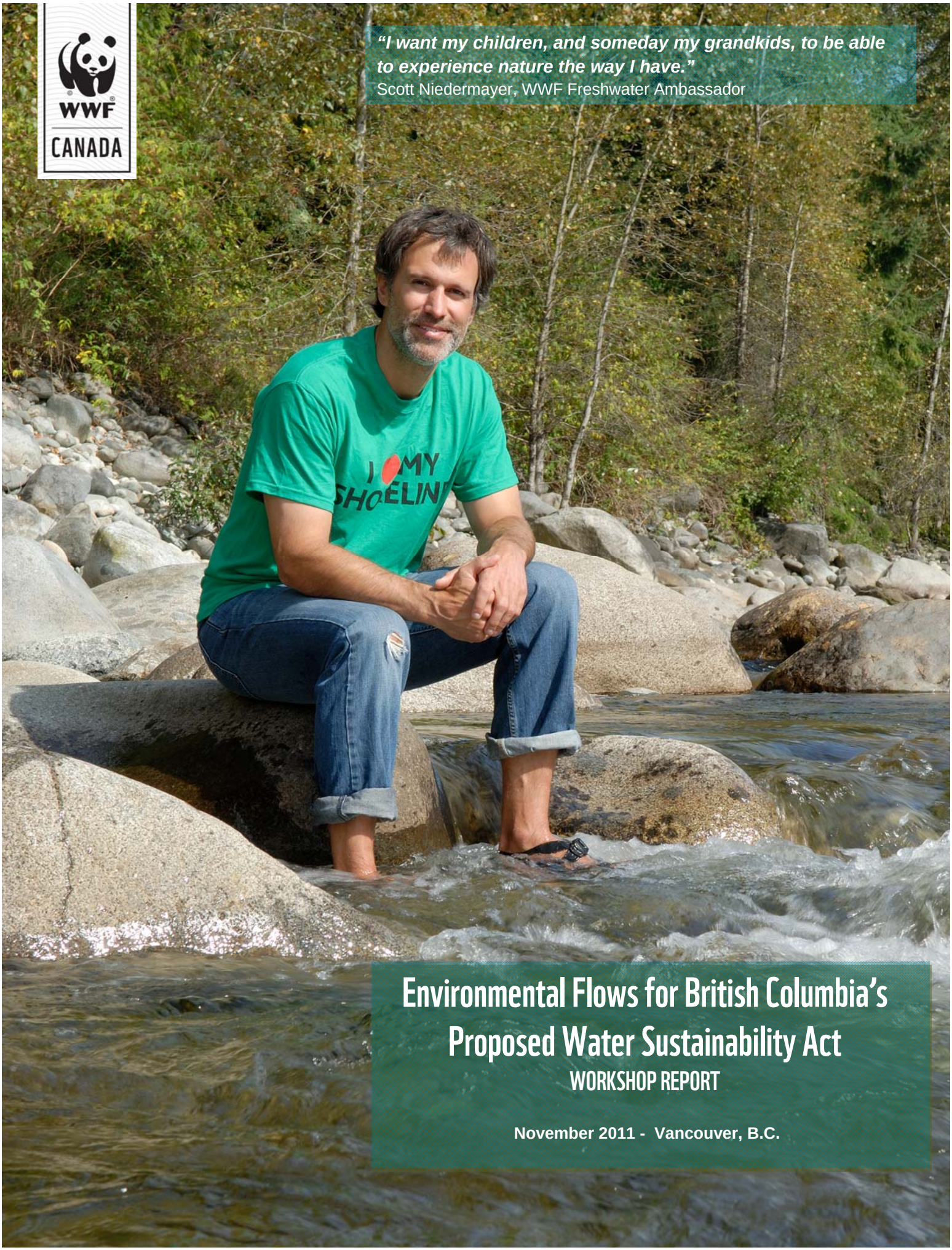

Environmental Flows for British Columbia's Proposed Water Sustainability Act

WORKSHOP REPORT

November 2011 - Vancouver, B.C.

Environmental Flows for British Columbia's Proposed Water Sustainability Act

Workshop Report

Hosted by WWF-Canada with B.C's Ministry of the Environment
and Ministry of Forests, Lands and Natural Resources
November 2011
Vancouver, B.C.

Thank you to the Gordon and Betty Moore Foundation for making this workshop possible.

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Environmental Flows for the Proposed BC Water Sustainability Act

WWF-Canada – BC MOE-MFLNRO Workshop Nov. 3, 2011 Vancouver BC

Summary of Key Points Prepared by WWF-Canada

This summary of key points from the workshop was prepared by WWF-Canada from detailed notes taken at all presentations, plenary sessions, discussions at the breakout cafes, summaries from the cafes, and question and answer sessions. Comments are not attributed to individuals.

This report summarizes the discussions held during the workshop. The report is not BC government policy. WWF has added a few additional paragraphs of commentary which are clearly labeled.

WWF Commentary

WWF is calling on the government to make environmental flows a key part of the proposed new BC Water Sustainability Act to protect British Columbia's river, watersheds, and ecosystems. To explore methods to achieve this goal, WWF and the Ministries of the Environment and Forests, Lands, and Natural Resource Operations held a workshop on November 3, 2011 on Environmental Flows in the Proposed BC Water Sustainability Act. We brought together over 50 of BC's water experts and practitioners to share ideas and experiences about how the province can protect environmental flows. Finding solutions to water challenges is imperative to reduce future conflict and cost arising from increasing water demands due to development, population growth and climate change. This document captures the discussions which took place at the workshop, and shows that there is broad consensus on the need to protect environmental flows in the new water act.

Representatives from the province of BC confirmed that draft legislation is not yet completed. WWF welcomes the province's commitment to release a version of draft legislation in the spring or summer of 2012, and looks forward to continued collaboration in the development of the Act.

WWF is also grateful for the support from the Gordon and Betty Moore Foundation for the workshop and for the Pacific region's freshwater program.

Summary of Key Points Prepared by WWF-Canada

The report first addresses the three major topics on the agenda. This is followed by a section covering a number of topics that were raised repeatedly by participants throughout the day and recorded by the note takers. The report is arranged into four main sections:

1. Approving new water licences

2. Regulating during scarcity
3. Planning in areas of over-allocation
4. Additional Key Insights

The report also provides material that was distributed to workshop participants. A list of workshop participants is attached as Appendix 1.

The Agenda and presentations from all presenters are attached as Appendix 2.

Two WWF-Canada papers on the terminology of environmental flows and WWF environmental flow reports from around the world that were distributed to all workshop participants are attached as Appendix 3.

The facilitator's workshop summary is attached as Appendix 4. WWF appreciates the assistance with facilitation, agenda organization and background research from Michael Harstone of Compass Resource Management.

This workshop summary report was written by Linda Nowlan, Mathieu LeBel, and James Casey of WWF-Canada.

I. New Water Licences- Environmental Flows Methods/Thresholds

1. Environmental flow method(s) and thresholds must be based solely on environmental flows science and should be peer-reviewed. The government should consider an expert and independent process in developing and selecting environmental flow method(s) and thresholds.

2. Social and economic interests should be considered after completion of the scientific assessment of environmental flow requirements and thresholds. A two part process is preferable so all can understand when decision makers choose to deviate from the scientific basis of an environmental flow determination. There is no ideal environmental flow regime for rivers or no 'wrong' point to be at on a 'tradeoff-curve' of social, economic, and environmental benefits, but the decision(s) regarding the granting of water licences and level of environmental flow protection should be transparent and based on predetermined scientifically defensible criteria.

3. Application of increasing precaution in environmental flow protection is desirable in situations of increasing uncertainty (e.g. absence of or limited data).

4. The water licencing process and environmental flows method(s) must consider cumulative water demands (e.g. existing licences) in water licencing decisions. In other words, the cumulative impact of an additional water licence on environmental flows needs to be evaluated.

5. The licencing process needs to be transparent. All information about licence applications and decisions should be made publicly available and include diverse perspectives.

6. A new Act should provide expanded opportunities for appeal of water decisions as the current Act is very limited compared to similar laws across Canada.

7. The environmental flow method(s) selected should be relatively simple to use and accessible for decision makers, but may be complex in terms of science underpinnings (e.g. a software application is a possibility).

8. Many jurisdictions are moving towards environmental flow recommendations that preserve the natural hydrograph, or parts of the natural hydrograph by (1) defining a maximum flow reduction factor (either a fixed-flow-value reduction from natural, or a per-cent-of-the-natural flow) from the natural flow on an instantaneous basis or a fixed value depending on a water-year type and season, and (2) some type of an ecosystem base flow (a flow at which further human-induced reductions in flow would result in unacceptable levels of risk to the health of the aquatic ecosystem) to protect the aquatic ecosystem during critically low-flow conditions.

9. River and stream hydrologic classifications are useful tools for environmental flows assessment.

10. 'Rigorous' adaptive management, that is the implementation of environmental flows accompanied by the commitment to monitor the response of the aquatic ecosystem to determine success in achieving desired objectives, and adjustment of environmental flows regime as needed and as knowledge improves over time, is a desirable goal.

11. Periodic reviews of water licences are desirable.

Draft Decision Process for Consideration Environmental Flow needs for all new allocation decisions

Step 1: Review application for risk factors.

Low risk applications are the majority of applications and are usually for irrigation, or single domestic uses.

Factors to consider:

- volume demand
- protected river or sensitive stream status under the Fish Protection Act
- SARA or provincially listed species (related to flow)
- water restrictions or water reserves
- diversion not supported by off stream storage
- flow sensitive landscape

Step 2: Assessing water supply.

Is the hydrograph natural? Can information be transferred from the main stream to the tributary?

Step 3: Determine Environmental Flow Needs.

Apply proposed new desktop method.

Draft baseline criteria for desktop method:

Method is easy to apply with few input variables.

i. Method is a decision aid, intended for reconnaissance level planning.

ii. Method should be adaptable as information improves over time with respect to riverine science, hydrology, and requirements of aquatic ecosystems.

iii. Method should be derived from ecologically based flow regime considerations and incorporate spatial and temporal flow conditions necessary to ensure long-term

protection of aquatic resources. Method addresses all parts of the natural (or naturalized) hydrograph.

iv. Method is appropriate for critical low flows where bulk of potential impacts are anticipated from for critical low flows where bulk of potential impacts are anticipated from diversions. Method includes identification of flow benchmark(s) (low flow, base flow or others) that serve as a trigger for management action.

v. Method has been peer reviewed and validated through local application.

Step 4: Scale reference stream to unnamed tributary.

The output from the desktop method is a graph which then is scaled to an unnamed tributary.

Step 5: Assess existing water demand.

Step 6: Determine additional considerations.

This is the second screen of the risk assessment framework, and considers factors such as:

- natural flow sensitivity of stream
- stream size
- species sensitivity
- extent of restrictions
- history of fish-flow conflicts
- volume and timing of request relative to supply
- temperature and nutrient loading impacts
- climate change projections
- proposed land use changes with impact on supply

Another factor that participants suggested could be on this risk list was the natural flow sensitivity of the stream.

Step 7: Request additional info from application if necessary.

Submit to DFO/FLNRO. The statutory decision maker incorporates all relevant info and makes a decision. The province is of the view that the regulator needs to make a decision that will not be appealed.

Participants commented that:

- There's a lot of data uncertainty.
- The province should consider a more precautionary approach

- Methodologies need to be consistent and efficient. Using a narrow scope of methods is OK as long as they meet criteria.
- Within the methods, what is needed is simplicity in application, not in the algorithms or science.
- Uncertainty in the data should guide the selection of the method (i.e. one method could be based on mean flow, another on low flow, especially in a lot of ungauged basins).
- With increasing scarcity, we will have access to much better water measurement (not as crude).

WWF Commentary

Jurisdictions that are moving towards environmental flow recommendations that include a maximum flow reduction factor component and an ecosystem base flow component include the Government of Alberta (Desktop Method for Establishing Environmental Flows in Alberta Rivers and Streams), New Zealand Ministry of Environment (Proposed National Environmental Standard on Ecological Flows and Water Levels), and Southwest Florida Water Management District (Minimum Flows and Levels). In British Columbia, a similar approach has also been proposed (Development of Instream Flow Thresholds as Guidelines for Reviewing Proposed Water Uses). It is also notable that this approach is reflected in academic literature such as Richter et al. (2011) A Presumptive Standard for Environmental Flow Protection which presents a presumptive standard restricting hydrologic alterations to within a percentage-based range around natural or historic flow variability, and acknowledges the need for a 'hands-off' or ecosystem base flow threshold where fish passage, water quality or other conditions are impaired by low flows.

II. Managing Water in Periods of Scarcity

12. Scarcity occurs when the natural flow doesn't satisfy water licencees' needs and environmental requirements. Simply put, water scarcity happens when there is not enough to go around.

13. The flow of water in natural watercourses varies seasonally and from year to year. The effects of a changing climate will continue to influence the uncertainty of how much water will be flowing at any given time in BC's creeks and rivers. With an increase in the protection of environmental flows needs, less water will be available for consumptive uses. More water use will need to be supported by storage of water to alleviate times of shortage and reduce the impacts of drought.

14. Regulation of water use during times of scarcity will need to take a site specific approach. A 'coarse filter' or rules-based approach can identify triggers for a regulatory response, but water managers will need to consider the specific circumstances of each case in determining what actions to take and when. Planning in advance of potential water shortages will help to avoid regulatory response by government regulators.

15. One option is to have the legislation put a new requirement on all licences that says from this date forward, all licences are subject to Environmental Flow requirements.

16. Participants discussed how water rights differ from other property rights. While some said the legal implication of reducing water rights was the same as taking away a house on private property, others said that people don't own the water, their licences give them a right to use the water, and the government can regulate how that right is exercised. The government says to land owners that private land cannot be used for certain purposes (i.e. hazardous waste disposal), and regulates many other features of how the land is used such as building height and envelope restrictions, tree retention, riparian protection, etc. The same ability to regulate use applies to water licences.

17. Storage rules are needed around the rate of filling of storage and what actions need to be taken if storage is not sufficient.

18. Ideally, involvement of local communities will help individual users to understand when risk levels start to go up. One proposal for the new Act is to empower a regional manager to make allowance for essential human needs.

19. In summary, to regulate during times of scarcity, a scale specifying levels of environmental flow protection would assist the decision-making process (e.g. thresholds specifying green (negligible ecosystem impacts), yellow (ecosystem experiencing stress), and red (ecosystem experiencing significant change) zones of expected ecosystem condition.

III. Addressing Over-allocation Through Watershed Sustainability Plans and Other Tools

20. The province is considering legal tools to respond to chronic shortages and conflicts, such as the use of a watershed sustainability plan (WSP). WSPs are meant to include water, land, and local government decisions but not include any activities regulated under the Forest and Range Practices Act.

21. The province notes that while a lot of new laws across Canada include big planning processes, BC has a limited appetite for this type of detailed prescriptive planning, and is more interested in using a cumulative effects framework, implemented through tools such as the proposed new Provincial Water Objectives. The proposal for the new Act recognizes the end of "big government "and emphasizes shared stewardship, shared governance, and downsizing the role of government.

22. The tools available now include a water management plan under Part 4 of the Water Act. No plan has yet been approved. Other than BC Hydro water use plans and water allocation plans on Vancouver Island, no other watershed plan has been endorsed by government. The province should be clear why existing plans are not used before introducing a new tool. Some noted that the main reason the government is not endorsing these plans is because of the cost. The province acknowledged that a number of planning tools are currently available but are not getting used.

23. Funds to create a plan are a necessary first step. Then resources are needed to implement the plan. For example, the Township of Langley plan did not have adequate resources to address implementation. One participant noted that the plan also did not get off the ground because the planning committee did not suggest licensing of groundwater. The main problem in Langley is groundwater depletion, but the multi-stakeholder plan did not

adequately address it. There was little political support for the plan. Council heard that the public wasn't going to support the plan, so they said they were going to change the plan because they wanted to get re-elected. The planning table did not try to build political support in the community.

24. Participants discussed whether plans should be led by local or provincial and federal governments, and generally agreed that senior governments need to provide data, and a local entity was better placed to prepare the plan. There has to be a significant group of people locally that believe they are better off with something rather than nothing. Local groups should not be discouraged from putting together their own plans as long as they're following the template and doing all the right things. Plans take a long time. Local groups should be responsible for funding the plans and senior levels of government can provide technical support and expertise (i.e. on drinking water quality and fish habitat needs).

25. A proactive approach to protecting environmental flows and making water licencing decisions would be to follow the provisions of a water plan, whether a watershed sustainability plan, or water allocation plan or water management framework.

26. The new Act needs to clarify what a watershed sustainability plan can and can't do. The WSA should be "really clear" about what a WSP would do, and the Act should:

i. Answer the questions: why would you want one? How is it going to help your community to have this plan?

ii. Include triggers, such as key watersheds that should have a watershed sustainability plan done (e.g. Nicola, Similkameen, etc.) and a commitment to act within those areas with timelines. Another potential trigger the province could consider is to list some of the areas where existing plans can be shifted into a WSP such as the Okanagan, Nicola, Cowichan, and Columbia. Others thought there should be no automatic grandfathering. When a plan is triggered, it needs to be matched with resources, there needs to be a dispute resolution process and plans developed locally about options to exercise in times of scarcity.

iii. Provide a template of minimum requirements for a watershed sustainability plan either in the Act, or in associated regulations or policies. Many participants agreed a standardized template for a WSP would be useful. The template should say the plan needs a minimum of X, Y and Z requirement, and may include more(i.e. it must include but is not limited to certain topics).

iv. Include a dispute resolution procedure.

v. Set a process with timelines which could be similar to the process to create and approve an Official Community Plan.

vi. Clarify responsibilities. Plans should be "local but not too local." If you create a plan, and get the community to agree to it in advance, the measures taken could work very well. Plans don't have to be scaled to the watershed, as political boundaries don't match watersheds.

vii. The Act also should state a clear procedure for approval. Participants noted that when plans go back to Cabinet, they always seem to stall. One option is to put timelines in the new Act (i.e. in the ON Clean Water Act, Cabinet has a defined period of time to consider a watershed protection plan, and then must either approve, partially approve or reject the plan. If Cabinet chooses either of the latter two options, it must provide reasons and the planning body may fix the plan and resubmit).

viii. Address funding. Participants had different views on how expensive the plans are. Key expenses need to be front ended. One view was that "Plans need to be delivered from outside government because there's no money in government." Others disagreed and said water protection was a critical government responsibility.

ix. Deal with existing licences.

x. Foster conservation. The principles of beneficial use should allow for flexibility.

xi. Include environmental flows as a key part of the WSP. "Find out what the water flow looks like" and incorporate that knowledge into different approvals and the provincial water objectives.

xii. Consider local funding solutions, such as those used by US counties.

xiii. Base plans on science.

xiv. Include transparency and precautionary flexibility provisions to address for climate change.

