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CUMULATIVE IMPACTS ANALYSIS for the City of Chelan Shoreline Master Program

Project: Comprehensive Shoreline Master Program Update

- **Task 9: Develop Cumulative Impacts Analysis**

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CUMULATIVE IMPACTS ANALYSIS

CITY OF CHELAN SHORELINE MASTER PROGRAM

1 INTRODUCTION

1.1 Shoreline Management Act Requirements

The Shoreline Management Act guidelines require local shoreline master programs to regulate new development to "achieve no net loss of ecological function." The guidelines (WAC 173-26-186(8)(d)) state that, "To ensure no net loss of ecological functions and protection of other shoreline functions and/or uses, master programs shall contain policies, programs, and regulations that address adverse cumulative impacts and fairly allocate the burden of addressing cumulative impacts."

The Guidelines further elaborate on the concept of net loss as follows:

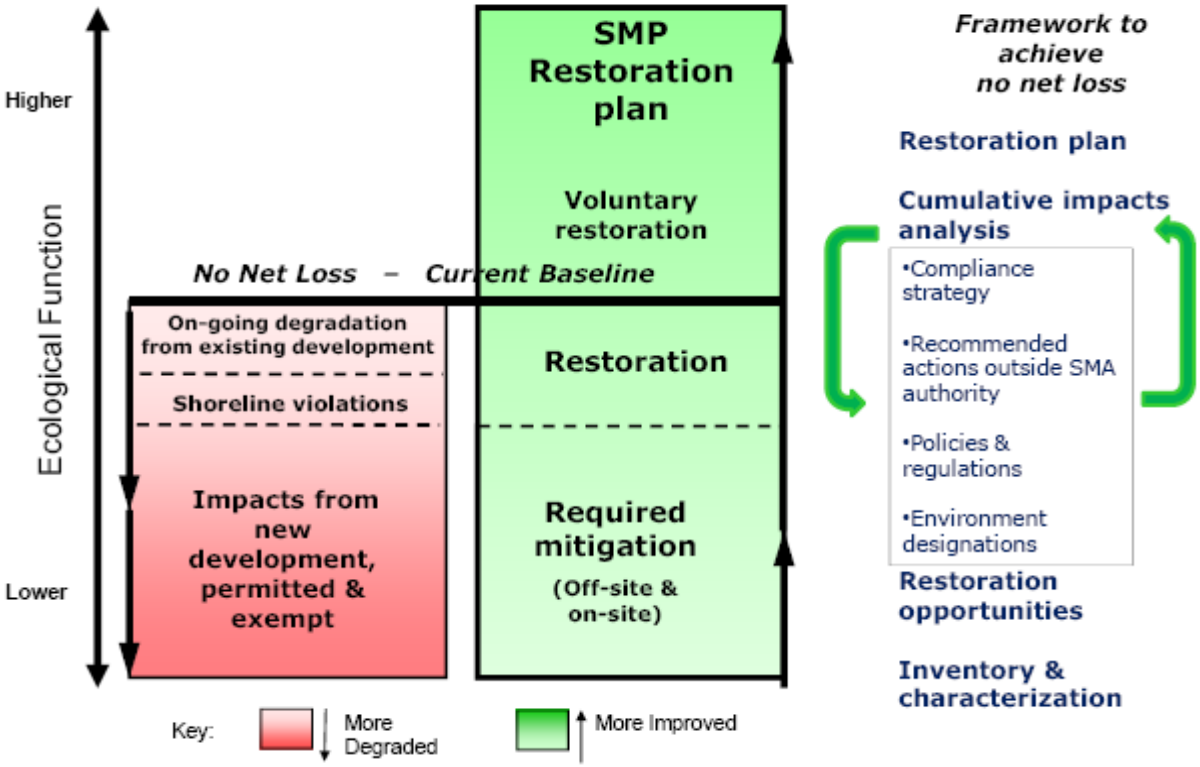
> *"When based on the inventory and analysis requirements and completed consistent with the specific provisions of these guidelines, the master program should ensure that development will be protective of ecological functions necessary to sustain existing shoreline natural resources and meet the standard. The concept of "net" as used herein, recognizes that any development has potential or actual, short-term or long-term impacts and that through application of appropriate development standards and employment of mitigation measures in accordance with the mitigation sequence, those impacts will be addressed in a manner necessary to assure that the end result will not diminish the shoreline resources and values as they currently exist. Where uses or development that impact ecological functions are necessary to achieve other objectives of RCW 90.58.020, master program provisions shall, to the greatest extent feasible, protect existing ecological functions and avoid new impacts to habitat and ecological functions before implementing other measures designed to achieve no net loss of ecological functions." [WAC 173-26-201(2)(c)]*

In short, updated SMPs shall contain goals, policies and regulations that prevent degradation of ecological functions relative to the existing conditions as documented in the City's characterization and analysis report. For those projects that result in degradation of ecological functions, the required mitigation must return the resultant ecological function back to the baseline. This is illustrated in the figure below. The City must be able to demonstrate that it has accomplished that goal through an analysis of cumulative impacts that might occur through implementation of the updated SMP. Evaluation of such cumulative impacts should consider:

(i) current circumstances affecting the shorelines and relevant natural processes [Chapter 2 below and Shoreline Analysis Report];

(ii) reasonably foreseeable future development and use of the shoreline [Chapter 3 below and Shoreline Analysis Report]; and

(iii) beneficial effects of any established regulatory programs under other local, state, and federal laws." [Chapter 5 below]



Source: Department of Ecology

As outlined in the *Shoreline Restoration Plan* prepared as part of this SMP update, the SMA also seeks to restore ecological functions in degraded shorelines. This cannot be required by the SMP at a project level, but Section 173-26-201(2)(f) of the Guidelines says: "master programs shall include goals, policies and actions for restoration of impaired shoreline ecological functions." See the Shoreline Restoration Plan for additional discussion of SMP policies and other programs and activities in Chelan County and the City of Chelan that contribute to the long-term restoration of ecological functions relative to the baseline condition.

1.2 Methodology

This cumulative impacts analysis was prepared consistent with direction provided in the Shoreline Master Program Guidelines as described above and using the information, both textual and graphic, developed and presented in the *Shoreline Analysis Report* as well as specific analysis conducted to support SMP development. To the extent that existing information was sufficiently detailed and assumptions about possible new or re-development could be made with reasonable certainty, the following analysis is quantitative. However, in many cases information about existing conditions and/or redevelopment potential was not available at a level that could be assessed quantitatively or the analysis would be unnecessarily complex to reach a conclusion that could be derived more simply. Further, ecological function does not have an easy metric. For these reasons, much of the following analysis is more qualitative.

Analysis of cumulative impacts is generally limited to areas that fall within the proposed shoreline jurisdiction; however, the area outside of the immediate shoreline jurisdiction was considered in determining effects for Shorelines of Statewide Significance.

The Aquatic shoreline environment is not evaluated individually in this CIA. Most development activities do not occur below the ordinary high water mark (OHWM), more typically occurring in the adjacent upland shoreland environments. However, shoreline modifications below the OHWM, such as docks and bank armoring, usually occur in conjunction with adjacent upland development and were evaluated in this analysis.

To estimate potential changes in land use along the shoreline, a land capacity analysis was conducted projecting growth over a 20-year timeframe. The land capacity analysis estimates development that may occur in the future along shorelines given draft shoreline environment designations and development standards. The method to determine shoreline land capacity is summarized below.

1. Determine shoreline use boundaries. The land capacity analysis includes all lands within shoreline jurisdiction, generally 200 feet upland of the ordinary high water mark, associated wetlands, the floodway, and up to 200 feet of floodway-contiguous floodplain where present (note- mapped floodway is not present in the City or its UGA). Additionally, parcels partially included in jurisdiction and extending beyond are included for Shorelines of Statewide Significance, due to the importance of these waterbodies and the ecosystem-wide processes emphasized in WAC 173-26-251.

2. Compile City land capacity analyses. Based on adopted Comprehensive Plan and City planner input, assumptions about vacant, partially used, and under-utilized properties have been compiled.

3. Determine land status. The analysis estimates developable acres by City and Urban Growth Area (UGA). The developable acres are also sorted by waterbody, shoreline environment designation, and future land use/zoning category. Developable acres include: 1) vacant (no building value); 2) partially used (e.g. single-family properties containing one home, but the land can be further subdivided); or 3) under-utilized (land value exceeds building value on multifamily, commercial or industrial properties).

4. Deductions. Constraints such as critical areas, shoreline setbacks, rights of way, and infrastructure are deducted from gross acres. Market factor reductions, which account for land that may not be available (e.g. owner does not wish to develop), are also included.

5. Densities or floor area ratios are applied to the net buildable acres to estimate total future dwellings or commercial/industrial square feet.

6. Public and mineral lands. Due to the different purposes for public lands/land trusts and mineral lands, typical assumptions regarding dwelling and commercial/industrial density were not applied. However, because these shoreline properties could be altered due to a variety of public purposes such as recreation, utilities, or resource extraction, acres estimates are provided for the City/UGA, as appropriate.

Appendix A provides a detailed matrix of assumptions and maps illustrating the categories of land status, including the three buildable categories as well as public and land trust properties.

Based on the results of the quantitative analysis of anticipated development, a qualitative analysis was performed to determine how foreseeable growth patterns might result in impacts to shoreline functions. A qualitative evaluation of potential impacts associated with possible future development, including upland development, overwater structures, and shoreline armoring, was conducted at a City-wide level. For each waterbody with anticipated development within shoreline jurisdiction, effects were evaluated in terms of hydrologic, shoreline vegetation, hyporheic, and habitat functions. A qualitative analysis was performed to determine how applicable regulations related to each of the impacts identified, and what, if any, regulations should be added or expanded to create more protection.

2 SUMMARY OF EXISTING CONDITIONS

The Shoreline Analysis Report included an evaluation of existing conditions in Chelan County and the Cities of Cashmere, Chelan, Entiat, Leavenworth, and Wenatchee. The sources and limitations of the data are listed in Table 9 of the Shoreline Analysis Report. Several types of data, including geology, soils, vegetation, and impervious surface coverage, provide a regional characterization of existing conditions, but are not appropriate for a local or parcel-based quantitative evaluation of existing conditions. Other data, including critical areas, may require a site-specific study to confirm the presence or absence of mapped features. Data gaps in the inventory data include aquifer recharge areas and shoreline stabilization. For a complete assessment of data limitations, assumptions, and data gaps, see Table 9 and Chapter 8 of the Shoreline Analysis Report. The following table (Tables 1) provides a summary of existing conditions by waterbody in the City of Chelan and its UGA.

2.1 Chelan (WRIA 47)

Approximately 87 percent of WRIA 47 is in federal, state, and local government ownership. The upper two-thirds of the WRIA can be accessed only by water, foot, horseback or air (floatplane) (Berg et al. 2004c). Current land uses in the WRIA as a whole include conservation, recreation, primary and secondary (vacation and second homes) residential, resorts and agriculture. Lake Chelan is the most developed shoreline in WRIA 47, with boating (e.g., docks and boat ramps), single- and multi-family development, and camping facilities. According to the NWI information, as much as 16 percent of the total shoreline area may be wetlands.

2.2 City of Chelan and Chelan UGA

The City of Chelan is situated on the eastern end of Lake Chelan. Residential development on Lake Chelan in the City and its UGA is marked by numerous private and shared-use piers and mooring buoys. On most single-family residential parcels, mowed lawns predominate, and shrubs and trees rarely occur between the house and the water's edge. Bulkheads are frequently present on residential parcels. Where the road borders the lakeshore, the shoreline often lacks any upland vegetation. Undeveloped shorelands along Lake Chelan are often associated with steeper slopes, which support small shrubs.

The City's parks, including Lakeshore Park and Lakeside Park, are primarily composed of mowed lawn, and trees are generally set back away from the shoreline. The Lakeshore Park shoreline is lined with a concrete bulkhead. In the downtown, mixed-use area on Lake Chelan, bulkheads and shared-use piers are common, and vegetation is generally lacking.

Nearly the entire Lake Chelan outflow is diverted out of the Chelan River, and sent directly to the Columbia River. The Chelan River experiences flow only in the spring and early summer. When the Chelan River does flow, it travels through a steep gorge to a broad floodplain at its mouth with the Columbia River. Vegetation is limited along the River's steep shorelines.

The Chelan UGA includes a small portion of land within shoreline jurisdiction of the Columbia River that is characterized by steep bluffs above the highway. The land is undevelopable, and because of its size, it will not be addressed in the remainder of this analysis.

Shorelines in the City of Chelan and its UGA contain less than 0.1 acre of priority habitat. All of the City's shorelines contain priority fish species. According to the NWI information, as much as 11 percent of the total shoreline area may be wetlands. However, most of these potential wetlands are located in the Chelan River shorelands. The portions of the Chelan River in the City and UGA contain substantial areas identified as geologic hazards.

A summary table (Table 1) provides further details on each waterbody's shoreline characteristics.

Table 1. Summary Table of Basic Characteristics of Each Shoreline Waterbody in the City of Chelan and its Urban Growth Area.

Jurisdictional Streams/Lakes	Area of Upland Shoreline Jurisdiction (acres)	Major Existing Land Uses[1]	Ownership Profile[2]	Critical Area/Priority Habitat or Species (PHS)[3] Presence	Presence of Impaired Waterbodies (303d list)? Yes/No Category 4 and 5 listed	Area (square feet) and Percent Coverage of Overwater Structures
Chelan River	28.03	Government (37%), Open Space (21%), Single Family Residential (18%), No Category (16%), Commercial (5%), Agriculture (3%)	Public (PUD) 60% Private 40%	Heritage Point common loon FEMA floodplain 50% wetland 44% geohazard	Yes: 4A-Pesticides	8,065 sf, 8.9%
Columbia River	0.02	Undeveloped Land (87%), No Category (13%)	Private 100%	PHS mule deer FEMA floodplain 100% geohazard	NA	NA
Lake Chelan	489.13	Other Residential (29%), No Category (27%), Single Family Residential (16%), Undeveloped Land (8%), Open Space (8%), Commercial (7%), Government (4%), Cultural/Recreation/ Assembly (2%), Natural Resources (<1%), Agriculture (<1%)	Private 90% Public (PUD, municipal) 10%	Heritage Point common loon Heritage Point western gray squirrel (2) FEMA floodplain 7% wetland 3% geohazard	Yes: 4C-Invasive species	81,889 sf, <1%

[1] Major existing land use is reported by acres located in shoreline jurisdiction rather than full parcels. “Government/Utility” includes governmental services, utilities, and other transportation and communication utilities.
[2] Acres of shoreline owned by public or private entities. Public includes municipal, County, PUD, state, and federal lands.
[3] PHS = Priority habitat or species as identified by WDFW

3 ANTICIPATED DEVELOPMENT

The tables below (Tables 2-3) provide a summary of the likely development potential within the proposed environment designations for each shoreline waterbody within the City and its Urban Growth Area. As explained in Section 1.2, the land capacity analysis includes all lands within shoreline jurisdiction, generally 200 feet upland of the ordinary high water mark, and associated wetlands. Additionally, parcels partially located in jurisdiction and extending beyond are included for Shorelines of Statewide Significance, due to the importance of these waterbodies and the ecosystem-wide processes emphasized in WAC 173-26-251.

For this reason, most of the cells in Tables 2 and 3 contain two numbers. The first number represents acreage, square feet or units in the "study area," which includes the shoreline jurisdiction as well as the remainder of any parcels that extend outside of jurisdiction if they are located on Shorelines of Statewide Significance. The second number (in parentheses) represents just the acreage, square feet or units in shoreline jurisdiction. The numbers are identical where a waterbody is not a Shoreline of Statewide Significance.

It is important to note that this analysis is intended to give an overall picture of the potential for development along shorelines, but is not an exact predictor of which parcels may develop or redevelop. In addition, the analysis does not provide a "rate" of development.

3.1 City of Chelan

Within the City of Chelan shoreline study area, approximately 208 single family and 99 multifamily dwellings are possible according to land capacity estimates, as well as about 42,505 square feet of commercial uses; removing existing single family dwellings, the net increase is 182 single family dwellings. The numbers drop by half, more or less, if considering the shoreline jurisdiction only at 41 single family and 51 multifamily units and 37,230 square feet of commercial space; removing existing single-family dwellings, the net increase is 33 single family dwellings. Most of the growth is along Lake Chelan. There is some small amount of commercial use in the Shoreline Residential-Single Family designation due to underlying highway commercial zoning.

Table 2. Potential for Future Development in the City of Chelan.

Environment Designation / Waterbody	Acres in Total Shoreline Jurisdiction	Acres Outside of Setbacks in Study Area (Jurisdiction)	Net Acres- Vacant in Study Area (Jurisdiction)	Net Acres- Partially Used/ Underused in Study Area (Jurisdiction)	Single Family Units in Study Area (Jurisdiction)	Multi-Family Units in Study Area (Jurisdiction)	Commercial Sq Ft in Study Area (Jurisdiction)	Industrial Sq Ft in Study Area (Jurisdiction)	Net Public Use Acres in Study Area (Jurisdiction)
High Intensity									
Lake Chelan	62.40	91.2 (41.2)	10.1 (4.21)	3.5 (6.08)	3 (2)	51 (17)	40,729 (36,376)	0	47.8 (15.7)
Shoreline Residential - Single Family									
Lake Chelan	40.69	122.6 (27.4)	15.4 (4.86)	36.0 (5.04)	205 (39)	0	1,777 (854)	0	0
Shoreline Residential - Multi Family									
Lake Chelan	13.00	9.99 (7.15)	0	4.0 (2.77)	0	40 (28)	0	0	1.0 (1.0)
Chelan River	0	0	0	0	0	0	0	0	0
Shoreline Park/Public									
Lake Chelan	32.29	11.38 (10.13)	0.47 (0.06)	1.33 (1.05)	0	6 (4)	0	0	8.9 (8.4)
Chelan River	21.11	29.4 (15.2)	0	0.3 (0.3)	0	2.5 (2.5)	0	0	29.0 (14.7)

3.2 Chelan UGA

The unincorporated Chelan UGA is expected to see similar growth compared to the City limits, with about 320 dwellings in the study area, dropping to about 104 in the shoreline jurisdiction; removing dwellings on partially developed properties, there would be 238 single-family dwellings total and 71 in shoreline jurisdiction. No commercial or industrial use is expected along Lake Chelan or the Chelan River.

Table 3. Potential for Future Development in the Chelan City-Associated UGA.

Environment Designation / Waterbody	Acres in Total Shoreline Jurisdiction	Acres Outside of Setbacks in Study Area (Jurisdiction)	Net Acres- Vacant in Study Area (Jurisdiction)	Net Acres- Partially Used/ Underused in Study Area (Jurisdiction)	Single Family Units in Study Area (Jurisdiction)	Multi-Family Units in Study Area (Jurisdiction)	Commercial Sq Ft in Study Area (Jurisdiction)	Industrial Sq Ft in Study Area (Jurisdiction)	Net Public Use Acres in Study Area (Jurisdiction)
High Intensity									
Lake Chelan	22.78	44.9 (7.0)	5.9 (0.45)	19.8 (3.23)	103 (15)	0	0	0	0
Shoreline Residential - Single Family									
Lake Chelan	66.43	106.3 (38.6)	20.2 (2.70)	31.7 (17.05)	208 (79)	0	0	0	11.7 (0.02)
Chelan River	4.21	1.6 (1.6)	1.6 (1.6)	0.93 (0.93)	4 (4)	0	0	0	0
Shoreline Residential – Multi Family									
Lake Chelan	0.07	0	0	0	0	0	0	0	0
Shoreline Park/Public									
Chelan River	2.72	0.99 (0.99)	0	0	0	0	0	0	0.3 (0.3)
Lake Chelan	1.04	0	0	0	0	0	0	0	0

4 PROPOSED SMP PROVISIONS

In its Shoreline Master Program Handbook, Ecology identified the following components of SMP provisions as potential means to help achieve no net loss of ecological functions.

- **Establish appropriate shoreline environment designations**. The environment designations must reflect the inventory and characterization. A shoreline landscape that is relatively unaltered should be designated Natural and protected from any use that would degrade the natural character of the shoreline.

- **Prohibit uses** that are not water-dependent or preferred shoreline uses. For example, office and multi-family housing buildings are not water-dependent or preferred uses.

- **Require that all future shoreline development**, including water-dependent and preferred uses, is carried out in a manner that limits further degradation of the shoreline environment.

- **Require buffers and setbacks.** Vegetated buffers and building setbacks from those buffers reduce the impacts of development on the shoreline environment.

- **Establish strong policies and regulations.** Policies and regulations will define what type of development can occur in each shoreline environment designation, determine the level of review required through the type of shoreline permit, and set up mitigation measures and restoration requirements.

- **In all cases, require mitigation sequencing**. The SMP must include regulations that require developers to follow mitigation sequencing: avoid impacts, minimize impacts, rectify impacts, reduce impacts over time, compensate for impacts, monitor impacts and take corrective measures.

The proposed SMP provisions described below implement the above guidance to the extent consistent with the City's local Comprehensive Plan and vision, facilitating the City's achievement of the no net loss standard.

4.1 Environment Designations

The first line of protection of the City's shorelines is the environment designation assignments. The shoreline use and modification matrix (3.2.1.f of the SMP)

identifies the prohibited and allowed uses and modifications in each of shoreline environment designation for the City of Chelan.

The table clearly shows a hierarchy of higher-impacting uses and modifications being allowed in the already highly altered environment designations, with uses more limited in the less developed areas either through prohibition or a requirement for a Conditional Use Permit. This strategy helps to minimize cumulative impacts by concentrating development activity in lower-functioning areas that are not likely to experience significant function degradation with incremental increases in new development.

4.1.1 City of Chelan

The City of Chelan's environment designation system was based on the existing land use pattern, which in turn influences the biological and physical character features and functions, as well as future land use. The City's environment designations include Aquatic, Shoreline Park/Public, Shoreline Residential-Single Family, Shoreline Residential-Multi Family, and High Intensity (Figure 1). The Shoreline Park/Public designation applies to the waterfront parks and other public lands on Lake Chelan and the Chelan River shorelines within the City. Shoreline Residential-Multifamily is the least common environment designation, and where it occurs, it is frequently separated from the shoreline by another environment designation.

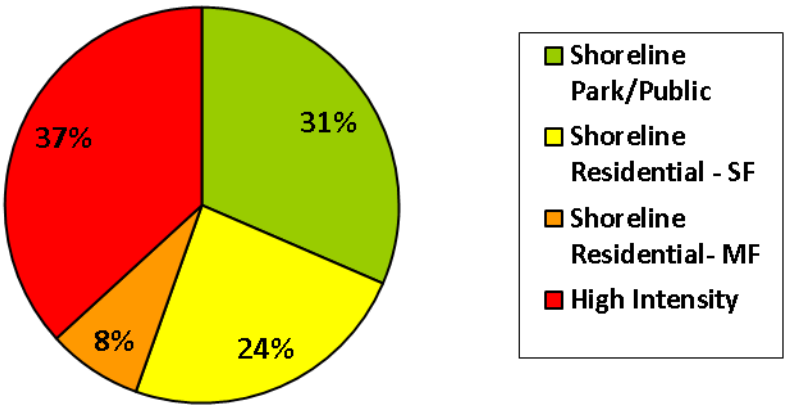


Figure 1. Distribution of Shoreline Environment Designations in the City of Chelan

Figure 2 shows how shoreline functions are distributed among the different shoreline environment designations. The greatest proportion of high functioning shoreline is located in the Shoreline Park/Public environment; however, the High Intensity and Shoreline Residential- Multi Family environments each include approximately 20 percent high-functioning shoreline.

