# Fixing Fraser Floodgates for Fish

RESILIENT WATERS

A project of MakeWay

WATERSHED WATCH SALMON SOCIETY

metro vancouver

EPS

Pacific Salmon Ecology and Conservation Laboratory

SFU FACULTY OF ENVIRONMENT

BRITISH COLUMBIA

KWIKWETLEM FIRST NATION

Fisheries and Oceans Canada

Pêches et Océans Canada

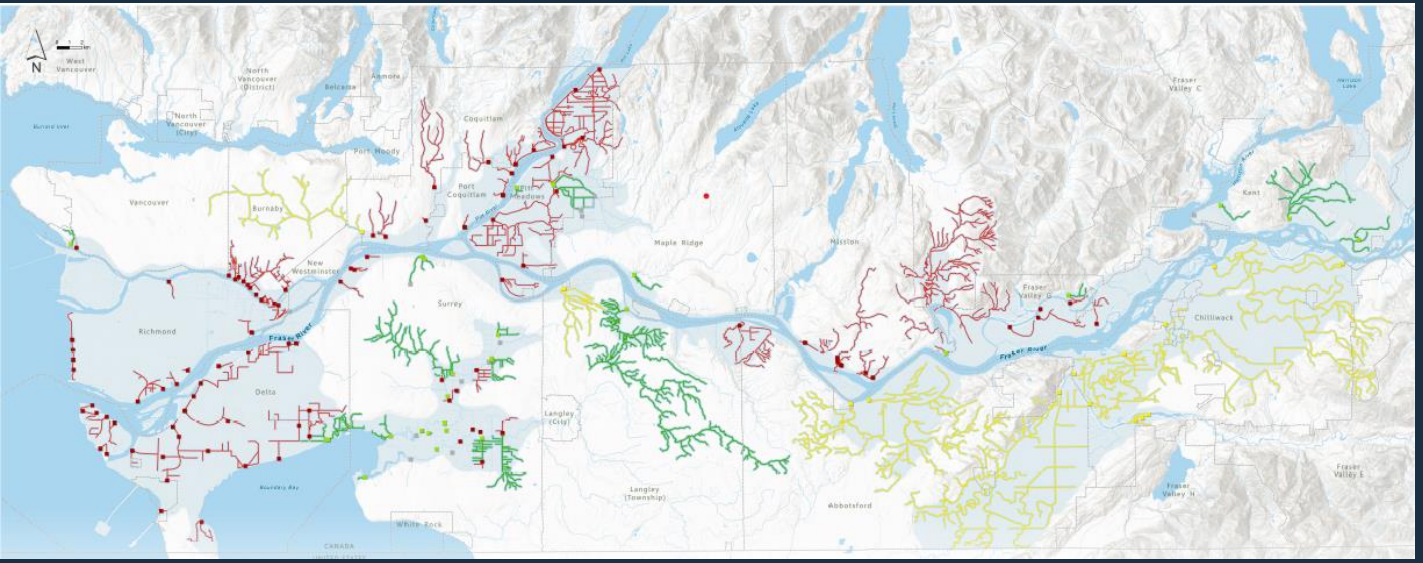
BONNEVILLE ENVIRONMENTAL FOUNDATION

PACIFIC SALMON FOUNDATION

REAL ESTATE Foundation OF BC

FWCP Fish & Wildlife COMPENSATION PROGRAM

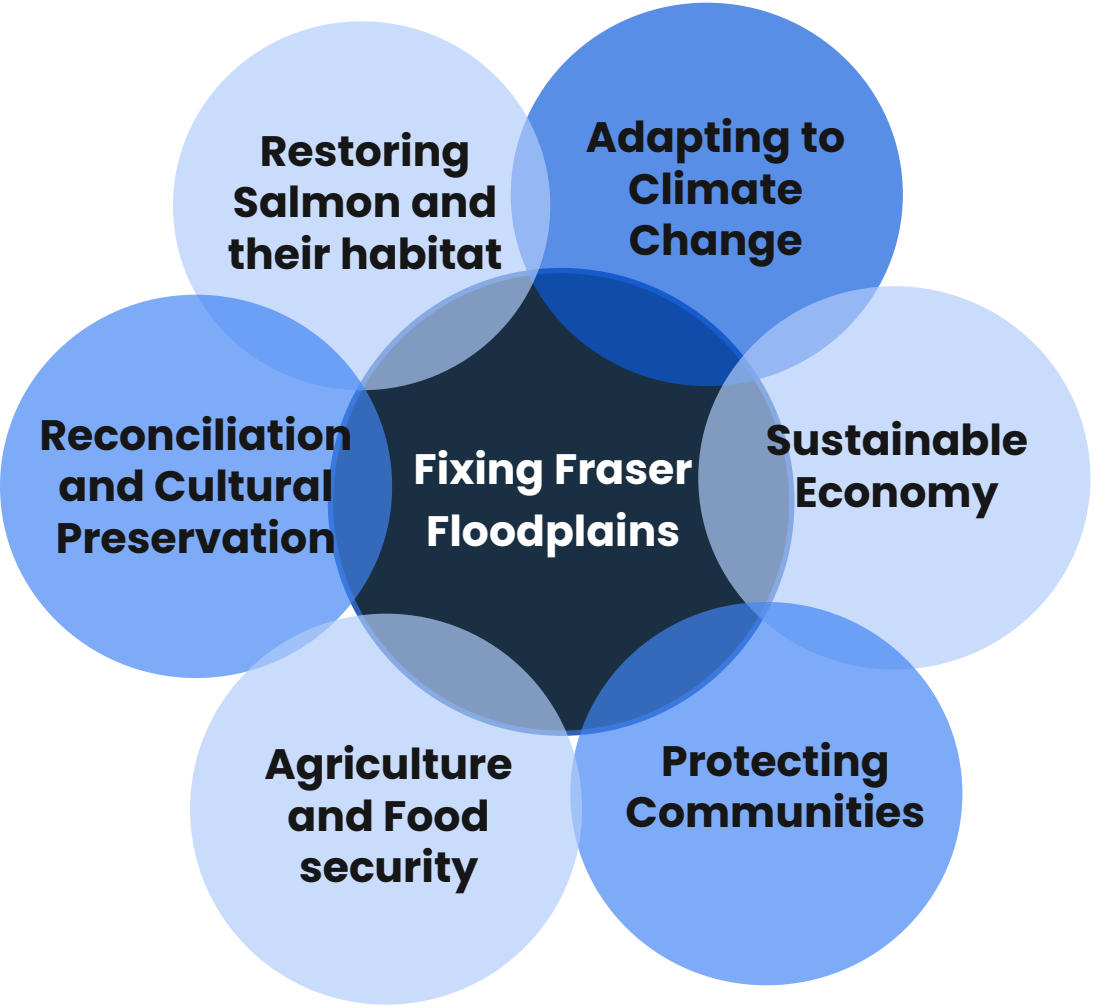
# How Resilient Waters Started




WATERSHED WATCH SALMON SOCIETY

- 160 Floodgates, 60 Pumpstations & 250 KM of dikes along the Fraser, aging and outdated
- Blocking 1500 km of important off-channel slough and stream salmon habitat (Watershed Watch, 2018)
- Loss of 85% of floodplain habitats (Finn et al. 2021)

