Bulkhead Study Technical Report

Lake Tapps Reservoir – City of Bonney Lake, Washington

Prepared for:
Cascade Water Alliance

Prepared by:
Herrera Environmental Consultants, Inc.

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Executive Summary

Cascade Water Alliance (Cascade) manages water levels in the Lake Tapps Reservoir (Reservoir), located within the City of Bonney Lake (the City) and unincorporated northern Pierce County, Washington, to support recreation, watershed stewardship, and future municipal water supply. Cascade acquired the White River–Lake Tapps Reservoir Project in 2009 and operates the Reservoir pursuant to water rights and approvals issued by the Washington State Department of Ecology. Current operations include seasonal increases in lake level to support recreation, with typical summer water elevations maintained near 542.6 feet To meet future drinking water supply needs, Cascade expects to use Lake Tapps Reservoir as a source of municipal supply starting in the early 2060s and anticipates needing to increase the summer recreational water level to 543.0 feet.

The Lake Tapps shoreline is designated a Shoreline of Statewide Significance In Washington State, "Shorelines of the State" are specific water bodies and their adjacent land areas legally designated for protection and management under the Washington State Shoreline Management Act (SMA), which is administered by Washington State Department of Ecology (Ecology). The City of Bonney Lake, in partnership with Ecology, is responsible for maintaining a Shoreline Master Program (SMP) that establishes policies, goals, and regulations related to future developments and uses of the shoreline areas within its jurisdiction, and that is tailored to the specific needs of the community while complying with the requirements established by the State for no less loss of shoreline ecological functions. To accommodate higher seasonal water levels, Cascade is coordinating with the City on a locally initiated SMP amendment that would allow limited increases in the height of existing shoreline bulkheads when they are repaired or replaced.

This Bulkhead Study Technical Report evaluates whether the cumulative effect of increasing the height of existing bulkheads within the City's shoreline jurisdiction would result in a net loss of ecological functions. The analysis focuses on potential effects to flooding, water quality, stormwater, wetlands and streams, shoreline geomorphology and erosion, vegetation, fish, and wildlife habitat. Baseline conditions show a highly developed shoreline that is predominantly bulkheaded (95 percent), with limited unarmored areas, minimal native riparian habitat, largely disconnected wetlands and streams, and low susceptibility to flooding, landslides, or significant erosion.

This Study finds that limited, in-place increases to the height of existing bulkheads would not result in significant environmental impacts or a measurable loss of shoreline ecological functions.

This Study finds that allowance for limited, in-place increases to the height of existing bulkheads would not result in additional flooding, erosion, water quality degradation, or adverse effects to stormwater systems, fish, wildlife, or shoreline stability. While minor shifts in wetland hydroperiod associated with prolonged higher seasonal water levels could result in subtle changes to wetland vegetation composition and associated ecological functions, these changes are anticipated to be limited due to the extensive existing armoring of the shoreline. Wetlands associated with the Reservoir are more susceptible to impacts from climate change

that could cause low seasonal water levels from decreased river flow and diversion to the Reservoir. The environmental regulations outlined by Title 16, Divisions II and III, Critical Areas and Shoreline of the City of Bonney Lake's Municipal Code (BLMC) require that all land uses or development applications be reviewed for potential impacts, which may result in property owners seeking to raise the heights of their existing bulkheads to submit site-specific assessment reporting to document baseline environmental conditions.

No new in-water or expanded structural construction footprints are proposed in relation to increasing the heights of existing bulkheads in situ. Therefore, the project would not represent a substantial alteration of existing conditions or result in a substantial loss of ecological functions. Accordingly, the findings support the City's consideration of a Shoreline Master Program amendment and associated regulatory review to increase bulkhead heights in situ.

The findings from this Study support the City's consideration of a Shoreline Master Program amendment and associated regulatory review to increase bulkhead heights in situ.

Introduction

Cascade Water Alliance (Cascade) currently manages water levels within the Lake Tapps Reservoir (Reservoir) located in the City of Bonney Lake (City) and unincorporated northern Pierce County, Washington for the purposes of water storage and future supply (Figure 1).

Cascade acquired the White River – Lake Tapps Reservoir Project (Project) from Puget Sound Energy in 2009. The Project includes the Reservoir along with extensive lands surrounding the Reservoir. Puget Sound Power and Light/Puget Sound Energy created the Reservoir between 1910 and 1912 by diverting water from the White River and constructing a series of dikes that merged four smaller lakes into one large resource, which was used for hydroelectric power generation until production ceased in 2004. Washington State Department of Ecology (Ecology) issued a Report of Examination (ROE) in 2010 that approved Cascade's use of Lake Tapps as a municipal water supply and issued final water right permits.

Cascade operates the Project in coordination with various stakeholders including local cities, Pierce County, and tribal governments under multiple agreements that govern instream flows, recreational lake levels, and watershed stewardship. Cascade currently raises the Reservoir water level each spring to 543 feet lake stage datum (which is used throughout this document and is 0.5 foot greater than National Geodetic Vertical Datum 1929 [NGVD 29]) for approximately 1 day per year and then adjusts and maintains the level at approximately 542.6 feet during the summer to support recreation use.

Cascade plans to use the Lake Tapps Reservoir as a future municipal water supply and anticipates management of higher water levels for increased water storage than current practices.

Cascade plans to use the Reservoir as a municipal drinking water supply with infrastructure construction starting in the early 2060s. The future use of the Reservoir as a drinking water supply will require increased water storage and management to higher water levels within the Reservoir than current practices. Cascade anticipates needing to increase the summer recreational level from 542.6 to 543 feet in the future, for an estimated period of 5.5 months from April 15 to September 30 each year.

Environmental regulatory compliance reviews for proposal actions within the Reservoir, a designated Shoreline of State-Wide Significance, is administered by the applicable local jurisdiction and the Washington Department of Ecology (Ecology) according to joint agency approved Shoreline Master Program (SMP) guidelines. To accommodate increased Reservoir storage capacity in the future, Cascade is working with the City to propose a locally initiated amendment to Bonney Lake's SMP to allow a slight increase in the regulated heights of existing shoreline bulkheads as they are repaired or replaced.

The main objective of the SMP is to ensure that "no net loss in environmental/ecological function," occurs as the result of a permitted activity. All shoreline project reviews require that mitigation sequencing to avoid, minimize and or mitigate for environmental impacts is addressed. Impact analysis and functional assessments are to be based on Best Available Science.

The purpose of this Study is to evaluate whether the cumulative effect of increasing the heights of existing bulkheads within the City's shoreline jurisdiction would result in a loss of environmental functions.

The City's Shoreline Management Regulations provide that improvements, such as bulkheads, which were in existence prior to October 16, 2014, are considered legally conforming. This date was chosen because it is the date of the baseline ecological condition by which the standard of no net loss was set by the City. Bulkheads determined to be legally conforming under Section 16.56.150 of the City of Bonney Lake's Municipal Code (BLMC) are still required to comply with current regulations when the bulkhead is repaired, replaced, or rehabilitated.

The purpose of this Bulkhead Study Technical Report (Study) is to evaluate whether the cumulative effect of increasing the heights of existing bulkheads within the City's shoreline jurisdiction would result in a loss of environmental functions. This Study includes an analysis of ecological functions and potential negative or positive effects on:

- Flooding
- Reservoir water quality
- Quality and quantity of stormwater runoff
- Native vegetation communities
- Fish and wildlife habitats
- Invasive plant growth
- Shoreline stability

This Study did not analyze the environmental conditions resulting from new bulkhead construction or the potential impacts of modifications of bulkheads outside of the Study Area in adjacent unincorporated areas of Pierce County, Washington.

As requested by Ecology, the Study also reviews equity issues in regard to the potential risk of increased flooding for those properties without bulkheads within the City that may be impacted by the raising of bulkheads on adjacent properties.

If an amendment to the City's SMP is approved to allow increased heights for existing bulkheads, property owners will be able to decide at their own discretion if they wish to raise the heights of their existing bulkheads according to City-required site plan submittals and permit review. If a net loss of ecological function is identified, the Study recommends potential mitigation measures for consideration by the City during the SMP amendment review.

The Study Area encompasses that portion of the Lake Tapps reservoir and the adjacent shoreline areas located within the City of Bonney Lake, Washington (Figure 1).

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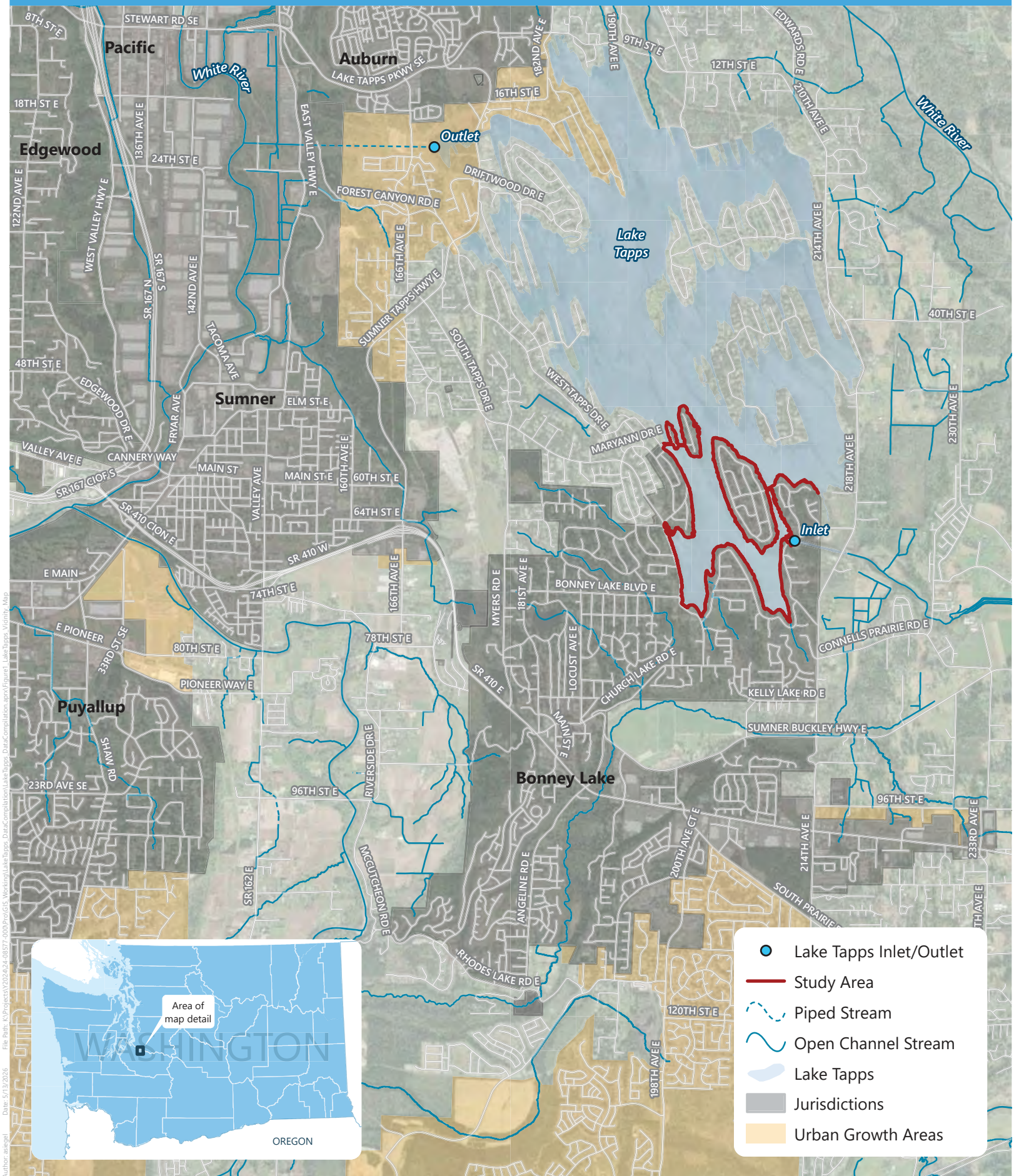
Figure 1. Lake Tapps Reservoir Bulkhead Study Area and Vicinity Map
City of Bonney Lake, WA



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Existing Baseline Conditions

Herrera conducted a desktop review of existing environmental data resources from publicly available agency data resources and mapping for the purposes of characterizing the existing baseline conditions of the Lake Tapps Reservoir Study Area and its immediate vicinity. Herrera evaluated the following environmental factors to characterize the baseline conditions within the Study Area: existing bulkheads/ shoreline armoring, shoreline and recreational use, climate, geomorphology, soils, hydrology including wetlands and streams, water quality, and vegetation, wildlife and fish habitats. References for data resources and maps reviewed for the Study are included in Appendix A: Cited Literature-References.

