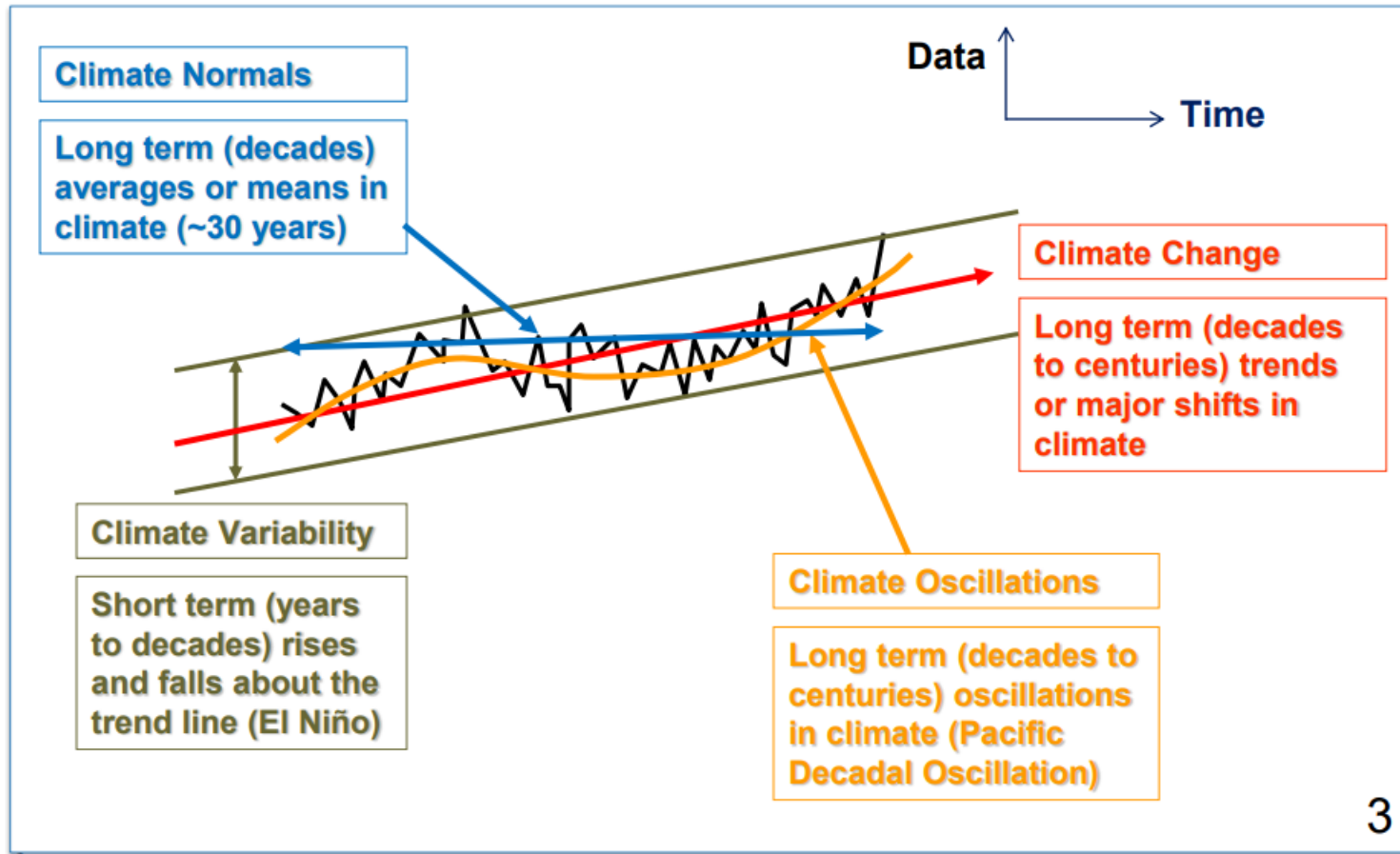


WEI Main Table Meeting #23: TWG update: climate change & issues scoping

Monday, September 27, 2021



Climate Change Modeling



Climate Change Modeling

- Mathematical models that describe atmospheric and ocean circulation (energy, water, carbon)
- Simulate historical climate changes and project future hydrological and climatic conditions
- Validated with real data and multiple models
- Different temporal and spatial scales (grids):
 - General Circulation Models (GCM): 100's of kms
 - Regional climate models (RCM): 100's of meters
- Numerous inputs: precipitation, air temperature, CO₂ etc.



