

# SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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## SEWRPC Staff Memorandum

### WATTS LAKE SURVEY, OZAUKEE COUNTY, WISCONSIN

December 30, 2025

In December 2024, Andrew Struck, Director of the Ozaukee County (County) Planning and Parks Department, discussed the Wisconsin Department of Natural Resources (WDNR) Grant Agreement for the Lake Monitoring and Protection Network Program with Southeastern Wisconsin Regional Planning Commission (Commission) staff. The Lake Monitoring and Protection Network program was established by WDNR to support networks of organizations conducting essential lake monitoring activities, such as baseline water quality measurements, inspecting watercraft for aquatic invasive species (AIS), and early detection AIS surveys. Mr. Struck requested that the Commission assist the County with fulfillment of their Grant Agreement by conducting lake surveys and creating reports that include baseline water quality conditions, lake morphometry and sediment composition, the aquatic plant community, and reporting AIS on Ozaukee County lakes. The Commission and the County entered into an agreement to conduct the study in December 2024. Two lakes, Spring Lake and Watts Lake, were surveyed in 2025.

#### LAKE BACKGROUND INFORMATION

Watts Lake is a 5.2-acre seepage lake located entirely in the Town of Saukville within Ozaukee County, Wisconsin. The Lake is located within the Cedarburg Bog State Natural Area. This State Natural Area is the largest, highest quality bog in southeastern Wisconsin and sustains 254 native plant species, including several critical plant and animal species.<sup>1</sup> The Bog is owned and managed by the WDNR and University of Wisconsin-Milwaukee. The Bog was designated as a State Natural area in 1952, and therefore Watts Lake has been mostly protected with little disturbance to the Lake and surrounding areas (see Figure 1). Due to the Lake being on the perimeter of the State Natural Area, it is within close proximity to surrounding urban development. The public can access the Lake through a handicap-accessible hiking trail. The trail was made handicap-accessible in 2009 through a grant written by The Friends of the Cedarburg Bog and leads to a fishing pier and interpretive signage located on the Lake's northwestern shore.<sup>2</sup>

Using the WDNR Watershed Explorer tool, Commission staff delineated the Lake's watershed and summarized the land use, soils, and pollutant loading information. The lake has a 199-acre watershed that

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<sup>1</sup> *Planning Report No. 42, 2<sup>nd</sup> Amendment to the Natural Areas & Critical Species Management & Protection Plan for the Southeastern Wisconsin Region (Dec 2025).*

<sup>2</sup> <https://bogfriends.org/handicapped-trail-at-the-north-end-of-the-bog/>

drains the surrounding wetlands and agricultural lands to the north of State Highway 33 (see Map 1).<sup>3</sup> The three most common soils types within the lake's watershed are the well-drained Hochheim series (32.5 percent), the very poorly-drained Houghton series (24 percent), and moderately-drained Ozaukee series (8.5 percent). Pollutant loading to the lake modeled via the Wisconsin Inland Lake Modeling Suite (WILMS) model predicts a non-point source loading of 69 pounds per year (see Table 1). As most phosphorus transported to lakes is bound to soil particles, these estimates could be considered a proxy for sediment loading sources as well. Row crop agriculture is predicted to be the predominant phosphorus loading source, contributing 52 pounds (75% of the total phosphorus). Ensuring that agricultural landowners are utilizing best management practices, such as reduced tillage and cover crops, could help protect the water quality of the Lake.

## **SURVEY FINDINGS**

Commission staff worked with Ozaukee County to complete the Watts Lake survey on August 13<sup>th</sup>, 2025. This work included lake bathymetric mapping, an aquatic plant survey, water quality measurements, and identification of aquatic invasive species (AIS). The weather conditions were warm and sunny with mild wind. The lake's water clarity was clear. The majority of the Lake shoreline was well-buffered with wetland plant species, including cattails, swamp loosestrife, poison sumac, and dogwood. Commission and County staff accessed the Lake via an accessible pier used for fishing and sightseeing off the Watts Lake Trail. A great pond snail, variable dancer damselfly, a painted turtle and native birds were observed during the survey (see Figure 2).

Commission and County staff completed a point-intercept aquatic plant survey of the Lake using a grid provided by the Wisconsin Department of Natural Resources (WDNR) (see Figure 3). Water quality measurements, including a Secchi disk reading and profiles of temperature, dissolved oxygen, dissolved oxygen saturation, pH, turbidity, conductance parameters, and total dissolved solids, measured using a Hanna Instruments meter, were recorded at the lake's deep hole site. Grab samples were also collected and sent to the Wisconsin State Laboratory of Hygiene for analysis of chloride, total phosphorus, and chlorophyll-a.

### **Lake Bathymetry and Sediment**

Commission staff recorded the depth at each point-intercept grid survey point and utilized a Humminbird Helix 7 to track water depths throughout the survey. Commission staff created a bathymetric map for the lake by interpolating the recorded water depths across the entire lake polygon using Reefmaster software. The resulting bathymetric map is shown on Map 2. Attaining a maximum depth of 29 feet, the lake has a mean depth of 14.9 feet and a volume of 76.9 acre-feet. The Lake quickly drops in depth in the central lobe while the western bay is uniformly shallow, around five feet of depth or less. The WDNR reports the lake sediment as predominantly muck, which appears to be correct based on the observations of Commission staff.<sup>4</sup>

### **Aquatic Plant Observations**

The shallow lake depths were ringed by floating-leaf plants, such as white water lily (*Nymphaea odorata*) and yellow pond lily (*Nuphar variegata*). Northern watermilfoil (*Myriophyllum sibiricum*) and coontail (*Ceratophyllum demersum*) covered much of the lake bottom and were also growing intermixed with common bladderwort (*Utricularia vulgaris*) and Fries pondweed (*Potamogeton friesii*).

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<sup>3</sup> As the watershed was delineated using a computer program, true watershed boundaries may differ.

<sup>4</sup> <https://apps.dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=13000&page=facts>

Commission staff observed ten aquatic plant species during the point-intercept survey (see Table 2). The total littoral vegetation coverage, or the percentage of aquatic plant occurrence in depths that were shallower than the maximum depth of plants, was 91.43. The maximum depth of colonization by plants was fourteen feet. The average rake fullness was 1.64 (see Map 3). The top five most common species observed were, in order of abundance within vegetated areas: northern watermilfoil (70.3 percent), coontail (53.1 percent), Fries' pondweed (*Potamogeton friesii*, 40.6 percent), white water lily (*Nymphaea odorata*, 36.0 percent), and common bladderwort (*Utricularia vulgaris*, 31.3 percent). No aquatic invasive species were observed during the survey.