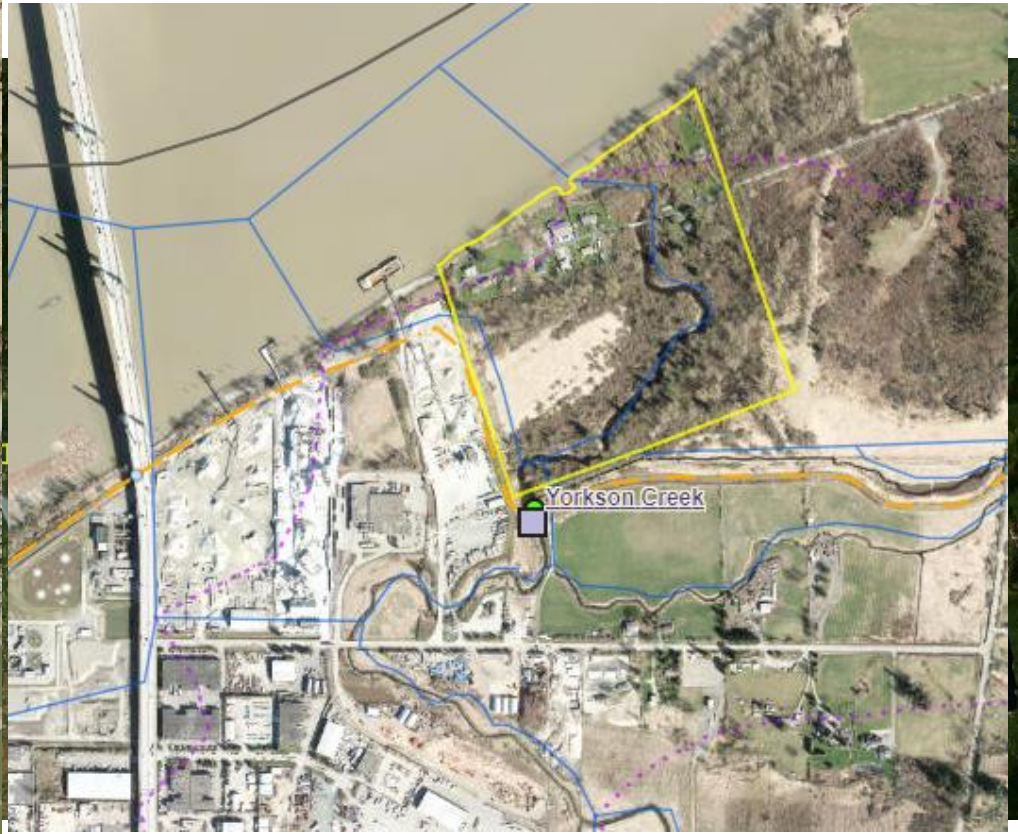
BC Salmon Restoration and Innovation Fund
Fonds de restauration et d'innovation pour le saumon de la C-B




# Fixing Fraser Floodplains

- Gateway and nursery for one of the largest and most diverse salmon populations in the world
- 4th largest port and 12th fastest growing region in NA
- Most productive and fertile agricultural land in BC
- 30 First Nations, 25 local governments, and 3 million people
- Climate change increasing and shifting flood risk type
- Prohibitively Expensive to upgrade flood infrastructure with status quo solutions = $8–10 billion

# Inequitable History of Flood Infrastructure



# Importance of Floodplain / Off-channel habitat for Salmon



- Crucial overwintering nursery habitat for out-migrating juvenile salmon, especially [Harrison] Chinook
- Adjusting to salinity closer to estuary



**Floodplain rearing of juvenile chinook salmon: evidence of enhanced growth and survival**

T.R. Sommer, M.L. Nobriga, W.C. Harrell, W. Batham, and W.J. Kimmerer

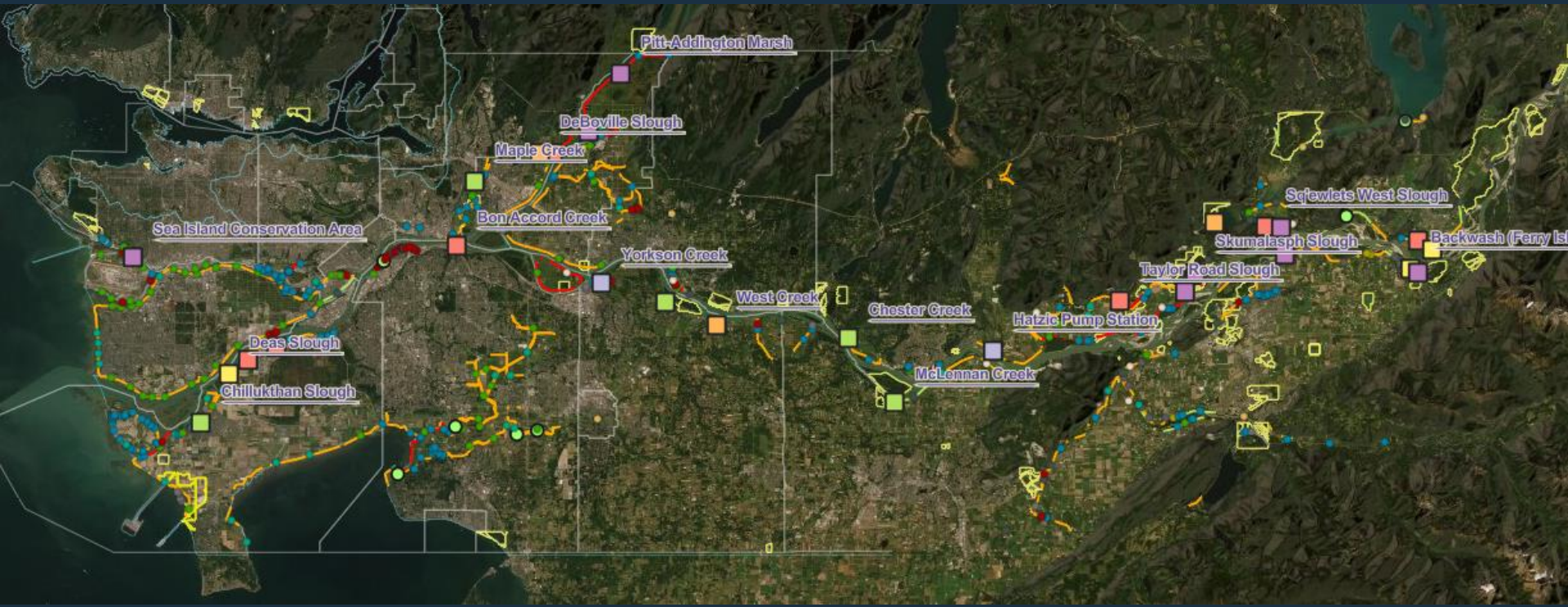
**Abstract**: In this study, we provide evidence that the Yolo Bypass, the primary floodplain of the lower Sacramento River (California, U.S.A.), provides better rearing and migration habitat for juvenile chinook salmon (*Oncorhynchus tshawytscha*) than adjacent river channels. During 1998 and 1999, salmon increased in size substantially faster in the seasonally inundated agricultural floodplain than in the river, suggesting better growth rates. Similarly, coded-wire-tagged juveniles released in the floodplain were significantly larger at recapture and had higher apparent growth rates than those concurrently released in the river. Improved growth rates in the floodplain were in part a result of significantly higher prey consumption, reflecting greater availability of drift invertebrates. Bioenergetic modeling suggested that feeding success was greater in the floodplain than in the river, despite increased metabolic costs of rearing in the

Environ Biol Fish (2008) 83:449–458
DOI 10.1007/s10641-008-9367-1

**Ephemeral floodplain habitats provide best growth conditions for juvenile Chinook salmon in a California river**

Carson A. Jeffres • Jeff J. Opperman •
Peter B. Moyle

# Identifying Restoration Opportunities: 2020-ongoing




www.resilientwaters.ca/map-data

26 high priority sites from Hope to Estuary

HOW WE'RE DOING IT

# Collaborative Research

- Site Assessments of flood infrastructure at Priority Sites - Pearson Ecological
- Colony Farm Floodgate Study – UBC Salmon Lab (Zachary Sherker), Kwikwetlem FN, Metro Vancouver (2021-ongoing)
- Pumpstation and Fish Passage Study - 2024-2027

Photo: Watershed Watch Salmon

Site Assessments- Fish and WQ at 26 priority sites Report Cards over 3 years

Data freely accessible [www.resilientwaters.ca/data](www.resilientwaters.ca/data)

PEARSON ECOLOGICAL

## Habitat Report Card 2021

| Taylor Road Slough | | High Priority |
|---|---|---|
| Type | Slough | |
| Flood Infrastructure | Top-hinged flood gate (very poor condition) | |
| Key Rights Holders and Stakeholders | Leq'a:mel First Nation<br>Private Landowners<br>North Nicomen Improvement District (Dike)<br>Fraser Valley Regional District | |
| Waterbody Immediately Downstream | Nicomen Slough > Fraser River | |
| Upstream permanent barrier | Collapsed culvert at crossing | |
| UTM Coordinates at Mouth | 10U | 565677 \| 5447690 |
| Dates visited | March 15-19; June 14-18; August 3-10 | |


**Summary**

- Consists of two ponds and a forested wetland surrounded by agricultural lands, immediately west of Lakahahmen Reserve (Leq'a:mel)
- Slough likely also connected to Nicomen Slough at upstream end during high water events prior to dike construction (1948)
- Flood gate is barely functional; gate has been repaired by local farmer and inlet to pipe is almost completely blocked by sediment. Dike is also in poor condition and was further damaged in November 2021 floods.
- Flood gate appears impassable under most conditions although Prickly sculpin and several invasive fish species occur inside the dike.
- Culvert at farm crossing where reach TR1 and TR2 meet is blocked by beaver and impassable to fish
- With access from Nicomen Slough restored, Slough is likely to be used by chum fry in spring, by over wintering Coho from North Nicomen and Norrish Creek and upstream Nicomen tributaries, and by other Cutthroat and Rainbow in spring and fall.

