

## Project Overview

As a result of invasive plant species, road construction, and fluctuating water levels, Beaver Lake is infilling at an increased rate. At current rate of infill it is likely that there will be no open water left within 10-20 years, and the wetland will evolve into wet meadow and then into a forest.

The Vancouver Board of Parks and Recreation and Stanley Park Ecology Society (SPES), through the Stanley Park Ecological Action Plan (2011) and Stanley Park Forest Management Plan (2009), have concluded that **doing nothing is not an acceptable option because of the loss of biodiversity and the aesthetic amenity.**

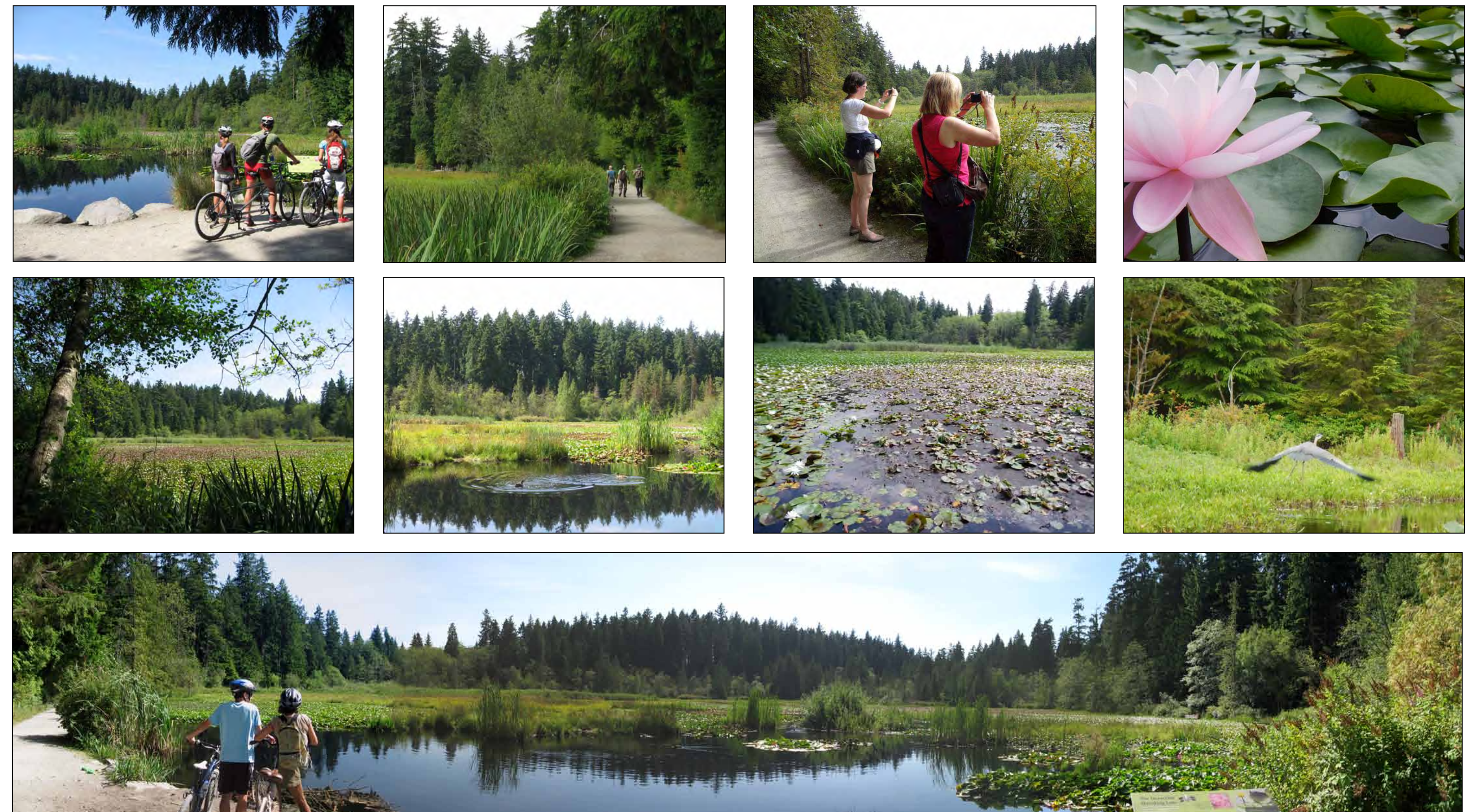
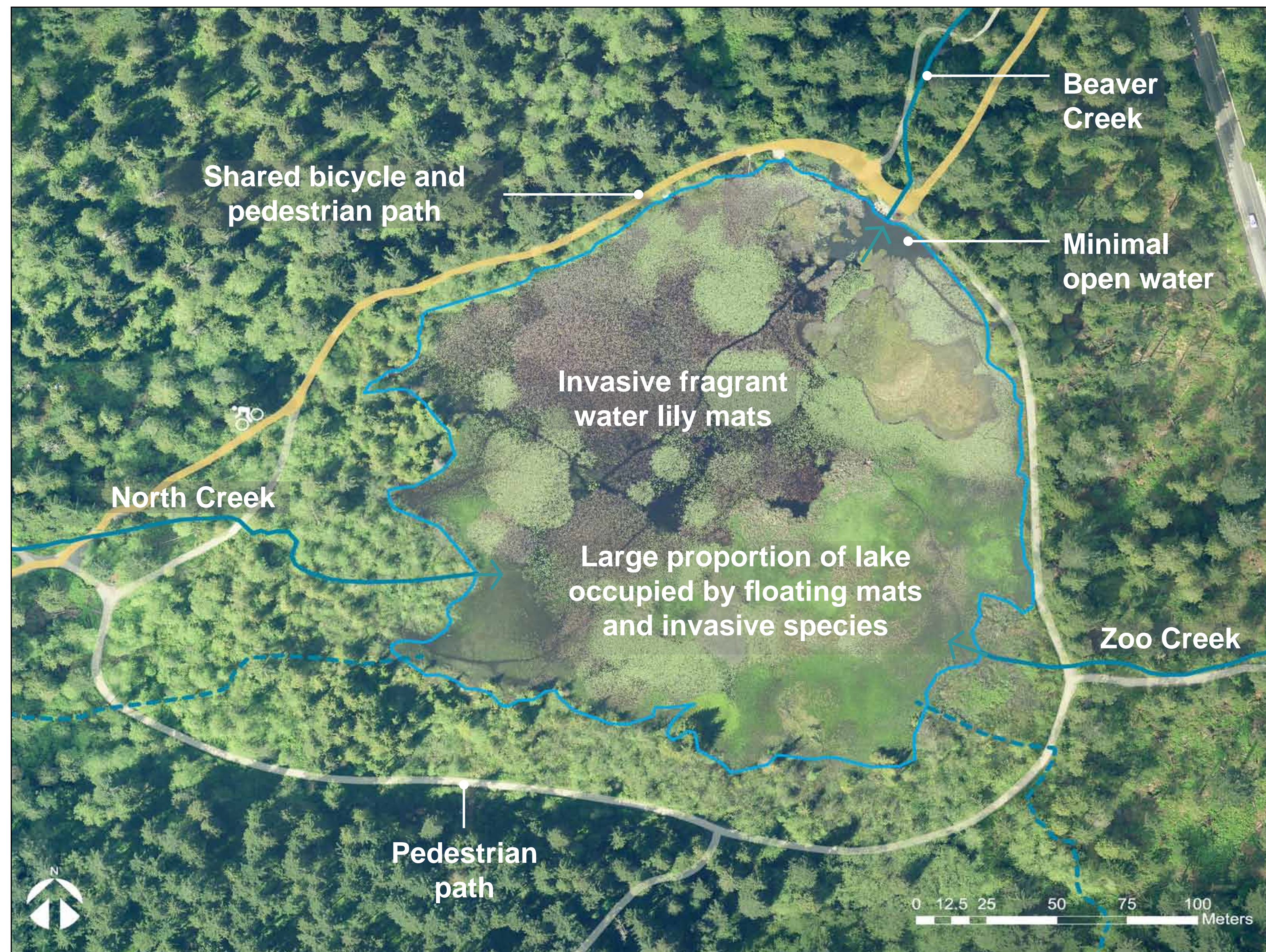
The Ecological and Culturally Sensitive Enhancement Plan for Beaver Lake project will provide a vision for the long term ecological viability and diversity of Beaver Lake, and provide the direction needed to achieve this vision.

The Park Board recognizes that Beaver Lake is an area of cultural and spiritual importance to the Musqueam, Squamish and Tsleil-Waututh First Nations.

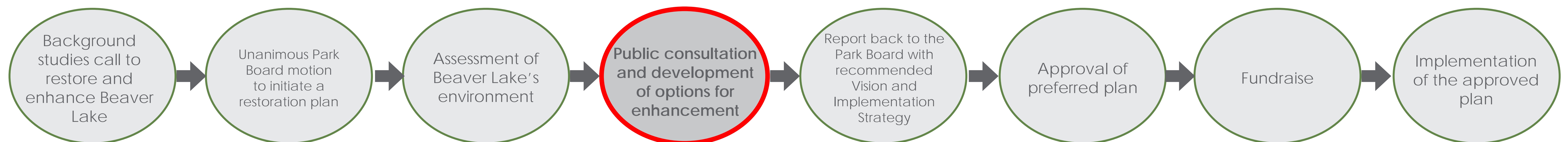
## Project Goal

*The goal of this project is to create a diverse and healthy ecosystem that provides passive recreation opportunities for the public, maximizes native biodiversity, respects cultural significance and requires minimal ongoing interventions to maintain its integrity.*

## Beaver Lake - Existing Conditions



## Where are we in the process?



## Recent History of the Lake

- Beaver Lake was originally a marshy pond with water levels that fluctuated seasonally based on rainfall and creek flows, and likely dried up during particularly hot summers.
- The lake provided good wildlife habitat and was used by First Nations for collecting food and medicinal plants and holding ceremonies since time immemorial.
- A perimeter trail and a dam with an outflow weir was installed in 1911, which significantly altered the natural drainage of the area.

- The lake was dredged in 1929, creating the basic form we see today.
- Other construction projects such as logging roads, the causeway (1938), and new trails changed the type and rate of sediment deposited in the lake.
- The invasive fragrant water lily planted to beautify the lake in 1937, along with other invasive plants, have all contributed to the rapid infilling of Beaver Lake.

