Section 3 -
Physical and Environmental Inventory

Pierce County Public Works and Utilities – Sewer Utility
Unified Sewer Plan Update

Section 3 – Physical and Environmental Inventory

Section 3 documents the land-use and environmental tenants of the four major basins in Pierce County and are organized around those basins.

- Chambers Creek – Clover Creek Drainage Basin - Section 3.1
- Puyallup River Drainage Basin – Section 3.2
- Nisqually River Drainage Basin – Section 3.4
- Kitsap Drainage Basin – Section 3.5

3.1 Chambers Creek – Clover Creek Drainage Basin

The Chambers Creek - Clover Creek Drainage Basin (Basin) is located in central Pierce County, between Puget Sound on the west and the ridge above the Puyallup River Valley on the east. Point Defiance and the southwest shore of Commencement Bay serve as the basin's northern boundary, and the City of DuPont lies on the southern boundary.

The basin encompasses approximately 104,258 acres (117 square miles) of land including the Cities of DuPont, including Northwest Landing, University Place, Lakewood, and Northwest Tacoma, Fircrest, the Towns of Ruston, and Steilacoom, as well as portions of Fort Lewis and McChord Military Reservations, and the unincorporated communities of South Hill, Frederickson, Mid County, Graham, Parkland, and Spanaway.

3.1.1 Topography

Lowland topography is generally flat to gently rolling. Elevations within the basin range from sea level to 600 feet at the southeast edge of the basin. The elevation of the basin averages between 200 to 400 feet. Topography in the southwestern portion of the basin (around American Lake) is fairly flat. As a result, the surface water tends to concentrate into lakes and wetlands.

Not all flow in the basin converges to a single point. The basin drains in a northwesterly direction, with primary discharge of Chambers Creek into Puget Sound just north of the Town of Steilacoom.

The Chambers Creek - Clover Creek Watershed is divided into four sub-watersheds, based on surface water flow: Chambers Creek, Clover Creek/Lake Steilacoom, Tacoma West, and American Lake. Basin topography within wastewater flows from these areas must be pumped from sub-basin to sub-basin.

3.1.2 Geology

The geology of the basin is primarily the result of glacial advances and retreats with deposits that extend to depths of 2,000 feet. The thickness of the top layer ranges from 1 to 300 feet, averaging 100 to 200 feet thick. Vashon till predominates in the level to hilly topography east of Parkland and also in Fircrest, University Place, Steilacoom, and northern portions of the City of Tacoma. Vashon outwash occurs in the level to rolling type topography in the remaining portions of the basin.

Non-glacial strata include floodplain sediments, and mineral and organic deposits in lakes and bogs. Non-glacial layers are fine-grained, more uniform than glacial outwash, and tend to have a lower permeability compared to the outwash layers.

3.1.3 Soils

Soils within the basin consist of unconsolidated sands, gravels, silts, and clays laid down in past glaciations. Common soil associations found within the basin are the Spanaway, Kapowsin, and Alderwood-Everett associations.

These soils have a high capacity of hydraulic transfer with pockets of very poorly drained soils. This combination of soils leads to a high potential for on-site sewer system failure due to high water tables, insufficient filtration to adequately protect groundwater quality, and/or an underlying compacted till layer which prevents proper functioning during periods of high rainfall.

3.1.4 Hydrology - Surface Water, Creeks and Lakes

Chambers Creek - Chambers Creek is the major surface water source in the basin and is a year round stream draining approximately 12.8-square miles. Chambers Creek originates at Steilacoom Lake, from which it flows north before joining Flett Creek and Leach Creek. From the confluence with Leach Creek, Chambers Creek flows west down a 100 to 200-foot deep canyon (a part of the Chambers Creek Properties) then discharges to Puget Sound. The stream gradients are gradual, averaging an elevation drop of 60 feet per mile.

Clover Creek - Flows for Clover Creek originate with a small spring northeast of Fredrickson flowing 8 to 10 miles to Lake Steilacoom. Many parts of Clover Creek have been re-channeled from the original streambed or run through culverts. These alterations have caused portions of the creek to experience intermittent flows, particularly during summer. During storm events flooding, affecting peak wastewater flows at the Chambers Creek Regional Wastewater Treatment Plant (WWTP), may occur.

American Lake - American Lake covers 1,100 acres, has a maximum depth of 90 feet, and a mean depth of 53 feet. The lake drains a surface area of 25.4 square miles. The majority of the inflow is supplied by ground water although some surface inflow is provided by Murray Creek. There are no natural outlets from the lake. On-site sewer systems are predominantly on the east side of the lake.

Gravelly Lake - Gravelly Lake covers 148 acres and has a maximum depth of 55 feet. The lake drains a surface area of 420 acres and is additionally fed by ground water. The lake has no outlet.

Lake Louise - Lake Louise covers an area of 39 acres and has a maximum depth of 35 feet. The lake drains a surface area of 210 acres. There are no inlets or outlets for the lake. It is fed by groundwater and stormwater run-off.

Spanaway Lake - Spanaway Lake covers an area of 280 acres and has a maximum depth of 28 feet. The lake drains a surface area of 10,800 acres. Coffee Creek serves as the primary inflow to the lake. The outlet for the lake is Spanaway Creek.

Lake Steilacoom - Lake Steilacoom was created in 1852 when a dam was built by early settlers on Chambers Creek. The lake covers 320 acres and has a maximum depth of 20 feet. Inflow to the lake is provided by Clover Creek, Ponce de Leon Creek and seven individual storm drain discharges. Chambers Creek serves as the outlet from the lake. Despite all residences being connected to sanitary sewers, the lake continues to experience water quality problems partially due to urban stormwater runoff. A study conducted by URS on behalf of the City of Lakewood indicated that the largest contributor to water quality problems is excess phosphorus entering the lake through both Ponce de Leon and Clover Creeks. The main causes of excess phosphorus are on-site septic systems and naturally occurring phosphorus in the soils.

3.1.5 Wetlands

Wetlands can have impacts on wastewater conveyance and treatment due to poorly-drained soils and/or high water tables making these areas unsuitable for on-site sewer systems. Dewatering is usually required during construction near wetlands because of the high ground water table, increasing the construction cost for conveyance lines. Critical Areas Development Regulations are designed to avoid, minimize, rectify, reduce or compensate for impacts arising from land development and other activities affecting wetlands.

Extensive wetland areas are associated with the Chambers Creek - Clover Creek Drainage Basin. Significant wetlands include: Spanaway Marsh the largest at 373 acres; Sequalitchew Lake and Sequalitchew Creek near DuPont; the headwaters of Flett Creek near South Tacoma Way and 72nd Avenue; Farrell Marsh, a 112-acre wetland near Steilacoom; and Owens Marsh located near I-5 and 84th Street, owned by the City of Tacoma. There are several other smaller wetland areas throughout the basin that are associated with creeks and lakes including Flett, Murray, Morey, Chambers, Clover, and Sequalitchew creeks.

Local Area maps and biologic studies in the basin refer to these smaller areas as both lakes and marshes, including Carp Lake, Boyles Lake, and Seeley Lake.

3.1.6 Flood Plains

The Clover Creek floodplain cuts east to west through the center of the basin. Interceptors crossing Clover Creek are known to contribute high inflow volumes during major storm events. Chambers Creek, Leach Creek, and Peach Creek lie in steep canyons creating narrow, confined flood plains.

3.1.7 Groundwater

The ground water system in the Chambers Creek - Clover Creek Drainage Basin is part of the Central Pierce County Sole Source Aquifer System as defined by the United States Environmental Protection Agency (EPA).

The Puyallup River forms the northern and eastern boundaries, the Nisqually River forms the southern boundary, and Puget Sound forms the western and northwestern boundaries. The “sole source” designation provides limited federal protection to drinking water supplies that have been identified as serving large populations where alternative drinking water supplies are scarce.

The ground water system in the Chambers Creek - Clover Creek Drainage Basin has eight layers of alternating permeability, with both a shallow and deep aquifer. Characterization of the ground water system is provided in the *Final Clover/Chambers Creek Basin Ground Water Management Program, 1991*.

The general direction of shallow aquifer flow is northwest toward Puget Sound. Ground water along the northeastern boundary of the basin flows toward the Puyallup River Valley. The velocity of the shallow aquifer ranges from 0.01 feet per day to 63 feet per day, with an average of 4.4 feet per day. Ground water gradients range from 10 to 250 feet/mile, and are typically 20 feet/mile.