IV. Additional Key Insights

<u>First Nations Water Rights, and Aboriginal Rights and Title</u>

27. First Nations rights and title are an important part of water protection. First Nations representatives were invited to this workshop but chose not to attend.

28. Treaty agreements related to water must be respected.

29. Meaningful consultation and accommodation for First Nations must be provided in water licencing, allocation and planning processes and decisions.

<u>Groundwater Regulation</u>

30. Groundwater should be regulated immediately and province-wide in the new Act.

31. Groundwater withdrawals should be part of environmental flows assessment and management.

<u>How to Replicate Experience of Successful Water Sustainability Examples in BC</u>

32. The Okanagan Basin is one of the most water stressed areas in Canada. Its' Water Board is made up of three regional districts. It has a Water Stewardship Council which meets every month and whose job is to bring attention to public issues of concern, such as too many wells leading to groundwater depletion. After 3 years, the OBWB WSC produced the Okanagan Sustainable Water Strategy to try to maintain a sustainable watershed in Okanagan till 2050. The Strategy has action items. A major advantage is the OBWB has taxing power to tax property holders, and these revenues support the water board and council and are used to fund innovative research projects to provide evidence for changes that are needed.

Funding Mechanisms

33. Water plans are expensive. The province subscribes to a policy of no net revenue. The hard part is to find seed money up front to do the plan, recon and field work to do the planning process. That's a part of the trigger - find out if anyone is willing to fund it. If there's no buy-in to fund it, then implementation will not be feasible

34. The Australia Murray-Darling basin example shows that putting $2 million into planning today will cost a lot less than $10 billion 10 years from now, as that's how much the government there is spending to buy back water rights and build new water infrastructure. In the US, counties are required to allocate funds into resource management and water use. In BC, participants said, some municipalities would use taxes and spending allocations if the province would allow them to do it.

35. Participants discussed the need to reflect the true cost of water in fees charged by the government. The annual revenue generated from water licensing fees is currently $350 million, with 98% of those fees from BC Hydro, and 2% from everyone else.

36. Water is not properly valued. Municipal water is not free. Costs are charged to deliver water, but it is not as expensive as internet or cable services. This is not right; water should be valued and priced higher.

37. For the WSA to be a success, stable funding is essential, whether from a local taxing power such as that used by the Okanagan Basin Water Board, through increases in water rental fees, or some other mechanism.

Trade-offs Between Science and Social Decisions on Flows

38. Some said the science part is easy, but the challenge lies in what do you do with this information.

39. The threshold in stream flow levels must be based on sound science, with transparency in this science to allow for external evaluation. The statutory decision maker then makes a decision to accept the scientific recommendation. If the decision maker sets a lower threshhold based on socio-economic considerations and trade-offs, transparency is needed so the public is clear how the decision was made. As well, with decision makers located all over province that may have the ability to decide for lower flows, they need clear criteria for how they do this.

Coordinated Approach with Existing Statutes

40. Existing statutes and mandates to implement environmental flow protection should be used in conjunction with the new proposed Water Sustainability Act. These statutes include, but are not limited to: the federal *Fisheries Act* and *Species at Risk Act*, and provincial laws such as the *Fish Protection Act*.

Beneficial Use

41. This concept of beneficial use is not as clear as it could be and the new Act can remedy this problem. For example, does the definition allow you to irrigate alfalfa every day, even if 80% of the water does not reach its objective and other ecosystem elements are not getting enough water?

42. If people are not using water beneficially, the province has the power to amend or cancel a water licence. When you have water rights, you also have responsibilities: to pay the licence fees, follow the licence's purpose and not waste water, and use water beneficially. If you do not meet these three requirements, then the province can cancel or amend your licence.

43. Agriculture is a special case. Farmers need water 24/7 and this can conflict with the need for August/September fish flows. One option could be to give farmers short term approvals for use in May and June. Then you could ask them to shut down in August and September when water is low, which could help rectify the problem. However, this would require more management: if you give out short term licences there needs to be staff checking on people to make sure they shut down in the middle of July.

Existing Water Licences

44. Drought response plans work reasonably well. People are willing to do the right thing if they understand the reasons and purpose. It's possible to get the community together if you show them the data on how to deal with the problem of water shortages and how others have done it.

45. People want alternatives -- people don't understand tradeoffs in certain water years. It's easier to restrict water use when you have a plan that the community has agreed on in advance. The community would have to agree in times of drought when to apply FITFIR, provide options within the plan that the community can choose from and agree upon.

46. One model to consider is from Australia – individuals have a water licence but there is a specific water allocation budget that is based on the actual water available that year, and licencees get a percentage allocation for that licence based on the total amount available.

47. Watershed Sustainability Plans proposed for the new Act must deal with existing water licences to provide the right degree of protection for environmental flows.

WWF- Canada Commentary:

In order to protect environmental flows and the aquatic ecosystem, it is essential for all water licences to be subject to environmental flow management conditions. Therefore, where existing water licences have been issued prior to the consideration of environmental flows, reconciliation of these licences with environmental flow conditions must occur. This is a challenging process that often leads to an impasse (take for example the difficulty in reconciling 2 senior licences in the Athabasca River following a decade of planning processes, public attention, science recommendations and government commitments) WWF-Canada , 2011 Securing Environmental Flows in the Athabasca River, http://assets.wwf.ca/downloads/wwf_canada_athabasca_report.pdf

However, the legal reform process provides a unique, and perhaps the most politically palatable, opportunity to reconcile and modernize existing water licences with prevailing scientific understanding and current societal expectations of sustainable water management. Some jurisdictions have already addressed the reconciliation of existing water licences with environmental flow management conditions in a fair manner to water licence holders during legal reform processes (e.g. New Zealand as described in WWF-Canada's 2011 WAM submission). Reconciliation of existing licences with environmental flow management is therefore achievable. The consequences of not reconciling existing licences with environmental flow management conditions are simply that, there is no legal certainty that environmental flow objectives will be met where there are existing licences.

The practice of issuing water licences issued in perpetuity or protecting existing water licences from periodic review (as was done in Alberta when the Water Resources Act was reformed into the Water Act) creates inflexible arrangements that cannot adapt to changing circumstances, reducing the ability to meet other water management objectives. It is reasonable that all water licences should be subject to similar management conditions, even where a priority system is in place.

BC Hydro Plans

48. A good example of a process to set environmental flows in water management plans that aim to meet social, economic, and environmental objectives, is the Water Use Planning process applied for operations at BC Hydro hydroelectric facilities. However, similar to Watershed Sustainability Plans, the Water Planning Process may not be possible to apply in all watersheds, and so there is a need for clear criteria (e.g. environmental, social, and economic) to be established in water licencing process to meet environmental flow thresholds. It's important to note that BC hydro water use plans were about how people operate storage/release water, not about taking water back.

Climate Change

49. Climate change will increase demands for water. Plans can no longer be stationary; they will require flexibility to address changing conditions brought about by climate change, and

allow people to work within a formalized process to address the issues. If you don't have flexible planning procedures in place, then in an emergency situation or a chronic shortage phase, it would be a scramble to get everyone on board to cut back on water use.

Appendix 1

List of Workshop Participants

Name of Participant	Organization
Anna Warwick Sears	Okanagan Basin Water Board
Tom Siddon	
Oliver Brandes	POLIS
Craig Orr	Watershed Watch Salmon Society
Randy Christensen	Ecojustice
Jeffery Young	David Suzuki Foundation
Marc Nelitz	ESSA Technologies
Mark Porter	ESSA Technologies
Ron Ptolemy	Ministry of Environment
Todd Hatfield	Solander Ecological Research
Steve Litke	Fraser River Basin Council
Paul Higgins	BC Hydro
Darren Sherbott	BC Hydro
Valerie Cameron	Ministry of Environment
Lynn Kriwoken	Ministry of Environment
Ted White	Ministry of Environment
Ted Van der Gulik	Ministry of Environment
Brian Symonds	Ministry of Forest Lands and Natural Resources Operations
Lee Hesketh	Fraser River Basin Council / Rancher
Matt Kennedy	Cloudworks Energy Inc
Adam Lewis	EcoFish
Hans Schreier	University of British Columbia
Ivan Thompson	Gordon and Betty Moore Foundation
Amy Huva	North Growth Foundation
Tony Maas	WWF Canada
Linda Nowlan	WWF Canada
Mat Lebel	WWF Canada
James Casey	WWF Canada
Arlin Hackman	WWF-Canada
Alicia Sierra	WWF-Canada
Drew Kilback	Catalyst Paper
Loch McJannett	Clean Energy BC
Albert van Roodselaar	Metro Vancouver
Ted Molyneux	BC Water and Waste Association
Al Caverly	Ministry of Environment
Brian Riddell	Pacific Salmon Foundation
Steven Hilts	Teck Mining
Bruce McFarlane	Ministry of Environment
Dean Watts	Department of Fisheries and Oceans
Cory Bettles	Cloudworks Energy Inc.
Greg Norton	Rescan Environmental Services
Jordan Rosenfeld	Ministry of Environment
Colleen Giroux-Schmidt	Innergex Renewable Energy Inc.
Stuart Croft	Summit Development
Scott Niedermayer	WWF-Canada Freshwater Ambassador
Andrea Barnett	Ducks Unlimited Canada

Dan Buffet	Ducks Unlimited Canada
Al Lil	Living Rivers Trust
Michael Harstone	Compass Resource Management
Jesse Baltutis	POLIS
Randy Cairns	Ministry of Environment
Selina Agbayani	WWF-Canada
Ola Sokolowski	WWF-Volunteer
Andjela Knezevic-Stevanovic	Metro Vancouver
Allan Locke	Alberta Sustainable Resource Development, Fish and Wildlife Division
Julia Berardinucci	Ministry of Forest Lands and Natural Resources Operations
Kim Hyatt	Department of Fisheries and Oceans

Appendix 2

Presentations

Presentation by Michael Harstone, Compass Resource Management

compass

Environmental Flows and BC's Proposed *Water Sustainability Act*

November 3rd, 2011

WWF

BRITISH COLUMBIA

GORDON AND BETTY MOORE FOUNDATION

Michael Harstone
Compass Resource Management

Welcome

2

Goals for the Day

Develop detailed input for BC on the practicalities of implementing environmental flow protection in the proposed BC *Water Sustainability Act*.

3

Proposed Agenda

- Welcome and Overview
- Evolving Environmental Flow Law
- Provincial Context
- WSA and Regulating Environmental Flows
- Café Break Out Discussions
- Plenary Discussion
- Case Studies
- Closing Panel and Plenary Discussion

4

About Today

- Designed to be interactive and focused
- Organized around areas that the province is seeking specific feedback on
- Information and ideas surrounding the WSA policy options are draft
- Many aspects of environmental flows discussed today may be more suited to subsequent regs/policies
- Unique opportunity to inform the drafting of a major piece of legislation (and how it may ultimately be implemented)

5

Ground Rules

- Strive for Inclusion and Respect
- Challenge ideas, not people
- Seek common ground
- Stay focused
- Let there be Humour!

6

Environmental Flows

Describe the quantity, timing and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend upon these ecosystems (Brisbane Declaration, 2007).

7

Evolving Environmental Flow Law in Canada

Linda Nowlan
Director, Pacific Conservation of WWF-Canada

8

Provincial Context

Valerie Cameron
Regional Manager, Water Stewardship
Forests, Lands and Natural Resource Operations

9

WSA and Regulating Environmental Flows

Ted White
A/Manager, Water Protection & Sustainability
Branch, Ministry of Environment

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Café Style Group Discussions

Overview

- The sessions are designed to be informal and interactive
- Four café break out groups will be held concurrently and participants will be invited to float between them as their interests and expertise dictate
- The topic areas for the cafés will be organized according to the main regulatory functions within the WSA **plus** an open café to explore something else?
- Each café will have a resource (content) person who will facilitate discussions and summarize key points

11

Café Style Group Discussions

Ground Rules

1. **One conversation at a time within the Cafés**
   - No side bar conversations ➔ move outside the rooms if you want a private conversation
2. Move between the cafés as your interests dictate, but be mindful you are joining a discussion already in progress
3. Treat each other with respect and make space for everyone to participate

12

Café Style Group Discussions

General Format

10 min Context

60 min Open Discussion

20 min Summary and Key Feedback Points

13

Café 1 – Approving New Water Licenses

Feedback Questions:

Process to Select Desktop Method(s):
- *Are the baseline criteria appropriate?*
- *Approach for ungauged streams?*

Assessing Risks:
- *What additional risk factors should be considered?*

Transparency / Consistency in Decision Making:
- *Are there other steps that could improve consistency and transparency in the decision-making?*

14

Café 2 – Regulating During Scarcity

Feedback Areas

- *What benchmarks should be used to trigger regulation?*
- *What is the best strategy for ungauged watersheds?*
- *Determining groundwater connectivity, what is the default (connected or not)?*

15

Café 3 – Planning in Areas of Over-Allocation (addressing chronic shortages)

Feedback Areas

Watershed Sustainability Plans

- *Under what circumstances would a plan be triggered?*
- *Does government have to lead the planning process?*
- *How will existing water rights be addressed where there is a need to reduce withdrawals?*

16

Café 4 – Open Discussion

Feedback Areas

- What other areas do people want to have input on?

17

Café 1 Approving Water Licenses	Rm 4805 (4th Flr)	Jennifer Turner
Café 2 Regulating During Scarcity	Rm 4405 (4th Flr)	Randy Cairns
Café 3 Planning with Over-Allocation	Rm 2800	Ted White
Café 4 Open Discussion	Rm 2800	Valerie Cameron

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Café Report Out

Café 1 – Approving WL	Jennifer Turner
Café 2 – Regulating during Scarcity	Randy Cairns
Café 3 – Planning / Over-Allocation	Ted White
Café 4 – Open Discussion	Valerie Cameron

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Case Studies

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Environmental flows in the Okanagan

Lee Hesketh
Fraser Basin Council

Ted van der Gulik
Ministry of Agriculture

Mark Porter
ESSA Technologies

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The Alberta Desk-Top Method for Determining Environmental Flows

Allan Locke
Alberta Environment

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Closing Panel and Plenary

Brian Riddell
Pacific Salmon Foundation

Craig Orr
Watershed Watch Salmon Society

Todd Hatfield
Solander Ecological Research

Kim Hyatt
Fisheries and Oceans Canada

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Wrap and Next Steps

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compass
Environmental Flows and BC's Proposed Water Sustainability Act
November 3rd, 2011
WWF
BRITISH COLUMBIA
GORDON AND BETTY MOORE FOUNDATION
Michael Harstone
Compass Resource Management

What are Environmental Flows?

Environmental flows describe the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems.

Brisbane Declaration on Environmental Flows endorsed by more than 800 delegates from 57 countries in 2007

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Countries/States with Flow Laws

- Switzerland Federal Law on Water Protection
- South Africa National Water Act
- Australia Commonwealth Water Act
- New South Wales Water Management Act No. 92 of December 2000
- Scotland Water Environment and Water Services Act
- EU Framework Directive on Water
- Water Environment (Water Framework Directive) (England and Wales) Regulations 2003
- Chile Law No. 20.017 of 11 May 2005 (amending the Water Code), at Art. 129bis
- 1 Nicaragua Resolutions of the National Environmental Authority No.0127-2006 6.
- Mozambique Decree of the Council of Ministers No.43/2007
- Israel Water Law of 1959, amended 2004
- New Zealand National Standard on Ecological Flows
- Mexico Environmental Flows National Standard
- Japan River Law
- Spain 2007 Water Planning Decree
- Kenya Water Act 2002
- USA: Washington, Oregon, California, Maine, Wyoming, Maine, Michigan, Florida, Georgia, Idaho, Montana, Arizona

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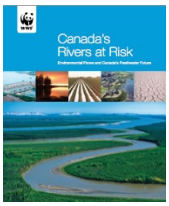
WWF Global and National Priority

"Some Canadian rivers at risk of drying up"



Recent examples of WWF flow headlines:

- Flow plan for less talk and more action as climate change hits rivers, World Water Week
- Going with the flow- restoring a living Yangtze
- Dutch water management system is obsolete, warns WWF

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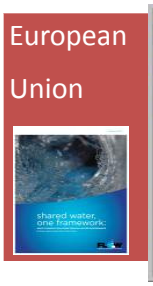
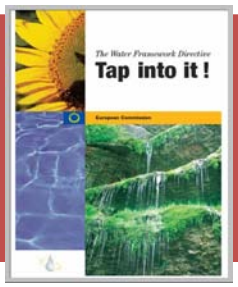
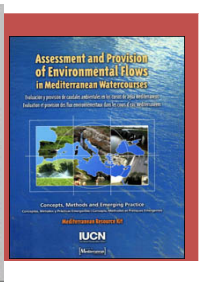
Leaders – Environmental Flow Law

European Union







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Leaders – Environmental Flow Law

Australia

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Environmental flow protection driving water law reform

Alberta

Environmental Flows Program helps protect healthy water flow by:

- providing policy recommendations
- conducting environmental flow studies
- researching aquatic and riparian habitat
- reviewing water licence applications
- working with other agencies and Watershed Planning and Advisory Councils to set flow and water standards that support healthy fish and wildlife populations

The Athabasca River in winter downstream from the oil sands projects, Alberta, Canada (c) Dave Bukhart / WWF-Canada

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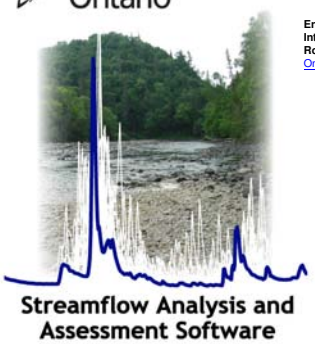
Ontario



Environmental Flow Methods - Integrating Policy and Science
Robert Metcalfe,
Ontario Ministry of Natural Resources

Conservation Authorities of Ontario:
Establishing Environmental Flow Requirements

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National Approach

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Environmental flows- Water Sustainability Act

- *By 2012, all land and water managers will know what makes a stream healthy, and therefore be able to help land and water users factor in new approaches to securing stream health and the full range of stream benefits.*
- ***By 2012, water laws will improve the protection of ecological values,** provide for more community involvement, and provide incentives to be water efficient.*
- ***Legislation will recognize water flow requirements for ecosystems and species.***
- *Government will require all users to cut back their water use in times of drought or where stream health is threatened.*

Living Water Smart, BC's Water Strategy, 2008

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… in the majority of cases environmental flow provisions remain at the stage of policy and debate rather than implementation, 2010.

