Structuring water management decisions: experiences from British Columbia and further afield

Wednesday 12 June 2024

Australian Academy of Science, Canberra

Watertrust Australia Ltd

Lee Failing

- Studied mechanical engineering and resource economics
- Currently Principal at Compass Resource Management and adjunct Professor in the School of Resource and Environmental Management at Simon Fraser University
- A career on improving quality of public decision making
- Numerous publications and practical guides

Daryl Fields

- An economist by training
- A career as a British Columbia Hydro manager
- Joined the World Bank to work on water issues associated with hydro facilities, national policies and transboundary rivers.
- Currently a member of the BC Hydro Board
- Was invited to join the staff of the World Commission on Dams

Michael Harstone

- A water resources engineer and decision analyst by training
- Currently a Principal at Compass Resource Management
- A career designing and facilitating public planning processes related to water policy, water management, species at risk (including ten WUPs)
- A SDM Trainer and contributing author on *Structured Decision Making: A Practical Guide to Environmental Management Choices*

Session I

Managing Water at Hydropower Facilities: British Columbia's Journey

.

Canberra

June 12, 2024

Prepared for Water Trust Australia

Prepared by Daryl Fields, M.Sc (Econ), ICD.D

Presentation Structure

I. Context:

Why did BC get into this?

II. Success Factors:

What were the key ingredients?

A little bit about BC Hydro (1961-)

- Vertically integrated: generation, transmission, distribution, energy efficiency, decarbonization, two subsidiaries (trade, hydrogen)
- 4.9 million customers (>95% of BC population)

- 31 generation facilities in 25 watersheds across BC
- 11,000 MW, 43,000 GwH/year, 73,000 km of transmission lines
- Additional 5500 MW from Independent Power Producer contracts
- >90% hydro

- Gross revenues: C$7.6 bn; Total assets: C$43 bn
- Extensive trade (import and export) as well as Columbia River Treaty with United States

- Wholly owned by the Province of British Columbia

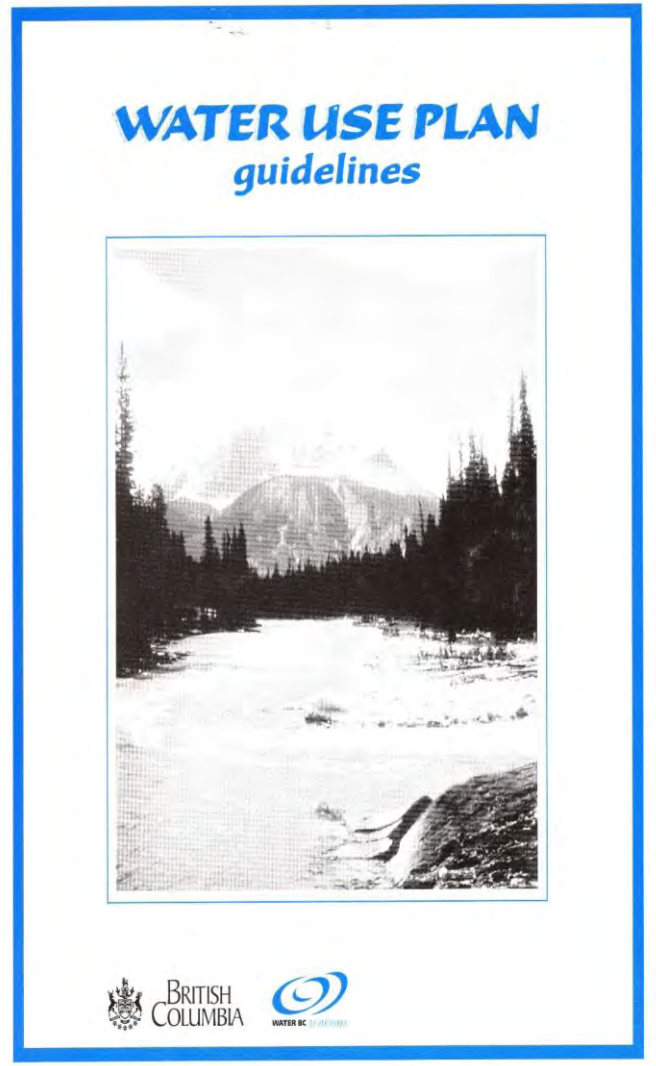
WHY? The world changed

New Interests.
New Players.
New Concerns

- Local actions and advocacy
- Fisheries Act litigation
- NAFTA
- Costly operational constraints
- Fragmented authority
- Public license to operate

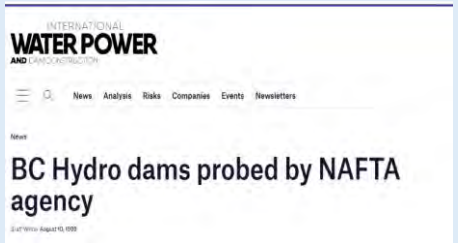
ESOR
+
Sustainability report
+
Alouette

ALOUETTE RIVER MANAGEMENT SOCIETY



PEOPLE FOR SALMON
THANK YOU FOR JOINING US IN OUR MISSION TO SAVE THE SALMON

Fisheries and Oceans Canada



What is Water Use Planning (WUPs)?

An approach to defining and managing BC Hydro's operations to balance diverse values of water

WUPs:

… will redefine operating boundaries for each licensed facility

… be developed through a collaborative planning process designed to consider economic, social, and environmental values

… [are] key to [BCHs] business success and role as a Crown corporation.

Hopes and Fears

More fish forever

Voice!

Learn and innovate

The unknown

We are not fish managers

Greenwashing

BCH has too much control

Threat to authority

Monetization

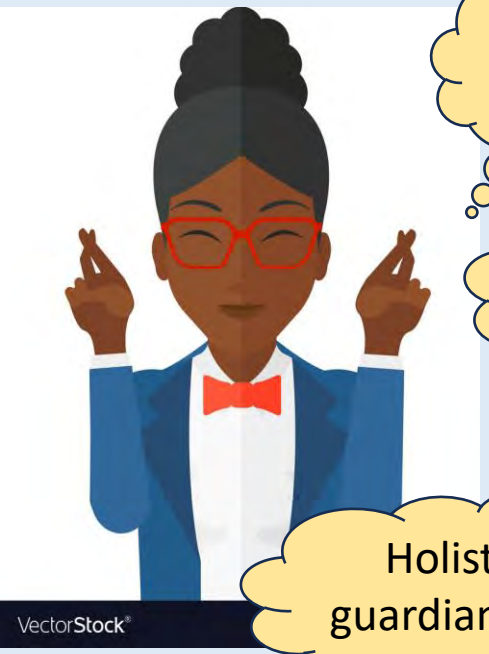
Coordi nation!

Public trust

No more courts

Capacity

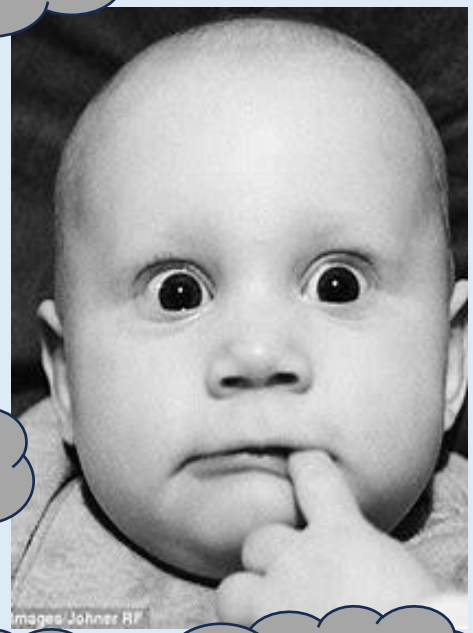
Wont change anything



Operational clarity

Bad faith

No ending!



More data, more science

Holistic guardianship

Transparency

Will DFO authorize?

Fish will dominate

Scientific credibility

II. Success factors

a) Principles: A common vision

b) Governance: Designing the parameters

c) Collaboration: Ensuring Line of sight

d) An enabling methodology: Structured Decision Making

a) WUP Principles: A common vision

Managing Water Responsibly
a Shared Resource

Principles of Water Use Planning

Recognition of multiple objectives: Water control facilities and, in particular, the BC Hydro system, provide benefits to British Columbians across a variety of cultural, economic, environmental, safety and social objectives; therefore the WUP process must consider this range of interests and values.

Recognition that tradeoffs (choices) have occurred and will occur: Because conflicts in the management of water may arise (between, for example, fish and power, or fish and flood control), water use planning seeks to find incremental improvements to balance various water uses.

No change to existing legal and constitutional rights and responsibilities: The purpose of the program is to clarify obligations in detailed operating plans, while maintaining the regulatory powers of, for example, the federal *Fisheries Act* and the provincial *Water Act*.

Embodies science and continuous learning through information gathering and analysis: The emphasis is on obtaining information about operational impacts that supports discussions, understanding, and improved decision making.

Collaborative, co-operative and inclusive process: The program brings together a wide variety of people to be part of decision making.

Focused on issue resolution and long-term benefits: Each WUP will be focused on real and achievable outcomes that can be measured.

WUP Principles (contd)

Recognition of multiple objectives: Water control facilities and, in particular, the BC Hydro system, provide benefits to British Columbians across a variety of cultural, economic, environmental, safety and social objectives; therefore the WUP process must consider this range of interests and values.

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Collaborative, co-operative and inclusive process: The program brings together a wide variety of people to be part of decision making.

Recognition of multiple objectives

➔ Power and non-power values (including environmental, social, economic)

No change in authorities

➔Regulators maintained compliance responsibilities

Collaborative, co-operative and inclusive process

➔ Representation across values, equal playing field, focus on solutions

WUP Principles (contd)

Recognition that trade-offs (choices) have occurred and will occurred

➔Keyword: balance

Embodies science and continuous learning through information gathering and analysis

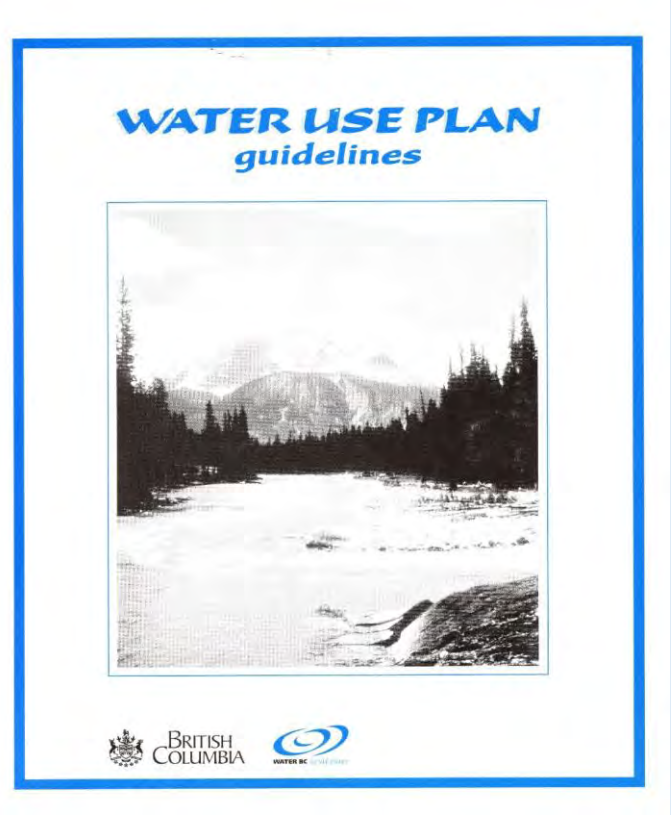
➔Calling for more rigorous and transparent use of knowledge in understanding and assessing choices

Focused on issue resolution and long-term benefits

➔There is work to be done and everyone can expect answers and, likely, changes

b) Governance: Designing the parameters

- Institutional structure: Who is involved?
- Accountability: Who decides what?
- Defined scope: What's in, What's out
- Remissions: Who pays?



Institutional Structure: Who is involved?

Interjurisdictional Structure

WUP Policy Cttee:
Deputy Ministers

WUP Steering Cttee:
Asst Deputy Ministers

WUP Management Cttee:
Senior staff

WUP Implementation Team

Consultative Committees

BC Hydro

ENGOs
BC Fisheries
Fisheries & Oceans
First Nations
Local Stakeholders
BC Hydro
BC Govt

Comptroller of Water Rights

Accountability: Who decides what?

Interjurisdictional Committees

WUP Policy Cttee:
Deputy Ministers

WUP Steering Cttee:
Asst Deputy Ministers

WUP Management Cttee:
Senior staff

WUP Implementation Team

Fisheries Act, Existing Rights and title

Consultative Committee Report

Consultative Committees

BC Hydro

Comptroller of Water Rights

Operating Orders

Defined Scope: What's in? What's out?

Consensus

"Each process will strive for, but not require, consensus on all aspects"

Boundaries

- Existing facility -- no infrastructure changes
- Existing licenses
- Recognizes existing legal and constitutional rights and responsibilities
- No historical grievances or footprint issues

Remissions: Who pays?

