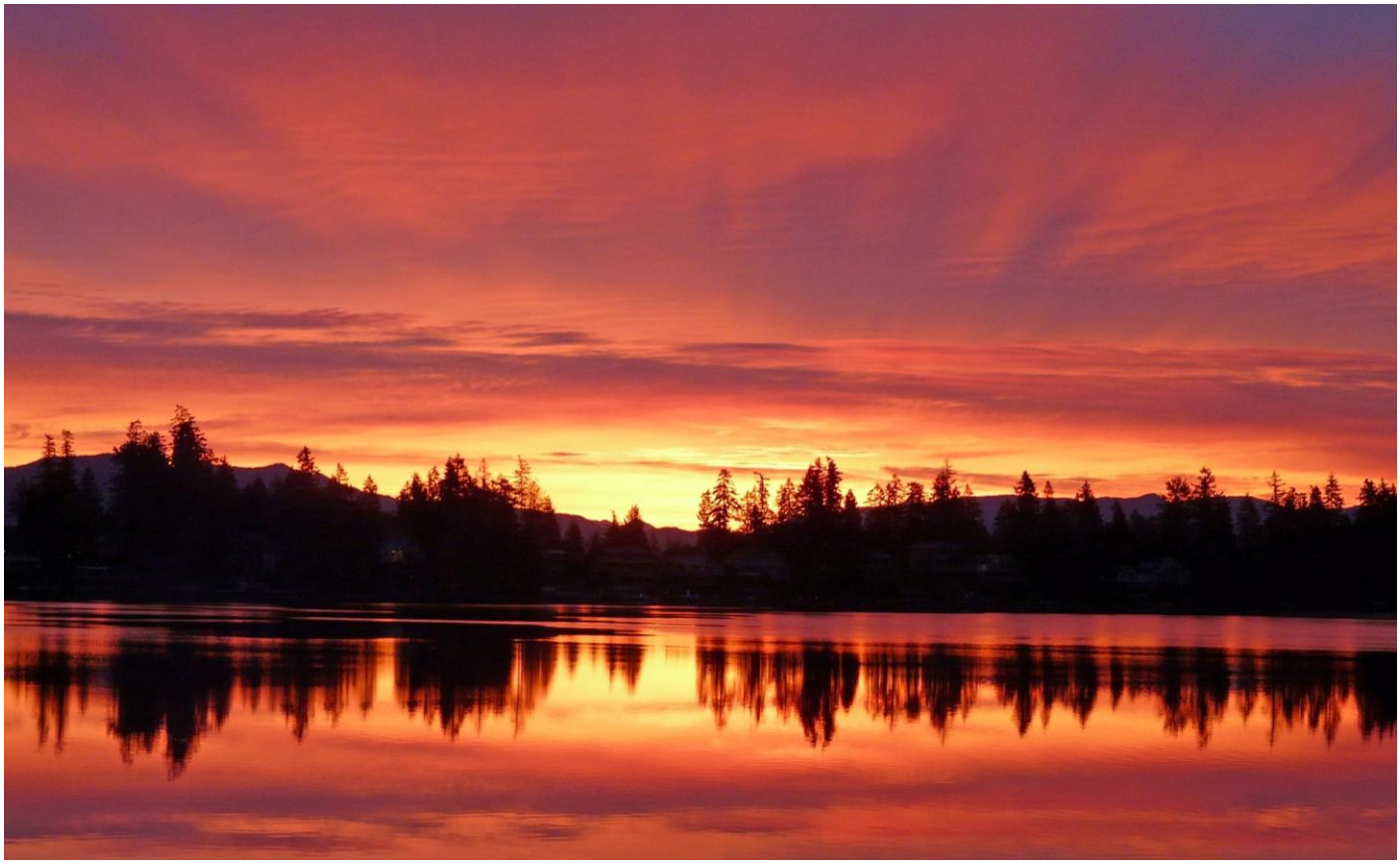
Draft

LAKE TAPPS RESERVOIR

Integrated Aquatic Vegetation Management Plan

Prepared for
Cascade Water Alliance

December 2024



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Acronyms and Other Abbreviations

Acronym or Abbreviation	Definition
AIS	Aquatic invasive species
BAT	Best Available Technology
Cascade	Cascade Water Alliance
DOM	Dissolved Organic Matter
Ecology	Washington Department of Ecology
EDRR	Early Detection and Rapid Response
EPA	US Environmental Protection Agency
ESA	Environmental Science Associates
HAB	Harmful Algal Bloom
HOA	Homeowner association
IAVMP	Integrated Aquatic Vegetation Management Plan
MIB	2-methylisoborneol
Milfoil	Eurasian Watermilfoil
OHWM	Ordinary High-Water Mark
Policy Framework	Cascade's Drinking Water Quality Policy Framework
PSE	Puget Sound Energy
SD	Secchi Disc
THMs	Trihalomethanes
WRIA	Water Resource Inventory Area

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LAKE TAPPS RESERVOIR

Integrated Aquatic Vegetation Management Plan

Purpose

The purpose of the Lake Tapps Integrated Aquatic Vegetation Management Plan (IAVMP) is to provide for a long-term, adaptive management strategy for aquatic plants in the Lake Tapps Reservoir that is cost effective, ecologically sustainable, and maintains the reservoir's water quality.

Executive Summary

In 2009, Cascade Water Alliance (Cascade) purchased the Lake Tapps Reservoir from Puget Sound Energy (PSE) as a source of future drinking water supply for Cascade's member agencies. Although the reservoir is unlikely to be used for this purpose for several decades, it is critical to protect the water quality today to avoid having to restore it in the future.

Currently, the Lake Tapps Reservoir is used for recreation (e.g. swimming, boating, fishing), fish and wildlife habitat, aesthetics, and wildlife viewing. Most lake-users are waterfront property owners, homeowner association members, and residents from the Seattle metropolitan area. The vast majority of the shoreline is developed with residential properties.

Data from 2004 to 2021 indicates that the trophic status[1] of the Lake Tapps Reservoir has been oligotrophic (low biological activity) to mesotrophic (moderate biological activity) (Herrera 2022). This low to moderate biological activity shows that the reservoir is currently in a healthy state. Maintaining high water quality in the Lake Tapps Reservoir is important for Cascade's future use as a drinking water source as well as for current and future recreational purposes. Keeping the reservoir in a healthy state could help lower capital and operating costs of removing contaminants, including taste and odor compounds, at the future treatment plant and reduce the risk of service disruptions.[2]

It is critical to protect the water quality in the Lake Tapps Reservoir today to avoid having to restore it in the future.

Eurasian watermilfoil (*Myriophyllum spicatum*) (milfoil) is a highly invasive, non-native aquatic plant and has been prevalent in the Lake Tapps Reservoir since PSE's ownership. Today, it is by far the most problematic aquatic plant in the reservoir. Classified as a Class C (non-regulated) noxious weed by Pierce County, the County recommends controlling milfoil. Milfoil is very aggressive and can form dense mats

[1] Trophic status is a measure of the overall biological productivity in a body of water. It is a key indicator of water quality and is based on the total biomass of living organisms in the water at a given time.

[2] Higher levels of contamination in raw water can result in operational problems in water treatment plants, such as filters getting clogged, which in turn could result in service disruptions.

on the water surface that interfere with navigation, disrupt natural water flow and mixing, limit light for native plants, clog water in-takes, and disrupt recreational activities. Importantly, when milfoil dies back in the fall, the decaying plants use up dissolved oxygen, adding nutrients to the water that potentially increase algae growth and related water quality problems (King County 2010).

In 2010, Cascade completed its first *Integrated Aquatic Vegetation Management Plan* (IAVMP). At that time, milfoil was classified by the State of Washington and Pierce County as a Class B noxious weed, requiring control. As such, the 2010 IAVMP's goal was to develop a long-term strategy to eradicate milfoil in the Lake Tapps Reservoir, and Cascade began treating milfoil with herbicides along with other control measures. By 2015, Pierce County no longer regulated milfoil. Thus, Cascade's 2015 IAVMP had a goal of implementing approaches that would result in a low density of milfoil populations. After evaluating various methods of control, the 2015 IAVMP recommended the continued application of herbicides to reduce milfoil populations.

As with the 2015 IAVMP, the 2025 IAVMP has a 10-year planning horizon and is a living document. The goal of the 2025 IAVMP is to provide a long-term, adaptive management strategy for aquatic plants in the Lake Tapps Reservoir that is cost effective, ecologically sustainable, and maintains the reservoir's water quality. While the 2025 IAVMP continues to focus on controlling milfoil, it also recognizes the need to identify and manage other nuisance aquatic plants to meet the Plan's goal.

In the summers of 2023 and 2024, Cascade conducted a reservoir-wide survey of aquatic plants. In total, 18 aquatic plant species were identified at 412 sampling points. Of the 18 species identified, four (including milfoil) were non-native. Among the most prevalent native species was native pondweed, whose population has increased over the past few years.

Since continued effective management of aquatic plants is key to keeping the reservoir healthy and from moving to a state of high biological activity (eutrophication), the 2025 IAVMP has three objectives:

1. Continue to maintain a low density of milfoil using the most cost-effective and environmentally friendly method(s) available.
2. Minimize or prevent overgrowth of other non-native plants (as well as over-production of nuisance native species) that are not currently prevalent in the Lake Tapps Reservoir through early detection and management.
3. Identify new aquatic plant infestations early and minimize introductions.

To achieve these objectives, the 2025 IAVMP makes two recommendations:

1. Continue the use of herbicides to control milfoil and other invasive, non-native plants.
2. Conduct reservoir-wide surveys on a regular basis to monitor the presence and absence of milfoil as well as other non-native and native nuisance plants to prevent infestations and overgrowth.

Cascade has a formal Drinking Water Quality Policy Framework (Policy Framework), a process to evaluate potential water quality actions. Cascade applied its Policy Framework to both recommendations and determined that both enable Cascade to maintain high water quality in the reservoir. The second recommendation is limited to surveys. If Cascade identifies issues with potential overgrowth of other nuisance plants during the surveys, it will apply the Policy Framework before taking action.

Problem Statement

Cascade purchased the Lake Tapps Reservoir in 2009 from Puget Sound Energy (PSE) as a source of future drinking water supply for its member agencies. Although the reservoir is unlikely to be used for the purpose for several decades, it is important to protect the water quality today to avoid having to restore it in the future.

Eurasian watermilfoil (*Myriophyllum spicatum*) (milfoil), a highly invasive aquatic plant, has been prevalent in the Lake Tapps Reservoir since PSE's ownership. Milfoil is capable of growing in up to 30 feet of water but typically grows in one to 15 feet. It primarily spreads by stem fragments that can produce new roots and root crowns. Milfoil is very aggressive and can form dense mats on the water surface that interferes with navigation, disrupts natural water flow and mixing, limits light for native plants, clogs water in-takes, and disrupts recreational activities. Studies have shown diminished lakefront property values on the order of <1% to 19% with incremental increased in milfoil abundance (Zhang et al. 2010, Olden et al. 2014).

Continued effective management of milfoil, as well as other invasive aquatic vegetation, is a key to protecting the Lake Tapps Reservoir's water quality for future municipal supply and current beneficial uses.

Importantly, when milfoil dies back in the fall, the decaying plants use up dissolved oxygen, adding nutrients to the water that potentially increase algae growth and related water quality problems (King County 2010). Through annual chemical treatment, Cascade has maintained a low density of milfoil in the reservoir. Continued effective management of milfoil, as well as other invasive aquatic vegetation, is a key to protecting the reservoir's water quality for future municipal supply.

Cascade has no regulator obligations or contractual obligations with the Lake Tapps Reservoir community, Tribes, or other stakeholder to control milfoil. Nonetheless, as noted above, keeping milfoil and other invasive vegetation growth in check provides current operational and future drinking water quality benefits to Cascade[2]. Controlling milfoil also maintains the ecological balance of the reservoir (protecting native plants and fish) and provides beneficial uses to the community in the form of swimming, boating, fishing, aesthetics, fish and wildlife habitat, and wildlife viewing.

Protecting Water Quality for Future Municipal Use

Trophic status is a measure of the overall biological productivity in a body of water. It is a key indicator of water quality and is based on the total biomass of living organisms in the water at a given time. Herrera Environmental Consultants (Herrera) carried out two years of baseline/routine water quality monitoring in the Lake Tapps Reservoir during water years (WY) 2020 and 2021 as part of Cascade's long-term Water Quality Monitoring Program (WQMP) (Herrera 2022).

Looking at data from 2004 to 2021, the trophic status of the Lake Tapps Reservoir has been in the oligotrophic (low biological activity) to mesotrophic (moderate biological activity) range (Herrera 2022). There have been minor algal blooms in Lake Tapps Reservoir. An unusual bloom was reported by reservoir residents in April 2021 and species of cyanobacteria were observed in the reservoir, although

infrequently, in 2020 and 2021 (Herrera 2022). This low to moderate biological activity shows the Lake Tapps Reservoir is currently in a healthy state, and continued effective management of aquatic plants is key to keeping the reservoir healthy and from moving into the state of high biological activity (eutrophication). Eutrophication occurs when excessive nutrient enrichment of a water body can lead to water quality issues such as the formation of harmful algal blooms (HABs), excessive algal blooms and scums, low water clarity, and the depletion of oxygen levels. Sources of nutrients, primarily phosphates and nitrates, may include watershed inputs, failing septic systems, agriculture, stormwater runoff, animal waste, and the decay of aquatic plants. Submersed aquatic plants, such as milfoil, that are rooted in the lakebed, obtain most of their nutrients from the sediment, which is returned to the water column when the plants decompose and is available for algae growth (King County 2010). Over time, this repeated contribution of nutrients, regardless of source, can lead to ecosystem imbalance and potentially eutrophication.

In addition to reduction in nutrient inputs, controlling milfoil and the overgrowth of other non-native plants (and potentially overgrowth of natives) is key to slowing down eutrophication.

Water supply reservoirs with high concentrations of dissolved organic material (DOM) may result in high levels of chlorinated organic molecules (contaminants) such as trihalomethanes (THMs) in finished drinking water (Cooke and Carlson 1990). A shift to a eutrophic state will see an increase in oxygen demand in deeper water, increased plant growth which, for water supply reservoirs, can result in diminished raw water quality, loss of reservoir volume, increased THM precursors, increased taste and odor problems associated with geosmin and MIB (2-methylisoborneol) produced by cyanobacteria, and increased drinking water treatment cost (Cooke and Carlson 1990). Although the Lake Tapps Reservoir is currently a low productivity waterbody with good water quality, there have been detections of cyanobacteria and the taste and odor compound, geosmin (Herrera 2020).

In nearby Spanaway Lake, also in Pierce County, there have been nearly annual exceedances of state recreational guidelines for microcystin. Microcystins are the most commonly measured and detected cyanotoxins and are potent liver toxin and possible human health carcinogen (EPA 2024). On August 20, 2024, Spanaway Lake was closed due to toxic algae. That closure was lifted September 30, 2024, following treatment with algaecide and lanthanum (a phosphorus-inactivation agent). At the national level, it was estimated that in Lake Waco (Texas) the city incurred an estimated $70 million between 2002 and 2012 to address tap water taste and odor problems associated with algae blooms (Dunlap 2015).

Management Goal and Objectives

Cascade's goal is to continue to protect water quality in the Lake Tapps Reservoir to ensure long-term sustainable supplies for a variety of uses, with priority placed on future municipal water supply.

To achieve this goal, Cascade aims to continue to manage nutrient loading in the Lake Tapps Reservoir through the following objectives:

Maintain a low density of milfoil using the most cost-effective and environmentally friendly method(s) available.

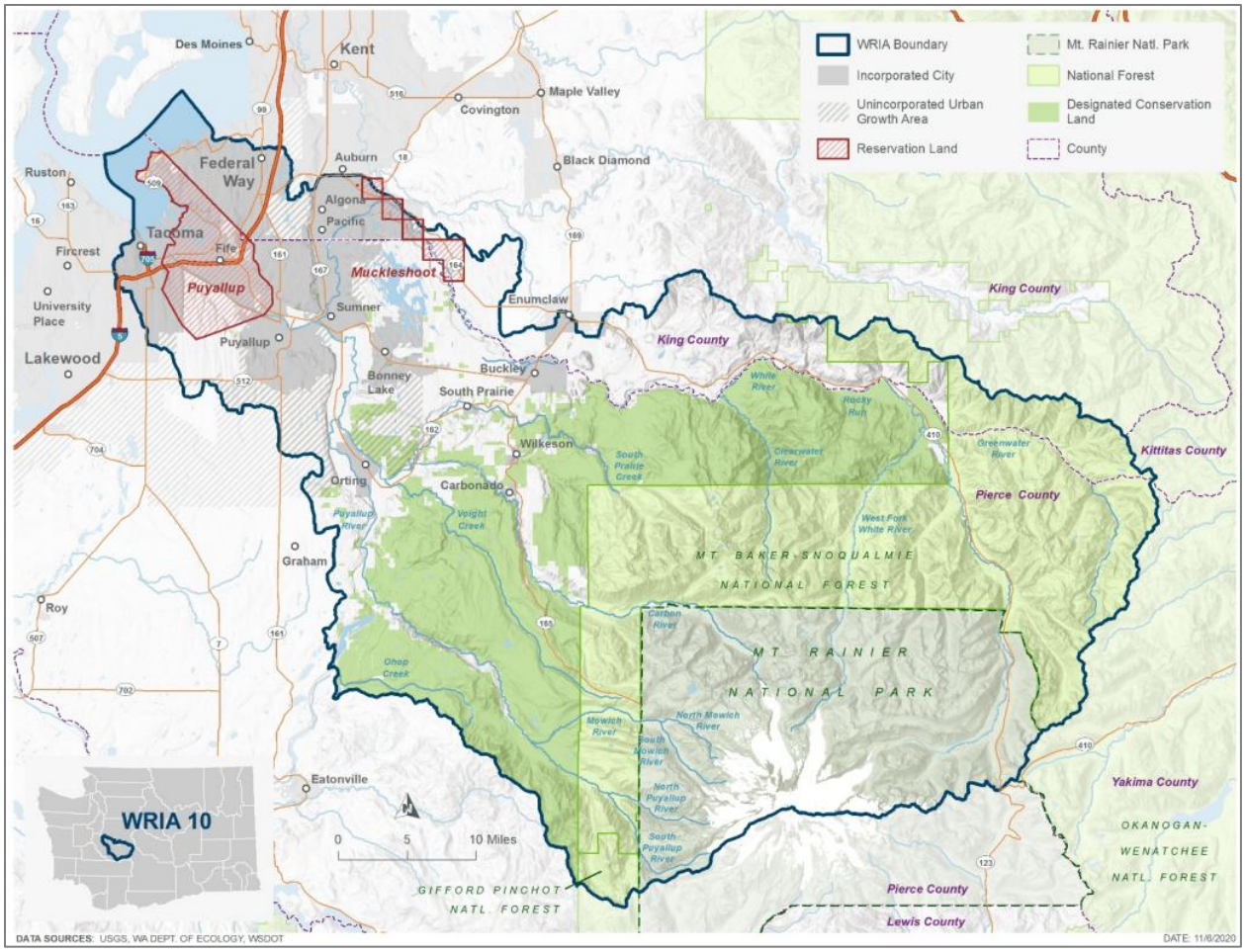
Minimize or prevent overgrowth of other non-native plants (as well as over-production of nuisance native species) that are not currently prevalent in the Lake Tapps Reservoir through early detection and management.

Identify new aquatic plant infestations early and minimize introductions.