Limit allowable water abstraction and flow alteration as soon as possible. It is much easier to implement requirements on new users than to enact changes to existing use.

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Tackling Implementation

- Require (not allow) environmental flows to be considered in all new licences
- Require review of key licences at periodic intervals to adjust conditions to address changing water patterns
- Watershed sustainability plans with flows as a priority and mandatory content and timelines

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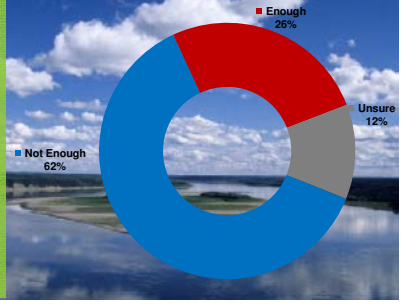
Environmental Flow Protection

To the best of your knowledge, are current rules governing water use in BC ENOUGH or NOT ENOUGH to ensure the future sustainability of BC'S fresh water resources?



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Presentation by Valerie Cameron, MFLNRO

Ministry of Forests, Lands and Natural Resource Operations

Making Water Use Decisions – the Provincial Context

Valerie Z Cameron
Provincial Water Stewardship Manager

Environmental Flows Workshop
Nov. 3, 2011

Ministry of Forests, Lands and Natural Resource Operations

Types of Decisions under the *Water Act*

- Water licences
- S. 8s – Short term use
- S. 9s – Approval for in stream works
- Notifications to a habitat officer for in stream works
- Amendments
- Regulation, including Orders
- S. 9 *Fish Protection Act* Order

Ministry of Forests, Lands and Natural Resource Operations

Processing applications

- **FCBC** accepts the application
- **Water Stewardship Officer will** handle the file. Assembles, analyzes information. Does the technical analysis. Interacts with client. Consults with agencies, FN. Site visit. Writes report.
- **Statutory Decision Maker (section head, Regional Water Manager, or Comptroller)** reads report, takes into consideration when making final decision.

Ministry of Forests, Lands and Natural Resource Operations

Considerations when making decisions

- Is there enough water?
- Habitat, environmental flow needs
- Will others' rights (water users, FN, etc.) be impacted?
- Beneficial use
- Target turn around times
- Appeals
- Decisions must be balanced and unfettered

Ministry of Forests, Lands and Natural Resource Operations

Considering environmental flows

- 1 in 5 year 7 day low flow
- Can use more detailed methods if available
- Variable hydrology in BC: one size doesn't fit all
- Sparse hydrological monitoring networks are a problem
- Most streams are regulated, not natural flows.
- Is storage possible?

Ministry of Forests, Lands and Natural Resource Operations

In the real world....

- Water allocation backlog is high
- Staffing levels are dropping
- Issues are more complex
- Decisions are more complicated
- Less time to do more work

Ministry of Forests, Lands and Natural Resource Operations

Concluding Remarks

- Decisions are directed by the *Water Act*
- Strive to make balanced, responsible decisions
- Government's direction: more streamlined, integrated decision-making
- Government is shrinking. Making do with less.

Ministry of Forests, Lands and Natural Resource Operations

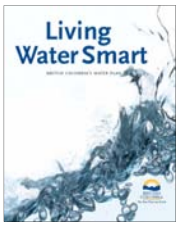
Environmental Flows & the proposed *Water Sustainability Act*

An Update on *Water Act* Modernization

Ted White & Randy Cairns
Water Protection and Sustainability
Ministry of Environment

November 3, 2011

Water Act Modernization



"By 2012, water laws will improve the protection of ecological values, provide for more community involvement, and provide incentives to be water efficient."

"By 2012, government will regulate groundwater use in priority areas and large groundwater withdrawals."

"Legislation will recognize water flow requirements for ecosystems and species."

Our water is under pressure

- Naturally flow sensitive areas
- Population growth and urbanization
- Climate change
- Competing demands

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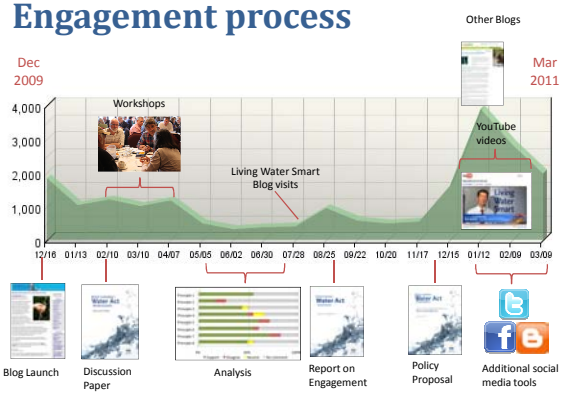
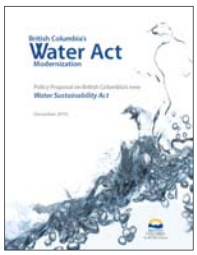
Engagement process



Policy Directions



1. **Protect Stream Health and Aquatic Environments**
   - Protect instream flows
   - Requirements incorporated into new licences
2. **Consider Water in Land Use Decisions**
   - Provincial Water Objectives considered in all land use and resource development decisions
3. **Regulate Groundwater Use**
   - Integrate with surface water allocation; licensing and fees
   - All large users and users in problem areas

Policy Directions

4. **Regulate During Scarcity**
   - Voluntary measures
   - Proportional reductions
   - Priority date (FITFIR)
   - Importance of use (deviate from FITFIR)
5. **Improve Security, Water Use Efficiency, Conservation**
   - Economic Instruments
   - Best Management Practices, Efficiency and Beneficial Use
   - Agricultural Water Reserves
6. **Measure and Report**
   - Actual water use
   - Stream flow, groundwater levels, well performance, water quality
7. **Enable a Range of Governance Approaches**
   - Increased collaboration and participation in activities and decisions
   - Delegation of decisions and activities to watershed agencies

WAM Process Status

- Refining policy options
  - Focusing on implementation options
  - Social, economic and environmental implications of policy recommendations
- Seeking direction from government on policy
- Preparing for additional engagement

Context for development of WSA

- Natural Resource Sector coordination
- Results based framework
- Transaction reduction
- Canada Starts Here: BC Jobs Plan
- Transparent & accountable processes
- Water Use Planning experience
- Drought Response Planning

Hierarchy of Policy

Legislation
- Provides the specific authority given by the Legislature
- May be enabling (RWM may grant) or restricting (Comptroller must)

Regulations
- Empowered by the Act
- "Delegation" to the executive branch of government

Administrative Instruments
- Licences, Approvals and permits granted under statutory authority
- Plans developed in accordance with statutory provisions
- Written policies that guide decision making
- Procedural guidelines and directives (IPP guidelines, Development Plans etc.)

Areas of focus today

- Considering Environmental Flows in all new surface and ground water decisions
- Regulating water use during scarcity
- Addressing chronic shortages

Café 1 – Considering Environmental Flows in new allocation decisions

Policy Direction
- Environmental flows must be considered in all surface and ground water allocation decisions
- Desk-top methods and risk matrix for most applications
- Detailed assessment for high risk projects

DRAFT Decision Process for Considering Environmental Flow Needs for All New Allocations

APPLICANT uses online tools to prepare application including 1st Screen of potential risks

↓

Submit application

↓

DECISION MAKER (FLNRO) reviews application
Applies desk-top method
2nd Screen of risk matrix
Require additional information, including Detailed Assessment from applicant
Applicant provides additional information

⟷

Refer application to DFO or other agencies who may:
Recommend detailed assessment
Provide environmental flow recommendation

↓

DECISION MAKER considers all relevant information and may:
Refuse application
Issue licence or approve short term use with terms and conditions

This decision is appealable.

Considering environmental flows in new allocations

Areas Seeking Input

- Process for selecting desk-top method(s)
  - *Are the baseline criteria appropriate?*
  - *Approach for ungauged streams?*
- Assessing risks of new allocations
  - *What additional risk factors should be considered?*
- Improve transparency and consistency in decision-making
  - *Are there other steps that could improve consistency and transparency in the decision-making?*

Café 2 – Regulation during scarcity

Policy Direction

- Rights "subject to" environmental flow
- Power to regulate for environmental flow needs
- FITFIR system of priorities
- Allowances for essential human needs
- Deviate from FITFIR in exceptional circumstances or in accordance with a Plan

Regulation during scarcity

Areas seeking input

- Possible benchmarks to trigger action include
  - 1-in-5 year, 7-day average low flow
  - Percent of mean annual discharge
  - Drought Plan 6th percentile
- Strategies for ungauged watersheds
  - *What is the best strategy for ungauged watersheds?*
- Determining groundwater connectivity
  - *What is the default? Connected or not connected?*

Café 3 – Addressing chronic shortages

Policy Direction

- Watershed Sustainability Plans as the tool to respond to chronic water shortages & conflicts
- First Nations and Multi-stakeholder plans
- Implemented via regulation

Addressing chronic shortages

Areas seeking input

- Mechanism to trigger a watershed sustainability plan
  - *Under what circumstances would a plan be triggered?*
- Responsibilities for planning activities
  - *Does government have to lead the planning process?*
- Effect of plan on existing licensees
  - *How will existing water rights be addressed where there is a need to reduce withdrawals?*

Café 4 – General Discussion

- Funding mechanisms for planning?
- Role of non-government organizations?

Presentation by Marc Porter, ESSA Technologies

Instream Flow Needs (IFN) for Okanagan Tributaries

ESSA Technologies Ltd.
Solander Ecological Research
WaterSmith Research

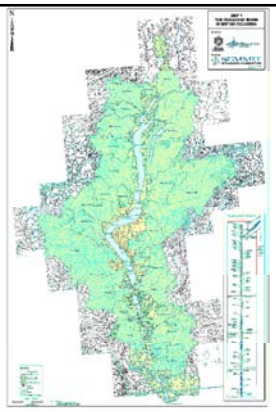
Presentation by Marc Porter (ESSA):
Environmental Flows/BC Water Sustainability Act Workshop

November 3, 2011

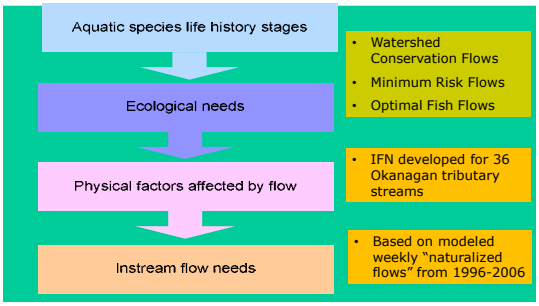
BC's new *Water Sustainability Act*

- **Policy Directions**: protect stream health and aquatic environments
  - Instream flow requirements will be established through the development and application of guidelines
  - Formula based instream flow assessments for all new water allocation decisions
  - Use of criteria and thresholds will be used to identify problem areas

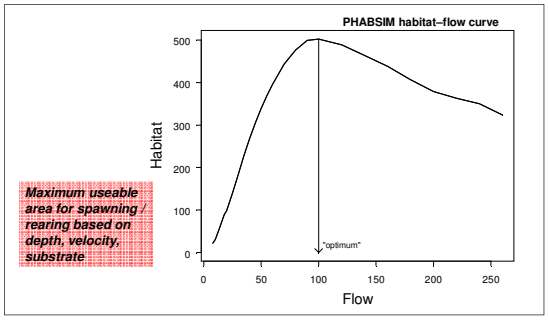
Okanagan River



Okanagan Instream Flow Assessment



Method 1. Meta-analysis of PHABSIM studies (Hatfield & Bruce 2000)



Meta-analysis (cont.)

- Peer-reviewed analysis of PHABSIM-based IFN studies throughout western North America
- Provides regression-based predictions of optimal habitat vs. flow relationships for salmon and trout species for different life stages
- Required inputs for the meta-analysis are MAD, lat/long

Species	Life stage	Equation	df	Adjusted R^2
Chinook salmon	Juvenile	$-0.998 + 0.939 \log_e(\text{MAD})$	1, 51	0.705
	Spawning	$-51.710 + 0.682 \log_e(\text{MAD}) + 11.042 \log_e(\text{longitude})$	2, 52	0.735
Rainbow trout	Juvenile	$-15.543 + 0.539 \log_e(\text{MAD}) + 4.400 \log_e(\text{latitude})$	2, 96	0.775
	Spawning	$-12.037 + 0.598 \log_e(\text{MAD}) + 3.623 \log_e(\text{latitude})$	2, 71	0.711
Steelhead trout	Juvenile	$-8.482 + 0.593 \log_e(\text{MAD}) + 2.555 \log_e(\text{latitude})$	2, 51	0.770
	Spawning	$-33.064 + 0.618 \log_e(\text{MAD}) + 7.260 \log_e(\text{longitude})$	2, 41	0.805
All salmonids pooled*	Juvenile	$-6.119 + 0.679 \log_e(\text{MAD}) + 1.771 \log_e(\text{latitude})$	2, 320	0.653
	Spawning	$-12.392 + 0.660 \log_e(\text{MAD}) + 1.336 \log_e(\text{latitude}) + 1.774 \log_e(\text{longitude})$	3, 308	0.681

- Then just need to know salmonid distributions and life stage periodicities to apply the appropriate regressions

Salmonid species-specific life stage periodicities observed in Okanagan streams

Species	Life stage	# of weeks	Start date	End date
Rainbow trout	Spawning	10	17-May	16-Jul
Rainbow trout	Rearing	52	1-Jan	31-Dec
Steelhead	Spawning	13	4-Apr	26-Jun
Steelhead	Rearing	52	1-Jan	31-Dec
Chinook	Spawning	5	17-Oct	15-Nov
Chinook	Rearing	5	1-Aug	31-Aug
Kokanee	Spawning	7	1-Sep	8-Oct
Kokanee	Juvenile migration	10	1-Apr	31-May
Sockeye	Spawning	8	16-Sep	31-Oct
Coho	Spawning	9	9-Oct	8-Dec
Coho	Rearing	52	1-Jan	31-Dec

Meta-analysis (cont.)

- Hatfield & Bruce PHABSIM meta-analysis focuses only on optimal flows for **salmonid rearing & spawning**
- Does not incorporate other potential instream flow needs (e.g., other fish species, other biota, channel formation, wetland linkages, etc.)
- Flows to satisfy such needs need to be calculated using other methods

Method 2: British Columbia Instream Flow Guidelines (BCIFN)

- Peer reviewed guidance (2003) for defining instream flow thresholds for water withdrawals
- Generates recommended **minimum risk** instream flows based on historic flow data (stream's unique hydrograph)
- Minimum flow is seasonally-adjusted based on percentiles of mean natural flows for each month
- Percentiles vary monthly to maintain physical and biological features of a natural hydrograph

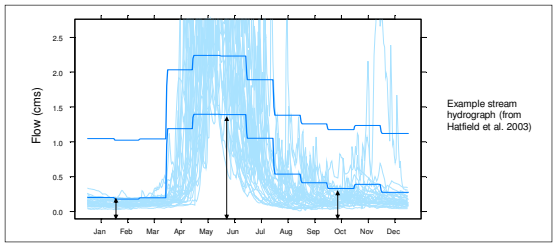
BCIFN (cont.)

- The minimum risk flow threshold in lowest flow month is set to the 90th percentile of flows in that month (i.e., highly conservative)
- The minimum risk flow threshold in highest flow month is set to the 20th percentile of flows in that month (i.e., most liberal)
- Minimum risk flow thresholds vary across other 10 months based on the formula:

$$90 - \left[\left(\frac{median_i - median_{min}}{median_{max} - median_{min}} \right) \times (90 - 20) \right]$$

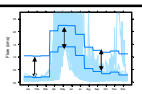
where $median_i$ is the median of mean flow for $month_i$

BCIFN (cont.)



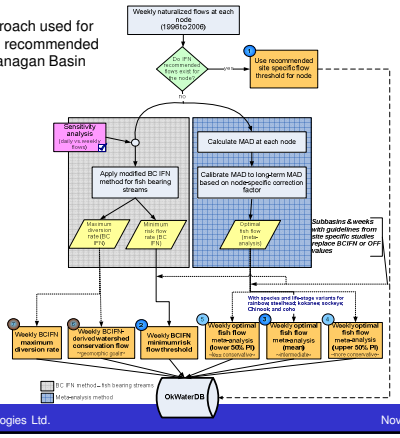
- BCIFN permits diversion/allocation when flows exceed the **minimum risk threshold** (lower blue line).
- Flows below this threshold should remain in stream (i.e. not diverted)

BCIFN (cont.)