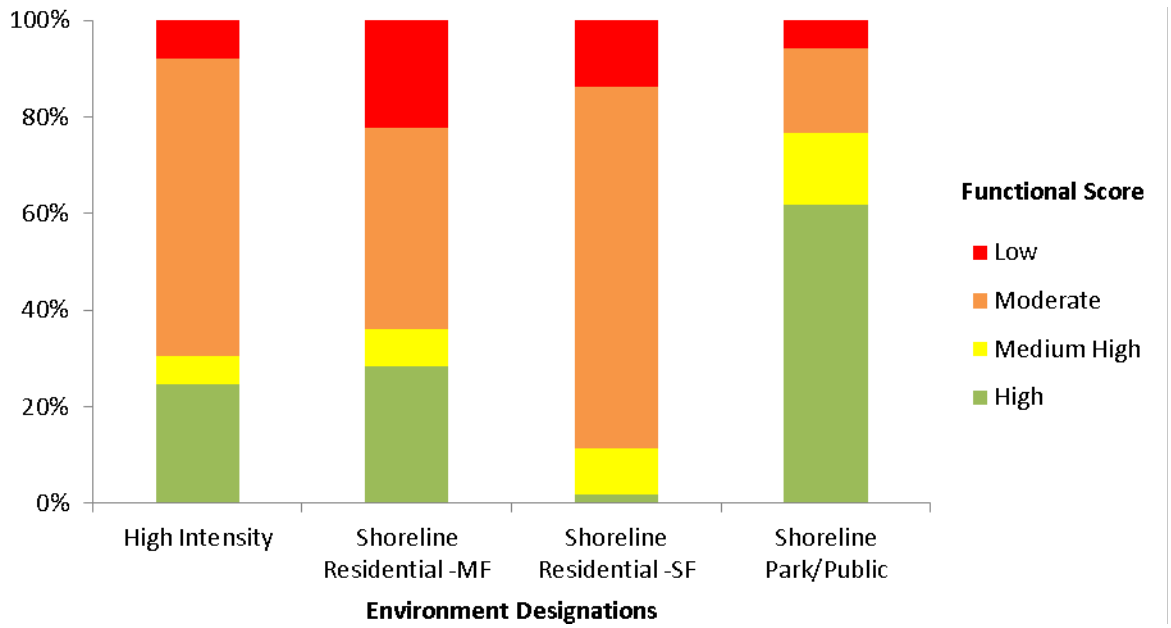


Figure 2. Distribution of Shoreline Functional Scores among Environment Designations in the City of Chelan

4.1.2 Chelan UGA

Environment designations within the City's Urban Growth Areas were classified to be consistent with the City's designations. The majority of lands in the Chelan UGA are designated as Shoreline Residential environment (Figure 3). The High Intensity environment occurs along the roadway, which separates Shoreline Residential development from the shoreline edge. Figure 4 shows how shoreline functions are distributed among the different environment designations. Higher-functioning areas comprise a significant portion of the UGA, with the highest proportion in the Shoreline Park/Public environment and the lowest proportion in the Shoreline Residential environment.

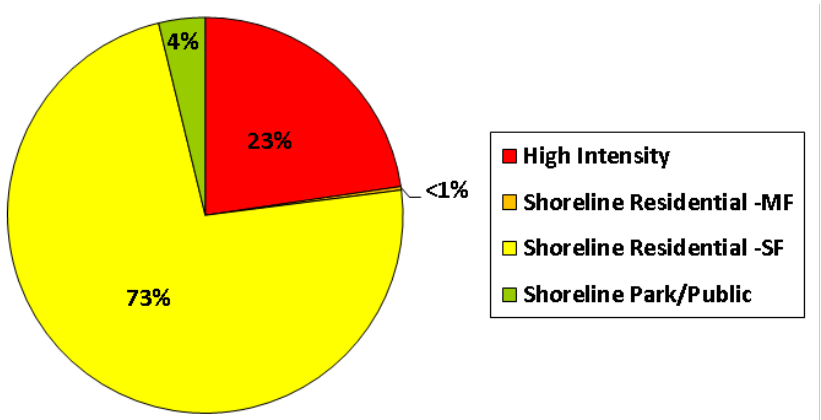


Figure 3. Distribution of Shoreline Environment Designations for Unincorporated Areas in the City of Chelan's UGA

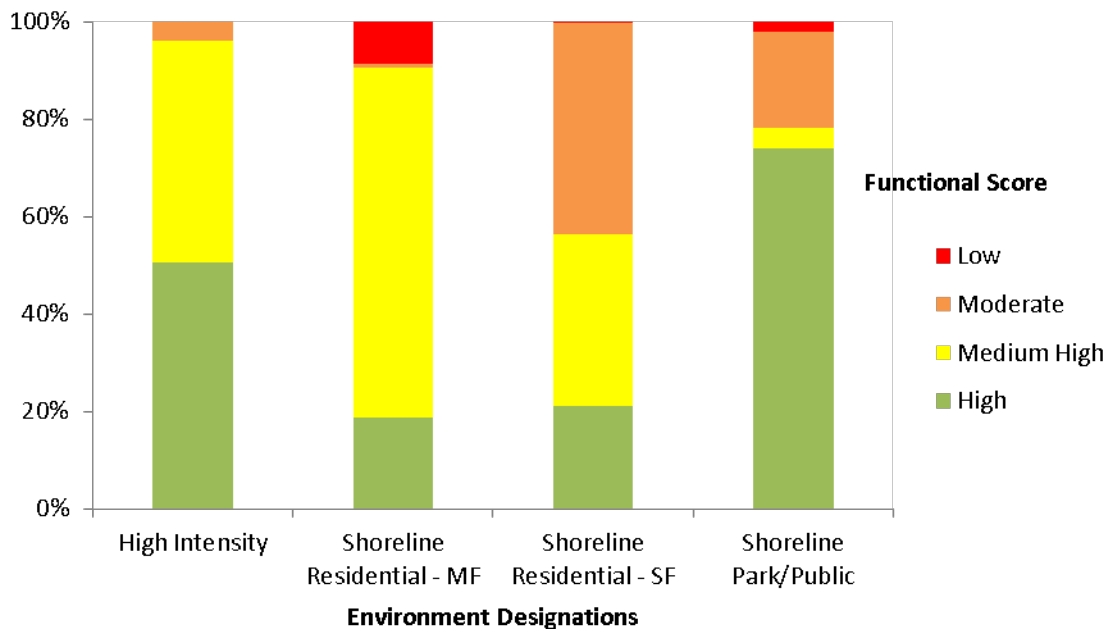


Figure 4. Distribution of Shoreline Functional Scores among Environment Designations in Unincorporated Areas of City of Chelan's UGA

4.1.3 Shoreline Setbacks

Specific shoreline setbacks were developed by environment designation, as shown in Table 4, below. Proposed setbacks were tailored to existing conditions in each environment designation to ensure that no net loss of functions is attained.

Table 4. Shoreline Setbacks by Environment Designation for the City of Chelan.

Environment Designation[1]	Standard Setback	Reduced Setback – with Performance Standards
Shoreline Park/Public		
Lake Chelan	See regulations in Section 4.4.3.A.2.iv (Vegetation Management)	
Chelan River	100'	50'
Shoreline Residential – Single Family – Lake Chelan	Tier 1: 50' Tier 2: 25'	Tier 1: Not applicable – see Variance Tier 2: 20'
Shoreline Residential – Multi-Family – Lake Chelan	35'	25'
Shoreline Residential – Single Family and Multi-Family – Chelan River	100'	50'
High Intensity	20'	10'

[1] When environment designations are parallel, the setback of the waterward environment extends only to the upland edge of that environment. The setback for the landward environment would apply to uses and modifications in that upland environment.

4.2 General Policies and Regulations

The SMP contains numerous general policies, with supporting regulations (see SMP Chapter 4), intended to protect the ecological functions of the shoreline and prevent adverse cumulative impacts. The General Policies and Regulations chapter applies to all activities, uses and modifications. These regulations are summarized below in Table 5, including an indication of which function or functions the regulation helps to protect.

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Table 5. Summary of Key SMP General Regulations that Protect Ecological Functions.

Shoreline Ecological Functions[1]				SMP Regulations Providing Protection for Ecological Functions
Hydrologic	**Water Quality**	**Shoreline Vegetation**	**Habitat**	
X	X	X	X	4.2.2.B (4.4.3.A, B, G; 5.2.2.T; 5.5.2.F; 5.8.2.B; 5.17.2.H; 8.2.3) Mitigation sequencing is required
X	X	X	X	4.2.2.C Mitigation is required for all projects that have adverse impacts on shoreline ecological functions
X	X	X	X	4.2.2.D Local jurisdictions are responsible for weighing cumulative effects of all uses and development, including exempt development. Local jurisdictions shall prohibit projects that result in unmitigated, adverse cumulative impacts.
X				6.1.1 and 6.1.2: The City and its UGA do not contain mapped channel migration zones or floodways in shoreline jurisdiction. The City implements flood hazard reduction in partnership with other agencies through the following means: • Plans and Policies: Growth Management Act comprehensive plans, Multi-Jurisdiction Natural Hazard Mitigation Plan, and watershed plans have been developed by Chelan County, the Cities, and other agencies and address flood hazard reduction policies, programs, restoration actions, and other capital improvements. • Regulations: critical area, floodplain and stormwater regulations.
		X	X	4.4.2.D A mitigation plan must be prepared when adverse impacts to shoreline vegetative functions are proposed.
X	X	X	X	4.4.2.G Clearing and grading shall be minimized, and BMPs shall be implemented to minimize and control erosion.
		X	X	4.4.2.E Tree removal other than hazard tree removal shall be mitigated at a 1:1 ratio.
		X	X	4.4.2.G One view corridor, limited to 25 percent of the width of the lot frontage, or 25 feet, whichever distance is less, may be permitted per lot with the submittal of a restoration plan. Whenever possible, view corridors shall be located in areas dominated with non-native vegetation and invasive species.
X	X			4.5.2.A Shoreline use and development shall incorporate measures to protect and maintain surface and groundwater quantity and quality in accordance with all applicable laws. (WAC 173-26-221(6)(b)(i))
X	X			4.5.2.B New development shall provide stormwater management facilities and implement best management practices and/or the current Stormwater Management Manual for Eastern Washington (WAC 173-26-221(6)(b)(ii)).
	X			4.5.2.G Consider low impact development measures.
X	X			5.9.2G Fill and grad proposals must control of erosion and sedimentation shall be implemented for all development in shoreline jurisdiction through an approved temporary erosion and sediment control (TESC) plan.
X	X			4.5.2.E Existing and new development required to hook up to municipal sewer (existing systems must hook up when onsite systems fail or malfunction).
X	X			4.5.2.F All materials that may come in contact with water shall be constructed of materials, such as untreated or approved treated wood, concrete, approved plastic composites or steel, that will not adversely affect water quality or aquatic plants or animals.

[1] Only primary effects of ecological functions are identified. Many actions may have indirect effects on each ecological function category.

4.3 Shoreline Uses and Modifications

The SMP contains numerous shoreline modification and use policies and supporting regulations (see SMP Chapter 5) intended to protect the ecological functions of the shoreline and prevent adverse cumulative impacts. Key shoreline use and modification regulations that help protect ecological functions are summarized below in Table 6, including an indication of which function or functions the regulations helps to protect.

Table 6. Summary of Key SMP Shoreline Use and Modification Regulations that Protect Ecological Functions.

Shoreline Ecological Functions[1]				Specific Shoreline Use or Modification	Potential Direct and Indirect Impacts to Shoreline Function	SMP Regulations Providing Protection for Ecological Functions	Related Watershed Restoration Efforts Underway or Planned (See Section 4.5)
Hydrologic	Water Quality	Shoreline Vegetation	Habitat				
X	X	X	X	All	See below	5.1.2.H, 5.2.2.V, 5.11.2.D, 5.13.2.H, ; 5.14.2.A.4; 5.17.2.B No net loss of ecological function	Refer to section 4.5
	X	X		Agriculture	Pesticide/ fertilizer runoff; Nutrient enrichment; Fecal coliform contamination; Riparian vegetation clearing; Erosion of fine sediment	5.3.2.C.2 Feedlots are prohibited.	• NRCS- Technical assistance and funding to farmers • Lake Chelan Subbasin Plan- programs to improve livestock grazing practices
X	X	X	X	Aquaculture	Hydrologic alterations; Diversion of streamflow; Nutrient enrichment; Potential competition with native populations Potential for fisheries enhancement from conservation hatcheries managed to enhance native salmonid populations	5.4 At present, there are no aquaculture uses within the City's shoreline jurisdiction. Due to lake water quality concerns; the urban condition of the City's lake shoreline including the commercial waterfront, residential, and recreation uses; and incised Chelan River, aquaculture is not a compatible use within City of Chelan shorelines. Accordingly, aquaculture is a prohibited use in shoreline jurisdiction.	
		X	X	Boating Facilities	Alteration of submerged aquatic vegetation, nearshore habitat, predator /prey relationships, and benthic community assemblages; Reduction in shoreline vegetative functions; Alteration of	5.5.2.A.3 New boating facilities are not allowed over areas of aquatic or emergent vegetation unless no other options are available or the facility would result in a net improvement of shoreline ecological functions.	• Lake Chelan Subbasin Plan- Eliminate or reduce exogenous species in Lake Chelan by 2015 through fisheries management practices
X			X			5.5.2.A.4 New boating facilities are not allowed in areas that would require dredging, where a flood hazard will be created, or where impacts to shoreline ecological functions and processes cannot be mitigated. Expansions of existing boating facilities should be designed to minimize the need for new or maintenance dredging.	
	X		X			5.5.2.A.5 Moorage at new or expanded boating facilities must be located at depths to prevent prop scour.	
X						5.5.2.A.6 Boating facilities to be located and designed to avoid the need for shoreline stabilization. If stabilization is necessary, only the minimum needed is permitted.	
		X	X			5.5.2.G.2 Covered docks or other covered structures are not permitted waterward of the OHWM, except for canopies on boatlifts associated with private residential docks.	

Shoreline Ecological Functions[1]				Specific Shoreline Use or Modification	Potential Direct and Indirect Impacts to Shoreline Function	SMP Regulations Providing Protection for Ecological Functions	Related Watershed Restoration Efforts Underway or Planned (See Section 4.5)
Hydrologic	Water Quality	Shoreline Vegetation	Habitat				
X			X		hydrologic processes; Alteration of sediment transport processes; Water quality impacts from facility construction, boat use and maintenance	5.5.3.A.4 Dimensional standards for boating facilities are established to minimize effects on ecological function. Standards minimize the width of piers, establish acceptable moorage depth, establish decking standards (Columbia River and Lake Wenatchee only), and limit the number of slips that may be created per associated dwelling unit.	
X						5.5.3.A.5 Launch ramps must be designed to minimize effects on hydrologic and sediment transport processes.	
	X					5.5.3.D Pump out facilities are required at new marinas.	
	X					5.5.3.D.1 and 2 Discharge of solid waste (including fish waste) or sewage into a waterbody is prohibited. Boating facilities are to provide garbage or litter receptacles. Marinas must provide restroom and sewage disposal facilities (pump out, holding, and/or treatment facilities).	
	X					5.5.3.D.4 New, expanded, and reconfigured marinas are required to provide fail-safe facilities and procedures for receiving, storing, dispensing, and disposing of oil or hazardous products, as well as a spill response plan for oil and other products.	
X		X	X			5.5.3.E .1 and 2 Applicants for new or expanded boating facilities must provide habitat surveys, critical area studies, and mitigation plans and an assessment of demand.	
X			X			5.5.3.E.4 New boat launch facilities are allowed only if existing facilities do not meet public demand	
X				Breakwaters, jetties, groins, weirs, and barbs	Disruption of hydrologic and sediment processes; In-water habitat alteration	5.6.2.B Groins are prohibited except as a component of a professionally designed community or public beach management program that encompasses an entire reach for which alternatives are infeasible, or where installed to protect or restore shoreline ecological functions or processes	
X						5.6.2.C Jetties and breakwaters are prohibited except as an integral component of a professionally designed marina. Where permitted, floating, portable or submerged breakwater structures, or smaller discontinuous structures, are preferred where physical conditions make such alternatives with less impact feasible.	
X	X		X	Dredging	Disruption of sediment, hydrologic, and floodplain processes; Water quality impairments-turbidity and heavy metals; Floodplain habitat disturbance; Disturbance of benthic substrate/ organisms; Disturbance of nearshore habitat	5.8.2.A New development shall be sited and designed to avoid and minimize the need for dredging.	
X	X		X			5.8.2.B Dredging is under specific circumstances when other alternatives are not feasible.	
X	X		X			5.8.2.F Disposal of dredge material is only allowed when ecological functions will be maintained or enhanced and when erosion, sedimentation, floodwaters and runoff will not increase shoreline impacts.	
X	X		X			5.8.2.H Dredge material disposal in open waters may only occur under the following conditions: 1. Offshore habitat will be protected, restored, or enhanced; 2. Adverse effects on water quality or biologic resources from contaminated materials will be mitigated; 3. Shifting and dispersal of dredge material will be minimal; and 4. Water quality will not be adversely affected.	
X	X		X			5.2.8.I A detailed analysis of purpose, existing conditions, potential impacts, proposed dredging methods, frequency, and duration, quantity of dredge material, and plans for disposal and maintenance dredging is required to apply for a conditional use permit.	
X		X	X	Fill and excavation	Disruption of sediment, hydrologic, and floodplain processes; Water quality impairments-turbidity and heavy metals; Floodplain habitat disturbance; Disturbance of benthic substrate/ organisms	5.9.2.B Fill and excavation within wetlands or waterward of the OHWM are only permitted under the following conditions: 1. Water-dependent uses, public access, and cleanup and disposal of contaminated sediments; 2. Disposal of dredged material conducted in accordance with the Dredged Material Management Program of WA DNR and/or the Dredged Material Management Office of the Corps; 3. Expansion or alteration of transportation facilities of statewide significance where alternatives to fill are infeasible; or 4. Ecological restoration or enhancement. Except for an ecological restoration project, fills waterward of the OHWM require a conditional use permit.	

Shoreline Ecological Functions[1]				Specific Shoreline Use or Modification	Potential Direct and Indirect Impacts to Shoreline Function	SMP Regulations Providing Protection for Ecological Functions	Related Watershed Restoration Efforts Underway or Planned (See Section 4.5)
Hydrologic	Water Quality	Shoreline Vegetation	Habitat				
X						5.9.2.C Fills or excavation not to be located where shoreline stabilization will be necessary to protect materials placed or removed.	
	X					5.9.2.G All fill and excavation proposals require temporary erosion and sediment control (TESC) plan, including BMPs.	
X	X	X	X	Forestry practices	Reduced infiltration; Increased peak flows; Erosion; Increased impacts of rain-on-snow events; Reduced habitat complexity	The City of Chelan and its UGA do not contain forested vegetation in shoreline jurisdiction. Accordingly, forest practices are prohibited in shoreline jurisdiction.	• Lake Chelan Subbasin Plan-programs to improve silviculture practices
	X			Industrial Uses	Water contamination; Reduced vegetative functions	5.11.2.B Nonwater-oriented industrial uses are allowed only if the site is physically separated from the shoreline by another property or public right-of-way prior to adoption of this SMP. On properties fronting the shoreline, new nonwater-oriented industrial development is prohibited, unless it provides a significant public benefit and it is part of a mixed-use project that includes water-dependent uses or navigability is severely limited at the proposed site.	
	X					5.11.2.C Accessory nonwater-dependent industrial development must be upland of the water-dependent or water-related portions of the development and comply with shoreline setbacks for nonwater-oriented uses.	
	X		X			5.11.2.F Industrial development and redevelopment are encouraged to locate where environmental cleanup and restoration of the shoreline area can be incorporated. Federal and state requirements for hazardous materials clean up or management shall be addressed.	
X				In-water Work and In-water Structures	Alteration of hydrologic processes; Alteration of sediment transport processes; Alteration of instream habitats; Erosion	5.2.2.B In-water structures and activities will be sited and designed to avoid the need for future shoreline stabilization activities and dredging. Modifications and uses located in the Aquatic environment shall be the minimum size necessary.	
X		X	X			5.2.2.L Alteration or disturbance of the bank and bank vegetation will be limited to the minimum necessary.	
X			X			6.2.2.A Projects that degrade shoreline functions are prohibited.	
	X	X				6.2.2.B Filled areas resulting from installation of in-water structures must be stabilized with bioengineering approaches.	
	X					6.2.2.C In-water structures must be constructed and maintained in a manner that does not degrade water quality.	
X			X			6.2.2.E Natural in water features such as snags, uprooted trees, or stumps shall be left in place unless it can be demonstrated that they are actually causing bank erosion or higher flood stages or pose a hazard to navigation or human safety.	
X	X	X	X	Mining	Disruption of sediment, hydrologic, and floodplain processes; Water quality impairments-turbidity and heavy metals; Floodplain habitat disturbance; Disturbance of benthic substrate/ organisms	At present, there are no mining uses within the City's shoreline jurisdiction or that of its associated UGA and it is not anticipated in the future. Accordingly, mining is a prohibited use.	• Holden Mine Cleanup Plan (USFS 2010): Actions to cleanup mine tailings in Railroad Creek
X		X	X	Private moorage facilities	Alteration of submerged aquatic vegetation, nearshore habitat, predator /prey relationships, and benthic community	5.5.4.A New development of two or more dwelling units is only allowed joint use dock facilities.	• Lake Chelan Subbasin Plan-Eliminate or reduce exogenous species in Lake Chelan by 2015 through fisheries management practices
			X			5.5.2.B.2 Lighting to be designed to minimize glare.	
			X			5.5.2.B.4 No skirting is allowed on any structure.	
X			X			5.5.4.B Dimensional standards minimize the width and area of piers and ramps.	
			X			5.5.4.F Floats must be at least 20 feet waterward of OHWM on the Columbia River and limit the length of a float to 20 feet in all waters.	
			X			5.5.4.C.3 Minimum height of piers is 2 feet above OHWM.	

Shoreline Ecological Functions[1]				Specific Shoreline Use or Modification	Potential Direct and Indirect Impacts to Shoreline Function	SMP Regulations Providing Protection for Ecological Functions	Related Watershed Restoration Efforts Underway or Planned (See Section 4.5)
Hydrologic	Water Quality	Shoreline Vegetation	Habitat				
	X				assemblages; Reduction in shoreline vegetative functions; Alteration of hydrologic processes; Alteration of sediment transport processes; Water quality impacts from boat use and maintenance	5.5.4.B. Establishes standards for piling material (no pentachlorophenol, creosote, copper naphthalene, chromate copper arsenate, or comparably toxic compounds) on all waterbodies, and for piling diameter, spacing of pilings, and total number of pilings on the Columbia River.	
			X			5.5.4.B No new structure may be installed within 100 feet of the outlet of any river or stream.	
			X			5.5.4.B Grating or clear translucent material is required for decking on the Columbia River and Other Waterbodies. Float materials contacting the water must be white in color or transparent on the Columbia River and Other Waterbodies. On Lake Chelan, decking may be grating or wood. If decking is wood, a minimum ½ inch space must be left between deck planks.	
			X			5.5.4.D Standards to limit the size, anchoring impacts, and proximity of buoys to nearshore habitats.	
			X			5.5.2.C Replacement docks must meet the dimensional, materials and mitigation standards for new private docks, unless the shoreline administrator approves an alternative plan that meets the following criteria: 1. All appropriate State and Federal agencies have approved the proposal; 2. The total square footage of the replacement structure is no larger than the existing dock.	
			X			5.5.2.D Additions to private docks must demonstrate a need for enhanced safety or water depth. New portions of docks must comply with new dock standards.	
			X			5.5.2.E Dock repairs must use the same materials specified for new docks (decking and pilings)	
		X	X			5.5.2.F Mitigation standards for new or expanded overwater structures.	
	X			Recreational Uses	Water quality impacts from pesticides/ fertilizers and boat use and maintenance	5.13.2.E Best management practices must be employed to prevent chemical contamination from the use of pesticides and fertilizers for recreation uses.	
X			X	Residential Development	Reduced infiltration; Reduced shoreline vegetative functions; Water quality impacts from fertilizers/ pesticides/ household wastes; Impacts from accessory uses	5.14.2.A.3, 5.14.2.B.2 Design and location to eliminate the need for future stabilization and flood control measures	
		X	X			5.14.2.A.5 Cluster development to avoid critical areas and to preserve natural features and minimize physical impacts.	
	X		X			5.14.2.D New over-water residences and floating homes are prohibited.	
	X					5.14.2.E Liveaboards are only permitted where best management practices for disposal of sewage and hazardous substances are employed.	
X			X	Shoreline Stabilization	Hydrologic and sediment transport alterations; Simplification of nearshore habitat; Reduction in shoreline vegetative functions	5.16.2.A, 5.16.2.E The SMP provisions establish a preference for soft structural shoreline stabilization over hard structural stabilization.	
X			X			5.16.2.B New and enlarged shoreline stabilization is not permitted unless a geotechnical analysis indicates that 1) it is needed to protect an existing structure from erosion, or 2) it is needed to protect a new development from erosion caused by wind and waves, and that non-structural approaches are not feasible. Shoreline stabilization is also allowed to protect ecological restoration projects or hazardous substance remediation.	
X			X			5.16.2.C If shoreline stabilization repairs are conducted waterward of the existing stabilization, they need to meet the provisions of a new stabilization measure.	

