FROM *WATER ACT* TO *WATER SUSTAINABILITY ACT:*

CHANGES AND OPPORTUNITIES TO ADVANCE WATER SUSTAINABILITY IN BRITISH COLUMBIA

SOIL548 Major Project

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Foreword

British Columbia's new *Water Sustainability Act (WSA)* (2014) will enable the sustainable management of water and aquatic ecosystems but requires a multi disciplinary understanding of the causes of water crises, the management complexities and the new water management changes and opportunities under the *WSA*. For this reason the intended audience of this project includes water allocation staff and statutory decision makers under the *Water Act (WA)*, as well as land managers and resource professionals in government who may be indirectly involved in water management. As with any new regulatory regime, identifying and clarifying opportunities for positive change is necessary to achieve the goals and positive outcomes of the *WSA*.

This document allows the reader to focus on sections that are appropriate to their level of water knowledge and experience.

It is recommended that readers with limited water related experience read through the document chronologically, as they may benefit from a more complete description of the background, context and definitions throughout. Understanding water management under the current *Water Act* provides context for understanding the significance of the changes and opportunities under the new *Water Sustainability Act.*

Experienced water allocation staff, decision makers and managers may benefit from: 3. New Water Sustainability Act (P.18); 4. Remaining Challenges (P.28); 5. Suggested Actions (P.30); and, 6. Conclusions (P.34).

The potential for achieving sustainable water management under the new *WSA* is promising. With the combined efforts of managers, water decision-makers and natural resource professionals, in identifying water issues and implementing provisions enabled under the *WSA*, sustainable water management is possible now an into the future.

NOTE: This evaluation is not intended to provide detail on the assessment and evaluation process that water professionals/decision makers must undertake, but rather identifies changes to the management regime for water under the WSA and the potential opportunities those changes will facilitate. The assessment and evaluation process is described to the degree necessary to demonstrate changes from the WA to the WSA and how the results can facilitate implementation of some WSA provisions.

Summary

This evaluation provides a comparative assessment of the potential changes to water allocation decision-making and opportunities for water management in British Columbia as a result of the introduction of the *Water Sustainability Act (WSA),* which will replace the *Water Act (WA)* in 2016. The goal of the *WSA* is to manage water sustainably under increasing demand, climatic variability and frequency of water scarcity. This evaluation focuses on the changes to the water management regime as a result of moving from the *WA* to the *WSA*, and in particular on (I) significant immediate changes to water allocation for societal and environmental purposes, and (II) opportunities water planning and protection provisions.

KEY MESSAGES

The new provisions under the *WSA* are environmentally and hydrologically significant modernized water management provisions that enable:

- Consideration and allocation of the complete hydrologic cycle
- Environmental water to be provided for in the statutory realm
- More efficient and effective drought management
- Legal establishment of water objectives and land use practice requirements
- Opportunities for flexible governance

Decision makers supported by resource professionals can achieve the goal of water sustainability now and in the future through a multi-disciplinary approach, and strategic and strong decision-making and leadership.

The purpose of this evaluation is to demonstrate how the *WSA* will change the water allocation decision making process and how, through water decision makers and natural resource professionals, those changes and water regulation, planning and other opportunities, the *WSA* can achieve the British Columbia government's goal of managing water sustainably under increasing demand, climatic variability and the resulting increased frequency of water scarcity.

The purpose of this evaluation is two-fold:

I. First, to identify significant immediate water management changes the *WSA* will provide for water allocation decision-making to support the goals of the *WSA* through the new regulation of

ground water and strengthened provisions for addressing environmental flow needs (EFN) and drought (critical flows) as a result of *WSA* implementation; and,

II. Second, to identify opportunities for water decision makers and resource professionals to understand, implement and support legal water objective establishment and water planning provisions in the *WSA,* and, be aware of other opportunities to achieve greater water sustainability.

With the *WSA* coming into force, government priorities initially being implemented are groundwater regulation and changes to EFN and critical flow provisions. These are environmentally and hydrologically significant modernized water management components required to consider and allocate water sustainably and, can allow improved opportunities for drought management under increasing climatic variability. Under the *WSA,* immediate changes to surface and ground water allocation decision-making and EFN provisions will allow consideration of the full hydrologic cycle, which is necessary for decision-makers to achieve the goals of water sustainability under increasing demand and increasingly variable spatial and temporal water availability. Under the *WA*, decision makers have been limited to only surface water considerations, and consideration of EFNs on an application-by-application basis. Consideration of the hydrologic cycle and environmental needs for water under the *WSA* can support further opportunities for the establishment of water orders and implementation of *WSA* planning provisions where hydrologic and environmental needs are not being met.

New water planning and protection provisions are potentially powerful tools. *WSA* changes to allow order and regulation establishment and water planning and protection provisions can provide protection to at risk water sources and change the degree to which water influences the management of other natural resources. The introduction of *WSA* planning provisions enables opportunities for regulating protection measures to address the impacts to water resources resulting from natural resource use, land development, over-allocation or adverse environmental changes. The *WSA* provides opportunities to integrate land based natural resource decision-making with water decision-making, planning and governance. Under the *WA,* water planning provisions are underutilised possibly because they do not provide for alternatives to government authority, and the infrequent occurrence of water scarcity.

British Columbia's new *Water Sustainability Act (WSA)* (2014) will enable the sustainable management of water and aquatic ecosystems through a multi-disciplinary understanding of, the causes of water crises, water management complexities and the new water management changes and opportunities

under the *WSA*. Some of the longstanding issues as a result of split authority for land use activities and water management and of data deficiencies and management will be addressed and supported by *WSA* implementation. Some issues are currently being addressed (pre-*WSA* implementation). Challenges will remain such as operational issues, the lack priority rights of First Nations, and the uncertainty around the extent of impacts of climatic variability. However, it is possible to achieve government's goal of water sustainability as a result of changes and opportunities with a multi-disciplinary understanding of the *WSA*, and strategic and strong decision-making and leadership. There are three suggested actions recommended by the author to advance water sustainability under the *WSA*.

Three Suggested Actions

- Decision makers and natural resource professionals must aware of the changes and opportunities under the *WSA*;
- Water budgets must be determined; and,
- Locations must be identified where water objectives and WSPs can be implemented successfully.

1. Context and Background

Water

Globally, water shortages are becoming more prevalent as demand and consumption rises, and climate variability exacerbates temporal and spatial water supply problems (Richter, 2014). All continents are affected, and the frequency and severity of water related issues are increasingly affecting locations that are considered water rich. Water scarcity is now considered a risk to social, environmental and economic security internationally. It is a critical issue that for the most part, British Columbia has been fortunate to avoid on large scales.

Water is required for human consumptive and sanitation purposes, industrial & agricultural operations, and environmental services. In the absence of water security: food security, economic security, and health and sanitation are at risk. Worst-case scenarios, like the *Millennium Drought*, in Australia from 1995 to 2009, or the California water bankruptcy and subsequent drought resulting from alternate water supplies being depleted, have played out around the world (Richter, 2014)[1]. Repercussions resulting from inadequate water management and planning are having significant impacts in many jurisdictions, including British Columbia (BC).

