Spanaway Lake Management Plan
Technical Memo

EXECUTIVE SUMMARY

Introduction and Purpose

In 2013, Pierce County received $400,000 from Washington State Legislature to research and develop a management plan for Spanaway Lake. Pierce County Surface Water management contracted with the consulting firm Brown and Caldwell (with assistance from Geosyntec and Dr. Mark Sytsma) to develop a thorough assessment of lake conditions and alternatives. Pierce County, along with Pierce County Parks and Recreation, Tacoma-Pierce County Health Department, Pierce County Sewers, Pierce Conservation District, United State Geological Survey and Spanaway Lake advisory group members will use this information to develop recommendations for the plan.

The objective of the Lake Management Plan (LMP) is to develop strategies to improve and protect the lake uses. The LMP is being developed in two phases. Phase 1 involves characterizing Spanaway Lake water quality and identifying and quantifying nutrient and bacteria sources affecting the lake. Phase 2 involves evaluating potential management measures based on the Phase 1 findings.

This watershed characterization technical memorandum summarizes the results of Phase 1 of the Spanaway LMP. The primary goal of the lake characterization technical memorandum is to describe the water quality and flow data collected and develop water quantity and nutrient budgets for Spanaway Lake. The water budget estimates groundwater as well as surface water that flows into and out of the lake. Also, the characterization identifies potential nutrient and bacteria sources.

Lake Features

Spanaway Lake is a large, natural kettle lake in central Pierce County, Washington. An area of approximately 17 square miles drains into Spanaway Lake, which has a surface area of 272 acres. The average and maximum lake depth are approximately 16 and 28 feet respectively. The largest source of water to the lake is groundwater, which contributes approximately 65 percent of the inflow to the lake. The main surface water source to the lake is a wetland system that feeds into Coffee Creek on the south end of the lake. Water discharges from the lake at the north end through Spanaway Creek. The lake supports a variety of uses including boating, fishing, swimming, and wildlife habitat. More than 170 single family homes and 160 multi-family residences have direct access to the lake shore. Pierce County operates a large, regional park on the north east shore of the lake that allows public access. The park receives approximately 500,000 visitors per year.

Water Quality

A Quality Assurance Project Plan (QAPP) was developed to guide collection of field data. Pierce County staff collected data following the procedures outlined in the QAPP between October 2014 and December 2015. Data collection included monitoring of flow, lake water quality, surface water quality, and groundwater quality in order to develop a nutrient budget for the lake, identify key nutrient sources, and support evaluation of lake management measures.

Identified water quality concerns for Spanaway Lake include excessive nutrients, low dissolved oxygen, and elevated fecal coliform bacteria. Elevated nutrient concentrations increase the growth of blue-green algae species that can produce substances toxics to people, pets, and wildlife. The number of days per year during which the Tacoma-Pierce County Health Department has issued advisories on the lake for toxic algae over the past 10 years has ranged from 64 days in 2011 to 318 days in 2015.

Elevated nutrient concentrations can also contribute to excessive aquatic plant growth. The primary nutrient of concern in Spanaway Lake is total phosphorus (TP), which intensifies both algal blooms and the growth of aquatic plants. Excessive growth of algae and rooted plants can cause large swings in dissolved oxygen concentrations. Dead algae and plant materials settle to the lake bottom where they decompose and remove dissolved oxygen from the lake water. Low dissolved oxygen levels are harmful to fish and other aquatic life.

Thermal stratification plays an important role in the lake's phosphorus cycle. From approximately April through October, water in the bottom of the lake is too cold and dense to mix with the warmer, well-oxygenated surface water. The deep water becomes anoxic (no oxygen) due to decomposition of dead plants and other organic matter on the lake bottom. As the lake bottom sediments become anoxic, they release phosphorus into the lake water. When the weather cools in the fall the temperature throughout the lake becomes uniform and the phosphorus-rich bottom water can mix with the rest of the lake and trigger algal blooms.

Based on the monitoring results from October 2014-December 2015, the total phosphorous (TP) load to the lake is about 1,000 kilograms per year (about 2,200 lbs/yr). As shown in Figure 1, roughly 55% of the TP comes from the lake bottom sediments (internal load), while groundwater and Coffee Creek respectively contribute about 29% and 12%. The current TP loading from the watershed is estimated to be about 35% higher than the watershed loading rate that would result in more pristine or oligotrophic lake conditions. The TP load from groundwater is predicted to slowly increase over time.

