

Cumulative Impacts on Urban Lakes: A Shoreline Assessment Tool for Lake Health*

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Urban lake shorelines are experiencing unparalleled development pressures, resulting in reductions and impairments to shoreline habitat function, diversity, and aesthetic value. Developed in British Columbia, Foreshore Integrated Management Planning (FIMP), is a cumulative assessment tool that offers a solution for addressing these issues, one that is applicable to urban lakes across North America. In the following article we will provide background on FIMP, identify the problems around the current approach to shoreline impact assessments, discuss urban lake case studies while demonstrating how FIMP survey methods allow determination of rates of loss, and are therefore a suitable tool to identify cumulative impacts along a shoreline for lake management planning purposes.

Shorelines are the lifeline of a waterbody and often the focus of the human communities that are built up around them. Much of all lake and river life begins on shorelines. They connect aquatic areas with terrestrial habitat and provide food, nutrients, liveable space, and protection for invertebrates, insects, fish, reptiles, amphibians, birds, and mammals. Healthy shorelines act as filters, stabilizers, nurseries, and playgrounds for a multitude of species by maintaining water and habitats of high quality. On a global scale, healthy, functioning lake shorelines can help reduce flood-related impacts, and provide people with food and shelter. The critical importance of a healthy shoreline cannot be overstated, and yet the development pressures on lakes around the world continue. These pressures and their associated risks to shoreline and lake health are only expected to increase as

more lakeside habitats urbanize, causing diminished ecological and economic value of the surrounding shoreline communities, while simultaneously impacting the survival of many different species. These development impacts are contributing to the greatest losses of biodiversity of our time. Globally, freshwater vertebrate populations have declined more than twice as steeply as terrestrial or marine populations (Tickner et al. 2020).

As a solution to this ever-growing problem, the Sensitive Habitat Inventory Mapping, or SHIM, protocol was first created in British Columbia by the Community Mapping Network in 2001. SHIM was adapted for lakes in 2006 to become Foreshore Inventory Mapping, or FIM. Subsequently, Living Lakes Canada, through its lake foreshore work in Canada, recognized a need to update and improve this lake foreshore tool. In 2020, through the support of a contribution agreement with Fisheries and Oceans Canada's Canada Nature Fund for Aquatic Species at Risk as well as other partners, Living Lakes Canada formalized the general approach and standardized the protocols for mapping, assessment, and guidance for small and large lakes in the Canadian Columbia River Basin. This lake survey methodology, renamed Foreshore Integrated Management Planning or FIMP (see Figure 1), helps agencies; non-profit organizations; local, provincial, and federal governments; and landowners understand lake foreshore habitat values and the prospective risks from proposed shore-altering activities. FIMP documents the foreshore condition of the entire lake and identifies, classifies, and provides an estimate of value for important habitats that should be protected or conserved from development, preferably in legally binding covenants or

lakeshore management plans. The 2020 FIMP process follows three general steps:

1. Shoreline inventories following the Foreshore Inventory and Mapping (FIM) protocol are undertaken and mapped.
2. Shoreline habitat sensitivities are determined using a ranking index called the Foreshore Habitat Sensitivity Index (FHSI).
3. The Foreshore Development Guide (FDG) is prepared to identify risks posed by different shore altering activities to inform land use decisions on the lake foreshore.

The problem with today's shorelines

Lake foreshore development on British Columbia lakes has increased over the past 50 years because of increasing human development pressures and continued demand for recreational lakeshore properties. Traditional development preference has evolved from a recreational cabin nestled in the woods with a small wooden dock to large, executive-style homes with associated engineered docks, boathouses, outbuildings, and extensive horticultural landscaping (Figure 2). The regulatory review and approval process for lakeshore subdivision and lot development has involved federal, provincial, and municipal governments, and, more recently, First Nations (see Sam, page 7, this issue). Approvals are often focused on specific sites and do not typically consider – or only superficially consider – cumulative impacts on shorelines. For example, site assessments and common mitigation strategies for land and water tenures for dock installations, foreshore substrate alterations (e.g., beach grooming and rock groyne construction), vegetation removal, building construction, road

