Draft
City of Enumclaw Shoreline Master Program Cumulative Impacts Analysis Enumclaw, Washington

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Prepared for

City of Enumclaw
Enumclaw, Washington

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LIST OF ABBREVIATIONS AND ACRONYMS

CAO	Critical Areas Ordinance
cfs	Cubic Feet per Second
City	City of Enumclaw
Ecology	Washington State Department of Ecology
EIA	Effective Impervious Area
EMC	Enumclaw Municipal Code
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
ft	Feet
ft^2	Square Feet
GIS	Geographic Information System
LWD	Large Woody Debris
NOAA	National Oceanic and Atmospheric Administration
RM	River Mile
SMA	Shoreline Management Act
SMP	Shoreline Master Program
SMZ	Shoreline Management Zone
SR	State Route
UGA	Urban Growth Area
USACE	U.S. Army Corps of Engineers
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WRIA	Watershed Resource Inventory Area

1.0 INTRODUCTION

This cumulative impacts analysis is one of a series of documents intended to provide technical information to support the City of Enumclaw, Washington (City; Figure 1) in the development of its first Shoreline Master Program (SMP), as required under the Washington State Shoreline Management Act (SMA). Landau Associates prepared this cumulative impacts analysis for Boise and Newaukum creeks based on foreseen conditions of the shoreline that would occur by applying the proposed land use designations and policies (under the SMP) to substantiate that proposed designations will ensure no net loss of shoreline processes and functions.

Under the Shoreline Management Act (SMA), the cumulative impact analysis requires consideration of the following factors:

- Shoreline ecological functions can be impacted by development subject to shoreline permits and by development that is not subject to permit requirements.
- Only impacts of reasonably foreseeable future development on shoreline ecological functions need to be considered.
- The goal of the analysis is to evaluate the extent to which the SMP achieves, as a whole, no net loss of ecological functions while accommodating appropriate and necessary shoreline uses.

Within shoreline areas, the frequency and magnitude of disturbances strongly affect the structure of the ecosystem as well as the rate of ecological processes (Pickett and White 1985). Dominant disturbance processes in the landscape include fire, floods, mass wasting, wind, and insect infestations. Most of these natural disturbance regimes are difficult to re-establish within an urban area, without risk to damage of life or property. Instead, a number of human-induced disturbances may occur even in relatively conserved areas (such as fire suppression, flood mitigation, etc.). A main goal of shoreline management is to reduce as many human-induced disturbances as possible, such as forest clearing, wetland destruction, and the transformation of the channel network, and to re-establish impacted areas by reversing the degradation.

2.0 METHODOLOGY

The methodology used to determine the cumulative impacts in the Shoreline Management Zone (SMZ) and the area of shoreline jurisdiction is based on:

- The current conditions, based on the findings outlined in the Characterization Report (Landau Associates 2009a)
- The foreseeable future development and use of the shoreline (Figure 2)
- The likely effects of future development on shoreline and watershed functions using the "Landscape Analysis" provided in the Characterization Report (Landau Associates 2009a)
- The likely beneficial effects of any established regulatory programs under other local, state, and federal laws as well as non-regulatory programs
- The analysis of impacts based on the City's adoption of the Washington State Department of Ecology (Ecology) 2005 Stormwater Management Manual for Western Washington (Ecology 2005).

3.0 RESULTS

Landau Associates evaluated the cumulative effects of incremental impacts on shoreline ecological functions from uses and activities allowable under the proposed SMP in accordance with Chapter 173-26 Washington Administrative Code (WAC) to assess how proposed policies and regulations cause and avoid such cumulative impacts. This evaluation is part of ongoing development of proposals for policies, environmental designations, and other regulations for and by the City. In preparing this document, Landau Associates personnel discussed with City staff shoreline use and emerging trends, exemptions, and the impacts of reasonably foreseeable development and land use on ecological functions, or other functions fostered by the SMA and SMP. The cumulative impact analysis was coordinated with the environmental review of the SMP.

3.1 ANALYSIS OF BASIN EFFECTS

Alterations to the physical structure of the landscape within the City's shoreline jurisdiction have affected ecological functions. Due to the flat terrain, poorly draining soils, and geology with low permeability within the Enumclaw Plateau, the SMZ area has historically been dominated by wetlands and likely small waterways, particularly within floodplains and depressions; however, much of the wetland area within the City has been altered by extensive ditching and channelization associated with urban development (Figures 3 and 4).

Despite alterations, important habitat exists within the SMZ (Figure 5). Streams within SMZs 1 through 3 have anadromous fish species, including species listed as threatened under the Endangered Species Act (ESA). All or portions of streams within SMZs 1 through 3 are designated by the National Oceanic and Atmospheric Administration (NOAA) as critical habitat for West Coast salmon and steelhead trout (*Oncorhynchus mykiss*)(under development) and evolutionarily significant units (ESUs) of Puget Sound Chinook salmon (*O. tshawytscha*), under the ESA (NOAA Fisheries website 2010). The stream channel within SMZ 4 is located upstream of a barrier to fish passage and has resident fish species. Uplands in portions of the SMZ also have Washington Department of Fish and Wildlife (WDFW) priority species or their habitats.

3.1.1 WATERSHED (BASIN-SCALE) ANALYSIS OF ALTERATIONS

Newaukum and Boise creeks are both river systems that serve as linkages between their watersheds and the marine waters of Puget Sound. In general, river ecosystem processes are influenced

primarily by the hydrogeologic setting, which includes climate, topography, geology and soils, and land cover. Note that the two basins are similar in many of these aspects.

The primary alterations to the landscape that affect ecological functions in the Boise and Newaukum Creek basins include the following:

- Land cover change (deforestation, increase in impervious surfaces)
- Wetland loss or degradation
- Stream channelization
- Addition of untreated stormwater, leaking septic systems, and agricultural activities.