Bulkhead Inventory

Cascade provided Herrera with the Bonney Lake Bulkhead Inventory, dated February 10, 2025, to initiate the review of parcels armored by bulkheads within the Study Area (Cascade Water Alliance 2025). Herrera cross-referenced this information using parcel maps and Google Earth aerial and streetscape imagery to identify the presence or absence of bulkheads on the shoreline properties situated within the City of Bonney Lake's Bulkhead Study Area.

96% of shoreline parcels within the Study Area are already armored by bulkheads or other hard structures.

A total of 476 parcels were identified in the Study Area, and bulkheads were identified to be present on the majority (458 parcels, or 96 percent) of the Study Area's shorefront properties. The analysis resulted in the identification of only 18 parcels (4 percent) along the Reservoir's shoreline within the City's jurisdiction as not currently armored by bulkheads or other hard structures (Figure 2). The height and condition of existing bulkheads, including materials and state of repair or misrepair, were not determined. Based on Cascade's communications with property owners, it is assumed that most bulkheads exceed 543 feet in height to accommodate the highest water level.

Shoreline Use

The City's SMP (Chapters 16.34–16.58 BLMC) applies to all shorelines of statewide significance within the City. In the City, shoreline jurisdiction includes the Lake Tapps Reservoir and Fennel Creek and associated underlying land and all lands within 200 feet, as measured horizontally from the ordinary high water mark (OHWM) of these waters. The City's shoreline jurisdiction also includes associated wetlands up to 200 feet beyond the OHMW, provided they are contiguous with shoreline areas. However, critical area buffers located more than 200 feet from the OHWM are not included in the City's shoreline jurisdiction.

Within the Study Area the following City shoreline environment designations apply (Figure 2):

- Shoreline Residential – Low- or medium-density residential intended to allow detached homes, duplexes, and related structures while protecting and restoring ecological functions (BLMC 16.40).

- Shoreline Multi-Family – High-density residential intended to allow multifamily development and related structures while protecting and restoring ecological functions (BLMC 16.42)
- Park – intended to support water-dependent and other water-enjoyment recreational uses while protecting and, where feasible, restoring ecological functions (BLMC 16.44)
- Lake Tapps – Aquatic – intended to protect, restore, and manage the unique features and resources waterward of the OHWM (BLMC 16.48).
- The majority of the shoreline within the Study Area is designated for residential use and armored by existing bulkheads (Figure 2) (City of Bonney Lake 2025). Only 13 residential parcels and 5 park parcels were identified as not armored. Eleven (11) of the unarmored residential parcels are located in low density residential zoning, one within the medium density residential area, and one within high-density residential. Five unarmored parcels are situated withing designated Park use areas. Inlet Park, comprised of four unarmored parcels, is a private Homeowners' Association (HOA) park located near the western terminus of Cascade Drive. One small unarmored parcel situated within the Park use designation is grouped among several other unarmored residential use parcels located near the terminus of Bonney Lake Boulevard East.

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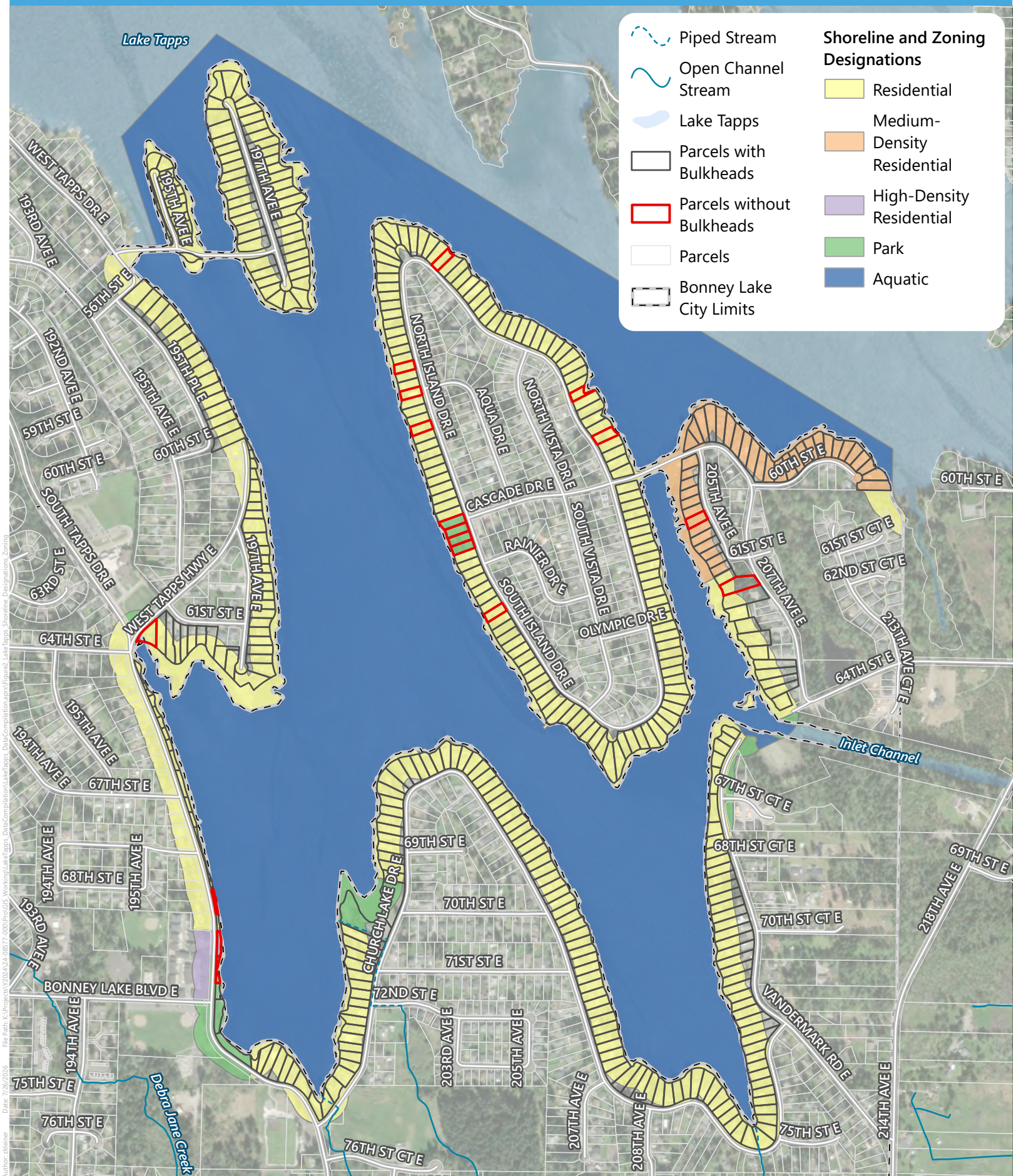
Figure 2. Shoreline Designations and Zoning City of Bonney Lake, Washington.



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Recreational Use

Lake Tapps is a popular recreational area for a variety of water sports, including sailing, motorboating, and jet skiing. Although the predominance of single-family residential use limits the availability for public access to the City's and Pierce County's lakeshore properties, the Reservoir has historically been reported to be overcrowded with motorboat activity during peak use in the summer (Pierce County Planning and Land Services 2005). The City provides recreational public access to Lake Tapps Reservoir through Allan Yorke Park (45 acres). Additional reservoir access within the City limits is available to homeowners' associations at two additional parks with boat launch facilities that are privately operated by the Church Lake and Inlet Island maintenance companies (City of Bonney Lake 2019).

Potential shoreline erosion and water quality impacts associated with recreational boat use is addressed in a later section of this report.

Climate

Lake Tapps Reservoir is located within the Puget Sound lowlands and is characterized by a mild maritime climate, northerly winds, and has an average summer temperature of 75 degrees and in winter of 34 degrees. Average annual precipitation is approximately 45 inches with over 150 days of rain per year (Staudmyer 2021).

Winds around the project area are dominantly recorded as blowing from the south and southwest, with winds directed towards the south are also common in the summer. Strong winds are dominant during cooler weather in the winter, whereas warmer summer months generally exhibit calm winds. Summer is prone to diurnal winds, where wind strength increases in the afternoon as a result of mixing cool winds from the Pacific with warmer winds that circulate around the west slopes of the Cascades (Staudmyer 2021). The wind climate at Lake Tapps Reservoir is generally low, with wind speeds averaging between 3 to 6 miles per hour (mph) and average maximum gusts around 25 mph during the winter months (based on *KWABONNE118* [Bonney Lake] station data from 2012–2025; Weather Underground, [n.d.]). The Bonney Lake/Lake Tapps weather station records the dominant wind direction annually to be from the west and southwest (Windfinder [n.d.]).

The maximum fetch or overwater distance wind blows within the project area is approximately 1.5 miles. Average wind waves on Lake Tapps Reservoir are estimated to be 0.1 foot, assuming 6-mph winds. Maximum wave heights can reach approximately 0.7 foot in gusts of 25 mph. Because the maximum fetch to this south region of the Reservoir is from northerly winds, properties in the Study Area that are the most susceptible to wind-generated waves are those along north-facing shores.

Hydrology

Lake Tapps Reservoir

Lake Tapps Reservoir is part of the Puyallup–White River watershed, categorized within Washington's Water Resource Inventory Area (WRIA 10). It is located in northern Pierce County, about 30 miles southeast of Seattle and northwest of Mount Rainier, within the White River sub-basin. The Reservoir is anthropogenically fed by the White River; its dispersion point is located approximately 8 miles to the east of the City near Buckley, Washington. The Reservoir's downstream outlet back into the White River is located approximately 10 miles to the north of the City within the City of Auburn's Urban Growth boundary in Pierce County, Washington (Figure 1). Operation of the Reservoir has changed since the cessation of power generation in 2004. Flow rates through the Reservoir have been reduced, averaging 121 cubic feet per second (cfs) from 2004 to 2010 (USGS 2012) versus 890 cfs from 1982 to 2003.