Shoreline Ecological Functions[1]				Specific Shoreline Use or Modification	Potential Direct and Indirect Impacts to Shoreline Function	SMP Regulations Providing Protection for Ecological Functions	Related Watershed Restoration Efforts Underway or Planned (See Section 4.5)
Hydrologic	Water Quality	Shoreline Vegetation	Habitat				
X			X			5.16.2.D Replacement of shoreline stabilization measures must meet the same standards as new stabilization measures, except that a geotechnical analysis is not required for replacement with an "softer" stabilization approach. Replacement of hard stabilization structures may not occur further waterward than the existing structure. Some fill waterward of the OHWM is permitted to provide enhancement of shoreline ecological functions.	
X		X	X			5.16.2.E Establishes standards for the minimization and mitigation of stabilization impacts. Mitigation measures include: improving substrate conditions waterward of the OHWM and planting native vegetation along the shoreline.	
X			X			5.18.2.F.3 Fill behind hard structural shoreline stabilization is limited to 1 cubic yard per linear foot.	
	X	X	X	Transportation and Parking	Water quality impacts (heavy metals and oils); Fish passage barriers; Reduced infiltration; Reduced vegetative functions	5.17.2.B.4 New roads and railroads must be setback from the OHWM as much as possible.	• Lake Chelan Subbasin Plan-programs to improve road management
X	X		X			5.17.2.D Shoreline crossings are to be designed to have the least ecological impacts.	
	X	X				5.17.2.H Parking facilities are prohibited unless parking outside of shoreline jurisdiction is not feasible to support the planned primary use.	
		X	X	Utilities	Reduced vegetative functions; Habitat disturbance	5.18.2 Provisions to minimize the ecological impact of utilities through location, design, and restoration of any disturbed areas.	

[1] Only primary effects of ecological functions are identified. Many actions may have indirect effects on each ecological function category.

4.4 Critical Areas

The SMP contains policies and regulations governing critical areas found within shoreline jurisdiction (see SMP Appendix B) intended to protect the ecological functions of the shoreline and prevent adverse cumulative impacts. Buffer and setback requirements included in these regulations are generally consistent with the City's critical areas regulations that apply outside of shoreline jurisdiction. In the City's UGAs, the County will apply the City's SMP regulations except that the County's critical areas regulations will be applied to any shoreline critical areas. These regulations are summarized for the County and City of Chelan in Table 7.

Table 7. Summary of Shoreline Critical Area buffer requirements.

Jurisdiction	Wetland Rating System	Stream Classification System	Buffer Width (feet)		
Chelan County	Ecology E. WA (2014)	WA DNR (WAC 222-16-030)	**Wetlands**	**High Intensity**	**Low Intensity**
			Cat 1	300	200
			Cat 2	200	100
			Cat 3	150	75
			Cat 4	50	50
			Shoreline Streams/Lakes		
			Natural	250	200
			Conservancy	250	200
			Rural	150	100
			Urban	100	75
			Lower Lake Chelan (w/ conditions)	50	25
			Non-Shoreline Streams/Lakes		
			Type S	250	200
			Type F	200	150
			Type Np	150	100
			Type Ns	50	50
City of Chelan	Ecology E. WA (2014)	None	**Wetlands**	**Standard buffer width**	**Maximum additional buffer for high scoring habitat functions**
			Cat 1	75	75
			Cat 2	75	75
			Cat 3	60	60
			Cat 4	40	Not applicable
			Streams	General protection standards only for fish and wildlife habitat conservation areas, no dimensional standards for buffers	

A summary of key shoreline critical area regulations in the City and County are described below.

4.4.1 County

The County identifies Class I and Class II Fish and Wildlife Habitat Conservation Areas, which are allotted different levels of protection. Development proposals within 1,000 feet of a wildlife habitat conservation area require notice to the state and review by the shoreline administrator. A Habitat Management and Mitigation Plan is required for major development in Class I Fish and Wildlife Habitat Conservation Areas and may be required of minor developments in Class I, as well as major and minor developments in Class II Fish and Wildlife Habitat Conservation Areas, subject to the Shoreline Administrator's review of likely impacts. For existing parcels with lot depths of three hundred feet or less, the riparian buffer width may be reduced to a maximum of twenty-five percent of the lot depth; provided, said riparian buffer is not less than twenty-five feet in width or less than the common line setback, whichever is greater.

Development within wetlands and wetland buffers also requires a Habitat Management and Mitigation Plan, which demonstrates that mitigation sequencing was followed. Buffer averaging is allowed for all fish and wildlife habitat conservation areas and wetland critical areas provided specific criteria, including that it will not degrade functions and that not averaging the buffer width would result in a hardship for the landowner.

Regulations specific to geologically hazardous areas apply to erosion hazard areas, landslide hazard areas (including steep slopes (>40%)), and avalanche hazard areas. Performance standards include measures to minimize and manage risks and ecological impacts.

4.4.2 City of Chelan

The City's wetland regulations allow for a buffer reduction of up to 25% provided that the remaining buffer area is enhanced with native vegetation and that the reduction will not:

- Adversely affect water quality;
- Destroy, damage, or disrupt a significant fish or wildlife habitat area, including scenic vistas;
- Adversely affect drainage and/or storm water retention capabilities;
- Lead to unstable earth conditions or create erosion hazards; and
- Be materially detrimental to any other property in the area of the subject property or the city as a whole (Appendix B, City of Chelan, 1.050.A.4.e).

Allowable activities within the buffer area are limited to the following:

- Low impact recreation facilities located in the outer 25% of the buffer area; wildlife viewing structures; and fishing access areas without vehicle access;
- Selective pruning of trees for safety or view protection; removal of trees that pose a significant safety hazard;
- Existing and ongoing agricultural activities;
- Maintenance of existing facilities, structures, ditches, roads and utility systems; and
- Artificial wetland construction approved as part of an overall site development plan or restoration or enhancement plan (Appendix B, City of Chelan, 1.050.A.4.f.i).

The City's geologically hazardous regulations apply to erosion hazard areas (including steep slopes, >30%), landslide hazard areas, and seismic hazard areas. Performance standards include measures to minimize and manage risks and ecological impacts.

4.5 Shoreline Restoration Plan

As discussed above, one of the key objectives that the SMP must address is "no net loss of ecological shoreline functions necessary to sustain shoreline natural resources" (Ecology 2004). However, SMP updates seek not only to maintain conditions, but to improve them:

> *"…[shoreline master programs] include planning elements that when implemented, serve to improve the overall condition of habitat and resources within the shoreline area of each city and county (WAC 173-26-201(c))."*

The guidelines state that "master programs shall include goals, policies and actions for restoration of impaired shoreline ecological functions. These master program provisions should be designed to achieve overall improvements in shoreline ecological functions over time, when compared to the status upon adoption of the master program" (WAC 173-26-201(2)(f)). Pursuant to that direction, City of Chelan prepared a Shoreline Restoration Plan.

Practically, it is not always feasible for shoreline developments and redevelopments to achieve no net loss at the site scale, particularly for those developments on currently undeveloped properties or a new pier or bulkhead. The Restoration Plan, therefore, can be an important component in making up that difference in ecological function that may otherwise result just from implementation of the SMP. The Restoration Plan represents a long-term vision for restoration that will be implemented over time, resulting in incremental improvement over the existing conditions.

The Shoreline Restoration Plan identifies a number of project-specific opportunities for restoration on both public and private properties inside and outside of shoreline jurisdiction, and also identifies ongoing County and City programs and activities, non-governmental organization programs and activities, and other recommended actions consistent with a variety of watershed-level efforts.

Major shoreline restoration opportunities for WRIA 47 and the City of Chelan that could contribute to achievement of no net loss of ecological functions or improvement in ecological functions are summarized below.

4.5.1 County

Many of the watershed planning and salmon recovery efforts in the County are administered by the Chelan County Natural Resources Department (CCNRD). CCNRD is a partner with the Cascadia Conservation District (CCD) in the early planning stages of the Lake Chelan (WRIA 47) watershed plan. The plan will have goals and objectives and include a list of restoration opportunities. Funding is available to implement priority restoration opportunities through the watershed planning act, grant funding (e.g., Salmon Recovery Funding Board (SRFB), Aquatic Lands Enhancement Account (ALEA), Bullitt Foundation, Washington Wildlife and Recreation Program (WWRP), Bonneville Environmental Foundation Watershed Program) and funding commitments from various implementation entities (e.g., Ecology, Bonneville Power Administration (BPA)).

WRIA 47

WRIA 47 Final Draft Planning Unit Charter

A WRIA 47 Watershed Plan is presently being completed and will include restoration goals and recommendations. CCNRD is the lead entity on this project, and the plan is due for submittal in 2012.

Lake Chelan Subbasin Plan

The *Lake Chelan Subbasin Plan* (Berg 2004) includes a detailed inventory, and concludes with a number of habitat or biological objectives for key species and key habitats in the basin. Many of the objectives are to conduct additional species/habitat assessments, "identify and provide biological and social conservation measures to sustain focal species populations and habitats," and in a number of instances to "[m]aintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silvicultural practices, fire management, weed control, livestock grazing practices, and road management…"

Holden Mine Cleanup

The USFS, in cooperation with Ecology and the US EPA, has developed a proposed plan to clean-up mine tailings associated with the formerly active Holden Mine, once one of the largest copper mines in the United States (USFS 2010). The mine disturbed approximately 120 acres along Railroad Creek and contamination extends downstream to the mouth of Railroad creek where it enters Lake Chelan. The proposed site clean-up will address surface water contamination by preventing the erosion of tailings and stopping the discharge of contaminated groundwater into surface water, including Railroad Creek, Copper Creek, and the Copper Creek Diversion.

4.5.2 City of Chelan

Don Morse Park

During development of the draft SMP, the City of Chelan implemented a Shoreline Restoration and Beach Enhancement plan at Don Morse Park. This project's key goals were to stabilize the shoreline, expand sandy beach areas, enhance water-based recreational opportunities, improve views and access to the Lake, increase opportunities for tourism and economic development, address existing safety and accessibility issues, and restore shoreline areas. Plan details can be found online: http://www.cityofchelan.us/parks/pdfdocs/donmorseparkmasterplanexecsummary.pdf.

Riverwalk Park

Coordinate with the Chelan County PUD to reduce shoreline armoring, improve streambank stabilization, remove non-native plantings, and add native vegetation and LWD.

Lakeside Park

Reduce shoreline armoring, vegetate the shoreline, and improve shoreline stabilization.

General

Many residential shoreline properties throughout the City's Lake Chelan shoreline have the potential for improvement of ecological functions through: 1) reduction or modification of shoreline armoring, 2) reduction of overwater cover and in-water structures (grated pier decking, pier size reduction, pile size and quantity reduction, moorage cover removal), 3) improvements to nearshore native vegetative cover, and/or 4) reductions in impervious surface coverage. A combination of native revegetation and bioengineering techniques could be used to prevent excessive erosion. Where opportunities for on-site mitigation and restoration are not available, projects could explore and consider opportunities

for enhancing any of the water-conveyance swales that enter Lake Chelan and drain areas developed for orchard, vineyard, or other uses. Enhancements of these corridors would improve wildlife habitat and increase the ability of these vegetated pathways to filter and treat pollutants originating from upslope uses.

5 OTHER REGULATORY PROGRAMS

5.1 Effects of Current City and County Regulations

5.1.1 Critical Areas Regulations

Critical Areas Regulations prepared under the Growth Management Act and adopted through County and City ordinance apply to designated critical areas outside of shoreline jurisdiction. Chelan County and the City of Chelan each has its own set of critical area regulations that dictate protection of environmentally sensitive areas, including wetlands, streams (fish and wildlife habitat conservation areas), geologically hazardous areas, frequently flooded areas, and aquifer recharge areas. All regulations use a version of the Department of Ecology's Eastern Washington Wetland Rating System.

Table 8 summarizes critical areas regulations for the County and City.

Table 8. Critical Areas Regulations Outside of Shoreline Jurisdiction.

Jurisdiction	Date of Last Update	Wetland Rating System	Stream Classification System	Buffer Width (feet)		
Chelan County	2007	Ecology E. WA (2004)	WA DNR Interim water typing system (WAC 222-16-031)	**Wetlands**	**High Intensity**	**Low Intensity**
Title No. 11.78-11.86; Fish & Wildlife Habitat Cons. Areas; Wetland Areas Ov. Dist.; Aq. Recharge Area Ov. Dist; Freq. Flooded Areas Ov. Dist.; Geo. Haz. Area Ov. Dist.				Cat 1	300	200
				Cat 2	200	100
				Cat 3	150	75
				Cat 4	50	50
				Shoreline Streams/Lakes		
				Natural	250	200
				Conservancy	250	200
				Rural	150	100
				Urban	100	75
				Lower Lake Chelan (w/ conditions)	50	25
				Non-Shoreline Streams/Lakes		
				Type S	250	200
				Type F	200	150
				Type Np	150	100
				Type Ns	50	50

Jurisdiction	Date of Last Update	Wetland Rating System	Stream Classification System	Buffer Width (feet)			
City of Chelan	2009	Ecology E. WA (2004/ 2007)	None	**Wetlands**	**Low Impact Land Use**	**Moderate Impact Land Use**	**High Impact Land Use**
Title No. 14.10A-E Wetlands; Crit. Aq. Rchg. Areas; Fish & Wildlife Habitat Cons. Areas; Geog. Haz Areas; Freq. Flooded Areas.				Cat 1	125	190	250
				Cat 2	100	150	200
				Cat 3	75	110	150
				Cat 4	25	40	50
				Streams	General protection standards only for fish and wildlife habitat conservation areas, no dimensional standards for buffers		

5.1.2 Chelan County

Comprehensive Plan: The *Chelan County Comprehensive Plan 2000* (with Amendments through 2014) guides land use and many other elements for a horizon period of 20 years.

In addition to the basic elements required by the Growth Management Act (GMA), such as land use, rural, housing, transportation, utilities, capital facilities, economic, and parks and recreation, Chelan County's Comprehensive Plan contains optional subarea plans. Subarea plans focus on smaller geographic areas and allow the County and citizens to develop local visions for a community's future. A subarea plan for Lake Chelan is in draft stage.

Land use designations fall into three broad categories: urban, rural, and resource. All categories can be found along waterbodies. Local areas of rural resort and recreation, rural village, rural waterfront, and rural industrial area, among others, are focused in smaller areas.

Zoning Code: The Comprehensive Plan and Subarea Plans are implemented through the Development Regulations, including the Zoning Code. Title 11 of the Chelan County Code provides zoning standards that more specifically direct uses, building bulk, scale, and location, and other design considerations. The zones match the Comprehensive Plan designations.

Floodplain Regulations: Floodplain regulations are contained within Chapter 3.20 – Flood Hazard Development and Chapter 11.84 – Frequently Flooded Areas Overlay District. Flood hazards as regulated under Chapter 3.20 are defined as "those lands which have been determined to carry the capacity of a base flood as identified by the Federal Insurance Administration." "Frequently flooded areas" as regulated under Chapter 11.84 are defined as "[t]hose areas located within the one-hundred-year floodplain" as mapped by FEMA. Other development in

frequently flooded areas must comply with Chapter 3.20 and the SMP. Chapter 3.20 contains a number of standards for developments approved in flood hazard areas, including requirements for anchoring, use of best practices in construction methods and materials, design standards for residential and nonresidential construction, limitations on fill/grading activities that would reduce the area's ability to store or move flood water.

5.1.3 City of Chelan

Comprehensive Plan: The *City of Chelan Comprehensive Plan 2007* provides for urban land use designations in the City and UGA, and addresses other important elements such as capital facilities (e.g. parks and recreation). The Comprehensive Plan may be updated no more frequently than on an annual basis.

Zoning Code: Title 17 Zoning regulates land in the city limits related to uses, building bulk, scale, and location, and other design considerations. Until land is annexed, the County is responsible for permitting in the UGA. However, the County has a Memorandum of Understanding with the City regarding the adoption and use of the City's zoning and zoning standards for review of proposals in the City's UGA.

Floodplain Regulations: Chapter 14.10.60E of the Chelan Municipal Code contains brief critical areas provisions for frequently flooded areas, describing the need for a sensitive areas study and for compliance with Chapter 15.10. Chapter 15.10, titled Flood Damage Prevention, applies standards to "areas of special flood hazard," which are equivalent to the extent of FEMA's 100-year floodplain. General standards are provided for all types of special flood hazard areas, including requirements for anchoring, use of best practices in construction methods and materials, and design standards for residential and nonresidential construction, including manufactured homes.

5.2 State Agencies/Regulations

Aside from the Shoreline Management Act, State regulations most pertinent to development in the City's shorelines include the State Hydraulic Code, the Growth Management Act, State Environmental Policy Act, tribal agreements and case law, Watershed Planning Act, Water Resources Act, and Salmon Recovery Act. A variety of agencies (e.g., Washington Department of Ecology, Washington Department of Fish and Wildlife, Washington Department of Natural Resources) are involved in implementing these regulations or otherwise own shoreline areas. The Department of Ecology reviews all shoreline projects that require a shoreline permit, but has specific regulatory authority over Shoreline Conditional Use Permits and Shoreline Variances. Other agency reviews of

shoreline developments are typically triggered by in- or over-water work, discharges of fill or pollutants into the water, or substantial land clearing.

Depending on the nature of the proposed development, State regulations can play an important role in the design and implementation of a shoreline project, ensuring that impacts to shoreline functions and values are avoided, minimized, and/or mitigated. During the comprehensive SMP update, the City will consider other State regulations to ensure consistency as appropriate and feasible with the goal of streamlining the shoreline permitting process. A summary of some of the key State regulations and/or State agency responsibilities follows.

Washington Department of Natural Resources: Washington Department of Natural Resources (WDNR) is charged with protecting and managing use of State-owned aquatic lands. Toward that end, water-dependent uses waterward of the ordinary high water mark require review by WDNR to establish whether the project is on State-owned aquatic lands. In Lake Chelan, for example, WDNR has authority over aquatic lands waterward of the 1079-foot elevation. In the Columbia River, WDNR has authority over activities extending into the original (pre-dam) channel. If WDNR has jurisdiction, the project may be required to obtain an Aquatic Use Authorization from WDNR and enter into a lease agreement. Certain project activities, such as single-family or two-party joint-use residential piers, on State-owned aquatic lands are exempt from these requirements. WDNR recommends that all proponents of a project waterward of the ordinary high water mark contact WDNR to determine jurisdiction and requirements.

Chelan County Public Utility District: Although the Chelan County PUD is not a State agency, it does act like an agency in its review and denial or approval of certain projects in Lake Chelan (Chelan Reservoir). The Chelan dam was completed in 1927, and was relicensed in 2006. As part of dam management, Lake Chelan is flooded, by right and by obligation, to 1,100 feet above sea level during summer months to accommodate private and public recreational uses.

Washington Department of Ecology: The Washington Department of Ecology may review and condition a variety of project types, including any project that needs a permit from the U.S. Army Corps of Engineers (see below), any project that requires a shoreline Conditional Use Permit or Shoreline Variance, and any project that disturbs more than 1 acre of land. Project types that may trigger Ecology involvement include pier and shoreline modification proposals and wetland or stream modification proposals, among others. Ecology's three primary goals are to: 1) prevent pollution, 2) clean up pollution, and 3) support sustainable communities and natural resources (http://www.ecy.wa.gov/about.html). Their authority comes from the State Shoreline Management Act, Section 401 of the Federal Clean Water Act, the

Water Pollution Control Act, the Federal Coastal Zone Management Act of 1972, the State Environmental Policy Act, the Growth Management Act, and various RCWs and WACs of the State of Washington.

Washington Department of Fish and Wildlife: Chapter 77.55 RCW (the Hydraulic Code) gives the Washington Department of Fish and Wildlife (WDFW) the authority to review, condition, and approve or deny "any construction activity that will use, divert, obstruct, or change the bed or flow of State waters." Practically speaking, these activities include, but are not limited to, installation or modification of piers, shoreline stabilization measures, culverts, bridges and footbridges. These types of projects must obtain a Hydraulic Project Approval from WDFW, which will contain conditions intended to prevent damage to fish and other aquatic life, and their habitats. In some cases, the project may be denied if significant impacts would occur that could not be adequately mitigated.

Watershed Planning Act: The Watershed Planning Act of 1998 (Chapter 90.82 RCW) was passed to encourage local planning of local water resources, recognizing that there are citizens and entities in each watershed that "have the greatest knowledge of both the resources and the aspirations of those who live and work in the watershed; and who have the greatest stake in the proper, long-term management of the resources." The Chelan watershed does not yet have a watershed management plan, although a draft Lake Chelan sub-basin plan was completed for the Northwest Power & Conservation Council in 2004.

5.3 Federal Agencies/Regulations

Federal regulations most pertinent to development in the City's shorelines include the Endangered Species Act, the Clean Water Act, and the Rivers and Harbors Appropriation Act. Other relevant federal laws include the National Environmental Policy Act, Clean Air Act, and the Migratory Bird Treaty Act. A variety of agencies (e.g., U.S. Army Corps of Engineers [Corps], National Marine Fisheries Service, U.S. Fish and Wildlife Service) are involved in implementing these regulations, but review by these agencies of shoreline development in most cases would be triggered by in- or over-water work, or discharges of fill or pollutants into the water. Depending on the nature of the proposed development, federal regulations can play an important role in the design and implementation of a shoreline project, ensuring that impacts to shoreline functions and values are avoided, minimized, and/or mitigated. A summary of some of the key State regulations and/or State agency responsibilities follows.

Section 404: Section 404 of the federal Clean Water Act provides the Corps, under the oversight of the U.S. Environmental Protection Agency, with authority to regulate "discharge of dredged or fill material into waters of the United States, including wetlands" (http://www.epa.gov/owow/wetlands/pdf/

reg_authority_pr.pdf). The extent of the Corps' authority and the definition of fill have been the subject of considerable legal activity. However, it generally means that the Corps must review and approve many activities in shoreline waterbodies, and other streams and wetlands. These activities may include wetland fills, stream and wetland restoration, and culvert installation or replacement, among others. Similar to Washington State Environmental Policy Act (SEPA) requirements, the Corps is interested in avoidance, minimization, restoration, and compensation of impacts.

Section 10: Section 10 of the federal Rivers and Harbors Appropriation Act of 1899 provides the Corps with authority to regulate activities that may affect navigation of "navigable" waters. Lake Chelan is a designated navigable water. Accordingly, proposals to construct new or modify existing in-water structures (including piers, marinas, bulkheads, breakwaters), to excavate or fill, or to "alter or modify the course, location, condition, or capacity of" these waterbodies must be reviewed and approved by the Corps.