**Restoration Opportunities**

TR1

- Extensive riparian plantings along south shore
- Add unanchored large woody debris
- Assess opening connection with TR3 under farm crossing

TR2

- Excavate accumulated sediment from pond where accessible with excavator.
- Add unanchored large woody debris
- Replace culvert culverts under farm crossing with beaver proof guarded culvert
- Extensive riparian plantings on both banks, maintaining a view of pond from house

### Indicators

| Indicator | Overall |
|---|---|
| Current connection to Fraser River | Top mounted flood gate, intake partially blocked |
| Accessible channel Length (current/potential) | 0/1240 |
| Potential Salmonid Use | Chum, Coho, Chinook, |
| Potential Species at Risk | Brassy Minnow |
| Introduced Fish and Amphibians | High catch rates |
| Riparian Condition | Mix of wide areas of native vegetation and areas with pasture to top of bank |
| Habitat Complexity | Abundant aquatic vegetation<br>Little woody debris |
| Water Quality | >20 C for and DO<2 at night in August |
| Potential for Habitat Restoration | High |

### Species Documented

| English Name | Halq'emeylem | Scientific Name | Status |
|---|---|---|---|
| Prickly Sculpin | | Cottus asper | Indigenous |
| Threespine Stickleback | Sqó:tqw | Gasterosteus aculeatus | Indigenous |
| Largemouth Bass | | Micropterus salmoides | Introduced |
| Pumpkinseed | | Lepomis gibbosus | Introduced |
| Brown Catfish | Mó:tqw | Ameiurus nebulosus | Introduced |
| Carp | Schólka | Cyprinus carpio | Introduced |
| Bullfrog | Wóles | Rana catesbeiana | Introduced |
| Green Frog | Wóles | Rana clamitans | Introduced |
| Signal Crayfish | | Pacifastacus leniusculus | Indigenous |

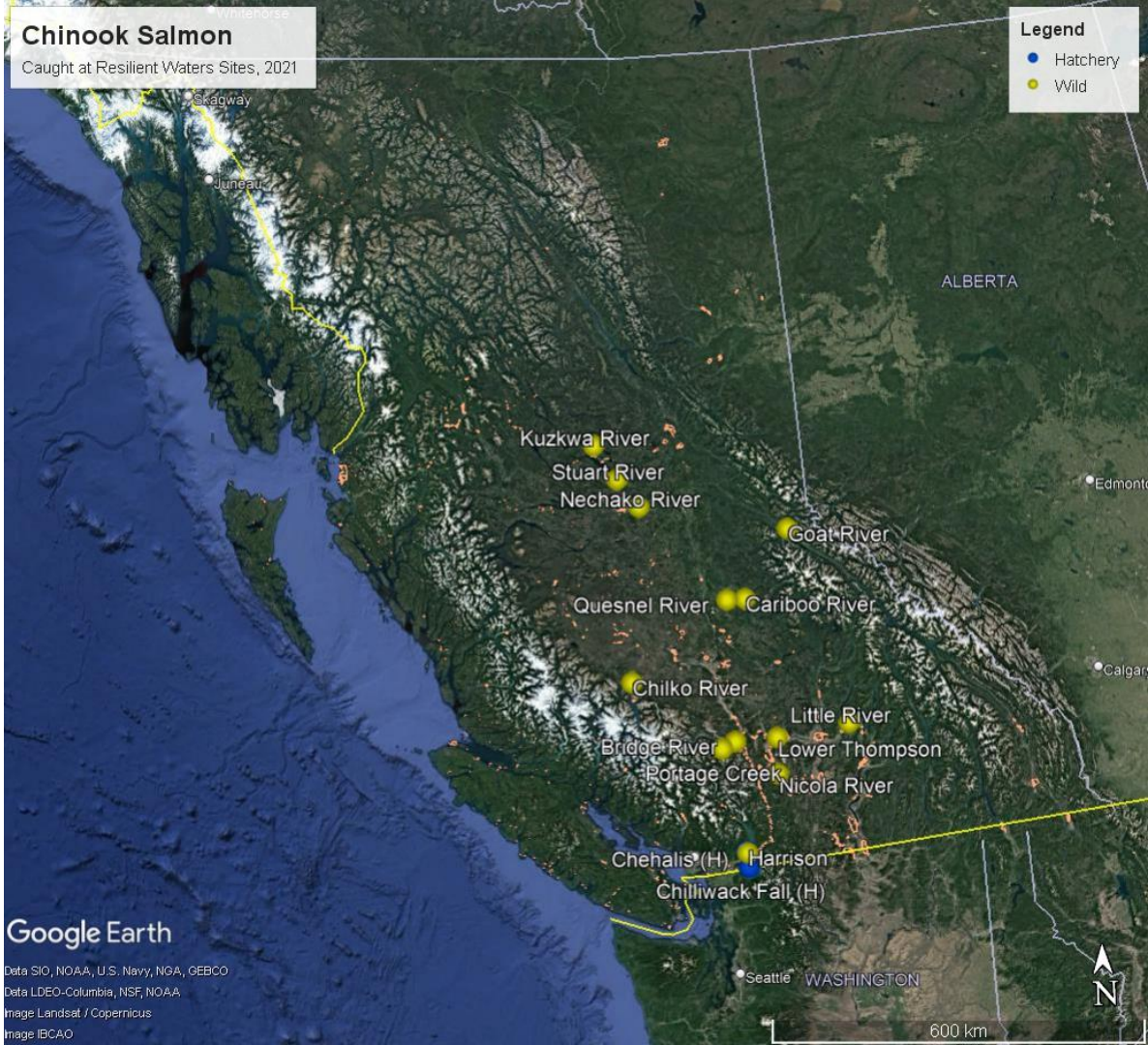
Halq'emeylem names provided by Carrielynn Victor, Sxwóyxwey Consulting, Cheam

