



Assessing the Health of the Lower Fraser River Through a Holistic Lens

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Cover Page Photo Credit: Sam Kohlmann

Disclaimer

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Introduction

The Fraser River Discovery Centre (FRDC) is a two-story place of learning about the Fraser River located adjacent to the Quayside boardwalk in New Westminster. Currently the majority of the FRDC's exhibits educate visitors predominantly through a western lens. One such exhibit is water health which portrays water as being measurable through water temperature, dissolved oxygen, and turbidity. In response to Canada's Truth and Reconciliation Commission, the FRDC has begun the work to center Indigenous ways of knowing in their exhibits. This work is being led by the Musqueam Indian Band who established a memorandum of understanding with FRDC in 2020. This relationship is intended to develop the Centre into x^wtatə́ləm, a place of learning about the Indigenous heritage and teachings of the river. Collaborative relationships are emerging and the FRDC is working to balance western science with Indigenous ways of knowing in its exhibits and programs. Etuaptmumk, the Mi'kmaw word for two-eyed seeing, aptly describes the end goal of the work the FRDC is undertaking. Regarding this project the FRDC has had some initial conversations and consultations with the Musqueam Indian Band, the FNFLF, and Indigenous individuals, yet x^wtatə́ləm and etuaptmumk are still ongoing processes.

The FRDC's exhibits are aging, and most are due for a change. x^wtatə́ləm is a few years away and in the interim, some exhibits will be updated. One such exhibit is the exhibit explaining river health. It displays measurements of pH, turbidity, dissolved oxygen, and temperature recorded by the University of the Fraser Valley at Fort Langley between 2010 and 2013. The FRDC looked to the UBC Sustainability Scholars to lead the creation of this new exhibit using an alternative lens that incorporates different ways of understanding river health. The main deliverable for the FRDC was a design for an interactive exhibit to replace their current water health exhibit.

Location

The research site for this exhibit is based on the visual bounds of the river from the FRDC. The building has sweeping views of the Fraser River extending from the Pattullo Bridge to the Queensborough Interchange. This section of the river is also part of the Fraser Estuary. At high tide seawater in the form of a salt wedge enters the river reaches the Pattullo Bridge. (K. Ashley, personal communication, May 2023) This is an important site to many Hə́nqə́mí́nə́m and Halqeméylem speaking people. The fishing village of Qayqayt was located on the south bank of the river. (R. Bailey, Katzie First Nation, personal communication, May 2023) In response to a survey sent to Musqueam Environmental Stewardship Department, this area is of immense significance to the history, culture, and way of life to the Musqueam. They state:

“It is hard to overstate how important the river is. The location is proximate to the missing Musqueam Reserve #1 which was appropriated and destroyed by the provincial government. The twinning of the Fraser River at this point is linked to the two-headed snake that came from Camosun Bog and created Musqueam Creek as she grew and made her way to the river.” (Musqueam Environmental Stewardship Department, personal communication, June 2023)

Research Approach

The research for this exhibit started off with the question, “What defines a healthy river?”. The answer to this question varies depending on who is answering. This gets the root of the FRDC’s initiative to move towards x^wtatəlíləm; their current exhibit answers this question from the perspective of western science. This project seeks to explore a more holistic definition of river health.

To answer this question, general background research was conducted on the research area. After an introductory overview had been completed, the FRDC reached out to connections they had which resulted in interviews with Jenna Duncan of the First Nations Fisheries Legacy Fund (FNFLF), Katzie First Nation council member Rick Bailey, and researcher Ken Ashley. In addition to this, a survey was sent to the Musqueam Environmental Stewardship Department.

Findings

Multisensory Approach

In a conversation with Katzie First Nation council member Rick Bailey, (Katzie First Nation, personal communication, May 2023) he spoke about smelling the combined sewer overflow in the river. A sensory approach, he indicated, is one way to understand river health. In the survey sent to the Musqueam Environmental Stewardship Department, (personal communication, June 2023) constant observation of the river was identified as “a part of traditional daily life”. Another survey question asked, “What do I see in a healthy river? What do I smell? How do I feel?”. The response:

“Green vegetation surrounding the river; an abundance and variety of wildlife using the river; a wide variety of life indicators and a minimal anthropogenic disturbance level;

naturally occurring shorelines and river beds; a variety of wildlife and fish and a natural smell, noise and light level. A healthy river should promote feelings of calmness and reduced stress levels.” (Musqueam Environmental Stewardship Department, personal communication, June 2023)

These sensory observations are engaging starting points for visitors as they learn about river health and analyze the health of the river on their own. This way, visitors can take part in the investigative process. By associating health with the senses, the process becomes accessible and easier to understand.