The Reservoir spans approximately 2,296 acres (around 4.5 square miles), with nearly 45 miles of shoreline. The mean depth of the reservoir is 25 feet, with a maximum depth of approximately 90 feet. The Reservoir has annual water level fluctuations of approximately 4 feet with the maximum drawdown occurring in the winter to a minimum water elevation of approximately 538 feet NGVD 29 (538.5 feet lake stage datum). Per Ecology's water right permit, peak elevations are in the summer as Cascade maintains "Normal Full Pool" reservoir levels from April 15 to September 30 of each year between 541.0 and 542.5 feet NGVD 29 (541.5 and 543.0 lake stage datum) as measured at the U.S.G.S. gage 1210100-Lake Tapps near Sumner, WA (Figure 3) (Cascade Water Alliance 2010).

Currently, Cascade raises Lake Tapps Reservoir each spring to about elevation 543 feet lake stage datum, then adjusts and maintains summer recreational levels at approximately 542.6 feet lake stage datum) depending on instream flow requirements and weather conditions (Cascade Water Alliance 2025). Within the described timeframe, operational variances due to forecasts or available precipitation are allowed; however, a formal proposal for a modification in the schedule of the reservoir levels and the definition of Normal Full Pool must be submitted to Ecology for review after completing an appropriate consultation with stakeholders and other interested parties.

Federal Emergency Management Agency's (FEMA) Flood Rate Insurance Maps (FIRM) 53053C0358E and 53053C0359E, each effective on March 7, 2017, indicate that the Lake Tapps Reservoir shoreline is situated within Special Flood Hazard Zone A. Zone A areas have a 1 percent annual chance of flooding in a given year and a 26 percent chance of flooding over 30 years. Because detailed analyses are not performed for the mapped Zone A area, no depths or base flood elevations are determined (FEMA 2017).

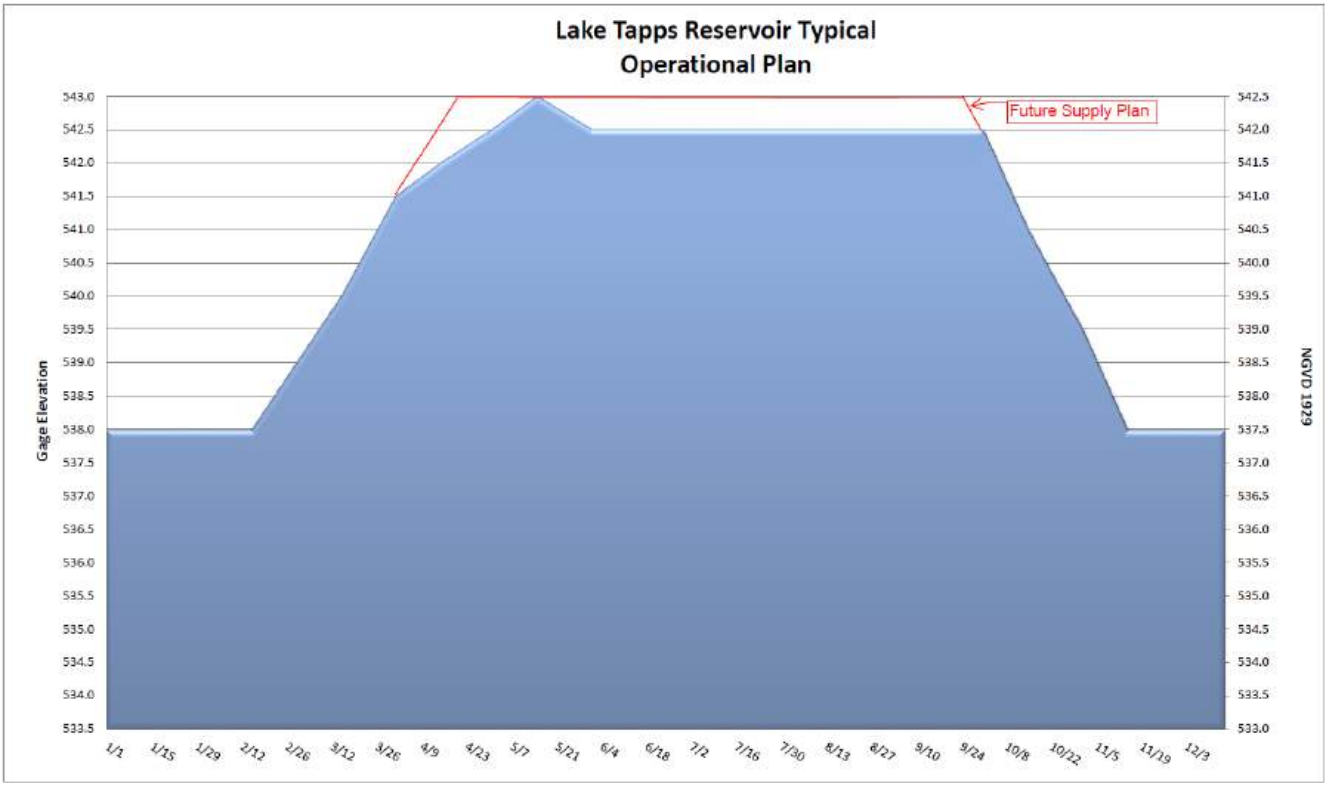

Figure 3. Lake Tapps Reservoir Typical Operation Plan.

Herrera reviewed the unarmored and armored parcels within the Study Area for potential risk to flooding based on the elevation of Typical Summer Water Level of 542.6 feet lake stage datum (Figure 4). None of the parcels surrounding the Reservoir within the City's jurisdiction are at risk to potential flooding. This is consistent with Cascade's understanding of the existing conditions, as no complaints are received in regard to flooding even when the seasonal high water elevation is maintained. (Cascade Water Alliance 2026).

Wetlands

The National Wetlands Inventory (NWI) maps several wetlands within the Study Area (Figure 5). The NWI is not comprehensive; additional wetlands that are not documented on the NWI may exist in the Study Area. Mapped hydroperiods within the known wetlands include permanently flooded, semi-permanently flooded, and seasonally flooded regimes.

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Figure 4. Lake Tapps Reservoir Bulkhead Study, Bonney Lake, WA
Existing Conditions: 542.6-ft Typical Summer Water Level.