Ecological processes and the alterations to landscape that affect those processes, as based on the guidance *Protecting Aquatic Ecosystems: A Guide for Puget Sound Planners to Understand Watershed Processes* (Stanley et al. 2005), are described below. For each basin, we discuss alterations to ecological processes.

3.1.1.1 Boise Creek Basin

Boise Creek contains areas of shoreline jurisdiction in the City and Urban Growth Area (UGA), and is designated a "shoreline of the state" from approximately river mile (RM) 11 downstream to the mouth of Boise Creek at the White River at RM 23.3 (Ecology website 1998). Several small tributaries feed into Boise Creek.

Boise Creek Land Cover and Land Use

As of 2001, urban and rural land uses (e.g., neighborhoods, industrial/commercial, single-family residences) accounted for approximately 10 percent of the area in the Boise Creek Basin and undeveloped areas made up of forested, shrub, and/or herbaceous land accounted for approximately 88 percent of its area (King County 2004). Historically, the Enumclaw Plateau area was likely dominated by deciduous and coniferous forest and extensive forested depressional wetlands (based on soils and geology; King County 2004). Currently, land cover in this area is dominated by herbaceous vegetation and urban land use [associated primarily with the City (King County 2004; Figure 6)]. Large areas covered primarily by coniferous forests are still present in the far eastern portion of the Upper Basin. Within the 200-foot riparian area of Boise Creek, the dominant land cover consists of mixed forest and herbaceous cover. Urban development comprises less than 1 percent of land cover (King County 2004).

Land use in the basin is illustrated on the City's Master Planning Land Use map, and by the zoning map for areas within King County or the UGA, as illustrated on Figure 7 (also referenced on Figure 2). County zoning within the Boise Creek Basin consists primarily of Agriculture, Rural

Residential (one house per 5 or 10 acres), Forest, and some Industrial [along State Route (SR) 410] (King County iMAP website, various dates) (see Figure 7). Much of the Ravine and Plateau areas, excluding the City, are designated as Agricultural Production District (King County iMAP website, various dates).

Boise Creek Basin Alterations

Boise Creek water processes are discussed in the Characterization Report (Landau Associates 2009a). Primary landscape alterations that influence water processes include increased impervious surfaces, vegetation removal, increased stormwater drainage, and water channelization.

Water movement (shallow subsurface flow) processes are converted to surface runoff processes as a result of removing soils, constructing impervious surfaces, and removing forest vegetation. These alterations prevent water from infiltrating into the soil, which results in increased flows in creeks. Simply clearing forest vegetation, even in rural areas that have little impervious cover, increases stream flow (Booth et al. 2002). A measure commonly used is the effective impervious area (EIA). Previous studies of the Puget Sound lowland readily observed damage to stream resources (i.e., unstable channels) if the EIA of a watershed exceeded 10 percent (Booth et al. 2002). The EIA for the entire Boise Creek Basin is estimated to be less than 10 percent, with most of the impervious surfaces located in the Plateau area, within Enumclaw and its UGA (King County 2004).

Predicted changes in peak water discharge is sensitive to urbanization and agriculture uses (and less so for forestry uses). On impervious deposits such as glacial till, the 10-year peak flow discharge can be maintained if less than 35 percent of the forested cover in a watershed has been removed (Booth et al. 2002). However, since flows are slightly higher in developed areas with more impervious surfaces, the mean daily flow rate in Boise Creek could increase (King County 2004).

Floodplains and depressional wetlands, followed by seasonally saturated areas, are important for storing surface water runoff. The water storage capacity of streams within the channel is reduced when streams are channelized or straightened, and the water storage capacity of associated floodways and wetlands is reduced when these areas are separated from the channel. Draining or filling of depressional wetlands results in a larger quantity of water delivered directly to downgradient aquatic ecosystems, such as creeks and streams, in a shorter period of time, increasing the peak flows and resulting in dynamic water level fluctuations. Current levels of channel complexity are below historical levels (King County 2004) (Figure 8). Prior to European settlement, large expanses of the Enumclaw Plateau were wetland; however, much of the stream channel length across the plateau currently consists of constructed ditches and straightened channels separated from the floodways and wetlands (King County 2004).

Two other alterations with a lesser effect on water processes are water withdrawal and urban development. Water withdrawal, for irrigation and drinking water, can influence surface and groundwater levels. The White River and its tributaries, including Boise Creek, have been experiencing declining flows due to urban growth pressure and increased demand for water (King County 2004). Enumclaw gets much of its water supply from two spring sources, Boise Springs and Watercress Springs, both of which are located within the Newaukum Creek Basin, and thus water withdrawal does not significantly affect the Boise Creek Basin. In urban areas, where impervious surfaces exist, rates of groundwater recharge (infiltration of surface waters to deeper soil layers) may be significantly decreased. However, this does not seem to be a primary concern for most of the Boise Creek Basin due to the distribution of recharge areas and the relatively low density of development in those areas, with the exception of the Ravine, near the White River.

The primary effects of these alterations on ecosystem processes within the Boise Creek Basin include:

- Reduced water storage (surface and shallow subsurface) processes
- Increased overland flow
- Increased peak flow volume and frequency of flood events.

Sediment

Sediment delivery and movement processes occur primarily in the Upper Basin where slopes are steeper and some erosion hazard areas exist, and near the mouth of Boise Creek at its confluence with the White River (Figure 9). In the steepest channels of the Upper Basin, and to a lesser extent in the Ravine, sediment is transported downslope and delivered to headwater channels by periodic debris flows. Sediment storage (associated with water storage processes) is a primary process in the Plateau, where coarse sediment movement downstream is limited by the low-gradient and low-confinement channel morphology of the creek (Stanley et al. 2005). In-stream channel erosion is the primary source of sediment and its movement is by fluvial (stream) transport during high flow events (Stanley et al. 2005). Depressional wetlands, floodplains, depositional stream channels, and lakes are important locations for sediment storage. These areas are present primarily in the low-gradient stream sections.