Climate Change Uncertainty

- Numerous international and national oversight bodies, including UN Intergovernmental Panel on Climate Change (IPCC)
- Representative Concentration Pathways (RCP 8.5) CO₂/GHG emissions scenario
- Coupled Model Intercomparison Project (CMIP 5/6): ensemble of models, database of coupled GCM simulations



Climate Change Local Collaboration

- UNBC:
- University of Quebec:
 - École de technologie supérieure (ÉTS)
 - National Institute of Scientific Research (INRS)
- UVic: Pacific Climate Impacts Consortium (PCIC)
- UBC
- Local communities



Climate Change Local Research

- Measuring and modeling rain, snow, wind, solar radiation, water temperature.
- Understanding how climate change will affect timing and magnitude of precipitation, runoff, and water temperature and how can we adapt
- Understanding how flow and temperature affects fish migration and survival

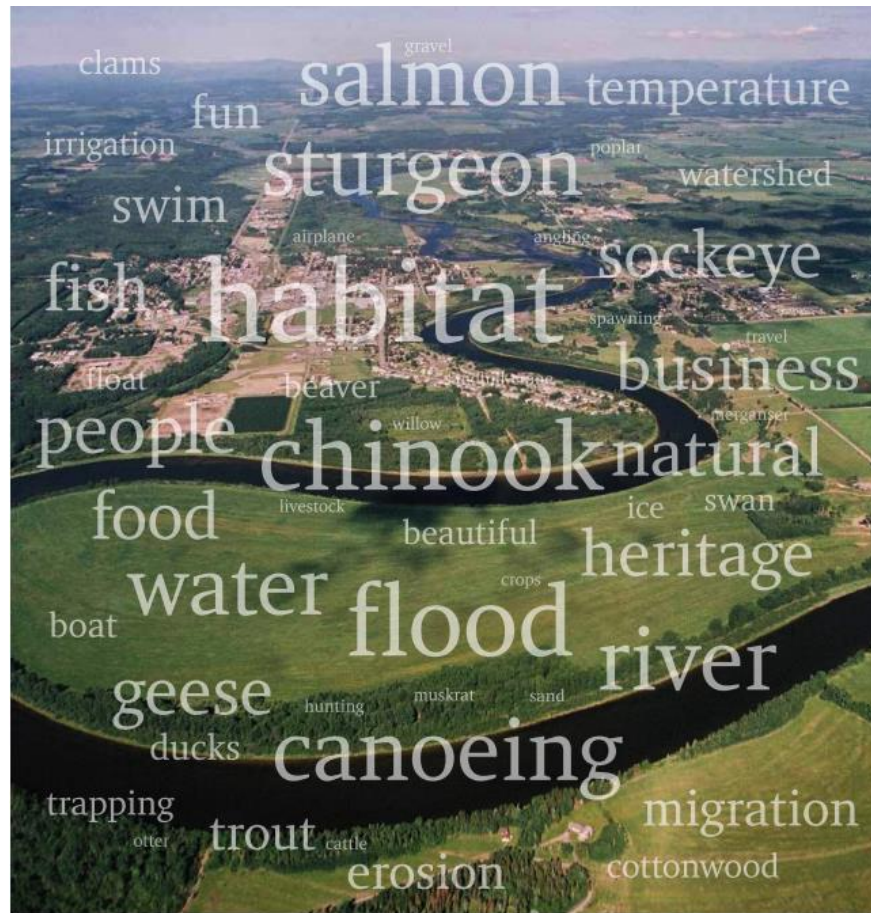


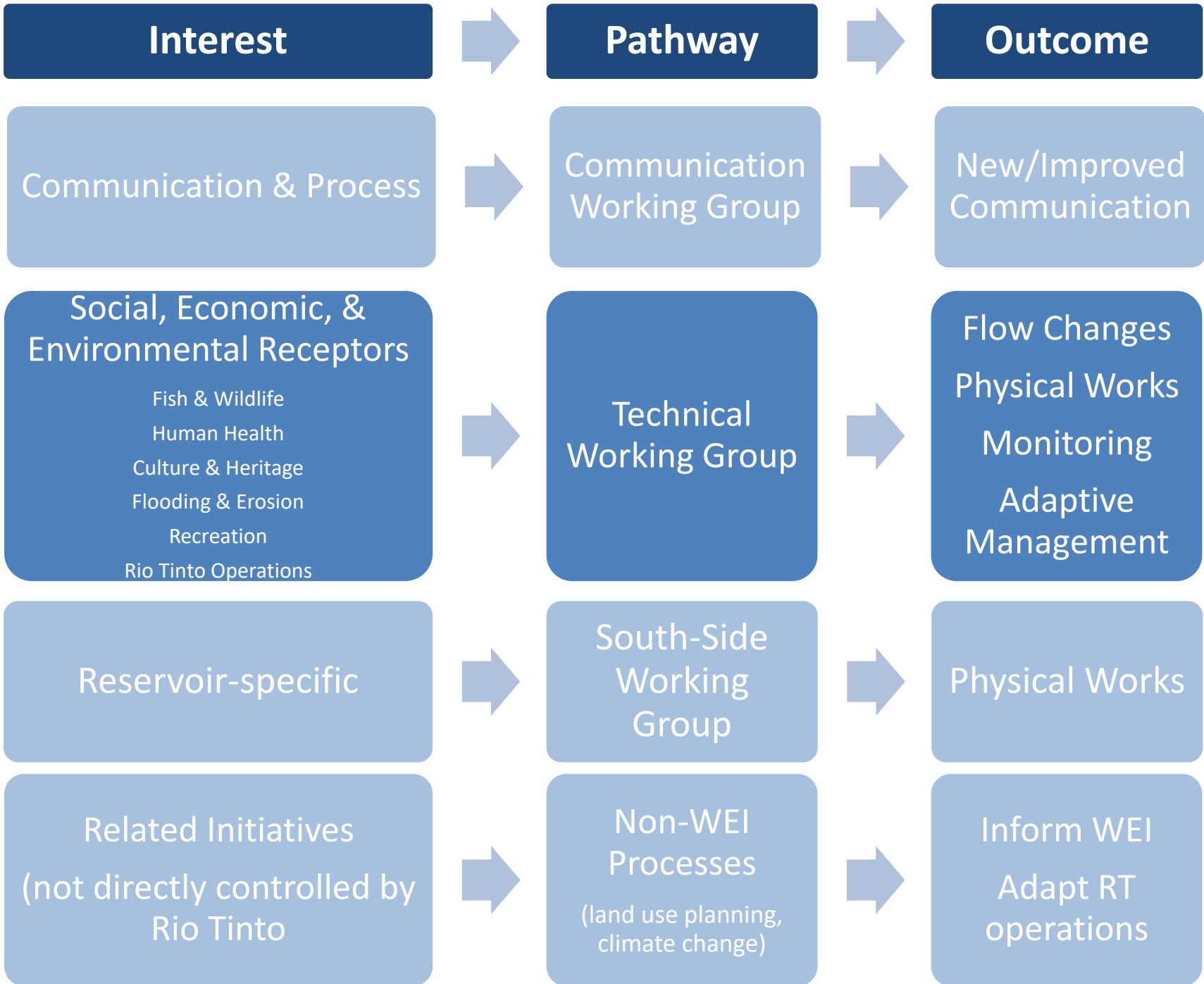
Climate Change & WEI

- TWG working with researchers (Stephen Dery, Richard Arsenault) and modelers (Alec Mercier, Ecofish) to understand how to incorporate climate change models into WEI
 - Suggested timeframe is 1950's-2099
 - Minimum 3-5 simulations
- Working on a short-term solution by piecing together various research and modeling
- Significant 2022 milestones:
