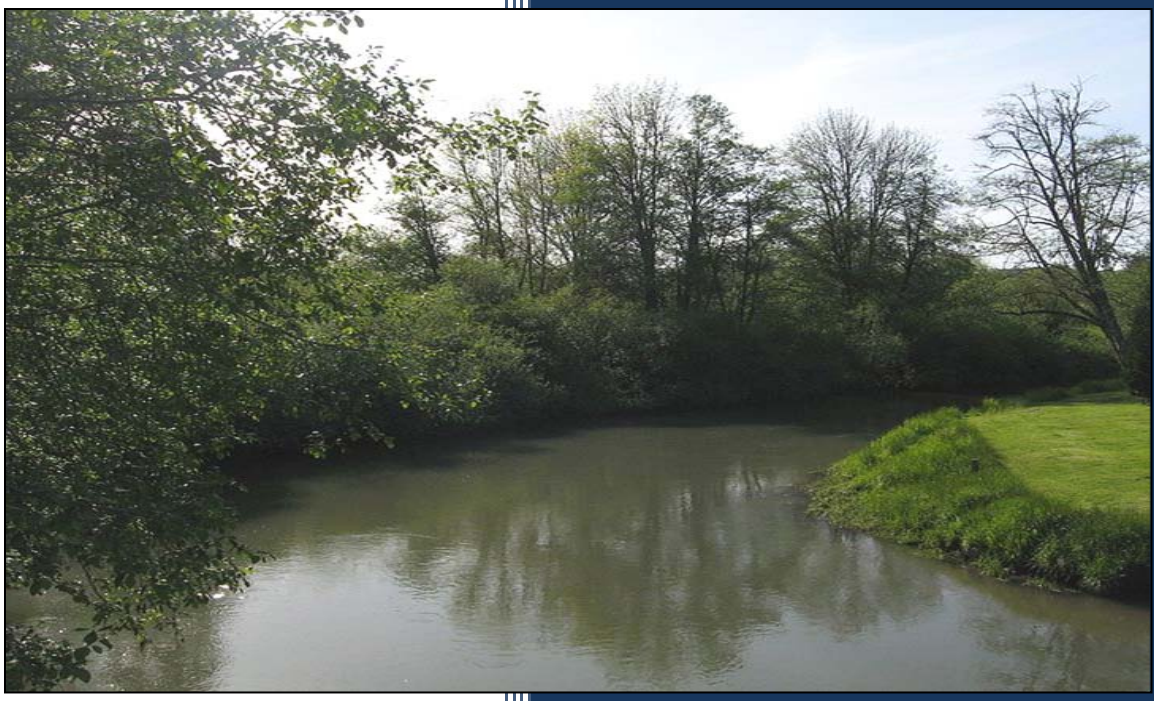
# FINAL
## June 2011

# Shoreline Inventory and Characterization

## Town of Bucoda



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**THURSTON REGIONAL PLANNING COUNCIL** (TRPC) is a 22-member intergovernmental board made up of local governmental jurisdictions within Thurston County, plus the Confederated Tribes of the Chehalis Reservation and the Nisqually Indian Tribe. The Council was established in 1967 under RCW 36.70.060, which authorized creation of regional planning councils.

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This report was prepared as part of the Thurston Regional Planning Council's 2010 regional work program.

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## About This Report

Consistent with Governor Gregoire's Plain Talk Executive Order 05-03 (2005), this report is written in a manner that is brief and to-the-point, uses non-bureaucratic language and features a clean design that promotes fast scanning and reading.

Scientific and legal references are kept to a minimum, replaced by a full list of sources in the report appendix.

Cover: Skookumchuck River at Volunteer Park, Bucoda, WA
Courtesy of Wikipedia, 2009

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# 1.0 INTRODUCTION

## 1.1 Background and Purpose

The Town of Bucoda (Town) obtained a grant (Grant No. 1000057) from the Washington State Department of Ecology (Ecology) to prepare a comprehensive update of the Town's Shoreline Master Program (SMP) as defined by the State of Washington Shoreline Management Act (SMA) (RCW 90.58). Thurston Regional Planning Council (TRPC) is acting on behalf of the Town to conduct a baseline inventory and characterization of the natural and built conditions within the Town's shoreline jurisdiction.

## 1.2 SMP Update Guidelines

The WA Department of Ecology has adopted new guidelines for the preparation of local SMP updates. WAC 173-26-201(3) (c) contains the relevant guidance for the preparation of this report, which is listed below:

- Gather and incorporate all pertinent and available information, existing inventory data and materials from state agencies, affected Indian tribes, watershed management planning, port districts and other appropriate sources.
- Ensure that, whenever possible, inventory methods and protocols are consistent with those of neighboring jurisdictions and state efforts.
- Map inventory information at an appropriate scale.
- Collection of additional inventory information is encouraged and should be coordinated with other watershed, regional, or statewide inventory and planning efforts in order to ensure consistent methods and data protocol as well as effective use of fiscal and human resources.
- Data from inter-jurisdictional, watershed, or regional inventories may be substituted for an inventory conducted by an individual jurisdiction, provided it meets the requirements of this section.

## 1.3 Study Area

The shoreline planning area for the Town of Bucoda lies within the Skookumchuck River Valley. It lies an equal distance between the Skookumchuck Dam (11 miles upstream) and the confluence of the Chehalis River in Lewis County (11 miles downstream).

While located in southern Thurston County, the community has close proximity to Lewis County and the City of Centralia some nine miles to the southwest. The Town is also upstream of the Twin Cities Flood Reduction Project planning area (for Centralia and Chehalis), which is being evaluated at this time.

**Photo 1: Entrance to Bucoda**

Bucoda is the smallest community within Thurston County, and the only incorporate town within the Skookumchuck River valley. The Skookumchuck watershed is one of the more rural locations within Thurston County. The 2009 population for the Town of Bucoda was estimated at 665 people. By 2030 the population of the Town is expected to increase to 1050 people (TRPC, 2009).

## 1.4 Bucoda Shoreline History

A brief history of Bucoda and its shoreline was created from several sources.

> The area around Bucoda was first pioneered in 1854. Aaron Webster used water from the Skookumchuck River to operate a sawmill there as early as 1857. Originally called Seatco, the legislature changed the name to Bucoda in 1890. The Town of Bucoda was incorporated on July 7, 1910.
>
> In 1878 the Washington State Territorial Prison was established along the banks of the Skookumchuck River. Men from the prison labored in the sawmill and millwork plant. These became the Seatco Manufacturing Company and after 1902 the Mutual Lumber Company.
>
> The mill burned down in 1912, but was rebuilt in 1919. By 1922, the town was dubbed "the little town with the million-dollar payroll," due to Mutual production, which built a hotel and housing for its workers. The mill closed in 1944. [Palmer and Stevenson, 1992; TRPC, 2009; and Historic Property Inventory Form # 474, and Town of Bucoda - Website]

Many of Bucoda's current shoreline features were established in this early history. Figures 9 & 10 in the Map Folio are a composite aerial photo of the town from 1936. Bucoda was platted in a grid street layout which exists today. In the aerial the Mutual Lumber Company facilities dominate the Town. Close inspection reveals a dam across the Skookumchuck River and a log pond next to the mill. Adjacent to the dam is a railroad bridge which serves the mill which has also been removed since that time. The current location of the Tono Road Bridge was slightly altered from the 1936 aerial photo when it was reconstructed in 1972.

**Photo 2: Early Bucoda**

**Photo 3: Mutual Lumber Company in Bucoda – 1927**

Photos provided courtesy of the Thurston County History Web site: www.co.thurston.wa.us/history

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# 2.0 SHORELINE MANAGEMENT ACT AND GROWTH MANAGEMENT ACT

## 2.1 Minimum Shoreline Jurisdiction

At a minimum, the Shoreline Management Act (SMA) applies to all Shorelines of the State. (RCW 90.58 & WAC 173-22).

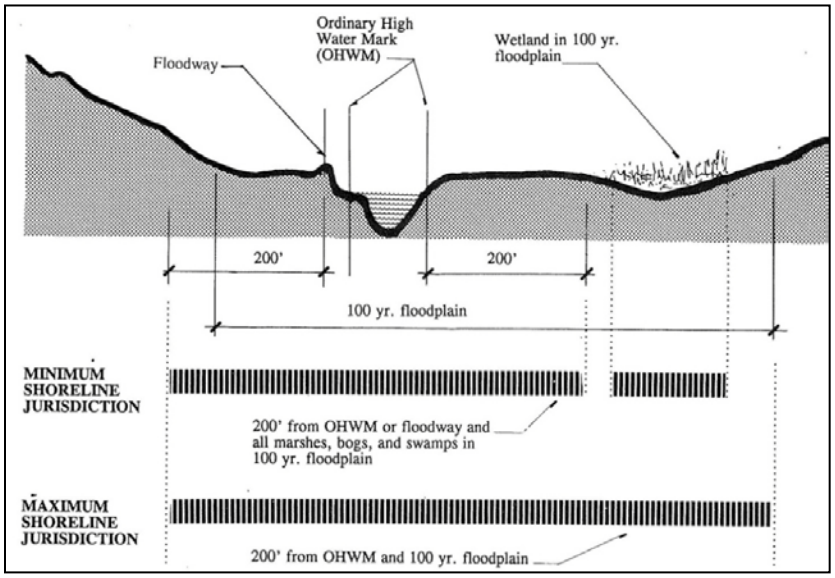


**Figure 1: Rivers and Streams Minimum and Maximum Shoreline Jurisdiction**
[Skowlund. 1994]

Within the Town of Bucoda, relevant 'Shorelines of the State' include:

- **"Streams"** with a mean annual flow of greater than 20 cubic feet per second. Mean annual flow is the average (actually the arithmetic 'mean') of the annual mean flows over a period of years. Mean annual flow is not the same as 'annual mean flow' which is the average daily flow over one year. The mean annual flow averages out years of low flows with years of normal or above average flows.

- "**Shorelands**" - Areas extending landward 200 feet in all directions as measured on a horizontal plane from the ordinary high water mark (OHWM). On rivers, the shoreland area also includes the entire **floodway** and contiguous flood plain areas landward 200 feet from the floodway.[1]

[1] The SMA defines floodway as "the area, as identified in a master program, that either: has been established in federal emergency management agency flood insurance rate maps or floodway maps, or those portions of a

- "**Associated Wetlands**" – those which are in *proximity* to and either *influence* or are *influenced by* a stream subject to the Shoreline Management Act. The entire wetland is associated if any part of it lies within the area 200 feet from either the ordinary high water mark or floodway.

Determining the minimum shoreline jurisdiction for Bucoda involved the following three steps process:

1. Determine the water features currently being regulated under the Shoreline Master Program.
2. Determine if any additional water bodies meet the criteria of shorelines.
3. Determine the extent of any associated wetlands or floodways meeting the criteria.

**Step 1:** The town of Bucoda currently regulates the entire length of the Skookumchuck River in the town limits. The Ecology rule defining the starting point for shoreline jurisdiction indicates the river meets the criteria for 20 cfs many miles upstream from Bucoda (WAC 173-18). A 1998 USGS study confirms the river flows at well above this minimum rate of flow at Bucoda.

In addition, the US Geological Survey maintains a gauging station on the Skookumchuck River near Bucoda (USGS 12026400) located some 3.3 miles downstream of the Town. The records exist from 1967 to the present. The monthly averages range from a high of 754 cfs for January to a low of 81 cfs in August. From these data sources it is clear that the Skookumchuck River within the Bucoda town limits continues to meet the definition of a "shoreline of the state" under the jurisdiction of the Shoreline Management Act.

TRPC inspected the legal descriptions of the Town's incorporation documents. It was determined that the bank of the Skookumchuck River, and not its centerline, was the boundary of the Town. This corrected boundary has been used for all the figures within the map folio.

**Step 2:** TRPC has determined in consultation with Ecology that there are no additional waterbodies that meet the SMA jurisdiction criteria in Bucoda.

**Step 3:** FEMA has mapped the 100-year floodplain within the Town. Bucoda does not have an adopted FEMA floodway; although Thurston GeoData Center has a data layer indicating the floodway boundary. The wetlands along the Skookumchuck River are generally confined to the riparian edge and the 100-year floodplain. A forested and

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river valley lying streamward from the outer limits of a watercourse upon which flood waters are carried during periods of flooding that occur with reasonable regularity, although not necessarily annually. The floodway is to be identified, under normal condition, by changes in surface soil conditions or changes in types of quality of vegetative ground cover condition, topography, or other indicators of flooding that occurs with reasonable regularity, although not necessarily annually.

scrub shrub wetland exists in the location of the former log pond for the Mutual Lumber Company mill. Figures 14 & 15, in the Map Folio, indicate the known extent of floodways and associated wetlands within Bucoda. Given the current location of the Skookumchuck River and the updated Town boundary, Bucoda has 81.9 acres in minimum shoreline jurisdiction.

## 2.2 Regulatory Framework

The Growth Management Act (GMA) and the Shoreline Management Act (SMA) were amended in recent years to clarify the regulatory framework for critical areas located within SMA jurisdiction:

- After Ecology approves a comprehensive Shoreline Master Program update, critical areas occurring within shorelines of the state will be regulated through the Shoreline Master Program (and not the Critical Areas Ordinance adopted under GMA.) Shoreline master programs may adopt critical areas ordinances by reference.

- Shoreline master programs shall provide a level of protection to critical areas located within shorelines that assures "no net loss" of shoreline ecological functions as defined by Ecology guidelines.
- Local governments were given a new option to extend shoreline jurisdiction to include land necessary for buffers for Critical Areas within their Shoreline Master Program.[2]

## 2.3 Optional Shoreline Jurisdiction

In addition to minimum jurisdiction, the local government may also choose to apply SMA regulations to additional areas, such as:

- Buffers around critical areas associated with a shoreline, or
- All or portions of the 100-year floodplain.

As part of the 1990 *Shoreline Master Program for the Thurston Region*, all seven local communities (including Bucoda) adopted the entire 100-year floodplain as shoreline jurisdiction.
The floodplain area within the Existing Shoreline Jurisdiction is 167.8 acres.

[2] RCW 90.58.030(3)(f)(ii): Any city or county may also include in its master program land necessary for buffers for critical areas, as defined in chapter 36.70A RCW, that occur within shorelines of the state…"

Approximately 45% of the Town lies within the Floodway or FEMA 100-Year Floodplain. Figures 5 & 6 in the Map Folio show the minimum shoreline jurisdiction and Figures 7 & 8 show the optional shoreline jurisdiction for Bucoda. For this SMP update Bucoda will need to determine if it wants to use the "minimum" or "optional" shoreline areas.

**Table 1**
**Bucoda Shoreline Jurisdictions**

| **Minimum Shoreline Jurisdiction** (Refer to Figures 5 & 6) | **Optional Shoreline Jurisdiction** (Refer to Figures 7 & 8) | **Existing Shoreline Jurisdiction** (Refer to Figures 7 & 8) |
|---|---|---|
| 81.9 acres | 85.9 acres | 167.8 acres |

## 2.4 Critical Areas Regulations

As required by the Growth Management Act, the Town of Bucoda has adopted a Critical Areas Ordinances (CAO) to protect important habitats and avoid development in hazardous locations. . The Town updated its Critical Area Ordinances in 2005based upon the Best Available Science and protection of ecological functions.

The Bucoda CAO designates the Skookumchuck River as a "Fish and Wildlife Habitat Protection Area." The standards require avoiding alterations as much as possible, and mitigating for unavoidable alterations within a 150-foot buffer area measured from the ordinary high water mark. This buffer is not a no-touch zone, but does include specific limitations on Clearing and Grading; Vegetation Removal, Disturbance, and Introduction; Fencing; Shoreline Erosion Control Measures; Streambank Stabilization; Roads, Trails, Bridges, and Rights-of-Way; Utility Facilities; Public Flood Protection Measures; Instream Structures; Water Conveyance Facilities; On-site Sewage Systems and Wells; New Agricultural Activities; Structures and Landscaped Areas; and Alteration of Watercourses. The CAO includes provision for averaging, reducing, or increasing the standard buffer widths, depending on site-specific circumstances. The CAO also allows applicants the flexibility to conduct a habitat assessment to determine whether or not a listed critical fish or wildlife habitat area, point location, and any associated buffers are located on the site for a proposed development.

There are CAO provisions for "Flood Hazard Areas" which address both Floodways and 100-year Floodplains. Development standards vary based upon the degree of hazard, within the elevation of the first habitable floor above the elevation of the 100-year flood being the principal standard.

The Town's "Wetlands" requirements assign variable buffer widths to wetlands based upon their rating under Ecology's rating system. The CAO also includes measure for preventing property damage from development on "Landslide Hazard Areas," however these steep slopes are located outside of the shoreline jurisdiction.

The existing regulations were adopted based on “Best Available Science,” and address protection of ecological functions. The Town may want to rely in great part on that existing regulatory framework as part of achieving “no net loss.” One of the goals of the SMP Update is to integrate appropriate development regulations into the Shoreline Master Program, thereby harmonizing Growth Management Act plans within the Shoreline Management Act.

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# 3.0 INVENTORY AND CHARACTERIZATION METHODS

## 3.1 Methods Overview

The inventory and characterization report documents shoreline conditions within the Town limits. The sources for the data and maps are noted in Section 8.1. The inventory was created by reviewing available and existing data and reports in the Section 8.2. There was extensive work by the jurisdictions (Tribes, Cities, County, Regional, State, Conservation District, Non-Profits among others). Geographic information systems (GIS) mapping for the Town is included in the Map Folio.

The Department of Ecology prepared a Channel Migration Assessment for the Town which is discussed in Section 4.3.1 Geologic Hazards - Channel Migration. Ecology also undertook a landscape scale assessment of the Upper Chehalis basin. The relevant portions that report for Bucoda are located in Section 10 Appendix.

## 3.2 Approach to Characterizing Ecosystem-wide Processes and Shoreline Functions

SMA guidelines require local jurisdictions to evaluate ecosystem-wide processes during the SMP updates (WAC 173-26). Ecosystem-wide processes that create, maintain, or affect the Town's shoreline resources were characterized using existing data and reports addressing watershed planning, water quality, and floodplain management.

The Washington Department of Ecology undertook a landscape scale assessment of the Upper Chehalis basin, titled *Chehalis Basin Watershed Assessment - Description of Methods, Models, and Analysis for Water Flow Process* (Stanley et al, 2010). While the report's coarse scale watershed characterization is not intended for use at the site scale, it helps place Bucoda into its broader watershed context. A summary of relevant portions of the landscape-scale assessment is included in the Section 10 Appendix.

## 3.3 Approach to Characterizing Jurisdictional Shorelines

The inventory portion of this report is organized into two sections, with supporting maps contained at the end of the report.

> **Section 4** contains a regional overview and a city-wide summary of required elements of the shoreline inventory including land use patterns, critical areas, and other areas of interest.
>
> **Section 5** characterizes distinct segments of the shoreline based on the inventory, and identifies opportunities for protecting and restoring the shoreline and improving public access.

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# 4.0. ELEMENTS OF THE SHORELINE INVENTORY

Ecology master program guidelines (WAC 173-26-201(3)(c)) require that the following elements of the natural and built environment be included in the shoreline inventory:

- Land use patterns, including existing structures and impervious surfaces, open spaces, water-related utilities, shoreline modifications, transportation and navigation, and existing and potential public access sites.
- Critical areas, including wetlands, aquifer recharge areas, geologically hazardous areas (landslide, erosion, seismic, and volcanic), habitat and species (listed and priority), and frequently flooded areas (floodways and flood hazards).
- Known historical or archaeological sites.
- Toxic/hazardous waste cleanup sites.
- Other areas of potential interest.
- Opportunity areas include those areas that represent potential for restoration, enhancement or protection.

## 4.1 Regional Overview

Bucoda is located along the banks of and within the floodplain of the Skookumchuck River. The Skookumchuck River is a part of the Upper Chehalis Watershed (Water Resource Inventory Area [WRIA] 23). See Figure 2 below.

**Figure 2: Chehalis River Basin – WRIA 22 & 23**

The Skookumchuck River basin is one the major watersheds within Thurston County. Thurston Regional Planning Council (TRPC) summarizes many types of natural resource data. Many data summarizes for the region are only available at the watershed scale. The available regional data for the Skookumchuck watershed is summarized on Tables 2 to 6 (on the following pages). The row for the Skookumchuck watershed has been highlighted within each table.

Tables 2 and 3 provide some historical perspective on the predominant conditions within the watershed. Between 1985 and 2000 they show that the Skookumchuck watershed has the highest percentage for timber harvesting, and the lowest percent of urbanization for any watershed in the county which are not in the Capitol Forest.

Table 4 indicates the Skookumchuck watershed remains a very rural area with only 52 acres being converted to urban land cover between 1985 and 2000.

Tables 5 and 6 use the year 2000 as a baseline, and forecast conditions out to 2030. The year 2000 total impervious land cover (TIA) within the Skookumchuck watershed was estimated at 1,422 acres, with the estimated addition of only another 277 acres forecast by the year 2030. This is the again the lowest increase of all the watersheds in the county which are not in Capitol Forest. Table 6 provides a similar forecast for effective impervious area.

