provided in Table 4-13.

TABLE 4-13 Public Safety WWTF Design Criteria					
Parameter	**Influent**		**Effluent**		**MBR Effluent**
Average Daily Flow	12,000	gpd			
Peak Daily Flow	12,000	gpd			
BOD	22	lb/day	5	mg/L	<5 mg/L
TSS	22	lb/day	5	mg/L	<5 mg/L
TKN	4	lb/day	10	mg/L	<10 mg/L
NO3-N	1	lb/day	10	mg/L	<10 mg/L
TP	0.8	lb/day	5	mg/L	<5 mg/L
Wastewater Temp.	10 to 20	°C	---	---	---

Source: Enviroquip Design Document (October 15, 2004)

UIC Injection Well Inventory Facility Number

The UIC facility identification number for the WWTF is WA105T-97-11090.

Description of Process Flow

Figures 4-9 and 4-10 provide a facility layout and process flow schematic for the Public Safety WWTF, respectively. Septic tank effluent is pumped from the septic tanks at the Tribal Government Complex, Public Safety building, Wellness Center and Community Center to a 1,500-gallon septic tank to the southeast of the MBR building. A level float in the tank shuts off the upstream pump stations at high water level. Effluent from the 1,500-gallon tank flows by gravity through a filter to a series of two 4,000-gallon equalization tanks and is pumped by a single equalization pump to the MBR anoxic basin. If necessary, when the MBR system is down for repair or maintenance, the influent septic tank effluent wastewater can be diverted directly to the drainfield pump station wet well by manually operating valves on the equalization pump discharge line. In the anoxic basin, the septic effluent is combined with an activated sludge stream that is recycled to the anoxic basin from the MBR basin by gravity to create a mixed liquor. From the anoxic tank, the mixed liquor is pumped by a feed forward pump to the pre-aeration basin and flows by gravity through the MBR tank back to the anoxic basin. Pre-aeration basin air is provided by two side channel vacuum pump blowers. Air is distributed to the tank by coarse bubble air diffusers. In the MBR basin, final effluent is filtered through the membrane filtration system using permeate pumps and pumped to the effluent pump station. Final effluent from the plant is not disinfected. Individual components of the treatment system are discussed in more detail below.

A 50 kW diesel fueled standby generator with automatic transfer switch located west of the MBR building provides emergency power to the WWTF in the event of a utility power failure.

Influent Septic Tank and Equalization Tanks

The influent septic tank effluent force mains enter the WWTF via three separate tanks placed in series. Effluent from the Tribal Government Complex, Public Safety Building Community Center and Wellness Center are pumped through a 1-1/2-inch PVC force main to a 1,500-gallon, two-chamber, septic tank. Additional solids are settled out in the first chamber of this tank. Effluent is filtered in the second chamber of the tank prior to flowing by gravity to two 4,000-gallon equalization tanks in series. A single high head submersible equalization pump is used to pump the septic tank effluent from the second equalization tank to the MBR Anoxic Basin. Valves on the discharge line from the equalization pump allow the MBR to be bypassed, discharging the septic tank effluent directly to the drainfield pump station wet well. Periodic cleaning of the equalization/septic tanks is required to remove solids that have settled out in the various tanks. Valves allow the operators to isolate either of the equalization basins for cleaning. When the second equalization basin is cleaned, effluent is not pumped to the MBR and the first equalization basin must provide sufficient storage time to allow for the cleaning.

Pumps at the individual septic tank locations that pump to the WWTF can also be closed to allow additional time to clean the tanks. Table 4-14 provides the design criterial for the equalization basin/septic tank effluent pump station.

TABLE 4-14 Public Safety Septic Tank/Equalization Basins Design	
Parameter	**Value**
Septic Tank	
Volume	1,500 gal
Number of Chambers	2
Filter Make and Model	Orenco FT1554-36
Diameter	2 in.
Screen Pore Size	1/8 in.
Equalization Tank 1	
Volume	4,000 gal
Number of Chambers	1
Equalization Tank 2	
Volume	4,000 gal
Number of Chambers	1
Equalization Pump	
Number of Pumps	1
Make and Model	Hydromatic SPD100H
Motor	1 hp, 208 V, 3 Phase
Type	High Head Submersible Effluent

WWTF Building

The WWTF building contains the MBR tank, equipment pad, electrical panel, and control panel. The control panel contains the equipment motor starters and a PLC to control the process equipment. The building has a metal frame with sheet metal exterior on a concrete pad. A manual trolley hoist and beam is mounted to the existing building framing. The structure is generally in good condition with no obvious rust.

MBR Treatment Tank

Secondary treatment, including biological nutrient removal and solids filtration, is provided in the MBR tank. The MBR tank consists of a single concrete tank partitioned by baffles into three separate basins; the anoxic basin, the pre-aeration basin and the MBR basin using 6-inch concrete baffle walls. The plant was sized based on the design flows and loadings given in Table 4-15.

TABLE 4-15 Public Safety MBR Design Flows and Loadings(1)	
Parameter	**Value**
Flow	
Peak Daily Flow	12,000 gpd
Average Annual Daily Flow	12,000 gpd
Loading	
BOD	220 mg/L
TSS	220 mg/L
TKN	40 mg/L
NO3-N	10 mg/L
Total Phosphorous	8 mg/L

(1) Enviroquip MBR Proposed Design Calculations, October 10, 2004.

Anoxic Basin

Septic tank effluent is pumped to the first step of the MBR treatment facility, the 1,500-gallon anoxic tank. In the anoxic tank the septic tank effluent is mixed with a recycle stream of nitrified wastewater which is pumped by a single feed forward pump to the pre-aeration basin, where it flows by gravity through the MBR basin back to the anoxic basin. The anoxic environment in the tank is suitable for denitrification of the nitrified recycle steam (conversion of nitrate to nitrogen gas). Mixing in the tank is provided by a mechanical 2-horsepower mixer. In addition to the removal of nitrogen, denitrification regenerates alkalinity that is lost during the nitrification process; therefore, stabilizing pH within the overall treatment process. Denitrification also reduces the oxygen demand required for the removal of BOD in the pre-aeration basin downstream of the anoxic basin.

A ½-horsepower self-priming centrifugal feed forward pump pumps the mixed liquor from the anoxic basin to the pre-aeration basin. The pumps are controlled based on signals from four level float switches located in the anoxic basin, that the plant’s Programmable Logic Controller (PLC) uses to start/stop the pump, based on the fluid level in the anoxic basin. Design criteria for the anoxic basin in provided in Table 4-16.

TABLE 4-16 Public Safety Anoxic Basin Design Criteria	
Parameter	**Value**
Anoxic Basin	
Tank Volume	2,000 gal
Dimensions	6'-0" x 6'-0" (LxW)
Side Water Depth	7'-6"
Mixer	
Number of Mixers	1
Make and Model	ABS - RW-2022
Capacity	2,000 gallons
Motor	2 hp, 460 V, 3 Phase
Feed Forward Pump	
Number of Pumps	1
Make and Model	Gorman-Rupp - 11 1/2A53-B
Capacity	45 gpm @ 15 ft. TDH
Motor	0.5 hp, 460 V, 3 Phase
Type	Self-Priming Centrifugal
Instrumentation	
Influent Flow Meter	None (Master Meter – Impeller Type Meter removed)
Automatic Influent Sampler	None
Automatic Effluent Sampler	None

Pre-Aeration Basin

Mixed liquor is pumped to the pre-aeration basin from the anoxic basin. The tank is aerated by two blowers which feed air through a coarse bubble diffusor system. The two blowers also provide air to the MBR basin as discussed in the MBR Basin section below. The coarse bubble diffuser system provides oxygen for the aerobic bacteria in the mixed liquor that break down and synthesize the organic matter and nitrify ammonia (converts to nitrogen). The blowers are equipped with variable frequency drives (VFDs). The pre-aeration basin contains a dissolved oxygen meter/transmitter that is used by the PLC to adjust the blower motor speed to maintain a set dissolved oxygen level in the basin. The pre-aeration basin design criteria is provided in Table 4-17.

TABLE 4-17 Public Safety Pre-Aeration Basin Design Criteria	
Parameter	**Value**
Pre-Aeration Basin	
Tank Volume	1,200 gallons
Dimensions	3'-0" x 6'-0" (LxW)
Side Water Depth	8'-9"
Diffusors	
Type	Coarse Bubble
Make and Model	Enviroquip – Tans Max Diffusors
Pre-Aeration Blowers	
Number of Blowers	2 (Shared with MBR Basin)
Type	Side Channel Vacuum Pump
Make and Model	Denver Gardner - SAH 95 (2BH)
Motor	2 hp, 460 V, 3 Phase
Instrumentation	
Dissolved Oxygen Meter	Danfoss – Oxy 4100

MBR Basin

Mixed liquor flows by gravity from the pre-aeration basin to the MBR basin. The MBR basin is equipped with two Kubota submerged membrane cassettes. Each cassette contains 75 flat plate membranes. Coarse bubble air diffusers are mounted below the cassette to scour the membranes during operation. Air is provided to the tank by two blowers equipped with VFDs to adjust the air flow through the diffusers. These blowers also provide air to the pre-aeration basin, as discussed above. To clean the diffusers, motor operated valves on the air lines to each cassette automatically open to allow mixed liquor to scour the diffuser assembly and be returned to the MBR basin. Two permeate pumps draw filtered effluent (permeate) through the membranes and pump it to the effluent pump station. Permeate flow rate is regulated via motorized valves on the discharge of the permeate pumps. The pumps are controlled by the level floats located in the anoxic basin. Waste solids are removed from the system periodically by pumping directly from the MBR basin to a sludge hauling truck.

The PLC controls a membrane relax mode, which is typically set to relax for one minute out of every 10 minutes. During relax mode, permeate production temporarily stops while scour air continues to flow across the membrane surface. During permeate production the surfaces of the cartridges are pulled slightly inward due to the differential pressure across them. By stopping the permeate flow during relax mode, the membranes return to a flat profile and allow the scour air to more effectively remove any accumulated material. The relax mode reduces the transmembrane pressure (TMP) required to generate a given permeate flow rate. When relaxing the membranes no longer returns a suitable transmembrane pressure, a chemical cleaning of the membranes is required. Typically, chemical cleanings are required approximately every 6 months. The MBR Basin design criteria is provided in Table 4-18.

TABLE 4-18 Public Safety MBR Basin Design Criteria	
Parameter	**Value**
MBR	
Tank Volume	2,750 gallons
Dimensions	7.5'-0" x 6'-0" (LxW)
Side Water Depth	8'-3"
Membranes	
No of Units	2
Cassettes per Unit	75
Make and Model	Kubota – SMU ES 75
Effective Membrane Area	8.6 ft^2 per Cassette, 1,290 ft^2 Total
Membrane Flux	9.3 gallons/ft^2/day
Type	Submerged Plate
Aeration/Membrane Blowers	
Number of Blowers	2 (1 Air Scour, 1 Aeration)
Type	Side Channel Vacuum Pump
Make and Model	Denver Gardner - SAH 95 (2BH)
Motor	2 hp, 480 V, 3 Phase
Permeate Pumps	
Number of Pumps	2
Make and Model	Goulds GTO73
Motor	3/4 hp, 460 V, 3-Phase
Type	Self-Priming Centrifugal
Control	Float Switch (Anoxic Basin)
Instrumentation	
Effluent Flow Meter	Endress Hauser – ProMag V
Turbidimeter	None

Effluent Pump Station

Permeate from the MBR basin is discharged by the permeate pumps to the effluent pump station wet well where it is pumped to the effluent drainfield. The wet well is a 48-inch-diameter concrete manhole with a single high head submersible effluent pump. The pump is controlled by four float switches located within the wet well (High Level, Pump On, Pump Off, Low Level). A local control panel contains an on/off/auto switch for the effluent pump. The design criteria for the effluent pump is provided in Table 4-19.

TABLE 4-19
Public Safety Effluent Pump Station Design Criteria

TABLE 4-19 Public Safety Effluent Pump Station Design Criteria	
Parameter	**Value**
Effluent Pump Station Design	
Number of Pumps	1
Make and Model	Orenco PEF5012
Capacity	39 gpm @ 27 feet TDH
Motor	0.5 hp, 208V, 3 Phase
Type	Submersible
Float Switch	
Number of Switches	4
Make and Model	Orenco MF4A-YGRW-66FS

The treated effluent is pumped from the effluent pump station to a mechanically operated drainfield distribution assembly with one 1-1/2-inch inlet and three 1-1/2-inch outlets to the drainfield valve vaults. One drainfield is dosed at a time. Effluent is directed to the individual drainfields through true union pressure activated spring check valves which are located on each outlet of the distribution assembly. When pressure in the active distribution line drops to 0.5 psi (i.e., each time the pump shuts off) the spring check valve is activated and the distribution assembly rotates a position and distributes effluent to the next drainfield in line.

Public Safety Drainfield

Treated effluent from the MBR is infiltrated to ground in three separate drainfield trenches. Each trench provides approximately 840 square feet of infiltration area for a total drainfield area of approximately 2,520 square feet. Three 1-1/2-inch-diameter PVC pressurized laterals distribute the effluent throughout each field. Ball valves located in valve vaults upstream of the drainfields are provided on each lateral to regulate flow through the system. Observation ports are provided on each lateral at the upstream end of the trench. The drainfield layout is shown on Figure 4-8. The estimated design infiltration rate for the maximum month flow of 12,000 gpd is approximately 4.8 gallons per square foot per day. The Public Safety WWTF drainfield design criteria is provided in Table 4-20.

TABLE 4-20 Public Safety WWTF Effluent Drainfield	
Parameter	**Value**
Force Main	
Diameter	3"
Material	PVC
Pressure Laterals	
Diameter	1-1/2"
Hole Size	3/16
Hole Spacing	6' OC
Inspection Ports	
Number per Bed	3
Diameter	4"
Distribution Valves	
Number of Valves	1
Beds per Valve	3
Make and Model	Orenco V6606A
Type	Mechanical Distribution Valve
Flow Range	15 – 100 gpm
Drainfield Beds	
Number of Beds	3
Length per Bed	112 ft.
Width per Bed	7.5 ft.
Space between Beds	20 ft.
Number of Pressure Laterals per Bed	3
Space between Pressure Laterals	2.5 ft.
Total Lateral Length	1,012 ft.
Total Drainfield Area	2,520 ft^2
Loading Rate @ MM (12,000 gpd)	4.8 gpd/ft^2

LUCKY EAGLE CASINO AND HOTEL WWTF

Information provided in the following sections is from documents obtained from the Tribe, Casino/Hotel administration and equipment manufacturers. The provided documents consisted of Operations and Maintenance manuals for the WWTF, partial as-built drawings for the WWTF and collection system and proposed partial Scopes of Supply for the WWTF. No design or planning documentation was received for either the WWTF or the collection system. In 2016, Gray and Osborne conducted numerous site visits to supplement and verify the documentation in an attempt to provide a complete understanding of the operation and condition of the facilities; however, they were not able to verify all components of the systems; therefore, some equipment models, capacities and volumes are listed as unknown in the following tables.

COLLECTION SYSTEM

The collection system for the Lucky Eagle WWTF consists of gravity sewer, pump stations, septic tanks and force mains. There are essentially two separate systems that flow to the WWTF, one for the Lucky Eagle Casino and another for the Hotel. These two systems converge just prior to entering the WWTF. The collection system is shown on Figure 4-11. The systems are described in more detail in the following sections.

Lucky Eagle Casino Collection System

The Lucky Eagle Casino collection system consists of a variety of pump stations, grease traps and septic tanks as shown on Figure 4-11, with design criteria summarized in Table 4-21.

The majority of the wastewater is collected from the various sources within the casino and conveyed by gravity to three separate 8-feet-diameter wet well pump stations on the east side of the Casino shown as Pump Stations 4, 5 and 6 on Figure 4-11. Each pump station has two submersible centrifugal, float controlled, 1/2-horsepower pumps, which pump the collected wastewater to three 10,000-gallon septic tanks operating in series. Waste from the restaurants is collected separately and routed through a series of three 17,000-gallon grease traps before being pumped to the septic tanks from Pump Station 7. Floatables and solids are removed from the waste stream in the septic tanks and septic tank effluent flows by gravity through a filter to a septic tank effluent pump station, Pump Station 8. Under normal operating conditions, three submersible float controlled 1/2-horsepower pumps pump the septic tank effluent south in three separate 3-inch parallel force mains to a common 6-inch force main that discharges to the WWTF equalization basin.

An additional pump station, Pump Station 2, pumps septic tank effluent from a 12,000-gallon septic tank located to the south 188th Avenue SW in a 3-inch force main to the common 6-inch force main to the WWTF. The pump station consists of an 8-foot-diameter wet well containing two submersible centrifugal pumps. The pumps are level float controlled.

Pump Station 3 pumps grease trap effluent from two 6,000-gallon grease traps located to the east of the new addition to the Casino to a connection to the 3-inch force main from Pump Station 1, which is pumped to the common 6-inch force main to the WWTF. The pump station is located in an 8-foot diameter wet well containing two submersible centrifugal pumps. The pumps are level float controlled.

All force mains from the various pump stations tie into a single 6-inch force main equipped with a tee and motor operated valves to allow flow influent to flow to either the WWTF equalization basin, during normal operation, or to the three surge tanks, during maintenance shut-downs or extreme high flow events. When the level in the equalization basin is high, a level sensor located in the equalization basin sends a signal to the PLC to divert influent flow from the equalization basin to three buried, precast concrete surge tanks. A signal is then sent to the two motor operated valves located on the 6-inch force main and the piping to surge tanks to open/close the valves to divert the flow to the surge tanks. The surge tanks consist of three separate tanks operating in series with a total volume of 27,000 gallons. From the surge tanks, the diverted flow is pumped by two surge pumps to either of the two lined, earthen storage basins. The stored flow is typically pumped back to the MBR equalization basin from storage basins using a small portable trash pump. Two dedicated blowers can provide air to storage basins, which are each equipped with a fine bubble diffuser system.

TABLE 4-21 **Lucky Eagle Casino Septic Tank and Effluent Pump Station Design Criteria**	
Parameter	**Value**
Pump Station 2	
Type	Septic Tank Effluent
Septic Tank Volume	12,000 gal
Wet Well Diameter	8 ft.
No of Pumps	2
Make and Model	Hydromatic SKV40 Submersible
Pump Control	Level Float
Pump Station 3	
Type	Grease Trap
Trap Volume	12,000 gal (2 x 6,000 gal)
Wet Well Diameter	8 ft.
No of Pumps	2
Make and Model	Hydromatic SKV40 Submersible
Pump Control	Level Float
Pump Stations 4, 5 and 6	
Type	Wastewater
Wet Well Diameter	17,000 gallons (each)
Diameter	8 ft. (each)
Number of Pumps	2 (each)
Pump Make and Model	Barnes
Pump Capacity	Unknown
Pump Motor	1/2 hp
Pump Type	Submersible Centrifugal
Pump Control	Level Float
Pump Station 7	
Type	Grease Trap
Trap Volume	51,000 gal (3 x 17,000 gal)
Number of Pumps	1
Make and Model	Barnes
Pump Motor	1/2 hp
Pump Type	Submersible Centrifugal
Pump Control	Level Float
Pump Station 8	
Type	Septic Tank Effluent
Septic Tank Volume	30,000 (3 x 10,000 gal)
Number of Pumps	3
Pump Make and Model	Barnes
Pump Motor	1/2 hp

TABLE 4-21 – (continued) Lucky Eagle Casino Septic Tank and Effluent Pump Station Design Criteria	
Parameter	**Value**
Pump Type	High Head Submersible Effluent
Pump Control	Level Float
Septic Tank Effluent Force Main	
Size	3-inch, 6-inch
Length	3x3-inch parallel lines, 550 LF each 6-inch, 220 LF
Material	PVC
Surge Tanks	
Number of Tanks	3
Total Tank Volume	27,000 gallons
Number of Surge Tank Pumps	2
Pump Make and Model	Unknown
Storage Basin 1	
Volume	760,000 gallons
Diffuser System	Fine Bubble
Storage Basin 2	
Volume	570,000 gallons
Diffuser System	Fine Bubble
Storage Basin Aeration Blowers	
Number of Blowers	2
Blower Make and Model	Unknown

Lucky Eagle Hotel Collection System

The hotel collection system was installed during the original construction of the Hotel. Wastewater is collected from the hotel and conveyed via gravity to a precast concrete wet well pump station containing two submersible, float-controlled, 1/2-horsepower pumps.

Wastewater is pumped from the pump station to three 10,000-gallon septic tanks operating in series where solids and floatable debris are separated from the waste stream. Septic effluent flows by gravity through a filter to the hotel septic tank effluent pump station, Pump Station 1. Pump Station 1 contains two float-controlled, submersible, 1/2-horsepower pumps, which pump the effluent through a 3-inch PVC force main south to the 6-inch force main which discharges to the WWTF equalization basin. The Hotel collection system design criteria is provided in Table 4-22.

TABLE 4-22 Eagle's Landing Hotel Septic Tank and Effluent Pump Station Design Criteria	
Parameter	**Value**
Pump Station 1	
Type	Septic Tank Effluent
Septic Tank Volume	30,000 gal (3 x 10,000 gal)
Wet Well Diameter	8 ft.
No. of Pumps	2
Make and Model	Barnes
Motor	1/2 hp

LUCKY EAGLE CASINO WASTEWATER TREATMENT FACILITY

History of Lucky Eagle Casino Wastewater Treatment Facility

Prior to 2006 and the construction of the MBR WWTF, septic tank effluent from the Casino's septic tanks was treated in a series of two lined earthen aerated lagoons. Treated effluent from the lagoons was pumped from a drip irrigation pump station to a subsurface drip irrigation drainfield system located to the east of the facility. The lagoons currently function as storage basins during emergencies or during maintenance and repair of the MBR facility. Typically, Storage Basin No. 1 is used for storage of influent wastewater and Storage Basin No. 2 is used as storage for plant effluent. The Storage Basins are connected hydraulically by a 12-inch PVC overflow pipe. Currently, the aeration systems for the ponds are not used. Overflow from either of the Storage Basins can be directed to the original drainfield pump station, which is equipped with two pumps that pump to the original drip irrigation drainfields.

Secondary treatment, including biological nutrient removal and solids filtration, is provided in tanks comprising the MBR treatment facility. The MBR treatment facility consists of a series of hydraulically connected metal tanks including the equalization basin, two anoxic basins and the aeration/MBR basin. An additional tank is provided for the storage of waste activated sludge. The MBR facility was started up in 2008.

The plant has a control panel located in the control room, which is equipped with the motor starters and a PLC for equipment control as well as an auto dialer to provide alarm communications to operators. The control panel also includes an Ethernet connection to allow for off-site access. In addition to the control panel, an HMI is also located in the control room.

The design of the plant was based on the following septic tank effluent flows and loadings listed in Table 4-23.

TABLE 4-23 Casino MBR Design Flows and Loadings	
Parameter	**Value**
Flow	
Maximum Daily Flow	0.15 mgd
Average Daily Flow	0.10 mgd
Loading	
BOD	350 mg/L
TSS	350 mg/L
TKN	79 mg/L

UIC Injection Well Inventory Facility Number

The UIC facility identification number for the WWTF is WA105T-97-90222.

Description of Process Flow

Figures 4-12 and 4-13 provide a facility layout and process flow schematic for the Lucky Eagle Casino WWTF, respectively. Septic tank effluent is pumped from the collection system to the MBR WWTF equalization basin. From the equalization basin, septic tank effluent is pumped to the anoxic basins by a single air lift pump. In the anoxic basins, the septic effluent is combined with an activated sludge stream that is recycled to the anoxic basin from the Aeration/MBR basin by two recycle pumps to create a mixed liquor. From the anoxic tank, the mixed liquor is pumped to the Aeration/MBR basin. Air is provided to the Aeration/MBR basin by fine bubble diffusers. In the Aeration/MBR basin, final effluent is filtered through the membrane filtration system by gravity and flows through a chorine contact chamber to an effluent pump station, where it is typically pumped to the rapid infiltration basin for disposal via a 3-inch PVC force main. Individual components of the treatment system are discussed in more detail below.

Equalization Basin

Influent initially enters the treatment facility at the equalization basin. The purpose of the equalization basin is to attenuate periodic higher influent flows and loadings to the plant to provide a more uniform flow and organic loading to the following treatment tanks. A magnetic flow meter is located on the influent line prior to the discharge to the tank. By design, the influent to the tank is screened prior to discharge, although due to the lack of solids in the influent, the fine screen mechanism is typically bypassed and influent is discharged, unscreened, to the equalization basin. An air-lift pump is used to pump the contents of the tank to the anoxic zone of the treatment facility. The air-lift pump provides a constant pump rate independent of the liquid level in the tank. The pump is on/off controlled based on signals to the PLC by a submersible level sensor in the MBR tank and is set to pump at a rate slightly higher than the average daily influent flow. A solenoid valve on the air injection line to this pump is used to turn the pump on and off. Air to the air lift pump is supplied by the aeration blowers discussed in the Aeration/MBR Basin section below. A submersible level sensor in the tank sends a signal to the PLC to actuate motor operated valves on the influent force main to divert the influent to the two-stage lagoon system if the water surface elevation in the tank is too high. A single constant speed positive displacement rotary lobe blower provides air for mixing the basin through a coarse bubble diffuser system. Table 4-24 provides the design criterial for the equalization basin/septic tank effluent pump station.

TABLE 4-24 Equalization Basin Design Criteria	
Parameter	**Value**
Equalization Tank	
Number of Tanks	1
Volume	25,000 gal
Dimensions	27.7 ft. x 11.5 ft. (LxW)
Side Water Depth	10.5 ft.
Fine Screen[1]	
Number of Screens	1
Screen Opening	1/8 inch
Make and Model	
Feed Forward Pumps	
Number of Pumps	1
Make and Model	Smith and Loveless – 4" Mini-Ject Airlift
Capacity	
Motor	
Type	Air Lift
Influent Flow Meter	
Number of Meters	1
Type of Meter	Magnetic
Make and Model	Rosemount – Series 8700
Equalization Blower	
Number of Blowers	1
Make and Model	Dresser Roots 32 URIA
Capacity	50 SCFM @ 7 psig
Type	Rotary Positive Displacement
Motor	3 hp, 460 V, 3 Phase
Diffusers	
Type	Coarse Bubble

(1) Currently Not Used.

Anoxic Basin

Septic tank effluent is pumped from the equalization basin to the first in a series of two anoxic basins. The two tanks are connected hydraulically by a single 12-inch pipe located near the bottom of the tanks. In the first anoxic basin (Anoxic Basin 1) the septic tank effluent is mixed with a recycle stream of nitrified wastewater that is pumped to Anoxic Basin 1 from the Aeration/MBR basin to create a mixed liquor. The recycle rate is adjusted manually by varying the valve opening of the valve on the recycle line.

The anoxic environment in the anoxic basin is suitable for denitrification of the nitrified recycle stream (conversion of nitrate to nitrogen gas). In addition to the removal of nitrogen, denitrification regenerates alkalinity that is lost during the nitrification process, therefore stabilizing pH within the overall treatment process. Denitrification also reduces the oxygen demand required for the removal of BOD in the preaeration basin downstream of the anoxic basin.

Each anoxic basin is equipped with two submersible mixers located at the upstream and downstream ends of each tank to keep solids in suspension. Design criteria for the anoxic basins is provided in Table 4-25.

TABLE 4-25 **Anoxic Tank Design Criteria**	
Parameter	**Value**
Anoxic Tanks	
Number of Tanks	2
Tank Volume (each)	31,255 gallons
Dimensions (each)	34.6 ft. x 11.5 ft. (LxW)
Side Water Depth	10.5 ft.
Mixers	
Number of Mixers per Tank	2
Make and Model	ABS RW 200 2021
Motor	2 hp, 460 V, 3 phase

<u>Aeration/MBR Basin</u>

Mixed liquor flows by gravity from the second anoxic basin to the Aeration/MBR basin. The Aeration/MBR basin is comprised of two separate zones, an aeration zone and a MBR membrane zone. Two rotary lobe positive displacement aeration blowers provide air to the basin. The aeration zone is equipped with fine bubble diffuser systems to provide mixing and oxygen for the biological treatment. The MBR zone is equipped with a coarse bubble diffuser system with diffuser heads beneath the membrane cassettes to provide scour air to remove solids from the membranes during operation.

The aeration basin is equipped with a dissolved oxygen meter and two aeration blowers are equipped with variable frequency drives (VFDs). There is no automated control of the aeration system. Scour air flow rate is measured using air flow meters located on the aeration piping to the coarse bubble diffusers. Manually operated valves on the aeration piping allow the operator to manually adjust the air flow to meet the design airflow set points to provide sufficient air to scour the membranes. The aeration blower discharge piping is also connected to the fine bubble diffusers in the aeration zone, the equalization basin air lift pump and the WAS tank coarse bubble air diffusers and is controlled by manually operated valves.

Each membrane cassette air diffuser header is equipped with a motor operated ball valve to allow mixed liquor to be drawn into the coarse bubble diffusers and discharged into the tank for diffuser cleaning.

The tank contains four membrane cassettes with a total of 600 flat plate membranes to filter solids from the mixed liquor. Permeate flows through the membranes by gravity. Each permeate line is equipped with two ball valves, one manually operated and the other motor operated. The manually operated ball valves are adjusted to allow a permeate flow rate approximately equal to the average daily influent flow to the facility. The motor operated ball valves open and close based on the side water depth in the MBR basin as provided by a submersible level sensor which is also used as a basis for control of the operation of the airlift pump in the equalization basin. There are no permeate pumps needed to draw water through the membranes. The flux through the membrane is dependent on the water surface elevation.

Two constant speed recycle pumps recycle mixed liquor from the aeration/MBR tank back to the first anoxic tank for denitrification.

Programming for the membrane system includes a relax mode with the frequency and duration as set by the operator. The relax mode controls the thickness of the biomass on the membranes and minimizes the transmembrane pressure required to achieve a given permeate flow rate. When relaxing the membranes no longer returns a suitable transmembrane pressure a manually operated chemical cleaning of the membranes is required. Typically, chemical cleanings are required approximately every 6 months. To chemically clean the membranes, a cleaning solution is allowed to backflow into the membranes by gravity through a connection to the membrane effluent lines. The chemical cleaning solution is pumped from the 325-gallon chemical storage tank located outside of the building to two 35-gallon elevated tanks located on each side of the MBR tank along the top of the MBR tank wall. The elevated tanks have an overflow line back to the chemical cleaning storage tank to provide a constant pressure head into the membranes.
Manual valves in the elevated tank lines to the MBR cassettes are opened allowing the cleaning solution to enter the membranes. The MBR tank design criteria is provided in Table 4-26.

TABLE 4-26 Aeration/MBR Tank Design Criteria	
Parameter	**Value**
Aeration/MBR Tank	
Tank Volume	30,000 gallons
Dimensions	34.8 ft. x 11.5 ft. (LxW)
Side Water Depth	10.0 ft.
Diffusers – Aeration	
Type	Fine Bubble
Make and Model	EDI Flexair/Mini Panel
Diffusers – Scour	
Type	Coarse Bubble
Aeration Blowers	
Number of Blowers	2
Make and Model	Dresser Roots 711 URAI
Capacity	620 SCFM @ 6 psig
Motor	40 hp, 460 V, 3 Phase
Membranes	
Number of Cassettes	4
Type of Cassettes	Flat Plate
Make and Model	2 x 200W Titan / 2 x 100S Titan
Total Effective Membrane Area	9,000 sf
Average Day Membrane Flux	11.1 gpd/sf
Peak Day Membrane Flux	16.6 gpd/sf
Recycle Pumps	
Number of Pumps	2
Make and Model	Goulds 3888D4 – WS7543D4
Capacity	Unknown
Motor	7.5 hp, 460 V, 3-Phase
Type	Submersible Centrifugal
Cleaning System	
Chemical Storage Tank	325 gal
Elevated Storage Tanks (2)	35 gal
Sampling Equipment	
Automatic Effluent Sampler	None
Automatic Effluent Sampler	None

Waste Activated Sludge Storage Tank

Waste activated sludge (WAS) is stored in a tank located between the second anoxic basin and the aeration/MBR basin. The plant was originally designed to waste sludge from the aeration/MBR tank using a 3-inch air-lift pump. The decant system was also designed to utilize a 3-inch air-lift pump system to transfer decant back to the aeration/MBR tank.

These 3-inch air-lift pumps are no longer used for wasting or decant. The operators now utilize a manually operated trash pump for wasting and a submersible pump manually lowered into the sludge waste tank for decant operation. The waste activated sludge is kept mixed and aerated with a coarse bubble diffuser system. Air is supplied to the tank from the aeration blowers for the aeration/MBR tank. The decant cycle is controlled manually by the operator. To decant, the operator manually operates valves to stop aeration of the tank and the sludge is allowed to settle. After a period of time, the operator lowers the submersible pump into the tank and starts the pump to pump decant back to the aeration/MBR basin. Thickened waste sludge is pumped directly from the tank to a waste truck to haul offsite for disposal via the trash pump.

Effluent Disinfection and Effluent Pump Station

Filtered effluent flows by gravity through a chlorine contact chamber to provide disinfection prior to disposal. From the chlorine contact tank, the effluent flows by gravity to the effluent pump station. The effluent pump station consists of a 6,000-gallon precast concrete wet well with six submersible 0.5-horsepower effluent pumps. Typically, effluent is pumped by two of the pumps within the wet well to the 5-acre rapid infiltration basin.

Of the other four effluent pumps, two are piped to a common discharge line to Storage Basin 1 and two are piped to a common discharge line to Storage Basin 2. Effluent is only directed to the storage basins during periods when the operator decides that effluent noticeably does not meet permit limits due to a plant upset. There is no effluent turbidimeter installed to monitor effluent turbidity. Pumps to the storage basins are manually operated with on/off switches. The overflow from the storage basins can overflow by gravity to the drainfield pump station, which is equipped with two pumps that are piped to the existing drip irrigation drainfields. The stored effluent can also be pumped back to the equalization basin using a portable trash pumps. No information is available for the drainfield pump station pumps or wet well. Design criteria for the chlorine contact chamber and effluent pump station are provided in Table 4-27.

TABLE 4-27 Effluent Pump Station Design Criteria	
Parameter	**Value**
Chorine Contact Chamber	
Tank Volume	Unknown
Residence Time	Unknown
Chemical Metering	Unknown
Pump Station	
Wet Well Volume	6,000 gal
Number of Pumps	6
Make and Model	Barnes
Capacity	Unknown
Motor	0.5 hp
Control	Level Float (to infiltration basin), Manual to Aeration Ponds
Type	High Head Submersible Effluent

Rapid Infiltration Basin/Drainfield

Prior to the construction of the infiltration basin, effluent from the treatment facility was discharged to the drainfield located to the east of the Casino. The drainfield consists approximately 4.5 acres with 27,000 linear feet of trench with a low-pressure drip system. Currently the drainfield is no longer in use although effluent can still be routed to this system through the force main from the drainfield pump station. Final effluent is typically discharged to a 1.8-acre (80,400 ft^2) infiltration basin located to the east of the drainfield, as scaled off of the casino WWTF construction drawings. At peak daily flow (150,000 gpd), this provides a design infiltration rate of 1.9 gpd/ft^2. The infiltration basin and drainfield locations are discussed and shown in Chapter 6.

CHAPTER 5

WASTEWATER FLOWS AND LOADS

INTRODUCTION

This chapter summarizes the waste flow and load estimates used to evaluate collection and treatment alternatives presented in Chapter 7 this Preliminary Engineering Report.

RESIDENTIAL WASTE FLOW AND LOAD PROJECTIONS

EXISTING AND FUTURE WASTE FLOWS

The Makum housing development has 7 lots and flow is estimated to be 1,750 gpd average based on 250 gpd per house.

The Tahown housing development also 25 lots and the flow is estimated to 6,250 gpd average based on 250 gpd per residence.

The Fern housing development has 17 lots and flow is estimated to be 3,500 gpd based on 250 gpd per residence

Table 5-1 presents the summary of flows for the central part of the Reservation. There is no anticipated growth in any of these areas so the flow estimates are utilized through the 20-year planning period.

TABLE 5-1
2017 - 2037 Estimated Residential Wastewater

Development Name	Population	AAF (gpd)	MMF (gpd)	PDF (gpd)	PHF (gpd)
Davis	104	8,320	10,400	20,800	33,280
Fern	48	3,500	4,375	9,600	14,000
Makum	18	1,750	2,200	4,400	7,000
Tahown	63	6,250	7,800	15,600	25,000

EXISTING AND FUTURE WASTE LOADS

As with waste flow, the waste load estimates as shown in Table 5-2 are consistent for the 20-year planning period. Loading estimates are based on USEPA studies and the Ecology Orange Book with BOD and TSS both equal to 0.2 pounds per day per capita (lb/d/cap). All of the collection system alternatives assume that new and existing residences will continue to use septic tanks, either individual or community. The estimates in Table 5-2 use a 50% reduction in BOD, an 80% reduction in TSS and a 5% reduction in TKN across the septic tanks. These removal rates are conservative estimates from the USEPA's *On Site Wastewater Treatment System Manual* (2002). Maximum monthly average daily loads are assumed to be 50% greater than average annual daily loadings.

TABLE 5-2 2017 - 2037 Residential Loadings						
	BOD (lb/d)		TSS (lb/d)		TKN (lb/d)	
	Average Annual	Max Monthly	Average Annual	Average Annual	Max Monthly	Average Annual
Davis	11	17	2	4	4	5
Fern	5	8	1	2	2	2
Makum	2	3	1	1	1	1
Tahown	7	10	2	2	2	2

COMMUNITY NON-RESIDENTIAL AREA

The Community Non-Residential area (CNA) consists of all tribally owned non-residential buildings in the central part of the Reservation. This includes the Tribal Government Complex (Administration Building, Child and Family Services, Elder Center, Youth Center, Natural Resources Building and Maintenance Shops), Wellness Center, Public Safety and Community Center. All of these structures are served by individual septic tanks. The septic tank discharge from many of these facilities flows to the Public Safety WWTF. For purposes of this Report, waste flow and load for all of these facilities is considered as one aggregate flow.

EXISTING AND FUTURE WASTE FLOW AND WASTE LOADS

Ideally, flows for the CNA would be modeled using either individually metered water use data or metered wastewater data. While the Tribe does monitor its water production, it does not keep track of water consumption by individual connections. As a result, it is difficult to separate residential water use from non-residential water use.

Since water use data is only available in aggregate form, and the Public Safety WWTF flow meter is not reliable, waste flows for the CNA have been estimated using typical unit flow data from standard references. Where possible, flow values were taken from Ecology's Orange Book; additional values were taken from *Wastewater Engineering* by Metcalf & Eddy (2014). Estimated current flows from each of the facilities in the CNA are presented in Table 5-4. The ratios of maximum monthly daily flow (MMF), peak day flow (PDF), and peak hour flow (PHF) to the average annual daily flow (AAF), are 1.25, 2.0, and 3.5, respectively. These ratios are consistent with typical peaking factors for small communities based on studies published in *Small and Decentralized Wastewater Management Systems* (Crites and Tchobanoglous, 1998). It should also be noted that the Ecology and Metcalf and Eddy references provide unit-flow values in terms of different flows: unit-flows in the Ecology Orange Book are in terms of MMF, while unit-flow from the Metcalf and Eddy reference are in terms of base flow for that unit.

