The Columbia Basin Water Smart Initiative

Building Sustainable Futures for Community Water Use

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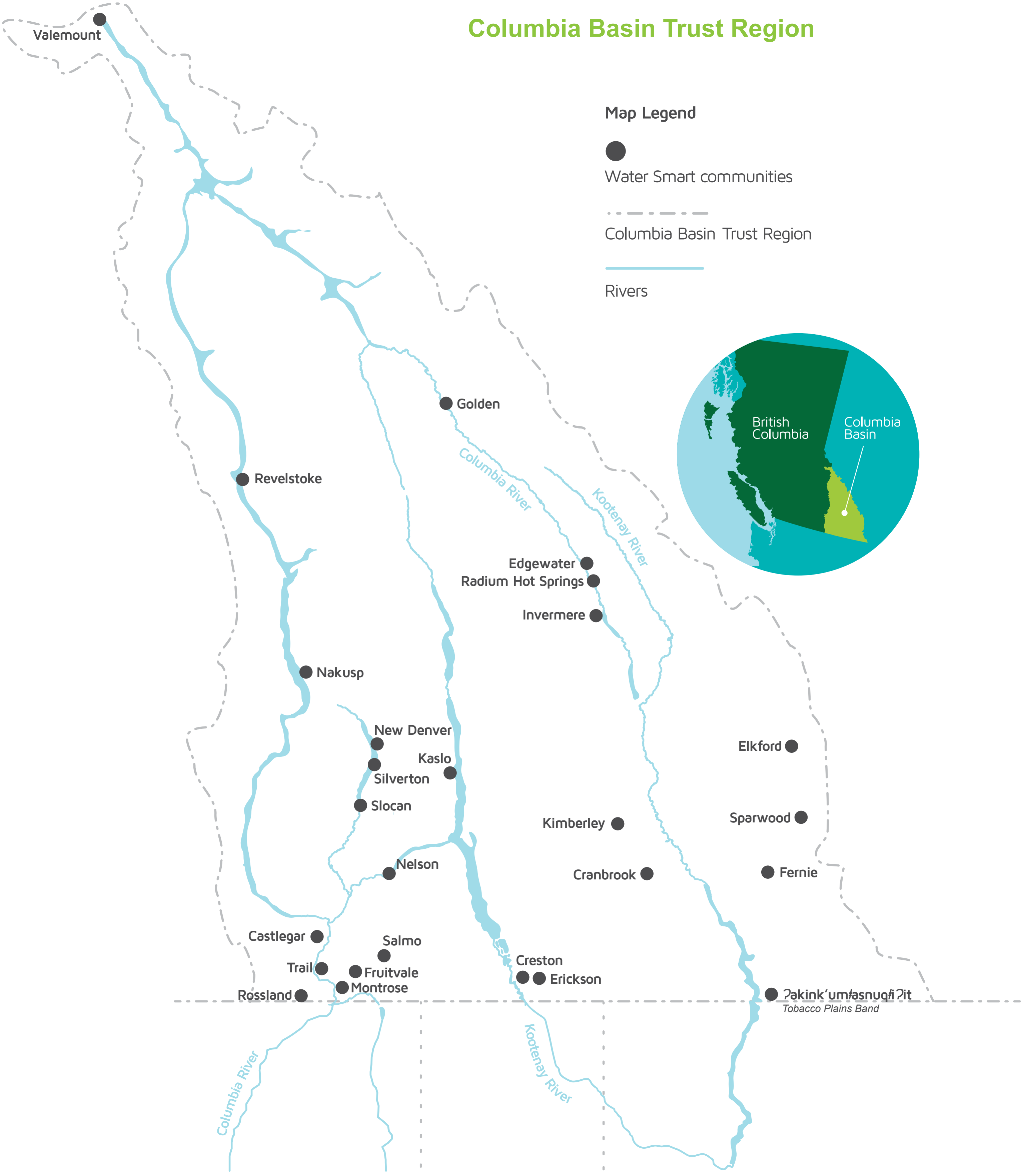
Columbia Basin Trust Region



Communities Becoming Water Smart

All communities in the Columbia Basin Trust region (the Basin) depend on local water sources for their drinking water, and most have enjoyed a plentiful and predictable supply as their historical norm. However, faced with rising costs of water treatment and distribution, a widening infrastructure funding gap, and a changing climate, communities have many reasons to manage water more wisely.

In collaboration with local governments, Columbia Basin Trust (the Trust) launched the Columbia Basin Water Smart Initiative (Water Smart) in 2009 as a collaborative, regional, data-driven water conservation initiative with two goals:

Conserve Water

Reduce community water demand[1] among participating communities in the Basin by an average of 20 per cent between 2009 and 2015.

Build Local Capacity

Support local governments to strengthen their capacity to implement effective water conservation plans, policies and actions.

Mayors and Regional District Board chairs from participating communities signed and committed to the Water Smart Charter[2] in 2010, and have since worked together with the Trust and other Basin communities to reduce water consumption.