*Prepared for Living Lakes Canada

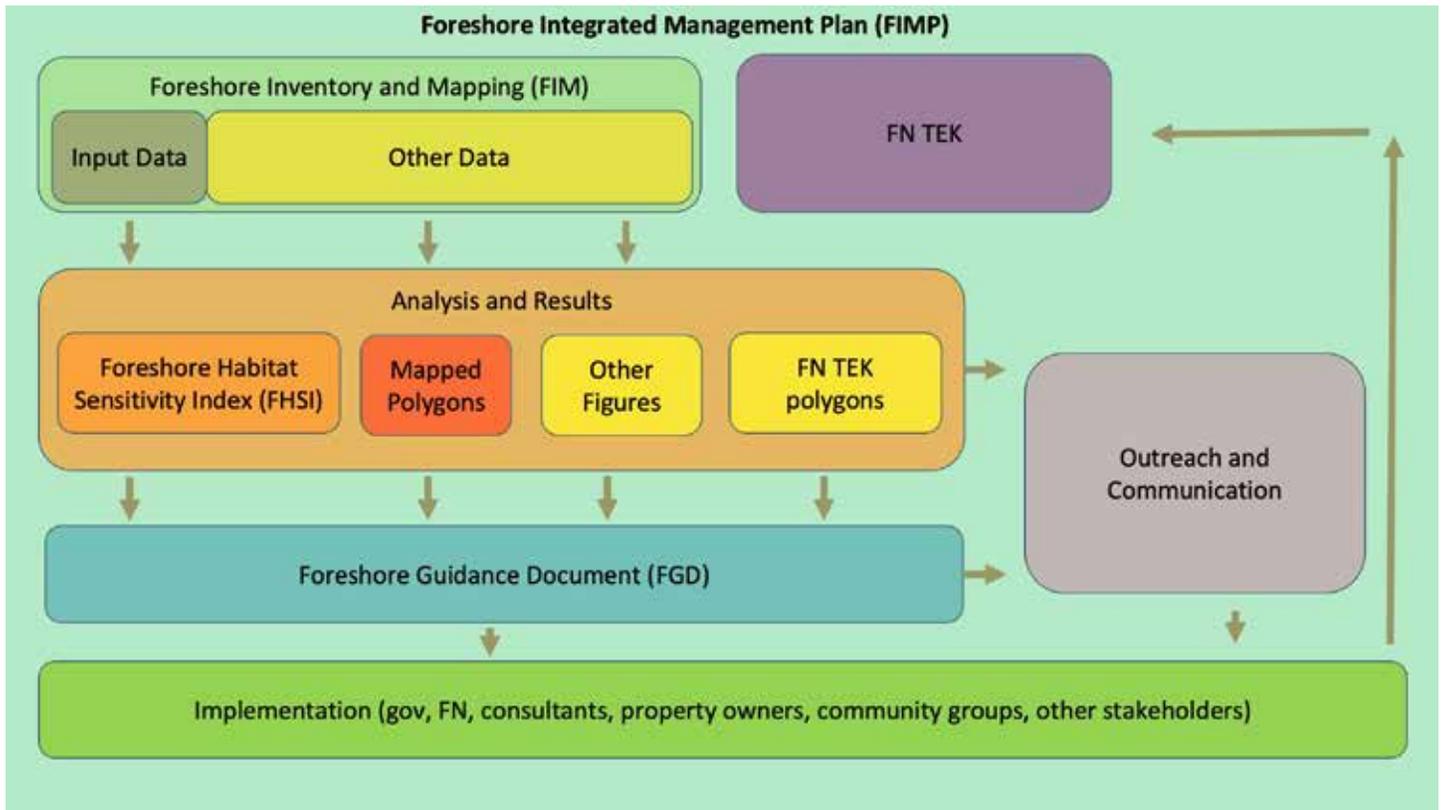


Figure 1. Foreshore Integrated Management Plan Process.