Sustainable Water Management

It has been demonstrated that the cost of unsustainable management of water resources far exceeds the costs of a strong governance framework and protection measures in advance of a crisis (Richter, 2014). In order to adequately manage water supplies sustainably, there must be a strong management/governance framework as a foundation.

Sustainable development can be defined broadly as development that meets the needs of today without compromising the ability of future generations to meet their needs (Brundtland, 1987). Sustainable water development can thus be considered to be the allocation and use of water to meet the needs of today, without compromising future access to adequate supplies of water of appropriate quality. Sustainable water development, by definition therefore requires that water allocation and the use of

[1] Further Reading: Australia's Millennium Drought and California Drought (Richter, 2014) and for California governance and drought (Christensen & Brandes, 2015)

terrestrial and aquatic ecosystems, which are responsible for regulating hydrologic cycles and maintenance of ecosystems services, must be managed sustainably.

The new *Water Sustainability Act (WSA)* is intended to provide the governance framework and legislative and regulatory tools to support the BC government's goal of sustainable water management.

> *"The (Water Sustainability) act will respond to* ***current and future pressures on our fresh water*** *- including groundwater - and position our province as a leader in water stewardship" and will* ***"strengthen provincial water management in light of growing demands for water and a changing climate."*** (BC Ministry of Forest Lands and Natural Resource Operations, 2015) emphasis added by Author.

Living Water Smart

Developing the foundation for modern water laws in British Columbia has been an ongoing process supported by the Living Water Smart (LWS) initiative and the LWS Plan (2009). The LWS established the Provincial Government's plan and vision for water sustainability. In the LWS initiative, the province highlighted a number of necessary changes to the way water is managed and established some of the key parameters for changes to water laws, which informed the development of the *WSA*.

In particular, the LWS Plan identified the need for water laws to increase the ability of decision makers to provide water flows for ecosystems and species, create greater flexibility for reducing withdrawals during drought, develop regulations for ground water use and allow for more flexible governance and decision making models. These changes have in turn been reflected in the new *WSA*.

The ability of the provincial government to achieve the vision of LWS and the goal of water sustainability will be contingent on the ability of government decision-makers to understand and utilise the powers afforded to them under the *WSA*.

Water Sustainability Act Goals

The goal of the *WSA* is to manage water sustainably under increasing demand, climatic variability and the frequency of water scarcity. Government identified the following sub-goals and objectives, considered by water professionals to be requirements for achieving water sustainability, in the development of the *WSA*:

- Managing the complete hydrologic cycle (surface and ground water)[2]
- Increasing provisions for environmental protection
- Creating opportunities for flexible water governance.
- Influencing other natural resource land use statutes and practices.

Water Governance

Water governance is defined as "the dual process of decision-making and holding those that make decisions to account" (Brandes & O'Riordan, 2014). In the case of BC, flexible governance would allow for alternatives to provincial government authority over water, and allow parties with a vested interest to participate in its governance.

[2] In this context the "complete hydrologic cycle" refers to fresh water on land that is currently needed for human and environmental purposes. It does not include much of the atmospheric water, oceans and ice etcetera in most cases.

2. Water Resource Management and Governance

Water professionals in British Columbia, aware of the expanding potential for water crises for decades, have proposed different ways to update the legislative and regulatory regime to improve water management and governance[3]. Management of only a portion of the hydrologic system (surface water) and sole government responsibility for water governance is not considered sustainable with diminishing government resources and increasing water challenges (Brandes & O'Riordan, 2014). It is with the following considerations and the potential future needs of British Columbia that provisions within the *WSA*, coming into force in the spring of 2016, have been developed.

- Water is the critical environmental good/service that enables and supports all other goods and services derived from the environment.
- Regulatory and governance regimes for managing water in BC are out-dated and do not adequately protect water sources.
- There is increasing climatic variability affecting the temporal and spatial distribution of water supplies, increasing risk to the environment and to water users reliant on these supplies.
- Land use intensity and economic development that impact water resources are increasing.
- Considering the complete hydrologic cycle and alternative governance models are foundational requirements for sustainable water management.

It is these considerations, set within the global context and with additional pressure from water professionals, that have influenced government to take action to address out-dated legislation for water and the sustainability of water management in BC. In 2009, the provincial government initiated the *Water Act (WA)* modernization process and began reviewing the existing *WA*, engaging the public and First Nations, and subsequently drafting the *WSA*. The Bill 18 *Water Sustainability Act* was passed in April of 2014 and is planned to come into force in 2016.

The purpose of this evaluation is to review how the new *WSA* provisions will change the water allocation decision making process and how, through water decision makers, those changes and other water protection and planning provisions, the *WSA* can achieve the BC government's goal of managing water

[3] Further Reading - (Brandes & O'Riordan, 2014; Brandes, 2013; Christensen & Brandes, 2015; Morris & Brandes, 2013; Richter, 2014)

sustainably. Initial provisions will come into force with the *WSA* in 2016 and are related to water decision-making for surface and ground water allocation and water for the environment (environmental flow needs). The second group of provisions to be evaluated are those provided for under the *WSA Part 3 – Protecting Water Resources* (Division 1- Water Objectives, Division 4 -Water Sustainability Plans (WSPs) and Divisions 5 - Temporary Protection Orders). *WSA* protection and planning provisions allow for governance flexibility, and provide significant opportunities for improving outcomes for water. By evaluating and comparing these new provisions to those available and utilised under the *WA* it is possible to determine whether there is potential for improved outcomes for water under the new *WSA*.

Evaluation Questions

To identify the potential for decision making under the *WSA* to improve outcomes for water and achieve the goals of water sustainability, the following questions will be addressed:

1. How do changes from *WA* to *WSA* improve provincial water allocation and management under increasing demand and changing climate to achieve goals of the *WSA*?
2. How will water protection and planning provisions enabled by the *WSA* improve water management and governance?
3. What are the remaining barriers to achieving the goals and objectives of the *WSA* and how can they be adressed?

Organizational Governance

Opportunities under *WSA* must be considered within the broader context of natural resource management. The majority of authorizations that grant access to natural resource extraction on Crown/public lands in BC, including water allocation, are primarily the responsibility of four government agencies (Bellringer, 2015):

- Forests Lands and Natural Resource Operations (FLNRO) has been designated as the agency responsible for ensuring the environmental, economic and social sustainability of natural resources and natural resource development.

- The other three agencies granting Crown land resource authorisations are the BC Ministries of: Environment; Energy and Mines, and; Natural Gas Development, which are beyond the scope of this discussion.

Water authorisations and allocations, previously under the Ministry of Environment, are now under the mandate of FLNRO. FLNRO staff are responsible for lands, forests, range, water and some mineral (non-major mines) authorizations under a number of statutes and regulations. These natural resource authorizations require FLNRO to consult with First Nations. The breadth of the FLNRO model is intended to allow for integrating and prioritising decision-making with respect to land and water resource authorizations.

Decision Making

Who is a Decision Maker?