 - Improved hydrodynamic and flow optimization models for the Nechako Reservoir (CEQUEAU)
 - Improved HEC-RAS discharge and temperature models for Nechako River



WEI Issues Refresher





Interest

Pathway

Outcome

Communication & Process

Communication Working Group

New/Improved Communication

Social, Economic, & Environmental Receptors

Fish & Wildlife
Human Health
Culture & Heritage
Flooding & Erosion
Recreation
Rio Tinto Operations

Technical Working Group

Flow Changes
Physical Works
Monitoring
Adaptive Management

Reservoir-specific

South-Side Working Group

Physical Works

Related Initiatives
(not directly controlled by Rio Tinto)

Non-WEI Processes
(land use planning, climate change)

Inform WEI
Adapt RT operations

**Social, Economic, &
Environmental Receptors**



Themes

Fish & Wildlife



Salmon
Sturgeon
River fish
Reservoir fish
Caribou
Beavers
Waterfowl & Shore-nesting
Birds
Osprey & Cormorants
Wildlife Habitat

Human Health



Water Quality
Methyl Mercury

**Social, Economic, &
Environmental Receptors**



Themes

Culture & Heritage



Indigenous Gravesites

Flooding & Erosion



Municipal flooding
Private property flooding
Backwatering
Bank erosion
Sediment transport

**Social, Economic, &
Environmental Receptors**



Themes

Recreation & Navigation



Boat launches & docks
Dead trees
Submerged hazards
Float planes & canoes
Hiking trails
Beaches