Aquatic plant metrics, such as species richness and the floristic quality index (FQI), can be useful for evaluating lake health. In hard water lakes, such as those common in Southeastern Wisconsin, species richness generally increases with water clarity and decreases with nutrient enrichment.<sup>5</sup> The FQI is an assessment metric used to evaluate how closely a lake's aquatic plant community matches that of undisturbed, pre-settlement conditions.<sup>6</sup> To formulate this metric, Wisconsin aquatic plant species were assigned conservatism (C) values on a scale from zero to ten that reflect the likelihood that each species occurs in undisturbed habitat. These values were assigned based on the species substrate preference, tolerance of water turbidity, water drawdown tolerance, rooting strength, and primary reproductive means. Native "sensitive" species that are intolerant of ecological disturbance receive high C values, while natives that are disturbance tolerant receive low C values. Invasive species are assigned a C value of 0. A lake's FQI is calculated as the average C value of species identified in the lake, divided by the square root of species richness.

Only nine aquatic plant species were directly sampled during the point-intercept survey and therefore included in the FQI calculation. The average C-value of Watts Lake's aquatic plant community was 5.6, and the FQI was 16.7. For reference, the average FQI value for the Southeastern Wisconsin Till Plains ecoregion is 20.0. The lower-than-average FQI score is influenced by the low species richness of Watts Lake. Although no known previous aquatic plant inventories have been taken for Watt's Lake, considering its location in the Cedarburg Bog State Natural Area, and presence of regionally uncommon plant species, Watts Lake may just naturally support few aquatic plant species. The Lake's average C-value and its lack of submerged invasive plants indicate that the plant community reflects somewhat undisturbed ecological conditions.

### **Water Quality**

It is the understanding of Commission staff that Watts Lake has not been sampled for water quality since 1986.<sup>7</sup> Commission staff have endeavored to provide as much insight as possible on the Lake's water quality using the available data from 1985, 1986, and 2025 survey within the context of the Lake characteristics and origin. County staff measured water quality parameters as a depth profile through the top fourteen feet of the lake, which was the maximum extent of the County's water quality probe. At depths beyond 14 feet, SEWRPC's water quality probe was used, collecting data on pH, DO, and temperature for the entire depth profile of the Lake.

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<sup>5</sup>Vestergaard, O. and Sand-Jensen, K. "Alkalinity and Trophic State Regulate Aquatic Plant Distribution in Danish Lakes," *Aquatic Botany* 67, 2000.

<sup>6</sup>S. Nichols, "Floristic Quality Assessment of Wisconsin Lake Plant Communities with Example Applications," *Lake and Reservoir Management* 15(2), 1999.

<sup>7</sup> Data retrieved from WDNR SWIMS database.

### **Temperature and Dissolved Oxygen**

Seasonal air temperature fluctuation and varying amounts of sunshine influence lake temperatures, causing waters to mix and stratify seasonally. In spring and fall, most lakes are well mixed and therefore are the same temperature from the water surface to the lake bottom. In summer, surface water warms and becomes more buoyant than underlying cooler water. Commission and County staff measured water temperatures as a depth profile down to 29 feet (see Figure 4). Water temperatures ranged from 6.12 to 24.96°C (43.02 to 76.93°F) with a decline in temperature with water depth. The thermocline appeared to begin with more than a 1°C drop every foot between 10 and 16 feet below the surface; thus, the lake likely thermally stratifies in summer and winter. All water temperatures measured are indicative of healthy conditions for warmwater fish species found in Southeastern Wisconsin.<sup>8</sup>

Dissolved oxygen (DO) levels are one of the most critical factors affecting the living organisms of a lake ecosystem. DO is generally higher at the surface of a lake where there is an interchange between the water and atmosphere, stirring by wind action (which aids in atmospheric oxygen diffusion into the surface waters at the air-water interface), and oxygen production by plant and algae photosynthesis. Metabolic processes, such as bacterial decomposition and respiration by aquatic organisms, consume oxygen and decrease DO concentrations. Dissolved oxygen was reported both in ppm, or parts per million, as well as percent saturation. While ppm measures the amount of oxygen in a volume of water, interchangeable with mg/L, the percentage of dissolved oxygen reports the relative amount of oxygen the water could hold at a given temperature and air pressure. When water is holding as much oxygen as can be absorbed, it is 100% saturated. However, saturation values above 100%, called supersaturation, can occur when photosynthesis is releasing oxygen faster than can be used, indicative of algae blooms or eutrophic conditions.

A minimum DO concentration of 5 mg/l is considered necessary for survival of most species of fish. Commission staff measured dissolved oxygen concentrations ranging from 0.05 to 6.42 mg/L<sup>9</sup> (see Figure 4), decreasing with depth until five feet, then increasing substantially up to 11 feet before again dropping. Percent saturation of DO showed similar data patterns, ranging from 0.3 to 73.4 percent throughout the water column. The lowest depths of the lake were nearly anoxic and would not be supportive of fish or other aquatic life.

### **Nutrients and Trophic Status**

Nutrients are elements and compounds needed for plant and algal growth. They are often found in a variety of chemical forms, both inorganic and organic, which may vary in their availability to plants and algae. Typically, growth and biomass of plants and algae in a waterbody are limited by the availability of the nutrient present in the lowest amount relative to the organisms' needs. Lake biological productivity is referred to in terms of "trophic status." Water clarity, total phosphorus, and chlorophyll-a are three important determinants of a lake's trophic status.

Water clarity, or transparency, provides an indication of overall water quality—the greater the clarity, the better the water quality. In most Southeastern Wisconsin lakes, water clarity is influenced by the abundance of algae and suspended sediment. Water clarity generally varies throughout the year as algal populations increase and decrease in response to changes in lake temperature, sunlight, and nutrient availability. Large rainfall events can also influence water clarity, with sediment-induced clarity declines caused by heavy runoff. Clarity is measured using a Secchi disk, a black-and-white, eight-inch-diameter disk. This disk is lowered into the water until it is no longer visible, at which point the depth is recorded, and then it is raised

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<sup>8</sup> docs.legis.wisconsin.gov/code/admin\_code/nr/100/102.pdf#page=18.

<sup>9</sup> Conversion of units from ppm to mg/L is a direct conversion of 1:1.

until visible again, when depth is recorded again. The average of these depths is called the “Secchi depth.” Commission staff measured a Secchi depth of seven feet at the deep hole site, which is indicative of relatively high water clarity and low abundance of algae and suspended solids. This Secchi depth was similar to the depth of 6.9 feet recorded in 1985, indicating little change in Lake clarity over time. Commission and County staff quantified the amount of clarity obstruction, commonly referred to as the turbidity, in Watts Lake with the water quality probe. Turbidity values were between zero and seven FNU, with the highest turbidity at the Lake’s surface. These values are consistent with the high water clarity observed.