Narrative Throughline

Echoing the Musqueam Environmental Stewardship Department’s response to our survey, Rick Bailey spoke of how fish are a good indicator of river health. (R. Bailey, Katzie First Nation, personal communication, May 2023) In our interview with Ken Ashley, he stated that fish like salmon die from many combined factors rather than a singular cause (K. Ashley, personal communication, May 2023). Fish act as throughlines for river health because they are influenced by so many factors. Based on the interviews and research that were conducted, the three fish that will act as throughlines for this exhibit are eulachon, salmon, and sturgeon. These fish were identified by the Musqueam Environmental Stewardship Department as primary food sourced at the research site. (Musqueam Environmental Stewardship Department, personal communication, June 2023)

Hardened Edges

Hardened edges along the banks of the Fraser River have gained prevalence in the past years as development has increased in the region. Taking the forms of training walls, dikes, jetties, rip rap, and causeways, this hardening of the river’s edge has changed the riparian and estuarine ecosystems where it has taken place. (Ashley, 2021) This hardened edge allowed developments to come up to the river’s edge and enabled dredging to occur all the way to the river’s edge.

Among the negative impacts this has had is the elimination of the detrital food cycle that fish and other animals rely on. Bacteria, decomposing plants, and algal biofilm collect along the water’s edge and are a great food source. This cycle connects estuarine plants to salmonids that are developing as they make their way to the ocean. (Ashley, 2021) The nutrients in detritus help developing fish grow and the plants provide shelter from predators. Loss of this habitat disconnects salmonids from this food source. This estuarine and riparian habitat, in addition to

providing food, is also the spawning grounds for fish like salmon. Elimination of these potential spawning grounds means fish must travel further to spawn and the viable area for spawning is reduced. (Ashley, 2021) The hardened edge of the Fraser River has increased steeply in recent decades as the Fraser River has been envisioned as a working river. Looking to the area surrounding the FRDC, this transformation is illustrated in figure 1. The viable spawning habitat and area for detritus to accumulate has been severely reduced.



Figure 1. Environmental transformation since colonization. The left panel shows the pre-settler condition of the region, and the right panel represents the 2023 condition. Blue represents natural areas, orange represents developed areas, and pink shows hardened river edges.

Hardened edges indicate that fish spawning habitat has been reduced and detrital food is not available. Because fish make up a large part of the ecosystem, the presence of a hardened shoreline indicates a stressed river ecosystem.

Another negative impact of hardened river and estuarine edges is the conformity they impose on the river. Rivers are dynamic and require the agency to move with the amount of water that is flowing over time. As they move, new habitats are created and transformed. In flood times, rivers expand into the floodplain, slowing down water and fertilizing the adjacent land. This is a vital function that is prevented by hard edges. In areas where the river has been restricted by hardened edges, during flood times, the water is unable to enter the floodplain and slow down. This results in a fast and dangerous river that does not support the floodplain habitat. (K. Ashley, personal communication, May 2023)

According to the Musqueam Environmental Stewardship Department, “privatization or control of shorelines have alienated the river from traditional access or use”, (Musqueam Environmental Stewardship Department, personal communication, June 2023). When asked about indicators we might use to assess and monitor river health of this section of the river part of their answer included the “percentage of natural shoreline vs. walls, dykes, riprap, etc.”

In the context of this project’s goal of creating an exhibit, this information can be explained in an engaging way to FRDC visitors. Using a multisensory approach, rip rap can be seen across the river along with the hardened shore beneath the center. Prompts like: “how many places can you see plants touch the water?” or “how far does the rip rap extend in each direction across the river?” can prompt visitors to observe the percentage of natural to hardened shorelines and connect new information with their surroundings.

Paving

Hardened river edges are often accompanied by paving behind it. Paving has replaced important natural habitats. According to the Musqueam Environmental Stewardship Department, “The marshes and riparian areas were/are also important for harvesting many plant species used for a range of purposes. In early days, there was also a variety of wild foods here, including the now extirpated “Indian” cherry and wildlife, including a wide variety of waterfowl.” (Musqueam Environmental Stewardship Department, personal communication, June 2023) Due to this development, “It is becoming harder to access natural areas to harvest and use for cultural purposes.” (Musqueam Environmental Stewardship Department, personal communication, June 2023)

Paving with common materials like asphalt and concrete also creates an impervious surface that prevents water from filtering into the ground. Instead, water is primarily diverted to a stormwater drain. Most of the time, stormwater that falls on paved surfaces in the area around the Fraser River is directed to a water treatment facility. During times of heavy rainfall, large quantities of water that would otherwise filter into the ground are directed through the sewer systems, eventually making their way to the river. If there is too much stormwater for the water treatment facility to handle, it is released untreated as combined sewer overflow (CSO).