The highest gradients occur at the southeast corner of the basin. Generally, a downward vertical gradient occurs from the shallow aquifer to the deep aquifer. An upward vertical gradient occurs in isolated locations, including the Flett Creek area and near Frederickson. This is most likely the result of heavy pumping.

The deep aquifer system is primarily unconfined and extends to a depth of 750 feet. Two large deep aquifer recharge areas exist where the shallow and deep aquifers are hydraulically connected, making these areas, one in south Parkland and the second in the South Tacoma Channel south of Highway 16 between Fircrest and Interstate 5 and north of 72nd Street, vulnerable to contamination from surface sources.

Recharge of the basin’s ground water systems is primarily surface recharge, with little or no subsurface recharge. Surface recharge includes infiltration from precipitation, surface water bodies, septic tanks, and stormwater.

Major surface water aquifer recharge areas include the upland areas south of Parkland and west of Frederickson. Ground water recharge from septic tank/leach field systems occurs primarily in the southeastern half of the basin, which still has large non-sewered areas.

The National Ground Water Association has classified the uppermost aquifer (less than 400 feet) as either moderately or highly vulnerable to contamination because of the excessively well drained soils that are

common throughout the area. The potential exists to replenish depleted aquifers in the future via recharge with reclaimed water.

3.1.8 Water Supply

Ground water from the basin provides drinking water for approximately 375,000 residents of Pierce County. For 230,000 of those residents groundwater represents the only viable source of drinking water. On an average day residents use approximately 63 million gallons of water, of which approximately 42 million gallons is supplied by basin ground water. During periods of peak demand, such as hot summer days, basin residents may use as much as 125MGD (million gallons per day); of that amount 109MGD must be supplied by basin ground water. The remainder comes from purveyors with other water sources.

3.1.9 Land Use

A summary of the land use cover in the basin is outlined in Table 3.1-1. A majority of land within the basin is located in the City of Tacoma and in suburban cities. Land use designation for this area is primarily moderate density, single family.

Table 3.1-1 Land Use in Cities and Towns in the Chambers Creek - Clover Creek Basin

City/Town	Current Developed Density[1]:	Projected Developed Density[1]:	Employment (commercial and industrial acreage):
City of DuPont	5.2	4.7	620
City of Tacoma	7.49	9.5	6,423
City of University Place	3.5	4.06	1,227
City of Lakewood	4.4	6.0	2,100
City of Fircrest	4.57	5.4	64
Town of Steilacoom	5.3	4.0	-

[1] Average Dwelling Units per acre

Commercial land use within the basin is primarily located adjacent to major arterial streets. The basin contains several County-designated Employment Center (EC) zoned land use districts, including Thun Field, Frederickson, Port of Tacoma, North McChord, and Lakewood Industrial Park.

Commercial lands fall within sanitary sewer service areas with the exception of the Glacier Northwest gravel mine in DuPont. Vacant land in the service basin is primarily located in areas within South Hill, Frederickson, Graham, Spanaway, and the cities of DuPont and University Place.

3.1.10 Land Use in Unincorporated Pierce County

Table 3.1-2 lists maximum allowable residential densities in urban land use designations in unincorporated Pierce County. The table also includes acreage for the land use designations in unincorporated Pierce County within the Chambers Creek – Clover Creek Drainage Basin.

Table 3.1-2 Average Allowed Residential Density & Acreage in Unincorporated Pierce County within the Chambers Creek/Clover Creek Drainage Basin

Land Use Designation	Average Density[1]	Total Acres[2]
Urban Growth Area – No Community Plan		
Employment Center (EC)	-[3]	13
High Density Residential (HRD)	20	3
Moderate Density Single Family (MSF)	4	1,132
Major Urban Center (MUC)	20	-[3]
Mixed Use District (MUD)	20	174
Neighborhood Center (NC)	16	9
Public Institution (PI)	-[3]	-[3]
Frederickson Community Planning Area[4ab]		
Community Employment (CE)	-[3]	308
Employment Center (EC)	-[3]	2,246
Employment Service (ES)	-[3]	75
Moderate High Density Residential (MHR)	18	142
Moderate Density Single Family (MSF)	4	4,168
Mixed Use District (MUD)	18	72
Residential Office/Civic (ROC)	12	63
Residential Resource (RR)	2	557
Single Family (SF)	4	372
Graham Community Planning Area		
Community Employment (CE)	-[3]	70
Moderate High Density Residential (MHR)	10	483
Mixed Use District (MUD)	103	185
Single Family (SF)	4	1,284
Mid Counties Community Planning Area[4b]		
Commercial Center (CC)	14	373
Community Employment (CE)	-[3]	821
Neighborhood Center (NC)	12	236
Residential Resource (RR)	2	546
Single Family (SF)	4	1,196

Land Use Designation	Average Density[1]	Total Acres[2]
Parkland/Spanaway/Midland Community Planning Area		
Activity Center (AC)	20	229
Community Center (CC)	20	124
Community Employment (CE)	-[3]	421
High Density Single Family (HSF)	6	25
Moderate High Density Residential (MHR)	20	596
Moderate Density Single Family (MSF)	5	4,680
Mixed Use District (MUD)	20	179
Commercial Mixed Use District (CMUD)	12	307
Office Mixed Use District (OMUD)	12	121
Neighborhood Center (NC)	8	33
Residential Resource (RR)	2	3,427
Research Office (RO)	-[3]	13
Residential Office/Civic (ROC)	12	200
Single Family (SF)	4	2,263
South Hill Community Plan Area		
Activity Center (AC)	18	76
Commercial Center (CC)	15	764
Employment Center (EC)	-[3]	911
High Density Residential District (HRD)	12	99
High Density Single Family (HSF)	10	662
Moderate High Density Single Family (MHR)	15	454
Moderate Density Single Family (MSF)	4	6,889
Mixed Use District (MUD)	20	94
Neighborhood Center (NC)	10	22
Residential Office/Civic (ROC)	10	12
Residential Resource (RR)	2	2,481
Urban Village (UV)	20	238

[1] Base Density per acre allowed by zone in Unincorporated Pierce County - Title 18A - Zoning adopted 7/1/2009.
[2] Acres in Unincorporated Chambers Creek/Clover Creek Drainage Basin - Source: PC Planning and Land Services 2009.
[3] Housing not an outright permitted use, One SFR may be allowed through special use permit.
[4] 18A.33.285 - Single-Family Detached Use Exception.
[a] Non-Industrial Zones. One single-family detached dwelling unit may be erected upon an existing vacant parcel, provided said parcel existed as a legal lot of record prior to the effective date of the Frederickson Community Plan (12/15/2002).
[b] Industrial Zones**.** Within the Frederickson and Mid-County Community Plan areas, a single-family detached dwelling unit may be allowed on an existing vacant lot of record with the approval of an Administrative Use Permit.

3.1.11 On-Site Sewer Systems

The high number of on-site sewer systems within the Basin in the past reflects the highly pervious gravel-like soils of the area and past regulatory policy defining functioning on-site sewer systems. The high permeability of the soils is excellent in terms of hydraulic transfer capacity however the soils are very poor in treating septic tank effluent and protecting groundwater from contamination. Decline in groundwater quality within the basin was the reason for construction of the WWTP and the sewering of the more densely developed areas.

3.1.12 Individual Domestic On-Site Sewer Systems

The completion of Utility Local Improvement District (ULID) 73-1 greatly reduced the use of individual on-site sewer systems in more heavily populated areas of Lakewood, Parkland, and Spanaway. Sewage disposal for much of the eastern half of the basin is still accomplished through subsurface drainage systems, primarily septic tanks and drainfields with the exception of the South Hill and Frederickson areas. Tacoma-Pierce County Health Department (TPCHD) records show approximately 15,000 active individual on-site sewer systems exist within the non-sewered portion of the basin.

3.1.13 Community On-Site Sewer Systems

Community on-site sewer systems serve multi-family residential complexes or groups of individual residences where sanitary sewers are not available. In 2001 the USP listed four community systems in the sewer service basin being maintained by the Utility:

- Cypress Green in the American Lake Gardens area of Lakewood,
- Etloh at Panorama View on Fox Island,
- Tahoma Vista in South Hill,
- Rainier Meadows in South Hill.

