# Climate Change Adaptation Opportunities through Infrastructure Upgrades

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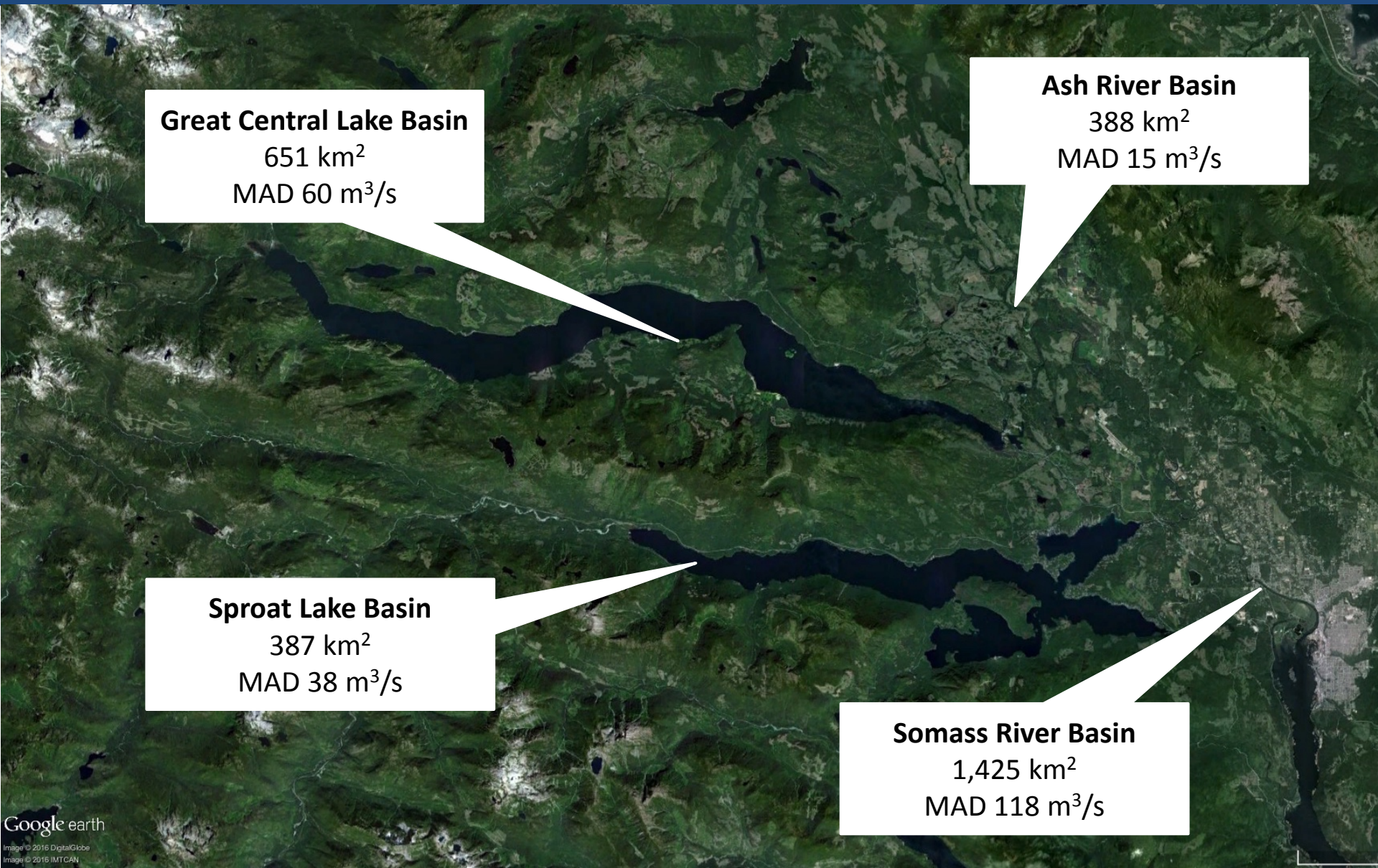
# Presentation Outline

- Existing and legacy water management infrastructure pose problems and opportunities.
- Dams and other water management facilities must transition from traditional flow-based principles to climate-adaptive schemes.
- This presentation highlights the issues and opportunities within the Somass Watershed on Vancouver Island, BC.