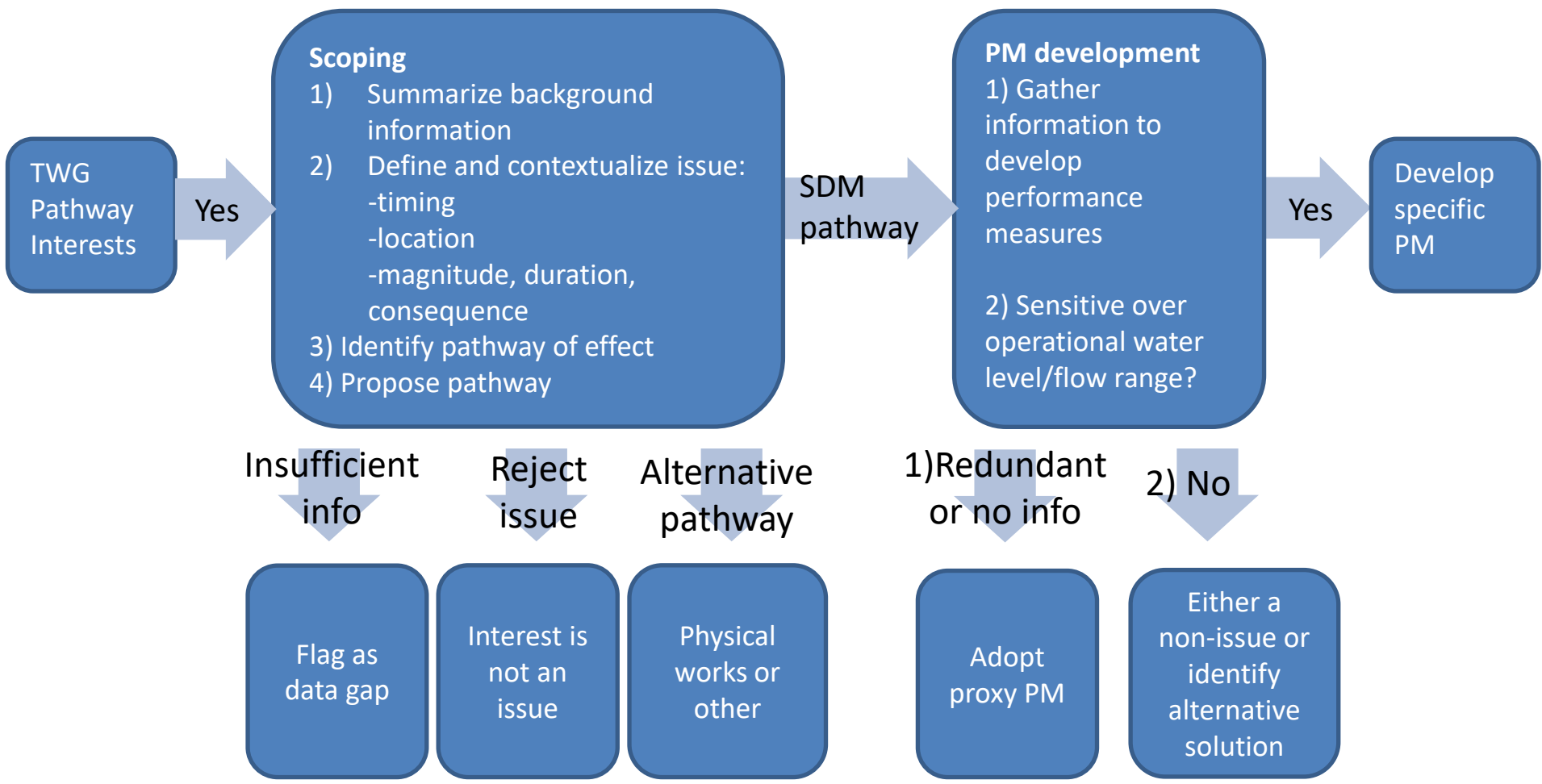
Rio Tinto Operations



Aluminum production
Operational Flexibility
Revenue

Overview of Issues Scoping





Issues Scoping Status



Issues Scoping: summary

Issue Pathway				Assessment Incomplete
SDM	Alternative Pathway	Not an Issue	Data Gap	
19	5	2	10	21



Flow/Structured Decision Making

Sub-Category	Interest	Issue	Issue Pathway				Assessment Incomplete
			SDM	Alternative Pathway	Not an Issue	Data Gap	
Nechako Reservoir - Fish	Fish entrainment	Fish entrainment Skins Lake Spillways may results in fish mortality, or reduces upstream population	X				
Nechako River - Anadromous Fish	River temperatures and river fish; Chinook salmon (habitat flow timing, temperature)	Short and long-term exposure to high water temperature can affect salmon migration success.	X				
		Short and long-term exposure to high water temperature can affect growth and survival of rearing juvenile salmon.	X				
Nechako River - Anadromous Fish	Chinook salmon (habitat flow timing, temperature)	Unsuitable velocities can reduce spawning	X				
		Reduced water depths between spawning and hatching can result in egg dewatering and mortality	X				
		The amount and suitability of habitat limits fish growth, fitness, and survival	X				
Nechako River - Resident Fish	River temperatures and river fish	Short and long-term exposure to high water temperature can affect fish growth and survival	X				
	Resident fish species (habitat, flows, temperature); Winter fish habitat flows	Extreme high and low flows can negatively affect fish habitat suitability and aquatic productivity	X				

