Habitat Modelling for Prioritization of Culvert /Fish Passage Remediation

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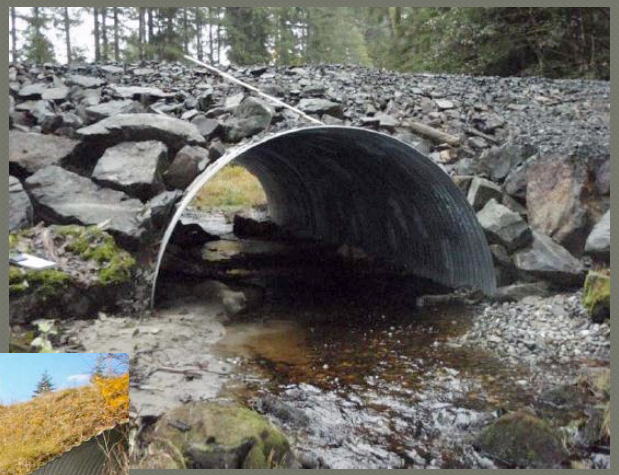
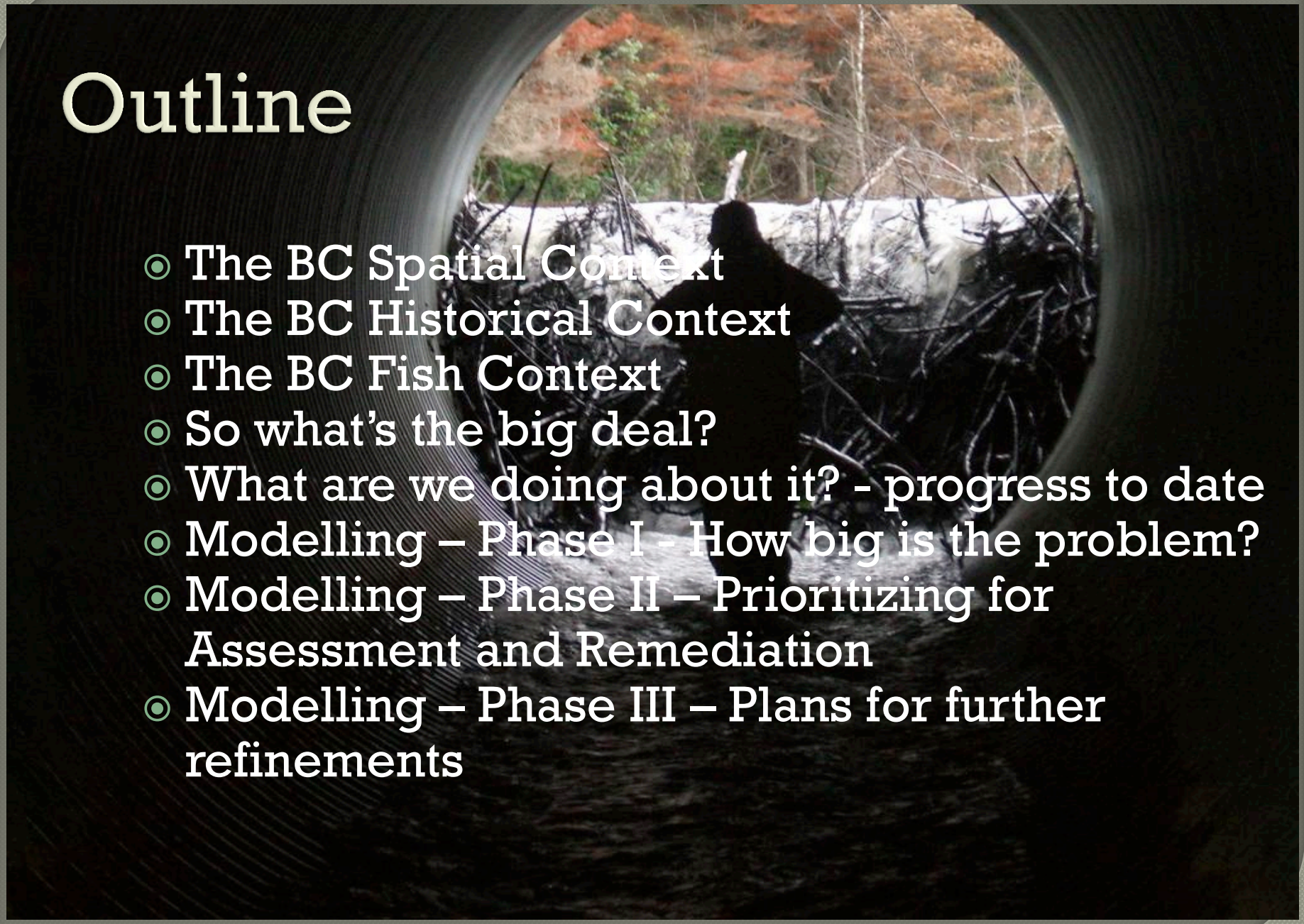


Q: Why did the fish cross the road?