The FLNRO Statutory Decision Maker (SDM) is responsible for allocating water and authorising its use under both the current *Water Act* and the new *Water Sustainability Act*. Section 12 of the *Water Act* designates the 'Comptroller of Water Rights' and the 'Regional Water Manager' (or delegated Assistant Regional Water Manager) as the SDM responsible for assessing water sources and making water allocation decisions and authorizing extraction and use.

Both statutory and 'delegated decision-makers' make water allocation decisions. Delegated decision makers provide advice and water allocation recommendations to the SDM, or, make decisions under authority delegated to them by the SDM.

For the purposes of this evaluation, both statutory and non-statutory decision makers and the regional water managers are provincial government water decision makers and will be referred to collectively as "the decision maker". Where the decision maker is not a water decision maker specifically, the decision-making role will be specified.

Decision makers are also responsible for components of the sustainable use and development of water resources including drought response, water use conflict mediation, and identifying the need for and implementing water resource protection measures where and when needed.

The organizational roles and positions in FLNRO responsible for the role of the water SDM vary greatly across the province, as does the professional background of water resource professionals. In many

areas of the province water allocation decisions are made at the regional level. In the Thompson Okanagan Region, water allocation decisions are made at the District level.

Decision-Making and First Nations

For any authorisation related to resource allocation, including water, that may impact aboriginal rights decision makers must consult First Nations (FN). Section 35 of the Constitution grants aboriginal rights to FN and a series of court decision have defined both the scope and nature of these rights and also what constitutes infringement of FN Rights (BC MARR, 2015; MoE, FLNRO, & MARR, 2015; SCC 44, 2014; SCC 74, 2004). Under the *WA*, decision makers must consult first nations on a decision-by-decision basis.

The June 26, 2014 Supreme Court Decision in favor of the Tsilhqot'in First Nation's claim to aboriginal title (SCC 44, 2014) has resulted in heightened awareness of government obligations to First Nations and may result in revised government processes for First Nations consultation. At this time the duty to accommodate and consult established under the Taku River Tlingit / Haida Nation decision, (SCC 73, 2004; SCC 74, 2004), prevails.

WSA implementation has resulted in engagement with FN on upcoming transition to *WSA* and regulations (MoE et al., 2015). Engaging with FN in advance of *WSA* implementation is necessary to ensure they have an understanding of the changes to the types of decisions they will be consulted on under the *WSA.*

Reconciliation Framework Agreements, Reconciliation Protocols and Strategic Engagement Agreements are currently being developed between the BC Ministry of Aboriginal Relations and Reconciliation and FN governments. Theses agreements and protocols identify opportunities for government-to-government relationships and FN involvement in natural resource management ranging from the policy level to on the ground allocation decisions. Agreements/protocols provide a framework and new opportunities for engagement and collaboration identifying water related values and objectives of significance to FN such as traditional uses related to water, riparian areas, and cultural resource heritage values and may provide specific ways to engage and consult with FN with respect to water. These agreements and protocols provide a significant opportunity in conjunction with the *WSA*.

Water Act Decision-Making

Allocations

Under the current *WA* surface water allocation decisions are made with consideration to (i) quantity of water, and (ii) prior existing licensed allocations (licenses) and applications. Allocation decisions made under the *WA* and associated *Water Regulations* include allocations for many water uses/purposes including domestic, municipal, agricultural and industrial use of surface water. Decision makers under the *WA* are required to assess existing extractions under surface water licenses, make an assessment of water availability and make allocations that will not unduly impact existing licensed users, or infringe upon First Nations rights such as traditional uses related to water (access to fish), riparian areas, and cultural resource heritage values.

Under the current *WA*, the quantity of water available is assessed through a number of different methods dependent upon the available water quantity data. Hydrometric flow data is rarely available, except on the more significant river systems and systems prone to flooding. As a result, short-term flow measurements or extrapolation techniques based on representative hydrologic systems are often used to assist water quantity evaluations. Methods for assessing flows are both quantitative (subject to data availability) and qualitative, making assessments somewhat subjective.

Water allocations are made for both permanent and temporary withdrawals and are spatially and temporally explicit. Decision makers consider a streams capacity for allocation including: how much water is being withdrawn and at what times of year, compared to how much water is in the stream over the year. Under the *WA*, surface water allocations are made on an application-by-application basis and without consideration to groundwater connectivity. Changes to water allocations when water supplies are limited as a result of climatic variability are difficult due to the complex multi-jurisdictional decision model developed over time.

Note to Forest Professionals

To understand the difficulty of water allocation decision-making, it may help those familiar with forest management to consider the forest authorizations decision-making framework. The framework - Forest and Range Practices Act (FRPA) and Regulations (FPPR), Forest Stewardship Plans (FSP's), forest inventory, Timber Supply Review (TSR), Annual Allowable Cut (AAC), and Land Use Plans (LUP), all provide the foundation for authorizing Cutting Permits (CP)/Timber Sales Licenses (TSL)/Small Scale Salvage (SSS) Permits etc. The forest management framework therefore enables decision makers to consider information from a variety of data sources, which represent a complex framework of checks and balances.

By comparison, water allocation decisions have historically been made in the absence of much of the information available under the forest management regime. Decisions on water allocation have been made without complete inventory information (i.e., little water data and no databases), without a higher-level water allocation plan (that would be equivalent to a TSR) and without a water budget (which would be equivalent to an annual allowable cut determinations). It is as if managers were required to authorize harvesting (CP, TSL, SSS) with only FRPA & FPPR and paper files of historic permits.

EFNs, Critical Flows and Drought Provisions

Environmental flow needs (EFN), critical flow needs and drought provisions are not provided for in the statutory realm of the *WA*. This creates a complex model where decision-makers seeking to address these values in times of water scarcity are forced to rely on various provisions available under other provincial or federal statutes and the use of policy.

EFNs versus Critical flows

The distinction between EFNs and critical flows is important. EFNs are defined as the volume and timing of water flow required for proper functioning of the aquatic ecosystem of the stream ("Environmental Flow Needs Policy," 2015). Critical flows are the minimum volume and timing of flow required in a stream before irreversible harm is done to the aquatic ecosystem, organisms and stream.

Out of necessity, EFNs and critical flow protection is achieved through the policy realm and/or the use of alternate provincial or federal statutes. Under the WA, decision-makers consider EFNs on an application-

by-application basis using the EFN Policy 2009 (amended 2015). The EFN policy was implemented as a result of the commitments made by government under LWS to provide consistent guidance to decision makers for protecting environmental needs for water. Until recently, protecting fish and fish habitat has been partially achievable under the federal *Fisheries Act*, which protected fish and fish habitat from harmful alteration or destruction but did not protect water flows. Changes to federal legislation introduced in 2013 reduced the power of the *Fisheries Act* and have made the use of that statute increasingly difficult. To supplement the *Fisheries Act* protection, decision makers use temporary orders under Section 9 of BC's *Fish Protection Act* to protect critical environmental flows for fish.

