

Lake Whatcom Integrated Risk Assessment Executive Summary

Because of suggestions of impaired ecological function, a screening level integrated ecological and human health risk assessment was conducted for Lake Whatcom in Whatcom County, Washington using the Relative Risk Method (RRM). This multiple-use watershed serves as the only surface water supply for over 86,000 people, while also supporting diverse fish and wildlife species. Historically land uses have included logging, mining, recreation and residential development. This is the first study utilizing the RRM to create an integrated risk model framework by incorporating human health into an ecological risk assessment. The integration of human health and ecological risk assessment is critical for this study area because humans live near the lake and drink the water. Although several jurisdictions work collectively on managing the lake, the watershed lacks a comprehensive management plan. This leads to some complex and conflicted land use policies, recreational uses, and data collection efforts.

This integrated ecological and human health risk assessment quantified the relative risks to the endpoints of birds, fish, flood control, humans, and water quality. Sources included dams, industrial discharges, land disturbance, recreation, septic and sewer systems, and transportation. Stressors included chemical, microbial, and physical contaminants released from the sources. These risk characterizations provide a rank-based assessment of ecological and human health risks that exist in a multi-use drinking water supply.

The two risk regions of Whatcom creek and the Middle Fork of the Nooksack River were geographically outside of the Lake Whatcom watershed. This is important when comparing risks between the regions. The Middle Fork of the Nooksack River is diverted through a pipeline into the south end of Lake Whatcom. The diverted flow accounts for about 1% of the total flow of the Middle Fork Nooksack River, but approximately 10% of the total surface water input to Lake Whatcom. For this risk region the calculations were based on 10% of the actual totals for each source, habitat, and stressor category. Whatcom creek is the only outlet for Lake Whatcom and was included to calculate risks to downstream habitat and endpoints from Lake Whatcom. However, since this risk region lies outside the Lake Whatcom watershed, and is fully urbanized only source categories of recreation and flood control and habitat categories of water and sediment were utilized in calculating the risk score.

There are many sources of stress to the Lake Whatcom watershed. The lake has been listed as an impaired waterbody under section 303(d) of the Clean Water Act for low levels of dissolved oxygen. In 2004, Lake Whatcom was listed for phosphorus, mercury, polychlorinated biphenyls(PCB's), and dieldrin. The original 303(d) listing for dissolved oxygen mandated the Department of Ecology to conduct a Total Maximum Daily Loading (TMDL) study to set an allowed quantity of these listed pollutants to be discharged per day into Lake Whatcom. The management team from the City of Bellingham, Whatcom County, and Lake Whatcom Water and Sewer District are required by law to reduce pollution levels to the allowable amount specified in the TMDL.

The results from the integrated risk assessment showed that the sources of land disturbance, transportation, and recreation contributed the most risk to the study area. The

order of risk from high to low from sources is 1) land disturbance, 2) transportation, and 3) recreation, 4) septic and sewer systems, 5) dams, and 6) industrial discharge. The risk score for recreation is more than double the risk score for septic and sewer systems. The risk score for the highest source, land disturbance, is five times greater than the lowest risk source of industrial discharge. The stressor with the highest risk is phosphorus. Stressors at a medium risk level are mercury, erosion, metals, altered flows, gasoline products, and stormwater runoff. Lowest risk stressors include legacy chemicals, endocrine disruptors, invasive plants, fecal coliform, and temperature. The habitat with the highest risk is water, followed by urban areas, sediment, and forest areas. The ecological endpoint at the highest risk is water quality, followed closely by fish and birds. The human health risk regions at the highest risk are the direct draw region and the human contact region, due to exposure to the raw water. When risk scores were integrated for ecological and human health, Risk Region 6 (Geneva/ Sudden Valley) and Risk Region 2 (Silver Beach neighborhood) had the highest total risk scores.

A Monte Carlo uncertainty analysis was performed using Crystal Ball software, and revealed that the risk model can successfully predict risks despite data gaps. Sources having high uncertainty and sensitivity were recreation and land disturbance. Reducing the uncertainty would provide more accurate quantification of risk. Data should be collected to quantify types, location, and frequency of recreational activities, including boat use for each of the major watersheds of Lake Whatcom. Additionally, stormwater flows and pollutant loading from impervious surfaces could be quantified, and bacteria levels could be sampled in tributaries and swimming areas to quantify bacteria levels from domestic pets versus other wildlife at swimming areas.

In all the human health categories there was a lack of site-specific data on sources and stressors, so reducing uncertainty in these categories would result in a more accurate risk prediction in the human health risk regions. Human health studies should include type and effectiveness of direct draw water treatment systems being utilized. The number and types of cancers, neurological impairment, reproductive impairment, and immunological impairment from ingesting versus contacting the treated and raw water from each human health region in Lake Whatcom should be determined. Measuring bacteria levels for tributaries and recreational contact areas would help decrease uncertainty associated with recreation and human health. Finally, quantifying the levels of disinfection byproducts in the distribution system for all treated water customers, not only City of Bellingham customers, would allow a better comparison for human health risks associated with disinfection byproducts in treated water.

In contrast to the current focus to limit Total Phosphorus levels in Lake Whatcom, which would only reduce risk to the watershed by 20 percent, the integrated risk assessment calculates risk for multiple sources and stressors. This becomes important for management because taking action to reduce risks from all stressors not just one would reduce a greater percentage of the overall risk to the lake.

The integrated framework developed in this study is applicable to other regions managing rapid population growth and development in multiple-use watersheds. The results of this integrated human health and ecological risk assessment model can provide guidance to managers to reduce risks to both the environment and human health. Future studies would include an integrated risk assessment on the urban creeks draining to Bellingham Bay and an integrated risk assessment on the Nooksack River.

Overall this research project found:

- That integrating ecological and human health risk assessment frameworks can be done using the relative risk model (RRM)
- That non-point sources such as land disturbance, transportation, and recreation are the largest contributors of risk to the endpoints
- That risk from stressors will only be reduced by about 20% by removing phosphorus, the stressor contributing the highest risk. Instead, implementing actions to reduce multiple stressors would reduce more of the risk to the endpoints
- That the Middle Fork of the Nooksack River risk region lies outside of the geographic boundary of the Lake Whatcom watershed, but was included in this study because a pipeline diverts water to Lake Whatcom to increase the drinking water supply at certain times of the year.