

Chapter 2 Existing and Projected Conditions

2.1 INTRODUCTION

Understanding the condition of Jefferson County's surface water resources requires an understanding of the County's natural features, its geology, climate, topography, and hydrology. It also requires an understanding of the County's patterns of population, land use, and development.

This chapter summarizes information from the:

- Jefferson County Comprehensive Plan,
- Jefferson County Unified Development Code,
- Jefferson County Critical Areas mapping,
- Protection of Riparian Ecosystems: A review of Best Available Science, Jefferson County Natural Resources Division, 2000,
- Water Resource Inventory Area (WRIA) 16 Skokomish – Dosewallips Technical Assessment (2002),
- Water Resource Inventory Area (WRIA) 17 Quilcene – Snow Creek Technical Assessment (2000),
- WRIA 16 Draft Watershed Management Plan (2005),
- WRIA 17 Watershed Management Plan (2003),
- Port Hadlock Urban Growth Area Stormwater Management Plan (2004),
- Land Use / Land Cover and Forest Seral Stage Classification Report (2004),
- Chimacum Creek Watershed Agriculture and Fish & Wildlife Habitat Protection Plan (2004),
- Lower Big Quilcene River Flood Hazard Management Plan (1998),
- Lower Big Quilcene Linger Longer Reach Feasibility Study and Action Plan (2005),
- Port Ludlow Drainage District Comprehensive Drainage Plan (2003),
- U.S. Census Bureau Census Tract Data (2000),
- U.S. Bureau of Reclamation Channel Migration Zone Study and mapping of east Jefferson County rivers (2004), and
- U.S. Soil Conservation Service, Soil Survey for Jefferson County, Washington.

The analysis in this chapter relies on mapping of watershed boundaries, census data, and land use designations conducted by the staff of the Jefferson County Inter-Departmental Data Management System. It is based on Jefferson County's adopted population projections (Jefferson County Comprehensive Plan 2004, Page 3-3).

The analysis in this chapter also relies on extensive personal communication by the Plan author with the staffs of the Jefferson County Departments of Community Development, Environmental Health, and Public Works and Natural Resources Division, the Jefferson County – WSU Cooperative Extension Water Quality Education, and the Jefferson County Conservation District.

Background information is also available on the Jefferson County web site:

<http://www.co.jefferson.wa.us/Departments.shtml>. Click on the links to Community Development and Natural Resources.

2.2 LAND AND CLIMATE

Jefferson County's geology, topography, and climate are the fundamental factors that determine the nature of its surface water resources.

Jefferson County is located on the north Olympic Peninsula. The Olympic Mountains occupy the interior of the County. They are composed primarily of deformed and weathered sedimentary and igneous rocks that were originally formed on the floor of the Pacific Ocean and subsequently uplifted. These formations are the bedrock of Jefferson County.

The Olympic Mountains are surrounded by foothills that in turn border coastal areas adjoining the Pacific Ocean, Straits of Juan de Fuca, Admiralty Inlet, and Hood Canal and Discovery, Port Townsend, Quilcene, and Dabob Bays.

Glaciers covered much of Jefferson County for thousands of years, receding only about 12,000 years ago. This left extensive areas of glacial till, a compact mixture of cobbles, gravel, sand, silt, and clay that is typically overlain by shallow soils. For instance, approximately 75% of the area of WRIA 17, the northeastern portion of the County, that is not covered by bedrock is covered with till. Till is resistant to erosion and typically has a low rate of permeability, i.e., it is not easily infiltrated by surface waters. This typically results in rapid runoff, perched water tables and shallow subsurface groundwater flow. There are also large areas of sand and gravel that were deposited as glacial outwash. Unlike till, this material is highly permeable and susceptible to erosion. The distribution of till and outwash affects the rates of surface water runoff and infiltration, groundwater recharge, and summer stream flows.

The County's climate is strongly influenced by moisture-laden winds that flow in from the Pacific Ocean. The Olympics partially block this flow. As a result the West End of the County receives well over 100 inches of precipitation per year, while Quilcene in the southeast receives an average of 55 inches and Port Townsend in the northeast corner receives only 19 inches.

Typically about 70% of the total precipitation occurs during the months from November-April, while May-October are comparatively drier. This pattern produces a wide variation in stream flows between the wetter and drier times of the year. This has significant implications, particularly in the drier northeastern portions of the County. Precipitation that recharges aquifers during wetter months is an important factor in maintaining summer stream flows. However, the steep terrain and predominance of bedrock and till that characterizes much of the interior of Jefferson County results in rapid runoff and slow infiltration and limits aquifer recharge.

Jefferson County's climate has produced extensive coniferous forests of Douglas fir, western hemlock, western red cedar, and Sitka spruce. Nearly 80% of eastern Jefferson County and an even greater percentage of the West End is forested.

Precipitation feeds the County's major rivers: the Duckabush, Dosewallips, and Big and Little Quilcene Rivers in the East and the Bogachiel, Hoh, Queets-Clearwater, and Quinault Rivers in the West. There are also numerous smaller streams that originate at lower elevations. Important streams in the eastern County include Chimacum, Donovan, Fulton, Leland, Ludlow, Salmon, Snow, Tarboo, and Thorndyke Creeks. There are also areas without significant streams, including the Quimper and Toandos Peninsulas, areas adjoining Oak Bay and Discovery Bay, and Marrowstone and Indian Islands.

The combination of steep topography, high precipitation and erosive material has produced streams and rivers with steep and narrow upper reaches and glacier-cut valleys that meander through coastal flood plains. They are subject to recurring flood events that result in bank erosion and sediment transport and deposition. Because of these dynamic processes, the County's rivers tend to shift their location over time through a channel migration zone, particularly in lower river reaches that are characterized by low gradients and sediment deposition. Channel migration produces a diverse network of main, side, and relict river channels, gravel bars, and terraces in the floodplain that provides important fish habitat. Roads, structures, and utilities within the channel migration zone are subject to damage. This has led to the construction of bank protection structures that inhibit the channel migration process and adversely impact fish habitat.

Logging and road construction have exacerbated natural flood events by increasing runoff and sediment recruitment. Construction of dikes in lower river reaches to control flooding has actually increased the effects of flood events by increasing flood velocities and limiting floodplain storage capacity.

Because of its numerous forested watersheds, Jefferson County has an abundance of fish populations including chinook, coho, and chum salmon and both fresh water and anadromous trout (steelhead and sea-run cutthroat). Jefferson County is also renowned for its shellfish resources, including oysters, clams, mussels, and crabs. Fishing and shellfish harvest have been mainstays of the County's economy for generations and important recreational activities. They also have important cultural significance. These resources are highly dependent on the quality of the County's surface water resources.

Three resident fish populations have been designated as threatened species under the Federal Endangered Species Act: Hood Canal summer chum salmon, Puget Sound Chinook salmon, and bull trout. In addition other salmon stocks have been reduced to critical levels.

2.3 LAND USE AND POPULATION

Jefferson County is comprised of three distinct parts. The Olympic National Park and Olympic National Forest occupy approximately 65% of the County's 1.16 million acres, mostly in the interior of the County. They separate two very distinct eastern and western portions. 96% of Jefferson County's estimated population of 28,308 (2005) resides in the eastern County. Because there is very little development, surface water management issues are limited in the western portion or West End of the County. They are mostly related to forest management and flooding. The analysis of surface water management issues in this Plan is focused on the eastern portion.

Jefferson County's current pattern of land use and population is based on historic patterns that began early in the County's 150-year history:

- The emergence of Port Townsend as a seaport and population and manufacturing center and the establishment of Fort Worden as a coastal defense fortification;
- The development of large lumber mills in Port Ludlow and Port Hadlock and the first steel mill on the West Coast in Irondale;
- The growth of logging towns in Brinnon and Quilcene;
- The establishment of farms and farming communities in the inland valleys south of Chimacum; and
- The creation of the Olympic National Park and Forest.

Land use and population also reflect more recent developments that occurred over the past 40 years:

- Residential and resort development in Port Ludlow;
- Residential and commercial growth in the Port Hadlock area;
- Shoreline residential development throughout the County;
- Rural residential development on the Quimper Peninsula; and
- Conversion of forested areas to residential development.

Future population and land use will continue to reflect these historic patterns, but they will also be greatly influenced by the County’s Comprehensive Plan, adopted in 1998 and subsequently updated. The Plan complies with the State Growth Management Act requirement to avoid sprawl in rural areas and channel new growth and development into existing developed areas. This Surface Water Management Plan reflects the population and land use patterns that are expected to occur based on the Comprehensive Plan’s goals, policies, and land use designations.

Projected County Population and Distribution

During the period from the early 1970’s to the mid-1990’s Jefferson County experienced rapid population growth, averaging approximately 3.5% per year. In 2000 the County’s overall population was 26,299. The 1998 County Comprehensive Plan projected the 2016 County-wide population to be 39,396. While Jefferson County is expected to continue to grow over the next 20 years, the rate is projected to be significantly lower than projected in 1998. The Jefferson County Comprehensive Plan adopted the Washington State Office of Financial Management 2024 mid-range population projection of 40,139. The Comprehensive Plan also adopted projected 2001-2024 population growth rates and projected 2024 population for Port Townsend, the Port Hadlock Urban Growth Area (UGA), the Port Ludlow Master Planned Resort (MPR), and remaining rural areas. This information is summarized below in **Table 2-1 Jefferson County Population Projection**.

Table 2-1				
Jefferson County Population Projection				
Area	2000 Population	Projected Growth (2001 - 2024)	Projected Growth Rate	Projected Population (2024)
Port Townsend	8,344	4,985	1.97%	13,329
Port Hadlock UGA	2,553	2,353	2.76%	4,906
Port Ludlow MPR	1,430	2,353	4.14%	3,783
Rural Areas	13,972	4,149	1.09%	18,121
County Total	26,299	13,840	1.78%	40,139

The Comprehensive Plan did not adopt projected growth rates for specific rural areas in the County. In order to assess potential impacts related to rural population growth, this Plan uses the distribution of residential building permits among eastern County watersheds for the period 1999-2003 to project the distribution of the 2024 rural population growth among eastern Jefferson County watersheds. This analysis is presented in **Table 2-2 Eastern Jefferson County Population by Watershed**. Notes that explain Table 2-2 are provided on Page 2-8.

See Figure 2-1 Jefferson County Comprehensive Plan Map

See Figure 2-2 Eastern Jefferson County Watersheds Map

See Table 2-2 Eastern Jefferson County Population by Watershed

NOTES for Table 2-2 Eastern Jefferson County Population by Watershed

(1) The County's projected 2000-2024 rural population increase, including the West End, is 4,149. The projection for Eastern Jefferson County was derived by deducting 155 (equivalent to the West End proportion of the County's current population) from the total projected population.

(2) 2000 population for each watershed was estimated by overlaying Census tract data on watershed boundaries. This process required proportionately allocating population to watersheds that overlapped Census tracts.