This system also degrades water quality. New Westminster is among the Metro Vancouver communities that use CSO. In times of high rainfall when the sewers are pushed beyond their capacity, to prevent sewer backups in buildings, stormwater and wastewater is diverted directly to the Fraser River. This has been identified as an issue by Metro Vancouver and operations are in

place to replace combined sewers with separate pipes for wastewater and stormwater. Progress is slow. In an effort to remedy this, in 2005, the City of New Westminster built a 20,000 cubic meter volume storage facility near the Quayside Off-Leash Dog Area at 1400 Quayside Drive. (Combined Sewer Overflow Management | City of New Westminster, n.d.) However, in 2020, the tank released 728,000 cubic meters of CSO into the Fraser River. Occurrences of CSO at New Westminster’s CSO tank and in Metro Vancouver for 2019 and 2020 are shown in table 1.

Using a multisensory approach, the effects of pavement can be communicated using sight and smell. A useful prompt could be, “Do you see more paved or natural surfaces next to the river?” and “What does the river smell like?”.

CSO FROM NEW WESTMINSTER’S CSO TANK AND METRO VANCOUVER FOR YEARS 2019 AND 2020					
Year	Name	Number of Days	Number of Events	Duration (hr)	Total Est. Volume (m3)
2019	New West. CSO Tank	19	10	173	368,000
2020	New West. CSO Tank	30	21	334	728,000
2019	Metro Vancouver	1,418	1,187	9,068	22,078,000
2020	Metro Vancouver	1,870	1,446	15,471	36,946,000

Table 1. CSO Data from Metro Vancouver’s 2019-2020 Biennial Report (Metro Vancouver, 2021)

Dredging

The Fraser River is a strategic body of water for maritime shipping in British Columbia. Large container ships dock at numerous locations along the Fraser River including the Fraser Surrey Docks. The depth of the river before development was traditionally around 6 meters which is too shallow for container ships. Dredging to 12 meters is required to enable shipping on the river. (Ashley, 2021)

Dredging has been attributed as a factor in the destruction of eulachon habitat. They spawn on the river bottom and do not penetrate far upstream. Dredging can destroy eggs. Since 1995, Fisheries and Oceans Canada (DFO) has suspended dredging during eulachon spawning season.

Dredging occurs 24 hours a day, every day except for the months of March, April, May, and half of June. (Committee on the Status of Endangered Wildlife in Canada, 2011)

Dredging also removes many tons of sediment a year from the river. This has had detrimental effects on the downriver community of Delta, which relies on sediment deposits to protect itself from storm surge and rising sea levels. Dredging is estimated to reduce the amount of silt Delta receives from three million tons to one million tons annually. (Ashley, 2021) This also adversely affects the nearby city of Richmond. Michael Church, University of British Columbia professor of fluvial geomorphology and large river dynamics who has studied the Fraser River wrote in a guest essay in *The Soul of the Fraser*, “the delta front is retreating under wave attack, vulnerable due to insufficient sediment additions”. (Ashley, 2021)

A good multisensory indicator for dredging is seeing container ships at the New Westminster Port. Seeing dredging ships themselves is inconsistent throughout the day and year and seeing the riverbed is not possible.

Water Treatment

Annacis Island is visible to the west of the FRDC. The Annacis Island Water Treatment Plant located there serves over 1 million people in the Metro Vancouver area. (Metro Vancouver, 2021b) It is a secondary treatment facility meaning it cannot remove microplastics and pharmaceutical drugs from the water it releases. (Ashley, 2021) Certain pharmaceutical compounds bioaccumulate in salmon with negative effects. For example, a 2011 study observed that compounds acting as endocrine disruptors adversely affected the immune systems of fish. (Milla et al., 2011) Further, a 2014 study observed that juvenile salmon moving through contaminated estuaries had a 45% lesser chance of survival than ones moving through uncontaminated estuaries. (Meador, 2014)

Pharmaceutical compounds are not readily observed by the senses. When using a multisensory approach to assess river health, distinguishing between levels of water treatment is difficult to observe. A relevant prompt could relate to water disposal in buildings such as, “Where does the water from the sink go?”. In this way, visitors can relate items they interact with daily to the health of the river.