Of these systems only Cypress Green, located in American Lake Gardens (Lakewood), and Etloh on Fox Island remain under the maintenance of the Pierce County Sewer Utility. The City of Lakewood will complete an extension in late 2010 to allow both Tillicum and American Lake Gardens to connect to the sewer collection system. At that time Pierce County will cease maintenance and operations and decommission the Cypress Green system.

3.1.14 Cascadia Community System

Pierce County also operates a temporary community drainfield system/sewer collection system in the Cascadia Sub-basin. The system is rated at 0.1MGD with future expansion through construction of a Membrane Bioreactor Treatment Plant to 11.7MGD. The current system is rated to serve 454 RE's. Currently 396 RE's are committed in four plats, 6 RE's are committed to the elementary school, and 1 RE is committed to the Discovery Center leaving 151 RE's available. Only the elementary school utilizes the community drainfield system.

3.2 Puyallup River Drainage Basin

The Puyallup River Drainage Basin, WRIA10, is predominantly located in Pierce County with the northern portion extending into King County (southern Auburn and Pacific). The Puyallup River Drainage Basin extends from Commencement Bay to the summit of Mount Rainier and has been divided into two significant sub-basins: the Lower Puyallup River Watershed and the Upper Puyallup River Watershed. The majority of urban development has occurred in the lower watershed.

3.2.1 Geology

The Puyallup River Drainage Basin is a product of mountain building, volcanic activity, and glaciations over the last fifty million years. The Lower Puyallup Watershed is in general, an area of low-lying terraces, dissected by lowland valleys. Topography is generally uniform with a consistent gradient downstream and valley floors varying in width from 1 to 1½ miles. Valley floors have been modified by alluvium deposits by the rivers which formed these valleys, including the Puyallup, White, and Carbon Rivers. Elevations within the lowlands range from sea level to 120 feet at Auburn and 240 feet at Orting.

Glacial moraines, terraces, plateaus, and mountains characterize the Upper Puyallup River Watershed. The slopes vary from 5 to 75 percent gradient. Drainage ways are generally well established although there are many lakes and poorly drained depressions. Elevations in this area vary up to 1,500 feet, with the majority of the land being below 700 feet.

The upper portion of the terraces and plateaus consists of an undulating plain with individual relief generally less than 100 feet. The drainage pattern is well developed and, in the western reaches, the streams are deeply incised.

The mountain province lies mostly southeasterly of South Prairie Creek. Peaks rise sharply from the valley floor to elevations of 1,500 feet. Elevations continue to increase in a southeasterly direction to approximately 7,000 feet at the crest of the Cascade Mountains.

Valley floors within the Basin have been modified by catastrophic volcanic mud and debris flows, or lahars originating from Mount Rainier. Two mudflows occurred within the Basin leaving behind a thick layer of dense, poorly drained soils. Approximately 4800 years ago the Osceola Mud Flow traveled down the White River Valley and now underlies the plain adjacent to Enumclaw and Buckley. The flow extends down the Fennel and South Prairie Creeks. The Electron Mud Flow occurred 500 years ago and traveled down the Puyallup Valley from Electron to McMillin just south of Sumner.

3.2.2 Soils

In general, soils in the glaciated uplands are loose to medium dense sands and gravel (recessional gravels) and very dense, hard, glacially compacted silty sands and gravelly silts (glacial till). The flood plain of the Puyallup River contains loose, wet, silty, fine sands, silt, and peat. The predominant soil associations found in the Puyallup River Drainage Basin are the Kapowsin, Alderwood-Everett, Puyallup-Sultan, Barneston-Scamman-Wilkeson and Buckley associations.

The *Puyallup River Basin Water Quality Management Plan, 1974* reported that less than 25 percent of the land area within the basin is suitable for septic tank development based upon soil classifications by the Soil Conservation Service. For future urban growth, the development of wastewater collection and disposal facilities is a necessary consideration.

3.2.3 Hydrology - Surface Water, Rivers, Lakes

All of the rivers in the Puyallup River Basin originate from the slopes of Mt. Rainier.

Puyallup River - The Puyallup River drains approximately 972 square miles. The north and south forks of the Puyallup originate at the base of the Puyallup and Tahoma Glaciers at the southwestern slope of Mt. Rainier. The two forks merge at river mile 45.7 within Snoqualmie National Forest. The river then flows northwesterly through agricultural lands of Orting, Sumner, and Puyallup, discharging to Commencement Bay. The major tributaries for the Puyallup River are the Carbon River, White River, and South Prairie Creek.

Carbon River - The Carbon River drains an area of approximately 230 square miles. It originates from Carbon and Russell Glaciers and flows in a northwest direction. The river joins the Puyallup River at Orting. The Carbon River is free of electricity generation or flood control modifications.

White River - The White River borders Pierce County on the north, draining an area of 494 square miles. It originates at the base of Emmons, Inter, and Fryingpan Glaciers. It contributes 50 percent of the mean annual flow to the Puyallup River System. The river flows through Buckley, Auburn, Pacific, and Sumner, where it joins the Puyallup River. Flow on the White River and lower Puyallup River is controlled through Mud Mountain Dam to prevent flooding and to maintain minimum flows.

Lake Tapps - The Lake Tapps reservoir was formed with the diking of the natural lake in 1910 with storage beginning in 1911 with flows diverted from the White River using the Lake Tapps Flume. Puget Sound Power & Light Company, now Puget Sound Energy, utilized this water for hydroelectric power generation. Since 2004, the Lake Tapps reservoir is no longer used for water storage for hydroelectric power generation.

Lake Tapps is the largest lake in the Puyallup River Drainage Basin. It covers 2,700 acres, with 40 miles of shoreline at high water. It has an active storage capacity of 46,700 acre-feet between the normal maximum and minimum pool elevation of 515 and 543 feet, respectively, which is available for power generation. The average depth of Lake Tapps is 25 feet, with a maximum depth of 90 feet.

Kapowsin Lake - Kapowsin Lake is located near the border of the Nisqually River Drainage Basin. The lake covers an area of approximately 512 acres.

3.2.4 Other Diversions

A diversion dam on the Puyallup River at river mile 41.7 diverts flow for the Electron Power Plant Flume. The flume is approximately 14 miles in length, discharging into a small reservoir of 120 acre-feet. The diverted flow is returned to the Puyallup River at river mile 31.2 after passing through the Puget Sound Power and Light Electron Power Plant.

Three diversions of 5 cubic feet per second (cfs) or more are used for fish propagation in the Puyallup Basin. The State Department of Fish and Wildlife operates a trout hatchery at Puyallup with a diversion of 15 cfs from Maplewood Springs, which is the headwater of Clarks Creek. Diverted water passes through the hatchery and is returned to the creek about 1,000 feet downstream from the diversion point.

Another hatchery approximately 2 miles southeast of Orting, operated by the State Department of Fish and Wildlife, diverts about 5 cfs from Voight Creek about a mile upstream from the hatchery. The diverted flow is returned to Voight Creek a short distance above the creek's confluence with the Carbon River. A privately owned hatchery located about a mile east of McMillin is entitled to divert 7.98 cfs from Canyon Falls Creek.

White River Lumber Company diverts about 5 cfs from Boise Creek near Enumclaw. The diverted water is returned to Boise Creek through a mill pond about half a mile downstream from the point of diversion. Irrigation uses divert about 8,200 acre-feet of water in the lower reaches of the White and Puyallup Rivers.

3.2.5 Floodplains

The lowland valleys include the lower Puyallup River Valley, which extends from Commencement Bay through Puyallup; the Orting Valley, which extends from Sumner south to Orting; and the White River Valley which extends from Sumner north to Auburn. The valley floor varies from approximately 1 to 20 miles in

width. It is fairly uniform with a constant gradient downstream, and with little relief from the base toe of the bluff.

The *Lower Puyallup Watershed Action Plan* identified septic drainfields and sewage as among the potential environmental/public health threats in the 100-year floodplain of the Puyallup and White Rivers. To reduce these threats, the Puyallup River floodplain upstream of Sumner was rezoned to encourage agricultural uses by establishing a minimum future lot size of five acres.