Participating communities included two regional districts, 23 municipalities, and one First Nation band. In 2010 and 2011, the Water Smart team worked closely with each community to develop *Water Smart Action Plans* to guide local conservation efforts. These plans established local water conservation targets ranging from five to 50 per cent reductions in demand by 2015.

Results 2009 to 2015

By December 2015, most participating communities were successful in reducing overall water use, with local reductions ranging between two to 39 per cent. Twelve communities reduced water use by 15 per cent or more during the initiative, including three that exceeded reductions of 20 per cent. These water savings are particularly impressive given that 2015 was the hottest year on record in the Basin and that hot weather normally tends to drive water use up, largely due to residential irrigation. Although a few communities were unable to reduce water use for various reasons, all participating communities gained new water conservation skill sets, notably in water use data collection and analysis, and expertise in water loss and peak demand management.

Fourteen Water Smart communities[3] had sufficiently accurate and comparable data from 2009 to 2015 to enable a detailed, independent evaluation of their efforts.[4] This evaluation provides valuable insights relevant to other Basin communities and beyond. A number of its major findings are included in this summary.

Water Smart Success

By December 2015, most participating communities were successful in reducing overall water use, with local reductions ranging between two to 39 per cent.

Challenges and Opportunities

Since 2009, Water Smart has heightened understanding of the unique context for water conservation in the Basin. Its detailed, data-driven approach has generated important findings to guide future efforts, highlighting two critical needs for Basin communities:

> **Improving and sustaining local water infrastructure:** Rising peak demand and system leakage are driving the need for more infrastructure capacity to store, treat, and distribute water. By lowering water demand, communities can mitigate the increasing cost of delivering fresh, potable water and extend the life of their existing infrastructure.
>
> **Increasing resilience to climate change:** While water in the Basin is generally abundant, climate projections indicate that water supply in the future will not be as reliable as it has been in the past. Summer 2015 provided an example of the water supply implications of low winter snowpack coupled with early and sustained above-average spring temperatures. By reducing water demand, Basin communities may avoid costly increases to water storage capacity and minimize environmental impacts to surface and groundwater sources during low-water times. This will help to ensure that water is available for human-use during periods of low water supply while safeguarding the year-round health of aquatic ecosystems.

Additional opportunities involve enhancing local capacity for promoting water conservation and adjusting water rates to assure sustainable water utilities. Human and financial resource limitations are commonly-cited challenges to water conservation. Finally, many communities will benefit from improved understanding of their water sources, whether surface or ground water.

This summary provides an overview of Water Smart's most important lessons, achievements and what's needed to safeguard fresh, safe, and healthy community water supplies for current and future generations of Basin residents.

The Water Smart Model

To work toward both community-specific and Basin-wide targets, Water Smart provided participating communities with a wide range of technical, educational, and financial resources to support development of lasting in-house capacity for effective water conservation.

Water Smart Match Funding of up to $10,000 per community per year to implement actions identified in each community's *Water Smart Action Plan*. Since 2009, some communities have accessed over $50,000 in match funding to support local water conservation planning, analysis and action.

Water Smart Team helped communities assess their water conservation priorities, and develop and implement their *Water Smart Action Plans* to achieve their water conservation targets. Support has included:

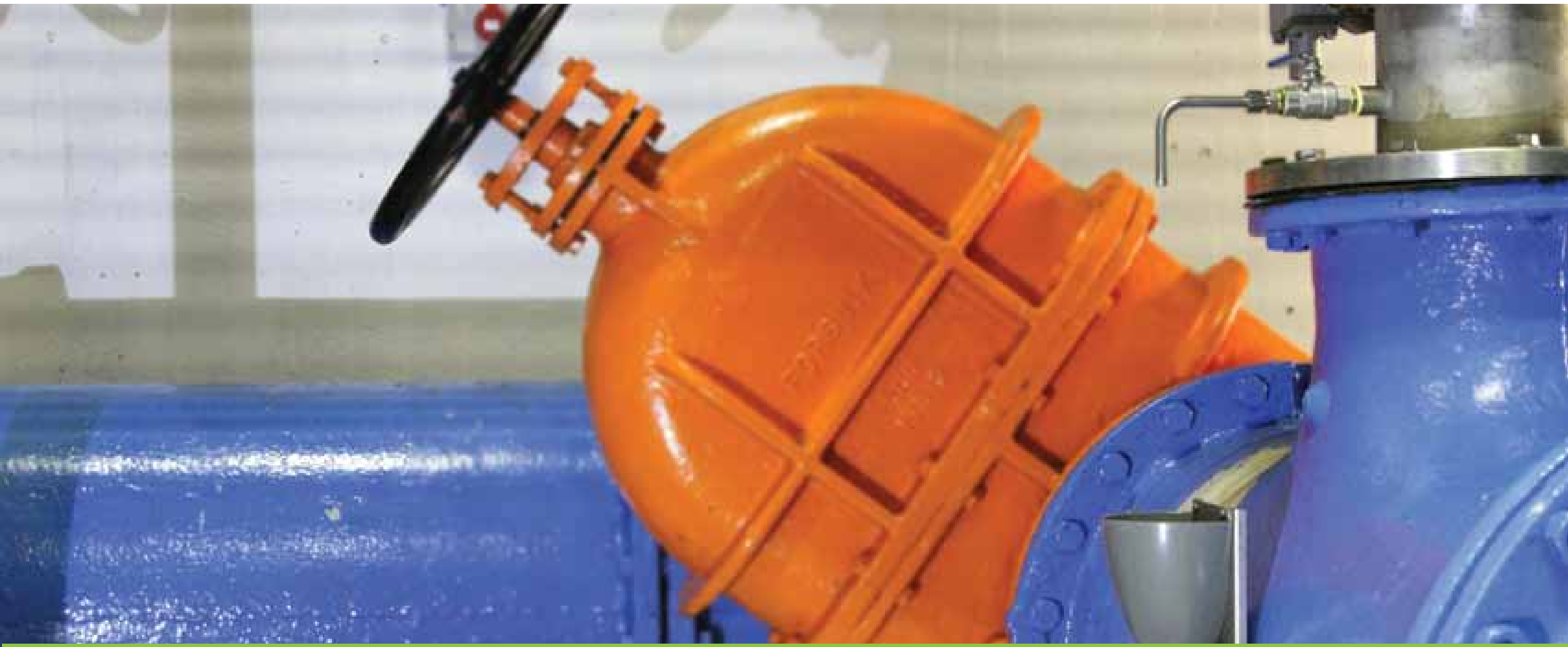
- technical guidance
- assistance in developing requests for proposals
- proposal submission review and comment
- evaluation of draft consultant reports
- development of technical resources
- ongoing data collection and analysis support for gross, monthly and leakage analysis data, and
- communications and outreach support.

Water Smart Ambassador Program was implemented by 13 Water Smart communities. The Ambassador program is a community-delivered, face-to-face public outreach and education program that focuses on supporting residential and park irrigation demand reduction.

Water Smart Learning Opportunities have included development of training courses in water loss management, irrigation, water utility rates, data collection and analysis, and more.

Water Smart Website was developed as a central access point for information and technical tools developed through the learning opportunities. It provides support for each community's public communications on water conservation and a place to share news and information with staff and elected officials in Water Smart communities.

Water Smart Collaboration Network was an informal network that arose from staff in Water Smart communities seeking to connect with and learn from each other. The Water Smart team connects individuals with knowledge and learning needs to help water operators across the Basin continue developing their water conservation skills.



"Water conservation in a perceived water-rich region like the Basin will only come about when residents and communities become aware of the challenges affecting their potable water supply. Thoughtful and on-going education about the realities of local water supply and demand will help ensure that communities have the benefit of reliable and cost-effective water distribution systems over the coming decades."

– Basin Community Water Manager

Four Factors Influencing Community Water Use

Water Smart confirmed four factors influencing community water use: human, infrastructure and technology, climate and weather, and land use. Local water use is often influenced by a combination of these factors. For example, irrigation practices can be influenced by all four factors.

HUMAN FACTORS consist of beliefs, norms and behaviours influencing water use choices such as:

- Perceptions that local water supplies are plentiful and conservation is not necessary.
- Norms and expectations about the appeal of green lawns and gardens, and misunderstandings about the amount of water needed to maintain a green lawn.
- Assumptions about what residents are willing to pay for clean, sustainable water supplies.[5]
- Perceptions of potential climate change impacts on local water supplies that may influence leadership and action on water conservation.

INFRASTRUCTURE AND TECHNOLOGY encompass public water collection, storage and distribution infrastructure, metering and the use of water efficient fixtures:

- Most Basin communities are facing the costs and challenges of aging water system infrastructure.
- Managing water loss in the water distribution system typically presents the best opportunity to reduce total water demand and improve the overall condition and longevity of local water infrastructure.
- Failure to properly operate and maintain in-ground irrigation systems (residential, commercial, and institutional) increases water use during peak watering season.
- Water metering is an important management factor in water conservation efforts. It must include, at minimum, accurate metering at the water system source and within the distribution system.[6]
- Reducing indoor water demand represents a third water conservation opportunity (after reducing leaks and peak demand). It involves widespread installation of water-efficient fixtures. For example, low-flush toilets reduce toilet-related water use by almost 70 per cent.

LAND USE may influence water demand. For example:

- Size and extent of lawns and gardens requiring watering.
- Prevalence of swimming pools.
- Amount of impermeable surface area.
- Average residential lot size.