Summary

The most engaging way to assess the health of Fraser River at this stage of the FRDC's progress towards x^wtatələm is through a multisensory approach. Questions that prompt the visitor to observe the river using their senses are an effective technique to engage them with exploring river health. The primary observable influences on river health to be presented in the exhibit are: hardened edges, paving, container ships, and the Annacis Island water treatment plant. Each of these influences fish, therefore fish have been chosen as narrative throughlines. The three fish selected are eulachon, salmon, and sturgeon. These were chosen based on their importance to the river ecosystem and to Indigenous communities.

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Appendix A: Visualization Information Panel

Is the Fraser Healthy?

Moving Towards a Holistic Approach to River Health

What is a healthy river? To answer this, a good starting point is through observation. What do you see, smell, feel, and hear on and near the river? This multi-sensory analysis is the first step to uncovering the underlying factors influencing the river and its health.

CONTRIBUTING VOICES



Musqueam Environmental Stewardship Dept.

The Musqueam Environmental Stewardship Department is part of the Musqueam Natural Resources Service Group. They are dedicated to planning for access, use, and management of the Musqueam's ancestral and traditional lands and waters for present and future generations.



Rick Bailey

Rick Bailey is a Katsie First Nation councillor and elder. He focuses on Aboriginal rights and fish and wildlife.



Ken Ashley, PhD

Ken is currently Director of the Rivers Institute at BCIT, an Instructor in BCIT's Ecological Restoration Program and is an Adjunct Professor in Civil Engineering at UBC.

Exhibit designed by Sam Kohlmann as part of UBC's 2023 Sustainability Scholar program.

Appendix B: Visualization Design with Exhibit Context Background

— Hardened Shoreline
 — Natural Shoreline
 — Paved & Developed Area
 — Natural Area

Are there more paved or natural surfaces next to the river?

Voices of the River: Musqueam Environmental Stewardship Department

"The marshes and riparian areas were/are also important for harvesting many plant species used for a range of purposes. In early days, there was also a variety of wild foods here, including the now extirpated "Indian" cherry and wildlife, including a wide variety of waterfowl... It is becoming harder to access natural areas to harvest and use for cultural purposes.

How much of the river's edge is hardened?

Hardened edges indicate that fish spawning habitat has been reduced and food is not available. Because fish make up a large part of the ecosystem, the presence of a hardened shoreline indicates a stressed river ecosystem.

Rivers require room to move with the amount of water that is flowing over time. In areas where the river has been restricted by hardened edges, during flood times, the water is unable to enter the floodplain and slow down. This results in a fast and dangerous river that does not support the floodplain habitat.

How does pavement feel when you travel over it?

Where does the water from the sink go?

The Annacis Island water treatment plant is a secondary treatment facility. It is unable to remove microplastics and pharmaceutical drugs from the water it receives. These materials collect in the tissues of salmon and have negative effects. Juvenile salmon moving through contaminated estuaries have a 45% lesser chance of survival than ones moving through uncontaminated estuaries.

Combined Sewer Overflow

In times of high rainfall when the sewers are pushed beyond their capacity, to prevent sewer backups in buildings, stormwater and wastewater is diverted directly to the Fraser River. In 2020, it was estimated that 778,800 cubic meters of combined sewer overflow was released into the Fraser River from New Westminster.

What does the river smell like today?

Combined Sewer Overflow can be smelled when it is released.

How easy it to access the water?

Indigenous groups have relied on the fish of the river for thousands of years. Sturgeon, salmon, and eulachon are important sources of food and medicine. Easier access by Indigenous group indicates a higher level of care and health of the area.

Voices of the River: Rick Bailey, Katie Elder & Council Member

"Just being on the water is important to Indigenous health and wellbeing"

"We are fishing later and later... Young people want to learn how to fish but there aren't as many fish to catch... If we don't fish we can't pass on knowledge and it will be lost"

How many container ships can you see today?

The river's natural depth is too shallow for container ships to enter. Dredging deepens the river from 6m to 12m which allows large container ships to enter the river.

Dredging has been attributed as a factor in habitat destruction of Eulachon. They spawn on the river bottom and do not penetrate far upstream. Dredging during this time destroys eggs. Since 1995, Fisheries and Oceans Canada has suspended dredging during Eulachon spawning season of March, April, May, and half of June.

How hot is the water?