In order to provide a degree of validation to this model, the waste flows predicted in Table 5-3 were compared to wastewater flow estimates derived from drinking water production data. These two estimates were found to be roughly equivalent.

TABLE 5-3 Community Non-Residential Area Estimate of Existing Flow								
Connection	**Units**	**Qty.**	**Flow per Unit (gpd/unit)**	**Base Flow[(4)] (gpd)**	**AAF (gpd)**	**MMF (gpd)**	**PDF (gpd)**	**PHF (gpd)**
Community Center[(1)]	Lump Sum	1	4,750	3,420	3,800	4,750	7,600	13,300
Public Safety[(2)]	Employees	5	10	50	56	69	112	196
Wellness Center[(3)]	1000 sq. ft.	14	500	5,040	5,600	7,000	11,200	19,600
Administration[(2)]	Employees	24	10	240	267	333	534	935
Child & Family Services[(2)]	Employees	23	10	230	256	319	512	896
Elder Center[(2)]	Employees	15	10	150	167	208	334	585
Elder Center[(2)]	Students	70	10	700	778	972	1,556	2,723
Youth Center[(2)]	Employees	5	10	50	56	69	112	196
Natural Resources[(2)]	Employees	10	10	100	111	139	222	389
Maintenance Shops[(2)]	Employees	5	10	50	56	69	112	196
Total Flows				**10,030**	**11,147**	**13,928**	**22,294**	**39,016**

(1) Based on design flow of Community Center septic tank as reported in Buffalo Design's construction documents (2008, C-11).

(2) Flow per unit based on base flow estimates from *Wastewater Engineering* (Metcalf and Eddy, 2014). Employee and student count based on descriptions provided by Don Terry (2015).

(3) Based on standard flow estimates from Ecology's Orange Book for a doctor's office (2008).

(4) Since base flow does not include infiltration and inflow (I&I), AAFis assumed to include base flow plus 10 percent I&I.

There are no specific plans for future facilities in the CNA but most likely, as population in the eastern part of the Reservation grows, so will the use of the CNA facilities. Table 5-4 shows the estimated CNA waste flows over time and assumes a 10% increase in waste flow over each ten-year period.

TABLE 5-4 Existing and Future Community Non-Residential Area				
Year		**2017**	**2027**	**2037**
Population Growth		-	10%	20%
Flow (gpd)	AAF	11,100	12,200	13,400
	MMF	13,900	15,300	16,800
	PDF	22,300	24,500	27,000
	PHF	39,000	42,900	47,200

TABLE 5-5 Summary of Community Non-Residential Area Loadings				
Year		**2017**	**2027**	**2037**
Population Growth		-	10%	20%
Septic Effluent				
BOD (lb/d)	Average Annual	14	16	17
	Maximum Monthly	18	20	22
TSS (lb/d)	Average Annual	3	3	4
	Maximum Monthly	4	4	5
TKN (lb/d)	Average Annual	7	8	9
	Maximum Monthly	9	10	11

LUCKY EAGLE CASINO AND HOTEL

EXISTING AND FUTURE WASTE FLOWS

The average flow for the Casino MBR WWTF from January 2016 to May 2017 is approximately 57,000 gpd. The maximum monthly average daily flow during that period was 70,855 gpd. This flow includes the recent expansion of slot machines and dining areas. The flows from the casino are expected to remain the same for some time to come.

EXISTING AND FUTURE WASTE LOADS

Influent to the Lucky Eagle WWTF has periodically tested for a variety of constituents between 2012 and 2015, including BOD, TSS, and TKN. With the exception of BOD, these tests have shown relatively consistent results, as shown in Table 5-6, suggesting that they are likely dependable values. While the BOD measurements have much greater variance, the mean value (325 mg/L) is greater than the median (270 mg/L), indicating that the data set is skewed high, and use of the mean value is a conservative approach.

On this basis, the concentrations shown in Table 5-6 were used to estimate waste loads, assuming that these concentrations remain relatively constant between maximum monthly average daily and annual average daily flows, and that any additional growth at the Casino will not change the concentration of the influent stream. The 20-year projected waste loads are shown in Table 5-7.

TABLE 5-6 Lucky Eagle WWTF Influent Characteristics			
	Average Value	**Samples**	**Standard Deviation**
BOD (mg/L)	325	7	140
TSS (mg/L)	46	58	8
TKN (mg/L)	50	6	6

TABLE 5-7 Lucky Eagle Casino and Hotel 2017 - 2037 Loadings			
	2017	**2027**	**2037**
BOD (lb/d)			
Average Annual	165	165	165
Maximum Monthly	206	206	206
TSS (lb/d)			
Average Annual	23	23	23
Maximum Monthly	29	29	29
TKN (lb/d)			
Average Annual	25	25	25
Maximum Monthly	32	32	32

SUMMARY OF EXISTING AND FUTURE FLOWS

One alternative being considered is to use available capacity in the Casino MBR to treat flow from the central part of the Reservation. Table 5-8 shows the combined flow for the CNA, Fern, Makum and Tahown areas.

TABLE 5-8 Existing and Future Community Combined Flows				
Year		**2017**	**2027**	**2037**
Population Growth		-	10%	20%
Flow (gpd)	AAF	23,000	24,000	25,000
	MMF	29,000	30,000	32,000
	PDF	52,000	54,000	56,000
	PHF	86,000	90,000	94,000

Table 5-9 shows the combined loadings for the CNA, Fern, Makum and Tahown areas.

TABLE 5-9 Summary of Combined Loadings				
Year		**2017**	**2027**	**2037**
Population Growth		-	10%	20%
Septic Effluent				
BOD (lb/d)	Average Annual	28	30	31
	Maximum Monthly	39	41	43
TSS (lb/d)	Average Annual	7	7	8
	Maximum Monthly	9	9	10
TKN (lb/d)	Average Annual	12	13	14
	Maximum Monthly	14	15	16

Table 5-10 shows the combined flow for the Casino, CNA, Fern, Makum and Tahown areas.

TABLE 5-10 Existing and Future Community Combined Flows Including Casino				
Year		**2017**	**2027**	**2037**
Population Growth		-	10%	20%
Flow (gpd)	AAF	80,000	81,000	82,000
	MMF	100,000	101,000	102,000
	PDF	179,000	181,000	182,000
	PHF	296,000	299,000	300,000

Table 5-11 shows the combined loadings for the Casino, CNA, Fern, Makum and Tahown areas.

TABLE 5-11 Summary of Combined Loadings Including Casino				
Year		**2017**	**2027**	**2037**
Population Growth		-	10%	20%
Septic Effluent				
BOD (lb/d)	Average Annual	193	195	196
	Maximum Monthly	245	247	249
TSS (lb/d)	Average Annual	30	30	31
	Maximum Monthly	38	38	39
TKN (lb/d)	Average Annual	37	38	39
	Maximum Monthly	46	47	48

CHAPTER 6

COLLECTION, TREATMENT AND DISPOSAL FACILITIES EVALUATION

INTRODUCTION

This chapter provides an assessment of the existing infrastructure's capacity to provide adequate collection, treatment and disposal of the projected 20-year wastewater flow and loading as developed in Chapter 5 of this Report. Note that in each case, the WWTFs were assessed for both of the collection system scenarios: septic tank effluent and grinder pump collection systems. The selection of the collection system type did not influence the capacity analysis.

This evaluation focuses on the following WWTF issues, at current and future design loadings:

- Capacity to treat projected WWTF flows and loadings.
- Compliance with expected future permit limits and Tribal Standards.
- TSS, BOD, ammonia and total nitrogen removal, including biological treatment performance.
- Solids handling capability.
- Effluent disinfection to meet acceptable quality.
- Standby power considerations.
- Other WWTF requirements to maintain reliability and redundancy.

DAVIS HOUSING DEVELOPMENT (PETOIE WWTF) COLLECTION SYSTEM

As described in Chapter 4, the collection system for the Davis Housing Development is a gravity sewer system with 8-inch mains that was installed in 1982. While the pipe material is not specified in the available as-builts, it is assumed to be rubber-gasketed PVC, based on the fact that the water pipes described in the Davis Drive as-builts are specified as PVC, and because PVC was the dominant type of gravity sewer pipe being installed by 1980.

Physical Condition

No specific information on the condition of the collection system was available for this Report. However, based on its age, which will be 55 years in 2037, the collection system is assumed to in good condition. Most PVC pipe failures occur within the first year due to improper installation (Folkman, Steven; *Water Main Break Rates in the USA and Canada*, Utah State University, April 2012), and PVC pipes which have been properly installed can be expected to last over 100 years (Burn, S., *Long-Term Performance Prediction for PVC Pipes*, AWWARF, May 2006).

Flow Capacity

The slope of the collection system pipes is unknown, so it is assumed to be 0.40 percent, which is the minimum specified in Ecology's Orange Book (2008). Assuming a Manning's n value of 0.013, an 8-inch pipe at this slope will carry a maximum of 530,000 gpd, which is well in excess of the projected peak hour flow for the Davis Housing Development of 29,120 gpd.

Historical WWTF Performance

There is no written documentation of WWTF performance or operations and maintenance record keeping for the Petoie WWTF. In 2016, Gray & Osborne, Inc. conducted sampling of the influent and effluent to the WWTF to assess the WWTF performance. During that site visit, WWTF staff reported that the existing waste activate sludge (WAS) holding tank is not used and that the WWTF solids are wasted twice per year when the tanks are cleaned. Operation in this manner results in an exceedingly high solids retention time (SRT), which will negatively impact the WWTF performance due to excessive dead and decaying microorganism accumulation in the process tanks. These conditions can lead to the inability of the process to denitrify and will also lead to the accumulation of phosphorus in the process, which will result in high effluent nitrate and phosphorus concentrations.

Effluent pH was not measured, but it is likely that operation in this manner also results in an acidic effluent with a low pH. It is highly recommended that solids be wasted regularly (at least weekly) for acceptable plant performance. This recommendation is further discussed below.

Table 6-1 summarizes the data from samples collected between 7/15/2015 and 8/21/2015 from the Petoie WWTF. These results are discussed below. Complete lab reports are available in Appendix B of this report.

TABLE 6-1
Petoie WWTF Wastewater Characterization Summary

Parameter	Location	Average Value (mg/L)	Standard Deviation (mg/L)
Alkalinity (as $CaCO_3$)	Influent	237	11
COD	Influent	312	24
BOD_5	Influent	165	31
	Effluent	N/D	0
Total Kjeldahl Nitrogen	Influent	52	2.6
	Effluent	N/D	0
NH_3-N	Influent	54	2.0
	Effluent	N/D	0
NO_2-N + NO_3-N	Influent	N/D	0
	Effluent	78	4.6
Total Phosphorous	Influent	63	11
	Effluent	63	4.7
Total Suspended Solids	Influent	36	11
	Effluent	N/D	0

N/D: Below detection limits

BOD Removal

The Petoie WWTF was achieving excellent BOD removal during the sampling period. Most effluent BOD concentrations were below the test method's detection limit of 2.0 mg/L.

Nitrification and Denitrification
The Petoie WWTF was achieving excellent nitrification during the sampling period; however, essentially no denitrification was taking place, as evidenced by the high effluent NO_2-N + NO_3-N values. The likely cause of the lack of denitrification is the extremely long SRT resulting from the infrequency of solids wasting operations as discussed above.

TSS Removal
The Petoie WWTF was achieving excellent TSS removal during the sampling period. Most effluent TSS concentrations were below the test method's detection limit of 2.5 mg/L.

Effluent Disinfection
The Petoie WWTF does not have any disinfection equipment and does not test for effluent fecal coliform. It is recommended that effluent be sampled and tested periodically for the presence of fecal coliform.

Since the Petoie WWTF peak day design flow is less than 100,000 gallons per day and it treats residential flow only, per requirements of WAC 246-272B, effluent disinfection is not likely required. However; due to the effluent drainfield's proximity to the existing drinking water well, it is recommended that the effluent be periodically sampled and tested for fecal coliform.

WWTF EVALUATION AT NEW DESIGN CRITERIA

An analysis of the performance requirements for each major component of the Petoie WWTF was performed based on the projected 2037 flows and loadings listed in Table 6-2, which includes projections for the Davis Housing Development, as well as for the possible addition of the Fern Housing Development. In order to perform this analysis, certain assumptions were made as to the facility's operating characteristics. The assumptions used in this evaluation are from Metcalf and Eddy's 2014 *Wastewater Engineering* text, which provides typical values for these parameters based on similar treatment plants elsewhere in the country. These parameters are listed in Table 6-3. The results of this analysis are summarized in Table 6-4. An in-depth analysis of the two scenarios is provided in the text that follows. An assessment of the possibility of accepting additional influent wastewater from the Fern Housing Development to the Petoie WWTF is provided at the end of this section.

TABLE 6-2 Petoie WWTF Collection Area 2037 Projected Flows and Loadings			
Petoie WWTF Collection Area:		**Davis**	**Davis + Fern**
Flows (gpd)			
Average Annual Daily		8,320	12,200
Maximum Monthly Average Daily		10,400	15,200
Peak Daily		20,800	30,400
Peak Hourly		33,300	48,600
Loadings with Septic Effluent			
BOD (lb/d)	Average Annual	11	16
	Maximum Monthly	17	25
TSS (lb/d)	Average Annual	2	3
	Maximum Monthly	4	6
TKN (lb/d)	Average Annual	4	6
	Maximum Monthly	5	7
Loadings with Grinder Pumps			
BOD (lb/d)	Average Annual	11	22
	Maximum Monthly	17	33
TSS (lb/d)	Average Annual	2	8
	Maximum Monthly	4	13
TKN (lb/d)	Average Annual	4	6
	Maximum Monthly	5	8

TABLE 6-3 **Biological Treatment Parameter Assumptions**			
Parameter	**Value**	**Units**	**Source**
Basin Volumes			
Anoxic Basin Volume	2,500	gallons	Measured
Pre-Aeration Basin Volume	2,500	gallons	Measured
MBR Basin Volume	4,000	gallons	Measured
Kinetic and Stoichiometric Constants			
$bCOD/BOD_5$ Ratio	1.64	None	Typical
(WAS) $bTKN/P_{X,bio}$ ratio	0.12	None	Typical
nbTKN/TKN Ratio	0.05	None	Typical
NH4/TKN Ratio	1.0	None	Measured
Fraction of nitrified nitrogen denitrified	0.5	None	Estimated
Y_H (heterotrophic yield)	0.4	lb/lb	Typical
Y_n (autotrophic yield)	0.12	lb/lb	Typical
f_d (fraction of cell mass remaining as cell debris)	0.15	lb/lb	Typical
$k_{d,20}$ (endogenous heterotrophic decay coefficient)	0.12	d^{-1}	Typical
$k_{dn,20}$ (endogenous nitrogenous decay coefficient)	0.17	d^{-1}	Typical
$\mu_{m, max, 20}$ (heterotrophic growth rate)	6.0	d^{-1}	Typical
$\mu_{n, max, 20}$ (autotrophic growth rate)	0.9	d^{-1}	Typical
K_S (substrate half-saturation coefficient)	20	g/m^3	Typical
$K_{n,20}$ (ammonia half-saturation coefficient)	0.74	g/m^3	Typical
K_O (oxygen half-saturation coefficient)	0.5	g/m^3	Typical
Design Temperature	10	^oC	Measured
$\mu_{m, max, t}$ (heterotrophic growth rate)	3.05	d^{-1}	Calculated
$k_{d,t}$ (endogenous heterotrophic decay coefficient)	0.081	d^{-1}	Calculated
$\mu_{n, max, t}$ (autotrophic growth rate)	0.46	d^{-1}	Calculated
$k_{dn,t}$ (endogenous nitrogenous decay coefficient)	0.115	d^{-1}	Calculated
$K_{n,t}$ (ammonia half-saturation coefficient)	0.442	g/m^3	Calculated
Additional Assumptions for NH_3 and NO_X Removal Requirements			
Average K (Airflow/AOR)	0.71	SCFM/lb/d	Estimated
MLSS Concentration	8000	mg/L	Estimated
X_b (Active Biomass)	2800	mg/L	Estimated
Observed yield (lb TSS/lb BOD)	0.60	lb/lb	Estimated
SRT	14.5	d	Estimated

TABLE 6-4
Comparison of Petoie WWTF Component Design Criteria and Projected Flow and Loadings

Component/ Parameter	Capacity/Criteria	Reference	2037 Davis Operating Condition	Meets Criteria	2037 Davis + Fern Operating Condition	Meets Criteria?
Influent Screen @ PHF	Unknown	NA	37,500 gpd	?	42,560 gpd	?
Equalization Tank	6 hrs of PHF-PDF	NA	6.3 hrs	Yes	4.3 hrs	**No**
Influent Pump	86,000 gpd5 PHF	Manufacturer	33,280 gpd PHF	Yes	48,640 gpd PHF	Yes
Recycle Pump	86,000 gpd$_5$ PHF (4x AADF$_2$)	Manufacturer	33,000 gpd (4x AADF$_2$)	Yes	49,000 gpd (4x AADF$_2$)	Yes
Aeration Basin Solids Retention Time (SRT)	14.5 d @ MMF Loading	M&E, 2014	23 days$_{1,3}$	Yes	16 days$_{1,3}$	Yes
Aeration Capacity	44 scfm$_4$	Manufacturer	25 scfm$_{3,4}$	Yes	37 scfm$_{3,4}$	Yes
Membranes (All Units in Service)	11.8 gfd @ AADF	Manufacturer	6.5 gfd	Yes	9.3 gfd	Yes
	13.5 gfd @ MMADF	Manufacturer	8.1 gfd	Yes	11.6 gfd	Yes
	18.2 gfd @ PDF	Manufacturer	16.1 gfd	Yes	23.3 gfd	**No**
	25.3 gfd @ PHF	Manufacturer	25.8 gfd	**No**	38.0 gfd	**No**
Membranes (One Unit Out of Service)	11.8 gfd @ AADF	Manufacturer	12.9 gfd	**No**	18.6 gfd	**No**
	13.5 gfd @ MMADF	Manufacturer	16.1 gfd	**No**	23.3 gfd	**No**
	18.2 gfd @ PDF	Manufacturer	32.3 gfd	**No**	46.5 gfd	**No**
Permeate Pump	36,000 gpd$_5$	Manufacturer	21,000 gpd	Yes	30,000 gpd	Yes
Effluent Pump	Unknown	Manufacturer	21,000 gpd	?	30,000 gpd	?
Primary Drainfield	2.0 gfd$_6$ @ PDF	WSDOH[6]	3.3 gfd	**No**	4.9 gfd	**No**
Backup Drainfield	1.0 gfd$_6$ @ PDF	WSDOH[6]	2.1 gfd	**No**	4.3 gfd	**No**
WAS Holding Tank	10 days	NA	3 d	**No**	2 days	**No**

(1) Based on an observed yield of 0.60 lb TSS/lb BOD, aerobic SRT of 14.5 days.
(2) MBRs typically require 4 x AAF to achieve at least 80 percent denitrification.
(3) Assumes biological treatment parameters as listed Table 6-3.
(4) Assumes that oxidation takes place only in the pre-aeration basin, with one of the two blowers inactive.
(5) Based on documentation from the manufacturer.
(6) Based on guidance from the Washington State Department of Ecology for Large On-Site Treatment Systems discharging to Soil Types 1 and 2 (WAC 246-272B, Sections 03400 (Table 1) and 06350 (18)). The actual infiltration rates of MBR effluent in the Petoie drainfield should be confirmed by a hydrogeological study onsite.

Septic Tanks

The septic tanks at the Petoie WWTF are undersized for the flows associated with the Davis housing development; however, since the septic tank effluent flows to an MBR WWTF, this is not a concern. The existing tanks provide 19,000 gallons of total volume, with approximately 3,300 gallons serving as flow equalization for the WWTF. This leaves about 15,700 gallons of effective volume for septic tank treatment. WDOH recommends 250 gallons of septic tank capacity per bedroom for community septic systems. The Davis housing developments has 96 bedrooms, which would require 24,000 gallons for septic treatment. Operations staff should measure the solids level in the septic tanks regularly and remove solids as required.

Headworks

Screen

The model number and capacity of the influent screen is unknown but appears to be sufficient for the existing influent flows. Influent to the Petoie WWTF is screened following the second septic tank using an Orenco Biotube-type filter with an unknown model number. However, the filter was installed during the most recent update to the WWTF in 2008 and was likely selected with the design flows of the WWTF in mind. Since the load to the facility has not changed substantially since that date and is not projected to change during the 20-year planning period, it is assumed that the screen is adequately sized for existing flows. If additional flow were routed to the Petoie WWTF, the screen would need to be assessed for its capacity to handle the additional flow.

Orenco Biotube filters are typically designed to be cleaned whenever the septic tank needs pumping.

Equalization Basin

The portion of the 10,000-gallon septic tank that serves as an equalization basin does provide sufficient equalization volume to equalize the flows in excess of the existing membrane peak day flow capacity for the existing flows, but it is not sufficient for handling flows associated with adding the Fern Housing Development wastewater.

Influent Pump

The existing 1/2-hp pump conveys 60 gpm (86,000 gpd) at 35 feet of head. This flow rate is adequate for both PHF scenarios. It is recommended that the WWTF have an uninstalled spare influent pump on hand to replace the existing pump when maintenance for that pump is required.

Anoxic Basin

Recycle Pump

The recycle pump in an MBR serves two purposes: (1) circulating the mixed liquor at a high enough rate to keep it from becoming too concentrated near the membranes; and (2) returning NO_X to the anoxic zone where it can be denitrified. Recycle rates in MBR WWTFs are typically a minimum of four times the Average Annual Daily Flow (AADF). As shown in Table 6-4, the existing recycle pump is sufficient for both future development scenarios.

Anoxic Basin

The Anoxic Basin volume is discussed below with the Pre-Aeration Basin.

Solids Residence Time (SRT)
The SRT for both scenarios was calculated and compared to the minimum required SRT as calculated and shown in Chapter 7. The minimum required aerobic SRT is 14.5 days. The pre-aeration tank volume is sufficient to provide the minimum aerobic SRT for the existing collection system and the expanded collection system to serve the Fern Housing area. Anoxic basins with a minimum capacity of 25 percent of the aeration basin is typically sufficient for denitrification; therefore, the existing anoxic basin is also adequately sized for both future development scenarios.

Aeration Capacity
Aeration demand was calculated using measured quantities based on the configuration of the aeration basin and typical correction factors as described by Metcalf and Eddy (2014) and as outlined in Chapter 7. For this assessment, the values listed in Table 6-4 reflect the aeration capacity of the Pre-Aeration Basin alone, and do not include the oxygen transferred by the coarse bubble diffusers in the MBR Basin. Even with this conservative assumption, the aeration system of the Petoie WWTF has adequate capacity to meet the calculated demand for both future development scenarios.

Membranes

Flat plate membrane manufacturers are currently providing 6- to 10-year full warranties on their membrane modules, but some membranes may last longer than 10 years if they are properly maintained and cleaned regularly. The existing WWTF O&M manual (provided by the membrane manufacturer) recommends replacing the membranes every 8 years. The membrane manufacturer (Kubota) has offered to conduct membrane integrity/tensile strength testing, at no charge, to help determine the strength of the existing membranes to estimate the remaining membrane life expectancy. Since the existing membranes are over 10-years old, this Report assumes that both existing submerged membrane units will be replaced in the next few years.

Effluent Pump Station

Additional information is needed to evaluate the effluent pumps. There are two effluent pumps, each powered by a 3/4-hp motor. However, without draining the effluent pump station to remove and inspect the pumps, the make, model, and capacity are unknown. The WWTF operator did not indicate any problems with the effluent pump station, so the pumps are assumed to be adequate for current flows. It is unknown if the existing pumps would be adequate to handle additional flows.

Effluent Drainfield

As discussed in Chapter 4, the effluent drainfield exceeds Ecology's hydraulic loading criteria of 2.0 gpd/ft^2 for both future development scenarios. While the Tribe is not subject to these regulations, these regulations nevertheless provide safe guidance for long-term infiltration capacities of on-site sewer system drainfields. Since the MBR effluent from this treatment facility has very low organic content, it is likely that the drainfield will accept higher infiltration rates than Ecology's hydraulic loading rate.

There are no records of maintenance for this drainfield. Minimum maintenance should include cleaning the diversion valves and checking squirt heights on laterals.

Backup Drainfield

The backup drainfield should only be used under rare MBR system shut-downs for the minimum time necessary for the following reasons (summarized from the 2014 Indian Health Service technical report: *Petoie Back-Up Drainfield Analysis for the Confederated Tribes of the Chehalis Reservation*).

- Drainfield is hydraulically undersized for septic effluent for both future development scenarios (as shown in Table 6-4).
- Some distribution laterals may be blocked, and there is no record of squirt heights at test locations.
- Without regular use, septic drainfields do not provide adequate nitrification or pathogen removal.
- The drainfield lacks a timed dosing system.

Since the back-up drainfield is inadequate for prolonged use, keeping records of the dates that it is used and the volume of wastewater flow sent to this drainfield is critical to knowing whether it is being over-used. A simple method of record keeping would be a log of when the system is diverted to the back-up drainfield, since this diversion appears to be manual. Installing a flow meter and maintaining flow records would provide a more robust record of use; however, estimating the flow volume by logging the influent flow during the diversion period would suffice.

There are no records of maintenance for this drainfield. Minimum maintenance should include cleaning the diversion valve, checking observation ports for blockage, and checking squirt heights on laterals.

Instrumentation & Controls

PLC and HMI System

A programmable logic controller (PLC) coordinates the action of the plant's pumps, blowers, and mixer. The desktop computer which was intended to serve as the human machine interface (HMI) for the PLC is no longer operational. The PLC continues to operate, but its settings cannot be changed onsite without a functional computer terminal. Currently, the plant runs on level control based on the float level in the anoxic zone.

The HMI computer should be replaced, and the SCADA software should be properly installed and configured for data collection. In addition to allowing for adjustments to the PLC, this would facilitate the task of record keeping, which is necessary to properly diagnose problems when they arise.

Dissolved Oxygen Meter

The dissolved oxygen (DO) meter in the Pre-Aeration Basin was not operational during Gray & Osborne's 2016 field visit.

To properly operate the plant this meter should be replaced. Insufficient aeration will cause incomplete BOD consumption and nitrification, increasing the likelihood of drainfield fouling and high ammonia levels in the effluent. Over-aeration increases electrical operational costs and can cause incomplete denitrification, leading to high levels of effluent nitrate and nitrite. Lab tests performed during the analysis period suggest that the Petoie WWTF may be over-aerated.

Turbidimeter

The turbidimeter was not connected to a power source when inspected during Gray & Osborne's 2016 field visit and is likely no longer operational.

It is recommended that a new turbidimeter be installed to monitor the effluent quality. Increases in turbidity may indicate a break or tear in a membrane cartridge. If left unchecked, a torn membrane will cause drainfield fouling. As previously stated, the membranes in this facility are nearing the end of their design life-spans, so it is likely that some of the existing membranes may soon fail. Therefore, since the plant has no reserve drainfield, the turbidimeter serves as a critical warning system for preserving the functionality of the existing drainfield.

Influent and Effluent Flow Meters

It is recommended that the both flow meters be replaced with new magnetic flow meters. It is further recommended that the totalized flow from both meters be recorded on a daily basis for operation, control and future planning purposes.

Standby Power

The Petoie WWTF has no provisions for standby electrical power. It is recommended that the WWTF have a dedicated standby generator installed or provisions for connecting an adequately sized trailer mounted generator to power the WWTF during utility power outages. The Tribe may also decide to use a diesel-powered pump to pump the septic tank effluent to the backup drainfield during utility power outages.

CAPACITY FOR TREATING FLOWS FROM FERN HOUSING DEVELOPMENT

As indicated in Table 6-4, the Petoie WWTF lacks the hydraulic capacity to treat flows from the Fern Housing Development in the areas of flow equalization, membrane flux, and effluent drainfield hydraulic loading. Upgrading these facilities would not be cost effective when compared to conveying the Fern Housing wastewater to the Casino WWTF for treatment as discussed in Chapter 7.

However, the Tribe may want to consider making critical upgrades to the Petoie WWTF to continue accepting flow from the Davis Housing Development.

COMMUNITY NON-RESIDENTIAL AREA (PUBLIC SAFETY WWTF AND ASSOCIATED COLLECTION SYSTEMS)

COLLECTION SYSTEM

As described in Chapter 4, the collection system for the CNA is a septic tank effluent (STEP) system, which is approximately 10 years old.

Physical Condition

No specific information on the condition of the collection system was available for this Report. However, based on its age, the collection system is assumed to be in good condition.

Flow Capacity

Since no operational problems or capacity issues have been reported for the existing system, the existing STEP collection system is assumed to have adequate capacity to transfer future projected flows to the vicinity of the Public Safety WWTF as designed and constructed.

HISTORICAL WWTF PERFORMANCE

There is no written documentation of WWTF performance or operations and maintenance recordkeeping for the Public Safety WWTF. In 2016, Gray & Osborne, Inc. conducted sampling of the influent and effluent to the WWTF to assess WWTF performance. There is no WAS holding tank at the WWTF. During the site visit, WWTF staff reported that solids are wasted twice per year when the tanks are cleaned. As discussed above, operation in this manner results in an exceedingly high SRT, which will negatively impact the WWTF performance due to excessive dead and decaying microorganism accumulation in the process tanks. These conditions will lead to the inability of the process to denitrify and will also lead to the accumulation of phosphorus in the process, which will result in high effluent nitrate and phosphorus concentrations. Effluent pH was not measured, but it is likely that operation in this manner also results in an acidic effluent with a low pH. It is highly recommended that solids be wasted regularly (at least weekly) for acceptable plant performance. This recommendation is further discussed below.

Table 6-5 summarizes the data from samples collected between 7/15/2015 and 8/21/2015 from the Public Safety WWTF. These results are discussed below. Complete lab reports are available in Appendix B of this report.

TABLE 6-5
Public Safety WWTF Wastewater Characterization Summary

Parameter	Location	Average Value (mg/L)	Standard Deviation (mg/L)
Alkalinity (as $CaCO_3$)	Influent	357	4.1
COD	Influent	184	21
BOD_5	Influent	126	72
	Effluent	7	6
Total Kjeldahl Nitrogen	Influent	64	8
	Effluent	5	1
NH_3-N	Influent	80	15
	Effluent	5	2
NO_2-N + NO_3-N	Influent	N/D	N/D
	Effluent	27	1
Total Phosphorous	Influent	63	14
	Effluent	66	8
Total Suspended Solids	Influent	26	8
	Effluent	N/D	N/D

N/D: Below detection limits

BOD Removal

The Public Safety WWTF was achieving sufficient BOD removal during the sampling period.

Nitrification and Denitrification

The Public Safety WWTF was achieving moderate nitrification during the sampling period and limited denitrification during the sampling period. The likely cause of the lack of denitrification is the extremely long SRT resulting from the infrequency of solids wasting operations as discussed above.

TSS Removal

The Public Safety WWTF was achieving excellent TSS removal during the sampling period.

Effluent Disinfection

The Public Safety WWTF does not have any disinfection equipment and does not test for effluent fecal coliforms. It is recommended that effluent be sampled and tested periodically for fecal coliform bacteria.

Since the Public Safety WWTF peak day design flow is less than 100,000 gallons per day and it treats commercial flow with a similar strength to that of residential septic effluent, per requirements of WAC 246-272B, additional effluent disinfection is not likely required. However; due to the effluent drainfield proximity to the existing drinking water well, it is recommended that the effluent be periodically sampled and tested to fecal coliform.

WWTF EVALUATION AT NEW DESIGN CRITERIA

An analysis of the performance requirements for each major component of the Public Safety WWTF was performed based on the projected 2037 flows and loadings from the community non-residential area and the other east residential areas, including the Fern Housing Development. This analysis is similar to the analysis conducted for the Petoie WWTF. For a discussion of each of the components analyzed, refer to the discussion above for the Petoie WWTF. The projected 2037 flows and loadings are listed in 6-6. The results of this analysis are summarized in 6-7.

TABLE 6-6 Projected 2037 Public Safety WWTF Flows and Loadings		
Public Safety WWTF Collection Area:		
Flows		
Average Annual Daily (gpd)		39,000
Maximum Monthly Average Daily (gpd)		48,000
Peak Daily (gpd)		90,000
Peak Hourly (gpd)		148,000
Loadings with Septic Effluent		
BOD (lb/d)	Average Annual	51
	Maximum Monthly	74
TSS (lb/d)	Average Annual	11
	Maximum Monthly	16
TKN (lb/d)	Average Annual	20
	Maximum Monthly	26
Loadings with Grinder Effluent		
BOD (lb/d)	Average Annual	104
	Maximum Monthly	146
TSS (lb/d)	Average Annual	56
	Maximum Monthly	78
TKN (lb/d)	Average Annual	21
	Maximum Monthly	29

TABLE 6-7
Comparison of Public Safety WWTF Component Design Criteria and Projected Flow and Loadings

Component/ Parameter	Capacity/Criteria	Reference	2037 Operating Condition (Septic Effluent)	Meets Criteria?	2037 Operating Condition (Grinder Pumps)	Meets Criteria?
Influent Screen @ PHF	Unknown	Manufacturer	148,000 gpd	**?**	NA	**NA**
Equalization Tank	3 hrs of PHF	NA	1 hr	**No**	1 hr	**No**
Influent Pump	150,000 gpd$_5$ @ PHF	Manufacturer	148,000 gpd	Yes	148,000 gpd	**Yes**
Recycle (Feed Forward) Pump	65,000 gpd	4x AADF$_2$	156,000 gpd (4x AADF$_2$)	**No**	156,000 gpd (4x AADF$_2$)	**No**
Aeration Basin Solids Retention Time (SRT)	14.5 d @ MMADF Loading	M&E, 2014	4 days$_{1,3}$	**No**	2 days$_{1,3}$	**No**
Aeration Capacity	44 scfm	Manufacturer	150 scfm$_{3,4}$	**No**	230 scfm$_{3,4}$	**No**
Membranes (All Units in Service)	11.8 gfd @ AADF	Manufacturer	30.2 gfd	**No**	30.2 gfd	**No**
	13.5 gfd@ MMADF	Manufacturer	37.2 gfd	**No**	37.2 gfd	**No**
	18.2 gfd @ PDF	Manufacturer	69.8 gfd	**No**	69.8 gfd	**No**
	25.3 gfd @ PHF	Manufacturer	114.7 gfd	**No**	114.7 gfd	**No**
Permeate Pump	12,000 gpd$_5$	Manufacturer	90,000 gpd	**No**	90,000 gpd	**No**
Effluent Pump	56,160 gpd	Manufacturer	90,000 gpd	**No**	90,000 gpd	**No**
Effluent Drainfield	1.0 gfd$_6$ @ PDF	WSDOH$_6$	36 gfd @ PDF	**No**	36 gfd @ PDF	**No**

(1) Based on an observed yield of 0.60 lb TSS/lb BOD, aerobic SRT of 14.5 days.
(2) MBRs typically require 4x AADF to achieve at least 80 percent denitrification.
(3) Assumes biological treatment parameters as listed Table 6-3.
(4) Assumes that oxidation takes place only in the pre-aeration basin, with one of the two blowers inactive.
(5) Based on documentation from the manufacturer.
(6) Based on guidance from the Washington State Department of Ecology for Large On-Site Treatment Systems discharging to Soil Types 1 and 2 (WAC 246-272B, Sections 03400 (Table 1) and 06350 (18)). The actual infiltration rates of MBR effluent in the Petoie drainfield should be confirmed by a hydrogeological study onsite.

As shown in Table 6-7, with the exception of the influent pumps, none of the Public Safety WWTF components are not sufficiently sized for the projected future flows and loadings. The Public Safety WWTF is currently running at or beyond its design capacity, based on the estimated influent flows and loadings presented in Chapter 5. Due to a lack of maintenance records, it is unknown how much, if any regularly scheduled maintenance has been performed on the Public Safety WWTF equipment. During the site visit, only one recycle pump was present without a backup pump, the influent flow meter was removed, the DO probe was not operational, and there was no effluent turbidimeter present. It is assumed that most of the equipment at the Public Safety WWTF would be required to be replaced even without increased influent flows. Preliminary project cost estimates to modify and expand the existing Public Safety WWTF to treat future flows and loadings indicate that expanding the existing plant is more expensive than diverting flow to the Casino WWTF to treat the combined projected flows and loadings. For the reasons cited herein, it is assumed that the flow from the community non-residential area and the other east residential areas, including the Fern Housing Development will be sent to the Casino MBR WWTF; and the existing Public Safety WWTF will be demolished upon flow transfer. The Casino MBR WWTF evaluation is presented in Chapter 7.

LUCKY EAGLE CASINO AND HOTEL

LOCATION WITH RESPECT TO 100-YEAR FLOODPLAIN

Based on the data provided by the Tribe, the Lucky Eagle Casino WWTF is located above the 100-year floodplain and its associated effluent rapid infiltration basin is located below the 100-year flood elevation.

COLLECTION SYSTEM

As described in Chapter 4, the collection system for the Casino and Hotel is a septic tank effluent (STEP) system, which was installed approximately 20 years ago.

Physical Condition

No specific information on the condition of the collection system was available for this report. However, based on its age, the collection system is assumed to be in good condition.

Flow Capacity

As described in Chapter 4, the Lucky Eagle Casino has a pressurized septic tank effluent collection system powered by eight pump stations. These pump stations vary in capacity from roughly 55 to 255 gpm. Peak Hour Flow in 2037 is projected at 200,000 gpd, or 140 gpm. As shown in Table 6-8, each Pump Station has adequate capacity to handle the 2037 design flow.

TABLE 6-8 Flow Requirements per Pump Station at 2037 Peak Hour Flow			
Pump Station	**Estimated Share of Flow(1)**	**Flow Demand (gpm)**	**Flow Capacity (gpm)**
1	20%	41	55
2	13%	26	55
3	13%	26	65
4	14%	28	170
5	13%	26	130
6	13%	26	130
7	14%	28	100
8	40%(2)	81	255

(1) Pump Station 1 handles all projected flow from the Hotel; Pump Stations 2 through 7 are assumed to evenly divide the flow from the Casino.

(2) Pump Station 8 receives flow from Pump Stations 4, 5, and 6.

Flow Configuration and Operation

The current collection system configuration for the Lucky Eagle Casino WWTF typically allows wastewater flow to be transferred to the WWTF influent equalization tank, but an automatically operated motorized valve is installed to allow influent to be diverted to Storage Basins 1 and 2 when the level in the equalization is tank high. The storage basins are outdoor, lined, earthen basins, which do not have a cover or odor control facilities.

Diverted wastewater to these basins must be pumped back to the WWTF using a portable trash pump and associated temporary piping. It is not known how often flow diversion to these uncovered basins occurs. If this occurs frequently and for appreciable lengths of time, it may result in odor complaints from casino patrons. For this reason, the Tribe may want to consider replacing these basins with a covered concrete equalization tank equipped with odor control and automatic pumping equipment. Alternatively, if the hydraulic capacity of the WWTF is increased, the new concrete equalization basin may not be necessary.