Watershed and Waterbody Characteristics

Watershed Characteristics

The Lake Tapps Reservoir is east of Tacoma, Washington, near the cities of Bonney Lake and Auburn in north central Pierce County. It is in the northwestern portion of the Puyallup-White River Water Resource Inventory Area (WRIA) 10) (**Figure 1**). WRIA 10 covers 1,000 square miles and drains the Puyallup, Carbon, and White Rivers to Commencement Bay and Puget Sound in Tacoma (Ecology 2021). The southeastern portion of the WRIA is heavily forested while the western portion is characterized as urban and agricultural. The area adjacent to the Lake Tapps Reservoir is predominantly urban (residential and commercial) with some forested and agricultural areas. The area adjacent to the White River is primarily classified as forest (evergreen and mixed) and barren. The Lake Tapps Reservoir is considered a Shoreline of Statewide Significance as it has a surface acreage of 1,000 acres or more measured at ordinary high-water mark (OHWM) (Pierce County 2024).



Source: Ecology, 2021.

Figure 1

WRIA 10 Vicinity Map and Land Uses

Lake Tapps Reservoir Characteristics

The region currently occupied by the Lake Tapps Reservoir was once four lakes (Tapps, Kirtley, Crawford, and Church Lakes) (**Figure 2**). Early in the1900s, Puget Sound Power and Light's White River Power Plant Project constructed a dynamic system of dikes, flumes, diversions, pipes and valves (**Figure 3**) constructed around the four lakes to form the Lake Tapps Reservoir. This context may explain some of its shoreline bathymetric complexity (**Figure 4**).

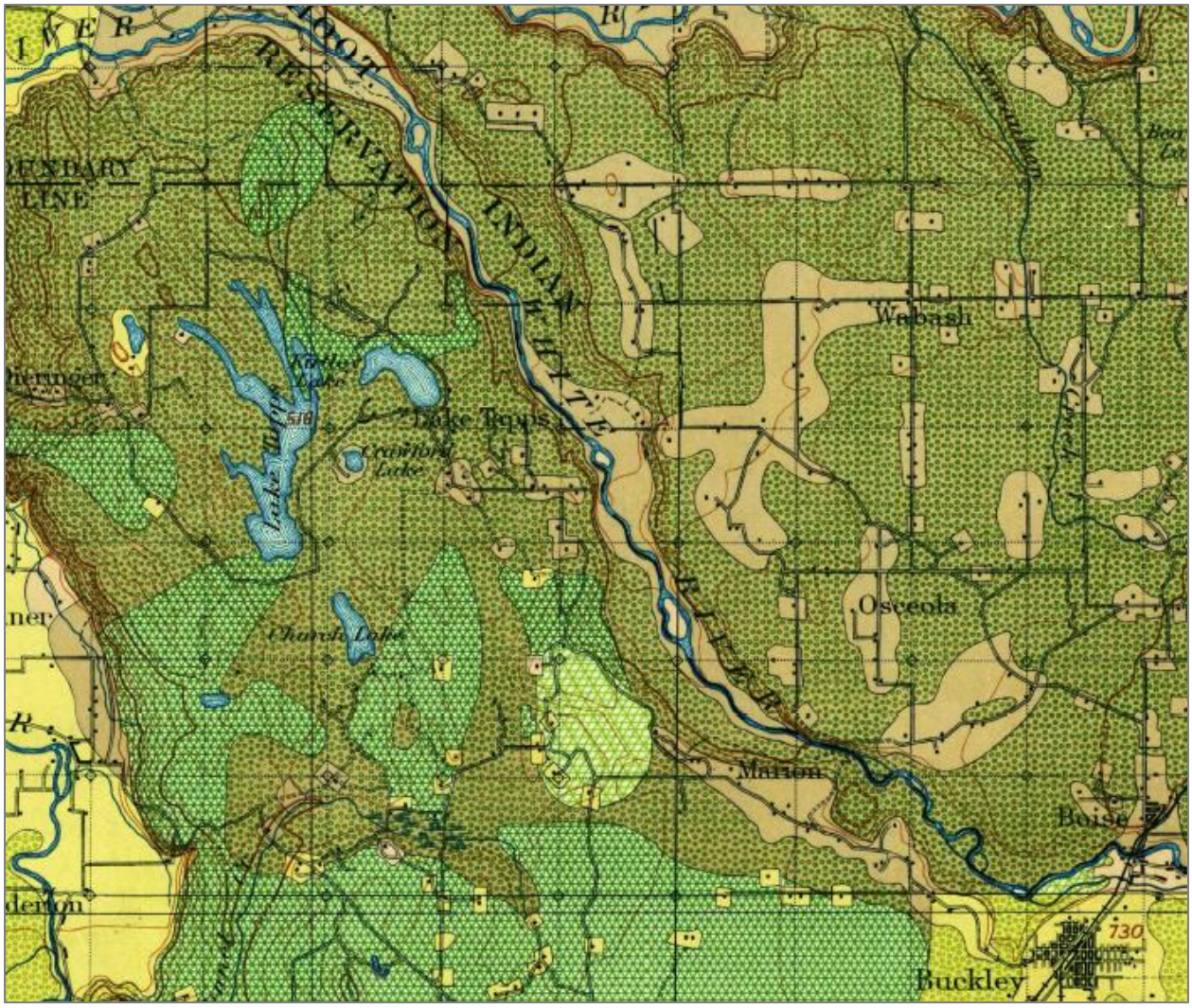


Figure 2

U.S. Geological Survey map, dated April 12, 1900, prior to the construction of infrastructure that formed the Lake Tapps Reservoir.

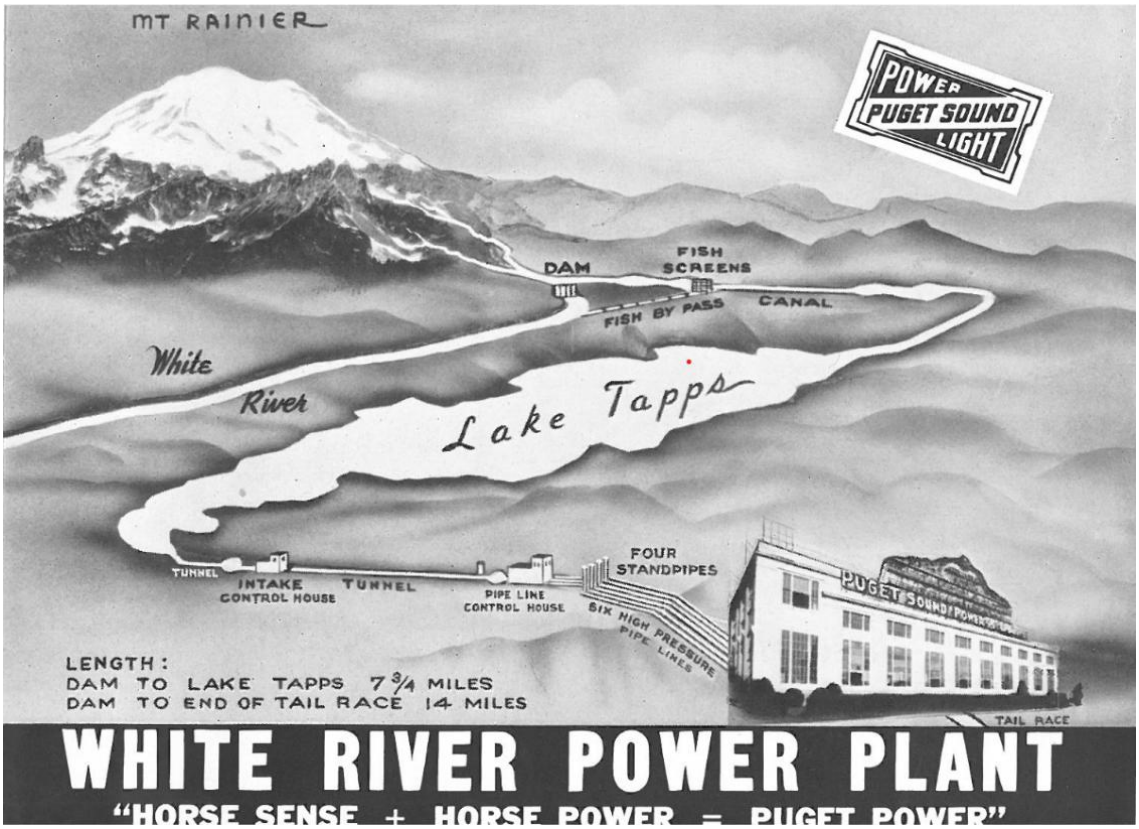
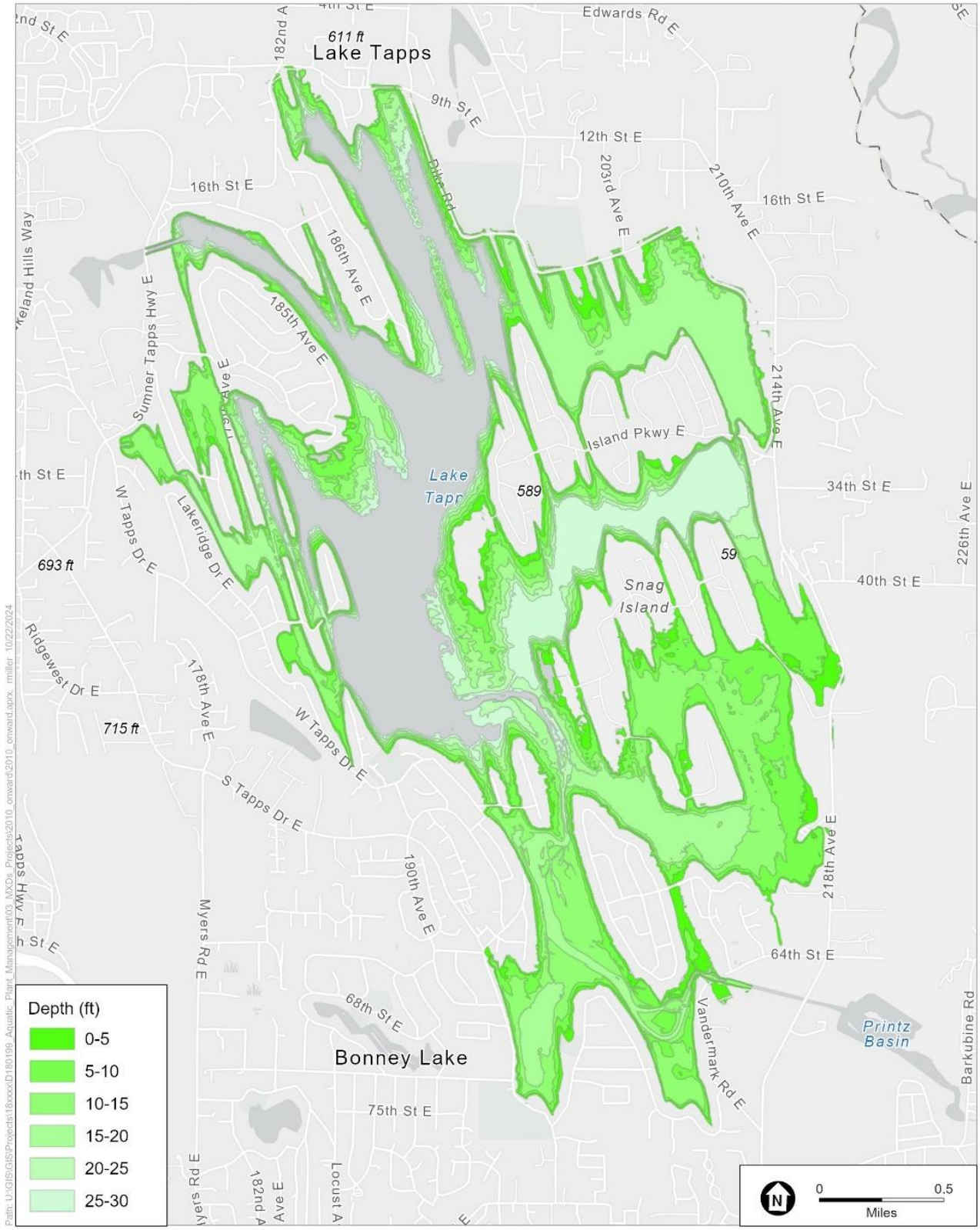


Figure 3
Early public outreach materials for Puget Sound Power and Light's White River Power Plant Project.

The historical and current source of water to the Lake Tapps Reservoir is the White River (**Figure 5**). The water quality of the Lake Tapps Reservoir is largely characterized by the chemical and biological attributes of the White River. The White River originates from the Emmons and Fryingpan Glaciers of Mount Rainer and contributes a significant bedload and suspended sediment load to the lake. When Lake Tapps was operated for power production, large diversions from the White River carried a high suspended solids load to the lake. Also at that time, hydraulic residence time at mean flow (949 cfs) was approximately 36 days and decreasing to 17 days at maximum flow (2,000 cfs) (Mueller 1997). Inflows were reduced in 2004-2006, averaging 159 cfs, which produced a residence time of 277 days. As a result of reduced suspended solids and the nearly sevenfold decrease in residence time, summer Secchi disc (SD) transparency during 2004-2006 increased from a historical average of 1 to 3.1 meters, allowing more light penetration for aquatic plant growth.

Until 2004, the reservoir was operated as a hydropower facility by PSE, with water released back to the White River through a tailrace canal on the reservoir's west side. When the reservoir was used for hydropower generation, water flow in the 20.7 miles of White River between the diversion dam and tailrace was often reduced to 30 cfs in the White River, resulting in impacts to water quality and the native fisheries.



Source: ESRI, 2024

Figure 4

Bathymetric map of the Lake Tapps Reservoir in 5-foot increments.

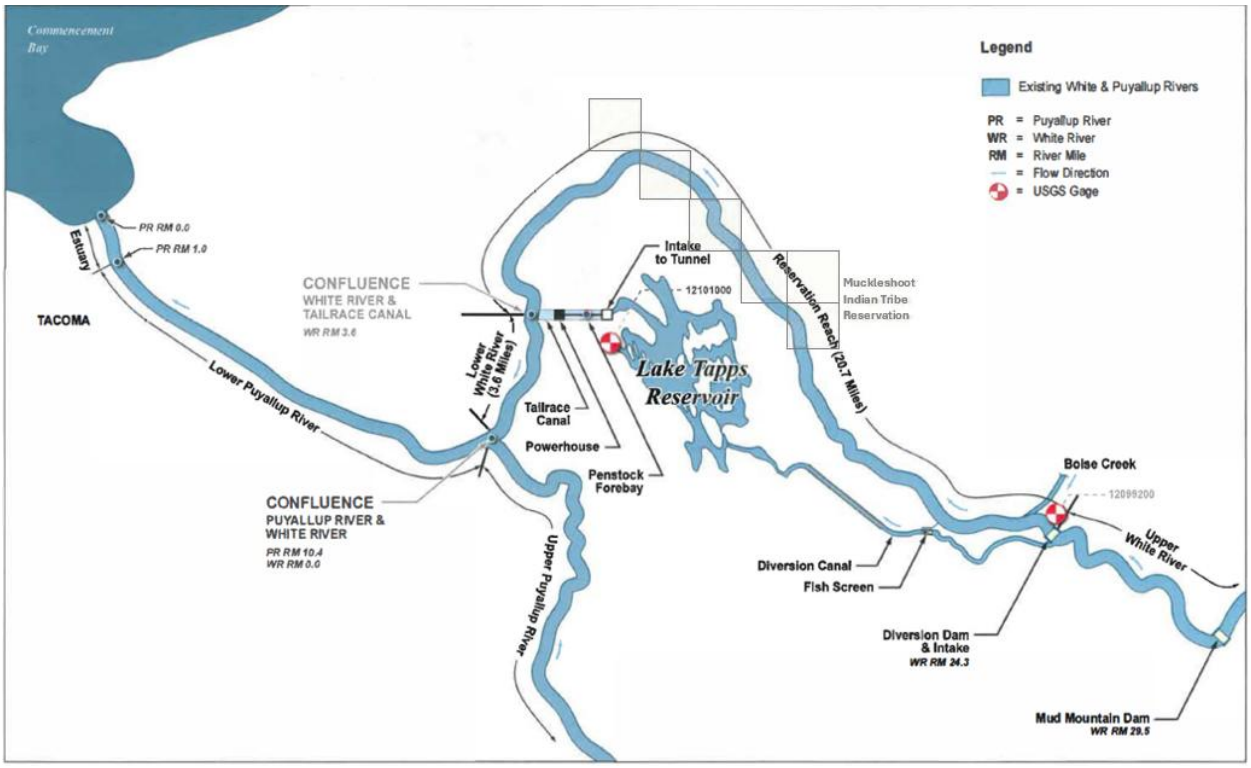


Figure 5
Schematic of water inflow and outflow at the Lake Tapps Reservoir.

Over time, instream flow requirements were increased, and due to the difficulty of generating enough power with the higher instream flow requirements, PSE decided to stop generating power in 2004.

Cascade purchased the Lake Tapps Reservoir in 2009 and negotiated increased instream flows with the Tribes with the 2008 White River Management Agreement. This resulted in even longer water residence time and increased water clarity in the Lake Tapps Reservoir, which potentially contributed to the more prolific growth of submersed aquatic vegetation.

Since 2009, water has been diverted from the White River from April 15 to October 31 to maintain recreational water levels in the Lake Tapps Reservoir at "normal full pool" (elevation 541.5 to 543 feet) per an agreement with the Lake Tapps Reservoir community.

The Lake Tapps Reservoir is routinely drawn down in the winter, typically from November 1 to February 1 (**Figure 6**). This drawdown period is used to conduct maintenance and repair work on the dikes and other operational structures, and to ensure that waves from severe winter storms do not overtop the reservoir's dikes. These drawdowns have been attributed to reducing the presence of invasive aquatic plants; however, it should be noted that rainfall during the drawdown months coupled with the temperate climate does not contribute to a decrease in plant abundance or density.

The Lake Tapps Reservoir has a surface area of 2,750 acres with the capacity to impound 46,700 acre-feet of water. The maximum depth is 80 feet with a mean depth of roughly 25 feet. The reservoir has approximately 45 miles of complex shoreline characterized by numerous islands and peninsulas.