Under the WA, decision-makers consider EFNs on an application-by-application basis making them subject to First-in-Time, First-in-Right (FITFIR). As a result, a water systems environmental flow needs are assessed against the quantity of the water remaining in the system at the time of a new application, which creates a moving goalpost that favours earlier applicants and makes EFNs are the last water considered in water systems.

First in Time First in Right – FITFIR

FITFIR is a common method for water rights prioritization and is used in BC under the *Water Act*. FITFIR gives priority to older (senior) water licenses over newer (junior) licenses. In times of scarcity, this results in newer licenses facing water restrictions, without the ability to consider the purpose of the license.

FITFIR will remain under the *WSA* but changed provisions allow prioritizing the purpose of the license in times of scarcity. Section 22 (7) (a) ranks water use purposes.

Currently, in times of water scarcity, drought measures under the BC Drought Response Plan (DRP) (2010) provide advice for the protection of water quantity. The DRP breaks drought response into four levels allowing decision makers to request increasing levels of voluntary water use reductions. Where voluntary reductions are not successful in reducing withdrawals sufficiently to protect EFN or critical flows, the *WA* allows for FITFIR reductions to take place. Under FITFIR in times of scarcity, junior water users can be required to cease water withdrawals regardless of the purpose of water use, while senior water users may continue withdrawals. Withdrawal reductions are not legally enforceable under the *WA* unless they are made under FITFIR provisions.

Water Management Plans

Under the *WA*, the minister can designate and area for water management planning. Water management plan (WMP) provisions available under the *WA* allow water use conflicts and risks to water quality to be addressed. The minister can establish who is responsible for developing the WMP, which can be a third party. The third party can develop a WMP, and perform monitoring and data collection, but there are not provisions to allow for third party governance.

Preparation for Water Sustainability Act Implementation

Government has begun preparation for *WSA* implementation, with advice from decision makers. Deficiencies now being addressed to support *WSA* implementation include:

- Securing additional decision maker capacity (particularly ground water science);
- Improving decision-making processes (streamlining allocation process through LEAN initiatives (See text box below));
- Development of water data information management systems and tool (e-Licencing and Aquarius); and,
- Creating greater integration with multi-disciplinary teams (FLNRO creation and establishment of multi-disciplinary management teams).

These improvements will support initial implementation of the *WSA*.

LEAN

The government of BC has been using the LEAN process to streamline processes for number of years. Through the LEAN process, subject matter experts identify and remove redundancies in work processes increasing efficiency. The intent is that increases in work process efficiency will reduce the timelines for water application processing (Womack and Jones, 1996).

3. New *Water Sustainability Act*

The goal of the *WSA* is to ensure that water is managed sustainably to meet current and future demands under increasing climatic variability and frequency of water scarcity[4]. Achieving *WSA* goals is contingent on decision makers and their ability to understand and utilise provisions in the *WSA* to balance current social, environmental and economic expectations for water access and use without compromising needs for water now and in the future. Many changes in provisions and opportunities in the *WSA* were present in the *WA* or other legislation and regulations, but housing provisions under one new *Act* is intended to allow for greater integration and increase effective application of provisions.

Some of the most significant immediate (I) changes for improving water sustainability under the *WSA* are regulating industrial ground water use, allowing for consideration of the complete hydrologic cycle and new mechanisms for protecting environmental and critical flow needs. Further opportunities for (II) water protection are possible under additional provisions for protecting priority water supplies and creating opportunities for new governance models.

(I) Changes to Water Management with *WSA* Implementation

With the implementation of the *WSA*, decision-makers will be mandated to consider the complete hydrologic cycle[5]. Governance and responsibility for the management of ground water will be vested in the provincial government under *WSA* Section 5. Groundwater consideration will necessitate subsequent changes to surface water decision-making with surface and ground water considered as one connected hydrologic system. At this time, it is expected that ground water regulations will be closely tied to new *WSA* surface water regulations (Vigano, 2015).

Existing ground water use that is hydrologically connected to surface water will need to be incorporated into the FITFIR allocation priority framework, and new ground water authorisations will need to be considered with respect to FITFIR. This change is significant in the decision-making realm. Moving to consideration of the complete hydrologic cycle requires changes to the current water allocation decision model as illustrated in *Figure 1*. *Water Allocation Decision-making Process under the Water Act and changes as a result of the Water Sustainability Act Implementation.*

[4] Team Approach to Water Stewardship – October 9, 2014
https://www.youtube.com/watch?v=wmAy9V6kKJw
[5] Further Reading: (Brandes, 2013; Christensen & Brandes, 2015; Richter, 2014)

Figure 1. Water Allocation Decision-making Process under the *Water Act* and changes as a result of the *Water Sustainability Act* Implementation