Removal of riparian vegetation in the Plateau and Ravine areas has reduced bank stability, thereby increasing bank erosion and delivery of fine sediment to the stream. Separation of the stream from its tributaries and associated floodplains and wetlands via armoring and channelization in the Plateau and Ravine areas has increased sediment transport and reduced storage processes. In the lower Plateau and Ravine areas, the creek was relocated and channelized, reducing floodplain connectivity. In

the Ravine area, the channel downstream from Mud Mountain Road underwent removal of a concrete-encased water pipeline in 2003, which caused gravel and cobble that had accumulated upstream from this structure to wash out to the White River and may be leading to short-term channel incision in Boise Creek and perching near the White River (King County 2004).

A primary land use alteration in the Upper Basin consists of historical timber harvest activities and road creation, which increased the sediment supply through erosion of road cuts and fills, washing of fines from road surfaces, failures of road fill prisms, logging landings, and scour at culvert outfalls (King County 2004). Historically, sediment from the Upper Basin would be deposited in the upper portions of the Plateau area, where gradient decreases. The Weyerhaeuser lumber yard maintains a stream diversion for use in lumber processing and a constructed side channel and flow control structure (which replaced the mill pond in 1994) carries streamflow around the former pond to the downstream reach, which results in storage of sediment from Sub-basins 6 and 7 in the old mill pond or in the large side channel (King County 2004). This reduction in transport by the sediment pond may be offset by increases in sediment from other land use management including forest practices and channel realignment in mainstem reaches along SR 410. A portion of the channel within Sub-basins 4 and 5 was partially realigned when SR 410 was constructed in 1936, which led to increased sediment erosion from adjacent erosion hazard areas (King County 2004). Much of this sediment is deposited within the Enumclaw Golf Course, in Sub-basin 4, where channel gradient decreases. Finally, land use management in the golf course has allowed for separation of wetlands and floodplains from the main channel (via channelization, armoring, and/or draining of wetlands), which has further increased sedimentation in this area.

In Reach 4, Boise Creek has been channelized and modified. This reach includes portions of the Enumclaw Exposition Center (former King County Fairgrounds), Enumclaw Sportsman Park, and the Enumclaw Golf Course. Overbank flooding occurs in the upper reach of Sub-basin 4.

The primary effects of alterations on sediment processes include:

- Increased sediment delivery to the golf course from the Upper Basin and the channel downstream from Mud Mountain Road
- Reduced sediment transport throughout the reach
- Increased storage in specific locations.

Nutrients, Toxins, and Pathogens

Historically, Boise Creek ran cool, clear, and nutrient-poor (i.e., oligotrophic), similar to most streams of the Pacific coastal ecoregion. Water quality concerns related to manure disposal by dairy farms began to be addressed in the 1970s. Since then, water quality degradation from land use change has been a growing concern (King County 2004). Boise Creek currently has impaired water quality requiring

remedial action, resulting primarily from increased nutrient loading, which can fuel algal growth and, in turn, increase temperature and biological oxygen demand within the system (King County 2004).

Alteration to pH within Boise Creek, which is generally caused by chemicals such as de-icers (alkalinity), fertilizers (alkalinity), agricultural production (acidity), or by natural causes from organic matter (acidity) and minerals (acidity or alkalinity) associated with agricultural production, are indicators that delivery of nutrients, toxins, and pathogens is increasing (King County 2004).

Movement (including transport, storage, and cycling) of nutrients, pathogens, and toxins is closely related to water movement (i.e., ammonium, nitrates, and dissolved phosphorus) as well as sediment processes (i.e., toxins and particulate phosphorus via adsorption). Transport and storage of pathogens, nutrients, and toxins are related to surface and shallow subsurface flow patterns and occur in streams, rivers, floodplains, and wetlands (with surface water connection), which are primary processes across the Plateau area.

Under natural conditions, all nitrogen originally becomes available to biota after it is fixed from atmospheric nitrogen, either by biota or lightning (small component), and there is no specific location where this occurs in the landscape. Phosphorus delivery is primarily from the weathering of rocks and occurs primarily in the Upper Basin. Pathogens include bacteria, protozoa, and viruses. Under natural conditions, the primary input of pathogens is the fecal material of wildlife. This occurs across the landscape, and no primary location is identified. In a natural system, toxin delivery is not a primary process.

Specific characteristics of these systems (including soils and vegetation) influence pathogens, nutrients, and toxins in different ways. Cycling of nitrogen includes biotic uptake by plants, decomposition, and nitrification (biological oxidation of ammonia with oxygen into nitrite, followed by the further oxidation of these nitrites into nitrates). Nitrification is a primary process in the Plateau area due to the abundance of seasonal depressional wetlands and riparian areas that provide the aerobic conditions necessary for the process to occur, as well as headwater streams, which provide opportunity for ammonium to become adsorbed to streambed sediments. An important mechanism for storage of nitrogen (ammonium) is assimilation by biota (plants), which is a primary process in the basin due to the presence of small headwater streams that allow plants to grow near the streambed. Adsorption of particulate phosphorus is most likely to occur in depressional wetlands with mineral soils or in upland areas with clay soils. Adsorption of toxins is most likely to occur in depressional wetland areas with soils of high cation exchange capacity (usually soils with high organic or clay content). Storage of toxins and pathogens occurs primarily within floodplain or wetland areas with organic soils, which are also dominant in the Plateau area.

Loss of pathogens (bacteria, protozoa, and viruses) is via mortality due to ultraviolet radiation, temperature, pH, salinity, predation, and starvation within areas with long water residence time (Stanley 2005). Areas where pathogens may die include depressional wetlands with mineral soils that are present in the Plateau. Loss of pathogens also occurs via export from the basin, which is a primary process in the Ravine. Loss of nitrogen is through denitrification (a microbe-facilitated process of nitrate reduction that results in the loss of nitrogen to the atmosphere via conversion to nitrogen gas), which occurs in soils that have shallow fluctuations in groundwater level (that provides a transition from aerobic conditions to oxygenated conditions), such as the seasonally saturated "wet fields" in the Plateau. Loss of toxins, as well as pathogens and nutrients, is via export from the system, within the Ravine.