Commission and County staff collected water grab samples that were submitted and analyzed at the Wisconsin State Laboratory of Hygiene for total phosphorus, chlorophyll-a, and chloride. Phosphorus is a key nutrient for aquatic plants and algae and its availability often limits their growth and abundance. Chlorophyll-a is a photosynthetic pigment whose abundance is used to indicate algal biomass within a lake. The total phosphorus concentration within the Lake was 0.0431 mg/L, which is higher than 0.04 mg/L numeric criterion that would indicate impairment due to nutrient enrichment based on WDNR standards for deep seepage lakes. This concentration is substantially higher than the 0.016 and 0.029 mg/l measurements recorded in 1985 and 1986. The chlorophyll-a concentration was 1.77 µg/L, which is lower than the 27 µg/L criterion that would suggest impairment of lakes and reservoirs. This chlorophyll-a concentration is lower than the 13 µg/L recorded in 1985. When converted to a trophic state index, these measurements indicate that Watts Lake is most likely a mesotrophic lake bordering on eutrophic, meaning that it is moderately to excessively rich in nutrients. Low chlorophyll-a values suggest low aquatic plant productivity, though high phosphorus may be coming in from surrounding agricultural land use.

#### ***pH, Specific Conductance, and Chloride***

The acidity of water is measured using the pH scale, a logarithmic measure of the hydrogen ion concentration on a scale of 0 to 14. Pure water has a pH of 7, neutral on the pH scale. In Wisconsin lakes, pH can range anywhere from 4.5 in some acid-bog lakes to 8.4 in hard water, marl lakes.<sup>10</sup> Many chemical and biological processes are affected by pH, as are the solubility and availability of many substances. Different organisms can tolerate different ranges of pH, with most preferring ranges between about 6.5 and 8.0. Although moderately acidic (slightly below a pH of 7) does not usually harm fish, as pH drops to 6.5 or lower, some species can be adversely affected, especially during spawning. In addition, many metals are more soluble in water with low pH than they are in water with high pH and can be released from lake sediment if present under low pH conditions.

With an average pH of 7.29, Watts Lake is a slightly basic waterbody.<sup>12</sup> The pH of the Lake ranged from 6.83 to 7.63 and was more alkaline near the surface and around 15 feet of depth (see Figure 4).

A waterbody’s pH can be affected by acids released by decomposition of organic material, underlying soil and bedrock type, and photosynthesis of aquatic plants, phytoplankton, and algae. Additionally, external factors such as pollutants contained in discharges from point sources and in stormwater runoff can also affect the waterbody’s pH.

Specific conductance is a measure of the ability of a liquid, such as lake water, to conduct electricity at a given temperature. This ability is greatly dependent on the water’s dissolved solids concentration: as the amount of dissolved solids increases, the specific conductance increases. The amount of total dissolved

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<sup>10</sup> Wisconsin Department of Natural Resources, Byron Shaw, Christine Mechenich, and Lowell Klessig, *Understanding Lake Data*:

[www.uwsp.edu/cnrap/UWEXLakes/Documents/ecology/shoreland/background/understanding%20lake%20data.pdf](http://www.uwsp.edu/cnrap/UWEXLakes/Documents/ecology/shoreland/background/understanding%20lake%20data.pdf).

<sup>12</sup> Lillie, R.A. and Mason, J.W, *Limnological characteristics of Wisconsin lakes: Wisconsin Department of Natural Resources Tech. Bulletin No. 138, 1983.*

solids (TDS) recorded in Watts Lake in 2025 ranged between 219 and 355 mg/L. Specific conductance values ranged between 440 and 721  $\mu\text{S}/\text{cm}$  @ 25 °C. The high correlation between TDS and specific conductivity can be observed by their nearly identical data shape when graphed (see Figure 4). While many dissolved solids, such as magnesium, are minerals leaching from soil and bedrock, salts containing chloride and sodium can contribute to higher specific conductance values as well. The average salinity, or the total amount of salts, was 0.28 PSU in Watts Lake,, which is typical for a freshwater system. For comparison, the salinity of seawater is 35 PSU.<sup>13</sup>

Chloride, a negative ion, readily forms salts (sodium chloride, magnesium chloride, calcium chloride) that are highly soluble in water causing dissociation of the ion. Under natural conditions, surface water in Southeastern Wisconsin contains very low concentrations of chloride with measurements in the early 20<sup>th</sup> century of 5 to 10 mg/L in Waukesha County lakes. Elevated chloride concentrations are generally associated with high specific conductance values, as the abundance of chloride ions increases the water's conductance. The chloride concentration was 30.9 mg/L, which is elevated beyond natural background concentrations and indicates that the lake has been influenced by road salt or other salt sources. Although the Lake is still far below the WDNR chronic toxicity standard of 395 mg/l, studies have indicated harmful biotic impacts in lakes with concentrations as low as 35 mg/l.<sup>14</sup>

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<sup>13</sup> <https://sfyl.ifas.ufl.edu/media/sfylifasufledu/miami-dade/documents/sea-grant/Temperature,-Salinity-and-pH.pdf>

<sup>14</sup> SEWRPC Technical Report No. 62, Impacts of Chloride on the Natural and Built Environment, 2024.

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**TABLES**

**Table 1**  
**WILMS Nonpoint Phosphorus Loading Output for the Watts Lake Watershed**

<b>Land Use Class</b>	<b>Area of Land Use Class (acres)</b>	<b>Percent of Watershed</b>	<b>Low Phosphorus export (kg/ha)</b>	<b>Likely P Phosphorus export (kg/ha)</b>	<b>High P Phosphorus export (kg/ha)</b>	<b>Annual Phosphorus Load (lbs) (Lower est. – Higher est.)</b>
Wetlands	66	33.3	0.10	0.1	0.1	6 <sup>a</sup>
Row Crop Ag	58	29.2	0.50	1.0	3.0	52 (26 – 155)
Rural Res (> 1 Ac)	38	19.0	0.05	0.1	0.25	3 (2 – 8)
Pasture / Grass	27	13.8	0.10	0.3	0.50	7 (2 – 12)
Forest	5	2.4	0.05	0.1	0.18	0 (0 -1)
Lake Surface	5	2.3	0.10	0.3	1.0	1 (0 – 4)
<b>Total</b>	<b>199</b>	<b>100.0</b>	<b>0.9</b>	<b>1.9</b>	<b>5.03</b>	<b>69 (36 – 186)</b>

<sup>a</sup> The lower and higher estimated loads are both calculated to be 6 pounds a year and thusly have no range.