- Compensation to BC Hydro for lost revenue caused by changes in operations to benefit non-power values

- Debate over:
  - Rationale
  - mechanism: rates, remissions on water rental fees, reduced dividend payment
  - “how much”

➔System Operations Fund developed by the Provincial Government

➔Remissions on water rental fees = GWh * cost of energy/GWh
$50 million/year based on collaborative bottom-up assessment of need

c) Collaboration: Line of Sight

➔ **Line of sight**

The line between two points
In WUPS, the line ran from the beginning of engagement to decision

Participants are present, feel heard, feel seen, contribute and understand their contribution

- Building blocks:
  - Structure - Clarity on the steps from beginning to end, including accountability
  - Transparency - Decision documents are vetted and shared
  - Facilitation - Participation in a language they understand, in a mindset that reflects their values
  - Decision structure - Integration of deliberation and analysis

d) An enabling methodology

Structured Approaches to Decision Making in Water Use Planning

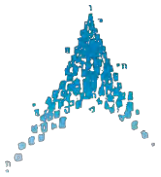
A framework for collaborative planning

Lee Failing, BSc Eng, MRM
compass

What I'll talk about…

Structured approaches to decision making in water use planning

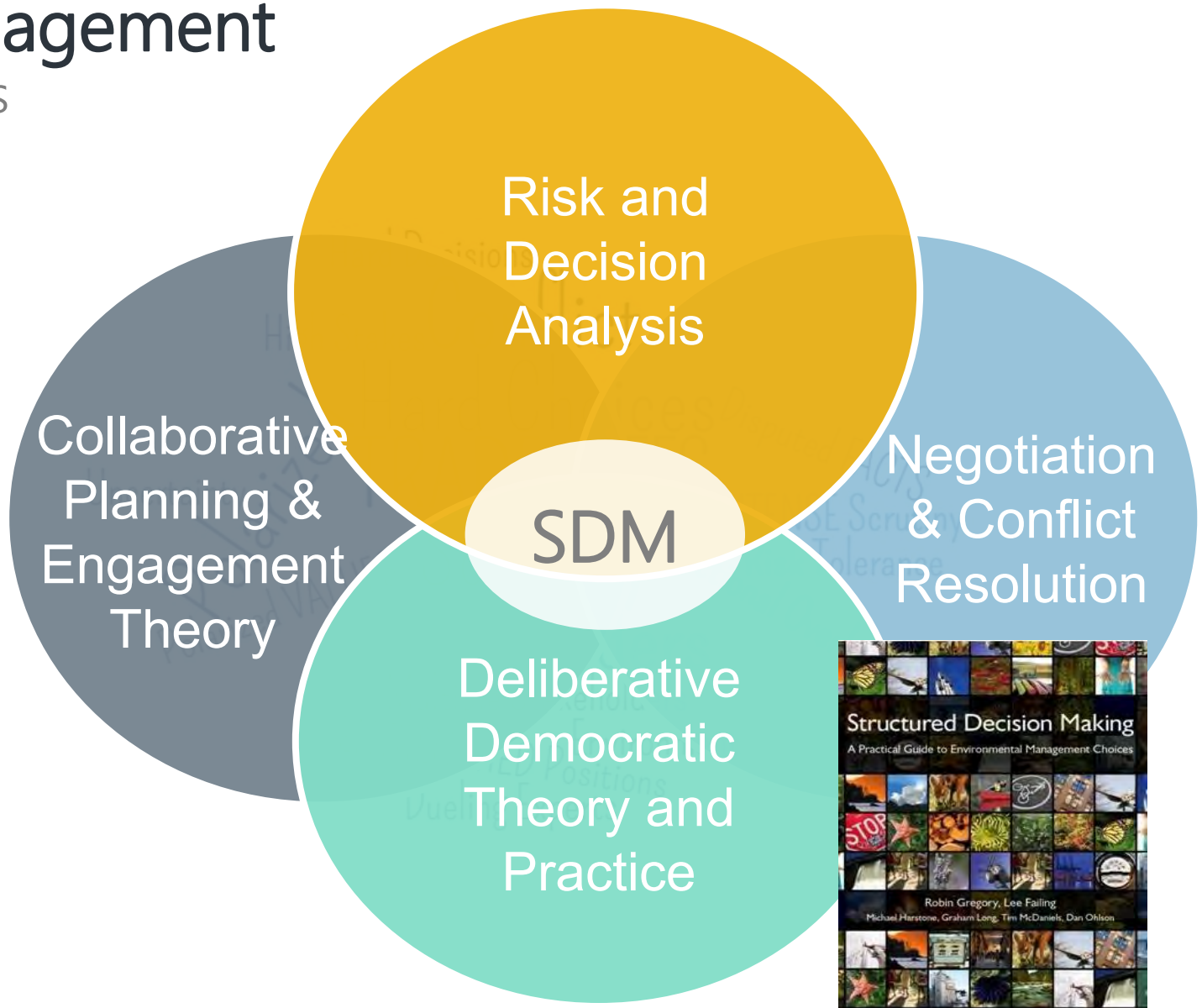
- What are structured approaches to decision making?
- What does it look like in practice?
  - The Bridge River Water Use Plan
  - Key success factors



Compass Resource Management

Decision analysts and facilitators

- Helping people work together to make tough resource and environmental management choices
- Good decision making draws on many fields of theory and practice
- Key is linking *analysis and deliberation,* and linking *technical work and engagement work*



We work on all kinds of messy problems…

Natural resources, infrastructure, community services, G2G shared decision making…

EXPERT JUDGMENT FOR GREATER SAGE GROUSE RELEASES

DRY CREEK WATER MANAGEMENT PLAN OPTIONS ANALYSIS

NICOLA G2G FORUM FACILITATION

COWICHAN VALLEY, CLIMATE CHANGE AND WATER USE PLANNING

ELK VALLEY WATER QUALITY PLAN

YELLOWKNIFE RECREATION PLANNING

COLUMBIA RIVER TREATY REVIEW

BATHURST CARIBOU RANGE PLAN

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM

CITY OF VANCOUVER COASTAL FLOOD RISK ASSESSMENT

MISSOURI RIVER RECOVERY PLANNING

SDM TRAINING FOR NORTHERN LAND MANAGERS

PORT OF VANCOUVER TERMINAL EXPANSION

CLIMATE ACTION PLANNING FOR BC

GREATER VANCOUVER TRANSPORTATION PLANNING

BOREAL CARIBOU RANGE PLANNING IN NWT

NORTH SHORE WASTE WATER TREATMENT PLANT

NANOTECHNOLOGY RISK SCREENING AND DECISION SUPPORT

LOWER ATHABASCA WATER MANAGEMENT FRAMEWORK

MACKENZIE BASIN BILATERAL WATER MANAGEMENT AGREEMENTS

METLAKATLA CUMULATIVE EFFECTS MANAGEMENT

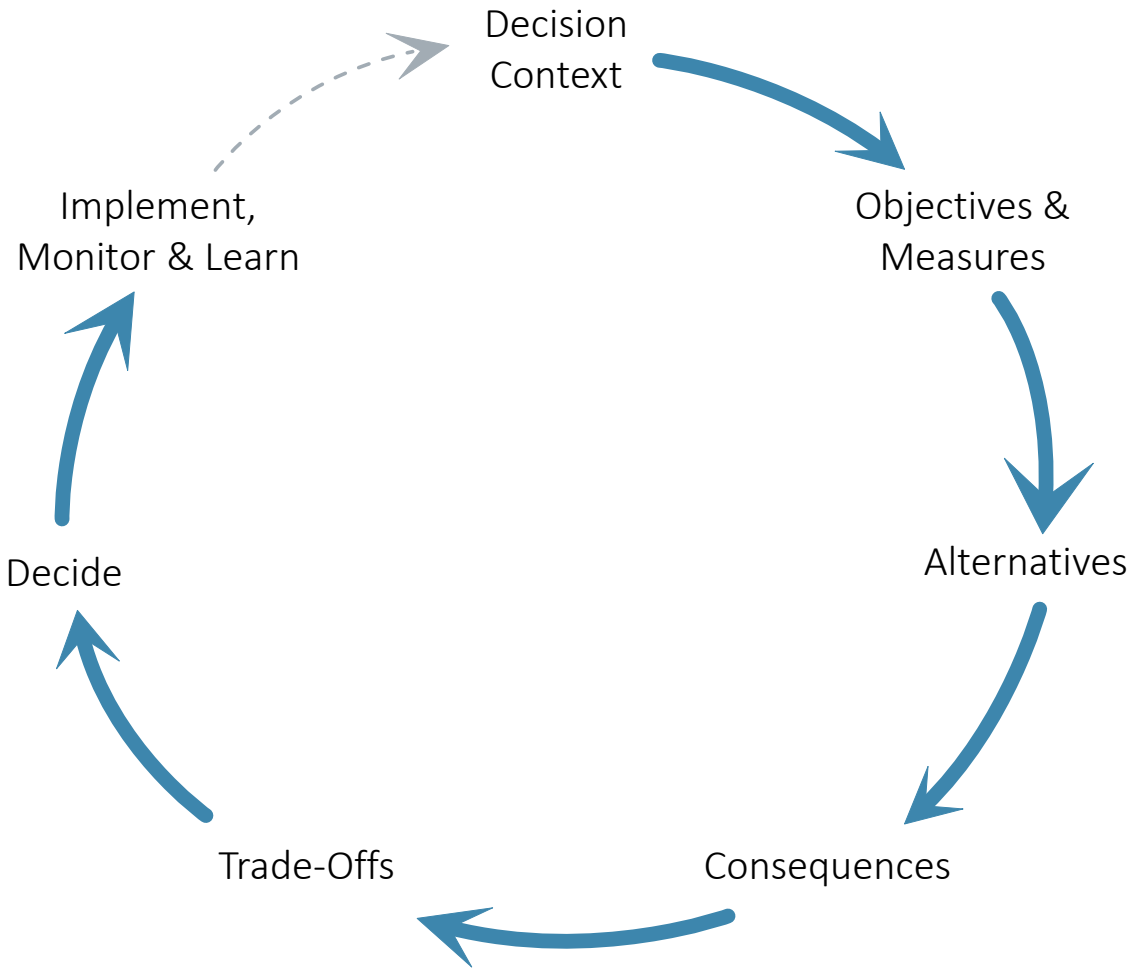
What we've learned

A structured decision process ….

- Provides a pathway and tools for dealing with conflict and complexity
- Builds shared understanding of contested evidence and hard trade-offs
- Democratizes decision making
- Builds capacity to work together
- Supports transparent, defensible, more broadly supported decisions

SDM… yep, the typical steps of policy/decision making

An organized approach for helping people work together to make informed and transparent value-based choices.



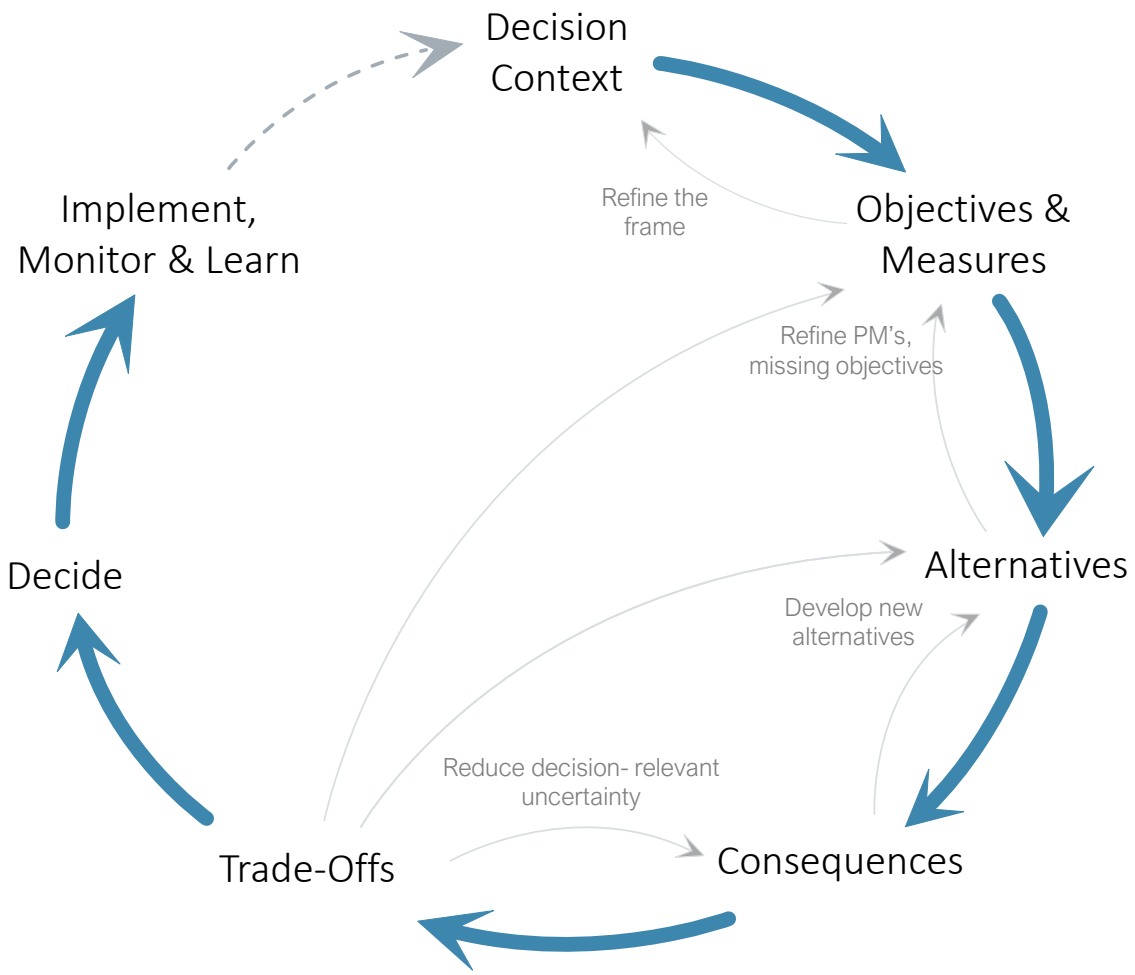
Rooted in the decision sciences

"A formalization of common sense for decision problems that are too complex for informal use of common sense"
(R. Keeney)

Analysis + Deliberation

Structured Decision Making

It's a little messier than it looks….