Outline

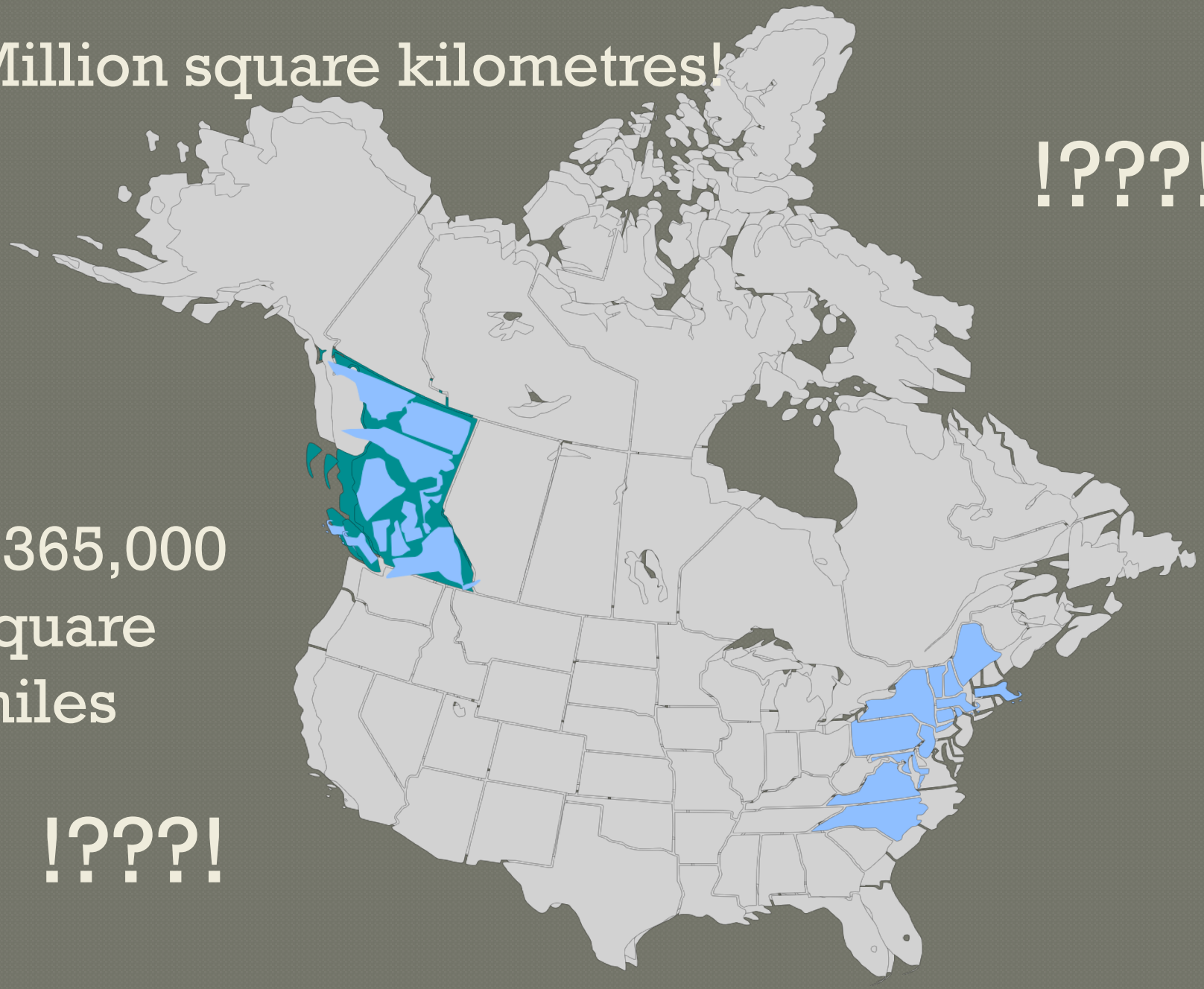


- The BC Spatial Context
- The BC Historical Context
- The BC Fish Context
- So what's the big deal?
- What are we doing about it? - progress to date
- Modelling – Phase I - How big is the problem?
- Modelling – Phase II – Prioritizing for Assessment and Remediation
- Modelling – Phase III – Plans for further refinements

BC in the Global / NA Context

1 Million square kilometres!

!???!

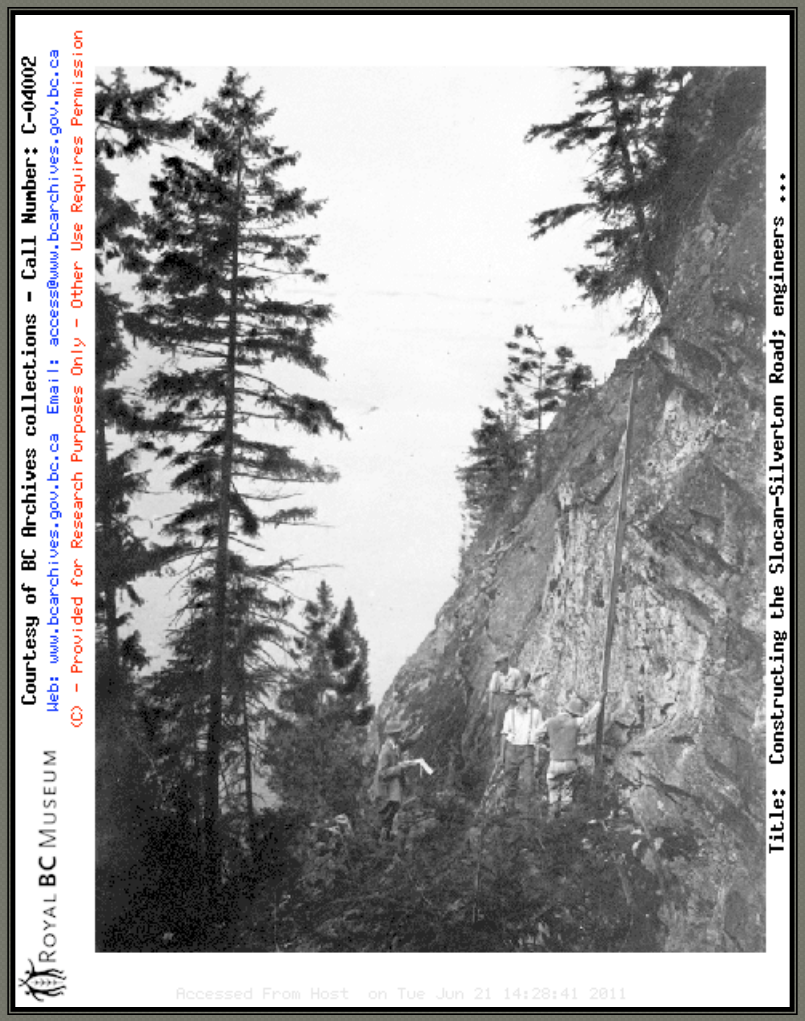


=365,000 square miles

!???!