Note: Information obtained from the WILMS Nonpoint Phosphorus Loading tool found at: <https://dnr-wisconsin.shinyapps.io/WaterExplorer/>

Source: WDNR and SEWRPC

**Table 2**  
**Ecological Significance of Aquatic Plant Species in Watts Lake**

<b>Species Name</b>	<b>Ecological Significance</b>
<i>Ceratophyllum demersum</i> (coontail)	Provides good shelter for young fish and supports insects valuable as food for fish and ducklings.
<i>Chara</i> spp. (muskgrass)	Excellent producer of fish food, especially for young trout, bluegills, small and largemouth bass, stabilizes bottom sediments, and has softening effect on the water by removing lime and carbon dioxide.
<i>Lemna minor</i> (small duckweed)	Provides food for waterfowl. Rapidly absorbs nutrients from water column.
<i>Myriophyllum sibiricum</i> (northern watermilfoil)	Offers shade, shelter, and foraging opportunities for fish; feathery foliage traps detritus.
<i>Nuphar variegata</i> (yellow water lily)	Provides food for waterfowl and mammals; provides habitat for fish and aquatic invertebrates.
<i>Nymphaea odorata</i> (white water lily)	Seeds consumed by waterfowl while rhizoids consumed by mammals.
<i>Potamogeton friesii</i> (Fries' pondweed)	Provides food source for fish, waterfowl, and muskrats as well as cover for fish.
<i>Potamogeton illinoensis</i> (Illinois pondweed)	Provides shade and shelter for fish; harbor for insects; seeds are eaten by waterfowl.
<i>Typha</i> spp. (cattail)	Nesting habitat and food source for aquatic and terrestrial life. Shallow, sheltered habitat provides spawning grounds for fish.
<i>Utricularia vulgaris</i> (common bladderwort)	Stems provide food and cover for fish; native.

Note: Information obtained from A Manual of Aquatic Plants by Norman C. Fassett, University of Wisconsin Press; Guide to Wisconsin Aquatic Plants, Wisconsin Department of Natural Resources; Through the Looking Glass: A Field Guide to Aquatic Plants, Wisconsin Lakes Partnership, University of Wisconsin – Extension; and U.S. Forest Service; Encyclopedia Britannica.

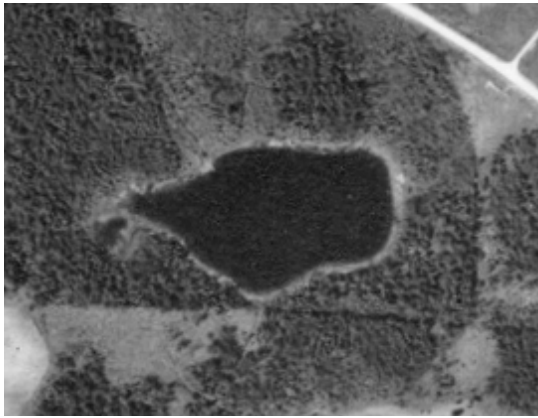
Source: SEWRPC

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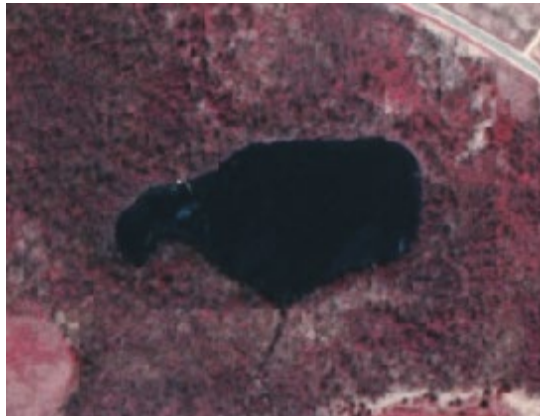
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**FIGURES**

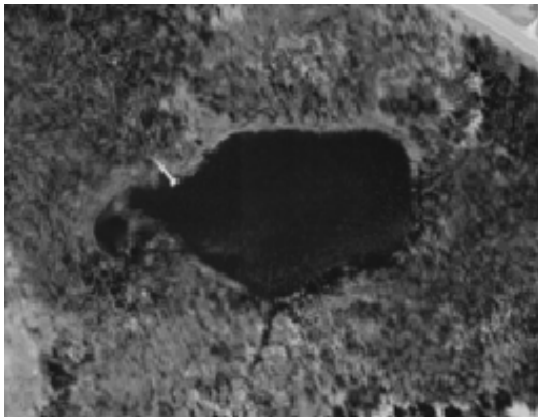
**Figure 1**  
**Aerial Imagery of Watts Lake: 1937, 1980, 2000, and 2022**



1937 Aerial



1980 Aerial



2000 Aerial



2022 Aerial

Note: The 1980 aerial photograph is red in color due to infrared imaging used for that year.

Source: U.S. Department of Agriculture and SEWRPC

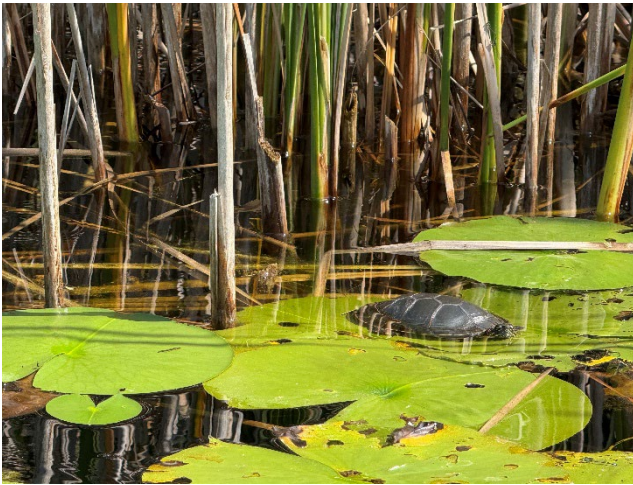
**Figure 2**  
**Images from Watts Lake: August 13th, 2025**