(3) Acres per Residence = Watershed area divided by the number of households. The number of households was estimated by dividing the number of residents by 2.2, the average number of residents per Jefferson County household.

(4) The distribution of the projected rural population increase to each watershed was based on its percentage of building permits for new single-family construction for the period 1999-2003.

(5) Port Townsend Bay and Quimper Peninsula Watersheds include both the City of Port Townsend and rural Jefferson County. The City's area is 4,529 acres. Building permit data and projected population growth are for the rural portion only.

(6) Lower Chimacum Creek Watershed includes most of the Irondale and Port Hadlock UGA as well as rural areas in Chimacum and along Rhody Drive and Prospect Avenue. A small portion of the UGA is outside of the watershed. The population projection for the UGA portion of the watershed was estimated as 86% of the overall 2024 UGA population projection by using the ratio of the 2000 UGA population within the watershed (2,203) to the overall 2000 UGA population (2,553). The population projection for the entire watershed equals 86% of the adopted UGA population projection plus a rural population projection based on the proportion of rural building permits.

(7) Port Ludlow Bay Watershed includes all of the Port Ludlow Master Planned Resort, rural residential areas such as Swansonville, and extensive areas of forestland. The population projection for the entire watershed equals the adopted MPR population projection plus a rural population projection based on the proportion of rural building permits.

[**Note:** The watershed populations for the Big and Little Quilcene Rivers, Salmon and Snow Creek, and Discovery Bay watersheds in Table 2-2 are different from the populations for these watersheds shown in the WRIA 17 Technical Assessment. This is due to errors that were made when population data from the Jefferson County Comprehensive Plan was transcribed into the Technical Assessment.]

Table 2-2 shows the 2000 average residential density (acres per residence) and the projected 2024 average residential density. This information is useful for conveying a sense of the development density in rural watersheds where residences and roads are the primary developments. It may not be accurate in watersheds with the significant commercial and industrial development, for instance, in the Port Hadlock Urban Growth Area portion of the Chimacum Creek watershed. It may also not be accurate for projecting growth in areas where the dynamics of development have shifted. For instance, population growth on Marrowstone Island may accelerate with the construction of a water system by the Jefferson County Public Utility District.

Population, Forest Cover, and Impervious Surface

Figure 2-1 Jefferson County Comprehensive Plan Map conveys the predominantly rural character of most of Jefferson County. It shows the extensive areas of the Olympic National Park (ONP) and Olympic National Forest (ONF) and designated forestlands, agricultural lands, and rural residential areas.

Figure 2-2 Eastern Jefferson County Watersheds shows the boundaries of eastern Jefferson County watersheds. For each watershed, **Table 2-3 Eastern Jefferson County Watershed Uses** shows the acreage and percentage for:

- Impervious surface area (TIA),
- Olympic National Park (ONP),
- Olympic National Forest (ONF),
- Designated forestlands,
- Existing forest cover,
- Designated agricultural lands,
- Designated rural residential areas, and
- Areas designated for more intense development:
 - City of Port Townsend,
 - Port Townsend Paper Company Heavy Industrial Area,
 - Glen Cove Light Industrial Area,
 - Port Hadlock Urban Growth Area (UGA),
 - Port Ludlow Master Planned Resort, and
 - Rural commercial and industrial areas.

The data regarding impervious surface area and forest cover are important because the percentage of impervious surface and forest cover are critical factors in affecting the health of surface water resources. Recent research cited in the Washington Department of Ecology 2001 Stormwater Management Manual indicates that impacts to a stream's hydrology, channel stability, and aquatic resources occur as mature forest cover in a watershed decreases and the impervious surface area increases. These impacts become significant as the forest cover declines to a range of 60%-75% and impervious surface area increases to a range of 3%-5%. This issue is discussed in detail in Chapter 3.

Common impervious surfaces include paved and graveled roads, parking lots, driveways, and roofs. Impervious surfaces prevent precipitation from infiltrating into the soil. This results in increased volumes of stormwater runoff and higher peak flows during storms. Stormwater that flows across roads and parking lots can carry increased concentrations of pollutants into surface water and groundwater.

Uncontrolled stormwater runoff can damage private property and public facilities such as roads and degrade public resources such as aquatic habitats and fish populations.

Table 2-3 below shows that overall Jefferson County has a very low percentage of impervious surface coverage. This is related to the very low level of development in its rural areas and relatively low level of development even in areas such as Port Hadlock and Port Ludlow. Impervious surface currently exceeds 20% in the Port Townsend Bay watershed that includes the most intensely developed areas of the City of Port Townsend. It exceeds 5% for the lower Chimacum Creek watershed that includes the Port Hadlock UGA. Based on population projections and existing impervious surface data, there is potential for impervious surface to reach the 3%-5% range in the Quimper Peninsula, Discovery Bay, Marrowstone Island, Oak Bay / Mats Mats Bay, and Lower Big Quilcene River watersheds. Other County watersheds are not expected to reach the 3%-5% range during the 20-year planning period based on their projected population growth, existing impervious surface, and the limits on commercial development in the County Comprehensive Plan.

Table 2-3 also shows that overall Jefferson County has a very high percentage of forest cover. The extent of Jefferson County's forest cover is due not only to the extensive forested areas of the Olympic National Park and Forest and State and private forestlands. Table 2-3 shows that a significant proportion of the County's forest cover is on lands that are designated rural residential. Considering that impervious surface is anticipated to remain at low levels in most County watersheds, maintaining forest cover on rural residential lands will be one of the most important factor affecting the health of surface water resources in the County's rural areas.

The Port Townsend Bay, Quimper Peninsula, lower Chimacum Creek, Marrowstone Island, and the lower Big and Little Quilcene watersheds are in the 60%-75% range of forest cover. In addition, watersheds with a significant percentage of rural residential designations, e.g. Discovery Bay, Oak Bay/Mats Mats Bay, Squamish Harbor, may decline into this range due to clearing for residential development. These areas should be monitored to determine their long-term trends in forest cover. This is discussed in greater detail in Chapter 3 Analysis of Major Issues and Chapter 8 Goals and Policy.

It is important to consider the data on forest cover in the context of the particular characteristics of individual watersheds. In the watersheds listed above, forest cover is an indicator of the extent of development. In other watersheds lower levels of forest cover are due to clearing that has accompanied agricultural activities (e.g., middle and East Fork Chimacum Creek and lower Salmon Creek) or the presence of glaciers and bedrock (e.g., upper Dosewallips and Duckabush Rivers).

Forest Land

The Olympic National Forest and State forestlands are managed for timber production, subject to Federal and State forest management plans. There are also extensive areas of private forestland. The County Comprehensive Plan designates approximately 88,000 acres of State and private land in eastern Jefferson County as commercial forestland. These lands are typically managed for timber production on a 60-80 year harvest rotation depending on site conditions. Analysis of Landsat imagery from 1999 indicates that approximately 75% of eastern Jefferson County is forested. The forested proportion of western Jefferson County is considerably higher.

See Table 2-3 Eastern Jefferson County Watershed Land Uses, Page 1

See Table 2-3 Eastern Jefferson County Watershed Land Uses, Page 2

Agricultural Land

Significant areas of the County are devoted to agriculture, particularly in the lowland valleys of Chimacum, Donovan, Leland, Salmon, Snow, and Tarboo Creeks. The Jefferson County Comprehensive Plan designates approximately 4,400 acres in the eastern County as Agricultural Land of Long-term Commercial Significance.

Agriculture in Jefferson County has been undergoing a transformation. Up until recently there was extensive dairy farming in eastern Jefferson County. Much of the County's agricultural land was used for pasture and hay production. The number of dairies has declined significantly. Currently there is only one dairy farm in operation. While livestock and hay production continue to be important, recently there has been growth in smaller scale production of specialized crops, such as vegetables, berries, cheese, fruit, and herbs. In 2004 Jefferson County redesignated 3,900 acres from Rural Residential to Agricultural Land of Local Importance. The redesignation will support agricultural production and allow agriculture-related uses on these parcels.

Rural Residential Land

The Jefferson County Comprehensive Plan designates approximately 65,000 acres in eastern Jefferson County as rural residential. These parcels are typically 5-20 acres. There are also subdivisions with smaller parcels at Beckett Point, Cape George, Irondale, and Kala Point on the Quimper Peninsula and Black Point, Bridgehaven, Olympic Canal Tracts, and Seamount Estates on Hood Canal. In 2000 more than 13,000 persons (over 50% of the County population) lived in rural areas, mostly rural residential areas. By 2024 nearly 4,000 additional persons are projected to live in eastern Jefferson County's rural areas.

Table 2-2 shows that a significant proportion of the County's forest cover is on land designated rural residential. Considering the importance of forest cover for protecting surface water resources and the potential for land clearing associated with rural residential development to significantly reduce forest cover, Jefferson County should consider adoption of policies and strategies that retain forest cover on rural residential land.

Urban Areas and More Intensely Developed Rural Areas

Approximately 9,400 acres of Jefferson County have been designated for Urban Growth Areas, Master Planned Resorts, and areas with more intense rural residential, commercial and industrial development. These include the:

- City of Port Townsend,
- Port Hadlock Urban Growth Area,
- Port Ludlow Master Planned Resort,
- Port Townsend Paper Company Heavy Industrial Area,
- Glen Cove Light Industrial Area,
- Villages of Quilcene and Brinnon, and
- Small rural commercial areas at Beaver Valley, Chimacum, Discovery Bay, Four Corners, Gardiner, Mats Mats, Nordland, the SR19/SR20 intersection, and WaWa Point.

City of Port Townsend

The City of Port Townsend covers approximately 4,529 acres. There are no streams within the City. There are extensive wetlands including Kah Tai lagoon, China Gardens, and the Winona-Levinsky

wetland corridor in the northwest portion of the City. There are approximately 8 miles of marine shoreline.

The City's 2000 population was 8,326. The 2024 population is projected to be 13,329. This is an additional 4,985 residents at an annual growth rate of 1.97%.

The City's water sources are surface withdrawals from the Big and Little Quilcene Rivers. The City's water right on the Big Quilcene River is 30 cubic feet per second. The City's actual use in 1999 was 15.5 cubic feet per second. The City's water right on the Little Quilcene River is 9.6 cubic feet per second.

The City is served by a sanitary sewer system that is operated under the conditions of a National Pollutant Discharge Elimination Systems (NPDES) permit issued by the Washington Department of Ecology.

Surface water management for the City of Port Townsend is not within the scope of this Plan.

Port Hadlock Urban Growth Area

The Port Hadlock Urban Growth Area is located at the southerly end of Port Townsend Bay about 5 miles south of the City of Port Townsend. It covers approximately 1,300 acres. The UGA had a population of 2,553 in 2000. The 2024 population is projected to be 4,906. This is an additional 2,353 residents at an annual growth rate of 1.97%.