An increase in delivery of toxins and pathogens is a primary alteration to the process, as indicated by increased number of sources, including manure from dairy farms, septic systems, and other agricultural and industrial activities. Primary alterations include drainage of water from wetland areas, which results in reduced storage time and shifts the processes toward transport and export of nutrients, toxins, and pathogens downstream.

Sanitary sewers and the City's wastewater treatment plant handle human waste within the Enumclaw city limits, but the unincorporated King County population is still operating on septic systems. Some nitrate emitted from these sources near the ground surface is taken up by plant roots, and some nutrients are carried horizontally in shallow groundwater. The 2002/2004 303(d) list of the Clean Water Act includes segments of Boise Creek as water quality-impaired for fecal coliform (near the confluence with the White River), and establishes a total maximum daily load (King County 2004), indicating that the ability of the ecosystem to store and/or remove pathogens (and via similar processes, toxins) is exceeded, resulting in increased export of nutrients and pathogens out of the watershed.

The primary effects of land use alterations on nutrient, toxin, and pathogen processes include:

- Increased delivery of nutrients, toxins, and pathogens
- Reduced storage and loss of nutrients, toxins, and pathogens
- Increased export of nutrients, toxins, and pathogens.

Organics and Large Woody Debris

Large woody debris (LWD) provides physical structure and cover, creates pools, deflects and breaks up stream flow, and stabilizes stream channels (Murphy and Meehan 1991). Delivery of LWD occurs due to mass-wasting events resulting from high flows within steep, unstable soils. Such conditions are present within the Upper Basin (see Figure 9). Additional delivery may occur in the Ravine area where slopes are steeper and some erosion hazard areas exist, as well as near the mouth of Boise Creek at

its confluence with the White River. Movement of LWD is not a primary process within the Plateau area, as stream velocity and gradient (less than 4 percent) are not sufficient to move large wood. Instead, the primary source of LWD in the Plateau area would result from wind-throw.

Land use changes (Weyerhaeuser lumber yard and associated flow control and channel realignment associated with SR 410) have resulted in storage of periodic debris flows upstream of the Enumclaw Golf Course that may have otherwise been transported downstream. Loss of riparian vegetation from riparian zones [within 100 feet (ft) of streams] has resulting in reduction in delivery from wind-throw.

The primary effects of land use alterations on organics and LWD processes include:

- Reduced LWD delivery
- Reduced LWD transport.

3.1.1.2 Newaukum Creek Basin

Newaukum Creek is designated a "shoreline of the state" from approximately RM 11, downstream to the Green River (Ecology website 1998).

Newaukum Creek Basin is divided into three areas for description, the Ravine, the Plateau, and the Upper Basin, which also includes the Alluvial Fan Reach (Figure 10).

- The Ravine is a small area consisting of a moderate-gradient stream channel that is incised and confined.
- The Plateau area consists of low-gradient stream reaches with relatively level topography. The City and/or its UGA are located within the Plateau area.
- The Upper Basin and Alluvial Fan Reach consists of confined channels in hilly topography.

Within each area, smaller sub-basins exist, which drain surface water into specific stream reaches (see Figure 10).

Streamflow rates in Newaukum Creek vary seasonally and are primarily dependent on steady snowmelt in the summer and rain in the winter, which tends to have a more variable flow magnitude. Mean daily flows near the mouth of the creek range from lows of 20 to 30 cubic feet per second (cfs) in late summer to approximately 100 cfs during winter. Average minimum daily flows in summer are near 10 cfs, whereas mean maximum daily flow rates range from 30 to 100 cfs in winter. Peak flow magnitude for a 10-year event is 1,300 cfs; the 50 year-event is 2,100 cfs; and the 100–year event may exceed 2,560 cfs (Latterell et al. 2007).

The Ravine is located where Newaukum Creek descends from the Enumclaw Plateau to the Green River Valley through a 4-mile-long ravine (RM 0.3 to RM 4.7). The middle section is unconfined

and contains wide, intact riparian buffers (Latterell et al. 2007), which contribute to input of sediment and LWD at high flows through bed and bank erosion (Latterell et al. 2007).

Newaukum Creek and most of its tributaries flow across the level plateau from RM 4.7 to RM 11.5. Significant overbank flooding occurs in this sub-basin (Latterell et al. 2007). Canopy cover is present in only 28 percent of the reach (Latterell et al. 2007). The tributary channels in the Alluvial Fan Reach (RM 11.5 to 12.1) exhibit plane-bed channel morphology and are likely to be sediment-rich with common gravel bars. These channels are inherently subject to flooding and avulsion as a result of progressive sediment accumulation (Latterell et al. 2007).

Land Cover and Land Use

Land cover in the Newaukum Creek Basin is dominated by agricultural fields in the upper part of the Ravine and Plateau areas and by forest cover in the Upper Basin (Figure 6). Secondary land cover includes wetlands and a mix of urban and rural developed land uses within Ravine/Plateau. Approximately 11 percent of the basin is primarily streams, riparian habitats, and wetlands, although the historical area (based on the extent of hydric soils) was likely four times larger than the current area. The dominant (70 percent of the total area) wetland type consists of "wet fields"; however, these areas were historically dominated by forested habitat (Latterell et al. 2007).

Zoning designations within Newaukum Creek Basin primarily consist of Agriculture (A-10 and A-35), followed by Forest (located primarily in the Upper Basin) (see Figure 7). Zoning designations also include Rural and Urban Residential [the latter is located primarily within the City and its UGA (City of Enumclaw 2008)]. Areas zoned Rural Residential (RA-2.5, RA-5, and RA-10) are also present primarily in the Plateau.