Flow/Structured Decision Making

Sub-Category	Interest	Issue	Issue Pathway			
			SDM	Alternative Pathway	Not an Issue	Data Gap
Nechako Reservoir - Caribou	Caribou access to islands	Land links can increase predating during calving migration	X			
Nechako Reservoir - Wildlife habitat	Wildlife habitat	Management of reservoir water levels can affect hydraulic connectivity to adjacent areas	X			
Nechako River - Beavers	Beaver lodges	High flows can flood dens during breeding	X			
Murray-Cheslatta - Gravesites	Inundation of archaeological sites (e.g. village sites, graveyards) Flooding in Murray-Cheslatta	Fluctuating water levels in Cheslatta expose cultural artifacts and ancestral remains.	X			
Nechako River - Municipal flooding		Open-water and overbank flooding damages property and makes land unusable	X			
	Flooding in Prince George and Vanderhoof; Maximum reservoir elevation	Groundwater flooding damages property, floods basements, and makes land unuseable	X			
		Ice-jam flooding causes inundation of land and property leading to damages and land loss	X			
Nechako River - Hiking trails	Access to trails and river	High river elevation results in flooding of hiking trails	X			

Flow/Structured Decision Making

Sub-Category	Interest	Issue	Issue Pathway				Assessment Incomplete
			SDM	Alternative Pathway	Not an Issue	Data Gap	
Aluminum	Need for reliable flows for power generation		X				
Revenue	Need for reliable flows for power generation		X				
Operational flexibility	Impacts on operations, cost, flexibility		X				

Alternative Pathway

Sub-Category	Interest	Issue	Issue Pathway				Assessment Incomplete
			SDM	Alternative Pathway	Not an Issue	Data Gap	
Nechako River - Resident Fish	Sturgeon; Sturgeon spawning and recruitment; Natural hydrograph	Suitable flows for sturgeon spawning and recruitment		X			
Nechako Reservoir - Caribou	Caribou access to islands	Woody debris can block access to key calving areas		X			
Nechako Reservoir - Osprey	Osprey habitat and productivity	Reservoir operations may affect productivity and fish populations		X			
Salmon harvest (Nechako River)	Ensuring a sustainable salmon harvest for Indigenous groups			X			
Nechako River - Private property flooding & erosion	River - Erosion itself; Maximum reservoir elevation; Irrigation infrastructure; Livestock fences in the river	High water erodes land under fencing and irrigation systems causing damage		X			

Not an Issue

Sub-Category	Interest	Issue	Issue Pathway				Assessment Incomplete
			SDM	Alternative Pathway	Not an Issue	Data Gap	
Nechako Reservoir - Osprey	Osprey habitat and productivity	Suitable osprey nesting sites may be reduced as existing trees standing in reservoir decay and fall over			X		
Nechako Reservoir - Water quality	Drinking water; Access to clean water; Methyl mercury	Methyl mercury can result from flooding organic debris			X		

Data Gap/Uncertainty

Sub-Category	Interest	Issue	Issue Pathway				Assessment Incomplete
			SDM	Alternative Pathway	Not an Issue	Data Gap	
Fish - General	Ramping	Fluctuating water levels in the reservoir or downstream (Murray-Cheslatta or Nechako) can strand fish in shallow water				X	
Nechako Reservoir - Caribou	Caribou access to islands	Steep muddy slopes can cause difficult access off shorelines and onto calving islands				X	
Nechako Reservoir - Moose	Moose migration	Steep muddy slopes can cause difficult access off shorelines				X	
		Woody debris blocks migration				X	
Nechako Reservoir - Waterfowl & ground nesting birds	Birds Spring and fall nesting	High reservoir elevation may flood nests				X	
		Low reservoir elevation may expose to predators				X	

Data Gap/Uncertainty

Sub-Category	Interest	Issue	Issue Pathway				Assessment Incomplete
			SDM	Alternative Pathway	Not an Issue	Data Gap	
Nechako Reservoir - Wildlife habitat	Wildlife habitat	Reservoir operation can cause drawdown zone banks (riparian habitats) to become scoured and vegetation communities to become impoverished				X	
Nechako Reservoir - Aquatic mammals (Otter, muskrat, beaver)	Beaver lodges	High flows can flood dens during breeding				X	
		Dropping water levels can expose den entrance during winter which can limit access				X	
Nechako River - Backwatering	Fraser Lake flooding and outlet weir	Backwatering of Fraser Lake inundates properties and beaches				X	