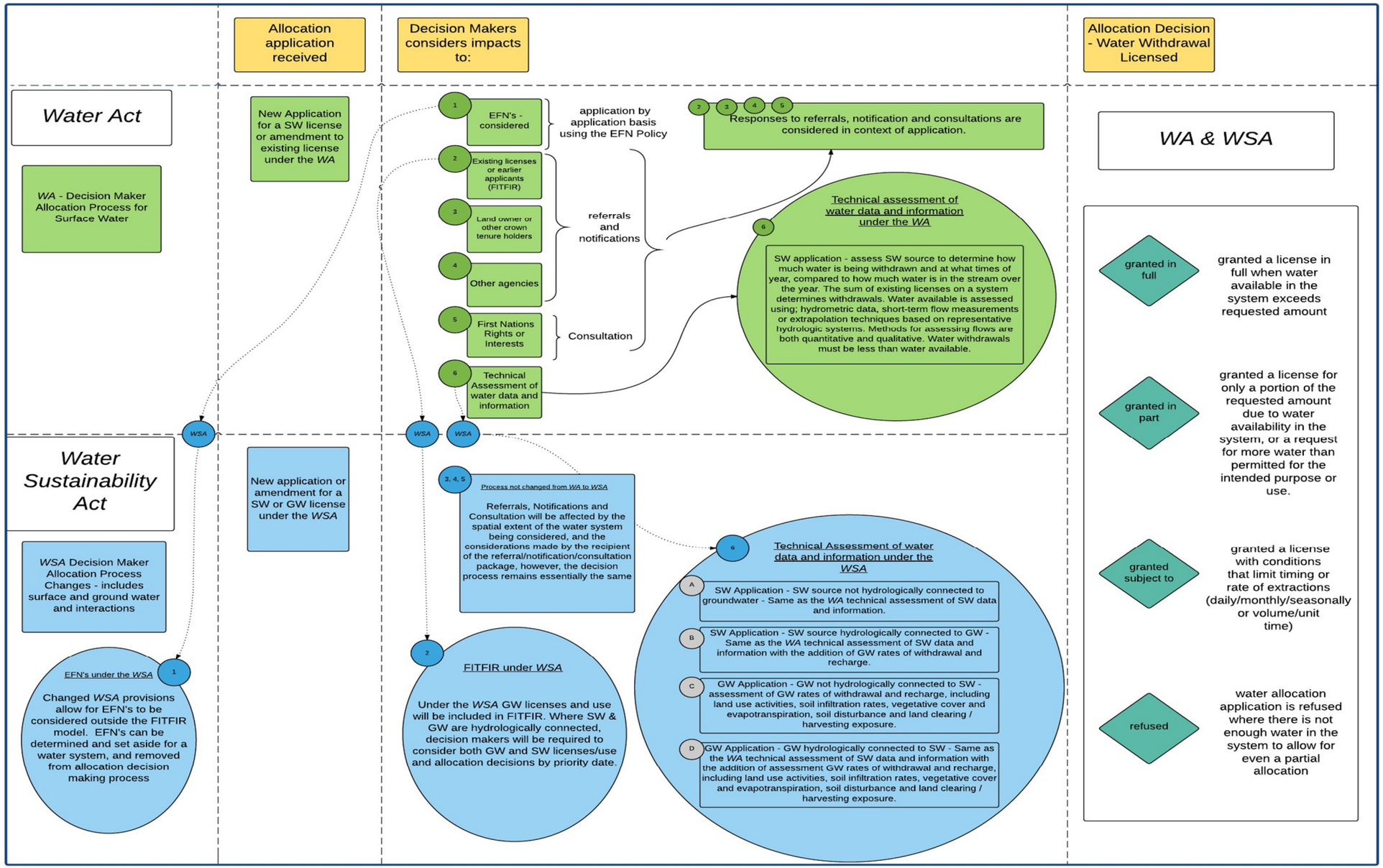

Figure 1. Water Allocation Decision-making process under the *Water Act* and changes as a result of the *Water Sustainability Act* Implementation

WA = Water Act

WSA = Water Sustainability Act

FITFIR = First in time, First in Right

EFN = environmental flow needs

SW = surface water

GW = ground water

Created by Katrina Sigloch August, 2015

Figure 1. shows changes to the current surface water allocation decision-making process as a result of *WSA* implementation and the incorporation of ground water and changes to EFNs. The process is described from the permitting and water allocation perspective, rather than the purely hydrological perspective while recognising that there is limited water data. Changed provisions under the *WSA* for water allocation are discussed in greater detail in the following sections.

Summary - Water Act to Water Sustainability Act changes to the water allocation decision process

Under the *WA* there is one type of application and process:

1. Surface water decision process (including EFN on application by application basis)

Under the *WSA* there are potentially four types of applications and processes:

1. Surface water application for a source not hydrologically connected to a known groundwater source
2. Surface water application for a source hydrologically connected to a groundwater source -
3. Ground water application for a source not hydrologically connected to surface water source – recharge via deep percolation and soil infiltration
4. Groundwater application for a source hydrologically connected to a surface water source and via deep percolation and soil infiltration

Under the *WSA*, EFNs can be removed from FITFIR and the water allocation process

(i) Surface Water Allocation

Surface water allocation decision-making under the *WA* (*Figure 1. WA*) is based on the assessment of a surface water source's capacity for withdrawals and impacts to other water users or affected parties. For the *technical assessment of water data and information (Figure 1.)* under the *WA* for each application, decision makers collate information/data from multiple sources (often paper files for existing licenses, miscellaneous studies, hydrometric monitoring data: rarely from comprehensive water data and information or long term hydrometric data), perform field data collection and often must find adjacent similar water sources with more comprehensive data and employ extrapolation techniques to predict water availability in the surface water system in question.

Under the *WSA,* surface water allocation decisions (*Figure 1.WSA*) will be required to consider hydrologic connectivity to groundwater sources. Currently, where groundwater sources are directly connected to surface water, groundwater withdrawals are impacting surface water systems and surface

water withdrawals are affecting groundwater systems. For example, when ground water withdrawals for irrigation cease, surface water systems see significant increases in flows. Although the impacts are evident, under the *WA* there are not mechanisms in place for decision-makers to address them. Under the *WSA*, decisions to restrict surface or ground water use will be possible.

(ii) Ground Water Allocation

Under the *WSA*, ground water is incorporated in Part 2 (5), which establishes government's responsibility for ground water management. The fundamental principle for sustainable ground water management is that the water extraction rate must not exceed the rate of recharge over time. Assessing ground water for allocation (*Figure 1*. *WSA*) requires an understanding of the characteristics of the individual ground water source. Groundwater sources vary in geomorphological characteristics, rate and source of recharge, vulnerability to land use and degree of connectivity to surface water systems. These factors contribute to unique considerations for each ground water source and will result in added complexity to surface water allocation considerations.

Although hydrologic systems are always connected in some way, the degree of connectivity is highly variable. Our ability to understand and capture the complexity and variability of water movement for the decision making process is not possible. As a result, four hypothetical simplified potential scenarios for allocation requests and decisions under *WSA* are likely (*Figure 1*. *WSA*).

(iii) Environmental Flow Needs and Drought Provisions

Provisions for EFNs, under *WSA* Section 15, require that for all new applications, the decision maker be required to determine and consider EFNs of a surface or ground water source (Appendix 1 - *Table 1. Approaches and Methods for Assessing Environmental Flow Needs*)[6]. EFN is considered under the *WA* in the policy realm under the EFN policy, however the requirements for determining and considering EFNs are now in the statutory realm under the *WSA* and include both surface and ground water systems.

[6] Further Reading: (BC EFN Policy "Environmental Flow Needs Policy," 2015)

Environmental Flow Needs

EFN determinations are incredibly difficult and are water source and value specific. Methods used to determine EFNs are often data intensive, and selected dependent upon the value that is being protected. In order to determine EFNs, it is necessary to know the value that is at risk, and determine the flows required to protect that value. Some values are already identified through higher-level plans, or have been identified as public values, but often there are regionally specific interests that determine values.

Where values have been identified (e.g. fish), EFN determinations must be made to consider life stages of the organism, the requirements for food sources EFNs and the timing of flows required for life stages. Each water source will have unique considerations dependant on the value being protected, and, the more data and knowledge we have about specific water systems, the better prepared we are to identify EFNs.

WSA requires that either government or proponents collect information about the water source and that decision makers assess the EFN requirements. Under the *WSA*, EFN will become a tool for decision makers to reject applications for allocations where environmental objectives will be compromised. Under the *WA* there was not a legal requirement to evaluate EFN and groundwater needs, and, protection of environmental values other than fish habitat was difficult to rationalise for allocation decision-making.

WSA provisions under Sections 86-88 allow for Temporary Protection Orders (TPO) for maintenance of critical flows for ecosystems and fish. Where a significant water shortage order has been declared, decision makers are required to determine critical ecosystem flows and critical flows for fish populations. Critical flows for fish, formerly protected under the Section 9 of the *Fish Protection Act* will be addressed under Section 88 of the *WSA*. Orders under Section 88 can be established in relation to timing and rate of withdrawals, and maintenance of critical flows can supersede FITFIR considerations. The use of TPO's under the *WSA* will require investment in regionally specific data collection and identification of values, to effectively and justifiably protect critical flows.