HISTORICAL WWTF PERFORMANCE

The Casino WWTF operations staff periodically samples influent and effluent for laboratory analysis and keeps records of this data along with data for solids wasting and operational and maintenance records. WWTF influent and effluent sampling data is available from February 2012 to April 2015. These test results are presented in Table 6-9 and are discussed below.

TABLE 6-9 Lucky Eagle Casino WWTF Wastewater Characterization Summary									
	Alkalinity (mg/L as aCO3)	**BOD (mg/L)**	**NH3-N (mg/L)**	**NO2-N (mg/L)**	**NO3-N (mg/L)**	**Oil & Grease (mg/L)**	**TKN (mg/L)**	**Total P (mg/L)**	**TSS (mg/L)**
Influent									
8/16/2012		545							
2/21/2013		324				24	54	10.4	
5/16/2013		380					54	7.2	70
9/12/2013						41			
10/10/2013						32			
11/14/2013						23			
2/13/2014						35			
3/13/2014		155	32.2		< 0.2		42	6.6	
5/22/2014		245	38.7		< 0.2	19	47	6.6	
12/11/2014		276	34.5		< 0.2	28	49	6.3	
4/30/2015		131	34.0	< 0.1	< 0.2	27	56	7.3	
Influent Average		**325**	**34.9**	**0.1**	**< 0.2**	**29**	**50**	**7.4**	**70**
Effluent									
2/21/2013	143	11	< 1.0		1.4	< 1	1.8	3.7	
5/16/2013		7.5	< 1.0		1.9		2.1	0.14	2.0 & ND(1)
9/12/2013						< 1			
11/14/2013						< 1			
3/13/2014		< 3.0	< 1.0		1.7		1.3	0.08	
5/22/2014		< 3.0	< 1.0		1.8		1.2	0.13	
12/11/2014		< 3.0	< 1.0		2.7		< 1	2.7	
4/30/2015		< 3.0	< 1.0	< 0.1	2.1	< 1	1.1	7.1	
Effluent Average	**143**	**4.7**	**< 1.0**	**< 0.1**	**2.0**	**1**	**1.4**	**1.7**	**< 2.0**

(1) Two TSS tests were performed on 5/16/2013. One was 2.0, the second was non-detect (less than 1.0 mg/L).

BOD Removal

The Casino WWTF achieved BOD removals expected of a MBR facility during the sampling period. Typical technology based effluent BOD limits are 30 mg/L. All of the tested effluent values were 11 mg/L or lower.

Nitrification and Denitrification

The Casino WWTF achieved excellent nitrification and denitrification during the sampling period. All effluent NH_3-N concentrations were below the test method's detection limit of 1.0 mg/L. Effluent NO_3-N averaged 2.0 mg/L.

Phosphorous Removal

With the exception of one sample, the Casino WWTF achieved very good phosphorous removal during the sampling period.

Effluent Disinfection

The Casino WWTF staff do not sample and analyze for effluent fecal coliform. It is recommended that effluent be sampled and tested periodically for fecal coliform bacteria.

TSS Removal

The two effluent TSS samples were taken during the sampling period show excellent TSS removal. Generally speaking properly functioning membranes should always produce effluent TSS levels near the detection limit of the test method. Higher TSS levels can be an indication of membrane damage.

WWTF EVALUATION AT NEW DESIGN CRITERIA

An analysis of the performance requirements for each major component of the Casino WWTF was performed based on the projected 2037 influent flows and loadings listed in Table 6-10. This analysis is similar to the analysis conducted for the Petoie and Public Safety WWTF's. For a discussion of each of the components analyzed, refer to the discussion above for the Petoie WWTF. The results of this analysis are summarized in Table 6-11. The flows and loadings for the Casino WWTF include contributions from the Fern, Makum and Tahown Housing developments and the CNA.

TABLE 6-10 Projected 2037 Casino WWTF Flows and Loadings		
Flows (gpd)		
Average Annual		82,000
Maximum Monthly		102,000
Peak Daily		182,000
Peak Hourly		300,000
Loadings		
BOD (lb/d)	Average Annual	196
	Maximum Monthly	249
TSS (lb/d)	Average Annual	31
	Maximum Monthly	39
TKN (lb/d)	Average Annual	39
	Maximum Monthly	48

TABLE 6-11
Comparison of Casino WWTF Component Design Criteria and Projected Flows

Component / Parameter	Capacity/Criteria	Reference	2037 Casino Operating Condition	Operating Condition Meetings Criteria?
Equalization Basin	3 hrs of PHF-MMF	NA	3.2 hrs	Yes
Surge Tanks	3 hrs of PHF-MMF	NA	3.4 hrs	Yes
Storage Basin 1	3 days @ PDF	NA	5 d	Yes
Storage Basin 2	3 days @ PDF	NA	3d	Yes
Feed Forward Pump	3,000,000 gpd[1] @ PHF	Manufacturer	292,000 gpd	Yes
Membranes (All Units in Service)	11.8 gfd @ AADF	Manufacturer	9.1 gfd	Yes
	13.5 gfd@ MMADF	Manufacturer	11.5	Yes
	18.2 gfd @ PDF	Manufacturer	18.4	**No**
	25.3 gfd @ PHF	Manufacturer	32.3 gfd	**No**
Membranes (One Unit Out of Service)	11.8 gfd @ AADF	Manufacturer	12.3 gfd	**No**
	13.5 gfd @ MMADF	Manufacturer	15.4 gfd	**No**
	18.2 gfd @ PDF	Manufacturer	24.6 gfd	**No**
Effluent Pumps	158,000 gpd[2] @ PDF	Manufacturer	167,000 gpd	**No**
Rapid Infiltration Basin	Unknown PDF Capacity	NA	2.1 gfd	Unknown
Aeration Basin Solids Retention Time (SRT)	14.5 d @ MMADF Loading	M&E, 2014	20 d	Yes
WAS Holding Tank SRT	10 days	N/A	13 days[3]	Yes
Aeration Capacity	620 scfm	Manufacturer	390 scfm	Yes

(1) Exact capacity was not available for this report. Typical value for a 4” diameter airlift pump, > 90% submerged is shown.
(2) Assumes Barnes Series EH-L pumps, 5 of 6 pumps active, 1200 ft. of 3-in. pipe, Hazen Williams C value of 140.
(3) Assumes 14.5 day solids retention time and biological treatment parameters as listed in Table 6-3

As shown in Table 6-7, with the exception of the membrane peak daily flow capacity and effluent pumps, all of the Casino WWTF components are sufficiently sized for the projected future combined casino and hotel flows and loadings, as well as other flows from the central reservations areas. The recommended WWTF upgrades for the projected combined flows and loadings are described in the next section.

RECOMMENDED CASINO WWTF UPGRADES

Membranes

The 2037 PDF flow for the combined flows will exceed the peak day capacity of the membranes. It is recommended that two additional submerged membrane units be installed in the existing MBR to increase the hydraulic capacity of the membrane system to pass the peak day hydraulic flow capacity and reduce equalization tank capacity requirements.

Flat plate membrane manufacturers are currently providing 6- to 10-year full warranties on their membrane modules, but some membranes may last longer than 10 years if they are properly maintained and cleaned regularly. Since the existing membranes are over 10 years old, it is recommended that all the existing membrane units be replaced within the next five years.

Human-Machine Interface (HMI)

The plant was originally a package plant and uses an outdated HMI. It is recommended that new HMI be installed that lets the operator check alarms, set points and other key operating criteria from a remote location.

Permeate Pumps

The plant relies on gravity head to drive flow through the membranes now which is very inefficient. It is recommended that new permeate pumps be installed to pull the filtered flow through the membranes under a vacuum. Three permeate pumps each rated for 275 gpm should be installed to provide redundancy.

Process Water Pump Station

The current plant does not have a process water pump station for side steams, tank draining and returning any diverted sewage that flows into the equalization lagoon to the treatment plant. It is recommended that a new pump station be constructed with submersible pumps to direct various flow streams back to the treatment plant. The pump station wet well would be a 6-foot dimeter manhole and would house two submersible pumps each rated at 140 gpm.

Effluent Pumps

The effluent pump chamber contains six pumps. The effluent pipe is 3-inch PVC. No design documents are available for the effluent system, but the effluent pipe discharges above ground, and its length is conservatively estimated at 1,200 feet. The pumps are described in design documents as 1/2-hp Barnes high head submersible effluent pumps. The Barnes pump models that fits this description are in the EH-L series. Assuming one pump out of service, the peak flow capacity for the five remaining pumps is 158,000 gpd, as indicated in Table 6-9.

Installing a new 4-inch effluent pipe would effectively double the capacity of the effluent pump chamber, and would meet the 2037 design flow requirements with capacity to spare. Alternatively, upgrading the existing 1/2-hp pumps to 1 or 1.5 hp pumps would adequately increase the capacity of the pump station.

Influent and Effluent Flow Meters

Based on the inaccuracy of these flow meters as described in Chapter 5, it is recommended that the both flow meters be replaced with new magnetic flow meters.

Effluent Turbidimeter

There is no effluent turbidimeter installed at the Casino WWTF. It is recommended that a new turbidimeter be installed. Increases in turbidity may indicate a break or tear in a membrane cartridge. As previously stated, the membranes in this facility are nearing the end of their design life, so it is likely that some of the existing membranes may soon fail. An installed turbidimeter would serve as a critical warning system for the WWTF operation and for protecting the downstream surface water and ground water quality.

Composite Sampler

At present, there is no composite sampler and all samples are grab samples only. It is recommended that a composite sampler be installed to take samples out of the effluent pump station wet well so that the WWTF operator has a much better idea of how the plant is performing.

Effluent Rapid Infiltration Basin Capacity

Effluent from the Casino WWTF flows to a rapid infiltration basin of unknown capacity. No hydrogeological studies of infiltration rates have been performed. As shown on Figure 6-1, the NRCS reports that the rapid infiltration basin is located in a region of Godfrey silty clay loam (map unit 41). This clay soil was designated in hydrologic soil group C/D, which means that under undrained conditions it has a stormwater infiltration rate of less than 2.1 gallons per square foot per day (gfd). The basin has an area of roughly 80,000 ft^2, so based on the 2037 design flows, the MMADF and PDF hydraulic loading rates to the basin are 1.3 and 2.1 gfd, respectively. Since these rates are very close to the predicted capacity of the basin, it is recommended that the Tribe perform a hydrogeological study to assess the infiltration rate of the existing rapid infiltration basin.

The Tribe may also consider utilizing the abandoned drainfield for treated effluent disposal as the soils in that area are much better suited to infiltration. A diversion valve could be used to send the effluent to either the abandoned drainfield or to the rapid infiltration basins depending on time of year, etc.

Standby Power

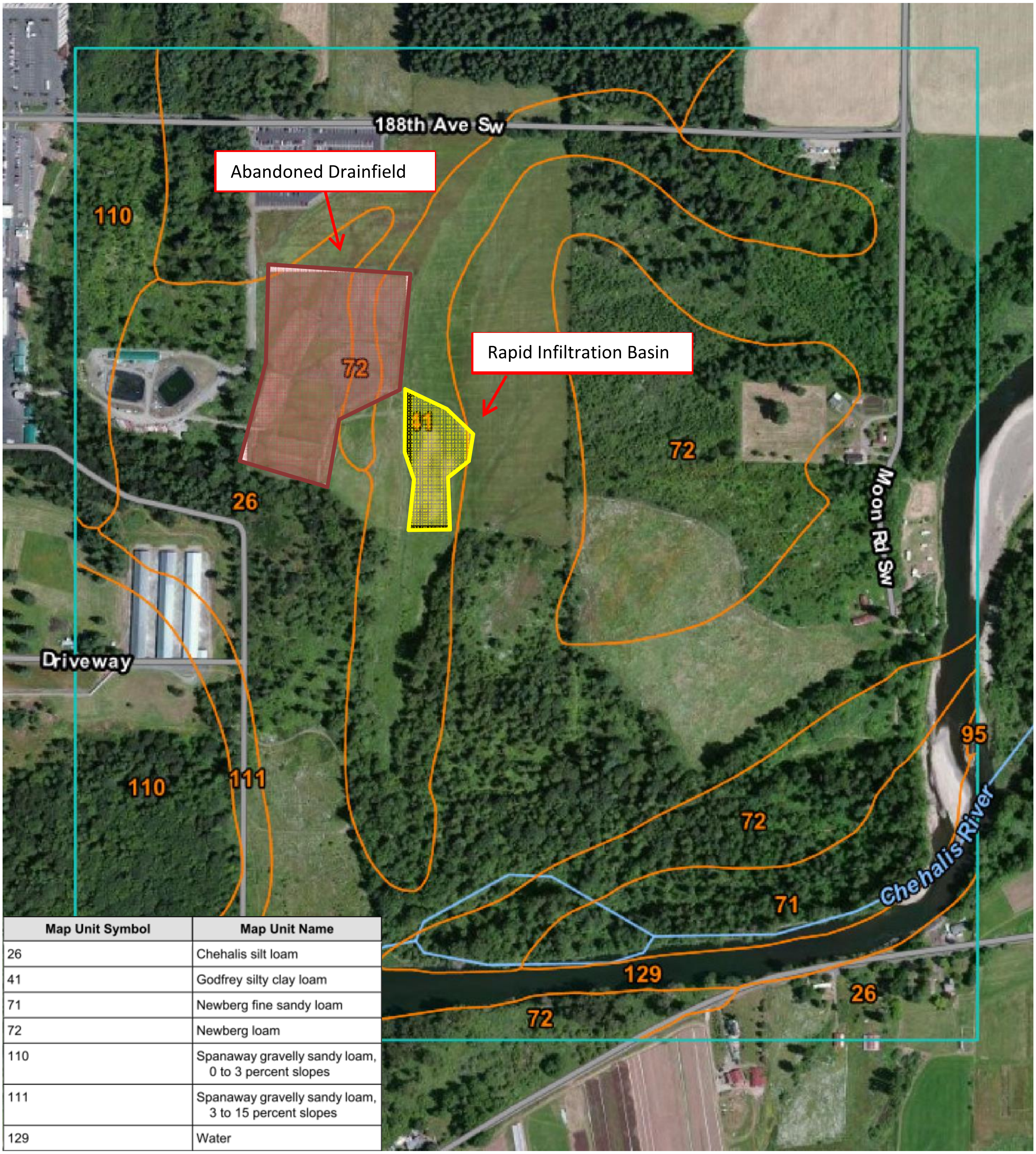
There is a standby generator installed to serve the Casino WWTF; therefore, no modification is necessary for this component.

SUMMARY OF ALL RECOMMENDED WWTF IMPROVEMENTS

A summary of the recommended modifications for each of the existing three WWTFs to treat the projected 20-year flows and loadings is presented below. It is further recommended that operational and maintenance records be maintained for all of the WWTFs.

RECOMMENDED PETOIE WWTF UPGRADES

The recommended upgrades to the Petoie WWTF to treat the projected 20-year flows and loadings from the Davis Housing Development are summarized in Table 6-12 below. As discussed previously, the Petoie WWTF lacks the hydraulic capacity to treat flows from the Fern Housing Development in the areas of flow equalization, membrane flux, and effluent drainfields. Upgrading these facilities would not be cost effective when compared to transferring the Fern Housing wastewater and treating it at the Casino WWTF, as discussed in Chapter 7.



Map Unit Symbol	Map Unit Name
26	Chehalis silt loam
41	Godfrey silty clay loam
71	Newberg fine sandy loam
72	Newberg loam
110	Spanaway gravelly sandy loam, 0 to 3 percent slopes
111	Spanaway gravelly sandy loam, 3 to 15 percent slopes
129	Water

Map Scale: 1:8,620 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 6-1
SOIL SURVEY FOR LUCKY EAGLE CASINO
WWTF DRAINAGE AREA

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TABLE 6-12 Petoie WWTF Upgrades Estimated Project Cost Summary				
Item No.	**Item Description**	**Quantity**	**Unit Price**	**Amount**
1	Replace Existing Submerged Membrane Units	2 EA	$9,000	$18,000
2	Install New DO Meter	1 LS	$18,000	$18,000
3	Install New Influent and Effluent Flow Meter	2 EA	$12,000	$24,000
4	Install New Turbidimeter	1 LS	$6,000	$6,000
5	Install New SCADA Computer and Provide Programming	1 LS	$20,000	$20,000
6	Install Connections for Temporary Diesel Drainfield Pump	1 LS	$2,000	$2,000
			Subtotal	$88,000
			Construction Contingency @ 20%	$18,000
			Total Estimated Construction Cost	$106,000
			Engineering, Administrative, Legal & Permitting @ 30%	$32,000
			TOTAL ESTIMATED PROJECT COST	**$138,000**

Note: All costs have been rounded to the next $1,000.
ENR Seattle Construction Cost Index – August 2017 = 10,724.95

The total estimated project cost estimated for modifications for the Petoie WWTF is $138,000. Additional projects that the Tribe may consider implementing include a drainfield hydrogeological evaluation for $60,000 and installation of a permanent standby power generator for $50,000.

RECOMMENDED PUBLIC SAFETY WWTF UPGRADES

Preliminary project cost estimates to modify and expand the existing Public Safety WWTF to treat future flows and loadings show that expanding the existing plant is more expensive than transferring the flows to the Casino WWTF. For the reasons cited above, it is assumed that the Casino WWTF will be used to treat the new flows and loadings projected from the community non-residential area and the other east residential areas, including the Fern Housing Development. The existing Public Safety WWTF would then be demolished upon transfer of flow to the Casino WWTF. The expanded use of the Casino WWTF evaluation is presented in Chapter 7.

RECOMMENDED CASINO WWTF UPGRADES

The recommended upgrades to the Casino WWTF to treat the projected 20-year flows and loadings from the Lucky Eagle Casino and Hotel, as well as the other combined flows are summarized in Table 6-13 below.

TABLE 6-13
Casino WWTF Upgrades Estimated Project Cost Summary

Item No.	Item Description	Quantity	Unit Price	Amount
1	Install 2 New Submerged Membrane Units and One Air Scour Blower	1 LS	$100,000	$100,000
2	Replace Existing Submerged Membrane	1 LS	$80,000	$80,000
3	Install new HMI and computer	1 LS	$50,000	$50,000
4	Install new permeate pumps	1 LS	$30,000	$30,000
5	Install new process water pump station	1 LS	$50,000	$50,000
6	Install new effluent pumps	1 LS	$20,000	$20,000
7	Install new influent and effluent flow meters	1 LS	$25,000	$25,000
8	Install new effluent turbidity meter	1 LS	$7,000	$7,000
9	Install new effluent composite sampler	1 LS	$25,000	$25,000
			Subtotal	$387,000
			Construction Contingency @ 20%	$78,000
			Total Estimated Construction Cost	$465,000
			Engineering, Administrative, Legal & Permitting @ 30%	$140,000
			TOTAL ESTIMATED PROJECT COST	**$605,000**

Note: All costs have been rounded to the next $1,000.
ENR Seattle Construction Cost Index – August 2017 = 10,724.95

The total estimated project cost estimated for modifications for the Casino WWTF is $605,000. The total project cost includes replacing the existing membranes and installing two new S&L Model 200 submerged membrane units (SMU) and an associated air scour blower. This modification will increase the peak day hydraulic capacity of the WWTF to 220,000 gpd with the largest SMU out of service and it will increase the peak hour hydraulic capacity of the WWTF to 330,000 gpd with all of the SMUs in service. The total membrane surface area with the two new SMU's would be 15,060 square feet (ft^2) and the total membrane surface area with one of the largest units out of service would be 12,048 ft^2. This increased hydraulic capacity eliminates the need for any additional flow equalization and will greatly decrease the risk of emergency overflow and required storage of influent wastewater in the existing outdoor storage basins. It is recommended that the existing storage basins be retained for emergency storage since the WWTF only has a single MBR tank and storage will be required if that tank needs to be taken off line for service.

The WWTF will continue to use chlorine to disinfect the treated wastewater prior to discharge.

CHAPTER 7

WASTEWATER CONVEYANCE, TREATMENT AND DISPOSAL ALTERNATIVES

INTRODUCTION

The purpose of this section is to present and evaluate conceptual alternatives for wastewater collection, treatment and end use of the treated effluent for the Chehalis Tribe.

There are numerous issues and alternatives that must be discussed and evaluated to arrive at a workable solution to the challenges of providing a wastewater treatment system for the Tribe. There are many houses within the reservation that still utilize septic systems and drainfields and the Tribe wants as many of those hooked up to a sewer system and treatment plant as possible.

In the Gray & Osborne report prepared in 2016, the recommended alternative was to construct a new MBR treatment plant that would replace the Public Safety MBR facility and be able to accept sewage from numerous other housing developments. However, the cost of this alternative was extremely high and the Tribe decided to look at other alternatives that would be more affordable. To that end, the Casino MBR has a lot of spare capacity now and can easily and affordably be retrofitted with additional membranes to add capacity so that it can accept the flow from the housing developments which are now on septic systems, as well as, flow from the CNA which now goes to the Public safety MBR WWTF.

This report will present two alternatives for how best to treat the sewage from the remaining housing developments that are still on septic systems except for the western part of the Reservation. The first alternative is to expand the collection system to include the Tribal Government Complex, Makum Housing Development, Wellness Center, Fern Housing Development, the Community Center and the Tahown Housing Development and direct that flow to the Casino MBR WWTF. The second alternative is to take the flow from the above sources and construct a new MBR WWTF with discharge to rapid infiltration basins as presented in the Gray & Osborne 2016 Plan.

A third alternative was considered but will not be detailed in this report. The other alternative was to construct a new secondary treatment plant using the Orenco AX-MAX package plant. This alternative was not considered any further because the AX-MAX does not provide the same level of denitrification as the MBR plants which is a major concern for the Tribe to protect their drinking water supplies. The AX-MAX also requires a very large footprint to build and non-floodplain land is at a premium on the Reservation. MBR plants are much more compact.

As summarized in Chapter 6, only minor modifications to the existing Petoie and Casino WWTFs and their associated collection and disposal systems are required to adequately treat the projected flows and loadings from their respective collection systems. Chapter 6 also concludes that because preliminary project cost estimates indicate that it is more expensive to expand the existing Public Safety WWTF to accommodate the projected future flows and loadings than to transfer flow to the Casino WWTF. In this chapter, the Tribe's most reasonable options for decommissioning the existing Public Safety WWTF, upgrading the collection system into a STEP system, and effluent disposal facility to serve the projected 2037 sewage flows from the east reservation area are evaluated. As part of this evaluation, design criteria for wastewater facilities and treatment goals are presented. Alternatives are described, compared and rated based on critical evaluation criteria, and a detailed cost estimate is presented for each.

All treatment alternatives are evaluated based on the ability to treat design flows and loadings projected for the year 2037 for facilities in the east reservation area, which do not currently flow to the Petoie or Casino WWTFs. The recommended alternatives are identified and further described in detail at the end of this chapter.

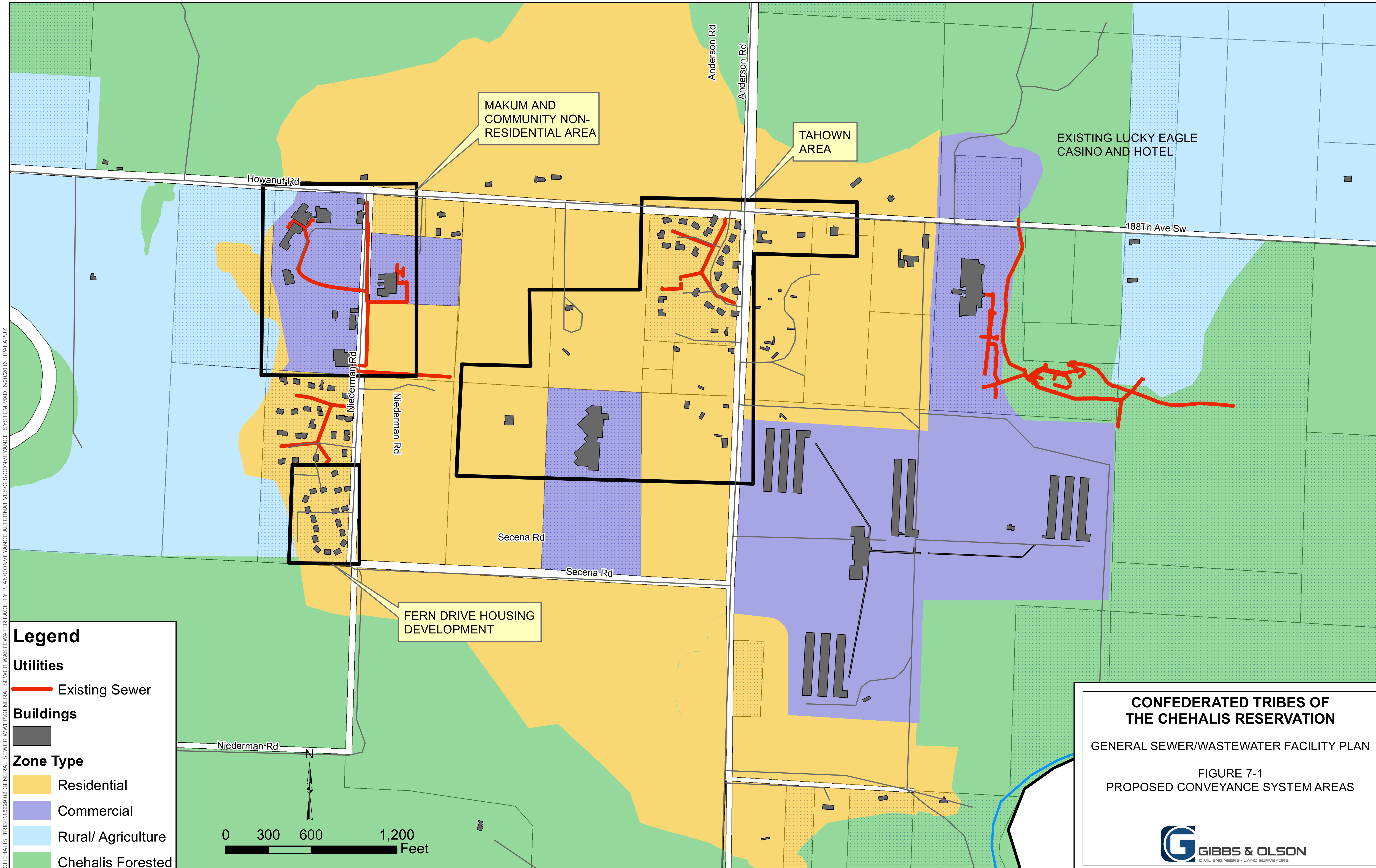
The evaluation and recommendation of wastewater treatment, conveyance and disposal facilities are presented below in the following sequence of component analyses, which reflects the order of development of the selected plan for new facilities:

- Evaluation of Conveyance System Alternatives
- Evaluation of WWTF Disposal Alternatives
- Evaluation of WWTF Processes
- Evaluation of Water Reclamation and Reuse

EVALUATION OF CONVEYANCE SYSTEM REVISIONS

GENERAL

This section provides a discussion and evaluation of the alternatives for conveyance of wastewater to the proposed treatment facilities. One type of wastewater collection system was considered in this evaluation: septic tank effluent pump (STEP). The costs associated with providing sewer service to three geographic areas with the single type of wastewater collection systems were estimated: Tahown Housing Development (Tahown), Tribal Complex (Community Non-Residential Area, CNA), and Makum Housing Development (Makum). The Fern Drive Housing Development area will be detailed in this report; however, Fern Drive conveyance system revisions are planned to take place at a future date after conveyance revisions of Tahown, CNA, and Makum. The location of these areas is shown in **Figure 7-1**. The conveyance system option assumes that wastewater will be conveyed by a system of newly installed force main piping to the Casino WWTF. In the option below, the Tribe would own and operate the collection system components including the STEP pump stations.



L:\CHEHALIS_TRIBE\15229.02 GENERAL SEWER WWFP\GENERAL SEWER WASTEWATER FACILITY PLAN\CONVEYANCE ALTERNATIVES\GIS\CONVEYANCE_SYSTEM.MXD, 6/20/2016, JPALAPUZ

For the STEP alternative, it is assumed that the existing septic tanks are in usable condition to be fitted with a prefabricated polypropylene vault equipped with an effluent filter, pump, floats, and control system. STEP systems pump only the liquid effluent from septic tanks, and the solids remain in the tanks. Pumping screened effluent allows small diameter pipes to be used to convey the flow, the STEP system filters require regular maintenance and the solids are required to be removed periodically, which increases O&M costs for this system.

A grinder pump system and vacuum pump system were presented in the 2016 Gray & Osborne report but were both more expensive than the STEP system and the Tribe prefers to handle the solids in the same manner as they do now which is to regularly pump them out of septic tanks and take them offsite for beneficial use.

SEPTIC TANK EFFLUENT PUMP (STEP) SYSTEM ALTERNATIVE - FUTURE

FERN DRIVE HOUSING DEVELOPMENT AREA

A schematic of the STEP system to serve the Fern Drive area may be seen on **Figure 7-2**. A simplex pump would be installed at each existing house. Where feasible, a single 1.5-inch diameter pipe would be shared by houses to convey flow to a 2-inch diameter collector line within Fern Drive. The collector line would convey flow north on Niederman Road from Fern Drive to the intersection of Niederman Road and the Community Center Utility Access Road. The wastewater will then be pumped in a 4-inch diameter pipe east to County Line Road SW. The line would then convey flow south on County Line Road SW to the intersection of Brairwood Road. The line would the convey flow east along Briarwood Road until the line will be offset by fittings to convey flow east just south of the fence enclosing the Casino parking lot. The line would then convey flow North on the east side of the Casino maintenance buildings until connection is made into the existing force main line to the Casino WWTF that is currently serving the Casino and Hotel.

The conveyance plan to Casino WWTF is shown in **Figure 7-3** and **Figure 7-4**.

The 2-inch diameter collector line would have sufficient capacity to convey flows from the development anticipated on the east side of Niederman Road, adjacent to the Fern Housing Development.

Estimated Fern Drive STEP System Project Cost: $649,000

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Confederated Tribes of the Chehalis Reservation
General Sewer Plan
Fern Drive STEP System
FIGURE 7-2

SEPTIC TANK EFFLUENT PUMP (STEP) SYSTEM ALTERNATIVE

COMMUNITY NON-RESIDENTIAL (CNR) AREA

A schematic of the STEP system to serve the CNR area may be seen on Figure 7-3. Many of the buildings within this area are currently served by a STEP conveyance system that conveys flow to the existing Public Safety WWTF located to the east of the Wellness Center. The following buildings do not appear to be connected to that system and would be by this alternative: Youth Center, Maintenance Shops, Natural Resources, Smoke House, and Public Safety. A simplex pump system would be provided at each building. The existing STEP conveyance system would be used to direct flow to the south side of the Wellness Center. Where feasible, a single, 1.5-inch diameter pipe would be shared by up to three buildings to convey flow to the existing collector lines. The new 4-inch diameter collector line would reroute flow that previously went to the Public Safety WWTF south along Niederman Road to the intersection of Niederman Road and Community Center Utility Access Road and eventually to the Casino WWTF. Conveyance plan to Casino WWTF is shown in **Figure 7-3** and **Figure 7-4**.

Estimated CNR Area STEP System Project Cost: $429,000

MAKUM HOUSING DEVELOPMENT AREA

A schematic of the STEP system to serve the Makum area may be seen on **Figure 7-3**. Where feasible, a single 1.5-inch diameter pipe would be shared by houses to convey flow to an existing 1-1/2-inch diameter collector line with Niederman Road. The collector line would then convey flow to a newly installed 4-inch diameter line located with Niederman Road, south of the wellness Center.

The new 4-inch diameter collector line would reroute flow that previously went to the Public Safety WWTF south along Niederman Road to the intersection of Niederman Road and Community Center Utility Access Road and eventually to the Casino WWTF. Conveyance plan to Casino WWTF can be viewed on **Figure 7-3** and **Figure 7-4**.

Estimated Makum STEP System Project Cost: $326,000

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Confederated Tribes of the Chehalis Reservation
General Sewer Plan
Makum & Community Non-Residential STEP System
FIGURE 7-3

TAHOWN AREA

A schematic of the STEP system to serve the Tahown area may be seen on **Figure 7-3**. It is assumed that a STEP system, with a duplex pump, would be installed at the existing communal septic system for the Tahown Housing Development. The duplex pump station would convey flow southeast along Tahown Drive to connect into a newly installed 4-inch diameter collector pipe within County Line Road SW. A simplex pump would be installed at each existing house within the Tahown service area. Where feasible, a single, 1.5-inch-diameter pipe would be shared by up to three houses to convey flow to the newly installed 4-inch-diameter collector line within County Line Road SW and within the Community Center Utility Access Road. See **Figure 7-3** for Community Center Duplex STEP system connection to newly installed 4-inch diameter collector line within Community Center Utility Access Road. The 4-inch diameter collector lines would convey flow to the existing Casino WWTF. The conveyance plan to the Casino WWTF can be viewed on **Figures 7-3** and **Figure 7-4**.

Estimated Tahown STEP System Project Cost: $1,300,000

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Confederated Tribes of the Chehalis Reservation
General Sewer Plan
Tahown Area STEP System
FIGURE 7-4

DRAWING: T:\CIVIL 3D\PROJECTS\01590001.ACT\CONTRACT DRAWINGS\SANITARY SEWER\CHAHALIS TRIBE SANITARY SEWER - CONTRACT DRAWING.DWG, LAYOUT TAB: FIGURE 7-4, PLOT DATE: 10/10/2017 3:19:12 PM, DRAWING SAVE DATE: 10/10/2017 3:17:09 PM, PLOTTED BY: SMCWILLIAMS

CONVEYANCE SYSTEM ALTERNATIVES LIFE CYCLE COST ANALYSIS

Table 7-1 provides a summary of the estimated project cost, present worth annual O&M cost, and 20-year life cycle cost for the STEP collection system. The detailed cost estimate is provided in Appendix D. As discussed above, the collection system alternative can all be expanded to accommodate future phases to buildout. The 20-year Life Cycle Cost Spreadsheet included in Appendix D summarizes the design life of the various collection system components, which was used to calculate the annual O&M costs. This spreadsheet also summarizes the annual O&M costs for electricity use, pump and lift station maintenance, sewer and force main flushing and inspection, mechanical component replacement, and septic tank pumping and hauling. The annual O&M cost was then converted to the present value and added to the capital project cost as shown below.

TABLE 7-1
STEP System Project Cost Estimate

Collection System Alternative	Estimated Capital Project Cost	Present Worth Annual Cost (20-Year)	Estimated Life Cycle Cost (20-Year)
STEP System	$2,055,000	$271,500	$2,326,500
STEP System – Future Fern Drive	$649,000	$151,600	$800,600

EVALUATION OF DISPOSAL METHODS

SELECTION OF DISPOSAL METHOD

This section provides a discussion and evaluation of the alternatives for disposal of the effluent from the potential Central WWTF. Two effluent disposal alternatives were eliminated prior to a comparison of three viable alternatives as discussed below.

Conveyance of untreated wastewater or treated effluent to another wastewater facility is not feasible due to the significant distance to an existing facility capable of handling the projected wastewater flows. The option to convey wastewater to the Grand Mound Wastewater Treatment Facility was considered in the Tribe's 2004 Wastewater Master Plan, which estimated the capital and annual operation and maintenance costs for this option to be $14,146,000 and $397,000, respectively. Based on the high costs associated with conveyance of wastewater to Grand Mound compared to the other options, this option is eliminated from further consideration.

Another alternative for disposal, which was eliminated from consideration, is effluent disposal via surface spray field. This alternative would surface apply the effluent using irrigation sprinklers. For this disposal system, the effluent must be applied at agronomic rates to a selected crop, thereby regulating the nutrient load and uptake by the crop. This alternative was eliminated from consideration due to the large land area requirements for the spray field and surrounding buffer zone, public access restrictions on the land that the effluent is applied, the burden of crop management, and the substantial maintenance required to control undesirable spray field vegetation.

The three options for effluent disposal which were considered include:

- Discharge through a new outfall to the Chehalis River.
- Infiltration to ground via subsurface drainfield on buildable land.
- Infiltration to ground via rapid infiltration basins located outside of buildable lands.

The first option for effluent disposal is discharge through a new outfall to the Chehalis River. The regulatory requirements and projected effluent limits for a discharge to the Chehalis River are discussed in Chapter 3. As discussed in Chapter 2, if the Tribe were to pursue a discharge outfall to the Chehalis River, an application to the EPA for an NPDES permit may be required since the EPA has jurisdiction over Indian Tribes for select circumstances. Therefore, permit requirements for an outfall to the Chehalis River may include an EPA NPDES permit, and an Army Corp of Engineers Section 7 permit. In addition, the Department of Fish and Wildlife and the Washington State Department of Natural Resources would need to be consulted for limitations for a river outfall.

Permitting requirements for a Chehalis River outfall would likely take several years. The probable effluent design criteria for discharge to a permanent outfall in the Chehalis River would be the more stringent of those listed in Tables 2-3 and in Table 2-5 for Tribe Class A surface water quality standards.

The second option for effluent disposal is infiltration to ground via an infiltration drainfield located on buildable lands, with a similar design as that used for the Petoie WWTF effluent system. The tribe defines buildable lands as the land area located above the 100-year flood elevation, as shown in Figure 3-3. The Tribe prefers to locate future effluent discharge systems outside of the buildable lands due to the relative small area of buildable lands on the reservation.

A value of $35 per square foot is assigned by the Tribe to buildable lands, which equates to $1,500,000/acre. An infiltration drainfield is recommended for installation above the 100-year due to difficulties associated with discharging to a drainfield that is submerged during a flood event. The permitting time frame for this option will likely be shorter than for the river outfall. Locating the drainfield on buildable lands will require that the drainfield be located to the east of the existing water well that is located in the vicinity of the Tribal Government Complex. Locating the drainfield in that area has the potential to place the drainfield within the 1-year or the 5-year capture zone of the drinking water well. The probable effluent design criteria for discharge to a drainfield are listed in Table 2-1.

The third option for effluent disposal is infiltration to ground via rapid infiltration basins located outside of the buildable lands on the reservation. This option is similar to the existing effluent infiltration system in place for the Casino WWTF. This option fulfills the Tribe's preference to place the infiltration system outside of the buildable lands and likely has a shorter permitting period than an outfall to the Chehalis River. As discussed in Chapter 2, the Tribe exercises its sovereignty and its rights as a "Tribe as State" and they have their own Chehalis Tribe Surface Water Quality Standards. Since this option will typically discharge to ground, but has the potential to discharge to surface water during 100-year flood events, the effluent design criteria is based on the more stringent of those for discharge to ground and for discharge to a surface water. Therefore, the probable effluent design criteria for this option would be the more stringent of those listed in Tables 2-1, 2-3 and 2-5, for a Class A surface water.

The matrix presented in Table 7-2 below presents a comparison of the three effluent disposal alternatives, which are rated in various pertinent features on a scale of 1 to 4, with 4 being the most preferred. The criteria used for this comparative analysis, along with a brief description of each, are listed below.