### Neighbouring Sites

# Genetic Fin Clip Analysis

~250 clips taken from high priority sites

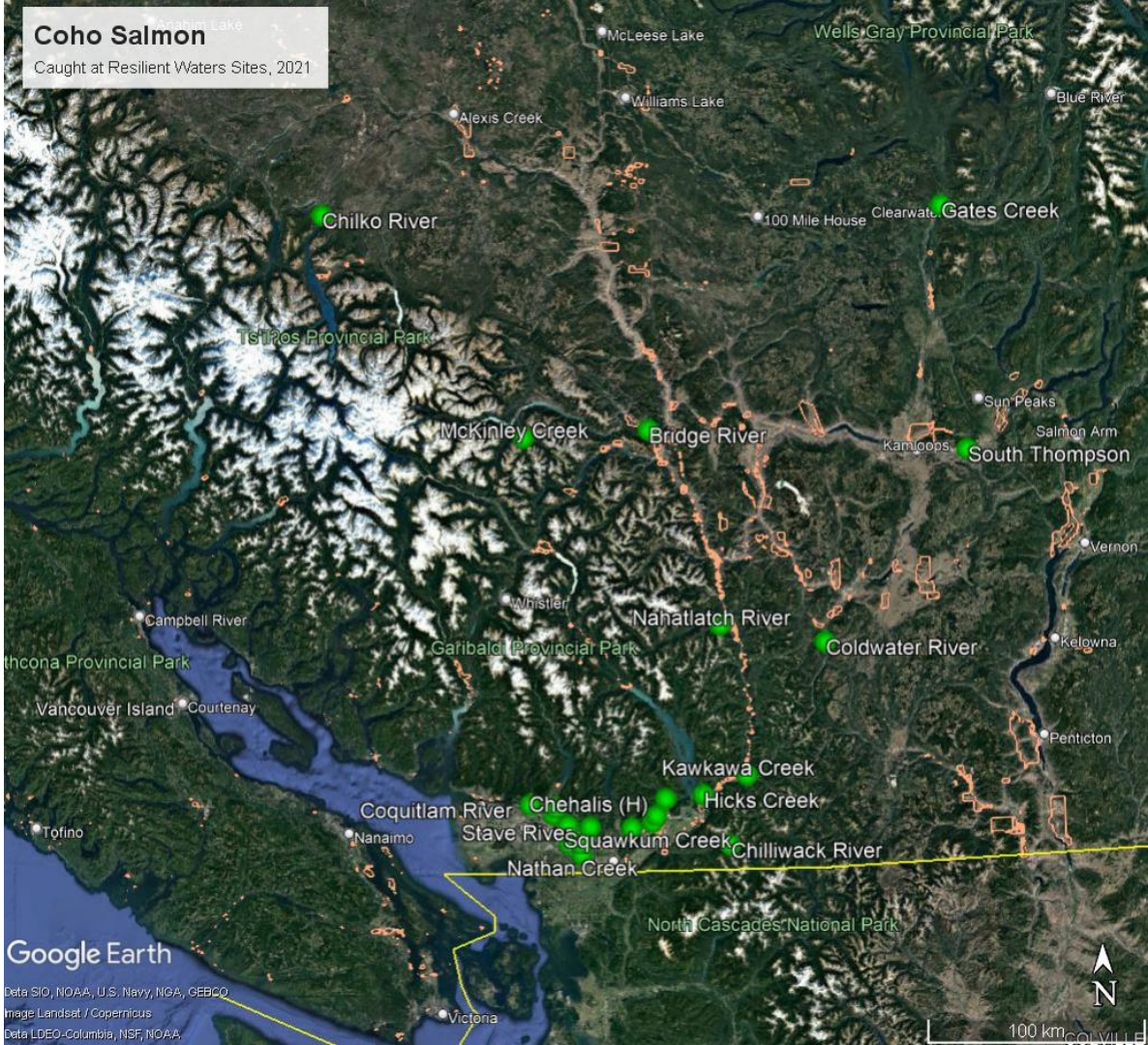
2021 Chinook – origin stream



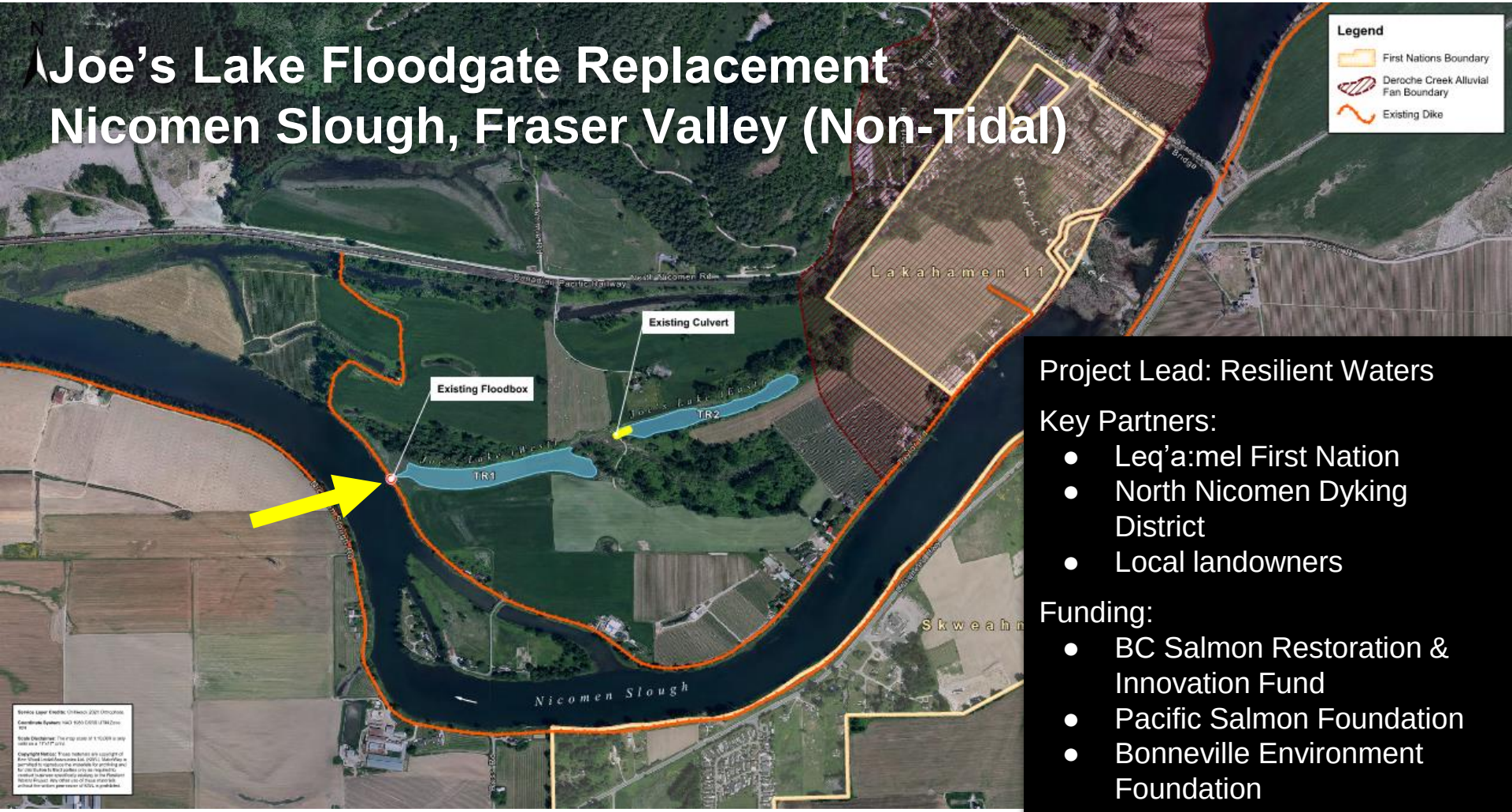
# Genetic Fin Clip Analysis

~250 clips taken from high priority sites

2021 Coho – origin stream



# Joe’s Lake Floodgate Replacement
# Nicomen Slough, Fraser Valley (Non-Tidal)




Project Lead: Resilient Waters

Key Partners:

- Leq’a:mel First Nation
- North Nicomen Dyking District
- Local landowners

Funding:

- BC Salmon Restoration & Innovation Fund
- Pacific Salmon Foundation
- Bonneville Environment Foundation