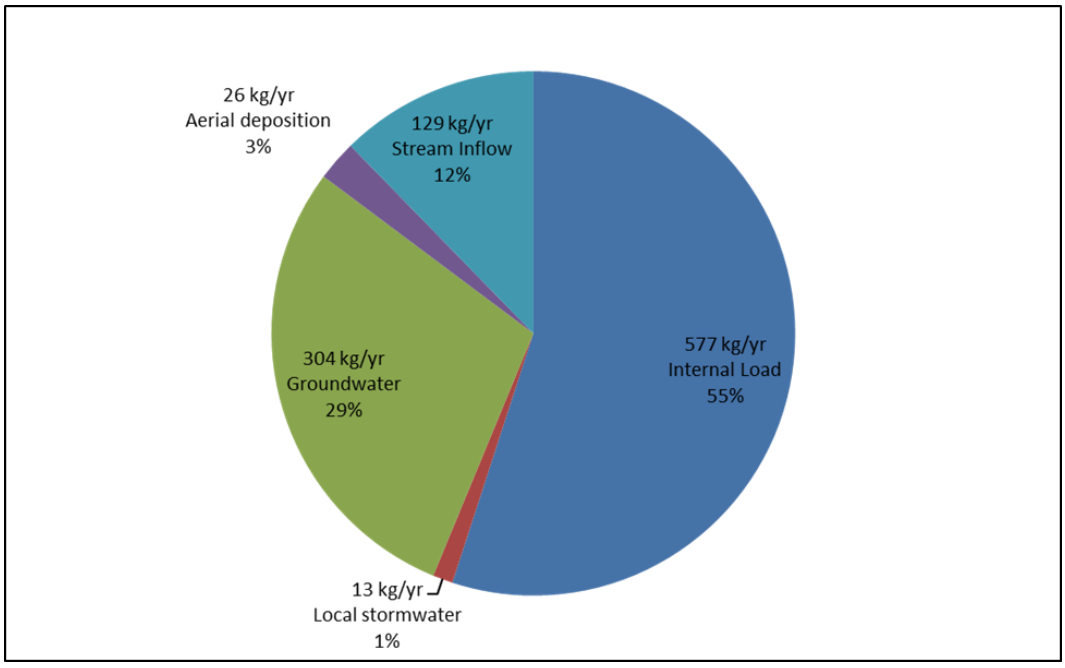

Figure 1 Estimated annual total phosphorous loading to Spanaway Lake

Fecal coliform and e. coli bacteria are indicators of potential fecal contamination. Elevated concentrations of these bacteria indicate that potentially harmful bacteria, viruses, or parasites may be present. In Spanaway Lake, elevated fecal indicator concentrations have been observed near the swimming areas.

Pollutant Sources

Identified primary sources for water quality concerns in the lake are as follows:

- Lake Sediment: The lake bottom sediment contains a large amount of phosphorous. Higher concentrations are found in the finer grained sediments in the deeper parts of the lake. The sediments can release P to the water column when the lake water becomes anoxic and also when lake water pH is high.
- Septic systems: There are nearly 4,000 onsite sewage disposal systems (OSDS) located up gradient of Spanaway Lake. Surface failures are rare due to the very permeable soils, but TP from OSDS can slowly move through the soil and reach the lake through groundwater flow. Septic systems installed in shallow groundwater areas close to the lake have the potential to contribute fecal coliform bacteria to the lake via groundwater transport. Model estimates indicate OSDS currently contribute on the order of 53 kg to 89 kg of phosphorus to the lake each year, which is about 17% to 20% of the current groundwater load to the lake. Because TP tends to move very slowly in the subsurface, the model predicts that the number of OSDS that affect the lake and OSDS TP loads will slowly increase over time.
- Waterfowl: Droppings from waterfowl have the potential to contribute both phosphorus and fecal coliform bacteria to the lake through aerial deposition and overland flow from shoreline areas. However, these contributions are not equal. As a source of phosphorous, the data suggest that waterfowl are very minor contributors, but as a source of fecal coliform bacteria, their impact is more significant. Spikes in fecal coliform bacteria along shorelines could be explained by the presence of waterfowl. Additional data on waterfowl use of the lake would aid in quantifying their impacts on the lake.
- Stormwater: Direct stormwater runoff appears to be a minor source of P and bacteria to Spanaway Lake. Only a small area around the lake contributes runoff directly into the lake. Because of the very permeable soils and numerous infiltration facilities, most stormwater in the watershed is infiltrated.

Next Steps

The project team is developing a preliminary list of potential short-term and long-term measures to improve water quality in Spanaway Lake. The team will tentatively identify the measures that appear most appropriate for Spanaway based on the characterization results, and develop draft criteria for comparing and selecting the measures. The team will solicit stakeholder input on the candidate list and evaluation criteria, and then compare the potential management measures based on the criteria.