Figure 2. Examples of shoreline with a high level of impact.

access, etc., do not consider the full extent of impacts from ongoing cumulative losses along the shoreline as each adjacent lot builds out. It is not possible to identify cumulative impacts on a site-by-site basis since the cost of data acquisition exceeds the reasonable expectations of, for example, one single landowner who might desire to construct a dock. This site-specific development and approval process has resulted in an onerous

workload for agency personnel, a reliance on voluntary compliance with guidelines or best management practices, and inadequate monitoring and enforcement of environmental legislation and regulations. The consequence has been the widespread, incremental loss and alteration of foreshore fish and wildlife habitats.

Until recently, foreshore development has been concentrated on municipal or

privately held, easily accessible low gradient lands (e.g., alluvial fans, gravel beaches, floodplains, etc.) that did not require excessive costs for road access, or highly engineered lot development or building construction. Once the accessible areas are no longer available, and real estate values increase, development demands progress towards steeper slopes requiring highly engineered access, larger buildings with construction, and

subdivision of lots in more difficult terrain. With new technology and easier access to heavy equipment, sites that were historically undevelopable are now available to develop for the more affluent investors. This progression has increased the development of new lands and the associated pressure on lake foreshore areas that were not previously considered in potential cumulative impact assessments. Even wetlands are now altered to permit water access, boat mooring, and beach construction to property owners.

Today, we see lake foreshore fish and wildlife habitats suffering from a “death of a thousand cuts” because the impact of each lot buildout can be justified as minor. This is exacerbated by guidelines and best management practices within all local, regional, and provincial government agencies that, while well-intentioned, continue to allow and even facilitate ongoing “minor” impacts while compromising entire lake foreshore health. The current development and regulatory model perpetuates the incremental loss of important and, in some cases, critical fish and wildlife habitats. Many of the habitat losses would likely not have triggered a permitting or legislative process, even where regulatory review triggers are in place; compliance and enforcement actions are usually limited resulting in a similar outcome – incremental loss of habitats. In time, lake ecosystem level impacts should be expected, possibly to a point where certain at-risk species and/or their habitats become so degraded they can no longer support the species that rely upon them (i.e., entire population-level impacts).

A different approach to an old problem

Lake foreshore habitat surveys conducted using FIMP indicate that incremental loss of fish and wildlife habitats is occurring and will likely continue if approval agencies proceed with viewing lake foreshore development through the lens of single lot approvals versus cumulative impacts to the entire waterbody. Data collected from FIMP surveys on several large lakes in the British Columbia Interior indicate that as the level of urbanization increases to higher density, the quantity of available natural shoreline decreases. These data also suggest that as privately held parcels

transition from a low-impact rural land use to a denser, higher-impact land use such as single, multi-family, commercial or, industrial, the level of shoreline disturbance will increase upwards of 50 percent. It is important to note that lakes surveyed occur across the Province of British Columbia and may have different local government regulations (e.g., City, Town, or Regional District/County), and likely different provincial regulatory legislation. As an example, the provincial Riparian Areas Regulation does not apply throughout the province.

Living Lakes Canada has placed a focus on repeating FIMP surveys for priority lakes, allowing a rate of change or loss of natural shoreline capital to be estimated. Results from several BC Interior urban lakes that have been surveyed twice, including Lake Windermere, Lake Okanagan, and Kootenay Lake, provide unique insights (Figure 3). For example, the second survey of these three lakes identified rates of loss of natural shoreline of -0.18 percent, -0.2 percent, and -0.29 percent, respectively. The FIMP results demonstrate the rate of loss is very similar across all three lakes despite each lake falling under the jurisdiction of different local and provincial governments. The FIMP data support the conclusion that current shoreline management policies and/or regulations (i.e., mitigating site-specific development) do not necessarily address the underlying need for policy and zoning change that is required to support foreshore lake health.