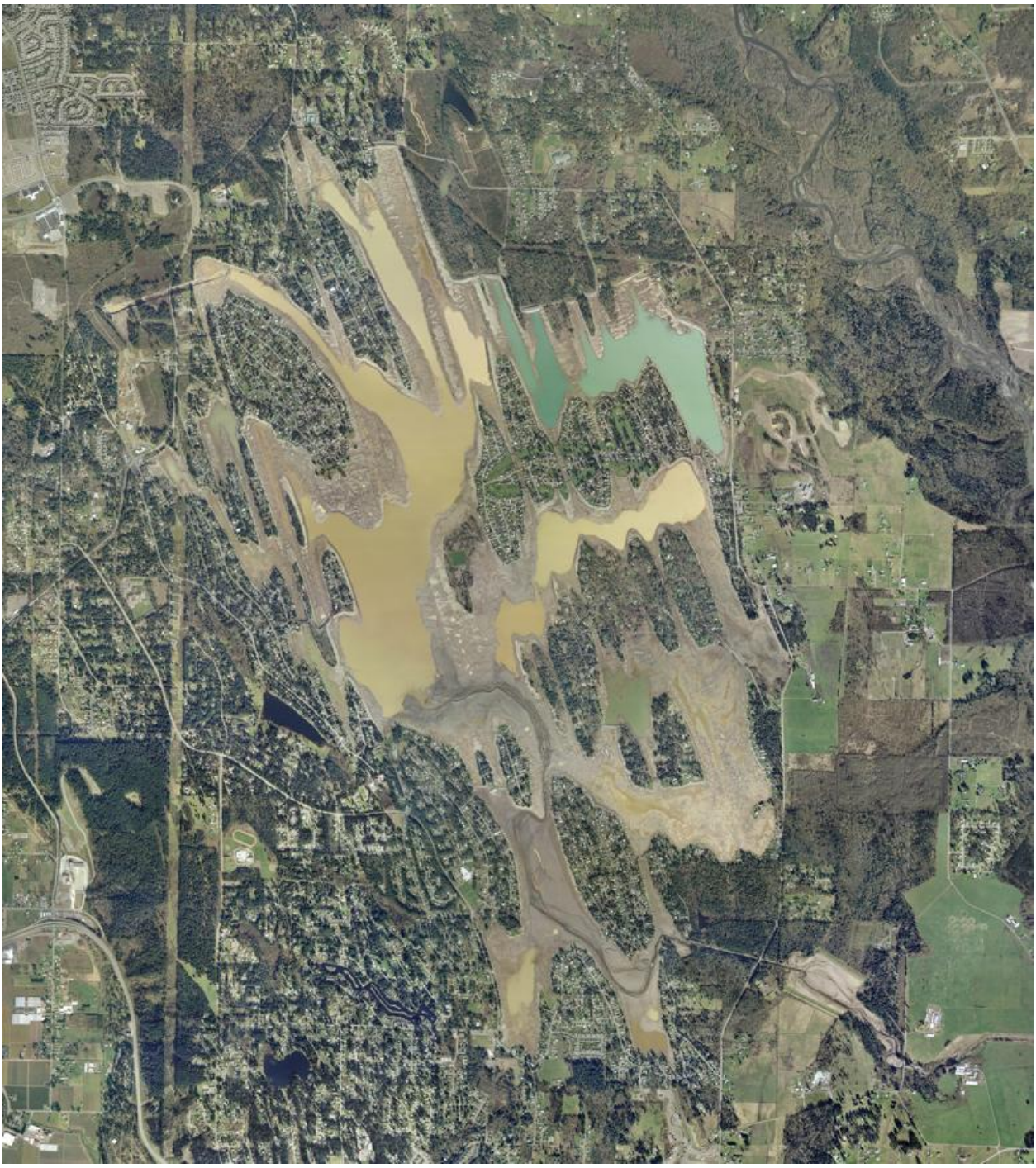


Figure 6
Aerial imagery from 2015 when the Lake Tapps Reservoir was drawn down for infrastructure repairs.

Approximately 1,600 residences are immediately adjacent to the Lake Tapps Reservoir with about 5,050 residences within a quarter mile of the lake. Much of the shoreline is characterized by cobble and gravel sediment bars with extensive armoring and numerous private boat launches. Silty sediment is more common to backwater areas and channels between islands.

Beneficial Uses of Lake Tapps Reservoir

Current beneficial uses of the Lake Tapps Reservoir include swimming, boating, fishing, aesthetics, fish and wildlife habitat, and wildlife viewing. The reservoir also provides views of Mount Rainier. Warm water fish species (largemouth bass, smallmouth bass, and yellow perch), rainbow trout, and tiger musky are popular sport fisheries at the reservoir. There are two public parks with boat launches on the reservoir: North Lake Tapps Park and Allan Yorke Park, with numerous access points for other recreational activities such as picnic facilities, playgrounds, athletic fields, hike/bike trails, and golf (**Figure 7**). Most resrvoir-users are waterfront property owners, homeowner association members, and residents from the Seattle metro area. The vast majority of the shoreline is developed with residential properties.

The vast majority of the Lake Tapps Reservoir shoreline is developed with residential properties, and beneficial uses include swimming, fishing, boating, and fish and wildlife habitat.

The Washington Department of Natural Resource (WDNR) Heritage Program database was reviewed. No rare species or rare and high-quality ecosystems, known as Element Occurrences (EOs), was found (WDNR 2024). Inclusion of rare plant communities could require additional protections.

Cascade purchased the Lake Tapps Reservoir as a source of future drinking water supply for its member agencies, with the purpose of meeting Cascade's mission to provide clean, safe, and reliable drinking water. At this time, Cascade expects to use the Lake Tapps Reservoir for municipal supply starting in the 2060s.

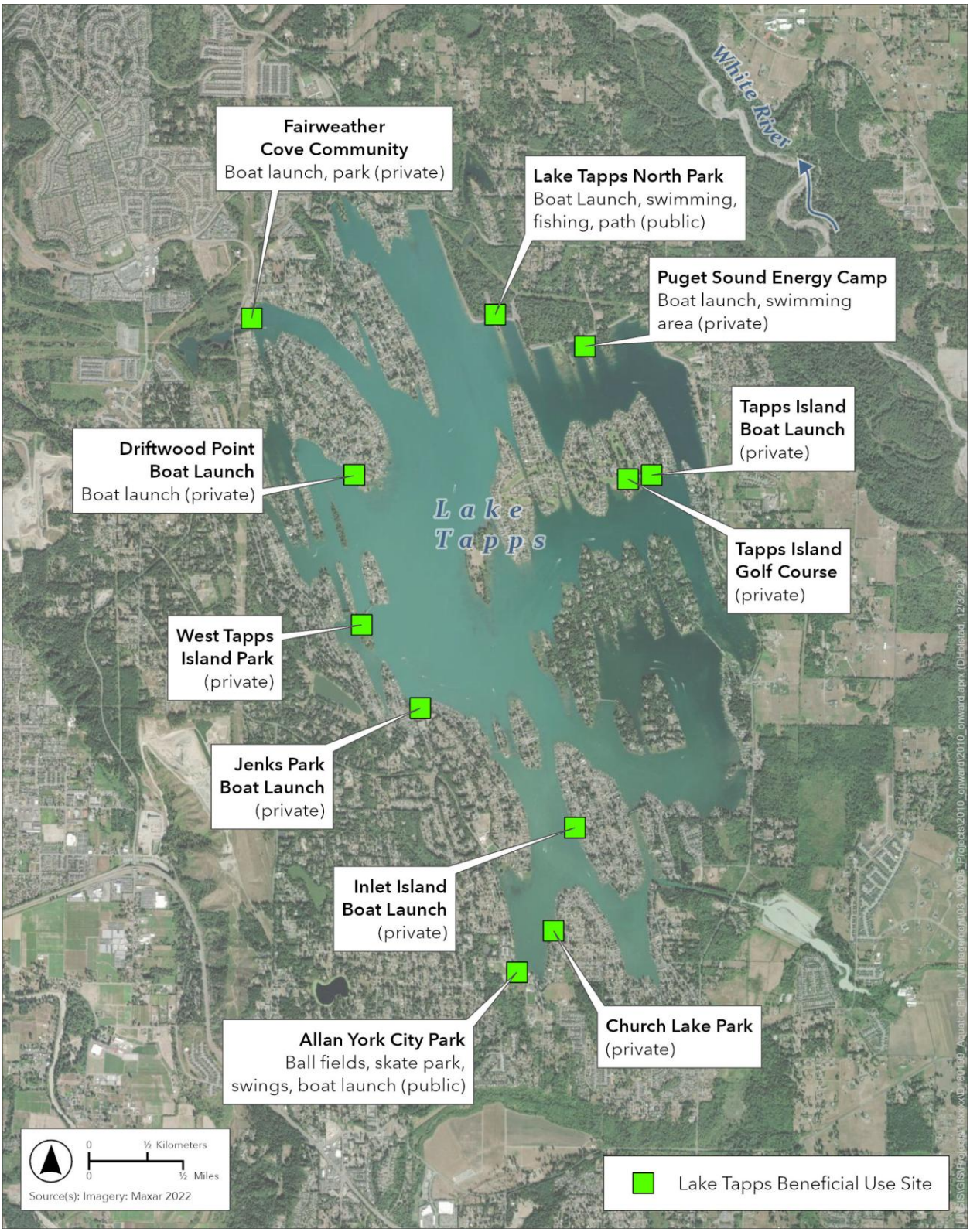


Figure 7
Location of Recreational Areas (Beneficial Uses) at Lake Tapps

Aquatic Plant Characteristics

Myriophyllum spicatum, Eurasian watermilfoil (milfoil), is widely known to alter aquatic ecosystems by forming dense mats that shade out other aquatic plants, degrade water quality, inhibit water flow and impact recreational activities (Washington State Noxious Weed Board 2024). Below the plant canopy, dissolved oxygen is routinely lower, there are increased shifts in daily pH levels, and sedimentation is increased (Gettys et al. 2020, Cooke et al. 2005, Frodge et al. 1990). The plant canopy also physically limits the mixing of atmospheric oxygen within the water column (Frodge et al. 1990). Such low or highly fluctuating dissolved oxygen levels in the water column provide poor habitat for invertebrates and fish.

Milfoil is the most problematic plant in the Lake Tapps Reservoir; it is non-native, aggressive, and can form dense mats that degrade water quality, inhibit water flow, and impact recreational activities.

A resrvoir-wide survey of aquatic plants in the Lake Tapps Reservoir was conducted by ESA and Cascade in 2023 and completed in 2024 (Appendix A). There were two components to the survey: 1) collection of rake grab samples to assess distributions and densities of plant species within the littoral zone and 2) a hydroacoustic survey to assess submerged aquatic plant coverage. Survey data was used to identify areas with current and potential aquatic plant problems and assess the effectiveness of management activities. In addition to milfoil, other non-native aquatic plants known to occur in the Lake Tapps Reservoir include wild celery (*Vallisneria americana*), yellow flag iris (*Iris pseudacorus*), and fragrant waterlily (*Nymphaea odorata*). There are at least 14 native submersed aquatic plants present. Most common are long-leaved/ribbon-leaved pondweed (*Potamogeton nodosus/epihydrus*[3]), stonewort (*Nitella* sp.), water nymph (*Najas guadalupensis*), and Canadian waterweed (*Elodea canadensis*).[4] Emergent aquatic plants are uncommon to the Lake Tapps Reservoir due to heavy water level fluctuation and shoreline armoring; however, yellowflag iris appears to be expanding (*Iris pseudacorus*).

By far the most problematic aquatic plant in the Lake Tapps Reservoir is milfoil, which was introduced to the U.S. from Europe in the 1940s and is now the most widespread submersed aquatic weed in the northern U.S. (Madsen 2009). *M. spicatum* is a Class B Noxious Weed in Washington, meaning prevention and containment are the primary goals (WAC 16-750-011). Species are "designated" for control at the state level (by region). Milfoil is non-designated in Region 2, which includes Pierce County. Though it is not known exactly when milfoil was introduced or became established in the Lake Tapps Resrvoir, it was noted as an issue with the Lake Tapps Community Task Force in 2000, and the PSE Reservoir Management Agreement between PSE and the Lake Tapps Community addressed milfoil.

Milfoil is capable of growing in up to 30 feet of water but typically grows in 1 to 15 feet. Though milfoil produces flowers and seeds, it primarily spreads by stem fragments that can produce new roots and root crowns. The starch-rich stems and root crowns of milfoil allow it to overwinter and survive long periods in the water or sediment. Fragments are commonly created mechanically by boat props; however, milfoil

[3] Identification unconfirmed

[4] ESA (Environmental Science Associates). Lake Tapps Reservoir reservoir-wide survey conducted 2023-2024 (see Appendix A)

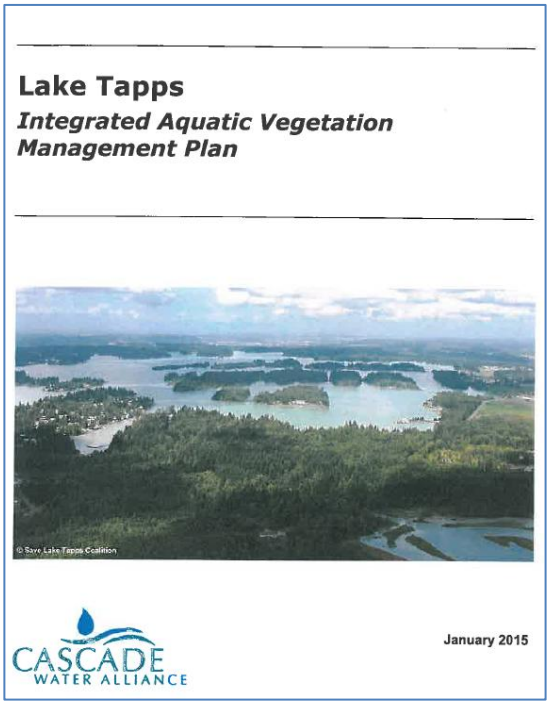
naturally fragments as part of its lifecycle. Like most invasive aquatic plants, milfoil forms thick surface mats that can impact water quality, interfere with recreation and fishing, and limit access to docks.

Past Management Efforts

In 2010, in part funded by a grant from the Washington Department of Ecology (Ecology), Cascade completed and began implementing its first IAVMP, a plan to manage milfoil in the Lake Tapps Reservoir. At that time, milfoil was classified by the State of Washington and Pierce County as a Class B noxious weed requiring control and spread-prevention measures. The 2010 IAVMP's purpose was to develop a long-term strategy to eradicate milfoil in the Lake Tapps Reservoir, continue improving existing beneficial and recreational uses, and ensure water quality to meet future drinking water demands. Implementation of the 2010 IAVMP was successful, but did not achieve the goal of eradicating milfoil.

Managing milfoil growth in the reservoir provides operational benefits to Cascade, as well as recreational and water quality benefits.

Today, the Washington State Department of Agriculture exempts Pierce County from its classification of milfoil as a Class B weed, and the Pierce County Noxious Weed Control Board considers milfoil to be a non-regulated noxious weed for which it encourages voluntary control measures. In addition to having no regulatory obligations to control milfoil, Cascade also has no contractual obligations with the Lake Tapps Reservoir community, Tribes, or other stakeholders.[5] Nonetheless, managing milfoil growth in the reservoir provides many current operational benefits to Cascade as well as recreational and ecological benefits. It also provides future drinking water quality benefits such as potentially lowering capital and operating costs of removing contaminants, including taste and odor compounds.



In 2015, Cascade updated its IAVMP with the goal of implementing plant control approaches that will result in a low density of milfoil populations. The 2015 IAVMP evaluated many means of controlling milfoil in the Lake Tapps Reservoir, including environmental manipulation, biological controls, manual controls, mechanical controls, and chemical controls. Many of these means of control were labor intensive, expensive, or unsuitable for the Lake Tapps Reservoir. Consequently, the 2015 IAVMP recommended the application of herbicides, in combination with other aquatic plant control methods such as hand pulling, to substantially increase the efficacy of controlling milfoil in the reservoir.

[5] The Lake Tapps Community Agreement calls for Cascade to control milfoil as required by law or to meet Cascade's operational goals.

Chemical Control

Cascade has, and continues to take, an adaptive management approach to managing aquatic plants. Since the 2010 IAVMP, Cascade has primarily managed milfoil growth with chemical treatments with good success.

In 2019, after approval by Washington State, Cascade began using the herbicide florpyrauxifen-benzyl (tradename: ProcellaCOR®) in its annual treatment program. Of the herbicides available for milfoil control, ProcellaCOR® is considered Best Available Technology (BAT), with a better environmental profile than other products like 2,4-D and Triclopyr. In addition, one or two pints of this product replaces between 200 and 400 pounds of 2,4-D or Triclopyr, thereby reducing the amount of herbicide required to be applied. ProcellaCOR® also has one of the fastest uptake times of any available aquatic herbicide, making it more effective in high water-exchange environments like the Lake Tapps Reservoir.

Cascade typically treats milfoil in two phases each summer, using boat surveys to determine areas that need treatment the most.

For typical treatments, Cascade and its limnologist conduct a boat survey late in the previous treatment year (September or October), then again in the spring of the upcoming treatment year (May) to identify the areas to be treated in the first round of treatment (late June to mid-July). Timing of the first treatment is a balancing act between treating as early as possible for the recreation season yet waiting long enough to be able to determine needed treatment areas by boat survey. In late July, Cascade conducts another boat survey to determine which areas to treat in the second round (usually mid- to late August). Complaints from residents about milfoil growth also strongly factor into the location of treatment areas. **Figure 8** illustrates ProcellaCOR® treatment areas for the years 2022 through 2024.

Cascade conducted a pilot study in 2018 on controlling milfoil with dry-land herbicide treatments and found it ineffective. In February 2018, four plots were treated with products registered for aquatic use to control milfoil, including: fluridone (tradename Sonar Genesis) + imazamox (tradename Clearcast) and triclopyr (tradename Renovate3). During the May 2018 survey, milfoil was observed in the general area and a visual assessment by divers showed the plot areas were not substantially different than the surrounding untreated area.

Milfoil

Other Control Methods

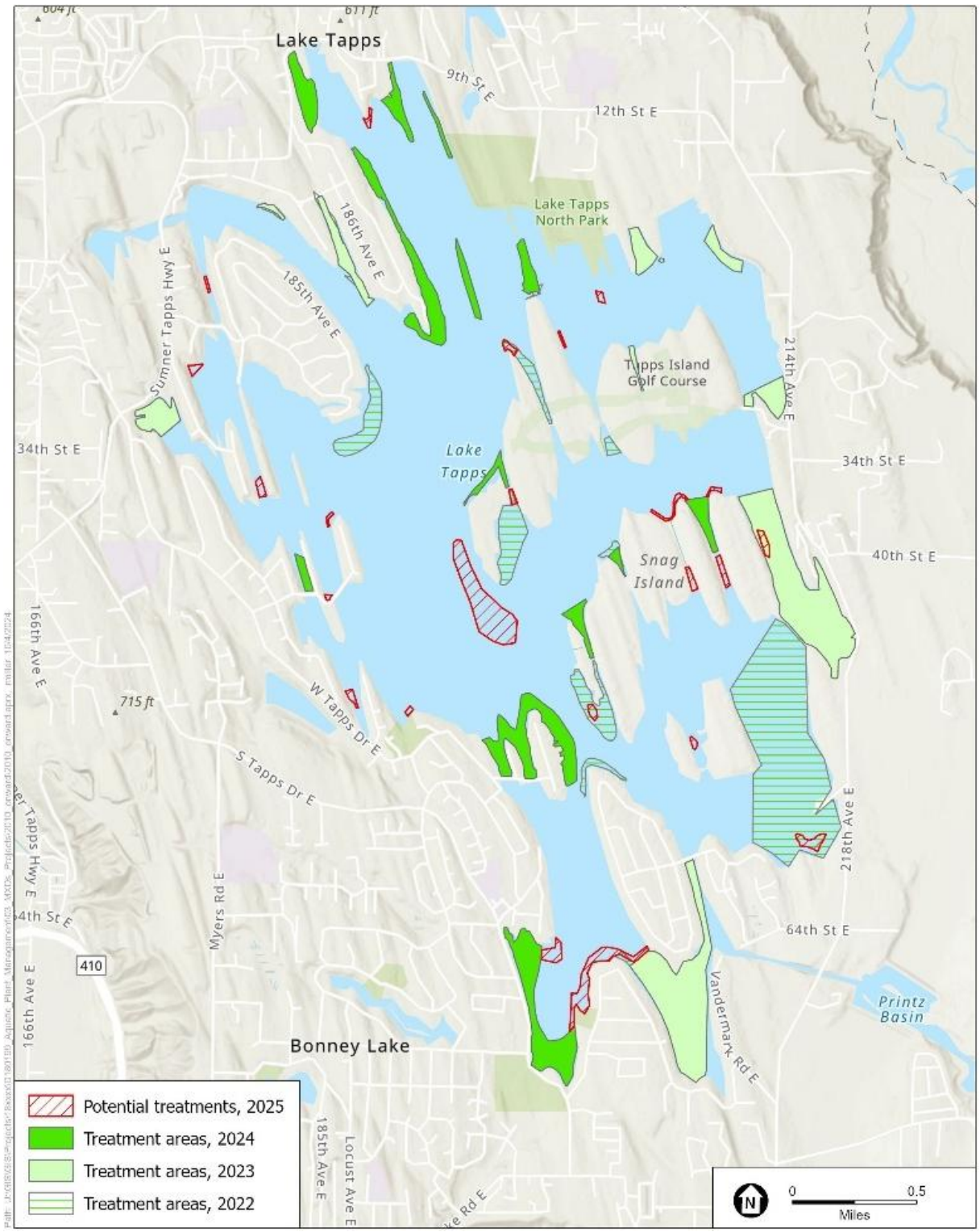
In addition to chemical treatment, over the years Cascade has employed and considered several other methods of milfoil control, as described below.