# Watershed Context and Impacts



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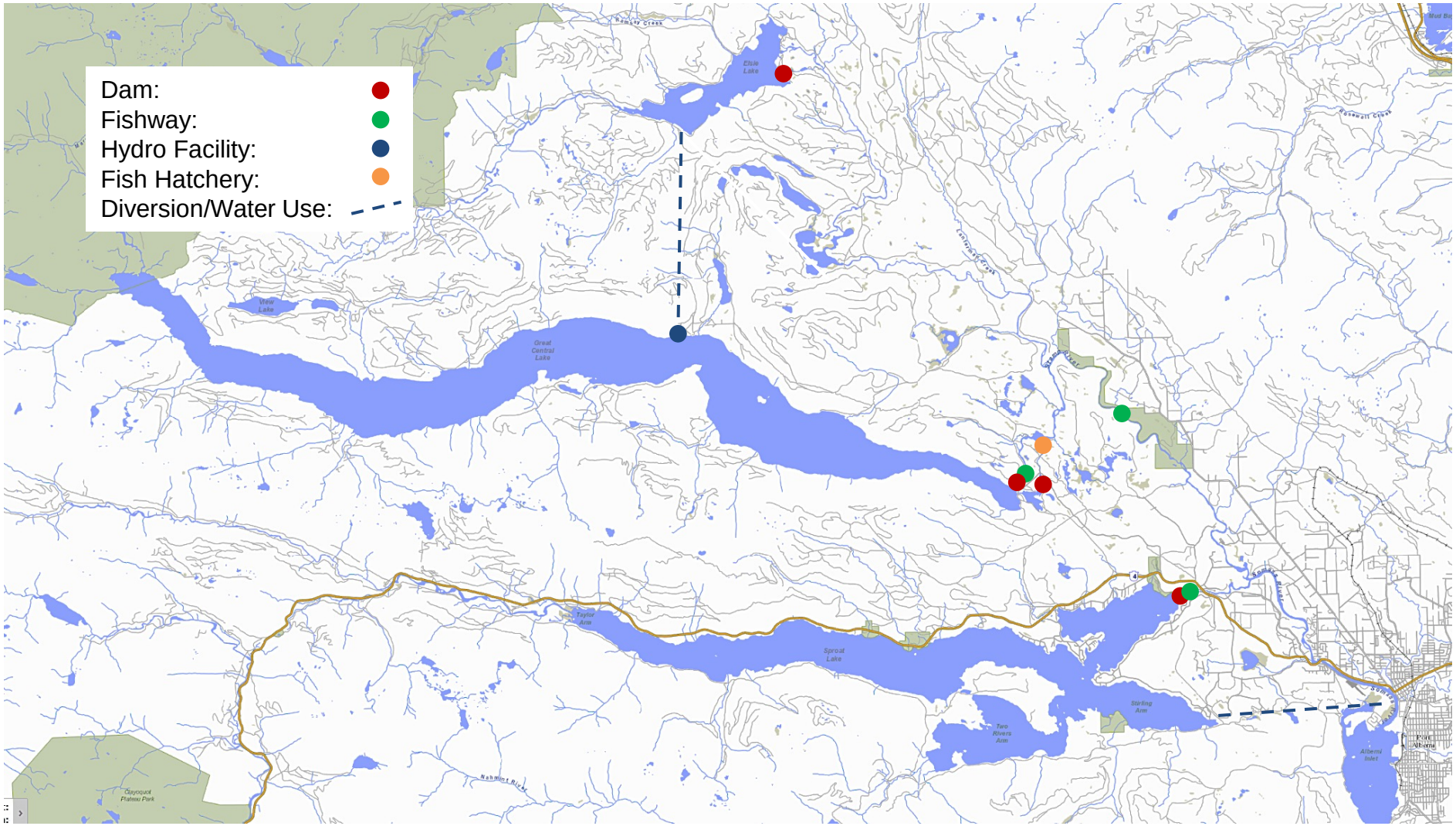
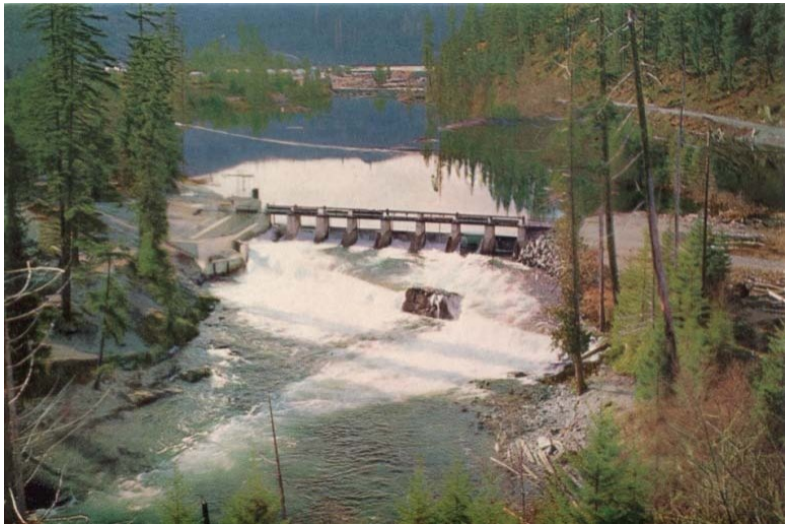