Federal Endangered Species Act (ESA): Section 9 of the ESA prohibits "take" of listed species. Take has been defined in Section 3 as: "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." The take prohibitions of the ESA apply to everyone, so any action of the City that results in a take of listed fish or wildlife would be a violation of the ESA and exposes the City to risk of lawsuit. Per Section 7 of the ESA, the Corps must consult with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service on any projects that fall within Corps jurisdiction (e.g., Section 404 or Section 10 permits) that could affect species listed under the Federal Endangered Species Act. These agencies ensure that the project includes impact minimization and compensation measures for protection of listed species and their habitats.

Clean Water Act: The federal Clean Water Act has a number of programs and regulatory components, but of particular relevance to Chelan County is the National Pollutant Discharge Elimination System (NPDES) program. In Washington State, the Department of Ecology has been delegated the responsibility by the U.S. Environmental Protection Agency for managing implementation of this program.

Federal Power Act: Under the Federal Power Act, the Federal Energy Regulatory Commission (FERC) is responsible for licensing nonfederal hydropower projects on navigable waterways and federal lands. The Commission's staff prepares an environmental analysis of every new and relicensed hydropower proposal to ensure that environmental impacts are weighed in the location, design, and ongoing use of hydropower dams.

6 SUMMARY OF POTENTIAL IMPACTS OF LIKELY DEVELOPMENT AND EFFECTS OF SMP

WAC 173-26-186(8)(d) guides local master programs to evaluate and consider cumulative impacts of "reasonably foreseeable future development on shoreline ecological functions." The most commonly anticipated changes in shoreline development involve residential, commercial, and industrial development. These activities include upland development, and may also include the development of overwater structures and/or shoreline stabilization. As directed by the WAC, the policies and regulations in the proposed SMP are designed to ensure that cumulative impacts do not result in a net loss of ecosystem functions. A discussion of the general potential impacts of these anticipated developments and the citywide effects of the SMP are provided in Sections 6.1-6.3, below.

Potential development is not limited to residential, commercial and industrial uses; however, the location, timing, and impacts of less common uses and development projects are less predictable. WAC 173-26-201(3(d)(iii) provides guidance that "for those projects and uses with unanticipatable or uncommon impacts that cannot be reasonably identified at the time of master program development, the master program policies and regulations should use the permitting or conditional use permitting processes to ensure that all impacts are addressed and that there is not net loss of ecological function of the shoreline after mitigation."

6.1 Summary of Potential Impacts Associated with Upland Development and Effects of SMP

6.1.1 General

The most commonly anticipated changes in shoreline use involve residential, commercial, and industrial development. These developments and developments accessory to these uses, including utility and transportation infrastructure, generally involve impacts to shoreline functions, which typically result from the replacement of pervious, vegetated areas with impervious surfaces and/or a landscape management regime that includes chemical treatments of lawn and landscaping. These actions have multiple potential effects on shoreline ecological functions, including:

- Reduction in ability of site to improve quality of waters passing through the untreated vegetation and healthy soils.

- Potential contamination of surface water from chemical and nutrient applications.
- Increase in surface water runoff due to reduced infiltration area and increased impervious surfaces, which can lead to excessive soil erosion and subsequent in-water sediment deposition.
- Elimination of upland habitat occupied by wildlife that use riparian areas.

The amount of space between the shoreline and a structure is an excellent quick evaluation of shoreline condition. The extent of native vegetation and the amount of impervious surfaces are often important indicators of shoreline function since these factors influence the quantity of stormwater runoff reaching shorelines. Changes in vegetation are a significant consideration when evaluating the net effects of development on shoreline ecological function. Riparian vegetation provides filtration of upland contaminants, bank stability, shading of waterbodies, habitat complexity (both aquatic and terrestrial), a source of terrestrial insect prey for fish, and increased water storage potential.

Table 9 identifies the potential impacts of specific likely changes in development in the City of Chelan and the primary anticipated effects of the SMP. Additional analysis of the effects of SMP provisions related to residential development is provided in Appendices B and C.

Table 9. Summary of Potential Impacts Associated with Upland Development in Shoreline Jurisdiction.

Shoreline Function	Major Types of Anticipated Future Development Likely to Affect Shoreline Function	Potential Impacts to Shoreline Function	Effects of SMP
River/Stream			
Hydrologic (includes hyporheic)	• Additional residential development within existing pockets of residential uses • Commercial and industrial development • Improvement and expansion of transportation and utility infrastructure	• Modification of flow regimes with construction of buildings, roads, or recreational-use structures • Increased runoff from added impervious surface and vegetation loss, increased potential for localized flooding, increased erosion and reduced groundwater recharge • Reduced groundwater recharge combined with increased stormwater	• Shoreline environment designations to concentrate development in least sensitive areas • Development restrictions in floodplains • Clustering of development to minimize physical impacts • Shoreline crossings for utilities and transportation to be designed to minimize ecological impacts • Mitigation standards for vegetation clearing

Shoreline Function	Major Types of Anticipated Future Development Likely to Affect Shoreline Function	Potential Impacts to Shoreline Function	Effects of SMP
	• Creation of more parks/public access sites	runoff rates means higher high flow volumes and lower seasonal low flow rates • Higher flows alter stream sediment balance	
Water quality		• Increase in runoff and associated water quality impacts • Increase in runoff and associated water quality impacts with the creation of new impervious surfaces • Vegetation loss reduces filtration of excess nutrients, sediments and pollutants during hyporheic exchange.	• Provisions to maintain surface and groundwater quality • Standards for stormwater management and low impact development • BMPs to minimize erosion • Standards for on-site sewage location and design • Industrial development encouraged to locate where environmental cleanup and restoration can be incorporated. • Vegetated setback standards
Shoreline vegetation		• Decrease in shoreline/riparian vegetation • Vegetation loss increases the potential for erosion, bank instability, turbidity, higher water temperatures • Vegetation loss reduces refuge and foraging opportunities for fish and wildlife • Vegetation loss produces less LWD for habitat forming processes	• Clustering of development to minimize physical impacts • Vegetated setback standards • Mitigation standards for vegetation clearing
Habitat		• Loss of or disturbance to riparian habitat • Loss of instream habitat complexity, less LWD for habitat forming processes • Vegetation loss reduces terrestrial insect subsidies	• Clustering of development to minimize physical impacts • Provisions to locate and design utilities and transportation infrastructure to avoid sensitive areas and restore disturbed areas

Shoreline Function	Major Types of Anticipated Future Development Likely to Affect Shoreline Function	Potential Impacts to Shoreline Function	Effects of SMP
		• Increased flow rates scour and redistribute gravel beds needed for spawning	• Vegetated setback standards • Mitigation standards for vegetation clearing
Lake			
Hydrologic	• Increased impervious surface • Creation of more parks/public access sites • Continued residential infill	• Change in stormwater management, flow rate, volume	• Shoreline environment designations to concentrate development in least sensitive areas • Development restrictions in floodplains • Clustering of development to minimize physical impacts • Shoreline crossings for utilities and transportation to be designed to minimize ecological impacts • Mitigation standards for vegetation clearing
Water quality		• Increase in runoff and associated water quality impacts with the creation of new impervious surfaces • Increase in pesticide and fertilizer inputs into lake reaches resulting from new and ongoing land uses • Removal of shoreline vegetation impacts erosion and bank stability, increases turbidity and water temperatures	• Provisions to maintain surface and groundwater quality • Standards for stormwater management and low impact development • BMPs to minimize erosion • Standards for on-site sewage location and design • Industrial development encouraged to locate where environmental cleanup and restoration can be incorporated. • Vegetated setback standards
Shoreline vegetation		• Decrease in mature shoreline vegetation as clearing for new upland development continues • Vegetation loss means greater potential for increased erosion, bank instability, turbidity,	• Clustering of development to minimize physical impacts • Vegetated setback standards • Mitigation standards for vegetation clearing

Shoreline Function	Major Types of Anticipated Future Development Likely to Affect Shoreline Function	Potential Impacts to Shoreline Function	Effects of SMP
		higher water temperatures • Loss of shoreline habitat complexity, less LWD for habitat forming processes	
Habitat		• Loss of or disturbance to riparian habitat during upland development • Lighting effects on both fish and wildlife in nearshore areas • Increase in pesticide and fertilizer inputs • Reduced shoreline habitat complexity, less LWD for habitat forming processes	• Clustering of development to minimize physical impacts • Provisions to locate and design utilities and transportation infrastructure to avoid sensitive areas and restore disturbed areas • Vegetated setback standards • Mitigation standards for vegetation clearing

Provisions in the proposed SMP guide future development and redevelopment to avoid, minimize, and mitigate for shoreline impacts caused by upland development. As described in Section 4.2 and summarized in Tables 5 and 6, provisions in the proposed SMP address potential impacts to vegetative, habitat, water quality, and hydraulic functions. The following specific use provisions also help to avoid a net loss of shoreline function from upland development:

- Cluster residential development to avoid ecologically sensitive areas.
- Design subdivisions of land so that newly developed lots will be able to comply with SMP requirements and not require a Shoreline Variance.
- Locate, design, and mitigate for roads and utilities servicing upland development.
- Locate industrial development where environmental cleanup and restoration of the shoreline area can be incorporated. Address federal and state requirements for hazardous materials clean up or management.

In addition to the above provisions, vegetation conservation and shoreline setback regulations are critical to maintaining and/or improving the functions of existing riparian vegetation. It is important that impervious surfaces be separated from the waterbody to the extent that those surfaces replace vegetation. In the proposed SMP, shoreline setback standards were established specific to each environment designation. Specific shoreline setbacks will be discussed below in Section 7. Wetland buffers found in the City and County (for

unincorporated UGA areas) shoreline critical areas regulations also limit the effects of development on shoreline-associated wetlands.

In general, new residential, commercial, and industrial development is expected within shoreline jurisdiction in the City and its UGA over the next 20 years. Standards for stormwater control, vegetation conservation, mitigation, setbacks, and other measures in the SMP, will help maintain ecological functions of the shoreline over the long term.

6.1.2 Ongoing Agriculture

Ongoing agricultural activities are not regulated by the SMA and are therefore not subject to the provisions in the proposed SMP. New agricultural activities are largely exempt from Shoreline Substantial Development Permits, but must comply with other provisions in the SMP, including implementing best management practices. Agricultural activities are expected to continue where present in the City and its UGA.

6.1.3 Upland Development outside of Shoreline Jurisdiction

Although SMP regulations only apply within shoreline jurisdiction, development outside of shoreline jurisdiction may influence shoreline ecological functions. The potential impacts of development outside of shoreline jurisdiction tend to be more indirect than impacts within shoreline jurisdiction; nevertheless, their potential effects can be significant, and include the following:

- Reduced infiltration potential on hillslopes and in headwater areas increases surface flows and reduces groundwater storage. This increases peak flows and flashiness of shoreline waterbodies, and may result in channel incision and reduced instream channel complexity.
- Increased impervious surfaces and reduced infiltration increases runoff of untreated waters and the potential for water quality degradation through the introduction of herbicides, pesticides, and heavy metals, and other toxic compound to the shoreline waterbody.
- Elimination of upland wildlife corridors.
- Development in floodplains is inherently susceptible to damage. Efforts to protect new developments have the potential to isolate floodplains, thereby interfering with shoreline processes.

Because SMP provisions do not apply to upland areas outside of shoreline jurisdiction, other local regulations, including zoning codes, critical areas regulations, floodplain regulations, and stormwater regulations, as well as applicable state and federal regulations, will guide development in those areas.

Despite these regulations and the spatial separation from the shoreline, developments near shoreline jurisdiction may have some impacts to shoreline functions. For those areas where extensive development is anticipated in the study area, but outside of shoreline jurisdiction, particular attention should be paid during review of those projects under other regulations to ensure that the upland impacts are fully mitigated and no net loss of functions is achieved.

6.2 Summary of Potential Impacts Associated with Overwater Structures and Effects of SMP

Overwater structures can adversely affect ecological functions and habitat in the following ways:

- Alter patterns of light transmission to the water column, affecting macrophyte growth and altering habitat for and behavior of aquatic organisms, including juvenile salmon and other prey species and the composition and diversity of benthic organisms.
- Interfere with long-shore movement of sediments, altering substrate composition and development.
- Contribute to contamination of surface water from chemical treatments of structural materials, as well as indirect effects of boat use and maintenance.
- Clearing of shoreline vegetation to accommodate docks reduces shoreline vegetative functions.

A reservoir, like Lake Chelan, where water levels are artificially manipulated, deserves special consideration with regard to the effects of overwater structures. Before assessing conditions and potential impacts for lower Lake Chelan, several overarching conditions must be considered; among these are the extent and timing of lake level fluctuations. Because of dam regulation, the water levels fluctuate so that levels are lowest in the winter months, and highest in late summer. Based on average historic lake level fluctuations, the period in which the lake is within 5 feet of OHWM (between 1,095 and 1,100 feet) extends from the beginning of June to the middle of November. It can be assumed that once the lake recedes beyond that depth, direct impacts (e.g., shading and structure provided by docks) become less significant on shoreline functions.

On the other hand, certain other indirect effects of dock construction, such as vegetation clearing along the shoreline to accommodate new structures, are less closely related to fluctuating lake levels, and impacts (e.g., reduced filtration by shoreline vegetation) are likely to occur year-round. The extent of submerged aquatic macrophytes is limited to a narrow band below the lake drawdown level in Lake Chelan as a result of water level fluctuation (Duke Engineering 2000). The limited occurrence of aquatic vegetation generally means that the impacts of

piers and docks that are related to aquatic vegetation are likely to be minimal to non-existent in Lake Chelan.

Additional discussion of the effects of overwater structures relative to the effects of shoreline development can be found in Appendix C of this report.

Table 10 identifies the potential impacts of specific likely changes in development in the City and its UGA and a summary of the effects of SMP provisions.

Table 10. Summary of Potential Impacts Associated with Over-water Structures in Shoreline Jurisdiction.

Shoreline Function	Major Types of Anticipated Future Development Likely to Affect Shoreline Function	Potential Impacts to Shoreline Function	Effects of SMP Provisions
Lake Chelan			
Hydrologic	• Creation of more parks/public access sites with associated over-water structures • Increased construction of single-family or community docks associated with existing or new residential use • Repair of replacement of existing piers	• Potential interference with movement of sediments, altering substrate composition and development	• Boating facilities and private moorage structures are prohibited in areas that would require dredging or flood hazard zones.
Water quality		• Water quality impacts associated with construction of docks and other in-water structures (e.g., spills, harmful materials use) • Water quality impacts associated with related uses of new docks (e.g., boat maintenance and operation)	• Toxic wood preservatives are prohibited • Pumpout facilities required for new marinas • Shoreline crossings to be designed to minimize ecological impacts
Shoreline vegetation		• Alterations of aquatic vegetation communities • Loss of riparian vegetation area • Loss of riparian vegetation increases the potential for erosion, bank instability, turbidity, higher water temperatures	• New boating facilities and private moorage structures prohibited over aquatic or emergent vegetation • Mitigation standards for new structures may include planting of shoreline vegetation • Mitigation required for vegetation removal
Habitat		• Increased shading in nearshore lake habitat areas resulting from dock and pier construction can	• Dimensional standards to minimize extent of overwater cover

Shoreline Function	Major Types of Anticipated Future Development Likely to Affect Shoreline Function	Potential Impacts to Shoreline Function	Effects of SMP Provisions
		affect macrophyte growth, and alter habitat for and behavior of aquatic organisms • Nighttime lighting effects on both fish and wildlife • Loss of habitat for benthic community, less LWD for habitat complexity	• Decking standards to maximize light penetration • Skirting and walled structures prohibited

SMP standards are designed to minimize the extent of overwater structures, particularly in the nearshore area. SMP standards prohibit skirting, walled structures, and several toxic preservatives that could otherwise impair water circulation, light attenuation, and water quality. The SMP provides specific dimensional criteria for boating facilities and private moorage to minimize the effects of overwater structures, particularly within the nearshore area. Together, these design standards minimize the area in which light transmission is affected, thereby limiting the potential impacts of new docks on the aquatic ecosystem. The SMP also provides standards for lighting overwater structures, which helps avoid behavioral impacts to aquatic species at night. In addition to limits on design, siting, and dimensions, the proposed SMP guides the location of boating facilities to minimize any ecological impacts. Furthermore, only joint-use piers are allowed for subdivisions of two or more waterfront dwelling units. This provision prevents the proliferation of single use piers with residential subdivision and development.

In addition to local shoreline permit requirements, both WDFW and the Corps require permits for the installation, replacement, and repair of overwater structures. Mitigation measures for overwater structures encouraged by WDFW include the removal of unused piles (especially those formerly treated with creosote), reduction of pile size and quantity, and general reduction in overall square footage of cover. As part of efforts to minimize and compensate for impacts, mitigation is often required. Any new or replacement structure would require a Hydraulic Project Approval (HPA) from WDFW and a Section 10 Rivers and Harbors Act permit from the Corps of Engineers. These agencies would likely require similar mitigation measures noted above for WDFW.

Expansion, reconfiguration, and repair of several overwater structures is expected. New structures will need to comply with strict regulations to minimize and mitigate impacts. Where existing shoreline vegetation is

degraded, mitigation measures proposed for new private moorage facilities are expected to offset the impacts of new overwater structure development. Where existing overwater structures are common, dimensional, material, and design standards are expected to reduce the individual impacts of structures compared to existing conditions. Overall, the improvements gained through repair and replacement over time, and mitigation associated with any new overwater structures are expected to achieve no net loss of ecosystem functions.

6.3 Summary of Potential Impacts Associated with Shoreline Stabilization and Effects of SMP

Shoreline stabilization measures typically have the following effects on ecological functions compared to natural shorelines:

- Reduced connectivity between floodplain and river, leading to reduced floodplain habitat diversity and floodplain functions.
- Reduction in nearshore habitat quality for juvenile salmonids and other aquatic organisms. Specifically, shoreline complexity from downed wood and emergent vegetation that provide forage and cover may be reduced or eliminated. Elimination of shallow-water and off-channel habitats reduces opportunities for small fish to find refuge from predators and from high flows.
- Reduction of natural sediment recruitment from the shoreline. This recruitment is necessary to replenish substrate and preserve shallow water conditions.
- Increase in wave energy at the shoreline if shallow water is eliminated, resulting in increased nearshore turbulence that can be disruptive to juvenile fish and other organisms.

Similar to overwater structures, the impacts of shoreline stabilization will vary seasonally in reservoirs, where water levels fluctuate widely. In lower Lake Chelan, the period in which the lake is within 5 feet of OHWM (between 1,095 and 1,100 feet) extends from the beginning of June to the middle of November; during other periods of the year, the actual shoreline recedes well away from the OHWM. It can be assumed that direct impacts of shoreline stabilization (e.g., habitat changes, sediment recruitment effects, and effects on wave energy) are not significant during periods when the Lake has significantly receded. On the other hand, certain other indirect effects of shoreline stabilization, such as vegetation clearing to accommodate new structures, are less closely related to fluctuating lake levels, and impacts are likely to occur year-round.

Repairs and replacements of existing bulkheads perpetuate the conditions described above. Table 11 identifies the potential impacts of specific likely changes in development in the City of Chelan and its UGA.

Table 11. Summary of Potential Impacts Associated with Shoreline Stabilization in Shoreline Jurisdiction.

Shoreline Function	Major Types of Anticipated Future Development Likely to Affect Shoreline Function	Potential Impacts to Shoreline Function	Effects of SMP Provisions
River/Stream			
Hydrologic (includes hyporheic)	New, replaced, and repaired shoreline modification such as bulkheads for shoreline residential uses, parks and public access sites, and other water dependent uses	• Reduction in LWD recruitment and other organic material as shoreline habitats are altered • Modification of flow regimes. • Reduction in floodplain function leads to higher peak flows, less groundwater recharge, and greater sediment scour and erosion. • Reduction of natural sediment recruitment from the shoreline. This recruitment is necessary to replenish substrate and preserve shallow water conditions.	• Residential development to avoid the need for future stabilization or flood control • Demonstration of need to protect primary structure required for new stabilization • Mitigation requirements include improving substrate conditions waterward of OHWM
Water quality		• Water quality impacts associated with construction • Reduction in floodplain connectivity reduces floodplain filtration potential • Removal of shoreline vegetation increases water temperatures	• Mitigation requirements include planting native vegetation
Shoreline vegetation		• Potential associated vegetation loss increases potential for erosion, turbidity, higher water temperatures potential	• Mitigation requirements include planting native vegetation
Habitat		• Reduction in shoreline complexity and emergent vegetation that provides forage and cover • Reduced floodplain connectivity limits off-channel refuge for fish during high flows • Reduction of natural sediment recruitment from	• Preference for soft-shoreline stabilization • Mitigation requirements include improving substrate conditions waterward of OHWM and planting native vegetation

Shoreline Function	Major Types of Anticipated Future Development Likely to Affect Shoreline Function	Potential Impacts to Shoreline Function	Effects of SMP Provisions
		the shoreline. This recruitment is necessary to replenish substrate and preserve shallow water conditions • Elimination of shallow-water habitat may also increase vulnerability of juvenile salmonids to aquatic predators	
Lake			
Hydrologic	• New, replaced, and repaired shoreline modification such as bulkheads for shoreline residential uses, parks and public access sites, and other water dependent uses	• Increase in wave energy at the shoreline if shallow water is eliminated, resulting in increased nearshore turbulence that can be disruptive to juvenile fish and other organisms. • Shoreline scour from downward force of waves hitting bulkheads	• Residential development to avoid the need for future stabilization or flood control • Demonstration of need required for new stabilization • Mitigation requirements include improving substrate conditions waterward of OHWM
Water quality		• Water quality impacts associated with construction • Removal of shoreline vegetation increases erosion	• Mitigation requirements include planting native vegetation
Shoreline vegetation		• Potential associated vegetation loss increases potential for erosion, turbidity, higher water temperatures	• Mitigation requirements include planting native vegetation
Habitat		• Reduction in nearshore habitat quality, shoreline complexity and emergent vegetation that provides forage and cover may be reduced or eliminated • Reduction of natural sediment recruitment from the shoreline. This recruitment is necessary to replenish substrate and preserve shallow water conditions	• Preference for soft-shoreline stabilization • Mitigation requirements include improving substrate conditions waterward of OHWM and planting native vegetation

Shoreline Function	Major Types of Anticipated Future Development Likely to Affect Shoreline Function	Potential Impacts to Shoreline Function	Effects of SMP Provisions
		• Elimination of shallow-water habitat may also increase vulnerability of juvenile fish to aquatic predators	

The SMP sets standards for new and repaired shoreline armoring, as well as conditions and uses where new shoreline armoring is allowed or prohibited. Under the proposed SMP, new developments must be designed and sited to avoid the need for structural shoreline stabilization wherever feasible. Residential subdivisions must be designed so that shoreline stabilization will not be required. Structural shoreline stabilization is not allowed except to protect restoration projects, or unless a geotechnical analysis demonstrates that it is necessary to protect a primary structure from erosive action caused by currents, waves, or other waterward processes.

Where structural stabilization is necessary, the SMP establishes a preference for soft structural stabilization and requires that the size of the structure be minimized to the greatest extent possible. Together, these measures should successfully minimize the extent of new shoreline stabilization, and may result in a reduction or softening of existing stabilization measures. Finally, the SMP requires mitigation for stabilization impacts. Mitigation measures include improving substrate conditions waterward of the OHWM and planting native vegetation along the shoreline. These measures are expected to mitigate for the changes in shoreline gradient associated with stabilization and to ensure that shoreline vegetative functions are maintained, or in some cases, improved.