3.2.6 Ground Water

The ground water system in the Puyallup River Drainage Basin is comprised of several shallow aquifers and deeper aquifers underlying the valley floor. The major aquifers in the basin are found in the Puyallup Valley and its tributary valleys that are filled with porous sand, silt and gravel deposits.

Ground water is present at shallow depths in the valley areas. The general direction of ground water flow in the central portion of Puyallup River Basin is to the north or northwest toward Puget Sound or Commencement Bay similar to the direction of flow in the Puyallup River. The water table slope ranges from 120 feet/mile in areas of great relief to 10 feet/mile in areas of little relief or coarse-grained, highly permeable materials. The average slope is 50 feet/mile (*Puyallup River Basin Water Quality Management Plan, 1974*).

The plateau northeast of the City of Orting and south of the City of Bonney Lake is bounded on the southwest by the Carbon River, on the east by South Prairie Creek, and on the northwest by Canyon Falls Creek. Ground water underlying the plateau includes a shallow aquifer, valley aquifers, and the Orting aquifer. The shallow plateau aquifer overlies the mudflow deposits of the Puyallup formation. The shallow plateau aquifer has a maximum thickness of greater than 70 feet, and is comprised of relatively high permeability sand and gravel deposits.

Static water level elevations are in the range of 450 to 550 feet. Ground water depths are approximately 225 to 275 feet below the ground, with seasonal water fluctuations of approximately four feet. The aquifer is recharged by infiltration of excess precipitation and slow seepage from lakes and wetlands. Direction of ground water flow is to the northwest. Most of the ground water discharges to Canyon Falls Creek and enters the Puyallup River Valley as surface flow.

Alluvial aquifers exist in the coarse deposits of the Carbon River and South Prairie Creek valleys. The Orting aquifer lies in the gravels below the valley floor. There is insufficient data to characterize the exact depth, recharge and flow direction of the Orting aquifer.

The *Pierce County Coordinated Water System Plan* estimates ground water recharge rate for the Lower Puyallup River Basin (215 square miles), based on the recharge rates for two sub-basins, the Lower Puyallup and Lake Tapps. Ground water recharge was estimated to be 7 to 16 inches per year for the Lower Puyallup area and 11 to 18 inches per year in the Lake Tapps sub-basin.

Aquifer recharge to the central portion of the basin is estimated to be 725,000 acre-feet per year, almost entirely from precipitation. Because of the impermeability of the consolidated rocks along the south and east edges of the basin, only a small quantity of water recharging the aquifers originates from the mountains or higher foothills (*Puyallup River Basin Water Quality Management Plan, 1974*).

3.2.7 Water Supply

The cities of Tacoma, Puyallup, Sumner, Fife, and Milton serve the urban population in the lowland valleys of the Puyallup River Drainage Basin. Tacoma and Puyallup also serve higher elevation areas, as does Bonney Lake and other water purveyors. Rural areas in the Puyallup River Drainage Basin are serviced primarily by individual or small group ground water wells.

The City of Tacoma is the largest water purveyor supplying water to more than 215,000 customers in Pierce and King Counties. Approximately 37 percent of Pierce County's population is provided direct service from the Tacoma Water Division.

3.2.8 Water Quality

Due to the 303(d) listings for the Puyallup River watershed, cumulative discharge issues will dictate allowable flows and waste loads from the WWTPs that discharge into the Puyallup River system. One Total Maximum Daily Load (TMDL) study has been completed and several more are underway by the Department of Ecology (DOE).

3.2.9 Puyallup River TMDL Wasteload Allocations

DOE completed a TMDL for dissolved oxygen in response to projected growth in population and WWTP discharges to the Puyallup River watershed in 1994. The Pelletier Study - *Puyallup River Total Maximum Daily Load for Biochemical Oxygen Demand, Ammonia, and Residual Chlorine 1993* - (Puyallup River TMDL) demonstrated that the dissolved oxygen standard would be exceeded based on projected wastewater flow increases unless treatment levels were increased. Biologic Oxygen Demand (BOD_5) and ammonia wasteload allocations were provided in the TMDL for existing WWTPs at current flows. These allocations have been issued in NPDES permits currently authorized for each WWTP.

3.2.10 Puyallup River TMDL Reserve Allocation Agreement

The Puyallup River TMDL identified a substantial reserve capacity for BOD_5 and ammonia; however there were no provisions in the TMDL for allocations from the reserve for expansion of existing or new wastewater facilities in the Basin. The EPA, DOE, and the Puyallup Tribe sponsored a mediation forum of diverse participants to establish the availability and procedures for obtaining BOD_5 and ammonia allocations from the reserve capacity for population growth within urban boundaries. The resulting mediated Reserve Allocation Agreement (RAA) (Puyallup River Mediation Committee, 1998) provides the guidance necessary to plan for future BOD_5 and ammonia wasteload allocations at the Sumner and New Upland WWTPs proposed in the USP.

Both the TMDL study and the RAA stipulate that there is no capacity for increased wasteload into the White River above Mile 4.3. Any discharge of ammonia, nitrogen, or phosphorus to the White River will require equivalent reductions elsewhere in the watershed.

The TMDL RAA includes BOD_5 and ammonia allocations for the unincorporated UGAs in Pierce County. This TMDL assumes that Pierce County and the Cities of Sumner and Bonney Lake would activate all of their reserve budgets earmarked for the Sumner and New Upland WWTPs at the projected build out condition. Projected BOD_5 and ammonia limits for the USP alternatives are based on the Puyallup River TMDL and the RAA. Should the new Buckley area WWTP discharge to the White River, microbiologic and total coliform limits may apply and nutrient offsets from other sources could be required.

The future limits will be more stringent than current AKART requirements for BOD_5 and more stringent than the mixing zone-based requirements for ammonia. The TMDL allows for exchange of BOD_5 and ammonia, so these facilities will have some flexibility in the selection of treatment plant process criteria to meet the TMDL requirements.

3.2.11 Potential Additional TMDLs

There are no limitations on nutrient discharges to the Puyallup River where the treatment facilities evaluated in this plan would discharge. There are also no existing data that suggest advanced treatment would be required for nitrogen or phosphorus at the Sumner WWTP or a possible new upland area WWTP.

Accordingly, the USP cannot assume treatment for nitrogen or phosphorus at these facilities. However, as effluent flow increases to the build out projections, or as project-specific facility planning proceeds, additional water quality studies will likely be required by DOE. Based on state and nationwide trends, it would be reasonable to expect some nutrient controls are required for expanded or new wastewater discharges into the Puyallup River.

There are no 303(d) listings in the Puyallup River Basin affected by the USP that would suggest other water quality parameters will be limited in new or expanded wastewater discharges.

3.2.12 Other Water Quality Considerations – Human Health Impacts

The DOE has established water quality criteria and modeling protocol to assess the potential for WWTP discharges to impact human health through direct contact or ingestion of fish and shellfish. These procedures are outlined in DOE's *Permit Writer's Manual* (DOE 1992). However, there is little effluent data on most of the human-health toxicants of concern at most treatment plants. Treatment plants that have tested for human-health toxicants have not detected most compounds.

As effluent monitoring and laboratory techniques advance in the future, the potential for new or expanded discharges in the Puyallup River watershed that could cause adverse human-health impacts will receive more scrutiny. These advances could lead to higher treatment or pre-treatment requirements at the Sumner or new upland WWTPs.

3.2.13 Anti-degradation Policy

The anti-degradation policy in the Washington State Water Quality Standards (WAC173-201A-070) states that no additional degradation of waters exceeding standards will be allowed unless it is shown to be in the public interest, and meets several other tests that DOE is in the process of adopting. Any increase in flow to the Sumner plant or wastewater discharge from a new upland plant will have to satisfy these requirements, or treat to a higher level that would not exceed current discharge concentrations or mass loadings of pollutants. The anti-degradation determinations will be made on a project specific basis as a result of wastewater facility planning or NPDES permit renewals.

3.2.14 Instream Flows

The White River is included on the state's 303(d) list of impaired waters for instream flow. Instream flows are also a concern for the Puyallup River during late summer low flows. Only the Centralized Treatment Alternative adopted in the 2001 USP would divert effluent from the watershed that would otherwise enter the river.

Approximately 10 cfs that would otherwise be discharged to the Puyallup River could be conveyed out-of-basin to the WWTP and discharged into Puget Sound. At the 7-day, 10-year low flow used by DOE to assess water quality impacts, this would represent an instream flow reduction of approximately 2 to 4 percent of ambient flow in the Puyallup River.