The UGA has three commercial areas totaling 257 acres: one centered on the Port Hadlock intersection, one that extends along SR 19 between SR 116 and Irondale Road, and one located at the Port Hadlock Marina. There is also a 25-acre light industrial area that includes an existing concrete plant.

There are numerous older residential plats. Many date from the early 1900's and have very small lots. The most extensive of these are the Irondale Plats, centered on the historic site of the Western Steel Company mill. They typically have 25 feet by 100 feet lots that have been combined to create building sites that are typically 12,500 - 15,000 square feet.

The Port Hadlock Urban Growth Area Stormwater Management Plan (2004):

- Analyzes existing surface water and stormwater conditions,
- Projects future conditions based on projected development in 2024,
- Proposes facilities and program activities to avoid significant impacts to surface waters and groundwater from stormwater runoff, and
- Provides planning level cost and revenue analysis for providing stormwater management facilities and programs.

The UGA has approximately 18% existing impervious surface coverage (2003). Based on projected development, the impervious surface coverage in 2024 would be approximately 28%.

See Port Hadlock UGA Stormwater Management Map

The UGA occupies approximately 20% of the lower Chimacum Creek watershed. Drainage analysis conducted for the UGA Stormwater Plan indicates that there is no significant stormwater runoff flowing directly to Chimacum Creek. This is due to the porous soils, flat topography, and numerous small, contained drainage basins in the UGA and to the undeveloped and forested buffers along the Creek. It is also due to the fact that there are only three road crossings: SR 116, Irondale Road, and Hunt Road. The Irondale Road crossing was recently retrofitted with stormwater treatment and infiltration facilities.

Most of the roads in the UGA are constructed to a rural stormwater management standard. They use road ditches to collect, convey, treat, and discharge stormwater runoff. There are also dry wells and infiltration trenches at a few locations. The only roads that have an urban standard storm sewer system with curbs, gutters, catch basins, and conveyance pipes is in the area adjacent to the Port Hadlock intersection.

The UGA Stormwater Plan identifies two locations in the UGA where stormwater discharges directly to Port Townsend Bay: the outfall from the storm sewer system located in the Port Hadlock Core and the drainage system for Fourth Avenue and Moore Street in Irondale. Water quality sampling indicates that stormwater runoff at these two sites has levels of pollutants typically found in urban stormwater, including metals, oil and grease, fecal coliform bacteria, nitrogen, phosphorus, and suspended solids. No degradation of marine waters related to these discharges was observed. The UGA Capital Improvement Plan proposes constructing treatment facilities for both of these outfalls. The Washington Department of Fish and Wildlife is planning to conduct a beach restoration project in Irondale. The project includes construction of a biofiltration swale that will treat runoff from Fourth Avenue and Moore Street.

Riparian areas along Chimacum Creek are within the 100-year flood plain. There is not a significant level of commercial or residential development in these areas.

Elevated levels of fecal coliform bacteria have been detected in marine waters near Port Hadlock. An investigation did not identify an upland source for this contamination. Marine sources are suspected due to the proximity of a large number of anchored boats, the Lower Hadlock boat ramp, and the Port Hadlock Marina. (Personal communication with Jefferson County Environmental Health Department)

The Jefferson County Public Utility District supplies potable water to the UGA from wells that are located within the UGA. The PUD has adequate water rights to serve the projected 20-year population increase. (Jefferson County Comprehensive Plan, Utilities Element)

The UGA is not currently served by a sanitary sewer system. Jefferson County has adopted a General Sewer Plan for the UGA. It proposes to serve the commercial, industrial, and multi-family residential areas of the UGA within 6 years. The sewer system would serve single-family residential areas within the 20-year planning horizon. Environmental analysis conducted for the UGA designation indicates that there is adequate land area with suitable soils to accommodate the projected population increase using on-site septic systems until sanitary sewers are provided.

Port Ludlow Master Planned Resort

The Port Ludlow Master Planned Resort (MPR) is located approximately 10 miles south of Port Townsend. It covers approximately 2,300 acres and had a population of 1,430 in 2000. The 2024

population is projected to be 3,783. This is an additional 2,353 residents at an annual growth rate of 4.14%.

The MPR is centered on a marina and resort facility at the historic Port Ludlow lumber mill and town site on Port Ludlow Bay. It also includes dense residential developments surrounded by significant open space areas, a 38.3-acre commercial area, and a golf course. The MPR is served by a water system and sanitary sewer system that are owned by the Olympic Water and Sewer Company. The sewage treatment plant is operated under the conditions of a National Pollutant Discharge Elimination Systems (NPDES) permit issued by the Washington Department of Ecology. The buildout population of the MPR is limited by water rights and sewage treatment plant capacity.

Ludlow Creek originates outside of the MPR and flows through the MPR into Port Ludlow Bay. Falls near the mouth of the Creek prevent fish passage.

Residential and resort development began in the middle 1960's in north Ludlow Creek. The only stormwater management facilities that were provided were road ditches and culverts and drainage easements in greenbelt areas. Development of the area south of Ludlow Creek began during the 1980s. Developments in this area were provided with stormwater management facilities that met existing standards.

The Port Ludlow Drainage District is a municipal corporation formed in 2000. It is authorized to plan for and make drainage improvements in the northern part of the Port Ludlow MPR. The District has developed a Comprehensive Stormwater Management Plan and begun implementing drainage improvements. It is anticipated that in the future, the District will expand to serve the southern part of the Port Ludlow MPR. (Personal communication with Drainage District Commissioners)

The marine waters of Port Ludlow Bay are classified by the State of Washington as AA Extraordinary. Occasionally, elevated levels of fecal coliform bacteria have been detected in Port Ludlow Bay. Boaters, both at anchor in the Bay and moored at the marina, have been identified as the likely source of this contamination.

Port Townsend Paper Company Heavy Industrial Area

The Port Townsend Paper Company mill is located immediately south of Port Townsend on Port Townsend Bay. The site encompasses 284 acres. It was developed in the 1920's. It is served by a wastewater treatment facility. Stormwater runoff from buildings, roads, and parking areas is collected, combined with process water, and conveyed to the treatment facility. The mill's wastewater facility is operated under the conditions of a National Pollutant Discharge Elimination Systems (NPDES) permit issued by the Washington Department of Ecology.

Glen Cove Light Industrial / Commercial Area

The Glen Cove Light Industrial / Commercial Area is located immediately south of Port Townsend. It encompasses approximately 126.5 acres. It is intended to be a light industrial area with limited commercial uses. Development began in the early 1980's. It is served by a municipal water system and on-site septic systems.

The area is approximately one-half mile west of Port Townsend Bay. There are no significant water bodies on or immediately adjacent to the area. With the exception of the southwesterly portion, the

soils in the area are well suited for infiltration. Most of the buildings in Glen Cove are equipped with downspout infiltration systems. Businesses that were developed since the County's stormwater regulations were first adopted in 1996 are also typically served by stormwater management facilities. No water quality or stormwater runoff issues have been identified in this area.

Rural Industrial Areas

In addition to the Port Townsend Paper Company and Glen Cove industrial areas, there are 5 areas designated for rural light industrial and forest resource-based industrial uses:

- Center Valley – 3.8 acres of forest resource-based industrial;
- Eastview Industrial Plat – 8 acres of light industrial adjacent to the City of Port Townsend;
- Gardiner – 24.9 acres of forest resource-based industrial;
- Quilcene – 22.3 acres of light industrial; and
- West End – 122.5 acres of forest resource-based industrial adjacent to US 101 and the Hoh River.

Rural Village Centers

The rural villages of Brinnon and Quilcene in south Jefferson County combine residential areas with Rural Village Center commercial areas. The Brinnon RVC encompasses 66 acres and the Quilcene RVC encompasses 51 acres.

The Brinnon RVC is mostly within the 100-year flood plain of the Dosewallips River. There is not a public water system in Brinnon. No significant surface water quality or stormwater runoff issues related to the RVC have been identified.

Small portions of the Quilcene RVC are within the 100-year flood plain of the Big and Little Quilcene River. No significant stormwater runoff issues related to the Quilcene RVC have been identified.

In 1995, benzene contamination from an unknown source was discovered in several private wells in Quilcene. Benzene contamination frequently originates from leaking gasoline tanks. The State Department of Health's drinking water program found that the shallow wells serving Quilcene's businesses and residents have limited capacity and are vulnerable to contamination from leaking septic systems and underground gas and oil tanks. In order to provide a safe water supply, the US Forest Service transferred water rights for 13 acre-feet of water per year (approximately 4,236,000 gallons) to the Jefferson County Public Utility District. The District will develop and operate a water system to serve Quilcene using a well that will not be as vulnerable to contamination as shallow wells now in use.

Rural Commercial Areas

The County Comprehensive Plan designates rural commercial areas at:

- Beaver Valley - 3.1 acres,
- Chimacum - 40 acres,
- Discovery Bay - 19.5 acres,
- Four Corners - 26.5 acres,
- Gardiner - 5.3 acres,
- Mats Mats - 5.9 acres,
- Nordland - 1 acre,
- SR19/SR20 intersection - 26.5 acres, and

- WaWa Point - 4.3 acres.

These designations recognize existing commercial areas and provide commercial services and employment opportunities in rural communities without creating extensive areas of clearing and impervious surface that can impact surface waters.

No significant surface water or stormwater runoff issues related to these rural commercial areas have been identified.

2.4 SURFACE WATER CHARACTERISTICS

Water Resource Inventory Areas

The State of Washington is divided into 62 Water Resource Inventory Areas (WRIAs) for the purposes of water resource planning. Jefferson County comprises portions of the following four Water Resource Inventory Areas:

- **WRIA 16 Skokomish-Dosewallips Basin**, including the Dosewallips and Duckabush Rivers;
- **WRIA 17 Quilcene-Snow Creek Basin**, including the Big and Little Quilcene Rivers and Chimacum, Salmon, Snow, Tarboo, and Thorndyke Creeks;
- **WRIA 20 Sol Duc-Hoh Basin**, including the Hoh River; and
- **WRIA 21 Queets-Quinalt Basin**, including the Queets and Clearwater Rivers.

WRIA boundaries are shown on **Figure 2-3**.

Water Quality

The State of Washington's water quality standards are contained in the Washington Administrative Code (WAC) Chapter 173. The standards are based on existing and potential uses and the natural water quality potential and limitations. Important water quality parameters in Jefferson County include fecal coliform bacteria, temperature, dissolved oxygen, turbidity, and pH. These parameters are discussed in Chapter 5.

Water quality monitoring conducted by Jefferson County, the Jefferson County Conservation District (JCCD), the Point No Point Treaty Council (PNPTC), and the Washington State Department of Health indicates that Jefferson County's surface waters are generally in good condition. The majority of freshwater rivers and streams and marine waters meet State Class AA Standards. Specific areas where water quality degradation has been identified are discussed briefly in Section 2.5 Surface Water Conditions In Selected Watersheds below. Additional detail is provided in the WRIA 16 and 17 Technical Assessments.