Watts Lake Shoreline



Informational Signage near Pier



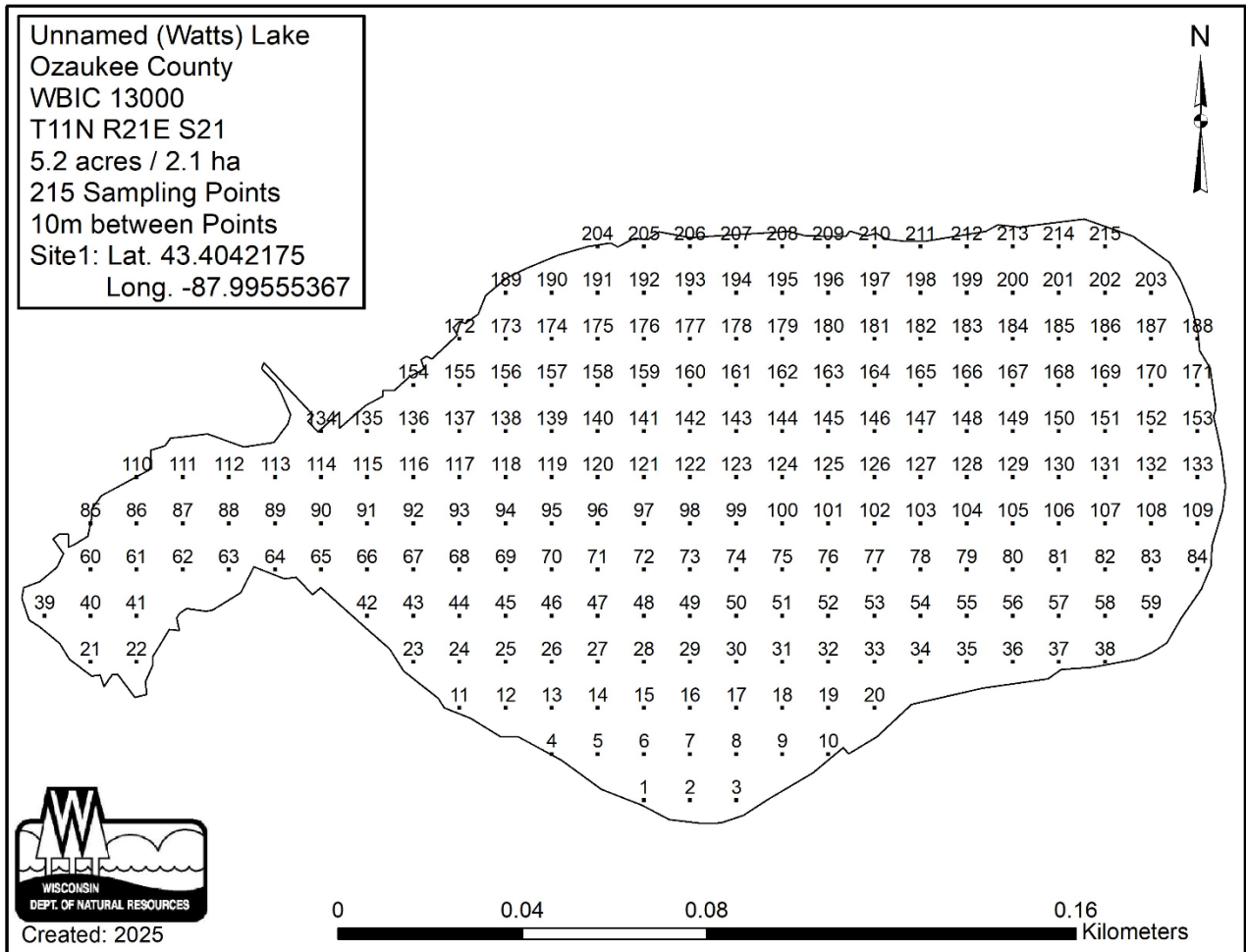
Turtle Sunbathing on Waterlily



Bay on West End of Watts Lake

Source: SEWRPC

**Figure 3**  
**PI Grid of Watts Lake**



Source: WDNR

**Figure 4**  
**Water Quality Profiles for Watts Lake**

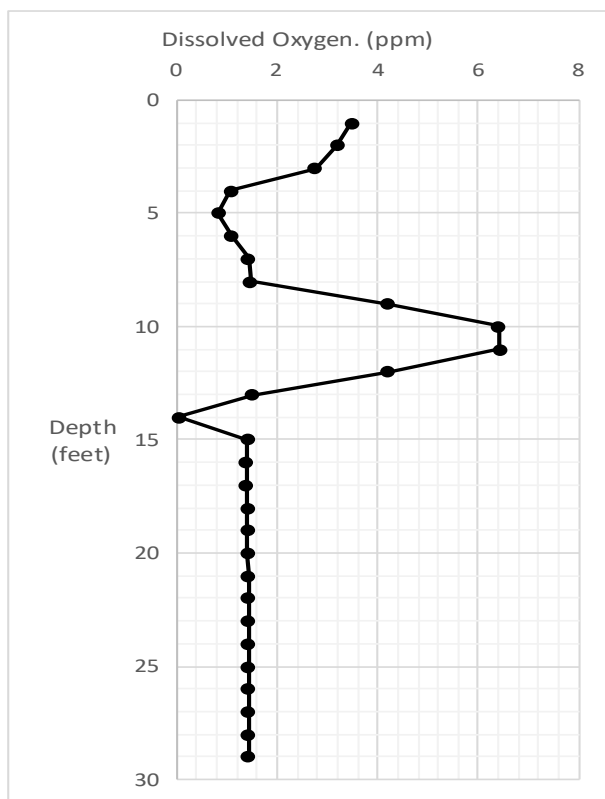
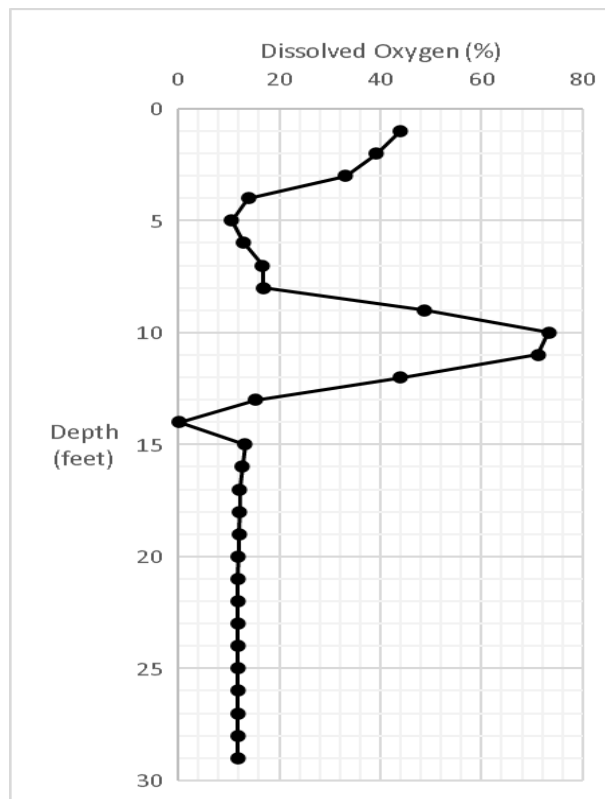
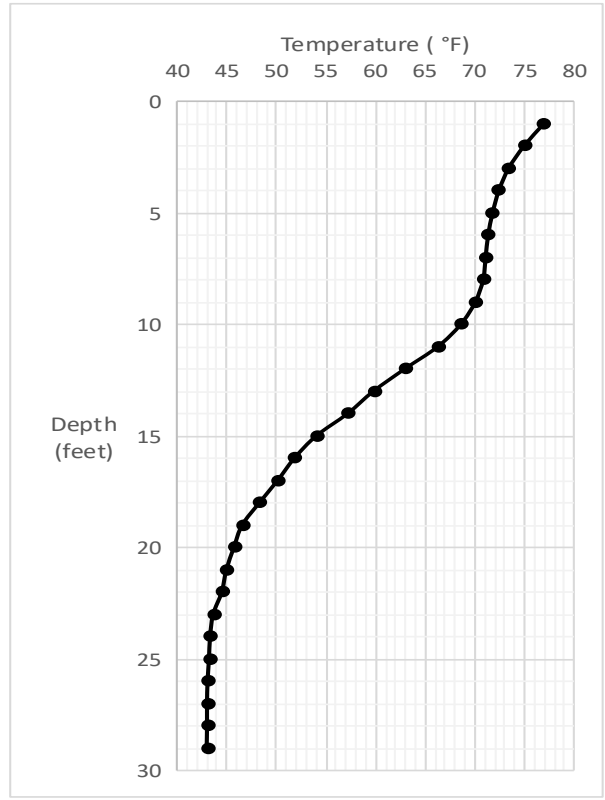
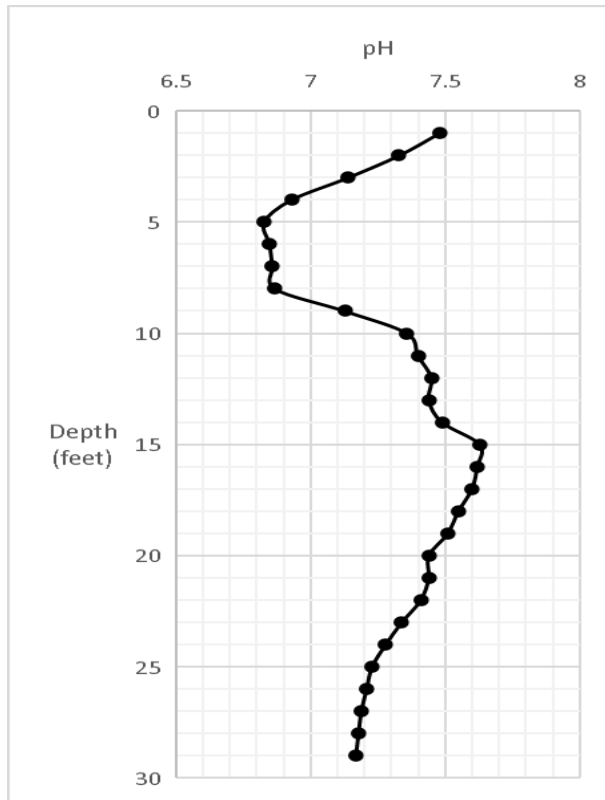


Figure 4 (cont.)