- Groundwater Protection – Refers to the potential for effluent to negatively impact groundwater quality.
- Drinking Water Protection - Refers to the potential for effluent to negatively impact drinking water quality.
- Surface Water Protection – Rates each site with regard to the potential for infiltrated effluent to reach and negatively impact surface water.
- Proximity to WWTF – Refers to the distance between the selected WWTF site and the proposed final effluent site and the associated conveyance system extensions that would be required. The likely WWTF site is in the vicinity of the existing Public Safety WWTF.
- Effluent System Capacity – The flow capacity that the discharge method can accommodate.
- Available Land – The amount of land available that is not already developed or planned for future development and has soils suitable for construction of the effluent system.
- Land Use Cost – The relative cost for the area of land to be used to the effluent system.
- Land Use Compatibility – Refers to the compatibility of the effluent system with the associated current and planned land uses on nearby properties.

- Cost – Refers to the capital cost associated with construction of a new discharge method.

- Permitting Time – Refers to the time required to apply for and obtain permitting for the effluent system.

TABLE 7-2
Effluent Disposal Alternatives Rating Matrix

Feature	Outfall To Chehalis River	Subsurface Drainfield on Buildable Land	Rapid Infiltration Basin Outside of Buildable Land
Groundwater Protection	4	2	3
Drinking Water Protection	4	2	4
Surface Water Protection	2	4	4
Proximity to WWTF	1	4	4
Capacity	4	3	4
Permitting	1	4	3
Available Land	4	1	4
Land Use Cost	4	1	4
Land Use Compatibility	4	1	4
Capital Cost	2	3	4
TOTAL	**30**	**25**	**38**

Note: Alternative features are rated from 1 to 4, with 4 being most preferable.

As summarized in Table 7-2 above, the option to dispose of effluent by infiltration to ground via rapid infiltration basins is the preferred option. The design criteria and description of the preferred option is discussed below.

DESCRIPTION OF RECOMMENDED EFFLUENT DISPOSAL ALTERNATIVE

Based on data obtained from the Natural Resources Conservation Service and presented in the *Petoie Back-Up Drainfield Analysis for the Confederated Tribes of the Chehalis Reservation* (Indian Health Services, 2014), the soils in the general vicinity of the Wellness Center are Types 1 and 2. The recommended infiltration rate for Soils Types 1 and 2 for high quality effluent is 2-4 gpd/sf per WAC 246-272B. The design infiltration rate is based on the conservative value of 2 gpd/sf. Two rapid infiltrations are recommended so that one basin can be brought offline for service. The area of each basin is sized to for the 20-year maximum flow of 48,000 gpd, or 24,000 square feet each. The infiltration capacity with both basins in operation is 96,000 gpd, which is greater than the projected 20-year peak day flow of 90,000 gpd.

Each rapid infiltration basin would have bottom dimensions of 200 feet by 120 feet, with a depth of 5 feet, and 3:1 side slopes. The project cost for the effluent infiltration system is included with the WWTF alternatives below.

The effluent disposal method for the expanded use of the Casino MBR WWTF would be the same as it is now with the use of rapid infiltration basins with no added cost as they currently have adequate capacity for the anticipated added flows.

POTENTIAL NEW CENTRAL WWTF

INTRODUCTION

This Section provides an evaluation for a new Central WWTF to meet the wastewater treatment requirements for the east side of the Chehalis Reservation for the 20-year period to 2037. The WWTF process technology selected for the alternatives analysis is a membrane bioreactor (MBR), followed by effluent ultraviolet disinfection with waste activated sludge holding and contract hauling of the biosolids to another WWTF. The selection of an MBR treatment process is based on the high effluent quality required for the effluent infiltration to ground, the Tribe's experience with three existing MBR WWTFs, and the small footprint required for MBRs. The small footprint of the facility is required because the WWTF represents a significant investment in resources, which is recommended to be constructed above the 100-year flood plain, where the land has a relatively high value of $1,500,000 per acre. Two WWTF MBR design alternatives were selected for analysis and cost comparison:

1. Conventional MBR WWTF
2. Package MBR WWTF

Both alternatives utilize MBRs for the central component of the liquid stream wastewater treatment and many of the components proposed for both alternatives are equivalent. The main difference between the two alternatives is that the conventional MBR alternative would operate at a lower biomass concentration (or mixed liquor suspended solids concentration) in a two-stage, preanoxic nitrogen removal configuration, utilizing aeration blowers and fine bubble diffusers for oxidation, and would have process tanks constructed by a construction contractor of reinforced steel. The package MBR alternative would operate at a higher biomass concentration in a simultaneous nitrification-denitrification configuration, utilizing a high purity oxygen injection system for oxidation, and would have process tanks constructed of painted steel, with the associated MBR equipment preassemble as a skid-mounted unit, which would be shipped to the site for installation by a construction contractor.

The design criteria for the WWTF analysis is below and a description of each the two WWTF design alternatives and a presentation of the estimated capital and life cycle costs follows the descriptions.

DESIGN CRITERIA

The influent design criteria for the Central WWTF from the recommended grinder pump system of this Chapter in presented in Table 7-3. The projected flows and loadings provided in Tale 7-3 are based on the projections summarized in Chapter 5. As discussed above, the expected technology-based effluent permit limits are likely to be the more stringent of those listed in Tables 2-1, 2-3 and 2-5, for a Class A surface water as in Table 7-4.

TABLE 7-3 Central WWTF Influent Design Criteria[1]			
Design Criteria	**2017**	**2027**	**2037**
Annual Average (AA) Wastewater Flow (gpd)	28,000	37,000	39,000
Maximum Month (MM) Wastewater Flow (gpd)	35,000	46,000	48,000
Peak Day (PD) Wastewater Flow (gpd)	65,000	87,000	90,000
Peak Hour (PH) Wastewater Flow (gpd)	108,000	142,000	148,000
Annual Average (AA) BOD_5 Load (lb/d)	48	94	104
Maximum Month (MM) BOD_5 Load (lb/d)	71	131	146
Annual Average (AA TSS Load (lb/d)	26	50	56
Maximum Month (MM) TSS Load (lb/d)	39	70	78
Annual Average (AA) TKN Load (lb/d)	8	20	21
Maximum Month (MM) TKN Load (lb/d)	12	27	29

(1) Based on grinder pump collection system

TABLE 7-4 Summary of Expected Technology-Based Effluent Permit Limits for the Central WWTF Rapid Infiltration Basin	
Parameter	**Value**
Monthly Average BOD_5 (mg/L)	30
Weekly Average BOD_5 (mg/L)	45
Monthly Average TSS (mg/L)	30
Weekly Average TSS (mg/L)	45
Monthly Average Total Nitrogen (mg/L)	10[1]
Monthly Average Turbidity (NTU)	0.2
Instantaneous Maximum Turbidity (NTU)	0.5
pH (S.U.)	6.5-8.5
Weekly Average Fecal Coliform (cfu/100 mL)	100

(1) Expected design criteria goal to meet groundwater quality standards per WAC 173-200.

CENTRAL CONVENTIONAL MBR WWTF

The components of the Central Conventional MBR WWTF alternative are summarized below and are described in detail in the following subsections. Table 7-5, at the end of this section, provides a summary of the component design criteria discussed below. The proposed general location of the Central WWTF is shown in Figure 7-8. The proposed Central Conventional MBR WWTF site plan is shown in Figure 7-9, and its associated process flow diagram is shown in Figure 7-10. The estimated project cost, annual O&M cost, and 20-year life cycle cost are presented in the Comparison of Alternatives Section below.

Central Conventional MBR WWTF Improvements:

- Construct grinder pump wastewater collection system as described above.
- Construct headworks.
- Construct buried concrete process tanks with common wall construction to include: one equalization basin, one anoxic basin, two aerobic MBR basins, and one waste activated sludge (WAS) holding tank.
- Construct operations building.
- Install effluent UV disinfection system.
- Construct non-potable water pump station.
- Construct plant drain pump station.
- Construct new odor control system.
- Construct effluent infiltration system as discussed above.

<u>Influent Flow Measurement and Sampling</u>

Influent wastewater will be pumped by the individual grinder pump stations to a common force main to the WWTF. The influent magnetic flow meter will be located in a below grade valve vault upstream of the influent screens. The influent sampler will be a refrigerated unit capable of collecting a flow-proportion sample from the influent pipe downstream of the influent flow meter and will be located at grade above the flow meter vault.

<u>Headworks</u>

The influent wastewater will be pumped by the individual grinder pump stations to a common force main to the WWTF headworks, which will consist of an influent flow meter, influent sampler, and two automatic, mechanical rotary drum influent screens with 2-mm perforated screen openings and one new screenings washer/compactor. The rotary drum screen will remove rags, plastics and fibrous material from the waste stream that could otherwise damage or impair downstream equipment. The screenings washer/compactor will wash organic material from the screenings, compact the screenings, and drop them into a trash receptacle or a trash bagger unit. The 2-mm perforation size is compatible with the membrane system. The rotary drum screens will be stand alone, self- contained units, constructed of stainless steel and on an elevated slab upstream of the anoxic/equalization basin. Each rotary drum screen consists of an internally mounted rotating perforated drum, located within a stainless-steel enclosure on a mounting frame. The pumped wastewater will flow into the drum through a pipe connection along the unit's centerline, and screened effluent will flow from a bottom pipe connection to the equalization tank. The rotary drum screens will be equipped with a common, manufacturer supplied, stainless steel chute, which will convey the screenings to the washer compactor, located at grade below the screens.

The screens will be mounted on a slab which will be 4 feet higher than the slab on which the washer/compactor unit will be mounted. A 4-foot-tall retaining wall will separate the two slabs to allow the screenings to drop into a common discharge chute to the washer/compactor.

Each rotary drum screen will have water supply lines equipped with two solenoid valves; one for washing the perforated drum and one for sluice water for conveying screenings from its associated side of the chute to the washer/compactor. The washer/compactor will have a water supply line with solenoid valve for a washwater connection. Washwater to the screens and washer/compactor will be supplied by the WWTF non-potable water system. Each rotary drum will have an overflow connection to the equalization pump station and will have an internal high-level switch to provide a high-level alarm and switch operation to the lag screen. Each rotary drum screen and the screenings chute will be equipped with an odor control pipe stub for connection to the odor control equipment. A motor operated valve will be installed on the influent connection to each screen for automatic switching of screen operation when one of the units fails or for operator selection of the lead screen.

Each screen will be provided with outdoor weather protection to prevent the screen from freezing during cold winter months.

Activated Sludge Basins

The activated sludge process basins will be configured to operate as a series of complete mix reactors set up to operate as a two stage, pre-anoxic, membrane bioreactor to achieve the effluent total nitrogen and BOD5 design criteria. Each of the zones will be designed to act as completely mixed activated sludge (CMAS) reactors designed for biological nitrogen removal and carbon oxidation. The activated sludge basins structure will be comprised of a common equalization basin, two parallel MBR (aeration) basins, and a common pre-anoxic basin.

Screened wastewater will flow by gravity from the influent rotary drum screens to the equalization basin, which will also receive gravity flow of the nitrified return mixed liquor from the MBR basins. The equalization basin will be equipped with two mixed liquor pumps to pump the combined influent and recycled mixed liquor to the anoxic basin, where it will gravity flow to the aeration basins, the MBR basins, and subsequently back to the equalization basin. The MBR basins will be equipped with influent isolation slide gates to allow either of the MBR basins to be taken offline at any time.

Biological nitrogen removal in the activated sludge basins is a two-step process. The first step in this process, nitrification, involves bacterial populations that oxidize ammonia to nitrate with the intermediate formation of nitrite. The second step in the process, denitrification, involves the reduction of nitrate to nitrogen gas, which is then released to the atmosphere. The WWTF will be designed to meet an effluent total nitrogen concentration of less than 10 mg/L. The aerobic zones (aeration basin and membrane basins) will be located downstream of the anoxic zones. Nitrification and oxidation of the remaining substrate occurs in the aerobic zones.

Aerobic capacity requirements are dependent on three major design criteria. These criteria are: solids retention time (SRT), net heterotrophic and autotrophic yields, and design mixed liquor solids (MLSS) concentration. SRT is the criteria of greatest importance for nitrification. The net specific growth rate of the nitrifying biomass is an order of magnitude lower than that of the carbon oxidizing bacteria and is, therefore, used as the basis for determining the aerobic SRT.

The first step in determining the design SRT is to calculate the maximum specific nitrifier growth rate (μn, max), decay rate (kdn), and ammonia half saturation coefficient (KN) at the winter design temperature of 10°C using the following equations:

$$\mu_{n,\max,10^0} = (\mu_{n,\max})(\theta^{t-20}) = (0.9/d)(1.072^{10-20}) = 0.449/d$$

$$K_{N,10^0} = (K_{N,\max})(\theta^{t-20}) = (0.74mg/L)(1.053^{10-20}) = 0.442mg/L$$

$$k_{dn,10^0} = (k_{dn,\max})(\theta^{t-20}) = (0.17/d)(1.029^{10-20}) = 0.128/d$$

Assuming an effluent NH3-N of 0.5 mg/L, a dissolved oxygen concentration of 2.0 mg/L during the aeration cycle, and an oxygen half saturation coefficient (*KO)* of 0.5 mg/L, the design nitrifier growth rate is calculated as follows:

$$\mu_n = (\mu_{n,\max,10^0})\left(\frac{N}{K_N + N}\right)\left(\frac{DO}{K_O + DO}\right) - k_{dn} = (0.449/d)\left(\frac{1}{0.442+1}\right)\left(\frac{2}{0.5+2}\right) - 0.128$$

This formula yields a net specific nitrifier growth rate of 0.126/day, which is then used to calculate the required SRT using the following equation:

$$SRT = \left(\frac{1}{\mu_n}\right) = \left(\frac{1}{0.126/d}\right) = 7.93\ days$$

The equations above and presented herein are taken from Metcalf and Eddy's 2014 Wastewater Engineering text. Reference Table 6-3 of this Plan for the assumed kinetic and stoichiometric constants used in this chapter.

Applying a safety/peaking factor of 2 to this value to accommodate daily fluctuations in ammonia load produces a design aerobic SRT on the order of 15 days, which will be used as the design SRT. In order to calculate the total aerobic mass required for the design SRT, the net sludge production for the treatment system must first be estimated, as discussed below.

The equations above and presented herein are taken from *Wastewater Engineering, Treatment and Reuse* (Fifth Edition, Metcalf and Eddy, Inc., McGraw-Hill, 2014). Reference Table 6-3 of this Plan for the assumed kinetic and stoichiometric constants used in this chapter.

Assuming a heterotrophic cell yield of 0.4 lb VSS/lb biodegradable COD (bCOD), an autotrophic yield of 0.12 lb/lb, an influent wastewater and biomass VSS/TSS ratio of 0.85, and a design temperature of 10 degrees C (all values typical for domestic wastewater), the total sludge production can be determined using the following equation:

$$P_{X,TSS} = \left[\frac{(Y)(S_0 - S)}{(1+(k_{d,t})(SRT))0.85}\right] + \left[\frac{(f_d)(k_{d,t})(Y)(S_0 - S)(SRT)}{(1+(k_{d,t})(SRT))0.85}\right] + \left[\frac{(Y_n)(NO_x)}{(1+(k_{dn,t})(SRT))0.85}\right] + X_{iVSS} + X_{iTSS}$$
$$= \frac{P_{x,Bio}}{0.85} + X_{iVSS} + X_{iTSS}$$

And

$$P_{x,vss} = P_{x,Bio} + X_{iVSS}$$

Where:

$P_{X,TSS}$ = mass of waste activated sludge per day, lb TSS/day
$P_{x,Bio}$ = biomass production lb VSS/day
$P_{x,vss}$ = mass of VSS per day, lb VSS/day
Y = heterotrophic cell yield, lb/lb bCOD = 0.4 lb/lb
Y_n = autotrophic cell yield, lb/lb bCOD = 0.12 lb/lb
S_o = influent bCOD, lb/day = 239 lb/d (assumed influent COD/BOD = 2.2 and bCOD/BOD = 1.64)
S = effluent bCOD, lb/day = 1.0 lb/d
$k_{d,t}$ = endogenous heterotrophic decay coefficient, 0.081 day^{-1} (see below)
$k_{dn,t}$ = endogenous nitrogenous decay coefficient, = 0.128 day^{-1} (from above)
f_d = fraction of cell mass remaining as cell debris, lb/lb = 0.15 lb/lb
NO_x = mass of influent NH_4-N that is nitrified lb/d= 22 lb/d

SRT = solids retention time of the SRT, days = 15
X_{iVSS} = influent volatile non-biodegradable solids, lb/day = 17.0 lb/d
X_{iTSS} = influent nonvolatile suspended solids, lb/day = 12.0 lb/d

The value for $k_{dn,10°C}$ (0.128 day^{-1}) was given previously and $k_{d,t}$ can be determined as follows:

$$k_{d,10^0} = (k_{d,\max})(\theta^{t-20}) = (0.12/d)(1.04^{10-20}) = 0.0811/d$$

Sludge production is calculated using the equation and parameters above:

$P_{X,TSS}$ = 90 lbs/day

And

$P_{x,Bio}$ = 52 lb/d
$P_{x,vss}$ = 69 lb/d

The formula above yields a total estimated waste sludge production of 90 pounds per day, which is equivalent to a total net yield of 0.65 lb/lb BOD_5 removed with 95 percent removal of the influent BOD_5. This yield results in a total required aerobic mass of MLSS of 1,350 lb at the design aerobic SRT of 15 days. Assuming a design MLSS concentration of 9,000 mg/L, a total aerobic volume of 18,000 gallons will be required (10^6(1,350/9,000/8.34)). The total combined volume of the two aerated MBR basins will have a volume of 20,000 gallons.

The proposed process tank configuration will provide the flexibility to accommodate the flows and loadings associated with the startup of the facility through the 20-year planning period for the minimum design SRT of 15 days.

The nitrogen mass balance and alkalinity requirements calculated indicate that an influent alkalinity concentration of greater than 287 mg/L as $CaCO_3$ will be required to maintain an effluent alkalinity of greater than 80 mg/L as $CaCO_3$. With an assumed influent wastewater alkalinity of 360 mg/L, based on the influent sampling and analysis for the Public Safety WWTF as presented in Chapter 6, no supplemental alkalinity addition will be required.

An internal recycle ratio in the range of 3 to 4 is typical for WWTF design. Recycle ratios greater than 5 are generally not warranted, because the incremental increase in NO_3-N removal is low. Higher recycle ratios also return more DO from the aerobic zone to the anoxic zone, which reduces the denitrification rate in the anoxic zone. The internal recycle pumps will be sized based on an internal recycle ratio of 3Q from the aeration basins to the preanoxic basin.

Incorporating denitrification into the treatment process will also improve the overall oxygen transfer efficiency of the system, which will, in turn, reduce power costs for aeration. The anoxic zone volume required for denitrification is dependent on the projected specific denitrification rate (SDNR), which is in turn dependent on the F/M ratio, among other factors. The biochemical pathways used to oxidize organic matter under anoxic conditions differ from those used under aerobic conditions only in that nitrate replaces oxygen as the terminal electron acceptor. The F/M ratio is important because it represents the relative quantity of substrate available for denitrification since organic carbon is required as the energy source for the bacteria during the reduction of nitrate.

There are several methods currently in use for sizing anoxic zones, the majority of which result in an anoxic volume that is between 15 and 30 percent of the total aeration basin volume depending on influent soluble BOD_5 concentrations and the level of nitrate removal required. The design will not include a deoxygenation basin between the MBR and preanoxic basin; therefore, the anoxic basin will be designed above the upper end of this range with the anoxic volume being approximately 35 percent of the total activated sludge MBR basin volume, or 7,500 gallons. In order to provide the most suitable environment for denitrification (oxygen free), the anoxic zones will be mixed using low speed submersible mixers.

The activated sludge MBR basins will be reinforced concrete basins with their top of wall at grade and will share common walls with each other and the equalization and anoxic basins, which will also share a common wall with the WAS holding tank, to reduce construction costs associated with excavation and concrete work. All of the basins will have removable flat covers to prevent leaves and debris from entering the process tanks and blinding the membranes, and the air from the equalization basin and the activated sludge basins will be vented to the plant's odor control system. Each of the activated sludge MBR basins will have a mud valve in the bottom slab to allow each tank to be drained to the plant drain pump station.

The equalization and anoxic basins will each be equipped with a submersible mixer that will run at all times.

Two aerated MBR basins will be constructed, each equipped with a fine bubble aeration diffuser system and dissolved oxygen meter for automatic control of the aeration blowers. The aeration blower size calculations are summarized in the following section.

The design specifications will require the membrane supplier to provide the membranes meeting the following requirements: Provide sufficient membrane equipment for the WWTF to treat the maximum day flow rate for 24 hours and the peak hour flow rate for a maximum of 3 hours with all membrane basins in service. Provide sufficient membrane equipment for the WWTF to continuously treat the maximum month flow rate with one membrane basin out of service for 31 consecutive days. If the submerged membrane units (SMU's) have integral air diffusers, clean-in place, and permeate systems, and are capable of being operated, isolated, and removed from a membrane basin individually, while continuing to operate all other SMU's in that basin, then the system shall be provided with sufficient membrane equipment for the WWTF to continuously treat the maximum month flow rate with one SMU out of service for 31 consecutive days.

Since the membrane system will be able to handle the projected peak hour flow to the WWTF with all units in service, an equalization basin is not required during most normal operational periods, but an equalization basin is recommended in order to give operators increased flexibility for operation and maintenance procedures. The equalization basin will have a total volume of 7,300 gallons. The equalization basin will be controlled to maintain a minimum water depth of three feet in order to allow the submersible mixer to remain operational at all times, thus providing an additional anoxic volume of 2,100 gallons over the volume provided in the anoxic basin. The operational equalization volume of the basin will therefore be 5,200 gallons. Based on an assumed maximum peak hour flux in the range of 22 to 25 gfd for the likely approved membrane modules and the associated membrane areas, the conservatively estimated maximum permeate flow with one SMU out of service is 79,000 gpd. The equalization basin will be able to store the difference between the design peak hour influent flow (148,000 gpd) and 79,000 gpd for two hours, as calculated below:

5,200/{(148,000 – 79,000 gpd) /(24 hr/d)} = 2 hours

Note that this scenario would only occur if the operated needed to take one MBR basin out of service during peak day flow conditions, which would typically not be recommended.

Aeration Basin Aeration System

Using data presented in the activated sludge basins section, the total oxygen requirement for the system is determined as follows:

Carbonaceous O_2 Demand	$= bCOD - 1.42(P_{x,bio})$
	$= (239\ lb/day) - 1.42\ (52\ lb/day)$
	$= 166\ lb/day$
Nitrogenous O_2 Demand	$= \mathbf{4.33(NO_x) - 2.86(NO_3\text{-}N\ dN)}$
	$= 4.33$ lb/lb (22.4 lb/day)–(2.86 lb/lb)(21.6 lb/day)
	$= 35\ lb/day$
Total O_2 Demand	$= C\ O_2\ Demand + N\ O_2\ Demand$
	$= 201\ lb/day$

Applying a safety factor of 1.20 to this to account for diurnal fluctuations in influent load, and assuming the MBR air scour provides 30% of the oxygen demand, the design oxygen demand is determined as follows:

Actual Total O2 Demand (AOTR) = *(1.20 P. F.)(0.7) (201 lb/day)*
= *169 lb/day*

The standard oxygen requirement (SOTR) can then be calculated from the actual oxygen requirement (AOTR) using the following equation (See Eqn. 5-5 Metcalf & Eddy, 4th Ed.).

$$SOTR = \left(\frac{AOTR}{(\alpha)(f)}\right)\left(\frac{C_{s20}\left(1+d_e\left(\frac{D_t}{P_s}\right)\right)}{\left(\beta(C_{st})\left(\frac{P}{P_s}\right)\left(1+d_e\left(\frac{D_t}{P_s}\right)\right)\right)-C_o}\right)\left(1.024^{(20-t)}\right)$$

Where:

SOTR	=	Standard Oxygen Transfer Rate, lb/day
AOTR	=	Actual Oxygen Transfer Rate, lb/day
α	=	K_{La} wastewater/ K_{La} clean water (see below)
f	=	Membrane fouling factor (0.9)
β	=	DO saturation relative to clean water (0.95)
C_{s20}	=	Steady-state DO saturation concentration of clean water at 20°C and standard atmospheric pressure (9.09 mg/L)
C_{st}	=	Steady-state DO saturation concentration of clean water at operating temperature (t) and standard atmospheric pressure (9.09 mg/L)
P_S	=	Atmospheric pressure at standard conditions (33.9 feet water)
P	=	Atmospheric pressure at the plant site elevation 140 ft (33.6 feet water)
D_t	=	Diffuser submergence depth (9.2 feet)
d_e	=	mid-depth correction factor (0.4)
C_0	=	Operating DO in basin (2.0 mg/L)
t	=	Design operating temperature (20°C)

By inserting this DO saturation value and the following design parameter values into the above equation for the actual oxygen requirement (AOTR), the standard oxygen requirement can be determined. These parameter values are based on accepted design values for diffused aeration systems operating in municipal wastewater treatment facilities. The design water temperature of 20 degrees C was selected because the higher loadings to the treatment facility are expected to occur in the summer months when wastewater temperatures may be in this range. Therefore, the higher loadings will cause the total oxygen requirement to be highest during the summer months.

The value for α has been shown to vary with the MLSS concentration according to the following equation:

$$\alpha = e^{(-0.08788*MLSS[g/L])}$$

With a design MLSS of 9,000 mg/l, this equation becomes:

$$\alpha = e^{(-0.08788*9.0\ g/L)} = 0.45$$

Using these values, the standard oxygen requirement (SOTR) is calculated as follows:

$$AOTR = (0.33)(SOTR) \rightarrow SOTR = 169/0.33 = 509\ lb/d$$

The resulting standard oxygen requirement is 506 lb/day. Assuming an average transfer efficiency of 2.0 percent per foot of water depth, or 18.4 percent at a diffuser depth of 9.2 feet (normal operating depth), the following equation is used to calculate the peak air demand:

$$AirDemand = \left(\frac{SOTR\ \ lb/d}{(lbO_2 / ft^3 air)(E)(1440\ \mathrm{min}/d)} \right)$$

$$= \left(\frac{509\ \ lb/d}{(0.0173\ \ lbO_2 / ft^3 air)(0.184)(1440\ \mathrm{min}/\ d)} \right)$$

This formula results in a total peak air demand of 110 standard cubic feet per minute (scfm) for the two basins.

Oxygen and mixing for the aerobic basins will be supplied by a diffused air system. The two aerobic MBR basins will be equipped with fine bubble diffusers to maximize the oxygen transfer efficiency and reduce power consumption. Each aerobic MBR basin will have an installed dissolved oxygen meter.

Two aeration blowers, located in the Operations Building, each rated at 70 scfm, will supply air to the aerobic basins. Each aerobic MBR basin will have its own dedicated blower and separate air supply header from the aeration blowers. One blower will provide air to one of the aerobic basins at a time. In this manner, the PLC will control the blower speed based on the dissolved oxygen concentration in the aerobic zone for which it is associated. The spare MBR air scour blower will also serve to back up the two aeration blowers.

Membrane Equipment

The membrane supplier will supply the membrane system equipment for installation by the WWTF construction contractor. The membranes will be installed in the concrete membrane basins, and the permeate pumps and air scour blowers will be installed in the Operations Building. The design membrane capacity is summarized in the Activated Sludge Basins Section above.

The membrane bioreactor basins are sized to accommodate equipment manufactured by Ovivo USA, LLC, and Kubota Membrane USA Corp., as specified in the budgetary proposals that these companies provided specifically for this project. Details on the membranes, permeate pumps, and scour air blowers are given in the Table 7-5 at the end of this section.

The membrane system supplier scope of supply will include:

- Submerged membrane units (SMUs)
- Permeate pumps
- Air scour blowers
- Two permeate magnetic flow meters (one for each membrane basin)
- Two blower air mass flow meters
- Three blower pressure transmitters
- One chemical cleaning solution magnetic flow meter
- One turbidimeter
- One MBR control panel with PLC and HMI

The membrane basin walls and bottom slab will be of reinforced concrete construction with removable aluminum or fiberglass covers. The tanks will have 3 feet of freeboard from the water surface to the top of wall to allow for the installation of piping and conduit below the tank covers. Mud valves will be installed in each of the tanks to allow them to be drained to the plant drain pump station. The finished grade around the tanks will be approximately 3 to 6 inches below the top of wall elevation. Because of the grade elevation around the tanks and the installation of covers, handrailing around the tanks will not be required.

Effluent Disinfection

The permeate will be pumped to the UV Disinfection System, which would be a pressurized, closed-vessel, low or medium pressure, high intensity system consisting of two units, one of which will be redundant. The UV system will be required to provide the minimum design dose at the peak day design permeate flow with one unit out of service. The UV vessels will each be equipped with UV intensity sensors and will have the ability to vary the UV dose with the effluent flow. Each UV vessel will also be equipped with an automatic UV bulb wiping system. The UV System will be equipped with an in-line UV transmittance meter to measure the UV transmittance of the effluent at all times. The piping and valves to the units will be configured so that any of the units may be bypassed for maintenance. Each of the units will be approximately 8 inches in diameter and 7-foot long maximum and will be mounted on pipe supports in the Operations Building.

Effluent Flow Measurement and Sampling

The permeate magnetic flow meters, which will be supplied by the MBR manufacturer, will serve as the effluent flow meter.

The effluent sampler will be a refrigerated unit capable of collecting a flow-proportion sample from the effluent pipe downstream of the UV Disinfection System.

Non-Potable Water Pump Station

A Non-Potable Water (NPW) Pump Station would be constructed to store and distribute the effluent NPW to the influent screen system spray wash connections, the WWTF irrigation system, washdown stations, hose bibs, and other process water uses at the WWTF. The disinfected effluent would be pumped to the NPW storage tank via the permeate pumps.

The NPW Tank will be a 12,000-gallon, 12-foot-diameter, polyethylene tank at grade outside the Operations Building, equipped with a submersible level sensor and a high-level float switch. Equipment mounted adjacent to the Operations Building for the NPW Pump Station will include two vertical turbine NPW pumps, a pressure transmitter, a NPW flow meter, and a pressure relief/pressure sustaining valve. Effluent flow in excess of the NPW water use will overflow by gravity to the effluent infiltration system.

Plant Drain Pump Station

The Plant Drain Pump Station will consist of two submersible centrifugal plant drain pumps, a submersible level sensor, and a float switch located within a 72-inch-diameter, below grade, concrete manhole adjacent to the activated sludge basins. Check valves and isolation plug valves for these pumps will be located in a below grade valve vault adjacent to the manhole. The Plant Drain Pump Station will receive flow from the various plant drains and will discharge to the influent screens.

Waste Activated Sludge (WAS) Holding Tank

A Waste Activated Sludge (WAS) holding tank will be constructed adjacent to the equalization basin to store WAS and scum removed from the activated sludge process prior to hauling offsite for treatment. The WAS holding tank will be sized to store the waste sludge production associated with the design criteria for a minimum of 14 days to limit the sludge hauling requirement to once every two weeks at the 20-year design loading.

WAS will be transferred by gravity to the WAS holding tank from a pipe connection to the anoxic basin through a magnetic flow meter and a motor operated valve, to allow automatic wasting of the WAS. Scum will be manually drained from the anoxic basin to the WAS holding tank via a telescoping skimmer valve.

The WAS holding tank will be equipped with a fine bubble aeration system and a dedicated aeration blower to provide aeration and mixing. The WAS blower will be located in the Operations Building. The discharge from the blower will be connected to the common air manifold so that one of the aerobic basin blowers or an MBR air scour blower can be used for the WAS holding tank as a backup unit.

The WAS holding tank will be equipped with a submersible centrifugal pump to transfer the liquid sludge to a tank truck.

The required WAS holding tank will have a volume of 18,000 gallons to provide a solids retention time of 21 days and 17 days at the annual average and maximum month loadings, respectively.

The expected VSS reduction in the WAS Holding Tank, at 20 degrees C at the SRT values discussed above, is 35 percent. With a Phase 1B WAS VSS production of 69 lb VSS/d, the actual oxygen requirement for the WAS Holding Tank is estimated assuming an oxygen demand of 2.3 lb O2/lb VSS destroyed as follows (and assuming zero oxygen credit for denitrification):

$$AOTR = (163\, lbVSS\ /\ d)(2.3 lbO_2\ /\ lbVSS)(0.35) = 55\, lb\ /\ d$$

Using the equations and values presented above in the Aeration Basin System, the standard oxygen requirement (SOTR) can be calculated from the equation above as follows:

$$AOTR = (0.33)(SOTR) \rightarrow SOTR = 55/0.33 = 160 \text{ lb/d}$$

The resulting standard oxygen requirement is 160 lb/day. Assuming an average transfer efficiency of 2.0 percent per foot of water depth, or 18.4 percent at a diffuser depth of 9.2 feet (maximum operating depth), the following equation can be used to calculate the peak air demand.

$$AirDemand = \left(\frac{SOTR\ lb/d}{(lbO_2 / ft^3 air)(E)(144 \min/d)} \right)$$

$$= \left(\frac{160\ lb/d}{(0.0173\ lbO_2\ /\ ft^3\ air)(0.184)(1440 \min/\ d)} \right)$$

This results in a peak air demand of 35 standard cubic feet per minute (scfm).

The aeration required for mixing is calculated using a fine bubble diffuser mixing requirement of 0.12 SCFM per square foot of surface area. With a tank that is 9-feet wide by 27-feet long (243 ft^2), the mixing requirement is estimated as:

$$MixingRequirement = (243 ft^2)\left(0.12\, {}^{SCFM}\!/_{ft^2}\right) = 30\, SCFM$$

The oxygen aeration requirement of 35 scfm is therefore greater than the air required for mixing.

The WAS Holding Tank will share a common wall with the equalization basin, one of the MBR basins, and the anoxic basin to minimize construction costs. The WAS Holding Tank will have the same width as the activated sludge MBR basins and will have a length equal to the combined length of the activated sludge basins, which will enable the WAS Holding Tank to easily be converted to an additional activated sludge train in the future. The WAS Holding Tank will be covered and vented to the odor control system in the same manner as the activated sludge basins.

The WAS Holding Tank will be equipped with a waste sludge pump to transfer WAS to a sludge hauling truck via a quick connect coupling at the headworks. This pump will have a design capacity to fill a 6,000-gallon tank truck in approximately 15 minutes.

The WAS Holding Tank walls and bottom slab will be of reinforced concrete construction similar to the other process tanks. The tank walls will be designed so that the tank can be drained for maintenance at any time and it will be provided with hydrostatic relief valve or extended slab to prevent uplift from high ground water when the tank is empty.

Odor Control System

Odorous air collected under the covered process basins and the headworks screens will be carried by a combination of above-grade and below-grade ducts from the respective odor generation sources to an odor control system. Odorous air piping will be of PVC construction.

Odorous air ventilation rates are selected to provide sufficient air exchange or collection rates for odor dilution and containment, effective collection of maximum process air flows, and corrosion control. The ventilation rate for the headworks influent screens is 100 cfm to provide for six air changes per hour in the internal space of the rotary drum screens and the connected screenings hoper and screenings washer/compactor. The ventilation rate for the process tank is based on the higher value of either the maximum process air flow rate or the headspace air exchange air flow rate at three air changes per hour for odor and corrosion control. The maximum process air flow rate to the process basins is 300 cfm.

The headspace air exchange, assuming the equalization basin is at minimum water surface elevation and the WAS holding tank and one aeration basin are empty, is 200 cfm. The value of 300 cfm will therefore be used for the design ventilation rate for the process tanks. This results in a total design ventilation rate for the odor control system of
400 cfm.

The inlet concentration of the odorous air to the odor control system was estimated based on data from other collection systems, with a peak instantaneous inlet H_2S concentration of 30 ppmv and an annual average inlet H_2S concentration of 6 ppmv. The odor control system will consist of a FRP or HDPE media vessel equipped with a top-mounted odorous air ventilation fan. A grease filter/mist eliminator will be included with the odor control system to help reduce moisture accumulations within the dual media bed. The ventilation fan will be provided with a sound attenuation enclosure and discharge silencer to reduce noise output.

The odor control media vessel will employ a dual media design that includes high capacity hydrogen sulfide virgin carbon and potassium permanganate media to target non-hydrogen sulfide odors such as mercaptans. The dual media design will be based on the following odorous air characteristics and hydrogen sulfide removal requirements.

The odor control system will be sized to provide 99 percent removal of hydrogen sulfide based on an average daily inlet hydrogen sulfide concentration of 6 ppmv.

Standby Power

Standby power will be provided at the WWTF by diesel fuel generator. The generator will be located outside and adjacent to the Operations Building on a concrete pad. The generator will operate during power outages and provide power to serve, at minimum, one influent screen, the washer/compactor, one mixed liquor pump, two permeate pumps, two aeration blowers, two air scour blowers, two submersible mixers, the UV disinfection system, one non-potable water pump, one plant drain pump, the odor control system, Operations Building, telemetry system, lighting, heating and other critical processes.

Operations Building

The design approach for the operations building is to create a simple building of the size and configuration needed to house all of the functional requirements. The operations building will have an office, restroom/locker room, electrical room, an area with counter space, sink, and refrigerator for sample preparation and storage for off-site analysis, and an equipment room to house the process equipment.

The building floor will be concrete slab on grade. The wall structure will have stud framing with gypsum wallboard interior and metal siding exterior, similar to the existing buildings located at the other two WWTFs. Doors and frames will be hollow metal (steel). Exterior windows will be vinyl, thermal break type with double pane, low e glass and argon gas air space for energy efficiency. The sloped roof will be steel for durability and low maintenance.

Operations Staff and Testing Requirements

Based on the requirements of WAC 173-230 and the Washington State Department of Ecology Criteria for Sewage Works Design, the "operator in responsible charge" of an MBR system should be certified as a group III operator. It is recommended that the Tribe employ an operator with this certification level. The WWTF design will incorporate automatic operation of most of the equipment via PLC and the plant operations will be able to be monitored remotely via internet connection; therefore, an operator will typically only need to be on site 2 to 3 days per week, which is consistent with other similarly sized MBR facilities. The costs presented below for this alternative assumes that the Tribe will contract with a professional WWTF operations company to provide WWTF operations, maintenance, sampling, and reporting services.

The testing requirement for the WWTF influent, effluent, and groundwater will be listed by EPA in the UIC permit. Influent and effluent testing requirements are anticipated to be a minimum of once per week testing of BOD, TSS, pH, TKN, and total nitrogen.
Sampling from the groundwater monitoring wells is anticipated to be required four times per year for analysis of numerous components.