See Figure 2-3 Olympic Peninsula Water Resources Inventory Areas Map

Under Section 303(d) of the Clean Water Act, the Washington Department of Ecology identifies water bodies that do not meet water quality standards. The 303(d) lists for eastern and western Jefferson County are shown in **Tables 2-3 and 2-4**.

Table 2-3 Final 1998 Section 303(d) List – East Jefferson County

Water body	Parameter	Location
Big Quilcene River	Fish Habitat	RM 2.8
Big Quilcene River	In-stream Flow	RM 2.8
Chimacum Creek	Temperature	RM 1.0, 3.5, 8.8
Chimacum Creek	Fecal Coliform	Section MB88JL
Donovan Creek	Temperature	RM 0.2
Dosewallips River	Fecal Coliform	Mouth
Duckabush River	Fecal Coliform	Mouth
Jackson Creek	Fish Habitat	Mouth
Leland Creek	Temperature	RM 0.2
Little Quilcene River	Temperature	RM 2.0
Marple Creek	Fish Habitat	Mouth
Ripley Creek	Temperature	RM 0.2
Tarboo Creek	Temperature	RM 2.5, RM 0.5
Thorndyke Creek	Temperature	RM 1.1

Table 2-4 Final 1998 Section 303(d) List – West Jefferson County

Water Body	Parameter
Alder Creek	Temperature
Anderson Creek	Temperature
Bogachiel River	Dissolved Oxygen
Bogachiel River	Temperature
Canyon Creek	Temperature
Elk Creek	Temperature
Fisher Creek	Temperature
Line Creek	Temperature
Maple Creek	Temperature
Nolan Creek	Temperature
Owl Creek	Temperature
Rock Creek	Temperature
Split Creek	Temperature
Tower Creek	Temperature
Willoughby Creek	Temperature
Winfield Creek	Temperature

Source: <http://apps.ecy.wa.gov/wats/WATSQBHome.asp>

The Technical Assessments compiled for WRIA 16 Skokomish – Dosewallips and WRIA 17 Quilcene – Snow indicate that most of the water quality problems identified on the 303(d) list are related to rural

resource land uses: agriculture and forest management. The effects of rural resource land uses on surface water resources are discussed in Chapter 3.

Water quality monitoring associated with marine waters has focused on two parameters: fecal coliform testing of commercial shellfish beds and monitoring dissolved oxygen in Hood Canal. Jefferson County's marine waters generally meet Class AA standards for fecal coliform with the exception of some areas in Port Townsend and Port Ludlow Bays near marinas and anchorages and near the mouth of the Duckabush River. There is a significant problem with low dissolved oxygen in Hood Canal. These issues are discussed in greater detail below.

Water Quantity

Eastern Jefferson County's geology and climate limit the seasonal availability of surface water. Much of the County is covered with basalt, sandstone, and glacial till that have limited infiltration and storage capacity. In addition most of the precipitation in the northeastern portion of the County occurs during the winter.

The summers are comparatively dry. Summer stream flows are therefore dependent on melt water from glaciers and snowfields and on groundwater.

Ensuring adequate summer stream flows for fish habitat is an important surface water management consideration. Since surface waters and groundwater are connected with each other, a withdrawal from one can influence the other. Both surface water and groundwater withdrawals can impact instream flows and fish habitat.

Most residents of rural Jefferson County depend on groundwater for domestic water. Much of this water comes from "exempt" wells that do not require a formal water right (RCW 90.44). These withdrawals are limited to less than 5,000 gallons per day. The Department of Ecology estimates that actual withdrawals for domestic use are significantly less than 5,000 gpd, typically around 350 gpd for domestic use. Surface water and groundwater withdrawals are also used for agricultural production, including irrigation and stock watering.

Based on the analysis conducted for the WRIA 17 planning process, there is broad consensus that water is not available in WRIA 17 streams for additional year-round surface water withdrawals. All of the currently unappropriated flow is necessary to protect in-stream values, including preserving fish and wildlife habitat.

There is, however, disagreement among WRIA 17 Planning Unit members regarding the adequacy of geo-hydrologic data and analysis to accurately characterize the connectivity of surface waters and groundwater and to establish limits on groundwater withdrawals for both domestic and agricultural use. There is also disagreement regarding the effect of groundwater withdrawals from "exempt" wells for residences served by onsite septic systems. In developing rules for groundwater withdrawals from "exempt" wells, the Department of Ecology assumes that one-half of the water used for domestic purposes will recharge groundwater through on-site septic systems. Others argue that this proportion is significantly higher.

The outcome of this debate and the State rule-making process being conducted by the Department of Ecology will determine the amount of groundwater available in rural areas of Jefferson County for domestic water use. This will in turn affect future population growth patterns.

The relationship between surface water and groundwater resources is discussed in Chapter 3. The Technical Assessments for WRIA 16 and 17 provide a detailed analysis of water quantity issues in eastern Jefferson County.

2.5 ANALYSIS OF MAJOR WATERSHEDS

This section discusses existing and projected conditions in major Jefferson County watersheds. Information regarding existing conditions was compiled by the Jefferson County Natural Resources Division and the Interdepartmental Data Management System (IDMS). The Technical Assessments for the WRIA 16 and 17 watershed planning processes were also important sources. The watershed boundaries are based on U.S. Geological Survey 6th Field Hydrologic Unit Codes mapped by IDMS. The watershed boundaries are depicted on Figure 2-2. The analysis of projected conditions is based on the goals and policies in the Jefferson County Comprehensive Plan, the development standards in the County's Unified Development Code, and the population projections in Table 2-2.

Quimper Peninsula and Port Townsend Bay

The Quimper Peninsula and Port Townsend Bay watersheds are located in the northeasterly corner of Jefferson County. While they are referred to as watersheds, they are both comprised of numerous small basins that drain independently into the marine waters of Port Townsend Bay, Admiralty Inlet, and the Strait of Juan de Fuca. For the purposes of this analysis they are treated as one watershed. They both include portions of the City of Port Townsend and adjoining industrial and residential areas from Cape George to the Kala Point development. In addition Chimacum Creek flows into Port Townsend Bay. They are in the rain shadow of the Olympic Mountains with an average of less than 17 inches of annual precipitation.

The Quimper Peninsula and Port Townsend Bay watersheds cover 11,332 acres. Of this, 4,466 acres (39%) are within the City of Port Townsend. In the year 2000 there was a population of 10,227. The City population was 8,344 and the remainder in Jefferson County was 1,883. The projected 2024 Port Townsend population is 13,329. The remainder in Jefferson County is projected to be 2,581.

While there are no designated forestlands in these watersheds, approximately 7,300 acres (64%) are forested. Approximately 5,700 acres (51%) are designated as rural residential land with allowed densities ranging from 1 lot per 5 acres to 1 lot per 20 acres. Approximately 5,100 acres or (45%) are designated for intense development, including the City of Port Townsend, the Port Townsend Paper Company mill site, and the 126.5 acre Glen Cove Light Industrial Area immediately south of the City. This figure overstates the level of actual development, since large sections of the Quimper Peninsula and Port Townsend are undeveloped and forested. The Port Townsend Bay watershed is the most intensely developed area of Jefferson County. It has approximately 20.6% impervious surface area. The Quimper Peninsula watershed has approximately 2.6% impervious surface area.

Surface Water Impacts

With the exception of approximately 180 acres of State forestland, forestry activities on the Quimper Peninsula are generally limited to residential or commercial site development. Surface water impacts typically associated with forestry are minimal. Impacts from the limited extent of farms and livestock rearing are also minimal.

There may be local impacts to wetlands resulting from previous development. Current Jefferson County regulations requiring wetland buffers should minimize future impacts.

Although localized flooding may occur, there are no significant, documented flood impacts in the watersheds.

Rural population growth in these watersheds will result in the loss of forest cover and increased impervious surface. However, considering the low density of development that is allowed, the small and generally intermittent nature of the stream systems, and Jefferson County's development regulations, significant impacts to surface waters from development in the rural portion of the watershed are not anticipated.

Water Quality

No water quality data for the Quimper Peninsula surface waters are available. There is a small potential for water quality degradation considering the low level of development and agricultural activity and the limited amount of surface water.

Water quality in Port Townsend Bay is generally good. Fecal coliform monitoring conducted by the Washington Department of Health has resulted in approval of the area for shellfish harvest. Based on existing land uses, the main potential source of non-point pollution in Port Townsend Bay is stormwater from the City of Port Townsend. There is a small potential for stormwater impacts from the Glen Cove Light Industrial Area considering the soils, topography, and distance from Port Townsend Bay and Jefferson County's requirement to provide stormwater management facilities for developments.

Chimacum Creek

The Chimacum Creek watershed is located in the lowlands and hills near Port Hadlock, Irondale, and Chimacum. Chimacum Creek has two forks (the Main Stem and the East Fork) that converge at River Mile (RM) 2.7 and flow north through a forested ravine to Port Townsend Bay. Together with small tributaries they comprise 29.5 miles of stream channel. The upland geology consists of glacial deposits overlying shale, sandstone, and basalt. The lowland valleys are characterized by deep muck and peat soil. The drainage lies in the rain shadow of the Olympic Mountains. Less than 22 inches of precipitation falls annually on the lower valley and 35 inches in the headwaters.

The Chimacum Creek watershed covers approximately 23,991 acres. In the year 2000 it had a population of approximately 4,668. 9,200 acres (39%) are designated as commercial forestland and 16,800 acres (70%) are forested. 9,300 acres (51%) are designated rural residential land. These figures indicate that a large portion of the forest cover in the watershed is on rural residential land. 3,100 acres (13%) are designated as commercial agricultural land. 1,350 acres (6%) are designated for intense development, including the Port Hadlock UGA and the Chimacum Neighborhood / Visitor Commercial Area. The total impervious area is approximately 1.6%.

The Chimacum Creek watershed has distinct upper, middle, and lower reaches with distinct land use patterns. The **upper watershed** (the Main Stem upstream from Eaglemount Road) encompasses approximately 5,615 acres. The 2000 population was 154 or 80 acres per residence. The projected 2024 population is 171 or 72 acres per residence. 3,400 acres (60%) are designated forestland and 4,300 acres (77%) of forest cover. 281 acres (5%) are designated agricultural land. 1,900 acres (34%) are designated rural residential with allowed densities ranging from 1 lot per 10 acres to 1 lot per 20 acres. There are only 3.8 acres designated for rural resource industrial use. The total impervious area is less than 0.1%.

The **middle watershed** that includes the Main Stem below Eaglemount Road and the East Fork down to their confluence near Chimacum, encompasses 13,110 acres. The 2000 population was 1,072 or 27 acres per residence. The projected 2024 population is 1,310 or 22 acres per residence. It has 5,200 acres (37%) designated forestland and 6,132 acres (69%) of forest cover. 1,990 acres (22%) are designated commercial agricultural land. 3,234 acres (36%) are designated rural residential with allowed densities ranging from 1 lot per 10 acres to 1 lot per 20 acres. There are 43 acres in Chimacum and Beaver Valley designated for rural commercial uses. The total impervious area is approximately 0.5%.