**Table 2**
**Estimate of Forest Harvest Activity in Thurston County**
**1985-2000**

| WATERSHED | Total Land Area (acres) | Estimate of Total Forest Lands 2000 (acres) | Total Harvest 1985-2000 (acres) | % of Total Forest Lands 1985-2000 |
|---|---|---|---|---|
| BLACK RIVER | 78,971 | 45,107 | 8,888 | 20% |
| BUDD/DESCHUTES | 104,019 | 59,267 | 9,842 | 17% |
| CHEHALIS RIVER | 47,034 | 21,636 | 4,763 | 22% |
| ELD INLET | 23,534 | 15,593 | 2,175 | 14% |
| HENDERSON INLET | 27,170 | 9,207 | 355 | 4% |
| NISQUALLY RIVER | 93,302 | 55,377 | 7,318 | 13% |
| SKOOKUMCHUCK RIVER | 55,163 | 42,237 | 15,947 | 38% |
| TOTTEN INLET | 21,401 | 16,546 | 2,833 | 17% |
| WEST CAPITOL FOREST | 19,272 | 17,472 | 3,843 | 22% |
| TOTAL | 469,867 | 282,441 | 55,964 | 20% |

**Source:** The Rate of Urbanization and Forest Harvest in Thurston County, 1985-2000, TRPC, 2002.

**Table 3**

## Urbanization by Watershed in Thurston County, 1985-2000

| | | 1985-2000 Conversion from: | | | | |
|---|---|---|---|---|---|---|
| WATERSHED | Total Land Area (acres) | Forested Lands (acres) | Agriculture Lands (acres) | Shrub Lands (acres) | Total (acres) | Percent of Total |
| BLACK RIVER | 78,971 | 4,248 | 2,110 | 1,551 | 7,908 | 10% |
| BUDD/DESCHUTES | 104,019 | 4,422 | 1,427 | 1,299 | 7,149 | 7% |
| CHEHALIS RIVER | 47,034 | 699 | 3,264 | 505 | 4,468 | 9% |
| ELD INLET | 23,534 | 1,193 | 73 | 199 | 1,464 | 6% |
| HENDERSON INLET | 27,170 | 1,322 | 1,470 | 420 | 3,212 | 12% |
| NISQUALLY RIVER | 93,302 | 6,115 | 1,275 | 98 | 7,489 | 8% |
| SKOOKUMCHUCK RIVER | 55,163 | 35 | 236 | 20 | 291 | 1% |
| TOTTEN INLET | 21,401 | 519 | 39 | 66 | 623 | 3% |
| WEST CAPITOL FOREST | 19,272 | 0 | 0 | 0 | 0 | 0% |
| **TOTAL** | **469,867** | **18,553** | **9,893** | **4,159** | **32,605** | **7%** |

**Source:** The Rate of Urbanization and Forest Harvest in Thurston County, 1985-2000, TRPC, 2002.

**Explanations:** Conversion designates the loss of one type of land use (forested, agriculture, or shrub) and replacement by an urban landscape. Urban landscapes contain a mixture of built features, landscaping, and natural features.

**Table 4**

## Change in Urban (Built) Land Cover in Thurston County, 1985-2000

| | Total | 2000 Urban Cover | | 1985 Urban Cover | | 1985-2000 Increase in Urban Cover | | |
|---|---|---|---|---|---|---|---|---|
| WATERSHED | (acres) | (acres) | (%) | (acres) | (%) | (acres) | (% of Total) | (% of 1985) |
| BLACK RIVER | 78,971 | 2,507 | 3% | 1,795 | 2% | 712 | 1% | 40% |
| BUDD/DESCHUTES | 104,019 | 8,864 | 9% | 7,154 | 7% | 1,710 | 2% | 24% |
| CHEHALIS RIVER | 47,034 | 2,040 | 4% | 1,517 | 3% | 524 | 1% | 35% |
| ELD INLET | 23,534 | 932 | 4% | 765 | 3% | 166 | 1% | 22% |
| HENDERSON INLET | 27,170 | 4,757 | 18% | 3,623 | 13% | 1,135 | 4% | 31% |
| NISQUALLY RIVER | 93,302 | 4,196 | 4% | 2,998 | 3% | 1,198 | 1% | 40% |
| SKOOKUMCHUCK RIVER | 55,163 | 693 | 1% | 641 | 1% | 52 | 0% | 8% |
| TOTTEN INLET | 21,401 | 400 | 2% | 354 | 2% | 45 | 0% | 13% |
| WEST CAPITOL FOREST | 19,272 | 131 | 1% | 131 | 1% | 0 | 0% | 0% |
| **TOTAL** | **469,867** | **24,520** | **5%** | **18,979** | **4%** | **5,541** | **1%** | **29%** |

**Source:** The Rate of Urbanization and Forest Harvest in Thurston County, 1985-2000, TRPC, 2002.

**Table 5**

## Estimate of Total Impervious Area by Watershed

| WATERSHED | Total Acres | 2000 Land Cover (acres) | 2000 Land Cover (percent) | Forecast 2030 (acres) | Forecast 2030 (percent) |
|---|---|---|---|---|---|
| BLACK RIVER | 78,971 | 2,640 | 3.3% | 4,894 | 6.2% |
| BUDD/DESCHUTES | 104,019 | 9,039 | 8.7% | 12,142 | 11.7% |
| CHEHALIS RIVER | 47,034 | 2,214 | 4.7% | 4,022 | 8.6% |
| ELD INLET | 23,534 | 944 | 4.0% | 1,564 | 6.6% |
| HENDERSON INLET | 27,170 | 4,889 | 18.0% | 6,572 | 24.2% |
| NISQUALLY RIVER | 93,302 | 4,354 | 4.7% | 7,355 | 7.9% |
| SKOOKUMCHUCK RIVER | 55,163 | 1,422 | 2.6% | 1,699 | 3.1% |
| TOTTEN INLET | 21,401 | 400 | 1.9% | 711 | 3.3% |
| WEST CAPITOL FOREST | 19,272 | 131 | 0.7% | 131 | 0.7% |
| **Total** | **469,867** | **26,032** | **5.5%** | **39,091** | **8.3%** |

**Source:** Completion of the Future Impervious Area Module Update - January 2007. http://www.trpc.org/resources/memojan2007.pdf

**Note:** Estimate includes residential and commercial growth.

**Table 6**

## Estimate of Effective Impervious Area by Watershed

| WATERSHED | Total Acres | 2000 Land Cover (acres) | 2000 Land Cover (percent) | Forecast 2030 (acres) | Forecast 2030 (percent) |
|---|---|---|---|---|---|
| BLACK RIVER | 78,971 | 1,828 | 2.3% | 3,515 | 4.5% |
| BUDD/DESCHUTES | 104,019 | 6,797 | 6.5% | 9,153 | 8.8% |
| CHEHALIS RIVER | 47,034 | 1,541 | 3.3% | 2,893 | 6.2% |
| ELD INLET | 23,534 | 681 | 2.9% | 1,147 | 4.9% |
| HENDERSON INLET | 27,170 | 3,665 | 13.5% | 4,964 | 18.3% |
| NISQUALLY RIVER | 93,302 | 3,134 | 3.4% | 5,409 | 5.8% |
| SKOOKUMCHUCK RIVER | 55,163 | 541 | 1.0% | 746 | 1.4% |
| TOTTEN INLET | 21,401 | 287 | 1.3% | 520 | 2.4% |
| WEST CAPITOL FOREST | 19,272 | 90 | 0.5% | 90 | 0.5% |
| **Total** | **469,867** | **18,564** | **4.0%** | **28,437** | **6.1%** |

**Source:** Completion of the Future Impervious Area Module Update - January 2007. http://www.trpc.org/resources/memojan2007.pdf

**Note:** Estimate includes residential and commercial growth.

## 4.2 Climate

Southern Thurston County has a predominantly marine climate characterized by mild temperatures both summer and winter. Extreme temperatures are unusual for the area because prevailing westerly winds bring maritime air over the basin and provide a moderating influence throughout the year.

During the spring and summer, high-pressure centers predominate over the northeastern Pacific, sending a northwesterly flow of dry, warm air over the basin. The dry season extends from late spring to midsummer, with precipitation generally limited to a few light showers during this period. Average summer temperatures are in the 50s and 60s degrees F, although hot, dry easterly winds that occasionally cross the Cascade Mountains can raise daytime temperatures into the 90s.

In fall and winter, strong winds and heavy precipitation occur throughout the basin. Storms are frequent and may continue for several days. Successive secondary fronts with variable rainfall may move onshore daily or more often. Heavy rainfall frequently is produced by these storms when warm, saturated air rises over the coastal range and west slopes of the Cascades.

Southern Thurston County and the area around Bucoda receives moderate to heavy rainfall when storms move onshore and through the basin. Normal annual precipitation at the closest rainfall gage in Centralia is 41.6 inches, with 77 percent falling during the period October through March.

Snowfall in the region is generally low. The average annual snowfall is approximately 9 inches, with a recorded extreme maximum of 45 inches. Most of the snowfall occurs in January, with an average of about 4.5 inches (USACE, 2003).

## 4.3 Geology

The underlying geology of the study area is the end product of long term-tectonic, glacial, fluvial, and hillslope processes occurring at the western end of the North American plate for over 40 million years (e.g. Snavely el.al., 1958 and Noble and Wallace, 1966). Glacial processes dominate the surficial deposits and landforms in the South Puget Sound lowlands. The complex geologic history of the region can be boiled down into three general time frames, ordered here from oldest to newest.

From 50 to 2 million years ago, volcanism and marine deposition formed bedrock which is now the basement rock that underlies the study area at depth. This volcanism likely occurred as the North American plate overrode more dense oceanic rocks. All of these rocks have been modified by compression stresses and faulting toward the end of this period. These rocks are typically referred to as the ‘Tertiary bedrock’ denoted on regional geology maps (WDNR, 2010).

Next, the landscape underwent glacial and inter-glacial periods between 2 million to 14,000 years ago. For much of the Pleistocene epoch, multiple continental glaciations have occurred that have provided the raw materials and shaped much of the modern landscape in the Puget Sound lowlands. The Vashon stade, ending around 14,000 years ago, was the most recent period where the study area was covered with glacial ice. Meltwater patterns from the retreating ice carved complex drainageways that likely included an outlet from the Puget Sound lowlands to what is now the Chehalis River and Grays Harbor. Significant deposition of coarser (outwash) and finer (till and lacustrine) glacial layers occurred during this period, resulting in unconsolidated deposits of greater than 900 feet thick in the study area (Noble and Wallace, 1966).

Finally, from 14,000 years ago to present, the post-glacial reorganization occurred following the recession of the large ice sheets. New drainage patterns formed when fluvial and hillslope processes modified the surficial landforms throughout the study area. The Skookumchuck River now occupies one of the valleys created as a glacial meltwater channel. Scatter Creek drainage flows across an extensive prairie of outwash gravels and sands. As a result, the Skookumchuck River flows into a southwest flowing valley to the Chehalis River at Centralia.

According to Noble and Wallace (1966), Bucoda is located on a gravel lobe of the Frost Prairie. The current WDNR state geology map is consistent with Snavely el.al. (1958) and places the Town on more recent alluvium. The hills around Bucoda are comprised of marine, brackish-water, and nonmarine sedimentary rocks with some interbedded volcanic rocks (Snavely el.al. 1958). However, the tops of the hills are comprised of outwash deposits from the Wingate Hill Drift which were laid down prior to the most recent (Frasier) glaciation period. Refer to Figure 9 on page 51 for a Geology Map of Bucoda and Southern Thurston County.

The coal beds can be found within the Skookumchuck Formation, which was named for its proximity to the river (Noble and Wallace, 1966). The coal beds were discovered at Tono (East of Bucoda) and mined via shafts. This regional of the county was been converted to an open pit coal mine (aka TransAlta) which opened in 1971 and continued to about 2005.

### 4.3.1 Geologic Hazards - Channel Migration

Chapter 173-26 WAC requires that channel migration areas be generally identified during the inventory and characterization phase of a Shoreline Master Program update. A Washington Department of Ecology hydrogeologist, Patricia Olson PhD LHG, prepared a study defining the general location of a channel migration zone in Bucoda and surrounding county lands. This report utilized the desktop method, which includes no field reconnaissance, described in Ecology's web guidance.[3]

[3] This report meets the SMP guidelines requirement to identify a Channel Migration Zone (CMZ) found at WAC 173-26-201(3)(c)(v)(ii).

Channel migration is a natural process associated with streams. Streams may migrate across valleys due to a variety of reasons including channel and bank erosion, meander chute cutoff, avulsion and aggradation. The channel migration zone represents the area within which a given stream may migrate over time. Channel migration is an important ecosystem process of streams supporting a number of ecological functions including wildlife habitat. The channel migration process is also an important risk factor for humans and infrastructure in those migrations can result in property damage and change flooding dynamics. Channel migration rates and streambank erosion can be accelerated by changes in flow patterns and loss of riparian cover including the loss of root masses which stabilize river banks (Olson, 2010).

The channel migration zone (CMZ) report compared orthophotos, floodplain maps, and LiDAR data to a composite 1936 aerial photograph prepared by TRPC (see Figures 9 & 10). Active and historic river channels were traced and comparison made.

**NOTE: The river was divided into three reaches, with slightly different reach boundaries from those in the Map Folio.** In the CMZ report there is no Reach 1 and the other reaches include both sides of the river. The CMZ Reach 2 extends from just south of the Town limits to the Tono Road Bridge. This bridge lies between CMZ Reach 2 (to the north) and CMZ Reach 3 (to the south). CMZ Reach 4 extends from the south Town limit to the Burlington Northern Santa Fe Railroad Bridge, largely in unincorporated Thurston County.

The CMZ report also addressed changes to the river hydrology, such as construction of the Skookumchuck Dam in 1971. (See Section 4.4.2) Given the dam's current operation and remote location to the Town, it is assumed to have little effect on channel migration at Bucoda (Olson, 2010).

Evidence of bank erosion and channel migration were observed for most reaches. Table 7 summarizes those results. Then the report finding and conclusions are summarized below.

**Table 7**
**Migration Rates by Reach and Bank Location – 1936 to 2006**
(Olson, 2010 reformatted)

| | Average Migration Rate | Maximum Migration Rate | Average Annual Rate |
|---|---|---|---|
| **CMZ Reach 2** | (Tono Road Bridge north to near Town limits) | | |
| East Bank | 63 feet | 201 feet | 0.9 feet |
| West Bank | 53 feet | 159 feet | 0.75 feet |
| **CMZ Reach 3** | (Tono Road Bridge south to Town limits) | | |
| East Bank | 35.1 feet | 90.5 feet | 0.5 feet |
| West Bank | 30.6 feet | 89.5 feet | 0.44 feet |
| **CMZ Reach 4** | (South Town limits to BNSF RR Bridge) | | |
| South Bank | 17 feet | 32.8 feet | 0.24 feet |
| North Bank | 41.8 feet | 100.6 feet | 0.60 feet |

- Within Bucoda's jurisdiction, the Skookumchuck River is unconfined with a low gradient. The gradient downstream of Bucoda is 5 ft per mile, whereas upstream of the Town is 19 ft per mile (LCCD, 1992).

- Cross-section profiles indicate [the location of current river] banks and previous channels. Many older channels are located within sandy soils whereas are less evident where there are clayey soils. A thin strip on sandy soils and bank erosion is evident in the profile and 2006 orthophoto [along the West Bank of CMZ Reach 2].

- In CMZ Reach 2 [north of the Tono Road Bridge] a single channeled meander pattern with meander chute cutoff is the dominant planform. The soils along the river are mostly sandy (> 35% sand). The valley bottom alluvium has a high erosion and high migration potential. The sandy banks are more erodible than the higher clay content banks downstream. Migration rates are substantially higher in CMZ Reach 2 than CMZ Reach 3 and CMZ Reach 4.

- CMZ Reach 3 [south of Tono Road Bridge] and CMZ Reach 4 [south Town limits to BNSF RR Bridge] are straight, sinuous planform. In CMZ Reach 3-4, the soils along the stream banks and within the floodplain have higher silt-clay percentages (> 50%). Clayey soils can inhibit meander development forming a relatively straight channel confined to narrower floodplain. The clay soil effect is evident in CMZ Reach 3 and 4, with low annual migration rates of 0.2-0.66 feet per year.

- CMZ Reaches 3 and 4 are adjacent to valley walls. These are underlain by sedimentary bedrock with a moderate erosion potential, and lower migration potential. Bank erosion possibly slumping occurred between 1936 and 2006. [Both] factors may be influencing channel migration along these reaches.

- There appear to be some avulsion hazard within CMZ Reach 3 and 4. The avulsion hazard may be relatively low but the existence of side channels near or at the same elevation of the main channel can be reoccupied during larger floods that can overtop natural levees or artificial constraints.

- All of the channel migration areas and potential avulsion hazard areas are located within the FEMA floodplain (Olson, 2010).

## 4.4 Surface Water Runoff

The Skookumchuck River originates in the Gifford Pinchot National Forest northeast of Centralia. It drains an area of approximately 181 square miles and flows into the Chehalis River at River Mile (RM) 67. The Skookumchuck River basin ranges in elevation from 160 feet at the mouth to 3,800 feet at the headwaters, with approximately two-thirds of the basin located below elevation 1,000 feet (USACE, 2003).

The basin has three distinctly different hydrologic regions, all of which are of approximately equal size. See Figure 3 below. The Upper Skookumchuck Watershed Assessment Unit (WAU) is 59 square miles in size. It is a steep, forested, mountainous area with elevations generally above 1,000 feet. The river flows through a steep-sided, narrow floodplain and drains into the reservoir behind Skookumchuck Dam. The Lower Skookumchuck region lies below the dam and extends to the Chehalis River. It has a drainage area of 66 square miles and Bucoda lies in this sub-basin. The Hanaford Creek drainage has a drainage area of 56 square miles and contains a relatively broad floodplain bordered by steep-sided ridges (LCCD, 1992).

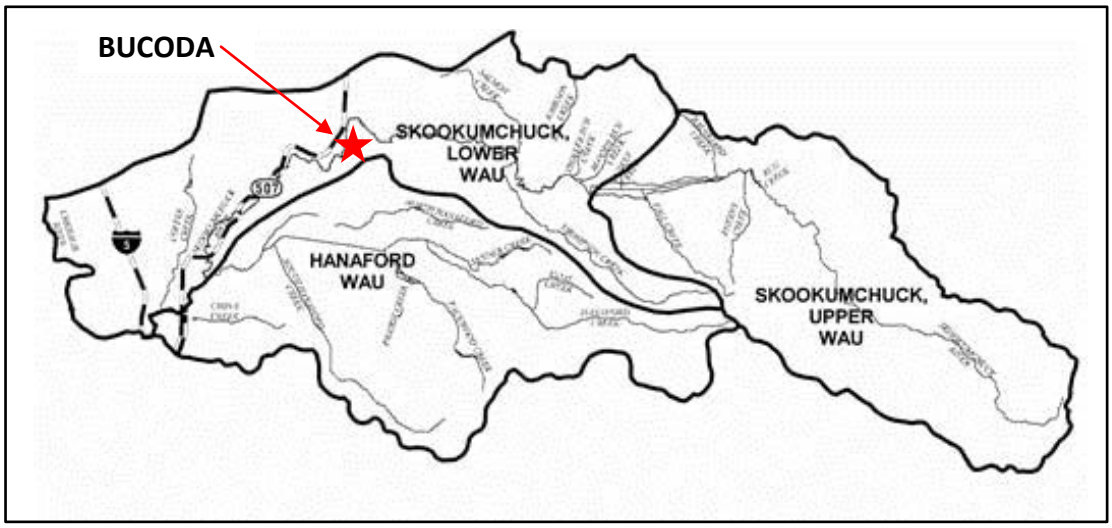



**Figure 3: Skookumchuck Watershed Sub-Basins**

Stream flow generated within the Chehalis River basin originates primarily from rainfall, although snowmelt occasionally augments runoff in the highest elevation reaches. Stream flows in the basin show seasonal variation characterized by sharp rises of short duration from October through March, corresponding to the period of heaviest rainfall. After March, flows tend to decline gradually to a relatively stable baseflow, which is maintained from July into October.

Major flooding occurs during the wet season, usually from November through February. Storms that cover the entire basin can cause widespread flooding. Flooding may also be localized; for example, storms centered over the Willapa Hills can cause flooding in the

upper Chehalis River, whereas those centered over the Black Hills and Cascade foothills may result in flooding in the Newaukum and Skookumchuck River Basins (USACE, 2003).

### 4.4.1 Flood Hazards

The following discussion on flooding has been summarized from the Bucoda Annex of *The Natural Hazards Mitigation Plan for the Thurston Region.* 2009.

In Bucoda major flooding occurs when the river rises to 17.5 feet or 6,500 cubic feet per second at USGS Gage 12026400 (Skookumchuck River near Bucoda). The river has reached this gage height 10 times since 1968. Major flooding results in deep and swift flood waters inundating residential and business areas and numerous roads.

Flooding from the Skookumchuck River is the most prevalent natural hazard that threatens the town. It can be virtually isolated by major flooding with SR 507 becoming impassable both to the north and south of town. In addition the Tono Road can be blocked due to flood waters.

**January 1990**

The Skookumchuck River crested at 16.6 feet and caused major flooding in downtown Bucoda. Floodwaters reached approximately four feet deep on Bucoda streets and prompted nearly 600 residents to evacuate; one elderly man died from natural causes during the evacuation.

**February 1996**

The flood of record for the Skookumchuck River for the Town of Bucoda occurred on February 8, 1996, when heavy rains caused the river to crest over 17.87 feet. Major flooding also occurred on the Deschutes and Chehalis Rivers. The 1996 flood resulted in the evacuation of dozens of residents in downtown Bucoda. Twenty-one properties were damaged. On South Main Street water was 2.2 feet above the cement sidewalks. On South Market, the high water mark was approximately 3.6 feet above ground surface. At the Town owned Volunteer Park water, mud and debris was 1.4 feet above the concrete foundation. The water mark on Nenant Street was 3.9 feet above the ground surface.

**January 6-16, 2009**

Flooding Volunteer firefighters went door to door in Bucoda warning residents of imminent flooding before floodwaters swallowed a nine-block stretch of the town of Bucoda (the town's worst flood event since 1996). Residents were forced to evacuate and a Thurston County dive team was deployed to assist residents. At least two households required rescue assistance. One home was red-tagged and 12 homes were yellow-tagged. The Intersection of 3rd Avenue and North Nenant Street incurred damages exceeding $12,000. Extensive road damage along five blocks of Market Street also occurred. At least one municipal well was forced to shut down due to possible contamination. The town-owned RV park restroom was also contaminated by floodwaters and required extensive cleanup.