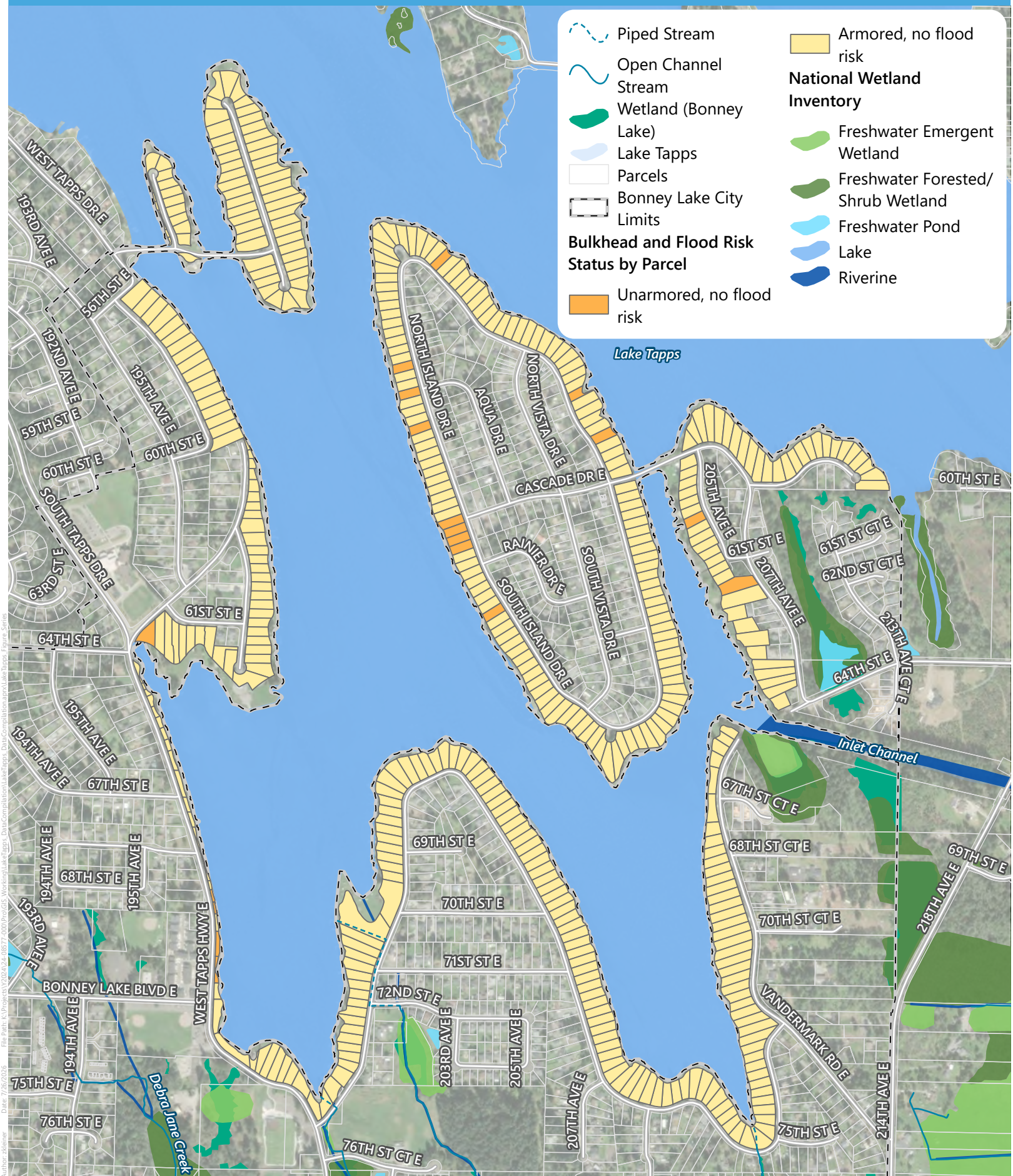

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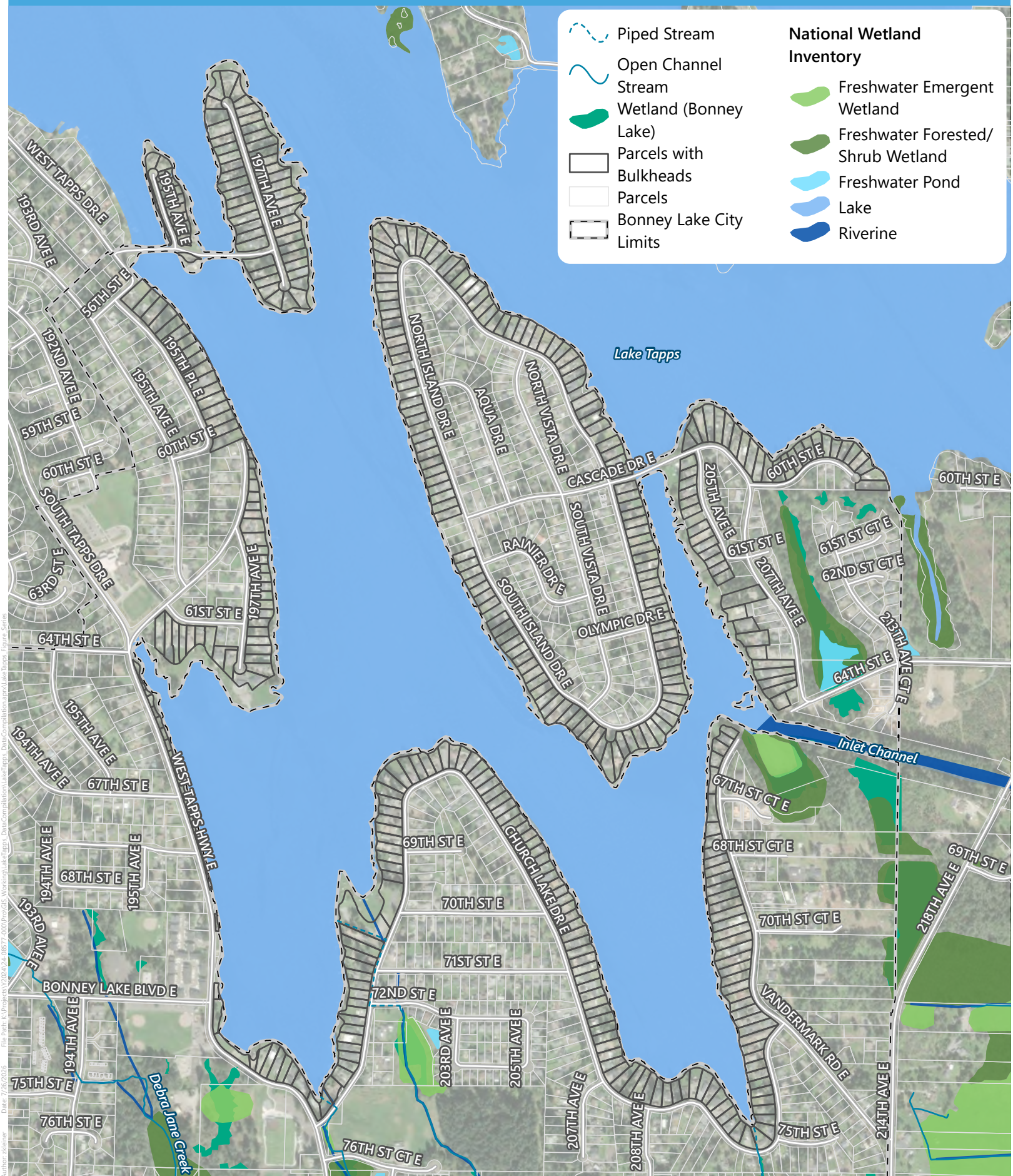
Figure 5. Lake Tapps Reservoir Bulkhead Study, Bonney Lake, WA Wetlands and Streams.



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Author: zKleiner

The Cowardin classifications of the mapped wetlands include palustrine emergent, palustrine scrub-shrub, and palustrine forested communities. The Reservoir is classified as lacustrine, with littoral unconsolidated bottom (i.e., nonpersistent with emergent vegetation less than 30 percent cover), Lacustrine wetlands are deeper, larger, and associated with lakes, whereas palustrine wetlands are generally shallower, vegetated areas like marshes, swamps, and bogs

With exception to the wetland area adjacent to the Reservoir's inlet channel, the surface water connections of the mapped wetlands to the Reservoir are typically interrupted by existing roadways and development infrastructure (Figure 5). The hydrology of riverine and palustrine wetlands that are influenced by stream and groundwater hydrology, respectively, may be indirectly affected by the Reservoir's water levels.

Streams

Two non-fish-bearing streams are mapped by the City and by Washington Department of Natural Resources (WDNR) as draining to the southeast end of the Reservoir within the Study Area (Figure 5; City of Bonney Lake 2025, WDNR 2026). These resources are classified as Type 4 and Type 5 waters. In accordance with Washington Administrative Code (WAC) 222-16-031, Type 4 Waters are perennial, non-fish-bearing streams that flow year-round during normal rainfall years, including any dry stretches within the defined channel below the point of continuous flow. Type 5 Waters are seasonal, non-fish-bearing streams with intermittent surface flow and are physically connected by an above-ground channel to one of those higher-order water types.

The inlet channel and the freshwater pond mapped in association with wetland to the north 64th Street East are identified by WDNR as Type X waterbodies. Type X waterbodies are non-typed per WAC 222-16, which includes drainage structures, such as cross drains, relief culverts, ditch diversions and water bars that are not intended to carry any typed water. Fish bearing (Type F) waters, Fennel Creek to the south and Debra Jane Creek to the west do have a direct hydrology connection to the Reservoir. The City's GIS mapping identifies the drainage to the Reservoir near the southwest corner of the Study Area as a stormwater ditch (City of Bonney Lake 2026).

Geomorphology

Prior to anthropogenic modifications, the Lake Tapps Reservoir and surrounding landscape were carved out by repeated glacial advances and retreats during the Pleistocene. Between glacial periods fluvial deposits and mudflows (lahars) from Mount Rainier contributed significant deposits to the landscape. The most recent glaciation occurred during the Vashon Stade of the Fraser glaciation, where the Puget Lobe extended south from Canada to Olympia, WA. This final glacial Stade sculpted the topography throughout the Puget Sound, leaving behind extensive glacial outwash and till deposits. Around the City of Bonney Lake, the dominant glacial unit is Vashon glacial drift, chiefly till. This unit is characterized by compacted diamicton (poorly sorted sediment with wide range of particle sizes), with sand and gravel deposits on top of the till. The topography is described as having a "stipple pattern," which is indicative of drumlinized ground moraines (elongated hills; WDNR 2025b).

The receding glacier calved off blocks of ice, which melted in place to create kettle lakes and glacial meltwater channels carved the complex topography we see today around the current Lake Tapps Reservoir. The diversion dam built in 1911 diverted the White River, flooding four kettle lakes, formerly known as Lake Kirtley, Lake Crawford, Church Lake, and Lake Tapps and the surrounding topography. The valley margins to the south and west of the current Lake Tapps Reservoir include lahar (dense volcanic debris flows) and fluvial (water dominated flows) deposits that are younger in age than these glacial deposits (Crandell 1963).

Natural Resources Conservation Service Soils

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey for the City of Bonney Lake maps six major soil units around the City's extent of the Lake Tapps Reservoir (Figure 6 and Table 1) (NRCS 2025). The soils run parallel to the Reservoir's shoreline and soil development is closely linked to glacial and mudflow deposits. The soil units include:

- Alderwood gravely sandy loam, 8–15% slopes (NRCS Map Unit 1C and 1D)
- Buckley gravelly silt loam, 0–3% slopes (NRCS Map Unit 8A)
- Indianola loamy sand 0–30% slopes (NRCS Map Unit 18B, 18C and 18E)
- Kapowsin gravelly ashy loam, 6–30% slopes (NRCS Map Unit 19C, 19 D)
- Orting Loam (NRCS Map Unit 28A)
- Shalcar muck (NRCS Map Unit 38A).

Overall, the soils are not prone to flooding or ponding and are moderately susceptible to wind and sheet/rill erosion.

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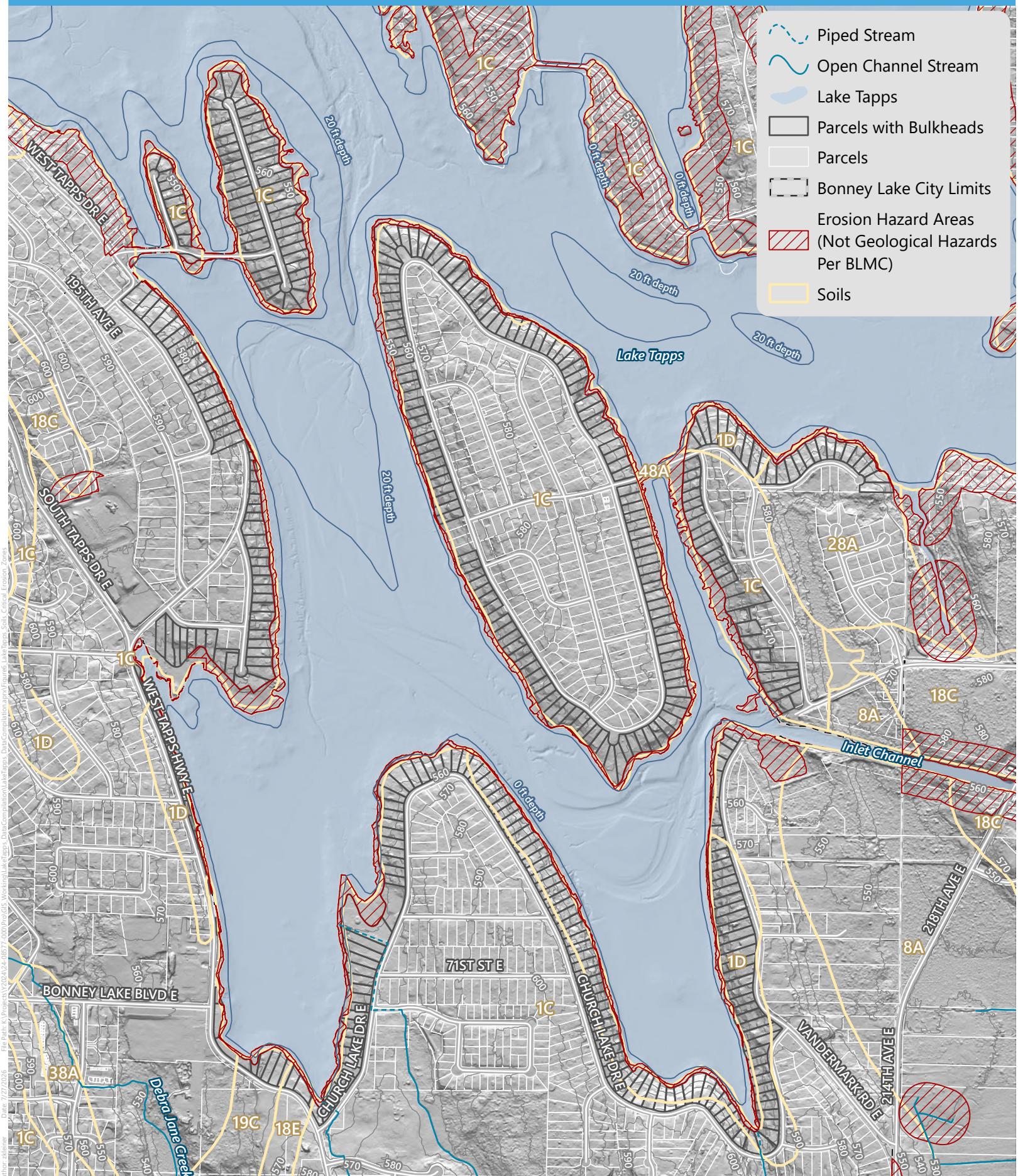
Figure 6. Lake Tapps Bulkhead Study, Bonney Lake, WA
Soils & Potential Erosion Areas Based on Direct Interface with Water.



