

Piping Water Between Watersheds

An Analysis of
Basin-to-basin and Sub-basin-to-sub-basin Diversions
in Alberta



Water Matters



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Summary

Two years after Alberta's recent water controversy involving a proposal to pipe water from the Red Deer sub-basin to the Bow River sub-basin, the issue of water diversions from one sub-basin to another is still outstanding. In light of increased water scarcity in southern Alberta, the potential is on the rise for proposals such as the one that erupted over the entertainment complex in Balzac, north of Calgary. As of yet, however, a policy void remains on so-called sub-basin-to-sub-basin diversions.

BOX 1

This report uses the term "basin-to-basin" to describe the movement of water between Alberta's seven large river basins and "sub-basin-to-sub-basin" diversions to describe those movements of water within a large river basin and between its sub-watersheds. We use these terms to avoid the confusion that often occurs with the use of the legal definitions. "Basin-to-basin" diversions are referred to as "interbasin transfers" under the *Alberta Water Act* and "sub-basin-to-sub-basin diversions" are often called "intra-basin transfers." An example of a basin-to-basin diversion would be between the South Saskatchewan River Basin (SSRB) and the North Saskatchewan River Watershed. A sub-basin-to-sub-basin diversion would be the movement of water between the sub-basins of the South Saskatchewan River Basin, which comprises four sub-watersheds (Red Deer, Bow, Oldman, South Saskatchewan).

Two years after the Balzac controversy, a development involving a proposal to pipe water from the Red Deer sub-basin to the Bow River sub-basin, a policy void remains on so-called sub-basin-to-sub-basin diversions.

Alberta's *Water Act* does prohibit water diversions between the province's seven large river basins, but Alberta has no formal policy to limit water diversions within these vast basins. Applications for sub-basin-to-sub-basin diversions are treated like any other water licensing application, despite their scope and potential for negative impact. Meanwhile, despite the prohibition, special Acts of Legislature do grant basin-to-basin diversions. In fact, Alberta's Legislative Assembly most recently approved two such proposals in December 2007. While Alberta Environment considers a number of factors in its licensing practice, no publicly accessible policy exists that elucidates whether basin-to-basin or sub-basin-to-sub-basin diversions sufficiently account for potential environmental, socio-economic, and cumulative impacts.

To mitigate the potentially negative effect of basin-to-basin as well as sub-basin-to-sub-basin diversions, the following questions are posed:

- What are their hydrological and ecological effects?
- What are the implications of the way Alberta defines its basins? How does Alberta compare to other jurisdictions? What is the most appropriate scale within which to move water?
- What are the socio-economic implications of sub-basin transfers in the province? How do we prioritize water use in Alberta?
- What is the cumulative impact of these types of diversions now and into the future?

This report makes a number of recommendations to the Alberta government.

Sub-basin-to-sub-basin diversions:

1. Discourage these diversions prohibiting those with a significant impact. While sub-basin-to-sub-basin diversions already exist in Alberta, there is recognition of the need to "live within the means of the watershed."¹ There is now more evidence to suggest that diversions of water from one watershed to another can have a wide range of impacts.

2. Establish a more appropriate scale of management under Alberta's *Water Act* and an accompanying regulatory framework for recognizing sub-basins under Alberta's *Water Act*.

3. Scrutinize all potential negative environmental, socio-economic, and cumulative impacts of both basin-to-basin and sub-basin-to-sub-basin diversions so they can be avoided or limited whenever possible. Adopt more specific guidance that establishes decision-making criteria that consider and weigh impacts. These decision-making criteria should be clear, specific, enforceable, and publicly accessible.

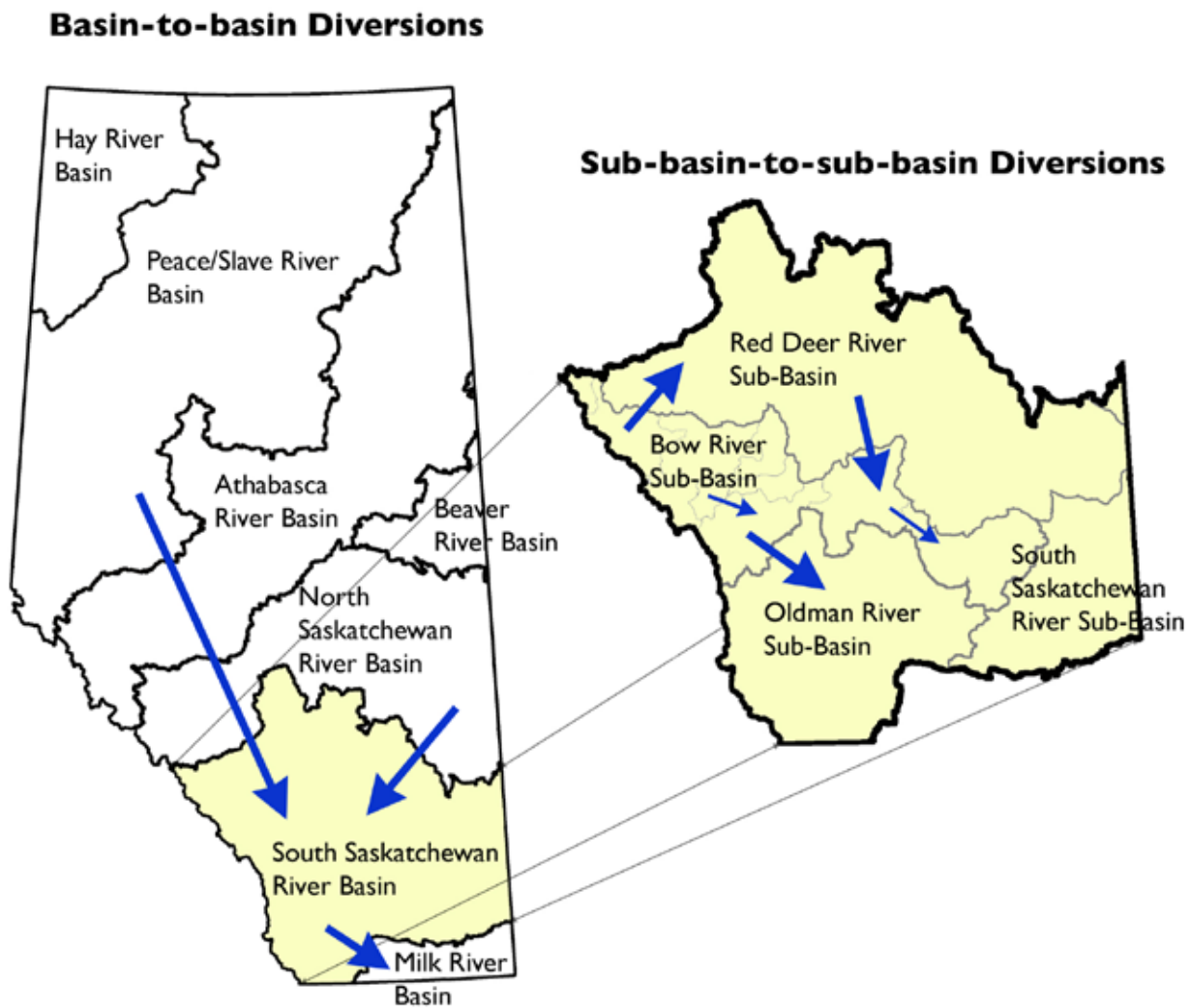
¹ Watersheds are areas of land that drain precipitation to a common destination, such as a river, lake, or ocean. This unit outlines a hydrological system wherein surface water movement links components and processes on the landscape (Acreman 2004). Watersheds are of varying sizes and can be sub-units of larger watersheds. River basins and sub-basins are alternative terms for varying sizes of watersheds.