BC Historical Context

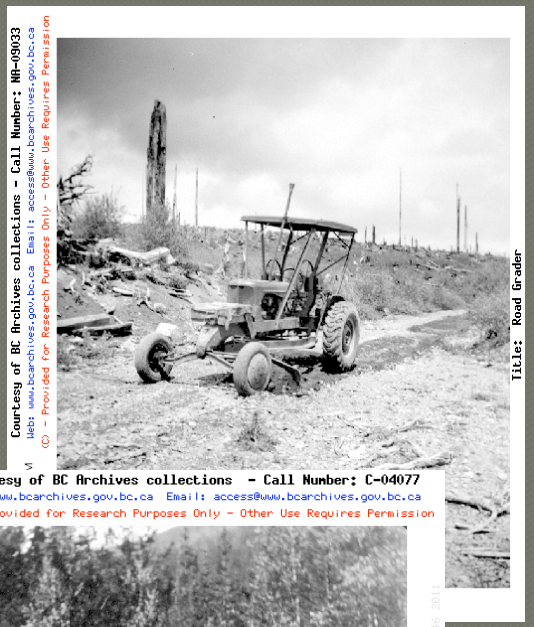
- 100 + year history of resource extraction
- Mostly logging but shifting to more mining and oil & gas
- Many different types of resource 'corridors'
- Just dealing with logging roads so far



Turn of the Century Road Building

- We still have roads that have been around since those days
- Road building standards have changed
- Massive legacy of over 550,000km (350,000 miles) of roads (some maintained, some not) left on the landscape

BC Road Construction – 1950s



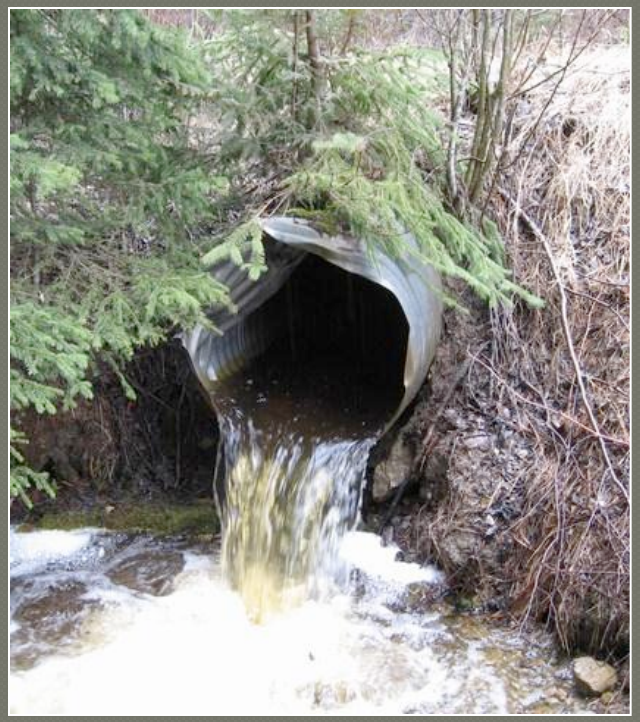
The BC Fish Perspective

- Over two dozen game fish in BC – over half of which are either anadramous or have a significant migratory component to their life cycle - not least of which are the 5 different species of Salmon:
  Chinook, Chum, Coho, Pink, Sockeye

- Fish Passage associated with closed bottom structures (e.g.. corrugated metal pipes) has long been an identified problem in British Columbia

- 1977 report to a Federal Provincial committee on Fishways and stream crossings. :
  - *"Poor culvert design and location can be ranked among the most devastating fish constraints to be found in the Province."*
  - *"Until adequate corrective measures are taken, fish populations will continue to be detrimentally affected, and the province will be burdened with the difficult task of replacing dwindling numbers of fish stocks."*

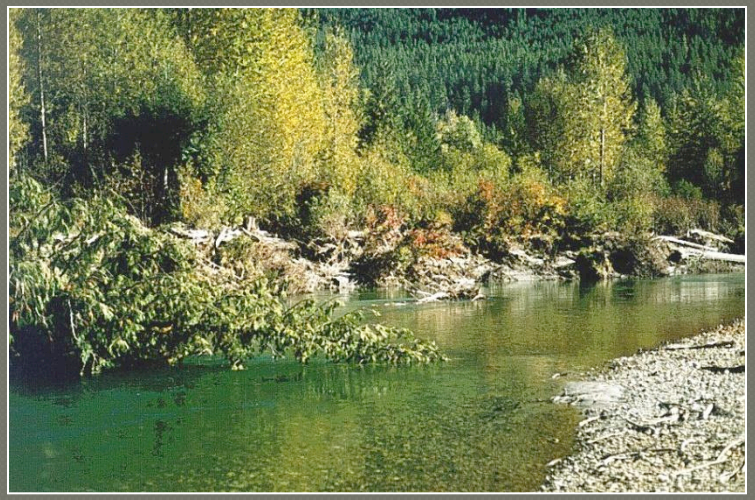
The BC Fish Perspective – con't



- Recent assessments completed in a variety of high value fisheries watersheds in BC have confirmed that this is still a major problem
- These assessments have found that up to 90% of the closed bottom culverts assessed failed to meet one or more of the fish passage criteria.
- BC's Coastal Cutthroat Recovery team has recently indicated that fish passage is one of the greatest concerns related to recovery of coastal cutthroat stocks.

So what's the problem?

Access to suitable habitat - spawning



High water refuge and overwintering habitat

Juvenile out-migration

What are we doing about it?