Bucoda has the highest per capita population in a flood hazard zone over any other community in Thurston County. Approximately 45 percent of the town lies within the so called 100-year floodplain, or Zone A on the Flood Insurance Rate map (FIRM). Another five (5) percent of the town is vulnerable to high groundwater and 500 year floods, or Flood Zone B.

Approximately 435 people (67% of the town's population), 170 residential units (67%), 25 employees (71%), 94 percent of the commercial buildings, and 100 percent of the government owned buildings are at risk for flooding (located within 100 year, 500 year, and high groundwater flood areas).

With 170 dwelling units within the 100-year floodplain, there are only 74 Flood Insurance Program policies within the Town. This is one of the higher percentages of coverage within Thurston County. Since 1978, there have been a total of 42 claims for flood damage awarded; totaling nearly $250,000. In 1996 Bucoda received a Community Block Grant to elevate 11 residences that were damaged in the 1996 flood. This should reduce repetitive loss claims within the Town.

In addition to reoccurring flooding, the Town is also threatened by a catastrophic failure of the Skookumchuck Dam. The dam currently provides a gross storage capacity of 35,000 acre-feet. If a catastrophic failure occurred, the entire Town of Bucoda would be inundated with flood water. The flood wave would reach the Town limits within 1 hour and 26 minutes to 1 hour and 56 minutes depending on the reservoir and river levels. The time to peak flood level varies from 2 hours and 8 minutes to 2 hours and 50 minutes.

Bucoda has a siren that sounds if the Town is to be evacuated. The local volunteer firefighters visit each and every residence and business during flood potential on a regular basis to inform residents of the flood status.

**Photo 4: Flooding on Nenant Street**
Courtesy of KOMO 4 News – January, 2009

**Table 8**
**Town of Bucoda Hazard Mitigation Initiatives**
(From Brewster, 2009)

| Priority | I.D. Number | Category | Action | Status |
|---|---|---|---|---|
| 1 of 5 | B-MH 2 | Hazard Preparedness | Prepare an addendum to the Town's Comprehensive Emergency Management Plan | Existing |
| 2 of 5 | B-MH 1 | Critical Facilities Replacement/Retrofit | Purchase and install a 30kW propane generator at the Bucoda Fire Department | Modified |
| 3 of 5 | B-MH 4 | Hazard Damage Reduction | Perform analysis of the Town's three critical facilities to identify the most efficient method of maintaining seat of government, emergency operations, and sheltering needs during a flood or earthquake | Existing |
| 4 of 5 | B-FH 1 | Hazard Damage Reduction | Stormwater management engineering and design for city streets | Existing |
| 5 of 5 | B-MH 3 | Hazard Damage Reduction | Establish an alternate well site for the Town. | Existing |

Hazard Category Codes are as follows:

EH=Earthquake Hazard; FH=Flood Hazard; LH=Landslide Hazard; MH=Multi Hazard; SH=Storm Hazard; WH=Wildland Fire Hazard; and VH=Volcanic Hazard.

### 4.4.2 Surface Water Impoundments

The Skookumchuck River is regulated by the Skookumchuck Dam, which is owned and operated by Scottish Power (PacifiCorp). The dam is located at RM 21.9, just upstream from Bloody Run Creek. The dam was completed in 1971. It is an earth fill structure approximately 190 feet high with a crest elevation of 497 feet (LCCD, 1992).

The primary purpose of the dam currently is to supply water for the Centralia coal-fired power plant, which has authority to divert up to 54 cfs of water from the Skookumchuck River. A portion of the water supplies a Washington Department of Fish and Wildlife (WDFW) fish rearing facility located approximately 0.5 mile below the dam (LCCD, 1992).

At the normal minimum operating pool elevation, the reservoir has a capacity of 35,000 acre-feet, extends approximately three miles up the valley, and covers an area of approximately 640 acres (LCCD, 1992).

**Photo 5: Skookumchuck Dam and Reservoir**
Approximately 11 mile upstream of Bucoda, Image courtesy of WSDOT - December 2009

## 4.5 Groundwater Patterns

While the river is the principle aquatic resource within the study area, groundwater flow is largely dependent upon infiltrated rainfall. The glacial deposits within the Skookumchuck River valley overlays the Tertiary bedrock of this area.

Groundwater aquifers and flow patterns have been investigated in the past by the USGS (Snavely et al 1958), with the most recent report being printed over 40 years ago (Noble and Wallace, 1966). These studies only identified a few geologic units within the vicinity of Bucoda.

Bucoda is located on a gravel lobe of Frost Prairie according to one report and on more recent alluvium in the other. Bucoda has a 60 foot well which is located in the river valley alluvium. The maximum depth of this deposit is estimated at 100 feet (Noble and Wallace, 1966).

Groundwater in the hills surrounding the Skookumchuck Valley is extremely limited. The bedrock beneath the valleys is likely the Skookumchuck Formation which also has limited groundwater (Noble and Wallace, 1966).

## 4.6 Water Quality Processes

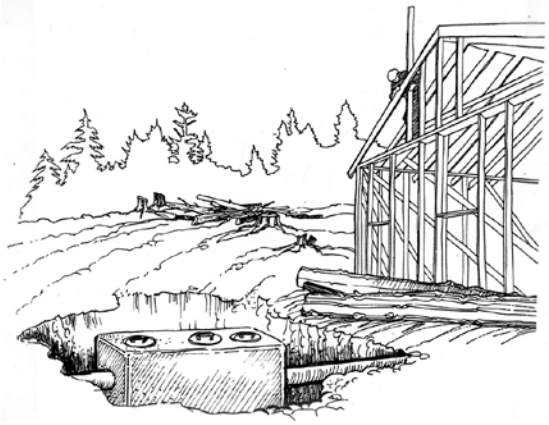
The quality of the water flowing through aquatic systems is the end result of the interaction of water with biota, soils, and urban and rural land uses, and infrastructure. Ecosystem processes that impact the source, concentration, and transport of mineral and organic constituents are: biotic uptake (e.g., plant growth), decomposition (e.g., plant death), adsorption (e.g., chemical binding), and dissolution (e.g., chemical unbinding). In general, elements cycle between dissolved and particulate forms in water to plants, animals, and soils; and back to the water column via decomposition.

Processes that influence water quality occur over a variety of scales. As water moves through an ecosystem, it has the opportunity to cycle (deposit, uptake, entrain, and/or transport) mineral and organic constituents that can affect water quality. The longer water is able to contact soil and vegetation, the more cycling can occur. Longer water contact times typically occur in low gradient areas in the landscape such as riverine and depressional wetland systems. Water contact time is shorter in areas where rivers have been channelized, and the floodplain filled and paved.

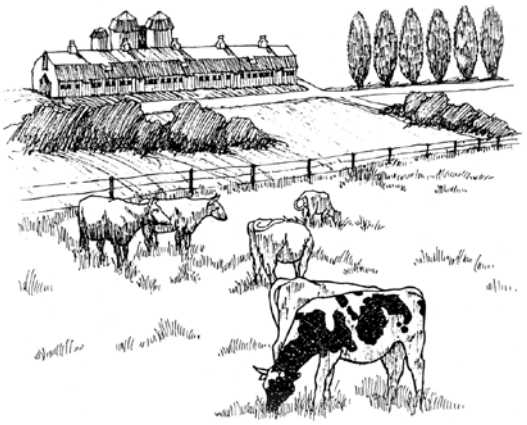
Alterations to water quality processes have occurred within the study area.

**Stormwater:** The installation of impervious surfaces and stormwater conveyance infrastructure can bypass natural hydrologic pathways that include infiltration and percolation through soils. Constituents that can negatively impact water quality (e.g., metals, oils and grease, nutrients, bacteria) can build up on impervious surfaces, to be washed off during storm events.

**On-Site Systems:** Bucoda does not have a wastewater treatment facility, and all of the structures in the Town are on on-site septic systems. The placement of a majority of these systems on a lobe and gravel and sand, and their proximity to the river valley make the Town a large potential contributing source to the groundwater.



**Agricultural Practices:** Outside of Bucoda agricultural fields which can be found throughout the floodplain both up and downstream of the Town may contribute to water quality problems. Poor animal keeping practices can be the source for high nutrient loading and Fecal Colifrom, an indicator of bacterial pollution.



### 4.6.1 Water Quality Standards

Water quality alterations can be generally assessed by comparing water quality in streams and rivers to State water quality standards. The Washington Department of Ecology (WDOE) maintains a database of water bodies where known water quality issues exist, known generally as the 303(d) list. Two segments of the Skookumchuck River are on the 2008 list, and are identified as category 4a. Those parts of the Skookumchuck River upstream of the mouth (which includes Bucoda) are listed for impairments to: 1) Temperature, and 2) Fecal Coliform (WDOE, 2008 Water Quality Assessment Tool).
In 2004, the U.S. Environmental Protection Agency (USEPA) adopted a clean-up plan for multiple basins within the Upper Chehalis Watershed (Rountry, 2004). This document contains a prioritized list of follow-up actions, with many of the implementation measures derived from a series of other technical documents. The table lists the Skookumchuck River as the lowest priority of 13 actions for Temperature (13 of 13) and for Fecal Coliform 16 of 23 actions (Rountry, 2004).

Generally, water quality in the Skookumchuck River is defined as "good" by the Thurston County Environmental Health Department. In water year 2007/08, there were two turbidity measurements above the water quality standard during the winter. Part II of the Fecal Coliform standard was violated in water year 2007/08. One temperature measurement in mid-summer 2009 indicated a possible temperature violation. (TCEH - Draft, 2010)

**Temperature**

In 2006, after the adoption of the USEPA Pollution Clean-Up Plan for the Upper Chehalis Watershed, the Washington Department of Ecology adopted a new temperature standard for the Skookumchuck River. (Payne, 2006) There are now two temperature standards that apply to the Skookumchuck River. The primary criteria of a 7-day average daily (DAD) maximum of 16 º C to protect core summer salmonid habitat, and an additional temperature criteria of a 7-DAD maximum of 13 º C applied between September 15 through July 1 to protect salmon and trout spawning and incubation (TCEH – Draft, 2010).

The temperature data collected through the Thurston County ambient monitoring program are instantaneous measurements. Because there are not continuous temperature recordings from which the 7-day average daily maximum can be calculated, the instantaneous data can only be used as an indicator of possible temperature violations. In July 2009 the temperature

measurement was 17.7 º C, which is greater than the 16 º C DAD standard and indicates that there may have been a temperature violation during this period (TCEH, 2010).

There is also an in-stream flow agreement that requires that water temperatures leaving the Skookumchuck Dam be between 10º to 13º C. The dam has a multi-level intake system that allows water temperature below the dam to be maintained at less than 16º C. When the reservoir drops below full pool and ceases spill, the water is then drawn from lower outlet gates, which lowers water temperatures in the stream below the dam. In 1992, dam operations were found to result in summer water temperatures at or below 13º C (LCCD, 1992).

The 2004 USEPA Pollution Clean-Up Plan for the Upper Chehalis Watershed identified the need for additional shade along the Skookumchuck River as a means of reducing stream temperatures. That plan calls for increasing the existing shade levels along the river by 20%. The addition of riparian vegetation along the Skookumchuck River is noted in the 2008 salmon restoration plan. It identifies the following as restoration actions that would improve the riparian conditions:

- Revegetate open riparian areas with native plants including conifers in appropriate places.
- Interplant conifers into hardwood riparian areas that were historically conifer areas.
- Plant conifers adjacent to and outside existing and limited existing conifer hardwood areas (Napier et al, 2008).

**Fecal Coliform**

The state water quality standard for fecal coliform bacteria has two parts: Part I – the geometric mean shall not exceed 50 colonies per 100 milliliters of sample and, Part II – no more than 10% of the samples shall exceed 100 colonies per 100 mL. The Skookumchuck River has met Part I of the fecal coliform standard all water years but 1998/99. Part II of the fecal coliform standard has not been met in more than half of the water years since the sampling has been conducted (TCEH - Draft, 2010).

Thurston County conducted water quality sampling of the Skookumchuck River from 1982-1985 in response to concerns about high bacteria levels in the river at Schafer Park by the Lewis County Health Department. Monitoring began again on the river in September 1993 at five locations between the SR-507 Bridge, southwest of Bucoda, and the Skookumchuck Dam. The number of sampling sites was reduced to two in March 1996: the downstream site at SR-507 Bridge and an upstream site near Coal Street in Bucoda. Beginning in water year 1999-2000, monitoring was reduced to one location at the SR-507 Bridge. This site is now sampled monthly. In water year 2007/08 part II of the fecal coliform standard was not met as

a result of three high results, in October 2007 and June and August 2008, but the standard was met in 2008/09 (TCEH –Draft, 2010).

### 4.6.2 Toxic and Hazardous Materials

There are number of chemicals and petroleum products that are identified as toxic or hazardous by the Washington State Department of Ecology. It maintains a database of known and suspected contamination sites which may included: sites of known contamination, the location of landfills and dumps, areas of elevated nitrate and chloride levels as well as pesticide contamination. The data includes site name and address, contaminant group and media, and remediation status.

A review of the records indicates that there is a former dump located southeast of downtown along the Tono Road. According to a 1992 report leachate from the former dump is flowing towards the Skookumchuck River, and the illegal dumping of household products is still a problem (LCCD, 1992).

## 4.7 Habitats

Bucoda is located at the southern extend of the Puget Trough province. This ecosystem is dominated by the presence of a broad coniferous forest but can include river floodplains, and other features, such as prairies (e.g., Frost Prairie south of Tenino) and oak woodlands (e.g. along Scatter Creek).

The floodplains of this region are highly influenced by the presence of large wood (known as Large Woody Debris [LWD]) from the previously forested river valleys. LWD significantly influences the geomorphic form and ecological functioning of riverine ecosystems in the Pacific Northwest. LWD consists of logs or trees that have fallen into a river or stream.

In a natural system, LWD provides organic material to aquatic ecosystems and is considered a principal factor in forming stream structure and associated habitat characteristics (e.g., pools and riffles). Riparian vegetation is the key source of LWD. LWD is primarily delivered to rivers, streams, or wetlands by mass wasting (landslide events that carry trees and vegetation as well as sediment), windthrow (trees, branches, or vegetation blown into a stream or river), or bank erosion (Stanley et al, 2005).

The presence, movement, storage, and decomposition of LWD influence shoreline functions as follows:

- Delivery of wood and organics affects vegetation and habitat functions such as instream habitat structure (pools and riffles) and species diversity; and

- Riparian vegetation and LWD, provides habitat in the form of nesting, perching, and roosting as well as thermal protection, nutrients, and sources of food (terrestrial insects) to a variety of fish and wildlife species.

The 2001 limiting factors report prepared for the Upper Chehalis Watershed (WRIA 23) indicates that the level of large woody debris in the Skookumchuck mainstem is "naturally low". "The lack of current LWD results in greater sedimentation transport, greater channel instability, more energy during floods that can increase scour, and less pools and cover available for migration and rearing salmonids." Road and railroads in the floodplain restrict the lateral movement of the river and increased sedimentation. Floodplain roads and railroads closely parallel about 3 miles of the Skookumchuck mainstream, primarily downstream of Bucoda. These facilities are more likely to be hardened and 2.2 miles of the mainstem has been rip-rapped or diked below Bucoda. There are no reported fish blockages on the mainstem of the Skookumchuck River (Smith and Wenger, 2001).

The limiting factors report suggested the following high priority actions to improve the riparian conditions (Smith and Wenger, 2001):

**GOAL:**

- *Open three or more miles of good quality habitat used by at least one stock of salmon* or steelhead.

**Restoration Actions:**

- Implement TMDL actions for water temperature and pH.
- Reconnect potential off-channel habitat.
- Restore wetlands and off-channel habitat.
- Increase activities that lead to natural recharge of the aquifers and maintain or improve hydrologic maturity.
- Increase instream LWD, or similarly functioning natural structures, to help address channel incision and flow issues. This includes:
    - Appropriate riparian restoration (see below)
    - Increase natural recruitment potential though riparian restoration.
- Revegetate open riparian areas with native plants including conifers in appropriate places.
    - Interplant conifer into hardwood riparian areas that were historically conifer areas. *(Moderate Priority)*
    - Plant conifer adjacent to and outside existing and limited existing conifer hardwood riparian areas. *(Moderate Priority)*
- Reduce livestock access to streams.
- Reduce water withdrawals from both surface and ground sources.
- Decommission roads at risk of landslides, especially side-cast roads.
- Increase protection of steep and unstable slopes.
- Correct high impact road sediment delivery problems via push-outs, cross-drains, and sediment traps etc.

Currently, there are no restoration proposal for anywhere on the mainstem of the Skookumchuck River or within the vicinity of Bucoda according to *The Chehalis Basin Salmon Habitat Restoration and Preservation Work Plan for WRIAs 22 and 23* (Napier et al, 2008). Within the year, there may be mitigation actions proposed within the vicinity of Bucoda as a part of the US Army Corps of Engineers General Investigation for the Twin Cities Flood Reduction Project.

### 4.7.1 Priority Habitats and Species of Concern

The Washington Department of Fish and Wildlife (WDFW) maintain a habitat database with the most current locations of "Priority Habitats and Species" and "Species of Concern." In general, priority species and their habitats are in sharp decline within Western Washington. Priority species include those with the concerns of extinction. These may be listed by the state or Federal government as "endangered" or "threatened." Examples might include the Bald Eagle or the Peregrine Falcon. The habitat database also includes species which are considered to be "sensitive" or "monitored", such as the Olympic Mudminnow.

Species of concern known or likely to be found in Bucoda are Chinook salmon. They are known to spawn in the mainstem of the Skookumchuck River, and utilization of shoreline areas within the Town limits of Bucoda has been documented by the Washington Department of Fish and Wildlife. Spawning of coho salmon, juvenile Chinook and steelhead can has also been documented in the smaller streams (WDFW, 2011). Other priority species know to frequent areas close to the Town are Harlequin Duck which can be found along the valley floodplain, and Elk in slopes to the east and south of the Skookumchuck River.

In addition to state and federal regulations protecting endangered species, local governments adopt regulation to protect priority habitats and species of concern. In the Town of Bucoda regulations are contained with the local Critical Areas Ordinance (CAO). In Bucoda they are referred to as Critical Fish and Wildlife Habitat Areas (BCC 18D.40). The specific CAO regulations which apply are summarized in Section 2.4.

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# 5.0 REACH SCALE INVENTORY AND ASSESSMENT

## 5.1 Bucoda Shoreline Reaches

For purposes of the analysis and characterization the minimum shoreline jurisdiction was divided into three stream "reaches." **These reaches are described on Table 9 and mapped on Figures 5 & 6.** Factors considered in delineating reach breaks included a combination of shoreline location, existing infrastructure, biological resources, existing shoreline designations, and existing land uses/zoning. Thurston County set reach break boundaries at the Town limits as part of its SMP characterization.

The west bank of the Skookumchuck River was divided into Reaches 1 and 2, separated by the Tono Road Bridge. Channel migration is more dominant above the bridge than below. Note that Reach 2b is part of the minimum shoreline jurisdiction but does not extend to the river's edge. It will be described within Reach 2. Reach 3 is located on the east bank of the river where the development pattern is less intense and ecological conditions are more intact.

**Table 9**
**Shoreline Reaches for Bucoda**

| Waterbody | Name of Shoreline Reaches | Shoreline Reach Location | Shoreline Length (feet) | Shoreline Area (acres) |
|---|---|---|---|---|
| Skookumchuck River | **Reach 1** | West Bank – N Town Boundary south to and including the Tono Road Bridge | 5,348 ft | 28.4 ac |
| | **Reach 2** | West Bank – Tono Road Bridge south to S Town Boundary | 2,257 ft | 15.7 ac |
| | **Reach 2a** | West (North) Bank – Southeast of 13th Street W to S Town Boundary | NA *(In Floodplain)* | 3.5 ac |
| | **Reach 3** | East Bank - N Town Boundary south to Tono Road Bridge and south to S Town Boundary | 4,107 ft | 34.3 ac |
| | **TOTAL*** | 8,370 ft (N Town limits to S Town Limits) | 11,712 ft *(both banks)* | 81.9 ac |

## 5.2 Reach 1 – West Bank *(Northern Town limit to Tono Road Bridge)*

***Summary***: Reach 1 extends from the northern Town boundary along the West Bank of the Skookumchuck River south to and including the Tono Road Bridge. This reach contains 28.4 acres in shoreline jurisdiction and 5,348 feet of shoreline. The reach lies predominately within the 100-year floodplain with a fringe of riparian habitat and exhibits active channel migration. .

### 5.2.1 Existing and Future Land Use (Zoning), Existing Shoreline Designation

***Existing and Future Land Use (Zoning):*** Land uses within Reach 1 contains all or part of 25 parcels which contain 9 residences. Outside the platted street area, the parcels are irregular in shape. While all the parcels are zoned Residential there is a high percentage of undeveloped land (pastures) between the structures and the river. There are a number of platted lots are undeveloped and there are several street ends. The river setback for those few parcels residences within the platted street grid can be less than 50 feet, where the residences outside the street grid range from 150 to 200 feet to the river.

***Existing Shoreline Designation:*** The existing Shoreline Environment Designation for this reach is "Urban." In the Urban Environment setbacks and minimum lot size of dry land area shall be as specified by the local zoning ordinance, where local zoning does not conflict with other provisions of the Shoreline Master Program (Aaland, 1990).