## Key Background Work Done to Date

- Various SPES studies: breeding bird, vegetation, fish, terrestrial gastropod, and small mammals surveys and amphibian monitoring. (2007-2013)
- Stanley Park Ecological Action Plan. (VPB, 2011)
- Sediment Characteristics of Beaver Lake and Implications for Remediation: A Pilot Project. (SFU, 2011)
- State of the Park Report for the Ecological Integrity of Stanley Park. (SPES, 2010)
- Wilderness on the Doorstep. Discovering Nature in Stanley Park. (2006)
- Various Post Secondary Student Studies - BCIT, Capilano College - Environmental Science Program, and UBC Students Zimmerman et al. (1999)
- Beaver Lake bathymetric survey. (1997)
- Beaver Lake Environmental Enhancement Project. (1996)
- The Natural History of Stanley Park. (Vancouver Natural History Society, 1988)
- A Technical and Economic Feasibility Study of the Beaver Lake/Creek Enhancement Project. (Hatfield Consultants Ltd., 1985)

## The Forest Marches In

From the time a lake is created, it begins to fill in with dead plants, eroded soil and other sediments. As plants decompose, they reduce oxygen levels in the lake and slow decay, which causes more vegetation to build up and further reduces lake depth. Water-loving plants gradually encroach into the middle of the lake to form a swamp. Eventually, shrubs and trees establish and a forest is formed.

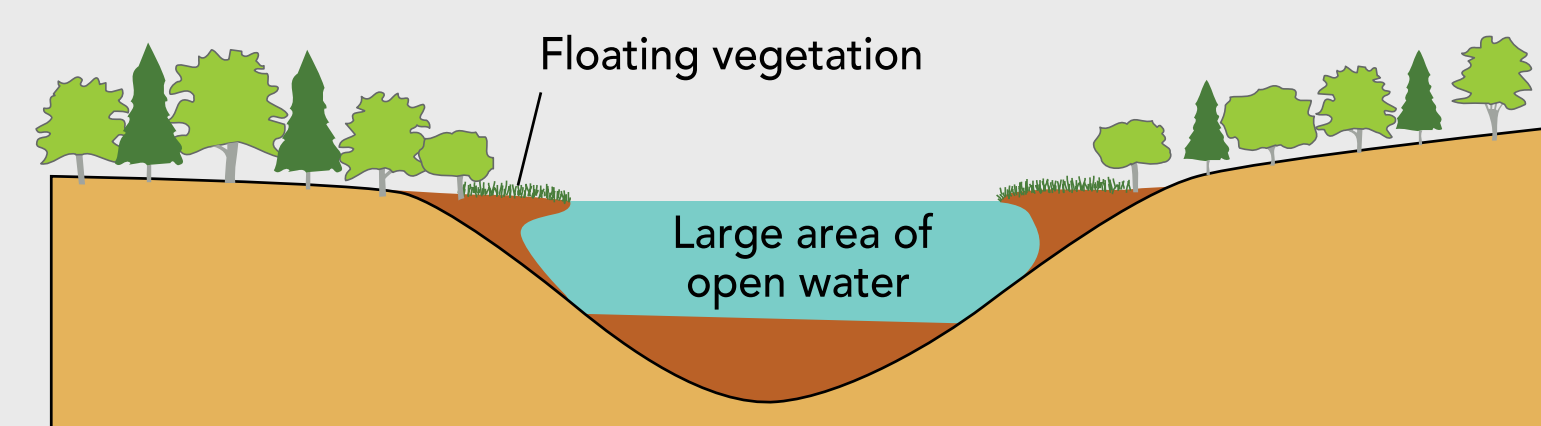
## Aging Faster Than Most

It often takes thousands of years for a lake to turn into a forest. But this process, called lake succession, is happening faster in Beaver Lake due to the spread of fragrant water lilies from eastern North America. Introduced in 1937 to beautify the lake, these lilies are robbing the water of oxygen as they die and decay - speeding up the natural process of succession.

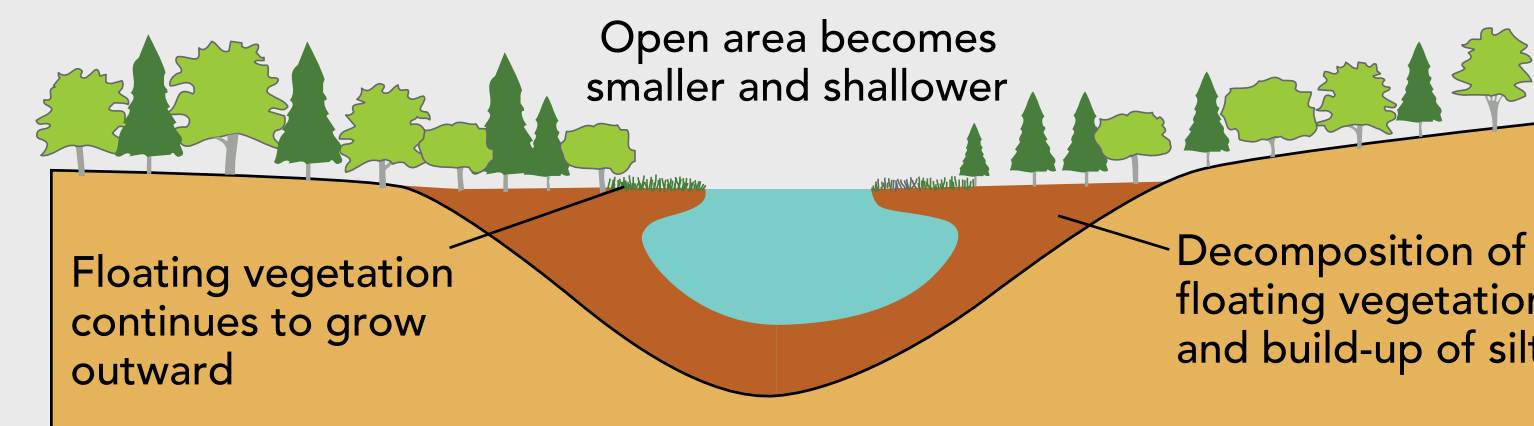
## Valuable Habitat While it Lasts

Many animals rely on the aquatic and adjacent upland Beaver Lake habitats, including dragonflies, frogs and salamanders, cutthroat trout, beaver, and other animals for foraging, nesting, residence and breeding.

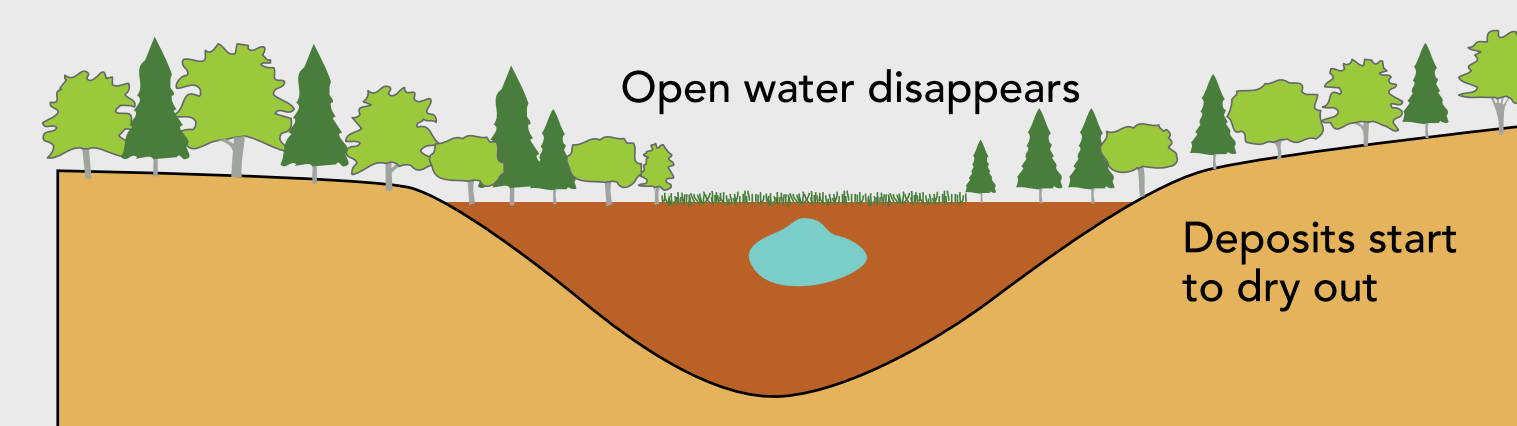
Due to urbanization, other lakes are not emerging to replace Beaver Lake.



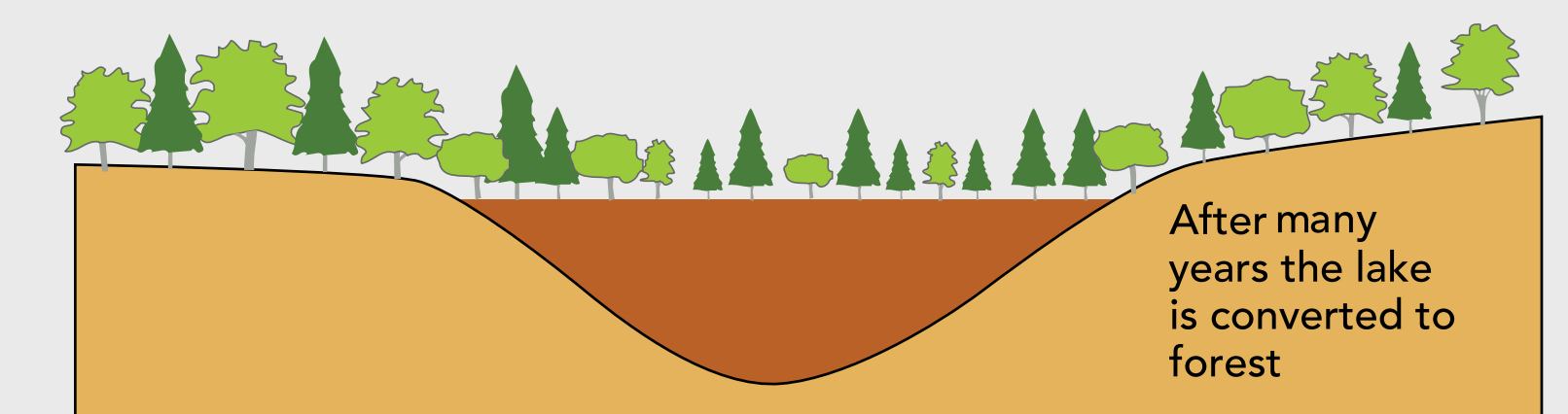
- Sediments, brought in by streams, settle in the lake.
- Reeds, rushes and other plants grow around the shore.
- Each winter, plants die and fall to the bottom to form a marshy edge.