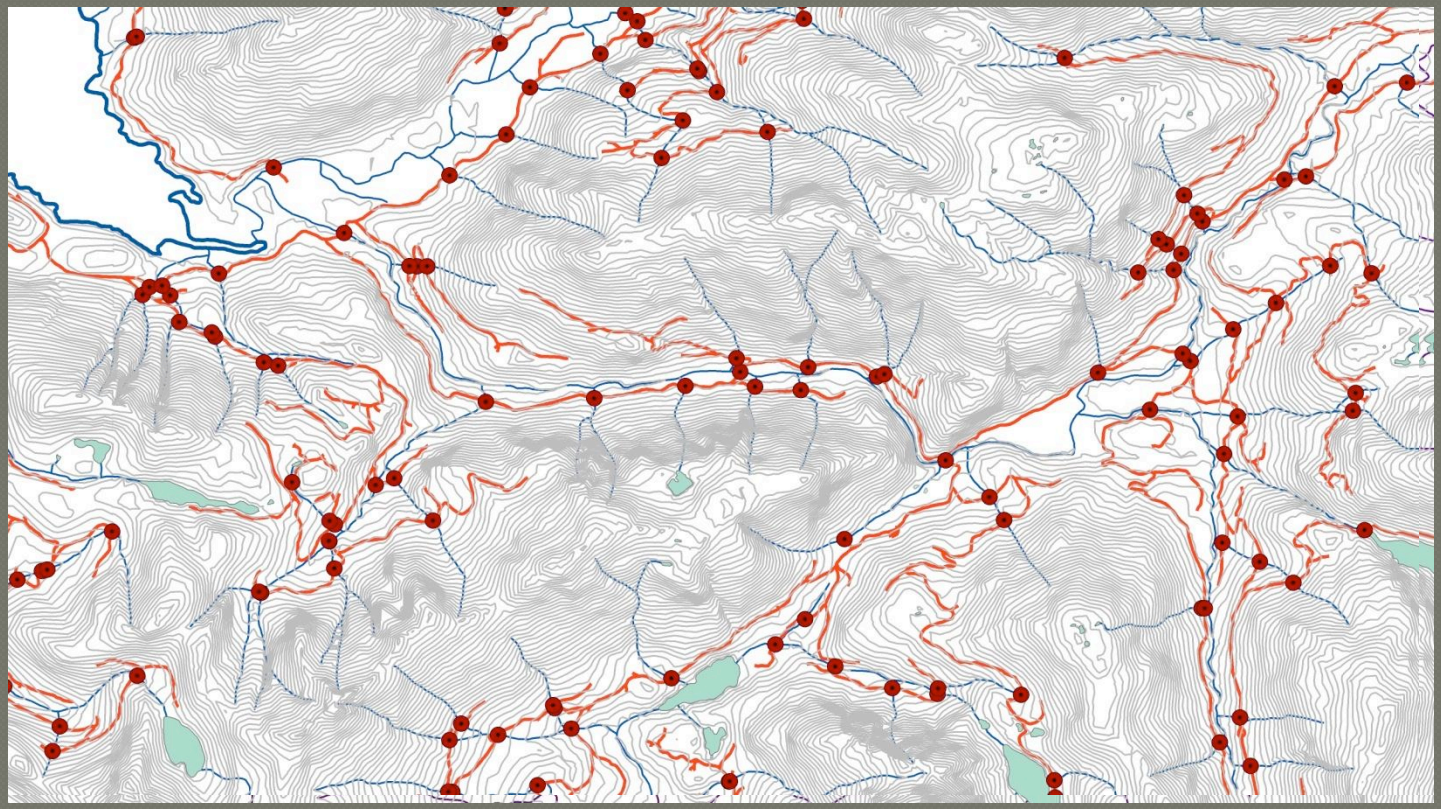
- Technical Working Group:
  - Ministry of Forests
  - Environment
  - Fisheries and Oceans
- Training
- Effectiveness Evaluation
- GIS Modelling
- One of the major categories of targeted funds
- Over $14 Million spent on Assessments and Remediation in the past 3 years

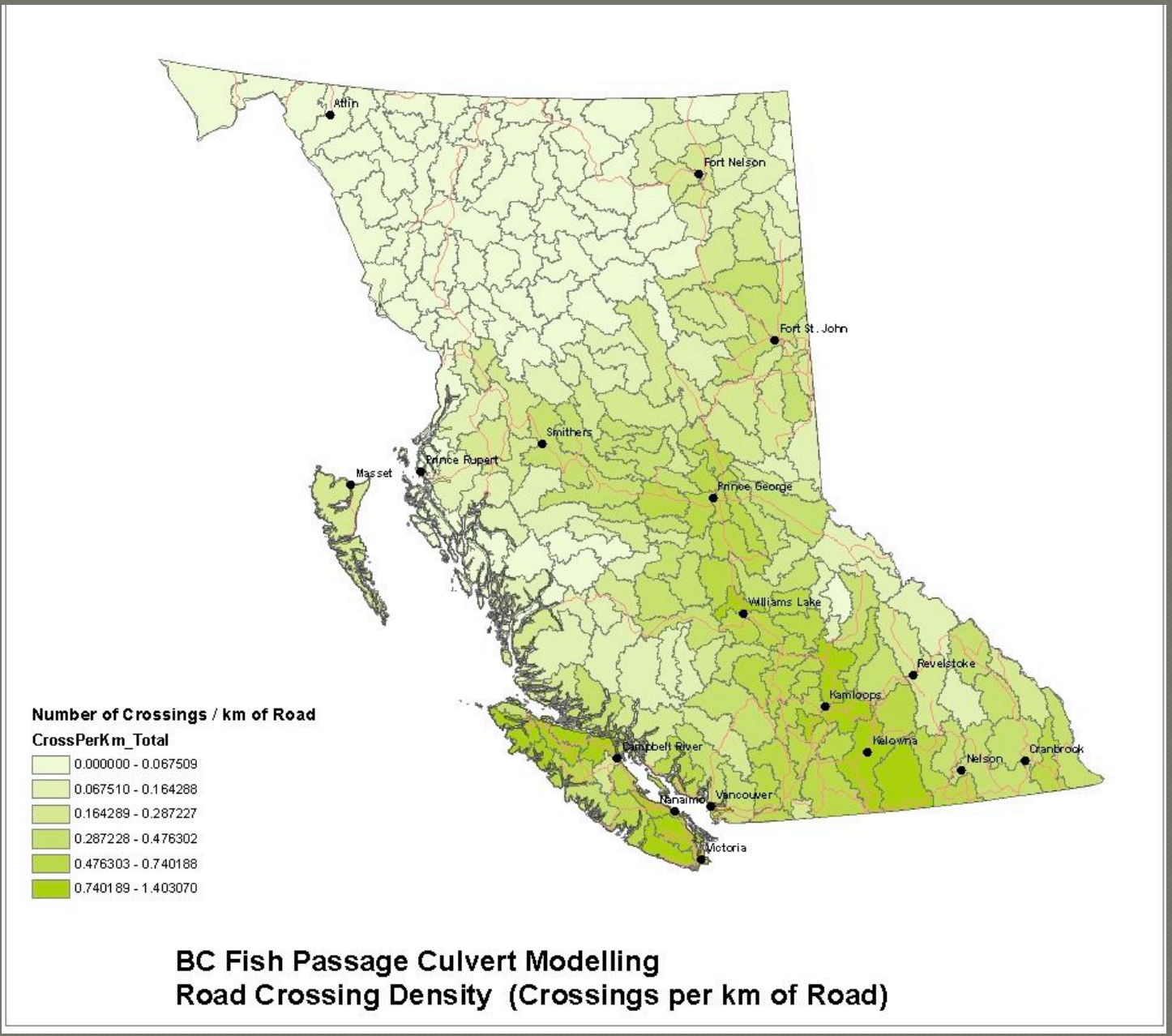
Modelling – Phase I
How big is the problem?