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Date: 7/27/2026
Author: zKleiner

Table 1. Natural Resources Conservation Service Soil Types in Bulkhead Study Area.

Map Unit	Soil Type	Setting & Parent Material	Drainage Class	Hydric	*GW Depth (in)	Restrictive Layer Depth (in)	*Ksat (in/hr)	Erosion (Wind / Water)
1C, 1D	Alderwood gravelly sandy loam (HSG B)	Hills & ridges; glacial drift or outwash over dense glaciomarine drift	Moderately well drained	No	18–37	20–39	0.00–0.06 (Very Low to Mod- Low)	Mod / Low
8A	Buckley gravelly silt loam (HSG C/D)	Depressions & drainages; lahar (mudflow) deposits	Poorly drained	Yes	0–20	20–39	0.00–0.06 (Very Low to Mod- Low)	Low / Low
18B, 18C, 18E	Indianola loamy sand (HSG A)	Terraces; sandy glacial outwash	Somewhat excessively drained	No	>80	>80	5.95–99.90 (High to Very High)	High / Low
19C, 19D	Kapowsin gravelly ashy loam (HSG D)	Along/at base of ridges (moraines); volcanic ash + glacial drift over dense glaciomarine deposits	Moderately well drained	No	11–24	>80	0.00 (Very Low)	Mod / High
28A	Orting loam (HSG D)	Plains & flatlands; mudflow deposits; rare ponding	Somewhat poorly drained	No	12–47	>80	0.06–0.20 (Mod Low to Mod High)	High / Mod
38A	Shalcar muck (HSG D)	Floodplains; organics over alluvium; frequent ponding	Very poorly drained	Yes	0	>80	0.00–0.06 (Very Low to Mod- Low)	Mod

*ksat – hydraulic conductivity, a soils ability to transmit water, from the most limiting soil layer

*GW – groundwater

Critical Erosion Areas

Herrera investigated recent data sets for indications of historical or recent landslides and possible geologically hazard areas, using a combination of LiDAR, aerial oblique photos, WDNR landslide inventory, and soil/geologic data (Sanborn 2020, WGS 2025, Ecology 2016, NRCS 2025, Pierce County 2024a). The City defines landslide hazards in detail in Section 16.28.010 of their code. The City's geological hazard mapping indicates potential landslide areas of 15–25 percent with very low liquification susceptibility in association with the Lake Tapps Reservoir Study Area. During the desktop review, Herrera found no geomorphic indicators of past slope failures and could not find historical records of landslide activity. Little to no landslide potential along the project area was found. During the desktop review, Herrera found no geomorphic indicators of past slope failures and could not find historical records of landslide activity. Little to no landslide potential along the project area was found.

The City's definition for "erosion" is the wearing away of the earth's surface as a result of the movement of wind, water or ice (Section 15.20.030 (14) BLMC). Pierce County defines erosion hazard areas as "areas with active land retreat as a result of wave action" that are adjacent to lakes and ponds larger than 2,000 square feet with slopes that are 20 degrees or more (Pierce County, 2024b). Pierce County maps erosion hazards areas that are predominately associated with soil types 1D and 1C, which are present throughout the project area (Figure 6). The Study Area's soil types 1D and 1C include somewhat shallow (20–39 inches) gravelly sandy loam that are generally well drained on slopes with low topographic relief (15–20%). These soils overlay glacial till with very low permeability, which can cause soil instability as water pools between the two soil units. However, due to shallow soil depths and relatively low slope angles, surface erosion is more likely than a landslide within the Study Area's shoreline areas. The Study Area's soil types are classified to have a low to moderate susceptibility to erosion by water and wind. Most of the erosion hazard areas mapped along the City's Lake Tapps Shoreline Study Area are currently armored by bulkheads. The County's mapped erosion hazard layer, however, does not account for shorelines that have armor. The vertical edge of the bulkhead wall is interpreted on the County maps as a steep slope rather than natural topography conditions and therefore areas susceptible to erosion hazards are overestimated (see Figure 6).

Herrera modified the County's mapping for those parcels with armoring to indicate areas for potential for erosion hazard as only occurring waterward of the bulkhead. Adjusting to accommodate the portion of the shoreline within the Study Area identified as having armor (approximately 96 percent), the percentage of area mapped as an erosion hazard is significantly reduced when assessed for the purposes of this Study to only include those areas where soils may interface directly with water (Figure 6). Stable shorelines are mapped along 0–3% slopes and are associated with poorly drained gravelly silt loam soil type (8A), that are present along the eastern edge of the Study Area adjacent to the Reservoir inlet channel.

Water Quality

The water quality in Lake Tapps Reservoir is generally good (Herrera 2025a). Compared to other lowland lakes in the Puget Sound, the Reservoir has lower algae productivity and higher water clarity. However, in the late summer, the Flowline can deliver cloudy waters diverted from the White River containing fine glacial flour, which can give the Reservoir an opaque coloration. The trophic state of Lake Tapps Reservoir borders between oligotrophic and mesotrophic (low and moderate amounts, respectively, of nutrients and algae). Occasionally, algae scums have been reported and sampled through Ecology's Washington State Toxic Algae program, but no exceedances of the recommended recreation criteria for cyanotoxins (toxins produced by blue-green algae) have been measured.

The Reservoir is not listed as impaired by any water, habitat, tissue, or sediment parameters on the current, EPA-approved Water Quality Assessment 303d list (Ecology 2026). The Washington State Surface Water Quality Standards (WAC 173-201A-600) identifies the Reservoir to be protected for all possible designated uses, including:

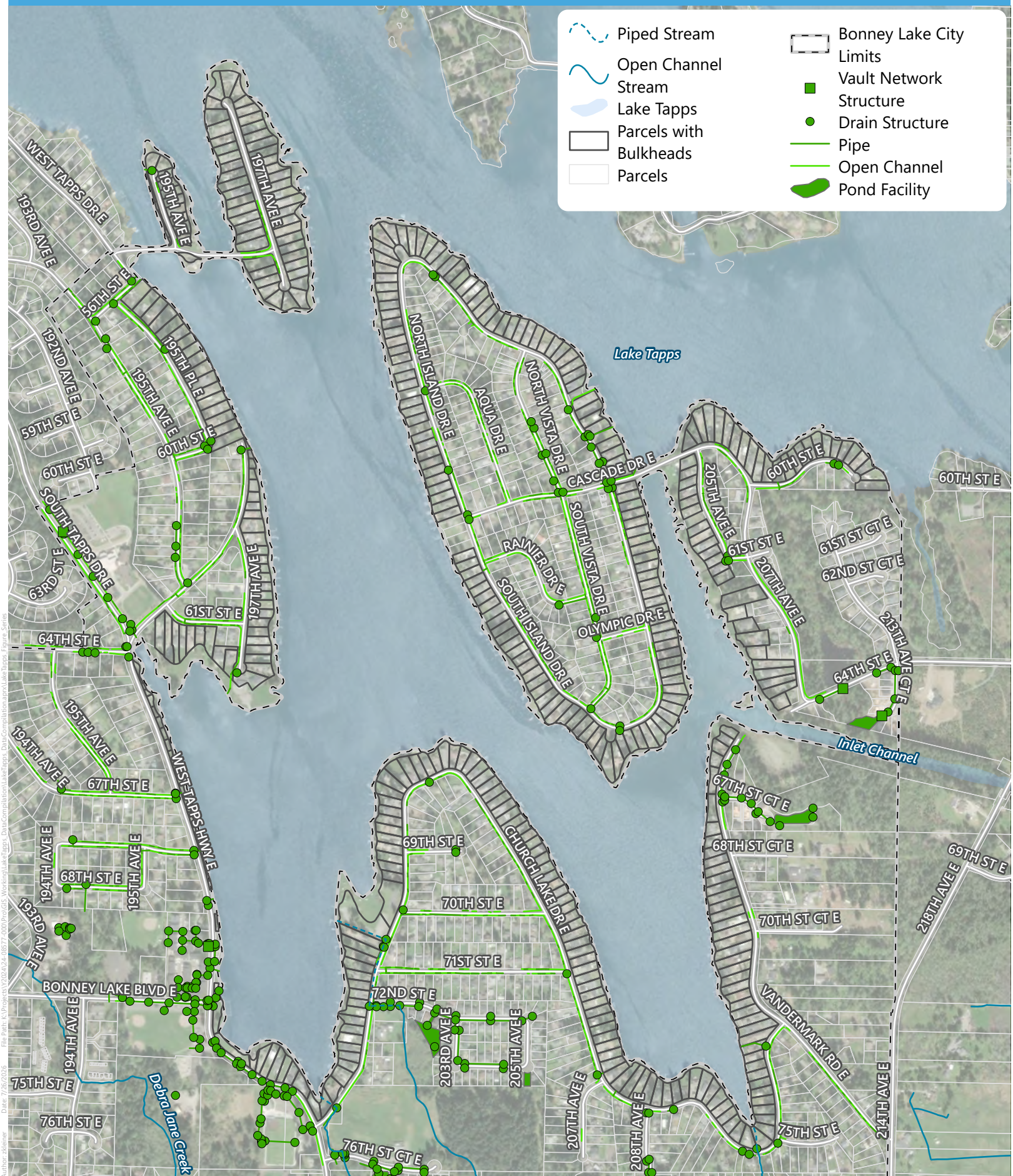
- Aquatic life – core summer salmonid habitat
- Recreational – primary contact recreation
- Water supply – domestic, industrial, and agricultural
- Wildlife habitat
- Harvesting
- Commerce and navigation
- Boating
- Aesthetic values

The diversion inlet from Printz Basin to the Reservoir is listed as a Category 5 degraded or impaired water body on the State's 303d list for dissolved oxygen (Ecology 2026). The diversion inlet is listed as a Category 2 "waters of concern" for water temperature.

Stormwater

Herrera reviewed the mapping of the City's stormwater infrastructure within the City's Study Area (Figure 7). A connected network of vaults, drains, pipes, open channels and pond facilities have been installed to manage the City's stormwater from developed areas.

Figure 7. Lake Tapps Reservoir Bulkhead Study, Bonney Lake, WA Stormwater Infrastrucutre.



Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: Esri, Bonney Lake, Pierce County, WDFW, NWI

0 300 600 1,200 Feet

Sewer Infrastructure

Herrera's review of the existing sewer infrastructure indicates that no onsite septic systems are documented on the shoreline parcels within the City's Study Area (Figure 8). Onsite septic systems are, however, identified to be prevalent along shoreline properties in unincorporated Pierce County. With exception to the City's sewer infrastructure routed along the water between 5602 and 5634 195th Place East, a combination of vaults, manholes, pumps and pipes route the City's managed sewer utilities primarily along established roadways, away from the Reservoir shoreline. Based on this mapping, concerns regarding the potential of failing septic systems to contribute towards water impacts within the Study Area are discounted.

Species and Habitat

Terrestrial Vegetation

Over the past 150 years, extensive logging, urban development, and the construction of Lake Tapps Reservoir have significantly altered the areas' native vegetation (Cascade Water Alliance 2010). Today, the area features a mix of vegetation types, including second- and third-growth forests with a higher proportion of deciduous species and the presence of non-native plants, which are typical of disturbed areas.