Manual Control Methods

Bottom barriers (pilot study). In January 2018, during the reservoir drawdown, burlap bottom barriers were installed over a 1.5-acre channel on the south side of Tapps Island. One layer of barrier was placed alongside a double layer of barrier, both secured by rocks. In July 2018, divers surveyed the area and found sediment covering the barriers from 0.5 to 6.0 inches. Fragments of milfoil were also observed growing on 40% to 50% of the barrier. They noted no observable difference between plant growth on the single or double layered barrier. Based on the rapid deposition of sediment and growth of milfoil within six months of installing the bottom barrier, Cascade determined this treatment method was not successful in controlling milfoil in the Lake Tapps Reservoir.

Diver hand pulling. Cascade used divers to hand pull milfoil for five years: 2013, 2014, 2016, 2017, and 2018. Diver hand pulling was very labor-intensive and expensive when compared to chemically treating milfoil. Based on this, Cascade ceased using divers in 2018.

Dense mat of milfoil growing in the Lake Tapps Reservoir.



Source: ESRI, 2023

Figure 8

Location of ProcellaCOR® treatments between 2022 and 2024.

Environmental Manipulation

Water level drawdown. As noted earlier, Cascade draws the water level down each winter for dike safety and maintenance projects. Cascade has not used the drawdown to control milfoil because to effectively do so requires freezing temperatures for at least two continuous weeks, with no precipitation.

Education and Awareness

Cascade's website. Cascade has an informative webpage on milfoil that includes photos, descriptions, options for homeowners to control milfoil, and information on Cascade's programs: https://cascadewater.org/lake-tapps/milfoil/.

Social media. Cascade has a Facebook page where it posts information on the milfoil treatment program and the annual meetings.

Community meetings. Cascade holds annual meetings at the Lake Tapps Reservoir where information about the milfoil treatment program is presented. Cascade also provides information to residents on the spread and prevention of invasive aquatic plant species establishment in the reservoir, and on available, effective, control options for milfoil that they can individually implement near their shorelines to complement Cascade's treatment program.

Signage. Cascade supports public boat launch signage regarding milfoil.

TappsWise Program. Nutrients from failing septic tanks, fertilizers, and stormwater runoff feed vegetation in the reservoir and can result in excessive growth of plants, algae, reduced water clarity, and stress on fish and wildlife. Cascade has partnered with the Tacoma-Pierce County Health Department since 2017 to improve water quality in the Lake Tapps Reservoir with the *TappsWise* program. This program offers workshops, site visits, and other education for homeowners around the reservoir.

A summary of all control methods evaluated in the 2015 IAVMP can be found in **Appendix B.**

Aquatic Plant Control Alternatives and Control Strategy

In 2023, Cascade adopted a formal Drinking Water Quality Policy Framework (Policy Framework), a process to evaluate potential water quality programs, projects, policies, and other actions. Since the Lake Tapps Reservoir will not be developed for municipal supply for several decades, the Policy Framework guides Cascade's decision-making on which water quality actions to implement, when to implement them, and how much to invest.

Cascade's Drinking Water Quality Policy Framework Assessment indicates that the benefits of controlling milfoil to protect water quality continues to outweigh the costs.

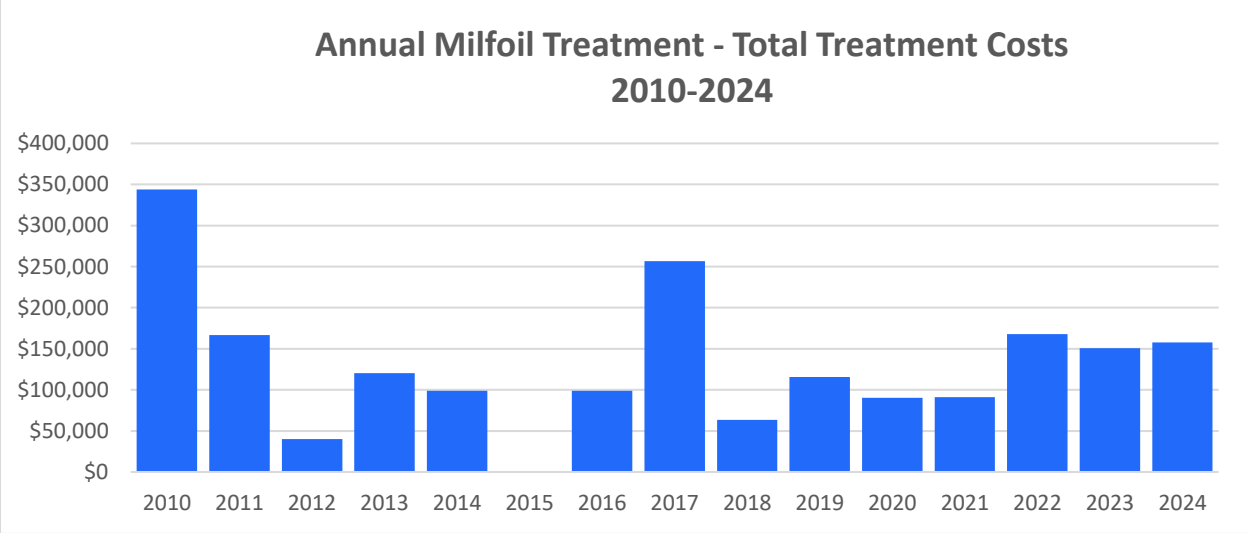
Cascade applied its Policy Framework to the milfoil program, to first assess whether this continues to be the preferred strategy. The assessment indicated that the benefits of controlling milfoil to protect water quality in the Lake Tapps Reservoir continues to outweigh the costs. The second part of the Policy Framework evaluated the options to control milfoil. As described earlier, based on prior evaluations, Cascade determined that chemical control is the most cost-effective means of control. More detailed information on the application of the Policy Framework can be found in **Appendix C.**

Preferred Milfoil Control Method

Use of ProcellaCOR® in the Lake Tapps Reservoir has been successful, as illustrated by the fact that only a few areas have required retreatment in the three years following treatment and is currently Cascade's preferred control method.

Cascade's preferred method of treatment for milfoil is ProcellaCOR®, which is considered Best Available Technology, has a better environmental profile than other products, requires less product, and has a fast uptake time, making it more effective in high-water exchange environments such as the Lake Tapps Reservoir.

Cascade has spent nearly $2,000,000 for milfoil treatment to date (**Figure 9**). The amount of treatment varies from year to year as shown in the graph below. Over the past three years, the annual cost has averaged $159,000. A comparable amount has been approved by Cascade's Board of Directors for 2025-2027.



Note: No treatments occurred in 2015 due to a maintenance drawdown.

Figure 9

Annual treatment costs of Eurasian watermilfoil in the Lake Tapps Reservoir for the years 2010 through 2024

Cascade has an adaptive management strategy for controlling aquatic plants and it has shown its ability to be nimble and adaptable to changing conditions. An example is the addition of a new component to the annual treatment program in response to community feedback. At the 2022 Lake Tapps Reservoir community meeting, residents offered to pay for treatment beyond Cascade's planned treatment areas. The following year and again in 2024, Cascade conducted a pilot project that allowed homeowner's associations (HOAs) and individual homeowners to pay Cascade's contractor for treatment (through Cascade's permit) beyond Cascade's planned treatment areas. Although participation was low during the pilots, Cascade feels this offers a great benefit to the homeowners and homeowners associations, and Cascade is offering this as an option to the community on a permanent basis. Cascade will continue to be adaptable and will strive to stay on top of the latest technologies and remains open to better options as they become available.

SEPA Review and Public Involvement

Cascade has overwhelming support from the community of its milfoil management program, as demonstrated by endorsements from many homeowners at well-attended annual public meetings. Cascade's public outreach will continue with its annual community meetings, informational webpage and social media, public boat ramp signage, and its partnership with the Tacoma-Pierce County Health Department *TappsWise* program to improve water quality.

A State Environmental Policy Act (SEPA) Review was conducted on this Lake Tapps Reservoir IAVMP. Three copies of the completed plan were sent to Ecology with a completed SEPA Plan Elements for review and comment, initiating a fourteen-day comment period. Comments received are included in the public record. The Determination of Non-significance was issued on December 19, 2024.

Monitoring, Watchlist, and Evaluation

Reservoir-wide surveys are a specific method for early detection of other non-native invasive aquatic plants. The recommended frequency for reservoir-wide surveys is every three years. The reservoir-wide plant surveys can be done in conjunction with the smaller scale annual plant treatment surveys. Community input and identification of potential new infestations of aquatic plants will also help guide the frequency of the more in-depth reservoir-wide surveys.

In 2023-2024, Cascade conducted a reservoir-wide macrophyte survey (**Appendix A**), and this information will assist in developing the chemical treatment strategy for the following years. The survey also identified plants other than milfoil, including native plants, that have, or may become, a nuisance and may require treatment. In total, 18 species of aquatic plant species were identified at 412 points sampled during early September 2023 and late August 2024, including observations of shoreline/emergent species. **Table 1** summarizes the species observed, listed in order of frequency of occurrence from greatest to least. Milfoil was present at 14.6% of the sample points scattered throughout the survey area. It should be noted that much of the milfoil found in the first half of the reservoir-wide survey in 2023 was treated in 2024.

Reservoir-wide surveys are an important method for early detection of non-native plants that may require a rapid treatment response to reduce future control costs due to the establishment of unwanted species.

In addition to evaluating management efforts, the purpose of the reservoir-wide survey is to provide early detection of other non-native aquatic plants. Based on information from sources such as the Washington State Noxious Weed Board, Pierce County Noxious Weed Control Board, Washington Department of Agriculture, Washington Department of Ecology, King County and personal peer communications, a "watch list" of species was developed to alert staff, homeowners, and contractors about what plants to look for such that rapid response measures can be implemented.

The science of invasion biology emphasizes the importance of early detection and rapid response (EDRR) and relies heavily on prevention as a means to reduce future control costs after an unwanted species becomes established. The Invasion Curve (**Figure 10**) is widely used to illustrate that prevention is the most efficient and least costly method of combating invasive species.

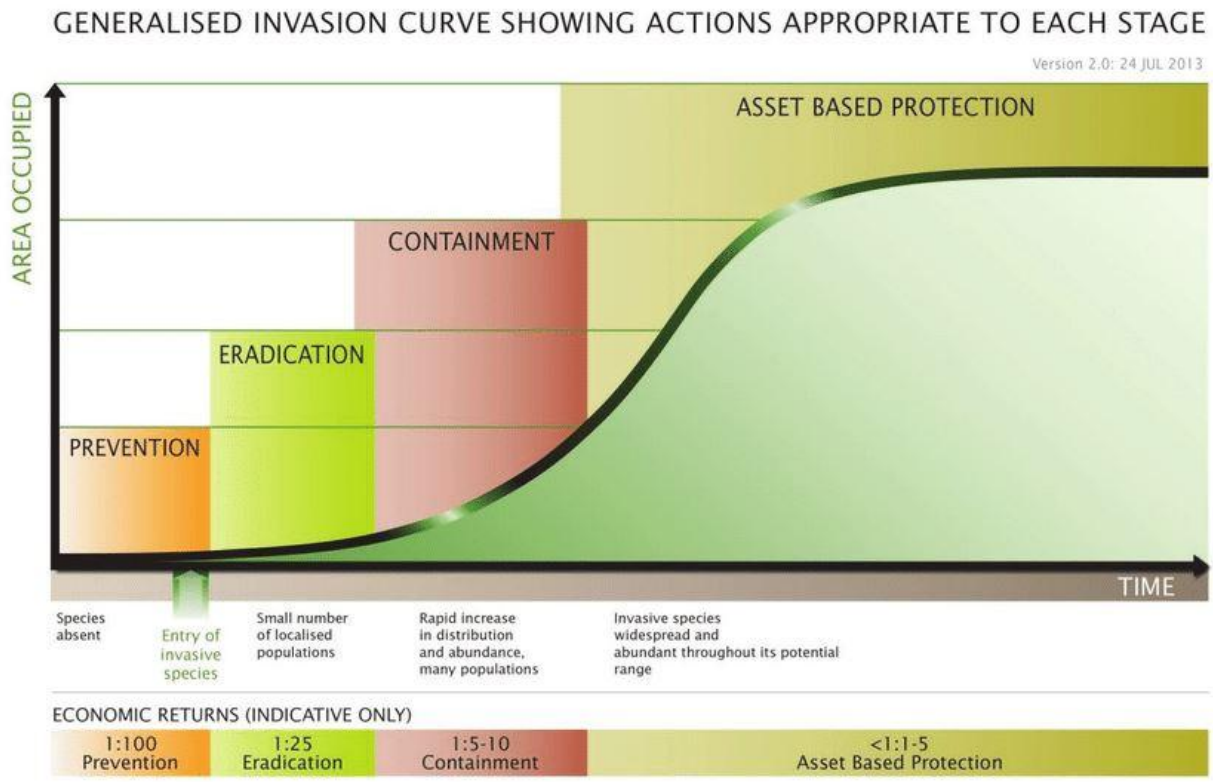
Cascade applied its Drinking Water Quality Policy Framework to the concept of conducting reservoir-wide surveys on a regular basis. The evaluation determined that the benefits of reservoir-wide surveys outweigh the costs, assuming a frequency of every three years. If, during reservoir-wide surveys, Cascade identifies non-native or nuisance native plants that could become problematic, it will apply its Policy Framework prior to treatment or other actions.

TABLE 1
AQUATIC PLANT SPECIES FREQUENCY OF OCCURRENCE IN THE LAKE TAPPS RESERVOIR DURING 2023 - 2024 RESERVOIR-WIDE SURVEY

Species	Common Name	Status	Frequency of Occurrence
Nitella sp[1]	stonewort	native	42.7%
Potamogeton nodosus/epihydrus	long-leaved/ribbon-leaved pondweed	native	37.9%
Najas guadalupensis	waternymph	native	36.2%
Elodea canadensis	Canadian waterweed	native	23.8%
Vallisneria americana	wild celery	non-native	21.1%
Myriophyllum spicatum	Eurasian watermilfoil	non-native	14.6%
Chara sp.[2]	muskgrass	native	7.5%
Potamogeton pusillus/foliosus[1]	slender pondweed/leafy pondweed	native	3.6%
Potamogeton richardsonii	Richardson's pondweed	native	2.7%
Potamogeton amplifolius	large leaf pondweed	native	2.0%
Potamogeton gramineus	variableleaf pondweed	native	1.9%
Nuphar polysepala	yellow pond lily	native	1.2%
Nymphaea odorata	fragrant water lily	non-native	1.2%
Ceratophyllum demersum	hornwort	native	0.5%
Potamogeton natans	floating leaf pondweed	native	0.5%
Eleocharis acicularis	needle spikerush	native	0.2%
Iris pseudacorus[3]	yellowflag iris	non-native	0.2%
Potamogeton praelongus	whitestem pondweed	native	0.2%
Site with no plants			12.1%

NOTES:

[1] Macroalgae
[2] Shoreline/emergent species



Source: Department of Primary Industries, Victoria.

Figure 80

The generalized species invasion curve, adapted from Harvey and Mazzotti (2014) and Haubrock et al. (2022). Labels at the top refer to the stages of the invasion process (the invasion stage is divided into low, medium, and high level). Bold labels refer to management actions appropriate at each stage of invasion. White boxes below the graph indicate terms used to refer to alien species within each invasion stage. Economic return values listed at the bottom indicate the amount of money that is returned based on the money invested at each invasion stage, adapted from Victorian Government (2010) and Reid et al. (2021).

A "watch list" of potential non-native aquatic plants, as well as potentially nuisance native aquatic plants, will assist Cascade, its contractors, and lake residents to identify new species in between recommended reservoir-wide surveys. **Table 2** summarizes aquatic plant species that should be considered for the "watch list" (descriptions are taken from resources cited above).

TABLE 2
AQUATIC PLANT "WATCH LIST" FOR THE LAKE TAPPS RESERVOIR

Common Name	Scientific Name	Weed Class[a,b,c]	Known Lake Occurrences in WA[d]
Brazilian elodea	*Egeria densa*	B	Battle Ground Lake (Clark Co.), Big Lake (Skagit Co.), Black Lake (Pacific Co.)
Curlyleaf pondweed	*Potamogeton crispus*	C	Isolated and very sparse observations in the Lake Tapps Reservoir; noted as wide and patchy distribution in nearby Spanaway Lake
Delta arrowhead	*Sagittaria platyphylla*	Quarantine list	Deep Lake (Thurston Co.)
Fanwort	*Cabomba caroliniana*	B	Solo Slough (Cowlitz Co.), Willow Grove Slough (Cowlitz Co.)
Floating primrose-willow	*Ludwigia peploides*	A	Occurrences of Ludwigia sp. in Battle Ground Lake, Haven Lake (Mason Co.), Solo Slough
Flowering rush	*Butomus umbellatus*	A	Boundary and Box Canyon Reservoirs (Pend Oreille Co.), Chambers Lake (Pierce Co.), Silver Lake (Whatcom Co.)
Grass-leaved arrowhead	*Sagittaria graminea*	B	Echo Lake, Lake Loma, Lake Roesiger (Snohomish Co.)
Hydrilla	*Hydrilla verticillata*	A	Previously in Lake Lucerne and Pipe Lake (King Co.)
Parrotfeather	*Myriophyllum aquaticum*	B	Buena Creek (Yakima Co.), Chehalis River (Grays Harbor Co. and Lewis Co.)
South American sponge	*Limnobium laevigatum*	A	Canal on Long Beach Peninsula (Pacific Co.)
Variable-leaf milfoil	*Myriophyllum heterophyllum*	A	Blue Lake (Thurston Co.), Clear Lake (Pierce Co.), Clear Lake (Thurston Co.)

NOTES:

a. Class A noxious weeds are non-native species whose distribution in Washington State is still limited. Eradication is the highest priority, and is required by law. It is prohibited to transport, buy, sell, offer for sale, or distribute plants or plant parts of quarantined species into or within the state of Washington or to sell, offer for sale, or distribute seed packets of seed, flower seed blends, or wildflower mixes of quarantined species into or within the state of Washington (WAC 16-752).
b. Class B noxious weeds are nonnative species whose distribution is limited to portions of Washington State.
c. Class C noxious weeds are widespread in Washington or are of special interest to the agricultural industry.
d. Washington Department of Ecology. Lakes Environmental Data. Available at: https://apps.ecology.wa.gov/lakes/. This dataset does not fully address noxious aquatic weeds in rivers.

As previously mentioned, at least three other non-native aquatic plants are known to occur in the Lake Tapps Reservoir. Wild celery is the most common, though generally limited distribution and far less abundant than milfoil and, while non-native, is not considered a noxious weed. Yellow flag iris, a Class C noxious weed, is limited to shorelines and is unlikely viewed as problematic to most homeowners. Like milfoil, yellow flag iris is non-regulated in Pierce County. Two instances of previously unreported fragrant waterlily were observed during the reservoir-wide survey, emphasizing the importance of these surveys. Fragrant waterlily is also a Class C noxious weed unregulated in Pierce County. Left unchecked, this species has great potential to spread across shallow backwater areas of the lake.

Conclusions

The Lake Tapps Reservoir is an important resource for Cascade's members, the Lake Tapps Resrvoir community, partner agencies, and other stakeholders. Protecting the water quality of the reservoir provides numerous benefits today, including operational benefits for Cascade, recreational benefits for the community, and habitat for fish and wildlife. Preventing eutrophication of the reservoir is also critical for Cascade's future use as a source of drinking water, as this can reduce treatment costs and service disruptions.