**BEFORE:**
JOE'S LAKE, DEROCHE
FAILED TOP MOUNTED
FLOOD GATE

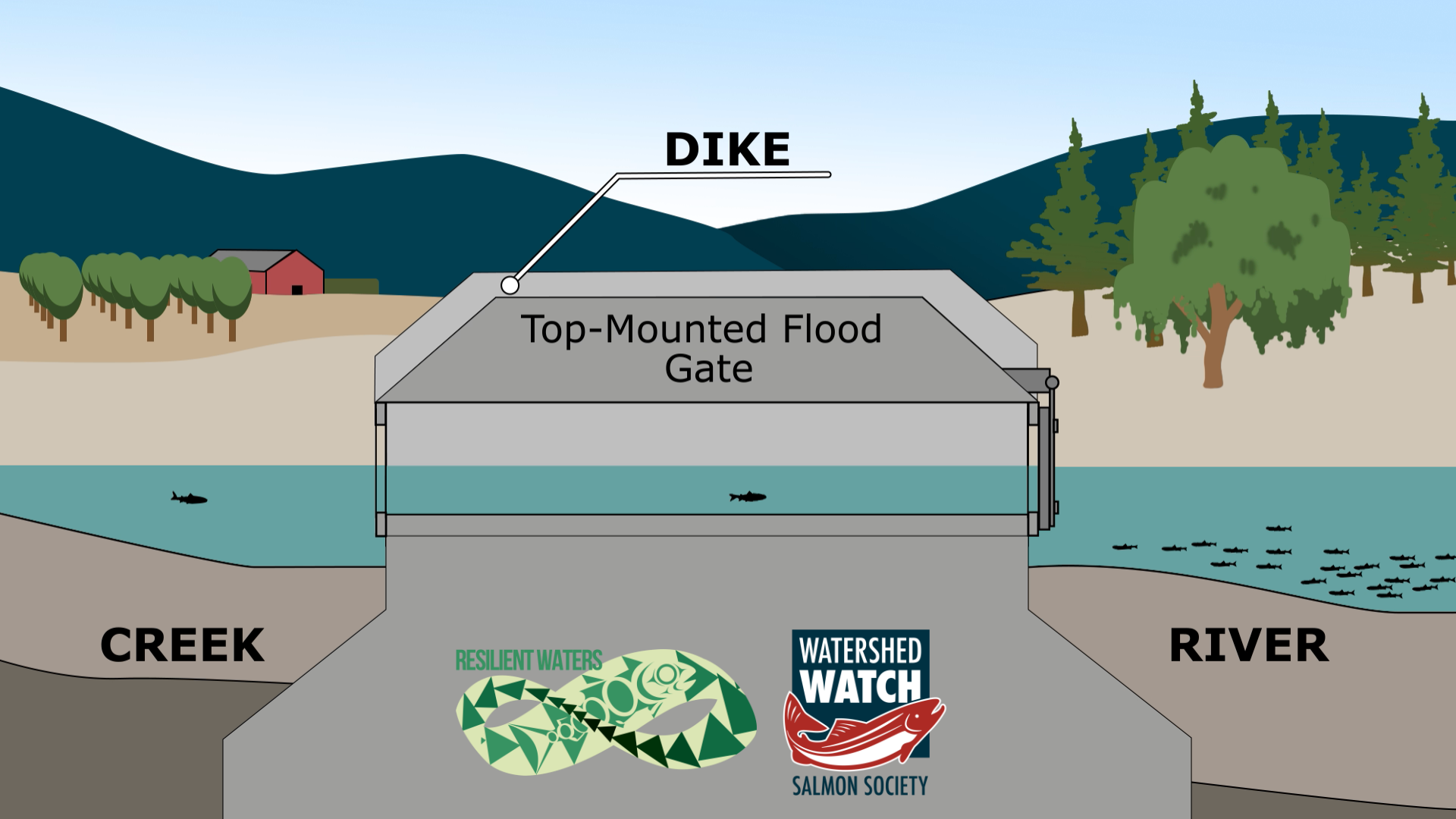
**THE PROBLEM:**

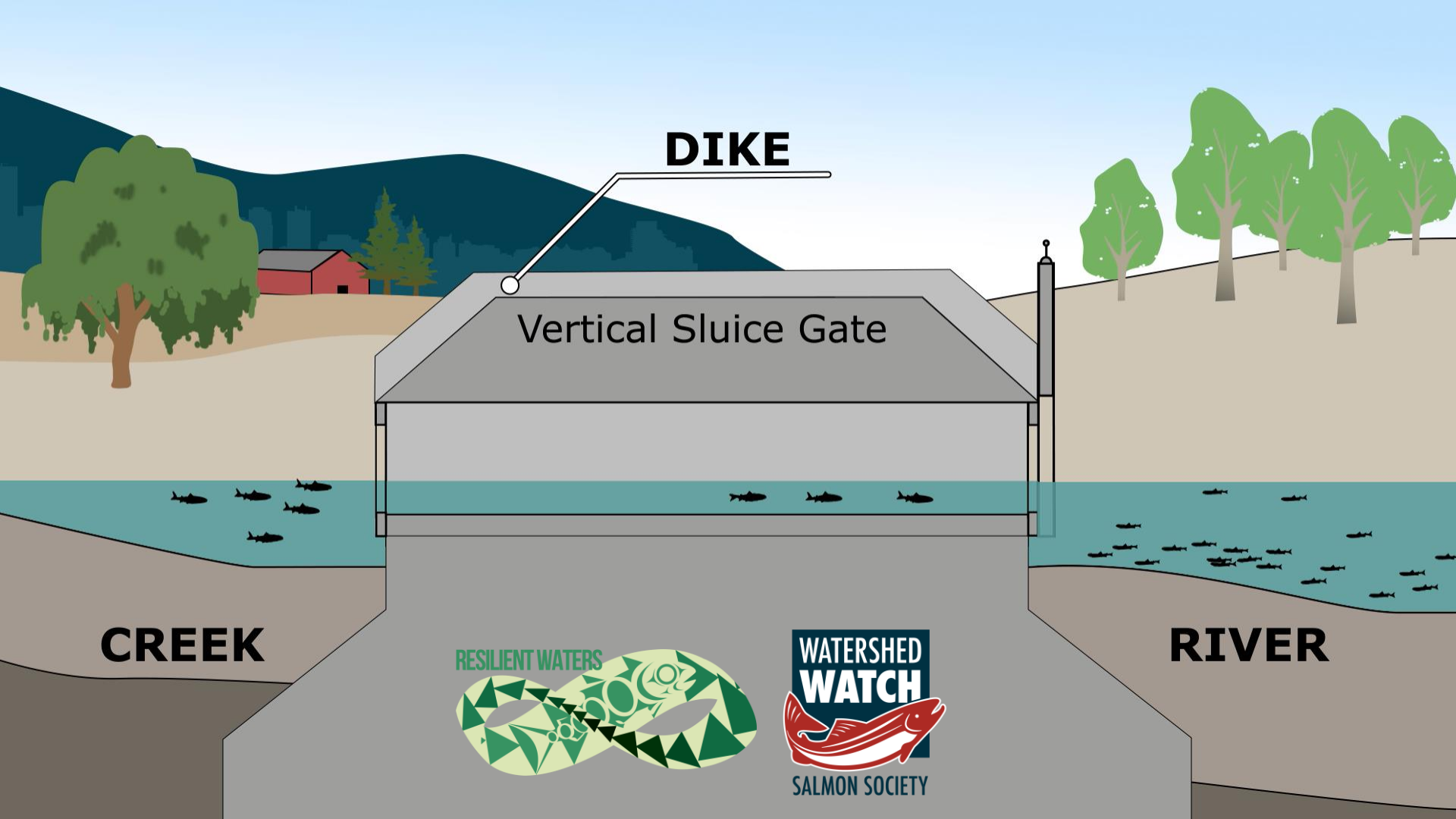
- Unable to handle projected water increase from climate change
- Collects debris and garbage
- Prevents fish access to critical overwintering habitat

**BEFORE (AERIAL VIEW):**
JOE'S LAKE, DEROCHE
FAILED TOP MOUNTED
FLOOD GATE

**THE PROBLEM:**

- Disconnected water flow creates higher water temperatures - fatal to salmon
- Restricted water flow causes decreased water quality, promoting the growth of invasive species and plant populations


DIKE
Top-Mounted Flood Gate
CREEK
RIVER
RESILIENT WATERS
WATERSHED WATCH
SALMON SOCIETY


DIKE
Vertical Sluice Gate
CREEK
RIVER
RESILIENT WATERS
WATERSHED WATCH
SALMON SOCIETY

**AFTER:**
**JOE'S LAKE, DEROCHE**
**FISH FRIENDLY**
**VERTICAL GATE**

## THE SOLUTION

- **When flood risk is high, gate closes to protect the community**
- **Reduced flood risk helps to ensure food security for the community**

**AFTER (AERIAL VIEW)**
**JOE'S LAKE, DEROCHE**
**FISH FRIENDLY**
**VERTICAL GATE**

## THE SOLUTION

- **Improved water flow and exchange prevents growth of algae and invasive plant populations**
- **Increased wetland habitat for juvenile salmon, waterfowl and ecological resilience**