CLIMATE AND WEATHER have significant impact on both infrastructure and water demand:

- Summer 2015 showed how a changing climate affects local water supply and demand. Following a winter of low snowpack, the Basin experienced extended periods of above-average temperatures in spring and summer 2015—breaking records in six communities—and below-average precipitation. Several communities had to undertake urgent action to reduce water use as a result of record low stream flows.
- Climate change is altering snow deposition and snow melt patterns. This is important because snow acts as a massive storage bank for water. Changes to the timing and rate of snow melt can have significant implications for community water sources, especially in mid-to-late summer and early fall when peak summer demand coincides with seasonal lows in water levels.
- Summer water use increases as outdoor temperatures rise, beginning at 14°C.
- Winter water consumption increases in communities that practice winter pipe bleeding to prevent freezing.

In Cranbrook, water from snow melt that once flowed in creeks in July is now flowing as early as March, creating new water storage challenges. The earlier snow melt is resulting in warmer water in both creeks and the City's reservoir, raising water quality concerns. Water quality concerns could necessitate construction of new water treatment facilities, which are costly to build and operate.

Water Smart Success

By 2015, 25 of 26 participating communities had achieved reliable water use data collection at the water source and/or within the distribution system.

Water Smart's Big Lessons

Seven years of Water Smart has generated four major lessons that can strengthen community water conservation efforts in the Basin and beyond.

Lesson #1
Good Data Illuminate Priorities

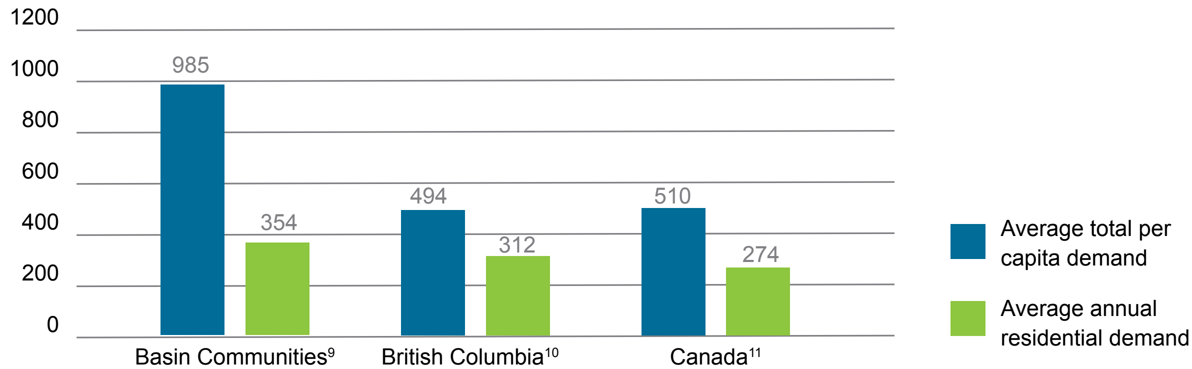
Collecting and assessing water data is essential to effective community water conservation efforts. Good quality data shows where the greatest gains can be made and which efforts are successful over the long term.

Water data collection and analysis in Canada has been characterized as "minimalist" and, accordingly, it remains difficult to accurately assess the state of water across Canada.[7] Similarly, a preliminary study in 2005[8] suggested Basin communities were using excessive amounts of water compared to other parts of Canada and the rest of the world. However, because most communities lacked consistent water accounting systems the study's findings could not be verified.

Water Smart supported communities to develop the data needed to accurately understand community water use and establish baselines from which to measure future progress. Its first success was establishing a comprehensive water accounting framework. Most Basin communities now have accurate and regionally comparable monthly data on how much water is distributed according to main categories of use, enabling communities to learn from each other's water management challenges and opportunities.

The data confirms that average daily total consumption in Basin communities is very high when compared to other jurisdictions (see Figure1). Average residential water use in the Basin exceeds B.C and Canadian averages by a lesser margin.

Figure 1. Average annual residential and total per capita water demand in litres per day (L/P/D)



Average daily total water consumption[12] among Basin communities ranges significantly from 551 litres per person per day (L/P/D) to 1784 L/P/D. Very large differences were found between total water consumption and residential water use.

In addition to improving their source metering, many Water Smart communities have introduced water metering within their water distribution systems. This has improved their ability to locate leaks and identify high-use zones, which benefits water conservation efforts and overall utility operations.

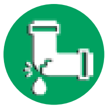
Since 2009, five Basin communities have implemented universal metering.[13] This enables accurate accounting of how much water is used for residential, leakage, irrigation, or industrial, commercial and institutional (ICI) demands – each of which varies significantly between Basin communities. Accurate customer-level data can drive more efficient and effective resource allocation and water conservation efforts.

Two communities, Rossland and Sparwood, have achieved consistent reductions in water use since completing their universal metering programs. They are now in a better position to account for and conserve water, and to generate and allocate sufficient financial resources to fund sustainable infrastructure maintenance and replacement.