Basin-to-basin diversions and sub-basin-to-sub-basin diversions:

4. Make the evaluation of basin-to-basin and sub-basin-to-sub-basin diversions publicly accessible as well as the supporting information on the specific proposal (e.g., environmental assessment, hydrological data).

5. Make purpose of use a key consideration with proposals for both basin-to-basin and sub-basin-to-sub-basin diversions. Diversions for drinking water purposes should receive special consideration.

Figure 1
Basin-to-basin and sub-basin-to-sub-basin diversions



Introduction

Albertans have been wise to question whether the approach to water supply in this province is sustainable over the long term, or even in the short term.

Since the controversial proposal to pipe water from the Red Deer sub-basin to the Bow River sub-basin for use by an entertainment complex in the hamlet of Balzac, north of Calgary, public concern has increased over these types of water diversions in Alberta.² Historically, it has been accepted practice in Alberta to pipe water from one watershed to another—for irrigated agriculture, for example. However, the pressure to divert water away from a basin has grown. The province's booming population coupled with the growing demands of industry contribute to an increasing number of requests for government-issued water licenses.

Albertans have been wise to question whether the approach to water supply in this province is sustainable over the long term, or even in the short term. Over the past decade, we have come to better understand the ecological consequences of exporting water from one watershed to another. New science has demonstrated that large amounts of water diverted away from a source river can result in an unsustainable water supply and prove harmful to riverine environments (Arnell 2002; Hunt 2004). Basin-to-basin and sub-basin-to-sub-basin diversions can negatively affect aquatic habitats on river systems when as little as two percent of river flow is diverted from the source watershed (Laserre 2006). These diversions can change the water quality and physical area of the aquatic habitat in the source watershed (Hunt 2004). In some instances, they can even degrade water quality, increase erosion and channel scouring, destabilize sediment in the receiving watershed, and lead to the introduction of non-native species (Hunt 2004).³

Of course, there are economic consequences as well. When communities lose water, they can also lose opportunities for local economic benefits, raising questions of equity. As a case in point, in late 2006, following the closure of three sub-basins in southern Alberta, controversy erupted over the application for a new water license in the hamlet of Balzac, located north of Calgary in the Bow River sub-basin.⁴ With the Bow River sub-basin closed to new licences,

² See Box 1.

³ The issue of moving water between watersheds is not just limited to surface water. Inadequately regulated groundwater may be easily subject to proposals to pipe between watersheds. While transfers of groundwater are complex (and beyond the scope of this report), piping groundwater can be detrimental to other users and to long-term viability.

⁴ In August 2006, the government stopped accepting applications for new water allocation licenses to three sub-basins in southern Alberta: the Bow, Oldman, and South Saskatchewan River sub-basins. This effectively placed greater, and perhaps unfair, pressure on the Red Deer River sub-basin, which remains open to new licence applications. See *Approved South Saskatchewan River Basin Water Management Plan* (Alberta Environment 2006). Alberta's *Water Act* provides the legal basis for these closures.

the applicant sought water from the Red Deer River sub-basin to the Bow River sub-basin to support the development of an entertainment complex.⁵ Citizens opposed this sub-basin-to-sub-basin diversion proposal arguing that the economic benefits of the water should stay within the Red Deer watershed.

In the midst of the Balzac controversy, the public learned that **Alberta has no formal policy to specifically address the piping of water between its sub-basins.** Alberta Environment follows certain licensing practices for all water licensing decisions, but no law or policy exists to explicitly oversee sub-basin-to-sub-basin diversions.⁶

While Alberta lacks a policy on sub-basin-to-sub-basin diversions, more stringent rules apply to basin-to-basin diversions. The Alberta *Water Act* essentially prohibits diversions between Alberta's seven large river basins unless authorized by the Legislative Assembly. These river basins are the Hay River Basin, the Peace and Slave River Basin, the Athabasca River Basin, the Beaver River Basin, the North Saskatchewan River Basin, the South Saskatchewan River Basin, and the Milk River Basin (*Water Act* s.1(1)(ff)).



Photo: Balzac Commercial Campus, Danielle Droitsch

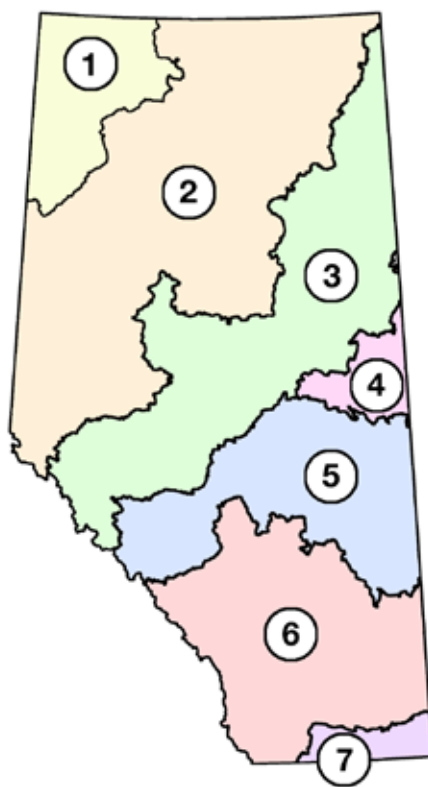
When communities lose water, they can also lose opportunities for local economic benefits, raising questions of equity.

⁵ Many similar movements of water do exist in Alberta. For example, the Western Irrigation District withdraws water from the Bow River and returns it to the Red Deer River watershed as does the Eastern Irrigation District.

⁶ See Appendix A.

Figure 2
Alberta's seven major river basins, as defined in the Water Act.

The lack of publicly accessible standard criteria that detail how environmental and socio-economic impacts are evaluated as well as the long-term cumulative effects of multiple basin-to-basin diversions is a concern.



1. Hay River Basin
(drainage area of ~ 40,000 km²)
2. Peace/Slave River Basin
(drainage area of ~ 180,000 km²)
3. Athabasca River Basin
(drainage area of ~ 140,000km²)
4. Beaver River Basin
(drainage areas of ~ 16,000 km²)
5. North Saskatchewan River Basin
(drainage area of ~ 55,000 km²)
6. South Saskatchewan River Basin
(drainage area of ~ 114,000 km²)
7. Milk River Basin
(drainage area of ~ 11,860 km²)

Most recently, there have been two proposals for basin-to-basin diversions (called “interbasin transfers” under Alberta’s *Water Act*).⁷ In 2002, 2005, and 2007, the Legislative Assembly approved three other basin-to-basin diversions.⁸

Albertans are now recognizing that, while there is legislation in place to prohibit basin-to-basin diversions, the Legislative Assembly now approves such diversions regularly. Also of concern is ***the lack of publicly accessible standard criteria—beyond internal Alberta Environment practice—that detail how environmental and socio-economic impacts are evaluated as well as the long-term cumulative effects of multiple basin-to-basin diversions.***⁹

⁷ Bill 54, the *County of Westlock Water Authorization Act*, and Bill 55, *East Central Regional Water Authorization Act*, appeared before the Alberta Legislature and were approved in December 2007.