DRAKE
321


770HC
LINCOLN
ELECTRIC


The
Langley
Group
1-800-667-9800
CHILLIPACK

# Joe’s Slough Floodgate Replacement Details

- Timeline ~ 4 years from funding application to construction completion
- Installed spring 2024, automated summer 2025 (solar panel / battery + controller)
- Cost = $1 million
  - $200K pre-construction (meetings, feasibility and modeling, engineering design, permitting) +
  - $800K construction – mainly cuz it involved ripping a dike apart and putting back together
  - Many dikes were constructed in late 1800’s or early 1900’s by farmers, never know what you’ll get
- Opened 5 hectares of slough habitat in high salmon value area – Coho, Chum, Chinook, potential for further future connections
- Multi-partner effort / table that has led multi-million $ funding restoration in the area
- Funded by BC Salmon Restoration Innovation Fund, Pacific Salmon Foundation, Bonneville Environment Fund

Fisheries and Oceans Canada

Pêches et Océans Canada

BRITISH COLUMBIA

PACIFIC SALMON FOUNDATION

BONNEVILLE ENVIRONMENTAL FOUNDATION

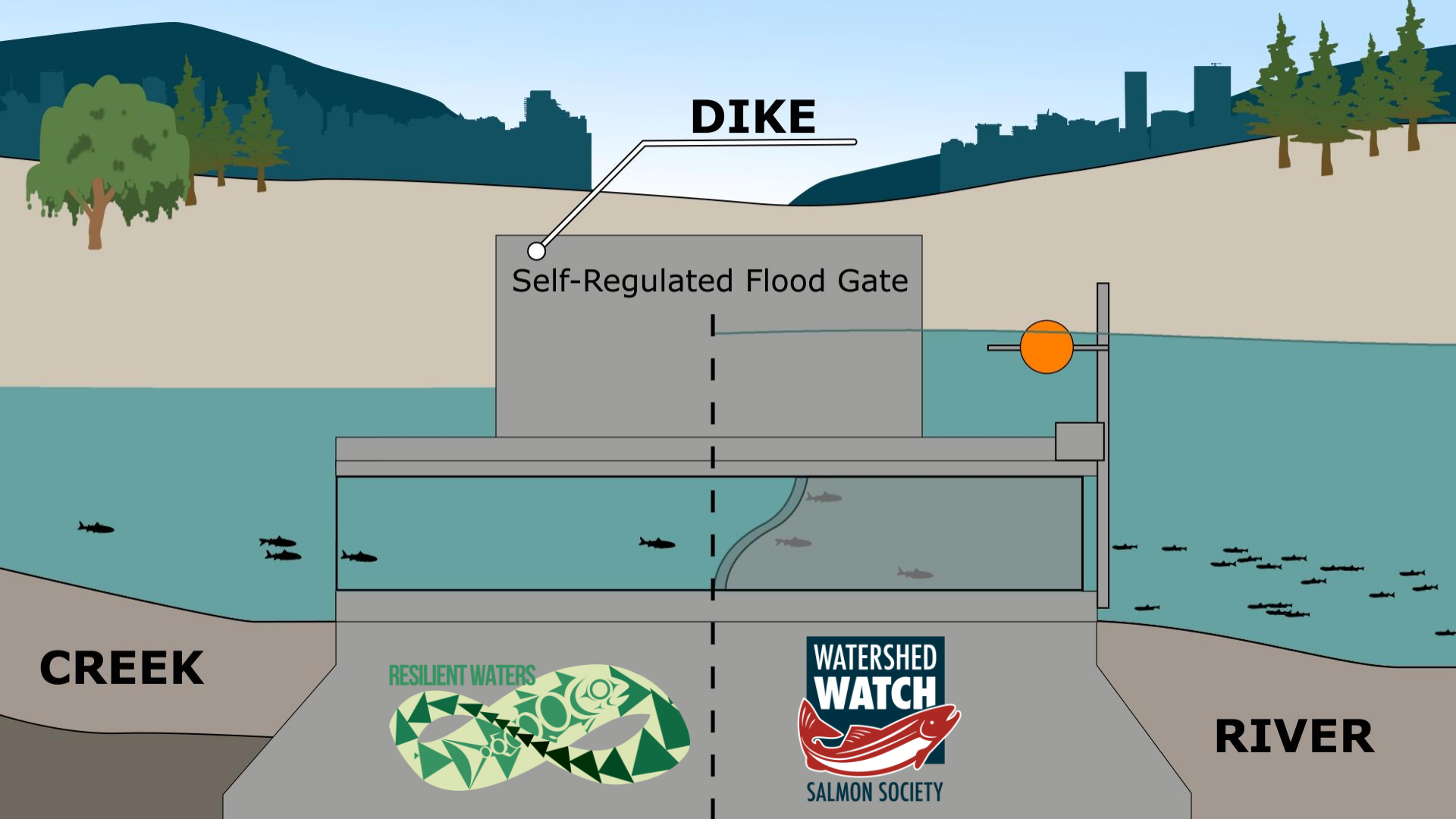
# Tidal vs. Non-tidal Scenarios

## Non-tidal

- more straight forward
- main vector of flood is freshet, once a year for sustained period (4-6 weeks)
- Solution = Vertical gate (can automate or manual close)

## Tidal

- more complex
- tides = 2x daily flood + interacting with other potential vectors of flooding (e.g. Coquitlam River) causing variable and unpredictable conditions constantly
- Solution = Self-Regulating Tidegate (SRT) which there are many options to choose from, no obvious or agreed on go to


DIKE
Self-Regulated Flood Gate
CREEK
RIVER
RESILIENT WATERS
WATERSHED WATCH
SALMON SOCIETY

# The Wild West of Self-Regulating Tide Gates

- Many different technologies and approaches
- Top-hinged, side-hinged, even vertical (not typical cuz of # of times opening and closing / day = wear)
- Water level trigger typically a float (no-power required), or sensor (power)
- Only 2 SRT's in whole Lower Mainland
  - 1 defunct Juel gate – on Musqueam Creek
  - 1 functional Golden Harvest GH-850R at Colony Farm on Coquitlam River
- See Juel Tide gates youtube channel
- Retrofits – easiest is chaining gate open. Yet to hear of an 'engineer approved' retrofit, but would be amazed to hear if one exists.

# Lessons Learned - Making Floodgate replacements happen

- Willing and interested local government and First Nation – priorities can vary, political cycles ebb and flow
- Solution needs to improve fish habitat + reduce flood risk + other benefits
- Funding programs are competitive and rarely prioritize multi-benefits, so cobbling things together (Washington's Floodplains by Design is a great exception to this rule, prioritizes multi-benefits)
- Typical full replacement = $1 million CAD start to finish (based on 2 examples)
- Regulations not well understood or enforced (not mandatory to install fish-friendlier gate solutions)
- Best Practices are not standardized, little education in the sector about doing this in a multidisciplinary way to meet fish passage and flood mitigation needs
    - Very interested to further this, reach out if you have ideas
- Many options exist and very little information easily available about each
- Balancing ongoing maintenance, operations, initial costs

# Once a floodgate is in…

- Maintenance, monitoring, responsibility
  - ensuring debris / beavers don’t impact closing and opening
  - who is checking it and when to make sure it’s working as intended - not just for floods but for fish too?