- As the amount of organics build on the lake bottom, the water gets shallower, and other plants take root along the shore.

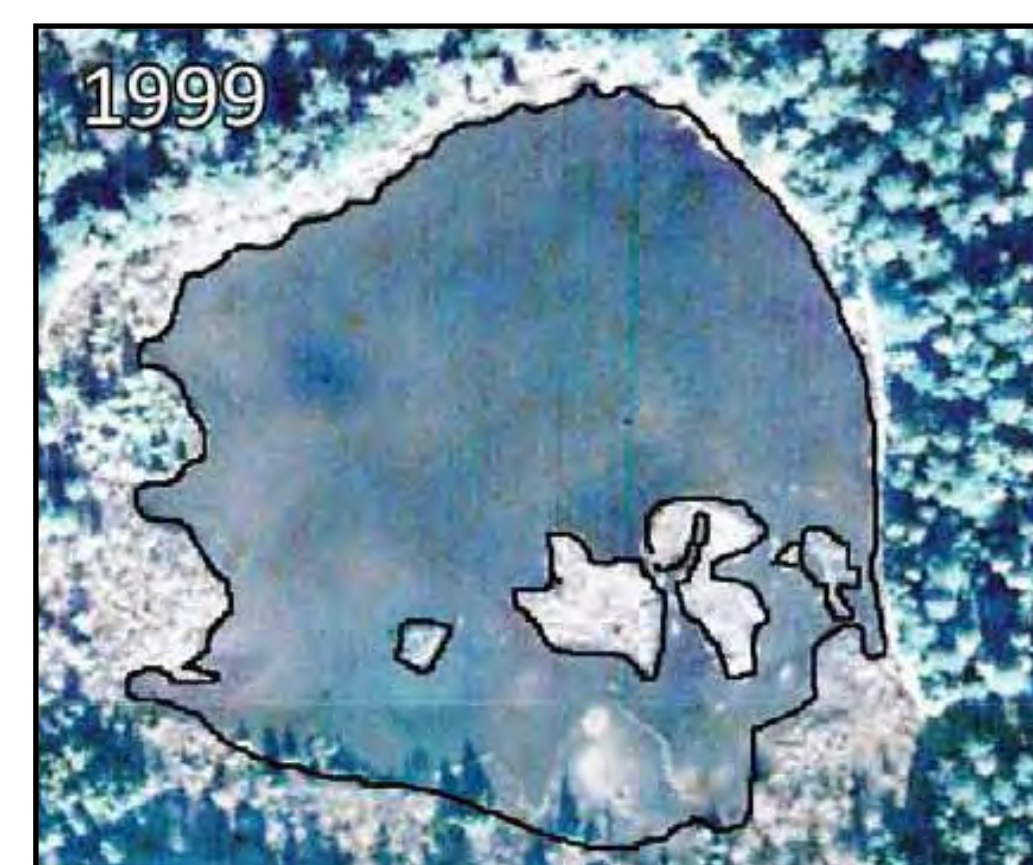
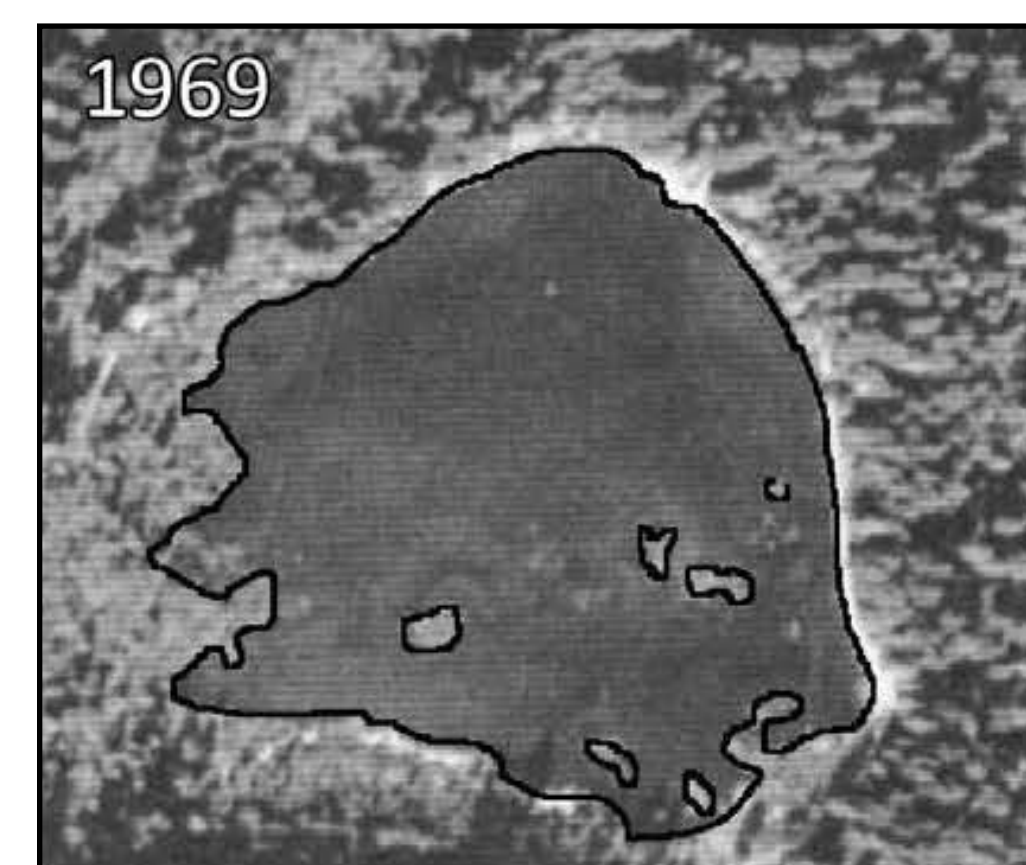


- Open water disappears and the lake becomes a swamp; trees and shrubs tolerant of wet conditions colonize the edges.



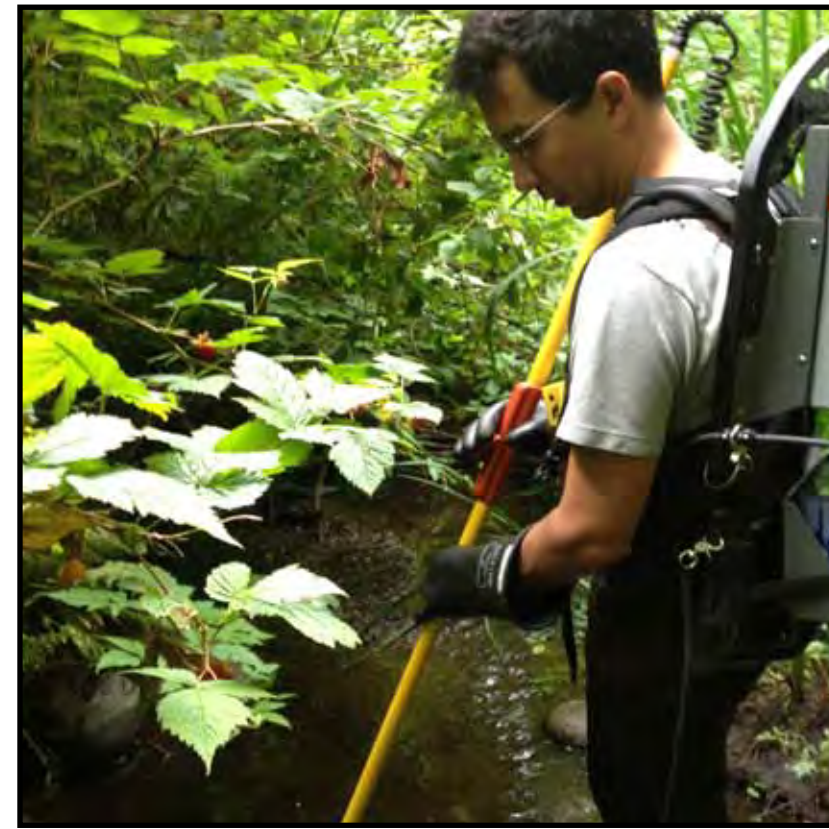
- Eventually, the swamp evolves into dry land and the forest takes over.

## Transition of Lake - Highlighting the Development of Islands



# 3. PROJECT TEAM

November 2013



**Chris Lee, AquaTerra Environmental Ltd., M.Sc., RPBio, Principal, Senior Biologist, Project Lead**

Chris Lee is a well-recognized species-at-risk expert and an authority on invasive species, habitat restoration and enhancement. Chris has successfully managed numerous large-scale, multi-faceted projects and brings a wide array of relevant experience to the Beaver Lake project, Chris has prepared environmental assessments, sediment and water sampling and analysis, and regulatory correspondence and approvals, as well as dredging practices and limitations, fish passage, and Erosion and Sediment Control (ESC) measures. He works regularly with First Nations and non-profit organizations, providing senior input on referrals and funded projects with an environmental component.