The **lower watershed** encompasses 5,266 acres from the confluence of the Main Stem and East Fork downstream to the mouth at Irondale. The lower 2 miles of the Creek flows through a forested ravine and extensive riparian and estuarine wetlands. The 2000 population was 3,442. The projected 2024 population is 5,958. It has 614 acres (12%) designated forestland and 3,675 acres (70%) of forest cover. 24 acres are designated commercial agricultural land. 2,885 acres (55%) are designated rural residential with allowed densities ranging from 1 lot per 5 acres to 1 lot per 10 acres. There are however, numerous existing smaller lots, primarily in Port Hadlock and Irondale that have resulted in more dense development. 1,300 acres are designated for intense development, mostly within the Port Hadlock UGA. The total impervious area of the lower watershed is less than 6%.

The lower Chimacum Creek watershed adjoins or is within commercial and residential areas that have been designated as the Port Hadlock Urban Growth Area. The UGA encompasses 1,320 acres. 1,035 acres are within the lower watershed. The 2000 UGA population was 2,553. 2,203 of the UGA residents lived within the lower watershed. The projected 2024 UGA population is 4,906. 4,415 are projected to live within the lower watershed.

The rural (non-UGA) portion of the lower watershed encompasses 4,231 acres. The 2000 population was 1,239 or 7.5 acres per residence. The projected 2024 population is 1,731 or 5.4 acres per residence.

The rural areas of the Chimacum Creek watershed encompass a total of 22,956 acres. The 2000 rural population was 2,465. It is projected to grow by 747 (30%) to 3,212 in 2024.

Jefferson County has developed a UGA Stormwater Management Plan. The Plan provides analysis of existing and projected surface water conditions and proposes actions that will avoid significant stormwater impacts related to development of the UGA. Aerial photo analysis conducted for the UGA Stormwater Management Plan indicated that there are 241 acres of impervious surface from buildings, roads, parking lots, and driveways within the UGA. This is 18% impervious surface coverage. This is projected to increase to 375 acres (28%) in 2024.

In its pre-settlement condition Chimacum Creek had significant runs of coho and chum salmon, steelhead, and sea-run cutthroat trout. These runs have been significantly reduced due to habitat degradation, particularly related to forestry in the upper watershed and agricultural activity in the middle watershed. Summer rearing habitat for coho salmon has been particularly affected. The summer chum run in the lower watershed went extinct in the 1990's due to habitat disruption, primarily sedimentation from the catastrophic failure of the Irondale Road in 1982. However, Chimacum Creek still has significant fisheries resources. Introduced chum salmon stock from Salmon Creek have become well established and extended their spawning range up to SR 116. The 2004 run numbered approximately 1,500 fish.

Chimacum Creek loses surface water and shallow groundwater around Chimacum. While there are not accurate measurements, based on stream flows, water levels in wells, and the geology in the area, it is likely that there is a net movement of surface water that recharges deeper groundwater aquifers.

Surface Water Impacts

Large areas of the Chimacum Creek watershed have been significantly degraded from their pre-settlement condition. Early settlers cleared riparian forests, drained wetlands and beaver ponds, and channelized the Creek before the 1900's. Chimacum Creek was further channelized when a drainage district was formed to improve the land for agricultural production. These activities significantly degraded fish habitat. Large areas of the watershed continue to be used for agricultural activities. Chapter 3 discusses the impacts of agricultural activities on surface waters. It includes recommendations for avoiding surface water impacts from these activities.

Currently forest management activities in the Chimacum Creek watershed occur primarily in the upper and middle watershed on private and State forestlands. There is also timber harvest in the middle and lower watershed related to residential and commercial site development. A significant amount of the forest cover in the watershed is on land designated as rural residential. Projected rural residential development could result in a significant reduction in forest cover that impacts the surface water resources of the Chimacum Creek watershed. This issue is discussed in Chapter 3. It includes recommendations for avoiding surface water impacts related to loss of forest cover from rural residential development.

The beach adjacent to the Creek mouth was filled during the early 1900's for industrial uses. This area was recently purchased by the Washington Department of Fish and Wildlife for the purpose of restoring a natural beach to enhance salmon habitat. The WDFW has also purchased several hundred acres of property adjacent to the Creek in order to protect salmon habitat from development impacts.

The level of existing and projected impervious surface in the lower watershed creates the potential for stormwater runoff impacts to Chimacum Creek. However, the UGA Stormwater Management Plan indicates that very little runoff flows into the Creek. This is due to highly pervious soils, flat topography, and small, contained drainage basins in most of the UGA, a mostly vegetated and undeveloped riparian area, and only three road crossings: SR 116, Irondale Road, and Hunt Road. In 2002 Jefferson County made drainage improvements to Irondale Road that provided stormwater treatment and infiltration and significantly reduced direct runoff to the Creek. In addition many commercial developments in the lower watershed have stormwater management facilities. Increased impervious surface in the Port Hadlock UGA has the potential to impact surface waters in Chimacum Creek and Port Townsend Bay. Chapter 3 includes recommended urban stormwater management activities to mitigate these impacts.

Flooding is common, but not severe along Chimacum Creek, particularly in the very low gradient sections of the middle watershed. This results from impounded water that cannot drain due to topography, not from increased velocity that degrades the channel and fish habitat and damages structures. The areas that flood are mostly not developed, so residences and roadways are generally not impacted. Occasionally, flooding does occur where SR 19 crosses the East Fork.

Water Quality

Chimacum Creek is listed on the State 303(d) list for exceeding temperature and fecal coliform standards.

Water quality monitoring has been conducted on Chimacum Creek since 1988 by several organizations, including Jefferson County, the Jefferson County Conservation District, and the Point No Point treaty Council. This data is compiled in the Technical Assessment for WRIA 17.

The Jefferson County Conservation District has been monitoring water quality on Chimacum Creek every other year since 1996 at 7 locations on the Main Stem, 5 locations on the East Fork, and 2 locations each on 2 major tributaries. The District monitors temperature, dissolved oxygen, fecal coliform, turbidity, pH, conductivity, and nutrients. In addition the District monitors intra-gravel dissolved oxygen at 3 sites from September through March. This is a critical factor influencing the success rate of salmon spawning. The District also monitors temperature from mid-May through mid-September using hourly data loggers at 9 sites on the Main Stem and 6 sites on the East Fork. Temperature affects dissolved oxygen and is a critical factor in summer rearing habitat for trout and coho salmon. While some water quality parameters consistently exceed State standards, the District's monitoring indicates that water quality parameters have generally improved and the long-term trends are positive. As more habitat improvement projects, such as riparian fencing and planting, are implemented, it is anticipated that water quality parameters will continue to improve.

Salmon and Snow Creeks

Salmon and Snow Creeks originate in the northeast flanks of the Olympic Mountains and flow northward into Discovery Bay. Salmon Creek has 8.7 miles of main stem and 21.8 miles of tributary stream channel. The watershed encompasses 10,638 acres. The headwaters are on the northern slope of Mount Zion in the Olympic National Forest. Snow Creek has 30 miles of main stem and tributary stream channel. The watershed encompasses 12,753 acres. The headwaters are also in the Olympic National Forest.

In the year 2000 the Salmon Creek watershed had a population of 76 or 308 acres per residence. The projected 2024 population is 80 or 292 acres per residence. 66% of the Salmon Creek watershed is within the Olympic National Forest or designated as commercial forestland and 86% is forested. While only 2% of the watershed is designated as commercial agriculture, a significant portion of the lower reaches of the lower watershed has been used for agricultural activities. 6% is designated rural residential land. The total impervious area is approximately 0.1%.

In 2000 the Snow Creek watershed had a population of 110 or 288 acres per residence. The projected 2024 population is 142 or 221 acres per residence. 87% of the Snow Creek watershed is within the Olympic National Forest or designated as commercial forestland and 83% is forested. 2% is designated as commercial agriculture and 10% is designated rural residential land. The total impervious area is approximately 0.2%.

There is an 11 acre Neighborhood / Visitor Commercial Area located near the mouths of Snow and Salmon creeks along Highway 101 at Discovery Bay.

Salmon and Snow Creeks historically had significant runs of chum and coho salmon, cutthroat trout, and steelhead. The Snow Creek summer chum run has been significantly depressed since the 1980's.

Salmon Creek's summer chum run has benefited from recent habitat enhancement projects that have restored sections of the creek that had been degraded by agricultural practices. The 2004 return was approximately 5,900 fish, the best ever recorded. The coho runs on both creeks have declined steadily since the mid-1970s. The status of these runs is critically low.

Surface Water Impacts

Historically, forestry and agricultural activities have impacted Salmon and Snow Creeks. The Washington Department of Fish and Wildlife and the Jefferson County Conservation District recently conducted a salmon habitat enhancement project on a large parcel of agricultural land on the lower reach of Salmon Creek.

Overall stormwater impacts from residential and commercial development are assumed to be very minimal due to the very low levels of development.

Rural population growth in these watersheds will result in some loss of forest cover and increased impervious surface. However, considering the relatively low population growth projection, the low density of development that is allowed, and Jefferson County's development regulations, significant impacts to surface waters from development in the rural portion of the watershed are not anticipated.

Flooding occurs along Highway 101 at the mouths of Snow and Salmon Creek during large storm events, especially when combined with high tides. In addition, Snow Creek has been armored from Snow Creek Ranch (at Crocker Lake) downstream to protect properties from flooding and bank erosion.

Water Quality

No water bodies in this sub-basin are listed as impaired on the Ecology 303(d) list. However, water quality samples collected in Snow Creek and tributaries between June and October 1998 all exceeded standards for temperature, dissolved oxygen, pH, and fecal coliform at least once during the period. On Salmon Creek fecal coliform concentrations measured at the mouth exceed State standards. Recent sampling on both Salmon and Snow Creeks indicates downward trends for fecal coliform at all but one sampling station on Salmon Creek.

Port Ludlow Bay

The Port Ludlow Bay watershed is located in east-central Jefferson County. It encompasses approximately 11,000 acres. Ludlow Creek, the major stream, has a total length of more than 10 miles. Falls close to the mouth prevent anadromous fish from using most of the creek. There are also numerous small, mostly seasonal drainages that flow into Port Ludlow Bay.

In the 2000 the Port Ludlow Bay watershed had a population of 1,945. The projected 2024 population is 4,415. 54% of the watershed is designated forestland and forest cover is 80%. Approximately 1% of the watershed is designated agricultural land. Approximately 3,000 acres (27%) are designated rural residential. The Port Ludlow Master Planned Resort (MPR) encompasses 1,945 acres, 17% of the watershed. The MPR designation allows intense residential, commercial, and resort development. The 2000 MPR population was 1,430, 74% of the watershed total. The projected 2024 MPR population is 3,783, 86% of the watershed total. Despite the presence of dense development, the Port Ludlow watershed has only approximately 0.7% TIA. This is due to extensive forestland and rural residential designations and to significant open space areas within the MPR.