⁸ These interbasin transfer acts are the *North Red Deer Water Authorization Act* (2002), *Stettler Regional Water Authorization Act* (2005), and the *Town of Bashaw and Village of Ferintosh Water Authorization Act* (2007). The latter two of these acts have been repealed and replaced by the new *East Central Regional Water Authorization Act*.

⁹ Alberta Environment practice ensures applicants carry out public consultation in both the receiving and source watersheds and that they prove the transfer would not result in negative ecological or hydrological effects (AENV 2007, pers.com). However, there is no public documentation of what criteria are considered in assessing an interbasin transfer proposal. An environmental impact assessment is only triggered under certain circumstances. See Appendix B.

More significantly, because the Alberta *Water Act* defines “basin” very broadly—with only seven basins for its 661,848 km² area, or an average of 94,549.71 km² per basin—the prohibition on basin-to-basin diversions is limited in its ability to discourage diversions of water between sub-basins, which are still often quite large.¹⁰ ***Clear, publicly accessible criteria and scrutiny need to exist to guide the diversions within these large basins as well as between them.*** Furthermore, there appears to be no public access to any analysis that is made in the course of deciding about basin-to-basin diversions.

To that end, this report contributes to the conversation about basin-to-basin and sub-basin-to-sub-basin water diversions in Alberta. It takes a brief look at current law, policy, and practice in Alberta and then turns to a discussion of the key considerations that need to be considered to mitigate the potentially harmful effects—namely, environmental considerations, considerations of scale, socio-economic considerations, and cumulative effects considerations. This report concludes that government needs to upgrade current policy on sub-basin-to-sub-basin diversions and improve aspects of the basin-to-basin diversions review, and makes specific recommendations to that end.

Water supply is affected not only by what happens between each vast river basin but also what happens within their confines. And, while sub-basin-to-sub-basin diversions cannot realistically be prohibited in this province, they can be better informed and better regulated.



Photo: Bow River at Calgary, Danielle Droitsch

¹⁰ For example, based on the *Water Act*, moving water from the Red Deer River sub-basin (49,648.95 km²) to the Bow River sub-basin (25,429.95 km²)—both within the South Saskatchewan River basin (121,095 km²)—is not prohibited. A proposal to pipe water from the Red Deer River sub-basin to the Oldman River sub-basin, hundreds of kilometres to the south, is not prohibited. At the same time, moving water from the Red Deer River a short distance to the North Saskatchewan River is prohibited except through a special Act of Legislature because the water would move between the South Saskatchewan and North Saskatchewan River basins.

Current Law, Policy, and Practice in Alberta

While sub-basin-to-sub-basin proposals are reviewed for their impact on a number of factors, certain issues associated with the movement of water from one watershed to another are not considered.

The *Water Act* prohibits basin-to-basin water diversions between Alberta's seven major river basins, permitting such diversions only by special Acts of Legislature. The *Water Act* does not address the movement of water within the large river basins (sub-basin-to-sub-basin diversions). Consequently, government policy treats major proposals to pipe water between sub-basins no differently than modest proposals to divert water to a community or business located nearby.

As part of its water allocation licensing practices (see Appendix B), Alberta Environment considers these factors when reviewing any water licensing application (GOA 2003):

- Water availability (e.g., using modelling results)
- Risk of shortage
- Hydrology of area
- Existing, potential, or cumulative impact on and conflict with other users, including household users, traditional agriculture users, and other licensees
- Existing, potential, or cumulative impact on aquatic environment
- Matters and Factors in a relevant approved water management plan
- Other government departments' jurisdiction
- Public statements of concern
- Watercourse at point of diversion
- Return flow quality
- Public safety concerns, especially around structures to operationalise the licence

While sub-basin-to-sub-basin proposals are reviewed for their impact as per the list of considerations above, certain issues associated with the movement of water from one watershed to another are not considered.

Factors Alberta Environment does *not* consider when reviewing water licence applications include the following:

- Sufficient water for all licensees
- Type of use
- Concerns of those who are not considered “directly affected”¹¹
- Impact on other users when the Director¹² deems a situation to be an emergency, or to not have an impact
- Watercourse downstream of diversion
- Return flow quantity
- Transport of biota among sub-basins

While the *Water Act* is silent with respect to sub-basin-to-sub-basin diversions, there is policy established in Alberta’s *South Saskatchewan River Basin Water Management Plan (SSRB WMP)*. This policy created a set of considerations that Alberta Environment (AENV) must take into account with every water license application made in the SSRB, which would include by definition all sub-basin-to-sub-basin diversions.¹³

While the SSRB WMP considerations (“Matters and Factors”) call for consideration of many environmental, hydrological, and cumulative effects such as water availability and the impact on other users, the SSRB WMP does not specify how they should be considered and weighed, and how they influence decisions. The Matters and Factors are a good starting point for policy making, but they need more elaboration to specifically address those issues associated with sub-basin-to-sub-basin diversions, which require special consideration.

A number of jurisdictions other than Alberta explicitly demand a high level of scrutiny prior to approving diversions of water across river basin boundaries—basins defined on a much smaller scale than in Alberta. They take a thorough look at the implications for the ecology, economy, and social fabric of the jurisdiction.¹⁴

Without specific and implementable policy and practice for sub-basin-to-sub-basin licensing, Alberta law and policy are ill equipped to consider the unique environmental, socio-economic, and cumulative issues associated with such diversions.

The 2006 controversy over the Balzac proposal prompted Alberta’s Environment Minister Rob Renner to request that the Alberta Water Council review existing law and policy and provide recommendations. On October 24, 2008, the Alberta Water Council made its recommendations public and available at www.albertawatercouncil.ca.

The remainder of this report evaluates other considerations that relate to sub-basin-to-sub-basin transfers in particular. It is suggested that these very same criteria may also be

A number of jurisdictions other than Alberta explicitly demand a high level of scrutiny prior to approving diversions of water across river basin boundaries—basins defined on a much smaller scale than in Alberta.

¹¹ See Part II pages 14-32 of *Public Access to Environmental Appeals: A Review and Assessment of Alberta’s Environmental Appeals Board* by Cindy Chiasson & Jodie Hierlmeier (2006, Environmental Law Centre: Edmonton) for a discussion of “directly affected.”

¹² The Director is an individual designated by the Minister of Environment to represent Alberta Environment in *Water Act* decisions and includes District Approvals Managers and Regional Approvals Managers.

¹³ See Appendix B.

¹⁴ See the Considerations of Scale section for more discussion. See Appendix C for a list of considerations by other jurisdictions—namely, the province of Ontario and the American states of Texas, Colorado, North Carolina, South Carolina, Tennessee, Georgia, and Massachusetts.

applied—if not already—to any basin-to-basin diversion (i.e., interbasin transfer) proposals.

These considerations include those issues associated with ecological impacts, scale, socio-economic considerations, and cumulative impacts.

It is recognized that some of these considerations are already taken into account for any sub-basin-to-sub-basin diversion but perhaps not in a publicly explicit manner or to the extent recommended in this report.



Photo: Athabasca River, Danielle Droitsch

Consideration: What Are the Alternatives?

A policy framework that operates to avoid sub-basin-to-sub-basin diversions would necessarily require the adoption of an alternatives analysis. The movement of water from one watershed to another is essentially a supply management tool that seeks to “create” more water than is otherwise available. This approach contrasts the demand management approach that focuses on only using what water is currently available, or, further, a soft path approach that questions whether water is needed at all depending on the service the water provides (Friends of the Earth 2004).¹⁵

Before evaluating the environmental, socio-economic, and cumulative impacts of sub-basin-to-sub-basin diversions, Alberta Environment could require, or otherwise encourage, applicants to seek and fully evaluate alternatives to moving water between watersheds. In other words, a policy framework could begin with evaluating whether there are alternatives to diverting water in the first place.