**Table 10**
**Reach 1 – Existing Land Use, Zoning, and Shoreline Designations**

| **Land Cover** (Refer to Figure 11) | **Zoning** (Refer to Figure 12) | **Shoreline Environment Designations** (Refer to Figure 7) |
|---|---|---|
| Residential (70%) | Residential | Urban |
| Agricultural – current use (16%) | Residential | Urban |
| Public Right of Ways (14%) | Residential | Urban |

### 5.2.2 Roads, Railroads, Utilities, Shoreline Modifications

***Roads, Railroads and Utilities:*** A number of local access streets are located within the minimum shoreline jurisdiction. Portions of Market St N, 1st Street E, 2nd Street E, River St N, and 4th Street E. The Tono Road Bridge and its approaches are located within this reach and it was rebuilt in 1972. A PSE overhead utility crossing is located adjacent to the bridge.

***Shoreline Modifications:*** As noted in the Ecology channel migration report, there is active ongoing migration occuring within this reach. While there are no official dikes or levees within this reach, inspection of the 2009 aerial photograph revealed approximatey 350 feet of shoreline armoring between 3rd Street E (extended) and 4th Street E; approximately 380 feet along an oxbow between 4th Street E and 5th Street E (extended), and approximately 380 feet along an oxbow just north of Tono Road. The northern area lies adjacent to existing residences, whereas the two southern areas lie adjacent to pastures.

### 5.2.3 Water Dependent/Oriented Uses

***Water Dependent/Oriented Uses:*** There are no Water Dependent, Water Enjoyment nor Water Related Uses located within this reach.

### 5.2.4 Historic Sites

***Historic Sites:*** There are no historical sites within this reach.

### 5.2.5 Public Access and Public Waterfront Land Owners

***Public Access and Public Waterfront Land Owners*:** There are no developed public access sites within this reach. However there are several pubic street ends that are described under Opportunity Areas.

### 5.2.6 Critical Areas

***Channel Migration, Floodway and Floodplains:*** The Ecology channel migration report indicates that this is the Town's most active migration reach. The soils along the river are mostly sandy (> 35% sand) and have a higher migration potential than doe the soils in Reaches 2 or 3. The average channel migration rate is estimated to be 0.9 feet per year with a maximum migration of over 200 feet when the oxbow channel (now on the opposite bank) was cut off. All the minimum shoreline jurisdiction lies within the FEMA 100-year floodplain.

All of the nine residences within this reach are located within the FEMA 100-year floodplain. Channel Migration Zones are regulated as Floodways and the Town's Critical Areas Ordinance (CAO) extremely restricts activities within Floodways. While there is no mapped FEMA Floodway, the "Floodway" designation is determined on parcel by parcel basis based upon the depth and velocity of the 100-year flood. The CAO provides for limited development activity within a 100-year floodplain. These are subject to site requirements and the elevation of new structures above the 100-year floodplain.

***Wetlands:*** Within this reach the wetlands are limited to the thin riparian corridor between the edge of the river to the top of the bank. There is an undeveloped riparian forested wetland at the 4$^{th}$ St E street end, an undeveloped parcel west bank parcel which extends across the river from Ohop St NE, and an undeveloped right of way south of 4$^{th}$ Street E. This is the largest forested wetland north of Tono Road. The wetlands along the east bank of the Skookumchuck River, within unincorporated Thurston County, have similar fringe riparian wetlands, with the exception of an oxbow wetland located generally from 2$^{nd}$ Street to 4$^{th}$ Street (extended).

***Critical Fish and Wildlife Habitat Areas:*** Mature Chinook salmon are known to spawn in the mainstem of the Skookumchuck River within the Town limits according the Washington Department of Fish and Wildlife (WDFW, 2011). The forested riparian corridor along this reach is less intact that Reaches 2 and 3. Coho salmon, juvenile Chinook and steelhead are also documented within the smaller streams. The oxbow wetland on the opposite shore of this reach is a major habitat feature.

### 5.2.7 Opportunities Sites

Within this reach there are opportunities for providing additional shoreline public access, protecting existing ecological functions, and improving currently degraded habitat. See Figure 16 in the Map Folio.

- ***Opportunity Site A***: Plant parallel rows of trees – *Private & public property*
  Project: Replanting forest vegetation along the western side of the river from the northern Town limits to about 3rd Street to deflect flood waters away from the Town. This would be an alternative to a dike or other shoreline armoring. Part of this area is a former river channel bed, and so is publicly owed. The remainder is on private property and would require a willing property owner for either fee simple acquisition or a conservation easement. Long-term management with require a conservation entity such as a land trust or similar non-profit organization.

- ***Opportunity Site B***: Reconnect former oxbow to river – *Private & public property*
  Project: This project lies across the river in unincorporated Thurston County, but is the best opportunity to increase riparian habitat adjacent to the Town. It would increase the cross sectional area, it may provide a slightly reduction in flood elevations. Some of the property is former river channel and is public property. The remaining private property would require voluntary fee simple acquisition or conservation easements. Long-term management with require a conservation entity such as a land trust or similar non-profit organization.

- ***Opportunity Site C:*** 4th Street E – *Undeveloped Street End*
  Project: 1) Trail to water's edge, and or
  2) Habitat Protection with Opportunity Site D

- ***Opportunity Site D***: Former River Channel – *Public Property*
  Project: Habitat Protection with Opportunity Site C

## 5.3 Reach 2 – West Bank (*Tono Road Bridge to South Town limits)*

***Summary:*** Bucoda's shoreline Reach 2 extends from the southern edge of the Tono Road Bridge along the West Bank of the Skookumchuck River south to the town limits. Reach 2a on the southwest corner of the town limits is part of the minimum shoreline jurisdiction but is called out separately because it doesn't directly border on the river. . This reach contains a total of 19.2 acres in shoreline jurisdiction and 2,257 feet of shoreline. The reach lies within a narrower floodplain with a fringe of riparian habitat and limited channel migration.

### 5.3.1 Existing and Future Land Use (Zoning), Existing Shoreline Designation

***Existing and Future Land Use (Zoning):*** Land uses in Reach 2 consist of 30 parcels and 23 residences. In Reach 2a there are two parcels and a single residence. Commercial zoning is limited to the south side of 7th Street E. Penitentiary Park, the site of the former territorial penitentiary, is located at the southern end of this reach. More parcels in this reach are oriented toward the river and there only a few undeveloped right of ways or street ends. The residences along Mill Creek Court SE are recent with most homes located outside the 100-year floodplain. Setbacks from these new structures to the river range from 120 to 220 feet with an average of about 170 feet.

***Existing Shoreline Designation:*** The existing Shoreline Environment Designation for this reach is "Urban." In the Urban Environment setbacks and minimum lot size of dry land area shall be as specified by the local zoning ordinance, where local zoning does not conflict with other provisions of the Shoreline Master Program (Aaland, 1990).

**Table 11**
**Reach 2 – Existing Land Use, Zoning, and Shoreline Designations**

| **Land Use** (Refer to Figure 11) | **Zoning** (Refer to Figure 12) | **Shoreline Environment Designations** (Refer to Figure 7) |
|---|---|---|
| Residential (80%) | Residential | Urban |
| Commercial (4%) | Commercial | Urban |
| Public Right of Ways (12%) | Residential & Commercial | Urban |
| Park (4%) | Public Use | Urban |

### 5.3.2 Roads, Railroads, Utilities, Shoreline Modifications

***Roads, Railroads and Utilities:*** Portions of River Street S, 8th Street E, Market Street S, Mill Creek Court SE, and 12th Street S are located within the minimum shoreline jurisdiction. The right of way for the Burlington Northern Santa Fe Railroad which used to serve the Mutual Lumber Company mill is located in this reach.

***Shoreline Modifications:*** Riprap has been placed in the river under the Tono Road Bridge. The Skookumchuck River was dammed downstream of the Tono Road Bridge to support the Mutual Lumber Company mill which was located in this reach. The mill closed in 1944 with the dam removed sometime thereafter. To the west of the river a mill pond was constructed, which now supports a forested/scrub shrub wetland.

### 5.3.3 Water Dependent/Oriented Uses

***Water Dependent/Oriented Uses:*** No Water Dependent, Water Enjoyment nor Water Related Uses are located within this reach.

### 5.3.4 Historic Sites

***Historic Sites:*** A single historic site was located in Reach 2. It is the site of the former state penitentiary. The Town currently owns this site, which is described in the Public Access section.

**Table 12**
**Reach 2 – Historic Sites**

| **Historic Sites** (Refer to Figure 13) | | | | | |
|---|---|---|---|---|---|
| Historic Site Name | Address | National Register | State Register | Local Register | Historic Inventory |
| Seatco Prison Site | 720 SW Factory Street<br>Bucoda, WA 98530 | Yes | Yes | --- | Yes |

### 5.3.5 Public Access and Public Waterfront Land Owners

***Public Access and Public Waterfront Land Owners*:** The Town of Bucoda has one facility located within this reach. Penitentiary Park is largely undeveloped, about 1.5 acres in size, and has a shoreline length of 100 feet.

**Table 13**
**Reach 2 - Pubic Access Site**

| **Public Access** (Refer to Figure 13) | | | | |
|---|---|---|---|---|
| Facility | Access | Fishing | Swimming | Boat Launch |
| • Penitentiary Park | Yes | Yes | Yes | No |

### 5.3.6 Critical Areas

***Channel Migration, Floodway and Floodplains:*** As noted in the Ecology channel migration report, there is limited ongoing migration occuring within this reach. The banks have a higher silt-clay percentages (> 50%) and are less likely to meander, and may form relatively straight channel within a narrower floodplain. The channel migration rates in this reach are relatively low at 0.2-0.66 feet per year. At Reach 2a the presence of a side channel near or at the same elevation of the river channel indicates a possible avulsion hazard. These areas could be reoccupied during larger floods. The channel migration and potential avulsion channel are located within the FEMA floodplain (Olson, 2010).

Nine of the 24 residences within this reach (38%) are located within the FEMA 100-year floodplain. Channel Migration Zones are regulated as Floodways and the Town's Critical Areas Ordinance (CAO) extremely restricts activities within Floodways. While there is no mapped FEMA Floodway, the "Floodway" designation is determined on parcel by parcel basis based upon the depth and velocity of the 100-year flood. The CAO provides for limited development activity within a 100-year floodplain. These are subject to site requirements and the elevation of new structures above the 100-year floodplain.

***Wetlands:*** The wetlands in this reach are limited to the thin corridor between the edge of the river to the top of the bank. A forested and scrub-shrub wetland now exists in the location of the former Mutual Lumber log pond. While now a wetland, the native soil is Spanaway Gravelly Sandy Loam at 0-3 % slope. This is an outwash soil and the same soil type as the rest of the Town within the grid street pattern.

***Critical Fish and Wildlife Habitat Areas:*** Mature Chinook salmon are known to spawn in the mainstem of the Skookumchuck River within the Town limits according the Washington Department of Fish and Wildlife (WDFW, 2011). The forested riparian corridor south of Tono Road Bridge is largely intact. Coho salmon, juvenile Chinook and steelhead are also documented within the smaller streams (WDFW, 2011).

### 5.3.7 Opportunities Sites

Reach 2 contains opportunities for providing additional shoreline public access, and improving degraded habitat. See Figures 16 & 17.

- ***Opportunity Site E***: Old Tono Road - *Street End*
  Project: Removing invasive species and replant with native vegetation

- ***Opportunity Site F***: 8th Street S – *Street End*
  Project: Removing invasive species and replant with native vegetation

- ***Opportunity Site G***: Penitentiary Park – *Town Park*
  Project: 1) Removing invasive species and replant with native vegetation
  2) Education and/or Historic Interpretative signage
  *(Contact - Thurston County Historic Commission)*

**Photo 6: Penitentiary Park**
Photo provided courtesy of WDOE 2010

## 5.4 Reach 3 – East Bank

***Summary:*** Reach 3 extends from the northern to the southern Town boundary along the East Bank of the Skookumchuck River. This lies both north and south of the Tono Road Bridge. This reach contains 34.3 acres in shoreline jurisdiction and 4,107 feet of shoreline. The reach contains a well forested riparian corridor and steeper slopes along the river. There is little indication of active channel migration, but a historical side channel exists parallel to the current channel location. Land uses in Reach 3 consist of undeveloped properties, newer residential properties, and a Town park.

### 5.4.1 Existing and Future Land Use (Zoning), Existing Shoreline Designation

***Existing and Future Land Use (Zoning):*** In this reach there are 11 parcels and a total of 4 residences. The predominant land use in this reach is residential with low densities. There is some Natural Resource land use, forestry and a low portion of public right of ways. The Town's Volunteer Park and RV Park are located in this reach.

***Existing Shoreline Designation:*** The existing Shoreline Environment Designation for this reach is "Conservancy." In the Conservancy Environment residential densities are a minimum of forty thousand (40,000) square feet of dry land area, lots of one hundred (100) feet (measured at the ordinary high water mark and at the building setback line), lot coverage with impervious surfaces of thirty percent (30%), and setback of one hundred (100) feet from the ordinary high-water mark (Aaland, 1990).

**Table 14**
**Reach 3 – Existing Land Use, Zoning, and Shoreline Designations**

| **Land Use** (Refer to Figure 11) | **Zoning** (Refer to Figure 12) | **Shoreline Environment Designations** (Refer to Figure 7) |
|---|---|---|
| Residential (62%) | Residential | Conservancy |
| Natural Resources (16%) | Residential | Conservancy |
| Public Right of Ways (5%) | Residential | Conservancy |
| Park (17%) | Public Use | Conservancy |

### 5.4.2 Roads, Railroads, Utilities, Shoreline Modifications

***Roads, Railroads and Utilities:*** Approximately 1,200 feet of the Tono Road south of the bridge and the southern half of Park Street are within the minimum shoreline jurisdiction. At the Tono Road intersection, Ohop Street SE lies just outside of shoreline jurisdiction and above the 100-year floodplain. A PSE overhead utility crossing is located adjacent to Tono Road.

***Shoreline Modifications:*** Riprap has been placed in the river under the Tono Road Bridge. The Skookumchuck River was dammed downstream of the Tono Road Bridge to support the Mutual Lumber Company mill which was located in Reach 2. The mill closed in 1944 with the dam removed sometime thereafter.

### 5.4.3 Water Dependent/Oriented Uses

***Water Dependent/Oriented Uses:*** There are no Water Dependent, Water Enjoyment nor Water Related Uses located within this reach.

### 5.4.4 Historic Sites

***Historic Sites:*** There are no historic sites located within this reach.

### 5.4.5 Public Access and Public Waterfront Land Owners

***Public Access and Public Waterfront Land Owners*:** The Town of Bucoda has two facilities with shoreline public access located within this reach. The first is Volunteer Park which includes 14 acres and the next is the RV Park at 0.4 acres. There are 540 feet of public shoreline downstream of the Tono Road Bridge and 260 feet upstream of the bridge.

**Table 15**
**Reach 3 - Pubic Access Sites**

| **Public Access Sites** (Refer to Figure 13 ) | | | | |
|---|---|---|---|---|
| Facility | Access | Fishing | Swimming | Boat Launch |
| • Volunteer Park - 14 acres | Yes | Yes | Yes | No |
| • RV Park - 0.4 acre | Yes | Yes | Yes | No |

### 5.4.6 Critical Areas

***Channel Migration, Floodway and Floodplains:*** Ecology's CMZ report indicated less channel migration in this reach due to the presence of more resistant marine sediment along the valley walls. A cross-section profile in this reach noted a side channel near or at the same elevation of the river channel. This avulsion hazard may be relatively low but could be reoccupied during larger floods. The channel migration and potential avulsion channel are located within the FEMA floodplain (Olson, 2010).

All four residences within this reach are located within the FEMA 100-year floodplain. Channel Migration Zones are regulated as Floodways and the Town's Critical Areas Ordinance (CAO) extremely restricts activities within Floodways. While there is no mapped FEMA Floodway, the "Floodway" designation is determined on parcel by parcel basis based upon the depth and velocity of the 100-year flood. The CAO provides for limited development activity within a 100-year floodplain. These are subject to site requirements and the elevation of new structures above the 100-year floodplain.

***Wetlands:*** Wetlands within this reach are located along the river in a relatively intact forested riparian corridor and along an unnamed stream to the north of Tono Road.

***Critical Fish and Wildlife Habitat Areas:*** Mature Chinook salmon are known to spawn in the mainstem of the Skookumchuck River within the Town limits according the Washington Department of Fish and Wildlife (WDFW, 2011). The forested riparian corridor along this reach is more intact that Reaches 1 and 2. Coho salmon, juvenile Chinook and steelhead are also documented within the smaller streams (WDFW, 2011).

### 5.4.7 Opportunities Sites

Within this reach there is an existing public access site where additional interpretative signage may enhance enjoyment of the shoreline. In addition, there may be opportunities for improving shoreline functions by removing invasive species from public property. See Figure 17 in the Map Folio.

- ***Opportunity Site H***: Volunteer Park/RV Park – *Town Park*

  Project: 1) Removing invasive species and replant with native vegetation
  2) Education and/or Historic Interpretative signage
  *(Contact - Thurston County Historic Commission)*

**Photo 7: Volunteer/RV Park**
Photo provided courtesy of WDOE 2010

# 6.0 DATA GAPS

This section describes specific data gaps or limitations identified during development of the shoreline analysis and characterization as required by Ecology's guidelines. This data gap list is not considered exhaustive, rather a list of sources and/or information need for future updates.

Data missing or not available for this report include:

***Updated Floodplain Mapping.*** The available floodplain mapping was prepared by FEMA in the early 1980s. A floodway delineation was prepared for the city but was not adopted. In February 2010, FEMA notified Thurston County it intends to remap the floodplain of the Skookumchuck River. A target completion date and financial commitment by FEMA are not yet in place.

***Skookumchuck Dam.*** The US Army Corps of Engineers is preparing a General Investigation for the Twin Cities Flood Reduction Project. There is one proposal to use the dam that is a part of the proposed General Investigation, and one which is an alternative proposal. A side-by-side comparison of these two proposals to modify the Skookumchuck Dam is not yet available.

***Comprehensive Sanitary & Stormwater Plans.*** This analysis does not describe whether the Town has a comprehensive approach or planning objectives for long-term capital improvements for sanitary sewers or the treatment of stormwater outfalls to the river. The City of Tenino recently constructed a Class A - reclaimed water, wastewater treatment facility for all of its on-site systems. The Town has no plans for anything similar at this time. Bucoda has adopted a Hazard Mitigation initiative (Table 8) to design and engineer city streets for stormwater management.

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# 7.0 SHORELINE MANAGEMENT RECOMMENDATIONS

The following recommendations synthesize the area-specific opportunities identified in Section 4 above and provide additional shoreline management recommendations in the context of other local and regional planning activities. These recommendations are intended to frame the future development of the Town's shoreline master program by identifying opportunities for ecological conservation, enhancement, and restoration, as well as areas to enhanced public access to the shoreline.

***Minimum or Optional Shoreline Jurisdiction.*** The Town of Bucoda is dominated by the floodplain of the Skookumchuck River. Currently 45% of the town is within the floodplain and in shoreline jurisdiction as the Town adopted the 100-year floodplain as optional shoreline jurisdiction in 1990. With the minimum shoreline jurisdiction being 81.9 acres, the Town will determine if the remaining 85.9 acres should again be in shoreline jurisdiction.

***West Bank - Shoreline Environment Designation.*** The current shoreline environment designation (SED) "Urban" for Reaches 1 and 2 is the least restrictive in the current master program. It actually has no minimum setback from the river. Bucoda's Critical Areas Ordinance (CAO) was adopted in 2005 and partially filled that gap with regulations to protect habitat and limit development within floodplains. For those reaches the Town may wish to consider adopting a designation which is more closely linked to the reach's ecological resources and which is consistent with the Town's Comprehensive Plan Land Use Plan.

***Opportunity Sites.*** There are possible Opportunity Sites listed in all three reaches. There are no proposed restoration sites along the mainstem of the Skookumchuck River. Taken as a whole or individually, these sites identify where the Town (or others) could improve public access or the ecological conditions along the river over time.

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# 8.0 REFERENCES

## 8.1 Data Sources

The state master program guidelines state that shoreline inventory and characterizations to support local SMP amendments should be based on scientific and technical information. Inventories should use existing sources of information that are both relevant and reasonably available (WAC 173-26-201(3)(c)).

Data for the following Reach Scale Inventory and Assessment was collected from a variety of sources. Maps and the Geographical Information System (GIS) data were prepared by TRPC. Data for the textual sections was collected from Federal, Tribes, state, county, and regional government agencies, conservations districts, and non-profits. Unless otherwise noted, the sources for the reach scale data are indicated in the inventory template on the following pages.

**Feature Name**

- 2009 Aerial Photography
- (Thurston GeoData Center, Thurston County)
- Urban Growth Areas line is shown in dashed black and white
- Minimum Jurisdiction is shown in transparent yellow.
- Reaches are mapped on the Ordinary High Water Mark.