Since milfoil is by far the most problematic aquatic plant in the reservoir, continued management to prevent overgrowth is key to maintaining high water quality. Based on prior experiences and evaluations of various control measures, continued chemical treatment, and specifically the use of ProcellaCOR®, is Cascade's preferred strategy.

In addition to controlling milfoil, Cascade aims to minimize or prevent overgrowth of other non-native plants (as well as over-production of nuisance native species) that are not currently prevalent in the Lake Tapps Reservoir. To achieve this, Cascade plans to conduct reservoir-wide surveys to identify and manage these issues before they become problematic.

As it has in the past, Cascade will continue to take an adaptive strategy to managing nuisance aquatic plants in the Lake Tapps Reservoir. It will strive to stay on top of the latest technologies and remain open to better options as they become available. Cascade will also continue to work with its regulators, partner agencies, and the Lake Tapps Reservoir community to maintain the reservoir's water quality for today and tomorrow.

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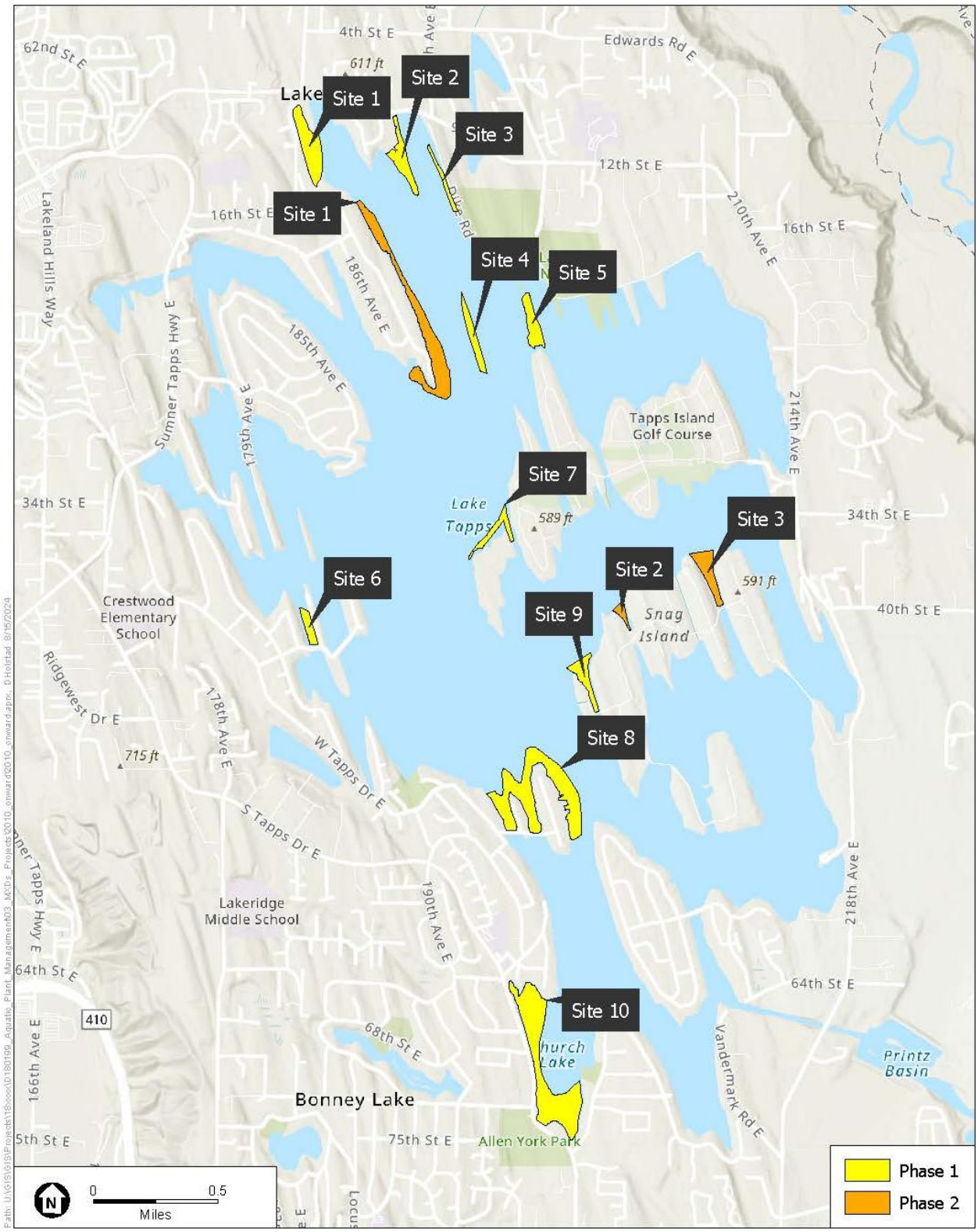
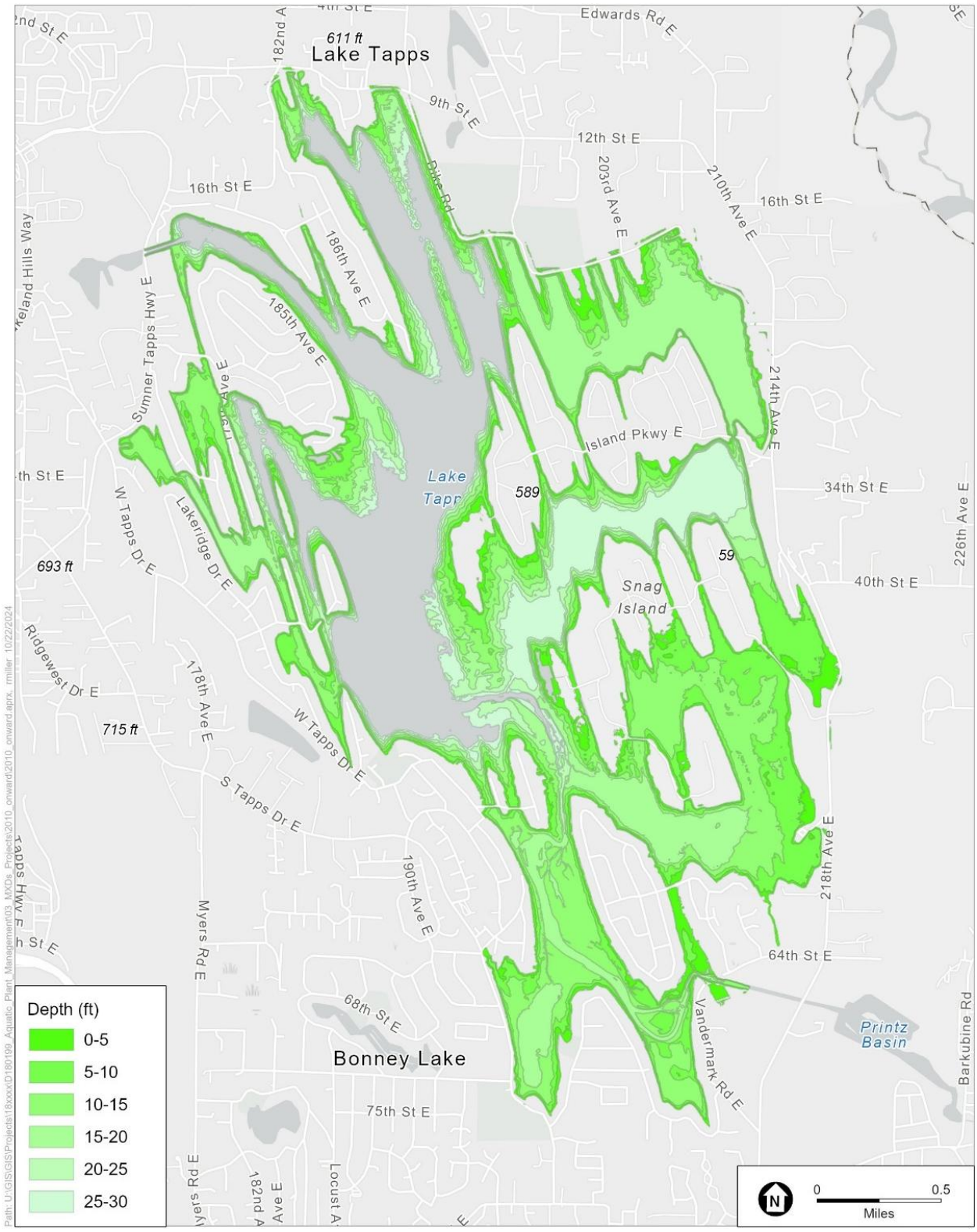
Appendix A

2023-2024 Reservoir-Wide Aquatic Plant Survey



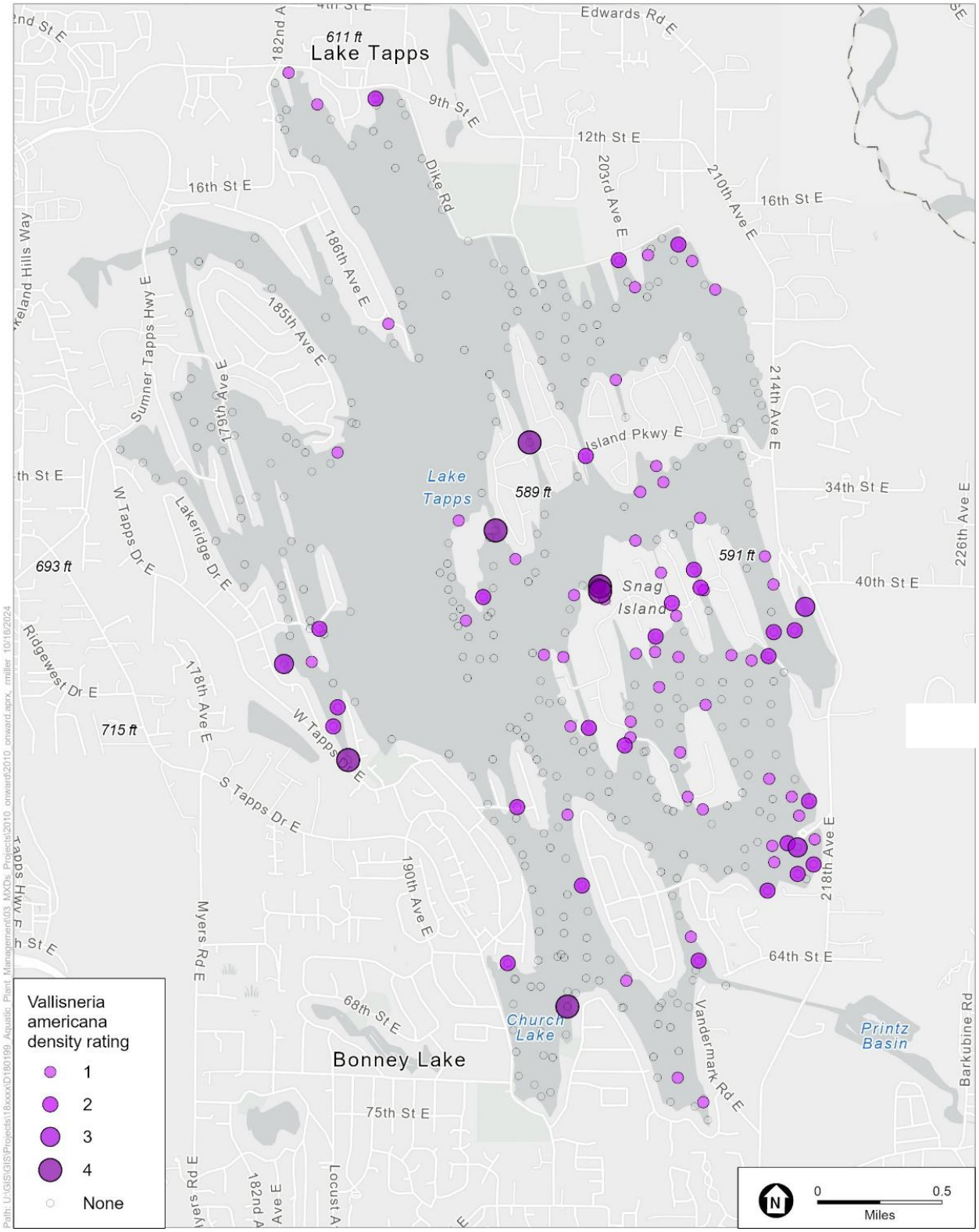
Source: ESRI, 2024

Figure A-1
Phase 1 and Phase 2 In-Water Herbicide Treatment Areas in 2024.



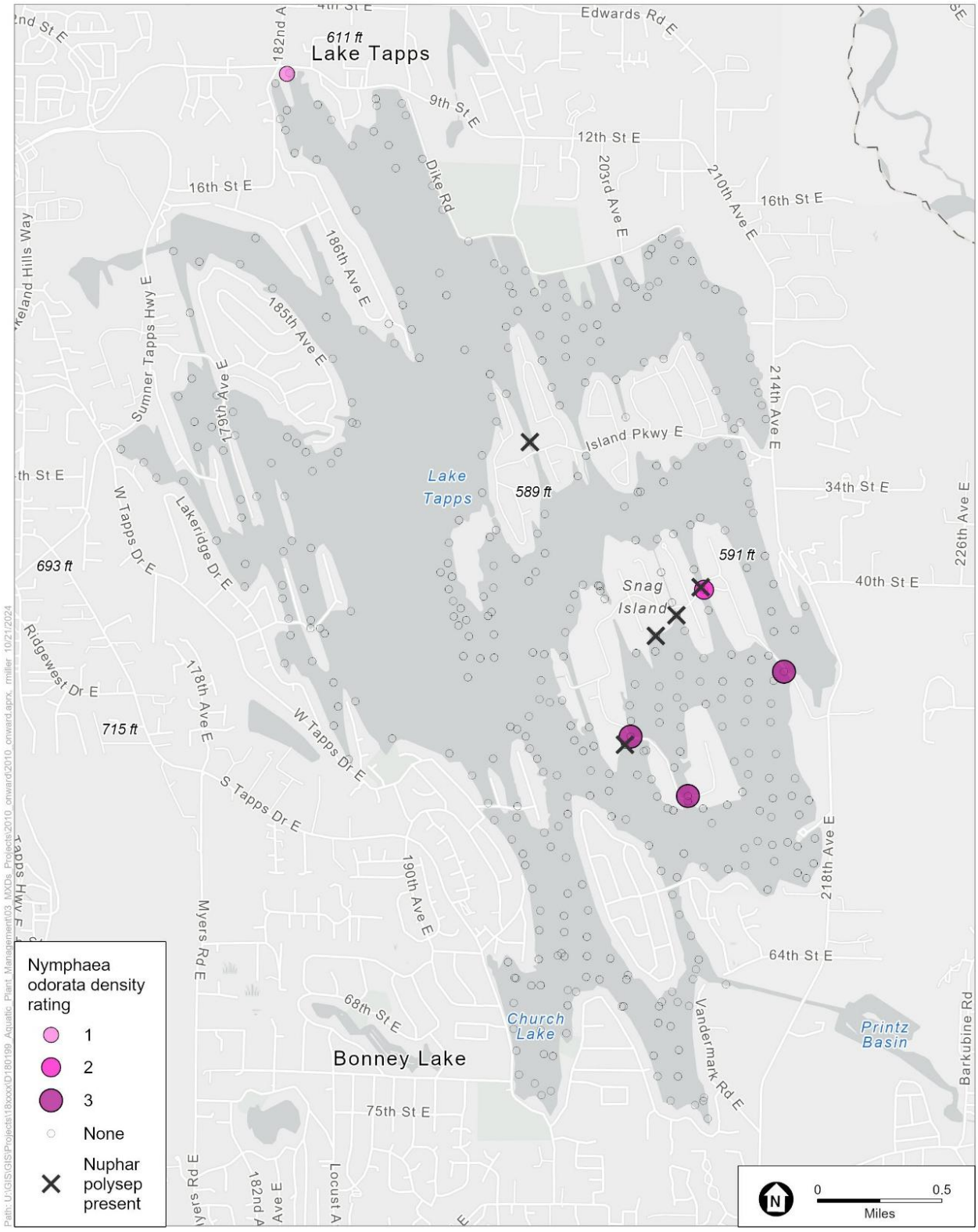
Source: ESRI, 2024

Figure A-2
Lake Tapps Reservoir 30 ft littoral zone and 0- 25 zone surveyed for aquatic plant species composition and aquatic plant height during September 2023 and August 2024.



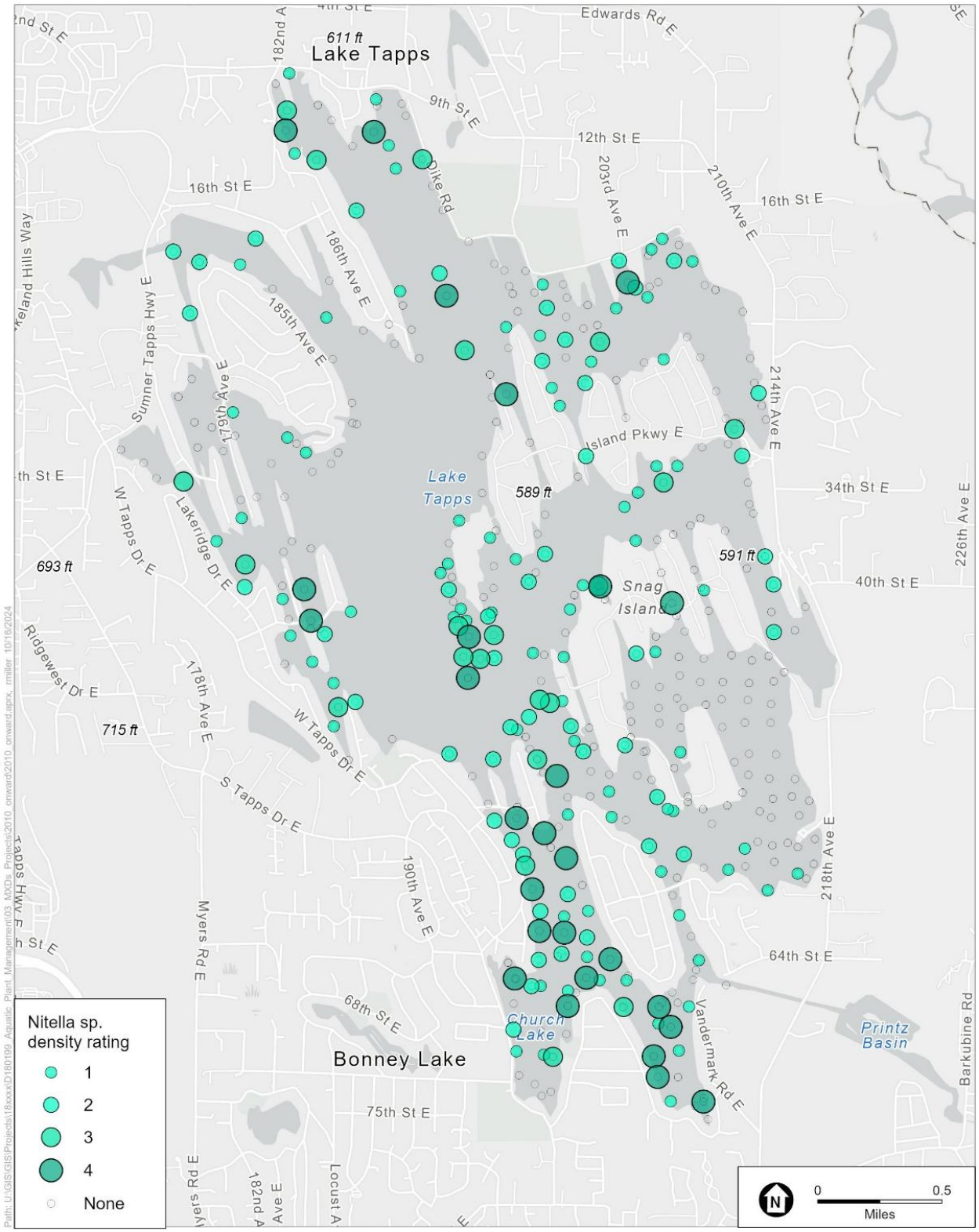
Source: ESRI, 2024

Figure A-3
Wild celery (*Vallisneria americana*) density measured during the 2023 - 2024 reservoir-wide survey.