Along these same lines, government could require the adoption of stringent conservation measures as part of or in lieu of a new water licence. Such an analysis could evaluate probable and comparative costs of other water supply alternatives that would not require a sub-basin-to-sub-basin diversion including water conservation and efficiency measures. Incentives could also be made available to facilitate use of alternative water sources (such as reclaimed or recycled water). Irrigation, for example, could use recycled water rather than freshwater. Source protection to maintain water quantity—such as through a comprehensive forestry management program in the headwaters of the receiving watershed—could be a mandatory component prior to an applicant’s request.

A policy framework could begin with evaluating whether there are alternatives to diverting water in the first place.

¹⁵ For a comprehensive description of the water soft path concept and research publications, visit Water Soft Paths, <http://www.foecanada.org/index.php?option=content&task=view&id=312&Itemid=135>

Environmental Considerations

Diversions of water between the seven large river basins in Alberta are prohibited under the *Water Act* partly because government acknowledges that these types of diversions can have negative environmental effects. The same negative environmental effects are also true at the sub-basin level. Moving water between watersheds of any size poses potential harm to both the source watershed and the receiving watershed.

Consideration: What are the possible hydrological effects of the diversion?

The effect of these diversions will vary depending on the amount of water diverted, the proportion of water diverted in relation to the size of watershed, and the timing of withdrawal.

Moving water from one watershed (whatever the size) to another without returning the water to the source watershed alters the hydrology in both watersheds, decreasing flow in the source watershed and augmenting the flow in the receiving watershed. The effect of these diversions will vary depending on the amount of water diverted, the proportion of water diverted in relation to the size of watershed, and the timing of withdrawal.

Loss of water from a source watershed can have immediate or incremental effects, but both are lasting (Draper 2005). A smaller watershed relying on less water has less capacity to withstand change, such as by water withdrawals, than a larger watershed with more water to lose. Since withdrawals from two to ten percent of flow can negatively impact a river's ecology, the cumulative effect of multiple withdrawals on a river must be a particularly significant factor in water allocation licensing decisions (Lasserre 2006). For example, withdrawals during low-flow periods (i.e., late summer through later winter in Alberta) can be especially harmful, further stressing a river.

Hydrological changes affect not only fish and aquatic habitat, but can also affect hydroelectric operations, flood control, navigation, recreation, and inter-provincial obligations. Moving water to another watershed can also affect the source watershed's ability to respond to emergencies, such as drought, and can potentially increase the risk of flooding in the receiving watershed.

Downstream, past the confluence of the affected watersheds, there may be little change in the system. However, the change may be great between the diversion point and the confluence

of the affected watersheds. This area downstream of the diversion point may be deprived of water, and the withdrawal might not only affect the aquatic ecosystem in this area but other users and uses as well. Because water flows, removing water in one place affects the rest of the system (Miller pers.com. 2007).

Diversion of water from one watershed to another eliminates the return of unconsumed water to the source watershed. Most water withdrawals involve at least some return of the withdrawn water to the watershed—otherwise known as “return flow.” Some uses, such as municipal uses, return a high percentage of water. Irrigation, on the other hand, returns less than 20 per cent of the water withdrawn, due largely to evaporation (Arnell 2002). A diversion of water from one watershed to another eliminates the potential for any return flow to the source watershed.

Return flow needs to be a key consideration among decision makers. How much of the water withdrawn from the source watershed will be returned to the source watershed, and how much will go to the receiving watershed? At least one American jurisdiction uses this equation:

$$\text{Transfer} = \text{withdrawal} - \text{return flow to source watershed (NCDWR 2006)}$$

Using this type of calculation may be one way to determine the significance of a sub-basin-to-sub-basin or basin-to-basin diversion (i.e., transfer).

Finally, a water availability analysis over a broad period considering low, medium, and high water years as well as the potential impacts of climate change is necessary to fully analyze any prospective hydrological effects of these diversions.

Consideration: What are the possible ecological effects of the diversion?

The ecological effects of moving water between watersheds vary considerably and are difficult to predict. In a river basin, each river (or tributary) that is upstream of a confluence with another river remains isolated. As a result, each upstream tributary can have its own ecological character, with distinct biological and chemical attributes. When attributes differ, diverting water from one river to another can transfer non-native, invasive species or biota, such as benthic invertebrates, vegetation, and seeds (biological attributes) or different concentrations of metals or nutrients (chemical attributes). Such movement can alter the existing ecosystem and affect water quality for human users in the receiving watershed.

Removal of water can affect the source watershed’s water quality by decreasing the water amount and, thereby, the watershed’s ability to assimilate waste and other pollutants. Therefore, the questions of what quality of water and how much water will be returned to the watershed are pertinent for both the receiving and source watersheds.

Questions to pose include the following: What waste load (i.e., what pollutants) and temperature will the return flow be carrying? Will that waste load and water temperature negatively affect human and non-human residents of the watershed to which the flow returns (Miller pers.com. 2007)?

As a result, water type—whether raw, treated, or reclaimed—is a factor. To eliminate risk of transferring non-native biota and of introducing poorer quality water, only treated water should be transferred between watersheds, not raw water.

A diversion of water from one watershed to another eliminates the potential for any return flow to the source watershed.

Considerations of Scale

Fundamental to the discussion of sub-basin-to-sub-basin diversions is the issue of scale. Because watersheds are nested within each other as sub-units of one another, the administration of water rights will arbitrarily decide at which scale, or sub-unit, to prohibit movement of water. With only seven major river basins, Alberta's law operates on a very large scale. In other words, current law in Alberta still permits large-scale water diversions across wide distances—from the Red Deer to the Oldman River, or between smaller watersheds, from the Blindman River to the St. Mary River, for example.



Photo: Oldman Near Lethbridge, Lorne Fitch

When compared to other jurisdictions that explicitly address basin-to-basin diversions (i.e., interbasin transfers), Alberta’s legislation defines river basins as far larger than do other jurisdictions.^{16 17}

Table 1
Comparison between Alberta and a number of American states that explicitly address basin-to-basin diversions (i.e., interbasin transfers)¹⁸

Province/State	Total area (km ²)	Number of river basins	Average area per basin (km ²)
Alberta	661,848	7	94,549.7
Texas	696,241	23	30,271.35
Colorado	269,837	8	33,729.6
Georgia	154,077	14	11,005.5
Tennessee	109,247	10	10,924.7
South Carolina	82,965	15	5,531.0
North Carolina	139,509	38	3,671.3
Massachusetts	27,360	28	977.1

With only seven major river basins, Alberta’s law operates on a very large scale.

Based on the average sizes of basins above, a basin-to-basin diversion in many of these American jurisdictions is equivalent to a sub-basin-to-sub-basin diversion in Alberta (e.g., the Bow River sub-basin is almost 25,000 km²)—for which no legislation or policy exists. Because these American states have legally defined their river basin on a far smaller scale than Alberta, they effectively review and track sub-basin-to-sub-basin diversions more closely than Alberta.

What is the most appropriate scale within which to move water?

The Alberta *Water Act*’s differentiation between its seven major river basins may function to discourage diversions between major basins, but it is ill equipped to address what are still large-scale water diversions that could pose a number of potential environmental, socio-economic, and cumulative concerns.