# Great Central Dam: historical storage project

- Original storage to augment minimum flows for pulp mill effluent dilution
- 98 $Mm^3$ storage is used for:
  - improve summer base flows
  - Flood protection and gravity surface flow for DFO hatchery
  - Pulse flows assist upstream salmon migration
- Owned by Catalyst Papers



# Robertson Creek Saddle Dam: upgrades and issues

- Wood crib dam built in 1957 when GCL dam raised
- Outlet gate and piping provides gravity water supply for DFO Robertson Creek facility
- Replaced in 2011 by Catalyst Paper for $1.7 M due to dam safety concerns

# Sproat Lake Weir: an almost natural lake system

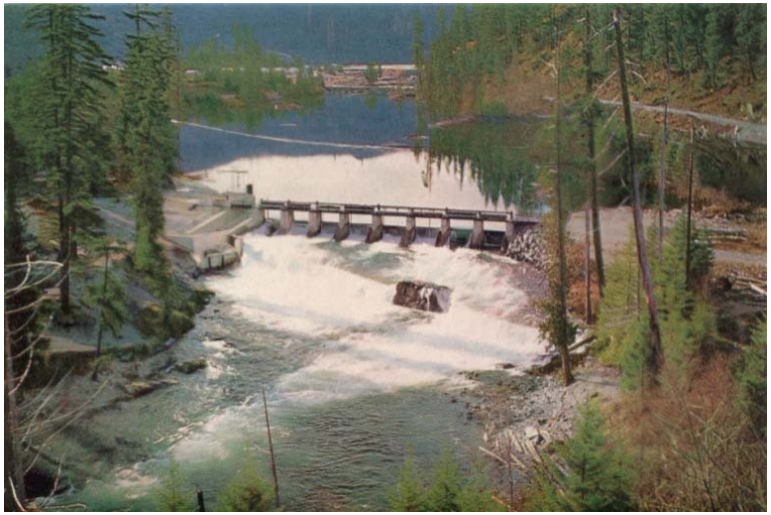
- Owned and operated by Catalyst Paper
- no regulation or minimum flow
- Maintains lake levels for mill water supply pipeline
- low flow slot operated in 2015
- frequent high river temperatures due to large lake area and small summer outflows

# Fisheries Infrastructure: values in the watershed

- Robertson Creek Hatchery: major Chinook, Coho and Steelhead production facility operated by DFO
- Stamp Falls Fishway: natural falls on the Stamp River
- Sproat Falls Fishway: natural falls below the weir
- Sproat Lake: community water supply
- Great Central Lake: current and future water source


# Somass Watershed: fish production powerhouse

- Large headwater lakes system in Great Central and Sproat Lake provide Sockeye spawning and rearing habitat
- Third largest salmon river in BC supporting major fisheries
- Impacted by five significant climate events since 1990
- migration delays and die-off of Sockeye in-river and estuary



# Somass Watershed: Climate Impacts

- Watershed partners responded to migration delays and sockeye mortalities with monitoring, closures and adaptive management of flow and fish
- Are conditions a glimpse at the future climate normal for the Alberni Valley?