- Take advantage of the new Freshwater Atlas
- A topologically enabled, hierarchical GIS layer which utilizes the 1:20,000 stream linework
- Added functionality now allows for:
  - Network analysis
  - Flow analysis

Modelling – Phase I
How big is the problem?

- Single-line streams =1.9 Million km
- Three different roads layers
- Streams x Roads = LOTS of crossings, 435,000 crossings!

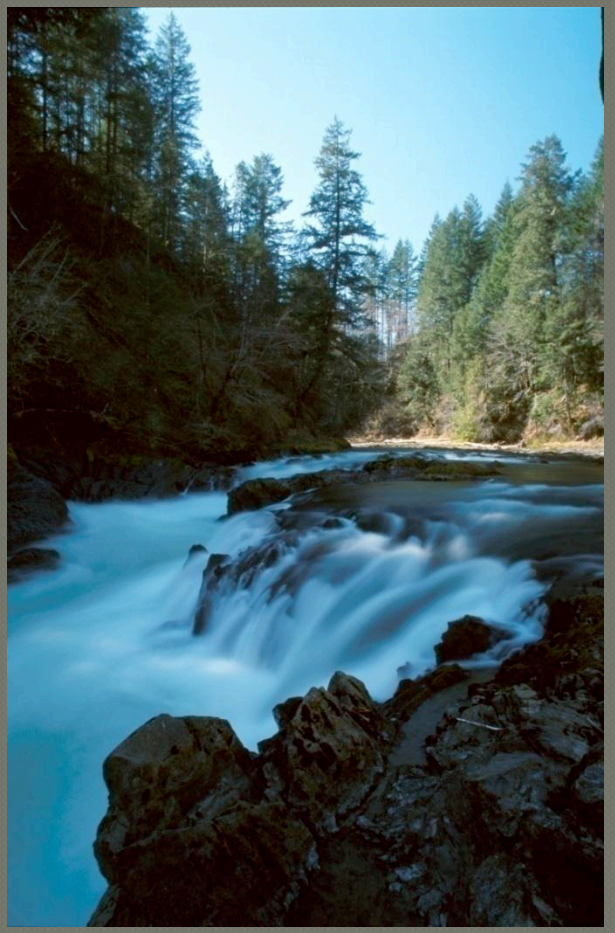




BC Fish Passage Culvert Modelling
Road Crossing Density (Crossings per km of Road)

How de we refine this?

- How many of these crossings are on fish streams?
- No comprehensive mapping of potential fish habitat for the entire province
- Freshwater Atlas allows us to attempt this for the first time

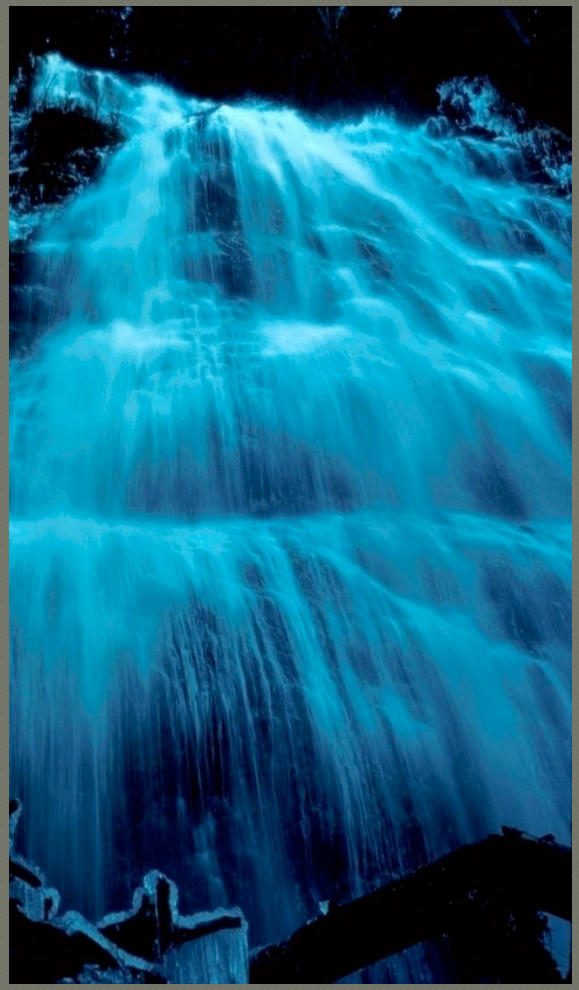


Potential Fish Habitat Model - Logic

- Stepped logic
- Use fish observations layer first – assume everything downstream of a fish observation is fish habitat – 160,000 observations
- Call this *observed* fish habitat

Potential Fish Habitat Model - Logic (continued)

- Then turn 180° and move upstream
- Assume fish habitat until otherwise indicated:
  - Obstruction
  - Gradient
- We use the obstructions and obstacles layers
  - Waterfalls
  - Dams
- The section of stream upstream of observed habitat but below a barrier is called *inferred* fish habitat



