AQUA SIERRA INC.

Mountainside HOA
Bill's Lake
Water Quality Summary and Management Recommendations

June 12, 2026

Aqua Sierra, Inc.
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Introduction

A site visit was conducted on June 12th, 2026, for Mountainside HOA at Bill's Lake, located at 500 Bills Ranch Rd. Frisco, CO 80443. Service by Aqua Sierra, Inc. (ASI) was requested to obtain pre-dredge water quality data. Objectives for this site visit include examining the lake for any immediate concerns, collecting water quality data, and identifying what plants are growing in the ponds.

Bill's Lake is considered a flow through system. Historically, the in/out flow rate of the lake is estimated to be 0.5 acre-foot per day during normal snowpack conditions. This year the flow rate is predicted to be less due to lower-than-average snowpack. The Mountainside HOA is investigating dredging Bill's Lake to increase the depth and reduce the growth of aquatic vegetation. The lake typically experiences an algae bloom in August following a sustained increase in surface temperature. This assessment follows the bathymetry survey and water quality assessment completed in 2024.

Site Assessment Observations

Bill's Lake is approximately 1.91 surface acres (SA) large. The max depth of the lake is 7.5 feet with an average depth of 3.7 feet. The dissolved oxygen (DO) level was 8.40 mg/L, and the water temperature was 64.0°F during the assessment. Water clarity, as indicated by a Secchi disc, reached the pond bottom at the 4-foot-deep sample site. During the assessment, a pH reading was collected from the surface with a value of 8.62. Filamentous algae was identified across the water body's surface and substrate. The largest bloom was seen on the surface directly in the center of the lake. The south end of the lake had a high density of invasive curly-leaf pondweed. Other plant species that were positively identified include canadian waterweed, sago pondweed, northern watermilfoil, and muskgrass. No fish activity was observed on site during the assessment.

Figure 1: Filamentous Algae Bloom

Figure 2: Invasive Curly-Leaf Pondweed

Water Quality Results and Discussion

Tables 1-3 below outline the results of the water chemistry panel, with values highlighted in red to indicate if a parameter is outside of the ideal range and should be addressed to reach and maintain goals. All results are reported in mg/L, other than pH (standard units) and conductivity (µmho/cm). The testing limit for orthophosphate is <0.1 mg/L, so values below this limit are not reported.

TABLE 1[1]: Buffering Capacity

Parameter	Ideal Range	Bill's Lake
Alkalinity	>100	29.5
Carbonate	<400	4
Bicarbonate	>20	29.5
pH	7.2-7.8	7.66
Calcium Hardness	>100	32.6
Total Hardness	100-300	39.6
Conductivity	0-1500	69

TABLE 2[2]: Water Quality → Metals

Parameter	Ideal Range	Bill's Lake
Boron	<0.1	0.05
Copper	<0.1	0.1
Iron	<0.1	0.293
Manganese	<0.05	0.05
Molybdenum	<0.5	0.5
Zinc	<0.5	0.1

TABLE 3[3]: Water Quality → Nutrient Profile

Parameter	Ideal Range	Bill's Lake
Ammonia Nitrogen	<0.1	0.03
Chloride	<140	7.97
Potassium	<5.0	0.6
Nitrate nitrogen	<0.1	0.27
Phosphate, Total	<0.1	0.1
Phosphate, Ortho	<0.01	0.1
Calcium	<160	13.1
Magnesium	<25	1.7
Sodium	<50	2.3
Sulfate	<50	4.37

The results of the analysis indicate that the water quality in the pond is good, although a few parameters fail to meet, or exceed the limit of their ideal range. The water exhibited

low buffering capacity with less-than-ideal levels of **Alkalinity**, **Calcium Hardness**, and **Total Hardness**. The water exhibited elevated levels of **Iron** and **Nitrate Nitrogen**. All of which should be addressed and monitored.

Please see the section below for a detailed analysis of each parameter and recommendations to help maintain resource health and appearance.

- pH and Buffering

The pH is the measurement of hydrogen ions (H+) within a solution, but this measurement can change significantly throughout the day, impacted by various biological processes.

When alkalinity is low, the pH within the water will have a greater daily swing. pH can crash overnight and spike during the day, causing severe photosynthesis problems. When these fluctuations occur, they harm fish and cause additional issues within the water body. Since Bill's Lake has low alkalinity and hardness, raising both will help reduce the magnitude of pH swings during the day.

- Metals

Metals are found in the aquatic environment through natural processes, including weathering and erosion, volcanic activity, geothermal activity, and the decomposition of organic matter. Human activities such as mining, manufacturing, waste disposal, and the use of certain pesticides and fertilizers can also introduce metals into the aquatic ecosystem. Some metals, such as copper, iron, manganese, and zinc, are essential micronutrients and crucial for biological processes. However, excessive metal concentrations in water can become toxic and negatively impact the aquatic ecosystem.

Bill's Lake contains high levels of iron. Iron is naturally occurring and found in soil and rock which can dissolve into groundwater. Iron-rich soils and rocks, iron-oxidizing bacteria, corrosion of iron pipes, and industrial activities are all factors that can increase iron in water. Iron can cause an offensive taste and create an orange discoloration causing wildlife to avoid the water body. Although not an immediate threat to aquatic life, high levels of iron can cause increased stress and reduce reproductive success.