Water

Water processes are the most important aspect of the riverine systems, as many other processes are closely tied to patterns of water delivery, movement, and loss across the watershed (basin). Water movement is an important process in the basin and includes surface and subsurface movement as well as storage. The geology of the Newaukum Creek Basin is generally dominated by deposits with low permeability (glacial till), and soils that restrict the flow of surface water to the underlying aquifers. Thus, groundwater storage and recharge is not a dominant process across the basin, but is an important process along the eastern portion of the basin (west of the bedrock hills) where coarse material composing the aquifer is exposed at the ground surface. Groundwater springs or seeps along the margins of the Osceola mudflow in the eastern portion of the Newaukum Creek Basin provide evidence that the water

storage capacity is being exceeded (Orr and Orr 2002). Overland and surface flows, and shallow subsurface flows, are a dominant process throughout the basin. In the low-gradient areas overlying less permeable deposits present within the Plateau, water can move laterally but only under high soil moisture conditions (Stanley et al. 2005). This is evident in extensive seasonally saturated, depressional wetlands (either historically or currently present). These areas provide surface storage of water and are important indicators of other processes as well (sediment storage, toxin storage, nutrient cycling, etc.). Water is primarily lost from the basin via surface flow, and via evaporation and transpiration. Floodplains and depressional wetlands, followed by seasonally saturated areas, are important areas for the storage of surface water runoff. Draining or filling of depressional wetlands results in a larger quantity of water delivered directly to downgradient aquatic ecosystems, such as creeks and streams, in a shorter period of time, increasing the peak flows and resulting in dynamic water level fluctuations. Prior to European settlement, large expanses of the Enumclaw Plateau were wetland; however, much of the stream channel length across the Plateau currently consists of constructed ditches and straightened channels (King County 2004). Current levels of channel complexity are likely below historical levels, although they have not been formally quantified (King County 2004) (Figure 8). King County estimates that people have created 77 miles of artificial channels and reduced the extent of wetlands by 80 percent within the Newaukum Creek Basin (King County 2004).

The water storage capacity of streams is reduced when streams are channelized or straightened. Shallow subsurface flow processes are generally converted to surface runoff processes as a result of the removal of soils, construction of impervious surfaces, and removal of forest vegetation by preventing water from infiltrating into the soil. Typically this results in increased peak flows in creeks and reduced base flows, essentially making the system flashier (subject to unstable flow regime, increased stormwater runoff quantities) (Latterell et al. 2007). Despite clearing forest vegetation, overall streamflow volume has decreased, which may be attributed to human alteration and/or climate change (Latterell et al. 2007), though water withdrawal may also contribute to this decrease in streamflow. Water withdrawal, for irrigation and drinking water, can influence surface and groundwater levels. Groundwater provides high quality drinking water to the residents of the Newaukum Creek Basin, including those within the City via two spring sources, Boise Springs and Watercress Springs.

Previous studies of the Puget Sound lowland observed damage to stream resources (i.e., unstable channels) if the effective impervious area (EIA) of a watershed exceeded 10 percent (Booth et al. 2002). The EIA for the entire Newaukum Creek Basin is estimated to be 11 percent (in 2007), but is higher (up to 59 percent) within developed areas, including the City and its UGA (Latterell et al. 2007).

In areas of urban development, increased impervious surface can restrict groundwater recharge rates. However, this may not be a primary concern for most of the Newaukum Creek Basin due to the distribution of recharge areas in the Alluvial Fan Area, and the relatively low density of development in those areas (consisting primarily of King County Forest Production District) (Latterell et al. 2007).

Primary landscape alterations that influence water processes include, but are not limited to, impervious surfaces, stormwater drainage systems, and water channelization. The primary effects of these alterations on ecosystem processes include:

- Reduced water storage (surface and shallow subsurface) processes
- Increased overland flow
- Reduced subsurface flow
- Decreased peak flow volume and frequency of flood events.

Sediment

Sediment delivery and movement processes occur where slopes are steeper, and are not dominant in the Plateau. In the steepest (zero and first order) channels of the Upper Basin, sediment may be transported downslope and delivered to headwater channels by periodic debris flows (Benda and Dunn 1997), while fluvial transport (occurring during high flow events) is a primary process in less steep areas. Large weather events or disturbances to Boise Ridge can cause flooding or out-of-channel flow in this area (Latterell et al. 2007).

Most of the bedload (the coarser particles, relative to suspended sediment, that are transported along the streambed) from the Upper Basin is deposited within the Alluvial Fan Reach, making this area a key location for deposition processes. Coarse sediment movement downstream is limited, primarily because overbank flooding occurs slowing stream velocities (Latterell et al. 2007). Because of the low gradient and low confinement of Newaukum Creek in this reach, it has a limited ability to move coarse sediment from the headwater reaches far out onto the Plateau. Conversely, sediment storage (associated with water storage processes) is a primary process in the Plateau. Indicators, such as aquatic plants growing from the streambed, are consistent with infrequent movement of streambed sediment (Latterell et al. 2007). Some steep tributaries to the mainstem located within the Ravine may also introduce sediment.

Removal of riparian vegetation in the Plateau and Ravine areas has reduced bank stability, thereby increasing bank erosion and delivery of fine sediment to the stream. Separation of the stream from its tributaries, associated floodplains, and wetlands via armoring and channelization in the Plateau and Ravine areas (as discussed under the analysis of water processes alterations) has increased sediment transport and reduced water storage capacity.

The primary effects of these alterations on sediment processes include:

- Increased sediment delivery
- Reduced sediment transport
- Reduced water storage in specific locations.

Nutrient, Toxin, and Pathogen Processes Alterations

A primary process alteration is manure from dairy farms, agricultural activities, septic systems, and industrial activities that increase the delivery of toxins and pathogens into the Newaukum Creek Basin. Other primary alterations include drainage of water from wetland areas, which reduces storage time and shifts the processes toward transport and export of nutrients, toxins, and pathogens downstream.