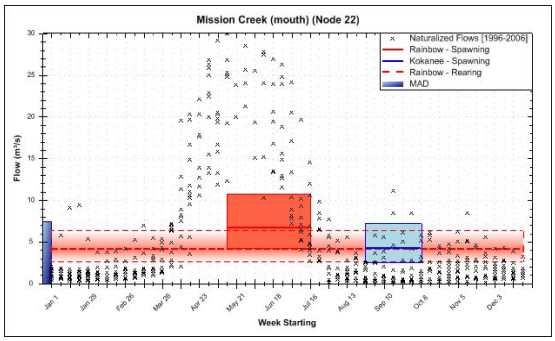


- BCIFN also generates a maximum diversion rate (which caps allowable water extraction/allocation); represented by upper blue line in figure
- This constant rate is set at the 80th percentile based on the entire period of record for the stream
- Subtracting the maximum diversion rate from the weekly naturalized flow allows calculation of a recommended **watershed conservation flow** for the higher flow periods

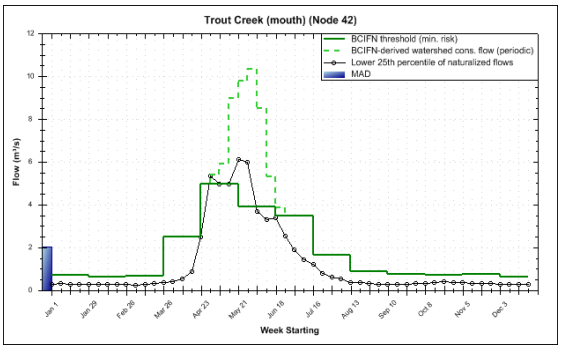
Overall approach used for determining recommended flows in Okanagan Basin tribs



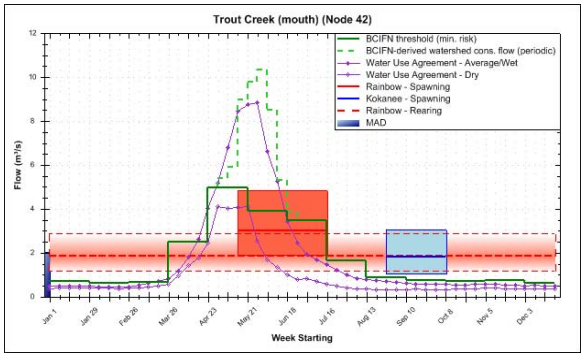
Optimal Flows (Meta-analysis)



BCIFN (Minimum Risk Flows)

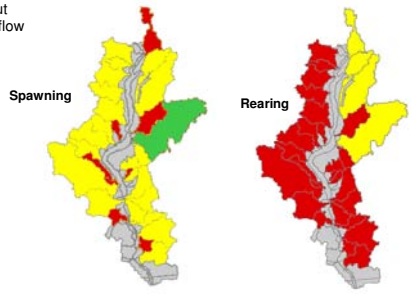


Combined Assessment vs. Negotiated Flows



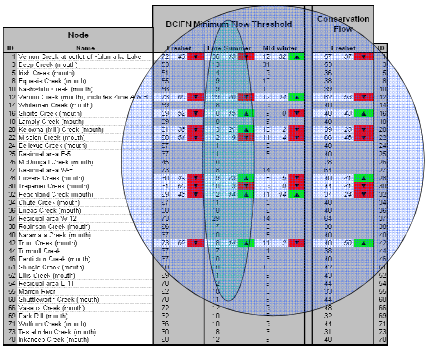
Threshold exceedance probabilities

Rainbow Trout (mean optimal flow 1996-2006)

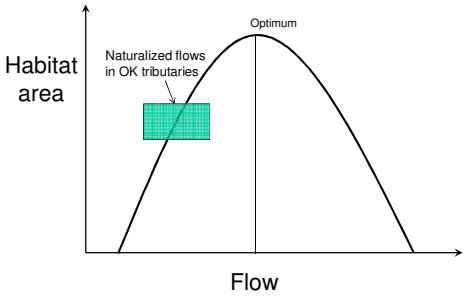


Green indicates flow achieves optimal flow thresholds > 75% of the time, yellow 25–75% of the time, and red < 25% of the time.

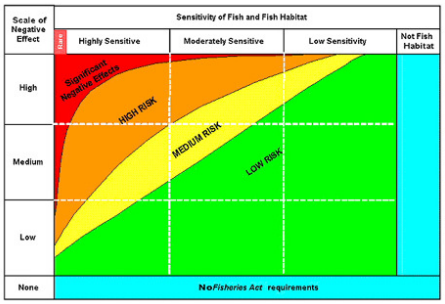
Flow regulation can help in late summer



Conditions often not ideal for fish in Okanagan streams (even with natural(ized) flows)



Example risk framework: DFO's Risk Assessment Matrix for reviewing proposed projects



IFN based on provincially modified Tennant (Montana) Method e.g. Vancouver Island Water Allocation Plans

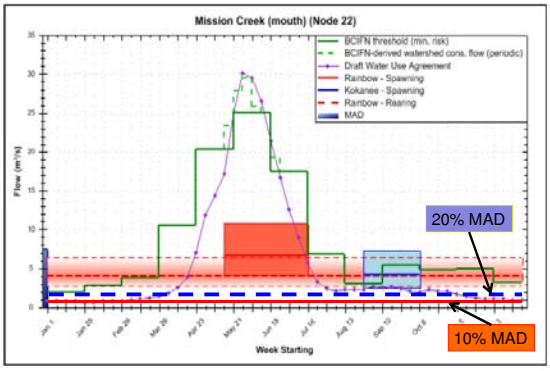
In drainages where fish are present, minimum flows required to sustain at least fair spawning and rearing habitat ≥ 10% MAD

Approach is assumed to provide a **conservative estimate of minimum flows** required

However lacks comprehensive biological validation

Does not account for regional or individual variation in stream flows or species needs

Flows	Description
30-60% MAD	Excellent spawning/rearing
20-30% MAD	Good spawning/rearing
10-20% MAD	Fair spawning/rearing
5-10% MAD	Poor spawning/rearing
< 5% MAD	Severely degraded spawning/rearing



Environmental Flow Comparison

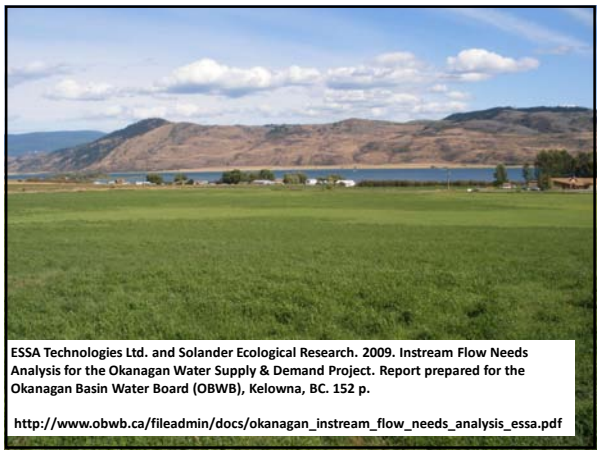
PHABSIM meta-analysis	BCIFN	Modified Tennant	UCUTs
Optimal Flows - for different salmonid species/life stages	Minimum Risk Flows & Watershed Conservation Flows	Critical Flow Magnitudes - for different life stages	Critical Low Flow Magnitudes & **Durations** - for different species/life stages
MAD-based	Natural hydrograph	MAD-based	Natural hydrograph
geographically adjusted	stream specific	general	stream specific

Instream Flow Needs (conclusions)

- There's considerable uncertainty in the required flows to achieve the needs of fish and other aquatic biota
- In general, Okanagan probably tough place to be a fish (*i.e.* habitat generally sub-optimal even under natural flows*)*
- Management can help – e.g. storage could allow desired flows in late summer/fall, but could harm mid-winter flow and affect geomorphic processes
- Negotiated instream flows will represent a compromise between the needs of biota and humans, and will ultimately be reflective of the values/weights we place on each

IFN Refinements – Suggested Next Steps

- Continue to explore alternative "default" approaches for defining IFN risk levels
- Determine how to integrate IFN thresholds into decisions around water volume allocations
- Undertake field studies to assess biological consequences of failing to meet different IFN thresholds under different approaches (e.g. survival rates, production losses, potential extirpation)

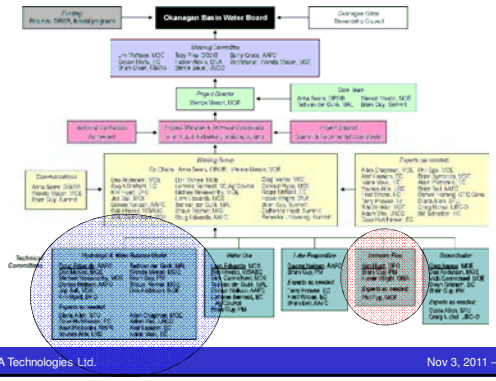


ESSA Technologies Ltd. and Solander Ecological Research. 2009. Instream Flow Needs Analysis for the Okanagan Water Supply & Demand Project. Report prepared for the Okanagan Basin Water Board (OBWB), Kelowna, BC. 152 p.

http://www.obwb.ca/fileadmin/docs/okanagan_instream_flow_needs_analysis_essa.pdf

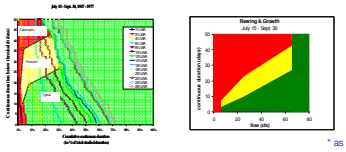
Extra Slides

Okanagan Basin Water Board Study Team



UCUT
(Uniform Continuous Under Threshold)

- Used to define habitat stressing low flow events based on an individual stream's historical natural hydrograph*
- Identifies the **magnitude and duration** of common and uncommon historical low-flow events



* as developed by P. Parsiewicz

Definition of UCUT habitat stressor elements

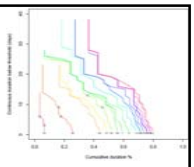
- **Frequency**: how often a particular flow/habitat event occurs
- **Duration (continuous):** how long a particular flow/habitat event lasts
- **Magnitude:** flow/habitat threshold levels
- **Timing:** of flows is defined by fish bioperiods

Result: defined low flow recommendations based on historic natural flow patterns

Flow/habitat thresholds defined by UCUT Curves

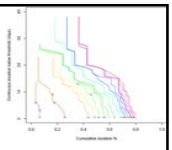
- **Common/typical threshold**: the highest of naturally occurring low flow/habitat levels
- **Critical threshold:** next most-common flow/habitat level above rare, below which useable habitat rapidly decreases
- **Rare threshold:** low flow/habitat levels that happen infrequently and only for short periods of time under natural conditions

Identifying low flow thresholds from UCUT curves



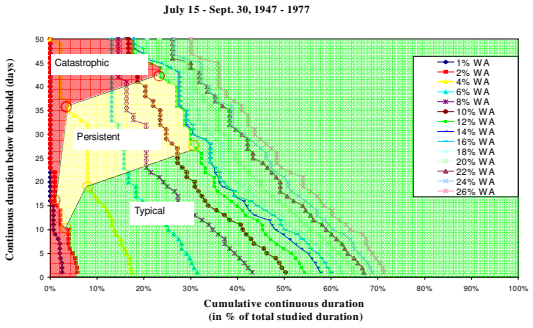
- Spacing between curves increases continuously, but in non-uniform increments.
- The wider the horizontal space between curves, the greater is the increase in frequency of events
- The presumed flow/habitat threshold is found where there is a significant gap in frequency

Inflection points in UCUT represent changes in duration of low flow events

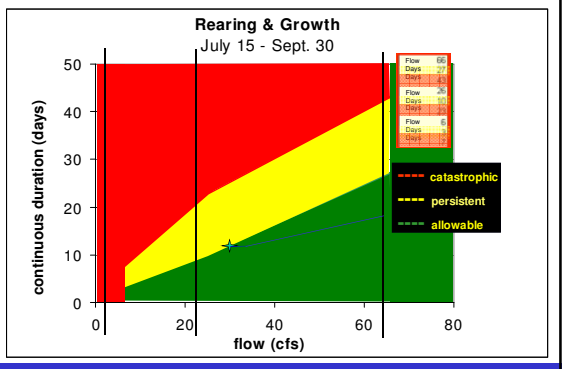


- **Typical duration** – expected to occur each year (intra-annual)
- **Persistent duration** - expected to occur but infrequently, not necessarily every year (inter-annual)
- **Catastrophic duration** - occurs only very rarely (decadal)

Defining UCUT inflection points



ACTogram



UCUT Flow Meter (Connecticut rivers)

As Of: 09/02/2007 For the BioPeriod: Rearing & Growth

	Pomperaug		Nonnewaug		Weekeepeemee	
As Of-	09/02/07	ACT Status	09/02/07	ACT Status	09/02/07	ACT Status
Flow (cfs):	12	Days Duration	1.7	Days Duration	0.96	Days Duration
Rare Event						
Flow Threshold (cfs)	11	0	5	11	7	15
Persistent Days Duration	9		8		7	
Catastrophic Days Duration	12		13		15	
Critical Event						
Flow Threshold (cfs)	20	9	6	11	9	22
Persistent Days Duration	15		10		15	
Catastrophic Days Duration	23		17		24	
Common Event						
Flow Threshold (cfs)	89	44	26	44	27	44
Persistent Days Duration	27		27		27	
Catastrophic Days Duration	43		43		43	

ACT Status Color Code Legend

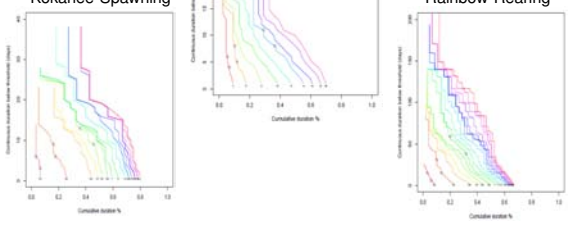
- Discharge Flow either above the "Flow Threshold" or below but within the timeframe of Persistent Days Duration
- Discharge Flow below the "Flow Threshold" for Persistent Days Duration or more. Preparatory management actions required.
- Discharge Flow below the "Flow Threshold" for Catastrophic Days Duration or more. Mandatory management measures in effect.

Mission Creek UCUTs

Rainbow Spawning

Kokanee Spawning

Rainbow Rearing

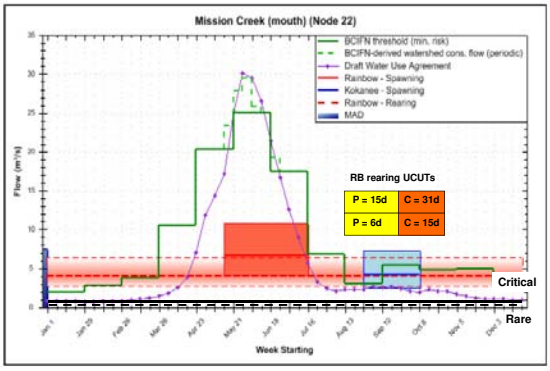


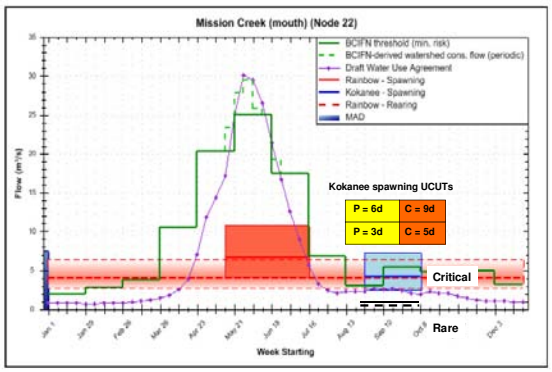
Kokanee Spawning – Mission Ck.

Flow Event	Flow threshold (cm/s)	Persistent duration (days)	Catastrophic Duration (days)
Typical	0.8	**9**	**13**
Critical	0.5	**6**	**9**
Rare	0.4	**3**	**5**

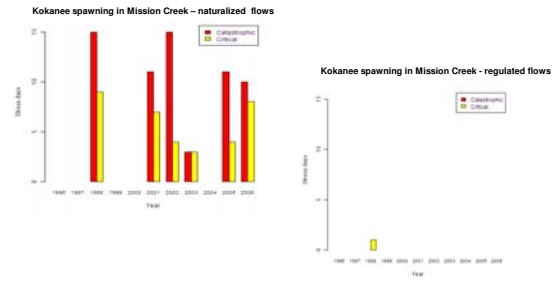
Rainbow Trout – Mission Ck.