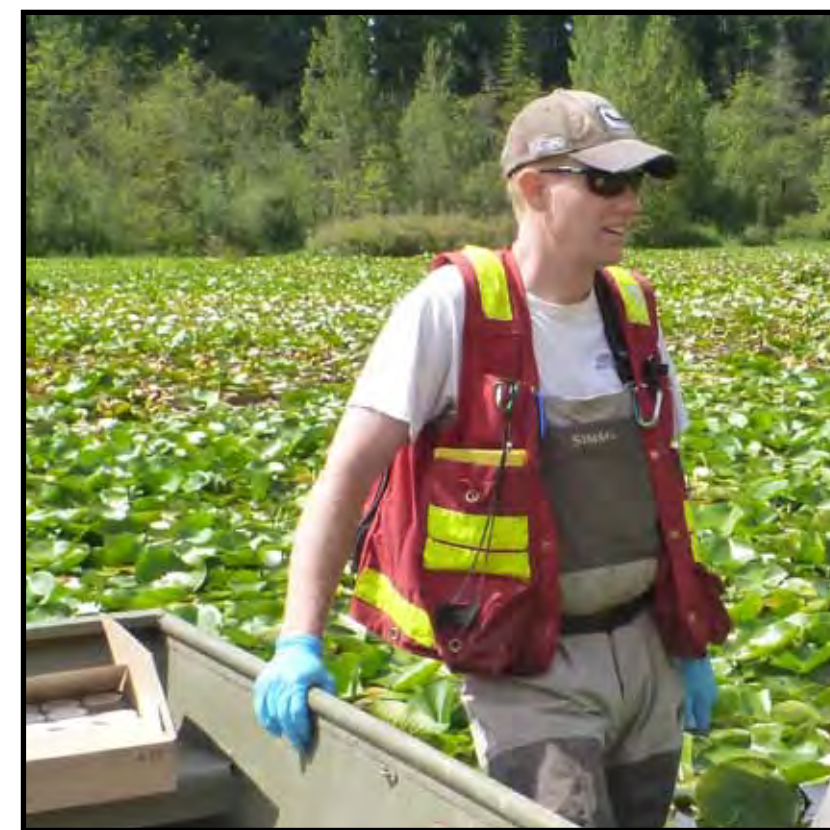
**Derek Ray, Northwest Hydraulic Consultants, M.Sc., P.Geo., Principal**

Derek Ray is a senior geomorphologist with over 17 years of experience applying coastal and river geomorphology theory and knowledge to various studies and engineering projects in British Columbia, Washington State and overseas. He completed a Masters Degree in Geography from Simon Fraser University and an undergraduate degree in Geography and Environmental Science from McGill University. His early-career experience focused on forestry-related watershed restoration, fish habitat assessment and restoration, and construction within sensitive aquatic ecosystems. A significant portion of this work was spent working with First Nations on forestry and fish habitat restoration projects in British Columbia and Washington State.



**Erik Lees, Lees+Associates Landscape Architects and Planners, BCSLA Landscape Architect, Principal**

Erik Lees brings over 30 years' experience in park and environmental planning, design and management to the team. His background in the public sector, and 15 years working on a wide range of public sector projects, gives him a sound understanding of the public process and a balanced perspective. He has been involved in many environmentally-based planning and design projects, including the GVRD "Biodiversity Action Plan for the Greater Vancouver Region," and the City of Vancouver's "Still Creek Rehabilitation and Enhancement Study" – a visionary project that won an award for environmental planning excellence from the Canadian Institute of Planners in 2007.



**Byron Kirkham, AquaTerra Environmental Ltd., B.Sc., RPBio, Senior Biologist**

Byron Kirkham has a background in groundwater and sediment sampling and analysis, laboratory testing, and aquatic and riparian habitat design. Recently, he successfully developed a restoration strategy for 20,000 m<sup>2</sup> of riparian habitat in the City of Abbotsford. He also participated in the approval process and monitoring of a large sediment removal project on Vancouver Island in 2013. Byron has also completed vegetation and wildlife inventories for park projects in the Lower Mainland and Fraser Valley, and recently completed a wetland and restoration project in Squamish, with a focus on increased habitat utilization by species-at-risk.



**Dr. André Zimmermann, Northwest Hydraulic Consultants, PhD, P.Geo**

Dr. André Zimmermann is an expert in fluvial geomorphology with considerable knowledge of sedimentology and watershed processes. He completed his Doctoral research at the University of British Columbia in Geography and his Masters Degree is from McGill University. André's solid academic background focuses on sediment transport, hydrology, geomorphology, fish habitat and the design of new scientific methods. As part of his undergraduate research project he contributed to a comprehensive study of the recent and historical sediment dynamics of Beaver Lake. In addition to his position at NHC, André is an adjunct faculty member in the Department of Geography at UBC, where he collaborates with students on applied research projects.



**Catriona Hearn, Lees+Associates Landscape Architects and Planners, BLA, Senior Associate**

Catriona Hearn has a diverse background in landscape planning and design and brings a lifelong personal interest in wetlands and the natural landscape to this project. As project manager for Falaise Park Wetlands Gardens and the Everett Crowley Parks Management Plan, Catriona worked with the Vancouver Park Board to create environmentally sustainable recreation areas within an urban context. Catriona is committed to engaging the community with the natural landscape on a variety of levels, to enhance public access and enjoyment, and to ensure ongoing appreciation of its value in the contemporary landscape.



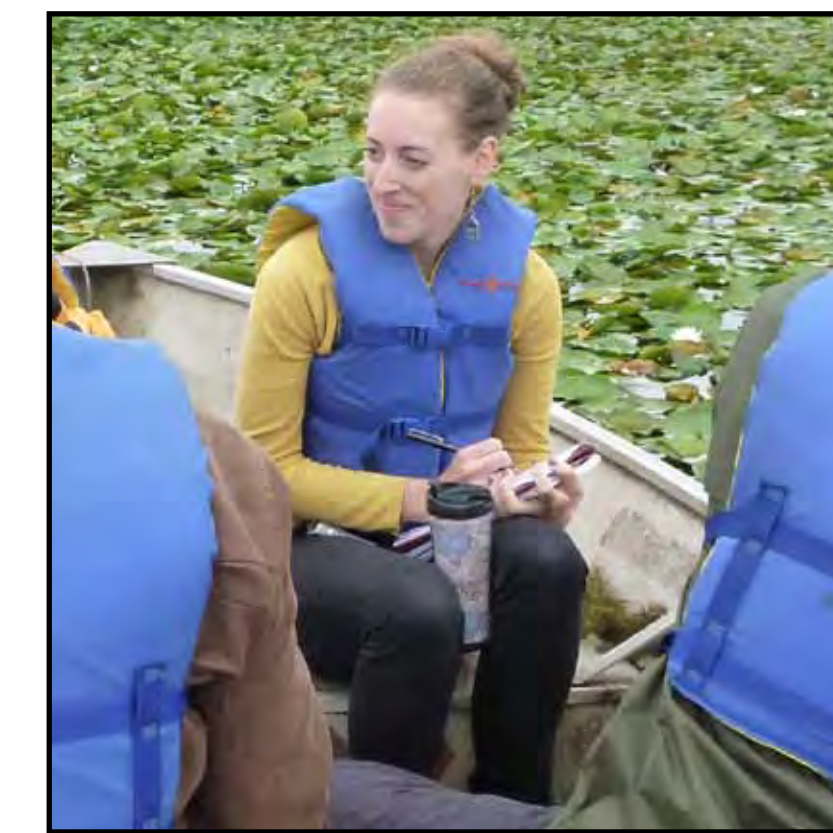
**Claudio Bianchini, RPBio, Wildlife Biologist and Species-at-Risk Expert**

Claudio Bianchini is a former SPES board member and a well-known wildlife biologist with experience across Canada. With over twenty years of relevant experience, Claudio has contributed to numerous projects and studies within Stanley Park and brings a unique insight pertaining to the subtleties and key issues of Stanley Park ecosystems. He has also served as a consultant to the Vancouver Parks Board, providing input on beaver and waterfowl management and has developed nest management plans for raptors and the Great Blue Heron rookery within the park. Claudio was also involved with the Burnaby Lake Rejuvenation Project, which has many similarities to the Beaver Lake project.



**Jemma Scoble, M.A.Sc. – First Nations Engagement and Consultation**

Jemma Scoble has diverse and extensive local experience working in the areas of First Nations engagement and consultation. She has unparalleled experience engaging First Nations in the planning, design, and delivery of habitat compensation and restoration projects throughout the Lower Mainland. She is dedicated to delivering projects in a culturally-appropriate manner, and is honoured to be working with the Musqueam, Squamish and Tsleil-Waututh First Nations on the Beaver Lake project.



**Katy Amon, Lees+Associates Landscape Architects and Planners, BA, MLA, BCSLA Intern**

Katy Amon was awarded an American Society of Landscape Architecture student research award for her thesis (based in Surrey BC), which proposed an evidence-based methodology for integrating native ecosystems and habitats into marginalized urban spaces. Previous related planning and design work includes the Stanley Park Cycling Plan, City of Toronto Natural Environment Trails Management Plan, and Metro Vancouver's Surrey Bend Regional Park Concept Feasibility Assessment. She was a planning intern for the Vancouver Park Board prior to completing her Masters Degree in 2009.



**Thomas R. Biebighauser, Wildlife Biologist and Wetland Ecologist, B.Sc.**

Thomas Biebighauser has restored over 1,600 wetlands in twenty-two provinces and states. He teaches practical, hands-on workshops across North America, where participants learn about wetland restoration by becoming involved in the design and construction of natural appearing and functioning wetlands. Tom has written three books describing how to restore wetlands and brings a unique, specialist expertise to this project.



**Dr. Valentin Schaefer, Urban Ecologist, Biodiversity Expert, Lake Restoration Specialist**

Dr. Val Schaefer is an ecologist who has developed unique expertise in ecological restoration and the emerging field of urban ecology. He uses an approach that combines ecology, natural history and landscape architecture. He recently was the Project Lead in developing the Invasive Species Management Strategy for the District of Saanich. He is a founder and former Executive Director of the Institute of Urban Ecology at Douglas College in New Westminster. Val is presently Faculty Coordinator of the Restoration of Natural Systems Program at the University of Victoria.



**John Kirbyson, Lees+Associates Landscape Architects and Planners, MRM**

John Kirbyson is a parks and recreation consultant with a Masters of Resource Management and is currently working towards the completion of a Certificate in Restoration of Natural Systems (UVic). Past Director of Parks, Recreation and Culture for the City of Penticton, as well as 25 years with the City of Burnaby, John became knowledgeable in managing parks projects of the nature and scope of the Beaver Lake Enhancement Plan. John was the City of Burnaby's Manager for the Deer Lake Management Plan and represented the City on a project dealing with similar issues at Burnaby Lake.

# 4. SINCE TIME IMMEMORIAL: FIRST NATIONS IN THEIR OWN WORDS

November  
2013

## x<sup>w</sup>məθk<sup>w</sup>əyəm Musqueam First Nation



The Musqueam people have been present in our traditional territory since time immemorial. Musqueam artifacts over 9,000 years old have been found in our territory, which includes all of present day Vancouver, extending north-west up Howe Sound and east up the Fraser Valley and to the South Arm of the Fraser River and still occupies what is now Vancouver and its surrounding areas.

Our ancestral language is həŋqəmiñəŋ, one of the 10 Central Coast Salish languages, and is often referred to as the Downriver dialect of Halkomelem because it is geographically situated between the two other major dialects of the same language.

The oral history of the Musqueam people that has been handed down through generations talks about our traditional territory, how we have always used the resources of the land for fishing, hunting, trapping, and gathering to maintain our livelihood. Musqueam oral history tells of a connection to these lands and waters since time immemorial.