3.2.15 Land Use

Urban areas in the Puyallup River Drainage Basin include: the cities of Bonney Lake, Buckley, Fife, Edgewood, Sumner, Milton, Orting, Pacific, and Puyallup; the towns of South Prairie, Wilkeson, Carbonado; and the southeast portion of the City of Tacoma.

Land use in urban areas includes industrial, commercial, and residential areas. Suburban cities surrounding Tacoma originated as agricultural and natural resource service centers; however, over time they have developed into communities that house part of the Tacoma/Puget Sound workforce.

Table 3.2-1 Land Use in the Cities and Towns within the Puyallup River Drainage Basin

City/Town	Current Developed Density[1]	Projected Developed Density[1]	Planned Employment (commercial and industrial acreage)
City of Bonney Lake	1.25	1.3	728
City of Buckley	2	1.7	620
City of Fife	6.9	9.1	841
City of Milton	2.6	3.04	127
City of Orting	4	5.1	15
City of Pacific	2.4	3.01	200
City of Puyallup	4.4	4.9	823
City of Sumner	2.18	5.46	1,622
Town of Carbonado	1.45	1.45	19
Town of South Prairie	3	3.1	5
Town of Wilkeson	1	1.45	7

Source: Comprehensive Plans of cities and towns, or staff of cities and towns.
[1]Units per acre

3.2.16 Unincorporated Pierce County

Table 3.2-2 lists allowable maximum residential densities in urban land use designations in unincorporated Pierce County. The table also includes acreage for the land use designations in unincorporated Pierce County within the Puyallup River Drainage Basin.

Table 3.2-2 Maximum Allowable Residential Densities and Land Use Acreage in Unincorporated Areas of Puyallup River Drainage Basin

Land Use Designation	Maximum Allowable Residential Density in Unincorporated Pierce County[1]	Acres in Unincorporated Puyallup River Drainage Basin
Moderate Density Single Family (MSF)	6	18,449
Activity Center (AC)	25	0
Community Center (CC)	25	752
Major Urban Center (MUC)	25	111
Rural Activity Center (RAC)	-[2]	0
Gateway Community (GC)	-[2]	NA
Rural Neighborhood Center (RNC)	-[2]	NA
Neighborhood Center (NC)	25	30
Mixed Use District (MUD)	25	1,718
High-density Residential District (HRD)	25	123
Employment Center (EC)	-	2,686

Source: Pierce County Planning and Land Services, Title 18A Development Regulations – Zoning, Section 18A.17.030.
[1]Units per acre
[2]The residential densities in Rural Centers shall be the same as permitted in the adjacent rural designations.

3.3 Sewer Service Basins in the Puyallup and White River Drainage Basins

Table 3.3-1 Sewer Service Basins in the Puyallup and White River Drainage Basins

Tacoma Central WWTP Sewer Service Basin	City of Fife Sewer Service Area
	Lakehaven Utility District Sewer Service Area
	Browns/Dash Point Sewer Service Area - Pierce County Wastewater Utility
	Hylebos Sewer Service Area - Pierce County Wastewater Utility
Sumner WWTP Sewer Service Basin	City of Bonney Lake Sewer Service Area
	Lake Tapps Sewer Service Area
City of Puyallup WWTP Sewer Service Basin	
City of Buckley WWTP Sewer Service Basin	
Rainier School WWTP Sewer Service Basin	
City of Orting WWTP Sewer Service Basin	
Town of South Prairie WWTP Sewer Service Basin	
Town of Carbonado WWTP Sewer Service Basin	
Town of Wilkeson WWTP Sewer Service Basin	

Unshaded Sewer Service basins are part of the Pierce County Wastewater Utility.

Table 3.3-2 Existing Wastewater Treatment Plant Capacities in MGD[1] of ADWF in the Puyallup Basin

Treatment Plant	2007 Volume	Permitted Capacity	Planned Capacity
Tacoma Central WWTP	27.0MGD	60.0MGD	-[2]
City of Sumner WWTP	1.6MGD	4.59MGD	6.1MGD[3]
City of Puyallup WWTP	5.3MGD	9.46MGD	13.79MGD
City of Buckley WWTP	.55MGD	1.0MGD	1.0MGD
Rainier School WWTP	.117MGD	.15MGD	.15MGD
City of Orting WWTP	.57MGD	1.2MGD	-
Town of South Prairie WWTP	.037MGD	.029MGD	.029MGD
Town of Carbonado WWTP	.024MGD	.065MGD	.065MGD
Town of Wilkeson WWTP	.09MGD	.13MGD	-

[1] Millions of Gallons per Day

[2] In a process of amending their general sewer plan.

[3] From Sumner WWTP data.

3.3.1 Tacoma Central WWTP Sewer Service Basin/Tacoma Central WWTP

In addition to providing service to Central, Northeast and South Tacoma and the urban service area inside the CUGA, the Tacoma Central WWTP provides contract wastewater treatment services to: Lakehaven Utility District, the Cities of Fife, Fircrest, and Milton via Pierce County Wastewater Utility, and portions of unincorporated Pierce County.

Treatment in these areas is provided at the Tacoma Central WWTP under a contract with Pierce County. Pierce County owns of 2.54MGD Average Daily Water Flow (ADWF) of capacity and 9.0MGD peak flow at the Tacoma Central facility.

The City of Tacoma owns and operates the Tacoma Central WWTP and collection system. This plant is a pure oxygen activated sludge secondary treatment plant with a permitted Maximum Month Flow (MMF) of 60MGD. Ninety (90) percent oxygen is used in aeration basins to provide efficient oxygen transfer to the bacteria in the treatment process. Aeration basins are covered to keep oxygen levels high in the tanks.

Biosolids Management - The Tacoma Central WWTP uses a thermophilic, dual digestion system which produces a Class A biosolids product. About 15 percent of annual production is liquid biosolids that are land applied to forest land in the winter and agricultural lands during dry periods or given away. Eighty-five percent of the biosolids are dewatered and mixed with sawdust to make a soil conditioning product called TAGRO Mix. Other product varieties are also offered including a potting soil.

Discharge Facilities - Treatment effluent is chlorinated at the outfall. The outfall extends three (3) miles from the plant, approximately 1200 feet, offshore in Commencement Bay at a depth of 150 feet.

3.3.2 City of Sumner WWTP Sewer Service Basin/Sumner WWTP

In addition to the providing service to the City of Sumner and its urban service area inside the CUGA, the Sumner WWTP provides contract wastewater treatment services to the City of Bonney Lake. Of the 4.59MGD of treatment capacity, the City of Bonney Lake owns 2.295MGD.The interlocal agreement between the City of Sumner and the City of Bonney Lake provides that either city can use up to 55% of the available capacity of the plant.

The City of Sumner WWTP owns and operates a secondary activated sludge treatment plant with a permitted capacity of 4.59MGD. The plant is located on a point of land between the Puyallup and White Rivers. A flood barrier exists around the WWTP site to protect the plant when water levels are high in the rivers. It consists of an earthen berm topped with a perimeter roadway.

3.3.3 Puyallup WWTP Sewer Service Basin/Puyallup WWTP

The City of Puyallup WWTP is a rotating biological contact secondary wastewater treatment plant with secondary clarification and chlorination. The facility is designed to treat an average dry weather flow of 4.79MGD, wet weather flow of 10.72MGD and peak flow of 19.0MGD. Discharge is to the Puyallup River. A four phased process to modify the City's sewer system to meet new requirements for BOD, ammonia, and chlorine has begun. The Puyallup Sewer Service Area includes areas within the City limits and associated UGA.

3.3.4 City of Buckley WWTP Sewer Service Basin/Buckley

The City of Buckley owns and operates a collection system and secondary wastewater treatment facility which utilizes oxidation ditches. The facility has a maximum permitted flow of 2.4MGD. Treated wastewater is discharged to the White River. The Buckley Sewer Service Area is Buckley city limits and UGA. Buckley has imposed a sewer moratorium until it is able to address I/I problems and increased water quality standards for wastewater.

3.3.5 Rainier School WWTP Sewer Service Basin/Rainier School WWTP

The Rainier School, through the Department of Health and Social Services, owned and operated a municipal secondary wastewater treatment system. The facility is now connected to the city of Buckley's WWTP.