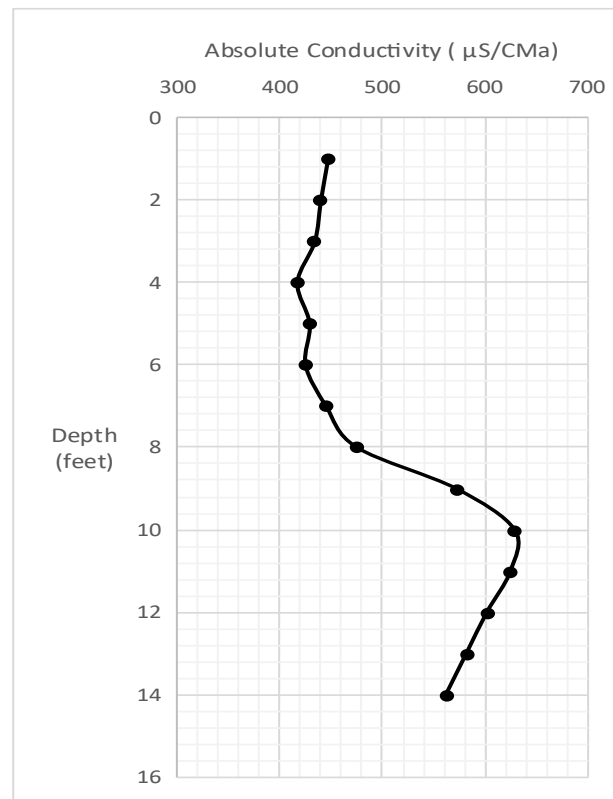
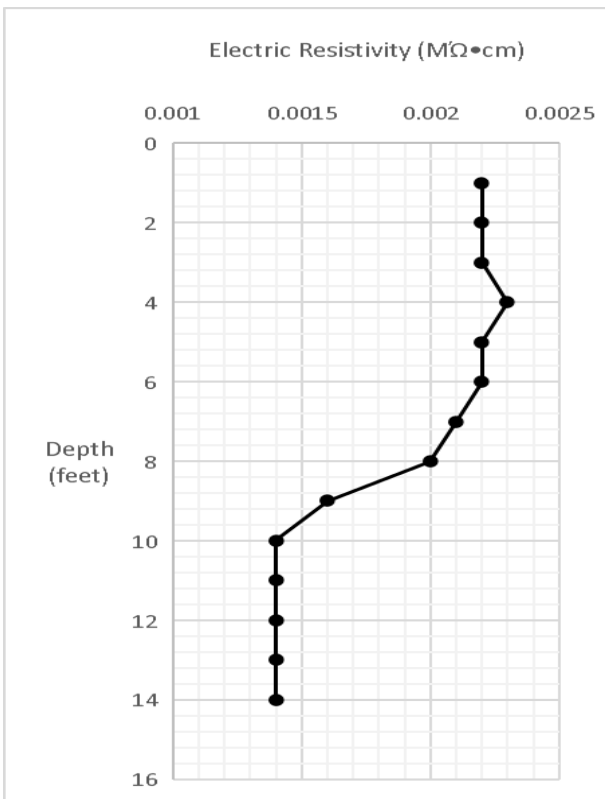
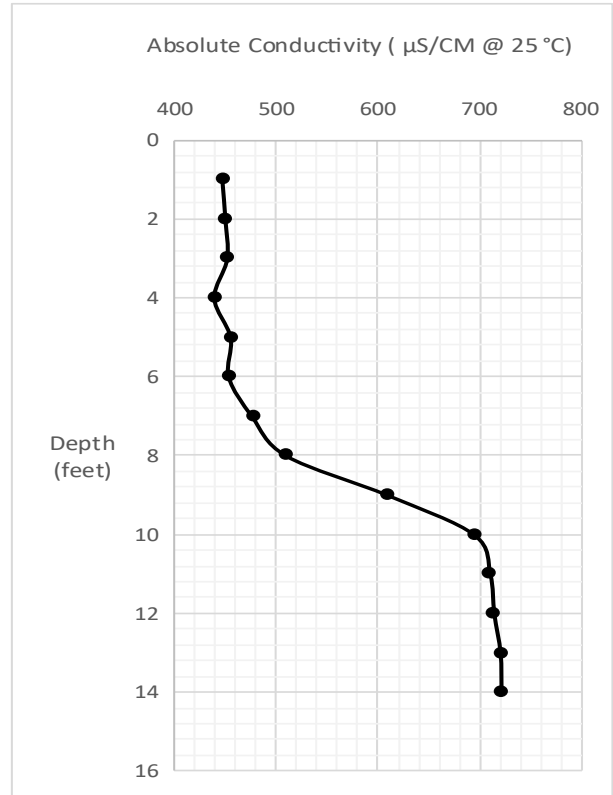
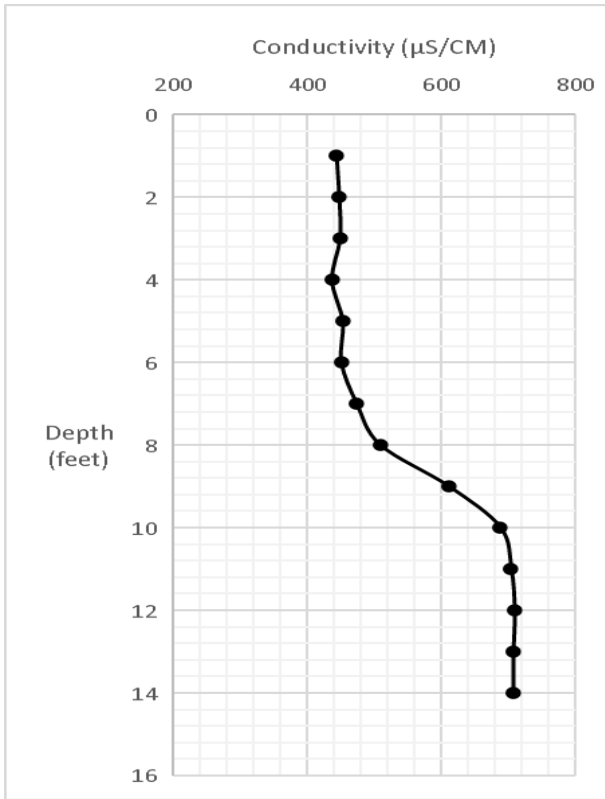