**WRIA, Watershed, Basin**

- WRIAs, Watersheds, Basins – Thurston GeoData Center

**Size/Length**

- TRPC LIDAR -corrected Hydro GIS Layer

**Topography**

- Topography – LIDAR – Puget Sound LIDAR Consortium (2002)

**Surface Hydrology**

- TRPC LIDAR-corrected Hydro GIS Layer and Various Basin Studies (listed below)

**Existing Shoreline Designations**

- Thurston GeoData Center & TRPC 1975 Regional Shoreline Master Program

**Minimal & Optimal Shoreline Jurisdiction**

- TRPC calculation - 2009 Aerial Photography, new town boundary, and 1975 SMP map

**General Land Cover**

- TRPC 2000 Land Cover Analysis and 2009 Aerial Photography

**Current Land Use**

- TRPC 2006 Buildable Lands Inventory

**Future Land Use (Zoning)**

- TRPC 2006 Buildable Lands Inventory, and Town of Bucoda

**Water Dependent/Oriented Uses**

- TRPC 2006 Buildable Lands Inventory, and research by TRPC staff

**Roads**

- Roads – Street Atlas of Thurston County; Thurston GeoData Center Roads Data Layer

**Railroads, Utilities**

- TRPC 2006 Buildable Lands Inventory and 2009 Aerial Photography

**Shoreline Modifications**

- Basin studies and TRPC observations

**Historic Properties**

- TRPC Historic Properties Database
- DAHP, Washington Information System for Architectural and Archaeological Records Data (WISAARD)

**Public Waterfront Land Owners**

- TRPC 2006 Buildable Lands Inventory

**Public Access**

- TRPC 2008 Regional Trails Plan
- TPRC 2009 Profile
- TRPC 1991 Shoreline Public Access Inventory

**Critical Areas**

**Wetlands**

- Wetland Indicators, TRPC

**Habitat Conservation Areas**

- Based on adopted Critical Areas Ordinances (buffers of streams)

**Priority Habitats & Species**

- Washington Department of Fish and Wildlife – not mapped due confidentiality per data sharing agreement

**Floodplains & Floodways**

- 100-year Floodplains – FEMA, Thurston GeoData Center
- Floodways - FEMA, Thurston GeoData Center

**Landslide Hazard Areas**

- Based on adopted Critical Area Ordinances

**Known sites with Toxic or Hazardous Materials**

- Elevated Nitrate Areas – Thurston GeoData Center
- Elevated Chloride Levels – Thurston GeoData Center
- Areas of Pesticide Contamination – Thurston GeoData Center
- Landfills and Dumps – Thurston GeoData Center
- Contamination Sites – Washington State Department of Ecology
- Leaking Underground Storage Tanks – Washington State Department of Ecology

**Water Quality - State Listings**

- United States Environmental Protection Agency—Total Maximum Daily Loads Program
- Washington State Department of Ecology—Surface Water Quality Standards, Water Quality Listings by Category, 2008 Integrated Water Quality Assessments—Surface Water and Sediments

**Water Quality - Local Information**

- *Thurston County Water Resources Monitoring Report—2008-2009 Water Year, 2008-2009 Water Year,* 2010

**Fisheries**

- *Draft - Thurston County Water Resources Monitoring Report—2008-2009 Water Year*, 2008-2009 Water Year, Thurston County Water Resources, Resource Stewardship Department, 2010.
- *Salmon Habitat Limiting Factors Final Report WRIA 23*– Washington State Conservation, Commission, 2001.
- *The Chehalis Basin Salmon Habitat Restoration and Preservation Work Plan for WRIAs 22 and 23,* 2008.
- *Skookumchuck Watershed Culvert Assessment.* Lewis County Conservation District, 2002.
- *Chehalis Basin Watershed Management Plan – Supplement Section*, 2002

## 8.2 Sources Citations


Aaland, N. 1990. *Shoreline Master Program for the Thurston Region.* Thurston Regional Planning Council, Olympia, WA

Ahmed, A. and Rountry, D. 2004. *Upper Chehalis River Fecal Coliform Bacteria Total Maximum Daily Load: Submittal Report.* Publication Number 04-10-041. Washington State Department of Ecology - Water Quality Program, Olympia, WA

Brewster, P. 2009. *The Natural Hazards Mitigation Plan for the Thurston Region.* Thurston Regional Planning Council. Olympia, WA

(Washington) Department of Archeology and Historic Preservation. 2002. *National Register of Historic Place Registration Form - Tenino Downtown Historic District.* Olympia, WA

Drost, B.W., G.L. Turney, N.P. Dion, and M.A. Jones. 1998. *Hydrology and quality of ground water in northern Thurston County, Washington.* U.S. Geological Survey, in cooperation with Thurston County Health Department.

Federal Emergency Management Agency. 1974. *Flood Insurance Boundary Map H-01, Town of Bucoda, Washington (Thurston Co.).* Washington, DC

Federal Emergency Management Agency. 1982. *Flood Insurance Study – Unincorporated Thurston County, Washington.* Washington, DC

Grette Associates. 2009. *DRAFT - Thurston County Shoreline Master Program Update – Shoreline Analysis and Characterization.* Tacoma, WA

Jennings, K. and P. Pickett. 2000. *Revised Upper Chehalis River Basin Dissolved Oxygen Total Maximum Daily Load Submittal Report.* Publication Number 00-10-018. Washington State Department of Ecology - Water Quality Program, Olympia, WA

Lewis County Conservation District. 1992. *Chehalis River Basin Nonpoint Action Plan for the Control of Nonpoint Source Pollution – Skookumchuck River.* Chehalis River Council, Chehalis, WA

Morrison, S. 2010. *Draft – Preliminary Shoreline Jurisdiction, Shoreline Master Program Updates for Bucoda, Tenino and Tenino and their Urban Growth Areas.* Thurston Regional Planning Council for Thurston County. Olympia, WA

Morrison, S. 1984. *Shoreline Master Program for the Thurston Region.* Thurston Regional Planning Council, Olympia, WA

Morrison, S. 1999. *Thurston County Flood Hazard Management Plan.* Thurston Regional Planning Council for Thurston County. Olympia, WA

Napier, L; C. Stussy, B. Demond, and J. Kliem. 2008. *The Chehalis Basin Salmon Habitat Restoration and Preservation Work Plan for WRIAs 22 and 23.* The Chehalis Basin Partnership Habitat Work Group. Montesano, WA

Noble, J. B. and E. F. Wallace. 1966. *Geology and Ground-Water Resources of Thurston County, Washington, WA. Volume 2.* Water Supply Bulletin No 10. United States Geological Survey, Water Resources Division.

Olson, P. 2010. *City of Bucoda SPM Update: Channel Migration Assessment.* Washington Department of Ecology, Shorelands and Environmental Assistance Program, Olympia, WA

O'Neal, R A, et al. 1975. *Shoreline Inventory for Thurston County.* Thurston Regional Planning Council. Olympia, WA

O'Neal, R Art, et al. 1975. *Shoreline Master Program for the Thurston Region.* Thurston Regional Planning Council. Olympia, WA

Rountry, D. et al. 2004. *The Chehalis/Grays Harbor Watershed Dissolved Oxygen, Temperature, and Fecal Coliform Bacteria TMDL: Detailed Implementation (Cleanup) Plan.* Publication Number 04-10-065. Washington State Department of Ecology - Water Quality Program, Olympia, WA

Shoreline Management Act of 1971. 1971. Revised Code of Washington 90.58.

Shoreline Management Act—Streams and Rivers Constituting Shorelines of the State. Washington Administrative Code 173-18:
Web URL: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-18.

Skowlund, P. 1994. *Shoreline Management Guidebook, 2nd Edition*. Washington Department of Ecology, Olympia, WA

Smith, C J and M Wenger. 2001. *Salmon and Steelhead Habitat Limiting Factors Chehalis Basin and Nearby Drainages Water Resource Inventory Areas 22 and 23*. Washington State Conservation Commission, Olympia, WA

Snavely, P. D. Jr., R. D. Brown Jr., A. E. Roberts, W. W. Rau, and J. M. Schopf. 1958. *Geology and coal resources of the Centralia-Chehalis district, Washington, with a section on microscopical character of the Centralia-Chehalis coal.* USGS Series - Bulletin 1053.

Stanley, S., J. Brown, and S. Grigsby. 2005. *Protecting Aquatic Ecosystems: A Guide for Puget Sound Planners to Understand Watershed Processes.* Washington State Department of Ecology, Publication #05-06-013, Olympia, WA

Stanley, S, S. Grigsby, T. Hruby, and P. Olson. 2010. *Chehalis Basin Watershed Assessment: Description of Methods and Analysis for Water Flow Processes.* Washington State Department of Ecology, Publication #10-06-006, Olympia, WA

Thurston County Storm and Surface Water Program, and Thurston County Environmental Health Division. 2010. *Thurston County Water Resources Monitoring Reports for Water Years 2008-2009.* Olympia, WA

Thurston Regional Planning Council. 1999. *Thurston County Flood Hazard Management Plan*. Olympia, WA.

Thurston Regional Planning Council. 2009. *The Profile.* Olympia, WA.

Thurston Regional Planning Council. 2010. *Thurston County Historic Properties Database*. Olympia, WA.

U. S. Army Corps of Engineers, 2003. *Centralia Flood Damage Reduction Project Chehalis River, Washington - Final General Reevaluation Report - Appendix A: Hydrology and Hydraulics.* U.S. Army Corps of Engineers, Seattle District, Seattle, WA

U.S. Department of Agriculture. 1990. *Soil Survey of Thurston County, Washington.* USDA Soil Conservation Service in cooperation with Washington State Department of Natural Resources and Washington State University, Agriculture Research Center.

Verd, K. and N. Wilson, 2002. *Skookumchuck Watershed Culvert Assessment – Water Resource Inventory Areas 23*. Lewis County Conservation District. Chehalis, WA

Williams, R.W.; R. M. Laramie, and J.J. Ames. 1975. A Catalog of Washington Stream and Salomon Utilization – Volume 2 Coastal. Washington Department of Fisheries, Olympia, WA

Washington State Department of Ecology. 2001. *Upper Chehalis River Basin Temperature Total Maximum Daily Load.* Publication Number 99-52. Washington State Department of Ecology - Water Quality Program, Olympia, WA.

Washington State Department of Fish and Wildlife. 2011. *Letter of March 11, 2011 to Thurston Regional Planning Council regarding the Draft Shoreline Inventory and Characterization Report for Bucoda.* Signed by Theresa Nation. Olympia, WA.

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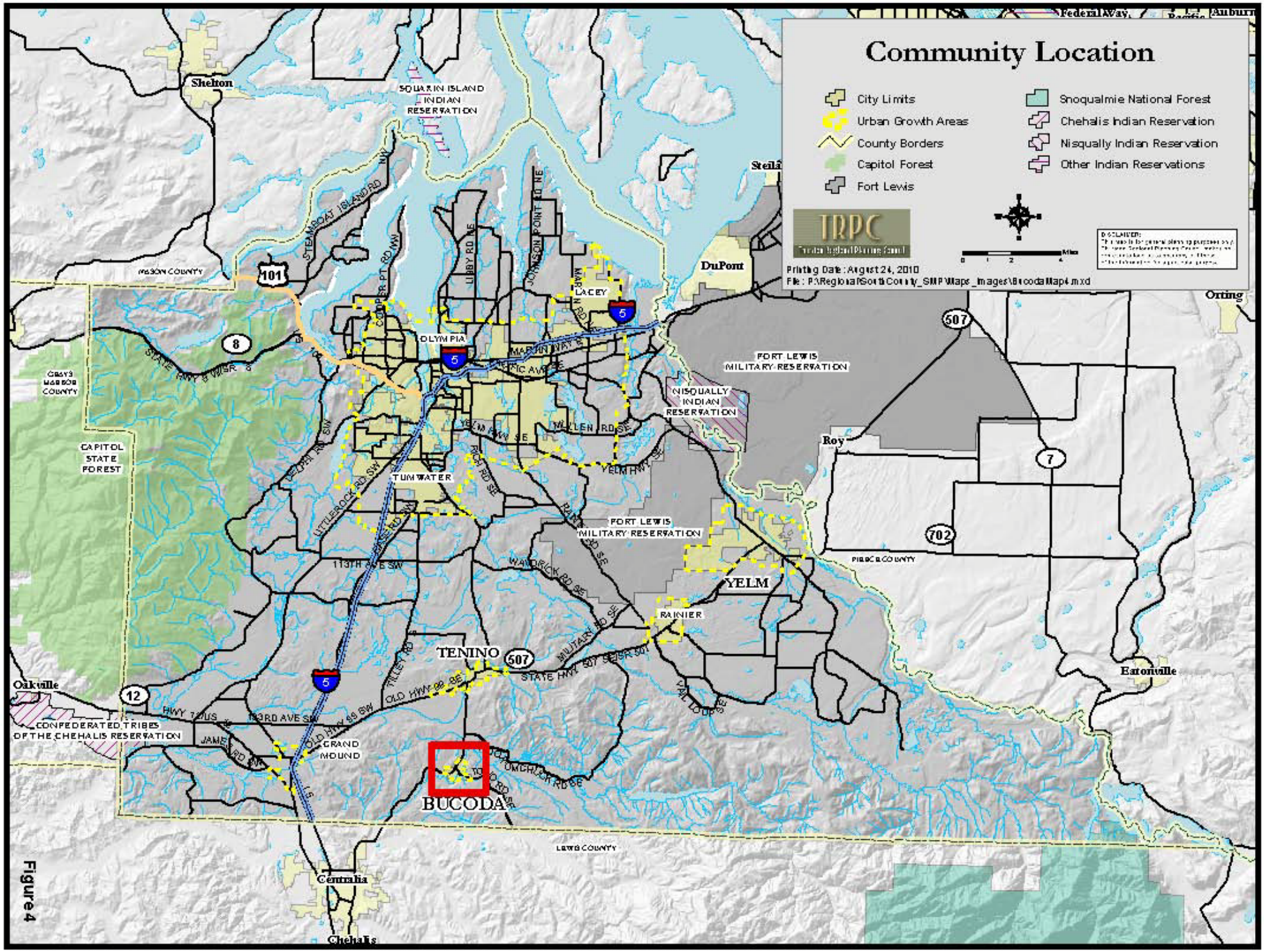
Community Location
City Limits
Urban Growth Areas
County Borders
Capitol Forest
Fort Lewis
Snoqualmie National Forest
Chehalis Indian Reservation
Nisqually Indian Reservation
Other Indian Reservations
TRPC
Printing Date: August 24, 2010
File: P:\Regional\SouthCounty_SMP\Maps_Images\BucodaMap4.mxd
Shelton
SQUAXIN ISLAND INDIAN RESERVATION
Steilacoom
DuPont
Orting
Federal Way
Auburn
LACEY
OLYMPIA
TUMWATER
FORT LEWIS MILITARY RESERVATION
NISQUALLY INDIAN RESERVATION
Roy
YELM
RAINIER
TENINO
BUCODA
GRAND MOUND
Eatonville
Oakville
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION
Centralia
Chehalis
CAPITOL STATE FOREST
MASON COUNTY
GRAYS HARBOR COUNTY
PIERCE COUNTY
LEWIS COUNTY
STEAMBOAT ISLAND RD NW
COOPER PT RD NW
LIBBY RD NE
JOHNSON POINT RD NE
MARTIN WAY E
PACIFIC AVE SE
YELM HWY SE
WILLEN RD SE
DELTA RD SW
LITTLEROCK RD SW
113TH AVE SW
RAINIER RD SE
WALDRICK RD SE
MILITARY RD SE
STATE HWY 507 SE
OLD HWY 99 SE
TILLEY RD
HWY 12 US
193RD AVE SW
JAMES RD SW
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507
7
702
12

Figure 4

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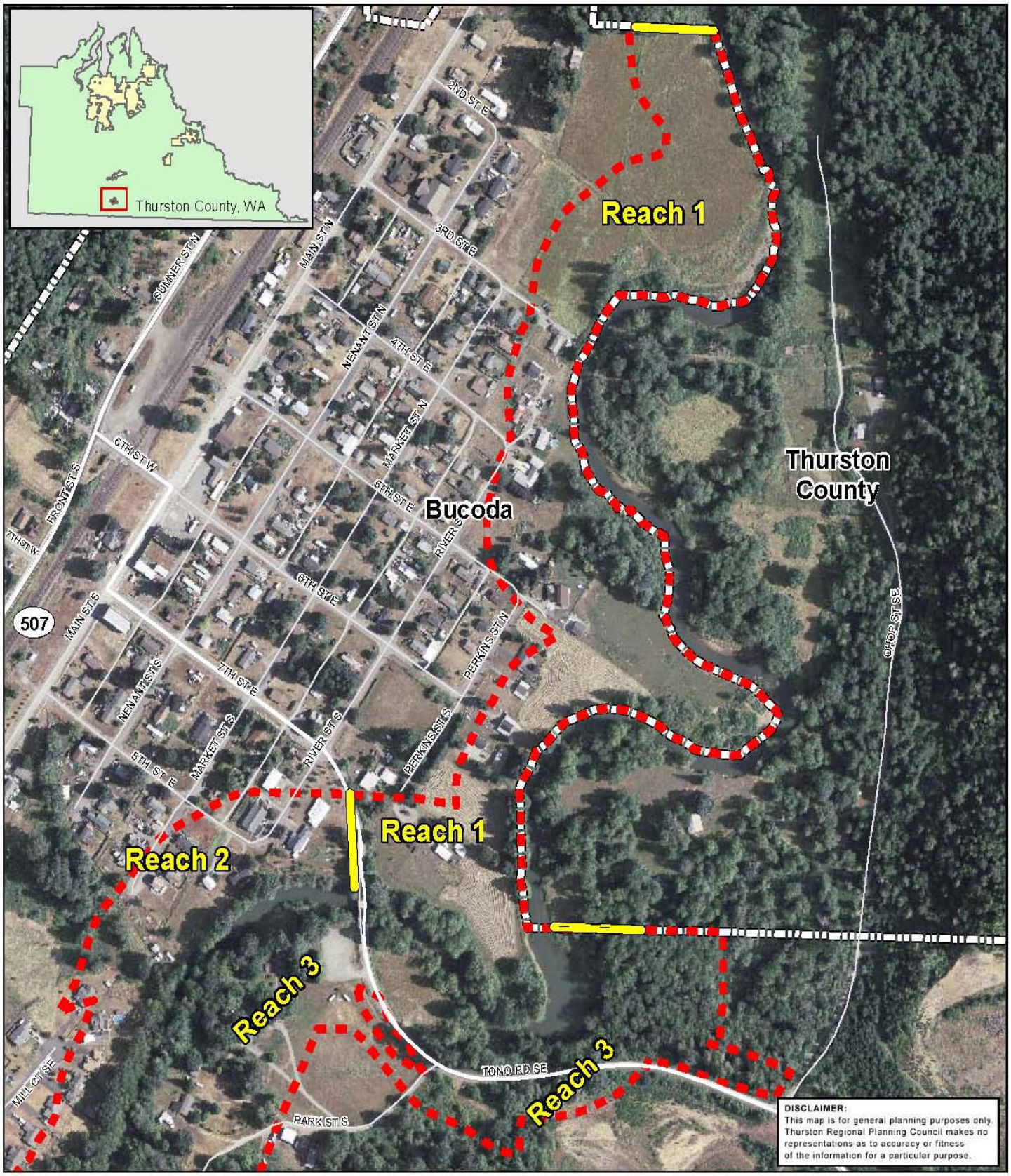


# 2009 Aerial Photos - North
# Reach 1, 2, and 3

City Limits / UGA

Reach Breaks

Minimum Jurisdiction

200 100 0 200 Feet

TRPC
Thurston Regional Planning Council

Printing Date: 9/8/2010
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Figure 5

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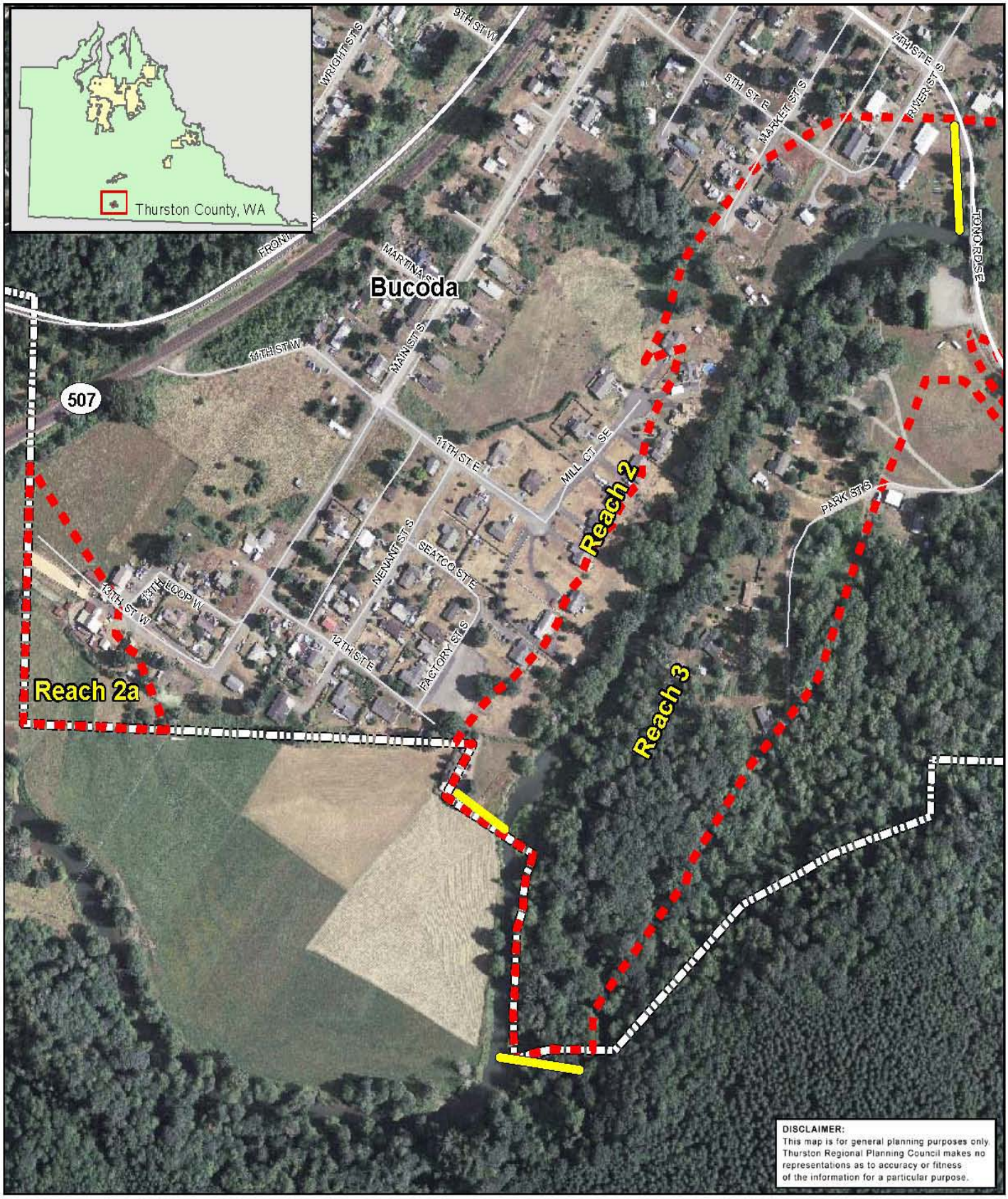