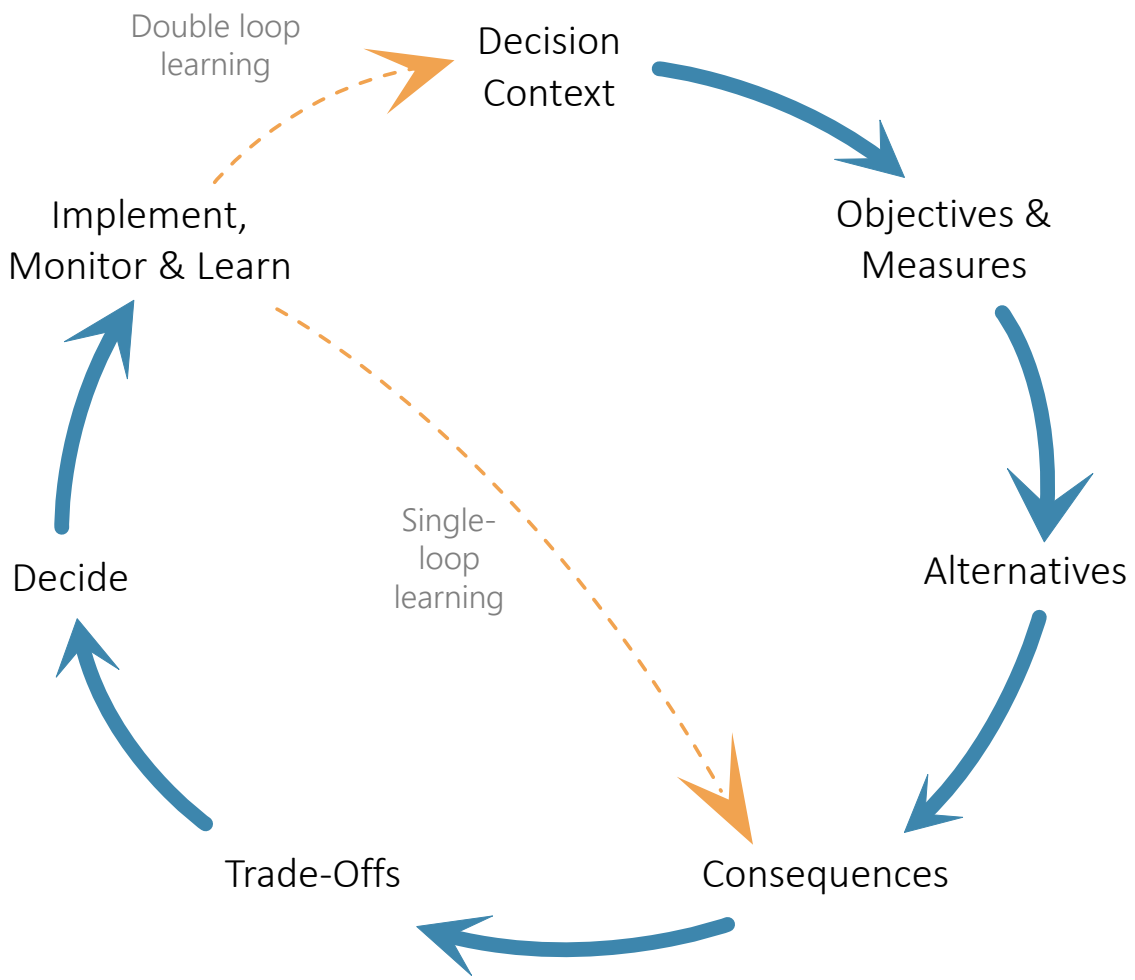


It's iterative and scalable….

Do as much or as little as you need to make an informed choice

The SDM-AM Cycle

The integration of SDM and AM has become a widely used framework for managing natural resources



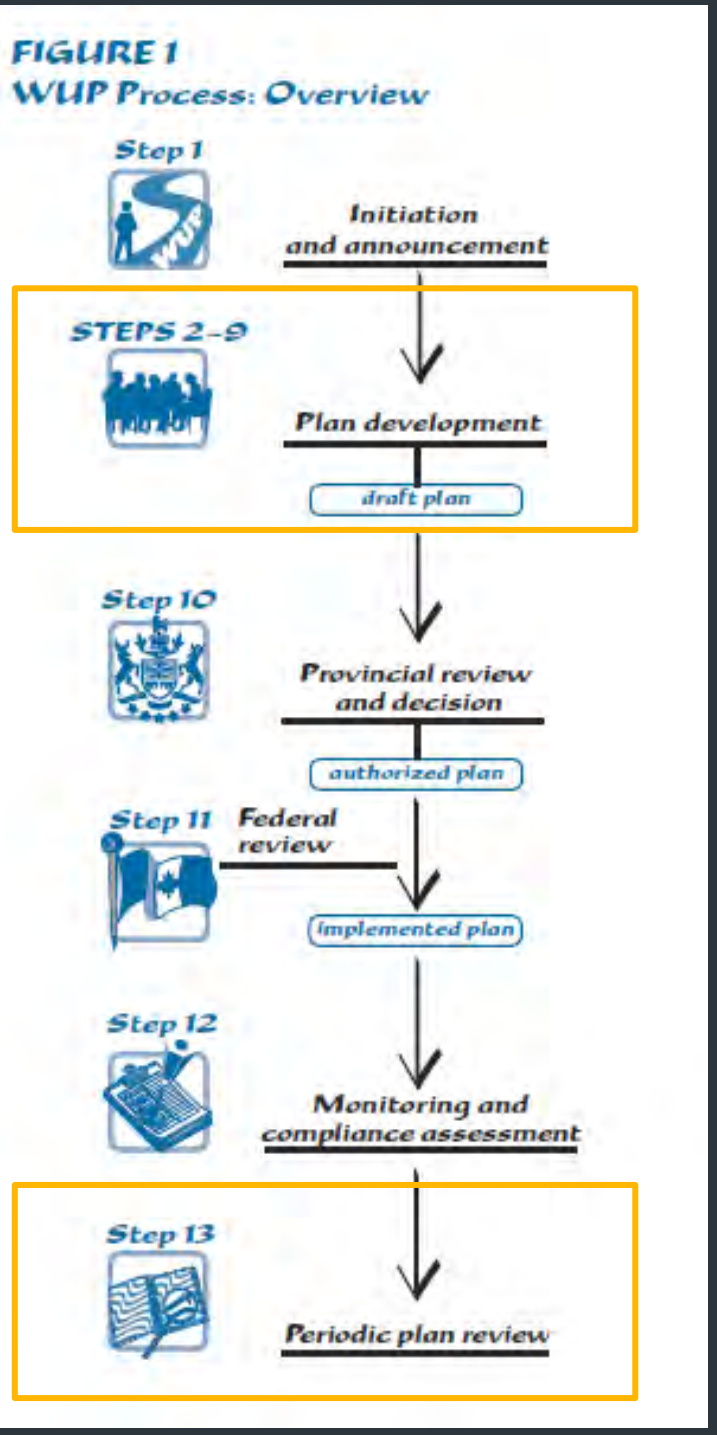
Most resource management decisions are complicated by uncertainty

Adaptive Management is an organized approach to deliberate learning through implementation

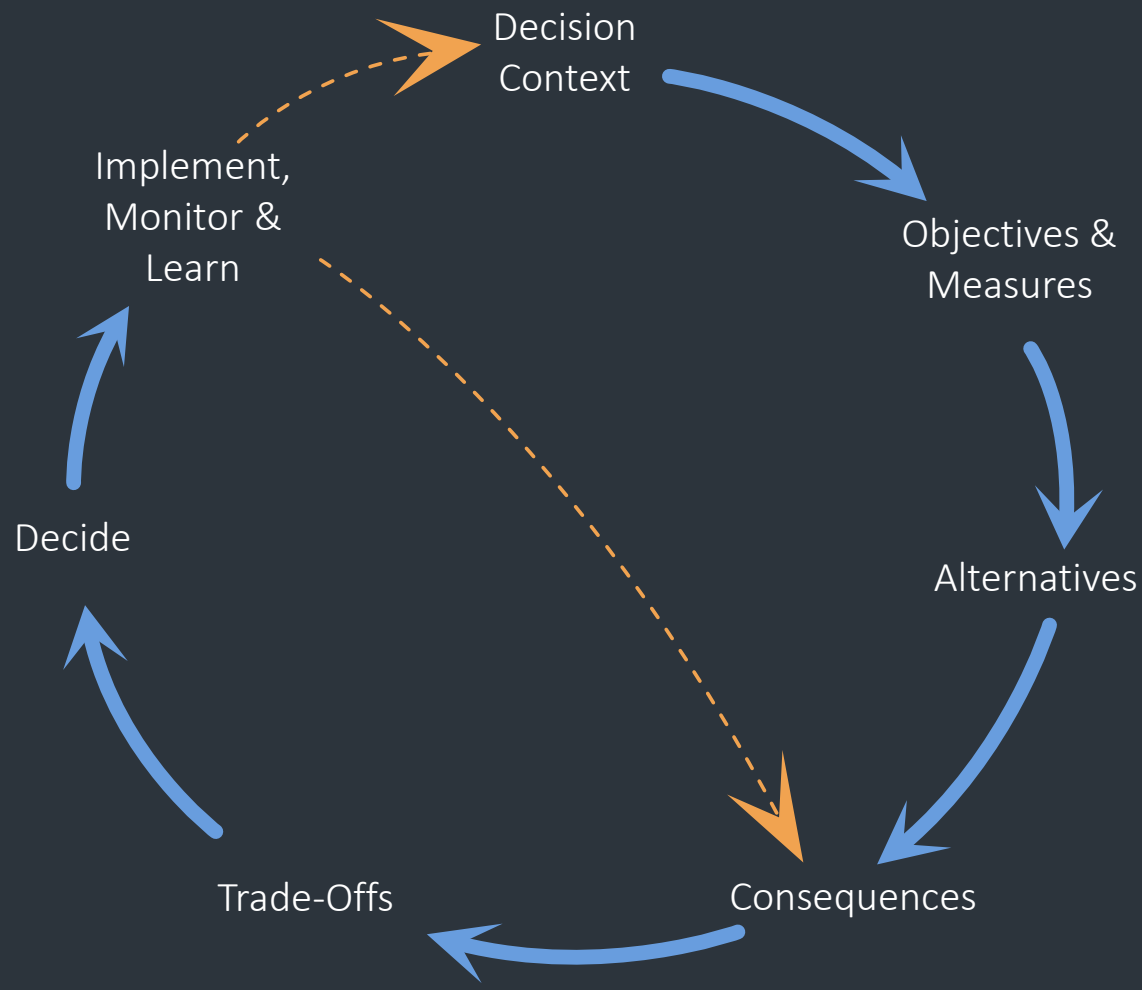
Bridge River Water Use Plan

And lessons from 20 years of structured decision processes

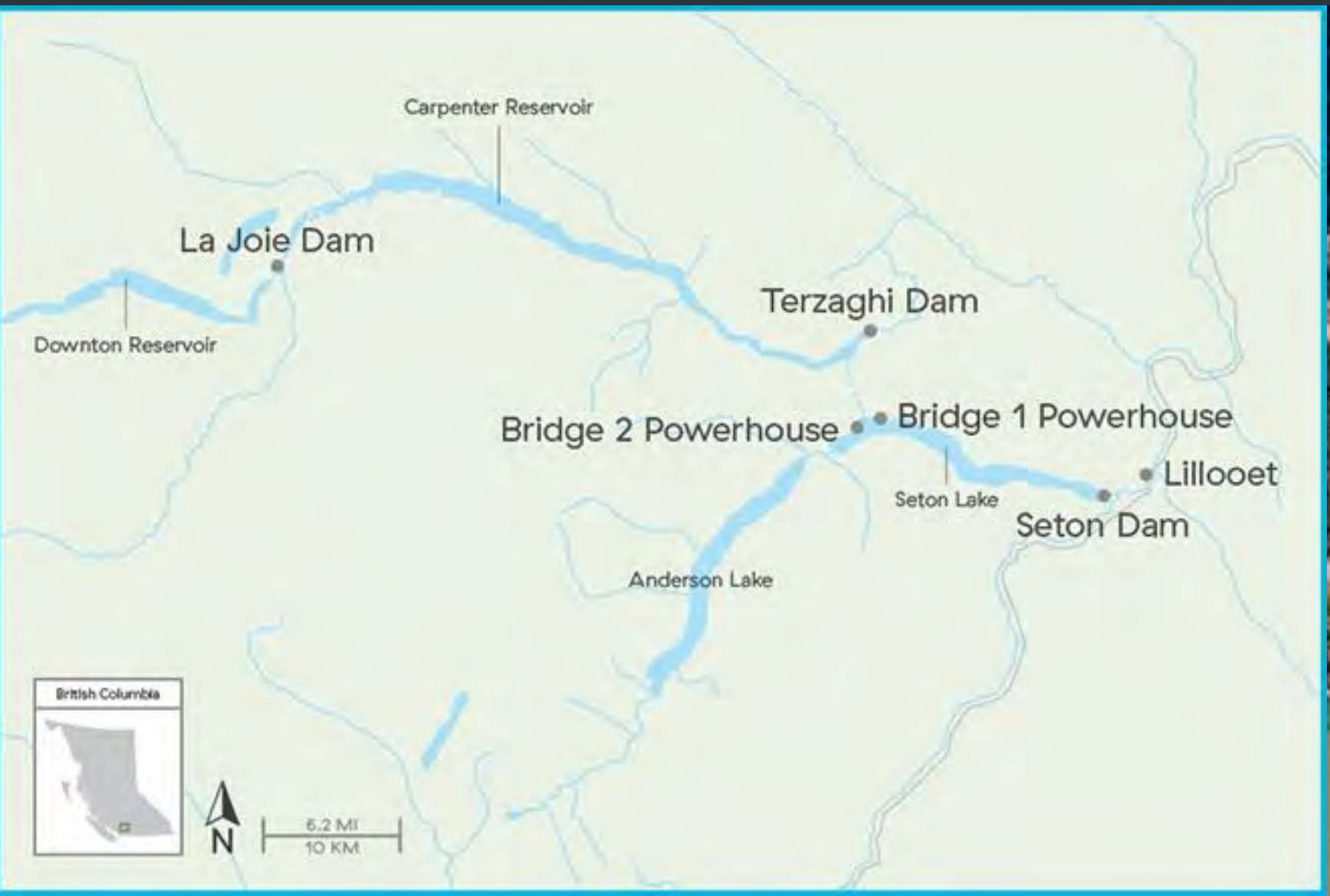
compass



Plan development process based on *structured decision making and adaptive management*