3.3.6 City of Orting WWTP Sewer Service Basin/Orting WWTP

The City of Orting owns and operates a collection system and aerated lagoon secondary wastewater treatment system. The facility has a permitted flow of 750,000 gallons per day (.75MGD). Treated wastewater is discharged to the Puyallup/Carbon Rivers. The Sewer Service Area for the City of Orting includes city limits and its UGA.

3.3.7 Town of South Prairie WWTP Sewer Service Basin/South Prairie WWTP

The Town of South Prairie owns and operates a collection system and a re-circulating gravel filter system with advanced treatment. The treatment system has a permitted flow of 38,000 gallons per day (.038MGD). Treated wastewater is discharged to South Prairie Creek. The Sewer Service Area for South Prairie is the established town limits.

3.3.8 Town of Carbonado WWTP Sewer Service Basin/Carbonado WWTP

The Town of Carbonado owns and operates a collection system and secondary wastewater treatment plant. The WWTP is designed for a monthly average flow of 100,000 gallons per day (.1MGD). The WWTP is a single cell aerated lagoon system with treated wastewater discharged to the Carbon River. The size and capacity of the treatment plant are adequate for the twenty-year planning horizon as identified in the *Town of Carbonado Comprehensive Land Use Plan, 1995*. The Sewer Service Area for Carbonado is the town limits.

3.3.9 Town of Wilkeson WWTP Sewer Service Basin/Wilkeson WWTP

The Town of Wilkeson owns and operates a collection system and secondary lagoon wastewater treatment system. The WWTP has a permitted flow of 70,000 gallons per day (.07MGD). Treated wastewater is discharged to Wilkeson Creek. The Sewer Service Area for Wilkeson is the town limits.

3.3.10 Pierce County Puyallup River Basin Sewer Service Areas

The Pierce County Wastewater Utility provides collection and transmission of wastewater within the Puyallup Drainage Basin for its customers. Treatment of these flows occurs at the Tacoma Central WWTP under contract. Pierce County facilities are located within three Sewer Service sub-basins as described in Table 3.7-1.

3.3.11 Bonney Lake/Lake Tapps Service Area (Sumner WWTP Sewer Service Basin)

The Bonney Lake Wastewater Utility collects and conveys wastewater through sewer pipelines owned by the City of Bonney Lake to the Sumner WWTP. The Bonney Lake/Lake Tapps service area consists of a primary service area outside of the City of Bonney Lake boundary near Lake Tapps. This area was transferred to the City of Bonney Lake along with Pierce County's treatment capacity at the Sumner WWTP through transfer agreement R2001-189 dated March 29, 2002.

3.3.12 Edgewood Sewer Service Area

The Edgewood Wastewater Utility collects and conveys wastewater through sewer pipelines owned by the City to the Lakota WWTP owned by the Lakehaven Utility District. The service area consists of a primary service area within the City of Edgewood located along Meridian Avenue. The City also has an Interlocal Agreement with the City of Fife to process approximately 350 equivalent residential units (ERUs) through the City of Fife's existing treatment capacity at the Tacoma Central WWTP.

3.4 Nisqually River Drainage Basin

The Nisqually River Basin, WRIA 11, drains 712 square miles of Thurston, Lewis, and Pierce Counties. The Joint Base Lewis McChord Military Reservation comprises 20 percent of the basin while Mt. Rainier National Park and the Snoqualmie National Forest comprise an additional 20 percent.

The northern portion of the basin is located within Pierce County. Several small communities exist in this portion of the basin: the City of Roy, the Town of Eatonville, and the communities of Alder, Ashford, Elbe, Graham, La Grande, and McKenna.

Muck Creek (Sub) Basin

The Muck Creek Basin is a 90 square mile sub-basin of the Nisqually River Basin. The basin lies entirely within the Puget Sound Lowlands and originates east of Fort Lewis, near the community of Graham flowing southwest through Fort Lewis and the City of Roy, emptying into the Nisqually River approximately 10 miles upstream from the river's delta.

Other than the parts of the communities of Graham and Roy, the sub-basin is classified as rural with a low level of development.

3.4.1 Topography

The Nisqually River Drainage Basin has four major land forms: delta, lowland valleys, terraces, and mountains. The Nisqually River divides into sloughs and channels to form the Nisqually Delta. The delta covers approximately 4,000 acres between Interstate Highway No. 5, the bluff west of McAllister Creek (Medicine Creek) on the west, the Union Pacific Railroad line on the east and the underwater drop-off on the north. Elevations in the delta are less than 20 feet above sea level.

The lowland valley includes the Nisqually River Valley from the delta to Yelm north through McKenna to Roy. The width of the valley floor varies from 1 to 3 miles. The valley floor is fairly uniform with a constant gradient downstream, and with little relief from toe to toe of the bluff.

On either side of the Nisqually River is the terrace province. The terraces are bordered by bluffs with slopes ranging from 20 to 75 percent, with flatter slopes predominating. The upper portions of the terraces are characterized by rolling plains, with gentle slopes having a relief of less than 100 feet. Mountains occupy the eastern half of the drainage basin, southeast of La Grande and Eatonville rising to 7,000 feet at the crest of the Cascade Mountains and 14,410 feet at the summit of Mt. Rainier.

3.4.2 Geology

The geology of the Nisqually River Drainage Basin is similar to that in other areas of Pierce County. The surface topography was formed primarily during the latest glacial advance. Glaciated uplands are comprised of advance outwash, till, and recessional outwash. The steeply sloping transitional zone between the uplands and floodplain areas contain interbedded coarse and fine grained sediments that are subject to sliding and slumping. The Nisqually Delta, formed where the Nisqually River enters Puget Sound, is an estuary of alluvial glacial and interglacial deposits.

3.4.3 Soils

Generally the soils in the glaciated uplands are loose to medium dense sands and recessional gravels and dense glacially compacted silty sands and gravelly silts or glacial till. The flood plain of the Nisqually River contains loose wet silty fine sands, silts, and peat.

The soil associations found in the Nisqually River Drainage Basin in Pierce County are Kapowsin, Alderwood-Everett, Puyallup-Sultan, Barneston-Scamman-Wilkeson, and Spanaway. The *Draft Nisqually River Basin Water Quality Management Plan, 1974* reported that less than 25 percent of the land area in the basin is suitable for septic tank development based upon soil classifications by the Soil Conservation Service. For future

urban growth, the development of wastewater collection and disposal facilities is a necessary consideration. No additional studies for wastewater collection and disposal facilities have been undertaken.

3.4.4 Hydrology – Surface Water, Rivers, Lakes

Nisqually River The Nisqually River originates on the southwestern slope of Mount Rainer at the base of the Nisqually Glacier and flows northwesterly for 78 miles until it discharges into Puget Sound. The main stream of the Nisqually is joined by eight tributaries upstream and five major tributaries downstream from Alder Dam. The Paradise River and Kautz, Tahoma, and Van Trump Creeks join the river within Mount Rainier National Park. Between the park boundary and Alder Dam the river receives the flows from the Little Nisqually River, Big Creek, Mineral Creek, and East Creek. Below Alder Dam the principal tributaries are the Mashel River and Ohop, Tanwax, Muck and Yelm Creeks.

Muck Creek Muck Creek is located just north of the City of Roy. Muck Creek flows through a series of lakes and marshes until it discharges into the Nisqually River, south of Murray Creek.

Alder Reservoir The Alder Reservoir is one of the principal lakes in Pierce County. It has 231,900 acre-feet of total storage, of which 179,660 acre-feet is considered usable. The City of Tacoma operates the reservoir for power generation. Treated wastewater from the Elbe Water and Sewer District mound system drainage enters into the reservoir.

Ohop Lake Ohop Lake is located just north of the Town of Eatonville. The lake has a surface area of approximately 236 acres. Ohop Creek provides the inflow to the lake and serves as the outlet from the lake. Private residences with on-site sewer systems line its shores.

Clear Lake Clear Lake is located just north of Ohop Lake. The lake covers an area of approximately 155 acres. Ohop Creek is the outlet for Clear Lake.