# 2009 Aerial Photos - South
# Reach 2, 2a, and 3

City Limits / UGA

Reach Breaks

Minimum Jurisdiction

200 100 0 200 Feet

TRPC
Thurston Regional Planning Council

Printing Date: 9/9/2010
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Figure 6

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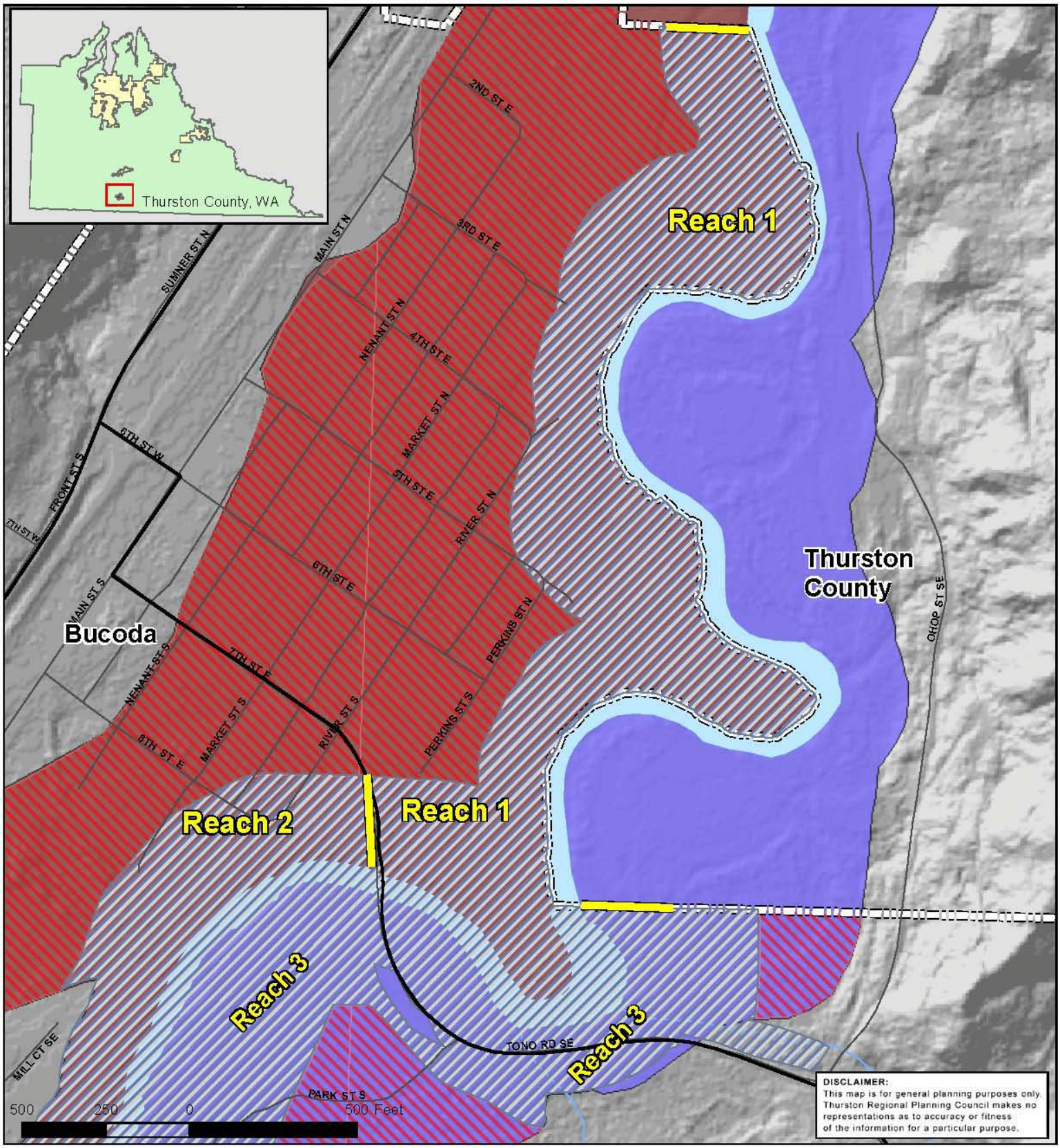


# Shoreline Jurisdictions and Environments - North

**Shoreline Jurisdictions**

- Minimum Jurisdiction
- Optional Jurisdiction

**Existing Shoreline Environment Designations**

- Conservancy
- Urban

- City Limits / UGA
- Reach Breaks

TRPC
Thurston Regional Planning Council

Printing Date: 9/9/2010
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Figure 7

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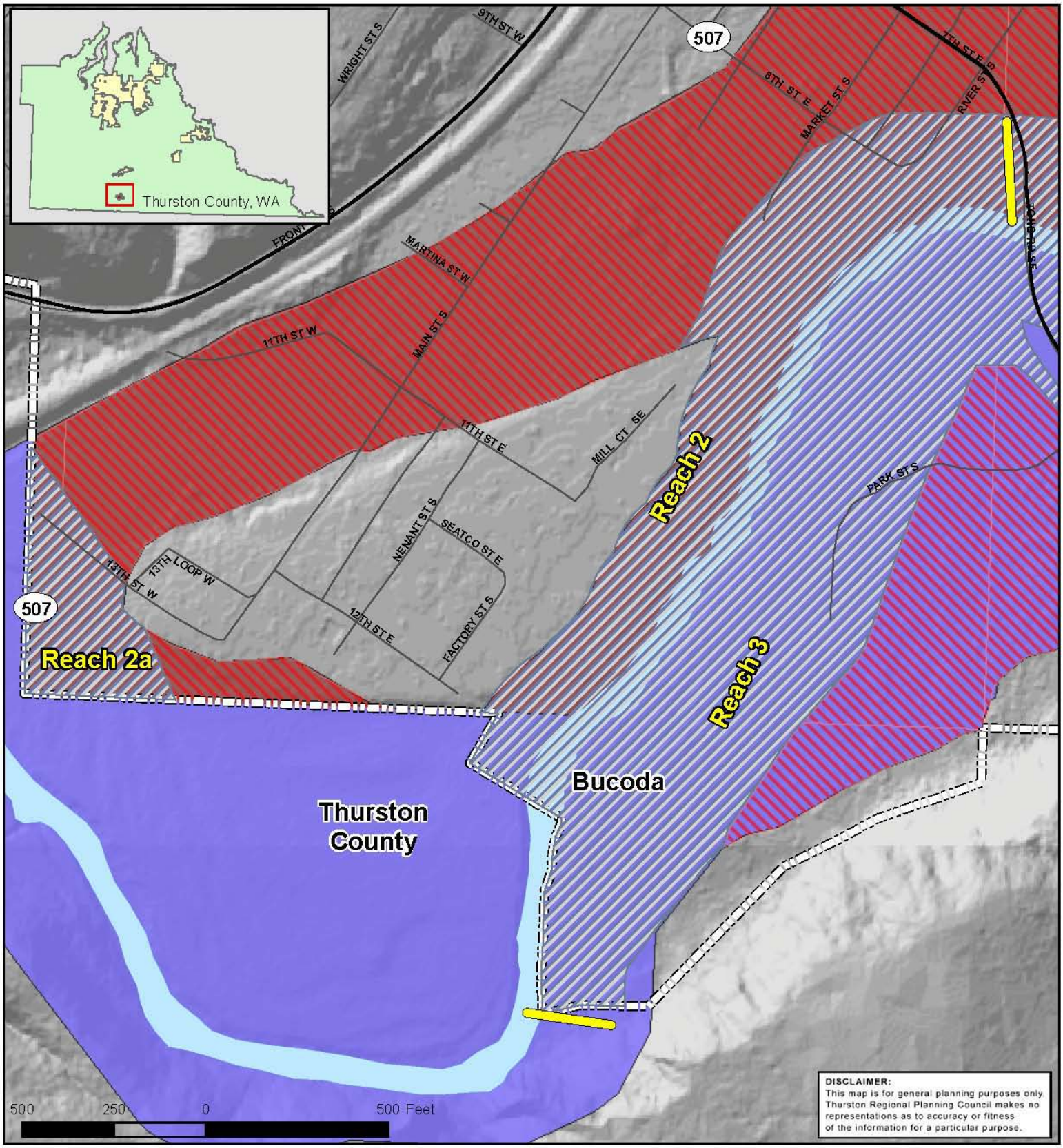


# Shoreline Jurisdictions and Environments - South

**Shoreline Jurisdictions**

- Minimum Jurisdiction
- Optional Jurisdiction

**Existing Shoreline Environment Designations**

- Conservancy
- Urban

- City Limits / UGA
- Reach Breaks

TRPC
Thurston Regional Planning Council

Printing Date: 9/9/2010
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Figure 8

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# 1936 Aerial Photo and 2009 River Location - North

City Limits / UGA 2009

Skookumchuck River 2009

Streams 2009

N
W E
S

500 250 0 500 Feet

Printing Date: March 23, 2010
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Figure 9

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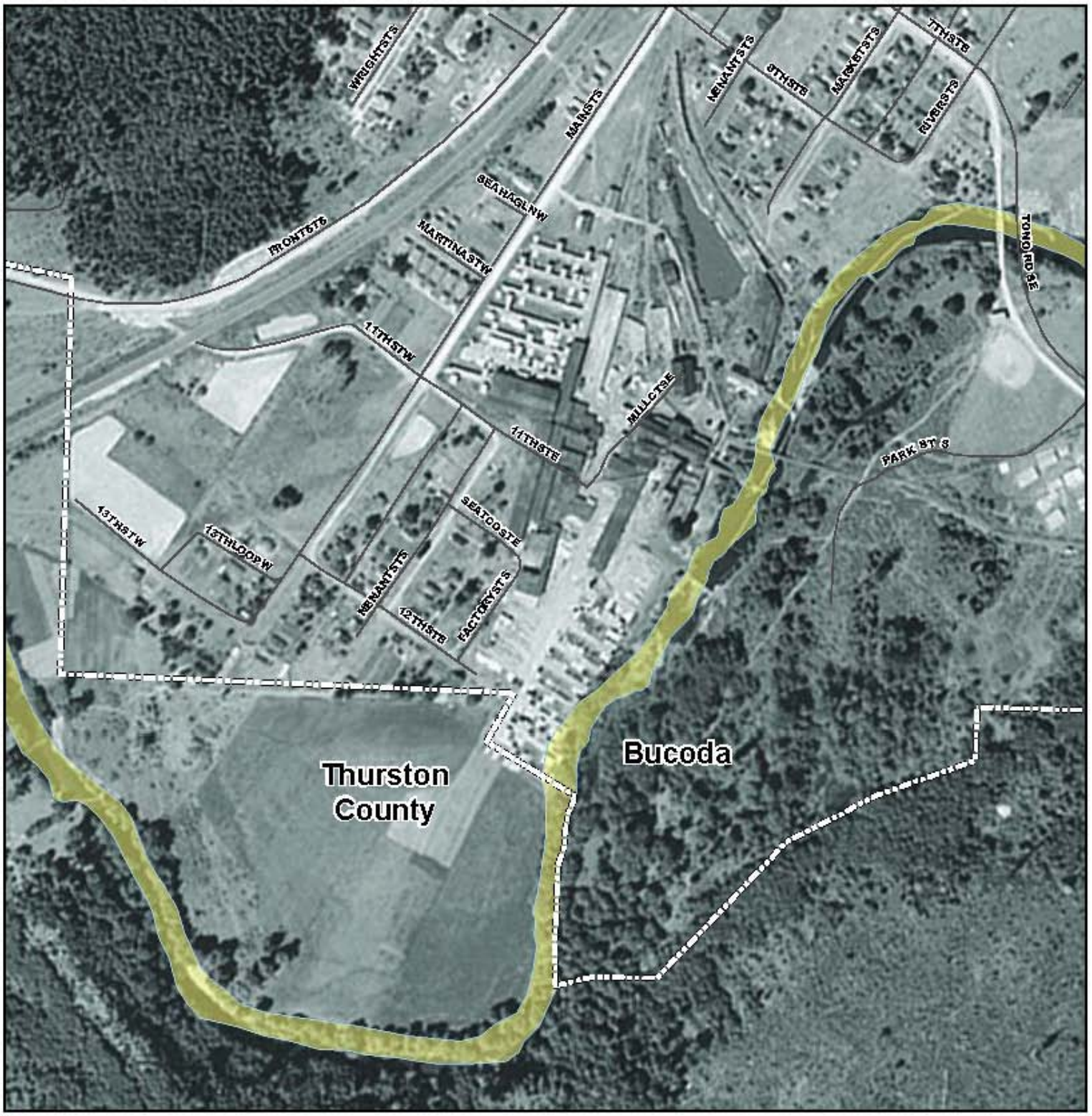


# 1936 Aerial Photo and 2009 River Location - South

City Limits / UGA 2009

Skookumchuck River 2009

Streams 2009

N
W E
S

500 250 0 500 Feet

Printing Date: August 24, 2010
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Figure 10

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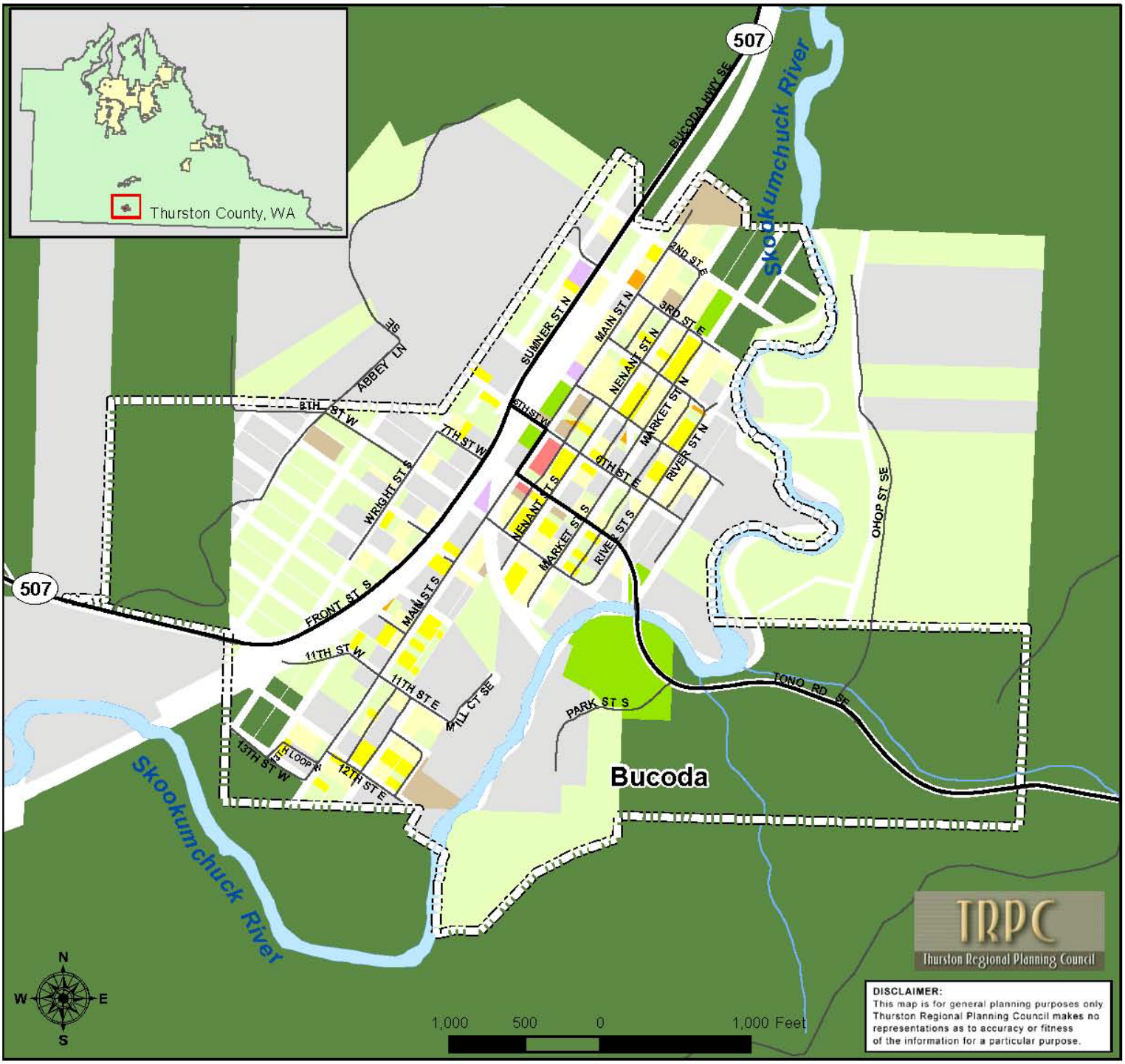


## 2006 Current Land Use

- Commercial
- Industrial
- Government/Institutional

Residential

- Low Density - 0 to <3.5 du/acre
- Moderate Density - 3.5 to <6.5 du/acre
- High Density - 6.5 to <14.5 du/acre
- Very High Density - 14.5 or more du/ac

Other

- Vacant Land
- Water Bodies
- Natural Resources (Public and Private)
- Parks, Preserves, & Open Space
- Parks Boundaries
- City Limits / UGA

*Source: TRPC Buildable Lands Program.*

Printing Date: 9/10/2010
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**Figure 11**

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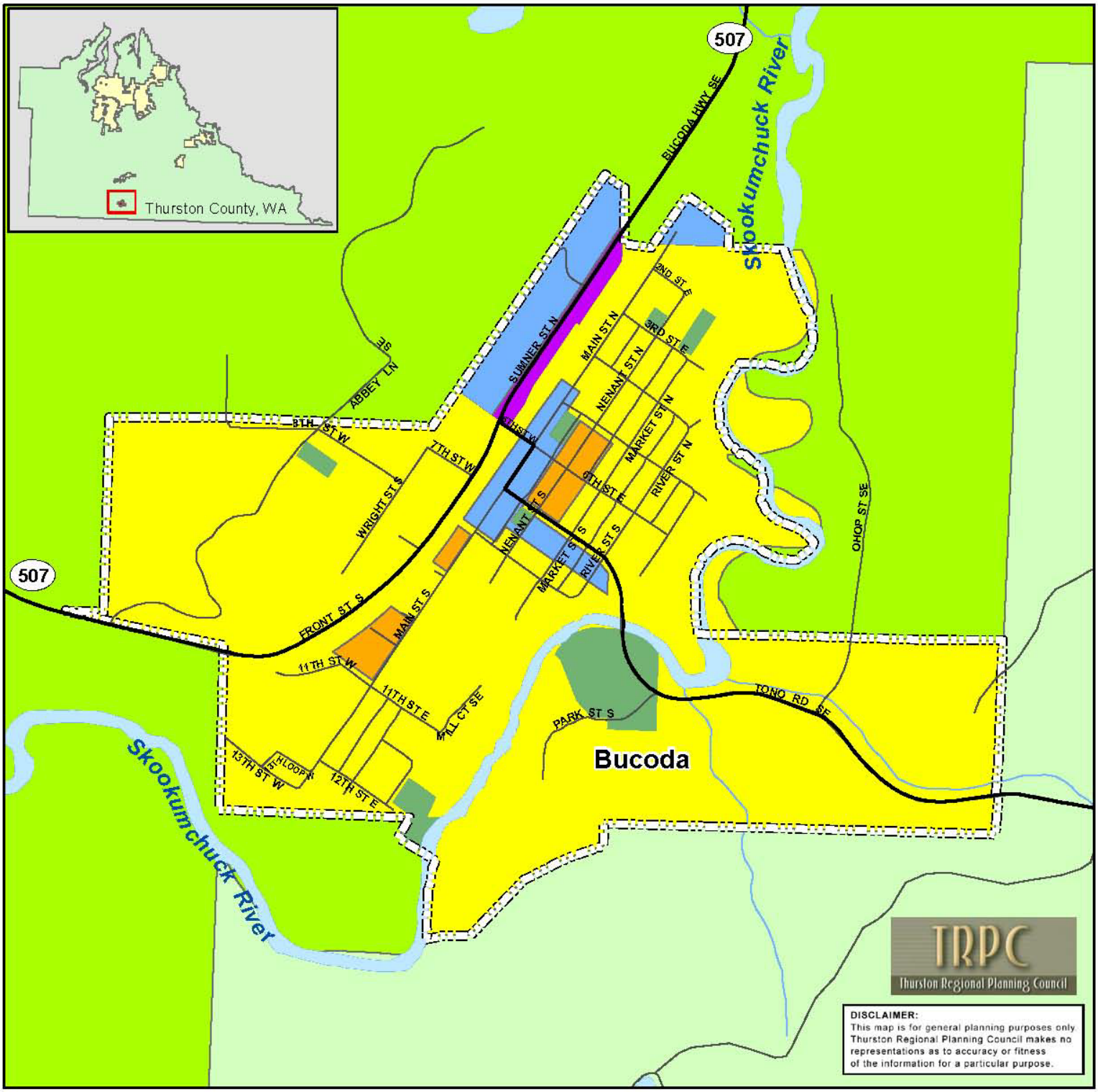


# 2010 Current Zoning

- RESIDENTIAL
- MULTIFAMILY RESIDENTIAL
- RURAL RESIDENTIAL RESOURCE 1/5
- COMMERCIAL
- INDUSTRIAL
- PUBLIC USE
- LONG TERM FORESTRY
- City Limits / UGA