Introducing flexibility within FITFIR for priority use (*WSA* Section 22) in combination with the *WSA* protection of critical flows and EFNs (*WSA* Section 86 or 87) gives decision makers greater flexibility in times of water scarcity by allowing for domestic use (and essential household use) to take priority over industrial use. Under the *WA*, enacting FITFIR did not provide decision makers with the flexibility to retain domestic water supplies of junior licenses. Increased flexibility to reduce water withdrawals of

lower priority uses in times of scarcity can better protect essential human needs for water. Under *WSA* domestic licenses will have priority, and other lower priority uses can be restricted.

WSA provisions have removed EFN and critical flows from FITFIR, which can enable decision makers to reserve water required for environmental services "off the top" (Vigano, 2015). This provision enables EFN establishment by water source or water system, rather than an on application-by-application basis, as is required under the *WA*.

Establishing and maintaining flows for critical flows and EFNs is a requirement for ensuring water sustainability and is a priority for the public and First Nations. Under the *WSA* decision makers must determine what the EFNs are for a specific water source and can make the decision to remove EFNs from water available for allocation.

(II) Opportunities for Water Protection and Planning under the *WSA*

Opportunities that will be possible (in many cases over the long-term) include the ability to legislate greater specific protection of critical or at risk water supplies, establishing connections between land use practices and water and enabling flexible governance where other non-government groups could be delegated the responsibility for water management in a specified area. Opportunities are provided in *WSA* Part 3 under Section 43 - *Water Objectives* and Sections 64-85 - *Water Sustainability Planning* provisions that will allow for objectives for water to be established at multiple scales. Decision makers and natural resource professionals should also be aware of other opportunities for collaboration with ongoing government priorities outside of the *WSA* (Community Watershed Investigation, Cumulative Effects, Integrated Monitoring) that can support achieving *WSA* goals. Each of these provisions and opportunities are discussed in greater detail in the following sections.

(i) Water Objectives

The *WSA* enables the establishment of Water Objectives (*WSA* Section 43) through regulation for the protection of water values: water quality, quantity and aquatic ecosystems. Establishment of water objectives and associated regulations occurs through ministerial orders informed by government decision makers through identification of 'at risk' water values. Decision makers must demonstrate that a water value is 'at risk' through data collection and identification of risk factors as well as demonstrate how proposed alternative actions will reduce risk to water supplies. Water Objective Regulations can specify (a) the considerations decision makers must make when reviewing resource use applications and

(b) define specific practice requirements and measures to address any impacts to water values at risk. Decision makers have the ability to identify areas requiring the establishment of water objectives from the provincial scale down to stream scale.

(ii) Water Sustainability Planning

In cases where water objectives have been established to protect water supplies, the *WSA* also enables Water Sustainability Planning provisions under Section 64-85. Water sustainability planning can take place for issues ranging from land use or over allocation, to dedicating water for agricultural use. The planning process can be initiated where water objectives have been established, and where water use, land use and/or other are shown to be unduly impacting water resources or aquatic ecosystems at risk. The Minister can initiate the planning process, or, be requested to do so, and by order may designate an area for Water Sustainability Plan (WSP) development. The evolutionary potential of WSP provisions under the *WSA* with respect to protecting water supply and quality, influencing land use and creating co-governance opportunities is promising.

The planning process for WSP development, initiated by ministerial order, can be for a number of purposes related to water supply and land use impacts (ecosystem restoration purposes, to resolve/reduce conflict between water users, to resolve/reduce conflicts between water users or land use impacts and the environment, and, risks to water quality or aquatic ecosystems). WSP provisions are designed to be scalable in both scope of influence and spatial extent and allow for varying degrees of WSP decision-making and enforcement authority to be delegated to proponents outside the provincial government.

WSPs allow for flexibility in their utility recognising that specific locations will have differing needs and protection interests and requirements. WSP provisions allow for integration with other strategic, operational or other planning processes in or adjacent to the plan area and can be used in conjunction with other statutes such as the *Drinking Water Protection Act*.

The *WSA* also allows for the development of regulations under WSPs, which can enable WSP components to supersede other statutes allowing for the protection of water from land use impacts. *WSA* Section 84 (2) lists statues and enactments that cannot be superseded by the *WSA,* but all other provincial statues can be superseded by the *WSA*. WSPs must be developed with consideration to potential impacts to other land users and where land use impacts are demonstrated, land use practice requirements can be incorporated in WSPs. Practice requirements in WSPs can then be enforced

through additional regulations, which can supersede any previous authority granted to licensees or permit holders.

In some cases, opportunities may already exist for decision makers and external bodies to request initiation of the planning and WSP development process and be prepared for co-governance arrangements. Established groups such as the Okanagan Basin Water Board, or, the Nicola Watershed Community Round Table are examples of external bodies, which through years of capacity building and priority value identification and strategy development, could be prepared to request initiation of the planning process for development of a WSP[7] and may be prepared for co-governance roles.

The longer-term opportunities under the *WSA* include the potential for watershed level consultation and/or watershed co-governance with FN as a result of First Nations Agreements and Protocols. Reconciliation Framework Agreements, Reconciliation Protocols and Strategic Engagement Agreements being developed between the BC Ministry of Aboriginal Relations and Reconciliation and FN governments provide a significant opportunity for water co-governance using WSPs. The frameworks identify water related values and objectives of significance to FN such as traditional uses related to water, riparian areas, and cultural resource heritage values and establish how the co-governance relationship will function. WSPs and co-management/governance with FN through agreements and protocols can provide the opportunity to see how water co-governance could work.

WSPs offer a potentially powerful tool for addressing critical water management and governance issues. In some cases the process of establishing a WSP could take decades due to the need to determine water availability and collect more complete hydrologic information. In other cases however, external bodies (e.g. water boards, water purveyors) have developed much of the necessary framework to enable requesting WSP initiation (Christensen & Brandes, 2015; Richter, 2014; Vigano, 2015).

[7] Further Reading: (Nicola WUMP Multi-Stakeholder Committee & Compass Resource Management Ltd., 2010; NWCRT, 2011; OBWB, 2015; Vigano, 2015).

Examples of potential Water Sustainability Plan Utility:

(These two opportunities are generic opportunities to demonstrate some potential for co-governance under the *WSA*; each water issue, planning process and potential resulting WSP will be unique.)

A decision maker can identify an area experiencing persistent water conflicts between users or users and the environment (EFNs or critical flows) and request that the Minister designate, by order, that area for development of a WSP. The scalable planning process could be for a watershed, or specific stream, which dictates the required stakeholder involvement. The WSP developed could establish locally relevant and specific measures to address water conflicts and/or escalation process. Authority for enforcement of some provisions in a WSP can be delegated to proponents, or, may remain with government.

Community Watershed Group, Water Purveyor or First Nation could request that the Minister designate, by order, an area for development of a WSP as a result of persistent water quality issues as a result of chronic low flows/land use/other in a specific sub-watershed. The WSP could allow for the development of best management practices or a source water protection plan focussing on water quality measures and targets. The WSP could compliment a drinking water protection plan.