- Operations
  - if manual who is going out to close if flooding is forecasted, open when flood recedes
  - if automatic, do you have a way to know the system is working?
  - if powered can install remote system (just installed at Joe’s Lake floodgate, solar powered, controllable online)

- Might sound simple but many of these easy to overlook, especially for lower capacity governments

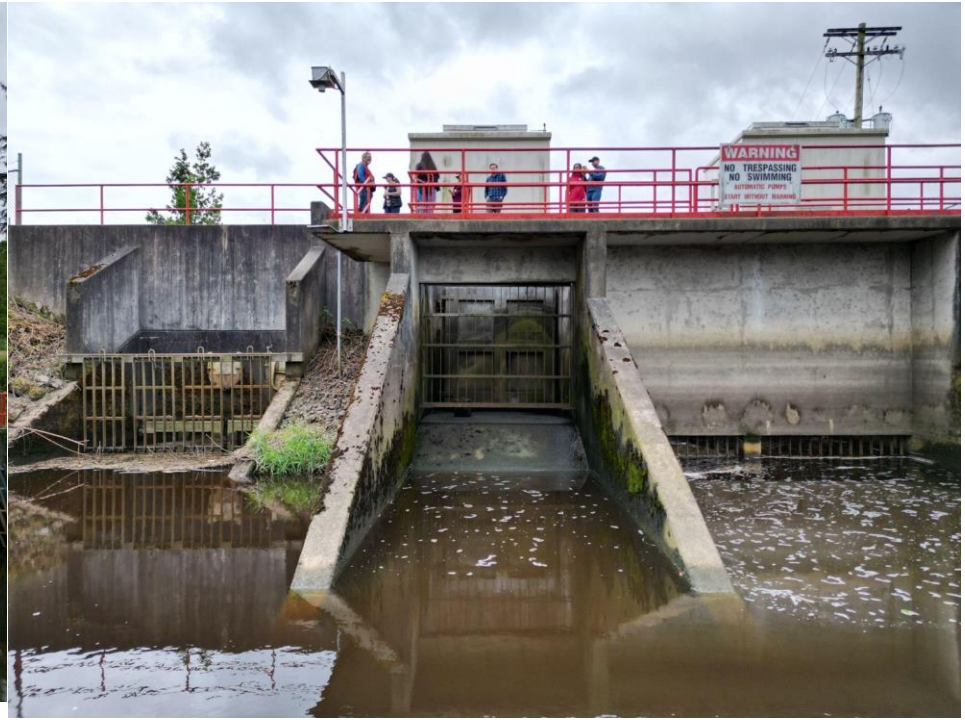
# Pumpstation Study - 2024-2027

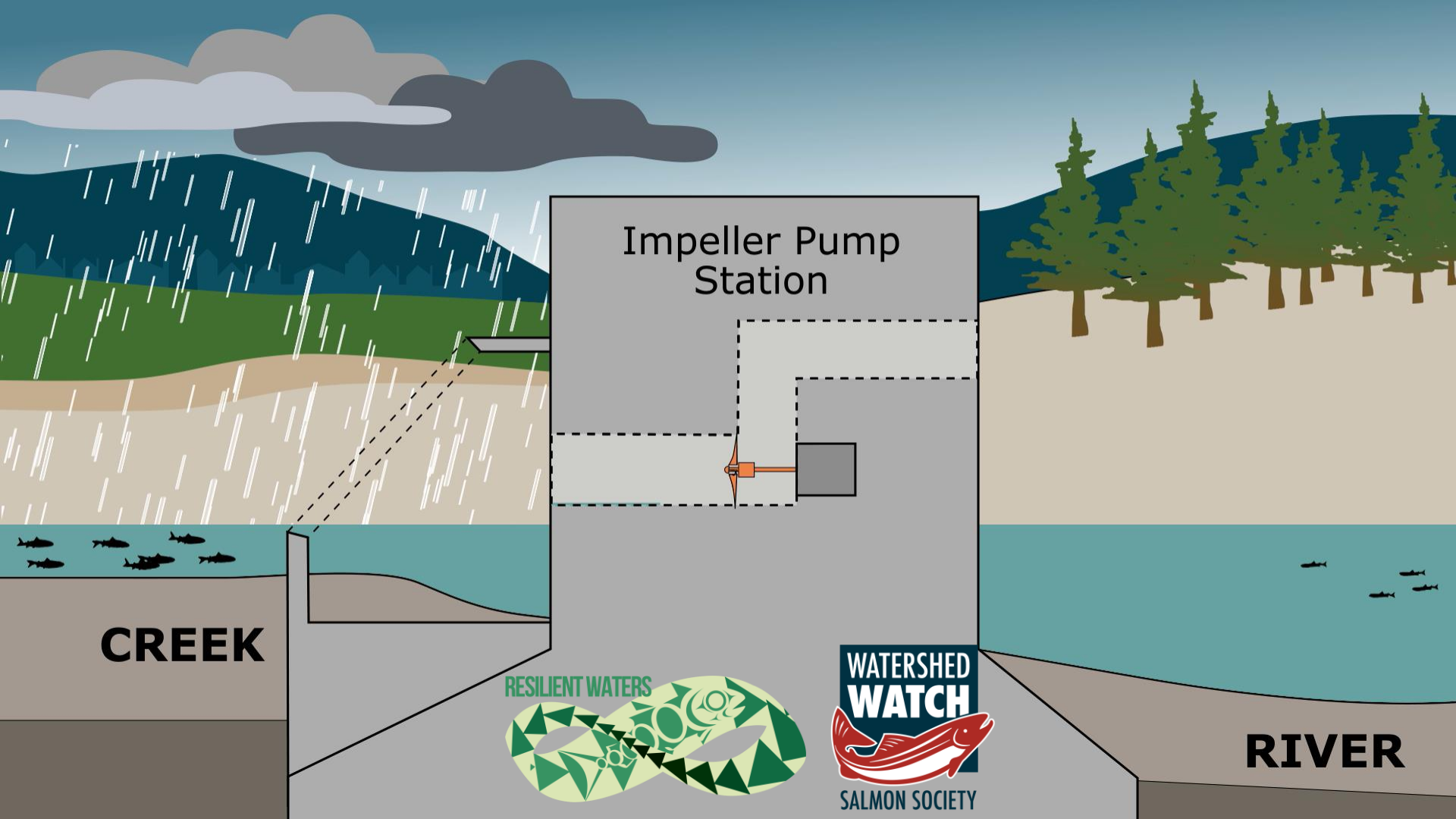
PACIFIC SALMON ECOLOGY & CONSERVATION LABORATORY

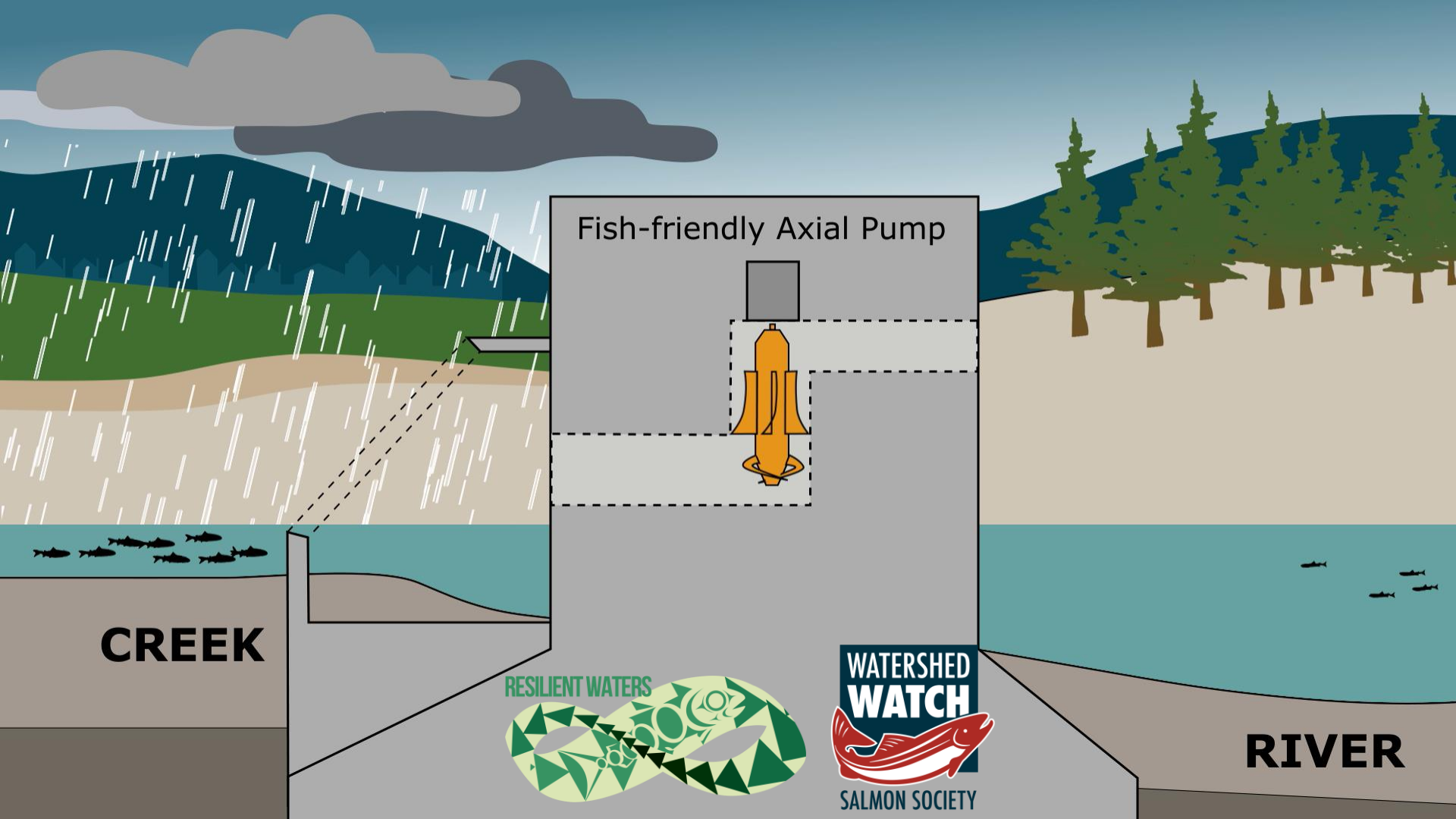
UBC

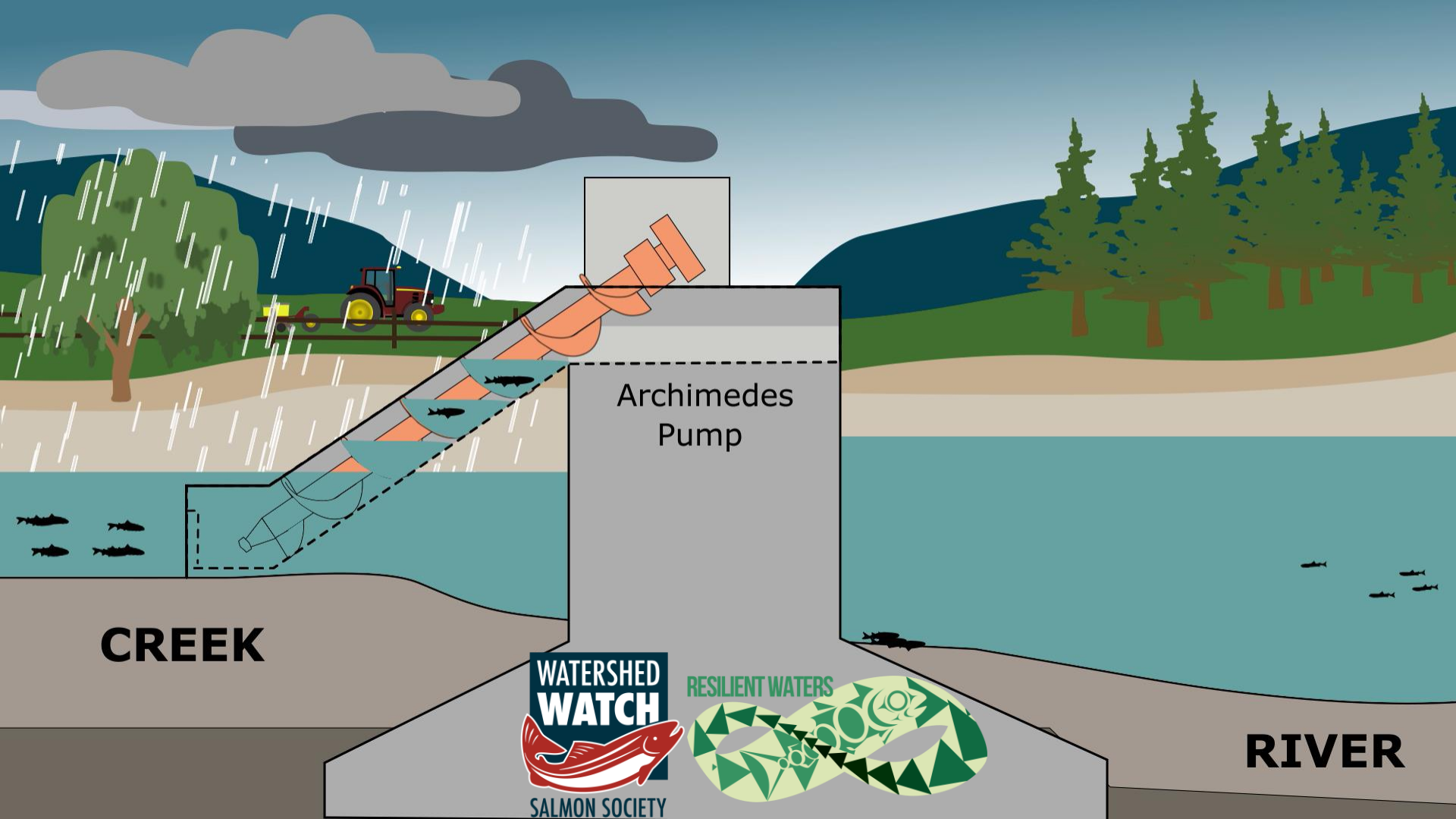
Fisheries and Oceans Canada

Pêches et Océans Canada


Impeller Pump Station
CREEK
RIVER
RESILIENT WATERS
WATERSHED WATCH
SALMON SOCIETY

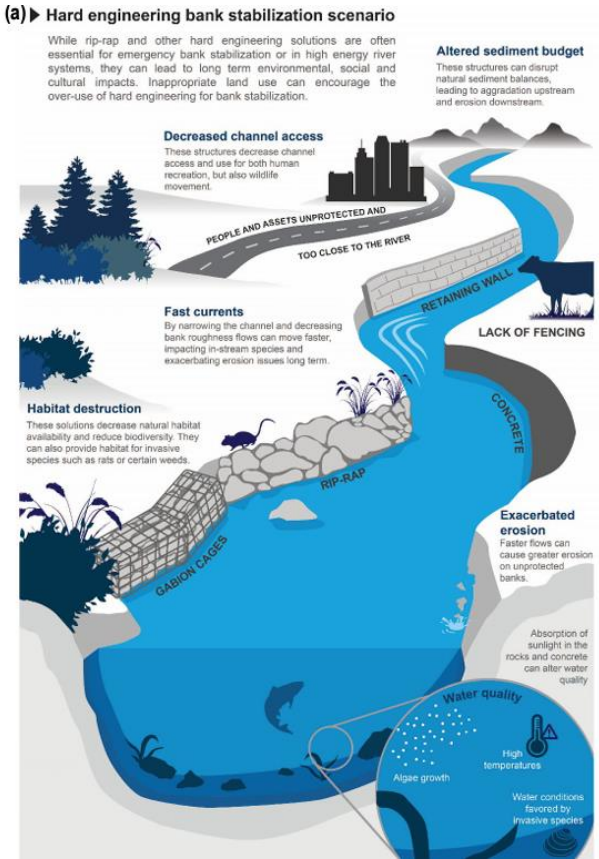

Fish-friendly Axial Pump
CREEK
RIVER
RESILIENT WATERS
WATERSHED WATCH
SALMON SOCIETY


Archimedes
Pump
CREEK
RIVER
WATERSHED
WATCH
SALMON SOCIETY
RESILIENT WATERS

HOW WE'RE DOING IT

# Advancing Best Practices

- Online Workshops and Webinars - Local and international experts
- Examples:
  - Bank Stabilization- NBS approaches (2024)
  - Farming Practices for Flood Resilience (2024)
  - Integrated Floodplain Management (2021)




# Lower Fraser Floodplains Coalition

EMERGENCY PLANNING SECRETARIAT
EPS
YO:YES SQ'EQ'O • WORKING TOGETHER

RESILIENT WATERS

ebbwater CONSULTING

kwl
KERR WOOD LEIDAL
consulting engineers

WATERSHED WATCH
SALMON SOCIETY

THE UNIVERSITY OF BRITISH COLUMBIA
School of Architecture
+ Landscape Architecture

WEST COAST
Environmental Law


# Thanks

A project of MakeWay

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