Potential Fish Habitat Model - Gradient Breaking Method

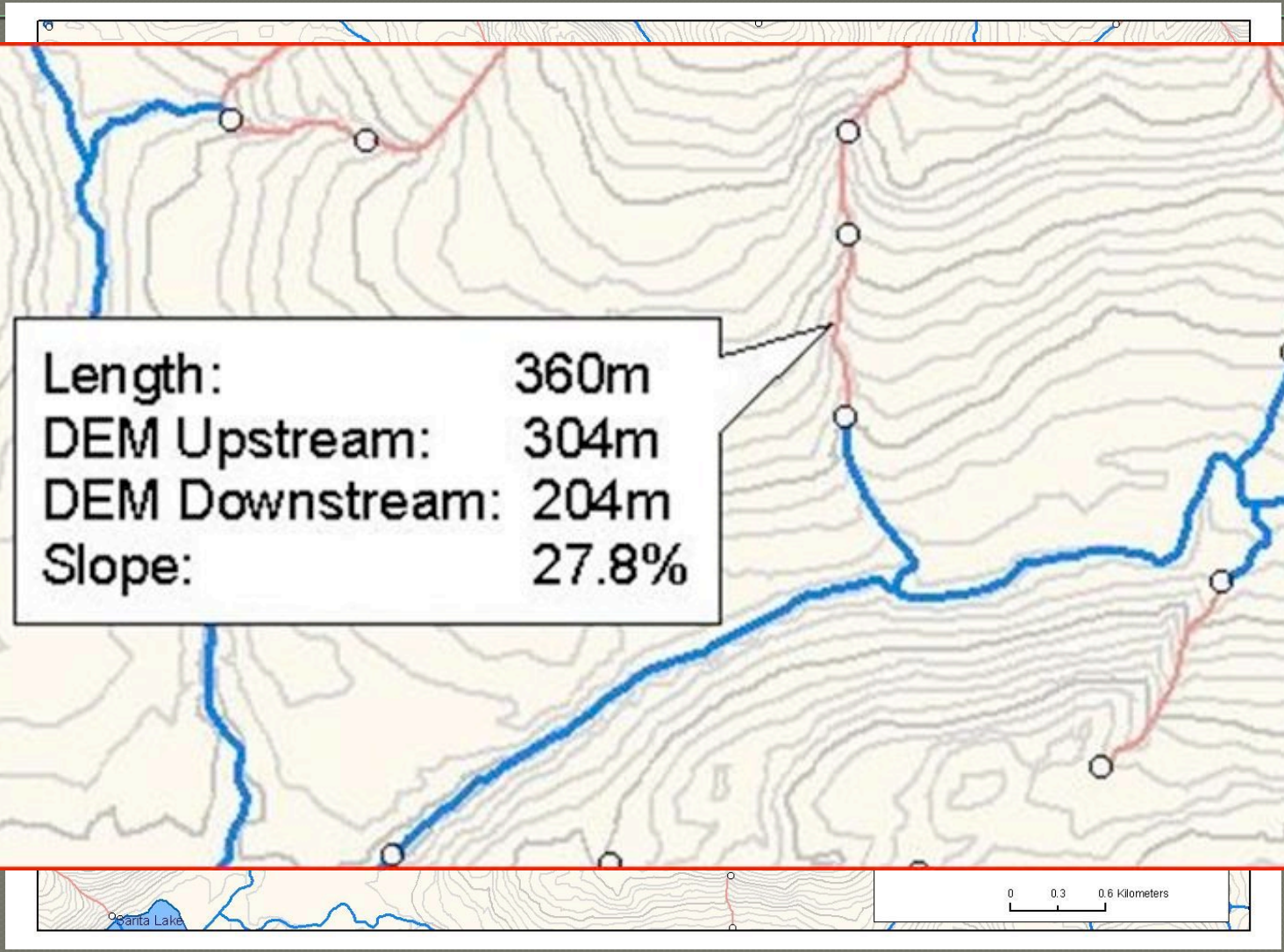
- Have to define our gradient threshold
- Have used 25% for our first round
- The challenge is to figure out where a stream becomes too steep for a sustained period to allow fish passage
- Utilize the contours and DEM to determine this

Potential Fish Habitat Model - Gradient Breaking Method

- Break each stream into segments - defined by contour crossing points
- Create a gradient breakpoint where the difference in length between 2 adjacent segments is greater than 2x the standard deviation of all the segments in that stream
- Determine gradient of each gradient segment using DEM elevations and length of segment


Non Fish Habitat
Inferred Fish Habitat
Observed Fish Habitat
15%
28%
12%
Q
P
O
N
M
L
K
J
I
H
G
F
E
D
C
B
A
Known Fish Observation
Δ sE.sF > Stn Dev A→Q
∴ establish a gradient break.
Then calculate slope for each gradient segment