Flow event	Flow threshold (cms)	Persistent duration (days)	Catastropic duration (days)
SPAWNING			
Common	14	**8**	**11**
Critical	6	**5**	**8**
Rare	4	**4**	**6**
REARING			
Common	1	**39**	**59**
Critical	0.5	**15**	**31**
Rare	0.4	**6**	**15**

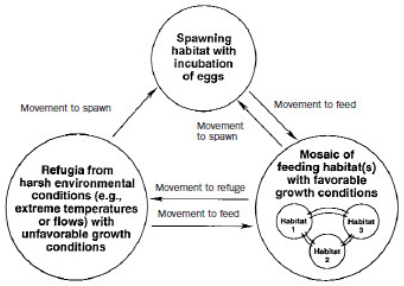




Calculated UCUT-defined Stress Days

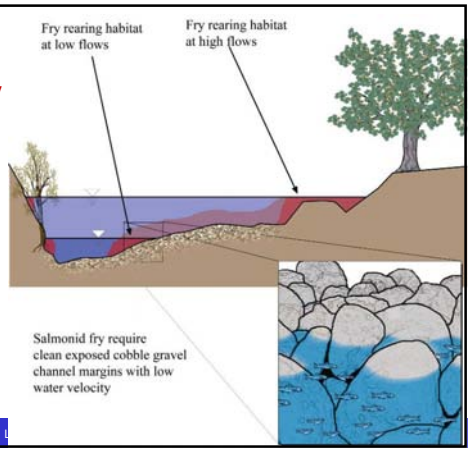


IFN in a Meta-population & Landscape Context

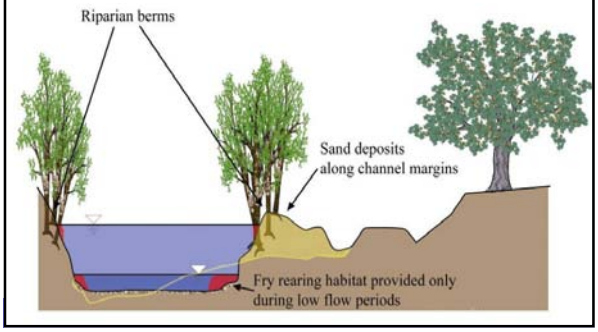


(from Schlosser and Angermeier 1995)

Pre-dam channel morphology and salmonid habitat



Impacts of modified channel morphology on salmonid habitat



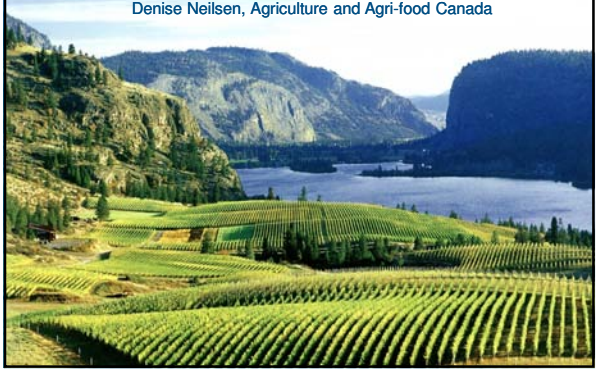
Modified Tennant – "made in BC" standards

Biological or Physical Requirement	Flow Recommendation (% MAD)
A. Rearing	20%
Juvenile	20%
Adult	> 55%
B. Over-wintering	20%
C. Incubation	20%
D. Migration and Spawning	30-200%
Summer Steelhead passage	50-100%
Spawning	equation: $1.56 * MAD^{0.63}$
Smolt Migration	50%
E. Short-term Maintenance	10%
F. Channel maintenance	> 400%
E. Wetland linkage	100%

- The approach is believed to provide a **conservative estimate of minimum flows**
- However lacks comprehensive biological validation and does not account for regional or individual variation in stream flows or species response

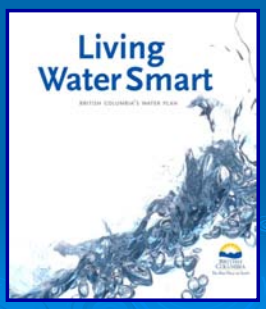
Reserving Water For Future Agricultural Needs

T.W. van der Gulik - Ministry of Agriculture
Denise Neilsen, Agriculture and Agri-food Canada



Province's Water Plan

- Plan requires increase in efficiency of 33% by 2020.
- Reserve water for agriculture
- Measure and report large water use by 2012



2

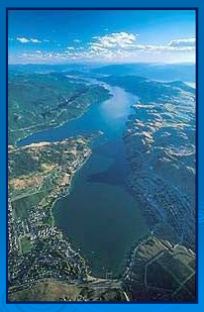
Irrigation Demand Model

AAFC – Denise Neilsen
Agri – Ted van der Gulik

Objective:
Develop a model that calculates agriculture's irrigation needs by purveyor, municipality, district and sub-watershed.

Methodology:
Determine Property-by-Property water use

Result:
Planning Tools that secure water for current and future agricultural needs



4

Irrigation Water Demand Model

- MAL and AAFC have developed a GIS-based irrigation water demand model
- Originally developed for the Okanagan Basin

5

Land Use Inventories: Data Collection

DATA COLLECTED ON

- General Land Use
- Land Cover
- Agricultural Activities
  (ex. Livestock)
- Agricultural Practices
  (ex. Wind machine)
- Irrigation Systems

FOR ALL PARCELS:

- In the ALR
- In an Agricultural Zone
- With Farm Class
- With agricultural use

6

Irrigation Water Demand Model

Unified Cadastre

- The agricultural area is divided into 398 map sheets

6

Land Use Inventories: Methodology

Maps are created using aerial photography and GIS

9

Land Use Inventories: Methodology

Cadastre

10

Land Use Inventories: Methodology

Cadastre

Land Cover is first digitized in GIS

11

Land Use Inventories: Methodology

Windshield survey

Each parcel is visited and the land cover and land use is classified and recorded.

12

Land Use Inventories: Results

Crop Type:

Apple

Pasture

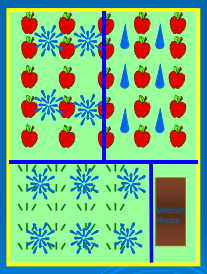
Irrigation System Type:

Sprinkler

Drip

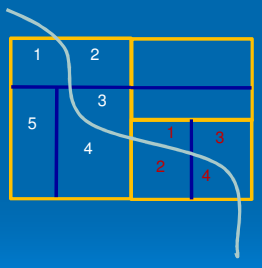
Building Type:

Medium sized House



13

Soils Boundary



There are 132,000 polygons generated for the Okanagan in the farming areas

Cadastre

Land and Crop Polygon

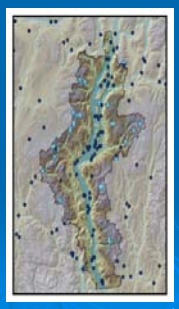
Soil Boundary

14

Irrigation Water Demand Model

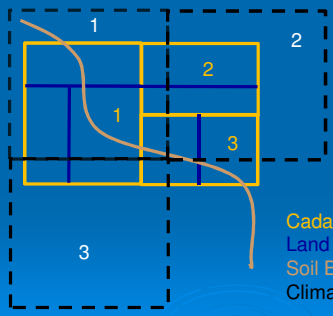
Climate data:

- A climate model has been developed on a 500 m x 500 m grid
- Provide current climate data based on historical and current information
- Climate change scenarios have been developed



13

Climate Data



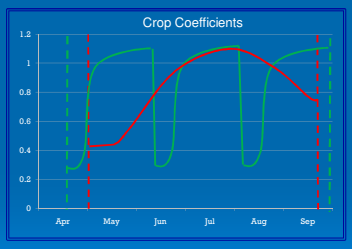
A climate cell gets assigned to each cadastre

Climate grid linked to Cadastre 1
Climate grid linked to Cadastre 2 and 3

Cadastre
Land and Crop Polygon
Soil Boundary
Climate Grid

16

Model Calculations



Apples
Alfalfa

Algorithm calculates water demand from:

- ETo calculated daily from climate data.
- Climate data to determine start and end of growing season.
- Crop coefficients to adjust daily Eto
- Soil and rooting depth information to calculate soil water storage, percolation rates and determine soil factors
- Irrigation system efficiencies

17

Results by Crop

Crop Group	Irrigated Area (ha)	Irrigation Demand (mm)
Apple	4,292	693
Berry	62	633
Cherry	1,121	733
Forage	8,520	755
Fruit	898	793
Golf	1,048	992
Grape	2,734	413
Landscape Turf	126	1,009
Nursery	385	909
Turf Farm	120	959
Vegetables	531	692
Total =	**20,033**	**704**

18

Groundwater Layer

19

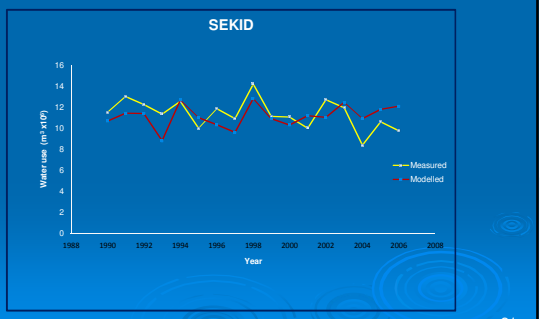
Results by Water Source

Water Source	Irrigated Area (ha)	Irrigation Demand (m^3)
Water License	1,672	11,455,582
Water Purveyor	14,966	107,930,320
Groundwater	3,394	21,695,142
Total	**20,033**	**141,081,043**

Assuming good management

20

Result Comparison



21

Irrigation Demand Model - Current

Table A1 Crop Water Demand 2003

Year: 2003 — Okanagan Basin - Average Irrigation Management

Water Source	Water Licence			Reclaimed Water			Groundwater			Total	
Agriculture / Crop Group	Irrigated Area (ha)	Irrigation Demand (m3)	Average Req. (mm)	Irrigated Area (ha)	Irrigation Demand (m3)	Average Req. (mm)	Irrigated Area (ha)	Irrigation Demand (m3)	Average Req. (mm)	Irrigated Area (ha)	Irrigation Demand (m3)
Alfalfa	1,275	9,010,934	707	96	647,964	677	852	5,767,594	677	2,222	**15,426,491**
Apple	4,079	29,174,262	717	-	-	-	211	1,511,750	717	4,281	**30,685,952**
Berry	44	291,916	672	-	-	-	18	110,656	603	62	**402,572**
Cherry	1,074	8,120,474	756	-	-	-	45	367,359	819	1,119	**8,487,833**
Corn	409	1,956,321	479	23	120,830	525	189	821,606	436	620	**2,898,757**
Forage	2,964	27,686,657	926	429	4,132,948	964	1,703	13,877,787	815	5,096	**45,457,392**
Fruit	792	6,576,735	830	-	-	-	102	771,618	759	894	**7,348,354**
Grape	2,290	9,780,281	427	6	15,923	250	426	1,863,362	427	2,723	**11,659,566**
Nursery	253	2,543,339	1,006	185	1,263,641	684	127	1,047,376	823	565	**4,854,356**
Turf Farm	60	606,512	1,008	-	-	-	46	414,190	911	106	**1,020,702**
Vegetable	370	2,732,012	739	-	-	-	137	845,546	618	507	**3,577,558**
Inactive	190	-	-	0	-	-	23	-	-	213	-
	13,790	98,239,383		739	6,181,306		3,887	27,398,844		18,416	**131,819,533**
Turf											
Golf	446	4,471,113	1,002	298	3,095,884	1,041	317	3,095,360	977	1,061	**10,662,357**
Landscape Turf	488	4,779,235	980	17	172,714	1,004	101	973,438	960	607	**5,925,388**
Domestic Outdoor	5,169	50,987,109	986	0	1,312	1,006	741	7,578,839	1,023	5,910	**58,567,260**
	6,104	60,237,457		315	3,269,910		1,159	11,647,637		7,577	**75,155,005**
Total	**19,893**	**158,476,840**	**797**	**1,054**	**9,451,216**	**897**	**5,046**	**39,046,481**	**774**	**25,993**	**206,974,538**

Current Agriculture Irrigated Demand 132,000,000 m3 – 64% of total demand

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Irrigation Demand Model - Future

Table A11 Crop Water Demand - Increased Agricultural Acreage and Domestic Buildout to 2040

Year: 2003 — Okanagan Basin - Average Irrigation Management

Water Source	Water Licence			Reclaimed Water			Groundwater			Total	
Agriculture / Crop Group	Irrigated Area (ha)	Irrigation Demand (m3)	Average Req. (mm)	Irrigated Area (ha)	Irrigation Demand (m3)	Average Req. (mm)	Irrigated Area (ha)	Irrigation Demand (m3)	Average Req. (mm)	Irrigated Area (ha)	Irrigation Demand (m3)
Alfalfa	4,469	27,733,769	621	94	615,746	679	1,159	7,841,402	676	5,722	**36,210,918**
Apple	7,088	46,353,895	654	42	263,067	625	974	5,907,341	607	8,104	**52,524,303**
Berry	43	291,674	672	-	-	-	18	107,125	604	61	**398,799**
Cherry	1,024	7,730,498	755	-	-	-	54	430,617	802	1,078	**8,161,115**
Corn	411	1,947,680	479	20	105,718	530	182	792,486	435	613	**2,845,883**
Forage	3,446	32,443,771	941	407	3,965,771	974	2,086	17,503,189	839	5,939	**53,912,731**
Fruit	763	6,337,678	831	-	-	-	101	763,842	758	864	**7,101,320**
Grape	2,158	9,257,317	429	6	14,317	252	415	1,777,314	428	2,579	**11,048,948**
Nursery	241	2,442,916	1,015	185	1,263,706	684	127	1,047,811	823	553	**4,754,431**
Turf Farm	52	529,111	1,019	-	-	-	36	330,022	918	88	**859,133**
Vegetable	368	2,723,014	740	-	-	-	136	842,391	619	504	**3,565,405**
	20,062	137,811,323		753	6,248,323		5,288	37,343,540		26,103	**181,402,986**
Turf											
Golf	663	4,635,377	1,002	293	3,045,970	1,061	284	2,792,974	985	1,019	**10,276,321**
Landscape Turf	471	4,616,938	981	17	172,756	1,004	102	978,823	959	590	**5,768,517**
Domestic Outdoor	4,826	47,618,401	987	156	1,497,405	959	1,266	12,719,155	1,004	6,249	**61,834,962**
	5,740	56,870,716		466	4,716,131		1,652	16,490,952		7,857	**77,877,800**
Total	**25,802**	**194,681,839**	**780**	**1,219**	**10,964,454**	**885**	**6,939**	**53,834,492**	**786**	**33,961**	**259,280,786**

Future Agriculture Irrigated Demand 181,500,000 m3 – 70% of total demand
Total irrigated demand for basin increased by 25% (207 – 260 million m3)

23

Irrigation Demand Model Applications

24

Farmland Riparian Interface Stewardship Program

- **To promote joint planning of habitat restoration and farmland activities between landowners, resource management agencies and community groups.**
- **To increase awareness of interactions between land use and habitat values, and**
- **To resolve conflict that may arise between resource agencies and landowners**
- **To generally increase understanding and cooperation between agencies responsible for resource management and the agricultural community regarding farmland development and use.**

Creighton Creek stream flow recovery plan

The goals of the project were to:

Inform the public, especially the irrigation water licensees of the critically low summer flows in the local creeks,

Promote water conservation,

Begin collecting data how much water was actually available and where it was going,

Improve stream morphology and riparian cover on Creighton Creek so that juvenile salmonid had a better chance of surviving low flows and

Look for alternative sources for irrigation water.

Water storage potential

Conclusions

- At the beginning of the project, it was thought that the creeks were dry or nearly dry because of over-irrigating. Even among the water users themselves, it was suspected that licensees were either exceeding their water rights or there were illegal withdrawals. It was also thought that by implementing water conservation methods, such as night-time irrigating or irrigators altering the days they watered, that less water would be used and there would be fewer times when the creek were so severely drawn down that fish kills resulted. However, none of these assumptions have proved true.

For the most part, irrigators were not exceeding their licenses. In fact, there were far more irrigators watering below their licensed amounts than there were exceeding it. Many of the irrigators interviewed were applying water at rates below the ET replacement rate. Rather, flow data shows that the creeks that have had little or no flow during the summer are over-licensed.

Many of the water licenses are not being used. In some cases, this is because the landowners are not actively farming or are currently operating under conditions that don't require irrigation. Some water licensees would like to irrigate, but are aware that there is not sufficient water. They may either have a low priority license or are situated far enough downstream on the creek that there is normally not enough flow available during peak season and are willing to exert the time and effort involved in having upstream irrigators with lower priority licenses cut back on their water withdrawals.

- Finding reasons to do the right thing.

Instream Flows and BC's Proposed Water Sustainability Act

A Desk-top Method for Establishing Environmental Flows in Alberta Rivers and Streams

Overview

Purpose

Application

Instream Flows and BC's Proposed Water Sustainability Act

Alberta IFN Classification Assessment Project

March 2000 – March 2003

Instream Flows and BC's Proposed Water Sustainability Act

Alberta IFN Classification Assessment Project

Since there are criticisms of standard setting methods,

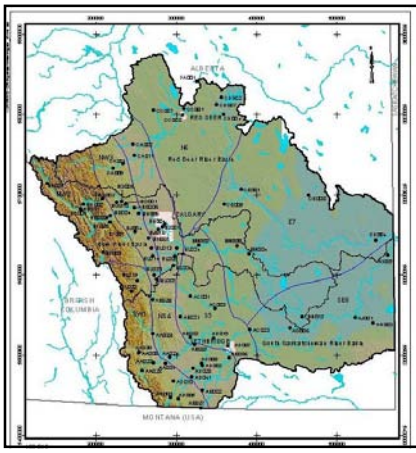
and applying site specific studies province-wide is very costly,

then we need an efficient, economical, and scientifically defensible IFN method to meet requirements under the *Water Act*.

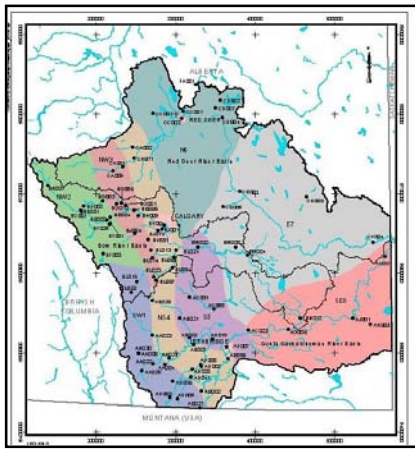
Instream Flows and BC's Proposed Water Sustainability Act

Goal of the IFN Classification System

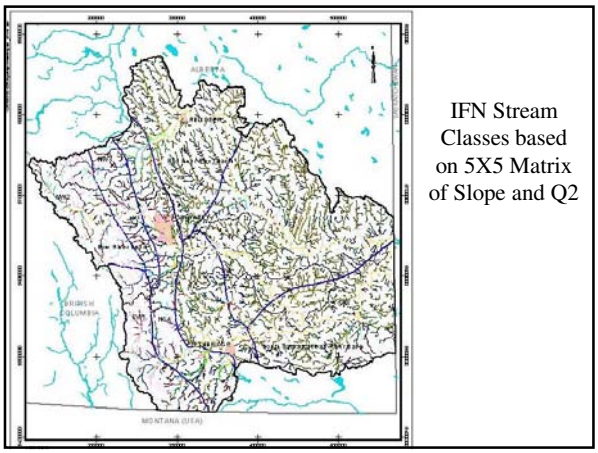
- Provide a mechanism to extrapolate measured site specific data (a flow recommendation) to another "similar" unmeasured river reach.