χ<sup>w</sup>ayχ<sup>w</sup>əy, spəpəyəq, ʔəyəlχən, χaʔχcə... these are just a few of our names for sites in and around what is now known as Stanley Park, an area once known for its abundant natural resources and spiritual sites.



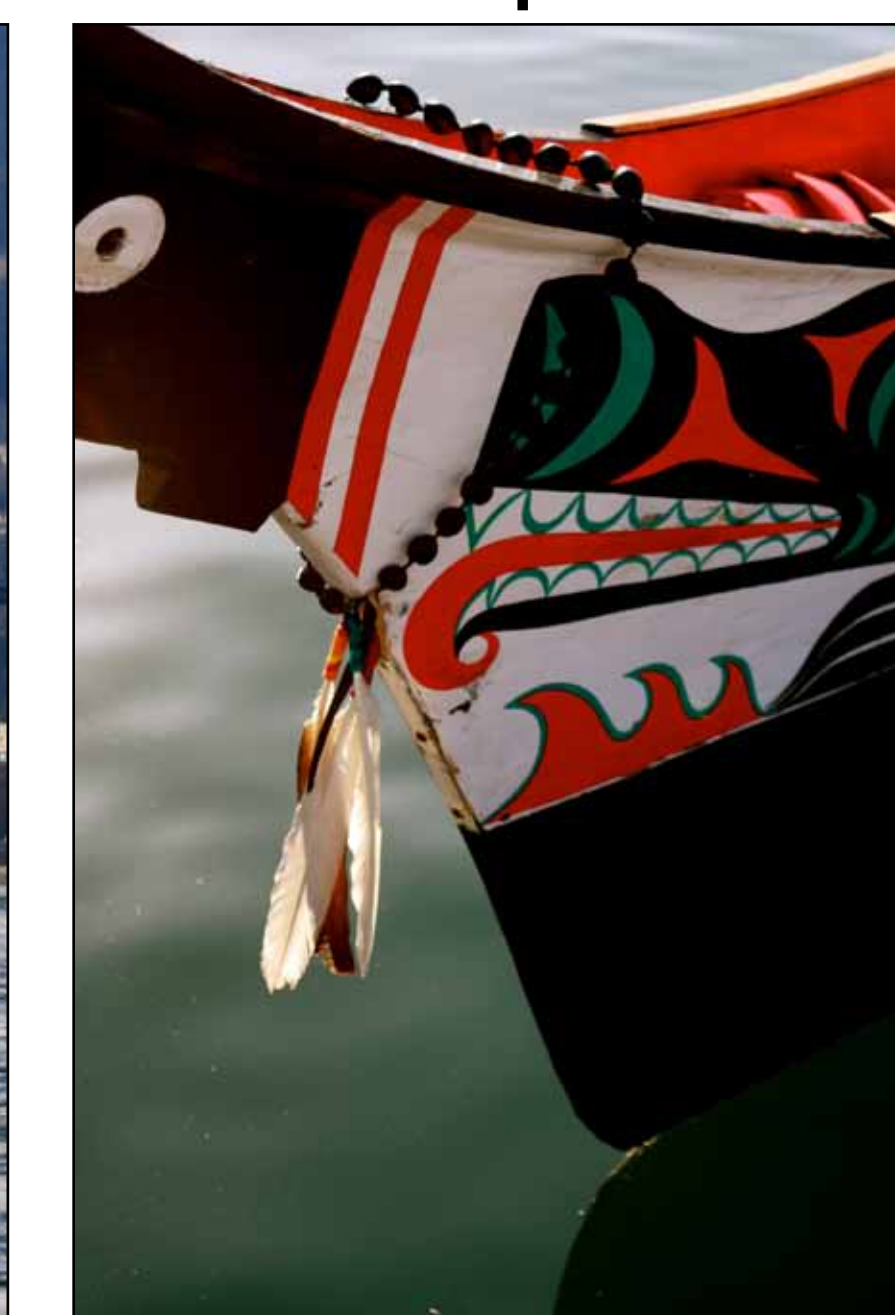
Photos courtesy of Musqueam Indian Band

[www.musqueam.bc.ca](http://www.musqueam.bc.ca)

## Skwxwú7mesh Squamish First Nation



Kayachten (Welcome) The Squamish people invite you to witness the beauty of our lands and waters, this area is known as Axachu7 (Beaver Lake). A prominent story from this area recounts the origins of a sacred mask used by Coast Salish peoples. You are invited to learn more of the rich history of the village sites and place names throughout Stanley Park, a place where our People flourished and lived since time immemorial.



Photos courtesy of Lisa Wilcox

[www.squamish.net](http://www.squamish.net)

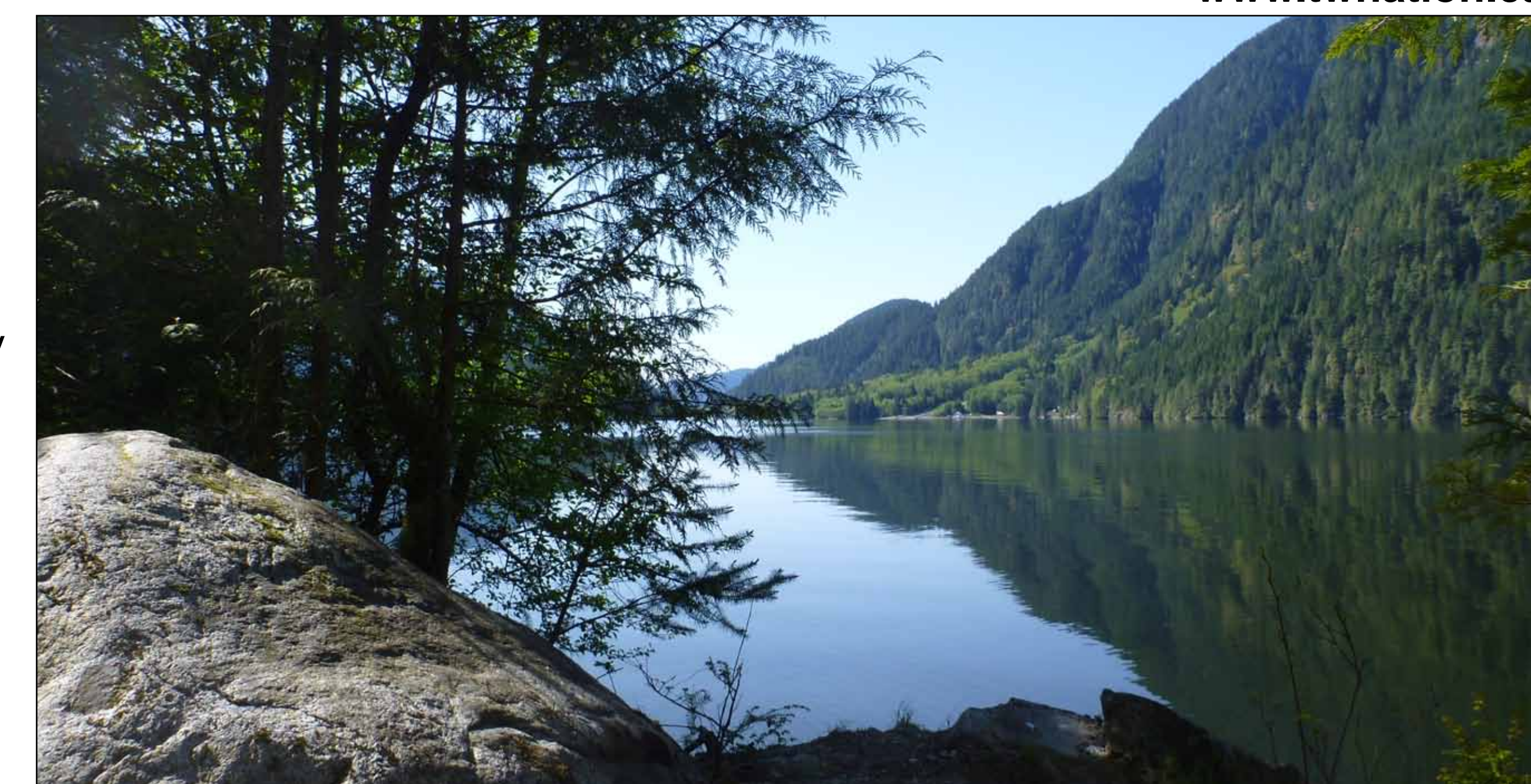
## səlilwətaʔt Tsleil-Waututh First Nation



We are the Tsleil-Waututh Nation, "The People of the Inlet" and have lived in and along the waters of Burrard Inlet and the Salish Sea, including what is now Stanley Park, since time out of mind. The first Tsleil-Waututh people were created from Burrard Inlet. Before contact with Europeans, the Tsleil-Waututh population was great, with villages of long houses stretching for kilometres along the Inlet. Today we are a Nation almost 500 people strong, based in North Vancouver along the shores of Burrard Inlet.

The traditional territory of the Tsleil-Waututh Nation was a veritable land of plenty. Tsleil-Waututh elders taught that when "the tide was out, the table was set." We have always been here, and we will always be here. Our People are here to care for our land and water.

Tsleil-Waututh people have acted as the stewards of the lands and waters of Burrard Inlet for thousands of years. It is now, and has always been the birthright and the obligation of the Tsleil-Waututh people to care for the lands and waters of our territory and to restore them to their prior state.



[www.twnation.ca](http://www.twnation.ca)

# 5. CONCEPT 1 | ISLANDS AND VIEWING PLATFORMS

Maximizes Habitat Creation and Biodiversity

November 2013



## Strengths

- Highest increase in animal diversity.
- Highest increase in plant diversity.
- Increases habitat for fish.
- Islands and woody debris provide for turtle basking/ nesting and shorebird/waterfowl habitat.
- Reduces prevalence of non-native invasives such as fragrant water lily and narrow leaf cattail.
- Vernal ponds improve wildlife, especially amphibian, habitat and reduce runoff into the lake.
- Zoo Creek stream restoration diversifies wildlife habitat.
- Increased opportunities for the lake to be used for re-introduction of species at-risk e.g. western painted turtle.
- Installed fish ladder in Beaver Creek and deepening of channel through lake to reduce water temperature would allow for salmon to travel from Beaver Creek to North Creek year round.
- Islands with trees shade and cool the channel and reduce evapotranspiration.
- Deeper water (max 5 metres) prevents recolonization by lilies.
- Expansion of bog increases plant diversity.