Potential Fish Habitat Model

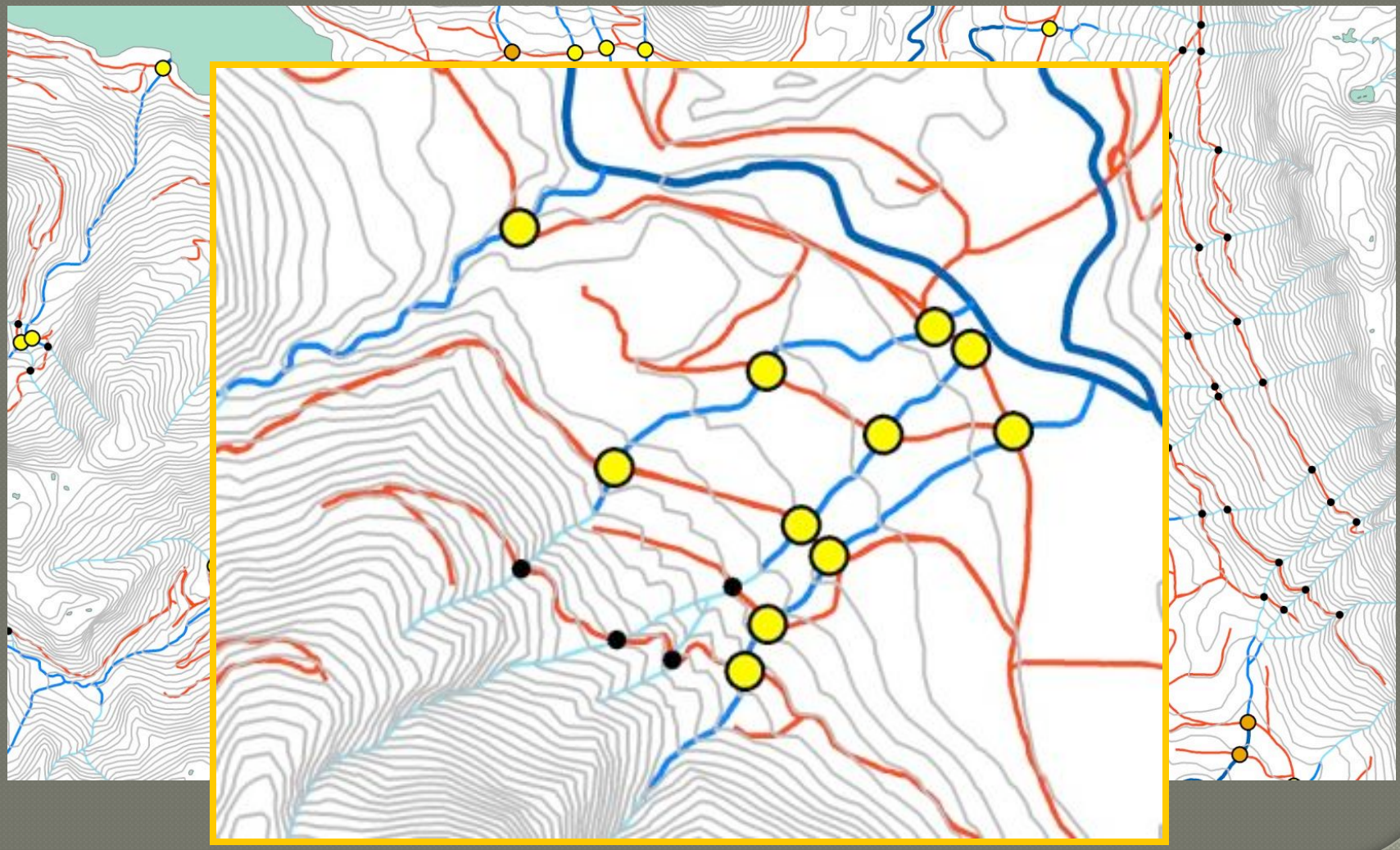


Interim Results

- Number of crossings = 435,000
- Number of crossings on modelled fish habitat = 313,000
- % of Closed bottom structures varies from watershed to watershed

- Anywhere from 40 to 90% will be closed bottom
- These need to be assessed in the field to see if they pass fish
- We have seen failure rates between 30 – 90%

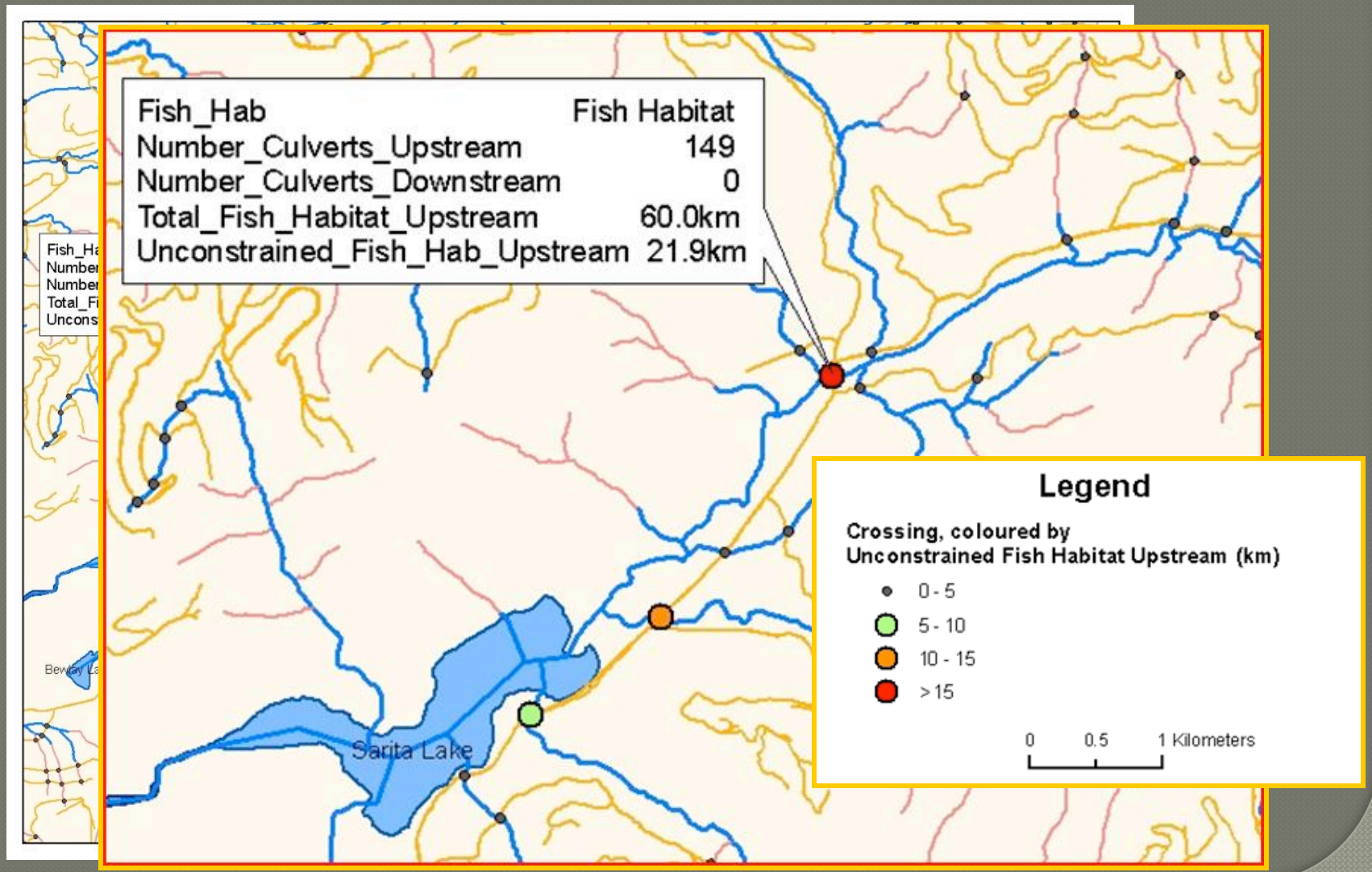
Modelling – Phase II - Prioritizing for Assessment and Remediation