DEM of SSRB

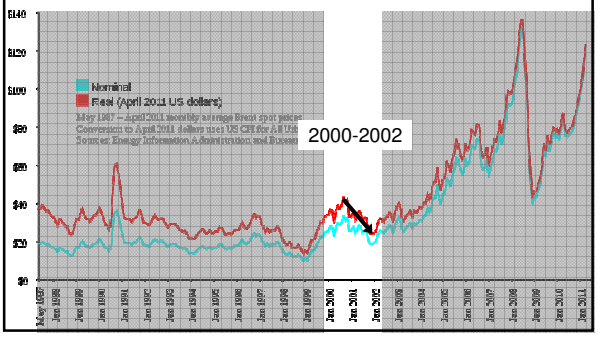


8 Hydrologic/ Geomorphic Regions



IFN Stream Classes based on 5X5 Matrix of Slope and Q2

Brent Spot Price for a Barrel of Oil



Instream Flows and BC's Proposed Water Sustainability Act

IFN Classification System was not Completed

- Stream classification based on Q2 and slope was partially validated.
- More detailed validation was required.

Classification Project ended in the spring of 2003

First draft of desktop guideline – October of 2003

Instream Flows and BC's Proposed Water Sustainability Act

RIVER RESEARCH AND APPLICATIONS
River Res. Applic. (2011)
Published online in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/rra.1571

DEFINING MINIMUM ENVIRONMENTAL FLOWS AT REGIONAL SCALE: APPLICATION OF MESOSCALE HABITAT MODELS AND CATCHMENTS CLASSIFICATION

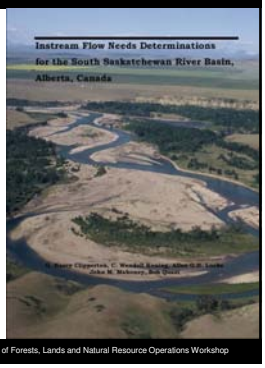
P. VEZZA[a]*, P. PARASIEWICZ[b], M. ROSSO[c] and C. COMOGLIO[a]
[a] *Department of Land, Environment and Geo-engineering, Politecnico di Torino, Turin, Italy*
[b] *Rushing Rivers Institute, Amherst, Massachusetts, USA*
[c] *Department of Hydraulics, Transport and Civil Infrastructures, Politecnico di Torino, Italy*

Minimum e-flow = 1.42 X Q_{95}

Instream Flows and BC's Proposed Water Sustainability Act

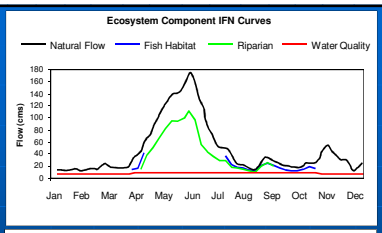
South Saskatchewan River Basin IFN Report

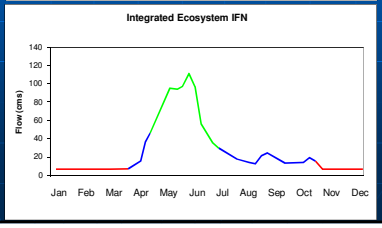
Recommendation for "full protection" of the aquatic ecosystem.



South Saskatchewan River Basin

Select the component with the greatest value



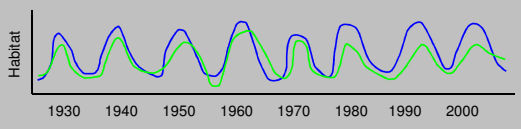


South Saskatchewan River Basin

IFN Determination – Fish Habitat

Part 1 – Percent Flow Reduction Factor

Metric 1: 10 % reduction in average habitat.
Metric 2: 15 % reduction in habitat for any given week.
Metric 3: 25 % reduction in habitat for any one instance.



River	Reach	Per cent-of-Natural Flow Component IFN Recommendation	Per cent Reduction from Natural Flow
South Saskatchewan River Basin*			
Red Deer	1	80%	20%
	3	80%	20%
	5	75%	25%
	6	80%	20%
	7	75%	25%
Bow	2	75%	25%
	4	45%	55%
Oldman	2	60%	40%
	3	70%	30%
	4	85%	15%**
	5	70%	30%
	6	80%	20%
	7	80%	20%
Belly	1	70%	30%
	2	80%	20%
St. Mary	1	60%	40%
Waterton	1	75%	25%
	2	80%	20%
Highwood River Basin*			
Highwood	2	80%	20%
	4	85%	15%**
Athabasca River Basin*			
Athabasca	2	73%	27%
	3	85%	15%**
	4	83%	17%
	5	80%	21%

* Maps of each of the river basins with more detailed information are provided on the following pages.

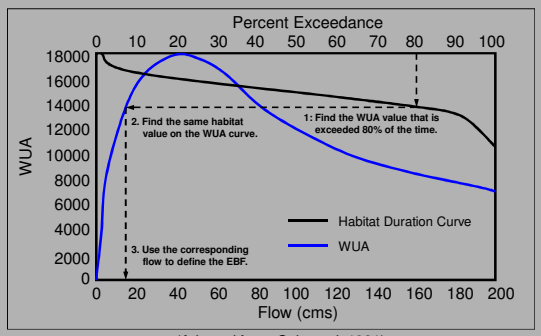
** Most conservative instantaneous flow reduction factor.

(Source: Clipperton et al. 2002; 2003; Paul 2006)

South Saskatchewan River Basin

IFN Determination – Fish Habitat

Part 2 – Ecosystem Base Flow



(Adapted from: Sale et al. 1981)

Range in weekly Ecosystem Base Flow per cent exceedance values interpolated from detailed studies on fish habitat, and riparian vegetation within the Province of Alberta.

River	Reach	Ecosystem Base Flow* Lowest	Average	Median	Highest
South Saskatchewan River Basin					
Red Deer*	1	78	88	89	89*
	3	69	86	89	89*
	5	85	89	89	89*
	6	82	88	89	94
	7	79	84	80	89*
Bow*	2	88	90	89	90
	4	84	90	89	9%
Forty Mile Creek*				90	
Pipestone River*				90	
Oldman*	2	86	89	89	89*
	3	79	83	80	89*
	4	79	80	80	89*
	5	79	86	89	89*
	6	78	86	88	89*
	7	79	87	89	89*
Belly*	1	47	82	81	89*
	2	74	83	81	89*
St. Mary*	1	78	85	88	89*
Waterton*	1	78	84	81	89*
Highwood*	2	46	75	87	96
	4	58	73	81	92
Athabasca River Basin					
Lower Athabasca River*	2, 4 and 5			80	

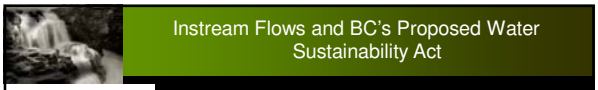
Except for the lower Athabasca River, values are based on the open water season (approximately weeks 14 44). Base flows determined for maintenance of water quality below municipal centres (ie. dilution of sewage effluent) were further excluded from the table. In the A "low" per cent exceedance value is a high flow value and a "High" per cent exceedance value is a low flow value.

1 Interpolated from tables in Appendix G of Clipperton et al. 2003.
2 Pisces Fluvial Associates (2007).
3 Hatfield et al. (WWE).
4 Interpolated from tables in Appendix VIII of Clipperton et al. (2003).
5 Based on the Athabasca River discussion provided in the current report and Appendix G.
6 Maximum EBF values are derived from 90 per cent flow exceedance for the EBF component of the Poplar Rule Curve (Clipperton et al. 2003). The 80 per cent values shown result from interpolating the EBF from the tables presented in Appendix G of Clipperton et al. 2003.

Range: 78 - 95

Range: 80 - 90

Parks Canada



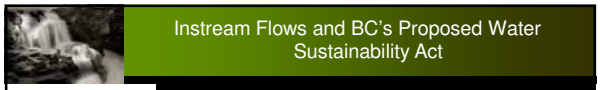
Instream Flows and BC's Proposed Water Sustainability Act

The Environmental Flow Guideline Formula

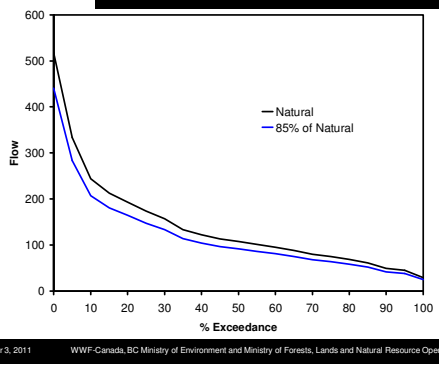
The formula for the desktop environmental flow guideline is the greater of either:

1) A 15% instantaneous reduction from natural flow; or

2) The lesser of either the natural flow or the 80% exceedance natural flow based on a weekly or monthly time step.

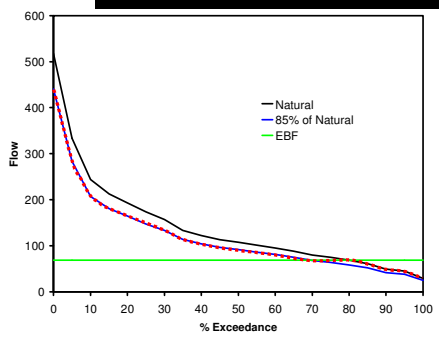


Instream Flows and BC's Proposed Water Sustainability Act

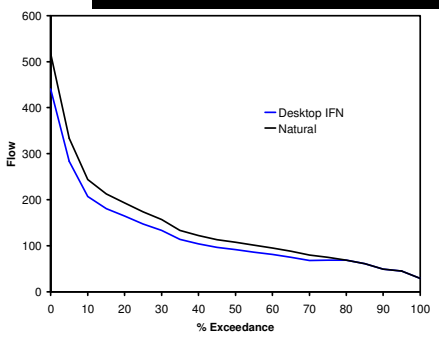


November 3, 2011 WWF-Canada, BC Ministry of Environment and Ministry of Forests, Lands and Natural Resource Operations Workshop

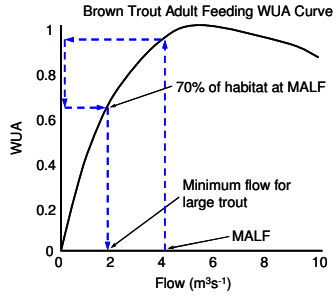
Instream Flows and BC's Proposed Water Sustainability Act



Instream Flows and BC's Proposed Water Sustainability Act

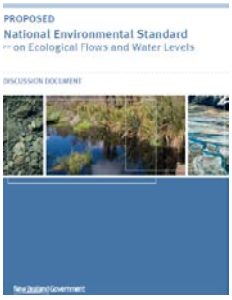


Instream Flows and BC's Proposed Water Sustainability Act



Source: Jowett and Hayes 2004

Instream Flows and BC's Proposed Water Sustainability Act



For rivers and streams with mean flows less than or equal to 5 m³/s:
A minimum flow of 90% of the mean annual low flow (MALF) and an allocation limit of 30% of MALF.

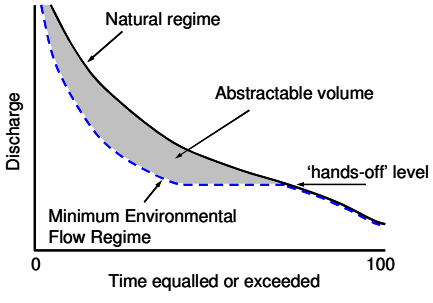
For rivers and streams with mean flows greater than 5 m³/s:
A minimum flow of 80% of MALF and an allocation limit of 50% of MALF.

Minimum flow – a flow at which the abstraction of water ceases.

MALF - The mean annual seven-day low flow.

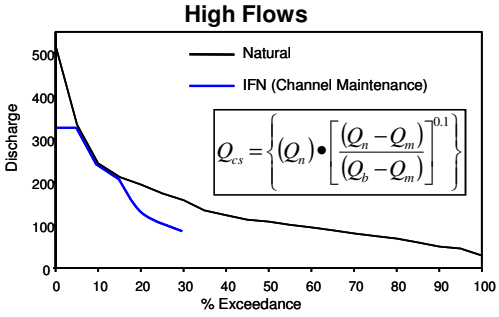
(New Zealand Ministry for the Environment 2008)

Instream Flows and BC's Proposed Water Sustainability Act

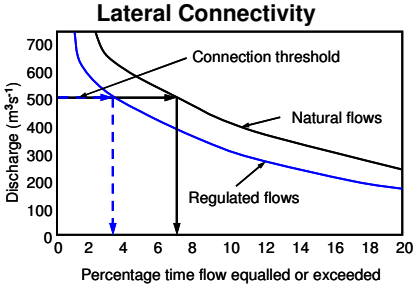


(Source: Acreman 2005)

Instream Flows and BC's Proposed Water Sustainability Act



Lateral Connectivity



(Source: Frazier and Page 2006)

ALBERTA DESKTOP METHOD FOR DETERMINING ENVIRONMENTAL FLOWS

International	United States		Canada
Australia	Alaska	New York	Banff National Park
France	California	Pennsylvania	British Columbia
New Zealand	Colorado	Rhode Island	Ontario
Norway	Florida	Utah	
South Africa	Idaho	Vermont	
United Kingdom	Maryland	Washington	
	Minnesota		

Definitions

Healthy Aquatic Ecosystems

"A healthy aquatic ecosystem is an aquatic environment that sustains its ecological structure, processes, functions, and resilience within its range of natural variability."

(Alberta Water Council 2008)

Definitions

Natural

"…pre-settlement (undisturbed or natural) condition..."

"The pre-settlement landscape of the SSRP area was defined as the conditions that may have been expected during the early to mid-1800s. The pre-settlement condition was defined as a landscape with no influences of agriculture, municipal settlements, water diversions or strong fishing pressure. Some human influence was expected (e.g., minor fishing pressure and altered fire regime from First Nations people). Natural disturbances events such as droughts, floods, and fires were considered as part of the pre-settlement landscape."

(Sullivan 2009)

Definitions

Full Protection

"Using current science, the team's objective was to determine instream flow needs that would fully protect the ecological integrity and biodiversity of the aquatic environment in the SSRB without regard to management constraints. Full protection meant that implementing the IFN would produce no measurable environmental decline due to anthropogenic causes over the long term."

(Goater et al. 2008)

Definitions

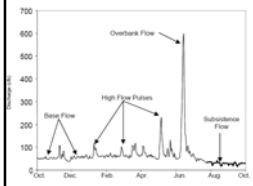
Ecosystem Base Flow

"A **critical threshold** was identified, below which water withdrawals would be curtailed. Based on this study, the recommended minimum flow was set to the weekly 90% exceedance flow. Withdrawal may not reduce the stream flow below the 90% exceedance flow."

(Golder and Associates 2002)

Definitions

Ecosystem Base Flow



"**Subsistence flow** is the minimum streamflow needed during critical drought periods to maintain tolerable water quality conditions and to provide minimal aquatic habitat space for the survival of aquatic organisms."

(US National Research Council 2005)

Instream Flows and BC's Proposed Water Sustainability Act

Definitions

Ecosystem Base Flow

"**Subsistence flows (7Q2)**: the component of an instream flow regime that represents infrequent, naturally occurring low flow events that occur for a seasonal period of time. They maintain water quality criteria and provide sufficient habitat to ensure organism populations capable of recolonizing the river system once normal, base flows return."

(Texas Water Development Board 2008)

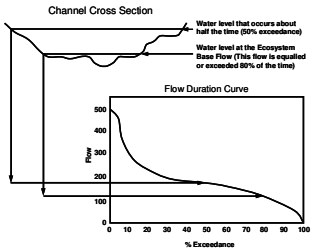
Instream Flows and BC's Proposed Water Sustainability Act

Definitions

Ecosystem Base Flow

"The EBF represents a flow at which further human-induced reductions in flow would result in unacceptable levels of risk to the health of the aquatic resources."

(AENV-ASRD 2011)



Instream Flows and BC's Proposed Water Sustainability Act

ALBERTA DESKTOP METHOD FOR DETERMINING ENVIRONMENTAL FLOWS

When does it apply?

1) Developed primarily for rivers that have **natural flows** and to make a **full protection** flow recommendation where site specific instream flow data is not available.
2) Can also be used to assess the degree of impact on flows in regulated systems (dams, weirs) and in systems where there is flow allocation.

Instream Flows and BC's Proposed Water Sustainability Act

ALBERTA DESKTOP METHOD FOR DETERMINING ENVIRONMENTAL FLOWS

When should it not be used?

The method should not be used when better scientific information is available.

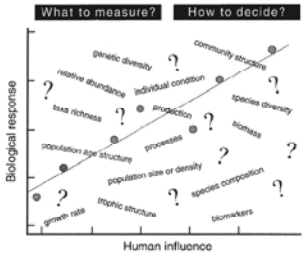
Instream Flows and BC's Proposed Water Sustainability Act

ALBERTA DESKTOP METHOD FOR DETERMINING ENVIRONMENTAL FLOWS

How will Alberta Environment use the Desktop Method recommendation?

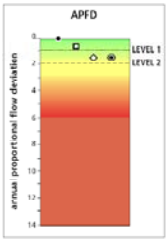
The Alberta Desktop Method is a tool that will **assist in water management and licensing decisions** by describing a full level of protection for what would otherwise require a complex environmental assessment. It is not a substitute for site-specific evaluation. However, conducting reach- or site-specific Environmental Flow determination typically requires a high level of effort and significant resources. For many applications, the level of effort may not be justified, yet there is still a **need to assure environmental protection in each licence that is issued**.