## Weaknesses

- Islands may contribute to more rapid infilling of lake over time, but should be mitigated by overall depth increase.
- Requires most extensive sediment and clay removal and disposal.
- Longest length of excavation and invasive species removal work (2-3 months).



- Greatly increases wildlife viewing and interpretive opportunities.
- Replicates natural coastal BC wetlands.
- Additional platforms and boardwalks expand viewing opportunities, educational and interpretive programming.
- Boardwalks provide additional interpretive opportunities.
- Vernal ponds, bog expansion and stream restoration increase wildlife viewing along trail, adding to the ecological experience of visiting Stanley Park.
- Composting toilet expands the range of programming and enhances visitor experience.

## Relative Costs

- Highest enhancement capital cost. \$\$\$\$
- High facilities capital cost. \$\$\$
- Low - moderate maintenance cost. \$-\$\$

- Seeks to maximize biodiversity. Islands provide habitat for mammals, birds, amphibians, reptiles, fish and insects - including both common and sensitive (species-at-risk) species. Vernal ponds, and improvements to Zoo Creek further enhance habitat.
- Fish ladder and 5 metre deep channel from Beaver Creek to North Creek increases potential for year round salmon habitat.
- 2.6 hectares of open water, to a maximum depth of 5m.
- High volume of sediment and clay removal and disposal.
- Moderate-High Lake Longevity (assumes periodic invasive species management around islands and edge areas following dredging to a maximum depth of 5m).
- Boardwalks, five additional viewing platforms and a composting toilet.



Habitat Mosaic and Boardwalk



Vernal ponds



Woody Debris



Salmon habitat

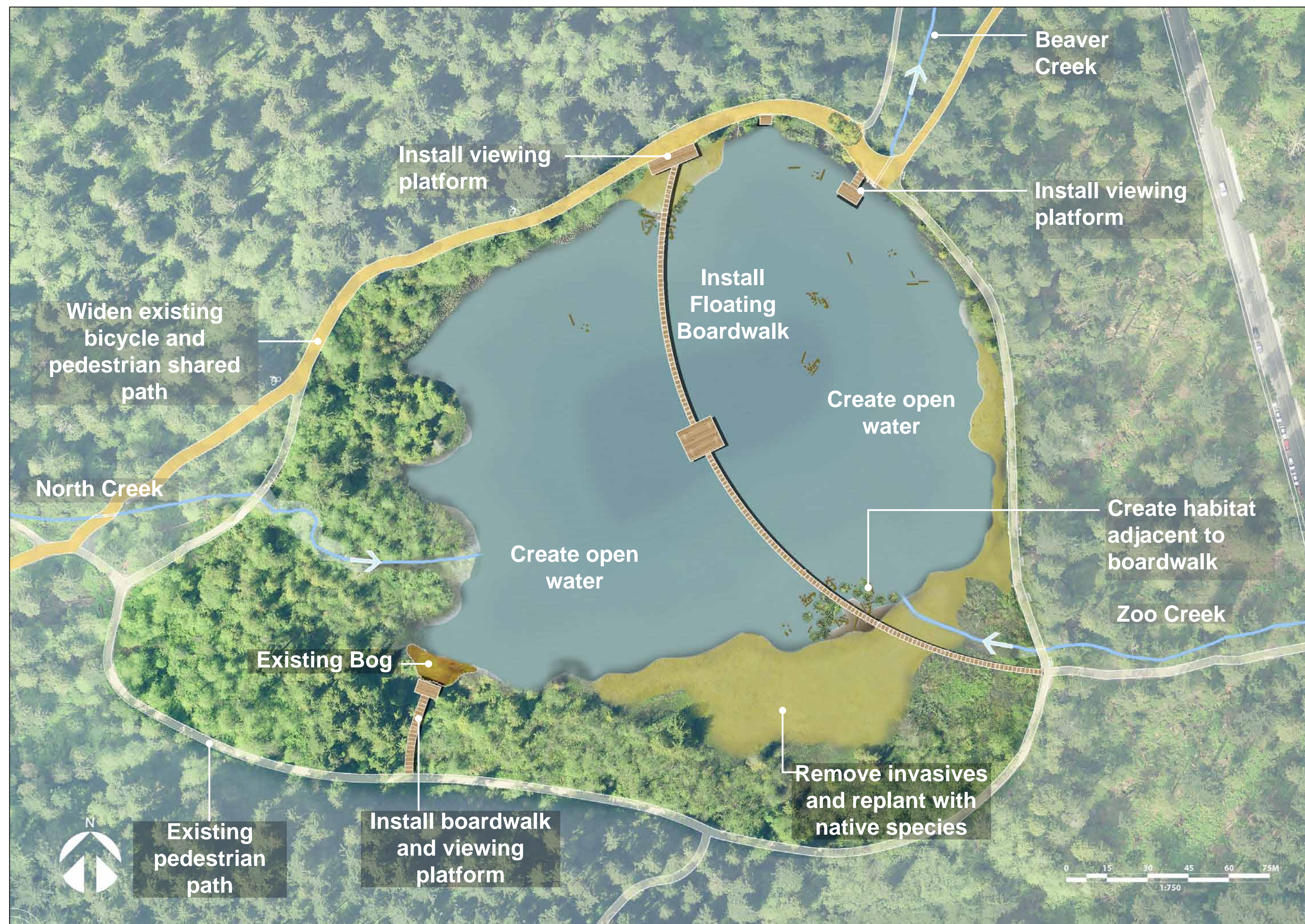


Section 1: Vernal ponds, path, viewing platform and habitat island

# 6. CONCEPT 2 | OPEN WATER AND FLOATING BOARDWALK

Increases Passive Recreation  
but Reduces Wildlife

November  
2013



- Seeks to remove all non-native plant species and replant with natives.
- Does not support fish.
- 3.15 hectares of open water, to a maximum depth of 1.5m.
- Low volume of sediment removal and disposal.
- High Lake Longevity (assuming on-going invasives removal following dredging to a maximum depth of approximately 1.5m).
- 2m wide floating boardwalk across the lake with central platform and two additional viewing platforms.

### Strengths

- Least increase in animal diversity.
- Moderate increase in plant diversity.
- Maximized removal of non-native plant species limits recolonization of invasive fragrant water lily.
- Woody debris enhances habitat.
- Boardwalk facilitates wildlife viewing and provides interpretive and passive recreation opportunities for visitors.
- Widened shared path on north edge of lake would reduce user conflicts.
- Removal of 100% non-natives and management would result in slowest future lake infill.
- Lowest volume of sediment removal and disposal.
- Short period of excavation and invasive species removal work (~1 month).

### Weaknesses

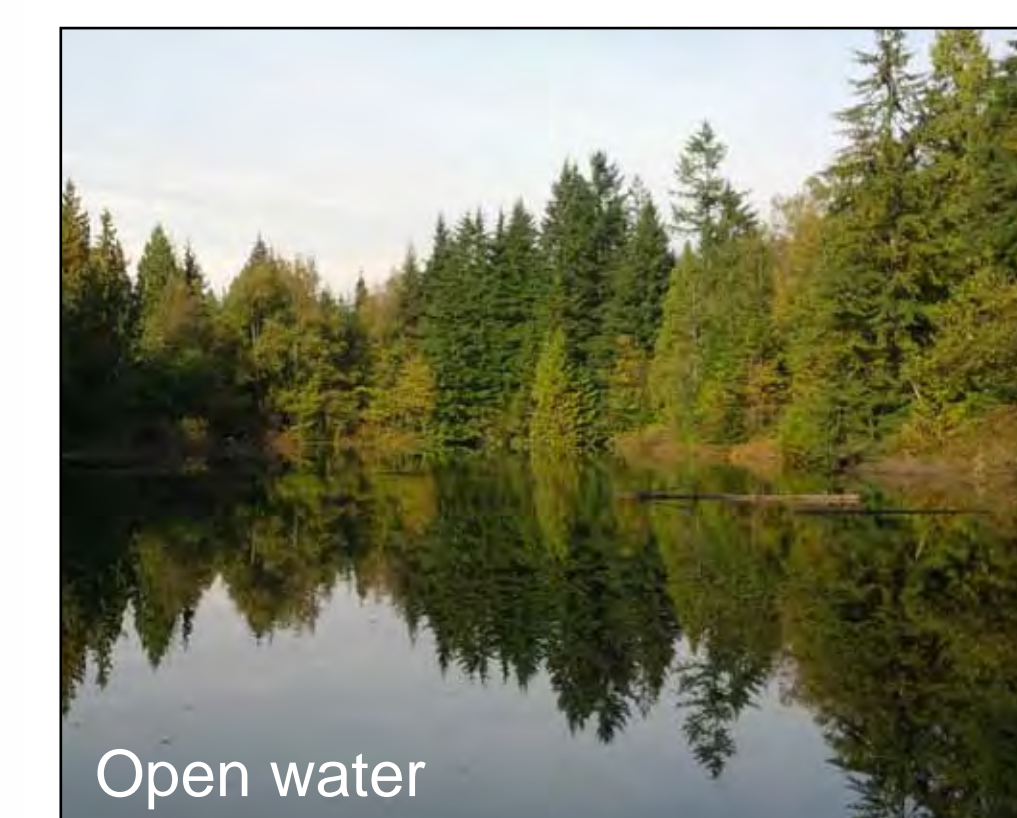
- A large investment of habitat reconstruction and extensive on-going maintenance is required.
- Negative impact on biodiversity by eliminating all non-native species.
- Human use of boardwalk across the lake would disturb wildlife, especially those requiring larger habitat patches and intolerant of disturbance (e.g. American bittern).
- Not suitable for salmon.
- Significant ongoing invasive and non-native species management.
- Canada geese droppings on boardwalk could require additional maintenance.