The degradation of the water quality is partially attributed to high nutrient concentrations resulting from agricultural practices in the Newaukum Creek Basin. Water quality concerns related to manure disposal by dairy farms began to be addressed in the 1970s. Since then, water quality degradation from land use change has been a growing concern and there has been an improvement in the water quality, including total nitrogen (Latterell et al. 2007). Even so, , there is still low dissolved oxygen and high total nitrogen and phosphorus concentrations in the water, particularly in sites subject to agricultural use (Latterell et al. 2007).

Sanitary sewers and the City's wastewater treatment plant handle human waste within the Enumclaw city limits, but the unincorporated King County population is still operating on septic systems. While the City's wastewater treatment facility is new, many of the county systems are antiquated, often installed contemporaneously with the houses they serve, and many do not adequately treat the nitrate from the waste. Some nitrate emitted from these sources near the ground surface is taken up by plant roots, while much of the rest is denitrified by bacteria in the aquifer. However, some nutrients can be carried horizontally a considerable distance.

Based on Ecology's Water Quality Index rating system for water year 2003/2004, Newaukum Creek was of "moderate concern" due to high fecal coliform bacteria counts, which are due to agricultural practices and failing septic systems within the Newaukum Creek Basin (Hallock 2002). The creek and its larger tributaries have minor water quality problems with fecal coliform bacteria (usually in the distribution system) and iron and manganese in the well water (Latterell et al. 2007). King County's Stream and River Ambient Monitoring Program considers the creek health to be in "fair" condition, based on the diversity and number of benthic macroinvertebrates (which respond to the water quality and are also used as indicators of the stream's ecological health) (King County 2004).

The primary effects of land use alterations on nutrient, toxin, and pathogen processes include:

- Increased delivery of nutrients, toxins, and pathogens
- Increased export of nutrients, toxins, and pathogens.

Organics and Large Woody Debris

Delivery of LWD is expected to occur within mass-wasting events associated with high flows in steep, unstable soils; these events occur within the Ravine and Upper Basin (see Figure 9). Movement of LWD is not a primary process within the Plateau area, as stream velocity and gradient (less than 4 percent) are not sufficient to move large wood. Instead, the primary source of LWD in the Plateau area results from wind-throw. This process is now limited due to lack of forest cover within riparian areas (within 100 ft of streams).

Land use change (conversion of forested areas to forestry and agricultural uses and for rural residential development) has contributed to the loss of riparian vegetation from riparian zones. Specifically, the loss of trees (within 100 ft of streams) has resulted in the reduction in delivery of LWD from wind-throw, and isolation of channels from floodplains and wetlands has resulted in reduction in delivery of organic matter from plant growth and decomposition into the stream system.

The primary effects of land use alterations on organic and LWD processes include:

- Reduced LWD delivery
- Reduced LWD transport.

3.2 EVALUATION OF SHORELINE MANAGEMENT ZONE CUMULATIVE EFFECTS

Water quality in Newaukum Creek is generally impaired and is on Ecology's List of Water Quality-Impaired Waters for temperature, dissolved oxygen, nutrients, and bacterial contamination [Section 303(d) of the Clean Water Act] (Hallock 2002). Specifically, it is considered to be of "moderate concern" (based on its Water Quality Index rating for 2003/2004). Following are more detailed descriptions of effects within areas of shoreline jurisdiction (see Figure 5). SMZ designations are described in the SMP Characterization Report (Landau Associates 2009a). Specific area designations are shown on Figure 2.

3.2.1 SHORELINE MANAGEMENT ZONE 1: NEWAUKUM CREEK

3.2.1.1 Shoreline Management Zone 1 Sub Area (Area 1) Mahler Park

This section of the shoreline is within an undeveloped City park. Any future development of this park will be consistent with the SMP, and is likely to include some public access. It is zoned Public Use.

Areas of Mahler Park within the floodplain of Newaukum Creek are within shoreline jurisdiction and impacts to any shoreline jurisdiction would be subject to the SMP and Critical Areas regulations.

3.2.1.2 Shoreline Management Zone 1 Tributary A (Area 2)

This area is primarily undeveloped or developed at very low density. It is currently being annexed into the City and the zoning will change from Urban Reserve (one dwelling unit per 5 acres) to R-2 [single family, minimum lot size of 8,400 square feet (ft^2)]. While there would be more density allowed in the City when these parcels develop, the City would require these areas (now on septic systems) to connect to the City sewer system and provide stormwater treatment per the 2005 Stormwater Management Manual (Ecology 2005) so there may be water quality improvements. These areas are subject to the SMP only where there are wetlands within the floodplain, so the area within shoreline jurisdiction is not likely to be developed as it would be if it were a critical area. These areas would require sewer extensions and possibly pump stations in order to develop or redevelop, so the City does not anticipate rapid development. Stormwater from these areas would flow into the nearby wetlands and streams and then into Newaukum Creek and would be a cumulative impact unless the stormwater was pre-treated.

3.2.1.3 Shoreline Management Zone 1 (Area 3)

This area is similar to Area 2, except that it is already located within the City.

3.2.1.4 Shoreline Management Zone 1 (Area 4)

This area is primarily undeveloped or developed at very low density. It is currently not within the City, but is within the City's UGA. There is not a current annexation proposal for this area and little or no additional development potential at current densities. If annexed, the zoning would change from 1 dwelling unit per 5 acres to R-1 (single family, one dwelling unit per 15,000 ft^2). While there would be more density allowed in the City if these parcels develop, the City would require these areas (now on septic systems) to connect to the City sewer system and provide stormwater treatment per the 2005 Stormwater Management Manual (Ecology 2005) so there may be water quality improvements. These areas are subject to the SMP only where there are wetlands within the floodplain, so the area within shoreline jurisdiction is not likely to be developed as it would be if it were a critical area and regulated under the City's Critical Areas Ordinance (CAO). These areas would require sewer extensions and possibly pump stations in order to develop or redevelop, so the City does not anticipate rapid

development. Treated stormwater from these areas would flow into the nearby wetlands and streams and then into Newaukum Creek.