- Nutrient

Nutrient availability in the water column helps regulate primary producers such as plants and algae. Nitrate, phosphorus, and potassium are the principal macronutrients required for plant and algae growth, while other nutrients, including calcium and magnesium, also contribute to primary production. Nutrient-rich environments, sometimes referred to as eutrophic environments, can exhibit excessive plant growth, thick planktonic blooms, and/or dense macrophyte growth. Aquatic environments with excessive nutrients can face a process called eutrophication, which can lead to oxygen depletion in the water column.

Bill's Lake has more than twice the ideal amount of nitrate nitrogen that should be in the water column. Nitrate is a byproduct of the natural nitrogen cycle which develops from

decaying organic matter including plant material and fish waste. Nitrates are a source of nutrients that can trigger excessive plant growth. As aquatic plants decompose, this process consumes massive amounts of dissolved oxygen. Ultimately, causing oxygen depletion (hypoxia) and increasing the potential for fish kills.

Management Strategies & Recommendations

Suggestions to improve pond health and prepare it for stocking are as follows:

- Water Quality Monitoring Program

An ongoing water quality monitoring program is the most effective way to adjust management strategies and proactively track trends in water chemistry. Aquatic resources change over days, months, and years. Identifying trends will enable the recognition of potential problems early, allowing for a targeted approach to management that yields the highest success rate in achieving aesthetic and fisheries goals. Water quality data is valuable for effective decision-making and adjusting strategies as needed. Maintaining and encouraging good water quality is ultimately the key to successful aquatic resource management, as it affects aesthetics, fish health, and ecological balance.

Creating a water quality monitoring program is highly recommended for Bill's Lake since the water body will be drained and dredged. Collecting post dredge water quality data will determine the efficacy of the dredge and water chemistry of the incoming water source. Continuing to monitor the water quality of Bill's Lake helps to determine potential problems early and allows for a proactive approach.

- Grass Carp Stocking Program

Grass carp are an effective management tool for controlling aquatic vegetation in ponds. These fish are strict herbivores that do not compete with other fish for food or habitat. Grass Carp are known to eat more than their body weight in vegetation every day until maturity, which typically occurs within three to five years after stocking. After this time, grass carp will continue to feed on plant material, but in much smaller amounts. Restocking is necessary to maintain adequate populations, as they are unable to reproduce. Stocking rates should be customized based on the identified vegetation types, density, human activity around the lake, as well as water temperature. It is essential to note that grass carp do not prefer all aquatic plants equally and will initially favor preferred species in areas with low disturbance.

Grass carp can tolerate a wide range of temperatures, 0-38°C (32-100°F). In the winter, they will go to the bottom of the lake, where the temperature is warmer, and slow down their metabolism. This would put them into a dormant state, letting them conserve their energy. They typically don't eat much in the winter, either. Grass carp are known to prefer to eat sago pondweed, canadian waterweed, and muskgrass. They will also eat curly leaf and northern watermilfoil, but it's not their most preferred choice. This management strategy is a natural treatment to help solve the aquatic vegetation problem.

Ultimately, this management strategy should only be implemented post-dredge. Grass carp can consistently manage aquatic vegetation growth, reducing the availability of nitrates from decaying plant material. Conservatively introducing grass carp to this system ensures that plant growth remains at a consistent and manageable rate. This strategy can be implemented post-dredge once we can identify which species of aquatic vegetation is recurring.

- Aeration

Proper aeration increases dissolved oxygen concentrations throughout the water body while lowering concentrations of phosphorus, nitrogen, iron, and manganese that contribute to poor water quality, most notably observed as algal and rooted vegetative growth. Increased oxygen also reduces anoxic environments that contribute to odor issues and dead zones and improves the efficacy of bacterial augmentation programs. Adding aeration to a pond can help minimize excessive plant growth, aid fish survival during winter, and help lower iron levels in the water.

Aeration should be implemented and installed when water levels are low, or the lake is drained. A proactive approach to this management strategy ensures that Bill's Lake has all the parameters necessary to maintain proper water quality, reduce metals within the water column, and improve fish health.

- Dredging

Dredging is the underwater excavation of sediments from the bottom of a water body. It is a method of environmental remediation and used to clean up water ways by removing excess organic material. Although this practice has beneficial outcomes including increased depth and the removal of sediments, there are negative aspects that should be understood. Dredging removes most of the present plant material from the bottom of the water body. Doing so results in the loss of habitat for fish and allows opportunities for invasive plant species to move in.

Summary

ASI values the opportunity to provide recommendations for improving the health and condition of Bill's Lake. During the site visit, Bill's Lake was observed to collect pre-dredge data. All recommendations are based on water quality results to prevent future issues. Overall, the water quality of Bill's Lake is in good condition with only a few parameters driving the excessive amount of plant growth. Dredging the water body to remove decaying plant material will help to increase depth and reduce aquatic vegetation growth. Installing an aeration system will reduce the amount of iron in the water body, minimize plant growth, and aid in fish survival rates. Introducing grass carp post dredge ensures the consistent management of plant growth proactively while maintaining a natural environment. Followed by creating a water quality monitoring program to collect data on the efficacy of the dredge, and for future management decisions. If questions or concerns arise, Aqua Sierra is available to provide valuable science-based solutions to all the recommended management strategies.

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