Catalyst

hupačasath

Fisheries and Oceans Canada

Pêches et Océans Canada

ALBERNI-CLAYOQUOT REGIONAL DISTRICT

City of Port Alberni

BRITISH COLUMBIA
The Best Place on Earth

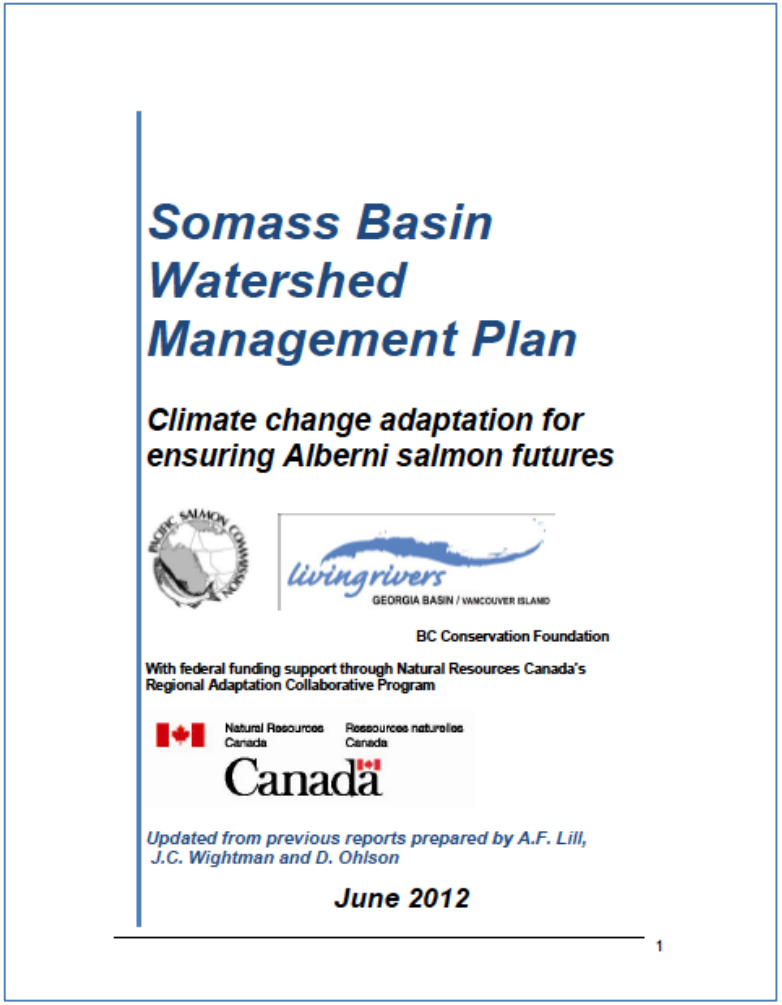
BRITISH COLUMBIA CONSERVATION FOUNDATION

Living rivers
GEORGIA BASIN
VANCOUVER ISLAND

# Somass Climate Change Adaptation Infrastructure

- Overall rationale for investment and planning outlined in report on climate change adaptation developed through and summarized with NRCAN funding in 2012

http://www.fraserbasin.bc.ca/_Library/CCAQ_BCRAC/bcrac_somass_watershed_plan_2d.pdf



# Somass Climate Change Adaptation Infrastructure

**Hypothesis**:
Episodic and potentially predictable high river temperature events, coupled with poor water quality in Alberni Inlet, have led to massive losses of sockeye that are a precursor to a future climate normal for Barkley Sound and Central Vancouver Island.