3.2.1.5 Shoreline Management Zone 1 (Area 5)

This area is primarily undeveloped or developed at very low density. It is currently being annexed into the City and the zoning will change from Urban Reserve (one dwelling unit per 5 acres) to R-2 (single family, minimum lot size of 8,400 ft^2). While there would be more density allowed in the City if these parcels develop, the City would require these areas (now on septic systems) to connect to the City sewer system and provide stormwater treatment per the 2005 Stormwater Management Manual (Ecology 2005) so there may be water quality improvements. These areas are subject to the SMP only where there are wetlands within the floodplain, so the area within shoreline jurisdiction is not likely to be developed as it would be if it were a critical area.

3.2.2 SHORELINE MANAGEMENT ZONE 2: BOISE CREEK

3.2.2.1 Shoreline Management Zone 2 (Area 6)

This area is zoned Public Use and developed with a golf course and single-family residences. The City does not expect these land uses to change. The golf course provides public access to Boise Creek. We expect that there is a potential conflict between use and maintenance of the golf course and protection of the functions and values of Boise Creek. The Boise Creek streamside corridor through the golf course has an impaired riparian zone. Segments have riprap armoring and bank hardening.

Based on conversations with City personnel and on the Restoration Report (Landau Associates 2009b), the Puyallup Tribe may have plans to re-route the Boise Creek channel, which may help to alleviate potential conflicts with the golf course use and maintenance. Incorporation of *Best Management Practices for Golf Course Development and Operation* (King County 1993) could provide enhanced water quality and habitat conditions.

3.2.3 SHORELINE MANAGEMENT ZONE 3: BOISE CREEK

3.2.3.1 Shoreline Management Zone 3 (Area 7)

This area is zoned Public Use and developed with the Foothills Trail, a wetland mitigation site, and SR 410. We do not expect these uses to change significantly. We do anticipate that there will be a need for a variety of street improvements within the SR 410 right-of-way that may include signals, additional lanes, and paving. The Boise Creek tributary streams in this area are channelized into ditches that are maintained by a drainage district. We do expect conflict between maintenance of the drainage

ditches and protection of the functions and values of the streams. There has been recent enhancement activity resulting from mitigation for the new wastewater treatment plant.

3.2.3.2 Shoreline Management Zone 3 (Area 8)

This area has some residential zoning, limited commercial zoning, and SR 410. This area is primarily undeveloped or developed at very low density. It is currently not within the City limits, but is within the City's UGA. There is not a current annexation proposal for this area, and little or no additional development potential at current densities. If annexed, the zoning would change from one dwelling unit per 5 acres to R-2 (single family, one dwelling unit per 8,400 ft^2). While there would be more density allowed in the City if these parcels were annexed and developed, the City would require these areas (now on septic systems) to connect to the City sewer system and provide stormwater treatment per the 2005 Stormwater Management Manual (Ecology 2005), so there may be water quality improvements. The largest undeveloped parcel within this area is subject to the SMP only where there are wetlands within the floodplain, so its shoreline jurisdiction is not likely to be developed because it is a critical area. These areas would require sewer extensions and possibly pump stations in order to develop or redevelop, so we do not anticipate rapid development. Stormwater from these areas would flow into the nearby wetlands and streams and then into Boise Creek.

3.3 COMPREHENSIVE PLAN

Enumclaw's Comprehensive Plan (City of Enumclaw 2005a) is a long-range policy document that identifies the course the community should take to achieve its long-term goals and objectives. This plan was initially prepared as an update to the City's 1999 comprehensive plan, but it grew into a complete plan rewrite, including new chapters that incorporate some of the City's planning efforts in parks and recreation, economic development, and community design.

The Comprehensive Plan is intended to comply with the Growth Management Act's requirements and to fulfill Enumclaw's need for an updated plan. It meets the state's legal requirements while also providing the City a very practical guide to help its annual budgeting, capital improvements, and future development.

3.3.1 GROWTH PROJECTIONS

According to Enumclaw's Comprehensive Plan (City of Enumclaw 2005a), Enumclaw's population increased steadily over the past 20 years with rising housing prices reflecting the increase in demand. Enumclaw (2000 U.S. Census population 11,116) has grown substantially since the turn of the

20th century. The 1980s brought a 33 percent increase in population, and the 1990s brought an almost 54 percent population increase despite the development moratorium enacted in 1998. The trends for Enumclaw show more than twice the growth rate of the rest of the state in the last two 10-year periods, 1980 through 2000. Enumclaw's population growth has been a constant for the past three decades, with a 175 percent population increase from 1968 through 2000.

According to the Comprehensive Plan, Enumclaw's population is forecast to reach 15,996 residents by the year 2022. This increasing residential population translates into increased demands on land and facilities. The City encourages densifying specific areas, preserving and conserving ecologically sensitive land, and pacing expansion into the UGA to match the City's ability to provide services. The increase in population will increase demand on schools, parks, and open spaces. Although there will be increases in land development, the community, through the Comprehensive Plan, expressed a desire to maintain Enumclaw's character by projecting that character onto future land development, emulating the urban pattern established within the City.

Currently, Enumclaw does not have any subdivision activity in any of the shoreline jurisdiction areas. There is one subdivision that has potential shoreline wetlands on it, but there are no proposed impacts to those wetlands. There are a couple of larger subdivisions that have been submitted to the City for preliminary plat approval, but the City does not anticipate that development to occur until the economy improves. Recently, development has slowed down due to the state of the economy (Shook 2010).

3.3.2 USE ANALYSIS

The City has identified logical areas for future City growth, development, and the provision of services in the Comprehensive Plan. Those areas are included within a larger area referred to as the City's Urban Growth Area (UGA). The City of Enumclaw's municipal boundaries encompass 2,945 acres, and the UGA encompasses another 1,407 acres.