Looking ahead, improved metering—which may include distribution systems meters, universal metering, regular water meter calibration and the introduction of water charges based on volume of use instead of a flat rate charge—is seen as one of the key strategies to adapt to increasing climatic variability.

Water Smart Success

Kaslo repaired a major leak in 2013, which resulted in a 39 per cent reduction in annual water use by 2015. This was accomplished cost effectively and without additional water conservation and education programs.



Lesson #2
Leaks are the Basin's Biggest Water Conservation Opportunity

Water loss through system leakage constitutes the single largest community water demand. Reducing leakage reduces infrastructure costs and improves climate resilience by reducing demand on local ecosystem supply.

It is estimated that annual water loss due to system leakage averages between 30 and 40 per cent for most Basin communities. While high, this rate of water loss is not unusual for aging water systems in developed nations.

Mitigating water loss is clearly the most important water demand problem and conservation opportunity facing most Basin communities. This will be an ongoing challenge as water systems age, especially as older parts of the system tend to be at higher risk of breakage. Addressing water loss reduces costs primarily by extending the life of water system infrastructure.

Water Smart was successful in supporting the development of in-house community capacity for quantifying water loss, leak identification and repair. Over a dozen communities implemented formal leak detection and repair programs, achieving considerable water savings by incorporating these activities as standard components of regular operations. These successes speak to the value of systematic, step-by-step approaches accompanied by strong internal commitments to water loss management.

Lesson #3
Reducing Peak Demand Reduces Infrastructure Costs

Peak demand, typically driven by irrigation, presents the second largest water conservation opportunity for community water systems. Reducing peak demand helps minimize costs associated with maintaining and expanding water supply infrastructure, and improves climate resilience.

Addressing peak demand proved to be a challenge because it is influenced by so many factors, including temperature, precipitation, type of outdoor and indoor water use, and commercial, institutional and agricultural practices. Further, individual behaviours, perceptions and biases can be difficult to influence.

One of Water Smart's key findings is that irrigation (typically lawn watering) has a major influence on peak demand. Demand increases in response to rising temperatures over 14°C. Even when it's raining, if it's getting warmer, many residents will continue to irrigate. Contrary to popular belief, automatic in-ground irrigation systems can use up to 30 per cent more water than surface irrigation due to factors such as improper installation and/or programing, lack of rain sensors, and failure to maintain the system seasonally to mitigate leakage.

Even though it remains an acceptable norm among many Basin residents to use more water during hotter weather, there are two reasons to revisit this practice:

- As peaks in community water demand get higher, more infrastructure is required to store, pump and treat water, and infrastructure wears out faster. Lowering peak demand helps ensure that the costs of getting fresh, potable water from source to tap are kept as low as possible.
- Climate change is projected to result in reduced community water availability and higher water demand. Reducing irrigation demand through wise watering practices when ecosystem supply is at its lowest helps avoid the need for costly increases to water storage capacity and also limits the drawdown of surface and groundwater sources during these low-water times of year. It also helps ensure that water is available for human use during periods of lower supply and contributes to the year-round health of aquatic ecosystems.

Water Smart Success

Despite record hot temperatures in 2015, Creston reduced its peak summer demand by 14 per cent over 2009 levels. This result is attributed to five years of consistent community outreach by Ambassadors coupled with watering restrictions initiated in late June.

From 2010 to 2016, many Basin communities hired Water Smart Ambassadors over the summer to help residents reduce outdoor water use. Ambassadors offered residents free lawn and garden assessments to help them understand the amount of water their lawns and gardens need to stay healthy. They also communicated information about watering restrictions. Overall, the Ambassador program was seen as instrumental in promoting effective water conserving practices.

While changing human behaviour in the short run may be difficult, sustaining those changes, once achieved, can be even more challenging. It requires a long-term vision and coordinated effort. For Basin communities to sustain progress, a mix of education, financial tools and bylaws should be considered. This is particularly important given the strong correlation between water demand, temperature and a warming climate.[14]

Basin communities should also consider developing and analyzing daily and hourly water data to determine the importance of, and opportunity for, peak hour and peak day water demand management. Without effective, proactive, and sustained responses by local governments and Basin residents, peaks in water consumption are likely to rise, putting pressure on infrastructure and ecosystems.

Lesson #4
Collaboration Accelerates Capacity Development

Water Smart's collaborative approach and support for peer-to-peer engagement was a driving factor in community success. This approach empowered Basin water managers and operators with knowledge, tools and technical support needed to build local and regional capacity for water conservation.

An unanticipated outcome was how Water Smart's collaborative, data-sharing approach fueled learning, capacity development, cooperation, and innovation among and between community water managers and operators. Prior to Water Smart, this kind of interaction between neighbouring communities was the exception, not the rule. However, Water Smart's focus on data collection and sharing illuminated common water conservation issues and challenges faced by Basin communities. By actively sharing information, including successes and failures, communities were able to develop a common platform for water utility personnel to engage in knowledge exchange and collaborative problem solving.