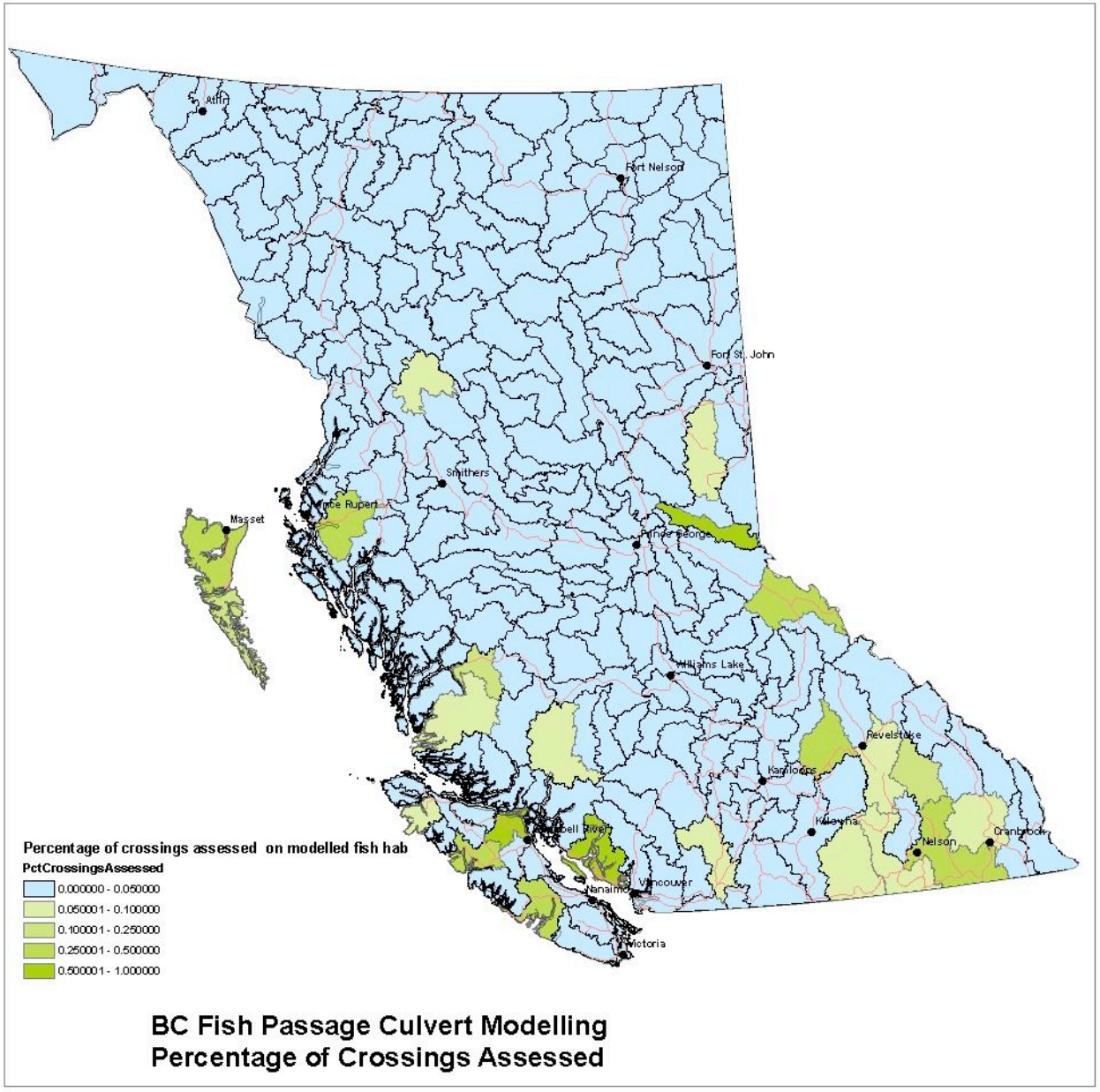


Modelling – Phase II - Prioritizing for Assessment and Remediation

- Calculate amount of habitat upstream of each culvert
- Calculate number of culverts downstream and upstream of each culvert
- Allows us to calculate the best potential 'Bang for Buck' for each watershed
- This guides efforts for both assessment and remediation work

Estimating Potential Upstream Habitat




Atlin
Fort Nelson
Fort St. John
Smithers
Prince Rupert
Masset
Prince George
Williams Lake
Revelstoke
Kamloops
Kelowna
Nelson
Cranbrook
Campbell River
Nanaimo
Vancouver
Victoria
Percentage of crossings assessed on modelled fish hab
PctCrossingsAssessed
0.000000 - 0.050000
0.050001 - 0.100000
0.100001 - 0.250000
0.250001 - 0.500000
0.500001 - 1.000000
BC Fish Passage Culvert Modelling
Percentage of Crossings Assessed
June, 2011

Modelling – Phase III
Plans for further refinements

- Can alter the gradient we use based on specific species of interest
- Can better estimate volume of habitat by including stream widths and lakes and wetlands
- At present it is a strictly linear measure
- Will begin to feed the assessment results into the GIS and be able to refine our modelling based on reality

Start moving from this

To this

Acknowledgements


Questions??