TABLE 7-5
Design Data Central WWTF Alternatives (2037 Design Criteria)

Parameter	Design Data	
	Package MBR WWTF	**Conventional MBR WWTF**
Influent Flow Meter		
Type	Magnetic Flow Meter	Magnetic Flow Meter
Quantity	1	1
Influent Sampler		
Type	Refrigerated Composite	Refrigerated Composite
Quantity	1	1
Headworks		
Screening Type	Rotary Drum Screen with Washer/Compactor	Rotary Drum Screen with Washer/Compactor
Quantity of Rotary Drum Screens	2 (1 duty, 1 standby)	2 (1 duty, 1 standby)
Screen Openings	2 mm	2 mm
Maximum Hydraulic Capacity	150 gpm	150 gpm

TABLE 7-5 – (continued) Design Data Central WWTF Alternatives (2037 Design Criteria)		
Parameter	**Design Data**	
	Package MBR WWTF	**Conventional MBR WWTF**
Activated Sludge System		
Process Basin Construction	Packaged System with Steel Tanks on Concrete Slab in Building	Partially Below Grade, Reinforced Concrete Tanks
Quantity Equalization Basin	1	1 (combined EQ/Anoxic)
Equalization Basin Volume	4,100 gal	7,300 gal
Total MBR Basin Volume	12,300 gal	20,000 gal
Side Water Depth	10 ft.	10 ft.
Design Aerobic SRT	12 days	15 days
Design MLSS	13,400 mg/L	9,000 mg/L
Design AA Solids Production (WAS)	1,040 gpd	860 gpd
Design MM Solids Production (WAS)	1,300 gpd	1,070 gpd
Actual Oxygen Required	365 lb O_2/d	201 lb O_2/d
Quantity Anoxic Basins	None	1
Anoxic Basin Volume	0 gal	7,500 gal
Quantity of MBR Basins	3	2
Qty. of Submerged Membrane Units (SMU's) per Basin	2	2
Total Membrane Surface Area	6,696 SF	6,240 SF
Membrane Flux at AADF (all basins in service)	5.8	6.3
Membrane Flux at MMADF (all basins in service)	7.2	7.7
Membrane Flux at PDF (all basins in service)	13.4	14.4
Membrane Flux at Peak Hour Flow (all basins in service)	22.1	23.7
Membrane Flux at Annual Average Flow (one SMU out of service)	8.7	12.5
Membrane Flux at Maximum Month Flow (one SMU out of service)	10.8	15.4
Membrane Flux at PDF (one SMU out of service)	20.2	NA
Anoxic Tank Mixer Quantity	NA	1
Anoxic Tank Mixer Type	NA	Submersible Mixer
Anoxic Tank Mixer Motor Size	NA	3 hp
Equalization Tank Mixer Quantity	1	1
Equalization Tank Mixer Type	Coarse Bubble Diffusers	Submersible Mixer
Equalization Tank Mixer Motor Size	NA	3 hp

TABLE 7-5 – (continued)
Design Data Central WWTF Alternatives (2037 Design Criteria)

Parameter	Design Data	
	Package MBR WWTF	**Conventional MBR WWTF**
Process Aeration Blowers		
Quantity	None	2 (1 duty, 1 standby)
Capacity	NA	60 SCFM
Motor Size, ea.	NA	5 hp
Supplemental Oxygen System		
Quantity of Oxygen Generators	1	NA
Type	Oxygen Concentrator with Internal Recycle	NA
Quantity of Injection Systems	1	NA
Oxygen Injector Type	Speece Cone	NA
Membrane Scour Air Blowers		
Quantity	3 (2 duty, 1 standby)	3 (2 duty, 1 standby)
Air Scour Rate per MBR	175 SCFM	76 SCFM
Motor Size, ea.	10 hp	10 hp
Carbon Addition System		
MicroC Feed Rate	11 gpd	NA
Equalization Basin Transfer Pumps		
Pump Quantity	2 (1 duty, 1 standby)	NA (see mixed liquor pumps)
Pump Type	Progressing Cavity	NA
Pump Capacity	100 gpm	NA
Pump Motor Size, ea.	10 hp	NA
Mixed Liquor Pumps		
Pump Quantity	2 (1 duty, 1 standby)	2 (1 duty, 1 standby)
Pump Type	Progressing Cavity	Submersible Centrifugal
Pump Capacity	100 gpm	3Q
Pump Motor Size, ea.	10 hp	3 hp
Permeate Pumps		
Quantity	2 (1 duty, 1 standby)	3 (2 duty, 1 standby)
Type	Progressing Cavity	Self-Priming Centrifugal
Capacity	100 gpm	60 gpm
Motor Size, ea.	10 hp	3 hp
UV Disinfection System		
Type	Closed Vessel	Closed Vessel
Quantity of Vessels	2 (1 duty, 1 standby)	2 (1 duty, 1 standby)
Design UV Transmittance	65%	65%
Design UV Dose at Peak Equalized Flow	30 MJ/cm^2 (reuse: 80 MJ/cm^2)	30 MJ/cm^2 (reuse: 80 MJ/cm^2)

TABLE 7-5 – (continued)
Design Data Central WWTF Alternatives (2037 Design Criteria)

Parameter	Design Data	
	Package MBR WWTF	Conventional MBR WWTF
Effluent Flow Meter		
Type	Magnetic Flow Meter	Magnetic Flow Meter
Quantity	1	1
Effluent Sampler		
Type	Refrigerated Composite	Refrigerated Composite
Quantity	1	1
Non-Potable Water Pump System		
Quantity of Pumps	2	2
Type of Pump	Vertical Turbine	Vertical Turbine
Capacity	50 gpm	50 gpm
NPW Tank Volume	10,000 gallons	10,000 gallons
WAS Storage Tank		
Quantity	1	1
Volume	20,000 gal	18,000 gal
Solids Retention Time (annual average)	19 d	21 d
Solids Retention Time (maximum month)	15 d	17 d
WAS Tank Blowers		
Quantity	1	1
Type	Positive Displacement	Positive Displacement
Capacity	40 SCFM	40 SCFM
Motor Power Requirements	5 hp	5 hp
Waste Sludge Pump		
Quantity of Pumps	1	1
Type of Pump	Submersible Centrifugal	Submersible Centrifugal
Capacity	300 gpm	300 gpm
Power Requirements	3 hp	3 hp
Effluent Infiltration Basins		
Number of Basins	2	2
Design Infiltration Rate	2 gpd/ft^2	2 gpd/ ft^2
Infiltration Area, Each	24,000 ft^2	24,000 ft^2
Total Infiltration Area	48,000 ft^2	48,000 ft^2

CENTRAL PACKAGE MBR WWTF

The WWTF site plan for the package MBR WWTF will be similar to that of the previously described conventional MBR WWTF scenario, with the exception that the process tanks and MBR equipment will be a complete packaged skid mounted system with steel tanks instead of concrete process tank construction with a separately supplied MBR system. The package WWTF design is based on a proposal provided by Ovivo USA, LLC for their packaged MBR system, known as MicoBlox.

The components of the package MBR WWTF alternative are summarized below and are described in detail in the following subsections. Table 7-5, at the end of the previous section, provides a summary of the component design criteria discussed below. The proposed Central Package MBR WWTF site plan is shown in Figure 7-11. The estimated project cost, annual O&M cost, and 20-year life cycle cost are presented in the Comparison of Alternatives Section below.

Package Central MBR WWTF Improvements:

- Construct grinder pump wastewater collection system as described above.
- Construct headworks.
- Install package MBR system, to include steel process tanks and other membrane equipment as discussed below.
- Construct waste activated sludge (WAS) holding tank and associated equipment.
- Construct operations building.
- Install effluent UV disinfection system.
- Construct non-potable water pump station.
- Construct plant drain pump station.
- Construct new odor control system.
- Construct effluent infiltration system as discussed above.

The proposed package MBR process design differs from that of the conventional MBR alternative in the following ways:

1. The proposed package MBR will have an operational mixed liquor suspended solids concentration of 13,400 mg/L compared to 9,000 mg/L for the conventional MBR alternative.
2. The package MBR process is designed to operate as a "simultaneous nitrification-denitrification" (SNdN) process whereby nitrification and denitrification occur at the same time in a single reactor without separate aerated and non-aerated zones as discussed below.
3. Due to the high mixed liquor suspended solids (MLSS) concentration and the selected SNdN process, an oxygen concentrator and injection system is required for the package MBR.
4. The package MBR process tanks will be of painted steel construction compared to reinforced concrete tanks for the conventional MBR alternative.
5. The package MBR system is delivered to the site with most of the mechanical equipment and instrumentation and associated process piping and electrical conduit and conductors installed.

The higher design MLSS concentration for the package MBR allows the process tank volume to be reduced compared to a lower concentration for an equivalent design solids retention time (SRT). The design SRT of the proposed package MBR was 12 days, while that of the proposed conventional MBR was over 15 days, resulting in an even greater difference in the required volumes between the two alternatives. As shown in Table 7-5, the design process tank volume for the package MBR is 40 percent smaller than that of the conventional MBR alternative.

Increasing the MLSS concentration in an aeration basin has the effect of decreasing the oxygen transfer efficiency from the air bubbles delivered by the fine bubble diffuser system. This lower oxygen transfer efficiency, therefore requires additional air to be delivered as the MLSS increases, which requires increased blower capacity and increases the operational electrical power cost. The proposed package MBR uses an oxygen concentrator and an injection system instead of a conventional aeration system consisting of blowers and aeration diffusers. The oxygen generator proposed is a pressure-swing adsorption unit, which uses a multi-bed adsorption process to provide a continuous flow of oxygen gas to the biomass. With this process, oxygen is separated from the ambient air by adsorption at high pressure, and the adsorbent is regenerated by blowdown to low pressure. The injector system includes a Speece cone, or downflow bubble contactor, which incorporates a prolonged oxygen bubble contact time resulting in high rates of oxygen transfer in a cone-shaped chamber. Only a single oxygen concentrator and injector was included in package MBR proposal; therefore, the Tribe would be required to have high purity oxygen cylinders delivered to the WWTF for periods when this system requires maintenance.

Since the proposed package MBR process is designed to operate as a "simultaneous nitrification-denitrification" (SNdN) process, separate anoxic and aerobic basins are not utilized as is discussed for the conventional MBR alternative. Historically, SNdN processes require a longer SRT, and therefore large tank volumes compared to equivalent two-stage processes because the nitrification and denitrification rates are less than optimal in the SNdN process. This is because only a portion of the biomass is used for each of these reactions and the nitrification rate is lower due to the low dissolved oxygen concentration required for the SNdN process. In addition, the denitrification rate is typically lower in the SNdN process due to substrate consumption in the aerobic portion of the floc. The proposed SRT by Ovivo for the package MBR is 12 days, which is less than the SRT proposed for the convention MBR alternative. Ovivo provided data for another SNdN WWTF that is in operation that showed adequate nitrogen removal; however, the operational data for the SRT of that WWTF was not provided for review. A thorough analysis of other Ovivo MicroBlox operational data was not conducted for this Plan, but would be recommended should the Tribe choose to select this alternative.

A typical steel tank manufactured today will have a life expectancy of about 25 years and is also dependent on the quality of the steel tank and construction technique, the corrosiveness of the wastewater, quality of the steel coating system, and level of maintenance of the tank. By comparison, a concrete wastewater tank is expected to have a life expectancy in excess of 75 years.

Because the package MBR system is delivered to the site with most of the mechanical equipment and instrumentation and associated process piping and electrical conduit and conductors installed, this portion of the WWTF has a lower project capital cost compared to the conventional MBR system.

Influent Flow Measurement and Sampling

Influent wastewater will be pumped by the individual grinder pump stations to a common force main to the WWTF. The influent magnetic flow meter will be located in a below grade valve vault upstream of the influent screens.

The influent sampler will be a refrigerated unit capable of collecting a flow-proportion sample from the influent pipe downstream of the influent flow meter and will be located at grade above the flow meter vault.

Headworks

The influent wastewater will be pumped by the individual grinder pump stations to a common force main to the WWTF headworks, which will consist of an influent flow meter, influent sampler, and two automatic, mechanical rotary drum influent screens with 2-mm perforated screen openings and one new screenings washer/compactor. The influent screen system for this alternative is equivalent to that described for the conventional MBR alternative, with the main difference being that the screens will be mounted on a structure which will be 14 feet above grade and the washer/compactor unit will be mounted at grade under the screen platform. Mounting the screens on an elevated platform is required to allow the screened effluent to flow by gravity from the bottom pipe connection of the screens to the package MBR plant, since the package plant will be mounted on a slab on grade to reduce excavation costs. The screen platform structure will be galvanized steel with aluminum or fiberglass grating with stairs, walkway platform, and handrailing and will be located outside of the operations building.

Membrane Package Plant

This package WWTF design is based on a cost proposal provided by Ovivo USA, LLC for their packaged MBR system, known as MicoBlox, which includes skid-mounted steel tanks and equipment. A general overview of the proposed process and the differences between the propose package MBR and the conventional MBR alternative are discussed above. The design of the membrane package plant is based on the results of a Biowin modeling effort conducted by Ovivo. The entire skid mounted package can be delivered to the site on a truck bed and some of the equipment will be required to be installed by a construction contractor. The skid-mounted system includes the following components which are further described below:

- Activated Sludge Process Basins, of painted steel construction, consisting of an equalization basin and three MBR basins
- Mixed Liquor Pumps
- Equalization Basin Transfer Pumps
- Oxygen Concentrator and Injector System
- MBR Submerged Membrane Units
- Permeate Pumps
- Clean-in-Place Chemical Addition System
- Supplemental Carbon Addition System
- Control System (SCADA, HMI, PLC, Control Panel)
- Instrumentation including Turbidimeter, DO Meter, TSS Meter, Level Transmitters, Permeate Flow Meter

The packaged MBR system is pre-designed and is delivered with most of the equipment installed and prepiped and prewired. The proposed process is a SNdN process with high purity oxygen injection system as discussed above, with an equalization basin followed by three MBR tanks. The equalization basin transfer pumps will transfer the influent from the equalization basin to the MBR the three MBR tanks in series. The mixed liquor pumps will constantly recirculate the mixed liquor from the third MBR tank though the oxygen injection system back to the first MBR tank.

The submerged membrane units and the associated equipment for the package MBR will be required to meet the equivalent hydraulic capacity requirements to that of the conventional MBR system.

The package MBR will be installed on a slab on grade located in the operations building. The proposed design capacity of each of the package MBR system components is summarized in Table 7-5 at the end of the preceding section.

Effluent Disinfection

The permeate will be pumped to the UV Disinfection System, which will be equivalent to that described for the conventional MBR alternative. The UV Disinfection System will be mounted on pipe supports in the Operations Building.

Effluent Flow Measurement and Sampling

The permeate magnetic flow meters, which will be supplied by the MBR manufacturer, will serve as the effluent flow meter.

The effluent sampler will be a refrigerated unit capable of collecting a flow-proportion sample from the effluent pipe downstream of the UV Disinfection System.

Non-Potable Water Pump Station

The NPW Pump Station will be equivalent to that described for the conventional MBR alternative.

Plant Drain Pump Station

The Plant Drain Pump Station will be equivalent to that described for the conventional MBR alternative.

Waste Activated Sludge (WAS) Holding Tank

Waste Activated Sludge (WAS) holding tank will be constructed to store WAS and scum removed from the activated sludge process prior to hauling offsite for treatment. Similar to the conventional MBR alternative, the WAS holding tank will be sized to store the waste sludge production associated with the design criteria for a minimum of 14 days.

The WAS holding tank for this alternative will be a stand-alone, partially below grade, reinforced concrete structure. The tank will be equipped with an aluminum or fiberglass cover and vented to the odor control system. The finished grade around the tank will be approximately one foot below the top of wall elevation. Because of the top of wall will be less than 30-inches above grade, and the tank will be covered, handrailing around the tank will not be required.

WAS will be transferred to the WAS holding tank from a pipe connection to the recycle piping, downstream of the MBR basins. Scum will be manually drained from the MBR package plant basins to the WAS holding tank via telescoping skimmer valves.

The WAS holding tank will be equipped with a fine bubble aeration system and a dedicated aeration blower to provide aeration and mixing. The WAS blower will be located in the Operations Building. The discharge from the blower will be connected to the common air manifold so that one of the aerobic basin blowers or an MBR air scour blower can be used for the WAS holding tank as a backup unit.

The WAS holding tank will be equipped with a submersible centrifugal pump to transfer the liquid sludge to a tank truck.

Odor Control System

The odor control system will be equivalent to that described for the conventional MBR alternative. Odorous air collected under the covered package MBR process basins, WAS holding tank, and the headworks screens will be carried by a combination of above-grade and below-grade ducts from the respective odor generation sources to an odor control system.

Standby Power

Standby power will be provided at the WWTF by diesel fuel generator. The generator will be located outside and adjacent to the Operations Building on a concrete pad. The generator will operate during power outages and provide power to serve, at minimum, one influent screen, the washer/compactor, one mixed liquor pump, one internal recycle pump, one permeate pump, the oxygen concentrator, two air scour blowers, the UV disinfection system, one non-potable water pump, one plant drain pump, the odor control system, Operations Building, telemetry system, lighting, heating and other critical processes.

Operations Building

The operations building design will be similar to that described for the conventional MBR. The package MBR system will be mounted on a concrete pad inside the equipment room similar to that of the existing casino WWTF. The equipment building roof will have removable panels to allow a contracted crane and operator to remove the submerged membrane units.

Operations Staff and Testing Requirements

Operations staff recommended certification criteria and permit testing requirements for the package MBR WWTF are equivalent to that described for the conventional MBR alternative. Additional operational oversite is required for the package MBR pure oxygen SNdN process.

COMPARISON OF WWTF ALTERNATIVES

The costs associated with the two WWTF alternatives discussed above are summarized in Table 7-6 below and the detailed cost estimates are provided in Appendix F. The operation and maintenance (O&M) costs were based on the following assumptions:

1. O&M will be accomplished by a contract WWTF O&M company with licensed operators. The costs are based on an existing contract for a similar size and type of WWTF.

2. Electrical power cost of $0.095/kWh.

3. Maintenance and repair costs include general equipment O&M costs, membrane replacement, and recoating of painted steel, and supply of high purity oxygen during maintenance of the package MBR oxygen concentrator.

4. Sludge treatment and disposal cost of $0.25/gallon, based on the current amount paid by the casino WWTF to have Northwest Cascade, Inc. FloHawks haul the sludge to a permitted facility for treatment.

5. Other miscellaneous costs include water, groundwater monitoring, maintenance, repair, laboratory and chemical costs.

Table 7-6 shows that package MBR alternative has a lower capital project cost, but the 20-year life cycle cost for the conventional MBR WWTF is $710,000 less than the package MBR WWTF. As shown in the detailed costs estimates provide in Appendix F, the operational costs associated with the MBR alternative which exceed those of the conventional alternative include sludge handling, recoating painted steel, and supply of high purity oxygen during maintenance of the oxygen concentrator.

As discussed above, a typical steel tank manufactured today will have a life expectancy of about 25 years and is also dependent on the quality of the steel tank and construction technique, the corrosiveness of the wastewater, quality of the steel coating system, and level of maintenance of the tank. By comparison, a concrete wastewater tank is expected to have a life expectancy in excess of 75 years. The Casino WWTF operator reports that, with less than 10 years of operation, each of the existing painted steel tanks are experiencing delamination of the original epoxy coating and corrosion of the steel; therefore, they are planning on recoating one of the four tanks per year over the next 4 years. In order to recoat a tank, it must be brought offline and cleaned, sand-blasted and painted in place. During the recoating operation, temporary bypass piping and piping will be required to be in place. The estimated cost for the painting alone for each tank is $30,000. This cost was used as a basis for estimating the maintenance requirements to recoat the package MBR components.

The alternative for the Central WWTF is the Conventional MBR alternative, based on the lower 20-year life cycle cost of this alternative.

From Table 6-13 the cost to upgrade and expand the capacity of the Casino MBR WWTF is significantly less than that of building a new treatment plant. Therefore, the recommended alternative is to upgrade and expand the capacity of the Casino MBR WWTF to handle the flow from the eastern part of the Reservation.

TABLE 7-6
WWTF Alternatives Project Capital Cost Summary (2016 Dollars)

	Conventional MBR WWTF	**Package MBR WWTF**
WWTF Project Cost	$4,810,000	$4,460,000
Annual O&M Cost	$207,000	$285,000
Total Present Worth of Annual O&M (20-year)	$2,813,000	$3,873,000
Total 20-Year Life Cycle Cost	$7,623,000	$8,333,000

WEST AREA WASTEWATER CONVEYANCE, TREATMENT AND DISPOSAL

The Tribe has opted to limit the wastewater facilities infrastructure planning and improvements projects to the east area and to continue with individual septic tanks and drainfield treatment for the residences located in the west area. A project to construct new facilities for wastewater conveyance, treatment, and disposal, in a similar manner to the potential Central WWTF for the east area, is estimated to have a project cost in the range of $6,000,000 to $7,000,000. However, the Tribe should consider the use of Orenco AX-MAX treatment systems for the western part of the reservation.

WATER RECLAMATION AND REUSE EVALUATION

GENERAL

This Report must evaluate the "opportunities for the use of reclaimed water" in accordance with RCW 90.48.112. Reclaimed water is defined in RCW 90.46.010 as "effluent derived in any part from sewage from a wastewater treatment system that has been adequately and reliably treated, so that as a result of that treatment, it is suitable for a beneficial use or a controlled use that would not otherwise occur, and is no longer considered wastewater."

Key differences between the requirements for water reuse and those for effluent disposal are the levels of reliability required within the treatment process, distribution, and use areas. The State of Washington's reuse treatment standards call for continuous compliance, meaning that the treatment standards must be met on a constant basis or the treated water cannot be used as reclaimed water.

The Tribe has installed purple pipe for future irrigation use for three ball fields located in the vicinity of the Community Center. The purple pipe has been installed from the intersection of Niederman Road and the utility corridor road to the ball fields via the utility corridor. Currently these ball fields receive drinking water for irrigation. The Tribe previously had a *Water Reclamation Project* (DCI Engineers, 2009) report prepared to preliminarily size the reclaimed water pumping and distribution system to serve the Community Center ball fields. That report is used as a basis for the evaluation below.

ALLOWABLE USES FOR RECLAIMED WATER

The Washington State Water Reclamation and Reuse Standards describe several allowable uses for reclaimed water, including:

- Agricultural irrigation;
- Landscape irrigation;
- Impoundments and wetlands;
- Groundwater recharge;
- Streamflow augmentation;
- Industrial and commercial uses; and
- Municipal uses.

Depending upon its end use, there are four categories of reclaimed water: Class A, Class B, Class C, and Class D. Class A has the highest degree of effluent treatment. In general, when unlimited public access to the reclaimed water is involved or when irrigation of crops for human consumption is the intended end use, the criteria will require Class A reclaimed water.

REUSE EVALUATION

Factors that could lead a wastewater treatment provider to pursue reclaimed water include the following:

- Regulatory Requirements. Regulatory conditions are such that making reclaimed water is a viable option compared to discharging secondary effluent.
- Environmental Benefits. There are substantial environmental benefits to making reclaimed water versus secondary effluent.
- Water Rights. The ability to make and reuse reclaimed water could benefit the Tribe's water rights.
- Cost Effectiveness. The cost to make and reuse reclaimed water is comparable to continuing to make and dispose of secondary effluent.

An evaluation of how each of these factors relates to the Tribe wastewater treatment utility is provided in the following sections.

REGULATORY REQUIREMENTS

Based on the recommendations presented in this Plan, the Tribe will dispose of its treated effluent by infiltration to ground. The regulatory requirements for effluent limits, equipment redundancy, and storage for reclaimed water treatment and distribution are more stringent than for discharge of secondary effluent to ground. These more stringent regulatory requirements result in higher capital and O&M costs for reclaimed water when compared to conventional secondary effluent.

A summary of the Class A reclaimed water standards is presented in Table 2-4. The main difference between the reclaimed water standard and the expected technology based limits for a rapid infiltration basin, as presented in Table 7-4 is that the reclaimed water standard has a much more stringent effluent disinfection requirement. And it is not possible to determine if this limit will be met as there is no regular monitoring of the Casino WWTF's effluent for coliforms.

ENVIRONMENTAL BENEFITS

The Tribe does not currently have, nor is there any known future, significant industrial water users that may benefit from reclaimed water. The most likely use for reclaimed water would be for irrigation of three ball fields located at the Community Center. The demand for reclaimed water for irrigation was estimated assuming an irrigation requirement of 1 inch per week during the time period from June 1 through October 1, for a total yearly usage of 16 inches per year. Based on the total ball field area of 2.7 acres, the yearly irrigation water use is estimated to be 1.2 million gallons per year.

WATER RIGHTS

RCW 90.46.120 states that the owner has the exclusive right to any reclaimed water generated by the wastewater treatment facility. Consequently, reclaimed water has the potential to benefit water purveyors who are water right deficient. However, the Tribe is not bound by State law and has plenty of water rights so this is not an issue.

RECLAIMED WATER SYSTEM EVALUATION

A reclaimed water system is not recommended at this time because there is no testing to guarantee that no inadequately disinfected effluent would be applied to the ball fields where children would be the primary users and the cost of the reclaimed water would be significantly higher than the continued use of potable water.

RECOMMENDED PROJECT

The recommend projected consists of the construction of a STEP collection system and expanded use of the Casino MBR WWTF and upgrades to the Petoie WWTF, as described in this chapter and Chapter 6 of this Report.

The estimated total project capital cost for the recommended project is presented in Table 7-7. The Capital Improvement Plan to implement the recommended project is presented in Chapter 8.

TABLE 7-7
Estimated Project Capital Cost Summary (2017 Dollars)

Project Component	Cost
Casino and Petoie WWTF Project Capital Cost	$743,000
Wastewater Conveyance System Project Capital Cost (without Fern)	$2,055,000
Total Project Capital Cost	**$2,798,000**

CHAPTER 8

CAPITAL IMPROVEMENTS AND FINANCE PLAN

AVAILABLE FUNDING SOURCES

The following state and federal programs can potentially provide funding for tribal sewer utility capital projects:

Grants:	Centennial Clean Water Fund (CCWF) Indian Community Development Block Grant (ICDBG) US Economic Development Administration (US EDA) US EPA State and Tribal Assistance Grant (STAG) USDA Rural Development (RD)
Loans:	USDA Rural Development (RD) Bureau of Indian Affairs (BIA) Indian Health Services (IHS)
Bonds:	Revenue Bonds
Other:	Utility Local Improvement Districts

CENTENNIAL CLEAN WATER FUND (CCWF)

The Department of Ecology administers the State Revolving Fund (SRF) and Centennial Clean Water Fund (CCWF) programs that provide low interest loans for water pollution control projects. The primary program requirements are to have an approved facilities plan and to demonstrate the ability to repay the loan through a dedicated funding source. The loans can be used to finance sewer system replacement for the elimination of excessive infiltration and inflow and for the construction of facilities with reserve capacities to accommodate flows corresponding to the 20-year projected growth in the service area. Land acquisition is not eligible for SRF funding.

Grant money is available only to those who can document hardship. Where financial hardship is determined, the total eligible project cost cannot exceed $10 million and the grant amount cannot be more than half of the project cost. Hardship is demonstrated when project costs for construction of facilities result in total cost for debt service and operation and maintenance in excess of 1.5 percent of the median household income.

Construction loan rates range from 60 percent of market rates to 0 percent depending on the level of hardship demonstrated by the Community. Those communities with moderate hardship may receive up to 50 percent principal forgiveness up to $5 million. Communities with documented severe hardship with very high sewer rates compared to median household income may receive 100 percent principal forgiveness up to$5 million. A project may be phased and receive funds from several cycles to complete the project. In addition, a higher grant amount may be available if the 3-year average local unemployment rate exceeds the 3-year average statewide unemployment rate.

Grants require a 50 percent matching fund, which is provided by a mandatory SRF loan. In-kind match can be used for force account work where the local utility or contractor working for the utility provides a portion of the project construction.

INDIAN COMMUNITY DEVELOPMENT BLOCK GRANT (ICDBG)

The Indian Community Development Block Grant program is a competitive source of federal funding for a broad range of community development projects. ICDBG funds may be used for housing, community facilities or economic development. A primary requirement of the ICDBG program is that the project must principally benefit at least 51 percent of the low-to-moderate income residents of the project area. ICDBG has two programs including Single Purpose and Imminent Threat. The Single Purpose program provides grant funds for activities designed to meet specific community development needs. Imminent threat grants provide a solution to problems of an urgent nature that were not evident at the time of the ICDBG single-purpose funding grant cycle or require immediate action. Wastewater treatment facility projects are grant eligible for up to $500,000 per application.

Eligible applicants for the ICDBG programs include all federally recognized Indian tribes, bands or nations.

USEPA STATE AND TRIBAL ASSISTANCE GRANT (STAG)

Local jurisdictions within the state of Washington can apply to the State and Tribal Assistance Grant program through the office of their local Congressional representative. The Congressional representative will work to add the project as a line item to the VA/HUD Appropriations Bill. Grant funding of up to approximately $2 million can be applied for. STAG funds have been unavailable for the past several years and it is uncertain if funds will be available at any time in the future.

USDA RURAL DEVELOPMENT (RD)

The RD Rural Utility Service administers a water and wastewater loan and grant program to improve the quality of life and promote economic development in rural areas.

Rural Development has a loan program that, under certain conditions, includes a limited grant program. Grants may be awarded when the annual debt service portion of the utility rate exceeds 1.0 to 1.5 percent of the applying entity's median household income.

In addition, RD has a loan program for low-income communities that cannot obtain funding by commercial means through the sale of revenue bonds. The loan program provides 30- to 40-year loans at an interest rate that is based on federal rates and varies with the commercial market. The current RD base loan rate is 2.75 percent. RD loans are revenue bonds and require a 1.1 debt coverage factor.

Eligible projects include the design, construction, expansion, extension or improvement of rural water, sanitary sewer, solid waste disposal, storm, and wastewater disposal facilities.

Basic criteria for RD funding follows:

- Dependent on inability to obtain funds from other sources at reasonable terms.
- A 45 percent grant is available if the median household income of the service area exceeds 80 percent of the statewide non-metropolitan median household income.
- A 75 percent grant is eligible if the service area is below the higher of the poverty line or 80 percent of the state non-metropolitan median household income, and the project is necessary to alleviate a health and safety issue.

Federally recognized Indian tribes in rural areas with populations less than 10,000 are eligible to apply for RD funding.

BUREAU OF INDIAN AFFAIRS (BIA)

The Office of Indian Affairs operates the BIA's General Assistance, Disaster Relief, Indian Child Welfare, Tribal Government, Indian Self-Government, and Reservation Roads programs.

INDIAN HEALTH SERVICES (IHS)

IHS provides clean water and sanitation facilities in consultation with tribes and has a limited funding program. IHS funds are available for residential wastewater services only. Tribal government facilities and businesses are not eligible for IHS funding. Projects may be evaluated based on the residential, commercial, and government proportions to determine eligible prorated components.

REVENUE BONDS

The most common source of funds for construction of major utility improvements is the sale of revenue bonds. These are tax-free bonds issued by a tribe. The major source of funds for debt service on revenue bonds is from monthly sewer service charges. In order to sell revenue bonds and make them marketable to investors, the bonds typically have contractual provisions for the tribe to meet debt coverage requirements. A tribe must show that its annual net operating income (gross income less operation and maintenance expenses) is equal to or greater than a factor, typically 1.2 to 1.4 times the annual debt service on all par debt. If a coverage factor has not been specified it will be determined at the time of any future proposed bond sale.

PROJECT FINANCING

The estimated project costs for the recommended collection system and WWTF Upgrade projects are presented in Table 8-1.

TABLE 8-1
Recommended Wastewater Facilities Project Components Cost Summary

Projects	Estimated Project Cost
Petoie WWTF Upgrades Project Capital Costs	$138,000
Casino WWTF Upgrades Project Capital Cost	$605,000
Total Collection System Project Capital Cost (without Fern)	$2,055,000
Total Project Cost	**$2,798,000**
Future Fern Project Capital Cost	$649,000

Two funding scenarios are presented for planning purposes. The first scenario assumes that the Tribe qualifies for moderate hardship grant money from the Centennial Clean Water Fund (CCWF). The second scenario assumes that the Tribe does not qualify for hardship grant money and is funded by State Revolving Fund (SRF) loan money administered by Ecology.

Funds that may be available through sources other than CCWF and SRF are not included in the analysis.

SCENARIO 1 – FUNDING WITH HARDSHIP GRANT MONEY

Assuming the Tribe meets the eligibility requirements for hardship, 50 percent of the project cost benefiting the domestic population could be funded by grant money from the Centennial Clean Water Fund. The remaining 50 percent of the project cost benefiting the domestic population would be eligible for low interest loans through the State Revolving Fund. Interest rates for 20-year SRF loans are currently 1.5 percent.

TABLE 8-2
Wastewater Facilities Project
Summary of Funding Assuming Hardship Demonstrated

Funding Type	Amount	Monthly Debt Service
CCWF Grant	$1,399,000[1]	-
SRF Loan	$1,399,000[1)]	$6,800[2]
Total		**$6,800**

(1) 50 percent of total project cost.
(2) Based on 20-year loan at 1.5 percent.

SCENARIO 2 – FUNDING WITHOUT HARDSHIP GRANT MONEY

This scenario assumes that the tribe cannot demonstrate hardship, and is therefore not eligible for grant money from the Centennial Clean Water Fund and would have to rely on low interest loans from SRF.

Table 8-3 summarizes the SRF loan funding scenario for the project.

TABLE 8-3
Wastewater Facilities Project
Summary of Funding Assuming Hardship Cannot beDemonstrated

Funding Type	Amount	Monthly Debt Service
SRF Loan	$2,798,000[1]	$13,500[2]
Total		**$13,500**

(1) 100 percent of total project cost.
(2) Based on 20-year loan at 1.5 percent.

SCHEDULE

The actual schedule for completion of the recommended improvements will be driven by funding application deadlines, preferred construction season, and time requirements for completion of design, permitting and construction. The anticipated schedule for completion of the recommended improvements is presented in Table 8-4.