Both the Corps and the WDFW have jurisdiction over new shoreline stabilization projects and repairs or modifications to existing shoreline stabilization. Where actions may affect federally threatened or endangered species, the Corps must consult with the U.S. Fish and Wildlife Service regarding potential Endangered Species Act issues. As part of those agencies' efforts to minimize and compensate for shoreline stabilization-related impacts, the federal agencies require mitigation, frequently through the implementation of native shoreline planting plans. Further, NMFS requires additional impact compensation measures for many bank modification projects, including angling the face of the structure landward to reduce wave turbulence, and/or shifting the structure as far landward as feasible.

Over time, the combined effects of the proposed SMP, implementation of the Shoreline Restoration Plan, permit reviews from the WDFW and the Corps, and planned restoration actions are expected to result in a reduction or softening of existing stabilization structures, and any new stabilization structures that are permitted will be accompanied by appropriate minimization and mitigation measures to offset shoreline impacts.

6.4 Summary of Potential Impacts Associated with Dredging and Effects of SMP

Dredging operations are conducted to serve several distinct objectives in the City of Chelan and Washington State. Channel dredging may be conducted for flood control, navigation, utility installation, the construction or modification of essential public facilities and regional transportation facilities, and/or restoration.

Dredging has potential impacts on ecological and physical processes, summarized below.

Dredging:

- Simplification of in-water habitats.
- Disruption of benthic community.
- Reduction in shallow-water habitat.
- Alteration in hydrologic and sediment processes.
- Reduction in water quality from turbidity and in-water dredge material disposal.

The SMP includes provisions to ensure that impacts are avoided, minimized and mitigated through the design, location, construction, and maintenance actions.

7 Cumulative Impacts on Ecological Function

In addition to the relevant regulations discussed in those sections above, the City developed certain regulations specific to local conditions, plans, and interests. The following discussion will build on the general discussion of potential impacts and effects of general SMP regulations from Section 6 to present a summary analysis of how planned development is likely to affect existing conditions on a local scale in light of local SMP regulations, other regulations (Section 5), and planned restoration (Section 4.5).

7.1 City of Chelan

The primary anticipated changes in the City of Chelan's shorelines include: single-family residential development in the Shoreline Residential - Single Family environment, redevelopment or expansion of underutilized parcels for multi-family residential development in the Shoreline Residential - Multi Family environment, and commercial development and redevelopment in the High Intensity environment on Lake Chelan (Table 12). Although the land capacity analysis indicates that multi-family residential development is likely in the Shoreline Park/Public environment, multi-family residential development is not an allowed use in that environment, and is not anticipated. Significant development on the Chelan River is not anticipated, and if any development were to occur, it would be physically separated from the shoreline by public lands.

Existing residential development on Lake Chelan is marked by mowed lawns and numerous private and shared-use piers and mooring buoys. Bulkheads are frequently present on residential parcels. Where the road borders the lakeshore, the shoreline often lacks any upland vegetation. Undeveloped shoreline lands along Lake Chelan are often associated with steeper slopes, which support small shrubs.

Table 12. Summary of waterbodies with likely residential, commercial, and industrial development in shoreline jurisdiction in the City of Chelan.

Waterbody / Environment Designation	Acres in Total Shoreline Jurisdiction	Acres Outside of Setbacks in Study Area (Shoreline Jurisdiction)	Single Family Units in Study Area (Jurisdiction)	Multi-Family Units in Study Area (Jurisdiction)	Commercial Sq Ft in Study Area (Jurisdiction)
High Intensity					
Lake Chelan	62.40	91.2 (41.2)	3 (2)	51 (17)	40,729 (36,376)
Shoreline Residential - Single Family					
Lake Chelan	40.69	122.6 (27.4)	205 (39)	0	1,777 (854)*
Shoreline Residential - Multi Family					
Lake Chelan	13.00	9.99 (7.15)	0	40 (28)	0
Shoreline Park/Public					
Lake Chelan	32.29	11.38 (10.13)	0	6 (4)*	0

Waterbody / Environment Designation	Acres in Total Shoreline Jurisdiction	Acres Outside of Setbacks in Study Area (Shoreline Jurisdiction)	Single Family Units in Study Area (Jurisdiction)	Multi-Family Units in Study Area (Jurisdiction)	Commercial Sq Ft in Study Area (Jurisdiction)
Chelan River	21.11	29.4 (15.2)	0	2.5 (2.5)*	0

* Despite land use analysis results, these uses are not permitted in the specified environment designation.

The effects of upland development are discussed in Section 6.1. On Lake Chelan, further development of overwater structures will likely accompany new residential development (both single-family and multi-family), and developments may seek to install shoreline stabilization. The potential effects of overwater structures and shoreline stabilization and likely effects of applicable SMP provisions are addressed in Sections 6.2 and 6.3. A more site-specific discussion of local impacts and the effects of provisions is provided below.

The proposed SMP includes provisions for the City of Chelan that require mitigation planting for any vegetation removal. This provision is expected to minimize the vegetative impacts of development, improve riparian vegetation functions, and improve shoreline wildlife habitat through the development of vegetated corridors.

The City's standard shoreline setback width in the High Intensity environment is 20 feet from the OHWM. Shoreline setbacks in the High Intensity environment are roughly consistent with existing development, in which setbacks range from 0 feet up to approximately 40 feet, and average approximately 25 feet.

In the Shoreline Residential - Single Family environment on Lake Chelan, the standard setback widths range depending on the designated shoreline tier (Tier 1 or 2). Most of the likely developable areas identified in the Shoreline Residential-Single Family environment falls within Tier 2, which has a standard setback of 25 feet. One large developable area is classified as Tier 1, with a 50-foot setback. Standard setbacks are 35 feet in the Shoreline Residential - Multi Family environment. Standard setback widths tend to be lower than the existing setbacks, which average approximately 65 feet in the two Shoreline Residential environments. In the case of the Shoreline Residential - Multi Family environment, most of the potential development (with the exception of approximately seven parcels) is physically separated from the shoreline by the

Shoreline Park/Public environment, so setback distances are less relevant. Both single-family and multi-family residential environments on the Chelan River have standard setback widths of 100 feet.

The City's SMP applies standard setbacks specific to each environment designation. A reduction of the standard setback widths may be approved in most areas if the applicant provides mitigation that results in a higher functioning setback than would be provided by a standard setback without enhancement, or if existing conditions prevent functional riparian conditions.

Although the setback requirements for development in the Shoreline Residential environment are lower than existing conditions, because of lake level fluctuation caused by dam operations, the actual distance between the lakeshore and development is much greater than the minimum setback width for the majority of the year when the water level is low. On the other hand, certain effects of development, such as the vegetation clearing and water quality impacts, are likely to occur year-round. The City's SMP provisions account for these functions by requiring water quality treatment and onsite infiltration or detention for new development. Together, the provisions for vegetation replacement, water quality treatment, and onsite infiltration for all new or redeveloped properties are expected to compensate for potential effects of smaller setback widths on the shorelines of Lake Chelan. Additional review of the effects of proposed setbacks is included in Appendices B and C.

As mentioned above, demand for new overwater structures and shoreline stabilization measures is expected to increase with new shoreline development. Replacement and repairs of existing overwater structures and shoreline stabilization measures are also likely. Because of water level fluctuations, direct impacts of overwater structures and shoreline stabilization in Lake Chelan are limited to the summer high water months. The proposed SMP provisions limit the impacts of overwater structures and boating facilities by establishing dimensional and design standards, requiring mitigation sequencing, requiring pumpout facilities at new marinas, and by restricting new subdivisions to joint-use piers. Shoreline stabilization impacts are avoided, minimized, and mitigated through mitigation sequencing, by prioritizing non-structural and soft shoreline stabilization options as an alternative to hard shoreline stabilization where feasible, by requiring a demonstration of need for shoreline stabilization, and by establishing mitigation standards.

Continued development of recreational and public access areas along the shorelines of the City presents potential increases in the intensity of land use in the City's public lands. Such changes could result in the removal of vegetation and increased impervious surfaces. The City's proposed SMP regulations require that public access shall avoid shoreline impacts and that any impacts

shall be mitigated. Furthermore, the proposed SMP requires the implementation of best management practices to limit water quality impacts from the use of pesticides or fertilizers that could be associated with the maintenance of public use sites.

Finally, implementation of the City's Shoreline Restoration is expected to restore shoreline areas.

7.2 Chelan UGA

The unincorporated Chelan UGA is expected to see minimal growth compared to the City limits, with an expected additional 41 single-family residential units in shoreline jurisdiction (Table 13). No commercial or industrial use is expected along Lake Chelan. No new development is anticipated along the Chelan River.

Similar to the City of Chelan, existing residential development on Lake Chelan is marked by mowed lawns, numerous private and shared-use piers and mooring buoys, and bulkheads. Where the road borders the lakeshore, the shoreline often lacks any upland vegetation. Undeveloped shoreline lands often occur on steeper slopes with only small shrubs. The County's existing buffer standards for the unincorporated Chelan UGA are the same as the proposed shoreline setbacks for the City of Chelan.

Table 13. Summary of waterbodies with likely residential, commercial, and industrial development in shoreline jurisdiction in the City of Chelan UGA.

Waterbody / Environment Designation	Acres in Total Shoreline Jurisdiction	Acres Outside of Setbacks in Study Area (Shoreline Jurisdiction)	Single Family Units in Study Area (Jurisdiction)
High Intensity			
Lake Chelan	22.78	44.9 (7.0)	103 (15)
Shoreline Residential - Single Family			
Lake Chelan	66.43	106.3 (38.6)	208 (79)
Chelan River	2.72	1.58 (1.58)	4 (4)

The proposed SMP includes provisions for the City of Chelan that minimize the removal of any vegetation and require mitigation through planting within the setback or in a vegetated corridor (2:1 replacement ratio for significant trees and

1:1 replacement ratio for all other vegetation). These provisions are expected to minimize the vegetative impacts of development, improve vegetated setback functions, and improve shoreline wildlife habitat through the development of vegetated corridors.

The proposed SMP also contains provisions requiring water quality treatment and onsite infiltration or detention for new development, which help address water quality issues typically associated with development along the shoreline.

Most of the developable land on the north side of Lake Chelan within the UGA is separated from the shoreline by a road. The road interferes with normal shoreline functions. The primary issue for those properties landward of the road is the control of stormwater runoff. Despite the physical separation, overwater structures are commonly associated with single-family residential development on the landward side of the road. SMP provisions requiring the minimization and mitigation for impacts of overwater structures will help prevent the degradation of shoreline functions.

8 Net Effect on Ecological Functions

The CIA indicates that future growth is likely to be targeted in specific waterbodies and environment designations in the City of Chelan, and these developments have the potential to impact specific shoreline functions. This analysis can help inform City officials of potential future shoreline impacts and the importance of specific proposed SMP provisions.

The proposed SMP, which includes the Shoreline Restoration Plan, is expected to protect and improve shorelines within the City and its UGA while accommodating the reasonably foreseeable future shoreline development. No net loss of shoreline ecological function will be achieved, and ecological functions may improve over time. Other local, state and federal regulations, acting in concert with this SMP, will provide further assurances of improved shoreline ecological functions over time.

As discussed above, major elements of the SMP that ensure no net loss of ecological functions fall into five general categories: 1) environment designations (SMP Chapter 3), 2) general policies and regulations (SMP Chapter 4), 3) shoreline use and modification provisions (SMP Chapter 5), 4) critical areas regulations (Appendix B of the SMP), and 5) Shoreline Restoration Plan.

Environment designations: The Shoreline Analysis Report provided the information necessary to assign environment designations by segment to each of the shoreline waterbodies (see **Chapter 3 of the SMP**). Shoreline uses and modifications were then individually determined to be either permitted (as substantial developments or conditional uses) or prohibited in each of those environment designations. The most uses and modifications are allowed in areas with the highest level of existing disturbance.

General provisions: **Chapters 4 and 6 of the SMP** contains a number of regulations that contribute to protection and restoration of ecological functions; these regulations pertain to shoreline critical areas, vegetation conservation and shoreline setbacks, flood hazard reduction, and water quality.

Shoreline modification and use provisions: **Chapters 5 and 6 of the SMP** addresses regulations specific to identified uses and modifications. Shoreline modification regulations emphasize minimization of size of structures, and use of designs that do not degrade and may even enhance shoreline functions. Use regulations prohibit uses that are incompatible with the existing land use and ecological conditions, and emphasize appropriate location and design of the various uses. These regulations also emphasize avoidance and minimization of ecological impacts via appropriate setbacks, protection and enhancement of vegetation, reduction of impervious surfaces and use of innovative designs such as LID techniques that do not degrade and may even enhance shoreline functions.

Shoreline Restoration Plan: The *Shoreline Restoration Plan* identifies a number of project-specific opportunities for restoration on both public and private properties inside and outside of shoreline jurisdiction, and also identifies ongoing County and City programs and activities, restoration partners, and recommended actions consistent with a variety of watershed-level efforts.

The following are some of the key features identified in the proposed SMP and this evaluation which protect and enhance shoreline ecological functions.

- Regulations focus development and growth in areas that are already developed or where functions are already degraded, while protecting those areas that are ecologically intact or otherwise sensitive to development pressures.

- Vegetation conservation areas and structural setbacks throughout the City are based on environment designation and existing conditions. Larger setbacks are required in areas with a higher need for protection of shoreline resources.

- SMP provisions require any projects with potential for significant adverse ecological effects to follow mitigation sequencing to avoid, minimize and mitigate any impacts.
- Planned restoration along the shorelines of WRIA 47 and the City will provide opportunities to restore shoreline ecological functions.
- Emphasis on achieving no net loss of shoreline ecological functions throughout shoreline jurisdiction.

Given the above provisions of the SMP, including the Shoreline Restoration Plan and the key features listed above, implementation of the proposed SMP is anticipated to achieve **no net loss of ecological functions in the shorelines of the City of Chelan.**

9 LONG-TERM MONITORING

City planning staff will track all land use and development activity, including exemptions, within its shoreline jurisdiction, and will incorporate actions and programs of other City departments as well. Reports will be assembled that provide basic project information, including location, permit type issued, project description, impacts, mitigation (if any), and monitoring outcomes as appropriate. Examples of data categories might include square feet of non-native vegetation removed, square feet of native vegetation planted or maintained, reductions in chemical usage to maintain turf, linear feet of eroding stream bank stabilized through plantings, linear feet of shoreline armoring removed, or changes to square footage of over-water cover.

The report would also recommend or describe relevant updates to City goals and implementation plans, and outline current and ongoing implementation of various programs and restoration actions (by the City or other groups) that relate to watershed health.

The staff reports will be assembled to coincide with Comprehensive Plan updates and will be used, in light of the goals and objectives of the Shoreline Master Program, to determine whether implementation of the SMP is meeting the basic goal of no net loss of ecological functions relative to the baseline condition established in the Shoreline Analysis Report. In the long term, the City should be able to demonstrate a net improvement in its shoreline environment.

Based on the results of these assessments, the City may make recommendations for changes to its SMP.

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APPENDIX A: LAND CAPACITY ANALYSIS

SHORELINE MASTER PROGRAM UPDATE: LAND CAPACITY ANALYSIS

Summary of Methodology
July 2011

BACKGROUND AND METHODOLOGY

The purpose of the shoreline land capacity analysis is to estimate development that may occur in the future along shorelines given draft shoreline use environments and development standards. The method to determine shoreline land capacity is summarized below.

- **Determine shoreline use boundaries.** The land capacity analysis includes all lands within the shoreline jurisdiction, generally 200 feet of the ordinary high water mark, associated wetlands, and the floodway. Additionally in two cases parcels partially included in jurisdiction and extending beyond are included:
    - Channel migration zone areas, since rivers may move over time; and
    - Shorelines of statewide significance, due to the importance of these waterbodies and the ecosystem wide processes emphasized in WAC 173-26-251.
- **Compile County and City land capacity analyses.** Based on adopted Comprehensive Plans and County and City planner input, assumptions about vacant, partially used, and under-utilized properties have been compiled.
- **Determine Land Status.** The analysis estimates developable acres by City, Urban Growth Area (UGA), and Watershed Inventory Analysis Area (WRIA). The developable acres are also sorted by waterbody, shoreline use environment, and future land use/zoning category. Developable acres include: 1) vacant (no building value); 2) partially used (e.g. single family properties containing one home but the land can be further subdivided); or 3) under-utilized (land value exceeds building value on multifamily, commercial or industrial properties).
- **Deductions.** Constraints such as critical areas, rights of way, and infrastructure are deducted from gross acres. Market factor reductions, which account for land that may not be available (e.g. owner does not wish to develop), are also included.
- **Densities or floor area ratios** are applied to the net buildable acres to estimate total future dwellings or commercial/industrial square feet.
- **Public and Mineral Lands.** Due to the different purposes for public lands/land trusts and mineral lands, typical assumptions regarding dwelling and commercial/industrial density were not applied. However, because these shoreline properties could be altered due to a variety of public purposes such as recreation, utilities, or resource extraction, acres estimates are provided for each WRIA and City/UGA, as appropriate.

The Table below provides a detailed matrix of assumptions. Maps are attached illustrating the categories of land status, including the three buildable categories as well as public and land trust properties. A spreadsheet is provided with the more detailed results.

It is important to note that this analysis is intended to give an overall picture of the potential for development along shorelines, but is not an exact predictor of which parcels may develop or redevelop. In addition, the analysis does not provide a “rate” of development.

Land Capacity Analysis Assumptions – Cumulative Impacts Assessment, June 20, 2011

No.	Step	Proposed Assumption	Chelan County Residential LCA	City of Cashmere Comp Plan LUE	City of Chelan Residential LCA	City of Entiat Residential LCA	City of Leavenworth Residential LCA	City of Wenatchee Comp Plan LUE
Geography/ Time Period			Date of land capacity analysis in current Comprehensive Plan					
1.	Base point in time	2011 (Use SMP Inventory Assessor data date as baseline)	Undated. Included in 2009 plan. New analysis in 2008 for Peshastin UGA.	2008	2009	2009	2003	2010 (land capacity similar to 2007)
2.	Study area boundaries	Shorelines of Statewide Significance or shorelines with CMZs: Parcels fully within or intersecting shoreline jurisdiction. Look at whole parcel – not just 200 foot jurisdictional area by water body (determined by WRIA, and cities/UGAs). Non-SSWS and non-CMZ: Shoreline jurisdiction only by water body (determined by WRIA, and cities/UGAs).	Unincorporated UGAs (Sunnyslope, Manson, Peshastin)	City and UGA	City and UGA	City and UGA	City and UGA	City and UGA
Gross Developable Land Inventory		Include private lands that meet criteria. Distinguish public/ public trust lands separately.						

No.	Step	Proposed Assumption	Chelan County Residential LCA	City of Cashmere Comp Plan LUE	City of Chelan Residential LCA	City of Entiat Residential LCA	City of Leavenworth Residential LCA	City of Wenatchee Comp Plan LUE
3.	Developable Land: Vacant, non-public	Assessor Building Value = $0; Remove lots less than 2,499 s.f. (In Leavenworth – retain lots less than 2,499 s.f. given development history of lot combinations.)	Vacant land and orchards Recommend: 2,499 instead of 2,500 to capture 25 x 100 cabin lots	Available land (not defined)	Vacant land and orchards	Vacant land and orchards	Vacant, non-governmental land Recommend: 10,000 or 20,000 s.f. (Note: for conservative estimate kept smaller screen. Can alter market factor if needed in Leavenworth.)	Vacant land in low density residential district, waterfront and Sunnyslope
4.	Developable Land: Partially Used, non-public	Single Family. Parcel is 2 times the minimum allowed by zoning. In City of Chelan – use 3x minimum lot size given some slope areas less than 40% that may be more difficult to develop. (Note: more conservative; may capture some ADU trend.)	Not addressed Recommend: method to account for ADUs	Available land (not defined)	Not addressed	Not addressed	Residentially used parcels greater than 1 acres Recommend: 2 times instead of 3.	Not addressed

No.	Step	Proposed Assumption	Chelan County Residential LCA	City of Cashmere Comp Plan LUE	City of Chelan Residential LCA	City of Entiat Residential LCA	City of Leavenworth Residential LCA	City of Wenatchee Comp Plan LUE
5.	Developable Land: Under-Utilized, non-public	Multifamily, commercial, industrial designated parcels occupied by single family uses. Also, multifamily, commercial, industrial parcels where the ratio of improvement value to land value is <1.0.	Not addressed	Available land (not defined)	Not addressed in supply (see below in deductions)	Not addressed in supply (see below in deductions)	Not addressed Recommend: removing small CC zone lots with 60% lot coverage. (Note: can remove CC zone property after #11 if needed)	Not addressed
6.	Public/Public Trust Lands	Code on maps as public and keep separate from vacant, partially utilized and underutilized land.	Not counted in LCA	Not counted in LCA	Not counted in LCA	Not counted in LCA	Not counted in LCA	Not counted in LCA
Deduct Critical Areas								
7.	Wetlands	Deduct actual wetlands acres using SMP inventory maps. Inventory map source: NWI.	Comp. Plan: Not deducted. Peshastin: Flat 5%.	Not deducted	Not deducted	Not deducted	Part of 15% flat deduction Recommend: deduct actual wetland acres	Not deducted
8.	Streams/lakes	Deduct streams and lakes based on ordinary high water mark using SMP inventory maps.	Comp. Plan: Lakes, rivers deducted Peshastin: Flat 5%.	Part of 12% flat deduction	Not deducted	Not deducted	Part of 15% flat deduction. Recommend: deduct based on OHW mark.	Not deducted

No.	Step	Proposed Assumption	Chelan County Residential LCA	City of Cashmere Comp Plan LUE	City of Chelan Residential LCA	City of Entiat Residential LCA	City of Leavenworth Residential LCA	City of Wenatchee Comp Plan LUE
9.	Steep Slopes/Soils	Deduct geo-hazards using SMP inventory maps (generally consists of landslides). Where slope information is complete use 40% slopes or greater.[1]	Comp. Plan: 40% slopes or greater deducted Peshastin: Flat 5%.	Part of 12% flat deduction	40% slopes or greater deducted	40% slopes or greater deducted (3% acres assumed to be steep slope in residential designations, and except 10% in the Mixed Tourist Recreational district)	Part of 15% flat deduction Recommend: Deduct using SMP inventory maps	Steep slopes (percent not identified)
10.	Floodplains	Deduct floodways.	Comp. Plan: Deduct floodways Peshastin: Flat 5%.	Part of 12% flat deduction	Not deducted	Not deducted	Part of 15% flat deduction Recommend: Deduct floodways	Not deducted
11.	Critical Area Buffers	Rural: Assume an average buffer of 125 feet for wetlands and 150 feet for Type F streams/lakes. UGAs: Assume average 75 feet for wetlands; 100 feet for Type F streams/lakes.	Not deducted Consider: Distinguishing larger wetlands. (Note: Due to limits of wetlands inventory data and variations in actual quality recommend continuing with average.)	Not deducted	Not deducted	Not deducted	Not deducted Recommend: Riparian buffers are 25' in current regulations. Assumed: Average buffers at left. Critical areas regulations likely to change in 2009.	Unclear

[1] In 2008 a digital elevation model with a 30m resolution was used; now, higher resolution topography data has become available (10m, possibly even higher) which would give us better vertical accuracy and would hopefully improve our results.