3.4.5 Floodplains

The Nisqually River floodplain contains loose wet silty fine sands, silts, and peat. Water is present throughout the floodplains at shallow depths. The flooding characteristics of the Nisqually River are partially controlled by Alder and La Grande Reservoirs. The Muck and Tanwax creeks have little or no floodplain. Ohop Creek has a fairly wide floodplain.

3.4.6 Ground Water

Groundwater pumped from wells in the lowlands is used mostly for individual home use and some agricultural irrigation uses. Wells of the greatest yield pump water from aquifers below the till layer. Few wells are more than 200 feet deep and the water-bearing zones are commonly less than 30 feet thick. Recharge to aquifers in the lowlands is mainly through infiltration of precipitation. Most of the ground water in the lowlands is dispersed naturally into the Nisqually River and its tributaries and into Puget Sound through springs that occur both above and below tide levels.

3.4.7 Land Use

A majority of the Nisqually River Drainage Basin is privately owned, much of it by forest product companies. Thirty percent of the basin is under the jurisdiction of various federal agencies with the balance owned by state, municipal, and tribal governments.

A majority of the land use in the basin is rural agricultural with scattered single-family residences. Fort Lewis, which fills much of the lowland valley portion of the basin, houses its permanent residents in the northern half of the Fort, within the Chambers Creek - Clover Creek Basin. All unincorporated portions of the Basin within

Pierce County are designated as rural. The eastern portion is designated for long-term commercial forestry. See Table 3.4-1.

Table 3.4-1 Land Use in Cities and Towns in the Nisqually Basin

City/Town	Current Developed Density[1]	Projected Developed Density[1]	Employment [2]
Town of Eatonville	3.4	3.0	79
City of Roy	1.6	2.8	33

[1] Units per acre.

[2] Both commercial and industrial acreages.

3.4.8 Existing Sewer Service Facilities

Pierce County has no sanitary Sewer facilities or service areas in the Nisqually River Basin.

Table 3.4-2 Sewer Service Basins and Treatment Capacities

Town of Eatonville WWTP Sewer Service Basin			
Treatment Plant	**2008 Volume**	**Permitted Capacity**	**Planned Capacity**
Town of Eatonville	.15MGD	.045MGD	.054MGD
Elbe Water and Sewer District Sewer Service Basin			
Treatment Plant	**2008 Volume**	**Permitted Capacity**	**Planned Capacity**
Elbe Water/Sewer District	.018MGD	.002MGD	.002MGD
Park Junction Water/Sewer District			
Treatment Plant	**2008 Volume**	**Permitted Capacity**	**Planned Capacity**
Park Junction Water/Sewer District	N/A	.18MGD	.018MGD
City of Yelm WWTP Sewer Service Basin			
Treatment Plant	**2008 Volume**	**Permitted Capacity**	**Planned Capacity**
City of Yelm	.20MGD	.30MGD	1.0MGD

[1] Millions of Gallons per Day

3.4.9 Town of Eatonville WWTP

The Town of Eatonville operates a secondary treatment plant of aerated lagoons and maintains its own collection system. Treated wastewater discharges to the Mashel River. The plant has a permitted monthly average wet weather flow of 45,000 gallons per day (.045MGD). The Town plans to improve its Sewer Service facilities to provide for the Eatonville UGA.

3.4.10 Elbe Water and Sewer District

The Community of Elbe has a mound system of wastewater treatment with a subsurface discharge to the Nisqually River. The system has a permitted capacity of 2,000 gallons per day (.002MGD) and serves 43 lots. The district is currently prohibited from adding any additional connections to the system due to a moratorium enacted by the State of Washington's Department of Ecology.

3.4.11 Park Junction Water and Sewer District

The Park Junction Water Sewer Utility will service only the Park Junction Resort (Resort) a Master Planned Community per the decision of the Pierce County Hearing Examiner.

Wastewater service for the Resort is planned to be provided by means of an on-site Membrane Bio-reactor (MBR) sized to handle a sustained peak flow of 175,000 gallons per day (0.18MGD) with ultraviolet

disinfection. The MBR will produce Class A effluent suitable for use as irrigation water for common landscape areas and a proposed golf course. Excess treated effluent is planned for discharge into constructed wetlands that drain into Sahara Creek. Residual solids will be transported periodically to the Tacoma Central Wastewater Treatment Plant via existing rail service.

On August 1st 2006, the Pierce County Council passed resolution 2006-71s establishing the Park Junction Water and Sewer District (District). This action authorized the formation District in the Elbe Area appointing three (3) initial Water-Sewer Commissioners. No other work has begun on either the water or sewer systems.

3.4.12 City of Yelm WWTP

The City of Yelm constructed one of the first water reclamation and reuse facilities (Plant) in Washington State. The Plant was one of five demonstration projects authorized through RCW 90.46.110 in 1997. The Plant was permitted in 1999 to produce Class A reclaimed water using sequential batch reactors for aeration and coagulation, continuous backwash sand filtration, and chlorination for disinfection. The reclaimed water is used for irrigation of residential lawns, and public areas at Yelm High and Yelm Middle Schools, Yelm City and Cochrane Parks, and water features located within Cochrane Park, and also for local fish pond and aquifer recharge. The City also provides limited fire protection through a dedicated reclaimed water fire system.

3.4.13 Existing Facilities within the Nisqually Basin

Pierce County does not have wastewater facilities within the Nisqually Basin, nor does the County maintain any community on-site sewer systems within the basin. No sewer service plans have been adopted for the Pierce County Wastewater Utility by Pierce County in the Nisqually River Basin. No records exist that indicate the *Nisqually River Basin Water Quality Management Plan 1974,* was adopted by either Pierce County or the Department of Ecology.

3.5 Kitsap Drainage Basin

The Kitsap Drainage Basin includes all of Kitsap County and portions of Pierce, Mason, and King Counties. The basin is bordered on the west and south by Hood Canal and on the north and east by Admiralty Inlet and Puget Sound, the basin also surrounds Carr Inlet and is bound by Case Inlet on the west and Colvos Passage and the Narrows on the east. Within Pierce County, the Kitsap Drainage Basin is comprised of Key Peninsula, Gig Harbor Peninsula, and several islands. The three largest islands are Fox, Anderson, and McNeil with the smaller islands of Raft, Herron, and Ketron. There are approximately 144 miles of shoreline.

In 1976, Pierce County amended the *Pierce County Generalized Comprehensive Plan* by adding portions of the *Kitsap Basin Water Pollution Control and Abatement Plan, 1975* for the Gig Harbor Peninsula, Longbranch Peninsula, and Island Areas. The Kitsap Basin Plan provided for a regional WWTP near Gig Harbor to service Gig Harbor, Fox Island, Henderson Bay, Wollochet Bay, and Hale Passage. In addition facilities studies were identified as next steps for Taylor/Filucy Bay, Van Geldern Cove, and Anderson Island.

An amendment of the *Kitsap Basin Plan* was proposed in 1986, which recommended that Pierce County construct a new wastewater treatment plant at the south end of the Tacoma Narrows airport. The amendment was not adopted.

The Kitsap Basin is primarily rural and contains no unincorporated Pierce County Urban Growth Areas. The Pierce County Comprehensive Plan and County-Wide Planning Policies prohibit provision of sewer services in rural areas. The City of Gig Harbor is the only local government with a designated Urban Growth Area and the City is the provider of sewer service on the Gig Harbor Peninsula.

In 1988 Pierce County conveyed four Pierce County maintained community sewer systems on the Gig Harbor Peninsula to the City of Gig Harbor. One community system, Etloh Panoramic Views on Fox Island, was re-conveyed back to the County and the County continues to maintain this facility.

A complete listing of the Pierce County Sewer Utility Legislative History may be found in Appendix E.

3.5.1 Topography

The Kitsap Drainage Basin lies within the Puget Sound Trough. The topography of the Kitsap Drainage Basin is made up of nearly level to rolling uplands. The uplands are broken by moderately steep to very steep slopes along drainage channels. Steep bluffs dominate the shoreline with up to 80 percent slopes along the eastern shore at the Narrows. Elevations in Pierce County range from sea level to 400 feet near the Kitsap County line.

3.5.2 Geology

The Kitsap Drainage Basin geology is similar to that of Pierce County. The surface topography was formed primarily during the latest glacial advance. Glaciated uplands are comprised of advance outwash, till, and recessional outwash.