TABLE 8-4 Capital Improvements Schedule	
Task	**Completion Date**
September 2017	Complete Preliminary Engineering Report
October 2017	Submit Funding Applications
June 2018	Secure Funding and Begin Design
2018 – 2019	Complete Design and Permitting
2019 – 2020	Construction of Wastewater Facilities Improvements
Mid to late 2020	Project complete

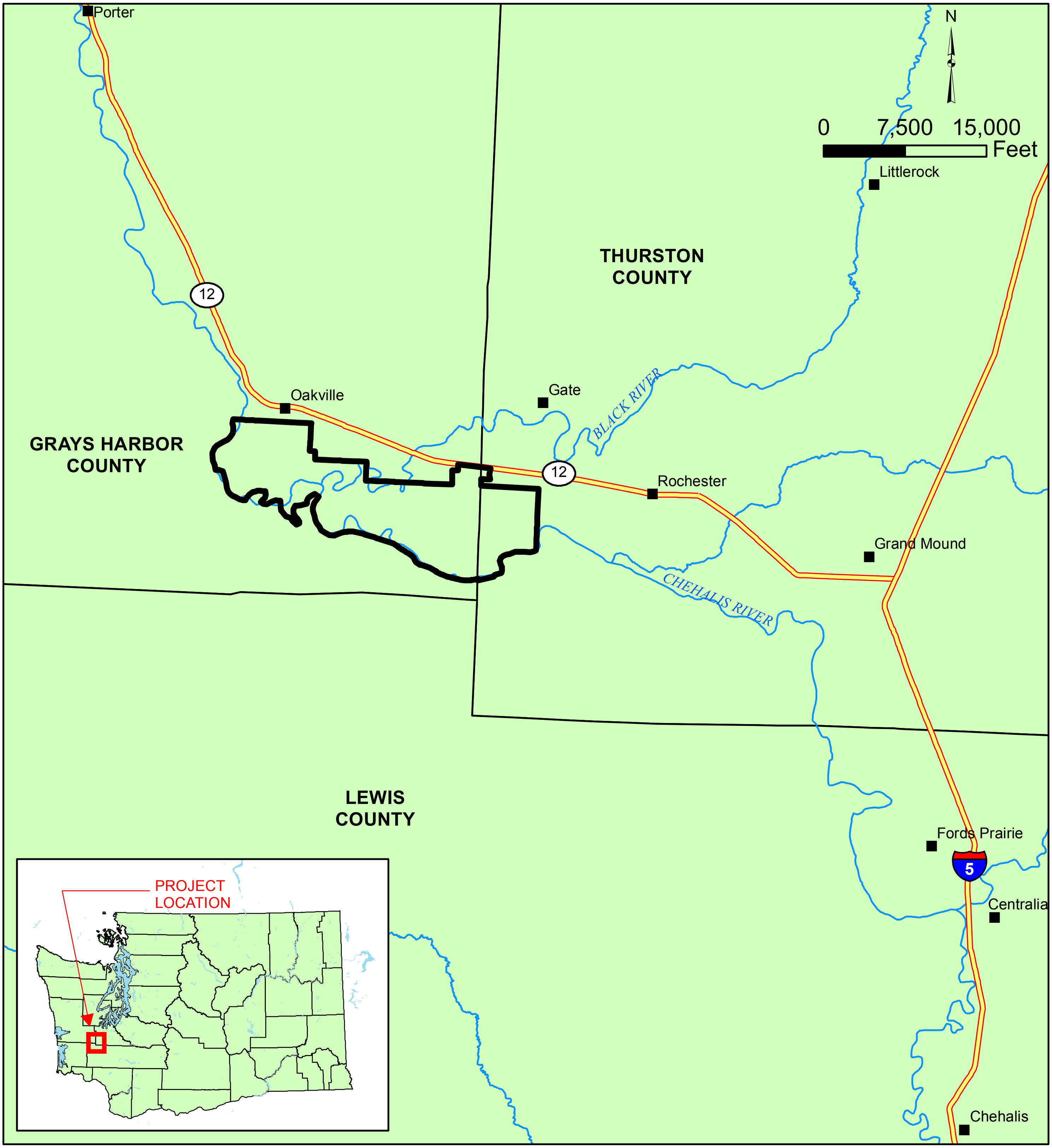
APPENDIX A

CHEHALIS TRIBE SURFACE WATER
QUALITY STANDARDS

TO BE FURNISHED LATER

APPENDIX B

CHAPTER 3 FIGURES



Legend

- CITIES
- CHEHALIS RESERVATION BOUNDARY
- HIGHWAY
- WATER
- COUNTIES

CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 3-1
STUDY AREA AND VICINITY

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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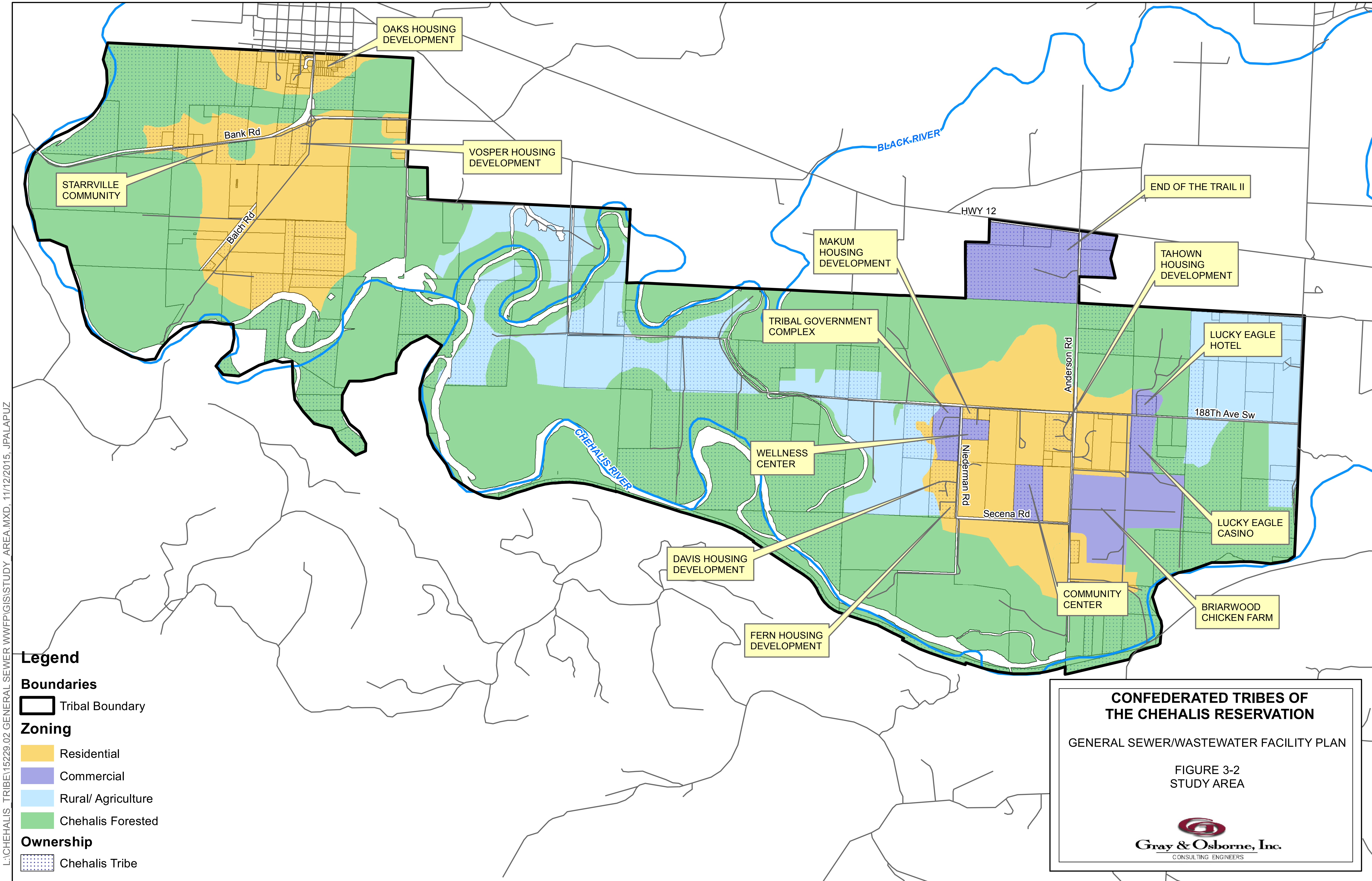

CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 3-2
STUDY AREA

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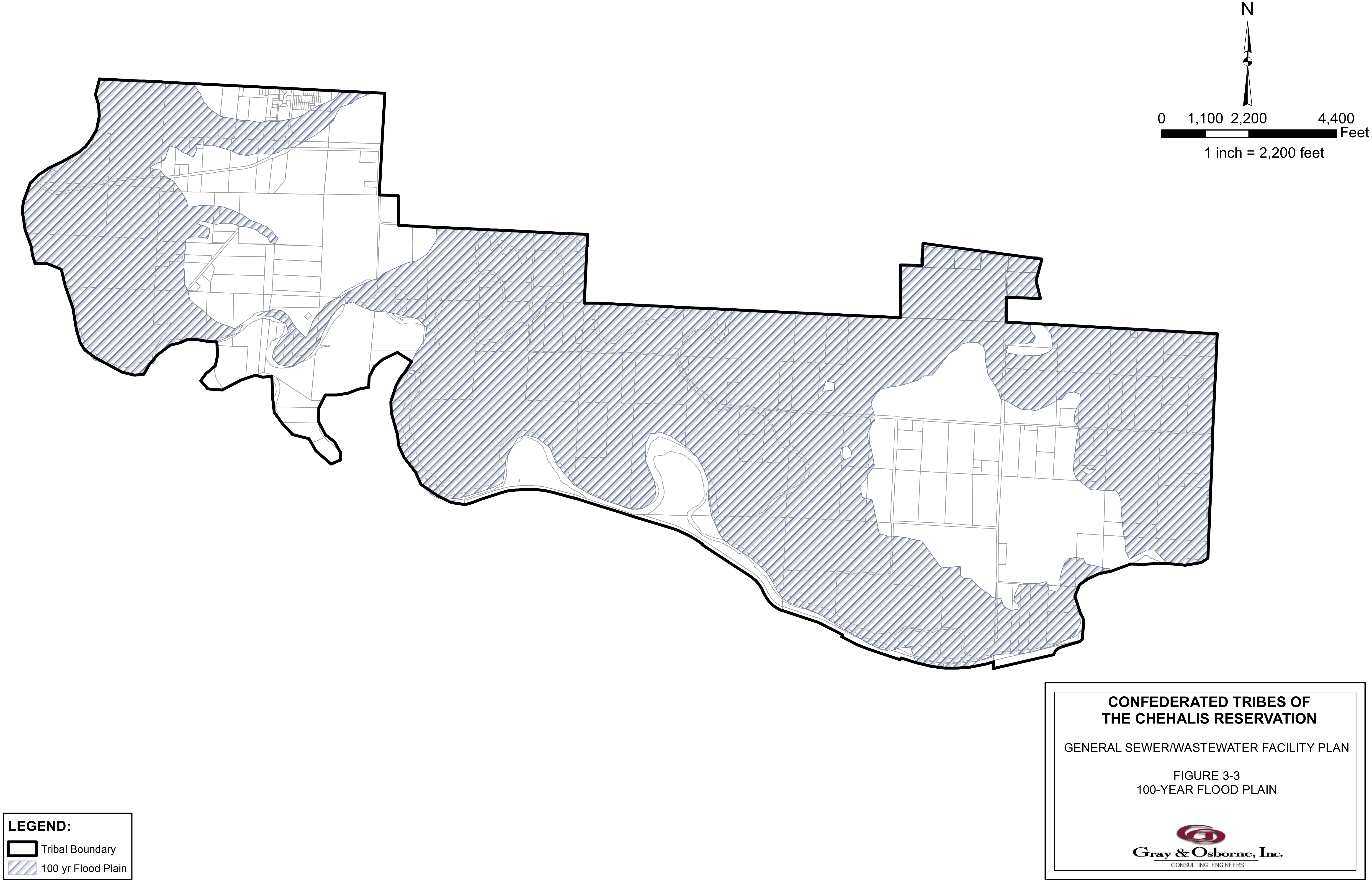

CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 3-3
100-YEAR FLOOD PLAIN

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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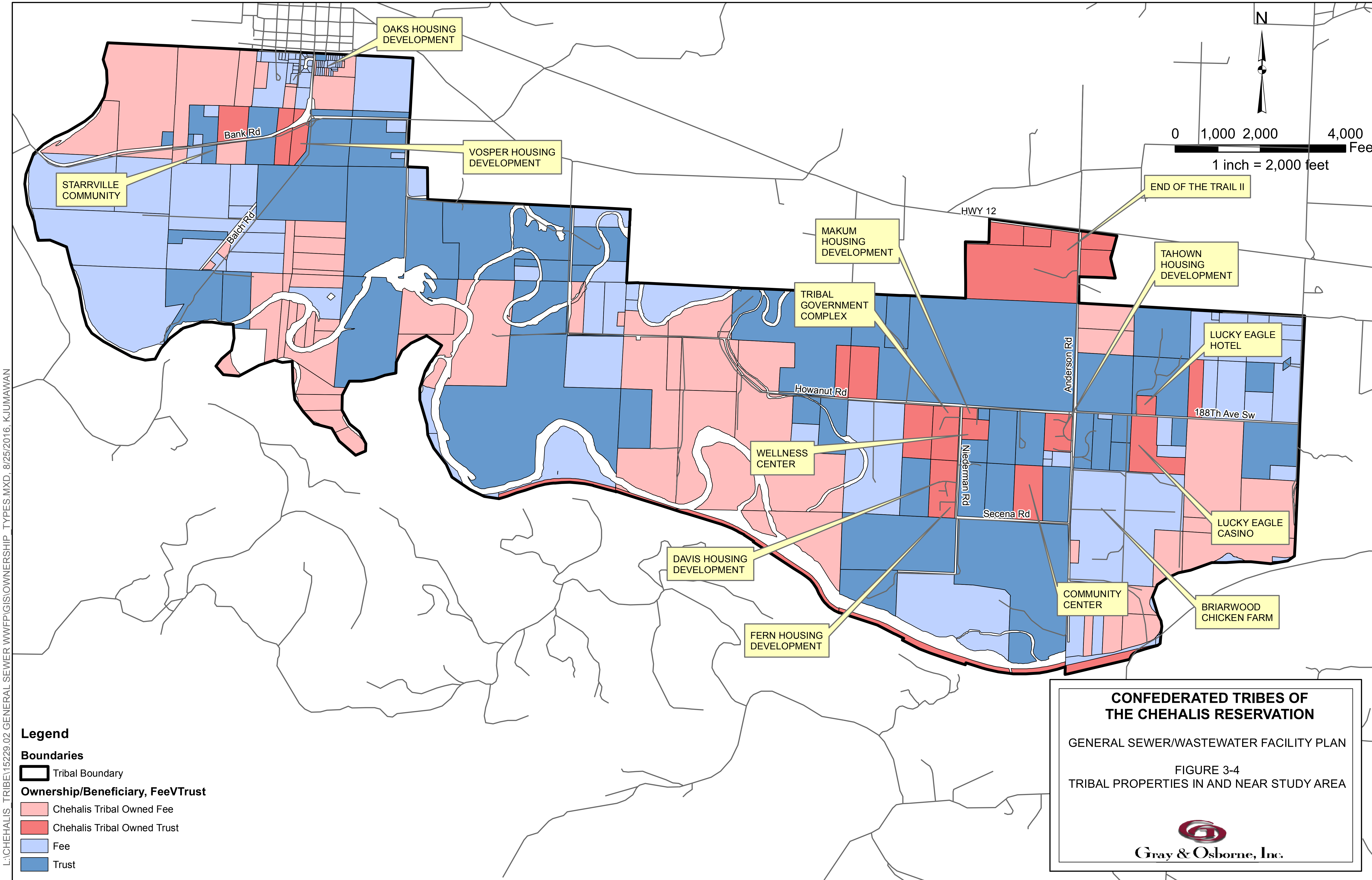

CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 3-4
TRIBAL PROPERTIES IN AND NEAR STUDY AREA

Gray & Osborne, Inc.

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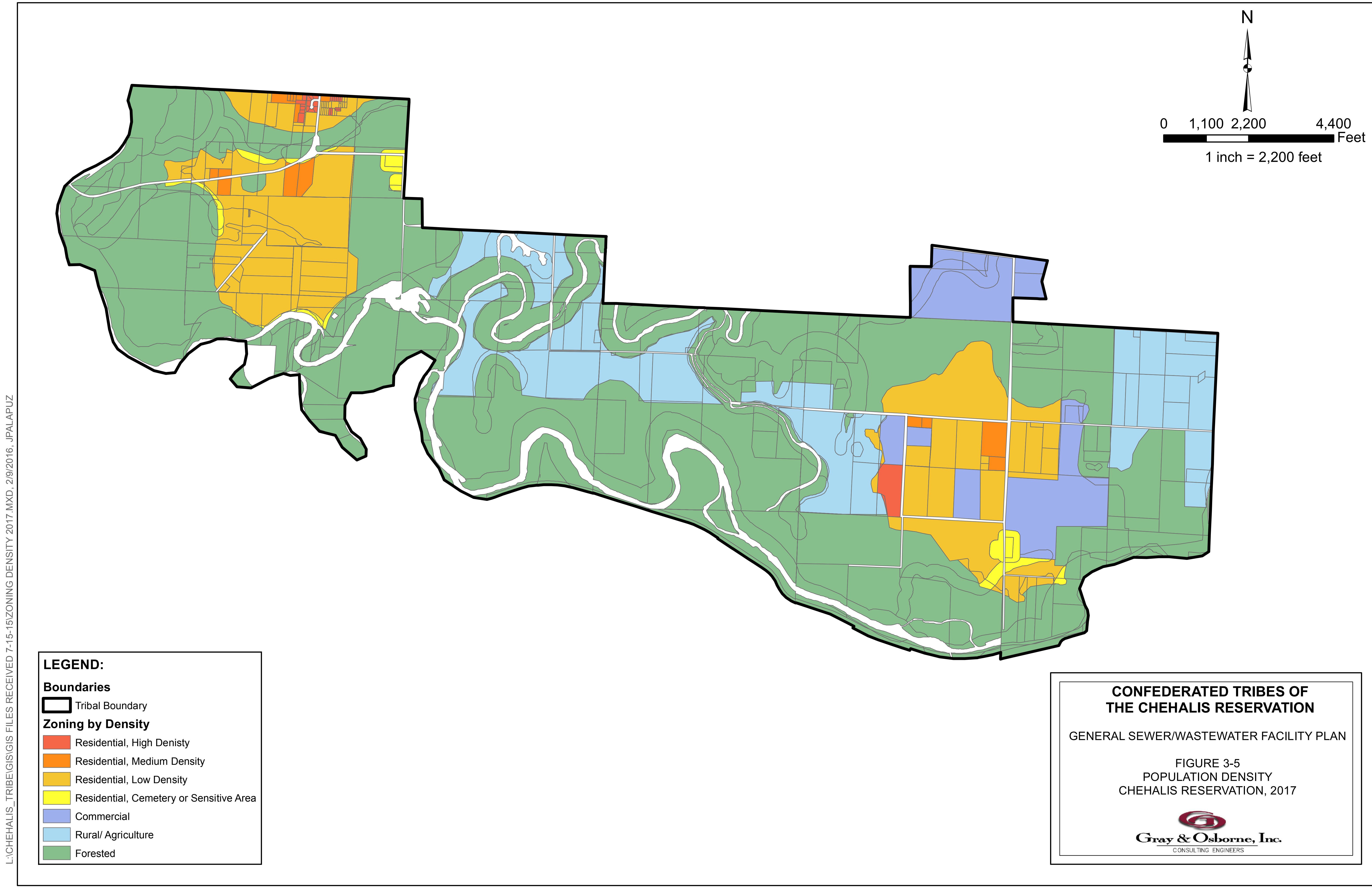
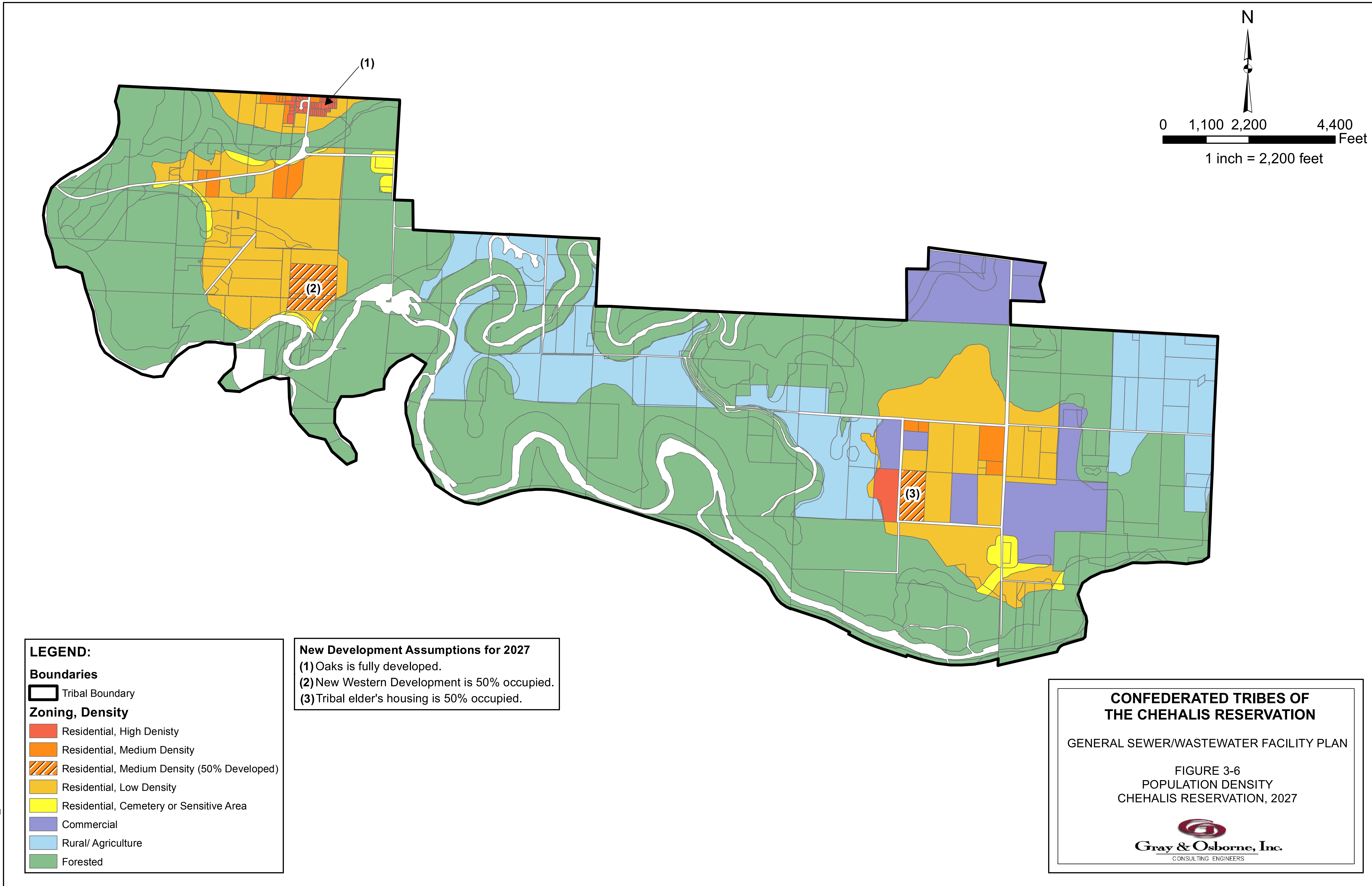


CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 3-5
POPULATION DENSITY
CHEHALIS RESERVATION, 2017

Gray & Osborne, Inc.
CONSULTING ENGINEERS



CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 3-6
POPULATION DENSITY
CHEHALIS RESERVATION, 2027

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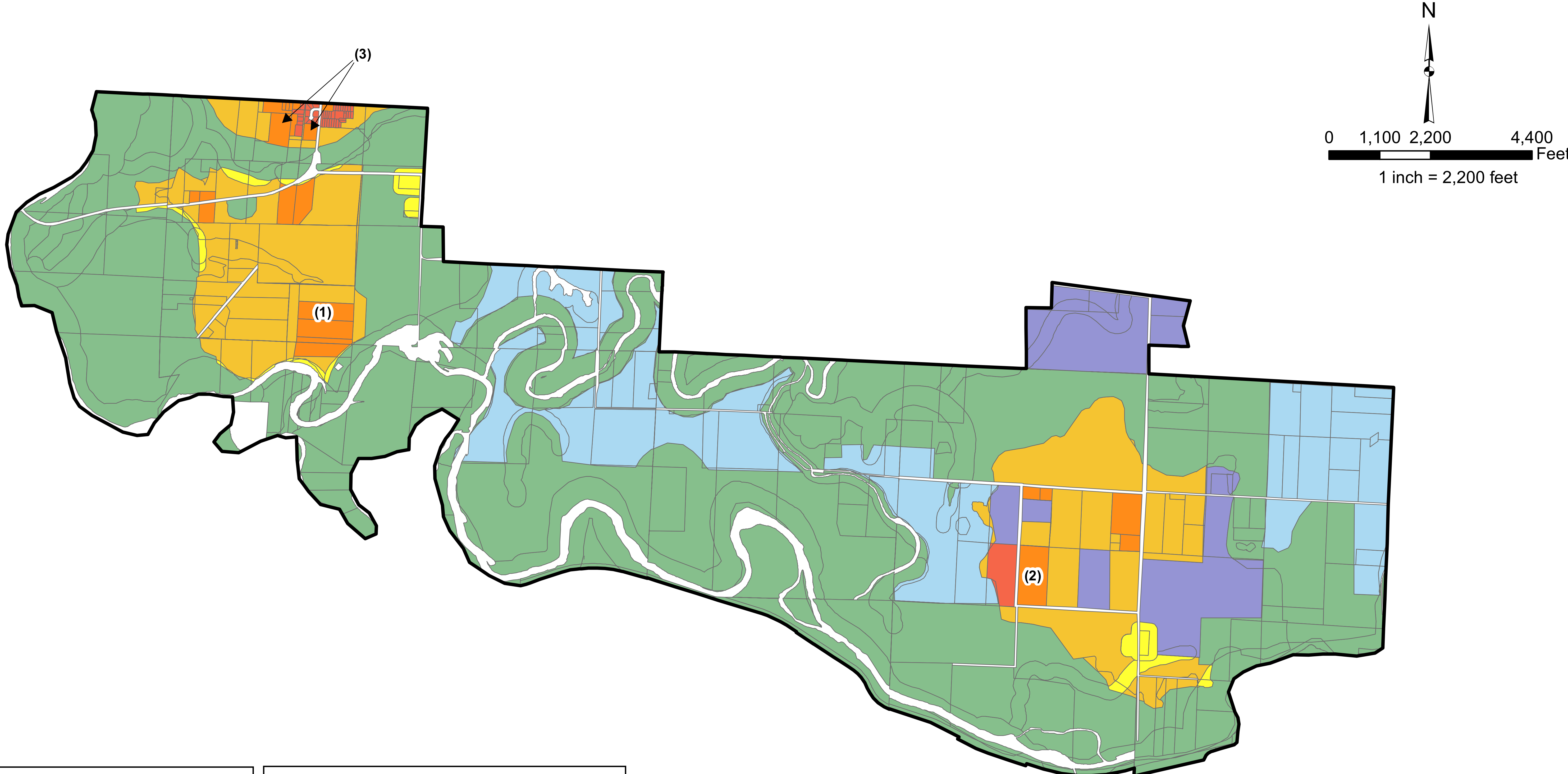
CONSULTING ENGINEERS



LEGEND:

Boundaries

- Tribal Boundary

Zoning, Density

- Residential, High Denisty
- Residential, Medium Density
- Residential, Low Density
- Residential, Cemetery or Sensitive Area
- Commercial
- Rural/ Agriculture
- Forested

New Development Assumptions for 2037

(1) New Western housing development is fully occupied.
(2) Tribal elder's housing is fully occupied.
(3) Two low density parcels reach medium density.

CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 3-7
POPULATION DENSITY
CHEHALIS RESERVATION, 2037

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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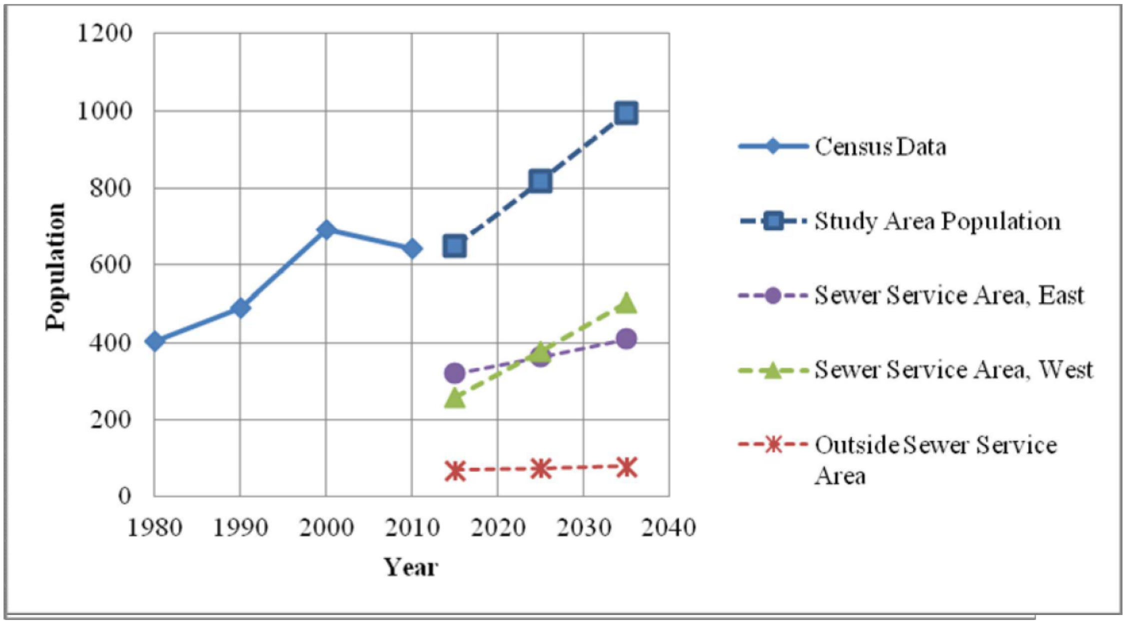


FIGURE 3-8

Historic and Projected Populations

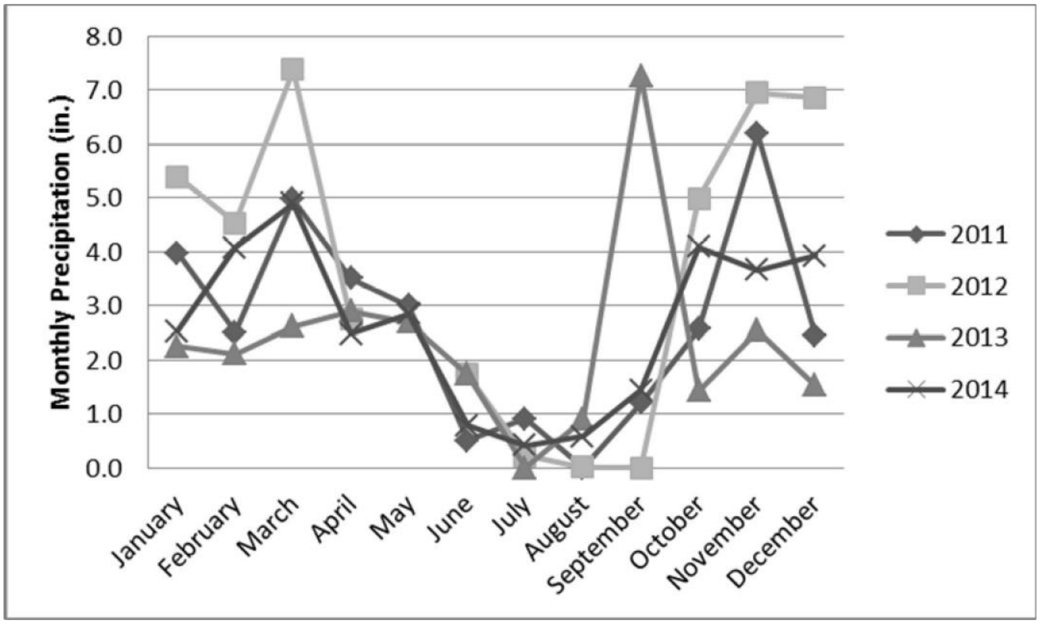
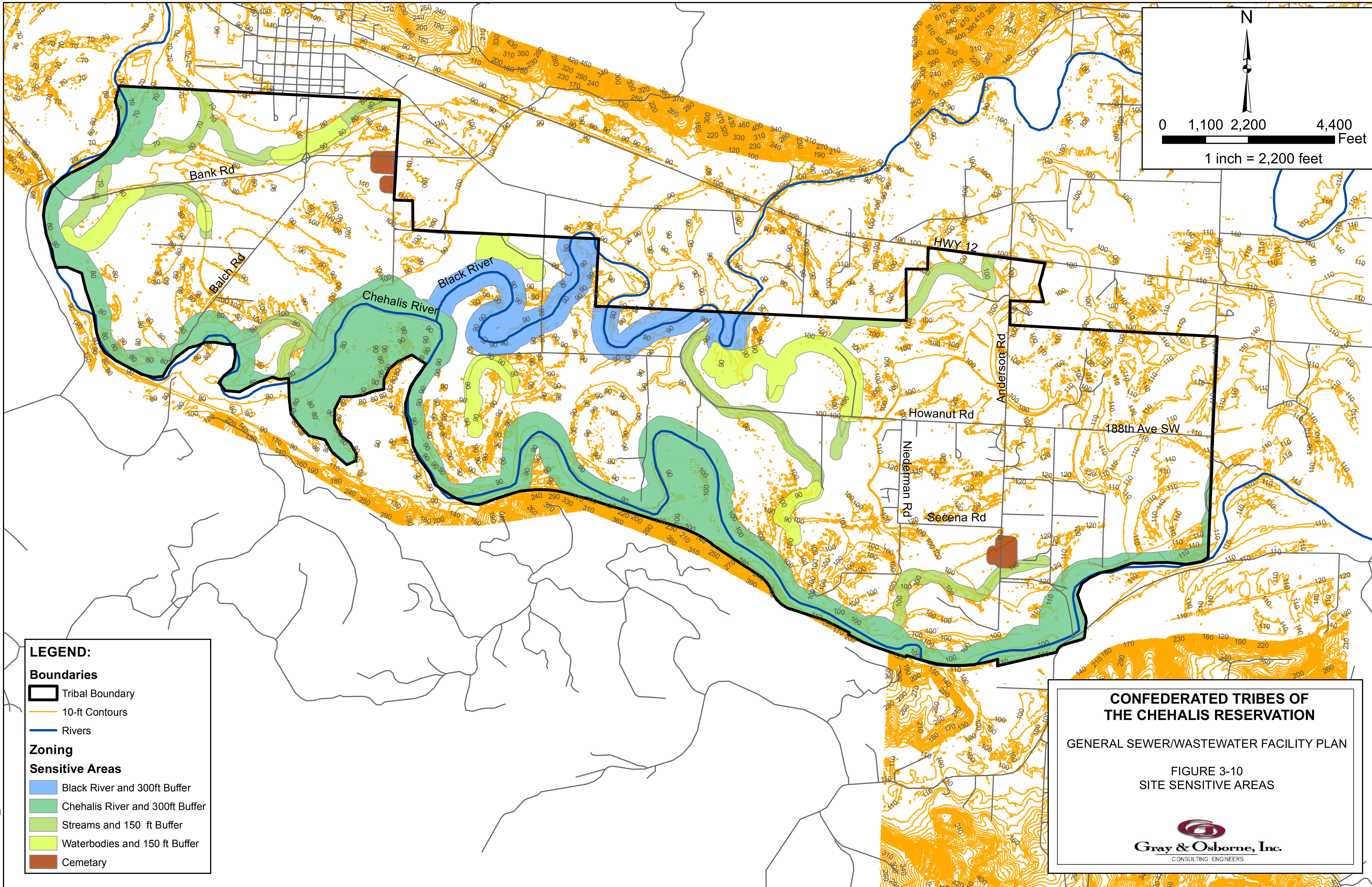


FIGURE 3-9

Chehalis Reservation Precipitation 2011 to 2014



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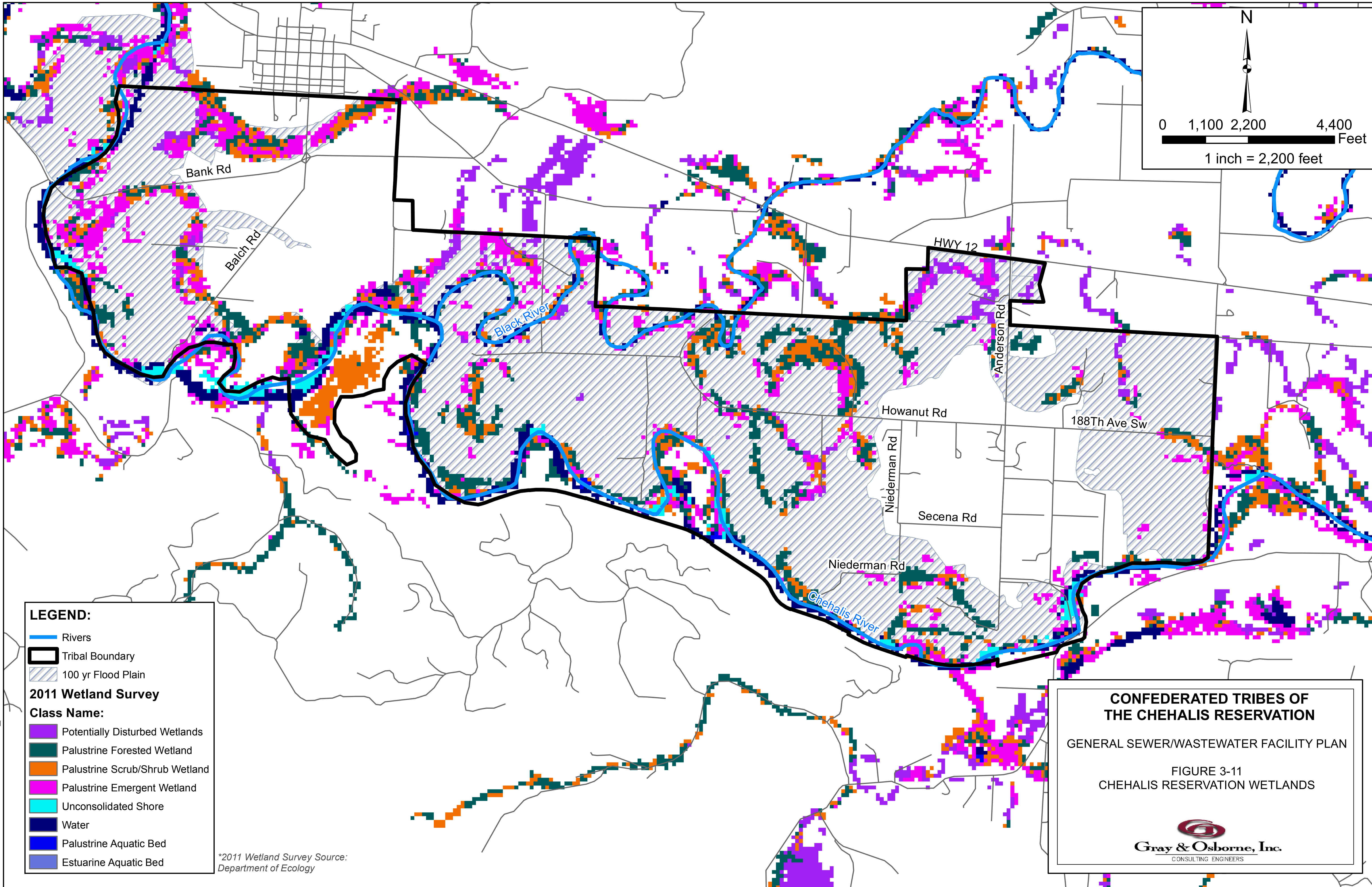
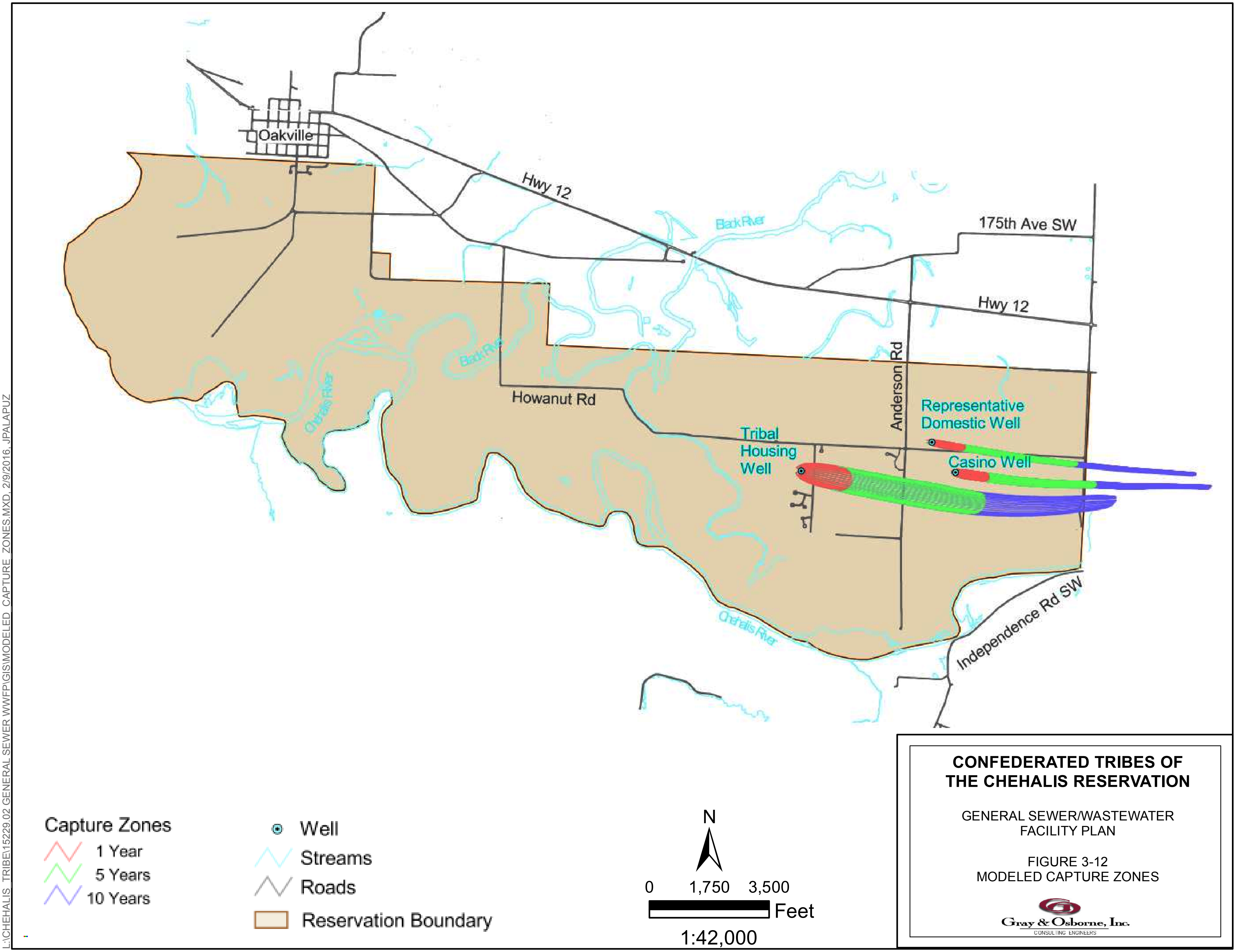