For residential growth, a surplus of 434 dwelling units beyond the housing target would result if the City achieves buildout of the residentially zoned land to the 2010 predicted levels. Since 1996, Enumclaw has achieved only 20 percent of its residential growth target, which is a slower-than-predicted growth rate. Local population trends confirm this slowdown, according to the Comprehensive Plan, and one cause may be the City's development moratorium that greatly restricts new residential construction (City of Enumclaw 2005a). While the growth rate has slowed since the moratorium, the lifting of the moratorium may increase demand for new housing units.

Approximately 1,000 new jobs in the commercial and industrial sectors were projected by the year 2012; by 2000, the City had already seen 75 percent of the expected growth.

There are several land use scenarios that are discussed in the Comprehensive Plan involving open space. The plan discusses the Central Business District, mixed residential development, nodes of development, and the SR 410 corridor. There are also degrees of alternatives for development scenarios including Expansion, Containment, and Nodes. The preferred land use scenario draws from each of the alternatives. Enumclaw is planning to grow into its Tier 1 expansion area (which is the current land to be annexed) and slowly expand into the UGA surrounding the community. Enumclaw will infill vacant land at higher than existing densities (containment). Enumclaw is planning to integrate smaller businesses near neighborhoods (nodes), and gradually shift toward more intense development around the Central Business District and intensify development along corridors on Griffin Street east of the downtown area and Porter Street near the northern city limits.

3.3.3 POTENTIAL ASSOCIATED WETLANDS

Connectivity to the shoreline of the state is the primary consideration for preliminarily determining if wetlands are associated with the shorelines. If the wetland or waterway is large and located partially within the floodway, the wetland is likely associated with shorelines, particularly for Boise and Newaukum creeks. Note that these wetlands and waterways require buffers under the City's CAO. The City landscape contains a variety of watercourse types including ditches, bioswales, channelized streams, and disturbed and undisturbed wetlands.

To identify associated wetlands, Landau Associates merged Geographic Information System (GIS) wetland layers from the National Wetlands Inventory, Washington Department of Natural Resources, King County Sensitive Areas Ordinance Wetlands, and City of Enumclaw 2007 Wetland Inventory. Merging the wetland layers with the shorelands information determined the potential associated wetland areas by showing the intersection with the shorelands and the 100-year floodplain. Selected wetlands that have a direct hydrological connection to Boise Creek or Newaukum Creek but were within the 100-year floodplain were designated as "Potential Associated Wetlands."

The shoreline jurisdiction of potentially associated wetlands that are not contiguous with the floodplain and that occur beyond the limit of the floodplain should be evaluated on a case-by-case, site-specific basis through the permitting process associated with land use applications through the City's CAO review process to determine cumulative effects to wetlands within shoreline jurisdiction. During the field review of the SMZ, Landau Associates noted areas where the wetland appeared more extensive than indicated on mapped inventories and where wetlands generally corresponded to the extent of mapped

hydric soil. However, documentation of the presence and extent of wetlands within the City was not within the SMP scope of work and, therefore, expansion of wetland areas beyond known mapped data sources is not shown. In general, throughout the course of historical development of the City, many of these wetlands have been altered and modified, mostly by vegetation removal but also by drainage and ditching.

Stream habitat and buffers (riparian areas) adjacent to regulated streams or waterbodies are designated as Fish and Wildlife Habitat Conservation Areas, as discussed in the City's CAO (Chapter 19.02.100). These areas—Boise Creek and Newaukum Creek—and their associated buffers are recognized as being important in the overall effort to restore and enhance salmonid habitat as well as for creating open space corridors adjacent to the two major watercourses in, or in close proximity to, the City. These areas provide mitigation opportunities that are consistent with goals and objectives defined in the City's Comprehensive Plan and in the watershed restoration and management plans being developed in Water Resource Inventory Area (WRIA) 9, which is the Green River Watershed and in WRIA 10, which is the White River Watershed.

3.4 RESTORATION

Consistent with state guidelines (WAC 173-26-186), the proposed SMP includes a Restoration Plan (Landau Associates 2009b). This document describes specific land use management practices and regulations that the City, in coordination with other governmental and non-governmental agencies, tribes, and citizens, can implement in order to maintain (conserve) and/or improve (restore, rehabilitate, or enhance) watershed processes and/or shoreline functions. Ecologically sound land use management practices are needed at both the landscape level (throughout the basin) and at the reach level (within shoreline jurisdiction). Therefore, continued coordination between multiple jurisdictions (state, county, and local) and agencies will be an integral component of conservation and restoration processes.

4.0 CONCLUSION

The development and use patterns along Enumclaw's shorelines are well established. There are limited opportunities for any development in the limited areas of shoreline jurisdiction. The system of shoreline environment designations and use regulations in the proposed SMP is consistent with the established land use patterns as well as the land use vision planned for in the City's Comprehensive Plan, zoning regulations, and other long-range planning documents. Based on this consistency, it is unlikely that substantial changes in shoreline uses will occur in the future. The updated development standards and regulation of shoreline modifications provide more protection for shoreline processes.

The restoration planning effort provides the City with opportunities to improve or restore ecological functions that have been impaired as a result of past development activities. In addition, the proposed SMP is intended to complement several city, county, state, and federal efforts to protect shoreline functions and values.

Many of the areas within shoreline jurisdiction are already designated for open space, public recreation, or other low-intensity land uses. Restoration activities, such as enhancing Boise Creek in the location of the golf course, will improve ecological function. New development would comply with existing regulations including the City's CAO and the EMC.

The cumulative impacts analysis is described in detail in Table 4.0. Based on an assessment of these factors, the cumulative actions taken over time in accordance with the proposed SMP are not likely to result in a net loss of shoreline ecological functions from existing baseline conditions. In concert with restoration planning efforts and resulting actions in the City, the regulatory provisions of the proposed SMP serve to improve the overall condition of shoreline resources in the City of Enumclaw.

Insert Table 4.0

5.0 USE OF THIS REPORT

This report has been prepared for the exclusive use of the City of Enumclaw and applicable regulatory agencies for specific application to the City of Enumclaw Shoreline Master Program. The reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

This document has been prepared under the supervision and direction of the following key staff.

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