No.	Step	Proposed Assumption	Chelan County Residential LCA	City of Cashmere Comp Plan LUE	City of Chelan Residential LCA	City of Entiat Residential LCA	City of Leavenworth Residential LCA	City of Wenatchee Comp Plan LUE
12.	Shoreline Buffers	Deduct shoreline buffers per each use environment – see summary table. Use lowest administrative buffer to achieve more conservative development potential. [Note this does not mean in practice that all applicants will request or receive the lowest buffer. It is a conservative assumption for the CIA analysis.]	See left	See left	See left	See left	See left	See left.
13.	SWSS and CMZ: Determine developable acres by planned land use category	For portion of parcels outside shoreline jurisdiction: Sum acres by category (public, vacant, partially used, and underutilized with critical area deductions) by planned land use category by WRIA, city, and UGA by waterbody. Use each jurisdiction's planned land use categories.	Adopted land use categories in Comprehensive Plan					
14.	All Shorelines	Shoreline Jurisdiction: Sum categorized acres (public, vacant, partially used, and underutilized with critical area deductions) by WRIA,	Adopted land use categories in Comprehensive Plan					

No.	Step	Proposed Assumption	Chelan County Residential LCA	City of Cashmere Comp Plan LUE	City of Chelan Residential LCA	City of Entiat Residential LCA	City of Leavenworth Residential LCA	City of Wenatchee Comp Plan LUE
		city, and UGA by Shoreline Use Environment by waterbody and by underlying planned land use category.[2]						
Deduct Future Infrastructure and Public Uses								
15.	Rights of Way and Other Development Requirements	Percentage reduction; vary by community.	Comp. Plan: 15% Peshastin: 30% Recommend: 20%	20% for future roads and utilities	15%	25% for future roads and utilities	20% for future roads and utilities Recommend: 5%	Unclear Assumed: 5% based on city input to recognize waterfront plan
16.	Schools, police/fire stations, water, sewer, recreation/ open space, and similar.	Percentage reduction based on lands for public purposes. Vary by community.	Comp. Plan: 7% Peshastin: 0% (see above) Recommend: 0% (combine with above)	Part of roads/utilities	7%	10%	Part of roads/utilities Recommend: 0% if deducting public lands (Note: can remove from consideration after Step 11 if needed)	Unclear Assumed: 0% based on city input to recognize waterfront plan

[2] In Entiat, tabulated results will focus on residential land; the CIA will insert data from Entiat on future growth on waterfront plan lands and city parks separately.

No.	Step	Proposed Assumption	Chelan County Residential LCA	City of Cashmere Comp Plan LUE	City of Chelan Residential LCA	City of Entiat Residential LCA	City of Leavenworth Residential LCA	City of Wenatchee Comp Plan LUE
Market Factor Deduction								
17.	Vacant lands	Vary by community.	Comp. Plan: 25% market factor and 15% for lands unavailable. Peshastin Sub-area: 20% flat market factor. Also assumed 40% of vacant would not develop. Recommend 20-25% Assumed: 20%	Comp. Plan: 15% Recommend: 25% due to water supply	25% (market/safety factor)	25%	15% Use GIS data	Comp. Plan: 25% Recommended: 5 or 10% Assumed: 5% based on city input to recognize waterfront plan
18.	Partially Used and Under-Utilized	UGAs: Use Plan assumption for each community, or where not included, 25% for land not likely to develop in next 20 years. Rural: 50% Agriculture and forestry lands treated as partially used/under-utilized	Comp. Plan: Not addressed Peshastin: Agricultural lands 25%	Comp. Plan: Not addressed Recommend: 25% due to water supply	30% - single family 20% multifamily 50% Tourist Accommodations and Special Use District (Unavailable/ Underutilized Land factor – percent not used for residential purposes)	Use 25% - other standards in Comp Plan not relevant for shoreline designations	Not addressed 25%	Unclear Assumed: 10% - based on city input to recognize waterfront plan

No.	Step	Proposed Assumption	Chelan County Residential LCA	City of Cashmere Comp Plan LUE	City of Chelan Residential LCA	City of Entiat Residential LCA	City of Leavenworth Residential LCA	City of Wenatchee Comp Plan LUE
Determine Population Capacity								
19.	Mixed Use Development Share	Vary by local plan. If not addressed, assume 50/50 share of development will be residential or commercial.	Comp. Plan: Not addressed Peshastin: Assume 10% of commercial or mixed use will include residential dwellings.	Not addressed	See underutilized/ unavailable factor	See underutilized/ unavailable factor	Not addressed 50/50	Comp. Plan: Unclear Waterfront Plan: Use economic study. Assumed 85%/15% residential/ commercial split based on report.
20.	Determine Total Dwelling Units Capacity By Zone	Multiply net acres of developable land in each zone by assumed density of each zone to determine total dwelling units of capacity. Subtract existing dwelling units.	Comp. Plan: Unincorporated UGAs 4 units per acre Peshastin: LDR 4, MDR 8; HDR 16 Proposed: Urban per above. Rural areas – base on zoning.	Single Family 6 units/acre Suburban Residential Average 3/acre Multi Family 15 units/acre	Single Family 3 du/ac Multi-family 9 du/ac Tourist Accommodatio ns 3 du/ac Special Use District 3 du/ac	Residential Low Density: Up to 4 units per acre (most relevant for shoreline) Residential Medium Density: Up to 10 units per acre Mixed Tourist Recreational: Up to 4 units per acre Current analysis: Assuming 25% unbuildable and 15 du/ac for Residential High Density	Goal is average 4.6 du/ac and average lot size of 9,400 s.f.	Comp Plan: 6.22 housing units (h.u.) per net acre from the low-density residential district Proposed: Waterfront Plan and Comprehensive Plan.

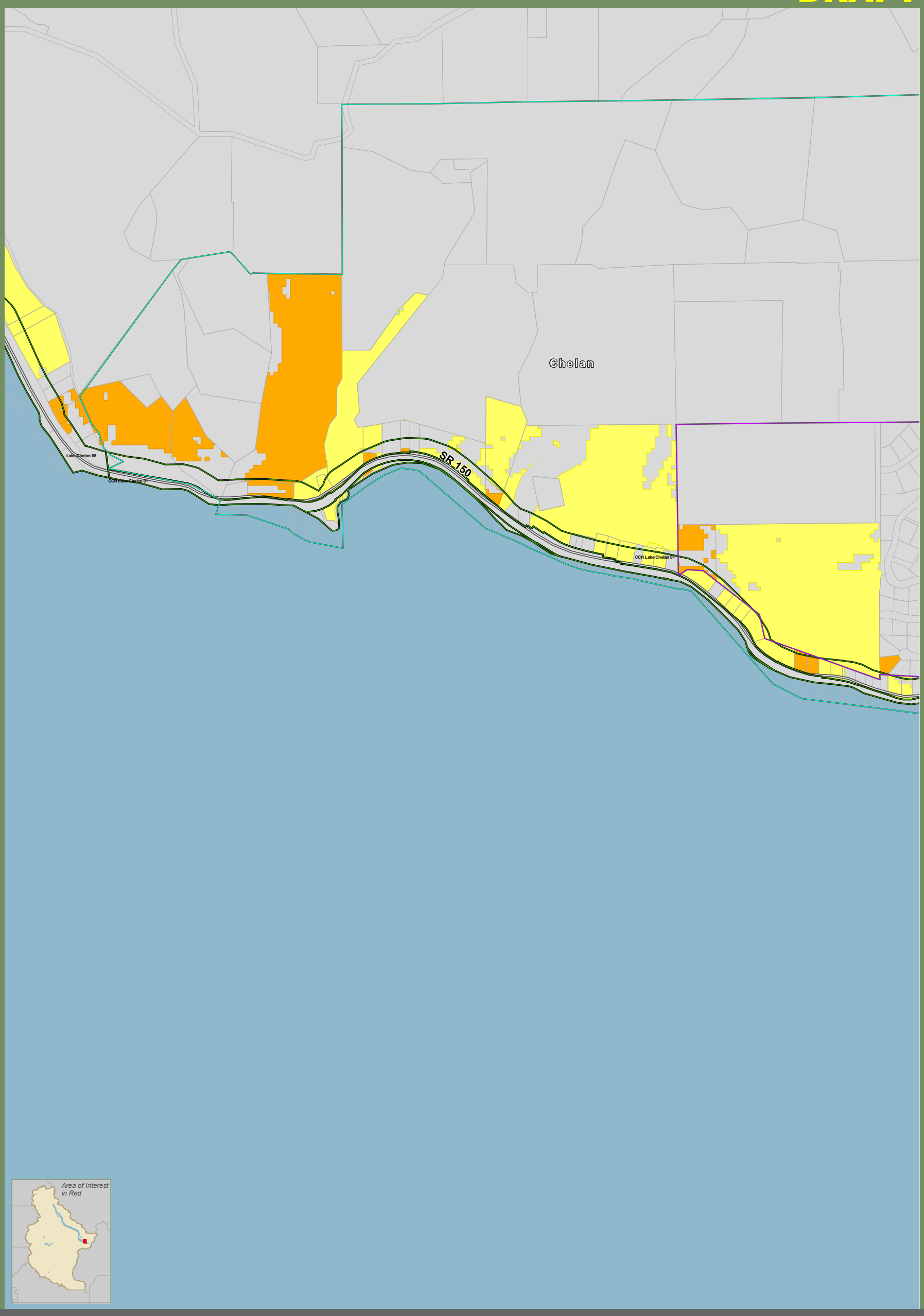
No.	Step	Proposed Assumption	Chelan County Residential LCA	City of Cashmere Comp Plan LUE	City of Chelan Residential LCA	City of Entiat Residential LCA	City of Leavenworth Residential LCA	City of Wenatchee Comp Plan LUE
Determine Employment Capacity								
21.	Determine Total Square Footage Capacity By Zone	Vary by community if there is information. Otherwise, multiply net acres of commercial and industrial developable land by the assumed floor area ratio. Commercial = FAR of 0.25 Industrial = FAR of 0.4 Subtract existing building square footage on partially used and under-utilized land.	No employment land capacity conducted Recommended: Review Transportation Plan assumptions for commercial and industrial growth	No employment land capacity conducted	No employment land capacity conducted	No employment land capacity conducted	No employment land capacity conducted	Comp. Plan: No employment land capacity conducted Waterfront Plan: Market demand prepared. Used proposed assumption due to lack of FAR information.

LAND CAPACITY MAPS

Vacant, Under-utilized, Partially Used, and Public/Land Trust Properties Excluding Shoreline and Critical Area Buffers

County Assessor Data 2011

July 2011



Vacant, Partially Used, and Underutilized Parcels

Chelan 01

Chelan County Shoreline Master Program

THE WATERSHED COMPANY

0 250 500
Feet
1 inch = 800 feet

June 2011
Data: WA DOE, WA OFM, USGS, TNC, Chelan County

LCA Categories

- Vacant
- Partially Used
- Under-Utilized
- Public or Land Trust
- Environment Designations

- Lakes
- Highways
- Parcels
- City Boundaries
- UGA Boundaries

Shoreline jurisdiction boundaries depicted on this map are approximate. They have not been formally delineated or surveyed and are intended for planning purposes only. Additional site-specific evaluation may be needed to confirm/verify information shown on this map.

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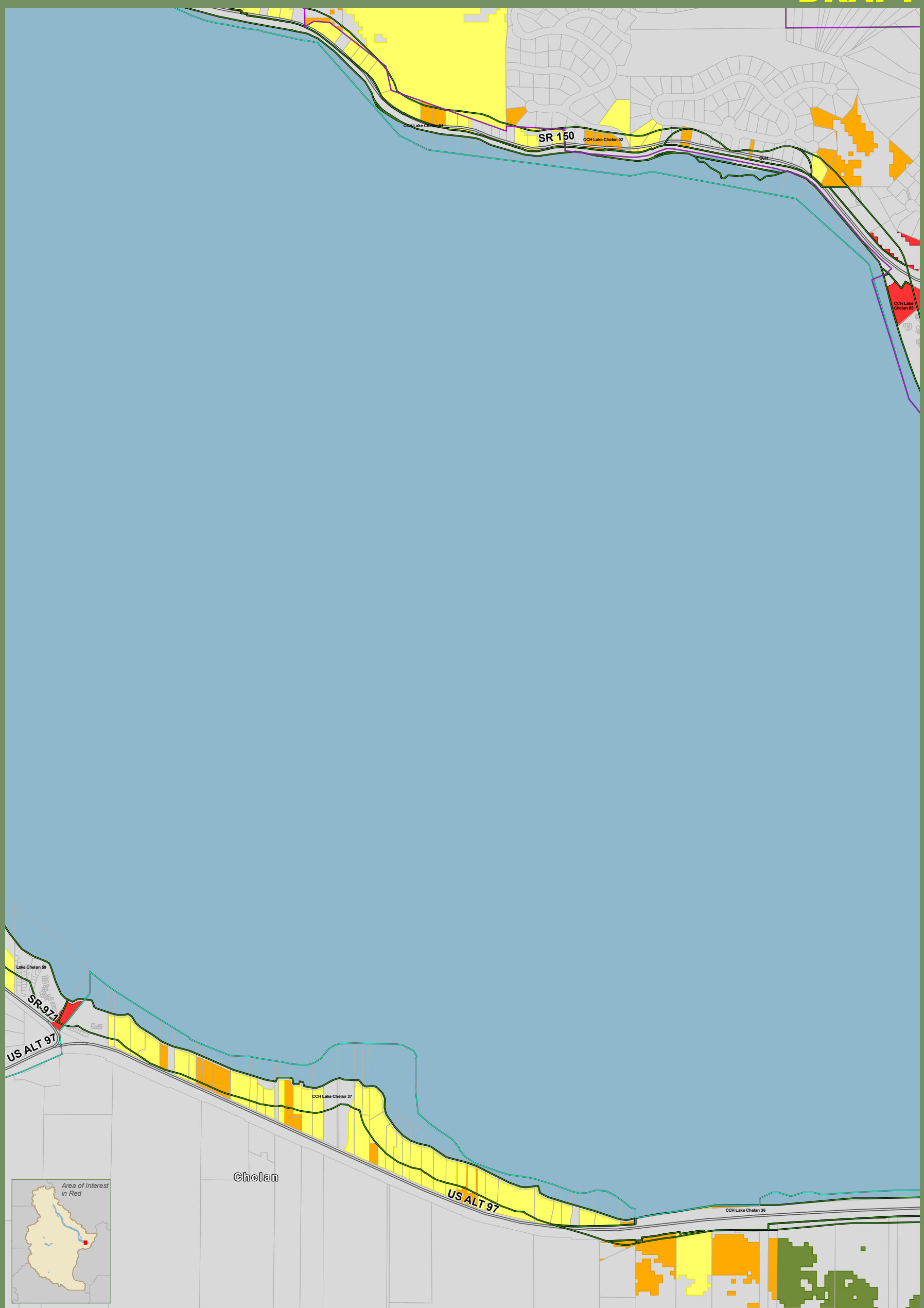

Vacant, Partially Used, and Underutilized Parcels

Chelan 02

Chelan County Shoreline Master Program

THE WATERSHED COMPANY

0 250 500
Feet
1 inch = 800 feet

June 2011
Data: WA DOE, WA OFM, USGS, TNC, Chelan County

LCA Categories

- Vacant
- Partially Used
- Under-Utilized
- Public or Land Trust
- Environment Designations

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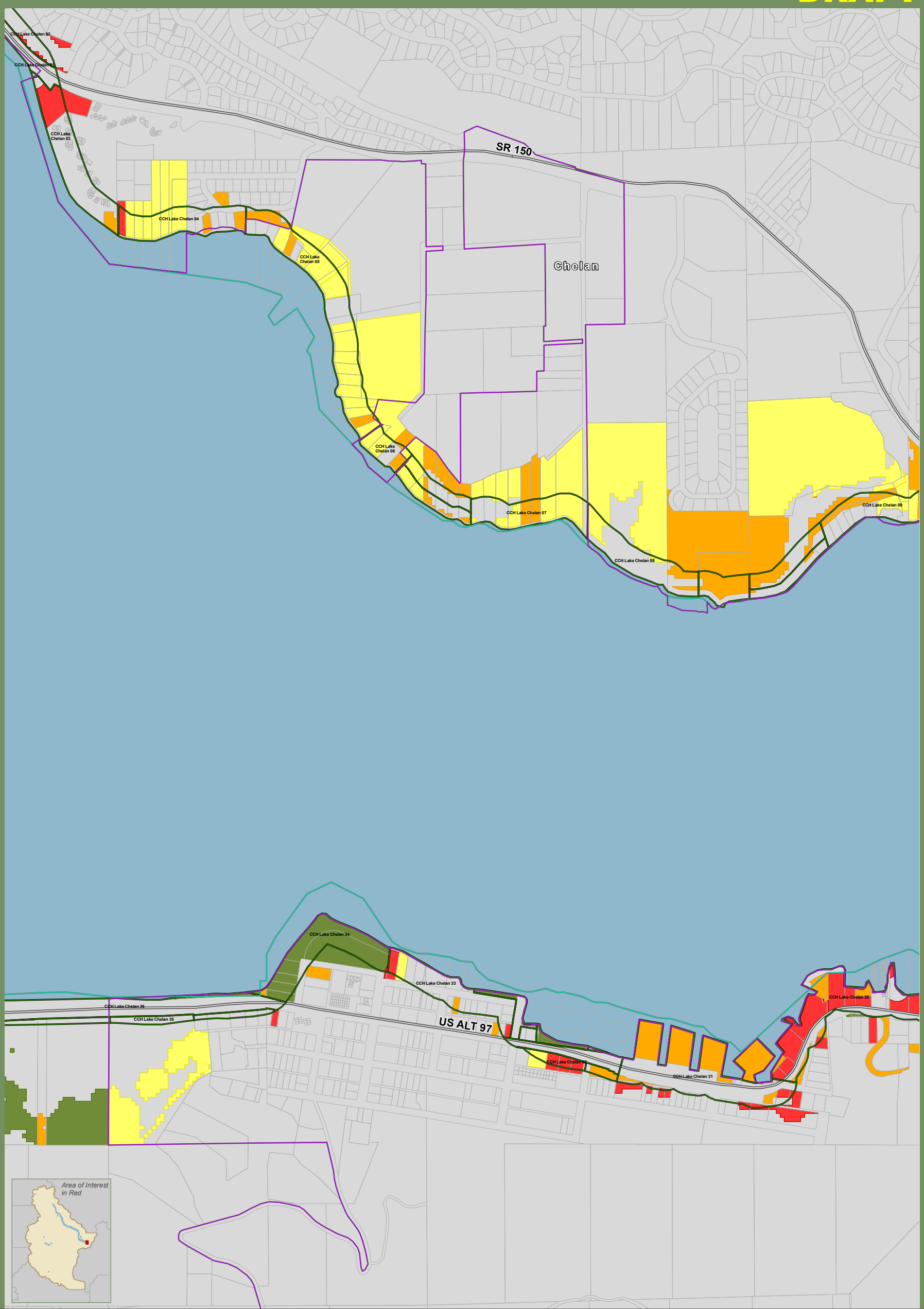

Vacant, Partially Used, and Underutilized Parcels

Chelan 03

Chelan County Shoreline Master Program

The Watershed Company

0 250 500
Feet
1 inch = 800 feet

June 2011
Data: WA DOE, WA OFM, USGS, TNC, Chelan County

LCA Categories

- Vacant
- Partially Used
- Under-Utilized
- Public or Land Trust
- Environment Designations

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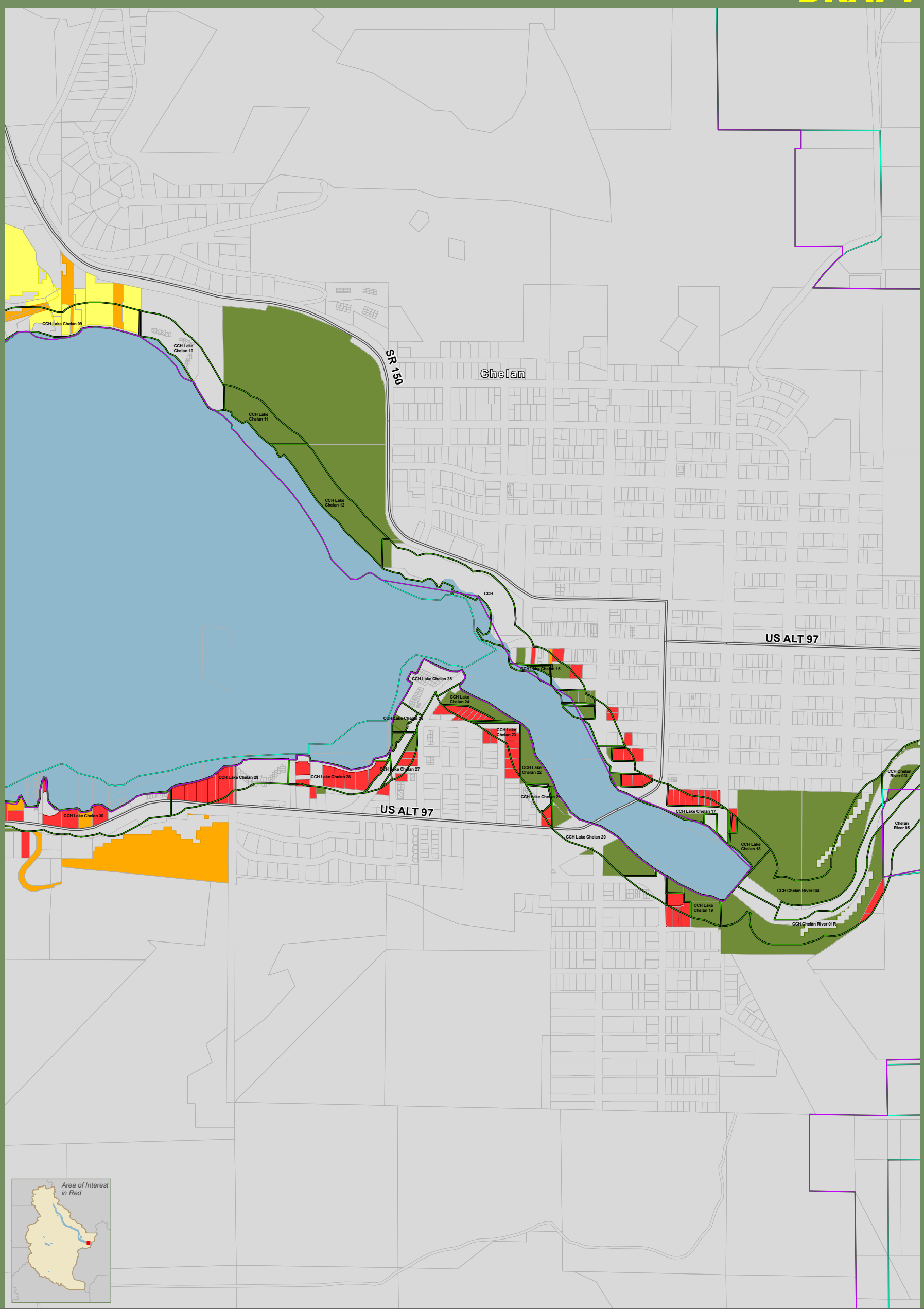

Vacant, Partially Used, and Underutilized Parcels

Chelan 04

Chelan County Shoreline Master Program

THE WATERSHED COMPANY

0 250 500
Feet
1 inch = 800 feet

June 2011
Data: WA DOE, WA OFM, USGS, TNC, Chelan County

LCA Categories

- Vacant
- Partially Used
- Under-Utilized
- Public or Land Trust
- Environment Designations