N
0 1,100 2,200 4,400
Feet
1 inch = 2,200 feet
Bank Rd
Balch Rd
Black River
HWY 12
Anderson Rd
Howanut Rd
188Th Ave Sw
Niederman Rd
Secena Rd
Niederman Rd
Chehalis River
LEGEND:
Rivers
Tribal Boundary
100 yr Flood Plain
2011 Wetland Survey
Class Name:
Potentially Disturbed Wetlands
Palustrine Forested Wetland
Palustrine Scrub/Shrub Wetland
Palustrine Emergent Wetland
Unconsolidated Shore
Water
Palustrine Aquatic Bed
Estuarine Aquatic Bed
*2011 Wetland Survey Source:
Department of Ecology
CONFEDERATED TRIBES OF
THE CHEHALIS RESERVATION
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 3-11
CHEHALIS RESERVATION WETLANDS
Gray & Osborne, Inc.
CONSULTING ENGINEERS
\\GOSERVER2\DATA1\CHEHALIS_TRIBE\15229.02 GENERAL SEWER WWFP\GIS\WETLANDS.MXD, 9/18/2015, JPALAPUZ



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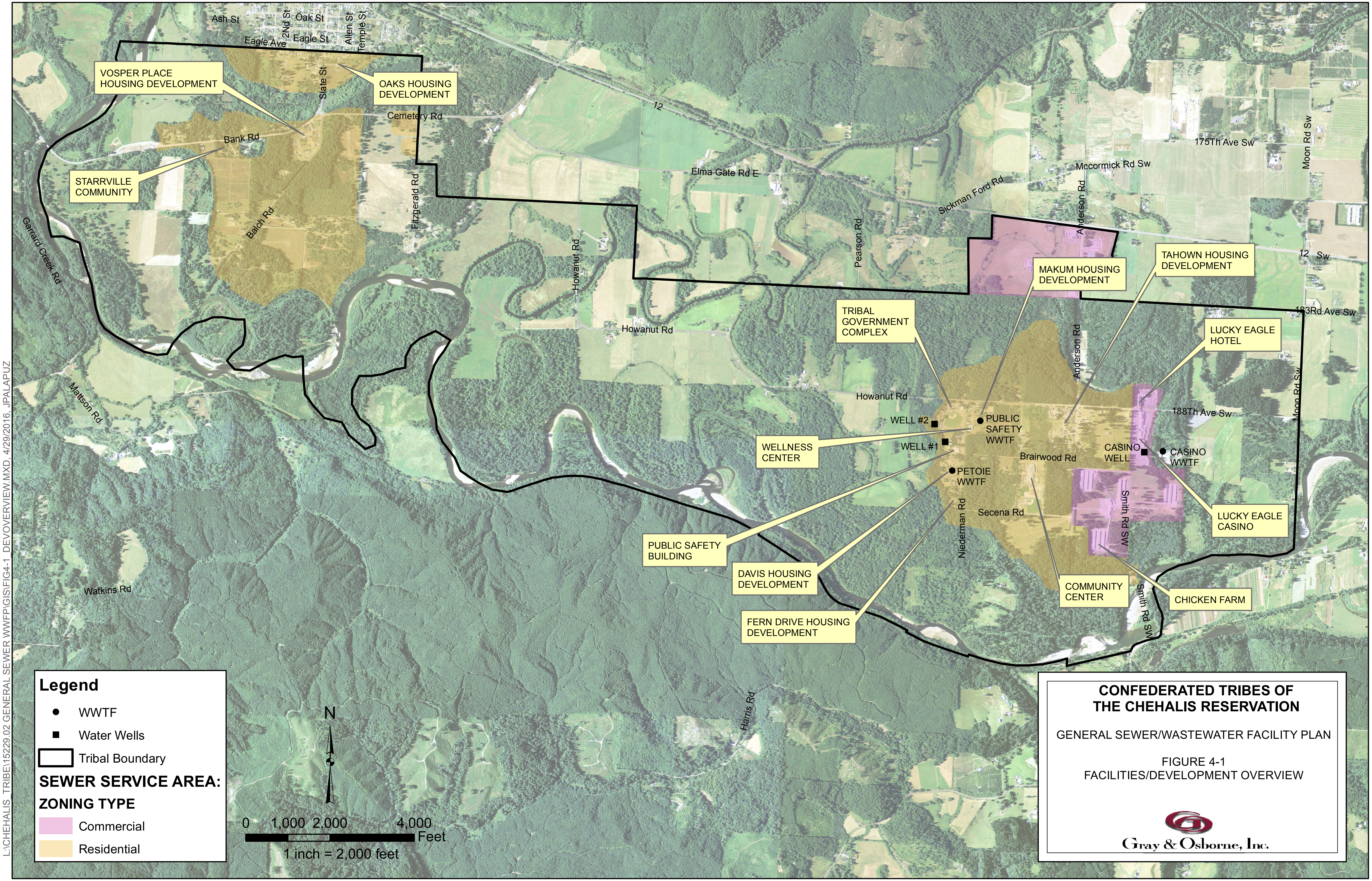
APPENDIX C

CHAPTER 4 FIGURES



CONFEDERATED TRIBES OF
THE CHEHALIS RESERVATION

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 4-1
FACILITIES/DEVELOPMENT OVERVIEW

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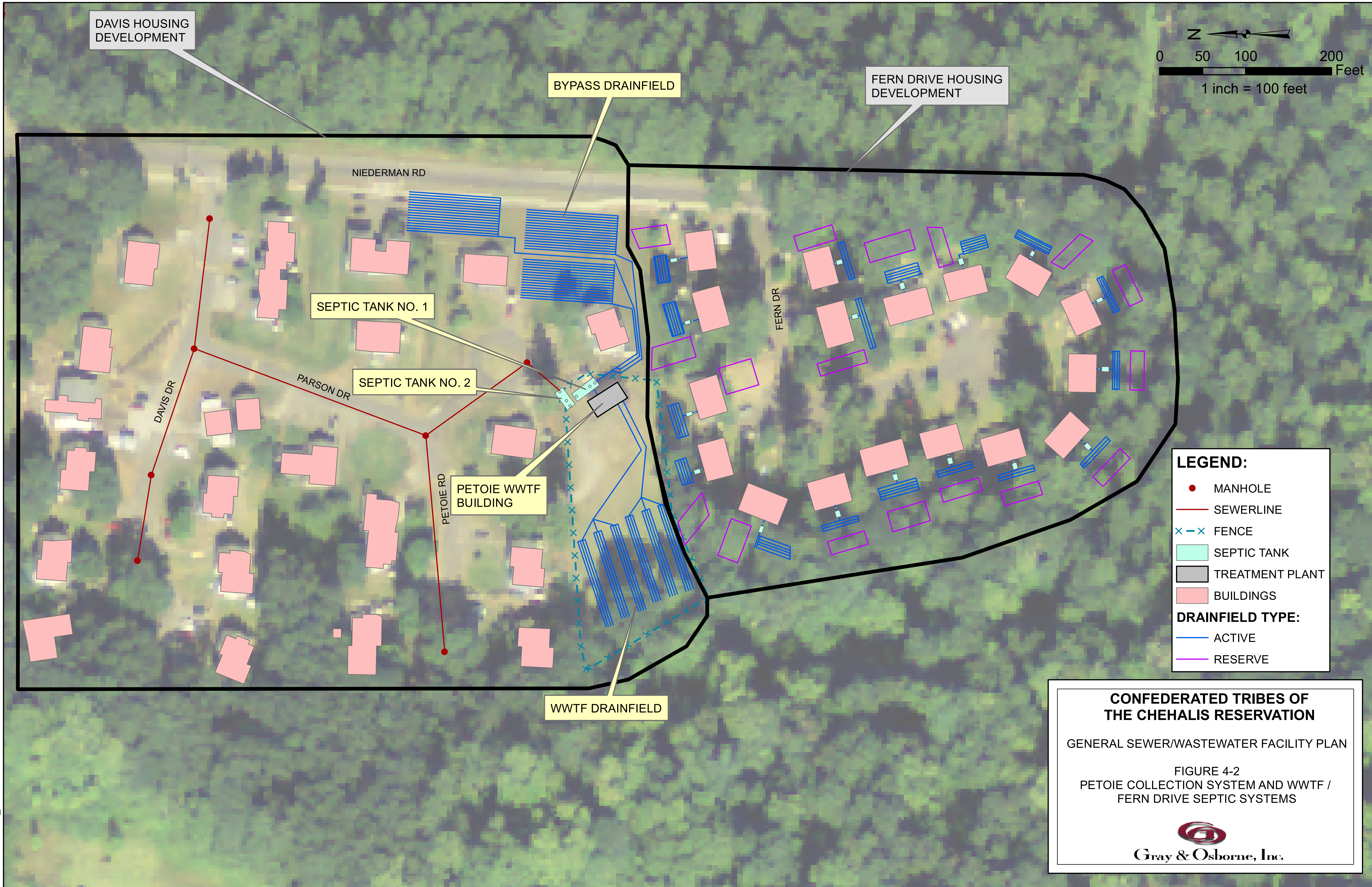
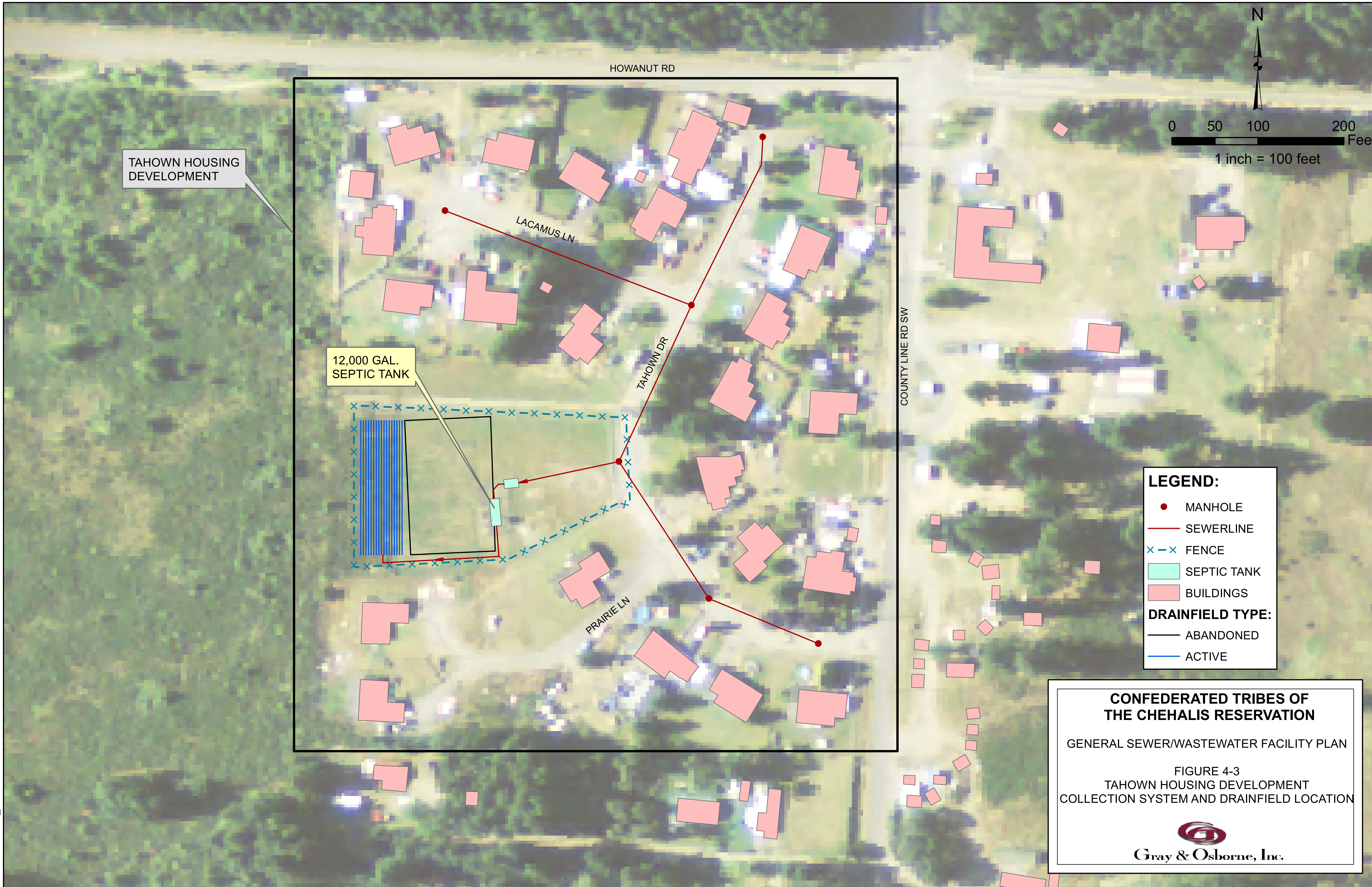


CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 4-2
PETOIE COLLECTION SYSTEM AND WWTF / FERN DRIVE SEPTIC SYSTEMS

Gray & Osborne, Inc.



CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 4-3
TAHOWN HOUSING DEVELOPMENT
COLLECTION SYSTEM AND DRAINFIELD LOCATION

Gray & Osborne, Inc.

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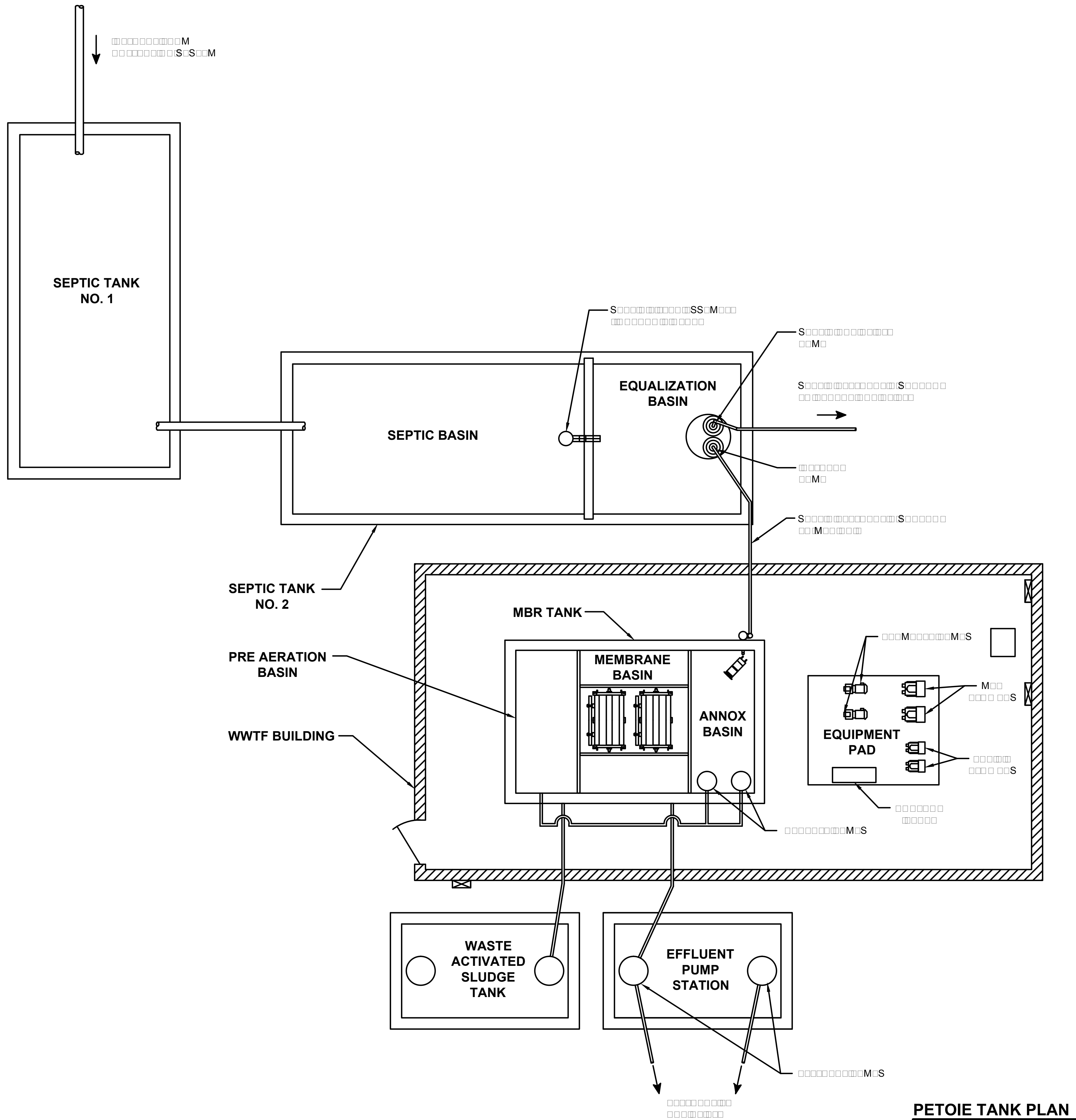
L:\CHEHALIS_TRIBE\15229.02 GENERAL SEWER WWFP\GIS\VOSPERPLACE.MXD, 8/11/2015, JPALAPUZ



PETOIE TANK PLAN

CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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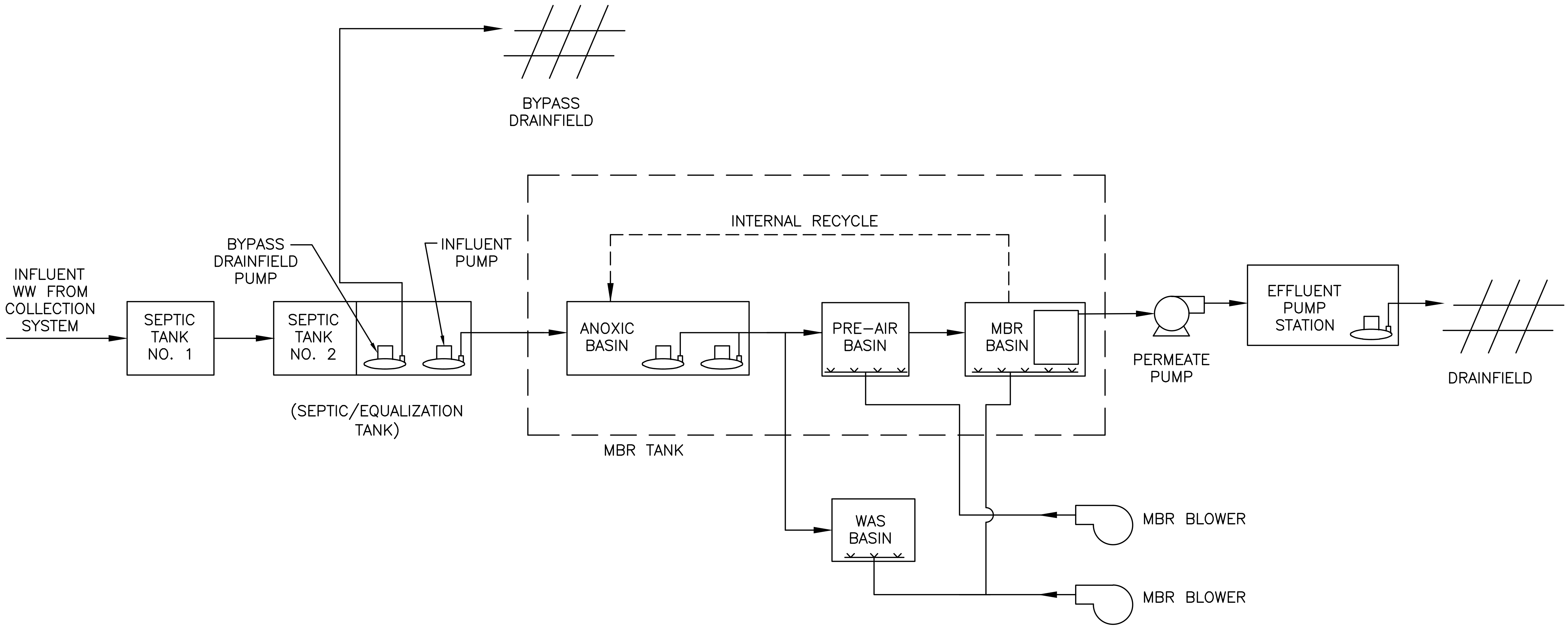


WASTEWATER TREATMENT
FACILITY PLANT SCHEMATIC

NOT TO SCALE

CONFEDERATED TRIBES OF
THE CHEHALIS RESERVATION

Gray & Osborne, Inc.
CONSULTING ENGINEERS

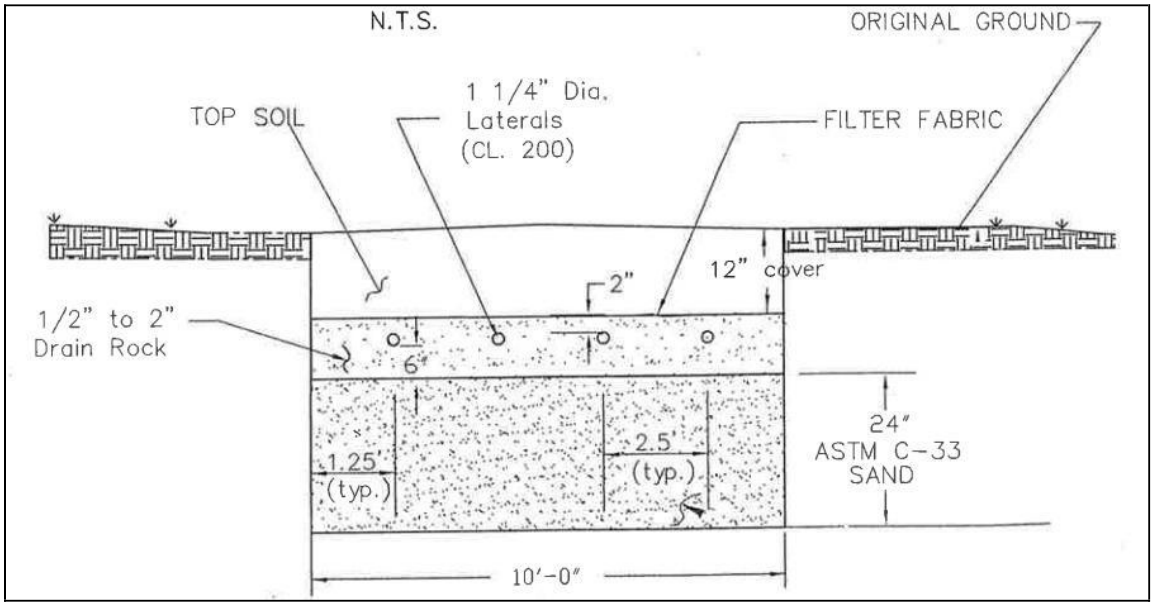
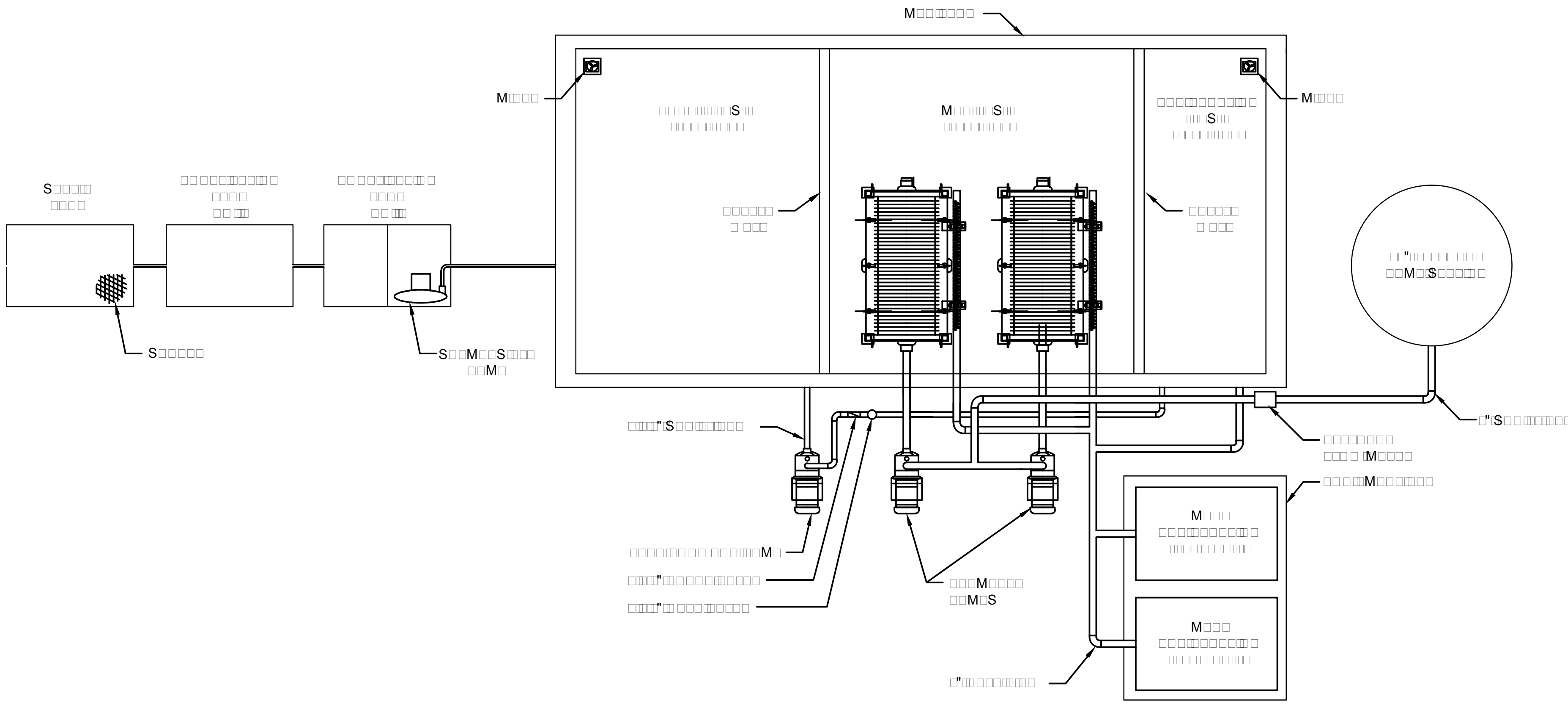
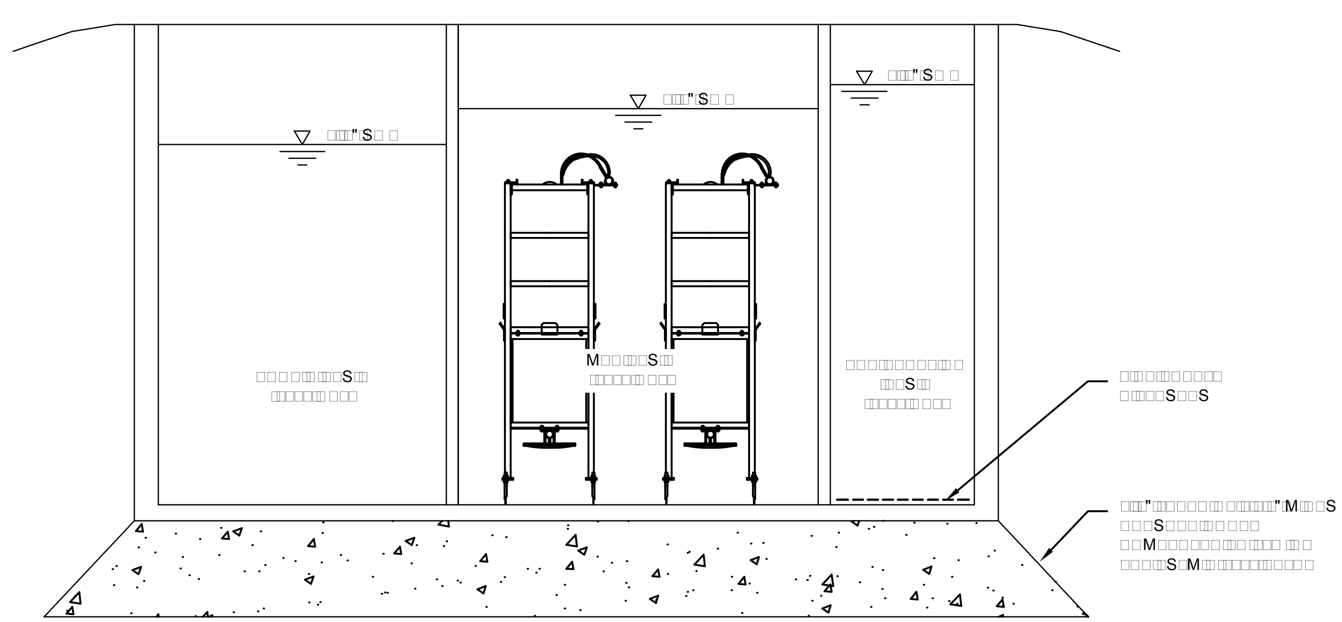


FIGURE 4-7

MBR Drainfield Profile (Source: Ayres & Associates, 2008)



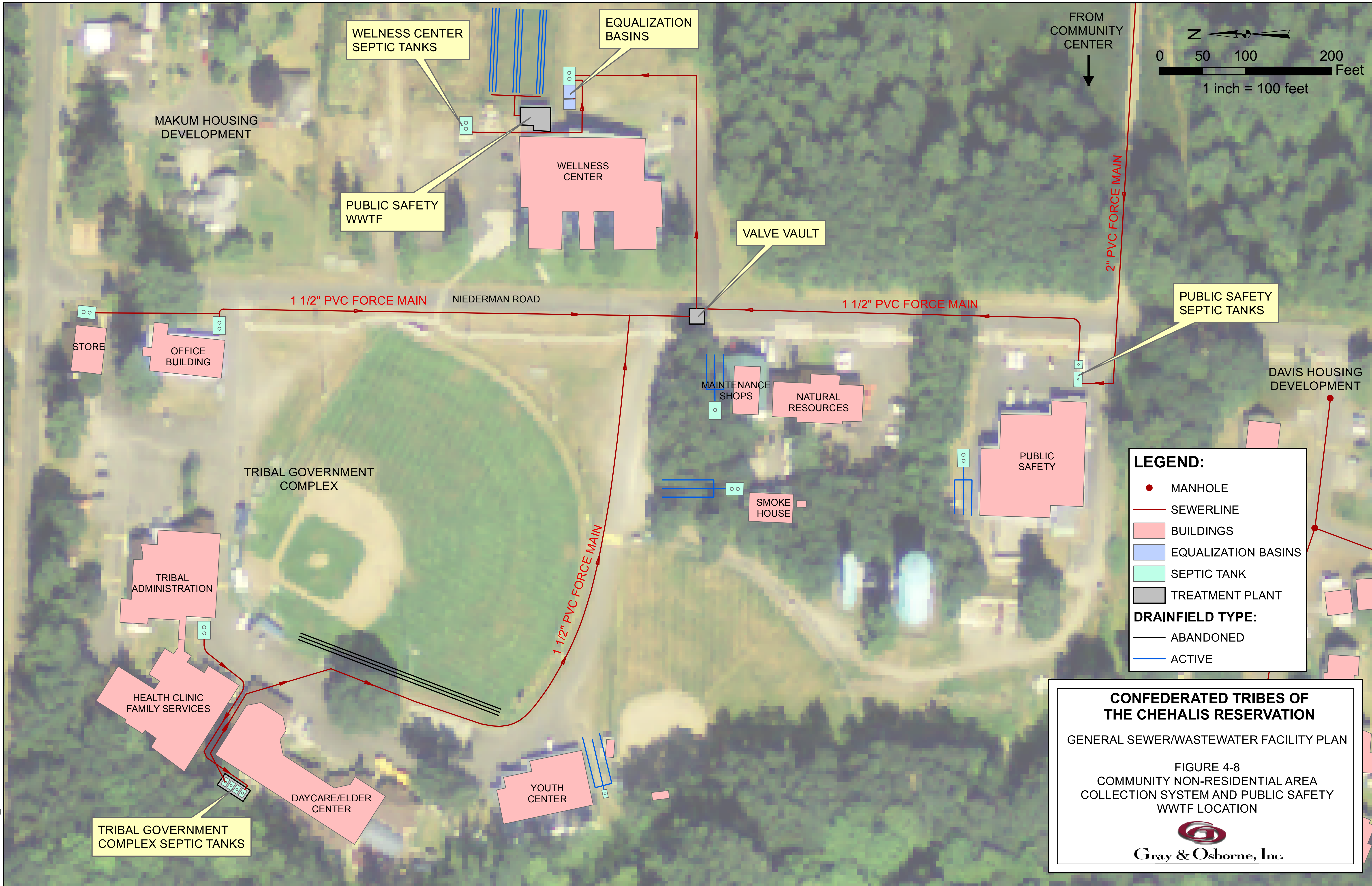
MBR SYSTEM PLAN



MBR TANK SECTION

CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

Gray & Osborne, Inc.
CONSULTING ENGINEERS



CONFEDERATED TRIBES OF
THE CHEHALIS RESERVATION

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 4-8
COMMUNITY NON-RESIDENTIAL AREA
COLLECTION SYSTEM AND PUBLIC SAFETY
WWTF LOCATION

Gray & Osborne, Inc.

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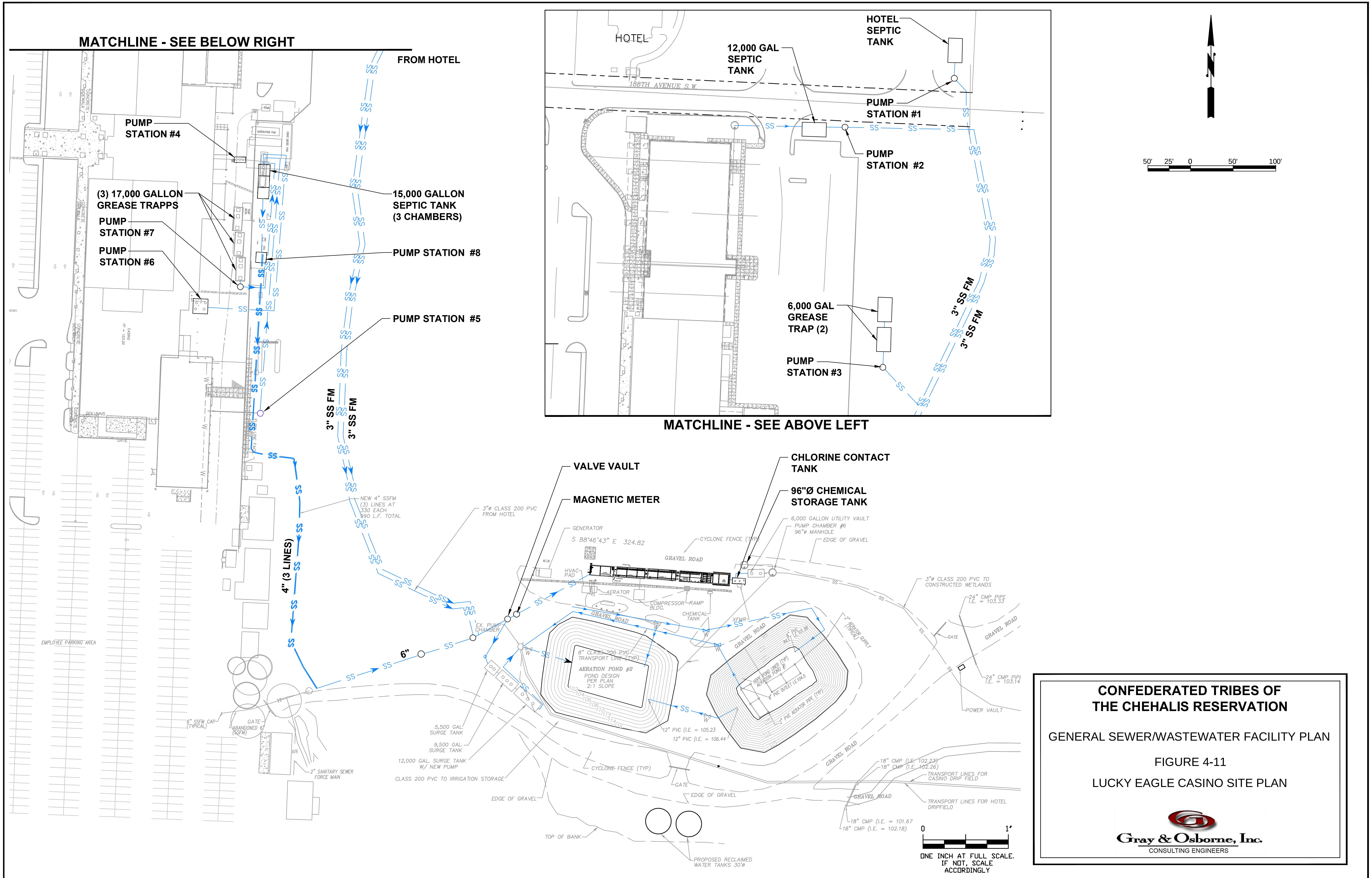


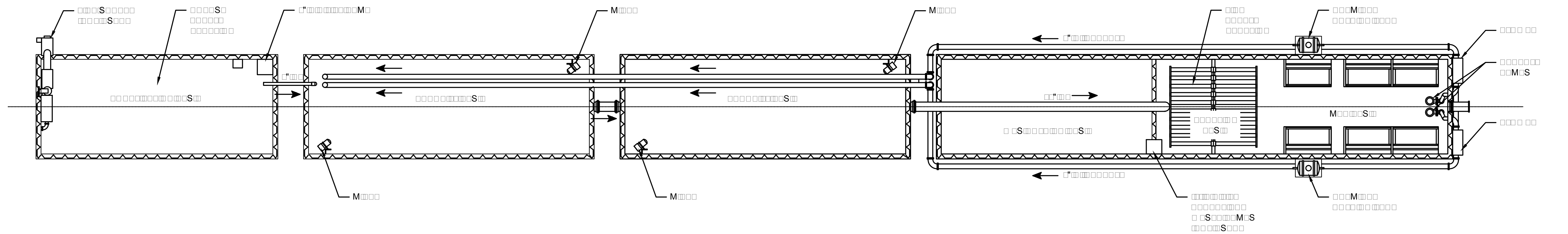
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