The Bridge River system

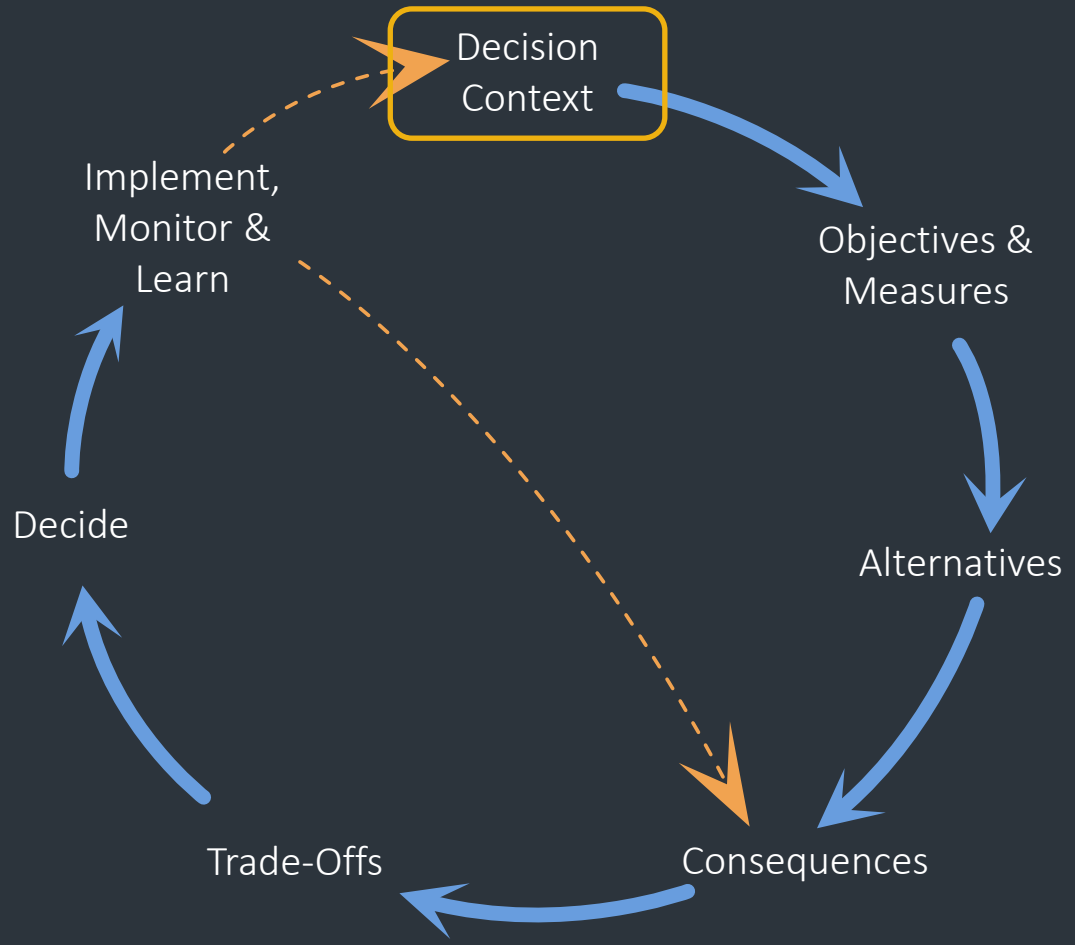


Bridge River WUP

Decision context and process design – Who's at the table?

Start with Guidelines and TOR

- Consultative Committee
  - ~20 members: BCH, gov agencies, environmental organizations, recreational groups, First Nations
- Technical Working Groups
  - Fish, Wildlife, Recreation
- First Nations Committee
  - Initially in parallel, then merged



Bridge River WUP

Clarifying values: decision objectives and performance measures

Positions

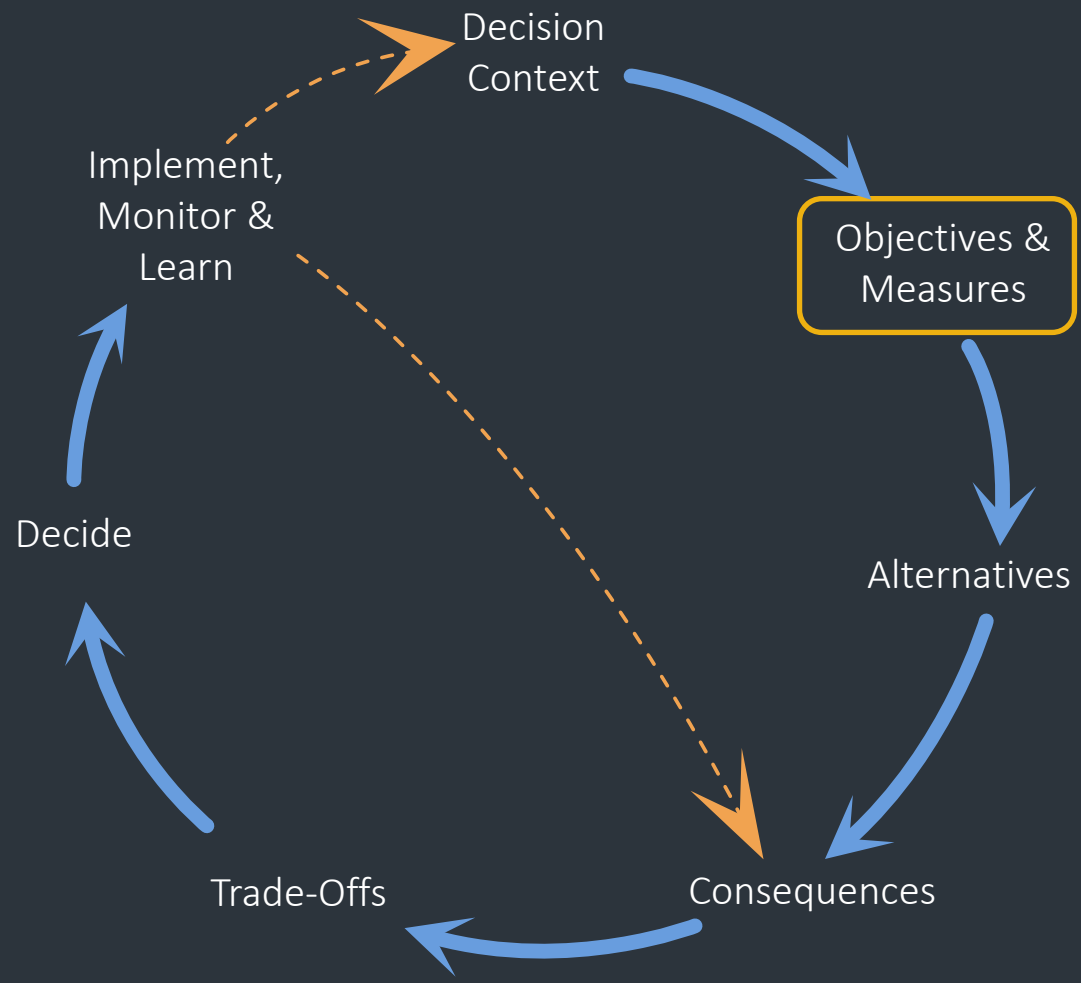
- "Want a smaller drawdown zone"
- "Want a more natural flow in the river"

Why is that important?

Affected by flow regime?

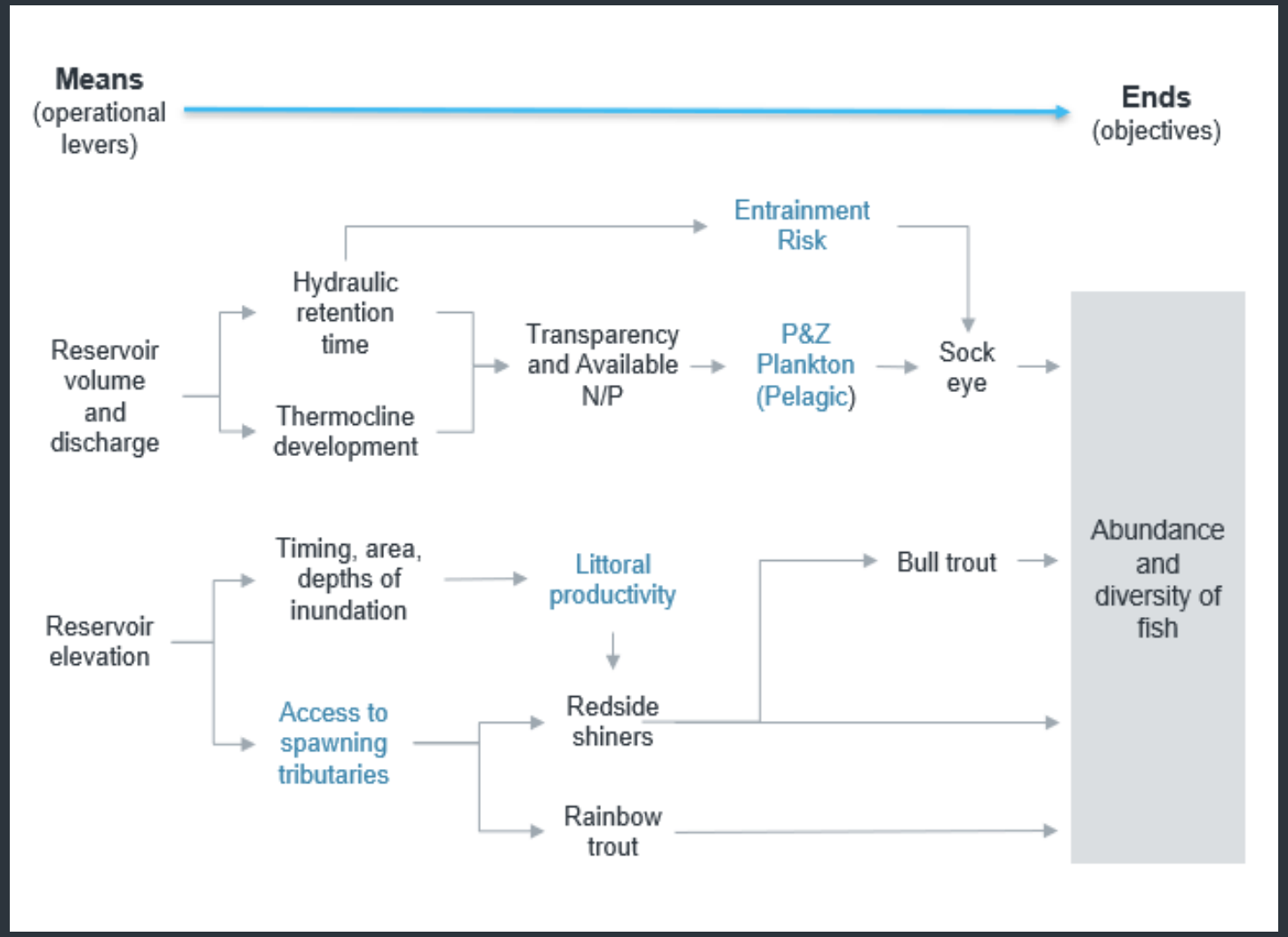
Objectives

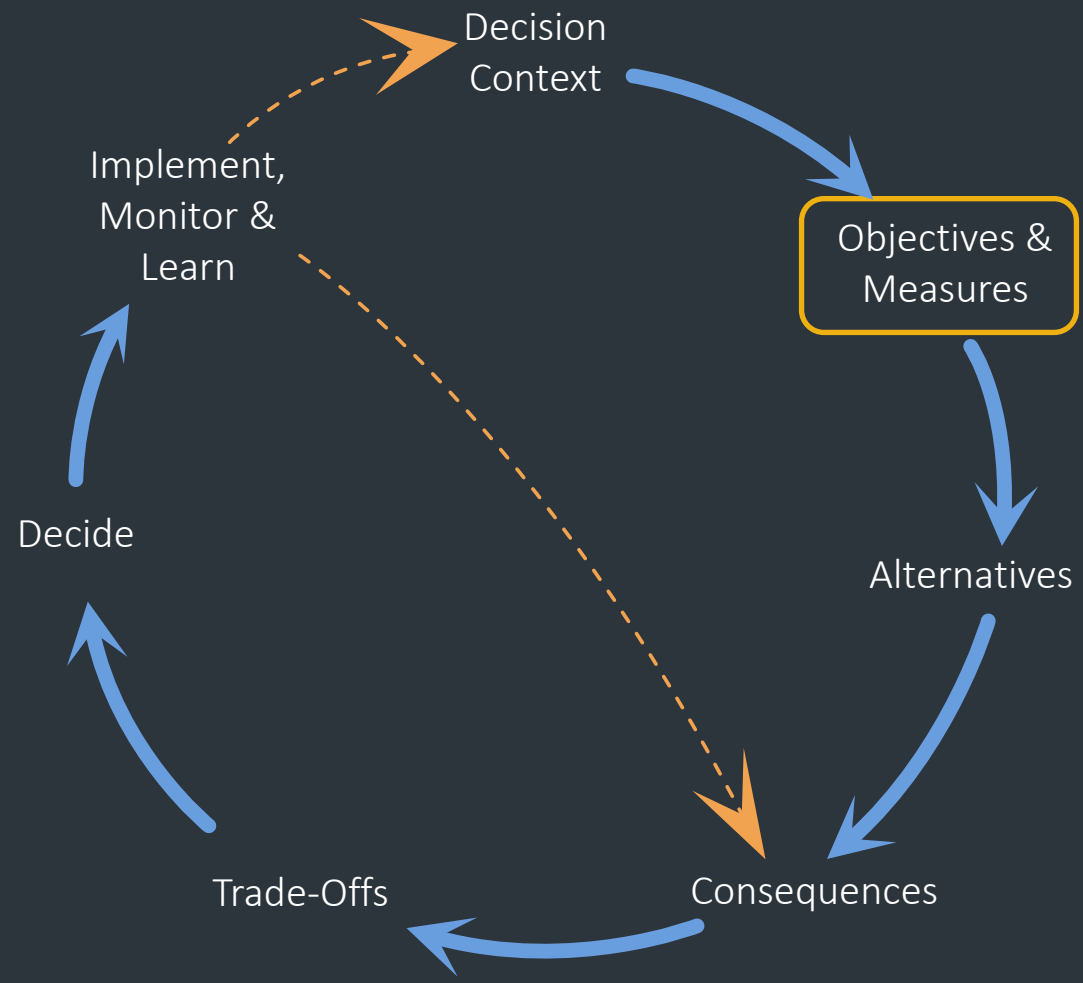
- Maximize the abundance and diversity of wild fish
- Maximize the area and productivity of wetlands and riparian areas