(iii) Other Opportunities

To fully achieve the goals of the *WSA*, decision-makers and natural resource professionals need to understand the changes and potential opportunities under the *WSA* and must also be aware of opportunities for collaborations with other ongoing initiatives and priorities of government.

There are three important initiatives taking place concurrently with *WSA* development and implementation that could support the goals of *WSA* and changed provisions and opportunities under the *WSA*. It is recommended that decision-makers and natural resource professionals be aware of and begin to explore the opportunities under these initiatives (and potentially other future initiatives) that will support decision making under *WSA* and further advance water sustainability.

1. The Forest Practices Board (FPB) has made recommendations for improving the management of Community Watersheds. FPB recommendations have led to a review of the *Forest and Range Practices Act* provisions for drinking water protection, water quality monitoring and higher level plan practice requirements, as well as, development of a guidance document for forest professionals, engineers and geoscientists to ensure that considerations and components of watershed assessments are meaningful. Further opportunities for progress in community water supply protection and governance may be possible through connections with *WSA* WSP provisions. (Forest Practices Board, 2014)

2. A cumulative effects assessment (CEA) framework is being established by the province with a significant focus on water and water related impacts. CEAs have already identified locations with unacceptable watershed conditions and are working to identify further priority areas for investigation. There are opportunities for a reciprocal relationship with CEAs and *WSA*. CEAs identify water values, and collect data and information that could support *WSA* decision-making, and, *WSA* provisions could assist in addressing issues found through CEAs. The CEA program will be aligning with *WSA* opportunities (Government of BC, 2015)[8]. For example, a completed CEA in the Merritt Timber Supply Area has demonstrated the need for alternative resource management practices to address water related values at risk (Vigano, 2015). This has initiated a plan for the development of water objectives, a first step to potentially starting a WSP process (Vigano, 2015).

3. Provincially an Integrated Monitoring (IM) group has been formed and an IM framework is being developed. The provincial IM framework has through consultation, identified water related monitoring and water data as a significant gap. The intent of IM is to develop a robust framework that oversees FLNRO resource monitoring, establishes priorities, and has authority to address deficiencies. Through IM, decision makers can expect improvements to water related monitoring.

[8] Further Reading - (Bellringer, 2015; Dubé, 2015)

4. Remaining Challenges

Challenges remain for effective implementation of the *WSA* including:

- Operational challenges of limited data, scientific complexity, insufficient staff resourcing and collaboration difficulty across resource disciplines;
- Consideration of long-term flow and/or climate data in allocation decision making; and,
- First Nations allocation priority under FITFIR.

Operational Challenges

Operational challenges of limited data, scientific complexity, insufficient staff resourcing and collaboration difficulty across resource disciplines remain. Operational challenges are alleviated somewhat by the advanced preparation for *WSA* implementation such as acquiring additional staff resources and the development of data and business applications (systems). Changes under *WSA* to incorporate groundwater and EFNs will require that increasingly complex hydrologic relationships be understood and interpreted to ensure water sustainability. Further improvements are needed to ensure critical water sources, and risks to those water sources, are identified and quantifiable, and that water data and information is easily accessible and utilised consistently by decision makers.

Climate Variability

In order for decision makers to ensure that allocations are sustainable over the long term, greater emphasis on consideration to long-term climatic changes are necessary. To achieve water sustainability, it is critical to account for climatic variability and the frequency and severity of extreme events resulting in water scarcity. Variability in temperature and precipitation significantly influence hydrologic systems and it is likely that some locations in the province, like the southern interior, are at greater risk than others (northern interior) (Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, 2008; Church & Ryder, 2010; Eaton & Moore, 2010; Kundzewicz & Robson, 2004; Rayner & Parker, 2010; Rodenhuis, Bennet, Werner, Murdock, & Bronaugh, 2009).

Evaluation of the potential impacts of climate on water quantity must use long-term climate records or predictive models, and stream flow discharge data for the critical low flow periods or months to establish trends and identify new patterns in frequency of extreme climate events. Understanding the long-term trends and frequency of extreme events can better inform decision makers on the future vulnerability of water supplies resulting in increased accuracy of allocation decision making and the identification of opportunities for the establishment of water objective and WSPs.

FITFIR and First Nations

First Nations water allocations are a potentially significant issue remaining with the FITFIR model under the *WSA*. As the term "First Nation" implies, aboriginal peoples relied on beneficial use of water and aquatic ecosystems and species prior to the implementation of BC's water laws. At the time of *Water Act* enactment, Indian bands were prevented from applying for or holding a water license. As a result, many First Nations are not holders of priority water licenses (Simms, 2014).

Although the *WSA* establishes priority water uses in times of scarcity and increases discretionary power of decision makers, FN under the FITFIR model may not adequately address the rights and entitlement of First Nations as the first people of BC to priority rights for water. This political issue could be problematic as water scarcity increases and will serve to divert attention from both *WSA* engagement and consultation with First Nations. Over time, this political issue will become significant.

5. Suggested Actions

British Columbia's new *WSA* has the potential to enable the sustainable management of water and aquatic ecosystems through a multi-disciplinary understanding of, the causes of water crises and management complexities and the new *WSA* changes and opportunities. Decision makers and resource professionals through changed provisions and opportunities in the *WSA* can achieve *WSA* goals of water sustainability through a multi-disciplinary approach, and strategic and strong decision-making and leadership. After evaluating the immediate changes and opportunities under *WSA,* and considering the remaining challenges, there are three suggested actions recommended by the author to advance water sustainability:

- FLNRO must ensure that decision makers and natural resource professionals are aware of the changes and opportunities under the *WSA* and that new processes are developed;
- FLNRO must support the development of Water Budgets, particularly in areas with at risk water supplies; and,
- FLNRO must identify where water objectives can be established and WSPs can be implemented successfully to encourage further implementation.

Decision-Makers and Resource Professionals

FLNRO management teams must ensure that water decision makers are aware of the changes and opportunities to maximize potential under the *WSA* and achieve water sustainability. As demand for water and climate variability increase, there will be increasing frequency and severity of water scarcity and potentially crises arising that require further implementation of *WSA* provisions.

In the short term, government and decision-makers must develop new water allocation processes that include groundwater considerations as well as methods to determine EFNs and to assess the degree to which climate extremes will affect water resources. Establishing new water allocation processes and defining the roles and responsibilities of decision-makers for EFN and climate considerations will support initial *WSA* implementation.

FLNRO management teams must ensure that natural resource professionals recognize the priority of sustainable water management. Natural resource professionals must understand how the *WSA* could influence natural resource practices where land use is demonstrated to be impacting water resources. Natural resource professionals must also understand how the *WSA* can assist in achieving other

government priorities, such as co-governance with First Nations and addressing the impacts of cumulative effects.

Water Budget Development

FLNRO regional management teams must dedicate resources to determine and establish water budgets for watersheds in their region/districts. Water budgets are an inventory of water by watershed that identify the critical low flow periods, consider current demand, and account for the variability in water supplies. Water budgets can determine annual water supply under variable climate extremes and be used to determine the maximum water withdrawals while maintaining ecosystem function over time.