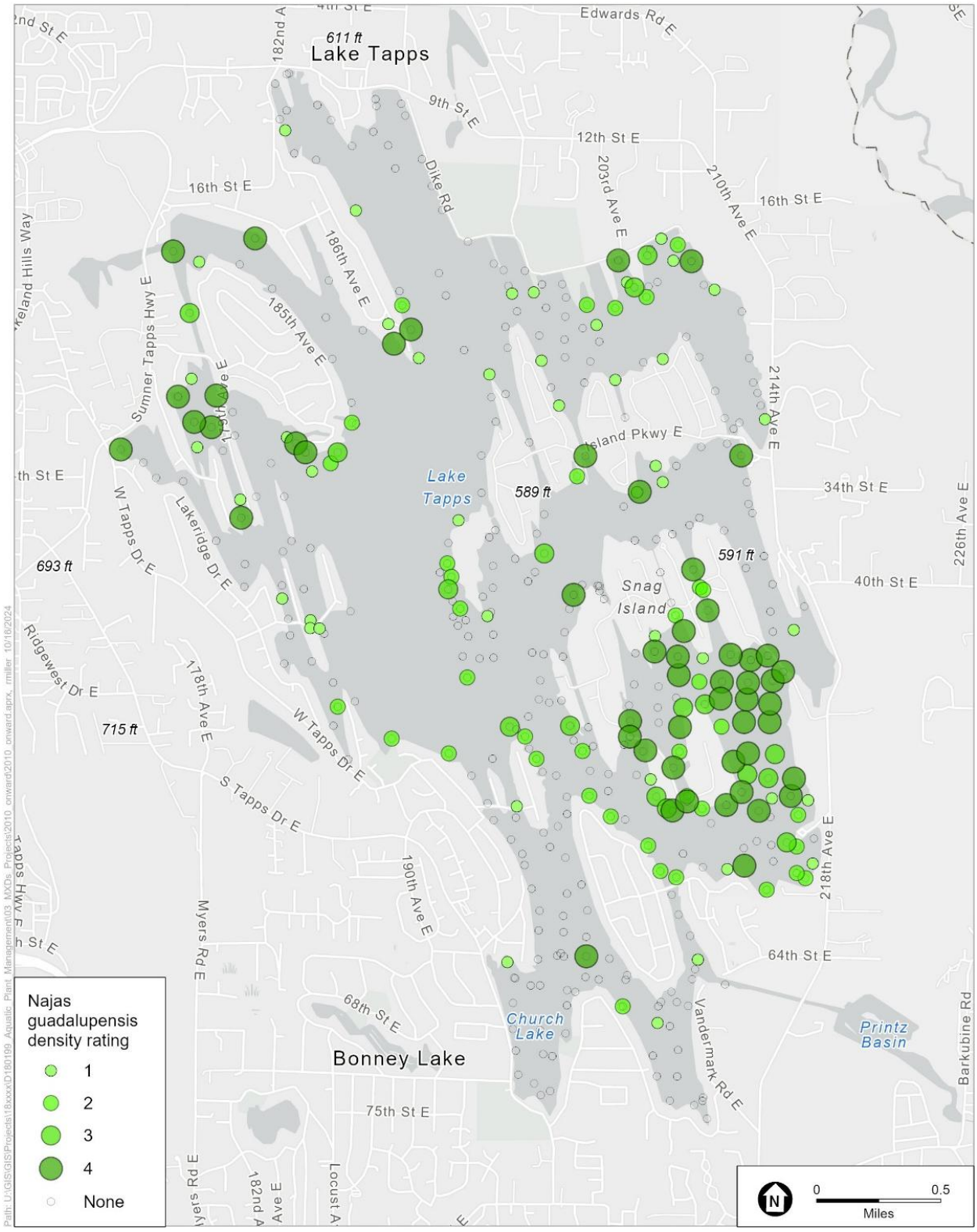
Source: ESRI, 2024

Figure A-4
Class C noxious weed fragrant waterlily (*Nymphaea odorata*) and native spatterdock (*Nuphar polysepala*) density measured during the 2023 – 2024 reservoir-wide survey.



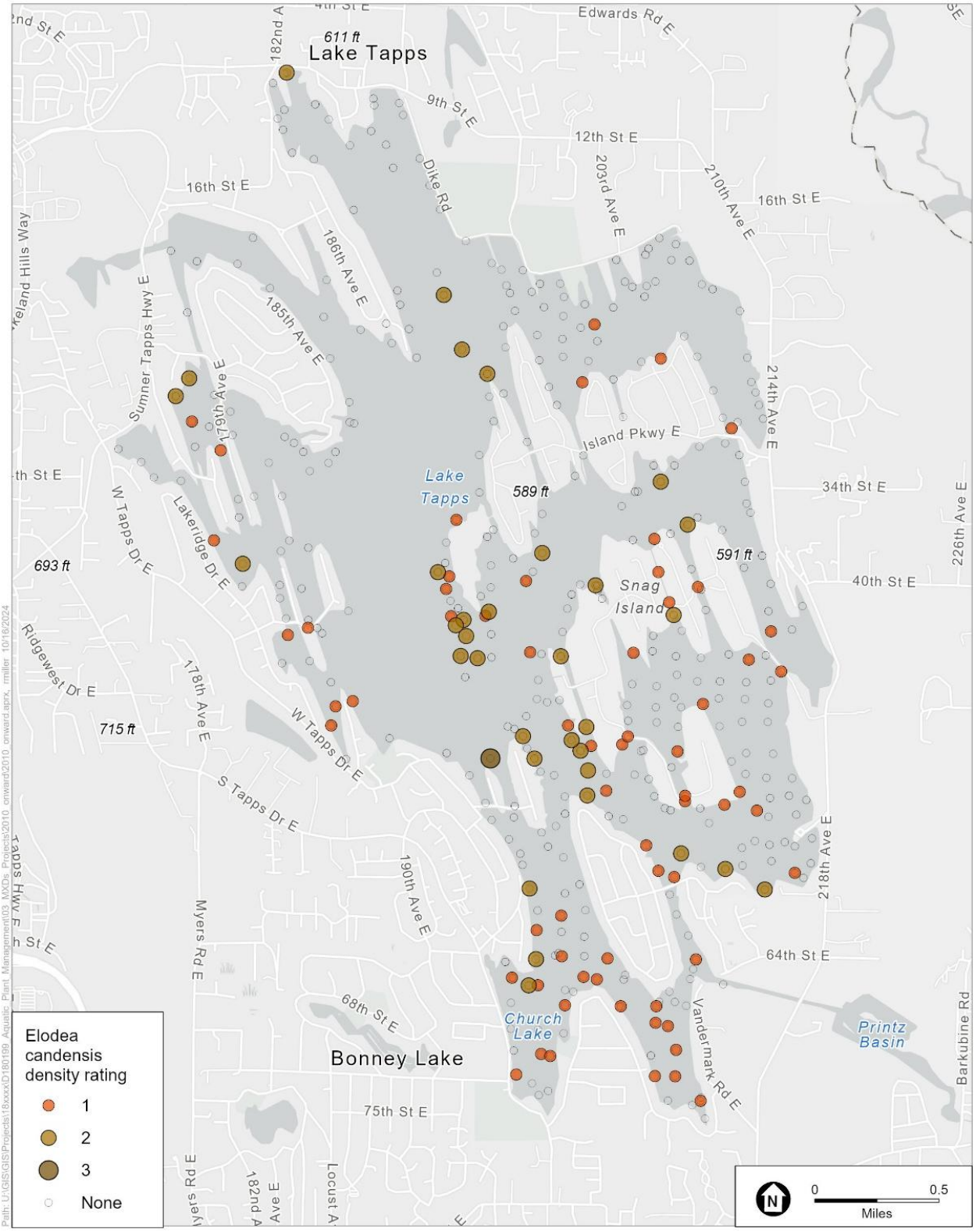
Source: ESRI, 2024

Figure A-5.
Nitella species density measured during the 2023 - 2024 reservoir-wide survey.



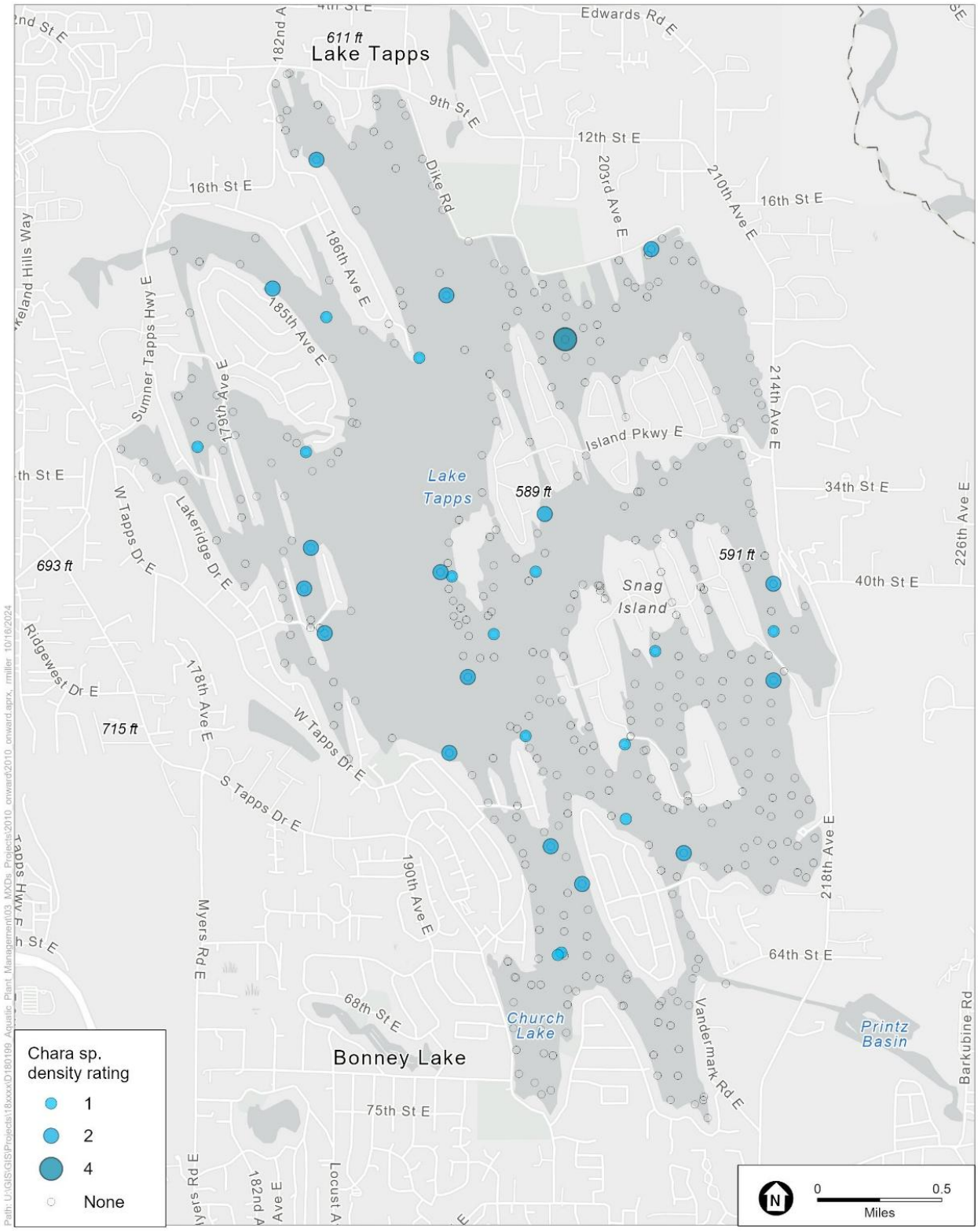
Source: ESRI, 2024

Figure A-6.
Waternymph (*Najas guadalupensis*) density measured during the 2023 – 2024 reservoir-wide survey.



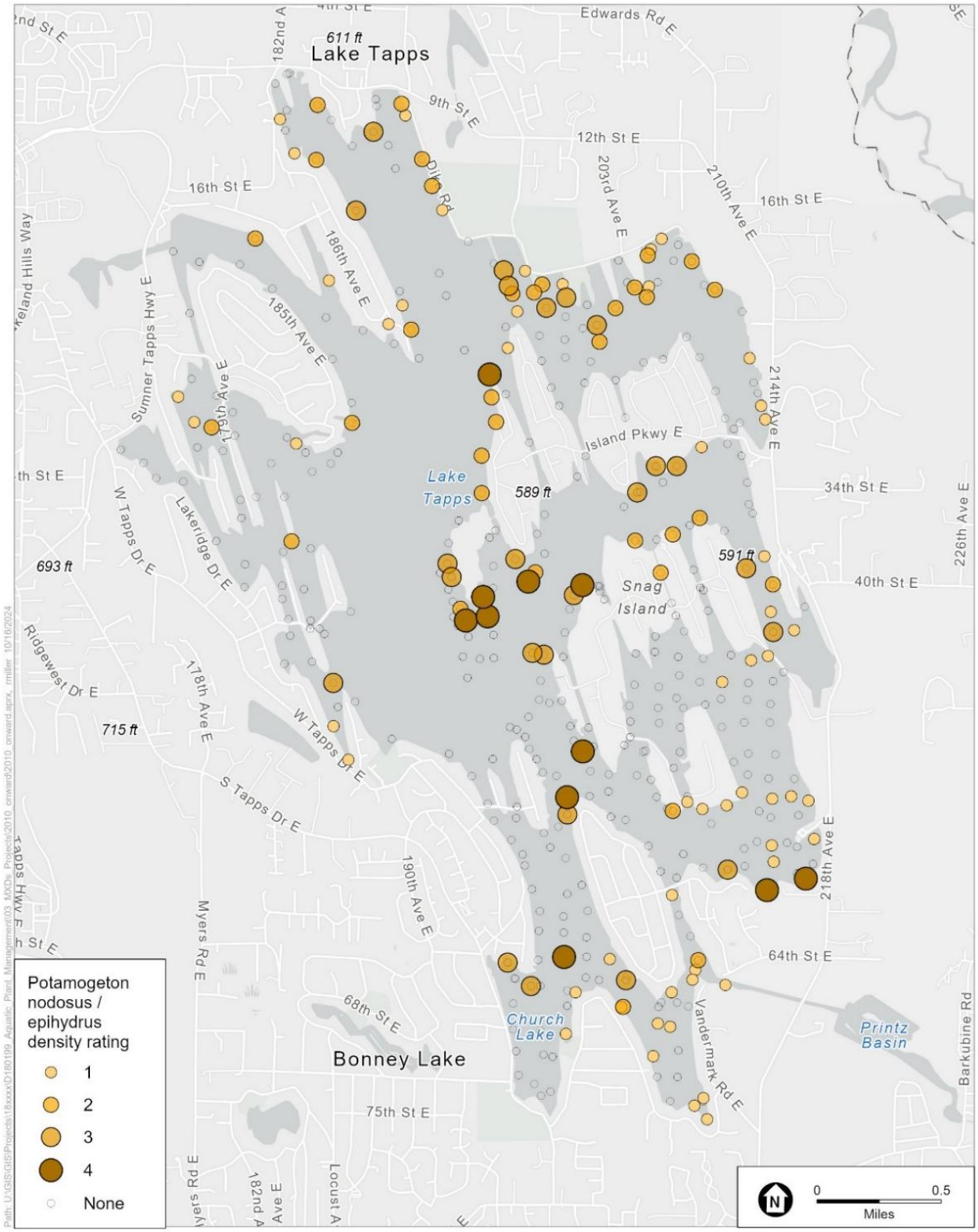
Source: ESRI, 2024

Figure A-7.
Canadian waterweed (*Elodea canadensis*) density measured during the 2023 - 2024 reservoir-wide survey.



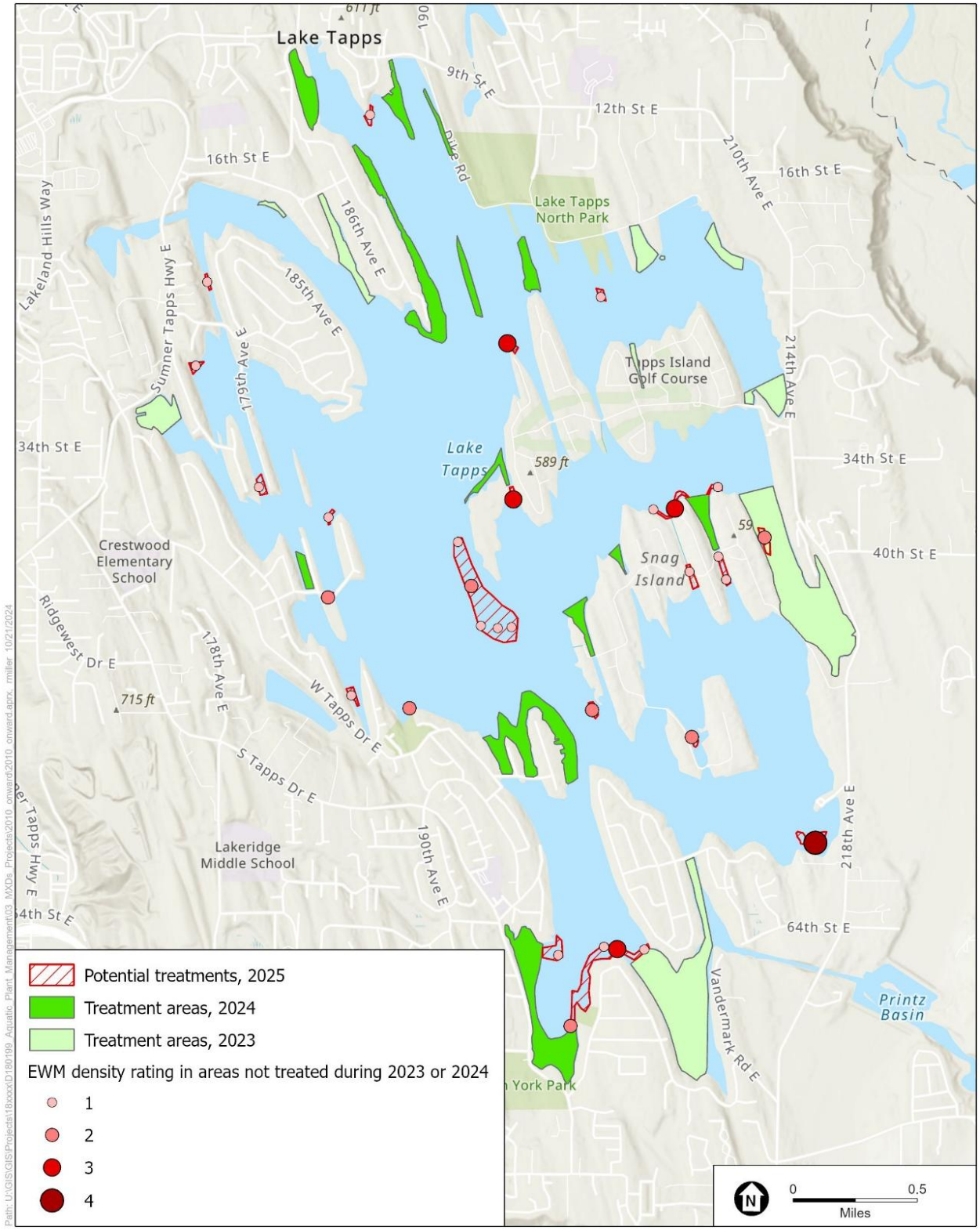
Source: ESRI, 2024

Figure A-8.
Chara species density measured during the 2023 - 2024 reservoir-wide survey.



