

# Best Available Science

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## *Lake Management Areas*

Prepared for the City of Sammamish  
by AMEC Environment and Infrastructure Inc.

## **Introduction**

This Best Available Science review describes information relative to protecting certain sensitive lakes identified as Environmentally Critical Areas (ECA) within the City of Sammamish (City). Per the City's ECA code (21A.50.355), Lake Management Areas were designated for Beaver Lake and Pine Lake to control total phosphorous loading (the key variable for eutrophication and the potential for algal blooms) and to establish specific criteria for development procedures within the Beaver Lake and Pine Lake watersheds.

This BAS review includes a brief overview of lake water-quality issues, conditions unique to the City, and a list of suggested research or actions that could improve the City's ECA code for sensitive lakes. The last update to the City's ECA code was conducted in 2005. Therefore, this review focuses on changes in the science and policy since that update.

## **Literature Review**

Protecting lake water quality from impacts from development is an issue common to municipalities and counties across Western Washington. The literature review for this report considers recent guidance from the State of Washington Department of Ecology (Ecology), King County, and studies that specifically address lakes within the City. These materials are listed below, under "references."

## **Lake Water Quality and Stormwater Management**

Sensitive lakes are those lakes particularly prone to eutrophication from increased phosphorus loading, which can occur due to a combination of water quality characteristics and watershed land development (King County, 2009a). Eutrophication of a lake can result in increased vegetation and algae growth, depletion of oxygen in bottom waters, decreased visibility in the water, and some impairment of recreational use. Taken to the extreme, hypereutrophic lakes are characterized by high algal productivity and intense algae blooms, fish kills due to oxygen depletion, and frequent impairment of recreational uses.

Land development and use contributes to increased phosphorus loadings to downstream water resources in several ways. Erosion of disturbed areas on construction sites can result in sediment transport to surface waters, which can cause algal blooms (King County, 2009a). Over-application of fertilizers and the discharge of detergents containing phosphates to the storm drainage system can also increase watershed loading of phosphorus.

Both King County (King County, 2009a) and Ecology (Ecology, 2011a) have requirements for development sites within sensitive lake watersheds that include the following:

## *Best Available Science Lake Management Areas*

- The treatment goal for stormwater treatment facilities that discharge to a surface drainage system within a sensitive lake watershed is 50% annual average total phosphorus (TP) removal.
- Infiltration of untreated stormwater from pollutant generating sources should be restricted within one-quarter-mile of a sensitive lake.
- Stormwater that is infiltrated within one-quarter-mile of a sensitive lake is to be treated to achieve 50% annual average total phosphorus (TP) removal.

As discussed further below, ECA code 21A.50.355 sets a more restrictive standard of 80% phosphorus removal, rather than 50%. Controlling phosphorus discharges to surface waters requires a combination of source control best management practices (BMPs) to prevent the release of phosphorus into stormwater, and treatment BMPs to reduce the amount of phosphorus present in stormwater discharges. Typical sources of phosphorus include detergents, cleaners, fertilizers, organic matter, and animal wastes (King County, 2009b). Ecology (2011b) identifies the following source control practices applicable to reducing phosphorus:

- Covered areas for car washing, which drain wash water to a wastewater treatment system.
- Fertilizer management for landscaped areas, including proper storage and avoiding over-application.

In 2011 the Washington State signed into law House Bill 1489 that amends RCW 15.54 by restricting the use and sale of turf fertilizer that contains phosphorus. This law goes into effect January 2013.

Low impact development (LID) is a stormwater management and land development strategy applied at the parcel and subdivision scale that emphasizes minimizing soil disturbance, conserving on-site natural features, adding vegetation, using pervious surfaces, minimizing impervious surfaces, and integrating all of these elements with engineered, small-scale hydrologic controls in order to mimic pre-development hydrologic functions. By reducing stormwater discharges from properties within a lake's watershed, it is expected that the release of pollutants downstream, including phosphorus, would be reduced. The City has incorporated provisions for LID in its Municipal Code (SMC 21A.85).

### **Unique Conditions in Sammamish**

Beaver Lake, Pine Lake, and Laughing Jacobs Lake are within the City. The City's current ECA code (Section 21A.50.355) establishes Lake Management Areas that designate Beaver and Pine Lakes as special areas for total phosphorous loading control and establishes specific criteria for development procedures within their watersheds.

The updated 2007 Beaver Lake Management Plan (King County, 2007) indicated that phosphorus levels had not changed significantly over the previous four years. Other indicators of lake health – transparency, dissolved oxygen, turbidity, and color – behaved similarly. The plan states “Beaver Lake water quality is good and has remained stable over time, but additional development in the watershed could still cause degradation of water quality.” Recommendations are made to retain open space and wetland/stream buffers, enforce

## *Best Available Science Lake Management Areas*

seasonal clearing and grading requirements, enforce temporary erosion and sediment control standards, encourage LID, and maintain the AKART standard for new development.