Most of the Reservoir shoreline within the City's Study Area is developed for residential use, with vegetation dominated by lawns, ornamental plantings, and disturbance-tolerant species, limiting the presence of native plants. Directly north of the City in unincorporated Pierce County, Tapps Island Golf Course also occupies a large area, landscaped with maintained turf. However, patches of native vegetation remain in scattered areas, including parts of Snag Island, several small islands and peninsulas within Pierce County, and select shoreline locations within the City. These areas support native trees such as black cottonwood (*Populus balsamifera* ssp. *tripocarpa*), willows (*Salix* sp.), Sitka spruce *(Picea stichensis*), red alder (*Alnus rubra*), Douglas fir (*Pseudotsuga menziesii*), western red cedar (*Thjua plicata*), and bigleaf maple (*Acer macrophyllum*), with understories of beaked hazelnut (*Corylus cornuta*), salal (*Gaultheria shallon*), non-native Himalayan blackberry (*Rubus ameniacus*), and mixed native and non-native grasses. The shoreline of the former Power Plant's penstock forebay retains relatively undisturbed forest, shrub, and herbaceous communities, including species like Douglas spirea (*Spiraea douglasii*), oceanspray (*Holodiscus discolor)*, and reed canarygrass (*Phalaris arundiacea*).

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Figure 8. Lake Tapps Bulkhead Study, Bonney Lake, WA Sewer Infrastructure.

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Author: zkleiner

Aquatic Vegetation

The Lake Tapps Reservoir supports several aquatic plant species, including three non-native species: Eurasian watermilfoil (*Myriophyllum spicatum*), fragrant waterlily (*Nymphaea odorata*) and curly-leaf pondweed (*Potamogeton crispus*); and many native species including but not limited to northern watermilfoil (*Myriophyllum sibiricum*), common water nymph (*Naja guadalupensis*), common elodea (*Elodea canadensis*), coontail/hornwort (*Ceratophyllum demersum*), spatterdock/yellow pond lily (*Nuphar polsepala*), long-leaf and ribbonleaf pondweeds (*Potamogeton nodosus, P. epihydrus*), wild/water celery (*Vallisneria americana*), and stonewort (*Nitella sp*.) (Cascade Water Alliance 2010; ESA 2025a,b). Emergent plants are uncommon due to shoreline armoring and fluctuating water levels. There are no rare, state or federally protected plant species in or near the Reservoir (WDNR 2025a).

Figure 9 illustrates the results of the inventory and mapping of aquatic macrophytes abundance sampling conducted in Lake Tapps in 2023 and 2024. (ESA 2025a). The relative abundance of aquatic vegetation was recorded as high, moderate, low, or rare to none based on the representative densities of separate species observed at each rake pull sampling point. The results indicate that a wide range of plant density and high species diversity are represented throughout most areas of the Reservoir, and that shoreline armoring is not impeding the overall growth of aquatic plants or limiting species diversity to only one species, such watermilfoil (see Figure 9). The 2025 annual Eurasian watermilfoil management report noted that there has been a substantial increase in the native plant community in the Reservoir (ESA 2025b).

Wildlife

The Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) database previously showed bald eagle and osprey nests around central and southern Lake Tapps Reservoir as well as a historic pileated woodpecker nest near North Park (last seen in 1990) (Cascade Water Alliance 2010). Lake Tapps Reservoir is currently mapped for regular concentrations of waterfowl providing "resting and nesting habitat for hundreds of waterfowl" (WDFW 2025a).

Fish

Native fish in the Puyallup-White River Watershed include bull (*Salvelinus confluentus*), steelhead (*Oncorhynchus mykiss),* and coastal cutthroat (*O. clarki*) trout species and coho (*O. kisutch*), chum (*O. keta*), sockeye (*O. nerka*), pink (*O. gorbuscha*), and Chinook (*O. tshawytscha*) salmon species (Cascade Water Alliance 2010; WDFW 2025a; WDFW 2025b; WDFW and NWIFC 2025). Before 1939, downstream-migrating fish from the White River could be entrained into the Lake Tapps Reservoir due to the lack of a fish screen (Cascade Water Alliance 2010). A rotating drum screen installed in 1939 helped but still posed a risk of injury to fish. In 1996, this was replaced with a vee screen, which diverts fish back to the White River via a bypass channel while allowing water to enter the diversion canal (Flowline). For upstream migration, the Buckley Fish Trap and ladder were built in 1948, the same year Mud Mountain Dam was completed. Returning salmonids are captured at the trap, then transported by truck and released upstream of the Mud Mountain Dam. In 2025, the United States Corps of Engineers completed rebuilding Mud Mountain Dam, which included an Archimedes screw to stop fish from entering the Flowline to the Reservoir.

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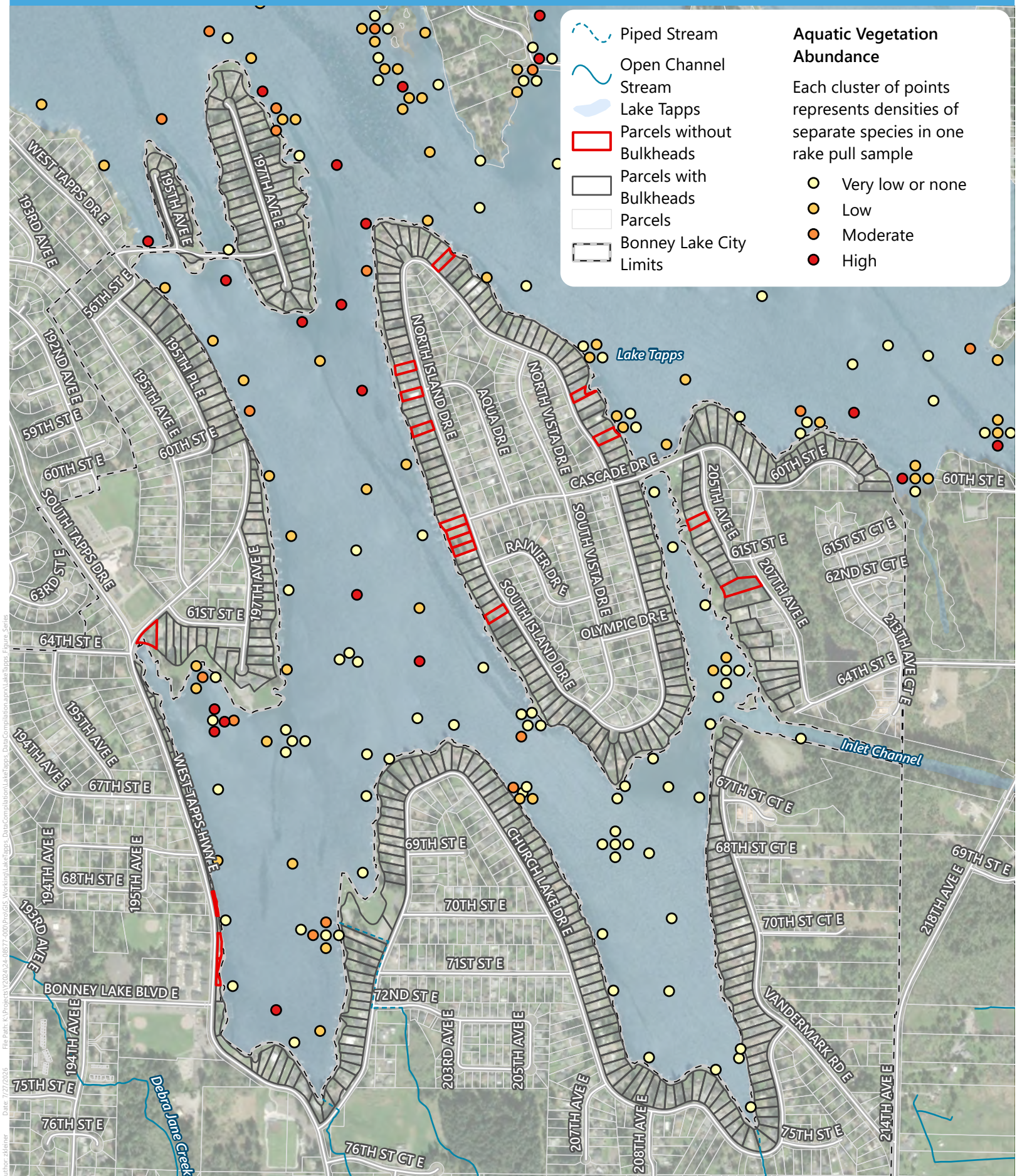
Figure 9. Lake Tapps Reservoir Bulkhead Study, Bonney Lake, WA Aquatic Vegetation.



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Author: zKleiner

Table 2 lists the native cold water and non-native warm water fish species found in the Reservoir (WDFW 2019, 2025a, 2025b; WDFW and NWIFC 2024). WDFW occasionally stocks (plants) the Reservoir with hatchery fish for recreational fishing. There are currently no state or federally listed fish species, or designated critical habitats associated with the Reservoir.

Table 2. Fish Species Documented in the Lake Tapps Reservoir.

Common Name	Scientific Name	Last Year Stocked
Native Fish		
Coho salmon	*Oncorhynchus kisutch*	2001
Kokanee	*Oncorhynchus nerka*	–
Cutthroat trout	*Oncorhynchus clarki*	–
Rainbow trout	*Oncorhynchus mykiss*	2026
Largescale sucker	*Catostomus macroheilus*	–
Mountain whitefish	*Prosopium williamsoni*	–
Sculpin	*Cottus sp.*	–
Red-side shiner	*Richarsonius blateatus*	–
Non-Native Fish		
Black crappie	*Pomoxis nigromaculatus*	–
Bluegill	*Lepomis macrochirus*	–
Common carp	*Cyprinus carpio*	–
Rock bass	*Ambloplites repestris*	–
Smallmouth bass	*Micropterus dolomieu*	–
Tiger musky	*Esox masquinongy* × *E. lucius*	2026
Yellow perch	*Perca flavescens*	–

Source: NWIFC. 2024; WDFW, 2025a, b, 2014.

Ecological Functions Analysis of Proposed Conditions

Climate Change

Changing weather impacts pose a serious challenge to the future water supply from Lake Tapps Reservoir given the significant constraints on operation of the Reservoir (Herrera 2025b). The seasonal pattern of flows in the White River is projected to shift as temperatures warm and precipitation patterns change, resulting in a transition from a snowmelt-driven peak in spring toward higher flows occurring in winter from rainfall runoff. This results in decreased flows in July and August and fewer days when flow is available for diversion into the Reservoir. Glacial melt is projected to temporarily offset the decrease in flows as the higher temperatures cause increasing melt. However, the benefit of flows from increased melt will eventually subside as the glaciers lose volume and retreat.

Cascade will need to adapt its operations to meet changing weather conditions over time. As river flows may decrease over time, Cascade's maintaining the Reservoir at full storage (541.5–543 feet lake stage datum) may be more challenging during the entire high demand season as planned (April 15 through September; see Figure 3), particularly during dry years. Recreational use will change as seasonal water levels within the Reservoir are managed based on regulatory agency requirements to provide continued water supply while also preserving protected fish and wildlife habitats present in the White River system, (exclusive of Lake Tapps and the flume).