**Climate Risk Reduction Objectives:**

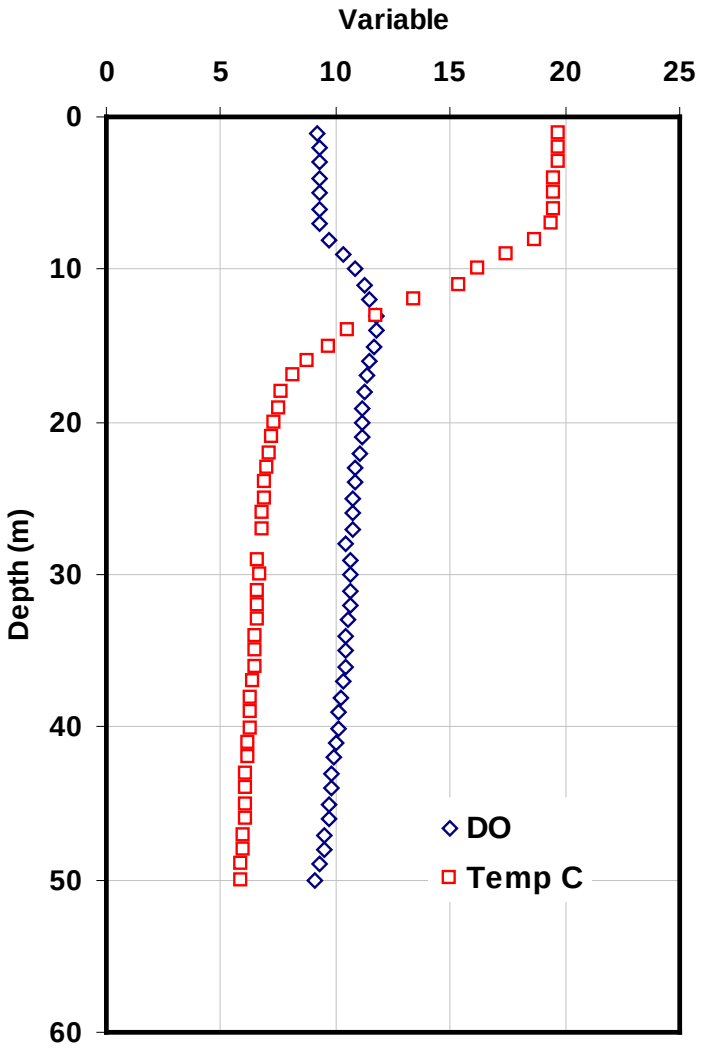
1. Improve in-river flow and new temperature control capabilities to mitigate die-off and migration delays
2. Improve Sockeye salmon upstream passage at points where delay and stress increase -> fishways
3. Improve water quality and habitat conditions for holding and rearing salmonids -> estuary

# Somass Climate Change Adaptation Infrastructure

- Undertook a review of dam operations and alternatives to stabilize flows and lake elevations (2003-2005)
- Developed an operational hydrologic/water balance model for the existing dam to aid operational planning (2007-2008)
- In 2009-2010, scoping and overview assessment of potential water temperature mitigation and low-head hydro potential

# Coldwater in Sproat Lake and GCL

- Cold isothermal water lies below the thermocline in GCL and Sproat Lakes
- Strong thermal stratification occurs May through late October every year
- Lakes destratify and are isothermal every winter