The gains and progress made through early collaborations and informal peer-to-peer networking paved the way for Water Smart to pilot an industry-certified peer-to-peer (P2P) approach to operator training. P2P training allows Basin water operators to both deliver and receive training within their communities, in small groups, and using hands-on, practical exercises as opposed to traditional classroom-based learning, while at the same time meeting the continuing education requirements of Provincial certification.

By strengthening connections between communities with similar challenges, Water Smart has fostered a strong professional network invested in best practices around water conservation, confirming the benefits of deep and persistent collaboration.

New Challenges in a Changing Climate

One of the most critical water conservation challenges facing Basin communities is understanding and responding to the dynamic relationships between climate change and the supply of water from ecosystems, human demand and water storage requirements. As our climate changes, new conditions will require communities and residents to adopt new norms around water use and implement appropriate water conservation strategies. Considerable effort has been made over the last decade to provide access to climate-related data[15] and to communicate the potential impacts of climate change on the Basin and its water resources.[16]

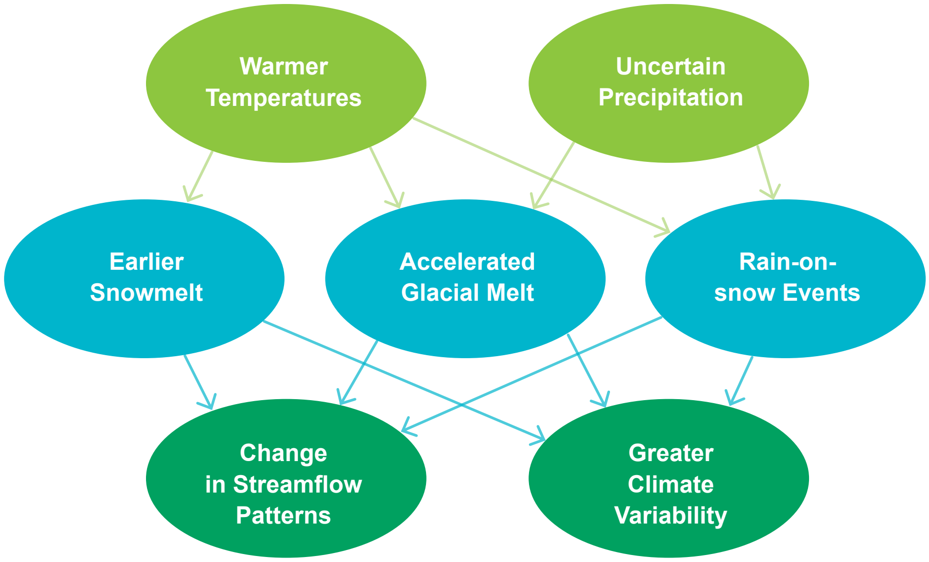
From 2009 to 2016, the Basin experienced some of the most extreme conditions in temperature and precipitation since the beginning of record-keeping over 100 years ago. Analysis of historical climate records show that weather extremes have been occurring more frequently in the Basin.

Future climate is projected to be increasingly variable both globally and locally. Extreme events such as droughts, floods, and wildfire are projected to occur with greater frequency in the Basin, with climate moisture projections for the latter part of this century predicting conditions similar to the dust bowls of the 1930s.

The growing vulnerability of surface water to shifts in climate and weather patterns is relevant to Basin communities. A significant implication for water managers is the shift from precipitation falling as snow to rain and the increase in temperatures. Earlier snow melt means that the peak streamflow period will occur earlier in the spring and this is expected to contribute to longer periods of low streamflow in the summer and fall, at the same time as demand is often the highest. Increased rates of evaporation due to warmer temperatures are expected to influence timing and availability for storage in reservoirs. Some communities may opt to rely more heavily on groundwater resources during emergency low-water conditions, but little reliable information is available about ground water resilience and the implications of climate change for aquifers in the Basin.

Figure 2 illustrates the climate change processes and impacts that are of greatest concern to Basin water managers.

Figure 2.
Main climate change processes in the Columbia Basin affecting surface water supplies.