¹⁶ Ontario, North and South Carolina, Tennessee, Georgia, and Massachusetts all have water allocation systems based on riparian rights, where land owners who are adjacent to water sources may put that water to beneficial use without impact on other users. Texas and Colorado have allocation systems based on prior appropriation, very similar to Alberta’s system of prior allocation, which allocates water to users through licences but includes limited riparian rights to household users adjacent to water sources. Because jurisdictions with riparian rights systems are dealing with rights, not licences with stated terms and conditions, more rules are explicitly stated in law to protect all water sources. In contrast, jurisdictions like Alberta can use licences to state terms and conditions on a licence-by-licence basis. However, Texas and Colorado also have stated limitations and considerations for interbasin transfers (i.e., basin-to-basin diversions). In establishing law and policy around sub-basin-to-sub-basin diversions, Alberta can learn from the decision-making procedures and considerations used in these other jurisdictions.

¹⁷ In the case of Georgia, this legislation has only been introduced to the Georgia General Assembly as House Bill 54, which, at the time of writing, has reached second reading by the House (GGA 2007).

¹⁸ Number of river basins refers to the number of river basins that the province or state defines in its legislation. Eight of Texas’ 23 defined river basins are coastal river basins, which are exempted from interbasin transfer provisions if adjacent to the basin of origin.

Use of the WSC system for administrative or licensing purposes could allow water-related issues to be addressed at their most appropriate scale, allowing management to be better grounded in the science of hydrology and current data-gathering initiatives.

To better address the issue of scale, Alberta could benefit from adopting a hydrologic unit classification system for licensing administration purposes. Hydrologic classification systems of watersheds delineate the nested boundaries of watersheds, from large river basins comprised of all tributaries running into a single river that terminates in an ocean or sea, to smaller and smaller river basins with fewer and fewer tributaries and smaller and smaller drainage basins running into a single river that joins another river.

Similar to the U.S. Geological Survey's hydrologic unit code classification system,¹⁹ the Water Survey of Canada (WSC) has created an alphanumeric system to identify drainage basins and watersheds in Canada. The system includes three levels of watersheds: major basins (e.g., Saskatchewan River Basin, 05), sub-basins (e.g., Bow River, 05B), and sub-sub-basins (e.g., Elbow River, 05BJ) (PFRA 2006). A more detailed level of naming indicates the hydrometric station number at certain reaches of the stream or river that measures daily rate of flow (WSC 2006).

Alberta Environment already uses this classification system to some degree to gather and archive hydrological data. The Alberta government could further use the Water Survey of Canada's classification system to redefine river basin planning areas for regulation on a smaller scale. A stream order classification system could designate guidelines for withdrawal decisions and be useful for determining thresholds and appropriate policy decisions.

Use of the WSC system for administrative or licensing purposes (e.g., to define planning units) could allow water-related issues to be addressed at their most appropriate scale, allowing management to be better grounded in the science of hydrology and current data-gathering initiatives. The threshold—or capacity to withstand change without detriment to the system—may vary by scale. Diversions from small water bodies (e.g., small lake, or small to medium stream) can bring large changes to the aquatic habitat (flow for fish, etc.), whereas a similar withdrawal from a larger water body might have less impact. Decentralizing watershed management to a smaller scale better addresses the local nature of water concerns and solutions. Meanwhile, the watershed remains part of a nested hierarchical water management system. Making this shift would better embrace *Water for Life's* vision of a watershed approach—which is to see the province's water resources “managed within the capacity of individual watersheds” (GOA 2003, 6).

¹⁹ See Appendix D.

Socio-economic Considerations

The protection of each watershed as a distinct entity is important for many reasons (Draper 2005; DeVinney and Johnson no date; Miller 2007; Sierra Club 2007; Fransen pers.com. 2007). The integrity of a watershed needs to be maintained not only for hydrological and ecological purposes but also to reflect the social values of Albertans. People across this province care deeply about maintaining local water security to protect their communities and livelihoods. Studies repeatedly reveal that water quantity and quality are of primary concern to Albertans today (Praxis Group 2007; SALTS 2007). As the Balzac controversy revealed, many will react strongly when they feel “their” water is at stake.

Social and economic implications must be central considerations in any basin-to-basin or sub-basin-to-sub-basin diversion proposal. The substantial cost of piping water long distances is often borne by taxpayer dollars, yet often justified in economic terms. The rationales provided often involve moving water to the best use, maximizing economic efficiency, and generating financial return (Draper 2005). In the end, however, it is far more expensive to pipe water long distances than to situate a community or development near a water source.

Consideration: What are the potential economic effects in both source and receiving watersheds?

While proponents of sub-basin-to-sub-basin diversions often use economic efficiency and need to justify piping water between watersheds, diversions come at a price. The source watershed incurs economic loss through lost opportunity to use the water in the future, whether for future domestic or economic demands (Draper 2005). The degree of harm to the source watershed depends on the magnitude of water loss and the current and future needs of the watershed (Draper 2005).

The receiving watershed (or applicant) must pay for infrastructure and energy to pump water across distance. More expensive technology and expanded water, wastewater, and delivery infrastructure may be necessary to make the transfer feasible. The cost will likely be funded from taxpayers’ pockets. Receiving watershed residents may also incur secondary “costs” like

People across this province care deeply about maintaining local water security to protect their communities and livelihoods.

greater growth and associated costs in the watershed because lack of water no longer limits economic and population growth.

The overall efficiency of water delivery infrastructure systems should be considered through regional planning and cooperation. Building 62 kilometres of pipeline, as would have been the distance of new pipe in the Balzac case, is inefficient when a pipeline and water system exist only a few kilometres away. Building this kind of infrastructure and pumping water great distances waste energy and resources.

Who should use what water for what purpose?

In the source watershed, water and watershed integrity will be central to preserving opportunities for the future.

As relative water scarcity increases in the southern part of Alberta, the issue of “purpose” becomes more significant. Alberta law, policy, and practice do not prioritize the purpose of water use. Prioritization is based on history, using the first-in-time, first-in-right principle, or FITFIR, where the oldest licences get their full allocation of water before more junior licences.²⁰

While the Province does not provide any preference for a certain type of use, it may consider the issue in the context of sub-basin-to-sub-basin diversions for domestic water supply needs.²¹ A distance limitation may also need to be imposed (Draper 2005).²²

What does the public think?

Because any basin-to-basin or sub-basin-to-sub-basin diversion can have wide-ranging and diverse effects, decision-making should be open, transparent, and include participation from the public. While current practice allows those considered to be “directly affected” to appeal a licensing decision, public sentiment, particularly in the source or receiving watershed, can help inform decision makers.²³ And, finally, for the approval process to be truly participatory, public notice needs to be widespread and lengthy.

What are the potential secondary effects now and in the future?

In the source watershed, water and watershed integrity will be central to preserving opportunities for the future. Future impacts from climate change should be considered, for example, by modelling future water availability. In the South Saskatchewan River Basin, climate change is likely to reduce overall water availability and change the timing of river flow regimes (Barrow and Yu 2005; Martz *et al.* 2007).

20 Priority is also granted to riparian household users: those adjacent to water bodies or above groundwater have priority over licence holders and registered traditional agricultural users (*Water Act* sec 27).

21 Emergency situations, such as multi-year droughts, could allow temporary movement of water between watersheds for public health reasons.

22 At least one U.S. jurisdiction (Georgia) regulates interbasin transfers prohibits transfers that cross more than one county (GDNR 2007).

23 The definition of “directly affected” is a narrow one, however, and it needs to be more broadly defined to include the residents of all watersheds who are affected by an application.