The changed *WSA* provisions resulting in consideration of the complete hydrologic cycle requires that allocation decision makers support the expansion of data driven decisions, and tools (Water data information systems, increased hydrometric and climate data collection and/or modeling capabilities) to manage water resources. Water budgets are a critical tool for water decision makers to ensure sustainable water resource management and should be developed province wide[9] (Healy, Winter, LaBaugh, & Franke, 2007). The priority locations for water budget development are watersheds that are over allocated, or, at/nearing full allocation, or experiencing increasing frequency of water scarcity or conflict. Decision-makers are aware of many of the locations that are a priority for water budget development.

Established water budgets will increase efficiency and certainty in the water allocation process, allow decision makers to better understand the vulnerability of specific water supplies, and support defensible data driven decisions. Water budgets will increase efficiency in determining water allocations, EFNs and critical flow needs by reducing the need to collect, collate and extrapolate water information and data for each allocation decision. Decision-making based on established water budgets would reduce individual water allocation transaction time by ensuring that accurate and easily accessible data is available to support decision-making. Water budget determinations made with consideration to climatic variability will assist decision makers to manage water sustainably with greater certainty under variable climate conditions over the long term. As water supplies are under increasing demand, water budget development can ensure informed data driven decision-making reducing the need for water conflict

[9] Water budgets have been established for some watersheds in the West Coast Region to assist in water management.

mediation in the future. Water budgets are a critical tool that can enable SDM's to meet new statutory obligations under the *WSA* and achieve water sustainability.

Water Objectives and WSPs

The ability to establish water objectives and WSPs under the *WSA* enables the protection of specific at risk water resources, while supporting sustainable water use and enabling co-governance models. The scope and complexity of water management issues requires that government pursue co-governance opportunities to address water issues at the appropriate scale to achieve water sustainability. Establishment of regionally specific water objectives and successful WSP implementation must be demonstrated to provide incentive for other locations to pursue the potentially time consuming process.

FLNRO decision makers and managers must identify watersheds where water objectives are needed and where there is the potential for WSP establishment. The CEA framework can be used to identify water values and CEAs can determine the risk to those values as a result of resource management and use. Where CEAs determine that water values are at risk, FLNRO decision-makers, professionals and managers should initiate the process of water objective establishment and evaluate the potential to establish WSPs.

As a starting point, watersheds to consider for WSP establishment are those with a combination of the following characteristics:

- Moderate water scarcity issues and/or water use conflicts;
- A CEA that demonstrates water related values are a risk and has established water objectives;
- Existing water data either through hydrometric monitoring, long term water monitoring data or, with established water budgets;
- An engaged FN operating in a location with an agreement or protocol for government to government relationships;
- An active and engaged group outside government such as a water board;
- Actively engaged and invested stakeholders who are working together on issues related to water or land management;
- A designated Community Watershed; and/or,
- Other priority issue identified by FLNRO managers.

A combination of the above criteria will provide greater likelihood of successful WSP implementation. A relatively small watershed with moderate water issues, existing data, and invested stakeholders will

reduce the potential for conflict and established water objectives will provide the foundation and context for WSP development. Where water issues can be quantified with data, and water issues have not escalated to crisis, cooperative planning can more easily take place. Invested and engaged FNs, groups and stakeholders can enable effective co-governance opportunities, which can reduce the role of the provincial government in governance. Co-governance with FN will not address the priority of FN under FITFIR, but will be a step towards achieving cooperative relationships that can evolve over time. Strategic and strong leadership in pursuing the establishment of water objective and WSPs are required to realize the potential of the new *WSA*.

6. Conclusions

The goal of water sustainability under increasing water demand and climate variability is achievable under the new *WSA* through strategic and strong decision-making and leadership. Changes under *WSA* that enable considerations of both surface and ground water, can allow decision-makers to meet both human and environmental needs. New *WSA* provisions can allow improved water allocation decision-making, environmental conditions and drought response, particularly in locations where water budgets that consider climate extremes are established. *WSA* provisions for the establishment of water objectives and WSP development will enable prioritisation of water values in locations of water scarcity, create co-governance opportunities and allow for other location specific priorities to be addressed. The new *WSA* can result in sustainable water management in BC with strong and strategic leadership by FLNRO managers, water decision-makers and resource professionals.

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Appendix:

Table 1. Approaches and Methods for Assessing Environmental Flow Needs

Method	Description	Values	Utility	Limitations
Tennant's Method (Tennant, 1976)	Used to determine safe range of flow for aquatic biota	Fish, wildlife, recreation and related environmental resources	Can be used in locations with little data as minimal data inputs required. Breaks the year into warm season and cool season. Only requires mean annual discharge, which can be measured or derived. Achievable	Based on a limited number of rivers of a certain size in the US -relevance to; other locations, other aquatic species, variable/unpredictable climatic conditions, needs to be determined on a case by case basis.
Made-in-BC modified Tennant's method (Ptolemy and Lewis, 2002)	Adapted for BC to account for salmonid requirements at varying life stages.	Fish (salmonid life stages) and supporting aquatic biota	Takes into account timing of EFNs and provides greater flexibility for variability of flow	Relies on data and expert opinion. Potentially difficult to implement and requires monitoring and adjustment in locations nearing thresholds. Unpublished in peer-reviewed literature.
Range of Variability Approach (Richter et al, 1997; Mathews and Richter, 2007)	Based on indicators of hydrologic alteration	Protects multiple values	Connects land use (alteration) with flow conditions and can be used to protect water systems that do not currently have priority values identified or established in regulation. Protects quantity of water with no specified purpose.	Protects the midrange of stream flows which may be at the expense of extreme flows; may favour biota that thrive in mid conditions rather than protect life stages that thrive in extremes.
Alberta Desktop method (Locke and Paul, 2011)	Uses percent of natural flow (acceptable reductions in flow) and ecosystem base flow (absolute minimum flow)	Can be used for any value as long as the thresholds are known	Accounts for seasonal variability and distribution of flows over the year, identifies critical low flows, relatively conservative.	Data intensive, requiring long term data, and for majority of water systems the data required is not available. Based on large rivers so applicability to smaller systems questionable
Hydraulic Methods	Identifies the inflection point of a streams discharge relative to its wetted perimeter	Multiple values	Relatively easy to implement where discharge and stream channel characteristics are known.	Highly subjective and variable. Some water systems have very gradual curve making inflection point difficult to quantify.
Habitat Methods (Weighted Usable Area; Physical Habitat Simulation. (Bovee and Cochnauer, 1977; Jowett 1997; Inglis et al 1994; Payne, 2003; Hatfield and Bruce, 2000)	Uses a combination of scientific information to quantify habitat suitability	Used for a specific species of interest (value)	Identification of specific conditions and flows required for a species (value) at given life stages. Recognises variability required to optimise conditions. Includes Stakeholder input, scientific input, data driven, simulation models. Rigorous.	Costly and time consuming. Difficult to apply on large scale May have utility in WSP process where extensive investigation has occurred and specific aquatic species is identified and has been studied.

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