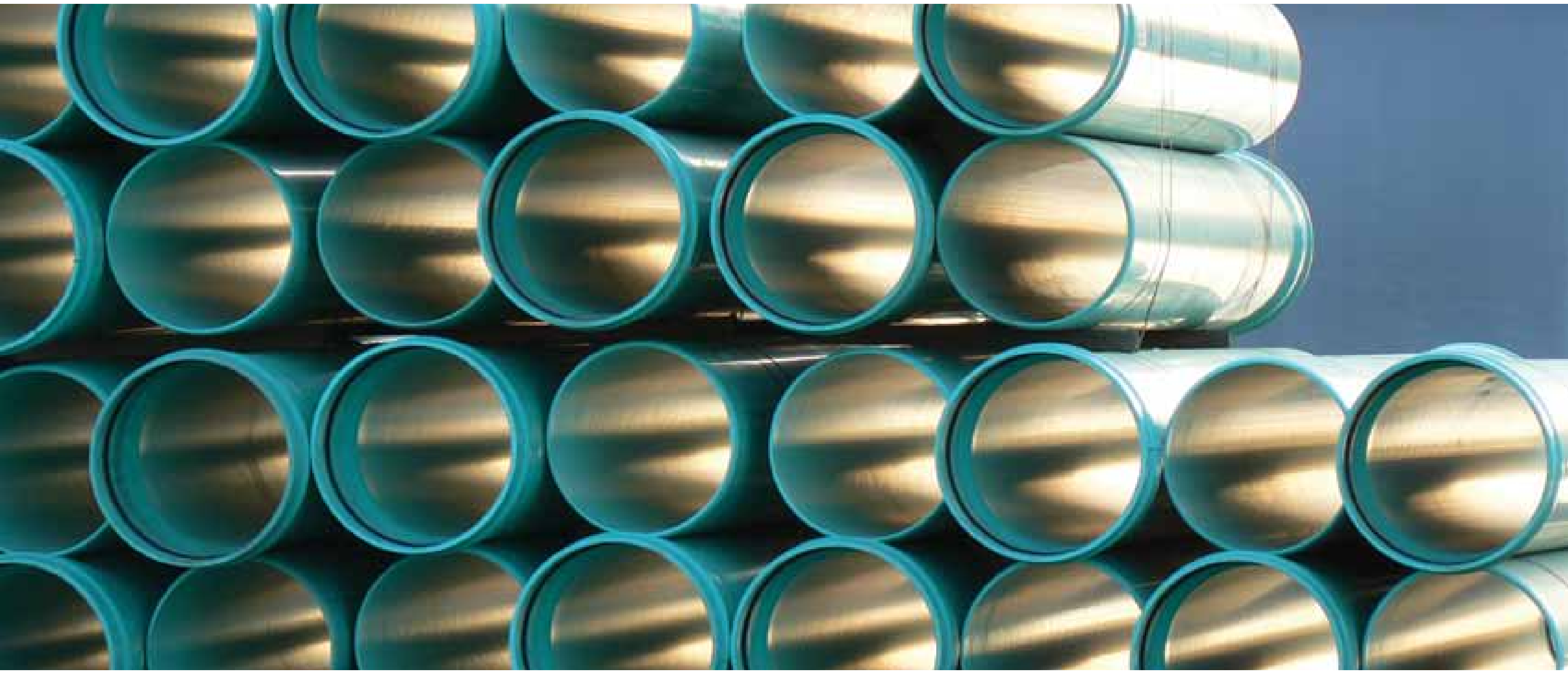


Forecast for East Kootenay: Communities relying on streams for their water supplies will need to either consider more water supply storage capacity or reduce their summer water use to avoid shortages in late summer. It typically costs much less to reduce peak demand than to increase storage or develop new water sources. This is mostly pertinent as summer temperatures in the drier southern portions of the East Kootenay continue to increase.

Forecast for West Kootenay: The West Kootenay is experiencing more spring rainfall events, so communities relying on stream flow as their water supply source will likely experience more floods and problems associated with sediment transport, which has an effect on water treatment. Flooding issues are of significant concern because they can be destructive to water system infrastructure. Unless there is sufficient storage capacity, much of the water from extreme precipitation events in spring and early summer will be unavailable once peak demand occurs in mid-to-late summer. However, as noted above, it typically costs much less to reduce peak demand than to increase storage.

"Climate change is having a huge effect on water supply and quality. Communities that adapt to the ever-changing reality will be financially healthier and capable of providing the level of service necessary to sustain and grow their populations."

– Basin Community Water Manager



The Call to Action

Water Smart has demonstrated the value of comprehensive water accounting, the importance of water loss management, and the need to better manage irrigation to reduce peak demand. The greatest benefits of water conservation for communities will come from improving the sustainability of local water infrastructure and increasing resilience to climate change.

Continued efforts in these two areas will help to ensure that human water demand does not exceed ecosystem supply and that the best opportunities are identified for reducing water demand to effectively adapt to future climate change and population growth.

1. Improving and sustaining local water infrastructure

From 2009 to 2015, conservation efforts were successful in most communities, yet sustaining consistent reductions will be challenging due to two main factors.

Successes in reducing distribution system leakage can be undermined rapidly in the absence of consistent and on-going analysis of night flow data coupled with a properly funded infrastructure repair and replacement program. Lasting water use reductions will also depend on communities preparing a reliable inventory of the age and condition of their water supply and distribution infrastructure. This creates the foundation for a staged repair and replacement plan to mitigate losses from leakage, e.g. an asset management program. This is a helpful step towards addressing the infrastructure funding gap.

Basin communities will be well-served by continuing to implement water conservation efforts as part of the regular operations and long term planning and management of their water distribution systems.