Decision Makers Want A Guideline That Explains Everything



(Source: Karr and Chu 1997)

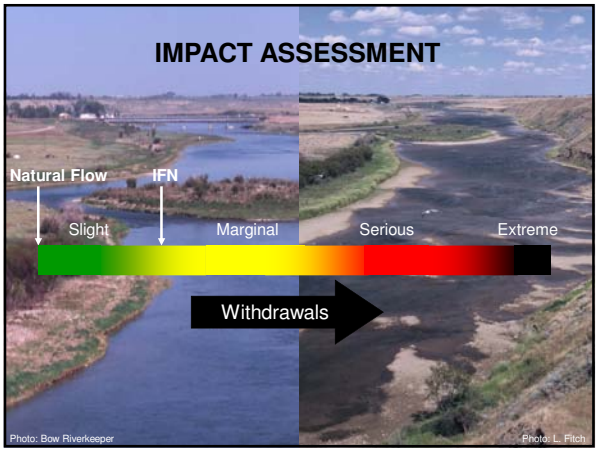
Decision Makers Want A Guideline That Explains Everything



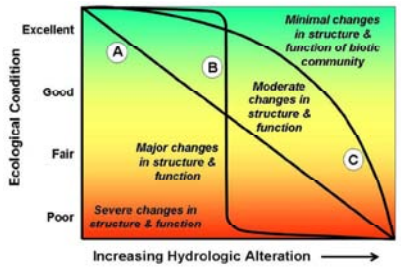
Benchmarking Methodology

Benchmarking involves compiling information on geomorphological and ecological changes from natural condition associated with various degrees of departure from the natural flow regime.

(Source: Brizga at al. 2001)



Thresholds



(Adapted from Davies & Jackson 2006)

Desktop Environmental Flow (IFN) Methods Used in Alberta

- Tennant Method (1979-82)
- Tessmann Method (1982-2003)
- Alberta Desktop (2003-today)

ALBERTA DESKTOP METHOD FOR DETERMINING ENVIRONMENTAL FLOWS

⚠ CAUTION

One size does *not* fit all.

Hatfield & Bruce 2000; Snelder et al. 2011

Value of the Environmental Flow Guideline Document

- Inform and educate Fish and Wildlife staff.
- Inform, educate and influence water licence regulators.
- Streamline the water licence referral process.
- Inform and educate the public.

The guideline serves as a good starting point for the economic versus environmental values discussion.

Legislation

Federal	***Provincial***
Fisheries Act	Environmental Protection & Enhancement Act
Canadian Environmental Assessment Act	Public Lands Act
Canada Water Act	Water Act
Navigable Waters Protection Act	Forests Act
Treaty 8 First Nations of Alberta	Wildlife Act
Department of Fisheries and Oceans' Policy for the Management of Fish Habitat	

Legislation

Federal	***Provincial***
Fisheries Act	Environmental Protection & Enhancement Act
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Canada Water Act	Water Act
Navigable Waters Protection Act	Forests Act
Treaty 8 First Nations of Alberta	Wildlife Act
Department of Fisheries and Oceans' Policy for the Management of Fish Habitat	

Alberta's *Water Act*

- FITFIR
- Must consider the matters and factors as specified in an ***approved*** water management plan.
- In the absence of an approved water management plan, the decision whether to apply an instream objective or environmental flow recommendation is on a case-by-case basis and is at the discretion of the designated Director.

Alberta's *Water Act*

- Market-based transfers of water use rights (*South Saskatchewan River Basin*).
- Water Conservation Holdback - the Director may withhold up to 10% of an allocation of water under a licence that is being transferred.

Alberta's *Water Act*

- The exact number of licences issued that impose conditions satisfying the Desktop Method is not explicitly tracked by database.
- Approximately a dozen licences (mostly in Northern Region with one in the Central Region) have been issued based on the Desktop Method recommendation.

Florida Environmental Flow Legislation

Florida Water Resources Act of 1972 allows water management districts to tax directly within their jurisdiction. This is perhaps the single most important factor of the Act. It creates a guaranteed tax base which allows the districts to carry out instream flow studies and implement solutions without having to go back to the state legislature for funding.

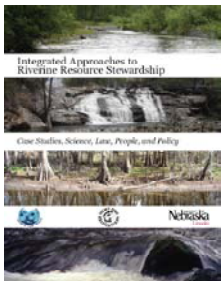
The five Water Management Districts are required by ***Florida Statute § 373.042*** to develop a priority list of water bodies for which they will establish minimum flows and levels. Each year the districts must update their list and submit them to the Florida Department of Environmental Protection for review and approval.

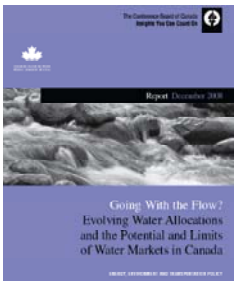
Recommendations for Others: Lessons Learned

- Legislative mandate has greatly facilitated the process
- *ad valorem* taxing authority of the Water Management Districts
- Peer review process

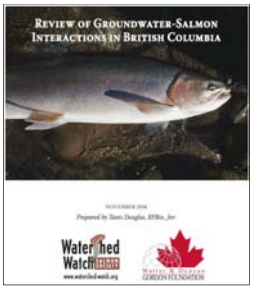
Southwest Florida Water Management District

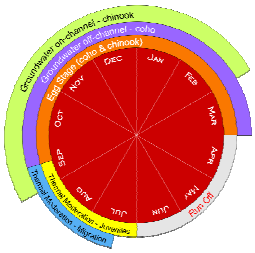
Chapter 12: Legal Tools for Instream Flow Protection





Groundwater Benefits Fish

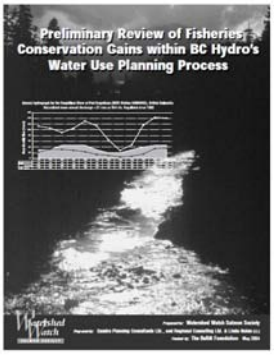




Richard Bailey diagram

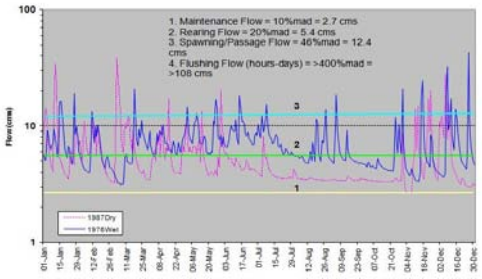
Temperature and Flows

Water Flow Benefits Fish



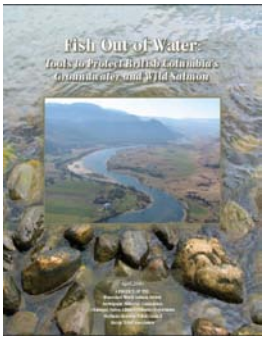
Water & Science Benefit Fish

Daily flows augmented by releases from Reservoir in a "wet" and "dry" year at Port Coquitlam (WSC 08MH002) in the Coquitlam River. Naturalized mad = 27 cms. Three conservation flow levels plotted. Assumes 2 cms release (Nov-May) and 3 cms (Jun-Oct).



Water Protection Benefits Fish

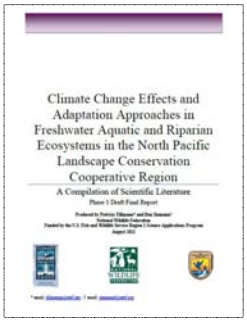
Who Protects Water and Fish Habitat?

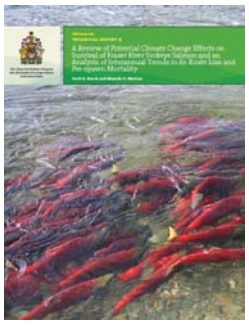


Largely Provincial Role -- WSA

Cohen inquiry raises water concerns

Thermal Stress





Water Act Modernization

Question from Cohen Counsel to Glen Davidson:
"If we're speaking of legislation and looking at the Water Act, to your understanding does it mandate you to consider in-stream flows or impacts on fish or fish habitat when deciding whether to issue a water licence?"

Answer from Davidson: "I wouldn't characterize it as mandating it; it allows for it."

Water Act Modernization

Testimony from Lynn Kriwoken: "What I'm hearing from the science and the information around the resource to regulate an individual well in West Coast of British Columbia may not be practical or pragmatic, so that's why we're taking an area-based critical area approach."

Water Act Modernization

Karen Campbell Question to Lynn Kriwoken:
"Would you agree that the province might consider including the Stuart River watershed as a problem area, given its importance to sockeye?"

Answer from Kriwoken: "Based on what I've heard from the science, yes."

Water Act Modernization

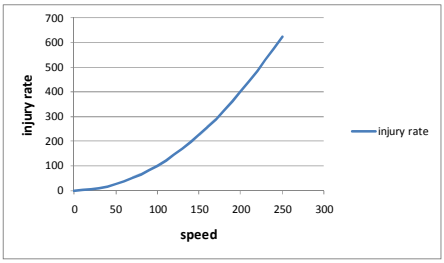
Testimony of Jason Hwang (DFO): "The biggest challenge I think is how this lands and gets implemented, because there are lots of decent ideas in the ***Water Act*** Modernization, but I don't see from where I sit currently the Province or any other entity being resourced to actually follow through and deliver."

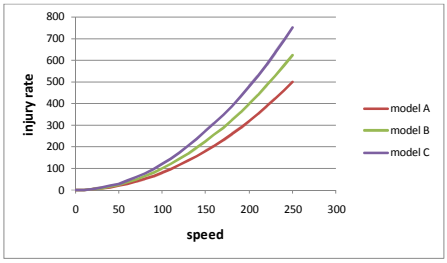
Water Act Modernization

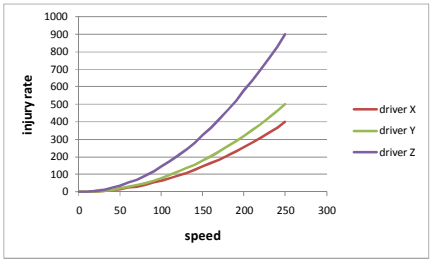
Pregnant Pause Phase

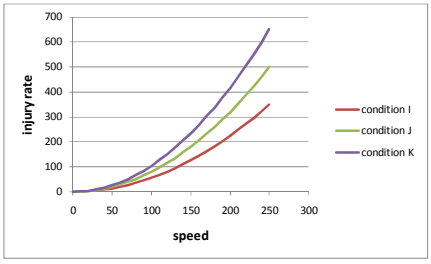
Environmental flows describe the quantity, timing and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend upon these ecosystems.

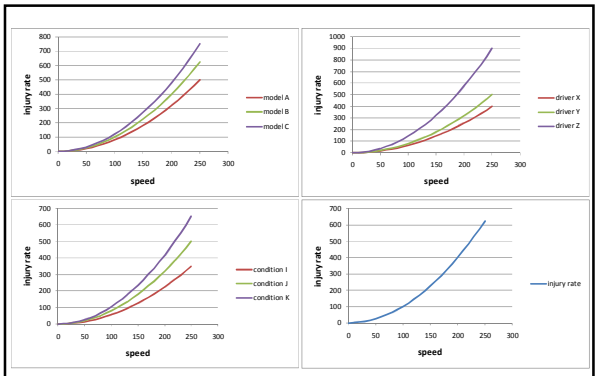
Example: Setting a speed limit.



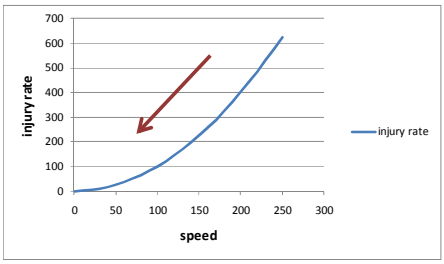




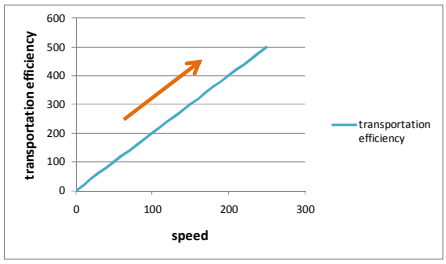


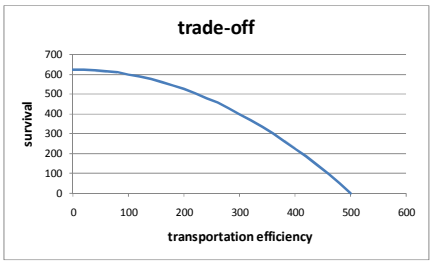


Minimize injuries from automobile crashes.

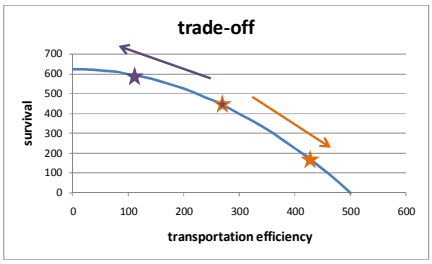


Maximize transportation efficiency.





Minimize injuries from automobile crashes.
Maximize transportation efficiency.



Good process will acknowledge:

1. Different objectives may lead to different decision end points.
2. Science provides the information base, but doesn't "solve" the issue.
3. Final decision requires careful consideration of different objectives, and is likely subjective.

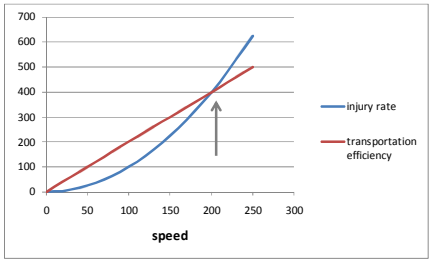
"100 km/hr feels about right for this stretch of road"

Environmental flows describe the quantity, timing and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend upon these ecosystems.

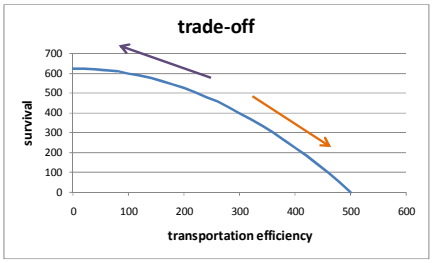
…flows required to sustain river system health and function …social and economic interests of current and future generations

I'm no expert in process, but …

- transparency
- broad representation
- focus on the information
- explicit recognition of trade offs and different values



Minimize injuries from automobile crashes.
Maximize transportation efficiency.



Appendix 3

Background Documents (Agenda, Terminology, and WWF Experience)

Environmental Flows and BC's Proposed *Water Sustainability Act*

Workshop by WWF-Canada/ BC Ministry of Environment and the Ministry of Forests, Lands and Natural Resource Operations

Objective:

Develop detailed input for BC MoE on the practicalities of implementing environmental flow protection in the proposed BC *Water Sustainability Act*.

Location:

SFU Segal Building
500 Granville Street
Room 2800

November 3rd 2011
8:00 am – 4:30 pm

Agenda

Time	Session	Presenter(s)
8:00 – 8:30	**Meet and Greet** • Coffee and tea provided	
8:30-9:00	**Welcome and Overview**	**Scott Niedermayer WWF Freshwater Ambassador** **Ted White, BC MOE** **Michael Harstone, Compass Resource Management**
9:00- 9:15	**Evolving Environmental Flow Law in Canada**	**Linda Nowlan, WWF**
9:15-9:30	**Provincial Context**	**Valerie Cameron, BC MFLNRO**
9:30-10:30	***Water Sustainability Act* and Regulating Environmental Flows**	**Ted White, BC MOE**
10:30	***Break***	
10:45	**Café Break Out Discussions** Café 1. Approving New Water Licenses Café 2. Regulating During Scarcity Café 3. Planning in areas of Over-allocation (Watershed Sustainability Plans) Café 4. Open Discussion	 **Jennifer Turner , BC MOE** **Randy Cairns, BC MOE** **Ted White, BC MOE** **Valerie Cameron, MFLNRO**
12:15 – 1:00	**Lunch**	

1:00- 2:00	**Café Report Out and Plenary Discussion**	**Michael Harstone, Compass Resource Management**
2:00 – 3:00	**6. Case Studies** · Implementation of Environmental Flows in the Okanagan · The Alberta Desk-top Method for Determining Environmental Flows	**Lee Hesketh, Fraser Basin Council / Mark Porter, ESSA Consultants** **Allan Locke, Alberta Environment**
3:00 – 3:15	***Break***	
3:15 – 4:15	**Closing Panel and Plenary Discussion**	**Brian Riddell, Pacific Salmon Foundation** **Craig Orr, Watershed Watch Salmon Society** **Todd Hatfield, Solander Ecological Research** **Kim Hyatt, Ecosystem Research Scientist, DFO**
4:15-4:30	**8. Wrap Up and Next Steps**	**Linda Nowlan, WWF** **Ted White , BC MOE**

Thank you to the Gordon and Betty Moore Foundation for making this workshop possible.