Bridge River WUP

Clarifying values: decision objectives and performance measures





Bridge River WUP

Clarifying values: decision objectives and performance measures

Maximize the abundance and diversity of fish in __ reservoir
- Maximize littoral productivity *(t carbon/year)*
- Minimize entrainment (*unitless stranding index*)
- Maximize tributary access (*hectares backwatered*)

Maximize abundance and diversity of fish in __ River
- Maximize natural shape (3-*point scale*)
- Minimize spills *(# days over threshold*)

Minimize damage from flooding
- Minimize property damage *(# days over threshold*)

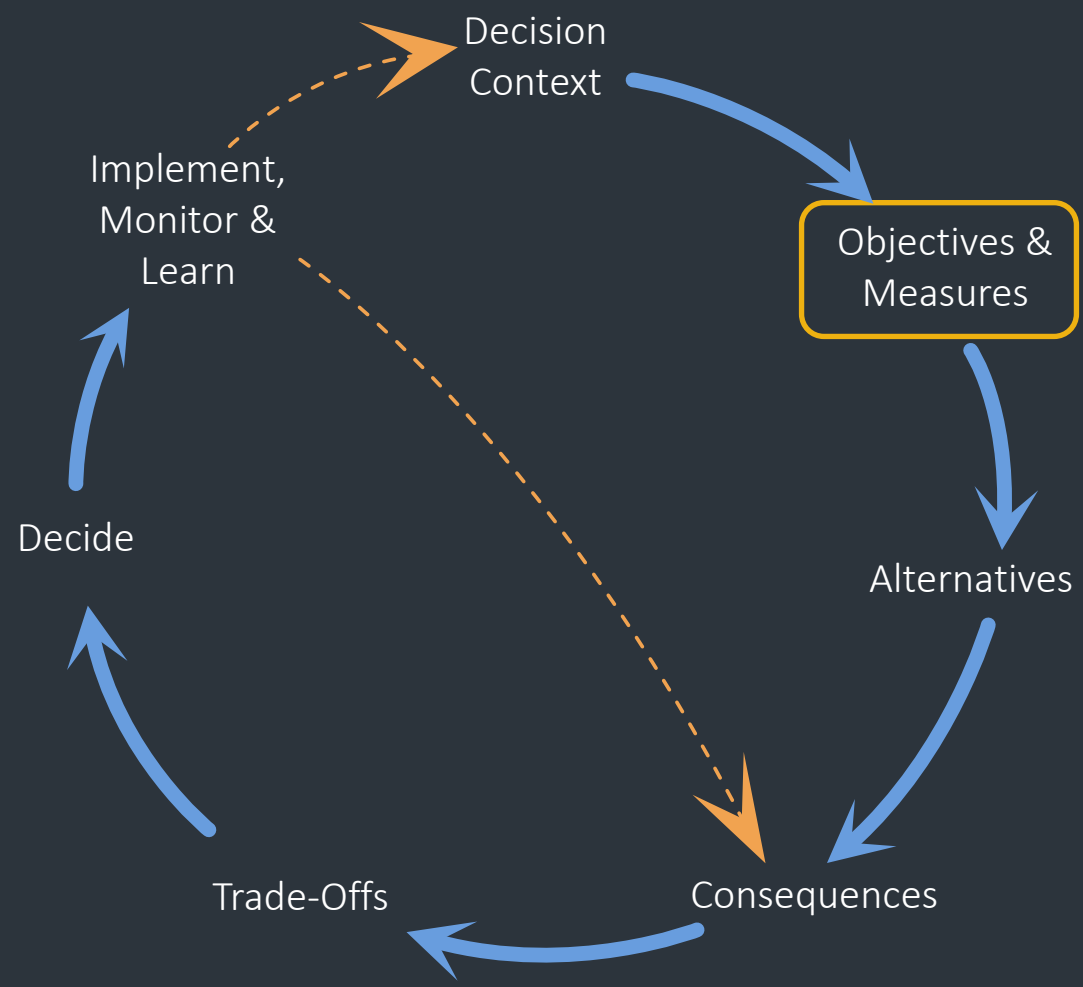
Maximize water quality at Seton Lake
- Minimize turbidity (*TSS load t / year)*

Maximize recreation opportunity
- Maximize aesthetic quality (*hectares of green-up*)

Maximize productivity of wetland and riparian habitat
- Maximize sedge-grass habitat (*weighted hectares*)

Maximize power benefits
- Maximize revenue (*net annual revenue, $/year*)

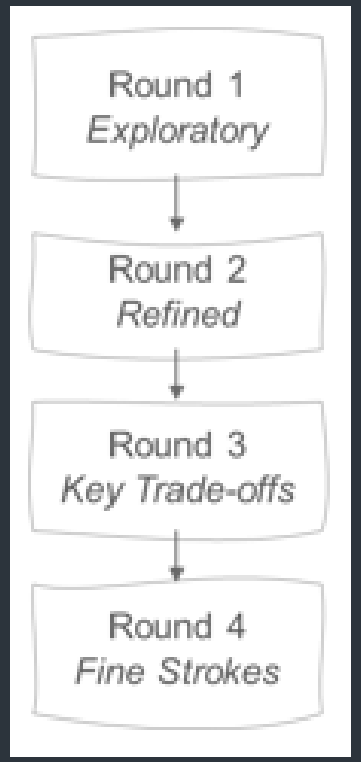
Simplified

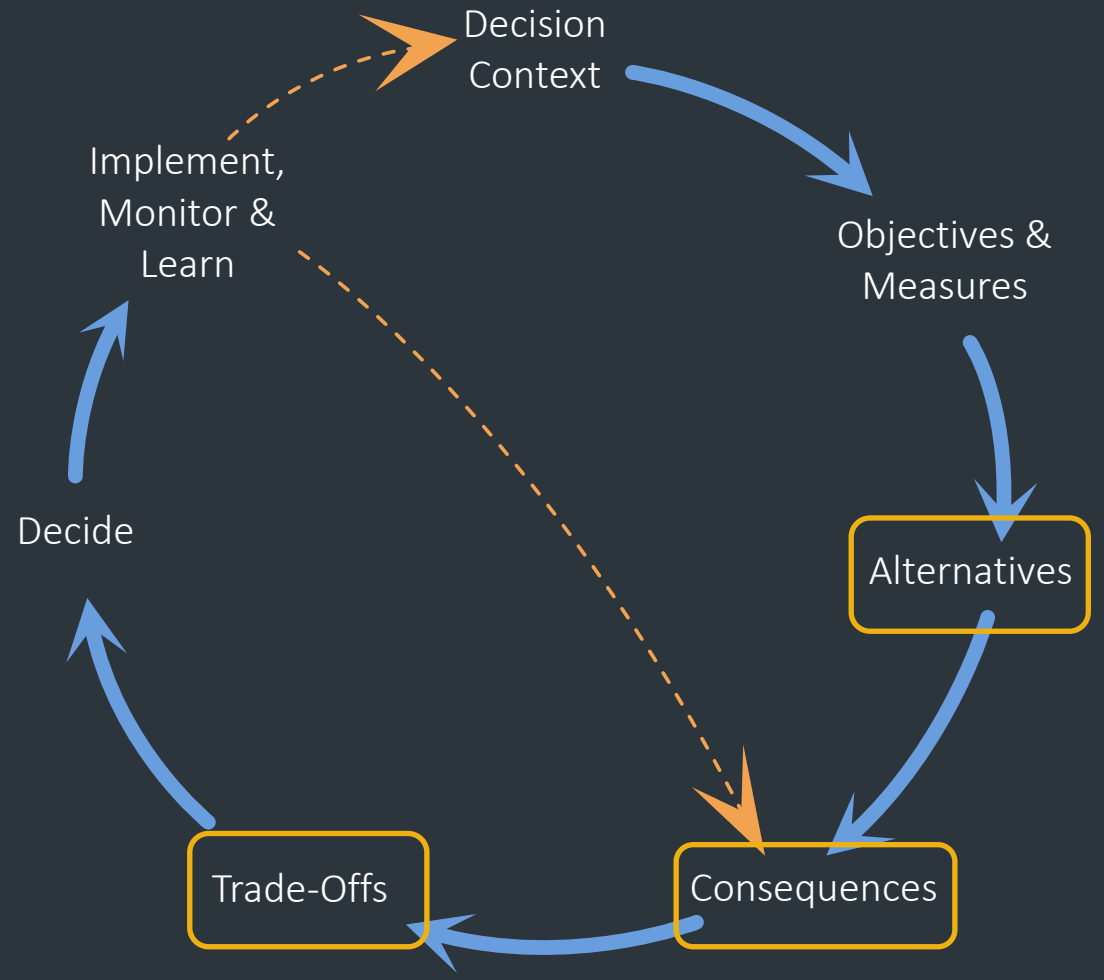


Bridge River WUP

Co-creating Alternatives – Iterative development of alternatives

- Alternative generation and evaluation occurs through several rounds
  - Use value-focused thinking
  - Start with ‘bookends’ to promote learning
  - Iteratively refine alternatives as you learn about trade-offs and uncertainties





Bridge River Water Use Plan – Consequence Table

Objectives Expand All Collapse All	Performance Measure	Units	Preferred Direction	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 8
Minimize flooding									
@ Lower bridge river	Flooding frequency	no. days/year	Lower						
@ Seton river	Flooding frequency	no. days/year	Lower						
Maximize fish abundance									
@ Carpenter Reservoir	Fish index	1-100	Higher						
@ Downton Reservoir	Fish index	1-100	Higher						
@ Lower bridge River	Fish index	1-100	Higher						
@ Seton Reservoir	Fish index	1-100	Higher						
Maximize water quality									
@ Seton Reservoir	Water suspended solids	Tonnes/y	Lower						
Maximize vegetated area									
@ Downton Reservoir	Weighted area	Hectares	Higher						
@ Carpenter Reservoir	Weighted area	Hectares	Higher						
Maximize power benefits									
Maximize power revenues	Revenue		Higher						

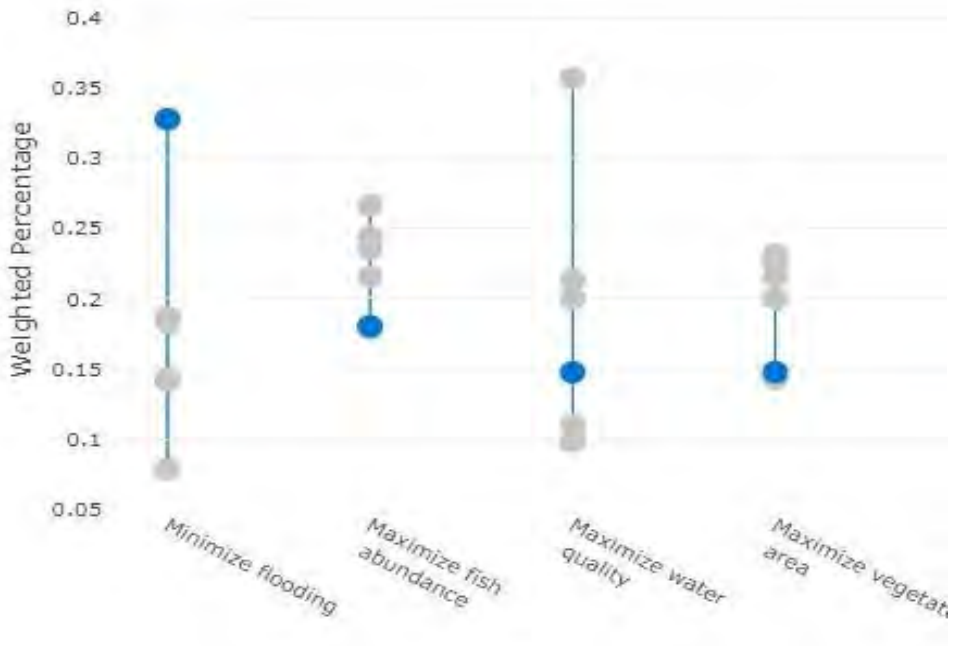
Bridge River Water Use Plan – Consequence Table