Another significant secondary effect of these water movements in the receiving watershed includes population, economic growth, and land-use changes. Therefore, a sub-basin-to-sub-basin diversion proposal may have a small hydrological and ecological impact, but it may have profound effects on a single community.



Photo: Bow River Southern Alberta, Danielle Droitsch

As relative water scarcity increases in the southern part of Alberta, the issue of “purpose” becomes more significant.

Consideration of Cumulative Impacts

The cumulative impact of multiple sub-basin-to-sub-basin diversions can be much larger. To adequately consider these impacts, current and projected consumptive uses within both the source and the receiving watersheds would be evaluated.

For example, government could establish a threshold for what can be diverted from a watershed (whether through diversions to another watershed or through consumptive uses) such as in South Carolina.²⁴ This may be done through setting instream flow requirements, i.e., necessary magnitude and timing of flows to maintain ecological integrity. Such a threshold for consumptive use in a watershed would provide a policy framework on how much water withdrawal any river can withstand.

Likewise, other associated impacts with a sub-basin-to-sub-basin diversion must be coordinated so that decision making is integrated and holistic enough to take into account the whole impact of a proposed development—from water supply intake to wastewater effluent release and stormwater management. Likewise, planning processes and regulatory requirements (e.g., environmental assessment of proposals) should be aligned at different planning scales (e.g., municipal and provincial processes) (Miller pers.com.2007a).

Land-use decisions must consider the availability of water and the effects a development might have on water. When land-use decisions are made prior to an evaluation of water sources and impacts, as is typically the case, approvals can create political and administrative pressure. In places like semi-arid southern Alberta, water-use decisions would ideally pre-date land-use decisions to avoid pressure for more water on an approved development.

Decision making needs to be effective, efficient, and equitable in meeting the needs of both source and receiving watersheds, while considering ecological health as paramount in outcome.

²⁴ For example, the state of South Carolina limits individual interbasin transfers to 5 per cent of the 7-day, 10-year low flow, or one million gallons or more of water per day on any day (South Carolina Code of Laws 2006).

Conclusions: Looking Forward

While Alberta has already a foundation for addressing large-scale basin-to-basin diversions, current law and policy could be improved to address the future challenges associated with sub-basin-to-sub-basin diversions.

The *Water Act*, the *SSRB Water Management Plan*, and *Water for Life* encourage Albertans to learn to live within the limits of a watershed. For example, *Water for Life's* set of principles directs water resources to “be managed within the capacity of individual watersheds” (GOA 2003, 6). Piping water between watersheds contravenes this concept of managing water use within the capacity of watersheds. Within this watershed management paradigm, *Water for Life* proposes three goals—safe secure drinking water, healthy aquatic ecosystems, and reliable quality water supplies for a sustainable economy. Decisions around the movement of water should aspire to these goals, while focusing on water conservation, knowledge and research, and partnerships.

Decision making for sub-basin-to-sub-basin diversions would require the adoption of a hydrologic unit classification system. The adoption of an explicit and publicly accessible policy framework that fully evaluates basin-to-basin as well as sub-basin-to-sub-basin diversions would enable decision makers to take into account all environmental, socio-economic, and cumulative considerations of out-of-watershed diversions.

Decision making needs to be effective, efficient, and equitable in meeting the needs of both source and receiving watersheds, while considering ecological health as paramount in outcome (Draper 2005). Government must determine a more appropriate scale of management. If government does not prohibit moving water between watersheds, it needs to determine what restrictions should be imposed. It must consider how best to protect both the source and receiving watersheds from any harm that would result from piping water between them.

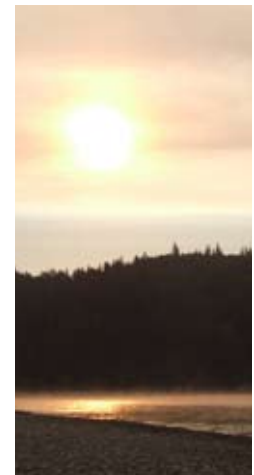


Photo: Gaby Zezulka-Mailloux

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The EC Watershed Lookup Service is available at:
<http://devgeo.cciw.ca/watershed/index.html>
An online sample interface to the EC Watershed Lookup is available at:
<http://devgeo.cciw.ca/watershed/sample.html>

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Appendix A

Summary of Alberta Environment’s water allocation licensing practice, including practice for approving basin-to-basin diversion (i.e., interbasin transfer) proposals

Alberta Environment’s (AENV) water allocation licensing practice distinguishes basin-to-basin water diversions (i.e., interbasin transfers) from other water licence applications. However, current legislation and policy does not distinguish applications for sub-basin-to-sub-basin diversions (i.e., intrabasin transfers) from other licence applications when approving licences.

The current practice of approving water licence applications (including sub-basin-to-sub-basin diversions) is based on water availability, impact on other users, and certain environmental and safety conditions, including structures to withdraw water (AENV 2007). The Director¹ must also consider any applicable approved water management plan, such as the 2006 *Approved South Saskatchewan River Basin Water Management Plan* that includes the Matters and Factors in Appendix B. Once the Director approves a licence application, a water licence states the water source and location of withdrawal, annual withdrawal volume, rate and timing of withdrawal, the priority of the licence (i.e., the priority date), and any conditions to which the licensee must adhere (AENV 2007).

AENV applies very deliberate and thorough analyses of “water availability” as a key step in the licence approval process to avoid any adverse impact on other licensees and to maintain current instream objectives.² For some applications, AENV uses modelling to determine water availability based on water conditions in past years, existing allocations, and water conservation objectives if applied in the region. For other applications, AENV analyses hydrology of the area to assess water availability and determine the risk of shortage on an annual basis (AENV 2007).

Significantly, issuing a licence does not guarantee water availability. In fact, Alberta Environment will issue a licence even if the modelling suggests the licensee will not be able to access water during some years. The prior allocation system (a water rights system based on the first in

¹ A Director represents Alberta Environment under the *Water Act* and includes District Approvals Managers and Regional Approvals Managers.

² A “water availability” analysis incorporates the provincial priority system of first in time, first in right.

time, first in right principle) dictates that more senior licensees will receive their full water allocation before more junior licensees receive any water. Given the existence of these senior licensees, AENV does not have any policy that restricts its ability to issue water licences even if there is high risk of the new licensee not receiving all or any of their water allocation.³ If water is considered to be available for any portion of the licensing period (e.g., medium or high water years), the water is made available to any applicant according to priority.

All licence applicants are eligible to receive water if they can demonstrate a use for the water, access to the water, and do not intend to convey it from one major basin to another (i.e., an interbasin transfer). Type of use is not a factor in the licence approval process.

AENV must take into account public opinion of those considered directly affected by a licence application decision through public notice and statements of concern—unless the Director is of the opinion that there is an emergency or there will be no adverse effect on the environment, household users, registered traditional agriculture users, or other licensees (GOA 2003, Sec. 108). The public may submit statements of concern within specified time periods. Once AENV makes a decision, those who submitted a statement of concern and are considered directly affected may appeal that decision to the Environmental Appeals Board.

To account for environmental and safety concerns, AENV considers impact on the watercourse where the point of diversion would be located, by construction of necessary structures and by water release in the area of water use (AENV 2007). Under the *Environmental Protection and Enhancement Act* (EPEA) quality of return flow is a consideration; but return flow quantity does not seem to be considered under either the *Water Act* or EPEA.⁴ Transport of biota from one ecosystem to another is only considered a concern if the basins are not naturally connected (i.e., interbasin transfer proposals).⁵ Based on the *Water Act*'s definition, AENV considers the sub-basins of the defined major river basins to be naturally connected; therefore, AENV is not concerned about transporting biota in water moving between sub-basins.