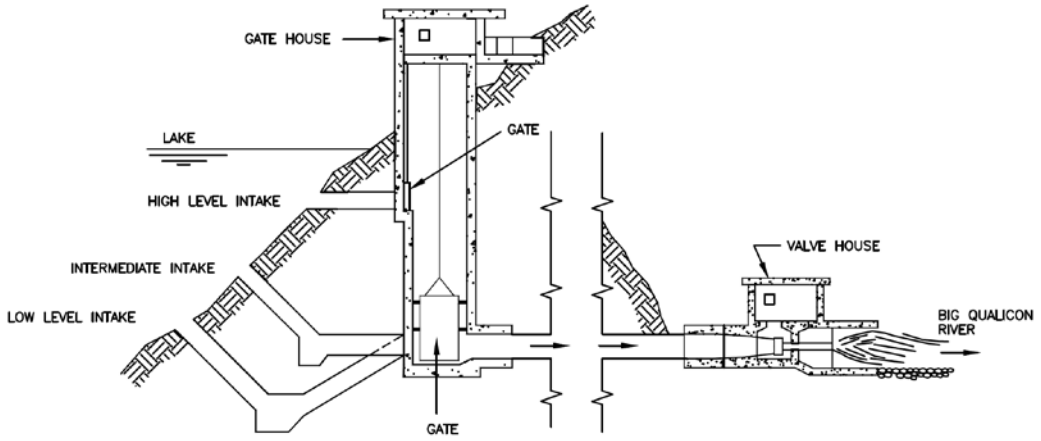


# Conceptual Temperature Mitigation Alternatives

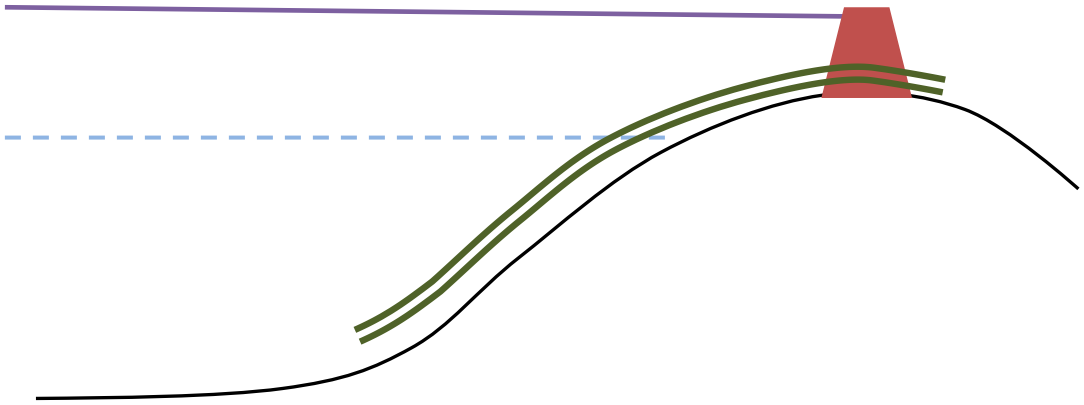
A. **Supply between 2-10 $m^3/s$ of water from depth out of Great Central and/or Sproat Lakes:**
   - "Push" coldwater out of lake with dam
   - Pump or siphon coldwater from lake bottom
B. **Reduce Stamp River temperatures at multiple locations:**
   - Augment groundwater inputs
   - Increase shading to reduce solar inputs
   - Release cold water above at multiple locations.