Although it is recognized that attempts to reduce the impact of site-specific shoreline development will continue as site-specific environmental impact assessments by professionals; government agency approvals; monitoring and enforcement of legislation and regulations; landowner education; the use of best management practices and guidelines; and habitat restoration, FIMP as a cumulative impact assessment tool can enhance these practices. Through the



Figure 3. (A) FIMP on Lake Windermere. FIMP Project Director Bruce Mac Donald leads a calibration exercise on Lake Windermere in the East Kootenay region of the Canadian Columbia Basin using the updated FIMP methods. LLC Photo.

identification and conservation of sensitive habitats at the lake level, development approval models can be shifted away from incremental site-specific approvals and impacts, to a holistic lake conservation model where key areas are identified and subsequently protected from the underlying mechanisms of change (e.g., subdivisions and changes in land use or density of use) (Figure 4). This management regime shift will require significant community and political discussion but will provide better protection of lake foreshore fish and wildlife habitats. This new approach has been successfully undertaken for Kootenay Lake in the BC Interior by local, regional, and First Nations governments and other stakeholders who formed the Kootenay Lake Partnership, a multi-agency initiative that supports healthy lake management approaches directed by the Foreshore Development Guide resulting from FIMP surveys.

Holistic lake management

At the community level, all stakeholders, governmental agencies, and non-profit organizations with a vested interest in lakeshore health, should begin to focus and place efforts on establishing processes that address the underlying mechanisms of change. For instance, lakeshore planning processes should start to consider how much land along a lake is set aside as Conservation Lands or Rural Reserves to ensure that some areas are permanently protected. Mechanisms to conserve private lands must be implemented. Consideration of watershed



B

3. (B) Lake foreshore habitat surveys conducted using Foreshore Integrated Management Planning or FIMP indicate whether or not incremental loss of fish and wildlife habitats is occurring, and allows a rate of change or loss of natural shoreline capital to be estimated when a lake is re-surveyed, as was the case with Lake Windermere in the East Kootenay region of the Canadian Columbia Basin (pictured here). LLC Photo.



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3. (C) FIMP Project Manager Georgia Peck (right) discusses the FIMP framework with Carol Luttmier, the program manager for Living Lakes Canada's Columbia Basin Groundwater Monitoring Program, during the FIMP methods calibration exercise on Lake Windermere. LLC Photo.

level impacts and the development of watershed planning processes must begin. For lakes that span multiple jurisdictions, cooperation is paramount to success, as fish, wildlife, and ecosystems do not respond to arbitrary legal and administrative boundaries society has created. In some cases, legislative tools already exist, but have yet to be implemented. For instance, local government (regional or municipal) could incorporate FIMP results into regional growth strategies, bylaws, and official community plans. Provincial governments could help facilitate use of tools within the Water Sustainability Act (in BC) through plans such as a Water Sustainability Plan

that can link land and water decision policy in a long-term watershed or ecosystem-based framework (Curran and Brandes 2019).

The need for this informed planning was felt in British Columbia in November 2021 when an atmospheric river created monumental storms, landslides, and unprecedented damage to infrastructure, homes, agricultural lands, and fish and wildlife habitats throughout the Lower Mainland and the southern interior of BC. With FIMP in place, pre-storm monitoring could have provided a baseline to allow assessments of the impacts of this catastrophic event, and the opportunity to develop more robust land use and

foreshore policy to increase resilience to future similar events, as is the anticipated norm.

These lessons emphasize the importance of addressing shoreline industrialization in a more effective and multijurisdictional way. A change of lens is required to begin looking at urban lakes as a single, multifunctional entity, and not multiple opportunities for development or urbanization. FIMP provides replicable and scientifically robust methods to track changes in land use, impacts from development, environmental degradation, restoration activities, and climate change. The challenge will be to develop policies that can adapt to changes demonstrated by



Figure 4. Examples of shorelines with no- to low-level of impact.

FIMP that enable better community climate adaptation and ultimately protect healthy aquatic ecosystems.

Individuals and agencies interested in the FIMP model and helping expand its application are encouraged to contact Living Lakes Canada FIMP Program Manager Georgia Peck at georgia@livinglakescanada.ca.

Suggested References

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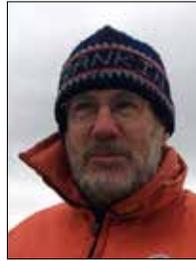
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