If, however, the application is to transport water between major basins (i.e., interbasin transfers), the Legislative Assembly can consider any factor in approving or refusing the interbasin transfer request through its legislative power. For an interbasin transfer proposal, the *Water Act* demands that the Minister of Environment undertake public consultation: the Minister must consult with the public “in a form and manner satisfactory to the Minister” before “a Bill to amend Sections 46 or 47 or to enact a special Act described in those sections is introduced into the Legislative Assembly” (*Water Act* Sec. 48). This consultation responsibility has been delegated to Alberta Environment and to the proposal's proponents as a matter of practice.

In the small number of interbasin transfers approved under the *Water Act*, Alberta Environment requires the transfer's proponents to consult with the public in affected communities of both the source and the receiving watersheds. The proponents must advertise in multiple

³ The *Approved South Saskatchewan River Basin Water Management Plan* (2006) proves the exception where the SSRB WMP led to the closure of the southern tributaries to new water allocation licence applications. Two other exceptions exist for Milk River in September 1985, *Southern Tributaries of the Milk River: Evaluation of Water Management Opportunities*, final report (November 1993), and High River in 1983 (Bankes 2006).

⁴ Return flow is the amount of water not consumed by the water user, or through evaporation or other water loss; it is the amount that flows back to the originating or other water body.

⁵ However, some major river basins, which are defined under the *Water Act* and between which transfers are prohibited except by special Act of Legislature, are naturally connected where their confluence is in Saskatchewan not Alberta. These river basins include the North and South Saskatchewan rivers and the Beaver River, all of which flow into the Saskatchewan River.

publications of the affected communities and hold open houses to address concerns and gather public input. Alberta Environment staff generally attends these open houses to observe and to confirm proponents' reports. The proponents must submit all communications, media responses, and comments from the public to Alberta Environment (Alberta Environment pers.com. 2007).

The proponents must also prove there are no negative ecological and hydrological effects. They must identify, quantify, and describe measures to mitigate any adverse impacts, including risk of biota transfer. The proponents must present these risks, mitigative measures, and benefits of the proposal to the participants at the public consultations (Alberta Environment pers.com. 2007).

AENV staff applies the *Water Act* and *Environmental Protection and Enhancement Act*, their regulations, standard procedures, and professional judgment in assessment of interbasin applications (Alberta Environment pers.com. 2007). If any application involves a mandatory activity under *Environmental Protection and Enhancement Act's* Environmental Assessment (Mandatory and Exempted Activities) Regulation—such as a water diversion structure and canals with a capacity greater than 15 cubic metres per second—an environmental assessment will be triggered, thereby providing additional scrutiny based on current environmental assessment standards (GOA 1993).⁶

Once Alberta Environment approves the application, the application is introduced to the Legislative Assembly for approval as a special Act of Legislature.

⁶ Neither of the two interbasin transfer proposals most recently approved by Alberta's Legislative Assembly included a mandatory activity under this regulation. Therefore, neither of the proposals required an environmental impact assessment, which includes a review by the Natural Resources Conservation Board or the Alberta Utilities Board.

Appendix B

South Saskatchewan River Basin Water Management Plan Matters and Factors (Alberta Environment 2006)

SSRB Water Management Plan (AENV 2006) Matters and Factors are to be considered in licensing decisions in the South Saskatchewan River Basin.

Table 1
Matters and Factors that must be considered in making decisions on applications for licences, preliminary certificates, or approvals affecting surface water in SSRB.

Matters and Factors	Guidelines
Existing, potential and cumulative effects on the aquatic environment	<ul style="list-style-type: none"> No significant adverse effect on the aquatic environment
Existing, potential, and cumulative effects on any applicable instream objective and/or Water Conservation Objective	<ul style="list-style-type: none"> No significant adverse effect on existing instream objectives and/or Water Conservation Objectives
Efficiency of use	<ul style="list-style-type: none"> Industry standards and best practices
Net diversion	<ul style="list-style-type: none"> Likely an amendment Existing allocation does not increase Quality and timing of return flow should be benign or beneficial for environment
Existing, potential, and cumulative hydraulic, hydrological, and hydrogeological effects	<ul style="list-style-type: none"> No significant adverse effect
With respect to irrigation, the suitability of land for irrigated agriculture	<ul style="list-style-type: none"> The land must be suitable for irrigated agriculture: Class 4 or better in accordance with the standards of Alberta Agriculture, Food, and Rural Development
Existing, potential, and cumulative effects on the operation of reservoirs or other water infrastructure	<ul style="list-style-type: none"> No significant adverse effect on operations unless the reservoir or infrastructure licensee agrees it is feasible to adjust operations to mitigate effects
First Nation Rights and Traditional Uses	<ul style="list-style-type: none"> Government of Alberta First Nation Consultation Policies and guidelines on Land Management and Resource Development Agreements with First Nations

Appendix C

Considerations for approving interbasin transfers¹ (i.e., basin-to-basin diversions) in other jurisdictions

A number of jurisdictions other than Alberta explicitly demand a high level of scrutiny prior to approving diversions of water across river basin boundaries. Below are two lists describing the factors these jurisdictions consider before approving these types of diversions.

Summary list of considerations from two jurisdictions (Texas and Colorado, U.S.) with allocation systems based on prior appropriation system (similar to Alberta's prior allocation system).

- Preference to (alternatives)
 - Economically viable local water sources
 - Demand management as other options are considered
 - Exploration of market-based approaches to water supply management, such as interruptible water contracts, water banking, in-state water leasing, and groundwater recharge management
- Feasibility and practicability of alternative supplies in the receiving basin to water transfer supply
- Projected need for water in source and receiving basins for period of time water requested (not to exceed 50 years in the case of Texas)
- Quantity requested
- Purpose of use
- Methods and efforts to put water to beneficial use

¹ As noted in the report, all of these jurisdictions define their basins on a smaller scale than Alberta. See Table I.

- Maintenance of
 - Existing tax base
 - Existing water rights in area
 - Proper stewardship of the land
 - Flows necessary for recreational, hydroelectric, and environmental needs concurrent with development of water for beneficial consumptive uses
- Adverse impacts to
 - Economic, environmental, and social impacts of future water projects and transfers
 - Existing water rights
 - Instream uses
 - Water quality
 - Aquatic and riparian habitat
- Provisions for mitigation measures for unavoidable adverse impacts as integral part of future water projects or transfers
- Provisions for compensation to source basin
- Benefits to both source and receiving basins
- Aggressive water conservation measures that do not injure other water rights, including drought contingency measures
- Efforts to educate public on importance of water and need to conserve, manage, and plan for the needs of current and future generations
- Detriments to source basin are less than benefits to receiving basin during proposed transfer period
- Prepared drought contingency and water conservation plans and implemented a water conservation plan to result in highest practicable levels of water conservation and efficiency achievable within receiving basin
- A new water right or amendment to an existing water right for a proposed interbasin transfer of water is junior in priority to water rights in the basin of origin only for the term of the amendment
- Restrictions do not apply to
 - Proposed transfer, which in combination with any existing transfers, totals less than 3000 acre feet of water per year from the same water right
 - A request for an emergency transfer of water
 - A proposed transfer from a basin to its adjoining coastal basin
 - A proposed transfer to municipal area partially within the source basin

Summary list of considerations from some jurisdictions with allocation systems based on riparian rights (Ontario, Canada; North Carolina, South Carolina, Tennessee, Georgia, and Massachusetts, U.S.)