Source: ESRI, 2024

Figure A-9
Floating leaf pondweed (*Potamogeton nodosus/epihydrus*) density measured during the 2023 - 2024 reservoir-wide survey.



Source: ESRI, 2024

Figure A-10.
Recent milfoil treatment areas (2023 and 2024) and potential treatment areas in 2025.

Appendix B

2015 IAVMP Evaluation of Milfoil Control Measures

Table B-1 summarizes the numerous milfoil control measures that were evaluated in Cascade's 2015 IAVMP.

TABLE B-1
AQUATIC PLANT CONTROL MEASURES EVALUATED IN THE 2015 IAVMP

Category	Control Measure	Advantages	Disadvantages
Environmental manipulation	Water control level (winter drawdown) – exposes plant stems to freezing and drying conditions.	Can be relatively inexpensive.	The temperate climate and precipitation in the northwest is less effective than in regions with lower temperatures and less precipitation.
Biological control (use of natural enemies to reduce milfoil's biomass)	Grass carp – consumes aquatic weeds.	Proper use can achieve long-term reductions in nuisance growth of vegetation.	Grass carp has exhibited a conspicuous lack of preference for milfoil.
	Watermilfoil weevil – feeds on aquatic plants.	Used in an integrated approach with other control techniques, can stress target plants, making them more susceptible to other control methods.	Very costly and no documented declines in milfoil in Washington that can be attributed to watermilfoil weevil.
Manual control - most appropriate for small, low plant density treatments.	Hand-pulling – removes rooted, submerged plants with divers.	Results in immediate removal of milfoil.	Highly labor intensive and costly; not appropriate for large, high plant density treatments.
	Hand cutting – cuts plants with tools/devices below the water surface but usually does not remove roots.	Results in immediate removal of milfoil.	Highly labor intensive and doesn't result in long-term growth reductions because since entire plant is not removed.
	Raking – tears plants from the sediment, breaking some plants off and removing some roots.	Results in immediate removal of milfoil.	Highly labor intensive; cleared plants may regrow, resulting in needing to rake several times during the summer.
	Bottom barrier – applies barrier material over the lake bottom to prevent plants from growing.	Easily applied to small, confined areas and doesn't result in significant production of plant fragments.	Installation can be labor intensive; costly materials with limited durability; periodic maintenance required; barriers are rapidly covered by sediment loading.
Mechanical control	Mechanical harvesting – involves large machines that cut aquatic plants then collect fragments by a conveyor belt system for disposal.	Results in immediate removal of milfoil and creates open spaces of water.	Very costly and only removes upper stem material; regrowth typically occurs within 30 to 60 days.
	Diver-assisted suction (diver dredging) – uses hoses that are attached to small dredges to suck up plant material.	Effectively removes milfoil around docks and other areas that are difficult to reach by large equipment.	Highly labor intensive and costly; not suitable for large areas.
	Hydraulic (suction) dredging – removes littoral sediments and associated rooted aquatic plants using hydraulic dredging equipment.	Removes entire plants, thus minimizing regrowth; can be used in larger areas than diver-assisted suction.	Very costly and highly disruptive to the local environment; permitting, transport, and proper disposal can be difficult.
	Rotovation – uses highly specialized large aquatic rototillers to uproot entire plants from the sediment, then uses a rake or mechanical harvester to remove the plants.	Removes entire plants, thus minimizing regrowth.	Very costly, labor intensive, equipment difficult to maneuver particularly with obstacles in the way (tree stumps and docks).

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Appendix C

Cascade's Drinking Water Quality Policy Framework

In 2023, Cascade adopted a formal Drinking Water Quality Policy Framework (Policy Framework), a process to evaluate potential water quality programs, projects, policies, and other actions. Since the Lake Tapps Reservoir will not be developed for municipal supply for several decades, the Policy Framework guides Cascade's decision-making on which water quality actions to implement, when to implement them, and how much to invest.

The Policy Framework is composed of two parts: policy drivers and criteria. The policy drivers answer the question "What's the purpose of the water quality action?". Once the policy drivers are identified, each proposed action is evaluated against a set of criteria. If a proposed action is determined to be viable vis-à-vis the Policy Framework, the final step is to evaluate it against alternative solutions.

Recommendation 1: Continue Milfoil Chemical Treatment

The Policy Framework evaluated whether controlling milfoil continues to be a good investment for Cascade, particularly with respect to protecting water quality as a source of future drinking water. It also evaluated which control method is most cost effective.

Policy Drivers. Treating milfoil is driven by the following three *policy drivers (#1, 3, and 6)*:

Policy Drivers	Assessment (Milfoil Treatment)	
1. Future Treatment Plant Requirements for Drinking Water. Improvements, programs, policies, or other actions implemented by Cascade which are likely to reduce capital and/or operating costs for future drinking water treatment by improving raw water quality. Evaluation will consider known or anticipated federal or state regulatory treatment requirements for drinking water, consideration of emerging drinking water quality issues, or water quality expectations for introducing Lake Tapps water supplies to regional systems not owned by Cascade.	☑	Protecting raw water quality could reduce future treatment capital and/or operating costs of removing contaminants, including taste and odor compounds, and reduce the risk of service disruptions (e.g. clogged filters due to algae).
2. Regulatory or Contract Water Quality or Lake Management Obligations. Improvements, programs, policies or other actions necessary to meet: a) Minimum requirements of regulatory agencies for owning, managing and operating a lake and a surface water system to be used for drinking water supplies. b) Obligations under current and future water rights issued by the State. c) Requirements of agreements or inherited obligations as part of the acquisition of the Lake Tapps project. Includes agreements with Puget Sound Energy, the Tribes, Lake Tapps homeowners, property deeds, and agreements acquired from Puget at the time of ownership transfer. d) County and City regulatory obligations as a property owner. e) Agreements executed by Cascade since the purchase of the Lake Tapps system.		
3. Cascade's Other Operational (Non-Treatment) Needs. Improvements, programs, policies, or other actions that are needed for Cascade to cost-effectively and efficiently operate and	☑	Preventing overgrowth of milfoil allows Cascade to easily navigate the reservoir to inspect dikes and

Policy Drivers	Assessment (Milfoil Treatment)	
maintain the water supply assets of the White River-Lake Tapps Reservoir system.		perform other maintenance work. It also prevents inlets from getting clogged.
4. Responsibilities of Others that Impact Water Quality. Working with the State, County, Cities and property owners to implement policies, regulations, programs, or practices that benefit the Lake Tapps system water quality. This may include, but not be limited to the following: a) Working with other agencies in the implementation of their regulatory obligations. b) Working with other agencies in the development of regulations and policies that benefit water quality. c) Working with other agencies to develop plans and programs that benefit the unique characteristics of the Lake Tapps watershed. d) Working with property owners in assuring compliance with regulatory requirements or agreements.		
5. Partnerships and Funding Opportunities. Water quality benefits derived as a result of partnerships with other agencies, groups, or private parties. Water quality issues may compose all or part of such arrangements and costs and benefits for water quality elements may need to be evaluated as part of all of the elements of such arrangements. Funding opportunities include grants, loans, or other financial considerations that would prioritize an improvement or program that would not otherwise be considered at that time.		
6. Being a Good Community Steward. Programs or actions that would be considered as part of being a neighbor, good steward of resources, and presence in the community. Programs and actions would have associated tangible and measurable or intangible benefits to Cascade either short or long term.	☑	Preventing overgrowth of milfoil facilitates recreational use which is extremely important to the Lake Tapps Community.

Criteria: Below is an assessment of how treating milfoil meets the Policy Framework criteria.

Criteria	Assessment (Milfoil Treatment)	
Threshold Criteria – All Four Threshold Criteria Must First Be Met		
A. Is within Cascade's Purposes (Mission) and can be implemented through its Powers or the powers of its partner agency/agencies.	☑	Cascade's Mission is to provide safe, clean and reliable water to our members. To fulfill our mission, we need to maintain the reliability and resiliency of the Lake Tapps Reservoir as a future source of municipal supply. Milfoil control helps protect water quality which is key to maintaining reliability and resiliency.
B. Meets one or more Board-adopted Strategic Plan Goals.	☑	Controlling milfoil meets several Strategic Goals: • *Asset Management Strategy 1* - Implement strategies and make investments to protect the Lake Tapps Reservoir as a future drinking water supply. • *Environmental Stewardship Strategy 9* - Sustainably manage Cascade's facilities, equipment, assets and capital projects in a way that minimizes impacts on the natural environment. • *Regional Leadership Strategy 12* - Maintain trust and a good working relationship with Cascade's member communities and Lake Tapps partners.
C. Specific drinking water quality benefits to Cascade can be identified.	☑	As described under *Policy Drivers*, controlling milfoil helps protect raw water quality in the Lake Tapps Reservoir.
D. Cascade has staffing capacity to implement the project.	☑	Cascade has and plans to continue to contract out milfoil treatment. This approach requires a limited amount of Cascade staff time.
Additional Criteria – Proposals that meet the Threshold Criteria must next be evaluated against all applicable Additional Criteria but do not need to meet all Additional Criteria.		
E. Funding is available	☑	Cascade's 5-year contract with a treatment contractor was approved by Cascade's Board and has the following budgeted amounts remaining: • 2025 - $160,000 • 2026 - $165,000 • 2027 - $165,000
F. Project is cost-beneficial (benefits exceed costs over the project's life).	Unable to determine NPV at this time	One of the main benefits of controlling milfoil is protecting raw water quality so that future treatment plant capital and operating costs are reduced. The net present value (NPV) was not calculated because the benefits (future avoided costs) cannot be quantified at this time.
G. Ease of implementation.	☑	Cascade has contracted out chemically treating milfoil since 2010. The level of effort for this program has been low.

Criteria	Assessment (Milfoil Treatment)	
H. Reduces Cascade's risk (e.g. legal, regulatory, operational, financial, etc.) or still results in benefits if risk doesn't materialize.	☑	Preventing overgrowth of milfoil reduces operational problems and risk for Cascade, such as avoiding clogged inlets and impeding crews' ability to navigate the reservoir to inspect dikes and perform other work.
I. Maintains or enhances Cascade's relationships with key stakeholders (e.g. regulators, Tribes, community, other agencies).	☑	The Lake Tapps Reservoir community consistently indicates its appreciation of Cascade's milfoil treatment program.
J. Maintains or improves public trust (e.g. consumer confidence).	☑	As noted above, the Lake Tapps Reservoir community appreciates Cascade's effort to control milfoil, which in turn generates trust. In addition, by protecting the raw water quality, Cascade should increase consumer confidence when the reservoir becomes a source of drinking water supply.

Alternative Solutions. The alternative to controlling milfoil is do nothing – do not control milfoil. As described earlier in this Plan, overgrowth of milfoil can lead to a degradation of water quality in the Lake Tapps Reservoir. For this reason, Cascade did not further consider this alternative. By extension, it is also important to manage other invasive aquatic vegetation to maintain the water quality of the reservoir.

Alternative Treatment Solutions. As described in Appendix B, in its 2015 IAVMP, Cascade evaluated numerous other options to control milfoil and found that chemical treatment is currently the most cost-effective option. In addition, as described in the *Past Management Practices* section, Cascade has employed a variety of control strategies validating the effectiveness of chemical treatment.

Preferred Strategy. Cascade's preferred strategy is to continue to control milfoil with chemical treatment, specifically using ProcellaCOR®. Cascade's practice is to recommend the amount invested in a given year, and that amount (or different amount) is approved by its Board of Directors. This practice is expected to continue in the future. While ProcellaCOR® has been the most cost-effective method to date, Cascade will continue to explore other chemical products and other control methods.

Recommendation 2: Conduct Reservoir-Wide Surveys Every Three Years

Policy Drivers. Conducting a reservoir survey as a means of monitoring the Lake Tapps Reservoir will likely result in Cascade taking action to: 1) eradicate regulated non-native species; and 2) prevent or control the overgrowth of nuisance non-native and native aquatic plants. As such, a reservoir survey is driven by the following four policy drivers (#1, 2, 3, and 6).

Policy Drivers	Assessment (Reservoir Survey)	
1. Future Treatment Plant Requirements for Drinking Water. Improvements, programs, policies, or other actions implemented by Cascade which are likely to reduce capital and/or operating costs for future drinking water treatment by improving raw water quality. Evaluation will consider known or anticipated federal or state regulatory treatment requirements for drinking water, consideration of emerging drinking water quality issues, or water quality expectations for introducing Lake Tapps water supplies to regional systems not owned by Cascade.	☑	Identifying and preventing overgrowth of other aquatic plants, both non-native and native, protects raw water quality and could reduce future treatment capital and/or operating costs (as described under Recommendation 1).
2. Regulatory or Contract Water Quality or Lake Management Obligations. Improvements, programs, policies or other actions necessary to meet: a) Minimum requirements of regulatory agencies for owning, managing and operating a lake and a surface water system to be used for drinking water supplies. b) Obligations under current and future water rights issued by the State. c) Requirements of agreements or inherited obligations as part of the acquisition of the Lake Tapps project. Includes agreements with Puget Sound Energy, the Tribes, Lake Tapps homeowners, property deeds, and agreements acquired from Puget at the time of ownership transfer. d) County and City regulatory obligations as a property owner. e) Agreements executed by Cascade since the purchase of the Lake Tapps system.	☑	Identifying and eradicating regulated non-native plants and species enables Cascade to meet Piece County noxious weeds regulations and Washington State invasive species regulations.
3. Cascade's Other Operational (Non-Treatment) Needs. Improvements, programs, policies, or other actions that are needed for Cascade to cost-effectively and efficiently operate and maintain the water supply assets of the White River-Lake Tapps Reservoir system.	☑	Identifying and preventing overgrowth of aquatic plants and species allows Cascade to easily navigate the reservoir to inspect dikes and perform other maintenance work. It also prevents inlets from getting clogged.
4. Responsibilities of Others that Impact Water Quality. Working with the State, County, Cities and property owners to implement policies, regulations, programs, or practices that benefit the Lake Tapps system water quality. This may include, but not be limited to the following: a) Working with other agencies in the implementation of their regulatory obligations. b) Working with other agencies in the development of regulations and policies that benefit water quality. c) Working with other agencies to develop plans and programs that benefit the unique characteristics of the Lake Tapps watershed. d) Working with property owners in assuring compliance with regulatory requirements or agreements.		

Policy Drivers	Assessment (Reservoir Survey)	
5. Partnerships and Funding Opportunities. Water quality benefits derived as a result of partnerships with other agencies, groups, or private parties. Water quality issues may compose all or part of such arrangements and costs and benefits for water quality elements may need to be evaluated as part of all of the elements of such arrangements. Funding opportunities include grants, loans, or other financial considerations that would prioritize an improvement or program that would not otherwise be considered at that time.		
6. Being a Good Community Steward. Programs or actions that would be considered as part of being a neighbor, good steward of resources, and presence in the community. Programs and actions would have associated tangible and measurable or intangible benefits to Cascade either short or long term.	☑	Identifying and preventing overgrowth of aquatic plants and species facilitates recreational use and is extremely important to the Lake Tapps Community.

Criteria. Below is an assessment of how conducting lake surveys meets the *Policy Framework criteria.* As above, the assumption is that a lake survey will lead to Cascade taking proactive action to address regulated non-native species and other nuisance plants.

Criteria	Assessment (Reservoir Survey)	
Threshold Criteria – All Four Threshold Criteria Must First Be Met		
A. Is within Cascade's Purposes (Mission) and can be implemented through its Powers or the powers of its partner agency/agencies.	☑	Cascade's Mission is to provide safe, clean and reliable water to our members. To fulfill our mission, we need to maintain the reliability and resiliency of the Lake Tapps Reservoir as a future source of municipal supply. Proactively identifying and controlling the overgrowth of aquatic plants and species helps protect water quality which is key to maintaining reliability and resiliency.
B. Meets one or more Board-adopted Strategic Plan Goals.	☑	Proactively identifying and controlling the overgrowth of aquatic plants and species meets several Strategic Goals: • *Asset Management Strategy 1* - Implement strategies and make investments to protect the Lake Tapps Reservoir as a future drinking water supply. • *Environmental Stewardship Strategy 9* - Sustainably manage Cascade's facilities, equipment, assets and capital projects in a way that minimizes impacts on the natural environment. • *Regional Leadership Strategy 12* - Maintain trust and a good working relationship with Cascade's member communities and Lake Tapps partners.
C. Specific drinking water quality benefits to Cascade can be identified.	☑	As described under *Policy Drivers*, identifying and controlling the overgrowth of aquatic plants and species helps protect raw water quality in the Lake Tapps Reservoir.
D. Cascade has staffing capacity to implement the project.	☑	Cascade contracted out a reservoir survey in the past year. This approach requires a limited amount of Cascade staff time.

Criteria	Assessment (Reservoir Survey)	
Additional Criteria – Proposals that meet the Threshold Criteria must next be evaluated against all applicable Additional Criteria but do not need to meet all Additional Criteria.		
E. Funding is available	☑	The cost of the 2023-2024 reservoir survey was less than $50K This is a relatively small amount of funding and can be included in the 2027 budget (or later budget) when the reservoir survey is next needed.
F. Project is cost-beneficial (benefits exceed costs over the project's life).	Unable to determine NPV at this time	One of the main benefits of controlling milfoil is protecting raw water quality so that future treatment plant capital and operating costs are reduced. The net present value (NPV) was not calculated because the benefits (future avoided costs) cannot be quantified at this time.
G. Ease of implementation.	☑	As noted above, Cascade recently contracted out a reservoir-wide survey, and the level of effort for the work was low.
H. Reduces Cascade's risk (e.g. legal, regulatory, operational, financial, etc.) or still results in benefits if risk doesn't materialize.	☑	Proactively identifying and controlling the overgrowth of aquatic plants and species reduces operational problems and risk for Cascade, such as avoiding clogged inlets and impeding crews' ability to navigate the reservoir to inspect dikes and perform other work.
I. Maintains or enhances Cascade's relationships with key stakeholders (e.g. regulators, Tribes, community, other agencies).	☑	Proactively identifying and eradicating regulated aquatic plants and species will maintain Cascade's good relationship with its regulators.
J. Maintains or improves public trust (e.g. consumer confidence).	☑	The Lake Tapps Reservoir community appreciates Cascade's effort to control milfoil, which in turn generates trust. Identifying and controlling overgrowth of other nuisance aquatic plants should further enhance that trust. In addition, by protecting the raw water quality, Cascade should increase consumer confidence when the reservoir becomes a source of drinking water supply.

Alternative Solutions. Two alternatives to conducting a reservoir-wide survey every three years were evaluated and summarized below.

Option	Pros	Cons
Do not conduct lake surveys	Eliminates costs of the survey ($50K every three years in 2024 dollars)	Cascade will need to rely on homeowners and its own limited boat surveys to identify the presence of regulated species and/or overgrowth of nuisance non-native or native plants.
Conduct lake surveys less frequently, such as every five years	Reduces costs of the survey ($50K every six years in 2024 dollars)	Identifying the presence of regulated species and/or overgrowth of nuisance non-native or native plants could be delayed, likely resulting in more treatment costs.

Preferred Strategy. Given the relatively small amount of funding to conduct the reservoir surveys, the recommendation is to perform the surveys, preferably every three years. However, Cascade will reevaluate the effectiveness and frequency of the surveys no later than in its next IAVMP, due in 2035.