Much of the development in the northerly portion of the MPR (north of Ludlow Creek) is detached single family residential on smaller lots. There is also a commercial area, hotel and condominium development, attached single family residential development, community center, and marina. When most of the northerly portion of Port Ludlow was developed, stormwater management facilities, other than road ditches and drainage easements, were not provided. Stormwater runoff from this portion of the MPR was conveyed in road ditches and drainage easements to Port Ludlow Bay. The Port Ludlow Drainage District was established in 2000 to address drainage deficiencies. The District has developed a Comprehensive Drainage District Plan that analyzes stormwater runoff quality and quantity, identifies drainage problems, and proposes drainage improvements and operations and maintenance activities to remedy identified problems. The District is currently implementing its Drainage Plan.

The more recent development in the southerly portion of the MPR is primarily single family residential. There is also an 18-hole golf course and related facilities. Most of the residential developments were provided with stormwater management facilities. Individual homeowners associations are responsible for maintaining these facilities. South Port Ludlow is expected to join the District in the foreseeable future. At that time, the District would be responsible for operation and maintenance of these facilities.

The MPR's water supply source is groundwater. The MPR is served by a sanitary sewer system that is operated under the conditions of a National Pollutant Discharge Elimination Systems (NPDES) permit issued by the Washington Department of Ecology. The Olympic Water and Sewer Company is the water rights holder and sewage treatment plant operator.

Jefferson County and the Port Ludlow Drainage District share responsibility for surface water management in the MPR. Jefferson County administers the implementation of development standards under the Unified Development Code. The County also maintains drainage facilities on County roads. The District has primary responsibility for planning and constructing stormwater management facilities and for their operation and maintenance, but the County and District have cooperated on planning and constructing drainage improvements.

Surface Water Impacts

Historically, forestry activities have impacted surface waters in the watershed. Current forestry activities in the watershed occur on private and State forestland. Agricultural activities have not had a major impact since agriculture is not a major activity in the watershed.

Rural population growth in the watershed will result in the loss of forest cover and increased impervious surface. However, considering the relatively low population growth projection, the low density of development that is allowed, and Jefferson County's development regulations, significant impacts to surface waters from development in the rural portion of the watershed are not anticipated.

Development in the MPR has resulted in the loss of forest cover and creation of impervious surface area. Since the initial development in north Port Ludlow was not served by stormwater management facilities, there is potential for impacts to marine waters. However, this has not been identified in monitoring conducted in Port Ludlow Bay.

Water Quality

Under an agreement with Jefferson County, Pope Resources and its successor, Port Ludlow Associates have monitored water quality in Port Ludlow Bay and the streams flowing into it since 1994. Water quality has remained relatively consistent over time, with no identifiable long-term trends. There have been no measurable changes in water quality from any tributary into Ludlow Bay and no measurable water quality degradation of the marine waters. Except for occasional seasonal spikes in fecal coliform, the marine waters of Ludlow Bay meet the State Class AA standards. Samples from small tributaries and roadside ditches occasionally exceed standards for individual water quality parameters during storm events. None of the tributary streams are listed on the 303(d) list of impaired water bodies.

Tarboo and Thorndyke Creeks

Tarboo and Thorndyke Creeks flow through rural watersheds into Dabob Bay and Hood Canal respectively. Tarboo Creek and its mapped tributaries have a combined length of 14 miles. The watershed encompasses 7,981 acres and drains to Dabob Bay. The main stem of Thorndyke Creek begins at Sandy Shore Lake and drains south to Hood Canal at Thorndyke Bay on the east side of the Toandos Peninsula. It has a length of more than 13 miles. The watershed encompasses 9,451 acres. It has numerous wetlands, ponds, and lakes.

In the year 2000 the Tarboo Creek watershed had a population of 163 or 108 acres per residence. The projected 2024 population is 205 or 86 acres per residence. 75% of the watershed is designated as commercial forestland and 82% is forested. 4% is designated as commercial agriculture and 7% is in agricultural production. 21% is designated rural residential land, primarily 10-acre and 20-acre designations. There is no land that is designated commercial. The total impervious area is less than 0.1%.

In the year 2000 the Thorndyke Creek watershed had a population of 50 or 416 acres per residence. The projected 2024 population is 79 or 263 acres per residence. 97% of the watershed is designated as commercial forestland and 82% is forested. 2% is designated rural residential land, primarily 10-acre and 20-acre designations. There is no land that is designated commercial. The total impervious area is approximately 0.2%.

690 acres in the watershed have been designated as a Mineral Resource Lands (MRL) Overlay District in the County Comprehensive Plan. This designation allows permit applications for mineral extraction operations greater than 10 acres. Jefferson County is currently reviewing an application by Fred Hill Materials for a 165-acre gravel mining operation (Wahl Lake) in the District. Jefferson County conducted a review of for the MRL Overlay and gravel mining permit applications under the State Environmental Policy Act (SEPA). The review addressed numerous issues including the effects of the proposals on instream flows in Thorndyke Creek. It determined that as conditioned by Jefferson County these activities are not likely to result in significant adverse impacts to Thorndyke Creek.

Tarboo and Thorndyke Creeks have runs of coho and fall chum salmon, steelhead, and cutthroat trout.

Surface Water Impacts

Historically, forestry activities have impacted both of these watersheds. Current forestry activities in the watersheds occur on private and State forestlands. Diking, draining, and stream channelization to improve agricultural production have impacted sections of Tarboo Creek. Several road culverts have been identified as fish passage barriers on Tarboo Creek. Five of those culverts have been replaced since 1999. Jefferson County is working with the Northwest Watershed Institute to restore habitat degraded by agricultural activities.

Stormwater impacts from residential development have not been documented. They are unlikely on a watershed scale based on the very limited extent of development.

Rural population growth in these watersheds will result in some loss of forest cover and increased impervious surface. However, considering the relatively low population growth projection, the high percentage of forest cover, the low density of development that is allowed, and Jefferson County's development regulations, significant impacts to surface waters from development in the rural portion of the watershed are not anticipated.

Water Quality

Tarboo and Thorndyke creeks have both been listed on the Ecology 303(d) list for exceeding temperature criteria for Class AA streams. Elevated water temperature is not apparently related to lack of forest cover in the riparian zone, as the reaches where water quality data were collected are forested.

Fecal coliform and turbidity samples have also exceeded State standards on Tarboo Creek.

Water quality in Tarboo and Thorndyke Creeks is critical for the extensive shellfish cultivation areas in Dabob and Thorndyke Bays. Water quality in both these Bays is good. Fecal coliform monitoring conducted by the Washington Department of Health has resulted in approval of these areas for shellfish harvest.

Little Quilcene River

The Little Quilcene River basin encompasses approximately 21,000 acres. There are 12.2 miles of main stem channel, and 81.2 miles of tributary streams. The river drains from the forested slopes of the Olympic National Forest into northern Quilcene Bay. The upper watershed down to RM 6.6 is steeply dissected with high gradient, confined stream channels. The lower watershed runs through glacial sediments, siltstone, sandstone, and alluvium.

In the year 2000 the Little Quilcene watershed had a population of approximately 353 or 131 acres per residence. The projected 2024 population is 474 or 98 acres per residence. 56% of the watershed is within the Olympic National Forest and 28% is designated as commercial forestland. 82% is forested. 1% is designated as commercial agriculture. 18% is designated rural residential land, primarily 10-acre and 20-acre designations. Five acres within the watershed are designated for commercial uses in the Quilcene Rural Village Center. The total impervious area is less than 0.1%.

The City of Port Townsend has a water right to divert 9.56 cubic feet per second (cfs) from the Little Quilcene, provided that a minimum instream flow of 6 cfs is maintained. The actual average annual diversion has varied from 3.6 to 5.1 cfs.

The Little Quilcene has a fall chum salmon population that is considered healthy and coho and summer chum salmon populations that are depressed.

Surface Water Impacts

Historically, forestry activities have impacted the Little Quilcene River. Current forestry activities in the Little Quilcene River watershed occur in the Olympic National Forest and on State and private forestlands.

Agriculture is primarily located in the lower reach of the Little Quilcene River and on Donovan and Jakeway Creeks, two independent drainages that flow into Quilcene Bay near the mouth of the Little Quilcene. Diking near the river mouth created additional land for agriculture, but constrained the river. This exacerbated flooding impacts and degraded salmon habitat.

Stormwater impacts from residential and commercial development are unlikely to have a watershed-scale impact based on the low percentage of impervious surface.

Rural population growth in the watershed will result in some loss of forest cover and increased impervious surface. However, considering the relatively low population growth projection, the low density of development that is allowed, and Jefferson County's development regulations, significant impacts to surface waters from development in the rural portion of the watershed are not anticipated.

There is frequent flooding in the lower mile of the Little Quilcene River. Flooding is exacerbated by dikes. To help mitigate flood damage, Jefferson County has purchased property on the north side of the Little Quilcene River estuary and is participating in studies of a dike setback project with the Hood Canal Salmon Enhancement Group.

Donovan Creek flows through a culvert under the East Quilcene Road that restricts tidal flow into estuarine wetlands adjacent to the Creek. Jefferson County, State agencies, and the Hood Canal Salmon Enhancement Group have discussed the possibility of removing the culvert and replacing it with a bridge.

Rural population growth in the watershed will result in some loss of forest cover and increased impervious surface. However, considering the relatively low population growth projection, the high percentage of forest cover, the low density of development that is allowed, and Jefferson County's development regulations, significant impacts to surface waters from development in the rural portion of the watershed are not anticipated.

Water Quality

The Little Quilcene River generally meets State water quality standards. It is listed on the Ecology 303(d) list for exceeding the temperature standard for Class AA water. There are two independent drainages in the watershed, Donovan and Jakeway Creeks that also flow into northern Quilcene Bay. These streams are of particular importance because of the potential to impact the shellfish resources of Quilcene Bay. Both exceeded State temperature standards in 2002. Donovan Creek exceeded the standard for fecal coliform in 2002. It is anticipated that excluding livestock from Donovan Creek by fencing riparian buffers and the dedication of a conservation easement on the lower reach will improve water quality.

Big Quilcene River

The Big Quilcene River watershed encompasses approximately 51,000 acres. The Big Quilcene system includes 18.9 miles of main stem channel, and 81.9 miles of tributary streams. The primary tributaries are Penny Creek, Townsend Creek, and Tunnel Creek. 82% of the watershed is within the Olympic National Park and Olympic National Forest, including 27,664 acres under the U.S. Forest Service Adaptive Management and Late Successional Reserves Program and 14,070 acres in the Buckhorn Wilderness Area. In addition 9% is designated forestland. Approximately 81% of the watershed is forested. The percentage of forest cover understates the undeveloped condition of the watershed since a significant percentage of the unforested land in the upper reaches of the watershed is above the tree line or covered with rock or snowfields.