Objectives Expand All Collapse All	Performance Measure	Units	Preferred Direction	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 8
Minimize flooding									
@ Lower bridge river	Flooding frequency	no. days/year	Lower	1	1	0	0	0	0
@ Seton river	Flooding frequency	no. days/year	Lower	6	6	6	6	6	5
Maximize fish abundance									
@ Carpenter Reservoir	Fish index	1-100	Higher	69	70	41	41	29	29
@ Downton Reservoir	Fish index	1-100	Higher	42	71	48	69	65	69
@ Lower bridge River	Fish index	1-100	Higher	100	100	100	90	25	10
@ Seton Reservoir	Fish index	1-100	Higher	66	66	66	66	33	10
Maximize water quality									
@ Seton Reservoir	Water suspended solids	Tonnes/y	Lower	94	89	77	84	108	78
Maximize vegetated area									
@ Downton Reservoir	Weighted area	Hectares	Higher	223	231	322	313	295	300
@ Carpenter Reservoir	Weighted area	Hectares	Higher	759	522	758	520	602	600
Maximize power benefits									
Maximize power revenues	Revenue		Higher	141	145	146	149	144	145

Bridge River WUP: Deliberating about trade-offs

Objectives	Performance Measure	Units	Preferred Direction	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 8
Minimize flooding									
@ Lower bridge river	Flooding frequency	no. days/year	Lower	1	1	0			
@ Seton river	Flooding frequency	no. days/year	Lower	6	6	6			
Maximize fish abundance									
@ Carpenter Reservoir	Fish index	1-100	Higher	69	70	41			
@ Downton Reservoir	Fish index	1-100	Higher	42	71	48			
@ Lower bridge River	Fish index	1-100	Higher	100	100	100			
@ Seton Reservoir	Fish index	1-100	Higher	66	66	66			
Maximize water quality									
@ Seton Reservoir	Water suspended solids	Tonnes/y							

Objectives	Weights
Minimize flooding	30.2%
Maximize fish abundance	7.06%
Maximize water quality	28.63%
Maximize vegetated area	10.2%
Maximize power benefits	23.92%



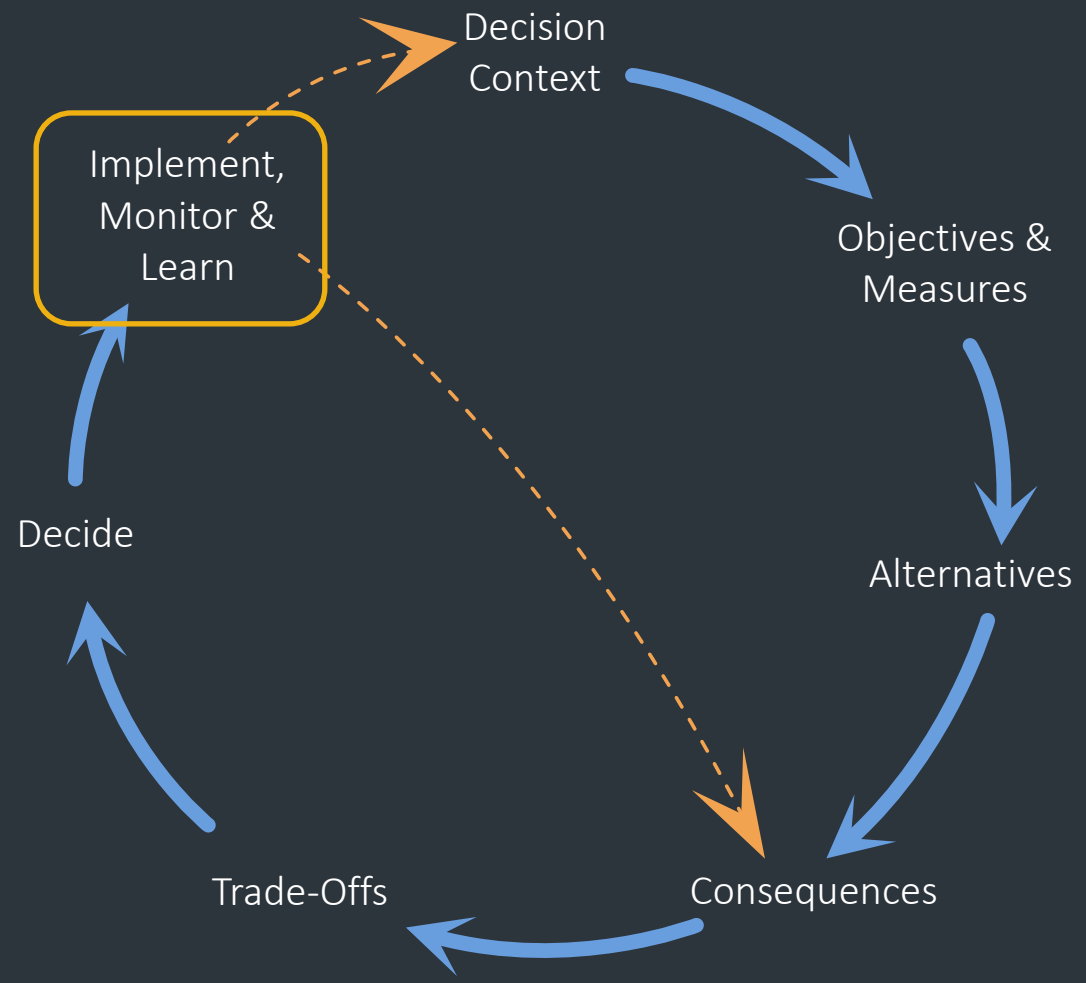
Use weighting to support deliberation, not to prescribe a solution

Poll for ‘level of support’:
Endorse
Accept
Oppose

Bridge River WUP

Dealing with uncertainty - expert judgment & adaptive management

1. Focus on decision-critical uncertainties
2. Use structured expert elicitation process to clarify key uncertainties
3. Consider experimental trials to test competing hypotheses

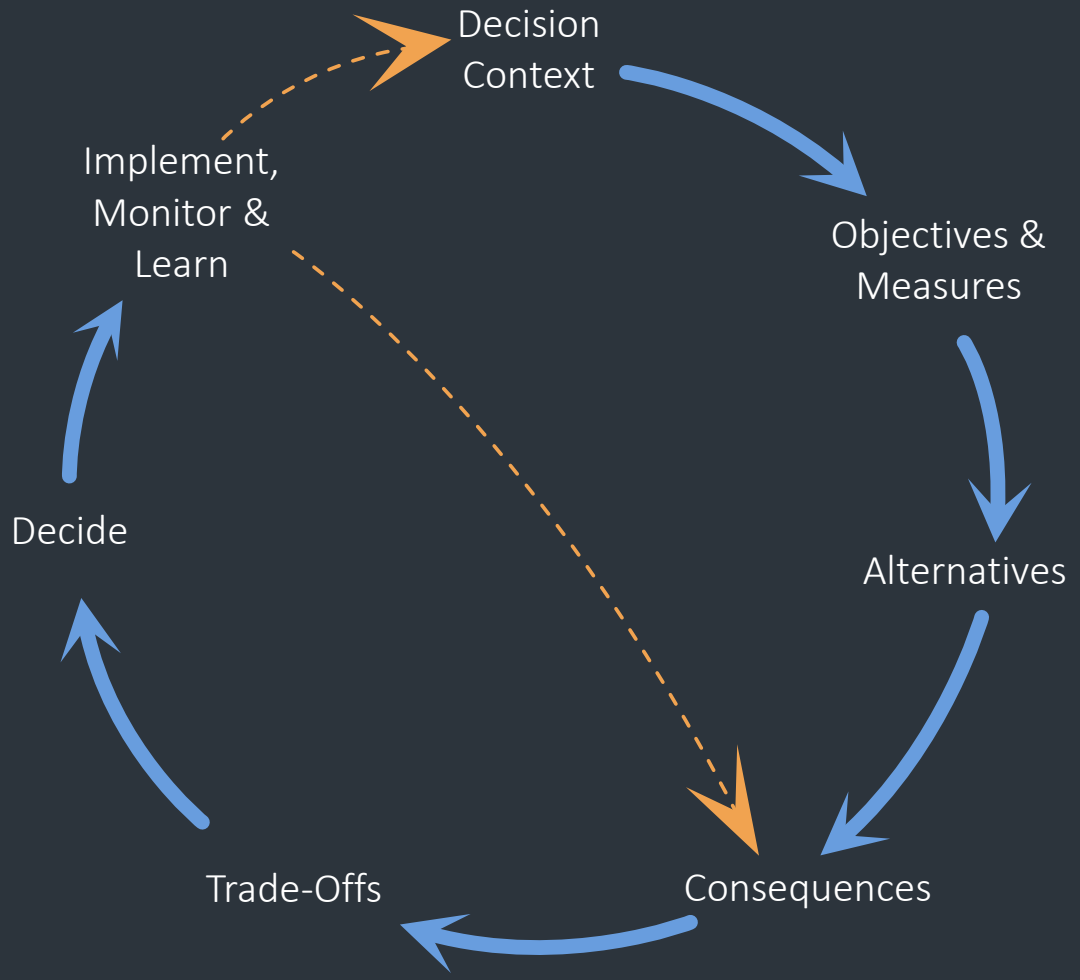


Bridge River WUP

The final plan

The final consensus plan included:

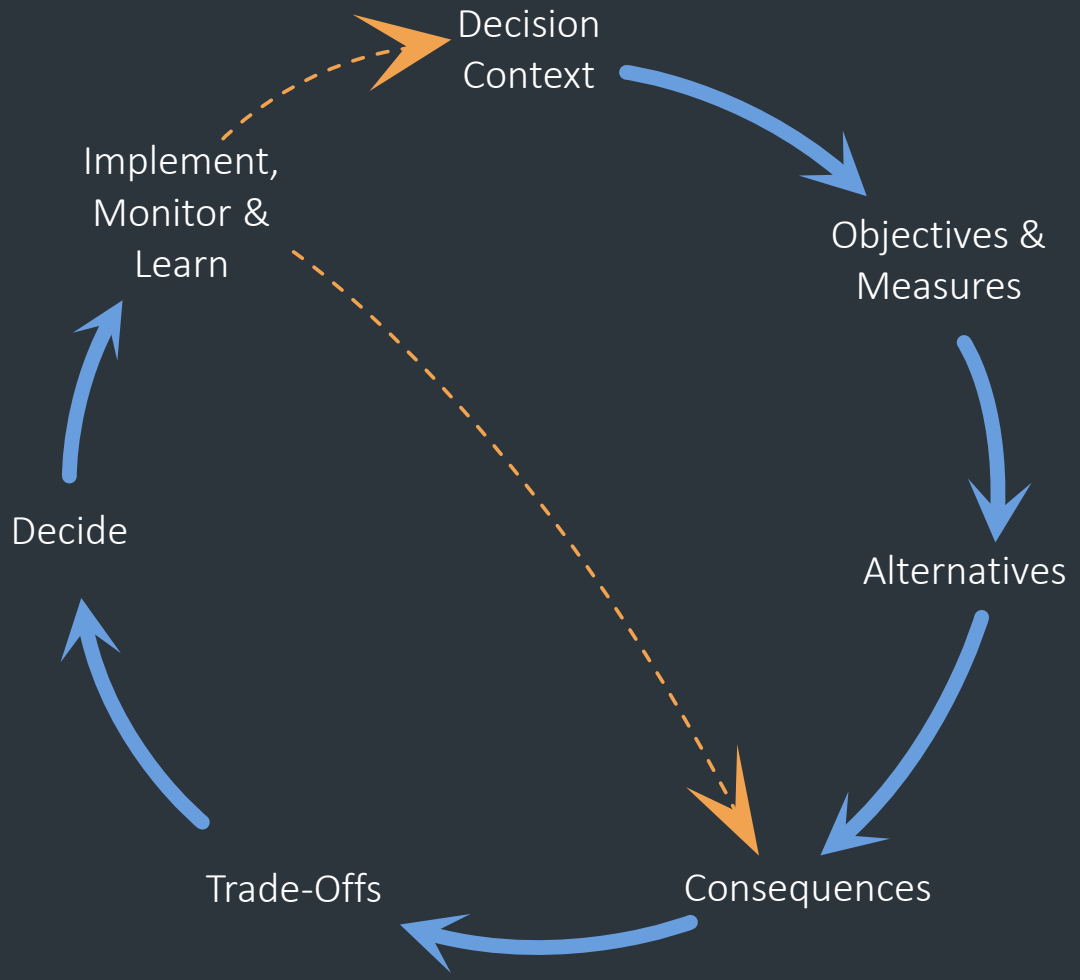
- An operating plan
- Mitigation works ‘in lieu’
- Monitoring plans
- Experimental trials
- Adaptive governance structure
- A commitment to review



Bridge River WUP

The outcome

- People learned (together)
- They changed their minds
- People with wildly different values agreed
- Trust was built, relationships strengthened
- Benefits for ecological, social and cultural values were achieved