Assessment Incomplete

Sub-Category	Interest	Issue	Issue Pathway				Assessment Incomplete
			SDM	Alternative Pathway	Not an Issue	Data Gap	
Fish - General	Resident fish habitat; Resident fish species (habitat, flows, temperature)	High TGP can cause mortality or unfavorable behavioral responses					X
	Fish access into tributaries; Kokanee spawning habitat access	Low flows in mainstem can prevent fish from accessing elevated or braided tributaries					X
		Low reservoir levels can impede fish access into tributaries					X
	Off-channel; Side-channels	Low water levels can limit access to side channel and off channel habitats					X
	Off-channel; Side-channels; Riparian restoration or enhancement	Loss of high flows may reduce recruitment and maintenance of riparian vegetation communities					X
	Invasive species and fish habitat	Reed canary grass					X

Assessment Incomplete

Sub-Category	Interest	Issue	Issue Pathway				Assessment Incomplete
			SDM	Alternative Pathway	Not an Issue	Data Gap	
Nechako Reservoir - Fish	Littoral productivity; Kokanee decline	Reservoir storage and outflow regime can affect primary or secondary productivity					X
		The amount and suitability of reservoir habitat limits fish growth, fitness, and survival					X
	Reservoir water temperature for fish	Fluctuating water levels and discharge effects on water temperature in reservoir (e.g., disrupt thermocline).					X
Murray-Cheslatta - Fish	Restoring fish habitat	Increased volume and velocity diversion flows from SLS have degraded habitat					X
	Umam	tbd					X
Nechako River - Anadromous Fish	Winter fish habitat flows for salmon	Unsuitable hydraulic conditions can reduce OW survival					X
Nechako River - Resident Fish	Resident fish species (habitat, flows, temperature); Winter fish habitat flows	Unsuitable hydraulic conditions can reduce OW survival					X
	Freshwater mussel distribution and abundance	TBD					X

Assessment Incomplete

Sub-Category	Interest	Issue	Issue Pathway				Assessment Incomplete
			SDM	Alternative Pathway	Not an Issue	Data Gap	
Nechako River - Waterfowl & ground nesting birds	Birds; Spring and fall nesting; potential; interaction with flushing flows;	High reservoir elevation may flood nests					X
	Water fluctuation impacts on floodplain nesting; Middle Nechako known as waterfowl staging area	Low reservoir elevation may expose to predators					X
Nechako River & Reservoir - Private property flooding & erosion	River - Erosion itself; Maximum reservoir elevation;	High water levels erode land adjacent to the river, leading to property loss					X
	Irrigation infrastructure; Livestock fences in the river	High water levels inundate land making it unusable for agriculture					X
Nechako River - Sediment transport	Sediment transport effects of erosion (from farms, tributaries) Natural hydrograph	Flow manipulation can alter the natural process of erosion and sediment transport					X
Murray-Cheslatta - Bank Erosion	Bank erosion along Skins Lake, Cheslatta Lake, Cheslatta River and Murray Lake Flooding in Murray-Cheslatta Habitat restoration in Murray- Cheslatta	Higher than historic discharges has caused large erosion of banks					X
Nechako River - Float planes and canoes	Recreation (e.g. canoeing)	Low river elevation results in insufficient water depths for float planes and canoes					X

Issues Scoping: summary

Issue Pathway				Assessment Incomplete
SDM	Alternative Pathway	Not an Issue	Data Gap	
19	5	2	10	21



TWG Next Steps

- Reservoir/erosion tour
- Continue to integrate climate change
- Review and integrate other research and information
- Continue to scope issues
- Finalize technical/summary memos
- Finalize reporting structure for issues scoping and PMs