Appendix D
ProcellaCOR® Safety Data Sheet

Conforms to HazCom 2012/United States

SAFETY DATA SHEET

ProcellaCOR EC

Section 1. Identification

GHS product identifier : ProcellaCOR EC

Recommended use of the chemical and restrictions on use

Identified uses : End use herbicide product

EPA Registration No. : 67690-80

Supplier's details : SePRO Corporation
11550 North Meridian Street
Suite 600
Carmel, IN 46032 U.S.A.
Tel: 317-580-8282
Toll free: 1-800-419-7779
Fax: 317-580-8290
Monday - Friday, 8am to 5pm E.S.T.
www.sepro.com

Emergency telephone number (with hours of operation) INFOTRAC - 24-hour service 1-800-535-5053

The following recommendations for exposure controls and personal protection are intended for the manufacture, formulation and packaging of this product. For applications and/or use, consult the product label. The label directions supersede the text of this Safety Data Sheet for application and/or use.

Section 2. Hazards identification

Hazard classification: This material is not hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29CFR 1910.1200.

Other hazards: No data available.

Section 3. Composition/information on ingredients

Chemical nature: This product is a mixture.

Component	CASRN	Concentration
Florpyrauxifen-benzyl	1390661-72-9	2.7%
Ethylhexanol	104-76-7	2.1%
Methanol	67-56-1	0.9%
Balance	Not available	94.3%

Section 4. First aid measures

Description of first aid measures

General advice:	If potential for exposure exists refer to Section 8 for specific personal protective equipment.
Inhalation:	Move person to fresh air. If person is not breathing, call an emergency responder or ambulance, then give artificial respiration; if by mouth to mouth use rescuer protection (pocket mask etc). Call a poison control center or doctor for treatment advice.
Skin contact:	Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.
Eye contact:	Hold eyes open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eyes. Call a poison control center or doctor for treatment advice.
Ingestion:	No emergency medical treatment necessary.
Most important symptoms and effects, both acute and delayed:	Aside from the information found under Description of first aid measures (above) and Indication of immediate medical attention and special treatment needed (below), any additional important symptoms and effects are described in Section 11: Toxicology Information.

Indication of any immediate medical attention and special treatment needed

Notes to physician:	No specific antidote. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient. Have the Safety Data Sheet, and if available, the product container or label with you when calling a poison control center or doctor, or going for treatment.

Section 5. Fire-fighting measures

Suitable extinguishing media:	Water fog or fine spray. Dry chemical fire extinguishers. Carbon dioxide fire extinguishers. Foam. Do not use direct water stream. May spread fire. General purpose synthetic foams (including AFFF type) or protein foams are preferred if available. Alcohol resistant foams (ATC type) may function.
Unsuitable extinguishing media:	No data available

Special hazards arising from the substance or mixture

Hazardous combustion products:	During a fire, smoke may contain the original material in addition to combustion products of varying composition which may be toxic and/or irritating. Combustion products may include and are not limited to: Nitrogen oxides. Hydrogen fluoride. Hydrogen chloride. Carbon monoxide. Carbon dioxide.
Unusual Fire and Explosion Hazards:	Violent steam generation or eruption may occur upon application of direct water stream to hot liquids.
Advice for firefighters Fire Fighting Procedures:	Keep people away. Isolate fire and deny unnecessary entry. Consider feasibility of a controlled burn to minimize environment damage. Foam fire extinguishing system is preferred

because uncontrolled water can spread possible contamination. Do not use direct water stream. May spread fire. Burning liquids may be moved by flushing with water to protect personnel and minimize property damage. Contain fire water run-off if possible. Fire water run-off, if not contained, may cause environmental damage. Review the "Accidental Release Measures" and the "Ecological Information" sections of this SDS.

Special protective equipment for firefighters: Wear positive-pressure self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, trousers, boots, and gloves). Avoid contact with this material during fire fighting operations. If contact is likely, change to full chemical resistant fire fighting clothing with self-contained breathing apparatus. If this is not available, wear full chemical resistant clothing with self-contained breathing apparatus and fight fire from a remote location. For protective equipment in post-fire or non-fire clean-up situations, refer to the relevant sections.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures: Isolate area. Keep unnecessary and unprotected personnel from entering the area. Refer to section 7, Handling, for additional precautionary measures. Use appropriate safety equipment. For additional information, refer to Section 8, Exposure Controls and Personal Protection.

Environmental precautions: Spills or discharges to natural waterways are likely to kill aquatic organisms. Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. See Section 12, Ecological Information.

Methods and materials for containment and cleaning up: Contain spilled material if possible. Small spills: Absorb with materials such as: Clay. Dirt. Sand. Sweep up. Collect in suitable and properly labeled containers. Large spills: Contact SePRO Corporation for clean-up assistance. See Section 13, Disposal Considerations, for additional information.

Section 7. Handling and storage

Precautions for safe handling: Keep out of reach of children. Do not swallow. Avoid contact with eyes, skin, and clothing. Avoid breathing vapor or mist. Wash thoroughly after handling. Keep container closed. Use with adequate ventilation. See Section 8, EXPOSURE CONTROLS AND PERSONAL PROTECTION.

Conditions for safe storage: Store in a dry place. Store in original container. Keep container tightly closed when not in use. Do not store near food, foodstuffs, drugs or potable water supplies.

Section 8. Exposure controls/personal protection

Control parameters: Exposure limits are listed below, if they exist.

Component	Regulation	Type of Listing	Value/Notation
Ethylexanol	Dow IHG	TWA	2 ppm
	Dow IHG	TWA	SKIN
Methanol	ACGIH	TWA	200 ppm
	ACGIH	STEL	250 ppm
	OSHA Z-1	TWA	260 mg/m³ 200 ppm
	ACGIH	TWA	SKIN, BEI

ACGIH	STEL	SKIN, BEI
CAL PEL	C	1,000 ppm
CAL PEL	PEL	260 mg/m^3 200 ppm
CAL PEL	STEL	325 mg/m^3 250 ppm

RECOMMENDATIONS IN THIS SECTION ARE FOR MANUFACTURING, COMMERCIAL BLENDING AND PACKAGING WORKERS. APPLICATORS AND HANDLERS SHOULD SEE THE PRODUCT LABEL FOR PROPER PERSONAL PROTECTIVE EQUIPMENT AND CLOTHING.

Exposure controls

Engineering controls: Use local exhaust ventilation, or other engineering controls to maintain airborne levels below exposure limit requirements or guidelines. If there are no applicable exposure limit requirements or guidelines, general ventilation should be sufficient for most operations. Local exhaust ventilation may be necessary for some operations.

Individual protection measures

Eye/face protection: Use safety glasses (with side shields).

Skin protection

Hand protection: Use gloves chemically resistant to this material. Examples of preferred glove barrier materials include: Chlorinated polyethylene. Neoprene. Polyethylene. Ethyl vinyl alcohol laminate ("EVAL"). Polyvinyl chloride ("PVC" or "vinyl"). Viton. Examples of acceptable glove barrier materials include: Butyl rubber. Natural rubber ("latex"). Nitrile/butadiene rubber ("nitrile" or "NBR"). NOTICE: The selection of a specific glove for a particular application and duration of use in a workplace should also take into account all relevant workplace factors such as, but not limited to: Other chemicals which may be handled, physical requirements (cut/puncture protection, dexterity, thermal protection), potential body reactions to glove materials, as well as the instructions/specifications provided by the glove supplier.

Other protection: Use protective clothing chemically resistant to this material. Selection of specific items such as face shield, boots, apron, or full body suit will depend on the task.

Respiratory protection: Respiratory protection should be worn when there is a potential to exceed the exposure limit requirements or guidelines. If there are no applicable exposure limit requirements or guidelines, wear respiratory protection when adverse effects, such as respiratory irritation or discomfort have been experienced, or where indicated by your risk assessment process. For most conditions no respiratory protection should be needed; however, if discomfort is experienced, use an approved air-purifying respirator. The following should be effective types of air-purifying respirators: Organic vapor cartridge with a particulate pre-filter.

Section 9. Physical and chemical properties

Appearance	
Physical State	Liquid
Color	Amber
Odor	Solvent
Odor Threshold	No data available
pH	4.24 (1% aqueous suspension)
Melting point/range	Not applicable to liquids
Freezing point	No data available
Boiling point (760 mmHg)	No data available
Flash point	> 100 °C (> 212 °F)
Evaporation Rate (Butyl Acetate =1)	No data available
Flammability (solid, gas)	Not applicable
Lower explosion limit	No data available
Upper explosion limit	No data available
Vapor pressure	0.0000002 mmHg at 20°C (68°F)
Relative Vapor Density (air = 1)	No data available

Relative Density (water = 1)	0.93
Water solubility	0.015 mg/l at 20°C (68°F)
Partition coefficient:	
n-octanol/water	No data available
Auto-ignition temperature	260°C (500 °F)
Decomposition temperature	No data available
Dynamic Viscosity	15.4 mPa.s at 20°C (68°F) 8.90 mPa.s at 40°C (104°F)
Kinematic Viscosity	14.2 mm^2/s at 20°C (68°F) 7.91 mm^2/s at 40°C (104°F)
Explosive properties	Not explosive
Oxidizing properties	Not oxidizing
Liquid Density	0.9257 g/cm3 at 20 °C (68 °F) *Digital density meter*
Molecular weight	No data available

NOTE: The physical data presented above are typical values and should not be construed as a specification.

Section 10. Stability and reactivity

Reactivity: No dangerous reaction known under conditions of normal use.

Chemical stability: Thermally stable at typical use temperatures.

Possibility of hazardous reactions: Polymerization will not occur.

Conditions to avoid: Exposure to elevated temperatures can cause product to decompose.

Incompatible materials: None known.

Hazardous decomposition products: Decomposition products depend upon temperature, air supply and the presence of other materials. Decomposition products can include and are not limited to: Carbon monoxide. Carbon dioxide. Hydrogen chloride. Hydrogen fluoride. Nitrogen oxides.

Section 11. Toxicological information

Toxicological information appears in this section when such data is available.

Acute toxicity

Acute oral toxicity Very low toxicity if swallowed. Harmful effects not anticipated from swallowing small amounts.
As product: LD50, Rat, female, > 5,000 mg/kg

Acute dermal toxicity Prolonged skin contact is unlikely to result in absorption of harmful amounts.
As product: LD50, Rat, male and female, > 5,000 mg/kg

Acute inhalation toxicity No adverse effects are anticipated from single exposure to mist. Based on the available data, respiratory irritation was not observed.
As product: LC50, Rat, male and female, 4 Hour, dust/mist, > 5.40 mg/l No deaths occurred at this concentration.

Skin corrosion/irritation Brief contact may cause slight skin irritation with local redness.

Serious eye damage/ eye irritation May cause slight eye irritation. Corneal injury is unlikely.

Sensitization Did not cause allergic skin reactions when tested in guinea pigs. For respiratory sensitization: No relevant data found.

Specific Target Organ Systemic Toxicity (Single Exposure)	Evaluation of available data suggests that this material is not an STOT-SE toxicant.
Specific Target Organ Systemic Toxicity (Repeated Exposure)	For the active ingredient(s): Based on available data, repeated exposures are not anticipated to cause significant adverse effects. For the major component(s): Based on available data, repeated exposures are not anticipated to cause significant adverse effects. For the minor component(s): In animals, effects have been reported on the following organs: Blood, kidney, liver, and spleen.
Carcinogenicity	For the active ingredient(s): Did not cause cancer in laboratory animals. For the major component(s): No relevant data found.
Teratogenicity	For the active ingredient(s): Did not cause birth defects or any other fetal effects in laboratory animals. For the major component(s): No relevant data found. For the minor component(s): Has caused birth defects in laboratory animals only at doses toxic to the mother. Has been toxic to the fetus in laboratory animals at doses toxic to the mother. These concentrations exceed relevant human dose levels.
Reproductive toxicity	For the active ingredient(s): In animal studies, did not interfere with reproduction. For the major component(s): In animal studies, did not interfere with reproduction. In animal studies, did not interfere with fertility.
Mutagenicity	In vitro genetic toxicity studies were negative. Animal genetic toxicity studies were negative.
Aspiration Hazard	Based on physical properties, not likely to be an aspiration hazard. No aspiration toxicity classification

Section 12. Ecological information

Ecotoxicological information appears in this section when such data is available.

Toxicity	
Acute toxicity to fish	Material is practically non-toxic to fish on an acute basis (LC50 > 100 mg/L). EC50, *Cyprinus carpio* (Carp), static test, 96 Hour, > 120 mg/l, OECD Test Guideline 203 or Equivalent
Acute toxicity to aquatic invertebrates	Material is slightly toxic to aquatic invertebrates on an acute basis (LC50/EC50 between 10 and 100 mg/L). EC50, *Daphnia magna* (Water flea), 48 Hour, 49 mg/l, OECD Test Guideline 202
Acute toxicity to algae/aquatic plants	Material is very highly toxic to some aquatic vascular plant species. ErC50, *Pseudokirchneriella subcapitata* (green algae), 72 Hour, > 5.4 mg/l, OECD Test Guideline 201 ErC50, *Myriophyllum spicatum*, 14 d, 0.000919 mg/l NOEC, *Myriophyllum spicatum*, 14 d, 0.0000954 mg/l

Toxicity to Above Ground Organisms

Material is practically non-toxic to birds on an acute basis (LD50 > 2000 mg/kg).

oral LD50, *Colinus virginianus* (Bobwhite quail), > 2500mg/kg bodyweight.

oral LD50, *Apis mellifera* (bees), 48 Hour, > 212.2µg/bee

contact LD50, *Apis mellifera* (bees), 48 Hour, >200µg/bee

Toxicity to soil-dwelling organisms

LC50, *Eisenia fetida* (earthworms), 14 d, mortality, >2,500 mg/kg

Persistence and degradability

florpyrauxifen-benzyl

Biodegradability: Material is expected to biodegrade very slowly (in the environment). Fails to pass OECD/EEC tests for ready biodegradability.
10-day Window: Fail
Biodegradation: 14.6 %
Exposure time: 29 d
Method: OECD Test Guideline 301B

Stability in Water (1/2-life)
Hydrolysis, DT50, 913 d, pH 4, Half-life Temperature 25 °C
Hydrolysis, DT50, 111 d, pH 7, Half-life Temperature 25 °C
Hydrolysis, DT50, 1.3 d, pH 9, Half-life Temperature 25 °C

Ethylhexanol

Biodegradability: Material is readily biodegradable. Passes OECD test(s) for ready biodegradability. Material is ultimately biodegradable (reaches > 70% mineralization in OECD test(s) for inherent biodegradability).
10-day Window: Not applicable
Biodegradation: > 95 %
Exposure time: 5 d
Method: OECD Test Guideline 302B or Equivalent
10-day Window: Pass
Biodegradation: 68 %
Exposure time: 17 d
Method: OECD Test Guideline 301B or Equivalent

Theoretical Oxygen Demand: 2.95 mg/mg

Chemical Oxygen Demand: 2.70 mg/mg

Biological oxygen demand (BOD)

Incubation Time	BOD
5 d	26-70 %
10 d	75-81 %
20 d	86-87 %

Photodegradation
Test Type: Half-life (indirect photolysis)
Sensitizer: OH radicals
Atmospheric half-life: 9.7 Hour
Method: Estimated.

Methanol

Biodegradability: Material is readily biodegradable. Passes OECD test(s) for ready biodegradability.
10-day Window: Pass
Biodegradation: 99%
Exposure time: 28 d
Method: OECD Test Guideline 301D or Equivalent

Theoretical Oxygen Demand: 1.50 mg/mg

Chemical Oxygen Demand: 1.49 mg/mg Dichromate

Biological oxygen demand (BOD)

Incubation Time	BOD
5 d	72 %
20 d	79 %

Photodegradation
Test Type: Half-life (indirect photolysis)
Sensitizer: OH radicals
Atmospheric half-life: 8-18 d
Method: Estimated.

Balance
Biodegradability: No relevant data found.

Bioaccumulative potential

Florpyrauxifen-benzyl
Bioaccumulation: Bioconcentration potential is moderate (BCF between 100 and 3000 or Log Pow between 3 and 5).
Partition coefficient: n-octanol/water(log Pow): 5.5 at 20 °C
Bioconcentration factor (BCF): 356 *Lepomis macrochirus* (Bluegill sunfish) 30 d

Ethylhexanol
Bioaccumulation: Bioconcentration potential is moderate (BCF between 100 and 3000 or Log Pow between 3 and 5).
Partition coefficient: n-octanol/water(log Pow): 3.1 Measured

Methanol
Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3).
Partition coefficient: n-octanol/water(log Pow): -0.77 Measured
Bioconcentration factor (BCF): <10 Fish Measured

Balance
Bioaccumulation: No relevant data found.

Mobility in soil

Florpyrauxifen-benzyl

Expected to be relatively immobile in soil (Koc > 5000).
Partition coefficient (Koc): 34200

Ethylhexanol

Potential for mobility in soil is low (Koc between 500 and 2000).
Partition coefficient (Koc): 800 Estimated.

Methanol

Potential for mobility in soil is very high (Koc between 0 and 50).
Partition coefficient (Koc): 0.44 Estimated.

Balance

No relevant data found.

Section 13. Disposal considerations

Disposal methods: If wastes and/or containers cannot be disposed of according to the product label directions, disposal of this material must be in accordance with your local or area regulatory authorities. This information presented below only applies to the material as supplied. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations. If the material as supplied becomes a waste, follow all applicable regional, national and local laws.

Section 14. Transport information

DOT Not regulated for transport

Classification for SEA transport (IMO-IMDG):

Proper shipping name	Environmentally hazardous substance, liquid, n.o.s. (Florpyrauxifen-benzyl)
UN number	UN 3082
Class	9
Packing group	III
Marine pollutant	Florpyrauxifen-benzyl
Transport in bulk according to Annex I or II of MARPOL 73/78 and the IBC or IGC Code	Consult IMO regulations before transporting ocean bulk

Classification for AIR transport (IATA/ICAO):

Proper shipping name	Environmentally hazardous substance, liquid, n.o.s. (Florpyrauxifen-benzyl)
UN number	UN 3082
Class	9
Packing group	III

This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Transportation classifications may vary by container volume and may be influenced by regional or country variations in regulations. Additional transportation system information can be obtained through an authorized sales or customer service representative. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.

Section 15. Regulatory information

OSHA Hazard Communication Standard

This product is not a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Sections 311 and 312

This product is not a hazardous chemical under 29CFR 1910.1200, and therefore is not covered by Title III of SARA.

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Section 313

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

Pennsylvania Worker and Community Right-To-Know Act:

The following chemicals are listed because of the additional requirements of Pennsylvania law:

Components	CASRN
Ethylhexanol	104-76-7

California Proposition 65 (Safe Drinking Water and Toxic Enforcement Act of 1986)

WARNING: This product contains a chemical(s) known to the State of California to cause birth defects or other reproductive harm.

United States TSCA Inventory (TSCA)

This product contains chemical substance(s) exempt from U.S. EPA TSCA Inventory requirements. It is regulated as a pesticide subject to Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requirements.

Section 16. Other information

Hazard Rating System
National Fire Protection Association (U.S.A.)

Health: 1 Flammability: 1 Instability: 0

Legend

ACGIH	USA. ACGIH Threshold Limit Values (TLV)
C	Ceiling
CAL PEL	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
Dow IHG	Dow Industrial Hygiene Guideline
OSHA Z-1	USA. Occupational Exposure Limits (OSHA) – Table Z-1 Limits for Air Contaminants
PEL	Permissible exposure limit
SKIN	Absorbed via skin
SKIN, BEI	Absorbed via Skin, Biological Exposure Indice
STEL	Short term exposure limit
TWA	Time weighted average

History

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Notice to reader

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