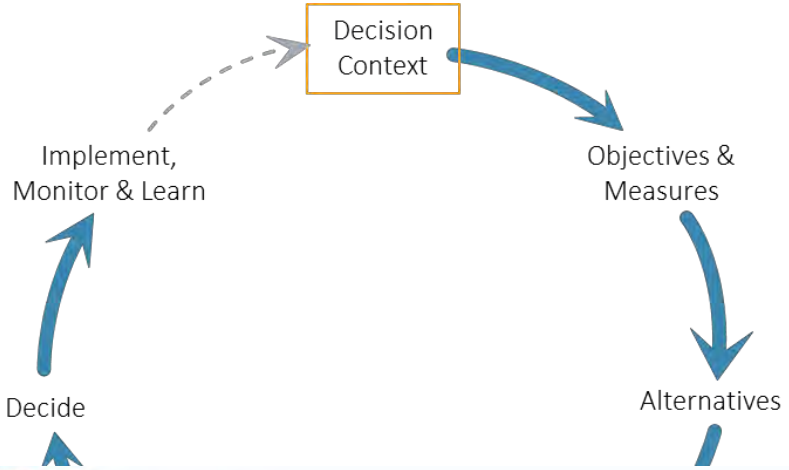


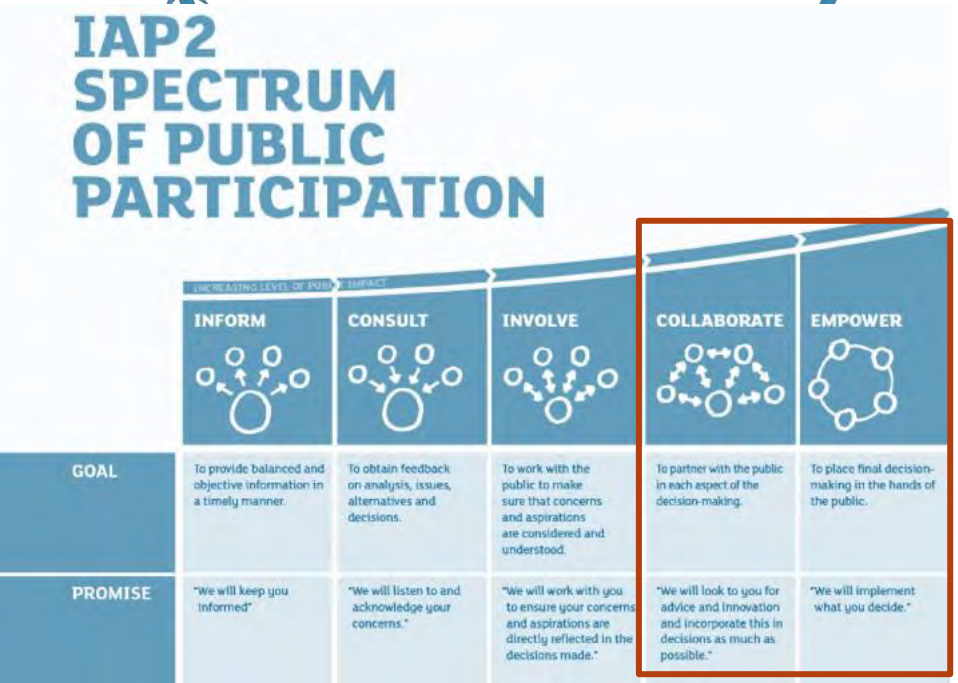
So what's going on?
What makes it work?

Key success factors

Key success factors

Shared understanding of scope and road map for the process



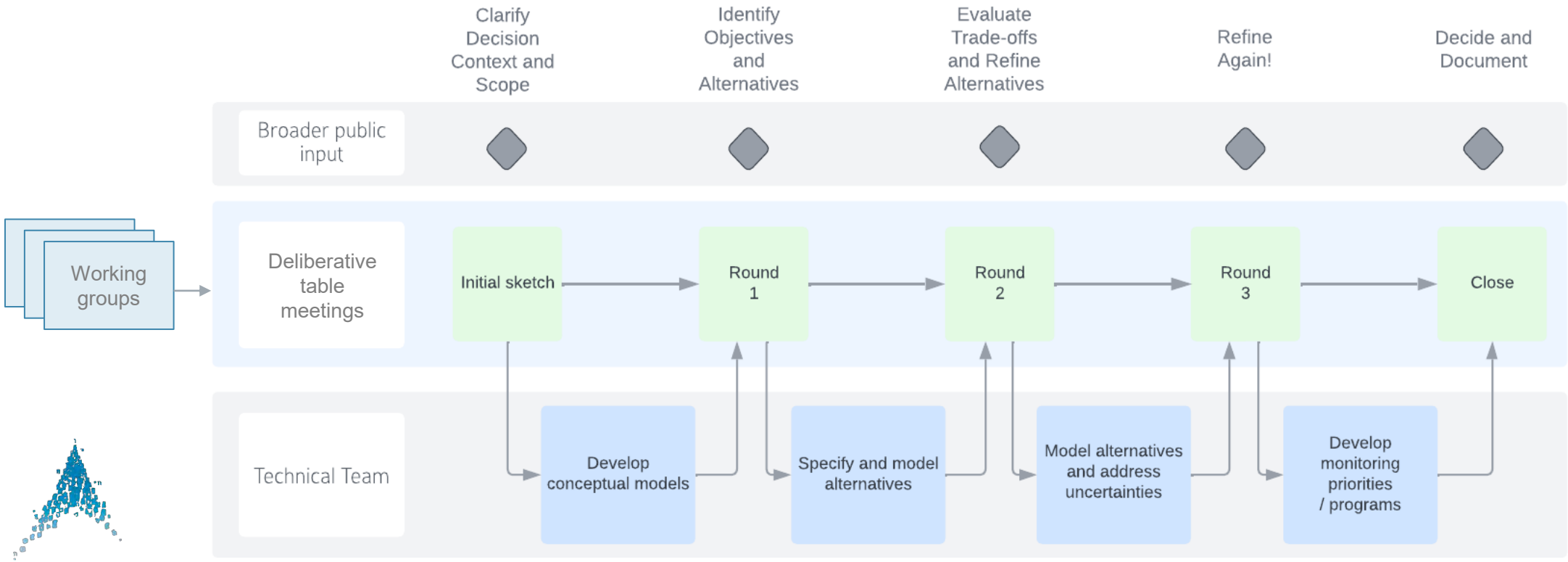


- Decision charter / process guidelines
  - Scope, roles, resources
- Decision 'sketch'
  - Informs engagement plan
  - Informs info-gathering and model-building
- Engagement process design
  - Depth and breadth
  - Iteration and shared learning
  - Integration of engagement and analysis
  - The role of consensus

Process Design considerations

Design the process for:

- depth and breadth – small deliberative table and broader public outreach
- iteration and shared learning – plan for several ‘rounds’ of evaluation
- integration of engagement and analysis – science serves the decision!



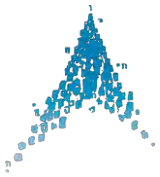
Key success factors

Good structuring is the foundation of good decisions

- Mind your facts and values
  - Separate technical judgments from value judgments
    - Levels the playing field and shifts balance of power
  - Hold space to talk about values
    - Reduces the incentive to manipulate the science
  - Decisions are value-based
    - *Informed* by technical analysis

Objectives	Performance Measure	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 8
Minimize flooding							
@ Lower bridge river	Flooding frequency	1	1	0	0	0	0
@ Seton river	Flooding frequency	6	6	6	6	6	5
Maximize fish abundance							
@ Carpenter Reservoir	Fish index	69	70	41	41	29	29
@ Downton Reservoir	Fish index	42	71	48	69	65	69
@ Lower bridge River	Fish index	100	100	100	90	25	10
@ Seton Reservoir	Fish index	66	66	66	66	33	10
Maximize water quality							
@ Seton Reservoir	Water suspended solids	94	89	77	84	108	78
Maximize vegetated area							
@ Downton Reservoir	Weighted area	223	231	322	313	295	300
@ Carpenter Reservoir	Weighted area	759	522	758	520	602	600
Maximize power benefits							
Maximize power revenues	Revenue	141	145	146	149	144	145

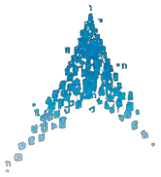
- People with very different values can agree on a solution



Key success factors

Co-learning

- Design for shared learning during the process
  - “Facts don’t change minds” (dueling experts)
  - Learning together does – the empty CT as a shared learning plan
  - Design for iterative learning
- Commitment to dealing with uncertainty over time
  - Identify decision-critical uncertainties
  - Commit to monitoring and adaptive management
  - Critical factor in achieving consensus



Key success factors

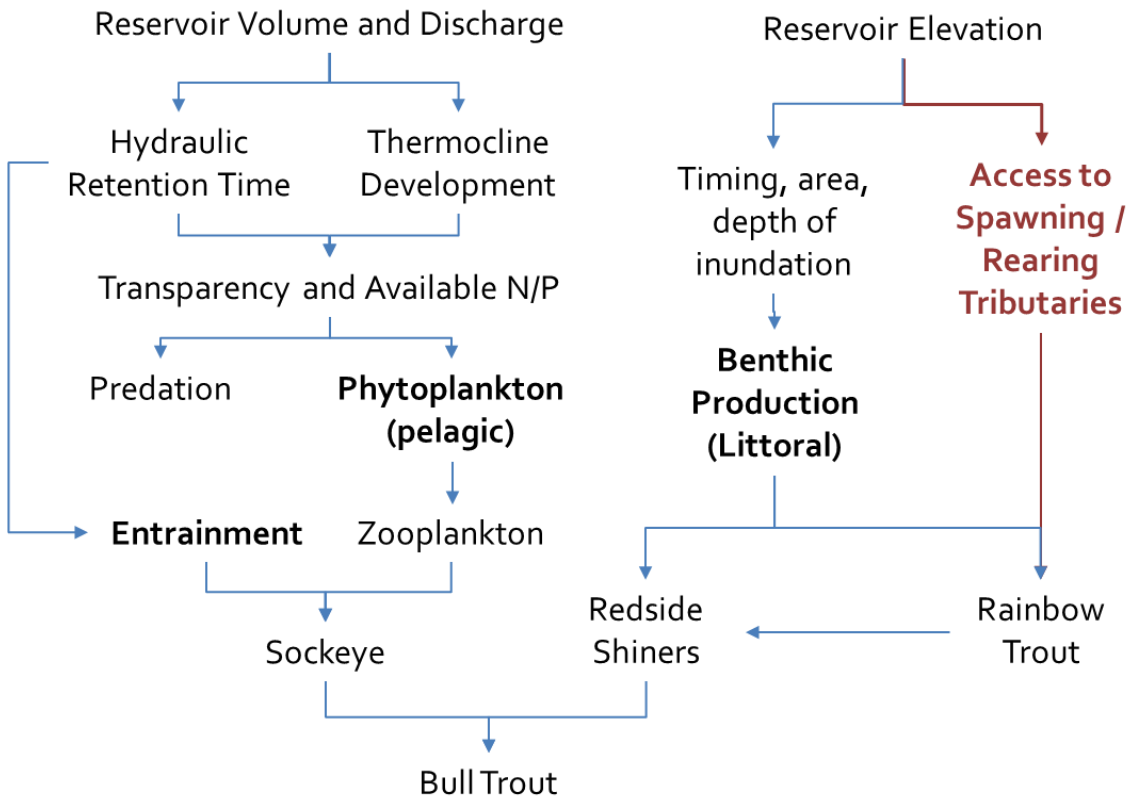
Leveling the playing field

- Technical vs non-technical
- Hard vs easy-to-quantify
- Accommodating other ways of knowing

Objectives and PMs – measure and report what matters, not what you have data for

Objective	Sub-objective	Measure (units)
Salmon	All species	Biomass (kg)
	Chinook	Biomass (kg)
Species at Risk	Harlequin ducks	Abundance (#)
Riparian Health	Adult cottonwood	Growth Mm /year
	Juvenile cottonwood	Growth Mm/year
River Health	Benthic community abundance	Millions of individuals
	Benthic community diversity	% EPT
Spiritual Quality	Voice of the river	Scale (1-5)
Finances	Power revenues	$ million per year
Learning	Scale	1-5

Competing hypotheses – put different ways of knowing on equal footing

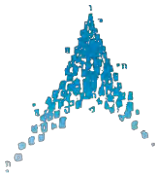


Key success factors

Cultivating the ability to deliberate effectively about value-based trade-offs

A good deliberative environment…

- Enables open and authentic conversations
  - Listening and respectful exchange, every voice is heard
- Promotes self-reflection and learning
  - It's not all 'us vs them', individuals grapple with own personal trade-offs
- Keeps the complexity in the conversation and moderates extreme views
  - Technical complexity and complexity of value-based trade-offs



Some key success factors

Recap

- A road map
- Careful structuring (facts and values)
- Co-learning and sustained commitment to it
- Level playing field
- Deliberating about value-based trade-offs
- Willingness to have open and authentic conversations

Session III

Results, Review and Reflection

Results: Outcomes

- ✓ Improved conditions for non-power values
  - ✓ BUT non-power outcomes not yet clear
- ✓ 22/23 WUPs by consensus
- ✓ Improved coordination, fewer jurisdictional overlaps
- ✓ Expanded knowledge & monitoring framework
- ✓ Comprehensive operating order revisions
- ✓ Stronger public license to operate
- ✓ Operating clarity, limits and authorizations
- ✓ Lower cost than expected

Results: Participant responses on WUP process

87% agreed or strongly agree that they were satisfied with the WUP process

VOICE

- 86% felt their interests were well-respected
- 90% felt the process encouraged open communication about interests

TRADEOFFS

- 93% gained a better understanding of others' values and interests
- 88% felt their understanding of trade-offs increased
- 88% understood trade-offs that were made between values

LINE OF SIGHT

- 84% had learned sufficiently about science, modeling process, and design parameters to have confidence in the CC report
- 78% felt the CC report well reflected discussions, analysis and decisions
- 92% understood how WUP decisions were made

FACILITATION

- 78% felt there was the right balance between analysis and discussion

Dovetail Consulting (2005)

The road to success is paved with challenges

- **Some participants felt:**
  - Scope should be broader
  - More training was needed
  - 50% felt some interests were not well addressed
  - Need to better engage local government, general public, first nations

(Dovetail Consulting (2005))

- **Demystifying the unknown**
  - Settling governance, boundaries
- **Curating line of sight**
  - Knitting languages and perspectives
  - Nurturing a culture shift
- **Engaging First Nations**
  - Perplexing governance environment

What is next?