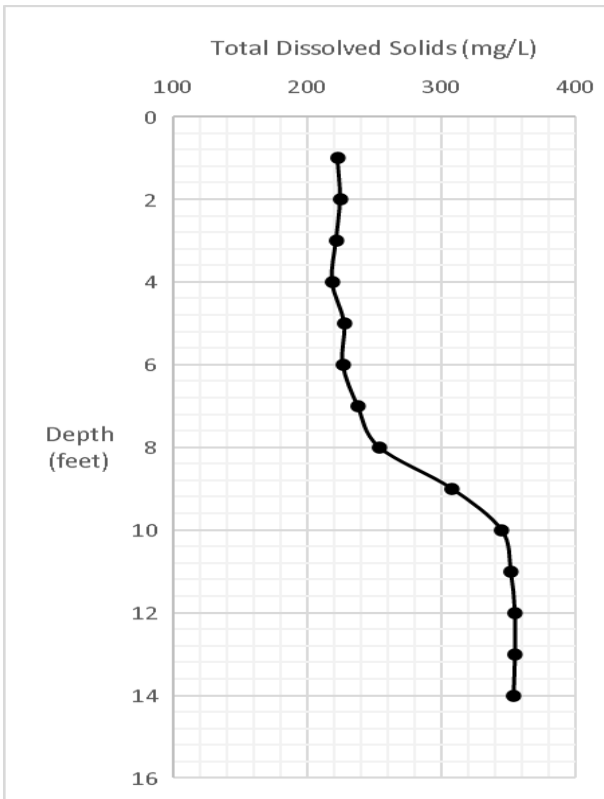
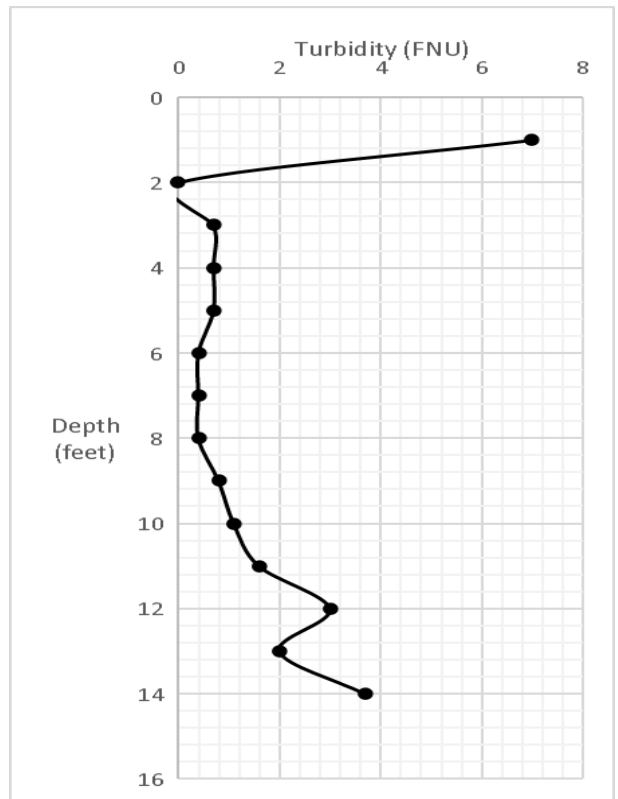
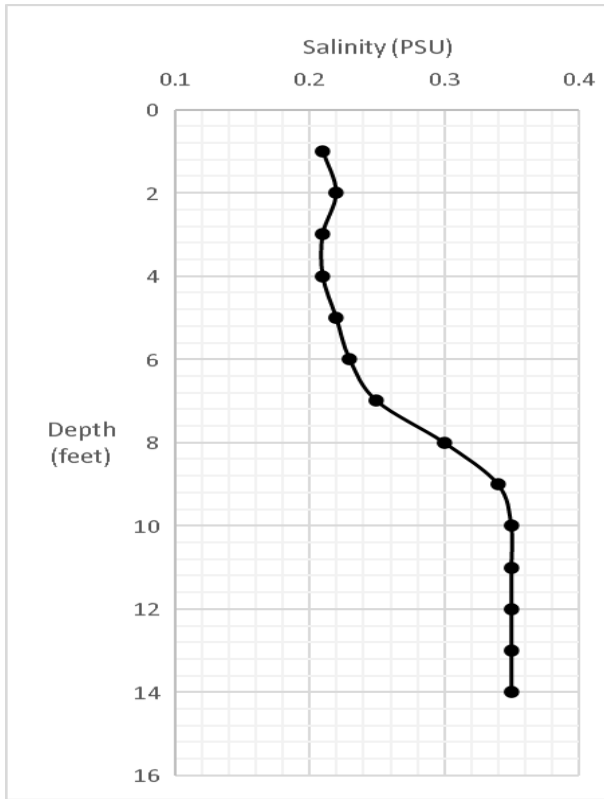