It is unlikely that climate change will influence demand for increasing shoreline armoring and bulkhead heights. Environmental regulators are starting to seek strategies for using softer approaches for defending shorelines rather than expanding hard armoring through bulkheads, when feasible. As best available science continues to demonstrate the long-term sustainability and benefits of soft shore defense strategies to accommodate climate change in various environmental conditions, new hard armoring may no longer be a viable permitted option. However, the demand for increasing shoreline armoring in the Study Area will be low because it is already almost entirely (96 percent) armored with bulkheads.

Hydrology

Potential Flooding Impacts

Currently, the reservoir water level is maintained at approximately 542.6 feet and only increased to 543 feet (lake stage datum, which is 0.5 foot greater than NGVD 29 datum) for 1 day per year. When the Reservoir is developed as a municipal water supply, Cascade anticipates extending the period with the water level at 543 feet to the full recreation season to meet the demand.

Herrera reviewed the potential for increased surface water inundation along the City's Lakes shoreline areas based on a small (5-inch) increase in reservoir level from a sustained level at 543.0 feet compared to the current typical summer water level at 542.6 feet (Figure 10). Herrera assumed that existing residences on unarmored parcels are setback at minimum horizontal distances of 10 feet or greater from the OHWM of the Reservoir. Mapping the 5-inch increase in reservoir water from 542.6 feet (see Figure 4) to 543 feet (see Figure 10) did not result in any change from the conditions identified at the current high reservoir level. Additional inundation extending on the shoreline parcels at the higher water elevation did not extend 10 feet horizontally from the Reservoir. Therefore, there is no expected risk of potential flooding of residences on unarmored parcels if Cascade were to increase the Reservoir's summer water level to 543 feet; the higher water level is not expected to create disproportionate impacts to owners of the unarmored parcels.

Increasing the summer water level to 543 feet is not expected to create flooding risk for shoreline residents whether their properties are armored or not.

The predominant soils within the Study Area are not prone to ponding or flooding. Analysis of the site's topography and aerial photos indicates that none of the parcels, armored or unarmored, within the Study Area are at risk of flooding when the Lake Tapps Reservoir elevation reaches its highest level at 543 feet (see Figures 4 and 10).

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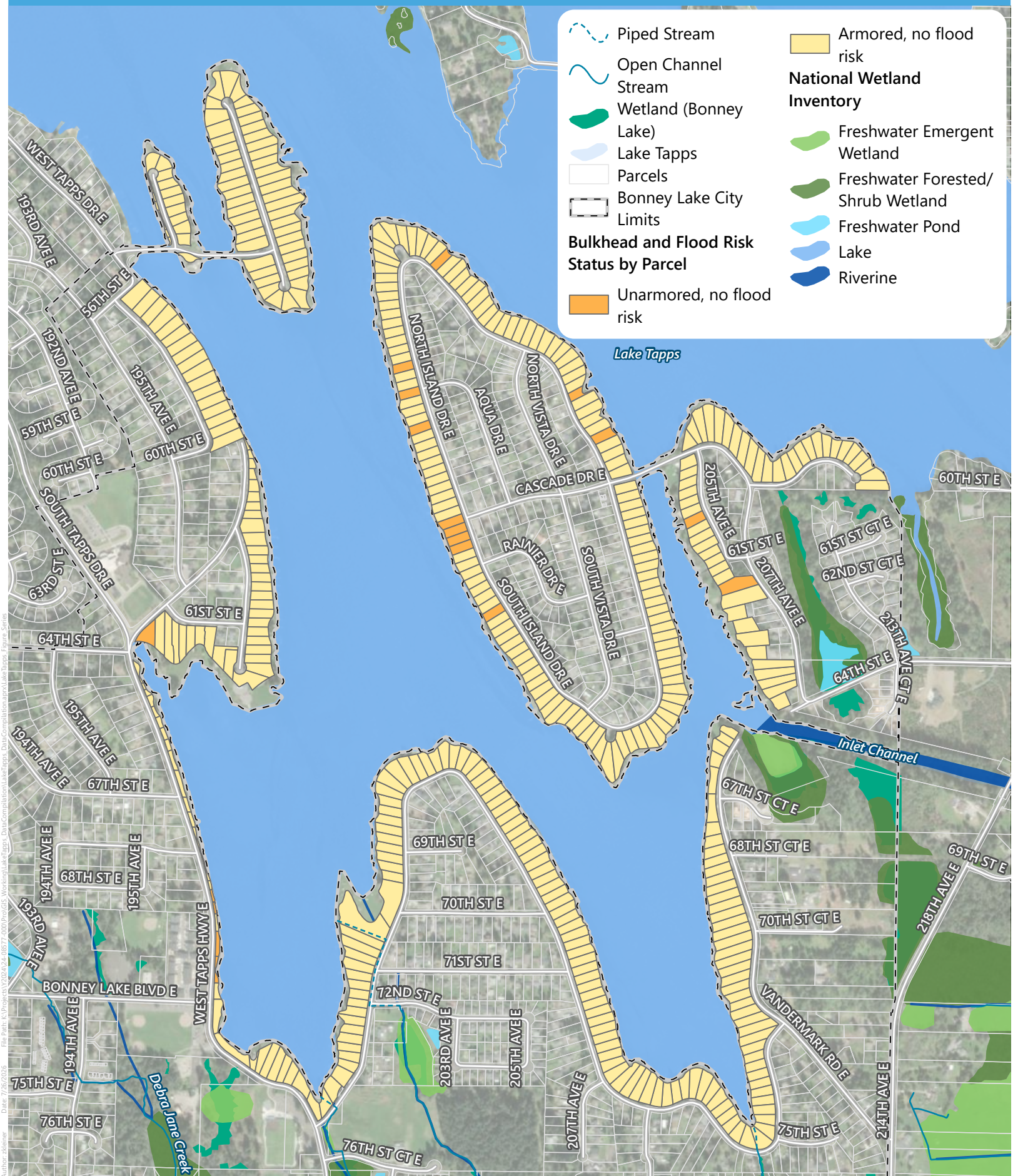
Figure 10. Lake Tapps Reservoir Bulkhead Study, Bonney Lake, WA
Proposed Conditions: 543-ft Future Summer Water Level.



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Wetlands and Streams

The natural conditions of the wetlands and streams are assumed to have been altered by urban development. With exception to the wetland area adjacent to the Reservoir's inlet channel, the direct surface water connections of the mapped wetlands to the Reservoir are interrupted by existing roadways. Direct overtopping of these roadways from increased flooding due to the proposed increased seasonal height in the Reservoir's water level is not anticipated (Figures 5 and 10).

This Study finds that an increase in reservoir level from 542.6 to 543.0 feet and the allowance for limited, in-place increases to the height of existing bulkheads would not result in additional flooding, erosion, water quality degradation, or adverse effects on stormwater systems, fish, wildlife, or shoreline stability.

The City's stormwater infrastructure, which includes multiple mapped stormwater pond facilities, are clustered near streams and the NWI mapped wetlands. Any culvert conveyances or stormwater inlets and outlets are not anticipated to be directly affected by the Reservoir's seasonal rise in water levels.

However, sustaining the Reservoir longer at a higher level may alter wetland hydroperiods associated with the Reservoir, which could alter the ecosystem functions the wetlands provide. The frequency, duration, and depth of inundation are all critical factors in defining the water regime necessary to sustain the existing wetland ecosystems. Wetland hydroperiod (i.e., depth and duration of water) is the most critical factor in shaping wetland type, function, and ecological communities (Mitsch and Gosselink 2015). It directly affects water chemistry, including oxygen and nutrient levels, which in turn influences plant and animal life. Prolonged inundation can stress or kill many plant species due to anoxic soil conditions (Stevens and Vanbianchi 1993), which can reduce species richness, while even small changes in water depth can significantly alter vegetation communities and potentially lead to the establishment of invasive species (Mitsch and Gosselink 2015). Wetlands are highly sensitive to even minor changes in water hydroperiod. A sustained shift in water depth as small as 0.3 meter (0.98 foot) can significantly alter wetland functions and shift the dominant vegetation type, for example, from forest or scrub-shrub to marsh or open water resulting in a change in ecological functions (NRC 1992).

Long-term wetland impacts from climate change are likely to be greater than impacts associated with the proposed water level increase.

An increase of 0.4 foot in the maximum lake level and increase in the duration of high reservoir from 1 day to 5.5 months in April to September could result in changes to the existing wetland conditions. However, climate changes resulting in persistent heat and drought over time is a much greater threat to wetland conditions and functions. As climate change progresses and river flows decline it is likely that diversion rates will be restricted, Reservoir levels will drop below the operational plan (Herrera 2025b), and wetland water levels will decline accordingly, particularly during late summer of dry years.

The action of property owners choosing to raise the heights of their existing bulkheads in situ is not anticipated to result in direct impacts (fill, excavation, vegetation clearing) to wetlands or streams. However, due to the lack of documented environmental baseline conditions, assessing potential effects on wetland and riparian functions associated with changes to vegetation communities and hydro-periods from reservoir level changes are difficult to quantify.

This Study finds that an increase in reservoir level from 542.6 to 543.0 feet and the allowance for limited, in-place increases to the height of existing bulkheads would not result in additional flooding, erosion, water quality degradation, or adverse effects on stormwater systems, fish, wildlife, or shoreline stability. While minor shifts in wetland hydroperiod associated with a sustained higher seasonal water level could result in subtle changes to wetland vegetation composition and associated ecological functions, these changes are anticipated to be limited in extent due to the extensive existing armoring of the shoreline. No new in-water or expanded structural construction footprints are proposed in relation to increasing the heights of the existing bulkheads. Therefore, an increase in the summer reservoir level would not represent a substantial alteration of existing conditions or result in a substantial loss of ecological functions. The City requires property owners to permit their bulkhead projects and any parcels located within the vicinity of mapped wetlands and stream may require site specific assessment reporting that will document the baseline environmental conditions for regulatory review.

Geomorphology

Due to the overall mild wind climate and fetch-limited basin, wind and recreational waves are not expected to increase significantly with a change in the Reservoir's seasonal higher water level. Wind speeds in the summer are generally mild, and wind waves are estimated to be significantly less than one foot and are likely to dissipate prior to reaching the shoreline.

Wake waves from boats are anticipated to be larger than wind waves. Standard recreational boats generate wake waves of 1 to 2 feet at 18–30 mph (St. Anthony Falls Laboratory, University of Minnesota 2020). Jet skis likely produce waves less than 1 foot, but the literature specifically focuses on boats and does not specify wake heights for jet skis. Based on Pierce County's 2005 Boat Management Plan (Pierce County Planning and Land Services 2005), there were 70 percent more motorboats on the reservoir than jet skis (Pierce County Planning and Land Services 2005). Recreational vessels that pose the greatest impacts to water quality and erosion are wake boats, as these generate the biggest waves at the lowest speeds with 1- to 4-foot waves at approximately 10–13 mph (Fay et al. 2022).