N W E S

1,000 500 0 1,000 Feet

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Figure 12

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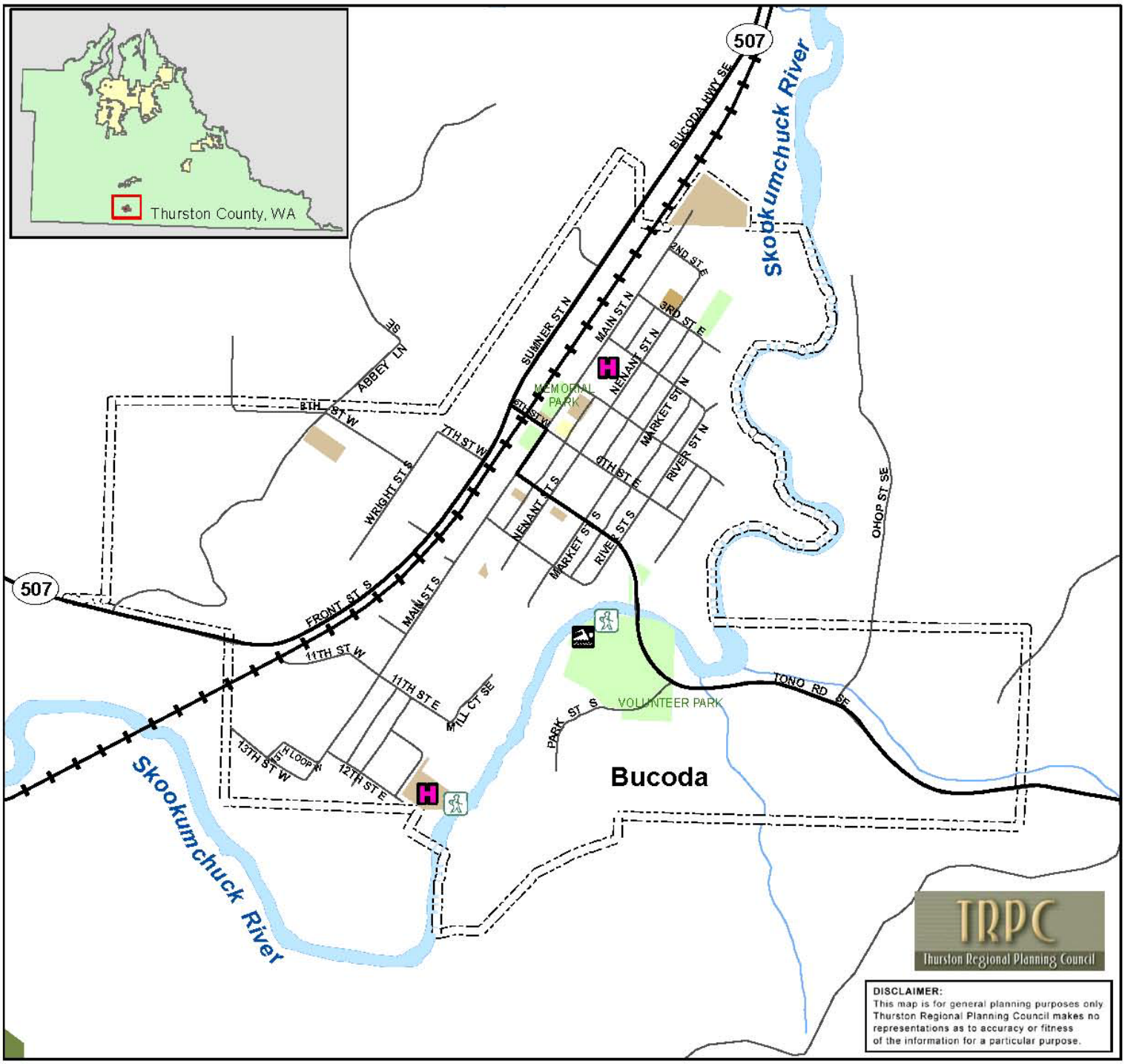


# Public Access, Public Lands and Historic Sites

## Public Lands

- Schools, Colleges, Universities
- Parks
- Public Natural Areas, Wildlife Areas and Preserves
- Other Local, State, Tribal Lands
- Powerline

## Private Institutional or Community Lands

- Subdivision Open Space
- Other Open Space including Land Trusts
- Churches and Private Camps
- City Limits / UGA

## Public Access

- River Access
- Swimming
- Historic Sites

*Source: TRPC Buildable Lands Program.*

1,000 500 0 1,000 Feet

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**Figure 13**

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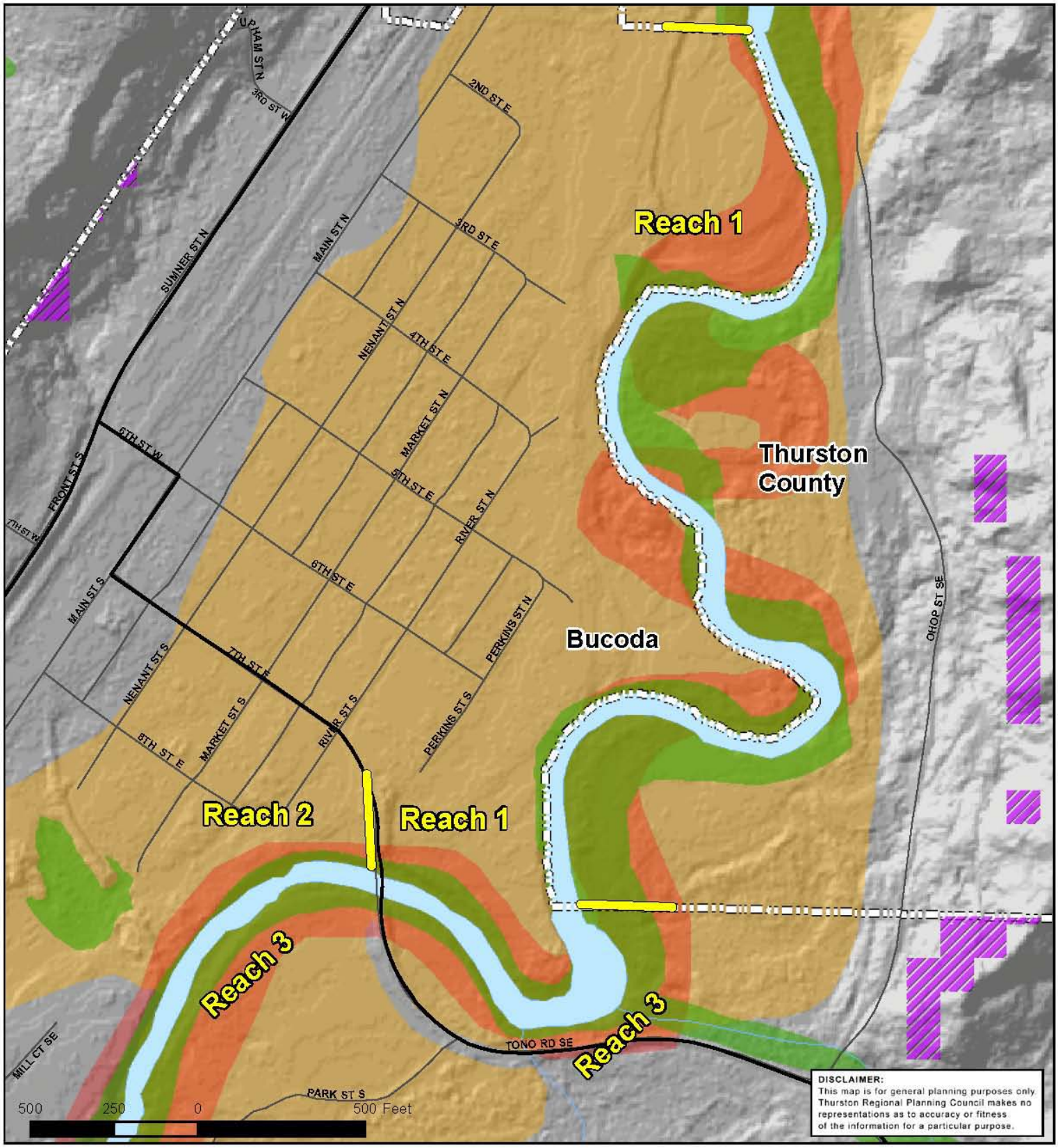


# Critical Areas - North

Steep Slopes

City Limits / UGA

Wetland Indicators

Floodways

100 Year Floodplain

TRPC
Thurston Regional Planning Council

Printing Date: Friday, September 10, 2010
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Figure 14

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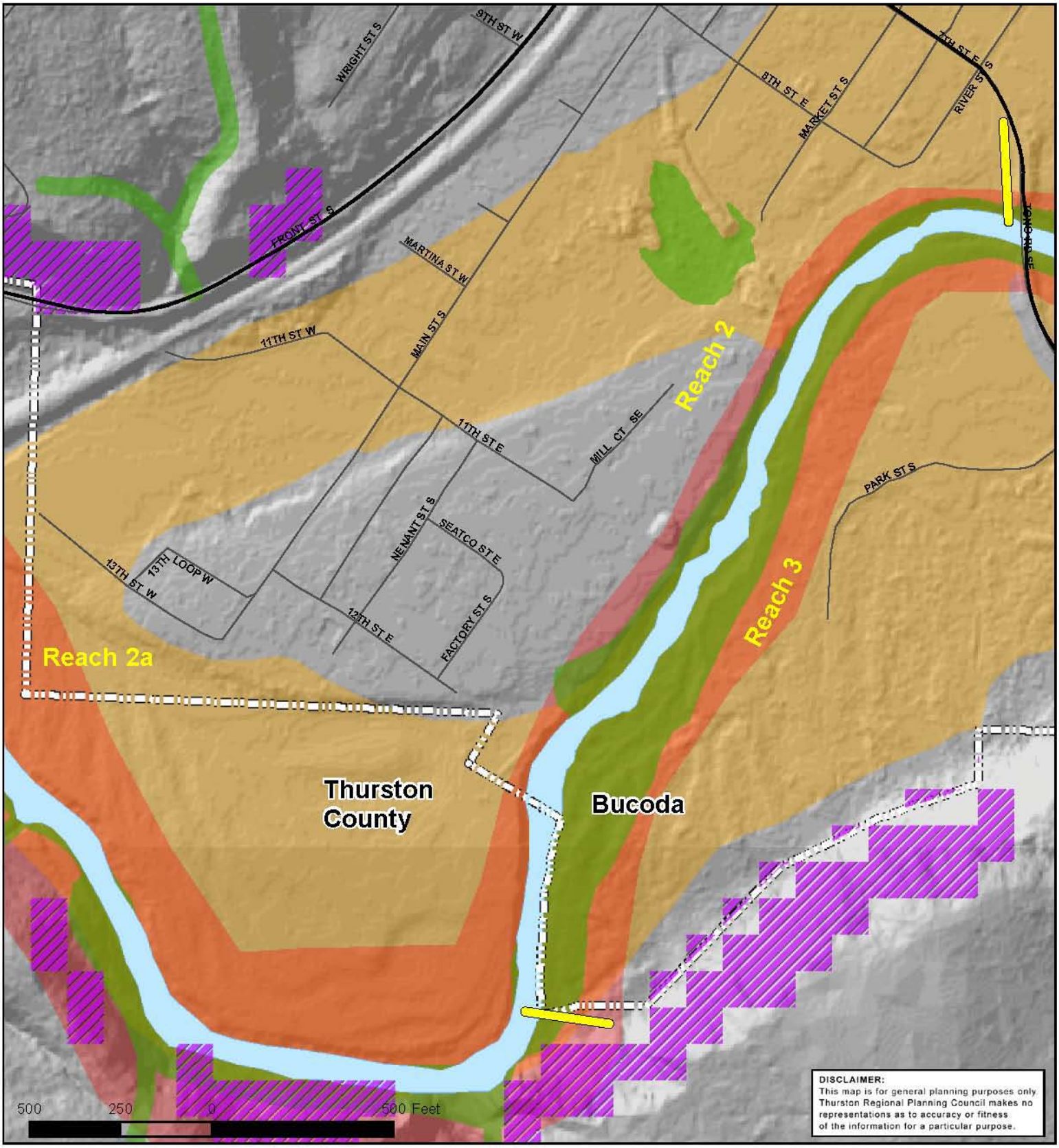


# Critical Areas - South

Steep Slopes

City Limits / UGA

Reach Breaks

Wetland Indicators

Floodways

100 Year Floodplain

TRPC
Thurston Regional Planning Council

Printing Date: Friday, September 10, 2010
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Figure 15

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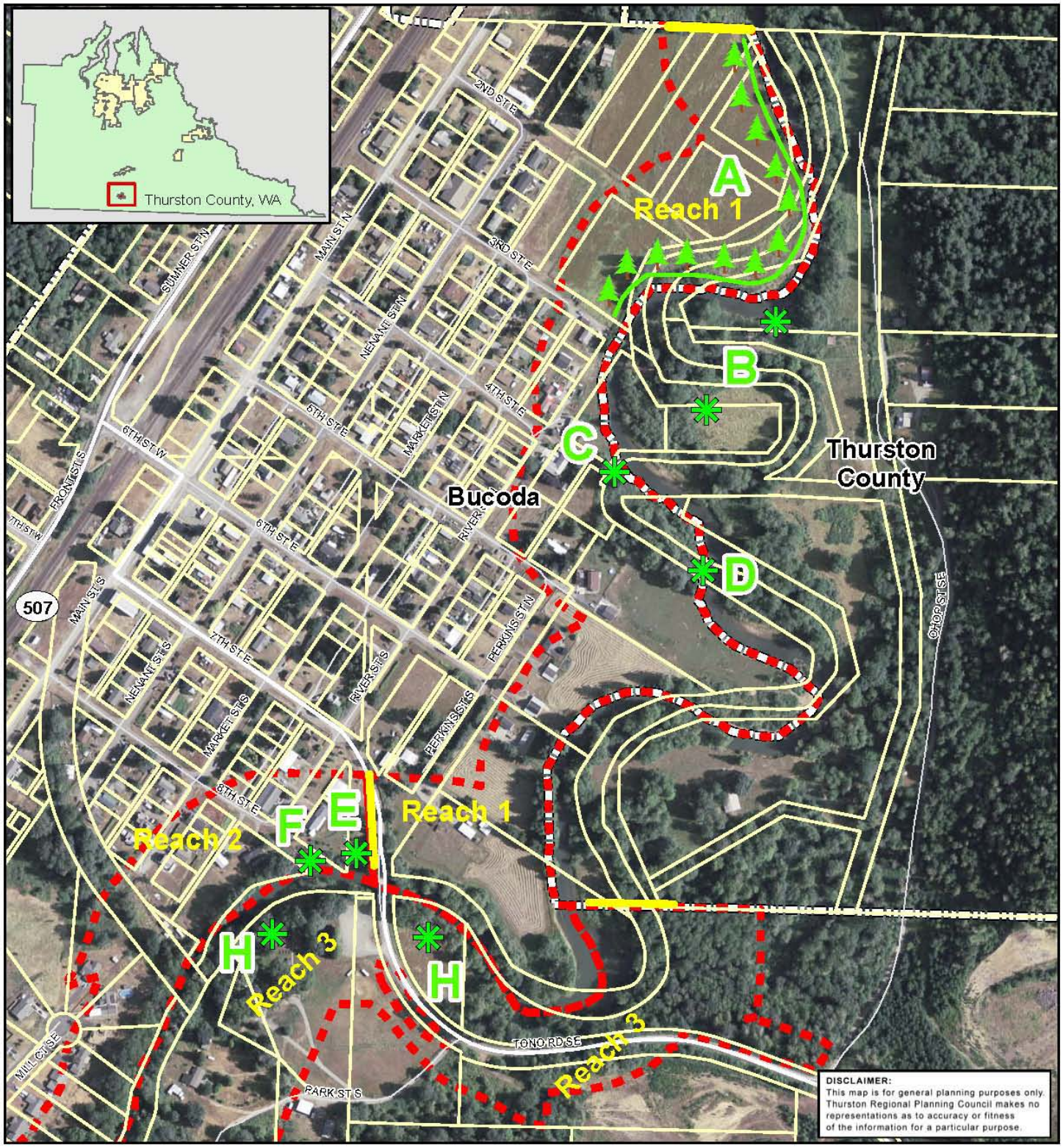


# Opportunity Sites - North

Aerial Photos Flown: 2009

thurston regional planning council

Town Limits / UGA

Minimum Jurisdiction

Parcel Lines

Reach Breaks

Opportunity Sites

200 100 0 200 Feet

Printing Date: Monday, March 21, 2011
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Figure 16

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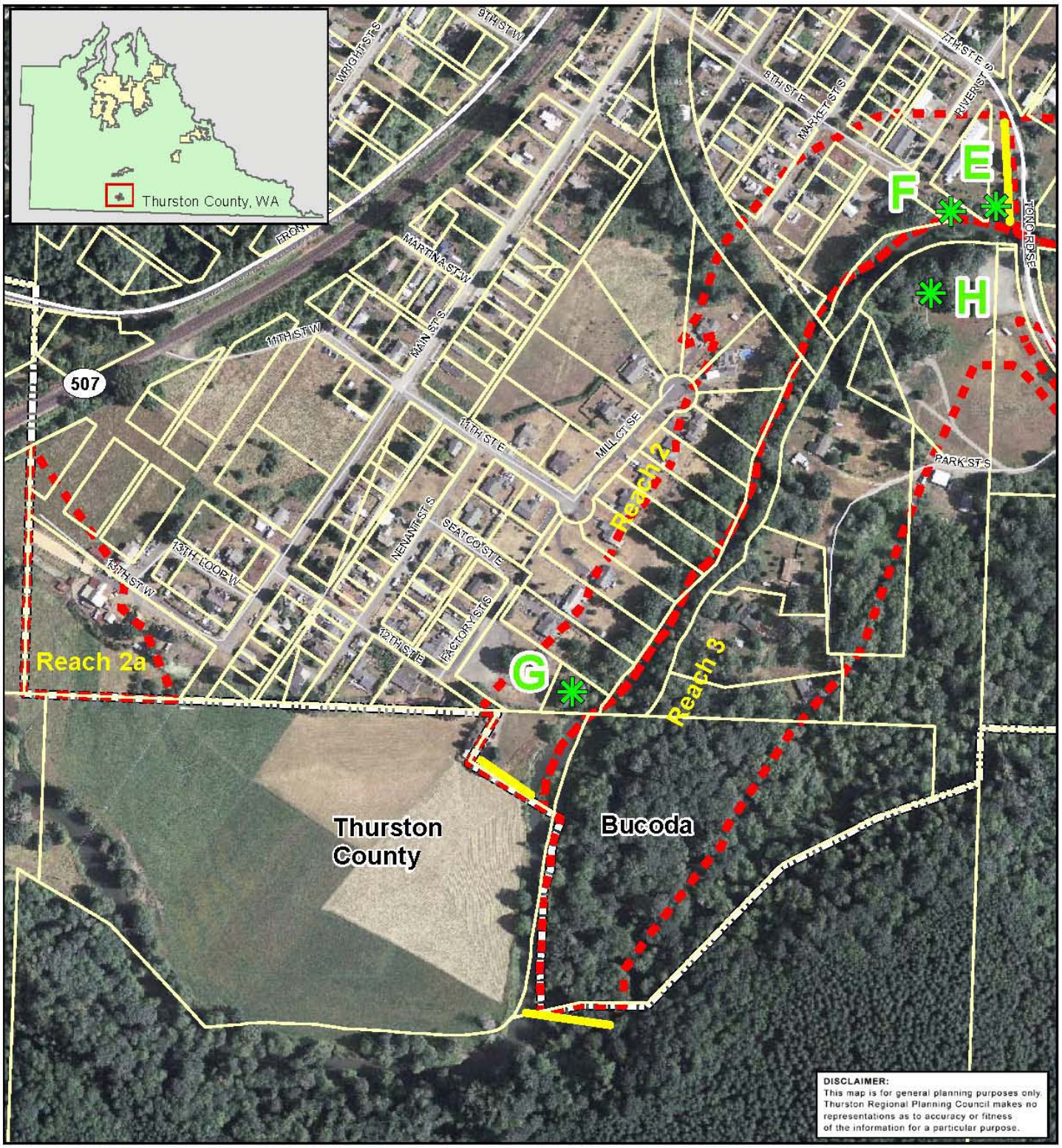


# Opportunity Sites - South

Town Limits / UGA

Minimum Jurisdiction

Parcel Lines

Reach Breaks

Opportunity Sites

200 100 0 200 Feet

Printing Date: Monday, March 21, 2011
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Figure 17

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# 10.0 APPENDIX

## 10.1. Ecology Landscape-Scale Assessment

The Washington Department of Ecology undertook a landscape scale assessment of the Upper Chehalis basin, titled *Chehalis Basin Watershed Assessment - Description of Methods, Models, and Analysis for Water Flow Process* (Stanley et al, 2010). While the reports course scale watershed characterization is not intended for use at the site scale, it will provide useful context locating Bucoda into its broader watershed context.

This analysis includes the application of a landscape-level analysis tool that has been developed by the Washington Department of Ecology (Ecology, 2005). This analysis specifically looks at hydrologic processes, where the important areas are, and how they have been altered over time. The two results are then taken together to suggest areas where protection or restoration of ecosystem process would be the most effective. While this analysis is specifically focused on hydrologic processes, the parameters used are fairly general landscape-level measures that can be used as a general proxy for overall level of functioning.

## 10.2 Important Areas and Alterations

Important areas and alterations for the Chehalis Watershed and study area were identified and assessed, consistent with the methods in Stanley et al, 2005 and Stanley et al, 2010. A watershed matrix was created which combines the results of the importance and impairment maps. Each box in the matrix corresponds with a management recommendation for that rating. See Figure A-1 below.