Figure 4 (cont.)



Source: Ozaukee County and SEWRPC

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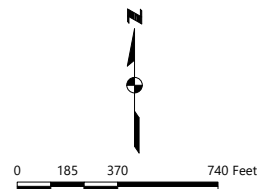
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**MAPS**

Map 1  
WDNR-Delineated Watts Lake Watershed



 Watts Lake Watershed

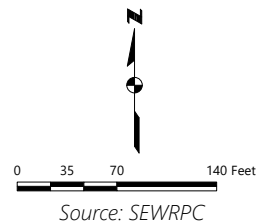


Source: WDNR and SEWRPC

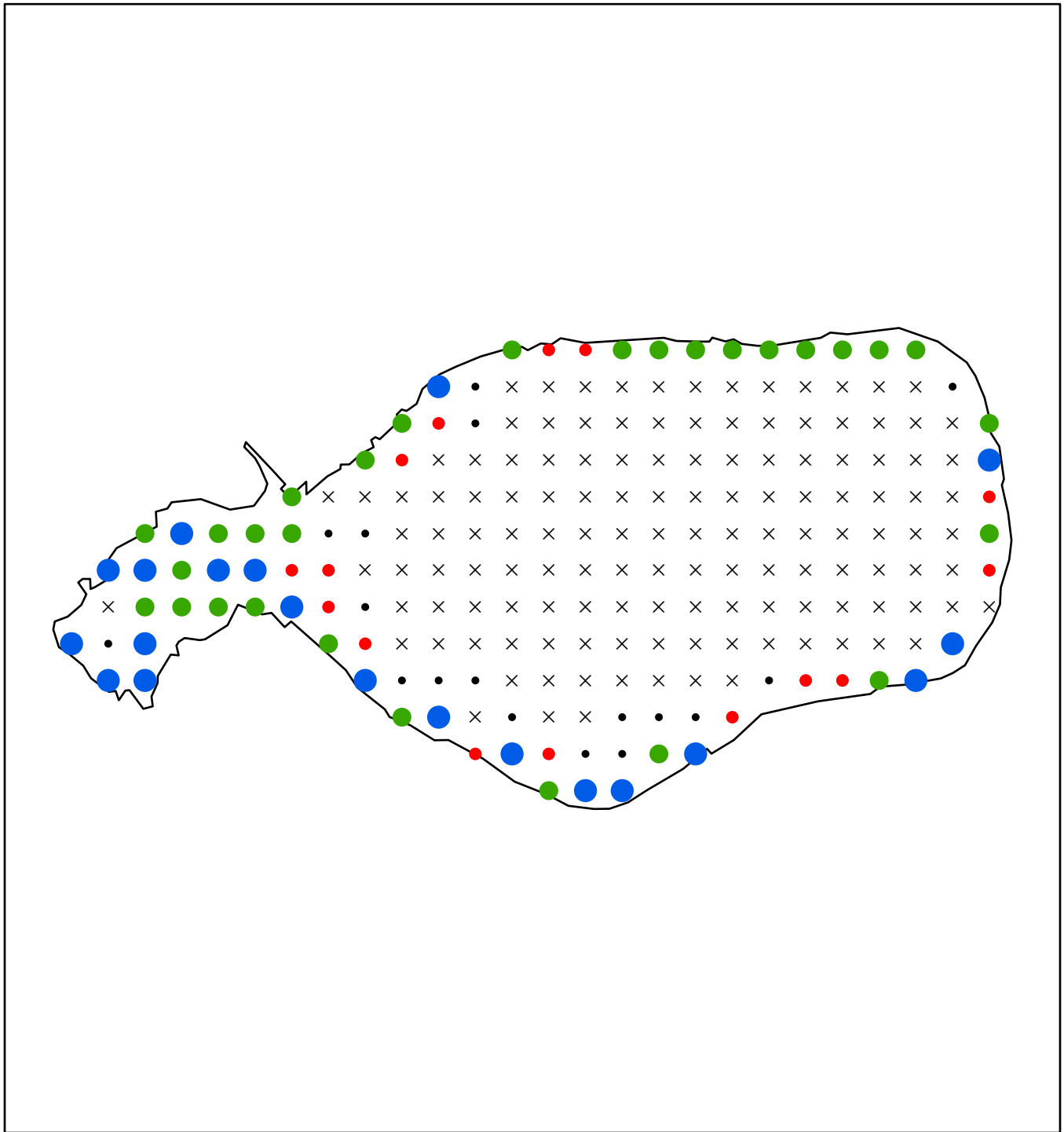
Map 2  
Bathymetry of Watts Lake



Note: Each line represents a 5' contour interval. Watts Lake's maximum depth is 29 feet.

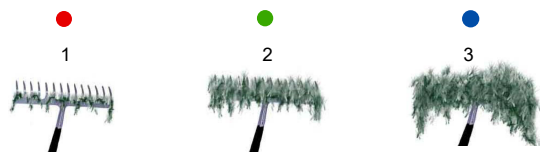


**Map 3**  
**Total Rake Fullness in Watts Lake: August 2025**



Note: Survey was conducted on Watts Lake on August 13th, 2025.

**RAKE FULLNESS RATING**



● VISIBLE NEARBY

• NO AQUATIC PLANTS FOUND    × NOT SAMPLED