In 2000 the watershed population was 558 or 135 acres per residence. The projected 2024 population is 591 or 128 acres per residence. 4% of the watershed is designated rural residential. This area is primarily in the lower reaches of the watershed. Less than 1% is designated agriculture. The watershed has only minimal impervious surface, less than 0.1%.

Even in the lowest and most developed reach of the watershed (2,450 acres) around the town of Quilcene, the 2000 population was only 455 or 12 acres per residence. The projected 2024 population is 480 or 11 acres per residence. 740 acres (30%) are designated forestland and 1,400 acres (58%) are forested. 1,500 acres (61%) are designated rural residential. There are 87 acres in the lower watershed that are within the Quilcene Rural Village Center. The impervious area is 2.1%.

The City of Port Townsend has a water right on the Big Quilcene. The average diversion is 24 cfs. The City currently reduces its diversion when stream flow drops below 51 cfs and stops diverting when stream flow reaches 27 cfs. This reduction is voluntary because the City's water right does not have a minimum flow requirement.

Summer and fall chum salmon, coho salmon, steelhead, and sea-run and resident cutthroat trout are found in the lower reaches of the river.

The US Fish and Wildlife Service operates a fish hatchery upstream from US 101 that diverts water from the Big Quilcene River and Penny Creek.

Surface Water Impacts

Historically, forestry activities in the National Forest, including timber harvest and road building, have had significant impacts in the watershed. Sediment transport, both natural and associated with forestry activities, has led to channel instability and flooding in the lower reach. Currently, there is very little timber harvest in the middle and upper watershed. In addition, diking near the mouth combined with sediment transport has contributed to aggradation of the riverbed and exacerbated flooding in the lower 2 miles of the River. This has impacted fish habitat.

To help mitigate flood damage, Jefferson County developed the Big Quilcene River Comprehensive Flood Hazard Management Plan. The Plan recommends purchasing impacted properties, setting dikes back, lengthening the Linger Longer Road Bridge, and other projects to widen the floodplain, increase flood capacity, disperse sediment, and improve fish habitat. Jefferson County has purchased floodplain properties and is willing to purchase additional properties from willing sellers. The County and Hood Canal Salmon Enhancement Group have removed the dikes on the north side of Jefferson County

the river downstream from the BPA transmission lines. The County Public Works Department recently completed a Big Quilcene River Linger Longer Reach Feasibility Study that provided engineering analysis of options for additional dike removal, dike setbacks, and bridge reconstruction.

Stormwater impacts from residential and commercial development are unlikely to have a watershed-scale impact based on the low percentage of impervious surface.

Population growth in the watershed will result in some loss of forest cover and increased impervious surface. However, considering the relatively low population growth projection, the high percentage of forest cover, the low density of development that is allowed, and Jefferson County's development regulations, significant impacts to surface waters from development in the rural portion of the watershed are not anticipated.

Water Quality

The Big Quilcene River is listed on the Ecology 303(d) list for impaired fish habitat and in-stream flow. The Class AA temperature standard is also exceeded, but the river is not listed as impaired due to excessive temperature.

Dosewallips River

The Dosewallips River watershed is the largest in eastern Jefferson County, 74,000 acres. It has over 28 miles of main stem and 105 miles of tributary streams. The Dosewallips' headwaters are in the mountains of the Olympic National Park. For most of its length the river flows through a deep, steep-walled valley, surrounded by conifer-dominated forest. It flows into Hood Canal at the community of Brinnon. There are very few tributary streams along the lower 12 miles of the river. Most of these tributaries are small and have a steep gradient. The lower segment of river has a braided channel that flows through a broad floodplain. There are dikes on the north side of the river upstream from Highway 101.

In 2000 the watershed population was 284 or 576 acres per residence. The projected 2024 population is 330 or 496 acres per residence. 69,000 acres (92%) of the watershed are within the Olympic National Park and the Olympic National Forest; 3,400 acres (5%) are designated forestland; and 51,000 acres (69%) are forested. The percentage of forest cover understates the undeveloped condition of the watershed since a significant percentage of the unforested land in the upper reaches of the watershed is above the tree line or covered with rock or snowfields. 1,742 acres (2%) of the watershed are designated as rural residential. The watershed has only minimal impervious surface, less than 0.1%.

Even in the lowest and most developed portion of the watershed (4,700 acres) around the town of Brinnon, the 2000 population was only 242 or 43 acres per residence. The projected 2024 population is 330 or 37 acres per residence. 800 acres (17%) are within the Olympic National Forest, 2,600 acres (55%) are designated forestland, and 4,100 acres (87%) are forested. 980 acres (21%) are designated as rural residential. The impervious area is 0.3%.

Brinnon is located along the north bank near the river's mouth. The Brinnon Rural Village Center (RVC) encompasses approximately 80 acres. Most of the RVC is located in the 100-year floodplain. The Dosewallips State Park occupies 425 acres on the south side of the river near the mouth and in the estuary.

The Lazy C Ranch, a partially developed 268 lot residential subdivision, is located adjacent to the Dosewallips River, approximately 1.5 miles from US 101. Most of the portion of the subdivision located between the river and the Dosewallips Road is within the 100-year floodplain. There has been a significant number of riverfront lots lost due to river channel migration.

Surface Water Impacts

Historically, forestry activities in the National Forest and on State and private land have had significant impacts in the watershed. Currently, forestry activities in the Dosewallips River watershed occur primarily on State and private forestlands.

Agricultural activities are limited in the Dosewallips River watershed.

The primary impact has been channelization of the river and disconnection of the river floodplain.

Stormwater impacts from residential and commercial development are unlikely to have a watershed-scale impact based on the low percentage of impervious surface.

Rural population growth in the watershed will result in some loss of forest cover and increased impervious surface. However, considering the relatively low population growth projection, the high percentage of forest cover, the low density of development that is allowed, and Jefferson County's development regulations, significant impacts to surface waters from development in the rural portion of the watershed are not anticipated.

Flooding and channel movement within the channel migration zone occurs frequently on the Dosewallips River. This is highlighted by the loss of residential lots within the Lazy C Ranch subdivision and by the road washout that occurred on the Dosewallips Road in the Olympic National Forest in 2001. Many sections of the river have been armored to protect against bank erosion and channel migration. Bank armoring, channelization, and loss of large woody debris have degraded fish habitat. The US Bureau of Reclamation has delineated the river's channel migration zone to assist property owners to minimize the risk to property and public safety.

Water Quality

Water quality in the Dosewallips River meets standards for Class AA waters. Elevated fecal coliform bacteria counts have contaminated shellfish beds near the river's mouth. These have been traced to seal populations and do not originate from upstream land uses.

Duckabush River

The Duckabush River watershed encompasses over 50,000 acres and contains 25 miles of main stem and 91 miles of tributaries. The river originates in the Olympic Mountains within the Olympic National Park and flows east through the Olympic National Forest. The river valley walls are generally steep, with a broad floodplain only in the lower reach of the river. The Duckabush River enters Hood Canal over a broad delta approximately four miles south of Brinnon.

44,000 acres (88%) of the watershed are within the Olympic National Park and the Olympic National Forest; 3,900 acres (8%) are designated forestland; and 37,000 acres (73%) are forested. The percentage of forest cover understates the undeveloped condition of the watershed since a significant percentage

of the unforested land in the upper reaches of the watershed is above the tree line or covered with rock or snowfields. 2,060 acres (4%) of the watershed are designated as rural residential.

There are no areas in the watershed that are designated for commercial or industrial uses. The only intense development in the watershed is the Olympic Canal Tracts, a residential development of several hundred small lots, some adjacent to the river, immediately upstream from Highway 101. The watershed's impervious area is less than 0.1%.

In 2000 the watershed population was 350 or 317 acres per residence. The projected 2024 population is 417 or 266 acres per residence.

Even in the lowest and most developed portion of the watershed (11,652 acres), the 2000 population was only 344 or 75 acres per residence. The projected 2024 population is 411 or 62 acres per residence. 5,600 acres (48%) are within the Olympic National Forest; 3,900 acres (34%) are designated forestland; and 9,800 acres (84%) are forested. 2,060 acres (18%) are designated as rural residential. The impervious area is 0.3%.

Surface Water Impacts

Historically, forestry activities in the National Forest and on State and private land have had significant impacts in the watershed. Currently, forestry activities in the Duckabush River watershed occur primarily on State and private forestlands.

Agricultural impacts are minimal on the Duckabush River because of the minimal agricultural activities occurring within the watershed.

Stormwater impacts from residential and commercial development are unlikely to have a watershed-scale impact based on the low percentage of impervious surface.

Rural population growth in the watershed will result in some loss of forest cover and increased impervious surface. However, considering the relatively low population growth projection, the high percentage of forest cover, the low density of development that is allowed, and Jefferson County's development regulations, significant impacts to surface waters from development in the rural portion of the watershed are not anticipated.

Flooding occurs frequently on the Duckabush River. Protecting banks from erosion and protecting property from channel migration has led to bank armoring particularly along the Hood Canal Tracts. Bank armoring and loss of large woody debris have degraded fish habitat. Armoring also transfers flooding and erosion impacts to adjacent properties. The US Bureau of Reclamation has delineated the river's channel migration zone to assist property owners to minimize the risk to property and public safety.

Water Quality

Water quality in the Duckabush River meets standards for Class AA waters. There are no documented water quality violations with the exception of elevated fecal coliform counts that have contaminated shellfish beds at the river's mouth. These have been traced to seal populations and do not originate from upstream land uses.

Western Jefferson County Watersheds

The western portion of Jefferson County (the West End) is comprised of the northern half of WRIA 21 Queets - Quinault and the southern half of WRIA 20 SolDuc - Hoh. It includes portions of the Bogachiel, Hoh, Queets, Clearwater, and Quinault watersheds. These watersheds drain the western slopes of the Olympics. They receive more than 134 inches of rainfall per year. The region is characterized by mountains, foothills, river valleys, and upland terraces with medium to high gradient streams. Typical soils are deep, silt loams.

The Federal government, State of Washington, and private timberland management companies own most of the land on the West End. Federal land is located within the Olympic National Park and Olympic National Forest. State land is predominantly timberland managed by the Department of Natural resources. Much of the remainder is within the Quinault Indian Reservation and the small Hoh Indian Reservation.

Land cover is predominantly forest. Development is limited to the Queets and Hoh Tribe villages, U.S. Park Service complex at Kalaloch, State Department of Corrections Clearwater Work Camp, and a small commercial area on the Upper Hoh Road. The 2000 population was 945. The impervious area is very low.

Surface Water Impacts

Historically, forestry activities, including timber harvest and road building in the National Forest and on State and private land have had significant impacts in West End watersheds. Currently, forestry activities occur in the National Forest and on State and private forestlands. Landslides related to forest roads and logging are common, particularly on the South Fork Hoh. This has contributed fine material into spawning gravel. Extensive logging has limited recruitment of large woody debris and contributed fine sediment. These factors have degraded fish habitat.