For many communities, increasing water utility charges should be a priority to generate sufficient revenues to achieve equitable, full cost recovery including the cost of replacing old and deteriorating infrastructure. This may require staged rate increases over an extended period of time. Revenue requirements, cost of services and rate studies are likely required in most communities to determine equitable and sustainable per cubic meter or flat rate charges for the water utility. It is also important that water utility policy makers adopt regulations that support achievement of specific local water conservation objectives and improvements to local water infrastructure.

2. Increasing resilience to climate change

Reducing water demand is a no-regrets strategy for increasing climate resilience. Significant reductions are achievable at comparatively low cost with minimal hardship to any individual.

Many communities do not have a good understanding of how much water they have available and what to do in an emergency situation, nor what the implications are for their local supplies from increased climate variability and extremes. Communities that rely on rivers and springs for their water face an increasing dilemma about how much water to use and how much to leave instream for the benefit of ecosystems during low water conditions. Several have limited groundwater sources for emergency back-up, and most could benefit from improved understanding of their groundwater sources.

Consistent with projections of increasing climatic variability and weather extremes, 2015 was a record hot and dry summer for most of the Basin. Weather and climate play a key role in both water demand and conservation. Thus, timely and effective water restrictions coupled with public outreach programs during hot and dry spring and summer months will be critical for preventing rising peaks in summer water demand.

3. Changing how we think about water

Shifting community norms and perceptions around water use will require water utilities to implement effective, data-driven public education programs that heighten awareness of local supply, infrastructure challenges and projected impacts of climate change. It is increasingly costly to build and maintain infrastructure to store and deliver safe, potable water to all households at all times. Human behaviour can be slow to change, and will require persistent and consistent outreach and education to achieve sustained results. Equipped with the lessons learned from seven years of Water Smart, local governments are now better equipped than ever to work with their water utilities to increase community water literacy, better support improvements in system performance and encourage innovation in service delivery.

Endnotes

1 For purposes of Water Smart, community water demand includes residential, municipal, institutional and commercial water use. Where possible, it excludes industrial and agricultural water consumption.

2 http://ourtrust.org/wp-content/uploads/downloads/CBT_WaterSmart_Charter.pdf

3 Cranbrook, Creston, Elkford, Fernie, Fruitvale – Beaver Valley Water Service, Golden, Kaslo, Nakusp, Nelson, RDCK Erickson, Revelstoke, Rossland, Sparwood and Trail

4 Schreier, H., M. Hamstead, E. Paré, and N. Klassen, *Evaluation of Community Water Conservation Efforts in the Columbia Basin 2009-2015* http://www.cbtwatersmart.org/docs/Schreier_Evaluation_Final-July2016.pdf

5 According to a BC-wide survey conducted by the BC Water and Waste Association, BC residents pay an average of $42/month for water and sewer services, yet believe they are paying $122/month, and are willing to pay $175/month. See www.bcwwa.org/resourcelibrary/Ipsos%202015%20Survey%20Results_Web_FINAL.pdf

6 Additional forms of metering include Industrial/Institutional/Commercial (ICI) metering, residential metering, and universal metering, which requires installation of water meters on all water system connections.

7 Bakker K., C. Cook (2011): *Water Governance in Canada: Innovation and Fragmentation, International Journal of Water Resources Development*, 27:02, 275-289.

8 L. Ronalds, *Columbia Basin Residents' Views on Water: Final Report*, January 2005.

9 Columbia Basin Water Smart. 2016. Aggregated data. Not published elsewhere. Residential demand is based on an average of the five Basin communities with universal metering.

10 Honey-Roses, J., D. Gill, C. Pareja. 2016. B.B. *Municipal Water Survey 2016*, Water Planning Lab, School of Community & Regional Planning, UBC, 40 pp. http://waterplanninglab.sites.olt.ubc.ca/files/2016/03/BC-Municipal-Water-Survey-2016.pdf

11 Environment Canada 2011. *Municipal Water Use Report*; Municipal Water Use 2009 Statistics. https://www.ec.gc.ca/eau-water/ED0E12D7-1C3B-4658-8833-347B527C688A/2011%20Municipal%20Water%20Use%20Report%202009%20Stats_Eng.pdf

12 Including leakage in the distribution system and unmetered industrial, commercial, institutional (ICI) uses.

13 Universal metering is water metering of all water connections (including residential) supplied by a water utility.

14 For additional information, see Schreier *et al*., pp.32-35.

15 The Pacific Climate Impact Consortium's Plan2Adapt tool generates maps, plots and data describing projected future climate conditions for regions throughout British Columbia. https://www.pacificclimate.org/analysis-tools/plan2adapt

16 *From Dialogue to Action: Climate Change, Impacts and Adaptation in the Canadian Columbia Basin*, Columbia Basin Trust, September 2012. http://ourtrust.org/?ddownload=336

Acknowledgements

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