# Potential Cold Water Release Facility

**Typical Low-level Outlet in a Dam**



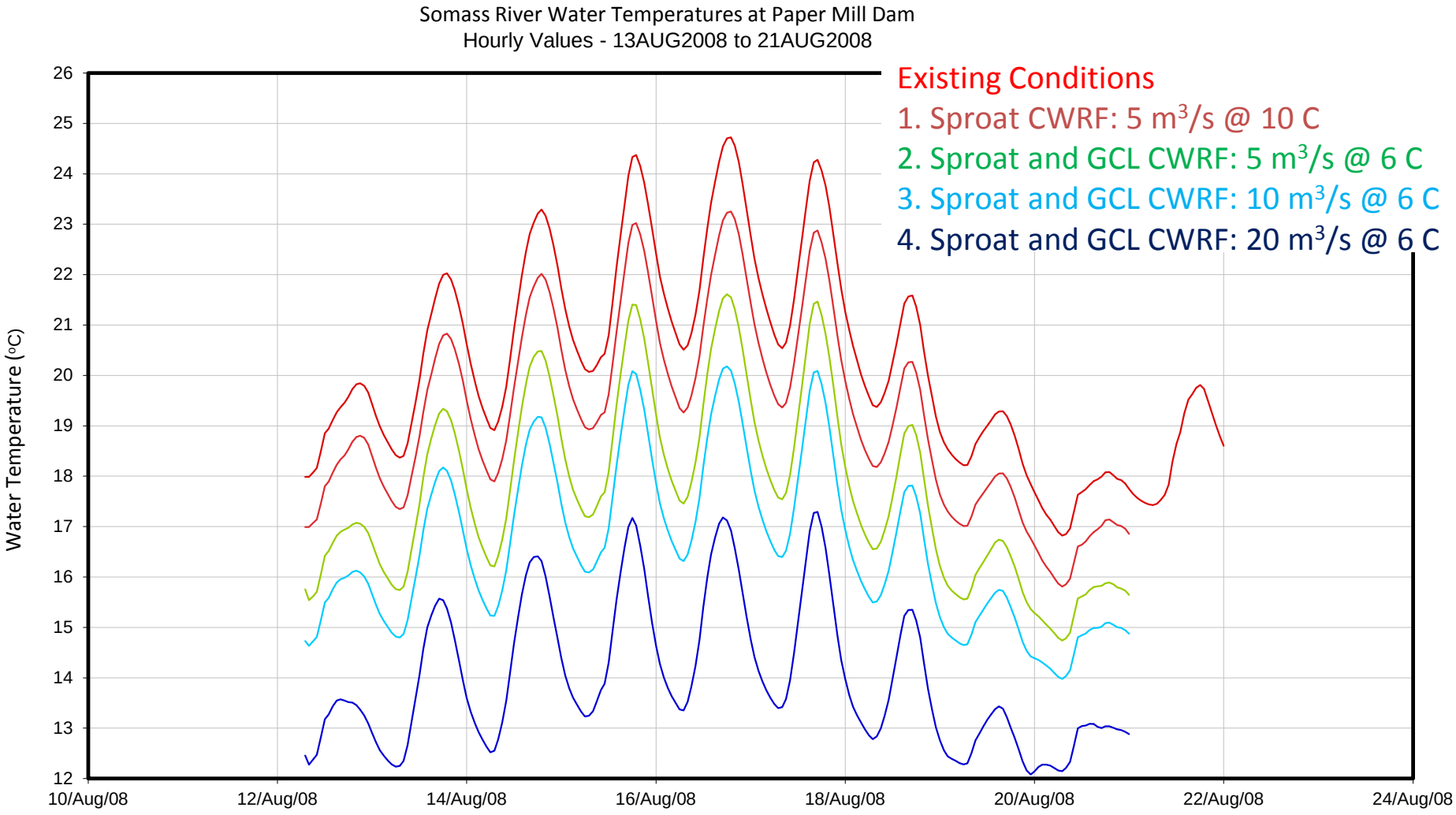

**Gravity-based Hypolimnetic Pipeline**



# Potential Cold Water Release Facility

- An assessment of the utility of a dedicated coldwater release facilities integrated into upgraded water control structures were investigated.
- Potential mitigation scenarios were examined against the base case model of existing 2008 conditions.
- Options:
    1. 5 $m^3/s$ coldwater release from Sproat Lake Weir
    2. Additional 5 $m^3/s$ coldwater releases from GCL Dam
    3. Additional 10 $m^3/s$ coldwater releases from GCL Dam
    4. Additional 20 $m^3/s$ coldwater releases from GCL Dam

# Scenario Results: Hottest Week in 2008



# Great Central Lake Cold Water Pipeline

# Climate Change Infrastructure: Somass CWRF

1. A coldwater release facility (CWRF) is conceptually viable at both Sproat Lake and GCL as there are demonstrated thermal benefits
2. Existing infrastructure, limnology and access re key features

# Somass Climate Change Adaptation: Strengths

- ✓ Effects are known and already happened
- ✓ High value resource and fisheries
- ✓ Modifiable existing infrastructure
- ✓ Strong science and engineering basis
- ✓ Can be staged or phased
- ✓ Key First Nations interests in the watershed and traditional fishery

# Somass Watershed Climate Adaptation "Toolbox"

# Closing

Thanks to all those involved on the Stamp-Somass, and to Craig Wightman, Al Lill, Barry Chillibeck for their work on the Somass Watershed Plan and this presentation.

Questions?