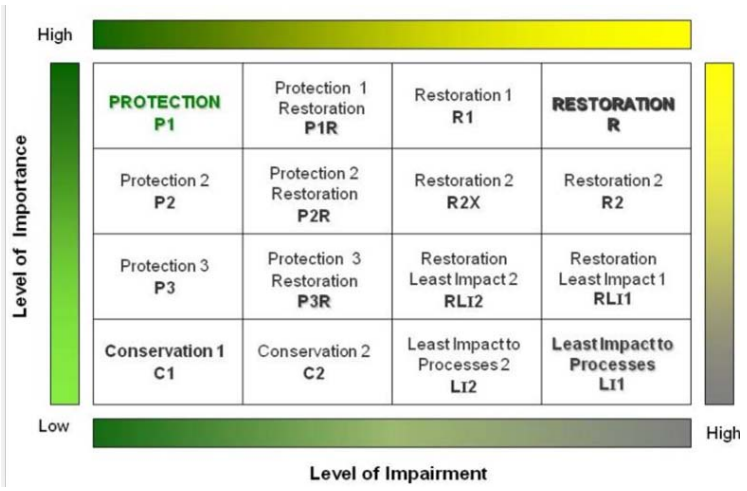



**Figure A-1: Watershed Management Matrix**
The colors correspond to colors used on a GIS map to represent areas most appropriate for restoration (yellow), protection (green) and less impact to processes (gray). (Stanley et al. 2010, p 60)

- Analysis units rating **high for importance** and **low for impairment** will be in the upper left corner of the matrix. These analysis units will be the most suitable candidates for PROTECTION, ensuring that the associated watershed process will remain intact.

- Analysis units rating **high for importance** and **high for impairment** will be in the upper right corner of the matrix will be most suitable for RESTORATION. Focusing restoration in these units will increase the likelihood that associated watershed processes will be restored.

- Analysis units rating **low for importance** and **low for impairment** will be in the lower left corner of the matrix. These analysis units will be the most suitable candidates for CONSERVATION. These areas have an intact suite of processes and functions that support existing aquatic ecosystems which would require considerable time to restore elsewhere on the landscape. Higher intensity land use activities may be appropriate, but care should be taken to establish land use patterns that protect and maintain watershed processes.

- Analysis units rating **low for importance** and **high for impairment** will be in the lower right corner of the matrix. These analysis units will be the most suitable candidates for LEAST IMPACTS TO PROCESSES. These areas can be considered as more suitable for urban land use activities.

## 10.3 Watershed Characterization Results

The results of the Chehalis Basin Watershed Assessment are depicted in the following figures. Figure A-2 shows the extent and id number of the assessment units around Bucoda. Figure A-3 shows the important areas, Figure A-4 shows the alteration areas, and Figure A-5 shows the importance and alteration areas combined together. The assessment units were analyzed within their landscape group, which is depicted by a large black line on these figures.

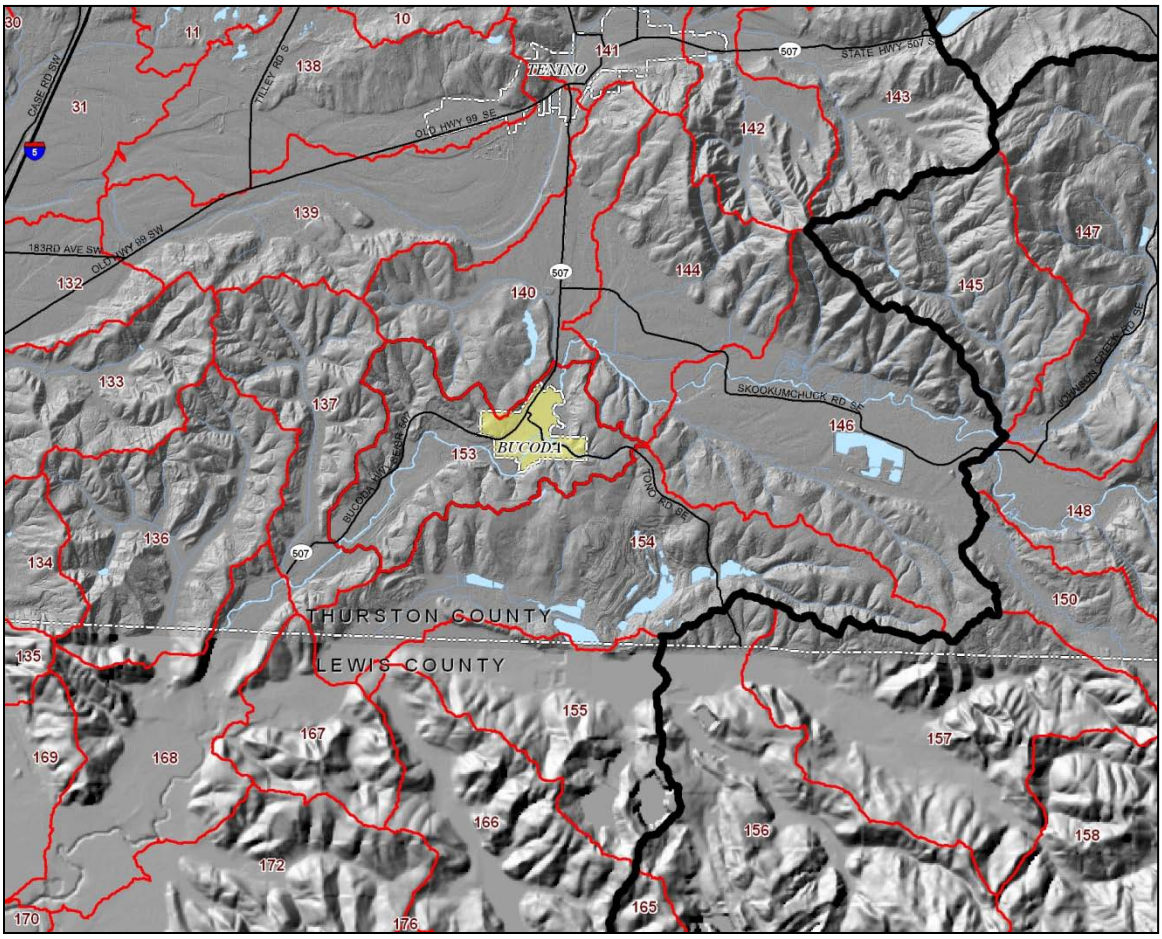



**Figure A-2: Watershed Assessment Units around Bucoda**

**Lowland Landscape Group** - Bucoda is located in watershed assessment unit #153 and the "lowland" landscape group. It is characterized by being less than 500 feet in elevation, low gradient landform, geologically composed of glacial drift, with lower precipitation and rain dominated storm events. These analysis units are 2 to 5 square miles in size. They tend to have diverse land cover types, and higher development pressure.

**Mountainous Landscape Group** - The "mountainous" landscape group (located to the east of Bucoda) is characterized by being higher than 500 feet in elevation, comprised of bedrock areas, rain-on snow- and snow dominated areas, higher precipitation areas, and high relief topography. These analysis units are larger being from 8 to10 square miles in size. They have a more uniform land cover type (forests), and with low pressure for development.

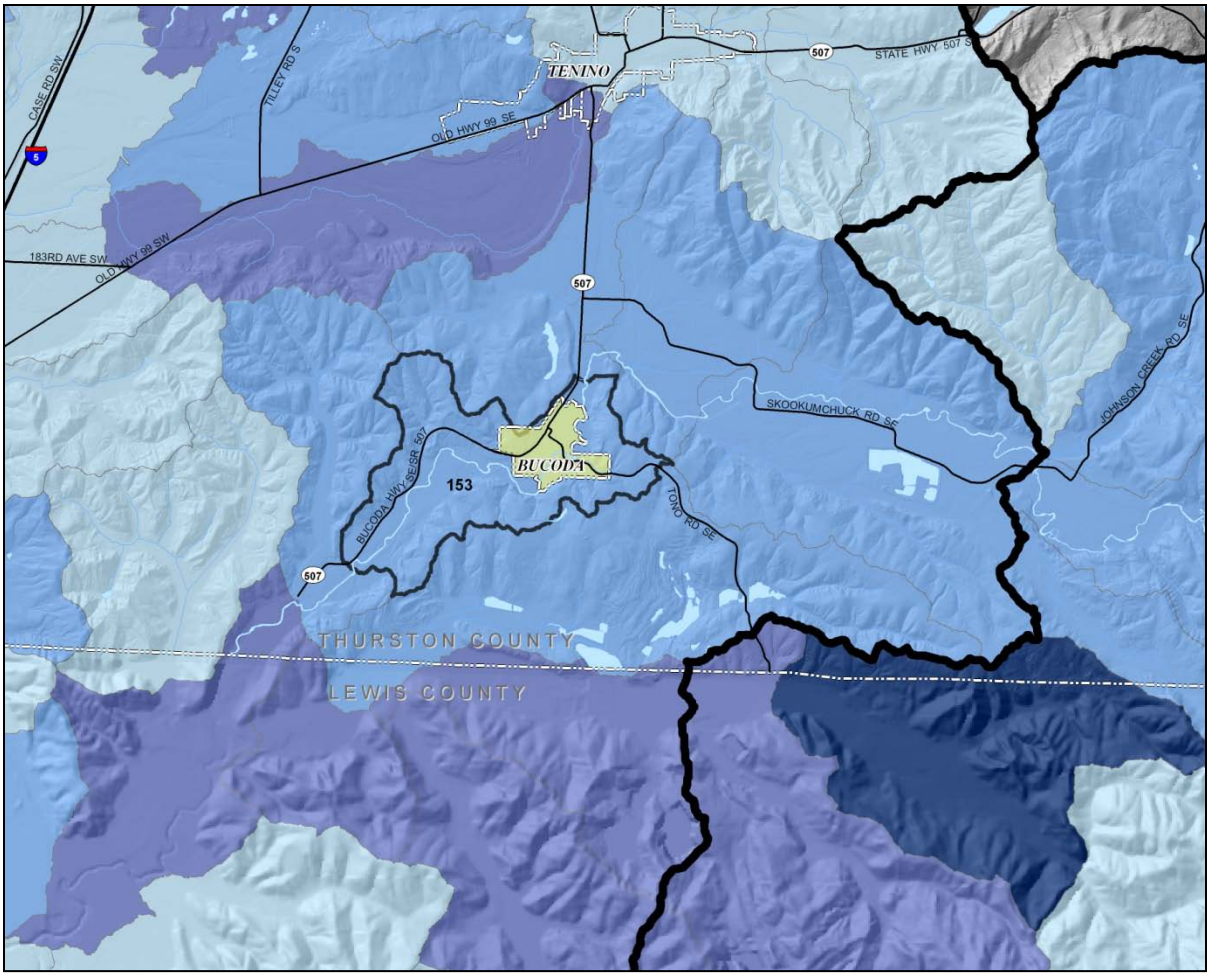
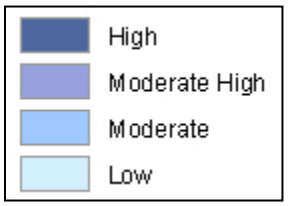



**Figure A-3: Summary of Important Areas for Watershed Processes**




This map represents results of all components (delivery, storage, recharge discharge). The black outline delineates the mountain from the lowland landscape group. Analysis units are evaluated only within their landscape group. Dark blue analysis units are the most important (High rating) and lightest blue analysis units are less important (Low rating) for the water process. This map shows the combined scores for all three components of the importance model - delivery, surface and ground water. Results are shown in quantiles.

The town lies in a large grouping of assessment units classified as *"Moderate"*. The *"Moderately High"* important units can be found to the southeast are along Skookumchuck River, to the southwest, and to the north along Scatter Creek downstream of Tenino. Areas of *"Low"* importance are scattered about in predominately forested drainages. The only *"High"* importance area is located within the TransAlta mine, as part of the mountainous landscape group.

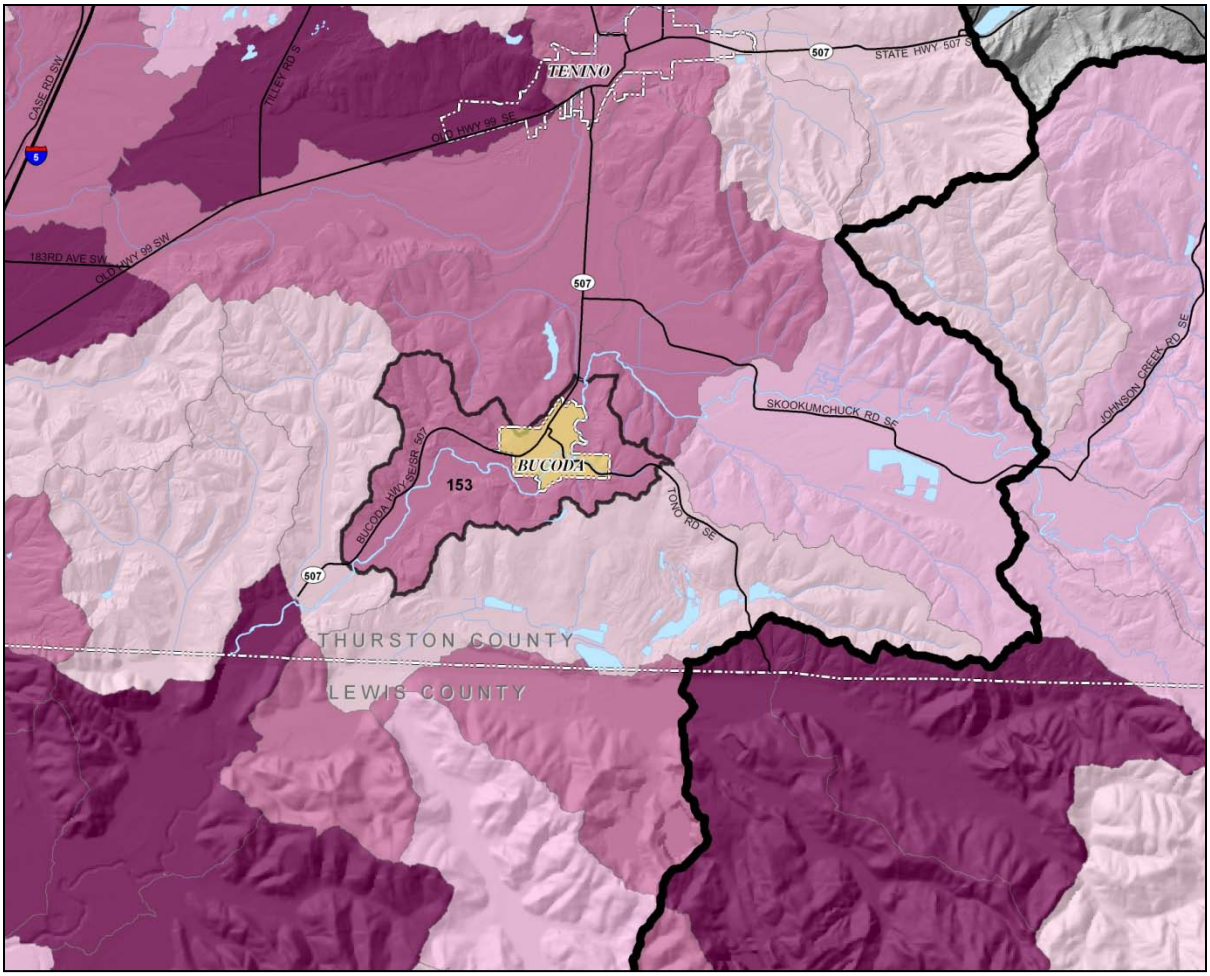
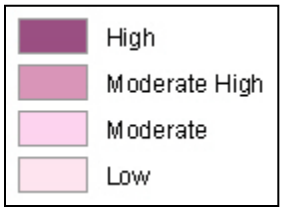



**Figure A-4: Summary of Alteration Areas for Watershed Processes**




In this map the darkest pink areas are the most impaired. The black outline delineates the mountain from the lowland landscape group. Analysis units are evaluated only within their landscape group. Impairments of the water flow process were displayed in separate GIS maps by Stanley et al, 2010, but are combined in this image. Results are shown in quantiles.

Bucoda lies in a large grouping of assessment units which are listed as *"Moderate High"*. Some assessment units to the south and west are classified as *"Low"* alterations. The Skookumchuck River Valley and Thompson Creek drainage upstream of Bucoda and Frost Prairie are less impacted areas with a *"Moderate"* category. Areas of *"High"* alteration are located in the Skookumchuck River Valley downtstream of Bucoda, Scatter Creek downstream of Tenino and parts of the TransAlta mine, as part of the mountainous landscape group.

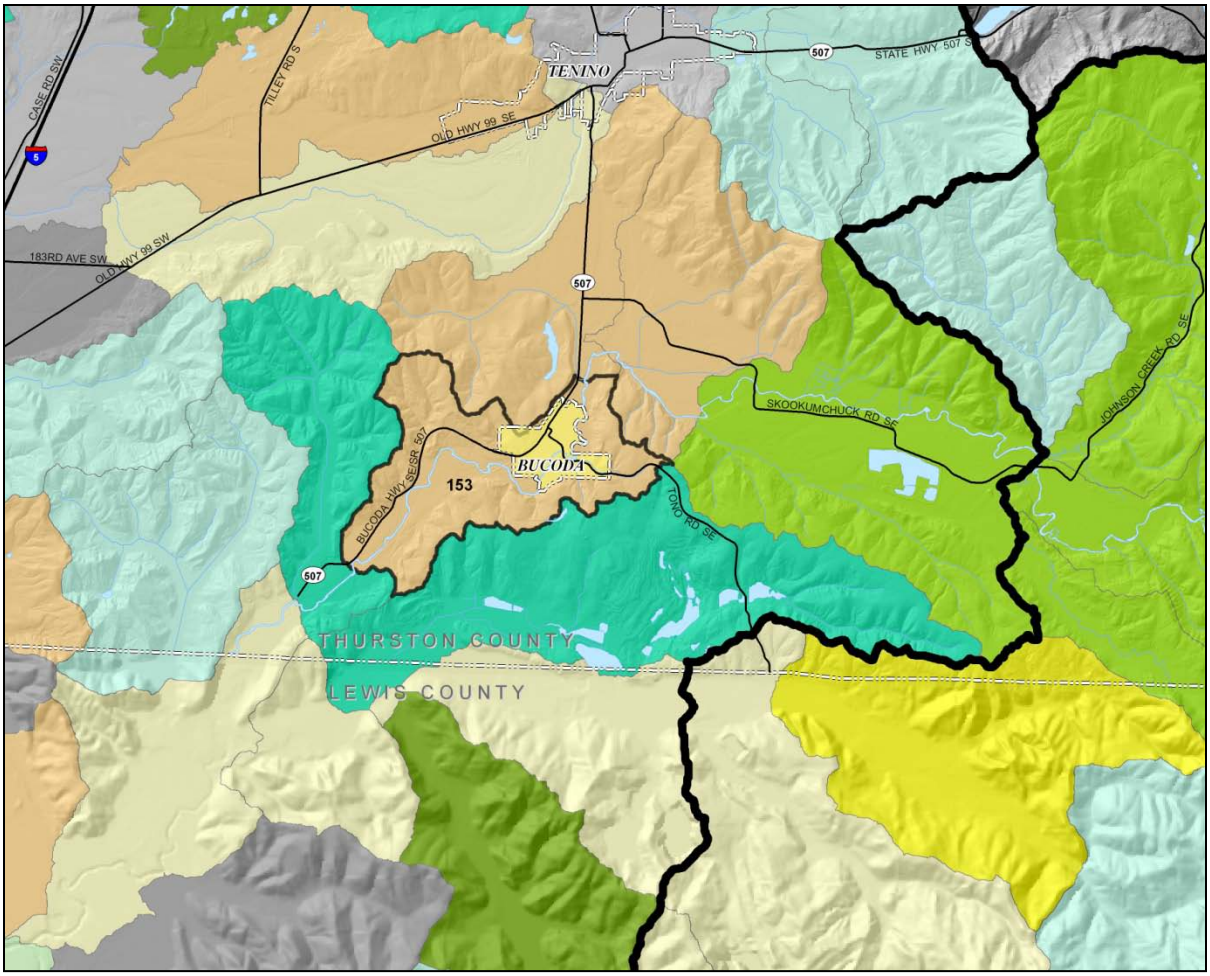



**Figure A-5: Summary of Importance and Alteration Areas for Watershed Processes**

| | | | |
|---|---|---|---|
| Protection | Protection / Restoration 1 | Restoration 1 | Restoration |
| Protection 2 | Protection / Restoration 2 | Restoration 3 | Restoration 2 |
| Protection 3 | Protection / Restoration 3 | Restoration Least Impact 2 | Restoration Least Impact 1 |
| Conservation 1 | Conservation 2 | Least Impact to Processes 2 | Least Impact to Processes 1 |

Combining the ratings of "importance" and "impairment" identifies a potential overall management approach for each analysis unit. Darker green indicates that an analysis unit is most suitable for protection of processes; darker yellow is most suitable for restoration of processes; orange to gray indicates analysis units where future disturbance will probably have less impact on watershed processes.

Bucoda and portions of Frost Prairie north of town are within the *"Restoration Least Impact 1 or 2"* category - orange color. This category is characterized by moderate levels of importance and moderate levels of alterations. The assessment units immediately to the south and west of Bucoda are in a *"Protection 3"* category. To the southeast of Bucoda, the bright yellow area is within the TransAlta coal mine and is the only unit in the *"Restoration"* category. Other restored portions of the mine to the southeast and the lower portion of the Skookumchuck River Valley to the southwest are in within the *"Restoration 2 or 3"* category. Up river of Bucoda and Frost Prairie the Skookumchuck River valley and the

Thompson Creek drainage are within a *"Protection Restoration 3"* category. The only assessment unit with the darkest green *"Protection Restoration 3"* category is in Lewis County along the South Hanaford Creek drainage.

Those boxes in the legend which are not colored are not found within the mapped extent.