Studies have shown that wake zones should consider vessel type, water depth, and distance from the shore to account for environmental impacts such as erosion and turbidity (Fay et al. 2022; Riesgraf et al. 2025; Francis et al. 2023; Daeger et al. 2022). Currently, regulations have established wake free zones for a motorized vessel to be 200 feet with a speed limit of 5 mph (Cascade Water Alliance 2004). However, in many of the shoreline areas in Bonney Lake, the 200-foot gap is not possible or is very narrow and the City receives complaints regarding damage to docks and behind bulkheads due to boat wakes and fast speeds. To minimize environmental impacts, the shoreline wake free zone for standard non-wake boats and jet skis should be set to include restrictions based on boat distances relevant to the City's shoreline configuration, reduced speeds and the water depth (10 feet, for example), such that the magnitude of

wakes generated within the zone will dissipate prior to reaching the shoreline and not be expected to cause significant shoreline erosion to areas that are not currently protected.

If property owners wish to increase their bulkhead heights in response to the higher water levels, there is no significant concern that this change will increase erosion to neighboring properties. A case study from 2009 can be used as a reference to further validate no cause for concern. In 2009, the *Grundy vs. Brack* court case was the result of a Puget Sound shoreline property owner raising their bulkhead above the height of their neighbors, causing the neighbor to be concerned that the change was deflecting wave energy onto their property and cause increased flooding (Findlaw 2025). The court concluded that raising the bulkhead had not caused significant damage to the adjacent property. This case took place on a coastal shoreline with a significantly higher and more dynamic wave climate than Lake Tapps Reservoir, including large wake waves generated by cargo ships. Based on this case study and findings in this report, raising the maximum lake level from 542.5 to 543 feet for a longer duration of time is not a significant concern for increased shoreline erosion or flooding.

There is no significant concern that the increased bulkhead height will increase erosion to neighboring properties.

Water Quality

The Lake Tapps Reservoir Water Quality Management Plan (Herrera 2025a) evaluated how water quality conditions may change when the Reservoir becomes a municipal water supply. A water quality concern is the potential for increased abundance and frequency of algae (cyanobacteria) blooms that negatively impact water treatment operations by clogging filters, increasing chemical use, and increasing the potential for plant failures. produce toxins (specifically cyanotoxins from cyanobacteria), clog filters, and increase treatment costs. Increased algae blooms would also increase the release of cyanotoxins that can harm humans and wildlife and result in closure of the reservoir to recreational uses. The primary cause of future algae blooms would be from the increased phosphorus loading resulting from the increased diversion of White River water into the Reservoir to meet the drinking water demand. Additional phosphorus sources of concern include stormwater inputs from watershed development and the release of phosphorus from Reservoir sediments.

While increased Reservoir inflow rates may negatively impact water quality by increasing the potential for algae blooms from increased phosphorus loading, fluctuating water levels do not impact Reservoir water quality. Herrera (2019) evaluated water quality effects of reservoir operations, focusing on the release of phosphorus from sediments during winter drawdown and the increased phosphorus loading from increased river inflow.

Increased input from the White River containing glacial flour and increased algae growth that may result from phosphorus in that glacial flour, may increase turbidity of the Reservoir (Herrera 2025). Increased turbidity decreases light penetration that may reduce the maximum depth and areal extent of submersed aquatic plant growth in the Reservoir.

This study finds that increasing reservoir water levels and bulkhead heights is not expected to degrade water quality.

Reservoir water quality will not be impacted by increasing the maximum reservoir level or existing bulkhead heights. The sustained higher reservoir levels will not increase wind and recreational waves and, therefore, will not increase wave-induced sediment suspension or soil erosion. Therefore, sustained higher reservoir levels will not increase phosphorus loading, algae blooms, or turbidity from sediment/soil suspension.

Species and Habitat

The proposed raising of the existing bulkhead heights in situ is not anticipated to negatively impact existing wildlife use, or terrestrial or aquatic vegetation in the Study Area. No in-water work is proposed and therefore direct impacts to fish and aquatic habitat are not expected. Although the heights of existing bulkheads may be increased, an extension of existing structure footprints further upland is also not anticipated. The majority of the upland vegetation adjacent to existing bulkheads along the shoreline is primarily maintained as residential lawn and/or landscaping. Tree impacts are not anticipated to result from changes in reservoir level or bulkhead height and the overall low habitat provided by terrestrial vegetation is not anticipated to be significantly changed or degraded in the Study Area.

In accordance with the City's permitting regulations, any exposed soils resulting from temporary construction activities shall be restored and or enhanced with native vegetation (SMP 3.B.11 and BLMC 14.50 and 14.80)

Ecological Functions Analysis Summary

Based on Herrera's review of the baseline and proposed environmental conditions, the in situ modification to increase existing bulkhead heights to accommodate Cascade's anticipated increase in maximum reservoir level from 542.6 feet to 543.0 feet seasonally from around April 15 to September 30 will not result in a significant loss of ecological functions within the City's Lake Tapps Reservoir shoreline jurisdictional area. While the analysis did not indicate any significant change between existing and proposed conditions, minor shifts in wetland hydroperiod associated with higher seasonal water level may result in subtle changes to wetland vegetation composition and associated ecological functions over time.

Potential ecological effects are largely limited to minor wetland hydroperiod changes that may influence vegetation over time.

No significant increases in flooding or erosion are anticipated to occur, and no degradation of water quality, wetlands, streams, native vegetation, fish and wildlife habitats have been demonstrated by the analysis conducted for this Study. Additional focused study and post-implementation monitoring may be warranted to better understand, track, and account for potential longer-term changes to wetland

hydroperiod and vegetation response to hydro period and climate changes, and to inform adaptive management or mitigation strategies if needed.

Based on the analysis of hydrology, wetlands, shoreline stability, water quality, fish and wildlife habitat, and stormwater infrastructure, the proposed allowance for in-place increases to existing bulkhead heights is not anticipated to result in a measurable loss of ecological functions at either the parcel scale or cumulative shoreline scale.

Regulatory Summary

Maintenance and Improvements to Existing Bulkheads

In-water improvements to maintain and improve existing structures, such as docks or bulkheads, typically have a more straightforward and feasible permit pathway than new construction, when sited within the footprint of an existing structure. Maintaining the existing footprint to minimize new impacts to aquatic resources or expanding into upland areas are key to permit approval. For regulatory compliance with the City's SMP, projects must demonstrate 'no net loss' of ecological functions. The following actions may be considered to be a net loss:

- Expanding structure dimensions in aquatic environments
- Changing materials (e.g., concrete where untreated wood used to be)
- Changing use or increasing overwater coverage
- Creating new shading, fill, or hardening

Shoreline Master Program

The City's Shoreline Master Program (SMP), Shoreline Element, and associated development regulations were updated by Ordinance No. 1633, adopted May 12, 2020, and the shoreline development regulations are in BLMC 16.34-58.

The following regulations apply to shoreline stabilization (which includes bulkheads) in BLMC 16.54.020.

A. *New development shall be located and designed to avoid the need for future shoreline stabilization where feasible.*

B.1–5 *New or enlarged structural shoreline stabilization measures to protect an existing primary structure or in support of either a new water-dependent or nonwater-dependent development, including a single-family residence, is allowed only when a geotechnical report demonstrates that nonstructural options are insufficient or infeasible, erosion is caused by natural processes, and upland issues cannot be addressed through other means. This stabilization must be the minimum necessary and justified by a significant risk of damage within three years. The report must also consider site-specific conditions, wave and wind factors, erosion rates, and the environmental tradeoffs of the proposed action.*

C. When structural shoreline stabilization measures are allowed pursuant to Subsection B, the stabilizing measures shall comply will all of the following:

1. New shoreline stabilization measures shall be located at or behind the OHWM. Where a documented area of special flood hazard exists, stabilization measures shall be located at the upland edge of the area of special flood hazard, except that soft stabilization measures may be located in the area of special flood hazard.

2. Soft shoreline stabilization that restores ecological functions may be permitted waterward of the OHWM; provided that the intent is not to create dry land.

3. Hard shoreline stabilization measures may only be used upon demonstration that soft shoreline stabilization measures are not to be sufficient to protect primary structures. The insufficiency and infeasibility of soft shoreline stabilization measures shall be addressed in a geotechnical report utilizing the criteria established in subsection (B)(1) of this section.

4. The construction of a bulkhead or other structural shoreline stabilization measures for the primary purpose of creating dry land is prohibited

5. Adequate toe protection and proper footings shall be provided to ensure bulkhead stability without relying on additional riprap.

6. Bulkheads shall be designed to permit the passage of surface water or groundwater without causing ponding or oversaturation of retained soil/materials of lands above the OHWM.

7. Fill behind bulkheads shall be limited to the minimum level necessary to fill the terrain behind the bulkhead to match the existing grade. Any filling in excess of this amount shall be considered landfill and shall be subject to the provisions for landfill and the requirement for obtaining a shoreline substantial development permit.

D. 1–6. Materials that are prohibited for shoreline stabilization structures include: degradable plastics and other nonpermanent synthetic materials; sheet materials, including metal, plywood, fiberglass, or plastic; broken concrete, asphalt, or rubble; car bodies, tires or discarded equipment; solid waste; and wood, timbers or other materials treated or coated with herbicides, fungicides, paint, pentachlorophenol arsenate compounds or creosote.

E. Existing shoreline stabilization structures may be replaced with a similar structure if all of the following are demonstrated:

1. The replacement structure shall be designed, located, sized, and constructed to assure no net loss of ecological functions.

2. Replacement walls or bulkheads shall not encroach further waterward of the OHWM or existing structure unless the residence was occupied prior to January 1, 1992, and there are overriding safety or environmental concerns. In such cases, the replacement structure shall abut the existing shoreline stabilization structure.

3. *For purposes of this section, "replacement" means the construction of a new structure to perform a shoreline stabilization function of an existing structure which can no longer adequately serve its purpose. Additions to or increases in size or height of existing shoreline stabilization measures shall demonstrate compliance with subsection B of this section. (Ord. 1491 § 15, 2014)*

The City's Shoreline Management Regulations provides that improvements, such as bulkheads, which were in existence prior to October 16, 2014, are considered legally conforming. This date was chosen because it is the date of the baseline ecological condition by which the standard of no net loss was set by the City. Bulkheads determined to be legally conforming under BLMC Section 16.56.150 are still required to comply with current regulations when the bulkhead is repaired, replaced, or rehabilitated.(Ord. 1491 § 16, 2014; Ord. 1633 § 41, 2020)

Critical Areas Ordinance

The City of Bonney Lake Municipal Code (BLMC) regulates wetlands; aquifer and wellhead protection areas; frequently flooded areas; geologically hazardous areas; and fish and wildlife habitat conservation areas (including streams), as defined by the State of Washington (RCW 36.70A; BLMC Title 16.20–16.30). BLMC Title 16.20–16.30 specifies methods for identification, classification, and protection of these resources, including buffers and development restrictions, as well as requirements for avoidance, minimization, and compensatory mitigation of impacts.

Disclaimer

Herrera Environmental Consultants, Inc. (Herrera) has prepared this report for use by Cascade. The results and conclusions in this report represent the professional opinion of Herrera based on its examination and data analysis of public domain information.

For this project, Herrera did not delineate shoreline, wetlands or stream boundaries. Final determination of jurisdictional shoreline, wetland, shoreline, or stream boundaries pertinent to environmental regulation are the responsibility of City of Bonney Lake and Ecology.

Discussion of regulatory implications in this section are made based on applicability of regulations in place at the time of this report.

Appendix A

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