Environmental Flows - Terminology

Environmental flows describe the quantity, timing and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend upon these ecosystems.[i]

There are various terms and definitions that convey much the same concept of environmental flows. These terms include, among others, instream flows, ecological flows, and environmental water allocations, and are often used interchangeably or synonymously with environmental flows. In some cases, these terms reveal limitations in earlier conceptions of environmental flows.[ii] For example, instream flows imply the flows needed to maintain ecosystem services from flows within the river channel, excluding the often important floodplain flows that overtop the channel.[iii]

The term instream flows originated and is still used in parts of North America, however the term environmental flows is so widely applied and entrenched[iv] that it is increasingly being promoted and adopted internationally and within Canada.[v] For instance, the Government of Alberta recently adopted the term environmental flows,[vi] shifting from the term instream flow needs that had been previously used.[vii]

In addition to the diversity of terms used to describe the concept of environmental flows, there are also a number of terms used to define different flows that account for seasonal and inter-annual variation, magnitude, timing, frequency, and rate of change.[viii] These terms include, among others, ecosystem base flows, subsistence flows, and over bank flows and may represent fundamental concepts and components of an environmental flows regime.[ix]

The definition of environmental flows presented above is taken from the Brisbane Declaration, a document prepared on behalf of over 750 delegates at the 10th International Riversymposium and Environmental Flows Conference held in Brisbane, Australia, in 2007 that highlighted the significance of environmental flows and set out a global action agenda to protect the world's rivers.[x] This definition is viewed as capturing the holistic nature of the environmental flows concept and is becoming increasingly endorsed.[xi] Furthermore, this definition also gives prominence to the social and economic significance of environmental flows, whereas other definitions of have tended to focus solely on environmental importance – that is the flows required to sustain river system health and function.[xii] Rather than being at the expense of social and economic interests, environmental flows are essential for providing both direct and indirect benefits on which current and future generations rely.[xiii]

WWF Experience with Environmental Flows Science/Policy/Management

Reports - Canada

Flowing into the Future: WWF-Canada Comments – British Columbia's Water Sustainability Act Policy Proposal (2011). This submission discusses the benefits of environmental flow protection, addresses the 'basics' of how the new Act could protect these flows, proposes methods to deal with existing water licences that compromise flows, and makes suggestions for procedures to determine environmental flows.

Securing Environmental Flows in the Athabasca River (2011). This report outlines the importance of establishing and implementing an Ecosystem Base Flow in the final water management framework for the Lower Athabasca River.

Canada's Rivers at Risk: Environmental Flows and Canada's Freshwater Future (2009). This report assesses how various pressures are affecting environmental flows in 10 of the nation's rivers.

Reports - International

The Itchen Initiative: Smarter Water Management for People and Nature (2011) – This report identifies solutions to the challenge of over-abstraction of water from its impacts on rivers in England and Wales, now and into the future.

Assessment of Environmental Flows for the Upper Ganga Basin (2011): This report presents an environmental flow assessment that was developed for the Upper Ganga (Ganges) Basin in India which takes into account ecological, geomorphologic, livelihood, spiritual and cultural requirements.

The Implementation Challenge – Taking Stock of Government Policies to Protect and Restore Environmental Flows (2010) – This report presents guidelines to advance the implementation environmental flows from the stage of policy and debate based on a number of international reviews, case studies and additional analysis.

Keeping Rivers Alive: A Primer on Environmental Flows and their Assessment (2009) – This report presents a number of key lessons in environmental flows and their assessment based on global experience in recent decades.

Securing Water for Ecosystems and Human Well-being: The Importance of Environmental Flows (2009) - The report highlights the role of environmental flows to simultaneously improve human well-being and sustain vital ecosystems.

Environmental Flows in the Marsh of the National Park of Doñana and its Area of Influence (2009). This report presents existing knowledge about the role of the water in the marshes of Doñana, Spain, in order to define the environmental flow needs of the marsh and its area of influence.

Free-flowing Rivers: Economic Luxury or Ecological Necessity (2006): This report assesses the state of the world's remaining free-flowing rivers and seeks to answer the question why we should maintain our last free-flowing rivers and whether this is a luxury or a necessity.

Rivers at Risk: Dams and the Future Freshwater Ecosystems (2004): This report analyses the construction and planning of dams on a river basin scale and examines the risks of dams to freshwater ecosystems.

Projects - Canada

Lower Athabasca River, Alberta - Phase 2 Framework Committee. The Phase 2 Framework Committee developed recommendations for the Phase 2 Water Management Framework for the Lower Athabasca River, including cumulative water withdrawal rules designed in part to protect environmental flows.

- Monitoring Technical Task Group. The Monitoring Technical Task Group developed monitoring recommendations for the Phase 2 Water Management Framework for the Lower Athabasca River. NOTE: Accessing the report requires websiteregistration.

Grand River, Ontario – Ecological Flow Requirements: Integrating Current Science into Practical Management of River Systems. In partnership with the Grand River Watershed Authority, Trout Unlimited Canada, and Conservation Ontario, this project aims to integrate environmental flows into water management and planning in the Grand River watershed.

St. Lawrence River - Restoring environmental flows in Lake Ontario and the St. Lawrence River. For almost a decade the International Joint Commission has been exploring options for changing how flows and levels in the Lake Ontario and the St. Lawrence River System. This joint-project with partners in Canada and the United States aims to promote a plan to restore more natural flows and levels, by engaging with stakeholders across sectors.

Saint John River, New Brunswick – Restoring the health of the Saint John River. In partnership with the Canadian Rivers Institute and the Conservation Council of New Brunswick, this project includes a community tour along the Saint John River that will present the results of the Saint John River – A State of the Environment Report, and to build support for plans to restore the health of river, including environmental flows.

Projects - International

Bosnia and Herzegovina - Living Neretva Project: This project aims to facilitate the development of an integrated river basin management model for the Neretva river basin, including a new methodology for environmental flow assessment to be used in Bosnia Herzegovina.

China – Environmental Flows and Sustainable Hydropower Development: Based on previous and ongoing research, this project is aimed at developing a framework and methods and providing guidance on environmental flows assessment and management for different river basins in China.

Mara River Basin – Managing the Mara River in Kenya and Tanzania: This project aims to help ministries in Kenya and Tanzania carry out an environmental flows assessment in preparation for basin planning.

Mexico – Protecting the Chihuahuan: This project is aimed at promoting more efficient irrigation practices and restoration of environmental flows in both the mainstem of the Rio Grande-Rio Bravos and its most important tributary, the Rio Conchos.

Tanzania – Restoring Water to Tanzania's Great Ruaha River: This project aims to identify and investigate options to restore flows to the Great Ruaha River.

Vietnam – Managing Environmental Flows: This project aims to design a national framework and methodology to assess sustainable river flows and ensure a healthy river system within Vietnam..

Zambezi River Basin – Environmental Flows in the Zambezi River Basin: This project aims to restore and protect environmental flows in the Zambezi River Basin by incorporating environmental flow provisions into operation of major hydropower dams in Zambia and Mozambique and river basin management plans, and to keep tributaries or river stretches with high ecological importance dam-free.

Endnotes

[i] Brisbane Declaration, 2007
[ii] Hirji and Davis, 2009
[iii] Dunbar and Acreman, 2001; Meijer, 2007; Hirji and Davis, 2009; Petts, 2009
[iv] e.g., Dyson et al., 2003; Tharme, 2003; Acreman and Dunbar, 2004; Smakhtin, 2007; Hirji and Davis, 2009
[v] e.g., Arthington et al. 2009; Bradford et al., 2011; Locke and Paul, 2011
[vi] ASRD, 2011
[vii] e.g., Clipperton et al., 2003
[viii] NRC, 2005; Locke and Paul, 2011
[ix] NRC, 2005; Locke and Paul, 2011
[x] Brisbane Declaration, 2007.
[xi] e.g., Arthington et al., 2009, ASRD, 2011
[xii] e.g., Annear, et al., 2004; Smakhtin, 2007; Sophocleous, 2007; Hirji and Davis, 2009
[xiii] Hirji and Davis, 2009

References

Annear, T., I. Chisholm, H. Beecher, A. Locke, P. Aarrestad, C. Coomer, C. Estes, J. Hunt, R. Jacobson, G. Jöbsis, J. Kauffman, J. Marshall, K. Mayes, G. Smith, R. Wentworth, and C. Stalnaker. 2004. Instream Flows for Riverine Resource Stewardship, Revised Edition. Cheyenne, WY: Instream Flow Council.

Brisbane Declaration. 2007. The Brisbane Declaration: Environmental Flows are Essential for Freshwater Ecosystem Health and Human Well-Being. 10th International River Symposium and International Environmental Flows Conference, Brisbane, Australia, September 3–6, 2007.

Acreman M.C., and M.J. Dunbar. 2004. Defining environmental flow requirements: a review. Hydrology and Earth System Sciences, 8: 861–876.

Alberta Sustainable Resource Development. 2011. Environmental Flows [Online]. Accessed 10-19-2011. Available at: http://www.srd.alberta.ca/FishWildlife/EnvironmentalFlows/Default.aspx.

Arthington A.H., R.J. Naiman, M.E. McClain, and C. Nilsson. 2010. Preserving the biodiversity and ecological services of rivers: new challenges and research opportunities. Freshwater Biology, 55: 1–16.

Clipperton, G.K., C.W. Koning, A.G.H. Locke, J.M. Mahoney, and B. Quazi. 2003. Instream Flow Needs Determinations for the South Saskatchewan River Basin, Alberta, Canada. Publication No. T/719. Alberta Environment and Alberta Sustainable Resource Development: Edmonton, AB.

Dunbar, M.J., and M.C. Acreman. 2001. Applied hydro-ecological science for the twenty-first century. In Acreman, M.C. (Ed.) Hydro-Ecology: Linking Hydrology and Aquatic Ecology. Proceedings of Birmingham Workshop, July 1999. International Association of Hydrological Sciences Publication No. 266, pp. 1–17.

Dyson M., M. Bergkamp, and J. Scanlon J. 2003. Flow: The Essentials of Environmental Flows. IUCN, Gland, Switzerland and Cambridge, U.K..

Hirji R., and R. Davis R. 2009. Environmental Flows in Water Resources Policies, Plans, and Projects: Findings and Recommendations. The World Bank, Washington, DC.

Locke, A., and A. Paul. 2011. A Desk-top Method for Establishing Environmental Flows in Alberta Rivers and Streams. Alberta Environment and Alberta Sustainable Resource Development, Edmonton.

Meijer, K.S. 2007. Human Well-Being Values of Environmental Flows: Enhancing Social Equity in Integrated Water Resources Management. Delft Hydraulic Select Series 10/2007. Amsterdam: IOS Press.

NRC (National Research Council). 2005. The Science of Instream Flows: A Review of the Texas Instream Flow Program. Committee on Review of Methods for Establishing Instream Flows for Texas Rivers, National Research Council. National Academy Press, Washington D.C. 162 pp.

Petts, G.E. 2009. Instream Flow Science for Sustainable River Management. Journal of the American Water Resources Association, 45(5): 1071-1086.

Smakhtin, V. 2007. Environmental Flows: A Call for Hydrology. Hydrological Processes, 21: 701-703.

Sophocleous, M.A., 2007. The science and practice of environmental flows and the role of hydrogeologists. Ground Water, 45(4): 393- 401.

Tharme R.E. 2003. A global perspective on environmental flow assessment: emerging trends in the development and application of environmental flow methodologies for rivers. River Research and Applications, 19: 397–441.

Appendix 4

Facilitator's Summary

Environmental Flows and BC's Proposed *Water Sustainability Act* Workshop

Facilitator Summary

Prepared for

World Wildlife Fund,
BC Ministry of Environment, and Ministry of Forests, Lands, and Natural Resource Operations

Prepared by

Michael Harstone
Compass Resource Management Ltd.
Suite 200, 1260 Hamilton Street
Vancouver, BC V6B 2S8
www.compassrm.com

Workshop Date

November 3rd, 2011

Acknowledgements

The World Wildlife Fund, Ministry of Environment, and Ministry of Forests, Lands, and Natural Resource Operations wish to thank presenters and participants for sharing their ideas and insight, which made the event such a success. They would also like to thank the Gordon and Betty Moore Foundation for their generous support to allow this workshop to happen.

Summary

Overview

On November 3rd, 2011 a workshop was held between environmental flow specialists, industry experts, and representatives from various government agencies to provide detailed feedback on the practicalities of implementing environmental flow protection within the proposed *Water Sustainability Act (WSA)*[1]. The workshop was co-hosted by the World Wildlife Fund, BC Ministry of Environment, and the BC Ministry of Forests, Land, and Natural Resource Operations. Over 50 participants from BC, Alberta, and Ontario joined in discussions on some of the draft ideas and propositions contained within the anticipated WSA related to environmental flows. The workshop was organized around a number of café-style breakout sessions and included a number of background and case study presentations illustrating how other areas and jurisdictions are dealing with some of the more challenging pieces of managing and regulating water resources. The workshop was a unique opportunity for participants to provide their opinions and advice to regulators involved in drafting a major piece of environmental legislation prior to submission to Cabinet.

Three regulatory areas were of particular interest to the province to solicit feedback on and they included specific questions related to 1) approving new water licenses, 2) regulating license holders during times of scarcity, and 3) planning in areas of chronic shortage where water resources had been over allocated. These topic areas served as a springboard to discuss other factors towards better protecting and managing environmental flows in the province. During the day's deliberations a number of topics were repeatedly raised and, as such, served as summarizing themes related to leadership, implementation, decision making & trade-offs, information and uncertainty, regulation triggers, community engagement, and clarity around WSA definitions. While a number of the identified WSA policies and environmental flow propositions appeared to be almost universally supported by workshop participants, the ability of the province to adequately resource the successful implementation and ongoing management were mentioned frequently as likely limiting factors, especially in light of recent trends within government. A number of discussions highlighted that the selection of environmental flows is both a science based and value based process, which requires careful consideration of the social implications as well.

Environmental Flows

The following definition was referenced and used during the workshop when referring to environmental flows:

> *"Environmental flows describe the quantity, timing and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend upon these ecosystems"*
>
> *(Brisbane Declaration, 2007)*

[1] Also known as the *Water Act* Modernization (WAM) process.

Workshop Goal

Develop detailed input for the BC Ministry of Environment on the practicalities of implementing environmental flow protection in the proposed BC *Water Sustainability Act*.

Workshop Agenda

8:30am	Welcome and Overview
9:00am	Evolving Environmental Flow Law
9:15am	Provincial Context
9:30am	WSA and Regulating Environmental Flows
10:45am	Café Break Out Discussions
1:00pm	Plenary Discussion
2:00pm	Case Studies
3:15pm	Closing Panel and Plenary Discussion
4:15pm	Wrap Up and Next Steps

Café Style Breakout Sessions

Workshop participants selected from among 4 café breakout groups to float between according to the following topic areas and specific feedback questions:

Café 1: Approving New Water Licenses

Process to Select Desktop Method(s):

Are the baseline criteria appropriate?

Approach for ungauged streams?

Assessing Risks:

What additional risk factors should be considered?

Transparency / Consistency in Decision Making:

Are there other steps that could improve consistency and transparency in the decision-making?

Café 2: Regulating during Scarcity

What benchmarks should be used to trigger regulation?

What is the best strategy for ungauged watersheds?

Determining groundwater connectivity, what is the default (connected or not)?

Café 3: Planning in Areas of Over-Allocation (i.e. addressing chronic shortages)

Watershed Sustainability Plans

Under what circumstances would a plan be triggered?

Does government have to lead the planning process?

How will existing water rights be addressed where there is a need to reduce withdrawals?

Café 4: Open Discussion Topic Area

This café was left open for participants to discuss other aspects of environmental flows that they felt were important.

Presentations

3 case studies were presented at the workshop, as follows:

- Instream Flow Needs (IFN) for Okanagan Tributaries – Marc Porter (ESSA)

- Reserving Water for Future Agricultural Needs – Ted van der Gulik (Ministry of Agriculture)
- Creighton Creek Stream Flow Recovery Plan– Lee Hesketh (Fraser Basin Council)
- A Desk-top Method for Establishing Environmental Flows in Alberta Rivers and Streams – Allan Locke (Alberta Fish and Wildlife)

As well, a number of presentations were made by the closing plenary speakers who included:

- Brain Riddel (Pacific Salmon Foundation)
- Craig Orr (Watershed Watch)
- Todd Hatfield (Solander Ecological Research)
- Kim Hyatt (Fisheries and Oceans Canada)

General Feedback

Workshop participants provided comments and suggestions on a wide variety of aspects related to environmental flows and more broadly about general water management issues in the province. This section does not attempt to summarize all the detailed comments, but rather to reflect on a few points or themes that were repeatedly raised by participants and noted by the facilitator.

Leadership	Environmental flow protection is a growing trend around the world and in Canada. BC has an opportunity to address many of the weaknesses associated with the existing *Water Act* and be seen as a leader. This opportunity is consistent with recent public opinions where the majority of British Columbians want to see improved rules for managing freshwater resources.
Implementation challenges	There were no shortage of implementation challenges highlighted during the discussions – *politics, shifting priorities, overlapping jurisdictions, limited resources, complexity, uncertainty, land use issues, local governance, etc*. None were raised more than the need to ensure stable and sustainable funding. While streamlining and improved collaboration across some areas would save some money, participants felt that additional resources will be required in order for the WSA to be effective and reach its intended objectives.
Decision making / trade-offs	The determination of selecting appropriate environmental flows is both science and value based. Where the value based side must consider both the social and the environmental implications. Good processes are needed to both explore and seek acceptable trade-offs across the multiple and often competing interests on an integrated basis (across sectors and jurisdictions) and through a deliberative setting with the affected parties.
Information and uncertainty	Lack of data and the need for good science were recurring themes throughout the day. People were supportive of the idea that the degree of (decision making) precaution should be commensurate with the uncertainty (information quality), scale, regional / hydrology context, and stakes (impacts). As well, there was an acknowledgement or shift towards more proponent/applicant

	responsibility when addressing information gaps as long as those requirements are clear, consistent, and fair.
Triggers	Selection of appropriate levels and thresholds is plagued by uncertainty, temporal, regional, spatial, and hydrological and land use considerations. Another way of thinking about this dilemma is in the context of the resulting prescriptive action in combination with an appropriate corresponding action threshold.
Community engagement	Two main themes emerged under the banner of local community involvement. The first dealt with communities having better and earlier access to information about the state of their water resources. As such, they will be in a better position to proactively respond when conditions require it. The second theme dealt more with communities being a valuable resource to support the delivery of the WSA: where active partnerships with First Nations and local communities take on an increasing role from information collection, funding, planning, and all the way through management tasks such as compliance monitoring and enforcement.
Definitions	There were a number of definitional issues raised during the day related to key words and tools and how they would guide or be applied in practice within the WSA. For example, stream health (riparian & wetland habitats), beneficial use, watershed sustainability plans, consumptive versus non-consumptive water use, provincial water objectives, etc.