The plan for Management of Pine Lake Water Quality (Tetra Tech, 2009) evaluates the water quality status of Pine Lake, based on water quality monitoring data and observations of algal bloom patterns. Phosphorus-laden water that entered the lake from one of the tributary subbasins was diverted in 1988. Tetra Tech (2009) documents that

...the quality of Pine Lake has improved greatly since this diversion. The historic spring cyanobacteria (blue-green algae) blooms have all but disappeared. However, fall and winter blooms still occur, as was the case in 2005. While diversion of phosphorus inputs was the cause for the spring bloom elimination, fall-winter blooms result largely from high phosphorus content in the anoxic hypolimnion (deep cold water zone), which becomes distributed throughout the whole lake following fall mixing.

The study recommends that stormwater BMPs continue to be implemented to maintain the health of Pine Lake, and advises that 80% phosphorus-reduction performance standard of the 2005 ECA code be continued. Recommended source controls to reduce phosphorus consist of imposing a strict pet waste ordinance, a phosphorus ban on all fertilizers within the watershed, and irrigation reduction (Tetra Tech, 2009). A state phosphorus ban for turf fertilizers goes into effect January 2013.

### **Relevance to Existing City Regulations**

The current ECA code requirements establish the Beaver Lake and Pine Lake watersheds as lake management areas in which new development is subject to specific standards for reducing the phosphorus in stormwater runoff. The code prescribes methods for analyzing and sizing stormwater BMPs that are presumed to meet the 80% phosphorus reduction standard. The ECA code allows a proponent to use equivalent or improved treatment methods if it can be demonstrated that the standard will be achieved. Based on the documents discussed above, this reduction standard continues to be appropriate within the Lake Management Areas.

While this standard is more stringent than that of King County and Ecology, in the current code it is only applied to new impervious surfaces subject to vehicular use. King County and Ecology, however, have thresholds that would trigger implementation of stormwater treatment for redeveloped impervious and pervious pollutant-generating areas. Introducing similar thresholds in the ECA code to trigger stormwater treatment for redeveloped sites and pervious pollutant generating areas would further reduce phosphorus loading to Beaver and Pine lakes.

Ecology has a procedure to evaluate emerging technologies for stormwater treatment known as the Technology Assessment Protocol – Ecology (TAPE protocol). The department maintains on their website<sup>1</sup> a list of emerging technology BMPs that have demonstrated the capability to achieve specific pollutant reduction targets. Practices that have followed Ecology's procedures to demonstrate performance capability are designated for Pilot Use, Conditional Use, or General Use, depending on the amount of verification that has been performed. Allowing practices designated for General Use for phosphorus control to be incorporated into stormwater treatment

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<sup>1</sup> <http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html>

*Best Available Science  
Lake Management Areas*

systems in the Lake Management Areas would increase the flexibility for developers and landowners to achieve targeted phosphorus reductions.

The procedures to analyze and design stormwater treatment BMPs for phosphorus reduction have been updated in both the Ecology (2011a) and King County (2009a) stormwater manuals. These standards could be incorporated by reference in lieu of the current prescriptive list of practices that is part of 21A.50.355(8).

The current ECA does not discuss source control BMPs that would provide phosphorus reduction benefits. Including provisions that restrict car washing to covered areas, require proper disposal of animal waste, and reduce the use of fertilizers with phosphorus would further the goal of reducing phosphorus in stormwater runoff in the watershed.

**Table 1. Summary of Recommended Changes to the Sammamish Environmentally Critical Areas Code**

Recommended code change	Best Available Science	Professional Experience	Case Law	Statutory Law
Consider introducing thresholds to trigger stormwater treatment for redeveloped sites and pervious pollutant generating areas, similar to those of King County and Ecology	King County 2009a			
Consider allowing stormwater treatment technologies that have been tested using Ecology's TAPE protocol and given a General Use Level designation to be incorporated into stormwater treatment systems in the Lake Management Areas	Ecology 2008			
In lieu of the current prescriptive list of practices that is part of 21A.50.355(8), reference the King County or Ecology manual procedures to size, analyze, and design stormwater treatment BMPs for phosphorus reduction, and require engineering design computations to demonstrate how the 80% phosphorus reduction level will be achieved for each development and redevelopment project site exceeding water quality treatment thresholds.	King County 2009a			
The current ECA does not discuss actions that would reduce phosphorus in stormwater runoff. Include source-control BMPs provisions, such as restricting car washing to covered areas, requiring proper disposal of animal waste, and reducing phosphorus-containing fertilizer use.	King County 2009b			RCW 15.54

**Research or Monitoring Needs**

A midcourse evaluation of Beaver Lake water quality based on data collected since 2006 is being prepared under the auspices of the current Beaver Lake Management District and will be published in 2012. The phosphorus modeling efforts of the past BLMDs are currently being revisited and updated as well. It is recommended that this modeling work include evaluating the impacts of various stormwater treatment performance goals for reducing phosphorus loading to the lake; specifically, whether the target of 80% phosphorus reduction in stormwater discharges for new development and redevelopment yields improved lake health when compared to the 50% phosphorus reduction target consistent with the standard used by King County and Ecology.

## **References**

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