### Relative Costs

- Low - moderate enhancement capital cost. \$\$
- Highest facility costs. \$\$\$\$
- Highest maintenance costs due to maximized on-going management of non-native plants. \$\$\$\$



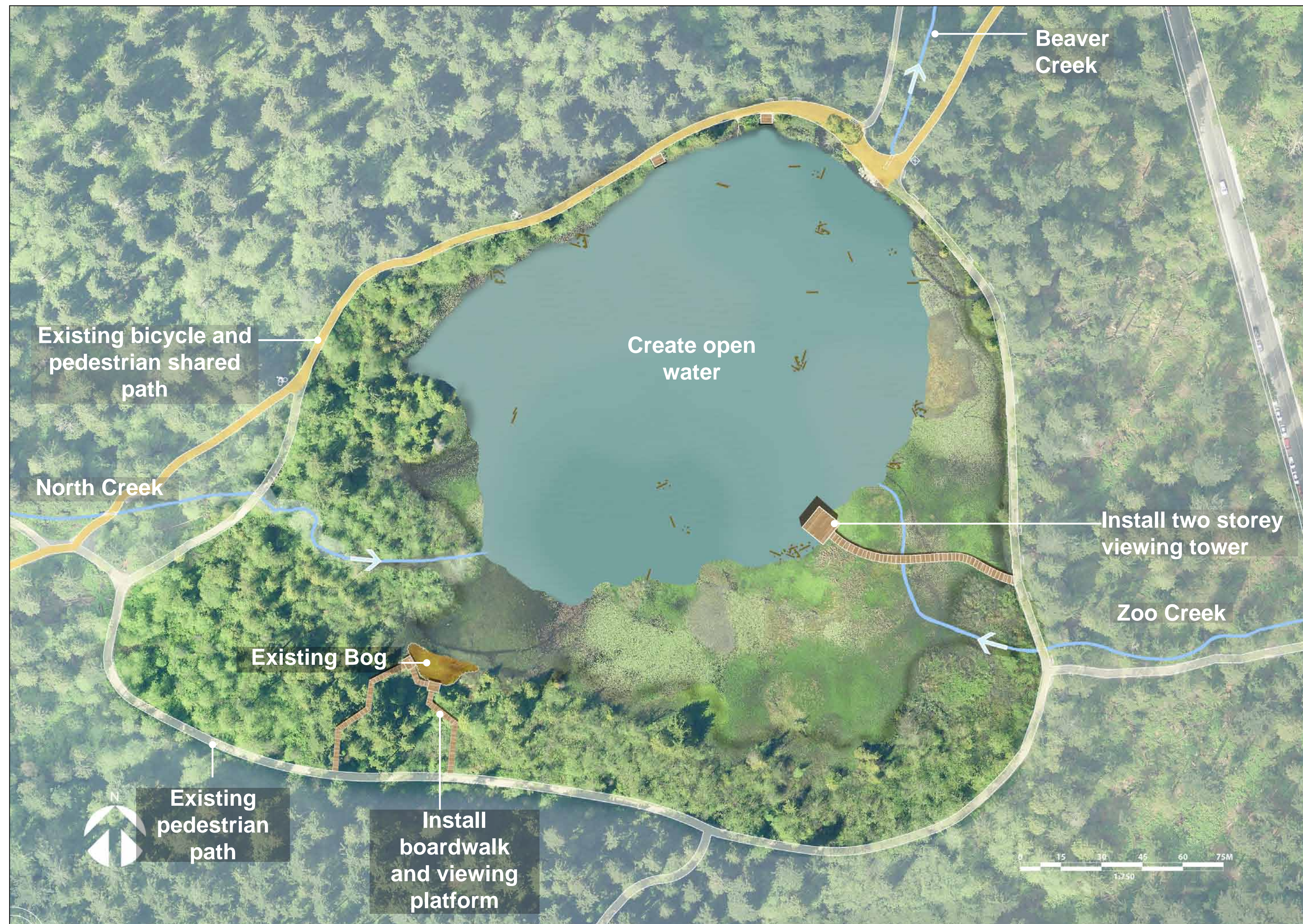
Section 2: Floating boardwalk



# 7. CONCEPT 3 | OPEN WATER AND VIEW TOWER

Low Habitat Creation and Biodiversity but  
Lowest Enhancement Capital Cost

November  
2013



- Seeks to remove vegetation, sediment and decaying organics from the lake and reduce, but not eradicate, the invasive fragrant water lilies.
- Does not support fish.
- 2.25 hectares of open water, to a maximum depth of 1.75m.
- Moderate sediment removal and disposal. Some fragrant water lilies would return annually and may lead to more rapid infilling of the lake if not managed.
- Low-Moderate Lake Longevity (assumes periodic invasives species management following dredging to a maximum depth of 1.75m).
- Two storey viewing tower and loop boardwalk trail to bog.

### Strength

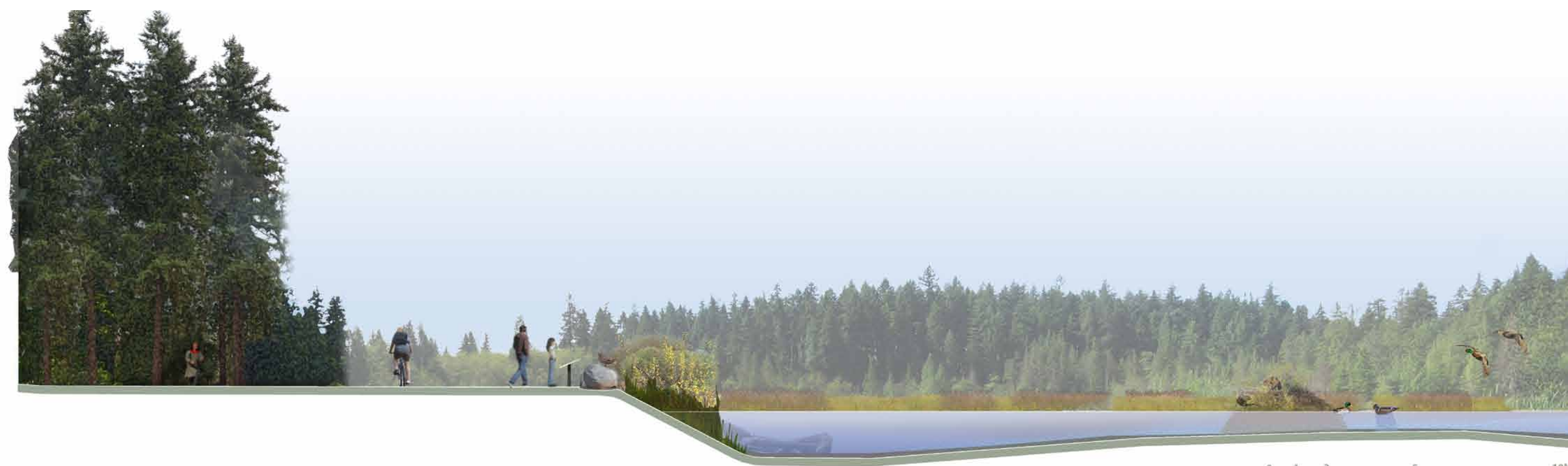
- Moderate increase in animal diversity.
- Reduces invasive fragrant water lily and narrow leaf cattail.
- Woody debris provides for increased habitat.
- Combination of open water and maximized riparian area provide habitat benefits.
- Creates a deep open water lake appearance.
- Tower provides a unique viewing opportunity.
- Short period of excavation and invasive species removal work (~ 1.5 months).

### Weaknesses

- Does not remove all water lily. Water lily will re-grow and mats will return without regular, ongoing management.
- View tower in this location may disturb wildlife.
- Does not increase plant diversity.
- Not suitable for salmon.
- Decreases wildlife viewing opportunities due to few places for animals to hide, feed, or nest.
- No increase in wildlife habitat and viewing opportunities along the trail.
- As fewer of the invasive lilies will be removed, the lake will infill more rapidly than other restoration options without regular, ongoing management.

### Relative Costs

- Lowest enhancement capital cost. \$
- Low - moderate facility costs. \$\$
- Low - moderate maintenance cost. \$-\$\$