GENERAL SEWER/WASTEWATER FACILITY PLAN

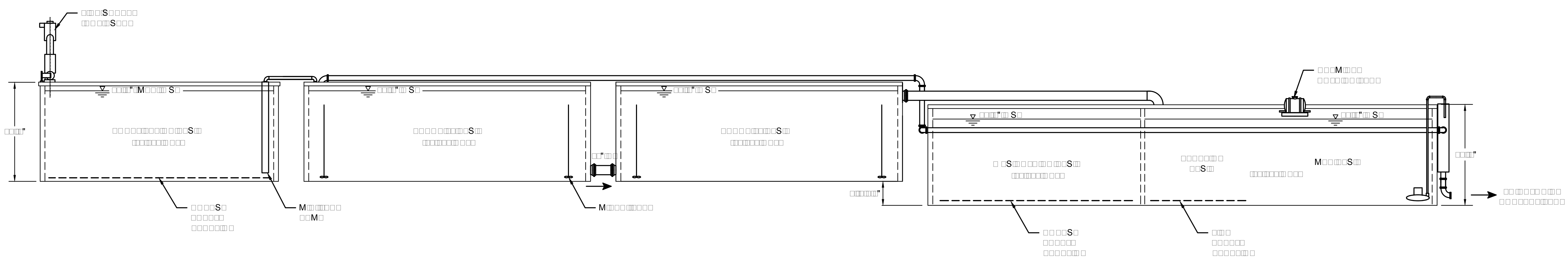
FIGURE 4-11

LUCKY EAGLE CASINO SITE PLAN

Gray & Osborne, Inc.
CONSULTING ENGINEERS



LUCKY EAGLE WWTF PLAN



LUCKY EAGLE WWTF ELEVATION

CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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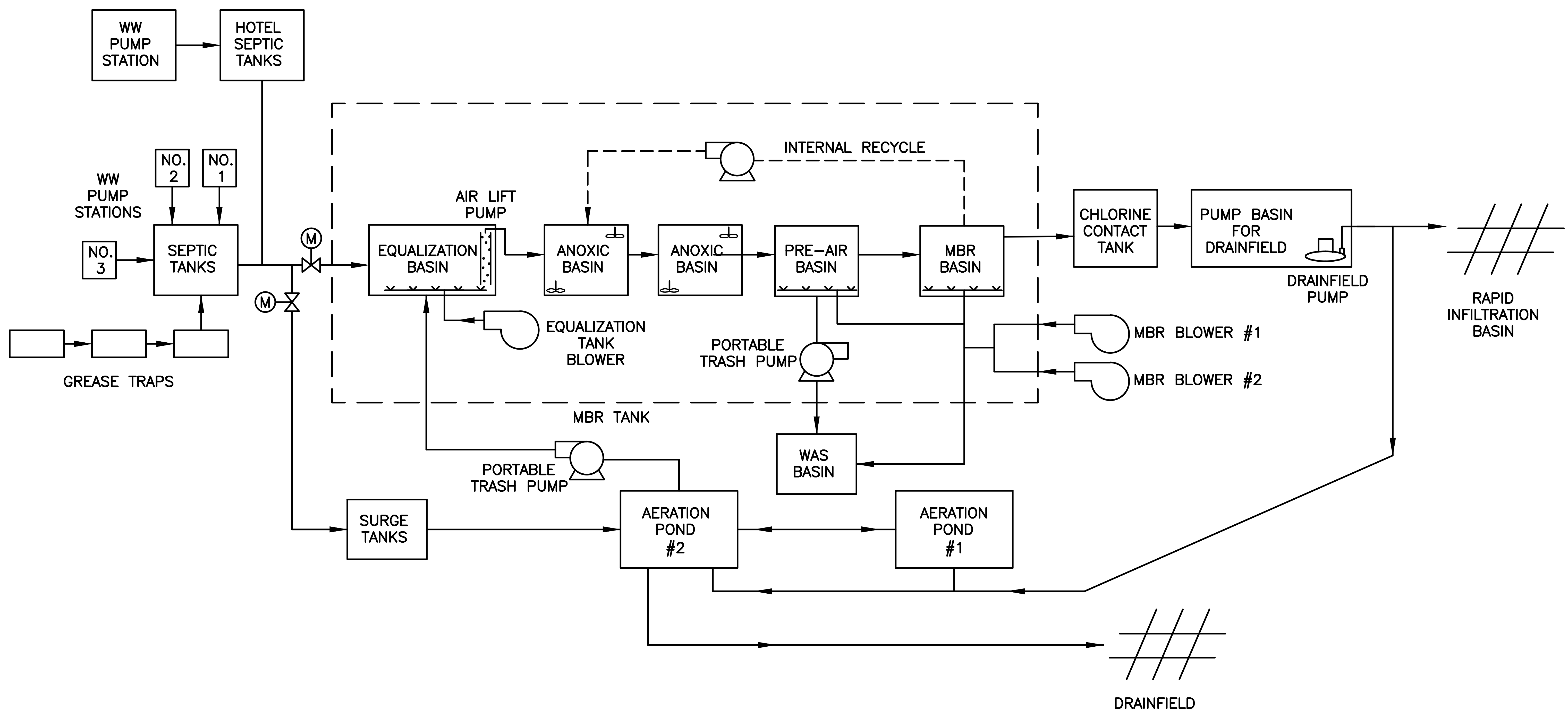

LUCKY EAGLE CASINO WWTF SCHEMATIC

NOT TO SCALE

CONFEDERATED TRIBES OF
THE CHEHALIS RESERVATION

Gray & Osborne, Inc.
CONSULTING ENGINEERS

APPENDIX D

DETAILED COST ESTIMATES

Confederated Tribes of the Chehalis Reservation
Opinion of Probable Construction Cost
Petoie WWTF Upgrades
Prepared by: Gibbs & Olson, Inc.
Date: Sept. 20th, 2017
Gibbs & Olson Project No. 0159-0001

Item No.	Item Description	Qty	Units	Unit Cost	Amount
1	Replace Existing Submerged Membrane Units	2	EA	$9,000	$18,000
2	Install New DO Meter	1	LS	$18,000	$18,000
3	Install New Influent and Effluent Flow Meter	2	EA	$12,000	$24,000
4	Install New Turbidimeter	1	LS	$6,000	$6,000
5	Install New SCADA Computer and Provide Programming	1	LS	$20,000	$20,000
6	Install Connections for Temporary Diesel Drainfield Pump	1	LS	$2,000	$2,000
			Construction Subtotal		$88,000
			Construction Contingency @ 20%		$18,000
			Total Construction Cost		$106,000
			Engineering, Administration, Legal & Permitting @ 30%		$32,000
			Total Project Cost		**$138,000**

Confederated Tribes of the Chehalis Reservation
Opinion of Probable Construction Cost
Casino WWTF Upgrades
Prepared by: Gibbs & Olson, Inc.
Date: Sept. 20th, 2017
Gibbs & Olson Project No. 0159-0001

GIBBS & OLSON
CIVIL ENGINEERS • LAND SURVEYORS

Item No.	Item Description	Qty	Units	Unit Cost	Amount
1	Install 2 New Submerged Membrane Units and One Air Scour Blower	1	LS	$100,000	$100,000
2	Replace Existing Submerged Membrane Units	1	LS	$80,000	$80,000
3	Install new HMI and computer	1	LS	$50,000	$50,000
4	Install new permeate pumps	1	LS	$30,000	$30,000
5	Install new process water pump station	1	LS	$50,000	$50,000
6	Install new effluent pumps	1	LS	$20,000	$20,000
7	Install new influent and effluent flow meters	1	LS	$25,000	$25,000
8	Install new effluent turbidity meter	1	LS	$7,000	$7,000
9	Install new effluent composite sampler	1	LS	$25,000	$25,000
	Construction Subtotal				$387,000
	Construction Contingency @ 20%				$78,000
	Total Construction Cost				$465,000
	Engineering, Administration, Legal & Permitting @ 30%				$140,000
	Total Project Cost				**$605,000**

Confederated Tribes of the Chehalis Reservation
Opinion of Probable Construction Cost
STEP system - Fern Drive Housing Development Area
Prepared by: Gibbs & Olson, Inc.
Date: Sept. 20th, 2017
Gibbs & Olson Project No. 0159-0001

Item No.	Item Description	Qty	Units	Unit Cost	Amount
1	Mobilization	1	LS	$35,000	$35,000
2	Surveying, Staking and As-Built Dwgs	1	LS	$8,000	$8,000
3	Environmental Controls	1	LS	$6,000	$6,000
4	Trench Excavation Safety Systems	1	LS	$4,000	$4,000
5	Dewatering	1	LS	$6,000	$6,000
6	Clearing and Grubbing	1	LS	$8,000	$8,000
7	Traffic Control	1	LS	$5,000	$5,000
8	Locate Existing Utilities	1	LS	$4,500	$4,500
9	2" PVC Pressure Main - (includes bedding and backfill)	1400	LF	$30	$42,000
10	1-1/2" PVC Pressure Main - (includes bedding and backfill)	1700	LF	$25	$42,500
11	Pressure Main Flushing Port	1	EA	$4,000	$4,000
12	Asphalt Treated Base	100	TONS	$100	$10,000
13	Sawcutting	2800	LF	$3	$8,400
14	Hot Mix Asphalt	200	TONS	$125	$25,000
15	Hydroseeding	1150	SY	$3	$3,450
16	Simplex STEP Sytem Retrofit and Electrical Controls	17	EA	$12,000	$204,000
	Construction Subtotal				$416,000
	Construction Contingency @ 20%				$83,000
	Total Construction Cost				$499,000
	Engineering, Administration, Legal & Permitting @ 30%				$150,000
	Total Project Cost				**$649,000**

Notes:
1. The Tribe is not subject to Washington State Sales Tax for work performed on the reservation.
2. ENR Seattle Construction Cost Index - August 2017 - 10,724.95
3. All Numbers from Construction Subtotal through Total Project Cost are rounded to the nearest $1,000.

Confederated Tribes of the Chehalis Reservation
Opinion of Probable Construction Cost
STEP system - Community Non-Residential Area
Prepared by: Gibbs & Olson, Inc.
Date: Sept. 20th, 2017
Gibbs & Olson Project No. 0159-0001

Item No.	Item Description	Qty	Units	Unit Cost	Amount
1	Mobilization	1	LS	$21,500	$21,500
2	Surveying, Staking and As-Built Dwgs	1	LS	$3,500	$3,500
3	Environmental Controls	1	LS	$5,000	$5,000
4	Trench Excavation Safety Systems	1	LS	$4,000	$4,000
5	Dewatering	1	LS	$6,000	$6,000
6	Clearing and Grubbing	1	LS	$5,000	$5,000
7	Traffic Control	1	LS	$5,000	$5,000
8	Locate Existing Utilities	1	LS	$4,500	$4,500
9	4" PVC Pressure Main - (includes bedding and backfill)	1560	LF	$50	$78,000
10	1-1/2" PVC Pressure Main - (includes bedding and backfill)	980	LF	$25	$24,500
11	Pressure Main Flushing Port	2	EA	$4,000	$8,000
12	Asphalt Treated Base	110	TONS	$100	$11,000
13	Sawcutting	3120	LF	$3	$9,360
14	Hot Mix Asphalt	220	TONS	$125	$27,500
15	Hydroseeding	650	SY	$3	$1,950
16	Simplex STEP Sytem Retrofit and Electrical Controls	5	EA	$12,000	$60,000
	Construction Subtotal				$275,000
	Construction Contingency @ 20%				$55,000
	Total Construction Cost				$330,000
	Engineering, Administration, Legal & Permitting @ 30%				$99,000
	Total Project Cost				**$429,000**

Notes:
1. The Tribe is not subject to Washington State Sales Tax for work performed on the reservation.
2. ENR Seattle Construction Cost Index - August 2017 - 10,724.95
3. All Numbers from Construction Subtotal through Total Project Cost are rounded to the nearest $1,000.

Confederated Tribes of the Chehalis Reservation
Opinion of Probable Construction Cost
STEP system - Makum Housing Development Area
Prepared by: Gibbs & Olson, Inc.
Date: Sept. 20th, 2017
Gibbs & Olson Project No. 0159-0001

Item No.	Item Description	Qty	Units	Unit Cost	Amount
1	Mobilization	1	LS	$17,500	$17,500
2	Surveying, Staking and As-Built Dwgs	1	LS	$2,750	$2,750
3	Environmental Controls	1	LS	$5,000	$5,000
4	Trench Excavation Safety Systems	1	LS	$4,000	$4,000
5	Dewatering	1	LS	$6,000	$6,000
6	Clearing and Grubbing	1	LS	$5,000	$5,000
7	Traffic Control	1	LS	$1,500	$1,500
8	Locate Existing Utilities	1	LS	$4,500	$4,500
9	1-1/2" PVC Pressure Main - (includes bedding and backfill)	1950	LF	$25	$48,750
10	Pressure Main Flushing Port	2	EA	$4,000	$8,000
11	Asphalt Treated Base	15	TONS	$100	$1,500
12	Sawcutting	410	LF	$3	$1,230
13	Hot Mix Asphalt	30	TONS	$125	$3,750
14	Hydroseeding	1150	SY	$3	$3,450
15	Simplex STEP Sytem Retrofit and Electrical Controls	8	EA	$12,000	$96,000
			Construction Subtotal		$209,000
			Construction Contingency @ 20%		$42,000
			Total Construction Cost		$251,000
			Engineering, Administration, Legal & Permitting @ 30%		$75,000
			Total Project Cost		**$326,000**

Notes:
1. The Tribe is not subject to Washington State Sales Tax for work performed on the reservation.
2. ENR Seattle Construction Cost Index - August 2017 - 10,724.95
3. All Numbers from Construction Subtotal through Total Project Cost are rounded to the nearest $1,000.

Confederated Tribes of the Chehalis Reservation
Opinion of Probable Construction Cost
STEP system - Tahown Housing Development Area
Prepared by: Gibbs & Olson, Inc.
Date: Sept. 20th, 2017
Gibbs & Olson Project No. 0159-0001

Item No.	Item Description	Qty	Units	Unit Cost	Amount
1	Mobilization	1	LS	$65,000	$65,000
2	Surveying, Staking and As-Built Dwgs	1	LS	$9,500	$9,500
3	Environmental Controls	1	LS	$5,000	$5,000
4	Trench Excavation Safety Systems	1	LS	$4,000	$4,000
5	Dewatering	1	LS	$6,000	$6,000
6	Clearing and Grubbing	1	LS	$6,500	$6,500
7	Traffic Control	1	LS	$5,000	$5,000
8	Locate Existing Utilities	1	LS	$5,000	$5,000
9	4" PVC Pressure Main - (includes bedding and backfill)	4465	LF	$50	$223,250
10	1-1/2" PVC Pressure Main - (includes bedding and backfill)	4000	LF	$25	$100,000
11	Pressure Main Flushing Port	6	EA	$4,000	$24,000
12	Asphalt Treated Base	310	TONS	$100	$31,000
13	Sawcutting	8700	LF	$3	$26,100
14	Hot Mix Asphalt	615	TONS	$125	$76,875
15	Hydroseeding	2715	SY	$3	$8,145.00
16	4" Isolation Valve	4	EA	$3,000	$12,000
17	4" Air Release Valve	2	EA	$10,000	$20,000
18	Simplex STEP Sytem Retrofit and Electrical Controls	13	EA	$12,000	$156,000
19	Duplex STEP Sytem Retrofit and Electrical Controls	1	EA	$50,000	$50,000
	Construction Subtotal				$833,000
	Construction Contingency @ 20%				$167,000
	Total Construction Cost				$1,000,000
	Engineering, Administration, Legal & Permitting @ 30%				$300,000
	Total Project Cost				**$1,300,000**

Notes:
1. The Tribe is not subject to Washington State Sales Tax for work performed on the reservation.
2. ENR Seattle Construction Cost Index - August 2017 - 10,724.95
3. All Numbers from Construction Subtotal through Total Project Cost are rounded to the nearest $1,000.

APPENDIX E

SEPA CHECKLIST

SEPA ENVIRONMENTAL CHECKLIST

Purpose of checklist:

Governmental agencies use this checklist to help determine whether the environmental impacts of your proposal are significant. This information is also helpful to determine if available avoidance, minimization or compensatory mitigation measures will address the probable significant impacts or if an environmental impact statement will be prepared to further analyze the proposal.

***Instructions for applicants*:**

This environmental checklist asks you to describe some basic information about your proposal. Please answer each question accurately and carefully, to the best of your knowledge. You may need to consult with an agency specialist or private consultant for some questions. You may use "not applicable" or "does not apply" only when you can explain why it does not apply and not when the answer is unknown. You may also attach or incorporate by reference additional studies reports. Complete and accurate answers to these questions often avoid delays with the SEPA process as well as later in the decision-making process.

The checklist questions apply to all parts of your proposal, even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The agency to which you submit this checklist may ask you to explain your answers or provide additional information reasonably related to determining if there may be significant adverse impact.

Instructions for Lead Agencies:

Please adjust the format of this template as needed. Additional information may be necessary to evaluate the existing environment, all interrelated aspects of the proposal and an analysis of adverse impacts. The checklist is considered the first but not necessarily the only source of information needed to make an adequate threshold determination. Once a threshold determination is made, the lead agency is responsible for the completeness and accuracy of the checklist and other supporting documents.

Use of checklist for non-project proposals:

For non-project proposals (such as ordinances, regulations, plans and programs), complete the applicable parts of sections A and B plus the SUPPLEMENTAL SHEET FOR NON-PROJECT ACTIONS (part D). Please completely answer all questions that apply and note that the words "project," "applicant," and "property or site" should be read as "proposal," "proponent," and "affected geographic area," respectively. The lead agency may exclude (for non-projects) questions in Part B - Environmental Elements –that do not contribute meaningfully to the analysis of the proposal.

A. Background

1. Name of proposed project, if applicable: **Preliminary Engineering Report for the Confederated Tribes of the Chehalis Reservation for Sewer Improvments including implementation.**

2. Name of applicant: **Confederated Tribes of the Chehalis Reservation: Planning Department**

3. Address and phone number of applicant and contact person: **Jesse Conwell, Confederated Tribes of the Chehalis Reservation Planning Department, 420 Howanut Road, Oakville, WA 98568, 360.709.1862**

4. Date checklist prepared: **October 2017**

5. Agency requesting checklist: **Washington Department of Ecology Integrated Water Quality Funding Program**

6. Proposed timing or schedule (including phasing, if applicable): **Report to be completed by 12/30/17. Design Activities 2018-19, Construction 2019-20.**

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain. **Design and construction related to the recommendations in the preliminary Engineering Report for wastewater collection and treatment will occur at a future date.**

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal. **An environmental report and NEPA will be prepared for this project.**

Existing environmental information includes:

- **Wastewater Master Plan, Brown & Caldwell, 2004;**
- **Results of the Chehalis Reservation Groundwater Study, Golder & Associates, 2012;**
- **Groundwater Modeling Report, Pacific Groundwater Group, 2003;**
- **Aquifer Evaluation for the Confederated Tribes of the Chehalis Reservation, David Evans & Associates, 1998;**
- **Petoie Bak-Up Drainfield Analysis for the Conferated Tribes of the Chehalis Reservation, Indian Health Services, 2014;**
- **Project Summary Sanitation Facilities for the Conferated Tribes of the Chehalis Reservation, HIS Project PO-04-J98, HIS 2004;**
- **Comprehensive Flood Hazard Management Plan, GeoEngineers, 2009;**
- **Geotechnical Engineering Study: Proposed Health Clinic Facility, 21 Niederman Road, Oakville, WA, GeoEngineers, 2005.**

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain. **No.**

10. List any government approvals or permits that will be needed for your proposal, if known.

- **National Environmental Policy Act (NEPA): Federally funded or permitted activities on the Reservation would require a NEPA Environmental Assessment and Finding of No Significant Impact (FONSI). In the event proposed activities would have an adverse environmental impact that could not be readily mitigated, an Environmental Impact Statement would be required.**

- **National Historic Preservation Act (NHPA) Section 106 consultation with concerned tribes regarding potential impacts to cultural, historic or archaeological resources would also be required.**

- **Construction activities within the 100-year floodplain require a Floodplain Development Permit from the Tribe.**

- **Review pursuant to Chehalis Tribe Codes and Regulations, Section 7.6.1.050 Reservation Groundwater Protection, Section 7.6.1.060 Water Quality Standards, and Section 7.6.1.070 regarding establishment of Sanitary Control Areas will be required, along with a Zoning review of proposed project elements per Title 10, Chapter 4.**

- **Further, the Chehalis Tribal Planning Department and the Tribe's Historic Preservation Officer, Dan Penn will be contacted regarding any Tribal concerns associated with Cultural or Historic issues.**

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page. (Lead agencies may modify this form to include additional specific information on project description.)

The purpose of this Report is to guide the Chehalis Tribe in providing sewer service through the year 2037. Principal components of this Report include abandonment of a small wastewater package plant and several individual and community dranfields and transfer of that flow to the Casino wastewater treatment plant (WWTP) that has available capacity. Septic tank effluent pumps (STEP) will be used to pump the treated sewage through approximately 16,000 feet of 1 ½" through 4" pipe.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist.

B. Environmental Elements

1. Earth

a. General description of the site:

(circle one): $\boxed{\text{Flat}}$, rolling, hilly, steep slopes, mountainous, other _____________

b. What is the steepest slope on the site (approximate percent slope)? **The planning area on the Chehalis Reservation is largely flat, sloping gently toward the Black and Chehalis River floodplains.**

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any agricultural land of long-term commercial significance and whether the proposal results in removing any of these soils. **Soils in the area consist of a deep series of flood and alluvial deposits from the Black and Chehalis rivers. Dominant soil types on the reservation are Spanaway gravelly loam, Chehalis silt loam, Newbert silt loam and Cloquato silt loam, which comprise 73% of the study area.**

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe. **As the Reservation is very flat, undisturbed soils are fairly stable. However, these low-density soils are more likely to experience greater damage due to seismic-induced subsidence or liquefaction.**

e. Describe the purpose, type, total area, and approximate quantities and total affected area of any filling, excavation, and grading proposed. Indicate source of fill. **Approximately 7,100 SY of area will be disturbed for the pipe installation. Approximately 3,500 CY of dirt will be removed and replaced to install the pipe. Approximately 500 CY of imported rock will be used for the pipe trench backfill and will come from a local rock supplier. Impoer backfill will only be used underneath any pavement; otherwise native fill will be used.**

f. Could erosion occur as a result of clearing, construction, or use? If so, generally describe. **Erosion could possible occur in and around excavation sites. Best management practices will be followed during construction to prevent erosion. Stormwater erosion control will be consistent with the Tribe's erosion control guideance.**

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)? **N/A**

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any: **Best management practices will be followed during construction. Stormwater erosion control will be consistent with the Tribe's erosion control guideance.**

2. Air

a. What types of emissions to the air would result from the proposal during construction, operation, and maintenance when the project is completed? If any, generally describe and give approximate quantities if known. **Diesel enigine emissions will result from construction activites.**

b. Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe. **None known.**

c. Proposed measures to reduce or control emissions or other impacts to air, if any: **None**

3. Water

a. Surface Water:

1) Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into. **The Chehalis Reservation is largely within and surrounded by the floodplains of the Black and Chehalis rivers.**

2) Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans. **No**

3) Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material. **None**

4) Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known. **No**

5) Does the proposal lie within a 100-year floodplain? If so, note location on the site plan. **Some of the piping will be installed within the 100-year floodplain of the Chehalis River but no structures are to be constructed with in it.**

6) Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge. **No**

b. Ground Water:

1) Will groundwater be withdrawn from a well for drinking water or other purposes? If so, give a general description of the well, proposed uses and approximate quantities withdrawn from the well. Will water be discharged to groundwater? Give general description, purpose, and approximate quantities if known. **No**

2) Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: Domestic sewage; industrial, containing the following chemicals. . . ; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve. **In 2010, the Census Bureau indicated that 642 people occupied the Chehalis Reservation. The Chehalis Tribe currently operates three membrane bioreactor wastewater treatment facilities at the Casino, Petoie (Davis Drive Housing Development) and the Public Safety Complex, which serves the central reservation. A number of large on-site septic systems and individual septic systemps are also currently in use, including:**

- Fern Oaks Housing Development
- Oaks Housing Development
- Starrville Community
- Tahown Housing Development
- Makim Housing Development

No waste material will be discharged to ground from septic tanks or large on-site systems associated with wastewater collection, conveyance, treatment and disposal alternataives reviwed in the preliminary Engineering Report. Projects identified in the Report will eliminate individual and large on-site septic systems on the Reservation by providing septic tank effluent pumps, conveyance pipelines to the casino WWTF. Needed improvements at the Petoie and Casino Wastewater Treatment Facilities would also be implemented.

c. Water runoff (including stormwater):

1) Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe. **Not applicable to the Plan.**

2) Could waste materials enter ground or surface waters? If so, generally describe. **No**

3) Does the proposal alter or otherwise affect drainage patterns in the vicinity of the site? If so, describe. **No**

d. Proposed measures to reduce or control surface, ground, and runoff water, and drainage pattern impacts, if any:

4. Plants

a. Check the types of vegetation found on the site:

X__ deciduous tree: alder, maple, aspen, other
X__ evergreen tree: fir, cedar, pine, other
X__ shrubs
X__ grass
X__ pasture
X_ crop or grain
___ Orchards, vineyards or other permanent crops.
X__ wet soil plants: cattail, buttercup, bullrush, skunk cabbage, other
X__ water plants: water lily, eelgrass, milfoil, other
___ other types of vegetation

b. What kind and amount of vegetation will be removed or altered? **Some grass and shrub/briars will be removed for the contruction of the pipeline.**

c. List threatened and endangered species known to be on or near the site. **The U.S. Fish & Wildlife Information, Planning and Conservation Database indicated that the following plant species listed as "threatened" may be present in the vicinity of the Chehalis Reservation:**

- **Golden Paintbrush, Castilleja levisecta**
- **Kincaid's Lupine, Lupinus sulphureus ssp. Kincaidii**
- **Nelson's Checker-mallow, Sidalcea ne/soniana**
- **Water Howellia, Howe/lia aqatilus**

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any: **No landscaping other than hydroseeding is proposed.**

e. List all noxious weeds and invasive species known to be on or near the site. **See attached Lewis County Noxious Weed list.**

5. Animals

a. List any birds and other animals which have been observed on or near the site or are known to be on or near the site.

Examples include:

birds: hawk, heron, eagle, songbirds, waterfowl, other:
mammals: deer, bear, elk, beaver, other:
fish: bass, salmon, trout, herring, shellfish, other:

b. List any threatened and endangered species known to be on or near the site. **The USFWS IPaC Species List for the Chehalis Reservation includes the following "threatened" animal species:**

- **Oregon Spotted Frog, *Rana pretiosa***
- **Marbled Murrelet, *Brachyramphus marmoratus***
- **Streaked Horned Lark, *Eremophila alpestris strigata***
- **Yellow-billed Cuckoo, *Coccyzus americanus***
- **Bull Trout, Salvelinus confluentus**
- **Olympia Pocket Gopher, *Thomomys Mazama pugetensis***
- **Tenino Pocket Gopher, *Thomomys Mazama tumuli***
- **Yelm Pocket Gopher, *Thomomys Mazama yelmensis***
- **There are currently no ESA-listed salmonids under the jurisdiction of the National Marine Fisheries Service in the Chehalis Basin and green sturgeon are generally limited to the lower few miles of the Chehalis River above Grays Harbor, so they are unlikely to be present in the project area.**

The WDFW Priority Habitats & Species On-Line Database indicates that there are northern spotted owl management areas to the west and south of the Chehalis Reservation, and that bull trout have been known to be present in the Chehalis River downstream of the project area. The presence of these ESA-listed birds and fish should not impact the proposed improvements to the wastewater collection, treatment and disposal systems on the Reservation.

c. Is the site part of a migration route? If so, explain. **Pacific salmon, bull trout, sturgeon and other aquatic species migrate up and down the Chehalis River. The Chehalis Reservation is located within the Pacific Migratory Flyway for waterfowl.**

d. Proposed measures to preserve or enhance wildlife, if any: **Implementation of the wastewater collection, treatment and disposal measures identified in the Sewer and Wastewater Facilities Plan would improve water quality and fish and wildlife habitat in the vicinity of the Chehalis Reservation.**

e. List any invasive animal species known to be on or near the site. **None known.**

6. Energy and Natural Resources

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc. **Operation of the facilities reviewed and proposed in the Plan will require additional electrical energy from the Tribe's electrical energy provider, Grays Harbor PUD.**

b. Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe. **No.**

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any: **Pumps and other electrical equipment associated with the projects will be of modern, energy-efficient design.**

7. Environmental Health

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste, that could occur as a result of this proposal? If so, describe. **No**

1) Describe any known or possible contamination at the site from present or past uses. **Monitoring of groundwater quality on the Reservation has identified increasing nitrate levels, possibly related to the use of on-site septic systems.**

2) Describe existing hazardous chemicals/conditions that might affect project development and design. This includes underground hazardous liquid and gas transmission pipelines located within the project area and in the vicinity. **The Washington Utilities and Transportation Commission Map of State Gas Transmission, Hazardous Liquid and Pipelines Operation over 250 PSIG was reviewed. The Puget Sound Energy Service Area in Thurston County terminates at the Grays Harbor County Line. All other significant energy transmission pipelines are located well to the east of the Chehalis Reservation and will not impact the project area.**

3) Describe any toxic or hazardous chemicals that might be stored, used, or produced during the project's development or construction, or at any time during the operating life of the project. **Toxic or hazardous chemicals associated with construction of wastewater conveyance, treatment and disposal infrastructure on the Chehalis Reservation will be limited to fuels, lubricants and coolants in construction vehicles and machinery and any chlorine-based cleaning chemicals used at the existing facilities.**

4) Describe special emergency services that might be required. **None will be required.**

5) Proposed measures to reduce or control environmental health hazards, if any: **Construction vehicles and equipment shall be fitted with hazardous materials spill clean-up kits and operators shall be trained in their use.**

b. Noise

1) What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)? **Noise levels on the Chehalis Reservation are generally low, with the exception of traffic along SR 12 and adjacent county roads, logging and farming operations.**

2) What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site. **Noise associated with construction of wastewater conveyance, treatment and disposal projects**

identified in the Plan would generate noise levels similar to those produced by adjacent farm and logging operations. Construction noise would be present over the course of approximately one year.

3) Proposed measures to reduce or control noise impacts, if any: **Noise-generating construction activities will be limited to normal daylight working hours to minimize potential noise impacts to adjacent land users or any particularly sensitive wildlife.**

8. Land and Shoreline Use

a. What is the current use of the site and adjacent properties? Will the proposal affect current land uses on nearby or adjacent properties? If so, describe. **The project area includes residential, commercial and administration areas on the Chehalis Reservation. The Lucky Eagle Casino and Hotel and commercial chicken farms are located on the eastern end of the Reservation/Thurston County.**

b. Has the project site been used as working farmlands or working forest lands? If so, describe. How much agricultural or forest land of long-term commercial significance will be converted to other uses as a result of the proposal, if any? If resource lands have not been designated, how many acres in farmland or forest land tax status will be converted to nonfarm or nonforest use? **The eastern end of the Chehalis Reservation located in Thurston County is occupied by a large commercial chicken farming operation. None of this area will be converted to nonfarm or nonforest uses.**

1) Will the proposal affect or be affected by surrounding working farm or forest land normal business operations, such as oversize equipment access, the application of pesticides, tilling, and harvesting? If so, how: **Work associated with the proposed projects identified in the Plan will be largely confined to the central and western portions of the Reservation and the commercial chicken farming operations are unlikely to be affected.**

c. Describe any structures on the site. **The Fern Drive and Tahown Housing Area consists of residential structures currently served by on-site septic systems. Niederman Road runs north past the Davis Housing Development to the site of the Public Safety Building and the associated WWTF.**

d. Will any structures be demolished? If so, what? **Existing on-site and community septic systems, associated pipelines and drainfields and the Public Safety WWTF will be demolished, once the new wastewater conveyance, treatment and disposal systems reviewed in the Plan are installed and operational.**

e. What is the current zoning classification of the site? **The project area discussed in the Plan covers several different Tribal Zoning densities, including Residential High Density, Residential Medium Density, Commercial and Low Density Residential Areas.**

f. What is the current comprehensive plan designation of the site? **Residential and commercial.**

g. If applicable, what is the current shoreline master program designation of the site? **Not applicable, as Washington's Shoreline Management Plan does not apply to Tribal**

Lands. All work on the proposed project will occur more than 200 feet from the Chehalis and Black Rivers.

h. Has any part of the site been classified as a critical area by the city or county? If so, specify. **No**

i. Approximately how many people would reside or work in the completed project? **An undetermined number of the Tribe's wastewater treatment facility operators and maintenance personnel would operate and maintain the proposed wastewater system improvements. The population in the residential and commercial areas served by these improvements would not be directly impacted by the project. However, providing sewer and wastewater treatment facilities to areas currently served by septic systems may allow for more dense development in the future.**

j. Approximately how many people would the completed project displace? **No private residents would be displaced associated with approval of the Plan or construction of proposed wastewater infrastructure projects identified in the Plan.**

k. Proposed measures to avoid or reduce displacement impacts, if any: **None required.**

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any: **The proposed sewer improvements have been located so as to minimize any impacts to surrounding properties.**

m. Proposed measures to reduce or control impacts to agricultural and forest lands of long-term commercial significance, if any: **The proposed wastewater collection and conveyance infrastructure will be located at the west end of the Chehalis Reservation, which is opposite the commercial and agricultural areas on the east end of the Reservation in Thurston County. Chicken farming operations and the Casino and Hotel on the east end of the Reservation will not be adversely impacted by construction or operation of the new facilities. The Plan identifies improvements to the Casino WWTF needed to allow continuing operations through 2036.**

9. **Housing**

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing. **The project alternatives reviewed and proposed in the Plan will not provide any additional housing. They will, however, provide adequate wastewater collection, conveyance, treatment and disposal for the Tribe's planned development through 2036.**

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing. **Projects reviewed and selected from the Plan will not eliminate/demolish any residential structures.**

c. Proposed measures to reduce or control housing impacts, if any: **None required.**

10. Aesthetics

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed? **Most of the propsed structures will be buried underground.**

b. What views in the immediate vicinity would be altered or obstructed? **No**

c. Proposed measures to reduce or control aesthetic impacts, if any: **None required.**

11. Light and Glare

a. What type of light or glare will the proposal produce? What time of day would it mainly occur? **Minor amounts of additional light and glare from the construction site will occur during the mid-day.**

b. Could light or glare from the finished project be a safety hazard or interfere with views? **No.**

c. What existing off-site sources of light or glare may affect your proposal? **Light generated by the Casino and associated parking area has minimal potential to impact construction activities proposed on the west end of the Reservation in the Wastewater Facilities Plan.**

d. Proposed measures to reduce or control light and glare impacts, if any: **None required.**

12. Recreation

a. What designated and informal recreational opportunities are in the immediate vicinity? **Recreational gaming at the Casino is likely the most significant recreational activity on the Chehalis Reservation. Hunting, fishing, canoeing and kayaking, hiking and cycling are all potential recreational activities in the vicinity of the Chehalis Reservation.**

b. Would the proposed project displace any existing recreational uses? If so, describe. **No.**

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any: **Delivery of construction materials and over-sized vehicles to the project sites will be properly flagged and time to minimize impacts to recreational traffic on the Chehalis Reservation.**

13. Historic and cultural preservation

a. Are there any buildings, structures, or sites, located on or near the site that are over 45 years old listed in or eligible for listing in national, state, or local preservation registers ? If so, specifically describe. **The Washington Department of Archaeology WISAARD Database was consulted regarding historic properties near the Chehalis Reservation project area. The Black River Bridge (Property ID 55323) and (Resource ID 44153) and the Sickman Ford Bridge (Property ID 55334) and (Resource ID 44168) were identified, but no determination regarding eligibility has been made for these structures. Two Historic Farmsteads east of the Reservation were identified as Erickson, Jonas and Maria Louisa Farmstead, and Jaaska House and Warehouse near Helsig Junction. In Oakville, west of the Reservation, the Charles N. Mills House at 204 Harris Avenue (Resource ID No. 10311) and the Oakville State Bank at 201 Pine Street (Resource ID No. 10310) were identified.**

Mr. Dan penn, Chehalis Tribal Historic Preservation Officer was contacted regarding any Tribal concerns associated with the wastewater collection, conveyance, treatment and disposal infrastructure improvements identified with the Plan.

b. Are there any landmarks, features, or other evidence of Indian or historic use or occupation? This may include human burials or old cemeteries. Are there any material evidence, artifacts, or areas of cultural importance on or near the site? Please list any professional studies conducted at the site to identify such resources. **The Black River Bridge (Property ID 55323) and (Resource ID 44153) and the Sickman Ford Bridge (Property ID 55334) and (Resource ID 44168) were identified.**

c. Describe the methods used to assess the potential impacts to cultural and historic resources on or near the project site. Examples include consultation with tribes and the department of archeology and historic preservation, archaeological surveys, historic maps, GIS data, etc. **The DAHP WISAARD Database was consulted regarding any cultural or historically significant structures in the project vicinity on or near the Chehalis Reservation. A Cultural Resources Survey of the sites proposed for ground disturbance will be conducted to satisfy NHPA Section 106 consultation requirements. Mr. Dan Penn of the Chehalis Tribe's Cultural Resources Department was contacted regarding any potential Tribal concerns associated with cultural or historic resources in the project area. He indicated that he would be able to provide any pre-construction surveys or construction monitoring required for the project.**

d. Proposed measures to avoid, minimize, or compensate for loss, changes to, and disturbance to resources. Please include plans for the above and any permits that may be required. **Mr. Dan Penn, the Chehalis Tribal Historic Preservation Officer (THPO) has been contacted regarding any pre-construction surveys or construction monitoring that may be required by the Tribe. In an email dated August 15, 2016 he indicated that there are no known cultural resources in the proposed project area. He also indicated that pre-construction surveys would be needed for the site of the infiltration basins, and that he could complete any pre-construction surveys or construction monitoring needed.**

14. Transportation

a. Identify public streets and highways serving the site or affected geographic area and describe proposed access to the existing street system. Show on site plans, if any. **The Chehalis Reservation and the subject project area detailed in the Plan can be reached from 1-5 via SR 12. Turn south from SR 12 onto Anderson Road and the Tahown Housing Area is located south and west of 188th Avenue SW. The Community Non-Residential Area can be reached by turning west on Howanut Road, and the Fern Drive Housing Development and the site proposed for the Central WWTF can be reached by turning south on Niederman Road from Howanut Road.**

b. Is the site or affected geographic area currently served by public transit? If so, generally describe. If not, what is the approximate distance to the nearest transit stop? **Grays Harbor Transit provides public transportation between Oakville and the AMTRAK Station in Centralia two days per week via Route 90.**

c. How many additional parking spaces would the completed project or non-project proposal have? How many would the project or proposal eliminate? **No additional parking is required.**

d. Will the proposal require any new or improvements to existing roads, streets, pedestrian, bicycle or state transportation facilities, not including driveways? If so, generally describe (indicate whether public or private). **Some of the proposed sewer mains proposed in the Plan will be located in, or adjacent to, existing road rights-of-way. Roads impacted by construction activities will be repaved in-kind, or improved in accordance with Tribal road standards.**

e. Will the project or proposal use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe. **No, the proposed construction activities identified in the Plan will be at least a few thousand feet from the Chehalis River. There are no railroad or airport facilities in the immediate project vicinity.**

f. How many vehicular trips per day would be generated by the completed project or proposal? If known, indicate when peak volumes would occur and what percentage of the volume would be trucks (such as commercial and nonpassenger vehicles). What data or transportation models were used to make these estimates? **No additional vehicular trips are anticipated.**

g. Will the proposal interfere with, affect or be affected by the movement of agricultural and forest products on roads or streets in the area? If so, generally describe. **No.**

h. Proposed measures to reduce or control transportation impacts, if any: **Road surfaces damaged by construction will be repaved and/or improved in accordance with Tribal standards.**

15. Public Services

a. Would the project result in an increased need for public services (for example: fire protection, police protection, public transit, health care, schools, other)? **No.**

b. Proposed measures to reduce or control direct impacts on public services, if any. [help] **None required.**

16. Utilities

a. Circle utilities currently available at the site:
electricity, natural gas, water, refuse service, telephone, sanitary sewer, septic system, other ___________

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed. **No additional utilities will be needed.**

C. Signature

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature: ____
Name of signee ____
Position and Agency/Organization __________________________________
Date Submitted: ____________