- Necessity
- Reasonableness²
 - Nature of applicant's use
 - Quantity requested³
 - Rate of withdrawal
 - Manner of withdrawal
 - Return flow to source basin (naturally or after use)
(Ontario's regulations will prescribe the amount that does not have to be returned to the source basin)
 - Monitoring and reporting (quantity, rate, manner, return flow)
 - Environmental feasibility
 - Economic feasibility
 - Water conservation
- Beneficial effects of water movement
 - Benefits for the state or province
 - Promotion of storage and conservation
- Detrimental effects⁴
 - Water supply needs
 - Wastewater assimilation
 - Water quality in source basin, especially under low-flow conditions
 - Water quantity
 - Water-dependent resources
 - Fish and wildlife habitat
 - Hydroelectric power generation
 - Navigation
 - Recreation
 - Flooding
 - Aesthetics
 - Impact on interstate water use
 - Impact on other users

2 In some U.S. states (e.g., Georgia), a transfer cannot cross more than one adjacent county except to satisfy critical needs, which are temporary, short-term needs such as equipment failure, source contamination, or severe drought impacting public health and safety (GGA 2007).

3 Ontario limits the request to less than 19 million litres per day, or less than an average of 19 million litres per day; or lower if prescribed by the regulations. For non-municipal uses, amount may not exceed 379,000 litres or more of water on any day or an average of 379,000 litres or more of water per day (Government of Ontario 2007).

4 In some cases, secondary effects, such as consequent population growth in the receiving basin, are also considered (Fransen 2007, pers.com).

- Alternatives to transfer or movement of water
 - Probable and comparative costs of alternatives
 - Environmental impacts of alternatives
 - Feasibility of alternatives
 - Water conservation and efficiency of alternatives
 - Identification and development of all viable water supply sources in receiving basin first so as to meet drinking water standards and is viable for wastewater
 - A comprehensive forestry management program on watershed lands in receiving basin
- Present uses (agricultural, municipal, industrial, and instream uses, and assimilative needs) in source basin and in receiving basin
- Stream flow in source basin, especially during low-flow conditions
- Projected needs in source basin and receiving basin
- Cumulative effects on source basin
 - Of water transfer
 - Of all past, authorised, and proposed transfers on stream flows in source basin
 - Of consumptive use currently authorized or in projected municipal plan
- Requirements of other state/provincial or federal with authority over water resources, and international treaties
- Water availability to respond to emergencies (e.g., drought) in source and receiving basins
- Communities and districts in receiving area must either have adopted or be actively engaged in developing a local water resources management plan
- Quantity, location, and timing of water returned to the source basin, or a downstream basin, or receiving basin
- Climatic conditions
- Reasonable instream flow in source river is maintained
- Any offsetting increases in flow in the source basin that may be arranged through permit
- Number of downstream river miles from which water will be diverted as result of the transfer
- Environmental impact assessment
- Consultation with affected governments (and other parties)
- Other facts and circumstances

Specific to groundwater inclusion:

- Pumping test to indicate environmental impacts of proposed groundwater withdrawal
- Correlation between surface water and groundwater in the source basin and potential for harm to either

Appendix D

United States Hydrologic Code

The United States uses a hydrologic unit classification system formulated by the U.S. Geological Survey (USGS). The system classifies four levels of watersheds: regions (e.g., Missouri region, or Texas-Gulf region), sub-regions, accounting units, and cataloguing units. Regions are the largest unit and cataloguing units are the smallest unit, although most are more than 700 square miles. The U.S. is comprised of 21 regions, 221 sub-regions, 378 accounting units, and 2264 cataloguing units. USGS is making efforts to develop smaller classifications.

Each watershed has its own code based on this system. A cataloguing unit has an 8-digit code (e.g., 07070003), where the “code uniquely identifies each of the four levels of hydrologic classification within four two-digit fields” (USGS 2006). The first two digits identify the region, the second two digits distinguish the sub-region, the third two digits distinguish the accounting unit, and the last two digits distinguish the cataloguing unit. These hydrologic units collect and drain precipitation into streams, rivers, lakes, wetlands, or groundwater. To monitor quality and quantity of surface and groundwater, these units are used to collect and organize hydrologic data (USGS 2006; Seaber *et al* 1987).

Appendix E

Definitions

Demand management This approach to water management does not seek a larger supply of water to satisfy demand. Rather, this approach seeks to reduce the demand for water and thereby remove the need for new water supply.

Groundwater This water flows underground in saturated soil and bedrock as part of the water (or hydrological) cycle. Groundwater is often found within **aquifers**, which are layers of granite, limestone, sandstone, or unconsolidated deposits, such as sand and gravel, which are capable of holding reserves of water.

Interbasin transfer This is an unnatural movement of water (e.g., through a pipe or a canal between watersheds) from one basin (or watershed) to another. The difference between intrabasin and interbasin tends to depend on what scale a jurisdiction's water law defines a basin.

Intrabasin transfer This is an unnatural movement of water (e.g., through a pipe or a canal between watersheds) from one sub-basin (or watershed) to another.

Prior allocation Like prior appropriation, this system of water rights is also based on the “first in time, first in right” principle and provides seniority to older water rights. However, unlike the prior appropriation system, the government allocates water under a prior allocation system, while water rights are appropriated in the western United States. This allocation does not necessarily confer a property right as it does under prior appropriation, meaning a rights holder can only appeal to the government not to another rights holder. Under prior allocation, the term “beneficial use” has no legal role in determining the nature of the water right; instead, legislation sets out the nature of the water right, which is further specified within a water licence or permit (Kwasniak and Lucas 2007).

Prior appropriation This system of water rights is based on the “first in time, first in right” principle and was established in western United States during early water use for gold and silver mining, where the first person to access water for a specific use has priority over the following person's access to water, who then has priority of the next person's access, and so on. The basic principles of prior appropriation are the water must be put to **beneficial**

use (for example, domestic, irrigation, municipal, industrial, recreation, and instream flow requirements for aquatic life), the water is of a definitive volume based on the beneficial use for which it is used, each water right has a specific priority relative to other water rights, and the right can be brought into an economic market system where a right to water is separable from the land and saleable (Caponera 1992).

Receiving basin/watershed The basin or watershed to which water from another basin or watershed is moved.

Riparian rights This system of rights does not give ownership or right of property to the water flowing past a riparian landowner (i.e., an owner of land beside a watercourse), but it gives the right to access that water and use it in a reasonable manner (i.e., use does not negatively affect downstream users). The same rights apply to groundwater above which a landowner holds title to the land.

Source basin/watershed The basin or watershed from where surface water is withdrawn to move to another basin or watershed.

Watershed Watersheds are areas of land that drain precipitation and surface water flow to a common destination, whether a larger river system or the ocean. This unit outlines a hydrological system wherein water movement links components (such as carbon in soil) and processes (carbon cycle) on the landscape (Acreman 2004). Watersheds are of varying sizes and can be sub-units of larger watersheds, such as sub-basins and river basins. The terms “watershed” and “basin” are sometimes used interchangeably.



Water Matters

As Alberta continues to chart its water management path, strong leadership from an independent non-governmental organization with expertise and resources dedicated to province-wide watershed protection is vital. Established in October 2007, Water Matters is a champion for watershed protection in Alberta.

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