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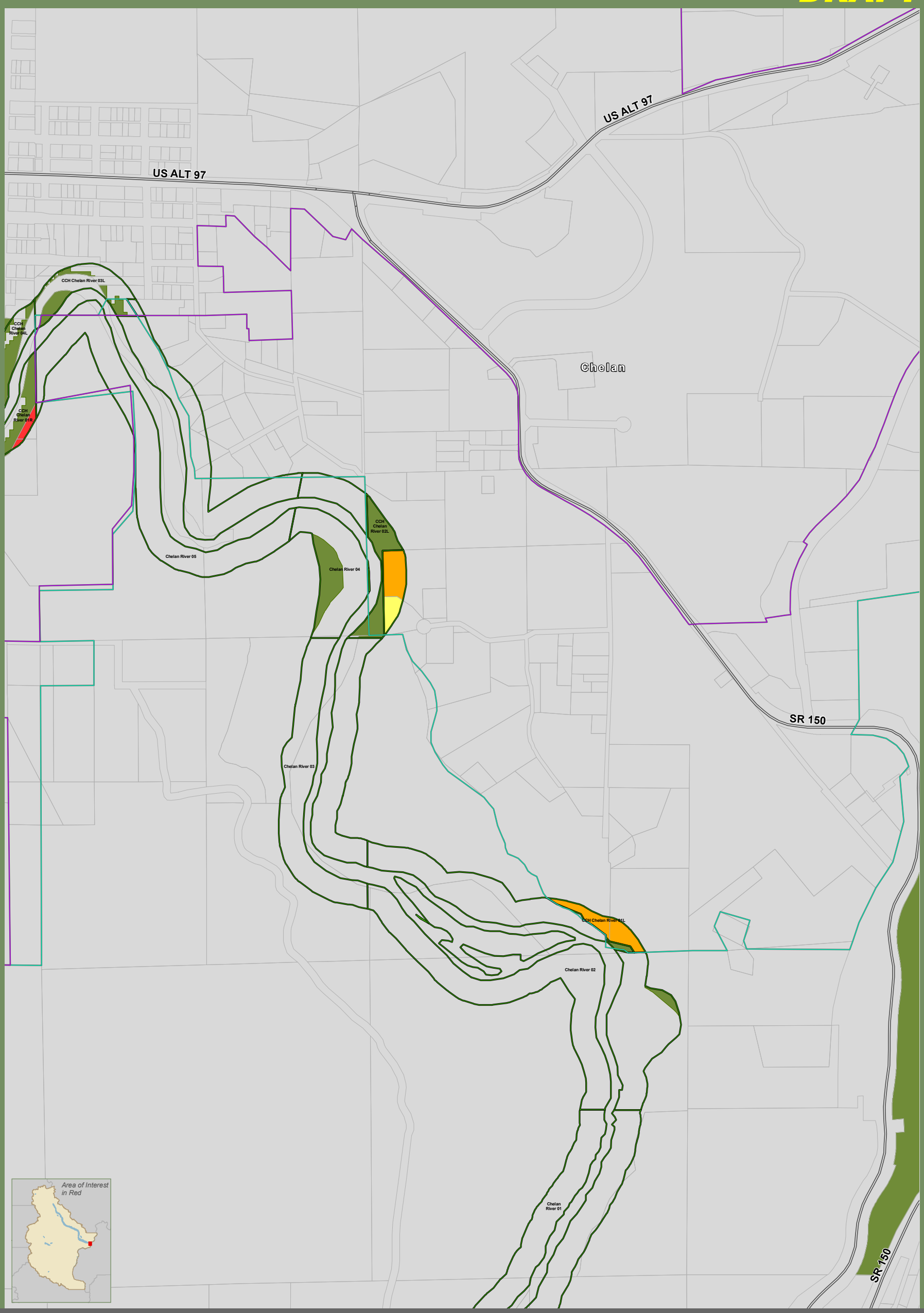

Vacant, Partially Used, and Underutilized Parcels

Chelan 06

Chelan County Shoreline Master Program

The Watershed Company

0 250 500
Feet
1 inch = 800 feet

June 2011
Data: WA DOE, WA OFM, USGS, TNC, Chelan County

LCA Categories

- Vacant
- Partially Used
- Under-Utilized
- Public or Land Trust
- Environment Designations

- Lakes
- Highways
- Parcels
- City Boundaries
- UGA Boundaries

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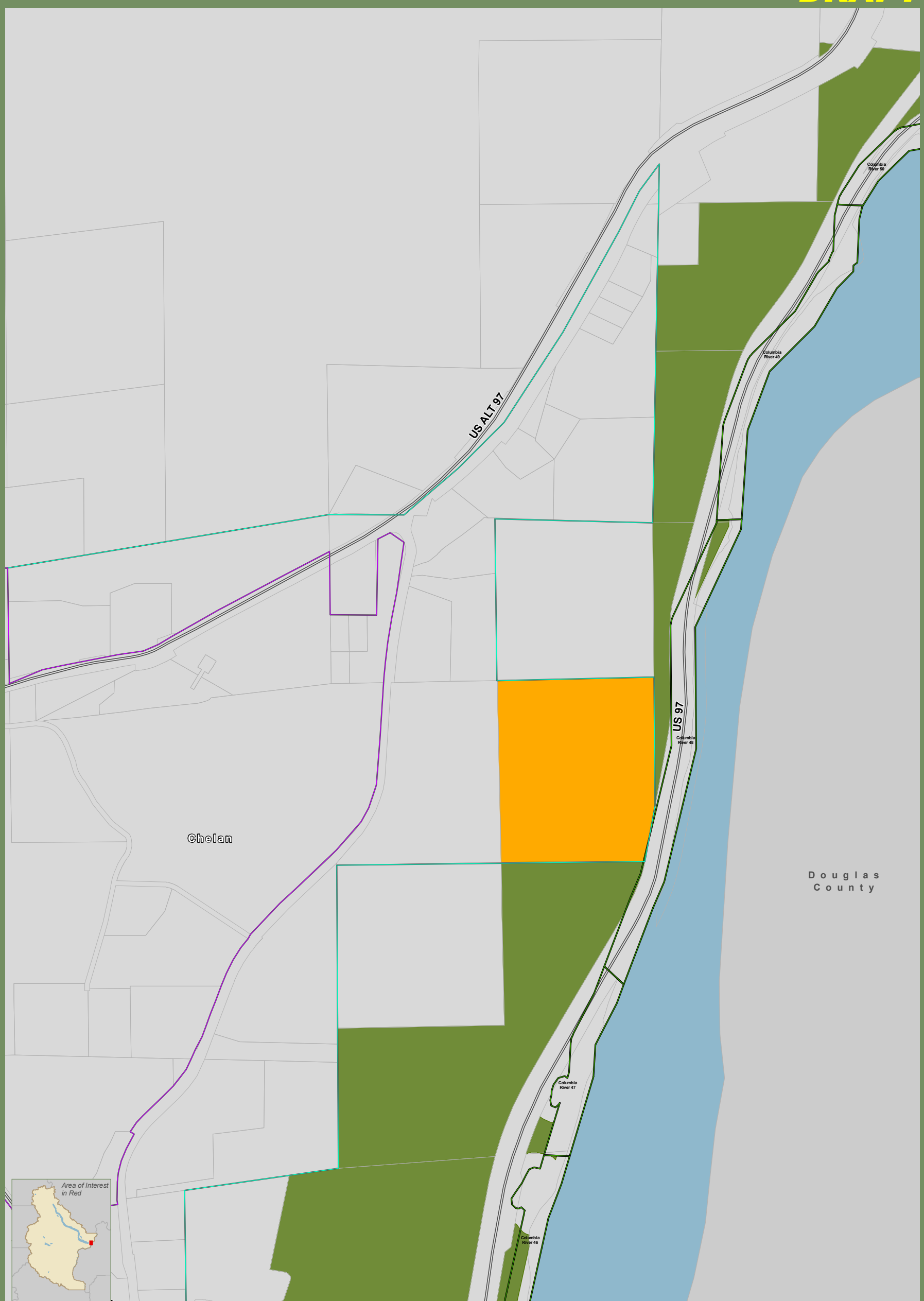

Vacant, Partially Used, and Underutilized Parcels

Chelan 05

Chelan County Shoreline Master Program

THE WATERSHED COMPANY

0 250 500
Feet
1 inch = 800 feet

June 2011
Data: WA DOE, WA OFM, USGS, TNC, Chelan County

LCA Categories

- Vacant
- Partially Used
- Under-Utilized
- Public or Land Trust
- Environment Designations

- Lakes
- Highways
- Parcels
- City Boundaries
- UGA Boundaries

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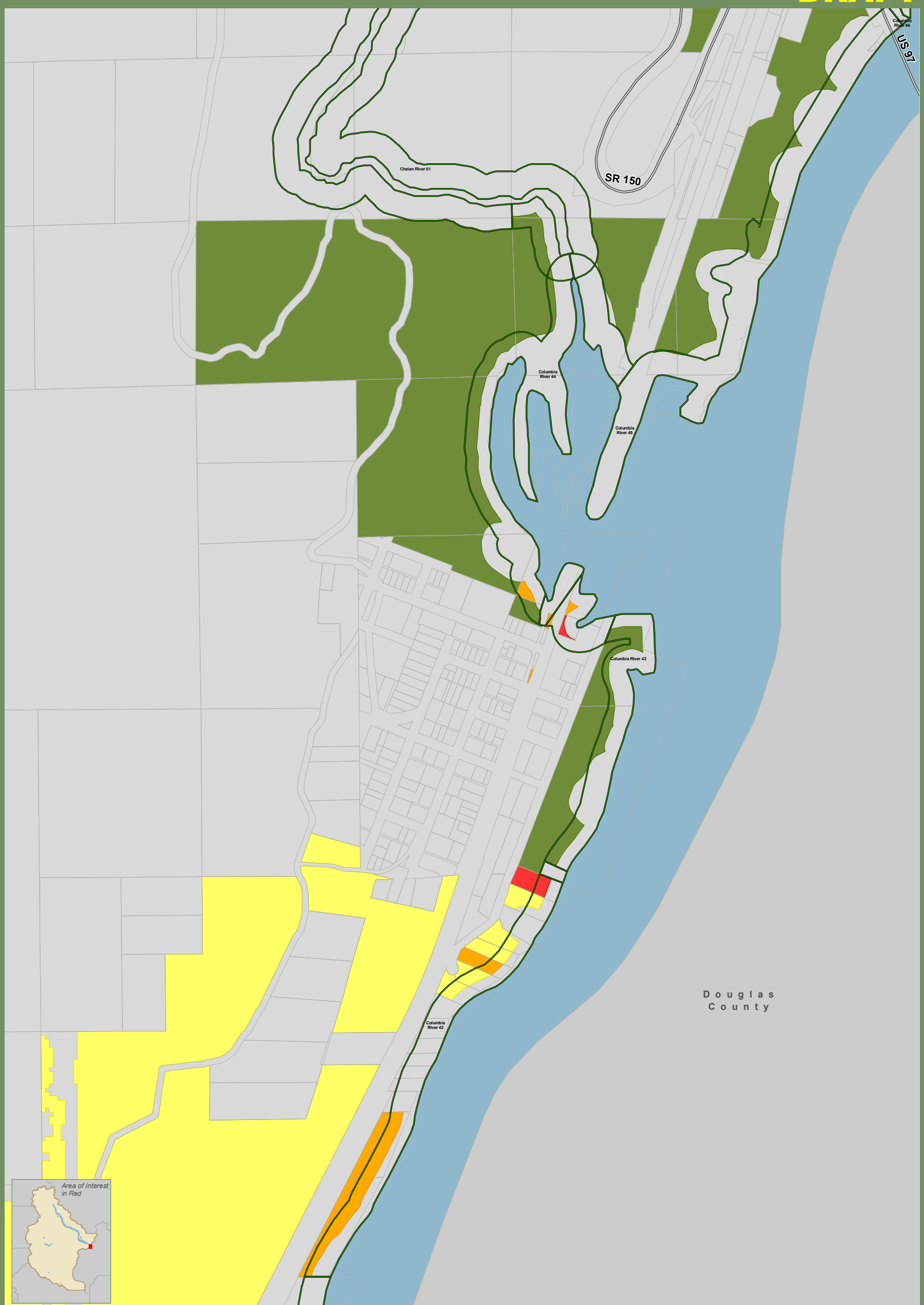

Vacant, Partially Used, and Underutilized Parcels

Chelan 07

Chelan County Shoreline Master Program

The Watershed Company

0 250 500
Feet
1 inch = 800 feet

June 2011
Data: WA DOE, WA OFM, USGS, TNC, Chelan County

LCA Categories

- Vacant
- Partially Used
- Under-Utilized
- Public or Land Trust
- Environment Designations

- Lakes
- Highways
- Parcels
- City Boundaries
- UGA Boundaries

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APPENDIX B: 2012 BUFFER REPORT

City of Chelan Shoreline Master Program: Buffer Science

October 2012

Introduction

The purpose of this document is to:

- Summarize current conditions for the Lake Chelan shoreline
- Discuss the ecological functions to be protected by shoreline regulations such as shoreline buffers, vegetation conservation, and other environmental regulations
- Present excerpts of SMP Guidelines and the SMP Handbook in terms of the issues weighed in setting appropriate buffers

Under separate cover we have also provided an outline of correspondence between the Consultant team and Ecology staff showing the coordination and collaboration that has occurred to date, and a key piece of correspondence that summarized the majority of that collaborative effort.

City of Chelan Shoreline Conditions

The City of Chelan is located in an arid area receiving less than 15 inches of rain annually, much of it likely falling as snow during the winter months. In the City and much of the Urban Growth Area (UGA), lakeshore properties are either developed or in many cases have been altered in preparation for development or associated with adjacent development. A significant number of properties already have an overwater structure, and even more properties have armored shorelines. Existing primary structure setbacks for single-family development range widely, from minimums of 6 and 8 feet from the Ordinary High Water Mark (OHWM) to maximums of 100-200 feet from the OHWM. Approximately one-quarter of the sampled properties (n=57) have primary structure setbacks of less than 25 feet, another quarter have setbacks between 25 and 50 feet. However, these numbers are misleading as the level of alteration is very high between the shoreline and the primary structure. The setback area typically includes primarily lawn and other hardscape, such as pools, large patios and other impervious surfaces, a number of which are parallel and adjacent to the shoreline edge. Non-native trees and shrubs are also found on some properties, although many have nothing but lawn except for shrubs and fences marking property lines.

Primary structure setback numbers from the high lake level are also misleading as lake level management has resulted in seasonal variation of the water's edge (see Exhibit 1 below, from http://www.chelanpud.org/lake-chelan-lake-levels.cfm, and Exhibit 2 showing images from Google Earth during the spring low water period). The information illustrates that in the winter months, when potential stormwater impacts are greatest, the water level drops to a distance of 40 feet in some of the steeper shoreline areas, but more commonly 80 to 150 feet, and in some cases is ~1,000+ feet waterward of the high lake level. Yet it is at the high lake level where armoring and the limit of upland

development are found. Overwater structures are often completely in the dry during 6-9 months of the year, with only the larger public, community or commercial structures extending partially waterward of the low lake elevation.

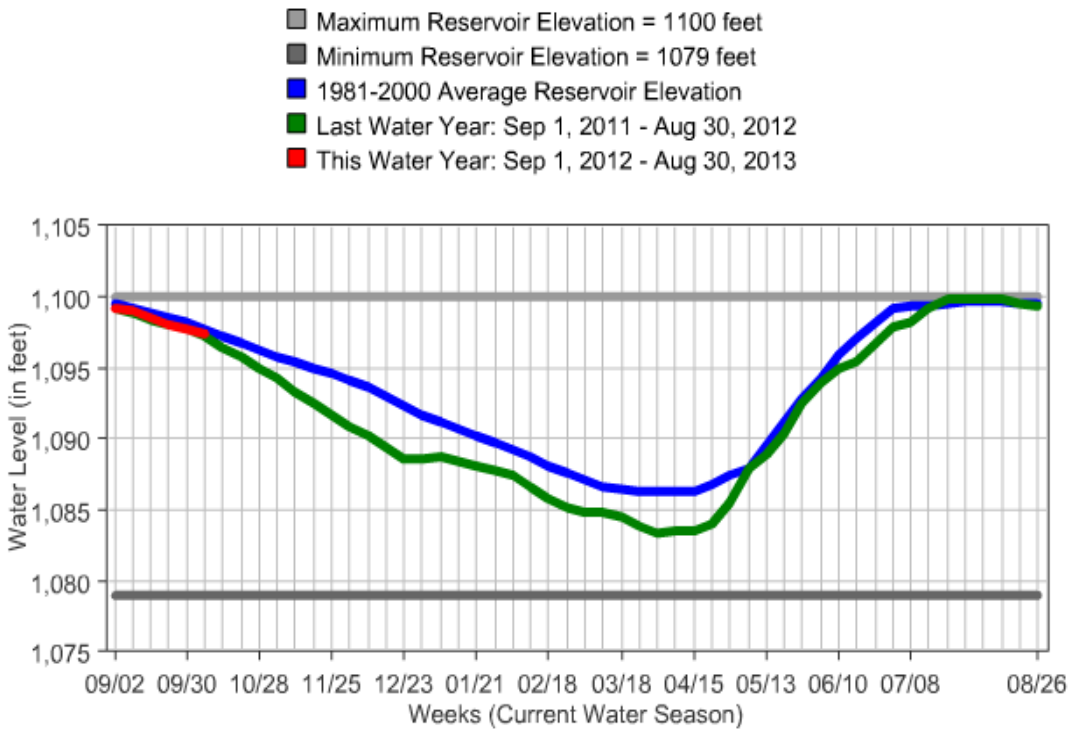

Exhibit 1. Lake Chelan Seasonal Lake Level

Exhibit 2A. Illustration of Lakefront Lots and Distance of Homes and Docks to Low Lake Water– Spaders Bay

Exhibit 2B: Illustration of distance of Shoreline Lots and Associated Docks to Low Water Level

Source: Images from Google Earth, April 2006

The lake is known for its generally clean and clear waters, a result of the ultra-oligotrophic (low nutrient) conditions. Total Maximum Daily Loads (TMDLs) have been developed by the Department of Ecology for DDT/PCBs and for total phosphorus. The lake is also a popular recreation destination because of its climate and waters. The Chelan Public Utility District (PUD) manages the lake level through its FERC license, maintaining a full pool (1,098 – 1,100 feet above mean sea level) from July through early September and for other months between May and October managing lake level so that it does not go below a certain minimum level necessary for lake recreation unless necessary to accomplish higher-priority purposes (such as maintenance of Chelan River flows for fish, flood hazard reduction, etc). How far down the lake is drawn each year is determined by the PUD based on their predicted inflow from rain and snowmelt.

With the exception of a common loon heritage point and a number of fish species (e.g., pygmy whitefish, rainbow trout, kokanee and Chinook salmon, and westslope cutthroat trout), no other Washington Department of Fish and Wildlife-designated Priority habitats or species are mapped in the City's lake shoreline jurisdiction. Wetlands are also not mapped in the City's lake shoreline jurisdiction. On Lake Chelan, mapped geologically hazardous areas in the City's shoreline jurisdiction coincide with those currently undeveloped properties on the northshore that still retain some native shrub-steppe vegetation, lack overwater structures, and appear to lack armoring.

Potential Ecological Functions Served by Shoreline Buffers

In theory, shoreline buffers can provide for a variety of water quality and habitat functions:

- Temperature control and microclimate maintenance
- Large woody debris
- Sediment filtration
- Pollution filtration
- Erosion control

- Wildlife habitat

Many of the potential functions of shoreline vegetation have little to no application in the City of Chelan, including those related to temperature control and provision of large woody debris. Other potential functions have very reduced opportunity to perform because of the management of the lake level by the PUD, which places the water's edge 10s to 100s of feet landward of the summer high water mark for 6-9 months of the year. The existing developed and armored condition of most of the City and the naturally rocky/steep sloped condition of the few remaining undeveloped areas limits the actual and potential value of any vegetation, particularly for wildlife or as a source of organic lake inputs.

Buffer functions related to water quality, however, do have some application regarding Lake Chelan. Lake Chelan listed water quality parameters are DDT/PCBs (managed under one TMDL) and phosphorus (managed under a separate TMDL[1]). The phosphorus listed is caused by septic systems and agriculture (primarily orchards), conditions generally not found in the City of Chelan's shoreline jurisdiction. However, DDT/PCBs are likely widespread in the basin, and disturbance of upland soils can mobilize the DDT (http://www.ecy.wa.gov/programs/wq/tmdl/LkChelanTMDLSummary.html).

WDFW recommends a range of riparian buffer widths shown in Table 1. However, according to WDFW's "Management recommendations for Washington's priority habitats: riparian" (Knutson and Knaef 1997), the recommended widths "only apply to riparian areas associated with streams and rivers" and are based on literature applicable primarily to forested parts of Washington State, primarily Western Washington forest types. Only one of the sources referenced that identified specific buffer widths was based on Eastern Washington forests, and none of the sources addressed recommended buffer widths for arid, non-forested Eastern Washington environments. More discussion of sediment filtration, pollution filtration, and erosion control, the primary buffer functions potentially applicable in the City's Lake Chelan shoreline jurisdiction, is found below the table.

Table 1. Washington State Department of Fish and Wildlife Buffer Ranges and Relevance in Lake Chelan Shoreline

Riparian habitat function	Range of reported widths in meters (feet)	Average of reported widths in meters (feet)	Relevant in the City of Chelan Lake Chelan shoreline jurisdiction?
Temperature control	11-46 (35-151)	27 (90)	No- not consistent with existing conditions
Large woody debris	30-61 (100-200)	45 (147)	No- not consistent with existing conditions
Sediment filtration	8-91 (26-300)	42 (138)	Yes – see below
Pollution filtration	4-183 (13-600)	24 (78)	Yes – see below
Erosion control	30-38 (100-125)	34 (112)	Yes – see below
Microclimate maintenance	61-160 (200-525)	126 (412)	No- not consistent with existing conditions
Wildlife habitat	8-300 (25-984)	88 (287)	No- not consistent with existing conditions

Source: First three columns from http://wdfw.wa.gov/publications/00029/wdfw00029.pdf

[1] A Total Maximum Daily Load, or TMDL, is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards.

Summary of Existing and Proposed Buffers and other Environmental Protection Features

Residential setbacks required under the City of Chelan's existing SMP "shall be identical to the rear yard setback required by the applicable zoning ordinance (as measured from the ordinary high water line); except where the average slope of the 50' portion of the lot abutting the water exceeds 100% and bedrock is exposed at the surface, the minimum setback may be reduced to zero." According to City of Chelan Code 17.20.040, the required rear yard setback is 20 feet in the R-1 Single Family Residential zone. In the Multi-Family Residential zone, the rear yard setback is 20 feet plus 1 foot for each 2 feet by which the building exceeds 30 feet in height. A common line setback is not incorporated in the existing City of Chelan SMP.

The proposed buffers are shown in Table 2 below. Except for park uses in the Shoreline Park/Public environment, each designation has been assigned a numeric standard buffer and a potential reduced buffer that can be achieved administratively through use of a number of mitigation options (e.g. improve ecological functions of the site through supplemental vegetation plantings between the development and the OHWM, improvement of any existing shoreline stabilization, etc.). The proposed buffer reduction options are intended to promote the addition of native vegetation and shoreline softening that leads to water quality and erosion protection while allowing for redevelopment in an urban environment. In the absence of the reduced buffer options, shoreline enhancement may be more difficult to attain.

Table 2. Shoreline Buffers by Environment Designation for the City of Chelan.

Environment Designation[1]	Standard Buffer	Reduced Buffer
Shoreline Park/Public		
Existing and proposed parks	Not applicable. See regulations in Section 4.5.2.D.5	
Other public lands	100'	50'
Shoreline Residential – Single Family – Lake Chelan[2]	Tier 1: 100' Tier 2: 50' Tier 3: 25'	Tier 1: 50' Tier 2: 25' Tier 3: 20'
Shoreline Residential – Multi-Family – Lake Chelan	35'	25'
Shoreline Residential – Single Family and Multi-Family – Chelan River	100'	50'
High Intensity	20'	10'

1 When environment designations are parallel, the buffer of the waterward environment extends only to the upland edge of that environment. The buffer for the landward environment would apply to uses and modifications in that upland environment. See 1-3 below for criteria guiding buffer reductions.

2 A buffer tier has been assigned to all waterfront parcels located in the Shoreline Residential – SF environment designation as shown on the map in Appendix F based on their existing conditions. Subdivisions of Tier 3 parcels take the Tier of the parent parcel. Subdivisions of Tier 1 parcels may be either Tier 1, Tier 2 or Tier 3 as outlined in Section 4.5.2.D.10.