Geologic hazards are the same as those described under the geologic discussion for the Chambers Creek – Clover Creek Drainage Basin. Erosion potential in the Kitsap Drainage Basin is confined to the steep ravines that drain to Puget Sound and along Artondale Creek. Slope stability in the Gig Harbor Peninsula is described as varying from stable to unstable, with most portions being classed as stable.

3.5.3 Soils

Generally soils found within the basin developed from unconsolidated glacial deposits that vary in depth from one to 150 or more feet. The major soil associations found within the basin include Everett, Sinclair, Alderwood, Indianola, and Harstine. Harstine soils make up the majority of the soils found on the Gig Harbor Peninsula.

The *Kitsap Basin Water Pollution Control and Abatement Plan, 1974* reported that the majority of the Kitsap Basin experienced either moderate or severe drainfield limitations. Fox, McNeil, Ketron, Anderson Islands, and large portions of the Gig Harbor and Longbranch peninsulas are severely limited in their suitability for on-site septic development based upon soil classifications by the Soil Conservation Service.

3.5.4 Hydrology – Surface Water, Rivers, Lakes

Creeks All creeks in the drainage basin flow directly into Puget Sound and most are less than two miles in length. Short creeks with small drainage basins experience low flows during the dry season of July to October. The four largest creeks are Artondale, Garr, Crescent, and McCormick Creeks, which drain nearly all of the interior area.

Crescent Lake *C*rescent Lake is the largest lake on the Gig Harbor Peninsula. It drains an area of approximately 1.18 square miles draining southward via Crescent Creek to Gig Harbor. The lake is considered to be eutrophic and is almost completely covered with aquatic plants.

Wetlands Intermittent marshy areas are common on the Gig Harbor Peninsula. The drainage basin has both seasonal and annual wetlands.

3.5.5 Floodplains

There are no major floodplains in the Kitsap Basin.

3.5.6 Ground Water

Because streams in the Kitsap Drainage Basin are short and do not offer a reliable water source, ground water is the primary domestic water source on the Kitsap Drainage Basin. Water supplies are obtained from the ground water sources in the Colvos Sand, the Salmon Springs Drift, and the pre-Salmon Springs deposits. Recharge to the shallow aquifers occurs through precipitation with discharge to Puget Sound. Deep aquifers are thought to be recharged at higher elevations such as the Olympic or Cascade mountain ranges. Discharge of deep aquifers is primarily to Puget Sound.

3.5.7 Land Use

With the exception of City of Gig Harbor, land use within the 101,000-acre basin is primarily rural, undeveloped forest land with low density agricultural, and residential areas and communities of varied density of development.

McNeil Island is state owned and is the site of McNeil Island Penitentiary. Along with the penitentiary there are approximately 100 private homes. The balance of the island is classified as a wildlife preserve.

The City of Gig Harbor is a mixture of residential, commercial, and industrial uses. North Gig Harbor is designated as one of the ten County Employment Centers. The area surrounding the City of Gig Harbor is a mixture of moderate density residential, planned employment, and residential communities. The City owns its own wastewater collection system and treatment plant.

Anderson, Ketron, and Fox Island are characterized by small communities and scattered residences. Several unincorporated communities such as Lakebay are located on Key Peninsula. Residential development in the basin is likely to continue in the future. Although the Pierce County Comprehensive Land Use Plan has set minimum lot sizes at 5 acres for the Gig Harbor Peninsula and 20 acres for the Key Peninsula, growth will not be immediately limited due to the large number of vested but vacant parcels.

3.5.8 Sewer Service Basins in the Kitsap Drainage Basin

Shaded Sewer Service basins are not part of the Pierce County Wastewater Utility

Table 3.5-1 Sewer Service Basins and Treatment Capacities

Ketron Island Community System Sewer Service Basin			
Treatment Plant	**2008 Volume**	**Permitted Capacity**	**Planned Capacity**
Ketron Island	Approximately .03MGD[1]	--[2]	--[2]
McNeil Island WWTP Sewer Service Basin			
Treatment Plant	**2008 Volume**	**Permitted Capacity**	**Planned Capacity**
McNeil Island	--[2]	.038MGD	1.0MGD
City of Gig Harbor WWTP Sewer Service Basin[3]			
Treatment Plant	**2008 Volume**	**Permitted Capacity**	**Planned Capacity**
City of Gig Harbor	1.6MGD	2.0MGD	--[2]
Taylor Bay Beach Club			
Treatment Plant	**2008 Volume**	**Permitted Capacity**	**Planned Capacity**
Taylor Bay Beach Club	--[2]	.029MGD	290 people

[1] Millions of Gallons per Day
[2] Data unavailable.
[3] Connection of Wollochet Harbor Club completed in 2002.

3.5.9 Ketron Island

Ketron Island and all water and sewer facilities on the island are privately owned. The Sewer Service system presently serves 14 residences. There are 265 platted lots in the Ketron Sunset Tract development with an additional 6 lots ranging from 5 to 52 acres in size for a total of 216.19 acres. The Island has a maximum potential at the current R-10 zoning classification of 286 residential lots. The treatment facility consists of a spiragester and chlorinator. Discharge is through a 500 foot outfall to Puget Sound.

3.5.10 McNeil Island

The Washington State Penitentiary is served by a Sequential Batch Reactor (SBR) with three reaction chambers, providing secondary treatment. The Main Institution WWTP has a design flow of 38,000 gallons per day (0.038MGD) with maximum flow of 1.0MGD. Discharge is through a 300 foot outfall to Puget Sound.

3.5.11 City of Gig Harbor WWTP

The City of Gig Harbor operates an activated sludge secondary treatment plant and maintains its own collection system. Treated wastewater is discharged into the Tacoma Narrows through a new sewer outfall. The plant is rated at 2.0MGD.

3.5.12 Wollochet Harbor Club WWTP

Connection of the Wollochet Harbor Club system to the City of Gig Harbor's WWTP was completed in February 2002.

3.5.13 Taylor Bay Beach Club

The Taylor Bay Beach Club is a private facility which provides activated sludge secondary treatment for 184 residential building sites. Treated wastewater is discharged to Taylor Bay in Case Inlet. The plant has a rated capacity of 3,000 gallons per day (0.003MGD) and a design population of 290 people.

3.5.14 Etloh Panoramic Views Community On-site Sewer System – Fox Island

Pierce County maintains the Panoramic Views (Etloh) Community On-site sewer System. The subdivision is located at the south end of Fox Island and has three active drainfields and one reserve drainfield. Total system capacity is rated at 3,480 gallons per day. Wastewater drains to a community septic tank where solids settle and are periodically pumped. Pierce County Public Works and Utilities will continue to maintain the Etloh system indefinitely.

Table 3.5-2 Pump Station for Etloh Community On-site Sewer System

Number	Name	Area Served	Type	Location	# of Pumps	Capacity
PS-85	Etloh	Fox Island	Submersible	506 - 13th Ct Fl	2	285 gpm

3.6 City of Tacoma - North End WWTP

Owned and operated by the City of Tacoma, the North End WWTP is a physical/chemical secondary treatment plant located at the mouth of Mason Creek at 4201 North Waterview Street in North Tacoma. It has a DOE approved design capacity of 7.2MGD and a permitted average wet weather design capacity of 10MGD.

The service area totals 5,460 acres and includes Point Defiance, Ruston, and the downtown area in the vicinity of Division Avenue, in addition to extensive residential areas southward of North 6th Street. Sludge is sent to the Tacoma's Central WWTP for digestion and dewatering to meet EPA's Exceptional Quality biosolids standards. Treated wastewater is discharged into Commencement Bay.

3.7 Joint Base Lewis McChord Sewer System – Tatsolo Point WWTP

Owned and operated by the Department of Defense, the Tatsolo Point WWTP is a secondary treatment facility consisting of primary clarification, trickling filtration, secondary clarification, and chlorination. With a nominal rated capacity of 7MGD and a maximum hydraulic flow of 15MGD Tatsolo WWTP treats wastewater from Joint Base Lewis McChord, the Veteran's Hospital at American Lake, and the Camp Murray National Guard Station.

Solids are digested anaerobically and dewatered before composting by a contract operation. Treated wastewater is discharged at 53 feet mean lower low water, 650 feet into the Gordon Point zone of South Puget Sound. Discharge is regulated by a NPDES discharge permit administered by the U.S. EPA.