The major West End river systems are subject to significant flooding and channel migration that has damaged County roads, particularly the Upper Hoh, Oil City, Quinault South Shore, and Clearwater Roads. Recent erosion has threatened the Clearwater River Bridge and necessitated the replacement of the Fossil Creek Bridge on the Oil City Road. These roads provide important access to State and private forestland and to the Olympic National Forest and Park.

Protecting County Roads in riparian corridors on the West End is a significant challenge for Jefferson County. In order to accomplish this, it has been necessary for the County to conduct extensive bank armoring. In order to mitigate the impacts to fish habitat, the County has placed large woody debris and constructed rock barbs and engineered log jams. During the past decade average annual emergency expenditures for these activities have been approximately \$900,000. Relocation of these roads to areas outside of riparian corridors should be investigated. This would require funding and cooperation from several State and Federal agencies.

Agricultural impacts are minimal because of minimal agricultural activities occurring in West End watersheds.

Stormwater impacts from residential and commercial development are unlikely to have a watershed-scale impact based on the low percentage of impervious surface.

Rural population growth in the watershed will result in a very small loss of forest cover and increased impervious surface. However, considering the relatively low population growth projection, the high percentage of forest cover, the low density of development that is allowed, and Jefferson County's development regulations, significant impacts to surface waters from development in the rural portion of these watersheds are not anticipated.

Water Quality

Water quality in the West End Rivers generally meets standards for Class AA waters. However, Table 2-4 lists several streams on the 303 (d) list for exceeding temperature standards. In addition the upper reaches of the Bogachiel River in Jefferson County are listed for both temperature and dissolved oxygen. The Department of Ecology also reports that the temperature standard is exceeded on Kalaloch Creek.

2.6 OTHER SURFACE WATER CONDITIONS

Flooding

There are several conditions in Jefferson County that fall under the general category of flooding. First, many Olympic Peninsula rivers and streams have steep, short drainages that are subject to high precipitation, both rain and snow. They tend to have a "flashy" hydrology, that is, they respond quickly to storm events. This characteristic can be exacerbated when cold weather and snow accumulation are followed by warm weather and heavy rain that melts snow and produces very high runoff. These high flows can inundate floodplains because river and stream channels lack the capacity to convey the runoff. High flows can also move sediments and erode banks, causing channels to shift through a meander zone that over time can include a large portion of the floodplain. Roads and buildings constructed in the flood plain can be damaged or destroyed by this channel migration. All of the large rivers in Jefferson County are subject to this movement.

In Jefferson County these types of floods are natural events, not related to runoff from impervious surfaces. Forest management activities, including timber harvest and road building, can increase the overall volume and peak flows of runoff that occur during these events. They can also add sediment to rivers and streams that contributes to flooding.

Dikes that were constructed to protect property from flood damage can, however, exacerbate flood events by cutting off rivers from flood storage capacity in secondary channels and floodplains, resulting in higher flows in the diked channel and in areas downstream of the dikes. These higher flows also increase flood velocities and sediment transport. Since sediment is confined to the diked channel instead of being distributed to floodplains areas, the elevation of the diked channel can become higher than the surrounding floodplain. These factors can significantly degrade fish habitat. They can also result in catastrophic flooding if dikes are breached. Making dikes higher and stronger to confine flood flows exacerbates this condition. This phenomenon occurs in diked portions of the Big and Little Quilcene Rivers.

Another form of flooding occurs in low land creek valleys with flat topography and limited hydraulic capacity. Floodwaters can inundate these valleys for extended periods during the winter. They typically lack sufficient velocity to erode banks and shift channels. This phenomenon occurs regularly in the Chimacum Creek flood plain south of Chimacum.

Most of the County's floodplain areas are characterized by agricultural lands, forestlands, and low-density residential development where the risk of large scale damage from flooding is minimal. However, portions of Quilcene and Brinnon are susceptible to flooding from the Big and Little Quilcene Rivers and the Dosewallips River. Flooding and channel migration have also impacted the Lazy C Ranch and Olympic Canal Tracts subdivisions on the Dosewallips and Duckabush Rivers.

Salmon and Trout Habitat

Jefferson County's surface waters provide habitat for numerous salmon and trout stocks, including chinook, coho, and chum salmon, anadromous trout (steelhead and sea-run cutthroat), and freshwater trout. Many of these stocks have been reduced to critical levels and three have been listed under the Federal Endangered Species Act (ESA): Hood Canal summer chum salmon, Puget Sound chinook salmon, and bull trout. Summer chum populations in the Dosewallips, Duckabush, and Big and Little Quilcene Rivers and Chimacum, Salmon, and Snow Creeks are covered by the ESA listing.

Salmon and trout require cold, oxygen-rich water; food sources and cover for juveniles; and diverse river and stream systems that provide stable spawning gravel, shade, large woody debris, and access to flood plains and side channels during high flow periods.

Salmon and trout populations have been impacted by freshwater habitat degradation, including loss of riparian vegetation, elevated water temperatures, reduced dissolved oxygen, unstable stream channels, fine sediment in spawning gravel, lack of large woody debris, loss of river and stream diversity, and fish barrier culverts that block access to spawning and rearing habitat.

Salmon and anadromous trout have also been impacted by degradation of near-shore marine habitat. In particular, filling and bulkheading have degraded spawning habitat for forage fish (surf smelt and sand lance) that are important salmon prey species.

Salmon and trout recovery is discussed in greater detail in Chapter 3 Issues and Analysis, Chapter 4 Existing Activities, and Chapter 5 Policy and Regulation.

Shellfish

Commercial and recreational shellfish harvesting are important activities in Jefferson County. The major shellfish production areas in Dabob, Quilcene, and Discovery Bays are world-renowned.

Water quality degradation from bacteria can result in the closure of shellfish beds. Typical contamination sources are failing on-site septic systems, livestock, stormwater runoff, marinas and vessels, and seals

In the past there were shellfish closures in Quilcene Bay due to failing septic tanks, livestock operations, and seals and at the Dosewallips State Park at the mouth of the Dosewallips River due to contamination from seals. These contamination sources have been remedied and the shellfish beds reopened.

There is an existing closure at the mouth of the Duckabush River that is due to contamination from seals. There is concern that shellfish beds in lower Port Townsend Bay and Mystery Bay could be impacted by contamination from anchored vessels.

Marinas and Boat Launches

Recreational boating, commercial fishing, and other marine activities are important components of Jefferson County's economy and lifestyle. Combined with the County's many miles of marine shoreline, this has led to the development of numerous boating facilities including:

- Port of Port Townsend's Port Townsend Boat Haven and Point Hudson marina facilities, Port Hadlock dock and the Mats Mats docks, and the Quilcene Boat Haven;
- Washington State Parks docks and mooring fields at Fort Worden, Fort Flagler, Mystery Bay, and Pleasant Harbor;
- Private marinas at Port Hadlock, Port Ludlow, Cape George and World Mark condominium development on Discovery Bay, Bridgehaven and Fisherman's Harbor on Hood Canal, and two in Pleasant Harbor south of Brinnon;
- Boat launches at Gardiner, Beckett Point, and Cape George on Discovery Bay, at the Port Townsend and Quilcene Boat Havens, Fort Worden and Fort Flagler State Parks, Lower Hadlock, Mats Mats Bay, Termination Point, Bridgehaven, Fisherman's Harbor, Point Whitney, and Triton Cove on Hood Canal; and
- Port Hadlock Yacht Club mooring field.

There are potential water quality problems associated with spills of oil, gasoline, diesel, and other hazardous materials and illegal sewage disposal from both vessels moored at marinas and at anchor.

Sewage from vessels has been identified as a factor contributing to elevated fecal coliform counts in Port Ludlow Bay.

On-site septic systems

On-site septic systems infiltrate wastewater through soil where harmful pathogens are consumed by natural bacteria in the soil. Properly designed, constructed, and maintained on-site septic systems can provide adequate treatment and disposal of sewage. Inadequately treated sewage from improperly functioning on-site septic systems can contaminate surface and ground waters and require the closure of shellfish beds.

Soil type is a primary consideration in locating and designing on-site septic systems. Soils with excessively high rates of permeability (high gravel and coarse sand components), excessively low rates of permeability (high levels of silt and clay), or shallow water tables may not provide adequate treatment. These soil types occur throughout Jefferson County.

With the exception of the City of Port Townsend and the Port Ludlow MPR, Jefferson County residents, businesses, and public facilities rely on on-site septic systems for sewage disposal. Jefferson County has been a leader in administering its on-site septic system program to ensure proper design, construction, operation, and monitoring of these systems. While there are isolated failures of on-site septic systems, there is not a systemic or regional problem that significantly affects surface water resources.

Hood Canal Low Dissolved Oxygen

During the past few years, low levels of dissolved oxygen (DO) in Hood Canal have had lethal impacts on marine life. In September and October of 2002 and 2003, the Washington Department of Fish and Wildlife observed fish kills in the south end of the canal. During the summers of 2003 and 2004, dissolved oxygen levels in the southern half of the canal dropped by as much as 25%. This

stressed and killed large numbers of marine organisms, including bottom fish, shrimp, octopus, and crab. Recent research shows that three major factors play a significant role in this situation:

- Poor water circulation,
- Stratification of the water column that prevents mixing of shallow and deeper water layers, and
- Nitrogen from upland human sources.

This problem is fundamentally related to the manner in which “fresher” shallow water and deeper marine waters mix in Hood Canal. Surface water flows northward out of the canal, while deeper marine water from Admiralty Inlet and the Straits of Juan de Fuca enters the canal, flowing southward after passing over a shallow sill. This deeper marine water is not particularly high in dissolved oxygen and continually loses it due to the respiration of plants and animals.

Even though Hood Canal has relatively large tide exchanges, tidal currents mainly move the same water back and forth with little mixing between layers. From late fall to early spring, rain and wind help to mix and oxygenate the surface water in Hood Canal. But from the spring to late fall, little oxygenation occurs. In addition, human-caused conditions may be exacerbating these natural conditions. Increased nutrients may be entering the Canal from on-site septic systems, agriculture, and livestock operations. The diversion of a portion of the flow of the North Fork of the Skokomish River to the City of Tacoma’s hydro-power facility at Potlatch may also have affected the input of oxygenated water into the lower Canal.

The summertime combination of sun and nutrient-rich waters creates perfect conditions for plankton blooms that initially oxygenate surface waters, but, when they die, sink to the bottom and use up oxygen as they decompose.

While the effects of this problem are currently limited to the southern portions of Hood Canal in Mason County and Kitsap County, decreased dissolved oxygen has been detected as far north as Dabob Bay. Jefferson County has supported actions to address low dissolved oxygen in Hood Canal before it becomes a problem in Jefferson County.

Additional information on low dissolved oxygen in Hood Canal is available at http://www.psat.wa.gov/Programs/hood_canal/hc_paca.htm.