Source: Integrated Draft, Shoreline Master Program, for the City of Chelan

The High Intensity buffer of 20 feet reflects the existing condition, which shows that half of sampled properties are set back 20 feet or less from the OHWM. Many of the uses in this environment are water-dependent or water-related, and will be required to provide public access and/or restoration through other provisions of the SMP. The Shoreline Residential-Multi-Family buffer of 35 feet is likewise based on the existing built condition. The Chelan River environments results in a proposed buffer of 100 feet.

The Shoreline Residential –Single Family-Lake Chelan environment includes a proposal for tiered buffers to reflect the distinct characters of developed (generally Tier 3) and undeveloped (generally Tier 1) lands in the City and its UGA that contain or are planned for residential development.

It should be noted that shoreline buffers are not the only environmental protection measures that can address shoreline functions of concern. The proposed SMP contains a suite of regulations that protect existing vegetation, particularly native vegetation and trees, in Vegetation Conservation and Shoreline Buffers (Section 4.5). The proposed SMP addresses soil erosion through the general Water Quality section (Section 4.6), and also in provisions of Vegetation Conservation and Shoreline Buffers (Section 4.5) which require retention of stormwater runoff onsite. The SMP also discourages use of chemical treatment of landscaping, and requires that any application of chemicals must be in strict conformance to the manufacturer's instructions.

Sediment Filtration

Riparian zones stabilize banks, slow and filter overland flow, and store sediment that is released into waterbodies gradually, mimicking natural rates of movement across the landscapes. Fine sediment is generally transported through stormwater runoff events in winter months, which corresponds with the time when levels in Lake Chelan are managed to be the lowest and the effective setback widths are the greatest (60-1,000+ feet). The effectiveness of sediment filtration by a riparian zone depends on riparian zone density and composition, overland flow volume, hillslope, width of the protected zone, and sediment particle size (Osborne and Kovacic 1993). Long-term studies indicate that a 98-foot-wide riparian zone may be needed to maintain sediment retention capacity over multiple years and a riparian zone closer to 300 feet would ensure effective retention of fine sediments.

The proposed shoreline buffers fall within the lower range of buffers in Table 1 for sediment filtration, but buffer widths are not the only protective measure for sediment filtration functions. Significant erosion can be minimized by limiting exposed soils, and this is required under the proposed SMP for the entire shoreline lot, not just the buffer area. The proposed standard requiring infiltration and detention of stormwater for entire shoreline developments will also capture sediment, thus improving sediment filtration functions. The proposed buffer, sediment control measures for entire lots, and the lower lake level during the most critical months would work together to address sediment filtration.

Pollution Filtration

Nitrogen and phosphorus are nutrients commonly found in fertilizers, and enter waterways through channelized runoff, groundwater flow, or overland flow. Similar to sediment transport, nutrients and other pollutants are transported to waterbodies through stormwater runoff events in winter months, which corresponds with the time when levels in Lake Chelan are managed to be the lowest and the effective setback widths are the greatest (60-1,000 feet). The addition of these nutrients to aquatic ecosystems can lead to poor water quality conditions, including reduced dissolved oxygen rates, increased pH, and eutrophication (Mayer *et al*. 2005). The rate of nitrogen removal from surface and groundwater flow is extremely variable depending on local conditions including soil composition, surface versus subsurface flow, riparian zone width, and riparian composition (Mayer *et al.* 2005). In 2005, the USEPA conducted an extensive review to investigate the qualities of a riparian zone that

effectively limit nutrient pollution (Mayer *et al*. 2005). A meta-analysis of all of the studies revealed that riparian zones removed nutrients through subsurface flow more effectively than surface flow (Mayer *et al*. 2005). In fact, riparian zones ranging from 3-675 feet removed around 89% of *subsurface* nitrates *regardless* of riparian zone width (Mayer *et al.* 2005). On the other hand, nitrogen removal in *surface* flow was positively correlated with buffer width, with effective filtration beginning at a minimum of approximately 110 feet.

The proposed shoreline buffer fall within the lower range of effective buffers for pollution filtration (Table 1). Because the proposed SMP requires treatment and either onsite infiltration or detention of stormwater for the entire development, and these methods will result in subsurface treatment of stormwater, the proposed SMP is expected to provide nutrient filtration that is better than the existing conditions, which rely only on setback widths for treatment of stormwater runoff. The proposed buffer, water quality treatment measures for entire lots, and the lower lake level during the most critical months would work together to address pollutant filtration.

Erosion Control

Trees, shrubs, and herbaceous plants commonly found in riparian zones provide bank stability and help control bank erosion. Beeson and Doyle (1995) found that major bank erosion is 30 times more likely on stream bends with bare banks compared to vegetated banks, and that densely vegetated banks are the most effective at resisting erosion. Another study found that vegetated stream banks are up to 20,000 times more resistant to erosion than bare stream banks (Smith 1976). Similar conclusions are expected for lakeshore settings. Few studies have examined the width of a riparian zone needed for bank stability, and those studies that have are generally focused on maintaining a sufficient width to allow for channel migration on streams, which is not a factor on Lake Chelan.

In the residential areas of Lake Chelan, much of the shoreline is armored with hard armoring that obviates the function of vegetation in bank stabilization. On unarmored lake shorelines, the type and density of vegetation at the ordinary high water mark is going to be of the greatest importance, rather than the width of the riparian zone. Proposed SMP standards that require replanting of any vegetation that contributed to shoreline ecological function and was adversely impacted during redevelopment are expected to be sufficient to maintain bank stability and control for excessive erosion. The vegetation conservation mechanisms apply to the full shoreline jurisdiction, and not just to the buffer area.

Summary of Proposed Buffers and Science

Although the buffer requirements for development in the Shoreline Residential environment are lower than one might expect when considering WDFW recommendations that were developed for forested conditions, because of lake level fluctuation caused by dam operations, the actual distance between the lakeshore and development is much greater than the minimum buffer width for the majority of the year when the water level is low. On the other hand, certain effects of development, such as the vegetation clearing and water quality impacts are likely to occur year-round. The City's SMP provisions account for these functions by requiring water quality treatment and onsite infiltration or detention for new development. Together, the provisions for vegetation replacement, water quality treatment, and onsite

infiltration for all new or redeveloped properties are expected to compensate for any potential effects of smaller buffer widths on the shorelines of Lake Chelan.

SMP Guidelines and Handbook Excerpts

The preceding discussion has focused on the science underlying the buffer and other environmental protection proposals. However, the SMP Guidelines (WAC 173-26) and Ecology's SMP Handbook (http://www.ecy.wa.gov/programs/sea/shorelines/smp/handbook/Chapter11.pdf) are based on multiple policy objectives consistent with the Shoreline Management Act: ecological protection, preferred water-oriented uses, and public access. The establishment of shoreline buffers is only one potential technique that can address ecological functions. In addition, guidance indicates that local governments can and should consider existing shoreline conditions, existing and future land uses, and the ability to achieve no-net-loss of ecological function.

From Shoreline Vegetation Conservation section of the SMP Guidelines:

- Establish vegetation conservation standards that implement the principles in WAC 173-26-221(5)(b). Methods to do this may include setback or buffer requirements, clearing and grading standards, regulatory incentives, environment designation standards, or other master program provisions. Selective pruning of trees for safety and view protection may be allowed and the removal of noxious weeds should be authorized. [The "principles" referenced here include extensive discussion about riparian corridor functions, use of available scientific and technical information, and specific mention of WDFW's management recommendations.]
- The intent of vegetation conservation is to protect and restore the ecological functions and ecosystem-wide processes performed by vegetation along shorelines. Vegetation conservation should also be undertaken to protect human safety and property, to increase the stability of river banks and coastal bluffs, to reduce the need for structural shoreline stabilization measures, to improve the visual and aesthetic qualities of the shoreline, to protect plant and animal species and their habitats, and to enhance shoreline uses.
- Master programs shall include; planning provisions that address vegetation conservation and restoration, and regulatory provisions that address conservation of vegetation; as necessary to assure no net loss of shoreline ecological functions and ecosystem-wide processes, to avoid adverse impacts to soil hydrology, and to reduce the hazard of slope failures or accelerated erosion.
- Local governments should identify which ecological processes and functions are important to the local aquatic and terrestrial ecology and conserve sufficient vegetation to maintain them. Such vegetation conservation areas are not necessarily intended to be closed to use and development, but should provide for management of vegetation in a manner adequate to assure no net loss of shoreline ecological functions.

Ecology's Handbook for vegetation/buffers says several things that help support establishment of buffers/setbacks that are not based solely on science:

- "Vegetation conservation standards, including buffers and setbacks, should be based on local shoreline conditions."
- "Some local governments with intensely developed shorelines have established only setbacks from the OHWM. Vegetation conservation is required, and planting new vegetation, replacing noxious weeds and invasive plants with native plants, and other habitat improvements are required for new or expanded development. These measures meet the requirements of the SMP Guidelines to protect ecological functions, as buffers do."

- "Shoreline buffers must be based on shoreline ecological functions, development patterns and anticipated preferred uses discussed in the SMP and supporting documents."
- "Therefore, when determining shoreline buffer width, you should consider the potential risk to the ecological functions. If ecological functions would be negatively affected, consider what measures would offset the impact to ecological functions. If mitigation measures and restrictions on land use would not offset the impacts from a smaller buffer, larger buffers are necessary to achieve no net loss of shoreline ecological functions."
- "The buffers and setbacks for marine and freshwater shorelines should be tailored to local conditions including existing shoreline functions and existing and planned land use and public access. Buffers and setbacks likely will vary within a local government's boundaries to reflect different shoreline conditions and functions."
- "People ask why their local shorelines have buffers or setbacks that are different than those in nearby areas. The answer is that the buffers reflect the local conditions including shoreline ecological functions and existing development -- these are not the same everywhere, so different buffers or setbacks are required. In all cases, however, buffers and setbacks should be designed, in combination with SMP regulations, to assure no net loss of shoreline ecological functions."
- "Following are general recommendations for buffers, based on Ecology's approval of several dozen SMPs…. Small-lot residential development in highly developed areas provides some ecological functions. Buffers or setbacks with vegetation conservation requirements of roughly 30 to 60 feet may be appropriate…"

Conclusion

The proposed shoreline buffers account for the primary ecological function of concern on Lake Chelan – water quality – and are designed to work in concert with other environmental protection measures that address entire developments such as water quality treatment, infiltration, and other measures. The shoreline buffers also account for Lake Chelan-specific conditions including natural and built environment conditions. They would allow the City to achieve no-net-loss of ecological function. In addition, they would include incentives to result in improved conditions – shoreline enhancement where no vegetation currently exists.

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APPENDIX C: UPDATED BUFFER SCIENCE MEMORANDUM

TECHNICAL MEMORANDUM

Date: September 26, 2014
To: Craig Gildroy, Planning Director
From: Sarah Sandstrom, Fisheries Biologist
Project Number: 071108.5
Project Name: City of Chelan SMP Update

Subject: Updated Review of Buffers and Scientific Literature Relevant to Lake Chelan

Background

This memorandum was prepared to 1) briefly compare the conclusions of the October 2012 City of Chelan Buffer Science Report and the City's proposed setbacks[1] with a recent review of buffer literature specific to semi-arid shorelines, 2) consider additional scientific literature relevant to ecological functions and shoreline development in Lake Chelan and 3) identify remaining data gaps relevant to shoreline development and ecological functions. WAC 173-26-201(2)(a) requires that SMPs be based on "the most current, accurate, and complete scientific and technical information." Although the body of scientific information concerning lake shorelines is extensive, far fewer studies have investigated the functions and ecological relationships specific to Lake Chelan. While the available scientific data may allow for inferences related to shoreline functions and the effects of development in Lake Chelan, it is recognized that there is some level of inherent uncertainty in those inferences and that data gaps remain. Explicit recognition of these gaps can help policy makers understand the range of possible outcomes from policy decisions.

Review of Shoreline Buffers

In 2013, in recognition of the unique characteristics and functions of riparian buffers on shorelines in semi-arid lands east of the Cascade Range, Ecology supported development of a review and analysis of buffer functions in semi-arid lands of nearby Grant County (Anchor QEA 2013). This memorandum evaluates how recommendations from the *Final Draft Semi-Arid Riparian Functions and Associated Regulatory Protections to Support Shoreline Master Program Updates* report (Anchor QEA 2013) (Semi-Arid Functions Report) compare with setback standards in the proposed City of Chelan SMP.

[1] The revised version of the SMP now refers to the shoreline buffers as shoreline setback to recognize that these are more accurately managed areas (consistent with SMA) rather than traditional critical area buffers.

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The Semi-Arid Functions Report (Anchor QEA 2013) focused on a review of literature specifically relevant to the Columbia Basin Plateau. Although the City of Chelan is located north of the Columbia Basin, in the North Cascades basin, based on the similar semi-arid climate and vegetative considerations, buffer functions in the Columbia Basin are expected to be generally similar to those found in Lake Chelan. The Semi-Arid Functions Report suggests that waterbodies with hydro-facility operations tend to have limited floodplain and associated riparian habitats in comparison to more natural systems (Anchor QEA 2013). The depth to the water table surrounding the lake generally fluctuates with lake levels. Because germination of riparian vegetation is generally dependent on moisture from groundwater in arid and semi-arid climates, lowered lake levels may limit riparian seedling recruitment (Braatne et al. 2007 cited in Anchor QEA 2013).

Based on a review of riparian functions specific to semi-arid climates, the Semi-Arid Functions Report identified recommended buffer widths for different types of waterbodies. For a lake with a narrow riparian corridor and a mix of developed shoreline with open space, the report notes that water quality protection would be expected to require the largest buffer (Anchor QEA 2013). In this scenario, the Semi-Arid Functions Report recommends a buffer width of 50 feet, with the opportunity to reduce width if additional surface water quality BMPs and treatment measures are employed and/or with habitat enhancements and demonstration of no net loss of ecological function (Anchor QEA 2013). The report does not specifically address the effect of water level fluctuations on effective buffer widths relative to water quality. The Semi-Arid Functions Report also suggests that a 40- to 50-foot buffer (depending on the hillslope) represents a conservative buffer width to effectively limit erosion (Anchor QEA 2013). For other functions (e.g., fish and wildlife, shade and cover, and organic input), the report recommends buffers that meet the “representative functional local condition.”

Consistent with the conclusions in the Semi-Arid Functions Report (Anchor QEA 2013), buffer functions related to water quality are expected to be most important for Lake Chelan. Lake Chelan is classified as ultraoligotrophic, with low nutrient input, low organic productivity, and high water transparency. As such, nutrient contributions to lake waters have the potential to substantially alter the aquatic ecosystem. A 1989 Department of Ecology assessment found that 10 to 25 percent of Lake Chelan’s phosphorus and nitrogen loading was the result of human activities, and total soluble nitrogen rates in orchard areas adjacent to the lake did not meet state drinking water standards (Montgomery Water Group et al. 1995). A TMDL for phosphorus was established in 1993 based on exceedances documented in 1987. Water quality sampling has been conducted in 1987, 1995, 1996, 1999, and 2007. Sampling since 1987 has indicated that total phosphorus concentrations meet the water quality standards, and a weak downward trend has been identified in total phosphorus concentrations over that time period (Newell and Coffin 2011). However, it is not clear whether the weak decreasing trend is a result of decreased phosphorus loading to the Lake, or whether it is related to different runoff and dilution characteristics (Newell and Coffin 2011). Sampling in 2007 confirmed that phosphorus is the limiting nutrient controlling growth of algal biomass in the Lake (Newell and Coffin 2011). Additionally, a TMDL and associated Water Quality Implementation Plan is in place to address DDT and PCBs in Lake Chelan (Anderson and Peterschmidt 2008). Anderson and

Peterschmidt (2008) note that the current loading of PCBs may be from soil erosion, storm water transport, and air deposition.

The standard setback proposed for shoreline residential development in the City of Chelan SMP is 25 feet. The proposed SMP also requires treatment and either onsite infiltration or detention of stormwater for any new development or redevelopment. These measures substantially minimize potential impacts to water quality from future development activities, and infiltration and detention standards are also expected to substantially limit impacts to Lake Chelan that would result in soil erosion. Additionally, as noted in the 2012 City of Chelan Buffer Science Report, the lake level drawdown in the winter is expected to allow for additional space for infiltration and sub-surface nutrient retention in winter months when runoff is most likely. Therefore, setbacks that are narrower than the 50 feet recommended in the Semi-Arid Functions Report may be adequate, consistent with the Report's finding that a buffer less than 50 feet is appropriate if additional surface water quality BMPs and treatment measures are employed and/or with habitat enhancements and demonstration of no net loss of ecological function.

A small portion of the City's residential shoreline is undeveloped, and the proposed SMP identifies wider setbacks for this area (Tier 1-Residential) compared to the remaining developed residential shoreline area (Tier 2-Residential). Parcels in the proposed Tier 1- Residential setback area have steep slopes, and the soil is characterized by bedrock and predominantly shallow soils. These characteristics limit the effective infiltration of runoff within the setback. As such, a wider vegetated area is recommended to help maintain water quality conditions. Any setback less than 50 feet would not be warranted in this area.

Proposed SMP standards that require replanting of any vegetation that contributes to shoreline ecological function and is adversely impacted during development or redevelopment are expected to help maintain the "representative functional local condition."

Data Gaps

While the available scientific data may allow for inferences related to shoreline functions and the effects of development in Lake Chelan, it is recognized that there is some level of inherent uncertainty in those inferences and that data gaps remain. Literature specific to arid and semi-arid climates and other dam-regulated waterbodies helps explain the functions of buffers and setbacks on Lake Chelan; however, the following questions identify remaining data gaps. General recommendations are provided for programs to address these data gaps. Specific sponsors and funding sources would need to be identified in order to implement these programs. They might be eligible for federal or State grant funding, or they could be sponsored by non-profit, local, regional, State or federal entities.

- Are water quality trends related to changes in shoreline practices or inter-annual variation?
    - Recommendation: Conduct regular water quality monitoring as part of the Long Term Monitoring Plan (LTMP) for phosphorous, DDT and

PCBs. Monitor and manage potential effects from rural septic systems and irrigation return flows (RH2 Engineering 2012).

- How effectively does the lake level drawdown limit nutrients and contaminants from affecting water quality in Lake Chelan on a long-term basis? Similarly, do organic inputs from shoreline vegetation at low lake levels have a measurable effect on primary and secondary productivity in Lake Chelan?
    - Recommendation: Conduct research to evaluate nutrient sources, transport, and fate in relation to seasonal water levels. In light of uncertainty and potential sensitivity of Lake Chelan to elevated nutrients, consider conservative regulatory standards to help limit the potential for inadvertently surpassing the thresholds for nutrient loading that maintain the water quality conditions of Lake Chelan.

Shoreline Ecological Functions and Development in Lake Chelan

The natural condition of Lake Chelan has been substantially altered by anthropogenic influences. These changes include shoreline development, docks, shoreline stabilization, lake level management, and introduction of non-native species. The Lake drawdown prevents the establishment of aquatic vegetation above the low water elevation. The fish community has been altered as a result of species introductions for sport fisheries. Native species include: westslope cutthroat trout, bull trout (thought to be extinct), mountain whitefish, pygmy whitefish, burbot, largescale sucker, longnose sucker, bridgelip sucker, northern pikeminnow, peamouth, redside shiner, and three-spine stickleback. Introduced fish species include: rainbow trout, kokanee, landlocked Chinook salmon, lake trout, smallmouth bass, largemouth bass, and eastern brook trout. Additionally, *Mysis* were introduced historically to support kokanee.

Schoen and Beauchamp (2010) recently conducted an analysis of the food web dynamics in Lake Chelan, concluding that lake trout are the predominant piscivorous fish within the lake (Schoen and Beauchamp 2010). Juvenile lake trout feed predominantly on *Mysis*, and transition to piscivory once they reach a larger size (over approximately 50 cm) (Schoen and Beauchamp 2010). Schoen et al. (2012) found that the consumption of kokanee by lake trout exceeded kokanee production in Lake Chelan between 2005 and 2009. In a comparable lake in Montana, the introduction of *Mysis* facilitated the population growth of the introduced lake trout population there; the rise in the lake trout population corresponded with the extirpation of kokanee and the reduction in native bull trout and cutthroat trout populations (Ellis et al. 2011). Similarly, targeted reductions of Lake Trout in Lake Pend Oreille since 2006 have corresponded with an increase in kokanee population numbers in Lake Pend Oreille, Idaho (Wahl et al. 2013). However, Schoen et al. (2012) projected that predation pressure on kokanee would continue to increase in Lake Chelan in the short term even if the numbers of harvestable lake trout were reduced. Increased predation pressure would result from the young cohorts of lake trout growing to reach piscivorous size. Given the existing food web dynamics in Lake Chelan and the empirical example of large scale trophic cascade in Montana, the fish community in Lake Chelan could potentially change significantly in future years.

Based on the understanding that the fish community consists of several introduced species, that community dynamics may be in a state of flux, and that the influence of shoreline development is likely to vary with lake levels, a question has been raised regarding the relative importance of nearshore and littoral changes to the aquatic habitat of Lake Chelan. In the absence of specific studies of shoreline habitat changes in Lake Chelan, the understanding of the effects of shoreline development rely on available inferences from other waterbodies (e.g., Beauchamp et al. 1994, review by Kahler et al. 2000, review by Carrasquero 2001, Francis and Schindler 2006). One study of another deep, oligotrophic lake in Washington, Lake Crescent, concluded shallow nearshore areas of the lake are disproportionately responsible for foraging and breeding habitats for the whole-lake food web (Hampton et al. 2011). The same study found that residential development is associated with highly localized impacts to nearshore algae, phytoplankton, and invertebrate communities that may not be measurable through offshore sampling methodology (Hampton et al. 2011). Another recent study in Lake Tahoe, another deep, oligotrophic lake, found that elevated nearshore turbidity was directly correlated with wind, boat use, and lake currents (Alexander and Wigart 2013).

In Lake Chelan, managers have hypothesized that the relative influence of overwater structures and shoreline development is reduced because shoreline development is located 10s to 100s of feet away from the water's edge for much of the year as a result of the managed water levels in the Lake. It stands to reason that the exposed lake bed can help to limit effects of development on the aquatic ecosystem; however, the role of the water level fluctuation in mediating the effects of shoreline development has not been specifically investigated. In conclusion, additional research is warranted to better understand the role of the shoreline conditions and shallow littoral areas of the lake for foraging, rearing, and breeding of both native and introduced species. In the interim, policy makers will be charged with developing shoreline development standards based on the known conditions specific to Lake Chelan, and inferences from known ecological relationships in other lake systems.

Data Gaps

As noted above, additional research is needed to fully understand the effects of shoreline development on the Lake Chelan ecosystem. Questions that remain as data gaps and recommendations to address these data gaps are identified below. General recommendations are provided to address these data gaps. Specific sponsors and funding sources would need to be identified to implement the recommendations. In the past, the Chelan Public Utility District (PUD) sponsored studies of the food web dynamics of the Lake. State and federal agencies, as well as the PUD are engaged in long-term monitoring of the fish community in Lake Chelan.

- How do the effects of shoreline development interact with the lake food web? What is the relative importance of physical changes to the shoreline in relation to biotic communities and functions in Lake Chelan? How do the fluctuating lake levels affect the relative importance of shoreline development?

    - Recommendation: Conduct studies of littoral habitat usage in Lake Chelan, specifically in relation to overwater structures, shoreline stabilization, and natural cover on a seasonal basis.
- Is the existing species composition and food web of Lake Chelan sustainable?
    - Recommendation: Continue long-term research on species composition and diets. The Washington Department of Fish and Wildlife, National Park Service, National Forest Service, and Chelan (PUD) have developed long-term fisheries monitoring plans (National Park Service et al. 2013).

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