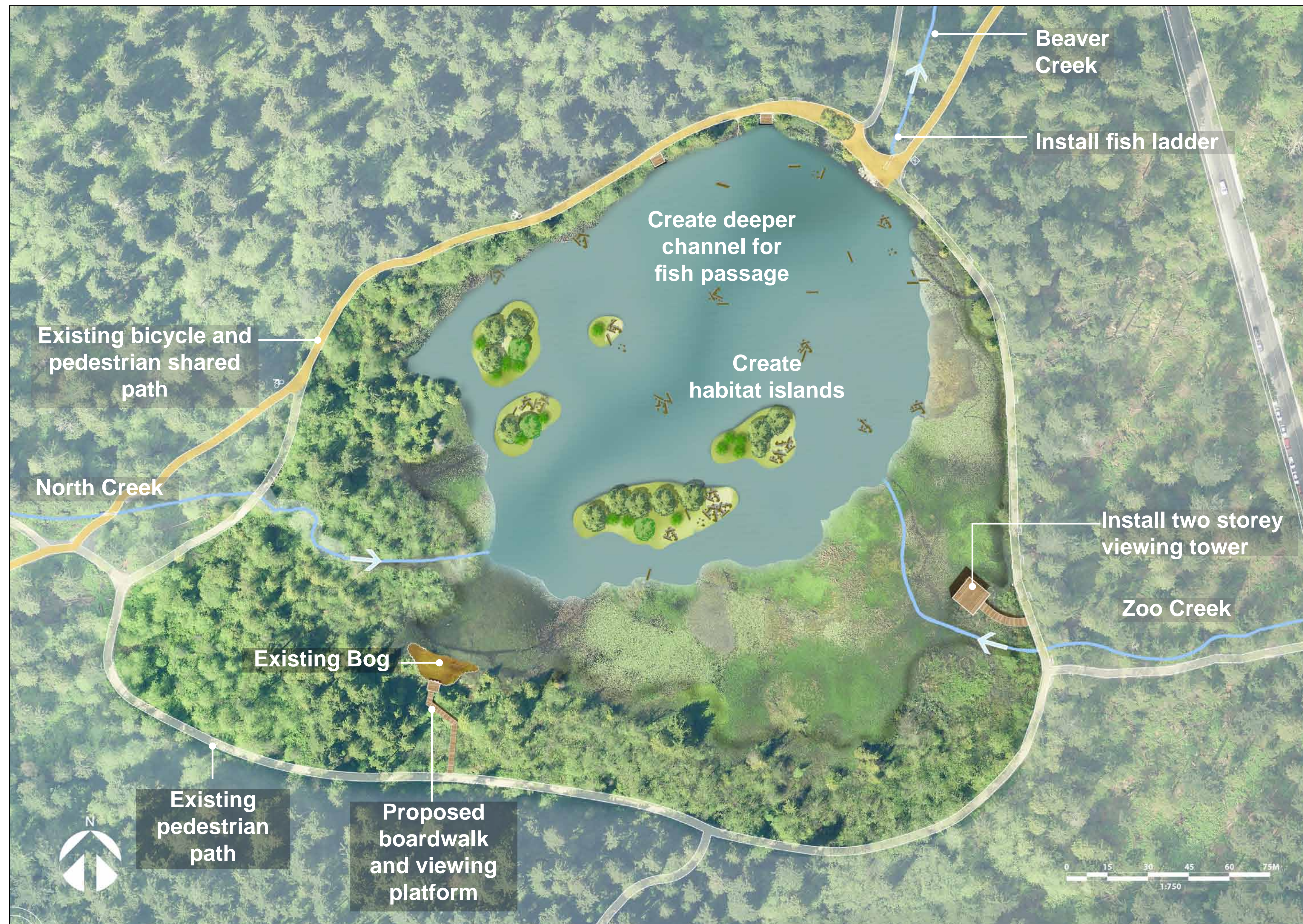
Section 3: North edge of lake



# 8. CONCEPT 4 | ISLANDS AND VIEW TOWER

Balances Habitat Creation and Biodiversity  
with Cost Considerations

November  
2013



- Seeks to remove vegetation, sediment and decaying organics from the lake and reduce, but not eradicate, the invasive fragrant water lilies. Excavated soil is used to create habitat islands for mammals, birds, amphibians, reptiles, fish and insects.
- A clear passage of 1.75m depth is created from Beaver Creek to North Creek to encourage seasonal fish movement through the lake.
- 2 hectares of open water, to a maximum depth of 1.75m.
- Moderate sediment removal and disposal. Some fragrant water lilies would return annually and may lead to more rapid infilling of the lake if not managed.
- Low Lake Longevity (assumes periodic invasive species management around islands and edge areas following dredging to a maximum depth of 1.75m).
- Two storey viewing tower and boardwalk trail to bog.

### Strengths

- High increase in animal diversity.
- High increase in plant diversity.
- Islands encourage turtle basking/nesting and use by shorebird, waterfowl and song birds.
- Woody debris provides increased habitat.
- Reduces invasive fragrant water lily and narrow leaf cattail.
- Fish ladder in Beaver Creek and deepening of channel through lake to reduce water temperature allows for seasonal movement of salmon to travel from Beaver Creek to North Creek.
- Islands with trees shade and cool the channel and reduce evapotranspiration.
- Increases wildlife viewing opportunities.
- Replicates natural coastal BC wetlands.
- Creates a deep open water lake appearance.
- The tower provides a unique viewing opportunity.

### Weaknesses

- Reduces, but does not eliminate, invasive species.
- Does not increase wildlife habitat and viewing opportunities along the trail.
- Moderate length of excavation and invasive species removal work (1.5 - 2 months)

### Relative Costs

- Moderate - high enhancement capital cost. \$\$ - \$\$\$
- Lowest facility costs. \$
- Lowest maintenance cost. \$



Section 4: View tower and edge of lake














# 9. ENHANCEMENT AND MANAGEMENT STRATEGIES

November  
2013







The following are ancillary enhancement strategies that could be incorporated into the final enhancement concept.

STRATEGY	APPROACH	RATIONALE	STRATEGY	APPROACH	RATIONALE
<b>CREATE MORE OPEN WATER</b>	<ul style="list-style-type: none"> <li>Reduce invasive aquatic plants, focusing on the fragrant lily and narrowleaf cattail.</li> </ul>	<p>These plants have formed a thick floating mat of organics that covers most of Beaver Lake. Left unchecked the lake will continue to infill, until it becomes forest.</p> 	<b>PREVENT THE SPREAD OF INVASIVE SPECIES</b>	<ul style="list-style-type: none"> <li>Remove invasive knotweed, giant hogweed, narrowleaf cattail and yellow flag iris.</li> </ul>	<p>Focus on early eradication. Remove narrowleaf cattail and yellow flag Iris to encourage high habitat value sedges.</p> 
<b>CREATE HABITAT MOSAIC AND SUPPORT SPECIES AT RISK</b>	<ul style="list-style-type: none"> <li>Establish pattern of islands and open water.</li> <li>Create vernal ponds.</li> <li>Introduce snags.</li> <li>Create turtle nesting sites on islands.</li> <li>Install bird nest boxes and large logs.</li> </ul>	<p>Expand the number of habitats to attract a range of species including great blue heron, western painted turtle, red legged-frog, and Pacific water shrew. Offer a variety of habitats with approximately 50% open water.</p> 	<b>MINIMIZE MAINTENANCE: ACCEPTANCE OF AN ALTERED ECOSYSTEM</b>	<ul style="list-style-type: none"> <li>Accept that some invasive species are well established and their complete eradication is not a cost effective, long term option.</li> <li>Focus on effective management and field surveys to minimize recolonization.</li> </ul>	<p>The park is a cultural landscape and not a pristine wilderness. This underscores the need to set a realistic enhancement target for Beaver Lake, rather than an unachievable natural lake with only native species.</p> 
<b>IMPROVE STREAM HEALTH OF ZOO, NORTH AND BEAVER CREEKS</b>	<ul style="list-style-type: none"> <li>Improve riparian zone plantings.</li> <li>Establish natural pools and riffles.</li> </ul>	<p>Improve fish habitat and augment Zoo Creek and North Creek to help supply water to Beaver Lake.</p> 	<b>CONTROL BEAVER DAMMING ACTIVITY</b>	<ul style="list-style-type: none"> <li>Widen and the outflow to Beaver Creek with a rock drain or similar beaver resistant fish passage structure, to prevent the beavers' continued damming and resultant flooding of the trail.</li> </ul>	<p>The beavers regularly block the main pipe through which water flows to Beaver Creek causing flooding and irregular downstream flows. Replacing the pipe with a rock drain would allow gradual seepage, undetectable to the beavers so they would no longer try to block it with dams.</p>  
<b>ENCOURAGE AQUATIC LIFE</b>	<ul style="list-style-type: none"> <li>Remove fragrant water lily to create and maintain more open water.</li> <li>Establish vernal ponds next to trail.</li> <li>Remove organic build-up in lake.</li> <li>Repair dam leakages.</li> </ul>	<p>Egg masses and tadpoles for the northwestern salamander require open water in lake and streams. All stages of life would benefit from vernal ponds. Vernal ponds would also increase water storage in the watershed.</p> 	<b>SUPPORT AND MAINTAIN NATIVE SPECIES</b>	<ul style="list-style-type: none"> <li>Relocate beavers and other native species during enhancement and return them upon completion.</li> </ul>	<p>Six beavers currently live in a lodge on the lake. They have created a small area of open water near the water control structures by cutting water lilies, shrubs and trees. This natural control of vegetation by aquatic mammals should be facilitated in the future.</p> 

# 10. ENHANCEMENT AND MANAGEMENT STRATEGIES

November  
2013

The following are ancillary enhancement strategies that could be incorporated into the final enhancement concept.

STRATEGY	APPROACH	RATIONALE	STRATEGY	APPROACH	RATIONALE		
<b>INCORPORATE PLANTS OF ETHNOBOTANICAL RELEVANCE</b>	<ul style="list-style-type: none"> <li>Plant native and culturally significant species</li> <li>Have observers for culturally modified trees (CMTs) and artifacts during enhancement work.</li> <li>Consider providing opportunities to aboriginal youth for project construction work.</li> </ul>	<p>The park as a whole is of cultural significance for the First Nations of the Musqueam, Squamish and Tsleil-Waututh bands who have occupied the site for centuries. First Nations representatives will be present on the site during this work to identify artifacts and culturally modified trees that will be preserved.</p>		<b>SUPPORT SALMON SPECIES</b>	<ul style="list-style-type: none"> <li>Install fish ladders to allow fish passage into Beaver Lake.</li> <li>Deepen the channel between Beaver and North Creeks and deliver more water to the lake during the summer.</li> <li>Introduce chum rather than coho Salmon.</li> </ul>	<p>Coho are annually released into Beaver Creek have been unable to return to spawn. Beaver Creek is effectively cut-off from Beaver Lake and North Creek, which has a resident Cutthroat Trout population.</p>	
<b>MAINTAIN THE BOG</b>	<ul style="list-style-type: none"> <li>Continue restoration efforts involving removal of trees and shrubs</li> <li>Introduce sphagnum moss.</li> <li>Maintain water levels.</li> </ul>	<p>SPES has been successful in restoring a small area of bog at the south end of the lake.</p>		<b>INSTALL GEOTEXTILE FABRIC</b>	<ul style="list-style-type: none"> <li>Install geotextile fabric in portions of the lake to control invasive water lilies and other non-native aquatic plants and control turbidity.</li> </ul>	<p>Geotextile fabric has been successfully used at other lakes in the Lower Mainland. The fabric is anchored out of sight, approximately 10 cm below the lake bottom.</p>	
<b>REINTRODUCE EXTIRPATED SPECIES</b>	<ul style="list-style-type: none"> <li>Assess species that have or likely occurred historically within the park and evaluate the option for reintroduction, contingent on habitat suitability determined through detailed habitat design.</li> </ul>	<p>Reintroducing species, e.g. red-legged frog, western painted turtle or muskrat, would increase biodiversity, restore natural ecosystem function, encourage other species, and even aid in the management of invasive plant species.</p>		<b>AERATE WATER</b>	<ul style="list-style-type: none"> <li>Install aerators situated so they are not visually obtrusive or operate only at night.</li> </ul>	<p>The use of aerators would improve water movement and oxygenation during the summer.</p>	
<b>INSTALL TWO STOREY VIEW TOWER</b>	<ul style="list-style-type: none"> <li>Install a two-storey view tower to provide a diversification of views of the lake.</li> </ul>	<p>Creating a tall viewpoint over Beaver Lake will increase interpretive and passive recreation opportunities.</p>		<b>INSTALL COMPOSTING TOILET</b>	<ul style="list-style-type: none"> <li>Install a composting toilet.</li> </ul>	<p>A composting toilet would expand range of programming and serve visitor needs without significant additional infrastructure.</p>	
<b>INSTALL ADDITIONAL BOARDWALKS AND VIEWING PLATFORMS</b>	<ul style="list-style-type: none"> <li>Provide boardwalks and viewing platforms to provide more ecologically sensitive access than gravel trails.</li> </ul>	<p>Expanding viewpoints to Beaver Lake will increase interpretive and passive recreation opportunities. Floating boardwalk across the lake would provide a different experience but will impact wildlife.</p>		<b>EXPAND INTERPRETIVE SIGNAGE</b>	<ul style="list-style-type: none"> <li>Implement an expanded interpretation signage program.</li> </ul>	<p>An expanded interpretive signage program will further educate and enhance visitor understanding of the lake and its surroundings.</p>	