Water use plan order review program

Objectives of WUPOR

- To determine whether orders are achieving intended objectives of the WUP
- To recommend how orders could be modified for sustained future operations
- To renew authorizations and orders, as determined by Fisheries and Oceans Canada and the Comptroller of Water Rights, respectively

Opportunities

- Build better understanding and seek consent and consensus with FN on operations
- Consider effects of climate change
- Evaluate further monitoring/studies

Water use plan order review program

WUP Order Review (contd)

- Status: 2 WUPORs submitted; 4 nearing completion; 6 underway. 14 to be started. Completion target: 2030

- Results:
  - Too early to tell (on an aggregate basis):
    - Non-power improvements relative to expectations
    - Value of studies and monitoring
  - 2 submitted reviews do not have extensive changes

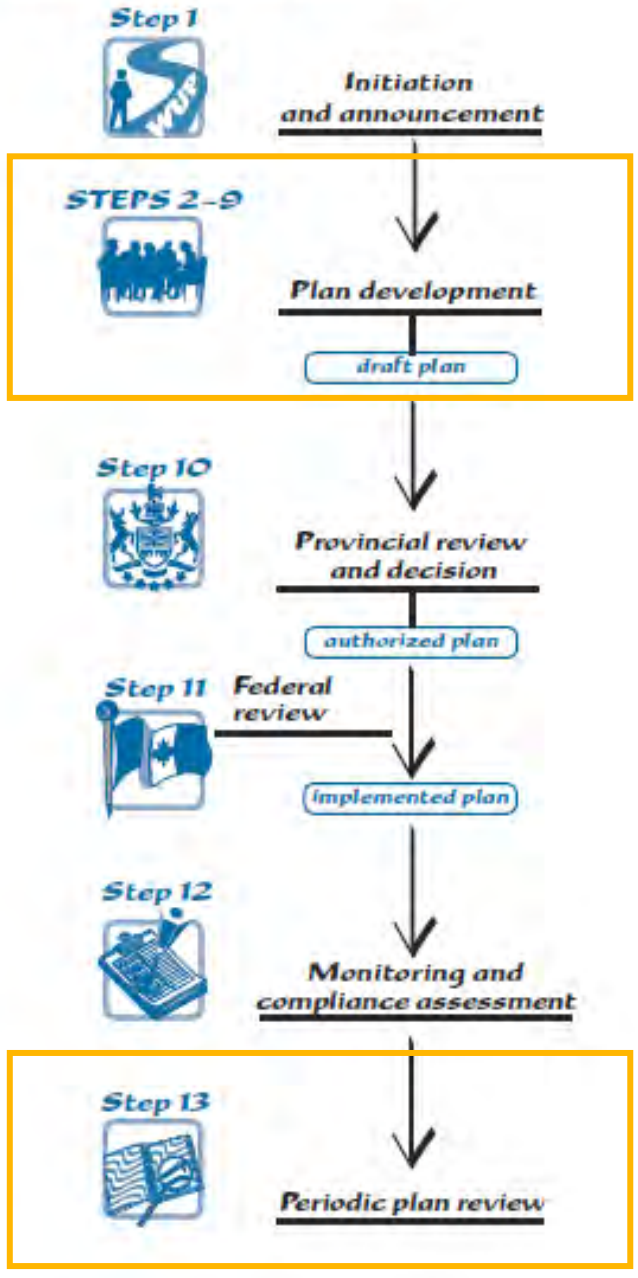
- Challenges:
  - Loss of continuity in participants (and related loss of institutional memory, knowledge and culture)
  - Expectations of scope
  - Future path to continue engagement – blending into existing approaches and activities; expand into role in watershed versus orders
  - Poor definition and structure

Cheakamus WUP

Revisiting it 20 years later….

compass

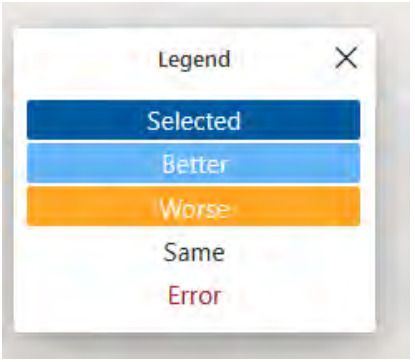
FIGURE 1
WUP Process: Overview



Cheakamus

Deliberation on Values-based Preferences and Trade-offs

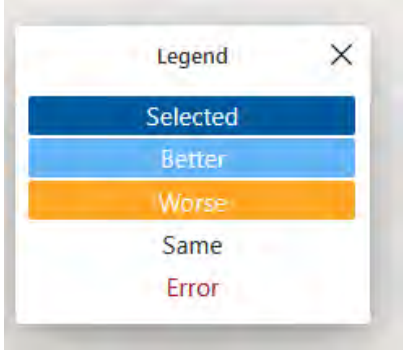
WUP 2002



Objective	Performance Measure	Unit	IFA	Optimal / Max Power	10 cms Minimum Flow	20 cms Minimum Flow	30 cms Minimum Flow	Pass all inflows
Power	Average annual power revenue over 32 water years	$ million/yr	27.5	39.2	37.4	32.9	27.2	0
Fish - chinook rearing	Median area of juvenile habitat for chinook	m2 (000s)	99.7	100.1	100.5	100.4	100.3	99.5
Fish - chum spawning	Median effective spawning area	m2 (000s)	5.8	8.0	10.2	8.2	4.3	2.8
First Nations Heritage and Culture	# days over flows>450 cms	# over 32 years	12	0	3	5	7	15
Aquatic Ecosystem	Average riffle benthic biomass	million grams	108.88	100.86	102.53	114.46	118.56	104.66
Flooding	# days over flows > 450 cms	# over 32 years	12	0	3	5	7	15
Recreation	Average # of days per year suitable for rafting and kayaking	#/yr	150	87	88	152	146	174

Collaboratively developed objectives and PMs, iteratively explored alternatives, weeded many out…

Deliberation on Values-based Preferences and Trade-offs
WUP 2002



Objective	Performance Measure	Unit	IFA	Alt "B" 15-20Min3-5-7Dam	Alt "C" 15-20MIN3-7Dam	Alt "D" 20Min7Dam
Power	Average annual power revenue over 32 water years	$ million/yr	26.9	34.0	33.0	32.3
Fish - chum spawning	Median effective spawning area	m2 (000s)	6.0	9.7	9.5	7.3
Recreation	Average # of days per year suitable for rafting and kayaking	#/yr	150	202	222	242

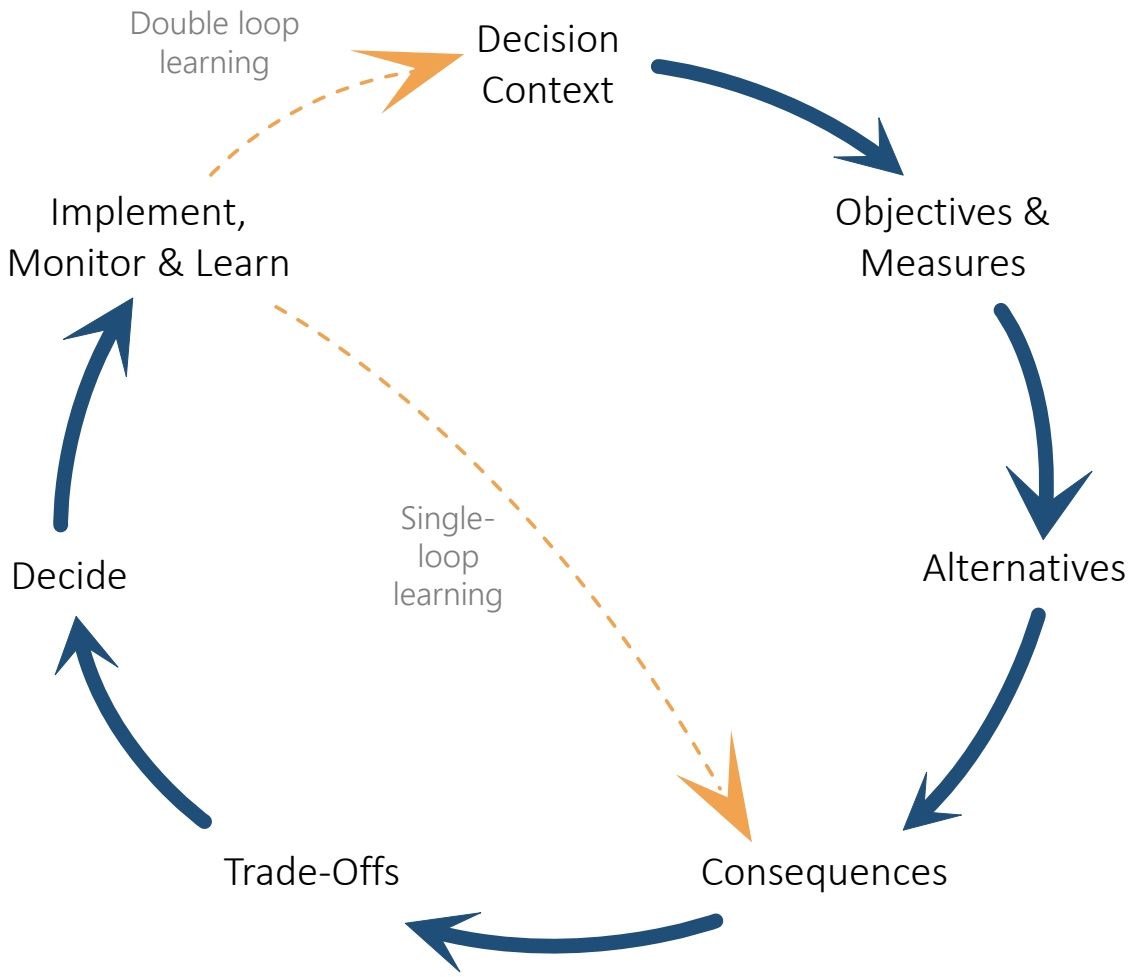
Consultative Committee Process outcome:

- Did not reach consensus on a preferred alternative
- Did reach consensus on a recommended monitoring program

BCH submitted and Water Comptroller approved a WUP based on Alt B (minimum flows for critical life history stages) + monitoring plan

Cheakamus Water Use Plan Review – WUP 2024

How to best operate the Cheakamus Hydro Facility given new information and new priority issues?



Same objectives, new PMs for fish and shift in First Nations values/priorities

Three main types of Alternatives:
1. Status Quo (Current WUP: Minimum flow requirements)
2. Flow-following requirements
3. Hybrids

Consequences estimated using new info from monitoring

Reached agreement in spite of residual uncertainties, *because of trade-offs with other values*

Final Consequence Table – WUP Review **2024**
(simplified)

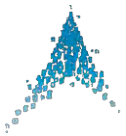
Objectives	PM Statistic	Unit	Max Power	WUP	WUP + Aug flows	Nat WUP	Hybrid #1_45%	Hybrid #2_45%
Indigenous Values, Resources, Culture and Way of Life								
Respect for spirit of the river	Difference from natural flows (Proportional method)	Index - proportional difference from natural	0.98	0.53	0.51	0.50	0.21	0.41
Power								
Power generation	Change in average annual power generation from WUP	% change in GWh/ year	18	0	-2	-4	-24	-8
Flooding								
Flooding risk to public and private property	# of days over 52 water years with Brackendale flows > 450 cms	# of days	9	9	9	8	10	9
Recreation								
Rafting	Mean; Preferred flows = >30 cms	# days/ peak rafting season	32	50	63	50	66	42
Wild fish								
Fish Habitat (BC Presumptive Instream Flow Method)								
Off-channel & tributary connectivity (Brackendale)	Mean daily deviation from MFT	cms	-26.5	-24.3	-24.3	-20.3	-13.1	-13.1
Off-channel & tributary connectivity (Daisy)	Mean daily deviation from MFT	cms	-27.1	-25.0	-25.0	-21.4	-12.9	-12.9
Fish Population (CMS Anadromous Reach)								
ST fry abundance (stock-recruit; no downramp)	median	# fall fry ('000s)	258	273	271	267	230	244
CM fry abundance (stock-recruit)	median	# of fry (millions)	6.35	5.49	5.48	5.54	5.60	5.49
CH fry abundance (RST-August model)	median	# fry (millions)	0.01	0.05	0.24	0.05	0.13	0.05

Advisory Committee Level of Support Across WUP Review Alternatives

Name	WUP	WUP + Aug flows	Nat WUP (no PFs)	Hybrid #1_30%	Hybrid #1_45%	Hybrid #2_30%	Hybrid #2_45%
Fisheries and Oceans Canada	Accept	Endorse	Accept	Oppose	Oppose	Oppose	Oppose
Squamish Nation	Oppose	Accept	Accept	Oppose	Oppose	Oppose	Oppose
Clint	Oppose	Endorse	Accept	Oppose	Oppose	Oppose	Oppose
CHessy	Oppose	Oppose	Accept	Oppose	Accept	Oppose	Oppose
BC Hydro	Endorse	Oppose	Endorse	Oppose	Oppose	Accept	Oppose
Scott MWLRS	Endorse	Accept	Endorse	Oppose	Oppose	Accept	Accept
Graham Young-Recreational Rafting	Endorse	Endorse	Accept	Accept	Accept	Oppose	Oppose

Some observations/take-aways

- Monitoring
  - Answered some, not all questions
  - Needs to be sufficient and sustained
- Exploring stakeholder-driven alternatives
  - Takes commitment, but enables learning… pays off?
- Values and trade-offs relatively robust over time
  - So far, the reviews (Cheakamus and Alouette) are making relatively modest tweaks
- Changes in First Nations context



REFLECTIONS

- WUPs moved the needle on water management
- WUPs designed for and moved the needle on working together
- SDM created a better approach to decision-aiding
- Partnering with First Nations remains a work in progress